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Environmental data for the eastern North Pacific and Bering Sea

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DIRECTOR'S FOREWORD

There is, in the Fisheries Centre, a strong emphasis on global assessments and databases, but it is also true that British Columbia and the eastern North Pacific are our hinterland, and the place where the Marine Mammal Research Unit concentrates much of its field work. It is thus appropriate that Edward Gregr and Ryan Coatta have completed and made available for wider distribution a dataset of spatial information on temperatures, chlorophyll and other environmental parameters for the eastern North Pacific.

All ecosystem modelling work done by researchers at the Fisheries Centre in various subsystems of the Eastern North Pacific confirms that both top-down and bottom-up effects shape the dynamics of the ecosystem and the fluctuation of individual species. This insight is not as obvious as it seems: There are ecosystems where changes in fishing regime are all that is needed to explain the different ecosystem states that are observed, and the changed abundances of the species embedded therein. This does not apply to the eastern North Pacific. Conversely, there are ecosystems that are driven predominantly from the bottom-up. The eastern North Pacific is not among those either, notwithstanding much talk about all-encompassing 'regime shifts'. Rather, the eastern Noth Pacific ecosystem appears to be genuinely controlled both by bottom-up and top-down processes, acting simultaneously, if with different intensities, on the different species groups within the system.

This combination of top-down and bottom-up controls can, in many cases, only be demonstrated by judicious choice of the scale at which local data sets are thought to apply. It is therefore extremely helpful to have a choice. The data sets presented in this report will help in this, as they range in coverage from the entire eastern North Pacific (120°E to 155°W, and 31.6°N to 66.5°N), through an intermediate scale covering the Bering Sea and Gulf of Alaska (130°E to 170°W, and 50°N to 65°N), to a higher resolution dataset of the northern Gulf of Alaska (129°E to 166°E, and 51°N to 61°N).

Finally, I want to laud the authors for devoting much energy to assembling and documenting their datasets such that they not only will later back their own work, but can be used by others working on the eastern North Pacific. Selfless undertakings of this sort are uncommon enough to deserve special praise.

ABSTRACT

As part of our investigations into Steller sea lion habitat use and fisheries economics, we have prepared a collection of physical oceanographic data for the eastern North Pacific and the Bering Sea. Data include rectified grids of chlorophyll-a concentrations, sea surface temperature, slope of sea surface temperature, sea level anomaly, wind speed, current velocity and direction, mixed layer depth, and bathymetry. Geographic Information System-compatible raster (gridded) data were created from available on-line sources as both monthly and long-term averages. Monthly averages were produced for all available years for each sensor at a spatial scale of 9x9 km^2 for the Gulf of Alaska and Bering Sea. We prepared long-term averages (climatologies) at 3x3 km^2 for the northern Gulf of Alaska, and for the entire eastern North Pacific we prepared each source data set at its native resolution. We evaluated the sea surface temperature data at the 9x9 km^2 scale using available quality data, and improved the data provided by interpolating through low quality pixels. Considerable processing was required to create a continuous North Pacific perspective, and to ensure that the data sets were correctly aligned at the different spatial scales. We also present 2-week averaged data from the output of a Regional Ocean Modelling System (ROMS) implemented for the northern Gulf of Alaska (3x3 km^2) for the year 2001. These data provide a representation of the changing, vertical structure of the ocean. Given the significant investment to create a rectified data collection, we have prepared the data for distribution to interested researchers. The ROMS data are provided in MS Access format, and the remote sensing data as binary float files. Federal Geographic Data Committee (FGDC)-compatible metadata have been prepared. The data described herein are available from the Marine Mammal Research Unit web site[1] or on request.

[1] www.marinemammal.org/MMRU/data

INTRODUCTION

Studies of marine animals and how their habitats are distributed in the ocean are constrained by the availability of data on the state of the ocean. Significant advances have been made describing the general distribution of species based on average ocean conditions (e.g., www.aquamaps.org). These approaches are demonstrably suitable for basin-scale analyses of population trends and fisheries economics. However they do not necessarily reflect the ecology of the marine species, which respond to seasonal and inter-annual dynamics and species interactions that cannot be well represented in global biogeographic studies.

Habitat studies of widely distributed marine species require data at similar extents. Data from remote sensing are one of the few sources of the broad-extent, comprehensive data sets necessary for such analyses. While many of these data are now available via on-line servers, they are often available only as global coverages, at various temporal resolutions, and occasionally at different spatial resolutions. The data are also often provided at various levels of processing, from the raw satellite data to the end product (i.e., temperature), which is typically what is relevant to marine habitat analyses.

Ocean circulation models provide another comprehensive view of the ocean, in this case including ocean dynamics and vertical structure, typically at high temporal resolution. To investigate the suitability of such models for habitat studies, we included the output from a ROMS (Regional Ocean Modelling System) model of the northern Gulf of Alaska, developed by Al Hermann and colleagues[2]. The volume of data created by circulation models means the output typically needs to be scaled for use in ecological studies. The use of such data for ocean habitat studies is rich with possibilities.

Data availability constrains both the attributes that are available, and their spatial and temporal resolution. One of the motivating factors was the desire to investigate how spatio-temporal scaling affects predictive models. This required the preparation of a large number of data sets, at variable resolutions.

The work required to make such data sets compatible for analysis in typical Geographic Information System (GIS) tools begins after the data of interest are obtained. While there are on-going improvements to the accessibility and compatibility of the data products available from the live-access servers, different variables are often in different digital formats. Typically, the spatial extents of global coverages range from -180 to +180 degrees longitude, adding an extra step to the data preparation for North Pacific analyses.

We conducted a series of analyses investigating the relationship between Steller sea lions, their prey, and various indicators of their physical habitat. We conducted these studies for two different spatial extents, at two spatial resolutions, and three temporal scales. To support this work, we built a collection of physical oceanographic data from satellite-borne remote sensors and ROMS model output. Given the level of processing required to make these various data sets suitable for use with standard, PC-based, analytical software (e.g., R, S-Plus, ArcGIS, IDRISI), we felt that making the processed data sets freely available to other researchers may benefit marine research in the North Pacific.

Remote sensing data for the northern Gulf of Alaska and Bering Sea data sets are provided in Alaska Albers (NAD27) equal-area projection with default (ESRI) parameters. The larger extent, eastern North Pacific data are provided in Mercator projection, using default parameters except the central meridian set to 180°. Bathymetric and remote sensing variables are provided as rasters in floating point file format. The circulation model output is provided as a series of 28 comma-delimited text files, one for each 2-week time period, referenced in geographic coordinates.

In this report, we describe the data sets, providing example images of each, and a brief description of the processing. Federal Geographic Data Committee (FGDC)-compatible metadata have also been prepared to facilitate the use of these data sets in future analyses.

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b. Arctic Region Supercomputing Center, UAF Fairbanks, PO Box 756020, Fairbanks, AK 99775. Phone: (907) 450-8600.

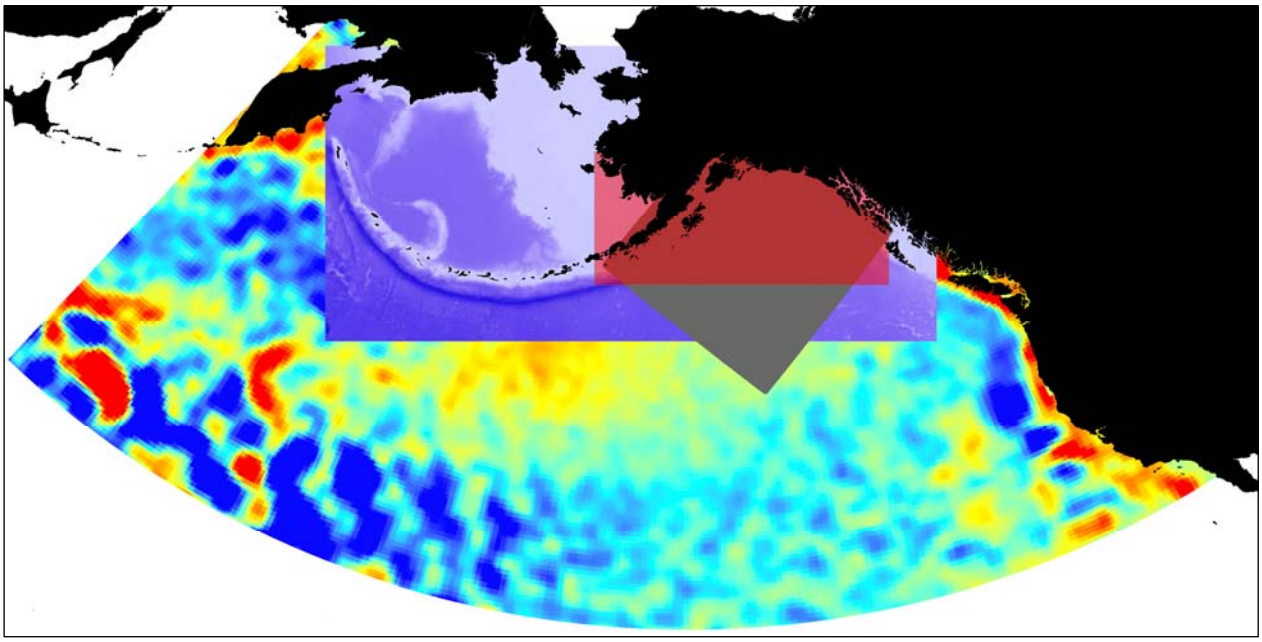

Figure 1: Extents of data sets described in this report. The largest extents include the entire eastern North Pacific and Bering Sea; the 9x9 km² study area (purple) includes the Gulf of Alaska and Bering Sea, while the 3x3 km² study area (red) includes the northern Gulf of Alaska. The extents of the Hermann circulation model are overlaid in grey.

METHODS

We first defined two study frameworks using the Smith and Sandwell global elevation model (Smith and Sandwell 1997) to interpolate the 3x3 and 9x9 km² study areas. We then prepared remotely-sensed data for sea surface temperature (SST), sea surface height (SSH), surface winds, and chlorophyll-a (chl-a) for the 3x3 km² northern Gulf of Alaska (nGOA) study area, and at 9x9 km² for the Bering Sea and Gulf of Alaska (BS/GOA) study area. The nGOA data were prepared as monthly, long-term averages (climatologies). The BS/GOA data were prepared as monthly averages, for all months of available data (Appendix 1). We also generated monthly climatologies for the entire eastern North Pacific, at the native resolution of the various sensors. This will provide some flexibility with respect to the spatial resolution of these monthly averages when used for other studies. These dynamic physical data are underlaid with a bathymetric rasters derived from the Smith and Sandwell global bathymetric coverage.

We processed the results from a Regional Ocean Modelling System (ROMS) implementation for the nGOA region for the year 2001 from output provided by A. Hermann and colleagues at the Alaska Fisheries Science Centre, Seattle Washington. Two-week averages for all of 2001 were obtained as NetCDF files, and processed to ASCII text files using MatLab scripts. The text files were then combined into an MS Access database. Variables extracted from the NetCDF files included temperature, salinity and current velocities at surface, mixed layer, and bottom depths. The data were provided on a rotated, geographic grid, with a nominal resolution of 3x3 km². The processed data are provided as a series of 28 tables in an MS Access database. Each table contains 230,400 records, each representing a ROMS model point. Each record contains its geographic coordinate, and a value for all variables for the specific 2-week time period.

Detailed processing steps and attribute descriptions are contained in the FGDC meta-data provided for each data set (Appendix 2).

RESULTS

Study areas

The GOA study area includes the on-shelf waters of the Gulf of Alaska, extending from approximately Unimak Bight (-163.5°) in the west to Prince of Wales Island (-132.5°) in the east. A grid cell size of 3x3 km^2 was determined to best support the available data. This corresponds to the nominal resolution of the bathymetric and biological data, and the output of the circulation model used. The resulting study area grid contained 300 rows and 665 columns giving a total of 199,500 cells. The portion of the study area within the U.S. Exclusive Economic Zone (EEZ) contained about 36,000 cells.

The Bering Sea and Gulf of Alaska (BS/GOA) study area encompassed the range of the western stock of Steller sea lions within U.S. waters. It also captured all the recorded NMFS Alaska Region observer data for 2001. We used a 9x9 km^2 grid because it represents the finest scale supported by the resolution of the environmental indicators available from satellite. The study area contained approximately 45,000 marine cells within the U.S. EEZ.

Bathymetry and slope

We used the original Smith and Sandwell (1997) data to interpolate a 3x3 km^2, Albers Alaska projected grid of the study area (Figure 2). The Smith and Sandwell data are a global coverage, in geographic coordinates, delivered as an ASCII XYZ file. Once the data were projected, we found that we needed to shift the points 3 km N, and 2 km W to align them with a correctly registered 1:63,360 scale State of Alaska coastline file (MMS 2002). The commonly distributed Smith and Sandwell data are shifted as a result of being moved from a point to a raster representation (Marks and Smith 2006). All on land points were removed prior to generating the bathymetric coverage. This included both points whose depth was >= 0, and those that occurred on land based on the Alaska coastline file).

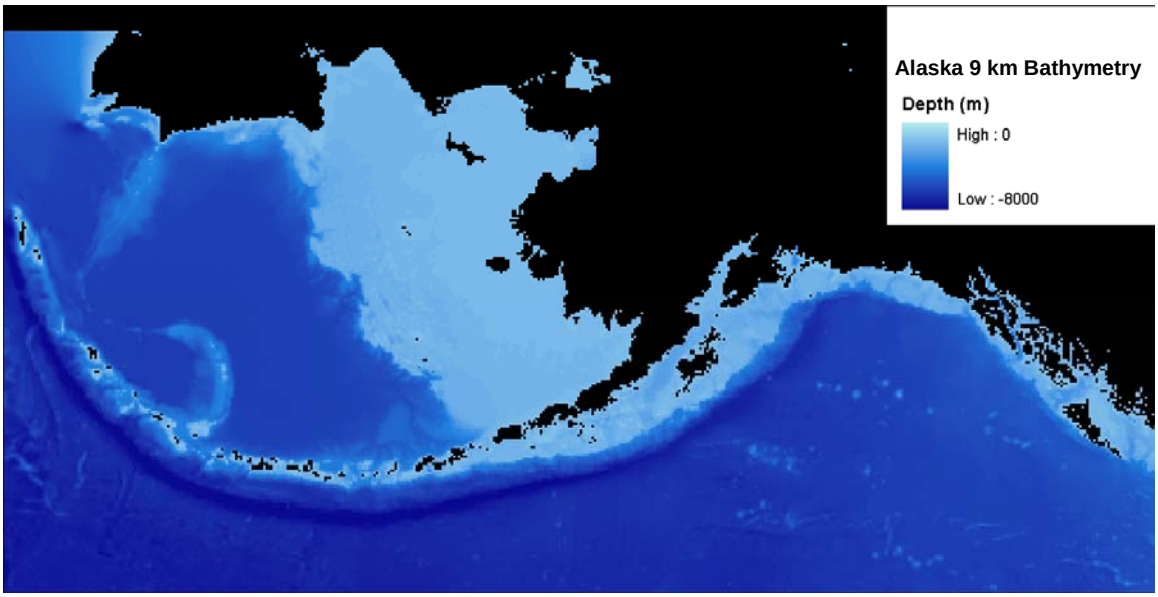

Figure 2: Bathymetry for the 9x9 km^2 Bering Sea / Gulf of Alaska study area.

We used the ArcGIS TopoRaster function to interpolate the 3x3 km^2 bathymetric grid for the North Pacific. Given the extents of this region, the process was completed using a mosaic of 4 rasters. The raster was then clipped to the specific regions of interest, using predefined rectangular coordinates. For the 9x9 km^2 GOA/BS study area, the data were extracted from the 3x3 km^2 North Pacific raster and spatially aggregated onto the coarser, 9x9 km^2 study grid.

A number of revised bathymetric products are now available including an updated global bathymetry from Smith (http://www.africanmarineatlas.net/BASE/pages/relief_grids.htm) and a competing ETOPO2

product (http://ngdc.noaa.gov/mgg/fliers/06mgg01.html). The differences between these data sets are well described by Marks and Smith (2006).

Slope was calculated separately for each of the study area bathymetries using the IDRISI SURFACE slope function, with a scaling factor of 1 (because both the vertical and horizontal units were metres) and units of degrees. Maximum slopes of 19.4° was obtained for the 3x3 km^2 scale, and 15.5° for the 9x9 km^2 scale.

The bathymetry and slope files are provided as binary float files (*.flt & *.hdr pair) for each study area (Appendix 1).

Chlorophyll

Estimates of basin-scale primary production are typically produced by processing multi-spectral (colour) images (e.g., Figure 3) with algorithms that estimate chlorophyll concentration (chl-a) from ocean reflectance. Colour sensors can be masked by cloud cover, and the processing of reflectance is confounded (particularly near shore) by inorganic particulate matter.

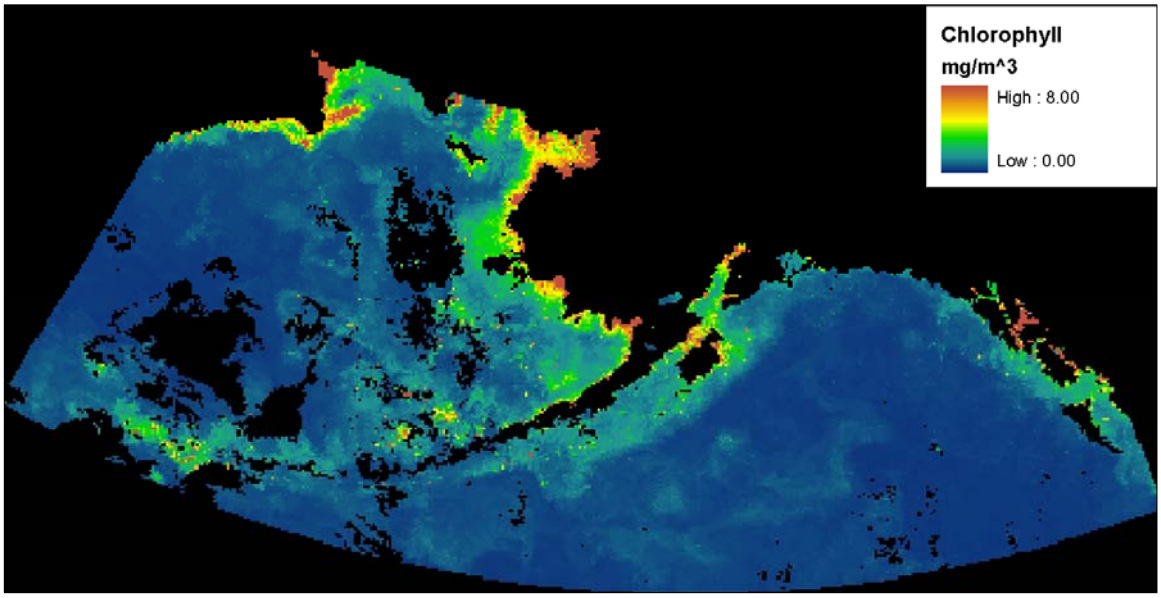

Figure 3: Example of chlorophyll-a concentrations for the 9x9 km^2 Bering Sea / Gulf of Alaska study area for July, 2005.

Global area coverage (GAC) Ocean Level-3 Standard Mapped Images (SMI) of predicted chlorophyll concentration (mg/m^3) were downloaded as monthly averages, in binary HDF (Hierarchical Data Format) files from the Ocean Color website (http://oceancolor.gsfc.nasa.gov/). While the web interface provides standard map images suitable for browsing available data, using the FTP server is more efficient for downloading large groups of files.

To process these products for use with GIS software, we used IDRISI to import and manipulate the data to match our study area extents and resolution. We imported the HDF files using the PARE function. This required the number of rows and columns, and the geographic extents to be entered as parameters. While this method proved adequate, we would recommend the use of the HDFEOS import function instead because it automatically retrieves the number of rows and columns from the files header information (see following section for details on HDFEOS).

The GAC images are centered on the Atlantic. To achieve a Pacific orientation, the imported images were clipped into two halves such that each half contained values from either the positive or negative side of 180° longitude. The column that determines this cutoff is dependent on the import function used above. The split images were then concatenated in reversed orientation such that their mutual 180 lines become the center of the image.

The chlorophyll images were provided in 256 byte format, meaning that the values range from 0 to 255. These values are converted to units of mg/m^3 using a logarithmic scaling equation:

$$mg / m^3 = 10^{(0.015 * [pixel\_value]) - 2} \quad \text{Equation 1}$$

Descriptions of the scaling equations for all Ocean Color products are described in http://oceancolor.gsfc.nasa.gov/DOCS/ocformats.html. The slope and intercept values for each data product are contained in its HDF header. They can also be found at http://oceancolor.gsfc.nasa.gov/seadas/doc/smigen/smigen.html.

Finally, each GAC image was clipped to our lat/long study area and projected to the Alaska Albers projection. Note that the projection is dependent on correct assignment of latitude and longitude to the raster image during import.

The MODIS data were used for the monthly nGOA climatologies, while the SeaWiFS data were used for the BS/GOA monthly averages to provide the longest possible time series (Appendix 1). For the 3x3 km^2 nGOA study area, we created monthly climatologies from monthly MODIS images for 2002 to 2005. These have a nominal resolution of 4x4 km^2. When calculating the climatologies pixels occupied by cloud cover were ignored, making the sample size for each pixel average variable. The resulting pixels were assigned a NoData value only if all of the months spanning all years from 2002 to 2005 had cloud cover. For the 9x9 km^2 Gulf of Alaska / Bering Sea study area, we used monthly, 9x9 km^2 SeaWiFS images for 1998 to 2005. December was omitted for all years because of excessive cloud coverage and low light levels in the study region during this month.

Sea surface temperature

For the 3x3 km^2 nGOA study area, we used MODIS temperature images for 2002 to 2005 with a nominal resolution of 4x4 km^2. These images were processed in the same manner as the chl-a data described above.

For the 9x9 km^2 BS/GOA study area, we downloaded monthly, 4x4 km^2 images of global sea surface temperature from the Pathfinder AVHRR (Advanced Very High Resolution Radiometer) sensor from the Physical Oceanography Distributed Active Archive Center (http://podaac.jpl.nasa.gov/) for 1992 to 2005 (e.g., Figure 4). Available data included ascending (day) and descending (night), and quality images. The AVHRR data are compiled from sensors spanning a number of NOAA (National Oceanic & Atmosphere Administration) polar orbiting satellites. Global coverage data are offered in binary HDF-SDS format at varying spatial and temporal resolutions from 1985 to present (temperature from ocean colour only begins in 1998).

Data were downloaded as binary HDF files. We imported the binary into IDRISI grids using HDFEOS import. HDFEOS automatically applies a planar (XY) projection to the surface and assigns extents equal to the number of rows and columns. These values need to be edited in the IDRISI RDC file (raster document).

However before assigning the correct extents and spatial reference to the RDC file, the images were edited to create a Pacific-centric orientation, as described for chl-a, above. In this case, HDFEOS import provided an advantage because the imported image was oriented so that it could be split exactly down the middle during clipping.

SST was obtained in byte format, with values ranging from 0 to 255. The pixel values were converted to degrees Celsius a scaling equation (Equation 2) described in the AVHRR user manual (http://www.nodc.noaa.gov/sog/pathfinder4km/userguide.html/).

$$[pixel\_value] * 0.075 - 3 \quad \text{Equation 2}$$

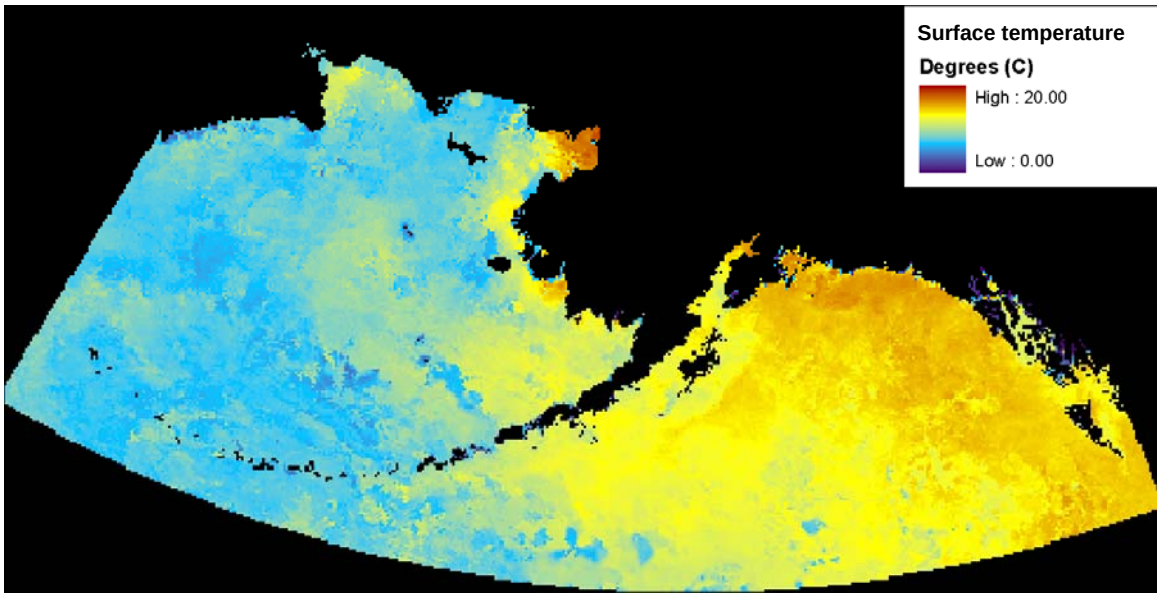

Figure 4: Example of sea surface temperature for the 9x9 km² Bering Sea / Gulf of Alaska study area, for July 2005.

Updated values for the scaling equations are contained in
http://poseidon.jpl.nasa.gov:2031/DATASET_DOCS/avhrr_pathfinder_sst_v5.html

Finally, each image was projected to the Alaska Albers projection. During this step, the images were re-sampled to match the 9x9 km² target grid by specifying the number of rows and columns required in the output image.

We also downloaded SST quality images corresponding to the temperature data. The quality images were in the same format and orientation as the data themselves, and were thus imported using the same process, with the exception of the pixel value conversion step.

The quality values ranged from 0 (low) to 7 (high) and indicated the quality of the corresponding pixel in the associated data file. According to the reference manual, good quality data have flag values of 4 or greater (http://poseidon.jpl.nasa.gov:2031/DATASET_DOCS/avhrr_pathfinder_sst_v5.html). We therefore created binary (0 and 1) rasters by classifying pixels with quality values from 0-3 as 0, and 4-7 as 1.

We used this binary quality surfaces to eliminate poor quality data pixels from the data images with the OVERLAY function. We converted the good quality pixels into vector point features and interpolated back on to the raster so that areas formerly containing low quality data were now interpolated from the surrounding good quality data. In the final processing step, a land mask was applied using the OVERLAY function to remove any data values on land as a result of the interpolation process.

SST slope

For the 9x9 km² BS/GOA study area only, we generated slope surfaces for each SST raster using the SURFACE slope function (e.g., Figure 5). The slope for a pixel is calculated based on the values of its neighbors (top and bottom, left and right – Equation 3).

$$tan\_slope = \sqrt{\left(\frac{right - left}{res * 2}\right)^2 + \left(\frac{top - bottom}{res * 2}\right)^2} \qquad \text{Equation 3}$$

The function does not ignore land/NoData values, leading to invalid slope values for pixels around coastlines and the edges of the study area. We therefore removed the invalid slope pixels using a buffered land mask and the OVERLAY function.

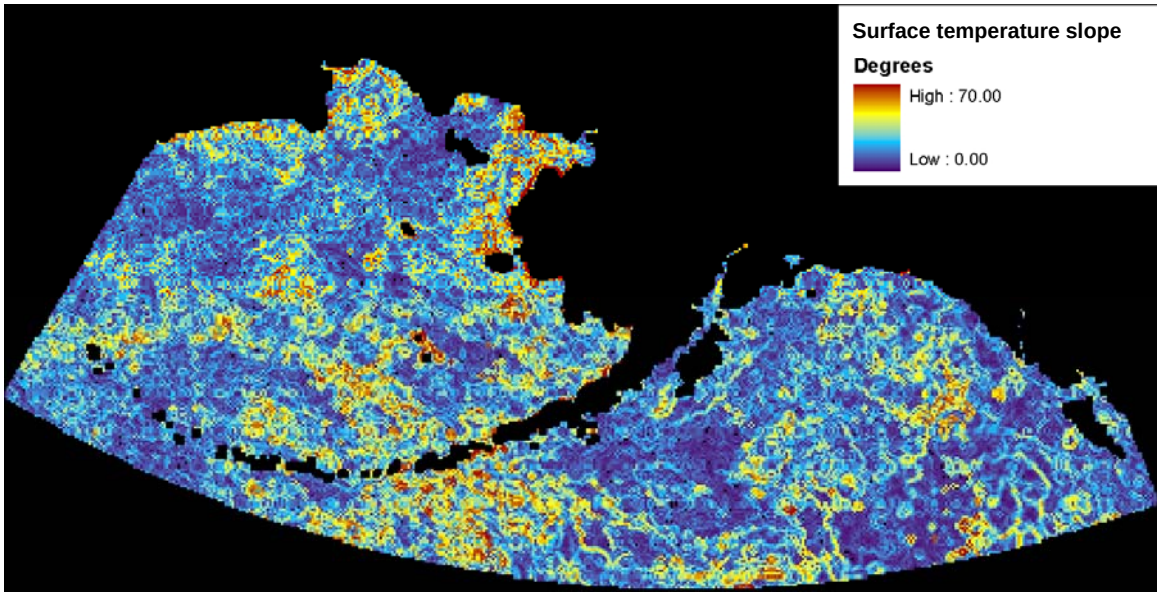

Figure 5: Example of sea surface temperature slopes for the 9x9 km² Bering Sea / Gulf of Alaska study area for July, 2007.

Sea level anomaly

We retrieved weekly merged sea level anomaly (SLA, cm) data processed from altimetry data gathered by the Topex/Poseidon and Jason-1 satellite missions (e.g., Figure 6). The merged data provide delayed-time, gridded SLA datasets. The delayed-time data sets have increased precision over near real-time datasets because they combine altimetry information from multiple satellites. Data sets produced from these missions are available as far back as October 1992, and data collection is ongoing. We downloaded the weekly data from the AVISO live access server (www.aviso.oceanobs.com) as binary NetCDF files, for the years 1993 to 2005.

We processed both monthly climatologies (GOA) and monthly averages (BS/GOA) using VBA scripts that referenced the IDRISI object library. As with the chlorophyll climatologies, the average calculation ignored no data cells to maximize data coverage, making the sample size for each pixel calculation variable. The nominal resolution of the source data is 1/3°, and thus improves somewhat towards the poles.

We imported the binary data files into IDRISI raster format using the HDFEOS function and found we had to rotate the imported SLA files 90° to achieve the appropriate orientation. The images were rotated counterclockwise using the TRANSPOSE function.

We manually edited the associated IDRISI RDC files after they were rotated to reflect the adjusted latitude/longitude extents, and to assign a proper spatial reference system (the HDFEOS function assigned incorrect spatial reference and extent information because of the rotation). After editing the RDC files, the images were clipped to match the extents and resolution of the target study area.

Monthly averaged SLA images were not available from AVISO so we computed our own using the weekly data files. We summed the values of common pixels from multiple weeks for each month, and then divided the result by the number of the values used in the sum. The count of valid pixels rather than the number of input images was used as the denominator when computing the monthly averages to avoid including NoData pixels. If a specific pixel had NoData for every week of a particular month then it was assigned a 0. The resulting monthly average data files were then projected and re-sampled to match the 9x9 km² study area, by explicitly stating the number of rows and columns of the output image generated by the PROJECT function.

The data of interest for each study area were extracted from the global coverages by modifying the extent and resolution as the data were clipped, and moved from geographic to projected space.

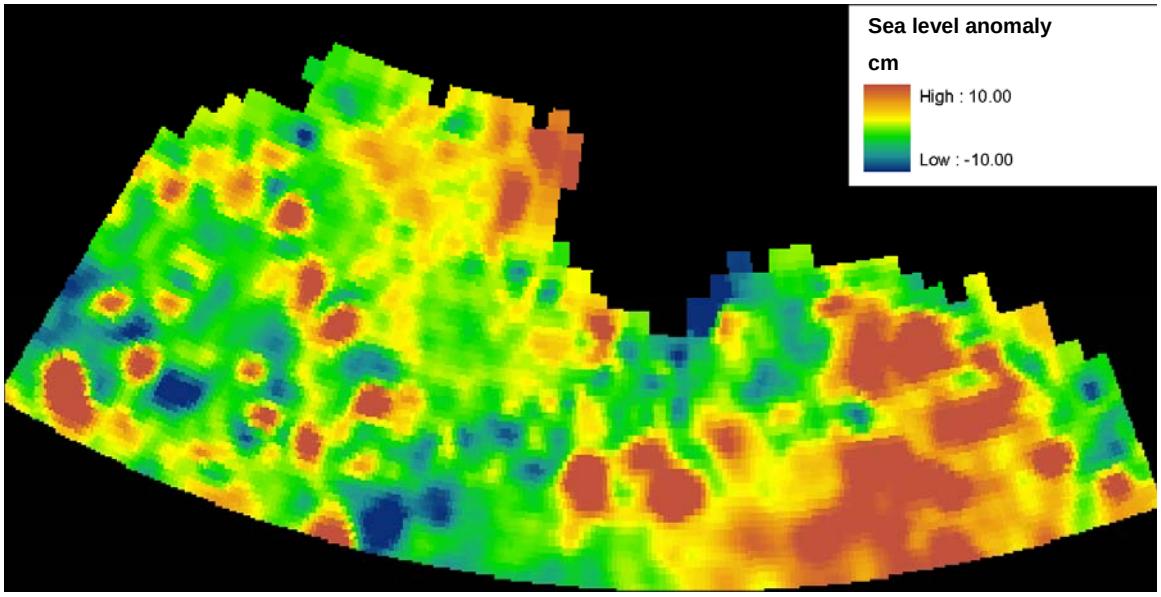

Figure 6: Example of sea level anomalies for the 9x9 km² Bering Sea / Gulf of Alaska study area for July 2005. The resolution of the source data (1/3°) is evident along the coastline, where a number of geographic features (i.e., Aleutian Islands) are un-resolved.

The GOA SLA data (12 monthly climatologies) are provided as a list of 12 float files. For the GOA/BS, the monthly averages are provided as a set of monthly float files for all available months (Appendix 1).

Surface wind speed

We used wind speed data (m/s) produced by NASA's Pathfinder program, provided online by the Remote Sensing Systems research group (http://www.remss.com/). The sensors – Special Sensor Microwave/Imagers or SSMI/I's – were onboard a series of satellites from 1988 to 2005. The binary data files we retrieved were formatted to a 0.25° grid and stored as monthly time averaged files (e.g., Figure 7). We obtained these data from the REMSS FTP site.

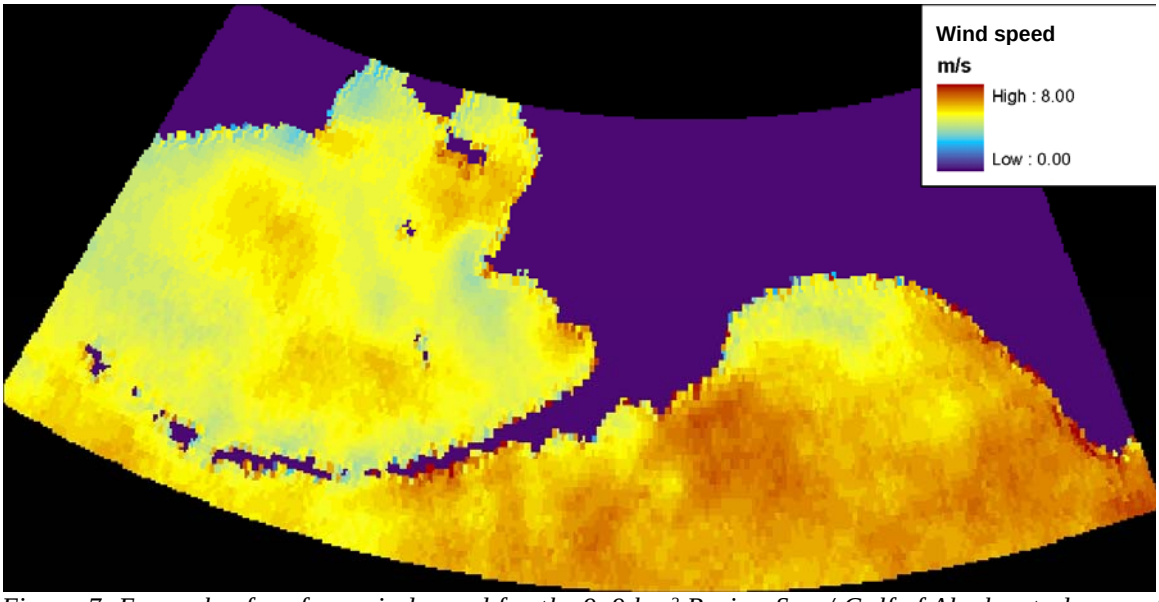

Figure 7: Example of surface wind speed for the 9x9 km² Bering Sea / Gulf of Alaska study area for July, 2005.

Binary data files were imported using the PARE function which required the extents and the spatial reference system for the resulting raster to be input explicitly. The source data contained 3 additional variables aside from the wind speed data in each downloaded image. We thus had to account for these other variables when calculating the PARE extent parameters in order to correctly identify the longitude and latitude extents of the wind speed portion of the composite image. Additionally, the wind speed images were initially inverted, and had to be flipped vertically to correctly orient the images (so that North was up).

We converted the 256 byte integer pixel data values to units of meters per second using a scale factor of 0.2 according to instructions on the source web page. The 5 maximum values in the wind data (251 to 255 prior to the scaling) represented data flags for features such as NoData and sea ice. In order to properly distinguish these flags from data, the flags were reclassified to negative integers ranging from -1 to -5.

Finally, we clipped the images to our BS/GOA study area and projected the data to the Albers Alaska spatial projection. The resolution was re-sampled to match our 9x9 km^2 target grid by specifying desired number of rows and columns.

The 12 nGOA monthly wind speed climatologies are provided as 12 float files for each variable. For the BS/GOA, the monthly averages are provided as monthly float files for all available months (Appendix 1).

Eastern North Pacific climatologies

During the process of documenting the processes required to prepare the remote sensing data, we felt that climatologies for broader extents, at a spatial resolution native to the source data, may also constitute a useful data product – one whose inclusion would require minimal additional effort.

We therefore prepared monthly climatologies for chl-a, SLA, SST, and surface winds at their native resolutions, for the entire eastern North Pacific and Bering Sea (Figure 1). The extents are approximately 66.5°N to 32°N, and from 156°E to 117°W.

We did not prepare a bathymetric framework for this data set, as each variable is presented at a different spatial resolution, without a common, rectified grid. Users of these data will therefore need to create a bathymetric raster for their area of interest, and then project the climatologies onto that grid to align the data sets at the resolution of interest.

As with the nGOA climatologies, these data are provided as a set of 12 binary floating point files. The data have been projected to a WGS 1984 Mercator projection with standard ESRI default parameters, except the central meridian was changed to 180°.

ROMS model output

Data on sea level anomaly (SLA), mixed layer depth (MLD), and temperature, salinity, and current velocity were obtained at 3 different depths (surface, below MLD, and bottom) from a Regional Ocean Modelling System (ROMS) model developed by Al Hermann and colleagues (Hermann et al. 2002; Hermann and Stabeno 1996) for the northern Gulf of Alaska. The model uses a rotated coordinate grid with a nominal resolution of 3x3 km^2. The data were provided (in 2005) by D. Musgrave (pers. comm.) as text files containing 2-week averages and variances, for March through September 2001 (13 time periods total).

Subsequently, these data were updated with an updated run for the entire 2001 calendar year. It is these data, obtained as NetCDF files, that were ultimately used in the analysis. We wrote MatLab scripts to extract and format the data for this study.

The complete data set contained a total of 230,400 points. After removing invalid points (using flags in the velocity fields), and restricting the points to the US EEZ and depths <= 600 m, a total of 36,280 points remained for the analysis.

For the analysis, the geographic locations on ROMS model grid had to be associated with the cells in the 3x3 km^2 GOA study grid. We used the NEAR function to associate the model points with the centroids of

the GOA study grid, using a tolerance of 3 km. The resulting lookup table provided a relationship between the ROMS model identifier and the study area GridID.

The data are provided as a series of 28 tables in an MS Access database. Each table is comprised of 230,400 records, each representing a model point. Each record contains its geographic coordinate, and a value for all the variables for the specific time period. The tables contain one column per attribute. The column headers are described below.

The variables obtained from the ROMS model (Appendix 1) were provided as 2-week averages for the year 2001 (Table 2).

Table 1: Regional Ocean Modelling System (ROMS) model variables and their description

Variable	Description
GridID, id	GridID: The link to the study area grid; id: The internal ROMS identifier.
lon, lat	Geographic coordinates to 2 decimal places.
mask	Marine areas masked as valid (1) or invalid (0) based on flags in the velocity fields. The delivered file contains only the valid points, and therefore all values should be 1.
SLA	Sea level anomaly (cm)
MLD	Mixed layer depth as calculated algorithmically by the ROMS model.
Dmld	Depth of model layer below the calculated mixed layer depth.
Tsurf, Tbot, Tmld	Temperature (°C) at surface, bottom, and depth below MLD.
Ssurf, Sbot, Smld	Salinity (psu) at surface, bottom, and depth below MLD.
Usurf, Vsurf, Wsurf Ubot, Vbot, Wbot Uamld, Vamld, Wamld, Ubmld, Vbmld, Wbmld	Velocity components (U, V, W) at surface, bottom, and at levels both above (amld) and below (bmld) the MLD model level. Velocities are in m/s, but note that vertical (W) velocities are several orders of magnitude smaller.

Table 2: Date ranges for the 2-week time periods for which the Hermann circulation model output was averaged.

Period	Start	End	Period	Start	End
1	2000-12-14	2000-12-27	15	2001-06-28	2001-07-11
2	2000-12-28	2001-01-10	16	2001-07-12	2001-07-25
3	2001-01-11	2001-01-24	17	2001-07-26	2001-08-08
4	2001-01-25	2001-02-07	18	2001-08-09	2001-08-22
5	2001-02-08	2001-02-21	19	2001-08-23	2001-09-05
6	2001-02-22	2001-03-07	20	2001-09-06	2001-09-19
7	2001-03-08	2001-03-21	21	2001-09-20	2001-10-03
8	2001-03-22	2001-04-04	22	2001-10-04	2001-10-17
9	2001-04-05	2001-04-18	23	2001-10-18	2001-10-31
10	2001-04-19	2001-05-02	24	2001-11-01	2001-11-14
11	2001-05-03	2001-05-16	25	2001-11-15	2001-11-28
12	2001-05-17	2001-05-30	26	2001-11-29	2001-12-12
13	2001-05-31	2001-06-13	27	2001-12-13	2001-12-26
14	2001-06-14	2001-06-27	28	2001-12-27	2002-01-09

DISCUSSION

This collection of monthly, physical oceanographic data is suitable for a range of oceanographic analyses at the temporal scale of months and seasons. The spatial scale of 9x9 km^2 is suitable for monthly studies, and could be aggregated if seasonal or long-term temporal averages were desired.

The data collection for the 3x3 km^2 northern Gulf of Alaska study area, by integrating remote sensing data with water column properties, represents one of the best physical data sets ever assembled for this region. Although the circulation model limits the data to a single year (2001), the breadth of predictive variables should provide a fertile background for further investigations into species-habitat relationships.

The quality control and refinement we applied to the 9x9 km^2 sea surface temperature represent an important improvement over the climatology files provided on the live access server. We would encourage anyone using remote sensing data to inspect the associated quality flags, when available.

These data can thus support analyses in the North Pacific and Bering Sea across a range of temporal and spatial scales. We hope this collection will be of use to marine scientists interested in species distributions, habitat description, marine classification, and protected area designation.

ACKNOWLEDGEMENTS

This work was supported by the North Pacific Research Board, the North Pacific Universities Marine Mammal Research Consortium, the North Pacific Marine Science Foundation, and the National Oceanographic and Atmospheric Administration. Al Hermann and Dave Musgrave facilitated access to the ROMS model output. Dylan Righi provided technical support with ROMS output processing.

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Smith, W.H.F. and D.T. Sandwell. 1997. Global Sea Floor Topography from Satellite Altimetry and Ship Depth Soundings. Science 277, 1956-1962.

Hermann, A.J., D. B. Haidvogel, E. L. Dobbins, and P. J. Stabeno. 2002. Coupling global and regional circulation models in the coastal Gulf of Alaska. *Progress in Oceanography*. 53: 335-367.

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Marks, K.M., and W.H.F. Smith. 2006. An evaluation of publicly available global bathymetric grids. Marine Geophysical Researches, 27:19-34. DOI 10.1007/s11001-005-2095-4.

APPENDICES

Appendix 1: Data sets prepared for economic & habitat studies of the eastern North Pacific and Bering Sea

Appendix 2: Federal Geographic Data Committee compatible metadata

APPENDIX 1 – DATA SETS PREPARED FOR ECONOMIC AND HABITAT STUDIES OF THE EASTERN NORTH PACIFIC / BERING SEA

Variable	Source / Sensor	Native resolution	Temporal resolution/extents	Data delivered	Data Product
Bathymetry	Smith & Sandwell	2 minute	n/a	3x3 km^2 – GOA study area 9x9 km^2 – GOA/BS study area. Metadata & binary float files (.flt and .hdr).	bathy_3km.flt (.hdr) bathy_3km_metadata.txt
					bathy_9km.flt (.hdr) bathy_9km_metadata.txt
Slope	Smith & Sandwell	2 minute	n/a	3x3 km^2 – GOA area 9x9 km^2 – GOA/BS area Metadata & binary float files (.flt and .hdr).	slope_3km.flt (.hdr) slope_3km_metadata.txt
					slope_9km.flt (.hdr) slope_9km_metadata.txt
Chlorophyll	MODIS	4 km	monthly 2002 to 2005	3x3 km^2 – GOA study area monthly climatologies.	month_01.flt – month_12.flt (.hdr) chla_3km_metadata.txt
	SeaWIFs	9 km	monthly Sep 1997 to May 2006	9x9 km^2 – GOA/BS study area monthly averages (96 months).	S19972441997273.flt (.hdr) (year/julian day start and end of each month) chla_9km_metadata.txt
Sea surface temperature (SST)	MODIS	4 km	monthly 2002 to 2005	3x3 km^2 – GOA area monthly climatologies.	month_01.flt – month_12.flt (.hdr) SST_3km_metadata.txt
	Pathfinder AVHRR	4 km	monthly Jan 1985 to Dec 2005	9x9 km^2 – GOA/BS area monthly averages (252 months) separate day and night products	198501.S04M3PFV50-SST-16B.flt (.hdr) (year/month coded in first block) SST_9km_metadata.txt
SST slope	Pathfinder AVHRR	4 km	monthly Jan 1985 to Dec 2005	9x9 km^2 – GOA/BS area monthly averages (252 months) separate day and night products	198501.S04M3PFV50-SST-16B.flt (.hdr) (year/month coded in first block) SSTSlope_9km_metadata.txt
Sea level anomaly (SLA)	Topex/Posideon	0.33°	weekly 1993 to 2003	3x3 km^2 – GOA area monthly climatologies.	month_01.flt – month_12.flt (.hdr) SLA_3km_metadata.txt
			monthly Oct 1992 to Jan 2006	9x9 km^2 – GOA/BS area monthly averages (160 months).	SLA_199210.flt (.hdr) (year/month coded in last block) SLA_9km_metadata.txt
Winds	SSMI	0.25°	monthly Jul 1987 to May 2006	3x3 km^2 – GOA area monthly climatologies.	month_01.flt – month_12.flt (.hdr) wind_3km_metadata.txt
				9x9 km^2 – GOA/BS area monthly averages (560 months).	F08_198707V5.flt (.hdr) (year/month coded in last block) wind_9km_metadata.txt
Water column properties*	Hermann et al.	3 km	2-week averages 2001	GOA area, 2-week averages. (28 time periods) 28 comma-delimited text files containing one column per attribute.	ValidHerm_0001.txt – ValidHerm_0028.txt Delivered as ROMS_GOA.zip ROMS_3km_metadata.txt

* Water column properties from the ROMS circulation model output include sea surface height, mixed layer depth (MLD), and temperature, salinity, and velocity at three depths – surface, below MLD, and bottom.

APPENDIX 2 – FEDERAL GEOGRAPHIC DATA COMMITTEE COMPATIBLE METADATA

Appendix 2.1 – 3x3 km² Bathymetry

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 20080222
      Title: 3km Bathymetry
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 3km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The resolution of the bathymetric source data was 2 minutes, provided as point measures.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 2007
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: None planned
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -166.0
      East_Bounding_Coordinate: -129.0
      North_Bounding_Coordinate: 61.0
      South_Bounding_Coordinate: 51.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
      Theme_Keyword: Bathymetry
      Theme_Keyword: Depth
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Floor
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address
        Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
        City: Vancouver
        State_or_Province: British Columbia
        Postal_Code: V6T 1Z4

Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained at a resolution of 2 minutes. The rescaling of the processed source images (using nearest neighbour) to match the 3x3 km study area does not affect the accuracy, however it does give the impression of higher precision. The precision of this product remains the same as the nominal precision of the source data.
Logical_Consistency_Report: None
Completeness_Report: Data are complete for the study area.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: The source data are known to be displaced. After shifting to rectify with a registered coastline, relative horizontal accuracy seems fine.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Meghan Miller, Walter H.F. Smith, John Kuhn, & David T. Sandwell
Title: An Interactive Global Map of Sea Floor Topography Based on Satellite Altimetry & Ship Depth Soundings http://ibis.grdl.noaa.gov/cgi-bin/bathy/bathD.pl
Publication_Date: 1997
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2001
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
We used the original Smith and Sandwell data to create a 3x3 km2, Albers Alaska projected grid of the study area. The Smith and Sandwell data are a global coverage, in geographic coordinates, delivered as an ASCII XYZ file. Since these data are known to be incorrectly registered, we found that a shift of 3 km North and 2 km West rectified the projected point file feature dataset with a correctly registered State of Alaska coastline file (Minerals Management Service 1:63,000 Ak coastline).
All on-land points were removed from the dataset prior to generating the bathymetric coverage. The points were removed by first deleting the points whose depth had a value greater than or equal to zero, and then removing those additional points that intersected our Alaska land polygon.
An interpolated bathymetric grid was generated using the ArcGis TopoRaster function. This process proved to be very resource dependent and had to be completed in multiple stages.Upon completion the individual raster grids were mosaic'd together to form a complete coverage. The raster grid was clipped to a specific region using a predefined rectangular shapefile.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 300
Column_Count: 665
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Bathymetry
Entity_Type_Definition: Ocean depth, deviation of the ocean depth from datum.
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview: Units are metres. 0 was used to flag land areas.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 3km Alaska Bathymetry
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20080222
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.2 – 9x9 km² Bathymetry

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 20070615
      Title: 9km Bathymetry
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 9km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: These data were obtained and prepared as part of a research project in the Bering Sea and Gulf of Alaska. The data series has been compiled and prepared for distribution in the hope that it may be useful to other researchers interested in studies on the same extents and resolution. The intent is make data from online servers, which are often not provided in user friendly formats, more accessible to researchers. The series is comprised of monthly averages for each variable at 9 km x 9 km spatial resolution, for years from 1988 to 2005, though not all data are available for all years, because of the timing of the different sensors. The data in the series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The resolution of the bathymetry source data was 2 minutes, provided as point measures.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska and Bering Sea.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 2007
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: None planned
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: 170.0
      East_Bounding_Coordinate: -130.0
      North_Bounding_Coordinate: 65.0
      South_Bounding_Coordinate: 50.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
      Theme_Keyword: Bathymetry
      Theme_Keyword: Depth
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: Bering Sea
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Floor
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address
        Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
        City: Vancouver
        State_or_Province: British Columbia

Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained at a resolution of 2 minutes. The rescaling of the processed source images (using nearest neighbour) to match the 9x9 km study area does not affect the accuracy, however it does give the impression of higher precision. The precision of this product remains the same as the nominal precision of the source data.
Logical_Consistency_Report: None
Completeness_Report: Data are complete for the study area.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: The source data are known to be displaced. After shifting to rectify with a registered coastline, relative horizontal accuracy seems fine.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Meghan Miller, Walter H.F. Smith, John Kuhn, & David T. Sandwell.
Title: An Interactive Global Map of Sea Floor Topography Based on Satellite Altimetry & Ship Depth Soundings http://ibis.grdl.noaa.gov/cgi-bin/bathy/bathD.pl
Publication_Date: 1997
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2001
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
We used the original Smith and Sandwell data to create a 3x3 km2, Albers Alaska projected grid of the study area. The Smith and Sandwell data are a global coverage, in geographic coordinates, delivered as an ASCII XYZ file. Since these data are known to be incorrectly registered, we found that a shift of 3 km North and 2 km West rectified the projected point file feature dataset with a correctly registered State of Alaska coastline file (Minerals Management Service 1:63,000 Ak coastline).
All on-land points were removed from the dataset prior to generating the bathymetric coverage. The points were removed by first deleting the points whose depth had a value greater than or equal to zero, and then removing those additional points that intersected our Alaska land polygon.
An interpolated bathymetric grid was generated using the ArcGis TopoRaster function. This process proved to be very resource dependent and had to be completed in multiple stages. Upon completion the individual raster grids were mosaic'd together to form a complete coverage. The raster grid was clipped to a specific region using a predefined rectangular shapefile.
For inclusion in this collection, the original 3km raster data were spatially aggregated onto the coarser, 9x9 km2 study area raster.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 235
Column_Count: 464
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000

False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Bathymetry
Entity_Type_Definition: Ocean depth, deviation of the ocean depth from datum.
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview: Units are metres. 0 was used to flag land areas.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 9km Alaska Bathymetry
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20070814
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.3 – 3x3 km² Bottom slope

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 20080222
      Title: 3km Bottom Slope
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 3km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. This data set contains calculated bottom slope. The resolution of the bathymetric source data from which the slope was calculated was 2 minutes.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
  Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 2007
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: None planned
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -166.0
      East_Bounding_Coordinate: -129.0
      North_Bounding_Coordinate: 61.0
      South_Bounding_Coordinate: 51.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
      Theme_Keyword: Bathymetry
      Theme_Keyword: Slope
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Floor
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address
        Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
        City: Vancouver
        State_or_Province: British Columbia
        Postal_Code: V6T 1Z4
        Country: Canada
      Contact_Voice_Telephone: 604-822-8181

Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained at a resolution of 2 minutes. The rescaling of the processed source images (using nearest neighbor) to match the 3x3 km study area does not affect the accuracy, however it does give the impression of higher precision. The precision of this product remains the same as the nominal precision of the source data.
Logical_Consistency_Report: None
Completeness_Report: Complete for study area.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No specific problems. Depends on underlying bathymetry.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Meghan Miller, Walter H.F. Smith, John Kuhn, & David T. Sandwell
Title: An Interactive Global Map of Sea Floor Topography Based on Satellite Altimetry & Ship Depth Soundings http://ibis.grdl.noaa.gov/cgi-bin/bathy/bathD.pl
Publication_Date: 1997
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2007
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.

Process_Step:
Process_Description:
We applied the IDRISI SURFACE function to the 3x3 km2 bathymetric coverage produced from the Smith and Sandwell data set. Please see the associated bathymetry data file for additional details.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 300
Column_Count: 665
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:

Entity_Type:
Entity_Type_Label: Slope
Entity_Type_Definition: Difference in elevation across the cell.
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview: Units are degrees. 0 flags land areas.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 3km Bottom Slope
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20080222
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.4 – 9x9 km² Bottom slope

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit, University of British Columbia
Publication_Date: 20070615
Title: 9km Bottom Slope
Geospatial_Data_Presentation_Form: raster digital data
Series_Information:
Series_Name: Monthly Oceanographic Data at 9km
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: These data were obtained and prepared as part of a research project in the Bering Sea and Gulf of Alaska. The data series has been compiled and prepared for distribution in the hope that it may be useful to other researchers interested in studies on the same extents and resolution. The intent is make data from online servers, which are often not provided in user friendly formats, more accessible to researchers. The series is comprised of monthly averages for each variable at 9 km x 9 km spatial resolution, for years from 1988 to 2005, though not all data are available for all years, because of the timing of the different sensors. The data in the series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The resolution of the bathymetry source data from which the slope was calculated was 2 minutes, provided as point measures.
Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska and Bering Sea.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 2007
Currentness_Reference: Current
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: 170.0
East_Bounding_Coordinate: -130.0
North_Bounding_Coordinate: 65.0
South_Bounding_Coordinate: 50.0
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Theme_Keyword: Bathymetry
Theme_Keyword: Depth
Theme_Keyword: Slope
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Gulf of Alaska
Place_Keyword: Bering Sea
Place_Keyword: North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Sea Floor
Access_Constraints: None. Available upon request.
Use_Constraints: Data are provided as is, with no warranty expressed or implied.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia

```
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
    Attribute_Accuracy:
        Attribute_Accuracy_Report: Original data were obtained at a resolution of 2 minutes. The rescaling of the
processed source images (using nearest neighbor) to match the 9x9 km study area does not affect the accuracy,
however it does give the impression of higher precision. The precision of this product remains the same as the nominal
precision of the source data.
    Logical_Consistency_Report: None
    Completeness_Report: Complete for study area.
    Positional_Accuracy:
        Horizontal_Positional_Accuracy:
            Horizontal_Positional_Accuracy_Report: No specific problems. Depends on underlying bathymetry.
    Lineage:
        Source_Information:
            Source_Citation:
                Citation_Information:
                    Originator: Meghan Miller, Walter H.F. Smith, John Kuhn, & David T. Sandwell
                    Title: An Interactive Global Map of Sea Floor Topography Based on Satellite Altimetry & Ship
Depth Soundings http://ibis.grdl.noaa.gov/cgi-bin/bathy/bathD.pl
                    Publication_Date: 1997
            Type_of_Source_Media: digital
            Source_Time_Period_of_Content:
                Time_Period_information:
                    Single_Date/Time:
                        Calendar_Date: 2001
                Source_Currentness_Reference: Extent of data processing.
            Source_Citation_Abbreviation: None
            Source_Contribution: The source data form the basis of this data set.
        Process_Step:
            Process_Description:
                We applied the IDRISI SURFACE funtion to the 3x3 km2 bathymetric coverage produced from the
Smith and Sandwell data set. For inclusion in this collection, the original 3km raster data were spatially aggregated
onto the coarser, 9x9 km2 study area raster. Please see the associated bathymetry data file for additional details.
            Process_Date: 20070331
Spatial_Data_Organization_Information:
    Direct_Spatial_Reference_Method: Raster
    Raster_Object_Information:
        Raster_Object_Type: Grid Cell
        Row_Count: 235
        Column_Count: 464
        Vertical_Count: 1
Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
        Planar:
            Map_Projection:
                Map_Projection_Name: Albers Conical Equal Area
                Albers_Conical_Equal_Area:
                    Standard_Parallel: 55.000000
                    Standard_Parallel: 65.000000
                    Longitude_of_Central_Meridian: -154.000000
                    Latitude_of_Projection_Origin: 50.000000
                    False_Easting: 0.000000
                    False_Northing: 0.000000
            Planar_Coordinate_Information:
                Planar_Coordinate_Encoding_Method: row and column
                Coordinate_Representation:
                    Abscissa_Resolution: 9001.318696
                    Ordinate_Resolution: 9001.318696
                Planar_Distance_Units: meters
        Geodetic_Model:
            Horizontal_Datum_Name: North American Datum of 1927
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Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Slope
Entity_Type_Definition: Difference in elevation across the cell.
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview: Units are degrees. 0 flags land areas.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 9km Bottom Slope
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20070814
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.5 – 3x3 km² Chlorophyll concentration

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit
      Publication_Date: 20080222
      Title: 3 km Monthly Chlorophyll (MODIS) Climatologies (mg/m^3)
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 3 km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. Monthly climatology chlorophyll concentration rasters were processed for all 12 months using remote sensing data collected between 2002 and 2005. Source data were retrieved in binary format at a 4 km resolution.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 20020701
        Ending_Date: 20050630
    Currentness_Reference: Contemporary
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: Currently no update is scheduled however new source data are being provided on a near real time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -166.0
      East_Bounding_Coordinate: -129.0
      North_Bounding_Coordinate: 61.0
      South_Bounding_Coordinate: 51.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Chlorophyll
      Theme_Keyword: Primary Production
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
      Theme_Keyword: Upwelling
      Theme_Keyword: Photosynthesis
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
      Temporal_Keyword: Climatology
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit

Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data was provided on a 256 value binary image, giving a maximum of 255 possible values. As there are global coverage, the range for the study area was considerably less. The values of 0-255 were converted to units of mg/cm^3 using a pixel value to concentration unit conversion equation:
CONCENTRATION = 10 ^ ((0.015 * PIXEL_VALUE) - 2)
Logical_Consistency_Report: None
Completeness_Report: Data are complete for the study area and time period.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy is 4 km.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: OceanColor Web
Title: Chlorophyll Concentration Climatology - Level 3 Monthly
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2001
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Download hdf binary data files via ftp. Import to IDRISI using HDFEOS import function. This imports the image in a Atlantic Central (-180 to +180) orientation with planar (pixel) coordinates.
The extents (which are by default set to the number of rows and columns in the image) must be modified to allow for proper projection. This is best accomplished by modifying the IDRISI Raster Documentation File (.RDC). Manually edit the RDC file to enter in the max/min xy geographic coordinates (-180 to 180 and -90 90) and change the projection to latlong. (NOTE: This same result can be achieved in ArcMap by rescaling the image with the appropriate scale factor to achieve a 360 scale in the x direction and a 180 scale in the y direction and then shifting the image into place).
Export from IDRISI to ARC RASTER Float format, then import to ArcGIS using the Float to Raster tool.
Assuming the extents were adjusted earlier as described, a geographic projection can now be assigned.
Convert the raster pixel values to chlorophyll concentration values using map algebra to implement the conversion equation: EXP10((0.015 * VALUE) - 2).
Using the Extract by Mask function, the resulting rasters were then clipped, projected to Albers Alaska, and resampled to 3x3 km2 using a pre-defined study area raster mask.
Process_Date: 20070331
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver

State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 300
Column_Count: 665
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Chlorophyll
Entity_Type_Definition: Ocean surface color
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview: Units are mg/m^3
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 3 km Monthly Chlorophyll (MODIS) Climatologies (mg/m^3)
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20080222

Metadata_Contact:
    Contact_Information:
        Contact_Organization_Primary:
            Contact_Organization: Marine Mammal Research Unit
            Contact_Person: Edward Gregr
        Contact_Address:
            Address_Type: mailing address
            Address: Foundation Room 247, AERL, 2202 Main Mall
            City: Vancouver
            State_or_Province: British Columbia
            Postal_Code: V6T 1Z4
            Country: Canada
        Contact_Voice_Telephone: 604-822-8181
        Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.6 – 9x9 km² Chlorophyll concentration

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit
      Publication_Date: 20080222
      Title: 3 km Monthly Chlorophyll (MODIS) Climatologies (mg/m^3)
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 3 km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. Monthly climatology chlorophyll concentration rasters were processed for all 12 months using remote sensing data collected between 2002 and 2005. Source data were retrieved in binary format at a 4 km resolution.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 20020701
        Ending_Date: 20050630
    Currentness_Reference: Contemporary
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: Currently no update is scheduled however new source data are being provided on a near real time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -166.0
      East_Bounding_Coordinate: -129.0
      North_Bounding_Coordinate: 61.0
      South_Bounding_Coordinate: 51.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Chlorophyll
      Theme_Keyword: Primary Production
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
      Theme_Keyword: Upwelling
      Theme_Keyword: Photosynthesis
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
      Temporal_Keyword: Climatology
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit

Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data was provided on a 256 value binary image, giving a maximum of 255 possible values. As there are global coverage, the range for the study area was considerably less. The values of 0-255 were converted to units of mg/cm^3 using a pixel value to concentration unit conversion equation:
CONCENTRATION = 10 ^ ((0.015 * PIXEL_VALUE) - 2)
Logical_Consistency_Report: None
Completeness_Report: Data are complete for the study area and time period.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy is 4 km.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: OceanColor Web
Title: Chlorophyll Concentration Climatology - Level 3 Monthly
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2001
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Download hdf binary data files via ftp. Import to IDRISI using HDFEOS import function. This imports the image in a Atlantic Central (-180 to +180) orientation with planar (pixel) coordinates.
The extents (which are by default set to the number of rows and columns in the image) must be modified to allow for proper projection. This is best accomplished by modifying the IDRISI Raster Documentation File (.RDC). Manually edit the RDC file to enter in the max/min xy geographic coordinates (-180 to 180 and -90 90) and change the projection to latlong. (NOTE: This same result can be achieved in ArcMap by rescaling the image with the appropriate scale factor to achieve a 360 scale in the x direction and a 180 scale in the y direction and then shifting the image into place).
Export from IDRISI to ARC RASTER Float format, then import to ArcGIS using the Float to Raster tool.
Assuming the extents were adjusted earlier as described, a geographic projection can now be assigned.
Convert the raster pixel values to chlorophyll concentration values using map algebra to implement the conversion equation: EXP10((0.015 * VALUE) - 2).
Using the Extract by Mask function, the resulting rasters were then clipped, projected to Albers Alaska, and resampled to 3x3 km2 using a pre-defined study area raster mask.
Process_Date: 20070331
Process_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver

```
                    State_or_Province: British Columbia
                    Postal_Code: V6T 1Z4
                    Country: Canada
                Contact_Voice_Telephone: 604-822-8181
                Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Spatial_Data_Organization_Information:
    Direct_Spatial_Reference_Method: Raster
    Raster_Object_Information:
        Raster_Object_Type: Grid Cell
        Row_Count: 300
        Column_Count: 665
        Vertical_Count: 1
Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
        Planar:
            Map_Projection:
                Map_Projection_Name: Albers Conical Equal Area
                Albers_Conical_Equal_Area:
                    Standard_Parallel: 55.000000
                    Standard_Parallel: 65.000000
                    Longitude_of_Central_Meridian: -154.000000
                    Latitude_of_Projection_Origin: 50.000000
                    False_Easting: 0.000000
                    False_Northing: 0.000000
            Planar_Coordinate_Information:
                Planar_Coordinate_Encoding_Method: row and column
                Coordinate_Representation:
                    Abscissa_Resolution: 9001.318696
                    Ordinate_Resolution: 9001.318696
                Planar_Distance_Units: meters
        Geodetic_Model:
            Horizontal_Datum_Name: North American Datum of 1927
            Ellipsoid_Name: Clarke 1866
            Semi-major_Axis: 6378206.400000
            Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
    Detailed_Description:
        Entity_Type:
            Entity_Type_Label: Chlorophyll
            Entity_Type_Definition: Ocean surface color
            Entity_Type_Definition_Source: None
    Overview_Description:
        Entity_and_Attribute_Overview: Units are mg/m^3
        Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat
Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22,
2008.
Distribution_Information:
    Distributor:
        Contact_Information:
            Contact_Person_Primary:
                Contact_Person: Edward Gregr
                Contact_Organization: Marine Mammal Research Unit
            Contact_Position: Researcher
            Contact_Address:
                Address_Type: mailing address
                Address: Foundation Room 247, AERL, 2202 Main Mall
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
    Resource_Description: 3 km Monthly Chlorophyll (MODIS) Climatologies (mg/m^3)
    Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
    Metadata_Date: 20080222
```

Metadata_Contact:
    Contact_Information:
        Contact_Organization_Primary:
            Contact_Organization: Marine Mammal Research Unit
            Contact_Person: Edward Gregr
        Contact_Address:
            Address_Type: mailing address
            Address: Foundation Room 247, AERL, 2202 Main Mall
            City: Vancouver
            State_or_Province: British Columbia
            Postal_Code: V6T 1Z4
            Country: Canada
        Contact_Voice_Telephone: 604-822-8181
        Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.7 – 3x3 km² Sea surface temperature

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit
      Publication_Date: 20080222
      Title: 3km Sea Surface Temperature Monthly MODIS Climatologies (deg C)
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 3km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. This data set contains monthly climatologies of sea surface temperature.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 20020701
        Ending_Date: 20050630
      Currentness_Reference: Contemporary
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: Currently no update is scheduled however new source data are being provided on a near real time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -166.0
      East_Bounding_Coordinate: -129.0
      North_Bounding_Coordinate: 61.0
      South_Bounding_Coordinate: 51.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Temperature
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
      Temporal_Keyword: Climatology
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address
        Address: Foundation Room 247, AERL, 2202 Main Mall
        City: Vancouver

State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data was provided on a 256 value binary image. This limits the number of valid values that can be represented to 255. As the source was a global coverage, the available range for the study area is considerably less than this.
Logical_Consistency_Report: None
Completeness_Report: Data is complete for the time period stated.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy is 4 km.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: OceanColor Web
Title: Sea Surface Temperature Climatology - Level 3 Monthly
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2001
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Download hdf binary data files via ftp. Import to IDRISI using HDFEOS import function. This imports the image in an Atlantic-centric perspective (-180 to +180) with planar (pixel) coordinates.
The extents (which are by default set to the number of rows and columns in the image) must be modified to allow for proper projection later on. This is best accomplished by modifying the IDRISI Raster Documentation File (.RDC). Manually edit the RDC file to enter the max/min xy geographic coordinates (-180 to 180 and -90 90) and change the projection to latlong. (NOTE: This same result can be achieved in ArcMap by rescaling the image with the appropriate scale factor to achieve a 360 scale in the x direction and a 180 scale in the y direction and then shifting the image into place).
Export from IDRISI to ARC RASTER Float format, then import to ArcGIS Raster format using the Float to Raster tool.
Given that the extents were properly assigned earlier, a geographic projection can now be assigned to the raster using the Define Spatial Projection tool.
The default pixel values ranging in value from 0-255 were converted to degrees Celsius using the following scaling equation using Map Algebra: ((0.15 * VALUE) - 2)
Using the Extract by Mask function, the resulting rasters were then clipped, projected to Albers Alaska, and resampled to 3km using a pre-defined study area raster mask.
Process_date: 20070301
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 300
Column_Count: 665
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000

```
                    Latitude_of_Projection_Origin: 50.000000
                    False_Easting: 0.000000
                    False_Northing: 0.000000
            Planar_Coordinate_Information:
                Planar_Coordinate_Encoding_Method: row and column
                Coordinate_Representation:
                    Abscissa_Resolution: 9001.318696
                    Ordinate_Resolution: 9001.318696
                Planar_Distance_Units: meters
        Geodetic_Model:
            Horizontal_Datum_Name: North American Datum of 1927
            Ellipsoid_Name: Clarke 1866
            Semi-major_Axis: 6378206.400000
            Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
    Detailed_Description:
        Entity_Type:
            Entity_Type_Label: Sea surface temperature
            Entity_Type_Definition: Temperature at ocean surface.
            Entity_Type_Definition_Source: None
    Overview_Description:
        Entity_and_Attribute_Overview: Units are degrees C. 0 flags land areas.
        Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat
Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22,
2008.
Distribution_Information:
    Distributor:
        Contact_Information:
            Contact_Person_Primary:
                Contact_Person: Edward Gregr
                Contact_Organization: Marine Mammal Research Unit
            Contact_Position: Researcher
            Contact_Address:
                Address_Type: mailing address
                Address: Foundation Room 247, AERL, 2202 Main Mall
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
    Resource_Description: 3km Sea Surface Temperature (MODIS) Monthly Climatologies
    Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
    Metadata_Date: 20080222
    Metadata_Contact:
        Contact_Information:
            Contact_Organization_Primary:
                Contact_Organization: Marine Mammal Research Unit
                Contact_Person: Edward Gregr
            Contact_Address:
                Address_Type: mailing address
                Address: Foundation Room 247, AERL, 2202 Main Mall
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
    Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
    Metadata_Standard_Version: FGDC-STD-001-1998
```

Appendix 2.8 – 9x9 km² Sea surface temperature

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit, University of British Columbia
Publication_Date: 20070615
Title: 9 km Monthly Average Sea Surface Temperature (ascending/descending)
Series_Information:
Series_Name: Monthly Oceanographic Data at 9km
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: These data were obtained and prepared as part of a research project in the Bering Sea and Gulf of Alaska. The data series has been compiled and prepared for distribution in the hope that it may be useful to other researchers interested in studies on the same extents and resolution. The intent is make data from online servers, which are often not provided in user friendly formats, more accessible to researchers. The series is comprised of monthly averages for each variable at 9 km x 9 km spatial resolution, for the years 1985 to 2005, though not all data are available for all months, because of the timing of the different sensors. The data in the series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The spatio-temporal resolution of the Sea Surface Temperature source data used were monthly, 4 km x 4km images, though the associated live access server maintains a range of other temporal scales.
Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska and Bering Sea.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 199201
Ending_Date: 200512
Currentness_Reference: Current
Status:
Progress: Complete
Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: 170.0
East_Bounding_Coordinate: -130.0
North_Bounding_Coordinate: 65.0
South_Bounding_Coordinate: 50.0
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Sea Surface Temperature
Theme_Keyword: Sea Surface Fronts
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Gulf of Alaska
Place_Keyword: Bering Sea
Place_Keyword: North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Sea Surface
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Monthly
Access_Constraints: None. Available upon request.
Use_Constraints: None
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher

Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained as 4km resolution images. These were re-sampled to a 9km resolution grid, which represents an accurate averaging of the 4km source data. Precision is limited by the 256 values contained in the original colour images.
Logical_Consistency_Report: None
Completeness_Report: Complete for study area and time period.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy is 4 km.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Physical Oceanography Distributed Active Archive Center
Title: Sea Surface Temperature AVHRR oceans pathfinder global 4km equal-angle SST V5.
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Range_of_Dates/Times:
Beginning_Date: 199201
Ending_Date: 200512
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Source data were downloaded via ftp as monthly binary HDF files with a 4x4 km resolution. The data were processed to match the 9x9 km resolution study area of the Gulf of Alaska and Bering Sea. Four files were produced for each month: Mean ascending (day) temperature, Mean descending (night) temperature, processed quality coverage, and a temperature slope coverage. Processing steps were conducted in the IDRISI software package:
IMPORT the binary files using the HDFEOS import function in IDRISI.
The images are split on 180 degrees longitude (i.e., the x range is from -180 to +180). These steps (including correct editing of the metadata and projection information) result in a layer that ranges from 0 to 360 degrees, providing a continuous representation of the North Pacific. WINDOW the image into two separate images and then CONCATENATE them back together in reversed order. Select the appropriate begin and end columns for each of the window images such that when they are CONCATENATED back together in reverse order the +/-180 longitude line will become the center of the image. Modify the associated ASCII RDC file with the new extents of the layer.
WINDOW the image to extract the desired study area extents (-190 to -130, 65 to 50).
To convert the colour image to degrees Celsius, multiply the image by 0.075 and subtract 3.
PROJECT the raster using the Albers Alaska projection using 464 columns x 235 rows to achieve a 9x9 km grid size over the extent of the study area.
OVERLAY the raster with the a mask generated from quality flag information used to categorize the level of quality of the measurements such that low quality measurement pixel are removed from the raster.
Convert the raster in to a point vector files using POINTVEC. NoData values (including those removed by the quality mask) are not exported to points. The points generated represent true data values with acceptable measurement quality. These points are then interpolated to create a continuous SST surface that is not contaminated with low quality inaccurate measurements. The interpolated surface is then masked with a land mask layer.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell

Row_Count: 235
Column_Count: 464
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: SST
Entity_Type_Definition: Monthly averages of sea surface temperature
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview:
SST (ascending or descending) in units of Celsius.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 9 km Monthly sea surface temperature (ascending/descending/quality/slope)
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20070605
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia

```
            City: Vancouver
            State_or_Province: British Columbia
            Postal_Code: V6T 1Z4
            Country: Canada
        Contact_Voice_Telephone: 604-822-8181
        Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
```

Appendix 2.9 – 9x9 km² Sea surface temperature slope

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit, University of British Columbia
Publication_Date: 20070615
Title: 9 km Monthly Average Sea Surface Temperature Slope (ascending/descending)
Series_Information:
Series_Name: Monthly Oceanographic Data at 9km
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: These data were obtained and prepared as part of a research project in the Bering Sea and Gulf of Alaska. The data series has been compiled and prepared for distribution in the hope that it may be useful to other researchers interested in studies on the same extents and resolution. The intent is make data from online servers, which are often not provided in user friendly formats, more accessible to researchers. The series is comprised of monthly averages for each variable at 9 km x 9 km spatial resolution, for the years 1985 to 2005, though not all data are available for all months, because of the timing of the different sensors. The data in the series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The spatio-temporal resolution of the Sea Surface Temperature source data were monthly, 4 km x 4km images, though the associated live access server maintains a range of other temporal scales.
Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska and Bering Sea.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 199201
Ending_Date: 200512
Currentness_Reference: Current
Status:
Progress: Complete
Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: 170.0
East_Bounding_Coordinate: -130.0
North_Bounding_Coordinate: 65.0
South_Bounding_Coordinate: 50.0
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Sea Surface Temperature
Theme_Keyword: Sea Surface Fronts
Theme_Keyword: Sea Surface Slope
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Gulf of Alaska
Place_Keyword: Bering Sea
Place_Keyword: North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Sea Surface
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Monthly
Access_Constraints: None. Available upon request.
Use_Constraints: None
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit

Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained as 4km resolution images. These were re-sampled to a 9km resolution grid, which represents an accurate averaging of the 4km source data. Precision is limited by the 256 values contained in the original colour images.
Logical_Consistency_Report: None
Completeness_Report: Complete for study area and time period.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy is 4 km.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: Physical Oceanography Distributed Active Archive Center
Title: Sea Surface Temperature AVHRR oceans pathfinder global 4km equal-angle SST V5.
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Range_of_Dates/Times:
Beginning_Date: 199201
Ending_Date: 200512
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Source data were downloaded via ftp as monthly binary HDF files with a 4x4 km resolution. The data were processed to match the 9x9 km resolution study area of the Gulf of Alaska and Bering Sea. Four files were produced for each month: Mean ascending (day) temperature, Mean descending (night) temperature, processed quality coverage, and a temperature slope coverage. Processing steps were conducted in the IDRISI software package:
IMPORT the binary files using the HDFEOS import function in IDRISI.
The images are split on 180 degrees longitude (i.e., the x range is from -180 to +180). These steps (including correct editing of the metadata and projection information) result in a layer that ranges from 0 to 360 degrees, providing a continuous representation of the North Pacific. WINDOW the image into two separate images and then CONCATENATE them back together in reversed order. Select the appropriate begin and end columns for each of the window images such that when they are CONCATENATED back together in reverse order the +/-180 longitude line will become the center of the image. Modify the associated ASCII RDC file with the new extents of the layer.
WINDOW the image to extract the desired study area extents (-190 to -130, 65 to 50).
To convert the colour image to degrees Celsius, multiply the image by 0.075 and subtract 3.
PROJECT the raster using the Albers Alaska projection using 464 columns x 235 rows to achieve a 9x9 km grid size over the extent of the study area.
OVERLAY the raster with the a mask generated from quality flag information used to categorize the level of quality of the measurements such that low quality measurement pixel are removed from the raster.
Convert the raster in to a point vector files using POINTVEC. NoData values (including those removed by the quality mask) are not exported to points. The points generated represent true data values with acceptable measurement quality. These points are then interpolated to create a continuous SST surface that is not contaminated with low quality inaccurate measurements. The interpolated surface is then masked with a land mask layer.
Slope (in degrees) was calculated using the SURFACE function. Boundary errors from the SURFACE functions at the study area edge and near land were removed using the OVERLAY function and a buffered land raster.
Process_Date: 20070331

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 235
Column_Count: 464
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: SST
Entity_Type_Definition: Monthly averages of sea surface temperature slope
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview:
SST slope (ascending or descending) in units of degrees.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 9 km Monthly sea surface temperature slope (ascending/descending)
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20070605
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit

Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.10 – 3x3 km² Sea level anomaly

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit
Publication_Date: 20080222
Title: 3 km Sea Level Anomaly Monthly Climatology (cm)
Geospatial_Data_Presentation_Form: raster digital data
Series_Information:
Series_Name: Monthly Oceanographic Data at 3km
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. This data set contains monthly climatologies of sea level anomalies.
Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 19930106
Ending_Date: 20051228
Currentness_Reference: Contemporary
Status:
Progress: Complete
Maintenance_and_Update_Frequency: Currently no update is scheduled however new source data are being provided on a near real time basis.
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -166.0
East_Bounding_Coordinate: -129.0
North_Bounding_Coordinate: 61.0
South_Bounding_Coordinate: 51.0
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Sea Level Anomaly
Theme_Keyword: Sea Surface Height
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Theme_Keyword: Surface
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Gulf of Alaska
Place_Keyword: North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Surface
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Monthly
Temporal_Keyword: Climatology
Access_Constraints: None. Available upon request.
Use_Constraints: Data are provided as is, with no warranty expressed or implied.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address

Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
The resolution of the weekly source data make the values less reliable in coastal areas, where land-flagged values change from month to month, at least partially in response to ice cover. To limit data loss in the monthly averages, zero (no data) values in the weekly surfaces were ignored. Thus, a monthly climatology value (in coastal regions, particularly in winter months) may be based on 1-4 weekly values per month, per year.
Logical_Consistency_Report: None
Completeness_Report: Data is complete for the time period stated.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: Minor problems encountered when rectifying the data with the coastline because of the size of the native format. Nominal accuracy is 1/3 degree.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: AVISO live access server - www.aviso.oceanobs.com
Title: Maps of Sea Level Anomalies
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2001
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
NetCDF binary data files were downloaded via ftp. Data were imported to IDRISI using HDFEOS import function. By default the images had a Pacific-centric orientation but were rotated 90 degrees clockwise from a standard East to West map layout. The images were rotated to the proper East to West layout by using the TRANSPOSE function in IDRISI.
Upon import, the extents were automatically assigned as the number of rows and columns in the image. Extents were updated by editing the IDRISI Raster Documentation (RDC) file to change the max/min xy geographic coordinates to -180 to 180 and -90 90, and the projection to latlong.
In order to accommodate the climatology averaging process, the default no data values had to be changed to zero so that they would be ignored during the count and sum steps below. This step was performed using the IDRISI RECLASS function to change the arbitrary no data value from 1.84467440737E19 to zero.
A temporary file was created for each input layer to calculate a count surface that represents the total number of input values for each pixel average. This was required because the IDRISI COUNT function ignores values <=1, and the SLA contains both positive and negative values. Thus all valid values were converted to >1 so that no valid values were ignored. COUNT was then used to create a surface that has 0 for no data/land pixels and 1 for valid data pixels. For each data layer a count layer was also created.
The above steps were performed for all of the input layers for the current month being processed. The monthly files were manually separated into their own individual directories. Once all of the input files were processed the monthly climatology was generated by calculating a sum of all of the count surfaces and a sum of all of the data surfaces. The two layers were then divided to create the resulting climatology.
The climatologies were exported from IDRISI to ARC RASTER Float format and imported into ArcGIS via the Float to Raster tool. After assigning an initial geographic projection, the rasters were clipped, projected to Albers Alaska, and resampled to 3km using a pre-defined study area raster mask with the Extract by Mask tool.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 300
Column_Count: 665

Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Overview_Description:
Entity_and_Attribute_Overview: Sea level anomaly (deviation in cm from long term average) recorded for each cell in the data raster.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 3 km Sea Level Anomaly Monthly Climatology
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 2008-02-22
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.11 – 9x9 km² Sea level anomaly

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 20070615
      Title: 9km Monthly Average Sea Level Anomaly
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 9km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: These data were obtained and prepared as part of a research project in the Bering Sea and Gulf of Alaska. The data series has been compiled and prepared for distribution in the hope that it may be useful to other researchers interested in studies on the same extents and resolution. The intent is make data from online servers, which are often not provided in user friendly formats, more accessible to researchers. The series is comprised of monthly averages for each variable at 9 km x 9 km spatial resolution, for the years 1985 to 2005, though not all data are available for all months, because of the timing of the different sensors. The data in the series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The spatio-temporal resolution of the Sea Level Anomaly source data was weekly, on 0.25 degree pixels.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska and Bering Sea.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 199210
        Ending_Date: 200512
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: 170.0
      East_Bounding_Coordinate: -130.0
      North_Bounding_Coordinate: 65.0
      South_Bounding_Coordinate: 50.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Sea Level Anomaly
      Theme_Keyword: Sea Surface Height
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: Bering Sea
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
      Temporal_Keyword: Weekly
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher

Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained at a resolution of 0.25 degrees. The rescaling of the processed source images (using nearest neighbour) to match the 9x9 km study area does not affect the accuracy, however it does give the impression of higher precision. The precision of this product remains the same as the nominal precision of the source data (0.25 degrees).

The resolution of the weekly source data make the values less reliable in coastal areas, where land-flagged values change from month to month, at least partially in response to ice cover. To limit data loss in the monthly averages, zero (no data) values in the weekly surfaces were ignored. Thus, a monthly value (in coastal regions, particularly in winter months) may be based on 1-4 weekly values.

Logical_Consistency_Report: None
Completeness_Report: The data are complete for years where data were available. 1992 is the only year with partial data.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy reported as 0.25 degrees.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: AVISO OceanObs
Title: Gridded Sea Level Anomalies, Near Real Time, Merged Jason1 and Topex/Posideon.
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Range_of_Dates/Times:
Beginning_Date: 199210
Ending_Date: 200512
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Source data were downloaded via ftp as weekly binary NetCDF format files with a 0.25 degree resolution. The data were processed into monthly averages and manipulated to match the 9x9 km resolution study area of the Gulf of Alaska and Bering Sea.

Processing steps were all conducted in the IDRISI software package:

Import to IDRISI using HDFEOS import function.

TRANSPOSE the image in order to rotate it 90 degrees counterclockwise to achieve the correct orientation (source images were found to be rotated 90 degrees clockwise). Update the RDC file to reflect the correct spatial extents (-360 to 0, -90 to 90) to allow proper projection and display.

WINDOW the raster to extract the desired data extents (-190 to -130, and 65 to 50).

RECLASS the extreme positive value used to represent NODATA to zero and use SCALAR to scale the surface by a multiple of 10000. This prepares the weekly images for use by the COUNT function, which treats negative and very small values as zero (note the scaled values were not used, they were simply used to ensure the correct operation of COUNT).

The above steps are repeated for all data files associated with the current year-month being processed.

When all weekly files for a particular month were processed, two new blank rasters were created using INITIAL with the raster parameters from an existing source week raster. These two rasters were used to store the sum of the weekly data files and the sum of the count surfaces for the current month.

OVERLAY the intermediate weekly data layers to sum their values.

OVERLAY the intermediate weekly count layers to sum the counts.

Perform one more OVERLAY to divide the summed data surface by the summed count surface to get a monthly average surface.

PROJECT the raster to the Albers Alaska projection using 464 columns x 235 rows to achieve a 9x9 km grid and match the existing study area.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 235
Column_Count: 464
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: SLA
Entity_Type_Definition: Sea Level Anomaly. Monthly deviation of the sea surface height from datum.
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview:
Units are cm.
0 was used to flag all areas of No Data in the raster. This includes land and regions outside the study area because of the projected space. While 0 could theoretically be a valid data value, we found no examples of this during extensive examination of the source data sets.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 9km Monthly Sea Level Anomalies
Distribution_Liability: Data are provided without warranty.

Metadata_Reference_Information:
Metadata_Date: 20070604
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.12 – 3x3 km² Sea surface wind speed

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit
      Publication_Date: 20080222
      Title: 3km Sea Surface Wind Climatologies (m/s)
      Geospatial_Data_Presentation_Form: raster digital data
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 3km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: This data was collected and prepared for scientific research and analysis. Data available online are not provided in a user friendly format and therefore require extensive processing to achieve desirable study area boundaries, matching raster grids and resolutions, and consistent spatial extents and projections. The data in this series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. This data set contains monthly climatologies of sea surface winds.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 19880116
        Ending_Date: 20041225
      Currentness_Reference: Contemporary
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: Currently no update is scheduled however new source data are being provided on a near real time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -166.0
      East_Bounding_Coordinate: -129.0
      North_Bounding_Coordinate: 61.0
      South_Bounding_Coordinate: 51.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Sea Winds
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: Bearing Sea
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
      Temporal_Keyword: Climatology
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address
        Address: Foundation Room 247, AERL, 2202 Main Mall

City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Attribute_Accuracy_Report: Original data were obtained at a resolution of 0.25 degrees. The rescaling of the processed source images (using nearest neighbour) to match the 3x3 km study area does not affect the accuracy, however it does give the impression of higher precision. The precision of this product remains the same as the nominal precision of the source data (0.25 degrees). The attribute data values were originally on a 0-255 scale where 0-250 represented data values and 251-255 were flag values.
Logical_Consistency_Report: None
Completeness_Report: Data is complete for the time period stated.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: Nominal accuracy is 0.25 degrees. No rectification problems were encountered.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: RSS (Remote Sensing Systems)
Title: SSMI Surface Wind Speeds http://www.remss.com
Publication_Date: 2007
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Single_Date/Time:
Calendar_Date: 2007
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
QSCAT data were downloaded via ftp (http://www.remss.com/) as monthly binary files with a 0.25 degree resolution. The data were processed to match an existing 3x3 km resolution study area of the Gulf of Alaska. The SSM/I data are composed of composite images representing data for 4 different variables, of which we extracted winds.

The SSM/I data files were imported using the PARE import function in IDRISI. During the PARE import process, the geographic coordinates of -360 to 0 degrees longitude and -630 to 90 degrees latitude were assigned as parameters to define the data extents. These coordinates were used in order to have the winds portion of the composite SSM/I image assigned coordinates of -360 to 0 and -90 to 90. The projection was also assigned as latlong during the PARE process.

The wind data were retrieved as composite images (multiple adjacent variable images). The wind portion was extracted using the WINDOW function to cut out the winds data. The wind image was then flipped upside down using TRANSPOSE in order to achieve proper NORTH-SOUTH orientation (upon import the winds image is upside down.) Multiplying the entire windows image by value of 0.2 is done to convert the 256 scaled values in to values of m/s.

The winds images were manipulated to achieve a Pacific-centric orientation. This was done by cutting the global rasters in to two halves and then concatenating them back together in opposite order. A Pacific orientation was achieved during the clip/projection processing in ArcMap as noted below.

In order to accommodate the climatology averaging process, the default no data values had to be changed to zeros so that they would be ignored during the count and sum steps below. This step was performed using the IDRISI RECLASS function to change the no data value (1.84467440737E19) to zero.

A temporary file was created for each input layer in order to calculate a count surface. The count surface represents the number of input values for each pixel during the average computation. The IDRISI COUNT function ignores values <=0.5. Because SLA contains both positive and negative values, an all positive surface must be used during the count step so that the negative values are not discounted during the COUNT function. Additionally the all positive surface was multiplied by 1000 to ensure that values between 0 and 1 are also not ignored by the COUNT procedure. COUNT was then used to create a surface that has 0 for no data/land pixels and 1 for valid data pixels. A count layer was created for each data layer.

The above steps were performed for all of the input layers for the current month being processed. Once all of the input files were processed the monthly climatology was generated by calculating a sum of all of the

count surfaces and a sum of all of the data surfaces. These two layers were then divided to create the final climatology average.

The resulting climatologies were exported from IDRISI to ARC RASTER Float format and then subsequently imported in to ARC GIS Raster format via the Float to Raster tool. After assigning an initial geographic projection, the rasters were clipped, projected to Albers Alaska, and resampled to the 3 km study area using a pre-defined study area raster mask with the Extract by Mask tool.

Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 300
Column_Count: 665
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:
Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Wind
Entity_Type_Definition: Surface wind speed.
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview: Units are m/s.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 3km Sea Surface Wind Climatologies (m/s)
Distribution_Liability: Data are provided without warranty.

Metadata_Reference_Information:
Metadata_Date: 20080222
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Foundation Room 247, AERL, 2202 Main Mall
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.13 – 9x9 km² Sea surface wind speed

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 20070615
      Title: 9 km Monthly Average Sea Winds
      Series_Information:
        Series_Name: Monthly Oceanographic Data at 9km
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: These data were obtained and prepared as part of a research project in the Bering Sea and Gulf of Alaska. The data series has been compiled and prepared for distribution in the hope that it may be useful to other researchers interested in studies on the same extents and resolution. The intent is make data from online servers, which are often not provided in user friendly formats, more accessible to researchers. The series is comprised of monthly averages for each variable at 9 km x 9 km spatial resolution, for the years 1985 to 2005, though not all data are available for all months, because of the timing of the different sensors. The data in the series have been rectified to the same study area boundaries, with matching raster grids and resolutions, and consistent spatial extents and projections. The spatio-temporal resolution of the Sea Winds source data was monthly, on 0.25 degree pixels.
    Purpose: Provide a rectified data set for ecological analyses of the Gulf of Alaska and Bering Sea.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 199210
        Ending_Date: 200512
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: 170.0
      East_Bounding_Coordinate: -130.0
      North_Bounding_Coordinate: 65.0
      South_Bounding_Coordinate: 50.0
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Sea Winds
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: Bering Sea
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address

Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Original data were obtained at a resolution of 0.25 degrees. The rescaling of the processed source images (using nearest neighbour) to match the 9x9 km study area does not affect the accuracy, however it does give the impression of higher precision. The precision of this product remains the same as the nominal precision of the source data (0.25 degrees).
Logical_Consistency_Report: None
Completeness_Report: The dataset is complete, no dates or values were skipped during the processing from source and output data.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: No problems were encountered when rectifying the data with the other data sets. Nominal accuracy reported as 0.25 degrees.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: RSS Remote Sensing Systems
Title: SSMI Surface Wind Speeds
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Range_of_Dates/Times:
Beginning_Date: 199210
Ending_Date: 200512
Source_Currentness_Reference: Extent of data processing.
Source_Citation_Abbreviation: None
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
Source data were downloaded via ftp from http://www.remss.com/ as monthly binary files with a 0.25 degree resolution. The data were processed to match the 9x9 km resolution study area of the Gulf of Alaska and Bering Sea. Processing steps were all conducted in the IDRISI software package:
IMPORT the binary files using the PARE import function in IDRISI (unlike files in HDF or CDF format, these files appear to have no header).
Each binary file contains a composite image of 4 variables. The variable of interest (identified as sea windws) is the top panel in the series of 4 images. Used WINDOW to isolate the top quarter of the image.
The images are also inverted, so the image was flipped using the TRANSPOSE function to reverse the order of the rows.
Convert the 0-255 pixel values into wind speed (m/s) by multiplying the entire dataset by 0.2 (SCALAR function).
WINDOW the image to extract the desired study area extents (-190 to -130, 65 to 50).
PROJECT the raster to the Albers Alaska projection specifying the corrent number of rows/cols to achieve a 9x9 km grid size matching the existing study area.
Process_Date: 20070331
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 235
Column_Count: 464
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Albers Conical Equal Area
Albers_Conical_Equal_Area:

Standard_Parallel: 55.000000
Standard_Parallel: 65.000000
Longitude_of_Central_Meridian: -154.000000
Latitude_of_Projection_Origin: 50.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 9001.318696
Ordinate_Resolution: 9001.318696
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: Wind
Entity_Type_Definition: Monthly averages of sea surface wind speed
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview:
Units are metres per second.
The data contains the following flags:
Land: -5
No SSM/I Observations: -4
SSM/I data exist but are bad: -3
Sea Ice: -2
Missing Data due to rain: -1
Outside Study Area: 0
NoData: See data flags above
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 9km Monthly Sea Winds
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20070605
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver

State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.14 – Eastern North Pacific chlorophyll concentration

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 20080411
      Title: Eastern North Pacific Monthly Chlorophyll Concentration
      Series_Information:
        Series_Name: Eastern North Pacific Monthly Surface Climatologies
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: These data were obtained and prepared as part of analyses conducted in the Bering Sea and Gulf of Alaska. The Eastern North Pacific climatologies, provided in the native resolution of the source data, were prepared to provide a more generalized, and consequently more flexible, form of the data used in our studies.
    Purpose: To support spatial analyses in the eastern North Pacific.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 199709
        Ending_Date: 200605
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: 155.0
      East_Bounding_Coordinate: 120.0
      North_Bounding_Coordinate: 66.5
      South_Bounding_Coordinate: 31.6
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Chlorophyll
      Theme_Keyword: Oceanography
      Theme_Keyword: Remote Sensing
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Eastern North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea Surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: Monthly
      Temporal_Keyword: Climatology
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:
      Contact_Person_Primary:
        Contact_Person: Edward Gregr
        Contact_Organization: Marine Mammal Research Unit
      Contact_Position: Researcher
      Contact_Address:
        Address_Type: mailing address
        Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
        City: Vancouver
        State_or_Province: British Columbia
        Postal_Code: V6T 1Z4
        Country: Canada
      Contact_Voice_Telephone: 604-822-8181

```
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Spatial_Data_Organization_Information:
    Direct_Spatial_Reference_Method: Raster
    Raster_Object_Information:
        Raster_Object_Type: Grid Cell
        Row_Count: 1575
        Column_Count: 2445
        Vertical_Count: 1
Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
        Planar:
            Map_Projection:
                Map_Projection_Name: Mercator
                Mercator:
                    Standard_Parallel: 0.000000
                    Longitude_of_Central_Meridian: 180.000000
                    False_Easting: 0.000000
                    False_Northing: 0.000000
            Planar_Coordinate_Information:
                Planar_Coordinate_Encoding_Method: row and column
                Coordinate_Representation:
                    Abscissa_Resolution: 9000.000000
                    Ordinate_Resolution: 9000.000000
                Planar_Distance_Units: meters
        Geodetic_Model:
            Horizontal_Datum_Name: D_WGS_1984
            Ellipsoid_Name: WGS_1984
            Semi-major_Axis: 6378137.000000
            Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
    Detailed_Description:
        Entity_Type:
            Entity_Type_Label: Chla
            Entity_Type_Definition: Monthly climatologies of chlorophyll concentration
            Entity_Type_Definition_Source: None
    Overview_Description:
        Entity_and_Attribute_Overview:
            Units are mg/m^3.
        Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Environmental Data for the Eastern North
Pacific and Bering Sea. Fisheries Centre Research Report, 2008.
Distribution_Information:
    Distributor:
        Contact_Information:
            Contact_Person_Primary:
                Contact_Person: Edward Gregr
                Contact_Organization: Marine Mammal Research Unit
            Contact_Position: Researcher
            Contact_Address:
                Address_Type: mailing address
                Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
    Resource_Description: Eastern North Pacific Chlorophyll Climatologies
    Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
    Metadata_Date: 20080411
    Metadata_Contact:
        Contact_Information:
            Contact_Organization_Primary:
                Contact_Organization: Marine Mammal Research Unit
                Contact_Person: Edward Gregr
            Contact_Address:
```

Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.15 – Eastern North Pacific sea surface temperature

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit, University of British Columbia
Publication_Date: 20080411
Title: Eastern North Pacific Monthly Temperature Climatologies
Series_Information:
Series_Name: Eastern North Pacific Monthly Surface Climatologies
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: These data were obtained and prepared as part of analyses conducted in the Bering Sea and Gulf of Alaska. The Eastern North Pacific climatologies, provided in the native resolution of the source data, were prepared to provide a more generalized, and consequently more flexible, form of the data used in our studies.
Purpose: To support spatial analyses in the eastern North Pacific.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 199210
Ending_Date: 200601
Currentness_Reference: Current
Status:
Progress: Complete
Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: 155.0
East_Bounding_Coordinate: 120.0
North_Bounding_Coordinate: 66.5
South_Bounding_Coordinate: 31.6
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Sea surface height
Theme_Keyword: Sea level anomaly
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Eastern North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Sea Surface
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Monthly
Temporal_Keyword: Climatology
Access_Constraints: None. Available upon request.
Use_Constraints: Data are provided as is, with no warranty expressed or implied.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada

Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Raster
Raster_Object_Information:
Raster_Object_Type: Grid Cell
Row_Count: 1575
Column_Count: 2445
Vertical_Count: 1
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Map_Projection:
Map_Projection_Name: Mercator
Mercator:
Standard_Parallel: 0.000000
Longitude_of_Central_Meridian: 180.000000
False_Easting: 0.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: row and column
Coordinate_Representation:
Abscissa_Resolution: 20000.000000
Ordinate_Resolution: 20000.000000
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: D_WGS_1984
Ellipsoid_Name: WGS_1984
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
Detailed_Description:
Entity_Type:
Entity_Type_Label: SLA
Entity_Type_Definition: Monthly climatologies of sea level anomaly
Entity_Type_Definition_Source: None
Overview_Description:
Entity_and_Attribute_Overview:
Sea level anomaly in units of cm.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Environmental Data for the Eastern North Pacific and Bering Sea. Fisheries Centre Research Report, 2008.
Distribution_Information:
Distributor:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: Eastern North Pacific Monthly Sea Surface Temperature Climatologies
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20080411
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr

Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.16 – Eastern North Pacific sea level anomaly

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit, University of British Columbia
Publication_Date: 20080411
Title: Eastern North Pacific Monthly Seal Level Anomalies
Series_Information:
Series_Name: Eastern North Pacific Monthly Surface Climatologies
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: These data were obtained and prepared as part of analyses conducted in the Bering Sea and Gulf of Alaska. The Eastern North Pacific climatologies, provided in the native resolution of the source data, were prepared to provide a more generalized, and consequently more flexible, form of the data used in our studies.
Purpose: To support spatial analyses in the eastern North Pacific.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 199210
Ending_Date: 200601
Currentness_Reference: Current
Status:
Progress: Complete
Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: 155.0
East_Bounding_Coordinate: 120.0
North_Bounding_Coordinate: 66.5
South_Bounding_Coordinate: 31.6
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Sea surface height
Theme_Keyword: Sea level anomaly
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Eastern North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Sea Surface
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Monthly
Temporal_Keyword: Climatology
Access_Constraints: None. Available upon request.
Use_Constraints: Data are provided as is, with no warranty expressed or implied.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada

```
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Spatial_Data_Organization_Information:
    Direct_Spatial_Reference_Method: Raster
    Raster_Object_Information:
        Raster_Object_Type: Grid Cell
        Row_Count: 1575
        Column_Count: 2445
        Vertical_Count: 1
Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
        Planar:
            Map_Projection:
                Map_Projection_Name: Mercator
                Mercator:
                    Standard_Parallel: 0.000000
                    Longitude_of_Central_Meridian: 180.000000
                    False_Easting: 0.000000
                    False_Northing: 0.000000
            Planar_Coordinate_Information:
                Planar_Coordinate_Encoding_Method: row and column
                Coordinate_Representation:
                    Abscissa_Resolution: 20000.000000
                    Ordinate_Resolution: 20000.000000
                Planar_Distance_Units: meters
        Geodetic_Model:
            Horizontal_Datum_Name: D_WGS_1984
            Ellipsoid_Name: WGS_1984
            Semi-major_Axis: 6378137.000000
            Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
    Detailed_Description:
        Entity_Type:
            Entity_Type_Label: SLA
            Entity_Type_Definition: Monthly climatologies of sea level anomaly
            Entity_Type_Definition_Source: None
    Overview_Description:
        Entity_and_Attribute_Overview:
            Sea level anomaly in units of cm.
        Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Spatial Data for teh Eastern North Pacific
and Bering Sea. Fisheries Centre Research Report, 2008.
Distribution_Information:
    Distributor:
        Contact_Information:
            Contact_Person_Primary:
                Contact_Person: Edward Gregr
                Contact_Organization: Marine Mammal Research Unit
            Contact_Position: Researcher
            Contact_Address:
                Address_Type: mailing address
                Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
    Resource_Description: Eastern North Pacific Monthly Sea Level Anomaly Climatologies
    Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
    Metadata_Date: 20080411
    Metadata_Contact:
        Contact_Information:
            Contact_Organization_Primary:
                Contact_Organization: Marine Mammal Research Unit
                Contact_Person: Edward Gregr
```

Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.17 – Eastern North Pacific sea surface wind speed

Identification_Information:
Citation:
Citation_Information:
Originator: Marine Mammal Research Unit, University of British Columbia
Publication_Date: 20080411
Title: Eastern North Pacific Monthly Surface Wind Speed
Series_Information:
Series_Name: Eastern North Pacific Monthly Surface Climatologies
Issue_Identification: First
Online_Linkage: NA
Description:
Abstract: These data were obtained and prepared as part of analyses conducted in the Bering Sea and Gulf of Alaska. The Eastern North Pacific climatologies, provided in the native resolution of the source data, were prepared to provide a more generalized, and consequently more flexible, form of the data used in our studies.
Purpose: To support spatial analyses in the eastern North Pacific.
Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 198707
Ending_Date: 200605
Currentness_Reference: Current
Status:
Progress: Complete
Maintenance_and_Update_Frequency: No update of this data series is scheduled. However new source data are currently being provided on a near real-time basis.
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: 155.0
East_Bounding_Coordinate: 120.0
North_Bounding_Coordinate: 66.5
South_Bounding_Coordinate: 31.6
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: Sea Winds
Theme_Keyword: Oceanography
Theme_Keyword: Remote Sensing
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: Eastern North Pacific
Stratum:
Stratum_Keyword_Thesaurus: None
Stratum_Keyword: Sea Surface
Temporal:
Temporal_Keyword_Thesaurus: None
Temporal_Keyword: Monthly
Temporal_Keyword: Climatology
Access_Constraints: None. Available upon request.
Use_Constraints: Data are provided as is, with no warranty expressed or implied.
Point_of_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
Contact_Address:
Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181

```
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Spatial_Data_Organization_Information:
    Direct_Spatial_Reference_Method: Raster
    Raster_Object_Information:
        Raster_Object_Type: Grid Cell
        Row_Count: 1575
        Column_Count: 2445
        Vertical_Count: 1
Spatial_Reference_Information:
    Horizontal_Coordinate_System_Definition:
        Planar:
            Map_Projection:
                Map_Projection_Name: Mercator
                Mercator:
                    Standard_Parallel: 0.000000
                    Longitude_of_Central_Meridian: 180.000000
                    False_Easting: 0.000000
                    False_Northing: 0.000000
            Planar_Coordinate_Information:
                Planar_Coordinate_Encoding_Method: row and column
                Coordinate_Representation:
                    Abscissa_Resolution: 20000.000000
                    Ordinate_Resolution: 20000.000000
                Planar_Distance_Units: meters
        Geodetic_Model:
            Horizontal_Datum_Name: D_WGS_1984
            Ellipsoid_Name: WGS_1984
            Semi-major_Axis: 6378137.000000
            Denominator_of_Flattening_Ratio: 298.257224
Entity_and_Attribute_Information:
    Detailed_Description:
        Entity_Type:
            Entity_Type_Label: SST
            Entity_Type_Definition: Monthly climatologies of sea surface wind
            Entity_Type_Definition_Source: None
    Overview_Description:
        Entity_and_Attribute_Overview:
            Wind speed in units of m/s.
        Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Spatial Data for teh Eastern North Pacific
and Bering Sea. Fisheries Centre Research Report, 2008.
Distribution_Information:
    Distributor:
        Contact_Information:
            Contact_Person_Primary:
                Contact_Person: Edward Gregr
                Contact_Organization: Marine Mammal Research Unit
            Contact_Position: Researcher
            Contact_Address:
                Address_Type: mailing address
                Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
                City: Vancouver
                State_or_Province: British Columbia
                Postal_Code: V6T 1Z4
                Country: Canada
            Contact_Voice_Telephone: 604-822-8181
            Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
    Resource_Description: Eastern North Pacific Monthly Wind Climatologies
    Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
    Metadata_Date: 20080411
    Metadata_Contact:
        Contact_Information:
            Contact_Organization_Primary:
                Contact_Organization: Marine Mammal Research Unit
                Contact_Person: Edward Gregr
            Contact_Address:
```

Address_Type: mailing address
Address: Room 247, AERL, 2202 Main Mall, University of British Columbia
City: Vancouver
State_or_Province: British Columbia
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Country: Canada
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Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998

Appendix 2.18 – Northern Gulf of Alaska ROMS model outputs

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Marine Mammal Research Unit, University of British Columbia
      Publication_Date: 2008/02/22
      Title: 3km Gulf of Alaska Regional Ocean Modelling System (ROMS) Output 2001
      Geospatial_Data_Presentation_Form: tabular digital data
      Series_Information:
        Series_Name: Bi-Weekly ROMS Output for 2001 in the Gulf of Alaska
        Issue_Identification: First
      Online_Linkage: NA
  Description:
    Abstract: Output from a Regional Ocean Modelling System (ROMS) circulation model for the northern Gulf of Alaska was obtained as 2-week averages for all of 2001 from Al Hermann and colleagues (NOAA Pacific Marine Environmental Laboratory). The data were processed from NetCDF files to ASCII text files using MatLab scripts. The text files were then combined into an MS Access database. Variables extracted from the NetCDF files included temperature, salinity and current velocities at surface, mixed layer depth, and bottom. The data were provided on a rotated, geographic grid, with a nominal resolution of 3km x 3km. Data are provided as a series of 28 tables in an MS Access database. Each table contains 230,400 records, each representing a model point. Each record contains its geographic coordinate, and a value for all variables for the specific 2-week time period.
    Purpose: These data were obtained as part of North Pacific Research Board Project #529 - Economic Valuation of Critical Habitat Closures. This work was the prototype for an analysis subsequently conducted across the entire the entire Bering Sea and Gulf of Alaska within the U.S. EEZ.
  Time_Period_of_Content:
    Time_Period_Information:
      Range_of_Dates/Times:
        Beginning_Date: 2000/12/14
        Ending_Date: 2002/01/09
    Currentness_Reference: Current
  Status:
    Progress: Complete
    Maintenance_and_Update_Frequency: None planned
  Spatial_Domain:
    Bounding_Coordinates:
      West_Bounding_Coordinate: -162.68
      East_Bounding_Coordinate: -132.16
      North_Bounding_Coordinate: 64.16
      South_Bounding_Coordinate: 46.7
  Keywords:
    Theme:
      Theme_Keyword_Thesaurus: None
      Theme_Keyword: Oceanography
      Theme_Keyword: Water column
      Theme_Keyword: Vertical structure
      Theme_Keyword: Velocity
      Theme_Keyword: Mixed layer depth
    Place:
      Place_Keyword_Thesaurus: None
      Place_Keyword: Gulf of Alaska
      Place_Keyword: North Pacific
    Stratum:
      Stratum_Keyword_Thesaurus: None
      Stratum_Keyword: Sea floor
      Stratum_Keyword: Mixed layer depth
      Stratum_Keyword: Sea surface
    Temporal:
      Temporal_Keyword_Thesaurus: None
      Temporal_Keyword: 2001
      Temporal_Keyword: bi-weekly
  Access_Constraints: None. Available upon request.
  Use_Constraints: Data are provided as is, with no warranty expressed or implied.
  Point_of_Contact:
    Contact_Information:

Contact_Person_Primary:
Contact_Person: Edward Gregr
Contact_Organization: Marine Mammal Research Unit
Contact_Position: Researcher
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Address_Type: mailing address
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State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: The accuracy of circulation model output is generally considered statistically correct (i.e., the long term average will be accurate), but not instantaneously correct. This model run has been shown to show more variability than actual in-situ measurements along the GAK line (K. Coyle, personal communication).
Logical_Consistency_Report: None
Completeness_Report: Data are complete for the time period stated.
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report: The data are positionally accurate within the limits of the stated resolution (3km x 3km). Minimal rectification problems were encountered with respect the the standard, 1:63,000Alaskan coastline.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Originator: D. Musgrave, K. Hedstrom, E. Dobbins and A. Hermann, personal communication
Title: 3 km ROMS model for the Northern Gulf of Alaska (2001)
Publication_Date: 20070101
Type_of_Source_Media: digital
Source_Time_Period_of_Content:
Time_Period_information:
Range_of_Dates/Times:
Beginning_Date: 20001214
Ending_Date: 20020109
Source_Currentness_Reference: Extent of model run at processing date.
Source_Citation_Abbreviation: Musgrave et al. Pers. comm.
Source_Contribution: The source data form the basis of this data set.
Process_Step:
Process_Description:
We obtained temperature, salinity and current velocity as netCDF (.nc) files, with one file for each 2-week period. Each netCDF file contained averages for all variables across the entire 3-dimensional structure (i.e., lat, long, and 30 vertical levels). The shape of the data was 482x482x30 cells. We used a MatLab script to extract the three depths of interest (surface, mixed layer depth, and bottom) from the netCDF files. We used a MatLab netcdf module to handle the extraction of the variables, and customized coding to 1) identify the model layer associated with mixed layer depth (MLD); and 2) calculate the current velocities at the different levels.

Extraction of the surface and bottom values from the vertical structure was straightforward. However to obtain values at the mixed layer, the correct level at each model point needed to be identified. While the model output included a calculated MLD, this value did not directly correspond to any of the 30 vertical model levels. We therefore wrote a routine to find the model level above and below the calculated MLD for each model point. Temperature and salinity were taken from the first level below the MLD.

Calculating the vertical velocities was complicated because, for computational reasons, the ROMS model represents velocities on an offset model grid. This required velocities to be calculated across the grid points of interest. This required more complex code than was used to extract temperature and salinity.

We extracted the horizontal current components u, and v from the layers both above and below the MLD. We also wrote a routine to calculate the vertical velocity (w) at each of the levels of interest (surface, bottom, above and below MLD). The MatLab code for the extraction of these data from the netCDF files is available on request from the authors.

For the analysis, the data were restricted to depths less than 600 m, within the US Economic Exclusion Zone (EEZ). This was done to more accurately reflect depths where trawl fishing occurs.

Process_Date: 2007/03/31
Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Point

Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 230400
Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Geographic:
Latitude_Resolution: 0.0195
Longitude_Resolution: 0.03
Geographic_Coordinate_Units: Decimal degrees
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.400000
Denominator_of_Flattening_Ratio: 294.978698
Entity_and_Attribute_Information:
Overview_Description:
Entity_and_Attribute_Overview: Each record contains geographic reference, sea surface height (cm), mixed layer depth (calculated), depth of model layer below the calculated mixed layer depth, temperature (°C) at surface, bottom, and depth below MLD, salinity (psu) at surface, bottom, and depth below MLD, velocity components (U, V, W) at surface, bottom, and at levels both above (amld) and below (bmld) the MLD model level. Horizontal velocities are in m/s, but note that vertical (W) velocities are several orders of magnitude smaller.
Entity_and_Attribute_Detail_Citation: Gregr and Coatta, 2008. Economic Valuation of Critical Habitat Closures NPRB Project #529 - Data Set Descriptions. Data report to the North Pacific Research Board. February 22, 2008.
Distribution_Information:
Distributor:
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Contact_Position: Researcher
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Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Resource_Description: 3km Gulf of Alaska Regional Ocean Modelling System (ROMS) Output 2001
Distribution_Liability: Data are provided without warranty.
Metadata_Reference_Information:
Metadata_Date: 20080222
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: Marine Mammal Research Unit
Contact_Person: Edward Gregr
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State_or_Province: British Columbia
Postal_Code: V6T 1Z4
Country: Canada
Contact_Voice_Telephone: 604-822-8181
Contact_Electronic_Mail_Address: gregr@zoology.ubc.ca
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998