

Oceanographic Data Sources, Data Management, And Software Tools For Marine Mammal Modeling

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Tools of the Trade

- 1) Oceanographic Data Sources
 - *In-situ*
 - Remotely-sensed
 - Climatologies
 - Ocean Models
 - Static
- 2) Data Management
 - Metadata
 - Data Formats
- 3) Software
 - Processing
 - Plotting/Visualization
 - Analysis/Statistics

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In-situ Data Sources

- Along-track
- Profiled
- Tow-yo'ed
- Moored

In-situ Data Sources

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Primary Measurements

- Water Depth
- Temperature
- Salinity
- Currents
- Fluorescence
- Zooplankton
- Acoustic Backscatter

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Thermosalinograph

Scientific Echosounder

Acoustic Doppler Current Profiler

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You are here (San Diego)

In-situ Data Sources

Resources

- Instrumentation
 - Oceanographers
 - Instrument Manufacturers
- Data Archives
 - National Oceanographic Data Center (www.nodc.noaa.gov)
 - National Data Buoy Center (www.ndbc.noaa.gov)

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Remotely-sensed Data Sources

- Passive
 - Sea surface temperature (AVHRR)
 - Ocean color (SeaWiFS)
- Active
 - Sea surface height (TOPEX/Poseidon)
 - Winds (QuikSCAT)

Remotely-sensed Data Sources

Coverage: Local
Resolution: 1 km
Available: ~twice daily

Coverage: Global
Resolution: 18 km
Available: Weekly

Remotely-sensed Data Sources

Resources

- Sea surface temperature
 - JPL Data Archive (poet.jpl.nasa.gov; podaac-www.jpl.nasa.gov/sst)
 - NOAA Coastwatch (coastwatch.noaa.gov)
- Ocean Color
 - NASA SeaWiFS (reason.gsfc.nasa.gov/OPS/Giovanni/ocean.seawifs.shtml)
- Sea Surface Height
 - JPL Data Archive (poet.jpl.nasa.gov)
 - Aviso (www.aviso.oceanobs.com)

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Climatological Data Sources

Climatology: Long-term average conditions
Anomaly: Deviation from the long-term average conditions

Climatology SST Pentad 35
June 20-24, 1985-87
SST (deg. Celsius)

Climatological Data Sources

Surface Salinity Climatology from World Ocean Atlas

Climatological Data Sources

Salinity at 1000 m Climatology from World Ocean Atlas

Salinity at 1000 m Climatology from World Ocean Atlas

Climatological Data Sources

Surface Temperature Front Climatology

July

August

Ullman, D.S. and P.C. Cornillon. 1999. Satellite derived sea surface temperature fronts on the continental shelf off the northeast U.S. coast. *Journal of Geophysical Research* 104:23459-23478.

Climatological Data Sources

Resources



- Global Climatology
 - World Ocean Database and World Ocean Atlas (www.nodc.noaa.gov/OC5/indprod.html)
- Regional or Local Climatology
 - Find in the literature and request data from authors

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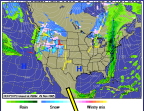

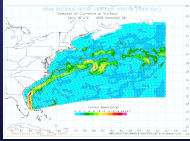
Ocean Model Data Sources

Back in the day...



→
?

Ocean Model Data Sources

Today...

$$\frac{\partial u}{\partial t} - f v + \frac{1}{\rho} \frac{\partial \tau_x}{\partial x} = 0$$

$$\frac{\partial v}{\partial t} + f u + \frac{1}{\rho} \frac{\partial \tau_y}{\partial y} = 0$$

$$\frac{\partial \rho}{\partial t} - \frac{\partial \rho_e}{\partial z} = 0$$

Model Surface Currents in the Northwest Atlantic from the NOAA Regional Ocean Forecast System

Ocean Model Data Sources

Resources

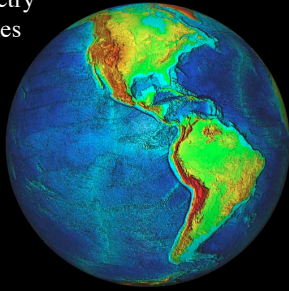
- Global Models
 - U.S. Navy Models (www7320.nrlssc.navy.mil/global_nlom)
- Regional Models
 - U.S. East Coast Regional Ocean Forecast Model (polar.ncep.noaa.gov/cofs)
- Local Models
 - Find local modelers and build collaborations

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Static Data Sources

- Bathymetry
- Coastlines



Static Data Sources

Resources

- High-resolution bathymetry (ETOPO5, ETOPO2, SRTM30_PLUS)
 - Scripps Institution of Oceanography (topex.ucsd.edu/WWW_html/mar_topo.html)
 - U.S. National Geophysical Data Center (www.ngdc.noaa.gov/mgg/global/global.html)
- Coastlines
 - U.S. National Geophysical Data Center (www.ngdc.noaa.gov/mgg/shorelines/shorelines.html)

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Metadata

Metadata: "Data about data"

Metadata

Metadata: "Data about data"


Why collect data about your data?

Metadata 

Metadata: "Data about data"

Why collect data about your data?

- Because you'll forget!!!
- Facilitates data sharing – your collaborators will thank you

Metadata 


Kinds of things to include in your metadata...

- Project name
- Geographic area
- Species of interest
- Platform
- Who collected the data (e.g., name, organization)
- Kind of data (e.g., salinity)
- Type of instrument (what it is, model, serial number)
- What kind of processing has been done to the raw data


Metadata 

Resources

- Metadata standards
 - Federal Geographic Data Committee Metadata Standard (www.fgdc.gov/index.html)


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Data Formats 

Which data format?

- Appropriateness for your data
- Ease of use
- Flexibility
- Portability
- Ability to accommodate metadata
- Data easily transferred to collaborators

Data Formats 

Which data format?

- ASCII (text) files
- Proprietary formats (Arc)
- Relational databases
- Scientific formats
 - HDF
 - NetCDF

Data Formats

Which data format?

- ASCII (text) files
- Proprietary formats (Arc)
- Relational databases
- Scientific formats
 - HDF
 - NetCDF

NetCDF

- Stores multidimensional array data
- Excellent capacity for metadata
- Platform-independent (can share between any machine)
- No compression (may not be the format of choice for archiving)

Data Formats

Resources

- Scientific data formats
 - HDF (hdf.ncsa.uiuc.edu)
 - NetCDF (www.unidata.ucar.edu/software/netcdf)

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Software

Processing

Software that will allow you to prepare your data for visualization and analysis

Ideally, should be flexible to deal with any and all features and idiosyncrasies in your data

- Extract regions of interest in satellite data
- Extract features in in-situ data
- Editing/quality controlling sighting data


Software

Resources

- Processing
 - Matlab (www.mathworks.com)
 - IDL (www.rsinc.com/idl)
 - Perl (www.perl.org)
 - ArcView/ArcGIS (www.esri.com)
 - IDRISI (www.clarklabs.org)

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Software 

Plotting/Visualization

Software that will allow you to qualitatively examine your data AND convey your results in public communications (presentations and papers)


Ideally, should be flexible to deal with any and all features and idiosyncrasies in your data

- Plot maps of distributions
- Plot environmental data in whatever form it comes in (e.g., temperature profiles)
- Plot relationships between variables


Software 

Resources

- GIS
 - ArcView/ArcGIS (www.esri.com)
 - GRASS (grass.itc.it)
 - MapInfo (www.mapinfo.com)
 - Others (see software.geocomm.com)
- Mapping
 - Generic Mapping Tools (GMT) (gmt.soest.hawaii.edu)
 - Online Map Creation (www.aquarius.geomar.de/omc)
 - Planiglobe (www.planiglobe.com/omc_set.html)
- Analytical software with plotting/visualization capabilities
 - Matlab (www.mathworks.com)
 - IDL (www.rsinc.com/idl)

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Software 

Analysis/Statistics

Software that will allow you to quantitatively examine your data


Must have the tools you need

- Basic statistics (t-test, ANOVA)
- Advanced regression models (GLM, GAM)
- Community analyses

Software 

Resources

- Analysis/Statistics
 - R (www.r-project.org)
 - Splus (www.insightful.com/products/splus)
 - SAS (www.sas.com)
 - Matlab (www.mathworks.com)
 - IDL (www.rsinc.com/idl)
 - ArcView/ArcGIS (www.esri.com)

Software 

Final thoughts on software...

- Beware of “push-button” processing and analysis – make sure you know what’s going on behind the scenes
- Learn to program a computer
 - C, FORTRAN, BASIC
 - Matlab, IDL
 - Arc
 - Perl

Acknowledgments

Thanks to my fellow Workshop Organizing Committee members...

- Ed Gregr
- Toshihide Hamzaki
- Ellen Hines
- Kristin Laidre
- Daniel Palacios
- Jessica Redfern
- Kathleen Vigness Raposa

This presentation available at

ftp://ftp.whoi.edu/pub/users/mbaumgartner/baumgartner_modeling.ppt

Data Formats

```

dimensions:
  n = 179 ;
variables:
  float depth(n) ;
    depth:long_name = "depth" ;
    depth:units = "meters" ;
  float temp(n) ;
    temp:long_name = "temperature" ;
    temp:units = "degC" ;
  float sal(n) ;
    sal:long_name = "salinity" ;
    sal:units = "PSU" ;

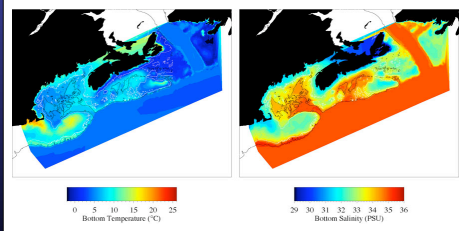
// global attributes:
:experiment = "North Atlantic Right Whale Ecology" ;
:platform = "NOAA Ship Albatross IV" ;
:cruise = "AL0504" ;
:instrument_type = "SBE 19plus CTD" ;
:serial_number = 4501 ;
:comments = "CTD data for cast 186" ;
:cast = 186 ;
:date = "05/19/05 18:00:00" ;
:lon = -69.2037 ;
:lat = 41.2932 ;
:water_depth = 98.0 ;
:designation = "DV40" ;
:set_ctd_flag_min_speed = 0.3 ;

```

NetCDF header

Climatological Data Sources

Summer Climatology of Bottom Temperature and Salinity



Loder, J.W., G. Han, C.G. Hannah, D.A. Greenberg and P.C. Smith. 1997. Hydrography and baroclinic circulation in the Scotian Shelf region: winter versus summer. *Canadian Journal of Fisheries and Aquatic Sciences* 54:40-56.