NCDC’s Coastal and Marine Archives:
Overview of Datasets and Framework

David Levinson, Ph.D.
Climate Monitoring Branch
National Climatic Data Center (NCDC)
NOAA / NESDIS
Asheville, NC

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Pacific Risk Management Ohana (PRiMO)
Workshop for Waves and Water Level (WWL) Hazards
Data Framework Development
NCDC Coastal & Marine Datasets

- International Comprehensive Ocean-Atmosphere Dataset (ICOADS)
- Integrated Surface Hourly (ISH)
  - Global Historical Climate Network – Hourly (GHCN-Hourly)
- Global Sea Surface Temperatures (SSTs)
  - Extended Reconstructed SST (ERSST)
  - Optimal Interpolation (OI)
- Blended Sea Winds
  - Multiple passive microwave platforms
- Other Marine Datasets:
  - Global Buoy Data
  - Ships Marine Data
  - Volunteer Observing Ship Climate (VOSClim) Project
 ICOADS Surface Wind Vectors

Jan wind

4 5 6 7 8 9 10 11
Integrated Surface Hourly (ISH)

NOTE: Map displays all stations in ISH database
ISH Data

✓ 1901 – present:
  – Very few stations during the early 1900s
✓ Archival dataset:
  – Conservative QA/QC (duplicates, etc.)
✓ ISH is a baseline dataset
  – Source for other hourly datasets (i.e. GHCN-Hourly)
  – Filtering, reduction, duplicate observation elimination
✓ GHCN-Hourly in development
  – Subset of ISH
  – Distilled research quality dataset focused on key variables
    • T, P, MSLP, Wind (speed and direction)
GHCN-Hourly Coverage in 2005
GHCN-Hourly

- All Stations
- 80% Complete
Extended Reconstructed Sea Surface Temperature (ERSST)

- ERSST (v. 1 and 2):
  - Historical analysis utilizes the irregular and often sparse SST data distribution
  - Begins in 1854, but better sampling by 1880s
  - Statistical methods developed to deal with the sampling problem

- ERSST has two components done separately: a low-frequency and a high-frequency component
  - Low-frequency component averages over large areas using 15-years of data
  - High-frequency component uses large-scale spatial covariance modes to analyze spatial patterns
  - Modes computed using recent satellite-based SST analysis (i.e. OI)
  - Sum of the low- and high-frequency component is the total ERSST analysis

- Research and operational comparisons
  - ERSST gives interannual and inter-decadal variations similar to analyses produced at other centers (i.e. HadISST)
In Situ SST Sampling used in ERSST (from ICOADS)

✅ Decadal sampling:
  - % of months with an observation for each 2° x 2° grid box

✅ Time series:
  - annual % of global sampling
New Higher Resolution SST Optimal Interpolation (OI) Analysis

✓ Resolution: Daily, 0.25°
✓ Data: Satellite plus *in situ* (ship and buoy) data
  – Satellite data to include
    • Infrared AVHRR: Longest satellite data set (ca. 1979)
    • Microwave AMSR: Not impacted by clouds so better coverage than infrared
  – Analysis begins in late 1981
✓ 7-Day large-scale satellite bias correction for each satellite
  – Analysis acceptable for climate studies
✓ Initial results shown for 2003
  – Separate analyses using AVHRR and AMSR to examine impact of different satellite data
Jan 2003: Mean SST Gradient

Dataset Issues:

- Sparse AVHRR data
- AMSR data missing near coast otherwise almost complete
- OI v.2 gradients very weak
- Daily OI and RTG gradients are similar
- AMSR OI has strongest gradients due to better data coverage than AVHRR
Blended Sea Winds

- Globally gridded sea surface wind speeds:
  - Data blended from multiple satellites (SSMI, TMI, QuickSCAT, AMSR)
  - Dataset begins in 1995
  - 0.25° grid boxes at multiple time resolutions (12-hr, daily, monthly)

- Blended Products:
  - Fill in the data gaps (time and space) of the individual satellite observations
  - Retrieval algorithm calibrated to in situ observations
  - Reduce the sub-sampling aliases and random errors

- 10 year climatology:
  - January 1995 to December 2004

- Experimental data:
  - 6-hourly time step data using Optimal Interpolation in development

- Products are available in multiple formats:
  - netCDF, MATLAB, FORTRAN IEEE

- Available online:
  - ftp://eclipse.ncdc.noaa.gov/pub/seawinds/
Sea Winds Satellite Coverage since 1987
Zonal Wind Speed Climatology

Seasonal Cycle of Zonal Mean Monthly Climatology (Jan1995–Dec2004)

- 40°N–60°N
- 20°S–40°S
- 60°S–60°N
- 20°S–20°N
- 10°S–10°N
- 20°N–40°N

Wind Speed (m/s)

Month of the Year

NCDC’s Coastal and Marine Archives:
Overview of Datasets and Framework
Why do we need a data framework?

Example: NOAA’s National Data Centers (NNDC)

✓ NNDC separated into 3 disciplines (and sub-disciplines):
  – National Oceanographic Data Center (NODC)
  – National Geophysical Data Center (NGDC)
  – National Climatic Data Center (NCDC)

✓ Coastal Climatologies and Hazards:
  – require integrated data framework
Example Problem:
Coastal Inundation & Erosion involves multiple systems

- **Bathymetry**
- **Permafrost**
- **Blue Water Wave Heights**
- **Shallow Water Wave Heights**
- **Storm Surge Scenarios**
- **Coastal Inundation & Erosion Scenarios**
- **Users**
- **Human Population Distribution Scenarios**
- **Societal Infrastructure Coastal Scenarios**
- **Biochemical Impacts (Ecosystems)**
- **Coastal Topography**
- **Sea Level Change**
- **Sea Level Change Scenarios**

**Data Sets:**
- Observations (~75)
- Models (~25)
- Land Mass & Ocean Properties (~20)
- Human Impacts
- Physical Impacts
- Sea Level Change (~12)

(# in parentheses represents data sets which must be integrated)
NOAA’s Data Framework Goal

Bridge the gaps between stove-pipe systems

- Integration of data across disciplines
- Improved data stewardship
- Leverage industry and community initiatives

Standard procedures, protocols, metadata, formats, terminology.
Translators and middleware

Weather  Climate  Oceanography  Biology  Geospatial Framework  Hydrology  Geophysics
NOAA’s Observation System Target Architecture

**Target Architecture:**
- Builds on existing systems
- Requirements/standards-based
- Leverages new technology
- Full and open data sharing
- Interoperable, affordable & efficient
- Sustainable Partnerships (National International)
NOAA’s GEO
Integrated Data Environment

✓ Scope
  – NOAA-wide architecture development to integrate legacy systems and guide development of future NOAA environmental data management systems

✓ Vision
  – NOAA’s GEO-IDE is envisioned as a “system of systems” – a framework that provides effective and efficient integration of NOAA’s many quasi-independent systems

✓ Foundation
  – built upon agreed standards, principles and guidelines

✓ Approach
  – evolution of existing systems into a services-oriented architecture

✓ Result
  – a single system of systems (user perspective) that is used to access the data sets needed to address significant societal questions
NOAA’s GEO-IDE
An essential component of environmental information management

Integrated observing, data processing and information management systems

Connected by NOAA’s Integrated Data Environment

Contributes to U.S. Global Earth Observation System (USGEO) and International Global Earth Observing System of Systems (GEOSS).
Summary

✓ Integrated data framework?
  – Multiple datasets and models to analyze coastal environment, WWL Hazards, Inundation/Erosion

✓ Monitoring WWL Hazards:
  – Requires high temporal resolution
    • Hourly, sub-hourly time steps

✓ NOAA’s IDE:
  – Establishes architecture for US GEO
  – Needs to be coordinated with other programs and agencies
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Subject Matter Experts

✓ SSTs (ICOADS, ERSST, OI):
  – Dick Reynolds and Tom Smith (NCDC)

✓ Blended Sea Winds:
  – Huai-min Zhang (NCDC)

✓ Integrated Surface Hourly (ISH):
  – Neal Lott, Fred Smith

✓ GHCN-Hourly:
  – Jon Burroughs (NCDC)
Mahalo
and
Mele Kalikimaka!