Marine climate indices: a data management perspective (w/ ICOADS Release 2.5 & MARCDAT-III)

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Marine Data Sources

• **ICOADS**
  ✓ critical and critically under-resourced

• World Ocean Database (WOD)
• Global Digital Sea Ice Data Bank (GDSIDB)
• Perm. Service for Mean Sea Level (PSMSL)

• Derived data sets (w/ uncertainty estimates), e.g.:
  ✓ Hadley Centre: [www.hadobs.org](http://www.hadobs.org)
  ✓ NCDC: ERSST, ERSLP
  ✓ SOEST/U. Hawaii: WASWind (adj. wind/wave)

• Reanalyses
• Satellite – SST, wind, ice, sea level, waves
  ✓ E.g. Project GlobWave…
# Marine indices: potential & progress

<table>
<thead>
<tr>
<th>Operational</th>
<th>Resources required</th>
<th>Research required</th>
<th>Data required</th>
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</thead>
<tbody>
<tr>
<td>Large scale pressure</td>
<td>Temperature indices</td>
<td>Atlantic Meridional Circulation</td>
<td>Max &amp; min temperatures</td>
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<tr>
<td>(e.g. NAO, PNA)</td>
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<tr>
<td>Large scale temperature</td>
<td>Marine winds and</td>
<td>Currents</td>
<td>Wind gusts</td>
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<tr>
<td>(e.g. ENSO)</td>
<td>pressures</td>
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<tr>
<td>Sea Ice parameters</td>
<td>Waves</td>
<td>Polar lows</td>
<td>Storm surges</td>
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<tr>
<td>Ocean heat content</td>
<td>Sea level</td>
<td>Hydrographic time series (e.g. ICES)</td>
<td>Extremes</td>
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<td></td>
<td>Salinity measures</td>
<td>Fisheries information &amp; biology</td>
<td>Precipitation</td>
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<tr>
<td>Ocean transports and water mass</td>
<td>Ocean chemistry</td>
<td></td>
<td>Ph/Ocean Acidification</td>
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<tr>
<td>properties</td>
<td>(e.g. dissolved oxygen)</td>
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<tr>
<td>Hurricanes</td>
<td>Deep convection</td>
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<td>Clouds, humidity</td>
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NOAA/ESRL: [http://www.esrl.noaa.gov/psd/data/climateindices/](http://www.esrl.noaa.gov/psd/data/climateindices/)
NCAR: [http://www.cgd.ucar.edu/cas/catalog/climind/](http://www.cgd.ucar.edu/cas/catalog/climind/)
JISAO: [http://www.jisao.washington.edu/data/#time_series](http://www.jisao.washington.edu/data/#time_series)
US CLIVAR: [http://www.usclivar.org/science.html](http://www.usclivar.org/science.html)
• Wave height and other sea state parameters can be measured by satellites – starting with GeoSat launched in 1985
  • 2 main methods: radar altimeter and synthetic aperture radar (SAR)
• The data for each satellite and sensor need to be converted to a common format
• Comparisons allow the development of consistent quality assurance and calibration to give climate records
• Databases of co-locations have been produced
  • Satellite crossovers
  • Buoy satellite matchups
Global Wave Statistics

Goal is to compare measured quantities from different satellites over different regions.

The following physical quantities will be compared:

- **Altimeter**
  - Significant wave height

- **Synthetic Aperture Radar**
  - Swell wave height
  - Dominant swell direction
  - Dominant swell wavelength

Preliminary results for North Atlantic Region
ICOADS Background

• **International Comprehensive Ocean-Atmosphere Data Set**

• Original COADS project initiated in 1981
  – Joint in US between NOAA (ESRL and NCDC) & NCAR

• Plus extensive international contributions including:
  – DWD, JMA, KNMI, UK Met Office and National Oceanography Center, Southampton

• Website including data and metadata access: http://icoads.noaa.gov/

✓ Formal links to JCOMM proposed
Objectives – Motivation


“...The objectives of ICOADS remain: to collect as much original estimated (non-instrumental) and measured surface in situ data as possible; to treat each observation systematically—preserving data source identification and measurement metadata with each record, and converting units and coding schemes to a uniform set; to perform basic quality checks; and to freely distribute the data and products worldwide.”


“Data archaeology and quality control are Cinderella sciences
 QC of historical archives requires expert manpower and is thus expensive
 It is a pre-requisite for reconstructing past history of the ocean state – the community is investing large amounts in reanalysis/assimilation machinery – we need comparable investment in assembly and QC of the feeder data sets”
Recent Data Mixture

Addition of Pub. 47 VOS metadata, with help from UK NOCS

The official R2.5 period (1662-2007) is now extended monthly with “preliminary” real-time data and products based (currently) on NCEP GTS data.
Improvements in ocean area coverage
Early Data Mixture Changes: Homogeneity Impacts

Better advance validation of newly available data sources needed

Thompson et al. 2008, *Nature*: A large discontinuity in the mid-C20th in observed global-mean surface temp
**Current Data Rescue Candidates for Blending**

Major contributions from NOAA/CDMP; Recovery of Logbooks and International Marine Data (RECLAIM) Project; Atmospheric Circulation Reconstructions over the Earth (ACRE)
11 Feb 1899
~12Z Sea Level Pressure (SLP)

C20th Reanalysis:
- colors = range of uncertainty
- red dots = obs locations
UK Royal Navy WW1 Era Ship’s Logs
Being Digitized via Citizen Science (“Crowdsourcing”)

http://www.oldweather.org/

356K pages have already been digitized (~46% of collection)

interest by citizen participants in follow-on e.g. US projects
Surface Temp. Datasets for 21st Century

• Exeter Workshop 2010
  – Primary focus on land surface temperature
  – Databank stewardship will include other data elements
  – Also with the importance of the ocean clearly recognized

• ICOADS keynote presentation
  – Plus ~12 marine/related participants

• Among ICOADS lessons learned:
  – Climate data archives are research development efforts, but
    bridge with operational activities at near-real-time
  – Too much emphasis on operations will impact resources to
    improve the historical record
  – Accurate translations of obs. (e.g. historical units) form the
    foundation for all subsequent work – must be adequately
    resourced and carefully validated
ICOADS Value-Added Database (IVAD)

- With COAPS/FSU (Smith/Bourassa)
  - 3-year proposal to NOAA/CPO COM
- To develop a master set of ICOADS observations with adjustments e.g.:
  - ship heating effects, SST bucket/intake etc.
  - Beaufort wind force, anemometer height
  - improved QC
  - uncertainty estimates assoc. w/ adjustments
- Central ICOADS data management
- Demonstrate impact on marine surface flux estimates (COAPS)
Third International Workshop on Advances in the Use of Historical Marine Climate Data (MARCDAT-III), 2-6 May 2011, Frascati, Italy

Latest in a series of international workshops (~every 2 yr), to showcase & build on recent advances in marine climatology:

- Evaluation, utilization and improvement of the over 300-year record of ICOADS (e.g. using satellite data)
- Development of multi-decadal, homogeneous gridded datasets for climate applications
- Characterization of uncertainty and bias in marine observations and products

Objective of recommending a 10-year action plan for improved integration & accessibility of climatological obs.
### ESA CCI - Focus of MARCDAT

<table>
<thead>
<tr>
<th>Satellite-based ECVs</th>
<th>Not in CCI (24 ECVs)</th>
<th>Later in CCI (10 ECVs)</th>
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Conclusions

• Marine climate indices are progressing
  • some intrinsic data differences w/ land community
  • need for further coordination and quality guidance?
• Surface temperature initiative offers an important new avenue for closer linkage between the communities
  • E.g. tracking data provenance
• Need to understand new records before we can add usefully to the climate record – a lot of work
• How to quantify data rescue benefits (e.g. reanalyses, SST, ecology) remains an important challenge