CLIVAR GSOP/GODAE Ocean Reanalyses Intercomparison Workshop ECMWF, 1 - 3 July 2013

1) Santa Fe June 2011
   What are areas of robustness in reanalyses?
   Ocean Climate Metrics
   Intercomparison plans

2) Woods Hole Nov 2012 (www.clivar.org/sites/default/files/ICPO189_WHOI_fluxes_workshop.pdf)
   Joint with Air-Sea flux workshop
   First comparison of Reanalysis metrics

3) This meeting
   Monitor progress – explain/reduce anomalous results
   Review working groups

4) GODAE OceanView Symposium Maryland Nov.4-8 (Abstract deadline July 15)
Themes

Theme 1) How to complete the current intercomparison (Deadline: GODAE Symposium).

Which scientific work is missing?
Should it be extended to cover longer period?
How to package the results? publications, presentations, summary paper
Any other short term action?

Theme 2) How to exploit ensemble of ocean reanalyses further?

Which variables can be used for validation of climate models?
Which aspects can be useful for real time monitoring?
Which aspects can be useful for understanding the real world?
Which aspects can be useful for Observing System Assessment?
Which aspects can be use for system development?
Facilitate Data Access

Current status

Data in a variety of repositories
- EasyInit, APDRC, MyOcean
- Often duplicates, with obsolete data, variety of formats and grids.

Summary Tables with description in a variety of webpages
- Reanalysis.org, EasyInit, NCAR climate data sets
- Often duplicates, no consistency or up-to-date ensured

How should we improve (consistency, avoid contradictions, up-to-date)
- Single repository?
- Data distributed in multiple repositories + central web page with links?
- Formats (CF compliant, others?)
- Grids?
ECMWF Perspective on Integrated Earth System Reanalysis – Dick Dee

ERA-CLIM: EU collaborative research project, 2011-2013, 9 global partners

Goal: Preparing input observations, model data, and data assimilation systems for a global atmospheric reanalysis of the 20th century

Main components:

1. Data rescue efforts (in-situ upper-air and satellite observations)
2. Incremental development of new reanalysis products
3. Use of reanalysis feedback to improve the data record
4. Access to reanalysis data and observation quality information
### ERA-CLIM reanalysis products

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Time Period</th>
<th>Details</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ERA-20CM</td>
<td>Ensemble of model integrations, using HadISST2 and CMIP5 forcing</td>
<td>1900-2010</td>
<td>125 km, 60 levels, 10 members</td>
<td>Complete</td>
</tr>
<tr>
<td>ERA-20C</td>
<td>Ensemble of reanalyses, using surface observations from ICOADS and ISPD</td>
<td>1900-2010</td>
<td>125 km, 60 levels, 10 members</td>
<td>In progress, available</td>
</tr>
<tr>
<td>ERA-20C/Land</td>
<td>Global land surface, meteorological forcing from ERA-20C</td>
<td>1900-2010</td>
<td>40 km, 10 members</td>
<td>Available end 2013</td>
</tr>
<tr>
<td>ERA-SAT</td>
<td>New reanalysis of the satellite era <em>(to replace ERA-Interim)</em></td>
<td>1979 onward</td>
<td>40 km, 91 levels</td>
<td>Available 2015</td>
</tr>
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</table>
GSOP/GODAE heat content intercomparison
Matt Palmer, Magdalena Balmaseda, et al.
Balmaseda et al. [2013]
Validation Period: Regional considerations

**Anomaly Correlation versus Altimetry - Gravimetry**
REAENS 2005 - 2009

**VERY GOOD AGREEMENT OF THE ENSEMBLE**
AMOC Definitions

- **Florida** = Flow through Florida straits
- **Ekman** = Wind stress implied transport through MidOcean section
- **MidOcean** = MidOcean flow – Ekman = Geostrophic flow
- **Throughflow** = Total transport through section (Bering straits + P+R-E)
Monthly MOC for 2004-2010
Monthly model MOC depending on RAPID MOC
### 2004-2010 MOC at 26.5N

<table>
<thead>
<tr>
<th>N</th>
<th>Meridional components (Sv)</th>
<th>Florida Current</th>
<th>Ekman</th>
<th>Midocean</th>
<th>Max MOC*</th>
<th>Total throughflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RAPID (Apr04-Mar11)</td>
<td>31.6</td>
<td>3.2</td>
<td>-34.8</td>
<td>17.6</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>JMA: MOVEG2</td>
<td>13.0</td>
<td>2.9</td>
<td>-17.0</td>
<td>12.7</td>
<td>-1.1</td>
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<tr>
<td>3</td>
<td>JMA: MOVECORE(04-07)</td>
<td>16.6</td>
<td>3.7</td>
<td>-21.9</td>
<td>12.6</td>
<td>-1.6</td>
</tr>
<tr>
<td>4</td>
<td>JPL_ECCO</td>
<td>25.5</td>
<td>3.1</td>
<td>-28.7</td>
<td>15.9</td>
<td>0.0</td>
</tr>
<tr>
<td>5</td>
<td>GFDL/NOAA</td>
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<td>3.8</td>
<td>-36.6</td>
<td>12.2</td>
<td>-1.2</td>
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<tr>
<td>6</td>
<td>GMAO/NASA</td>
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<td>8</td>
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<td>3.1</td>
<td>-28.9</td>
<td>15.6</td>
<td>-1.7</td>
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<tr>
<td>9</td>
<td>GloSea5/METO (2004-2009)</td>
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<td>3.1</td>
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<td>16.3</td>
<td>-1.5</td>
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<td>ECMWF</td>
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<td>12.9</td>
<td>-1.2</td>
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<tr>
<td>11</td>
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<td>-36.6</td>
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<td>17.9</td>
<td>-1.4</td>
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</tbody>
</table>

* - MOC integrated from surface
-1Sv throughflow ~ -0.2Sv of MOC
Points for Discussion

- Florida strait v MidOcean transports
- Why are model heat transports lower than Observed?
- Depth structure of AMOC transports?
- AMOC at other Atlantic latitudes
- Role of temporal eddies in transports
- Does current Assimilation increase/improve mean AMOC?
- Should we be looking to assimilate RAPID AMOC measurements?
- Ensemble estimates of AMOC transports?
Sea Ice Intercomparison
Greg Smith, Jean-François Lemieux and Frederic Dupont
Mean March Sea Ice Thickness: 2007

Too thin

Too thick
Timeseries of ice volume for September

- Large uncertainty in volume as compared to extent.
- Some agreement in downward trend from 1995 onwards.
- PIOMAS is a well validated reference model run.
- Surprisingly, most models have overly thin ice.
How to complete the current intercomparison

• Proposed a list of action items to prepare for the GODAER OceanView Symposium by completing/enhancing the analysis for various parameters (e.g., including SSS, deep ocean changes), including submitting abstracts to the symposium.
• Proposed a few action items for “Best Practices” (data format, naming convention of different synthesis products; metadata such as depth info; references; co-author lists).
• Suggested enhancing scientific/diagnostic analysis of certain variables (e.g., potential change of S in the deep ocean; the spatial pattern of the deep ocean changes of T & S).
• Disseminate results through CLIVAR Exchange (summary of intercomaprinson efforts), Ocean Sci., Ocean Dyn. Or Clim. Dyn. (a collection of papers for analysis/comparison of different variables), BAMS to highlight a topic of broad interest (e.g., deep ocean changes).
Current Inter-comparison (THEME I)

1. ACTION Complete data submission. Deadline mid September.
   1. Salinity (SSS (0-10m average) and additional products Li Shi to send request)
   2. Steric Height (possibly new reanalysis. Andrea)
   3. Sea Ice (new reanalysis. Greg)
   4. Heat Content (Matt)
   5. Sea Level (Fabrice, request complete time record)
   6. MLD (Takahiro, complete time record)


3. ACTION: Heat and Salt content on similar format (Matt Palmer and Li Shi to request)

4. ACTION: request vertical resolution details (bottom depth of each layer (Fabrice)

5. ACTION: Consistent naming of reanalysis products among variables (Fabrice)

6. ACTION: Submit abstracts to GODAE . Deadline 15th of July (everyone)

7. ACTION: CLIVAR Exchanges. (NICO) A description of project and short article showing at least one highlight per product (everybody)

8. ACTION: Contact Editor Ocean Science (Ocean Dynamic and Climate Dynamics) to request special issue

9. ACTION:: Submit papers to Ocean Science

10. ACTION: Contact producers informing on plans on GODAE/CLIVAR/others preference on anonymity (Magdalena).
How to exploit ensemble of ocean synthesis products further?

- Which variables can be used for validation of climate models?
- Which aspects can be useful for real time monitoring?
- Which aspects can be useful for understanding the real world (process studies)?
- Which aspects of the intercomparison can be useful for Observing System Assessment?
- Which aspects can be use for system development?

The following factors affect the answers to many of the questions above:

- “Signal-to-spread” ratio;
- Change of spread in space and time;
- Dependence on the parameter/quantity.
Recommendations for “How to exploit ensemble of ocean synthesis products further”

- Provide and archive ensemble mean and spread of each intercomparison quantity to
  - evaluate impact of observing system (in space and time)
  - System improvement
  - Robustness of synthesis products as a whole for interring variability in the real world

- Enhance interactions with other community:
  - Promote the utility of ocean synthesis by other communities (e.g., initializing decadal prediction; evaluation of climate models).
    - Central Data portal with uniform format (preferably CF compliant): EasyInit; work with ESG/CMIP/obs4MIP
    - Complete and update metadata info in reanalysis.org and EasyInit.
  - Interaction with the Working Group for Ocean Model Development (WGCMD)
    - Provide a common framework for intercomparison (e.g., a subset of the GSOP/GODAE OceanView metrics and WGOMD metric).

- Work with the obs community to
  - gain better estimate of obs uncertainty (e.g., provide feedback to data developers about the consistency among data products).
  - Consistent dataset for assimilation (QC procedure, uncertainty)
Value-added aspects of synthesis products beyond observations

- Complete space-time (including hi-frequency) distribution of MLD, D20, etc.
- Inferred/derived quantities: transports, esp. in regions where no direct obs are available (e.g., AMOC at 48N), steric height distribution in space.
Issues identified

• Strategy for the use of certain type of data (e.g., RAPID):
  • Withhold for independent validation or assimilate?
  • How to assimilate? Raw profile or derived quantities? Assimilate integral quantities?

• Automatic procedure to compute ocean climate indices; portal (OOPC, ICDC/ Hamburg, GODAE OceanView)
RecommendaJon

DATA ARCHIVE of ENSEMBLE MEAN AND SPREAD (EasyInit for Instance)

• Useful information for system development

• Needed to assess progress (each vintage of reanalysis needs to be better than previous)

• Needed to facilitate definition of indices

• Needed to facilitate process studies

• Need a name for the product and a version number (EA)v1

• Need format (CF compliant, homogenize variables names) and variable names.