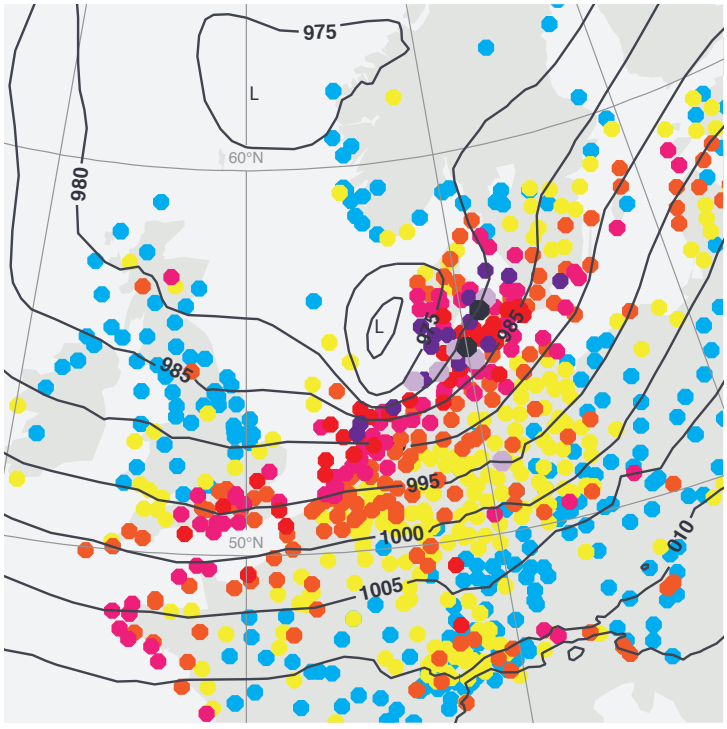
ECMWF Feature article

from Newsletter Number 137 – Autumn 2013

METEOROLOGY

Ocean Reanalyses Intercomparison Project (ORA-IP)



www.ecmwf.int/en/about/news-centre/media-resources

doi:10.21957/qn75r1ai

This article appeared in the Meteorology section of ECMWF Newsletter No. 137 – Autumn 2013, pp. 11–12.

Ocean Reanalyses Intercomparison Project (ORA-IP)

Magdalena A. Balmaseda, Fabrice Hernandez, Tong Lee,
Andrea Storto, Maria Valdivieso, Kirsten Wilmer-Becker

Several ocean reanalyses products are produced worldwide with different purposes and methodologies. The joint GODAE OceanView/CLIVAR-GSOP workshop in Santa Cruz (13-17 June 2011, *Oke et al.*, 2011) called for a community action on exploitation of the latest ocean reanalyses for real time climate monitoring and intercomparison. The first stage would be to complete an Ocean Reanalysis Intercomparison Project (ORA-IP), although the ultimate goal would be near real-time monitoring of the ocean through indices based on an ensemble of reanalyses.

A viable proposal was put forward in Santa Cruz, based on the criteria of minimum effort. The following procedure was proposed.

- **Production centres, including operational and reanalysis centres.** These would provide relevant information (i.e. gridded fields of basic primary variables) in agreed formats and grids (where applicable) to enable the agreed intercomparison procedure.
- **Processing centres.** For intercomparison purposes each processing centre would take on a particular variable in which it has a strong interest and expertise.

They would process ensemble statistics based on the input from the individual production centres, and create relevant indices or metrics or graphics which could be directly compared.

The ORA-IP workshop at ECMWF

The ORA-IP initiative proposed in Santa Cruz achieved enough momentum: (a) relevant ocean variables and responsible processing agents (de facto, individuals that volunteered to do the work) were identified, (b) the processing agents produced documents for specific data requests, grids and format, and (c) different production centres provided the data in the requested format. It was time then to assess progress and discuss the way forward, and to this end a workshop was held at ECMWF from 1 to 3 July 2013.

By the time of the workshop at ECMWF, the scope of the intercomparison exercise was the understanding of the consistency and differences between the reanalysis products, the evaluation of fit-for-purpose, and the exploitation of this variety of reanalysis using the ensemble approach. The intercomparison targeted various areas.

- Routine monitoring of indices of societal relevance with uncertainty estimates using the ensemble.
- Production of robust data sets for understanding the ocean and for initializing and evaluating decadal prediction and IPCC models.
- Recommendations for future reanalyses production by identifying the weaknesses of existing approaches and the suitability of the ensemble approach.

The workshop format consisted of presentations by the various processing agents on the different variables, followed up by in-depth discussion of the results. Table 1 provides a list of the variables chosen for intercomparison, along with the responsible agent. The different ocean reanalyses included in the study appear in Table 2.

AFFILIATIONS
Magdalena A. Balmaseda, ECMWF, Reading, UK
Fabrice Hernandez, Mercator-Océan, Ramonville Saint Agne, France
Tong Lee, NASA Jet Propulsion Laboratory, Pasadena, USA
Andrea Storto, CMCC, Bologna, Italy
Maria Valdivieso, Department of Meteorology, University of Reading, UK
Kirsten Wilmer-Becker, GODAE OceanView, Met Office, Exeter, UK

 doi:10.21957/qn75r1ai

The following outcomes were expected.

- Specific recommendations on how to finalize the intercomparison of the chosen ocean variables (i.e. those listed in Table 1).
- Recommendations on how to make the results and data accessible to the wide climate community.
- Recommendations on how to improve the ocean observing system, assimilation methods, models and surface fluxes.

The various points were discussed in two working groups, which provided recommendations in a final plenary session.

Ocean variable	Responsible agent	Institution
Steric height	Andrea Storto	CMCC, Italy
Sea level	Fabrice Hernandez	Mercator-Océan, France
Ocean heat content	Matthew Palmer	Met Office, UK
Depth of 20 degree isotherm	Fabrice Hernandez	Mercator-Océan, France
Mixed layer depth	Takahiro Toyoda	MRI-JMA, Japan
Salinity	Li Shi	BMRC, Australia
Surface fluxes and transports	Maria Valdivieso	University of Reading, UK
Atlantic meridional overturning at 26°N	Vladimir Stepanov & Keith Haines	University of Reading, UK
Sea ice	Gregory Smith	Environment Canada

Table 1 List of ocean variables intercompared.

Product	Institution
CFSR	NCEP, USA
GODAS	NCEP, USA
Glosea5	Met Office, UK
ORAS4	ECMWF, UK
PEODAS	BMRC, Australia
GLORYS	Mercator-Océan, France
C-GLORS	CMCC, Italy
UR025.4	University of Reading, UK
GEOS5	NASA/GMAO, USA
ECDA	GFDL, USA
SODA	University of Maryland, USA
ECCO-NRT	NASA/JPL, USA
ECCO-v4	NASA/JPL, USA
GECCO2	Hamburg University, Germany
MOVE-C	MRI/JMA, Japan
MOVE-G2	MRI/JMA, Japan
MOVE-CORE	MRI/JMA, Japan
K7-ODA	JAMSTEC, Japan
K7-CDA	JAMSTEC, Japan
ARMOR3D	CLS, France (T/S & SLA)
NODC	NOAA, USA (T/S only)
EN3	Met Office, UK (T/S only)
LEGOS	LEGOS, France (SLA only)

Table 2 List of ocean reanalysis products entering the intercomparison. The product in green is an ocean-only simulation (i.e. it does not assimilate ocean observations) and those in blue are observation-only products (i.e. they do not use an ocean model) using temperature and salinity profiles (T/S) and/or sea level anomalies (SLA).

Recommendations

The recommendations were structured in two big themes: (a) how to finalize the current intercomparison in the short term and (b) how to exploit further the ocean reanalyses (in the medium term). The importance of using reanalysis for real-time climate monitoring was acknowledged during the workshop, but not discussed explicitly. It was considered that the recommendations for two themes provided guidance and infrastructure on how to extend the intercomparison to eventual real-time monitoring.

Theme I: How to finalize the current intercomparison?

- The current intercomparison should be finalized, including the minimum base period 1993-2009. There should also be a focus study on the 2004-2009 Argo period.
- The intercomparison should include an evaluation of the ensemble mean, spread and signal-to-noise ratio for mean, seasonal cycle, interannual variability and trends.
- The ORA-IP results should be ready for presentation in the GODAE OceanView Symposium (November 2013).
- The ORA-IP initiative and results should be announced in CLIVAR Exchanges.
- The ORA-IP results should be published in a special issue of a peer-reviewed scientific journal in order to reach the wider oceanographic and climate community.

Theme II: How to exploit ensemble of ocean synthesis products further?

- Interaction with the user community should be promoted. Climate scientist, seasonal and decadal forecasts community are users of ocean reanalysis products. The reanalysis can be used for process studies, for validation of climate models, and for initialization and verification of long lead forecasts.
- The ORA-IP variables should be archived in a public data repository, including ensemble means and spreads, in the grid used for the intercomparison (1°×1° latitude/longitude regular grid) and in an user-friendly grid and format (netcdf CF-compliant format). An ORA-IP version number should be part of the metadata. The version number is important if we want to trace progress between subsequent ORA-IP, including improvements in the observing system and in the assimilation methods. Signal-to-noise ratios on different time scales are essential information to assess the adequacy of variables for process studies, forecast initialization, forecast verification and monitoring of climate indices. A public archive will benefit the interaction with the user communities.
- In addition to the ORA-IP ensemble mean and spread upon the overlapping 1993–2009 period, it would be desirable to archive the individual reanalysis products in the same grid and format, although this may not be easy in a first instance due to data policy issues.
- The information in current public web pages such as reanalysis.org and EasyInit should be as comprehensive as possible and kept up-to-date.
- Interaction with the Working Group for Ocean Model Development (WGCMD) in the area of model evaluation and metrics should be encouraged.
- Interaction with the observation community should be encouraged to (a) improve the observation quality control and (b) obtain guidance regarding observation uncertainty. The result of this interaction should be improved and consistent quality controlled data sets for assimilation and better formulation of the observation errors in the data assimilation.

Further reading

Oke, P., M. Martin, M.A. Balmaseda, G. Brassington & **K. Wilmer-Becker,** 2011: *Report on the GODA Ocean View - CLIVAR GSOP Workshop on Observing System Evaluation and Intercomparison.* https://www.godae-oceanview.org/outreach/meetings-workshops/task-team-meetings/godae-ocean-view-gsop-clivar-workshop/

 doi:10.21957/qn75r1ai