ISDA-Online

October 07, 2022, 15 – 17 UTC

“Reanalysis”

Organizers / Conveners: ***Marcin Chrust*** *(ECMWF),* ***Laura Slivinski*** *(NOAA/ESRL), and* ***Javier Amezcua*** *(Tec. de Monterrey, Mexico; U. Reading, UK)*

In these last years, reanalysis datasets have become more diverse, including global and regional versions for different Earth-system components: atmosphere, ocean, land, etc. More ambitiously, couples reanalyses are emerging. Furthermore, single-trajectory and ensemble reanalyses are emerging. We invite contributions in all these areas.

Program: (UTC)

15:00 – 15:05	**Welcome**
15:05 – 15:25 (17’+3’)	**Findings from the CLIVAR workshop on future U.S. earth system reanalysis efforts.** Sergey Frolov, Thomas Auligne, Dick Dee, Ron Gelaro, Patrick Heimbach, Mike Patterson, Isla Simpson, Laura Slivinski, Cecile Rousseaux
15:25 – 15:40 (12’+3’)	**A Lagrangian translation of the ERA-5 re-analysis** Lucie Bakels, Andreas Stohl, Katharina Baier
15:40 – 15:55 (12’+3’)	**Towards systematic inter-comparison of ocean reanalyses and statistical mapping methods for long-term ocean heat content estimation** Andrea Storto, Chunxue Yang
15:05 – 16:20 (12’+3’)	**A CESM+DART Atmospheric Reanalysis for Forcing Ocean, Land, and Other Surface Models** Kevin Raeder, Timothy J. Hoar, Mohamad El Gharamti, Benjamin K. Johnson, Nancy Collins, Jeffrey L. Anderson, Jeff Steward, Mick Coady
16:20 – 16:35 (12’+3’)	**LETKF-based Ocean Research Analysis (LORA) in the Western North Pacific region** Shun Ohishi, Takemasa Miyoshi, Misako Kachi
16:35 – 16:50 (12’+3’)	**A preliminary evaluation of the ECMWF ORAS6 ocean and sea-ice reanalysis with ensemble ocean DA system** Hao Zuo, Marcin Chrust, Philip Browne, Magdalena Alonso Balmaseda, Patricia de Rosnay, Eric de Boisseson, Beena Balan Sarojini
16:50 – 17:00	**Closing: Information on upcoming sessions**

Please note:

- When you login to the session before 15:00 UTC, and everything could be quiet, this is most likely because we muted the microphones.
- The times in UTC are approximate. In case of technical problems, we might have to change the order of the presentations.
- **Time Zones**: 15 – 17 UTC

  Europe: 04 – 06 pm BST (London) | 05 – 07 pm CEST (Berlin)
  Asia/Australia: 11 – 01 am CST (Shanghai) | 00 – 02 am JST (Tokyo) | 02 – 04 am AEDT (Sydney)
  Americas: 08 – 10 am PDT (San Fran.) | 09 – 11 am MDT (Denver) | 11 – 01 pm EDT (New York)

Findings from the CLIVAR workshop on future U.S. earth system reanalysis efforts.

Sergey Frolov (NOAA), Thomas Auligne (JCSDA), Dick Dee (Plane A),
Ron Gelaro (NASA), Patrick Heimbach (Texas A&M), Mike Patterson (US CLIVAR),
Isla Simpson (NCAR), Laura Slivinski (CIRES), Cecile Rousseaux (NASA)

In spring of 2022, US CLIVAR conducted a workshop on the future of the U.S. reanalysis efforts. Meeting attendants representing a wide array of international reanalysis producers, agency representatives, and scientific and commercial users developed a 10-year roadmap for a suite of consistent Earth system reanalysis that is needed to support missions of the U.S. government agencies and public-sector users. In this presentation, we define the requirements for the consistent reanalysis as well as a hierarchical approach for development of the reanalysis suite. Needs for specific investments into the shared infrastructure will be documented and the need for interagency coordination will be articulated.

A Lagrangian translation of the ERA-5 re-analysis

Lucie Bakels[1], Andreas Stohl[1], Katharina Baier[1]
[1]University of Vienna

Scientific studies where transport in the atmosphere plays an important role would benefit from a Lagrangian re-analysis that provides meteorological data along continuous trajectories.
We will present our plans for the creation of a novel Lagrangian re-analysis which will help answering a range of scientific questions about energy and water vapour transport and energy conversions in the atmosphere, and the dynamic processes leading to extreme events of temperature, wind and precipitation. For example, using a precursor of the final Lagrangian dataset, anomalies in atmospheric transport were causally linked to ENSO teleconnections in a recently submitted paper by our group.
The Lagrangian particle dispersion model FLEXPART is driven off-line with data from the ERA-5 re-analysis, which translates the Eulerian information into a Lagrangian analogue. The data will eventually be stored in an easily searchable database and shared with researchers worldwide.

Towards systematic inter-comparison of ocean reanalyses and statistical mapping methods for long-term ocean heat content estimation

Andrea Storto[1], Chunxue Yang[1]

[1]Institute of Marine Sciences (ISMAR), National Research Council (CNR) of Italy, Rome, Italy

Ocean reanalyses, which embed ocean model dynamics, and statistical mapping (or objective analyses) of observations both contribute to shed light on the long-term global and regional ocean warming. However, their comparison does not always show consistent results, especially for those regions and/or periods that are under-sampled, and, for instance, in terms of high-frequency variability. There are however significant differences in the way the most used reanalyses and objective analyses are configured, which hamper the interpretation of their differences in representing climate signals. Using the same variational data assimilation scheme, in terms of formulation, background, and observation errors, we build fully consistent versions of a global reanalysis and global objective analysis, at about 1° of spatial resolution for the period from 1958 to 2021. We show preliminary results about the comparison of reanalyses and objective analyses in three different cases, where either real observations or differently formulated synthetic profiles are assimilated.

LETKF-based Ocean Research Analysis (LORA) in the Western North Pacific region

Shun Ohishi[1], Takemasa Miyoshi[1], Misako Kachi[2]
[1]RIKEN
[2]JAXA

Various ocean analysis datasets have been produced by operational centers and research institutions and have been used for a variety of geoscience studies. In the Pacific region, the following high-resolution ocean analysis datasets are now available: JCOPE2M (Miyazawa et al. 2017) and FRA-ROMS II (Kuroda et al. 2017) with 3D-VAR, FORA-WNP 30 (Usui et al. 2017) with 4D-VAR, and DREAMS (Hirose et al. 2013) with a Kalman filter. To the best of the authors' knowledge, no ensemble Kalman filter (EnKF)-based high-resolution analysis datasets exist yet for the Pacific region. The TOPAZ4 (Sakov et al. 2012; Xie et al. 2017) is created by an EnKF-based sea-ice coupled system constructed for the North Atlantic and Arctic regions but is released only around the Arctic region on the website of CMEMS (https://marine.copernicus.eu/).

We have developed an eddy-permitting EnKF-based ocean data assimilation system in the western North Pacific (WNP) region (Ohishi et al. in review a, b). With the recent enhancement of the high-performance computing resources, we are now able to integrate a sufficiently high-resolution system to resolve fronts and eddies. Therefore, this study aims at creating an eddy-resolving EnKF-based ocean analysis dataset in the WNP region and comparing the accuracy with the existing analysis and observational datasets known as JCOPE2M and AVISO (Ducet et al. 2000), respectively. The dataset constructed in this study is referred to as LORA standing for the Local ensemble transform Kalman filter (LETKF)-based Ocean Research Analysis. The validation results show that the LORA has sufficient accuracy of sea-surface horizontal velocity and temperature for a variety of geoscience research as well as fisheries, marine transports, and marine environment consultants.

A preliminary evaluation of the ECMWF ORAS6 ocean and sea-ice reanalysis with ensemble ocean DA system

Hao Zuo[1], Marcin Chrust[1], Philip Browne[1], Magdalena Alonso Balmaseda[1], Patricia de Rosnay[1], Eric de Boisseson[1], Beena Balan Sarojini[1]

[1]ECMWF

Ocean and sea-ice reanalyses are reconstruction of historical ocean and sea-ice states by ingesting observations into simulated model states through data assimilation methods. Reanalysis provides invaluable information for climate monitoring and is essential component in long-term prediction such as seasonal to decadal forecasts. The Ocean ReAnalysis System-6 (ORAS6) is the 6th generation of ocean and sea-ice reanalysis system developed at ECMWF. Compared with the current operational system-5 (ORAS5), ORAS6 has incorporated a series of major system changes. The ocean and sea-ice model has been upgraded to NEMOv4 + SI3 and is now driven by hourly Atmospheric forcing from ERA5 with additional wind fixings. A new ensemble-based variational ocean data assimilation system has been developed within the framework of NEMOVAR. This new EDA system is constructed with a hybrid covariance model. Thanks to improved ensemble generations and some novel approaches implemented for correlation model computation, this EDA system can provide flow-dependent background error variances and correlation scales, both of which are critical for better assimilation of sea surface observations. Instead of nudging, SST observations are now directly assimilated with this EDA system in ORAS6, together with other in-situ and surface observations. Assimilation of L3 sea-ice concentration data from OSI-SAF within the multi-category SI3 has been implemented as well. Changes also include a novel FWB closure scheme which allows constrain of Atmosphere-Ocean FW fluxes using external product (e.g., ERA5); and a revised bias correction method which accounts for error also from SST increments. We will present results from a prototype ORAS6 reanalysis with a focus on performance evaluation against its predecessor ORAS5 and ORAP6.

A CESM+DART Atmospheric Reanalysis for Forcing Ocean, Land, and Other Surface Models

Kevin Raeder[1], Timothy J. Hoar[1], Mohamad El Gharamti[1], Benjamin K. Johnson[1], Nancy Collins[1], Jeffrey L. Anderson[1], Jeff Steward[2], Mick Coady[3]

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Ensemble reanalyses of the ocean, sea ice and land are crucially dependent on both the mean and variability of atmospheric forcing. An ensemble atmospheric reanalysis using the Community Earth System Model with the Data Assimilation Research Testbed generated a unique dataset of ensembles of surface fluxes and other variables required by non-atmosphere component models. These data can force reanalyses and hindcasts with CESM component models; CLM5 (land), CICE5 (sea ice), POP2 and MOM6 (ocean), MOSART (atmospheric chemistry), and CISM (land ice). They can also force non-CESM Earth system models. This presentation describes the generation and quality of the reanalysis and how to access and use the dataset for reanalyses with other models.

This reanalysis used a 1 degree CAM6-FV configuration of CESM to assimilate millions of observations per day during 2011-2020. Data saved include 80-member ensembles of:
1) High-frequency, ensemble, atmospheric forcing for non-atmospheric models of CESM,
2) Weekly CAM6, CLM, and CICE restart files,
3) 6 hourly prior estimates of the assimilated observations,
4) 6 hourly land model plant growth variables,
5) 6 hourly ensemble mean atmospheric analyses.

The reanalysis' ensemble spread and agreement with observations vary with atmospheric field, location, and time. These can be evaluated in great detail using 3), above.

This 130 Tb dataset has a combination of a large ensemble, high frequency, and multiyear time span, providing opportunities for statistical analysis and use as a training dataset for machine learning (>10^10 labeled atmospheric observations and ensembles of model estimates). It is freely available from the Research Data Archive at NCAR.