GODAE OceanView

Data Assimilation Task Team (DA-TT)

Overview and status

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Contents

- DA-TT overview
- Status of work plan
- GODAE OceanView (GOV) Symposium in 2018

DA-TT Overview

Objectives

- To coordinate and improve the assimilation of ocean and sea-ice data into ocean, sea-ice and coupled models by providing a forum for discussion, and by creating a framework for inter-comparison of aspects of data assimilation.

- To provide a focus for diagnosing and understanding model and observation biases through the use of data assimilation techniques, and discuss results with model developers and observation specialists.

DA-TT Overview

Themes

- Improving the representation and parameterisations of error covariances for data assimilation
- Improving the capacity of current data assimilation systems to make use of all available observations
- Development of data assimilation systems for coupled models
- Development of hybrid data assimilation for the ocean

Current activities in the DA-TT work plan:

1. Improving understanding of error covariances in existing DA systems via a common set of coordinated single observation experiments
2. Identifying and quantifying model and forcing bias that are common to global data assimilation systems via coordinated experiments
3. Promoting the development of hybrid data assimilation methods in the ocean (eg. ensemble variational methods)
4. Organise meetings of the TT to foster the development of data assimilation, establish linkages, forge collaborations, and encourage joint publications

DA-TT members

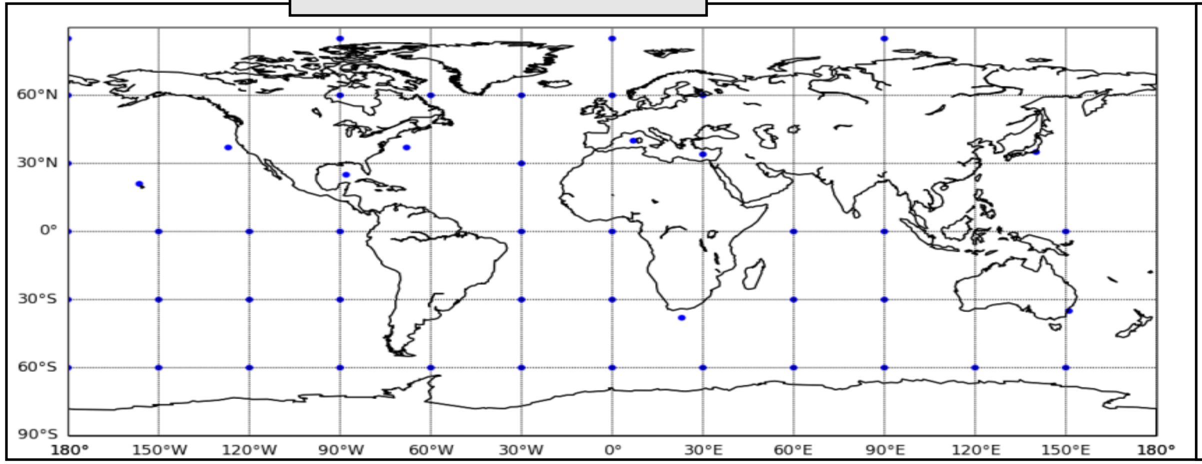
- Matt Martin (Met Office)
- Andy Moore (UCSC)
- Greg Smith (EC and IV-TT)
- Pavel Sakov (BoM)
- Peter Oke (CSIRO and OSEval-TT)
- Charles-Emmanuel Testut (Mercator)
- Laurent Bertino (NERSC)
- Anthony Weaver (CERFACS)
- Magdalena Balmaseda (ECMWF)
- Andrea Storto (CMCC)
- Young Ho Kim (KIOST)
- Arthur Vidard (INRIA)
- Clemente Tanajura (REMO)
- Pierre De Mey (LEGOS and COSS-TT)
- Norihisa Usui (JMA/MRI)
- Jim Cummings (NRL)
- Avichal Mera and Carlos Lozano (NCEP)
- Alexander Kurapov (Oregon State University/NOAA)
- Francois Counillon (NERSC)
- Paulo Oddo (CMRE)
- Hernan Arango (Rutgers University)
- Stefano Ciavatta (PML)
- Anna Teruzzi (OGS)

Status of work plan

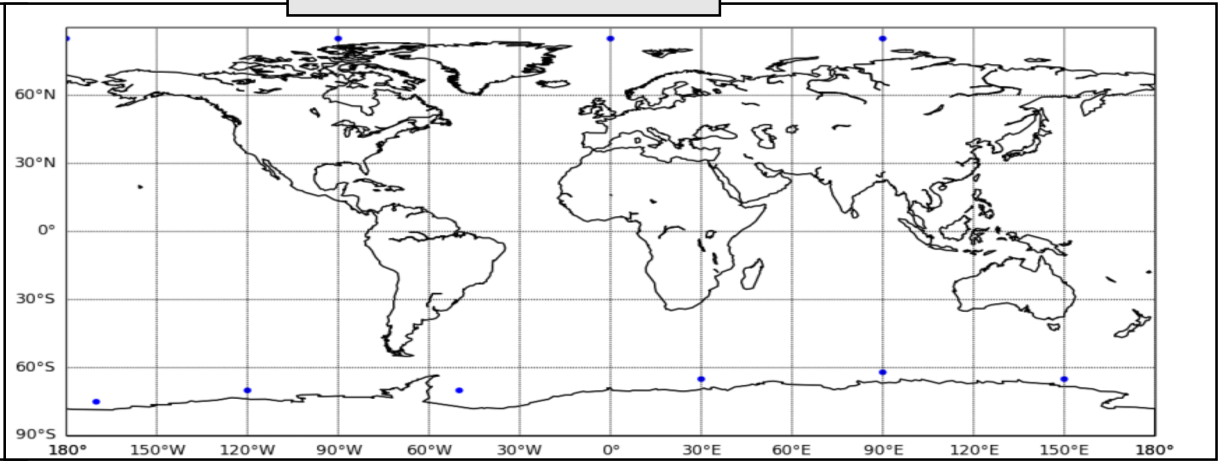
1. Inter-comparisons: idealised observation experiments

Objective: Improving understanding of error covariances in existing DA systems via a common set of coordinated experiments assimilating multiple widely-spaced observations.

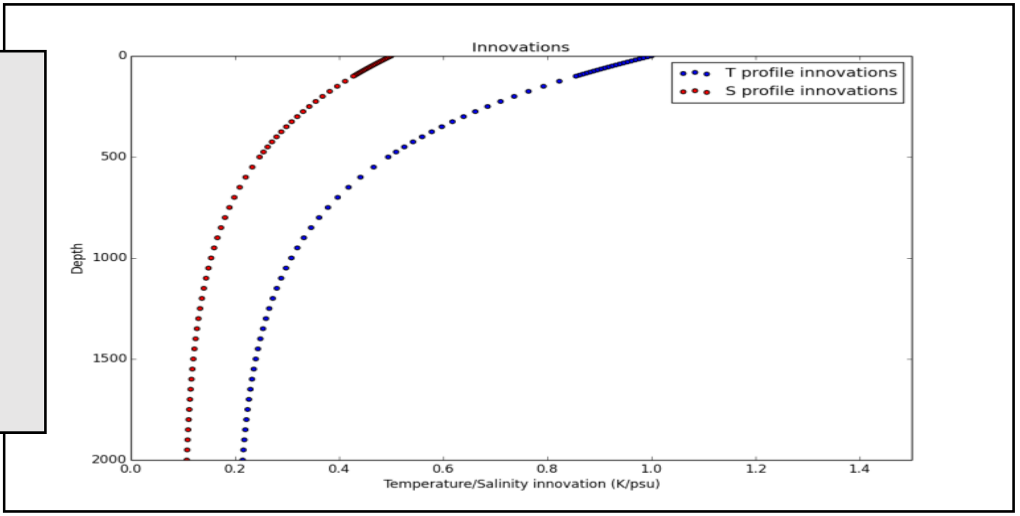
T/S/SLA/SST locations



Sea-ice conc. locations



- Innovations (observation-minus-background) specified for 12Z 1st June 2015.
- Specification of the innovations:
    - SST: 0.5K
    - SLA: 8cm
    - Sea-ice concentration: 10%
    - T/S profiles →

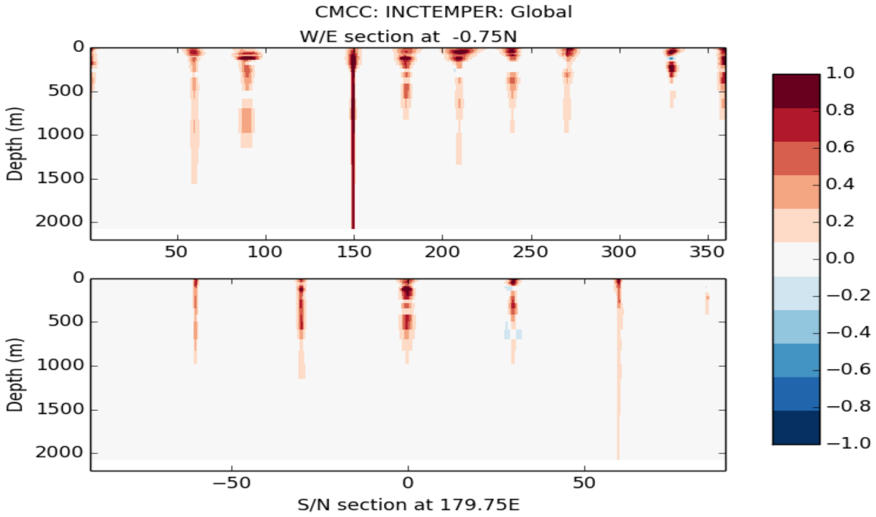


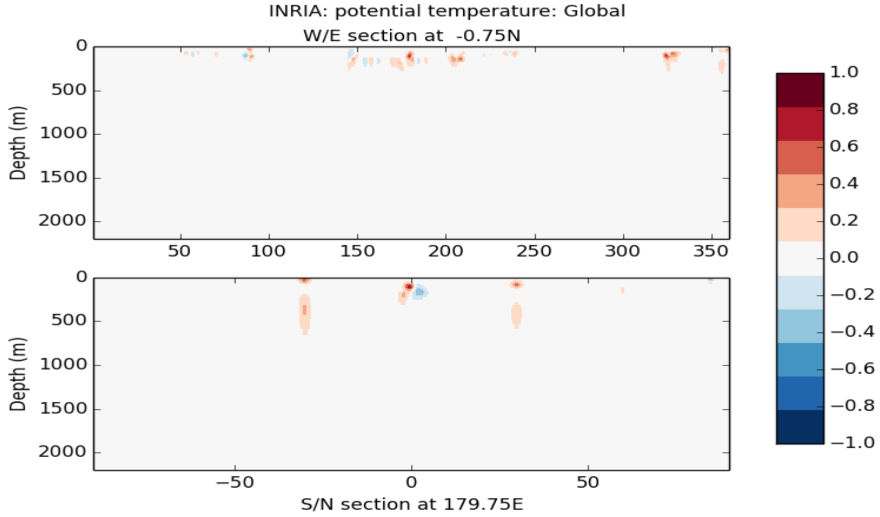
Method:

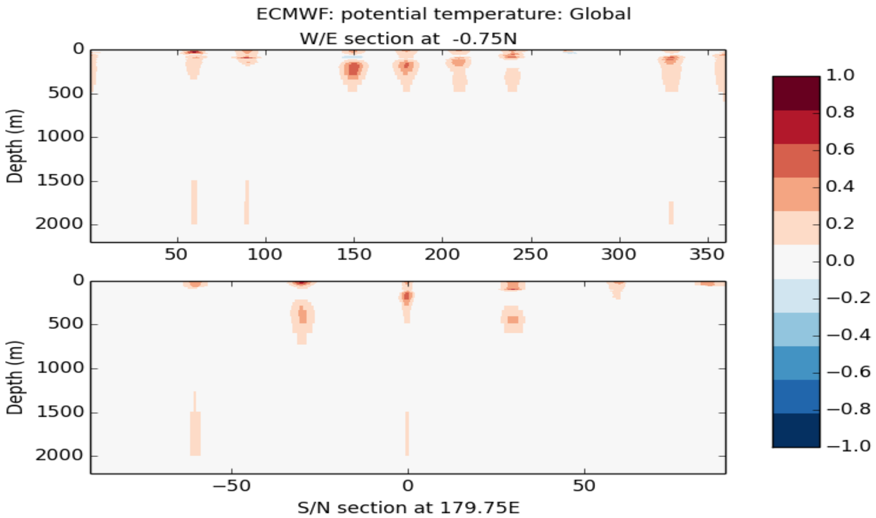
- Each system uses their background field for 1st June 2015 and converts the innovations into (pseudo) observation values.
- For each obs type, run the assimilation system and generate a set of increments.
- The increments will be interpolated to a common ¼ degree grid.
- They will then be compared to understand how each of the DA systems weights the observations, and spreads information in the horizontal, vertical and between variables.
- An additional part of the experiment is also proposed, whereby the increments are included in a 10-day forecast to see how they are propagated/retained by the model.

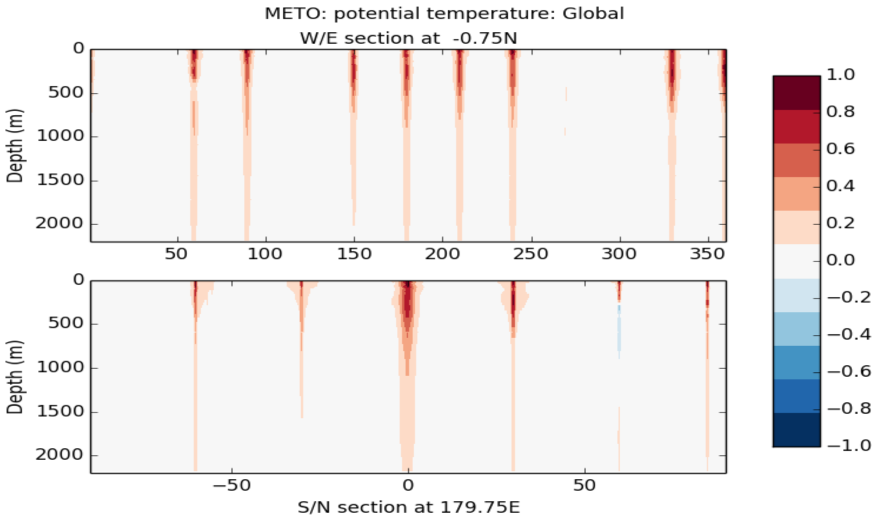
Institute	Scheme	Region	Horizontal resolution	Vertical coordinate	Time-window
CMCC	OceanVar 3DVar	Global	1/4°	50 z-levels	7 day.
ECMWF	NEMOVAR 3DVar	Global	1°	42 z-levels	5 day.
INRIA	NEMOVAR 4DVar	Global	1/4°	75 z-levels	10 day. Obs in middle of the window
METO	NEMOVAR 3DVar	Global	1/4°	75 z-levels	1 day. Obs in middle of the day.
UCSC	ROMS 4DVar	California Current	1/10°	42 σ-levels	4 days. Obs time is midnight on day 2.

T/S profile obs: T incs cross-sections

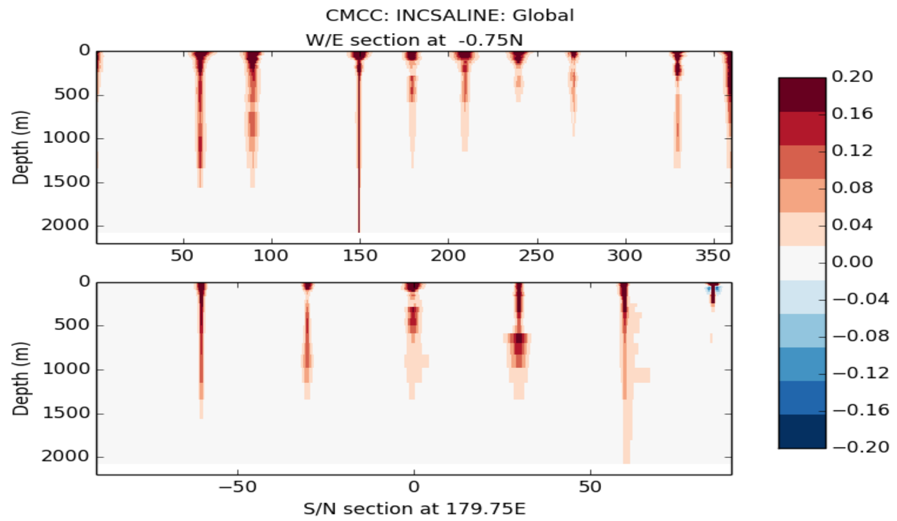


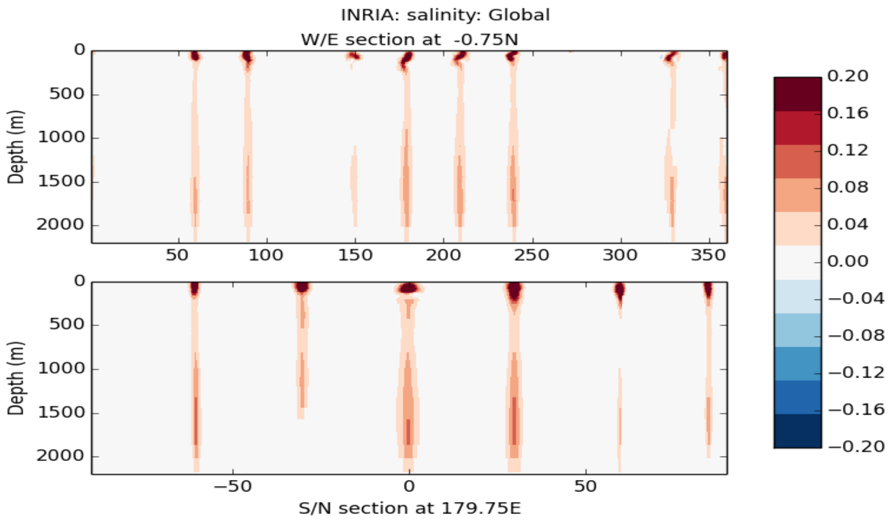


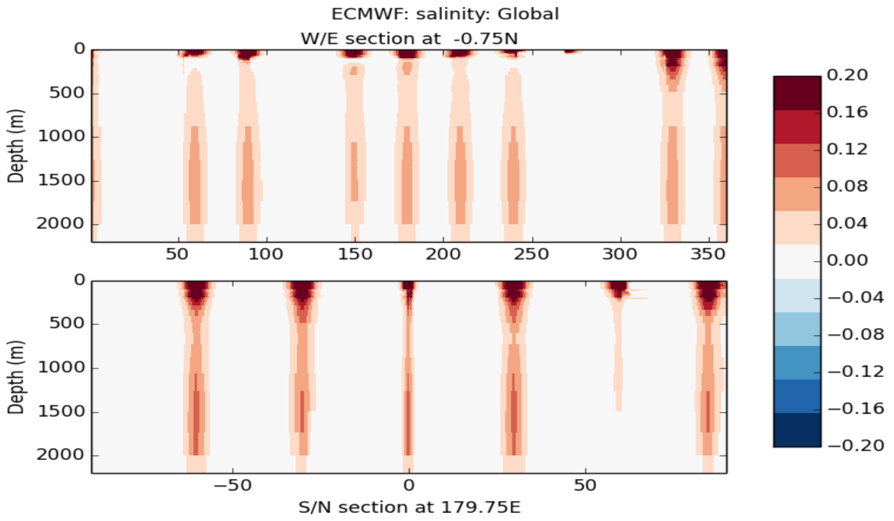


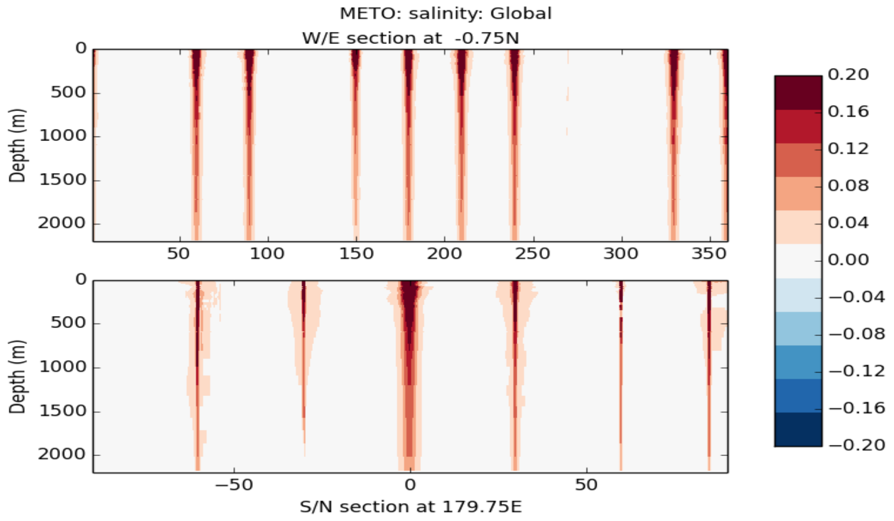


T/S profile obs: S incs cross-sections



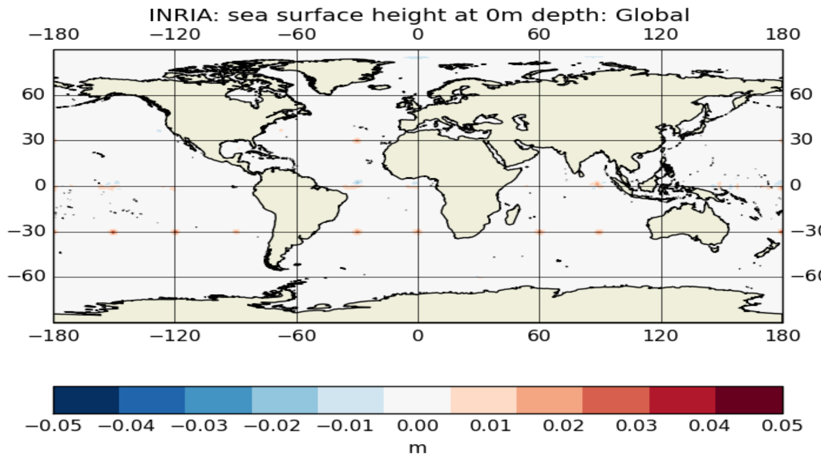


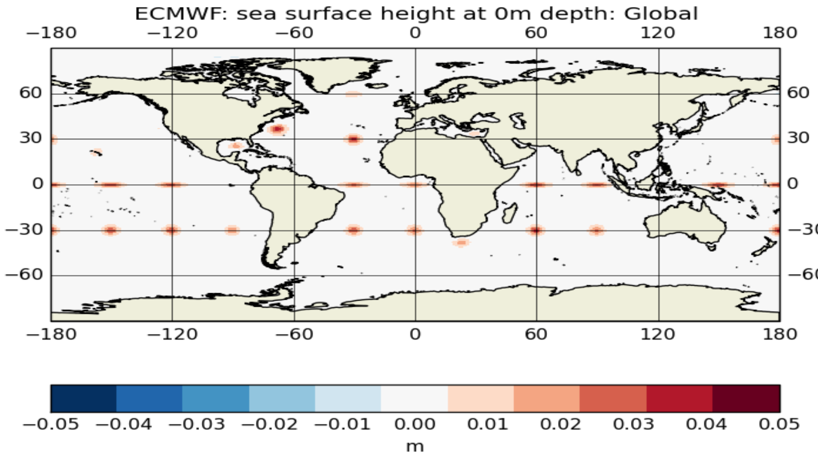


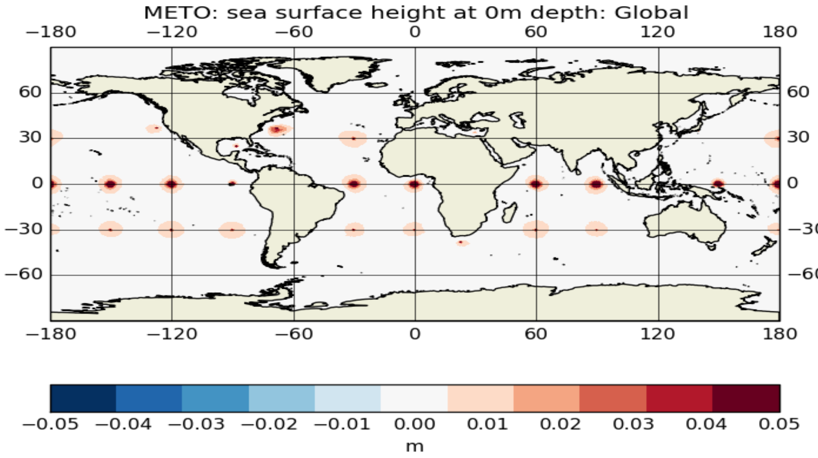


T/S profile obs: SSH increments

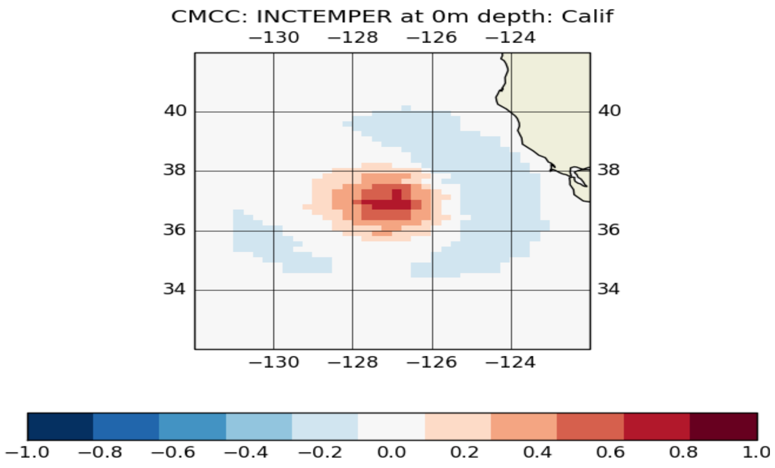
No SSH incs from CMCC

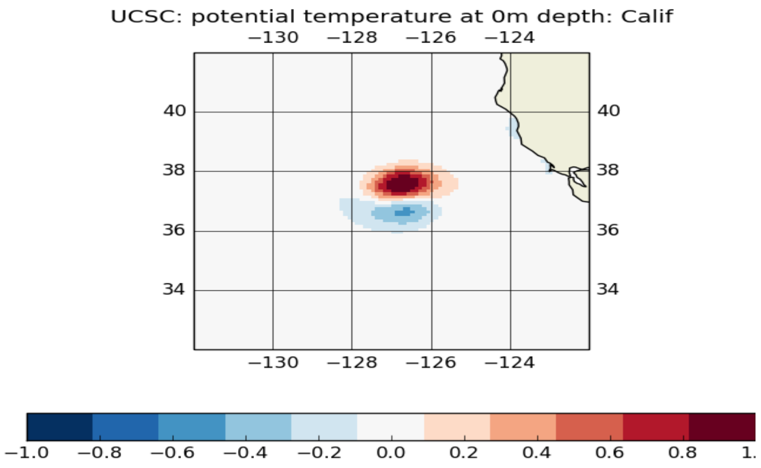


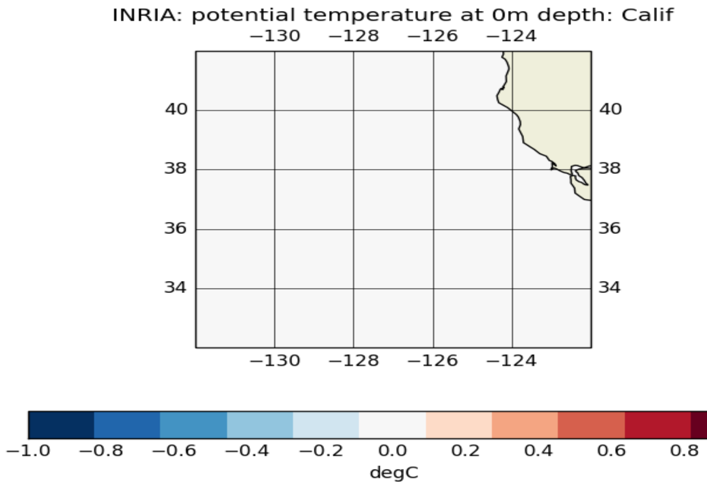


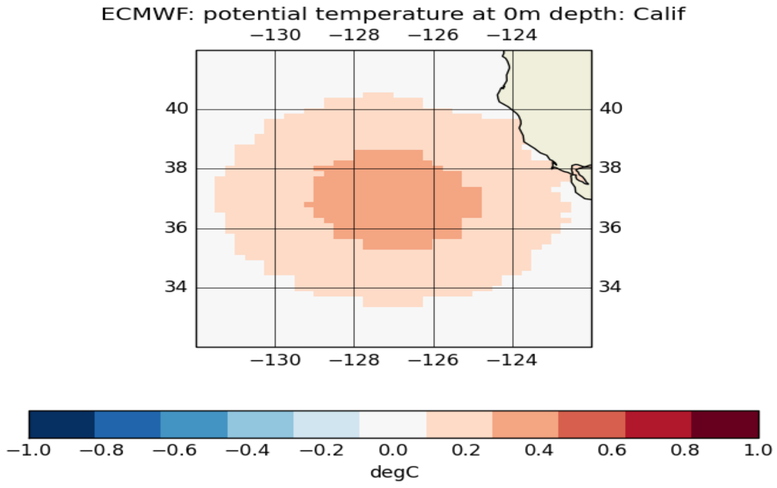


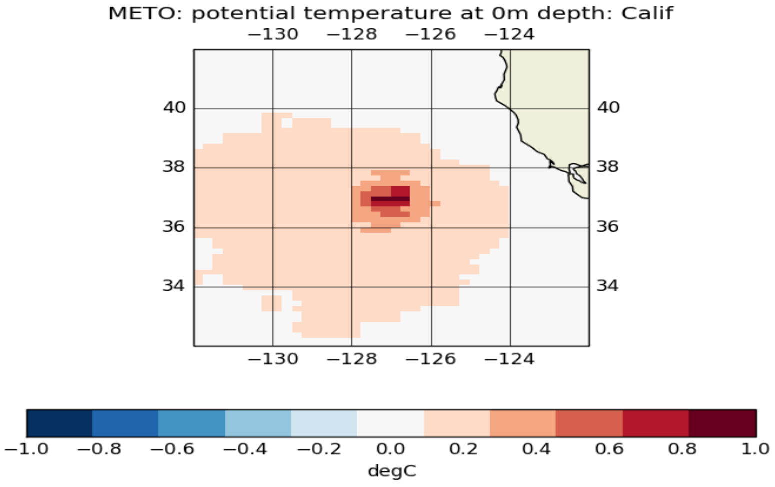
T/S profile obs: T incs at surface



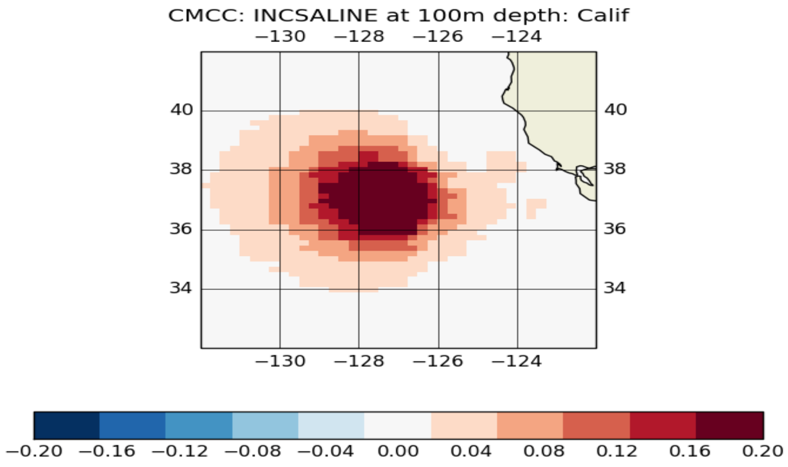


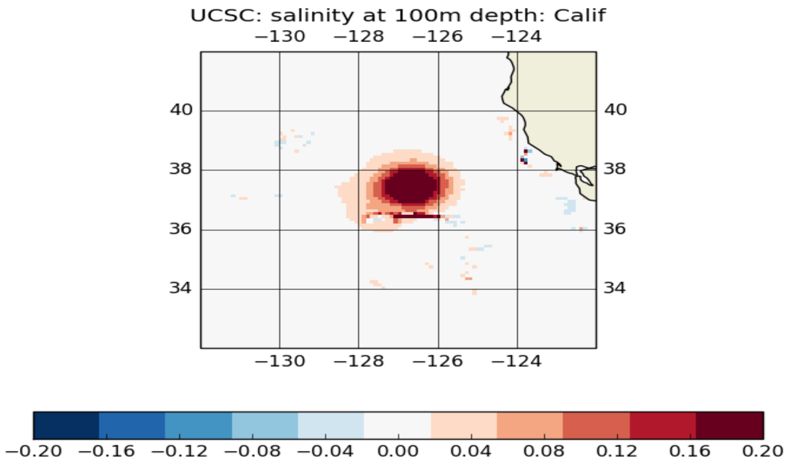


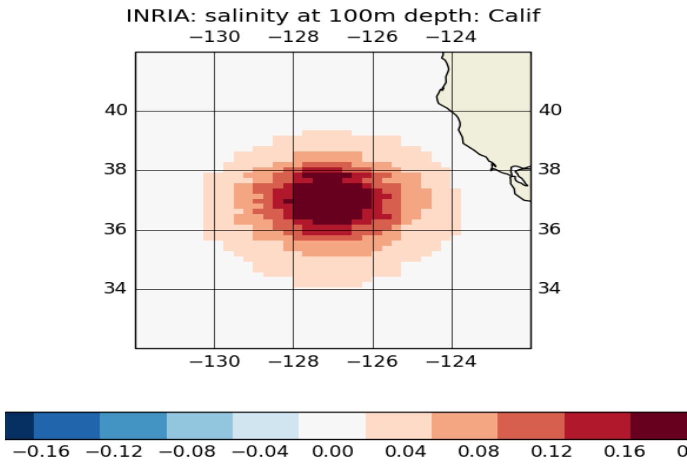


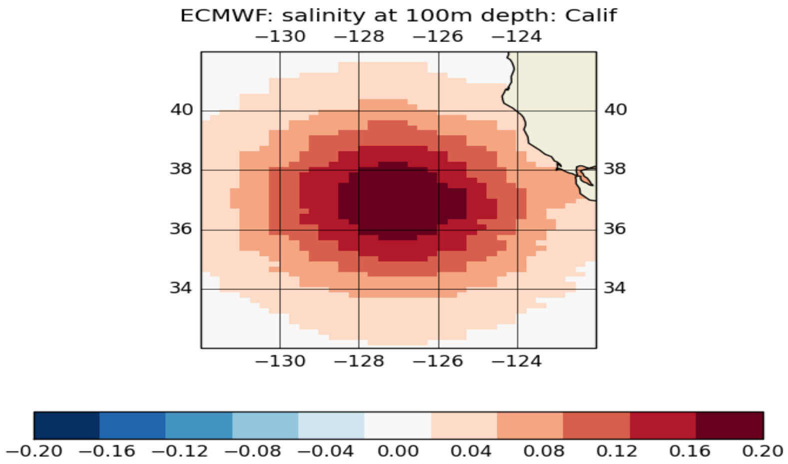


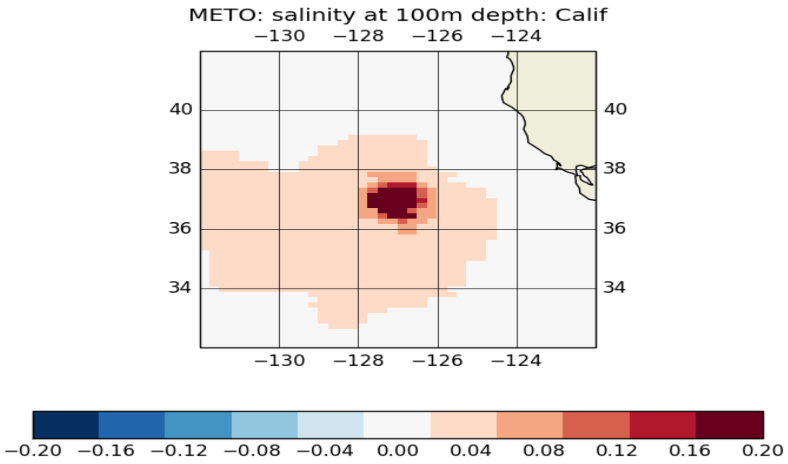
T/S profile obs: S incs at 100m











2. Inter-comparison of average increments

- Since about 2005 Argo has provided almost global coverage of T, S profiles to 2000 m depth every 10 days.
- Satellites have also provided high resolution surface temperature and surface height data
- Atmospheric analyses in this period are also relatively reliable

- So we would expect ocean data assimilation systems to provide accurate re-analyses of T and S during this period

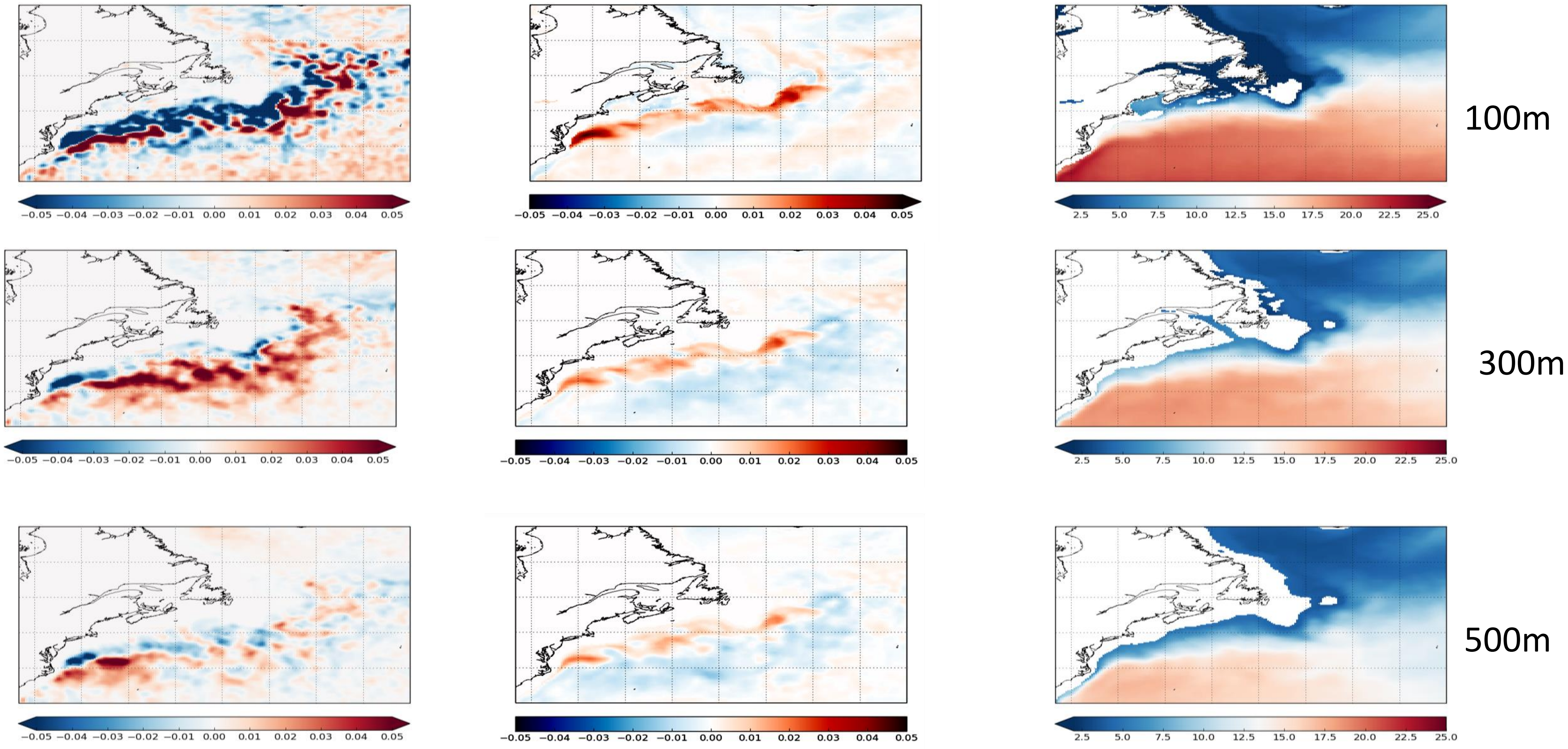
- We can use these analyses to assess ocean model systems:
    - start model forecasts from the analyses and subtract "final" model state from the analyses

- We can then explore development of systematic errors in the first few months of the integrations:
    - before feedbacks complicate the assessment
    - and examine seasonal and geographical variations
- Seasonal forecast systems "naturally" produce suitable forecasts for study.

- If the assimilation scheme is working well the ***time-mean assimilation increments*** should be equal and opposite to the model system's mean errors

FOAM/Glosea5: Zoom in the Gulf Stream region

Increments compared to 2-month forecast biases
DJF season only



Mean incs (K/day)

Forecast bias (K/day)

Model mean (deg C)

Inter-comparison of average increments

- Vertically integrated temperature increments from MetO and ECMWF. Also compared with NCEP and NRL outputs (not shown).

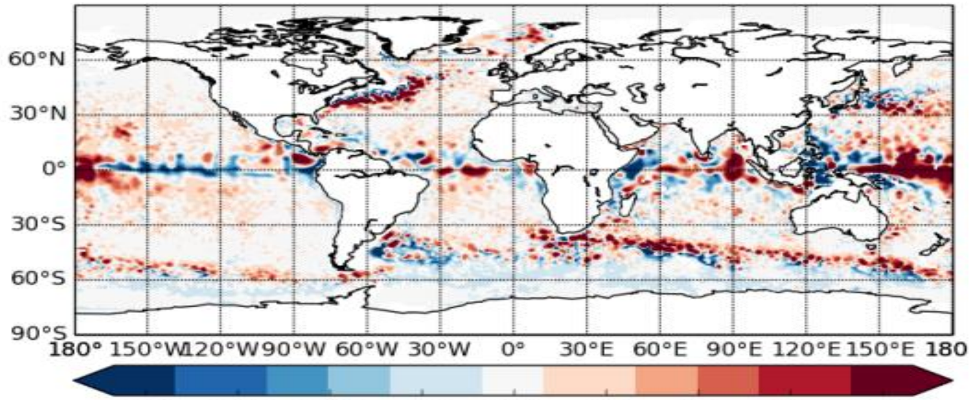
- Some common features between the systems and some differences

- Fronts seem to slump / weaken initially in many regions

    - Would this be true in higher resolution models?
    - Preliminary comparisons with NRL outputs at 1/12° resolution show much less dipolar structure in the frontal regions.

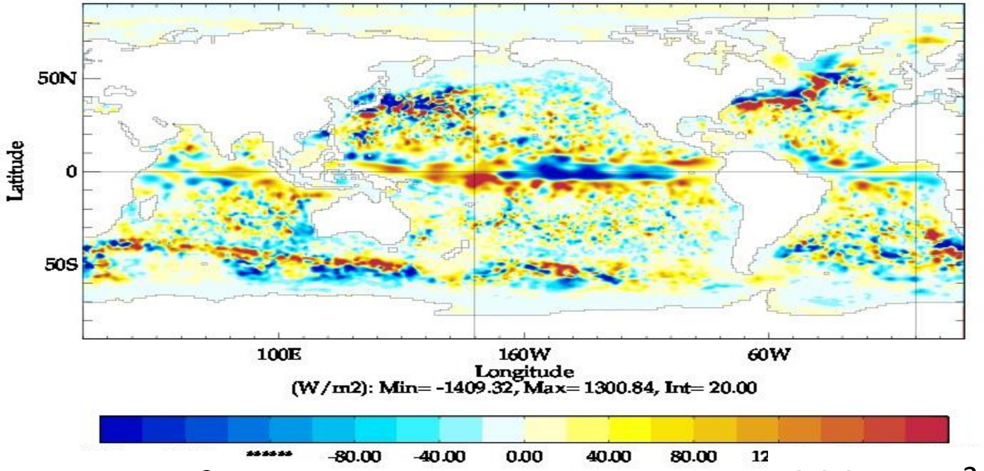
- Net vertically integrated heat inputs from data assimilation are large compared with standard estimates of surface heat fluxes.

MetO FOAM/GloSea5 (1/4^o)



-500 Wm^{-2} 500 Wm^{-2}

ECMWF ORAP5 (1/4^o)



-200 Wm^{-2} 200 Wm^{-2}

3. Hybrid data assimilation

- Progress on hybrid ensemble/variational data assimilation at a number of institutes, e.g. UCSC, CERFACS, ECMWF, CMCC, CMRE

- See talks on Thursday morning.

4. Organise workshops

- Aim:

  Foster the development of data assimilation, establish linkages, forge collaborations, and encourage joint publications

- Progress:
  - 1st workshop, May 2015 in Exeter, UK.
  - 2nd workshop, July 2016 in Santa Cruz, USA. Joint workshop with Marine Ecosystem Analysis and Prediction (MEAP) –TT.
  - 3rd workshop, Oct 2017 in La Spezia, Italy. Joint workshop with the Observing System Evaluation (OSEVal) –TT.

GODAE OceanView Symposium and Review 2018

GODAE OceanView symposium and review

Inputs needed from the DA-TT are likely to be:

- Overview of the progress in ocean and coupled DA relevant to GOV since the last symposium in 2013.

- Review the DA-TT and how it is working, e.g.
    - Are the work plan items the right ones?
    - Are they making progress?
    - Does the TT provide benefit to the GOV (and wider) community?
    - How can the TT work better?

- Any inputs/thoughts related to these are welcome as inputs to the preparation for the symposium and review.