CLIVAR Global Synthesis and Observations Panel

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[1]CSIRO, [2]SIO

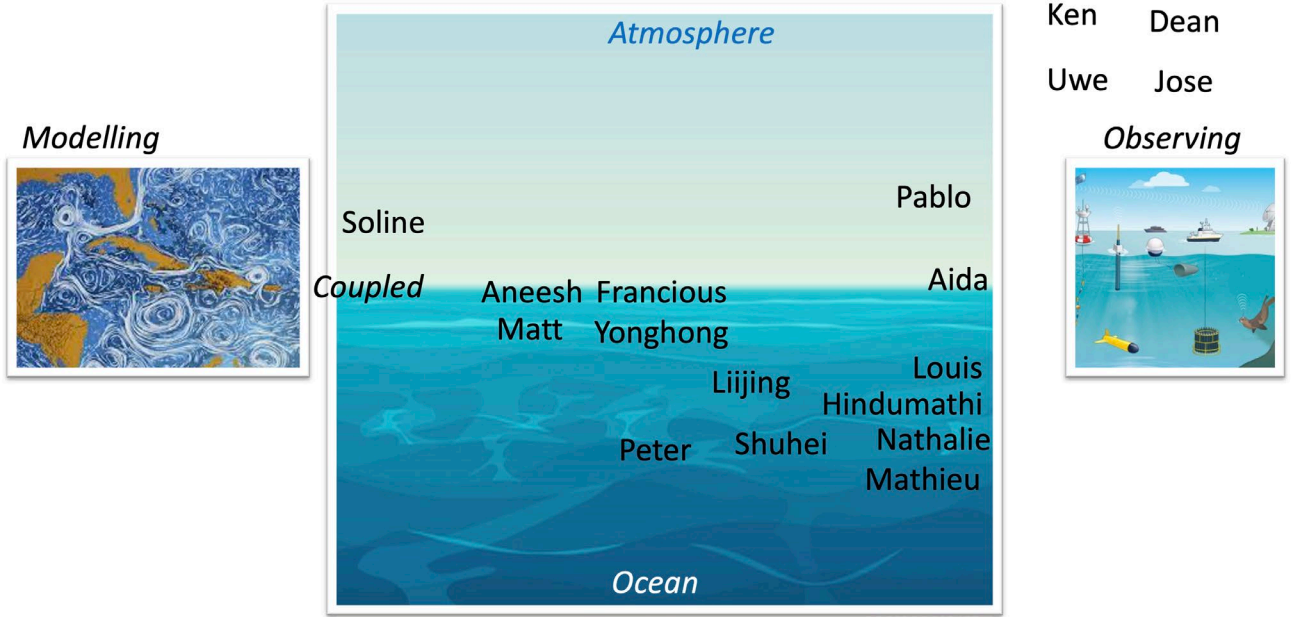
Outline:

- *GSOP on one slide … who are we? what are our skills? what are our interests? what we do?*
- *What are our Joint Activities?*
- *What's our strength? And weakness?*
- *Ocean Decade, Lighthouse Activities/Challenges …*

CLIVAR GSOP *… on one slide*

Recall the science-based points in our terms of reference:
"synthesis" refers to data-assimilation, reanalysis, forecasting, hindcasting, modelling, etc.

- *Develop, promote, and implement strategies for … synthesis …*
- *Define requirements for … observations … and promote use … in synthesis …*
- *Develop metrics to evaluate … syntheses*
- *Promote utility of synthesis products …*



GSOP Panel Members

Name	Role		Institute	Country
Nathalie Zilberman	Co-Chair	2023	Scripps Institution of Oceanography	USA
Peter Oke	Co-Chair	2024	The Commonwealth Scientific and Industrial Research Organisation (CSIRO)	Australia
Matt Mazloff	Member	2021	Scripps Institution of Oceanography	USA
François Counillon	Member	2021	NERSC	Norway
Lijing Cheng	Member	2021	Institute of Atmospheric Physics, Chinese Academy of Sciences (IAP-CAS)	China
Shuhei Masuda	Member	2022	Japan Agency for Marine-Earth Science and Technology (JAMSTEC)	Japan
Louis Clement	Member	2022	National Oceanography Centre	UK
Hindumathi Palanisamy	Member	2023	WCRP Secretariat	Switzerland
Aneesh Subramanian	Member	2023	University of Colorado Boulder	USA
Mathieu Belbeoch	Member	2023	OceanOPS	France
Aida Alvera Azcárate	Member	2023	University of Liège	Belgium
Yonghong Yin	Member	2024	Australian Bureau of Meteorology	Australia
Soline Bielli	Member	2024	Laboratoire de l'Atmosphère et des Cyclones (LACy)	La Réunion, France
Pablo Canziani	Member	2024	Consejo Nacional de Investigaciones Cientificas y Tecnológicas(CONICET)	Argentina
Ken Ando	Ex officio		Vice-Chair / Tropical Moored Buoy Implementation Panel	Japan
Dean Roemmich	Ex officio		co-Chair of the Argo Steering Team	USA
Uwe Send	Ex officio		Co-chair / OceanSITES	USA

Joint Activities

- How does data assimilation of observations impact dynamical balance of models?
    - Understanding the elements of synthesis that rarely get considered
    - Can we learn how to better exploit observations by understanding what's done well, and what's done poorly in different systems?

- What metrics are most suitable for assessing data assimilating systems?
    - Most assessments report a standard set of statistical metrics: mean, standard deviation, root-mean-squared differences, mean absolute differences, correlations, …
    - Can we do better?

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Proposed Approach

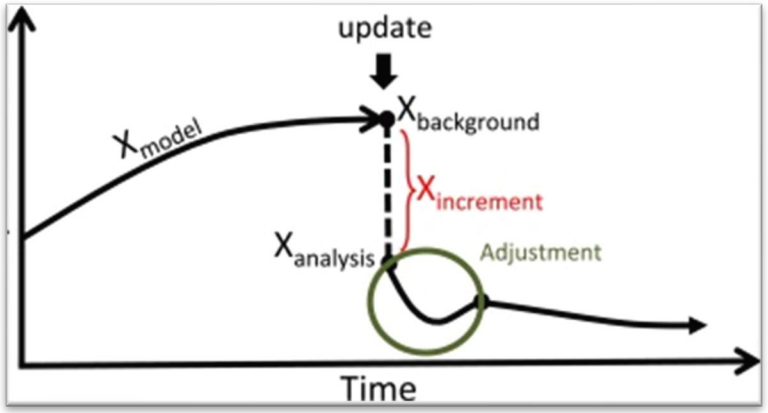
Compare dynamical balance of a model with and without assimilation.

Experiments can use as little as a single example/update.

- EXP BGF: background field at T=t
- EXP AN: analysis field at T=t
- EXP INIT: model field at T=t+dt

What's unique here?

1. Multiple model/analysis/assimilation systems
2. Multiple analysis systems, all filtered by the same model

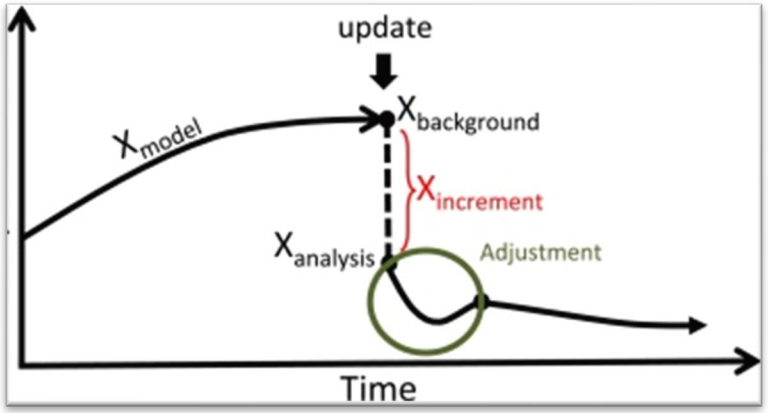


How does data assimilation of observations impact dynamical balance of models?

Systems includes:

- Ensemble-based ocean reanalysis, 1/10^{o}-res (CSIRO)
- Ensemble-based OI analysis, 1/10^{o}-res (CSIRO)
- 4dVar ocean-BGC, 1/4^{o}-res (SIO)
- OI ocean analysis, 1^{o}-res (IAP-CAS)
- Coupled atmos-ocean, 1^{o}-res (NERSC)
- Coupled atmos-ocean, 1.4^{o}-res (BoM)
- Limited-area atmos, 1/20^{o}-res (LACy)

… mix of data-assimilating models and analysis systems
… models will include assessment of initialization
… analysis systems will be limited to diagnostic metrics



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Metrics:

For BGF and AN:

- Volume, mass, energy, vorticity
- Density inversions instabilities

…

For BGF, AN, and INIT:

- Amplitude of vertical velocity: an indication of divergence, and therefore geostrophy (recall that geostrophic fields are non-divergent)
- Amplitude of ageostrohic field
- Rossby number – noting that Ro>1 indicates highly non-linear regime

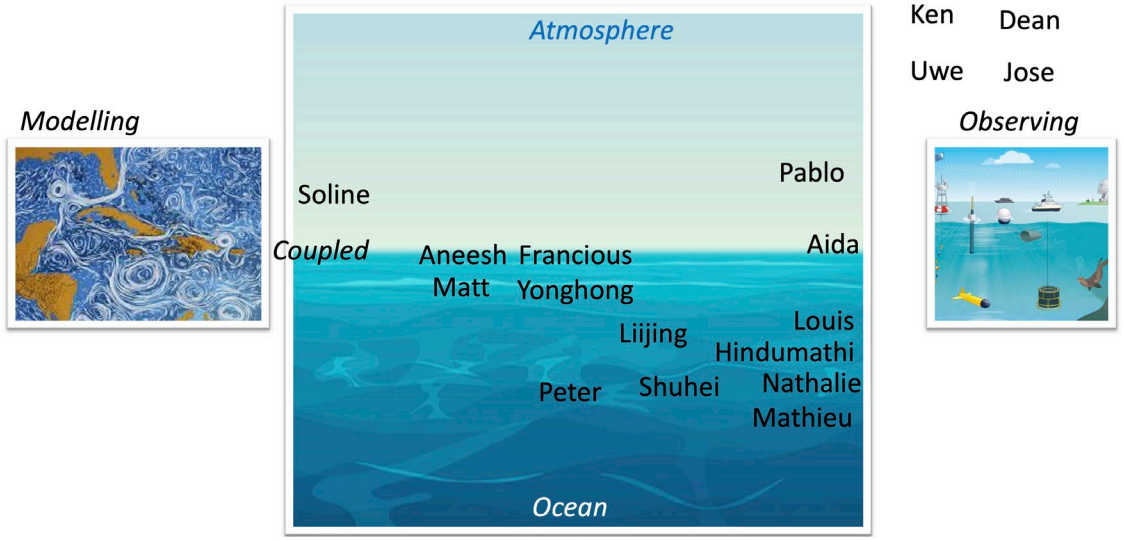
$$Ro = (V_x - U_y)/f$$

…

What's the strength of CLIVAR GSOP?

What's our strength?

- Mix of … data assimilation/modelling and observational researchers;
  … ocean, coupled, atmosphere-focussed researchers



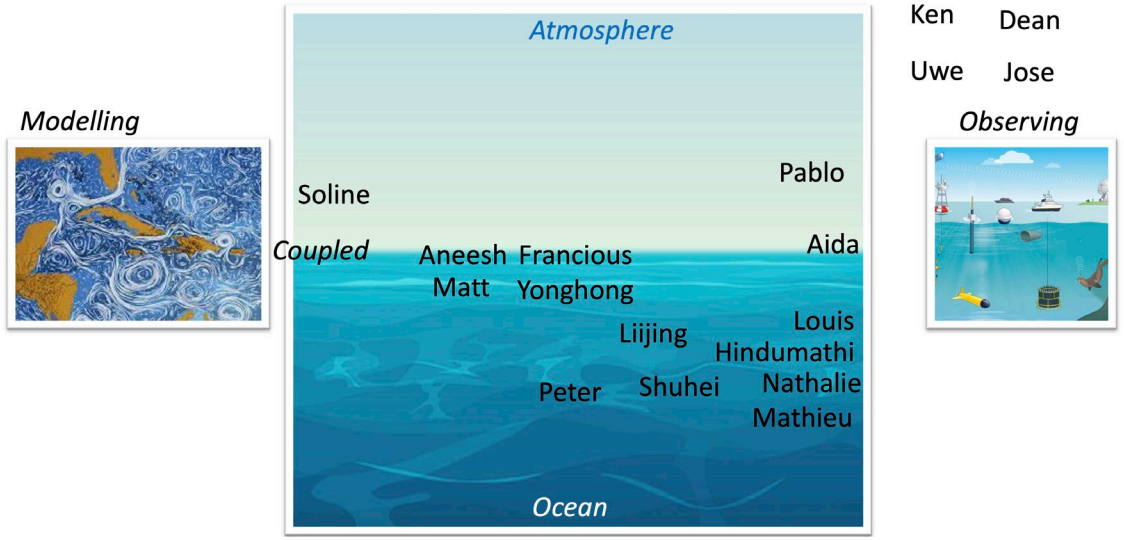
What's the strength of CLIVAR GSOP?

What's our strength?

- Mix of … data assimilation/modelling and observational researchers;
  … ocean, coupled, atmosphere-focussed researchers

What's our biggest challenge?

- Mix of … data assimilation/modelling and observational researchers;
  … ocean, coupled, atmosphere-focussed researchers



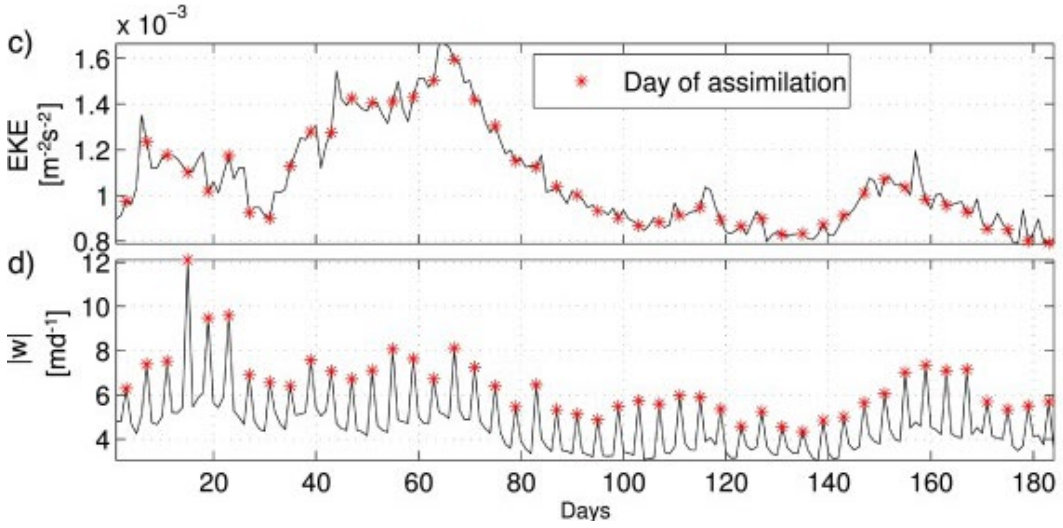
Links to Ocean Decade, Lighthouse Activities/Challenges, …

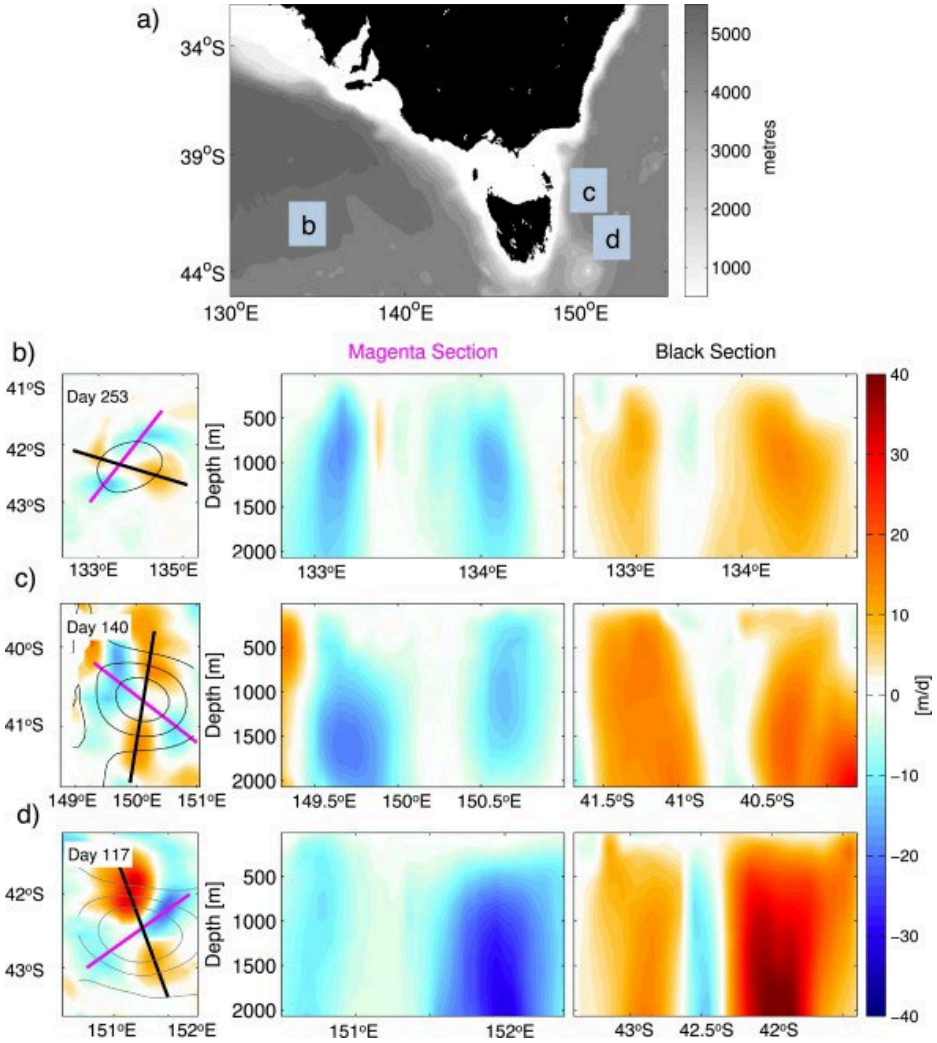
We really have no coordinated engagement from our Panel, but … individuals on our panel have strong engagement:

- Decade Programs:
  - ForeSea
  - Co-Design
  - Observing Together
  - DITTO
- Decade Projects:
  - OneArgo
  - SynObs
  - …
- WCRP Lighthouse Activities/Challenges:
  - Ocean Twin
  - Regional Sea-level Change and Coastal Impacts

How does data assimilation of observations impact dynamical balance of models? What metrics are most suitable for assessing data assimilating systems?

- *Example*: how does data assimilation impact the vertical velocities around an eddy?
- *Findings*: adjustments are unbalanced, with divergent properties?
- *Implications:* Greater attention to balanced data assimilation is warranted.





Pilo, G.S., Oke, P.R., Coleman, R., Rykova, T. and Ridgway, K., 2018. Patterns of vertical velocity induced by eddy distortion in an ocean model. *Journal of Geophysical Research: Oceans*, *123*(3), pp.2274-2292.