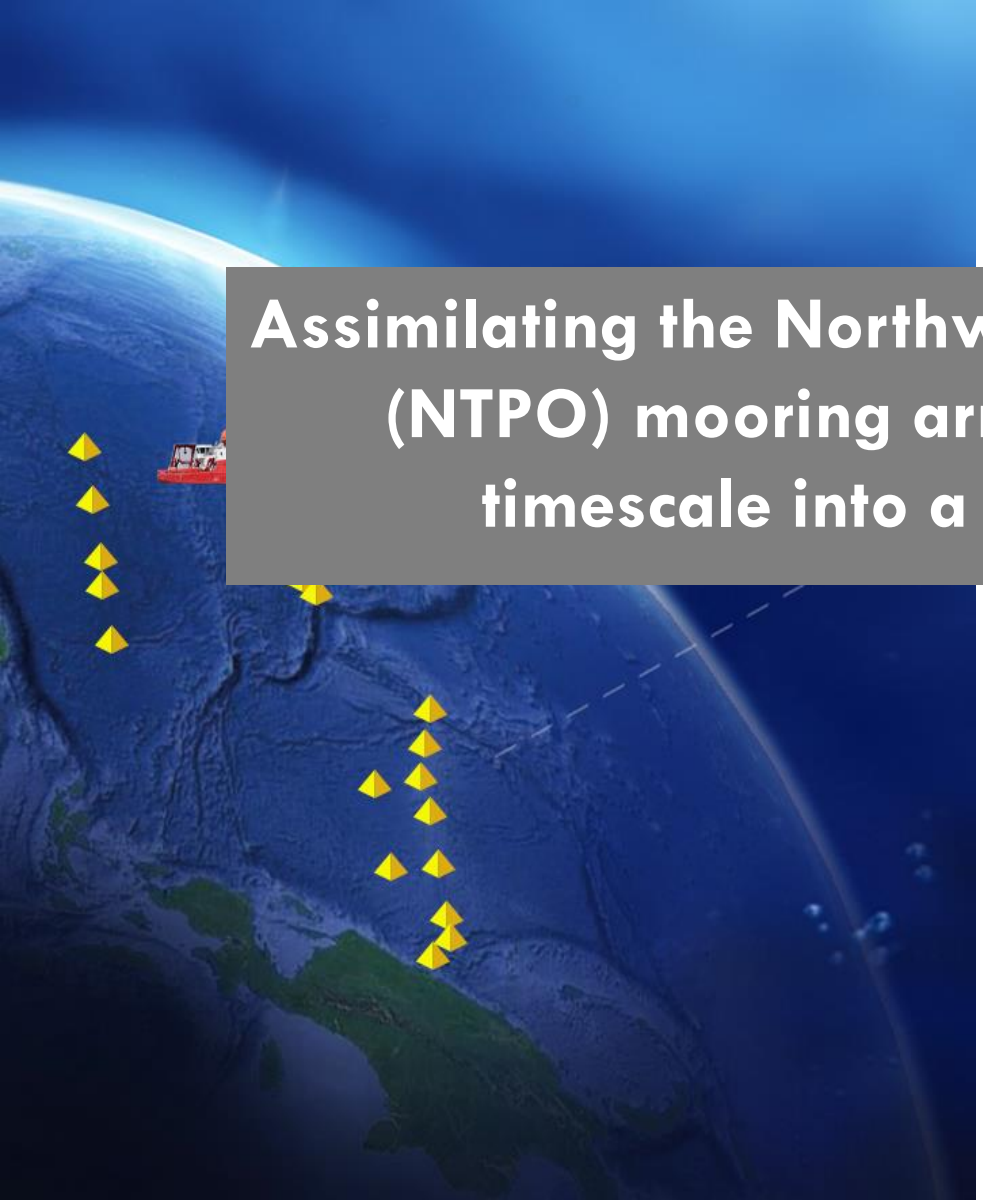

Assimilating the Northwestern Tropical Pacific Ocean (NTPO) mooring array on the low-frequency timescale into a regional ocean model

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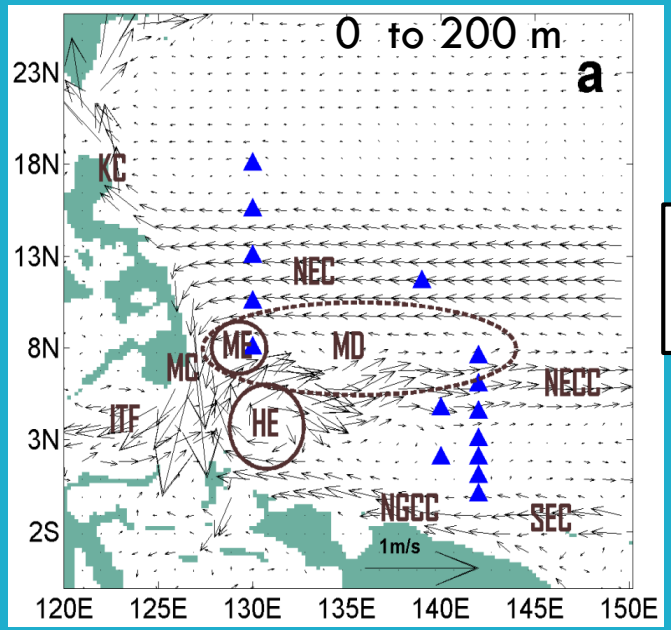
How to assimilate the moored velocity profiles into the ocean model?

The mooring observation system was established in 2013 by WPOS project.

It includes 15 moorings to observe time-serials of velocity profiles above 1000 m using ADCP.



Model: ROMS
Ass. Method: EnOI

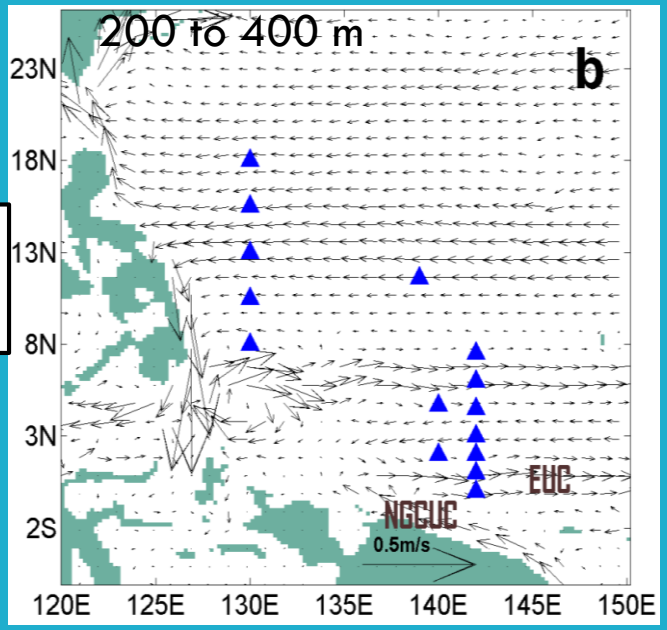


Fig. Simulated vertical-averaged circulation. Blue triangles denote the NWTPO moorings.

The character of the NWTPO current system on different timescales

There are many time scales in the velocity observed by ADCP
The unresolved time-scale signals in the model will be assimilated as a "wrong" observation.

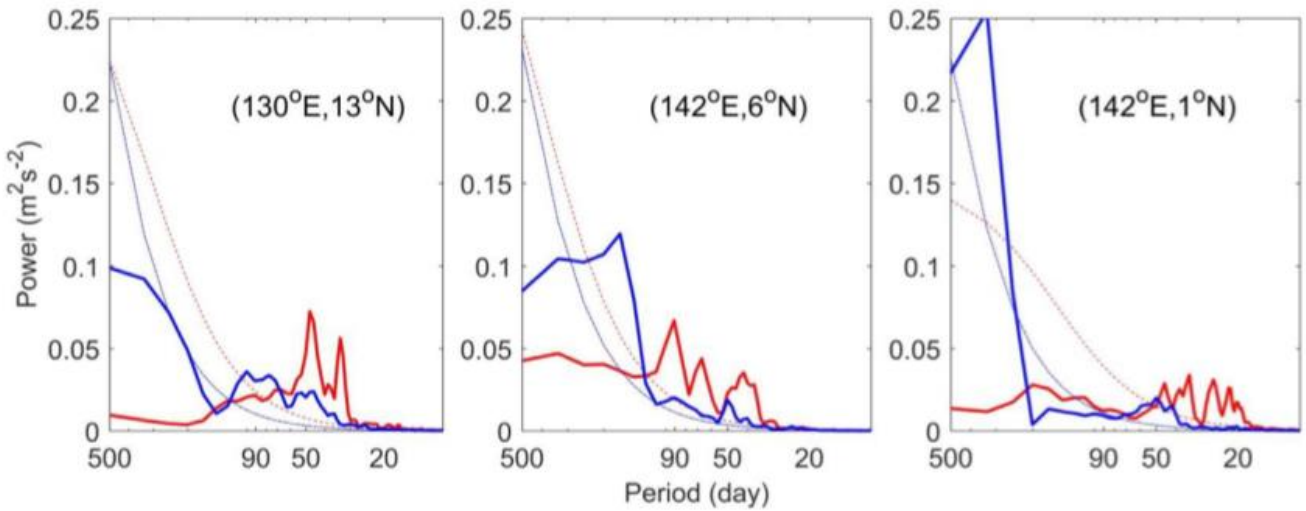


Fig. Power spectra of 0–500 m averaged zonal (blue) and meridional (red) velocity (unit: m^2/s^2) at three mooring sites

V : intra-seasonal variability

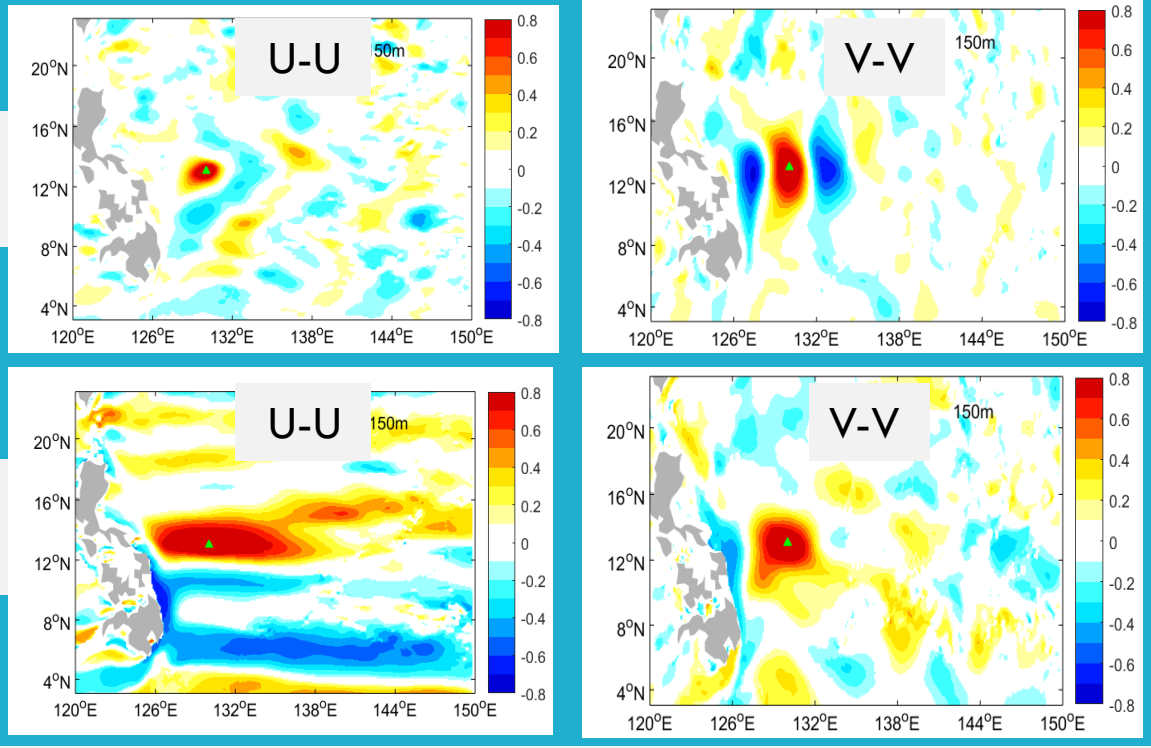
U : not only intra-seasonal variability, but also low-frequency variability

The character of the ensemble on different timescales

The zonal and meridional components of velocity have different spatial scale;
Separated multi-scales might be a good scheme for velocity assimilation.

Intra-seasonal ensemble

Low-frequency ensemble



Different spatial scale even in same time scales

Ensemble-based correlations between the U(V) at (130°E, 13°N) and U(V) in its surrounding area

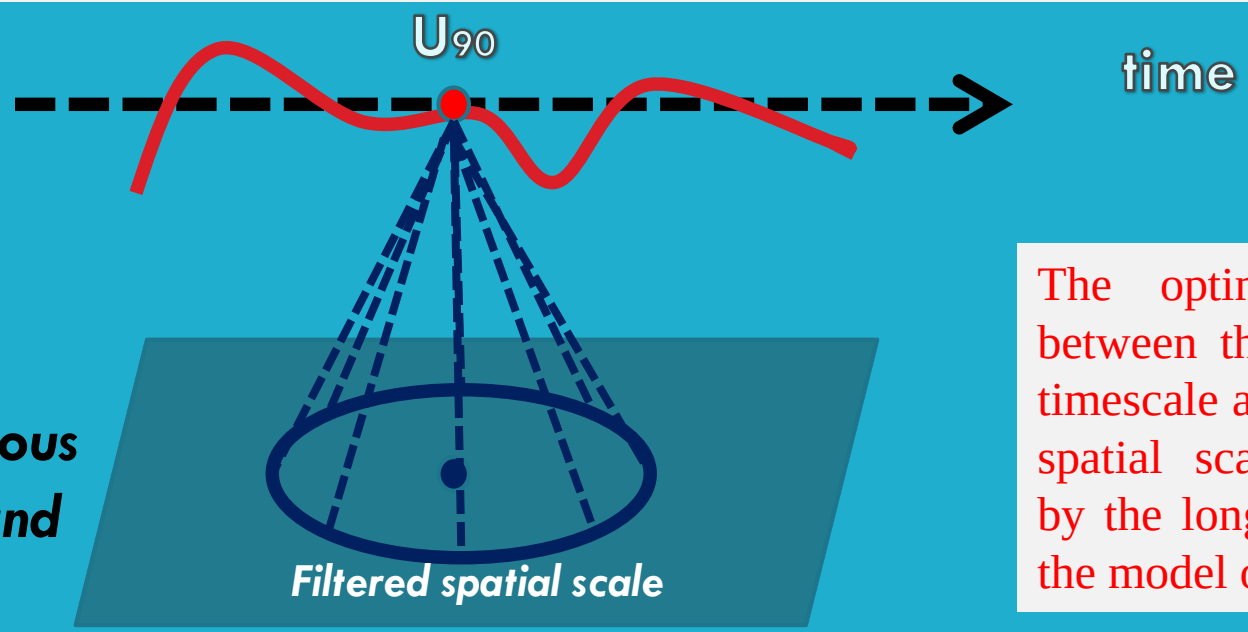
90-day-low-pass-filter:

Both BEC and forcasting field need to be low frequency.

The area-averaged field is used to match the low-frequency time scale.

$$\varphi^a = \varphi^f + \alpha(\mathbf{C} \circ \mathbf{P}_{low})\mathbf{H}^T(\alpha\mathbf{H}(\mathbf{C} \circ \mathbf{P}_{low})\mathbf{H}^T + \mathbf{R})^{-1}(\mathbf{d}_{low} - \mathbf{H}(\varphi^f_{low}))$$

The low background fields are derived from the filtered in horizontal space:



The optimal relationship between the low-frequency timescale and the horizontal spatial scale is calculated by the long-term data from the model outputs

The zonal current fields can be reconstructed reasonably

Both the position and intensity of NECC, SEC and EUC are corrected after assimilating the low frequency velocity.

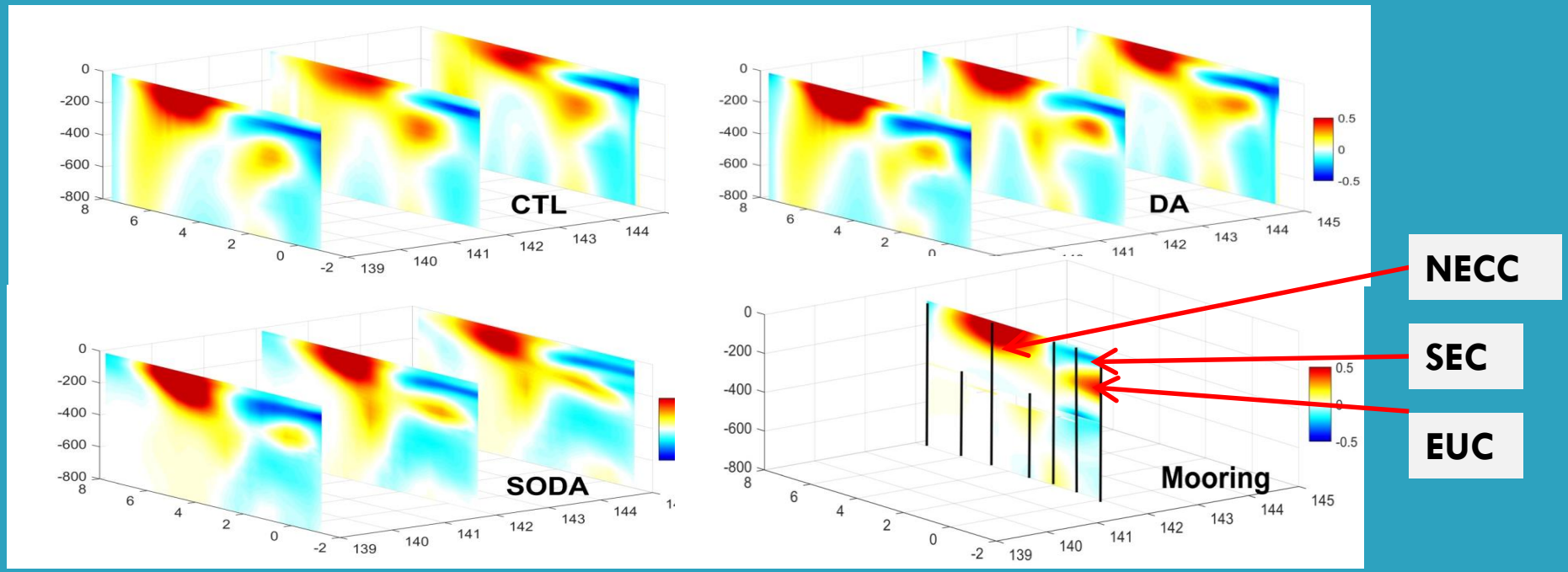


Fig. Mean distributions of zonal current (U) along 142°E during October 2014 – July 2015 .

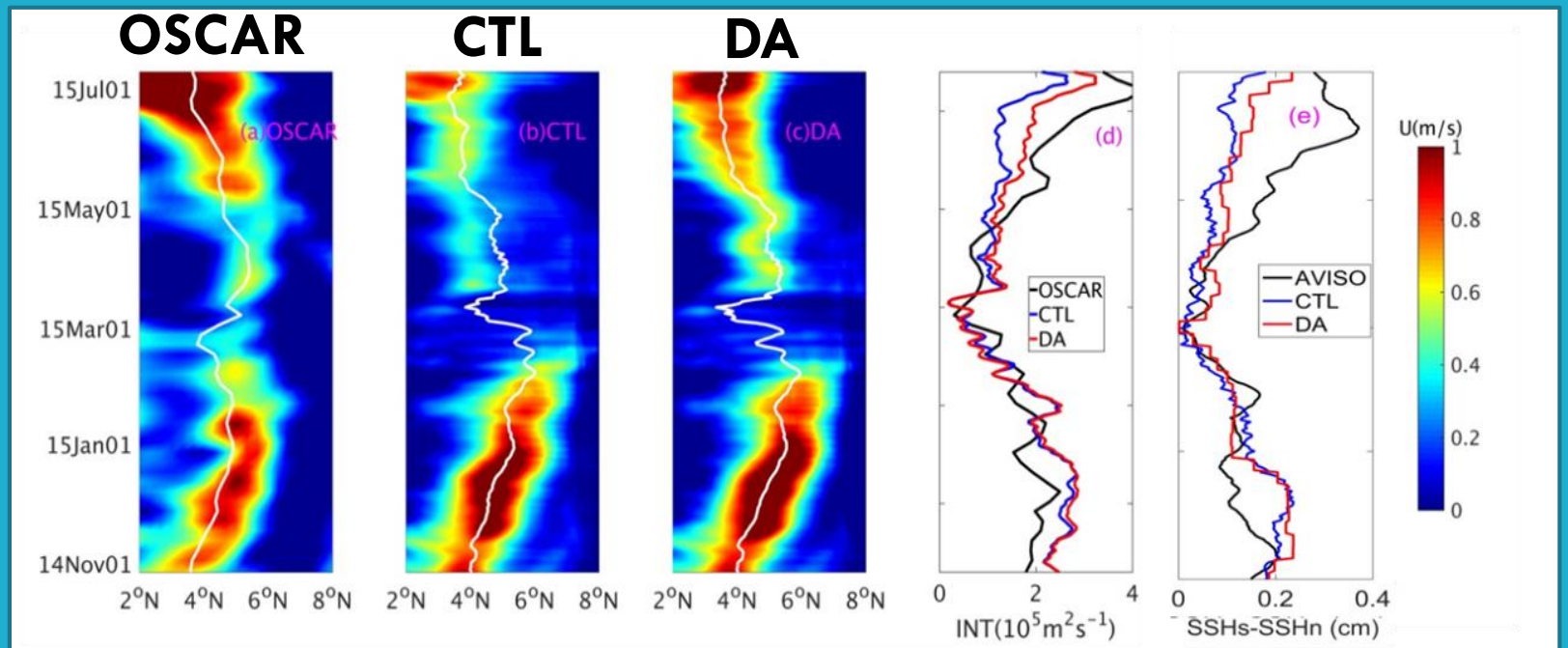
Significant improvements in the NWTPO current system

Assimilating the low frequency velocity can improve the handcast of the axis and intensity of NECC.

time series of NECC averaged over 0–30 m and the NECC axis

time series of NECC intensity

time series of SSH gradient



Conclusions

- A conversion from area-average to low-frequency timescale is used to obtain the low frequency background fields for assimilating the low frequency NWTPO mooring array observation.
- Significant improvements are achieved for the simulation of low-frequency variations of NWTPO current system