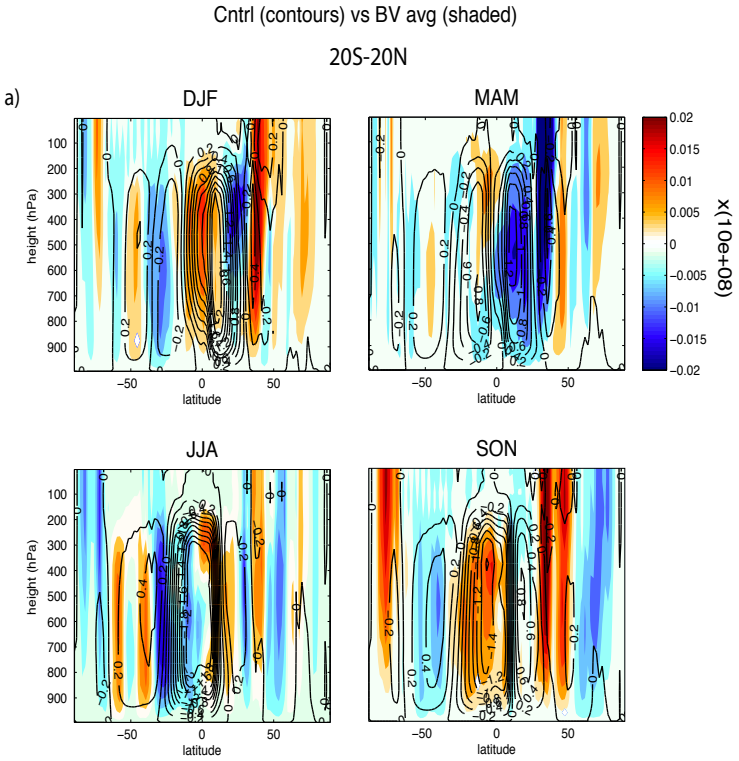
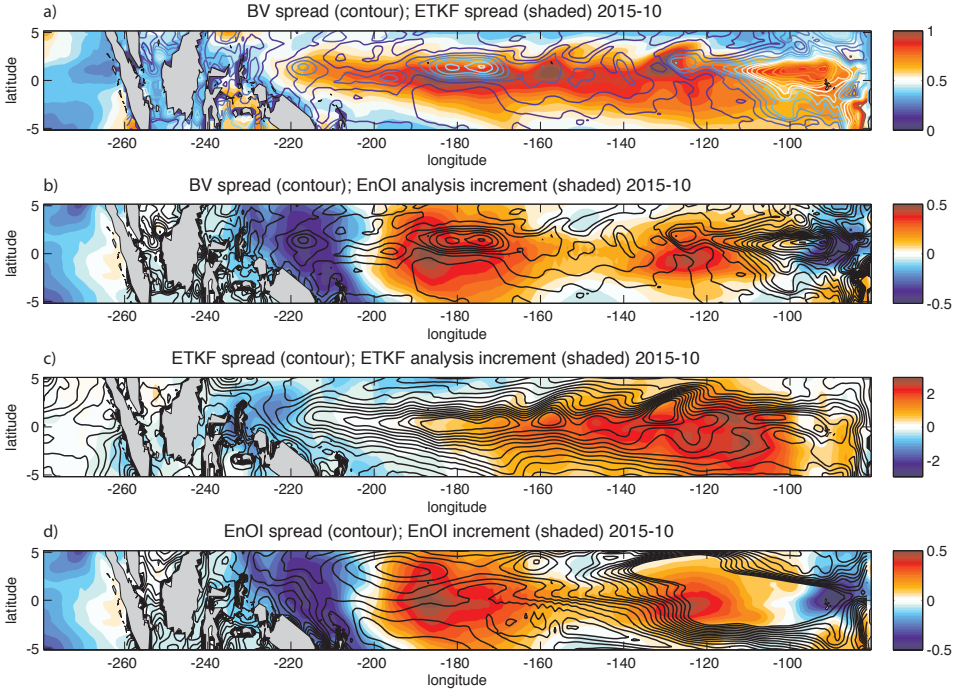
Tropics-Extra-tropics

Coherent tropospheric response to modulation of tropical convection



ETKF versus BVs case study 2016 El Nino

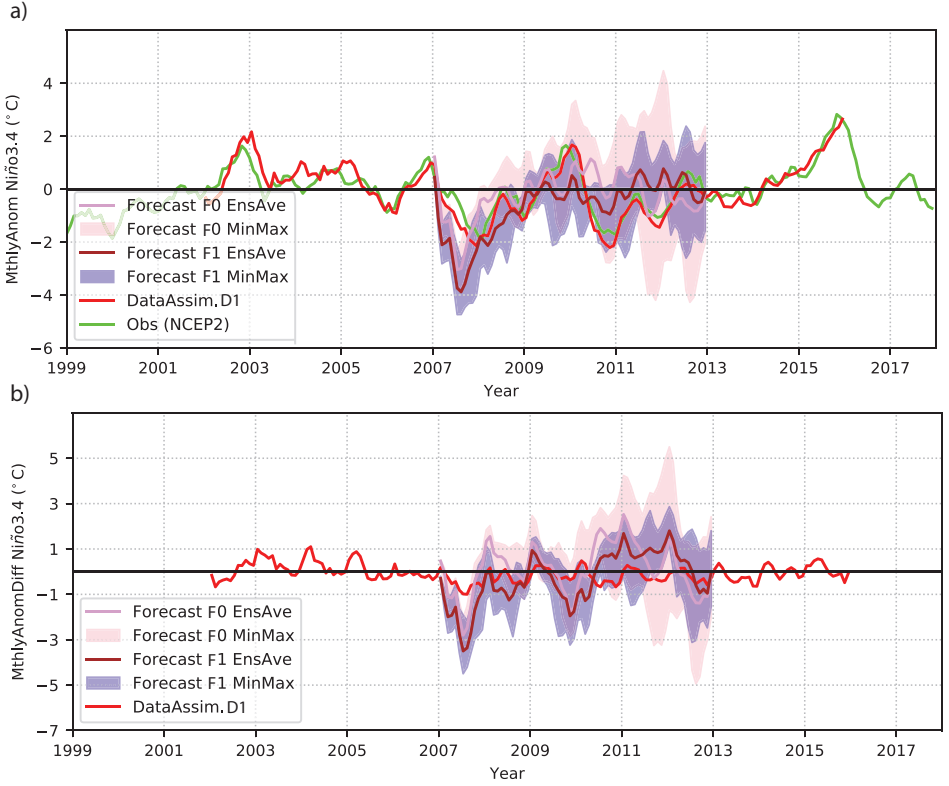
- Ensemble spread versus analysis increment during build up to 2016 El Niño.
- BVs add similar flow dependent structures to ETKF background covariances.



ENSO Prediction case study

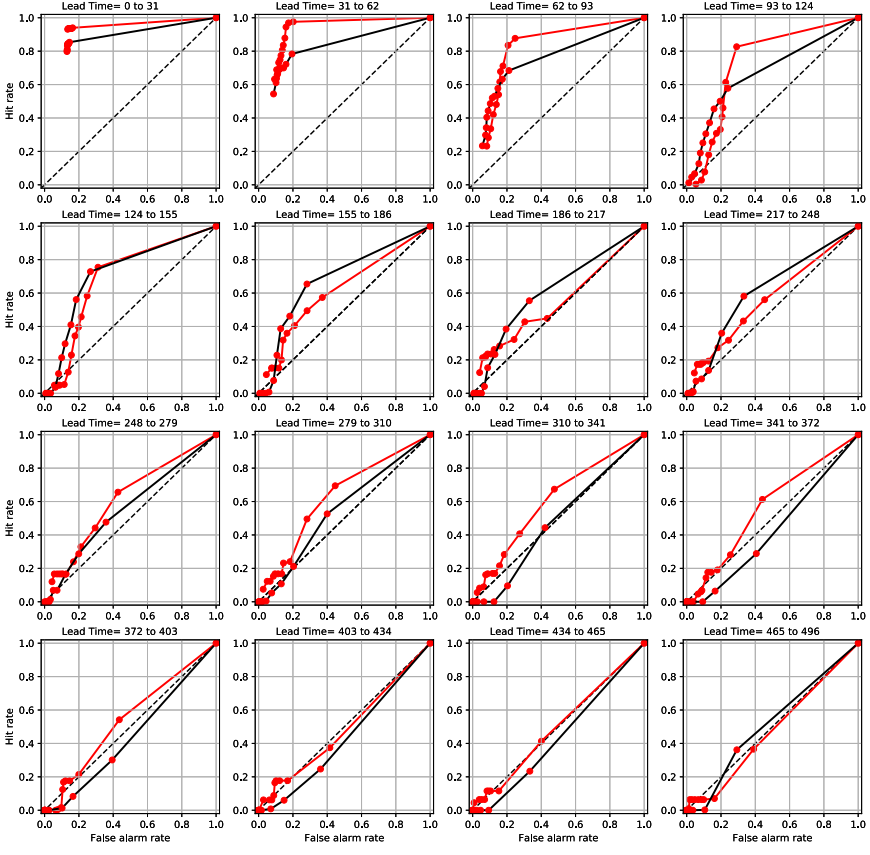
- Ensemble forecasts of NINO3.4 beginning January 2007 comparing isosurface BVs (F1) to BVs generated between 20°N-20°N renormalised to 1% of the background RMSE (F0).
- Spread reduced in isosurface ensemble due to reduced error growth in regions unrelated to the thermocline.
- D1 is the reanalysed state estimates as compared to NCEP reanalysis v2.

Note: no SST perturbations are used in isosurface BVs - predictability comes from thermocline perturbations)



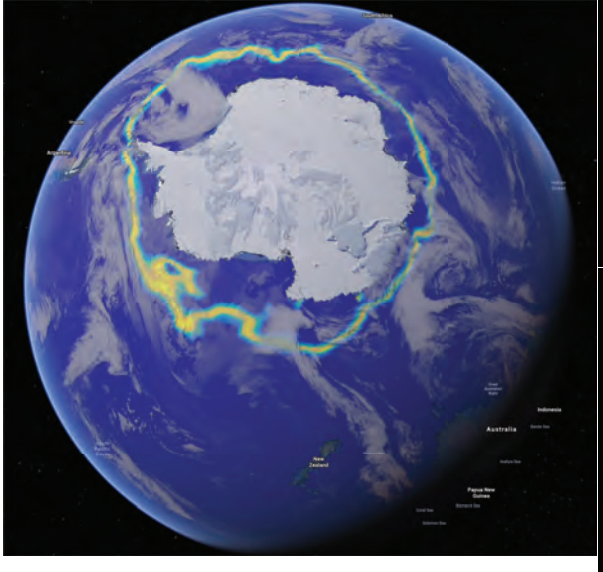
ENSO Prediction: ROC curves for NINO4

ROC curves of the F0 20°S-20°N (black) and F1 isosurface (red) hindcasts (3960 model years) for NINO4 calculated over a 15 year period (2 year lead-times, 11 members each starting every month over the period 2003 to July 2017)

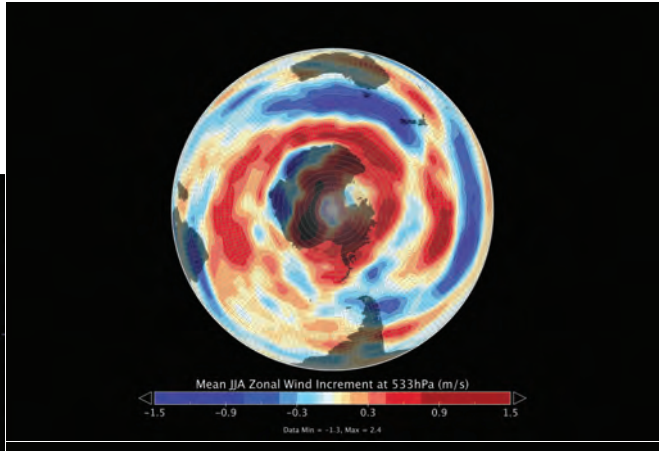


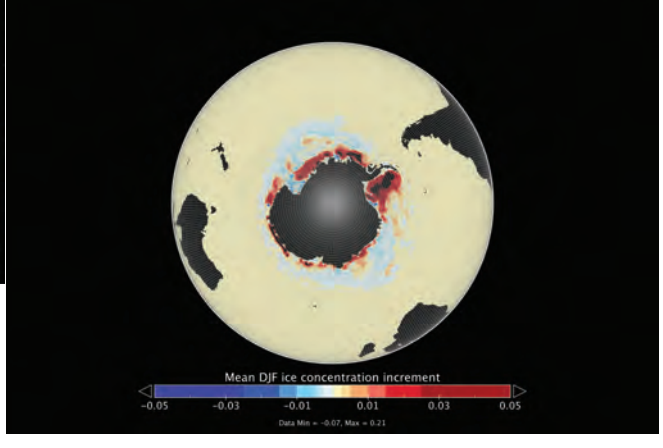
Current work

- Assimilation of high resolution JRA-55 reanalysis data (hybrid sigma-pressure levels)
- Assimilation of OSISAF sea-ice concentration



ensemble spread 2014-06-06





Current work

Reanalysis and decadal prediction

- 1988-2018 Coupled reanalysis (96 member ETKF)
- 1960 onwards Hindcast / forecast - 5 year leadtime initiated every season - 30 member ETKF + multiscale breeding

Model configurations and development

- CM2.1 (2 degree atmosphere, 1 degree ocean (MOM5)
- CM2.5 (50km atmosphere (AM2/LM2, 1/4 degree ocean (MOM5))
- CMFLOR (50km atmosphere, 1 degree ocean)
- ACCESS ESM1.5 comparison studies (future model for decadal MIPS)
- KPP ocean surface boundary layer parameterization (CVMix Griffies et al 2015)

Conclusion

- A properly observed ocean is required to constrain the slow climate ”manifold”
- For multi-year forecasting we do not try to track the fast convective or synoptic scales of the atmosphere but rather excite the slow predictable modes coupled to the ocean.
- Optimal perturbations for state estimation are not necessarily optimal for forecasting a given climate mode at a given lead time and should be augmented or replaced by perturbations specific to the phenomena of interest.
- Here we show that it is possible on seasonal timescales to modulate the mid-troposphere jets via targeted perturbations to the tropical thermocline however, how longer timescale memory residing in the subtropical oceans affects the atmosphere and predictability is still unclear.
- The CAFE system is being developed as a tool to target and understand the mechanisms by which coherent variability determines predictability in the climate system in the near term.

References

- O'Kane, T.J., P.A. Sandery, D.P. Monselesan, P. Sakov, M.A. Chamberlain, R. Matear, & M. Collier (2018) ”Coupled data assimilation and ensemble initialization in CAFE with application to near term ENSO prediction.” (In review)

Thank You

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