UNCERTAINTY IN DETECTING HISTORICAL OCEAN CLIMATE VARIABILITY

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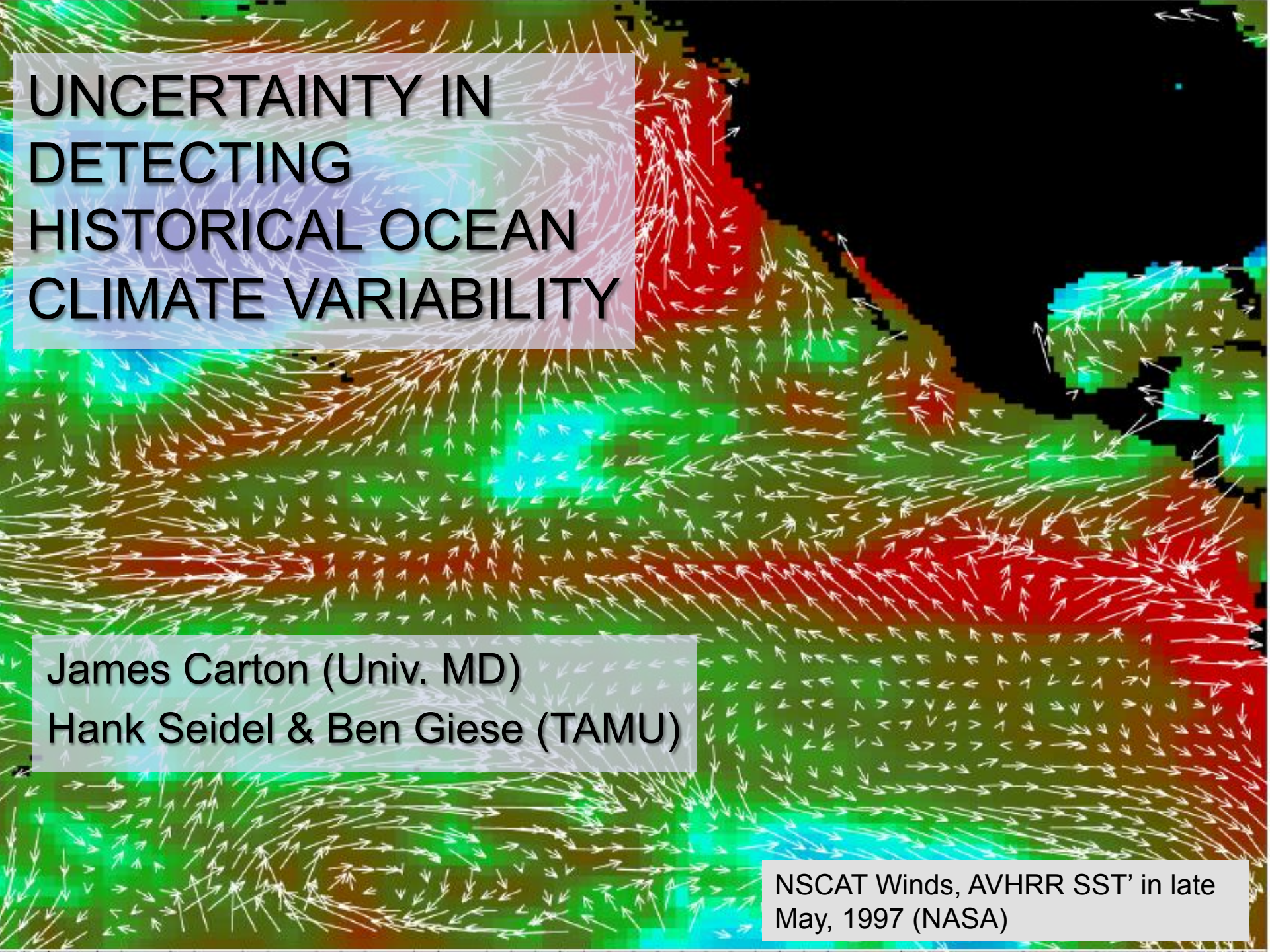


NSCAT Winds, AVHRR SST' in late May, 1997 (NASA)

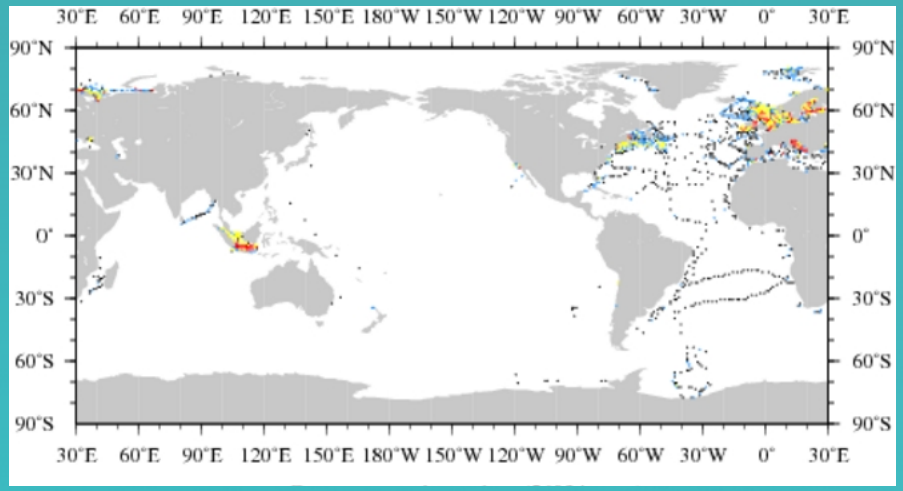
Summary

Present a plan for evaluating the potential of historical ocean reanalysis

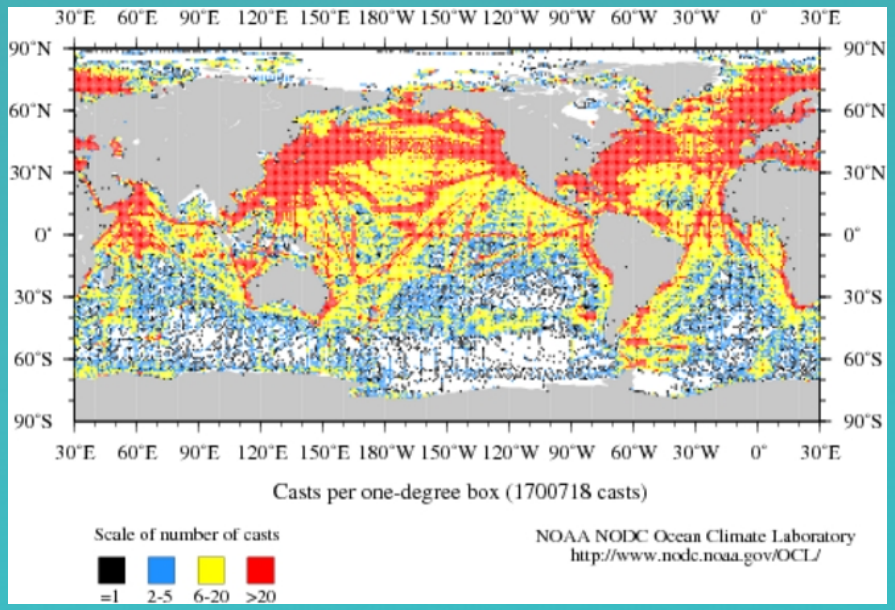
Provide an example: could we have resolved the climate anomalies of the late 1990s if they had occurred earlier in the 20th century?

Sampling Problem

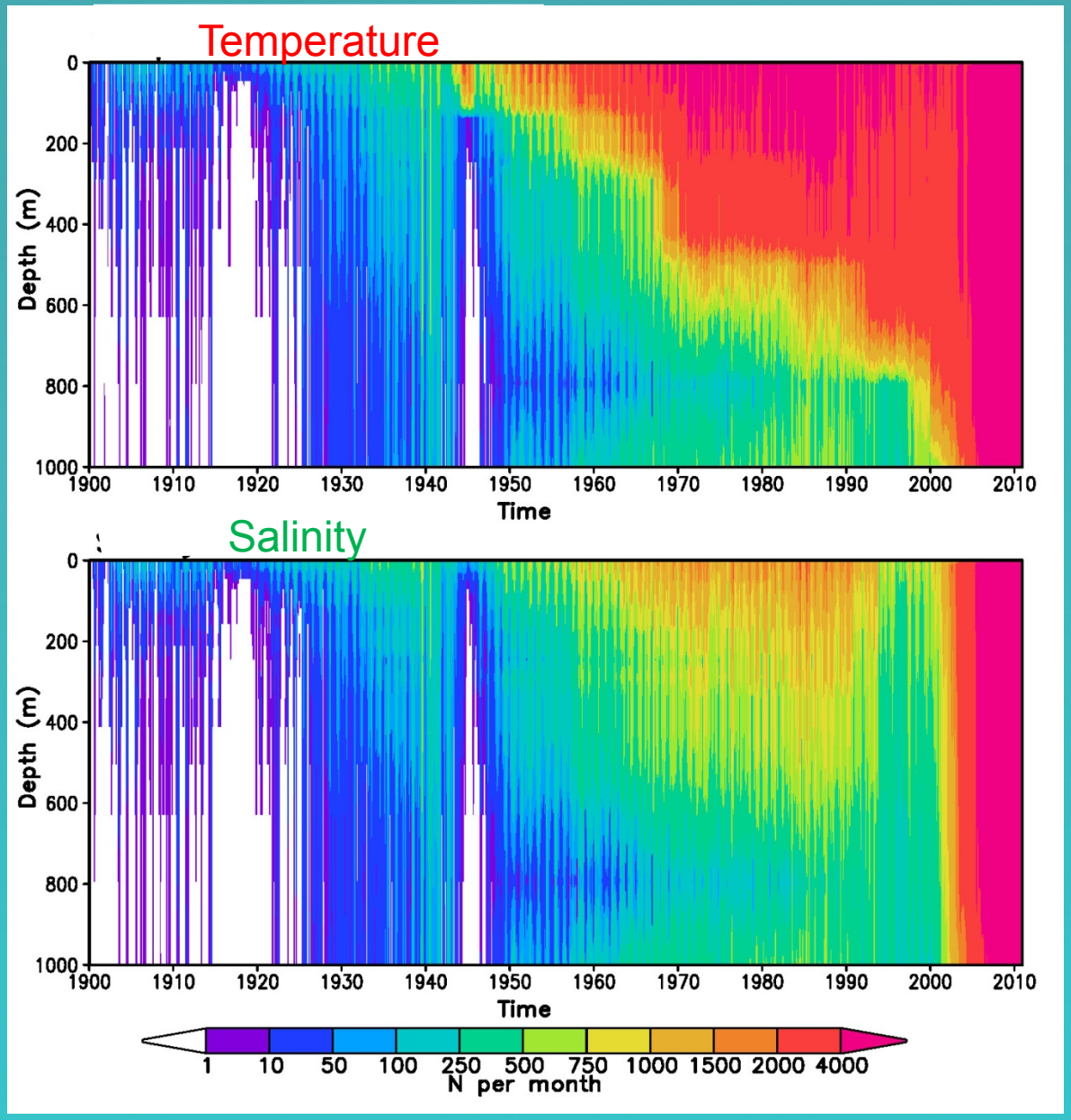
1910-1919 (56,034 profiles)



1980-1989 (1.7M profiles)

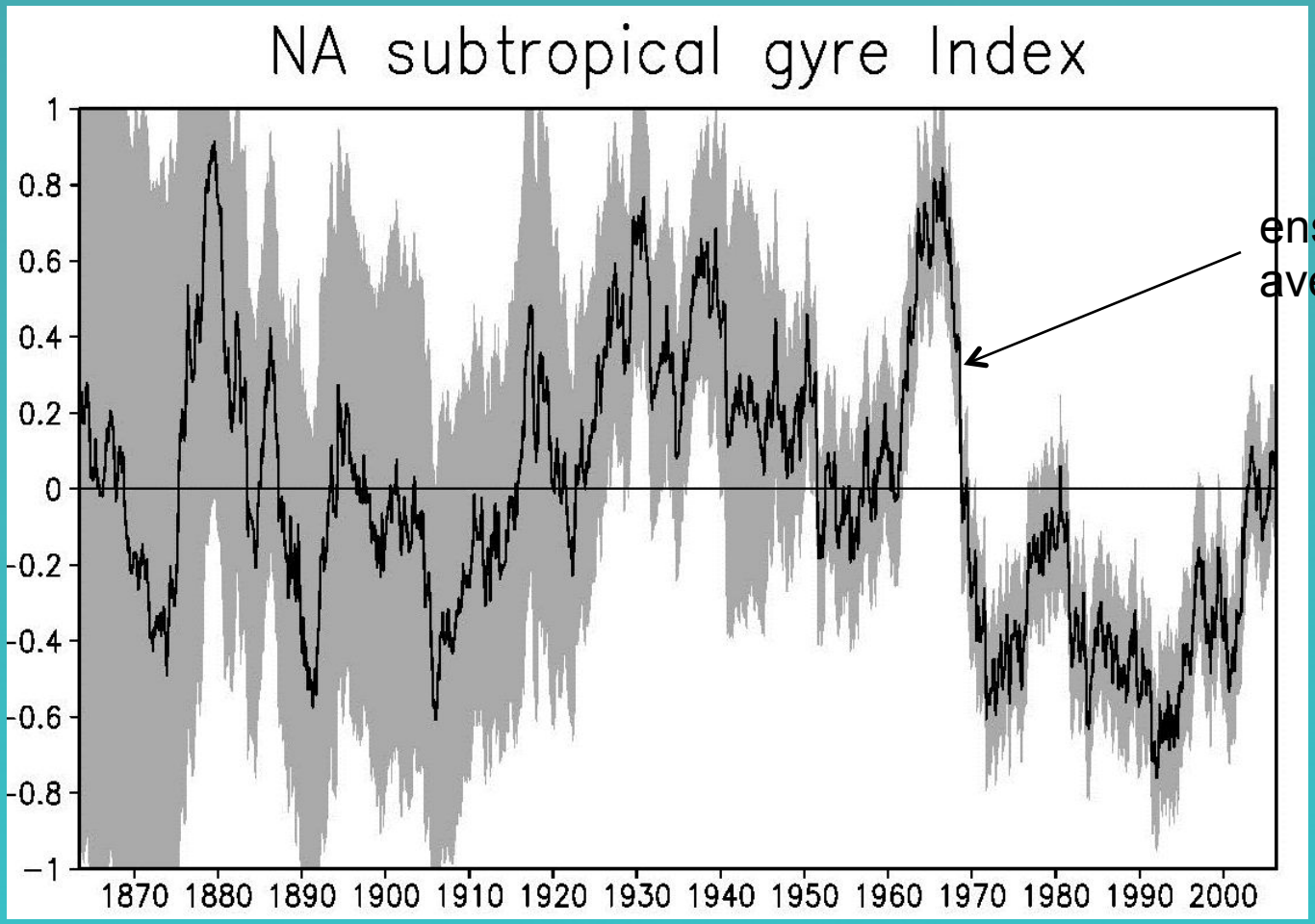


Gradual deepening of the historical profile data



Data from WODB-2009
(total: 7×10^6)

20CRv2 wind stress curl anomaly in the subtropical North Atlantic (20-40N)



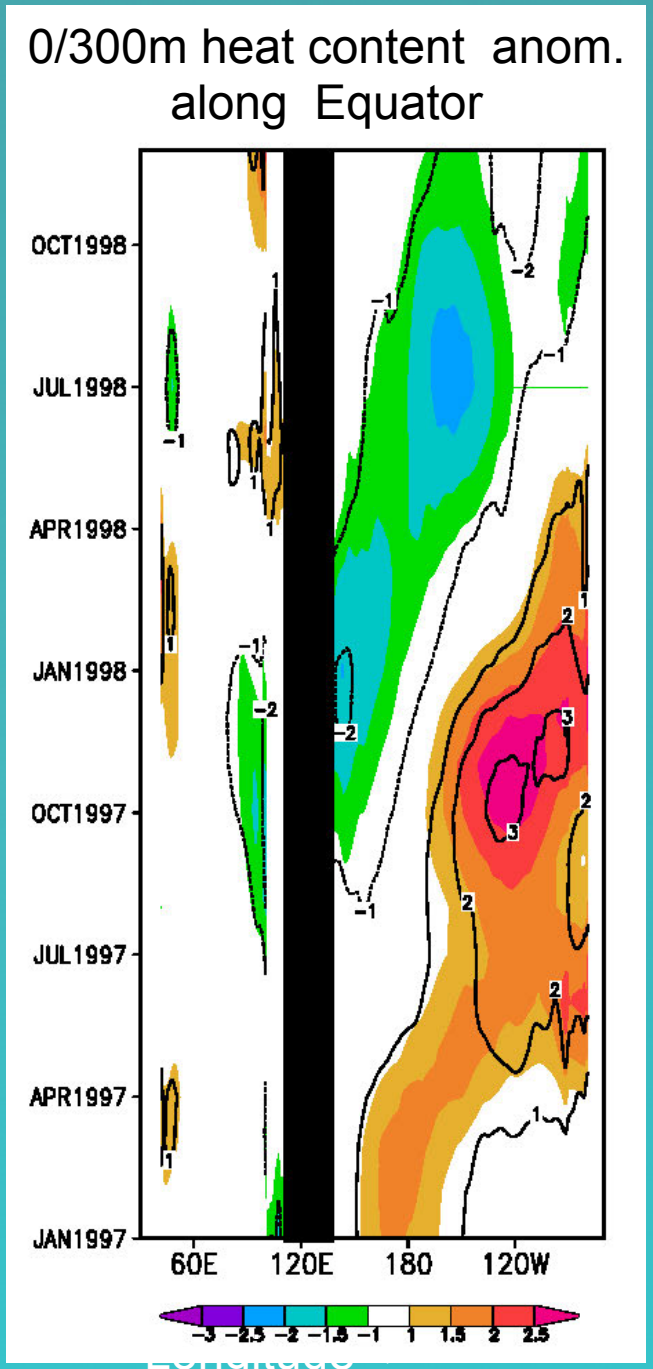
Plan

1. Carry out simulation (*Nature Run*) forced by 20CRv2 ensemble mean surface forcing
2. Sample *Nature Run* at the locations, depths, times, variables that actually exist in the NODC and ICOADS archives.
3. Shift the dates of observations to the 1990s (1927->1997; 1947->1997; 1967->1997, etc)
4. Assimilate observations into SODA, and use 'degraded' surface forcing
    a. Climatological monthly forcing
    b. Single 20CRv2 ensemble member

Nature Run

(and a comparison to observations)

A simulation of the circulation of the global ocean using a 0.4°x0.25° OGCM through 1998 driven by 20CRv2 monthly surface fluxes.



Colors: Nature Run
Contours: SODA reanalysis

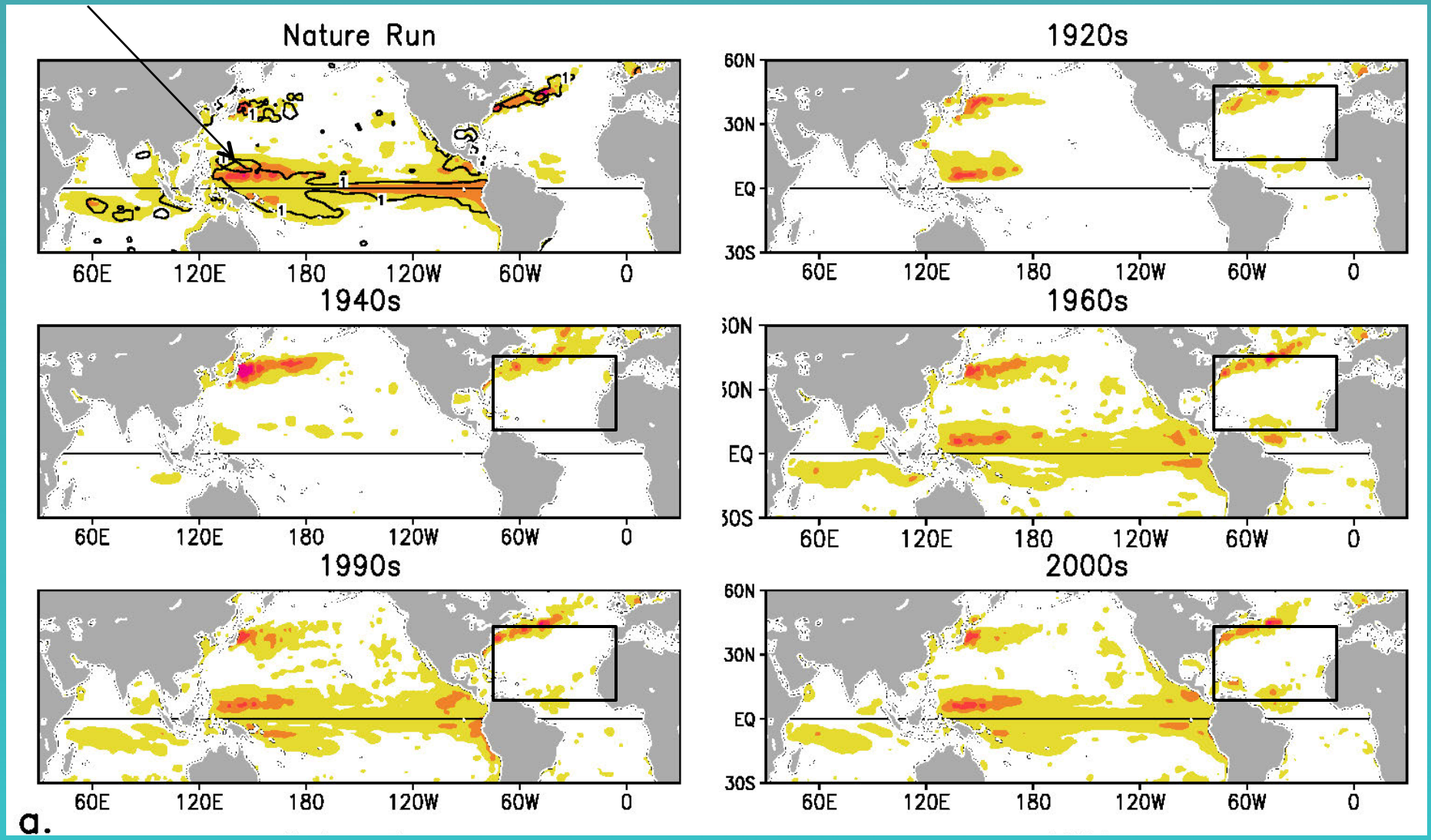
5 experiments:

1920s
1940s
1960s
1980s
2000s

RMS HC' (0-300m) (1995-1999)

clim forcing

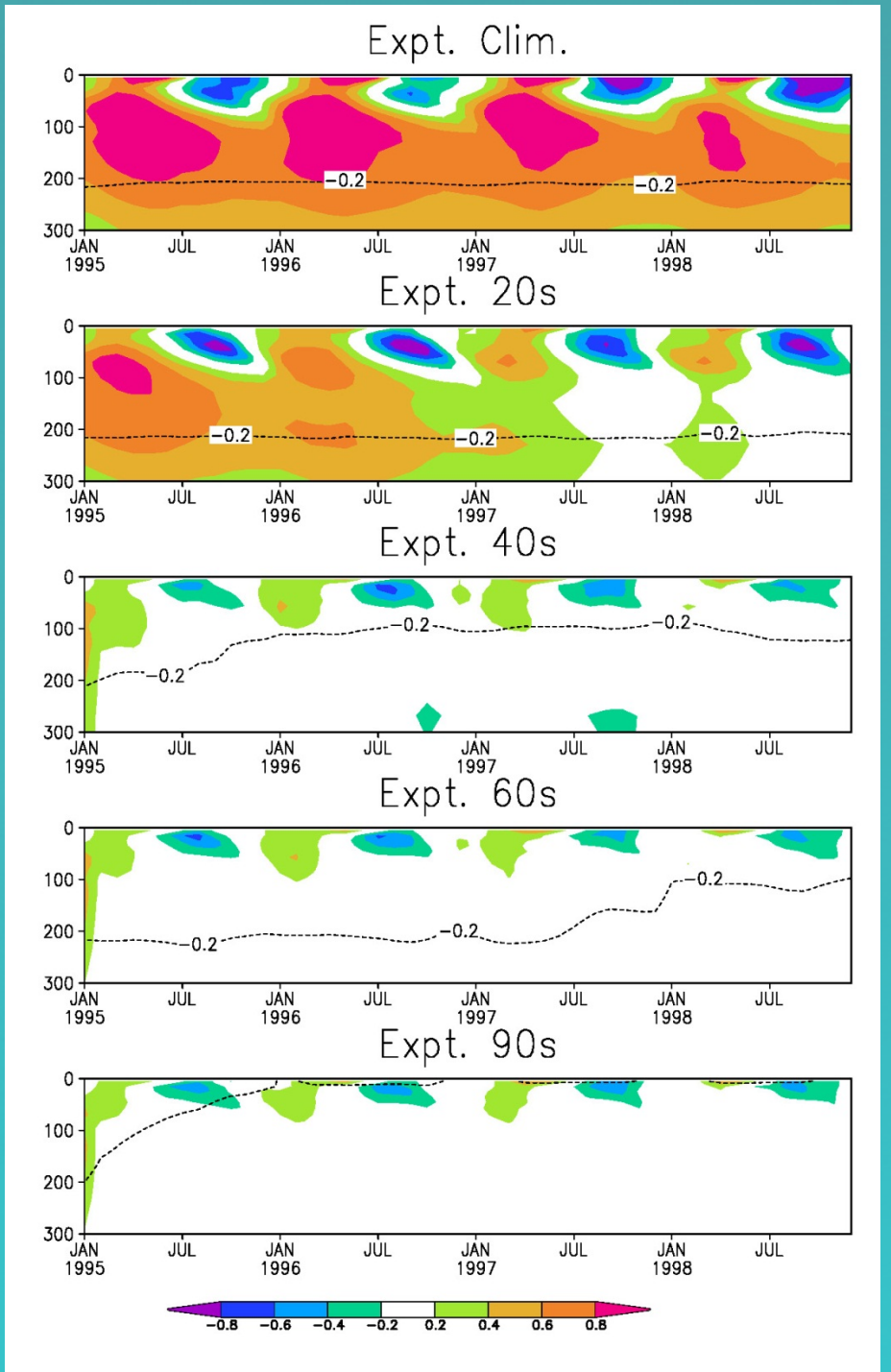
Observed



North Atlantic Temp/Sal error

(with depth and time)

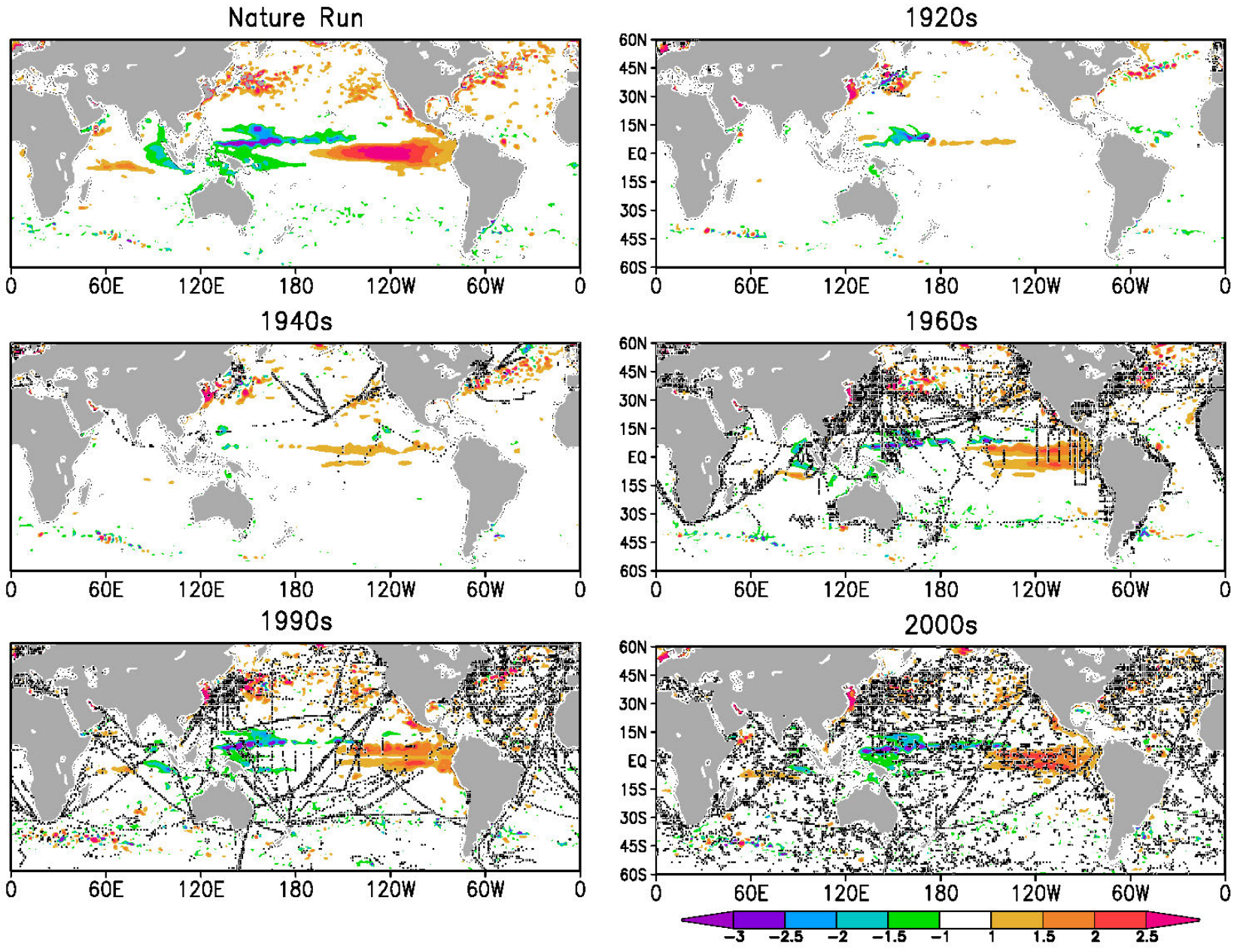
Experiments



clim forcing

El Nino: HC' Sept.-Nov., 1997

clim forcing



How good was the 1990s observing system?

Ensemble winds

El Nino

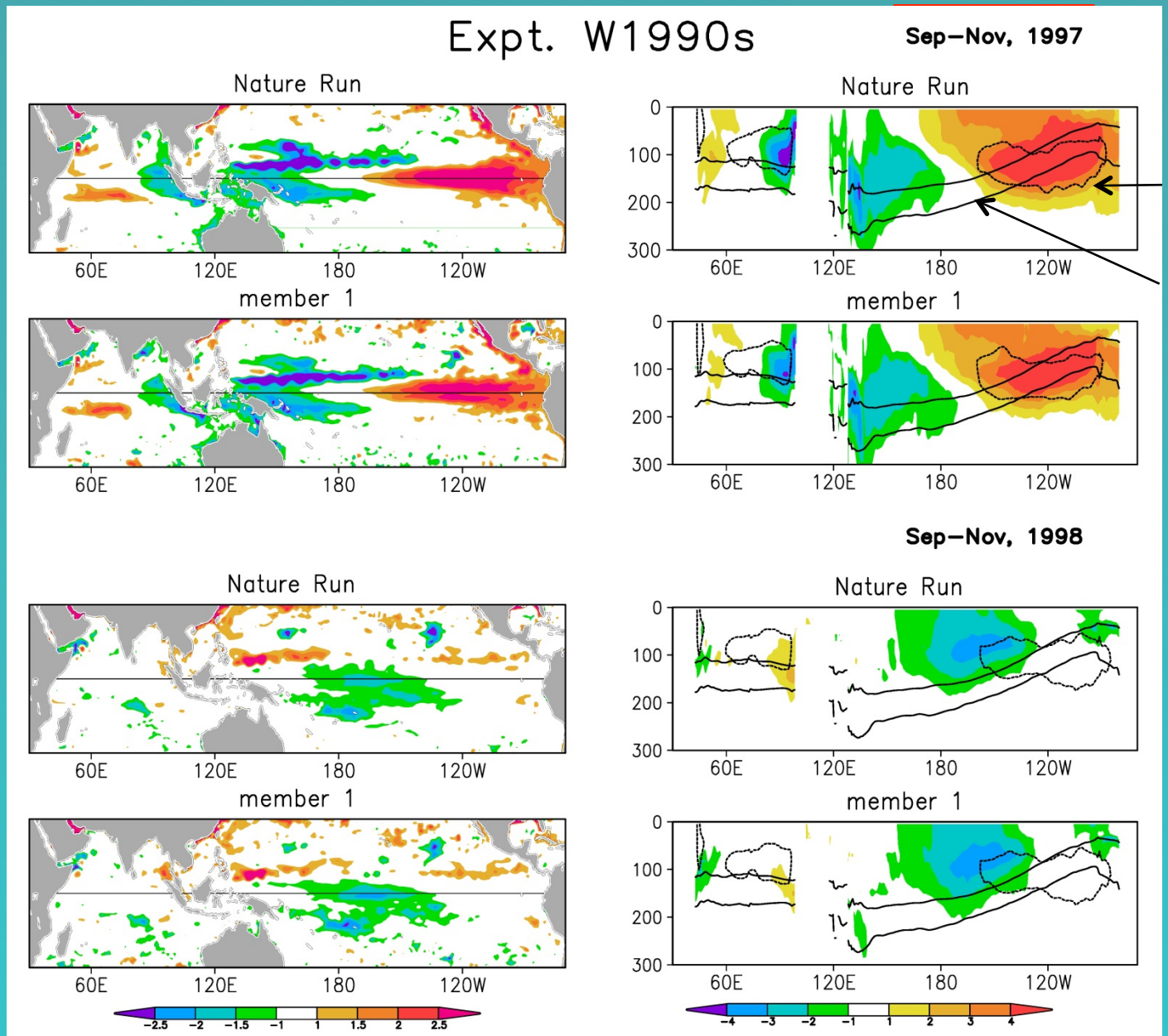
Truth

Our Estimate

La Nina

Truth

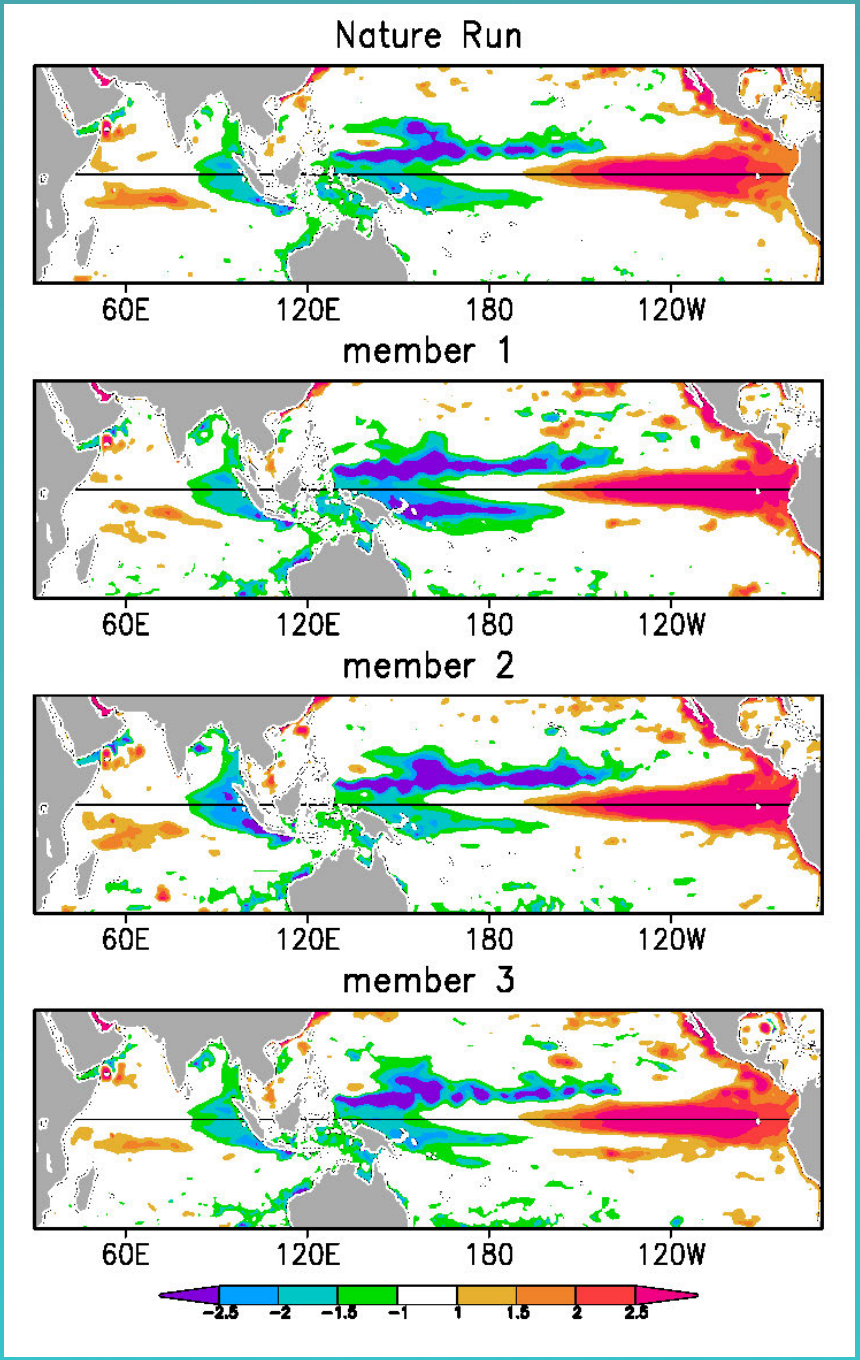
Our Estimate



Ensemble winds

1920s experiment

HC' Sept.-Nov., 1997



Summary

- The plan for evaluating the potential of historical ocean reanalysis
  - Made possible by ensemble atmospheric reanalysis
  - Improved assimilation methods, e.g. coupled assimilation, may offer additional potential
- Could we have resolved the climate anomalies of the late 1990s if they had occurred earlier in the 20th century?
  - prior to the ~1960s the historical observing network alone provided limited information.
  - 20Crv2 winds and fluxes dramatically improves our estimates prior to the 1940s (however, 20CRv2 uncertainty is likely underestimated in tropics)

Carton, Seidel, and Giese (JGR, Feb 2012)