

TAO/TRITON Array and NCEP-GFDL Project on TAO Observing System Experiments

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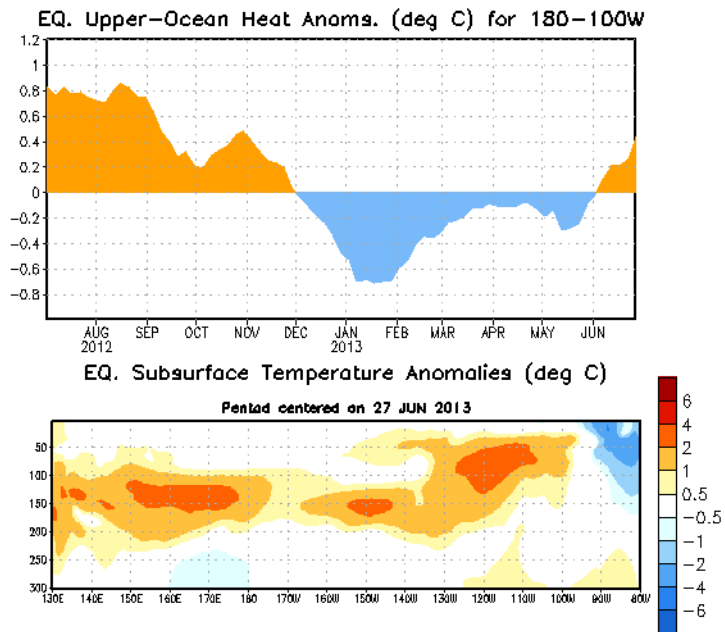
GFDL Participants: Gabriel Vecchi, Xiaosong Yang

U.S. CLIVAR Summit, Annapolis, Maryland, July 9-11, 2013

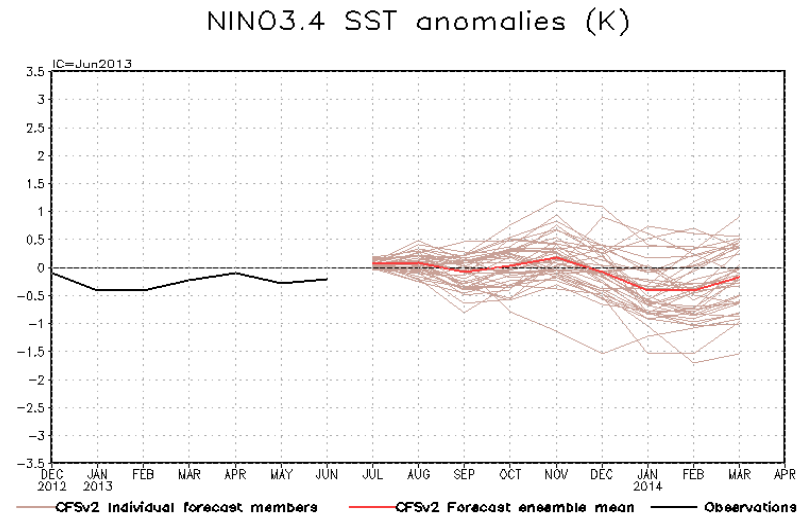
TAO/TRITON: Cornerstone of ENSO Observing System

- Real time ENSO monitoring and prediction
- Ocean initialization for seasonal predictions
 - Behringer et al. 1998; Alves et al. 2003; Balmaseda et al. 2007; Balmaseda and Anderson 2009; Stockdale et al. 2011; Xue et al. 2013

ENSO Diagnostic Discussion



CFSv2 NINO3.4 Forecast

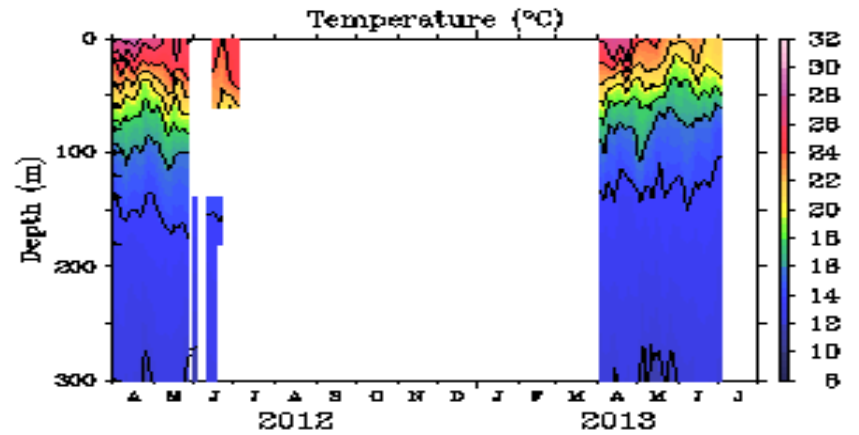


Status of TAO/TRITON Array

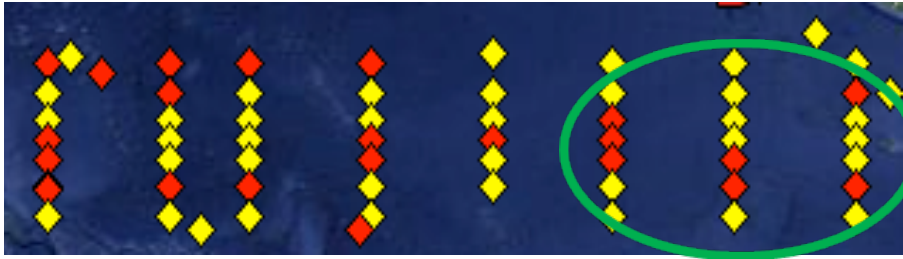
Beginning of Feb 2013



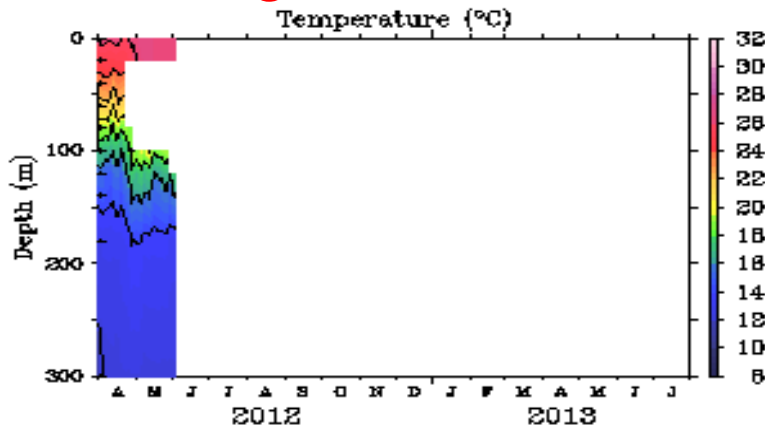
95W, 0N
Missing Jun 12 - Mar 13



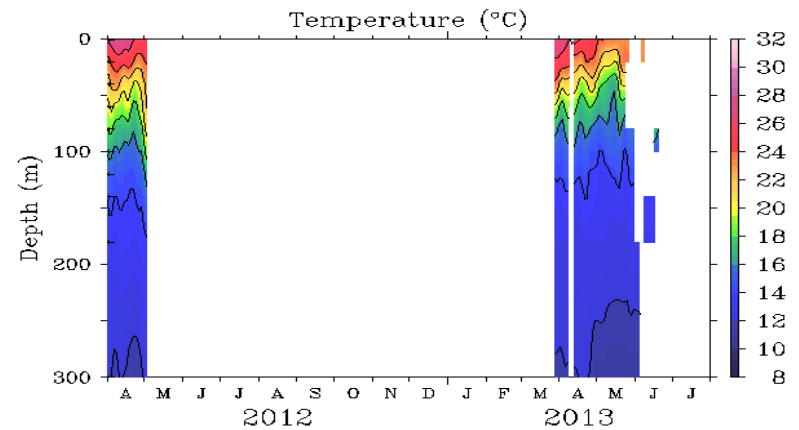
Beginning of July 2013



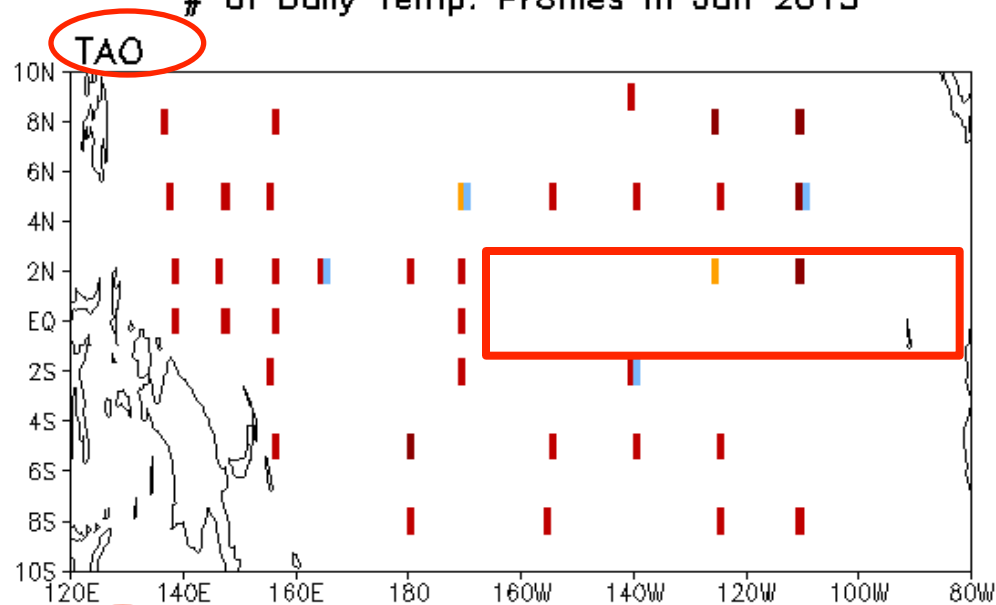
125W, 0N
Missing Jun 12 – Jun 13



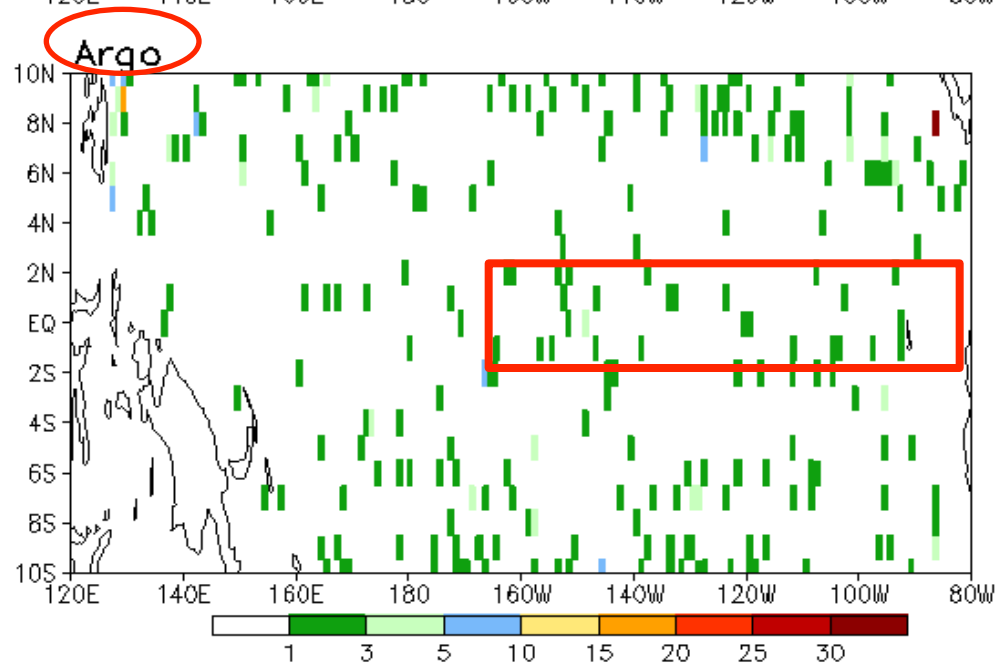
110W, 0N
Missing May 12 – Mar 13



of Daily Temp. Profiles in Jan 2013

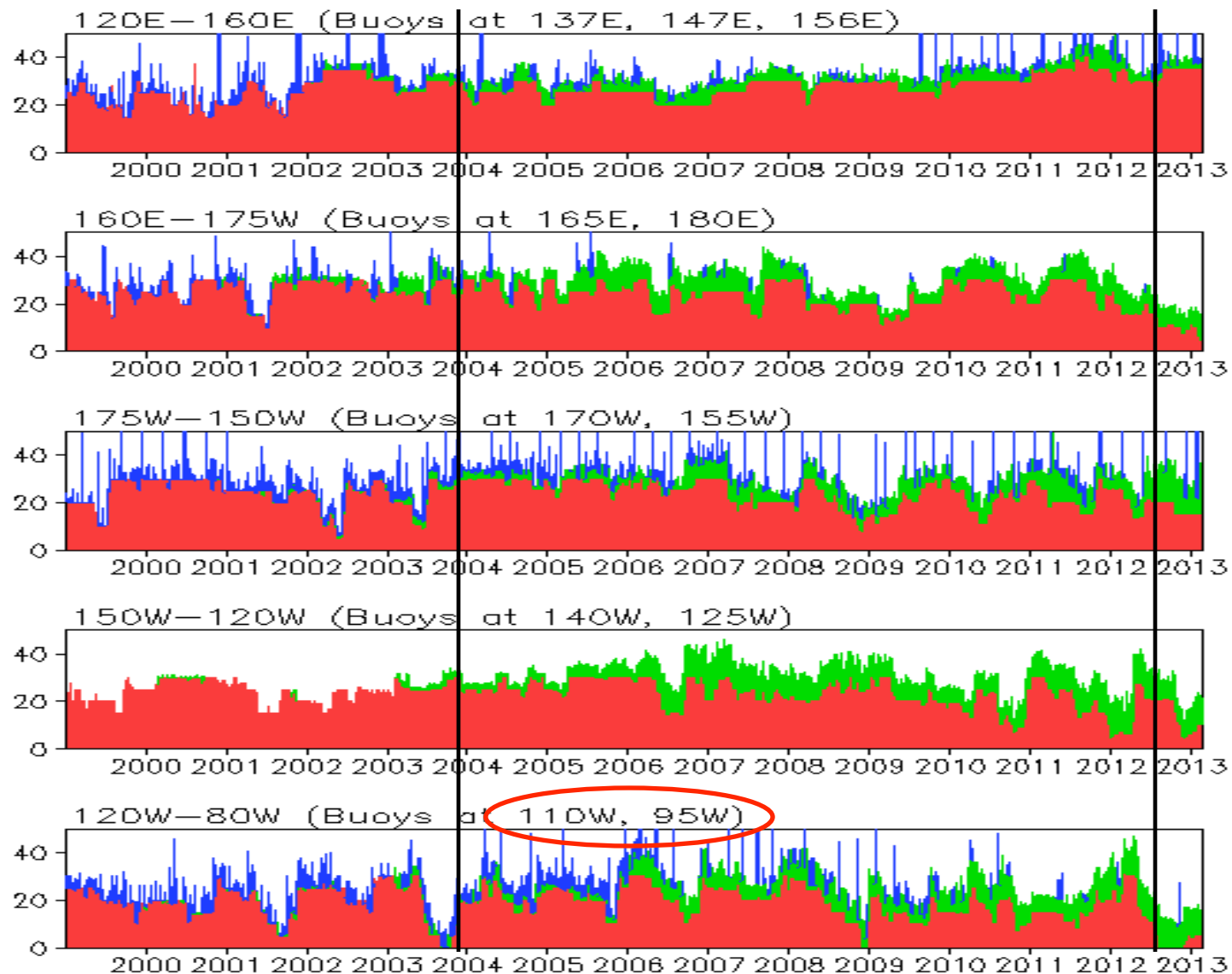


30 profiles



< 3 profiles

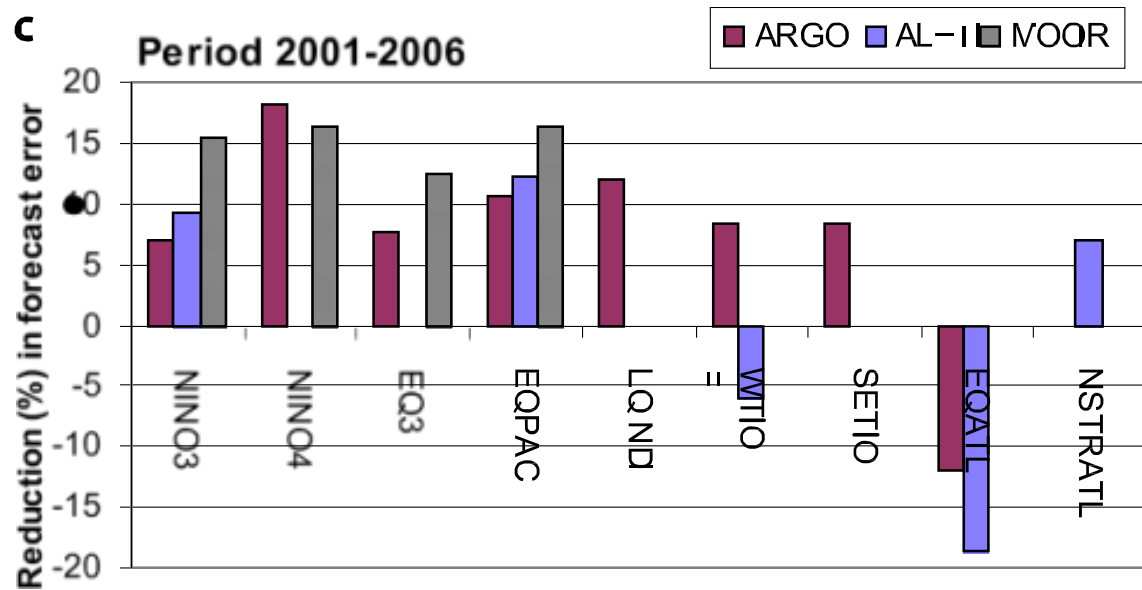
of Daily Temp. Profiles every 5 Days in 3S-3N
TAO(red, 30 is 100% return rate), ARGO(green), XBT(blue)



Why there is a need for TAO Observing System Experiments for ENSO Forecast

- **TAO array has frequent missing data due to mechanical failure and vandalism; What is the influence on ENSO prediction?**
- **The advent of altimetry sea level data since 1993 and Argo data since 2000 supplement the TAO data**
- **Ocean data assimilation schemes have been advanced and may be in a position to better handle data from alternate observing platforms**
- **Seasonal forecast models have improved and may be in a position to better assess the values of improved ocean initializations**
- **Can we assess the relative contribution of TAO and Argo data to ENSO forecast skill using the current generation of ocean reanalyses and seasonal coupled models?**

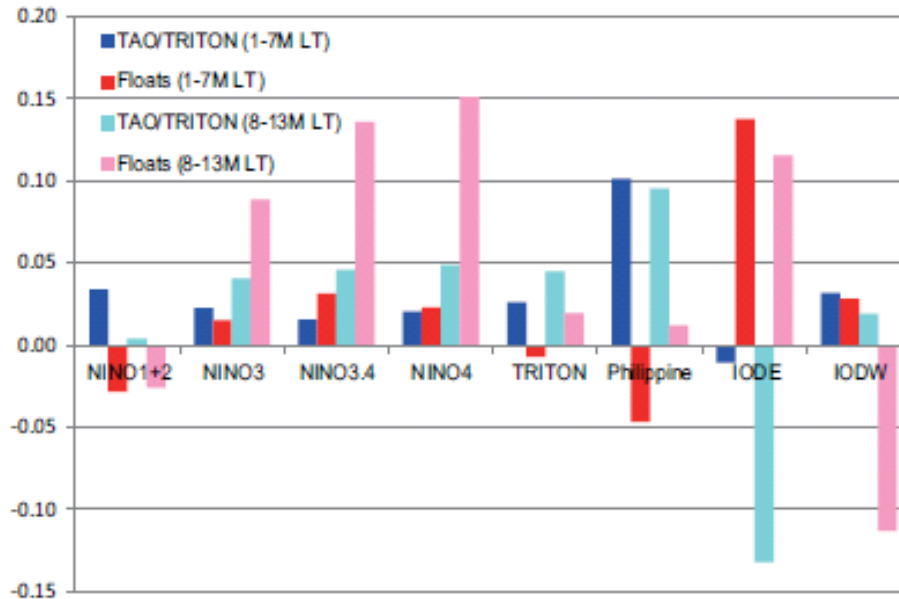
Previous Works on OSEs



Balmaseda and Anderson 2009

- ECMWF S3 system
- Four OSEs with aLL data, noTAO, noArgo, noAltimetry
- Hindcasts from Jan 1, Apr 1, Jul 1 and Oct 1 in 2001-2006 with 5 ensembles
- Argo improved skill most in NINO4 and eq. Indian Ocean
- TAO improved skill in the whole eq. Pacific
- Altimetry improved skill in NINO3 and subtropical N. Atlantic
- **The results are for 2001-2006 and likely model-dependent**

Previous Works on OSEs



Fujii et al. 2011

- **JMA seasonal forecast system**
- **Three OSEs with aLL data, noTAO, noArgo**
- **Hindcasts from Jan 1, Apr 1, Jul 1 and Oct 1 in 2004-2008**
- **Argo improved skill in the whole eq. Pacific and eastern Indian Ocean**
- **TAO improved skill in the whole eq. Pacific and precipitation**
- **The results are for 2004-2008 and likely model-dependent**

NMME Forecast Providers

Model	Hindcast Period	Ensemble Size	Lead Times	Arrangement of Ensemble Members	Contact and reference
CFSv2	1982-2009	24(28)	0-9 Months	4 members (0,6,12,18Z) every 5 th day	Saha (Saha et al. 2010)
GFDL-CM2.2	1982-2010	10	0-11 Months	All 1 st of the month 0Z	Rosati (Zhang et al. 2007)

NCEP-GFDL Project on TAO OSEs

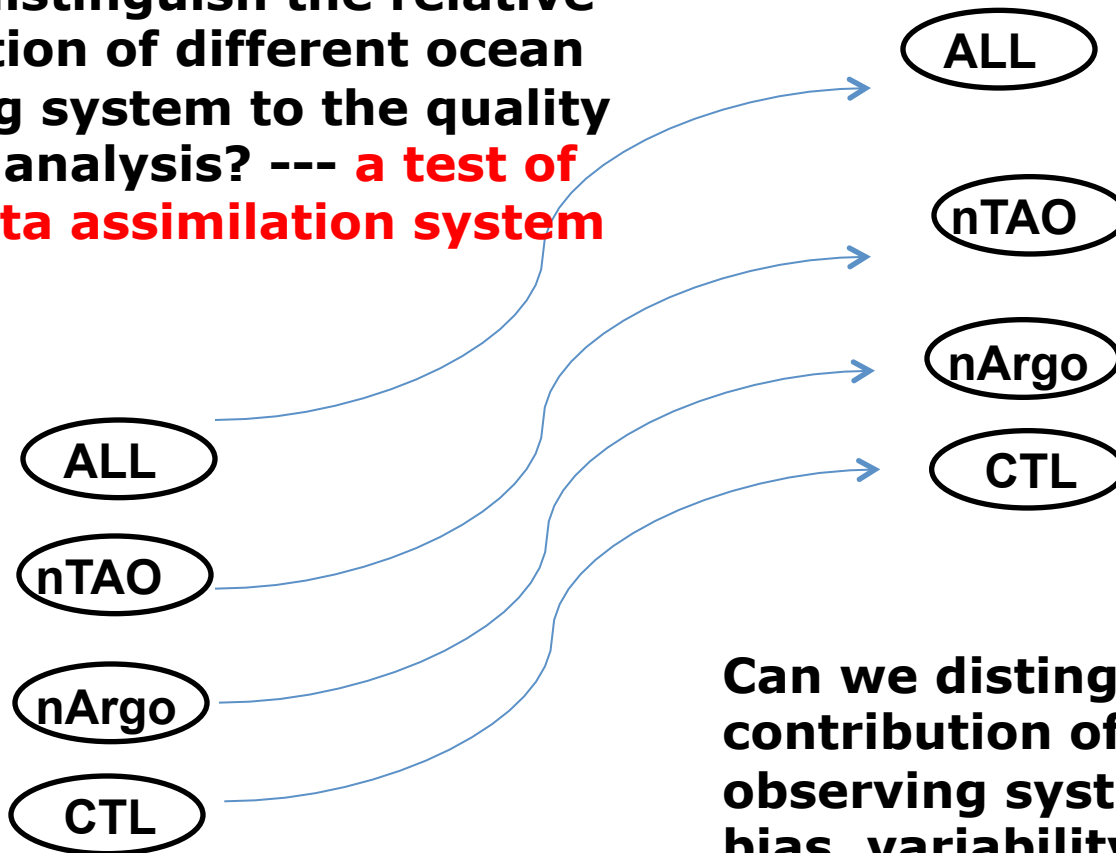
Data assimilated	CTL (no ocean data) (2000-2011)	ALL (all ocean data) (2000-2011)	nTAO (all except TAO) (2000-2011)	nArgo (all except Argo) (2000-2011)
XBT	×	√	√	√
TAO	×	√	×	√
Argo	×	√	√	×

- **NCEP GODAS vs GFDL Ensemble Coupled Data Assimilation**
- **Four OSEs with no data, aLL data, noTAO, noArgo**
- **Hindcasts from Jan 1, Apr 1, Jul 1 and Oct 1 in 2004-2011 with 6 and 10 ensembles**
- **The results are for 2004-2011 and based on two seasonal forecast systems**

Analysis Strategy

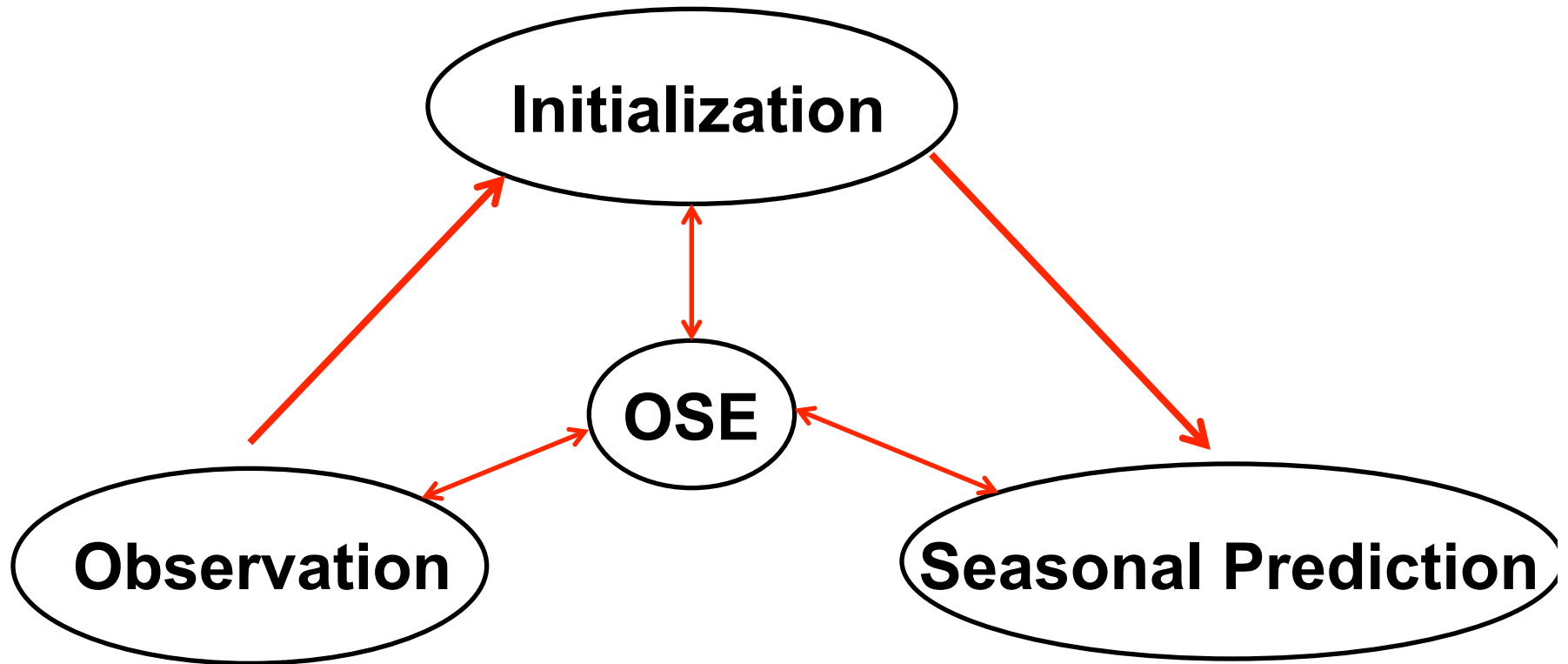
Can we distinguish the relative contribution of different ocean observing system to the quality of ocean analysis? --- **a test of ocean data assimilation system**

more data ↑



Can we distinguish the relative contribution of different ocean observing system to the mean bias, variability and forecast skill of ENSO? --- **a test of seasonal forecast system**

Roles of Observing System Experiments (OSEs)



Thanks!

Comments and Suggestions?