ENSO breakout discussion items

- Outstanding challenges/issues ?
- Are root causes identified ?
- Broader implications of ENSO errors ?
- Which approaches to reduced these errors are promi
- Need to design/coordinate focused experiments ?
- Where does lack of observations inhibit progress ?

Outstanding challenges/issues

El Niño errors in coupled GCMs:

- amplitude: too large diversity (dominate over response to CC)
- structure: westward extension, too narrow around equator
- frequency: too frequent, single-peaked
- mode/type: SST-type El Niño events in linear regime
- mean state and seasonal errors large for many models

Other outstanding issues:

- incomplete theoretical understanding of ENSO (oscillators, MJO,..
- defining appropriate metrics
- detailed observations of El Niño events scarce (wind stress produ vary ~30-40%)

Root causes

Analysis suggest:

- atmosphere GCM has a dominant role
- ocean GCM modulates amplitude (but second order)

Role of mean state:

- mean and annual cycle of wind stress too strong (critical !)
- no clear relation between mean state and ENSO amplitude
- what aspect of the mean state matter ?
- mean state vs. decadal variability

Other aspects:

- amplitude easier than frequency to relate to model errors
- long-term mean errors can be seen early on (a few months)
- model improvements often come from atmospheric convectic
- but no general rule ("anecdotal") – share experience
- impact of errors outside tropical Pacific

Broader implications of ENSO errors

Large implications as dominant mode of variability !

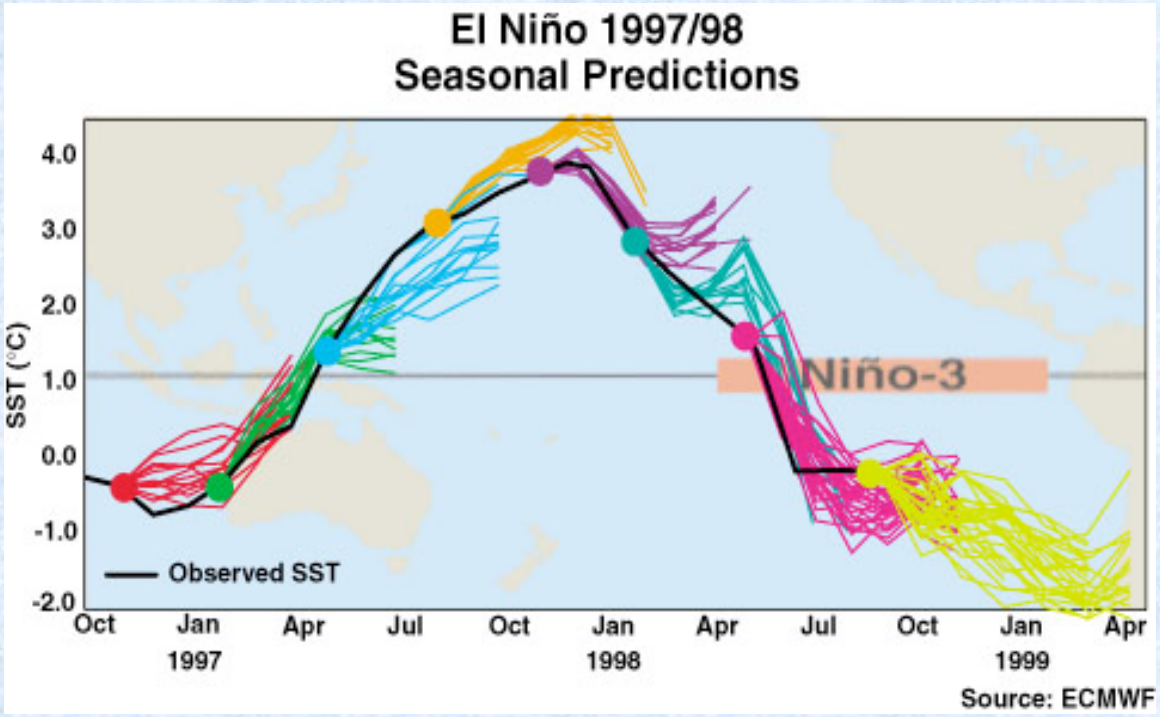
- **projections of ENSO change inconclusive**
- **teleconnections**

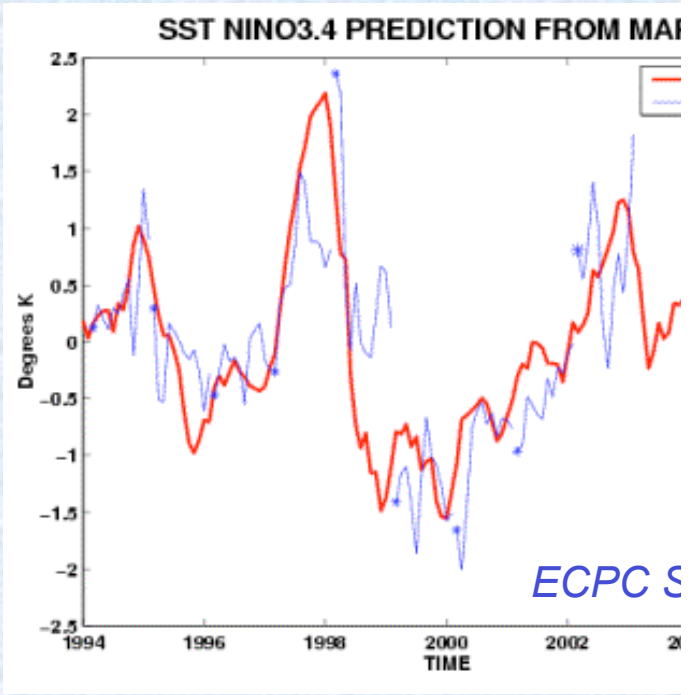
Approaches to reduce ENSO errors

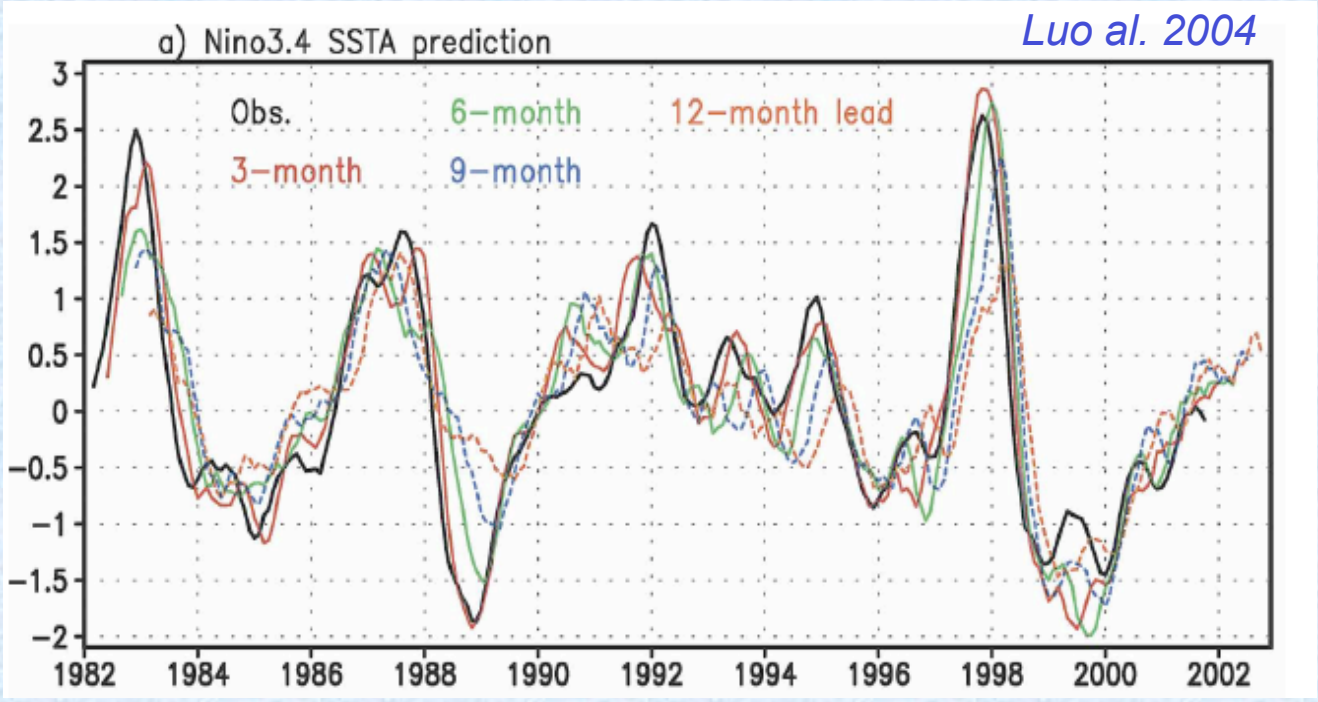
- improve mean climate (model strategy: validate forced then couple)
- use of simpler frameworks (ICM, HCM, energetics)
- use of multi-model
    - comparison via metrics (key driver for model improvement !)
    - ENSO focused coordinated experiments

Proposal:

- control coupled run with nudged observed wind stress (30+10y)
- from this control, launch regular seasonal range "forecasts"


El Niño 1997/98
Seasonal Predictions
SST (°C)
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
Niño-3
Observed SST
Oct
Jan
Apr
Jul
Oct
Jan
Apr
Jul
Oct
Jan
Apr
1997
1998
1999
Source: ECMWF


SST NINO3.4 PREDICTION FROM MAI
Degrees K
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
1994
1996
1998
2000
2002
TIME
ECPC S


a) Nino3.4 SSTA prediction
Obs.
3-month
6-month
9-month
12-month lead
3
2.5
2
1.5
1
0.5
0
−0.5
−1
−1.5
−2
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002

Luo al. 2004

Benefits of seasonal-range coupled runs

1. El Niño forecast skill tests ENSO-relevant processes, and provides a relevant metric of model performance.
2. These runs provide rich diagnostic possibilities, to see ho (and sometimes why) coupled errors develop in the tropic in the context of detailed observations.
3. Good configuration to look at cloud-SST interactions, in conditions specific to a given year, allowing detailed comparison with eg satellite data.

contribution from Tim Stockdale

Feasibility of seasonal coupled runs

- Simple initialisation
  - Ocean model with specified wind, SST forcing
  - AMIP style atmosphere initial conditions would be OK
  - Options/details to be discussed
- Computationally cheap
  - Eg Feb+Nov starts, 1993/5/7/9/2001, 5 member ensemble= years integration
- Coordination issues
  - Groups can work on their own if they wish
  - But might be better to set reference experiment(s)
  - TFSP, WGM, WGCM, WGSIP may be able to help

Metrics

Basic or "essential" metrics

- requires observed reference
- relies as little as possible on ENSO theories
- should also be applied to forced components (AMIP, CORE,
- should give an accurate skill measure to non-ENSO specialis (A/B/C)

More advanced metrics (= diagnostics to understand)

- function of errors as measured by basic metrics
- may rely on theoretical hypothesis and less on directly obse variables
- will require a ENSO specialist's eye to conclude/make progr

Example of proposal for ENSO basic/essential metrics

From joint NCAS/IPSL/Hadley Centre effort

- **maps + sections mean state and annual cycle variables** (SST, τ, U,
- **annual cycle** (nino4 τ_x vs. nino3 SSTA) **longitude/time at equator an**
  10S/10N lat/time diagrams in W/C/E Pacific (SST, τ, precip,...)
- **standard deviation & skewness maps of SST and τ_x**
- **SSTA nino3 & SO time series stats + mean value + annual cycle (SF**
- **coupling strength diagnostic**
- **normalised spectra, autocorrelations of nino3 SSTA**

- **validation data: TAO profiles +... and same physics forced runs (CC**
  set-up)

On-going activities / next steps

Ad-hoc "ENSO in IPCC AR4" group

- met in Paris May 2006
- BAMS paper being written on "ENSO in coupled GCMs"
- informal group for metrics discussion
- next meeting this afternoon 1:30-4:00 pm

Support for a "CLIVAR ENSO work group" (i.e MJO)