WGCM/WGSIP decadal prediction proposal

A brief introduction

Outline

- **Lessons from seasonal prediction**
  - Starting from close to an observed state is OK
  - Clean initial states need some care
  - Model errors dominate
  - Models can be tested
- **Outline of decadal prediction proposal**

Lessons (?) from seasonal prediction

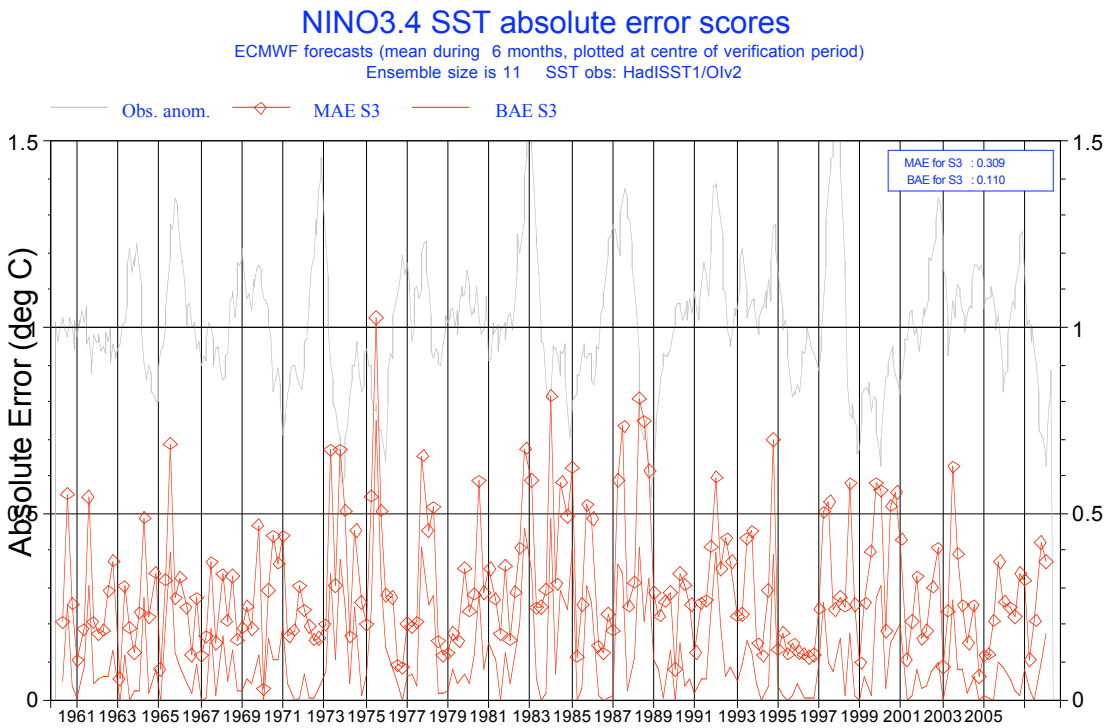
- **Lesson 1: starting from obs. state is OK**
  - To the extent that things are linear, subtract an estimate of the drift
  - Non-linearities mean that errors *do* hurt; but a simple argument states that the integrated effect of the problem is *less* if we start close to reality
  - "Equilibrium" start or well sampled hindcast set both need many years of integration.

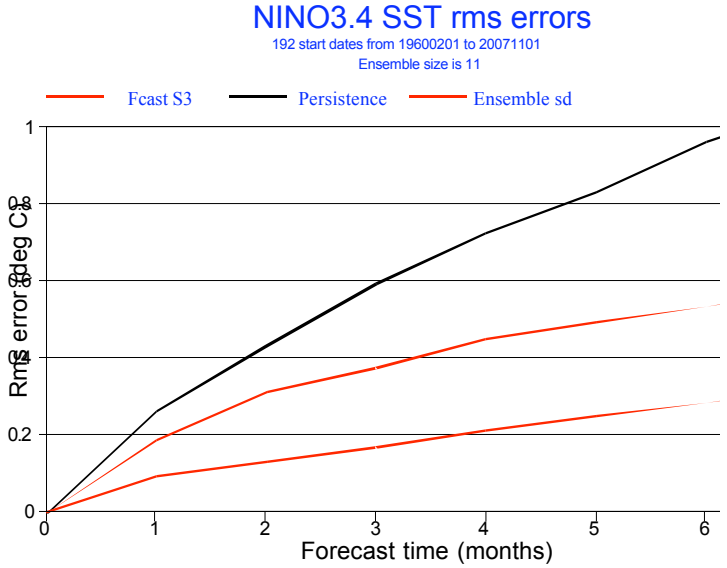
- **Lesson 2: clean initial states need some care**
  - Forced ocean model can "fight" data, and in this case a close fit to the ocean data can introduce a lot of noise.
  - Might be an argument not to correct the mean state of the forced ocean model – or at least, only correct slowly varying part of system (eg large scale water mass properties)

Lessons (?) from seasonal prediction

- **Lesson 3: model errors dominate**
  - In most cases, model error rather than initial error dominates ENSO forecast performance. This is also true in the pre-TAO era.
  - For teleconnections, circulation changes, changes over land (ie, mapping SST anomalies to parameters of societal interest), the performance of the model is even more critical.

Forecast errors 1960-2007





ECMWF

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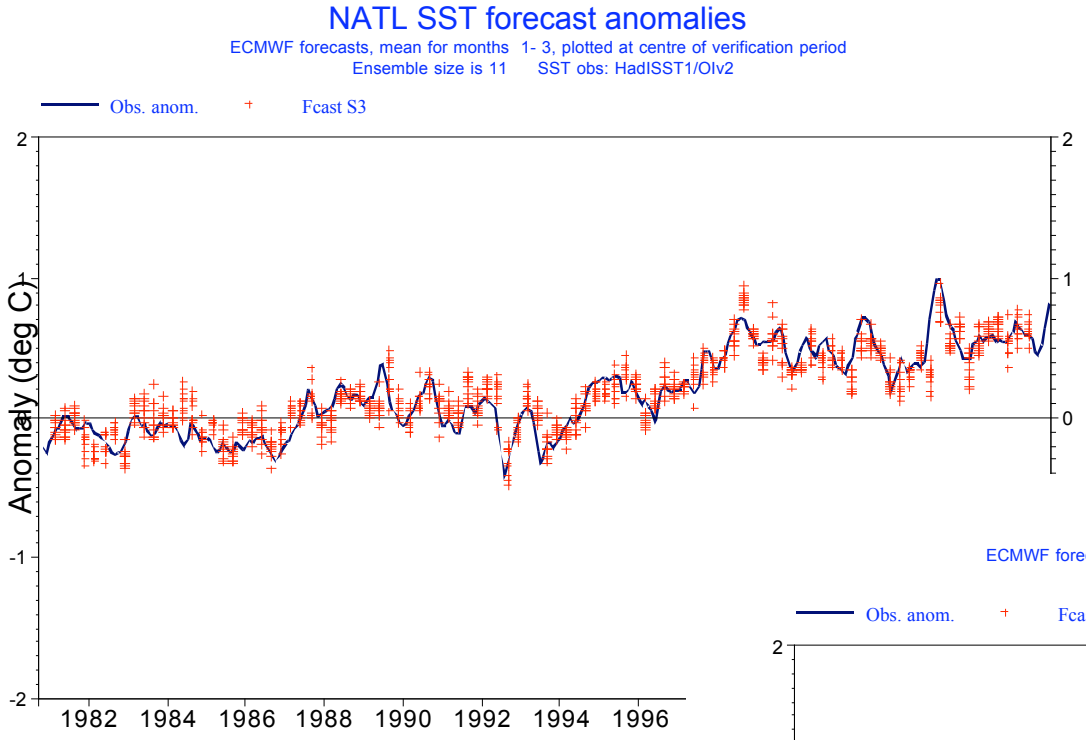
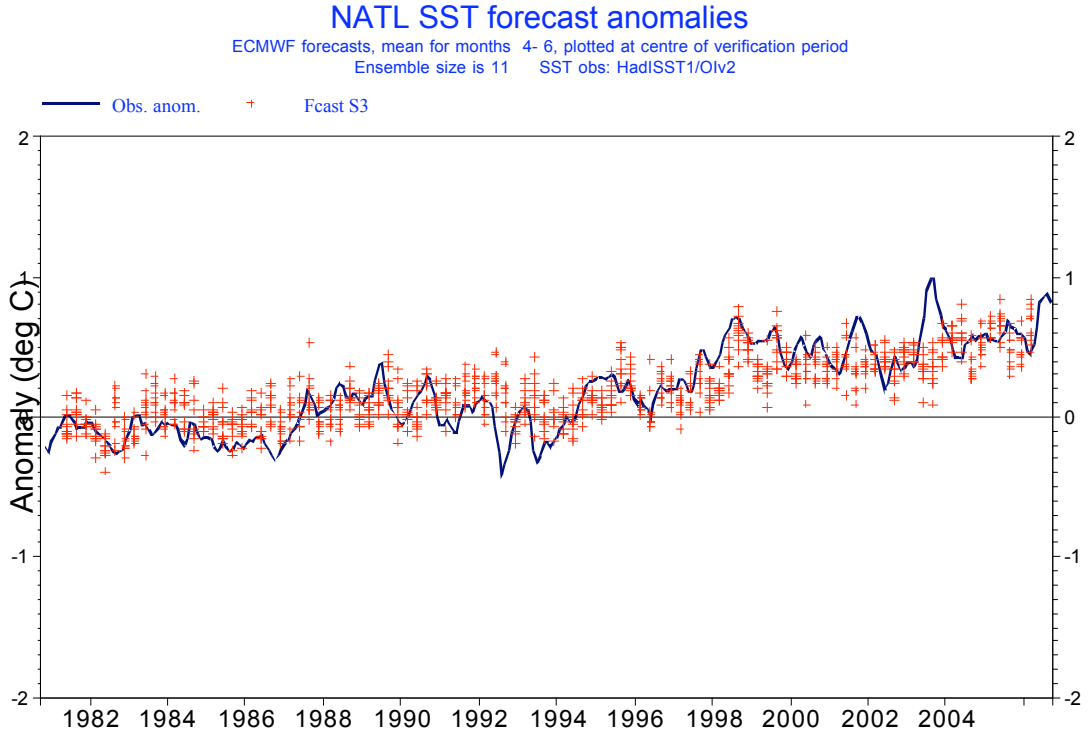
- **Lesson 4: models can be tested**
  - Making initialized forecasts is a good way of testing a coupled model, and allows estimation of future performance
  - Even if model errors dominate, attention to initialization can help
- **Additional comment**
  - Decadal trends matter a lot in seasonal prediction



Some trends are handled well …



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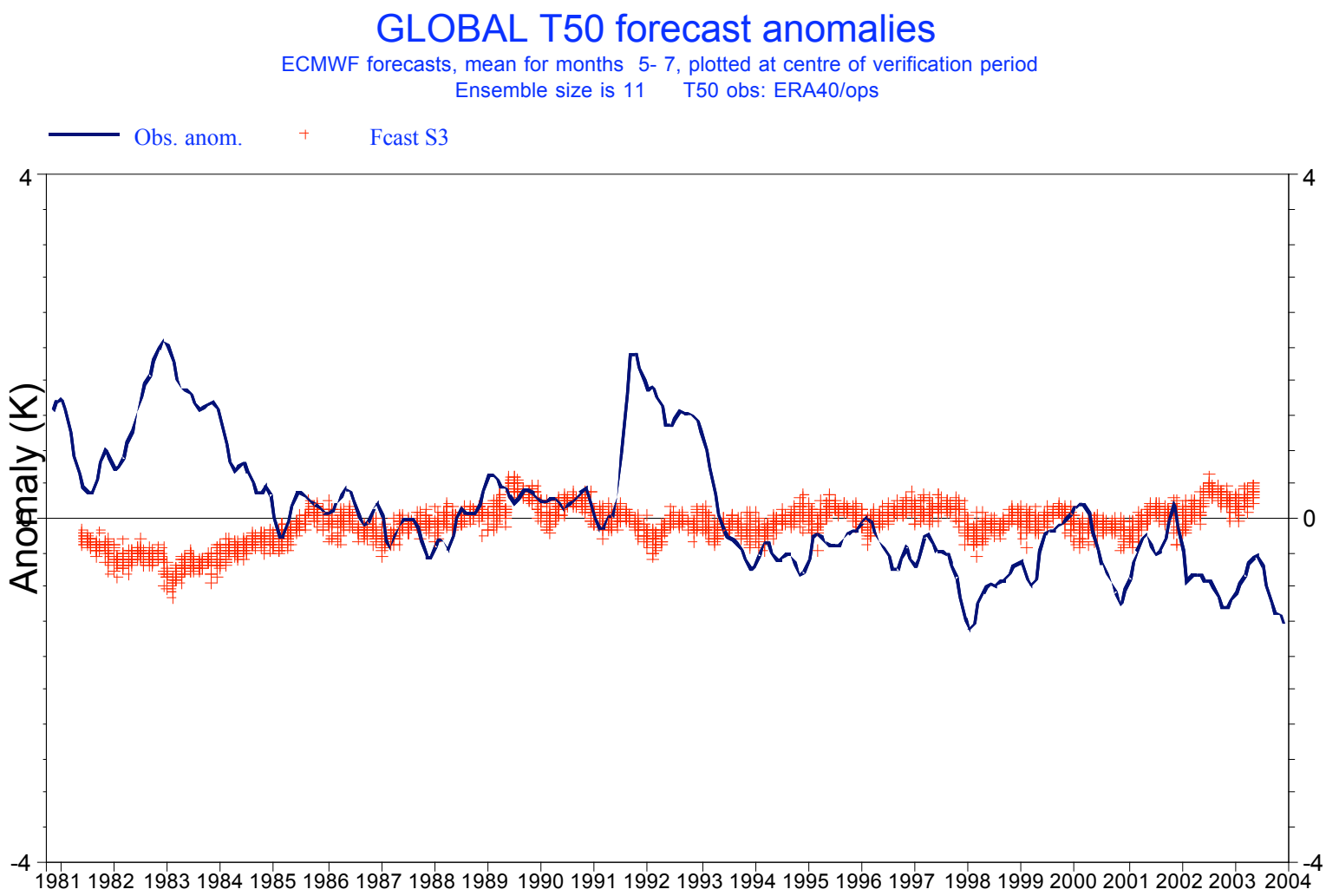

WGCM/WGSIP decadal prediction proposal

- **Origin: WGCM meeting in Hamburg, Sep 2007**

- **Input 1:**
  - JSC request for WGSIP and WGCM to help coordinate a preliminary decadal prediction experiment

- **Input 2:**
  - WGCM/IPCC requirement to define initialization for short-term climate runs (to 2030) (Aspen document)

Basic concept

- **Put everything in a common framework**

  (Note: Not quite the same as “do everything”)

- **Objective 1**
  - Short term prediction of climate to 2030 (or 30 years)
  - Some groups/governments want to do this with high resolution models

- **Objective 2**
  - Developing the science of multi-decadal prediction in the context of a changing climate
  - Study sensitivity to initialization method
  - Characterize errors and uncertainties in multi-decadal predictions
  - Will use affordable models

*High res: up to T318; _ deg ocean

Framework

- **Objective 1:**
  - Initial dates 1st Nov 1960, 1980, 2005 (or 1970 and 2000)
  - 25 or 30 year integrations, 3-10 ensemble members
  - Initial conditions to represent “observed” anomalies in some way
  - All observed forcings (future: specified single scenario without volcanoes)
  - Will look at the DIFFERENCE in climate between different periods
  - Large ensemble size/high resolution -> look at statistics of windstorms etc
  - Does not require elimination of model drift
- **Objective 2 runs:**
  - 1. Same runs as Objective 1
  - 2. 10 year integrations, dates 1965, 1970, 1975 etc (as ENSEMBLES)
  - 3. “Control” runs, extended CMIP5 C20th runs (no initial conditions)
  - 4, 5 and 6: Additional studies and sensitivity runs

Simple comments on initial conditions …

- **For a 25 year forecast, initial conditions matter**
  - At least, relative to pre-industrial initialization and 150 year trajectory
  - *Which* aspects matter most is poorly known:
    - Global ocean heat content
    - Arctic ice thickness
    - North Atlantic thermohaline circulation – T/S fields in N Atlantic
    - (Only N Atlantic???)
    - Wind driven ocean circulation - gyres, Pacific decadal state, ..
  - How well do we know each of these initial conditions?
    - Relative to pre-industrial spin-up
    - Most interested in the difference between the start of different forecasts
    - *I.e.* relative changes over 1980-present (or 1960-present or …)

Possible options

- **Keep the proposal**
  - But modify aspects of it as required
- **Split the proposal**
  - Objective 1: for AR5 only, include eg experiments 2.1 and 2.2
  - Objective 2: 2.2-2.5 as a separate decadal prediction study, building on European ENSEMBLES project
  - (Maybe still a common *framework*, but two proposals)
- **Re-write from scratch ….**