Current activities on decadal prediction

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Contents

Effects of initialisation on variables other than surface temperature

• Sampling model uncertainties vs sampling initial state uncertainties (Interest in "seamless" prediction)

• Summary of relevant European projects

• See also Doug Smith's talk on initialisation topics

Decadal prediction system (DePreSys, based on HadCM3)

- Include projected changes in greenhouse gases, sulphate aerosols, volcanoes and solar cycle.

- Initialise anomalies of:

  - Atmospheric winds, temperature and surface pressure

  - Ocean temperature and salinity

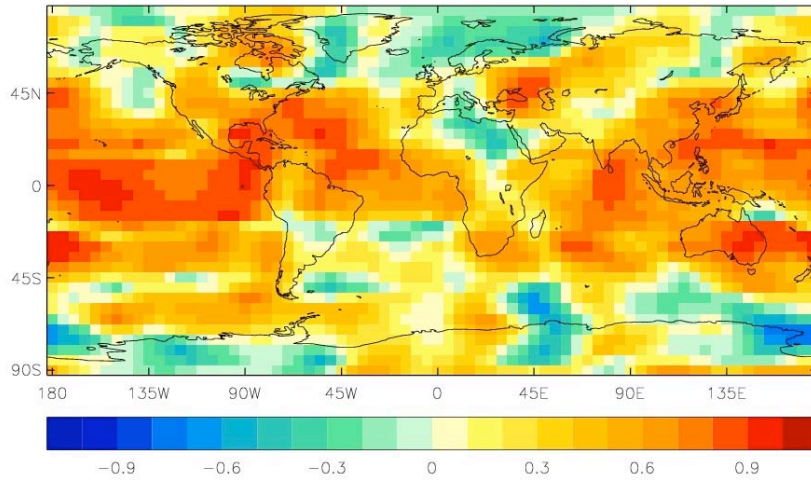- Parallel "NoAssim" runs using same external forcings, but omitting assimilation of analyses of observations

Skill and uncertainty in decadal predictions

- 9 member DePreSys ensembles started from 1 Nov and 1 May, 1991-2001 (22 hindcasts)

- Compare ensembles sampling initial state uncertainties (lagged initial dates) and modelling uncertainties (perturbed physics)

- Perturbed parameters selected to sample a wide range of ENSO amplitudes and climate sensitivities

- For November start dates, also test impact of initial conditions using two parallel sets of initialised and uninitialised perturbed physics hindcasts (DePreSys and NoAssim)
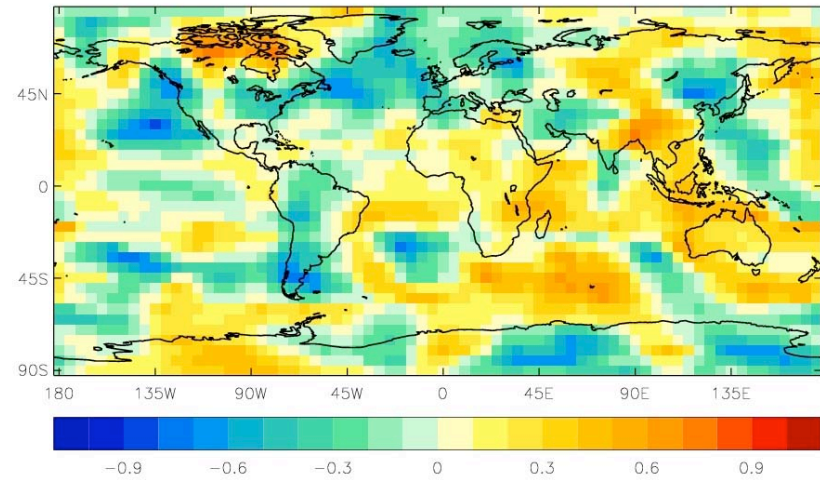
- Contribution to EU ENSEMBLES project
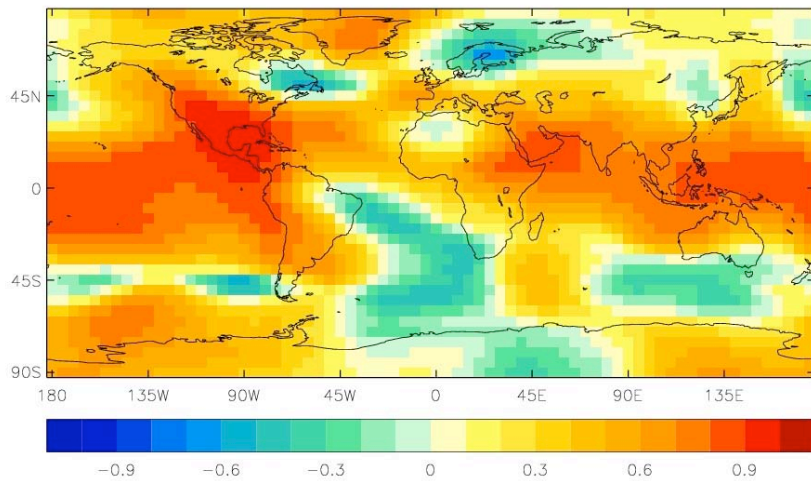
Year 1

Precipitation: Corr = 0.41   Corr = 0.02
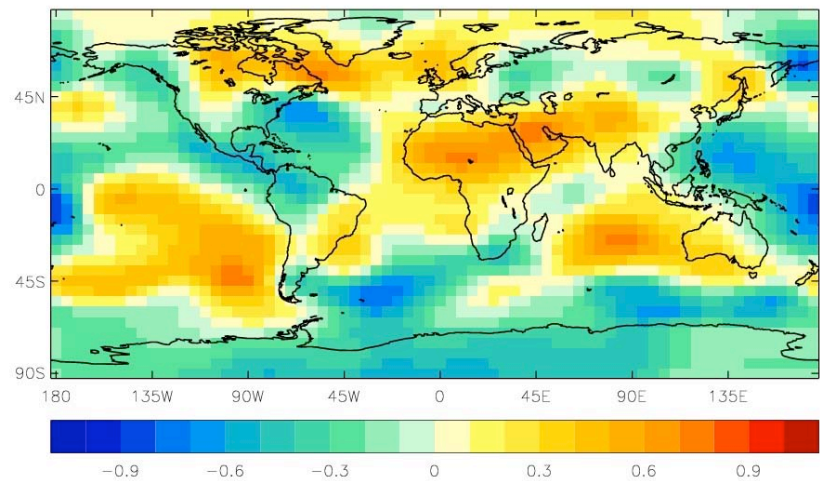

DePreSys_PPE   DePreSys_PPE_NoAssim

MSLP: Corr = 0.40   Corr = 0.00
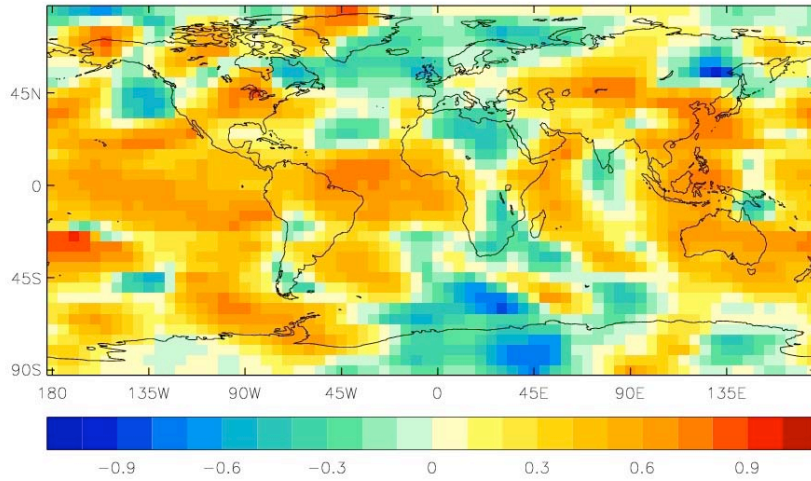
Year 2

Precipitation: Corr = 0.25   Corr = -0.03
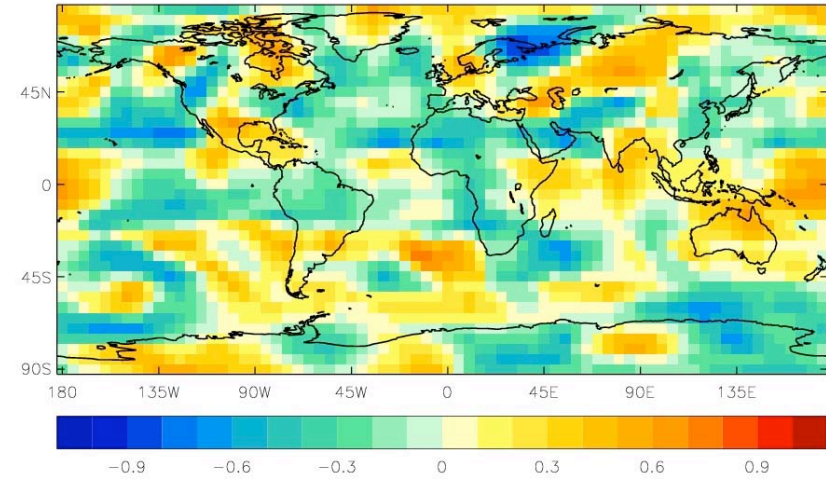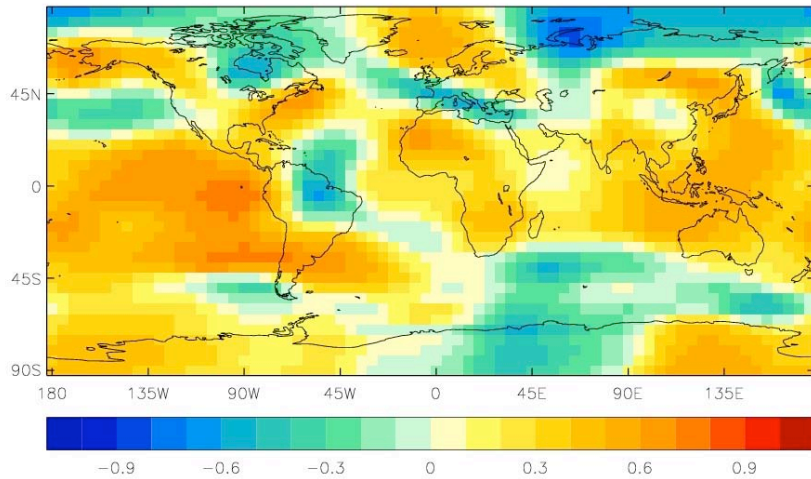

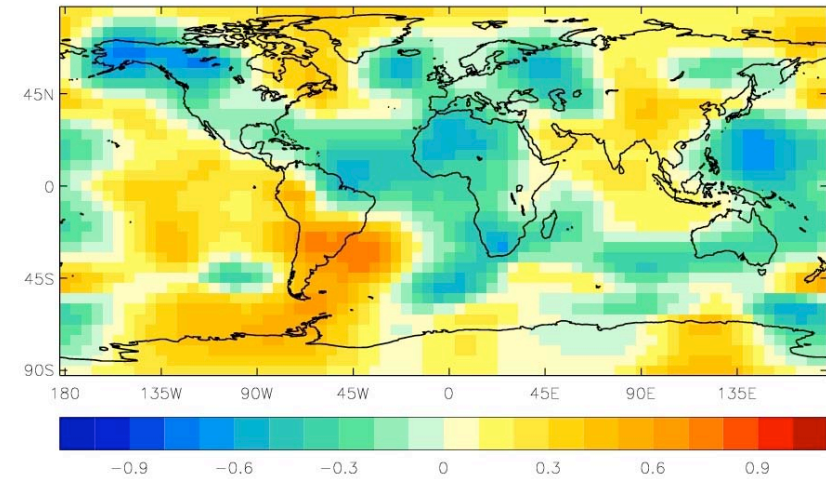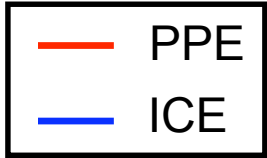DePreSys_PPE   DePreSys_PPE_NoAssim
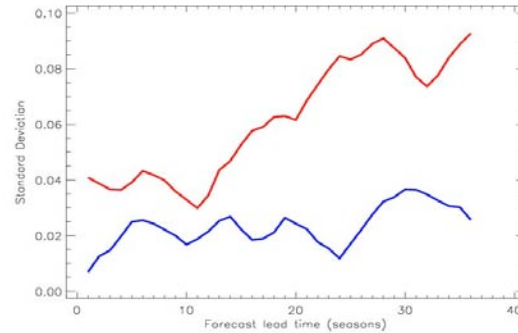
MSLP: Corr = 0.21   Corr = -0.02

Skill and spread of annual mean hindcasts out to a decade
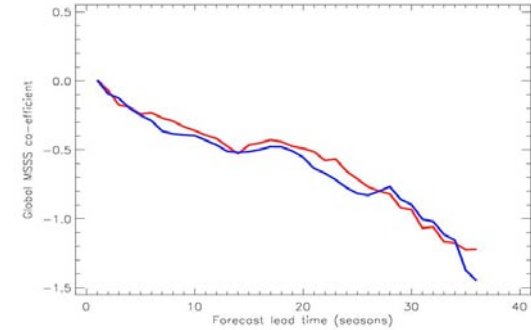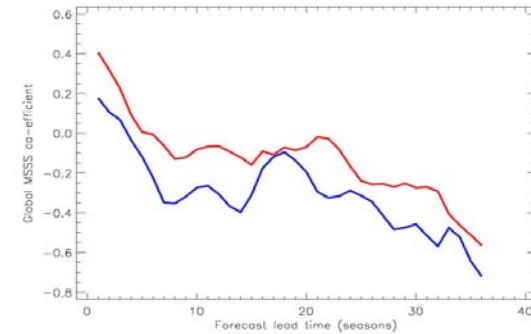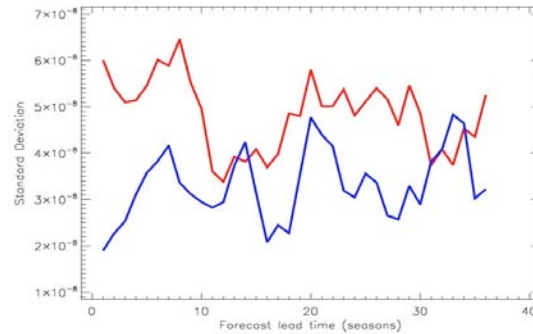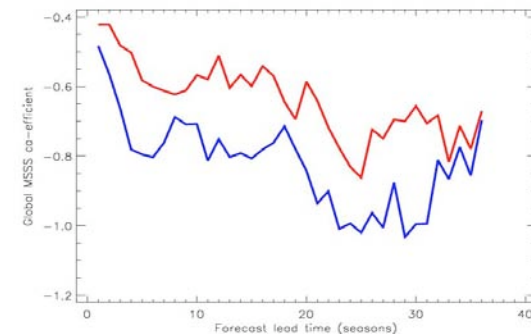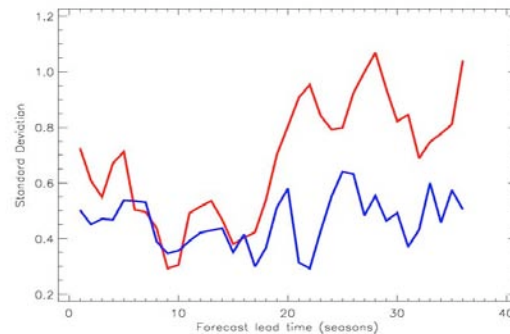
Seamless prediction systems ?

• Could verification of shorter range forecasts (NWP, seasonal, decadal) provide additional observational constraints on longer term climate projections ?

• See Palmer et al. (2008), BAMS

• Do the same set of processes determine uncertainties and errors at different lead times ?

• Need to deploy the same (or at least traceable) climate prediction systems across near-term and multidecadal time scales to answer this properly

• We hope to use our perturbed physics ensembles to take an initial look at this

Transient climate response vs seasonal (left) or decadal (right) forecast error for nine perturbed variants of HadCM3
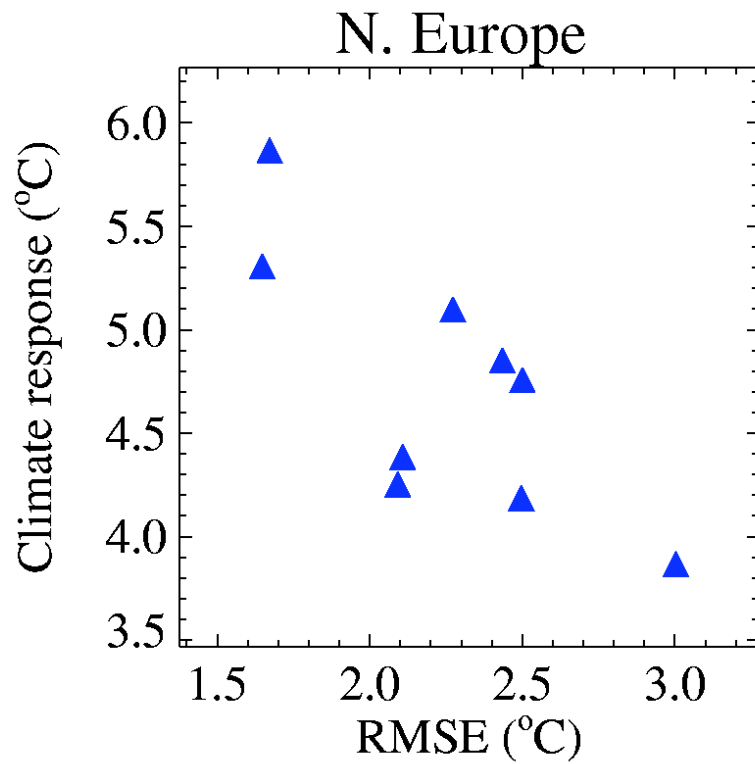
Seasonal-decadal prediction in the EU ENSEMBLES project

- Three systems: multi-model (ECMWF, GloSea, DePreSys, Météo-France, IfM-Kiel, CERFACS, INGV), stochastic physics (ECMWF) and perturbed parameters (DePreSys).
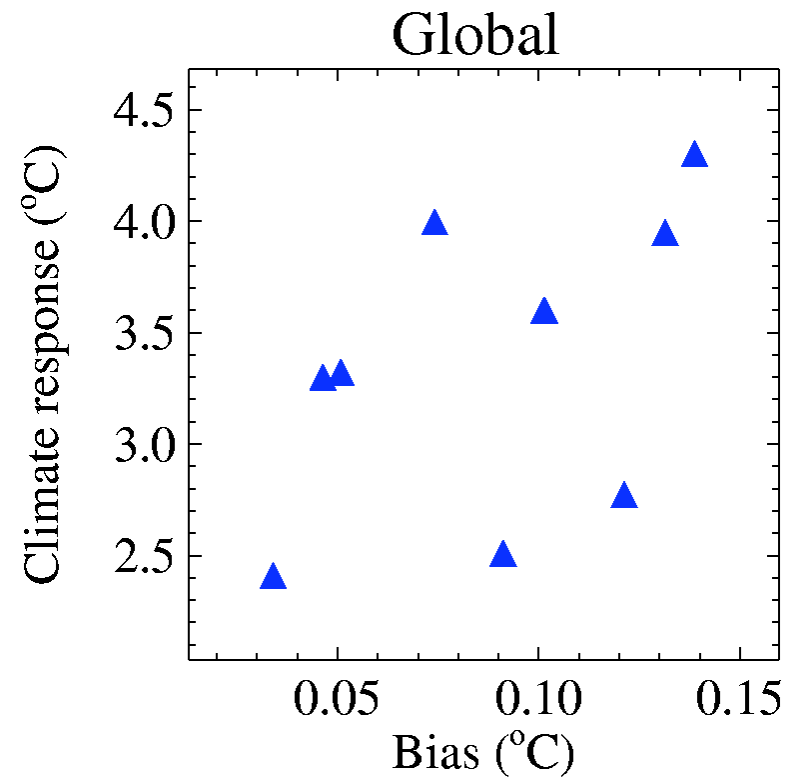
- Hindcasts in two streams:

  - o Stream 1: hindcast period 1991-2001, seasonal (May and November start dates), annual (November start date) and 2 decadal (1965 and 1994), 9 member ensembles.

  - o Stream 2: As in Stream 1 but over 1960-2005, with 4 start dates for seasonal hindcasts, at least 1 for annual and at least one 3-member decadal hindcast every 5 years.

  - o Additional simulations: DePreSys_PPE carries out a 10-year hindcast every year and a 30-year hindcast every 5 years + lots of sensitivity experiments from the other contributors.

Further EU projects (1)

COMBINE (Comprehensive Modelling of the Earth System for Better Climate Prediction and Projection)

- Use new climate model components developed since AR4
- Input to AR5
- Decadal and centennial timescales
- Initialisation Work Package: assess different initialisation strategies
    - assimilate full values and remove bias calculated from hindcasts
    - anomaly initialisation
    - empirical model error correction diagnosed from assimilation runs

Further EU Projects (2)

THOR (thermohaline overturning at risk?)

- analyse mechanisms driving the THC

- assess skill on decadal timescales (using ENSEMBLES hindcasts)

- assess relative impact of greenhouse gases and initial conditions using following hindcasts using:

  - A 1965 initial conditions, observed GHGs (including aerosols) from 1965
  - B 1994 initial conditions, observed GHGs from 1994
  - C 1965 initial conditions, observed GHGs from 1994
  - D 1994 initial conditions, observed GHGs from 1965

- Idealised experiments to assess impact of observations of predictability of THC