Decadal climate prediction studies at the Max Planck Institute for Meteorology

Reported by Marco Giorgetta

- Recent work by Holger Pohlmann et al. (submitted to J. Climate)
- Ongoing work by Daniela Matei
- Prospect for future climate prediction studies

Improving Decadal Climate Predictability through the Initialization of a Coupled Model with the GECCO Oceanic Synthesis

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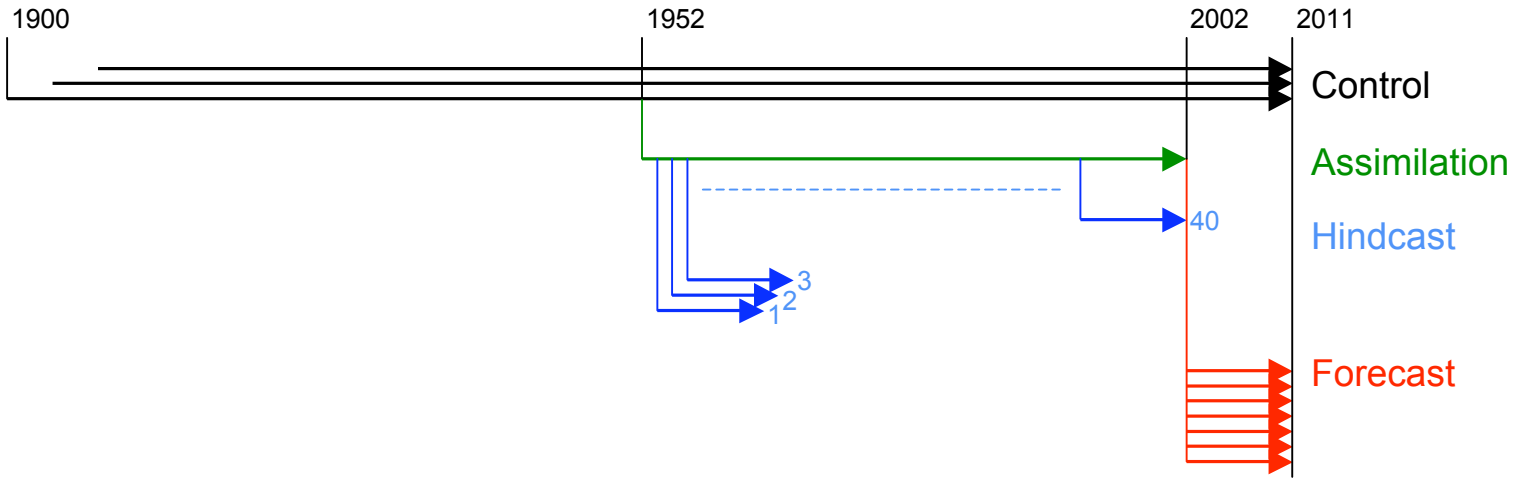
Pohlmann et al.: Questions and methodology

- Are decadal hindcast experiments for the transient 20th century closer to the assimilation experiment than a control run which is not initialized?
- This implies the questions for which variables, where, and for how long the initialization (of the ocean) bears an advantage.

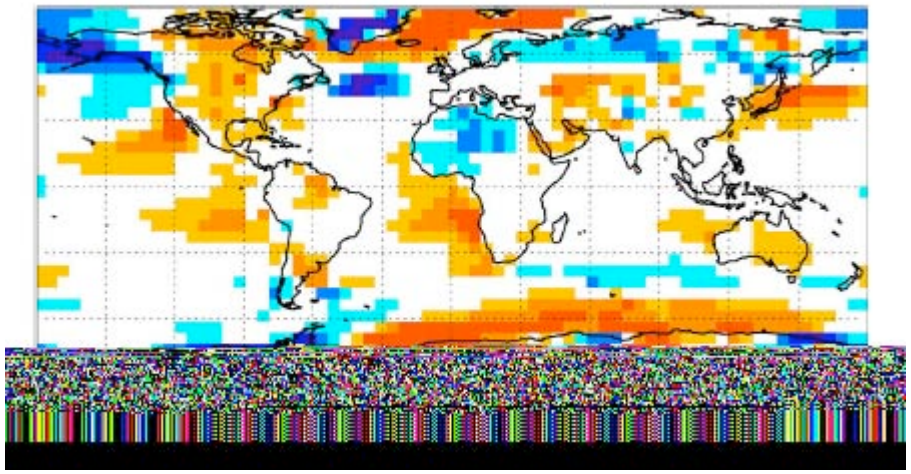
- ECHAM5/MPI-OM climate model (~ MPI-M IPCC AR4 model)
- GECCO ocean synthesis 1952-2001
- 10 year hindcasts and forecasts
  (forecast: cf. James' presentation)
- Compare hindcast skill against skill of uninitialized 20th century simulations and against skill of persistence
  - **Northern Atlantic annual mean SST**
  - annual mean Atlantic MOC (Sv) at 48°N
  - global and annual mean SST

Pohlmann et al.: Experimental design

Experiments	*Initialization*	*Forcing*	*Amount*	*Period*
Control	In 1900, 1910 and 1920 from an IPCC AR4 20th century simulation	GHG + aerosol	3	1900 – 2011
Assimilation	In 1952 from Control (initialized in 1900)	GHG + aerosol and T + S from ECCO	1	1952 – 2001
Hindcast	At the end of every year from Assimilation	GHG + aerosol	49 / 40	10 years duration
Forecast	At the end of Assimilation	GHG + aerosol	7	2002 – 2011



Pohlmann et al.: Model bias of Control simulation



Surface air temperature difference between the **control integration** and the **CRU climatology**, for the average over the period **1961-1990**.

Pohlmann et al.: North Atlantic annual mean SST (°C)

Time series

HadISST

Assimilation

Control

Anom. Cor. | RMSE

H-cast/HadISST

H-cast/Assim

Ctrl/Assim

95% CL

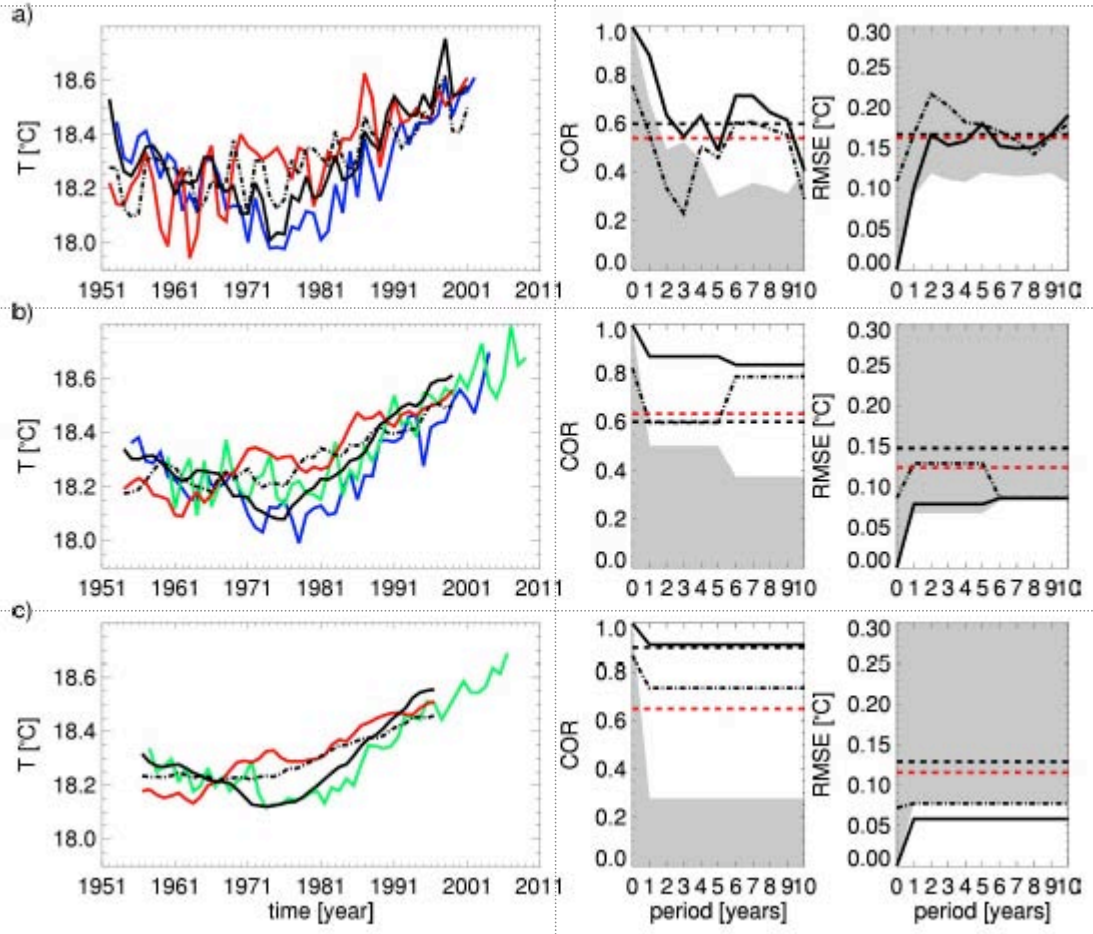
Persistence

h/f cast year 1

h/f cast year 1-5

h/f cast year 5-10

h/f cast year 1-10



Pohlmann et al.: Problems

- H-cast/assim. anomaly correlation coefficients are worse than h-cast/obs.

- SST of assimilation run, driven by GECCO synthesis, differs too much from observations
- GECCO assimilation procedure allows for too large deviations

- GECCO data only applicable in ice free regions
- Current GECCO data end in 2001

→ New GECCO planned by D. Stammer and A. Köhl

- Need for global ocean synthesis
- Smaller deviations from observations

Daniela Matei

- New aspects:
  - Use same model for synthesis and h/f casts
  - Extend assimilation run until 2007

- Build surrogate ocean synthesis
  - MPIOM simulations forced by NCEP/NCAR reanalysis
    - Surface heat flux from bulk formula → SST
    - Freshwater flux (incl. 50 largest rivers)
    - Surface salinity relaxed to obs. climatology
  - 10 member ensemble 1947-2007

- Assimilate daily **ensemble mean 3D fields of T + S and sea ice** (thickness + concentration) into ECHAM5/MPIOM using the **anomaly assimilation method**.

- Hindcast and forecasts similar to Pohlmann et al.
  - Assimilate ensemble mean data
  - Assimilate data from single ensemble members

Prospect for future climate prediction studies in Hamburg

- CLISAP: Integrated Climate System Analysis and Prediction
  - Large scale 5 year research project at U. Hamburg with participation of MPI-M
  - **Plans to develop a climate monitoring and prediction system**

- CSC: Climate Service Centre
  BMBF funded 5-year project, possible tasks:
  - dissemination of of data
  - Regionalization
  - large scale or quasi-operational simulations for the German research community

- BMBF program for climate prediction (scheduled for 2009 – ?)

- "COMBINE" proposal to European commission: Develop/test different initialization and bias correction methods, climate predictions and sensitivities to model improvements (stratosphere, …)

- "Storm" project of German research consortium: Explore benefits of high spatial resolution for climate simulation and climate prediction (Atmosphere > T250, Ocean ~0.1°)

Summary

- Climate prediction is a hot topic
- Funding agencies (EC, BMBF, DFG) and institutions are investing
- Challenges
  - Biases in climate models (= general problem)
  - Data assimlation in ocean model or in coupled model
  - Quantification of uncertainties in analysis products, and in predictions
  - Dissemination: make useful predictions
  - Education: Shortage of students and scientists