

CliC Science Themes

1. What are the magnitudes, patterns and rates of change in the terrestrial cryosphere on seasonal-to-century time scales? What are the associated changes in the water cycle?
2. What will be the contribution of the cryosphere to changes in global sea level on decadal-to-century time scales?
3. What will be the nature of changes in sea-ice distribution and mass balance in both polar regions in response to climate change and variability?
4. What will be the impacts of changes in the cryosphere on atmospheric and oceanic circulation? What is the likelihood of abrupt or critical climate and/or Earth system changes resulting from processes involving the cryosphere?
5. How do monitored changes in the cryosphere reflect the variability and change in the climate system? How can these monitored changes be combined with proxy or paleo-records and the results of modelling studies to improve our understanding of climate change?
6. What elements of climate predictability over a range of time scales involve the cryosphere and associated processes and how can we increase the predictive skill of long-range forecasting techniques through the use of cryosphere data, information, and modelling?

CliC Modelling Overview

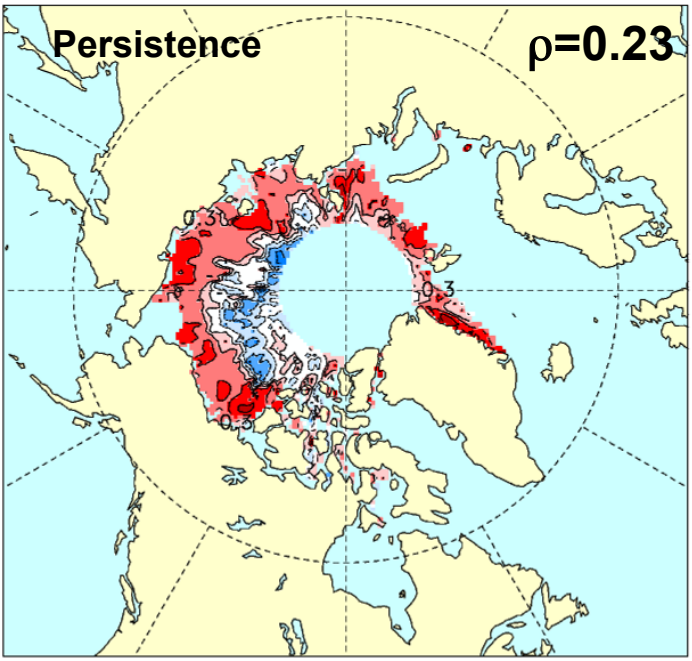
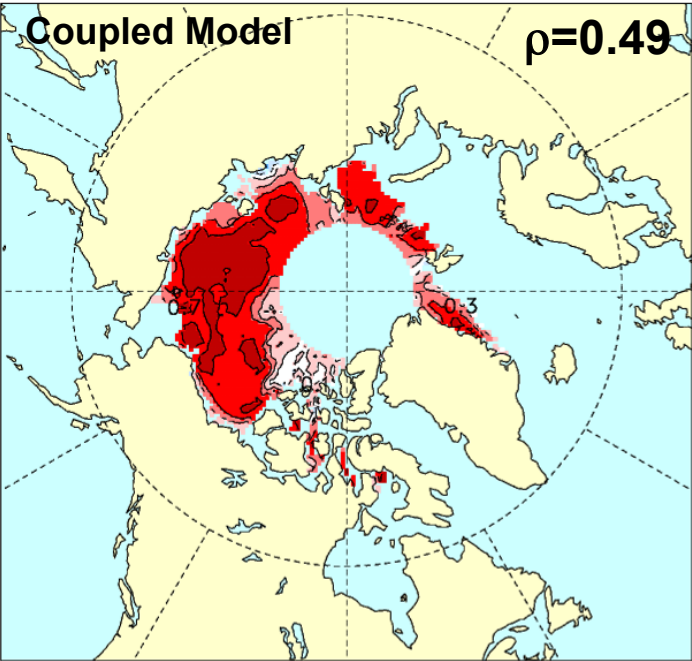
- Modelling has not been a major focus of CliC recently, though it is increasingly recognized as an area in which CliC should be more active.
- Some work is connected to regional climate modelling, cryospheric prediction, analysis of modelled feedbacks, and ice sheet dynamics.
- There is certainly opportunity to play a bigger role in:
 - fostering analysis of the cryosphere in climate and Earth System models;
 - promoting/coordinating improvement of process models and parameterizations;
 - collaborating on improving models of various kinds.
- This is consistent with suggestions in WCRP White Paper on Cryosphere Grand Challenges.
- CliC has not been particularly engaged in WGCM, WGNE or WGSIP, though Polar Prediction initiative is one avenue for better engagement in the latter.

Initial sea-ice forecast results from CCCma ...

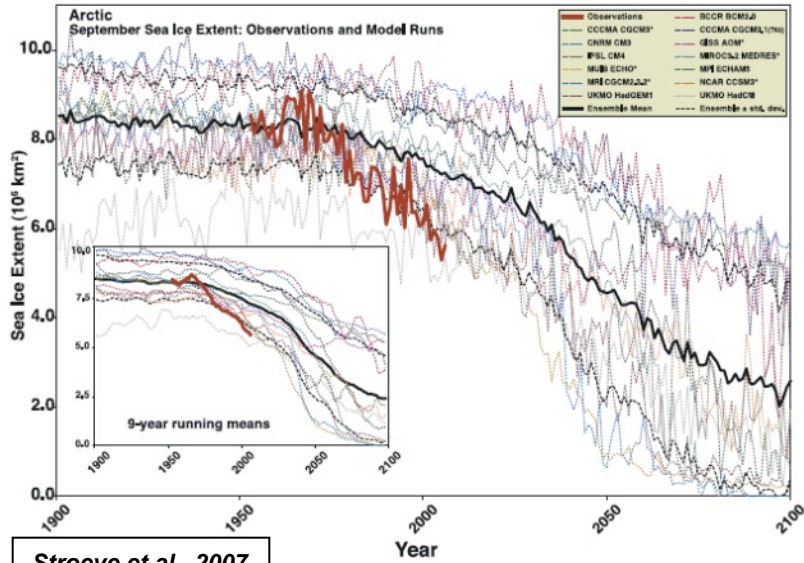
September Forecast, 1 month lead (i.e. initialized July 31)

CHFP2A HADISST(HR) ICE M09 I=07 L=1 1979-2008 CORR(U)=0.4868 L=NA O=0.487

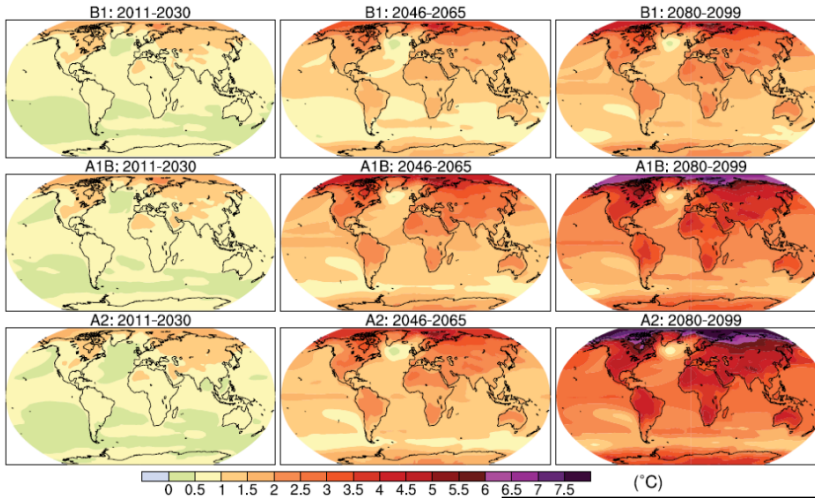
HADISST HADISST(HR) ICE M09 I=07 L=1 1979-2008 CORR(U)=0.2342 L=NA O=0.233



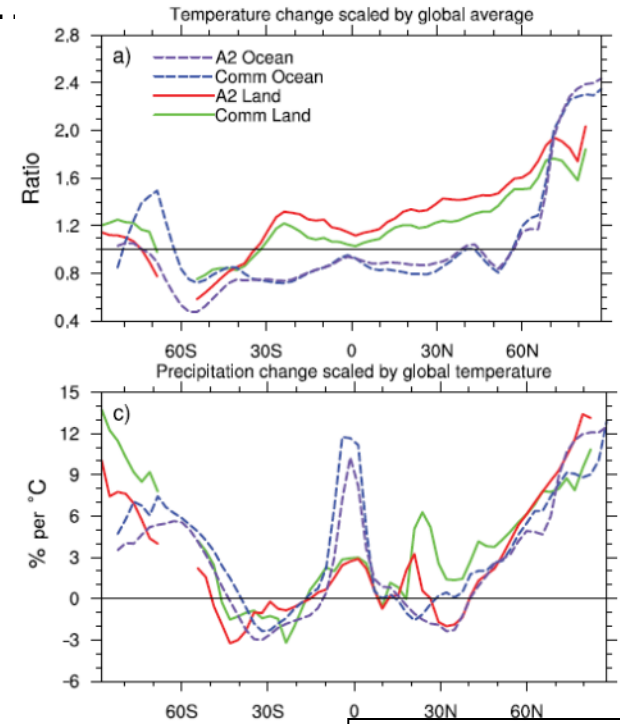
Some longer time-scale issues ...



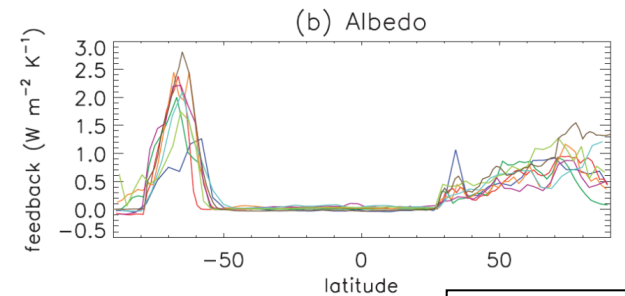
Stroeve et al., 2007



IPCC Fourth Assessment



IPCC Fourth Assessment



Crook et al., 2011

CliC Modelling and WMAC

- The cryosphere clearly plays an important role in shaping future climate change, and many uncertainties in future climate projections and future climate impacts involve the cryosphere in some way.
- WCRP has a strong record in championing improvements in climate models and in coordinating international effort in model development and application.
- CliC should be more directly and actively involved in this, and the WMAC provides a way of integrating more specialized work on cryosphere modelling with global Earth System modelling, climate prediction, and regional downscaling.