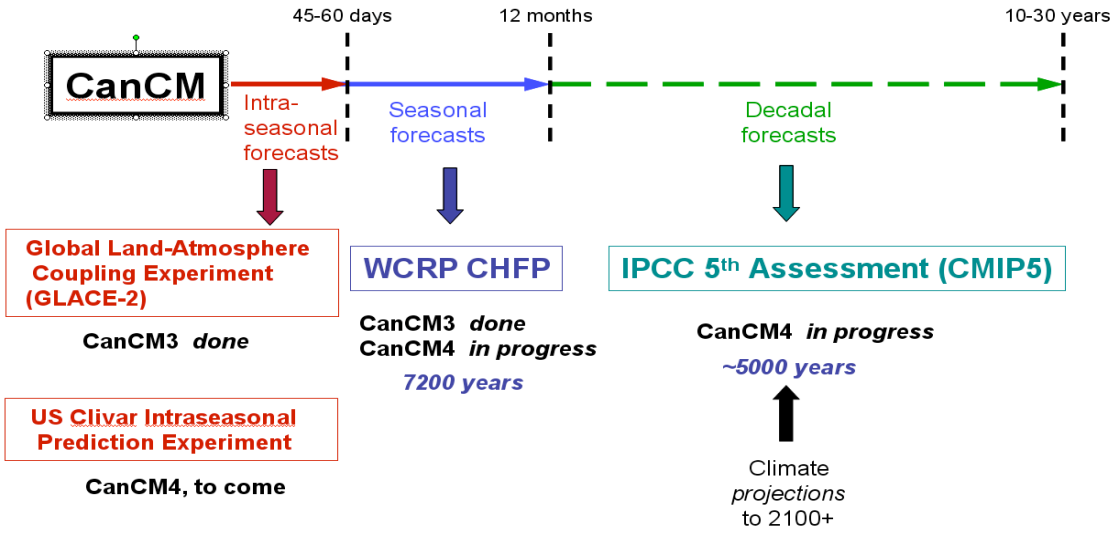
Subseasonal to Decadal Prediction at CCCma

Wm. Merryfield, W.-S. Lee, S. Kharin, G.J. Boer, J. Scinocca, G. Flato

Overview



The Figure above, summarizes most of CCCma's participation in sub-seasonal to decadal prediction research and development.

Models

CCCma's contributions to the WGSIP CHFP and to the decadal prediction component of CMIP5 comprise forecasts from two models:

- CanCM3 couples the atmospheric model CanAM3 (T63L31) to a new ocean model CanOM4 (1.4^{o}x0.94^{o}L40)
- CanCM4 couples CanOM4 to a new atmospheric model CanAM4 (T63L35)

The earth-system version of CanCM4 forms the basis for CCCma's contribution to the climate change simulation component of CMIP5.

CanCM3 includes basic time-dependent radiative effects of greenhouse gases and aerosols and CanCM4 incorporates a more complete treatment including solar and volcanic forcing. Both models show vigorous ENSO-like variability in freely running simulations, with typical amplitudes moderately less than observed in CanCM3, and moderately greater than observed in CanCM4.

Forecast initialization

Initial conditions for the forecasts are generated by an ensemble of coupled assimilation runs. Each run assimilates 6-hourly atmospheric winds, temperatures and moistures from the ERA (=ERA40+ERA interim) reanalyses using a constant incremental nudging (CIN) procedure. SST is relaxed to ERSST values (before 1981) or weekly OISST V2 (1981 to present) datasets and sea ice concentration is relaxed to the monthly HadISST dataset. Three-dimensional ocean temperatures from the monthly GODAS analysis are then assimilated into the model following the method of Tang et al. (2004), with a subsequent salinity adjustment following the method of Troccoli et al. (2002).

The result is a realistic atmospheric initialization, improved initialization of the ocean and improved ground temperatures and soil moistures (compared to analyzed values from Berg et al., 2003). CanCM4 initial conditions for CHFP include volcanic aerosol forcing, which decays with a time constant of 1 year as the forecast proceeds.

Forecasts and analysis

Subseasonal: forecasts based on CanCM3 have contributed to the GLACE-2 project (Koster et al. 2010), and a CanCM4-based contribution to the US Clivar Intraseasonal Prediction Experiment is anticipated.

CHFP: forecasts having an ensemble size of 10 for each of the two models are initiated at the beginning of all months from 1979-2008, running for 12 months. Forecast skills are computed independently for the two models, and also for the combined 20-member multimodel ensemble.

ENSO prediction skills of CCCma/CHFP multiseasonal forecasts are very competitive with retrospective forecasts from other centres in terms of correlation and MSSS scores. Skills of the combined (CanCM3+4) forecasts are generally higher than for either model alone. Because of Canada's northern location, predictions of sea-ice are of interest and there is evidence of some skill for the first several months compared to persistence. A version of the forecast system is being prepared for possible operational use.

Strat-HFP: CCCma will participate in the Strat-HFP forecasting experiment with special L71(100km) vs L41(31km) versions of CanAM3.

Decadal forecasts based on CanCM4 have underway according to CMIP5 specifications and skill analyses are progressing.

Data availability

The CHFP daily and monthly forecast data are being served via an OPeNDAP server at CCCma, which has been configured to mirror the ENSEMBLES data server. At present all atmospheric data from the CanCM3 forecasts are available on this server, with data from the CanCM4 forecasts expected to become available later in 2010.

References

Berg, A. A., J. S. Famiglietti, J. P. Walker, and P. R. Houser, Impact of bias correction to reanalysis products on simulations of North American soil moisture and hydrological fluxes, J. Geophys. Res., 108(D16), 4490, doi:10.1029/2002JD003334, 2003.

Koster, R. D., et al. (2010), Contribution of land surface initialization to subseasonal forecast skill: First results from a multi-model experiment, Geophys. Res. Lett., 37, L02402, doi:10.1029/2009GL041677.

Tang, Y., R. Kleeman, A. M. Moore, J. Vialard, and A. Weaver (2004), An off-line, numerically efficient initialization scheme in an oceanic general circulation model for El Niño-Southern Oscillation prediction, J. Geophys. Res., 109, C05014, doi:10.1029/2003JC002159.

Troccoli A., M. A. Balmaseda, J. Segschneider, J. Vialard, D. L. T. Anderson, K. Haines, T. Stockdale, F. Vitart, and A. D. Fox (2002), Salinity Adjustments in the Presence of Temperature Data Assimilation, Monthly Weather Review 130, 89-102