Assessing Seasonal - Interannual Prediction Skill and Predictability

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http://www.gfdl.noaa.gov/~rgg/si_workdir/Forecasts.html

ABSTRACT

As part of the National Oceanic and Atmospheric Administration (NOAA) Climate Test Bed (CTB) program, plus collaborative efforts with the Asia-Pacific Economic Cooperation Climate Network (APCN) and the International Research Institute (IRI), the Geophysical Fluid Dyanmics Laboratory (GFDL) has developed near real-time fully coupled (Tier-1) and real-time atmospheric (Tier-2) seasonal-interannual (S/I) prediction systems. A number of retrospective (and some prospective) ensemble forecasts have been produced from initial conditions starting as early as January 1979 through the present time. These integrations used the GFDL GCM versions CM2 and AM2 for coupled and atmospheric GCMs respectively. This particular study focuses primarily on a hierarchy of winter season ensemble forecasts for the period 1991 to 2000 using initial conditions from Novembers. The forecasts include Tier-1 predictions and Tier-2 predictions using both predicted and persisted SSTs. Forecasts are compared to observations as well as an ensemble of AMIP runs forced with observed SSTs. Assessments of predictability and forecast skill are made using a number of metrics including signal-to-noise ratio, anomaly correlations, rms errors and anomaly probability forecasts.

S-I Prediction Systems / Experiments

Tier 1

. CM2.0, fully coupled GCM [Delworth, T. L., et al. (CMDT), 2004] –
6 member ensemble, 1 year predictions, 1979->2000+,
I.C. = Jan1, Apr1, Jul1, Oct1; May1 and Nov1 (1991->2000+)

Tier 2

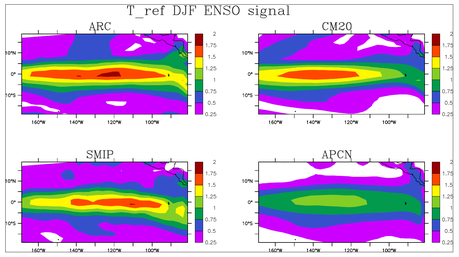
AM2p12b, atmospheric GCM [GAMDT, 2004] -

. AMIP runs (observed SST), 10 member ensemble, 50 + years, 1950->2000+

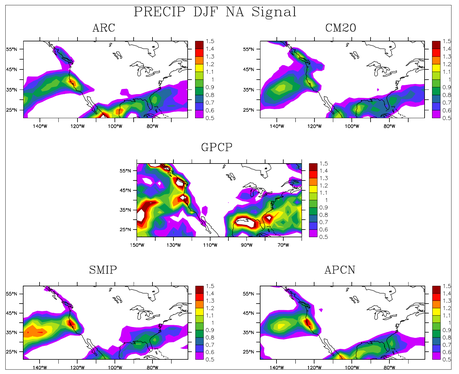
. SMIP runs (persisted SST anom), 6 member ensemble, 6 month predictions, 1991->2000+, IC = Jan1, Feb1, …, Dec1

. CliPAS (APCN) hindcasts/forecast (SNU predicted SST), 10 member ensemble, 5 month predictions, 1979->2005, IC = May1 and Nov1

. IRI (real-time) forecasts (3 predicted + persisted SST), four 10 member ensembles, 7 month predictions, 2004 Aug ->, IC = Jan1, …, Dec1



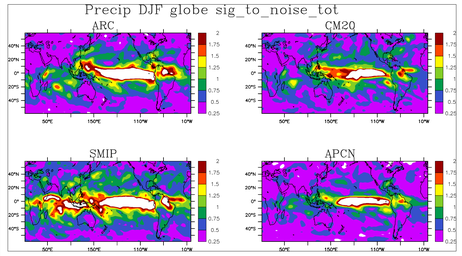
ENSO Signal: AMIP (top left), Coupled (top right), Persisted SST (bot left),APCN Tier 2 (bot right)



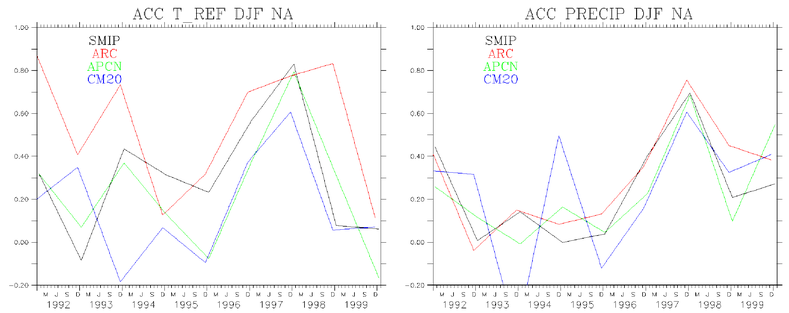
NA Precip Signal: AMIP (top left), Coupled (top right), Persisted SST (bot left),APCN Tier 2 (bot right), GPCP analysis (center)

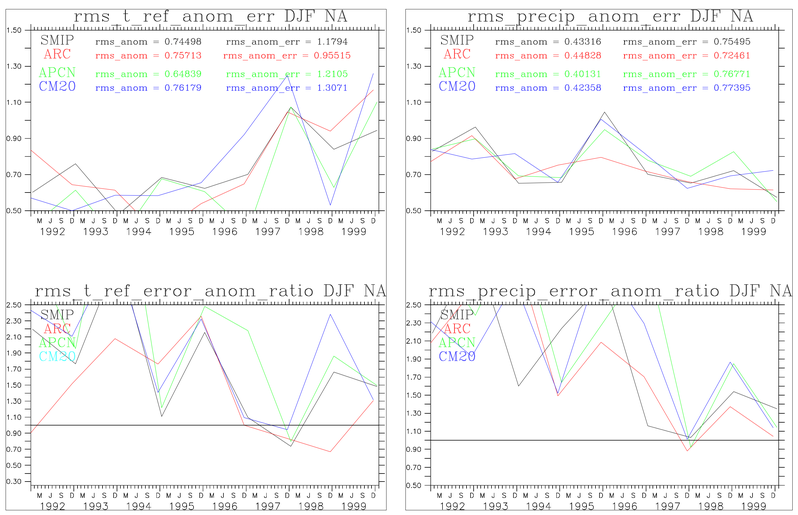
Predictability Metrics

. Signal (S) – Interannual Stnd. Deviation
. Noise (N) – Ensemble Stnd. Deviation
. Signal to Noise Ratio = S/N
. Anomaly Correlation Coefficient (ACC)
. Root Mean Square (RMS) Anomaly Error
. RMS Anomaly Error Ratio



Potential Predictability for 1991-2000 indicated via S/N ~1 or greater.
AMIP (top left), Coupled (top right), Persisted SST (bot left),APCN Tier 2 (bot right)





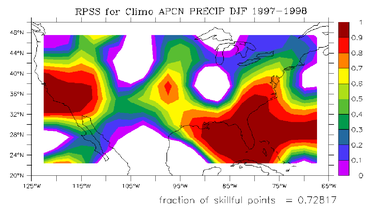
Anomaly correlation coefficients and RMS error stats for 1991-2000 DJF, 2m T (left) and precipitation (right) over N. America.
Seasonal predictions are 1 month lead.

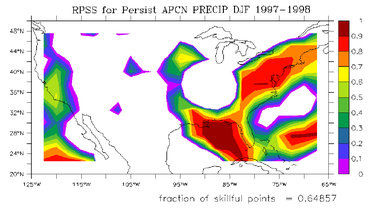
Ensemble Forecast Probability Distributions

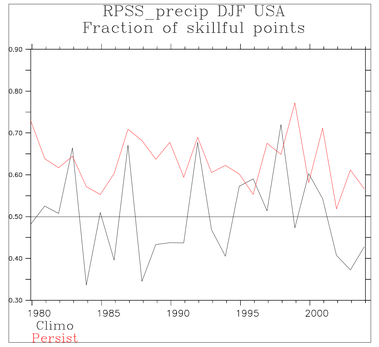
. Tercile Forecasts - 3 category probability forecasts (above, normal, below), using historical GCM integrations to define range of anomalies
. Calculate Ranked Probability Score (RPS) and then Ranked ProbabilitySkill Score (RPSS) following Wilks 1995 and Goddard et al., 2003, i.e.,

RPS = SUM(CP_{Fm}—CP_{Om})^2, where m=1,3 and CP = cumulative probability of a category

RPSS = 1- RPS_{fcst}/RPS_{ref} , where ref = climatology, persistence





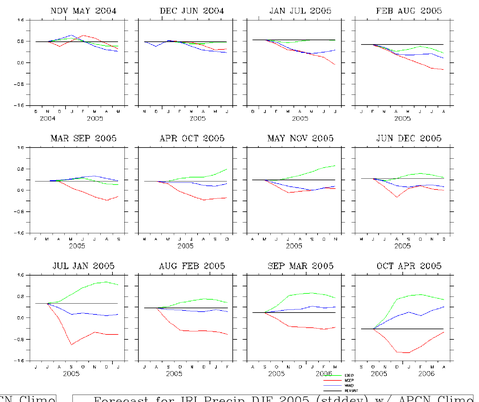


Future Directions

Higher Resolution - M90L24(->56?)

Participate in Tier 1 & Tier 2 SI Predictions as part of CTB, CliPAS, COPES and IRI Multi-Model Ensembles

Need to better assess/sample uncertainty of ocean IC



Winter Forecast
DJF
2005—2006