Decadal Prediction: Can it be Skillful? (BAMS, 2009)

product of 2008 AGCI session

1. Need for decadal predictions

2. Observed and modeled decadal phenomena that could potentially contribute to prediction skill

3. Science and data issues
   a. Initialization
   b. Generation of ensemble forecasts
   c. Predictability

4. Examples of decadal predictions

5. Decadal prediction evaluation

6. Introduce CMIP5 experimental design

Propose we update the 2009 BAMS paper with results from this workshop
Discussion topics:

TECHNICAL ISSUES

--terminology (forecast vs. prediction vs. projection vs. outlook)

--bias correction (not even mentioned in BAMS paper); issue of trend in bias corrected states, initial state-dependent drift; non-linear drift; what about bias-correcting 30 year predictions?

--number of ensemble members vs. number of initial states (every year vs. every 5 years)

--evaluation metrics (RMS, correlation, MSSS, CRPSS, SVD analyses, relative entropy, etc.) Goddard et al BAMS paper in prep

--how to generate ensembles (review various methods being employed)

--Initialization methods (review various methods being employed):
1. Fully coupled data assimilation; 2. Weakly coupled data assimilation; 3) coupled nudging; 4) employ existing reanalyses of atmosphere/ocean and interpolate to model grid; (issue of sea ice); 5) full field vs anomaly

--upper ocean heat content depth (300m, 500m, 700m)

--trend removal for evaluating forced vs. internal (linear vs. nonlinear)

What will be the base climatology? Lagged-average ensemble to increase ensemble size?
SCIENCE ISSUES

--how do we put error bars on prediction maps?

Error bars versus probabilities (range of possibilities) – is there a difference?

Forecast reliability, rather than just deterministic skill.

--seem to get a lot of skill from forcing, some from predicting internal variability (N. Atl, trop Pac); PDO/IPO/PDV, AMO/AMV, AMOC

Different spectral properties (i.e. timescales) from different models for these variability.

--what is the crossover time when initial condition skill gives way to forced skill?

Last paper this was motivated by Hawkins and Sutton graph. Now have results from Grant & Haiyan and from George B.

--are there some initial states that are more predictable than others?

--current status of predictability

--statistical models vs. dynamical models for decadal prediction

Some examples from perfect model context (Hawkins). Is there anything from real forecasts? Hawkins seemed to have some preliminary stuff.

--issue of response uncertainty: calibrated vs. un-calibrated forecasts
--presentation: yr 1, yrs 2-5, yr 6-10, 11-15, 16-20, or a decade: yr 1-10, 11-20, etc.

Should consider this in the signal-to-noise issue.

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Value of first year? Is system still adjusting and first year or two should be thrown out? Probably depends on analysis and initialization. State estimation versus initialization & forecast skill.

What can we learn from the experiments beyond skill. E.g. model errors.

Case studies.

Robustness of mechanisms. Are models getting right answers for right reasons?

Spatial scale
MULTI-MODEL METHODOLOGIES

--will a multi-model ensemble out-perform any single model (as in other applications)?

Even before the MM, do this for ‘all’ individual models.
Send draft of metrics paper (and website) to meeting participants to encourage calculation of metrics that can be put together in this paper.

--will initialization put the forced response on the “right track” so that it outperforms a free-running 20th century simulation without initialization?

‘Committed climate change’ initial condition versus predicting natural variability. How can you actually do this?

--Geert-Jan’s method of trend removal to isolate forced vs. internal variability skill

--Claudia’s method (without weighting) to form pdfs for regions

--Ben’s proposed multi-model averaging with ranges

--Gabe’s hurricanes

-- Holger MOC variability (ENSEMBLES project)

-- Grant range of predictability from different models

--Jerry and Haiyan multi-model averaging
Doug S mention of realtime decadal prediction exchange