SESSION: (B2) Modelling issues in S2D prediction

(B2-04)

Estimating errors in model variability: a comparison between seasonal re-forecasts and continuous multi-decadal simulations with the ECMWF coupled model

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In seasonal and decadal predictions initialised from real-world conditions, the drift of the model's climate (including both mean state and variability) from the observed state to its long-term attractor makes the estimation of systematic model errors particularly demanding, since errors during the drifting phase are dependent on both the phase of the seasonal cycle and the forecast time. Typically, in order to calibrate seasonal forecasts and assess their errors, a large set of ensemble re-forecasts is run, with initial dates spanning all months for at least two or three decades. Because of the substantial overlap between integrations started from dates in consecutive weeks or months, seasonal re-forecast require a total integration time possibly reaching thousands of years: for example, the operational ECMWF system SEAS5 is calibrated using 25-member ensemble re-forecasts spanning 36-years, for a total of 6,300 years of simulation.

In inter-comparison projects aimed at estimation of climate change, the “current” model climatology is usually estimated by running continuous integrations spanning the historical period, initialised from a model state obtained from a long spin-up run. Since all (or at least most of) the climate drift is supposed to occur during the spin-up phase, historical multi-decadal simulations provide estimates of the model mean-state and variability which are representative of the model's asymptotic attractor. A challenging question is to what extent diagnostics of modelled variability in multi-decadal historical runs match corresponding results obtained from initialised re-forecasts in a state of climate drift.

ECMWF has run historical multi-decadal simulations for the 1950-2014 period as a contribution to the EU-funded H2020 PRIMAVERA project, using a version of the coupled model almost identical to that used in the seasonal forecast system SEAS5. This talk will compare diagnostics of low-frequency variability and teleconnections derived from the SEAS5 re-forecasts and the PRIMAVERA historical runs, with a focus on tropical-extratropical interactions during the northern winter and teleconnections associated with monsoon systems. We show that a number of differences (or similarities) between observed and model statistics on atmospheric variability show a similar pattern in the initialised and multi-decadal runs. On the other hand, multi-decadal runs are able to reveal errors in the slow components (deep ocean, sea-ice) of the climate system which are difficult to detect significantly in seasonal experiments because of a smaller signal-to-noise ratio. Therefore, we argue that continuous, multi-decadal historical simulations represent a valuable and conceptually simple addition to the traditional experimental set-up for the optimization of coupled models used in initialised predictions.