Session 5 - Poster P28

Impact of initialisation on the reliability of decadal predictions

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The EUCP Project

The **EUropean Climate Prediction system** project (EUCP) is a new EU Horizon 2020 project, which will develop an **innovative** European ensemble climate prediction system based on a new generation of improved, typically higher-resolution climate models, covering **timescales from seasons to decades** initialized with observations. One of its main goals is to obtain a **seamless** climate prediction system.The climate information provided by the system will be **co-designed with users** to support practical and strategic climate adaptation and mitigation decision-taking on local, national and global scales.

Towards a seamless near term European Climate Prediction System

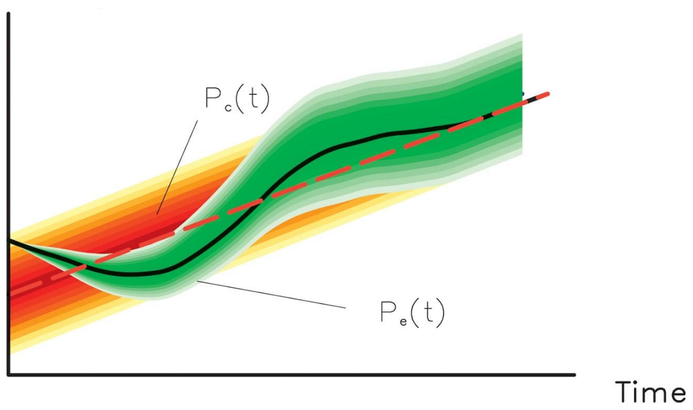

Fig. 1: From Branstator and Teng, 2010, J. Climate. Schematic of a time-evolving distribution under a changing external forcing. The red shadings indicate a probability density distribution of a No-INIT forced simulation (projection) over time, whereas the green shades illustrate the temporal evolution of an INIT forecast distribution of the same quantity.

Develop methodologies to **bring together initialised decadal climate predictions and non-initialised climate projections** (Fig. 1) based on global climate models, in order to provide **seamless climate information** for users over a period of 1 to 40 years into the future with a focus on the European region

- **Comparisons** of predictions: global **initialised** (INIT) **versus non-initialised** (NoINIT) simulations for common prediction time horizons. Estimation of the prediction time until which the INIT predictions show more **skill** than NoINIT simulations for different large-scale and local variables → here compare in terms of **reliability**
- **Combination** of global INIT forecasts with NoINIT forced-only projections. Tests of the combining methods with a perfect model setting. Estimation of **added value** for combined predictions for different variables and regions.

Comparing INIT and NoINIT in terms of reliability

What?

Reliability = *agreement between the predicted probabilities and observed relative frequencies of a given event*

How?

Analysing **rank histograms** and **reliability diagrams** for both INIT and NoINIT **multi-model** runs (total of 36 ensemble members for each, see Table 1) over their common period 1961-2005, for different **variables** (surface temperature, precipitation, sea-level pressure) and **indices** (global mean temperature - GMT, Atlantic Multidecadal Variability index - AMV), and for different **forecast times** (forecast year 1, average of forecast years 1 to 5). Using the **same ensemble size** for INIT and NoINIT to allow for a fair comparison.

*Table 1: List of the different runs used in this study (models with * were not yet included in the results below).*

Project	Centre	Model (version)	INIT ensemble size	NoINIT ensemble size
CMIP5	BCC	BCC-CSM1.1	4	1
CMIP5	CCCMA	CanCM4	10	10
CMIP5	BSC	EC-Earth*	5	11
CMIP5	NOAA-GFDL	GFDL-CM2.1	10	10
CMIP5	Met Office	HadCM3 (full field)*	10	10
CMIP5	Met Office	HadCM3 (anomaly)*	10	10
CMIP5	MIROC	MIROC5	6	3
DPLE/LENS	NCAR	CESM1-CAM5*	40	42
SPECS	IPSL	IPSL-CM5A-LR	3	4
SPECS	MPI	MPI-ESM-LR (v1)	5	3
SPECS	MPI	MPI-ESM-LR (v2)	3	3
SPECS	MPI	MPI-ESM-MR	5	3

First results : the Multi-Model AMV index

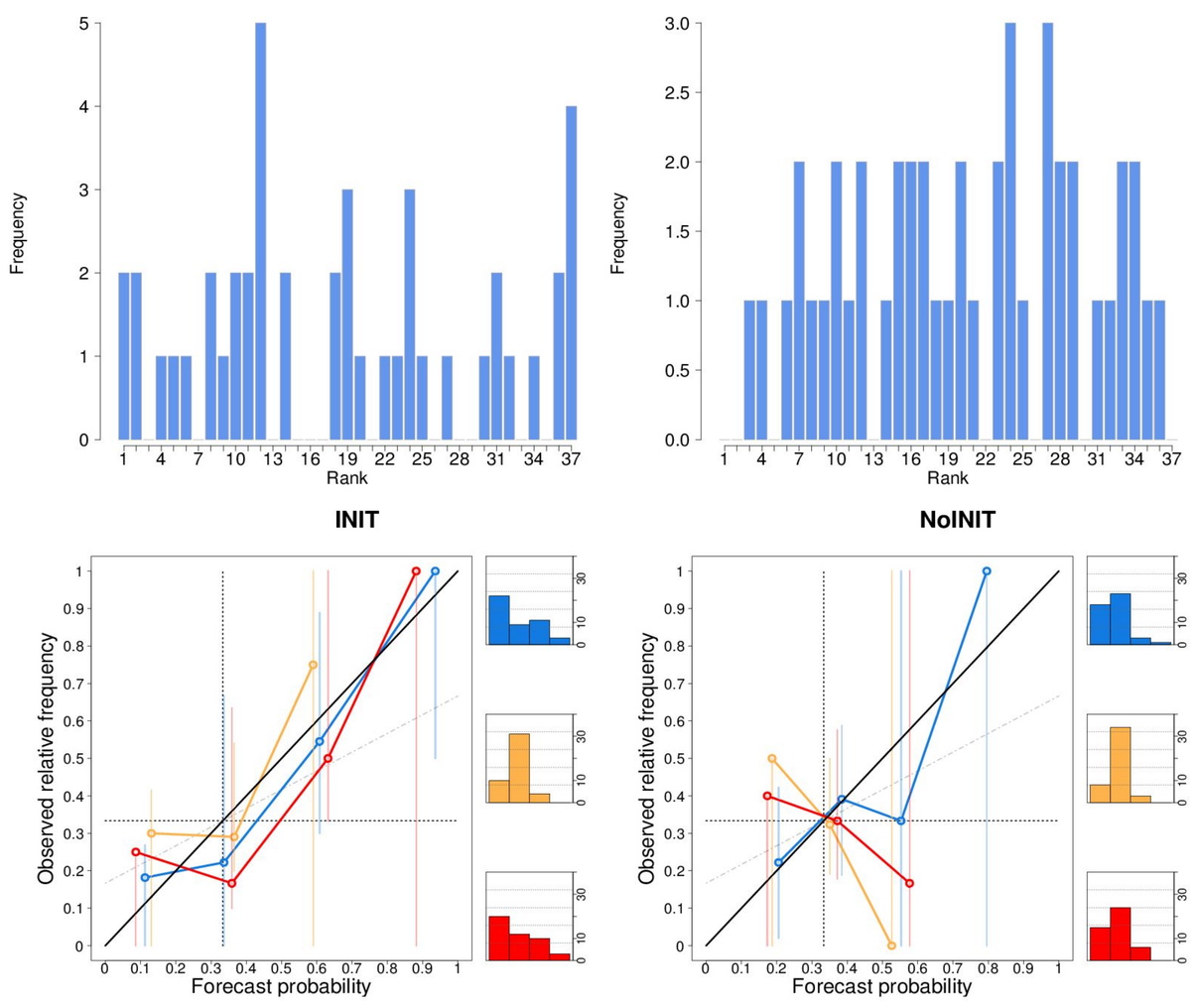

Fig. 2: Reliability analysis for the MM (8 models, 36 ensemble members) AMV index in INIT (left) and NoINIT (right) simulations, over the period 1961-2005, for forecast year 1. Above: Rank histograms. A perfectly reliable forecast would have a flat rank histogram. Below: reliability diagrams. Three events are represented: above-normal (red), normal (orange) and below-normal (blue). The sharpness diagrams (smaller panels) show the predicted frequencies for each event and probability range. The diagonal line indicates perfect reliability. The dot-dashed line represents the no-skill line. Consistency bars illustrate how likely the observed relative frequencies are under the assumption that predicted probabilities are reliable. (Verfaillie et al., in prep.)

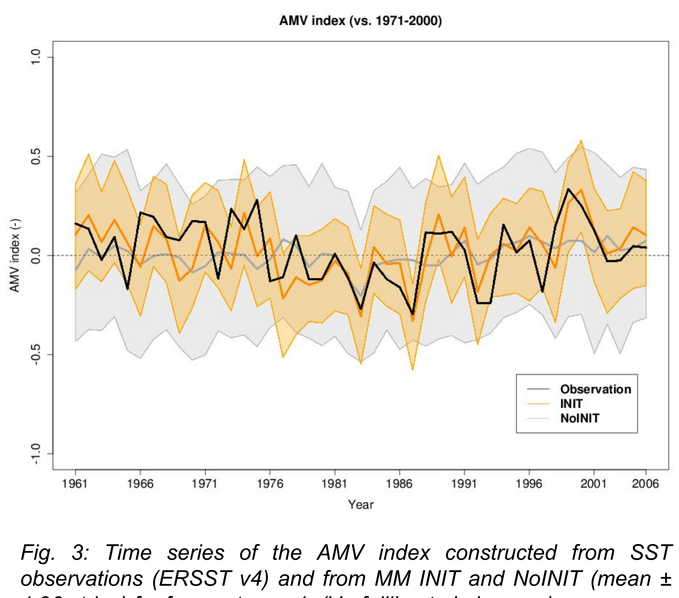

Fig. 3: Time series of the AMV index constructed from SST observations (ERSST v4) and from MM INIT and NoINIT (mean ± 1.96 stdev) for forecast year 1. (Verfaillie et al., in prep.)

First results using the Multi-Model (MM) **AMV index**, as defined by Trenberth and Shea (2006), show:

- **better agreement** with observed time series and **less spread** in INIT compared to NoINIT (Fig. 3)
- **more reliability for INIT than NoINIT**. This is especially the case in reliability diagrams, rank histograms providing less clear information (Fig. 2). Other preliminary results using the GMT (not shown) are not as conclusive.

Next steps

- Use a **larger ensemble**, including EC-Earth, HadCM3 and CESM1-CAM5 models
- Use **CMIP6** simulations once available
- Assess the reliability of **calibrated** ensembles?
- Look at **precipitation**, **surface temperature** and **sea-level pressure** over specific regions (Europe, Atlantic, Pacific, …)

Acknowledgments

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