SPECS/PREFACE/WCRP Workshop on Initial Shock, Drift, and Bias Adjustment in Climate Prediction
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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Towards the operational use of climate forecasts at DWD – technical challenges and user involvement

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Fig. 1: Schematic of seamless prediction

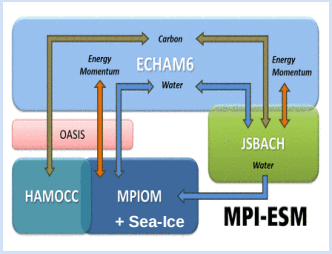

Fig. 2: Schematic overview of climate model.

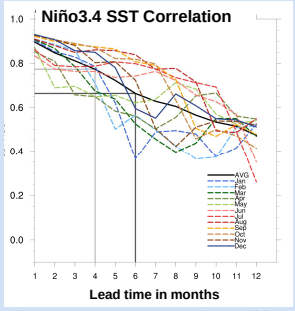

*Fig.3: **SEASONALS**: ACC of Ensemble mean SST for all 12 start months (1981-2014):*
- *4th month: 0.78*
- *6th month: 0.67*
- *low skill at forecast starts in late winter and spring*
- *good for starts in summer and autumn*

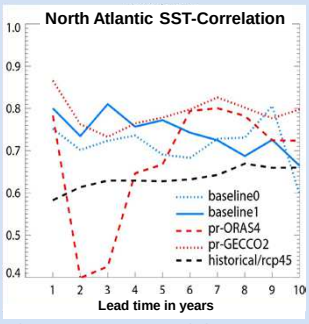

*Fig. 4: **DECADALS**: Correlation coefficients of modelled SST compared to observations against lead year (40°-60°N, 0°-60°W). Full-field initialization (pr-ORAS4, pr-GECCO2) – problems pronounced for early lead years. Adapted from Pohlmann et al. (in preparation).*

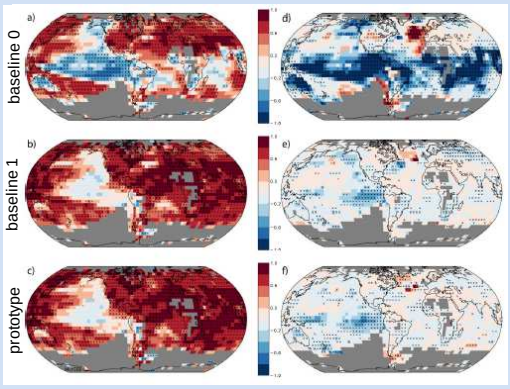

*Fig 5.; **DECADALS**: Anomaly correlation (left) with anomaly correlation of historical subtracted (right) of surface temperature averaged over the lead years 2-5 (MPI-ESM-LR). Adapted from Marotzke et al. (2016).*

Deutscher Wetterdienst (DWD) plans to provide seasonal forecasts routinely beginning in summer 2016. On the decadal time scale DWD is involved in the MiKlip II project on medium range climate forecasts funded by the German Ministry of Education and Research with the aim of establishing decadal forecast operational use in 2019. With this project we also initiate a close interaction with potential users of climate forecasts discussing their needs and the limitations of the climate forecasts directly. This assures that the users understand and utilize correctly the newly available decadal prediction data.
With the poster we present the strategy of DWD on the way from the model output to the forecast product.

Seasonal Forecasts

The seasonal prediction system GCFS1 (German climate forecast system) is jointly developed by MPI-M, University Hamburg and DWD. The setup is based on a CMIP5-close version of MPI-ESM-LR.

Assimilation: Full-Field-Nudging		
Atmosphere	**Ocean**	**Sea-ice**
vorticity, divergence, temperature, surface pressure	temperature, salinity (3D)	sea-ice concentration
HC: ERA-Interim FC: IFS-Analyses	HC: ORA-S4 FC: ORA-S4 near-real-time	HC: NSIDC NASA team FC: ORAS4 near-real-time
relax Time: 1day	relax Time: 10days	relax Time: 20 days

Initialised from full-fields in both atmosphere and ocean, the system shows strong drift in the first 3-6 months particularly in regions where the model climate shows large errors (Baehr et al., 2015) (Fig. 3). However, after an a posteriori bias correction the hindcast skill is largely what can be expected from such a system.

Decadal Forecasts

The current setup (pre-operational) is based on the MPI-ESM-HR model (Müller et al., 2016) which will produce an ensemble prediction in a resolution of T127L95 (Ocean TP0.4L40). By the end of the project phase a transition to the ICON model is planned. During the first phase of MiKlip several systems with the low resolution version of MPI-ESM (T63L47, -LR) were used (Marotzke et al. 2016). Both anomaly and full-field initialization and two ocean reanalysis data sets (ORAS4 and GECCO2) were tested. Initializing with ocean reanalyses data improved the skill of the hindcasts compared to the uninitialized simulations initialization (Kröger et al., 2016).

Initialization technique (Fig. 4 and Fig. 5)	
Anomaly	+ No initialization shock + Lower bias in early lead years - Reduced skill in tropical pacific
Full-Field	- Initial drift towards cold-bias not recovering during decadal simulation - Drift problematic for downscaling applications - Reduced skill in the North Atlantic + Increased skill in the tropical Pacific + Higher correlation in late lead years (yr 6-9) - ORAS4: Lower correlation in early lead years - GECCO2: Higher RMSD in early lead years

For the pre-operational decadal prediction system the strategy is to proceed with anomaly initialization as the default and further test with nudging coefficient settings of the full-field. The higher resolution is expected to increase stratospheric variability and should provide a better understanding of the biases.

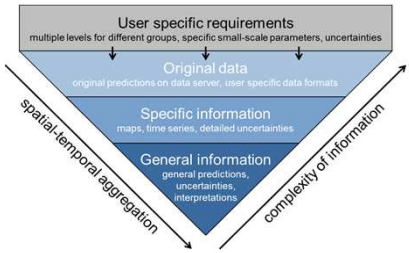

Fig. 6: Schematic overview of possible multi-level standard decadal prediction products following user needs.

User-oriented products

The project SUPPORT aims at analysing user needs in decadal predictions, e.g. via annual workshops. Furthermore, user-oriented test products will be developed in close interaction. A questionnaire was filled out by 69 public administration or research institutions. It reveals extensive wishes in terms of decadal prediction pro-ducts: quality of hindcasts, mean and spread of forecast ensemble, different variables (mainly temperature & precipitation), transient 10-year time series, yearly updates, regional or local scale over Germany, graphs and maps with interpretation text.
The first user workshop on decadal predictions at DWD in April 2016 was attended by 30 members from administration or research institutions and private companies. They discussed requirements of possible decadal prediction products: multiple levels for different user groups, specific small-scale parameters, communication of uncertainties. A first attempt for possible multi-level standard decadal prediction products is shown in Fig. 6. Some specific products will be developed in close cooperation with selected users. These test products will incorporate bias and drift adjust-ments developed within the *MiKlip II* community.

Baehr et al, 2015: The prediction of surface temperature in the new seasonal prediction system based on the MPI-ESM coupled climate model. *Climate Dynamics*. **44**, 2723-2735

Domeisen et al, 2015: Seasonal Predictability over Europe arising from El Nino and Stratospheric Variability in the MPI-ESM Seasonal Prediction System. *J. Clim.*, **28**, 256–271.

Kröger et al., 2016: Evaluation of full-field initialization for the MiKlip decadal prediction system: An initial shock in the North Atlantic. (in preparation).

Marotzke et al. 2016: MiKlip - a National Research Project on Decadal Climate Prediction, *BAMS* (submitted)

Müller et al., 2016: A high resolution version of MPI-ESM-1, *JAMES* (in preparation)

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See further contributions to this activity:
Poster: Kröger et al.: Evaluation of full-field initialization for the MiKlip decadal prediction system: An initial shock in the North Atlantic.
Talk: Pohlmann et al: Slow recovery from initialization shock in the tropical Pacific in MPI-ESM decadal hindcasts

FONA Decadal Climate Prediction BMBF
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