

VECAP: VERification, CALibration and ASsessment of Predictability of Medium-range Climate Predictions Using Satellite Data

Project Status:

VECAP is a joint project of the DWD (Deutscher Wetterdienst) and the MIUB (Meteorologisches Institut der Universität Bonn) that contributes to the probabilistic evaluation of the MiKlip system using reanalyses and satellite data. One focal point is the simulation of satellite radiances from climate model output which enables an evaluation in the instrument's parameter space, thereby reducing uncertainties on the side of the observational datasets.

During the first phase of the VECAP project, a basic suite of statistical methods for the probabilistic evaluation of the MiKlip system was developed (MIUB) and provided to Module D. The methods have been used for a first probabilistic evaluation of the MiKlip system (Baseline 0 and Baseline 1, MIUB and DWD). Satellite simulator software (COSP) was successfully tested with MPI-ESM for CloudSat and IASCI and is currently used in the development of simulators for TRMM PR and IASCI (DWD). With this, the milestones M1.1, M1.2 and M2.1 have been accomplished.

Recommendations:

- MIUB: Use of the basic evaluation suite (VECAP-tools) for the probabilistic evaluation of MiKlip system.
- DWD: Inclusion of COSP (at minimum for ISCCP, TRMM PR, IASCI) for generation of a subset of MiKlip prototype simulations by Module D.
- DWD: Use of selected parameters from satellite-based CM SAF datasets HOAPS and CLARA-A1 (formerly AVHRR GAC) for standardized evaluation of the MiKlip system.
- MIUB: Use of a fixed ensemble size with same number of runs for each starting point for the MiKlip prototype system.
- MIUB: Enhancement of the ensemble size of the uninitialized 20th century runs to match the ensemble size of the prototype system.

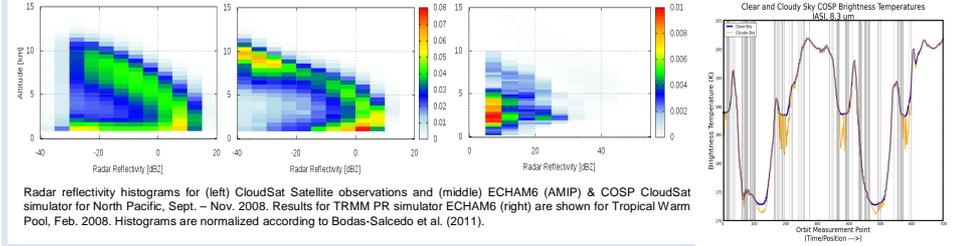
Basic evaluation system (WP0; MIUB): Statistical methods for the standardized evaluation of the MiKlip hindcasts and forecasts are developed using scores and skill scores.

Satellite simulators (WP3; DWD): Satellite simulators are developed for TRMM PR and IASCI utilizing COSP (Bodas-Salcedo et al., 2011) for use with ECHAM6. The approach requires physical assumptions to represent hydrometeors and the consideration of sub-grid scale variability.

Methods

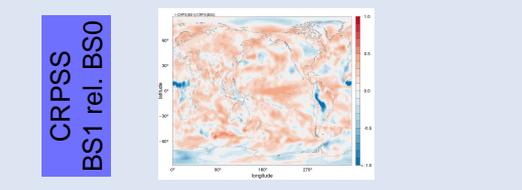
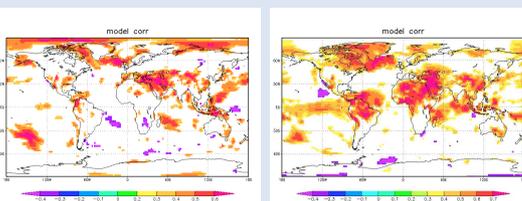
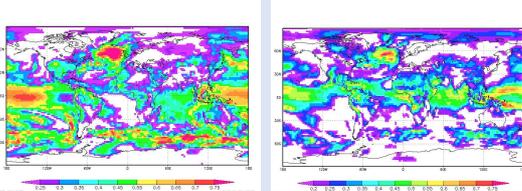
- ANOVA (*Analysis of Variance*): Tests whether the model signal is sharp. The variance between different ensemble mean predictions should be a large part of the total variance.
- ANALYSIS-RANK HISTOGRAM ARH: Average of the rank of each observation within the associated ensemble of model predictions.
- CRPSS: CRPS is the averaged comparison of the predictive model CDF with observations. CRPSS is the CRPS skill score of the predictive CDF relative to the climate CRPS or another reference (e.g. Baseline1 vs. Baseline 0).
- BASICS: Means, biases, standard deviations, ratio of standard deviations, correlations between model prediction and observations.
- ESS (*Ensemble Spread Score*): Quotient between the average ensemble spread and the prediction error variance.
- BSS: Analog to CRPSS for discrete cases comparing predictive probabilities against events of observations.

CloudSat CPR TRMM PR IASCI



- The COSP radar simulator was successfully tested for the **CloudSat Cloud Profiling Radar (CPR)**. Results show an overestimation of thin cirrus clouds, an underestimation of clouds in the mid- to high-troposphere and the too frequent occurrence of weak precipitation events in ECHAM6.
- A first radar simulator version was implemented for **TRMM Precipitation Radar (PR)** using nadir geometry. Results indicate that the strength of the signals is too weak.
- For **IASCI**, both clear-sky and overcast cases are functional in the COSP simulator utilizing RTTOV. The overcast case is currently carried out using simple assumptions in place of missing parameters (i.e. convective cloud cover, cloud type, and liquid/ice water content). Furthermore, fractional cloud cover requires the consideration of subgrid-scale variability, which will be included via a maximum-random overlap approach.

Evaluation of Surface Air Temperature (TAS) Baseline 0 Baseline 1



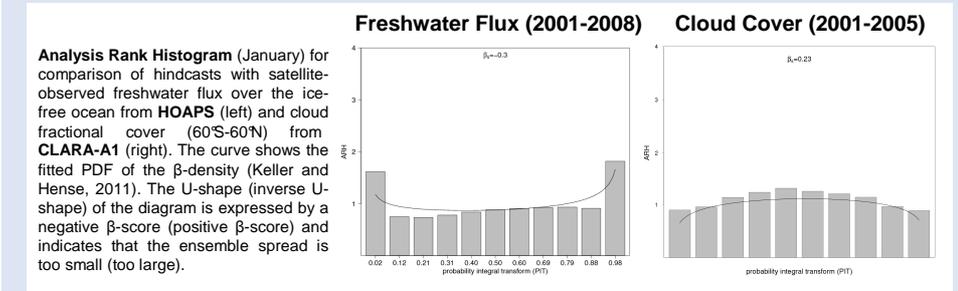
ANOVA

COR

CRPSS BS1 rel. BS0

Probabilistic evaluation using CM SAF satellite data (WP2; MIUB & DWD): Methods developed within WP0 are used to evaluate MiKlip hindcasts against satellite-based freshwater flux from HOAPS (Andersson et al., 2010) and fractional cloud cover from CLARA-A1 (Karlsson et al., 2013).

- Results are shown for a 10-member ensemble of Baseline 0 initialized in January 2001.
- Cloud data for MPI-ESM are obtained by applying the ISCCP simulator to model output.



- Evaluation of hindcasts against satellite-derived data using ARH shows (i) an underestimation of the hindcast ensemble spread for freshwater flux over the ice-free ocean and (ii) an overestimation of the ensemble spread for global (60°N-60°S) cloud cover.

Literatur:
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