Monitoring and Modelling of Mass Variations and Transport in the System Earth (MOMA-EARTH)

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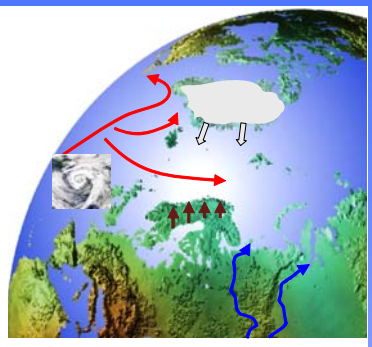
Project Goal:

Determination of a consistent time series of global mass variations and mass exchange in the Earth system from geophysical models for atmosphere, ocean, hydrology, ice mass, solid Earth and from GRACE observations.



Objectives & Expected Results:

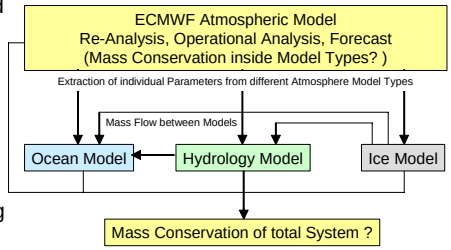
(1) Improved geophysical models of global mass variations with special emphasis on mass exchange and mass conservation.
(2) Generation of a multi-year time series of gravity field variations by combination of geophysical model results and synthesis of GRACE gravity field time series.
(3) Studies on prediction of gravity field variations including their feedback/benefit to geophysical models and separability of mass variation phenomena from the integrated gravity field time series.

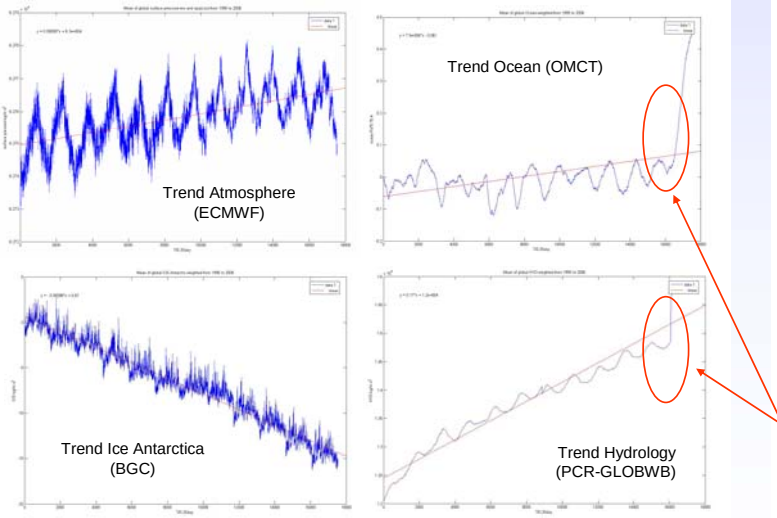
Motivation for the Project:

Geophysical Models for the sub-systems of the Earth differ significantly concerning resolution in time and space as well as in the applied schemes for mass exchange and mass conservation. In order to combine them with observations from GRACE as well as to apply them for Earth system simulation studies they need to be linked together adequately and mass conservation within the water cycle has to be ensured. Until today, models applied in the SPP1257 do not yet fulfill these requirements. Also using GRACE results for scaling and/or combining the geophysical models not yet is at a conclusive stage and need further investigations.

The chart on the right hand side shows the mass fluxes between the geophysical models of the water cycle.

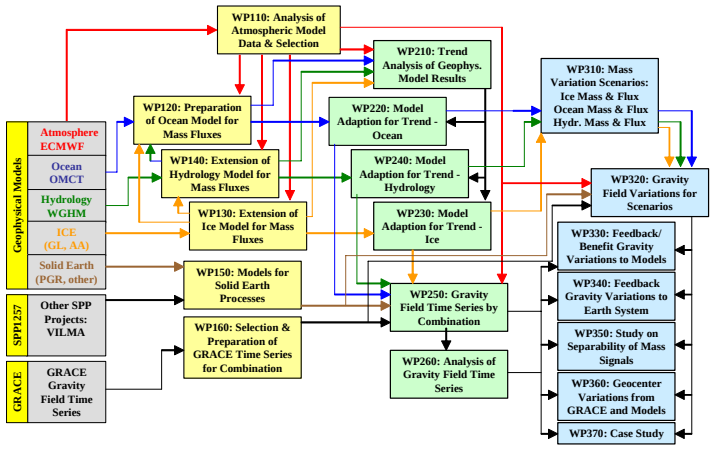
The figures below show some results from a preliminary study regarding mass conservation & trends in the geophysical sub-systems.





Project Structure & Goals:

Input:	WP100:	WP200:	WP300:
State of the Art Models & Data	Geophysical Models & Mass Exchange	Combination of Models & Mass Conservation	Prediction, Model Feedback, Application, Separability

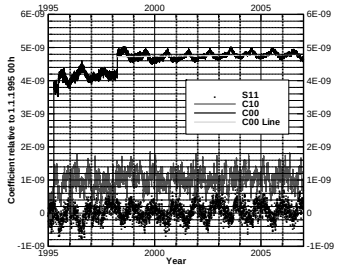


Relations to SPP1257 Goals & Projects & other DFG Projects:

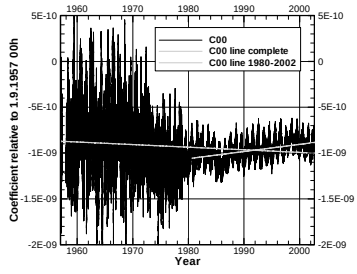
- The proposed project aims to contribute to the main SPP1257 goal: "Consistent Data Combination and Mass Signal Separation"
- The proposed project interacts with several other SPP1257 projects: MaSiS, JIGOG, IDEAL-GRACE, ANTARCTIC-IMB, GREENLAN-ISE and VILMA.
- The results of the proposed project also contributes to the goals of the DFG research unit: "Earth Rotation and Global Dynamic Processes"

Preliminary Trend Analyses for Geophysical Models:

All geophysical models contributing to the water cycle are driven by parameters from the same atmospheric model (see chart on the left hand side). Therefore the atmosphere model plays a central role for consistent modeling of mass flux and mass conservation in the water cycle. The figures below and on the left hand side show trend analyses for different versions and time periods of the ECMWF atmosphere model.



Time series of degree 0 and 1 gravity potential harmonics determined from ECMWF operational analysis surface pressure.



Time series of degree 0 gravity potential harmonics determined from ECMWF re-analysis surface pressure data.

Also mass flux between the geophysical models and mass conservation of the water cycle need to be modeled consistently. Any problem in one domain immediately would have impact in other geophysical domains. Example: From the preliminary study one can identify the impact of a jump in the hydrology model to the ocean model (see jumps in the global mean for both models).