The Stable Water Isotope Intercomparison Group (SWING)

First Results of a New Model Intercomparison Study

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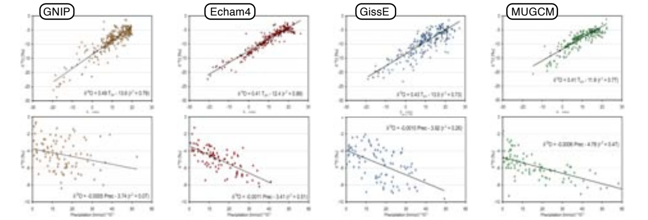
Project Objectives

The general purpose of the SWING project is an international inter-comparison of current state-of-the-art general circulation models with stable water isotope ($H_2{}^{18}O$, HDO) built into the hydrological cycle (so called Isotope GCMs) and related observational isotope data. It brings together scientists with a common wide range of interest in both modeling and measuring stable water isotopes and its application to the Hydrological Cycle and Earth System problems.

The SWING project serves as a platform exploring the following topics:

- enable an overview about ongoing isotope GCM modeling capabilities
- serve as a platform for common isotope simulation experiments of the various research group (model-model-intercomparison)
- identify the most important need of new observational isotope data in space, time and the various aggregate forms of water (model-data-intercomparison)
- strengthen the linkage between the modeling community and the key contributors of observational water isotope data
- serve as an interface to other isotope model intercomparison studies, e.g. IPILS (see lower right text box "Cross Linkage to Other Projects")



Comparison of "Temperature Effect" and "Precipitation Effect" of all 3 GCM versus GNIP observations: All three models reproduce both effects fairly well, but show less variability than the GNIP data. Temperature (Precipitation) Effect is analyzed for all observational data with 2m temperature below (above) 20°C, only. Model results are interpolated to match the GNIP station locations.

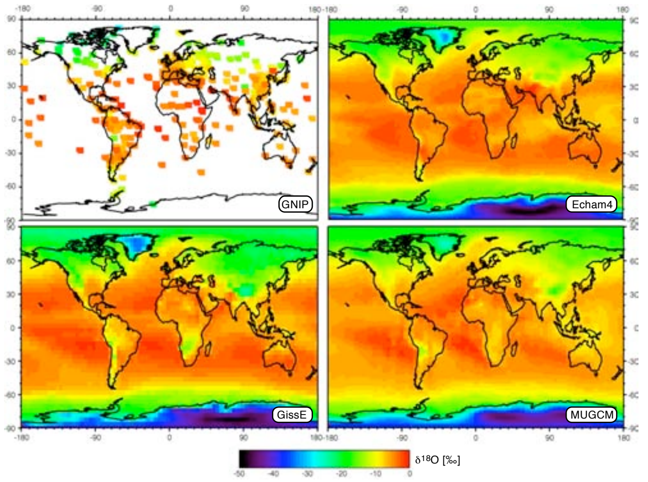
SWING Simulations & Analyses

First common SWING simulations and analyses focus on model-data-intercomparison for the present-day climate. Results presented here stem from 3 different Isotope GCMs (spatial resolution in brackets):

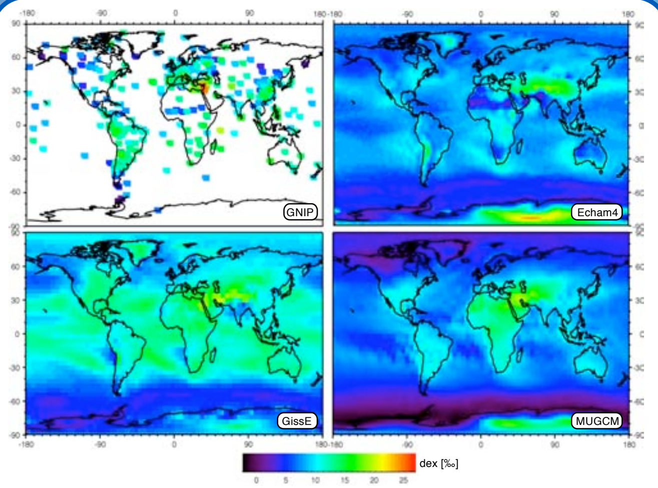
Echam4 (~2.8°x2.8°) GissE (5°x4°) MUGCM (~5.6°x3.3°)

All three Isotope GCMs were run for a 20-year simulation period with identical boundary conditions: HadISST Data, atmospheric CO_2 level of the year 1980, present-day solar insolation, no isotope enrichment of ocean surface layer. Model simulation results are compared to the latest Global Network of Precipitation (GNIP) data set compiled by the Isotope Hydrology Section of the IAEA.

Future SWING simulations will include a transient simulation spanning the last century plus several paleo time slices (e.g LGM, YD, 8.2k).



Global pattern of long-time mean $\delta^{18}O$ values of precipitation as derived from GNIP observational data (upper left plot), and the Echam4 (upper right), GissE (lower left) and MUGCM (lower right) simulations. All models are capable of simulating the main characteristics of the global pattern: a temperature-related gradient from low to high latitudes, gradual $\delta^{18}O$ depletion on continents, strong $\delta^{18}O$ depletion over polar ice sheets. However, model results show some substantially differences on a regional to continental scale (e.g. Southern Africa, Greenland).



Global pattern of long-time mean Deuterium Excess (dex, defined as dex = $\delta D - 8\ \delta^{18}O$) values of precipitation as derived from GNIP observational data (upper left plot), the Echam4 (upper right), GissE (lower left) and MUGCM (lower right) simulations. In contrast to their good agreement in reproducing the global $\delta^{18}O$ pattern, the models show substantially differences in this "second-order" isotope effect in most regions. None of the models is capable of reproducing the strong positive Deuterium Excess values in the eastern part of the Mediterranean Sea.

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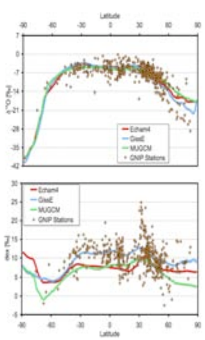

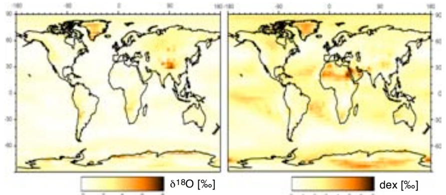

<u>Above:</u> Global pattern of the standard deviation (1σ) of the simulated long-time mean $\delta^{18}O$ and Deuterium Excess (dex) values, based on the 3 different GCM simulations. For $H_2{}^{18}O$, analyses show strongest model differences for Greenland, the Himalayan Plateau, and coastal Antarctica. For the Deuterium Excess, model differences are found for Greenland, Northern Africa, interior Antarctica, and tropical Pacific and Atlantic Ocean regions.

<u>Left:</u> Latitudinal average of the simulated long-time mean $\delta^{18}O$ and Deuterium Excess of the three different GCM (colored lines), as compared to the GNIP observations (diamonds). All models show similar latitudinal mean $\delta^{18}O$ values, but differ in their dex values. They all tend to underestimate $\delta^{18}O$ depletion (dex enrichment) between 60°N- 90°N (0°- 45°S).

Cross-Linkage to Other Projects

- SWING is a working group of the GEWEX Hydrometeorology Panel (http://ecpc.ucsd.edu/projects/ghp/).
- IPILPS (Isotopes in Project for Intercomparison of Land-surface Parameterization Schemes) comprises the land-surface modeling component of the SWING project (http://ipilps.ansto.gov.au).

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