MEGARUN

SIMULATION AND UNDERSTANDING OF GLACIAL CYCLES

Abstract: The main goal of the MegaRun activity is to improve understanding of the role which ice sheets played in past climate change and to study the interrelation between internal dynamics of the ice sheets and CO_2 under the influence of orbital forcing.

MOTIVATION

Despite numerous empirical investigations and modeling studies, the nature of glacial cycles remains poorly understood. The lack of progress in solving the glacial cycle puzzle might be related to the existence of fundamental gaps in our understanding of the Earth system. Alternatively, it is possible that all major processes are known and sufficiently well understood, and 'just' putting together all essential components can lead to a breakthrough in the understanding of glacial cycles. The goal of MegaRun is to test the second possibility by using the Earth system model of intermediate complexity CLIMBER-2.

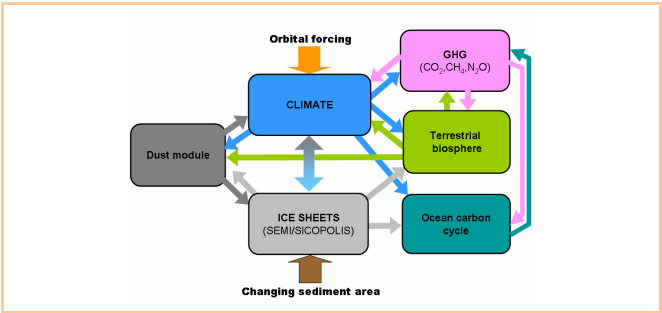

Figure 1. Principle structure of the CLIMBER-2 model illustrating the interaction between different components envisaged in MegaRun activity.

AIM OF ACTIVITY

We aim to simulate the temporal dynamics of the climate and the Northern Hemisphere ice sheets during the Quaternary with orbital forcing as the **only externally prescribed** forcing. Changes in the atmospheric concentration of major greenhouse gases and eolian dust will be simulated. *MegaRun* will span at least the last 2 million years, the period of time which encompasses two distinct regimes of glacial variability: the dominant 40-kyr cyclicity before 1 Myr BP and the dominant 100-kyr cyclicity during the last 1 million years.

PROGRESS REPORT

Most of the model components required for *MegaRun* have already been developed, implemented, coupled and tested within the QUEST projects during the past decade. Recently, we performed a series of simulations

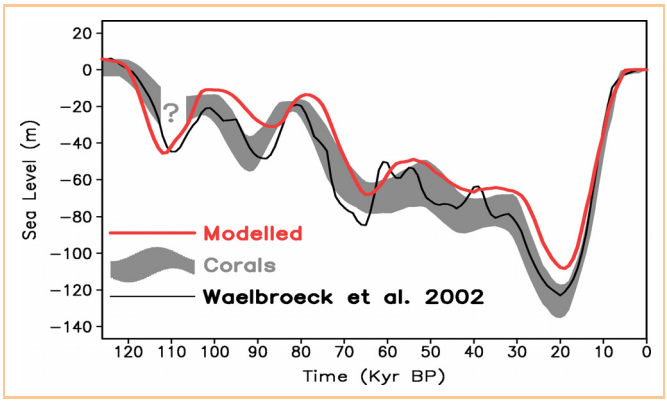

Figure 2. Simulated sea level during the last glacial cycle

of the last glacial cycle with CLIMBER-2 forced by orbital variations and atmospheric greenhouse gases. We do have some promising results towards explaining glacial-interglacial CO_2 variability. Individual modules which are required for the MegaRun, such as oceanic carbon cycle, dust have been tested.

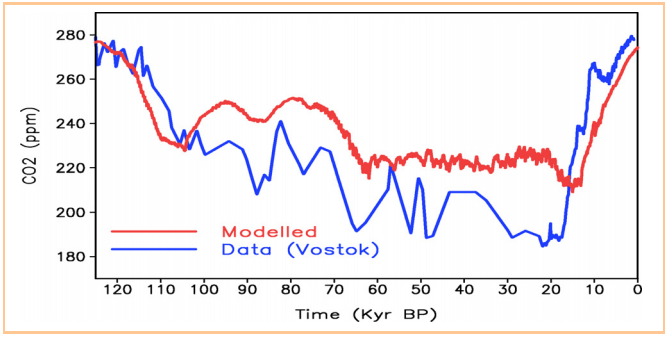

Figure 3. Offline simulation of atmosphericCO_2 concentration during the last glacial cycle

FUTURE WORK

• Analysis of model sensitivity. Testing of hypotheses of the mechanisms of the mid-Pleistocene transition. Starting *MegaRun*, i.e., performing a model run over the past 2 million years driven by orbital variations only.
• Testing of Ruddiman's hypothesis on early anthropogenic climate change. Applying the model to the future with a number of CO_2 emission scenarios to assess the long-term and extremely long-term impact of the anthropogenic climate change on the ice sheets.

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RESEARCH DOMAIN I - EARTH SYSTEM ANALYSIS
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