SUMO - Supermodeling by combining imperfect models

Work package 5: Year 1

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November 4, 2011

Summary

The goal of WP5 is to construct a super climate model and use it to perform a climate change projection. The following three state-of-the-art climate models were selected:

- ECHAM5/MPIOM from the Max-Planck Institute for Meteorology,
- ECHAM5/NEMO from IFM-GEOMAR, and
- IFS/NEMO, an initiative from European Centre for Medium-range Weather Forecast (ECMWF) member states, lead by the KNMI

In Year 1, WP5’s aim was to construct a super climate model from these models with manually chosen connections, and this was project deliverable 5.1, due at month 12. Unfortunately, the work in WP5 was significantly delayed, because this part of the project was moved to the University of Bergen with Noel Keenlyside, when he began a new appointment there at 15th of August. The work in WP5 effectively began on August 20th, with the appointment of Dr. Mao-Lin Shen, as a SUMO funded postdoctoral scientist.

Important progress was nonetheless made in three areas. First, an initial design for the prototype super climate model was determined. The model will consist of two atmospheric models (ECHAM5 and IFS) coupled to one ocean model (NEMO or MPIOM). Atmospheric fluxes will be computed independently in each atmospheric model from ocean/sea-ice surface boundary conditions. The ocean model will be driven by a weighted combination of these fluxes, i.e.,

\[ F_i^o = \alpha_i F_i^{a1} + (1 - \alpha_i) F_i^{a2} \]  

(1)

where \( F_i \) is flux \( i \) (e.g., zonal wind stress) received by the ocean model \( o \) from atmosphere models \( a1 \) and \( a2 \). Different fluxes may be differently weighted: \( \alpha_i \). This
formulation follows Kirtman et al. (2003) who restricted themselves to $\alpha_i = \{0, 1\}$, but will extend on it to consider $\alpha_i = [0, 1]$. Choice of $\alpha_i$ shall be initially manual, but simple stochastic-based training schemes that minimize model mean errors will also be tested. The above formulation is not necessarily conservative, and strategies to overcome global imbalances, such as computing global corrections, could be needed.

Second, the benefits of several coupling software were assessed, and a decision was made to use a pseudo parallel version of OASIS3 (Valcke, 2010). This version allows different fields to be exchanged between models on different processes, allowing an efficient exchange of data among model components and limiting the exchange bottleneck. OASIS4 software was not selected, as only a beta version is available. The NCAR coupler was also not selected, although its parallelisation strategy is superior to OASIS3. Adopting it would involve significant coding, and as there are only two years of the project remain, this is currently not deemed to be an option. However a different strategy may be followed, depending on whether this choice is not satisfactory and the results from WP3 on the testing of other coupling strategies. To become familiar with the OASIS3 coupler, Mao-Lin Shen attended an OASIS3 training session in Toulouse, 7th-9th September 2011.

Third, work began on porting the Kiel Climate Model to a scalar architecture. This is necessary to take full advantage of computer power in Germany and later in Norway. This has involved updating OASIS3 to the pseudo-parallel version.

Due to the delays described above, deliverable 5.3 to construct a super climate model with manually chosen connections shall be delivered in 4-6 months.

References
