

Understanding of Processes in Decadal Climate Variability

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The new German research project "MiKlip – Decadal Predictions" (<http://www.fona-miklip.de/en/>) aims to develop a system for climate predictions for up to a decade ahead. One part of MiKlip (Module B) deals with the incorporation of those processes in climate models that are important for the realistic representation of decadal climate variability, and the understanding of the important processes in the numerical prediction system.

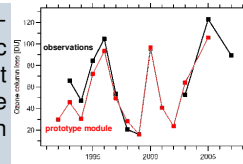
Stratosphere Processes

solar forcing and internal variability (STRATO)

Application of chemistry climate model EMAC (ECHAM-Messy Atmospheric Chemistry) with T42/L39, model top at 0.01 hPa, interactive chemistry module and improved UV/VIS radiation scheme.

fast ozone module (FAST-O3)

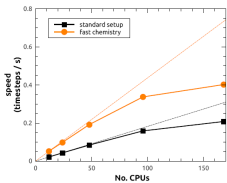
Development of a semi-empirical fast stratospheric chemistry and transport scheme with an interactive ozone layer for application in global climate models.



improved model formulations related to aerosols, clouds and ozone (LiCoS)

Implementation of a more sophisticated time-step controller for the integration of the chemical ordinary differential equations in EMAC → model speedup factor for chemistry is 4-5 and for the whole model about 2.

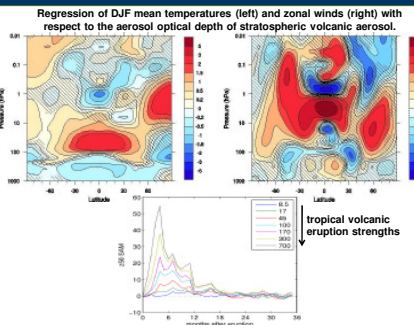
In standard setup the model scales better.



impact of volcanic eruptions (ALARM)

Analysis of MPI-ESM-MR and MAECHAM5-HAM simulations:

- Response to volcanic eruptions shows tropospheric cooling, low- to mid-latitude lower stratosphere warming, Northern Hemisphere (NH) high-latitude upper stratosphere warming and increase of NH polar night jet (Schmidt et al., 2013, JAMES, 5, doi: 10.1002/jame.20014).
- For extremely strong volcanic eruptions a significant positive Southern Annular Mode (SAM) is simulated, which increases westerlies.



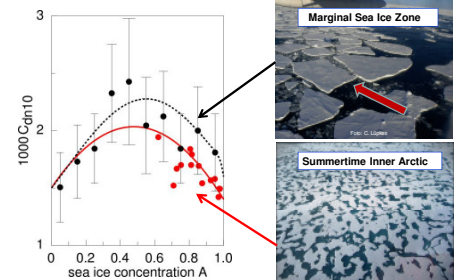
Processes dealt with in MiKlip Module B



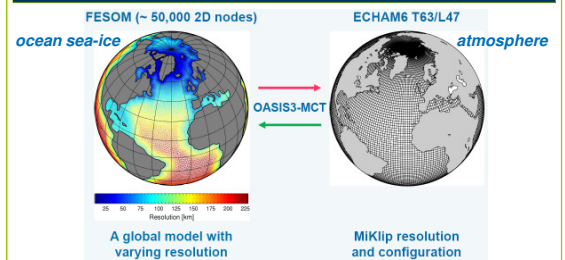
Arctic Sea-ice Processes

parameterization of processes in atmospheric boundary layer (SPARCS)

Parameterization of drag coefficients for different regimes of sea ice morphology developed for climate models (Lüpkes et al., 2012, J. Geophys. Res., 117, D13112, doi:10.1029/2012JD017630).



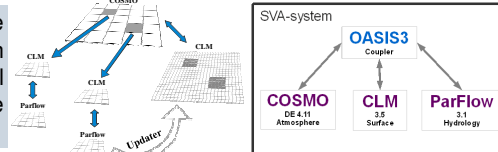
regional refinement of global coupled models (TORUS)



Land Processes

adaptive soil module (MCRA)

A simplified model is run in the whole domain, while the full complex system is run on the smaller catchment scale with full physics. The Updater is based on the concept of adaptive parameterization.



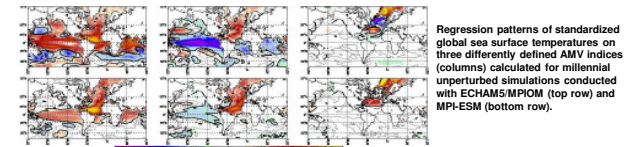
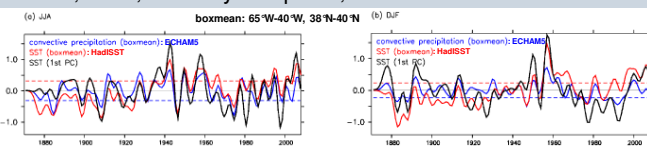
Mechanisms of Decadal Variability

air-sea interaction over the Atlantic (ATMOS)

- Gulf Stream SST variability has a significant influence on the precipitation variability in this region in ECHAM5.
- Atmospheric response differs seasonally: Deep convective-like signal in summer, in winter atmospheric fronts seem to play a significant role.
- Hand et al., 2013, Clim. Dyn. in press, doi:10.1007/s00382-013-1715-y

dependency of feedbacks and processes on model properties (MultiClip)

Our interpretation of simulated phenomena describing multidecadal variability depends on model properties as well as on the statistical constructs we employ for their description (Zanchettin et al., 2013, Clim. Dyn. in press, doi:10.1007/s00382-013-1669-0).



Involved Projects from MiKlip Module B (<http://fona-miklip.de/en/251>):

- ALARM:** Alert for large volcanic eruptions in medium term climate prediction (MPI-M: C. Timmreck, H. Schmidt; GEOMAR: K. Krüger)
- ATMOS:** The atmospheric response to decadal ocean variability and its implications for predictability (GEOMAR: R. Greatbatch)
- FAST-O3:** Fast stratospheric ozone chemistry for global climate models (AWI: M. Rex; FUB: U. Langematz)
- LiCoS:** Linking composition and circulation of intermediate spatio-temporal scales (MPI-C: J. Lelieveld; MPI-M: B. Stevens)
- MCRA:** Model complexity reduction approach (Uni Bonn: S. Kollet, C. Simmer, V. Venema; FZ Jülich: H. Bogena)
- MultiClip:** Mechanisms of inter- to multidecadal variability and their implications for climate predictions (MPI-M: J. Jungclaus, W. Müller, J. Bader)
- SPARCS:** Scale dependent parameterization of processes in the atmospheric boundary layer over Arctic sea ice (AWI: C. Lüpkes; Uni Hamburg: L. Kaleschke)
- STRATO:** The role of the stratosphere for decadal climate prediction (FUB: U. Langematz; DLR: M. Dameris; GEOMAR: K. Matthes)
- TORUS:** Towards regionally focused modeling of decadal climate predictions (AWI: D. Handorf, K. Dethloff, T. Jung, W. Hiller)