Simulation Laboratories for Climate Sciences and Environmental Research

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What are Simulation Laboratories?

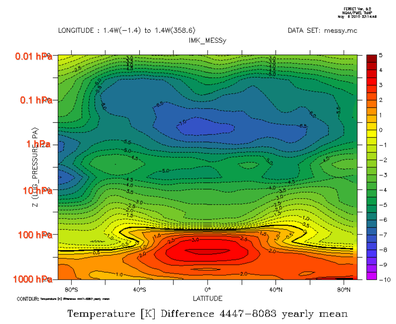
- The Jülich Supercomputing Centre (JSC) and the Steinbuch Centre for Computing (SCC) have established Simulation Laboratories (SimLabs) as a new community-oriented research and support infrastructure. Dedicated SimLabs for climate sciences and environmental research at both sites act as an interface between the atmospheric science community and high-performance computing specialists at the centres.
- The SimLabs' mission is to provide high level support in utilizing the HPC facilities at JSC or SCC, first by porting global and regional climate models to the supercomputers, and then in optimizing the performance of these models by enhancing their parallel scalability, load balancing and data I/O.
- The SimLabs also perform their own research on scientific applications, including the development of highly-scalable algorithms for climate models, numerical weather prediction and data assimilation. This work is typically done in close cooperation with atmospheric institutes through common projects in climate science and environmental research.

Call for High-Level Support

- As part of an effort to formalize the support activities, JSC invited current and potential users of the supercomputers in Jülich to apply for high-level support from the SimLabs in autumn last year. In this pilot phase, proposed work packages were limited to 2 person-months of SimLab staff resources. The applicant or members of his/her group were expected to contribute an equivalent amount of manpower to the project.
- Examples of selected SimLab support projects:
  - Development of a parallel template for stochastic atmospheric chemistry simulations, together with the University of Cologne.
  - Porting of the radiative transfer model SCIATRAN to JuRoPA to retrieve water vapor from SCIAMACHY measurements, together with the University of Bremen.
  - Update of the chemistry solver in the Chemical Lagrangian Model of the Stratosphere (CLaMS), together with the Institute for Energy and Climate Research in Jülich.
- A new call by JSC for high-level support from the SimLabs will be issued in October 2011.

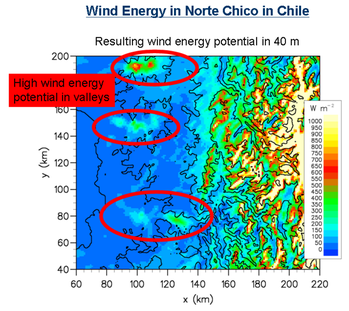
Research Activities

- Regular update of supported atmospheric regional and global model systems:
  - EMAC (global) [Jöckel et al., 2006]
  - KASIMA (global) [Kouker et al., 1999]
  - KAMM (Mesoscale) [Adrian and Fiedler, 1991]
  - COSMO-ART (regional) [Vogel et al., 2009]
  - COSMO-CLM (regional) [Rockel et al., 2008]
  - WRF (regional) [Michalakes et al, 2001]
- Performing of test and standard simulations with this model systems and providing of model data for comparison with observations [Wetzel et al., 2010].
- Development of a new parameterization of polar stratospheric clouds in EMAC [Kirner et al., 2011].
- Performing of EMAC long-term simulations with boundary conditions of IPCC and WMO.



Temperature [K] Difference 4447–8083 yearly mean

- Development of the EMAC submodel Age of Air.
- Extension of COSMO-ART into the stratosphere and merging with the COSMO/MESSy system (two way online nesting).
- Performing of EMAC simulations with respect to the influence of high energy particle precipitation.
- High-resolution simulations with COSMO-CLM for Northern Africa.
- Simulations with KAMM for evaluation of the wind energy potential in Chile and Thailand.



Supercomputing in Jülich

- JUGENE (Jülich Blue Gene) is a supercomputer built by IBM based on the Blue Gene/P architecture. In May 2009 the newly configured JUGENE was unveiled. It includes nearly 300,000 processor cores with 512 MByte memory per core. With a peak performance of about one Petaflop it is currently the ninth fastest computer in the world.

- While JUGENE is mainly dedicated to high-scaling applications, the supercomputer JuRoPA (Jülich Research on Petaflop Architectures) is provided for general purpose computing. It includes 2208 compute nodes (17,664 processor cores) with 24 GByte memory per node. The system has 207 Teraflop peak performance.

How to apply for computing time?

- Project applications for the supercomputers JUGENE and JUROPA may be submitted by any scientist qualified in his or her respective field of research. Computing resources are allocated on the basis of independent referees' reports.
- Apart from the scientific relevance of the project, an important criterion for the allocation of computing resources is that the project can make reasonable use of the computers, i. e. use a large number of processors in parallel.
- Computing time periods are yearly - with the possibility of application twice per year - and will begin 1 May and 1 November each year. The deadline for the next call for proposals will be 31 August 2011.
- European scientists from outside of Germany should apply for computing time on JUGENE via PRACE (Partnership for Advanced Computing in Europe).
- More information at www.fz-juelich.de/jsc.

Supercomputing in Karlsruhe

- The SCC operates the parallel computer HP XC3000 (HC3) as high performance computer and throughput computer of KIT. The HC3 consists of 356 eight-way compute nodes with two Intel Xeon Quad Core sockets with 2.53 GHz frequency (2,848 processor cores) and 24 or 48 or 144 GByte local memory.

- More information about the HC3 and how you can apply for computing time at www.scc.kit.edu/dienste/hc3.php.

Contact

- Please contact us, if you are interested in the research and support activities of the Simulation Laboratories or the supercomputing facilities operated by JSC and SCC.

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References

- Adrian, G. and F. Fiedler, *Simulation of Unstationary Wind and Temperature Fields over Complex Terrain and Comparison with Observations*, Beitr. Phys. Atmosph. 64, 2748, 1991
- Attig, N., R. Esser, P. Gibbon, *Simulation Laboratories: An Innovative Community-Oriented Research and Support Structure*, Proceedings of the Cracow Grid Workshop (CGW'07), 16-18 October 2007
- Jöckel et al., *The atmospheric chemistry general circulation model ECHAM5/MESSy1: consistent simulation of ozone from the surface to the mesosphere*, Atmos. Chem. Phys., 6, 5067-5104, 2006
- Kirner et al., *Simulation of polar stratospheric clouds in the chemistry-climate-model EMAC via the submodel PSC*, Geosci. Model Dev., 4, 169-182, 2011
- Kouker et al., *The Karlsruhe Simulation Model of the Middle Athmosphere (KASIMA), Version 2*, Wissenschaftliche Berichte FZKA 6278, Forschungszentrum Karlsruhe GmbH, Karlsruhe, 1999
- Michalakes et al., *Development of a next generation regional weather research and forecast model. Developments in Teracomputing. Proceedings of the Ninth ECMWF Workshop on the Use of High Performance Computing in Meteorology*, W. Zwieflhofer and N. Kreitz, Eds., World Scientific, 269276, 2001
- Rockel et al., *The Regional Climate Model COSMO-CLM (CCLM)*, Meteorol. Z. 17, 347348, 2008
- Vogel et al., *The comprehensive model system COSMO-ART Radiative impact of aerosol on the state of the atmosphere on the regional scale*, Atmos. Chem. Phys., 9, 86618680, 2009
- Wetzel et al., *First remote sensing measurements of ClOOCl along with ClO and ClONO2 in activated and deactivated Arctic vortex conditions using new ClOOCl IR absorption cross sections*, Atmos. Chem. Phys., 10, 931-945, 2010