Planet Simulator

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A Scope of the model

The **Planet-Simulator** is a MIC (**M**odel of **I**ntermediate **C**omplexity) which can be used to run paleo- and climate-simulations for time scales up to 10 thousand years or more in an acceptable real time. The priorities in development were set to speed, user friendliness and portability. Its modular structure allows a problem dependant configuration. There exist also applications for the Martian atmosphere [Segschneider et al., 2004] and the atmosphere of the Saturn moon Titan [Grieger et al., 2005]. A coupling interface enables the addition of ocean models, ice models, vegetation etc.. A graphical "Model Starter" (Figure 1) can be used for easy and fast setup and configuration. An interactive mode with a **G**raphical **U**ser **I**nterface (Figure 2) can be used to view atmospheric fields while changing model parameters on the fly. This is especially useful for teaching, debugging and tuning of parameterizations.

B Model components

Atmosphere

The atmospheric module of the Planet Simulator is PUMA-2 (**P**ortable **U**niversity **M**odel of the **A**tmosphere), developed from PUMA [Fraedrich et. al., 1998]. PUMA-2 is a spectral model with triangular truncation. It solves the moist Primitive Equations on σ-coordinates in the vertical. Resolutions range from T21 and five levels for very fast running simulations to T42 and ten levels for a more realistic or detailed simulation, though other resolutions are also available. Included are boundary layer, precipitation, interactive clouds and radiation.

Ocean

A mixed layer ocean (ML) is included in the Planet Simulator. An interface for coupling of the full ocean models LSG and UVIC is in preparation.

Sea ice

Thermodynamic sea ice model.

Terrestrial Biosphere

Simulator of Biospheric Aspects (SimBA, Kleidon).
Temperature, surface wetness and radiation control biomass und vegetation cover.

Miscellaneous

The Planet Simulator is designed for high flexibility in order to simulate also other planets or moons with atmospheres. Successful simulations were done recently by [Segschneider et. al., 2004] for the planet Mars and by [Grieger et. al., 2005] for the Saturn moon Titan.

C Limitations

The model has the typical problems of all spectral models, like the Gibb's phenomenon visible in the orography and the necessary correction of gridpoints with negative humidity. The parametrizations are optimized for speed and efficiency as typical for EMIC models.

D Performance

Due to the high portability the Planet Simulator can be run on a wide range of computers ranging from mainframes to PC's. It is fully parallelized and can be run on as many CPUs as latitudes (32 for the standard T21 resolution). On a PC with a single Pentium-IV Processor at 3GHz the Planet Simulator in standard configuration runs one year of simulation in 10 minutes wall clock time. Using a PC with two CPUs speeds up the program at a factor 1.8 - 1.9 such using about 5 minutes per simulation year.

E Applications

Simulation of the Martian atmosphere.
Simulation of Titan's atmosphere.
Paleosimulation of the Earth.

F References

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