Summerschool Assignments

Each group (=2 students) performs and analyzes during the summer school one simulation experiment. In total we have 12 groups, although we perform only 6 different types of experiments that are described below, i.e. two groups perform the same experiment (except for a small modification see below). **It will be your task to explain what happens in these experiments.** You will give a final presentation of your results on Friday.

Before analyzing the experiments please write down some sentences, on what you expect to happen in them. Think about the consequences for the different earth system compartments. How will climate change? What happens with the hydrological and carbon cycle? Will the state of the ocean change? How are plants and plankton reacting? **The hypothesis descriptions will be collected Tuesday after the coffee break.** End of the week we will compare your final understanding with the expectations you had before full analysis of the experiments.

Each group of students has an account name for our computer system. The account names are related to the experiments as follows:

Account name	Experiment	Experiment IDs
easym1,easym7	Cloud top mass flux	sus0001,sus0007
easym2,easym8	Soil respiration	sus0002,sus0008
easym3,easym9	Ocean mixing	sus0003,sus0009
easym4,easym10	Ocean photosynthesis	sus0004,sus0010
easym5,easym11	Ocean albedo	sus0005,sus0011
easym6,easym12	Flat earth	sus0006,sus0012

Short experiment descriptions

(You find more hints for how to setup the experiments in the handouts.)

<u>Cloud top mass flux</u>
In this experiment the effect of overshooting convective updrafts is examined. The scheme for convective clouds computes upward mass fluxes from the boundary layer to the level where rising air looses buoyancy with respect to the air in the environment. A small fraction is however allowed to pass across the top of the convective cloud into the next higher level, where this overshooting air is mixed with the dry and warmer ambient air. In this experiment, the fraction of upward mass flux that overshoots is changed from 27% to 0%. This fractional convective mass flux across the top of the cloud is set by the parameter *cmfctop* in *mo_cumulus_flux.f90* of the ECHAM model. The parameter depends on the resolution of the ECHAM model. Please change *cmfctop* from 0.27 to 0.

Soil respiration

In this experiment the consequences of an abrupt increase of slowly decomposable leaf litter is analyzed. The relative amount of fast and slowly decomposable litter is controlled by the parameter Frac_C_fast2atmos that you find in the "land cover type library file" (lctlib_albedo_snow.def). It controls the fraction of carbon released from the fast soil pool to the atmosphere, instead of passing it over to the slow soil pool. Usually Frac_C_fast2atmos has a value around 0.75. It depends on the vegetation type (can you imagine why?). In the experiment it is reduced to 0.05 for all vegetation types.

Ocean Mixing

In this experiment the effect of increased vertical mixing in the ocean is examined. The background coefficients for mixing of momentum (ABACK) and tracers (DBACK) represent the mixing effect of tides and breaking of internal waves and other processes. Both numbers are set in the OCECTL namelist in the run script and shall be increased to ABACK=1.25E-3 and DBACK=2.625E-4.

Ocean photosynthesis ("Strangelove ocean")

In this experiment we simulate the effect of the Doomsday Machine from the movie “Dr. Strangelove or: How I Learned to Stop Worrying and Love the Bomb”. When it is detonated, it will produce lethal radioactive pollution which is poisoning all marine plants and inhibit their ability to do photosynthesis. Set the value of pi_alpha in beleg_bgc.f90 of HAMOCC to Zero.

Ocean Albedo

In this experiment the effect of increased sea water albedo is examined. The sea albedo (calbsea) is set in the routine mo_surface_ocean.f90 of the ECHAM model. Please increase the value of calbsea drastically from 0.07 to 0.2.

Flat Earth

This experiment tests the effect of mountains, high plateaus etc., i.e. of surface elevations on the climate. Surface elevations are represented by the surface geopotential, which is seen by the resolved flow, and by surface parameters describing the sub grid-scale surface features. These parameters are used by the so-called sub grid-scale surface orography parameterization, which computes a drag on the flow above mountains or blocks the low level flow, if conditions apply. In this experiment the geopotential and the parameters describing the unresolvedororgraphy are set to 0, resulting in a “flat Earth” (though the surface roughness remains unchanged). The following steps are necessary:

The suface geopotential geosp and the orography parameters oromea, orostd, orosig, orogam, orothe, oropic and oroval are multiplied by 0.95 each time step in the echam routine physc. In the jsbach module mo_jsbach_interface theLand%Surface%elevation and theLand%Surface%oro_std_dev are set to zero.

Mini-Ensemble

Usually in performing climate experiments one repeats them several times with slightly different initial conditions to see what part of the results comes from internal variability. Since in the summerschool two groups perform the same experiments we have the oppertunity to do a mini-ensemble (size 2). More precisely: the groups with user names easyms7 to easyms12 shall run their experiments **sus0007 to sus0012** with a slightly changed horizontal diffusion. To this end they have to **add the following lines** to the ECHAM-namelist:

```
&DYNCTL
    ENSTDIF  = 1.0001
 /
```

This changes the factor by which horizontal diffusion high in the atmosphere is increased from one layer to the next. This is not exactly the same as using different initial conditions, but since nobody knows the exact value for this factor, and the change is so tiny (from 1.0000 to 1.0001) this is admissible. You have to assure that this change is active only during the first year of simulation (more details during the Hands-on session).

Schedule

You will start the experiments on Monday afternoon. The following days, while the model is still running, you will have the opportunity to analyze the results during the Hands-on sessions. Thursday we will perform a roundtable discussion on the results obtained so far. Friday afternoon, you will give a final presentation of your explanation of the experiment outcomes. Please note that all pair of groups working on the same experiment type will have to present their results jointly in a single talk. So please start early comparing results with the respective other group!

More detailed Experiment overview

Experiment	**Cloud top mass flux**	**Soil respiration**	**Ocean mixing**	**Ocean photosynthesis**	**Ocean albedo**	**Flat Earth**
Experiment IDs	sus0001, sus0007	sus0002, sus0008	sus0003, sus0009	sus0004, sus0010	sus0005, sus0011	sus0006, sus0012
Process	Relative convective cloud mass flux at level above non-buoyancy	Reduced soil respiration	Vertical mixing	Ocean photosynthesis	Ocean shortwave albedo	Surface forcing of atmospheric waves
Parameter	cmfctop	Frac_C_fast2atmos	DBACK, ABACK	pi_alpha	calbsea	geosp, oromea, orostd, orosig, orogam,orothe, oropic, oroval
Standard	cmfctop = 0.27	0.72-0.82	DBACK=1.05e-5, ABACK=5e-5	pi_alpha=0.02*0.4	0.07	From surface files
Modified	cmfctop = 0.00	0.05	DBACK=2.625e-4, ABACK=1.25e-3	pi_alpha=0	0.2	Reduce parameters at the beginning of *physc* by 5% at every timestep; set elevation parameters in mo_jsbach_interface to 0.
Module / subroutine	mo_cumulus_flux.f90	mo_cbal_cpools.f90	namelist of MPI-OM	beleg_bgc.f90	mo_surface_ocean.f90	physc.f90, mo_jsbach_interface.f90
Modification: where?	code	input file: lctlib_albedo_snow.def	namelist	code (HAMOCC)	code (ECHAM)	Code (ECHAM, JSBACH)