

GAME Handbook

GAME Development Team

1 Running the model

All physical quantities in this document are to be multiplied with their respective SI units.

Listing 1: Example input file.

```
#!/bin/bash
operator=MHB
overwrite_run_id=1
run_id=jw_perturbed_moist
run_span=3600
write_out_interval=900
grid_props_file=grids/B4L26T30000_M2_O2_OL17.nc
init_state_filename=test_4_B4L26T30000_M2_O2_OL17.grb2
init_state_file=input/$init_state_filename
output_dir_base=output
cfl_margin=0.2
diffusion_on=1
dissipation_on=1
tracers_on=1
rad_on=0
radiation_delta_t=3600
write_out_mass_dry_integral=1
write_out_entropy_gas_integral=1
write_out_energy_integral=1
column_mode=0
column_index=10
export OMP_NUM_THREADS=4
number_of_cpus=1
source core/run.sh
```

Listing 1 is an example of an input file. Table 1 explains the meanings of the variables.

2 Generating required files

2.1 Grid generation procedure

A grid is determined by the following five properties:

- the resolution, specified via the parameter RES_ID
- the orography, specified via the parameter ORO_ID
- the height of the top of the atmosphere, specified via the parameter TOA
- the number of layers, specified via the parameter NUMBER_OF_LAYERS
- the number of layers following the orography, specified via the parameter NUMBER_OF_ORO_LAYERS

The grid generator needs to be recompiled for every specific resolution, top height, number of layers as well as number of orography following layers. Therefore change the respective constants in the file `grid_generator.c` and execute the bash script `compile.sh`. Then run the grid generator using the bash script `run.sh` with the desired `oro_id`.

2.2 Generating a new orography file

Orography files are generated with the code residing in the directory `orography_generator/src`. Firstly, change the parameter RES_ID in the file `orography_generator.c` to the desired value and compile. Then source the bash script `run.sh` with the desired `oro_id`. Tab. 2 shows the definition of the orography IDs.

name	domain	meaning
operator	string	Operator of the model, for example Company XYZ, Inc.
overwrite_run_id	0, 1	if 0: use auto-generated run_id, if 1: use manually set run_id (see next line)
run_id	string (optional)	run_id to be used if overwrite_run_id is set to 1
run_span	integer	How long the model shall run into the future.
write_out_interval	integer ≥ 900	Every how many seconds output shall be generated.
grid_props_file	string	File name of the grid properties file.
init_state_filename	string	File name of the initialization state file.
init_state_file	string	Full path of the initialization state file.
output_dir_base	string	The directory to which output shall be written.
cfl_margin	double	Manual reduction of the time step below the CFL criterion: $\Delta t = (1 - \text{cfl_margin})\Delta t^{(\text{CFL})}$.
diffusion_on	0, 1	diffusion switch
dissipation_on	10, 1	dissipation switch
tracers_on	0, 1	tracers switch
rad_on	0, 1	radiation switch
radiation_delta_t	double $\geq \Delta t$	Every how many seconds the radiation flux densities shall be updated.
write_out_mass_dry_integral	0, 1	Switch to decide whether a global integral of dry mass shall be written out at every time step.
write_out_entropy_gas_integral	0, 1	Switch to decide whether a global integral of the entropy shall be written out at every time step.
write_out_energy_integral	0, 1	Switch to decide whether a global integral of the energy shall be written out at every time step.

Table 1: Input file explanation.

ORO_ID	description
0	no orography
1	orography of JW test
2	Gaussian mountain of 8 km height and 224 m standard deviation located at 0 N / 0 E

Table 2: Definition of orography IDs.

TEST_ID	description
0	standard atmosphere
1	standard atmosphere with Gaussian mountain (ORO_ID = 2)
2	JW dry unperturbed
3	JW dry perturbed
4	JW moist unperturbed
5	JW moist perturbed

Table 3: Definition of test IDs.

2.3 Generating a new test state file

A new test state can be generated with the code in the directory `test_generator/src`. Therefore, firstly change the parameters `RES_ID`, `NUMBER_OF_LAYERS` and `NUMBER_OF_ORO_LAYERS` in the file `test_generator.c`. Then compile by sourcing the file `compile.sh` before executing the file `run.sh` with the specific `test_id`. Tab. 3 shows the definition of the test IDs.

Sei $\psi : A \subseteq \mathbb{R}^3 \times \mathbb{R} \rightarrow \mathbb{R}^n$ der atmosphärische Zustandsvektor. Alle fundamentalen physikalischen Gesetze sind erster Ordnung in der Zeit, daher kann man schreiben

$$\frac{d\psi}{dt} = F(\psi), \quad (1)$$

wobei F die Physik enthält. Diskretisiert man dies auf ein zeitliches Gitter nt_0 mit $n \in \mathbb{Z}$ und interpoliert zwischen zwei Zeitschritten $n, n+l$, erhält man

$$\psi_{n+l} - \psi_n = \int_{nt_0}^{(n+l)t_0} F(\psi) dt. \quad (2)$$

Die Anzahl der dabei involvierten Zeitschritte ist $l+1$.