

LMDZ tutorial

Configurations, input files, forcing data

LMDZ tutorial
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Contents

- Configurations
- LMDZ with realistic physics and surface
- Aqua-planet or all-land planet
- Relaxation to a 3D-temperature field

Configurations: many ways to use LMDZ

Coupling with another model

- Soil, vegetation, hydrology: **Orchidée**
<http://labex.ipsl.fr/orchidee>
- Ocean, sea ice, marine biogeochemistry:
Nemo
<http://www.nemo-ocean.eu>
- Tropospheric chemistry, aerosols: **INCA**
<http://www-lscea.inca.cea.fr>
- Stratospheric chemistry: **Reprobus**
Marchand et al., JASTP, 2012

Configurations of LMDZ itself

- 1 or 3 dimensions
- Nudging or not
- Zoom or not
- Realistic or idealized "physical" part of the model

Use case:
LMDZ alone
3 dimensions
no nudging
realistic (terrestrial) physics and surface

What is left to choose

- Some run-time parameters (among which concentration of greenhouse gases)
- Initial state
- Boundary (that is, surface) conditions
- Forcing atmospheric data: ozone field, fields of aerosols

Run-time parameters

- Chosen in text files which have suffix `.def`
- Home › Utilisateurs › Guides › LMDZ pas à pas › Utilisation comme boîte noire › **Variables des fichiers `.def`**

Run-time parameters (continued)

- Syntax:
`variable=value`
Case sensitive
TRUE or FALSE for logical values
Character values without quotes
Comment lines start with #
Example: `gcm.def`
- Semantic separation of run-time parameters among six `.def` files

Run-time parameters (continued)

- `gcm.def`: dynamics
 - Zoom: `clon` and `clat` (center), `grossism[xy]` (zooming factor), `dzoom[xy]` (range), `tau[xy]` (steepness of transition)
- `physiq.def`: parameterizations
- `output.def`: fine tuning of output (choice of variables, frequency...)

Run-time parameters (continued)

- `config.def`: level of output, coupling with other models, radiative transfer, forcing data (ozone, aerosols, greenhouse gases)
 - No ocean model: `type_ocean=force`
 - No coupling with Orchidée: `VEGET=bucket` or `VEGET=betaclim`
 - Concentration of greenhouse gases: `co2_ppm`, `ch4_ppb`...
 - Number of calls to radiative transfer procedure, per day: `nbapp_rad`

Run-time parameters (continued)

- `run.def`: length of the run, dates, calendar
 - Number of days of run: `nday`
 - Starting date of the first run in a sequence of runs: `dayref` (day number in the year) and `anneeref`. You do not change these when you continue a simulation, starting from the end of a previous simulation.
 - Calendar: `calend` (character variable)

Run-time parameters (continued)

- `traceur.def: tracers`
 - Special syntax
 - 1st line: number of tracers
 - Then one line per tracer, with a number identifying the advection scheme
 - For more information on available advection schemes: `infotrac.F90`

INCLUDEDEF lines in .def files

- `run.def` is the first file read.
- Other `.def` files are read only if there is a corresponding `INCLUDEDEF` line in `run.def`. Cf. distributed `run.def`.

List of all used parameters

- Parameters have default values in the Fortran source files.
- →The `.def` files that you will provide will probably not mention all the parameters.
- Also, be careful: you will not get an error message for a mistyped parameter name in your `.def` files, it will just be ignored.

List of all used parameters (continued)

- So, if you want to see all the parameter values that were used for your run: each run creates a set of files `used_*.def`.
- Script for easier comparison of two sets of `.def` files:
<http://lmdz.lmd.jussieu.fr/utilisateurs/outils/utilisation-de-lmdz#section-5>

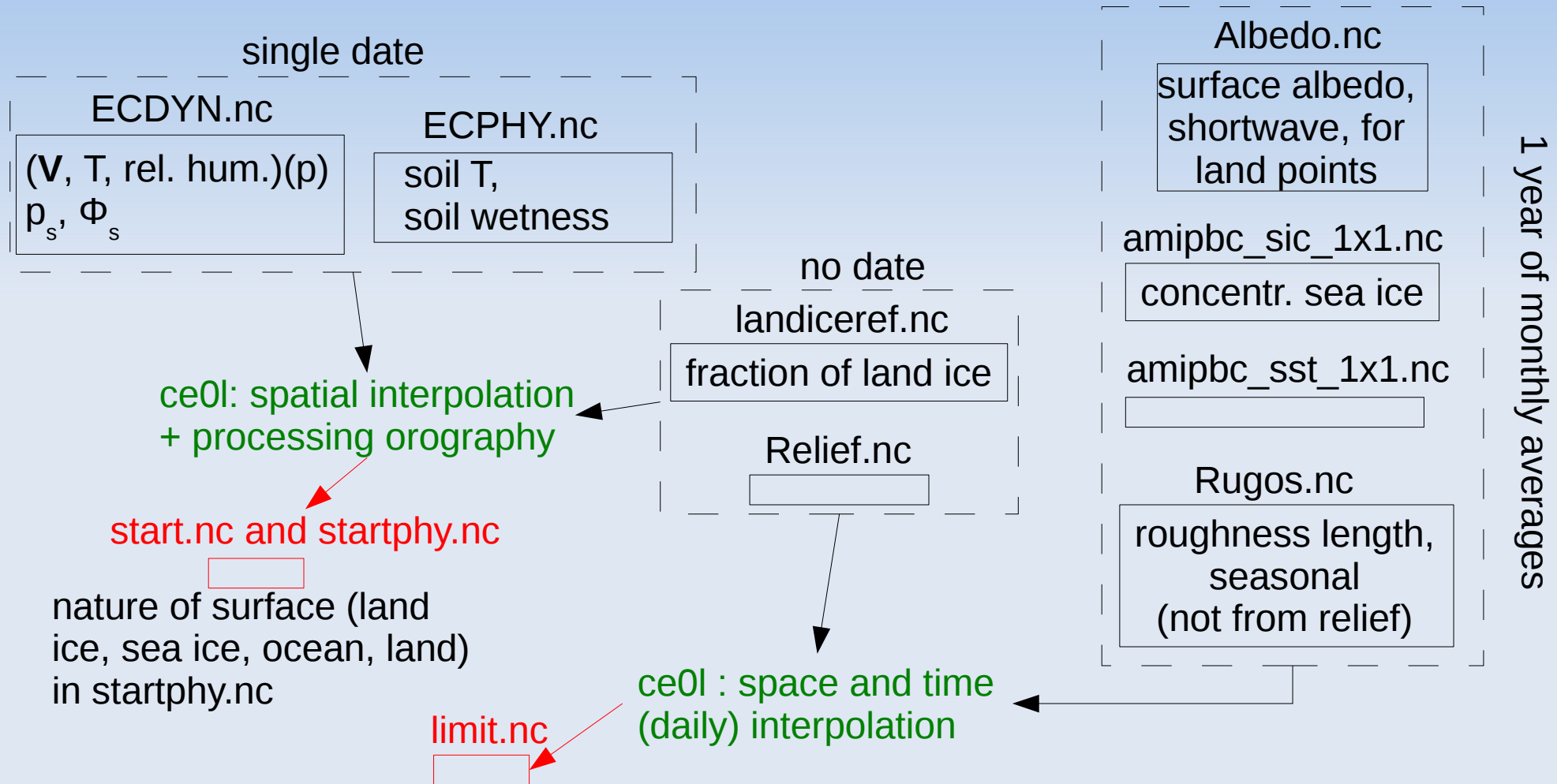
Initial state and boundary conditions

- Separate program: ce0l
(ce0l stands for "création état 0 limites")
- Distributed with the program gcm, compiled with the same tools
- Run ce0l with the same **.def** files than those you want for gcm.

Initial state and boundary conditions (continued)

- ce0l creates 2 files for initial state:
start.nc for the dynamics part of gcm
startphy.nc for the physics part of gcm
- ce0l creates 1 file for 1 year of boundary conditions:
limit.nc

Initial state and boundary conditions (continued)



Calendar

- Calendar is used in ce0l to create boundary conditions
- For years with constant length, 360 or 365 days:
calend=earth_360d
or
calend=earth_365d

Calendar (continued)

- For the real calendar (with leap-years), run `ce0l` for each year you want boundary conditions for:
`calend=gregorian`
`anneeref=<the right year>`

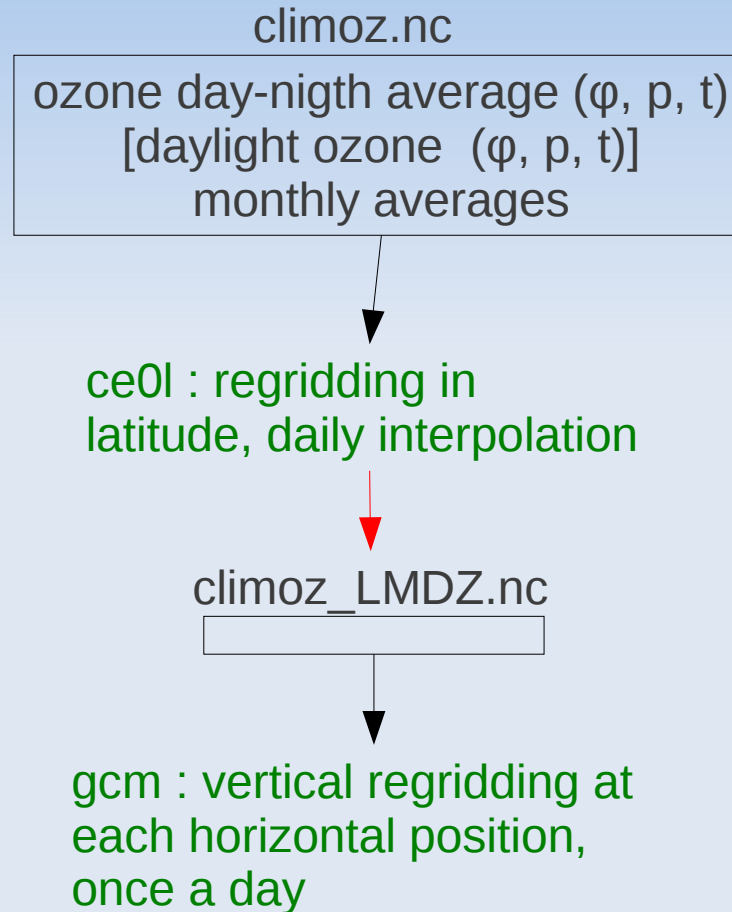
Ozone

- Run-time parameter in config.def:
`read_climoz` = - 1, 0, 1 or 2
- 0: analytic expression for the ozone field (see `ozonecm_m.F90`)
- - 1 (use with `solarlong0` = 1000): made symmetric with respect to the equator, for use with annual mean insolation

Ozone (continued)

- 1: read day-night average of ozone field from a NetCDF file
- 2: also read daylight average from the same file (good idea if there are a few model layers in the mesosphere)

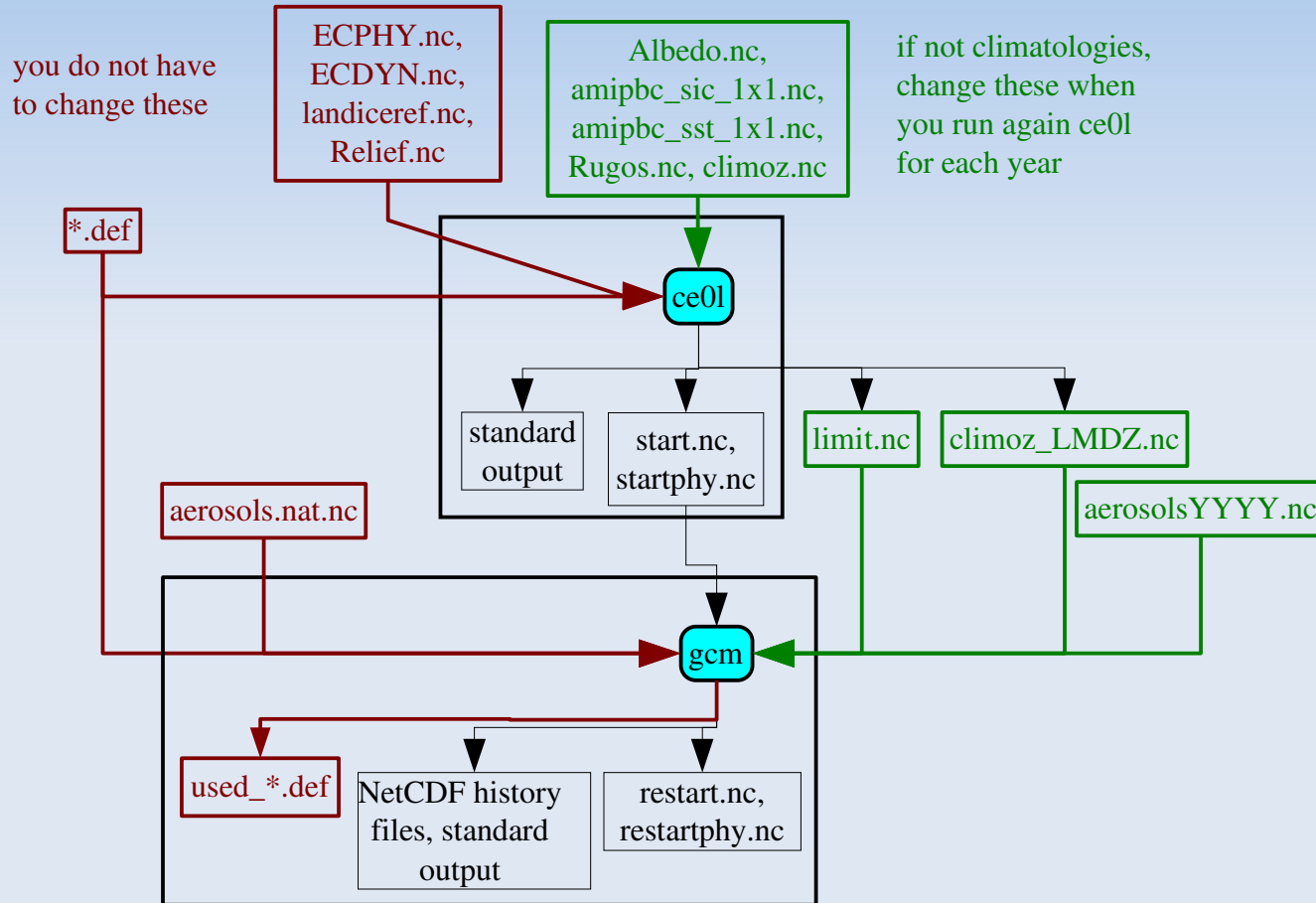
Ozone (continued)



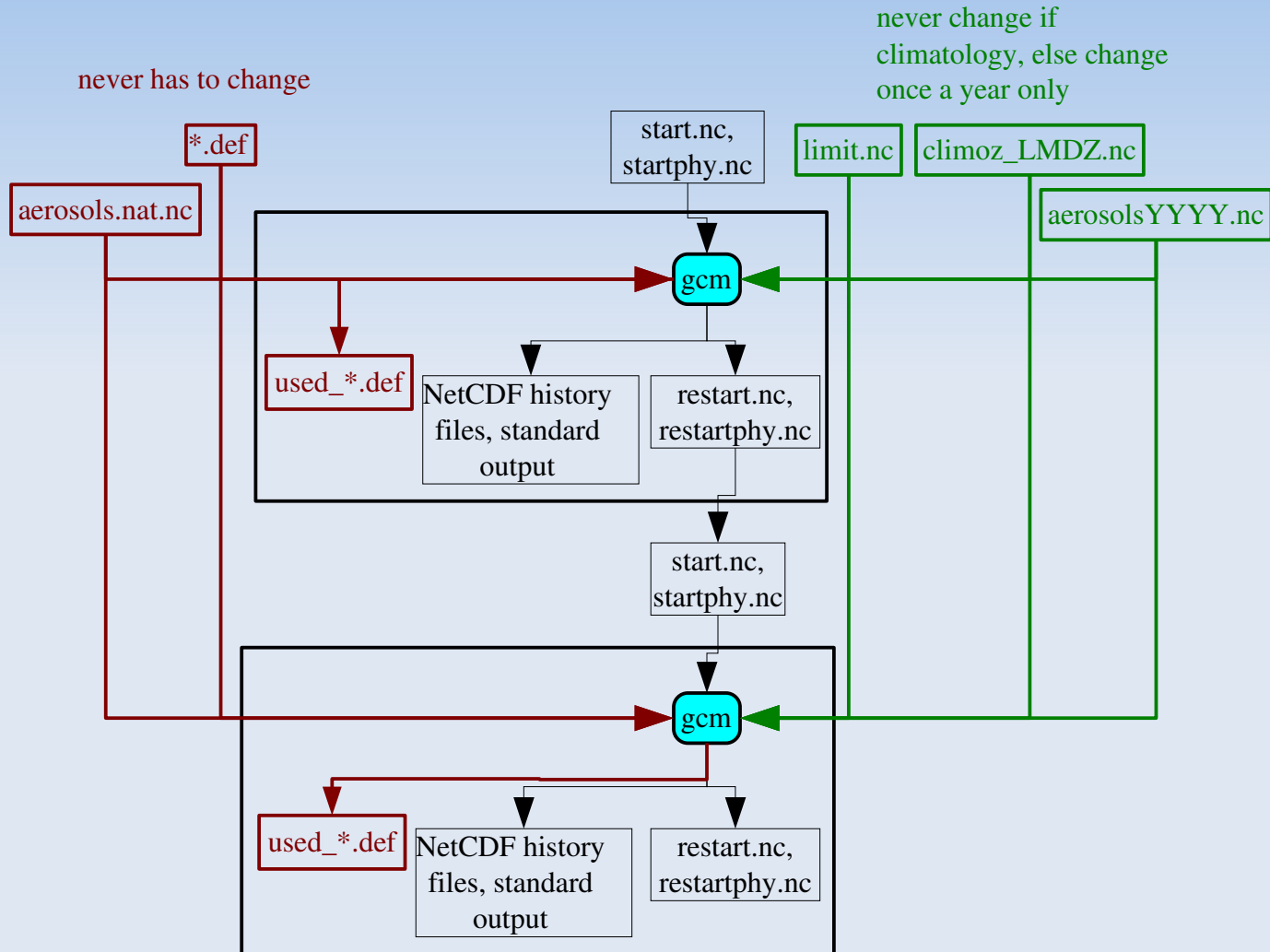
Aerosols

Cf. presentation by Olivier BOUCHER

Putting it all together



Chaining one-month runs



Where do you get the input files ?

Run-time parameters

Template `.def` files are distributed with LMDZ source files

- Directory `DefLists`
- `physiq.def_L39_AR40.0`: 39 levels, physics used for AR4, old physics
- `physiq.def_L39_NPv3.2`: new physics of AR5
- `physiq.def_L79_NPv5.17h`: new physics of AR6 (still evolving)

Initial state and boundary conditions

- NetCDF files required by ce0l are at:
 - http://www.lmd.jussieu.fr/~lmdz/LMDZ_Init
 - `ergon:~rpsl035/IGCM/INIT/ATM/LMDZ`
 - `curie:/ccc/store/cont003/dsm/p86ipsl/dmf_import/IGCM/STORAGE/INIT.tar`

Initial state and boundary conditions (continued)

- You will find:
 - landiceref.nc, Relief.nc, Albedo.nc, Rugos.nc
 - sea ice and SST from 1870 to 2015, from [AMIP](#)
 - ECDYN.nc and ECPHY.nc for a single date. If you need another date, see:
<http://lmdz.lmd.jussieu.fr/utilisateurs/outils/utilisation-de-lmdz#section-12>

Forcing data for CMIP 5

- A lot of data, for pre-industrial, historical or future simulations (with different scenarios)
- NetCDF files are stored at the national supercomputing centers, IDRIS and CCRT, so you need to find access to them

Forcing data for CMIP 5: ozone

- `ergon:~rpsl035/IGCM/INIT/ATM/LMDZ/Ozone/HYBRIDE/v2.$scenario/tro3_${year}.new.nc`
- For the scenarios:
clim = historical then RCP 8.5
RCP26, RCP45, RCP60
- `curie:/ccc/store/cont003/dsm/p86ipsl/dmf_import/IGCM/STORAGE/INIT.tar`

Forcing data for CMIP 5: ozone (continued)

- Wiki

<http://forge.ipsl.jussieu.fr/igcmg/wiki/InfosOzone>

Forcing data for CMIP 5: aerosols

- ergon:~rpsl035/IGCM/BC/ATM/LMDZ/
LMD\$resolution/AR5/\$scenario/
aerosols_11YearsClim_\${year}_v5.nc
- For the resolutions:
 - 128 118
 - 128 88
 - 144 142
 - 280 280
 - 96 95

Forcing data for CMIP 5: aerosols (continued)

- And for the scenarios:
HISTORIQUE, RCP26, RCP45, RCP60,
RCP85, esm2_experiment
- Each file contains all aerosol types.
- [Wiki](http://forge.ipsl.jussieu.fr/igcmg/wiki/InfosAerosol)
<http://forge.ipsl.jussieu.fr/igcmg/wiki/InfosAerosol>

Aqua-planet or all-land-planet

Definition

- Zero relief
- Only one type of surface globally : either land or ocean
- Surface temperature is:
 - forced for an aqua-planet
 - computed for a land-planet (we still have to choose an initial field)

Selecting the aqua- or land-planet

- Run-time parameter **iflag_phys** (integer) in gcm.def
Choose $\text{iflag_phys} \geq 100$ (instead of default value 1 for Earth surface, full physics)
- $\text{iflag_phys} = 101$ to 107, 109 to 114, 120, 121:
aqua-planet
 $\text{iflag_phys} = 201$ to 207, 209 to 214, 220, 221:
land-planet

Selecting the aqua- or land-planet (continued)

- Different T_s fields, constant for aqua-planet, initial value only for land-planet
- See (analytic) definition of the 15 T_s fields in procedure `profil_sst` (file `phyaqua_mod.F90`)
- Note: all the T_s fields are uniform in longitude and symmetrical with respect to the equator.

Initial state and boundary conditions

- You do not go through the ce0l step
 - Set run-time parameter `read_start` to FALSE in `gcm.def`
gcm creates an initial state
 - gcm also creates a file `limit.nc` for boundary conditions
- gcm creates `restart.nc` and `restartphy.nc` so switch `read_start` to TRUE for the next run

Forcing data

- For an aquaplanet, it may be a good idea to use adapted sun position, ozone and aerosol fields, symmetrical about the equator
- `read_climoz = - 1` and `solarlong0 = 1000`
- No symmetrical aerosol field ready so either create it yourself or set:
`flag_aerosol = 0`

Idealized physics: relaxation to a given
3-dimensional temperature field

Selecting temperature relaxation

Set run-time parameter `iflag_phys=2` in `gcm.def`

- Analytic definition of the 3D equilibrium temperature field
- Damping of low-level wind to represent boundary-layer friction
- From Held and Suarez (1994)
- Some run-time tuning parameters (relaxation time...), see `inicademic.F90`

Initial state, no boundary condition

- You do not go through the ce0l step
 - Set run-time parameter `read_start` to FALSE in `gcm.def`
gcm creates an initial state
 - No file `limit.nc`
- gcm creates `restart.nc` (no `restartphy.nc`) so switch `read_start` to TRUE for the next run

Note

- No other forcing data
- You do not use `physiq.def`, `config.def` nor `output.def`
- You can bypass compilation of physics files with option `-p nophys` of `make1mdz_fcm` → much quicker compilation