Input files, forcing data

LMDZ tutorial
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Contents

Introduction (1/2)

- This presentation: a few explanations, many pointers to web sites (so please download this file) and to paths on machines.
- A large part of this presentation is a bird’s eye inventory of input files for LMDZ.

Introduction (2/2)

- A lot of this, you do not have to know if you use libigcm, because choosing and getting the necessary files will be automated.
- The information here may be useful if you have non-standard needs.
- There are many ways to use LMDZ...

Coupling with another model (1/2)

- Soil, vegetation, hydrology: Orchidée
- Ocean, sea ice, marine biogeochemistry: Nemo
- Tropospheric chemistry, aerosols: INCA
- Stratospheric chemistry: Reprobus
  Marchand et al., JASTP, 2012

Coupling with another model (2/2)

- The sets of input files and input parameters vary with the set of models you couple.

Configurations of LMDZ itself

- 1 or 3 dimensions.
- Nudging or not.
- Realistic or idealized ”physical” part of the model.
- The sets of input files and input parameters vary with the above choices.

LMDZ with realistic physics and surface

- LMDZ alone
- 3 dimensions
- no nudging
- realistic (terrestrial) physics and surface (well, more or less: the continents and relief are there, but no Orchidee)

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 (1/6)

- Chosen in text files which have suffix `.def`
- Syntax:
  `variable=value`
  Case sensitive
  TRUE or FALSE for logical values
  Character values without quotes
  Comment lines start with #
  Example: gcm.def

Run-time parameters (2/6)

- Semantic separation of run-time parameters among seven `.def` files (for LMDZ alone, without Orchidee)

Run-time parameters (3/6)

- `gcm.def`: dynamics
- `physiq.def`: parameterizations
- `output.def`: fine tuning of output (choice of variables, frequency…)
- vert.def: vertical discretization

Run-time parameters (4/6)

- `config.def`: level of output, coupling with other models, radiative transfer, forcing data (ozone, aerosols, greenhouse gases)

Run-time parameters (5/6)

- `run.def`: length of the run, dates, calendar
  - 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 (6/6)

- `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: `dyn3d_common/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 (1/3)

- Parameters have default values in the Fortran source files.
- → The `.def` files that you will provide will probably not mention all the parameters.

List of all used parameters (2/3)

- Also, be careful: you will not get an error message for a mistyped parameter name in your `.def` files, it will just be ignored.
- 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`.

List of all used parameters (3/3)

- Script for easier comparison of two sets of `.def` files

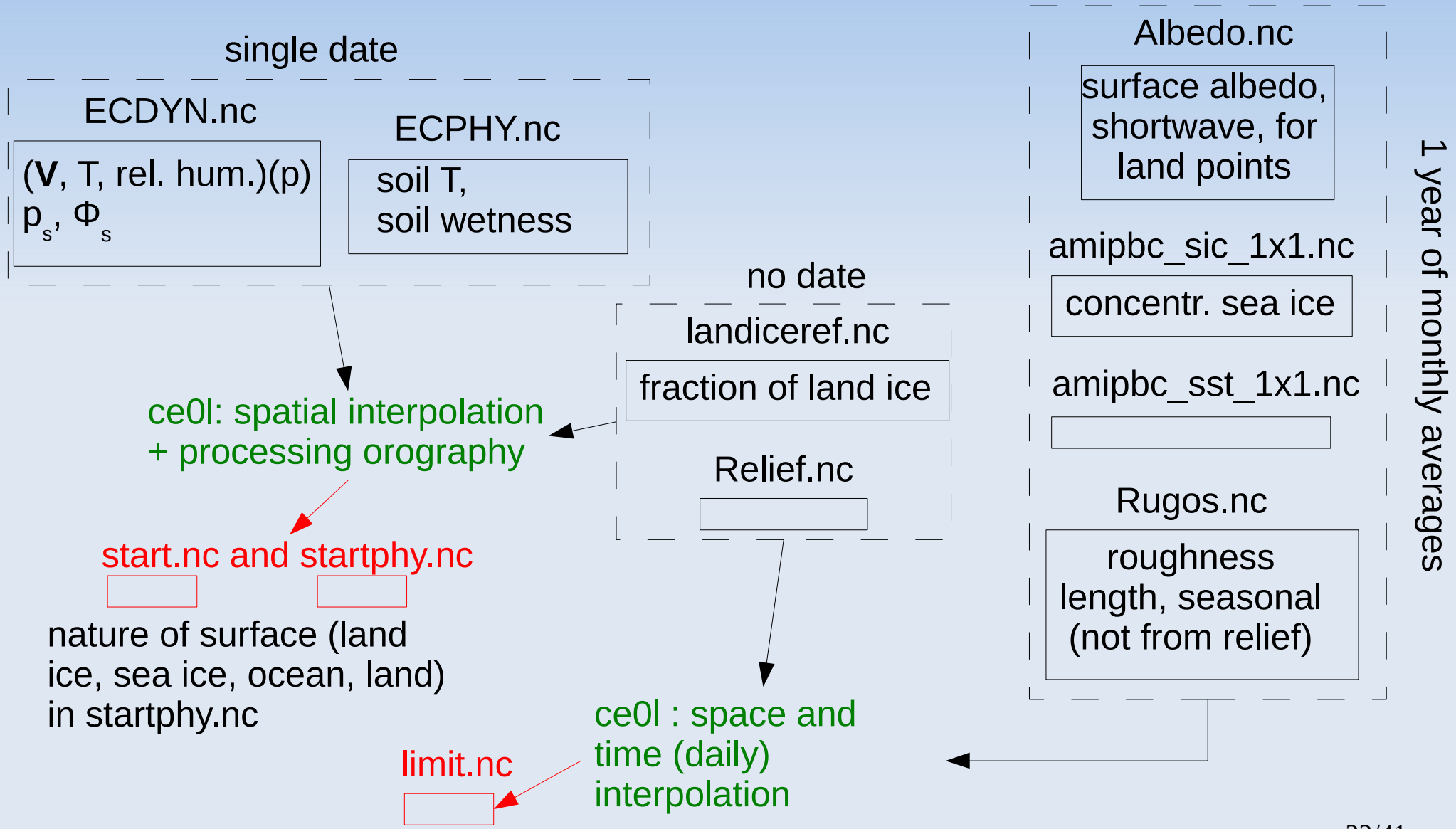
Initial state and boundary conditions (1/3)

- 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 (2/3)

- 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 (3/3)



Calendar (1/2)

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

Calendar (2/2)

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

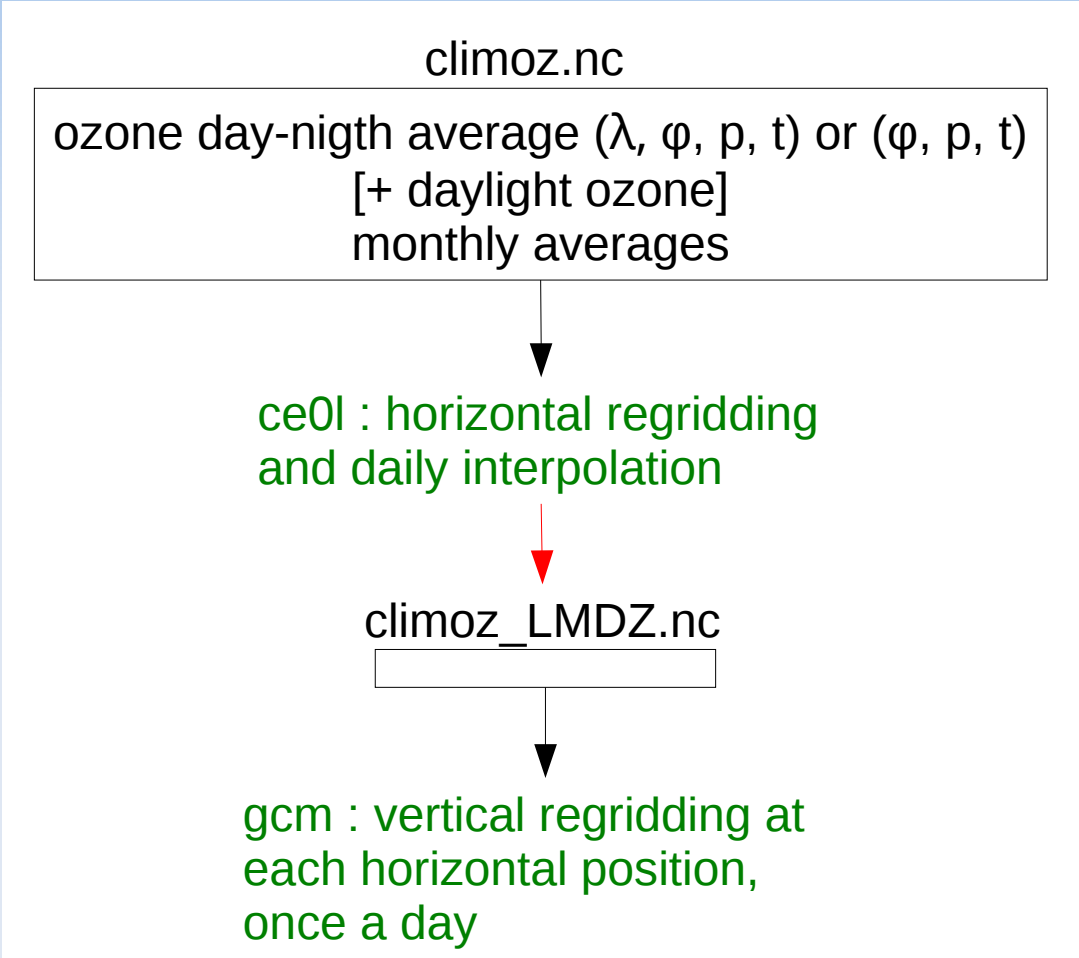
Ozone (1/3)

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

Ozone (2/3)

- 1: read day-night average of ozone field from a NetCDF file (this is what you want for CMIP 6 input).
- 2: also read daylight average from the same file (good idea with Reprobus CMIP 5 input and if you run LMDZ with a few model layers in the mesosphere).

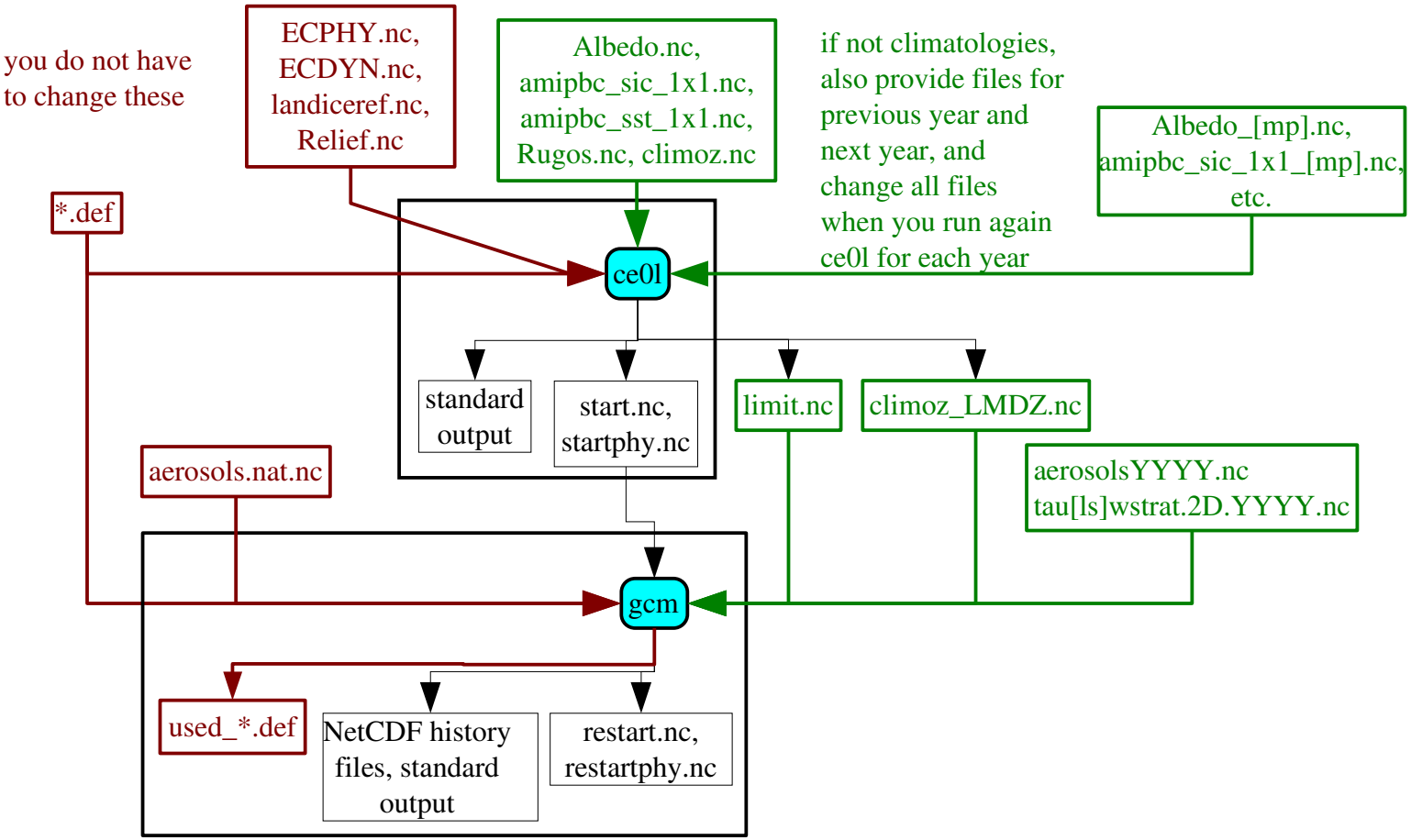
Ozone (3/3)


climoz.nc
ozone day-nigth average (λ, φ, p, t) or (φ, p, t)
[+ daylight ozone]
monthly averages
ce0l : horizontal regridding
and daily interpolation
climoz_LMDZ.nc
gcm : vertical regridding at
each horizontal position,
once a day

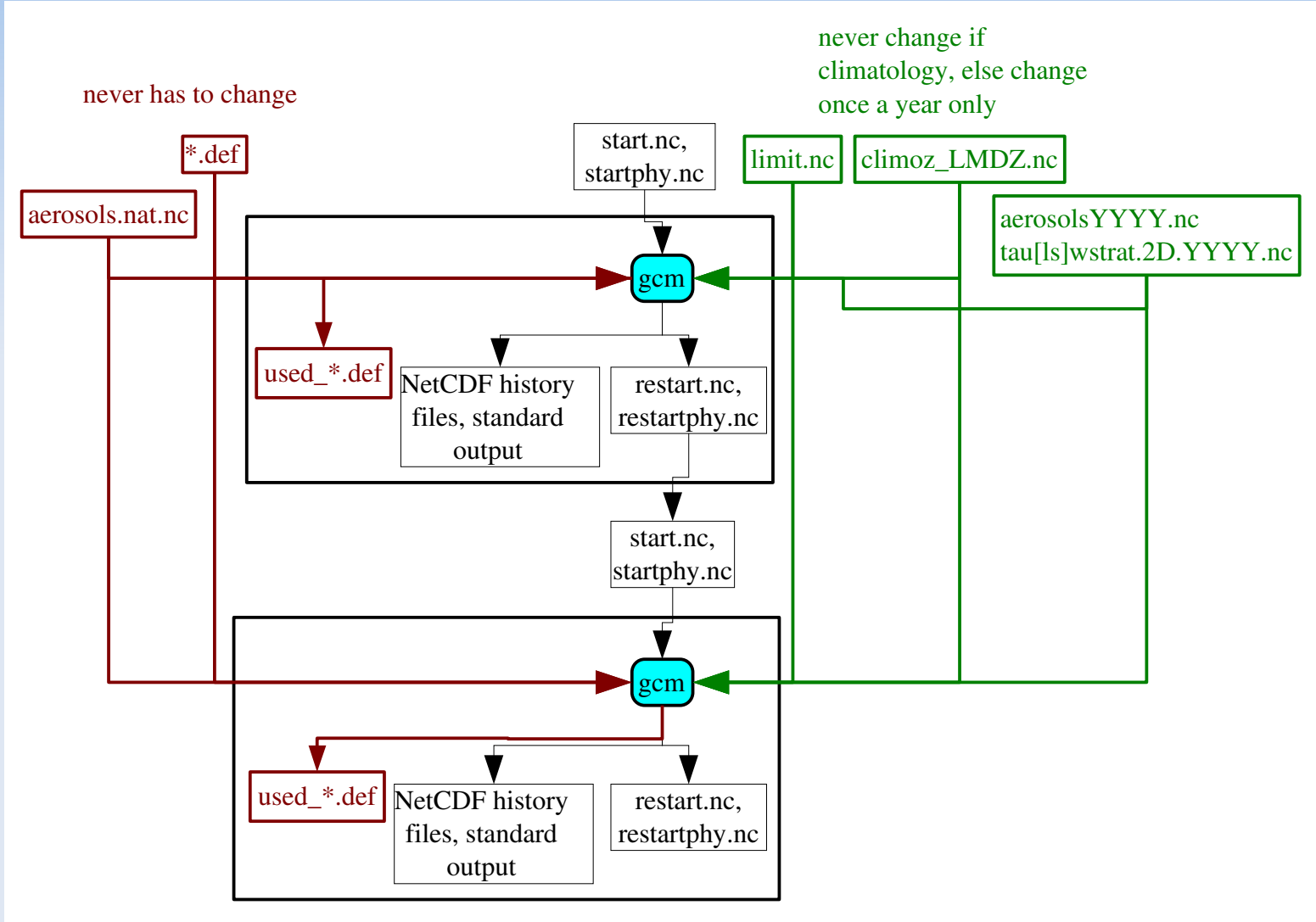
Aerosols

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_Npv6.0.*: new physics of AR6 (still evolving)

Initial state and boundary conditions (1/3)

- NetCDF files required by ce0l are duplicated on machines at IDRIS, TGCC and the IPSL computing center, Ciclad. See the exact path `R_IN` for each machine at:
  Repository for shared files

Initial state and boundary conditions (2/3)

- SST and sea-ice files in subdirectory: `$R_IN/ATM/LIMIT/AMIP.v20170419/original/360x180/BCS`
- The files are also on web servers:
  - LMDZ account page at LMD
  - IPSL THREDDS server

Initial state and boundary conditions (3/3)

- You will find:
  - landiceref.nc, Relief.nc, Albedo.nc, Rugos.nc
  - sea ice and SST from 1870 to 2016, from AMIP
  - ECDYN.nc and ECPHY.nc for a single date. If you need another date, see: Création d'un fichier ECDYN (from ERA interim)

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 TGCC, so you need to find access to them.

Forcing data for CMIP 5: ozone

- `$R_IN/IGCM/INIT/ATM/LMDZ/Ozone/HYBRIDE/v2.$scenario/tro3_${year}.new.nc`
- For the scenarios:
  - clim: historical then RCP 8.5
  - RCP26, RCP45, RCP60
- Information sur les fichiers ozone

Forcing data for CMIP 5: aerosols (1/3)

- `$R_IN/ATM/LMD$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 (2/3)

- And for the scenarios: HISTORIQUE, RCP26, RCP45, RCP60, RCP85, esm2_experiment

Forcing data for CMIP 5: aerosols (3/3)

- Each file contains all aerosol types.
- 1855 for aerosols.nat.nc
- Informations sur les simulations LMDZ-Orchidée-Inca utilisées pour la création des forçages aérosols des runs CMIP5

Forcing data for CMIP 6

- Ozone input files for ce0l are at IDRIS:
  `/workgpfs/rech/dzt/rdzt079/IGCM/ATM/OZONE/Ureading.v20160907/original/144x96_12Fields`
- Official site for CMIP 6 input
- Aerosol input files from INCA:
  `$R_IN/ATM/AEROSOLS/CMIP6/v1/144x142/L79`
- Stratospheric aerosols:
  `$R_IN/ATM/STRATAERO/CMIP6/v1`