METEO FRANCE
Toujours un temps d'avance
CNRM-GAME

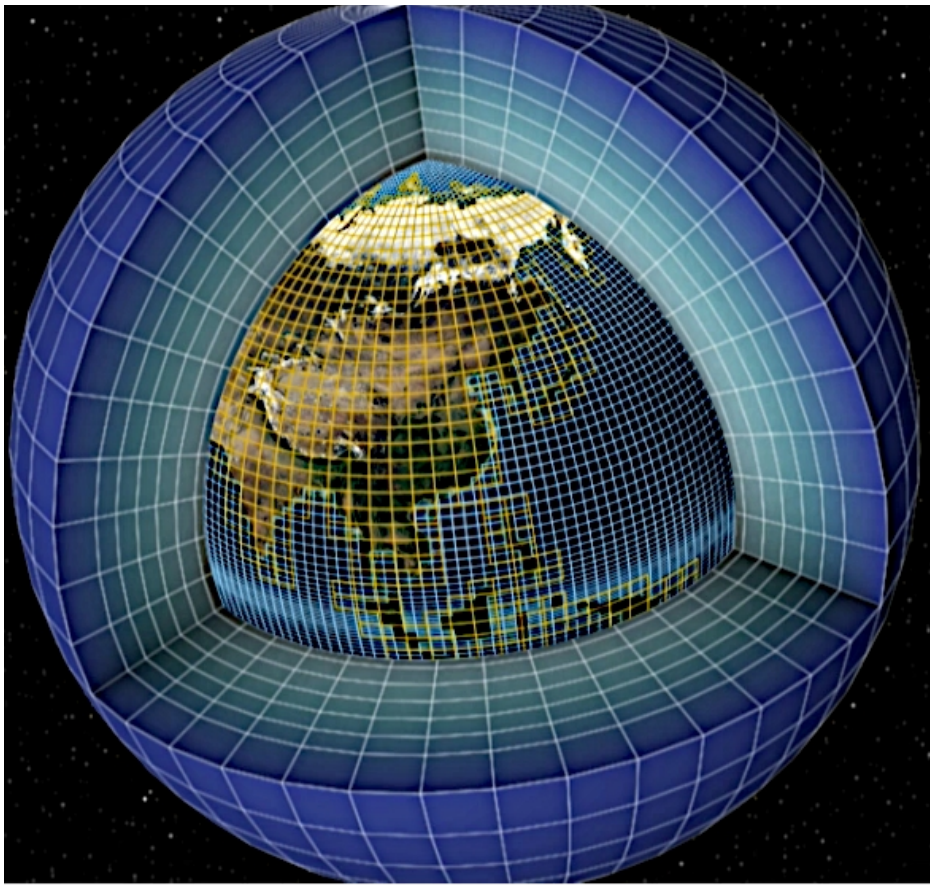
Institut Pierre Simon Laplace

French Global Modelling Groups :

IPSL (Paris)

&

Météo-France / CNRM / CERFACS (Toulouse)



Outline :

- Next versions of OAGCMs and ESMs
- Recommendations for CMIP6

Towards IPSL-CM6 AOGCM...

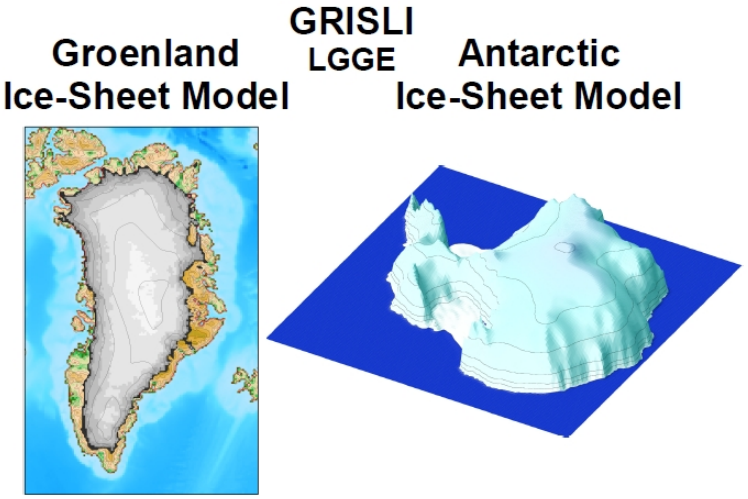
Improved atmospheric physics, including :

new radiation scheme (RTTM),
convection (e.g. stochastic triggering),
clouds (e.g. vertical subgrid-scale variab, StCu),
soil hydrology

NB : Most developments made as part of GASS activities.

Improved ocean and sea-ice models

Coupling of AOGCM with ice-sheet model



Two resolutions :

LR : atmos : 2.5° x 1.2° x L79 ; ocean : 1° x L75
MR : atmos : 1.2° x 0.6 ° x L79 ; ocean : 0.25° x L75

More efforts will be put on the reduction of large-scale biases in the coupled model, and on model tuning.

Towards IPSL-CM6 ESM...

Compared to IPSL-CM5 ESM :

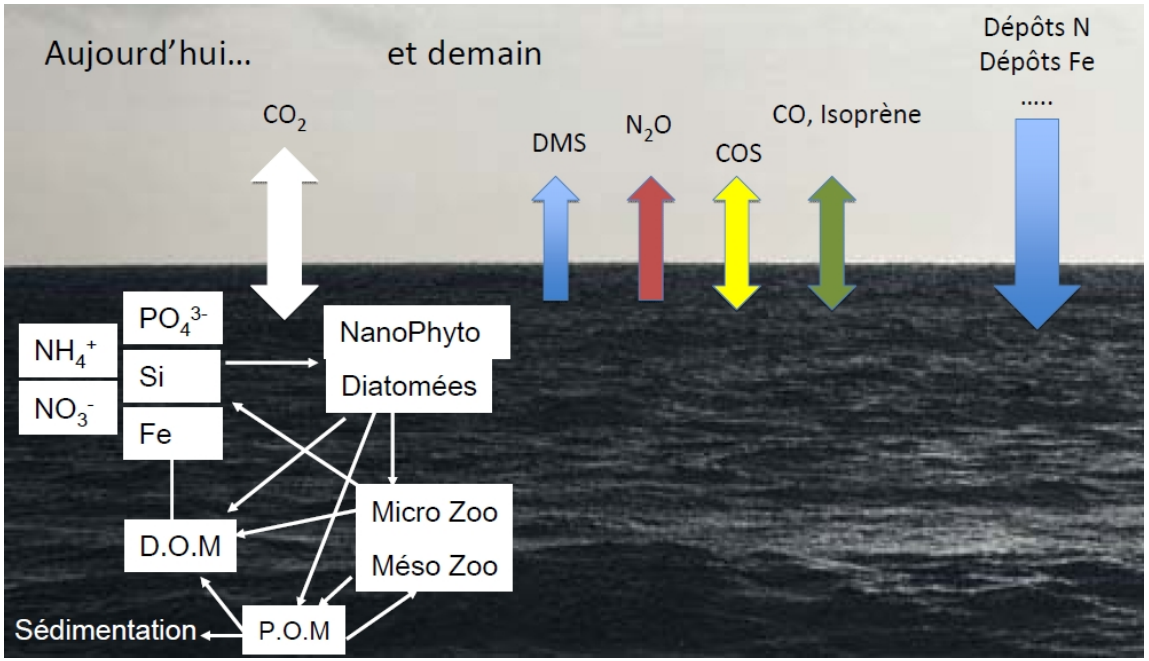
Better coupling between atmospheric chemistry and biochemistry

- over land (nitrogen cycle, aerosols, etc)

- over ocean (iron from mineral dust, DMS, etc)

+ Fires + treatment of high-latitude processes (e.g. permafrost)

+ Stratospheric aerosols



Towards CNRM-CM6 AOGCM...

AOGCM : two versions should be available :

- CNRM-CM6-LR: Lower resolution ARPEGE-Climat 6 (1.4°) NEMO (1°)
  - ~ current model but increased vertical resolution in both components
- CNRM-CM6- HR: Higher resolution ARPEGE-Climat 6 (0.5°) NEMO (1/4°)

What will be new?

- New atmospheric physics (including new convective scheme)
- Multiple energy balance model for the soil-vegetation-snow continuum, including :
  - New continental hydrological scheme
  - New snow scheme
- Increased atmosphere-ocean coupling frequency.

Towards CNRM-CM6 ESM..

Which ESM components will be available (by order of maturity) ?

- Interactive stratospheric chemistry on-line
- Carbon Cycle
- Interactive aerosol scheme and tropospheric chemistry

Most simulations including ESM will be done with the CNRM-CM6-LR model

(including detection/attribution)

CNRM-CM6-HR will be used mainly to run core experiments

(AMIP, historical, scenarios, no ensemble)

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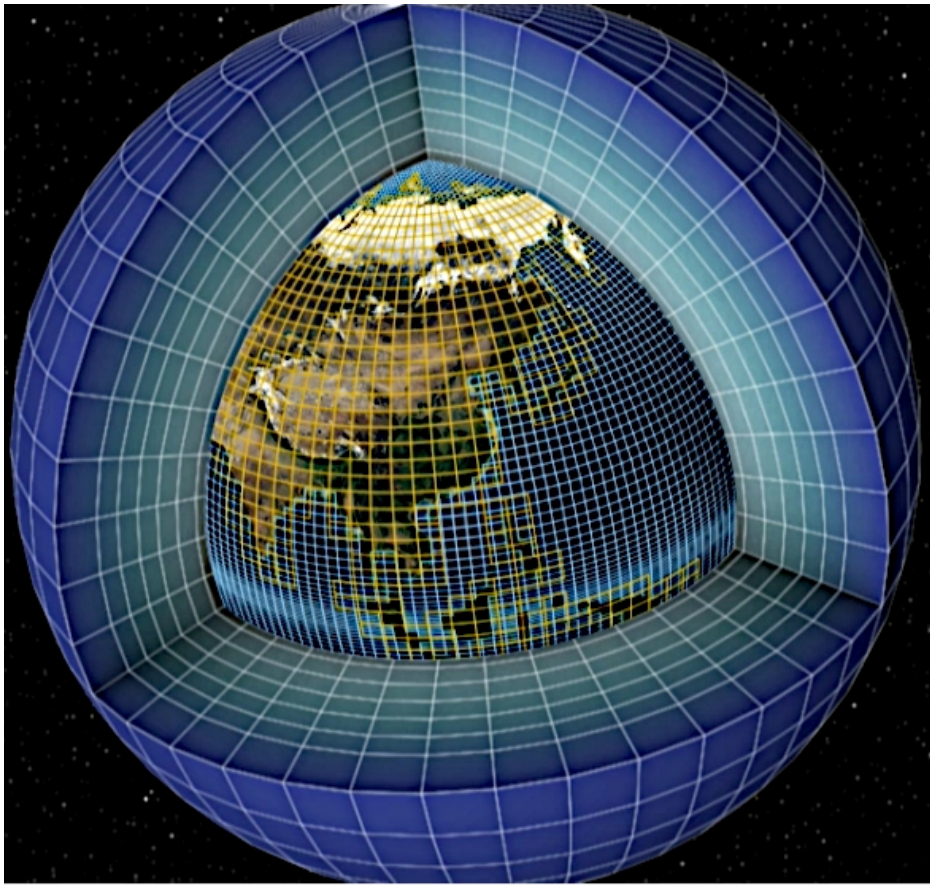
From CMIP5 to CMIP6



Lessons &

Recommendations

CMIP5 was a Great Project in Many Respects

However :

- **From one CMIP to the next :**

  - persistent, long-standing model biases

  - similar range of uncertainties in climate projections

- **We should learn more from :**

  - RCPs

  - near-term experiments

CMIP should consider these issues very seriously when designing CMIP6.

Scientific Focus of CMIP6 (suggestions)

- **Interpretation of long-standing model biases**
  (in the perspective of reducing them)

- **Understanding of the climate response to various forcings and interpretation of model uncertainties**
  (quantifying uncertainties is not enough ; robust and uncertain results must be understood)

- **Understanding of mechanisms underlying decadal climate variability and predictability**
  (focus on skill is not enough)

General Recommendations :

- **Promote continuity with CMIP5** (experimental protocol, infrastructure)
- **Promote targeted, idealized experiments** (focus on science questions)
- **Be more specific about forcings** (e.g. aerosols, volcanoes, solar constant)

Synchronization among the MIPs is an important issue !

And of course :

- **Ensure more time for model analysis**
- **Consult the modeling groups as early as possible** (infrastructure, design, etc)

Interpretation of Model Biases

1. Include in the *Diagnostic, Evaluation and Characterization (DEC)* set of experiments :

- forced atmospheric experiments (AMIP)
- forced ocean experiments (aka CORE II of WGOMD)
- forced land-surface experiments (might federate GASS/GSWP, MsTMIP, ISIMIP initiatives)

NB : simulations should be as long as possible to analyze both biases and tendencies

... and include detailed outputs (e.g. COSP, high-frequency)

2. Encourage the set up of a SR-MIP (Sensitivity to Resolution MIP) :

- assess the impact of horizontal/vertical resolution ; high-top/low-top
- would avoid having in the DEC model simulations differing only by resolution
- model outputs could be provided both on native and specified grids

3. Connect CMIP6 to other MIPs, such as :

- evaluation of radiation codes (RT-MIP)
- MJO diabatic heating project, Transpose-AMIP, etc
- Transpose-CMIP ?
- experiments nudged by atmospheric reanalyses ?

Climate Response to Specified Forcings (robustness & uncertainties)

1. Include experiments with *individual*, *prescribed* forcings :

- aerosols (transient or not, idealized or not)
- solar constant (e.g. abrupt change)
- volcanoes, ozone, land-use, etc
- all forcings together

2. Include experiments aiming at better diagnosing the radiative forcing

- *both* for historical period *and scenarios*

3. Encourage OAGCM experiments in the DEC, and ESM experiments in the satellite MIPs

4. Promote simple experiments in idealized frameworks (e.g. aquaplanets)

5. Encourage modeling groups to explore potential feedbacks from of ice-sheets

Decadal Climate Variations and Predictability

1. More emphasis on physical mechanisms :

- outcome of near-term experiments should not be limited to skill measures
- understanding the underlying mechanisms should be central in the design of expts
- revisit the respective weight of nb of members, nb of starting dates, length of runs

2. Recognizing that modeling groups have different scientific interests and resources :

- propose a limited set of standard experiments focusing on mechanisms
- keep more extensive experiments focusing on predictability skill separate (decadal-MIP?)

3. Make the experimental design of near-term experiments less fuzzy, e.g. :

- date of restart : Nov 1st or Jan 1st : big difference for ENSO predictability
- specification of the volcanic forcing in hindcasts
- starting dates every year

Other Recommendations and Suggestions

1. Adjustements in the length of simulations :

- start AMIP in 1950 instead of 1979 (Sahel drought, etc)
- start historical in 1900 instead of 1850 (very little forcing during 1850-1900)
- extend the length of piControl from 500 to 1000 years (to better estimate internal variability)
  + request a minimum ensemble size for some DEC simulations

2. Output of high resolution models :

- a concern for data storage and model analysis
- provide model outputs on native and/or specified coarser grids ?

3. Freezing of the CMIP infrastructure :

- as early as possible (including tables of variables)
- as user-frienfly as possible (ESG, documentation, etc)

4. Organize technical workshops on CMIP infrastructure and data management

- would be complementary to CMIP analysis workshops
- would facilitate the sharing of experiences around technical aspects of CMIP