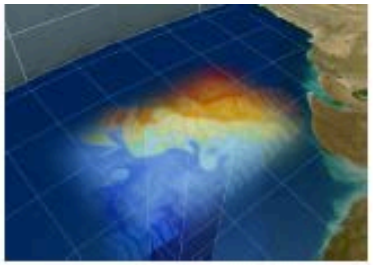
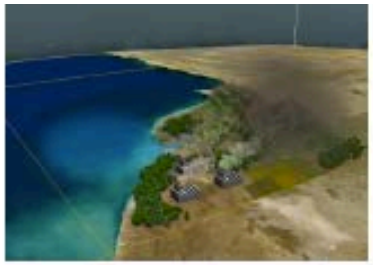
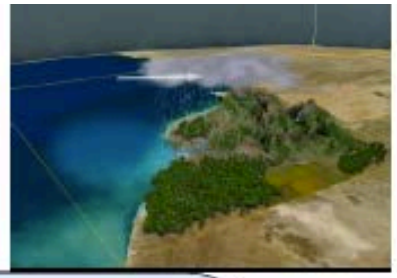
Institut Pierre Simon Laplace

Institut de recherche en sciences de l'environnement

Développements chimie et aérosols pour IPSLCM6

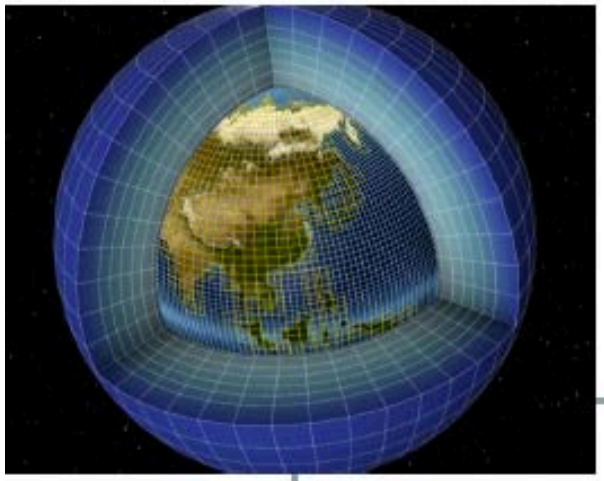
Model Components

INCA / REPROBUS
(chimie atmosphérique)
(aérosol)

ORCHIDEE
(surfaces continentales)
(végétation)

LMDZ
(atmosphère)



OASIS
(coupleur)

OPA
(océan)

LIM
(glace de mer)

PISCES
(biogéochimie marine)

NEMO

All components developed in-house, apart from
-LIM : at Louvain & IPSL
-OASIS : at CERFACS

Model Versions

IPSL-ESM : IPSL-CM6.1 (beta version since summer 2015 – ready mid2016)

Physical Components :

- Atmosphere : Improved Version of IPSL-CM5B used in CMIP5
- Ocean : from NEMO-v3.2 to NEMO-v3.6
- Sea-ice : from LIM2 to LIM3

ESM Configurations

- Standard : physical + carbon cycle (ORCHIDEE, PISCES)
- Standard w/ (1) interactive aerosol incl. nitrate, (2) full chemistry

Standard Resolution : IPSL-CM6.1-LR (similar to MR for IPSL-CM5)

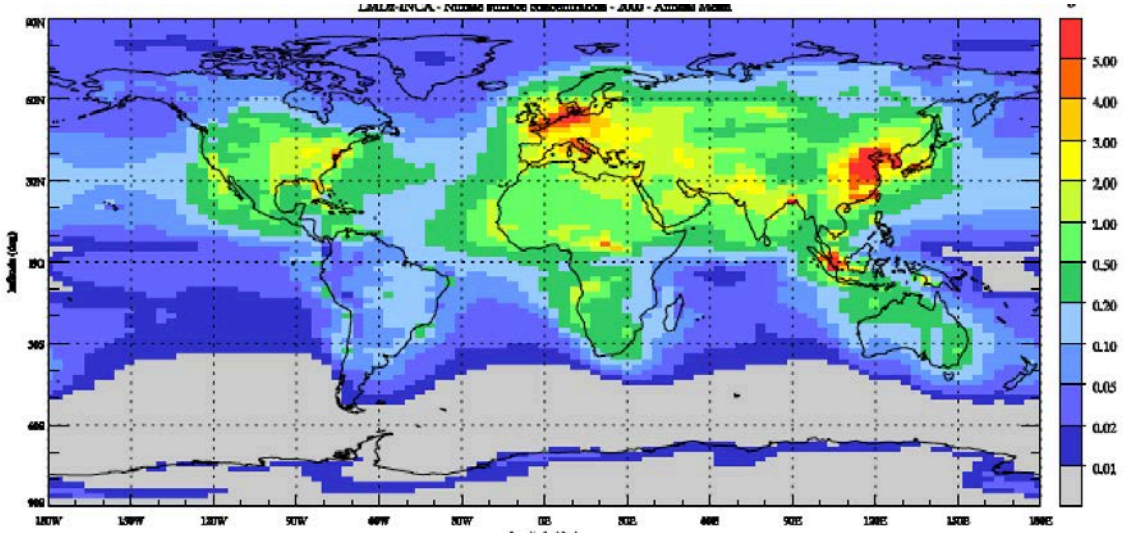
- Atmosphere : 144x144 (2.5°x1.5°) L79 & Ocean : ORCA1 (~1°) L75

IPSL-ESM : IPSL-CM6.2 (improved components – from CRESCENDO not before 2018…)

Atm. Chemistry and Aerosols : INCA

INCA in IPSL-CM6.1

- New radiative code RRTM
- N-cycle (Hauglustaine et al. 2014)
- Aerosols : major developments on dust mineralogy / iron content
  (Journet, Balkanski, Harrison
  Wang et al.,)



Nitrate Aerosols – Present Day (Hauglustaine et al.)

Atm. Chemistry and Aerosols : INCA

INCA in IPSL-CM6.1

- New radiative code RRTM
- N-cycle (Hauglustaine et al. 2014)
- Aerosols : major developments on dust mineralogy / iron content
  (Journet, Balkanski, Harrison
  Wang et al.,)

Planned Developments w/ CRESCENDO

- Focus 1 : Secondary Organic Aerosols (w/ K. Tsigaridis)
- Focus 2 : N-cycle and deposition
- Focus 3 : Dust emissions and soluble Fe deposition

Who ? : Y. Balkanski, D. Hauglustaine, J. Lathière, O. Boucher, S. Szopa
A. Cozic
Post-Doc CRESCENDO

Biogeochemistry (INCA – ORCHIDEE – PISCES)

1- Coupled / integrated Carbon & Nitrogen cycle (2016)

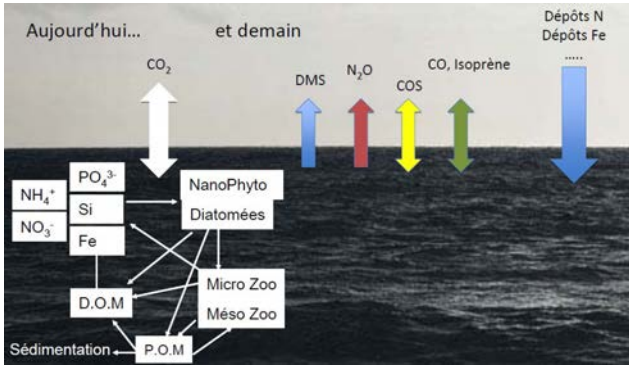
- N-cycle in ORCHIDEE (+ N_2O)
- Variable Stoechiometry C-N-P in PISCES (+N_2O)
- Atm. nitrogen cycle + deposition in INCA

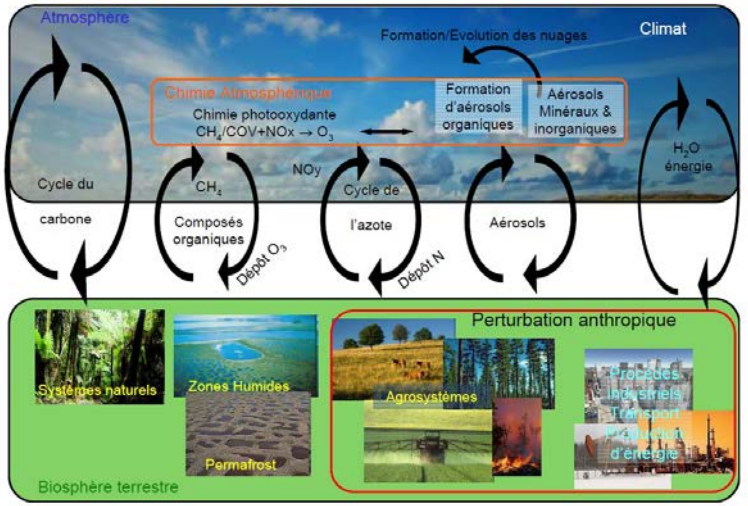
2. VOCs and secondary aerosols (SOA) (2016-2017)

- Formation of SOA in INCA
- Emissions (marine + terrestrial of BVOCs)

3. Others…

- Land use + Forest managment
- carbon lability (soil, ocean)
- high-lat process w/ORCHIDEE





Overview AerChemMIP

Co-chairs:

Bill Collins(UK), Jean-François Lamarque (USA), Michael Schulz (Norway)

AerChemMIP will quantify **forcings**, **feedbacks** and global-to-regional climate **response** (ΔT,ΔP) from changes to:

- NTCF emissions (aerosols, O_3 precursors)
- Reactive GHGs concentrations (N_2O, CH_4, ODSs)

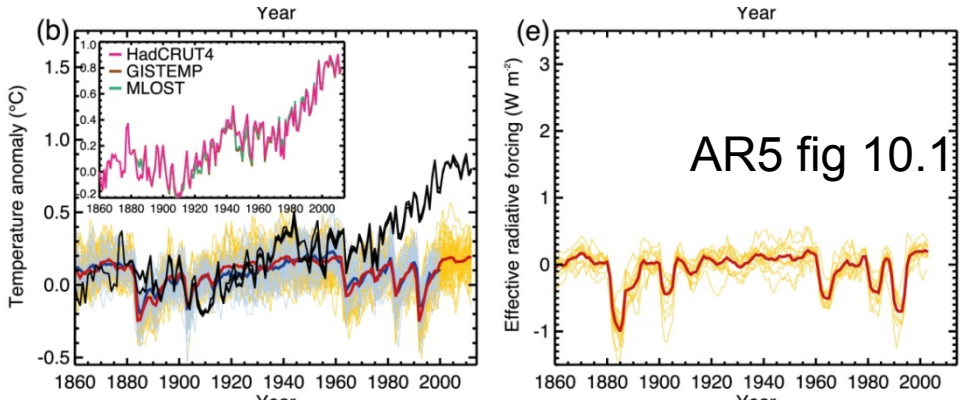
→ It will provide essential new data to answer CMPI6 Q1 "How does the Earth system respond to forcing?". AerChemMIP will provide data on past and future changes in the chemical composition of the atmosphere and estimate the associated forcings

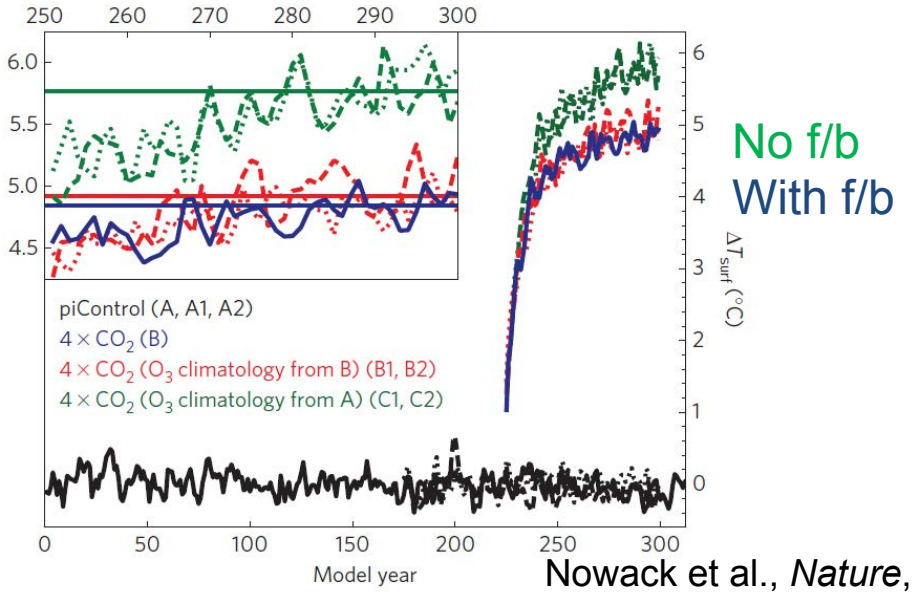
→ It will provide significant contributions to WCRP theme "Biogeochemical forcings and feedbacks" (Chemistry-climate feedbacks, uncertainty associated with natural emissions,…)

Motivation 1: Quantification of the transient Effective Radiative Forcing of Near-Term Climate Forcers

- Quantification of Effective Radiative Forcing of NTCFs for historical runs with interactive aerosol (+chemistry)
  - Needed for D&A
  - Improves on AR5 and Forster 2013
  - Includes tropospheric O_3

- Quantification of biogeochemical feedbacks
  - e.g., chemistry-climate feedback under a 4xCO_2 with (AerChemMIP) vs without (RFMIP) interactive aerosols and chemistry changes the climate sensitivity



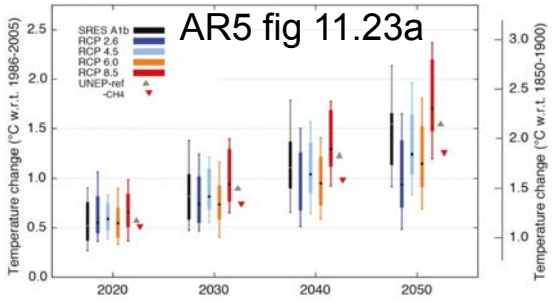


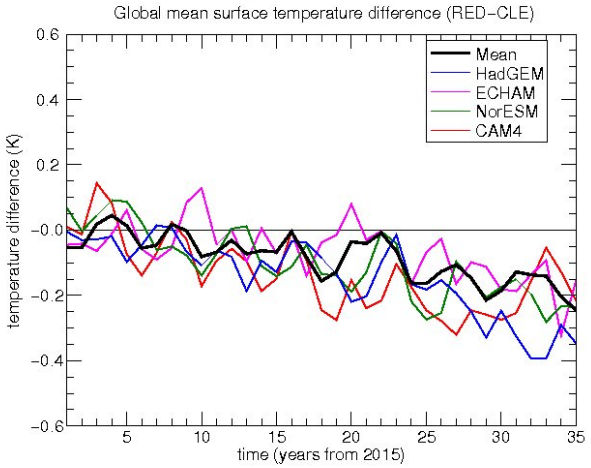
Nowack et al., *Nature*, 2015

Motivation 2: Quantifying the climate impacts of Near-Term Climate Forcers

- Importance of NTCFs in climate prediction scenarios
  - AR5: near term ΔT spread was due to Near-Term Climate Forcers
  - ECLIPSE (FP7): Mitigation of CH4, BC compared to business as usual

➢ AerChemMIP will quantify the climate effects of NTCF mitigation based on a variant to ScenarioMIP Tier1 SSP3-7





Stohl et al. (2015)