TM5 development for AerChemMIP

Tommi Bergman
KNMI
Twan van Noije, Phillippe Le Sager,
Risto Makkonen, Roland Schrödner et al.

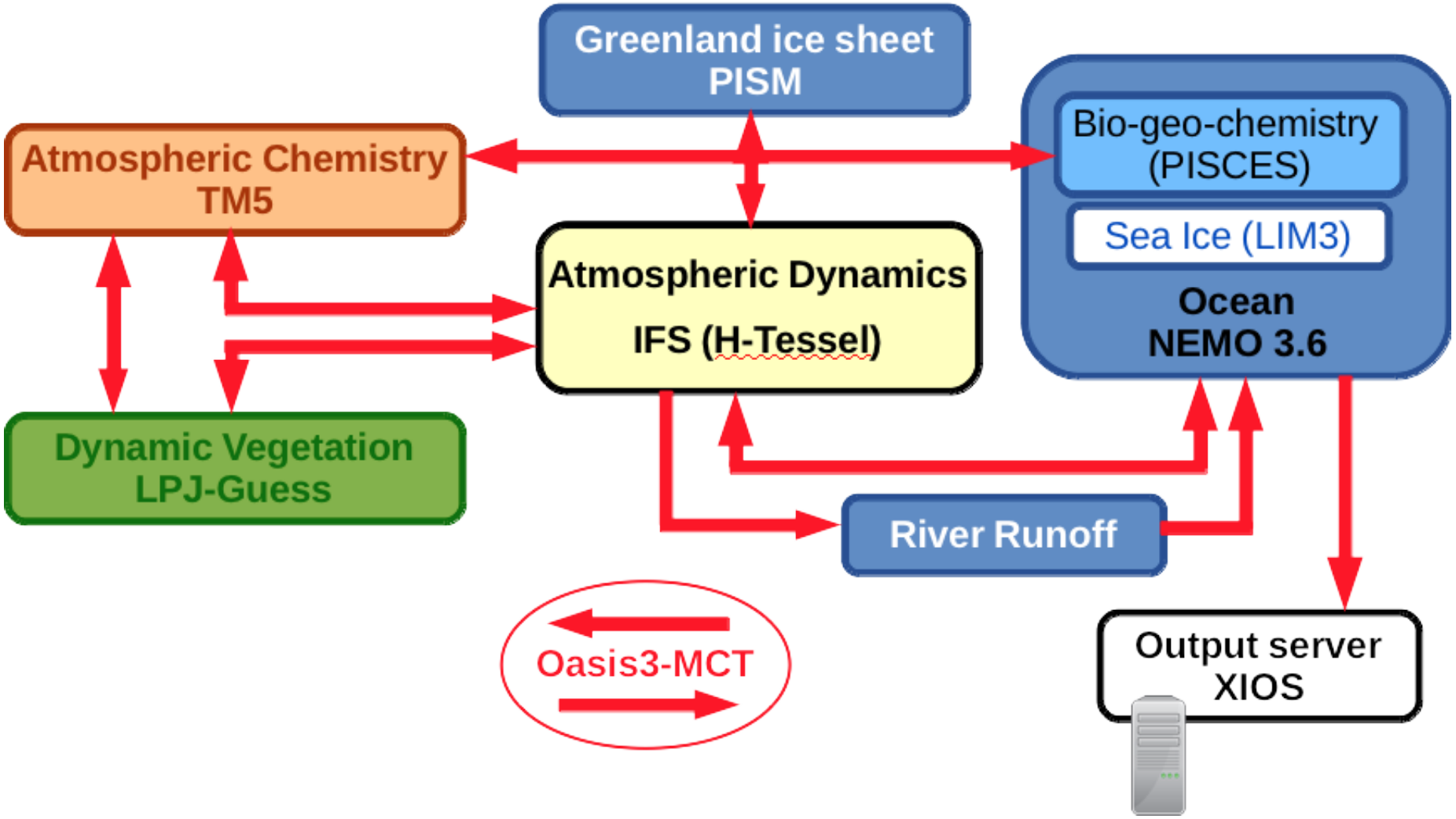
AerChemMIP

Quantifying the effects of chemistry and aerosols in CMIP6

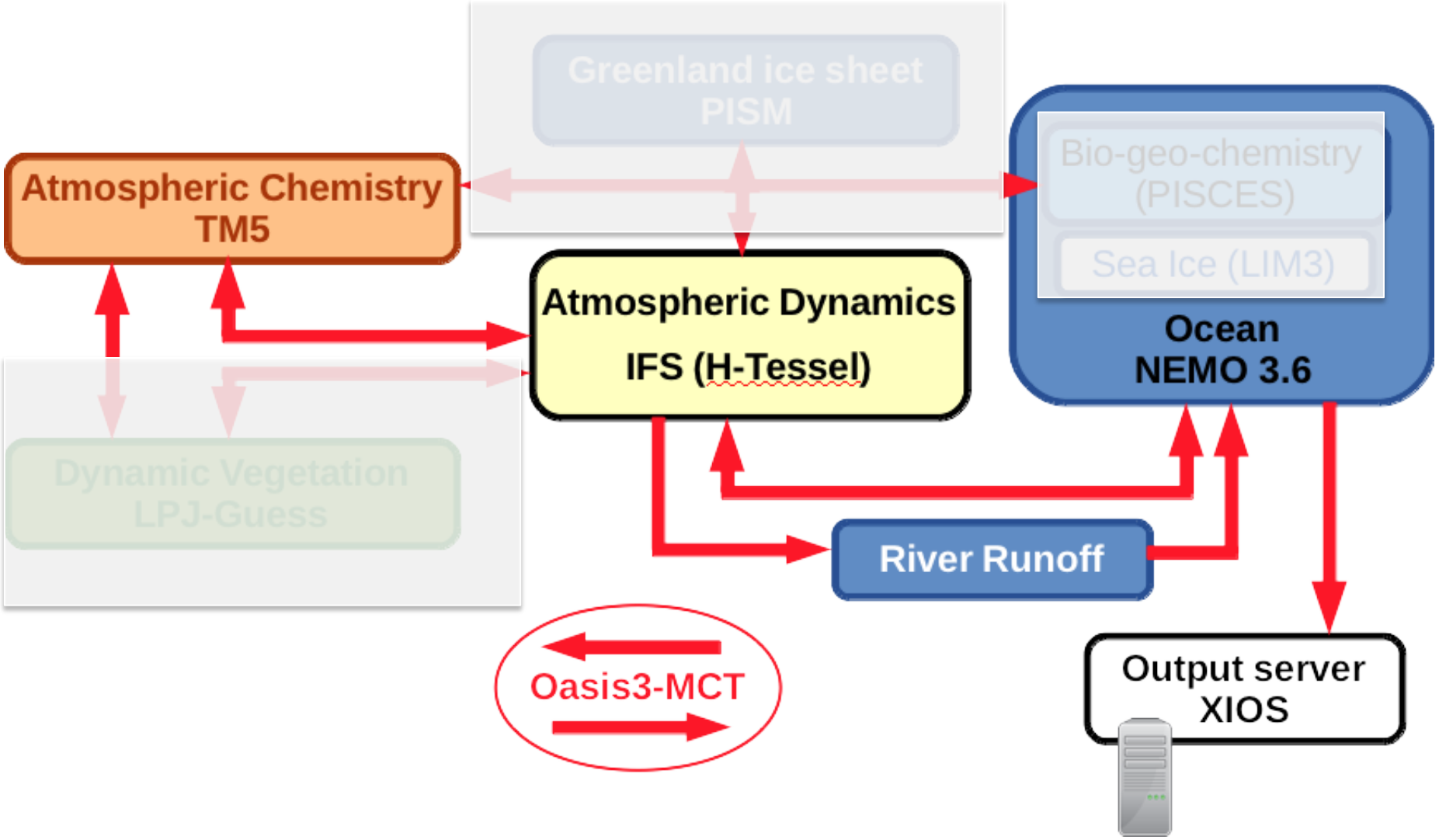
- How have anthropogenic emissions contributed to global radiative forcing and affected regional climate over the historical period?
- How will future policies (on climate, air quality and land use) affect these species and their climate impacts?
- Can the uncertainties associated with anthropogenic emissions be quantified?
- Can climate feedbacks occurring through changes in natural emissions be quantified?

Collins et al., GMDD, 2016

Components of 3.2 EC-Earth



Components of 3.2 EC-Earth

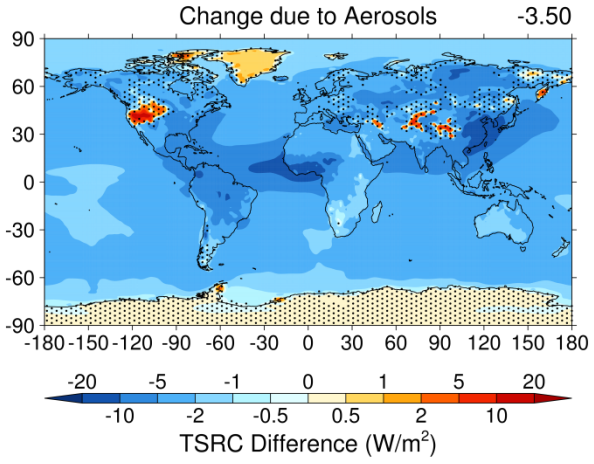


EC-Earth3-AerChem

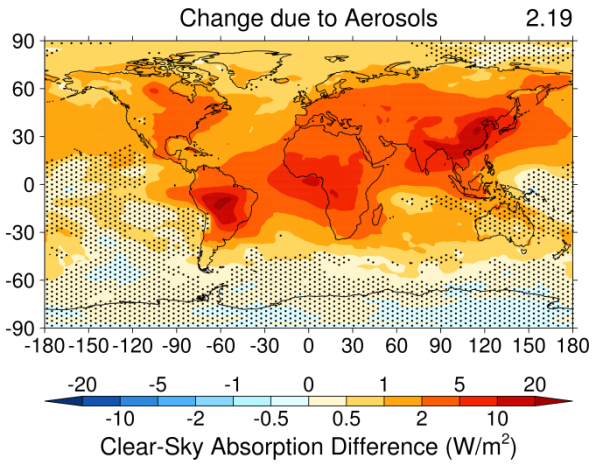
- Interactive coupling between IFS and TM5
- TM5 provides aerosol fields, ozone and methane concentrations
- Preliminary AMIP test simulations (2005-2010), last 5 years to estimate aerosol direct radiative effects (DRE) of anthropogenic + natural aerosols

Clear-sky SW effects

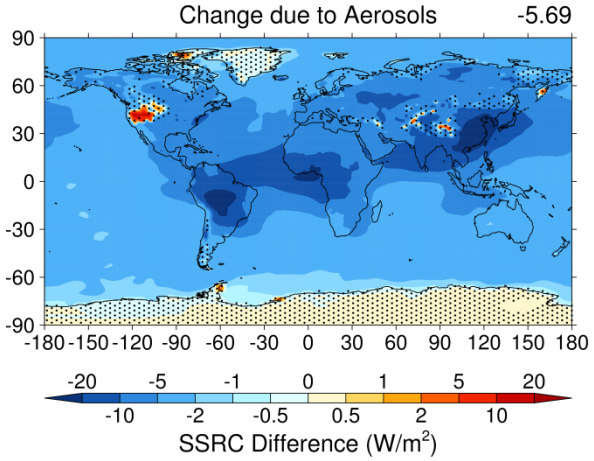
TOA



Atmosphere



Surface



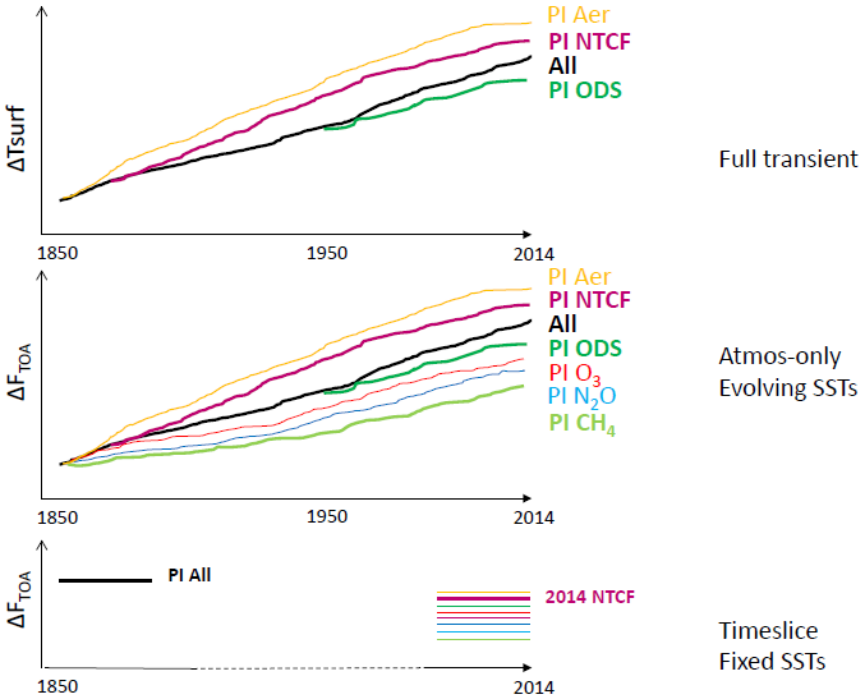
TM5 / IFS to finish for AerChemMIP

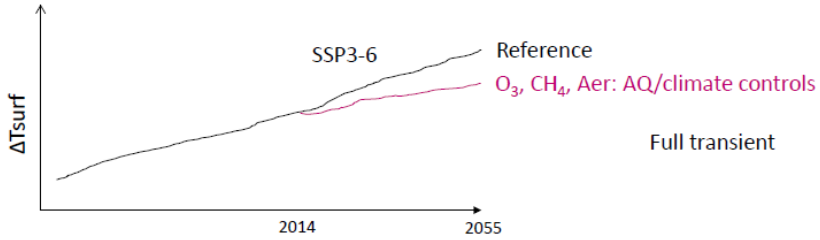
- Secondary Organic Aerosol implementation (KNMI, U of Helsinki, U of Lund)
- Cloud activation Based on Abdul-Razzak-Ghan (Finnish Meteorological Institute)
- The determination of aerosol radiative forcing using a radiation double call (Finnish Meteorological Institute)
- Output implementation (KNMI)
  - XIOS to reduce computation time

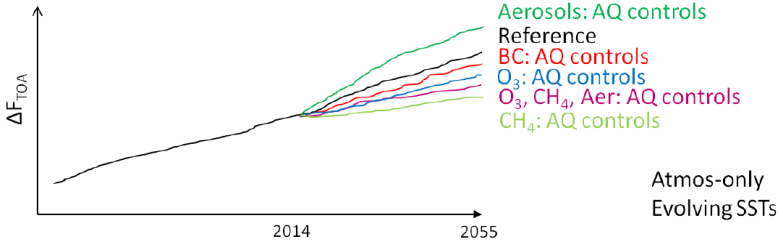
AerChemMIP simulations

- More than 20 simulations
- Over 2000 simulation years of runs
  - DECK ~550
  - Other ~1600 (TIER1)
  - KNMI, UH, FMI and BSC

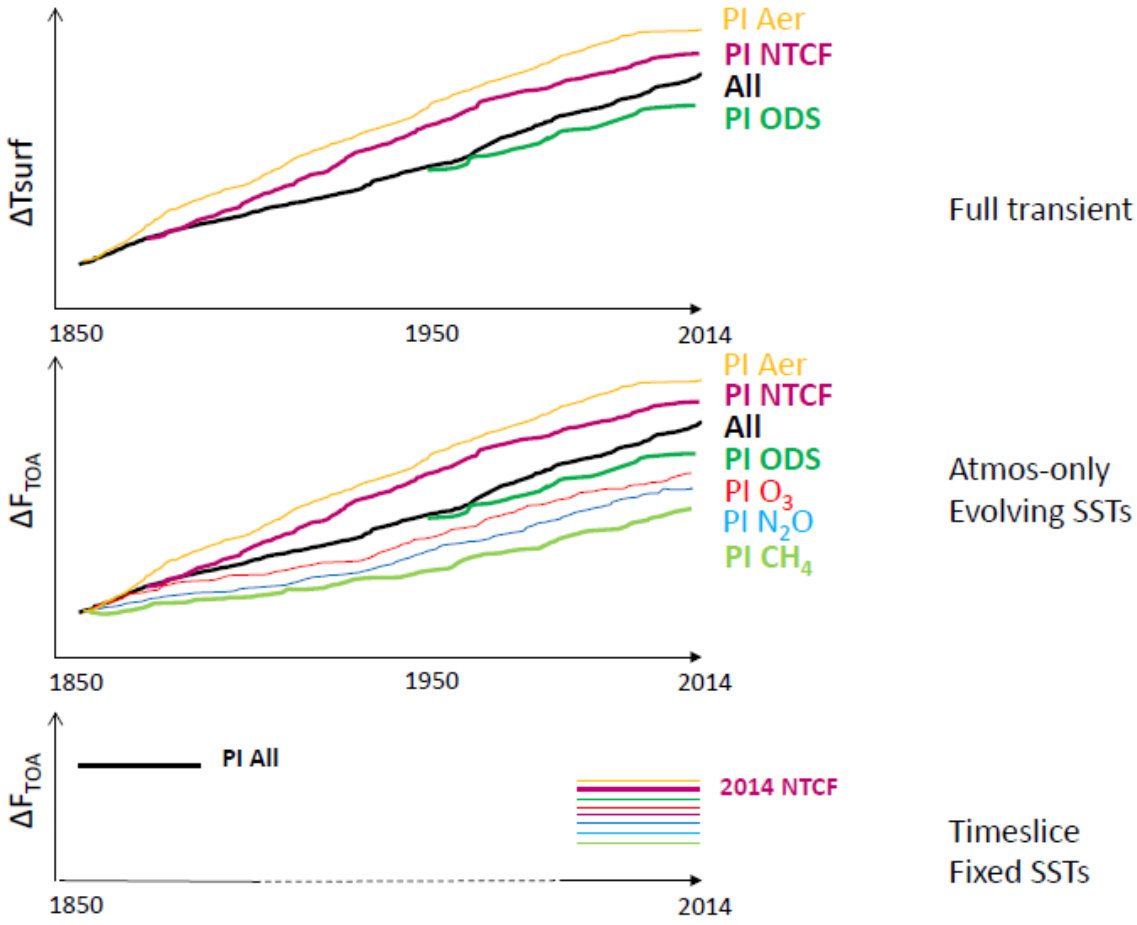
- Interactive aerosols
- AMIP / Full ocean model



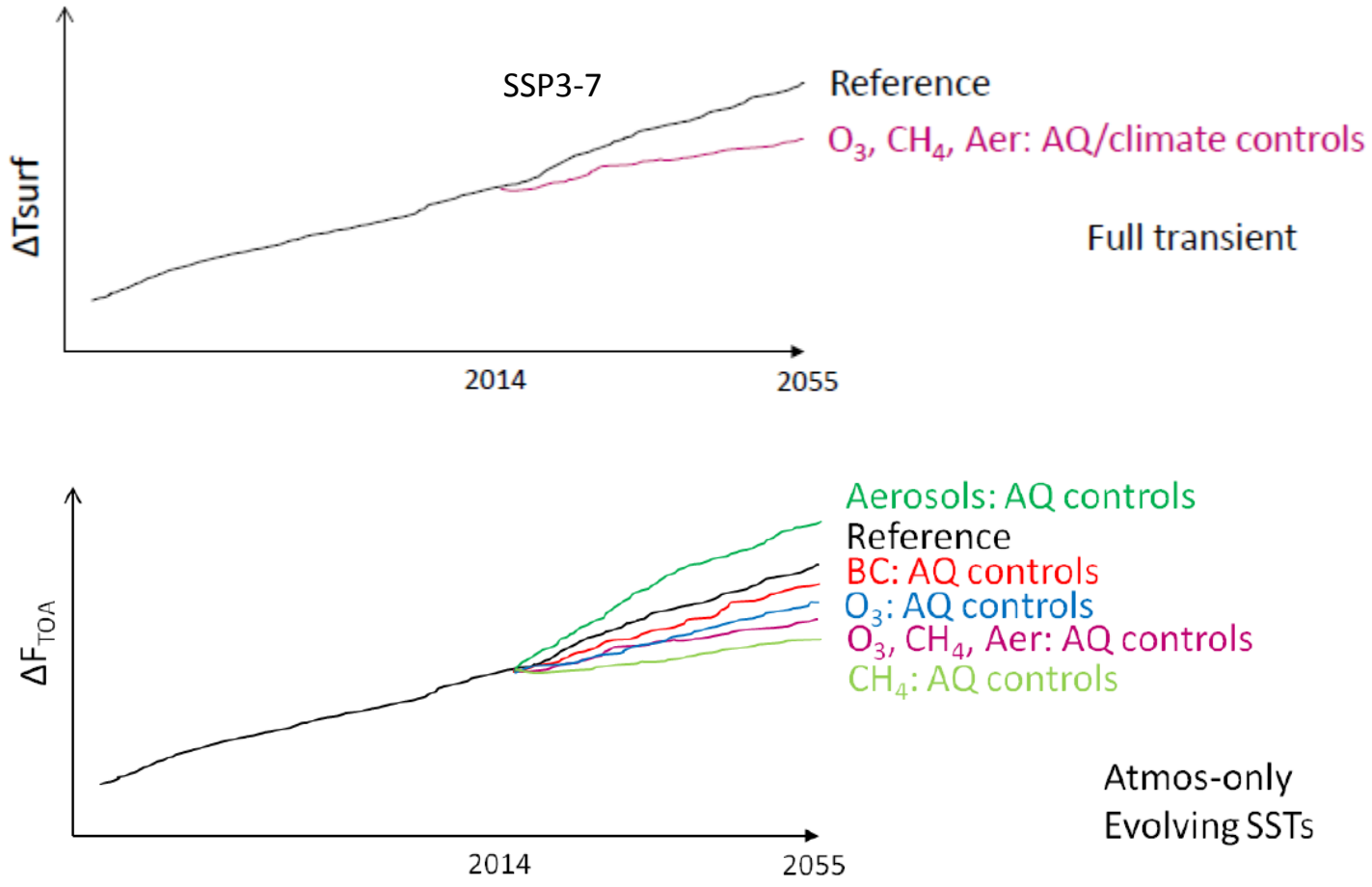




Historical simulations



Future simulations



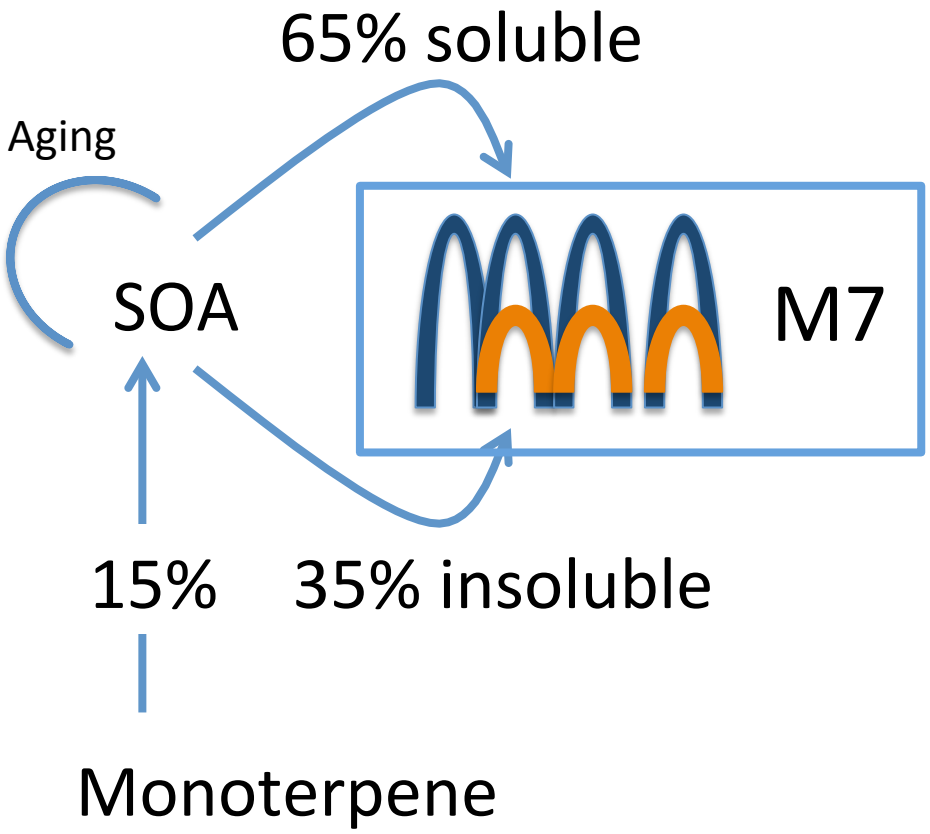
TIMELINE

- End of march
  - Model freeze
  - Secondary organic aerosol scheme
  - Aerosol activation to cloud droplets
- Summer
  - Diagnostic output
  - Performance of the model
  - Double call to radiation
  - Tuning of AMIP version
- After summer
  - AMIP
  - piControl spinups

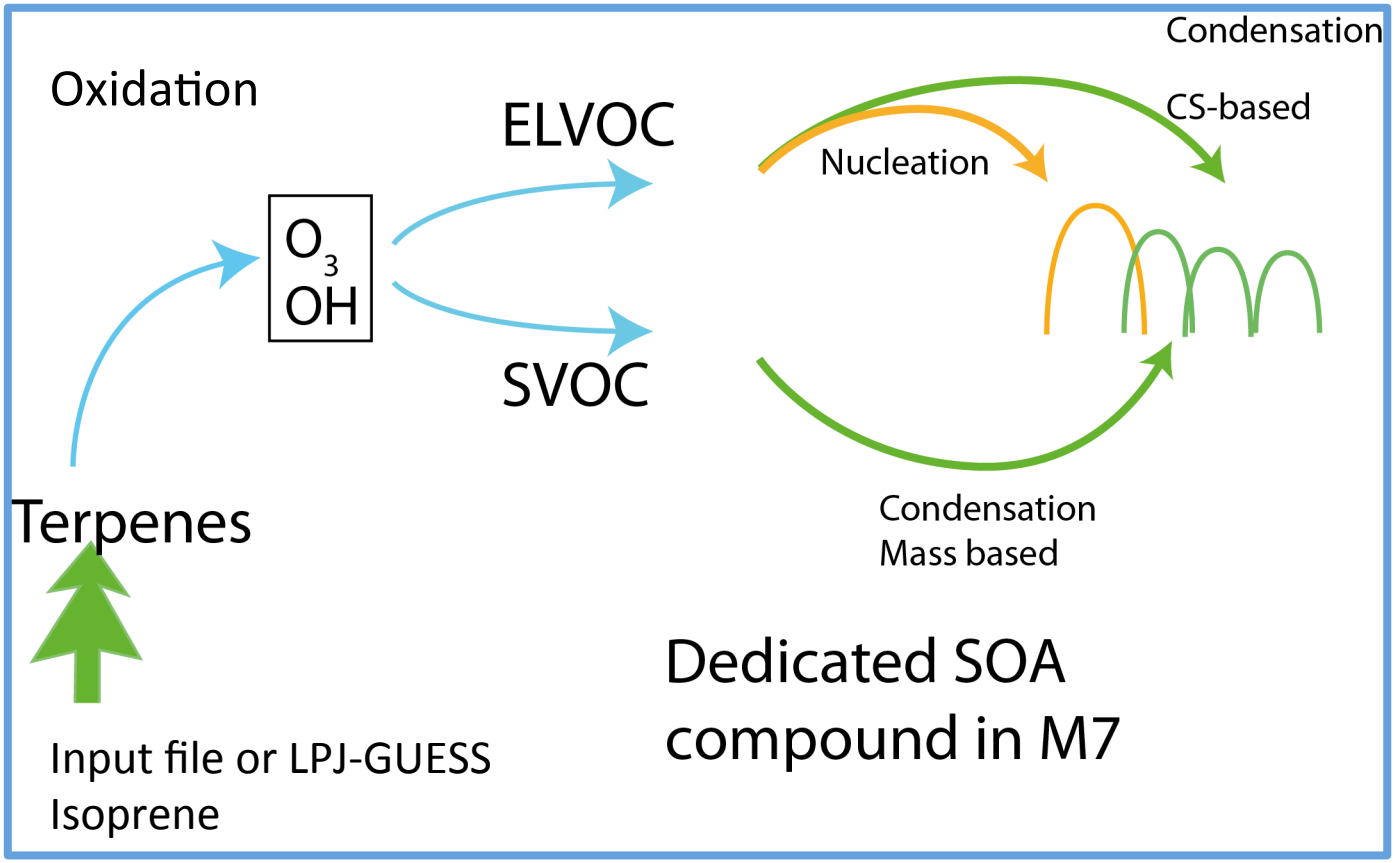
SECONDARY ORGANIC AEROSOLS

Secondary organic aerosols (SOA)

- Current SOA
  - Terpenes read from input files
  - Constant yield of 15%
  - All in Aitken mode
  - No boundary layer nucleation
- New SOA
  - Oxidation of terpenes (isoprene)
  - Condensation of organics
  - Boundary layer nucleation with organic nucleation



SOA Scheme

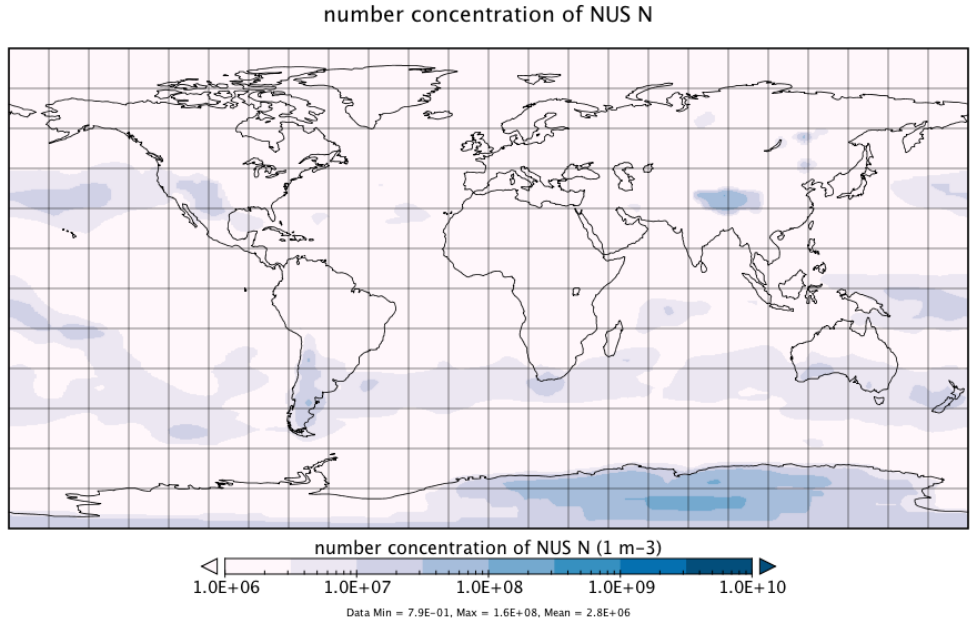


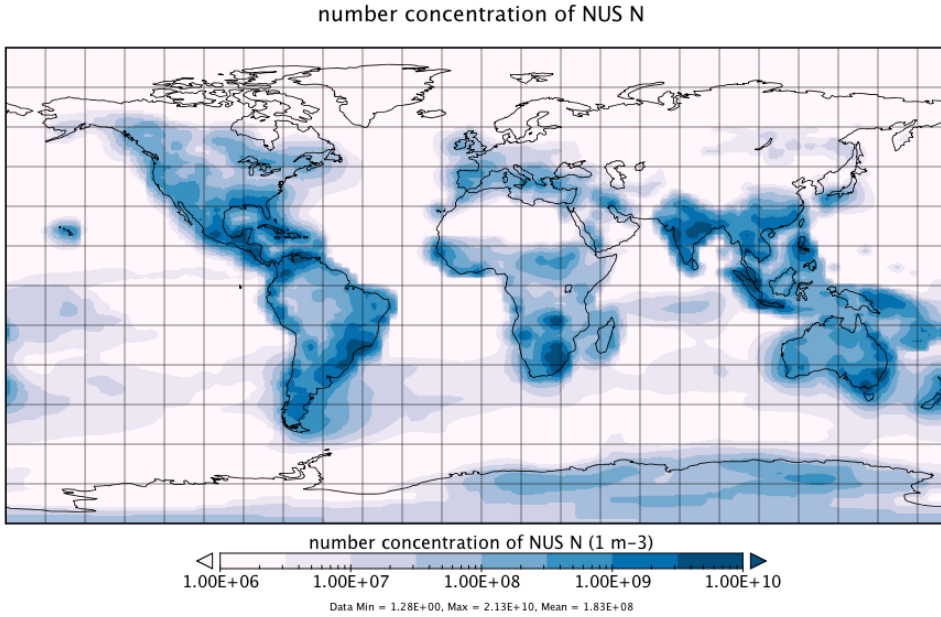
Nucleation
J3=K[ELVOC][SA]
(Paasonen et al.2010)

Changes in N_nus
2010 January

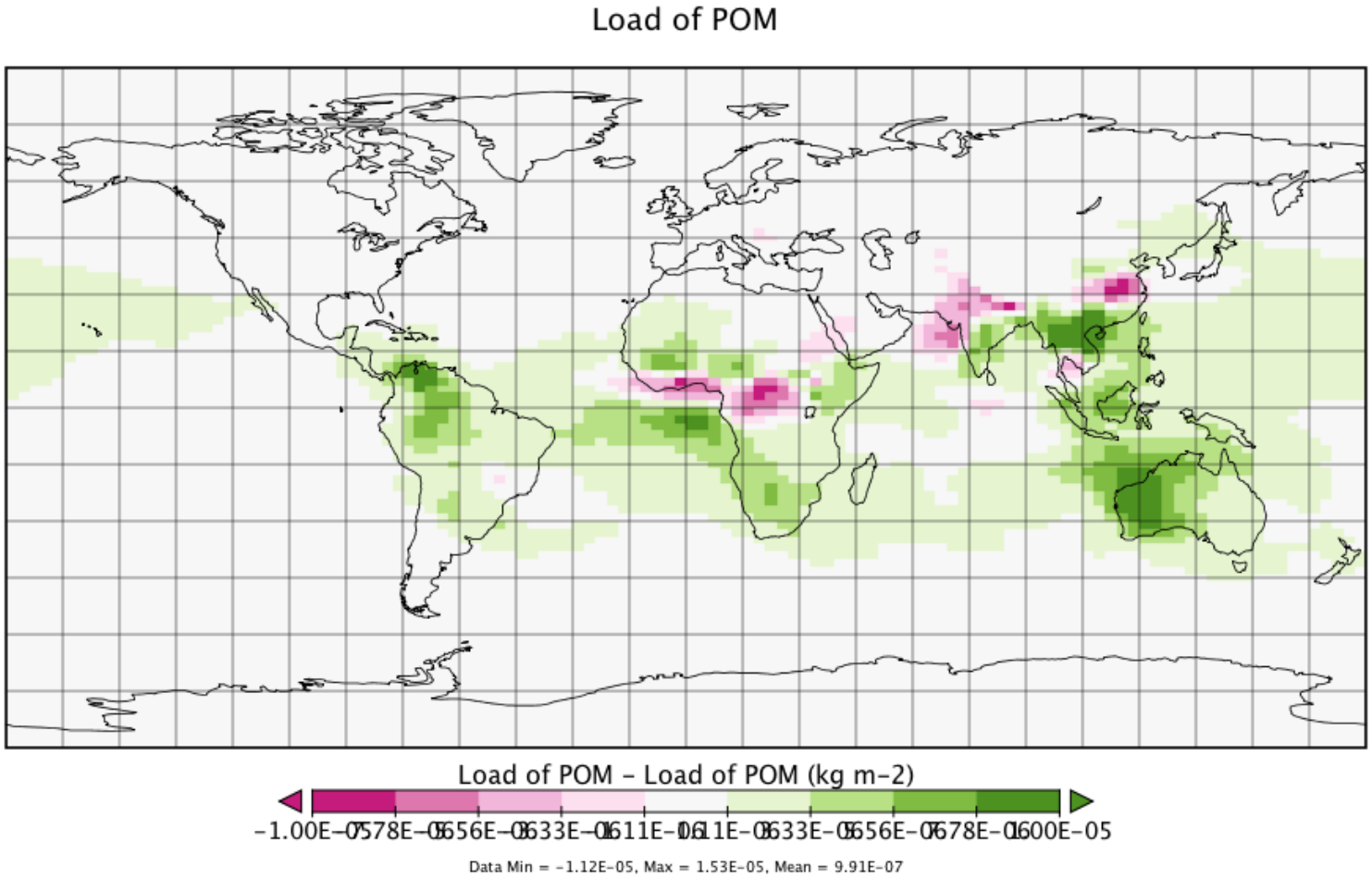
- Old SOA
- Vehkamäki et al. nucleation

- New SOA
- Paasonen et al. 2010





Change in load of organic aerosol 2010 January



Summary and future

- Standalone model evaluation/description of freezed version
- Model freeze at the end of March
- Tuning during summer
- First runs starting summer/fall
- Continue with coupling to LPJ-GUESS and adding Isoprene