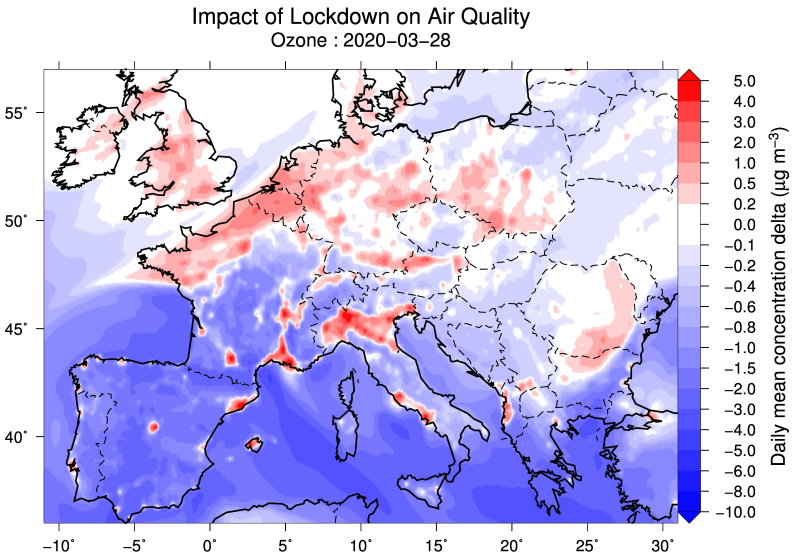
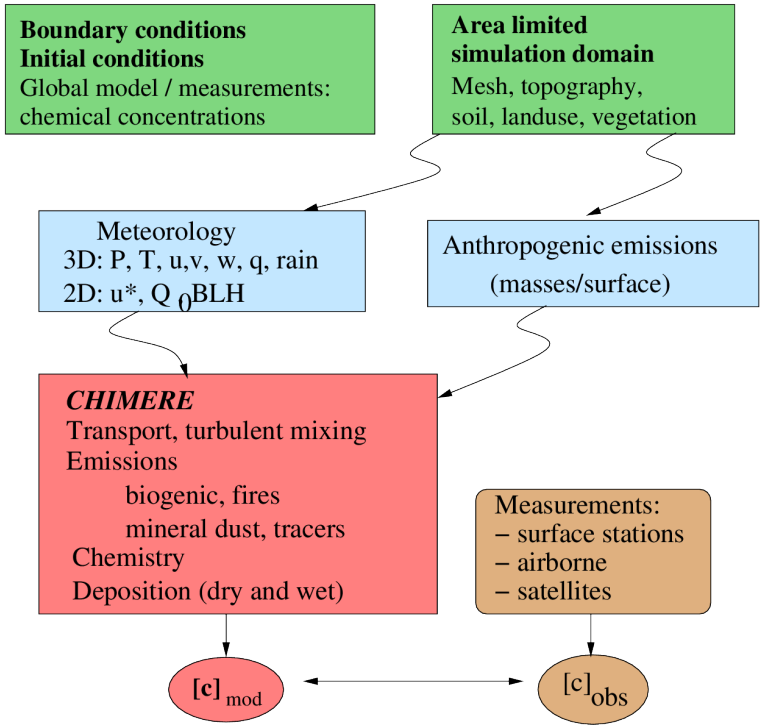
CHIMERE overview



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A chemistry-transport model for research on processes, scenarios and forecast

- CHIMERE calculates and provides atmospheric concentrations of tens of gas-phase and aerosol species at hourly frequency
- External forcings are required to run a simulation: meteorological fields, primary pollutant emissions, chemical boundary conditions
- CHIMERE is distributed under the General Public License and is a National Tool of the French Institut des Sciences de l'Univers
- The code is completely written in Fortran90, and running scripts are written in shell (using gnu-awk for input datafiles processing). The model needs a linux cluster for simulations.



A chemistry-transport model for research on processes, scenarios and forecast

CHIMERE is used for:

Physical and chemical processes research

- Transport and mixing, turbulence
- Aerosols chemistry
- Dust and fire emissions and transport
- Particles deposition
- Clouds, radiation and chemistry
- Vegetation and chemistry interactions

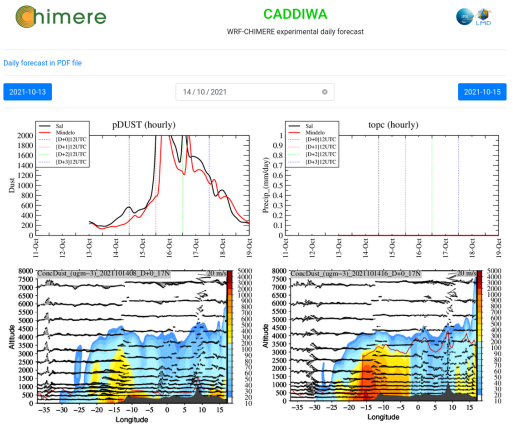
Scenarios and climatologies

- Past and future emissions impacts
- Ensemble analysis

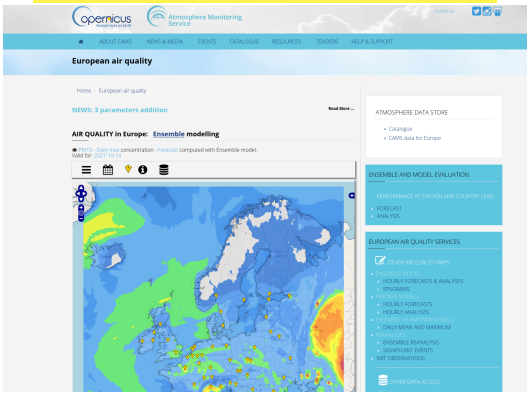
Forecast

- Experimental forecast at LMD during specific field experiments
- Operational forecasts:
  - In Europe: CAMS
  - In France: PREVAIR
  - Over many regions: Regional air quality networks

LMD experimental forecast: CADDIWA



ECMWF-CAMS ensemble forecast



Model development and references

Model developments:

- Developed in LMD and LISA
- A scientific committee with several researchers (each one having a specific scientific expertise)
- An executive committee with one scientist per institute

For questions about:

- The model use: **chimere-users@lmd.polytechnique.fr**
- The model schemes: **chimere@lmd.polytechnique.fr**

BESSAGNET Bertrand
IPSL/LMD
DR CNRS



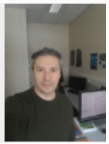
CHOLAKIAN Arineh
IPSL/LMD (Technical coordination)
CNRS Research Engineer



MAILLER Sylvain
IPSL/LMD
IPEF



MENUT Laurent
IPSL/LMD
DR CNRS



PENNEL Romain
IPSL/LMD
Polytechnique Research Engineer



SIOUR Guillaume
IPSL/LISA (model coordination)
CNRS Research Engineer



VALARI Myrto
IPSL/LMD
Assistant Phys. Sorbonne Univ.



Reference papers: general and for each process:
https://www.lmd.polytechnique.fr/chimere/CW-articles.php?page=CW-art-refpubs.php

The model versions

Model availability:

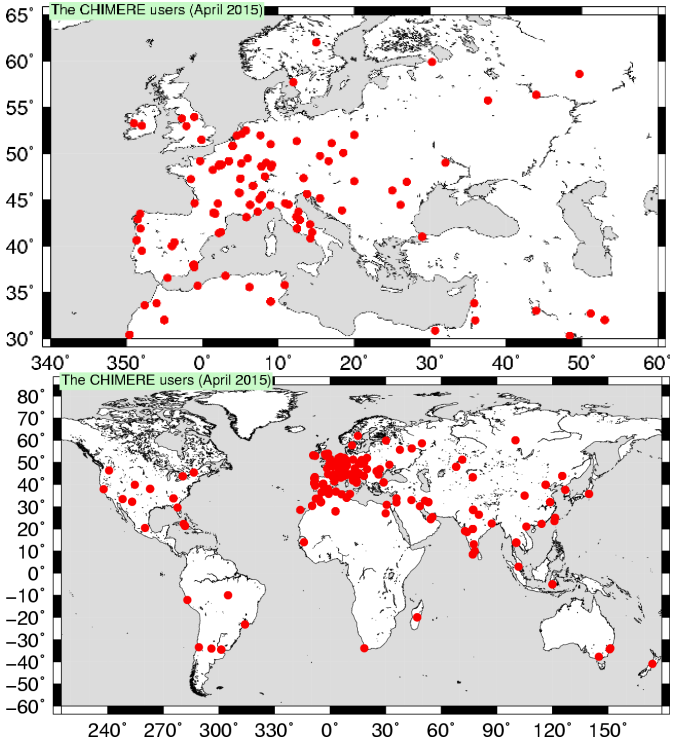
Free access on the model web site:
http://www.lmd.polytechnique.fr/chimere

The current model versions:

- One new version every three years (v2017, v2020, v2023)
- Intermediate releases depending on evolution or bug found

The CHIMERE users:

- More than 300 users (registered on the e-mail list),
- In more than 120 research institutes (universities, air quality networks, private companies, etc.)



Reference:

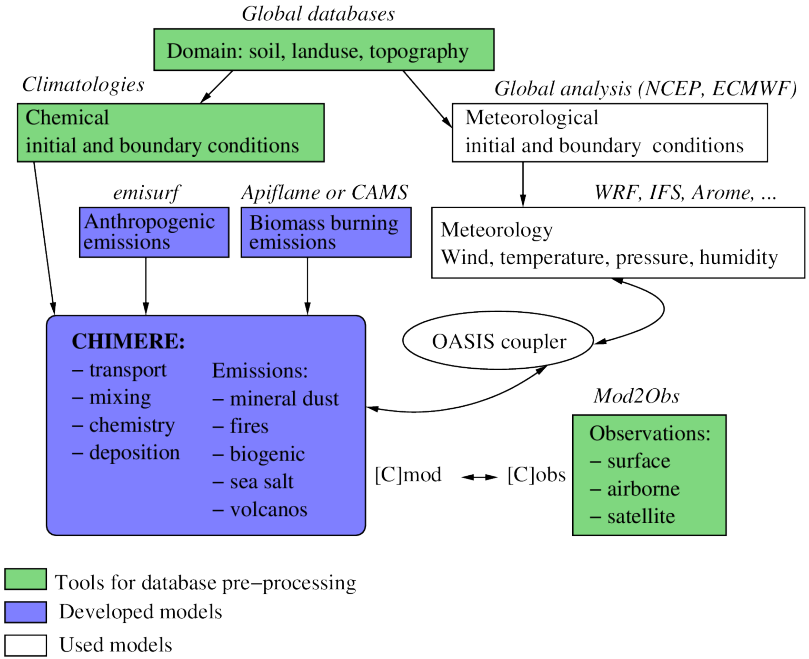
- Menut, L., Cholakian, A., Pennel, R., Siour, G., Mailler, S., Valari, M., Lugon, L., and Meurdesoif, Y.: The CHIMERE chemistry-transport model v2023r1, Geosci. Model Dev., 17, 5431-5457, 2024.

CHIMERE and the pre-processors

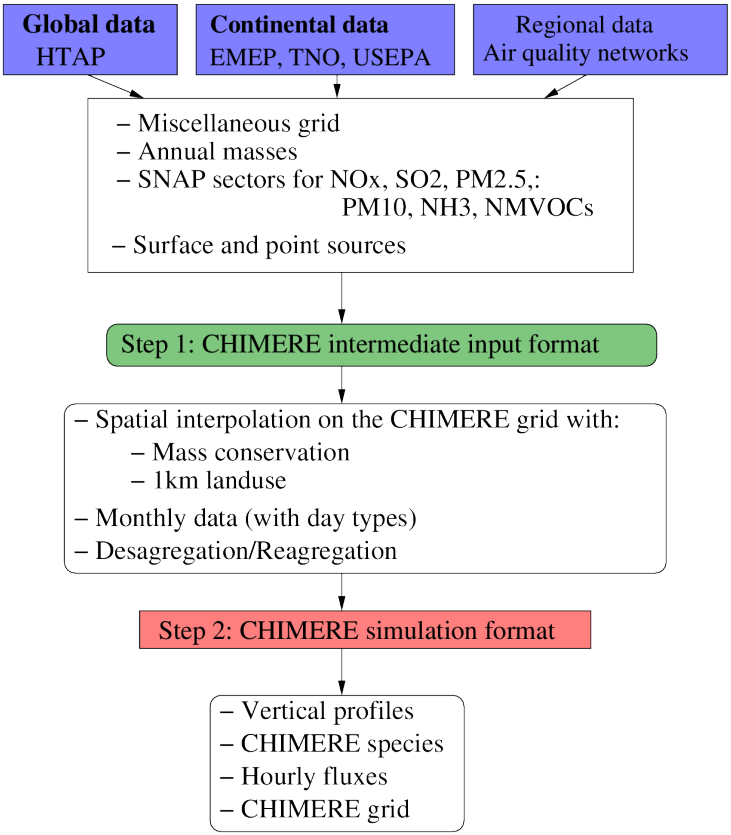
Not only a chemistry-transport model

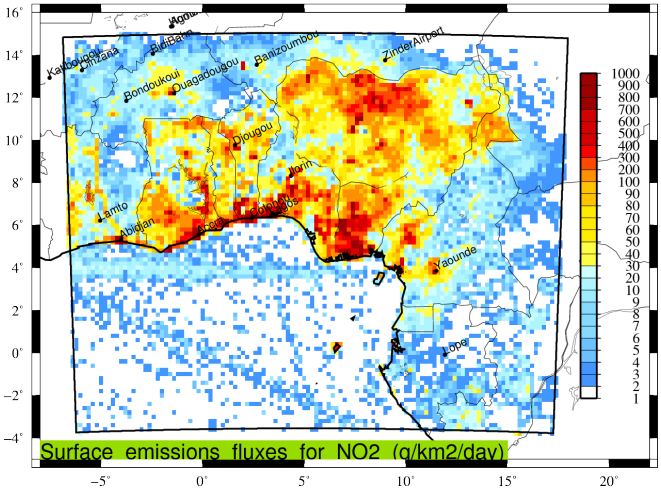
Many programs and tools are provided for:

- Build adaptated landuse and soil properties
- Build initial and boundary conditions
- Build meteorological fields on the CHIMERE grid with an hourly time-step
- Build emissions: anthropogenic, biogenic, dust, fires
- Compare model outputs to observations (surface, lidars, satellites data etc.)
- Plot results as maps, time series, vertical cross-sections etc.



CHIMERE and the pre-processors: EMISURF





NO_2 surface anthropogenic emissions fluxes.

Référence:

Menut L., A.Goussebaile, B.Bessagnet, D.Khvorostiyanov, A.Ung, 2012, Impact of realistic hourly emissions profiles on modelled air pollutants concentrations, Atmospheric Environment, pp. 233-244, doi:10.1016/j.atmosenv.2011.11.057

From urban to hemispheric domains

Urban domains

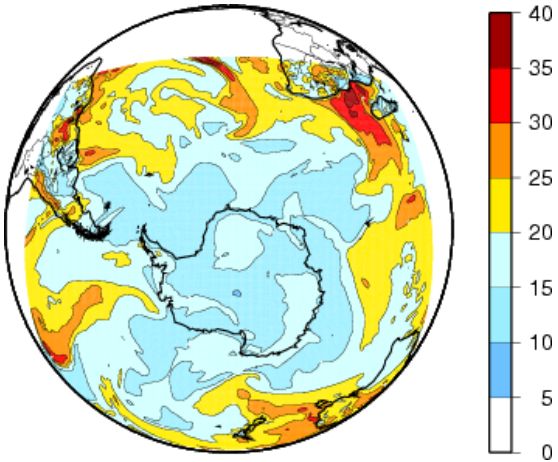
- Study high spatial resolution problems
- Turbulence and differences rural/urban environments
- Local recicurlations
- Impact of pollution on population

Regional domains

- Study interactions between several kind of sources (anthrpogenic and natural)
- Plume transport

Hemispheric domains

- To produce homogeneous boundary conditions for the regional domains (same model, same chemistry etc.)
- To allow long-range transport studies of dust, fires and volcano plumes



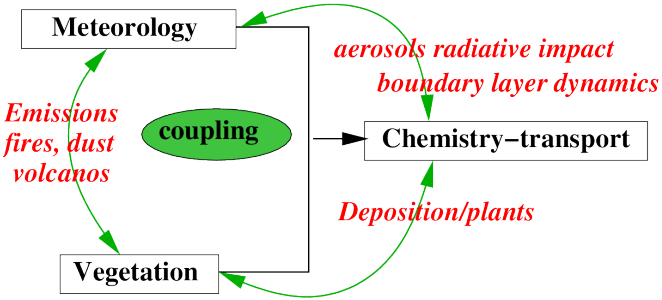
Interactions between processes: Online coupling for meteorology/aerosol interactions

Add interactions between radiation, clouds formation and aerosols concentrations

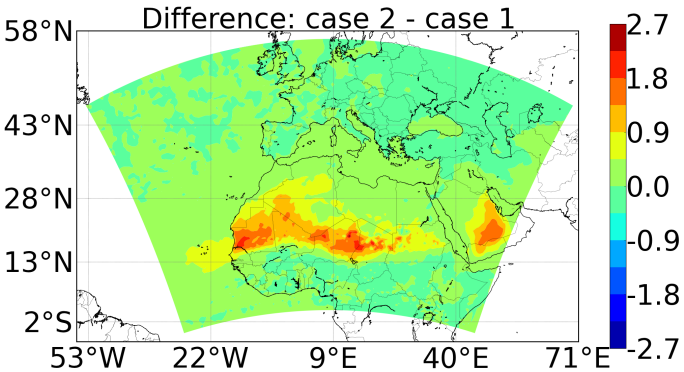
- The direct effect: aerosols and radiative fluxes, [Briant et al., 2017]
- The indirect effect: cloud formation, [Tuccella et al., 2019]

Methodology:

- Use of an external coupler OASIS (developed at CERFACS)
  - Currently, development with WRF only
  - But flexible and open to other models
- Constraints: developed and optimized for fast runs
- Perspectives: Add vegetation in the coupling (ORCHIDEE)



Direct effect: impact on 2m temperature



(Briant et al., 2017)

References

- Briant, R., Tuccella, P., Deroubaix, A., Khvorostyanov, D., Menut, L., Mailler, S., and Turquety, S.: Aerosol-radiation interaction modelling using online coupling between the WRF 3.7.1 meteorological model and the CHIMERE 2016 chemistry-transport model, through the OASIS3-MCT coupler, Geosci. Model Dev., 10, 927-944, doi:10.5194/gmd-10-927-2017, 2017

- Tuccella P., L.Menut, R.Briant, A.Deroubaix, D.Khvorostyanov, S.Mailler, G.Siour, S.Turquety, Implementation of aerosol-cloud interaction within WRF-CHIMERE online coupled model: evaluation and investigation of the indirect radiative effect from anthropogenic emission reduction on the Benelux, Atmosphere 2019, 10, 20; doi:10.3390/atmos10010020