Météo-France update : past evolution of the MOCAGE model and research results

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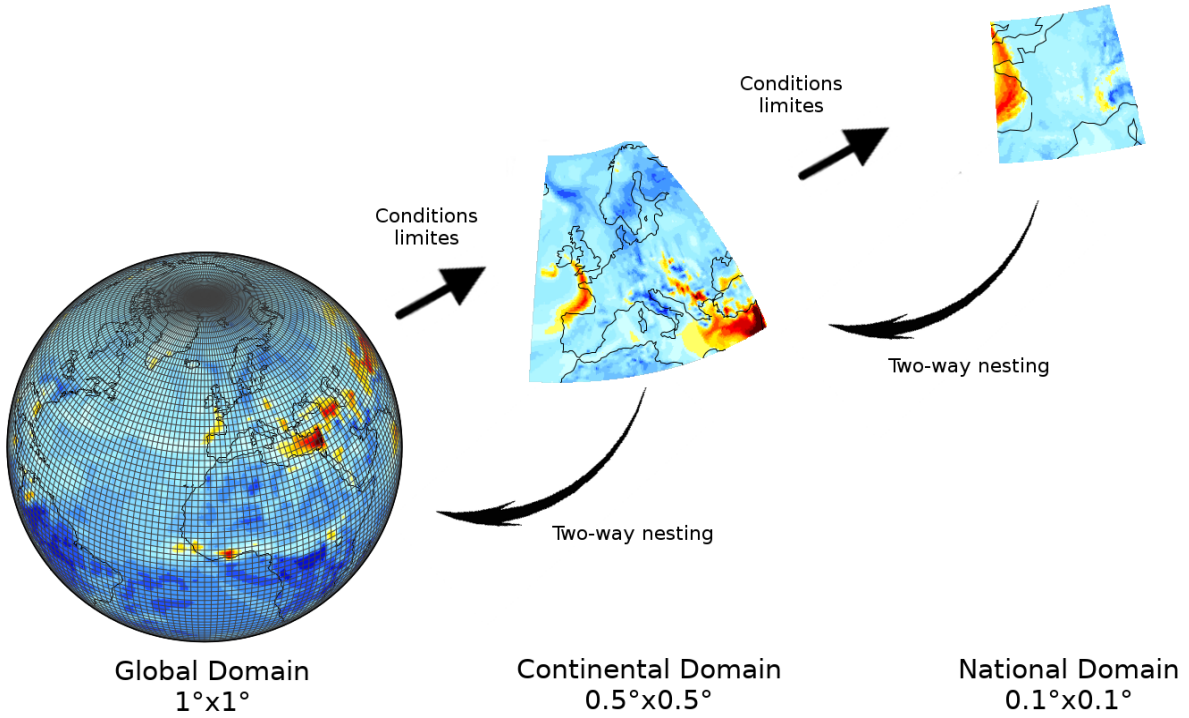
Summary

The MOCAGE model : general features

- Off-line Chemistry Transport Model
- Semi-lagrangian transport scheme with convection (Bechtold et al., 2001) and diffusion (Louis, 1979)
- Two-ways nesting capabilities
- 47 σ-hybrid vertical levels from surface up to 5 hPa



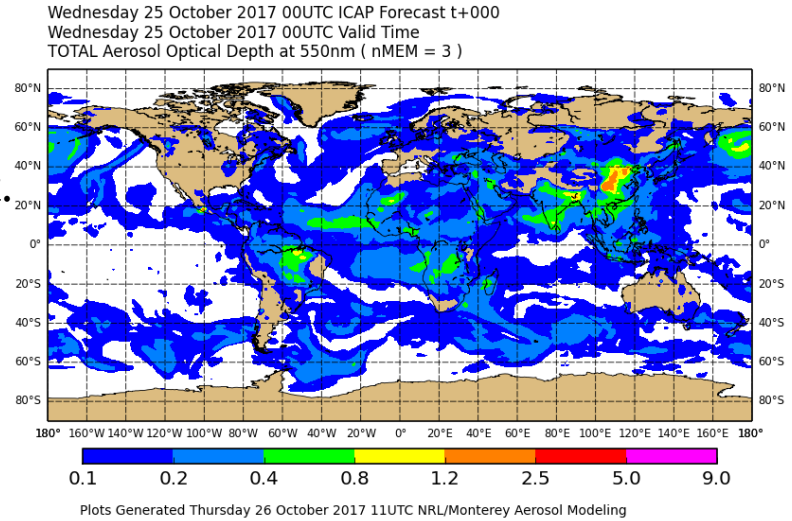
The MOCAGE model : aerosols

- Chemical scheme RACM (troposphere) and REPROBUS (stratosphere)
- 95 gaseous species, 55 photolysis, 322 chemical reactions
- 4 primary aerosols :
  - Desert Dust : dynamic emissions (Marticorena and Bergametti, 1995)
  - Sea Salt : dynamic emissions (Gong, 2003 and Jaeglé, 2011)
  - Black Carbon : emission inventory (MACCity)
  - Primary Organic Carbon : emission inventory (MACCity)
- Secondary Inorganic Aerosols computed with ISORROPIA (v2.1)
- Sectionnal representation using 6 bins for each aerosol

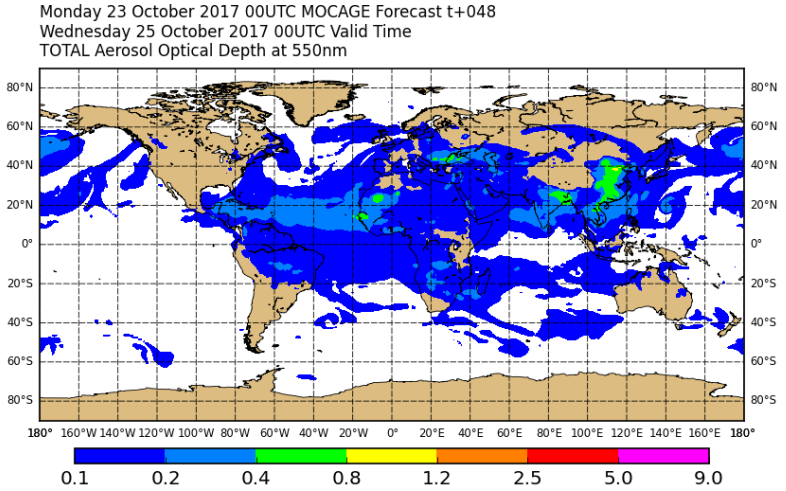
AOD computation correction

- From the 25th October, we fixed an issue in the AOD calculation for the ICAP supply chain (hygroscopicity)

ICAP MME 25th Oct. t+000

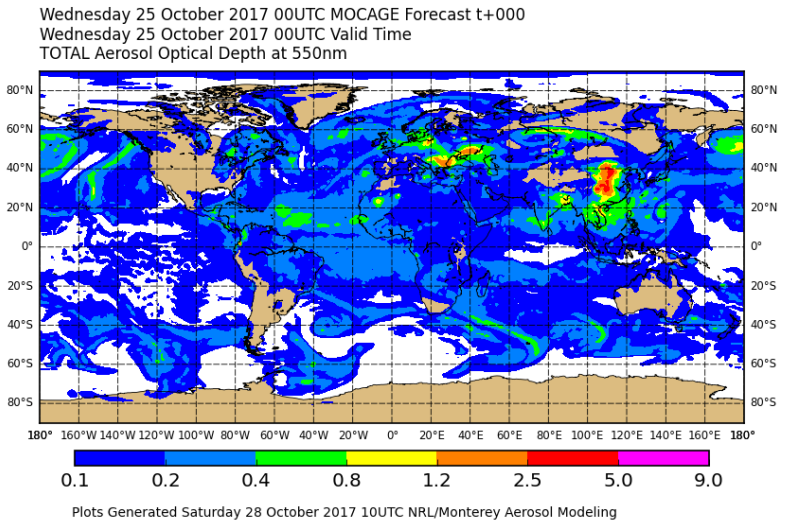


MOCAGE 23th Oct. t+048



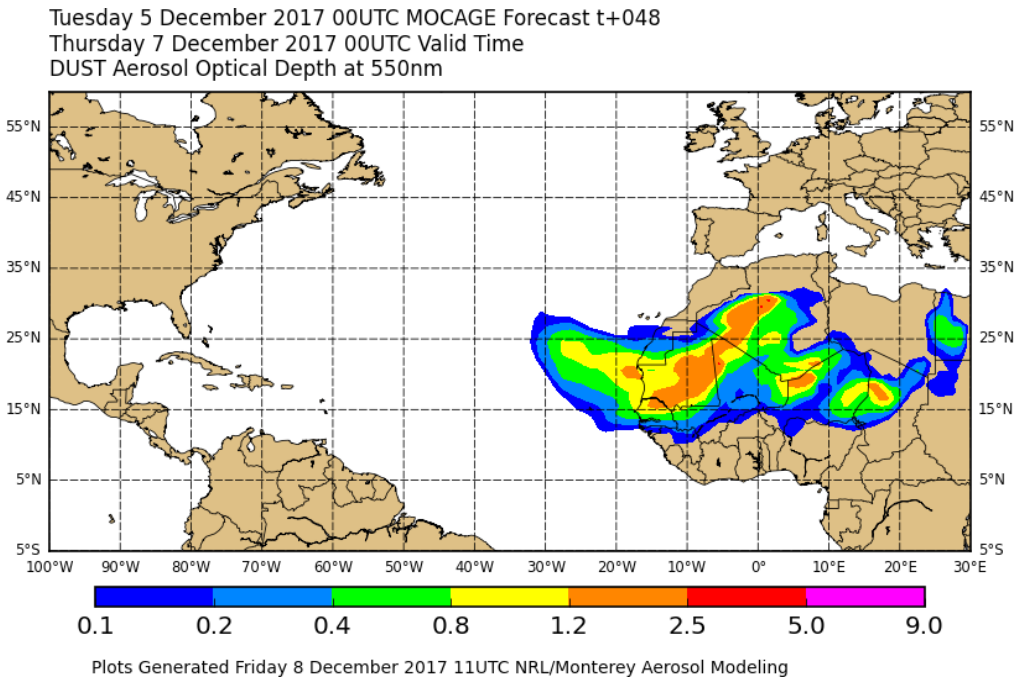
The simulation of the 25th October is more coherent with the ICAP MME than the simulation of the 23rd October t+048

MOCAGE 25th Oct. t+000

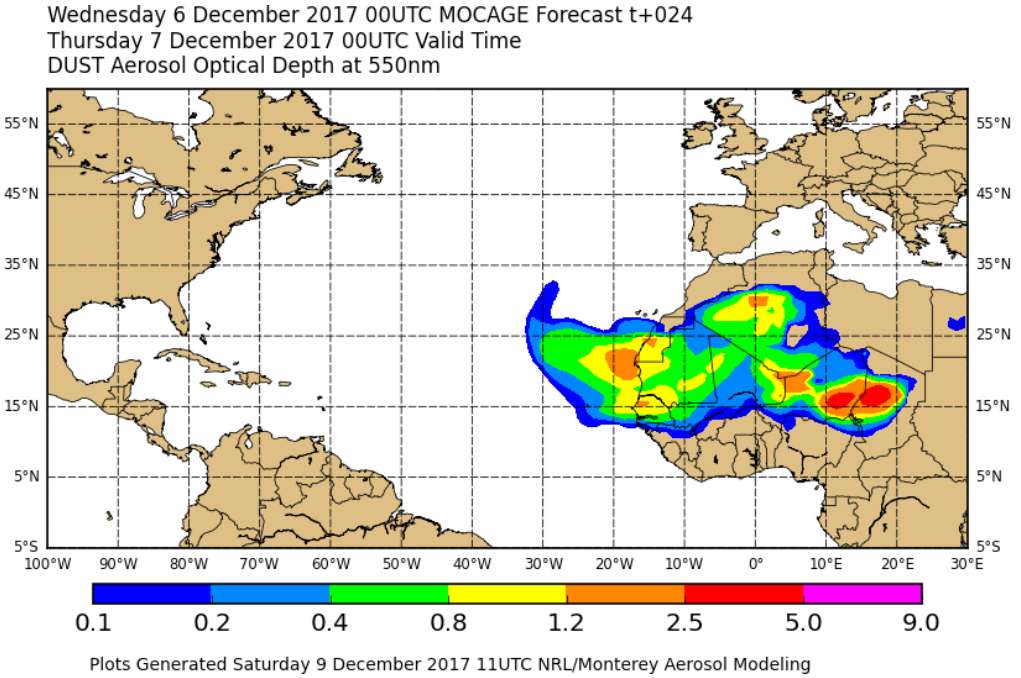


The latest operationnal version

- Since December 2017, SURFEX, a new surface scheme is used in the numerical weather prediction system ARPEGE that we use as meteorological input
- Among others, surface winds are quite different hence the dynamic emissions, especially desert dust



5 Dec. t+048 : valid for 7 Dec. 00UTC



6 Dec. t+024 : valid for 7 Dec. 00UTC

Modeling SOA : a multiple approach

1. Very simple method based on primary organic carbon emissions : SOA are directly emittted scaled on primary OC (Castro et al., 1999)
2. Simple method based on the ageing (OH oxydation) of a precursor emitted proportionally to anthropogenic CO (Spracklen et al, 2011)
3. Simple method based on the oxydation of isoprene and alpha-pinene (Spracken et al., 2011)
4. Advance approach based on the model SOAP: chemistry of the aging of the COV which condense then into the aerosol phase thaks to a thermodynamic equilibrium module (Couvidat and Sartelet, 2015)

Anthropogenic Biogénic Anthropogenic and biogenic

Modeling SOA : first results

- The first method (the simple one) has been implemented and tested over Europe. We emitted directly SOA following the relation :

$$SOA \sim POA$$

- Over the JJA period of the year 2013, when comparing to the AQeR PM observations:

PM10	Biais	MNMB	FGE	Corr
REF	-7,8	-0,54	0,7	0,27
SOAv1	-6,8	-0,44	0,63	0,30

PM25	Biais	MNMB	FGE	Corr
REF	-1,9	-0,11	0,57	0,44
SOAv1	-1,1	0,01	0,54	0,45

Preliminary but encouraging results

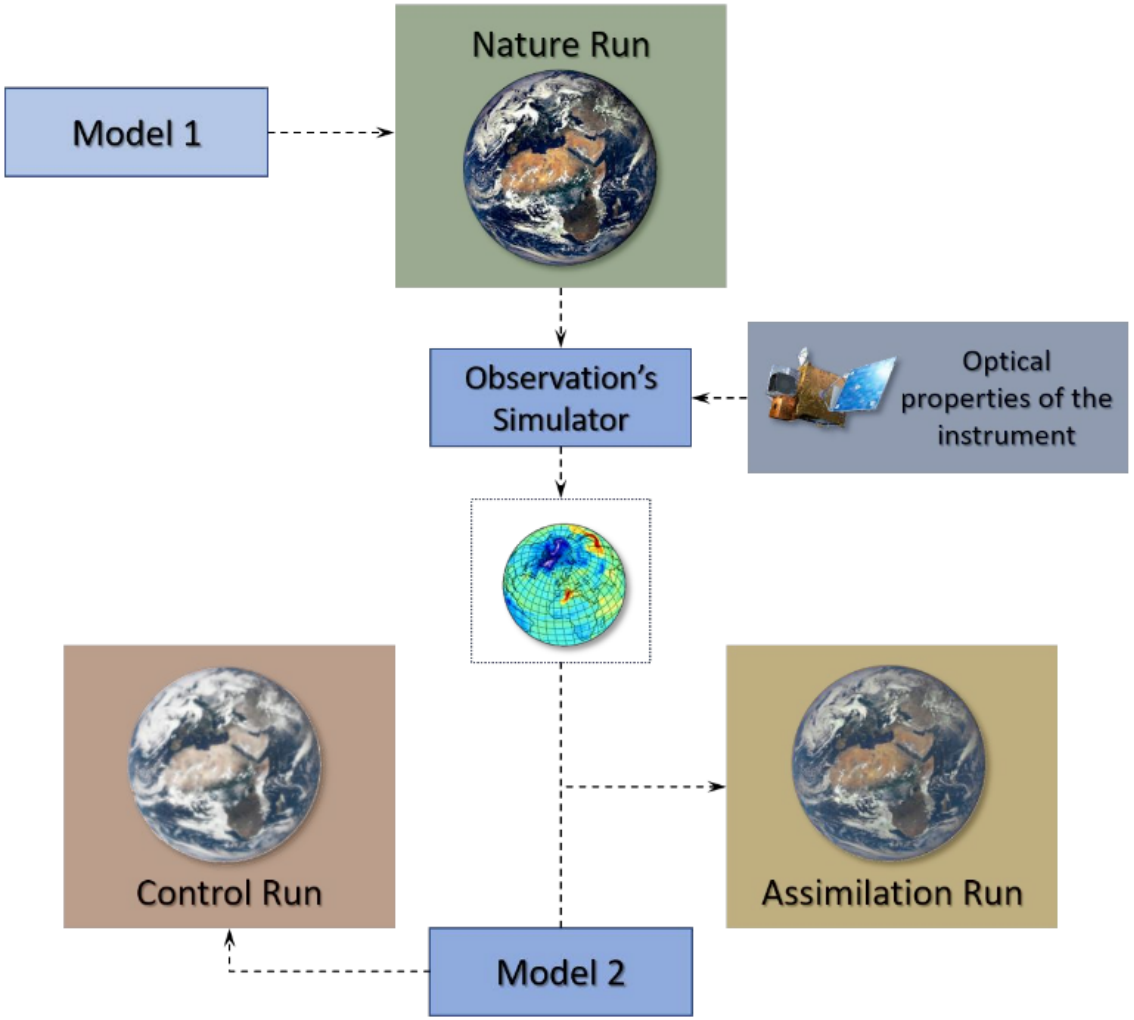
MTG-I/FCI OSSE

Descheemaecker et al., In prep

- Added value of the MTG-I/FCI instrument for the aerosols forecasting through assimilation using an Observing System Simulation Experiment (OSSE)
- Next Meteosat generation (MTG) will be based on two platforms
  - MTG-I for Imager carrying the Flexible Combined Imager (FCI) and the Lightning Imager (LI)
  - MTG-S for sounding carrying the Infra-Red Sounder (IRS) and Ultraviolet Visible Near-infrared (UVN) spectrometer
- The FCI instrument :
  - Sequel of the SEVIRI instrument
  - 8 channel in VIS and NIR
  - Full disk scan in 10 min at 1km resolution
  - European rapid scan in 2.5 min at 0.5 km resolution

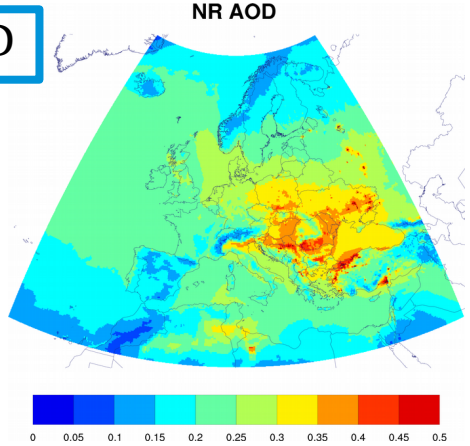
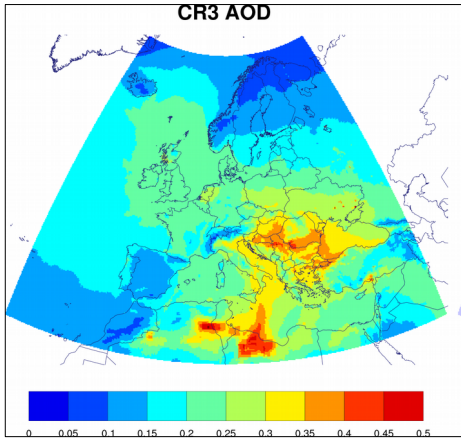
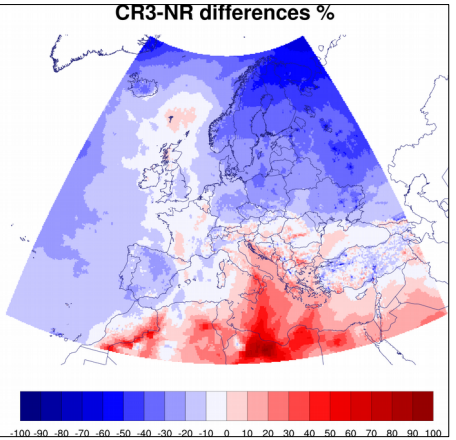
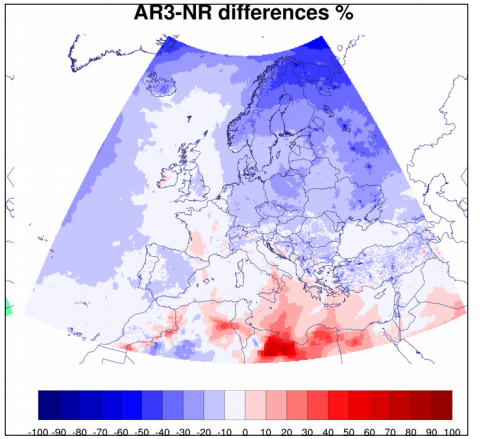
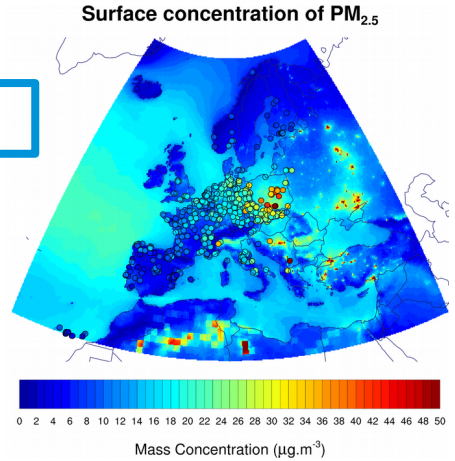
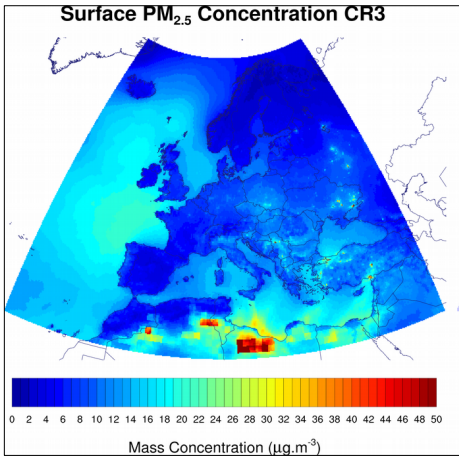
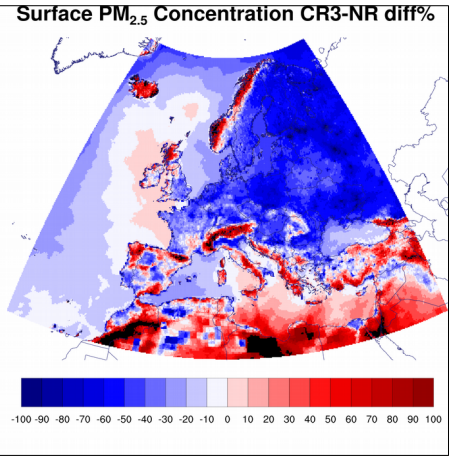
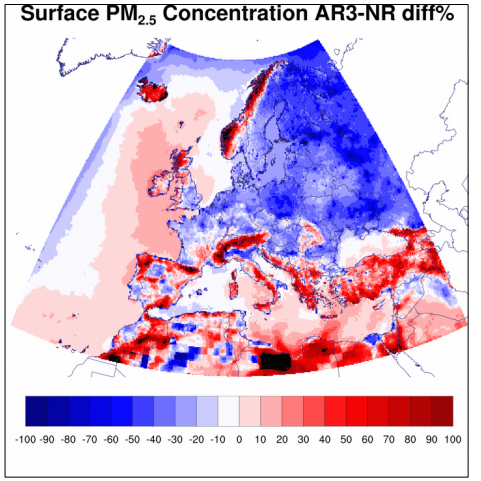
MTG-I/FCI OSSE

Descheemaecker et al., In prep



MTG-I/FCI OSSE

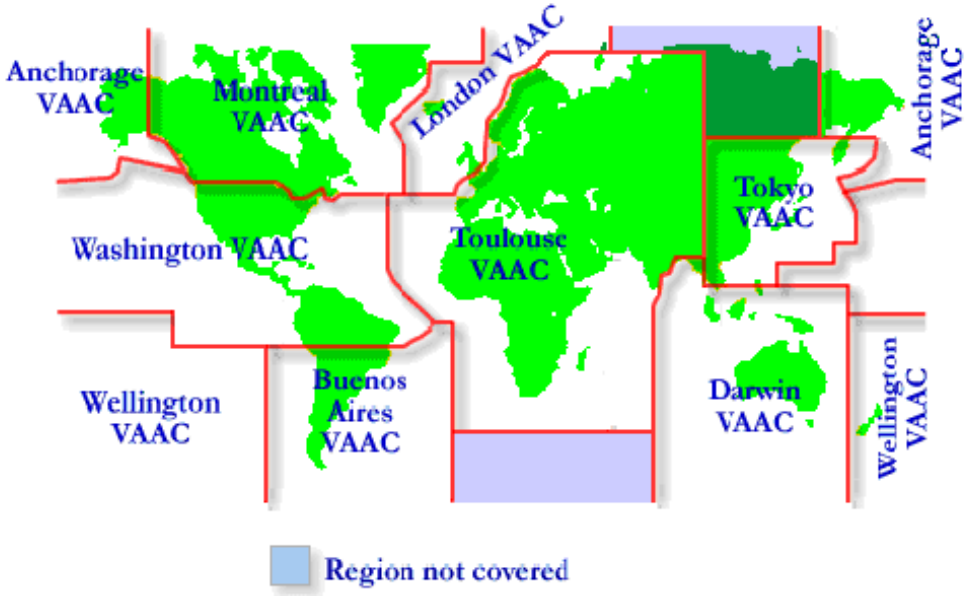
Descheemaecker et al., In prep

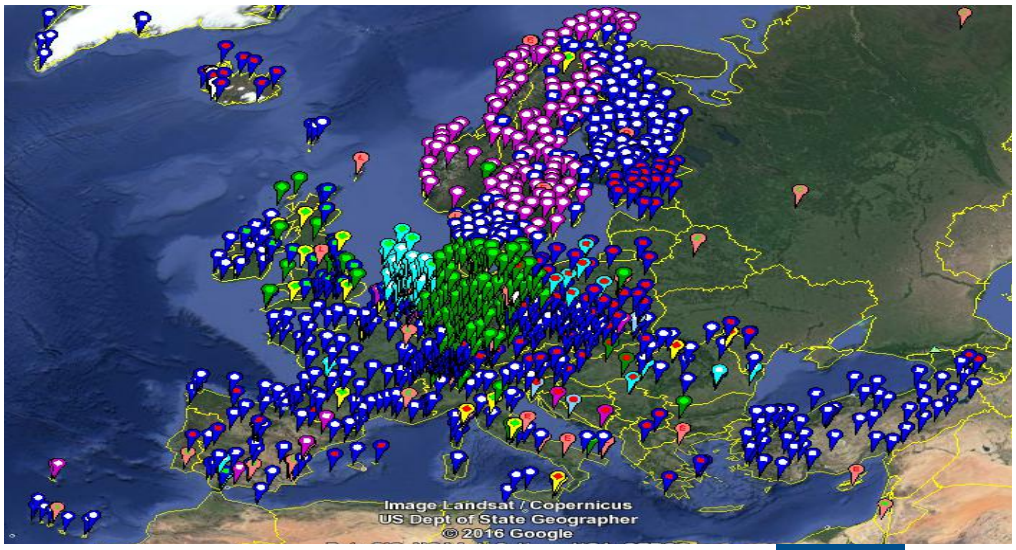
	NATURE RUN	CONTROL RUN	CR-NR %Diff	AR-NR %Diff
AOD				
PM2.5				

Météo-France update: MOCAGE - 26 June 2017

Volcanish ash modelisation

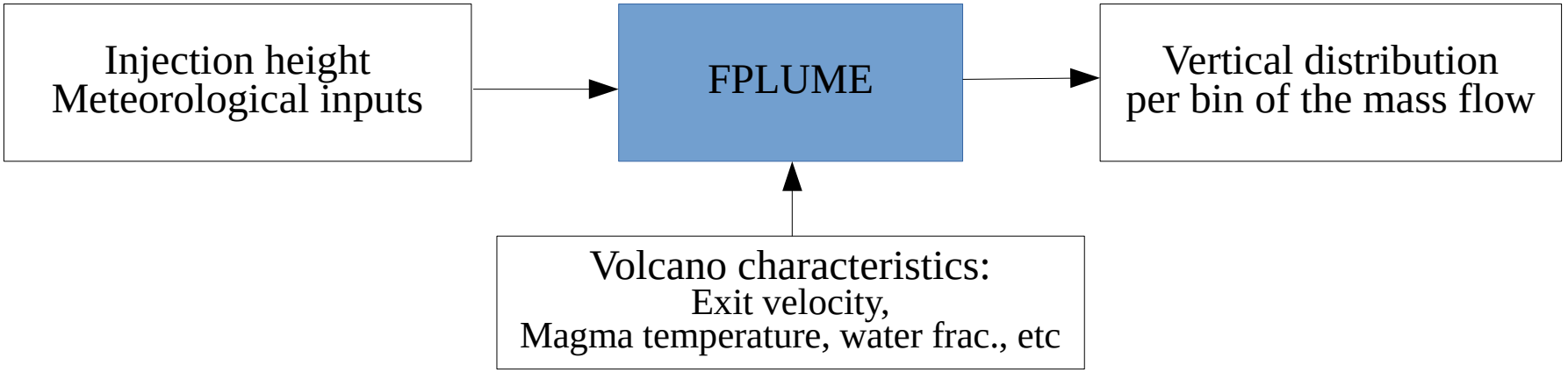
- Météo-France is the Volcanish Ash Advisory Center (VAAC) for the European-African region
- Need to give a quick response in case of volcanic eruption in terms of ash concentrations
- Aim is to improve the modelisation and to develop an assimilation system based on lidar data from Météo-France and the European E-PROFILE database





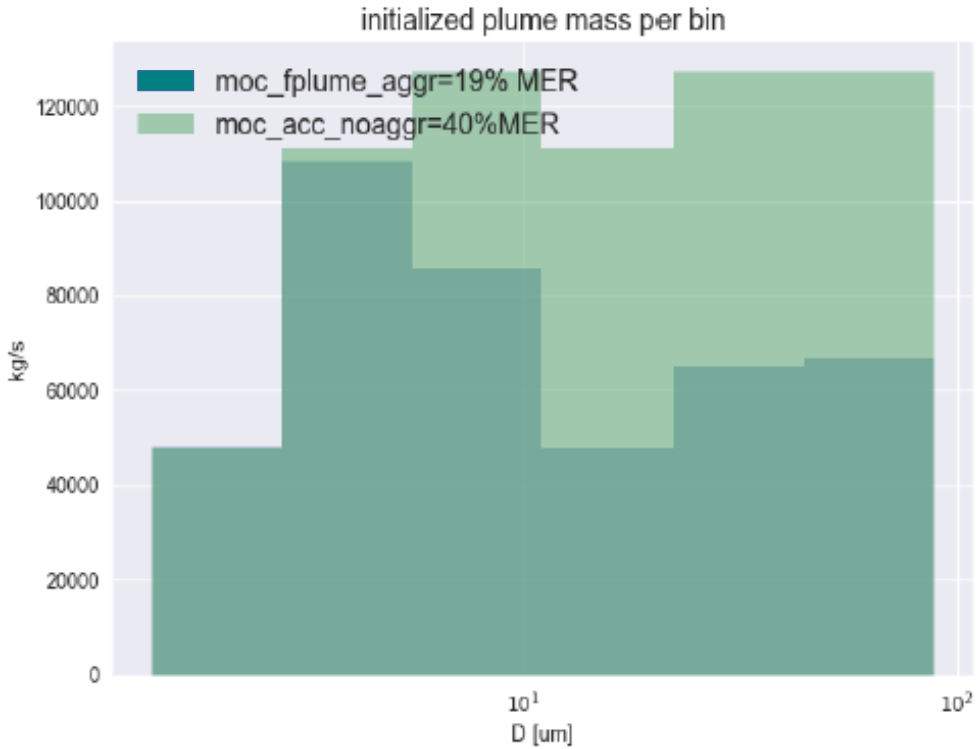
Volcanish ash modelisation: FPLUME

- Big incertitude on the emission (mass, injection height, vertical distribution, etc)
- Historically we use Mastins et al. (2009)
- Implementation of FPLUME (Folch et al., 2016) :
  - 1D model of the steady state

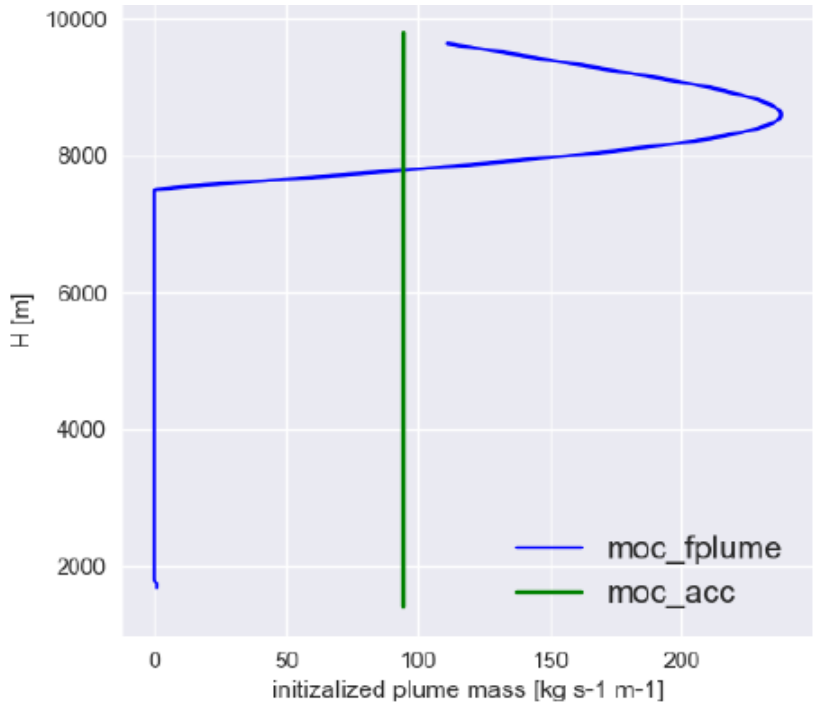


Volcanish ash modelisation: FPLUME

- Case of the eruption of the Eyjafjallajökull (May 6th, 2010)



Size distribution of the eruption



Vertical distribution of the eruption

Volcanish ash modelisation: FPLUME

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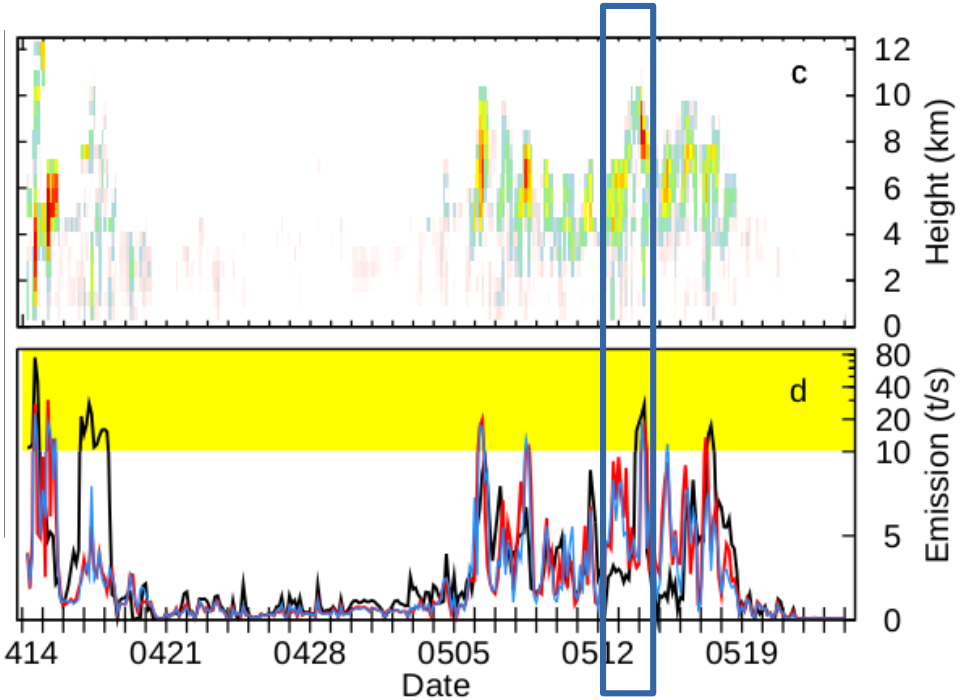
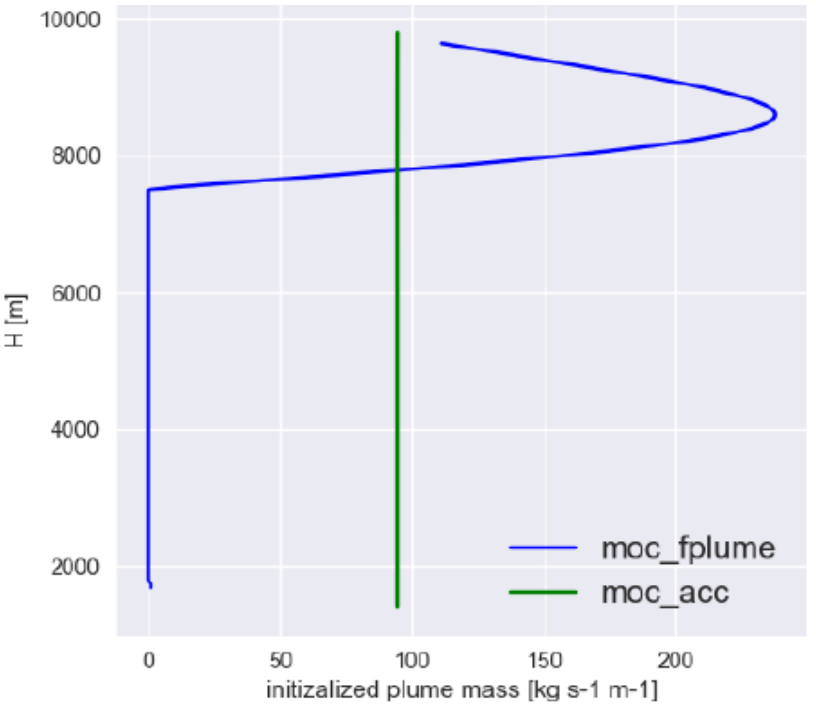


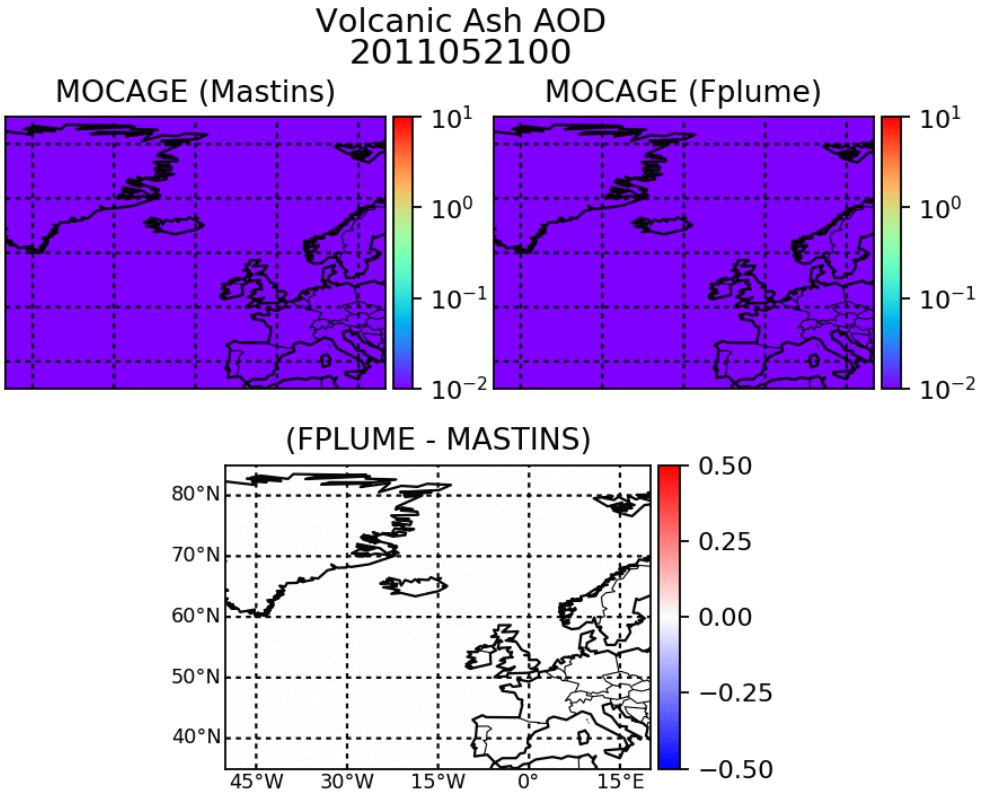
Stohl et al., (2011) emission estimation by an inversion method



Vertical distribution of the eruption as given by the two schemes in MOCAGE

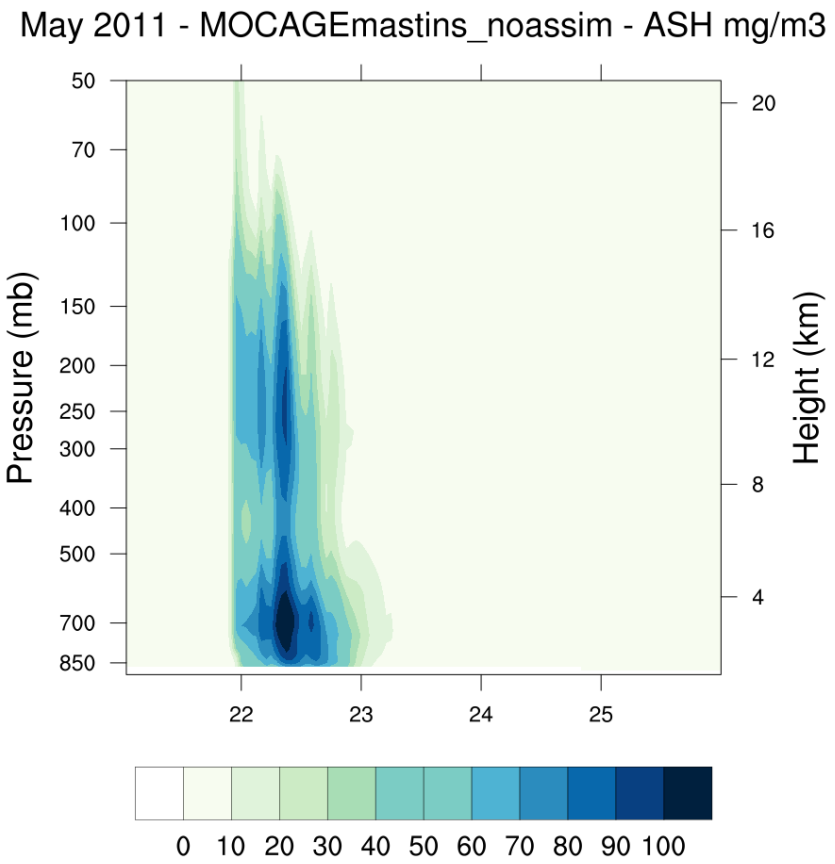
Volcanish ash modelisation: FPLUME

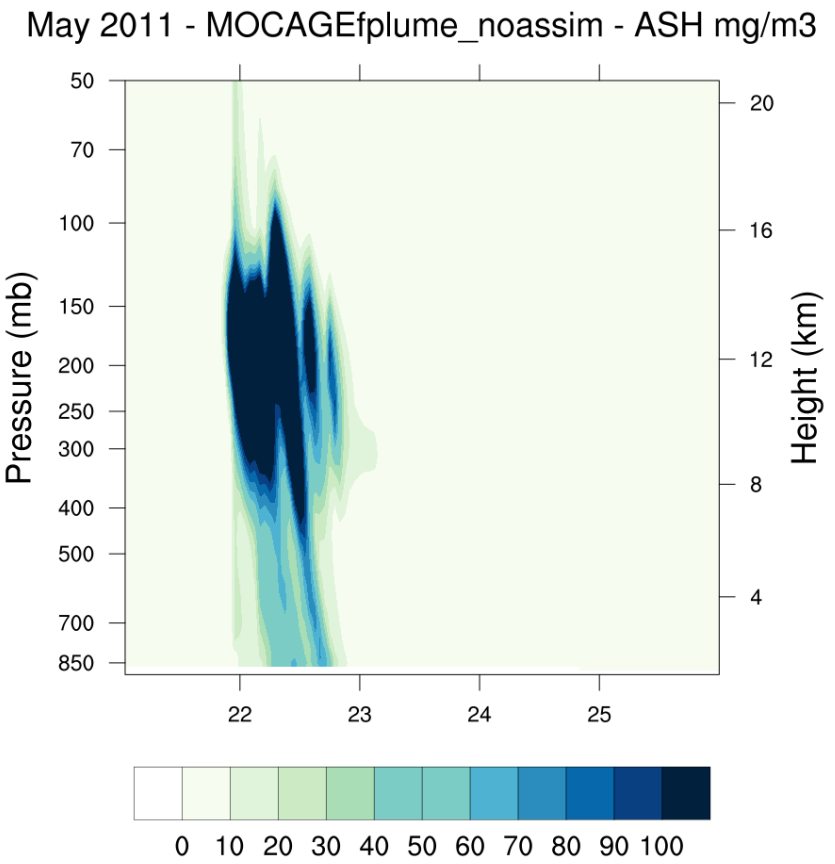
- Grimsvötn (May 2011) eruption
- Injection heights come from radar measurements
- Mass flow comes from Fplume
- MOCAGE 1°x1° using ARPEGE numerical weather prediction input



- Small differences in the plume (total column of volcanish ash)

Volcanish ash modelisation: FPLUME

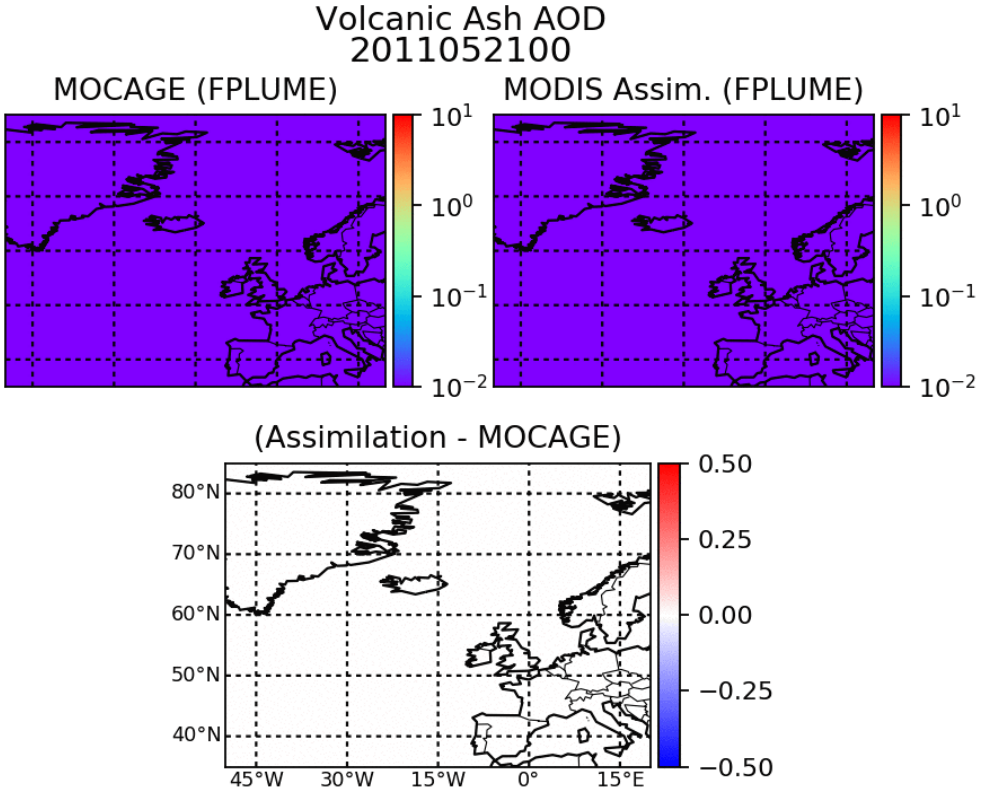




- Big differences in the vertical distribution above the volcano over the time

MODIS AOD data assimilation system

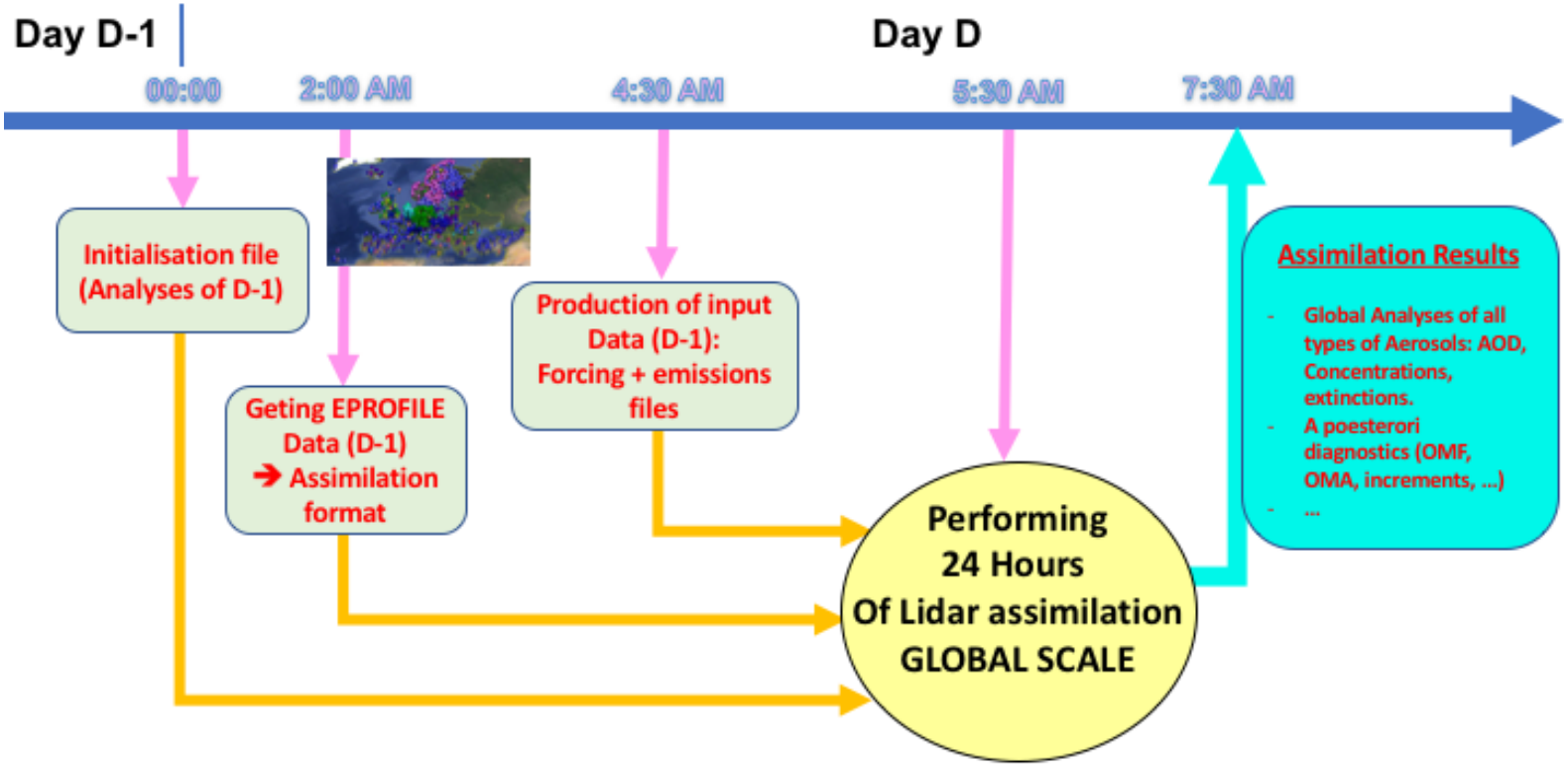
- Same input as previously
- Assimilation of the MODIS AOD during the run



Actually there is a pre-operationnal run every day assimilating MODIS AOD for volcanish ash

Towards a lidar data assimilation system

- Coming work is to set up an assimilation chain for European E-PROFILE lidar data



Thank you for your attention !

Jonathan.guth@meteo.fr