

Biogenic emission factor assessment and recalculation for metropolitan France

Arineh CHOLAKIAN (LMD), Guillaume SIOUR (LISA), Marie
CAMREDON (LISA), Matthias BEEKMANN (LISA)



Context

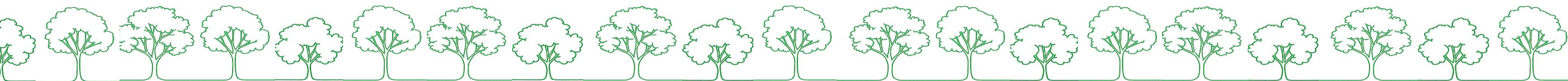
MEGAN (Model of Emissions of Gases and Aerosols from Nature)

Calculates biogenic emissions for several VOCs using several inputs

- Can provide emission factors for these VOCs as an intermediary result
- Has different versions, for this study two versions matter :
 - v2.1
 - v3.0
- Version 2.1 is integrated in CHIMERE
 - works online
 - Global maps of emission factors for ~20 VOCs are used to calculate emissions in CHIMERE



$$ER_i = EF_i \cdot \gamma_{LAI} \cdot \gamma_{(PPFD,i)} \cdot \gamma_{(T,i)} \cdot \gamma_{(Age,i)} \cdot \gamma_{(SM,i)} \cdot \gamma_{(CO2,i)} \cdot \rho_i$$



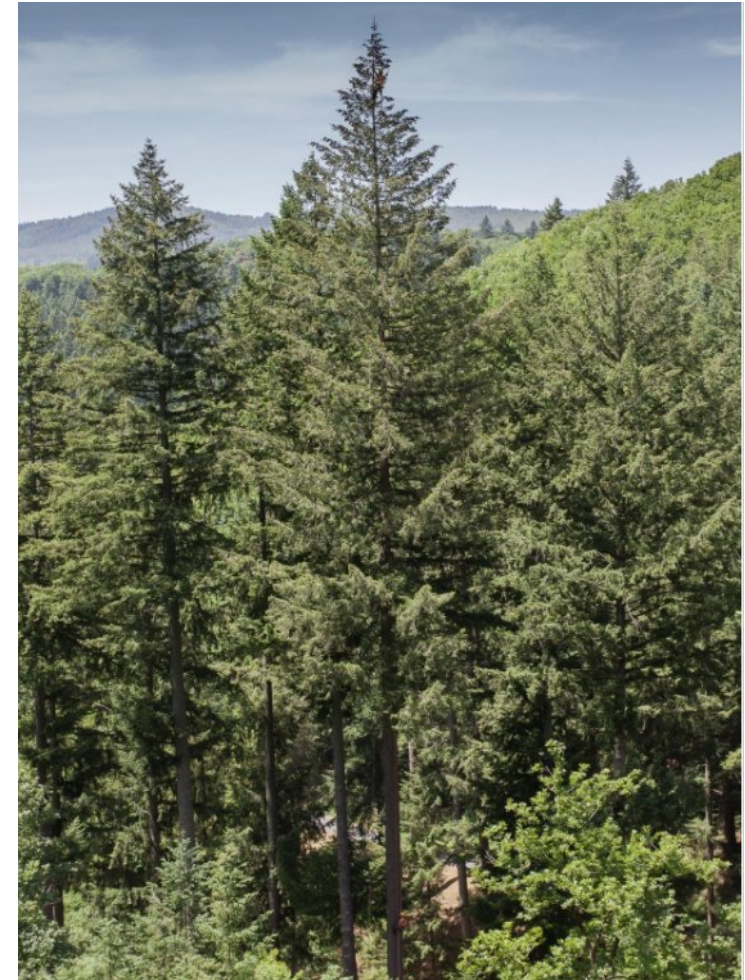
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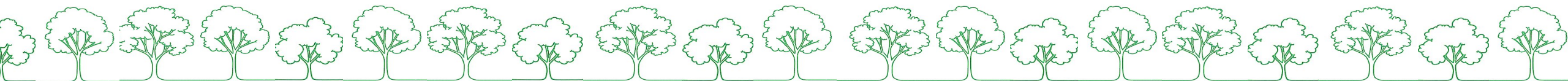
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Common Douglas-fir
Height:~69m (46.05N 3.87E)



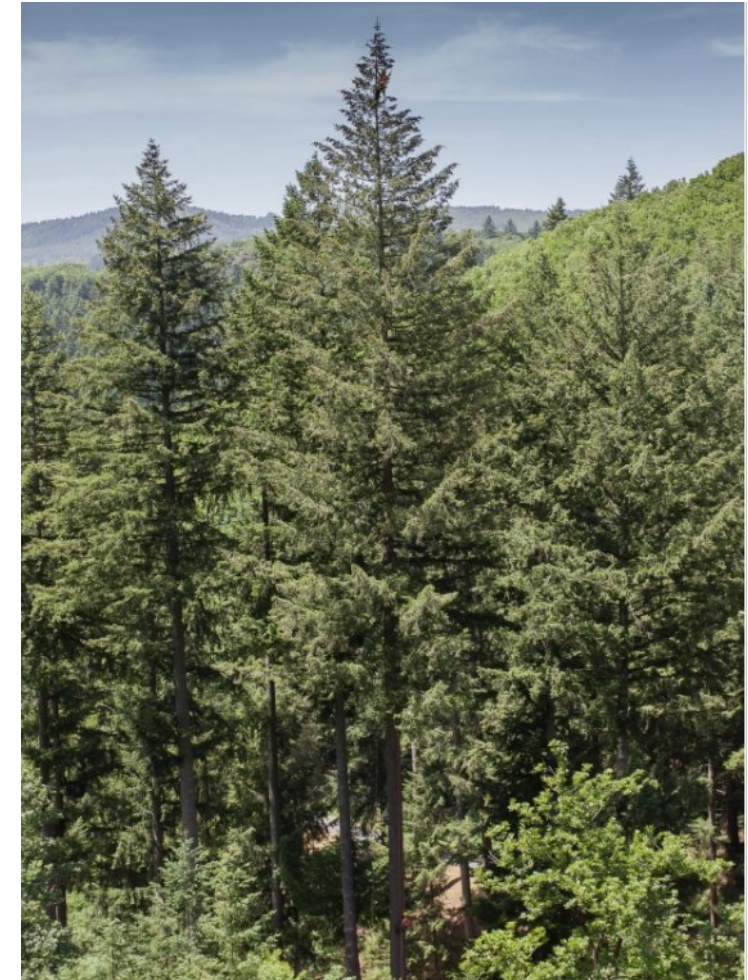
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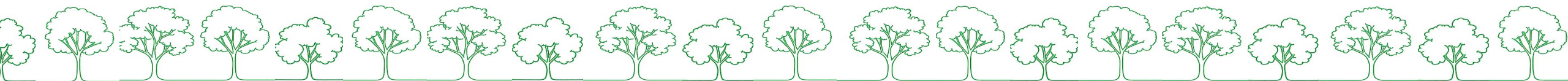
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Common Douglas-fir
Height:~69m (46.05N 3.87E)



Methodology

Inputs

Ecosystem map

MEGAN3: tree species

MEGAN2: PFT mix

Veg type fractions

Per cell:

tree/shrub/herb/crop

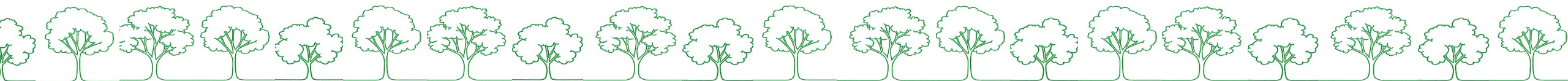
EF database

MEGAN3: per species

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Compound classes

Detailed compound
to MEGAN class map



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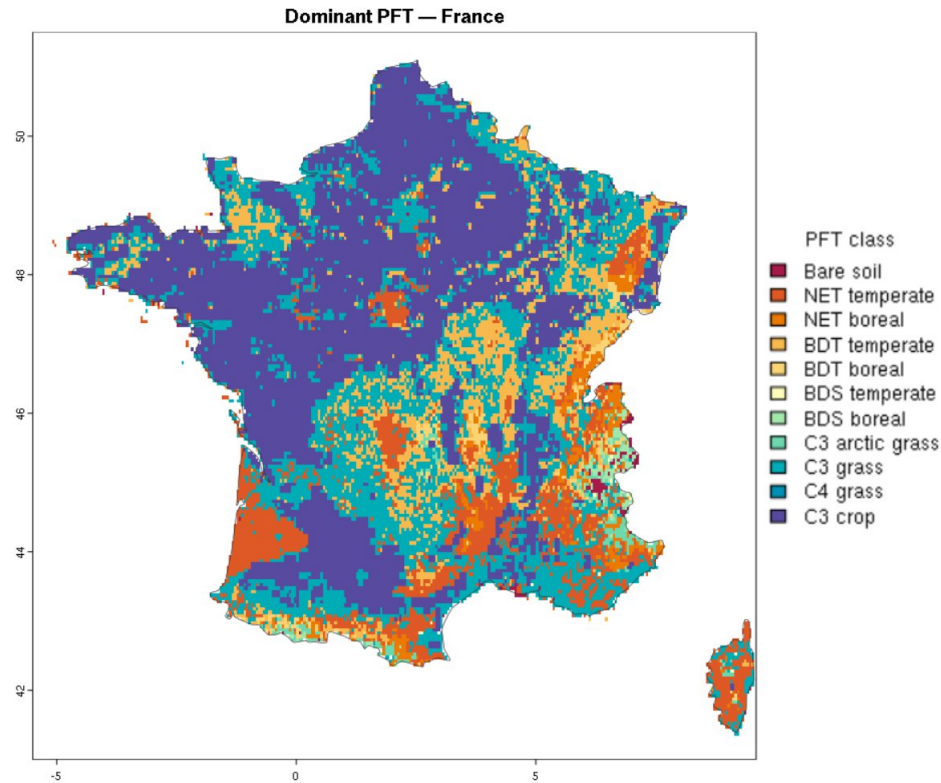
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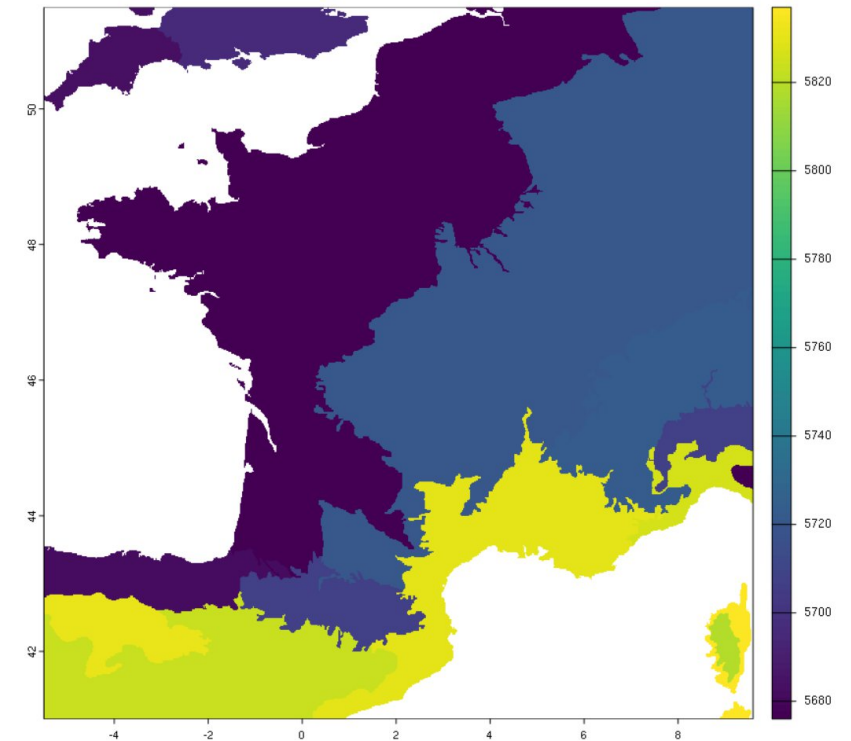
Detailed compound
to MEGAN class map

MEGANv2



PFTs (plant functional types)
17 grouped plant groups in total

MEGANv3



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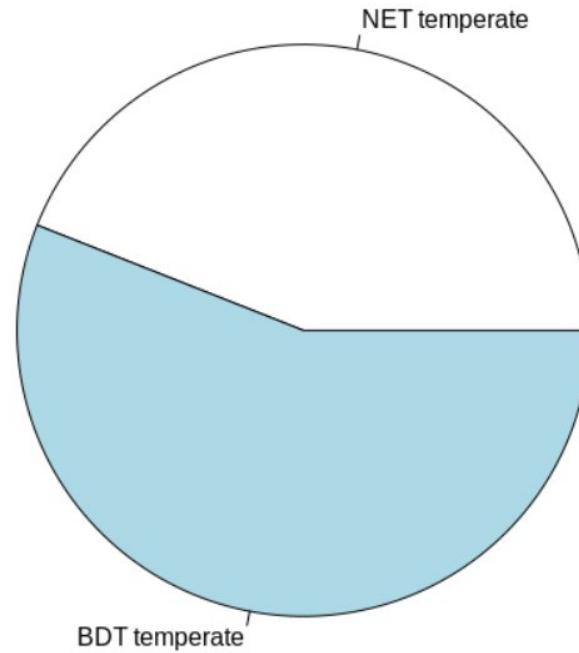
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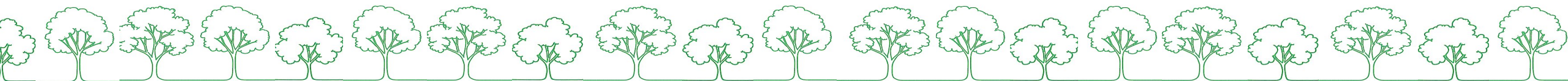
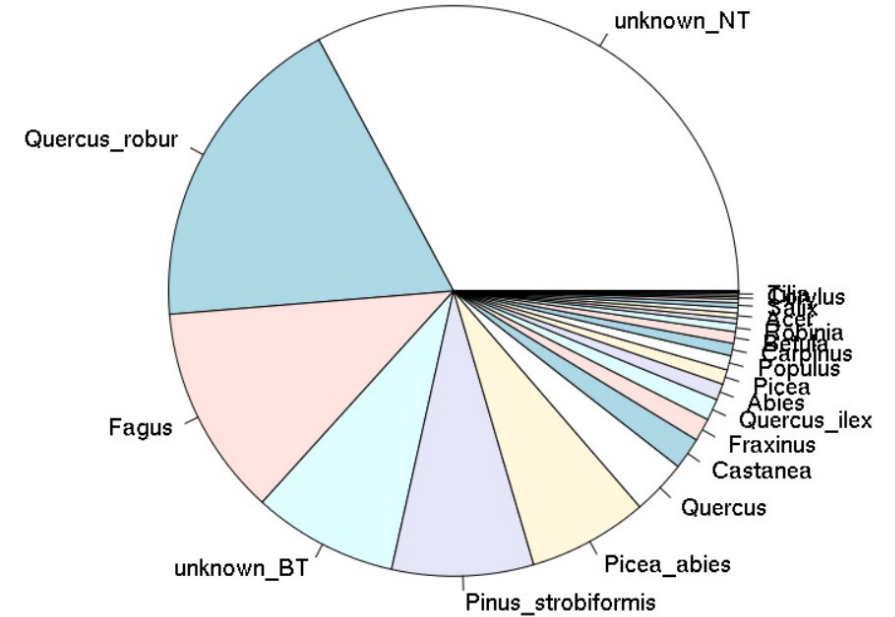
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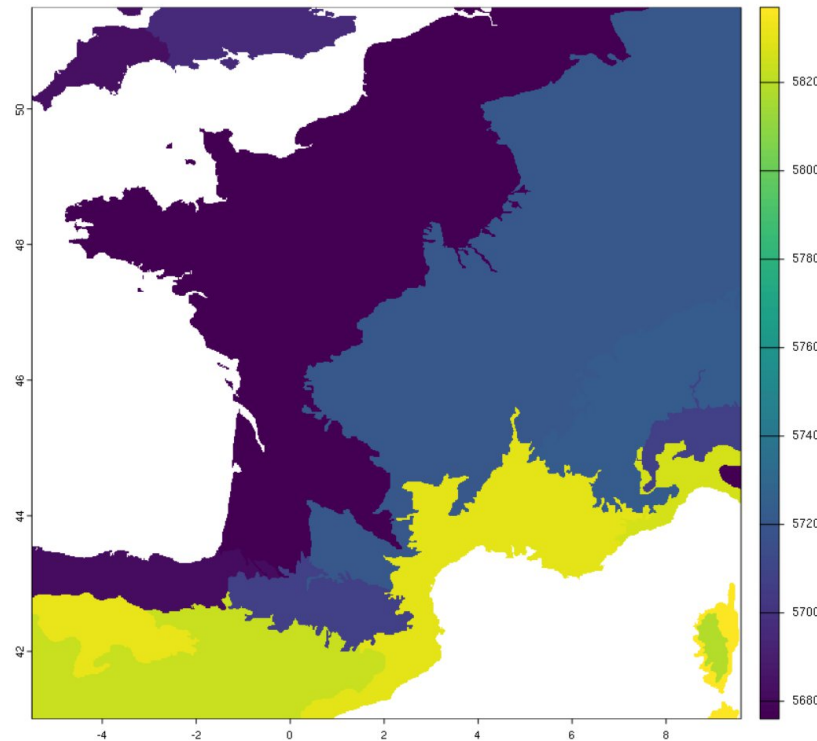
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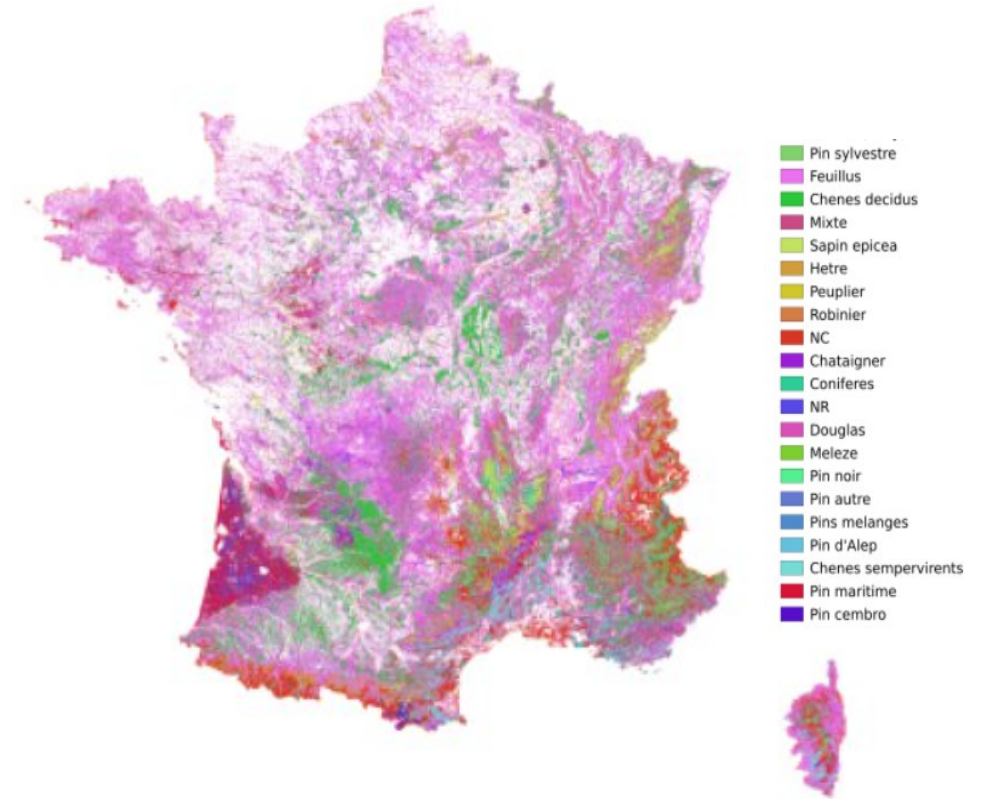
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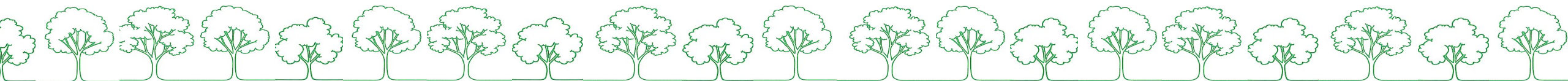


Ecotypes
1370 ecotypes in total

MEGANv3 - modified



Ecotypes per cell
about 189 000 ecosystems



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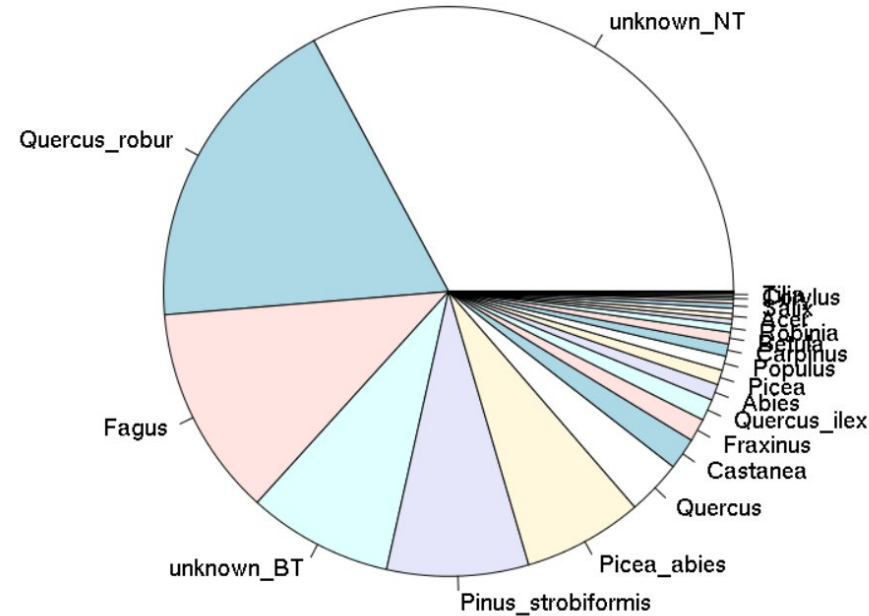
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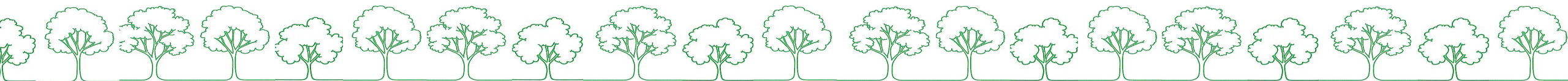
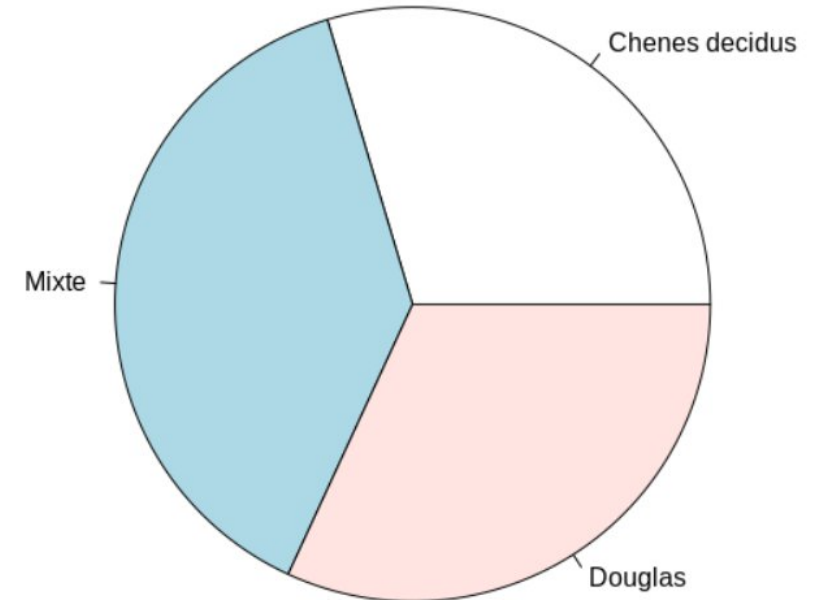
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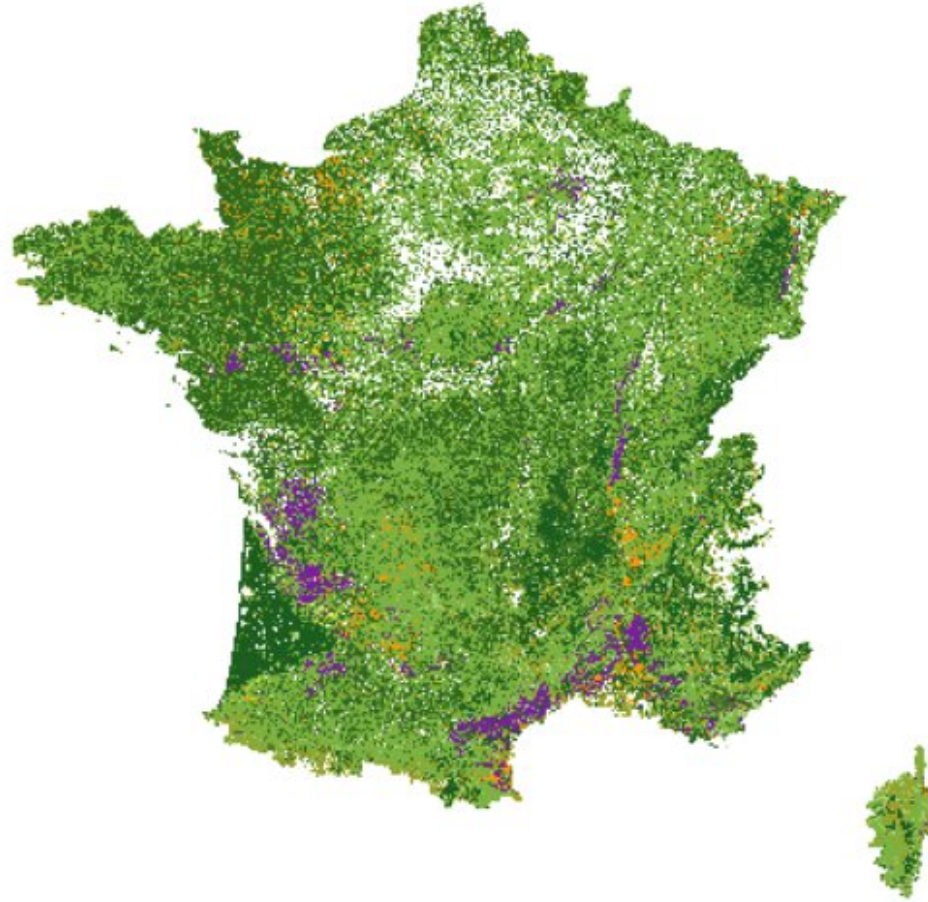
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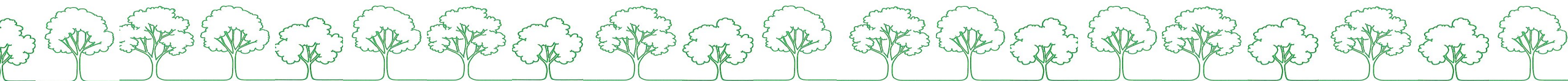
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Detailed compound
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BDTopo landcover



Corine landcover



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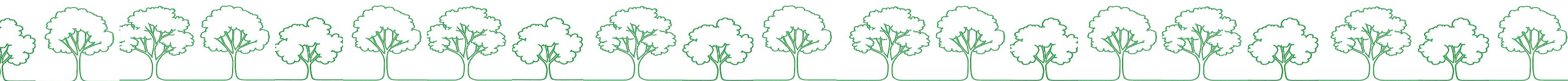
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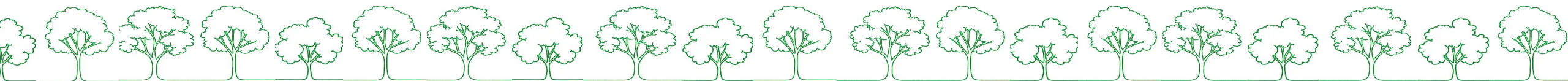
Processing

EF computation

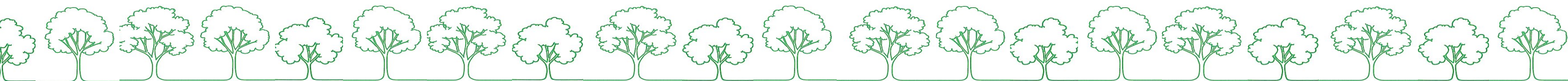
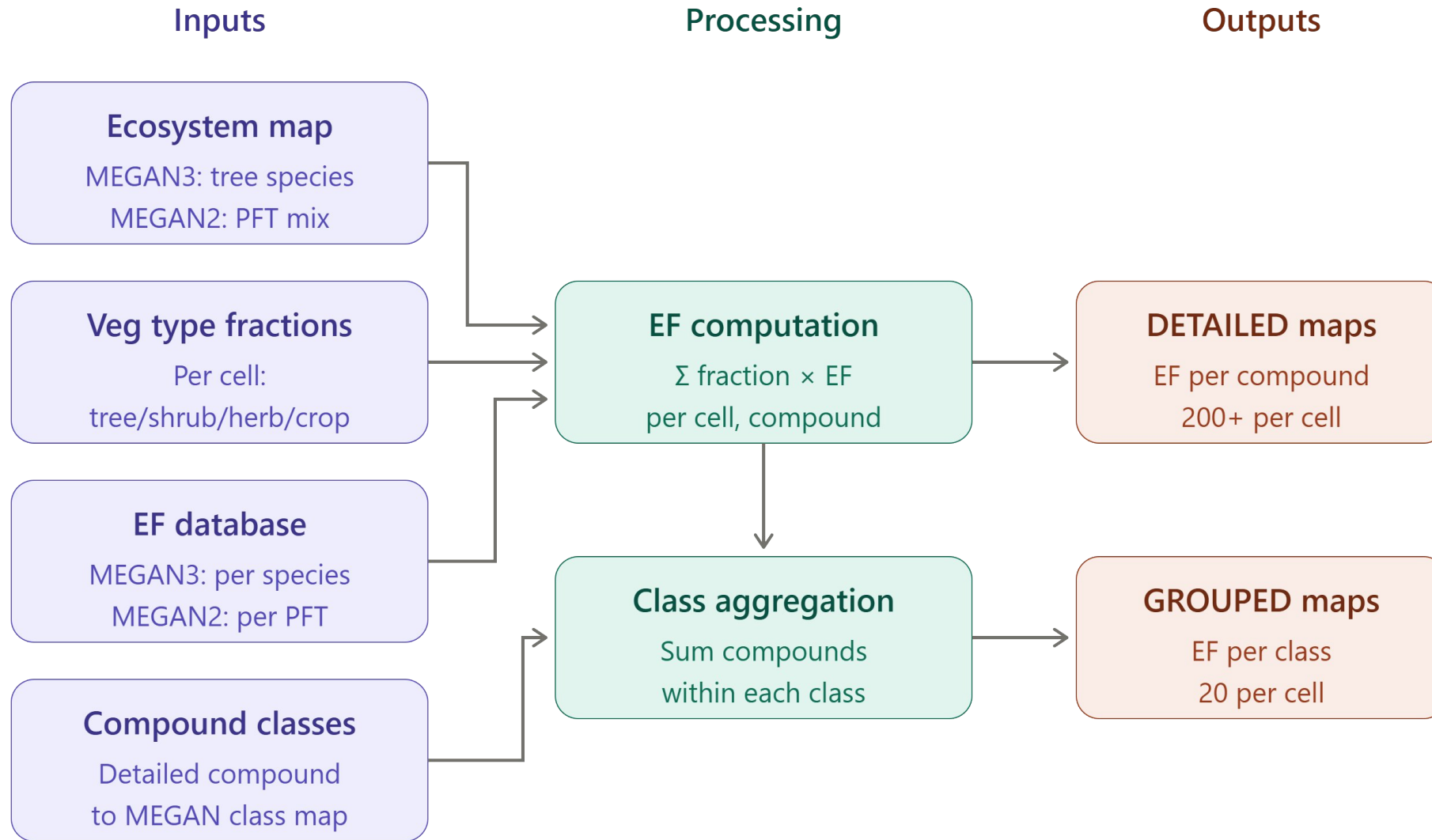
$\Sigma \text{ fraction} \times \text{EF}$
per cell, compound

Class aggregation

Sum compounds
within each class



Methodology

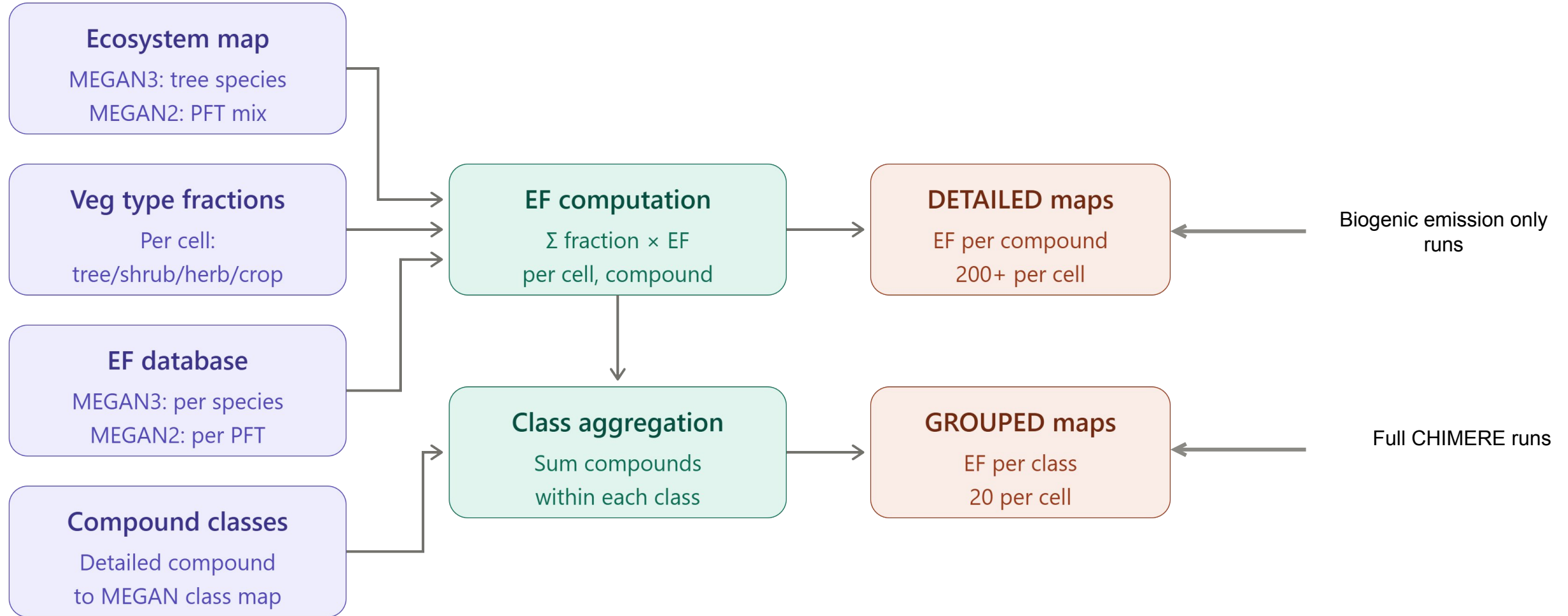


Methodology

Inputs

Processing

Outputs



Measurements

Test case to evaluate biogenic emissions : the ACROSS campaign

Measurement period : June/July 2022

Meteorological measurements

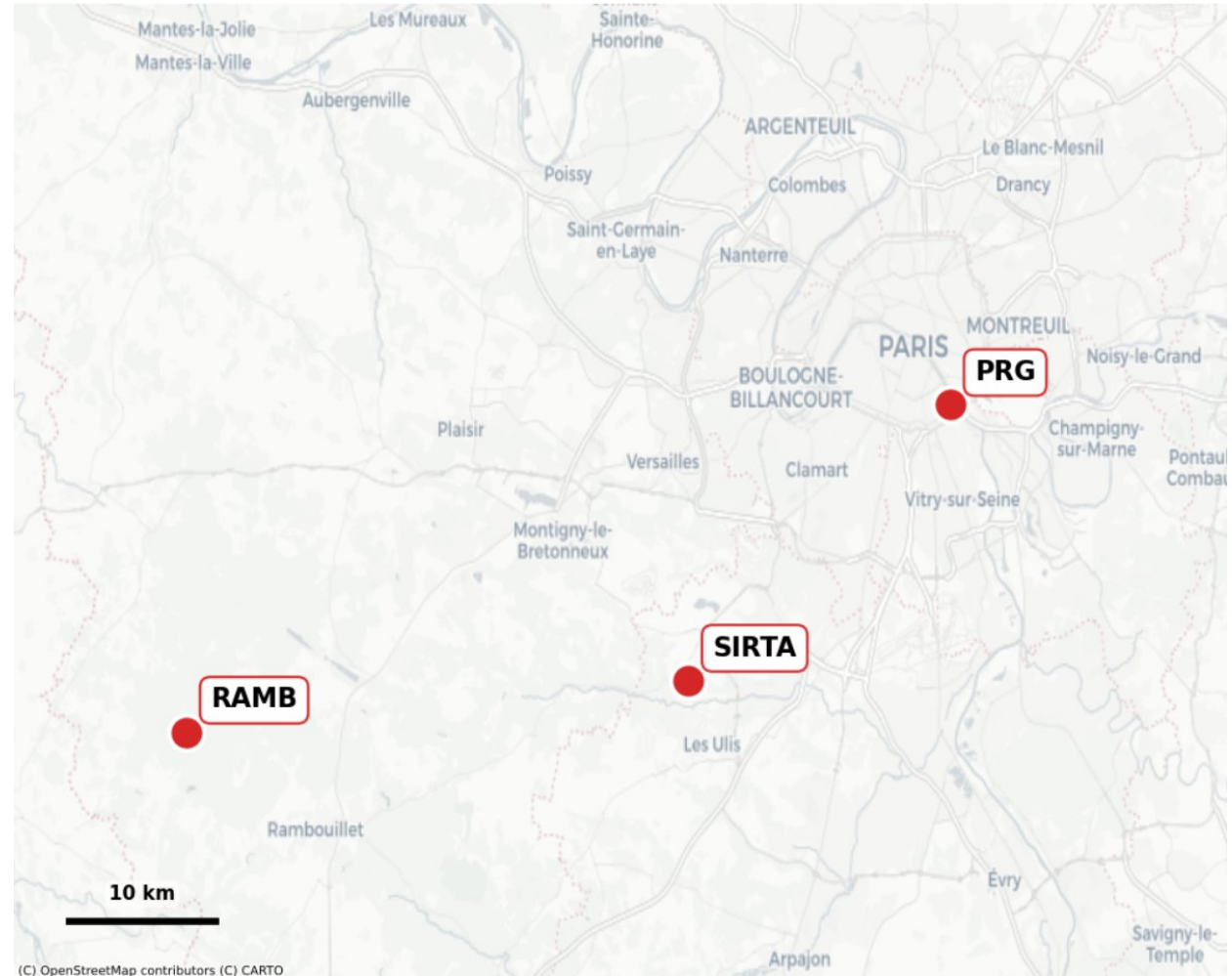
O3 / PM10 / PM2.5 / PM1

PM speciation

VOC speciation

This presentation focusing on :

- Rambouillet site
- Sirta site
- PRG site



Simulations

Nested simulation on two domains :

ACR30 (30kmx30km) and ACR6 (6kmx6km)

ACR2(2kmx2km , possible, but not yet done)

Vertical resolution : 15 layers from 998hPa to 300hPa

Aerosol bin sizes : 10 bins from 0.01 μm to 40 μm

SOA scheme : VBS

Horizontal/vertical advection schemes : Van Leer

Meteorological fields : WRF4.3

Meteorological global inputs : GFS

Anthropogenic emissions : CAMS-REG

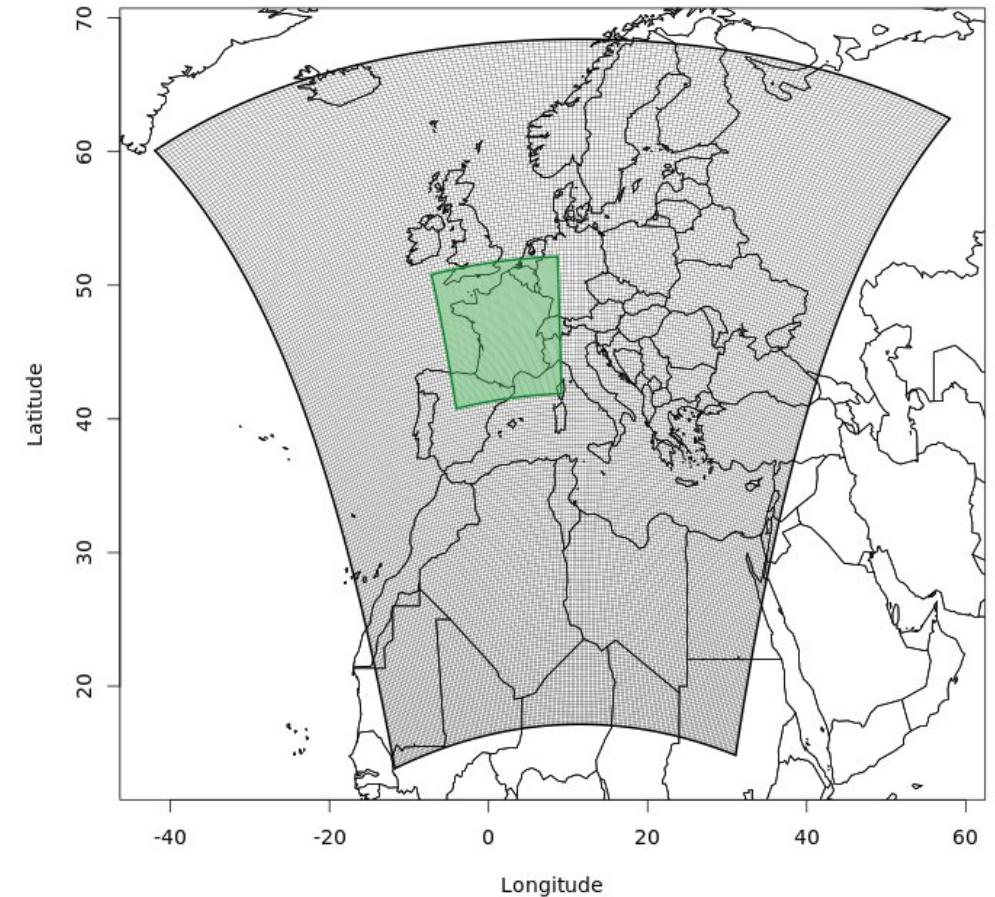
Fire emissions : CAMS GFAS

Boundary/initial conditions : CAMS global reanalysis 3h ensemble

Sea salt emissions : included

DMS emissions : included

Dust emissions : included



Simulations

Name	Landcover	Tree database	Megan version	Detailed biogenic outputs	LAI
MEGAN2	USGS	PFTs	V2.1	No	MODIS
M3_orig_BDTopo	USGS	MEGAN Eco file	V3.0	Yes	MODIS
M3_BDforet_BDTopo	BDTopo	BD-Forêt	V3.0	Yes	MODIS
M3_BDForet_BDTopo_Corine	Corine	BD-Forêt	V3.0	Yes	MODIS



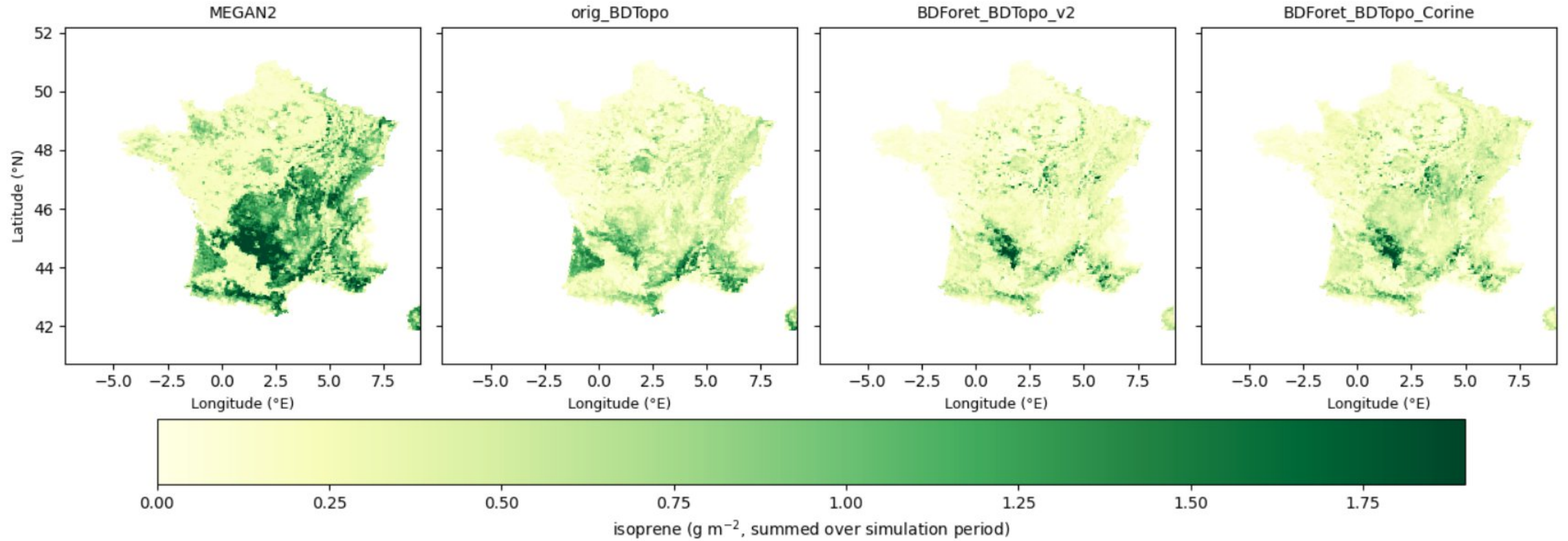
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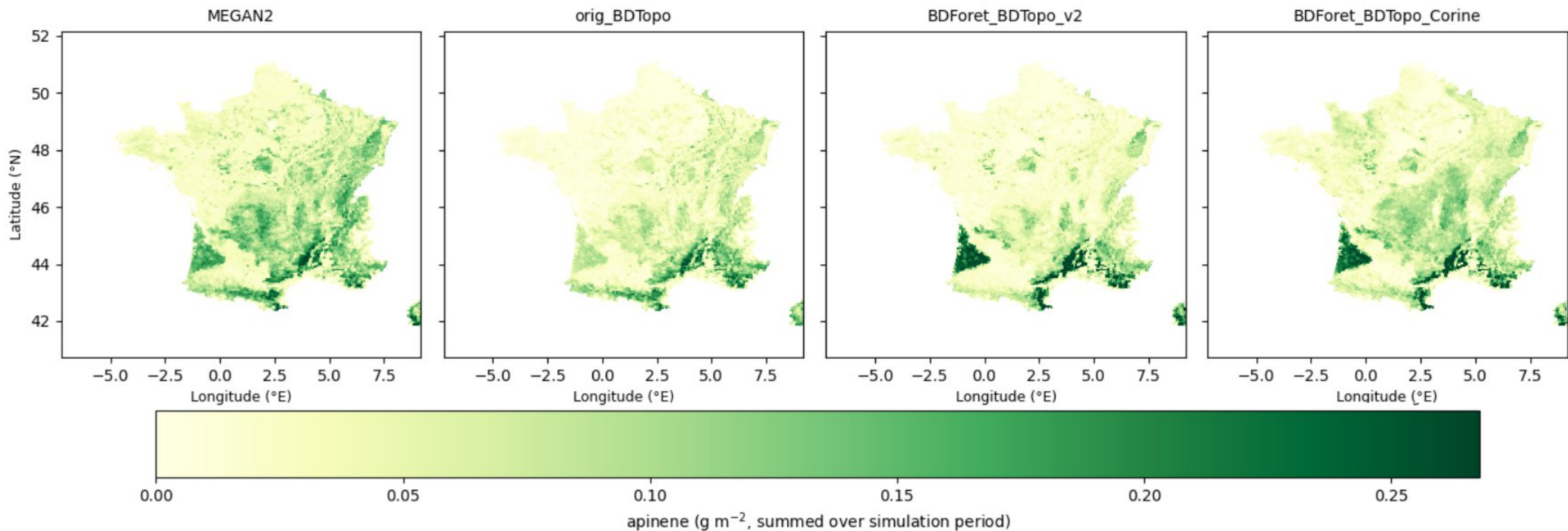
Meteorological validation has been done
Regulated species validation has been done



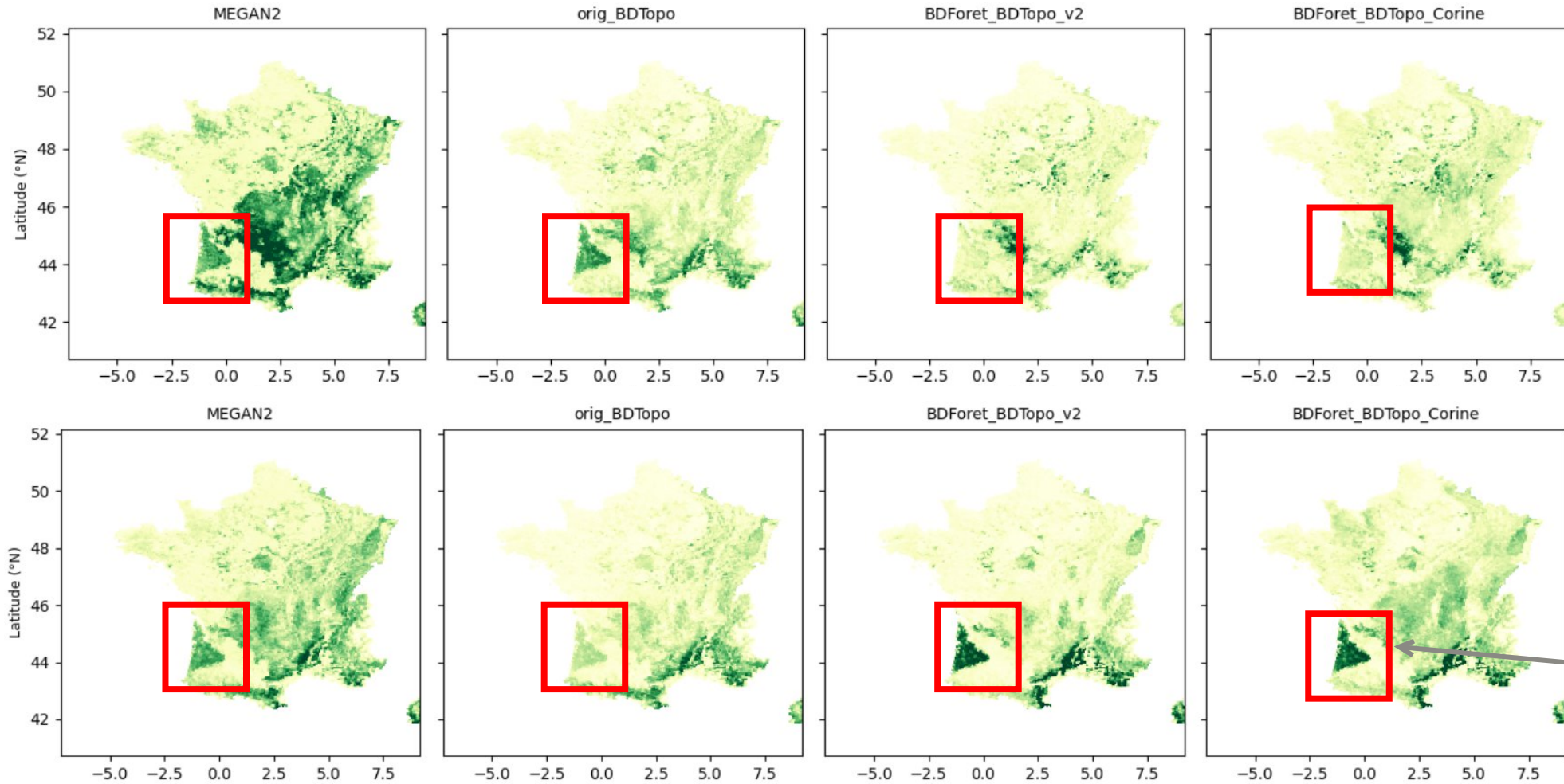
Comparison of biogenic emissions : Isoprene



Comparison of biogenic emissions : α -pinene



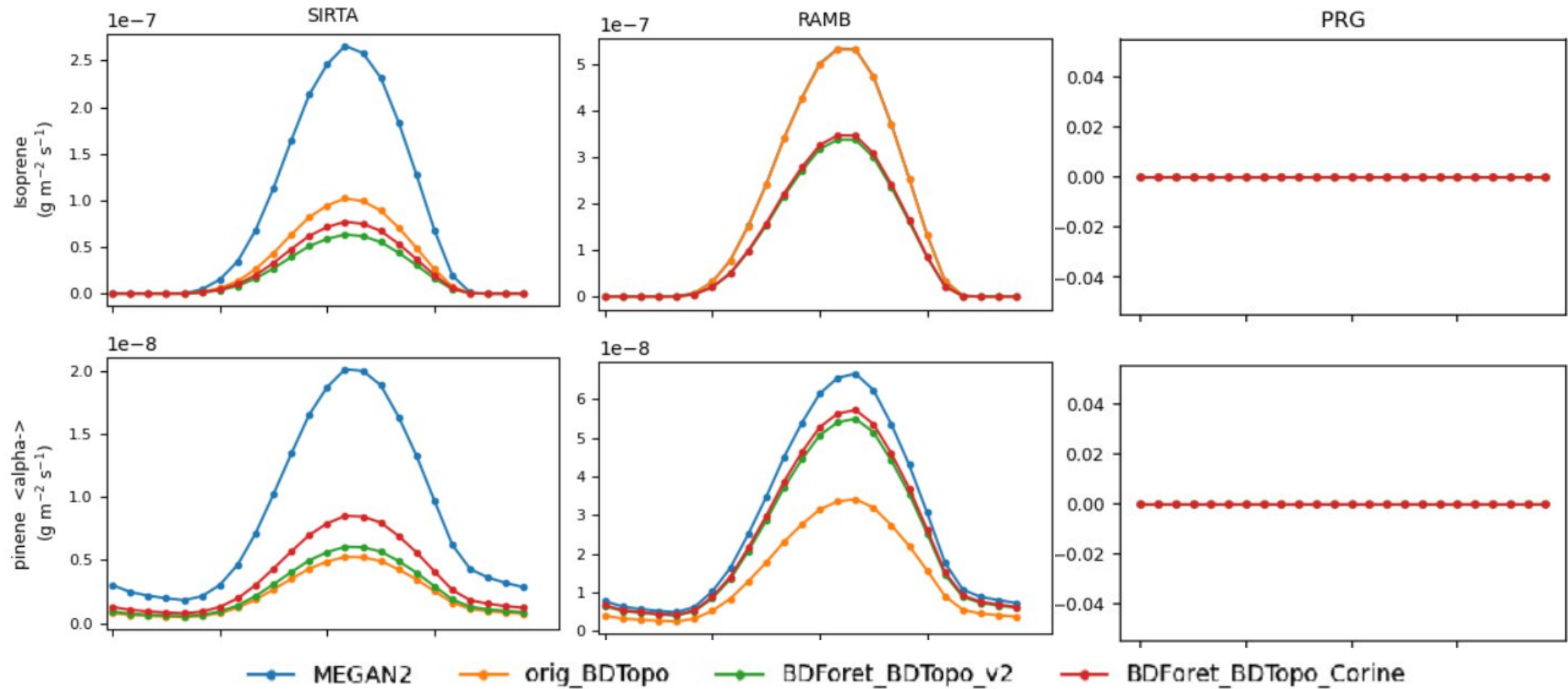
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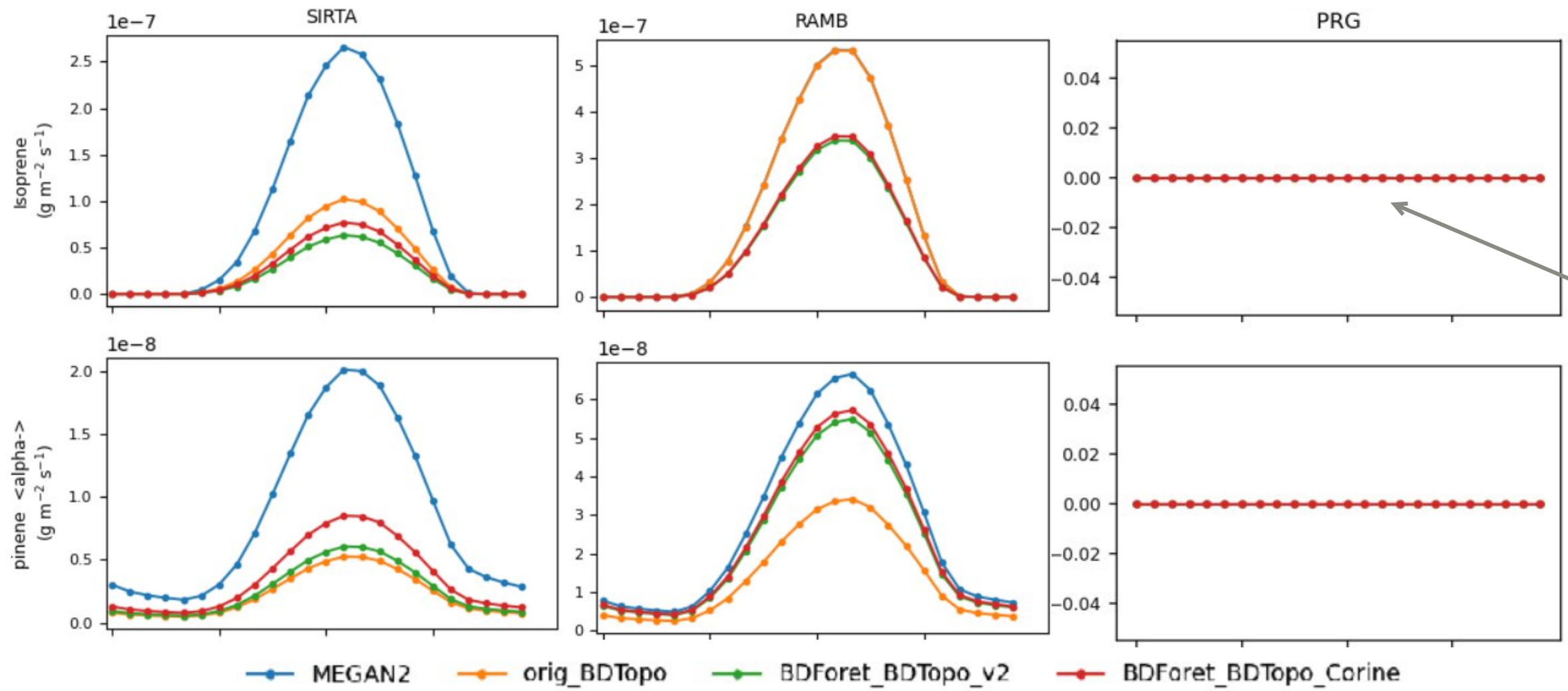
Cholakian et al, 2023



Diurnal comparisons for different sites



Diurnal comparisons for different sites



ECLAT project

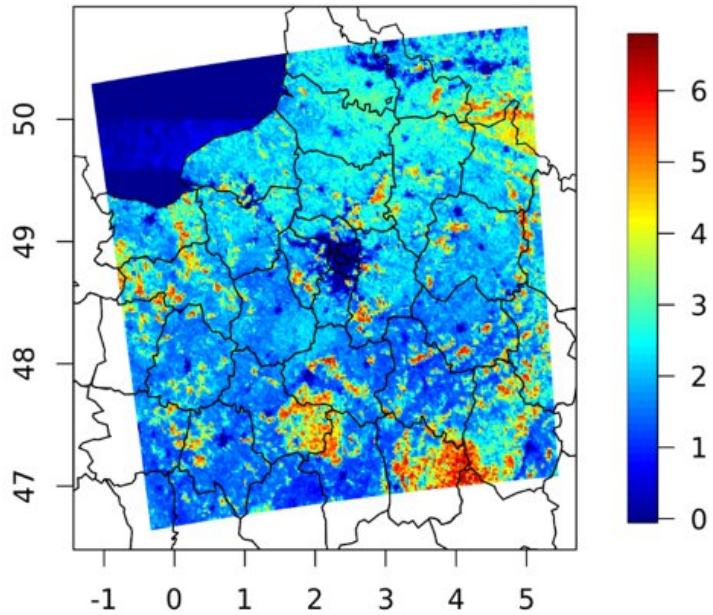
Why?



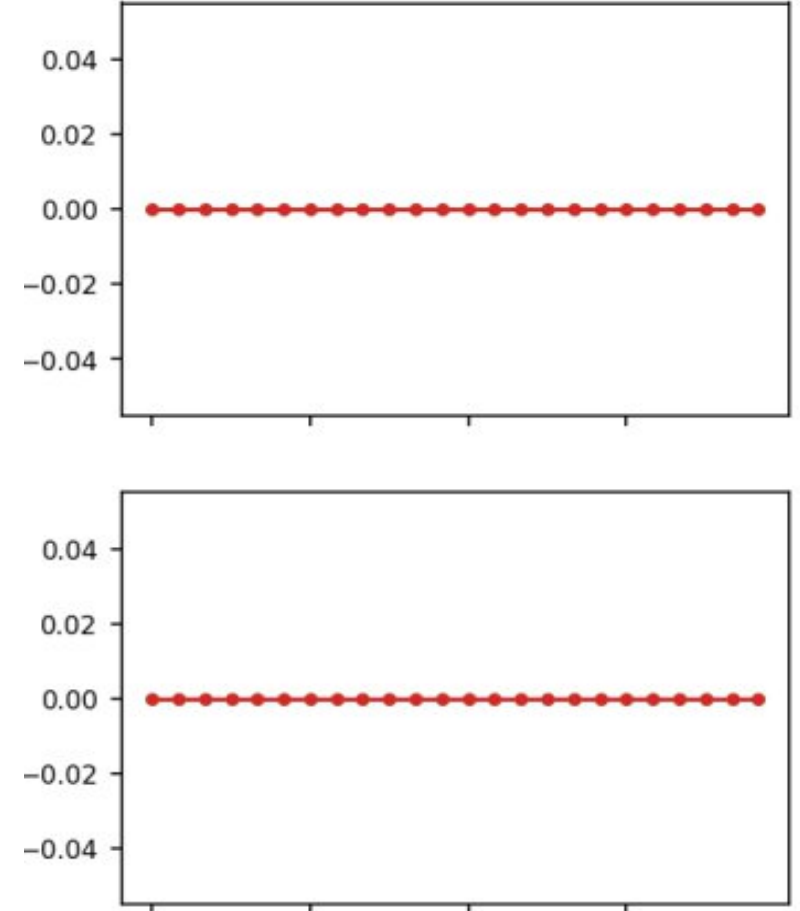
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MODIS



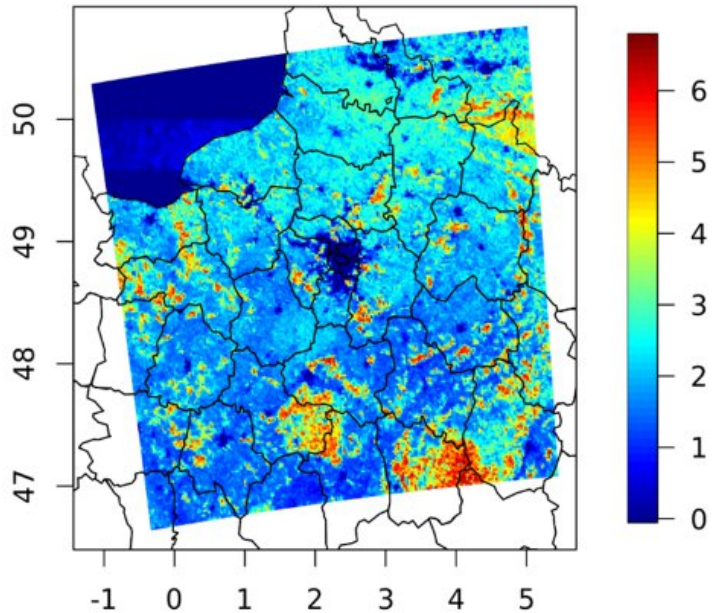
PRG



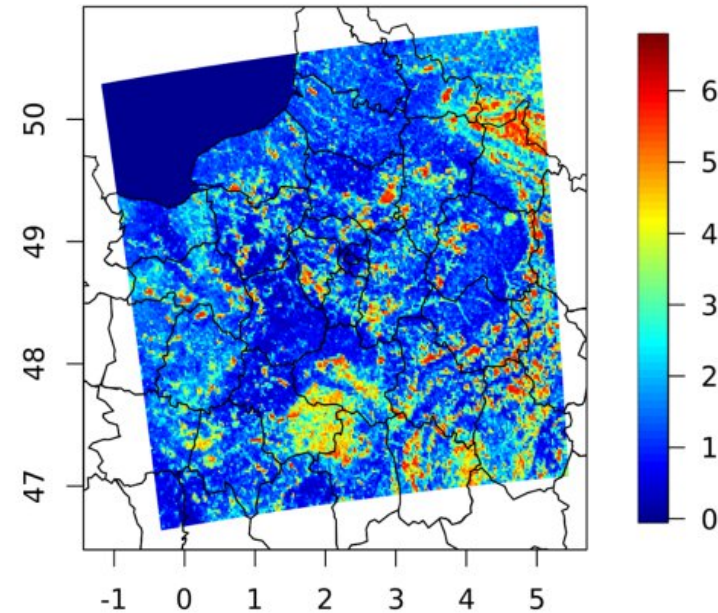
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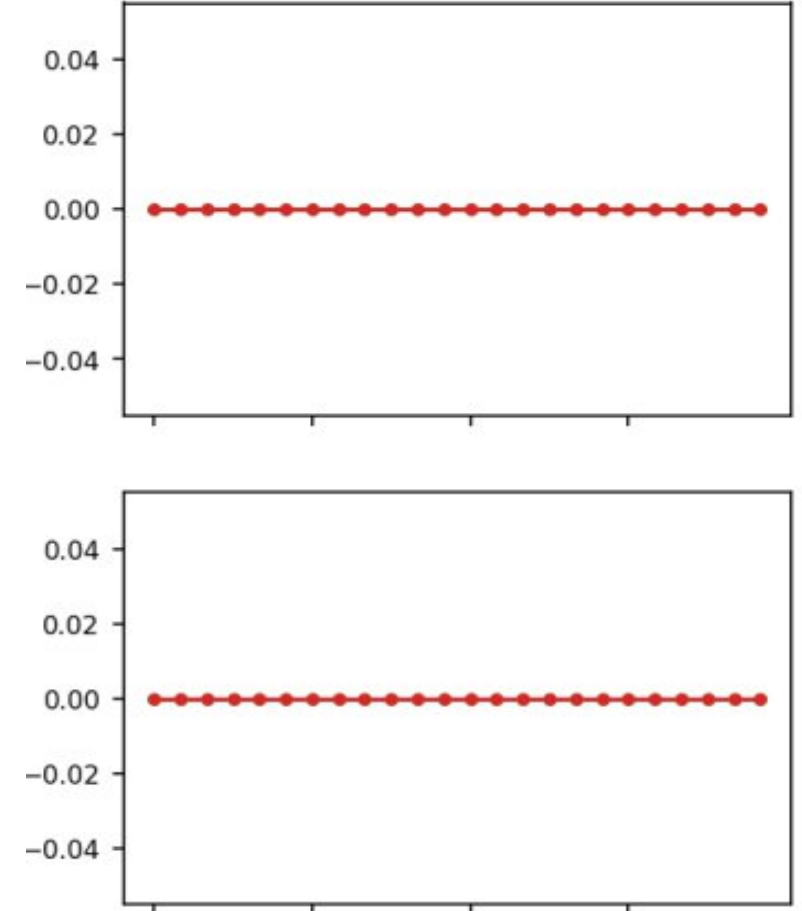
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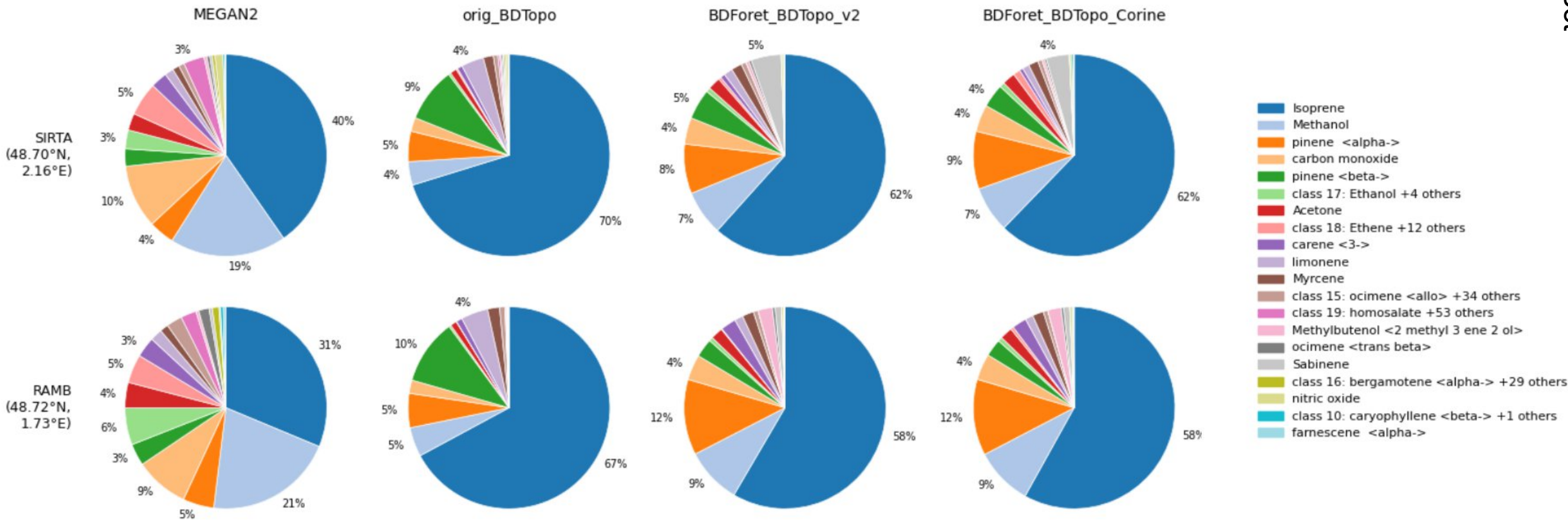
Copernicus



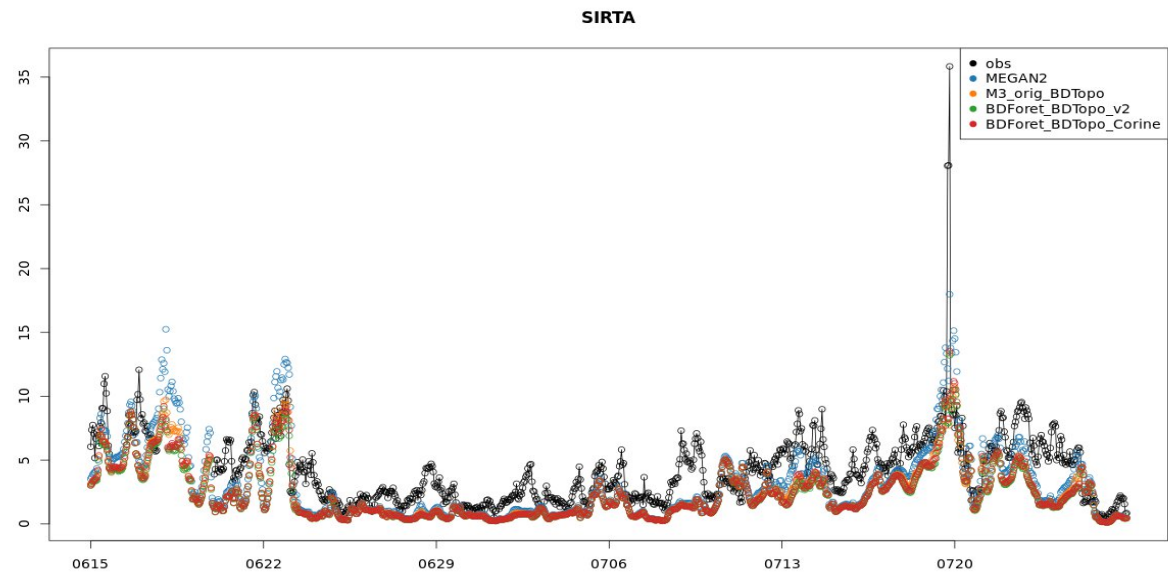
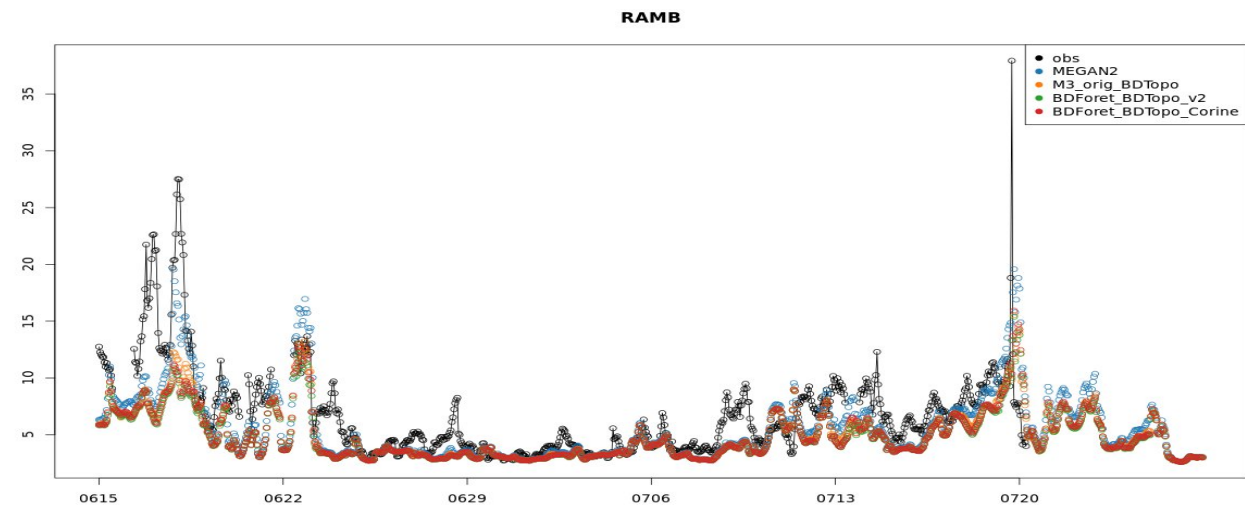
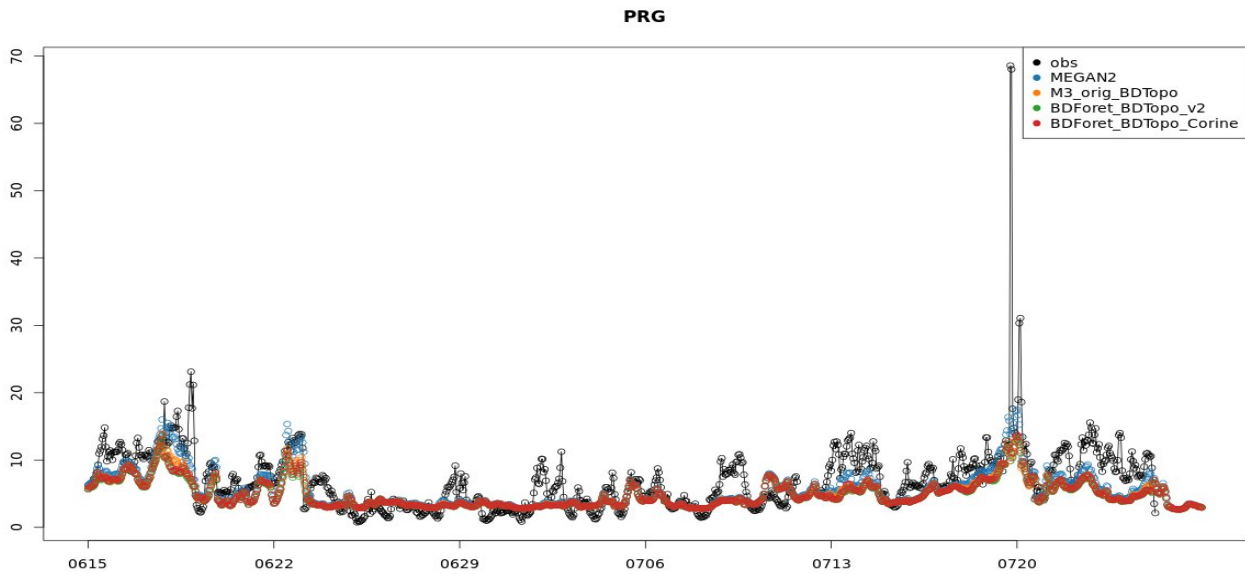
PRG



Detailed composition of biogenic emissions



Grouped outputs : concentrations



Prospective

- Comparison of simulations to VOC measurements
 - For the 3 sites
 - For different altitudes in RAMB (if measurements available)
- Tests on Leaf area index
 - Copernicus LAI dataset
- Tests on physical Canopy model corrections

Publication is on preparation.

