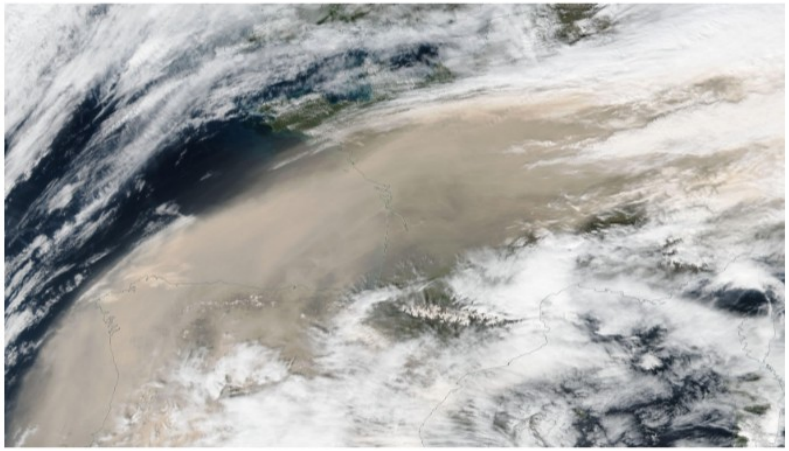
Considering NRT aerosols from IFS-COMPO and MOCAGE for radiation in AROME cy49t1

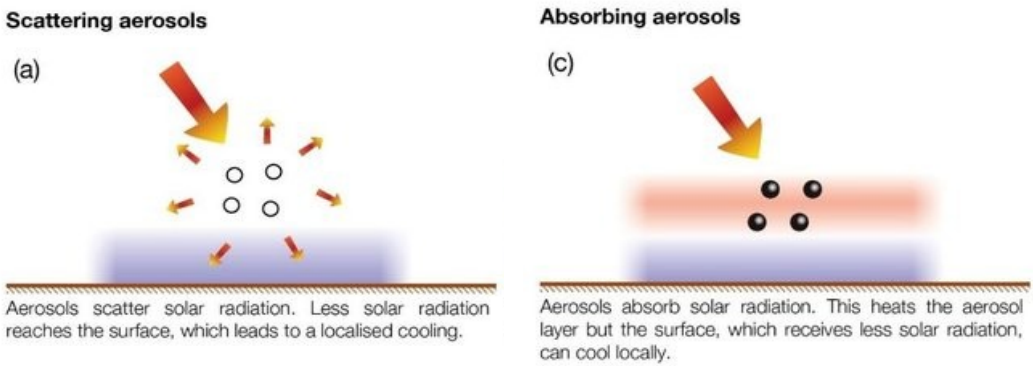


TERRA Satellite picture
16 March 2022 12TU

Salomé Antoine, Yann Seity, Marie Mazoyer (CNRM, Météo-France)

6th ACCORD All Staff Workshop 13-17 April 2026
salome.antoine@meteo.fr & marie.mazoyer@meteo.fr

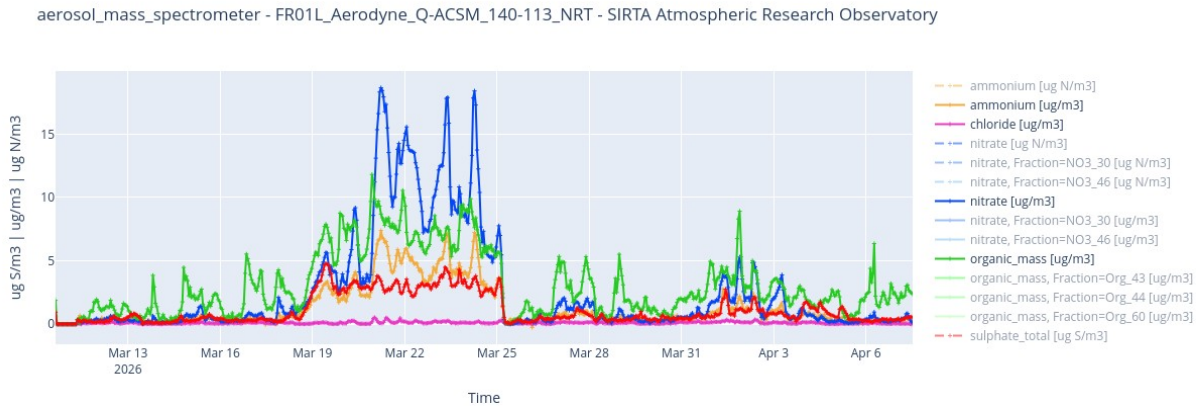
Aerosols-radiation interactions



Boucher et al., 2013

⇨ Effects depends on aerosols species (mass and optical properties)
Extensively studied within climate model

⇨ Aerosols mass and species highly variable from day to day without accounting for dust intrusion and wildfires

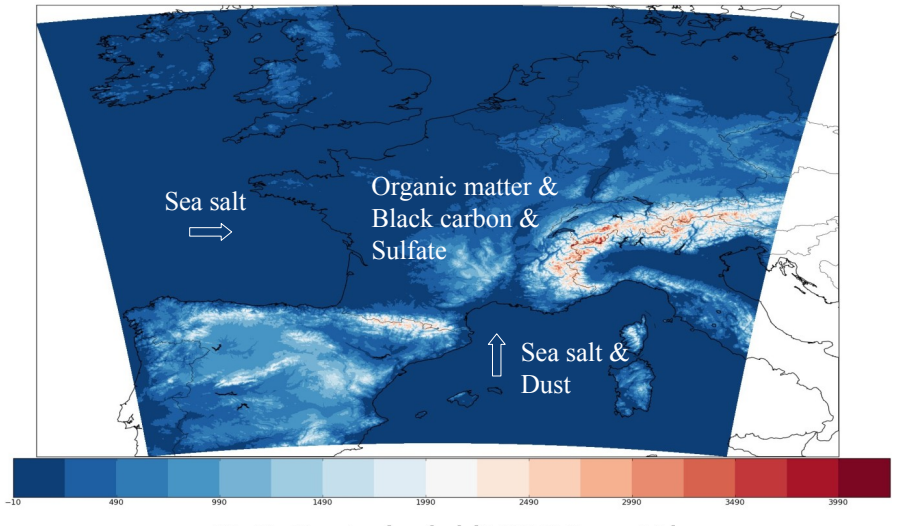


AROME (since cycle 48) – radiation parameterization - aerosols

⇨ **EcRAD with McIca solver**
CAMS **climatology** with 11 aerosols species

Aerosols species	M_{ext} (m².kg-1)
• **Sea salt film drop mode**	**4 080,34**
jet drop mode	432,98
spume drop mode	122,77
• **Desert dust fine mode**	**2 496,68**
coarse mode	955,08
super-coarse mode	406,53
• **Organic matter hydrophobic**	**2 321,03**
hydrophilic	**3 418,84**
• Black carbon hydrophobic	13 487,80
hydrophilic	13 487,80
• **Sulfate**	**6 295,94**

Perez et al., 2024



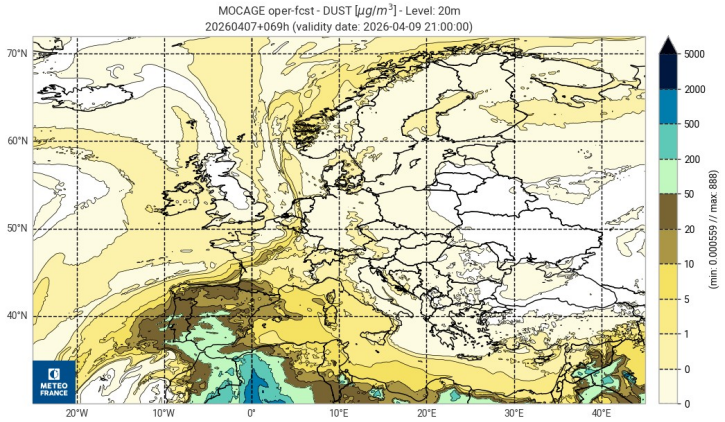
AROME-oper

*M_{ext}: mass extinction coefficient (amount of radiation extinction, **scattering** + absorption) at 80% humidity*

AROME – aerosols in Near Real Time

Spatio-temporal variability :

- IFS-COMPO chemisty-transport model : two daily production at ~ 40km output each 3-h, same species as CAMS climatology
- MOCAGE chemisty-transport model : daily production at ~ 50km output each 1-h, re-mapping for same species as CAMS climatology (initialy 6 bins for each specie)

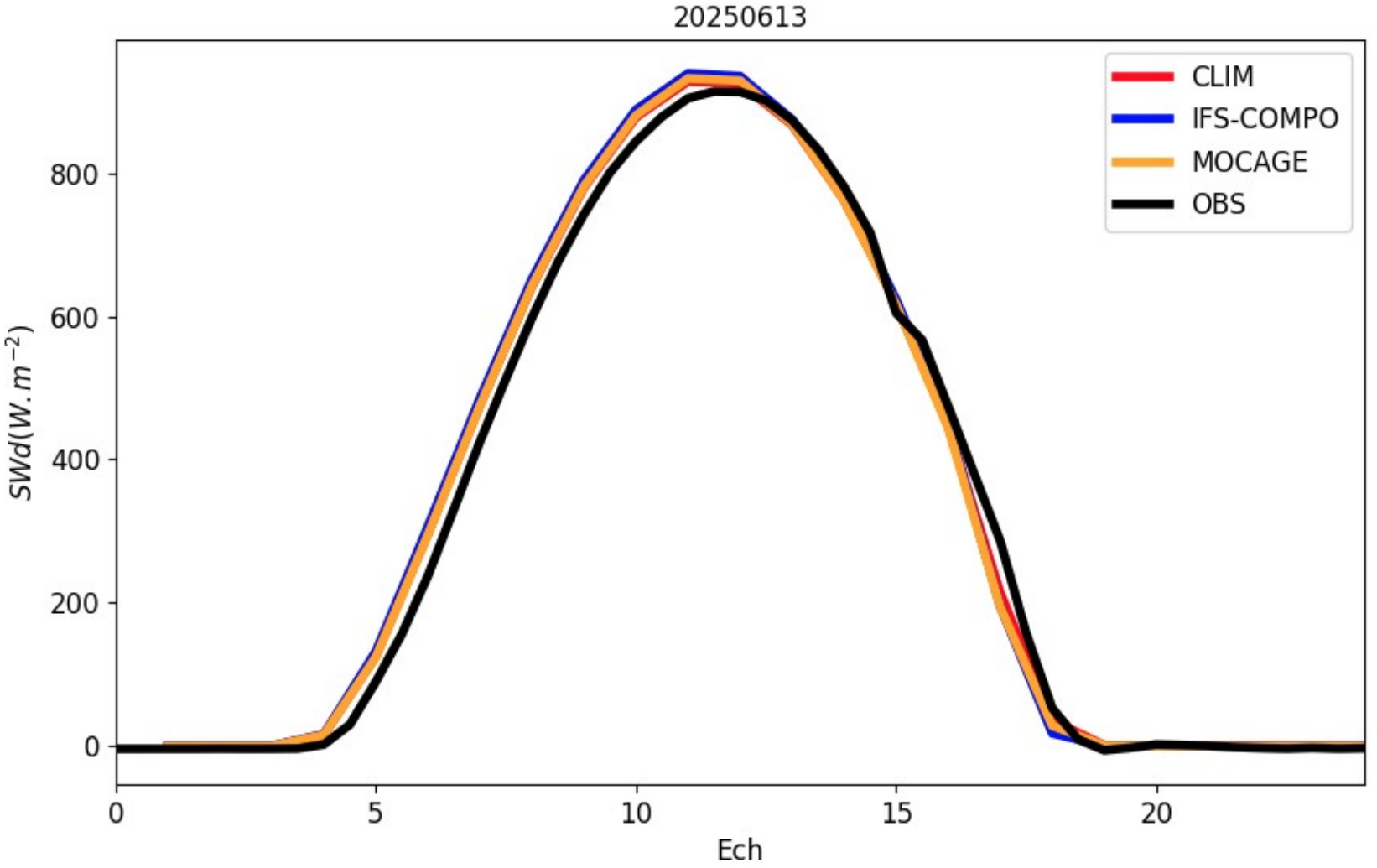


Cycle 48 t1 and 49 t1, what is read (dynamical adaptation) :

- IFS-COMPO → analysis netcdf taken on Mars and remapped on Arpege grid
- MOCAGE → analysis produced on the Arpege format

- Aerosols are transport with GFL but no coupling at the moment (0 is used) issue of huge file transfert for IFS-COMPO while no issue for MOCAGE
- MOCAGE better consistancy for the advection with the coupling model (MOCAGE uses ARPEGE)

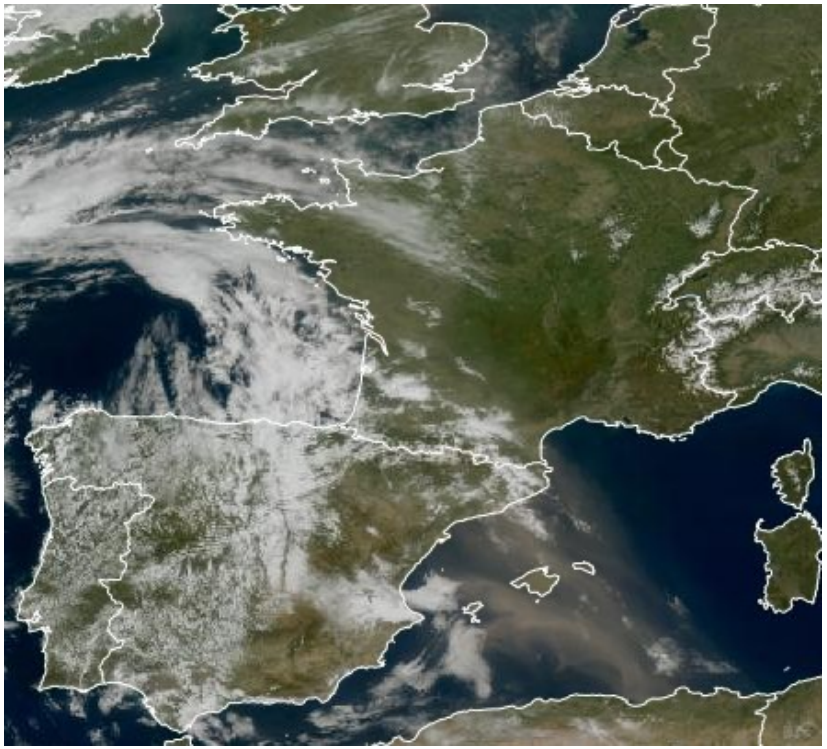
A clear sky day at Toulouse – 2025-06-13 - Meteopole Flux station



Some cases study

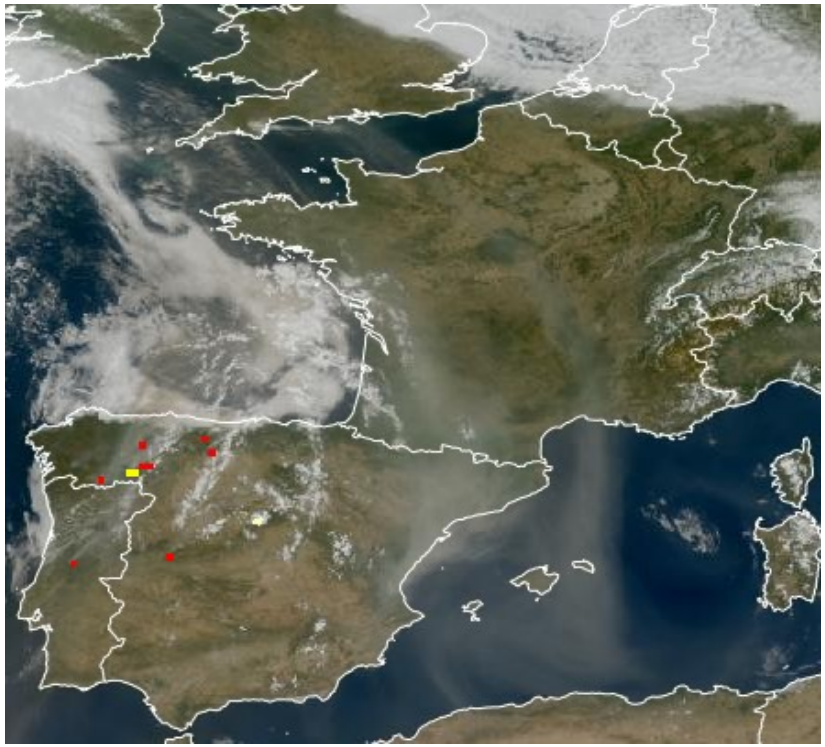
Dust intrusion, 1 may 2025

EUMETSAT GeoColor 12 UTC



Iberian smoke, 17 august 2025
and … dust instrusion

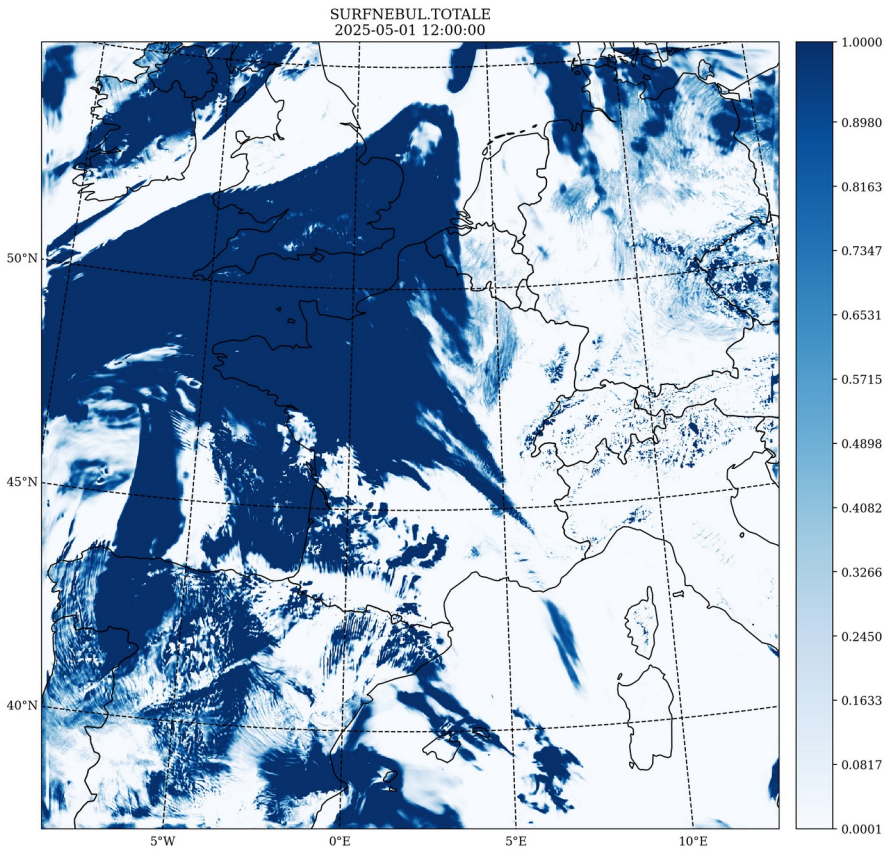
EUMETSAT GeoColor 12 UTC



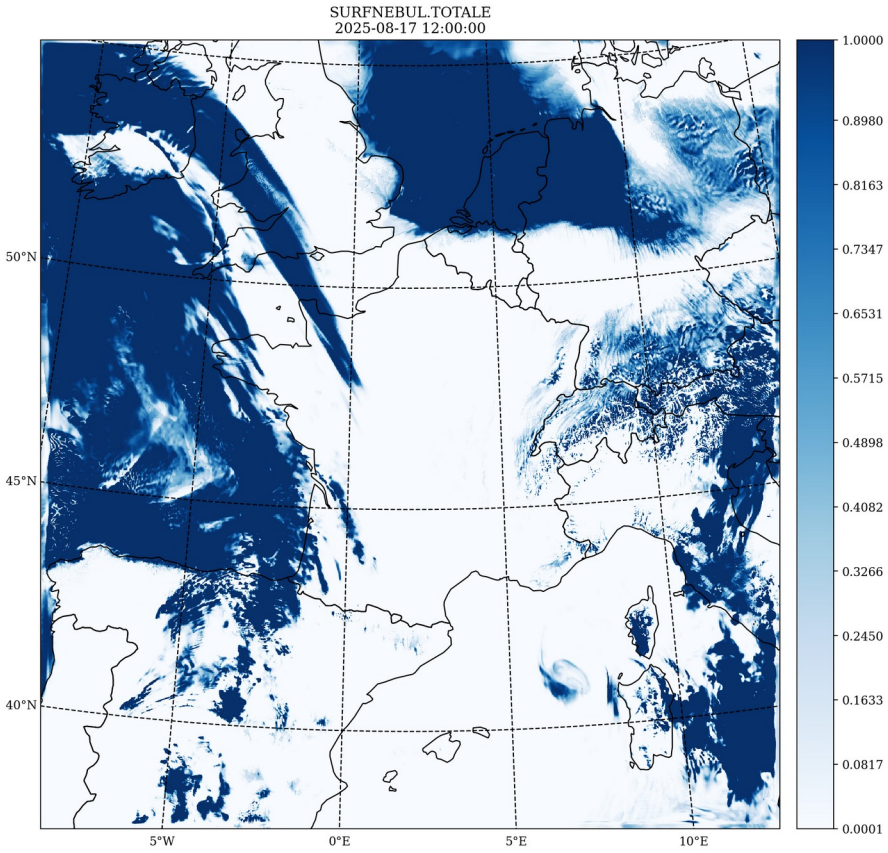
Tx forecasted 38°C -> till +4 °C error

Nebulosity in the model at 12 UTC

Dust intrusion, 1 may 2025



Iberian smoke, 17 august 2025



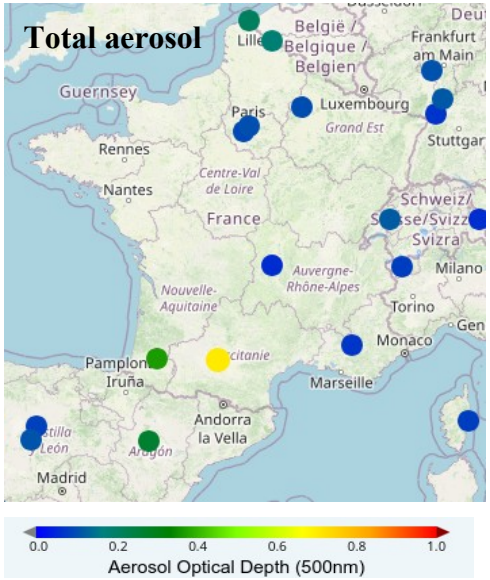
→ No differences between model experiences

→ No cloud interactions

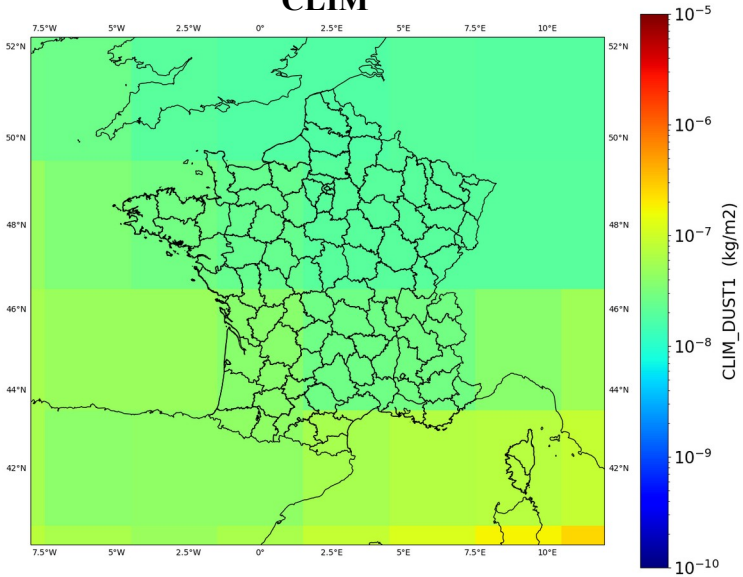
Aerosols variability, 700 hPa, **Dust intrusion**, 1 may 2025, 12 UTC

Dust fine mode

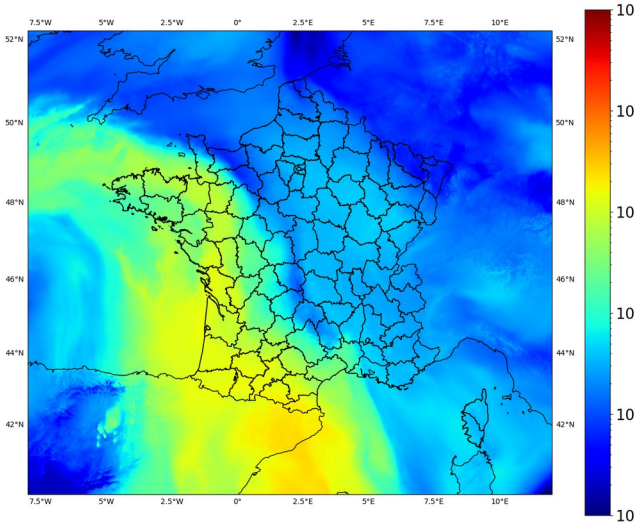
AERONET (11 – 12 UTC)



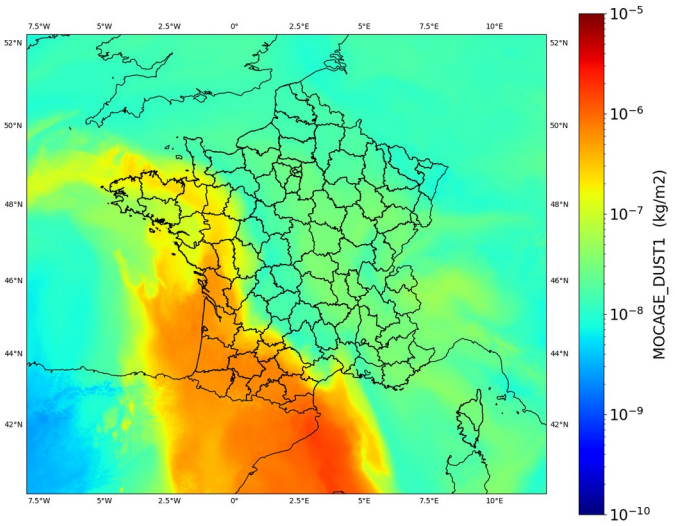
CLIM



IFS-COMPO



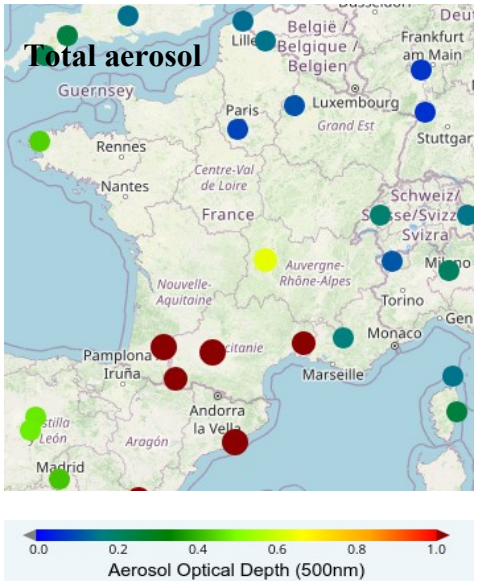
MOCAGE



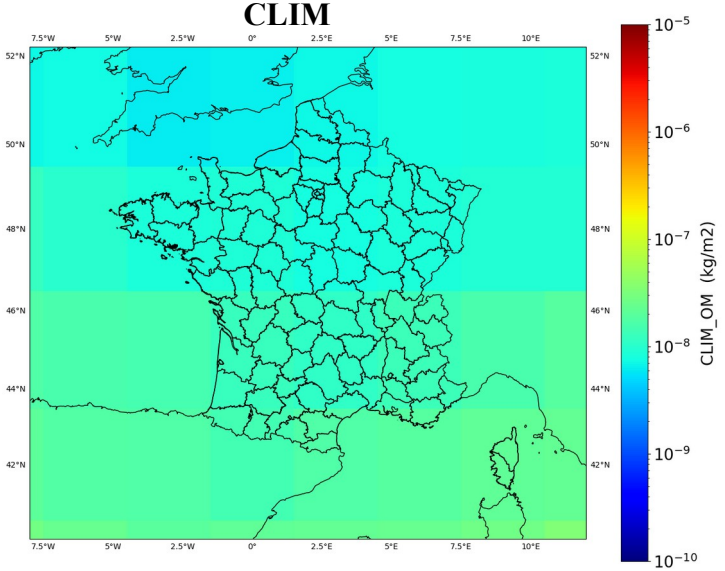
Aerosols variability, 700 hPa, **Iberian smoke**, 17 august 2025, 12 UTC

Organic matter

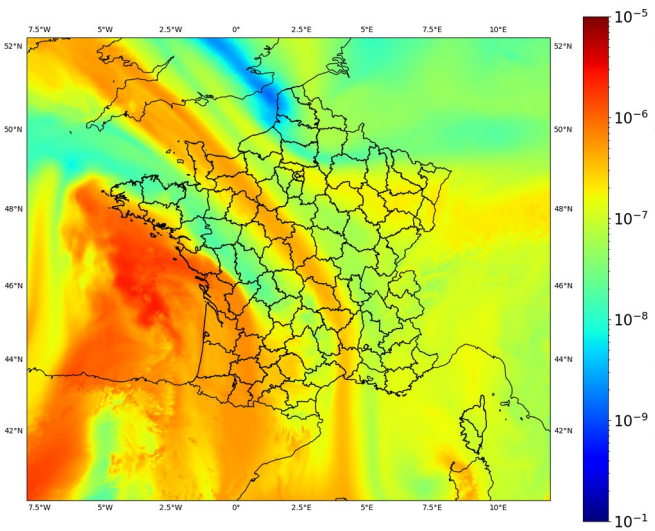
AERONET (11 – 12 UTC)



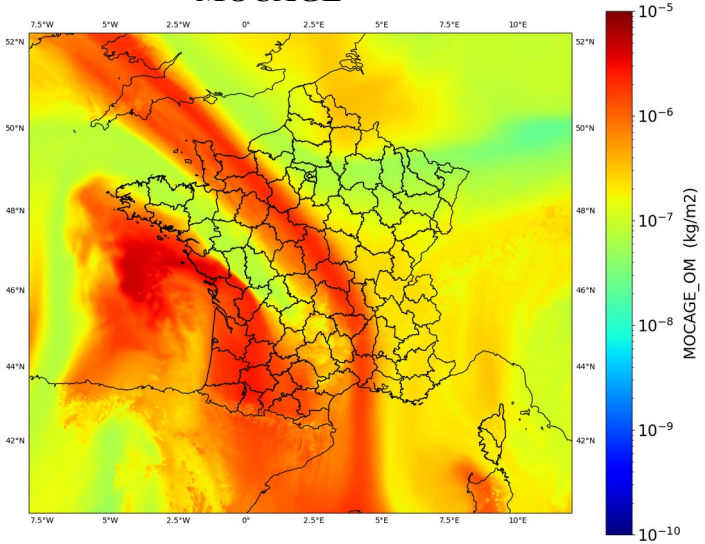
CLIM



IFS-COMPO



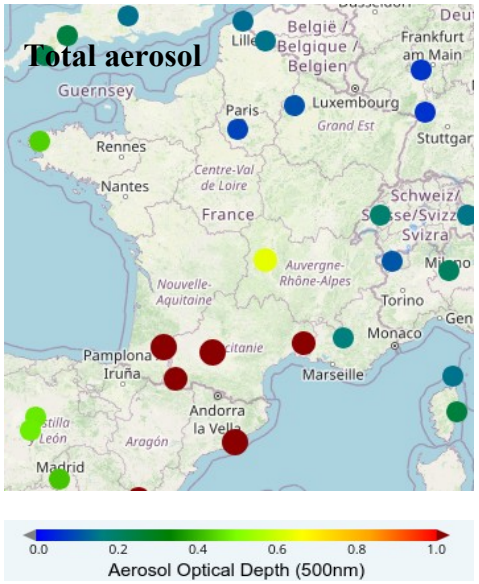
MOCAGE



Aerosols variability, 700 hPa, **Iberian smoke**, 17 august 2025, 12 UTC

Dust fine mode

AERONET (11 – 12 UTC)



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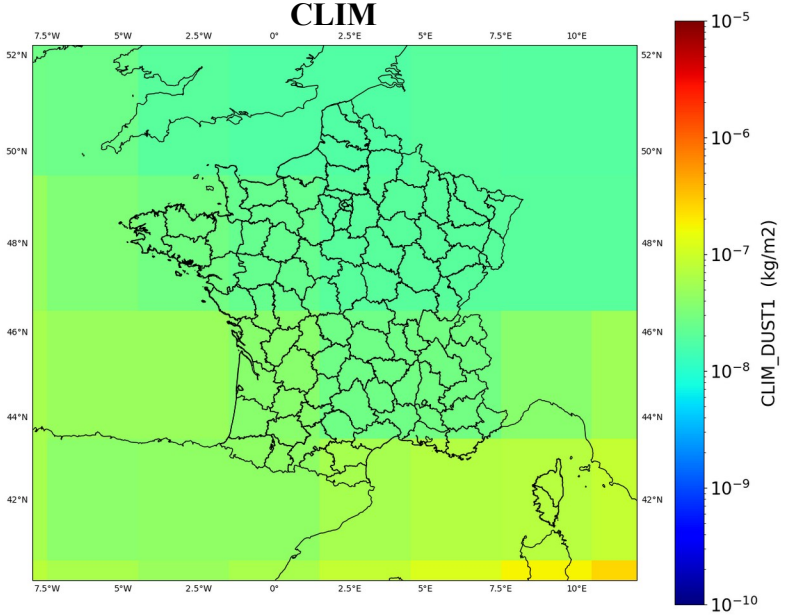

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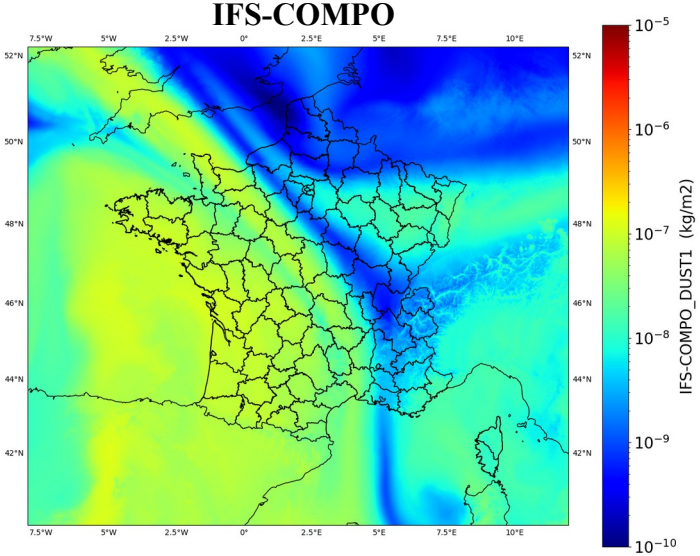
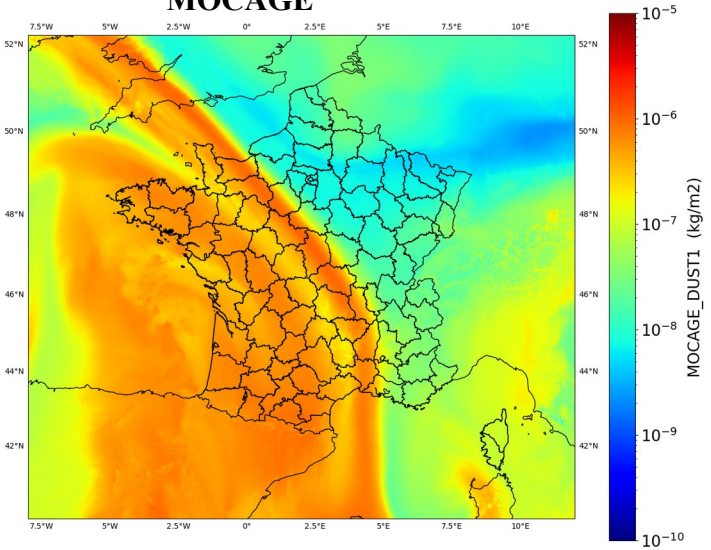


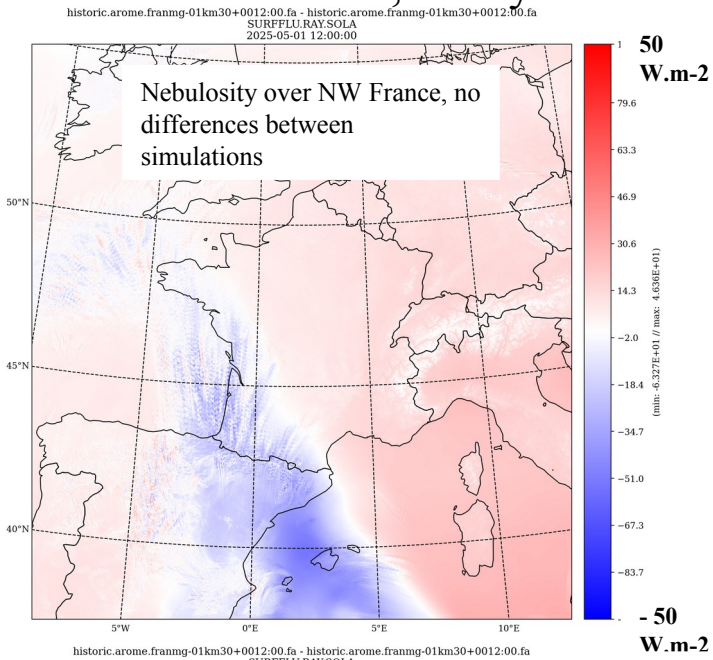
MOCAGE



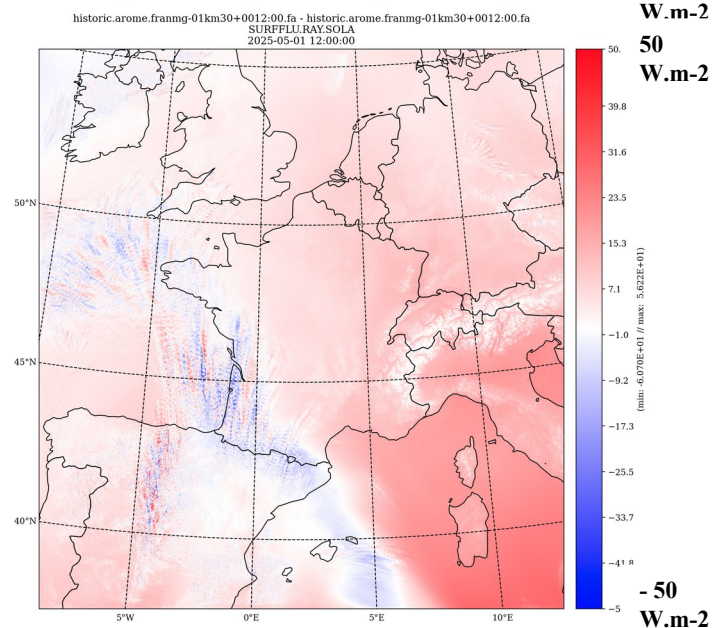
SWn differences at 12 UTC → test[ifs-compo,mocage] - ref[clim]

Dust intrusion, 1 may 2025

IFS-COMPO - CLIM



MOCAGE - CLIM



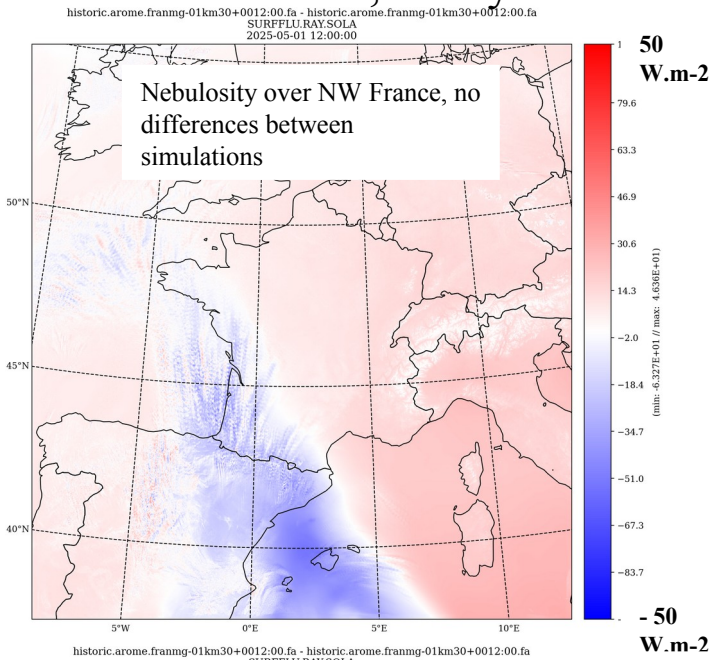
SWn differences at 12 UTC → test[ifs-compo,mocage] - ref[clim]

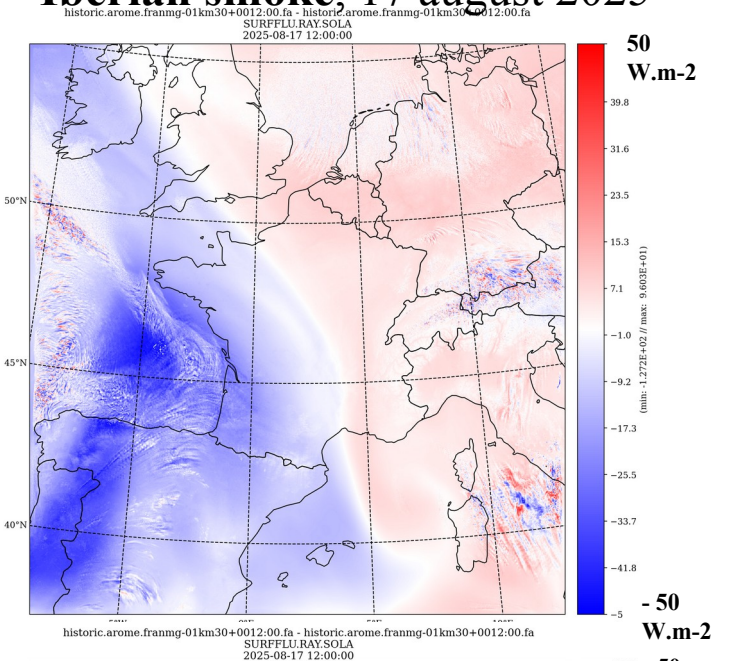
Dust intrusion, 1 may 2025

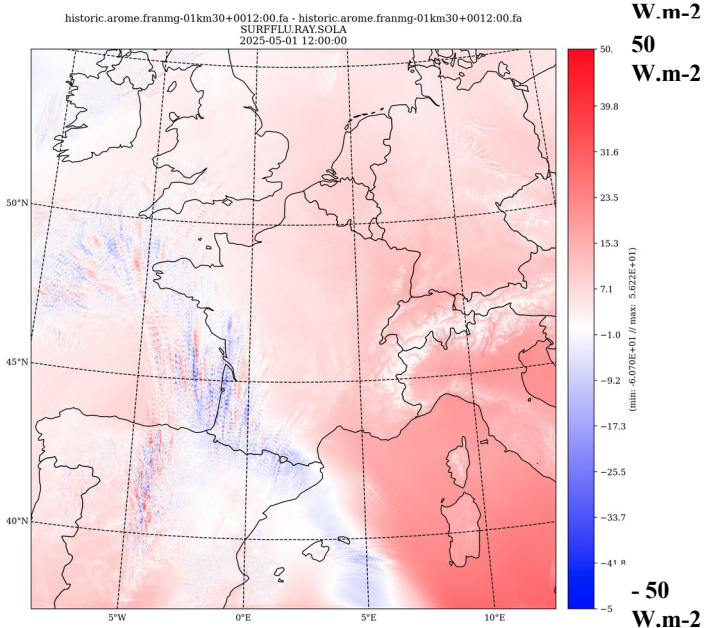
Iberian smoke, 17 august 2025

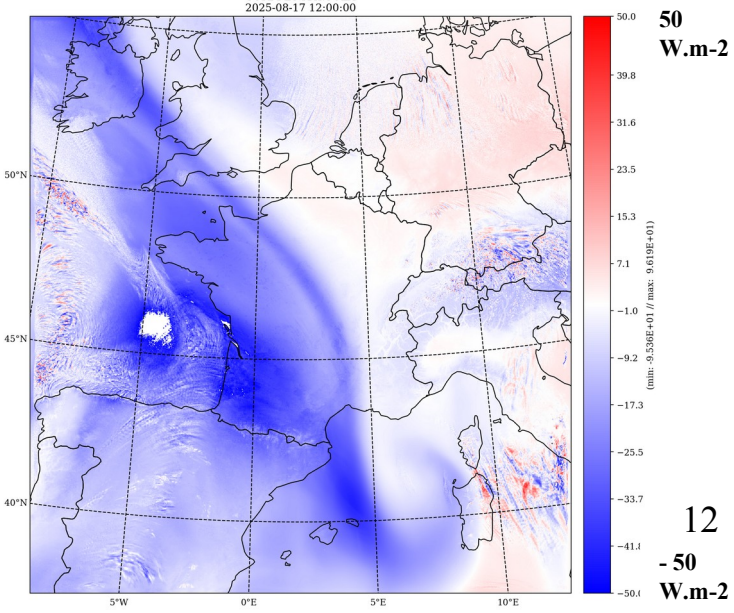
IFS-COMPO - CLIM

MOCAGE - CLIM





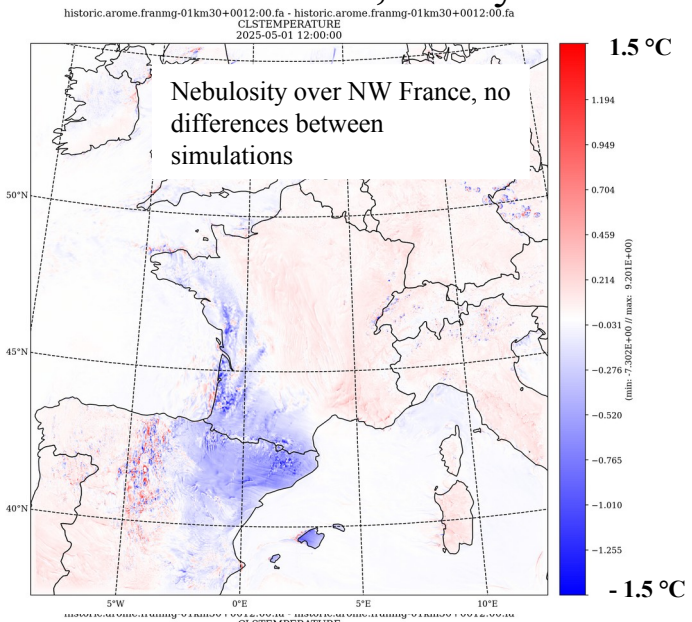




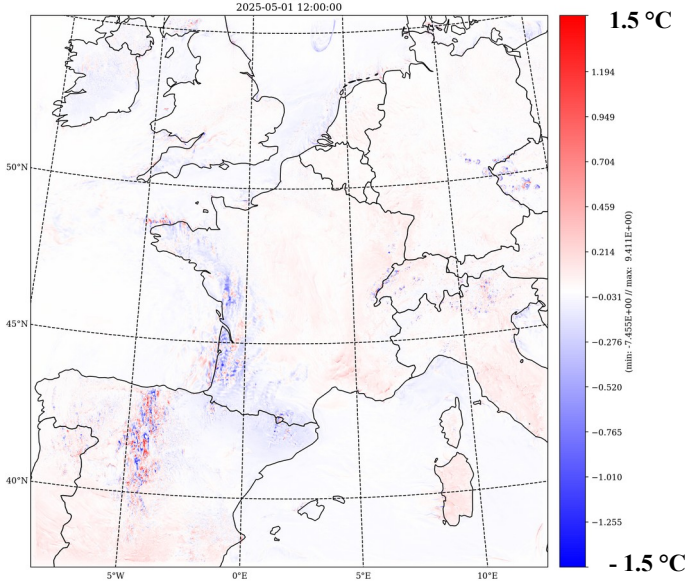
T2m differences at **12 UTC → test[ifs-compo,mocage] - ref[clim]**

Dust intrusion, 1 may 2025

IFS-COMPO - CLIM



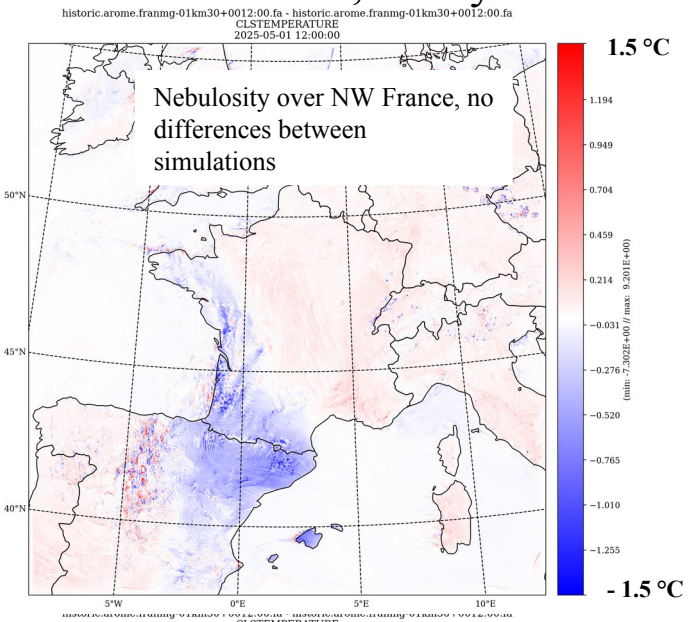
MOCAGE - CLIM



T2m differences at **12 UTC → test[ifs-compo,mocage] - ref[clim]**

Dust intrusion, 1 may 2025

IFS-COMPO - CLIM



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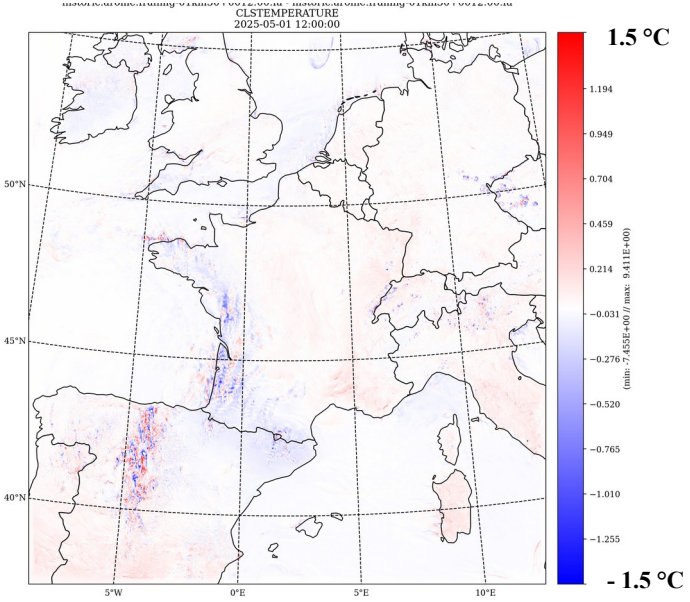
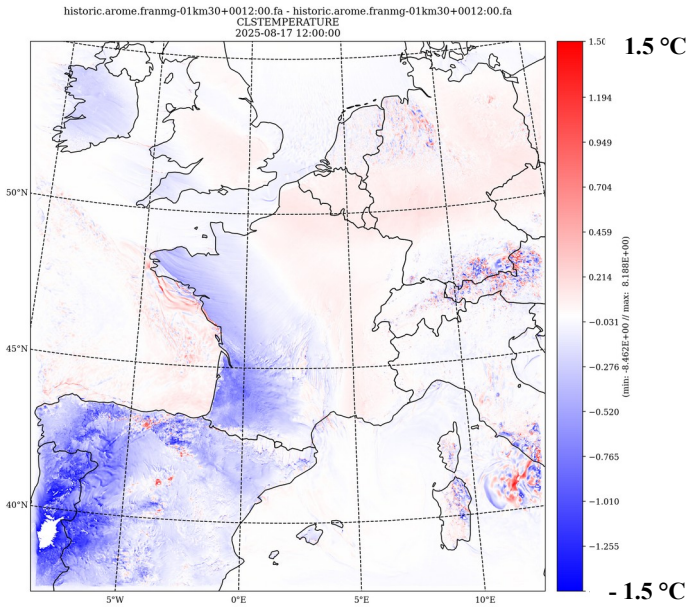
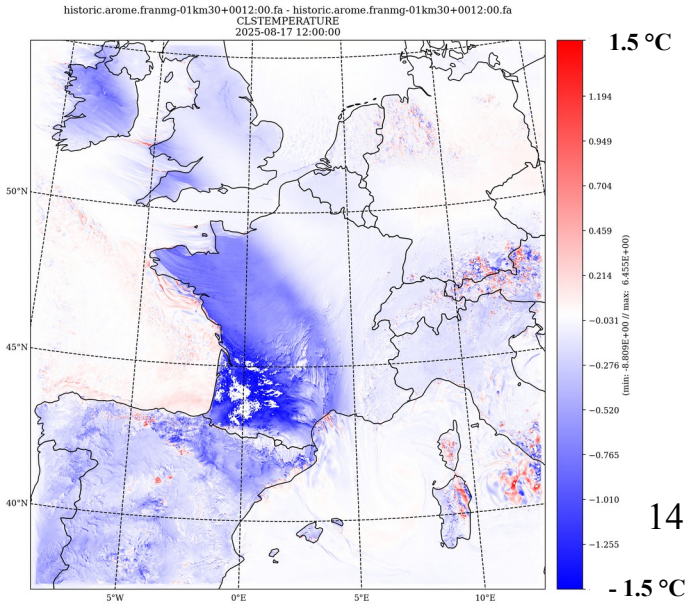


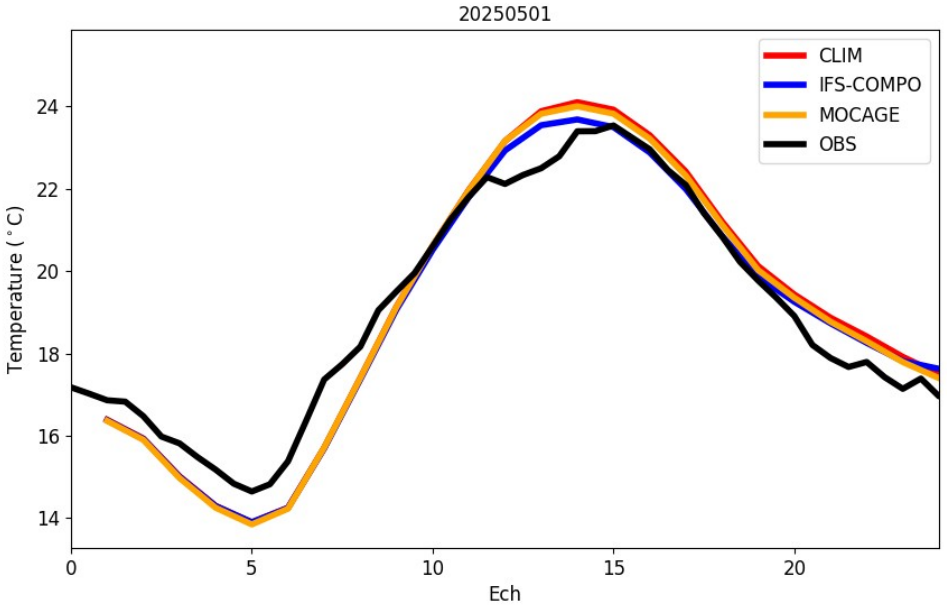
Iberian smoke, 17 august 2025



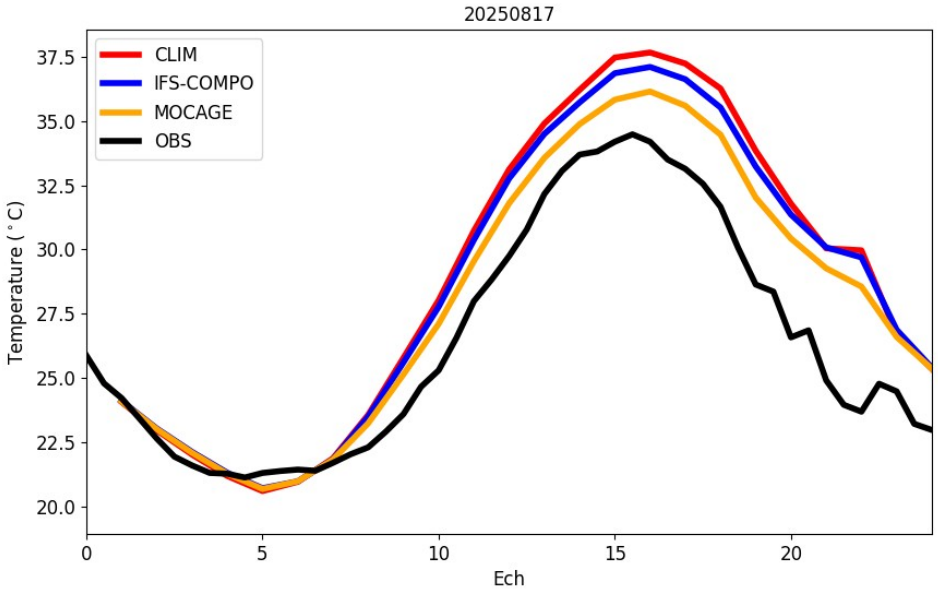


T2m at Toulouse - Meteopole Flux station

Dust intrusion, 1 may 2025



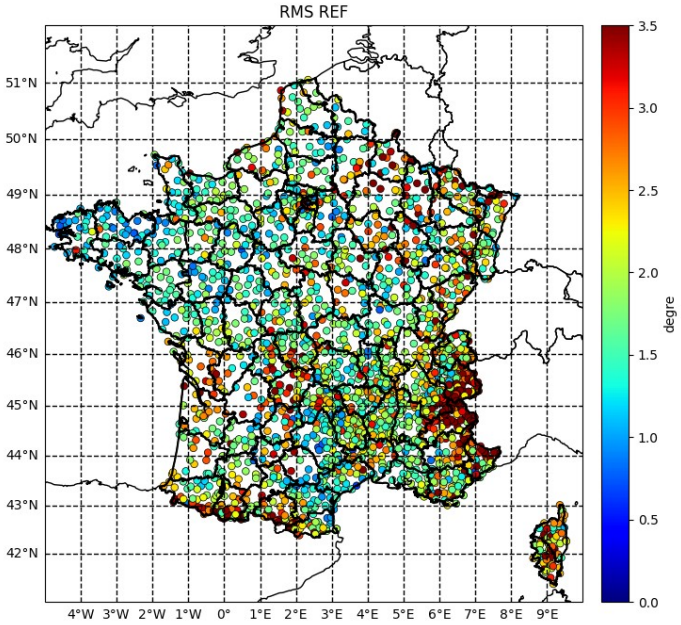
Iberian smoke, 17 august 2025



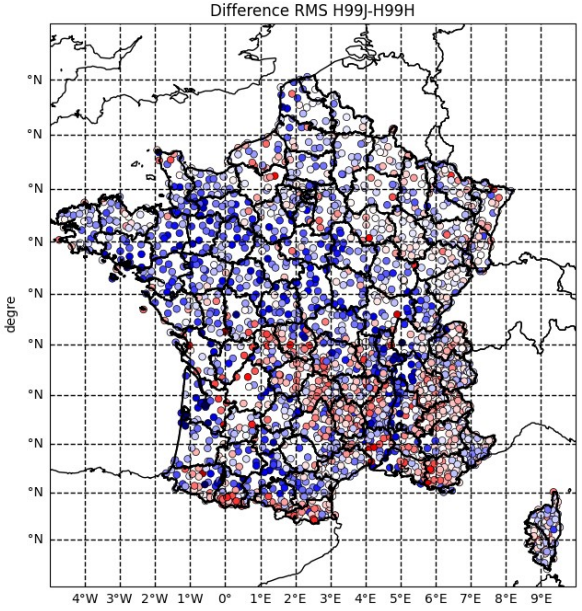
T2m rmse over 51h

Dust intrusion, 1 may 2025

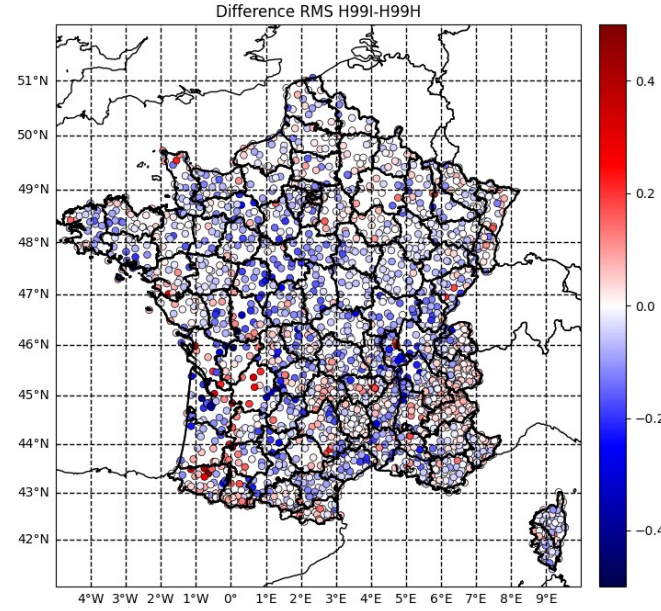
CLIM



IFS-COMPO - CLIM



MOCAGE - CLIM



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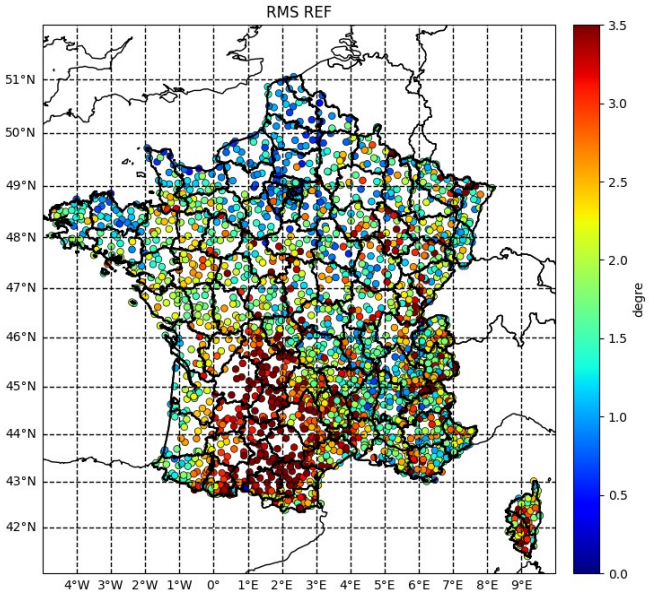
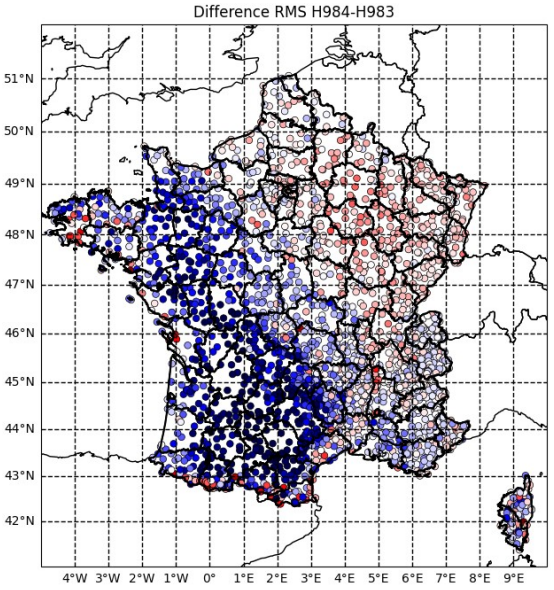
Iberian smoke, 17 august 2025

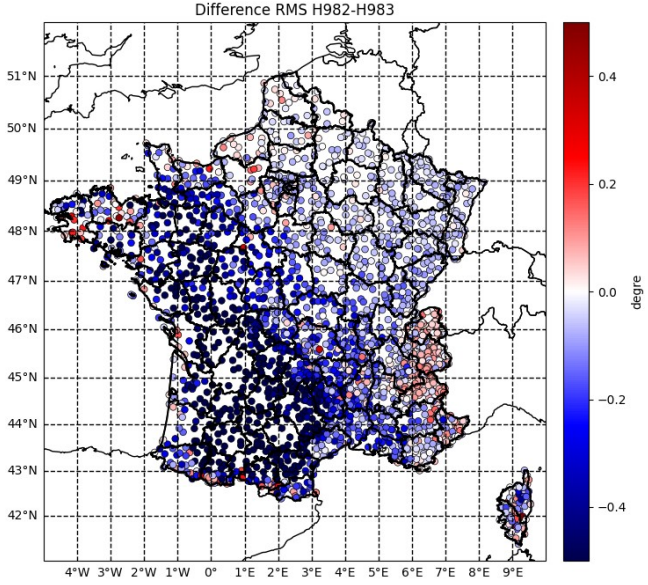
CLIM



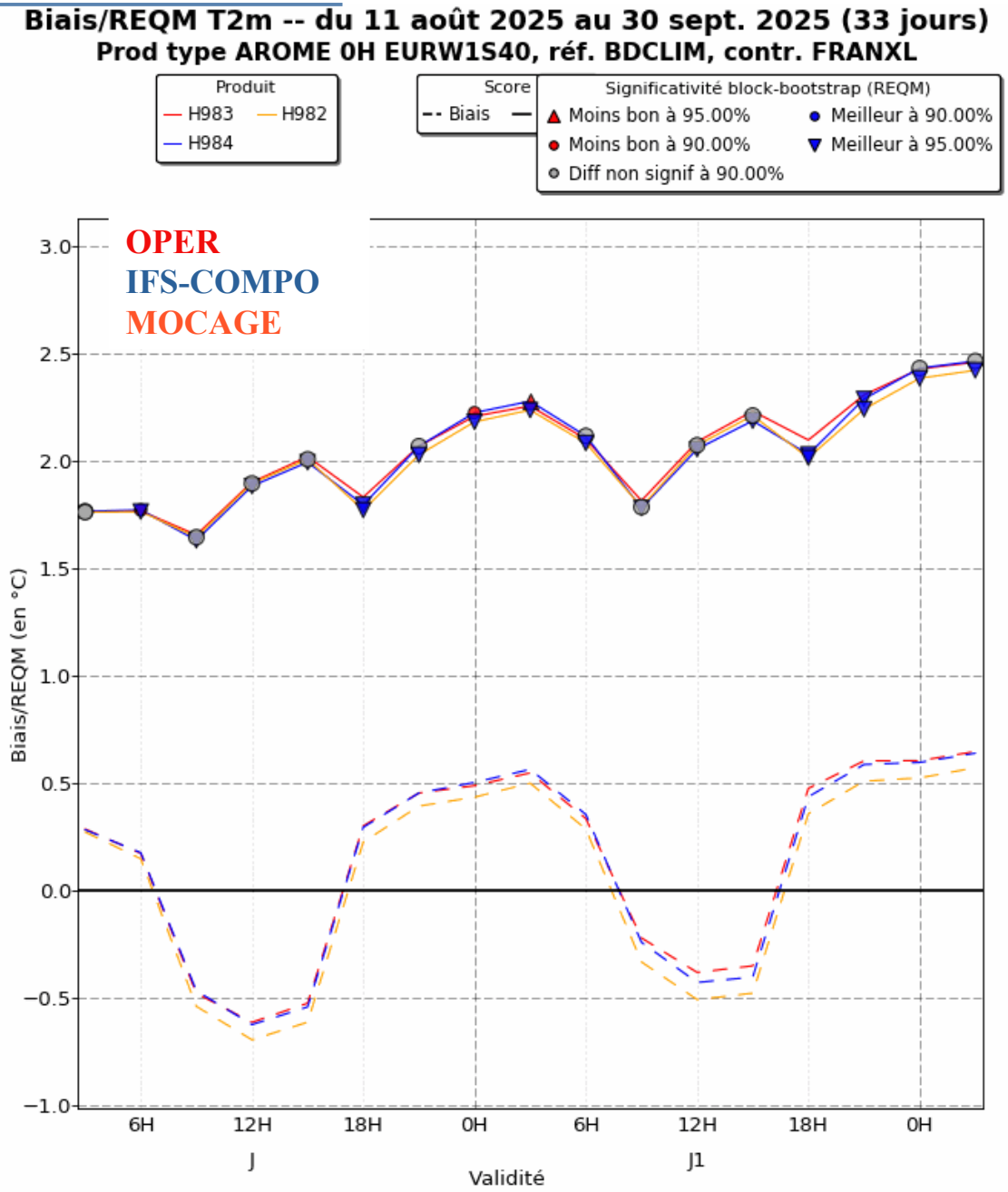
IFS-COMPO - CLIM



MOCAGE - CLIM

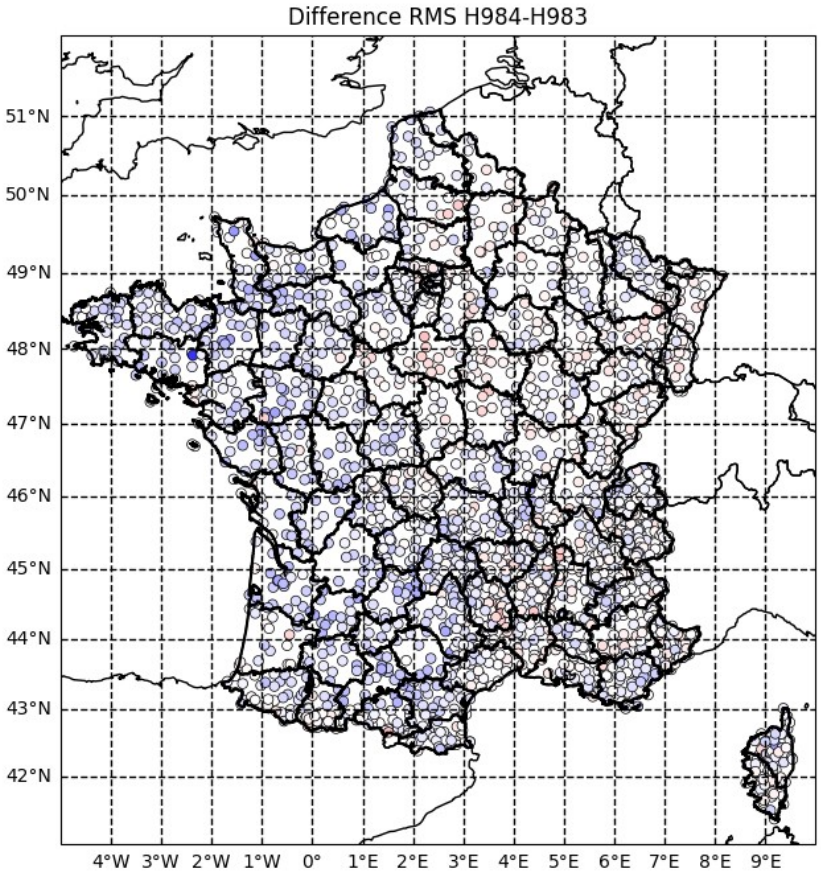


Skills – T2m – summer period

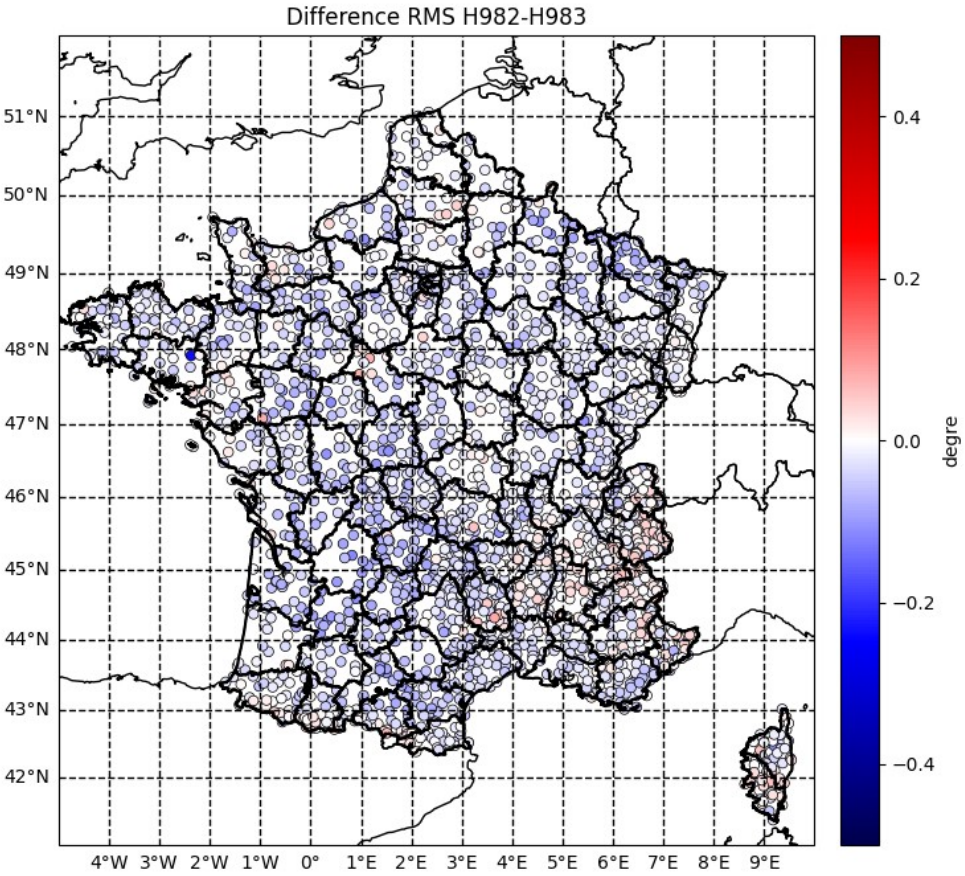


Skills – T2m – summer period

IFS-COMPO - CLIM

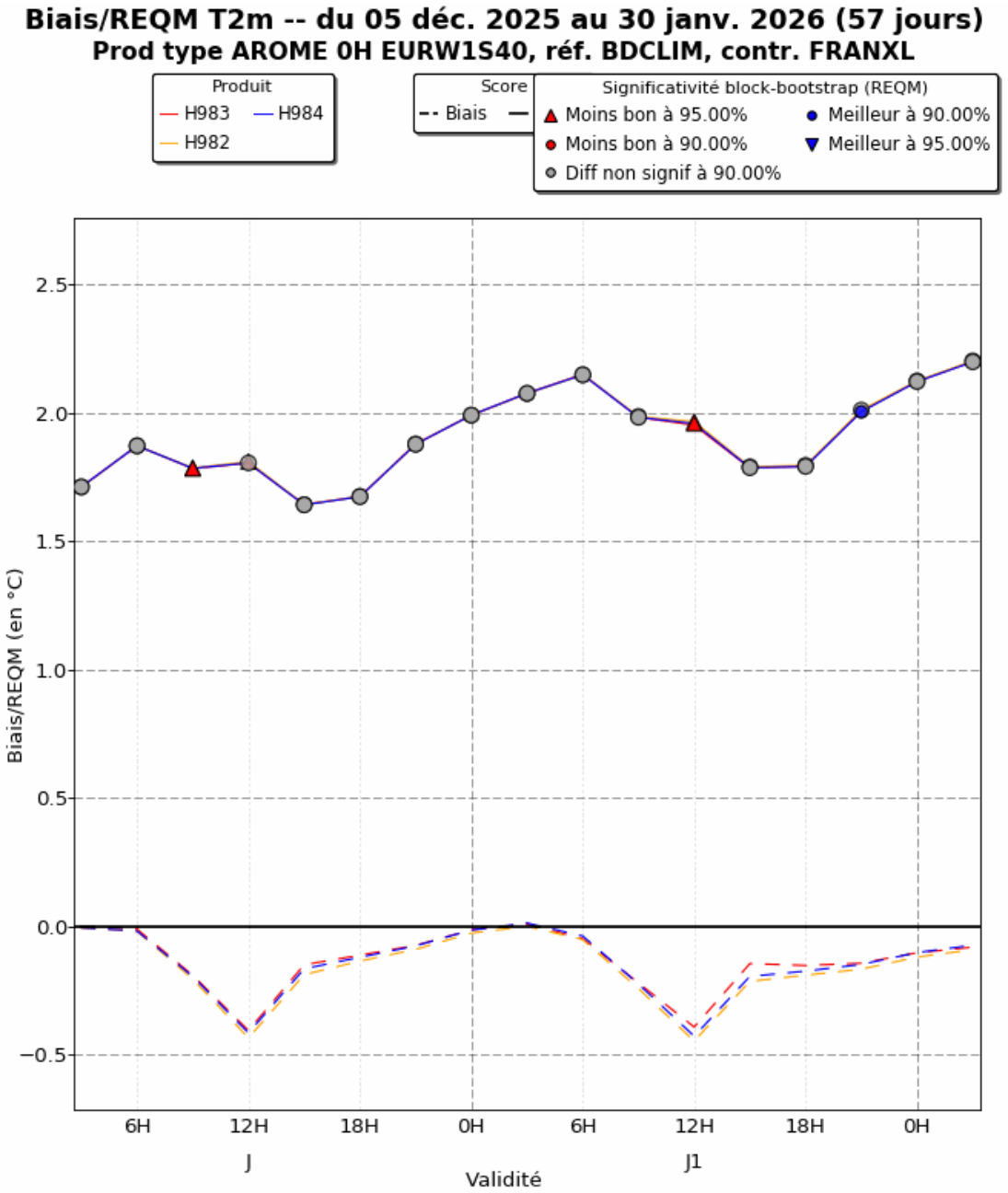


MOCAGE - CLIM



Skills – T2m – winter period

OPER
IFS-COMPO
MOCAGE



Conclusions

→ Possible to represent **spatio-temporal variability of aerosol** using near real time aerosols from chemistry-transport model as **IFS-COMPO** or **MOCAGE** as input for **radiation** in AROME with **6 % higher CPU time** and **66 % more memory** used (+12 GFL)

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Conclusions & *Future work*

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- **Set-up of coupling** with ARPEGE running with MOCAGE aerosol, evaluation of coupling cost
- **More cases study** with evaluation of **model AOD** at different longwave for **different aerosol contribution** : scattering (SW) vs absorbing (LW)
- Consideration of **aerosols indirect effect** on cloud (dust act as very good IFN) on going work with LIMA 2-moment microphysic scheme

Bibliography

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