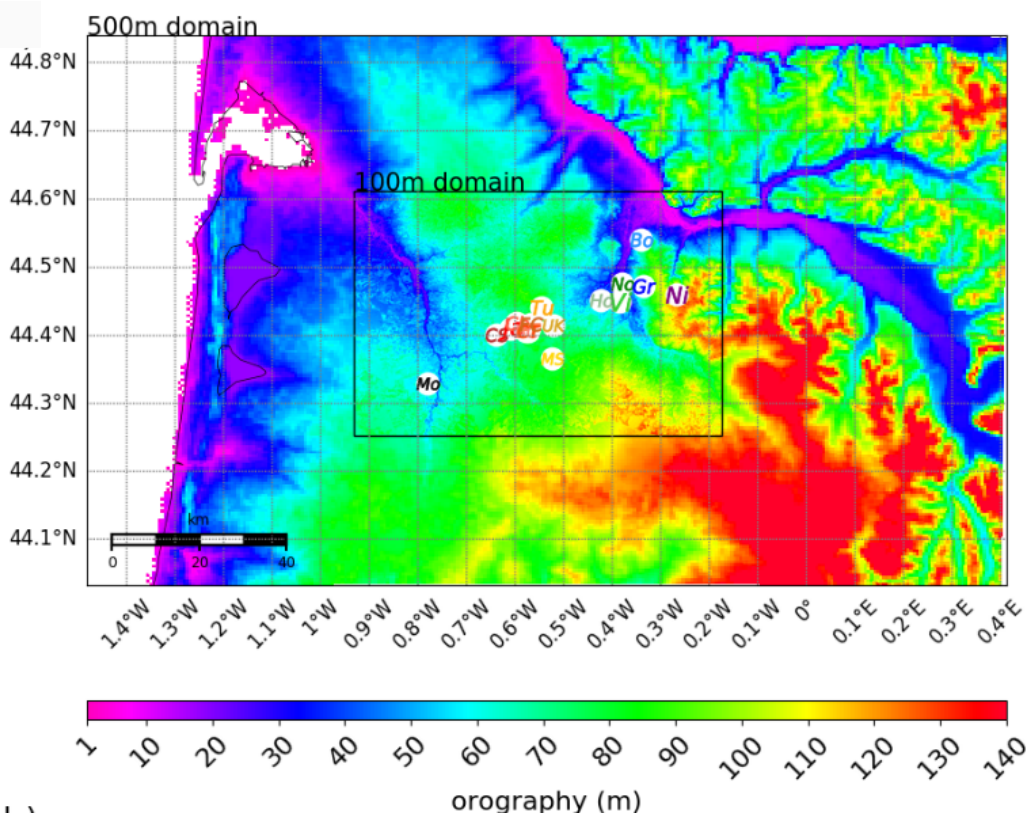
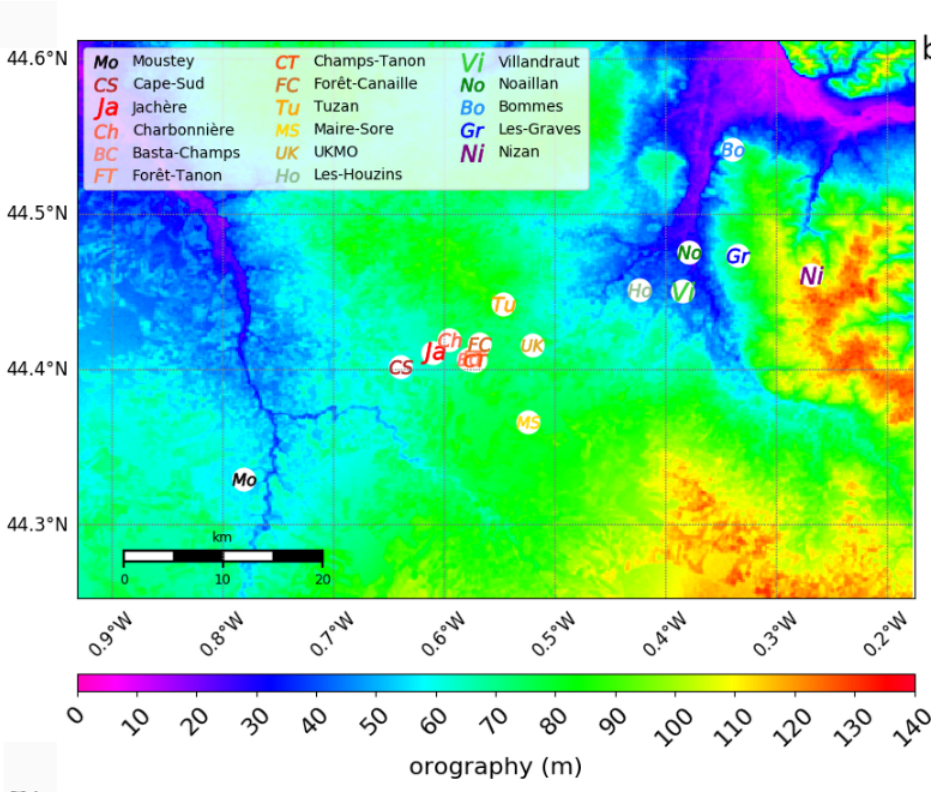
WP3 : 3D Large Eddy Simulations (LES) and impact of heterogeneities

Task 3.1 : LES and validation

- Run of the **most documented IOP (6, 11 and 14)** with Meso-NH at Dx=**100 m** resolution (not LES), first vertical level 1.5 m, with the best configuration (*Marie*) + **IOP 5** (*Maroua*).



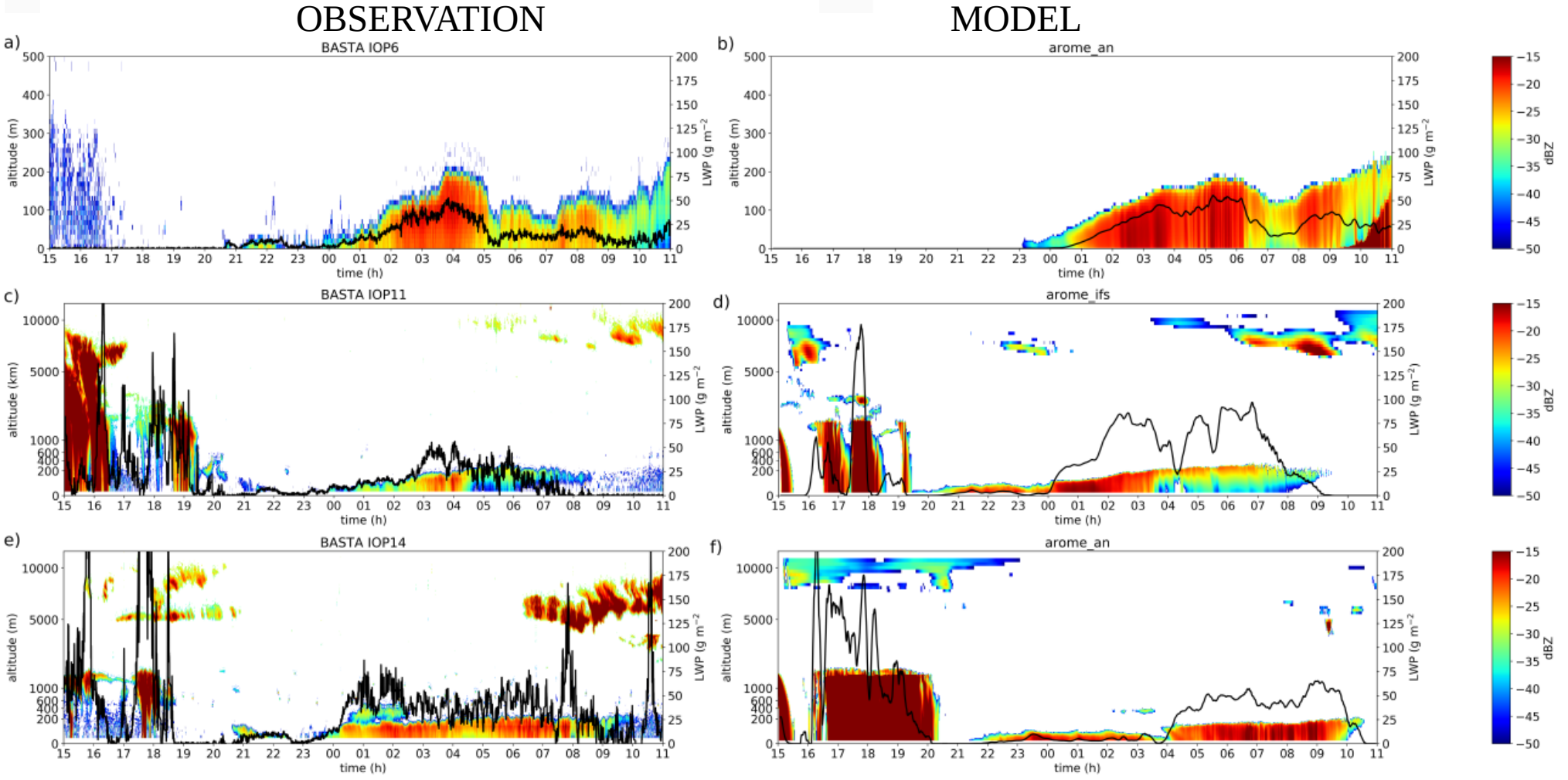


- For LES, a higher vegetation database (<300 m) would be necessary

WP3 : 3D Large Eddy Simulations (LES) and impact of heterogeneities

Task 3.1 : LES and validation

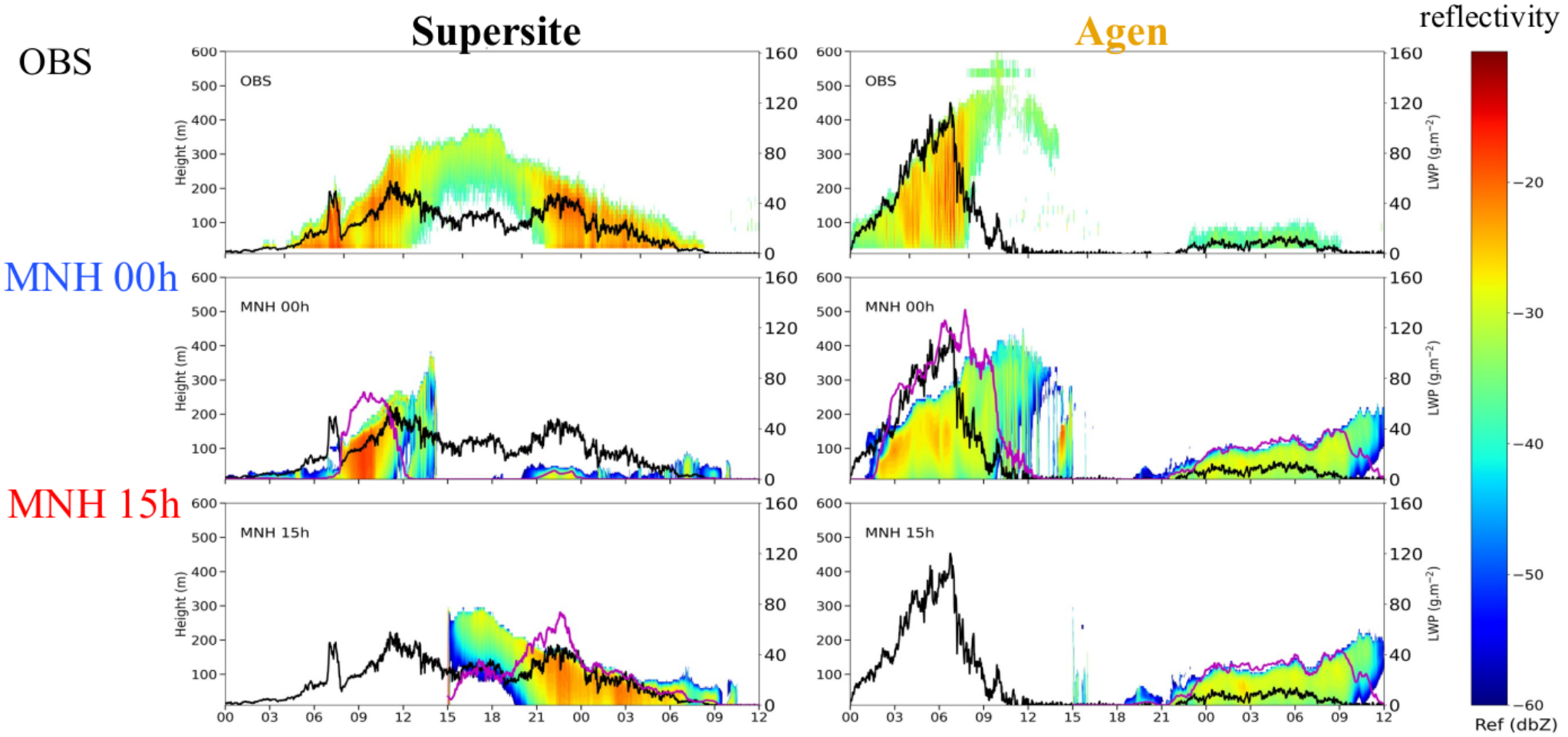
- **IOP 6, 11 and 14** (*Marie*)



WP3 : 3D Large Eddy Simulations (LES) and impact of heterogeneities

Task 3.1 : LES and validation

- **IOP 5** (Radiative +Stratus lowering, Maroua).



WP3 : 3D Large Eddy Simulations (LES) and impact of heterogeneities

Task 3.1 : LES and validation

- Evaluation of **IOP6, 11 and 14** with local surface measurements (17 sites), radar : *Marie*

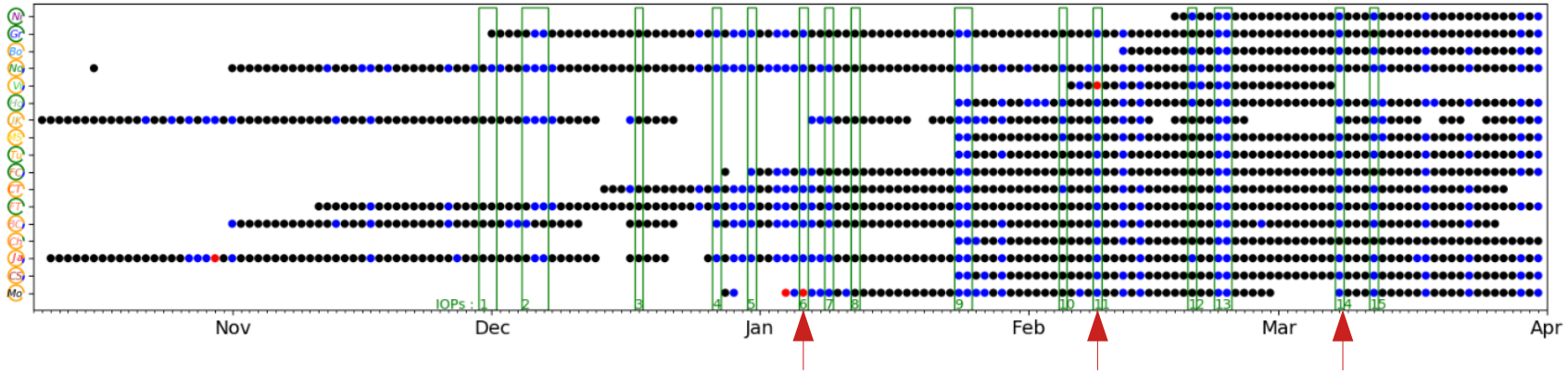


FIGURE 4 Visibility sensor availability (black dots), fog measurements (blue dots) and inoperable measurement

- Evaluation of **IOP6** with wind lidar, MWR : *Cheikh*
- Evaluation of **IOP5** with regional measurements, wind lidar, MWR : *Maroua*
- **To come** : Microphysics (q_c, N_c, DSD) compared to ground and tethered balloon measurements : *Théophane*

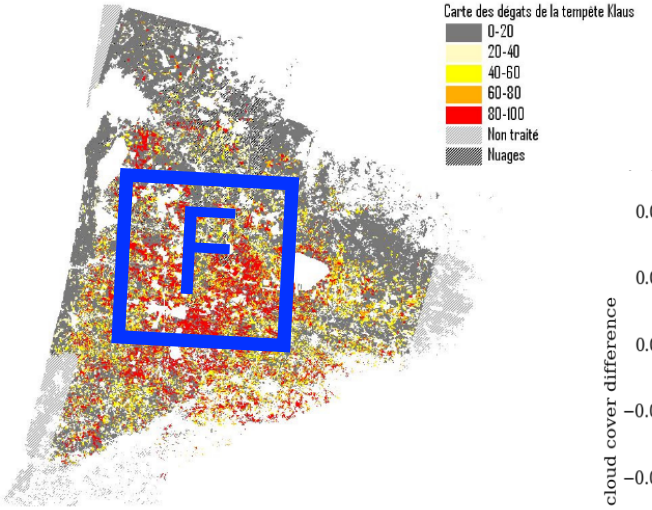
WP3 : 3D Large Eddy Simulations (LES) and impact of heterogeneities

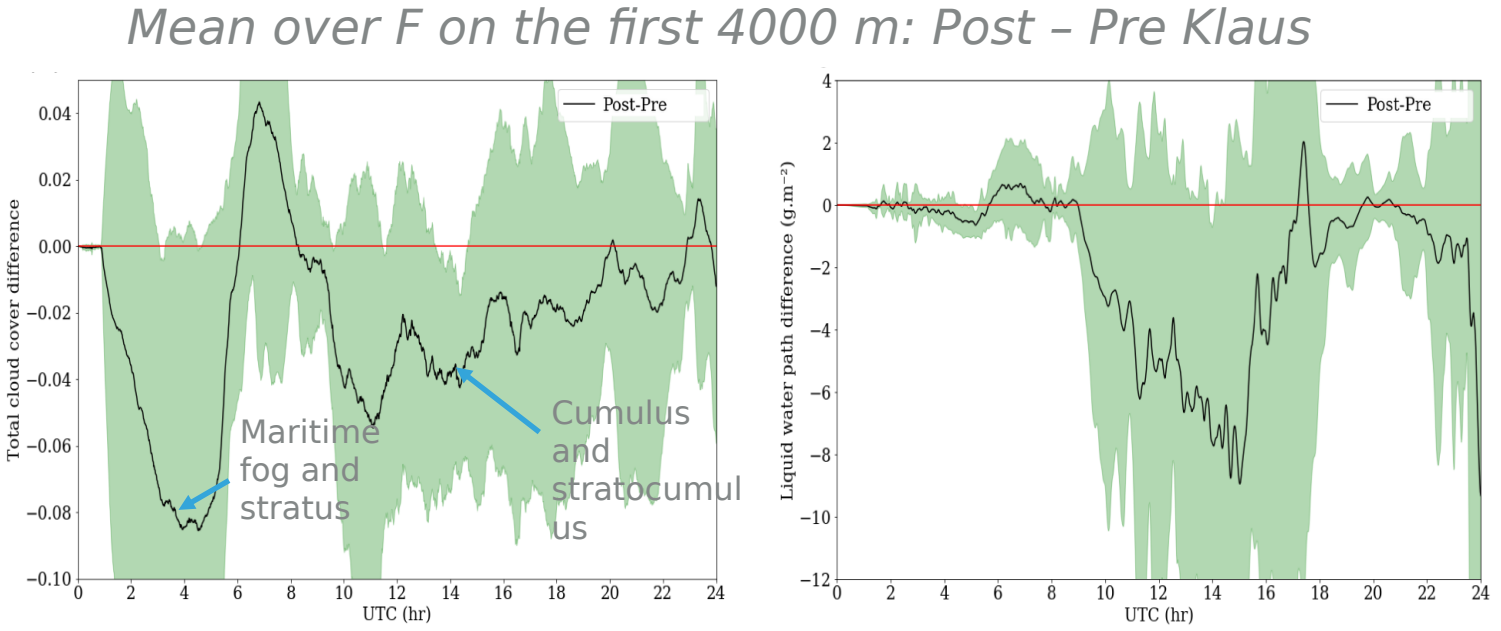
Task 3.2 : Impact of vegetation heterogeneities

- **At regional scale**, we know that the Landes forest tends to favor fog :

  - *Pauli et al. (2022)* : Enhanced Nighttime Fog and Low Stratus Occurrence over the Landes

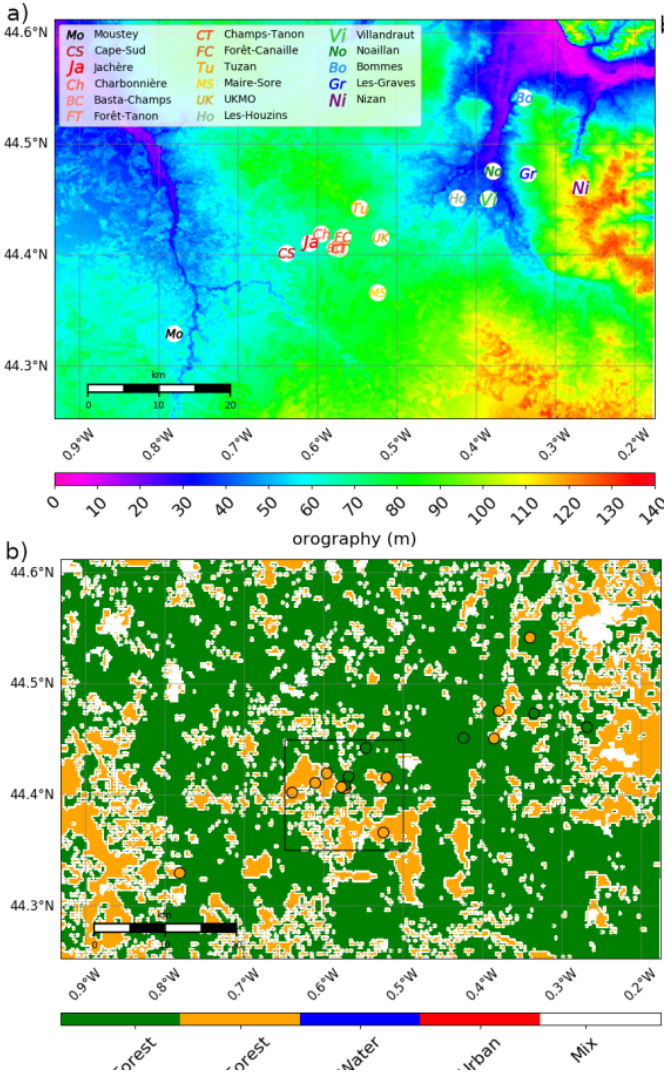
  - *Noual et al. (revision JGR)* : Impact of the Klaus storm (2009) on 15 simulated summer BL cloud cases :

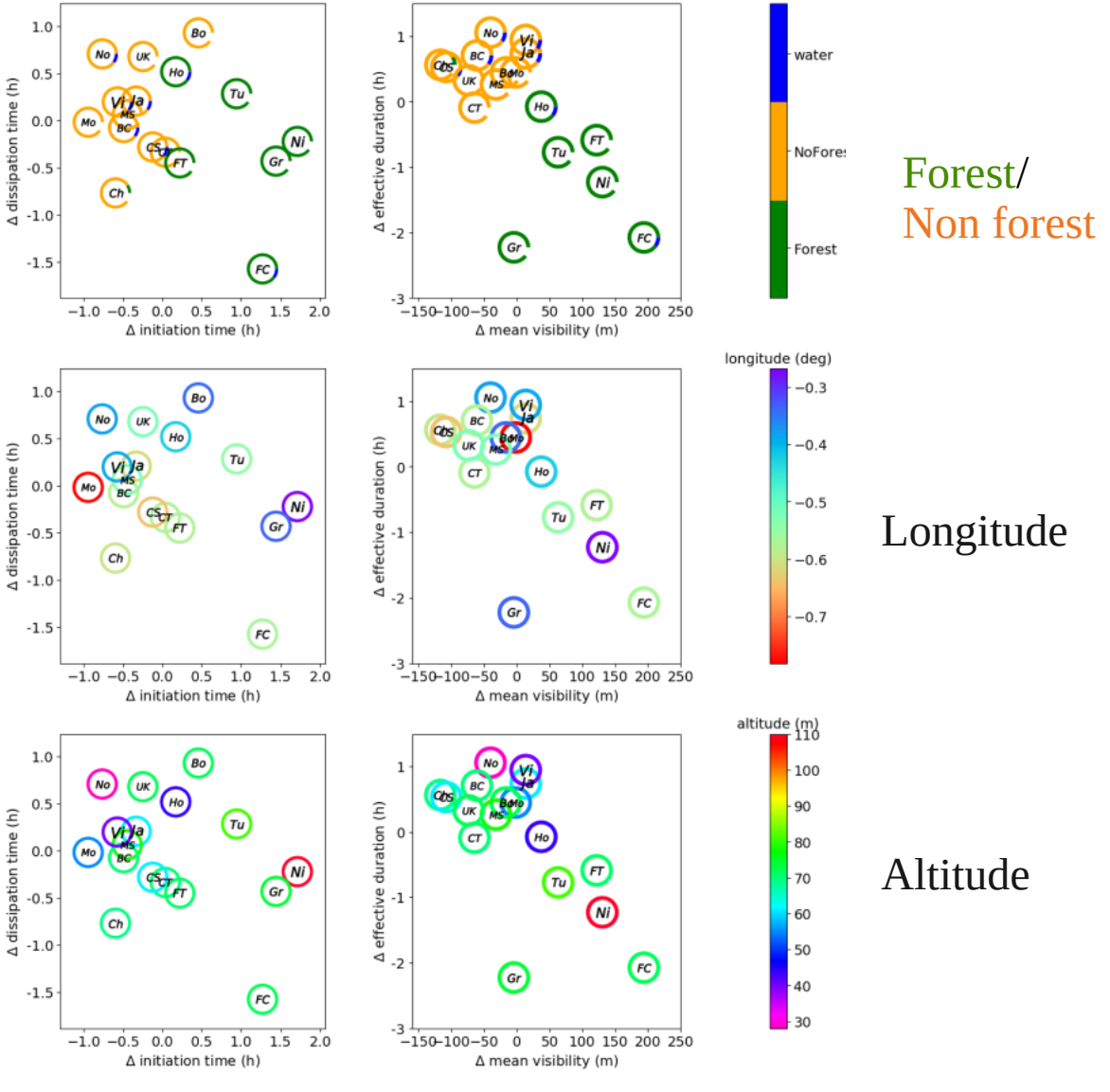




Task 3.2 : Impact of vegetation heterogeneities

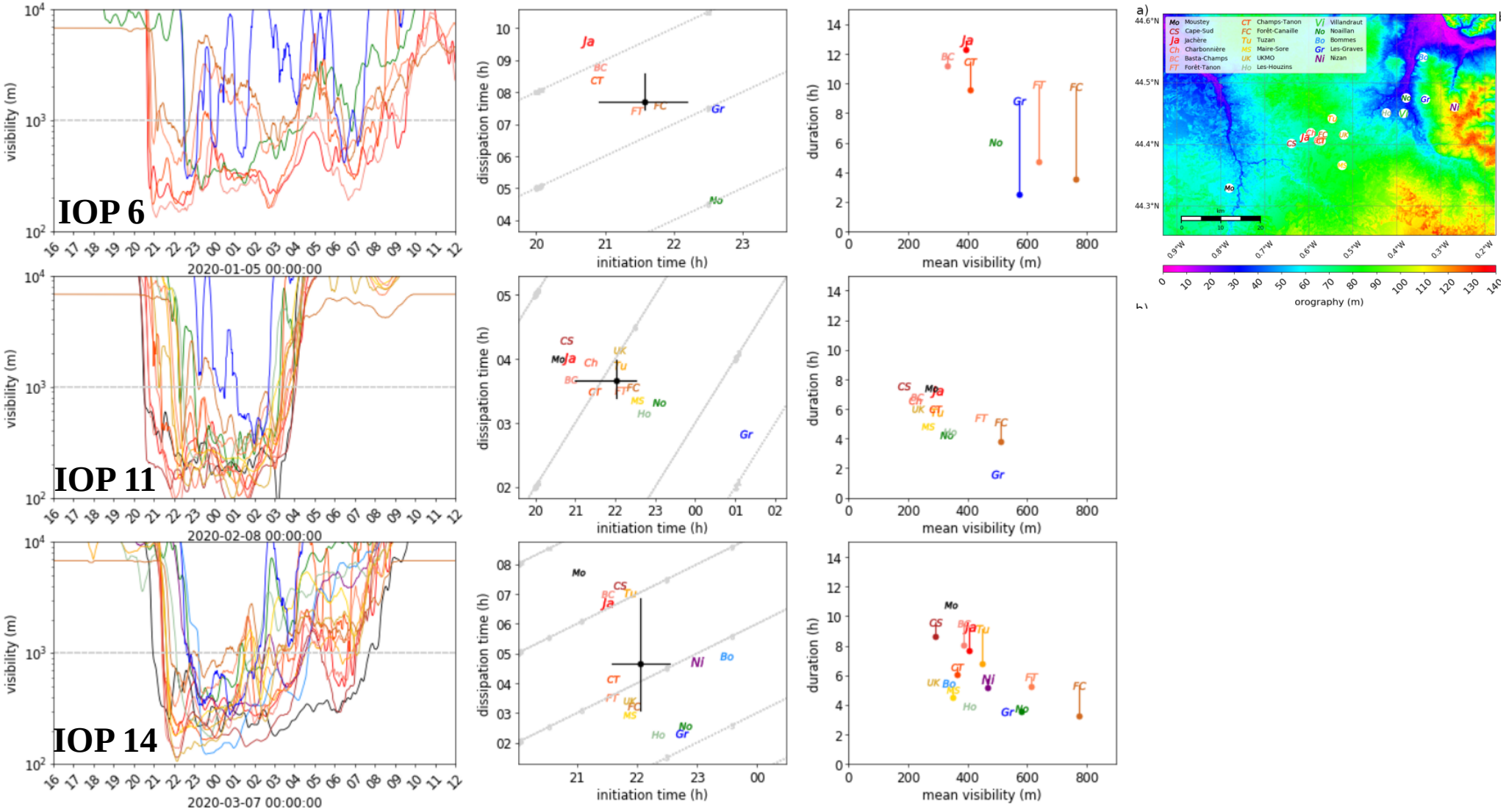
- **At local scale during SOFOG3D**, variability is first due to surface heterogeneities (*Marie):* 34 sampled SOFOG3D cases





Task 3.2 : Impact of vegetation heterogeneities

- IOP6, 11 and 14 are representative of the variability between the sites (*Marie)*



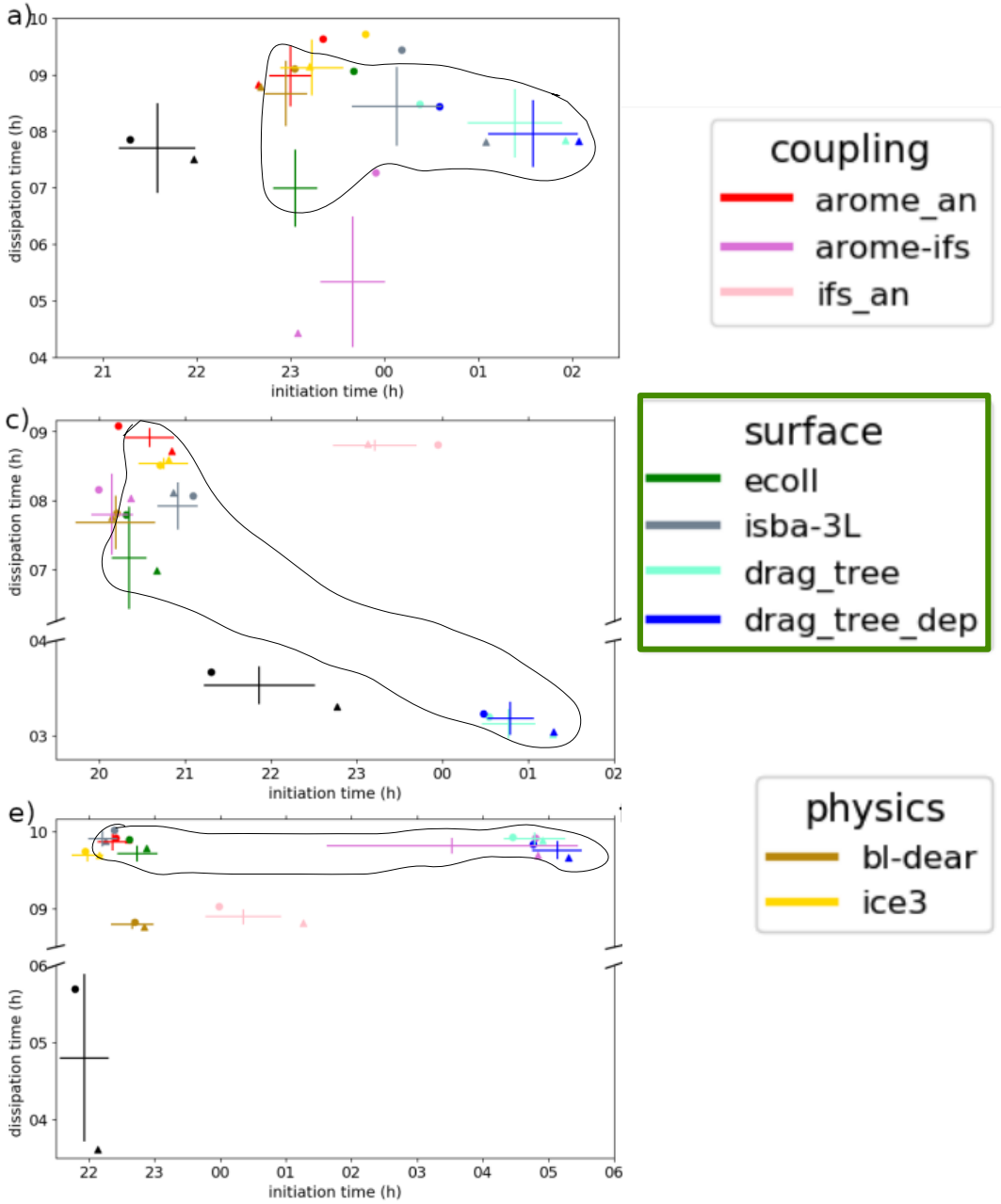
Task 3.2 : Impact of vegetation heterogeneities

- 100 m simulations present a sensitivity to the surface representation (*Marie)*

IOP 6

IOP 11

IOP 14



- Larger impact of the surface than the atmospheric parametrizations

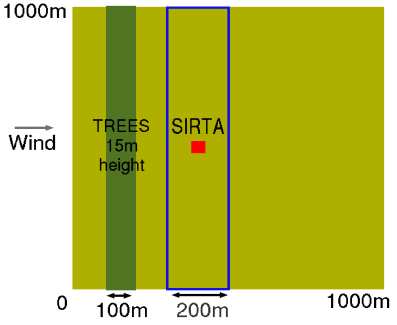
- Generally, surface sensitivity tests mainly impact the initiation

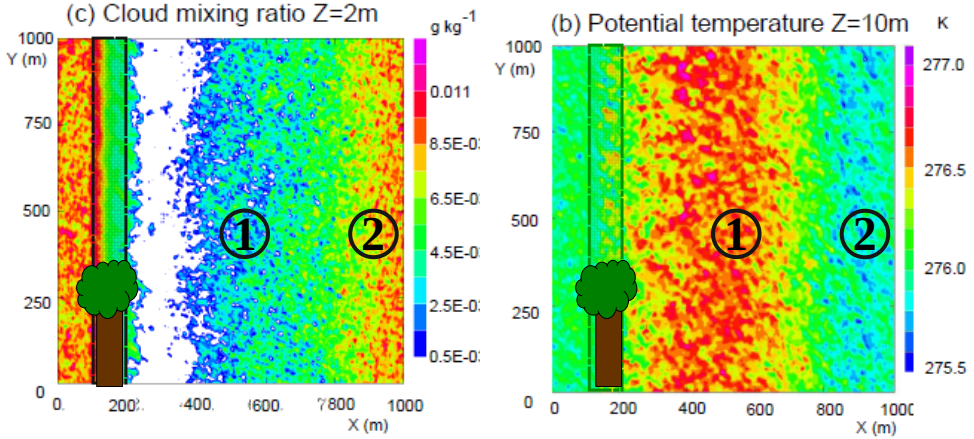
- The surface database (EcoSG – 300m vs EcoII – 1km) also impacts the dissipation

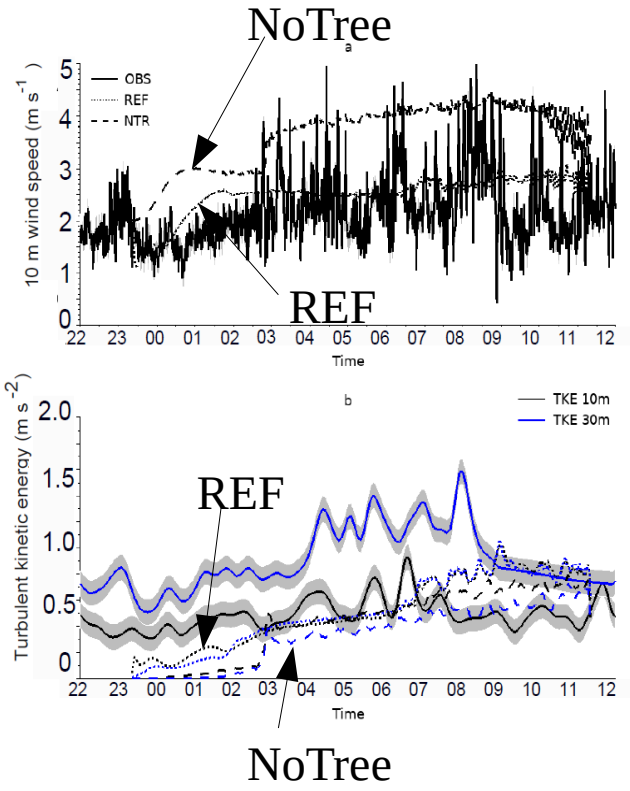
- At 100 m, the tree drag effect delays the initiation too much

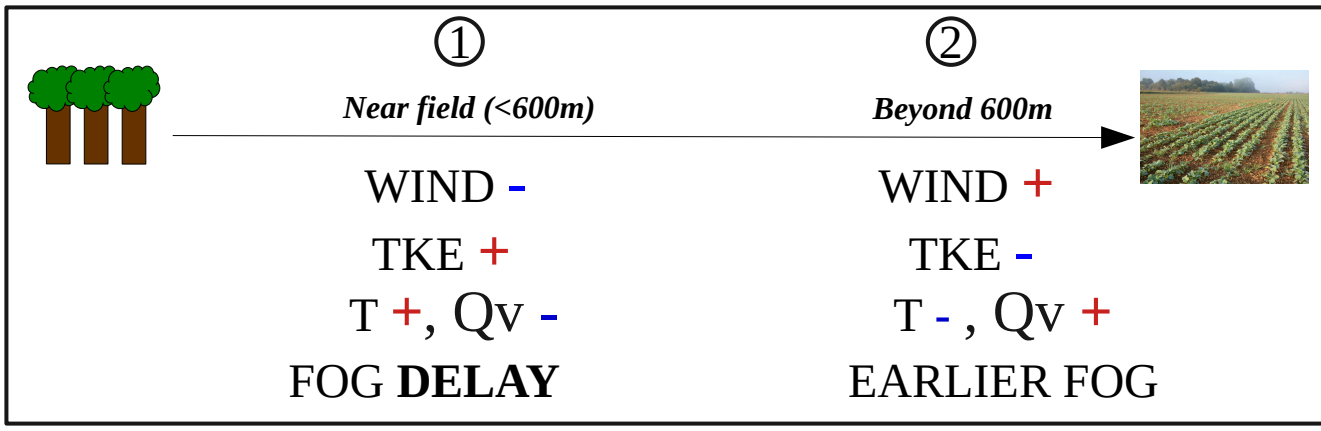
Task 3.2 : Impact of vegetation heterogeneities

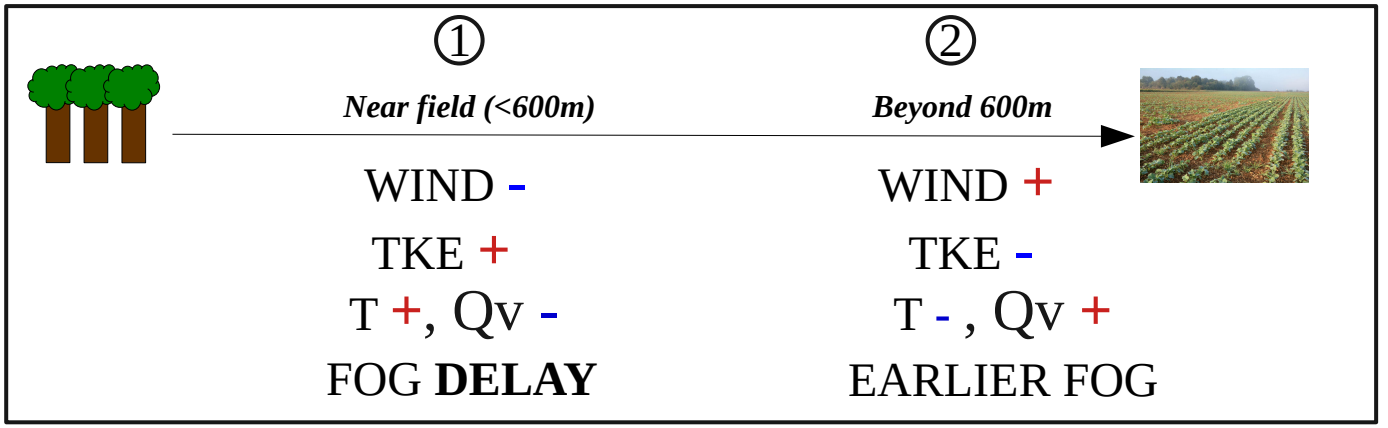
State of knowledge : mainly Mazoyer et al. (2017) : LES (5m) at SIRTA, near a barrier of trees
Impact **only at the fog formation**





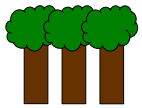






Mazoyer et al. (2017)

2 studies in SOFOG3D : *Taufour et al., Thornton et al.* *(*without consideration of the wind direction)

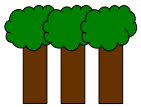


① ***Near field (<600m)*** WIND **-** TKE **+** T **+**, Qv **-** FOG **DELAY**

② ***Beyond 600m*** WIND **+** TKE **-** T **-** , Qv **+** EARLIER FOG

Mazoyer et al. (2017)

2 studies in SOFOG3D : *Taufour et al., Thornton et al.* *(*without consideration of the wind direction)



Forêt-Tanon — *Narrow forest clearing, **3m** wide, **very sheltered***

Les Houzins — *Large forest clearing, **200m** wide*

UKMO ~ — *Open site, **700m** surrounded by trees*

Champs-Tanon — *Maize field, **800m** surrounded by trees*

Jachère — ***Open site***

Taufour et al. (model)

WIND **-** TKE **+** T **–** (as H lower) Qv **-** FOG DELAY

WIND **+** TKE **-** T **+** Qv **+** EARLIER FOG

In agreement with Mazoyer et al. (2017) except for T

Thornton et al.

T **–** 3nd formation

T **+** TKE **-** 1st formation 2nd formation

Task 3.2 : Impact of vegetation heterogeneities

Agreement between *Taufour et al.* and *Thornton et al.* **for T**: lower temperature at the more sheltered sites. Explanations : sensible heat fluxes or LWD ?

More discussion about :

- **vertical mixing** : reduced by the sheltering effect in *Thornton et al.* but the model show the opposite in *Taufour et al.* and *Mazoyer et al. (2017)*

- **shift in the formation** : agreement in the delay at the more sheltered sites, more differences between the more sheltered and the open sites

Is there a scale of openness somewhere between very open sites (Jachere, Charbonniere) and very narrow forest clearings (Foret-Tanon) where fog formation is enhanced by sheltering from the surrounding forested area (Le Couye, Les Houzins) ?

Further studies would be necessary to quantify how « sheltered » a region may be for earlier fog onset:

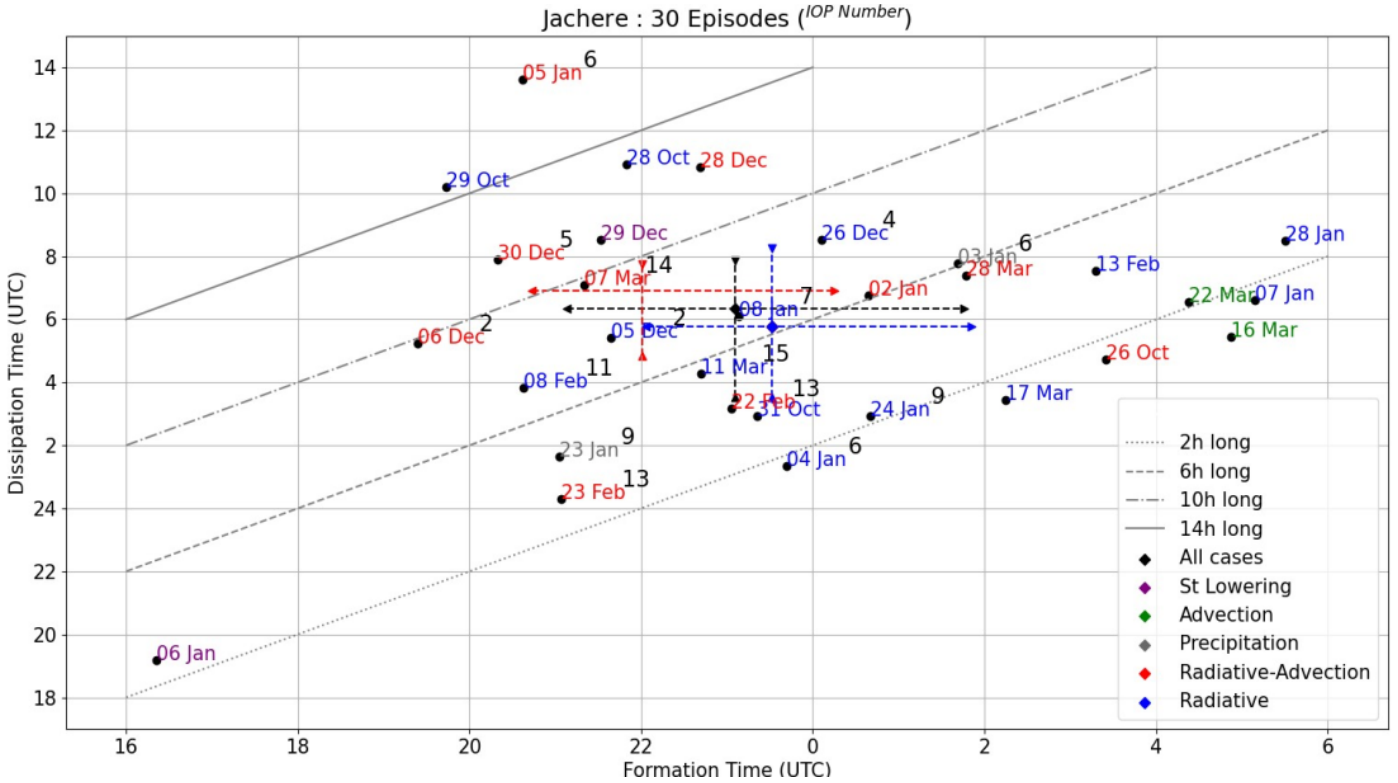
- **LES** applied to an IOP of SOFOG3D

- Requirement for **further measurement campaigns** to explore the fog life cycle on a very fine scale within forests and their surroundings to better describe the transition from forest to clearing

WP3 : 3D Large Eddy Simulations (LES) and impact of heterogeneities

Task 3.3 : Impact of orography and advective processes

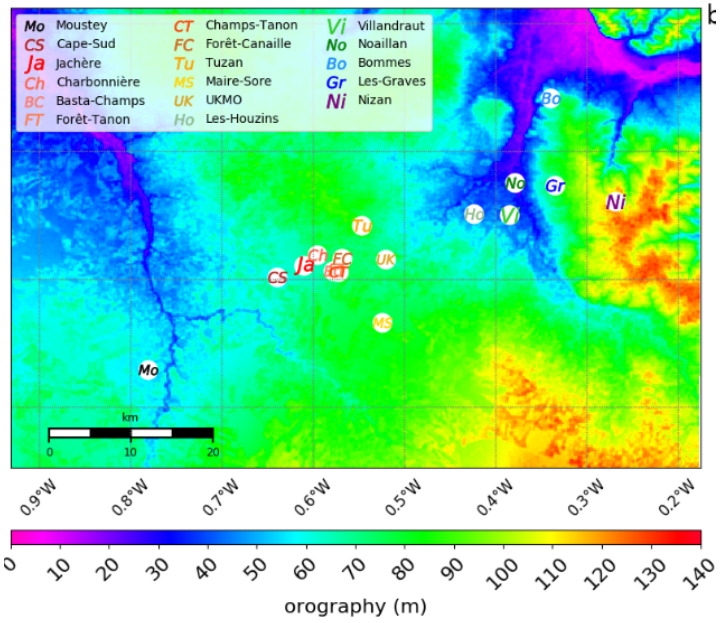
Théophane : Large number of radiative-advective fogs during SOFOG3D linked to the strong maritime influence



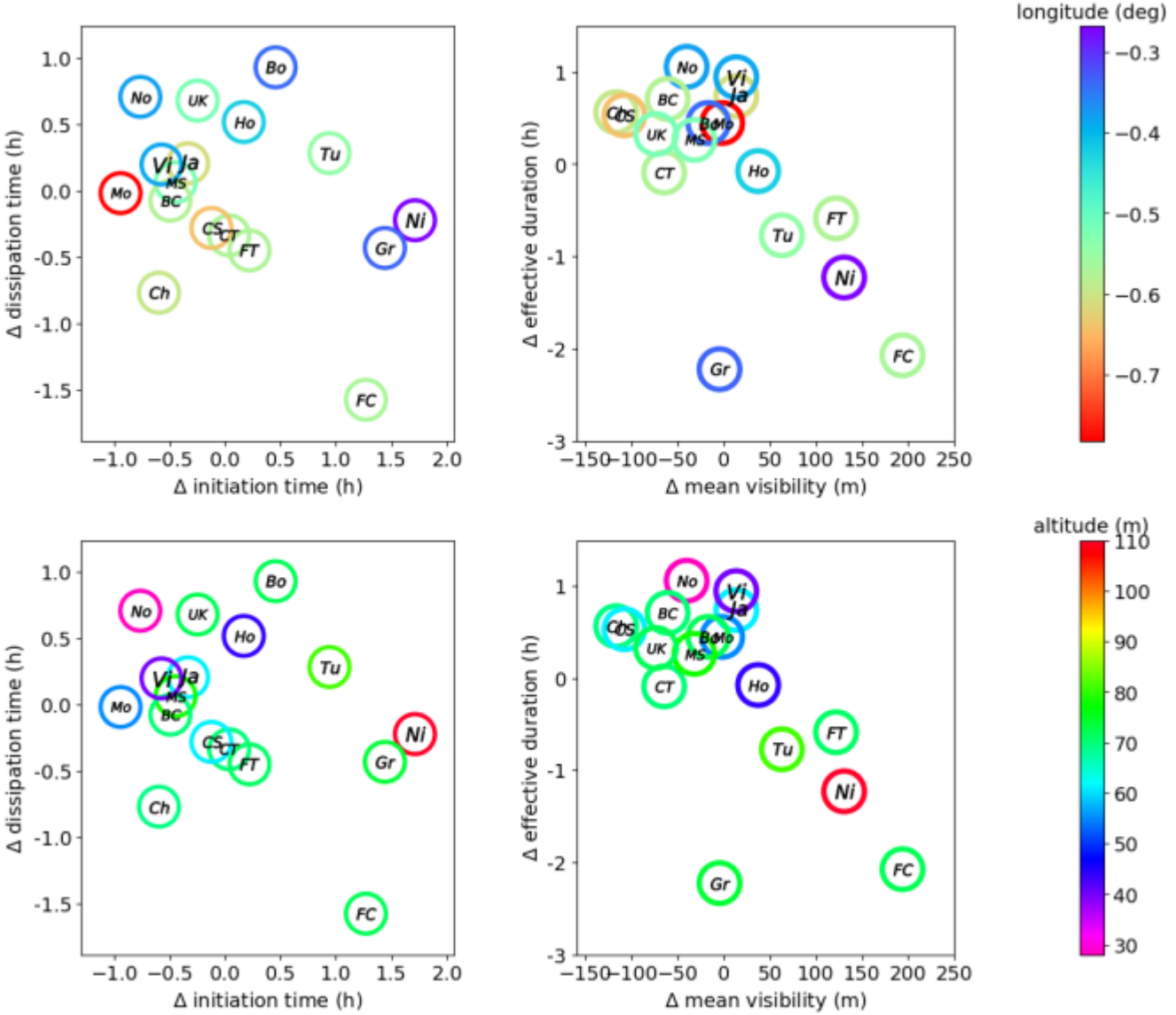
- 14 Radiative fogs
- 10 Radiative-Advective fogs
- 2 Advective fogs
- 2 Stratus Lowering
- 2 Precipitation fogs

A statistic of the regional sites during SOFOG3D would be useful

Task 3.3 : Impact of orography and advective processes (local scale)



Marie : 34 sampled SOFOG3D cases



- Some influence of longitude and altitude at the initiation :
  - On average, **Moustey** (most westerly) initiates first, and **Nizan** (most easterly) 1h30 later
  - **Noaillan** (lowest site) initiates 30 min earlier than **Nizan** (highest site)

- Most likely combined effects of longitude, altitude and vegetation