Assimilation of airborne water vapor lidar observations during COPS
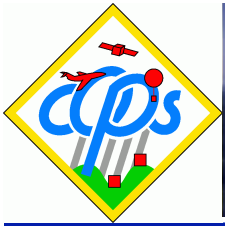
Evelyne Richard [1], Matthias Grzeschik [1], Soline Bielli [1], Cyrille Flamant [2] and Christoph Kiemle [3]

[1] CNRS / UPS Toulouse, France
[2] CNRS /IPSL Paris, France
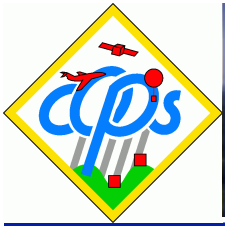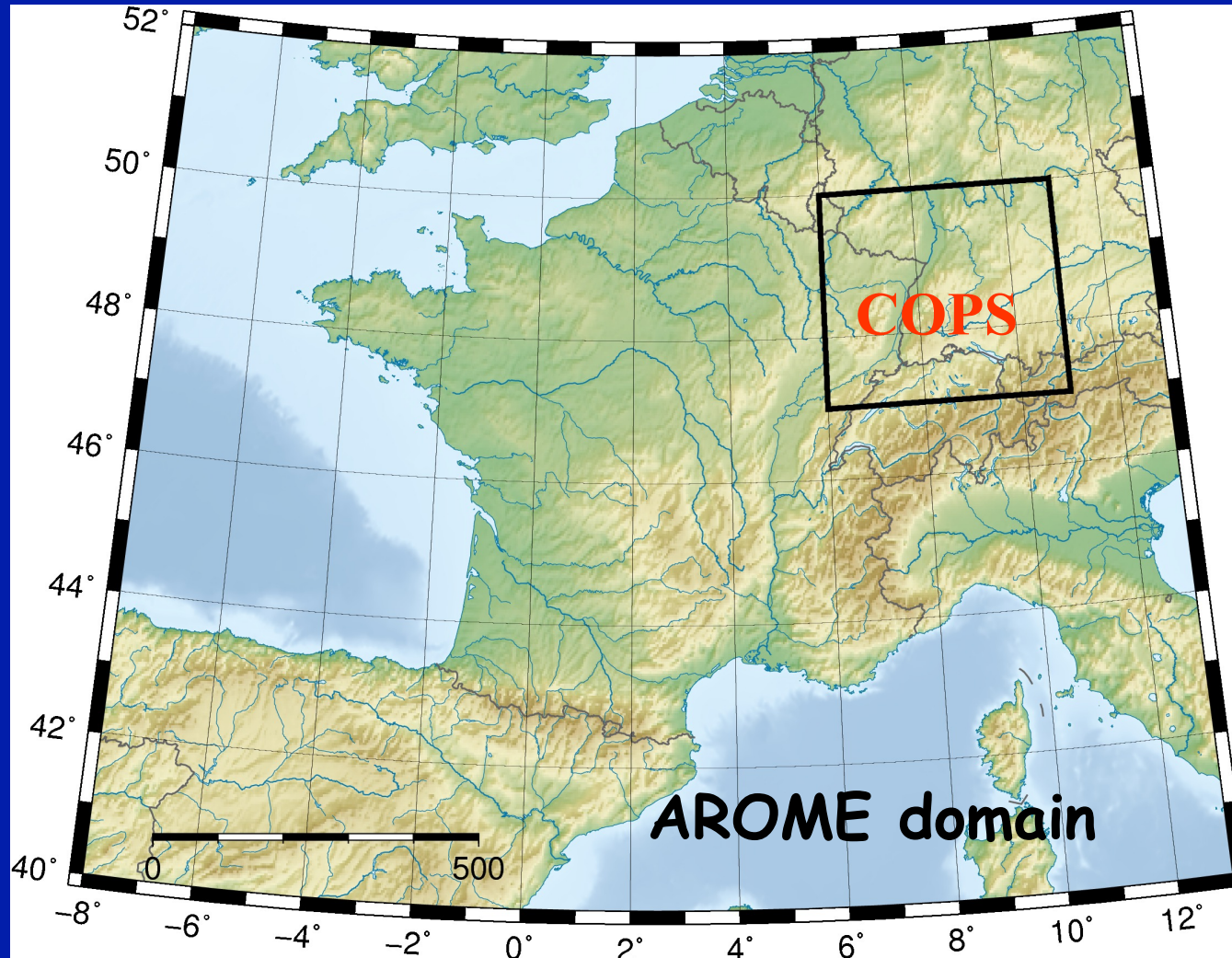[3] DLR / IPA Oberpfaffenhofen, Germany

Motivation

- Investigate the impact of water vapor lidar data assimilation on mesoscale weather forecast

- Using
  - the WV observations collected by the two airborne lidar systems Léandre & Wales
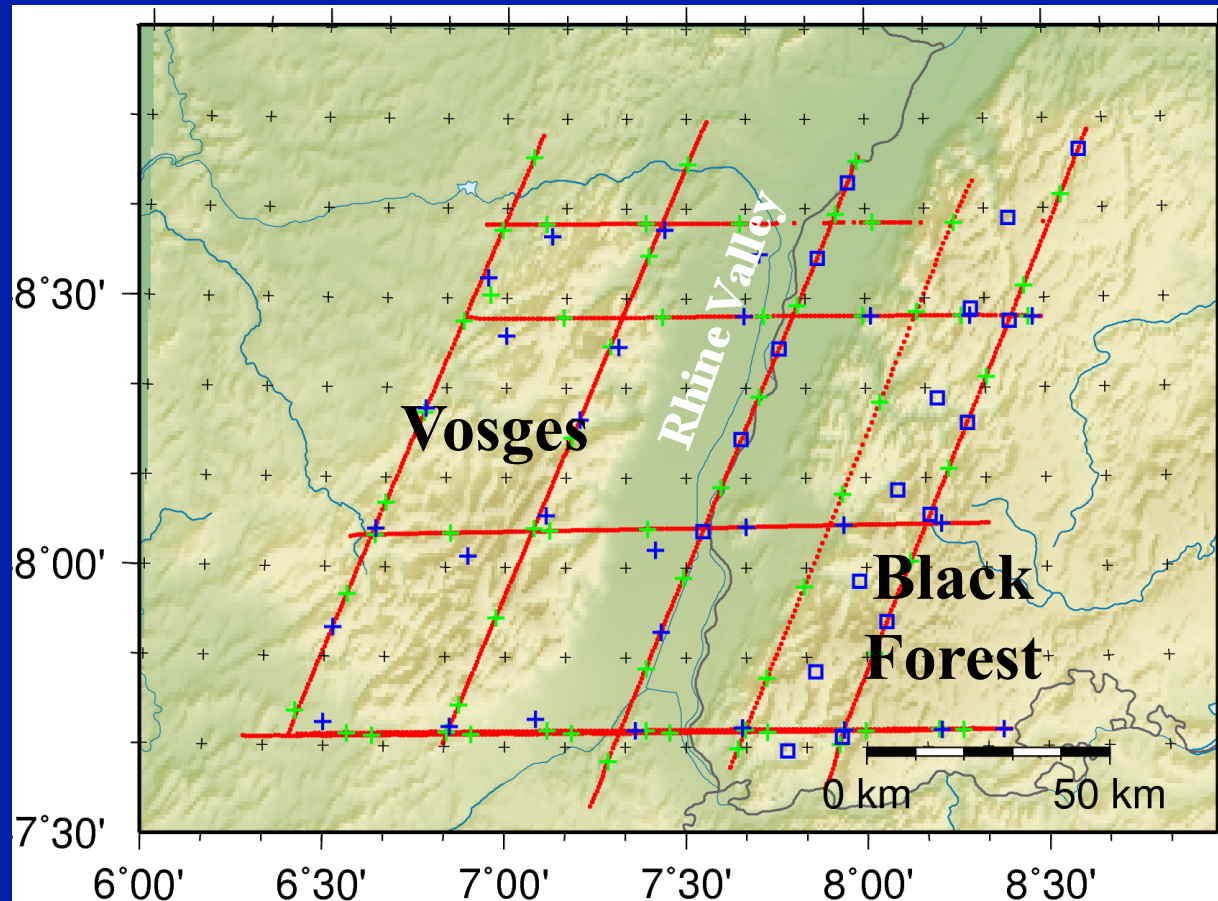 - the AROME numerical weather prediction system (3D Var, DX=2.5km)

COPS: Convective Orographically-driven Preciptation Study
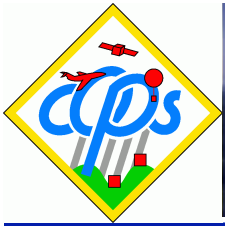
Available observations

Léandre & Wales:

July 2007

11 days

22 hours

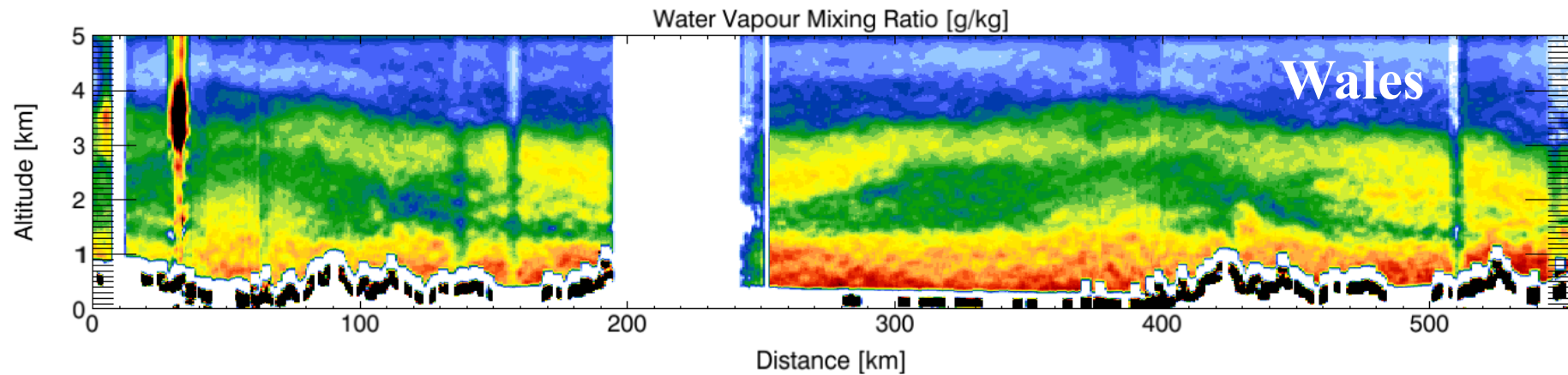mostly over the COPS area

Generic flight pattern

Water Vapour Mixing Ratio [g/kg]

Wales
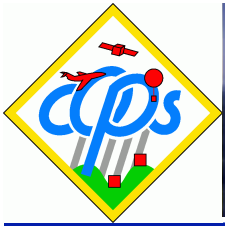
- Blacklist the wrong/suspicious values
- Thin the data
- Remove the bias
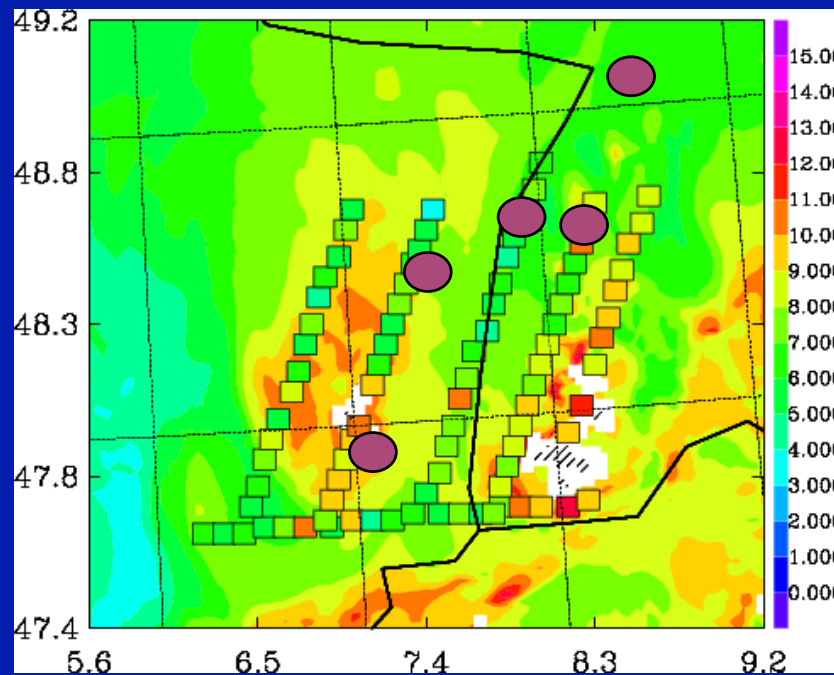- Specify the observation errors

→ Assimilated as dropsondes

- Assimilation
    - 30 day-period : 4 July / 3 August
    - Rapid Update Cycle (3h)
    - COPS additional RS black listed ($\rightarrow$ verification)
    - 3 assimilation cycles : Control, Léandre, Léandre + Wales

- Forecast
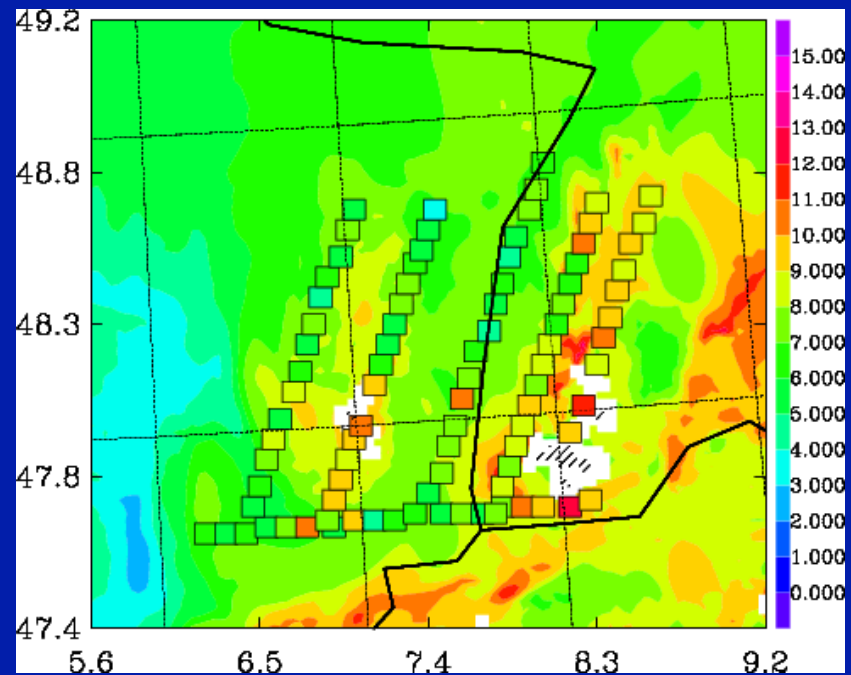   - 3 sets of daily forecasts
    - 30 h forecasts starting at 00 UTC

Analysis vs lidar observations
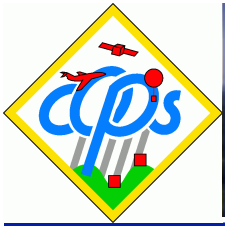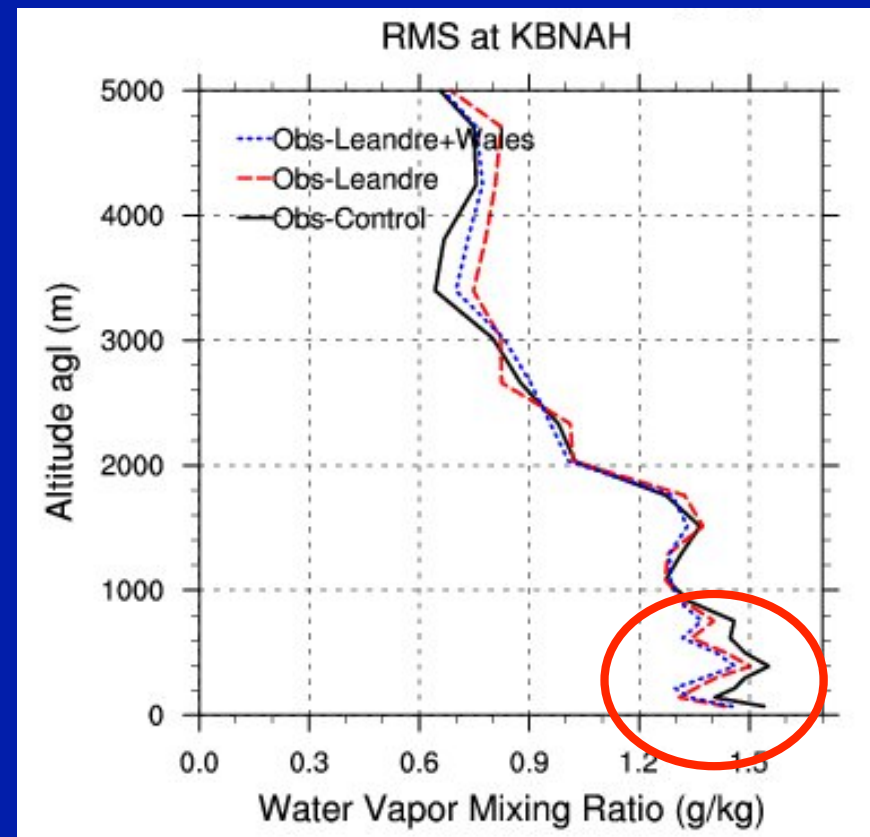## 15 July 09 UTC - rv @ 1000 m

Control

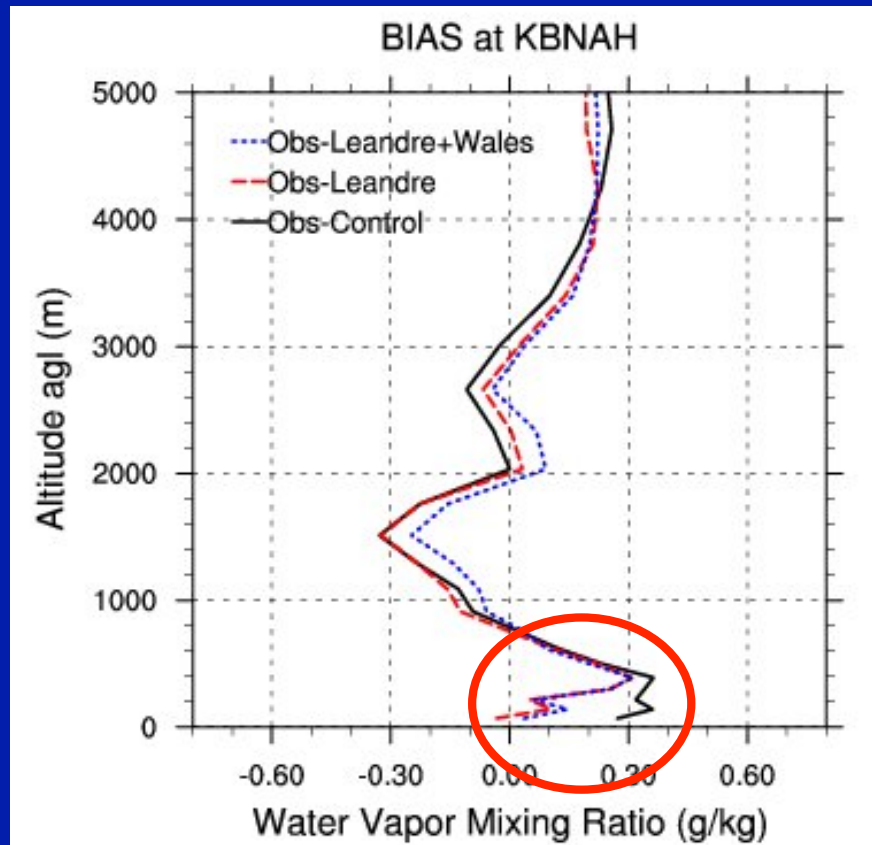**Léandre & Wales**

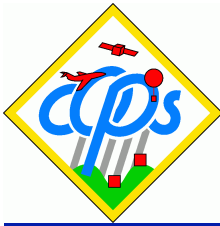# Significant reduction of the analysis to lidar observation departure

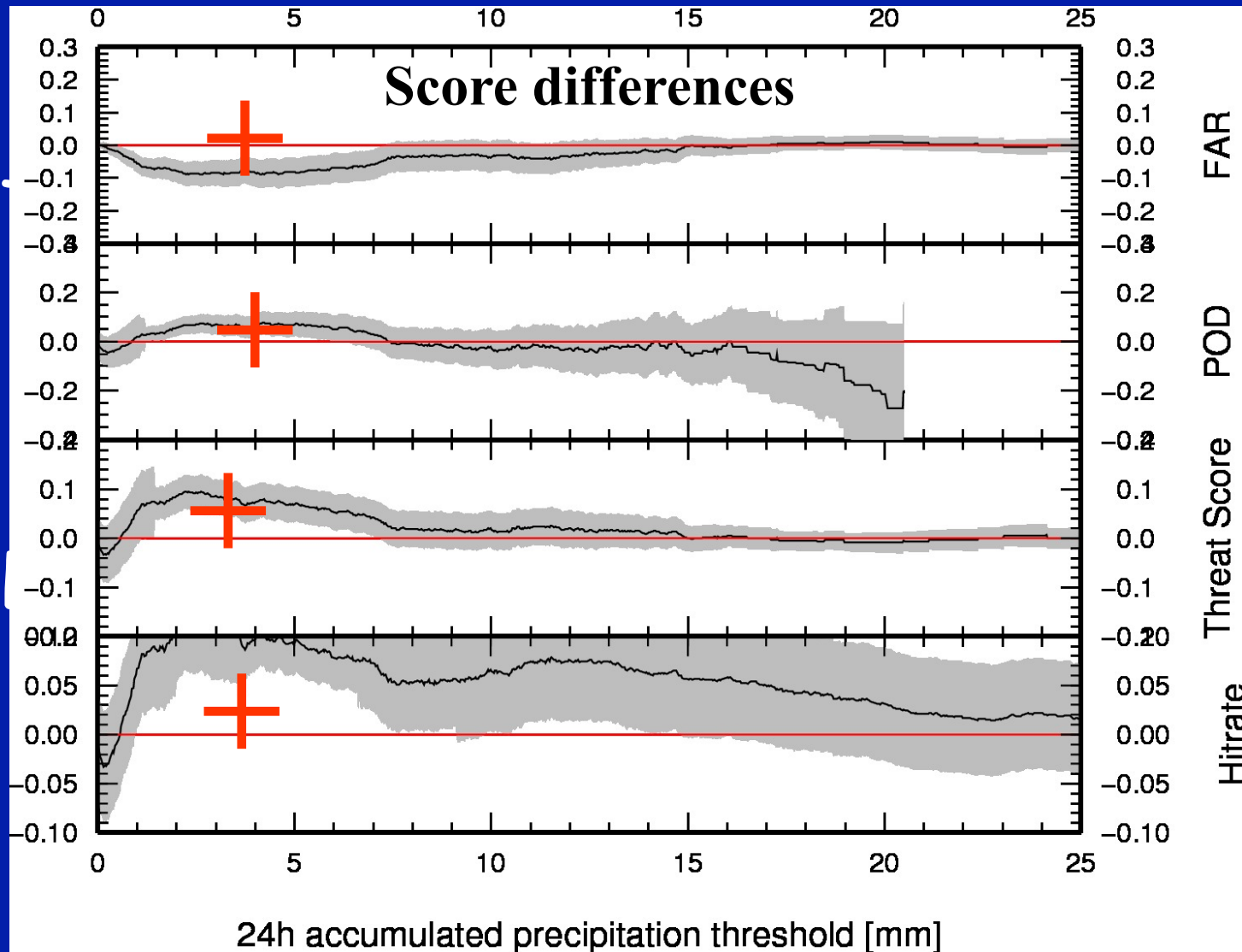**Analysis vs COPS soundings (~300 RS over the period))**

BIAS at KBNAH / RMS at KBNAH
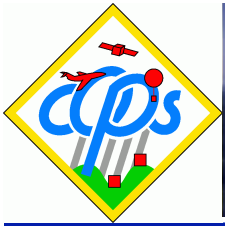
Significant reduction of bias (0-500 m) and RMS (0-1000 m)

Score differences
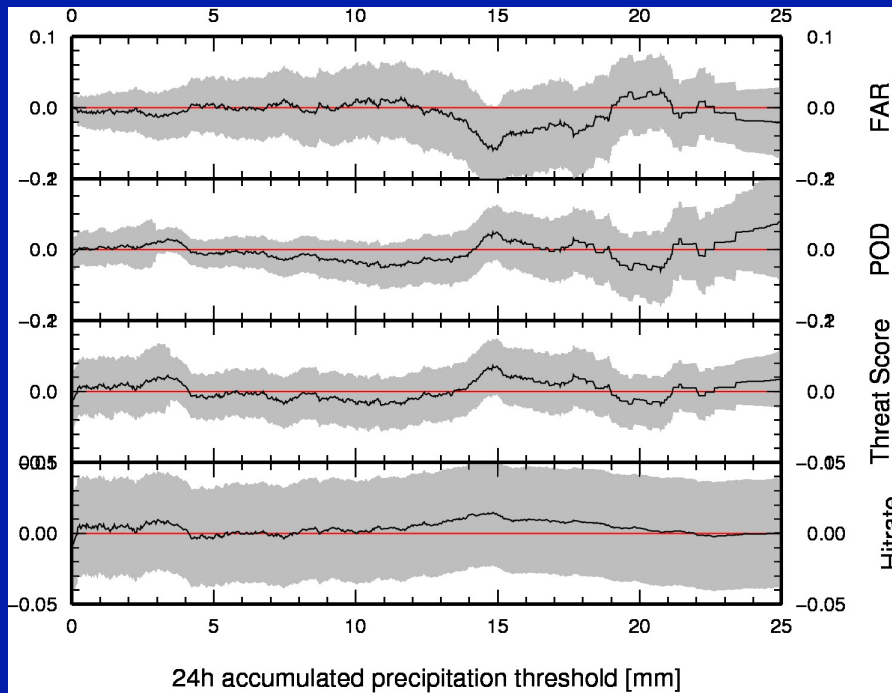
24h accumulated precipitation threshold [mm]
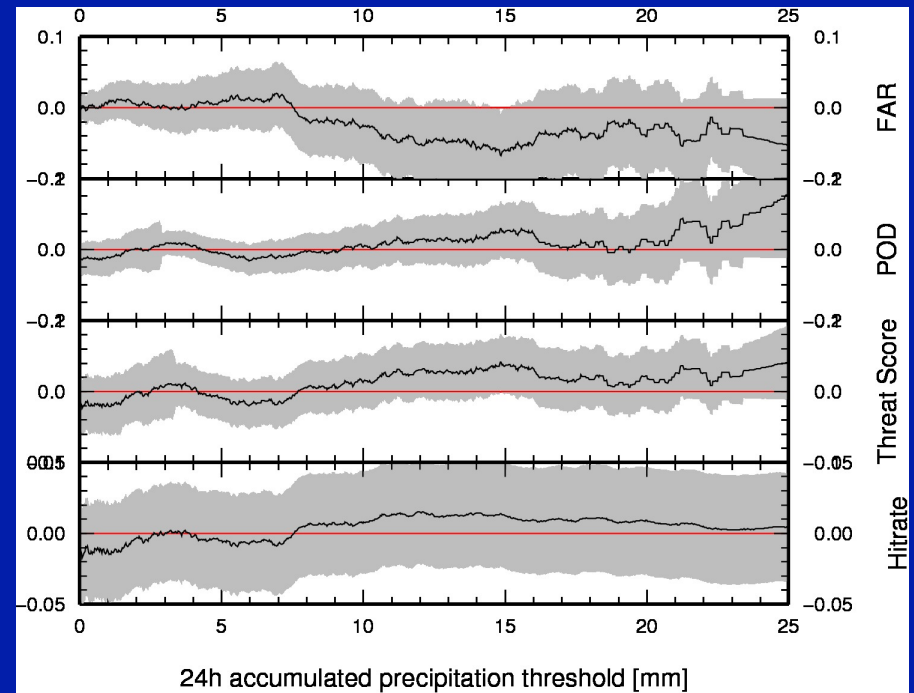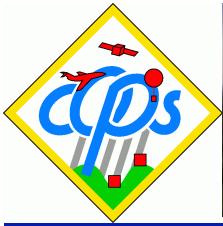
a)

Impact on the 24h precipitation forecast

Léandre

Léandre & Wales

Over the whole period : No significant impact on the 24h precipitation (+06h/+30h) whatever dataset, whatever analysis …
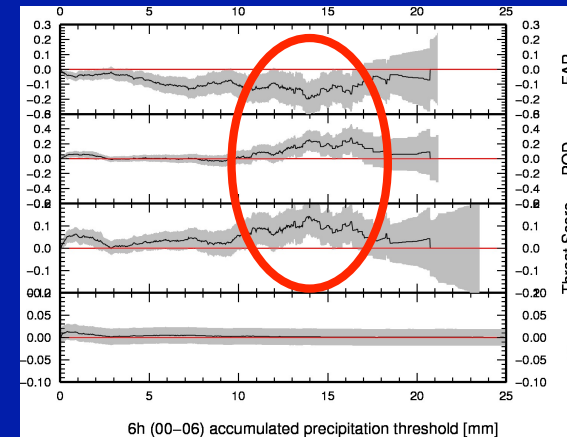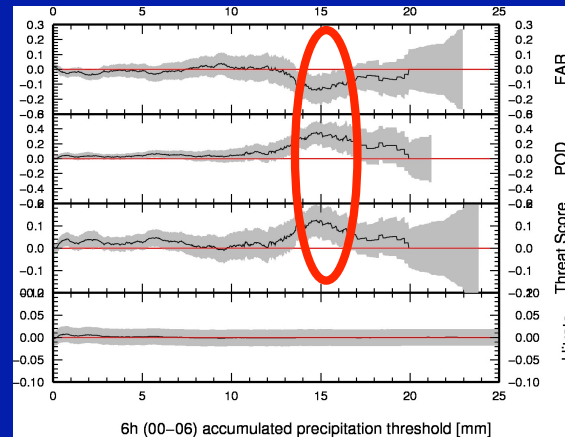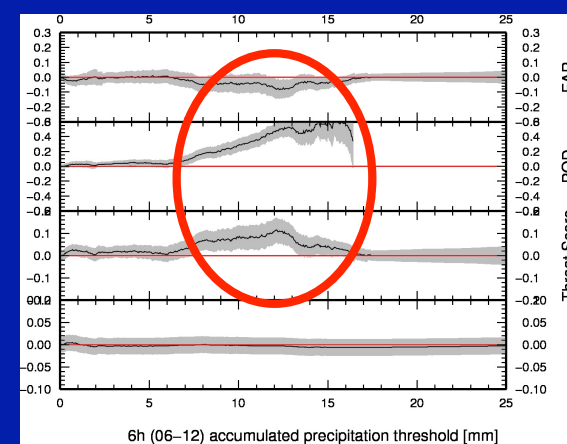
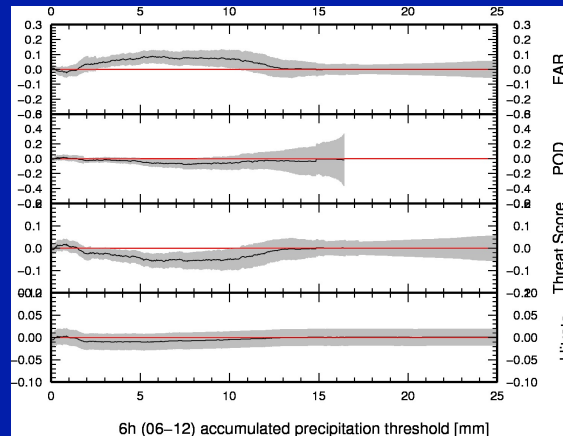# Impact on the 6h precipitation forecast

Léandre
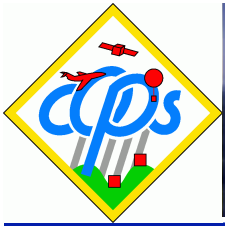
Léandre & Wales

00-06 UTC

06-12 UTC

Over the whole period: Improvement of the precipitation forecast lasting up to 6h with Léandre and 12h with Léandre & Wales
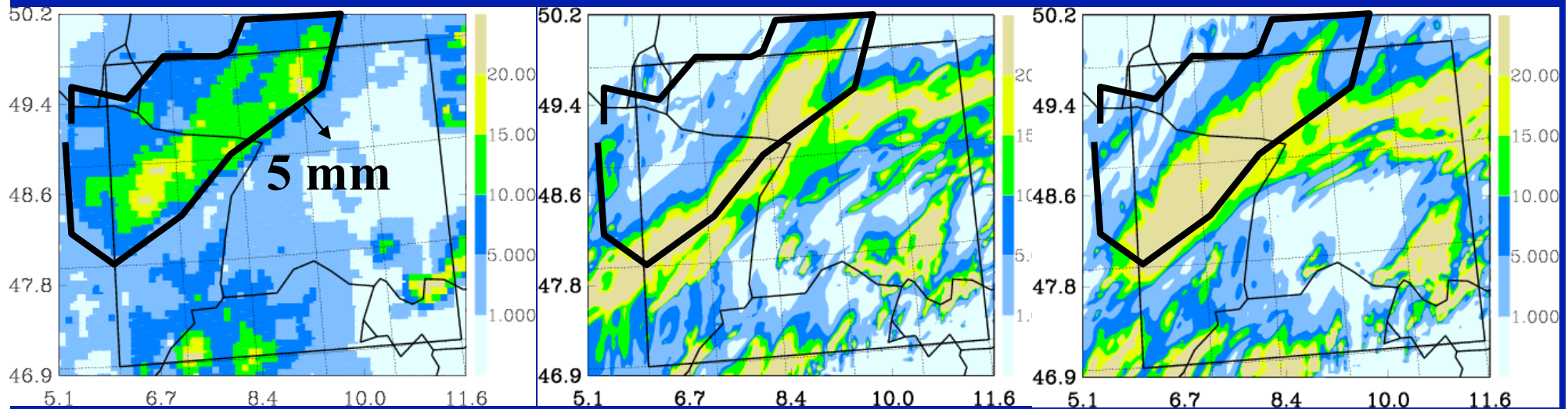
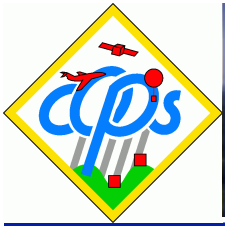# 19 July : MCS over Burgundy in France moving towards Germany

Vera Analysis

Control

Léeandre & Wales

5 mm

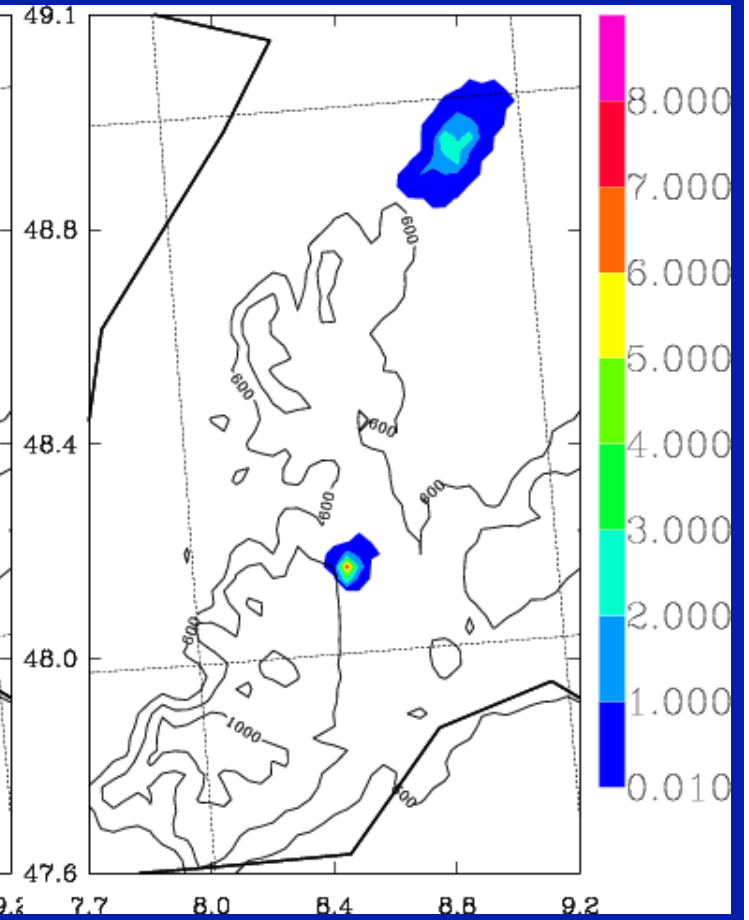For organized systems : Better location of the precipitation band with Léandre & Wales
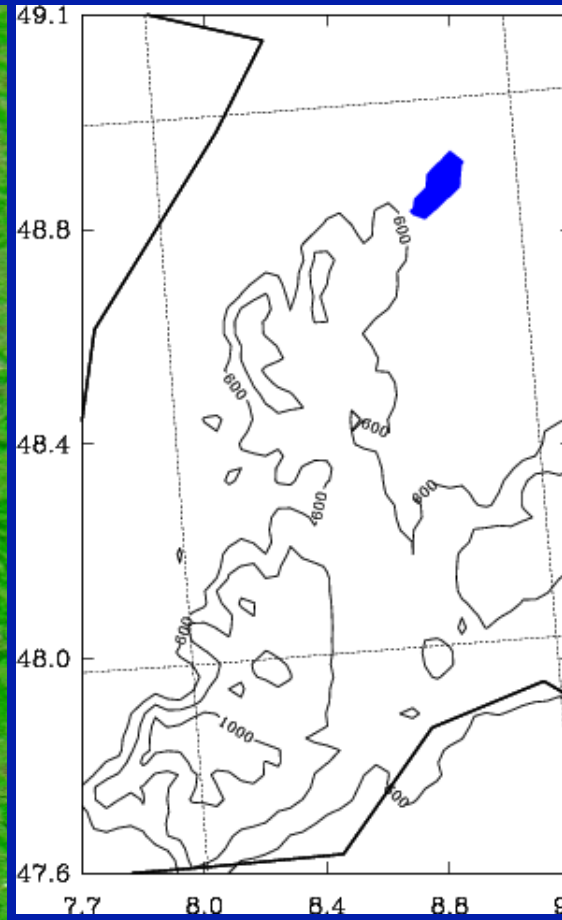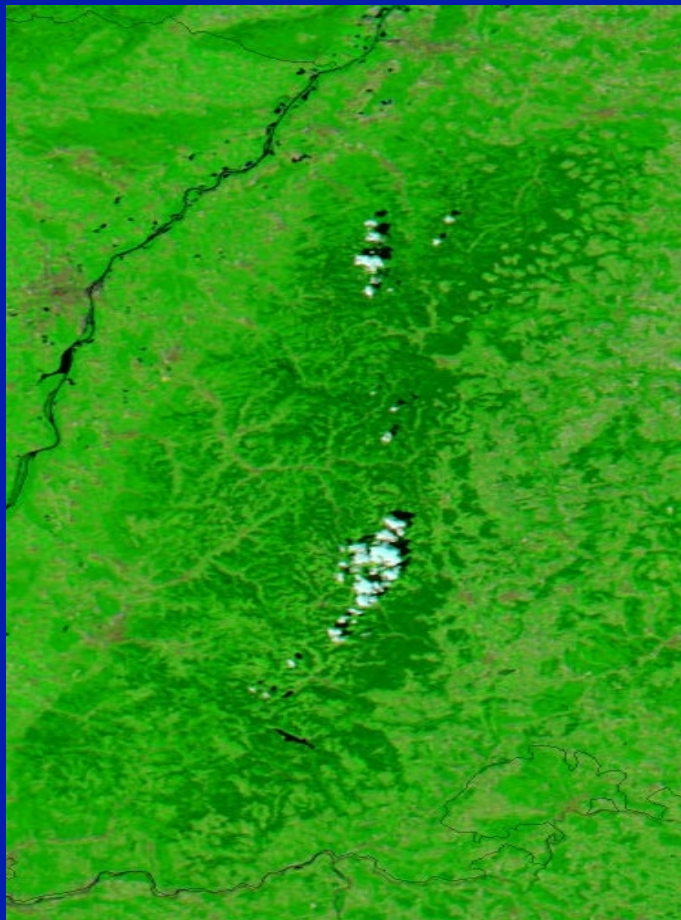
15 July : Isolated storm over the Black Forest

**MODIS** **Control** **Léandre & Wales**

**15 July : Convecton initiation better captured**

Summary

- The WV airborne lidar observations collected during COPS were assimilated with the AROME NWP system.

- Positive impact on the moisture analysis: significant reduction of low-level bias (0-500m) and RMS error (0-1000m)

- Over the whole period, positive impact on the precipitation forecast in the first 6h (Léandre) and in the first 12h (Léandre & Wales)

- Case study analysis :
  - Better location of the precipitation pattern (eg 19 July)
  - More accurate triggering of the convection (eg 15 July)
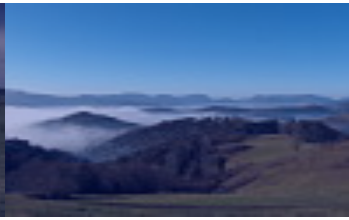
More about COPS

- COPS Special issue QJRMS 2011
- Review paper: Wulfmeyer et al.
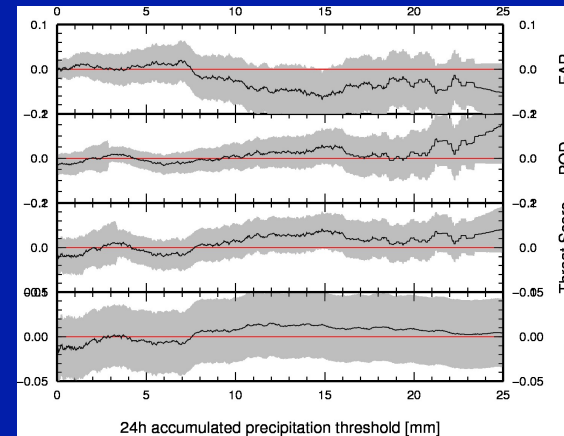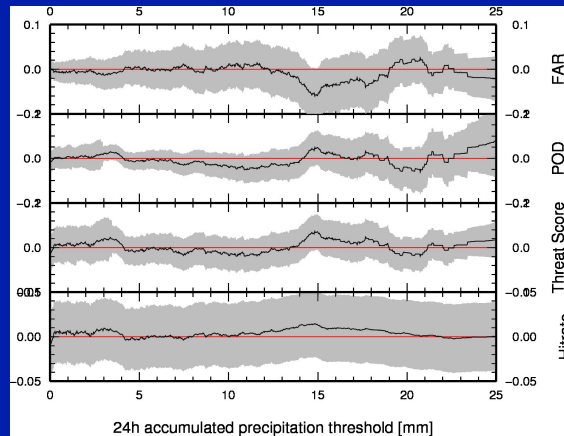- Lidar observations : Bhawar et al.

Questions ?
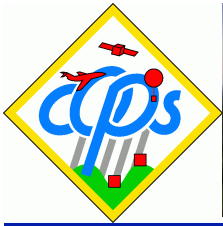
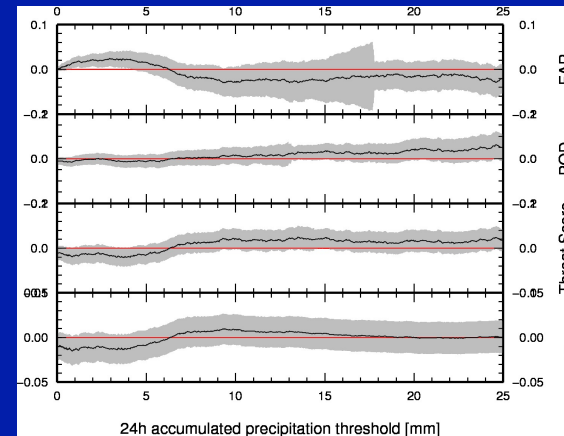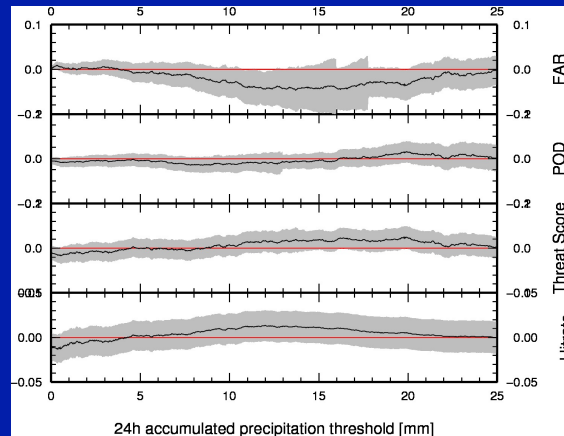# Impact on the 24h precipitation forecast

Léandre
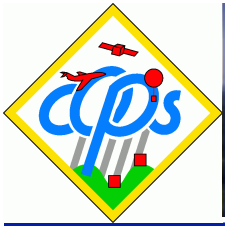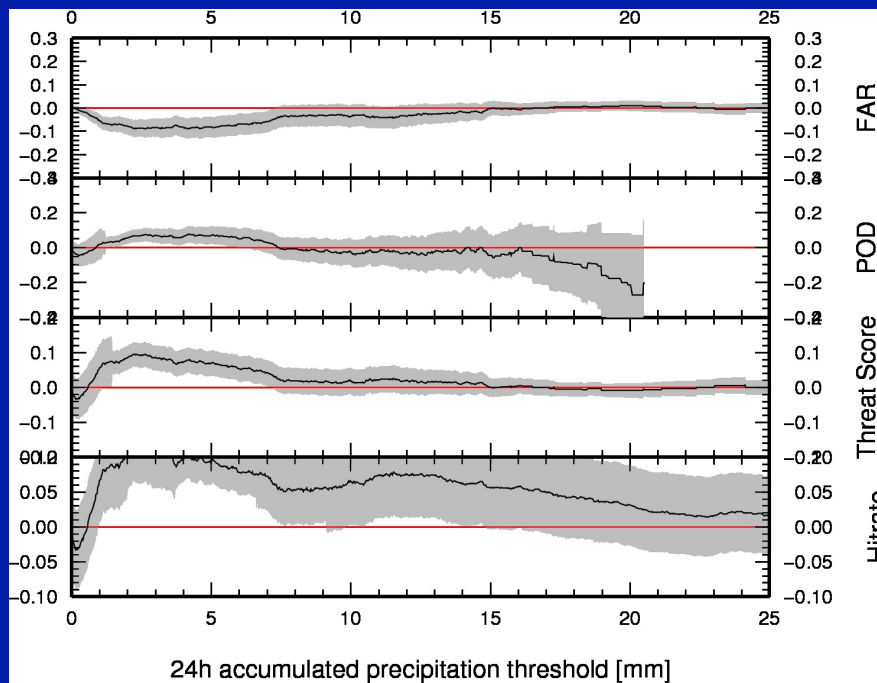
Léandre & Wales

OBS

VERA

No significant impact on the 24h precipitation (+06h/+30h) whatever dataset, whatever analysis ...
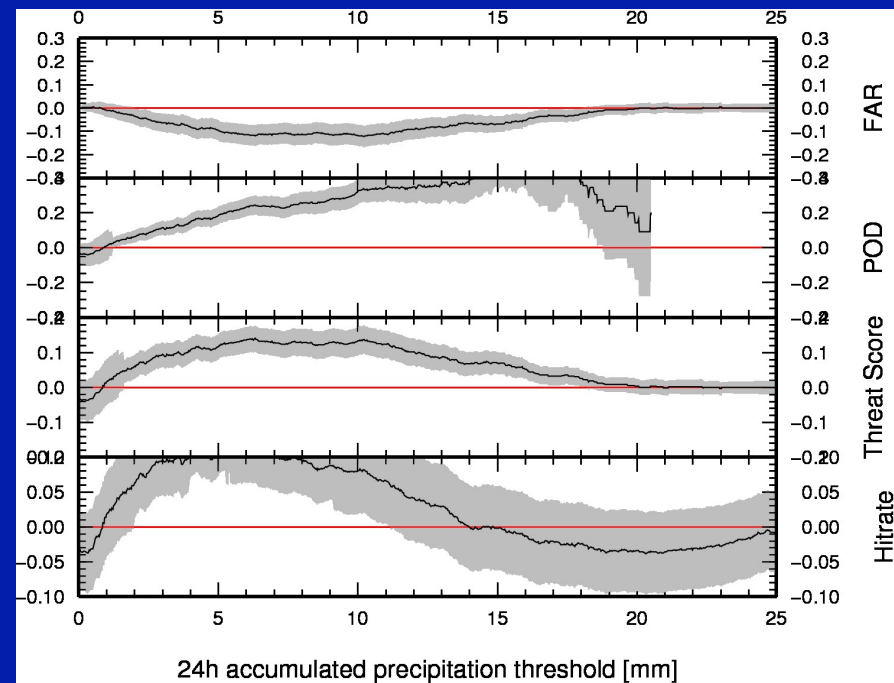
Case study : 19 July

Léandre

Léandre & Wales

19 July : Large improvement of the 24h precipitation forecast