

Jordi Moré ¹, Jordi Mercader ¹, Abdelmalik Sairouni ¹, and Manel Bravo ¹

¹ Meteorological Service of Catalonia (SMC)

✉ jordi.more@gencat.cat

WRFDA

- WRF Data Assimilation module (3DVAR)

➤ Minimisation of the cost function $J(x)$:

$$J(x) = \frac{1}{2}(x - x_b)^T B^{-1}(x - x_b) + \frac{1}{2}(y - H[x])^T R^{-1}(y - H[x])$$

➤ Where B can be:

$$B = B_s \quad \text{WRF+DA}$$

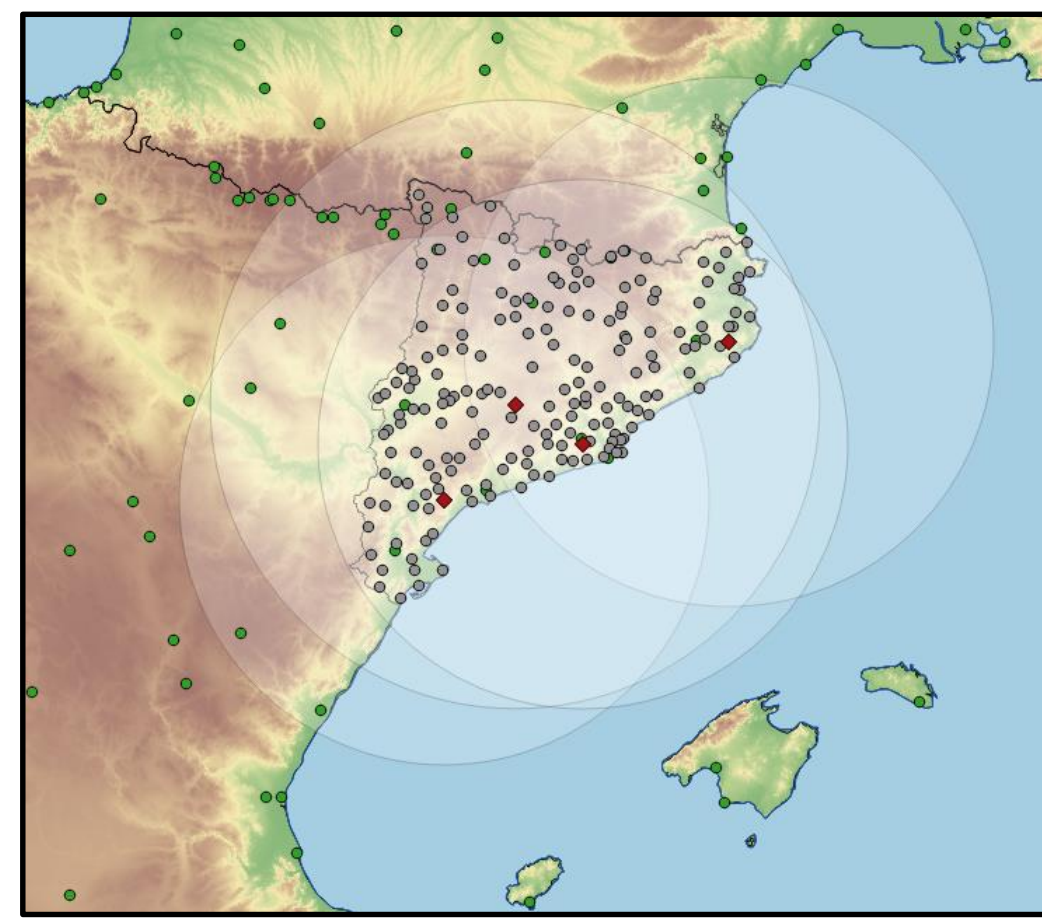
$$B = \frac{1}{2} B_s + \frac{1}{2} B_e \quad \text{WRF+3DEnVar}$$

➤ And:

B_s = static (climatological) background error matrix
 B_e = ensemble background error (flow of the day)

Barker, D. M., X.-Y. Huang, Z. Liu, T. Auligne, X. Zhang, S. Rugg, A. A. AL KATHERI, A. Bourgeois, J. Bray, Y. Chen, M. Demirtas, Y. Guo, T. Henderson, W. Huang, H.-C. Lin, J. Michalakes, S. Rizvi, X.-Y. Zhang, 2012: The Weather Research and Forecasting (WRF) Model's Community Variational/Ensemble Data Assimilation System: WRFDA. Bull. Amer. Meteor. Soc., 93, 831-843

OBSERVATIONS



AWS (grey circles)
 METAR/SYNOP (green circles)
 RADAR local network (red diamonds)

- SFC**
- ~ 35 METAR/SYNOP
 - ~ 200 AWS

- RADAR**
- Reflectivity
 - Radial velocity

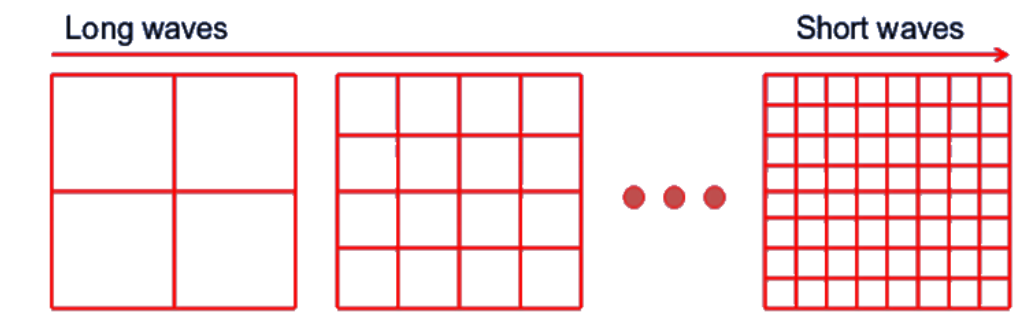
- SATELLITE (*)**
- VIS 0.6 μm
 - MIR 3.9 μm
 - IR 10.8 μm

(*) only in LAPS/STMAS

LAPS/STMAS

- Space and Time Multiscale Analysis System (Variational LAPS)

- Sequential **variational analysis** based on a **multigrid decomposition** technique



➤ Minimisation of the cost function $J^{(n)}$ at every grid level:

$$J^{(n)}[X^{(n)}] = \frac{1}{2} X^{(n)T} X^{(n)} + \frac{1}{2} [H^{(n)} X^{(n)} - Y^{(n)}]^T O^{(n)-1} [H^{(n)} X^{(n)} - Y^{(n)}]$$

➤ Final analysis from the obtained analyses at all grid levels:

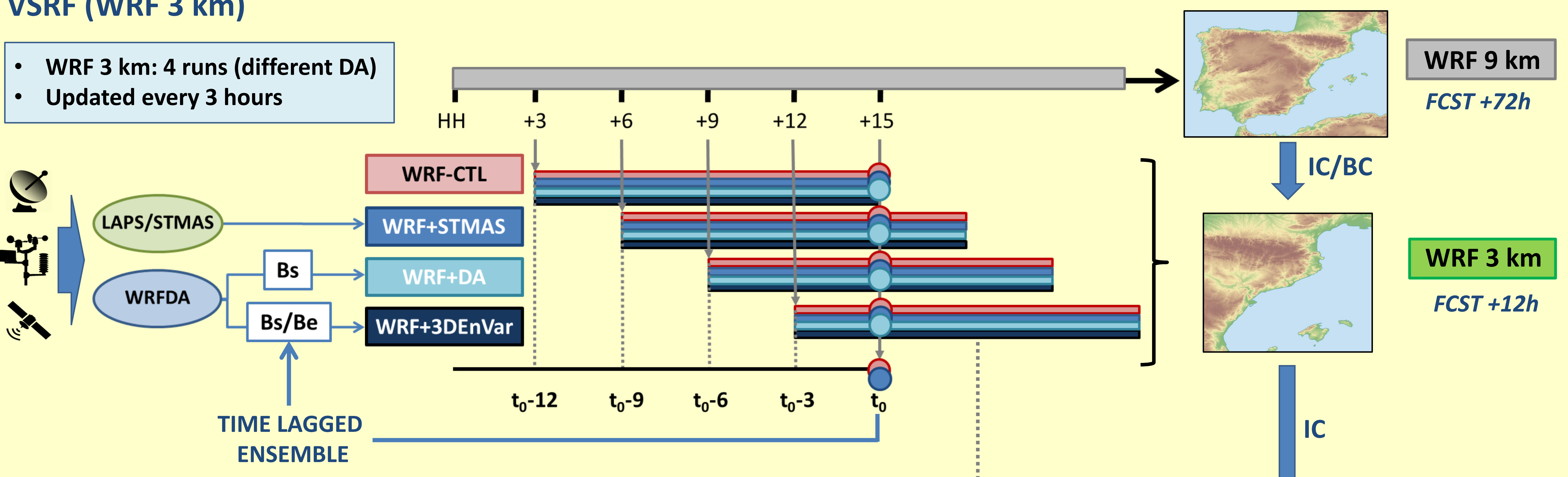
$$X = X^b + \sum_{n=1}^N X^{(n)}$$

Xie, Y., S. E. Koch, J. A. McInley, S. Albers, P. Bieringer, M. Wolfson, and M. Chan, 2011: A space and time multiscale analysis system: A sequential variational analysis approach. Mon. Wea. Rev., 139, 1224-1240.

SYSTEM DESCRIPTION

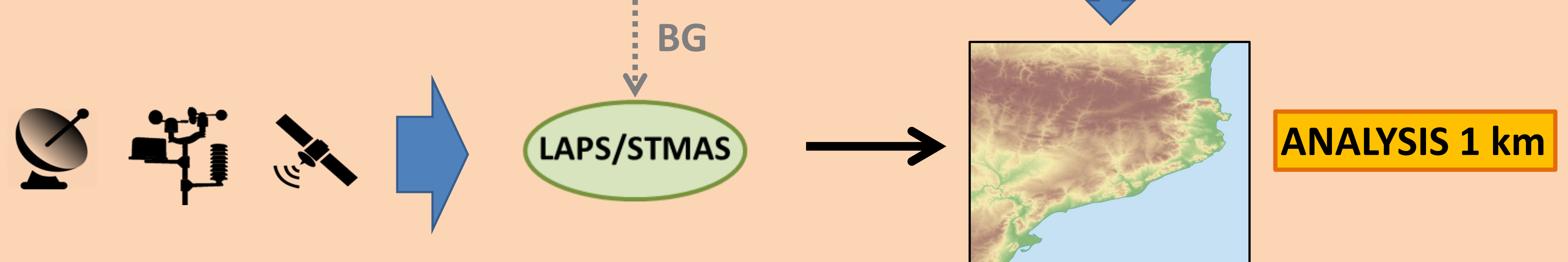
VSRF (WRF 3 km)

- WRF 3 km: 4 runs (different DA)
- Updated every 3 hours



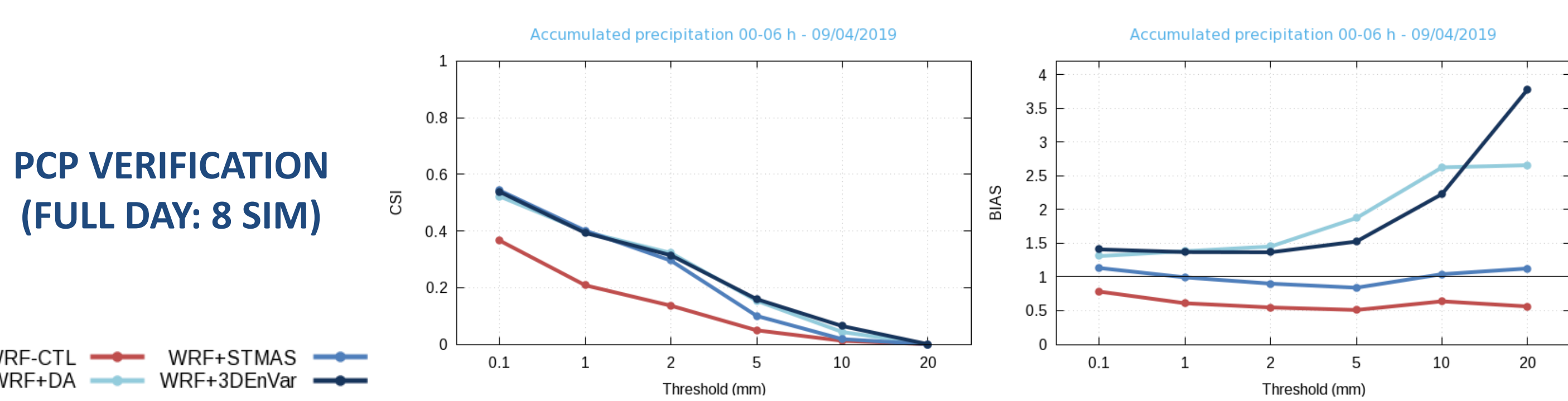
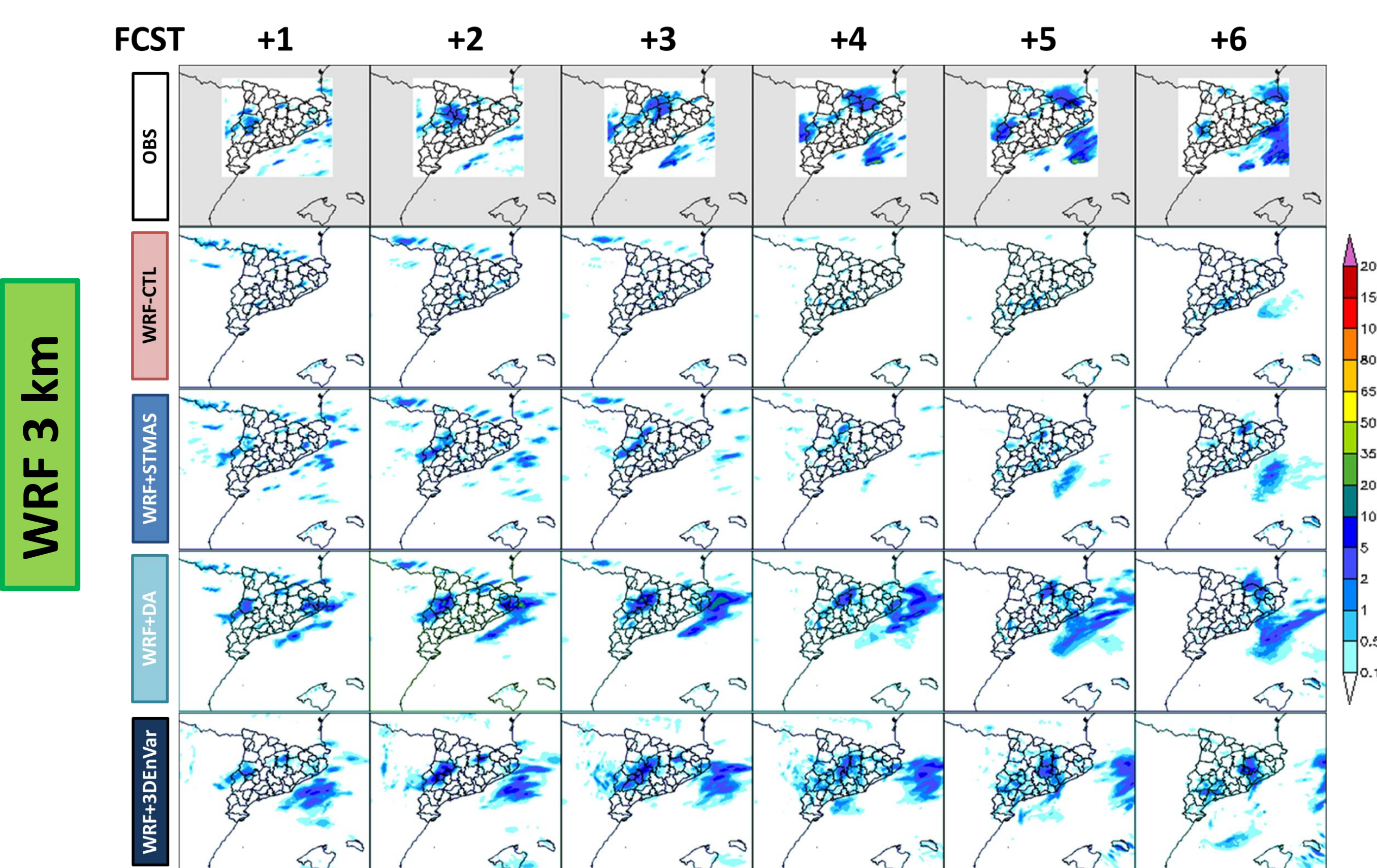
HI-RES 3D ANALYSES (STMAS 1 km)

- High frequency: updated every 30'
- Last available forecast used as analysis BG



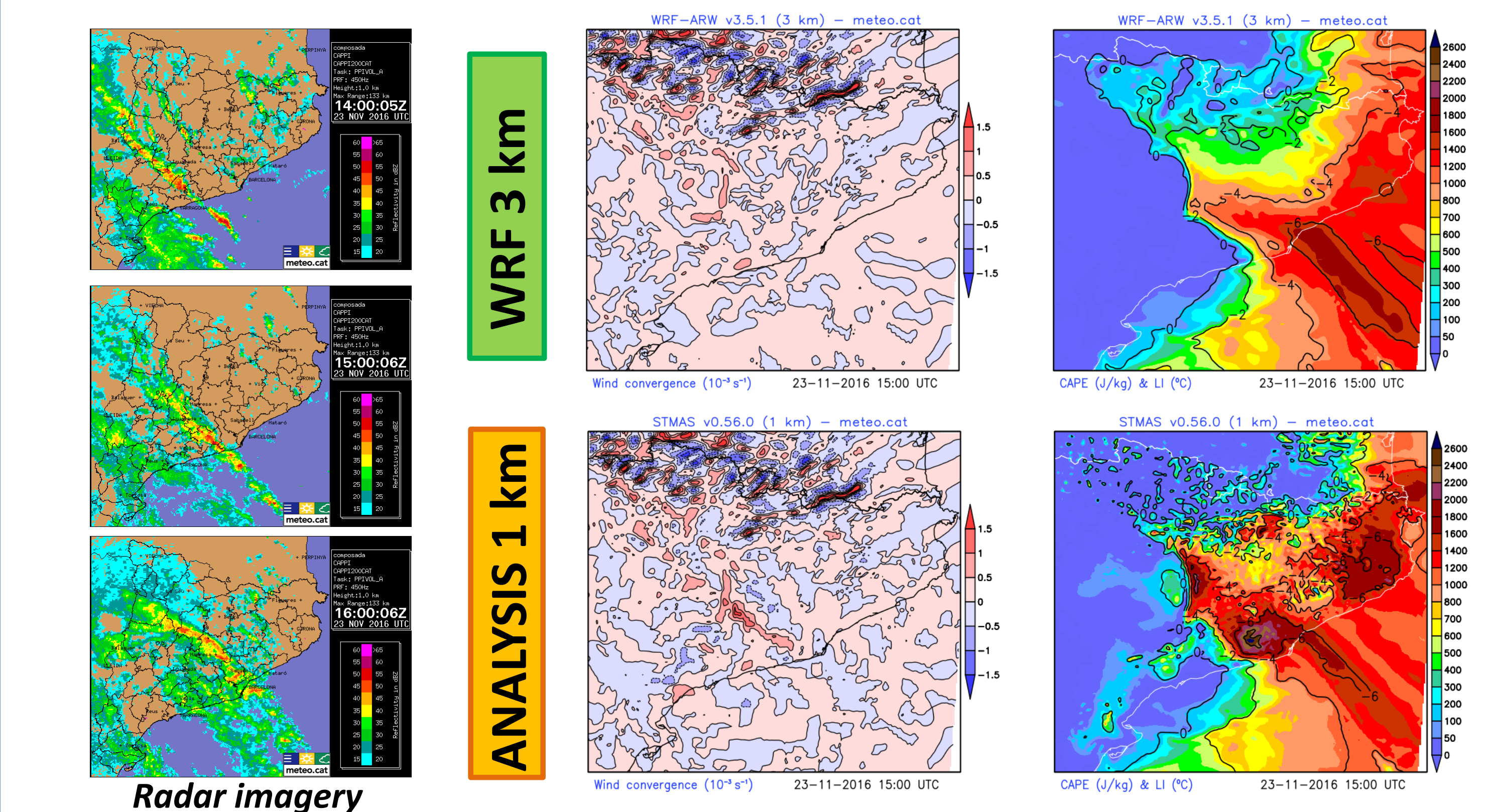
EXAMPLE 1

SIM: 09/04/2019 00 TU



EXAMPLE 2

23/11/2016 15 TU



FUTURE WORK

- Compute probabilistic outputs from VSRF (WRF 3 km)
- Test the impact of other observations and different cycling methodologies in VSRF (WRF 3 km)
- Integrate VSRF (WRF 3 km) and HI-RES 3D analyses (STMAS 1 km) in a seamless prediction system