WRFDA-4DVAR radar data assimilation for operational very short-range precipitation forecasts in Catalonia: Initialisation strategies and preliminary results

SCREEN CAPTURE WELCOME

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Purpose

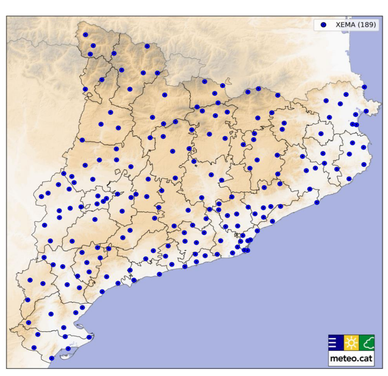
Use of **WRFDA-4DVAR** to obtain **timely** analysis in an operational framework to initialise **very short-range** weather forecasts, comparing different assimilation methodologies.

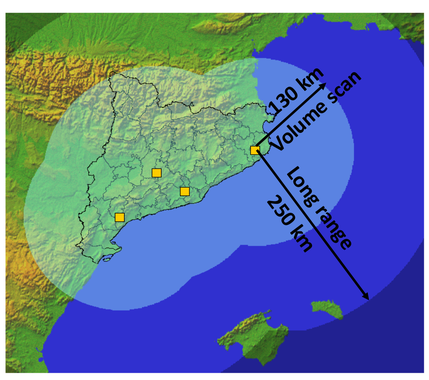
Strategies

- Short-window 4DVAR (**SW4D**): 10 minutes assimilation window.
- 4DEnVAR (**4DEn**): 30 minutes assimilation window.
- Multi resolution 4D-4DenVAR (**MR4D**):
  - 4DVAR at low resolution (9 km), 30 minutes assimilation window.
  - 4DEnVAR at 3 km, 30 minutes assimilation window.

These are compared to the operational 3DEnVAR technique (**3DEn**) and to the control (**CTL**) simulation (without data assimilation).

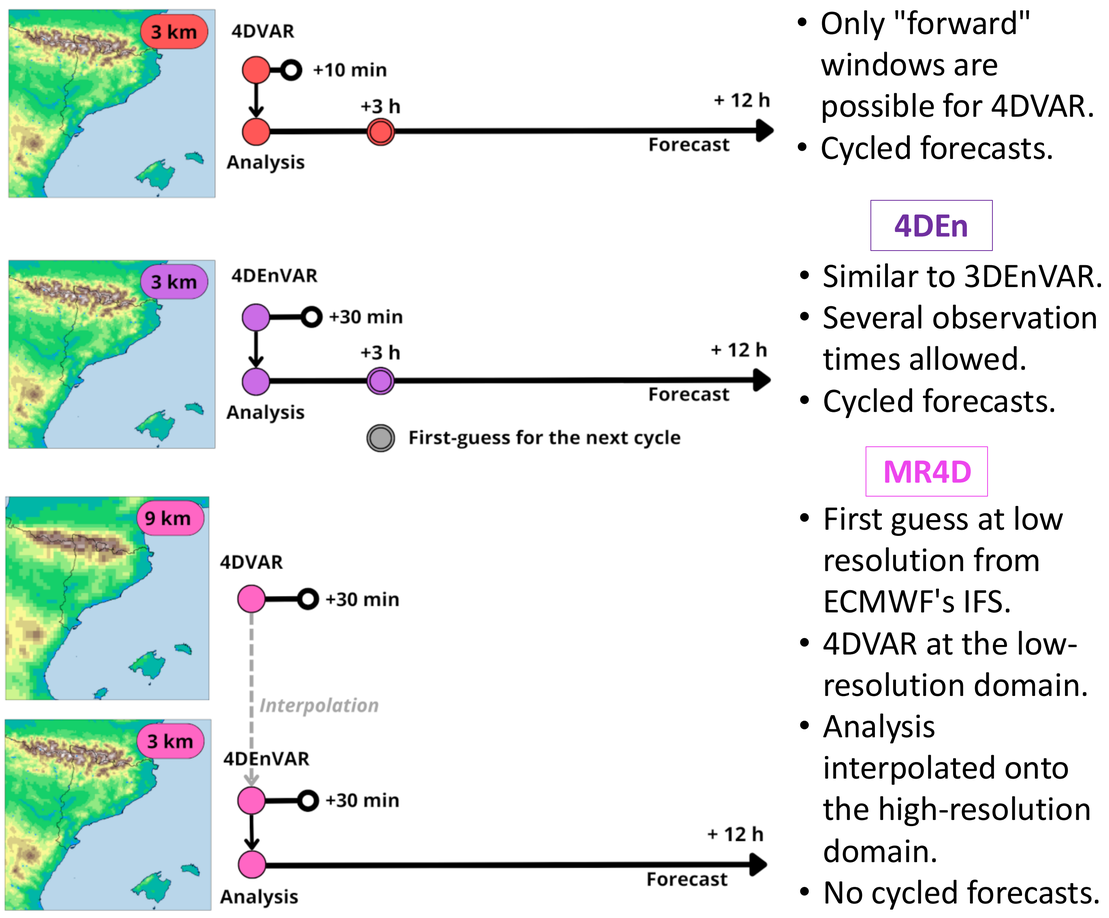
Observations





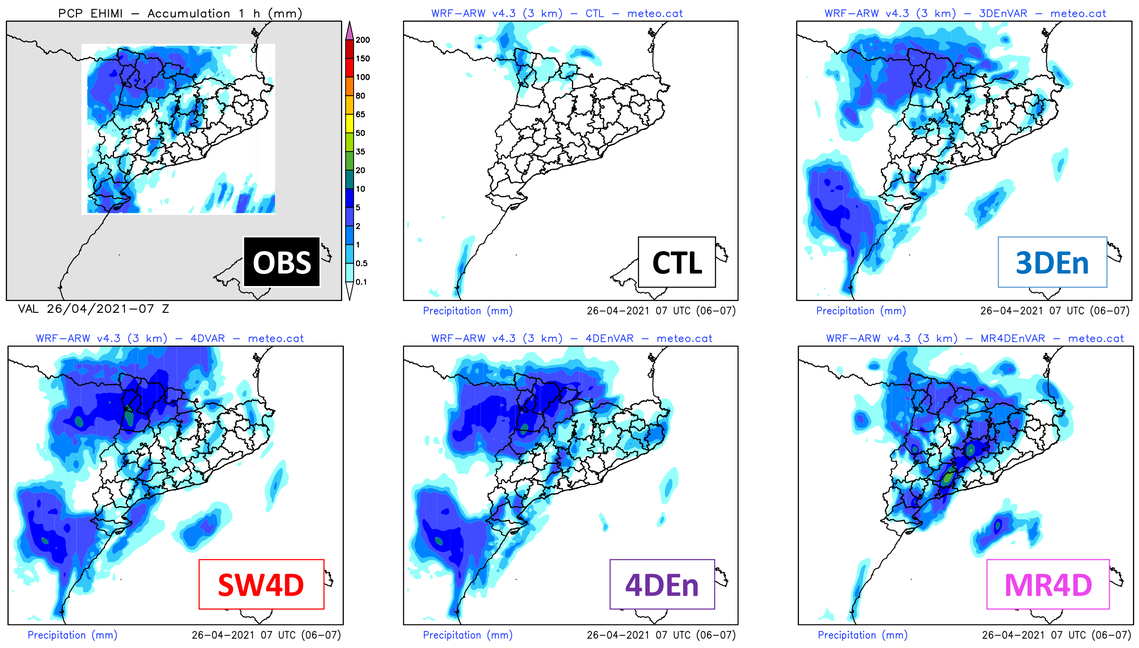
Very dense observational network: **189 AWS** and **4 C-band radars**.

Model set-up

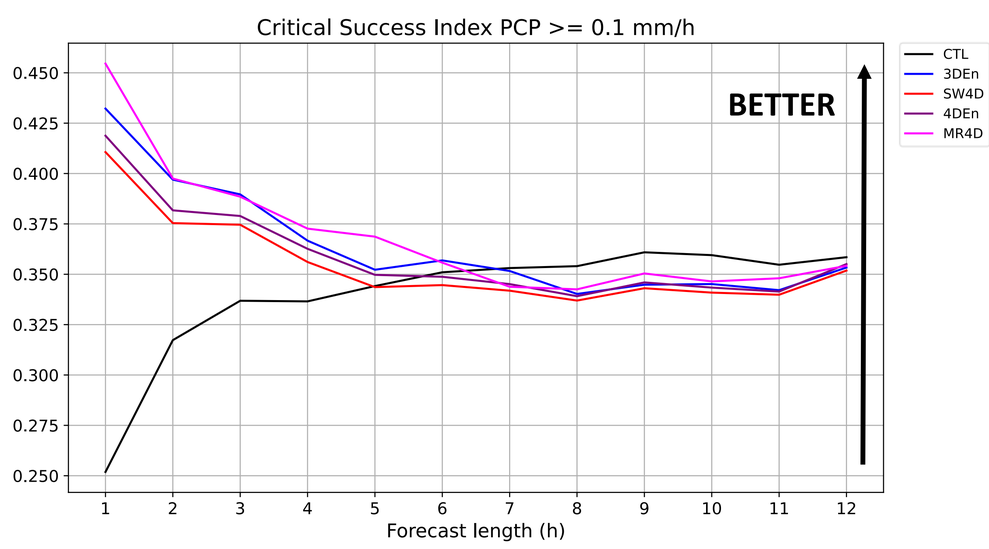


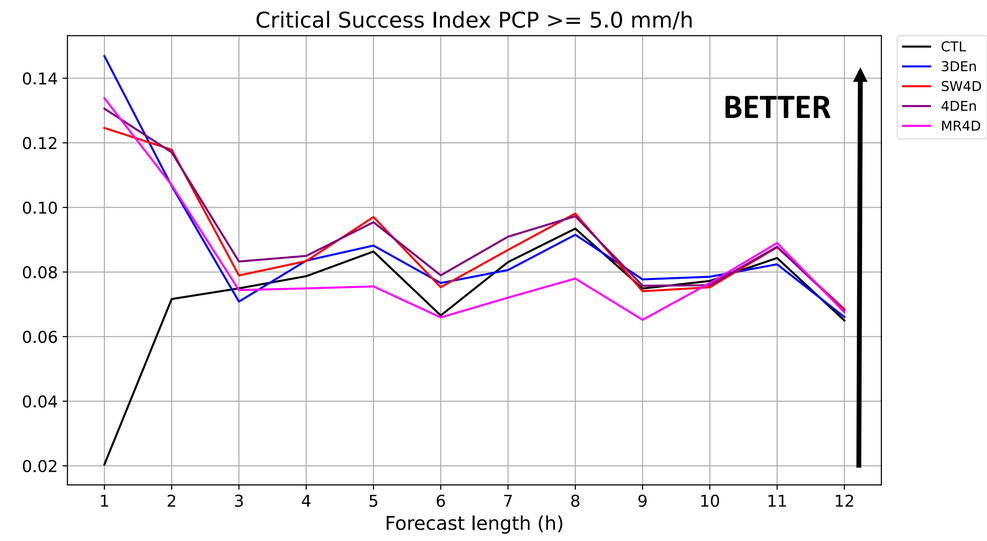
Precipitation forecasts: an example

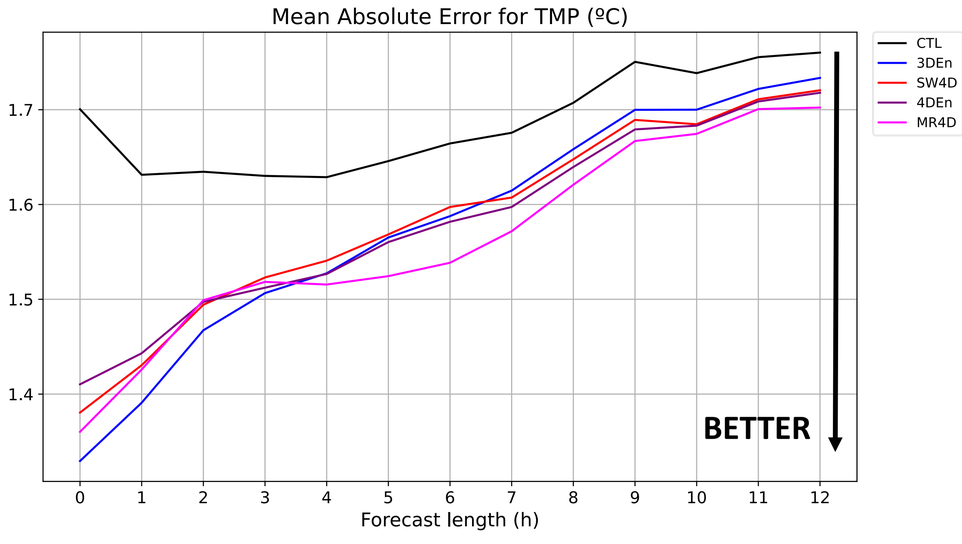
Simulation: 26/04/2021 06 UTC **+ 1h**



Objective verification







Summary and conclusions

- **Three initialisation strategies** using 4DVAR methods have been tested:
  - For a selection of 10 rainy days.
  - Simulations with WRF-ARW (v4.3) every 3 hours.
  - A **total of 80 simulations for each assimilation experiment**.
- In general, **simulations initialised with 4DVAR methods forecast higher precipitation rates** than those that use 3DVAR, especially for the first hours.
- In general, the **MR4D method results in larger and more continuous precipitation fields**, given that data assimilation at low resolution introduces initial conditions favourable to precipitation over a wider part of the domain. This also implies a **large positive bias** (not shown).
- The objective verification shows that **MR4D has a higher skill than other methods for low precipitation thresholds (0.1 mm/h)** whereas **SW4D or 4DEn attain better results than other methods for higher rates (5 mm/h)**.
- **Except for the 4DEn technique**, the other 4DVAR-based methodologies **have a large computational cost,** and their **resulting forecasts are comparable** to those from **3DVAR-**based methods. **Only 4DEn is feasible to use** for very short-term forecasts.
- However, 4DVAR techniques show **promising results in conventional variables** (temperature, RH and wind) even for the longest forecast horizons. Thus, these assimilation methods **could be applied for longer-range forecasts**.

Acknowledgements: Teammates of the Applied Research and Modelling Area of the SMC, Mercè Barnolas (SMC) and Nico Pineda (SMC).

Generalitat de Catalunya

EMS Annual Meeting Barcelona & online | 2–6 September 2024

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