

# The current status and future plans in observation handling/assimilation of radar data in the HIRLAM community

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## Introduction

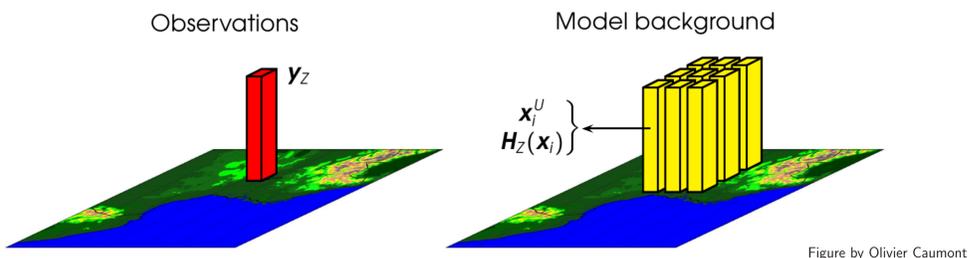
- ▶ **Harmonie** is the high resolution successor of the HIRLAM model
- ▶ Supports **AROME physics** and **ALADIN non-hydrostatic dynamics**
- ▶ **Meso scale data assimilation**: Observations of high temporal frequency and high horizontal resolution is crucial
- ▶ Assimilation of volume data of **radar reflectivity** and **radial winds** is under implementation
- ▶ HIRLAM members that plan to use radar data in HARMONIE
  - ▶ Denmark, Ireland, Norway, Spain, Sweden, The Netherlands, (Finland)
  - ▶ LACE countries

## Method

The methods used are developed by **Météo-France** [1, 2, 3, 4, 5]

### Radar reflectivity:

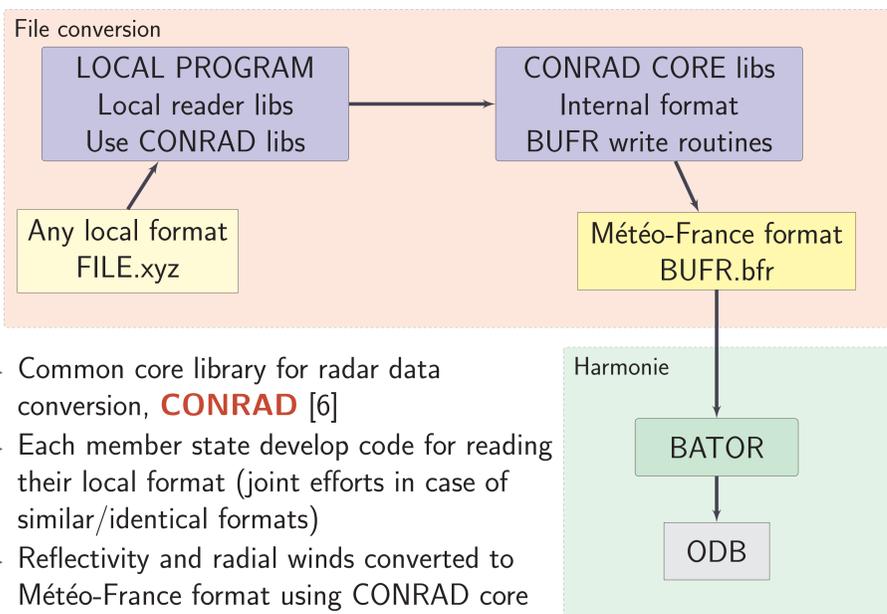
- ▶ Combination of **1D Bayesian** and **3DVAR** schemes:
- ▶ 1D **humidity profiles** are **retrieved** utilizing reflectivity measurements
- ▶ Comparing radar reflectivity with **simulated reflectivity** ⇒ **pseudo-observations** of relative humidity (RH)
- ▶ **Pseudo-observations** assimilated using **3DVAR**



### Radar radial winds:

- ▶ Super-observations of radial wind volume data are created using filtering and smoothing techniques

## CONRAD – CONVersion of RADar data



- ▶ Common core library for radar data conversion, **CONRAD** [6]
- ▶ Each member state develop code for reading their local format (joint efforts in case of similar/identical formats)
- ▶ Reflectivity and radial winds converted to Météo-France format using CONRAD core

## Further plans

### Extend BATOR:

- ▶ to accept polar data
- ▶ different scan strategies
- ▶ different volume sizes
- ▶ data thinning for different data representations
- ▶ Possibly develop a common **quality control suite**
- ▶ Assimilated radar data with **Rapid Update Cycling (RUC)**
- ▶ Extended radar data impact studies



## Acknowledgments

- ▶ Météo-France/ALADIN is acknowledged for providing the radar data methods and the radar BUFR format.
- ▶ Thibaut Montmerle and Eric Wattrelot are acknowledged for their kind assistance in explaining the method and data format conversion

## Status

### Denmark:

- ▶ 5 radars, internal format (→HDF5)
- ▶ Polar coordinates
- ▶ Scan strategies: Long range for reflectivity, short for radial wind
- ▶ No assimilation experiments yet

### Spain:

- ▶ 15 radars (OPERA BUFR + HDF5)
- ▶ Polar coordinates
- ▶ Scan strategies: Long range for reflectivity, short for radial wind
- ▶ OPERA BUFR plugin to CONRAD
- ▶ Ongoing experiments

### The Netherlands:

- ▶ 2 radars
- ▶ Successful experiments of radial velocity assimilation in HIRLAM. Hourly update cycle, up to +9 hours
- ▶ Radar radial winds assimilation in HIRLAM hourly cycle since 12 September 2011

### Ireland:

- ▶ 2 radars in multiple formats
- ▶ Multiple grid types available
- ▶ Different elevation angles and scan strategies
- ▶ No assimilation experiments yet

### Sweden:

- ▶ Radar data from 12 radars in HDF5
- ▶ Polar coordinates
- ▶ 10 elevation angles 2 km bin size for the lower and 1 km for the higher
- ▶ Ongoing experiments with radial velocities and HDF5 plugin to CONRAD

### Norway:

- 8 radars (soon 9), polar coordinates, different scanning strategies and data layout.
- Successful experiments with winds
- Successful experiments with reflectivity

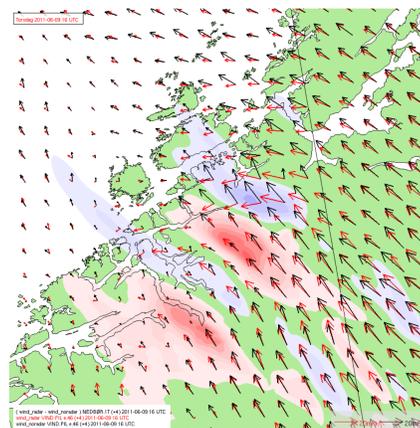


Figure: Radial wind assimilation: Changes in wind field and placement of precipitation (analysis differences with/without radar winds)

### LACE countries:

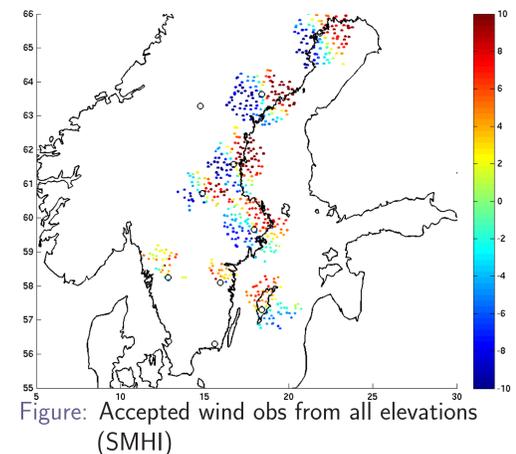
- Austria, Croatia, Czech Republic, Hungary, Romania, Slovakia, Slovenia
- ▶ Model version: ALARO
- ▶ Adjustment of the observation operator for reflectivity to ALARO microphysics is needed
- ▶ No assimilation experiments yet

### Hungary:

- ▶ 3 radars (soon 4)
- ▶ Scan strategies: Long range for reflectivity, short for radial wind
- ▶ Bin size 500 m, soon 125 m
- ▶ 10 elevations
- ▶ Started reflectivity experiments

### Croatia:

- ▶ Developing C++ interface/plugin for CONRAD
- ▶ Makes it easy to use existing C/C++ radar libraries
- ▶ Experiments at screening stage
- ▶ Plan to assimilate for ALARO



## References

- [1] O. Caumont et al., A radar simulator for high-resolution nonhydrostatic models, *J. Atmos. Oceanic Technol.* **23**, 1049 (2006).
- [2] O. Caumont, V. Ducrocq, G. Jaubert, and S. Pradier-Vabre, 1D+3Dvar assimilation of radar reflectivity data: a proof of concept, *Tellus A* **62**, 173 (2010).
- [3] T. Montmerle et al., Regional scale assimilation of radar data at Météo-France, HIRLAM Technical Report 68, Météo-France, 2008.
- [4] T. Montmerle and C. Faccani, Mesoscale assimilation of radial velocities from doppler radars in a preoperational framework, *Mon. Wea. Rev.* **137**, 1939 (2009).
- [5] E. Wattrelot, O. Caumont, S. Pradier-Vabre, M. Jurasek, and G. Haase, 1D+3Dvar assimilation of radar reflectivities in the pre-operational AROME model at Météo-France, in *ERAD2008*, 2008.
- [6] CONRAD, <https://svn.met.no/viewvc/prepradar/>, <http://lists.met.no/mailman/listinfo/conrad>, <https://svn.met.no/prepradar/trunk/doc/conrad-pres.pdf>.