Koninklijk Meteorologisch Instituut

Institut Royal Météorologique

Königliche Meteorologische Institut

Royal Meteorological Institute

News about the EUMETNET statistical postprocessing benchmark

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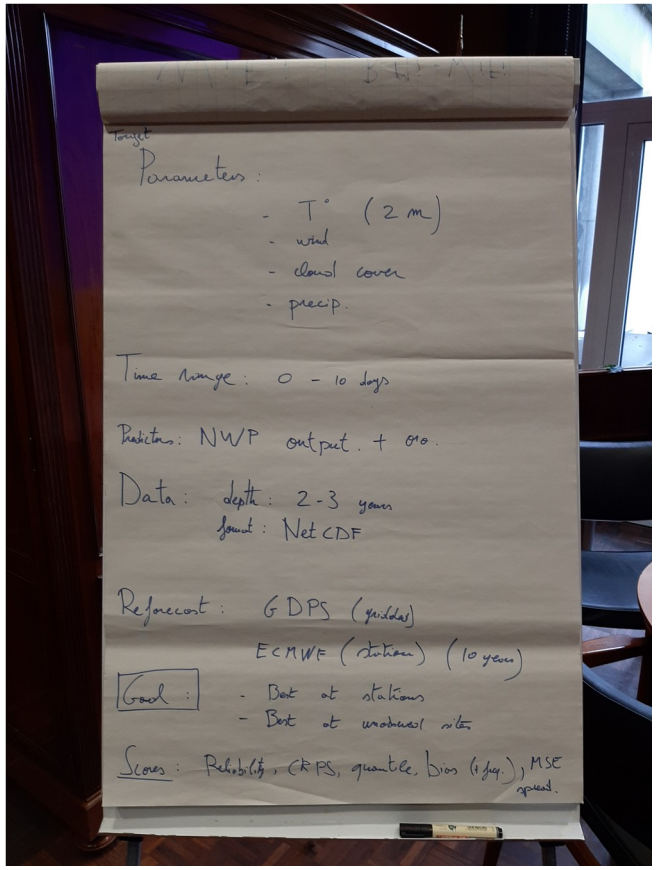
Royal Meteorological Institute of Belgium
& EUMETNET

EGU 22 26 May 2022, 15:10 CEST

Introduction

- The benchmark is an important deliverable of the Eumetnet PP module.
- Discussed at the December 2019 PP workshop.
- Emerging idea and goal: try to automate it as much as possible, with multiple different aspects of PP being treated (modularity).
- Need for a common dataset (gold dataset?)
- If not possible, at least produce specific and meaningful studies.



Collaborators

BAMS
Essay

Statistical Postprocessing for Weather Forecasts

Review, Challenges, and Avenues in a Big Data World

Stéphane Vannitsem, John Bjørnar Bremnes, Jonathan Demaeyer, Gavin R. Evans, Jonathan Flowerdew, Stephan Hemri, Sebastian Lerch, Nigel Roberts, Susanne Theis, Aitor Atencia, Zied Ben Bouallègue, Jonas Bhend, Markus Dabernig, Lesley De Cruz, Leila Hieta, Olivier Mestre, Lionel Moret, Iris Odak Plenković, Maurice Schmeits, Maxime Taillardat, Joris Van den Bergh, Bert Van Schaeybroeck, Kirien Whan, and Jussi Ylhaisi

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05 Apr 2021
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01 Mar 2021
DOI:
https://doi.org/10.1175/BAMS-D-19-0308.1
Page(s):
E681–E699

And many others joining !

Planned development phase

I. The "hacky" phase

This phase should aim to develop a first stub of the benchmark, with a few selected methods and people involved, to:

- Evaluate the diversity of possible method's outputs and how to translate them into a "common language".
- Select and define the inputs and final outputs of the benchmark.
- Identify possibilities of automation.
- Agree on scores and metrics.
- Get a grasp about the coding effort required on each side.
- Identify future guidelines for a docker architecture.

This phase should focus first on stations-based post-processing, with the extension to gridded forecasts at a later time.

II. "Toward automation" phase

With the experience accumulated during the hacky phase, try to:

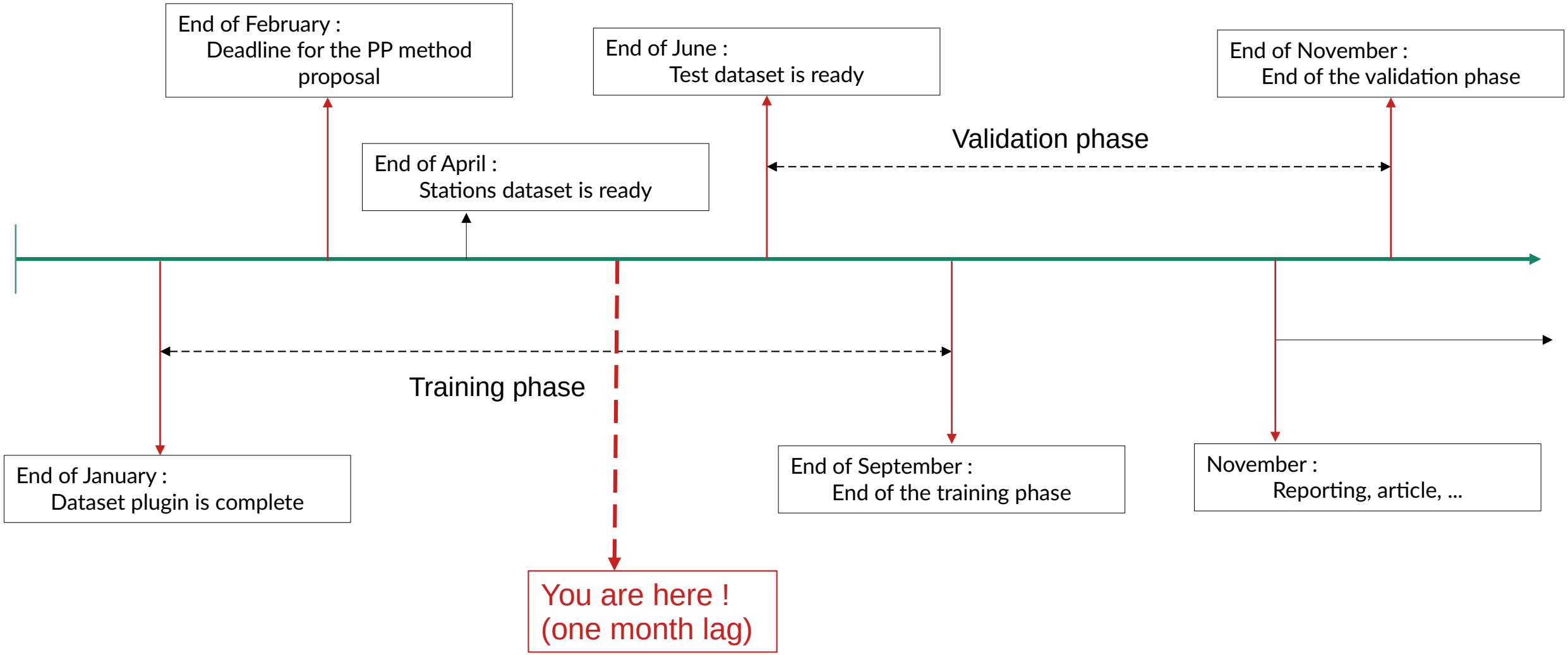
- Automate the upload of code and compute its scoring.
- Develop a flexible framework the uploaders/developers through tools like docker/kubernetes.
  - Only the inputs and desired outputs should be fixed and decided.
  - From the benchmark PoV, the PP codes are black boxes processing the I/O.

Code upload and scores display through a Web interface

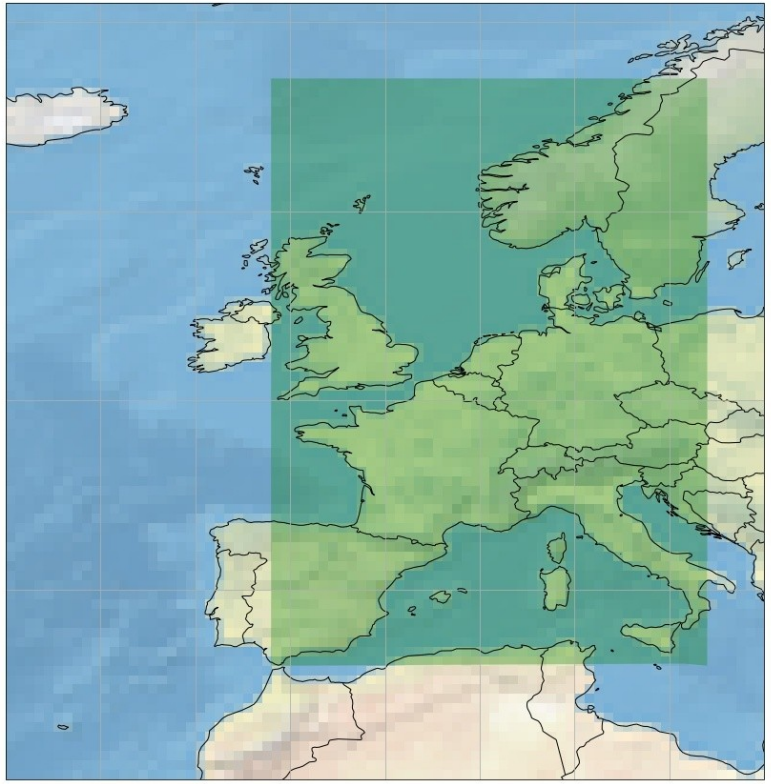
Happening on the European Weather Cloud

Hacky phase timeline

The "hacky" phase (year 4 – 2022) – collaboration on a first « handmade » benchmark



The benchmark dataset



- 47 differents fields
- Training : 2 years of data (2017-2018)
- Test : 2019
- Includes:
  - Ensemble reforecasts (+ control)
  - Ensemble forecasts (+ control)
  - High resolution forecasts (deterministic run)
  - ERA5 reanalysis (gridded truth)
  - Station datas (open data)
- Resolution: 0.25°x0.25°
- Area : **big part of Europe**
- Total size: **~7 Terrabytes**
- Available through a simple interface :
  https://github.com/Climdyn/climetlab-eumetnet-postprocessing-benchmark

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	Field	ECMWF Key	To be postprocessed	Reduced predictor (*)	Remark
1	2 metre temperature	2t	x		
2	10 metre U wind component	10u	x		
3	10 metre V wind component	10v	x		
4	Total cloud cover	tcc	x		
5	Total precipitation	tp	x		
6	10 metre wind gust in the last 6 hours	10fg6	x		
7	Minimum temperature at 2 metres in the last 6 hours	mn2t6	x		
8	Maximum temperature at 2 metres in the last 6 hours	mx2t6	x		

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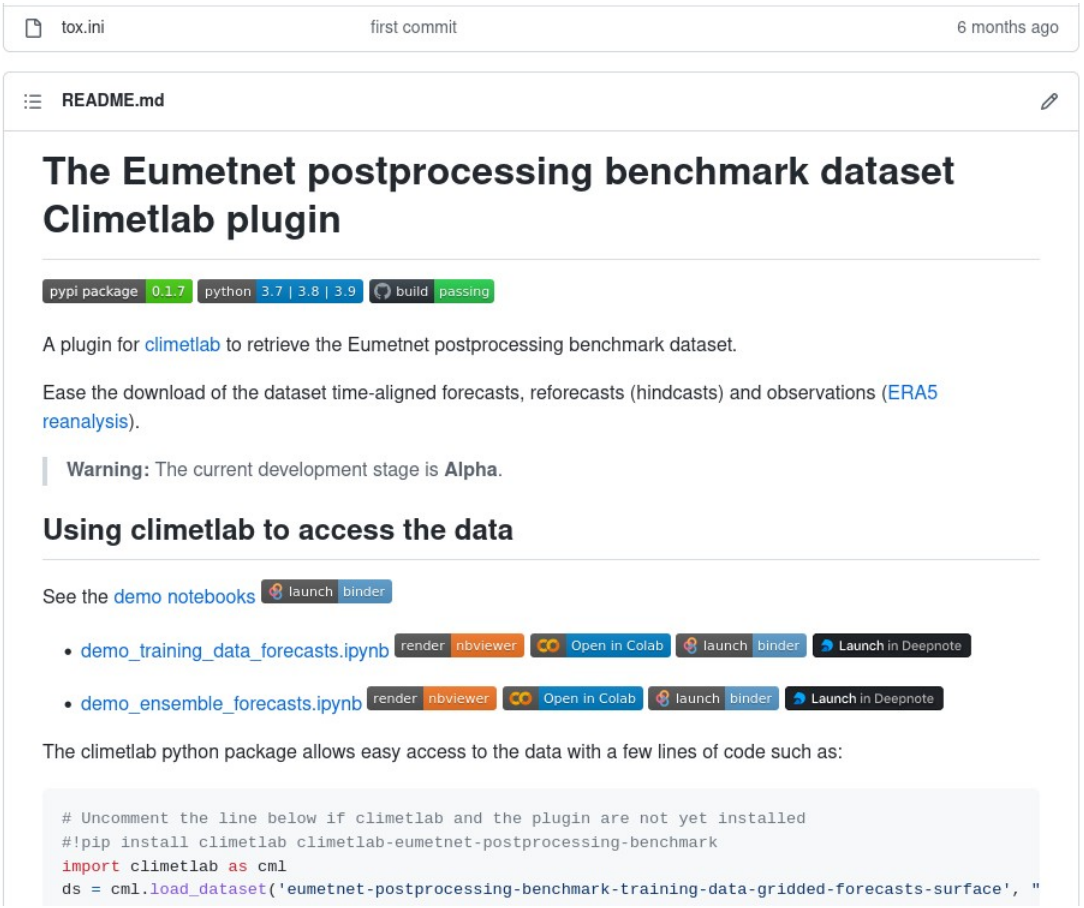


tox.ini first commit 6 months ago

README.md

The Eumetnet postprocessing benchmark dataset Climetlab plugin

pypi package 0.1.7 | python 3.7 | 3.8 | 3.9 | build passing

A plugin for climetlab to retrieve the Eumetnet postprocessing benchmark dataset.

Ease the download of the dataset time-aligned forecasts, reforecasts (hindcasts) and observations (ERA5 reanalysis).

> **Warning:** The current development stage is **Alpha**.

Using climetlab to access the data

See the demo notebooks launch binder

- demo_training_data_forecasts.ipynb render nbviewer Open in Colab launch binder Launch in Deepnote
- demo_ensemble_forecasts.ipynb render nbviewer Open in Colab launch binder Launch in Deepnote

The climetlab python package allows easy access to the data with a few lines of code such as:

```
# Uncomment the line below if climetlab and the plugin are not yet installed
#!pip install climetlab climetlab-eumetnet-postprocessing-benchmark
import climetlab as cml
ds = cml.load_dataset('eumetnet-postprocessing-benchmark-training-data-gridded-forecasts-surface', "
```

Contributors 2

jodemaey Jonathan Demaeyer

retostauffer Reto Stauffer

Languages

Python 69.1%

Jupyter Notebook 30.7%

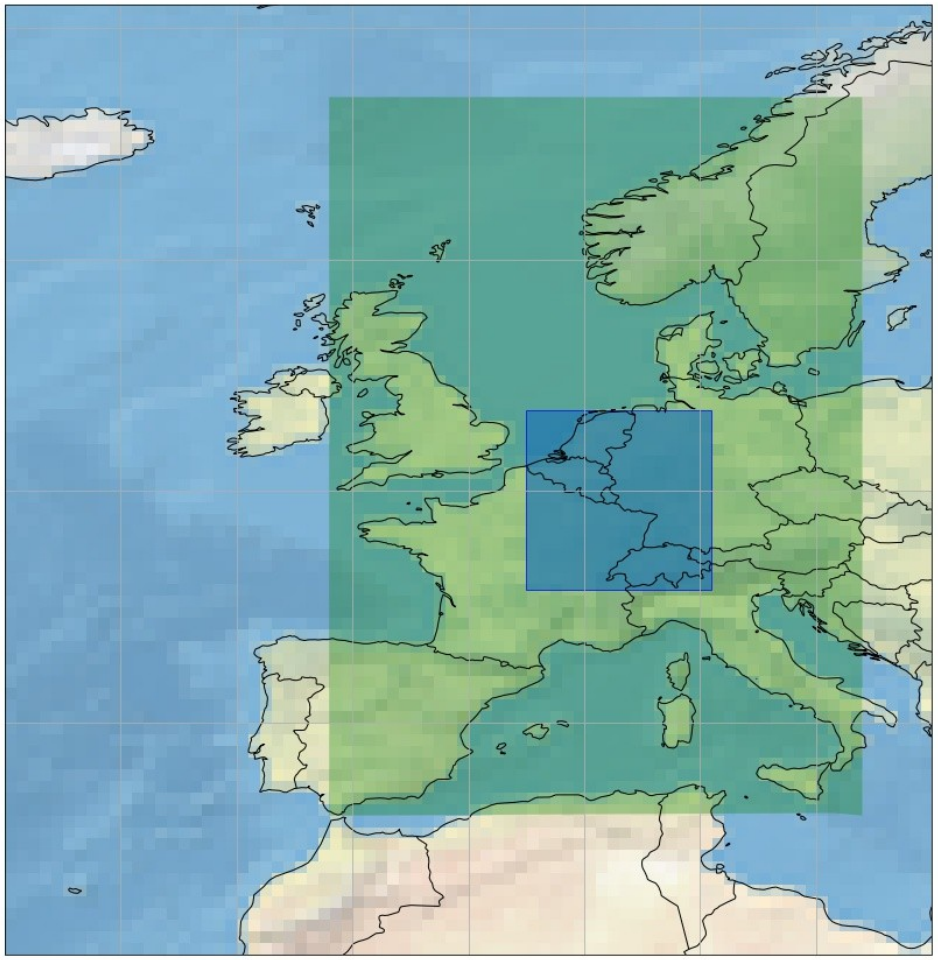
Makefile 0.2%

Access with a R interface also planned.

The hacky phase dataset

- Same fields, forecasts & observations
- Zarr format
- Smaller domain
- 5 days lead time
- 6 hourly
- Total size: **~200 Gigabytes**
- Not yet published

Hacky phase dataset domain



Zarr access with R or Python

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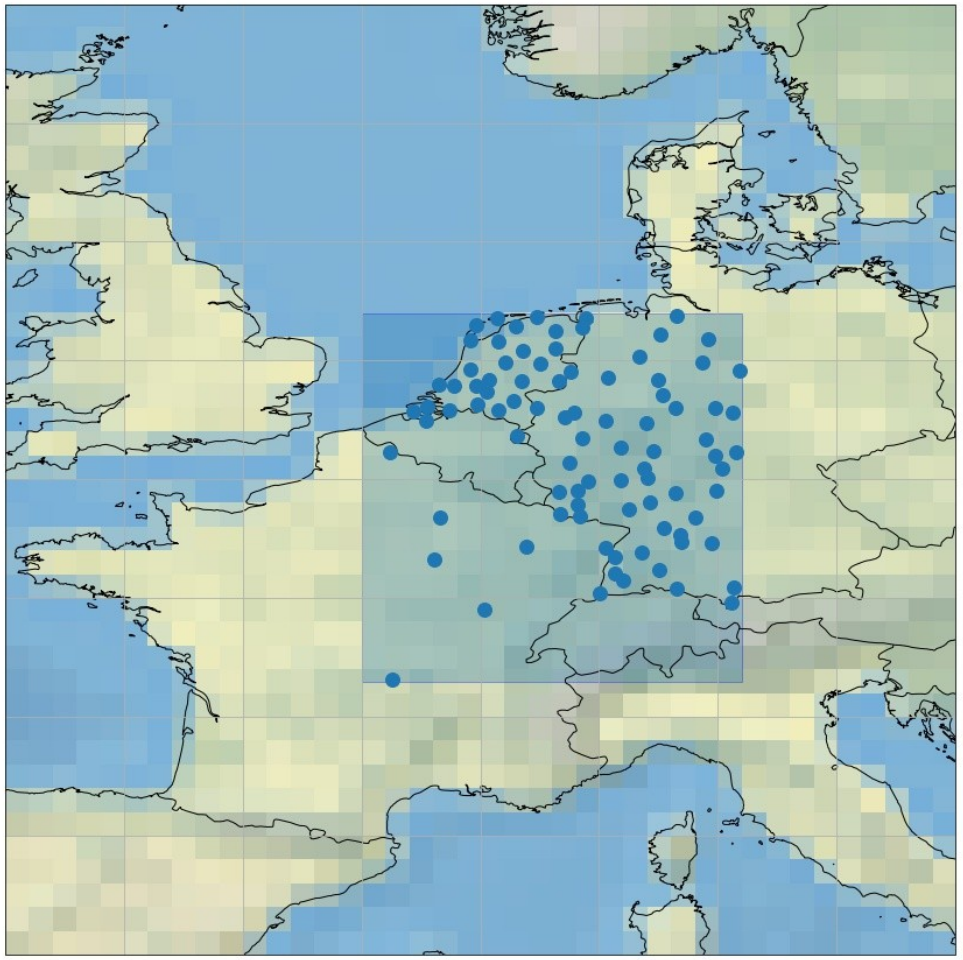
Stations available

- France
- The Netherlands
- Germany

Stations planned

- Belgium
- Switzerland (under discussion)

Hacky phase dataset domain



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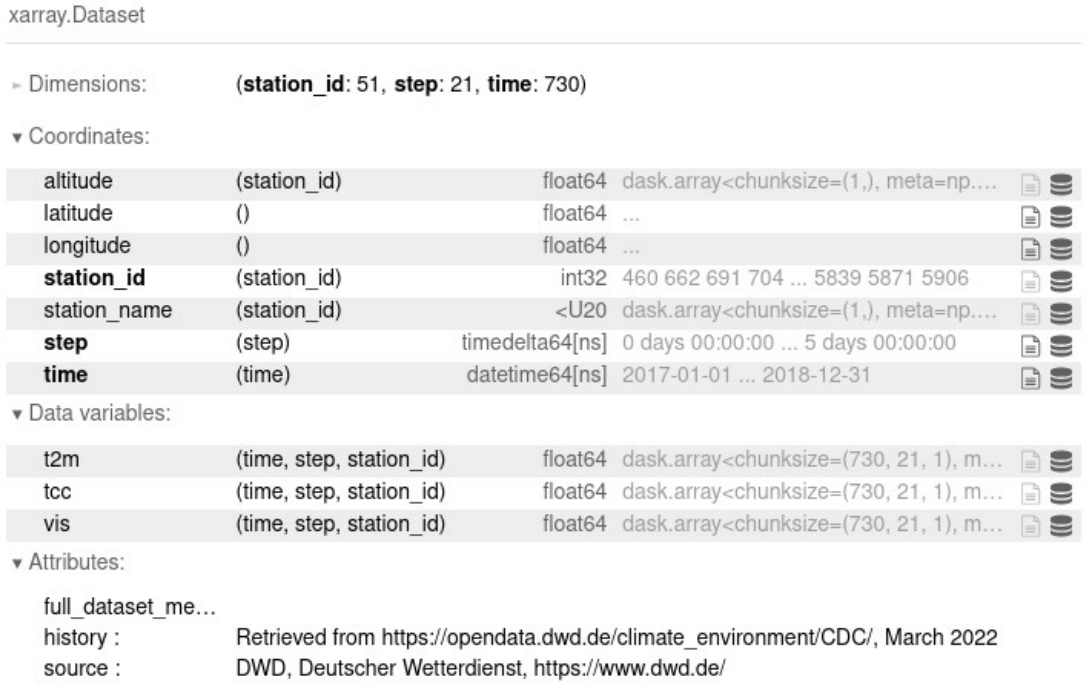


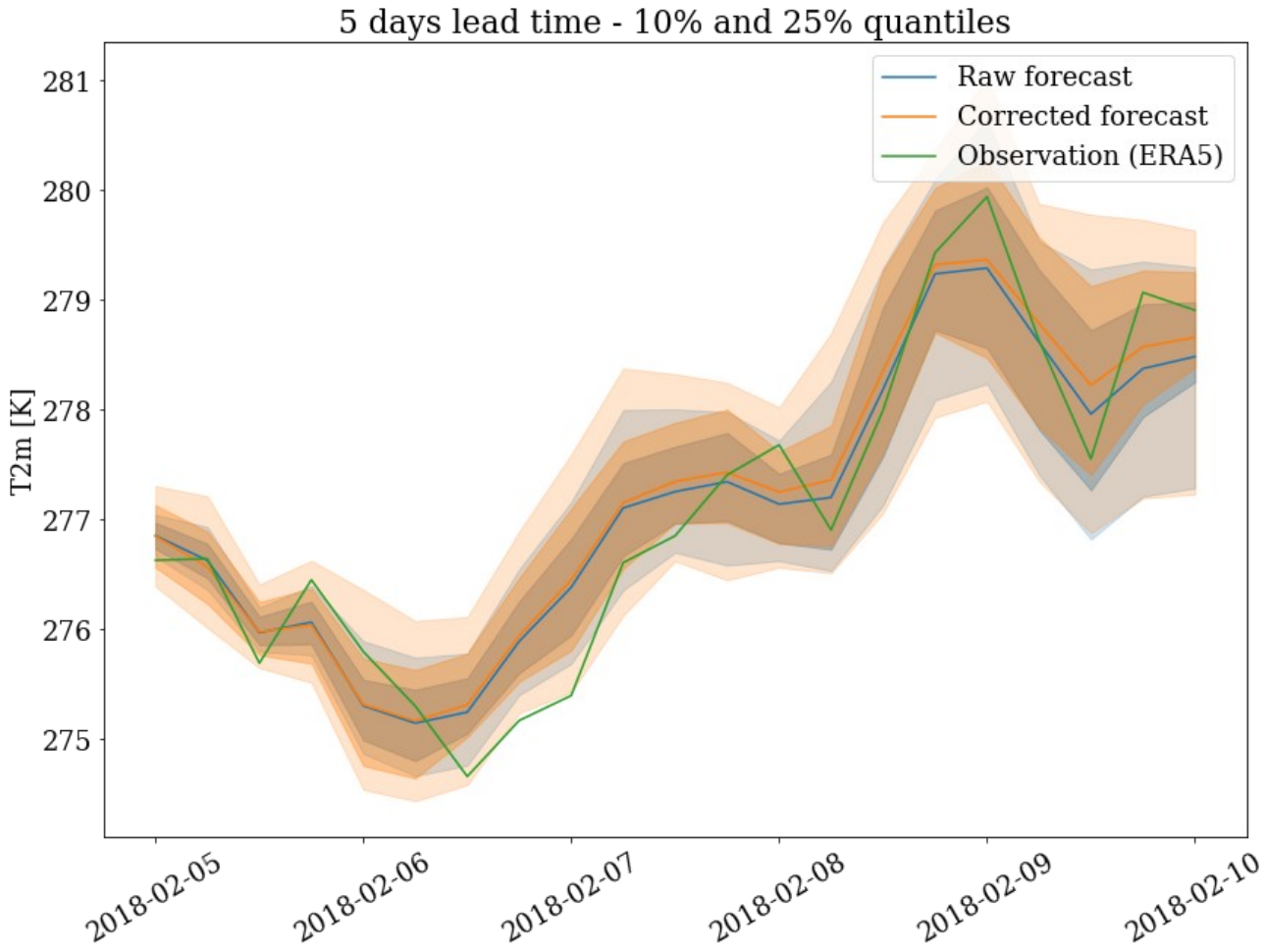
xarray.Dataset

▸ Dimensions:	(**station_id**: 51, **step**: 21, **time**: 730)		
▾ Coordinates:			
altitude	(station_id)	float64	dask.array<chunksize=(1,), meta=np....
latitude	()	float64	...
longitude	()	float64	...
station_id	(station_id)	int32	460 662 691 704 ... 5839 5871 5906
station_name	(station_id)	<U20	dask.array<chunksize=(1,), meta=np....
step	(step)	timedelta64[ns]	0 days 00:00:00 ... 5 days 00:00:00
time	(time)	datetime64[ns]	2017-01-01 ... 2018-12-31
▾ Data variables:			
t2m	(time, step, station_id)	float64	dask.array<chunksize=(730, 21, 1), m...
tcc	(time, step, station_id)	float64	dask.array<chunksize=(730, 21, 1), m...
vis	(time, step, station_id)	float64	dask.array<chunksize=(730, 21, 1), m...
▾ Attributes:			
full_dataset_me...			
history :	Retrieved from https://opendata.dwd.de/climate_environment/CDC/, March 2022		
source :	DWD, Deutscher Wetterdienst, https://www.dwd.de/		

Zarr access with R or Python

An example to benchmark against (MBM)

Applying Member-by-Member postprocessing to the temperature field (1 predictor)



Training over 2 year of reforecasts

Van Schaeybroeck & Vannitsem, Ensemble post-processing using member-by-member approaches: theoretical aspects. QJRMS 2015.

An example to benchmark against (MBM)

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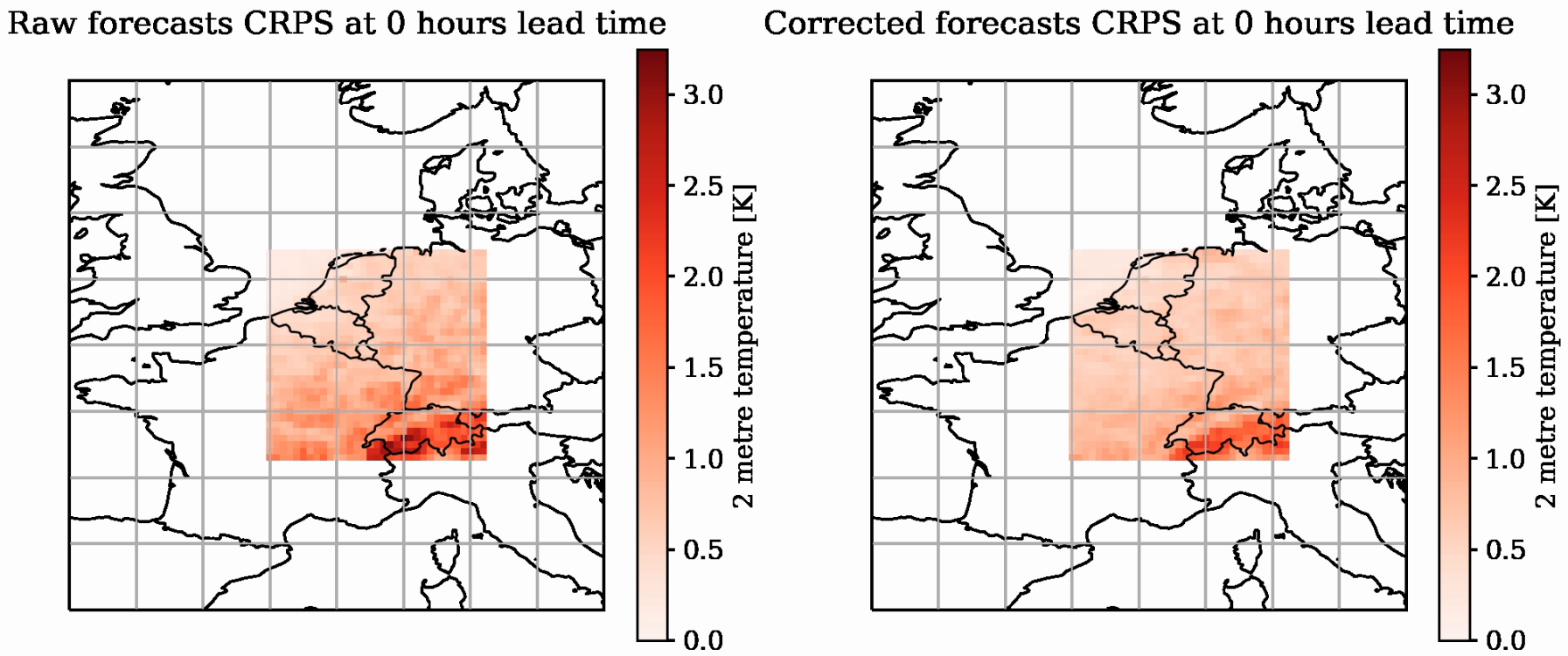

CRPS score averaged over 2 years forecasts, lower is better !

Van Schaeybroeck & Vannitsem, Ensemble post-processing using member-by-member approaches: theoretical aspects. QJRMS 2015.

The hacky phase Tiers organization

On stations + gridded data :

Tier 1: Simple postprocessing of the temperature

- **Variables:** 2 metre temperature, Tmax and Tmin
- **Predictors:** Only the variable itself

Tier 2: Simple postprocessing of the rainfall

- **Variables:** 6h accumulated rainfall
- **Predictors:** Only the variable itself

Tier 3: More advanced postprocessing of the temperature

- **Variables:** 2 metre temperature, Tmax and Tmin
- **Predictors:** All the variables available in the gridded benchmark dataset

Tier 4: More advanced postprocessing of the rainfall

- **Variables:** 6h accumulated rainfall
- **Predictors:** All the variables available in the gridded benchmark dataset

Different workgroups:

- EMOS
- MBM methods
- Neural networks & Machine Learning
- Random forest
- Verification
- ....

If you are interested...

If you want to propose an idea and join the workgroups:

→ Open to National Meteorological Institutes & Academia

→ Simply contact me: jonathan.demaeyer@meteo.be

THANK YOU

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