Probabilistic Nowcasting: Insight into a global-based and an object-based approach

5th RealPEP Project Meeting

Ricardo Reinoso-Rondinel, Martin Rempel, Raquel Evaristo, Silke Trömel, and Clemens Simmer

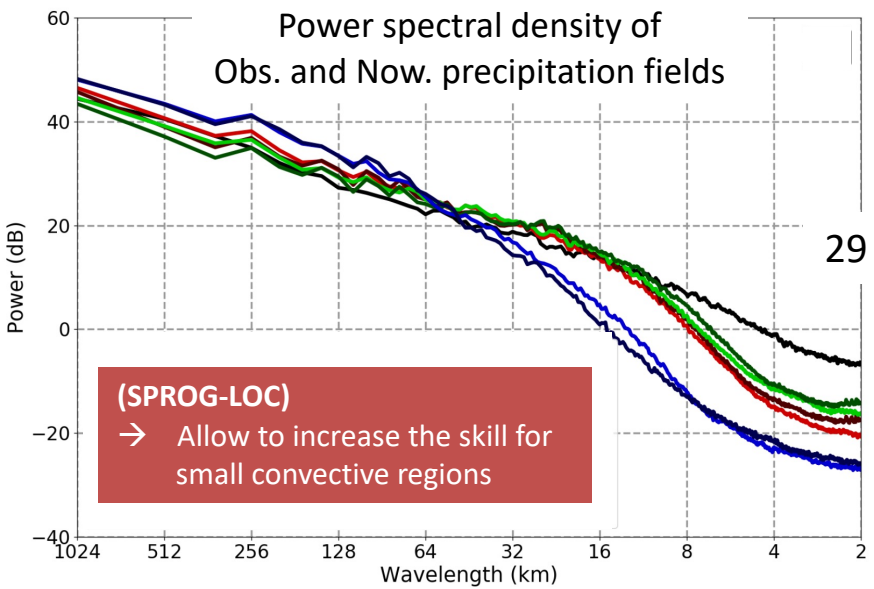
April 28, 2022

A: **SPROG** → **SPROG-LOC**

(SPROG-LOC)

→ A rapid-computed spatially localized AR model

→ The auto-regression is controlled by 2-D coefficients (adaptive filtering)

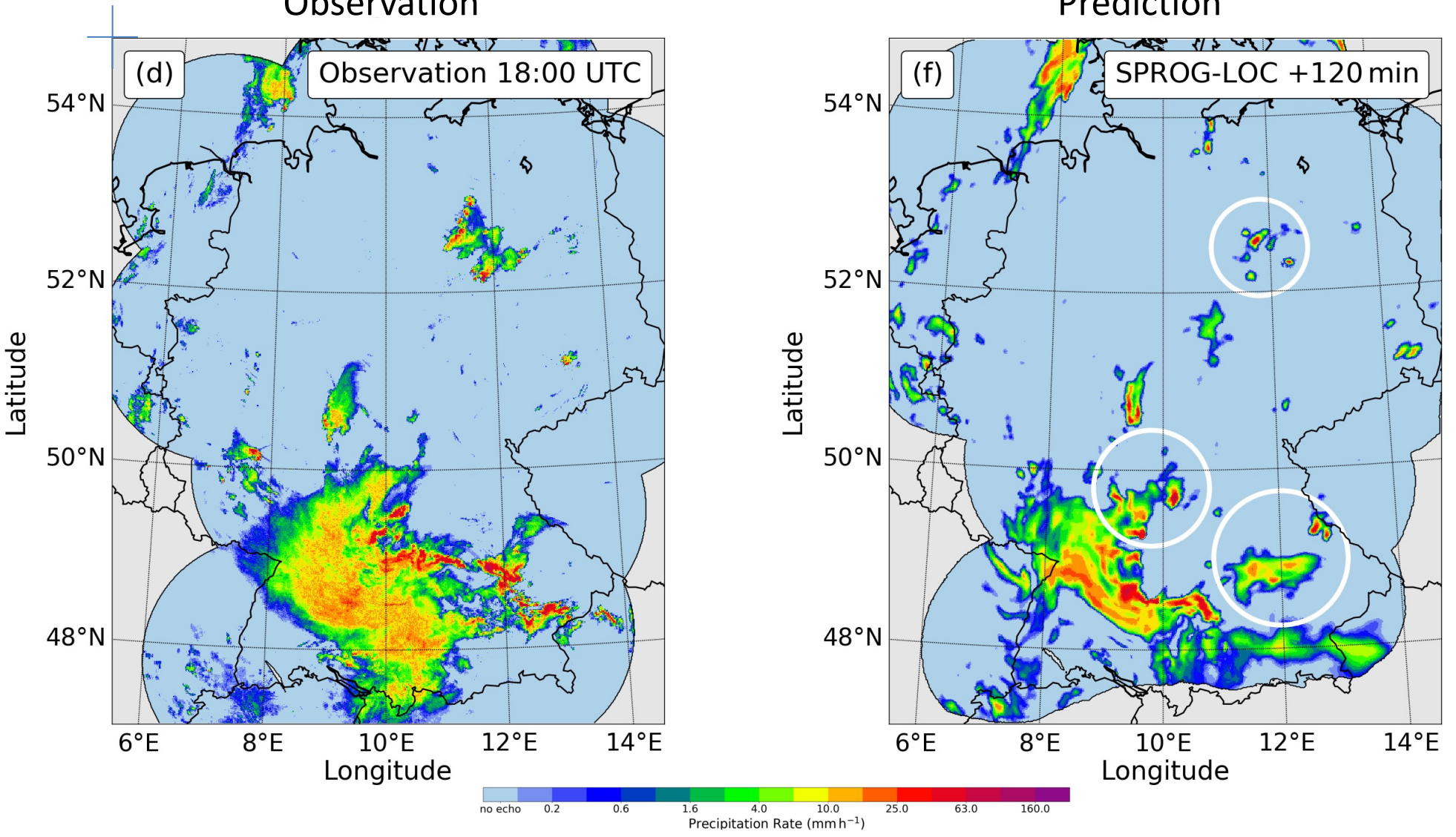


29 May 2016 – 1600 UTC

Observations

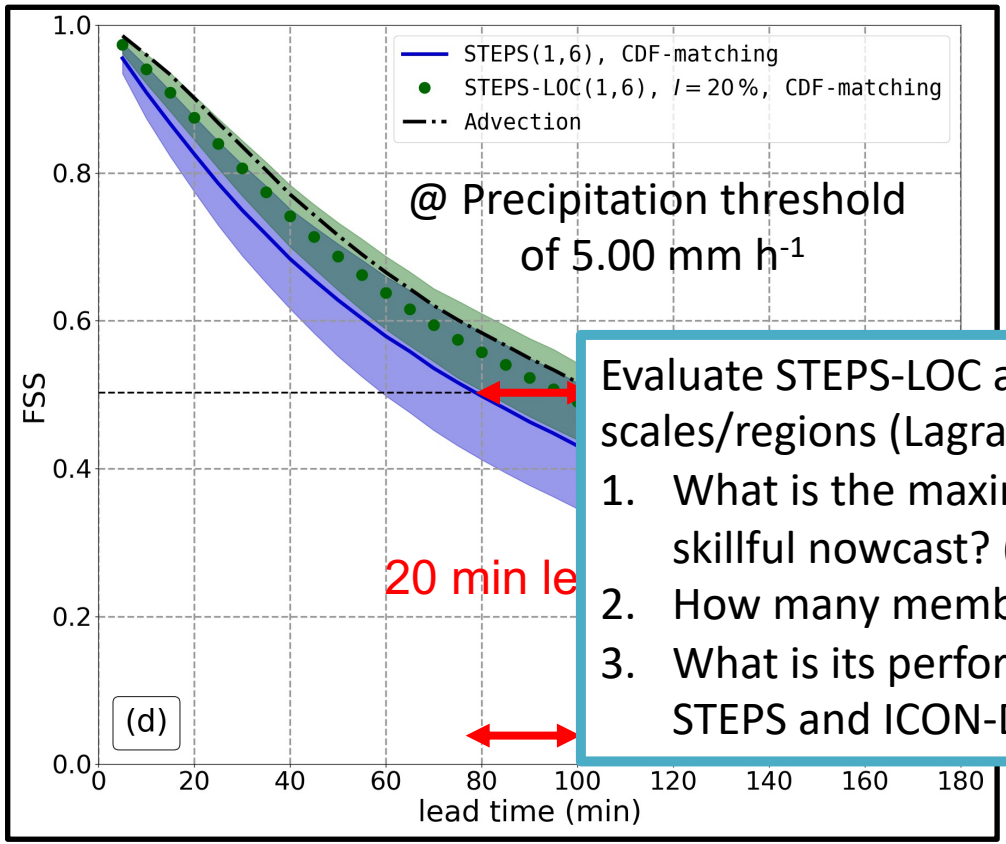
SPROG-LOC @ + 60 min

SPROG @ + 60 min


Observation
Prediction
(d)
Observation 18:00 UTC
(f)
SPROG-LOC +120 min
54°N
52°N
50°N
48°N
Latitude
6°E
8°E
10°E
12°E
14°E
Longitude
no echo
0.2
0.6
1.6
4.0
10.0
25.0
63.0
160.0
Precipitation Rate (mm h^{-1})

B: **STEPS** → **STEPS-LOC**

(STEPS-LOC)→ adds stochastic perturbations to the localized AR process

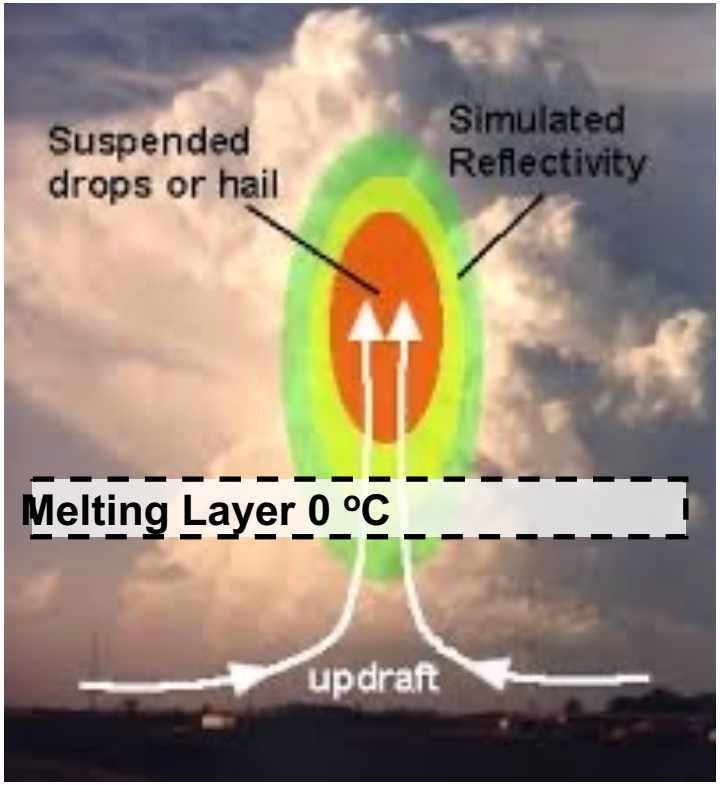


Evaluate STEPS-LOC at large and small scales/regions (Lagrangian)

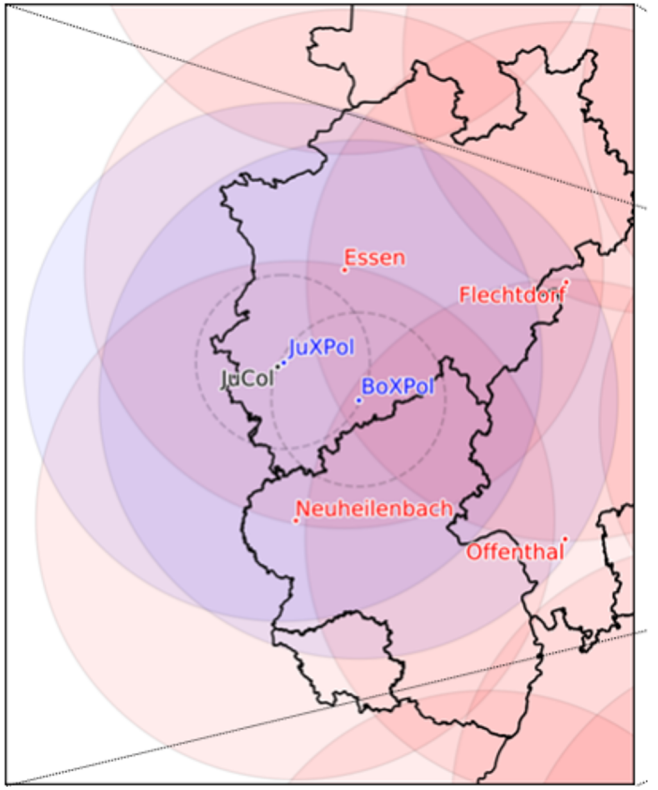
1. What is the maximum lead-time to obtain skillful nowcast? (synoptic situation)
2. How many members are needed?
3. What is its performance compared to the STEPS and ICON-D2-RUC models? (hourly)

C:

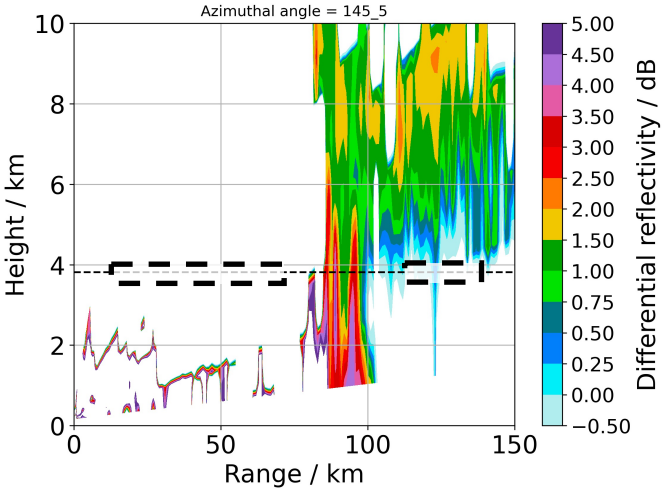
HAILSIZE (ZDR-Columns) → RealPEP (ZDR-Columns)

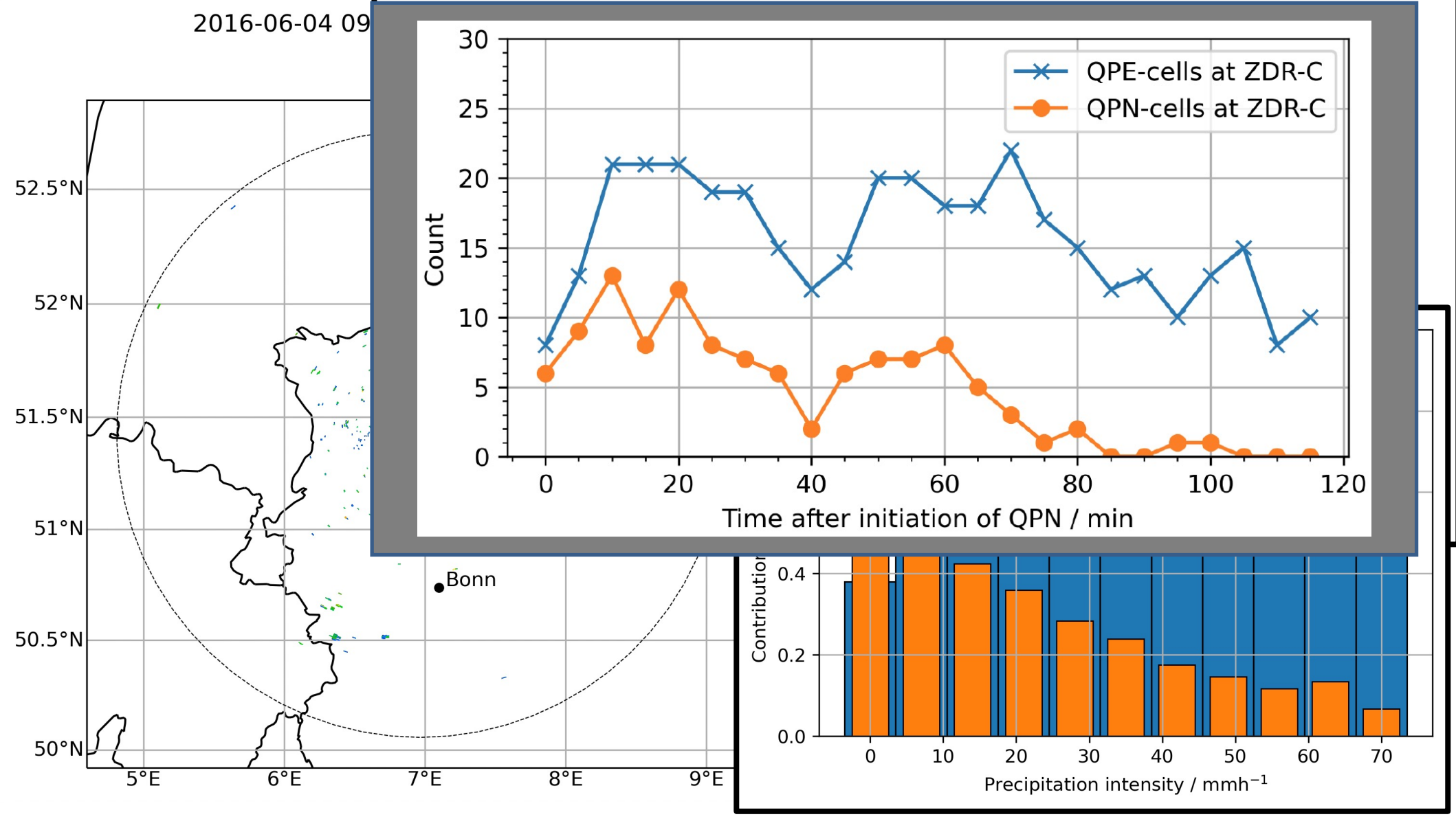


https://www.noaa.gov/



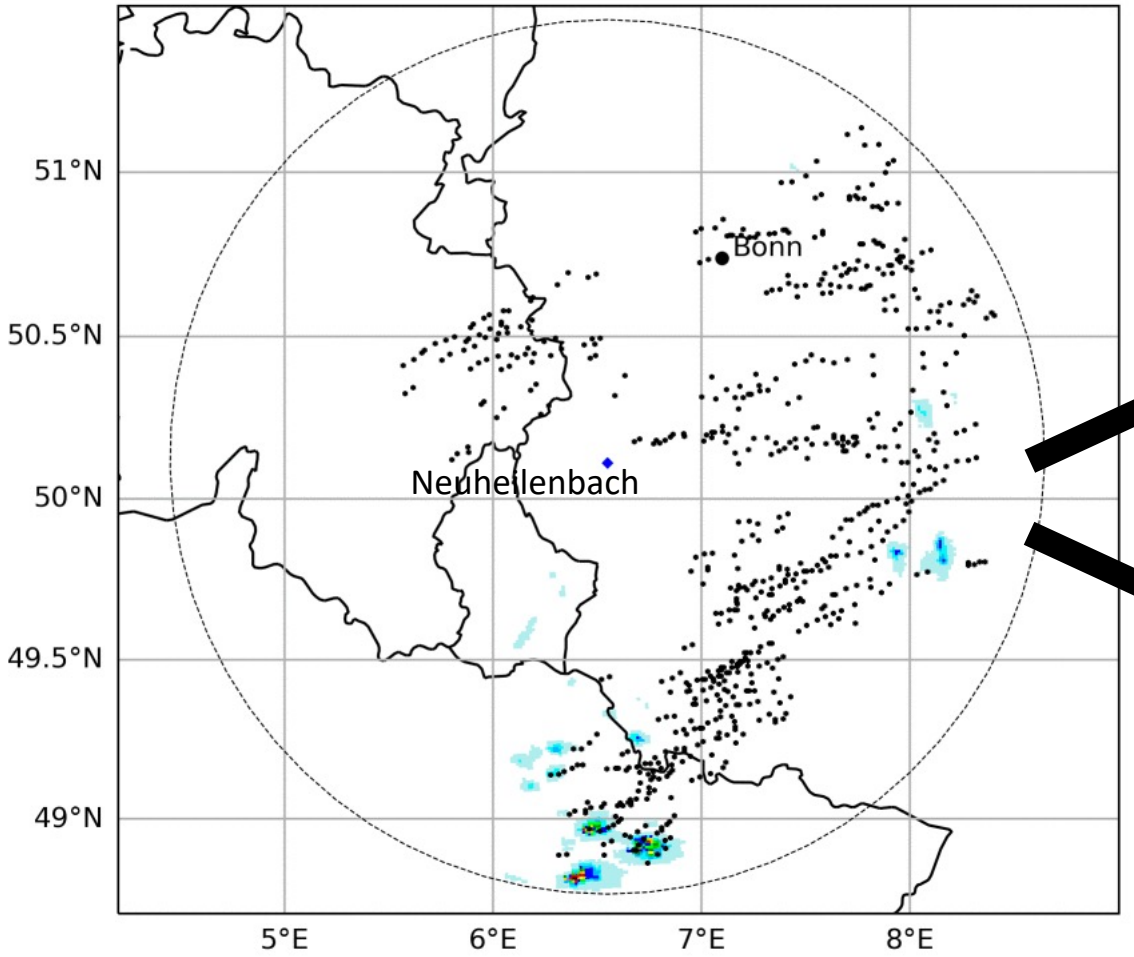
Interpolated vertical structure of Differential Reflectivity

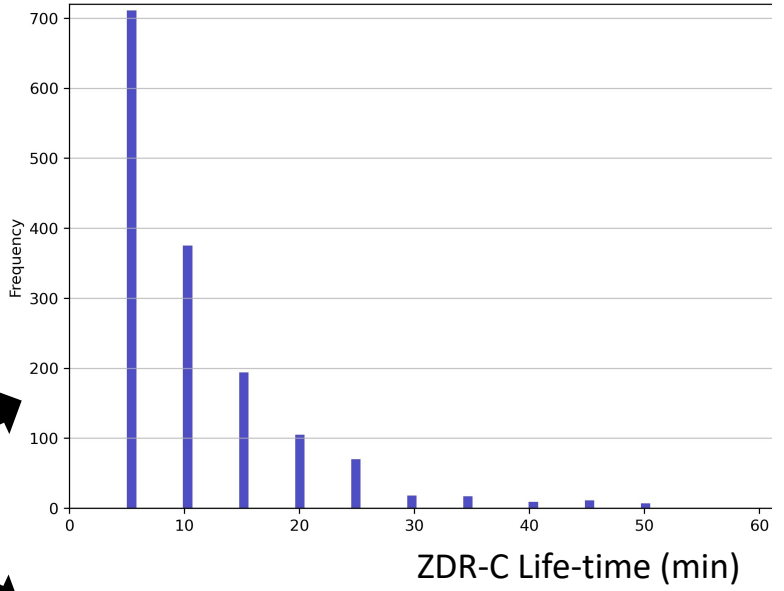


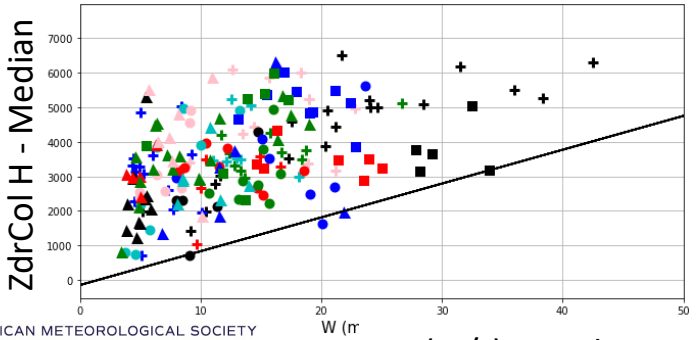

2016-06-04 09
52.5°N
52°N
51.5°N
51°N
50.5°N
50°N
5°E
6°E
7°E
8°E
9°E
Bonn
QPE-cells at ZDR-C
QPN-cells at ZDR-C
Count
Time after initiation of QPN / min
Contribution
Precipitation intensity / mmh^{-1}

Tracking of ZDR-Columns associated with precipitation

2017-06-22 11:00 UTC

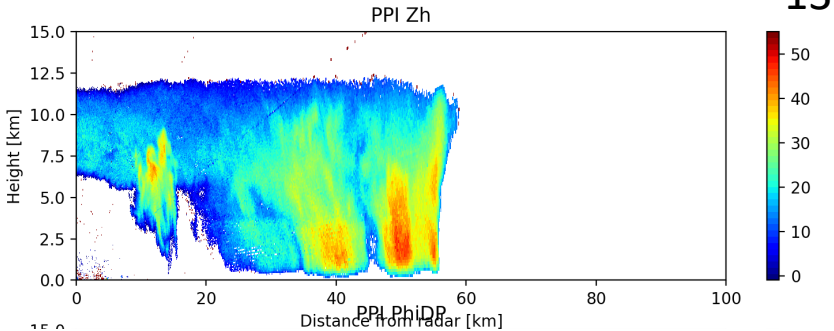


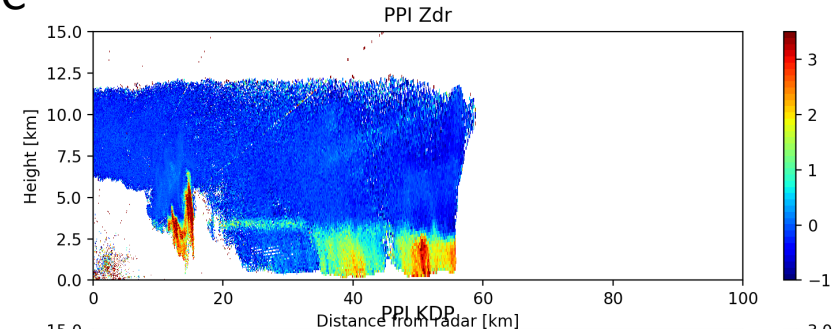




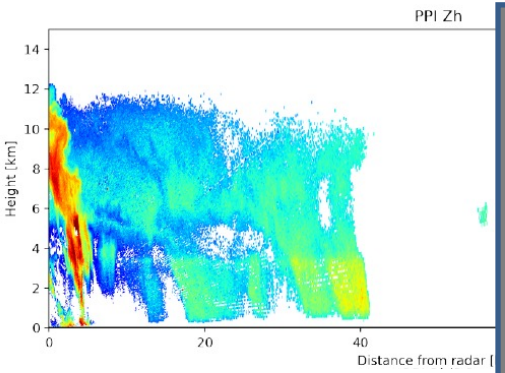
Observation from BoxPOL (X-band radar at Bonn) 2017-06-22

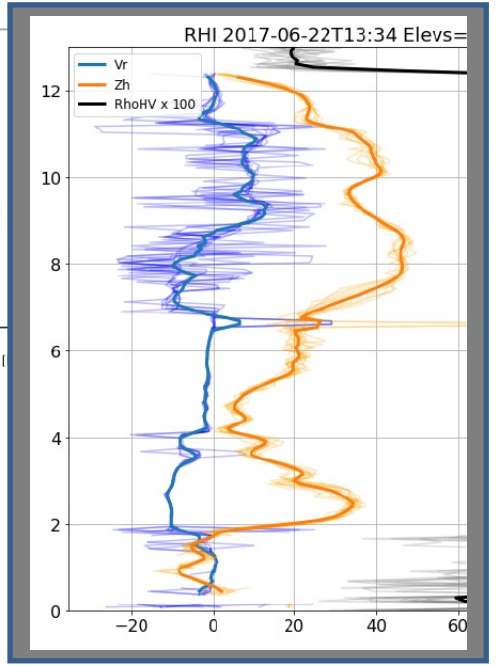
13:20 UTC

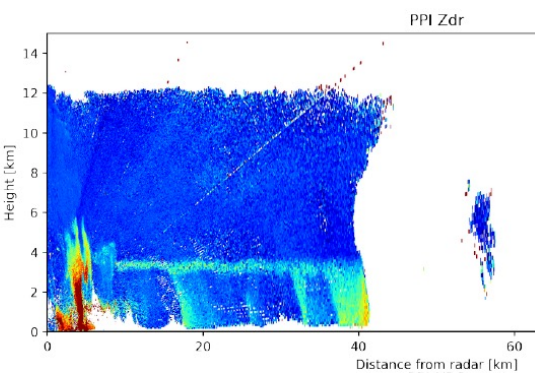




13:35 UTC







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AS1.29

EDI

Aviation Meteorology And Nowcasting: Observations and Models (AMANOM)

Convener: Ismail Gultepe | Co-conveners: Wayne Feltz, Stan Benjamin, Martin Gallagher, Chunsong Lu

Presentations | Wed, 25 May, 10:20–11:50 (CEST) Room 0.11/12

Ongoing collaboration:

- Ju-Yu
- Mohamed

Presentations: Wed, 25 May | Room 0.11/12

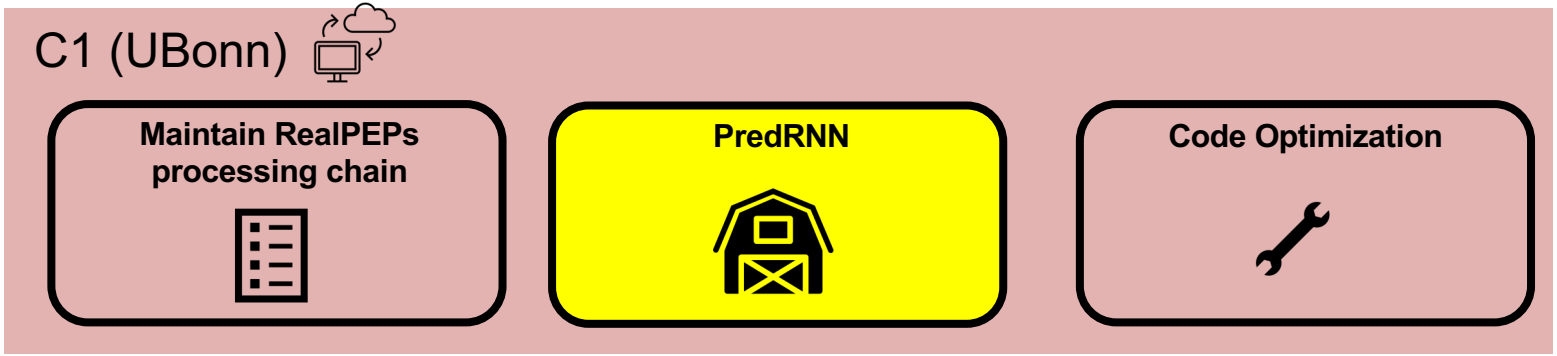
11:19–11:26 | EGU22-11210

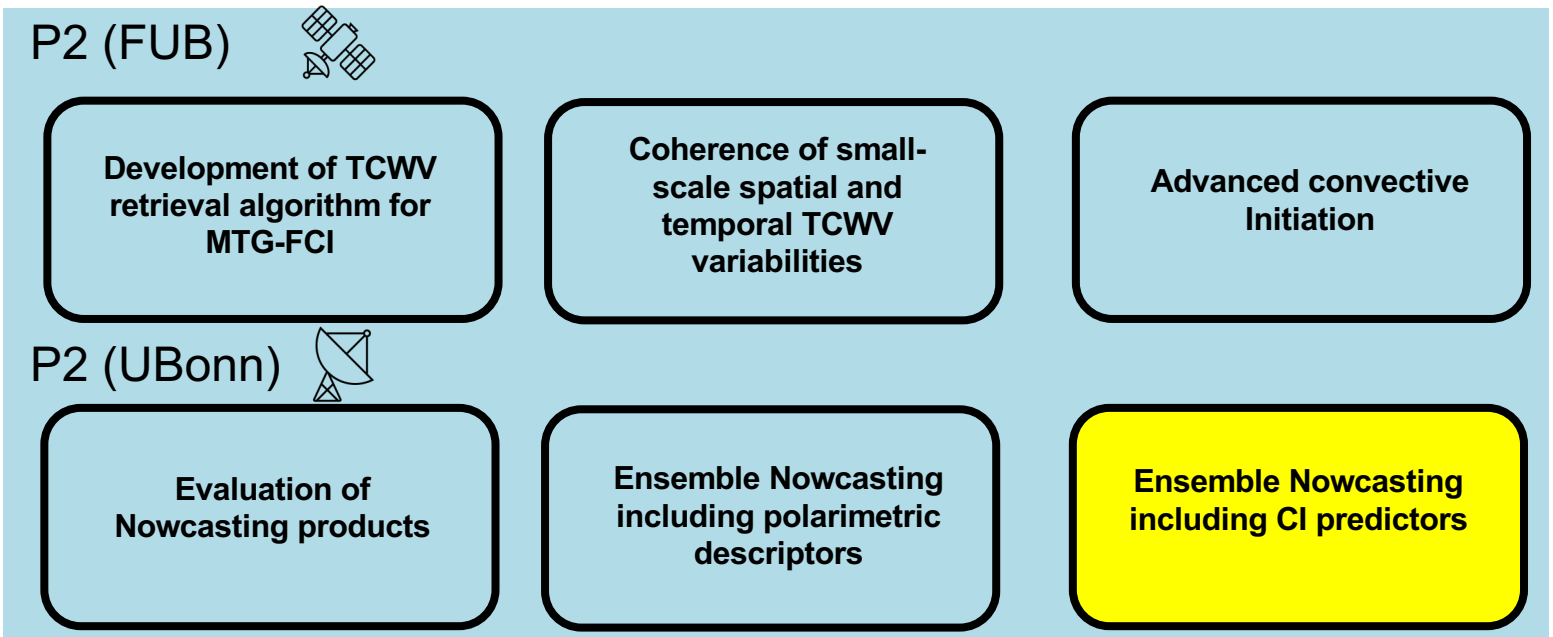
Information content of differential reflectivity columns for precipitation nowcasting

Raquel Evaristo, Ricardo Reinoso Rondinel, Felix Crijnen, Ju-Yu Chen, and Silke Trömel

Columns of differential reflectivity, the difference between the horizontal and vertical reflectivity, hereafter Zdr columns, are vertical columns of enhanced Zdr that extend above the environmental 0°C level. These are easily identified when observed by polarimetric radars. Physically, these columns consist of rain dominated by large drops that are being lofted above the freezing level and have been recognized as a proxy for the location of updrafts. Their potential for nowcasting severe weather has been shown in several past studies. We have developed an algorithm that identifies and tracks Zdr columns from

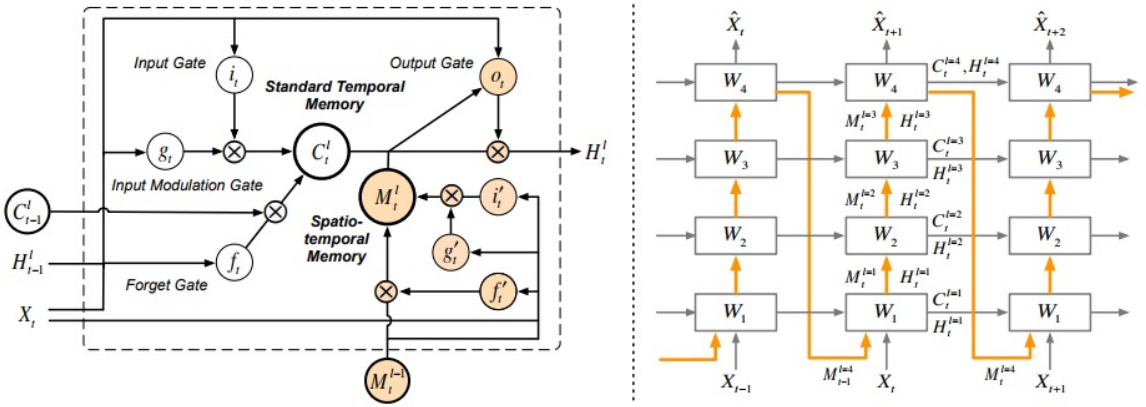
Phase 2 plans





C1

- Predicive Recurrent Neural Network (PredRNN)



- Wang et.al (2017)
- Memory states flow through the Network in a zigzag direction
- Using LSTM and spatiotemporal LSTM, predRNN can efficiently model shape deformations and motion trajectories
- Trained by QPE fields from radar and CML (P1)
- Model implementation in Python/C++

Copy of 4_RNN_AMS_short_course.ipynb ☆

File Edit View Insert Runtime Tools Help Last edited on March 28

+ Code + Text

Recurrent neural network (RNN) for radar nowcasting (ConvLSTM)

Hands-on exercise for AMS short course - AI in Weather Radars

Haonan Chen and V. Chandrasekar

March 28, 2022

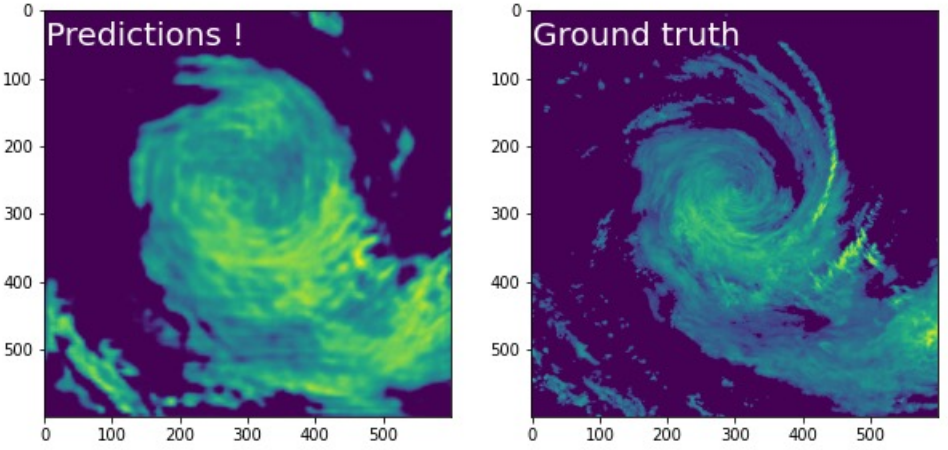
Mount Google Drive to Colab

```
[ ] from google.colab import drive
    drive.mount('/content/drive/')
    %cd /content/drive/My Drive/
    #!ls
```

```
Mounted at /content/drive/
/content/drive/My Drive
```

Import required libs

```
[ ] import numpy as np
    import os
    import time
    import pylab as plt
    import pickle
    import tensorflow as tf
    from tensorflow import keras
    from tensorflow.keras import layers
    import keras.backend as K
    from sklearn.metrics import classification_report
```



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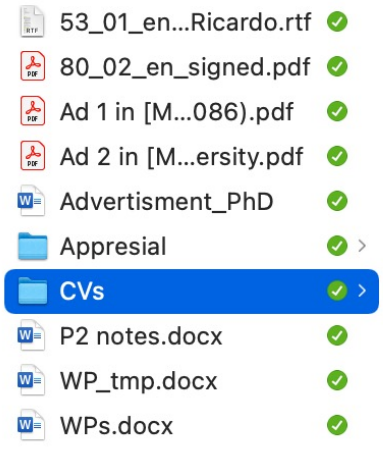
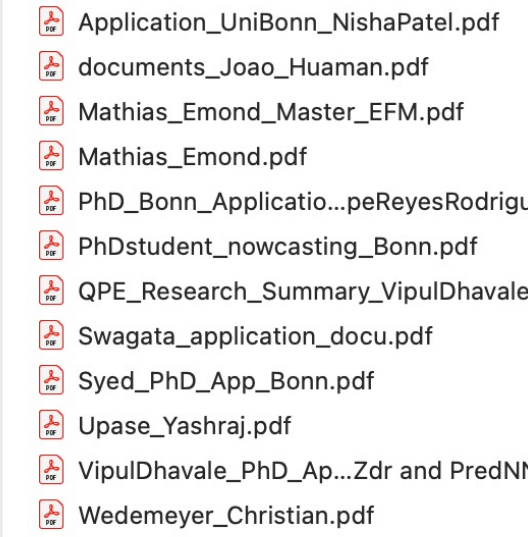
UNIVERSITÄT BONN

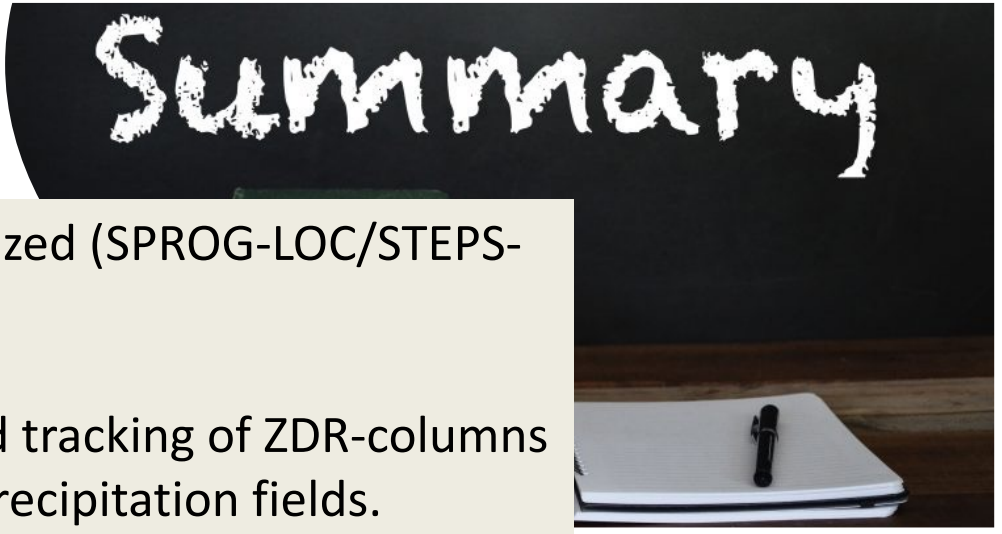
The Institute for Geosciences, Department of Meteorology, of the University of Bonn invites applications for a

Position as PhD student (75% E13 TV-L)

within the second funding phase of the DFG research unit 2589 „Near-Realtime Quantitative Precipitation Estimation and Prediction“ (RealPEP, https://www2.meteo.uni-bonn.de/realpep). RealPEP thrives to achieve significant improvements at all stages along the process chain from Quantitative Precipitation Estimation (QPE), Precipitation Nowcasting (QPN), numerical prediction of quantitative precipitation (QPF) and predicting discharge and potential flash floods in small- to meso-scale catchments (FFP). RealPEP will rely on a multi-sensor data exploitation platform to monitor the precipitation generating atmosphere and tackle urgent science questions to better identify mechanisms that determine the onset, location, intensity, and development of precipitating systems. Developments will be implemented for near-realtime processing in order to be able to mitigate risks to society and ecosystems.







1. Working on the documentation of the localized (SPROG-LOC/STEPS-LOC) algorithms

2. Preliminary results on the identification and tracking of ZDR-columns show a spatial-temporal consistency with precipitation fields.

3. Collaboration with RealPEP partners are ongoing.

4. Hand on recurrent neural network (RNN)

5. PhD student to be confirmed