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Environmental Physics

# Supporting CINDI-3 on-site decision making

with tailored forecasts using  
Flexpart-WRF

CINDI-3 Workshop 2025

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Heidelberg 19.03.2025

The thumbnail shows a page with the following content:

- Top left: Universität Bremen logo.
- Top right: LAMOS logo.
- Center: **CINDI-3 Mobile**  
cindi3, created on 2024-06-15
- Below: From 2024-06-15 00:00:00 to 2024-06-18 00:00:00
- Bottom: **DISCLAIMER: Not an official forecast**  
The forecast is not an official prediction and should not be relied upon as authoritative.  
It was generated using the models WRF and Flexpart, based on GFS data.  
Uncertainties in the model mean that the actual state may differ.  
It is provided for informational purposes only and should be regarded as a general guide.  
Creators assume no liability for any consequences resulting from its use.  
For more information, contact alepou@uni-bremen.de.
- Bottom right: 2024-06-15, Page 01/30

# Motivation

- Campaigns are labor and cost intensive operations
- Positioning of instruments is crucial

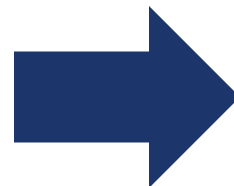
## Stationary

- One time decision

## Mobile

- Daily/Subdaily decision

Tailored forecasts serve as  
foundation for decisions



Effective use of resources  
Minimizing periods with no “signal”

Picture from Frederik Tack



Picture from IUPHB Team

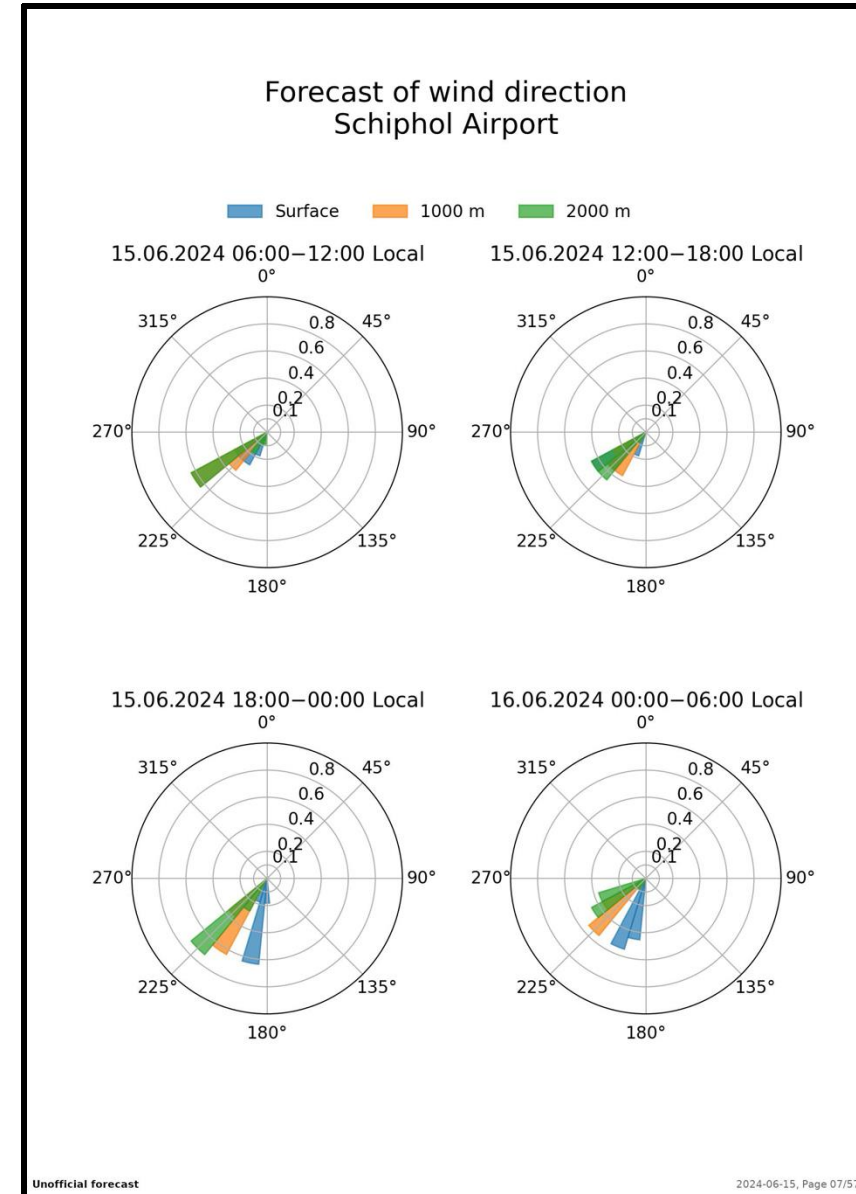


# Tailored to CINDI-3

- Tailored to CINDI-3
  - Cloud cover
  - Precipitation
  - Largest plume positions
  - Wind profiles at Schiphol Airport
  - Some more experimental figures

} Mobile instr.  
planning

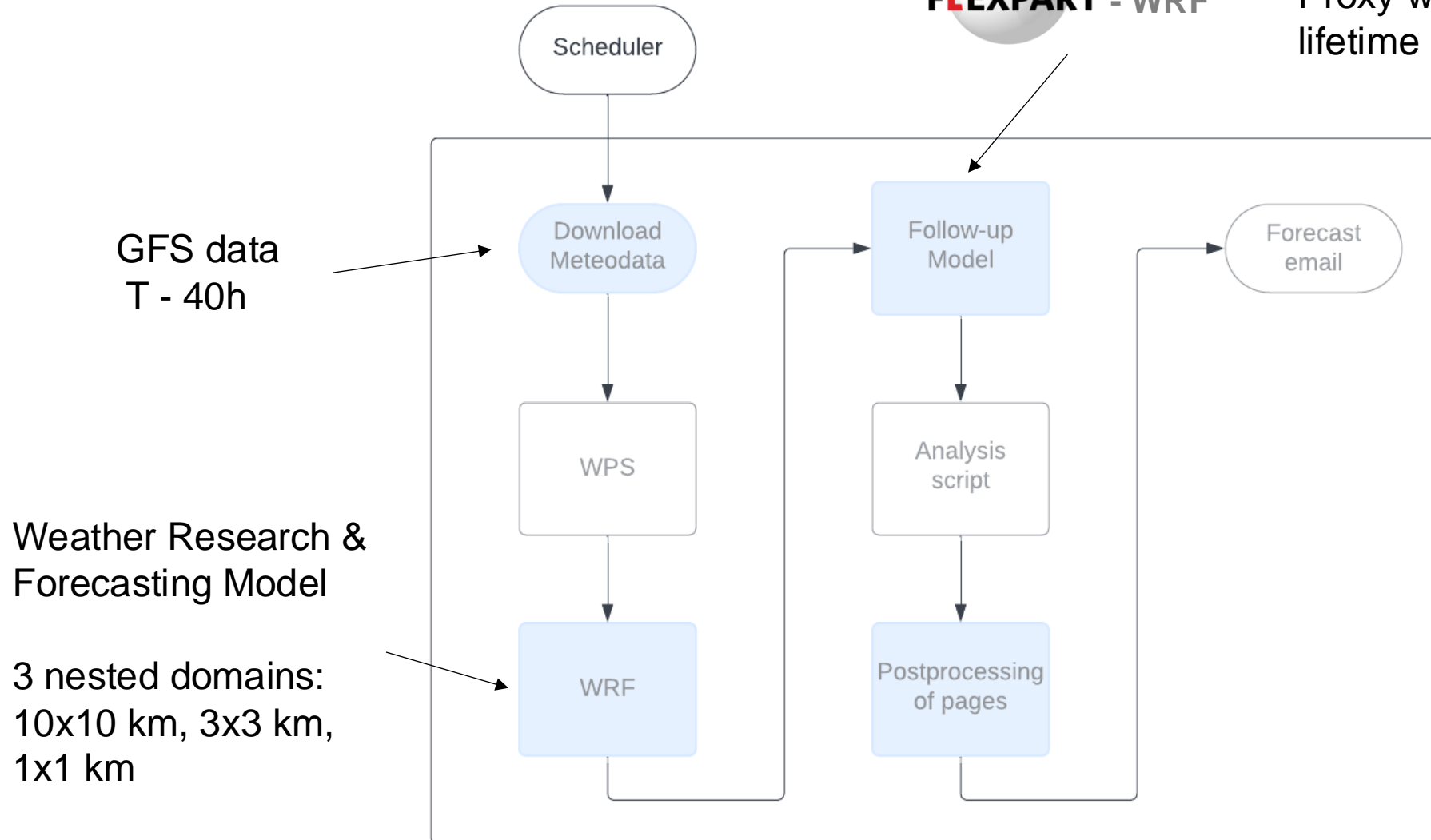
Important for probability  
of flight clearance



# Forecast Setup



- Dispersion model
- Proxy with NO<sub>2</sub>- like lifetime

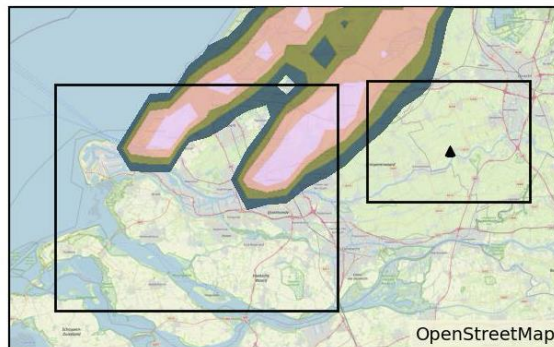


# Flexpart-WRF Setup

## Base case

- Based on CAMS-GLOB-ANT v6.2
- $0.1 \times 0.1^\circ$
- All anthropogenic sectors included

15.06.2024 12:00–18:00 Local



## High resolution

- Top 60 point sources within the region
  - Based on Pollutant Release and Transfer Register (PRTR)

15.06.2024 12:00–18:00 Local



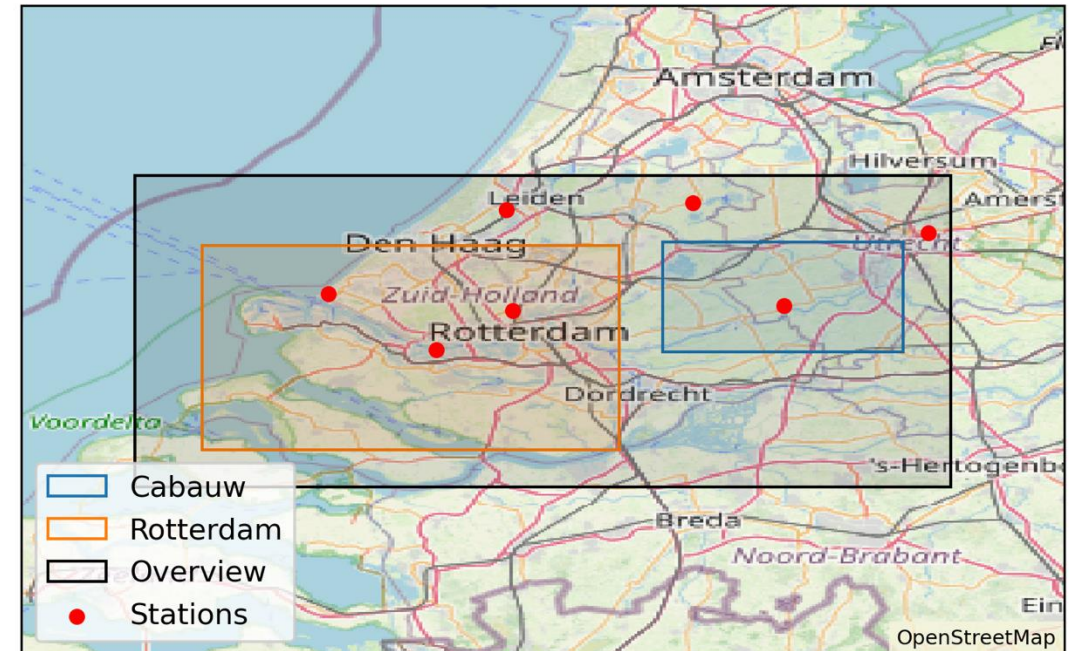
# Comparison to ground stations

- Meteorological data from KNMI
- 7 inside the forecasted area

CINDI-3 Duration

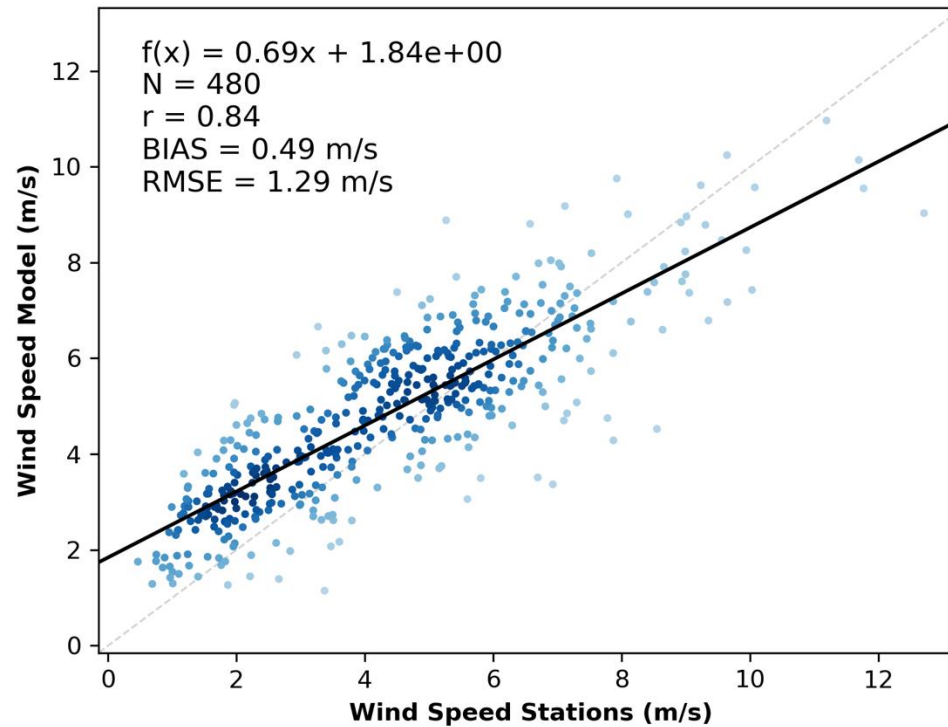
June  
↓

<b>Week 2</b>	27	28	29	30	31	01	02
<b>Week 3</b>	03	04	05	06	07	08	09
<b>Week 4</b>	10	11	12	13	14	15	16
<b>Week 5</b>	17	18	19	20	21	22	23

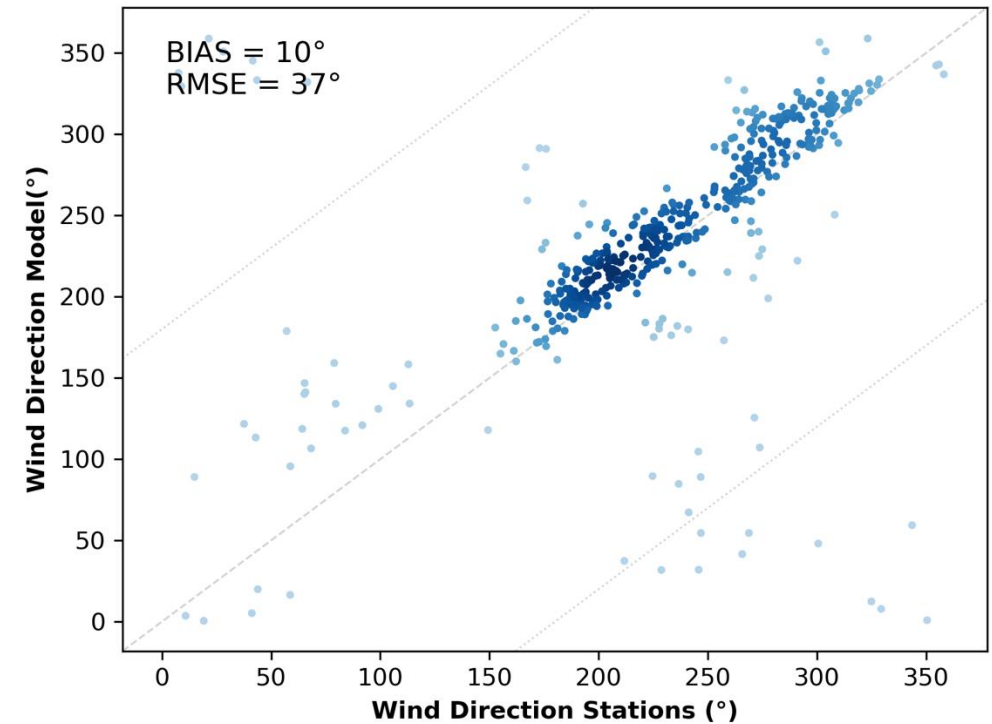


# Comparison to stations

Wind speed  
(6 hour mean)



Wind direction  
(6 hour mean)

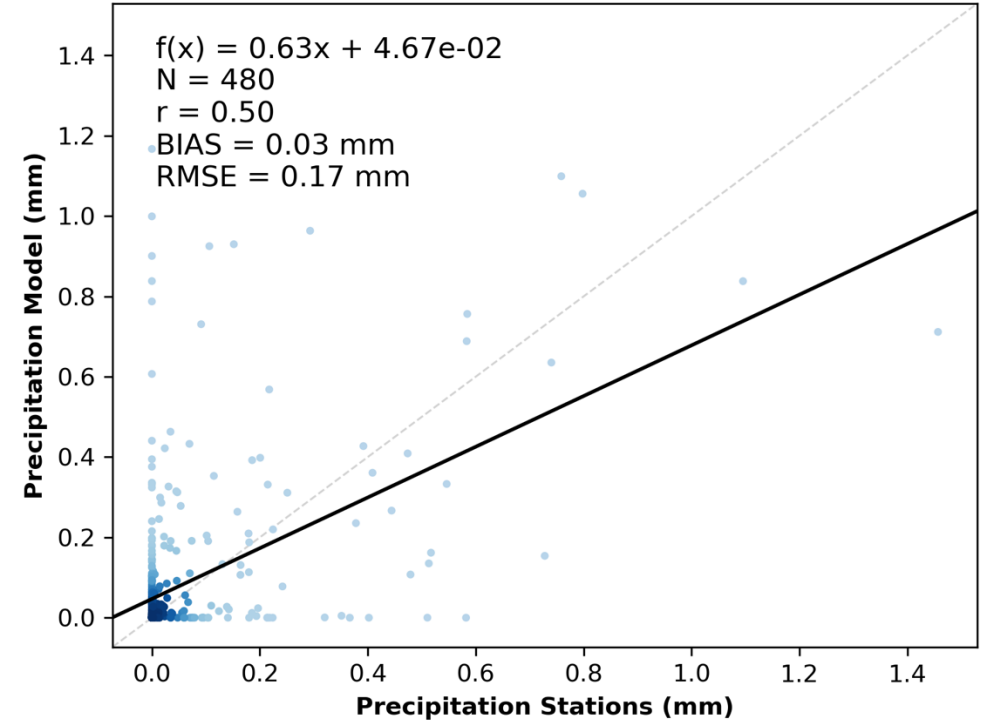
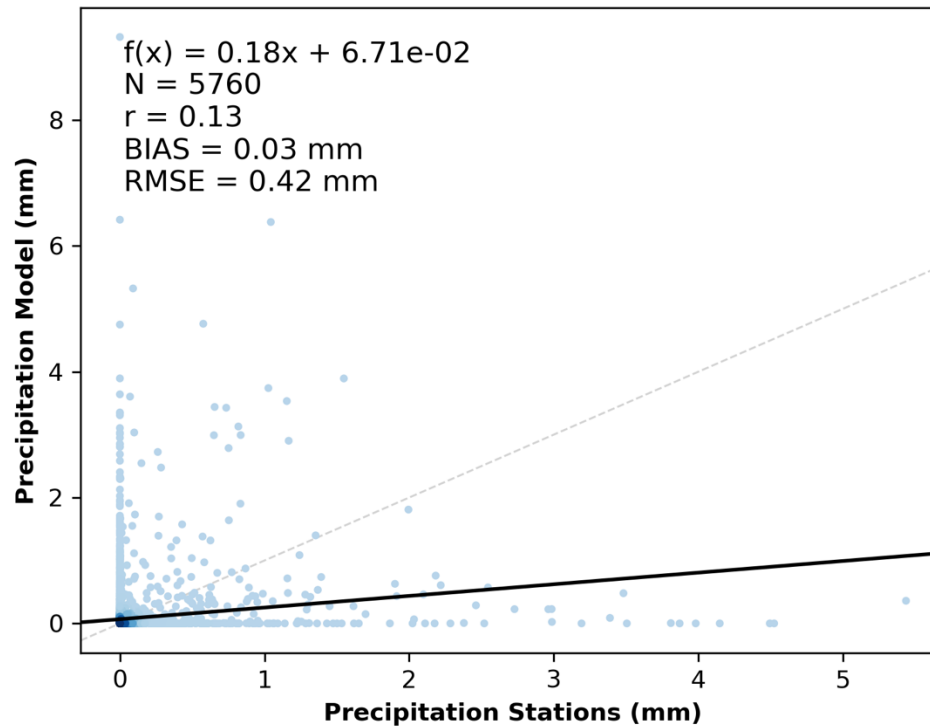


# Comparison to stations

Temporal binning

Precipitation  
(30 minute sum)

Precipitation  
(6 hour mean)

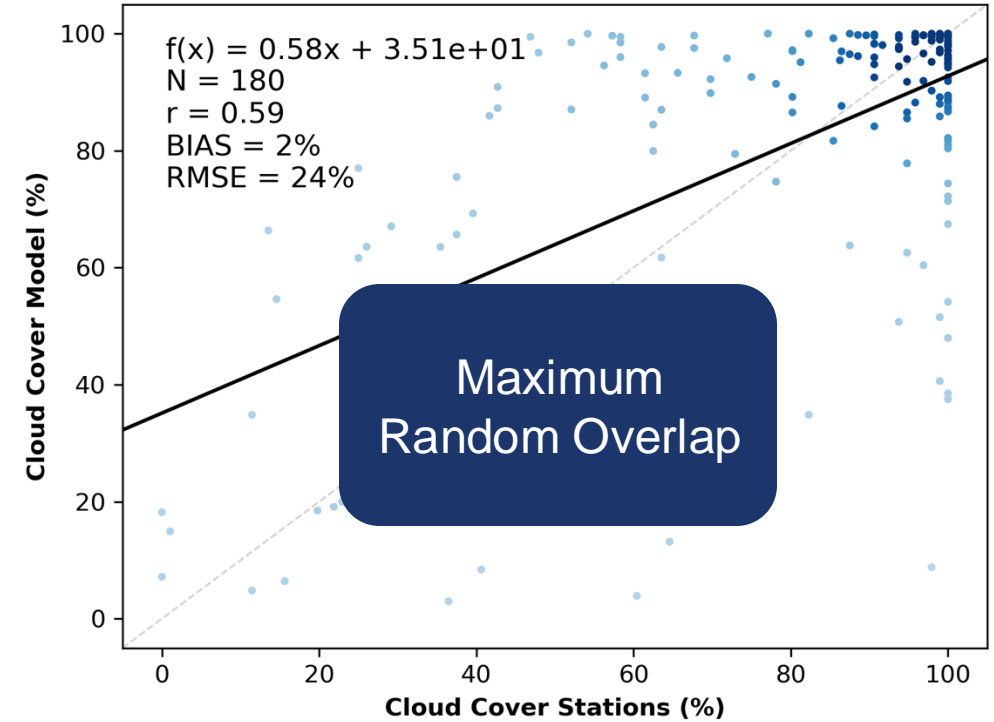
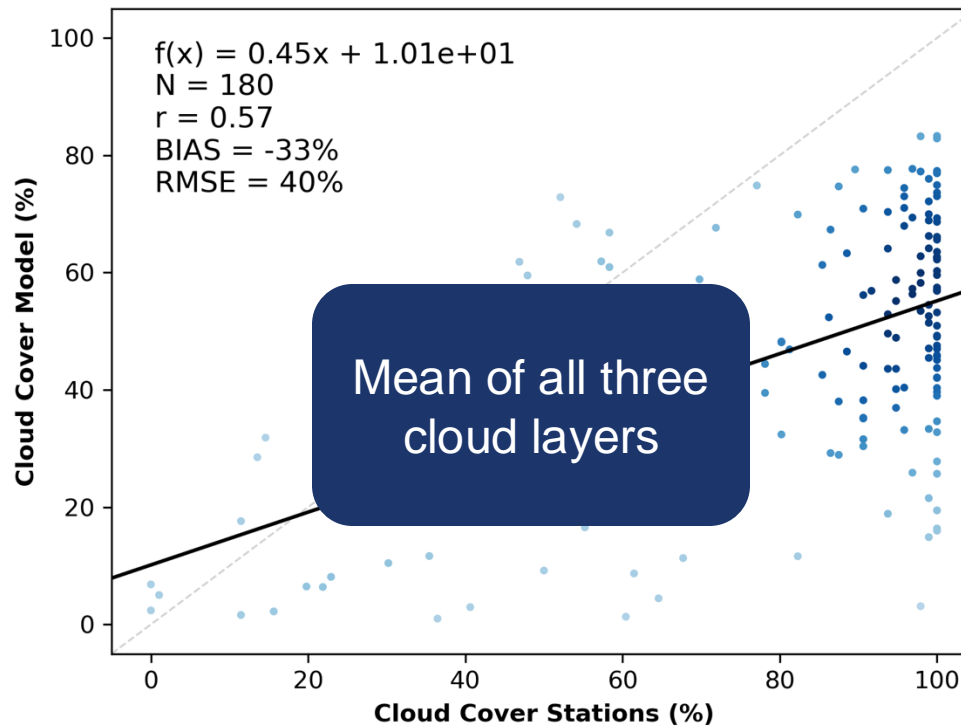


# Comparison to stations

Change in computation

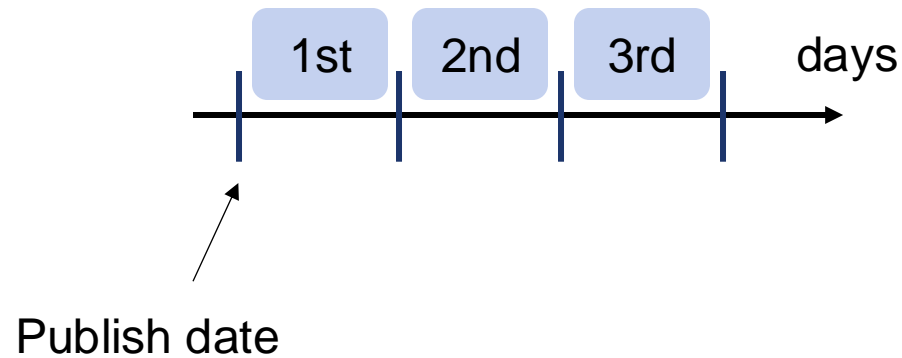
Cloud cover  
(6 hour mean)

Cloud cover  
(6 hour mean)

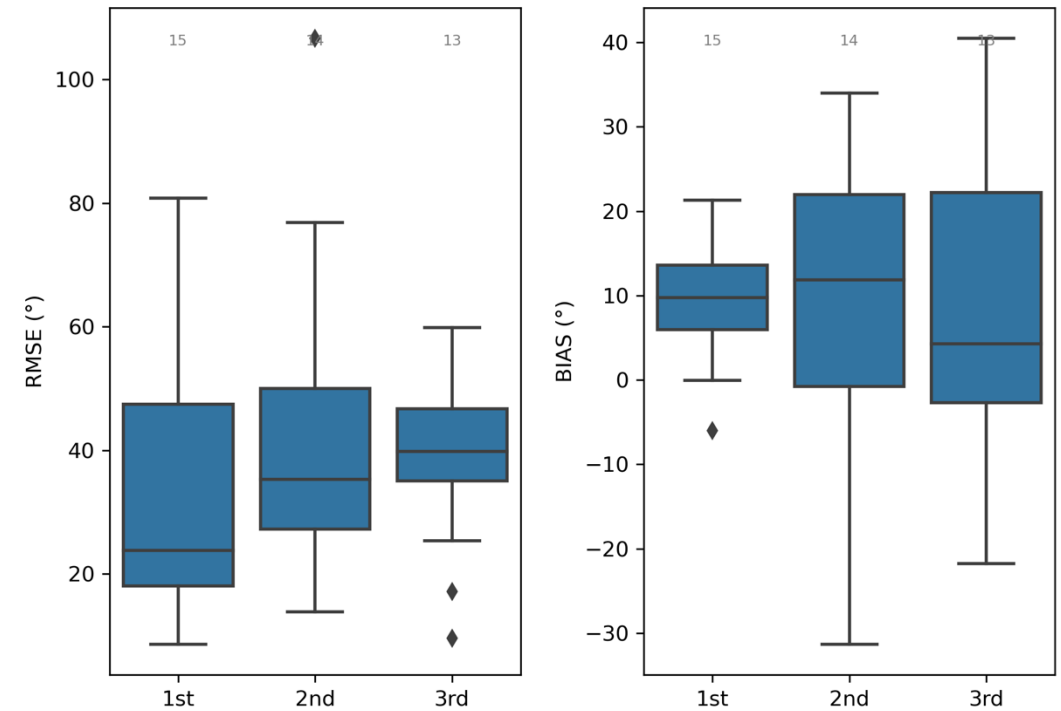


# How much does it worsen?

- Published multiple days in advance

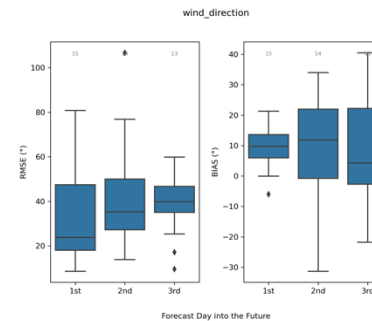
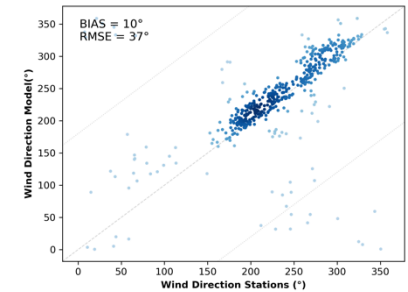
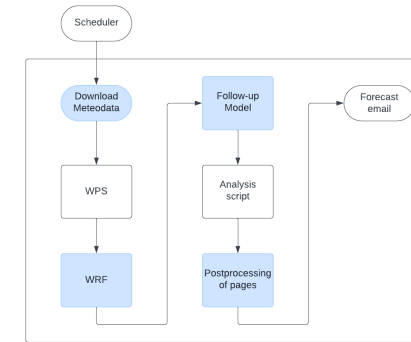


## Wind direction



# Summary

- Working automated tailored forecasting system
- Good agreement for wind speed/direction
  - New cloud cover computation more accurate
  - Precipitation timing hard
- Expected degradation towards days further ahead in the forecast



# Outlook

- Compare forecasts with output using reanalysis data
- Validation of "plume model"
  - Compare  $\text{NO}_2$  magnitude with DOAS data
  - Validate plume locations with mobile platforms

Open for collaborations!

