OpenSense Training School

OS-based nowcasting with pysteps

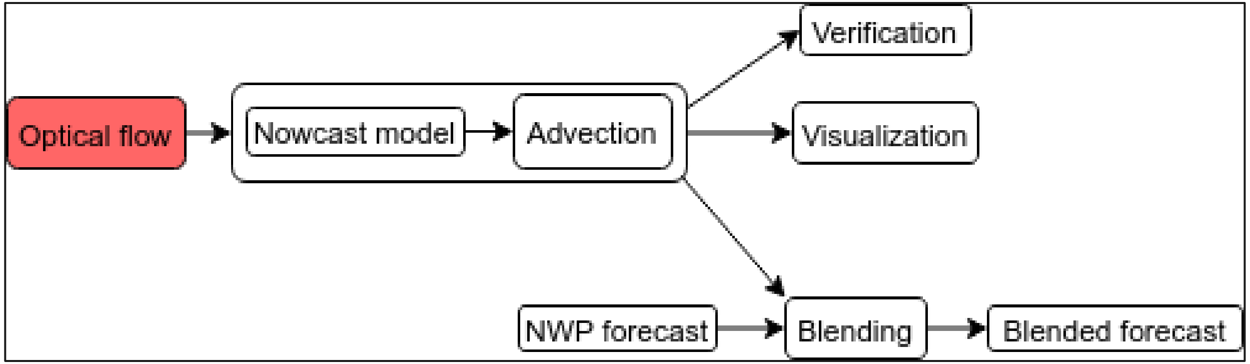
Wrap up and closure

Training instructors:

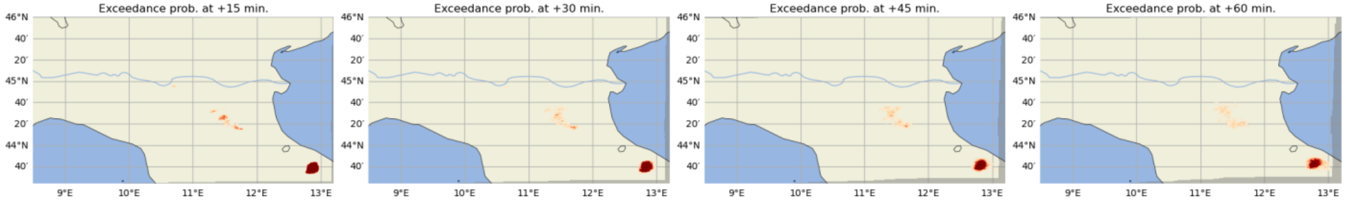
Jenna Ritvanen (Finnish Meteorological Institute) and Ruben Imhoff (Deltares)

What we have learned today

Reading data with pysteps and a full nowcasting workflow



Reading data with pysteps and a full nowcasting workflow


Exceedance prob. at +15 min.
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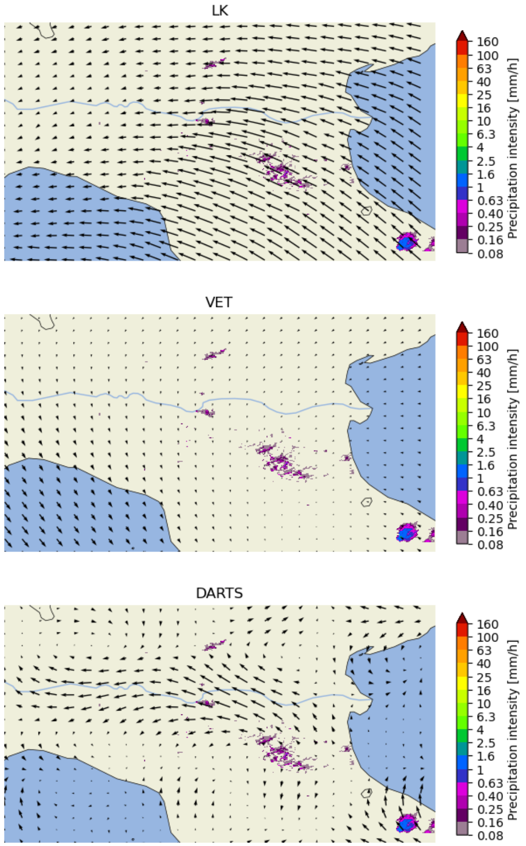


Your experience

- Was it easy/hard?
- Do you think you could make a nowcast yourself now with your own data?

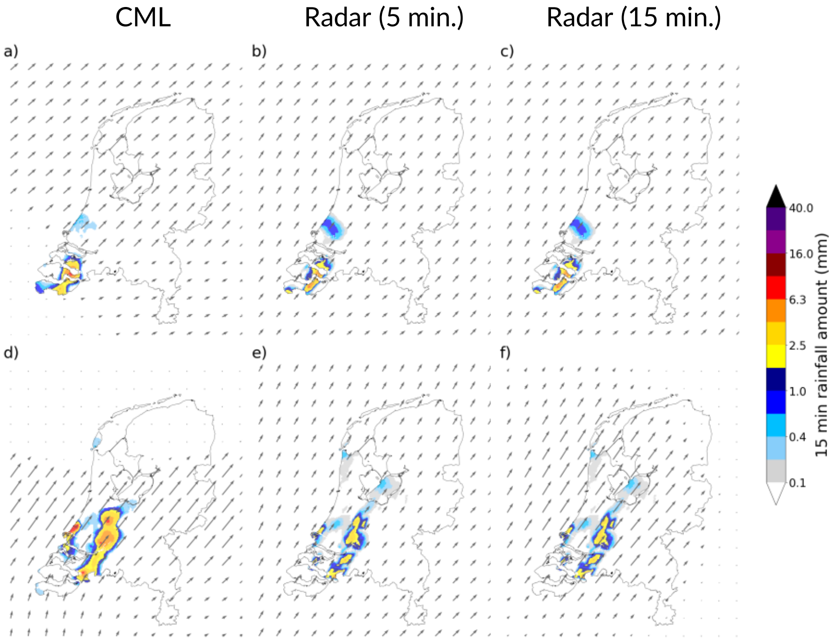
- How did the different nowcasts (methods) compare?
- What was the quality of the nowcasts with the different OS product?

- Further questions?

Challenges when using OS data compared to conventional radar data

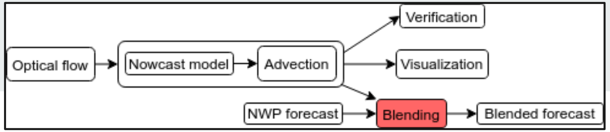
Challenges when nowcasting with OS data

- Advection field derivation
- Data consistency
- What challenges did you come across?
- Can we directly go for nowcasting with OS data?
- How to improve it?



Imhoff et al., GRL, 2020

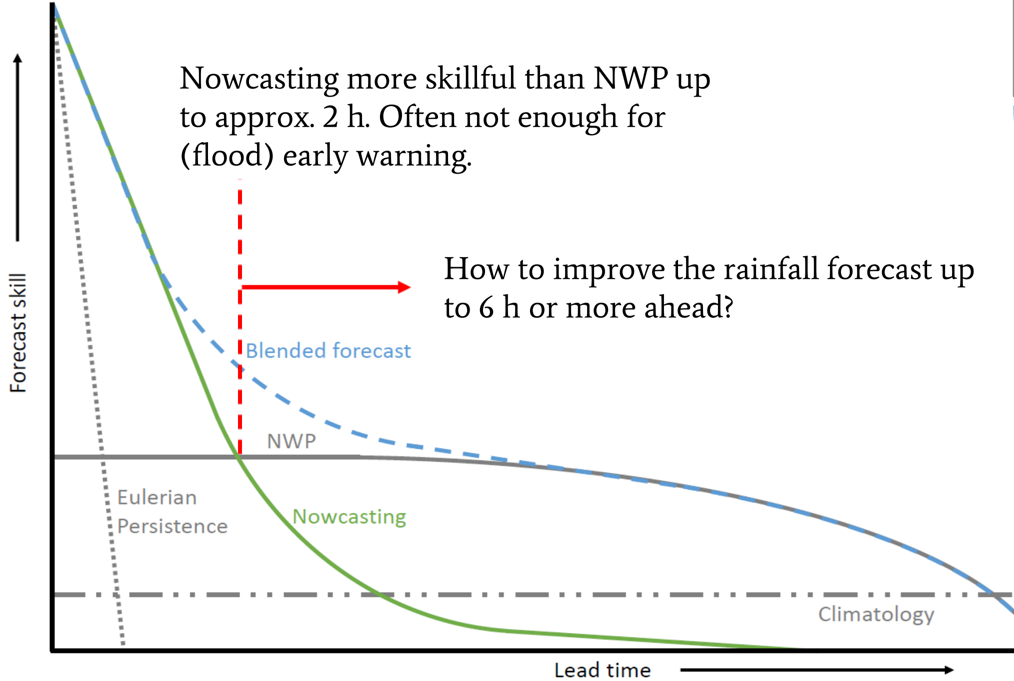
What more is possible with pysteps?



Optical flow → Nowcast model → Advection → Verification, Visualization, Blending

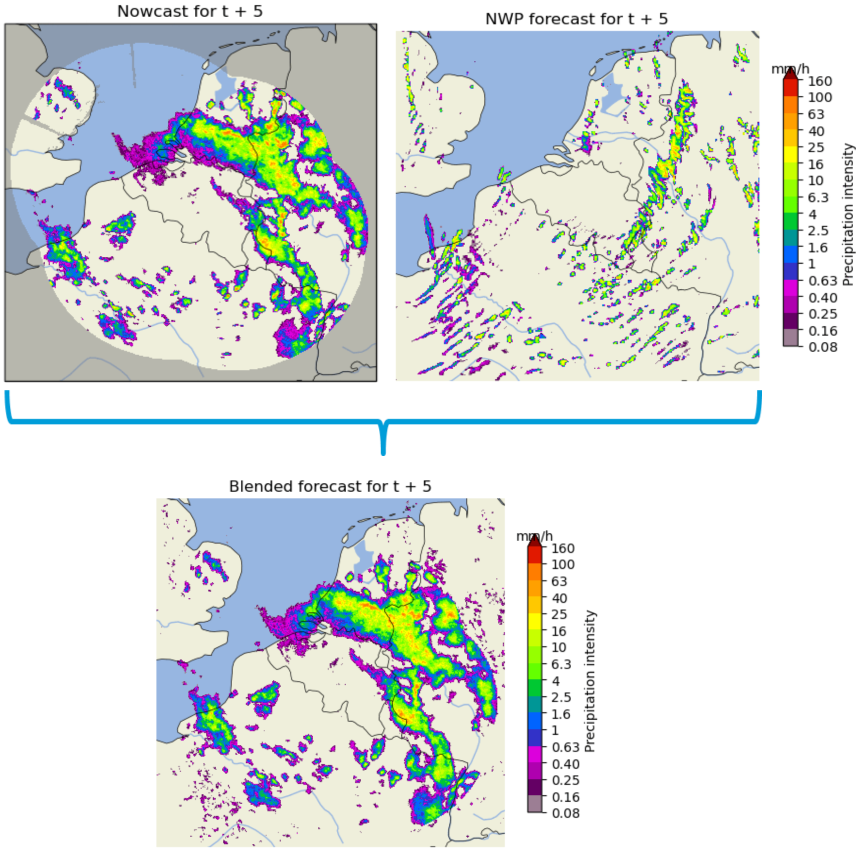
NWP forecast → Blending → Blended forecast

Blending with NWP



Nowcasting more skillful than NWP up to approx. 2 h. Often not enough for (flood) early warning.

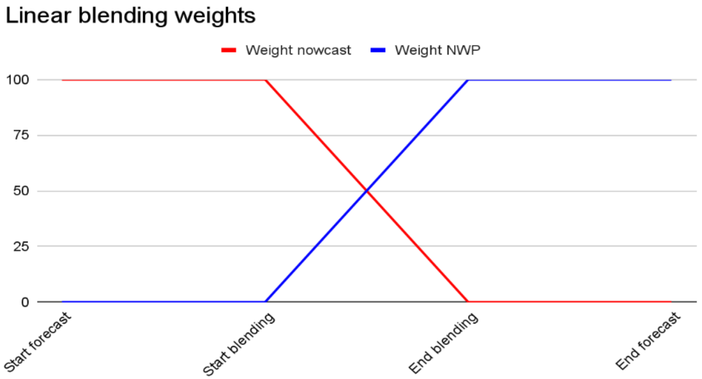
How to improve the rainfall forecast up to 6 h or more ahead?



Blending with NWP: methods in pysteps

1. Linear blending

- Fixed start and end point of blending procedure
- Weights go linearly from 1 to 0 and 0 to 1.

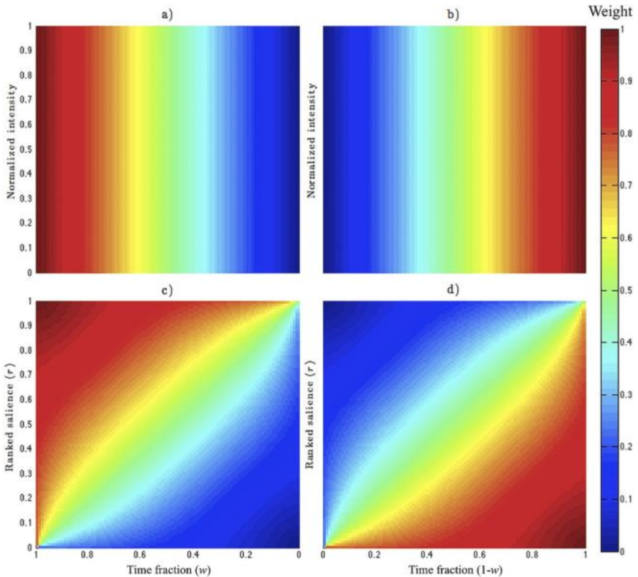


2. Saliency-based blending

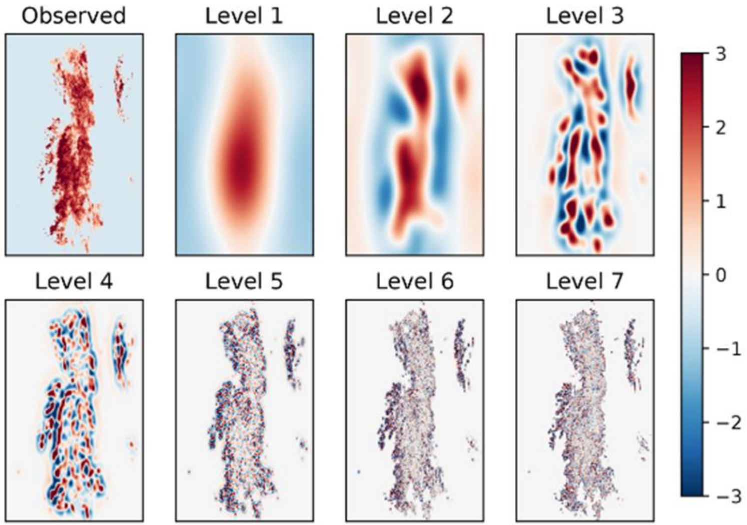
- Similar to linear blending, but:
- Preserves pixel intensities over time if they are strong enough according to their ranked salience.

Hwang et al., 2015, Weather and Forecasting

3. STEPS blending (see next slide)

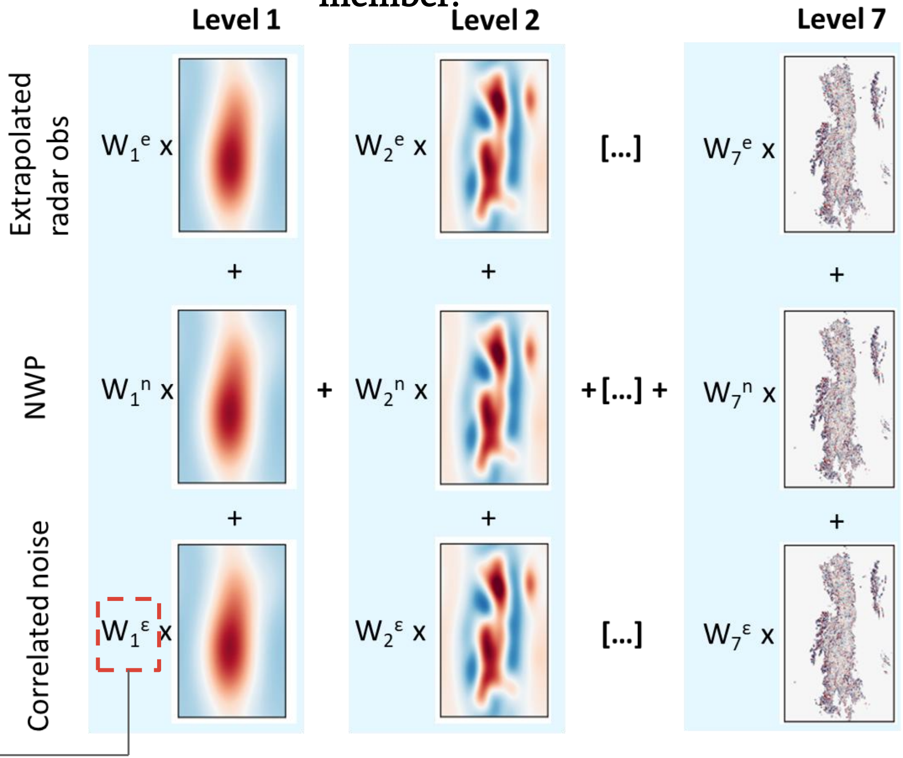


The STEPS method



Pulkkinen et al., 2019

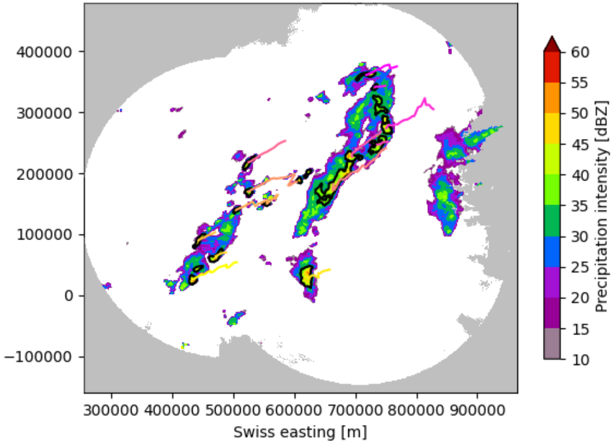
Per ensemble member:

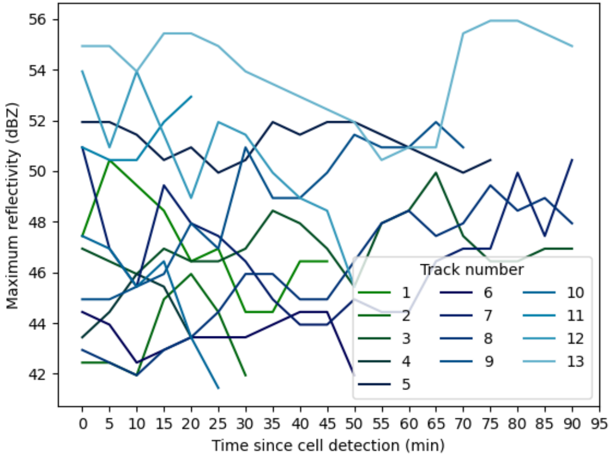


Blending weights depend on initial and expected future skill

T-DaTing module: Thunderstorm Detection and Tracking

- Identify and track thunderstorm cells from radar images
- Visualize cells and tracks in time
- Study properties of the cell tracks
- Tracking algorithm from the Swiss TRT Thunderstorms Radar Tracking algorithm
  - Hering et al., 2004, ERAD 2004
  - Feldmann et al., 2021, Weather Clim. Dynam
- For how to use, see the example in the gallery

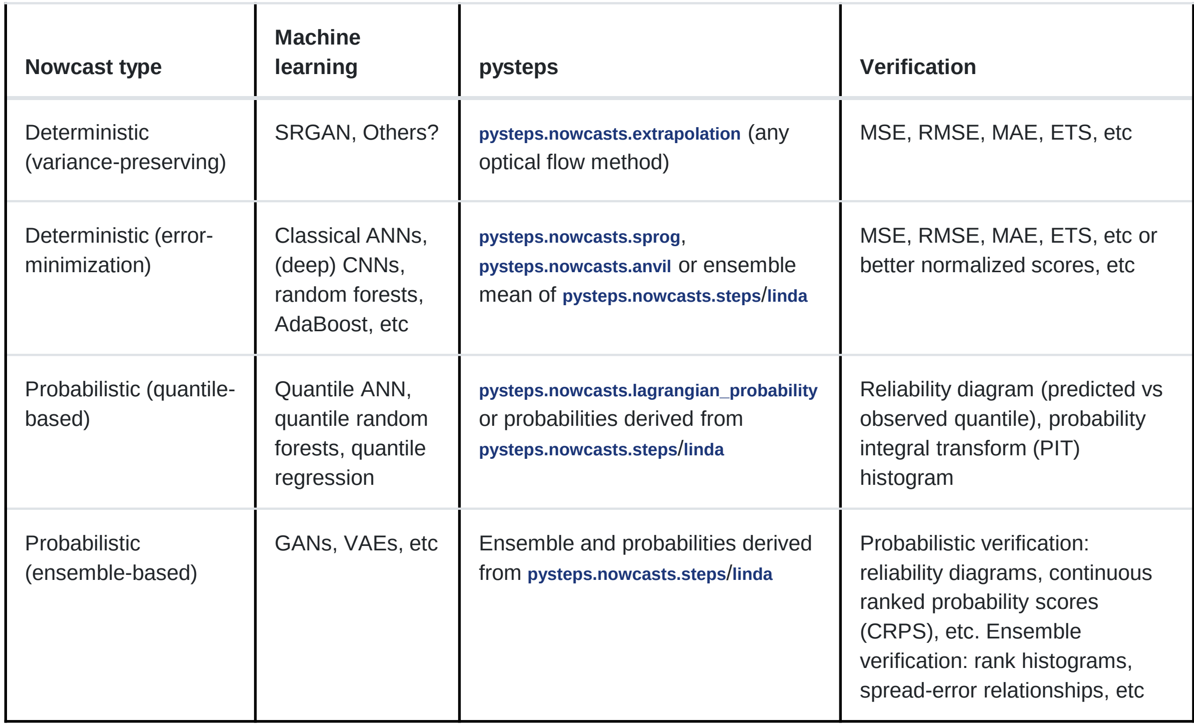




Benchmarking other methods

- When selecting correct method to benchmark against e.g. machine learning models, consider what do you want to achieve with the model
  - preserve variance
  - minimize error
  - represent uncertainty?
- To get comparable forecasts, use methods that try to achieve similar objectives
- For a more detailed discussion, see the documentation

From the documentation:



Nowcast type	Machine learning	pysteps	Verification
Deterministic (variance-preserving)	SRGAN, Others?	**pysteps.nowcasts.extrapolation** (any optical flow method)	MSE, RMSE, MAE, ETS, etc
Deterministic (error-minimization)	Classical ANNs, (deep) CNNs, random forests, AdaBoost, etc	**pysteps.nowcasts.sprog**, **pysteps.nowcasts.anvil** or ensemble mean of **pysteps.nowcasts.steps/linda**	MSE, RMSE, MAE, ETS, etc or better normalized scores, etc
Probabilistic (quantile-based)	Quantile ANN, quantile random forests, quantile regression	**pysteps.nowcasts.lagrangian_probability** or probabilities derived from **pysteps.nowcasts.steps/linda**	Reliability diagram (predicted vs observed quantile), probability integral transform (PIT) histogram
Probabilistic (ensemble-based)	GANs, VAEs, etc	Ensemble and probabilities derived from **pysteps.nowcasts.steps/linda**	Probabilistic verification: reliability diagrams, continuous ranked probability scores (CRPS), etc. Ensemble verification: rank histograms, spread-error relationships, etc

Thank you!

Jenna Ritvanen (Finnish Meteorological Institute) and Ruben Imhoff (Deltares)