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SCREEN CAPTURE
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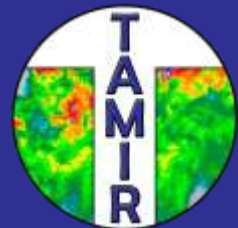
Object-based tracking and nowcasting of gust fronts

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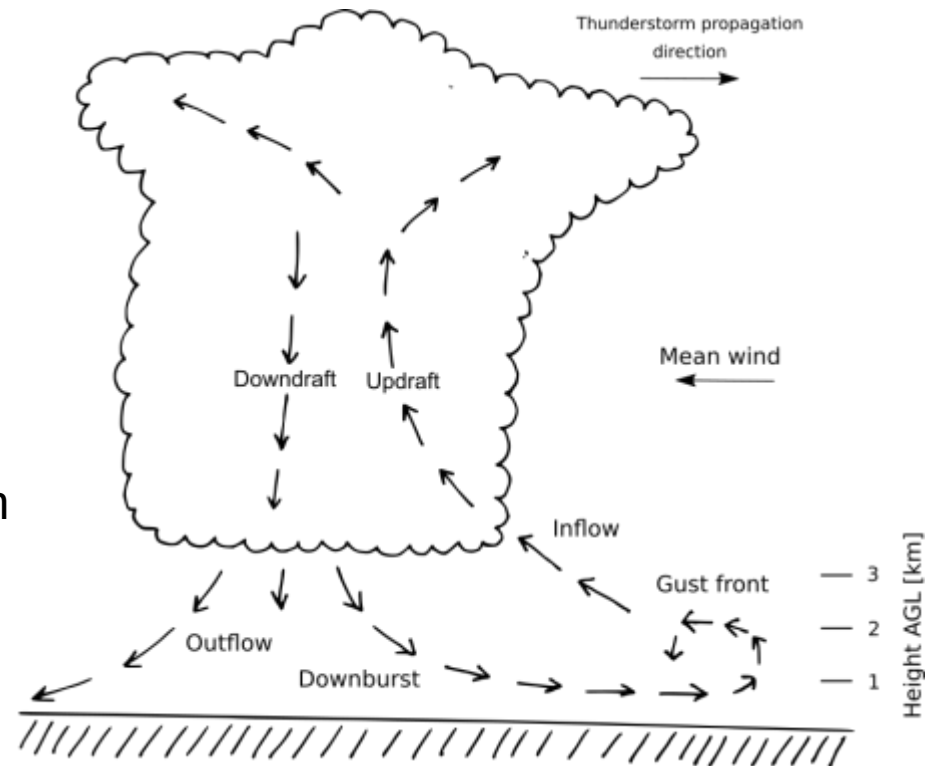
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Gust fronts in thunderstorms are hazardous to society

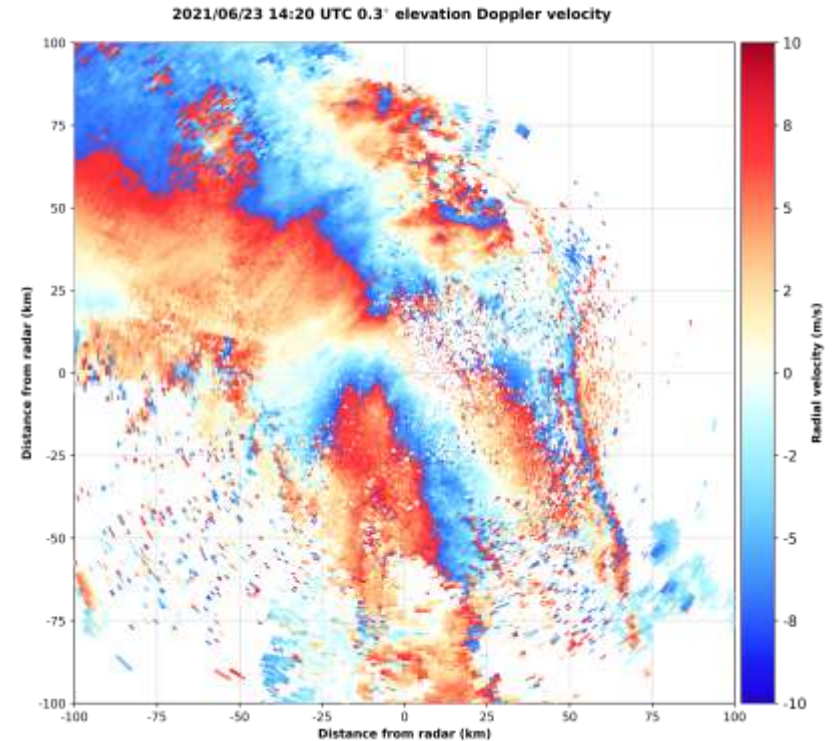
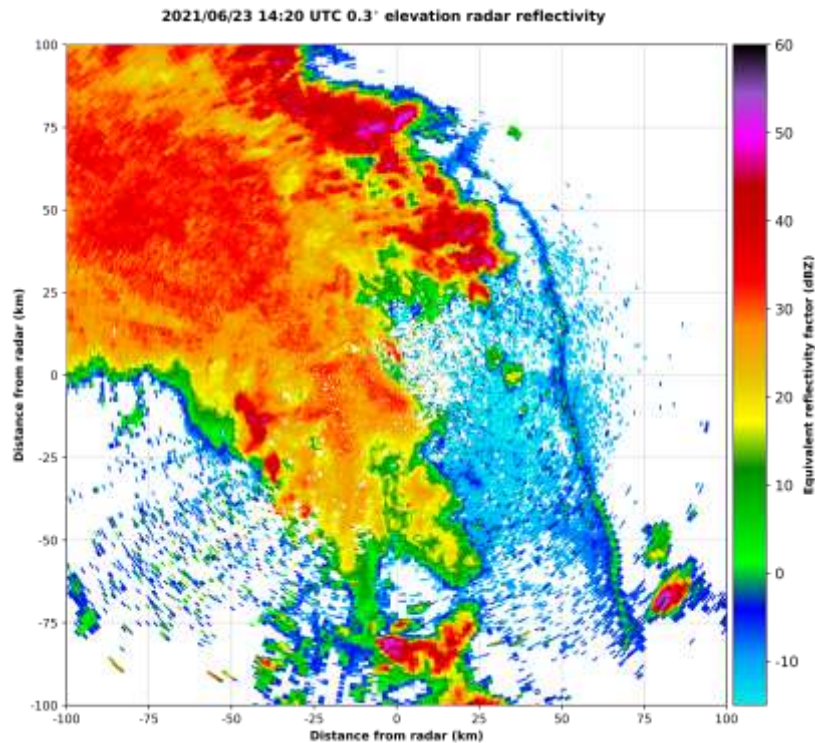
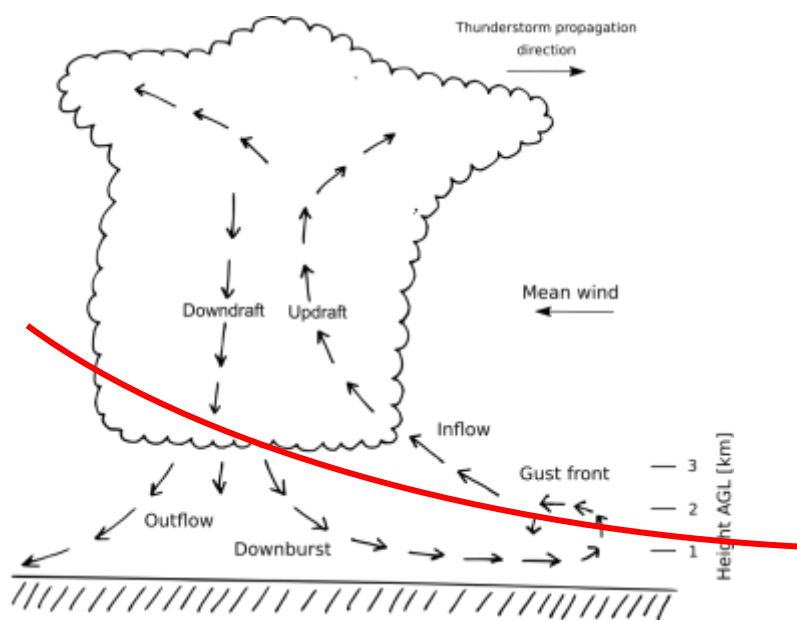
- Reliable short-term forecasts - i.e. nowcasts - of gust fronts would increase safety and reduce costs for example in aviation
- Advantages of object-based nowcasting
 - Several observation sources can be combined
 - The forecast can be augmented with additional information about the hazard
- Thunderstorm development can be observed by weather radars typically every 5 minutes



Gust fronts in weather radar

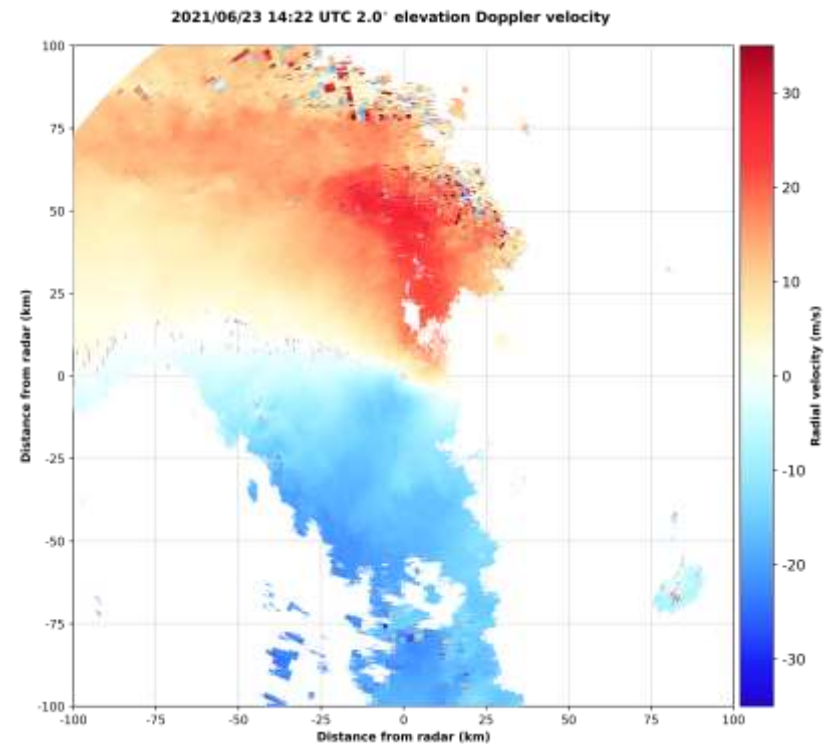
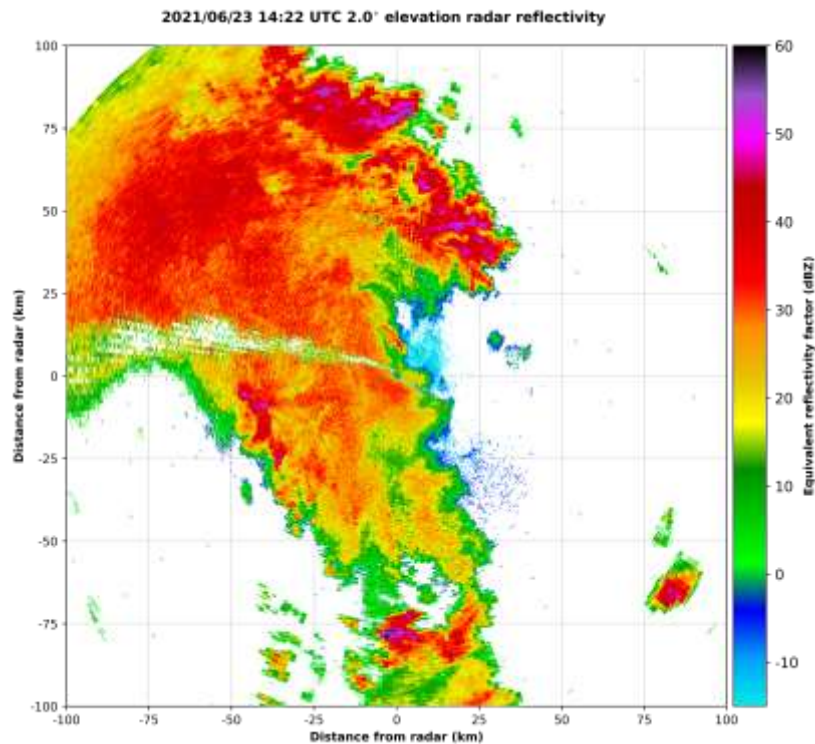
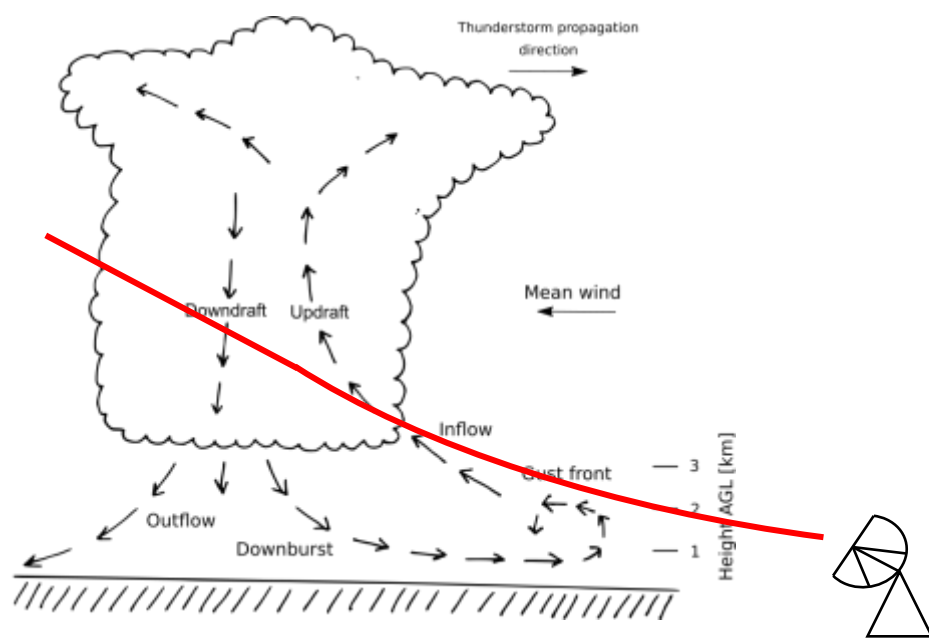
Low elevation radar reflectivity images can capture the thin-line signature of the gust front.

If the thin-line signature is not seen, the wind hazards can be detected from the Doppler velocity.



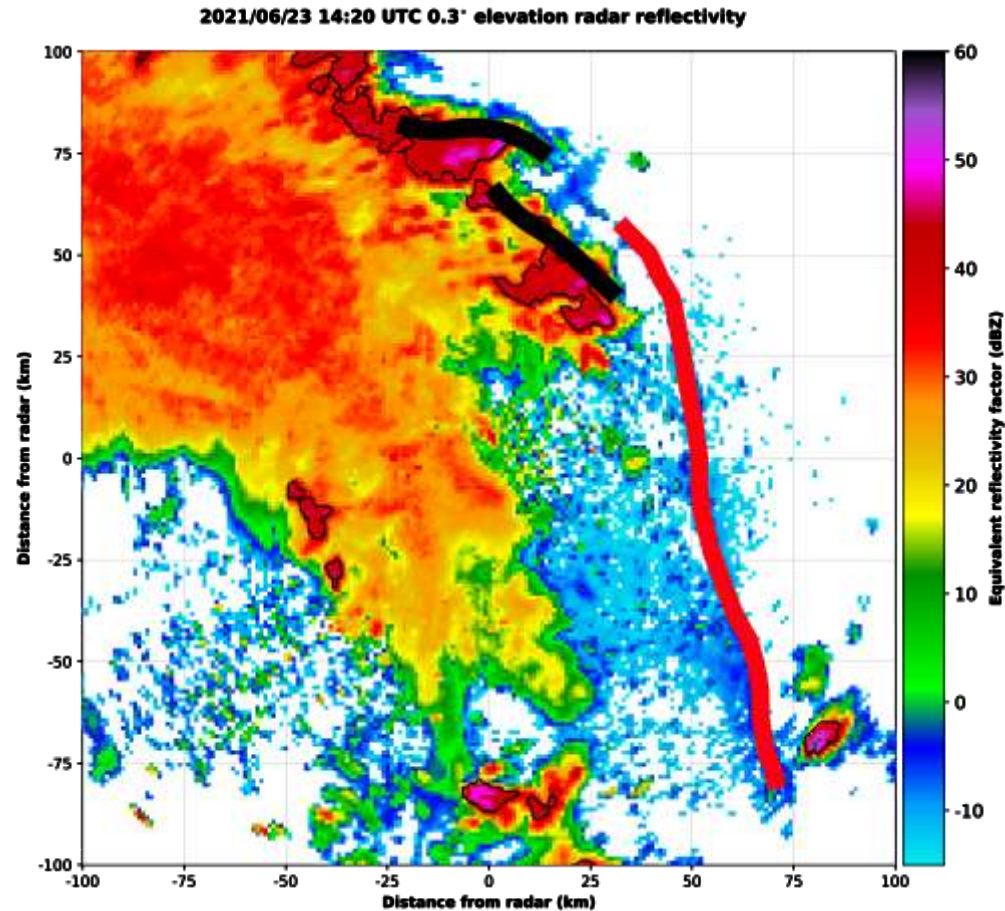
Gust fronts in weather radar

Higher elevation radar images can capture the strong wind shear area inside the cloud.

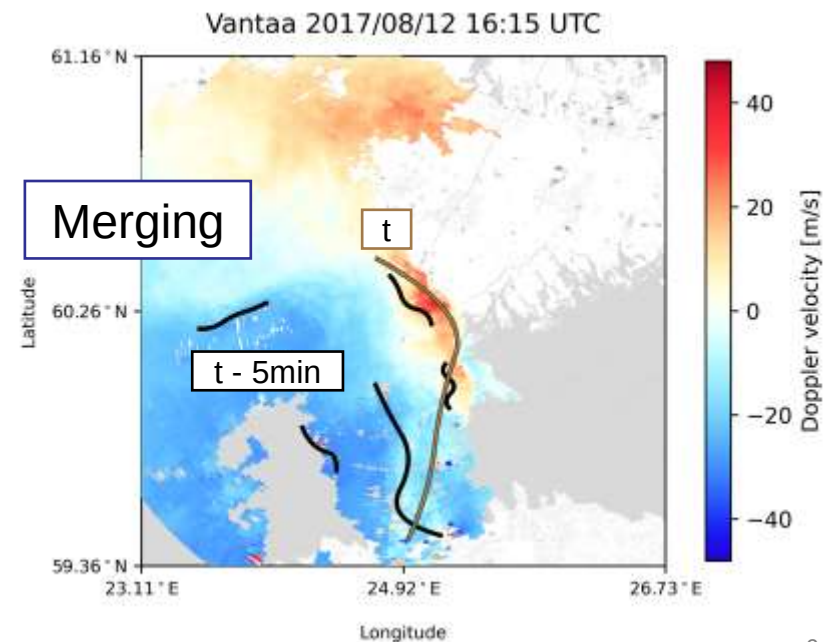
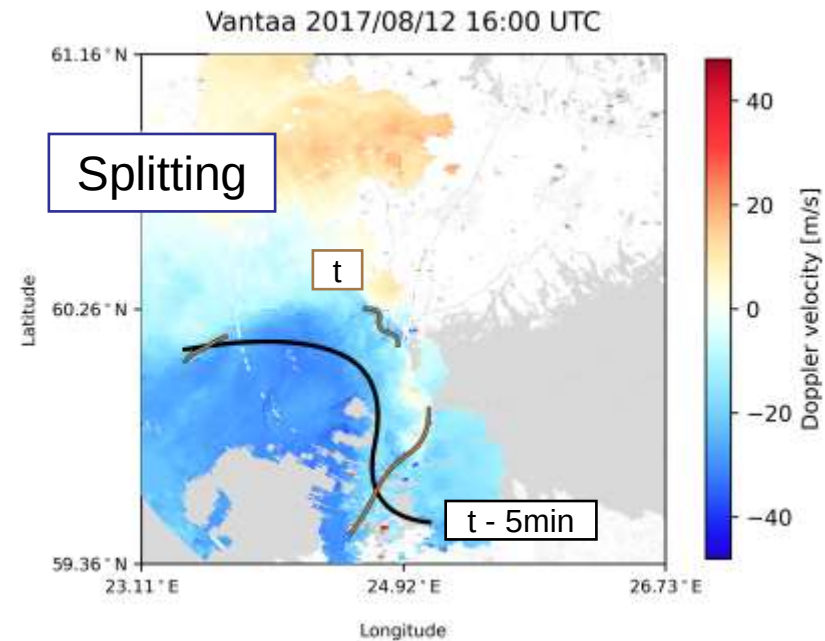
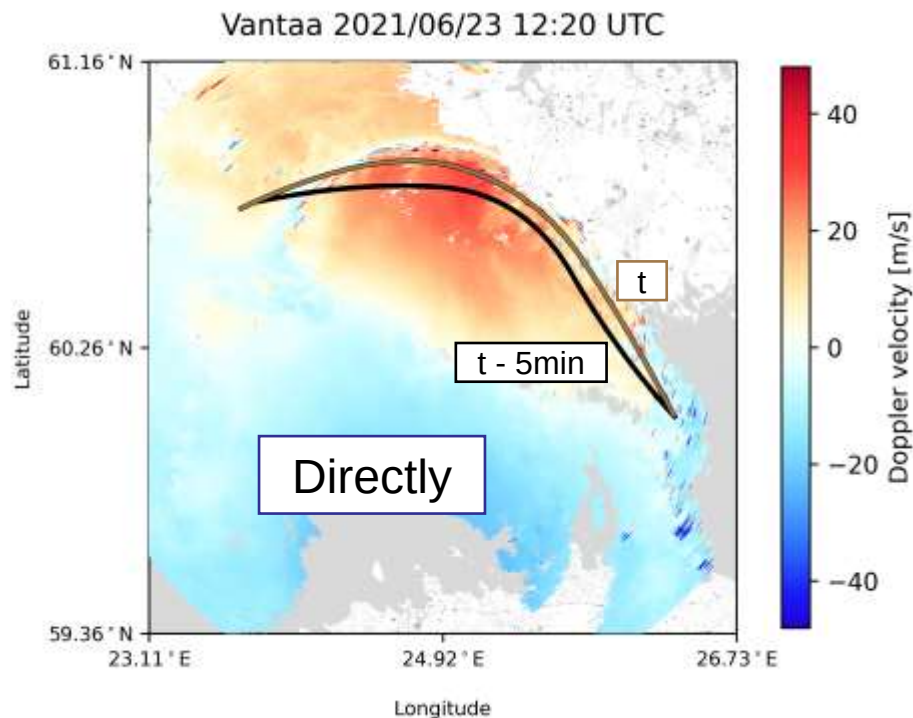


Object-based representation of gust fronts

- Object-based nowcasting has been used successfully to predict thunderstorms (e.g. Rossi et al. 2015)
- High-reflectivity cores of the thunderstorm can be approximated as polygons
- Gust fronts and strong wind shear areas are approximated with curves
 - Existing methods to track the objects don't work for gust fronts

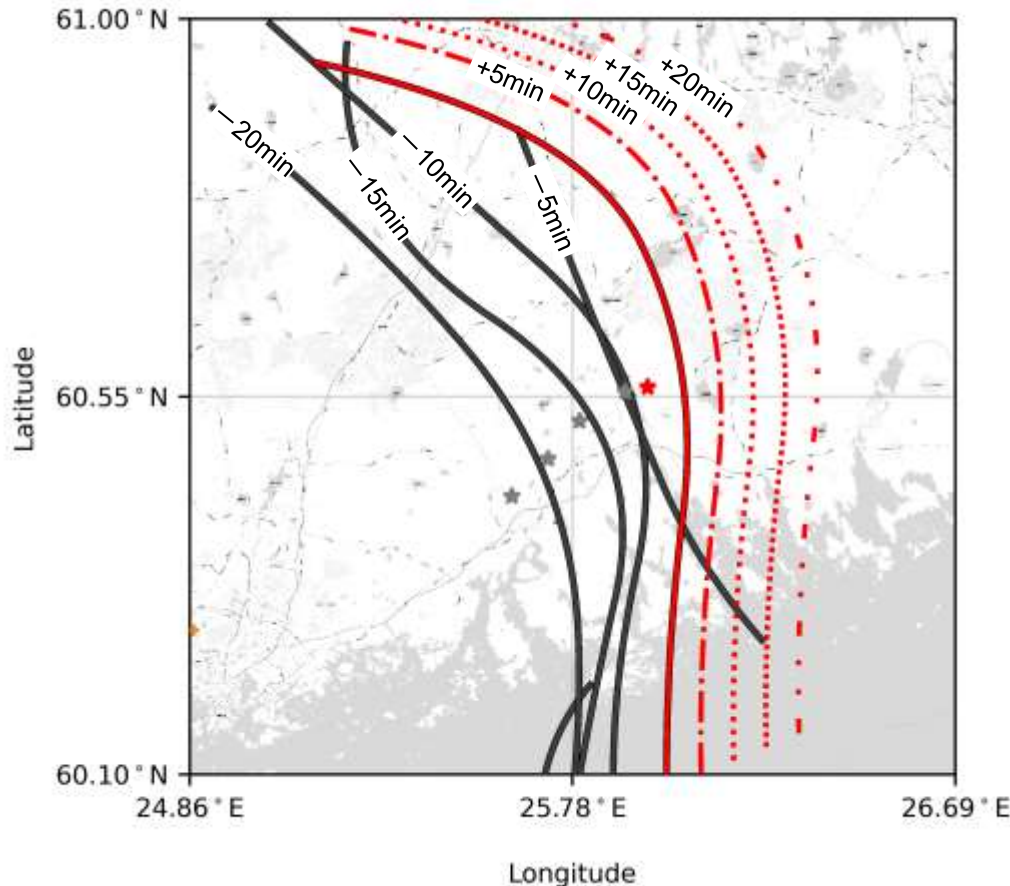


To track gust fronts, we need to match the gust front objects between timesteps



Nowcasting the gust front location with a Kalman filter model

Vantaa 2017/08/12 17:00 UTC



- For each object, we calculate the location as median of the curve
- Based on the previous locations, current location is corrected with a Kalman filter model
- New locations are forecast assuming constant propagation velocity

Bar-Shalom, Y., Li, X. R., and Kirubarajan, T.: Estimation with Applications to Tracking and Navigation, John Wiley & Sons, New York, NY, USA, 545 pp., <https://doi.org/10.1002/0471221279>, 2001.

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Summary

- An object-based method for nowcasting gust fronts
- Heuristic rules for tracking the gust fronts including merging and splitting
- Suitable for gust fronts and strong wind shear in leading edge of thunderstorm cloud

