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Providing probabilistic rainfall nowcasts at European scale

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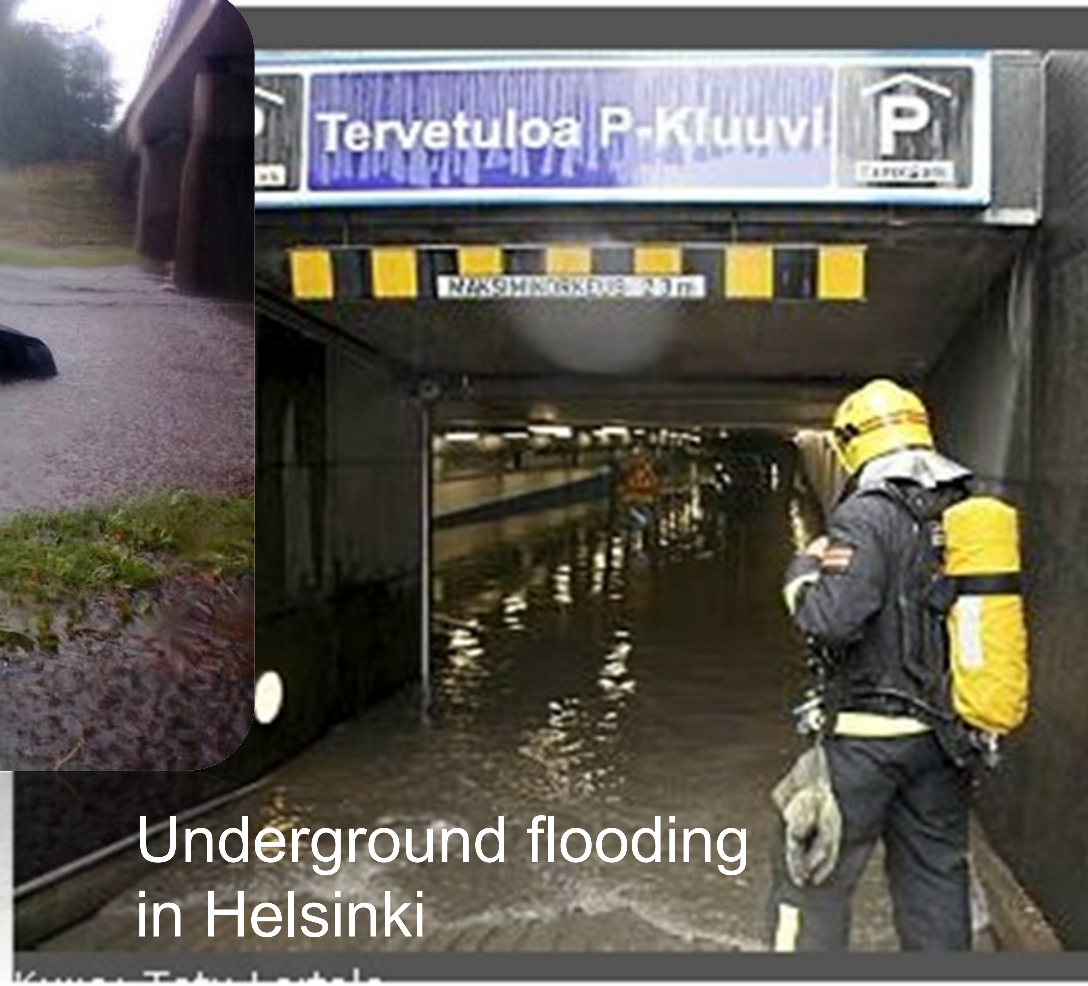
Objective: Real time optimization of local actions which depend on precipitation, especially risk management



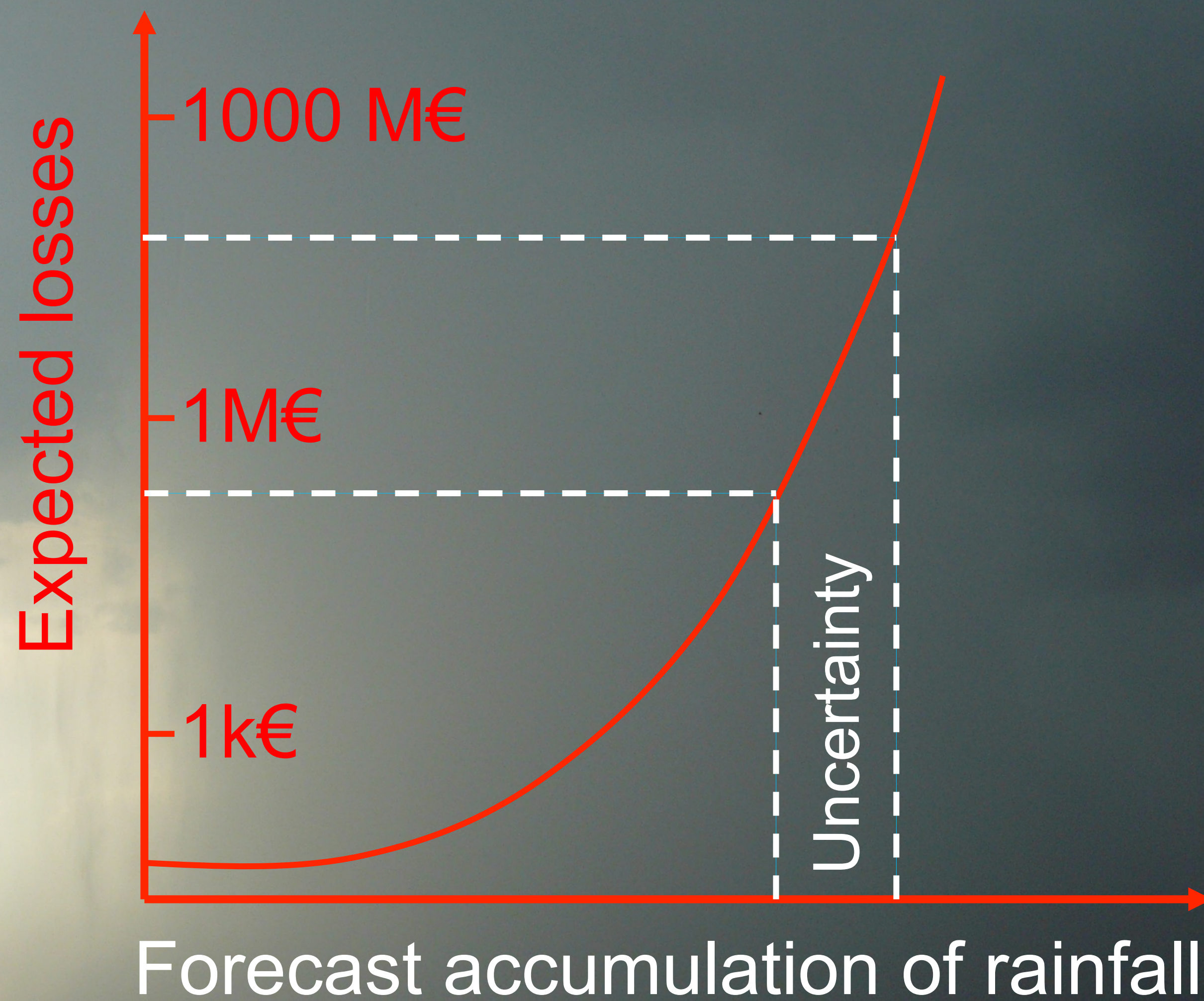
Socio-economic risk of a future weather event =

{probability of the event} x

{expected losses induced by the event}

Example: 0.01 (1 %) x 1000 M€ = 1 (100 %) x 10 M€

Rainfall event = exceedance of a fixed accumulation during a period, e.g. 50 mm/h



Conclusion: Forecasts of exceedance probabilities are vitally important for risk management and reasonable in meteorological sense

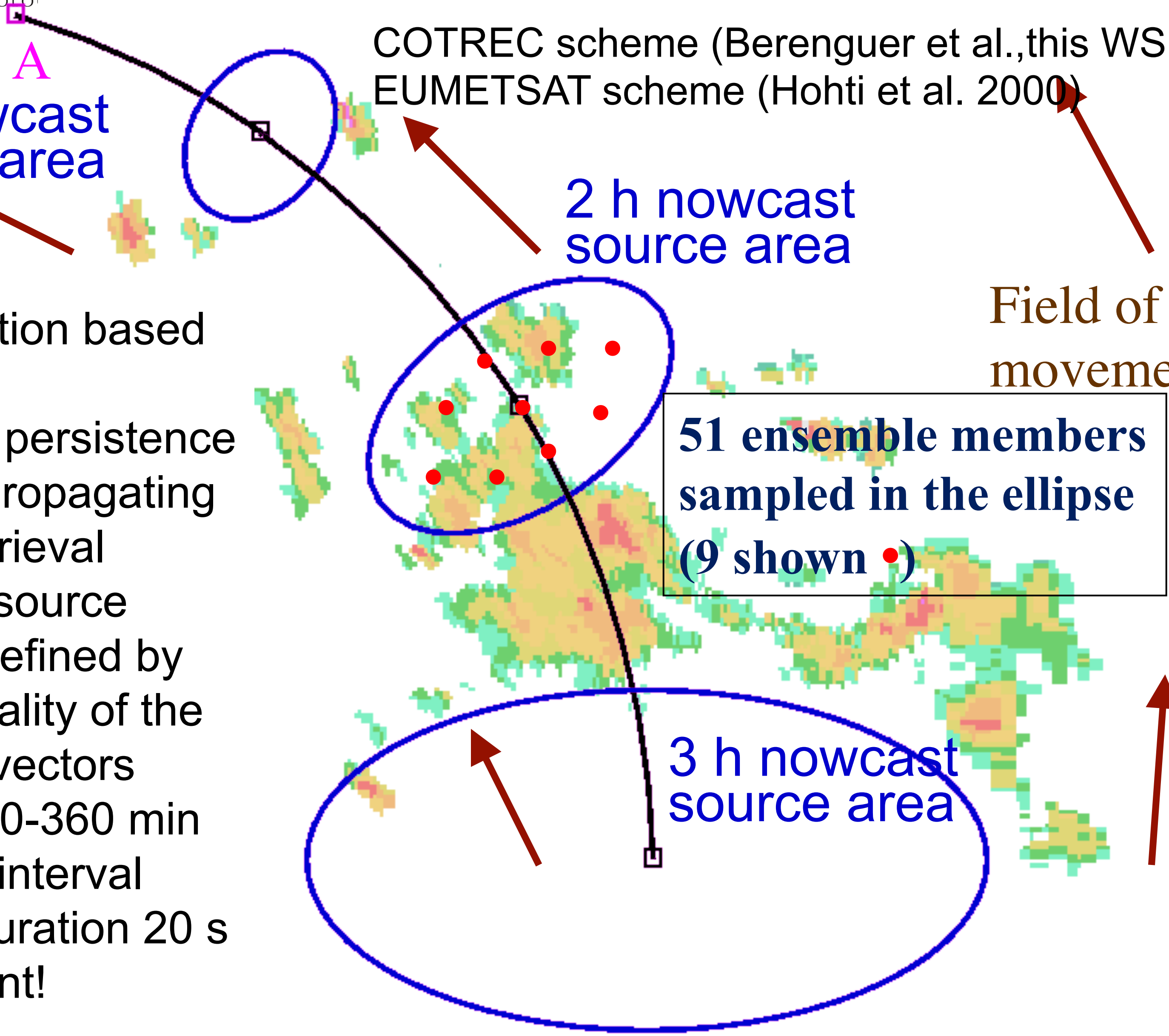
An example at a specific location and time period:

- Probability of exceeding 1 mm/3h = 98 %
- Probability of exceeding 10 mm/3h = 60 %
- Probability of exceeding 100 mm/3h = 15 %

The tool for obtaining exceedance probabilities is ensemble prediction system (EPS) i.e. instead of a single nowcast we compute multiple alternative scenarios which estimate real probabilities for lead times 0 – 6 h.

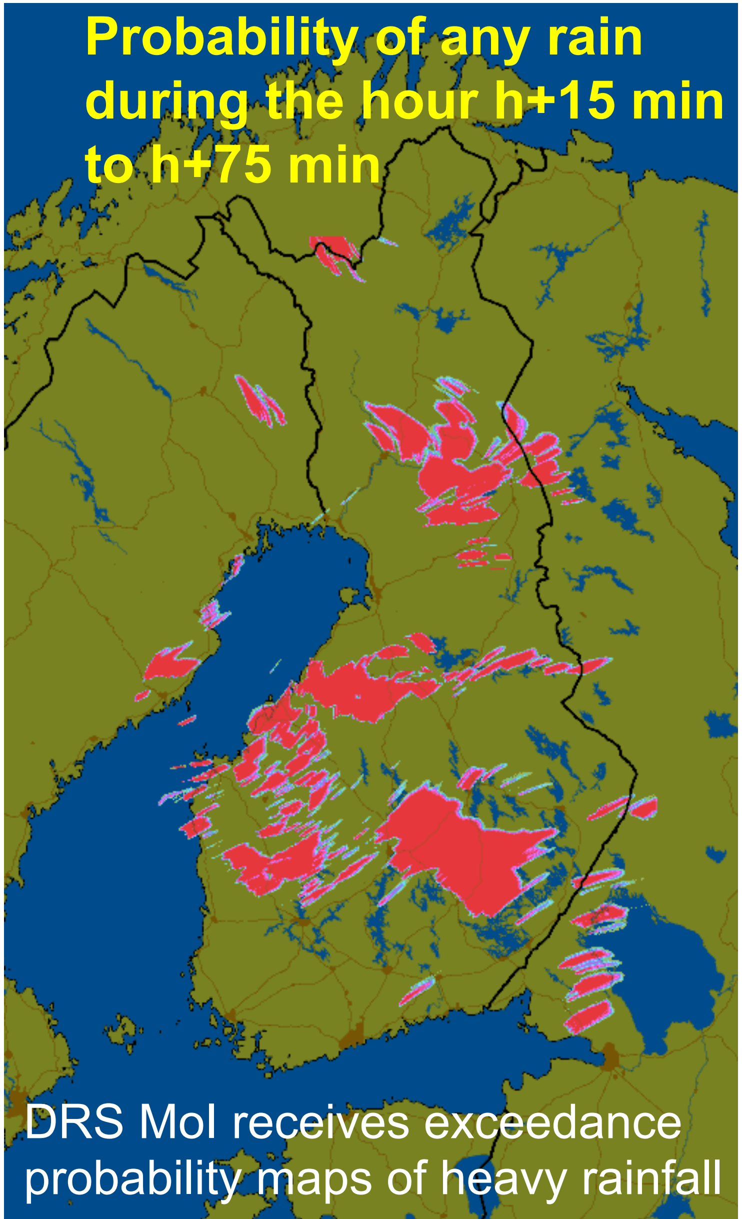
Radar based ensembles

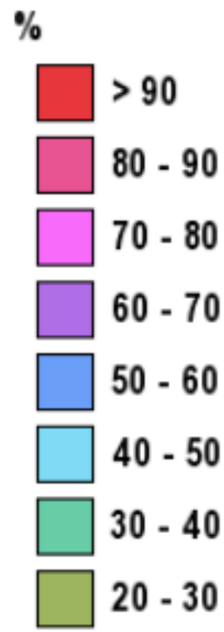
COTREC scheme (Berenguer et al.,this WS, 2005)
EUMETSAT scheme (Hohti et al. 2000)



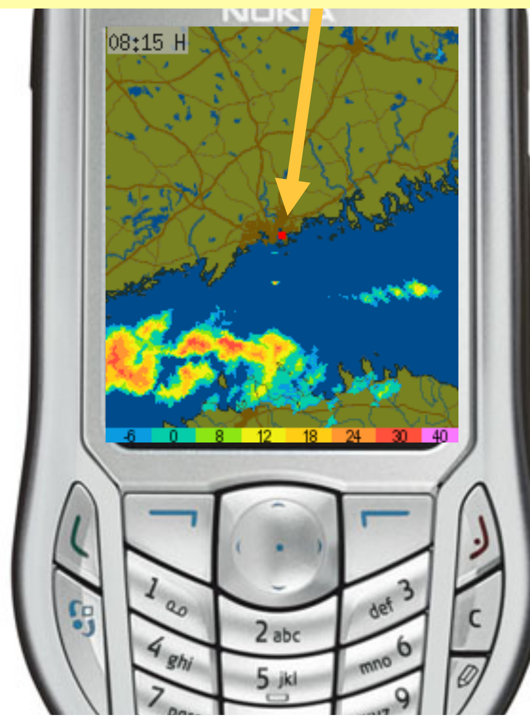
- Autocorrelation based vector field
- Lagrangian persistence
- Backward propagating nowcast retrieval
- Size of the source ellipses is defined by the local quality of the movement vectors
- Lead times 0-360 min
- Computing interval 5-30 min, duration 20 s
- QC important!

Probabilistic radar-based nowcasts useful from continental scale down to local urban scale





Example SMS message: Weak rain at Helsinki city center during 08:45 – 09:45. The probability of rain is 57 %. (service available for any user)



Operational interactive service of FMI: see the poster of Koistinen et al.

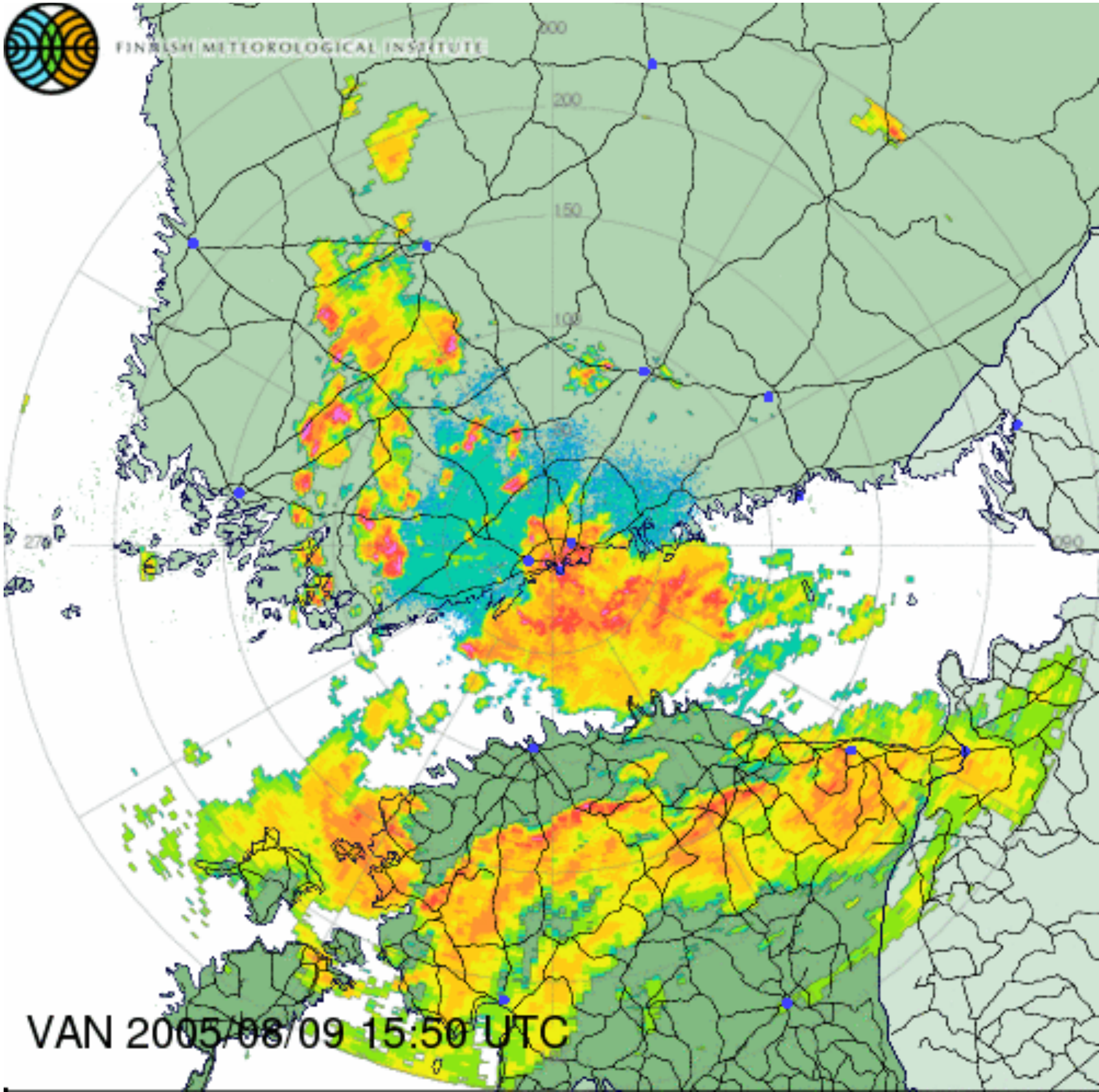
Limitation: predictability in radar nowcasts is commonly shorter than 6 h

Meteorological reasons:

- Growth and decay of rain systems, especially small thunderstorms.

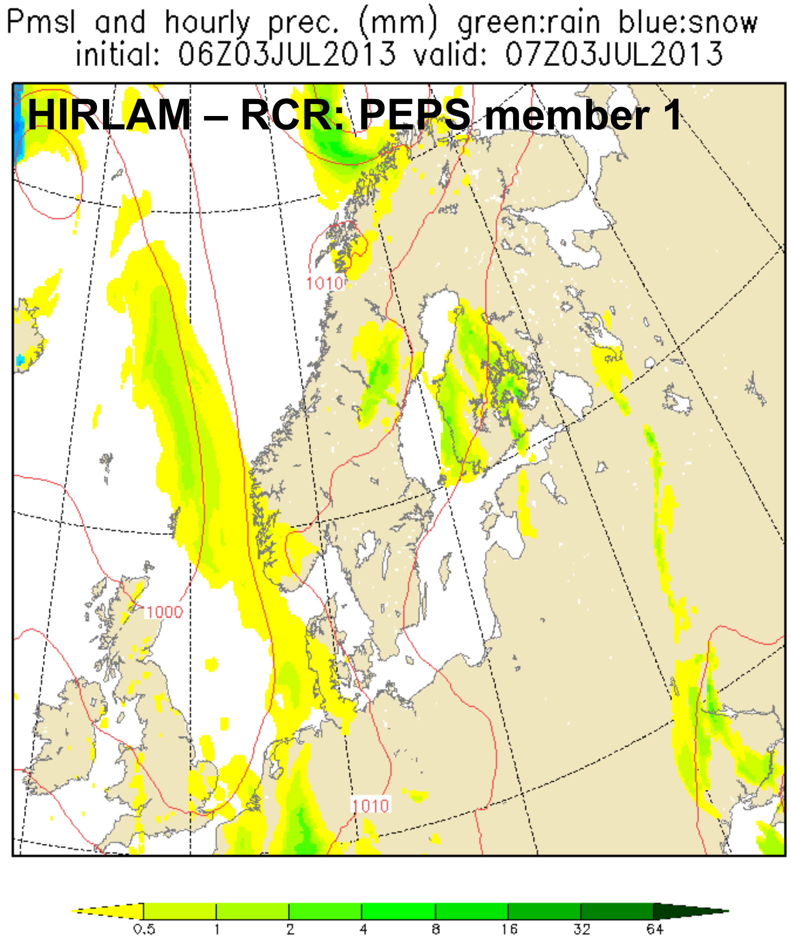
Other reasons:

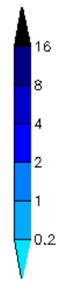
- OPERA data is not covering all Europe. See Sempere, Berenguer this WS and the poster by Rossi et al. of using lightning location data for extending the radar coverage of precipitation.
- Quality and availability of radar data.
- Approximations in the nowcasting schemes.

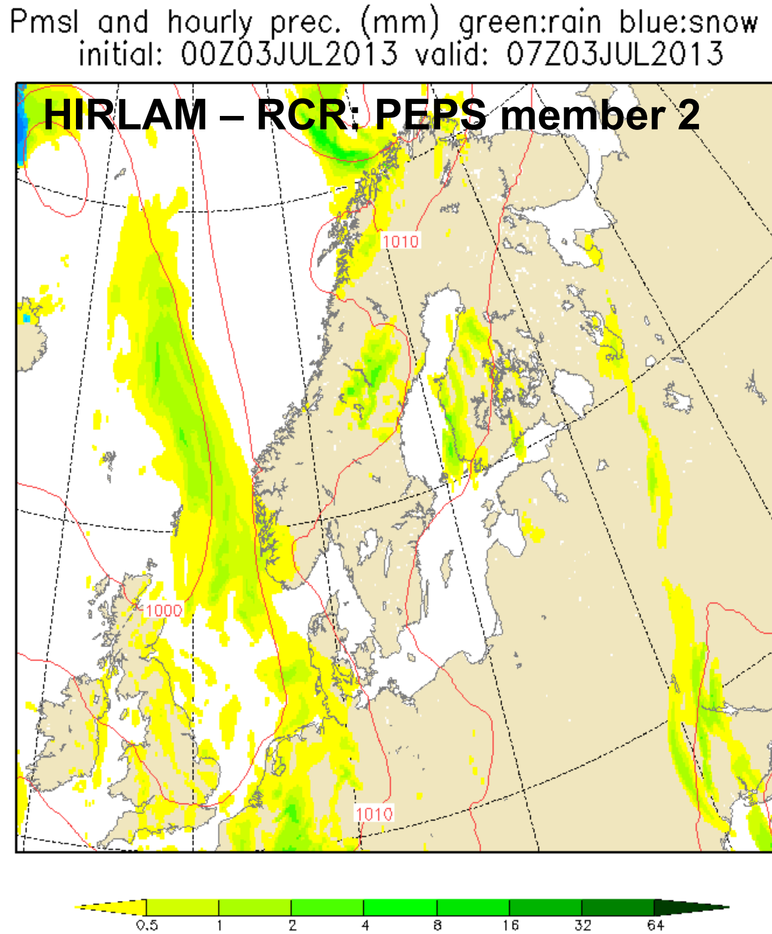


Numerical weather prediction (NWP) applied for 2-6 h ensembles (at FMI up to 96 h)

- EPS (ECMWF) and PEPS (HIRLAM) methods applied (Theis et al. 2005)
- 51 ensemble members computed covering all Europe in HAREN but a full set of stable probability maps is not yet shown on the website.
- Limitations: Update cycles of NWP are too sparse (6 -12 h) for nowcasting and often convective systems don't match the real ones in time and place.

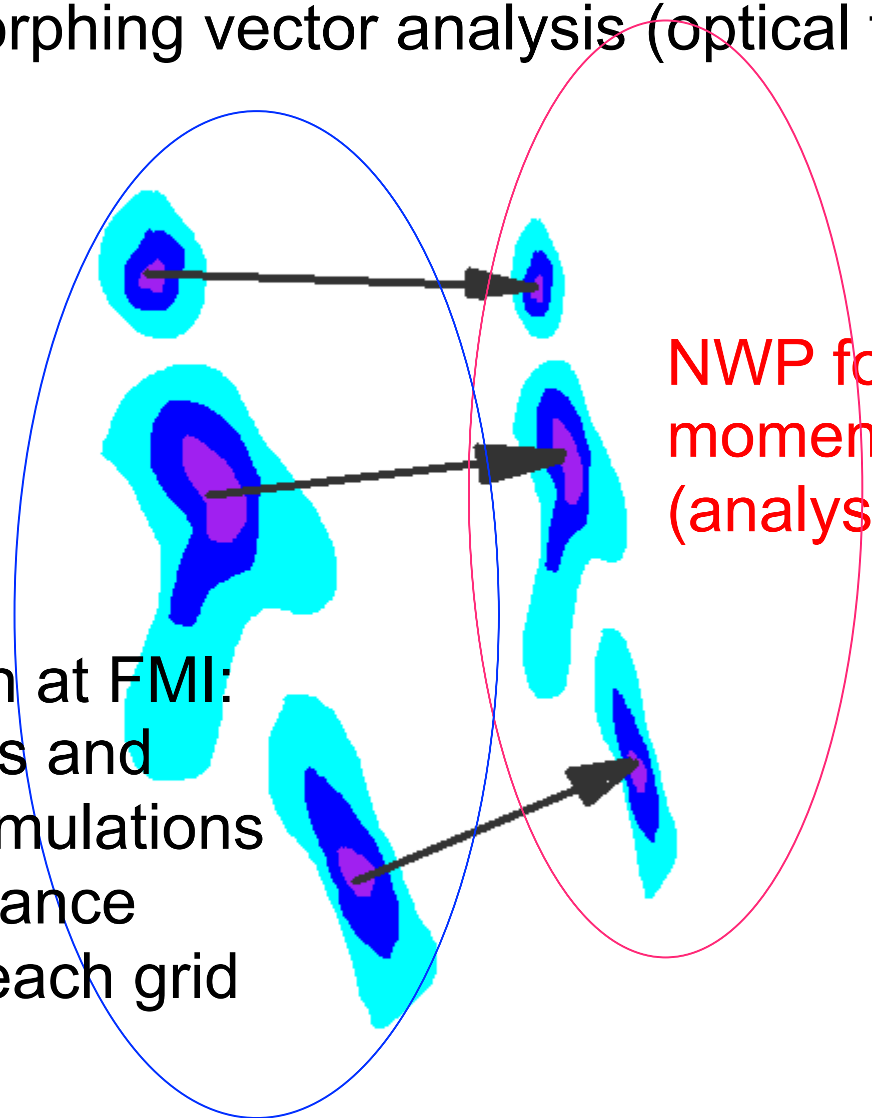






Challenge: Blending of radar and NWP ensembles for obtaining integrated nowcasts

Ideal example: Integration of radar and NWP by applying continuous morphing vector analysis (optical flow)



Working solution at FMI: We omit patterns and blend only accumulations of equal exceedance probabilities at each grid point.

Future risk management process

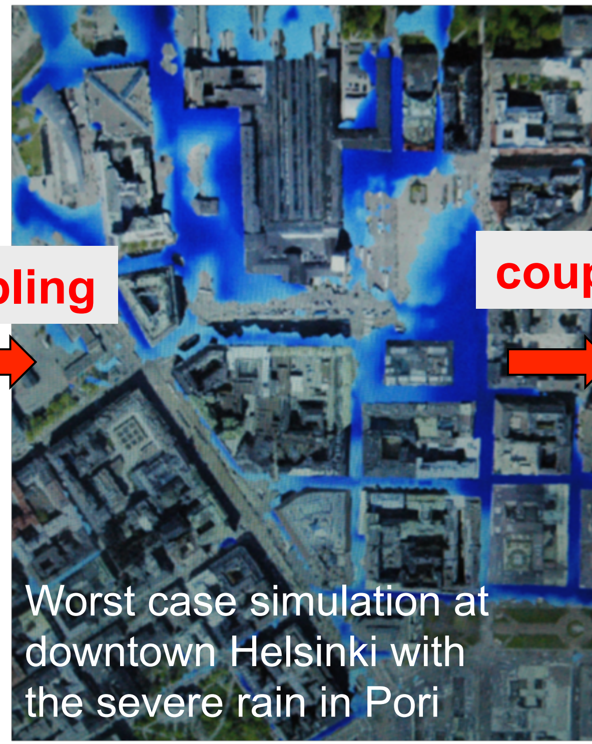
Overflow risk management and automatic alarming for real estates and rescue personnel was recently tested in Helsinki city center in a pilot study. Three process phases:

1. Rainfall ensembles

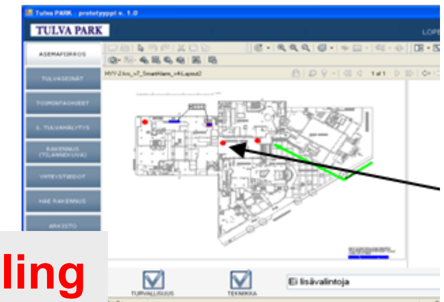
2. Water flow ensembles

3. Event monitoring, alert and civil protection systems

coupling



coupling



”Traffic light” flood risk monitoring & forecasts at critical points

Risks in real estate scale (upper)
Risks in city scale (lower)

”Traffic light” flood risk monitoring & forecasts at critical points

Still lot to do in a ”smart city” as only the process step 1 is quasi-operational!

Conclusions

- HAREN is a pilot R&D platform for European radar and NWP based probabilistic precipitation nowcasts.
- Probabilistic forecasts have a great potential in the risk management induced by high impact weather.
- Automatic alerts updating every 15 minutes for each location in Europe, and possibly even tailored by each user, is a challenge for the traditional, regional warning practices of NWSs (legislation, insurances, role of meteorologists).
- Coupling of rainfall ensembles with hydraulic & hydrologic models and, finally, with risk estimation models will give even better tools for civil protection.