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Advection correction of radar-based probability of hail in Belgium

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Hail damage

13-14 August 2015

≈ 1000 ha

fruit gardens

7-9 June 2014

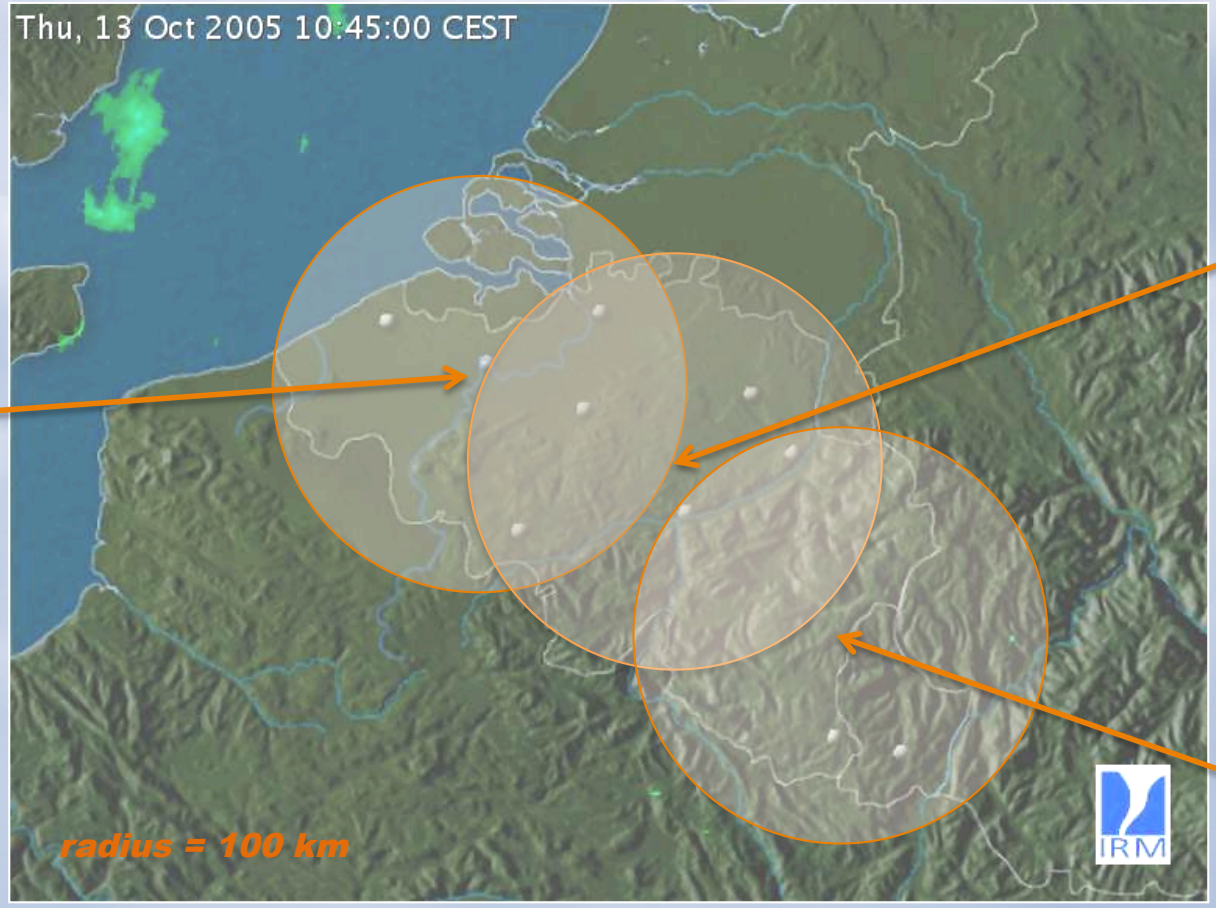
≈ 500 MEUR

total loses

Radar-based hail detection in Belgium

Zaventem
Belgocontrol (2003)

Jabbeke
RMI (2012)



Wideumont
RMI (2001)

Raw radar data archive

Radar in Wideumont (2002)

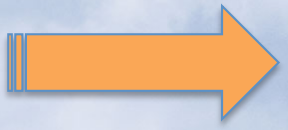
mean availability **97%**

scan 1

5 elevations, 5 minutes

scan 2

10 elevations, 15 minutes



single scan (from 2014)

15 elevations, 5 minutes

Radar in Jabbeke (2012)

mean availability **89%**

single scan (from 2012)

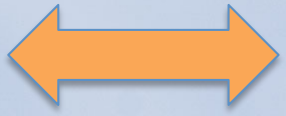
15 elevations, 5 minutes

Radar in Zaventem (2004)

mean availability **95%**

monitor mode

11 elevations, 5 minutes



hazardous mode

14 elevations, 5 minutes

Radar-based probability of hail

Waldvogel's method

$$ETOP_{45} \geq H_0 + 1.4$$

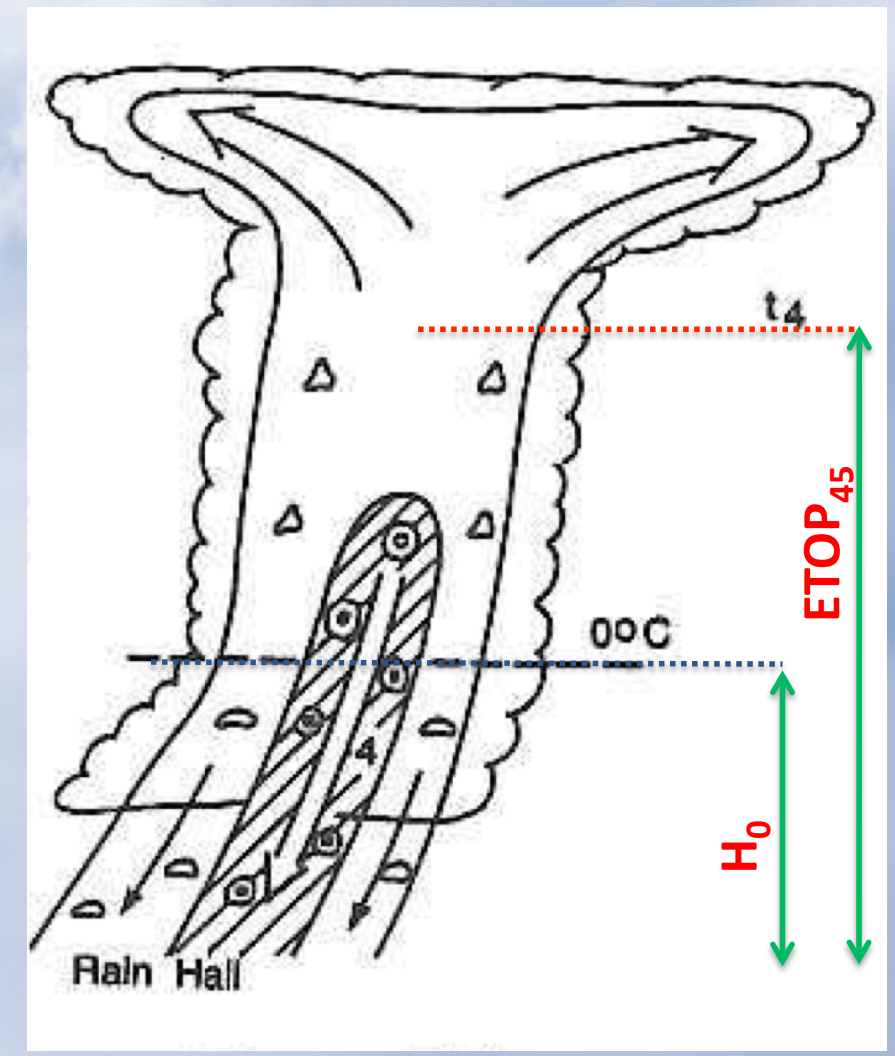
H_0 is a (0^0 C) – isotherm height

$ETOP_{45}$ is a height of 45dBZ echotop

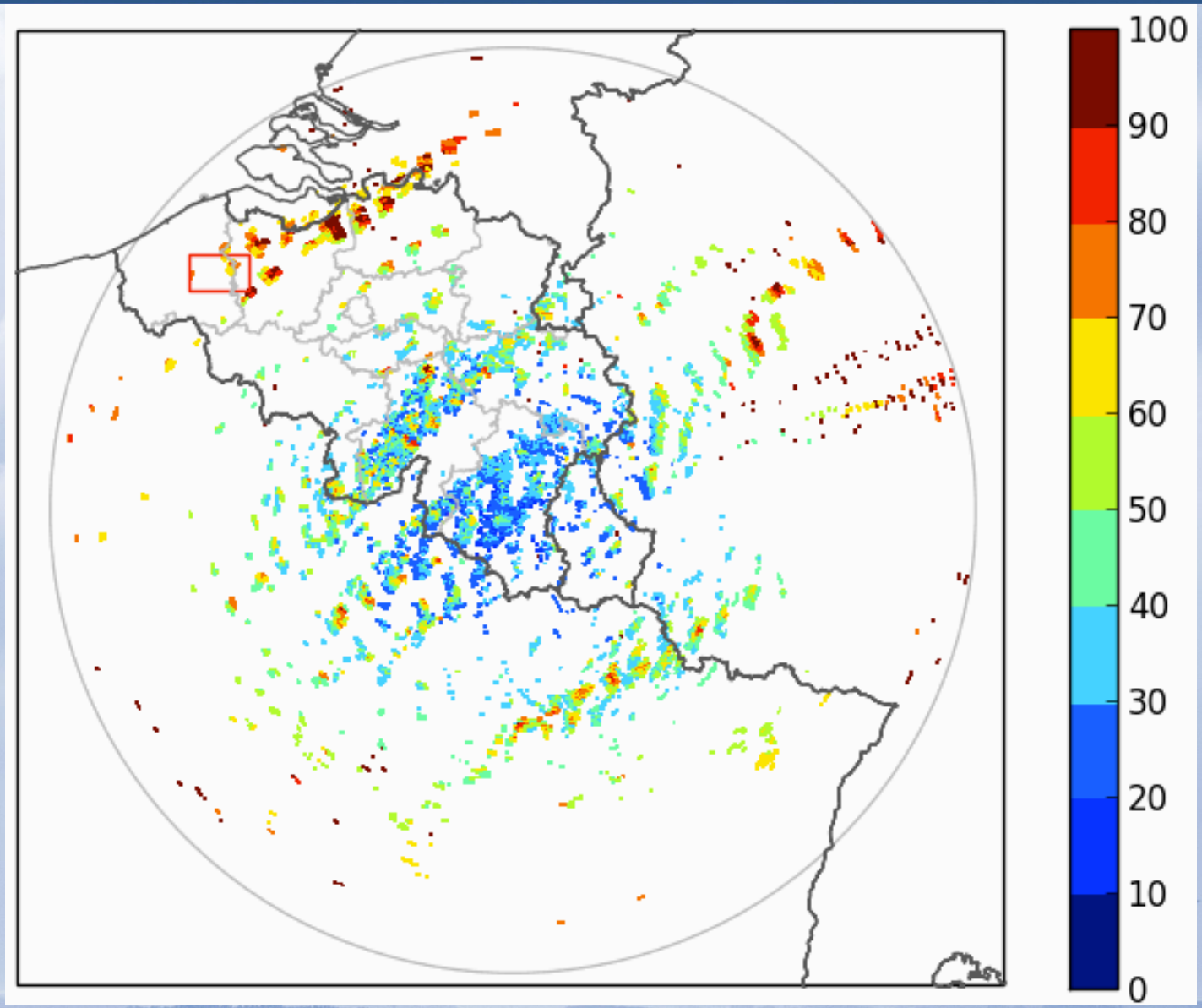
POH – Probability of Hail

$$POH = 0.319 + 0.133(ETOP_{45} - H_0)$$

Holleman, (2000)



Daily Maximum Probability of Hail



Advection Scheme

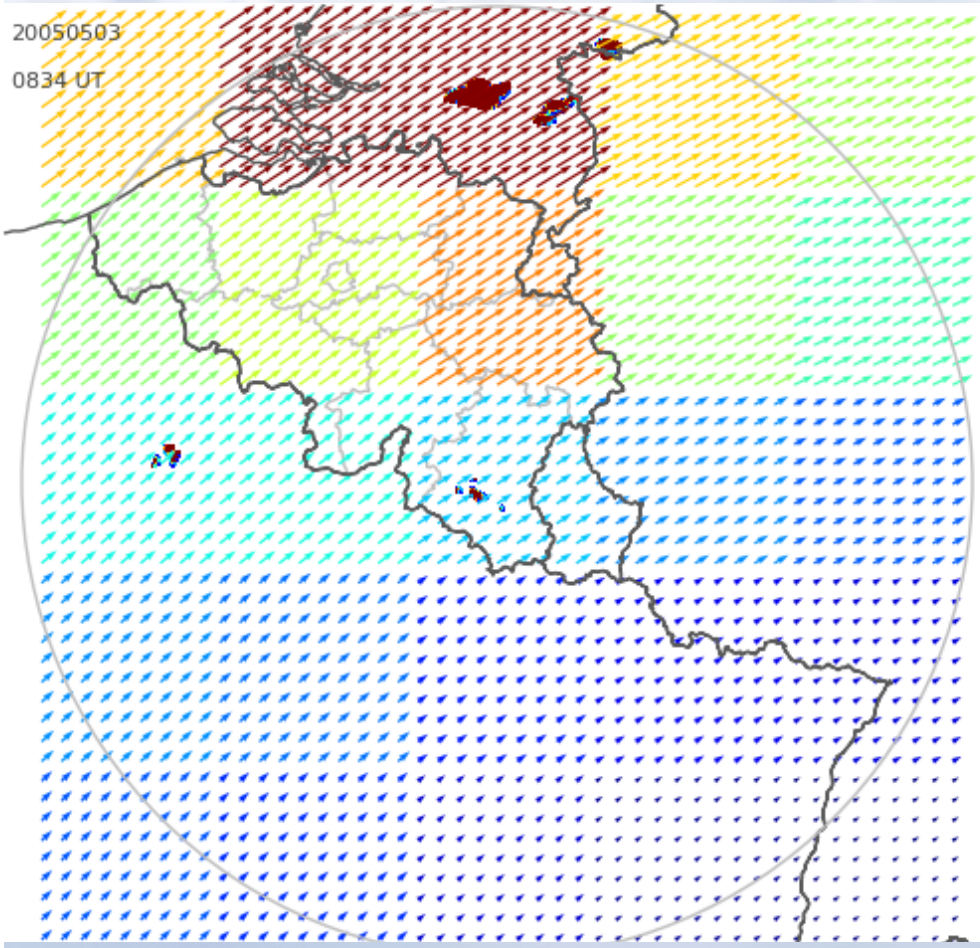
The Optical Flow Constraint (OFC)

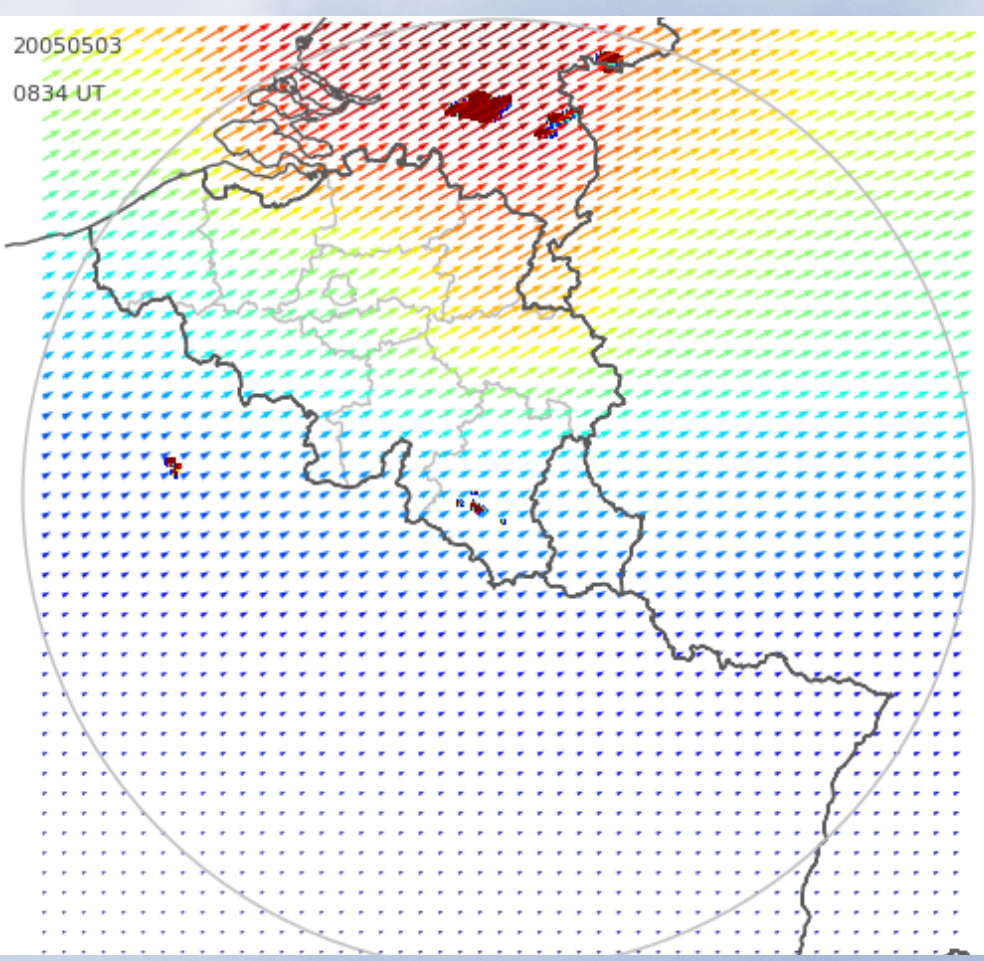
$$D_t R = u\frac{\partial R}{\partial x} + v\frac{\partial R}{\partial y} + \frac{\partial T}{\partial t} = 0$$

- Partial derivatives estimated using finite-difference method
- Domain split into a number of blocks
- OFC solved for each block using least squares
- Between block continuity imposed by Laplacian minimization
- Interpolation of block velocities on the fine observation grid
- Constant vector backward-in-time advection of precipitation field

(Bowler, Pierce and Seed, 2004)

Velocity Vectors

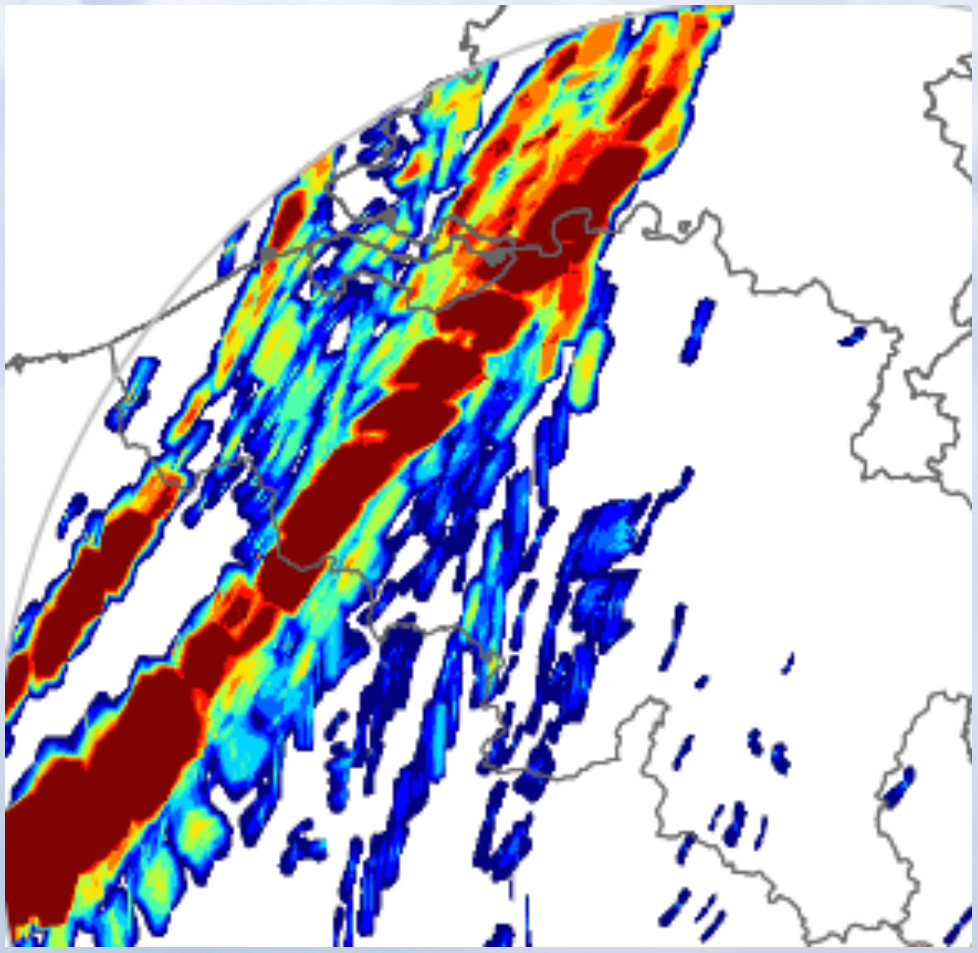




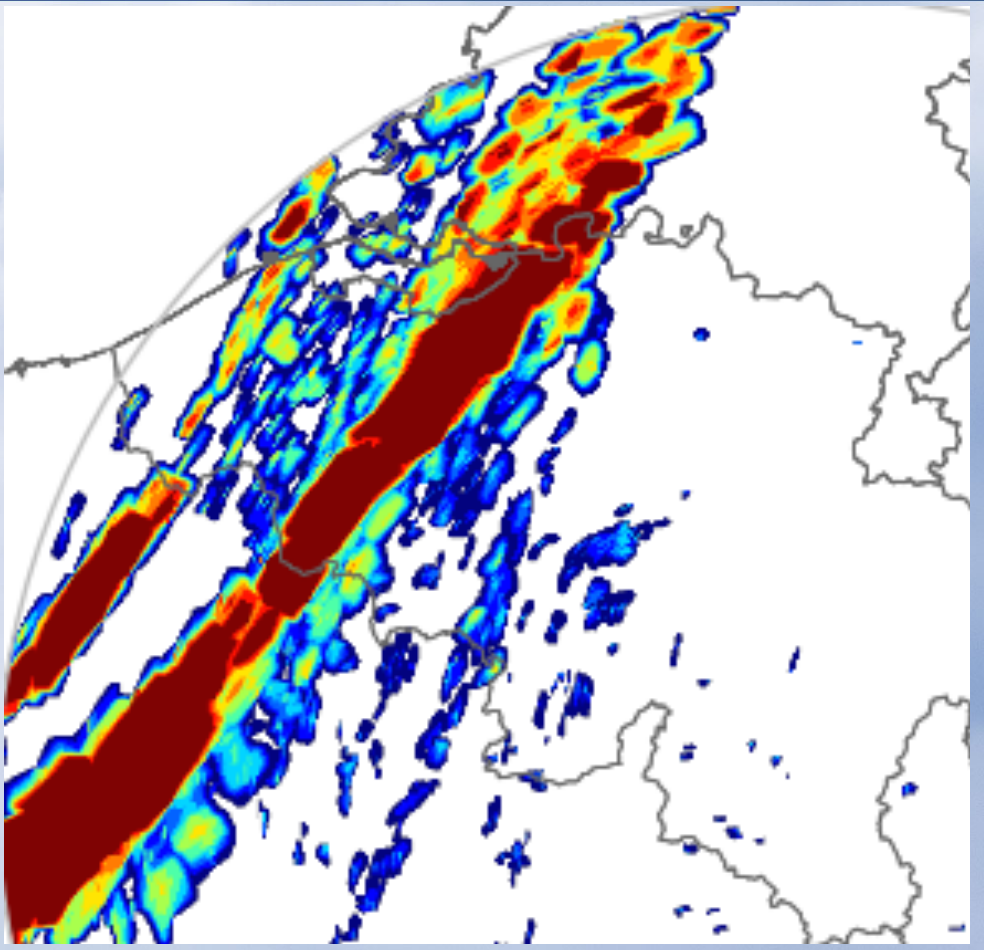
calculated per block

interpolated on fine grid

Velocity Vectors Calculation

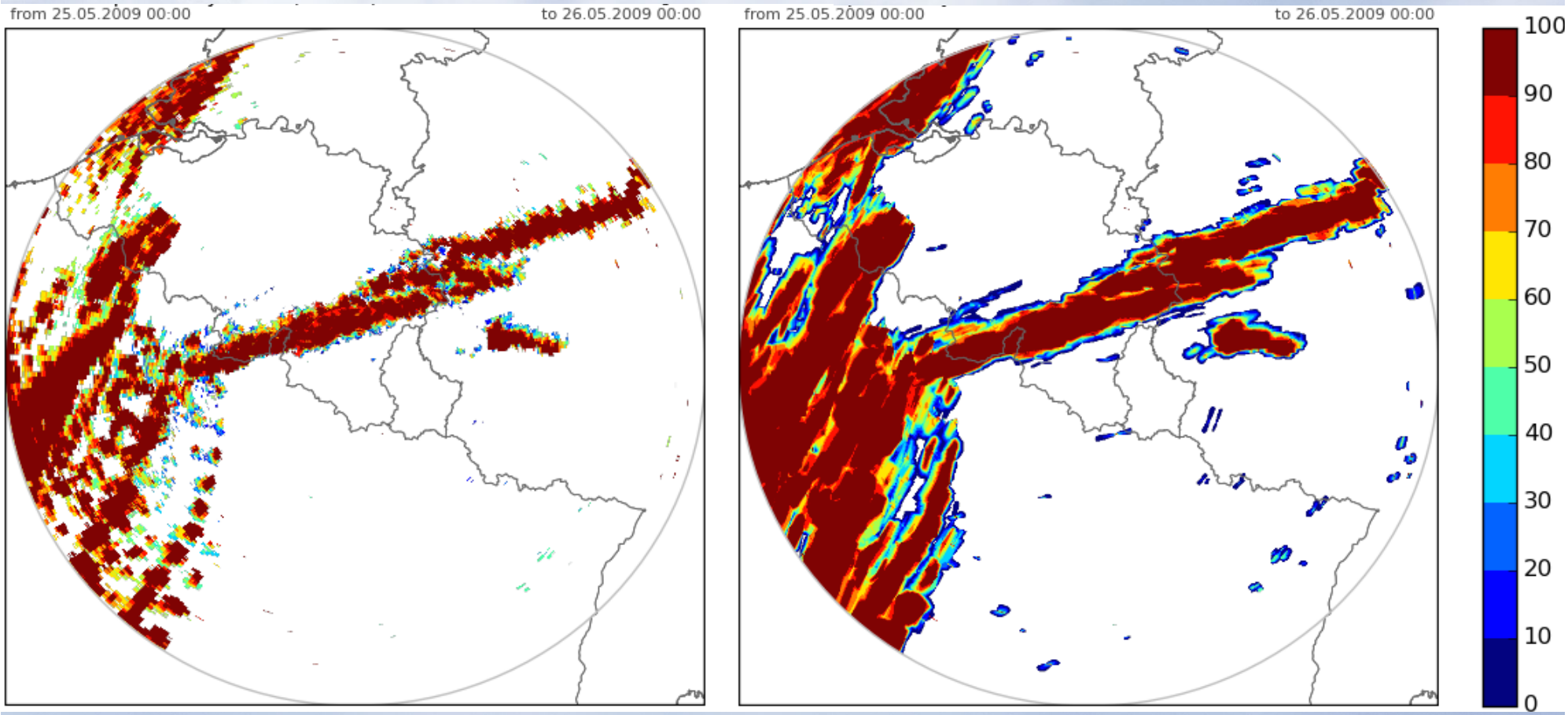


based on rain rates



based on probability of hail

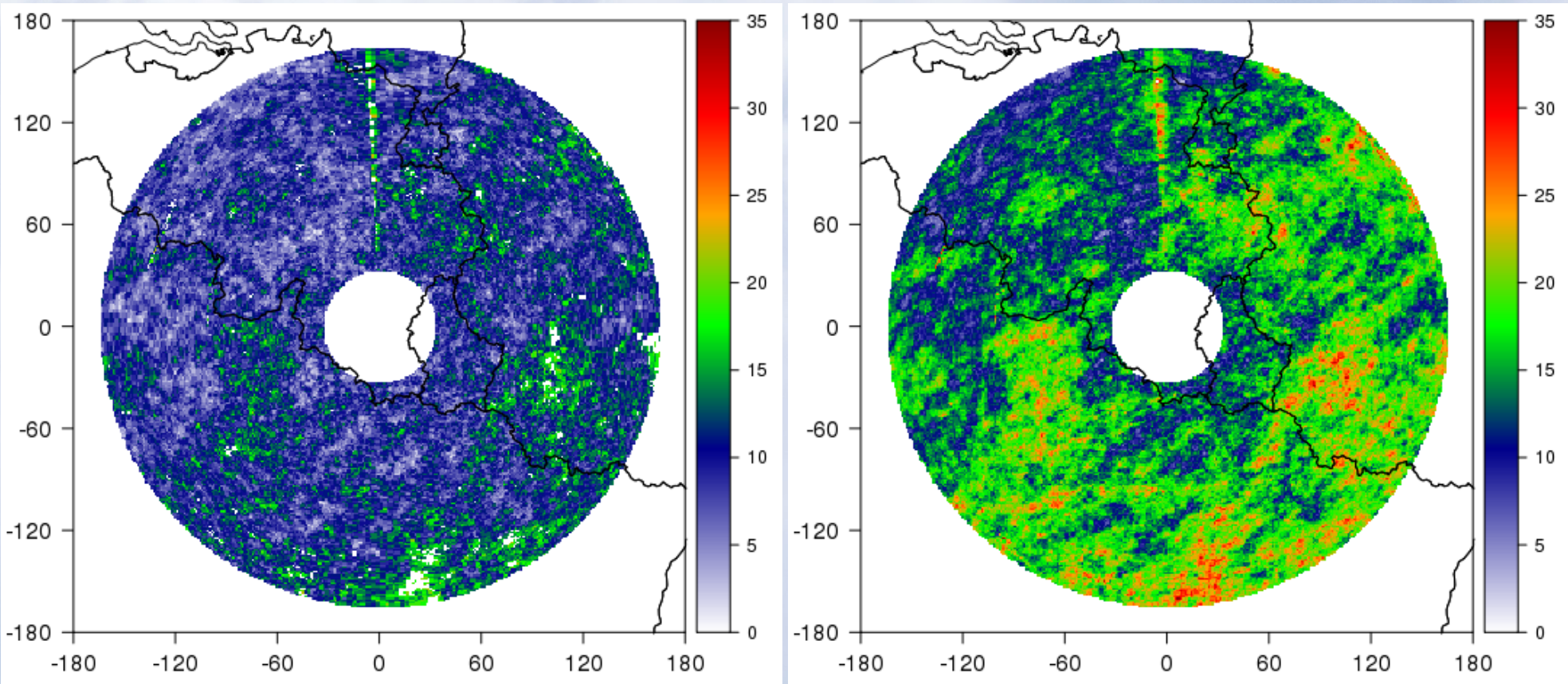
Daily Maximum Probability of Hail



Not advected

Advected

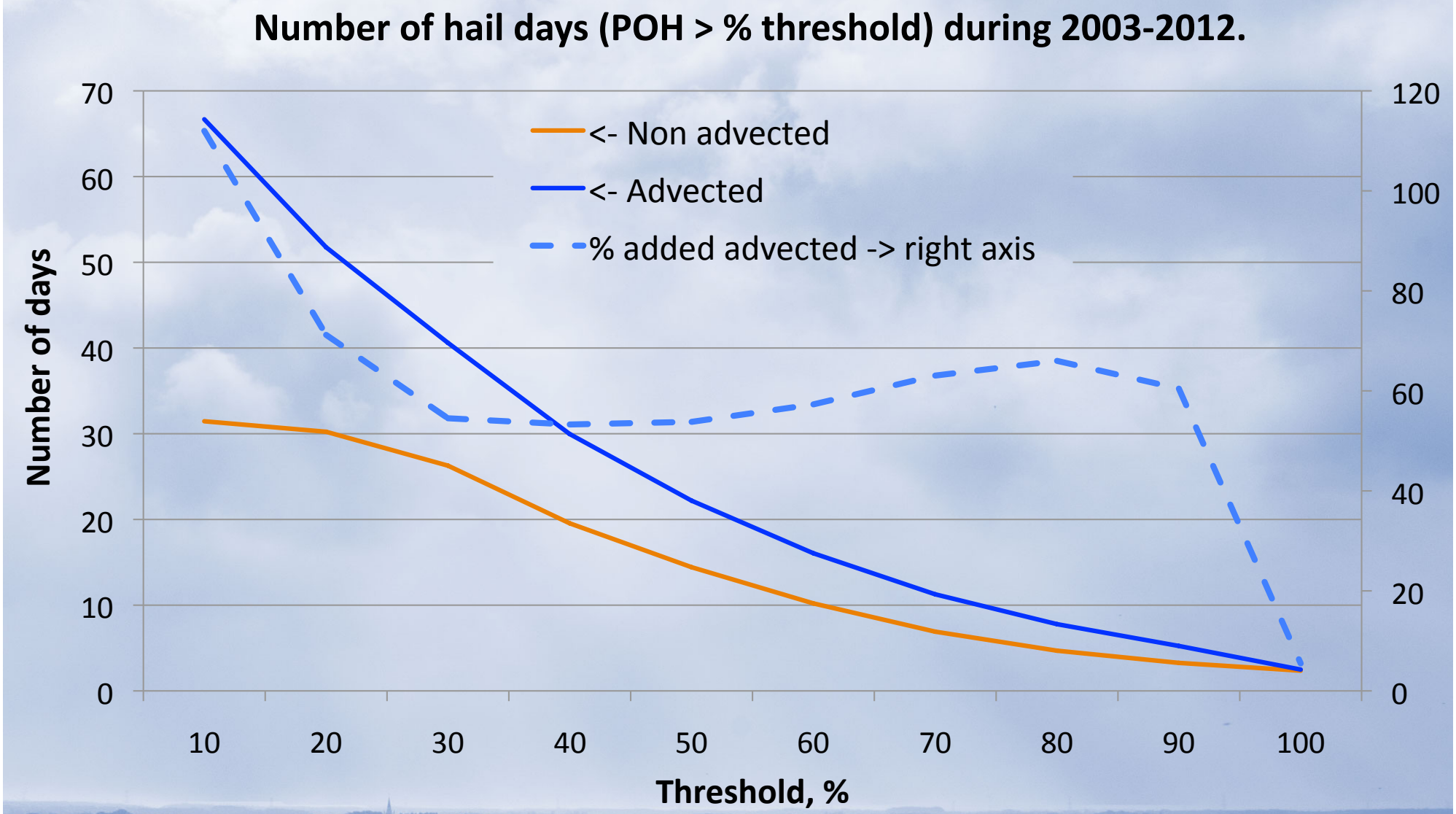
Advection & number of hail days



Number of hail days in ten hail seasons 2002-2012 (60% POH threshold)

Not advected	Advected
mean 10 days	mean 16 days

Mean number of hail days



Conclusions

- The advection correction influence is significant for 15 minutes scan.
- Velocity field estimation is better with POH than with rain rates.
- Advection correction is important for hail statistics
- Will it be the case for 5 minutes scan?