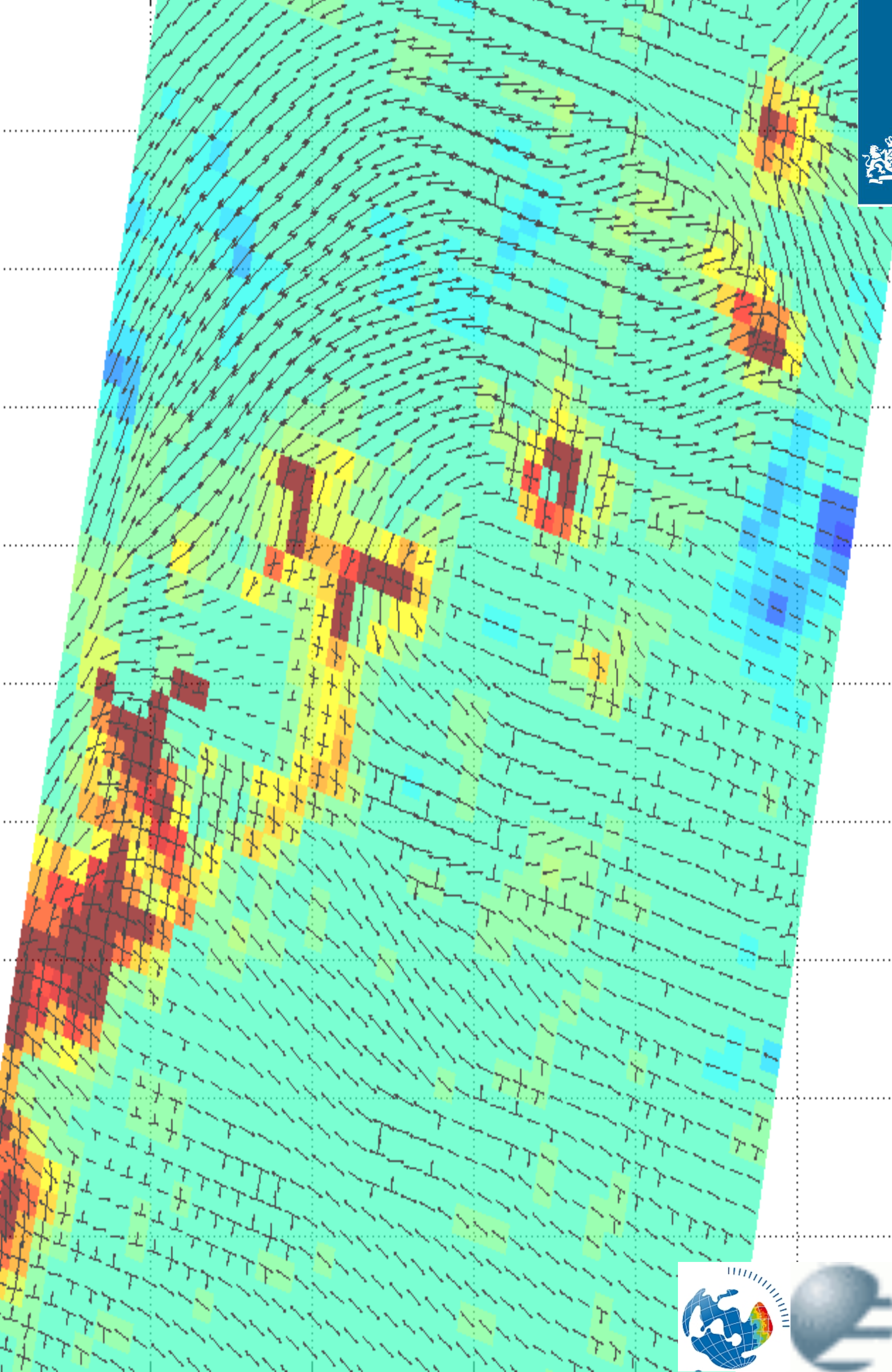

# Scatterometer winds for mesoscale dynamics

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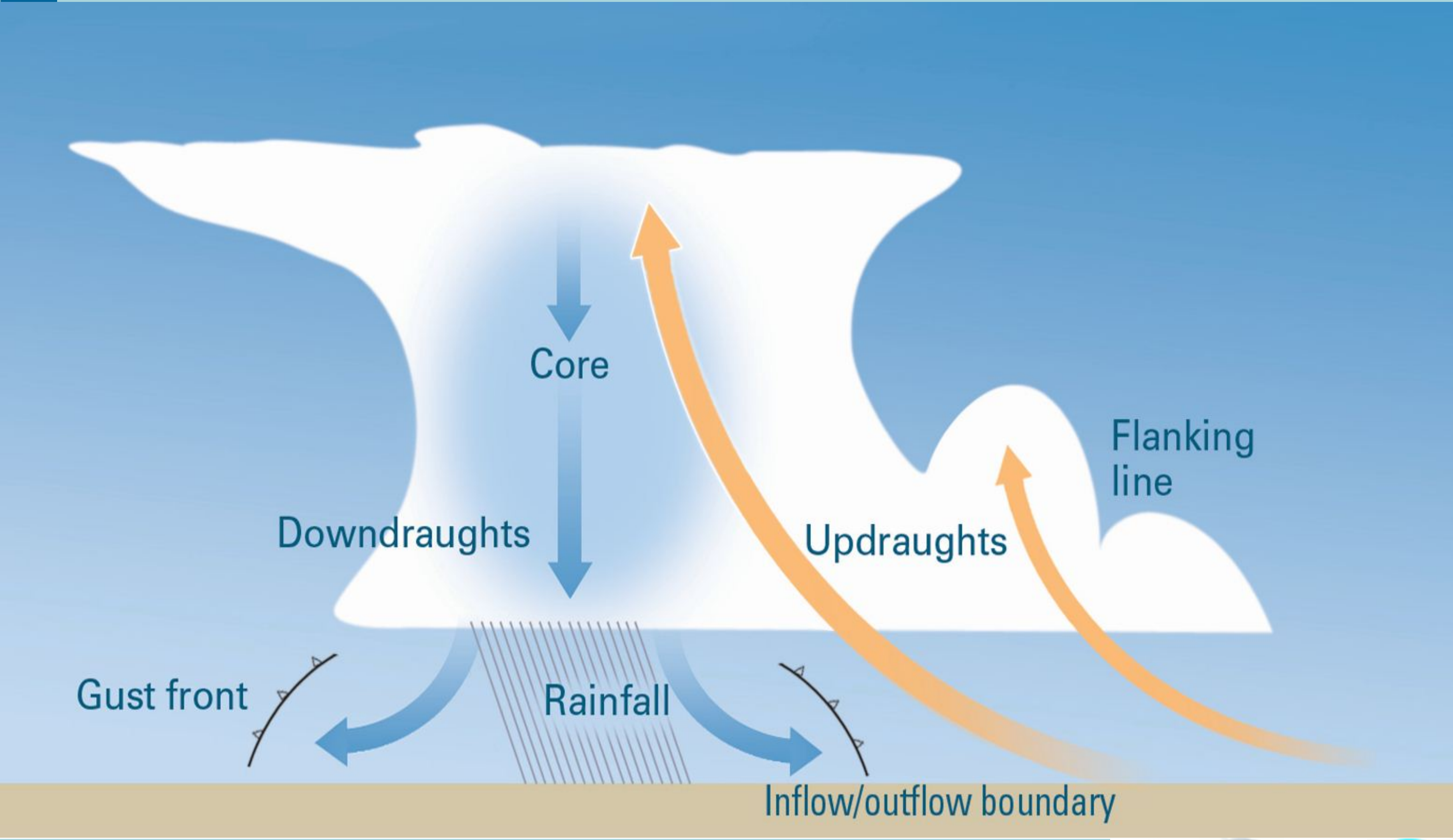
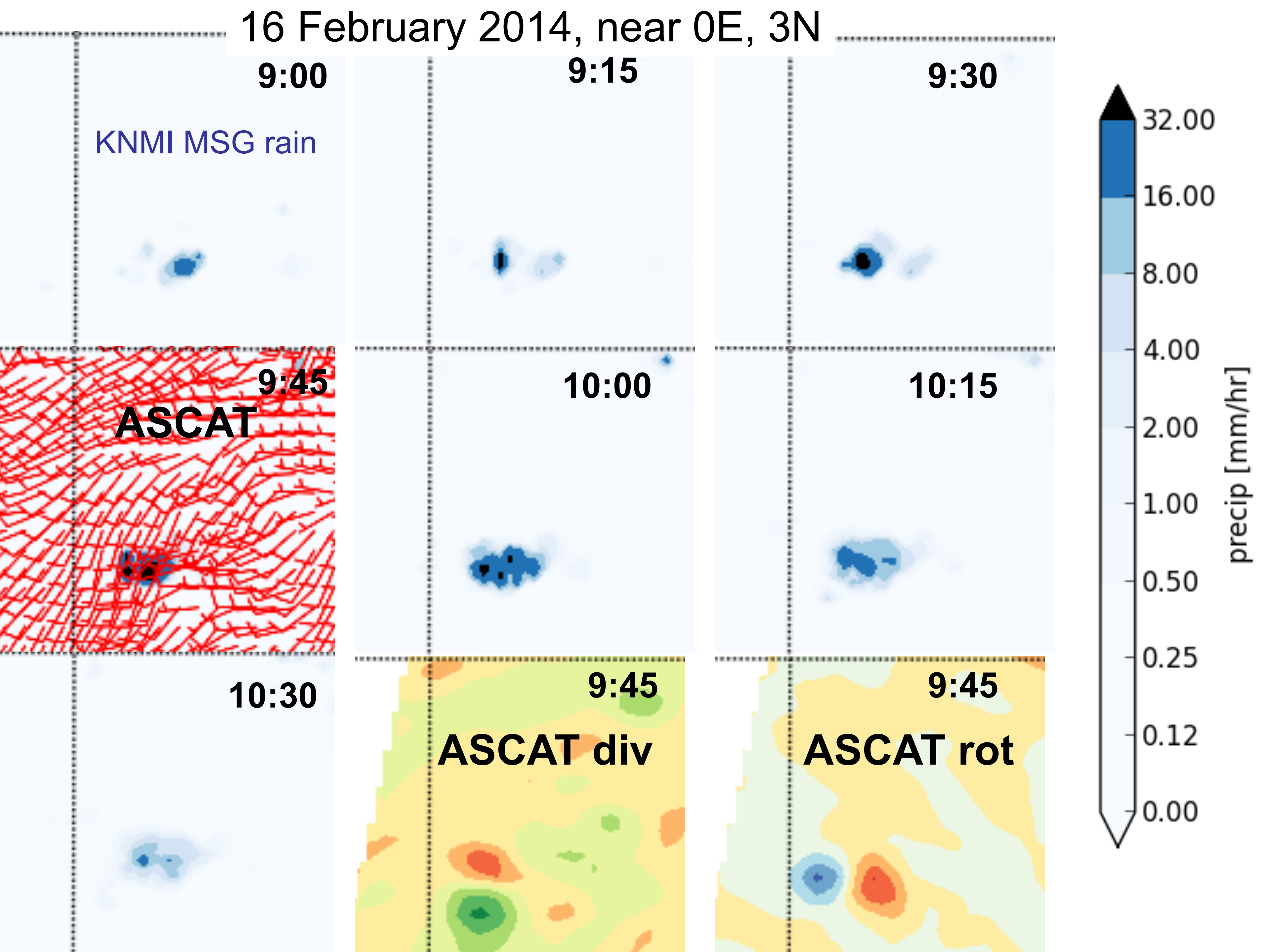
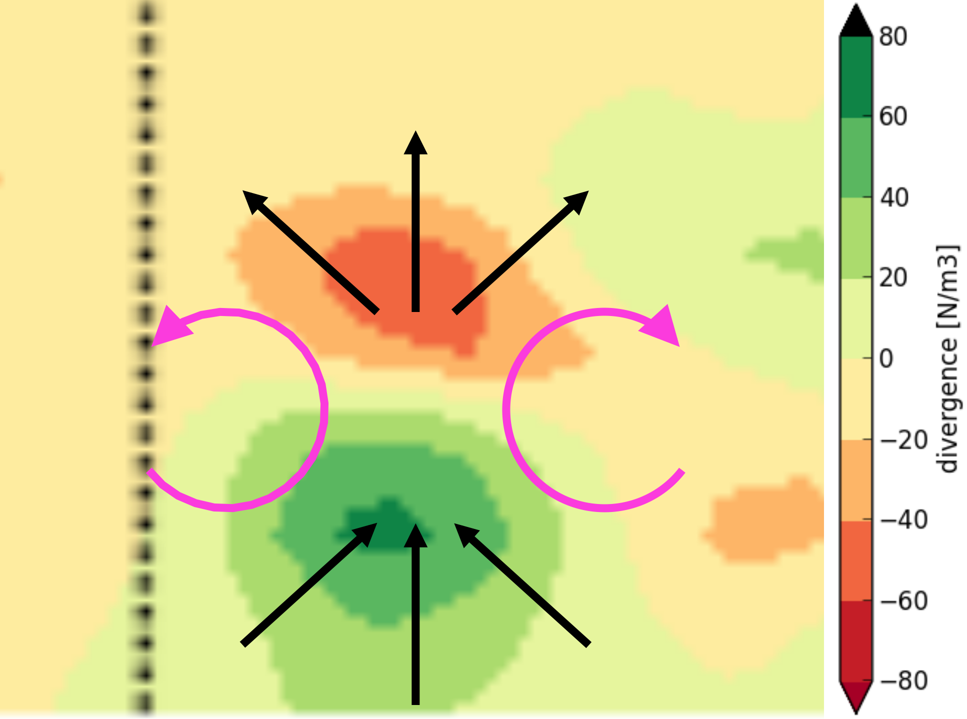
# Overview

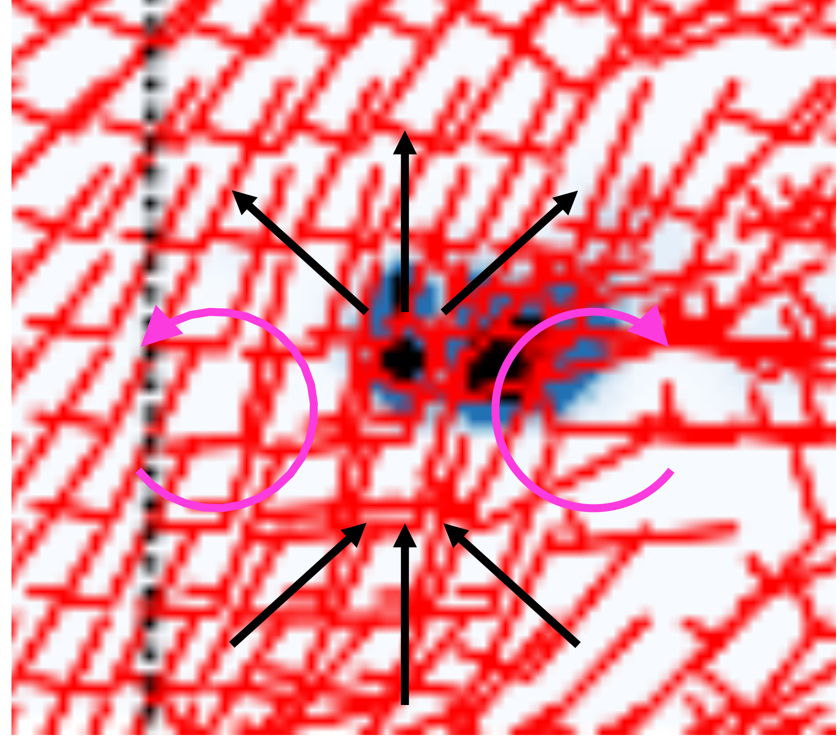
- Convection
- Geophysical Model Function departure, cone distance or MLE
- QC

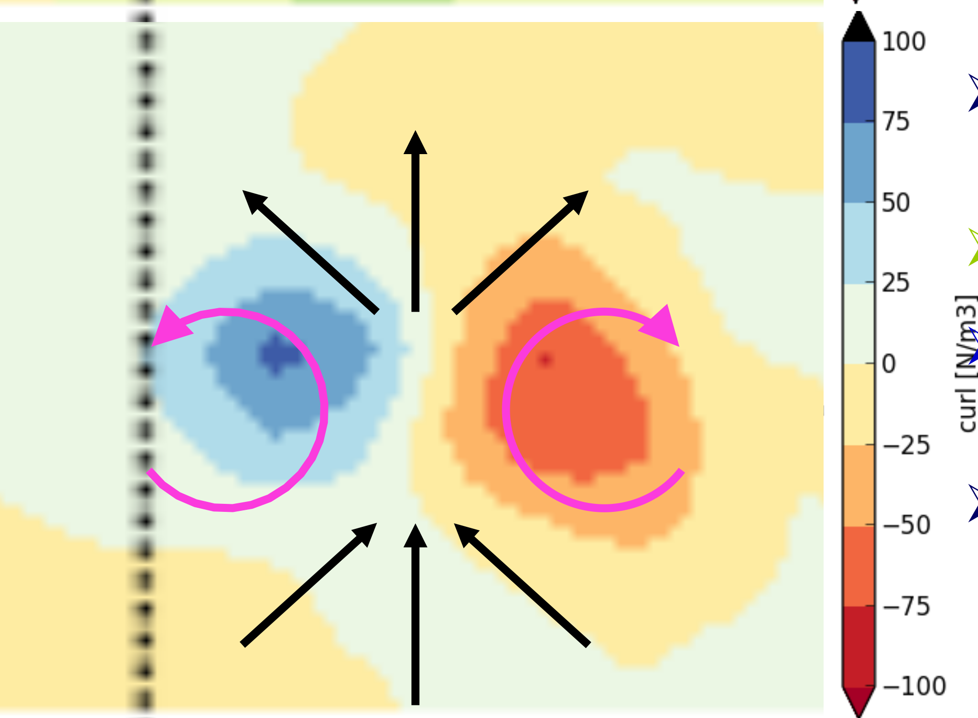
# Convection


Core
Downdraughts
Updraughts
Flanking line
Gust front
Rainfall
Inflow/outflow boundary

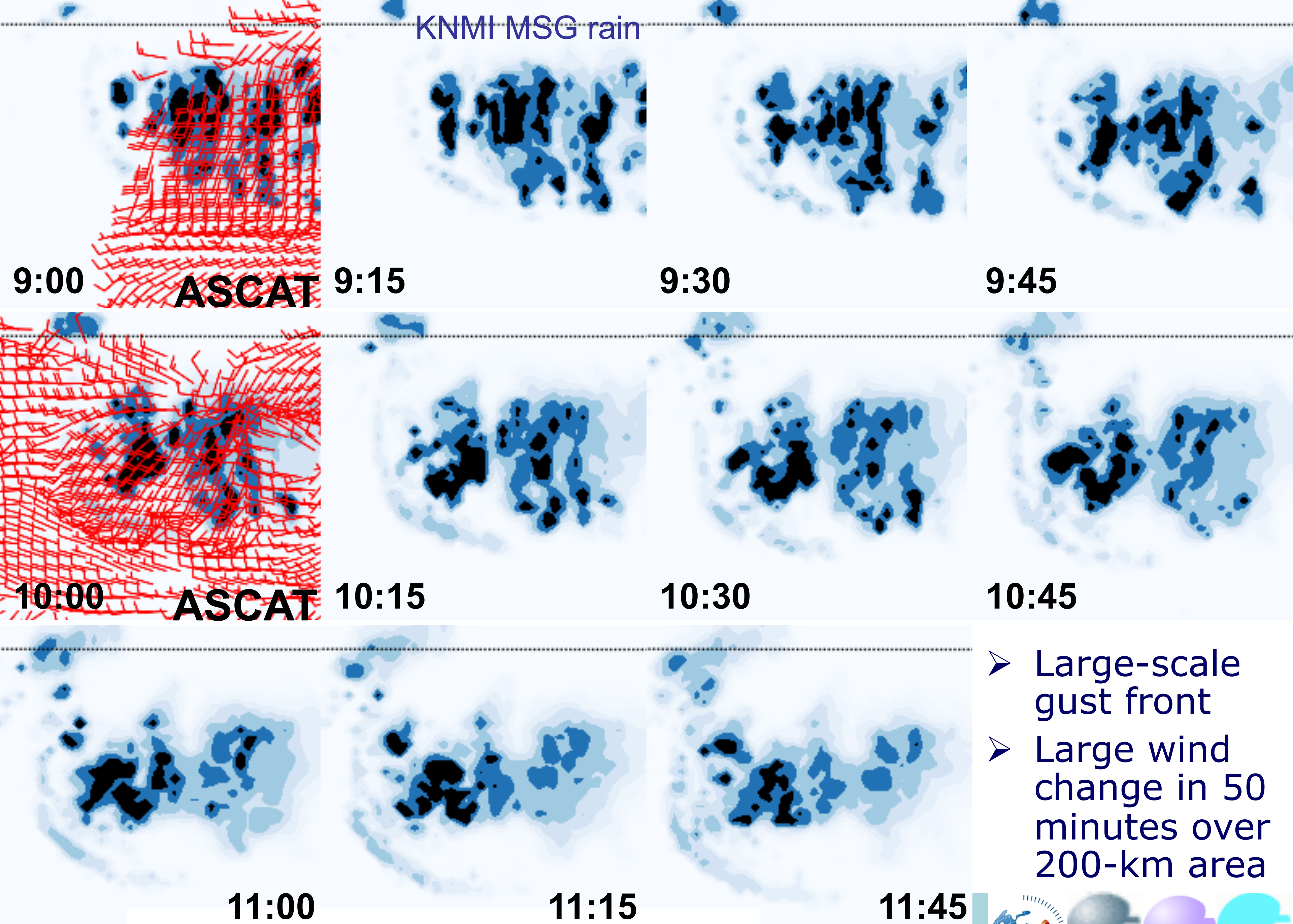

16 February 2014, near 0E, 3N
9:00
KNMI MSG rain
9:15
9:30
9:45
ASCAT
10:00
10:15
10:30
9:45
ASCAT div
9:45
ASCAT rot
32.00
16.00
8.00
4.00
2.00
1.00
0.50
0.25
0.12
0.00
precip [mm/hr]






- Convergence and curl structures associated with convective cell
- Inflow convergence
- Precipitation is associated with wind downburst
- Shear zones with curl (+ and -)

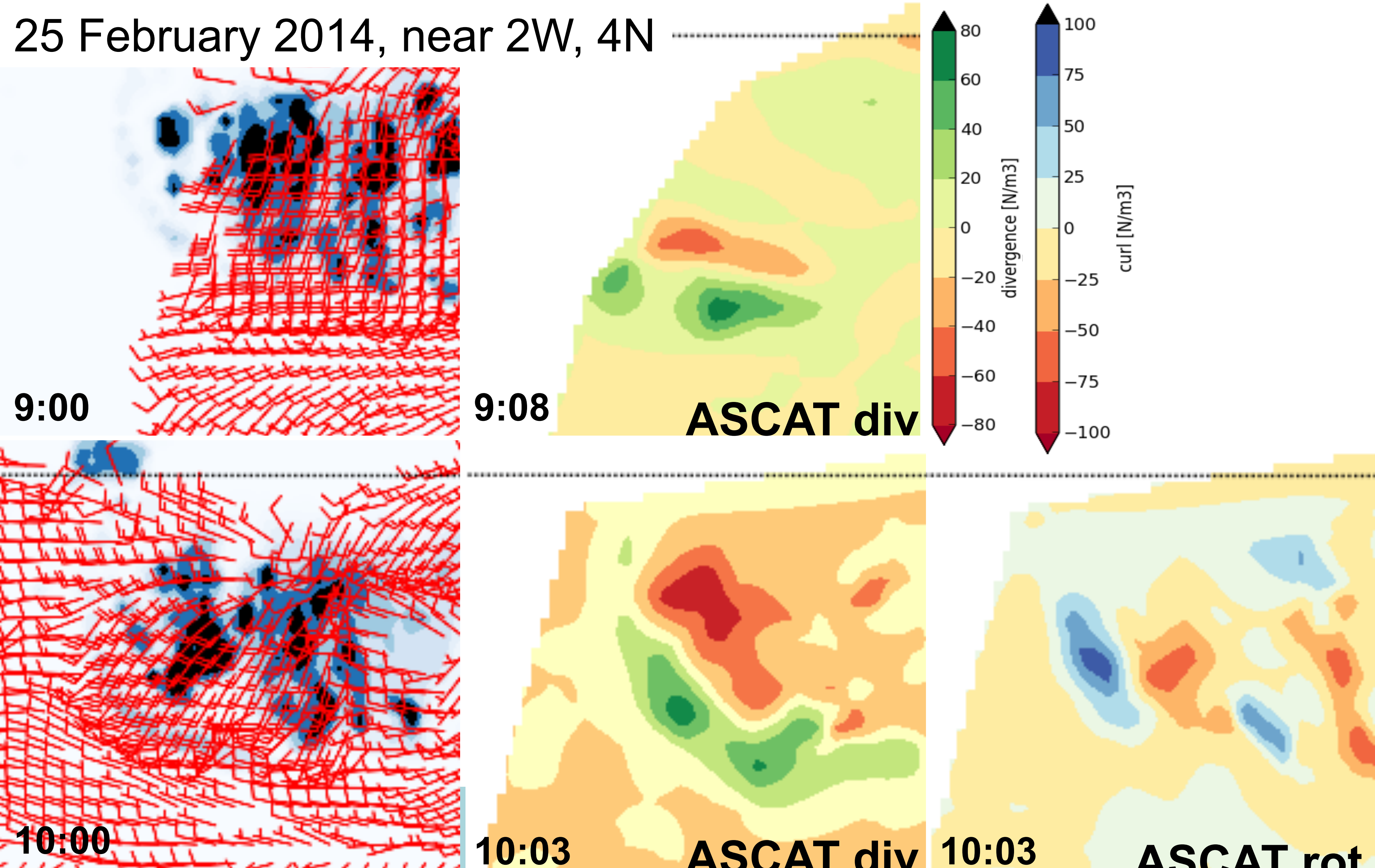



25 February 2014, near 2W, 4N

- Large-scale gust front
- Large wind change in 50 minutes over 200-km area

# Developing gust band

25 February 2014, near 2W, 4N

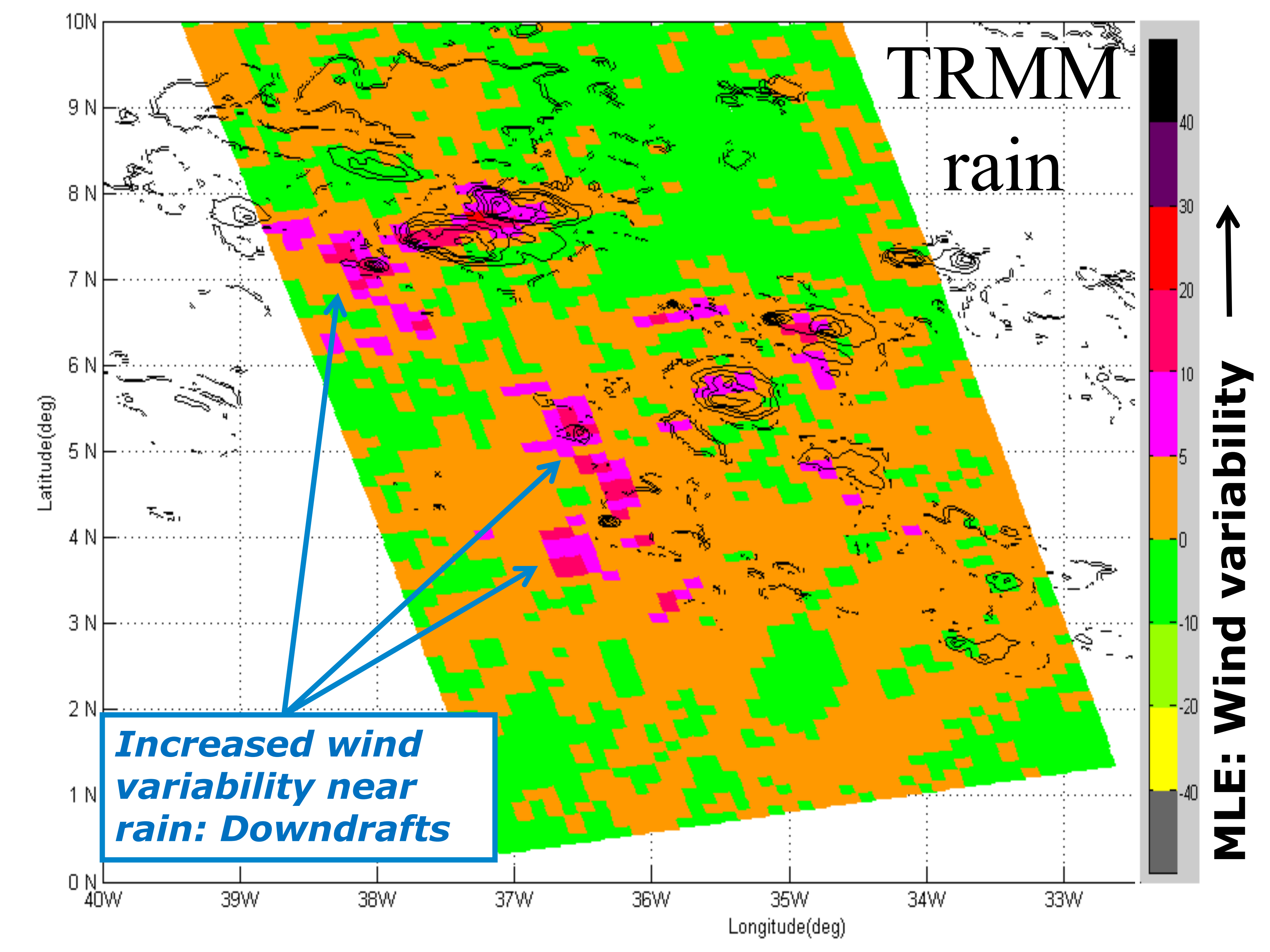


# $MLE$ – GMF (cone) distance

The GMF represents mean conditions on the globe; locally differences occur due to non-nominal conditions:

- Sub-WVC wind variability
- Rain splash
- Rain cloud attenuation and backscatter (Ku band)
- Land contamination
- Sea ice contamination
- Sea structures
- . . .

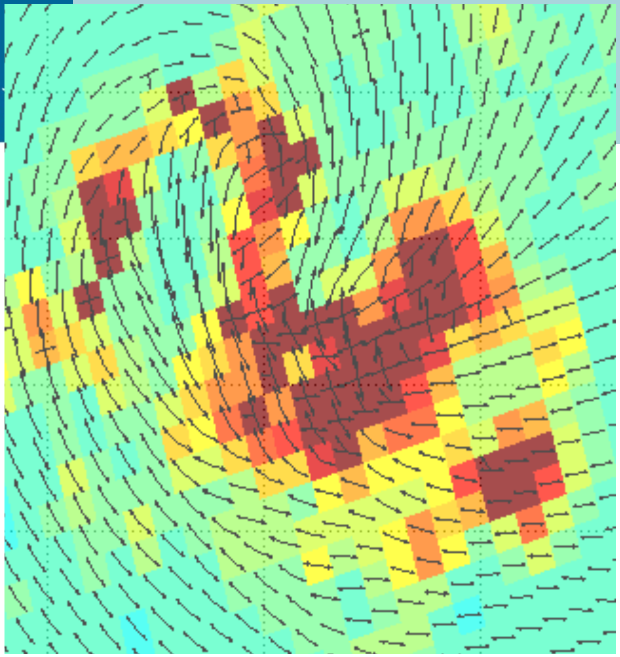
- For ASCAT sub-WVC wind variability appears most prominent; most extreme near lows, fronts and convection



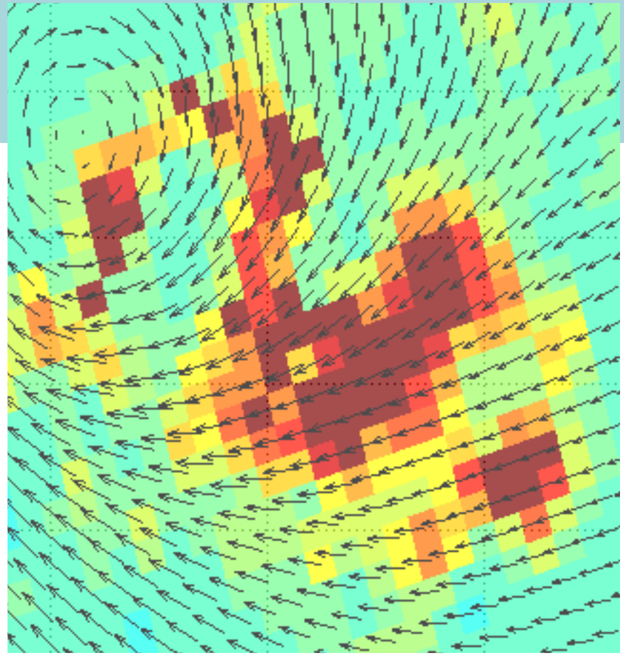
TRMM
rain
Increased wind
variability near
rain: Downdrafts
MLE: Wind variability
40
30
20
10
5
0
-10
-20
-40
10N
9 N
8 N
7 N
6 N
5 N
4 N
3 N
2 N
1 N
0 N
Latitude(deg)
40W
39W
38W
37W
36W
35W
34W
33W
Longitude(deg)

# Ambiguity

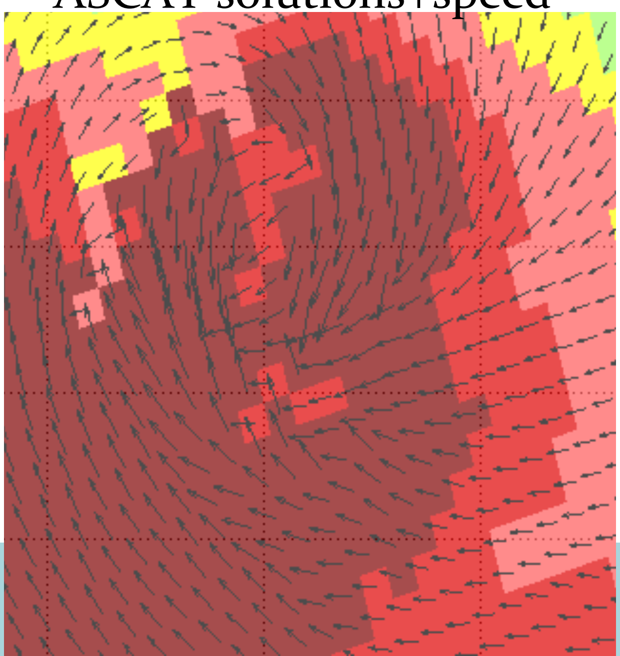
ASCAT ambiguities+MLE



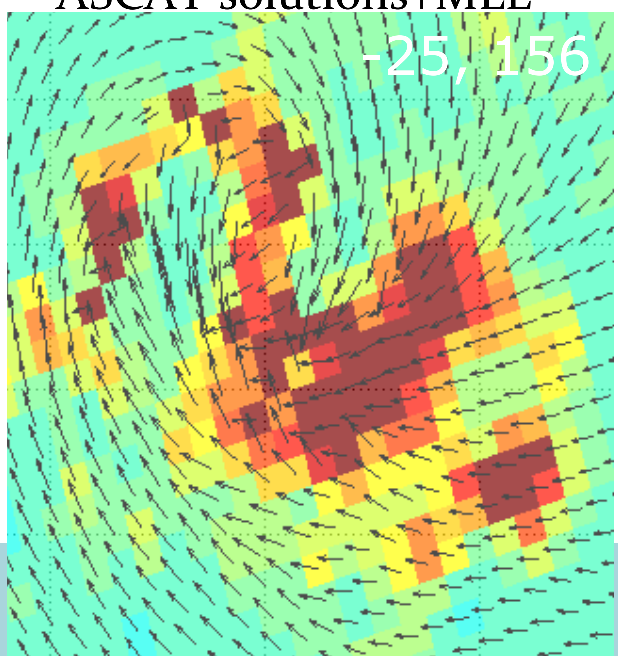
ECWMF wind+MLE



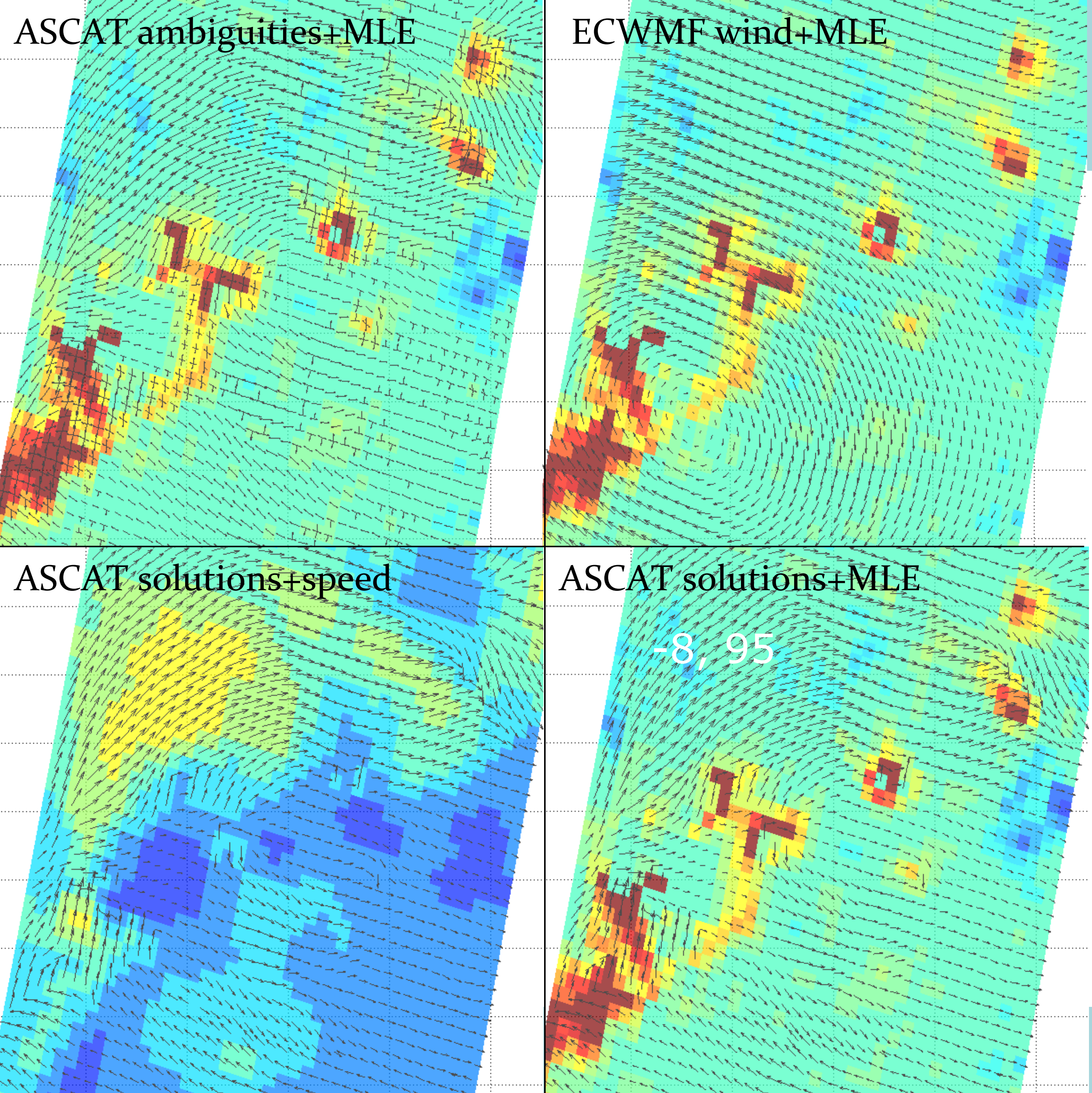
ASCAT solutions+speed



ASCAT solutions+MLE




- Ambiguities show streamlines of the flow; can you follow them?
- Is ECMWF right?
- Do you see consistency in the ASCAT winds and the ASCAT *MLE*s?
- Are there better ASCAT solutions to the ambiguity problem?

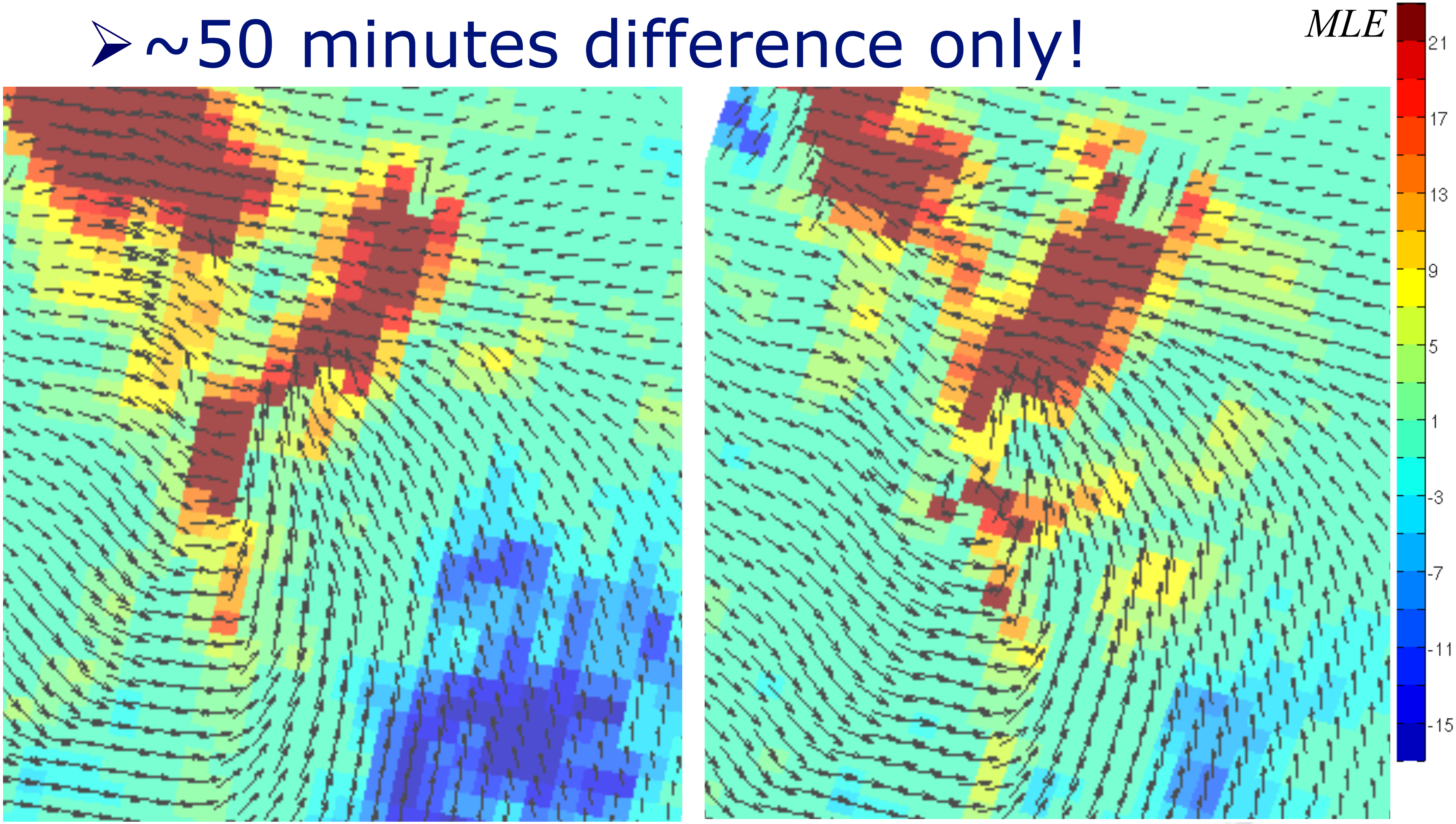



# Use MLE

- Denotes flow boundaries
- Nowcasting
- Ambiguity removal
- Proxy for large and short-scale forecast errors
- QC to remove un-representative observations in data assimilation

# ASCAT-B and ASCAT-A

- ~50 minutes difference only!

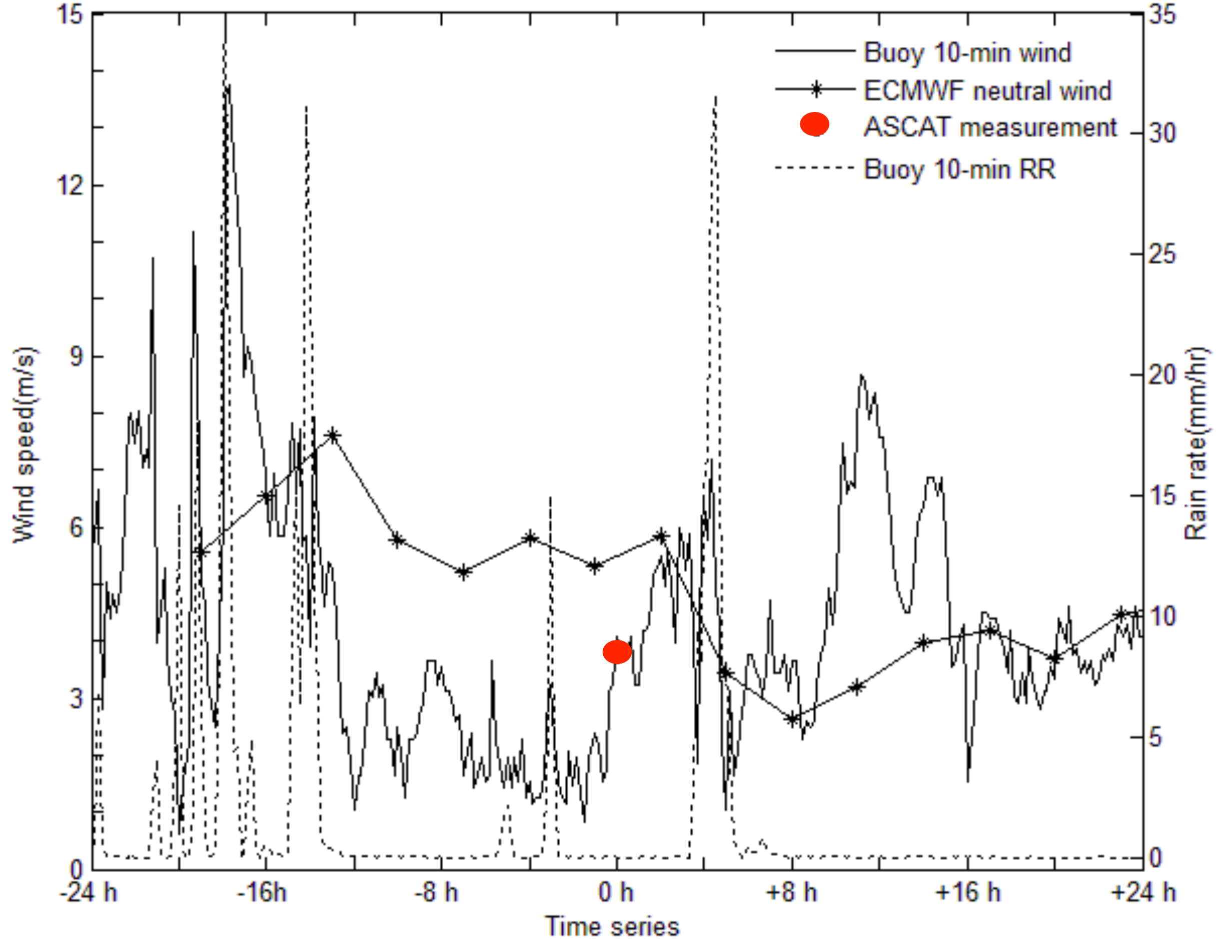


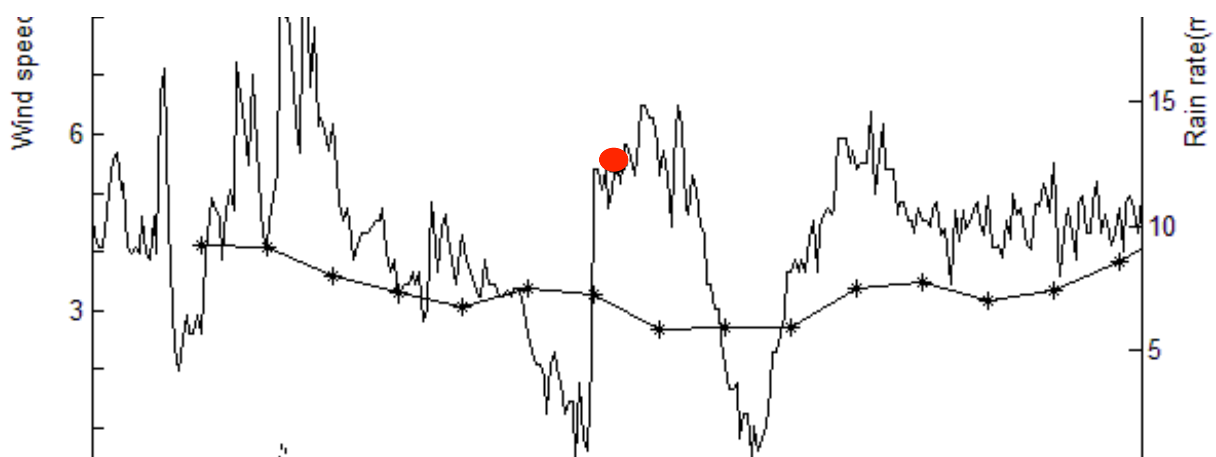

33, -137; 18:40/19:30 March 28, 2013

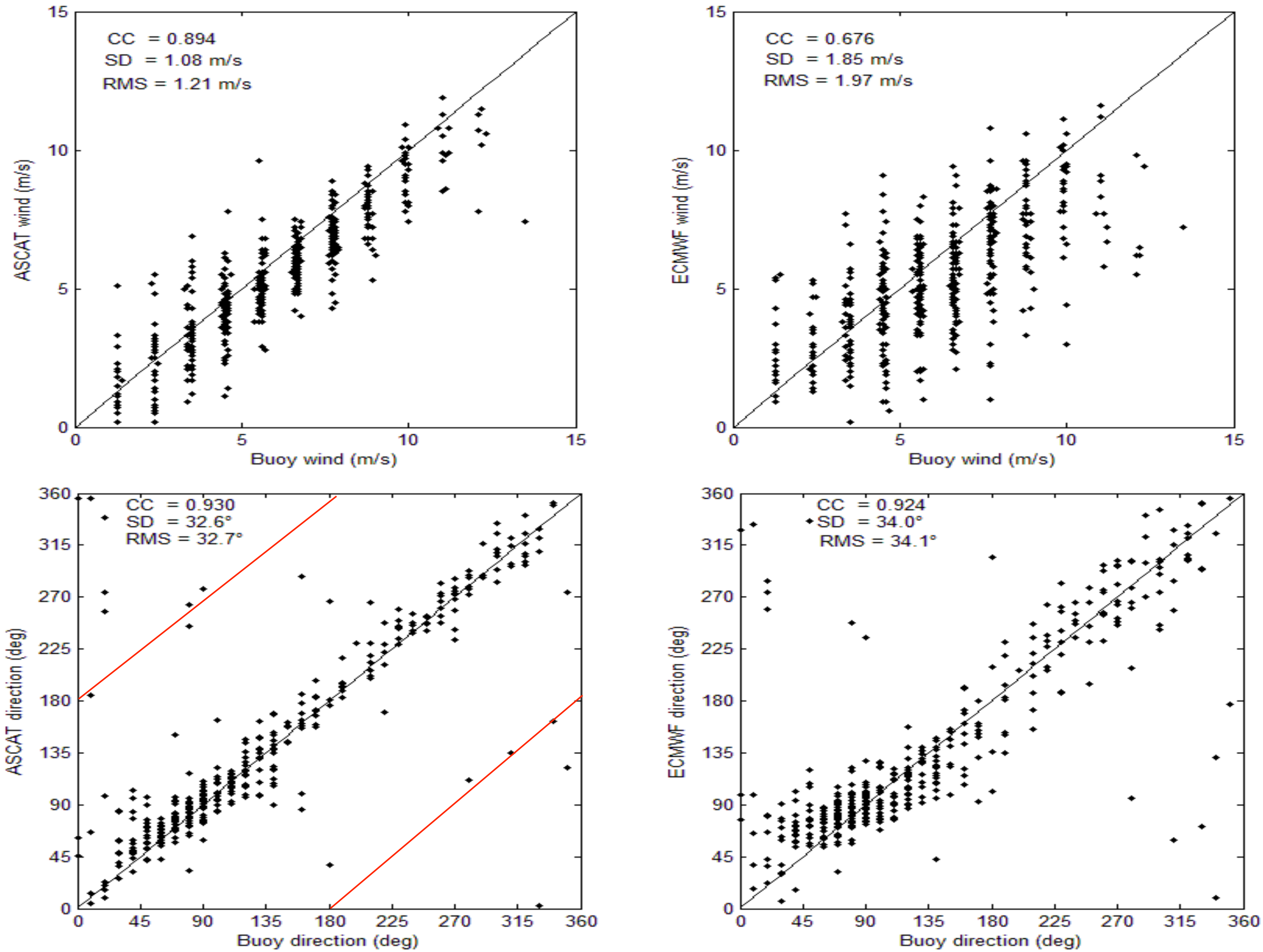
# Tropical variability

1. Dry areas reasonable
2. NWP models lack air-sea interaction in rainy areas
3. ASCAT scatterometer does a good job near rain
4. QuikScat, OSCAT and radiometers are affected by rain droplets

➢ Portabella et al., TGRS, 2011





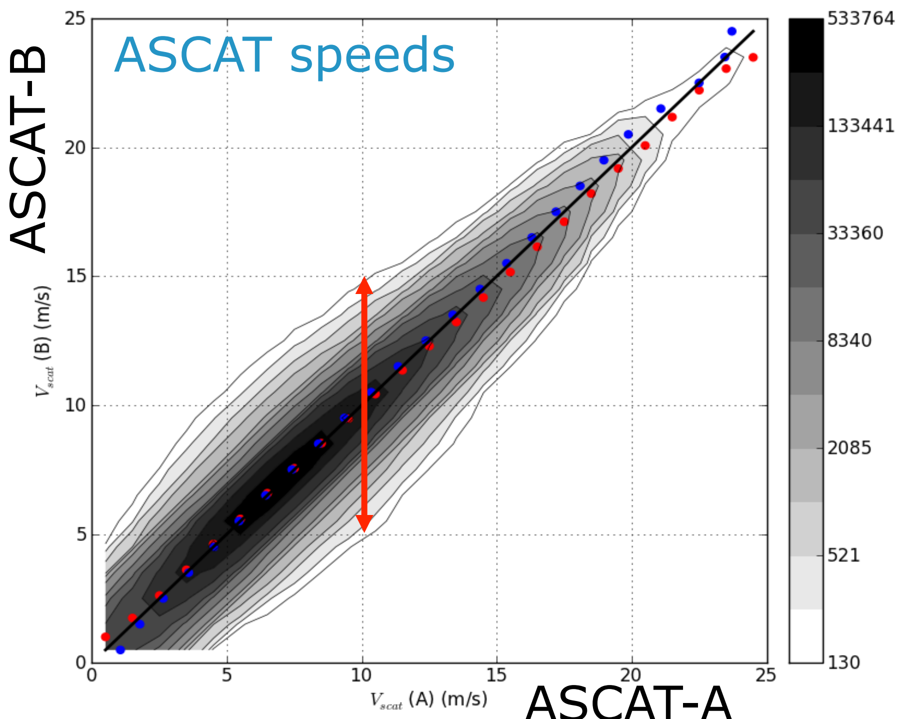

ASCAT 25 km (selected) winds closer to buoy winds than ECMWF winds in rainy areas (**buoy rain data**).

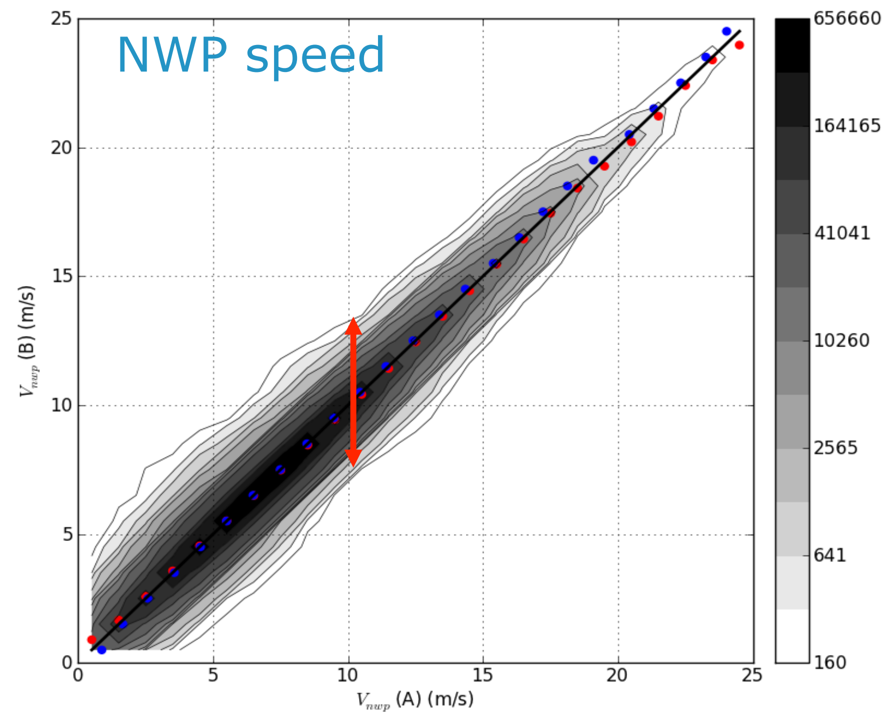
# ASCAT-A ASCAT-B collocation

- Global, Δt=50min.

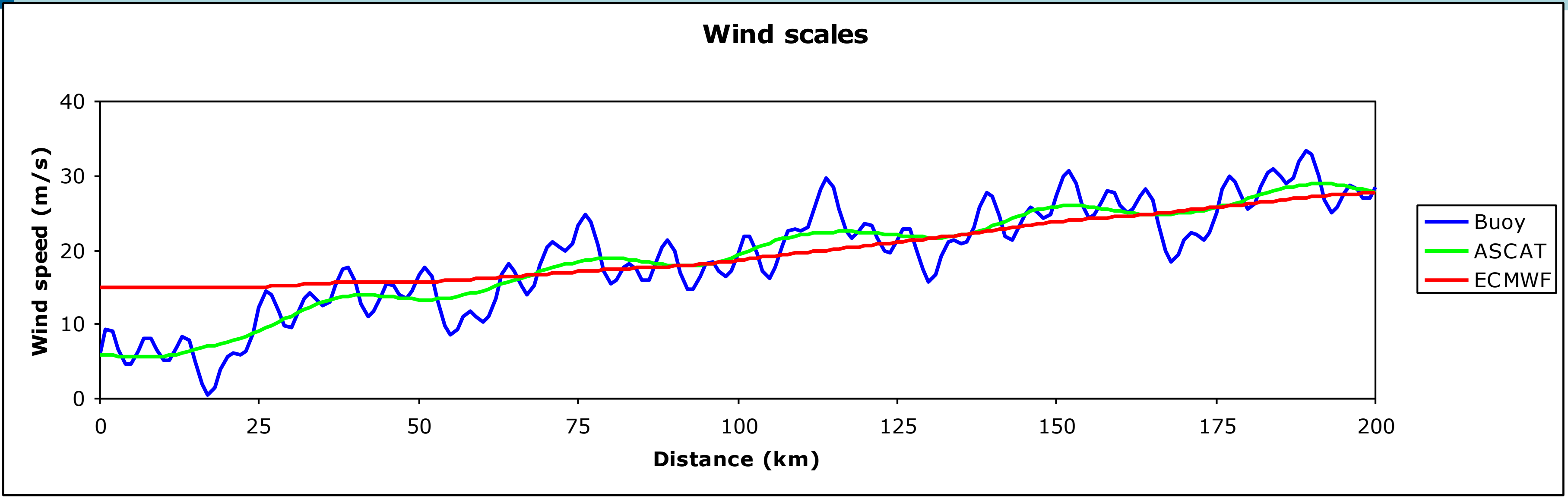
➢ Small spread in NWP due to 50 minutes time difference (smooth wind fields)

➢ Larger spread in ASCAT due to much smaller resolved scales (e.g., convection)



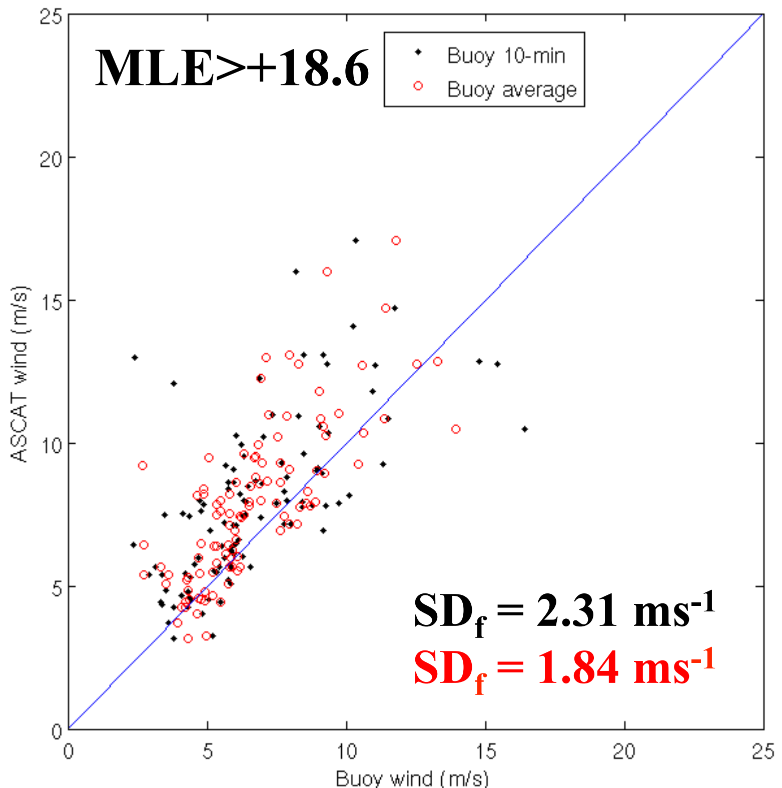
# Spatial representation

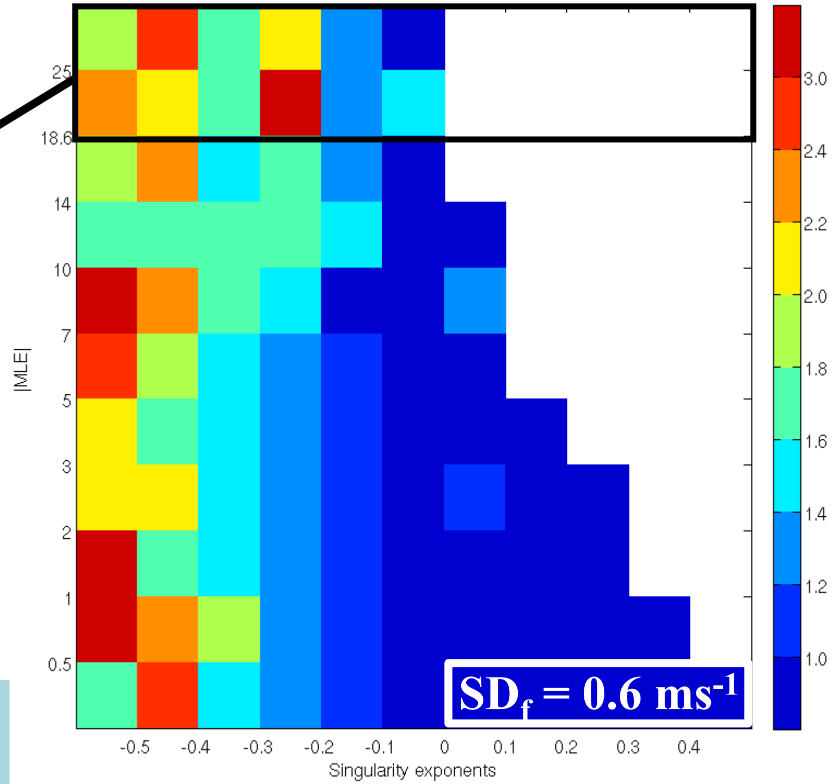


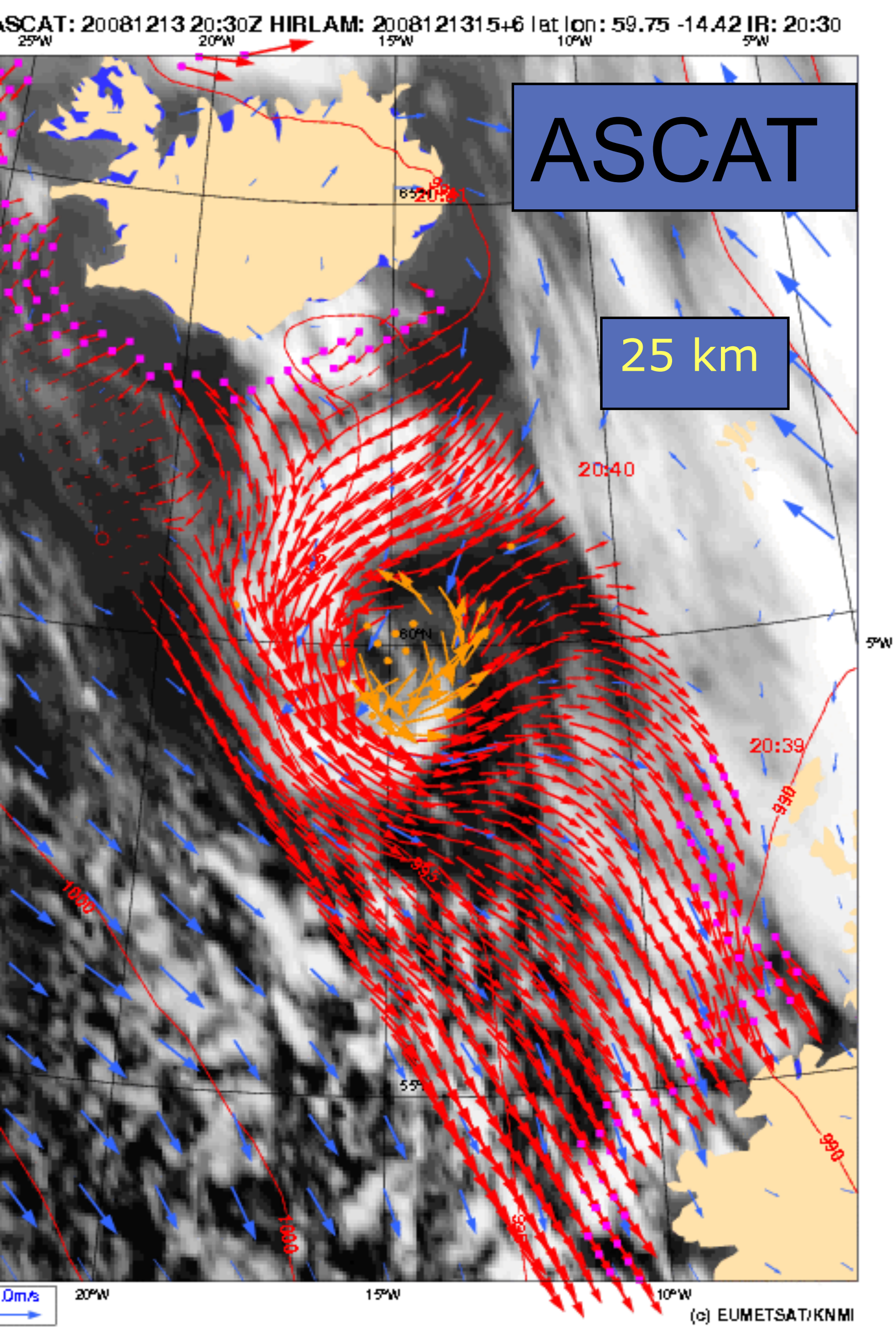

- We evaluate area-mean (WVC) winds in the empirical GMFs
- 25-km areal winds are less extreme than 10-minute sustained in situ winds (e.g., from buoys)
- So, extreme buoy winds should be higher than extreme scatterometer winds
- Extreme global NWP winds should be generally lower due to lacking resolution (over sea)

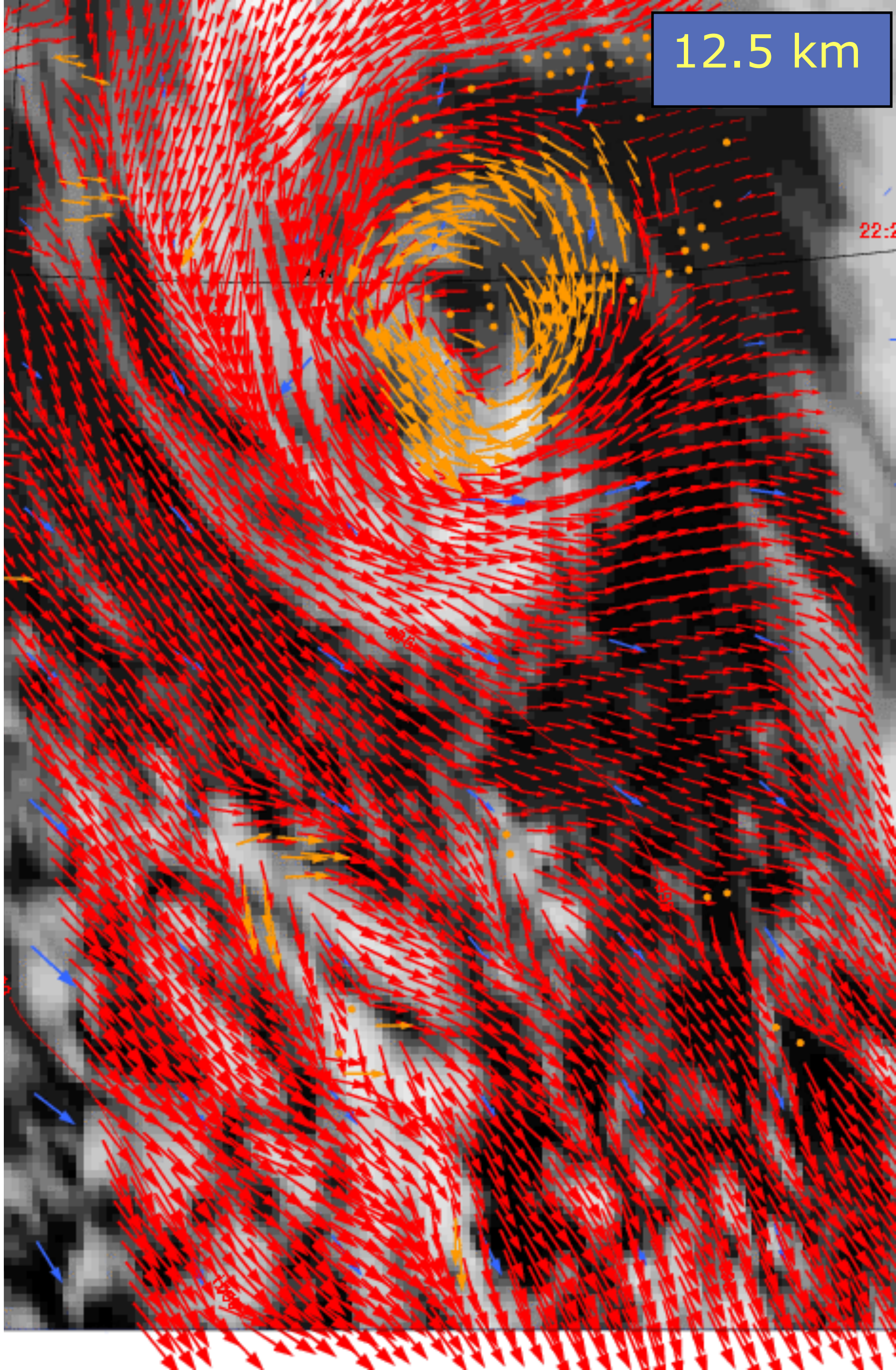
# QC: Which error is acceptable?

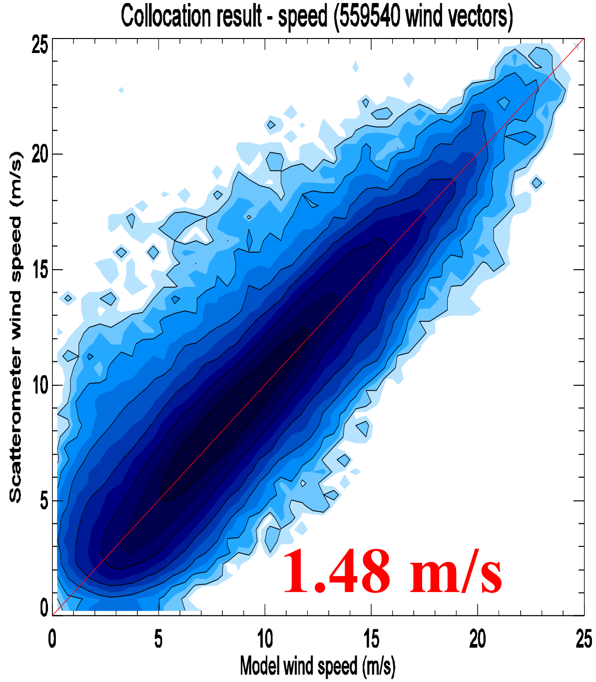
- We can produce winds with SD of buoy-scatterometer difference of 0.6 m/s, but would exclude all high-wind and dynamic air-sea interaction areas
- The winds that we reject right now in convective tropical areas are noisy (SD=1.84 m/s), but generally not outliers!
- What metric makes sense for QC trade-off?

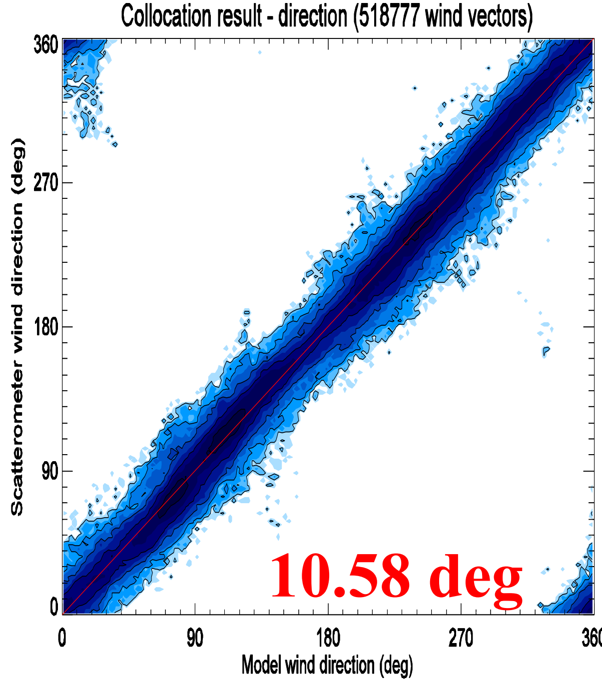



ASCAT: 20081213 20:30Z HIRLAM: 2008121315+6 lat lon: 59.75 -14.42 IR: 20:30
ASCAT
25 km
20:40
20:39
990
995
1000
(c) EUMETSAT/KNMI

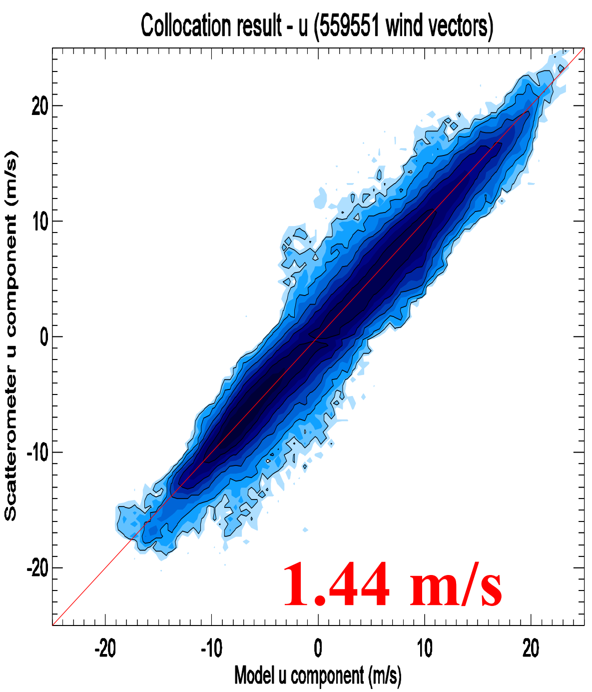

12.5 km

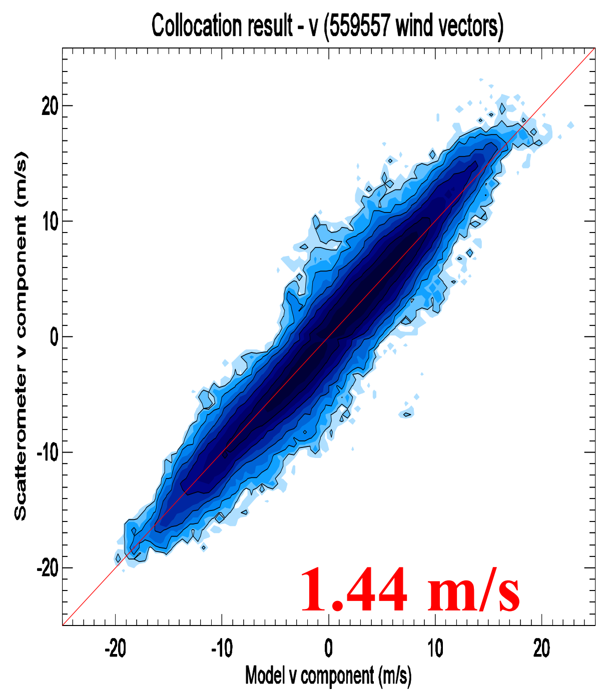



# KNMI HY2A vs ECMWF

- NWP ocean calibration (standard for wind processing)
- Speed, direction and vector components
- Outlier detection



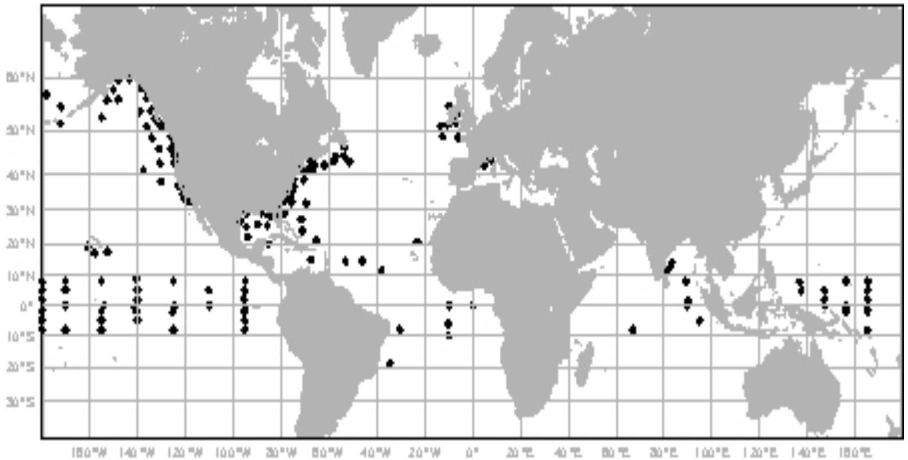




- Small scales evolve fast, so when we want to determine (initialize) them in 4D, we will need many observations

# Summary

- ASCAT-A and –B tandem are excellent for investigating dynamical aspects of convection
- MLE denotes gustiness and wind variability
- MLE complements imagery, particularly in case of convection or in pin-pointing extratropical fronts under a heavy cloud deck
- MLE could be used in 2DVAR and NWP
- Do not throw valuable ASCAT data away, unless you cannot handle it ☺

# Triple collocation



Data from November 2012 to January 2013

- Errors on scatterometer scale
- A and B very similar

| m/s | Scatterometer $\sigma_u$ | Scatterometer $\sigma_v$ | Buoys $\sigma_u$ | Buoys $\sigma_v$ | ECMWF $\sigma_u$ | ECMWF $\sigma_v$ |
|---|---|---|---|---|---|---|
| ASCAT−A 25−km | 0.63 | 0.71 | 1.21 | 1.35 | 1.39 | 1.44 |
| ASCAT−B 25−km | 0.63 | 0.66 | 1.26 | 1.39 | 1.38 | 1.42 |
| ASCAT−A Coastal | 0.76 | 0.84 | 1.18 | 1.34 | 1.54 | 1.57 |
| ASCAT−B Coastal | 0.81 | 0.79 | 1.24 | 1.35 | 1.53 | 1.57 |