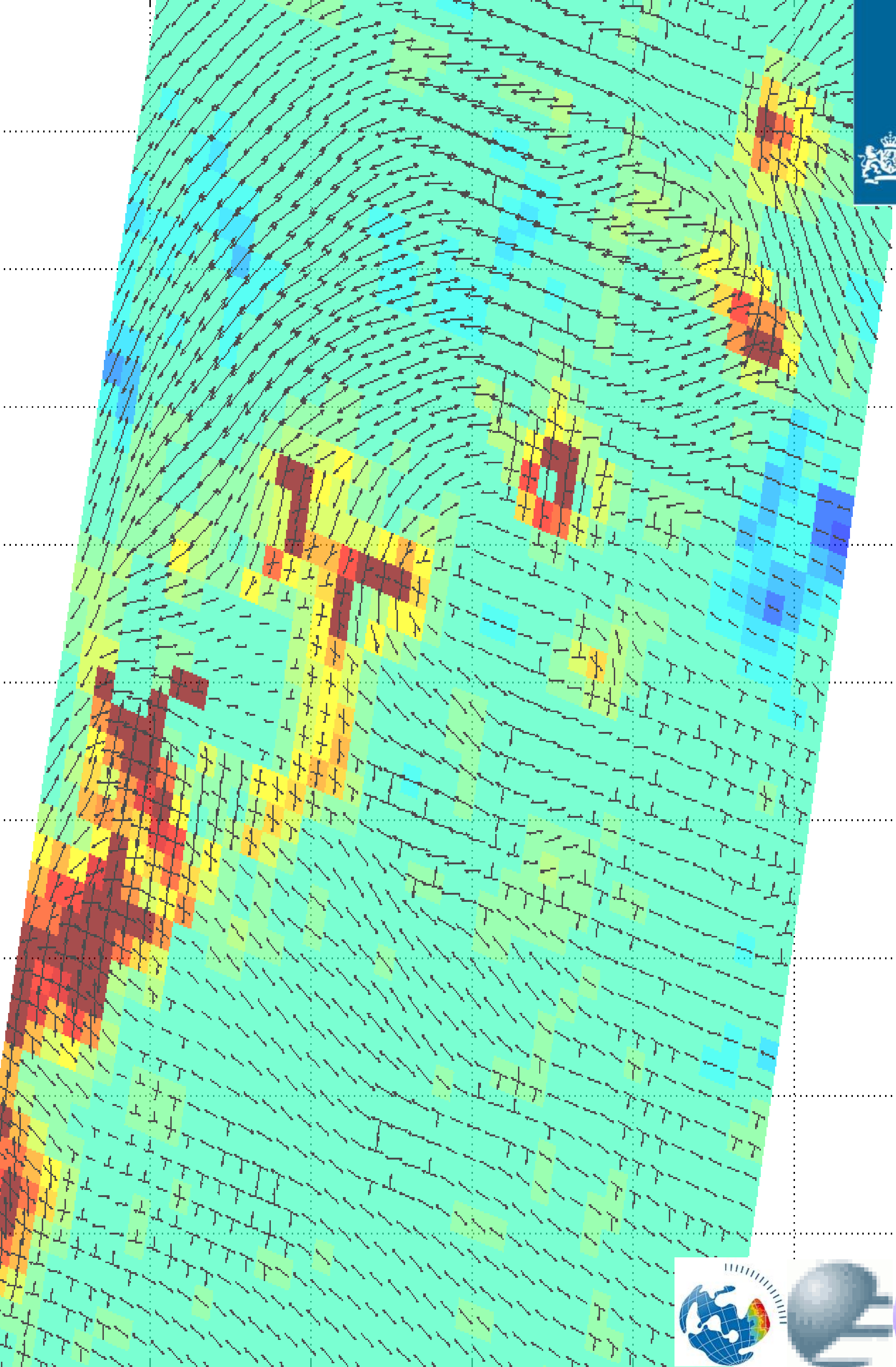

Standards in the Evaluation of Scatterometer Wind Products

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Motivation

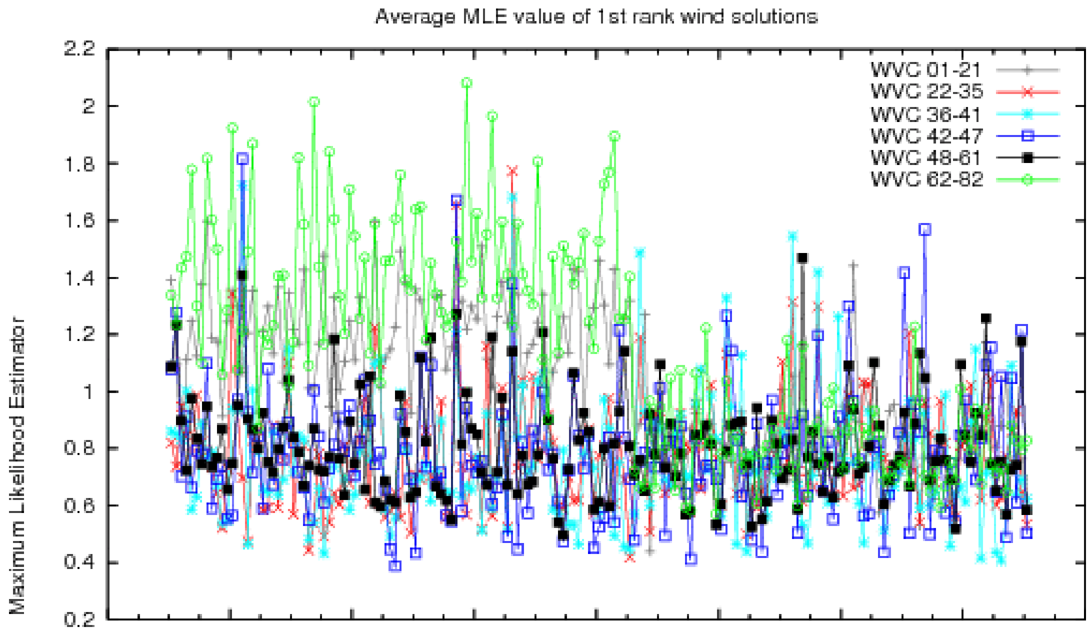
- Several producers provide OVW FCDRs, which are usually defensible by their own verification metric
- However, these products cannot be easily understood nor combined by the user community
- Mature stable products exist over long times, but not reprocessed according to GCOS guidelines; some uncoordinated L2 and higher reprocessing plans exist
- Matchup data bases exist too, but by producer
- Moored buoys are the main reference
- Quality metrics and assessment standards (software) exist too by producer, but resolution, wind scale, wind quality to be coordinated/agreed
- The IOVWST could address ECV coordinated needs (when mandated as such)
- Cal/val support for OSCAT has been very successful; the combined IOVWST methods work well!

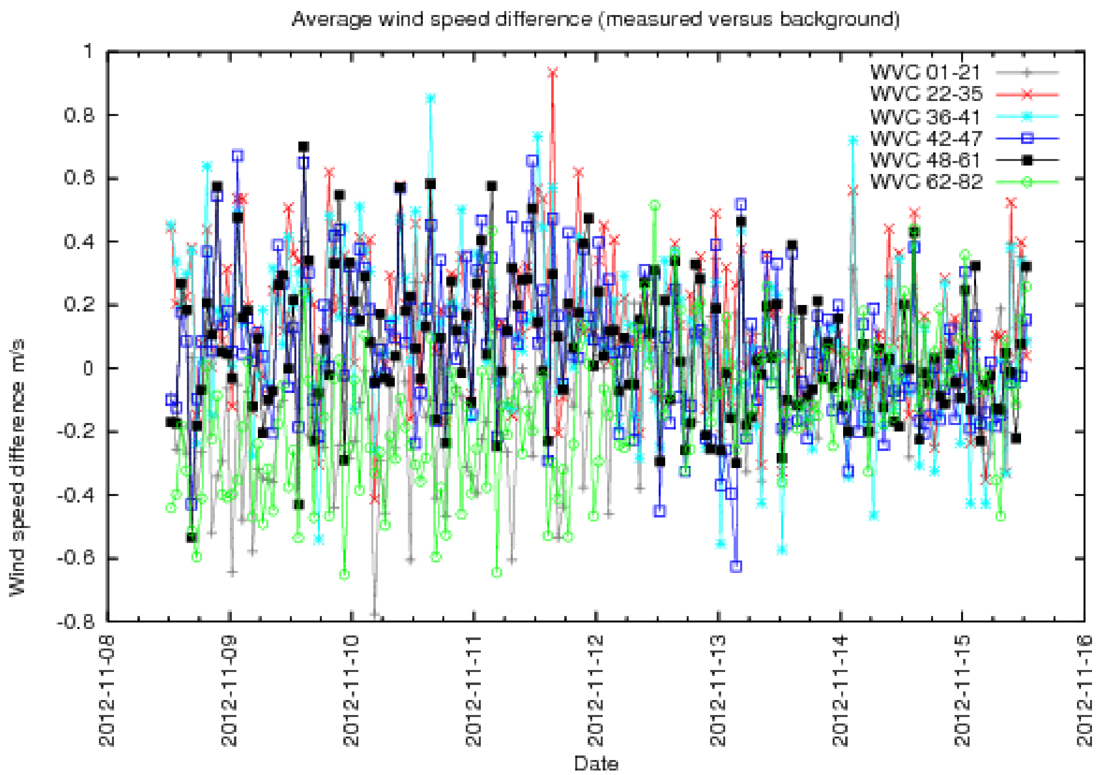
L1 Calibration

- Transponder procedure in development for ASCAT
- Rain forest (stable points)
- Sea ice / snow /desert (stable points)
- Geographically limited, while some errors may be orbit phase dependent

- NWP ocean calibration successfully used for winds
- Need to combine all methods of calibration, including ocean calibration
- Calibration procedures and GMFs need to be shared between producers to achieve intercalibrated NRCS

Monitoring



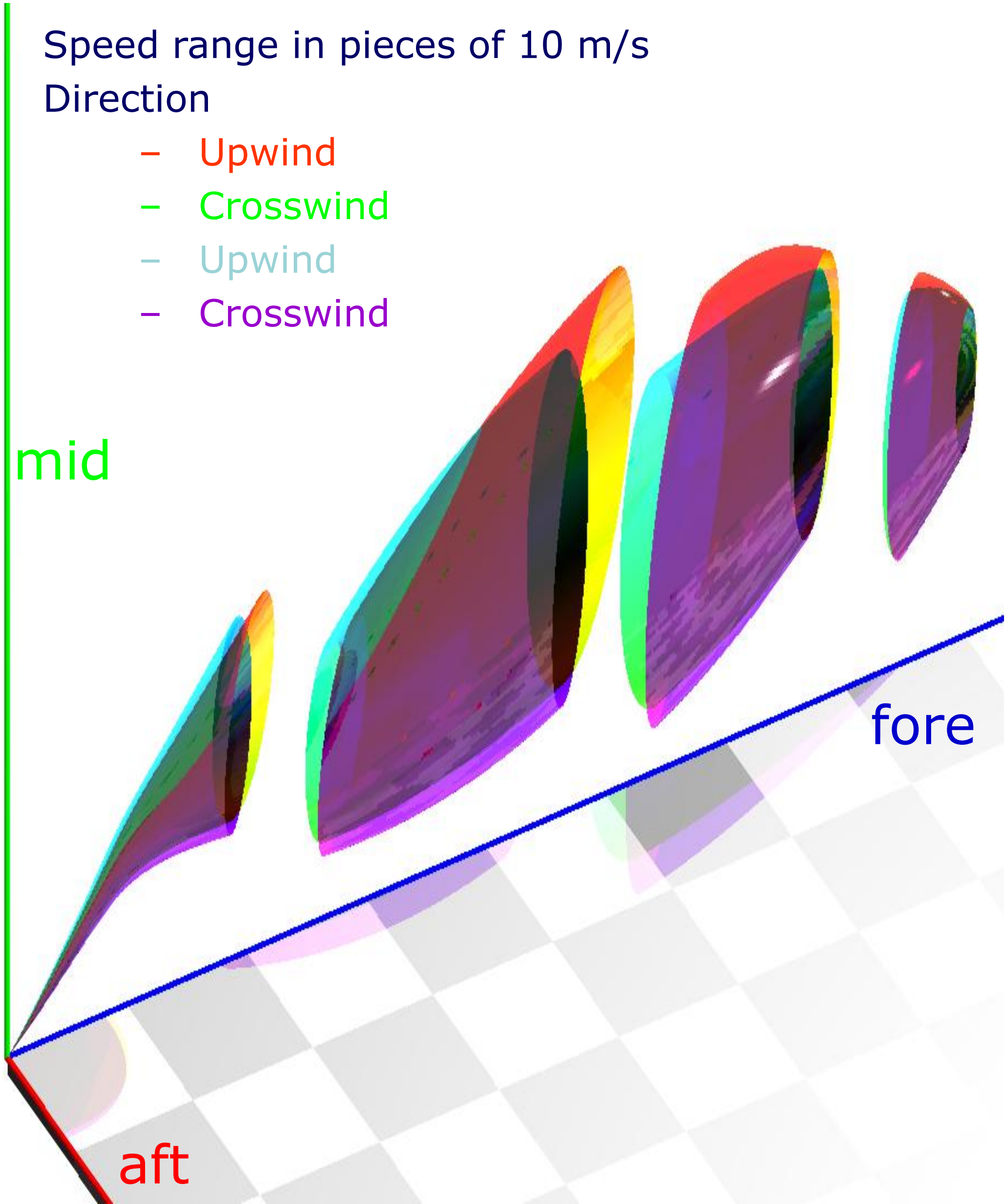


www.knmi.nl/scatterometer

- Confirm stability of instrument over full record
- Automatic alerts based on multiparameter flag

- NOC provides improved cone positions and more uniform quality winds
- Separates backscatter inconsistencies from GMF errors

Cone surface



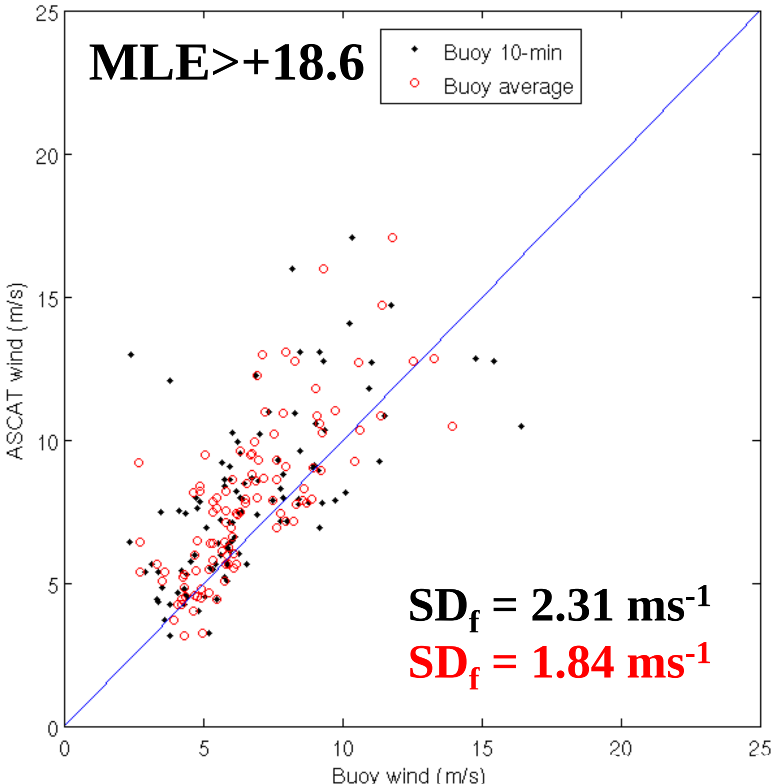
- For a given cross-track swath WVC number, the incidence angles of all beams are fixed
- Since

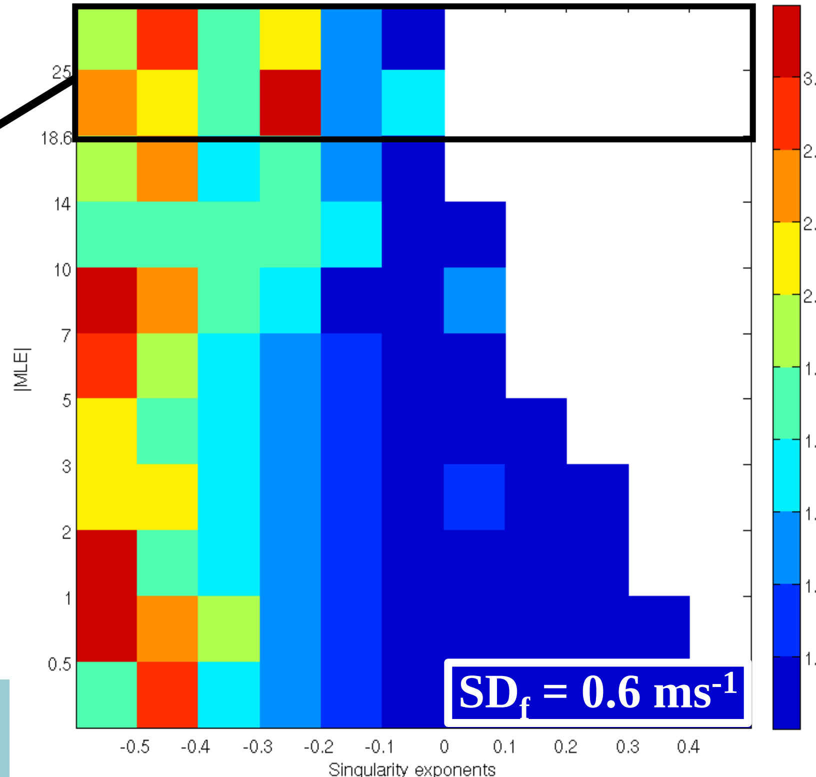
  $$\sigma^0 = \mathrm{GMF}(U10N,\ \phi,\ \theta,\ \lambda,\ \mathrm{pol})\ ,$$

  only $U10N$ and ϕ change when the satellite is orbiting the earth
- $U10N$ and ϕ span a cone-like surface:
  - $U10N$ increases away from the origin
  - Wind direction ϕ opens the cone surface
- The GMF cone is very close to the σ^0 triplets (<5 %)
- $U10N$, i.e., add ρ_{AIR} (ECMWF)

QC: Which error is acceptable?

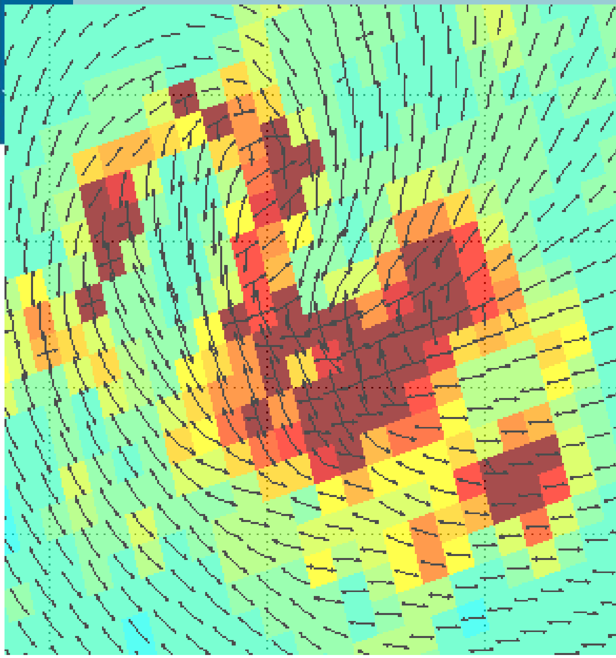
- We can produce winds with SD of buoy-scatterometer difference of 0.6 m/s, but would exclude all high-wind and dynamic air-sea interaction areas
- The winds that we reject right now in convective tropical areas are noisy (SD=1.84 m/s), but generally not outliers!
- What metric makes sense for QC trade-off?



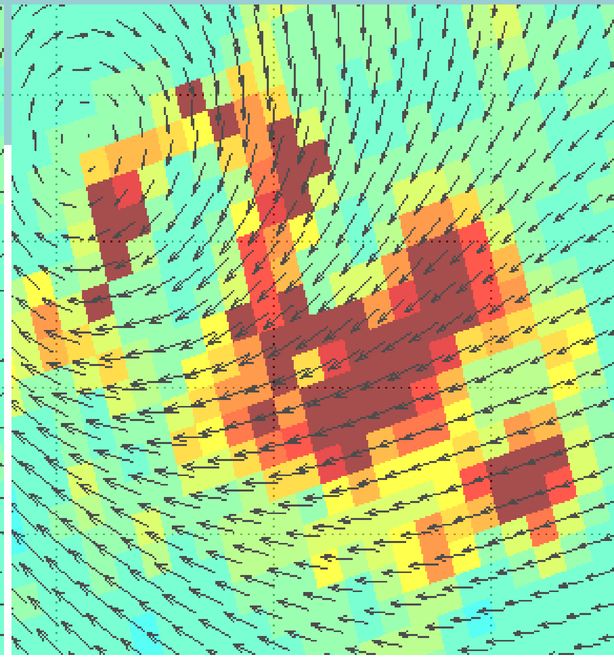


Ambiguity

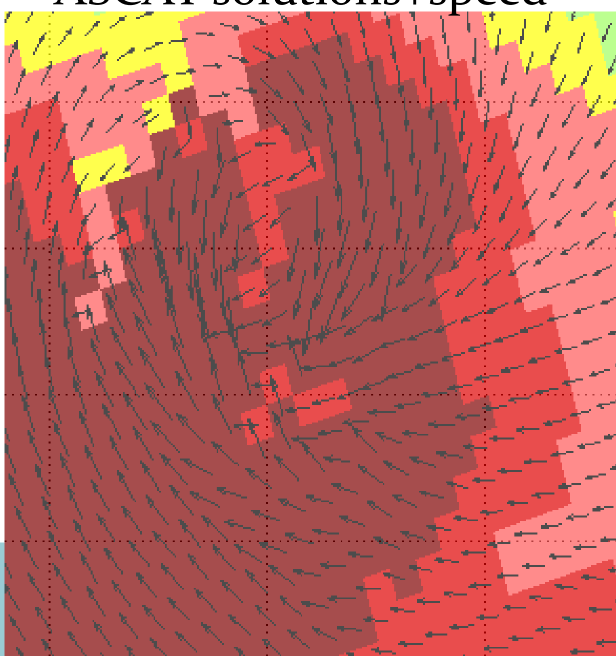
ASCAT ambiguities+MLE



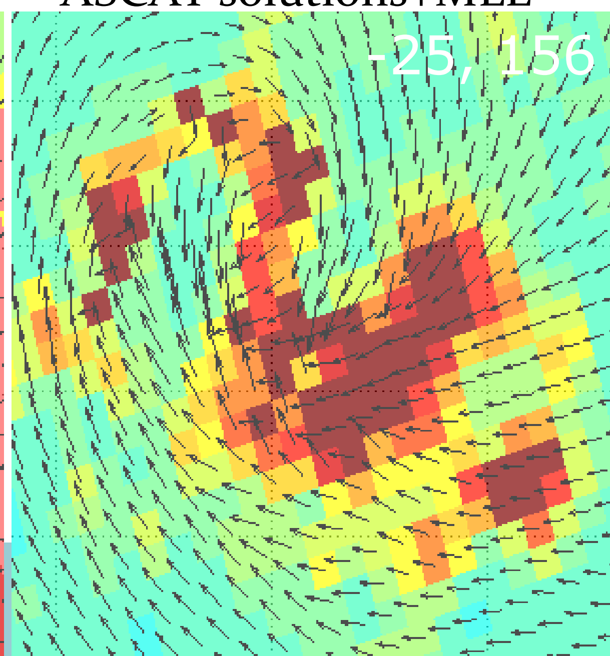
ECWMF wind+MLE



ASCAT solutions+speed

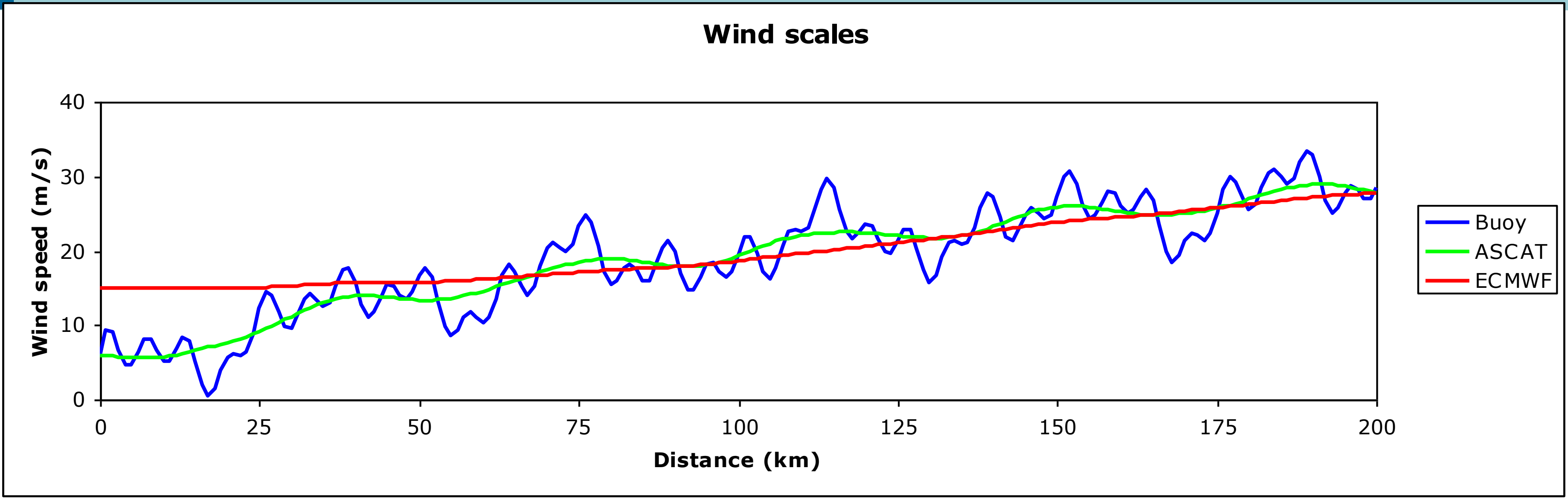


ASCAT solutions+MLE

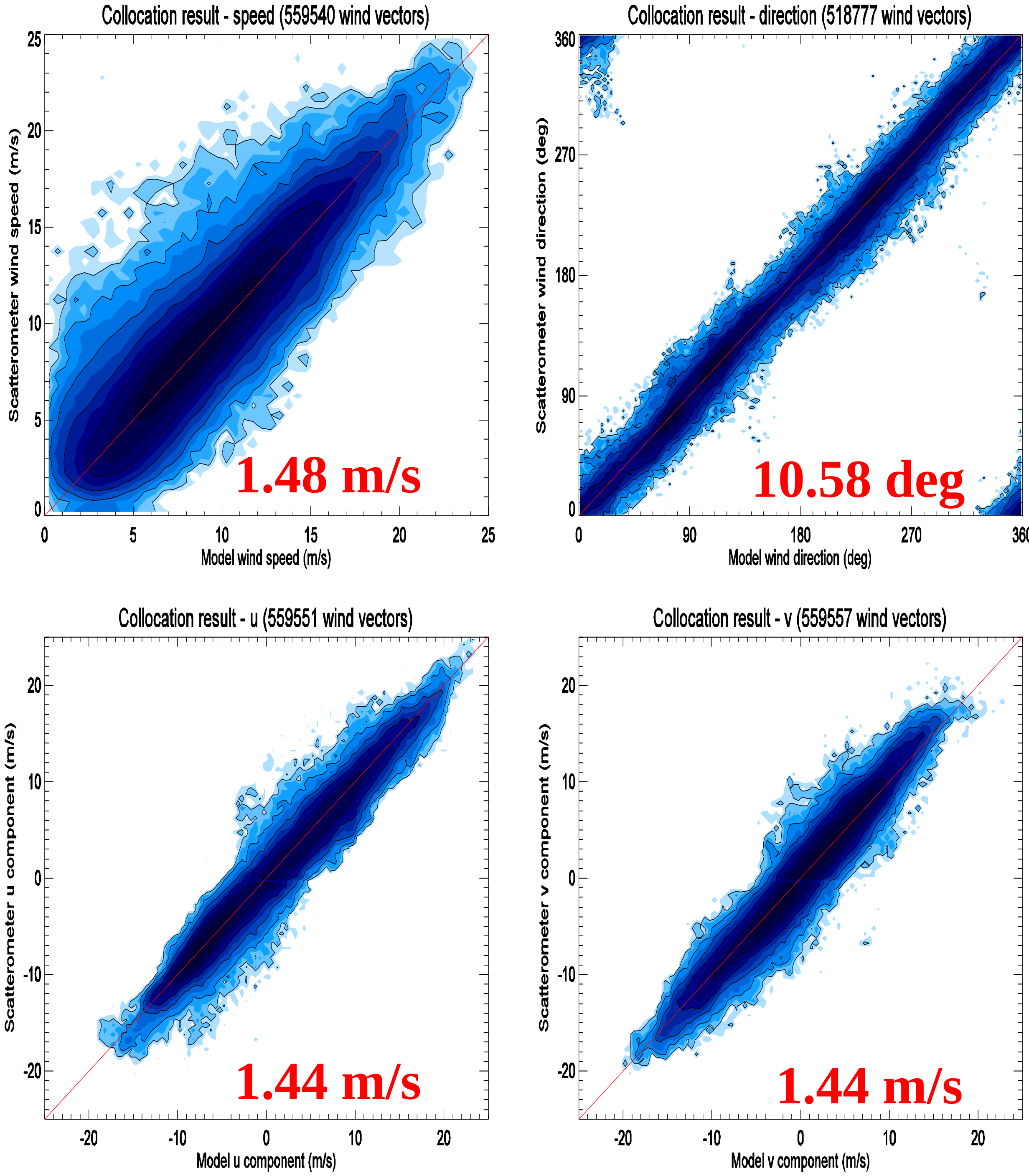


- Ambiguities show streamlines of the flow; can you follow them?
- Is ECMWF right?
- Do you see consistency in the ASCAT winds and the ASCAT *MLE*s?
- Are there better ASCAT solutions to the ambiguity problem?

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)

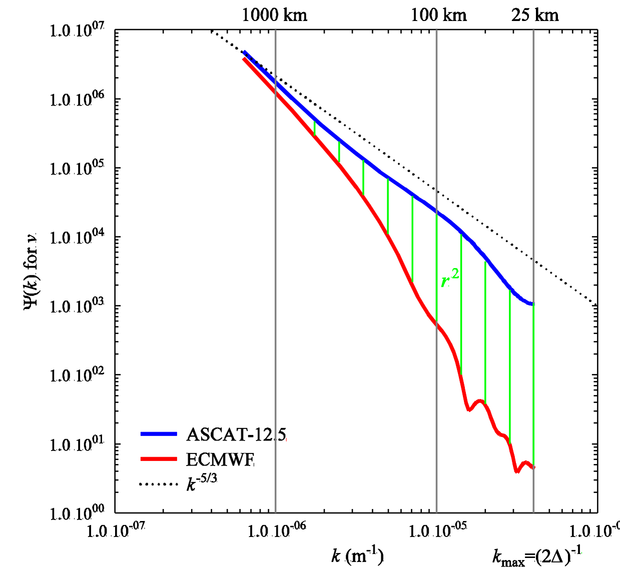


NWP comparison

- NWP ocean calibration (standard for wind processing)
- Speed, direction and vector components
- Cross-track WVC dependencies
- Outlier detection
- $U10N_{OPS} \approx U10N_{ERA} + 0.2$ m/s
- ECMWF coastal *U10N* is best obtained on reduced Gaussian grid; KNMI makes ECMWF *U10N* available for ERA (and OPS)

Precision, accuracy: triple collocation

	u	*v*
Bias ASCAT (m/s)	0.15	-0.02
Bias ECMWF (m/s)	0.28	0.08
Trend ASCAT	1.01	1.01
Trend ECMWF	1.03	1.04
σ ASCAT (m/s)	0.69	0.81
σ ECMWF (m/s)	1.50	1.52
Representation error (m/s)	0.79	1.00



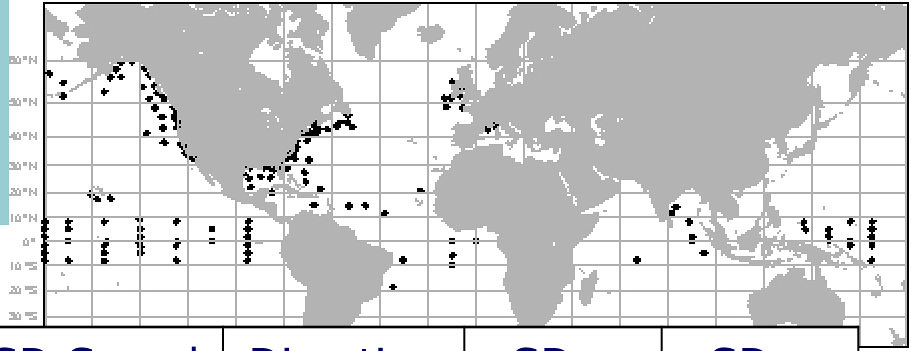
Spatial representation error from spectrum difference integrated over scales from 25 km to 800 km

Representation error is part of ECMWF error

- OSI SAF NRT req. 2 m/s, WMO in speed/dir.

See also Vogelzang et al., JGR, 2011

Collocate collocations

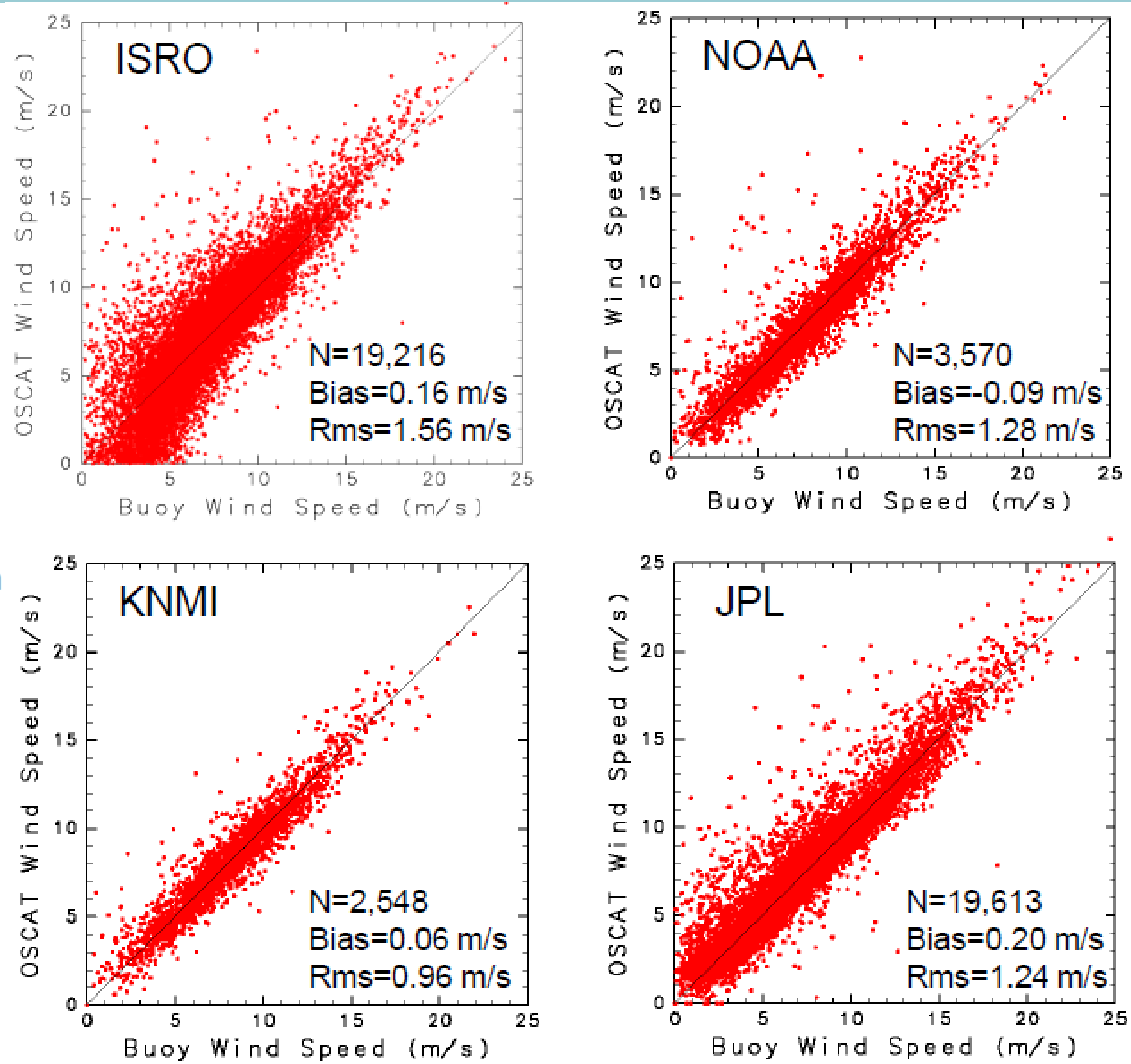


OSCAT 50-km product SDs v2010	SD Speed m/s	Direction degree	SD *u* m/s	SD *v* m/s
L2B, collocated OWDP, ≥ 6 m/s	1.34	19.40	2.41	2.30
OWDP, collocated L2B, ≥ 6 m/s	1.33	16.67	2.02	2.12

- Since QC differs by product, comparison of validations of different products are only useful when the same sample of WVCs is used, i.e., collocated products
- Holds for all validation metrics (buoy, NWP)
- The other rejection categories may be tested too

Independent verification

1. ISRO/NRSC (ver. 1.3)
   - 50 km resolution
   - 1 Jan. 2011 – 31 Mar. 2012 (15 months)
2. NOAA/NESDIS
   - 25 km resolution
   - 1 Jan. 2012 – 31 Mar. 2012 (3 months)
3. KNMI/OSI SAF
   - 50 km resolution
   - 1 Dec. 2012 – 31 Mar. 2013 (4 months)
4. JPL/PODAAC
   - 12.5 km resolution
   - 1 Jan. 2011 – 31 Dec. 2011 (12 months)
   - Rain correction + Cross-track bias correction



- ➢ Still QC differences need to be documented
- ➢ At least same buoy QC
- ➢ Ebuchi plots!

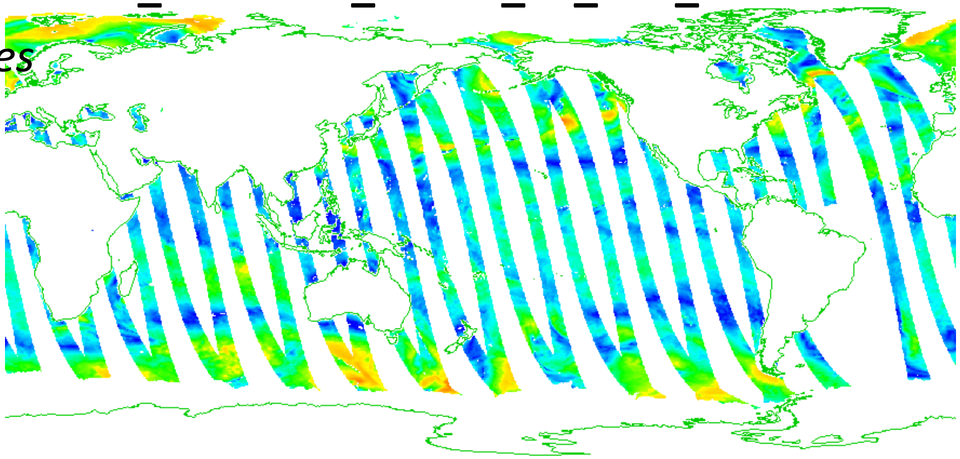
Naoto Ebuchi, Tokai Un., Japan
coaps.fsu.edu/scatterometry/meeting/past.php#2013

Gridded daily L3 products

www.myocean.eu

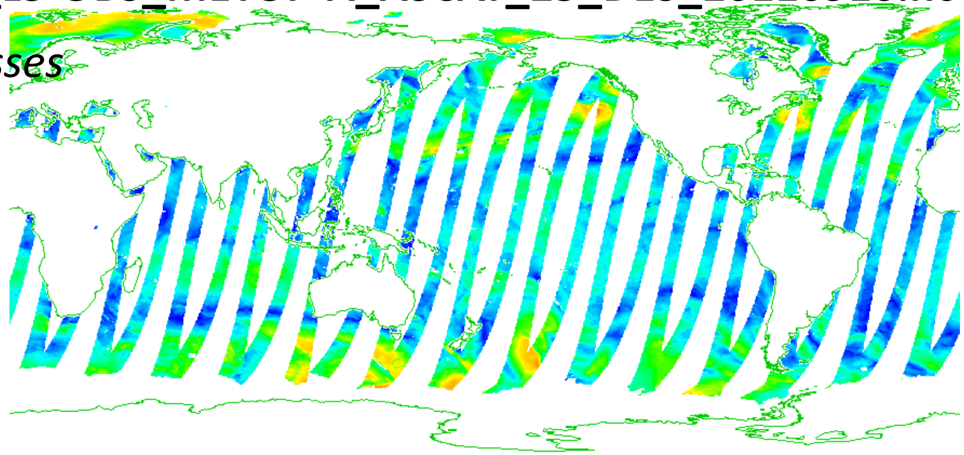
GLO-WIND_L3-OBS_METOP-A_ASCAT_25_ASC_20110910.nc

Ascending passes



GLO-WIND_L3-OBS_METOP-A_ASCAT_25_DES_20110910.nc

Descending passes



- Use L2 $U10N$ and τ
- No time mixing
- New swath grid for derivatives $\nabla\cdot\tau$ and $\nabla\text{x}\tau$
- Both for NWP and scatterometer fields
- Scatterometer NWP sampling may be compared with uniform mean NWP field to obtain sampling error
- Correct for it?

Define Uncertainty, Stability, Resolution

- Users have little clue how different products compare and whether they use the product most fit for their purpose
- Standardization of methods (software?) to assess uncertainty, resolution and stability to be discussed in the IOVWST
  - NWP ocean calibration, triple collocation, CDF matching
  - The resulting speed scale standard would be applicable to scatterometers, radiometers, altimeters and SAR
  - Accuracy of speed scale TBD (speed dependent)
    - Need dropsondes and SFMR records for extremes
- Producers to share match-up data bases
- Independent cal/val (e.g., Ebuchi)
- Publish / post results for users (in central place(s))

Suggested actions

- Obtain data set details from producers and make ECV inventory
- Reprocessing of all satellite winds following GCOS guidelines
- Share matchup data bases (incl. accurate NWP inputs)
- Collocate collocations
- Coordinate quality metrics and assessment standards (software) on resolution, **wind scale**, wind quality
- IOVWST to collect and address wind ECV coordinated needs
- Perform scatterometer intercalibration, also using RapidScat
- Develop a reference wind scale (intercalibration) for all satellite winds, scatterometer, radiometer, altimeter, SAR (incl. extremes)

- CEOS VC (satellite agencies) to promote satellite coordination and intercalibration (OSCAT was great success)
- Maintain L1 reprocessing facilities (e.g., ESA ERS) Extend moored buoy network in open ocean