



Rain-induced wind variability depicted by scatterometers

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Outline

- Is rain-induced wind variability well resolved by ASCAT and/or ECMWF?
- Any rain "contamination" effects on ASCAT?
- Is the ASCAT operational QC effective under rain conditions?

Rain Effects

The radar signal is attenuated by the rain as it travels to and from the Earth's surface $\rightarrow \sigma_0$ Retrieved wind speed

The radar signal is scattered by the raindrops. Some of this scattered energy returns to the instrument $\rightarrow \sigma_0$ Retrieved wind speed

The roughness of the sea surface is increased because of the splashing due to raindrops \rightarrow

 σ_0

Retrieved wind speed Directional information can be lost

Variable roughness due to wind downbursts Confused sea state, speed/direction unclear





Mean Vector RMS



Wind Speed



ASCAT rain effects for RR>6 mm/hr

Is EMWF depicting equatorial rain-related effects (downbursts, convergence)?

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Wind Direction

ASCAT

ECMWF



Need for a reference wind/rain data source: **Buoys** (reliable except for extreme winds)



Limitation: only 3400 ASCAT-ECMWF-Buoy collocations over 4.5 years

Note that only buoys with rain gauges are used

Tropical variability

- 1. Dry areas reasonable
- 2. NWP models lack airsea interaction in rainy areas
- 3. ASCAT scatterometer does a good job near rain
- QuikScat, OSCAT and radiometers are affected by rain droplets
- Portabella et al., TGRS, in press





ASCAT 25 km (closest w.r.t. buoy) winds closer to buoy winds than ECMWF winds in the vicinity of rainy areas

VICINITY OF RAIN

RAIN



ASCAT wind distribution shift due to rain splashing (**buoy** rain data).

Buoy validation

	ASCAT – Buoy (m/s)	ECMWF – Buoy (m/s)
RAIN-FREE	1.57	2.16
VICINITY OF RAIN	2.41	3.34
RAIN	3.45	4.00

VRMS difference between ASCAT and buoy winds (first column) and between ECMWF and buoy winds (second column). A triple collocation calibration and 3-sigma filtering has been applied, where sigma is 1.5 m/s in both u and v components.

ASCAT operational QC





- Rainy measurements mostly inside the cone due to loss of anisotropy
- Similar effect for increased wind variability (not shown)
- Consistent with current QC

QC effectiveness

Category	Accept		Reject	
	Number	VRMS	Number	VRMS
Rain-free	2442	1.81	0	/
Vicinity of rain	413	2.67	1	/
Rain	181	4.36	10	6.63

VRMS difference between ASCAT and buoy winds for QC-accepted and QCrejected data. No triple collocation calibration or 3-sigma filtering applied.





Longitude(deg)

UTC:2009-1024-20:30



Conclusions

- ASCAT-ECMWF-TMI analysis
 - ECMWF apparent degradation in vicinity of rainy areas, e.g., tropical Pacific
 - ASCAT rain-related artifacts
 - Wind speed distribution shifts
 - Crosswind direction accumulations
- ASCAT-ECMWF-buoy analysis
 - Although limited dataset and representativeness issues, buoy wind and rain are reliable (except for very high winds)
 - ECMWF does not well resolve rain-induced wind variability (issues in: Convective scheme? Resolution?)
 - ASCAT well resolves winds near rainy regions
 - Impact of heavy rain on ASCAT quality due to large sub-WVC wind variability and/or direct rain impact
 - Need for a more effective QC (ongoing work) see Wenming's presentation next



ASCAT 12.5km wind product

- Is rain-induced wind variability well resolved?
- Rain effects in scatterometer measurements?
 - What is the actual resolution of ASCAT and ECMWF?

ASCAT-ECMWF-TMI Collocations (2008)

About 0.5M collocated rain data



Mean Vector RMS (ITCZ Pacific)





ASCAT rain effects for RR>6 mm/hr

Is EMWF depicting equatorial rain-related effects (downbursts, convergence)?

Wind Direction (ITCZ Pacific) ASCAT ECMWF









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



ASCAT 12.5 km (selected) winds closer to buoy winds than ECMWF winds in the vicinity of rainy areas (**buoy rain data**).



ASCAT 12.5 km (closest w.r.t. buoy) winds closer to buoy winds than ECMWF winds in the vicinity of rainy areas

	ASCAT – Buoy (m/s)	ECMWF – Buoy (m/s)
RAIN-FREE	1.78	2.29
VICINITY OF RAIN	2.74	3.54
RAIN	4.26	4.34

VRMS difference between ASCAT and buoy winds (first column) and between ECMWF and buoy winds (second column). A triple collocation calibration has been applied.

Effect of wind variability in the 3D measurement space











UTC:2009-1024-23:30





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