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Royal Netherlands Meteorological Institute  
*Ministry of Infrastructure and the Environment*



## Towards an improved ocean forcing using scatterometer winds

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# Outline

- 1 Sampling errors
  - Scatterometer constellation (2013)
  - ERA\* higher resolution data set
- 2 Summary

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# DATA: ASCAT-A, ASCAT-B, OceanSat-2, HY-2A and RapidScat I

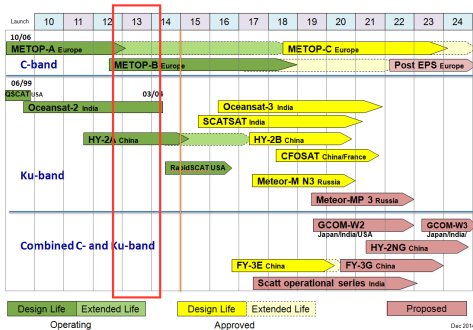


Fig.1 Scatterometer missions over time (years)

**25 km products [50 km]**

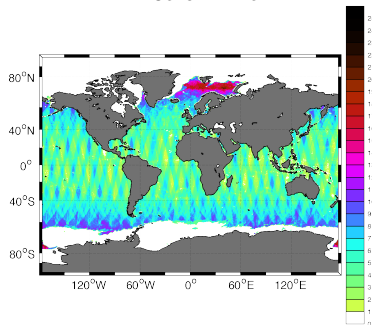
**Real Constellation (RC):**  
 ASCAT-A&B (9:30&21:30)  
 OceanSat-2  
 (12:00&00:00)  
 HY-2A (6:00&18:00)

**Sim. Constellation (SC):**  
**RC + RSCAT**

# Assessment of the maximum global daily coverage I

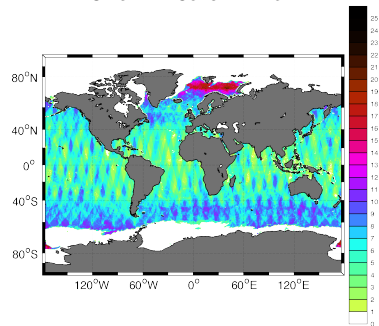
	ASCAT-A	ASCAT-B	OSCAT	HSCAT
ascending	3	3	4	5
descending	3	3	4	4
both	6	6	8	7

REAL CONSTELLATION



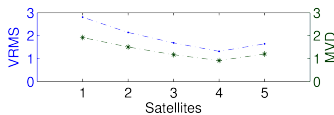
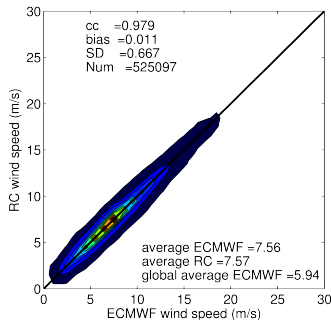
MAXIMUM NUMBER OF SATELLITE PASSES FOR A DAY.  
ERA-INTERIM ON SCATTEROMETER SAMPLED  
ORBITS (0.25X0.25 GRID)

SIMULATED CONSTELLATION



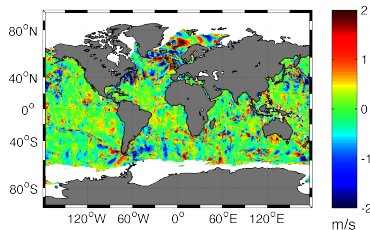
- Substantial increase in the spatial coverage for a day
- Sampling density variations with time and latitude
- More than 5 passes at mid-latitudes
- Better coverage in the tropics and (notably) at mid latitudes for the SC

# Sampling errors: non-uniform time mean vs. uniform time mean I



VRMS and MVD as a function N satellites in orbit(2013)

- The mean day for the real constellation has the lowest bias and std
- Larger errors in areas of strong wind variability

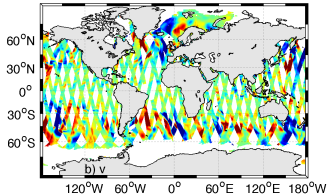
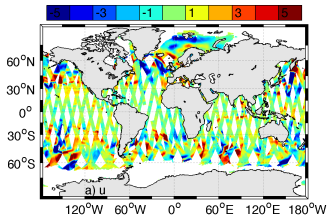


THE COLOR MAP DEPICTS THE WIND SPEED DIFFERENCES BETWEEN A DAY OF THESE SCATTEROMETER-SAMPLED ECMWF WINDS AND UNIFORMLY SAMPLED ECMWF WINDS.

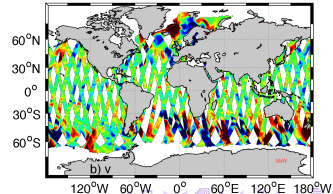
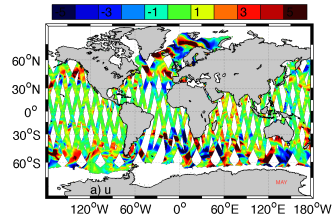
# DATA: ASCAT-A, ERA-interim climatology 2012 (U10s)

- stress eq. winds: 12.5 km product (coastal) [25 km] (KNMI), climatology [200 km spatial resolution]
- Regions of strong wind variability, as in the storm track areas.

[ERA - SCATT SAMPLED ERA] DEC 1<sup>st</sup> [m/s]



[ERA - SCATT SAMPLED ERA] MAY 1<sup>st</sup> [m/s]



# Correction of ERA interim surface winds ( $U10s^*$ )

## Resolving both atmospheric and fine ocean scales

The use of modeling for research would widely benefit from a wind stress forcing data set with high spatial and temporal resolution.

## Correction

$U10s^*(t) = U10s(t) + \text{small scale variability}$

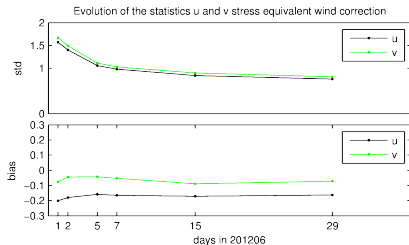
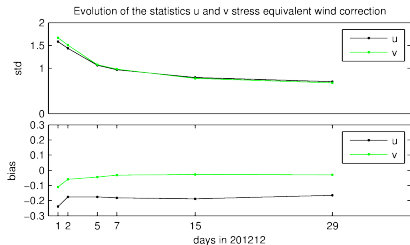
$\text{Correction} = (U10s_{scatt} - U10s_{ERAs})(\bar{t})$

Scatterometer data will provide information on smaller scales

This "noise" contains information on the eddy scale for ocean currents, moist convection, coastal interaction and stability parameterization of surface fluxes



# How long should the winds be accumulated?

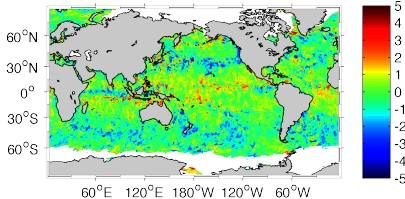


## Compromising on the accumulation length

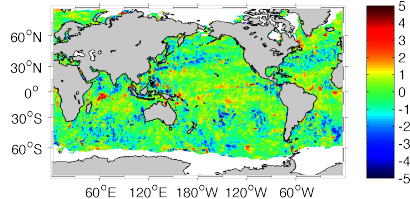
- The length of the accumulation should be weighted according to the physical phenomenon one intends to resolve
- A 5 day accumulation should still account for the eddy scale on strong West boundary current systems like the Gulf stream, the Agulhas or the Kuroshio current (stationary)

● This systematic correction is seasonal dependent

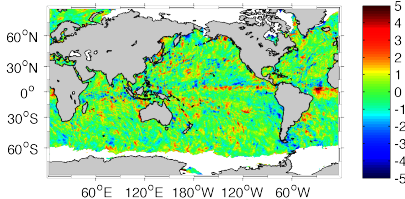
Stress equivalent wind: correction u for 5



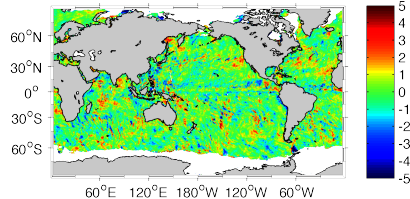
Stress equivalent wind: correction u for 5



Stress equivalent wind: correction v for 5



Stress equivalent wind: correction v for 5



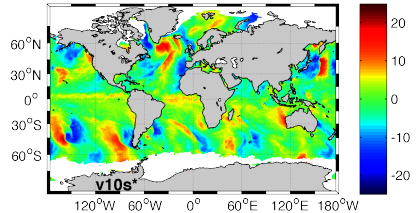
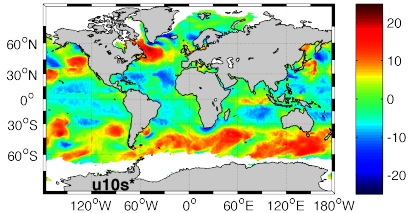
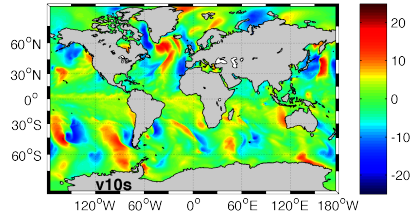
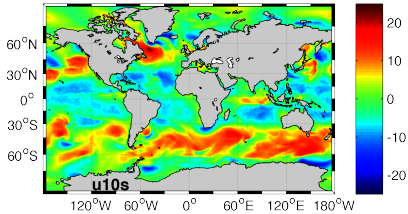
DEC (5-d mean difference)

JUN (5-d mean difference)

# ERA vs ERA\*

STRESS EQUIVALENT U-WIND COMPONENT DEC 1<sup>st</sup>[m/s]

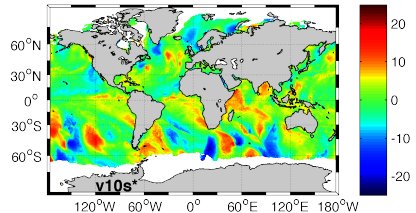
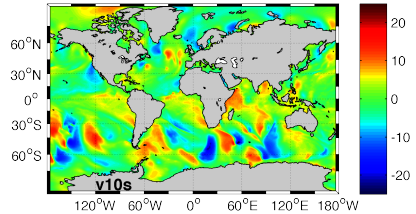
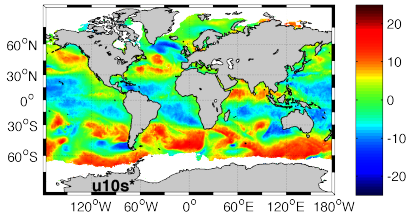
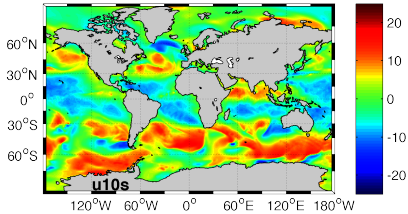
STRESS EQUIVALENT V-WIND COMPONENT DEC 1<sup>st</sup>[m/s]



# ERA vs ERA\*

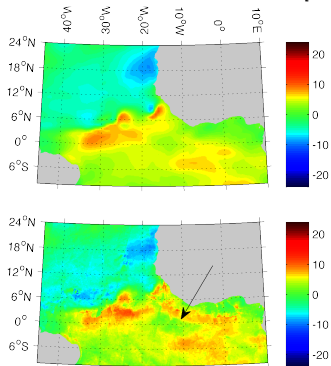
STRESS EQUIVALENT U-WIND COMPONENT JUNE 1<sup>st</sup>[m/s]

STRESS EQUIVALENT V-WIND COMPONENT JUNE 1<sup>st</sup>[m/s]



# ERA\* Details

STRESS EQUIVALENT V-COMPONENT JUNE 1<sup>st</sup> [m/s]



- v-wind component ERA\* (bottom) shows a clear meridional wind effect south of the African coast and another effect south of the equator
- Moist convection?
- Needs further spatial and temporal analysis
- Test implications for curl and divergence

# Summary

## Main results

- 1 Wind scatterometer constellation increases temporal and spatial coverage (although remains latitude dependent)
- 2 low bias and std between a non-uniform daily time mean and a uniform daily time mean
- 3 Sampling errors prevail on regions of strong wind variability
- 4 ERA\* corrected stress equivalent data set resolves small scales details

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## NEXT

- 1 Further develop the mitigation of the sampling errors of the scatterometer constellation winds
- 2 Validation of the stress product with global current data
- 3 Compute the 10-m stress data set for 2008 both for the Ku-band scatterometer QuikScat and ASCAT

THE END :-)  
*Thank you!*



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