

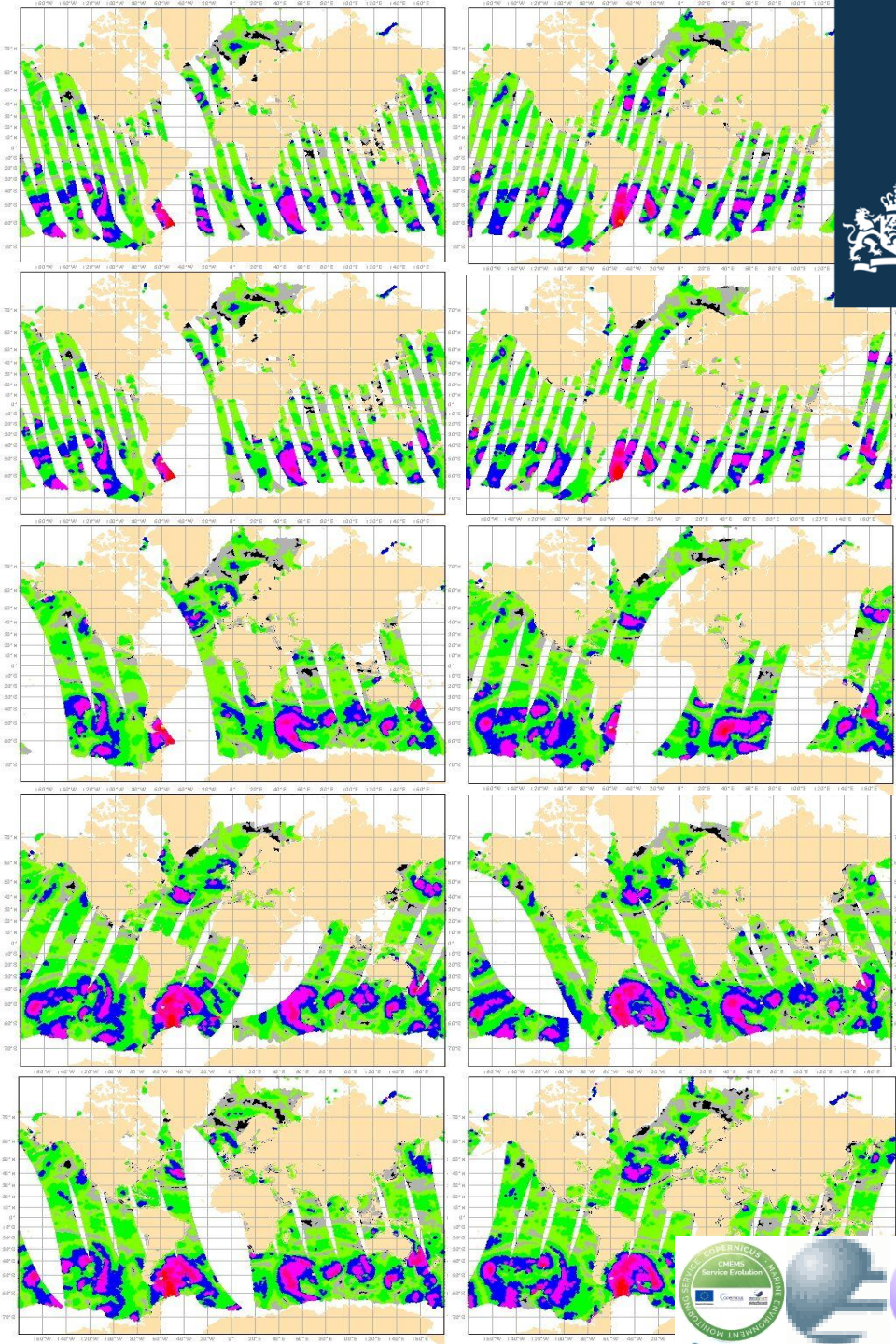


Royal Netherlands  
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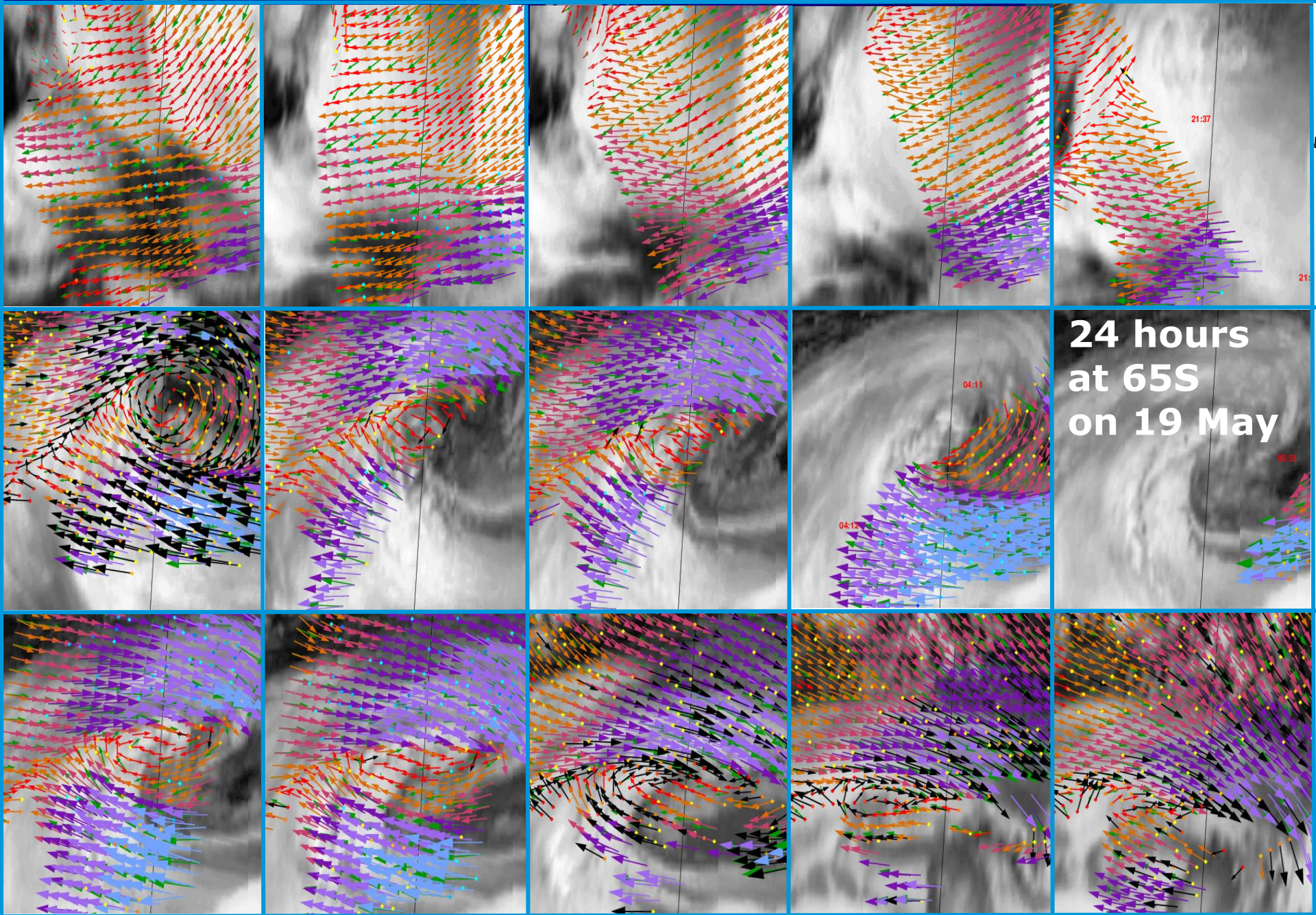
# Virtual Scatterometer Constellation

[Ad.Stoffelen@knmi.nl](mailto:Ad.Stoffelen@knmi.nl)

Group leader active sensing  
R&D Satellite Observations (RDSW)  
Chair CGMS IWWg OSW Task Group  
James Cotton and Josephine Hall

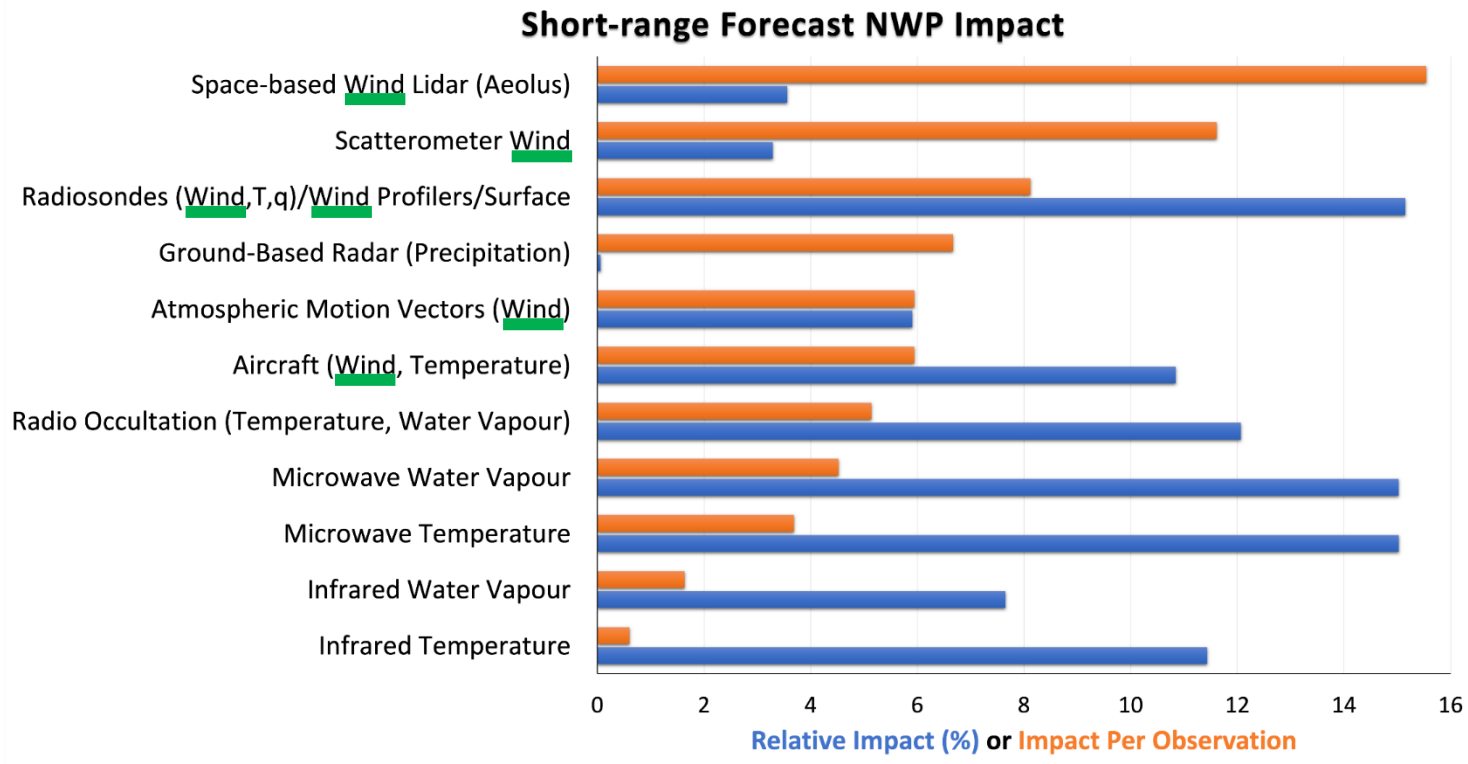






[scatterometer.knmi.nl/tile\\_prod](https://scatterometer.knmi.nl/tile_prod)

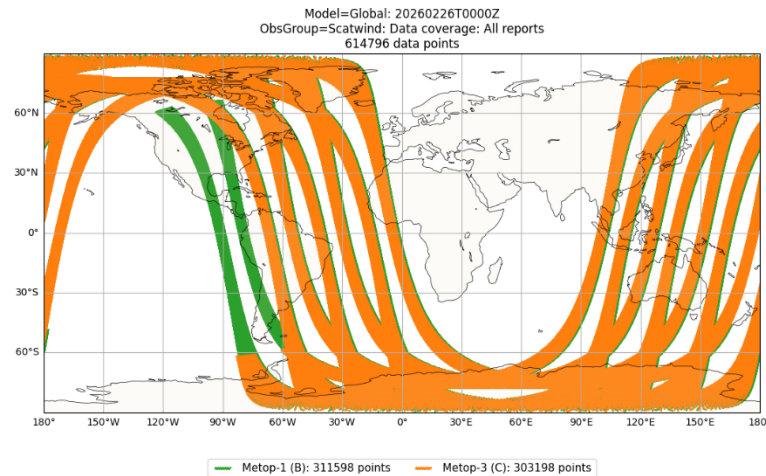
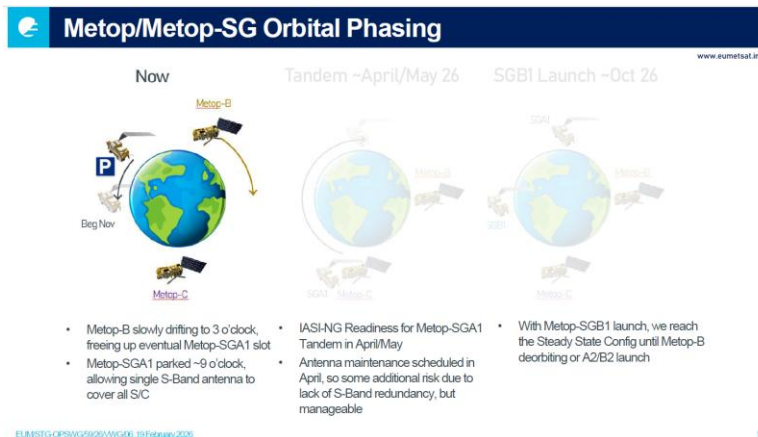
# Relevance of winds in forecasting



➤ **More and timely wind observations would be very helpful !**

# Current status

From STG-OPSWG 58th Meeting Item 6.3



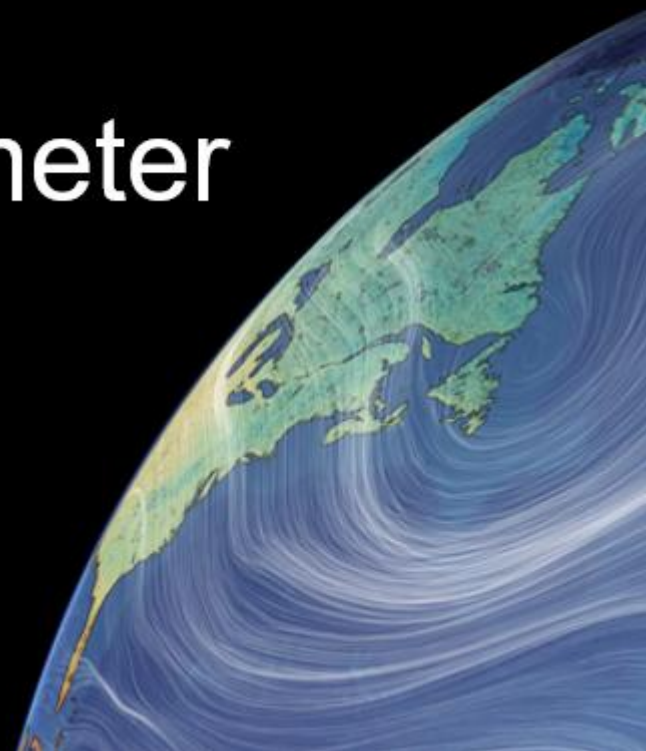
- Current orbit phasing of Metop-B/C results in almost complete overlap of the ASCAT swaths

- Last summer the EUMETSAT OSI SAF at KNMI was complimented with the full ASCAT coverage twice daily (due to orbit maneuvering)
- With EPS-SG another opportunity arises for ASCAT/SCA to be so useful!  
Please recommend this.

 **Met Office**

# Exploiting the scatterometer constellation

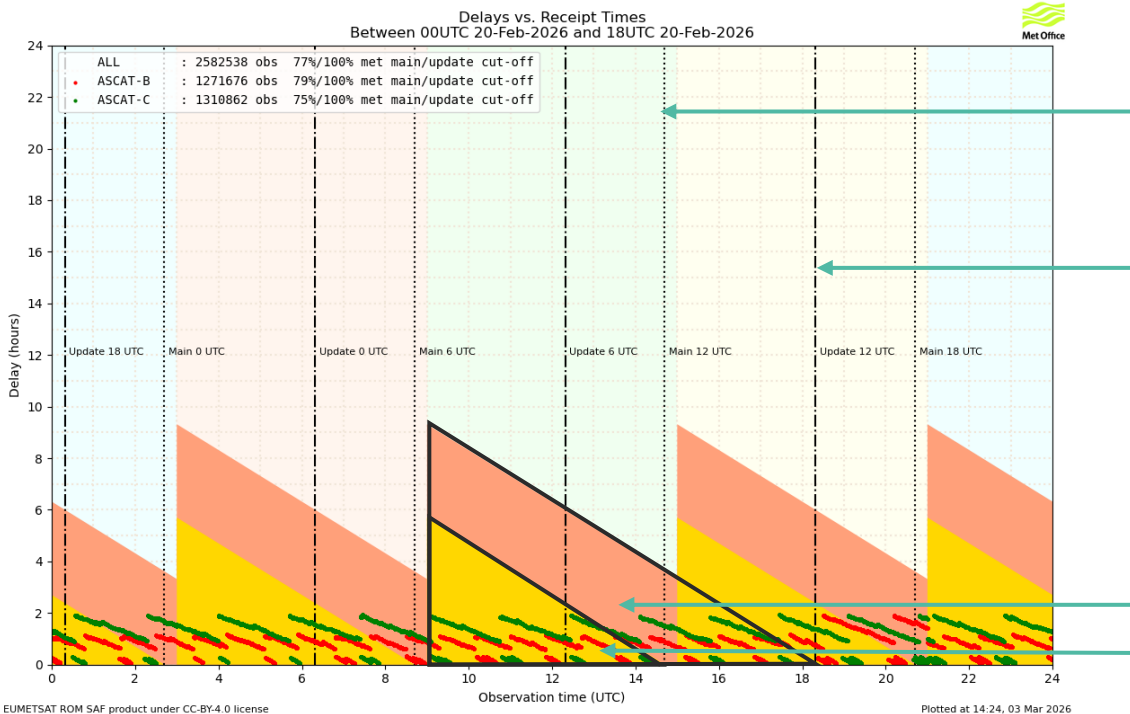
James Cotton, Josephine Hall



# How much ASCAT can be used?

Delays vs receipt times for an example day (20 Feb 2026)

12 UTC window [0900,1500) UTC



**Main** 12 UTC model run starts at 14:40 UTC (*before the end of 6-hour window*)

**Update** 12 UTC model run starts at 18:15 UTC

For data to be available for operational assimilation, its observation time must be within the model analysis window and be delivered to MetDB before the cut-off time for that window.

Data must lie in

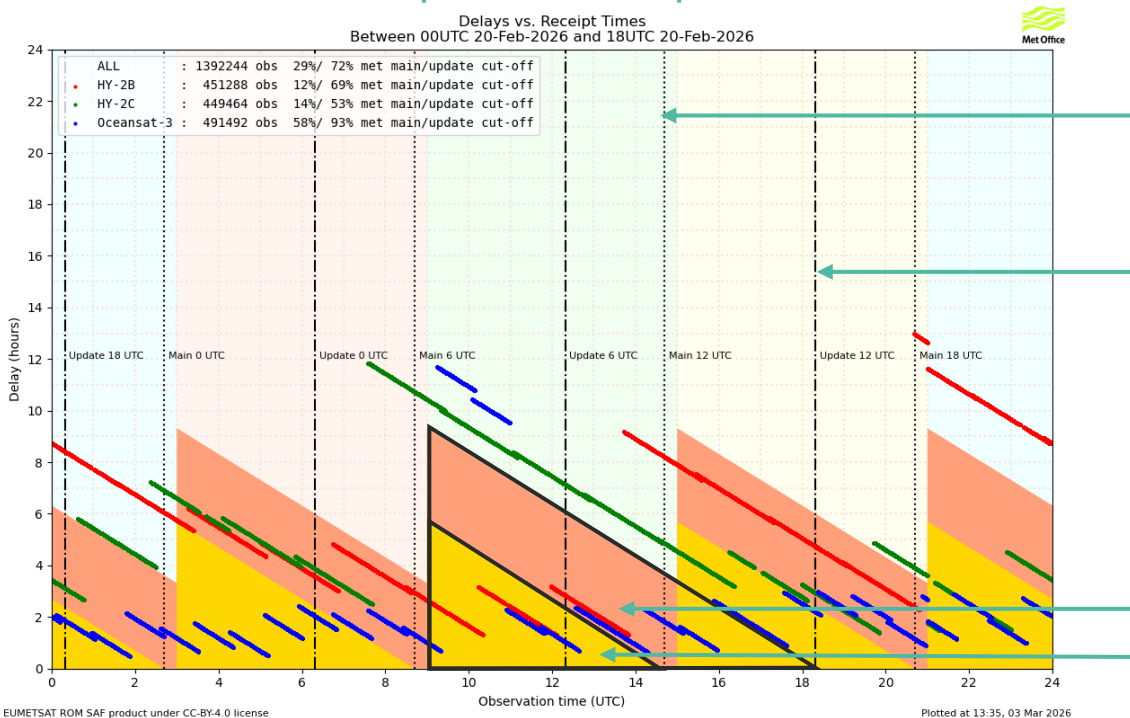
- Pink trapezium for Update runs
- Yellow triangles for Main runs,

**For this day.. 77% in Main and 100% in Update**

# How much Ku-band can be used?

Delays vs receipt times for an example day (20 Feb 2026)

12 UTC window [0900,1500) UTC



**Main** 12 UTC model run starts at 14:40 UTC (*before the end of 6-hour window*)

**Update** 12 UTC model run starts at 18:15 UTC

For data to be available for operational assimilation, its observation time must be within the model analysis window and be delivered to MetDB before the cut-off time for that window.

Data must lie in

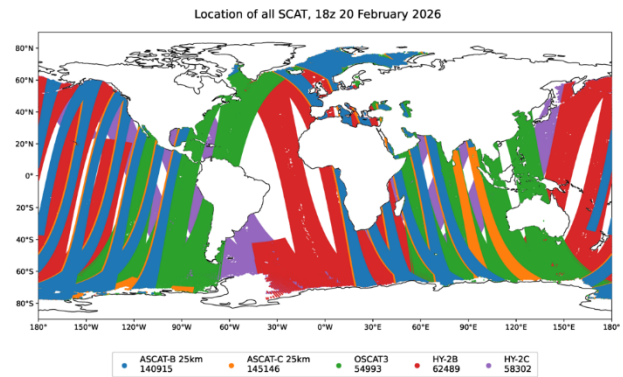
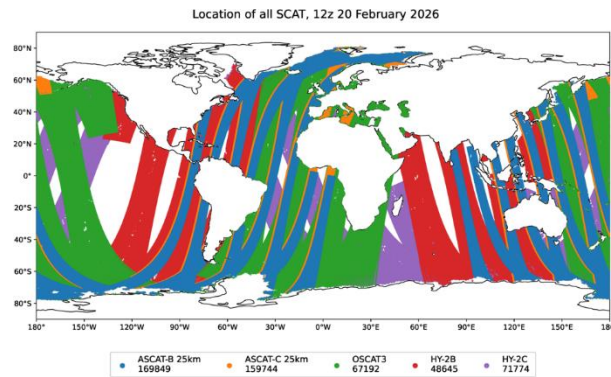
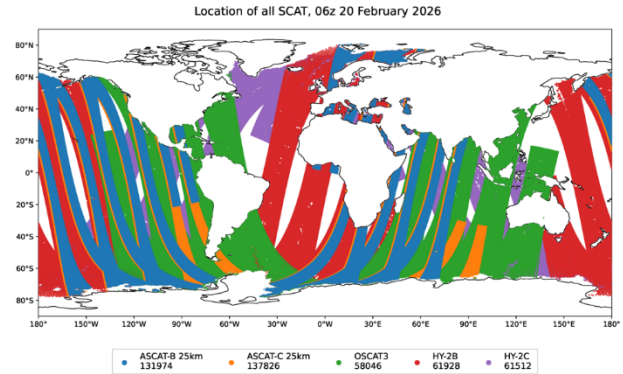
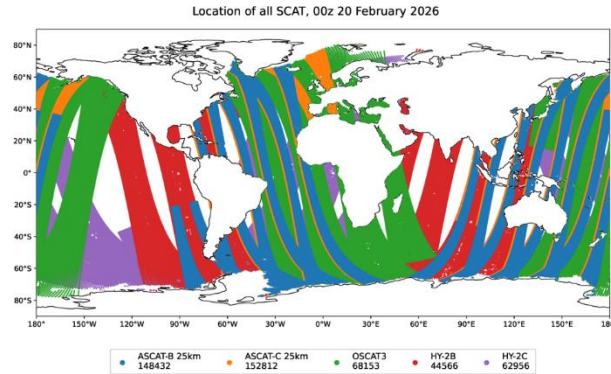
- Pink trapezium for Update runs
- Yellow triangles for Main runs,

**For this day.. only 12% of HY-2B could be used in Main, only 53% of HY-2C could be used in Update. Oceansat-3 does better at 58% in Main and 93% in Update. Some better timeliness for HY-2B in 12 UTC cycle.**

# Coverage with no time constraints

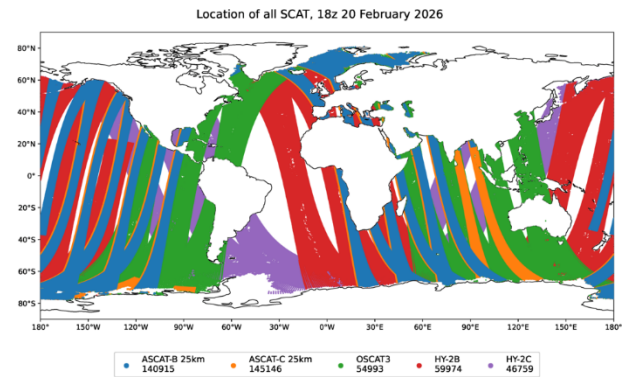
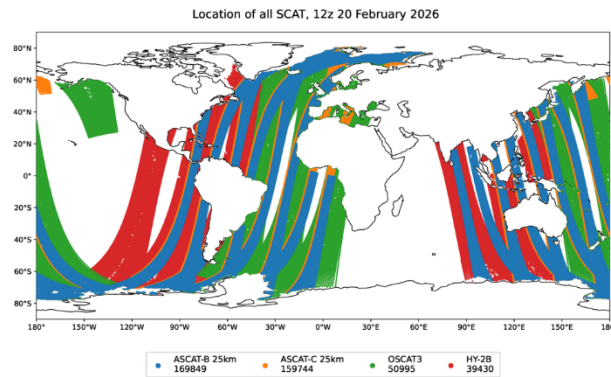
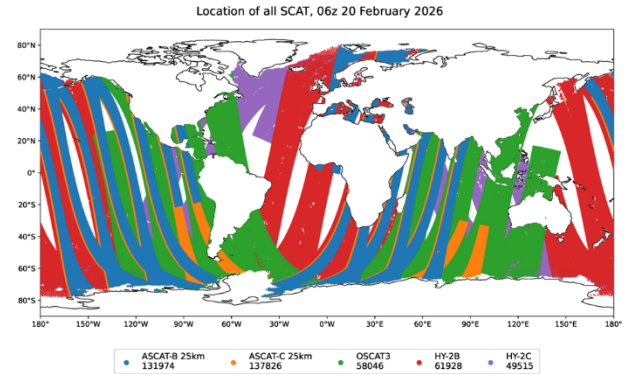
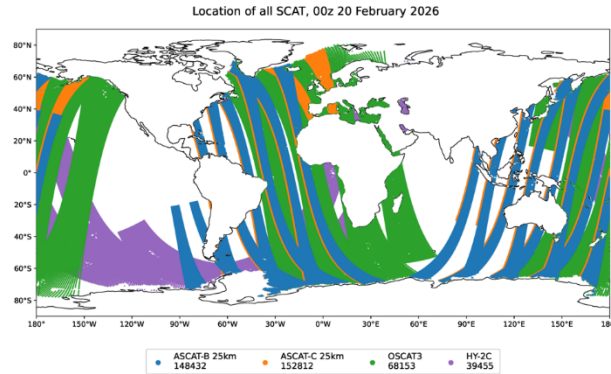
Example day 2026-02-20

e.g. if we were doing a reanalysis



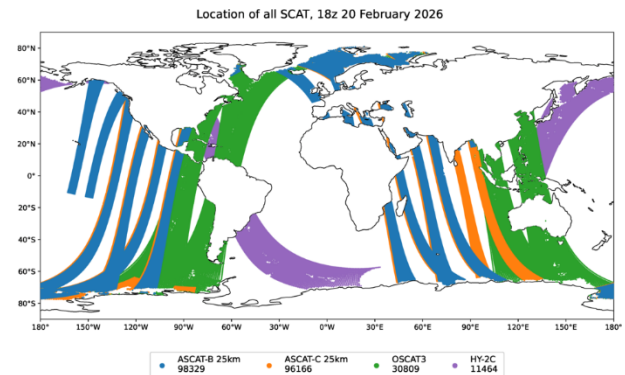
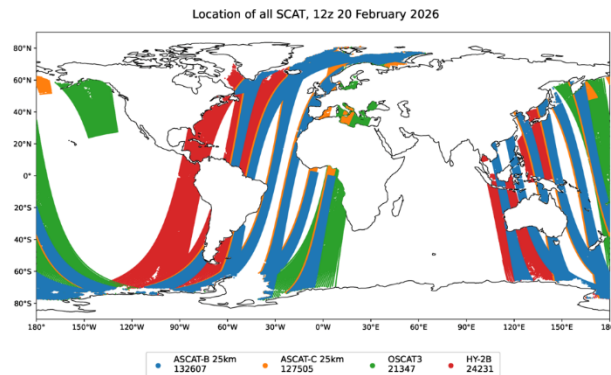
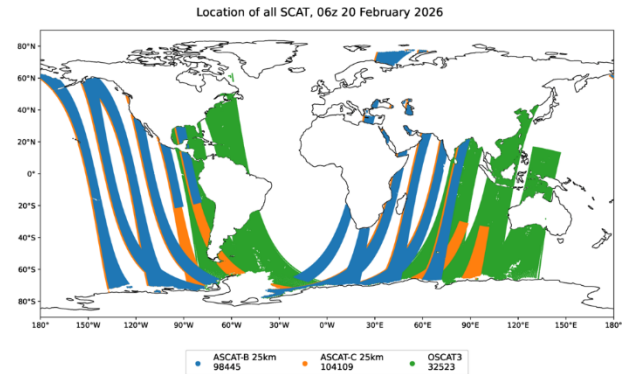
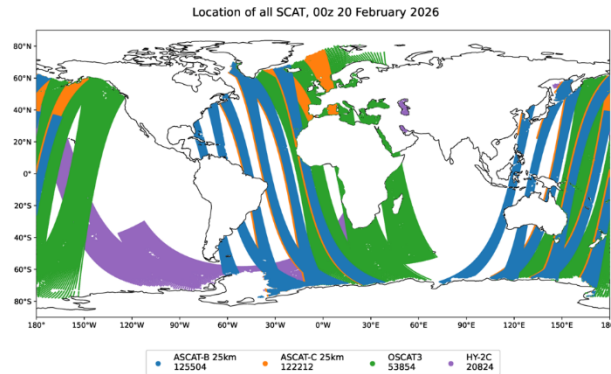
# Coverage with Update time constraints

Example day 2026-02-20



# Coverage with Main time constraints

Example day 2026-02-20







# Further reading . .

Services:

[scatterometer.knmi.nl](http://scatterometer.knmi.nl)

[osi-saf.eumetsat.int](http://osi-saf.eumetsat.int)

[marine.copernicus.eu](http://marine.copernicus.eu)

[ESA Aeolus DISC](#)



Ad Stoffelen

Active Instruments group leader, Satellite Division, [KNMI](#)  
Verified email at knmi.nl - [Homepage](#)

[Wind](#) [satellite](#) [NWP](#) [data assimilation](#)

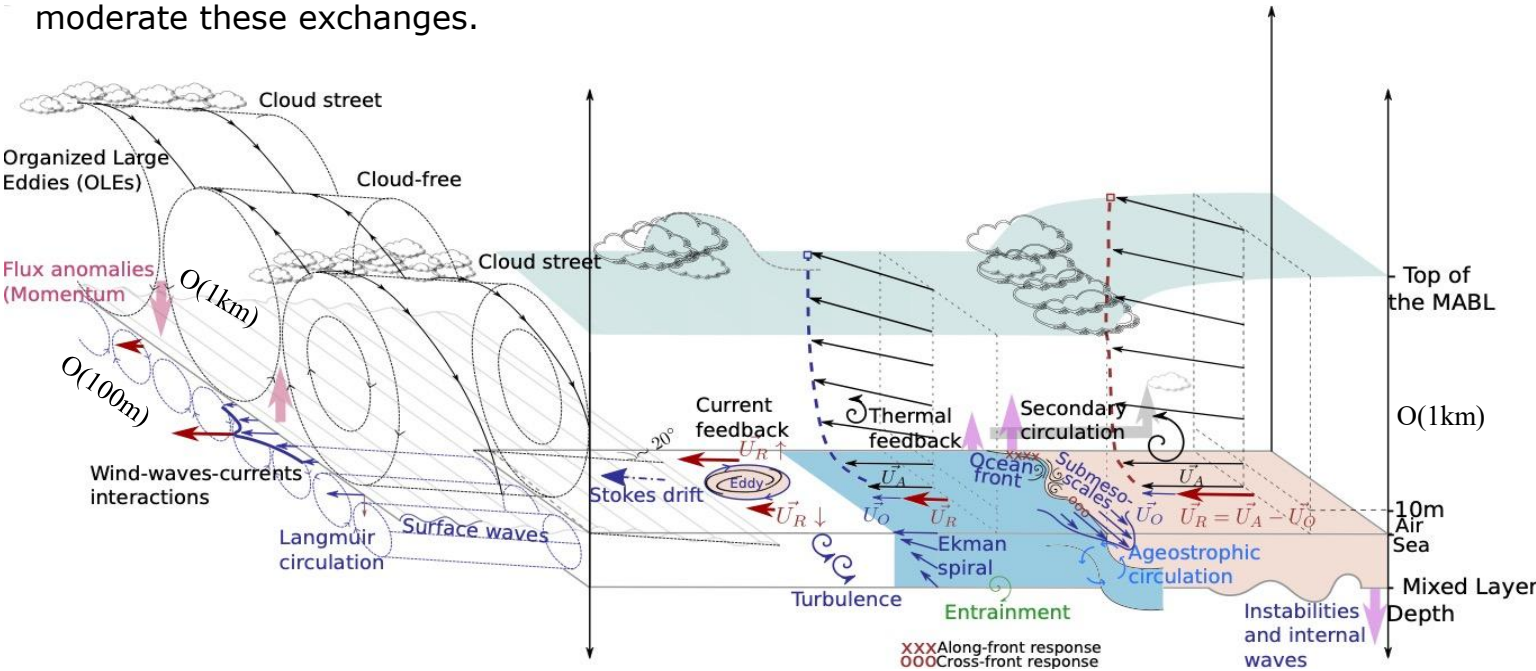
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TITLE	CITED BY	YEAR
<a href="#">Recent innovations in satellite-based applications and their impacts on tropical cyclone analyses and forecasts</a> C Velden, J Knaff, D Herndon, A Mouche, J Hawkins, G Panegrossi, ... Journal of the European Meteorological Society 2, 100011	3	2025
<a href="#">A rain effect elimination approach using FengYun-3E WindRAD dual-frequency measurements</a> K Zhao, A Stoffelen, J Verspeek, A Verhoef, Z Li, N Xu, L Chen, X Zhai, ... Atmospheric and Oceanic Science Letters, 100725		2025
<a href="#">Development of an OSI SAF radiometer wind product</a> S Samuel, A Verhoef, A Stoffelen		2025
<a href="#">Reduction of persistent stress-equivalent wind biases with machine learning and scatterometer data</a> E Makarova, M Portabella, A Stoffelen IEEE Transactions on Geoscience and Remote Sensing		2025
<a href="#">An extreme value method to study decadal hurricane wind trends</a> A Payez, A Stoffelen, C de Valk, R Giesen arXiv preprint arXiv:2505.08591		2025
<a href="#">Multi-decadal variability in ocean surface wind differences between scatterometer observations and reanalysis model fields</a> R Giesen, A Stoffelen EGU25		2025
<a href="#">WindRAD Scatterometer Quality Control in Rain</a> Z Li, A Verhoef, A Stoffelen Remote Sensing 17 (3), 560	3	2025
<a href="#">Aeolus lidar surface return (LSR) at 355 nm as a new Aeolus Level-2A product</a> LD Labzovskii, GJ van Zadelhoff, DP Donovan, J de Kloe, LG Tilstra, ... Atmospheric Measurement Techniques 17 (24), 7183-7208		2024
<a href="#">Wind and Sea State Signatures in Wind Scatterometry: An analysis</a> X Xu, A Stoffelen IEEE Geoscience and Remote Sensing Magazine	2	2024
<a href="#">Enhanced tropical cyclone ASCAT winds guided by SAR-learned spatial structure functions</a> W Ni, A Stoffelen, K Ren, J Vogelzang, Y Zhao, X Yang, W Wang IEEE Transactions on Geoscience and Remote Sensing	3	2024
<a href="#">Objective Estimates of Tropical Cyclone Wind Radii from Remote Sensed Data</a> CR Sampson, M Frost, ML Surratt, CP Camacho, JA Knaff, C Jackson, ...		2024

- NWP Ocean Calibration (NOC) NRCS beam pattern corrections have been used for ERS, ASCAT-A, ASCAT-B and ASCAT-C commissioning (Verspeek et al.)
    - Absolute reference are **global moored buoys** and NOT the ECMWF model; triple wind collocation links scatterometer, buoy and ECMWF model biases and error variances
    - An accurate empirical Geophysical Model Function (GMF CMOD7) is used as consolidated reference (applicable to WindRad, ASCAT, ERS and SAR); instruments are better than physics can prescribe
    - An empirical C-band VH (based on SAR) and HH GMF (NOT based on SAR, but on WindRad) exist and these can be used for SCA commissioning
    - NOC-corrected NRCS data also help other applications, such as sea ice products
  - Cone metrics was elaborated by Maria Belmonte Rivas (2017) as intercalibration method for C-band scatterometers
    - Uses the idea of an expected and fixed relationship between the NRCS from fore, mid and aft beams
    - Links the beam pattern of one instrument to another, or from left swath to right swath (Simon)
    - Cone metrics and NOC variations in beam pattern are generally consistent over a year to within 0.1 dB (ECMWF winds/GMF uncertainty in NOC)
    - Cone metrics for ERS and ASCAT has been very stable over many years (within a few hundredths of dB, apart from few anomalies)
    - Useful for SCA monitoring (KNMI, Simon)
  - Could be extended to Ku-band scatterometer intercalibration, but no resources for development yet (ECV)
- ✓ **The fact that measurement space is well defined, makes scatterometers a unique FCDR reference**

# Processes at the air-sea interface

Exchanges of **heat**, **gas**, **momentum** at the air-sea interface depend on the **thermal**, **chemical**, **kinematic** unbalance between ocean and atmosphere that are modulated by many **small-scale processes** that substantially moderate these exchanges.



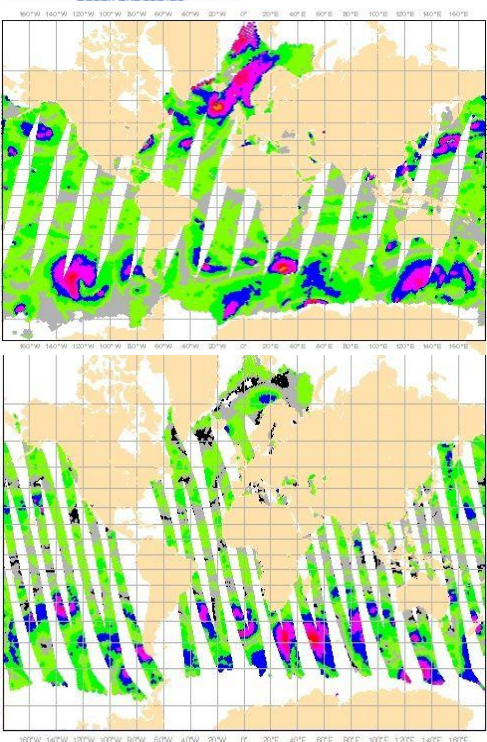
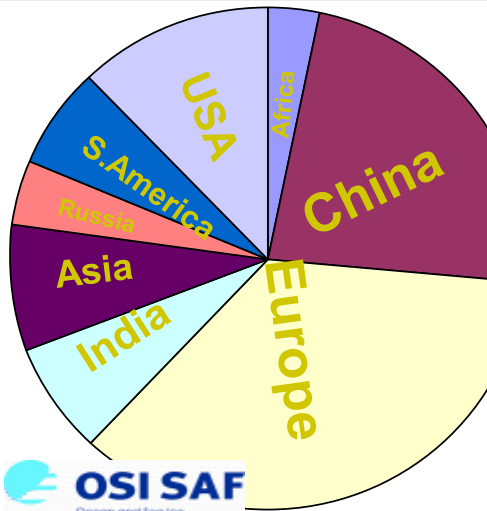
## Air-sea fluxes

depend on

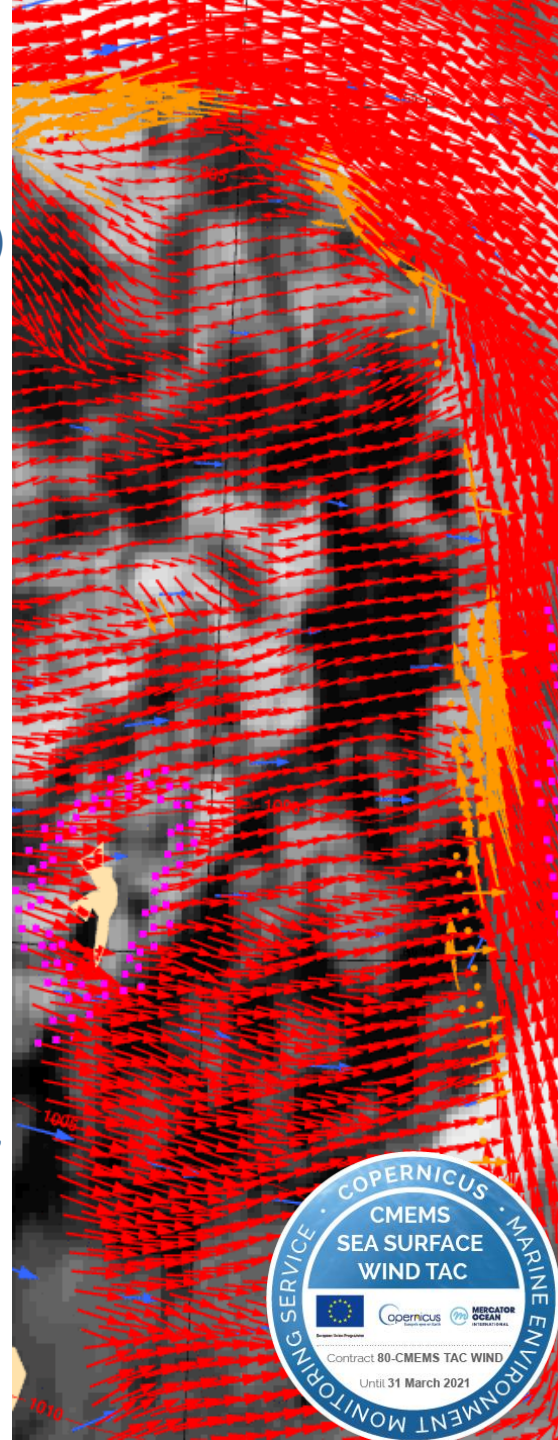
- **Surface stress** (impacted by ocean velocity and by air velocity, which is affected by SST)
- **Boundary layer thickness** (which varies by 2 orders of magnitude in different stability conditions)
- **Km-scale ocean** (eddy) dynamical circulations and phenomena

- Atmospheric and ocean models are dynamically coupled by parameterisations (with errors)
- > 70% van het aardoppervlak
- Some modes are difficult to predict (El Nino, MJO, AMOC, ..)
- Do these modes change in a changing climate? With what consequences?

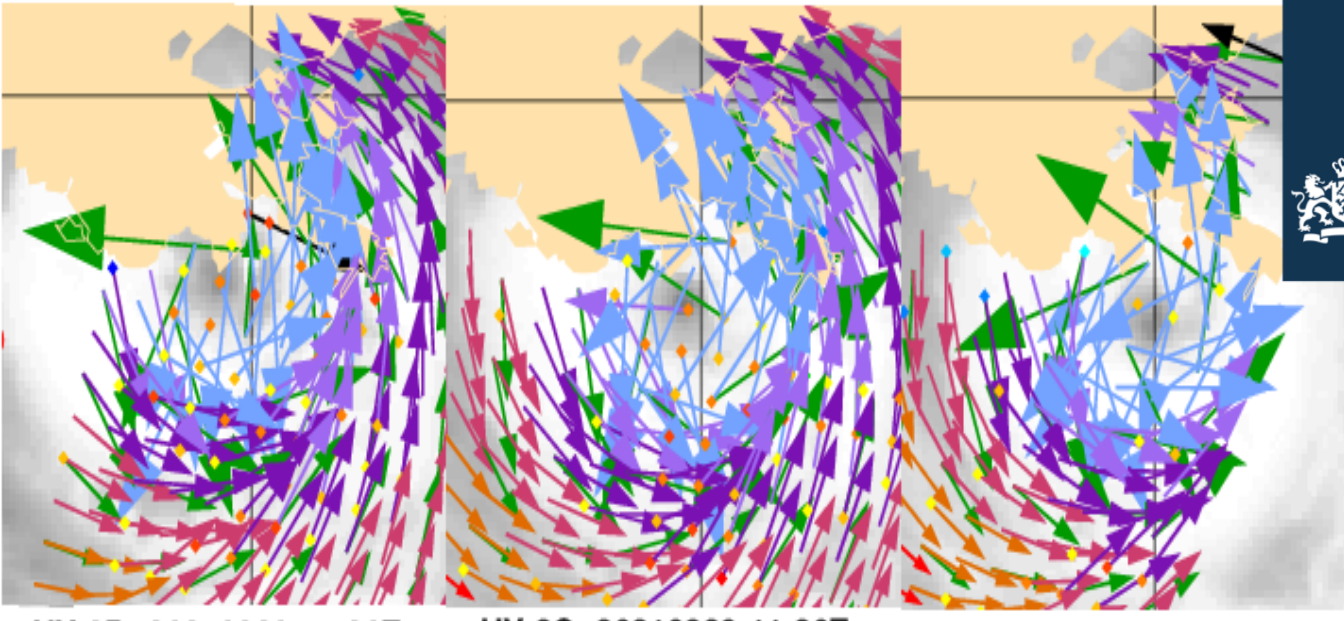
# Satelliet Wind Services



- 24/7 service windgegevens (EUMETSAT SAF)
- Internationale constellatie van satellieten
- Wind van hoge kwaliteit, QC
- Tijdigheid 30 min. – 2 uur
- Serviceberichten
- QA, monitoring
- L2-softwarediensten (NWP SAF)
- Publieke windprocessorsen
- ECMWF modelvergelijking
- L2/L3/L4 Registraties van klimaatgegevens
- Copernicus diensten windgegevens
- Betrokken organisaties: KNMI, EUMETSAT, EU, ESA, NASA, NOAA, ISRO, CMA, WMO, CEOS, ..
- Gebruikers: NHC, JTWC, ECMWF, NOAA, NASA, NRL, BoM, UK Meto, M.France, DWD, CMA, JMA, CPTEC, NCAR, . . .
- Meer informatie:  
[scatterometer.knmi.nl](http://scatterometer.knmi.nl)  
[scat@knmi.nl](mailto:scat@knmi.nl)



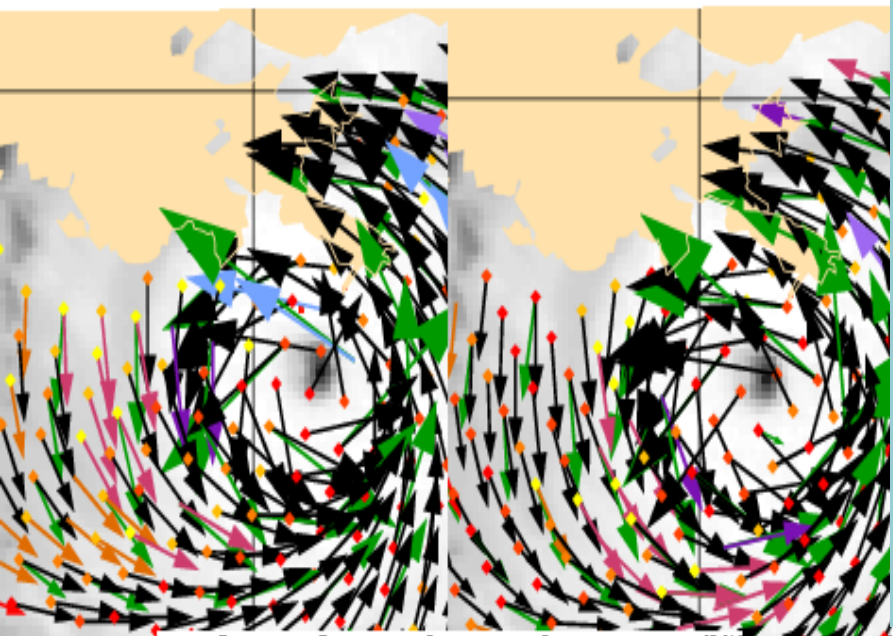
ASCAT-B: 20210829 16:30Z ASCAT-C: 20210829 15:30Z ASCAT-A: 20210829 14:30Z



Royal Netherlands  
 Meteorological Institute  
 Ministry of Infrastructure and the  
 Environment

HY-2B: 20210829 11:30Z

HY-2C: 20210829 11:30Z



- ❖ 5 scatterometers zien Ida aan land gaan
- ❖ Sterkte consistent met NHC-adviezen, maar . .
- ❖ Orkaan in-situ windsnelheidsschaal verschilt van afgemeerde boeien, onze in-situ wind snelheidsreferentie
- ❖ De in-situ referentiewindsnelheidsschaal bepaalt ook de oceaanoeverstand en -fluxen, NWP u10
- ❖ Scatterometerwinds hebben geen lange golven nodig en meten bij afluiddige wind de orkaan goed

EUMETSAT OSI SAF, [Ida land-fall news story](#)  
 EU Copernicus Marine Core Services

