Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

OSI SAF wind products and services

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The EUMETSAT Network of Satellite Application Facilities
OSI SAF Ocean and Sea Ice
EUMETSAT

Royal Netherlands
Meteorological Institute
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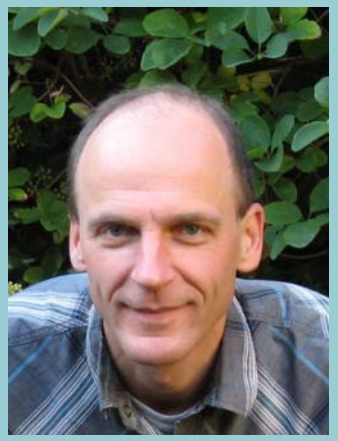


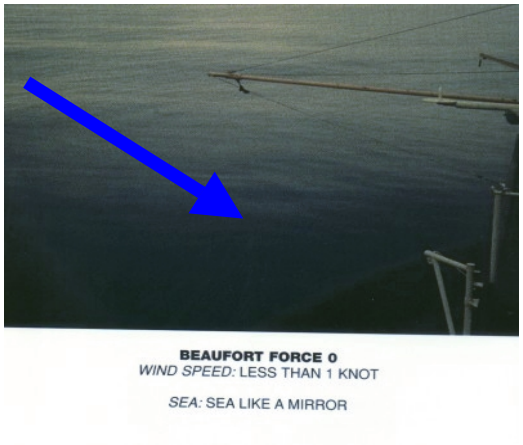
Outline

- Principle of scatterometry
- Wind processing method
- Current available wind products
- Products visualisation and monitoring information
- Data formats
- Quality information
- Two multiple choice questions

Principle of scatterometry

- The scatterometer is a radar instrument capable of measuring
- ocean winds from space. But how can it do this?

Backscatter modulation by surface roughness



Courtesy
Z. Jelenak, NOAA

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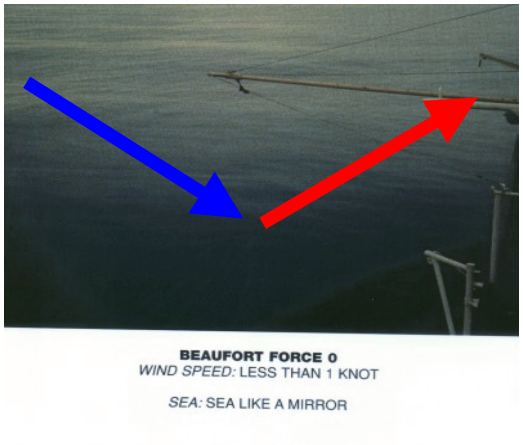

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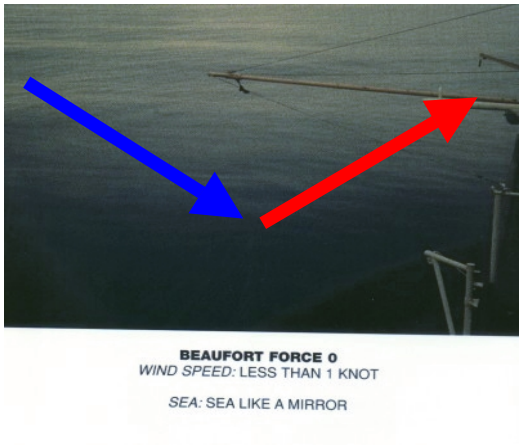
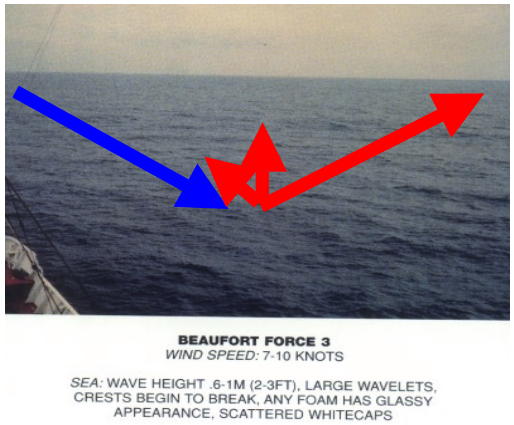


BEAUFORT FORCE 0
WIND SPEED: LESS THAN 1 KNOT

SEA: SEA LIKE A MIRROR

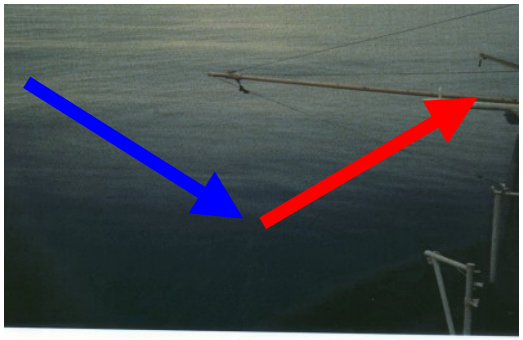


BEAUFORT FORCE 3
WIND SPEED: 7-10 KNOTS

SEA: WAVE HEIGHT .6-1M (2-3FT), LARGE WAVELETS, CRESTS BEGIN TO BREAK, ANY FOAM HAS GLASSY APPEARANCE, SCATTERED WHITECAPS

Courtesy
Z. Jelenak, NOAA

Backscatter modulation by surface roughness

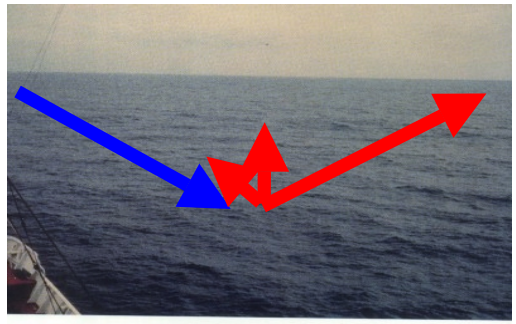


BEAUFORT FORCE 0
WIND SPEED: LESS THAN 1 KNOT

SEA: SEA LIKE A MIRROR

BEAUFORT FORCE 6
WIND SPEED: 22-27 KNOTS

SEA: WAVE HEIGHT 3-4M (9.5-13 FT),
LARGER WAVES BEGIN TO FORM, SPRAY IS PRESENT,
WHITE FOAM CRESTS ARE EVERYWHERE



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Courtesy
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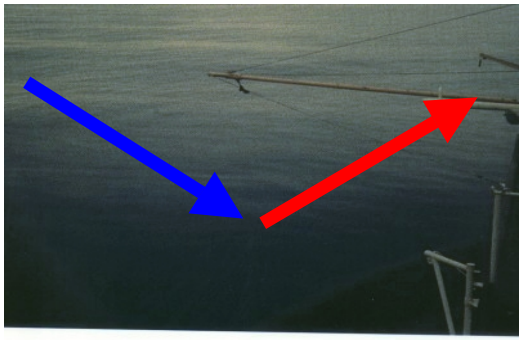
Backscatter modulation by surface roughness



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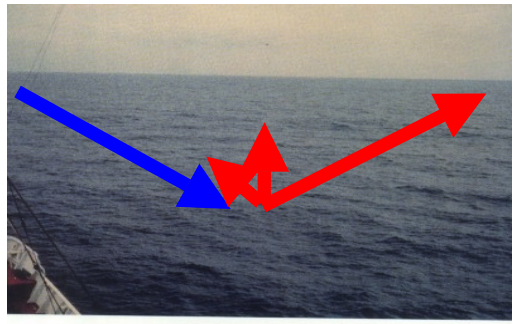

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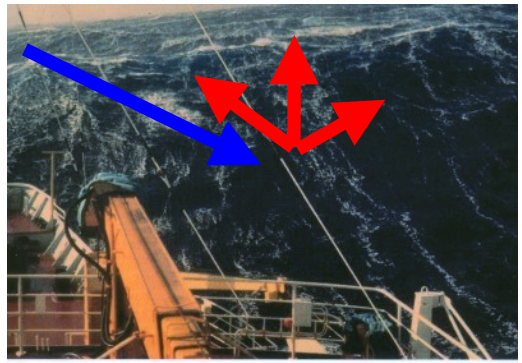
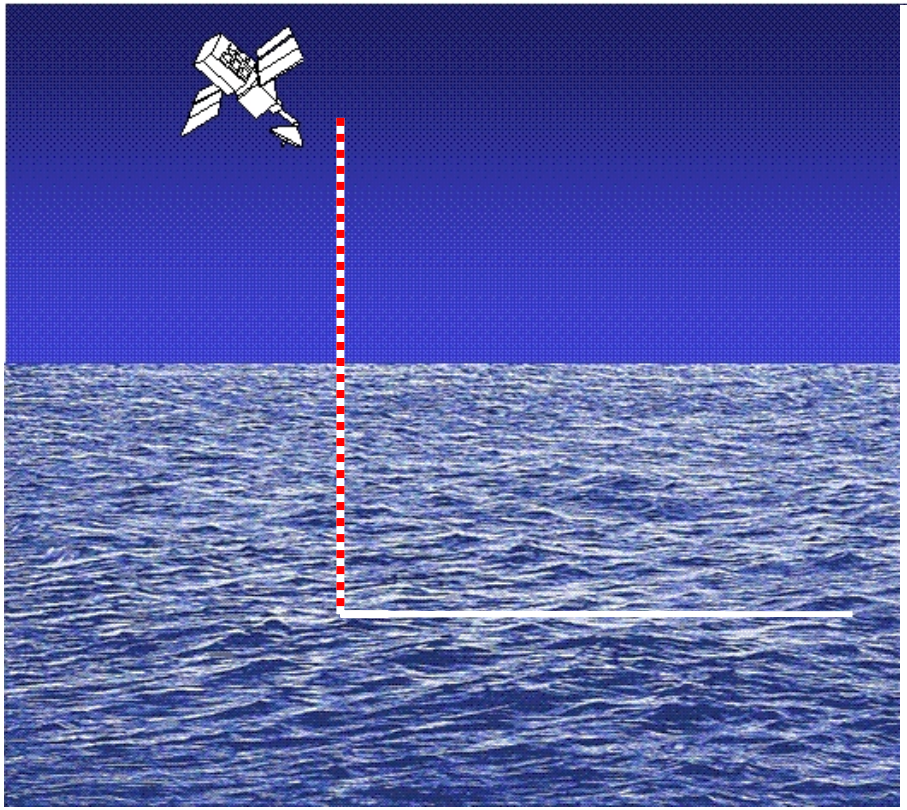


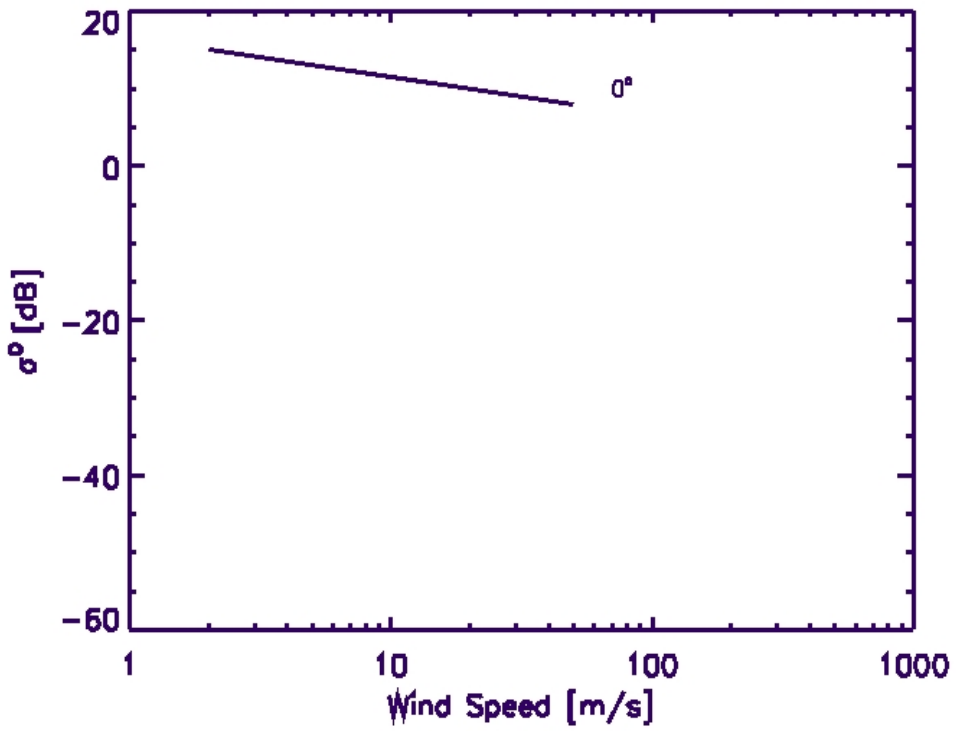
BEAUFORT FORCE 9
WIND SPEED: 41-47 KNOTS

SEA: WAVE HEIGHT 7-10M (23-32FT), HIGH WAVES, DENSE STREAKS OF FOAM ALONG DIRECTION OF THE WIND, WAVE CRESTS BEGIN TO TOPPLE, TUMBLE, AND ROLL OVER. SPRAY MAY AFFECT VISIBILITY.

Courtesy
Z. Jelenak, NOAA

Backscatter as a function of incidence angle





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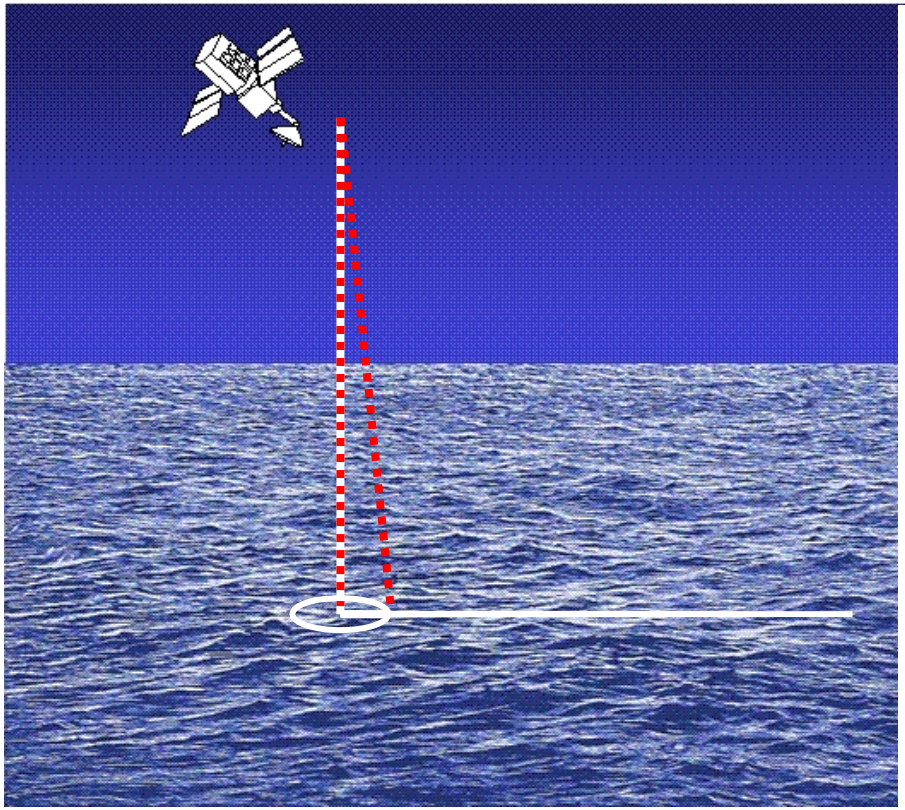

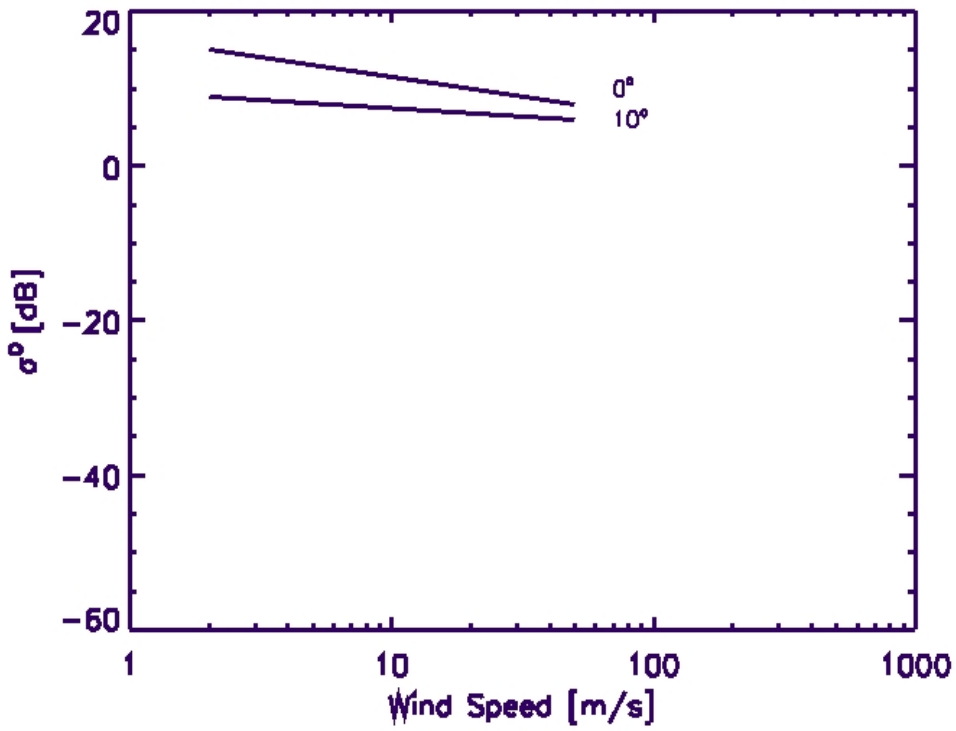

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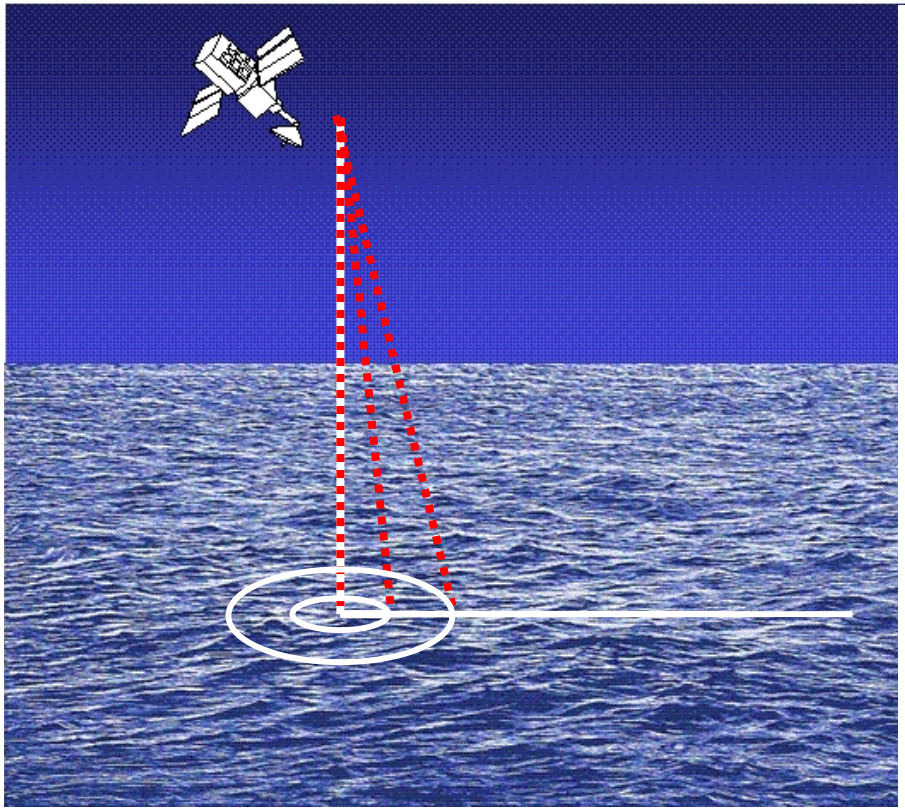

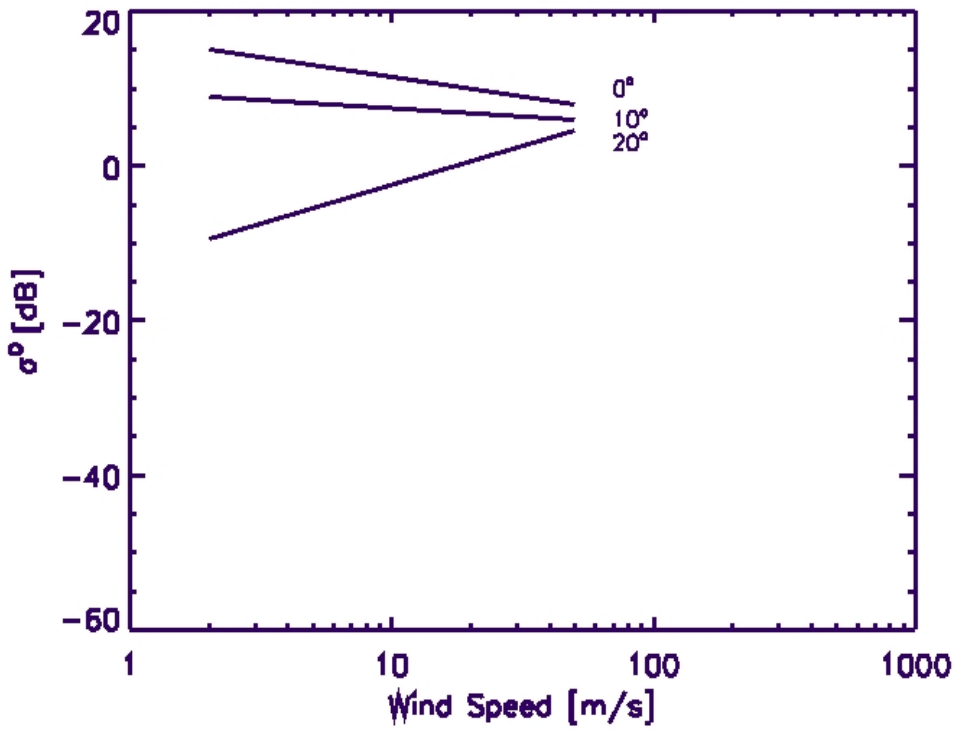

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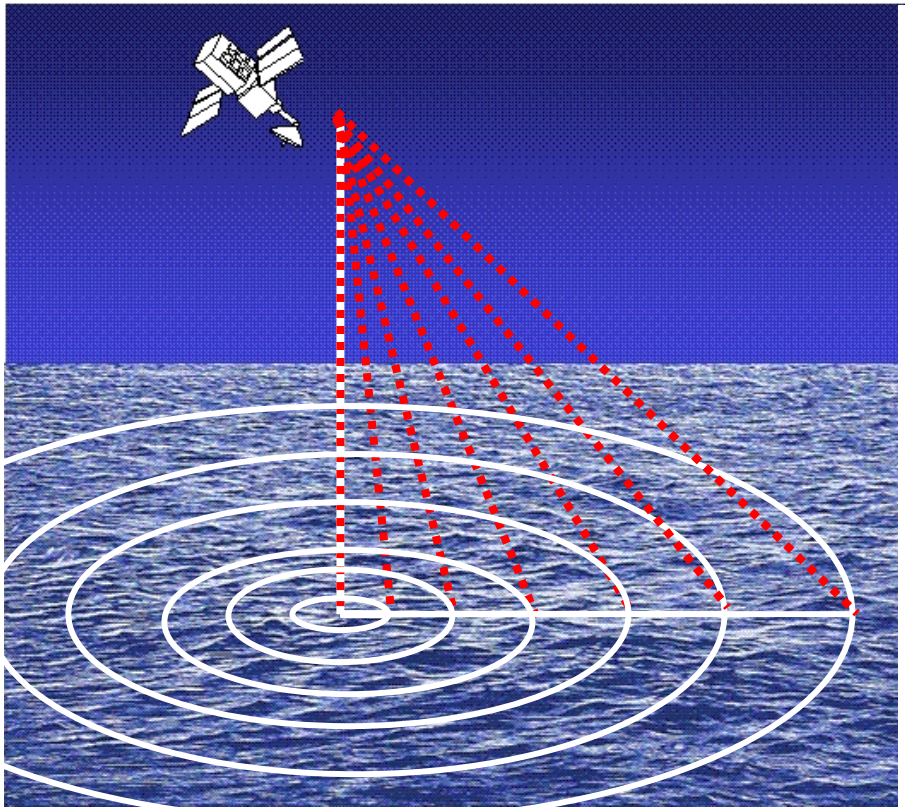
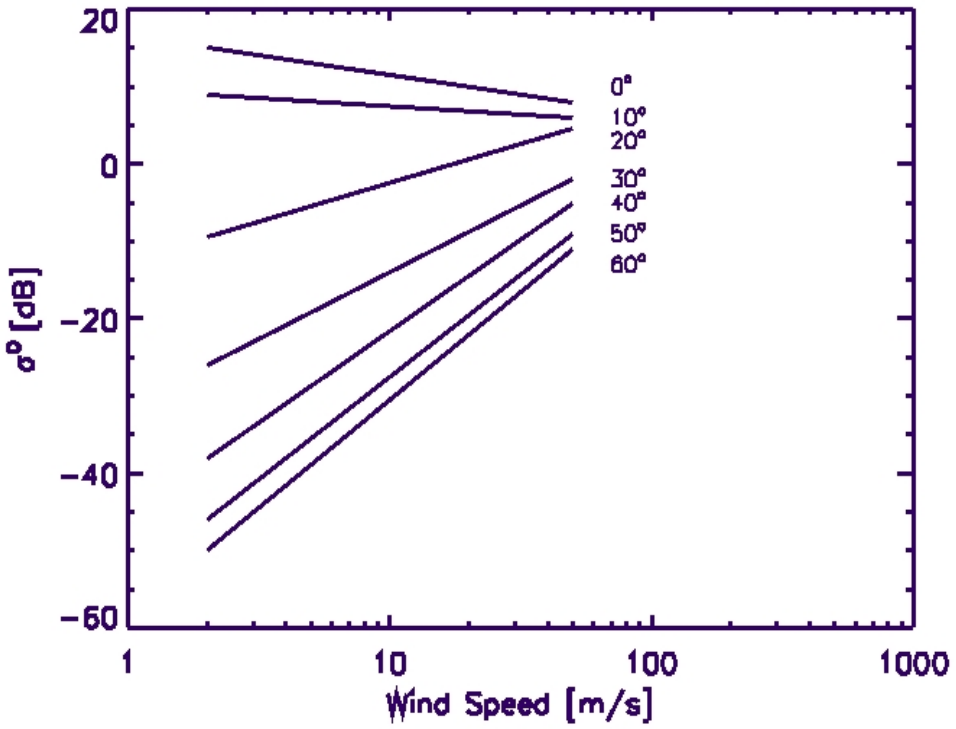
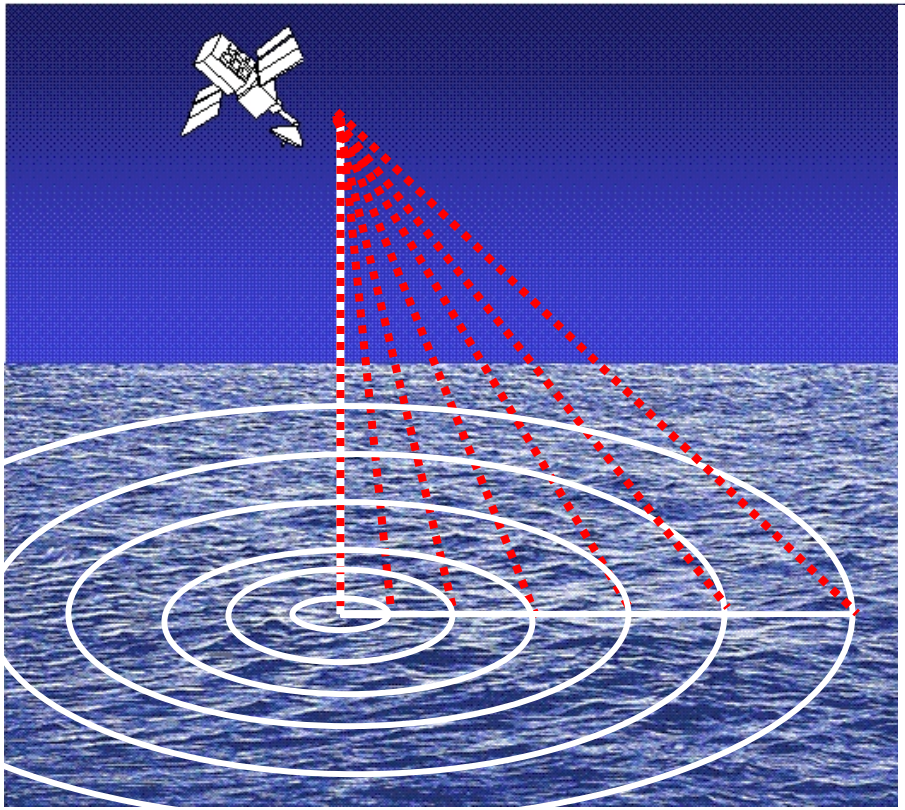


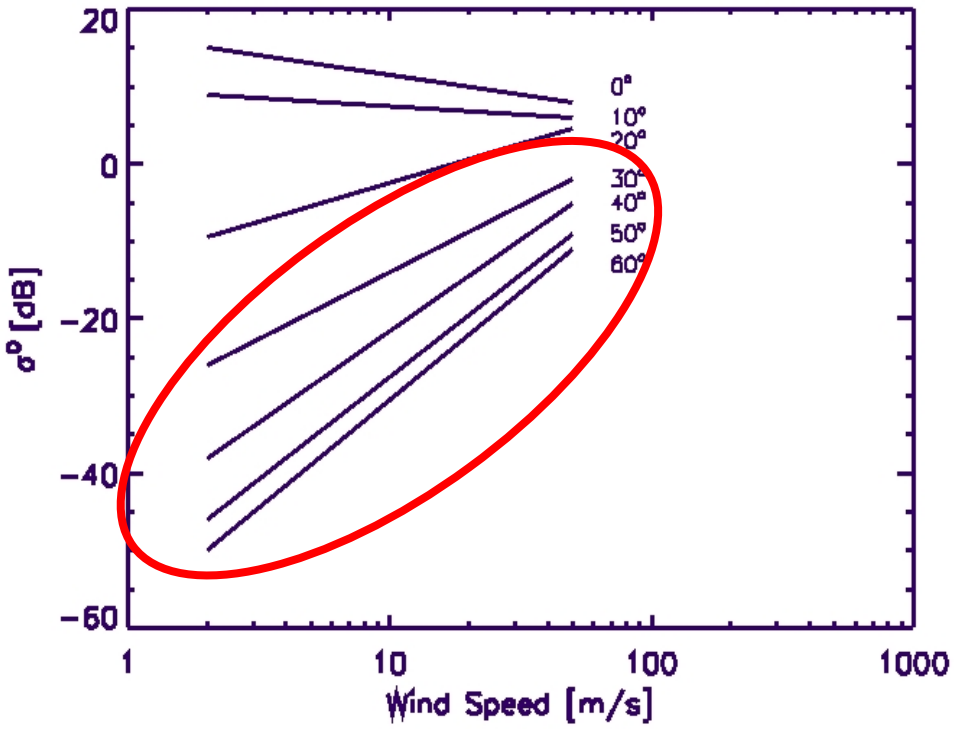


Courtesy
Z. Jelenak, NOAA

Backscatter as a function of incidence angle

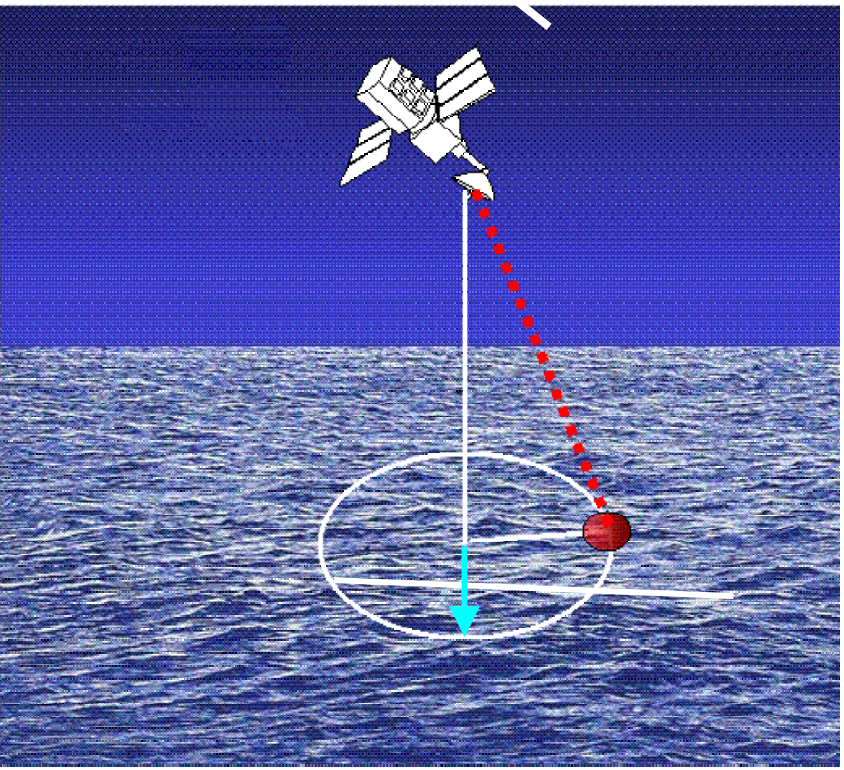
Best wind speed sensitivity at moderate incidence angles (30° - 60°)

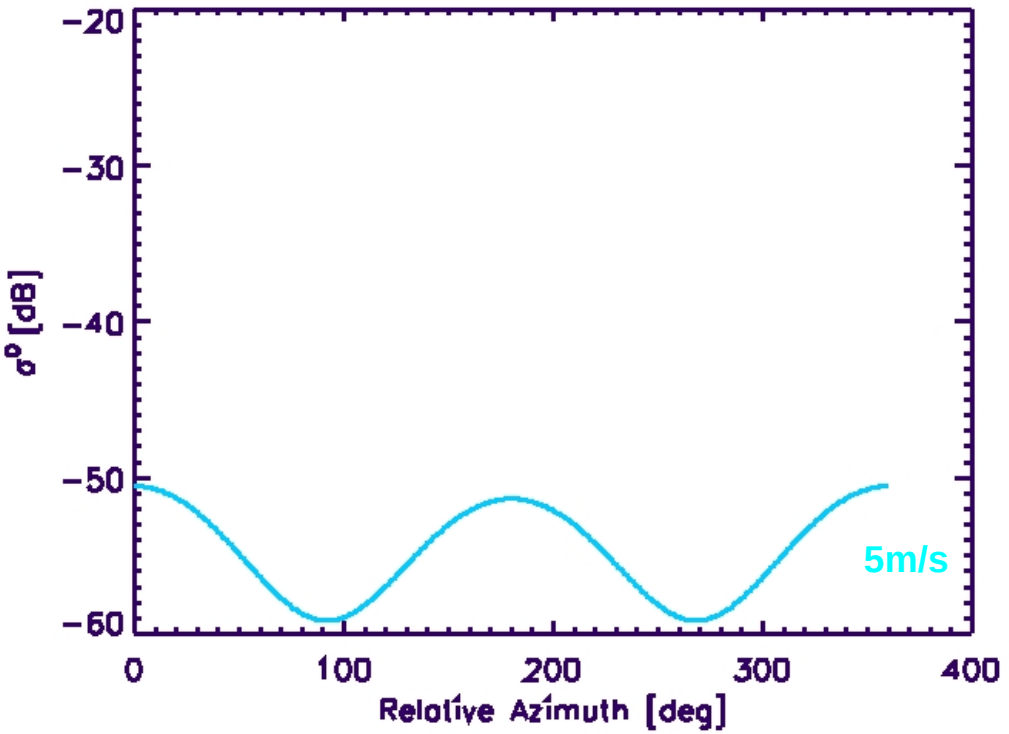




Courtesy
Z. Jelenak, NOAA

Backscatter sensitivity to wind direction





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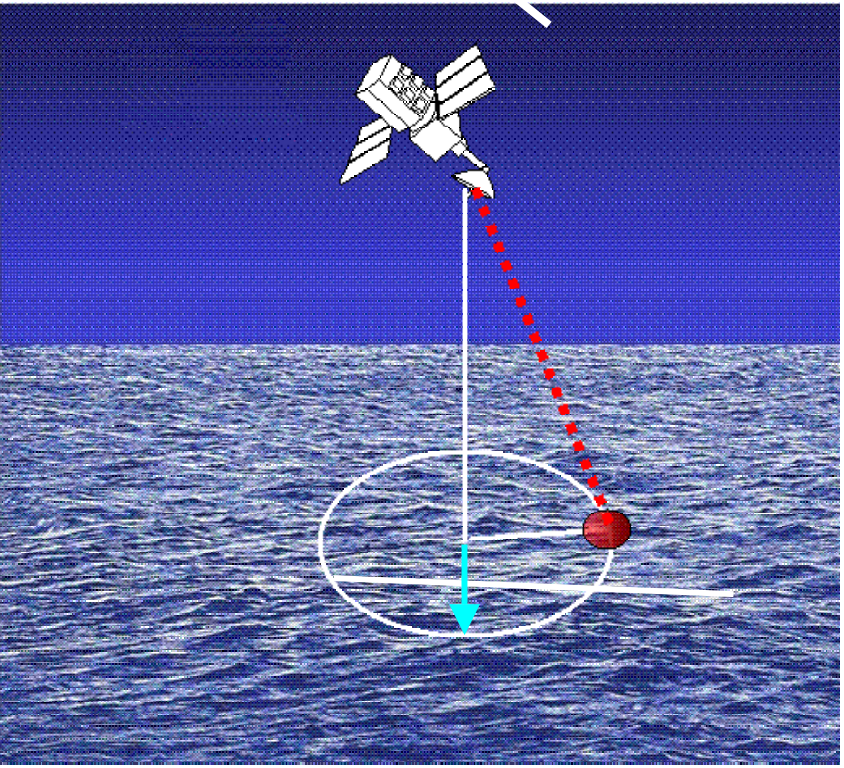

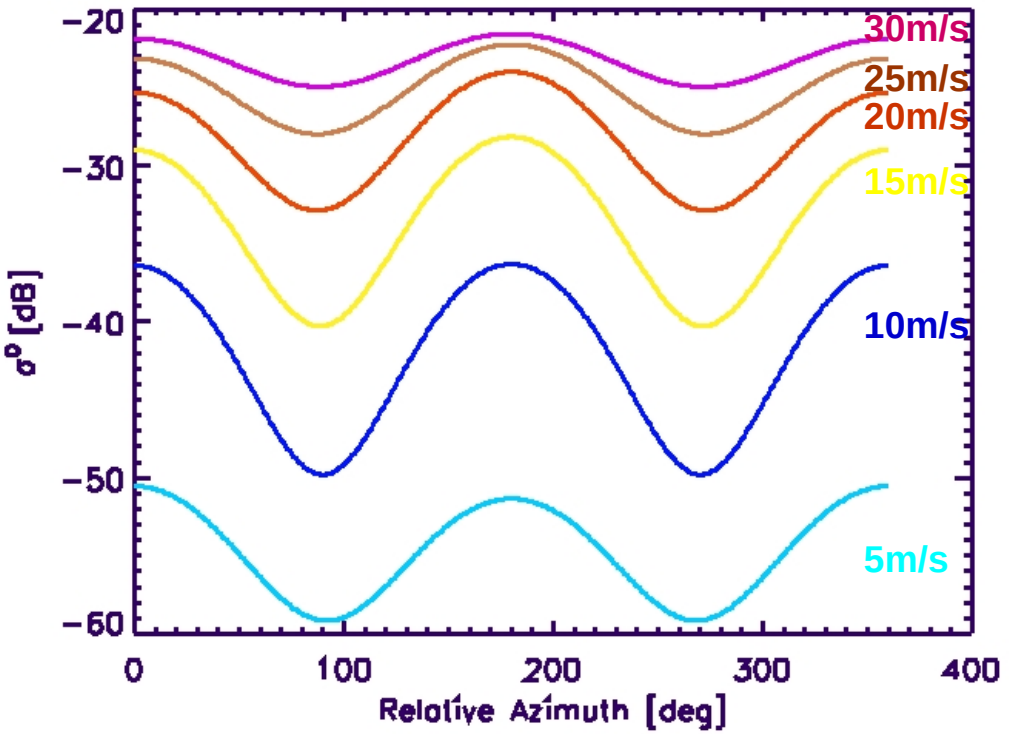

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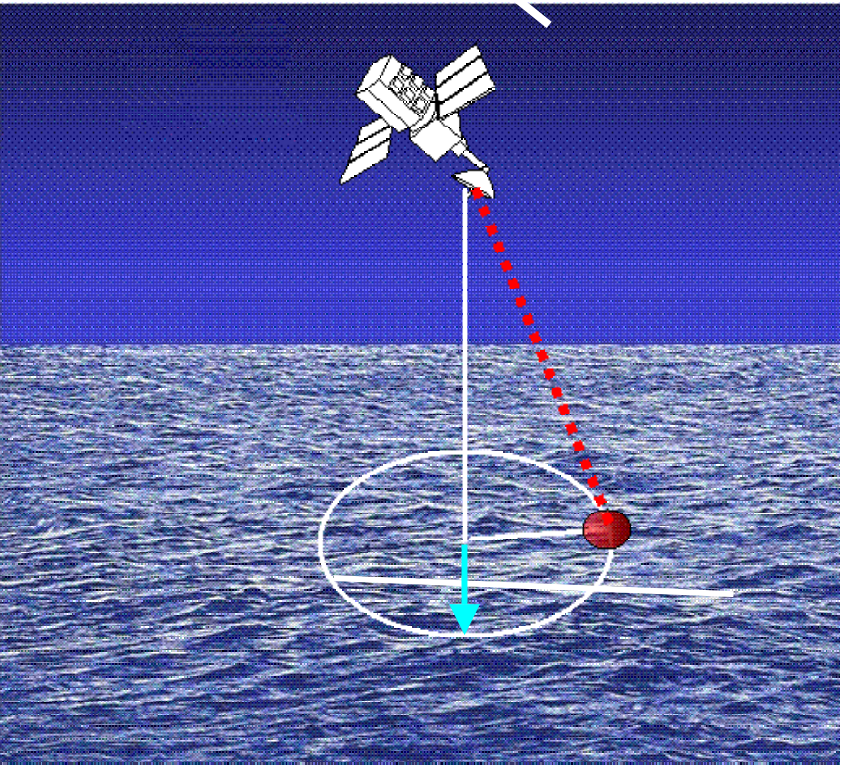
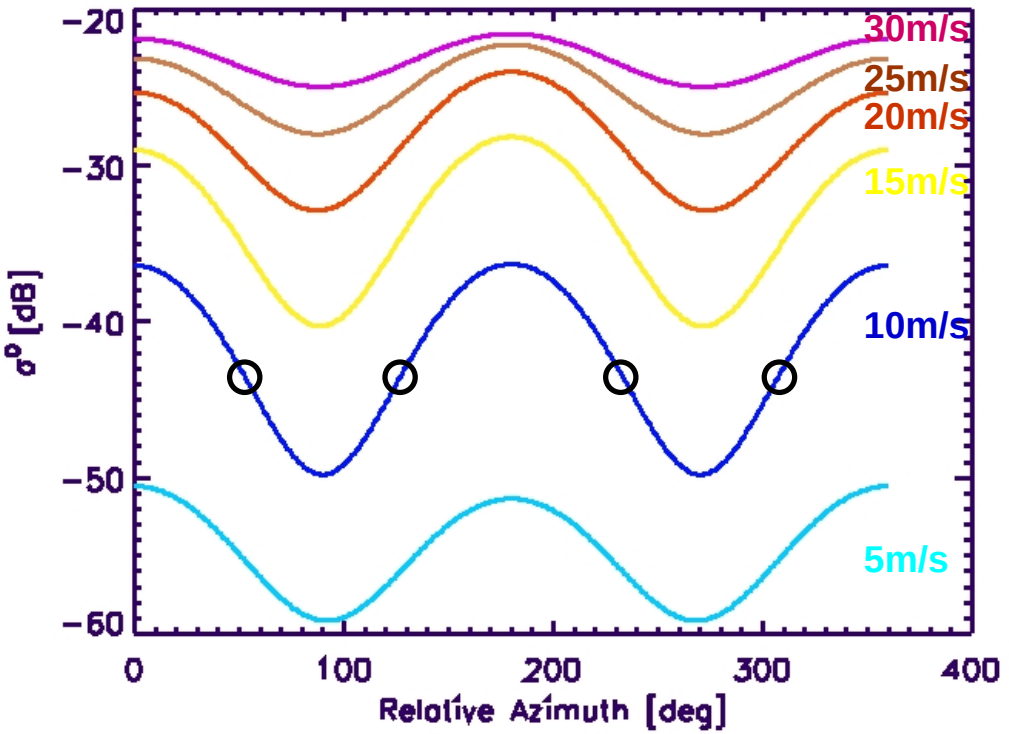
Backscatter sensitivity to wind direction

Note that multiple wind directions give the same backscatter!





Courtesy
Z. Jelenak, NOAA

Geophysical Model Function

An empirical geophysical model function (GMF) relates ocean surface wind speed and direction to the backscatter cross section measurements.

$$\sigma_0^{\text{model}} = GMF(U, \varphi, \theta, p, \lambda)$$

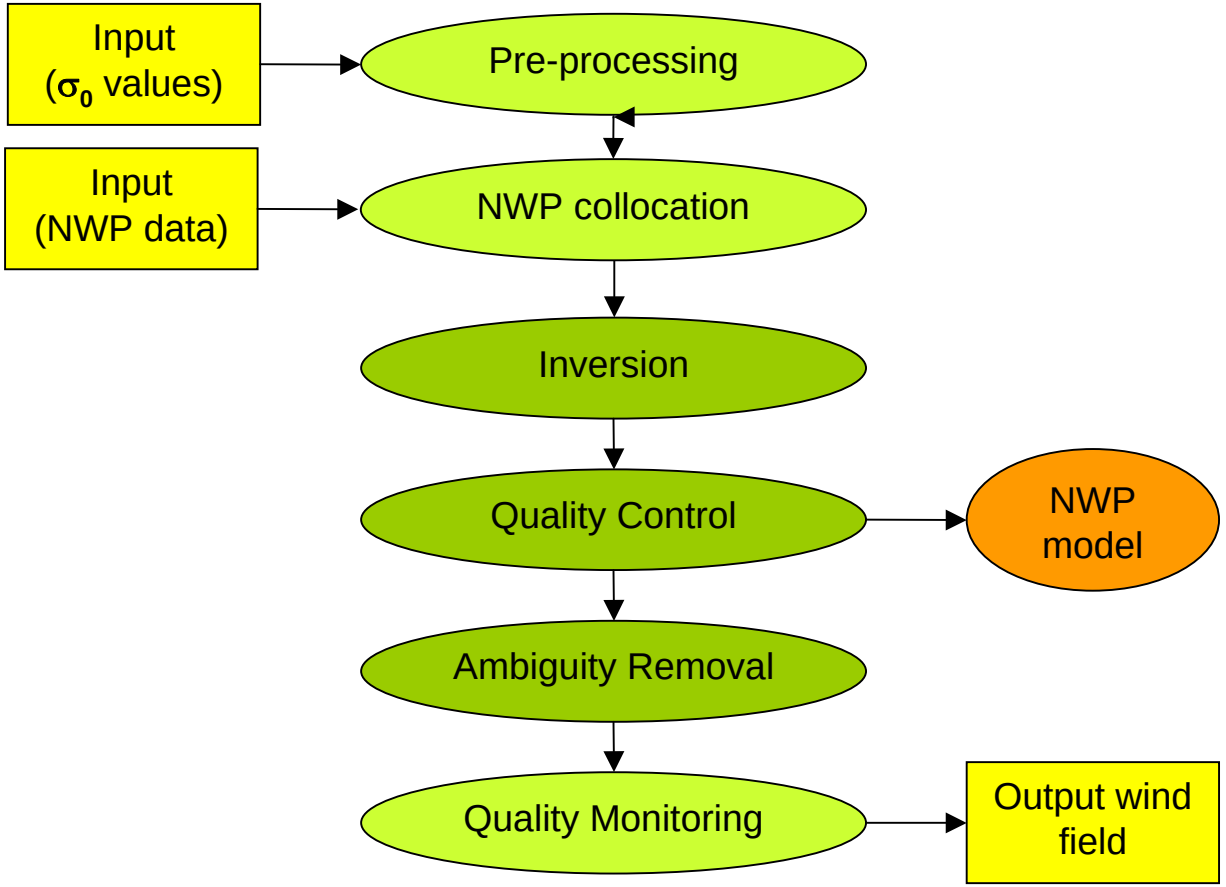
U : wind speed
φ : wind direction w.r.t. beam pointing
θ : incidence angle
p : radar beam polarization
λ : microwave wavelength

We need more than one view (azimuth) direction to obtain a good wind direction sensitivity!

Wind processing overview

General overview of wind processing steps

- Processing of level 1 to level 2 takes generally less than 10 minutes
- Ambiguity removal is necessary to select best wind vector out of the inversion solutions
- NWP assimilation of wind vector ambiguities is possible before ambiguity removal step



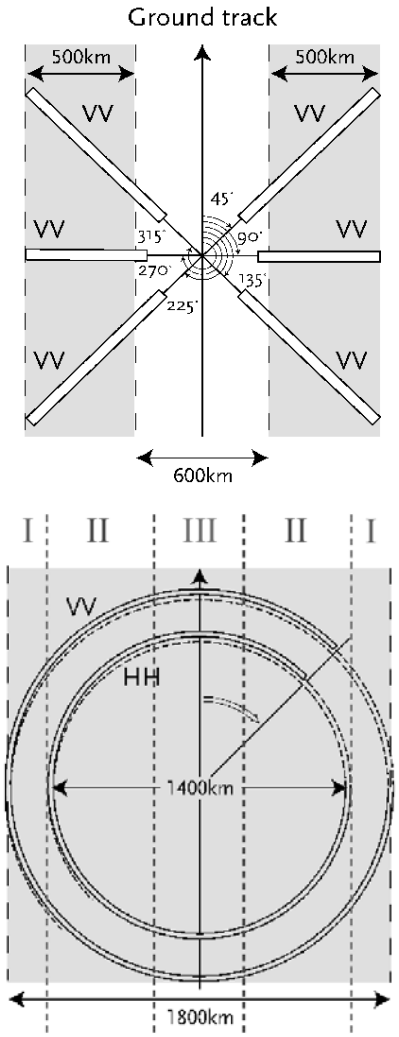
Scatterometer instruments

Fixed fan beam

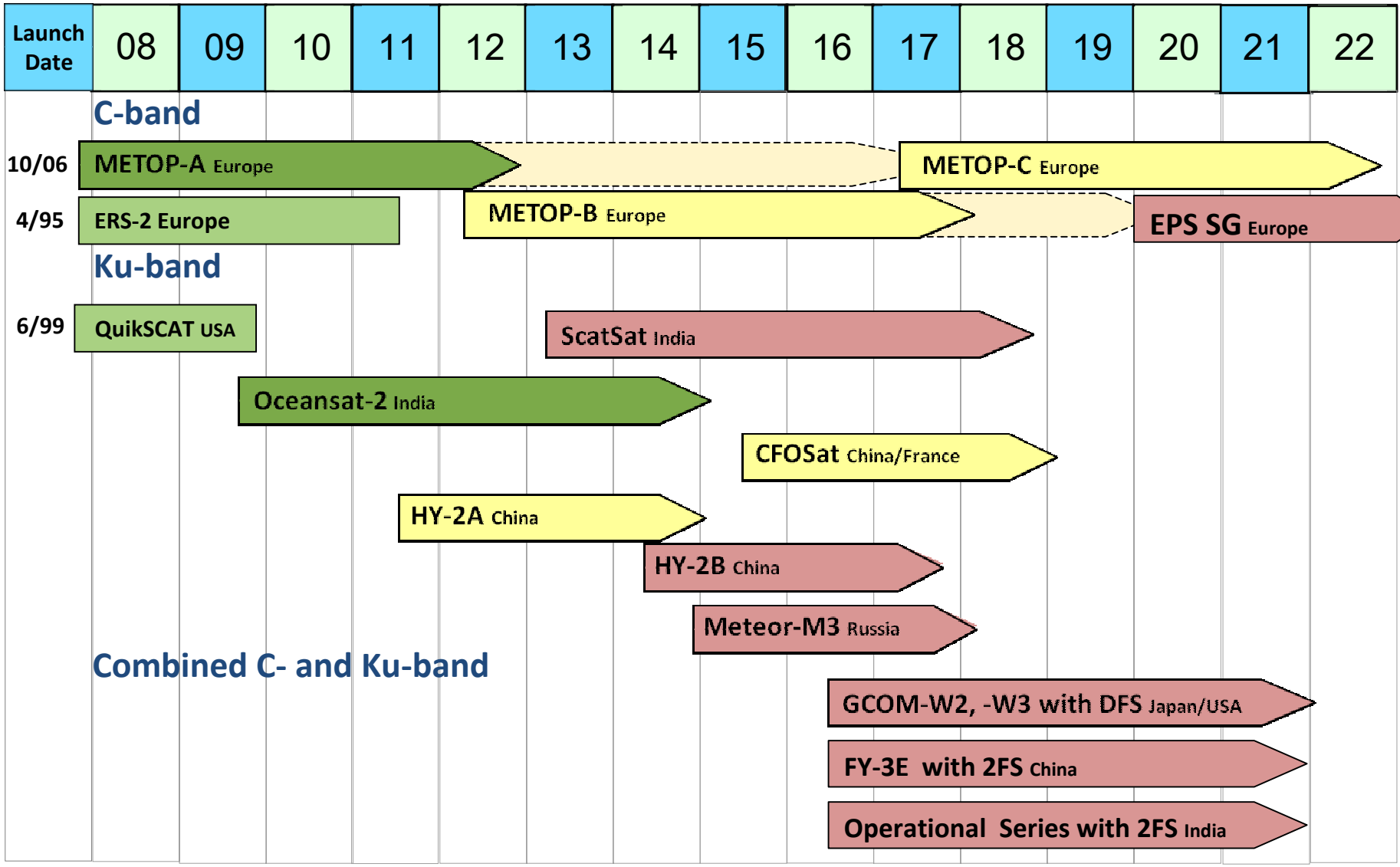
- C-band (5 cm), Ku-band (2 cm)
- VV-pol & Dual-pol
- Resolution: 25-50 km
- Fixed geometry
- Seasat, ERS-1/2, NSCAT, ASCAT

Rotating pencil beam

- Ku-band
- Dual polarization
- Resolution: 25 km
- Varying geometry
- SeaWinds-1/2, Oceansat-2



SCATTEROMETER MISSIONS



Design Life | Extended Life — Operating

OSI

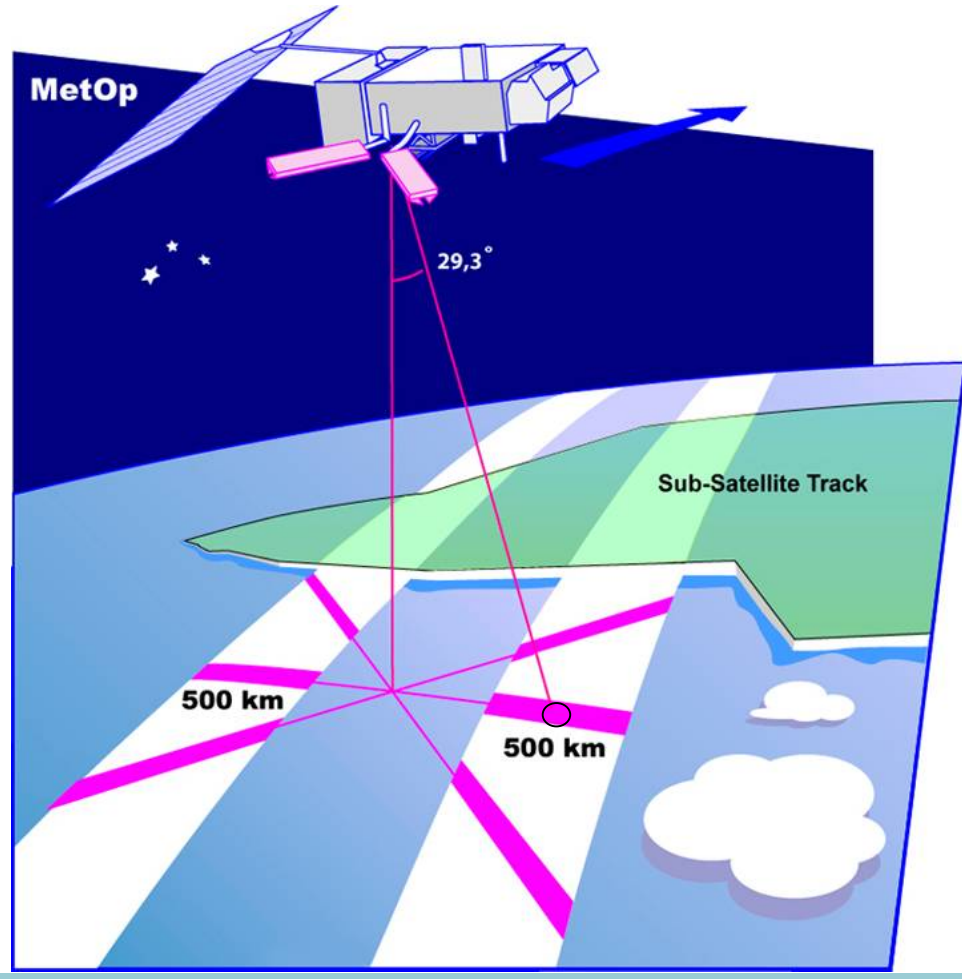
Designed | Extended — Approved

Proposed

based on sw 24feb11

The ASCAT scatterometer

- C-band radar instrument on board of the Metop-A satellite
- Launched in 2006; Metop-B and Metop-C to be launched in the coming years
- Each Wind Vector Cell is sampled by three radar beams (fore, mid and aft)
- The three measurements are combined to compute wind speed and direction over the oceans
- Two swaths, left and right of the satellite are covered



Available products

Current operational products:

- ASCAT 25 and 12.5 km global winds (OSI SAF) – timeliness ~120 min
- ASCAT 12.5-km global coastal winds (OSI SAF) – timeliness ~120 min
- ASCAT 25 and 12.5 km regional winds (EARS) – timeliness ~20 min

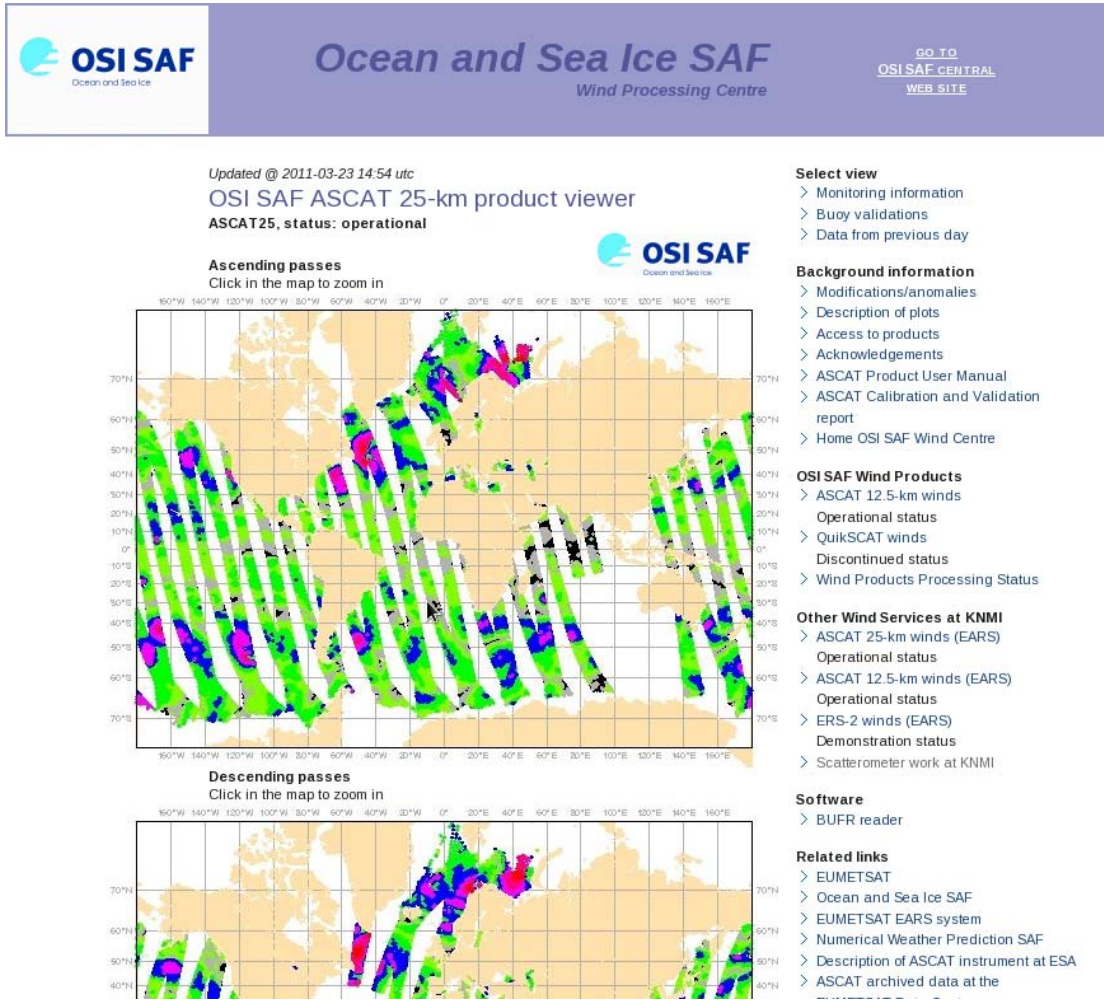
EARS winds available for ascending tracks from Equator to North Pole, and descending tracks from HRPT stations in European/North Atlantic regions.

Upcoming:

- Oceansat-2 (India) 50-km global winds (OSI SAF), currently in development status

Web visualisation

- Visit www.knmi.nl/scatterometer for near-real time visualisation of available products
- Product user manuals and other documentation available
- Clicking in the world map will open a detail plot with wind vectors



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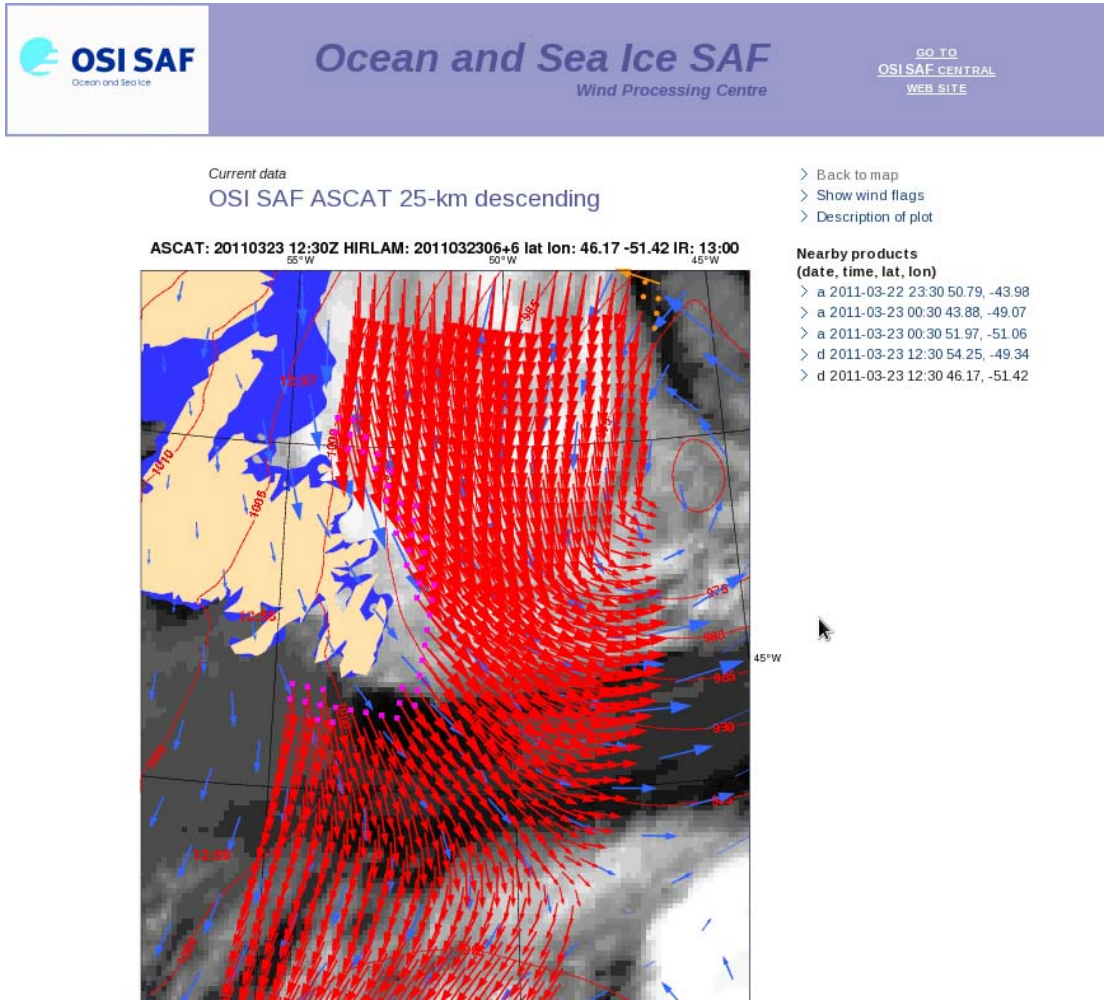
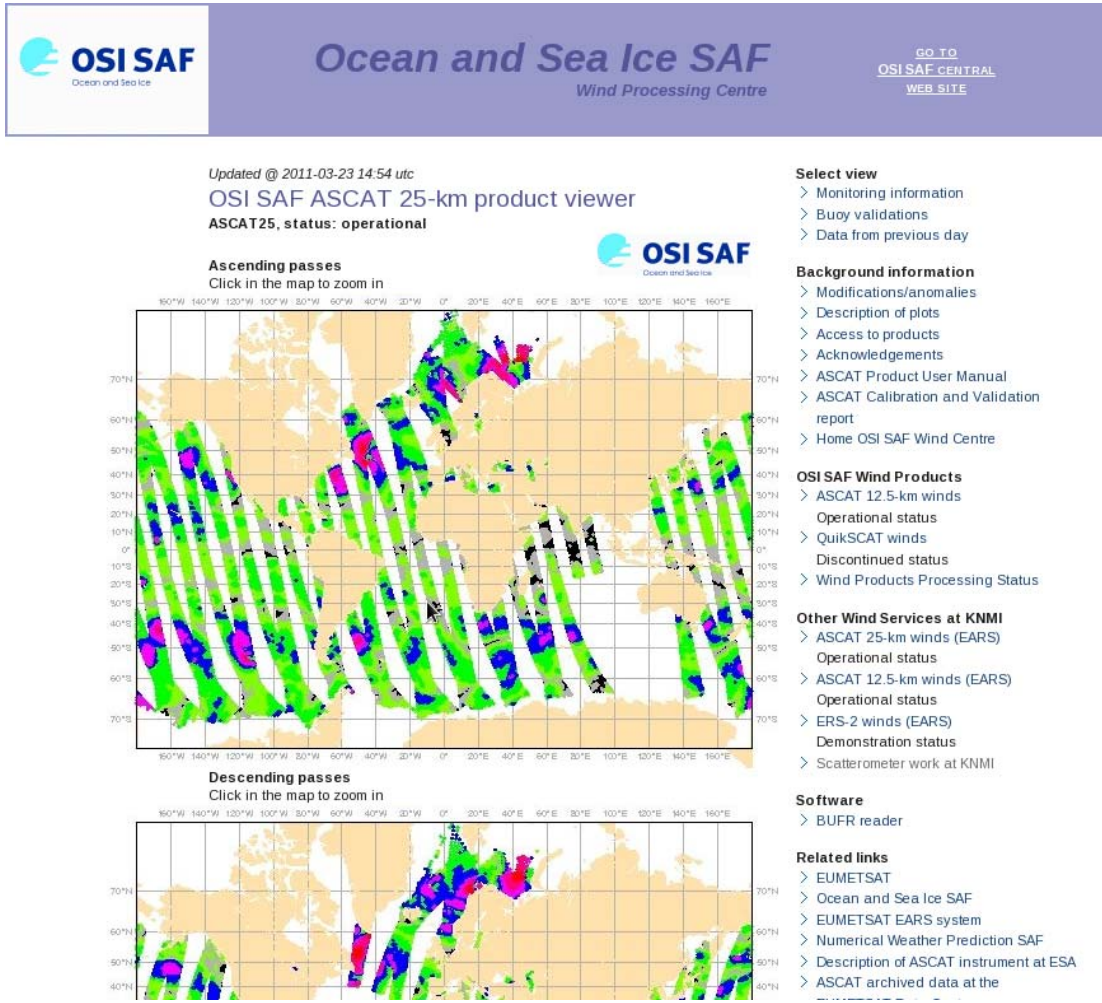


Product monitoring

- Monitoring information is continuously available on the product pages
- Weekly and quarterly statistics against ECMWF winds are available
- Monitored parameters are
  - MLE (distance to GMF)
  - Wind speed bias vs. ECMWF
  - *u* and *v* RMS scat-ECMWF
  - timeliness
- These are the most sensitive parameters to instrument anomalies



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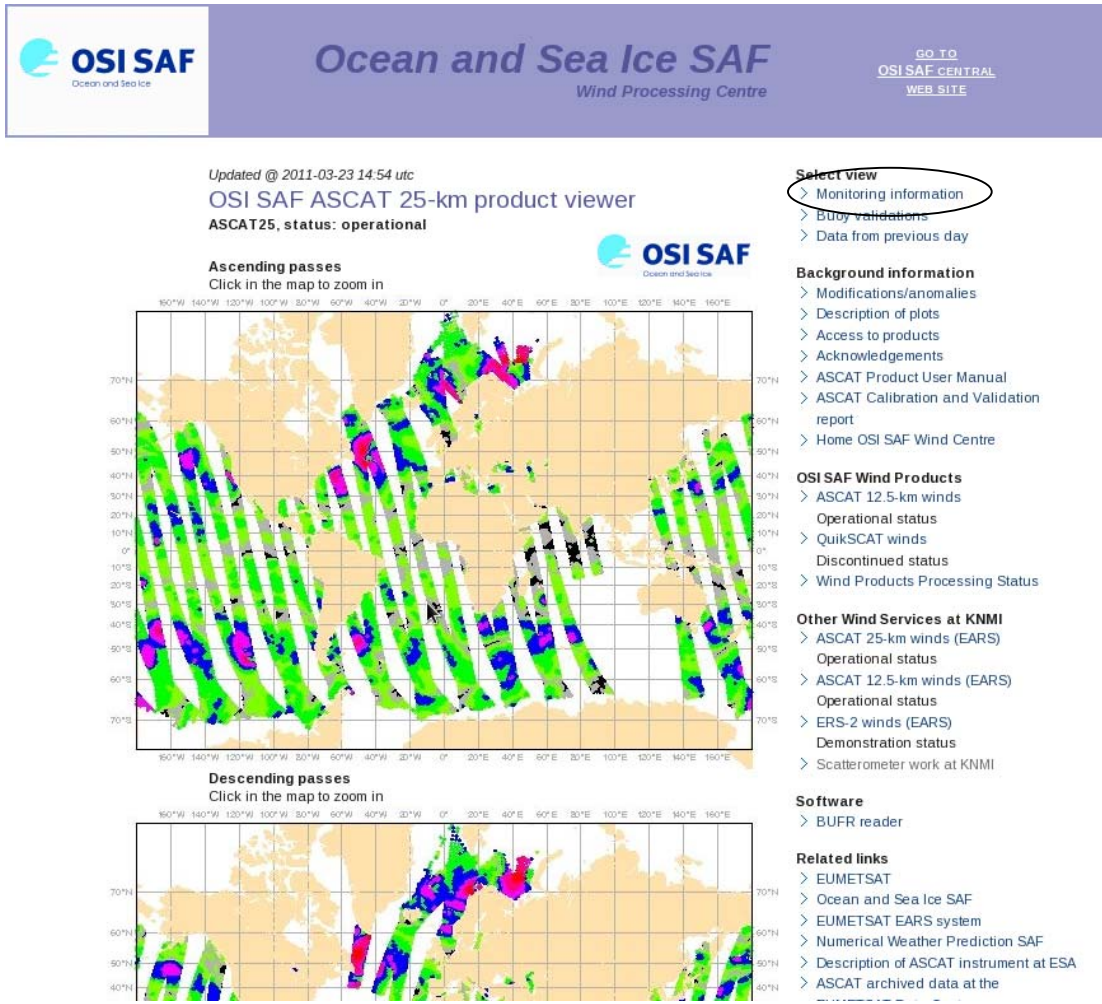

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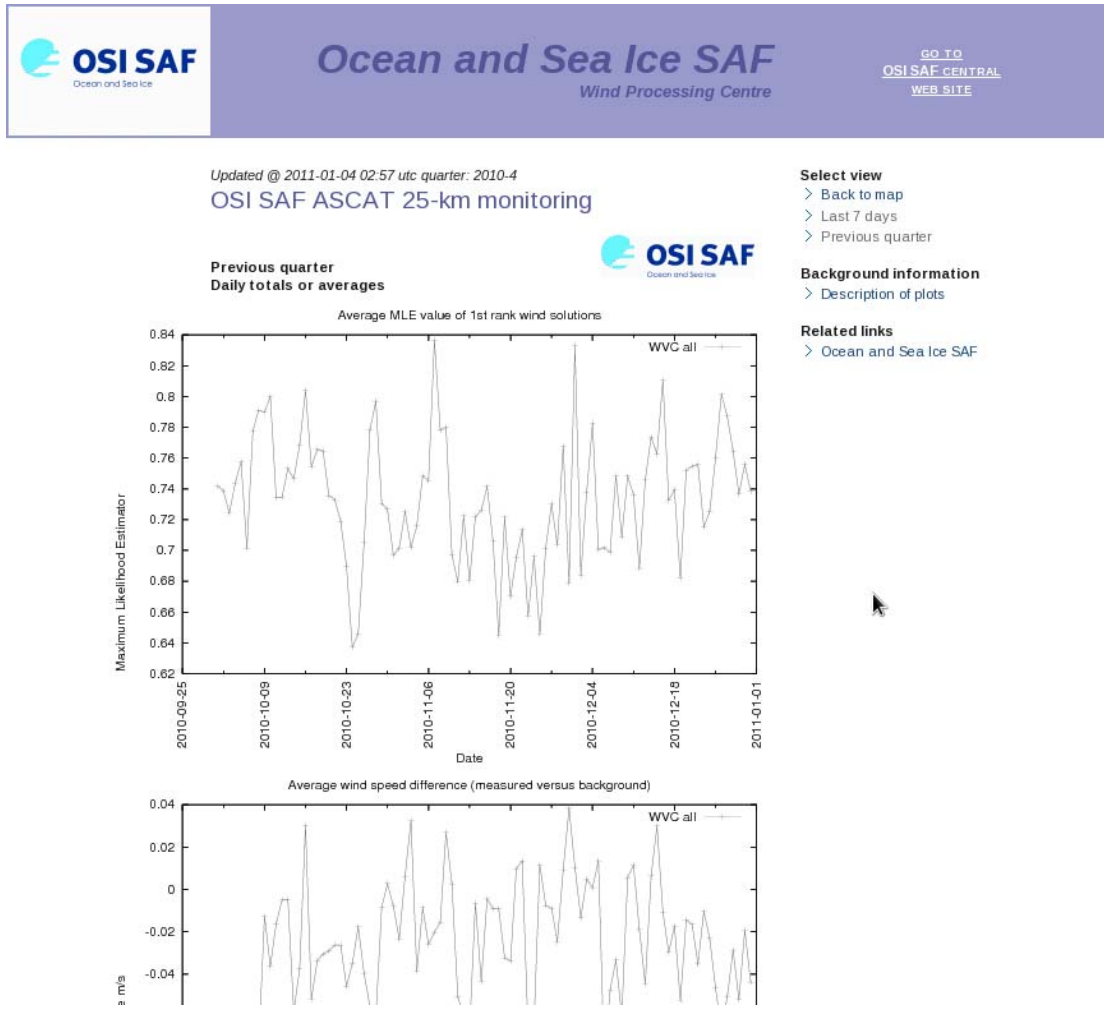
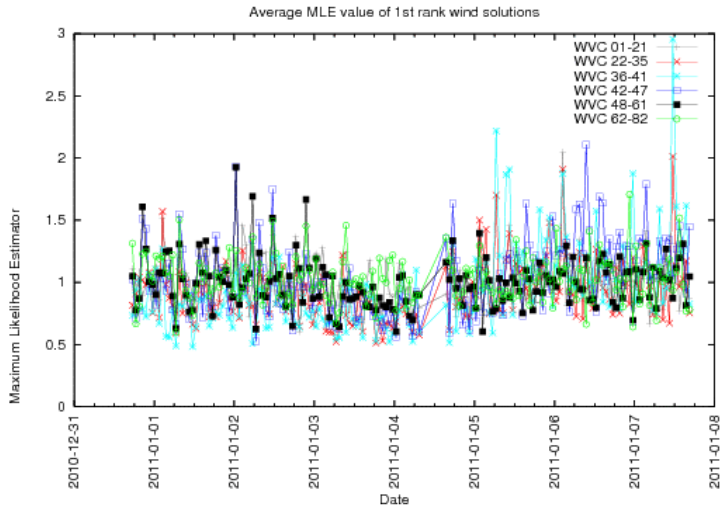
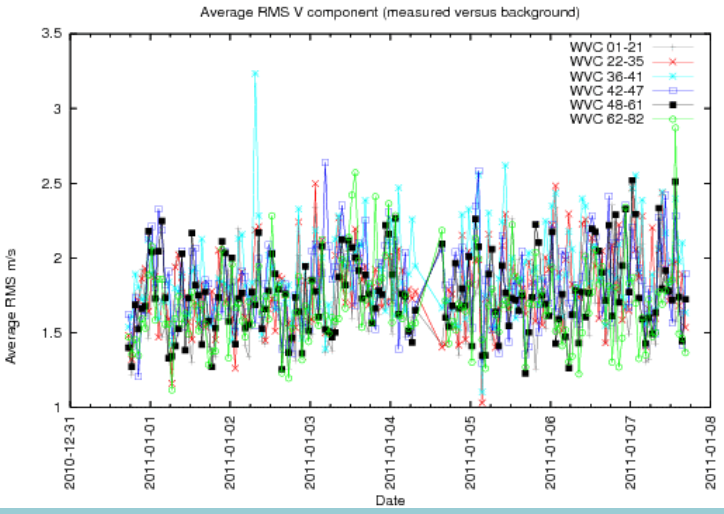
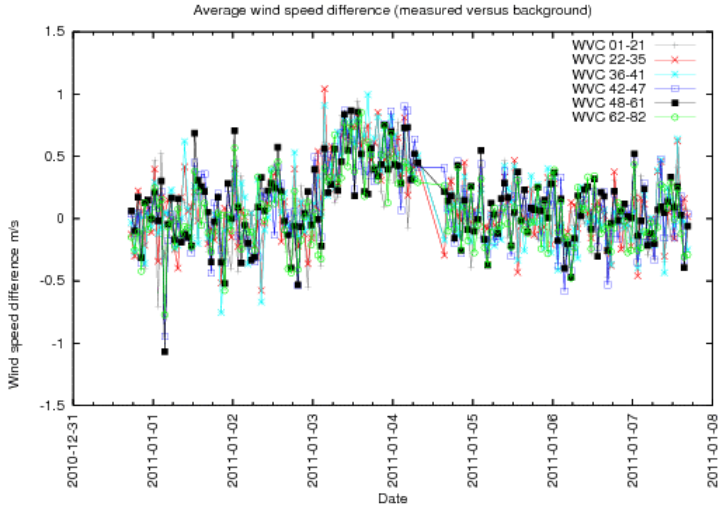


Product monitoring (2)

- ASCAT instrument anomaly of 3-4 January 2011: reduced RF-power
- Step is detected easily in wind speed bias (~0.5 m/s) but less clear in MLE values and *v* component RMS
- Automatic e-mail notification mechanism in place

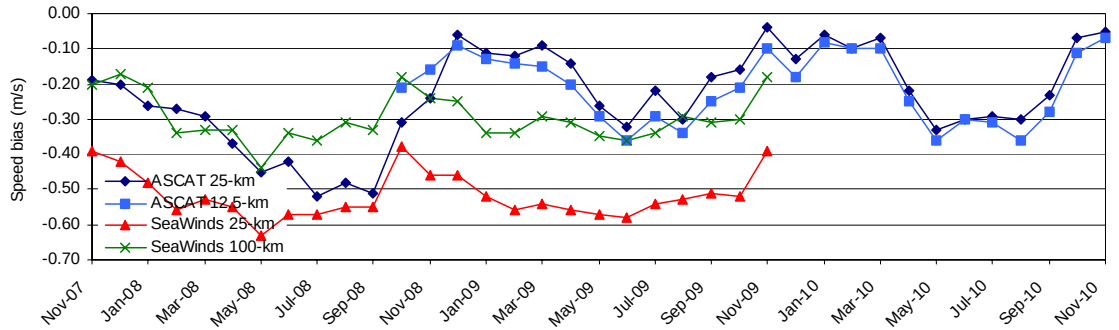


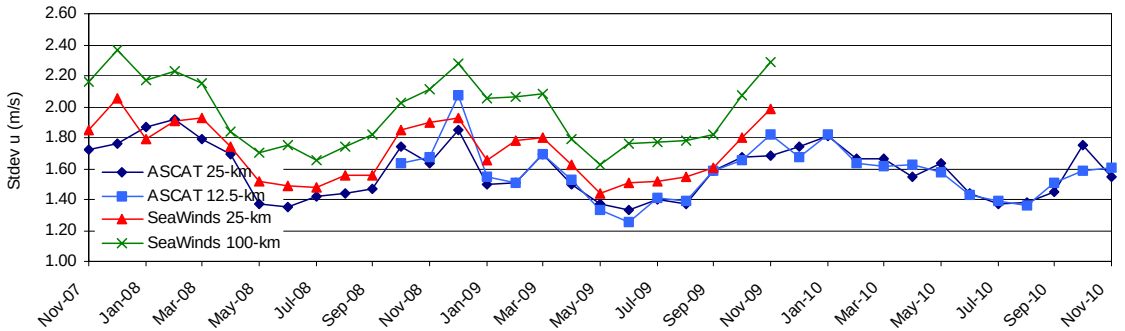


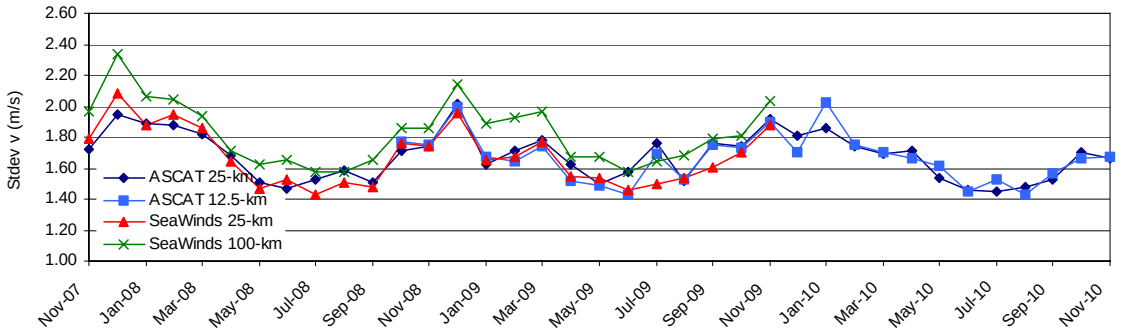


Buoy validation

- Products are validated against a quality controlled buoy data set
- Monthly validation results (speed bias, *u* and *v* standard deviations) available on the web
- Target accuracy 0.5 m/s for wind speed bias and 2.0 m/s for wind components RMS
- Results from all products are also published in the OSI SAF Quarterly Reports







How to get the products

Near-real time products

- EUMETCast, available in Europe, Africa, North & South America
  See EUMETSAT website and Product Navigator for details
- KNMI FTP server, contact scat@knmi.nl for access
- GTS, only for ASCAT EARS and 25-km global products

Archived products

- EUMETSAT Data Centre: ASCAT in BUFR and NetCDF format
- PO.DAAC: ASCAT in NetCDF format

Support and helpdesk

Don’t forget to register as a product user at www.osi-saf.org or scat@knmi.nl.

- You will receive service messages in case of outages, anomalies or product upgrades
- We will handle your queries about the availability or usage of the data

Product formats: BUFR and NetCDF

All wind products are available in BUFR format

- BUFR data contain both backscatter and wind data, in global ASCAT products also surface soil moisture
- BUFR decoding software is available from ECMWF, a simple decoding program in Fortran is available on http://www.knmi.nl/scatterometer/bufr_reader/

The global wind products are also available in NetCDF format

- Only one template/format available, compliant with the Climate and Forecast (CF) Metadata Convention
- Contains only wind data: selected wind vector
- Products can be displayed with e.g. Unidata IDV

Quality information

Wind vector cell quality flag:

- Land, ice presence: for information
- KNMI Quality Control: is set in case of too large distance to GMF or too high Kp values. Data are suspect!
- Variational Quality Control: is set in ambiguity removal step, spatial inconsistency detected. Data may be suspect.
- See Product User Manuals for more information and advice!

The End

- Questions?