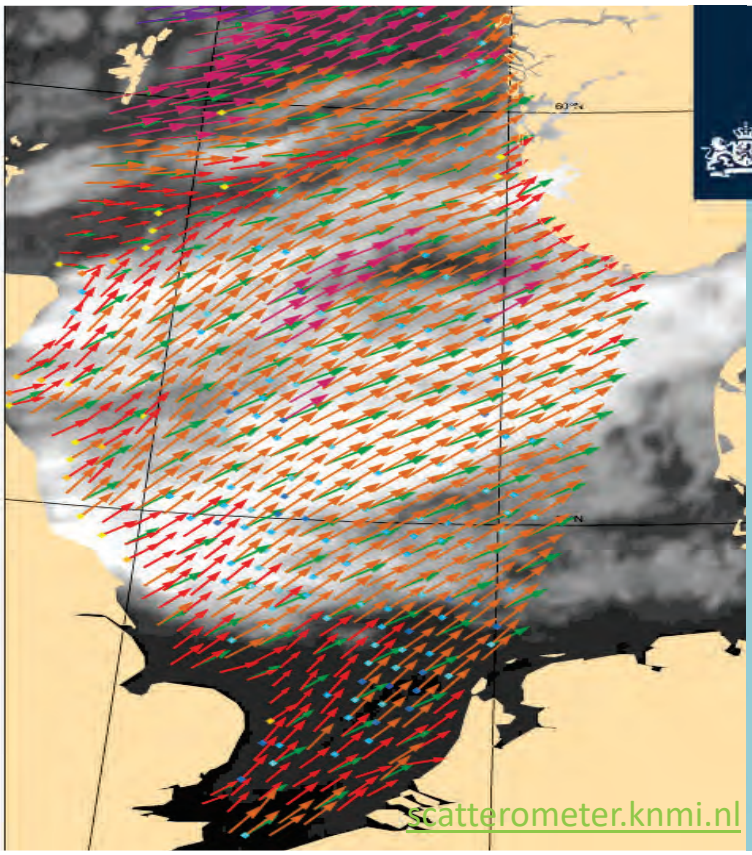


Royal Netherlands Meteorological Institute
Ministry of Infrastructure and the Environment

Seas of Satellite Observations

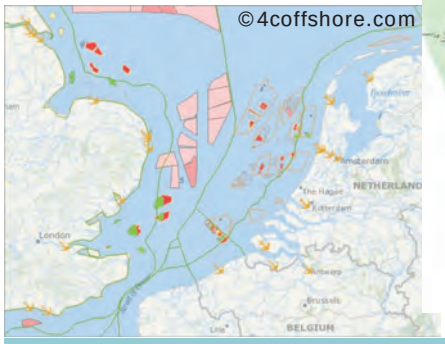
Ad.Stoffelen@knmi.nl

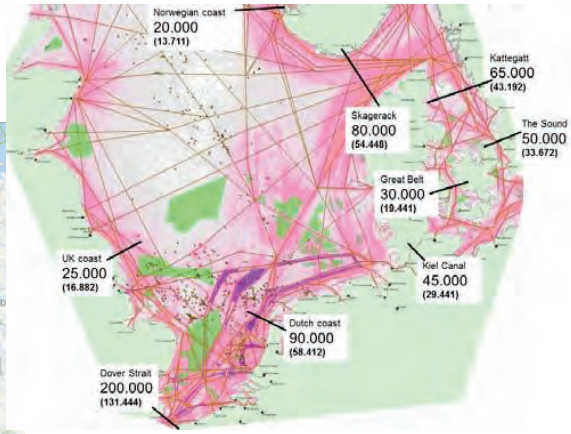
EUMETSAT OSI SAF
OCEAN AND SEA ICE

COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE
CMEMS SEA SURFACE WIND TAC

Netherlands

- Increasing economic activity North Sea
- 20 Billion Euro for Delta up to 2050, more later depending on climate action!
- 1/3 NL below mean sea level





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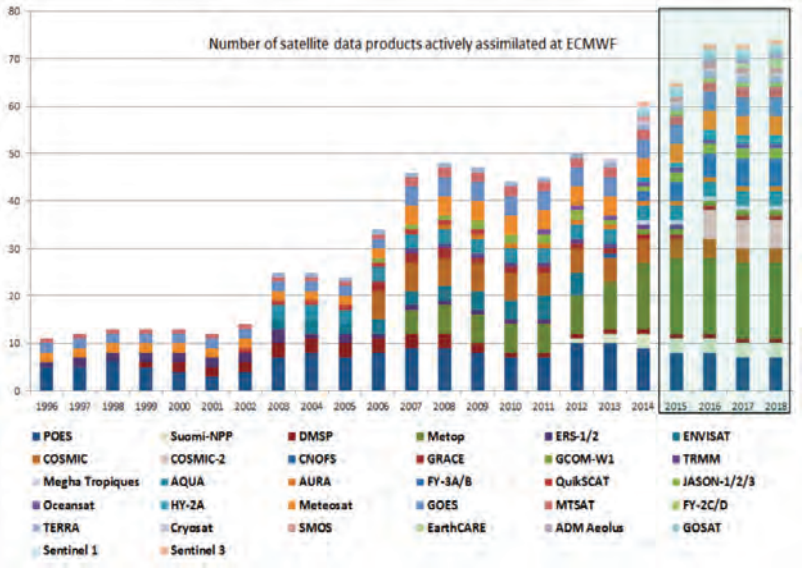
What do satellites observe?

- Both NRT and off-line, e.g. climate series
- Large spatial coverage
- LEO Polar satellites (2x per day)
- Continuous Geo images (daylight for VIS)
- GEO & LEO constellations

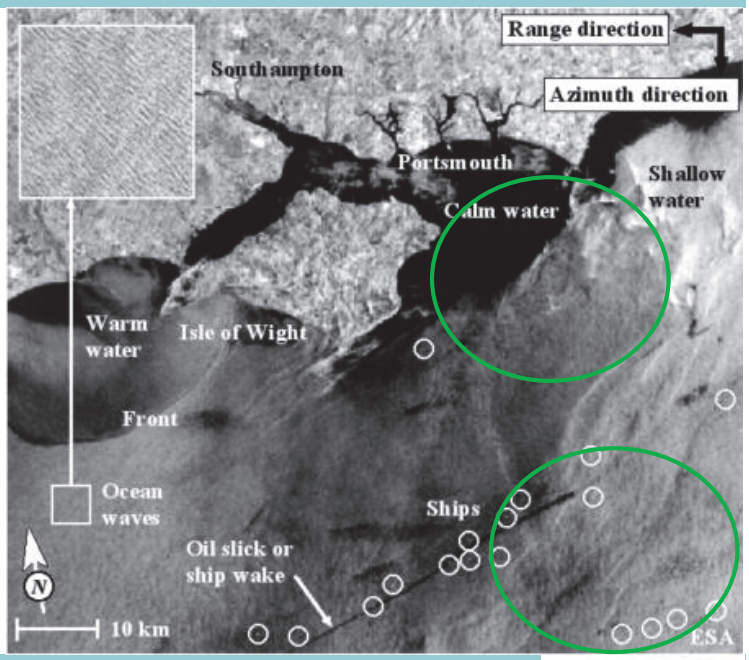
Variables from satellites:

- Wind (μwave Scatterometers, EUMETSAT, ..)
- Waves (μwave Altimeters, Sentinel-6)
- Storm surge (μwave Sentinel-3, altimeters)
- Sea Surface Temperatuur, SST (IR, μwave)
- Ocean colour (VIS, UV, IR)
- Water quality, Chlorofyll (VIS)
- Cloud, Aerosol (UV, VIS, IR)
- Rain (radar, μwave imager, geo IR)
- Lightning (GOES)
- Bathymetry (μwave)



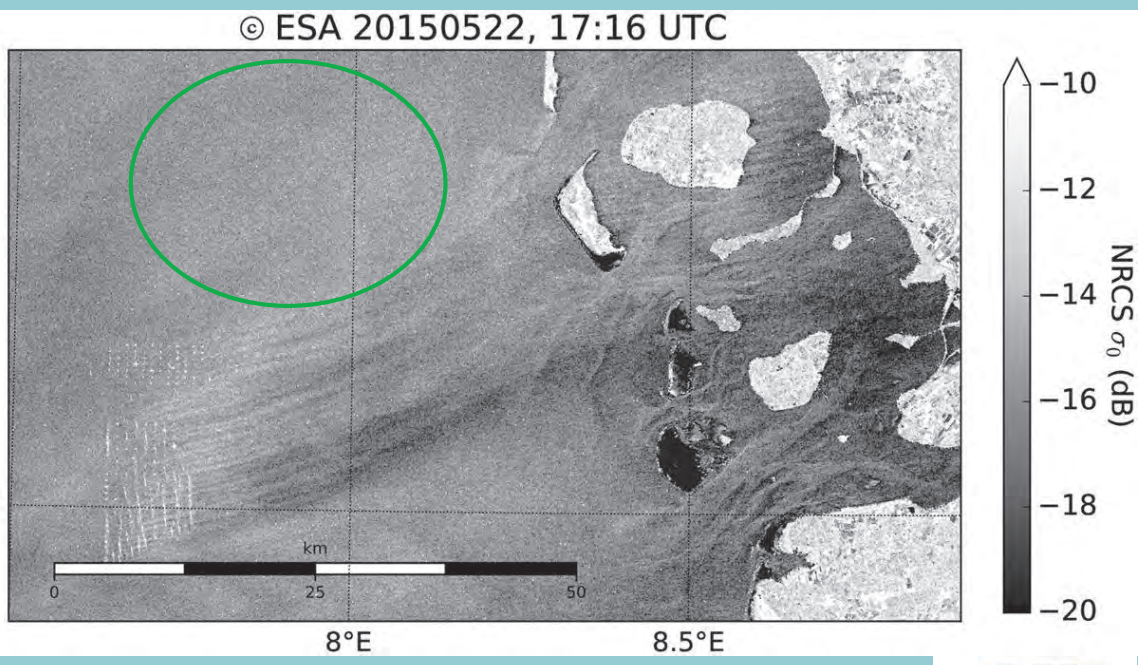
Ocean NRCS (all weather)

- Views many geophysical variables:
  - Wind, waves, ocean currents, bathymetry, oil spills, ocean wakes, wind wakes, ships, . .
  - Captures much variability at low winds and near the coast
  - The signal is much more uniform and wind/wave-related at high winds and in open sea
- Real aperture radars on scatterometers have typically 25-km footprints (ASCAT)
  - Well calibrated (< 0.1 m/s per decade)
  - Good coverage
- Synthetic Aperture Radars (SAR) capture high-resolution patterns
  - Much less well-calibrated than wind scatterometers
  - Low coverage and cannot track atmosphere features
- Response depends on wavelength and polarization (VV, HH, VH)
- Doppler is useful for ocean motion
- Based on empirical geophysical models (data learning)



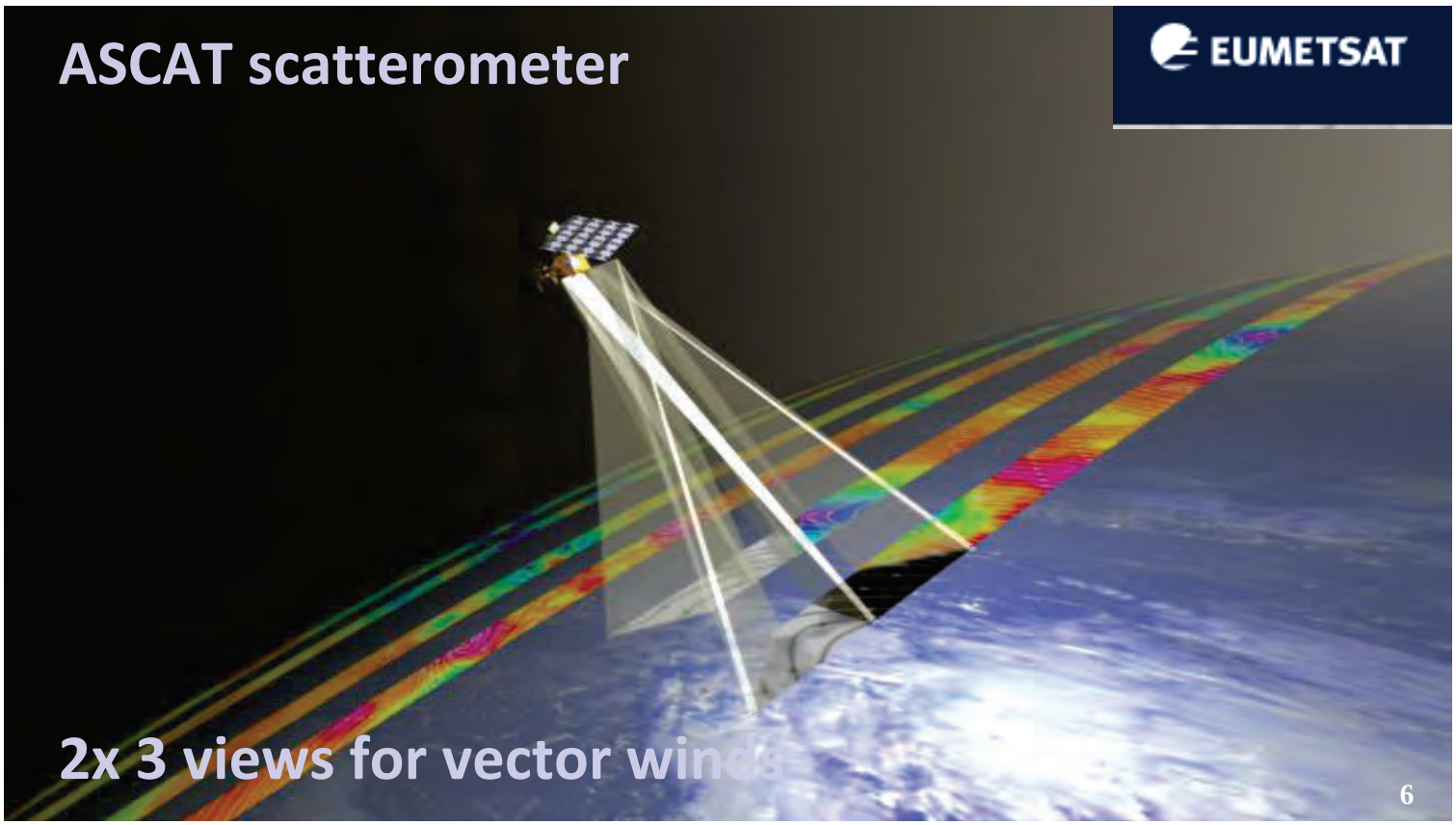
Off-shore wind park effects

- S-1 SAR shows 1st evidence of long-range wind park effect
- Depends on atmospheric stability
- Energy?
- Coastal environment/ coastal protection?



ASCAT scatterometer

EUMETSAT



2x 3 views for vector winds

NWC SAF

Nowcasting and Very Short Range Forecasting

Nowcasting is a weather forecast for the next few hours, based on current information.

Learn more about NWC SAF

AC SAF

Atmospheric Composition Monitoring

The AC SAF processes satellite data on ozone, other trace gases, aerosols and ultraviolet data.

Learn more about AC SAF

CM SAF

Climate Monitoring

The CM SAF generates and archives high-quality climate datasets.

Learn more about CM SAF

LSA SAF

Land Surface Analysis

The LSA SAF exploits remotely-sensed data on land, land-atmosphere interactions and biosphere applications.

Learn more about LSA SAF

H SAF

Operational Hydrology and Water Management

The H SAF generates and archives datasets and products for operational hydrological applications.

Learn more about H SAF

OSI SAF

Ocean and Sea Ice

The OSI SAF provides comprehensive information on the ocean-atmosphere interface.

Learn more about OSI SAF

NWP SAF

Numerical Weather Prediction

The NWP SAF supports the interface between satellite data and European activities in NWP.

Learn more about NWP SAF

ROM SAF

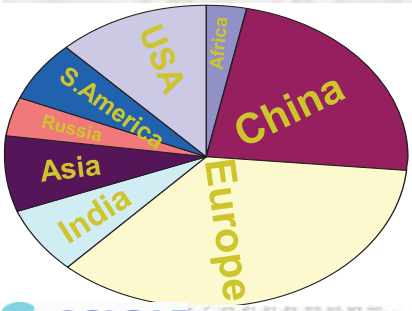
Radio Occultation Meteorology

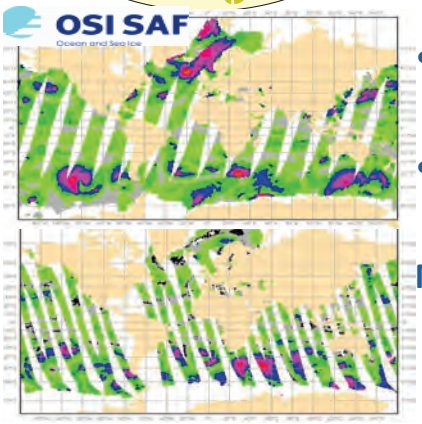
The ROM SAF generates and archives high-quality GNSS Radio Occultation (RO) data for NWP.

Learn more about ROM SAF

EUMETSAT OSI SAF OCEAN AND SEA ICE

Satellite Wind Services





24/7 Wind services (EUMETSAT SAF)

- International constellation of satellites
- High quality winds, QC
- Timeliness 30 min. – 2 hours
- Service messages
- QA, monitoring

Software services (NWP SAF)

- Portable Wind Processors
- ECMWF model comparison

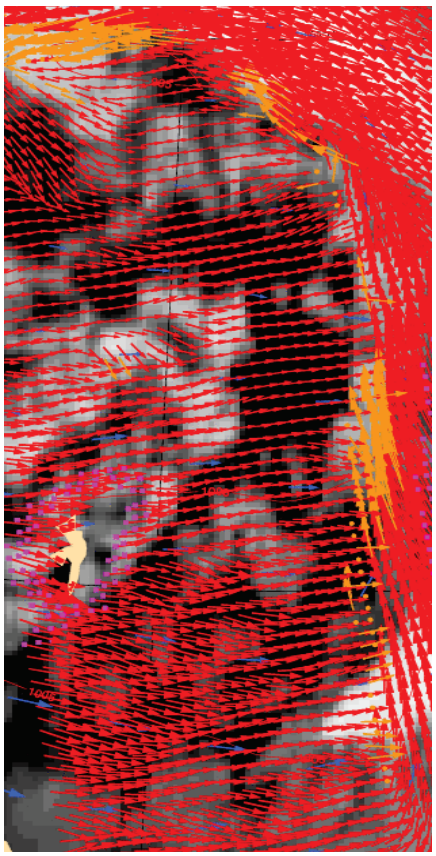
- Organisations involved: KNMI, EUMETSAT, EU, ESA, NASA, NOAA, ISRO, CMA, WMO, CEOS, ..
- Users: NHC, JTWC, ECMWF, NOAA, NASA, NRL, BoM, UK MetO, M.France, DWD, CMA, JMA, CPTEC, NCAR, NL, . . .

More information:

scatterometer.knmi.nl

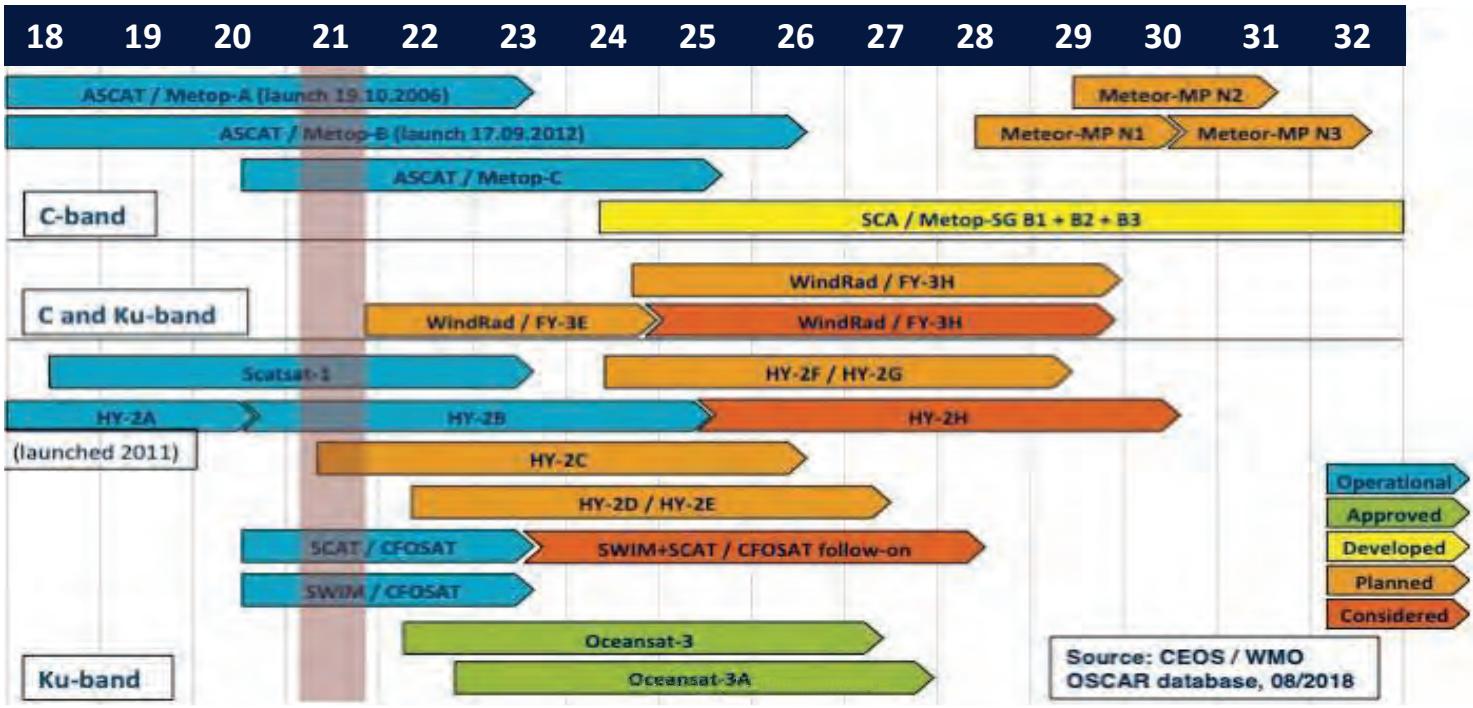
Wind Scatterometer Help Desk

Email: scat@knmi.nl

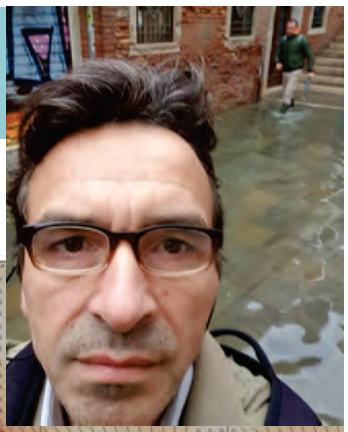


Scatterometer golden age

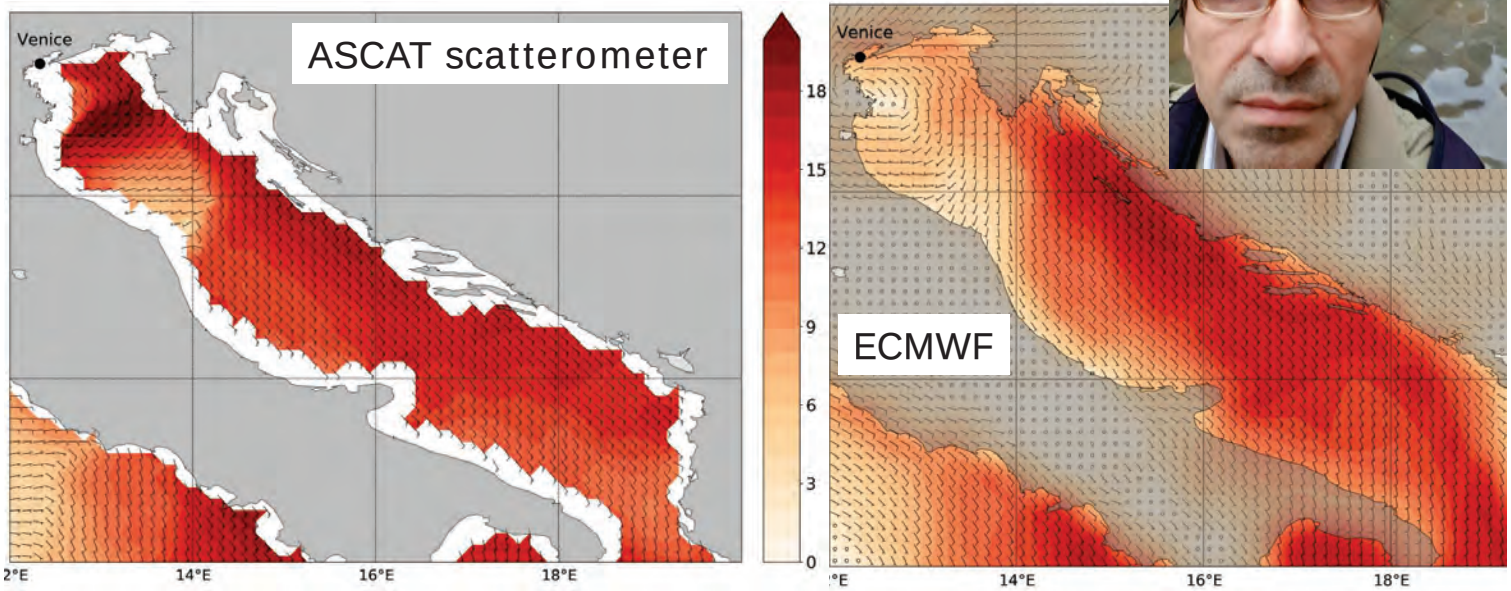
Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu



Venice before Covid



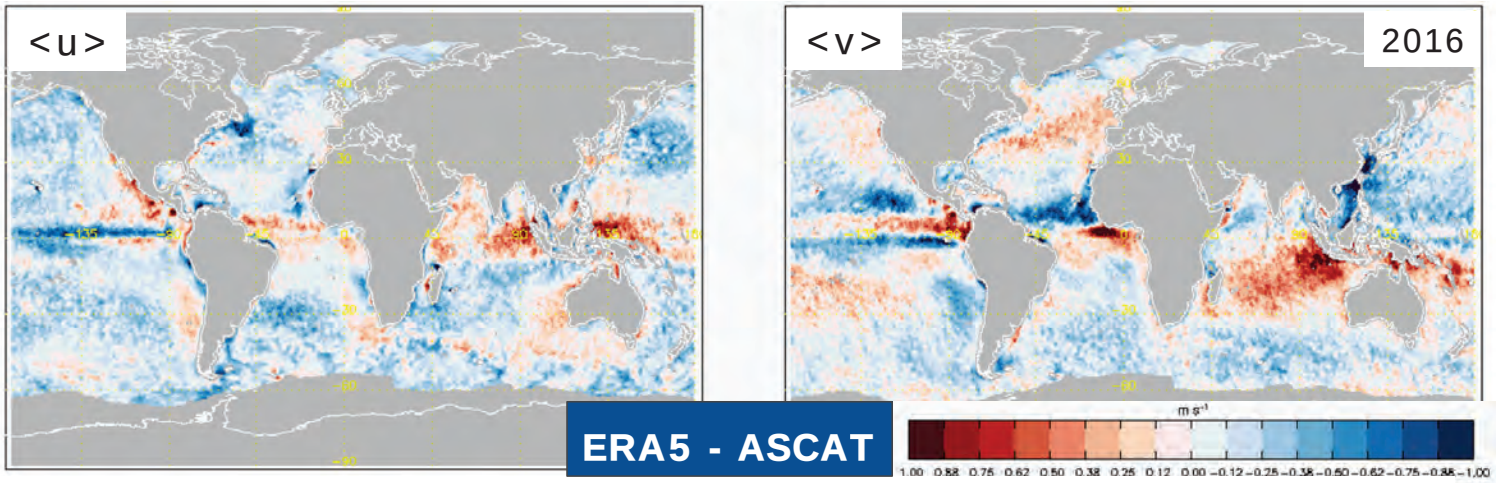
First peak flood underestimated by 20 cm, 12 Nov. 2019



Zonal, Meridional Errors

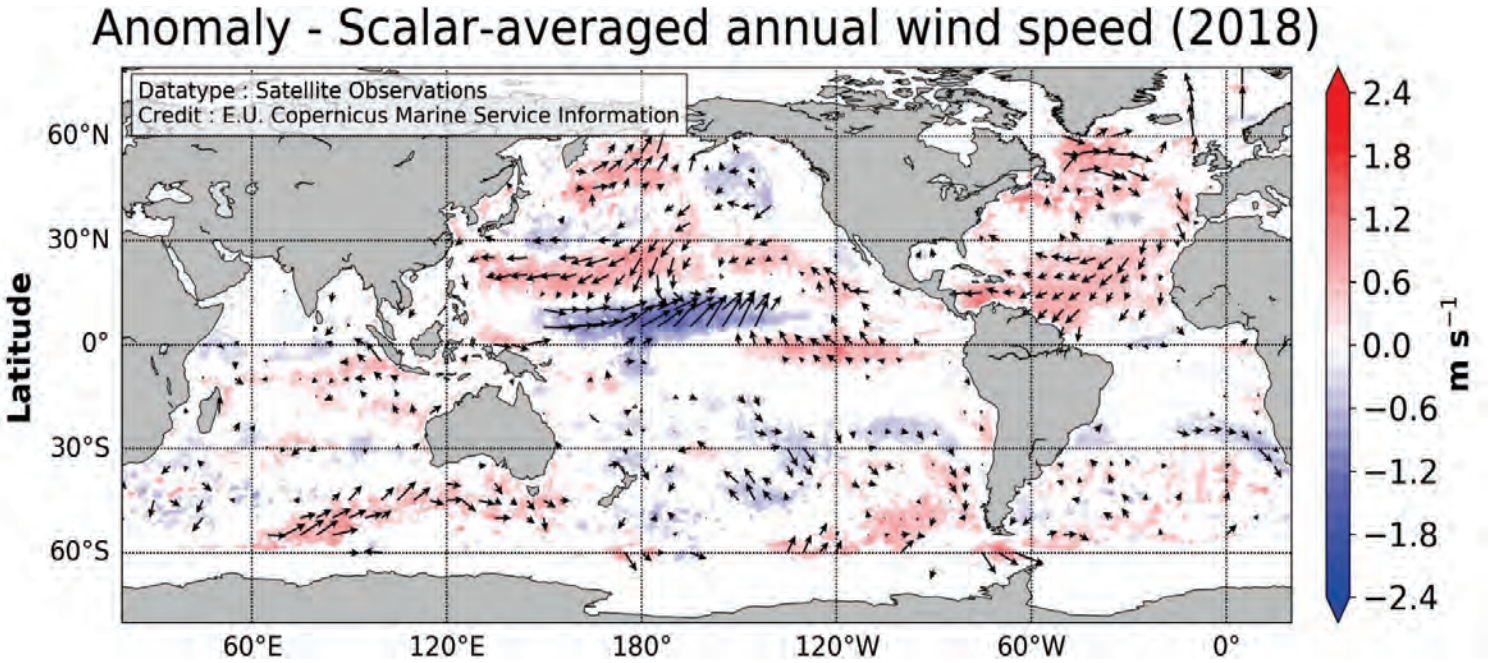
Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu

- ERA5 has substantial spatial bias patterns on large scales and small scales
- After GlobCurrent correction



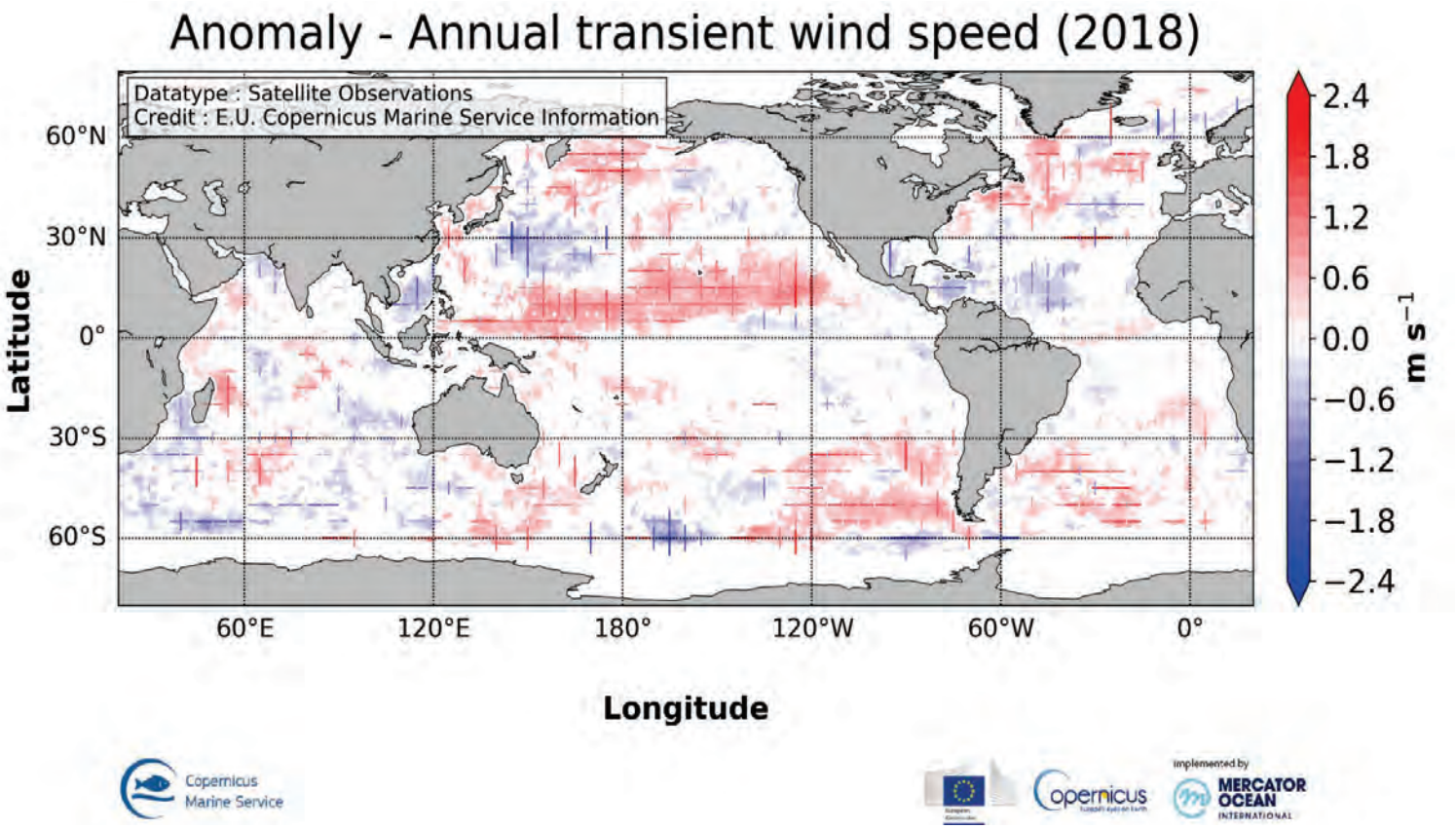
→ Noise is related to ocean eddy variability over a year, coastal effects
→ Meridional errors in areas with moist convection, parameterization error

Belmonte & Stoffelen, 2019



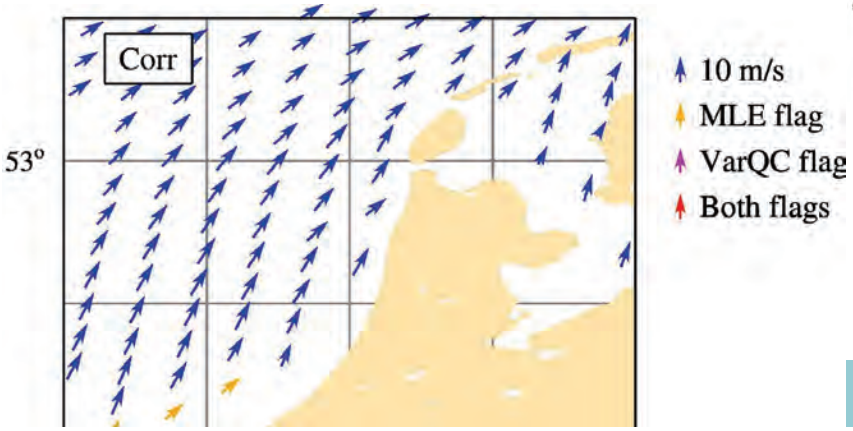
Copernicus Marine Service

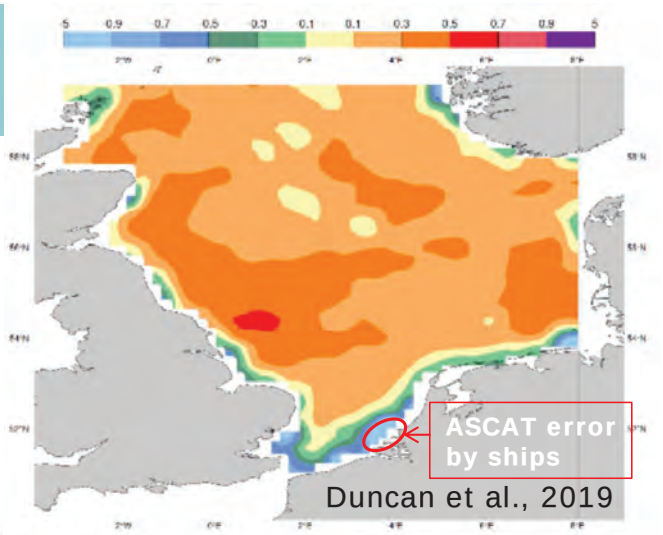
- Air-sea interaction
- Ocean forcing, mixing
- SST
- Primary production



More coastal winds

- New ASCAT land contribution flag to get 50% closer to the coast (~10 km)
- Also available for QuikScat
- Use SAR for variability studies, e.g., S-1
  Portabella, Johannessen, Stoffelen, 2002





Downscaled NWP model winds minus ASCAT winds show systematically deficient NWP model winds near coast

EUMETSAT OSI SAF

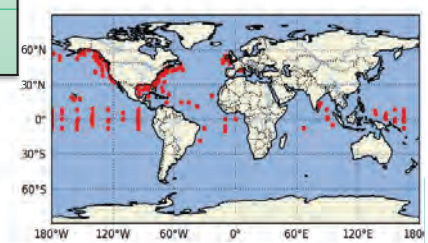
Further references

- www.copernicus.eu/about-copernicus/infrastructure/discover-our-satellites
- EUMETSAT, www.osi-saf.org , www.eumetsat.int/altimetry-services
- Copernicus Marine Environment Monitoring Service marine.copernicus.eu/
- https://climate.copernicus.eu/
- https://atmosphere.copernicus.eu/
- http://www.eumetrain.org/

Triple collocation

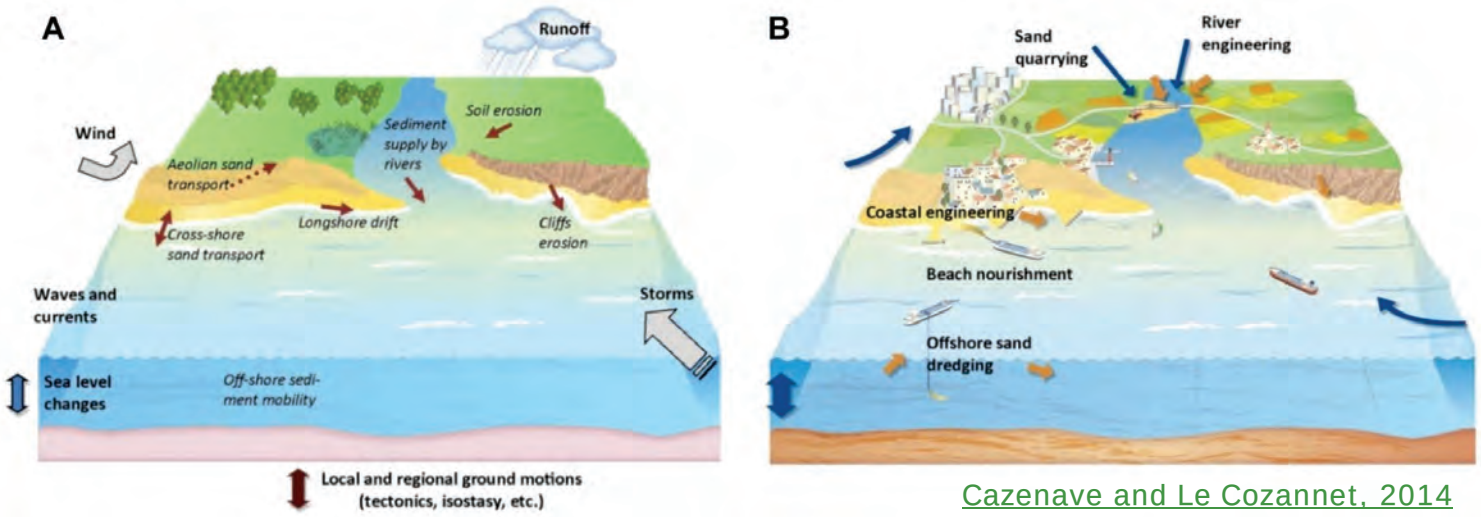
- Triple collocation of buoy, ASCAT and ECMWF wind data on 12.5 km grid
- Gives estimates of the error in (u, v) wind components
- ASCAT well within requirements (1.4 m/s)

Feb-April 2019	Buoy		Scatterometer		NWP	
	σ_u	σ_v	σ_u	σ_v	σ_u	σ_v
ASCAT-A	1.17	1.35	0.68	0.81	1.37	1.41
ASCAT-B	1.18	1.31	0.62	0.78	1.36	1.46
ASCAT-C	1.18	1.34	**0.67**	**0.78**	1.40	1.39



Coastal dynamics

- Dynamical coastal processes are poorly observed, but determine safety, off-shore economic activities, water quality, productivity, . . .



Cazenave and Le Cozannet, 2014

www.osi-saf.org

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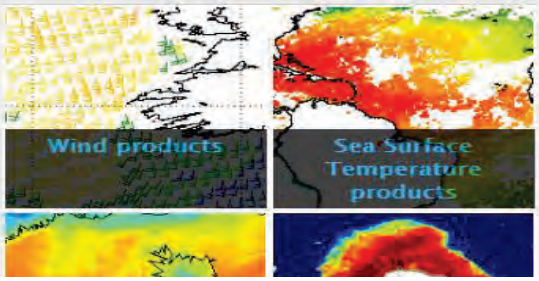
EUMETSAT OSI SAF OCEAN AND SEA ICE

Observing oceans from space

The OSI SAF develops, processes and distributes, in near real-time, products related to key parameters of the ocean-atmosphere interface. Products are accessible on local FTP servers with flexible extraction interface, EUMETCast, and EUMETSAT Data Center (EDC). The OSI SAF also offers climatological data records. The OSI SAF team focuses on scatterometer winds (and soon microwave winds), Sea Surface Temperature (SST) and sea Ice Surface Temperature (IST), radiative fluxes : Downward Longwave Irradiance (DLI) and Surface Solar Irradiance (SSI), sea ice concentration, edge, type, emissivity, drift.
The OSI SAF currently use data from meteorological satellites both in geostationary and polar orbit.

4 domains of products



Top story

CFOSAT and WindRad Rotating Fan-beam SCATterometer Simulation and Wind Retrieval Performance Evaluation

Friday, 20 September, 2019 - 11:44

scatterometer team at KNMI assessed the performan of CFOSAT and WindRad Rotating Fan-beam Scatterometer Simulation and Wind Retrieval.

Here below, Zhen Li explains briefly what was done and what was found during this study.

What did we do?

- Built a simulation framework for all existing rotating-beam scatterometer types (rotating fan-beam and rotating pencil-beam).

Read more

5 last service messages