



**Jet Propulsion Laboratory**  
California Institute of Technology

# **Multi-sensor Worldwide Ocean Winds Version 0.2**

## **Product**

### **Sensor Performance Characterization**

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*with special thanks to*  
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*Koninklijk Nederlands Meteorologisch Instituut,*  
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*Indian Space Research Organization,*  
*for providing access to NRT ScatSAT-3 backscatter*

# MWOW Mission Overview

- Combines ocean surface wind retrievals from multiple satellite sensors onto a 1/8 and 1/64 degree global grids with 6-hourly temporal resolution.
- Preserve the contributions from each satellite/instrument (**no averaging or gap filling**)
- Provides analyzes-ready cross-calibrated wind estimates across platforms with:
  - characterized instrument-specific uncertainties and common quality control methodology
  - a unified, multi-sensor wind dataset in a common format and on a common grid
- Version 0.2 is a preliminary product including 7 sensors that is provided to get feedback from US Federal Agency stakeholders in order to support co-design of official products.

# MWOW Versions

## Version 0.2 (now)

- Duration: July 2025-present
- Sensors: ASCAT-B/C, HY-2B/C, SWOT, SMAP, ScatSAT-3 on EOS-6
- Cross-calibration not yet performed
- 4 day latency complete product

## Version 1: (Sept. 2027)

- Duration July 1999-present
- Existing Sensors: ASCAT-B, ASCAT-C, EOS-6, SMAP, SWOT, HY-2B, HY-2C, Sentinel-1, NISAR, GMI, AMSR2, SSMI-F16, SSMI-F17, SSMI-F18.
- Historical Sensors: ASCAT-A, ScatSat-1, QuikSCAT, TMI, earlier SSMI sensors, and possibly COWVR and CYGNSS.
- Initial cross calibration performed
- TBD hour low latency product
- 4 day latency complete product

# MWOW v0.2 Data Access

## Data Products (PO.DAAC)

**Low-Res EPI (0.125°, all sensors)**

[doi.org/10.5067/MWOW-6H-V02E](https://doi.org/10.5067/MWOW-6H-V02E)

**Low-Res Standard (0.125°)**

[doi.org/10.5067/MWOW-6H-V02](https://doi.org/10.5067/MWOW-6H-V02)

**High-Res EPI (1/64°, all sensors)**

[doi.org/10.5067/MWOW-6HHR-V02E](https://doi.org/10.5067/MWOW-6HHR-V02E)

**High-Res Standard (1/64°)**

[doi.org/10.5067/MWOW-6HHR-V02](https://doi.org/10.5067/MWOW-6HHR-V02)

*Low-Res: ~14 km global grid*

*High-Res: ~1.7 km (SAR-resolution)*

*EPI: includes HY-2B/C*

*Standard: excludes HY-2B/C*

## User Tools (Open Source)

[github.com/nasa-jpl/MWOW-user-tools](https://github.com/nasa-jpl/MWOW-user-tools)

**Available in:**

Python, MATLAB, IDL, Ferret/pyFerret

**Capabilities:**

- Open/combine multi-file datasets
- Point time series extraction
- Ship/platform track matching
- Regional subsetting
- Inter-sensor collocation & stats
- Wind field video generation
- Command-line interface
- Jupyter notebook examples

# Quality Control in MWOW v0.2

- Quality Indicator (QI) per grid cell:
  - QI = 0: Good — highest confidence retrieval
  - QI = 1: Slightly impacted (e.g., light rain, sub-optimal geometry)
  - QI = 2: Significantly impacted (e.g. moderate rain with correction, near coastal data with land contamination correction, etc)
  - QI = 3: Invalid — omitted or missing data, only fill values reported in product

**Wind Speed Statistics vs Reference (m/s)  
QI=0 (best quality) and All Valid Data (QI≤2)**

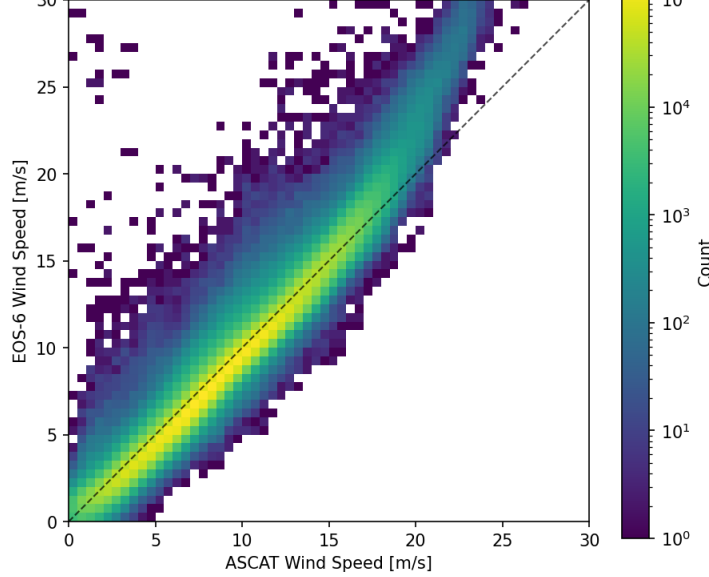
	<b>EOS-6 vs ASCAT</b>	<b>HY-2B vs ASCAT</b>	<b>HY-2C vs ASCAT</b>	<b>SMAP vs HY-2B  lat &lt;50</b>	<b>SWOT vs ASCAT</b>
<b>Bias (m/s) QI=0</b>	-0.35	0.02	0.01	0.18	0.08
<b>Std (m/s) QI=0</b>	0.74	0.60	0.57	2.09	1.03
<b>N (millions) QI=0</b>	7.4M	16.8M	14.6M	41.8M	3.1M
<b>Bias (m/s) All Valid</b>	-0.22	0.02	0.04	0.27	0.07
<b>Std (m/s) All Valid</b>	1.32	0.68	0.70	2.52	1.16
<b>N (millions) All Valid</b>	13.9M	27.8M	19.2M	45.5M	3.7M

**Wind Direction Statistics vs Reference (degrees)  
QI=0 and All Valid (QI≤2) — excluding speeds < 3 m/s**

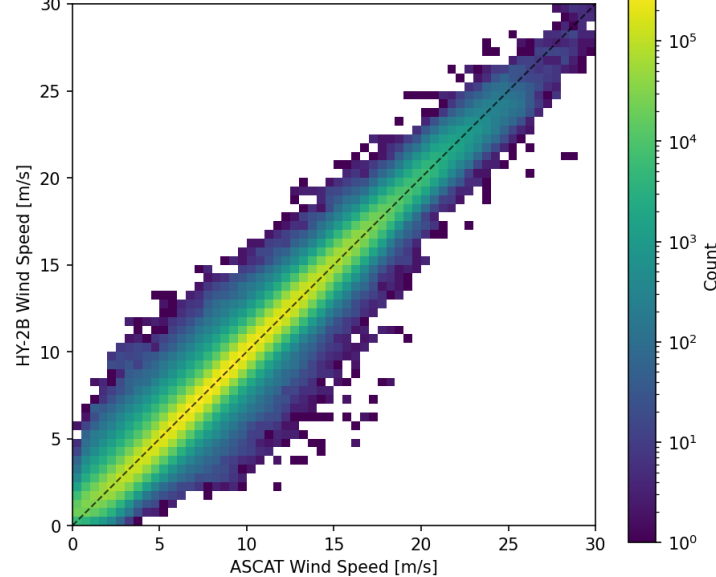
	<b>EOS-6 vs ASCAT</b>	<b>HY-2B vs ASCAT</b>	<b>HY-2C vs ASCAT</b>	<b>SMAP vs HY-2B  lat &lt;50</b>
<b>MAD (deg) QI=0</b>	5.2	5.0	5.1	6.4
<b>RMS (deg) QI=0</b>	21.1	14.4	13.9	16.2
<b>N (millions) QI=0</b>	10.3M	8.2M	32.2M	55.6M
<b>MAD (deg) All Valid</b>	5.7	5.3	5.1	6.5
<b>RMS (deg) All Valid</b>	25.0	17.6	15.6	17.0
<b>N (millions) All Valid</b>	20.0M	16.5M	52.7M	62.7M

# Comparing 4 Sensors to ASCAT

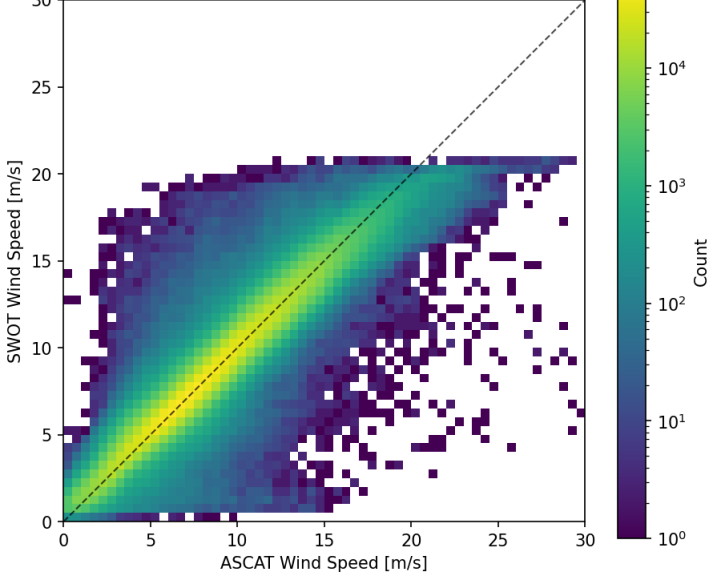
EOS-6 vs ASCAT | Bias: -0.35 m/s Std: 0.74 m/s N=7,411,585



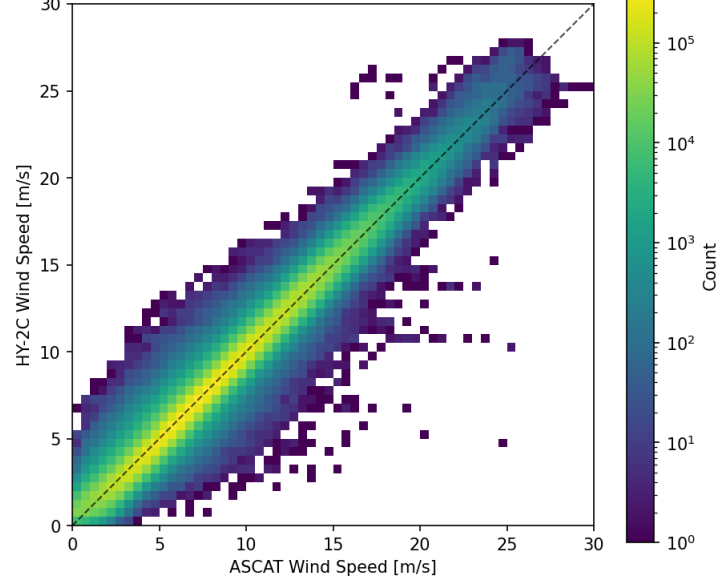
HY-2B vs ASCAT | Bias: 0.02 m/s Std: 0.60 m/s N=16,819,670



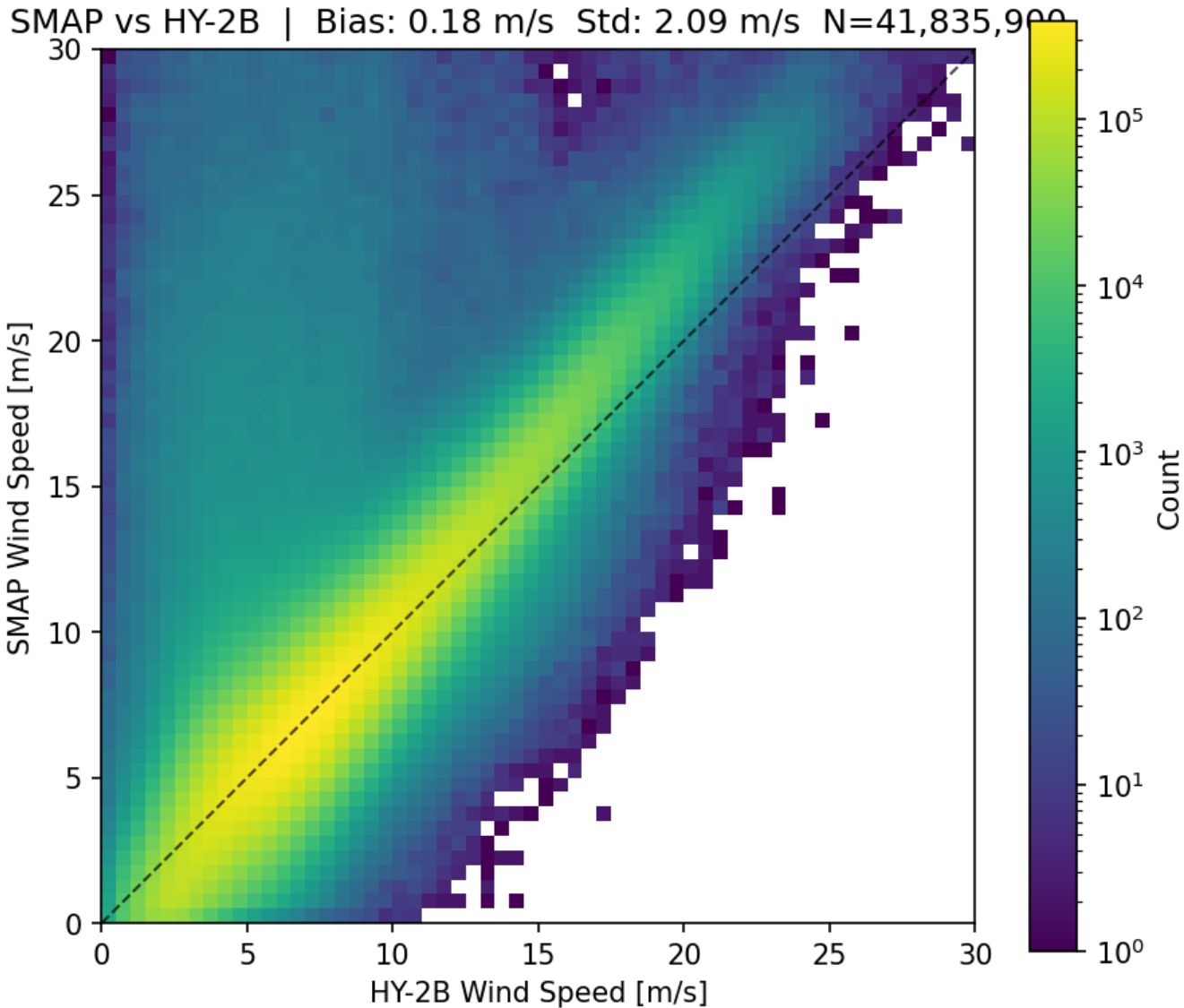
SWOT vs ASCAT | Bias: 0.08 m/s Std: 1.03 m/s N=3,141,224



HY-2C vs ASCAT | Bias: 0.01 m/s Std: 0.57 m/s N=14,603,519

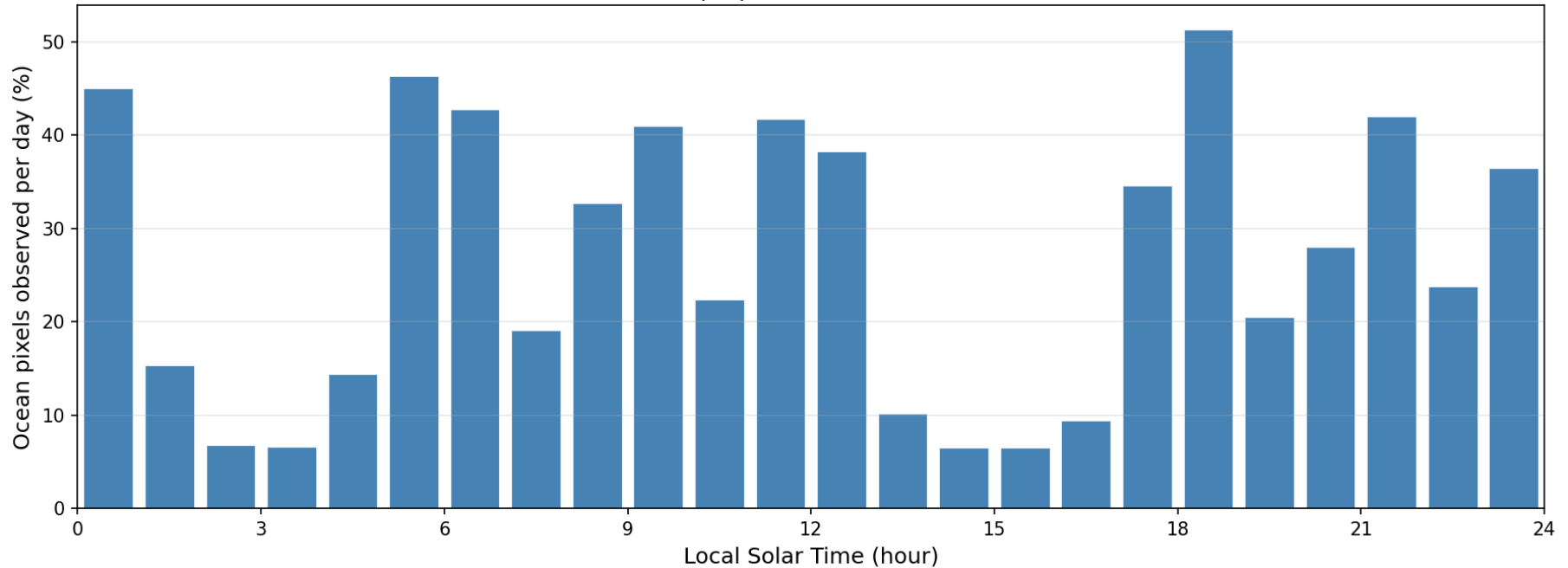


# Comparing SMAP to HY-2B



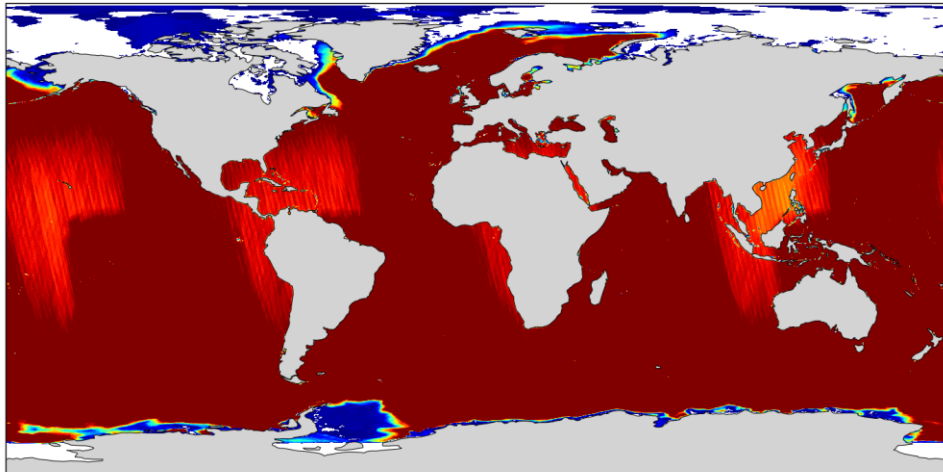
# Hourly Coverage version 0.2

Combined Multi-Sensor Daily Ocean Coverage by Local Time  
(all sensors,  $QI \leq 2$ ,  $|\text{lat}| \leq 60^\circ$ , 2026-01-01 to 2026-05-03)

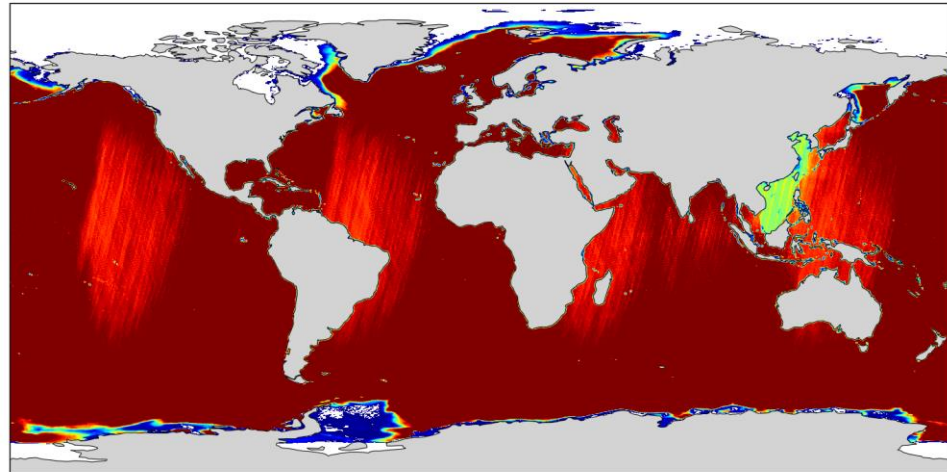


# Coverage every Six Hours

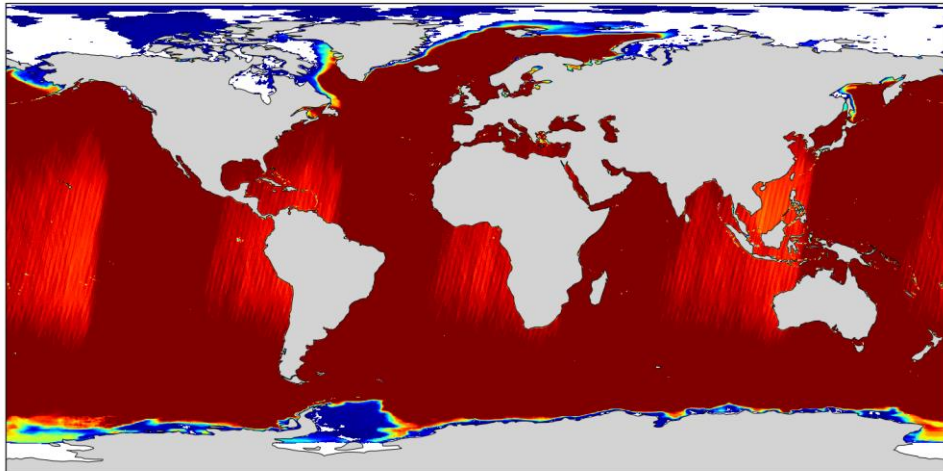
Multi-Sensor Daily Coverage: LST 21:00-03:00  
(all sensors combined,  $QI \leq 2$ , 2026-01-01 to 2026-05-03)



Multi-Sensor Daily Coverage: LST 03:00-09:00  
(all sensors combined,  $QI \leq 2$ , 2026-01-01 to 2026-05-03)

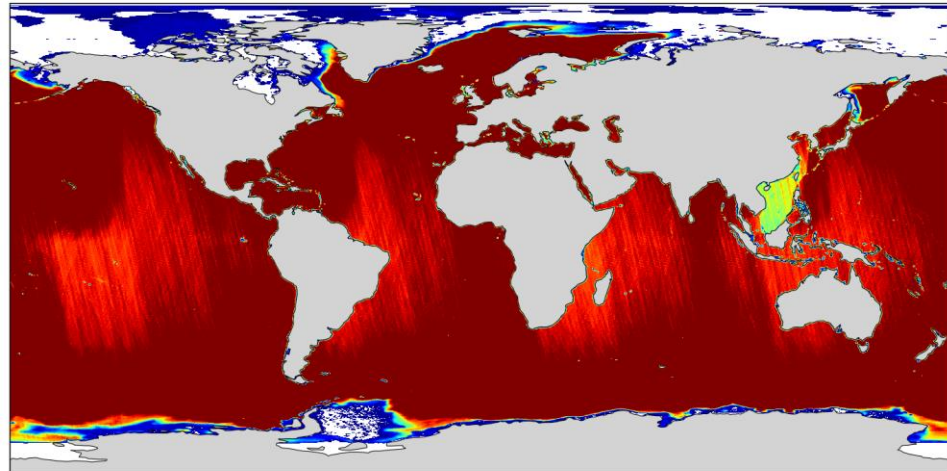


Multi-Sensor Daily Coverage: LST 09:00-15:00  
(all sensors combined,  $QI \leq 2$ , 2026-01-01 to 2026-05-03)



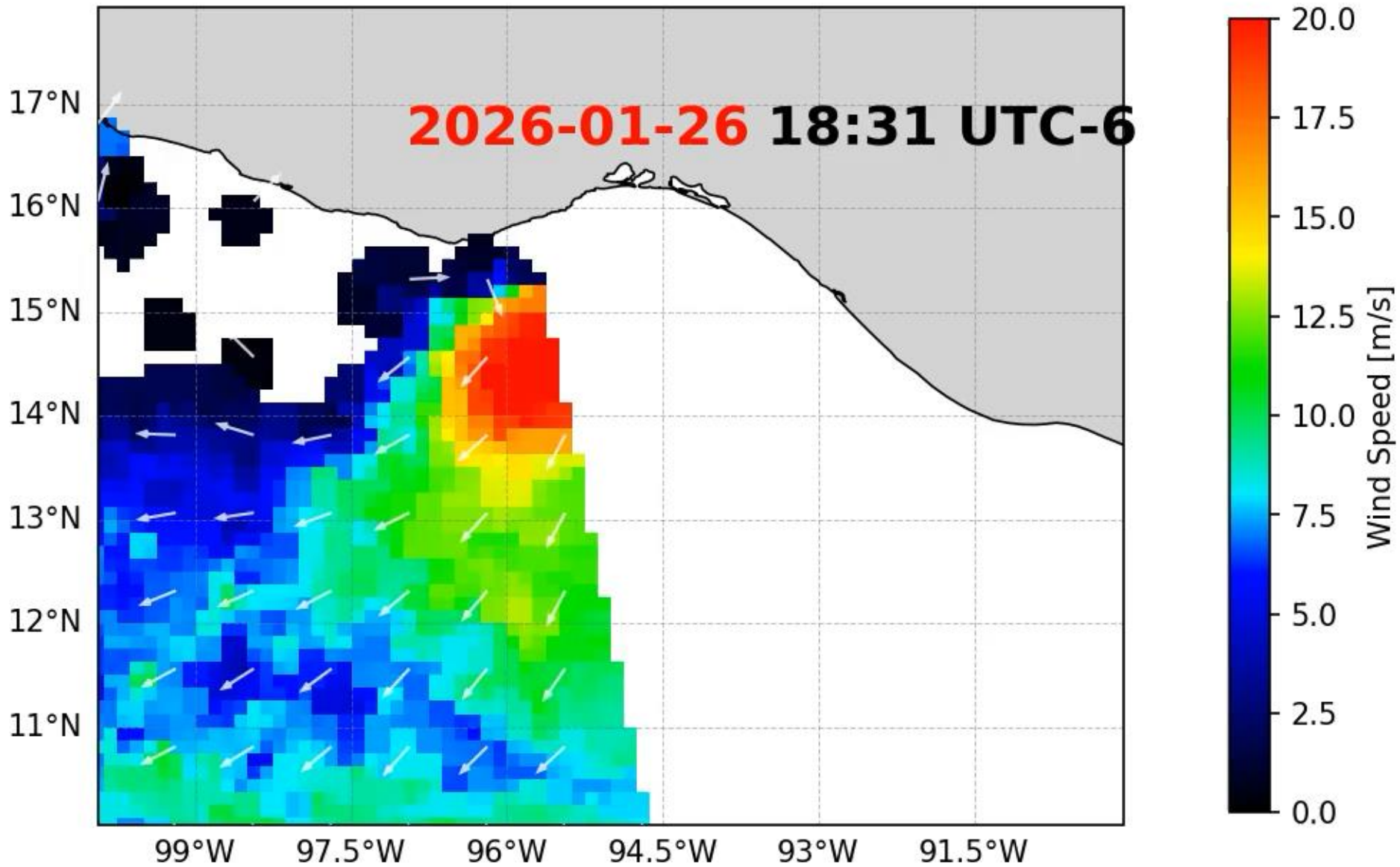
% of days observed

Multi-Sensor Daily Coverage: LST 15:00-21:00  
(all sensors combined,  $QI \leq 2$ , 2026-01-01 to 2026-05-03)



% of days observed

Wind Speed — 10N to 18N, 100W to 90W  
SMAP



# Summary

- HY-2C, HY-2B: Excellent agreement with ASCAT-B/C because all four sensors were cross-calibrated at KNMI.
- EOS-6: overall negative bias, positive speed bias for large wind speeds, good standard deviation (-0.42, std 0.66 m/s at QI=0), retrieved by JPL using GMFs developed for ScatSAT-1 and QuikSCAT which skew higher than KNMI winds above 20 m/s
- SWOT: good agreement with ASCAT (bias 0.08, std 1.07 m/s) but needs to be retuned to match correct scales (2-km SWOT speeds were tuned to match 20-km ASCAT )
- SMAP: Requires improved QC — to eliminate and/or correct sea-ice contaminated winds
- Future work:
  - Develop wind retrieval for NISAR
  - Cross calibrate all Version 1.0 sensors to ASCAT directly or indirectly (e.g. SMAP)
    - Two different ASCAT GMFs KNMI and NOAA will be used to calibrate against