



WindSat Polarimetric Microwave Radiometer: Advanced Sensor Products and Risk Reduction for NPOESS MIS

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WindSat Description

- WindSat has demonstrated ocean surface vector wind measurement capability with polarimetric microwave radiometry.
 - Algorithms continue to improve
- Jointly Sponsored by US Navy and the NPOESS Integrated Program Office
- Launched 2003-01-06 on STP's Coriolis satellite bus into sun-synchronous orbit
- More than 59 months of data collected
- Risk reduction for NPOESS Microwave Imager / Sounder (MIS)
- WindSat Special Issue, IEEE TGRS, March 2006.



Freq. (GHz)	Channels	BW (MHz)	EIA (deg)	IFOV (km)
6.8	v, h	125	54.0	39 x 71
10.7	v, h, +/- 45, lc, rc	300	50.3	25 x 38
18.7	v, h, +/- 45, lc, rc	750	55.9	16 x 27
23.8	v, h	500	53.5	20 x 30
37.0	v, h, +/- 45, lc, rc	2000	53.5	8 x 13

WindSat Data Utilization and Availability

Utilization

- Near real time processing of imagery and ocean EDRs at US Navy Fleet Numerical Meteorological and Oceanographic Center (FNMOC)
- Tropical cyclone monitoring and forecasting
 - NRL-Monterey, FNMOC, Joint Typhoon Warning Center and National Hurricane Center
- Data assimilation into numerical weather prediction models
 - tests show positive impact on forecasts
 - operational in Navy's NAVDAS/NOGAPS since Dec. 2006
 - planned operational use by U.K. Met Office
 - in testing for NCEP, ECMWF

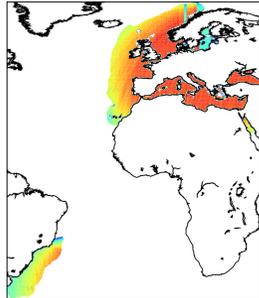
Data availability

- Near real time data on shared processing network (NESDIS, NAVO, NRL-Monterey, AFWA, CSU/CIRA)
- New archive data sets
 - ocean EDRs (v. 2.0) and brightness temperatures (SDRs) (v. 2.0): <http://www.cpi.com/datacenter>
 - soil moisture (v. 1): <http://laits.gmu.edu:8099/windsat/search.jsp>

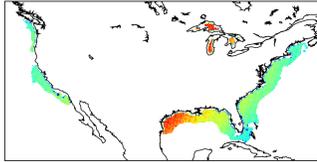
WindSat RFI over the Ocean

- 10.7 GHz from TV satellites
 - Europe, descending pass
 - South America, ascending pass
- Isolated 6.8 GHz
 - North Sea
 - Gulf of Mexico, just south of Louisiana
 - Indian Ocean
 - Maldives
 - off the coast of India near Mumbai
- 18.7 GHz from DirectTV
 - US coastlines, descending pass

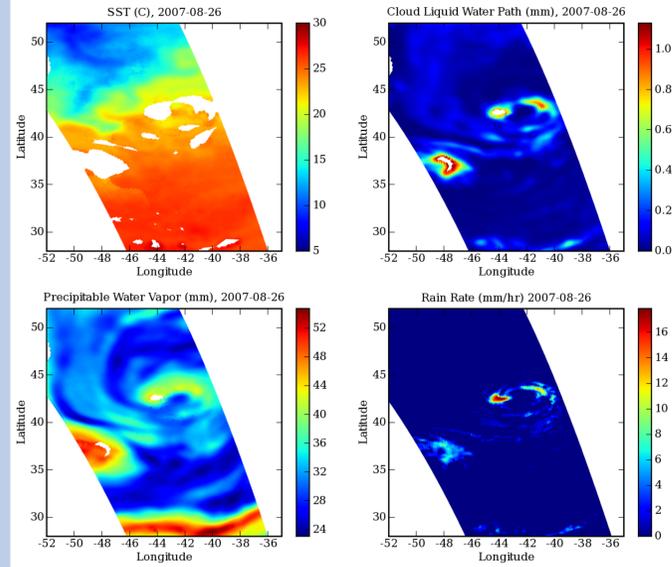
RFI over the Ocean, 10.7 GHz



RFI over the Ocean, 18.7 GHz



Ocean EDRs

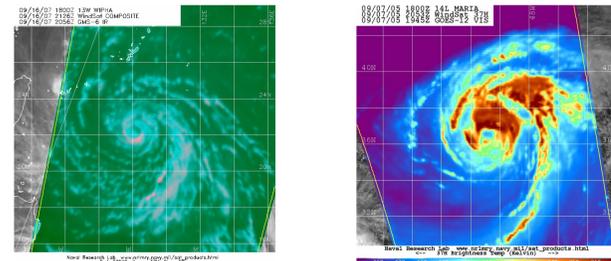


Recent Changes

- Improved modeling for high winds (> 20 m/s)
- Three resolutions:
 - Low: 50 km x 71 km (operational)
 - Medium: 35 km x 53 km (in testing)
 - High: 25 km x 35 km (in testing)
- All three resolution included in archive dataset
- Geophysical model improvements for vertical and horizontal channels
- Median filter algorithm modified to improve ambiguity selection and reduce the influence of NWP wind field used for initialization (nudging)
- Rain rate added (based on GPROF algorithm)

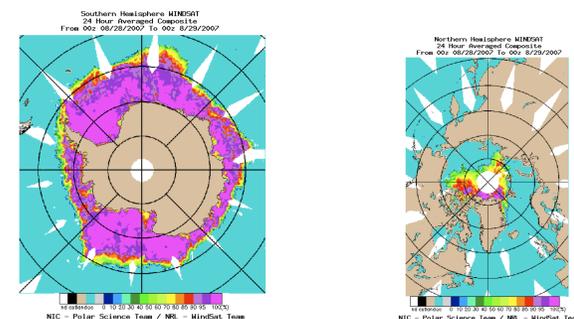
Imagery

- Native resolution and 12.5 km along track sampling
- along scan sampling distance varies from 3 km to 15 km
- NRL-Monterey Tropical Cyclone Page (www.nrl.navy.mil/tc pages)



Sea Ice

- Sea ice concentration based on SSM/I NASA Team algorithm
- daily level 3 product at <http://science.natice.noaa.gov/windsat.htm>

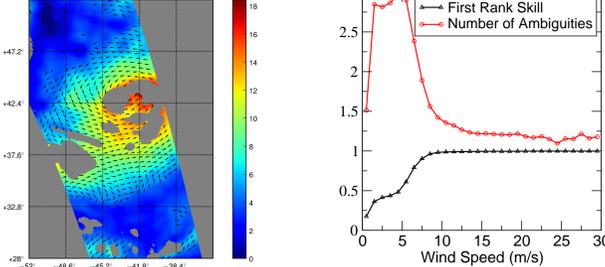


Ocean Winds - Version 2 Algorithm

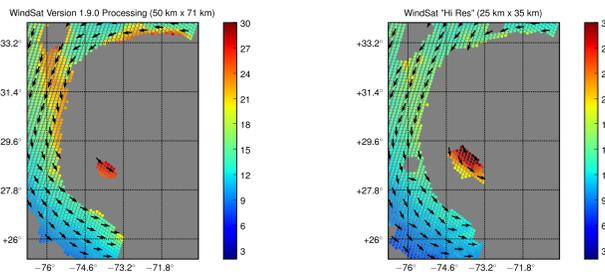
Improvements in this Version

- Improved performance for storms and high wind speeds
- Retrievals at multiple resolutions
- Higher ambiguity selection skill and fewer retrieved ambiguities
- Better flagging for rain and RFI
 - Retrievals with reduced channel set when RFI is present

Low Res. Winds (m/s), 2007-08-26

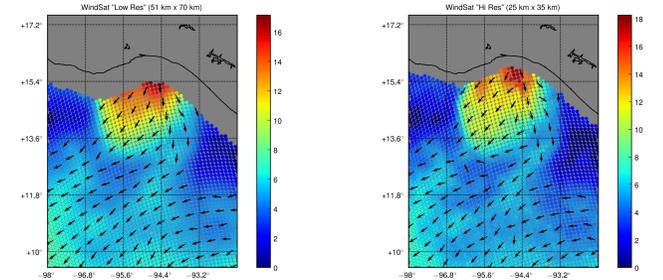


Hurricane Isabel, 2003-09-17 1129UTC

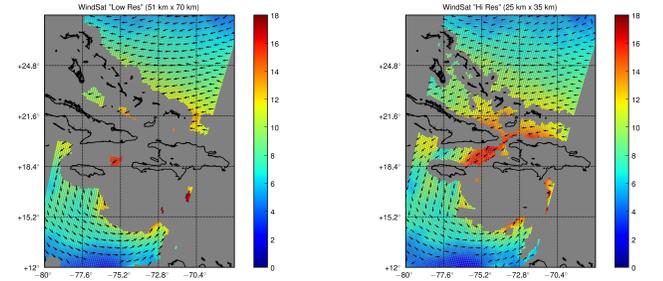


Gap Wind in the Gulf of Tehuantepec, 2004-01-06

- Low res. max wind speed: < 17 m/s
- High res. max wind speed: > 18 m/s
- High res. shows detail in wind speed variation

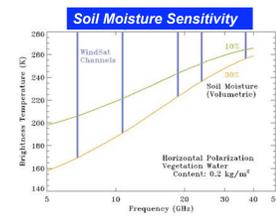


Hurricane Dean, 2007-08-19, Low Res / Hi Res



Soil Moisture

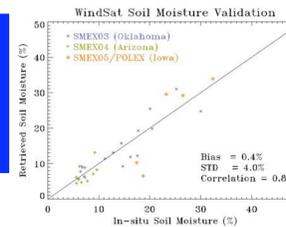
Retrievals



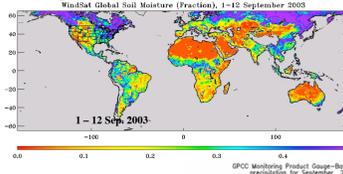
- Since 1978, most satellite soil moisture algorithms use 6 to 18 GHz frequencies.
 - Separation of vegetation, LST and soil moisture effects is critical.
 - C-band is lost to RFI for now
- Forward Model**
- Parameterized radiative transfer and surface roughness models
 - Static and dynamic ancillary data
- Retrieval Model**
- Simultaneous soil moisture and vegetation retrievals
 - Maximum Likelihood Estimation using dual-polarization at three frequencies (10, 18, and 37 GHz) simultaneously.

SMEX 2003-2005 Validation

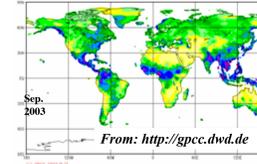
- Preliminary US Validation.**
- SMEX03: rangeland and winter wheat
 - SMEX04: sparse shrubland, mountains
 - SMEX05: agricultural - corn, soybean
- WindSat Retrieval Uncertainty:**
- 4% with 0.4% bias volumetric soil moisture at 50 km Horizontal Cell Size (HCS) for low to moderate vegetated land.



Soil Moisture and Precipitation

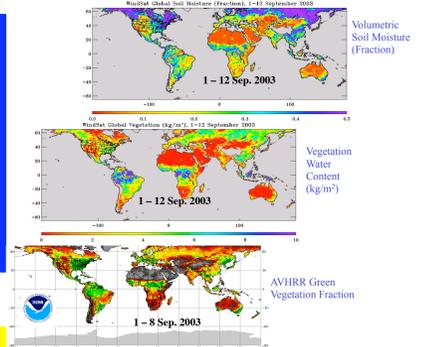


- Indirect comparisons
- Capture high moisture in the subarctic regions
 - Canada, Europe, Asia
- Show consistent features with Monsoon patterns.
 - Africa, India, China, North America



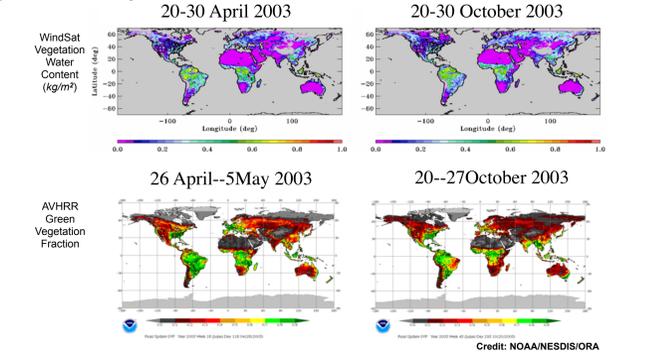
Soil Moisture and Vegetation

- Global soil moisture patterns are consistent with dry/wet patterns of climate regimes.
 - Sahara, Arabian, Gobi, Australia, South Africa, US, high lat. wet regions
- Soil moisture is roughly correlated with vegetation with some exceptions.
 - India, Canada
- Good agreement between WindSat retrieved Vegetation Water Content and AVHRR derived Green Vegetation Fraction



No vegetation validation

Vegetation Comparison



More at this Conference

- WindSat Land Surface Products as a Tool for the Analysis of 2003 European Heat Wave
 - Li Li and P. W. Gaiser, Naval Research Laboratory
 - Thursday, 15 January 2009, 11:00 AM-12:15 PM, Room 127C