NRL Tropical Cyclone Web Page Augmentations

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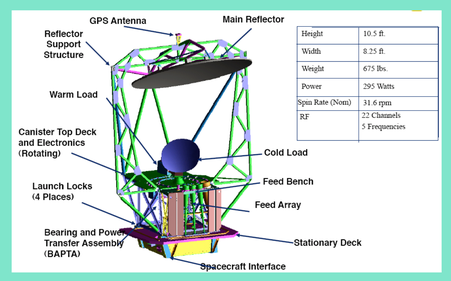
WindSat Polarimetric Radiometer:

Objective: Ocean surface wind vectors via polarimetric microwave radiometry

Purpose: Risk reduction for NPOESS CMIS sensors

Channels: 10.7, 18.7, 37.0 GHz Fully polarimetric
6.8, 23.8 GHz Dual polarimetric



Height	10.5 ft.
Width	8.25 ft.
Weight	675 lbs.
Power	295 Watts
Spin Rate (Nom)	31.6 rpm
RF	22 Channels 5 Frequencies

Launch: January 6, 2003

Altitude: 830-km

LTAN: 1759

Spacecraft: Coriolis

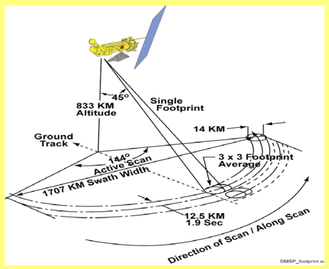
Freq, GHz	Channels	NEDT (1)	FOV, km
6.8	v, h	0.48	40x60
10.7	v, h, ±45, lc, rc	0.37	25x38
18.7	v, h, ±45, lc, rc	0.39	16x27
23.8	v, h	0.55	12x20
37.0	v, h, ±45, lc, rc	0.45	8x13

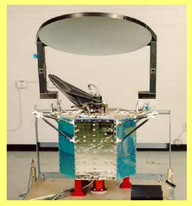
Special Sensor Microwave Imager Sounder (SSMIS):

Objective: Measure ocean surface wind speeds, rainrate, CLW, TPW, brightness temperature imagery (Tbs), and temperature-moisture soundings.

Purpose: SSM/I follow-on out till the NPOESS era.

Channels: 19.35, 37.0, 91.655 GHz Dual polarimetric (V & H pol)
22.235 GHz Single polarimetric (V-pol)





Launch: October 18, 2003

Altitude: 850-km

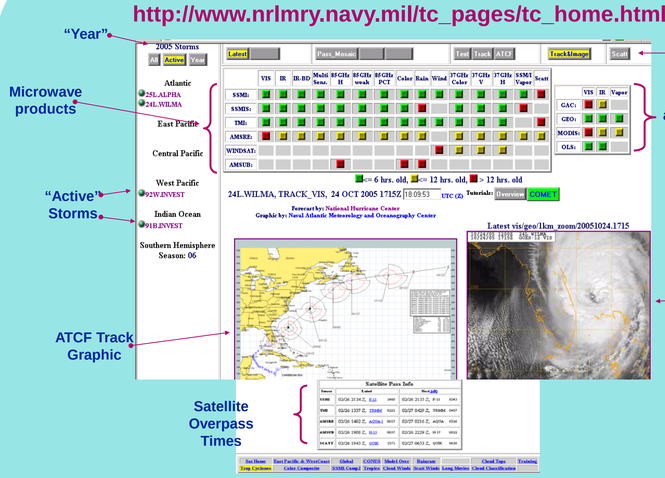
LTAN: 2044

Spacecraft: DMSP F-16

Freq, GHz	Channels	NEDT	IFOV- km
19.35	v, h	0.70	73x47
22.235	v	0.70	73x47
37.00	v, h	0.50	41x31
91.655	v, h	0.90	14x13

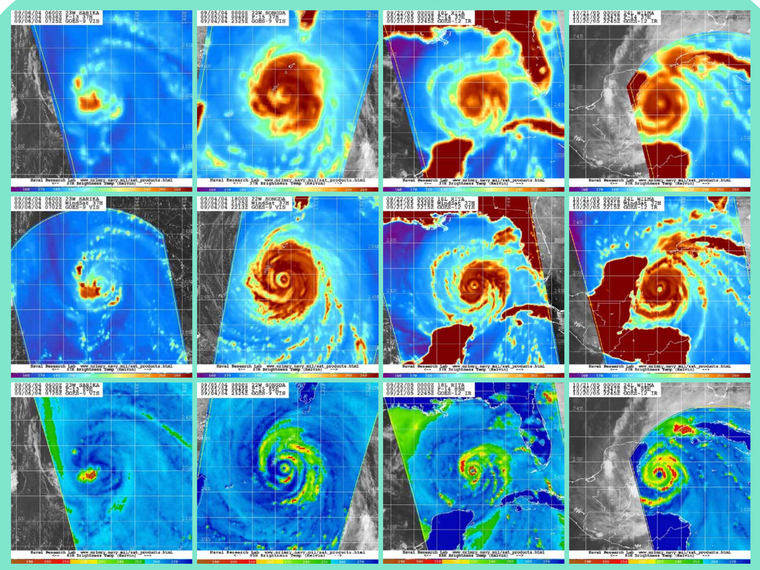
NRL TC Web Page

http://www.nrlmry.navy.mil/tc_pages/tc_home.html



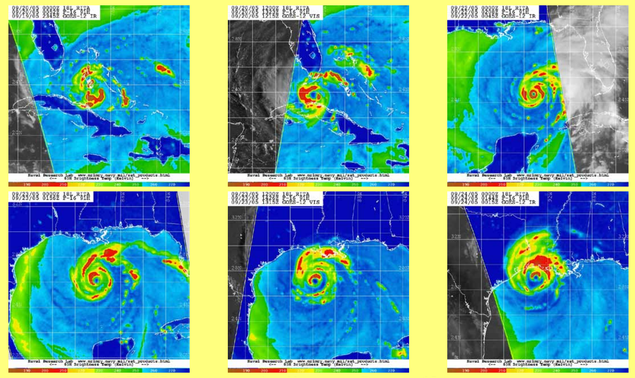
Sample TC page view with Hurricane Wilma display on 24 October, 2005. ATCF track graphic, GOES-EAST visible image and multi-colored passive microwave product buttons indicating data timeliness [<6 hours old (green), 6-12 hours (yellow),> 12 hours (red). Active storms (91B, 92W, and 25L Alpha currently cover three basins. All products updated automatically upon receipt of new digital data sets.

SSM/I & WindSat 37 GHz TC Views

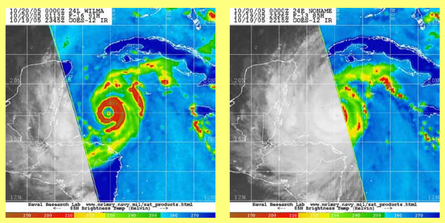


WindSat's superb 37 GHz H pol Tb resolution is highlighted via near coincident comparisons with poorer resolution SSM/I 37 GHz H and similar resolution SSM/I 85 GHz products for four TCs. Top row (SSM/I 37 GHz H), middle row (WindSat 37 GHz H), bottom row (SSM/I 85 GHz H). WindSat identifies Sarika's (column 1) circulation center better than SSM/I products, captures the double eyewall configurations in Songda (column 2), Rita (column 3) & Wilma (column 4) that are not evident in SSM/I 37 GHz data, but are viewed in 85 GHz. WindSat's lack of 85 GHz data is partially mitigated by high resolution 37 GHz Tbs that enhance the mapping of TC structural characteristics which help infer intensity changes.

SSMIS 85 GHz H-pol Views of Hurricane Rita



Montage shows six (6) SSMIS overpasses for Hurricane Rita at ~12-hourly intervals while the storm gains strength in the Bahamas, transits through the Florida Straits, attains Cat 5 status in the central Gulf of Mexico and takes on a double eyewall configuration until TX/LA landfall. SSMIS thus greatly aided passive microwave temporal sampling in concert with SSM/I, TMI, AMSR-E, WindSat and AMSU-B data sets available on the NRL Tropical Cyclone web page.



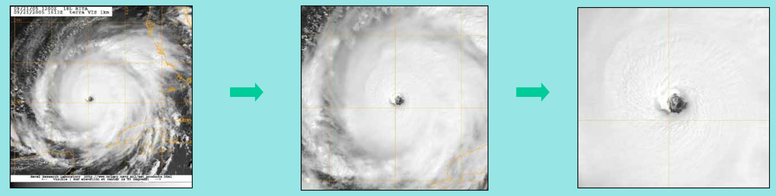
SSMIS swath is 300-km wider than SSM/I, thus mitigating some of the previous frustrations.

New and Future TC-Web Products

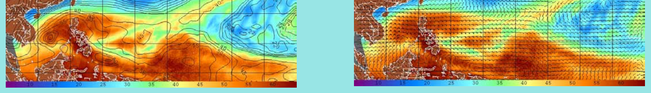
Aqua Overpass of Hurricane Rita on 21 Sep 2005 1-km Ch2 (0.85 um)

Aqua Overpass of Hurricane Rita on 21 Sep 2005 1/2-km Ch2 (0.85 um)

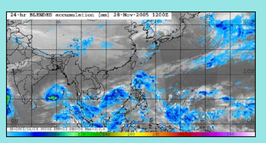
Aqua Overpass of Hurricane Rita on 21 Sep 2005 1/4-km Ch2 (0.85 um)



MODIS 3-scale (1, ½ and ¼-km) visible depictions of rainband structure, overshooting tops, and eyewall tilt and meso-vortices.

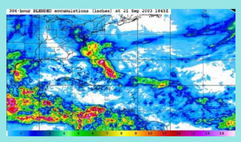


Microwave total precipitable water (TPW) composites from DMSP F-13/14/15 (SSMI) and F-16 (SSMIS) overpasses. Overlays are the associated TPW contours and 850 hPa wind vectors from the Navy's NOGAPS global model.



24-hr rain totals for western Pacific.

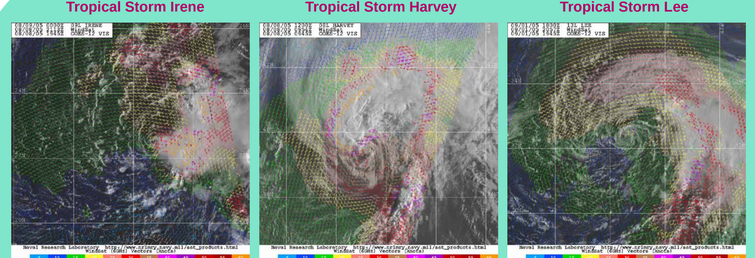
Storm totals for Hurricane Isabel.



Accumulated precipitation from the NRL Blended-Satellite technique (Turk and Miller, 2005). The accumulations are updated every 3 hours globally by time-integrating backwards to output accumulations at 3, 6, 12 and 24 hours, as well as 2-7 day totals at 00 UTC each day. Capability to move around the globe and extract values as the need arises.

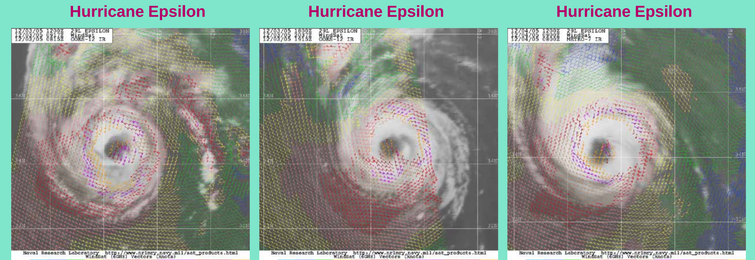
WindSat Wind Vectors

Tropical Storm Irene | Tropical Storm Harvey | Tropical Storm Lee



WindSat wind vectors overlain on coincident GOES-12 visible imagery for three Atlantic tropical storms. Examples readily depict WindSat's ability to monitor surface wind fields for heavily sheared systems. Exposed low-level circulations and their highly asymmetric wind fields can be mapped in non-rain areas. Note dramatic discontinuities in wind speed with Irene and Lee both exhibiting winds < 10 kt in the SW quadrant and gale force winds in the NE. All winds are from the operational WindSat algorithm at FNMOC (Bettenhausen, et al., 2005) and no attempt has been made to refine the rain flag algorithm or modify values if they are rain contaminated (small circle at base of wind barb tail). Rain flagged data should be used with caution.

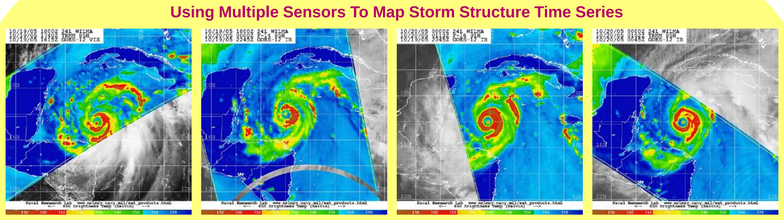
Hurricane Epsilon | Hurricane Epsilon | Hurricane Epsilon



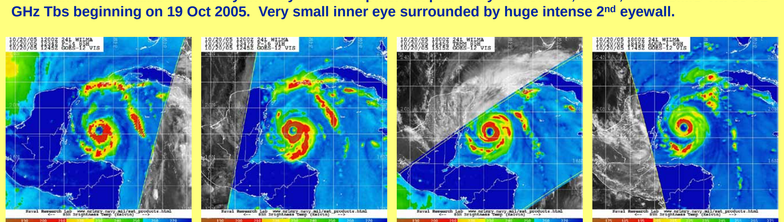
WindSat wind vectors overlain on GOES-12 and Meteosat-7 IR for three overpasses of Hurricane Epsilon (Atlantic basin), each twelve (12) hours apart. Note: 1) large rain-free eye permits retrieval attempts in huge eye, 2) consistent high wind speed asymmetry in SW quadrant, 3) 1025-km swath can infrequently provide multiple views/day and supplement QuikSCAT and ERS-2 data in Atlantic basin. Typical temporal coverage is less optimal.

TC Passive Microwave Constellation Monitoring:

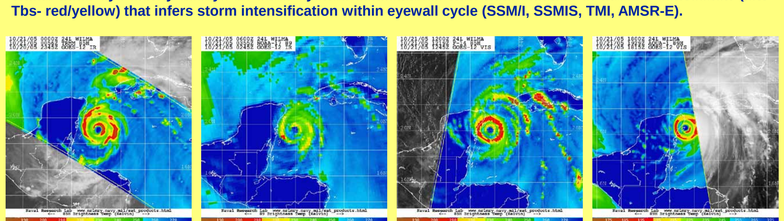
Using Multiple Sensors To Map Storm Structure Time Series



Hurricane Wilma rainband and eyewall cycle development captured by use of TMI, SSM/I, and SSMIS via 85-91 GHz Tbs beginning on 19 Oct 2005. Very small inner eye surrounded by huge intense 2nd eyewall.



Wilma inner eye slowly decays as outer eyewall consolidates with wide annulus of intense convection (low Tbs- red/yellow) that infers storm intensification within eyewall cycle (SSM/I, SSMIS, TMI, AMSR-E).



Hurricane Wilma exhibits rapid structural change to two eyewall system in < 10 hours and then slowly tightens up over the next 18 hours prior to Mexico landfall. Prolonged, strong two eyewall configuration extends heavily damaging winds further along coastline than in most single eyewall scenarios.

Recent New Satellite Datasets and Efforts:

TRMM TMI/PR: Added combined TRMM TMI/PR precipitation data to TC web page.

Coriolis-WindSat: Surface wind vectors added. Other Environmental Data Records (SST, rainrate, cloud liquid water and total columnar water) will be available with next update of the EDRs this Spring.

SSMIS: Added similar products to SSMI. Examining capabilities for expanded 50-56, 150, 183 GHz such as warm core structure, and intra-pass morphing (MIMIC at UW-CIMSS)

MODIS: Via collaborative effort with the NASA/NOAA Near Real Time Processing Effort (NRTPE), 1-km resolution MODIS imagery available as well as ½ and ¼-km during daytime overpasses of Terra and Aqua.

NOAA-18: With the addition of NOAA-18 into the primary afternoon orbit position, there are four functional AMSU-B (MHS on NOAA-18) instruments.

References:

Bettenhausen, M. H., C. K. Smith, R. M. Bevilacqua, N. Wang, P. W. Gaiser, and S. Cox, 2006, A nonlinear optimization algorithm for WindSat wind vector retrievals, In review, IEEE Trans. Of Geosci. Rem. Sensing, (WindSat special Issue).

Lee, T. F., F. J. Turk, J. D. Hawkins, and K. A. Richardson, 2002: Interpretation of TRMM TMI images of tropical cyclones, Earth Interactions E-Journal, 6, 3.

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Acknowledgments:

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