

Jeff Hawkins¹, Joe Turk¹, Kim Richardson¹, Thomas F. Lee¹, Cristian Mitrescu¹, Charles Sampson¹, and John Kent³
 Chris Velden², Derrick Herndon², Dave Stettner², Howard Berger², Tony Wimmers², Tim Olander²

¹Naval Research Laboratory, Marine Meteorology Division, Monterey, CA 93943

²Cooperative Institute for Meteorological Satellite Studies, U. of Wisconsin, Madison, WI and ³Science Applications International Corporation, Monterey, CA 93940



NRL TCS-08 Web Page:

<http://www.nrlmry.navy.mil/TCS.html>

Scatterometer & CloudSat Environmental products
 Vis/IR Imagery suite
 Storm Basins & Names
 Microwaver/lander product suite
 Latest 1-km Visible/IR imagery (GEO/LEO)
 30 minute MTSAT refresh with AVHRR/OLS as available
 Automated Tropical Cyclone Forecasting (ATCF) System warning graphic

TCS Web Procedures:

1. Receive TCS invest/gensis start and updates via NPS and Guam operations center emails,
2. Receive JTWC invest and numbered storm updates every 6 hours via JTWC,
3. Update all satellite products upon receipt of digital data,
4. All products available via on-line archive (disk space)

Tropical Cyclone Structure-2008/ THORPEX-Pacific Asian Regional Campaign: Experiments and Collaborative Efforts

TCS-08 was part of a much larger international consortium of field programs throughout southwest and southeast Asia geared to gathering measurements aimed at studies encompassing a wide variety of scientific endeavors as noted on this regional graphic (Courtesy: Parsons/Har).

TCS-08 Goals:

- 1) Tropical cyclone genesis,
- 2) Tropical cyclone structure and structure change,
- 3) Extratropical transition (tropical to extra-tropical structure)

CIMSS TCS-08 Field Program Support Web Page

<http://cimss.ssec.wisc.edu/tropic2/parc>

Real-Time Products with Storm Coverage
 Invest Products

Summary: CIMSS TC web page includes near real-time satellite intensity estimates, visible/IR and water vapor imagery, satellite, scatterometer, buoy and ship winds, convergence & divergence (850 mb), vorticity, deep-layer mean, TPW, morphed microwave imagery (MMIC), SST & CHC products.

NRL Microwave Product Suite: TCS-08 Sample

QuikSCAT and WindSat ocean surface wind vectors monitor Nuri's developing surface wind circulation while negatively being impacted by intense precipitation (see WindSat retrieval techniques and QuikSCAT cross swath directions).

CloudSat's 94 GHz radar overpasses Nuri on Aug 16-20, 2008 highlighting: a) sparse convective towers that significantly increase in number, b) formation of central dense overcast (CDO) as manifested by cirrus outflow that grows in area and width with time and development of anvil/eye aloft, and c) value of coincident microwave imagery that assists in mapping the spatial extent of near-only CloudSat data.

Summary: Data fusion via vis/IR and active/passive microwave provides powerful knowledge multiplier.

Tropical Cyclone Structure (TCS-08) Field Program:

Satellite Data Utilization and Scientific Studies

- 1) TCS-08 mission planning and real-time aircraft and sensor deployment guidance
- 2) Targeted observations (i.e. focused rapid-scan-produced winds)
- 3) Enhanced sat data assimilation studies for TC forecast improvement
- 4) Validation of experimental sat-based TC intensity estimation algorithms
- 5) Enhanced satellite data set for TCS-08 process and case studies

TCS-08 Resources:

Aircraft & Sensors	WC-130J USA	NRL P-3 USA	DOTSTAR Taiwan	DLR Falcon Germany
SFMR	☀			
Eldora Radar	☀	☀		
Lidar	☀	☀	☀	☀
Dropsondes	☀	☀	☀	☀
Flight Level Met Data	☀	☀	☀	☀
AXBTs	☀	☀	☀	☀
Drifting Buoys	☀	☀	☀	☀

WC-130J carried out high level (~27,000-30,000') patterns whenever feasible for weaker systems and thus complemented the lower-level (~8,000-12,000') NRL P-3 flights in terms of 3-dimensional atmospheric monitoring. SFMR = Stepped Frequency Microwave Radiometer, Eldora (3.4 GHz dual beam radar), AXBT (airborne expendable bathythermograph).

Satellite-Derived TC Invest Products

CIMSS AMSU-A Cross Sections:
 Product uses microwave sounders on polar-orbiting platforms. Warm core signature in the product can show intensification of system. Allows forecasters/analysts to view internal TC structure. Have added to JTWC experimental analysis dataset for operational support.

TCS-08 - Genesis of Typhoon Nuri:
 Favorable conditions Valid: 14 Aug, 2008 2313 UTC Valid: 15 Aug, 2008 1257 UTC

TCS-08 - Development of Warm Core in Typhoon Nuri from AMSU:
 Pattern of favorable upper-level divergence (solid contours) is revealed before and during Nuri's genesis (red 'X'). Analyses are produced from high-resolution wind fields derived from MTSAT during TCS-08.

Analysis of deep-layer-mean wind shear derived from high-density satellite winds are a critical diagnostic for TC intensity forecasts.

Google Earth (GE) Facilitates Real-time Data Fusion

TCS-08 flight tracks overlain on MTSAT image
 TCS-08 flight tracks overlain on 85 GHz image

Blue WC-130J flight track, yellow: NRL P-3 flight track, light green with light blue TC symbols: storm track

MTSAT visible imagery used in real-time was partially helpful in vectoring NRL P-3 into "open-water" sections of typhoon Jangmi's eye

F-16 SSM/I 91 GHz imagery more clearly outlines the "open-water" section of typhoon Jangmi's eye, greatly assisting P-3 flight operations

Drifting buoys overlain on TRMM & MTSAT visible imagery
 Buoy overlain on Typhoon Jelawat 91 GHz imagery

Summary: Enhanced visualization via incorporation of multiple real-time data sets enhanced drifting buoy deployment and ensured location will encompass the desired Cat-5 environmental forcing.

Satellite Product Data Catalog: NRL, CIMSS, EOL

NRL TC web page catalog: <http://www.nrlmry.navy.mil/TCS.html>

- Select storm or invest from left panel
- Select product button in the main display panel
- Click on "Previous" to list all products (sorted by date/time) and select product

CIMSS winds: <http://cimss.ssec.wisc.edu/tropic/parc/archive/mf1/winds.html>
 CIMSS derived products: <http://cimss.ssec.wisc.edu/tropic/parc/archive/mf1/derived.html>
 CIMSS movie loops: <http://cimss.ssec.wisc.edu/tropic/parc/archive/movie/tparc.mov>

NCAR/EOL web page catalog: http://catalog.ssi.ucar.edu/cgi-bin/vparc_2008/ops/index

- Select day and the satellite product from the product matrix

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Satellite-Derived TC Intensity Estimates: Typhoon Nuri

As part of TCS-08, newly developed objectively-based satellite TC intensity estimation algorithms are being compared to existing operational methods, such as the Dvorak (DVK) Technique. Estimates during Typhoon Nuri from the objective Advanced Dvorak Technique (ADT) and two AMSU-based methods are shown above. In addition, a weighted consensus approach, called SATCON, uses these three members to derive consensus estimates. Validation of these new approaches using the TCS-08 recon data is underway.