IMPACT AND APPLICATIONS
OF GCOM-W OCEAN
PRODUCTS AT NOAA

NOAA/NESDIS/STAR
Zorana.Jelenak@noaa.gov

Zorana Jelenak, Suleiman Alsweiss, Paul S Chang
Outline

• AMSR-2 Ocean Products Introduction
• AMSR-2 Utilization Examples:
  • Near-real time tropical cyclone forecasting: Tropical cyclone structure, location and intensity analysis
  • Near real time and research impact: SST measurements indicating the onset of rapid intensity decay in a tropical cyclone
  • Extratropical (ET) transition process and ET cyclone structure analysis
• Conclusions
Near Real-Time and Retrospective AMSR2 Product Portal

Ocean NRT Products
- MW brightness temperature
- Tropical Cyclone forecasting
- Data assimilation
- SST, Wind Speed, Cloud liquid water, Water Vapor, Rain Rates
  - Blended Products
  - NWP Model validation
  - Climate studies
  - Research

http://manati.star.nesdis.noaa.gov/gcom
Current Users of Near Real-time GCOM – W Data

- US NOAA National Weather Service
  - Tropical Cyclone Monitoring and Forecasting
  - Numerical Weather Prediction Model Assimilation
  - Marine Forecasting and Monitoring
  - Hydrological and Precipitation Forecasting and Monitoring
  - Seasonal and Climate Forecasting
- US National Ice Center
- US Department of Defense
  - AFWA
  - FNMOC
  - NAVO
  - Naval Research Laboratory
    - Joint Typhoon Warning Center
    - Oceanographer of Navy
- Leading Numerical Weather Prediction Centers outside US including: Japan, ECMWF

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US NWS GCOM Data Product Priorities (initial) for AWIPS2

| AMSR-2 Imagery (36H, 36V, 89H, 89V, GHz) |
| AMSR-2 Cloud Liquid Water |
| AMSR-2 Precipitation (Type/Rate) |
| AMSR-2 Precipitable Water |
| **AMSR-2 Sea Surface Wind Speed** |
| AMSR-2 Snow Cover/Depth |
| AMSR-2 Snow Water Equivalent |
| AMSR-2 Soil Moisture |
| AMSR-2 Sea Ice Characterization |
| AMSR-2 Sea Surface Temperature (SST) |
| AMSR-2 Surface Type |
Currently NHC is utilizing data from the following microwave radiometers:

- TRMM/TMI
- SSMIS (F16, F17, and F18) and 1 SSM/I (F15)
- WindSat
- AMSR2 (Data implemented in operational stream in August 2013)
Uses of Microwave Imagery

Overview

- Determining if a formative system has a well-defined center, a requirement to initiate advisories
- Locating the center of TCs when the center is not apparent in conventional visible or infrared imagery, especially for weaker systems at night
- Assessing trends in TC structure and intensity, such as eyewall formation and eyewall replacement cycles

Images courtesy FNMOC TC webpage

AMSR-E 89-GHz and 36-GHz color composite images clearly show the center of TS Philippe at 0501 UTC 1 October 2011

Center location is not apparent in corresponding infrared image
With the help of the above-mentioned AMSR pass, the initial motion is estimated to be 290/11. There is no change to the track forecast reasoning, as Georgette will be steered by a strong mid-level ridge to the north that will weaken and shift westward during the next several days.
The coverage of cold convective tops has increased over the past few hours and a 0921Z GPM pass and 0935Z AMSR pass showed that the center of Georgette was near the middle of the CDO feature. Based on the improved convective organization, the initial intensity has been set to 75 kt, which is close to the latest Dvorak estimates from SAB and UW-CIMSS. The hurricane has an opportunity to strengthen a bit more in the short term before SSTs cool below 26C by 24 hours.
AMSR2 Utility at NHC

Utilization of MW Radiometer Data in NHC Discussions 2013-2014 Hurricane Seasons

- MW data is most useful for monitoring changes in storm convection and structure and within 2013-2014 season data has been used almost 50% of time in this purpose.
Quantifying Impact of Microwave Data on TC Forecasting

- To assess impact of MW radiometer on NHC operations we examined usage of MW data during 2010-2014 Atlantic and East Pacific hurricanes seasons in Automatic Tropical Cyclone Forecast system
- We have also examined NHC discussions issued 4 times a day during TC event
- MW radiometers used are TRMM, DMSP SSMIS (F16,17 and 18) and SSMI (F15), and AMSR-E and AMSR2
Number of TC during Atlantic and East Pacific 2010-2014 Hurricane Seasons

Ch2010-2014 NHC East Pacific Microwave Fixes
(Includes SSMIS, TRMM, GPM, AMSR, and WindSat; 2014 data through 13 November)
STAR JPSS Annual Science Team Meeting, 8-12 August 2016

# of NHC Microwave Fixes for 2010-2014 Hurricane Seasons

**East Pacific**

**ASMR-E**
Fully utilized in NHC operations until Oct 2011

**ASMR-2**
Introduced to NHC operations in August 2013
ASMR-E
Fully utilized in NHC operations in
Atlantic

ASMR-2
Introduced to NHC operations in August 2013
EXAMPLE OF AMSR-2 IMPACT ON NEAR REAL TIME FORECAST AND RESEARCH: EAST PACIFIC HURRICANE BLANCA JUN 2015

Plots courtesy of Michael Brennan, NHC
Peter Black, NRL
TROPICAL STORM BLANCA DISCUSSION
NUMBER    8
NWS NATIONAL HURRICANE CENTER MIAMI
FL       EP022015
1000 AM CDT TUE JUN 02 2015

Blanca is intensifying. Geostationary imagery shows a CDO and prominent banding features, and a 0828Z AMSR-2 image from GCOM-W1 showed a low- and mid-level eye feature. The latest Dvorak estimates from TAFB and SAB are T3.5/55 kt, and the latest ADT is T4.5/77 kt. The initial intensity is set to 60 kt for this advisory. Given that Blanca has developed the inner-core features seen in microwave imagery and the shear is now below 10 kt, the cyclone appears to be poised for a period of rapid intensification.

The NHC forecast is near the highest guidance, showing Blanca becoming a major hurricane tomorrow, and conditions appear favorable for continued strengthening through 72 hours, when the SHIPS, LGEM and FSU Superensemble all show a peak near 120 kt. However, even this forecast could be conservative given that the SHIPS RI index shows a 95 percent chance of a 40-kt increase in the first 24 hours.
Blanca’s Development through MW Imager Eyes

Pinhole Eye Development

Eyewall Replacement Cycle

Eyewall Collapse during Rapid Decay

Second RI with Single Eye Formation

Asymmetric Decay over cold water prior to Landfall
AsMR-2 SST indicate possibility of Rapid Decay

- Second rapid decay occurred as Blanca crosses San Lucas front into cold SSTs < 26°C and landfall on Baja detected by AMSR-2 SST

- “Only rain rates greater than about 10 mm/hr (dark blue) impair SST estimation”
  - Flagging scheme doesn’t need to be too conservative for forecasting uses as required by data assimilation
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- WindSat
- AMSR2 (Data implemented in operational stream in August 2013)
ExtraTropical Transition
West Pacific 06-08 October 2015
Radiometer Observations – Wind and Rain Fields
ExtraTropical Transition
West Pacific 06-08 October 2015
Scatterometer + Radiometer Observations

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AMSR2 10061528  WINDSAT 10062004  ASCAT-B 10070002  WINDSAT 10070720

RapidScat 10071503

SSMIF16 10071907  SSMIF17 10072053

ASCAT-A 10080024

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~300km  40kts  ~550km  40kts  ~1300km  40kts  ~1300km

~1000km  ~1000km  ~1000km
ExtraTropical Transition
West Pacific 06-08 October 2015
Radiometer Observations – Water Vapor and Rain Fields
ExtraTropical Transition
West Pacific 06-08 October 2015
Radiometer Observations – SST and Cloud Fields
Conclusions

• AMSR2 provides all-weather information critical for tropical cyclone forecasting, hydrological applications such as extreme precipitation, flash flood forecasting, and drought forecasting, and marine environmental weather information (wind speed, which contributes to wave height forecasting, and sea surface temperature).

• NOAA’s JPSS program’s level 1 requirements for microwave imagery are met by GCOM-W1 AMSR2. JPSS provides real-time access via Svalbard to meet NOAA and Japan’s latency requirements.

• Microwave imager observations from AMSR2 are routinely used by NOAA, DoD, Japan, EUMETSAT, and other environmental agencies for weather forecasting and environmental monitoring applications.
  – Importance of AMSR2 data for tropical cyclone forecasting is evident in many forecast discussions from the National Hurricane Center and Joint Typhoon Warning Center.
  – Continuity of AMSR2 type observations are important to the operational weather and research communities.