NOAA/NESDIS Near-Real Time Wind Vectors from WindSat Polarimetric Measurements

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Why Microwaves?

• **Strengths**
  – Relatively insensitive to atmospheric effects
  – Clouds are mostly transparent
  – Sensitive to surface roughness

• **Weaknesses**
  – Poorer resolution
  – Sensitivity to rain
Scatterometer

- A scatterometer is an active instrument that transmits a known microwave signal and measures the backscattered energy from the ocean surface.
- Designed to retrieve the wind speed and direction in all weather conditions
- Currently being used by the operational weather community
- Retrievals impacted only in higher rain events

Radiometer

- MW radiometer directly measure naturally originating thermal mw radiation from wind roughened ocean surface that is in general partially polarized
- Multiple frequencies and polarizations allow for simultaneous retrievals of different surface and atmospheric parameters
- Surface parameter retrievals more complicated in storms
WindSat-Mission

- Risk reduction mission for NPOESS CMIS
- Successfully launched on January 6\textsuperscript{th} 2003 with the objectives to:
  - Demonstrate the capability of Polarimetric Microwave Radiometry to measure the Ocean Surface Wind Vector from Space
  - Show potential to measure other EDR’s: SST, Water Vapor, Cloud liquid water, rain rate, sea ice and snow cover
Polarimetric Microwave Radiometry

- Tb’s measured by satellite radiometer consists of:
  - Signal that is emitted from the ocean surface and travels upwards
  - Upward traveling atmospheric radiation
  - Downward traveling atmospheric and cold space radiation that is scattered back from the ocean surface

\[ Tb = f(ws, \varphi, sst, wv, clw) \]
WindSat EDR’s

Cloud Liquid Water

Sea Surface Temperature

Total Precipitable Water

Surface Wind Field

Rain Rate
Together the EDR’s Tell a More Complete Story

Total Precipitable Water

Cloud Liquid Water

Surface Wind Field
Wind Speeds Retrievals
Clear Sky – CLW<0.2

- RMS error 0.9m/s for cloud free regions
- Retrieval algorithm dependent on all EDR’s
- Stand alone high clouds and rain algorithm
- Stand alone wspd retrieval algorithm addresses RFI influenced points
Wind Speed Retrievals in High CLW and Rain Regions

Global WindSat (SSMI-like) wind speed retrievals (purple) and new WindSat wind speed retrievals (green) in high-CLW vs. GDAS wind speed. QuikScat (red) and WindSat (blue) wind speed retrievals in high CLW vs. GDAS mean wind speed.
Wind Direction Retrievals
Clear Sky – CLW<0.2
Hurricane Fabian
Ocean Surface Winds
Training Module
COMET Program

http://deved.meted.ucar.edu/npoess/ocean_winds
Conclusions - Operational Utilization and Validation

- Leverage operational tools and collaborations developed for QuikScat
  - NRT web page access
    http://manati.orbit.nesdis.noaa.gov/windsat
  - NCEP/OPC and TPC ocean vector winds impacts on operational warnings and forecasts
- Leverage QuikScat NAWIPS and AWIPS efforts to get WindSat into NWS operational environment
### WindSat

- **Resolution**
  - 60km

- **EDR’s**
  - TPW
    - std~1mm [0-50]mm
  - CLW
    - std~0.03mm [0-2]mm
  - Rain Rate
    - std~1mm [0-30]mm/hr
  - SST
    - std ~0.7°C [5-32°C (both 10.7Ghz and 6.8Ghz channels available)]

- **Limitations**
  - Clw>0.2mm degradation in retrievals of surface parameters
  - RFI
  - Coast

### QuikScat

- **Resolution**
  - 25km
  - 12.5km
  - 2.5km

- **EDR’s**
  - Wind Speed
    - Std ~0.8m/s [3-35m/s]
  - Wind Direction
    - Std ≤ 20° for wspd>3m/s

- **Limitation**
  - Wind speed and direction retrievals degrade in rainy areas