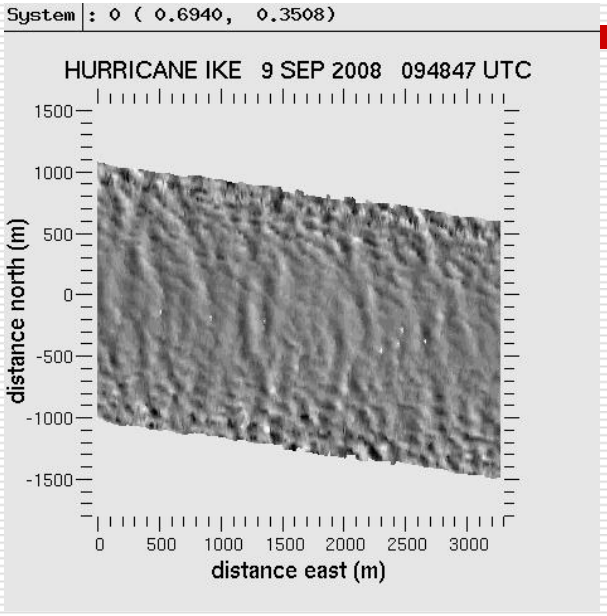
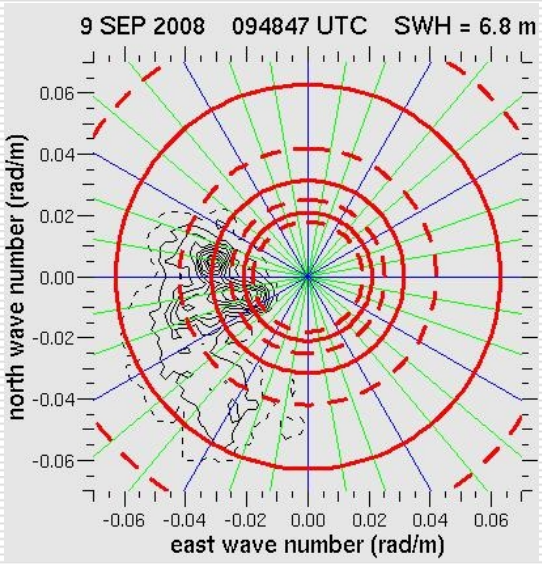
PROCESSING WSRA WIDE SWATH RADAR ALTIMETER DATA ON THE FLY





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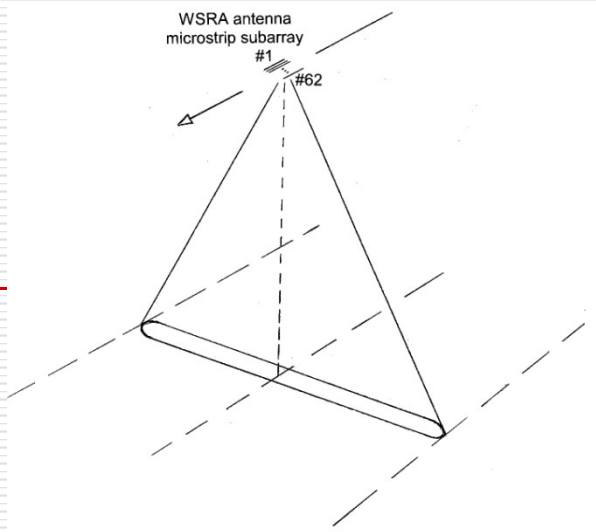
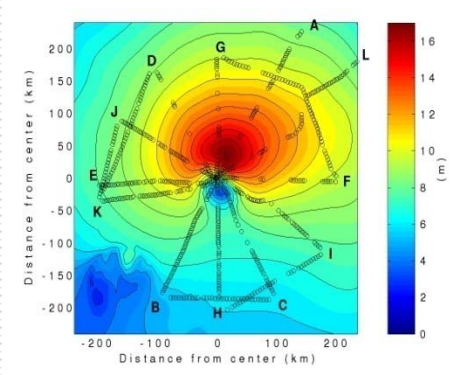
PROSENSING

Operational WSRA



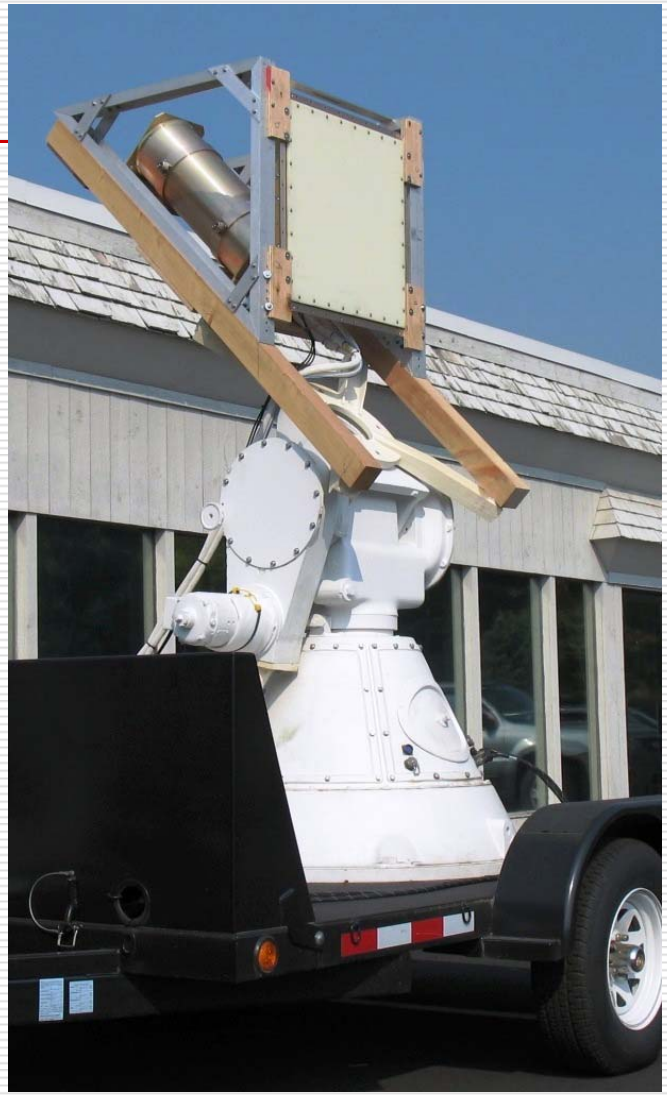
- Why?
  - Mapping ocean wave height (surface topography) within the inner core of hurricanes
  - Measurement of ocean directional wave spectra
  - Real-time reporting of 12-foot seas radius
  - Directional wave input to coupled TC-ocean-wave models, i.e. HWRF



➢NASA prototype demonstrated instrument feasibility and data product utility ⇒ operational WSRA on multiple aircraft would provide routine data to enhance hurricane forecasting

Technology Description:

- Digital beam forming antenna
  - Microstrip planar antenna array
  - Comprised of 62 sequentially sampled subarrays
  - Size: 30 in x 30 in x 2 in
- Transmitter
  - 20 W solid-state transmitter
  - pulse compression processing
  - compression ratio of 1000:1 (at a flight altitude of 500 m) to over 6000:1 (at a flight altitude of 3 km)
  - 10-60 kW effective peak power
- Digital Receiver
  - WSRA DAQ Hardware: Echotek ECDR-2-12210-PMC 210 digitizer embedded in a single board dual core Pentium processor



WSRA Data Collection During the 2008 Hurricane Season

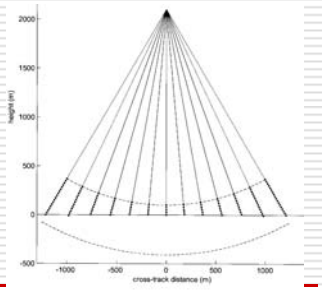
- In August and September of 2008 ProSensing operated and collected data with WSRA on six missions.

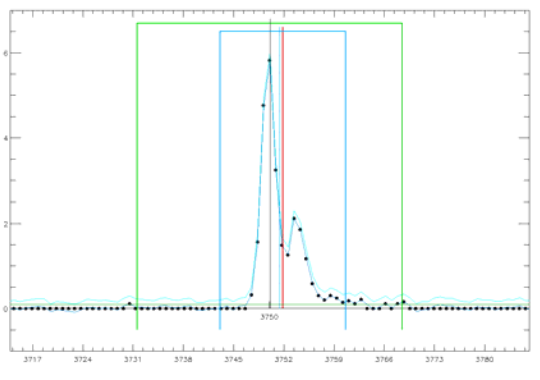
- WSRA data was collected over a wide range of ocean surface conditions: from calm seas up to CAT 3 hurricanes.

Storm Name	Takeoff Date/Time UTC	Duration (hrs)	Data Collected
Test Flight ( )	05AUG08 / 14:00	3	250GB
Tropical Storm Fay	18AUG08 / 00:00	8	325GB
Hurricane Gustav CAT 1	01SEP08 / 08:00	8	350GB
Hurricane Ike CAT2 and CAT3	10SEP08 / 08:00	8	425GB
	11SEP08 / 08:00	8	420GB
	12SEP08 / 08:00	8	470GB

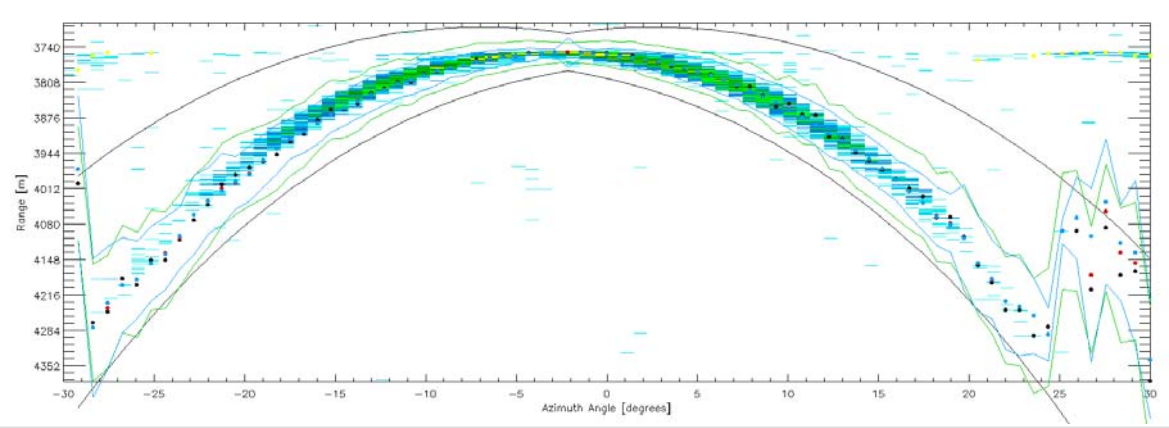
WSRA Data Processing Algorithm

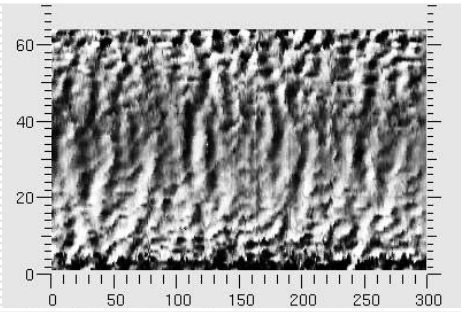
Raw Data to Sea Surface Cross-Track Profiles





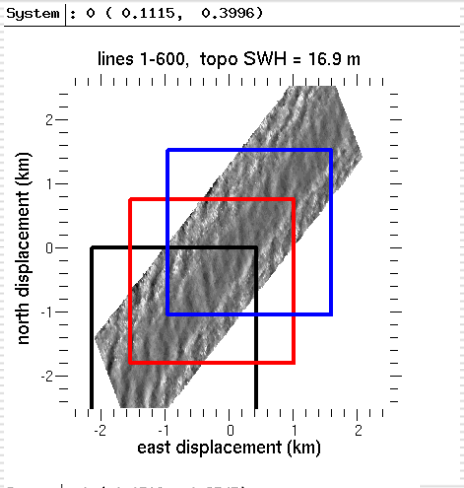
- Sequential transmission and collection of raw I&Q data for each of 62 antenna array elements.
- Performing de-chirping FFT on each of the 62 I&Q vectors.
- Averaging coherently subsequent frames of 62 vectors with the coherent integration time equivalent of the antenna traveling a distance of about 60 cm.
- Multiplying the data with correction coefficients.
- Performing the digital beam forming FFT at each range gate.
- Calculating the magnitude (power) for the each beam return. Figure to left shows the radar return for one beam at nadir. The 80 beams create a “frame” (left below).
- Averaging frames together to reduce signal fading. The averaging was set to generate 10 averaged frames per second.

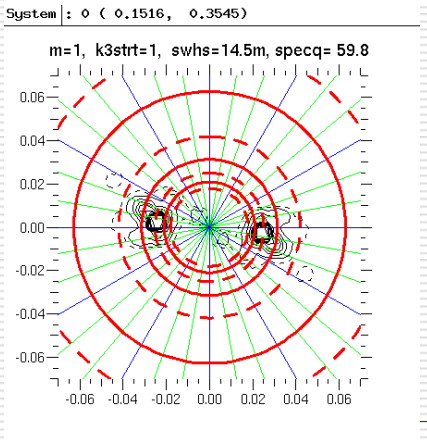




WSRA Data Processing Algorithm

Surface Profiles to 2D Directional Wave Spectra





Processing performed on the “backend” laptop

- Processing data block represents 14.5 minute segment containing 8700 accumulated surface profiles
- Corresponding flight data added to each surface profile
- Knowledge of the latest eye fix with location and time
- Surface profiles are converted to topographic map
- Sub segments of the topographic map processed by 2D FFT into 2d directional wave spectra
- Ambiguous spectral lobes eliminated
- Doppler-corrected directional spectra and extracted wave parameters transmitted to onboard FTP site

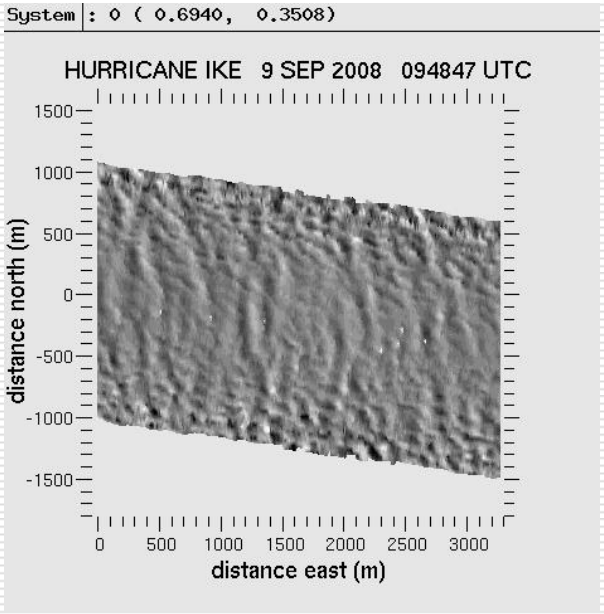
WSRA Transfer & Display data products at NHC

- From onboard FTP site WSRA spectra automatically transmitted to FTP site at AOC
- WSRA application running at NHC on the JHT server (Muskie) download spectra as they become available on the AOC FTP site.
- WSRA data displayed on NMAP2 within NAWIPS

Transfer scripts and display developed and tested under JHT Funding FY08 to Dr. Walsh

WSRA Data Quality

- WSRA has expanded the operational range of the measurement conditions over the retired NASA prototype SRA
- WSRA has obtained usable signal from significantly higher altitudes (12,500 feet vs 5,000 feet).
- WSRA signal was not significantly attenuated even under high rain rate conditions often found in hurricanes.
- WSRA has demonstrated its capability to measure ocean wave spectra under a variety of wind conditions.



WSRA Development Funded by JHT Program

Title: **In-Flight Data Processing for the Wide Swath Radar Altimeter (WSRA) for Real Time Reporting of Directional Ocean Wave Spectra from the NOAA WP-3D Hurricane Reconnaissance Aircraft**

- ***Analysis of data collected during the 2008 season (storms Fay, Gustav and Ike) to aid development of the optimized WSRA processing code.***
- **Re-coding the processing algorithm in C for unattended in-flight execution**
  - **(as promised to F.Marks, J. McFadden, and E. Rappaport ☺)**
- **Acquisition of the in-flight processing computer**
- ***Analysis of WSRA data and operations from the verification test flight***
  - ***scheduled for March 3rd, 2010***
- ***Development of the software for transmission of data products from the NOAA P-3 to NHC via satellite internet link.***
- **Support of the WSRA operation during the 2010 hurricane season**
- **Completion of a turnkey WSRA system development**
- **Operation of the turnkey autonomous WSRA during the 2011 hurricane season**

Processing on the Fly is The End