ATOMIC paper – WSRA input

***2.2 Remote sensing instruments***

**WSRA -** The NOAA Wide Swath Radar Altimeter (WSRA) is a digital beamforming radar altimeter operating at 16 GHz. It generates 80 narrow beams spread over ±30º from the overall antenna boresight to produce a topographic map of the sea surface waves and the backscattered power. The WSRA (PopStefanija et al., 2020) provides continuous real-time reporting of several data products: (1) significant wave height, (2) directional ocean wave spectra, (3) the wave height, wavelength, and direction of propagation of the primary and secondary wave fields, (4) rainfall rate and (5) sea surface mean square slope (mss).

***3.3 WSRA data file***

The WSRA Level-4 netCDF files in the ATOMIC archive ( <https://www.prosensing.com/atlantic-tradewind-ocean-atmosphere-mesoscale-interaction-campaign-atomic/> ) contain the following variables:

• **directional\_wave\_spectrum** When a wave topography map is transformed into a directional wave spectrum with a two-dimensional FFT there is a 180⁰ ambiguity in the wave propagation direction. Half the energy is deposited in the real spectral lobe and half is deposited in an identical artifact lobe propagating in the opposite direction. The artifact lobes must be deleted and the energy doubled in the real lobes. In a hurricane environment the process is done automatically be integrating the time/spatial varying wind field to predict wave propagation directions. In ATOMIC the process assumed that all waves were propagating in the half plane with an orthogonal directed towards 205⁰. Variance values are in m2.

• **directional\_wave\_spectrum\_180** To cover the possibility that the wrong spectral lobe was deleted in directional\_wave\_spectrum, these spectra contain both the real and artifact spectral lobes, which are no longer identical because each lobe has been Doppler-corrected and variance-corrected assuming it was the real lobe.

• **dominant\_to\_secondary\_partition\_angle** indicates the North relative angle as boundary between the dominant and secondary wave fields, if two have been identified.

• **dominant\_wave\_direction** is the propagation direction of the dominant wave field in degrees.

• **dominant\_wave\_height** is the significant wave height of the ocean dominant wave field in meters.

• **dominant\_wave\_wavelength** is the peak wavelength of the ocean dominant wave field in meters.

• **hurricane\_eye\_distance\_east** is not relevant in ATOMIC.

• **hurricane\_eye\_distance\_north** is not relevant in ATOMIC.

• **latitude** in degrees

• **longitude** in degrees

• **peak\_spectral\_variance** is the peak spectral variance in m2 of the directional ocean wave spectra.

• **platform\_course** is the North-relative aircraft track angle received from aircraft IWG1 in degrees.

• **platform\_orientation** is North-relative aircraft heading received from aircraft IWG1 in degrees.

• **wsra\_computed\_roll** is the average WSRA computed aircraft roll attitude determined at -20, -10, 0, 10, 20 s displacements relative to the observation time.

• **platform\_radar\_altitude** is the aircraft altitude in meters determined by the WSRA.

• **platform\_speed\_wrt\_ground** is the aircraft ground speed received from aircraft IWG1 in m/s.

• **rainfall\_rate** - five independent values of rain rate (mm/hr) determined at -20, -10, 0, 10, 20 s displacements relative to the observation time.

• **rainfall\_rate\_median -** median value of the 5 values in rainfall rate.

• **sea\_surface\_mean\_square\_slope** - five independent values of mean square slope (mss) determined at -20, -10, 0, 10, 20 s displacements relative to the observation time.

• **sea\_surface\_mean\_square\_slope\_median -** median value of the 5 values in sea\_surface\_mean\_square\_slope

• **sea\_surface\_wave\_significant\_height** (SWH) in meters.

• **secondary\_wave\_direction** is the propagation direction of the secondary ocean wave field in degrees, if one exists.

• **secondary\_wave\_height** is the significant wave height of the secondary ocean wave field in meters, if one exists.

• **secondary\_wave\_wavelength** is the peak wavelength of the secondary ocean wave field in meters, if one exists.

• **time** is the time of the observation in seconds since the start of the observation specified in the file’s global attribute “time\_coverage\_start”

• **trajectory** is an integer identifier for observation instant.

• **wavenumber\_east** is the set of 65 spectral wavenumber values along the east axis.

• **wavenumber\_north** is the set of 65 spectral wavenumber values along the north axis.

• **wind\_direction** is the upwind direction at the aircraft altitude in degrees.

• **wind\_speed** at the aircraft altitude in m/s.

• **wave\_direction\_predicted** identifies the half-plane orientation predicted to contain the direction of propagation for eight wavelengths (366, 256, 197, 160, 135, 116, 102, 91 m) computed to aid in deleting artifact lobes. For ATOMIC all values were set to 205⁰.

• **swh\_correction\_ratio** is the ratio of the corrected spectrum SWH to the SWH of the encounter spectrum.

***8 References***

PopStefanija, I., C. W. Fairall, and E. J. Walsh: Mapping of Directional Ocean Wave Spectra in Hurricanes and Other Environments, IEEE Transactions on Geoscience and Remote Sensing, submitted for publication.