Wind Direction Editors for Use in the Creation of SAR Wind Speed Imagery

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EXTENDED ABSTRACT

This extended abstract summarizes an article to be published in the American Meteorological Society's *Journal of Applied Meteorology and Climatology* under the title "Manual and Semi-Automated Wind Direction Editing for Use in the Generation of Synthetic Aperture Radar Wind Speed Imagery." Deriving high resolution near-surface wind speed from SAR backscatter requires knowledge of the corresponding wind direction because of the wind direction dependence of the relationship between SAR backscatter and wind speed. The usual sources of wind direction data are numerical weather prediction (NWP) models, scatterometers, and signatures within the SAR image. At times, each of these wind direction sources can fail to provide accurate wind direction data. For example, NWP model wind direction fields can have position errors and either missing or extraneous wind shift features. Scatterometer observations can be contaminated by land and can mishandle the ambiguity resolution near frontal and vortex wind shifts. SAR itself can provide wind direction data only in those regions where meteorological phenomenon yield along-wind streaks in the near-surface wind speed field. Thus, each wind direction source has its own set of liabilities.

This study focuses on three methods for editing gridded wind direction data. Those methods are manual editing, manual morphing, and semi-automated morphing. All examples presented in the corresponding article are for correcting the U.S. Navy's NOGAPS NWP model wind directions. However, the editing methods are applicable to all gridded wind direction data. The SAR data employed is ScanSAR Wide (processed at the Alaska SAR Facility) from the SAR onboard the Canadian Space Agency's *RADARSAT-1*. Following [1], the SAR-based wind speed fields are produced using the CMOD4 GMF modified for horizontal-horizontal polarization using a polarization parameter of 0.6.

The manual wind editor implemented for this study has a graphical user interface based on that presented in [2], and is written in the Matlab computer language (http://www.mathworks.com/). The editor provides a display of the wind speed field derived from the SAR backscatter field and wind direction field. This wind speed field can be recalculated and redisplayed at the push of a button as the analyst edits the input wind direction field. The advantage of manual editing of gridded wind direction data is that it allows for the incorporation of many wind direction information sources as well as human insight into the wind direction analysis procedure. The primary disadvantage of manual editing is that a single SAR analysis may take up to 30 minutes to complete and is computationally demanding.

Manual morphing is a wind direction editing technique that can be implemented if the wind direction pattern is correct with the exception of feature position errors. Manual morphing thus involves the movement of mis-positioned wind direction data to their correct geographic location. Manual morphing of gridded wind direction data is more time efficient than manual editing and is generally easier to implement. However, a drawback of manual morphing is that it does not allow the analyst to incorporate all available wind direction information sources. For example, if a feature is erroneously absent in the initial gridded wind direction field, the analyst can't correct the error by morphing.

For cases of misplaced singularities in the gridded wind direction field (*e.g*., cyclones, anticyclones, and col points), there exists a characteristic hourglass-shaped error signature in the SAR-based wind speed field. Thus, for these cases, a semi-automated application of the morphing approach can be applied. Semi-automated morphing is more time-efficient than manual morphing and requires little user input beyond error signature identification. The disadvantage of semi-automated morphing is that the analyst must assume *a priori* a radius of influence for the movement of wind direction data points. This radius of influence can be difficult to gauge.

The corresponding article provides examples of each of the wind direction editing techniques described above. It is argued that at times, these wind direction editing techniques can benefit the analyst. For the case studies presented in the article, the limited amount of analyst time spent on a single image makes this data fusion technique practical.

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