The Cross-Calibrated Multi-Platform (CCMP) Wind Analysis 3.0 Carl Mears^{1,*}, Tong Lee², Andrew Manaster¹, Lucrezia Ricciardulli¹, Xiaochun Wang³, Frank Wentz¹, Susan Wijffels⁴, and Shayne McGregor⁵

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Background:

> CCMP combined satellite retrievals with a background field to produce a complete wind analysis over the ocean every 6 hours.

> Problems we are trying to solve

- Systematic Differences between the background field (ERA5) and satellite retrievals (particularly at winds > 15 m/s) limit the accuracy of the analyzed product
- (less important) Background field is relative to the fixed Earth, satellite winds are relative to the (perhaps moving) ocean surface.
- (less important) Systematic differences between scatterometer and radiometer winds cause regional biases.

> Philosophy/Approach:

- RSS scatterometer winds are stipulated to be most accurate product.
- Adjust ERA5 to statistically match scatterometers.
 - Adjustments are stationary on interannual time scales
- Adjust radiometer winds to match *adjusted* ERA5 winds
 - Allows use to extend CCMP to before the scatterometer era.
- Also, OSCAR currents are used to adjust ERA5 NS winds so that they are oceansurface relative. This limits CCMP 3.0 to 1993 onward.
- To match ERA5 winds to scatterometers, Ο we primarily use a wind speed adjustment based on histogram matching. This allows simple adjustment of vector and scalar winds.

Two types of adjustments made to ERA-5

- 1. Multiplicative adjustment
- Derived to match wind speed PDFs
 - Allows application to wind vectors
 - Depends on latitude and time of year
- 2. Vector component bias
 - speed PDFs
- Depend on time of year and location (maps). 3. Neither Adjustment depends on **which** year it is.



- Fig .2 Comparison of ERA5 with ASCAT-A w/wo adjustments: • Histograms now match at all winds • Also includes small vector adjustments the depend on location.

Adjustments made to Radiometers

adjustments.



Before Adjustment

- Small adjustments with little effect on wind

1. Small, location-dependent additive speed

After Adjustment

-1.00-0.75-0.50-0.25 0.00 0.25 0.50 0.75 1.00 Wind Speed Difference, ERA5-F13 (m/s)

The CCMP Analysis

- 1. The observation and the background are combined using a variational analysis.
- 2. The cost function which minimizes both difference between the analyzed field and the input winds and the spatial derivatives of the innovation. (For details see Atlas et al, 2010)
- 3. No buoys were used
- 4. ASCAT-B was withheld so it can be used as a independent comparison dataset.



Fig. 3 Comparison CCMP 3.0 with ASCAT-B: • Collocations with 1 hour – causes funny shape due to nearconstant equator crossing time for ASCAT-B



Fig. 4 Comparison 3 version of CCMP and ERA5 with ASCAT-B: • Improvements most dramatic where CCMP has no satellite observations analyzed (not surprising).



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