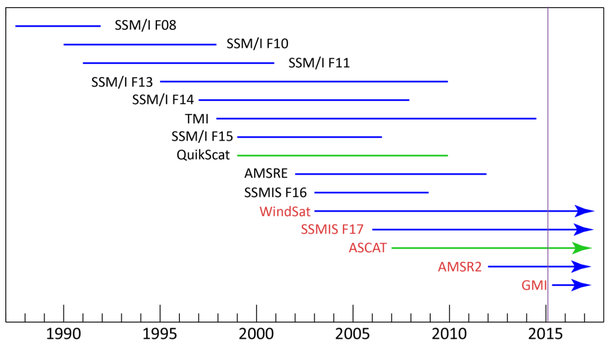
The influence of *in situ* wind measurements on CCMP winds

Carl Mears, Lucrezia Ricciardulli, and Frank Wentz, *Remote Sensing Systems*, Santa Rosa, California, USA
Joel P. Scott, *Goddard Space Flight Center*, Greenbelt, Maryland, USA
Ross Hoffman and S. Mark Leidner, *Atmospheric and Environmental Research*, Lexington, Massachusetts, USA
Robert Atlas, *Atlantic Oceanographic and Meteorological Laboratory*, Miami, Florida, USA

Remote Sensing Systems

What is CCMP?

CCMP is a Level-4 vector wind product produced by combining satellite measurements, *in situ* measurements from moored buoys, and a background field derived from a numerical weather prediction model. The current version of CCMP uses the ERA-Interim Reanalysis as the background field. The various data are combined using a variational analysis, which minimizes a cost function (Atlas *et al*., 2011), which is defined so that when satellite or *in situ* measurements are present, CCMP wind agree well with them, and smoothly transition to the background values as we move to regions without observations.



Disadvantages of using in-situ data in CCMP

The current, publically available version (Version 2.0) of CCMP uses in-situ data from moored buoys. This has three disadvantages:

1. If all buoys are used, there is no independent source of data to evaluate the quality of CCMP.
2. If the buoy measurements disagree with the background field or the satellite winds, the point-like nature of the buoy data, coupled with its fixed location, leads to distortions in the CCMP wind field. These are especially obvious in the curl or divergence of the CCMP field, as pointed out by MacGregor et al. (2017).
3. CCMP cannot be created until the *in situ* data are available (the same problem exists to an even greater degree for the background field if reanalysis fields are used.)

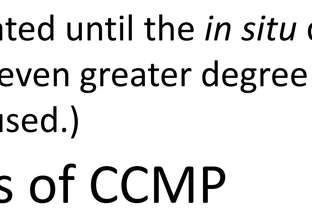
Two new versions of CCMP

We have developed two new versions of CCMP to address and investigate these problems.

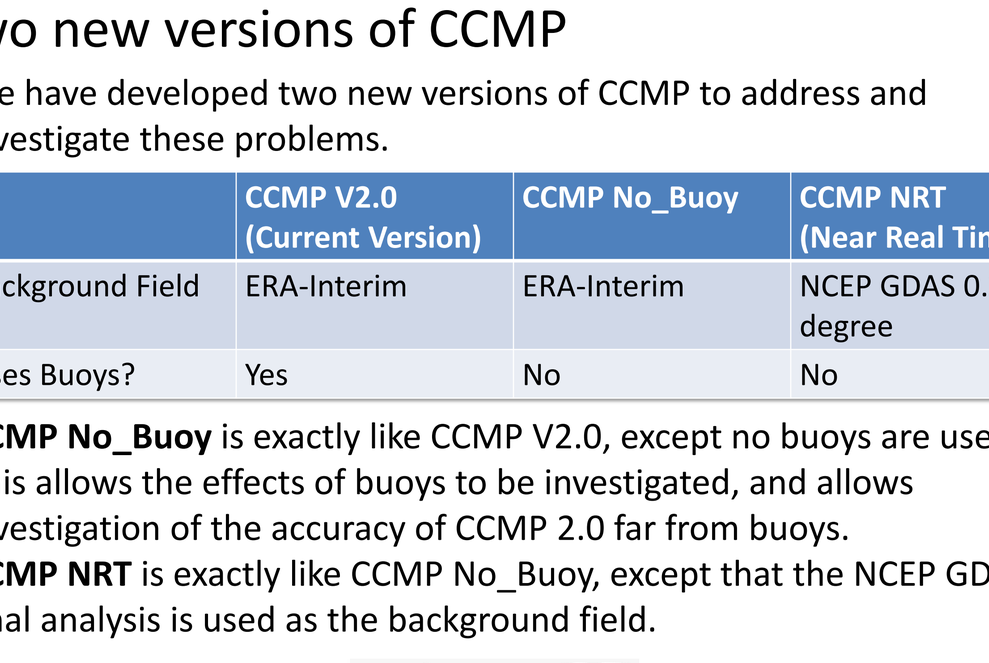
	CCMP V2.0 (Current Version)	CCMP No_Buoy	CCMP NRT (Near Real Time)
Background Field	ERA-Interim	ERA-Interim	NCEP GDAS 0.25 degree
Uses Buoys?	Yes	No	No

CCMP No_Buoy is exactly like CCMP V2.0, except no buoys are used. This allows the effects of buoys to be investigated, and allows investigation of the accuracy of CCMP 2.0 far from buoys.
CCMP NRT is exactly like CCMP No_Buoy, except that the NCEP GDAS final analysis is used as the background field.

These 10 maps show the differences between CCMP NRT, and its NCEP background field for an example time step

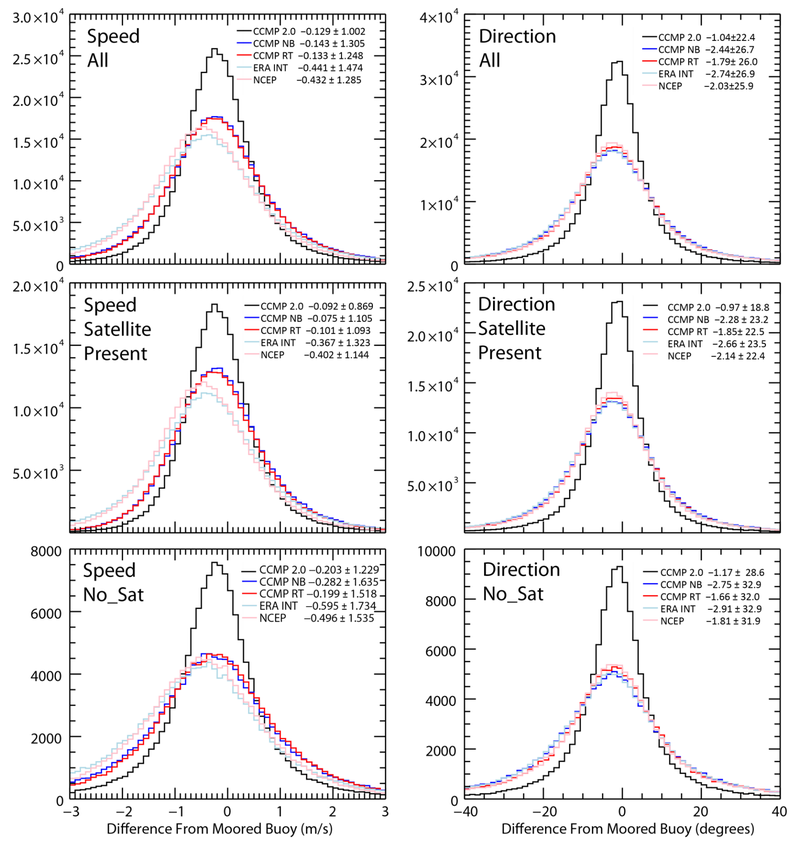


Differences are large only when collocated satellite measurements are present.



Comparison of CCMP with buoy winds

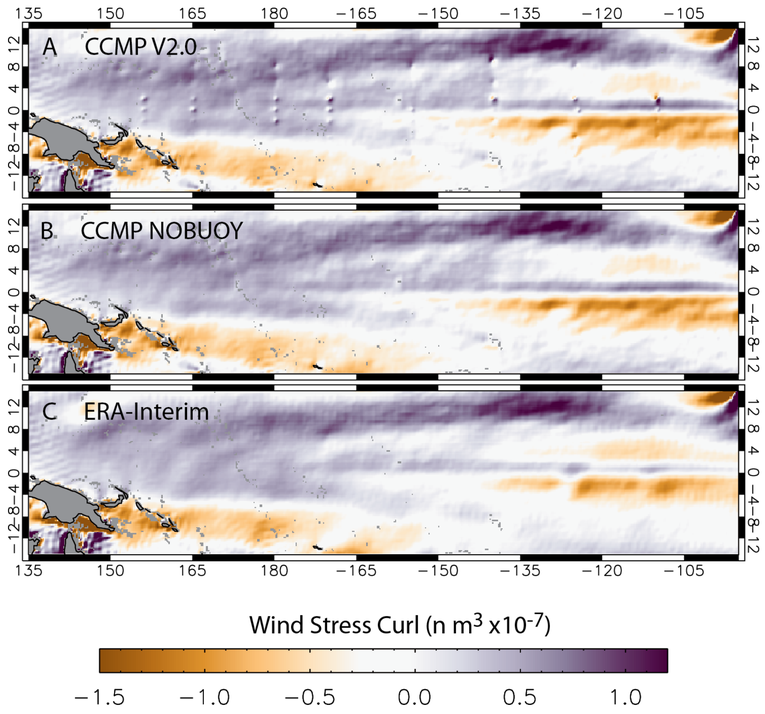
When CCMP V2.0 is compared to buoys, the results are not representative of the accuracy of CCMP at locations far from buoys. This is because the CCMP analysis "pulls" the results toward the buoy measurements when they are included. The new versions without buoys can give a more realistic picture of CCMP accuracy.



These histograms are accumulated over the 3-year period 2015-2017.

The above plots show that CCMP V2.0 agrees best with buoys – not surprising. Both CCMP No_Buoy and CCMP NRT show improvements over their respective backgrounds, especially in speed. Note that the background fields are already improved in regions with satellite winds since most NWP models ingest satellite wind data in one way or another.

Wind stress curl in the tropics



This is the wind stress curl averaged over all of 2016 in the tropical Pacific. The pattern of "dimples" in the top plot is due to measurements from the TOA-Triton Buoys.

Removing Buoys from CCMP fixes the distortion of the wind stress derivative fields near the TOA – Triton buoys while preserving the satellite information provided by the CCMP analysis.

Conclusions and the Future

Removing buoy measurements from CCMP allows us to do a more honest evaluation of CCMP quality. Using the NCEP operational analysis as a background will allow us to produce CCMP RT with a latency of 2 days or less. Future work includes analysis to ensure that long term trends and the diurnal variability are accurate in CCMP.

References

Atlas, R. M., R. N. Hoffman, J. Ardizzone, S. M. Leidner, J. C. Jusem, D. K. Smith, and D. Gombos (2011), A cross-calibrated, multi-platform ocean surface wind velocity product for meteorological and oceanographic applications, Bulletin of the American Meteorological Society, 92(11), 157-174.

McGregor, S., A. S. Gupta, D. Dommenget, T. Lee, M. J. McPhaden, and W. S. Kessler (2017), Factors influencing the skill of synthesized satellite wind products in the tropical Pacific, Journal of Geophysical Research: Oceans, 18, doi: 10.1002/2016JC012340.