Impact of usage of multiple-satellite sensors on accuracy of sea surface wind data.

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Sea surface winds drive surface ocean circulations including western boundary currents such as Kuroshio with momentum transfer from the atmosphere to the ocean. Kuroshio transports a large amount of heat from low latitudes to middle latitudes and affects on not only the weather in areas around Japan but also global climate. Therefore, it is important for not only scientific community but also our society to globally obtain accurate wind data at the sea surface.

Since 1990s, satellite data have been widely used for monitoring of global sea surface winds and are considered to be very important because satellite observation provides us global sea surface wind data with highly spatial and temporal resolutions. Most satellites observing sea surface winds have sun-synchronous orbits and provide observation data at the same place two times per a day. Thus, when we estimate a daily-mean value using these satellite wind data, we can expect that the value has errors from a true daily-mean value.Tomita and Kubota (2011) investigated this issue and proposed that use of multiple-satellite data make the sampling errors reduce. Based on their results, new product of the sea surface wind, the Japanese Ocean Flux Data Sets with Use of Remote Sensing Observation (J-OFURO) -3 has been constructed by multiple-satellite data. The number of satellite sensors used in this product is different depending on year. This allow us to expect that the accuracy of a daily-mean value changes from year to year.

The purpose of this study is to describe time variation of accuracy in daily-mean wind data included in J-OFURO3 and to investigate causes of the time variation by comparing with in-situ measurement data by moored buoy. In this study, the daily-mean buoy data are assumed to be true values. We calculate various statistic values such as RMS error, bias, correlation between the satellite and bouy data. Results reveal that the RMS error and bias tend to decrease and the correlation increases from year to year meaning remarkable improvement of the statistical value. In the next step, we examined the relationship between the yearly statistics and the yearly number of satellite sensors. Then, we ranked the number of sensor and prepared a scatter diagram of yearly values between ranking and three kinds of statistics and estimated the correlation. We found that the correlations between the two are basically very high. However, it was confirmed that statistics sometimes improved despite the decrease of the number of satellite. This, next we focused on an interval of observation time within a day. We ranked ascending order of the maximum value of time intervals that satellites do not observe, and we carried out the analysis in the same way as before. The result is that the correlation between yearly variation of RMS error and maximum time intervals was found to be high. Finally, we carried out the sane analysis using the overall rank obtained by adding the two ranks. The result is that the correlation between the two was found to be very high and especially the correlations between overall rank, and RMS errors or correlations are remarkably increased.

From above results, we can conclude that the accuracy of daily-mean sea surface wind data in J-OFURO3 has been clearly improved with the years and the improvement strongly depends on usage of sensors of multiple satellites. Also, we found that it depends on not only the number of a satellite sensor but also on the maximum value of time intervals that satellites observations are not covered.

Keywords: validation, multiple-satellite data, sea surface wind