A comparison of the new meteorological data to the currently used meteorological data

Wayne Robinson, 22 Jul 2014

Meteorological data is used in the ocean color processing to help characterize the atmospheric contributions to the top-of-atmosphere (TOA) radiances so they can be properly removed, leaving the desired water-leaving radiances. This determination is important because the atmospheric portion of the TOA radiance is about 85% of the total signal and any error in the atmospheric radiance results in a magnified error in the water-leaving radiance. Four quantities are used to do this characterization:

1. Surface wind information is used to estimate and remove the amount of sun glint from the water surface
2. Surface pressure is used to determine the amount of Rayleigh radiance,
3. Surface relative humidity (RH) is used to help in choosing the best aerosol model, and
4. Precipitable water (PW) is used to determine the atmospheric transmittance.

Prior to the 2014 ocean color reprocessing, the meteorological data used consisted of either NCEP Reanalysis 1 data used mainly during the CZCS mission (Oct 1978 – 1986) or NCEP real-time ancillary data from the Global Forecast System used for the modern mission era starting with OCTS (Oct 1996 – present). In the period from 1997 – 2008 the real-time RH showed numerous shifts and drift in the average RH. This period was reprocessed with the help of the Reanalysis 1 to stabilize the RH while preserving the higher resolution of the real-time data.

The meteorological data to be used in the 2014 reprocessing was improved to extend the use of the NCEP reanalysis data and to repair some problems discovered in the current meteorological data record. NCEP has produced an improved version of its reanalysis: the NCEP/DOE Reanalysis 2, which corrects some errors in Reanalysis 1 and improves physical process parameterizations. The Reanalysis 2 data fields will be used directly as the met data or to improve all existing real-time data parameters, not just RH. This improvement will be applied to the real-time data as soon as new Reanalysis 2 data becomes available. Also, an error in the generation of the ancillary met parameters led to a switching around of the RH and PW fields in most of the data for 1996 up to April, 1997. The use of the Reanalysis 2 data will remove this error from the met data record.

The new ancillary met record was examined to be sure the processing was working correctly and to compare it to the current met data in use. Statistics were gathered for the current and new data and these statistics are plotted for the entire period where ocean color observations exist. The average values of the 4 meteorological values are compared.

Wind Speed

The average wind speed over the global oceans for the current and new ancillary data are shown in Fig 1. On average, the new wind field is 1. m sec^{-1} lower in the CZCS era (1978 – 1986) and 0.4 m sec^{-1} lower in the modern era (1997 – present). The new wind field is more smooth in the start of the modern era where the current data shows some instances of a significantly higher wind. Note that the wind at 10 m was not available in the Reanalysis 2 data and the 10 m wind was derived from the standard pressure level winds and a power law wind profile correction (Hsu et. al., 1994).

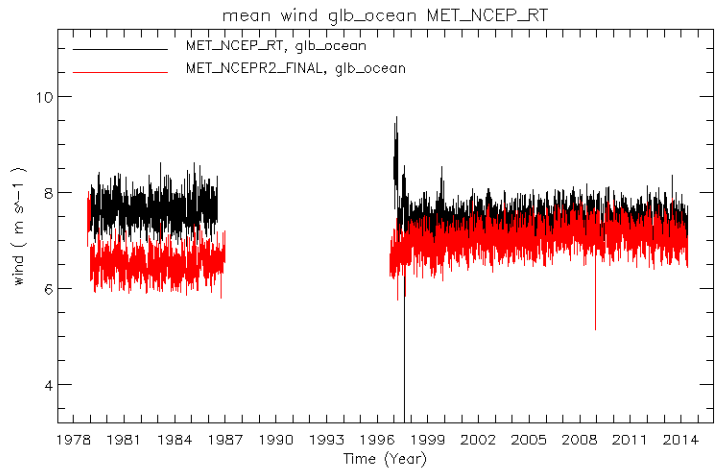

Figure 1. Average wind speed over the global oceans. Black is the current data average and red is the new wind data.

Surface Pressure

The mean sea level pressure is shown in Fig 2. The new and current values of this parameter are very similar, only differing by a few millibars.

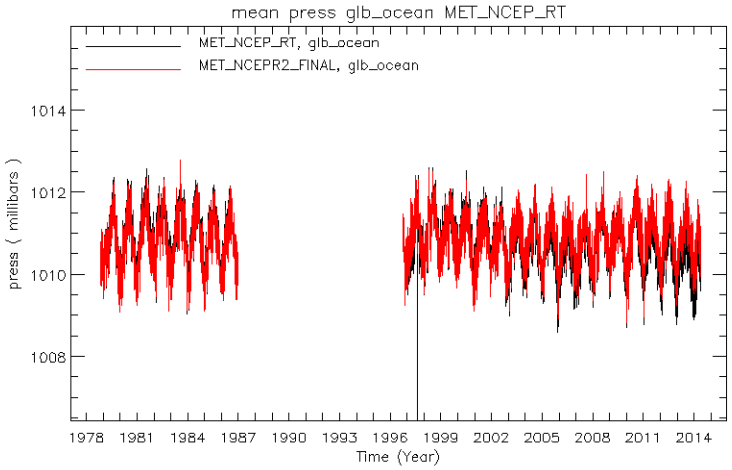

Figure 2. Average mean sea level pressure over the global oceans. Black is the current data average and red is the new wind data.

Precipitable water

The precipitable water is shown in Fig 3. The error in the current data due to the switching of the PW and RH fields is evident in the trace of the black line going to much higher values (from 26 mm to around 77 mm) in 1996 and the start of 1997. Although the effect of this error was not detected directly in the satellite data fields, it could have had some impact. The new PW differs from the current by only 1 mm at most.

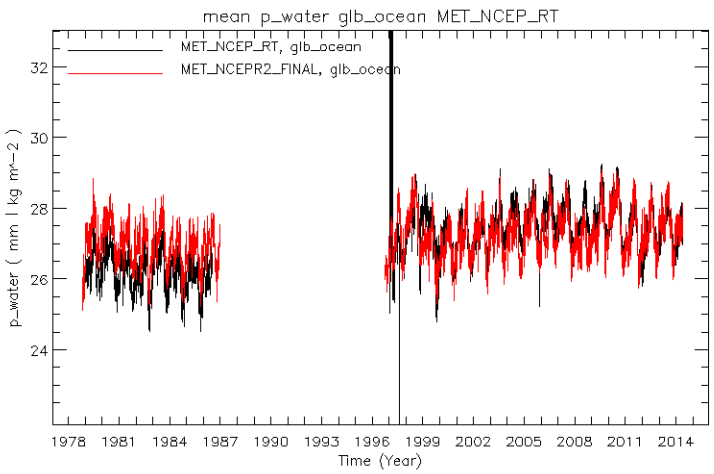

Figure 3. Average precipitable water over the global oceans. Black is the current data average and red is the new wind data.

Relative humidity

The relative humidity is shown in Fig 4. The RH has shown the greatest amount of variability in the real-time data – around 2011, it showed a shift of approximately 1%. Also, the effect of the switched RH and PW fields is seen in the start of the modern era. The new RH record is about 2% higher than the current data in the modern era and 4% lower in the CZCS era. This happened to the real-time data because when the Reanalysis 1 correction for 1997 – 2008 was made, the average RH from the Reanalysis 1 was reduced by a factor of 0.91 to make the resulting RH more closely match the real-time average values. The same factor was not applied to the CZCS era RH. No factor will be applied to the Reanalysis 2 RH since this correction will will be maintained into the future.

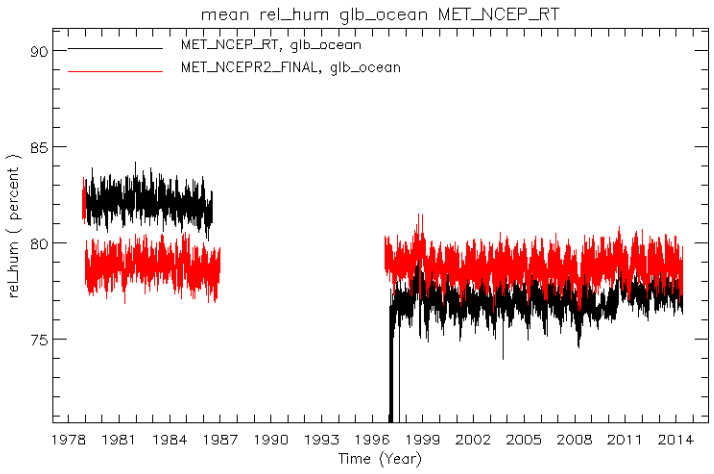

Figure 4. Average relative humidity over the global oceans. Black is the current data average and red is the new wind data.

Summary

The new ancillary meteorological data, which is a combination of the real-time NCEP data and the NCEP Reanalysis 2 will be a more consistent and stable ancillary source than the current data. The new data also corrects a large error seen in satellite ocean color data in 1996 and early 1997 (OCTS was the only sensor affected).

References

Hsu, S. A., Eric A. Meindl, and David B. Gilhousen, 1994: Determining the Power-Law Wind-Profile Exponent under Near-Neutral Stability Conditions at Sea, Applied Meteorology, Vol. 33, No. 6, June 1994.