P3.6 CHARACTERIZATION OF A REGIONAL WIND USING SSM/I AND QUIKSCAT DATA

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1. INTRODUCTION

DISCOVER, a NASA REASoN funded project, provides both radiometer and scatterometer data to the scientific community. These consistently processed, carefully inter-calibrated ocean data sets have been used to look at both global and regional wind features. The DISCOVER SSM/I and QuikSCAT wind speeds agree overall with model winds (generally less than 0.5 m/s with ~1.0 m/s standard deviation) for nearly all ocean regions. However, when comparing satellite winds to those from NCEP GDAS model, for example, we find a region of consistently higher differences as shown in Figure 1. This region coincides with the Caribbean Low Level Jet (CLLJ). The CLLJ is defined by Amador (1998) as a low level wind maximum near 925 mb that occurs from June through September and is strongest between 70^{o}W and 80^{o}W with an axis near 15^{o}N. Using NCEP/NCAR Reanalysis data, he found zonal wind speeds on the order of 14 m/s.

More recent papers (Mo, 2005; Wang, 2007; Whyte 2008) have also used model data to further describe the characteristics of the CLLJ and relate this feature to climate patterns. Whyte (2008) noted that the wind maximum in the CLLJ region exists year-round, with July the maximum zonal speed (up to 16 m/s) and September the minimum (<8 m/s). The region of higher satellite 10-meter surface winds shown in figure 1 coincides with the CLLJ region defined in all these studies, that of 11.5^o – 16.5^o N and 70^o to 80^o W, and is shown by a black box in Figure 1.

In this study, we looked at the 22 years of SSM/I data, 12 years of TMI wind and sea surface temperature (SST) data, and 10 years of QuikScat ocean vector winds to determine if the satellite 10-meter surface wind characteristics agree with the characteristics of the 925mb winds discussed in previous CLLJ studies.

2. RADIOMETER AND SCATTEROMETER WINDS

DISCOVER microwave radiometer data are carefully inter-calibrated at the brightness temperature level and therefore provide quality ocean wind speed data free of orbital drifts or calibration errors. This process results in geophysical products from the SSM/I (F08, F10, F11, F13, F14, F15), TMI, and AMSR-E instruments that are consistent across instrument platforms. Data from these radiometers are available

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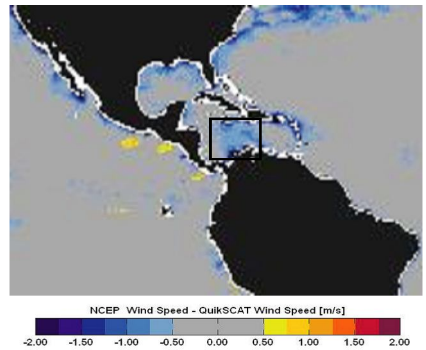

Figure 1. Mean wind speed difference between NCEP GDAS and QuikSCAT winds for July 2002 to June 2003.

from July 1987 through the present as gridded maps on various time scales (e.g., 4x-daily, daily, weekly, monthly) at 0.25 degree resolution and are released in near real-time (3-12 hours post observation) on a 24×7 basis. Data can be viewed and downloaded freely via the RSS web site (www.remss.com) or via the DISCOVER web site (www.discover-earth.org).

The SeaWinds instrument (referred to as QuikScat) has been operating since July 1999 and now provides nearly 10 years of consistently processed ocean vector winds. QuikScat winds are also available at www.remss.com as 0.25 degree gridded maps of varying time scales. These scatterometer winds agree well with the radiometer wind speeds despite the fact that these passive and active microwave instruments measure ocean winds differently. Figure 2 shows SSM/I (top) and QuikScat (bottom) monthly maps for 2003. This year is representative of the agreement between the instruments for all other years.

3. SURFACE WIND CHARACTERISTICS

The annual pattern of surface winds is shown in Figure 2. Highest wind speeds typically occur in January/February and June/July, while lowest wind speeds are found throughout the region in October. The annual pattern of winds seen in 2003 is similar to that of other years, varying only by the wind intensity and location of very highest winds.

QuikScat data show wind directions vary little throughout the year, with persistent easterly winds (flowing towards 270 deg) throughout most of the region. Winds west of 73 deg W longitude and south of 14 deg N latitude turn and become northeasterly winds (flowing towards 250 deg). Why the surface winds turn in this manner is not currently known.

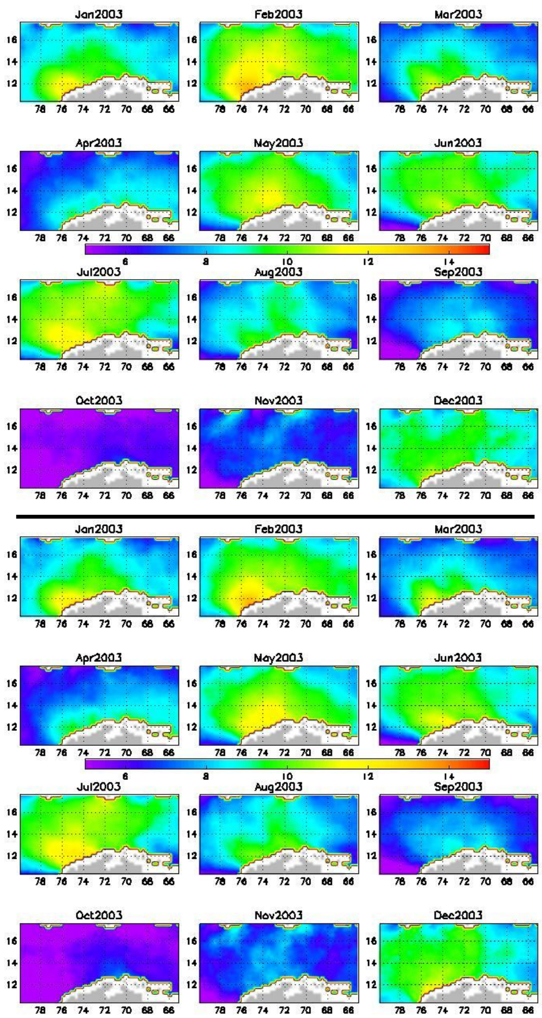

Figure 2. Monthly wind speed maps (in m/s) for SSM/I (top) and QuikSCAT (bottom) during 2003. The annual pattern of winds in this region is similar to that of other years.

Maps of TMI winds match those of SSM/I and QuikScat. The equatorial orbit of TMI allows for the sampling of all times of day unlike the polar orbits of SSM/I and QuikScat. We use the 12 years (1997 to 2008) of data to obtain hourly maps of winds for each month. The hourly maps of July are shown in Figure 3 and demonstrate how the winds change throughout the day. Little diurnal variation exists (less than 2 m/s) and wind maximums occur just after midnight, with minimums around noon. The lower wind speed months (Sep/Oct) show slightly higher diurnal variation (up to 4 m/s) with maximums shifted more towards early morning (not shown).

4. SUMMARY

Characteristics of the surface winds in many ways match those described in the literature for the CLLJ. The months of maximum and minimum are the same, the intensity of the wind is similar, the region of high winds matches that found in the literature, and the minimum diurnal variation with highest speeds at night are all characteristics found previously using model data. In addition, the pattern over time shown by a longitude time plot in Whyte (2008) matches that seen in SSM/I and QuikScat. Figure 4 shows the 22 year pattern of winds averaged over 14-16 deg N latitude. Maximum winds in this time period reach 12 m/s, lower than the reported 925mb jet winds. There are periods of higher winds and lower winds, many of which coincide with ENSO activity.

We find the following characteristics are different than those found using model data as reported in the literature:

- The winter wind maximums are higher than summer wind maximums.
- The region of highest surface winds is found near 11 deg N latitude, not the 15 deg N latitude of the 925mb jet.
- The region of highest surface winds extends northwest off the Colombian coast, most often near Barranquilla.
- Surface wind directions turn from easterly to northeasterly in the region of maximum surface winds.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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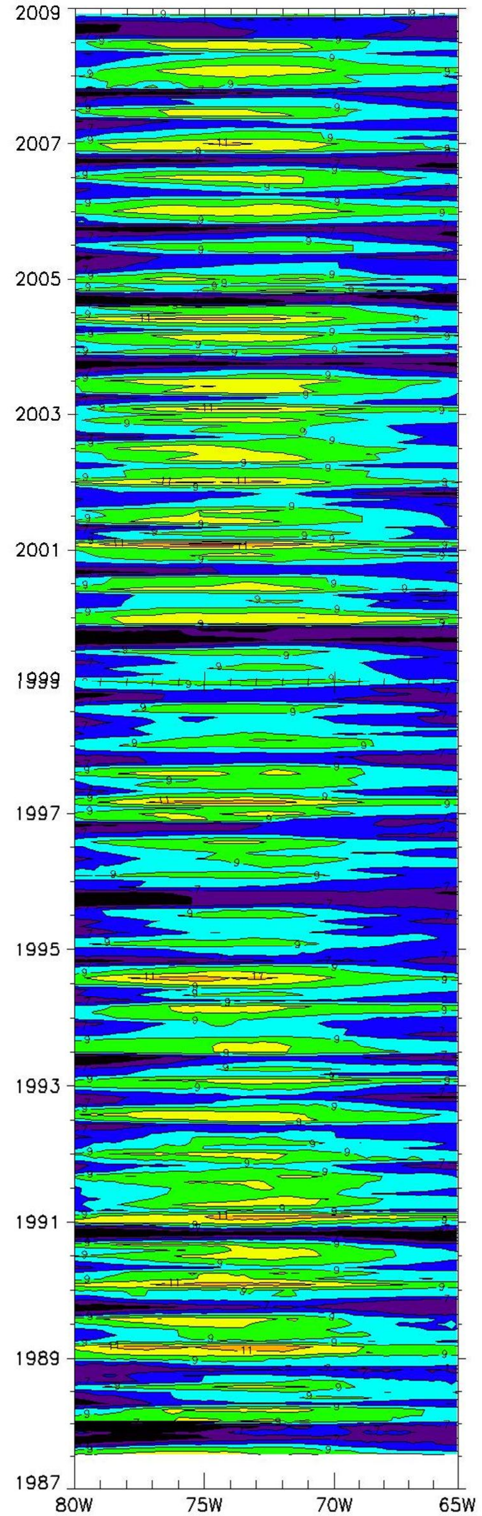

Figure 4. SSM/I time-longitude plot of surface wind speeds averaged over 14-16 deg N latitude. Contours are in m/s with yellow = 10 m/s and orange = 11 m/s. The highest wind speed during these 22 years is 12 m/s.

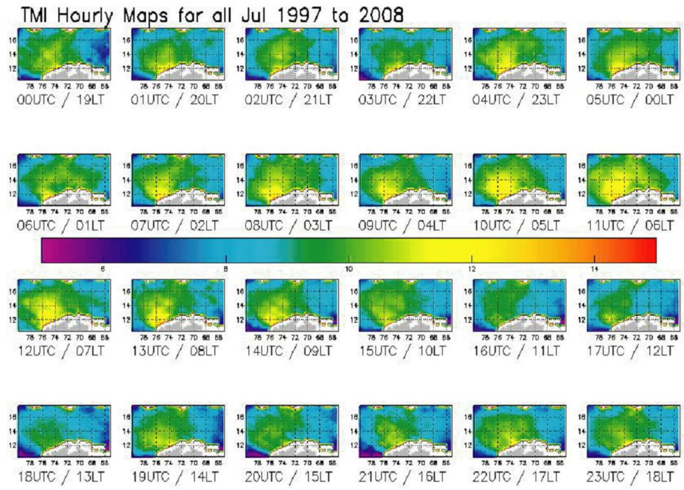

Figure 3. Maps of wind speeds (in m/s) for each hour of the July mean day averaged from all TMI data 1997 to 2008.