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Comment on "Low frequency variability in globally integrated tropical cyclone power dissipation" by Ryan Sriver and Matthew Huber

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[1] *Sriver and Huber* [2006] (hereinafter referred to as SH06), in an effort to examine low frequency tropical cyclone (TC) intensity trends, utilized atmospheric reanalysis data (ERA40 [*Uppala et al.*, 2005] and NNR [*Kalnay et al.*, 1996]) to develop a TC power dissipation (PD) climatology. The variance of the normalized filtered TC PD time series (SH06, Figure 1) matched up well (especially after 1978) with the results of *Emanuel* [2005] (hereinafter referred to as E05), who employed the best-track (BT) dataset. SH06 therefore asserted that the ERA40 TC PD climatology was an independent, uncorrected, and robust representation of trends in global TC activity. Furthermore, SH06 concluded that the power dissipation index (PDI) developed by E05 was an accurate estimate of the PD. In this comment, we question the veracity of SH06's assertion that the ERA40 PD is an independent confirmation of E05's findings.

[2] SH06 acknowledged that the ERA40 surface wind data was perhaps unreliable prior to the assimilation of satellite observations (~1979). Nevertheless, they claimed that the ERA40 correctly distinguished TC winds from the background wind field (SH06). Furthermore, they asserted that since the TCs were not 'bogused' into the ERA40, their methodology and results were ''truly independent'' of previous studies' BT approaches (e.g., E05).

[3] Upon calculating the global ERA40 PD and PDI (SH06, Figure 1), SH06 found the curves overlapped ($R > 0.98$) and concluded that the trends in maximum sustained winds were nearly identical to trends in area-integrated storm winds. This result is not surprising after examining the ERA40 TC wind fields. Figure 1a is the West Pacific (WPAC) and North Atlantic (NATL) basin subset of TC wind observations from 1958–2001 for the ERA40 and E05 BT. Henceforth, we address the assumptions made by SH06 concerning the ability of ERA40 to accurately and consistently depict TC winds from two viewpoints: the maximum wind speed (PDI) inside the prescribed $7° \times 7°$ TC footprint and the area-integrated wind speed (PD).

[4] The bottom dashed lines in Figure 1a are the ERA40 maximum wind (top line) and mean wind (bottom line) inside the storm footprint. *There is no significant trend in either quantity.* The overall wind speeds, either area-integrated or maximum, are considerably less than the BT maximum sustained wind. The ERA40Mean and ERA40Max winds for major TCs also do not exhibit a significant trend throughout the dataset (Figure S1 of the auxiliary material).[1]

[5] Upon examination of our Figure 1a, we do not agree with SH06's contention that the reliability of ERA40 surface winds prior to 1979 caused degraded correlations with the E05 BT PDI. One would expect a noticeable jump or discontinuity in the mean or maximum winds. Instead, the ERA40 consistently (albeit a considerable underestimate) depicts TC wind speeds throughout the entire 1958–2001 period in the mean sense (WPAC + NATL). A Saffir-Simpson scale breakdown is provided in Table S1 for the WPAC and the NATL combined for the pre- and post-satellite eras. During both eras, the difference between a Category 1 and 5 is only 1.5 m/s or about a 10% difference in wind speed with large variability. There are many instances in the ERA40 in the NATL of a Category 4+ resolved with less than 11 m/s surface winds including Hurricanes Donna (1960), Flora (1963), Edith (1971), Andrew (1992), and Cindy (1999). EPAC basin major TC representations are exceptionally weak with major TC maximum winds of 8 m/s (not shown). These results are consistent with *Manning and Hart*'s [2007]; SH06 erroneously described the ERA40 TC representations as ''correct'' and ''robust''.

[6] In Figure 1b, the heavy black line is an unfiltered, normalized reproduction of E05 BT PDI from SH06's Figure 1 for the WPAC + NATL. The red (green) line represents the PD (PDI) calculated from ERA40 surface winds while the blue line represents the PDI calculated using only an arbitrary constant wind value of 8 m/s. Since the energy plotted is normalized by standard deviations from the mean energy, the choice of constant wind is indeed arbitrary.

[7] Figure S2 provides the global PD and correlations for the ERA40, NNR, and an arbitrary constant averaged wind speed. The correlation between the NNR and ERA40 is $R = 0.96$, which agrees with the nearly overlapping curves in SH06's Figure 2. SH06 claim that this high correlation is evidence of the ''robustness'' of the reanalysis products. Again, from our previous discussion on the actual TC wind representations in the ERA40 and NNR, this claim is baseless. The area-averaged wind used in the global PD calculation, regardless of the dataset, varies little about a constant value. Hence, any arbitrary constant wind can be chosen (Figure 1b, blue line) to eliminate the year-to-year

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[1]Auxiliary material data sets are available at ftp://ftp.agu.org/apend/gl/2006gl028283. Other auxiliary material files are in the HTML.

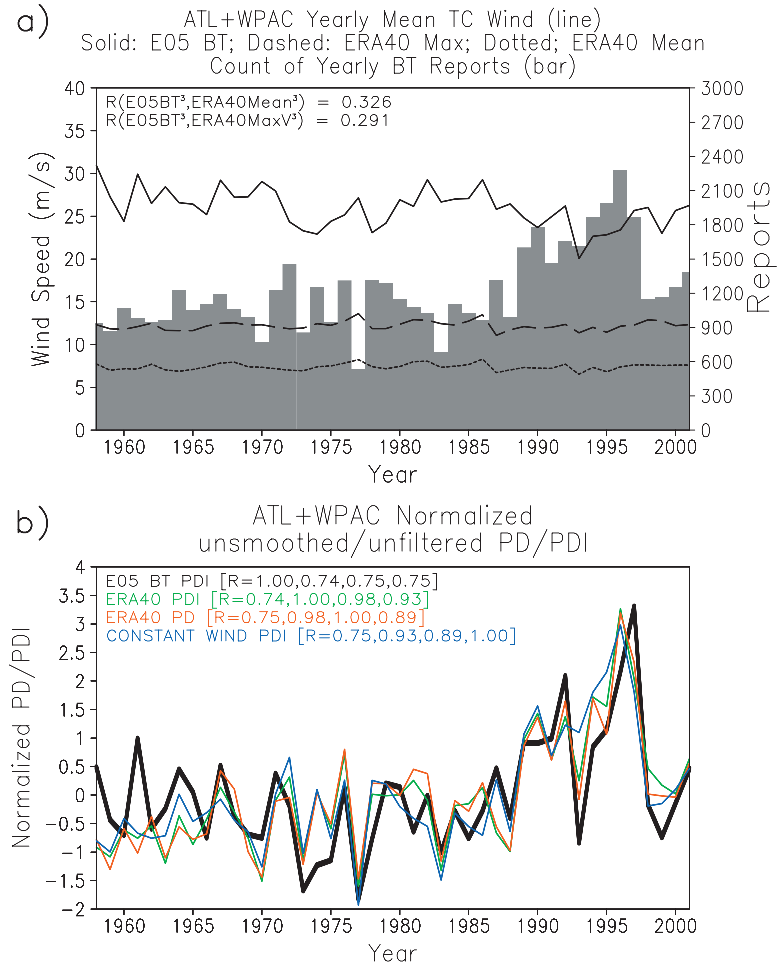

Figure 1. For all 1958–2001 NATL and WPAC TCs: (a) Mean yearly winds for BT, ER40Mean, and ERA40Max (lines) with number of yearly BT reports in the background bar chart. Correlations are between the respective annual-mean cubed wind quantities. (b) PD/PDI normalized according to each time series individual mean and standard deviation. The line colors are described in the legend along with respective R values in matrix for comparison.

intensity variations so that only the TC lifespan and frequency are retained. The correlation between this constant wind and the ERA40 still exceeds R = 0.90. Thus, approximately 80% of the global PD variance is explained simply by the duration and frequency provided by the BT dataset.

[8] To effectively compare with E05, SH06's Figure 1 concentrated only on the WPAC and NATL and attributed large differences between the ERA40 and E05 normalized PDI prior to 1979 to shortcomings in the ERA40. However, with the conclusions drawn from the ERA40Mean and ERA40Max winds from Figure 1b, this disagreement is not supported by the data utilized. We see from Figure 1a that with normalized, unfiltered quantities, the ERA40 or NNR curves (PD and PDI) appear to be well-correlated with the BT PDI during the transition into the satellite period (∼1979). In fact, R > 0.85 whether the period 1979–2001 or 1967–2001 is chosen (not shown), and bifurcates prior to the late 1960s (R = 0.16 for 1958–1967).

[9] E05 applied adjustments to the WPAC BT winds with weighting corrections changing in 1967. Figure 2 addresses the nature of this bifurcation and shows the year-to-year correlation between 6-h E05 BT winds and 6-h ERA40 mean winds (7° × 7° footprint average) along with the three years of E05 weighting change (red, blue, and green lines). The combined and individual basin plots clearly show the bifurcations in the WPAC and ATL correlations coinciding with the E05 corrections. The data quality in both the BT and reanalyses is of course more highly suspect during these periods and is likely a contributing factor as well. It is noteworthy that the correlations are far more uniform overall in the NATL basin where one pre-1970 correction was applied.

[10] In summary, the *track* database is the same for both the E05 and SH06. Thus, the annual total existence (hours) of TCs is the same among the two datasets. Based upon this and this alone, it is incorrect to assert that any track-dependent statistics (such as PD or PDI) derived from these two datasets are independent. Accordingly, the time integral and area-integral are irrelevant when comparing the ERA40 PD/PDI to the E05 BT PDI since each quantity is constant: 6-hour Δt or 7° × 7° footprint (latitude effects notwithstanding). Thus, the resulting relevant comparison for independence is simply the TC wind cubed (whether maximum wind for PDI or area-averaged wind for PD). Hence, the contribution to R between ERA40 PD and E05 BT PDI that is independent of the frequency of occurrence in the E05 BT is simply the correlation between 6-hourly V^3

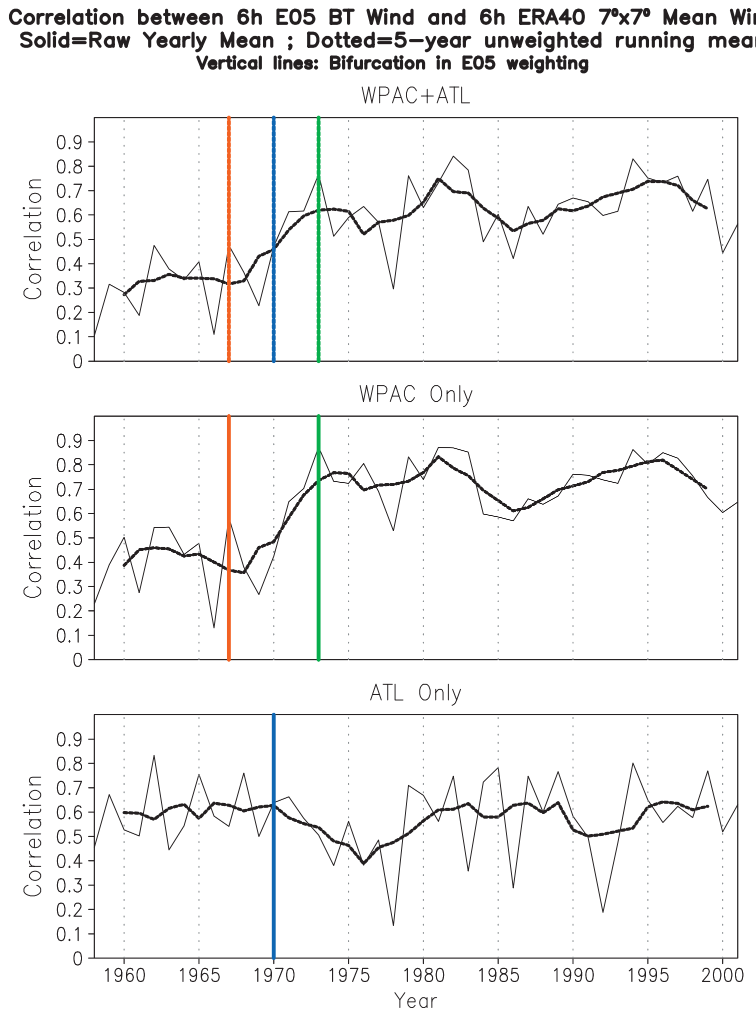

Figure 2. Correlation between 6-h BT and ERA40 Mean winds. Solid vertical line is the average R value calculated each year with the 5-year unweighted running mean (vertical dotted). The red/green (blue) lines indicate the endpoints of the respective WPAC (ATL) wind correction periods in E05.

measures in ERA40 and E05 BT. Correlations of accumulated annual means cannot be used here since it would result in unequal weighting among 6-h times from year to year.

[11] As shown in Figure 1a, the correlation between V^3 for the entire dataset (TS strength and above) varies between 0.29 and 0.33 (ERA40 maximum and mean winds). When only Category 3+ track points are considered (Figure S1), the correlation decreases to less than 0.08 ($R = 0.10$ for Category 1+, not shown). Thus, at best 10% of the PDI/PD signal is independent between the E05 BT and ERA40. It follows that 90% of the correlation between ERA40 PD and E05 BT PDI is a function of the year-to-year variability in storm existence (lifespan) rather than intensity.

[12] *From Figure 1a, the annual mean E05 BT and ERA40 max and mean winds have remained nearly constant from 1958–2001*. The average intensity of TC winds in the ERA40 is that of a marginal tropical storm with little physical difference between Category 1 and 5 winds (Table S1; consistent with *Manning and Hart* [2007]). Moreover, only TC Michelle (2001) in the WPAC + NATL reached a maximum ERA40 wind speed of hurricane strength (>33 m/s). There are no other TCs in the ERA40 with surface winds above tropical storm strength.

[13] The correlation between WPAC+NATL BT and ERA40 PD (PDI) does not change due to the insertion of satellite data in 1979 as SH06 conjectured. The normalized, unfiltered comparisons in Figure 2 show that the time series diverge in the late 1960s. As suggested by the WPAC individual panel in Figure 2, three bifurcation points in the correlations between the ERA40 winds and "corrected" E05 BT winds coincide with adjustment periods in E05.

[14] Since ERA40 and NNR cannot meaningfully distinguish between Category 1 and 5 TC surface winds for PD calculations, an arbitrary constant wind may be used instead of reanalysis products to arrive at nearly the same global PD time series ($R \sim 0.90$). This is not evidence of robustness as concluded by SH06. Furthermore, correlation of the ERA40 PD (V^3) with the Accumulated Cyclone Energy metric (V^2) does not provide any additional evidence of reanalysis products' independence.

[15] In conclusion, the relationship between the ERA40 PD and BT PDI is a result of dataset interdependence on frequency and lifecycle with less than 10% of the correlation arising from intensity variability. Thus, we contend that SH06 does not independently confirm prior studies [E05; *Webster et al.*, 2005; *Trenberth*, 2005].

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