Comments on “Monitoring and Understanding Trends in Extreme Storms: State of Knowledge”

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Kunkel et al. (2013) reviewed the state of the science with regards to long-term changes and trends of various extreme storms that impact the continental United States. In particular, they addressed severe convective storms, precipitation, snowstorms, and—of interest to this comment—hurricanes. All of the analyses presented in Kunkel et al. (2013) (their Figs. 1–7 and Tables 1 and 2) were focused on observations taken over the continental United States, with the notable exception of hurricanes. Instead, their Fig. 5 provided data (updated from Kossin et al. 2007) for the entire North Atlantic and northwestern Pacific basins going back only to 1970 in the form of power dissipation index (PDI). They did reference one study on U.S. hurricane activity (Landsea 2005) and mentioned that it indicated no significant long-term trends. That paper, however, is now dated because of the passing of a decade of new observations as well as revisions being made to the first half of the twentieth century U.S. hurricane record through the Atlantic hurricane database project (Landsea et al. 2008, 2012, 2014; Hagen et al. 2012). Given that Kunkel et al.’s (2013) goal was to “present a clear record . . . about what is known and unknown and why about . . . extreme weather and climate types affecting the United States” (p. 499), this comment examines the most up-to-date record of U.S. hurricanes and the associated century timescale trends.

Hurricanes striking the continental United States compose a sizable percentage (23%) of all Atlantic basin hurricanes since 1972, the first year for reliable all Atlantic basin hurricane frequency owing to the invention of Dvorak satellite intensity technique (Dvorak 1975) coupled with available satellite imagery for the basin. The rather lengthy coastline of the United States tends to experience more hurricane strikes in busy seasons, but not

Fig 1. Continental U.S. hurricanes from 1900 through 2014. The time series is derived from the updated format of the Atlantic hurricane database (HURDAT2; Landsea and Franklin 2013) with results from the reanalysis (Landsea et al. 2008, 2012, 2014; Hagen et al. 2012) incorporated through 1955. The red curve provides a 1–2–1 filter applied twice to smooth interannual variability. The black line provides the linear trend.
every active year causes more U.S. landfalls because of variability in genesis locations and steering flow. The linear correlation coefficient of U.S. hurricanes with all Atlantic basin hurricanes is 0.49 for the years 1972–2014 (statistically significant beyond the 99.8% level after accounting for serial correlation). Thus, while the sample size per season of U.S. hurricanes is substantially smaller than for all Atlantic basin hurricanes, the U.S. hurricane time series reflects some of the same variability as seen in the whole basin.

Figure 1 provides an analysis of U.S. hurricanes from 1900 through 2014. The record begins at the start of the twentieth century as it was approximately at that time that enough coastal communities were established along the U.S. Gulf of Mexico and Atlantic Ocean coasts to ensure a relatively complete monitoring of all U.S. hurricanes (Landsea et al. 2004). Before about 1900, some hurricanes making landfall in parts of relatively unpopulated Texas, Louisiana, and Florida would have been underestimated in their intensity and considered tropical storms (or even missed completely), making the U.S. hurricane record incomplete. The figure shows that there has been a small, statistically insignificant downward trend in the frequency of U.S. hurricanes in this century-long time series. Instead, the record is dominated by interannual- to decadal-scale variability, with the busiest periods occurring in the 1910s, the 1930s to the 1950s, the mid-1980s, and the mid-2000s, while the quietest periods are seen during the 1920s, the 1970s to the early 1980s, the early 1990s, around 2000, and the last few years.

This U.S. hurricane record then puts the results of Kunkel et al. (2013) for Atlantic basinwide activity showing a sizeable increase in activity since 1970 into perspective. The long U.S. landfall record is an indication that this recent upward phase of activity in the Atlantic basin was preceded by quiet and active periods of similar magnitude. Furthermore, because of the use of over 100 years of reliable U.S. hurricane records, one can conclude that there has been no long-term century-scale increase in U.S. hurricane frequencies.

REFERENCES


Reply to “Comments on ‘Monitoring and Understanding Trends in Extreme Storms: State of Knowledge’”

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We welcome the comments of Landsea (2015, hereafter L15) and we applaud his efforts toward reanalyzing past tropical cyclone data in the Atlantic (Landsea et al. 2008, 2012, 2014; Hagen et al. 2012). However, L15 does not substantially change the conclusions stated in Kunkel et al. (2013, hereafter K13). L15 voices two main concerns:

1) The U.S. landfalling hurricane time series considered by K13 is dated.
2) The U.S. landfall record exhibits multidecadal variability that places the changes since 1970 into a larger perspective than K13 provided. Related to this concern, L15 introduces assertions about the relationship between U.S. landfall variability and basinwide North Atlantic variability.

We will address each of these points here:

1) K13 stated “Landfalling tropical cyclone activity in the United States, as well as East Asia, shows no significant long-term trends (e.g., Landsea 2005)” (p. 506). We are not aware of any published papers that have updated the U.S. landfalling hurricane time series beyond the papers cited in K13 [including not just Landsea (2005) but also Vecchi and Knutson (2011)]. L15’s inference that K13 presented dated information is not supported and the update introduced by L15 is in complete agreement with the statements of K13.

2) K13 stated “Owing to pronounced multidecadal variability evident in longer-term records of Atlantic basinwide or U.S. landfalling tropical cyclone frequency (e.g., Vecchi and Knutson 2011, see their Fig. 5), the period since around 1970 (e.g., Fig. 5) appears to be too short to draw confident inferences about longer-term (e.g., century scale) trends in Atlantic tropical cyclone activity” (p. 506). L15 fundamentally concurs with the broader perspective that K13 provides about the inability to draw confident inferences about century-scale trends from the observed post-1970 Atlantic activity.

In K13, a conscious choice was made to focus on the increases over the shorter period since the 1970s and address the attribution for these increases, because much of the state of knowledge is being actively promulgated on this shorter period. This is demonstrated by the citations in K13 as well as the IPCC Fifth Assessment Report (Bindoff et al. 2014) published subsequent to K13. The contrasting emphases of K13 and L15 are both important; one does not preclude the other, and the emphasis of L15 has been previously addressed (e.g., Knutson et al. 2010; Seneviratne et al. 2012; Hartmann et al. 2014; Zwiers et al. 2013). Anthropogenically forced change and internal climate variability have most likely affected North Atlantic hurricane activity and sea surface temperatures in a broad range of ways, and the quantification of these influences remains a significant research challenge (Dunstone et al. 2013; Tung and Zhao 2013; Zhang et al. 2013; Carslaw et al.

1 The authors list on this reply comprises a subset of authors from K13 who specialize in tropical cyclone research, provided comments, or helped lead the overall author team’s work.
2013; Mann et al. 2014). Century-scale trends forced by steadily increasing greenhouse gases are not the only focus of detection and attribution studies and should not define the state of knowledge.

Statements about the relationship between U.S. landfall variability and basinwide variability remain controversial (Holland 2007), and we would argue that the statements of L15 should be subjected to a more formal review than a comment/reply exchange provides. In addition to the decreased signal-to-noise ratio of measured trends when subsetting basinwide activity (K. Nzerem et al. 2006, unpublished manuscript; Emanuel 2011), there are substantial questions about whether U.S. landfalling activity can serve as an adequate proxy for basinwide North Atlantic activity when there are systematic and significant relationships between climate and tropical cyclone track variability (Kossin et al. 2010, 2014). This latter point was discussed briefly in K13. Finally, although the correlation of 0.49 identified by L15 is statistically significant, the associated common variance of only 24% emphasizes that the variability of the U.S. landfall record leaves a very large part (76%) of the basinwide variance unexplained.

Given the importance of understanding changes in the U.S. landfalling hurricane activity and how they relate to basinwide North Atlantic variability and trends, we feel that it is crucial to have the data and methods, as well as assertions of common variance between landfall and basinwide activity, subjected to a more formal and complete peer review, and we hope that Landsea and/or others will undertake a more thorough study.

REFERENCES


Seneviratne, S. I., and Coauthors, 2012: Changes in climate extremes and their impacts on the natu-
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