Reply to "Comments on 'Monitoring and Understanding Trends in Extreme Storms: State of Knowledge'"

Citation: Kossin, James P. et al. "Reply to 'Comments on "Monitoring and Understanding Trends in Extreme Storms: State of Knowledge."'" Bulletin of the American Meteorological Society 96.7 (2015): 1177–1179. © 2017 American Meteorological Society

As Published: http://dx.doi.org/10.1175/bams-d-14-00261.1

Publisher: American Meteorological Society

Persistent URL: http://hdl.handle.net/1721.1/107890

Version: Final published version: final published article, as it appeared in a journal, conference proceedings, or other formally published context

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[1] 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.

DOI:10.1175/BAMS-D-14-00261.1

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.

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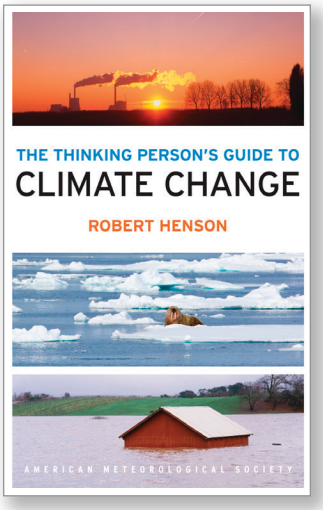

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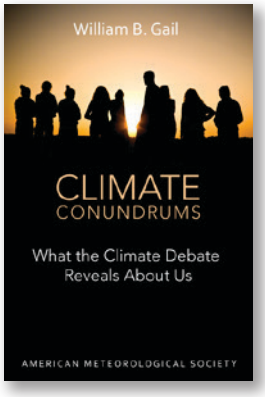

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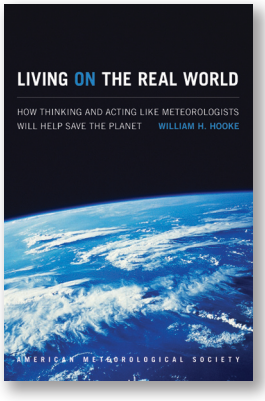

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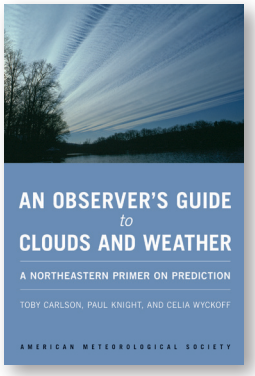

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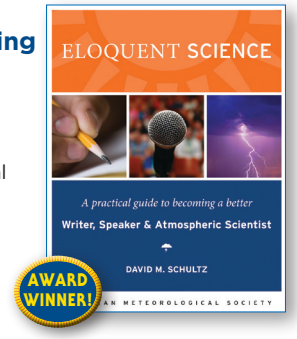

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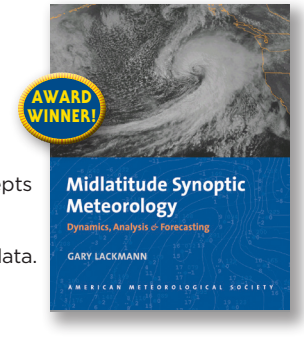

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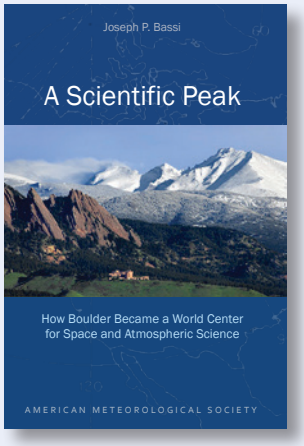

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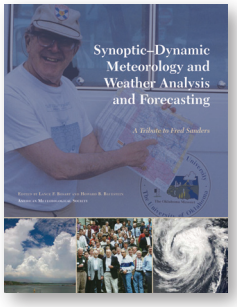

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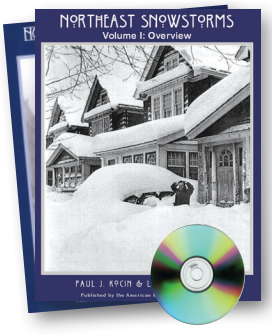

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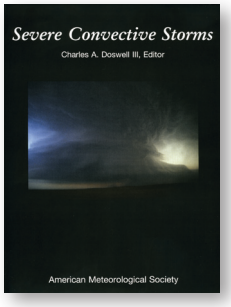

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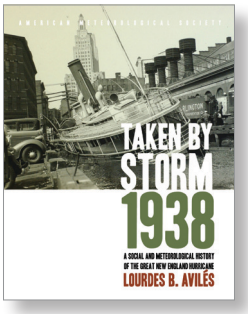

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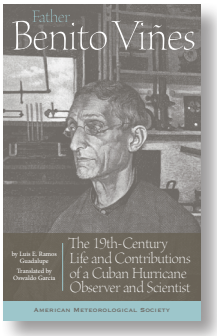

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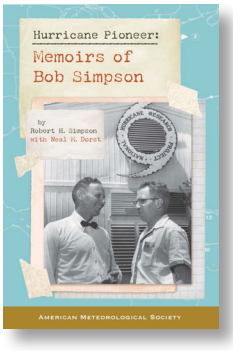

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