CORRESPONDENCE

Comments on "Changes to the North Atlantic Subtropical High and Its Role in the Intensification of Summer Rainfall Variability in the Southeastern United States"

JEREMY E. DIEM

Department of Geosciences, Georgia State University, Atlanta, Georgia

(Manuscript received 13 July 2011, in final form 6 July 2012)

ABSTRACT

In a recent article, Li et al. examined changes in the summer-season location of the western ridge of the North Atlantic subtropical high from 1948 to 2007 because there has been an increase in interannual summer rainfall variability in the southeastern United States. The following major conclusions by Li et al. are incorrect: the western ridge has undergone a significant westward trend since the late 1970s; the western ridge had increased meridional movement during 1978–2007 compared to 1948–1977; and global warming appears to be contributing to the westward expansion of the western ridge. Results presented in this paper reveal that the western ridge has been moving eastward over the past three decades, there was no change in latitudinal variance, and a westward movement of the western ridge should not be linked to global warming.

1. Introduction

In a recent article, Li et al. (2011, hereafter LLFDW11) conclude that the intensification of summer (i.e., June–August) rainfall variability in the southeastern United States has been caused by a westward expansion of the western ridge of the North American subtropical high (NASH), and that global warming is a cause of the westward expansion. Analyses of the NASH using National Centers for Environmental Prediction (NCEP)–National Center for Atmospheric Research (NCAR) reanalysis data (Kalnay et al. 1996) covered the period 1948–2007. LLFDW11 define the western ridge as the point where the 1560-hPa line intersects the ridge line of the NASH, and the mean climatological longitude of the western ridge is 86°W (i.e., over the southeastern United States). I do not take issue with the finding of increased rainfall variability, since it has been reported in other studies (e.g., Wang et al. 2010; Diem 2012). There are, however, three major incorrect conclusions in LLFDW11 that deal the western ridge of the NASH, and those conclusions are analyzed in separate sections of this paper.

2. Longitudinal movement of the western ridge

LLFDW11 state that there has been "a significant westward trend of the western ridge of the NASH since the late 1970s" (p. 1501); however, my analyses revealed that the ridge actually has moved significantly *eastward*. Longitudinal anomalies of the western ridge are shown in Fig. 1 herein; LLFDW11 values were extracted from Fig. 3 in that article, while I used NCEP–NCAR reanalysis data and methods described in LLFDW11 to create a new database of western-ridge longitudes from 1948 to 2010. In addition to not providing a longitude anomaly value for 2007, LLFDW11 also fail to report that the anomaly values have been normalized. Nevertheless, there is a perfect correlation between the two sets of anomalies for 1948–2006. Using one-tailed Spearman's ρ correlation tests, I examined trends in the longitude of the western ridge for all time periods with an ending year of 2010. Therefore, correlation coefficients were determined for 34 periods (e.g., 1948–2010, 1949–2010, … , and 1981–2010). I also examined the trend from 1948 to 2007, which matches the time period used in LLFDW11. The only significant ($\alpha = 0.01$)

Corresponding author address: Jeremy E. Diem, Department of Geosciences, Georgia State University, P.O. Box 4105, Atlanta, GA 30302.
E-mail: jdiem@gsu.edu

DOI: 10.1175/JCLI-D-11-00390.1

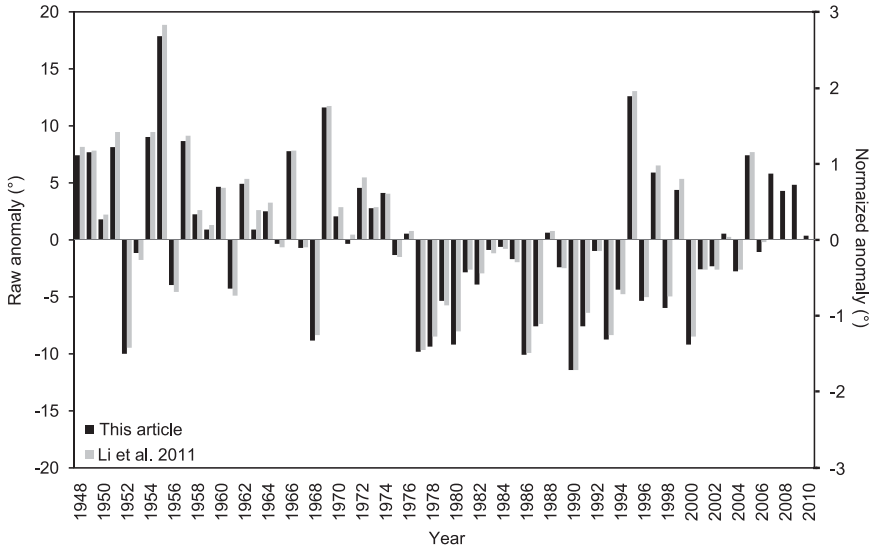

FIG. 1. Longitude anomalies for the western ridge of the North Atlantic subtropical high from this paper (primary *y* axis) and from Li et al. (2011) (secondary *y* axis) from 1948 to 2010.

negative trend (i.e., significant westward movement) occurred for 1948–2007; therefore, excluding values from 2008, 2009, and 2010 produced a significant result. The significant positive trends (i.e., significant eastward movement) for western-ridge longitude were found for 1974–2010, 1975–2010, 1976–2010, 1977–2010, 1978–2010, 1979–2010, 1980–2010, 1981–2010, and 1948–2007. The western ridge was at its westernmost position from 1977 to 1987 (Figs. 1 and 2), but it has moved eastward since then.

Figure 1 reveals an abrupt westward shift of the western ridge of the NASH in the mid-1970s. The shift corresponds with a shift from the cold phase of the Pacific decadal oscillation (PDO) to the warm phase of the PDO (Mantua et al. 1997). The western ridge of the NASH began moving significantly eastward after the shift.

3. Latitudinal movement of the western ridge

LLFDW11 claim that the increased rainfall variability during 1978–2007 compared to 1948–77 was caused in part by increased meridional (i.e., latitudinal) movement of the western ridge during 1978–2007; however, I did not find any change in latitudinal movement from 1948–1977 to 1978–2007. The latitude of the western ridge is shown for each year in Fig. 3. Unfortunately, latitude data are not provided in LLFDW11; therefore, direct comparisons cannot be made. The standard deviations of latitude during 1948–77 and 1978–2007 were 2.04° and 2.03°, respectively.

4. Global warming and changes in the western ridge

LLFDW11 claim that global warming appears to be contributing to the changes of the NASH; however, if it has been affecting the western ridge, then it has been causing an eastward movement rather than a westward movement. Global temperature data were obtained from the National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies (GISS) surface temperature analysis site (http://data.giss.nasa.gov/gistemp/), and one-tailed Pearson product-moment correlation tests revealed no significant (α = 0.01) negative correlations between temperature and western-ridge longitude when considering all possible periods ending in 2010 (Fig. 4); both same-year and previous-year global surface temperatures were examined in conjunction with western-ridge longitude. In fact, the only significant correlations were positive correlations covering 1976–2010, 1977–2010, 1978–2010, and 1979–2010. Global warming beginning in the mid- to late 1970s has coincided with an eastward movement of the western ridge of the NASH.

5. Conclusions

Multiple conclusions made by LLFDW11 concerning changes in and controls of the location of the western ridge of the NASH are incorrect. LLFDW11 make the following incorrect statements about the western ridge: it has undergone a significant westward trend since the late 1970s; it had increased meridional movement during 1978–2007 compared to 1948–77;

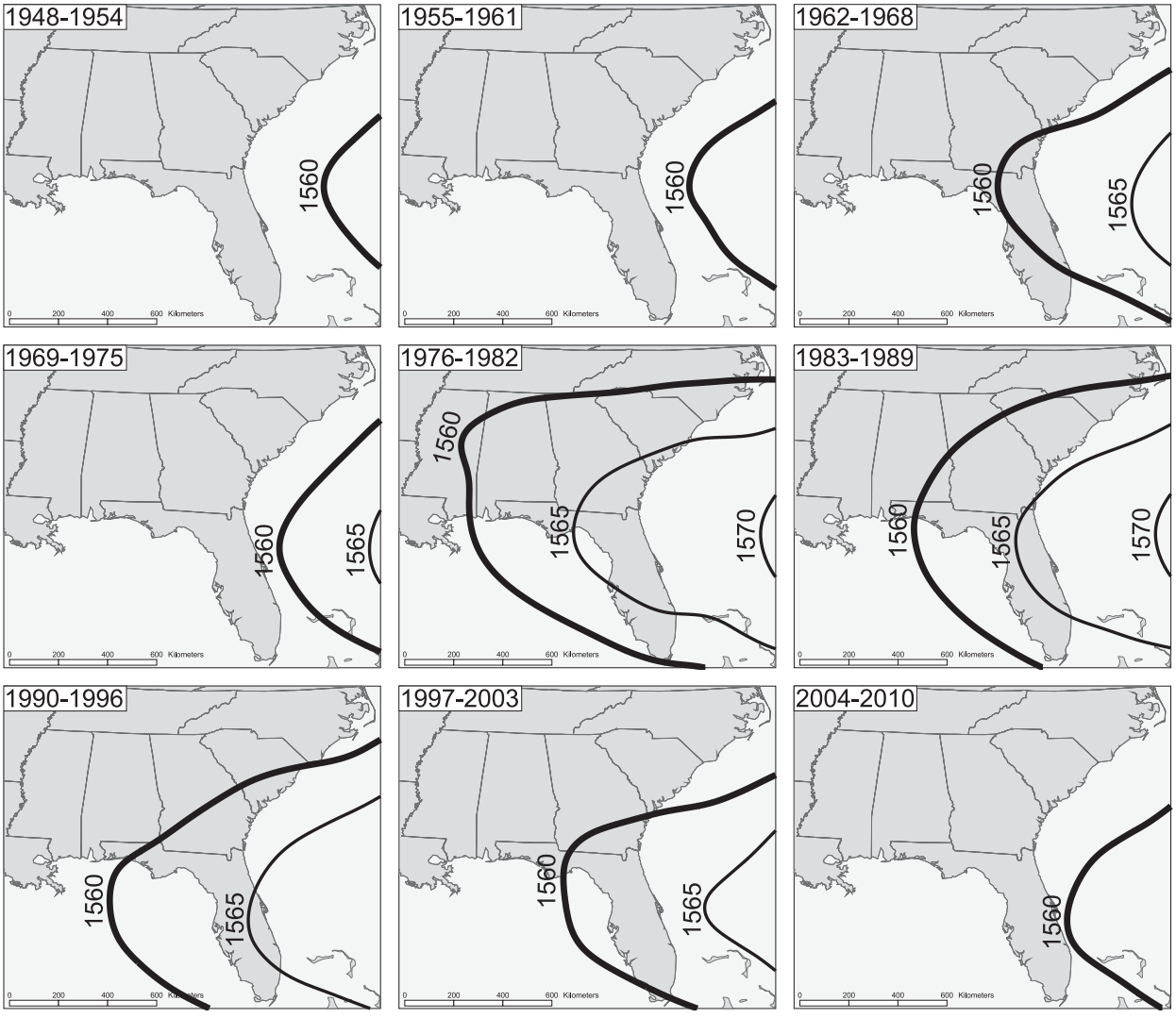

FIG. 2. Mean position of the western ridge of the North Atlantic subtropical high for nine 7-yr periods from 1948 to 2010. Li et al. (2011) use the 1560-m line to represent the western boundary of the NASH. Only the 1560-, 1565-, and 1570-m lines are shown.

and global warming appears to be contributing to its westward expansion. My analyses of the western ridge have revealed the following: 1) the western ridge actually has moved significantly eastward since the late 1970s; 2) there was no change in latitudinal variances of the western ridge between 1948–77 and 1978–2007; and 3) global warming has not caused the western ridge to move westward. LLFDW11 is misleading about the impacts of global warming on the western ridge of the NASH: there is no solid evidence that global warming over the past several decades has caused the western ridge to move westward and that the westward expansion of the ridge has caused increased interannual rainfall variability.

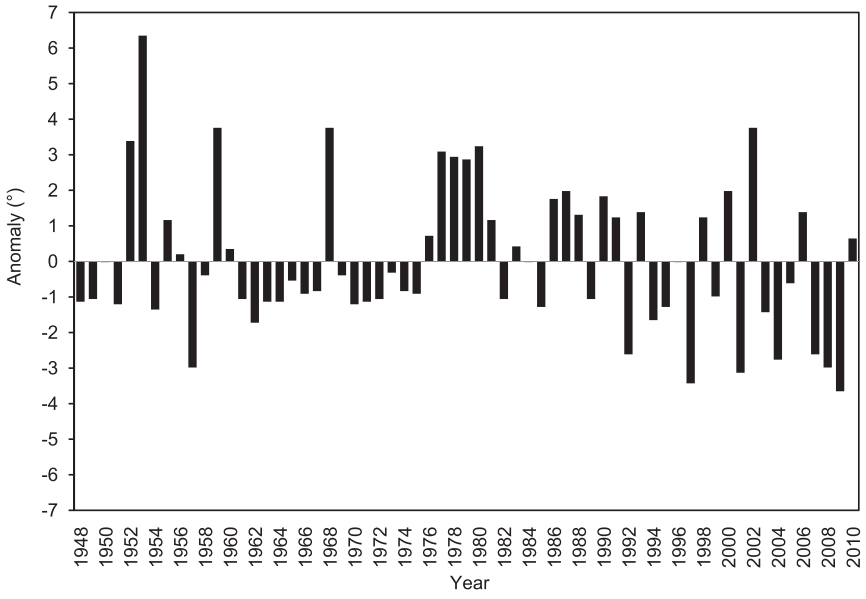

FIG. 3. Latitude anomalies for the western ridge of the North Atlantic subtropical high from 1948 to 2010.

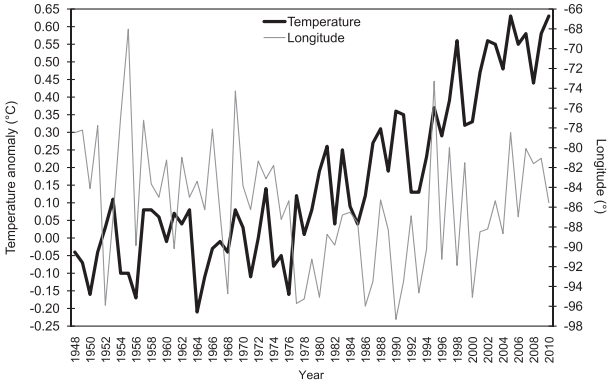

FIG. 4. Global surface temperature anomalies (1951–80 base period) and longitude of the western ridge of the North Atlantic subtropical high from 1948 to 2010.

REFERENCES

Diem, J. E., 2012: Influences of the Bermuda high and atmospheric moistening on changes in summer rainfall in the Atlanta, Georgia region, USA. *Int. J. Climatol.,* doi:10.1002/joc.3421, in press.

Kalnay, E., and Coauthors, 1996: The NCEP/NCAR 40-Year Reanalysis Project. *Bull. Amer. Meteor. Soc.,* **77,** 437–471.

Li, W., L. Li, R. Fu, Y. Deng, and H. Wang, 2011: Changes to the North Atlantic subtropical high and its role in the intensification of summer rainfall variability in the southeastern United States. *J. Climate,* **24,** 1499–1506.

Mantua, N. J., S. R. Hare, Y. Zhang, J. M. Wallace, and R. C. Francis, 1997: A Pacific interdecadal climate oscillation with impacts on salmon production. *Bull. Amer. Meteor. Soc.,* **78,** 1069–1079.

Wang, H., R. Fu, A. Kumar, and W. Li, 2010: Intensification of summer rainfall variability in the southeastern United States during recent decades. *J. Hydrometeor.,* **11,** 1007–1018.