Introduction to special section on The role of the Atlantic warm pool in the climate of the Western Hemisphere

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[1] All the contributors to this special section discuss observational studies of the influence of the Atlantic Warm Pool (AWP) on the Earth's climate, and investigate the reproducibility of these results in atmospheric models, by examining the influence of the AWP using coupled ocean–atmosphere–land models, and by exploring the effect of the AWP on the climate and on the occurrence of hurricanes under different scenarios of global warming.

[2] The Atlantic warm pool (AWP) is a large body of warm water that comprises the Gulf of Mexico, the Caribbean Sea, and the western tropical North Atlantic. The AWP is subject to a significant degree of seasonal cycling, and the area covered by it fluctuates considerably, in that at its maximum extent, it has an area almost three times that at its minimum.

[3] Some authors have recently observed the strong influence of the AWP on the global and regional climate. *Wang et al.* [2006], for example, showed evidence of the influence of the anomalous behavior of the AWP on summer rainfall and Atlantic hurricane activity in the Western Hemisphere. *Durán-Quesada et al*. [2010] and *Gimeno et al.* [2009, 2010, 2011] provided some recent examples of the role of AWP as the main source of moisture on both sides of the Atlantic.

[4] Through numerical modeling, *Wang and Lee* [2007] and *Wang et al.* [2007] showed that the effects of the annual variations in the AWP are (1) to weaken the summer North Atlantic Subtropical High (NASH); (2) to strengthen the summer continental low over the North American monsoonal region; (3) to reduce the strength of the easterly Caribbean Low-Level Jet (CLLJ) and its associated westward transport of moisture; (4) to weaken the southerly Great Plains Low Level Jet (GPLLJ) and thereby to alter the character of its northward transport of moisture; and (5) to reduce the tropospheric vertical wind shear in the main region of hurricane development, thereby increasing the moist static instability of the troposphere, both of which are believed to favor the formation of hurricanes and their development during the Atlantic hurricane season.

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[5] These important effects of the AWP suggest that its influence on the global and regional climate merit further study. Climatic phenomena such as the El Niño–Southern Oscillation, the North Atlantic Oscillation, and the Atlantic Multidecadal Oscillation can act on, or interact with, the AWP at interannual to multidecadal time scales, and thus have an indirect influence on the climate.

[6] In this special section of *JGR-Atmospheres*, the contributors all discuss observational studies of the influence of the AWP on the climate, and investigate the reproducibility of these results in atmospheric models, by examining the influence of the AWP using coupled ocean–atmosphere–land models, and by exploring its impact on climate and on hurricanes under different scenarios of global warming.

[7] Some of the more recent observations on the dynamics of the Caribbean Sea have been the cause of some excitement for atmospheric scientists, and are yet to be fully explained. The presence of the Caribbean Low Level Jet (CLLJ) [*Amador*, 1998] and its barotropically unstable nature [*Molinari et al.*, 1997] have caused a number of theories to be put forward to explain the interseasonal and intraseasonal variability of the climate over the AWP. The origin of the CLLJ has not been well established, but its role in determining precipitation over the Antilles, Mesoamerica and southern North America is critical. The previous analyses of *Schubert et al.* [2009] and *Méndez and Magaña* [2010] have shown how the characteristics of the CLLJ may lead to prolonged periods of drought over North America. The analyses by *Drumond et al.* [2011] point to the importance of the CLLJ, by examining the transport of moisture over the IAS or the characteristics of the precipitation there, and *Taylor et al.* [2011] showed the importance of the CLLJ in the annual cycle of precipitation over the Caribbean. There are numerous interactions between the AWP, the local circulation and the regional climate, highlighting the complex nature of the dynamical processes of the climate in the IAS. Therefore, *Misra et al.* [2011] showed that sea breezes in southwestern and northwestern Florida are modulated by variations in the size of the AWP on interannual time scales. During those years when the AWP is large, when the low-level, large-scale, mean trade winds are weak and the surface of the ocean is warm, the resulting circulations of the sea breeze are weaker than they are during those years when the AWP is small. The intensity of the CLLJ may result in anomalies in SST off the coast of northern South America, which may in turn affect regional convective activity. *Chan et al.* [2011] presented an example of the complex interactions that are

possible over the AWP. The numerous interactions among the various phenomena must all be accounted for if the variability of the climate over the IAS is to be explained. Interactions between transient and mean flows may well determine some of the more important regional characteristics of the temperature and climate. This is the case for the tracks of tropical cyclones, the structure of the mean flow and the regional precipitation. If the projections of regional climate change over the Caribbean Sea are to be deemed to be reliable, all these processes must be rather better simulated by the regional climate models than they are at present. The work of *Comarazamy and González* [2011] has been useful to show the current trends in the climate of the Antilles that may be the result of changes in large-scale circulation, while *Jury and Gouirand* [2011] analyzed the decadal climate variability of an area close to the AWP, namely the Eastern Caribbean. The area of influence of the AWP is not without remote influences, and *Kelly and Mapes* [2011] found that interannual variations of the Indian monsoon reflect changes in the strength of the zonal mean easterlies. They found downstream teleconnections with the westward displacement of the North Atlantic subtropical High (NASH), and precipitation in the West Atlantic (WATL), with an increase in rainfall in India in June and July corresponding to a decrease in rainfall in the WATL.

[8] This special section of JGR constitutes an important contribution to the foregoing discussion, and will spur renewed efforts to examine the dynamical processes that determine climate variability and change over the IAS. New ideas and hypotheses are put forward to improve our understanding of the rich variety of the climatic phenomena present in a region that contains more than 30 million inhabitants, and which is frequently vulnerable to extreme meteorological and climatological events.

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