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Editorial

Large-Scale Dynamics, Anomalous Flows, and Teleconnections 2018

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The topic of large-scale dynamics, anomalous flows, and teleconnections (LDAT) continues to be of great interest to the weather and climate community, especially given recent changes in climate during the last few decades and projected climate changes [1]. The impact of climate change could be very complex, especially regarding its impacts on teleconnections (e.g., [1]), the occurrence and dynamics of severe weather events (e.g., [2]), or the occurrence and intensity of large-scale events associated with local temperature and precipitation variability such as blocking anticyclones. Additionally, research has shown that large-scale regional anomalies are associated with regional anomalies of radiatively important gasses such as water vapor or ozone or with the concentration of atmospheric aerosols.

Many recent studies continue to examine the behavior of teleconnective regimes in more detail than ever within various regions of the globe in order to understand how these might change in the near and far future. A better understanding of these phenomena and their local, regional, or global impacts will provide more information to the private and public sectors so that societies can be better prepared to meet their needs while minimizing their exposure to destructive phenomena.

Knowing the climatological and dynamic character of flow regimes that impact regional weather and climate is essential for long-range forecasting or constructing future scenarios. The study of I. Rousta et al. examined the nature and distribution of atmospheric vorticity in the region of the Middle East and Asia during winter-season precipitation events occurring in Iran. Cluster analysis was used to identify the prevailing large-scale configuration of atmospheric pressure centers from 1961 to 2013 based on variables such as the occurrence of significant precipitation and vorticity at mandatory levels (1000, 850, 700, and 500 hPa). This study identified five different synoptic scenarios that were associated with more persistent precipitation events (low pressure over Iran and a strong Siberian High) as well as heavy precipitation events (high pressure over East Europe and low pressure over Iran). The latter scenario is similar to the flooding rains that occurred in the region in association with the strong blocking event that occurred over Eastern Europe and Western Russia during the summer of 2010. They also found that three of the patterns associated with winter precipitation events formed and decayed over the study region, while two of them originated outside the area. Additionally, they examined the dynamics that contributed to upward motions in these patterns.

It is of great importance that climate models should be evaluated based on their ability to simulate the general character of climate, as well as specific features of the general circulation. To this end, O. Lhotka and A. Farda investigated the relationship between flow anomalies and daily surface temperature and pressure biases in a climate model ensemble by using historical circulations and comparing them to the National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute for Research in Environmental Sciences (CIRES) twentieth-century reanalyses. The climate model used was the Centre National de Recherches Météorologiques (CNRM) Climate Model version 5.1 (CM5.1), and this model is part of the Coupled Model Intercomparison Project (CMIP). Three ensemble members were chosen for study with differing initial conditions using spatial resolution that is consistent with the reanalyses used. They found that, while the CNRM-CM5.1 model skillfully reproduces the general temperature patterns for the globe, this model has similar weaknesses to other CMIP models. The most relevant issues found in all three ensemble members are as follows: (a) warm (cold) biases in the South (North) Atlantic, (b) positive temperature and negative pressure biases in the South American and African upwelling regions, and (c) the frequency of zonal flow over North America resulting in warm temperature biases. Presumably, such temperature and pressure biases will be influential in the model's ability to simulate interannual variability.

In the observation and study of teleconnections, indexes are used to quantify the existence, phase, and intensity of the phenomenon in a simple and straightforward way using standard observations. Here, K. Liu et al. developed a dynamical index to quantify and understand the India-Burma Trough (IBT). Studying the IBT is important also to understand the behavior of Southeast Asian Monsoon over time. Additionally, the IBT is an important feature in providing moisture to societies that are impacted by this feature for agricultural production and drinking water. Their proposed index sums up vertical motions obtained from five pressure levels between 700 hPa and 500 hPa, inclusive, within the IBT geographic location. In order to obtain a positive number, the obtained value is multiplied by a negative one. They used the monthly Modern-Era Retrospective Analysis for Research and Application (MERRA) provided by the Goddard Earth Sciences Data and Information Services Center (GES DISC) from 1979 to 2012. As many studies of midlatitude cyclones demonstrate, the upward motion in the IBT region is associated with the advection or flux of vorticity and temperature. The new index, like others, also reflects the strength of the IBT and possesses an annual cycle. Changes in the strength of this index will also be the result of the strength and position of the synoptic patterns in adjacent regions.

Teleconnections and anomalous flows can be associated with extreme events on very local time and space scales. J. L. Rabinowitz et al. examined the correlation between atmospheric blocking occurring within the Pacific Ocean region and heavy rainfall for an agriculturally important region in the Midwest USA. Many authors have demonstrated the link between anomalous weather and blocking within the regions they impact and those areas up- and downstream of these events. While climate models project that the occurrence of blocking may not change appreciably in the future, such events will still be associated with extreme weather [1]. J. L. Rabinowitz et al. examined parameters such as block intensity, block size, block onset lead time, block duration, and genesis location and found associations with heavy rainfall ($>50.8\text{ mm } 24\text{ h}^{-1}$) in the mid-Mississippi River Valley since 1999. This study found that there was a greater propensity for Pacific Region blocking during La Nina years to be associated with heavy rainfall events in the study region. This is likely due to the impact of blocking on the storm track over this region. They also found that strong blocking events were associated with larger rainfalls. Additionally, blocking events that formed further west in the Pacific were associated with larger regional rainfalls.

In conclusion, these contributions to the topics examined in the LDAT series continue to provide insight into the unresolved issues related to large-scale meteorological phenomena. In doing so, the new information will be available to the operational community as they strive to provide improved forecast skill to the general public, as well as policy-makers.

Conflicts of Interest

The editors declare that they have no conflicts of interest regarding the publication of this special issue.

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