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*Editorial*

# Large-Scale Dynamics, Anomalous Flows, and Teleconnections

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In the last decade, there has been much interest in the topic of large-scale dynamical meteorology, including the phenomena of anomalous atmospheric flows such as blocking anticyclones and teleconnections. There is also interest in the topic of global climate change and how it may drive subsequent changes in the climatological character of the large-scale flow and blocking. Several studies in recent years have examined the question of whether large-scale flow changes could potentially lead to the more frequent occurrence of severe or extreme weather events. There has also been research in the predictability of large-scale flows and teleconnections, as improvements in our understanding of these topics have led to advances in long range forecasting (LRF). LRF generally entails forecasts of ensemble statistics of monthly or seasonal temperatures and precipitation or their anomalies. These forecasts are used routinely by economic and agricultural interests and policy makers in order to make optimal decisions about the use of resources.

Studying the behavior of large-scale flows predates the birth of meteorology as a distinct branch of physical science (e.g., [1]). Concepts such as barotropic or hydrodynamic instability were of interest to the physics community for many years. Then, in the early 20th century, Wilhelm Bjerknes and those in the Bergen School laid the foundation for examining large-scale atmospheric flows as geostrophically balanced systems. Geostrophy is the most rudimentary approximation of a geophysical flow that can still be considered realistic. While geostrophy provides the underpinnings of our understanding of large-scale flows to this day, the assumption of pure geostrophy would be too limiting. Given the sparse observations of the early 20th century, this understanding was sufficient. Soon after, Rossby [2] and Ertel [3], using potential vorticity dynamics, described the behavior of large-scale inertial waves in the atmosphere.

The advent of numerical modeling by the middle of the 20th century opened the door to understanding more about the character of large-scale flows in the atmosphere. The studies of Edward Lorenz (e.g., [4]), which examined chaos and predictability in large-scale flows, were stimulated by an interest in understanding why the Northern Hemisphere jet stream seemed to vacillate between low amplitude (zonal) and high amplitude (meridional) state. About the same time, atmospheric blocking anticyclone events as a distinct phenomenon appeared as a subject of interest in the published literature nearly 50 years after Garriott [5] first coined the term. Atmospheric blocking typically describes a persistent, midlatitude ridging in the middle and upper troposphere that impedes the regular progression of synoptic-scale cyclones along a storm track. They can also occur episodically and dominate regional flow regimes for an entire season or more. Later in the 20th century, the concept of teleconnections gained currency as meteorology endeavored to explain why weather and climate in one region on the planet correlated strongly with weather and climate in far distant regions [6].

Following this development, there has been attention paid to the interannual variability and now the interdecadal variability in teleconnection patterns. This attention to interannual variability has extended to anomalous flows and blocking as well.

As we move into the 21st century, there are still issues in large-scale flow dynamics that have yet to be explored. While the dynamics of large-scale meteorology have been largely described, one outstanding issue is anticipating a change in the hemispheric flow regime. This change can influence the timing of the onset and termination of blocking events and can happen gradually or quite abruptly.

One of the contributions to this issue examines large-scale flow regime changes in a numerical model. Other contributions examine the interannual variability of large-scale and general circulation features such as the jet stream/storm tracks, the monsoon circulations, and regional teleconnections. These studies are important for understanding the future evolution of our climate. Blocking most recently contributed to the deadly heat wave that occurred over western Russia during the summer of 2010. As stated above, extreme events and their occurrence are an important topic of study. This event stimulated much research including those in this issue examining the source of water vapor which led to high humidity during this heat wave and the predictability of drought in Eastern Europe and western Russia. Another avenue of study in large-scale dynamics that developed during the mid-20th century was the energetics of large-scale flows. The energetics of large-scale flows in an increased carbon dioxide environment are also examined using commonly accepted possible future climate scenarios. The research presented here will stimulate our further understanding of the behavior and variability in large-scale atmospheric flows and aid in the development of tools for long range forecasting.

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