ATS/CIRA Colloquium

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Sudden Stratospheric Warmings and their Surface Impacts

Hosted by David Thompson

3 p.m. Thursday, Feb. 13
ATS room 101

Sudden stratospheric warmings (SSWs) are midwinter events in which the primary stratospheric circulation, which is characterised by a strong cyclonic vortex over the polar cap, abruptly breaks down, leading to an explosive warming of the polar stratosphere. SSWs modify the circulation throughout the stratospheric column. Furthermore, it is now well established that they tend to modify the large-scale circulation near the surface for up to 2 months following the stratospheric event. Fundamentally, SSWs are a manifestation of anomalously strong two-way interactions between upward propagating planetary waves and the mean flow. However, the conditions that trigger anomalously strong wave-mean flow coupling leading to an SSW are still not well understood. While tropospheric precursors to SSWs have often been noted (e.g., blocking), SSWs have also been shown to spontaneously arise due to fortuitous coupling of a fixed wave field provided by the troposphere and the concurrently evolving state of the stratosphere.

In the first part of this talk I will present evidence based on reanalysis data and climate model simulations that the explosive dynamics associated with SSWs primarily take place within the stratosphere. Anomalous upward wave fluxes from the lower troposphere may play a role for some events, but seem less important for the majority of them. In the second part of this talk I will discuss the surface impact of SSWs based on a case study of the SSW that occurred during February 2018, which was followed by a severe cold spell over Eurasia. Specifically, ensembles of extended-range forecasts show that the cold spell was predicted with the observed strength roughly 10 days in advance. However, the probability of occurrence of the cold spell was doubled up to 25 days in advance, when the SSW occurred. Our results support that it is the subsequent evolution throughout the lower stratosphere following the SSW, rather than the occurrence of the SSW itself, that is crucial in coupling to large-scale tropospheric flow patterns.