



## **Is tropospheric weather influenced by solar wind through atmospheric vertical coupling downward control?**

Paul Prikryl (1,2), Takumi Tsukijihara (3), Koki Iwao (4), Donald B Muldrew (5), Robert Bruntz (6), Vojto Rušin (7), Milan Rybanský (8), Maroš Turňa (9), Pavel Št'astný (9), and Vladimír Pastirčák (9)

(1) Physics Department, University of New Brunswick, Fredericton, NB, Canada (paul.prikryl@unb.ca), (2) Geomagnetic Observatory, Natural Resources Canada, Ottawa, ON, Canada (paul.prikryl@canada.ca), (3) Department of Earth and Planetary Sciences, Kyushu University, Fukuoka, Japan, (4) National College of Technology, Kumamoto College, Yatsushiro, Japan, (5) Emeritus, Communications Research Centre, Ottawa, ON, Canada, (6) Johns Hopkins University Applied Physics Laboratory, Laurel, MD, USA, (7) Astronomical Institute, Slovak Academy of Sciences, Tatranská Lomnica, Slovakia, (8) Slovak Central Observatory, Hurbanovo, Slovakia, (9) Slovak Hydrometeorological Institute, Bratislava, Slovak Republic

More than four decades have passed since a link between solar wind magnetic sector boundary structure and mid-latitude upper tropospheric vorticity was discovered (Wilcox et al., *Science*, 180, 185-186, 1973). The link has been later confirmed and various physical mechanisms proposed but apart from controversy, little attention has been drawn to these results. To further emphasize their importance we investigate the occurrence of mid-latitude severe weather in the context of solar wind coupling to the magnetosphere-ionosphere-atmosphere (MIA) system. It is observed that significant snowstorms, windstorms and heavy rain, particularly if caused by low pressure systems in winter, tend to follow arrivals of high-speed solar wind. Previously published statistical evidence that explosive extratropical cyclones in the northern hemisphere tend to occur after arrivals of high-speed solar wind streams from coronal holes (Prikryl et al., *Ann. Geophys.*, 27, 1-30, 2009; Prikryl et al., *J. Atmos. Sol.-Terr. Phys.*, 149, 219-231, 2016) is corroborated for the southern hemisphere. A physical mechanism to explain these observations is proposed. The leading edge of high-speed solar wind streams is a locus of large-amplitude magneto-hydrodynamic waves that modulate Joule heating and/or Lorentz forcing of the high-latitude lower thermosphere generating medium-scale atmospheric gravity waves that propagate upward and downward through the atmosphere. Simulations of gravity wave propagation in a model atmosphere using the Transfer Function Model (Mayr et al., *Space Sci. Rev.*, 54, 297-375, 1990) show that propagating waves originating in the thermosphere can excite a spectrum of gravity waves in the lower atmosphere. In spite of significantly reduced amplitudes but subject to amplification upon reflection in the upper troposphere, these gravity waves can provide a lift of unstable air to release instabilities in the troposphere thus initiating convection to form cloud/precipitation bands (Prikryl et al., *Ann. Geophys.*, 27, 31-57, 2009). It is primarily the energy provided by release of latent heat that leads to intensification of storms. These results indicate that vertical coupling in the atmosphere exerts downward control from solar wind to the lower atmospheric levels influencing tropospheric weather development.