

Ann. Geophys. Discuss., author comment AC2  
<https://doi.org/10.5194/angeo-2021-23-AC2>, 2021  
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## Reply on RC1

Paul Prikryl et al.

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Author comment on "Heavy rainfall, floods, and flash floods influenced by high-speed solar wind coupling to the magnetosphere–ionosphere–atmosphere system" by Paul Prikryl et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2021-23-AC2>, 2021

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## Reply to Referee #1 on behalf of all authors

RC1: 'Comment on angeo-2021-23', Anonymous Referee #1, 07 May 2021

The study of P. Prikryl et al. is very interesting. It evaluated a lot of observations and the application of the superposed epoch analysis provided convincing results about a correlation between solar wind perturbations and heavy rainfall. It cannot be expected that the authors can provide a complete physical explanation of this correlation. However, I have two major comments:

1) Please explain why auroral gravity waves with reduced amplitudes at the tropopause (factor 1000–10000, line 512) have an impact on the tropospheric weather. In the troposphere, there are many other perturbations which have larger amplitudes.

**Reply:** *This is a commonly raised question about the physical mechanism that we are proposing. The release of conditional symmetric instability, particularly in the warm frontal zone, has been known to initiate convection and result in frontal precipitation bands. We provide references in the revised manuscript. Even an infinitesimally small displacement of a moist air parcel can initiate slantwise convection. In our previous publication we showed that warm frontal cloud bands, sometimes called striated delta clouds, in rapidly intensifying extratropical cyclones, tend to be observed following arrivals of high-speed streams. When down-going AGWs over-reflect in the warm frontal zone of extratropical cyclones, even a small lift they would provide to a moist air parcel that is already rising over the cold air ahead, can initiate slantwise convection, thus forming a precipitation band. Furthermore, the over-reflection of gravity waves can result in amplification. Certainly, there are many other sources of gravity waves of larger amplitudes in the troposphere itself, but they would not be synchronized with solar wind events. Also, we are not aware of any reports of a specific type of tropospheric perturbation that would reach the instability region to explain the initiation of convection and its banded structure other than stochastic fluctuations. Although stochastic fluctuations can trigger convection, in our opinion, they would neither explain the observed link to solar wind nor the coherent wave structure of the striated delta clouds. In the revised manuscript we added a paragraph in Section 7.*

2) Please add a discussion about alternative explanation, e.g. variation of the ionospheric conductance by TIDs leading to more thunderstorms.

**Reply:** *In the Introduction we included a short review of previously observed sun-weather links and alternative physical mechanisms to explain them.*

Minor comments:

Fig 10b caption, please explain the red + marks *The symbol is now explained in the caption.*

line 457 Pioneer spacecraft in 1970s was .... (singular?) *"spacecraft" is both the singular and the plural form.*