Ann. Geophys. Discuss., referee comment RC2
https://doi.org/10.5194/angeo-2022-14-RC2, 2022

Comment on angeo-2022-14

Anonymous Referee #2

Referee comment on "Multi-instrument observations of polar cap patches and traveling ionospheric disturbances generated by solar wind Alfvén waves coupling to the dayside magnetosphere" by Paul Prikryl et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2022-14-RC2, 2022

Review of "Multi-instrument observations of polar cap patches and traveling ionospheric disturbances generated by solar wind Alfven waves coupling to the dayside magnetosphere" by Prikryl, Gillies, Themens, Weygard, Thomas and Chakraborty

The paper is well written, contains interesting new results and should be published in Annales Geophysicae after suitable revision.

Main Comments

There are two distinct parts to solar wind high speed streams. At the leading edge where the high speed stream interacts with the upstream slow speed stream, a "corotating interaction region" or CIR (GRL 3, 3, 137-140, 1976; JGR 100, A11, 21717-21733, 1995) forms. CIRs have both high magnetic fields and high plasma densities, higher than the following high speed stream proper. The Alfven wave amplitudes are also higher inside the CIR due to the compression (GRL, 22, 23, 3397-3400, 1995). It will be interesting for the AG readership to know where your effects are strongest, associated with the CIR or the high speed stream proper. Also since the plasma densities inside the CIR are high, can this play a role in magnetic reconnection and the tongues of ionization?

Introduction Section. I doubt that Jim Dungey (1961) intended to imply that the interplanetary magnetic field remained southward and there occurred a steady state of energy input into the magnetosphere. This statement should be reworded a bit to remove this implication. Short duration (~30 min to 1 hr) southward magnetic fields causes substorms (PSS, 12, 273-282, 1964; JGR, 77, 16, 2970, 1972; JGR, 78, 4, 617-629, 1973). Longer duration (hrs) southward fields cause magnetic storms (JGR, 99, A4, 5771-5792, 1994; JGR 113, A05221, doi:10.1029/2007JA012744, 2008). Southward component interplanetary fields associated with Alfven waves in either CIRs or high speed streams have been shown to do the same, cause substorms and DP2 events (JGR, 73, 11, 5549-5559, 1958; JGR, 95, A3, 2241-2252, 1990; JGR 100, A11, 21717-21733, 1995; JASTP 66, 167-176, 2004). In the JGR 2000 paper it was noted that southward IMFs with durations less than 15 min were not geoeffective. Can you please mention (roughly) the duration of the southward components of the Alfven waves? The ionospheric currents that you mention most certainly must be DP2 currents. Please quote and discuss.

Line 52. It should be noted that spacecraft observations of the polar cap and auroral zone noted auroral patches during HILDCAA intervals (southward component of Alfven waves in solar wind high speed streams causing reconnection). Please see p235-243 in AGU mon. 167, 2006; *Substorms 7: Proceedings of the 7th International Conference on Substorms,* edited by N. Ganushkina and T.I. Pulkkinen, *1*, 67, 2004. These papers should be quoted.

Line 113. The reference to the HCS discovery should be quoted here. It is JGR 83, 717, 1978.