ION-NEUTRAL COUPLING IN THE HIGH LATITUDE THERMOSPHERE: PART II

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On 24th November, 1982, The North-South (B_z) component of the Interplanetary Magnetic Field (IMF) became positive for a period of about 11 hours reaching a relatively large and steady value of $\sim$25 nT. During this rare occurrence, the Dynamics Explorer-2 (DE-2) spacecraft was in a configuration that enabled the dynamics of both ionic and neutral species of the high-latitude F-region to be mesaured simultaneously along the track of the polar-orbiting satellite. Results from two Northern (winter) polar passes of DE-2, extracted from a larger data set, are shown to illustrate the response of the neutral F-region to ion drag forcing arising from a configuration of ion convection characteristic of strongly northward IMF. The measured neutral winds differ appreciably from those more commonly observed for periods of southward IMF. The multi-cellular ion drift pattern associated with positive B_z is observed to drive a similar but less structured and weaker neutral wind configuration in the winter polar cap. Major features of the ion drift pattern are mimicked by the neutral circulation but smaller-scale and more irregular structures of ion flow are not. This is ascribed to the relatively long time constant (few hours) for momentum exchange between the ion and neutral gases. The results demonstrate that sunward flow of neutral gas can be established and maintained by ion drag in the central polar cap for positive B_z.

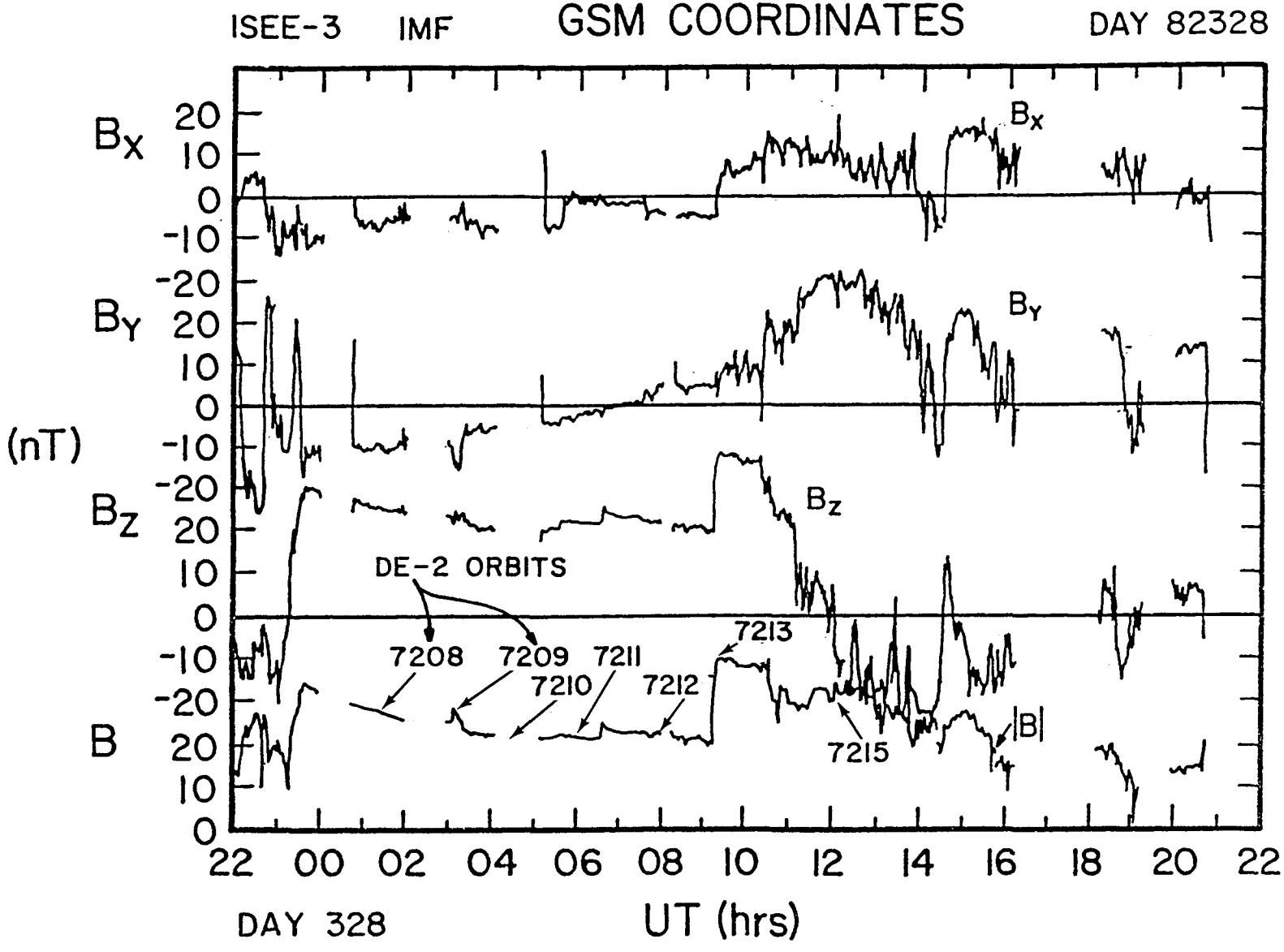

Figure 1. Variation of the Interplanetary Magnetic Field as measured by ISEE-3 during 24th November, 1982. The times corresponding to the orbits studied are indicated.

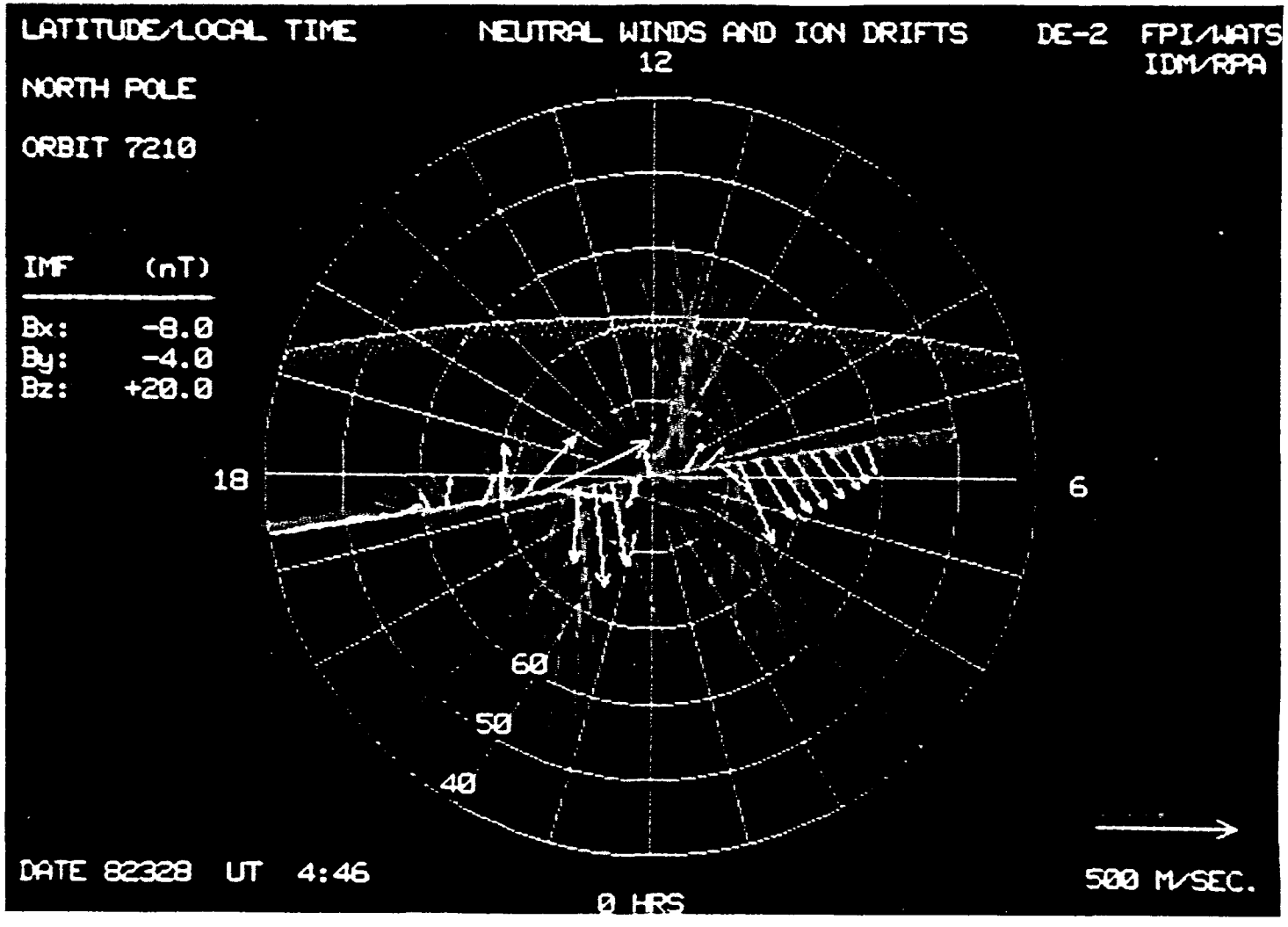

Figure 2. Neutral wind and ion drift vectors for orbit 7210 plotted in geographic polar coordinates (latitude, pole to 40°N; local solar time). The neutral winds are coded by the yellow (white) arrows, and the ion drifts are coded by the red (gray) bars. The curved line represents the solar terminator (90% solar zenith angle). The symbol N refers to the location of the invariant pole at the UT of the pass. Note the scale difference of a factor of 2 indicated at lower right.

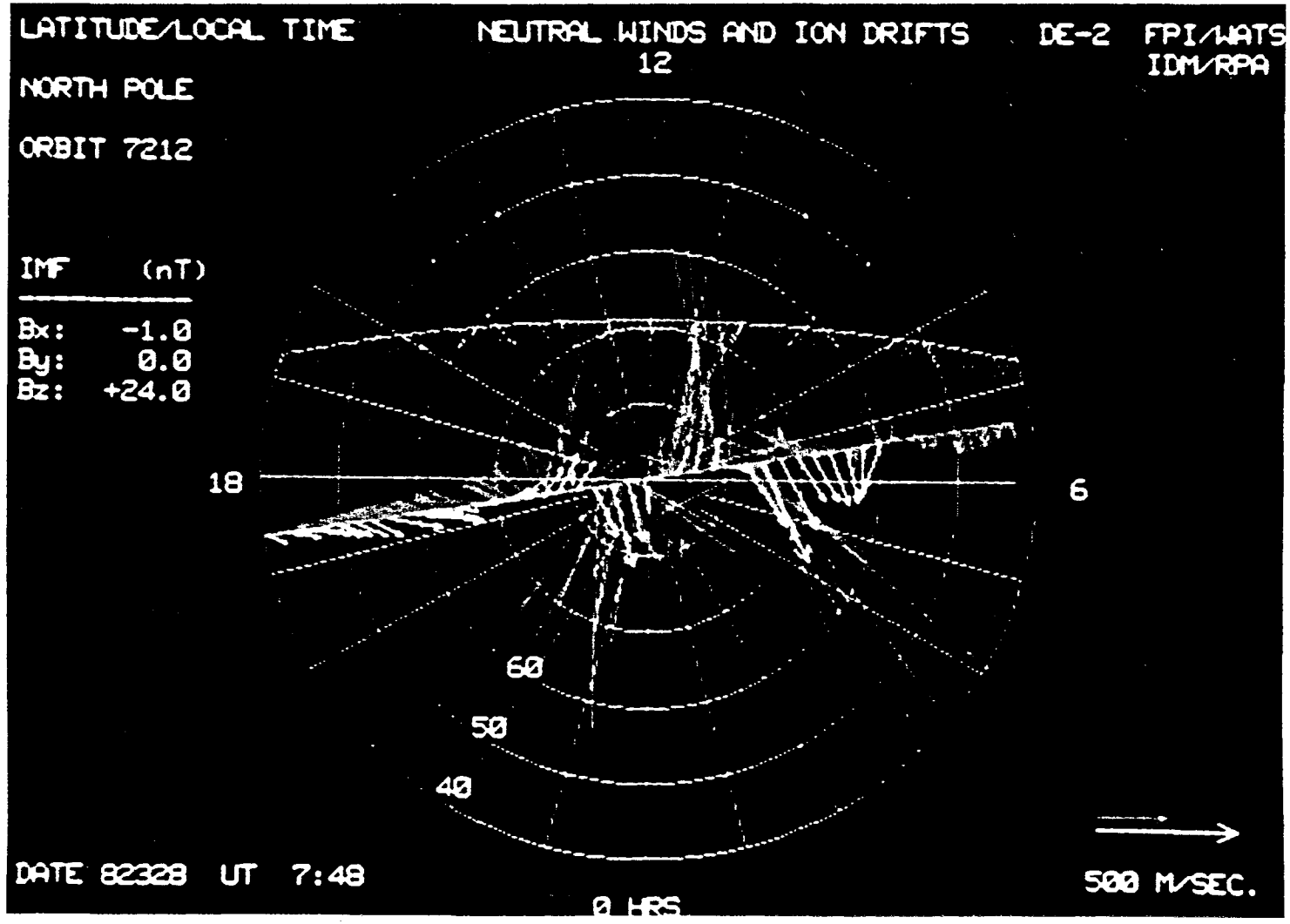

Figure 3. Neutral wind and ion drift vectors for orbit 7212 plotted in geographic polar coordinates (latitude, pole to 40°N; local solar time). The neutral winds are coded by the yellow (white) arrows, and the ion drifts are coded by the red (gray) bars. The curved line represents the solar terminator (90% solar zenith angle). The symbol N refers to the location of the invariant pole at the UT of the pass. Note the scale difference of a factor of 2 indicated at lower right.

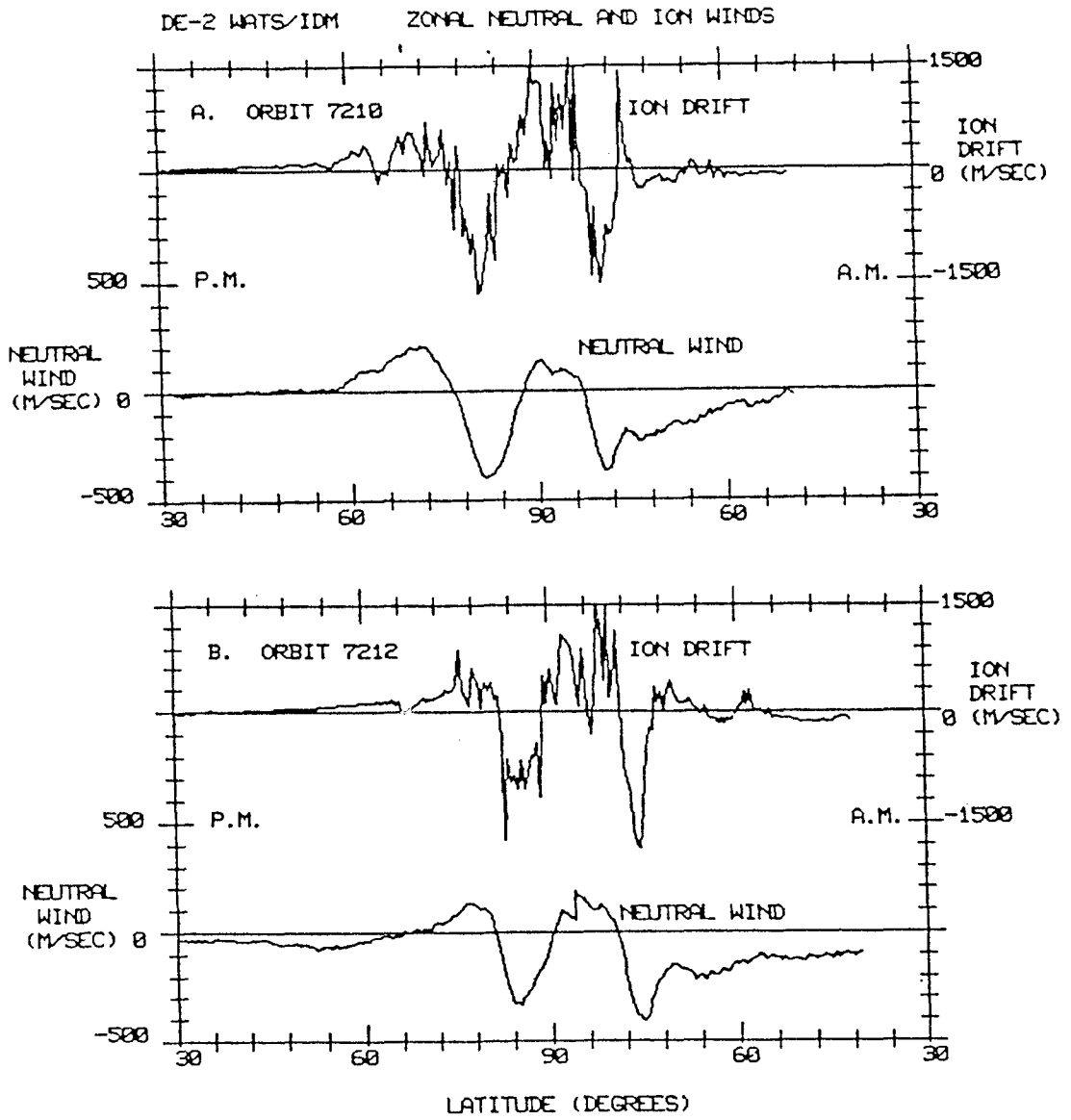

Figure 4. Zonal neutral winds and ion drifts measured on DE-2 for a) orbit 7210 and b) orbit 7212 plotted as a function of latitude along the track of the satellite. Neutral zonal winds are plotted according to the scale shown on the left, ion zonal drifts according to the scale on the right.