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BROAD PLASMA DECREASES IN THE EQUATORIAL IONOSPHERE

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Abstract. This paper presents an analysis of spacecraft observations of plasma decreases in the equatorial ionosphere during June solstices and solar minimum.

1 INTRODUCTION

The C/NOFS satellite, launched in April 2008, carried as part of its payload the Planar Langmuir Probe (PLP), designed to measure plasma densities along the satellite orbit. During the 3 months centered on June 2008, the PLP detected regular density decreases in the equatorial region, in particular around the South Atlantic Anomaly (SAA). These consisted of large (up to 6 hours in local time) regions in which the density decreased by a factor of 2. We refer to these structures as Broad Plasma Decreases (BPDs)[1]. They are not to be confused with equatorial plasma bubbles[2] which are narrow, deep structures associated with intense scintillations.

A study of DMSP data during simultaneous periods revealed that comparable structures were detected around the SAA. The latitudinal extent of the BPDs was 30^o. It should be noted that at C/NOFS, which is in a low-inclination orbit, altitudes during the June 2008 period were in the 400-500 km range when BPDs were observed, while DMSP is in a high- inclination orbit at 840 km. Examination of other years during solar minimum showed that BPDs were regularly observed by DMSP in the SAA and June solstices. Thus the DMSP database of BPD events extends from 2005 present and also includes 1996. Our results demonstrate that even during solar minimum, the ionosphere presents surprising challenges to accurate modeling and forecasting.

2 OBSERVATIONS

An example of the events analyzed in this study is shown in Figure 1. Figure 1A shows the C/NOFS data for a BPD observed on 19 June 2008. Figure 1B, below, shows

a nearly simultaneous BPD observed on DMSP. The arrow indicates the BPDs on both spacecraft.As shown, the BPDs are generally large, both in latitude and longitude; they tend to occur around the SAA (although the C/NOFS data also show occurrence over the Indian Ocean). The structures are much larger than equatorial plasma bubbles (EPBs), although EPBs can be observed forming along the steep sides of the BPD. This is apparent in Figure 1A.

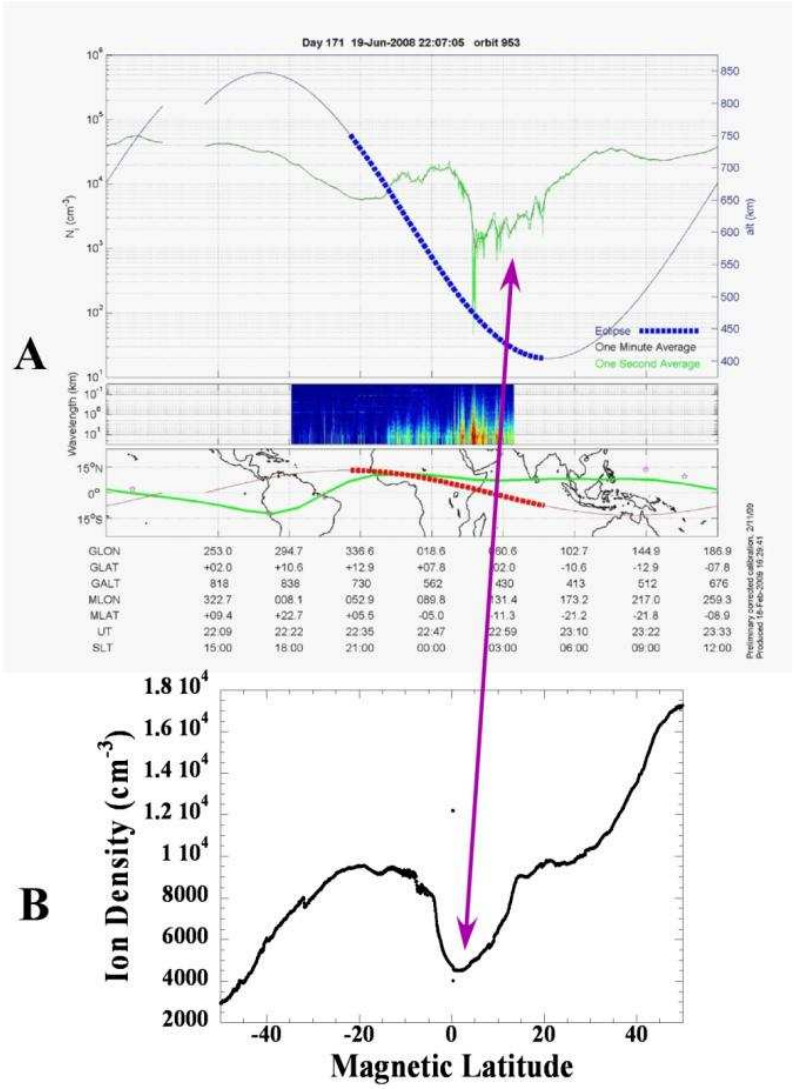

Figure 1: Example of BPDs on C/NOFS (A, top) and DMSP (B, bottom) spacecraft on 19 June 2008.

We examined neutral densities from the GRACE and CHAMP satellites during the same periods when BPDs were observed on the DMSP spacecraft and found a number of coincident decreases in neutral densities. Statistical analysis of the thermospheric densities exhibited tidal structures during these periods with a local minimum in density

around the SAA.

3 DISCUSSION

The thermospheric results suggest local cooling of the neutrals and plasma within the BPDs. We confirmed that the ion temperatures were approximately 550K on DMSP for a selected BPD event. This is significantly less than the IRI model for the satellite location and also less than has been reported for nightside equatorial measurements during solar minimum. We are continuing to pursue possible mechanisms for generating the BPDs and will present the results of analysis of selected events as well as global statistics of ion densities during solar minimum.

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