Interhemispheric conjugate effect in longitude variations of mid-latitude ion density

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Interhemispheric coupling between the northern and southern mid-latitude ionosphere through the plasmasphere is difficult to confirm directly from observations. A possible result induced by this coupling is interhemispheric conjugacy of the mid-latitude ionosphere. In this paper, interhemispheric conjugate effect in longitude variations of mid-latitude total ion density (N_i) is presented, for the first time, using the Defense Meteorological Satellite Program (DMSP) measurements; northern and southern N_i longitude variations at 21:30 LT are similar between magnetically conjugate mid-latitudes around solar minimum June Solstice of 1996. The conjugate effect after sunset also occurs around the June Solstice in other solar minimum years but disappears when solar activity increases. We suggested that mid-latitude interhemispheric coupling is responsible for the conjugate effect. Neutral wind induced ionospheric transport causes topside longitude variations via upward diffusion at summer mid-latitudes; this further induces similar longitude variations of topside N_i at winter mid-latitudes via the summer to winter interhemispheric coupling. The conjugate effect occurs only inside the plasmapause where magnetic flux tubes are closed and the plasma in these tubes can stably corotate with the Earth. The conjugate effect not only proves mid-latitude interhemispheric coupling through the plasmasphere, but also implies that neutral wind induced transport can affect ionospheric coupling to the plasmasphere at mid-latitudes.