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Recent Ulysses solar wind observations: Persistent latitude variations in a new polar coronal hole

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Ulysses crossed its highest southern latitude ($>80^{\circ}$ S) for the third time in February 2007. As during its first orbit, from mid- to high latitudes, the spacecraft was immersed in relatively steady, tenuous, fast solar wind from a large circumpolar coronal hole. Also as seen in previous high latitude data, this fast solar wind had a small but clear latitudinal gradient of $\sim$1 km/s/deg of heliolatitude. During much of the high latitude observations from the previous solar minimum, the heliospheric current sheet tilt was very small, making it hard to definitively separate effects drive by heliomagnetic latitude, or angle from the magnetic dipole, from heliogeographic latitude, which is ordered by the Sun's spin axis. During the most recent approach to solar minimum, however, the heliospheric current sheet has remained significantly more tilted than in the previous solar cycle while the latitudinal variations have remained very similar. These observations demonstrate a remarkable association - that the latitudinal gradients are related to solar rotational axis and not the orientation of the polar coronal holes and heliomagnetic equator. This study presents the recent solar wind observations from the south polar coronal hole for the first time, quantifies the small latitudinal gradients in these observations and compares them to gradients of previous polar coronal holes, and explores possible explanations for these enigmatic variations.