

The summary report of the sub-group 4

"Coronal hole and high speed solar wind" of TG3 scientific issues

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The polar region that is covered by coronal hole is the roots of the high speed solar wind that influences the space environments around the earth. It is well known that the coronal holes in both the poles disappear near solar maximum. Since the period of the CAUSES-II program covers the rising phase of Cycle 24, we performed the monthly polar monitor observations with Hinode satellite for investigating the evolution of the magnetic field distribution and coronal activity. The monitoring data show us the following behaviors of the polar region.

The magnetic fields in the polar region are constructed from the small patches and the large patches, and the threshold for the classification of the patches is 10^{18} Mx. The large patches are the root of the open field from the polar region and the roots of the high speed wind. During the rising phase of Cycle 24 that corresponds to the period of the polar reversal, only the large patches with the major polarity in the polar region is decreased and there is no change of the small patches [1]. Comparing between the photospheric magnetic field and the coronal activity, we found that polar X-ray jets occur above the large patches [2]. Based on the polar magnetic field distribution and the relationship between the X-ray jets and the large patches, we can image that the X-ray jets cause the influence of the high speed solar wind. Nevertheless, X-ray jets can not supply the energy and mass to the solar wind because the total energy of the jets that were observed with Hinode is not enough for the acceleration of the solar wind. For the acceleration of solar wind, numerous small jets that are not be able to detect by XRT/Hinode are needed if we assume that the energy for the solar wind acceleration is supply by the jet phenomena. We also found that the most productive region of X-ray jets is the coronal hole boundary, not the polar coronal hole [3].

The polarity reversal is progressing now (in the fall of 2013), and the reversal in the south polar region is significantly delayed from the north polar region [1]. We need to continue the monitoring

of the polar region and to compare the phenomena near the Sun and the solar wind using the long-term data.

[1] Shiota et al., "Polar Field Reversal Observations with Hinode", 2012, ApJ, 753, 157

[2] Shimojo and Tsuneta, "The Relation Between Magnetic Fields and Coronal Activities in the Polar Coronal Hole", 2009, ApJ, 706, 145L

[3] Sako et al., "A Statistical Study of Coronal Active Events in the North Polar Region", 2013, ApJ, 775, 22