A Decadal Statistical Study of Plasma and Magnetic Parameters in Upflowing Plasma Observed with Hinode/EIS in 110 Active Regions

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Abstract

Since their discovery by the Hinode EUV Spectrometer (EIS), persistent plasma upflows from active region (AR) peripheries have been observed and found to be ubiquitous. We carry out a statistical study, the largest to date, of AR upflow properties in 110 ARs. Using the Hinode/EIS instrument and observing the ARs at or near central meridian passage, we determine various plasma parameters for upflow plasma in each AR. These are: Fe XII line intensity (I), Doppler velocity (v), non-thermal velocity (vnt), electron temperature (Tₑ) and electron density (nₑ) where the latter two parameters are obtained from appropriate Fe XII/Fe XIII line pair ratios. Using our statistically significant sample, we determine characteristic values for AR upflow plasma parameters and their mutual dependence on other plasma parameters. From co-aligned EIS Doppler maps with SOHO/MDI or SDO/HMI magnetograms, we study the relationship of plasma and magnetic field parameters determined separately for leading and following magnetic polarities in order to look for potential asymmetries. We also link the upflow plasma properties to global magnetic parameters like total flux and AR complexity. As the sample of ARs covers nearly a solar cycle, the dependence of the AR upflow parameters on the cycle phase during which they emerge is analysed in order to see whether or not they are influenced by a changing global magnetic topology.