Active Region Emission and Coronal Field Extrapolation

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The unusual sensitivity of Active Region Emission to coronal magnetic field has prompted many studies in which microwave images are compared with coronal field extrapolations to yield further detailed information on physical condition in the corona. Most such studies concern whether a particular linear force-free (or the potential) field extrapolation is consistent (or inconsistent) with the observed microwave images in terms of magnetic field strength. As the techniques of coronal field extrapolations grow more sophisticated, we require a more powerful means to relate the Active Region Emission to coronal field extrapolation models. Here we go beyond the consistency check for field strength and investigate both magnetic and temperature structures in 3D space with multifrequency microwave images. We demonstrate such capability using high-quality microwave images and the field lines and isogauss surfaces that are derived from a state-of-the-art nonlinear force-free field extrapolation of a photospheric vector magnetogram. We rely only on the widely-accepted hypothesis that the temperatures at different points on a given magnetic field line in the corona should be well correlated, due to the rapid transport of heat along field lines in the corona, and the fact that observed microwave intensity at a frequency represents a true electron temperature on a thin isogauss surface. This allows us to relate temperatures in separate regions in the corona in terms of field line connectivity and thus explore magnetic field and temperature in one context. This diagnostic acts both as a test of the field line extrapolation and as aid in understanding the physical condition in the active region corona.