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Energetics, composition change and 630nm emission altitude variation investigated using a tristatic configuration of EISCAT radars and Fabry-Perot Interferometers in Northern Scandinavia

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A series of measurements of a common volume of the polar upper atmosphere at 240km altitude have been made where the thermosphere and ionosphere have been independently observed by 3 Fabry-Perot Interferometers and 3 EISCAT radars. The results have shown that meso-scale variation of the upper atmosphere produces a large amount of Joule heating that is not accounted for by current models. Fractal analysis is being applied to the data to estimate the appropriate time resolution for ion velocities to be used in energy calculations. Instead of averaging over an hour or two, as is currently done to produce electric field models, the initial results point to a resolution of a few minutes at most. Corroboration of these meso-scale energy calculations is found by comparing the corresponding changes in the EISCAT radars' ion and electron temperatures and the FPIs' neutral temperatures. Significant composition changes seem to appear during geomagnetically active conditions. These are clearly indicated by periods when the ion temperature appears to drop anomalously below the neutral temperature. Such ion temperature drops are energetically impossible except for very brief periods since the dominant thermospheric bath would quickly warm up the ions. Only a common volume experiment with independent measurements of Ti and Tn would have been able to reveal this anomaly. The 630nm emission height will be investigated in February 2005 by scanning one FPI along the line-of-sight of another to find the altitude with the best match of intensity and temperature. Earlier investigations using the whole fields-of-view of the 3 FPIs (which covers an area of 6º latitude

and 15º longitude in the region of the auroral oval) shows little change in emission altitude due to the prevailing geophysical conditions at a given location, but some distinct latitudinal variation.