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Height-resolved energy exchange rates in the ionosphere

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The electromagnetic energy exchange between the high-latitude ionosphere and magnetosphere can be described in terms of electromagnetic energy exchange rate q_{EM}, which is a sum of ion-neutral frictional heating rate q_J (sometimes called Joule heating) and work done on neutrals q_m. We have examined the height-resolved energy exchange rates in the ionosphere by using a one-month database obtained by EISCAT incoherent scatter radar measurements in Tromso. The CP2 scan mode of the EISCAT radar makes it possible to deduce conductivities, electric fields and neutral winds in the E region and hence estimate the different energy exchange rates.

We will show characteristic examples for different situations, like a quiet ionosphere dominated by altitude-dependent neutral wind structures (probably caused by atmospheric gravity waves), or active conditions dominated by strong electric fields and intense electromagnetic energy input into the ionosphere. In general, the ion-neutral frictional heating altitude profiles are affected by vertical structuring in horizontal winds. Also, the ionosphere can be at some altitudes a sink of EM energy and at other altitudes a source of EM energy. On rare occasions, the net effect of the ionosphere is to act as an EM dynamo (source of energy).