



Changes in tropospheric infra-red radiation associated with ionisation from energetic particles

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We report results from an experiment indicating that atmospheric ions created by high-energy particles modulate infra-red radiation measured at the surface. A thermopile filter radiometer tuned to a $9.15\mu\text{m}$ absorption band, known to be associated with infra-red absorption of molecular cluster ions, was used to monitor changes following events identified by a cosmic ray telescope sensitive to high energy ($>400\text{MeV}$) particles, principally muons at the surface. The change in longwave radiation in this absorption band due to molecular cluster ions is 7 mWm^{-2} for each event recorded by the cosmic ray telescope.

Surface muons often originate from air showers producing bursts of high-energy particles, and hence ionisation, over a wide area, and we believe that numerous cluster-ions created in these air showers are responsible for the observed absorption. The integrated atmospheric energy change for ions created by each detected high-energy particle event is 1.9 Jm^{-2} . Infra-red absorption from molecular cluster-ions is expected to occur continuously and globally, but calculations suggest that it has a small effect on climate.