

***IMBALANCED RADIATION ENTROPY AND IMPLICATIONS FOR
REMOTE SENSING***

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For presentation at the
American Geophysical Union 2012 Fall Meeting
San Francisco, CA
Dec. 3-7, 2012

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ABSTRACT

The Earth system is driven by a large imbalance of entropy between incoming shortwave and outgoing radiation; however radiation energy has been the predominate focus in studying the role of radiation in shaping the Earth's climate, with radiation entropy largely ignored. Here we first show that radiation energy is necessary and sufficient only if the Earth system emits as a blackbody radiation at thermal equilibrium whereby both radiation energy and radiation entropy are solely determined by the temperature and independent of the material property. We then demonstrate with a graybody radiation model that for more realistic non-blackbody emission, radiation energy alone is not enough and radiation entropy is needed to close the system. A new remote sensing approach is presented to simultaneously gauge the longwave emissivity and temperature by co-measurements of radiation energy and radiation entropy. Further explored is the potential of utilizing high resolution spectral radiation measurements for this purpose.