Comparative global energy budgets for the climates of terrestrial and gas giant planets

Conference or Workshop Item

Comparative global energy budgets for the climates of terrestrial and gas giant planets

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The weather and climate on Earth are generally determined by the amount and distribution of incoming solar radiation. This must be balanced in equilibrium by the emission of thermal radiation from the surface and atmosphere, but the precise routes by which incoming energy is transferred from the surface and within the atmosphere and back out to space are important features that characterize the current climate. This has been analysed in the past by several groups over the years, based on combinations of numerical model simulations and direct observations of the Earth's climate system. The results are often presented in schematic form[1] to show the main routes for the transfer of energy into, out of and within the climate system. Although relatively simple in concept, such diagrams convey a great deal of information about the climate system in a compact form, and are especially valuable pedagogically at school and undergraduate level.

Such an approach has not so far been adopted in any systematic way for other planets of the Solar System, let alone beyond, although quite detailed climate models of several planets are now available, constrained by many new observations and measurements. Here we analyse the global transfers of energy within the climate systems of a range of terrestrial planets within the Solar System, including Mars, Titan and Venus, as simulated by relatively comprehensive numerical circulation models of such planets. These results will then be presented in schematic form for comparison with the 'classical' global energy budget analysis of Trenberth et al.[1] for the Earth, highlighting the important similarities and differences. We also consider how to extend this approach towards other Solar System and extra-solar planets, including Jupiter, Saturn and hot Jupiter exoplanets.

[1] Trenberth, K. E., Fasullo, J. T. and Kiehl, J.: Earth's global energy budget, BAMS, Vol. 90, 311-323, 2009.