Geophysical Research Abstracts
Vol. 17, EGU2015-1646, 2015
EGU General Assembly 2015

Detecting climate forcing and feedback signals in surface climate change

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The Earth has warmed in the last century and a large component of that warming has been attributed to the build-up of anthropogenic greenhouse gases. There are also numerous feedback processes which can introduce strong, regionalized asymmetries to the overall warming trend. These processes alter the surface energy budget, and thus affect the surface air temperature, which is one of the primary measures of how the climate is changing. However, the degree to which a given forcing or feedback process alters surface temperatures is contingent on the effective heat capacity of the atmosphere which is defined by the depth of the planetary boundary layer. This can vary by an order of magnitude on different temporal and spatial scales, which can lead to a strongly amplified temperature response in shallow boundary layers. Therefore, if a climate forcing or feedback is acting across a wide range of conditions of the boundary layer, then this non-linear response of the surface climate to perturbations in the forcing must be accounted for in order to correctly assess the effect of the forcing on the surface climatology.