2016

How Big is a Cloud: A Statistical Analysis of Cloud Size Distributions Derived from Large Eddy Simulations

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Abstract

To accurately represent cumulous clouds in climate and weather models, it is important to understand how large clouds, in certain cloud fields, are. These fields can be described by a cloud size distribution (CSD), the number of clouds of a certain defined size. This study utilized data from a Large Eddy Simulation (LES), a high resolution numerical model describing the atmosphere, to explore what defines the cloud size distribution. First, we have developed a toolkit to illustrate the cloud size distribution by using the slope and deriving an estimate for the scale break. Second, we performed a statistical analysis of cloud size distributions for several cases and measurement methods. Based on this analysis, we found that cloud size distributions do not compare well from case to case; but are comparable, regardless of time, within cases. Large eddy simulations of smaller domain sizes result in cloud fields that underestimate the number of clouds. Lastly, analyzing the cloud size distribution methods showed that, although similar, not all measurement methods obtain identical results. In particular, CSDs from linear transects through the cloud layer ("fly-through") deviate significantly from other methods.