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Meaningful decompositions of cloudiness to study its effects on the Earth's radiation budget

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The role of clouds in the planet's energy flows is widely accepted. In this presentation, we discuss two approaches to decompose the effects of clouds on the Earth's radiation budget, one based on passive observations (Cloud Regimes derived from MODIS, CR) and one active observations (Cloud Vertical Structure classes derived from CloudSat and CALIPSO, CVS). The analysis reveals the kind of clouds and cloud mixtures that are strongest radiative warmers and coolers from the perspective of the planet as a whole, the surface, and the atmosphere. The degree of radiative warming or cooling is expressed in terms of the sum of shortwave and longwave cloud radiative effects. We find that all CRs cool the planet as a whole and the surface; those dominated by high clouds warm the atmosphere and those by low clouds cool it. When using cloud vertical configuration as the criterion of cloud decomposition, two of ten CVS classes with high clouds are found to be radiative warmers of the planet as a whole and six two be radiative warmers of the atmosphere; still all CVS classes cool the surface. The ultimate global radiative importance of the various CRs and CVS classes depends critically on their global frequency of occurrence; we will identify the most prominent contributors to the TOA, surface and atmospheric global cloud radiative effect.