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Cloud inhomogeneities, aerosol particles, thermodynamic phase, and crystal shape in hyperspectral shortwave measurements and model calculations

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It was recently discovered that cloud inhomogeneities introduce systematic spectral biases in observed and modeled irradiance and radiance. We will discuss the different mechanisms and magnitude of these biases in spectral radiance and irradiance measurements and model results. After classifying the spectral effects for realistic and idealized cloud fields, we will discuss whether they will affect the spectral retrieval of, e.g., phase and crystal shape from future space-borne shortwave spectral imagers, or the radiance-to-irradiance conversion in traditional satellite-based assessments of cloud-aerosol radiative effects. We will discuss how the Shannon information content of spectral cloud measurements reflects biases due to 3D cloud inhomogeneity within a generalized statistical inverse method framework.