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Cloud regimes as phase transitions.

Clouds are repeatedly identified as a leading source of uncertainty in future climate predictions. Of particular importance are stratocumulus clouds, which can appear as either (i) closed cells that reflect solar radiation back to space or (ii) open cells that allow solar radiation to reach the Earth's surface. Here we show that these clouds regimes – open versus closed cells – fit the paradigm of a phase transition. In addition, this paradigm characterizes pockets of open cells (POCs) as the interface between the open- and closed-cell regimes, and it identifies shallow cumulus clouds as a regime of higher variability. This behavior can be understood using an idealized model for the dynamics of atmospheric water as a stochastic diffusion process. With this new conceptual viewpoint, ideas from statistical mechanics could potentially be used for understanding uncertainties related to clouds in the climate system and climate predictions. (Received September 16, 2016)