A physically-based bimodal diagnostic cloud scheme: description and evaluation

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The UK Met Office uses a diagnostic CFP for its operational regional forecasts (~1km grid spacing) over the UK. This scheme assumes a uni-modal, symmetric pdf of the sub-grid saturation departure variability. However, a long-standing systematic lack of cloud necessitates an empirical bias-adjustment in operational forecasts. This paper explores the origin of this bias and proposes a new physically-based, diagnostic CFP. The proposed CFP first identifies entrainment zones (EZ) near sharp inversions. In the EZ it is then assumed that air parcels from above the inversion penetrate into the mixed layer, leading to two modes of variability residing within a single grid box. Weights are assigned to each mode so as to conserve the grid-box mean saturation departure. An extensive process-based and multi-year statistical evaluation shows that the new scheme significantly improves cloud forecasts, for the right reasons, over the US Great Plains ARM site and over the UK.