While fully accounting for 3D effects in Global Climate Models (GCMs) appears not realistic at the present time for a variety of reasons such as computational cost and unavailability of 3D cloud structure in the models, incorporation in radiation schemes of subgrid cloud variability described by one-point statistics is now considered feasible. Significant momentum for this development was gained once it was demonstrated that CPU-intensive spectrally explicit Independent Column Approximation (ICA) calculations are not required to conduct robust GCM simulations; rather, spectral integration can be achieved via Monte Carlo. Such a "McICA" approach has been implemented in Goddard's GEOS-5 GCM in conjunction with the RRTMG radiation package. GEOS-5 with McICA can adopt horizontally variable clouds which are allowed to overlap arbitrarily both in terms of cloud fraction and layer condensate distributions. In our presentation we will show radiative and other impacts of the combined horizontal and vertical cloud variability on multi-year simulations of an otherwise untuned GEOS-5 with fixed SSTs. Introducing cloud horizontal heterogeneity without changing the mean amounts of condensate reduces reflected solar and increases thermal radiation to space, but disproportionate changes may increase the radiative imbalance at TOA. The net radiation at TOA can be modulated by allowing the parameters of the generalized overlap and heterogeneity scheme to vary, a sensitivity whose limitations we will discuss. Results from an investigation on how other mean cloud properties can be re-tuned in order to approach net radiation flux balance at TOA will also be presented.