3rd International Conference on Earth System Modelling
Vol. , 3ICESM-370, 2012
3rd International Conference on Earth System Modelling
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Annual cycle of the global mean energy balance in a mechanistic middle-atmosphere GCM

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Applying a new continuous radiation parameterization in a mechanistic general circulation model including the surface energy budget, we observe an annual cycle of the global mean energy balance at the TOA (with an amplitude of about 2.5 Wm-2) as well as at the surface (with an amplitude of about 3 Wm-2). The major part of the TOA energy balance can be ascribed to the north-south asymmetry in the activity of planetary waves during winter. An analysis of the variation of the energy balance at the surface shows that the maxima coincide with the corresponding maxima in the absorbed solar radiation at the surface while the minima are observed when the long wave emission of the surface achieves its maximum. The annual cycle of the energy balance at the surface and at the TOA are positively correlated. In this paper, different physical mechanisms responsible for this vertical coupling of the energy balances at the surface and at the TOA as well as their relative importance are investigated and discussed.