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Modelling Venus' atmospheric mean meridional circulation: sensitivity to radiative transfer scheme and to specific heat

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A convective zone located between roughly 50-55 km altitude, in the middle cloud region, has been observed in Venus' atmosphere by Pioneer Venus and Vega 2 probes. Below this zone, the vertical profile of temperature in Venus' troposphere is close to neutral stability. Since the wind field is closely coupled to the temperature field, this points out the link that exists between the specific heat values, defining the adiabatic temperature lapse rate, and the circulation. Based on a general circulation model of the Venus' atmosphere developed by our team, this work illustrates the sensitivity of the mean meridional circulation to the radiative transfer scheme, and to the choice of specific heat values. For radiative transfer, models of Venus' atmosphere have been using either a simple solar forcing with newtonian cooling, or a more complex scheme computing self-consistently the temperature profile and the cooling rates. The corresponding mean meridional circulations are compared and discussed. Though these general circulation models often take into account a constant value for the specific heat – which is necessary for the usual definition of potential temperature –, this variable is strongly varying with temperature in Venus' atmosphere, by more than 40% from the upper cloud region down to the surface. We have recently modified our general circulation model in order to take this dependency into account, using a new definition of potential temperature. The impact of this modification on the modelled circulation is discussed.