Modeling the Dynamics of the Venus Atmosphere; Past, Present, and Future

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The modeling of Venus atmosphere dynamics will be reviewed. The status of the subject today and the path to the present will be emphasized together with a plan for future progress. It is clear that despite all the ground-based and spacecraft observations of the Venus atmosphere and all the models of the atmosphere's dynamics, the way in which the global retrograde superrotation of the atmosphere is established and maintained is not entirely understood. A complete understanding of the phenomenon will require not only additional modeling, but more observations as well, since some fundamental processes in the models are almost completely unconstrained by data. These processes include the nature of the surface-atmosphere interaction and the radiative heating and cooling of different parts of the atmosphere. While emphasis is placed on the zonal circulation, the weaker meridional circulation of the Venus is completely unknown though it is crucial in transporting atmospheric angular momentum and maintaining the zonal winds. The nature of the atmospheric boundary layer is essentially unknown. Is it stable or convective? How does the boundary layer vary spatially? There is limited information on the structure and composition of the clouds and the temporal variability of these properties, important for determining solar heating and long wave radiation. Clearly, we are not yet there in terms of understanding how the Venus atmosphere works. We need to make the numerical models more realistic, but to do that we need to have more measurements of parts of the atmosphere that are challenging to access.