Small-scale disturbances reproduced by AFES for Venus (Atmospheric general circulation model For the Earth Simulator)

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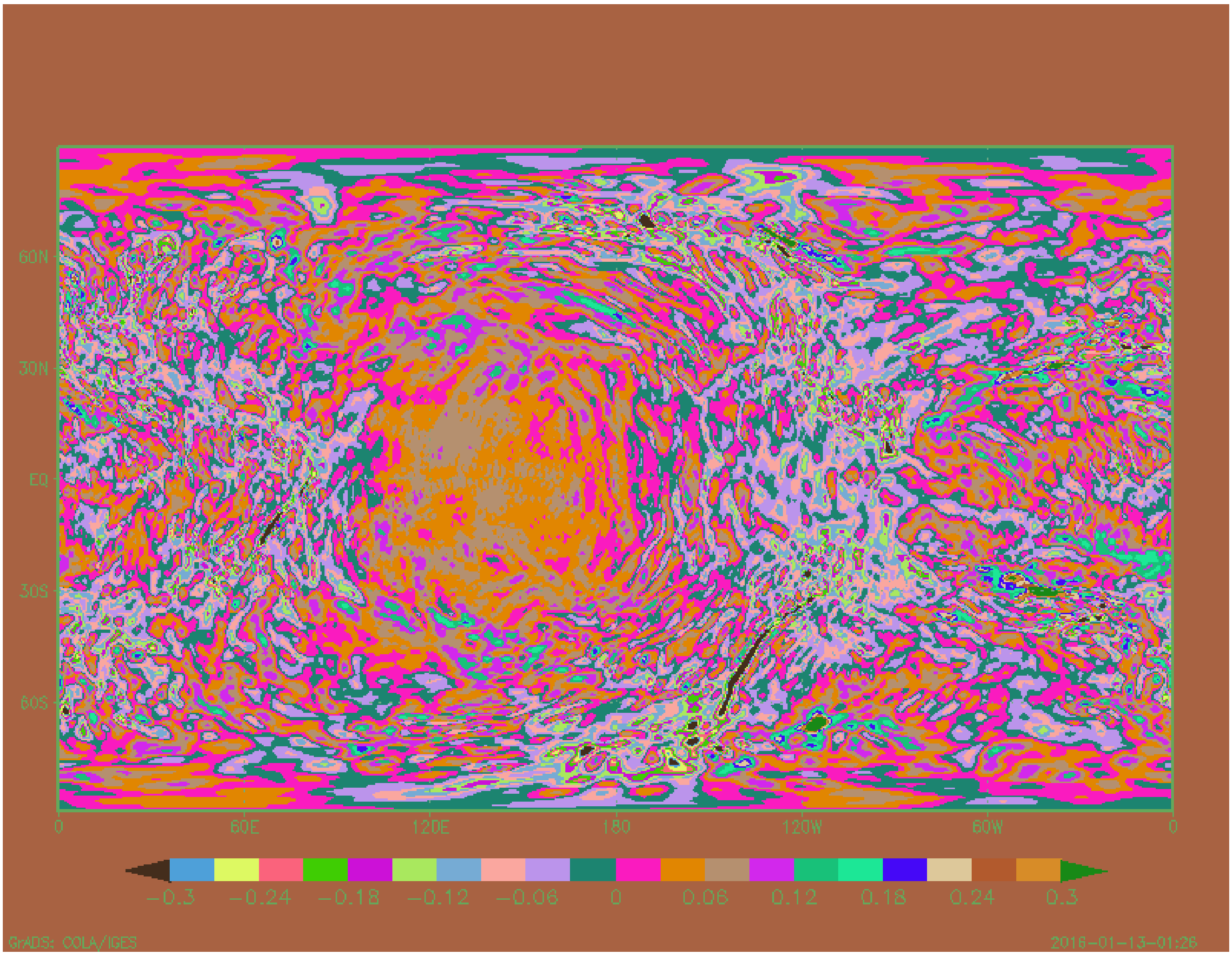
An atmospheric general circulation model (AGCM) for Venus on the basis of AFES (AGCM For the Earth Simulator) have been developed to perform a very high-resolution simulation (e.g., Sugimoto et al., 2014a). The highest resolution is T319L120, namely, there are 960 times 480 horizontal grids (grid intervals are about 40 km) with 120 vertical layers (layer intervals are about 1 km). In the model, the atmosphere is dry and forced by the solar heating with the diurnal and semi-diurnal change. The infrared radiative process is simplified by the Newtonian cooling. Then the temperature is relaxed to a prescribed horizontally uniform temperature distribution which has a virtual static stability of Venus with almost neutral layers. We set a fast zonal wind in a solid-body rotation as the initial state.
Starting from this idealized superrotation, the model atmosphere reaches a quasi-equilibrium state within 1 Earth year. This state is stably maintained for more than 10 Earth years. The zonal-mean zonal flow with weak midlatitude jets has almost constant velocity of 120 m/s in latitudes between 45°S and 45°N at the cloud top levels, which agrees very well with observations. We have investigated small-scale disturbances reproduced in the model. In the cloud layer, baroclinic waves develop continuously at midlatitudes and generate Rossby-type waves at the cloud top (Sugimoto et al., 2014b). At the polar region, warm polar vortex zonally surrounded by a cold latitude band (cold collar) appears successfully (Ando et al., 2016). As for horizontal kinetic energy spectra, divergent component is broadly (k > 10) larger than rotational component compared with that on Earth (Kashimura et al., in preparation). In the presentation, the relation between small-scale gravity waves and large-scale thermal tides will be also shown.

Keywords: Venus, GCM, Waves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