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Semi-annual oscillations in the atmosphere of Mars

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We report on the first detection of the semi-annual oscillation (SAO) in the atmosphere of Mars. The semi-annual periodicity is found in the difference between day- and night-time atmospheric temperatures, a good proxy for solar tides, measured from Mars Global Surveyor. Simulations with a general circulation model proved this modulation of tidal amplitudes is a manifestation of the SAO of zonal winds in Martian tropics. Our numerical experiments revealed significant differences in driving mechanisms of the SAO between Mars and Earth. On Mars, unlike on Earth, equatorial Kelvin waves supply only small retrograde torque to the mean circulation. Instead, thermal tides and quasi-stationary planetary waves induced by flow over Martian topography contribute strongly to the prograde (super-rotation) acceleration. The existence of the SAO on Mars suggests that this phenomenon is not a result of the unique terrestrial environment, but a more general consequence of wave-mean flow interactions in atmospheres of fast-rotating planets.