Thermal convection in the porous methane-soaked regolith of Titan

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Radar images of Titan surface taken by the Cassini Radar (RADAR) and Cassini Visual Infrared Mapping Spectrometer (VIMS) on board of Cassini spacecraft, as well as images taken by Descent Imager/Spectral Radiometer (DISR) on board of Huygens lander do not indicate the presence of methane lakes. It suggests that the atmospheric methane is supplied from subsurface sources. If the whole regolith is highly porous, large volume of liquid methane can be stored beneath the surface. This hypothesis was discussed in the last decade by several authors. It is possible, that the regolith was episodically out-gassed (Tobie G., 37th DPS, abstr.53.08). However, methane could continuously diffuse to the atmosphere (Kossacki K. J. and Lorenz R, 1996).

In the present paper we consider convection of liquid methane in the porous methane-soaked regolith. Two dimensional numerical model of such convection is developed and applied to simulate processes in the Titan's regolith. Basic conditions for the existence of the convection is determined as a function of the regolith layer's thickness, its permeability, temperature gradient etc. We also discuss the role of convection in the process of the exchange of gas beetwen the regolith and Titan's atmosphere.