EPSC Abstracts
Vol. 6, EPSC-DPS2011-520, 2011
EPSC-DPS Joint Meeting 2011

Titan's aerosol optical constants in the 100-1500 cm^{-1} spectral range constrained from Cassini/CIRS data

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Abstract

Aerosols play a fundamental role in the radiative budget of Titan's atmosphere. They absorb 40% of the incident sunlight, thus constituting the major source of the stratosphere heating. On the other hand, they are optically thin at thermal infrared wavelengths and therefore allow the heat from the lower atmosphere to escape to space [3].

We constrained the spectral dependence of the imaginary index of Titan's aerosol in the thermal infrared spectral range (100 – 1500 cm^{-1}, 100 – 6.7 microns). We used the observed aerosol opacity derived from Cassini/CIRS data [7] and assumed that it is due to fractal particles of 3000 monomers, as observed by Huygens/DISR [6]. By using an algorithm calculating the extinction cross section of a fractal particle, developed by [1, 5], we were able to constrain the spectral dependence of the aerosol imaginary index.

We show that the aerosol imaginary index in the mid- and far-infrared ranges globally differs from that of tholins, the Titan aerosol analogues produced in the laboratory, and particularly from that of [2], which is the refractive index commonly used in models. Nevertheless, the imaginary index of Titan's aerosol shows some absorption signatures that are seen in some tholin spectra like for instance at 1380 cm^{-1}, which could be due to the presence of C-CH3 and/or C-(CH3)2 groups [4].

References

[1] Botet, R., Rannou, P., Cabane, M., C.: Mean-field approximation of Mie scattering by fractal aggregates of identical spheres, App. Optics, Vol. 36, pp. 8791-8797, 1997.

[2] Khare, B.N., Sagan, C., Arakawa, E.T., Suits, F., Callcott, T.A., Williams, M.W.: Optical constants of organic tholins produced in a simulated titanian atmosphere – From soft X-ray to microwave frequencies, Icarus, Vol. 60, pp. 127-137, 1984.

[3] McKay, C.P., Pollack, J.B., Courtin, R.: The greenhouse and antigreenhouse effects on Titan, Science, Vol. 253, pp. 1118-1121, 1991.

[4] Quirico, E. and 14 colleagues: New experimental constraints on the composition and structure of tholins, Icarus, Vol. 198, pp. 218-231, 2008.

[5] Rannou, P., Cabane, M., Botet, R., Chassefière, E.: A new interpretation of scattered light measurements at Titan's limb, J. Geophus. Res., Vol. 102, pp. 10997-11014, 1997.

[6] Tomasko, M.G., Doose, L., Engel, S, Dafoe, L.E., West, R., Lemmon, M., Karkoska, E., See, C.: A model of Titan's aerosols based on measurements made inside the atmosphere, Planet. Space Sci., Vol. 56, pp. 669-707, 2008.

[7] Vinatier, S., and 12 colleagues: Analysis of Cassini/CIRS spectra of Titan acquired during the nominal mission. II:Aerosol extinction profiles in the 600-1400 cm^{-1} spectral range, Icarus, Vol. 210, pp. 852-866, 2010.