Radiative Transfer for Atmospheres with Clouds

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To study the temperature in a gas subjected to electromagnetic radiations, one may use the Radiative Transfer equations coupled with the Navier-Stokes equations. The problem has 7 dimensions; however with minimal simplifications it is equivalent to a small number of integro-differential equations in 3 dimensions. A numerical implementation using an $\mathcal{H}$-matrix compression scheme allows us to measure the effect of clouds and airplane contrails on the temperature in the atmosphere. The result is very fast and the method is capable of handling variable absorption and scattering functions of spatial positions and frequencies.

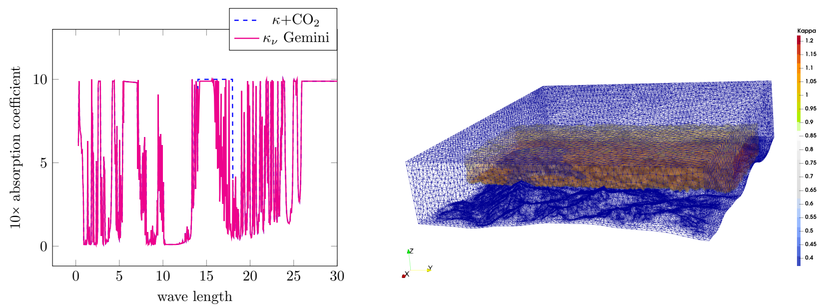

Figure 1: Left: Absorption κ_ν versus wavelength (c/ν) read from the Gemini data site. A CO_2 perturbation of $\kappa_n u$ is shown too. Right: The topography and the mesh and the x-dependency of κ. The level surfaces of κ show a fractal cloud between 0 and 1 as a y-elongated region above Chamonix between altitude 3000m and 7000m.

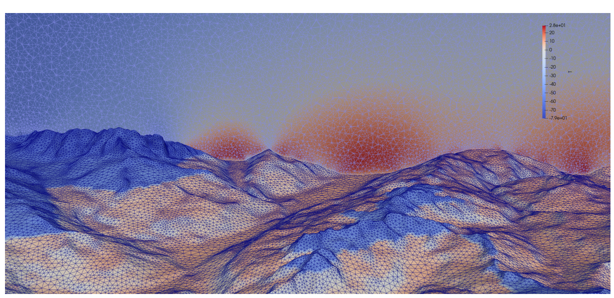

Figure 2: Ground and vertical temperatures (in ^{o}C) in the valley of Chamonix. The mesh is shown in blue on the ground and the intersection of the mesh with the vertical plane is shown in white.