Atmospheric Diffusion: a novel analytical approach for natural and anthropogenic sources

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Abstract

Atmospheric diffusion is currently studied following the novel analytical approach named GILTT (General Integral Laplace Transform Technique). The method allows the solution of the Advection-Diffusion equation for any actual meteorological scenario, including the low-wind condition and/or dry deposition to the ground. Such a solution is written as a converging series expansion, then a generalized Laplace transform allows to solve a differential problem as a matrix algebra one.

The GILTT solution can be applied to several diffusion issues: atmosphere (pollutant emissions in the atmospheric boundary layer (ABL), volcanic emission in the free atmosphere, ..), condensate matter (heat diffusion, …), astrophysics (solar coronal diffusion, …). Two issues are focused: anthropogenic pollution in the ABL (the first and only tackled problem with GILTT), and volcanoes emission in the free atmosphere (troposphere and stratosphere).

Short range pollutant dispersion inside the ABL will be presented. The strong predictive ability of the GILTT solution and a comparison with experimental data can lead a rigorous selection on turbulence and wind parameterizations. A deep understanding of the series expansion highlights pollutant distribution features as well as plume symmetries.

Large scale volcanic plume dispersion can be a stimulating further challenge to improve existing modelling. Furthermore, at short range scales, an upgraded description for transport and diffusion/deposition (near the ground) of heavier erupted matter might be realized.