Geophysical Research Abstracts
Vol. 17, EGU2015-14262, 2015
EGU General Assembly 2015


# Development and validation of a 3D Lattice Boltzmann model for volcano aeroacoustics

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Infrasound measurements have a great potential for the real time characterization of volcanic plume source parameters [Ripepe et al., 2013]. Nonetheless many shortcomings have been highlighted in the understanding of the infrasound monitoring. In particular, the application of the classical acoustic source models to volcanic explosive eruptions has shown to be challenging and a better knowledge of the link between the acoustic radiation and actual volcanic fluid dynamics processes is required. New insights into this subject could be given by the study of realistic aeroacoustic numerical simulations of a volcanic jet. Our work mainly focuses on developing and validating such numerical model to determine when and if classical model source theory can be applied to explain volcanic infrasound data. Lattice Boltzmann strategies (LB) provide the opportunity to develop an accurate, computationally fast, 3D physical model for a volcanic jet and wave propagation. In the field of aeroacoustic applications, dedicated LB schemes has been proven to have the low dispersion and dissipative properties needed for capturing the weak acoustic pressure fluctuations. However, when dealing with simulations of realistic flows, artificial boundaries are defined around the flow region. The reflected waves from these boundaries can have significant influence on the flow field and overwhelm the acoustic field of interest. A special absorbing boundary layer has been implemented in our model to suppress the reflected waves [Xu et al., 2013]. In addition, for highly multi–scale turbulent flows, such as volcanic plumes, the number of grid points needed to represent the smallest scales might become intractable and the most complicated physics happen only in small portions of the computational domain. The implementation of the grid refinement, in our model allow us to insert local finer grids only where is actually needed [Lagrava et al., 2012] and to increase the size of the computational domain for running more realistic simulations. 3D LB model simulations for turbulent jet aeroacoustics have been accurately validated. Both mean flow and acoustic results are in good agreement with theory and experimental data available in literature.

Xu H., Sagaut P., (2013), Analysis of the absorbing layers for the weakly-compressible lattice Boltzmann methods. J. Comput. Physic 245, 14-42.
Lagrava D., Malaspinas O., Lätt J. (2012), Advances in multi-domain lattice Boltzmann grid refinement. J. Comput. Physics 231, 14, 4808-4822.
Ripepe, M., C. Bonadonna, A. Folch, D. Delle Donne, G. Lacanna, E. Marchetti, and A. Höskuldsson (2013), Ash-plume dynamics and eruption source parameters by infrasound and thermal imagery: The 2010 Eyjafjallajökull eruption, Earth Planet. Sci. Lett., 366, 112–12.