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Interactive comment on "FALL3D-8.0: a computational model for atmospheric transport and deposition of particles, aerosols and radionuclides. Part I: model physics and numerics" *by* Arnau Folch et al.

Fabio Dioguardi (Referee)

fabiod@bgs.ac.uk

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This manuscript present the new version of FALL3D, a widely used and known dispersion model. The new version of FaLL3D here presented includes substantial improvements, particularly in the numerical method for solving the advection-diffusion-sedimentation equation and the parallel implementation. The former, thanks to the implementation of a less diffusive scheme, will prevent the numerical diffusion that characterized previous version of FALL3D, hence allowing to better capture sharp gradients of the computed field (e.g. ash concentration in the atmosphere). This has a

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fundamental importance, e.g., for volcanic ash dispersion simulations, i.e. for better defining the position and extent of the volcanic ash cloud in the atmosphere. The parallel implementation has been substantially improved by the implementation of the domain decomposition method, which will significantly reduce the required computation time and optimize the usage of FALL3D on supercomputers. No need to mention the importance of this improvement in particular in terms of the run-time of dispersion simulations, especially when high-resolution computation with different grainsize bins are going to be used for near real-time forecasts. The manuscript is well organized, written and supported by tables, figures and references. The two reasons detailed above already serve as I have some minor comments I wish the authors to address. These are also visible in the attached highlighted version of the PDF document. Specifically:

- Abstract. I would like the authors to add some more explicit conclusive statements on the impact of the improvements of FALL3D, particularly the implication and possible future applications that are now possible thanks to the new features.

- Line 67-69. Could the authors provide more detail here? To my knowledge, all model parametrizations of the volcanic source (a part from more complex models) assume a relationship between plume height/trajectory and emission rate at the source, regardless the grainsize distribution. Hence, total emission rate should always apply to the whole granulometric spectrum. Why do the authors write "several"? Can they provide examples for which the above does not necessarily apply?

- Line 118. I would like the authors to give more insight on the limitations/consequences of the "passive transport" assumption for solid particles here. Could they explain which is, e.g., the maximum particle size for which this assumption may be considered reasonable?

- Line 160. Could the author give more insight and/or instruction to the reader and model user on the "characteristic grid cell measure"?

- Line 262. Is there a particular reason why the model of Degruyter & Bonadonna

(2012) has been removed from FALL3D?

- Please check the use of symbols throughout the manuscript, some symbols have been used twice for different physical quantities/constant. Some examples are highlighted in the attached manuscript but I urge the authors to review all symbols and possibly add a Symbol list table.

Other few minor corrections are suggested in the attached document.

For all the above I recommend the manuscript to be accepted for publication after minor revisions addressing the points above have been made.

Fabio Dioguardi, PhD

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