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Volume 7, issue 6 | Copyright

Development and technical paper | 13 Nov 2014

Applicability of an integrated plume rise model for the dispersion from wild-land fires

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Received: 16 Dec 2013 – Discussion started: 16 Jan 2014 – Revised: 17 Sep 2014 – Accepted: 01 Oct 2014 – Published: 13 Nov 2014

Abstract. We have presented an overview of a mathematical model, BUOYANT, that was originally designed for the evaluation of the dispersion of buoyant plumes originated from major warehouse fires. The model addresses the variations of the cross-plume integrated properties of a buoyant plume in the presence of a vertically varying atmosphere. The model also includes a treatment for a rising buoyant plume interacting with an inversion layer. We have compared the model predictions with the data of two prescribed wild-land fire experiments. For the SCAR-C experiment in Quinault (US) in 1994, the predicted vertical extents of the plume at maximum plume rise were between 500 and 800 m and between 200 and 700 m, using two alternative meteorological data sets. The corresponding observed injection heights of the aerosol particles measured using an airborne lidar (light detection and ranging) ranged from 250 to 600 m. For the prescribed burning experiment in Hyytiälä (Finland) in 2009, the model predictions were compared with plume elevations and diameters, determined based on particulate matter number concentration measurements onboard an aeroplane. However, the agreement between modelled and measured results substantially depends on how the properties of the source term are evaluated, especially regarding the convective heat fluxes from the fire. The results demonstrate that in field experiments on wild-land fires, there are substantial uncertainties in estimating both (i) the source terms for the atmospheric dispersion computations and (ii) the relevant vertical meteorological profiles.

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How to cite: Kukkonen, J., Nikmo, J., Sofiev, M., Riikonen, K., Petäjä, T., Virkkula, A., Levula, J., Schobesberger, S., and Webber, D. M.: Applicability of an integrated plume rise model for the dispersion from wild-land fires, Geosci. Model Dev., 7, 2663-2681, https://doi.org/10.5194/gmd-7-2663-2014, 2014.