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Exploring and Improving Methods of Validating a 1D Plume Rise Model for Wildfire Emissions: The Use of BIRD and MODIS Earth Observation Products

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The lifetime and transport of wildfire smoke plumes within the atmosphere is largely determined by their injection height which is currently poorly parameterized in many chemistry transport models (CTMs). Current research efforts have mainly focused upon embedding a sub-grid scale plume rise model such as the Freitas Plume Rise Model into a CTM. Here, we update methods of plume rise model validation using earth observation data. We focus on the Freitas model, where plume rise is determined by convective energy flux, estimated from information on fire size and energy release rate, along with local atmospheric conditions. Parallel work to that presented here is developing a version of the Freitas model that uses measures of active fire area and fire radiative power (FRP) retrieved from the MODIS sensor. Here we identify and collect fire and plume information to investigate the quality of the MODIS retrievals of fire characteristics by comparison with images from the high resolution BIRD HSRS sensor. Accompanying work tests improvements made in Freitas model output using BIRD-derived measures of active fire area and FRP validated against observations of plume height from the Multi Angle Imaging Spectroradiometer (MISR) identified in this poster. A total of 21 fire clusters (ranging from 0.0002 to 10.6 Ha) in Siberia over two dates in July 2003 were identified in the BIRD imagery which also had matching observations of plume height available from the MISR sensor. BIRD derived active fire area and FRP were input to the Freitas model and plume height output validated against MISR observations. A subset of 7 of these fire clusters were identified in the MODIS imagery and used as a way to compare estimations of active fire size and FRP. Results show that although MODIS and BIRD detect a relatively similar FRP for fire clusters (r^2= 0.84), active fire size derived from MODIS is strongly dependent on the method of calculation, which affects plume rise within the Freitas model. Although trends identified are based on a small number of observations, this exploratory study has demonstrated improvements possible in plume rise model validation by using high resolution data.