**Coupled fire-atmosphere modeling – new capabilities, challenges and opportunities in the context of air quality forecasting**

Adam K. Kochanski1, Derek V. Mallia1, Jan Mandel2, Farren Herron-Thorpe3, Joseph Vaughan4

*1 Department of Atmospheric Sciences, University of Utah, Salt Lake City, UT*

*2 Department of Mathematical and Statistical Sciences, University of Colorado, Boulder, CO*

*3[Washington State Department of Ecology](https://www.researchgate.net/profile/institution/Washington_State_Department_of_Ecology)*

*4Department of Civil and Environmental Engineering, Washington State University, Pullman*

As fire-related air pollution becomes more prevalent due to climate change and the growth of the wildland-urban interface, the impacts of wildfires and prescribed burns on air quality are increasingly becoming a concern for fuel, fire and air quality managers, alike. Existing modeling frameworks used for assessing fire effects on air quality generally require a forecast of the fire area in order to compute the fire emissions used for smoke forecasting. Satellite products can only provide estimates of already burned area, thus future emissions are estimated based on simple assumptions regarding fire growth and diurnal variations of fire activity. Consequently, diurnal fire emissions have to be approximated based on a simplified diurnal cycle independent of fire weather conditions. As a result, these assumptions can have adverse effects on simulated emissions and fire plume injection heights, which ultimately impacts the smoke dispersion forecast.

With the advent of increased computational resources, in addition to the development of coupled fire-atmosphere models, real-time fire and smoke forecasting is becoming a reality. As a result, many of the processes that were once parameterized in air quality models can now be explicitly resolved. Here we present an overview of an integrated coupled fire-atmosphere and chemical transport model WRF-SFIRE-CHEM (WRFSC), and demonstrate its applications to air quality modeling. We present results from numerical simulations of selected wildfire events and comment on the forecasting capabilities in the light of the last fire season. We also discuss challenges, data needs and future opportunities in the context of modelling of smoke effects on air quality.