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Diurnal variations of wildfire emissions in Europe: analysis of the MODIS and SEVIRI measurements in the framework of the regional scale air pollution modelling

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Wildfires episodically provide a major contribution to air pollution in many regions of the world. For example, the extreme air pollution level and strongly reduced visibility were observed in the Central European region of Russia during the intensive wildfire events in summer of 2010. Such episodes provide a strong impetus for further developments in air pollution modeling, aimed at improving the ability of chemistry transport models to simulate and predict evolution of atmospheric composition affected by wildfires. The main goals of our study are (1) to investigate the diurnal cycles of air pollutant emissions from wildfires in several European regions, taking into account the fire radiative power (FRP) satellite measurements for different vegetation land cover types and (2) to examine the possibilities of improving air pollution simulations by assimilating the diurnal variability of the FRP measurements performed by the polar orbiting (MODIS) and geostationary (SEVIRI) satellite instruments into a chemistry transport model. These goals are addressed for the case of wildfires occurred in summer 2010.

The analysis of both the MODIS and SEVIRI data indicate that air pollutant emissions from wildfires in Europe in summer 2010 were typically much larger during daytime than during nighttime. The important exception is intensive fires around Moscow, featuring an almost "flat" diurnal cycle. These findings confirm the similar results reported earlier [1] but also extend them by attributing the flat diurnal cycle only to forest fires and by examining a hypothetical association of the "abnormal" diurnal cycle of FRP with peat fires. The derived diurnal variations of wildfire emissions have been used in the framework of the modeling system employed in our previous studies of the atmospheric effects of the 2010 Russian wildfires [2, 3]. The numerical experiments reveal that while the character of the diurnal variation of wildfire emissions has a rather small impact on the simulated evolution of primary air pollutants (such as CO and PM10), it considerably affects variability of daily ozone maximums. Moreover, it is found that assimilating the diurnal variability of wildfire emissions derived from the FRP measurements into our model leads to significant improvements in the agreement between the simulated and measured ozone concentrations in the Moscow region.

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