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Semi-natural studies of a wildfire impact on air transport processes

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Abstract

Many wildfires (forest, steppe, and peat) occur every year in the world. An increase in temperature can result in an increase in the size of the burnt-out area, fire frequency, and the scale of the effects (Westerling et al., 2006; Wotton et al., 2017). In this work, we present the results of multiyear semi-natural experimental studies of the propagation of the front of a steppe fire and its effect on meteorological parameters, the formation of atmospheric turbulence due to the dissipation of turbulent structures in the flame, and the emission of gaseous combustion products and aerosols. Large-scale turbulence is observed in the front of a seminatural fire, which is absent in laboratory conditions. The predominance of large-scale turbulence in a flame results in turbulization of the atmosphere in the vicinity of a combustion center. Strong heat release in the combustion zone and flame turbulence increase the vertical component of the wind velocity and produce fluctuations in the air refractive index, which is an indicator of atmospheric turbulization. Variations in the gas and aerosol compositions of the atmosphere are measured in the vicinity of the experimental site. The related experimental data expand the fundamental knowledge about the effect of wildfires on changes in wind speed, air temperature, turbulence, and transport of combustion products. Changes in the aerosol and gas compositions of the atmosphere during a wildfire are recorded with a delay caused by atmospheric transfer processes and can be used in systems for the remote detection of wildfires.

Keywords: wildfire, atmosphere, IR thermography, combustion, turbulence

References

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