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Numeral Modeling of Smoke Aerosol Interaction with Cloudiness over Catastrophic Wild Fires in Siberia

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The increase of burning area in Siberia, the extension of fire season and fires intensity leads to significant carbon emission. One of the important tasks is to describe the spread of smoke aerosol and other combustion products using actual meteorological data and fire state information. A smoke aerosol covers territory a hundreds times larger then the burning area and has an effect on forming of the cloud and sediment formation exactly above the fire zone.
Well known that smoke particles are condensation nucleus of water vapor and of water droplets coagulation and of crystallization.
The no-hydrostatical model of atmospheric boundary layer, taking into account the phase change in the system vapor-water-ice, was developed for calculation of different scenarios of convective cloudiness forming over catastrophic wild fires.
The analysis of remote sensing data relating to catastrophic fires is carried out for Asian part of Russia for the period from 2002 to 2008. The followings regular dependences were of interest:
• the anomalously dry weather is set during long period on the areas of catastrophic fires
• the expected reserve cloudiness which would partly suppress such fires does not spread through this areas.
Calculations showed that increasing of the smoke aerosol concentration at the top of cloud can result in decreasing of total precipitations amount. The penetration of smoke aerosol in the atmospheric boundary layer stimulates rapid water drops crystallization. Clouds with an «icy top» provide more weak precipitation, than the clouds, which tops consist of mixture of icy crystals, snow and raindrops. This is in accordance with theoretical considerations and experimental investigations of micro physical processes in clouds.
Monitoring of meteorological situation from space, cyclones and clouds dynamics, specifies air circulation transformation which takes place above the catastrophic fires area. We can suppose a positive feed-back between heat and mass release and atmospheric processes, resulting in long duration of mass fires in Siberian taiga regions.
The numeral modeling of smoke aerosol propagation takes into account the processes of convection, turbulent exchange, humidity, speed and direction of wind. Calculating of spatial and temporal precipitations distribution at the presence of smoke aerosol allowed us to assume, that vertical heat and mass transferring in the mass forest fires region, can appear as the influencing factor on atmospheric circulation in a zonal scale.
Using mathematical modeling, we have shown, that the large particles of smoke aerosol, emitted out of the burning area can result in diminishing of thundershowers precipitations in Siberian region. It can be substantial in the mechanism of positive feed-back, resulting in the long mass fires duration.

KEYWORDS: mass forest fires, smoke aerosol, atmospheric boundary layer, no-hydrostatical model, precipitation, heat and mass transferring, positive feed-back, boreal Siberia