Geophysical Research Abstracts
Vol. 15, EGU2013-2217, 2013
EGU General Assembly 2013
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Fire Danger Estimation in Siberia Using SMOS Data

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One of the most important tasks of fire monitoring is to forecast the conditions that determine the possibility of occurrence and spread of fire in forests. Weather fire danger assessment is mainly based on the analysis of the meteorological parameters recorded by weather stations. The main drawback of such a method for the fire danger assessment is an absence of regular network of weather stations. This situation takes place, for example, in Siberia. The area of possible interpolation of weather stations data is generally up to 30 km. The analysis of the existing network of weather stations shows that there should be an interpolation in the zone up to 100 - 150 km between weather stations which restricts the correctness of weather fire danger distribution maps for the forest zone of Siberia. The area of research associated with the development of methodologies for the forest fire danger assessment remains urgent today. To solve this problem it is necessary to perform a geospatial analysis of fire distribution and distribution of forest fuel moisture which can only be done with the involvement of satellite monitoring. This can provide the necessary spatial coverage and frequency of data updates. Over the past 30 years the technical means of remote sensing and methods of land cover moisture measurement were developed. In 2009 the SMOS spacecraft was launched by the European Space Agency, equipped with microwave radiometer operating at the frequency of 1.4 GHz. Moisture is restored based on the angular dependence of the brightness of temperatures measured by spacecraft (Level 1C product). Geospatial analysis of the relationship between occurrence of fires, burned areas as well as fire radiative power during the fire season and land cover moisture measured by SMOS was performed. Daily updated database of forest fires detected using MODIS radiometer over the fire seasons of 2010 - 2012 as well as the land cover moisture data obtained from SMOS measurements were used in the analysis. The study area covered the territory of Siberia, including areas where extreme fire behavior was observed. Also the time series of land cover moisture measured by SMOS satellite and weather fire danger indices calculated using ground weather stations were compared. The results showed that in most cases the relationship between moisture and fire danger index values can be found. The increase in soil moisture was accompanied by a reduction of weather fire danger indices values. The highest correlation coefficients between moisture measurements and fire danger indices were obtained for southern regions (-0.5 – -0.6), however for the stations located in the central and northern regions the relationship was weaker. The analyses indicated that it was difficult to obtain a reliable relationship between remote sensed land cover moisture and fire weather indices for the whole territory of Siberia. However such dependencies can be apparent for individual regions.