Geophysical Research Abstracts
Vol. 21, EGU2019-10532-1, 2019
EGU General Assembly 2019

Atmospheric Circulation Characteristics associated with wildfires occurrence in the Mediterranean Basin

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Wildfires have been recognized as an intrinsic factor of the Earth system affecting vegetation functioning, structure and distribution with consequent impacts on terrestrial ecosystems, biogeochemical cycle, atmospheric composition, surface albedo and climate. At the same time, large uncontrolled fires are an environmental hazard due to their adverse effects on natural systems, the economy and human health. Wildfires regime is controlled by both, natural and human factors, such as vegetation type and cover, climate, weather, land management practices including human ignitions. Weather in particular, plays a key role in fire ignition and fire behavior as well, in terms of spreading, severity and suppression. Frequently, large fire events are the synergistic result of fuel load and anomalous atmospheric conditions.

This work examines the atmospheric circulation characteristics associated with wildfires events occurring in the Mediterranean basin, a region which counts the most fires, and hence burned areas, in Europe. Wildfire data, namely ignition date and total burned area, are taken from MODIS (MODerate resolution Imaging Spectroradiometer) database over the period 2002-2016. For our analysis 2533 wildfires with a burned area of at least 500ha, which occurred in 871 days during the warm period of the year (May to September) are considered. In order to identify the atmospheric circulation characteristics associated with those wildfires, gridded (2.5°x 2.5°) NCEP/NCAR reanalysis data of 500 and 1000hPa geopotential height and 1000hPa temperature over the broader European area and 850hPa relative humidity across the Mediterranean basin are analyzed. Following the synergistic application of Factor Analysis for data dimensionality reduction, and Cluster analysis for the objective classification of daily synoptic conditions, seven (7) homogenous and distinct to each other mean atmospheric circulation patterns emerged. Specific characteristics of the revealed patterns favor the ignition and spread of wildfires in certain regions of the Mediterranean Basin. Wildfires in the Balkan Peninsula are favored by the intensification of the northerly flow over the region, due to the strengthening of the pressure gradient between the enhanced and spatially extended Azores Subtropical Anticyclone and the Asian thermal low. Iberian Peninsula wildfires are associated with the dominance of dry and windy conditions, controlled by the relative position and strength of the anticyclonic circulation over the Atlantic Ocean, whereas a thermal low developed over southern Spain and/or northwestern Africa plays also a key role.