Geophysical Research Abstracts,
Vol. 11, EGU2009-11181, 2009
EGU General Assembly 2009

The Impact of Climate Variability on the Wildfire Behaviour of Distinct Land Ecosystems

L. Viegas, D. Stevenson, and C. Merchant
Institute of Atmospheric and Environmental Science, University of Edinburgh, United Kingdom

The objective of our research is to investigate the impact of climate variability on geographic, ecological, seasonal and inter-annual distributions and magnitudes of biomass burning and on the correspondent quantity and quality of pyrogenic emissions, across a variety of ecosystems. With this purpose, we used 10 years of monthly, 1°x1° gridded burnt fraction and pyrogenic emissions data, from the Global Fire Emissions Database version 2 (GFEDv2), together with land-cover data, from the Goddard Institute of Space Studies (GISS), and with climate data from ECMWF reanalyses, the Global Precipitation Climatology Project (GPCP) and the Global Hydrology Resource Centre (GHRC). Knowledge about the ecosystems – climatology, topography, orography, vegetation species and structure – did not influence the statistical analyses themselves, which relied only on data for 1°x1° resolution pixels, but it was used before and after, first to choose eco-regions (ecosystems within geographical regions) with a reasonable ecological, geographic and climatic homogeneity, and then to draw conclusions and explanations. Overall, the climate parameters that showed significant statistical relationships with burnt area (absolute rank-correlations above 70%), in more eco-regions, were air and soil temperature, humidity, rainfall, wind and lightning density, and also precipitation and snow cover up to 6 months preceeding the fire season. The most extreme cases of inter-annual variability occurred in equatorial rainforests. These ecosystems rarely burn, since they are sparsely populated and lightning strikes are almost always simultaneous with rain, but, when fires do occur, like during ENSO related droughts, a great quantity of carbon is released to the atmosphere, because of the rainforests rich content in fuel loads. Monsoon moist-deciduous forests also became very prone to fires, in years when the onset of the rainy season was delayed. Earlier snow melt and/or diminished winter precipitation appeared associated with larger burnt areas during the fire season in northern temperate forests. The world ecosystems with more wildfires were grasslands and tropical/ subtropical drought-deciduous woodlands and shrublands. In subtropical shrublands and grasslands, fires tended to repeat the same behaviour year after year, with shrubs and grass growing quickly during the wet summer season, particularly with positive anomalies of relative humidity and rainfall, and then burning easily during the dry winter season, specially with positive temperature anomalies and fast winds. The strongest positive rank-correlations between wildfires and air or soil temperature (above +0.8) were found in African grasslands with 10-40% wood cover. The strongest negative rank-correlations with air humidity and rainfall (below -0.7) were also found mostly in African ecosystems: grasslands, tropical rainforests, tropical/ subtropical evergreen broad-leaved forests, evergreen sclerophyllous woodlands, tropical/ subtropical drought-deciduous forests and woodlands and xeromorphic shrublands. In African tropical regions, burnt area was negatively rank-correlated (below -0.75) with lightning, because thunderstorms are usually followed by convective rain; in subtropical regions, where many lightning strikes occur during dry weather, rank-correlations became positive, albeit weakly (below +0.4). It was also in Africa that burnt area was more strongly positively linked with fast winds: in tropical/ subtropical drought-deciduous woodlands (above +0.8) and in grasslands and shrublands (above +0.6). Relative humidity was generally found to be the most useful predictor of wildfire activity, but good statistical models with humidity as the predictor (correlations above 80% between real and predicted burnt area and residuals normally distributed) were found almost exclusively in grasslands and shrublands, especially in Africa, where fire behaviour was more regular. In forests and woodlands, where wildfires had more irregular patterns, and fire return periods were larger, there were not enough fires in 10 years of data to obtain useful predictive models.