



The role of drought length and magnitude in the temporal evolution of fire occurrence and burned area size in mainland Spain

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Understanding the contribution of dry periods to forest fire behaviour is a key factor to determine the potential impacts of climate change. Several works suggest that coincident drought conditions and high temperatures promote larger fires, which may experience increased occurrence given the more than likely growth of extreme weather events. However, while analysing relationships between drought and burnt area is a common topic in wildfire science, few works have dealt with their impact in fire occurrence and cause. To explore the influence of drought on wildfires we computed the Standardized Precipitation-Evapotranspiration Index (SPEI), a standard meteorological index that normalizes drought across regions and climates, recommended as a drought indicator by the World Meteorological Organization. SPEI was used to summarize the influence of drought duration (temporal scale of the SPEI calculation) and magnitude (value of SPEI) on fires in Spain. Our main goal was to analyse the relationships between drought, fire frequency (N) and burned area (BA) in different scenarios of fire size (all fires, fires above 1 Ha and fires above 100 Ha) and ignition source (natural, unintended and arson). To do so, we constructed time series of fire activity and SPEI at monthly level. Fire data series (N and BA) were constructed using fire records from the Spanish General Statistics on Wildland Fires database (EGIF). In turn, SPEI was calculated at different time scales (3, 6, 12 and 24 months). Time series were then decomposed into season and trend components and submitted to correlation analysis by means of the Spearman's Rho Rank Correlation test. This procedure was conducted for each combination of temporal component, fire size, ignition source and SPEI level to provide a deep insight into the underlying factors linked to the temporal evolution of fire activity.

Correlation outputs suggest that short-term droughts (SPEI 3 and 6) have more influence in fire occurrence (N) than extended droughts (SPEI 12 and 24), in part because the later are uncommon events. The seasonal cycles of short-term SPEI are highly associated to the occurrence of human-caused (unintended plus arson) large fires (size >100 Ha). Natural fires in the hinterland region of Spain require longer dry conditions, being more correlated to SPEI 6 than SPEI 3, but not going any further (SPEI 12 or 24). Regarding the trend component, which is linked to the overall temporal evolution of forest fires, the larger association is detected between natural fires above 1 Ha and SPEI 3. On the other hand, despite showing high correlation values in some regions, change in accidental and arson fires do not show strong association with SPEI-drought. The affected burnt area (BA) depicts a different spatial pattern. Seasonal cycles of BA seem to be strongly associated to SPEI 24, thus with prolonged dry conditions. This behavior is clearly displayed in the northern half and hinterland of mainland Spain. On the contrary, the trend component of BA is more spatially diverse and dispersed across the territory, with no clear pattern.