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Looking into a fuzzy future: coupled effect of pyrogeography and a changing climate on an already fragile terrestrial ecosystem

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Unprecedented wildfires swept Mediterranean Europe in the summer of 2021 wreaking havoc economically and socially while clearing large swaths of forest land. Those that scorched the southern coastal highlands in Turkey came on the heels of a heat wave and at the peak of the arid season. Nearly two thirds of the Anatolian Peninsula are under the influence of Mediterranean-type climate and prone to seasonal wildfires, a quality that also encourages high species diversity. The region's heterogenous topography is home to different meso- and micro-climates which in turn translate into high rates of endemism. Although fire as disturbance is essential for the regeneration of Mediterranean-type ecosystems, potential changes in fire frequency and severity, coupled with longer periods of drought expectations - mainly as a result of anthropogenic deforestation and climate change - is duly raising concerns. The expected increase in the frequency and intensity of climate-based disturbances necessitates some form of a predictive mechanism for future protection and mitigation, especially for these otherwise fire-adapted ecosystems. Dynamic Global Vegetation Models (DGVMs) with built in disturbance schemes when forced with future projections of climate models can be powerful tools in this regard.

In this study, we present our preliminary findings from six different model simulations, run with LPJ-GUESS, a process based DGVM. We initially introduced three native conifer species with different fire histories and significant distributions in the Anatolian Peninsula to the model and forced it with climatic drivers from ERA5 Land reanalysis dataset for the historical period. Once confident that our simulation results closely reflected the historical fires in the remote sensing datasets available through Google Earth Engine, we continued to force the model with climatic drivers from different model contributions to CMIP6, bias-corrected, interpolated to the 9-km horizontal resolution of ERA5 Land reanalysis and reflecting the RCP 8.5 scenario. All simulation results were analyzed using Climate Data Operators (CDO), ArcGIS, and R computing language.

Our preliminary results indicate an overall increase in pyro-diversity for the country across all simulations. A potential expansion of wildfire range towards the northwest was also observed, a curious outcome as this region includes the western Black Sea mountain ranges that are known for high precipitation rates. These mountains are also home to a rich forest cover with a fine mixture of broadleaved and conifer species spreading horizontally along different altitudinal belts. In light of our preliminary findings and along with our continuing research on the effects of any potential future climate-change related shifts in the fire regime on forest composition, we urge

additional study of different landscape scale disturbances (i.e. soil erosion and landslides) which may potentially be triggered as a result of a diversifying and intensifying fire regime and which may have a significant impact for the terrestrial ecosystems and livelihood.

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