Using LSA SAF Fire Radiative Power data to calibrate an hourly index of meteorological fire danger

3. Exploring the applications and impacts of new satellite data

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The Satellite Application Facility on Land Surface Analysis (LSA SAF) operationally disseminates a Fire Risk Map product (FRM, LSA-504v2) that provides daily forecasts of meteorological fire danger associated to probabilities of wildfires exceeding a specified threshold of released radiative energy, over the Mediterranean Basin. The product was calibrated using values of Fire Radiative Power (FRP) as derived from observations by the SEVIRI instrument on-board MSG satellites and values of the Fire Weather Index (FWI), the major component of the Canadian Fire Weather Index System (CFWIS), as derived from ERA-5 reanalyzes. The FRM product is currently used in Portugal for fire prevention and firefighting by public agencies like the Civil Protection Service and private entities like Navigator, a Portuguese pulp and paper company. Active fires, however, also exhibit strong sub-daily variability that relate to local weather conditions favoring or inhibiting the ignition and spread of fire. This raises the need for an hourly assessment of meteorological fire danger that would allow defining windows of opportunity to successfully fight a given fire. For this purpose, we first extend the definition of FWI that was originally designed to be computed at 12h local time to an hourly index. The procedure consists in computing FWI using the meteorological conditions of each hour for the CFWIS components and using a linear combination of the conditions from the two previous days (for estimates of the hourly index at am local times) or previous and current day (for pm local times) for the components with memory in the moisture codes of CFWIS. The result is an hourly FWI that presents a smooth transition between days and keeps the hourly FWI at 12h identical to the standard daily FWI. We then fit a statistical model (base model) consisting of a truncated log-normal with two generalized Pareto tails to the logarithm of hourly FRE, and then improve the model by adding FRP as covariate of the eight parameters of the base model, first using the values of the standard FWI at 12h, and then the hourly values of FWI. To avoid problems related to spatial and temporal correlation of both FRP and FWI, a random sample of 50,000 pairs of FRP and FWI was obtained from a set of 569,019 observations covering Portugal during the period 2004-2019. The goodness of fit of the base model is assessed by the Anderson-Darling test. The better performance of the model using the standard FWI at 12h as covariate over the base model is assessed by means of the Bayes Factor and by applying the Vuong’s closeness test, and the same procedure is used to assess the better performance of the model using hourly FWI as covariate over the one using standard FWI. Finally, the model with hourly FWI is used to compute values of probability that an active fire at a certain location and time will have an FRP greater than a prespecified threshold, and these values are used to define windows of opportunity to successfully fight the fire. As an illustration of the procedure, results are applied to several large wildfire events that took place in Portugal (e.g. July 2016, October 2017 and August 2018). Research was developed within the framework of EUMETSAT Satellite Application Facility for Land Surface Analysis (LSA SAF) and FCT project Fire-Cast

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