Cross-Country Risk Quantification of Extreme Wildfires in Mediterranean Europe

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Background

Figure 1: Destruction after 2018 fire in Mati, Greece (source: REUTERS)

Wildfires can lead to extensive environmental and socioeconomic impacts

- Individuals/Communities
- Properties/Infrastructure
- Ecosystems

Background

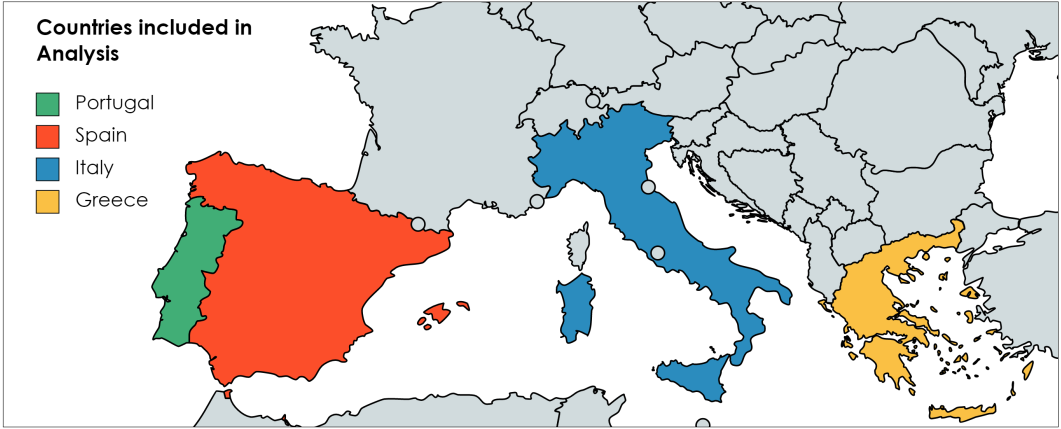


Figure 2: Study area.

Background

Terminology

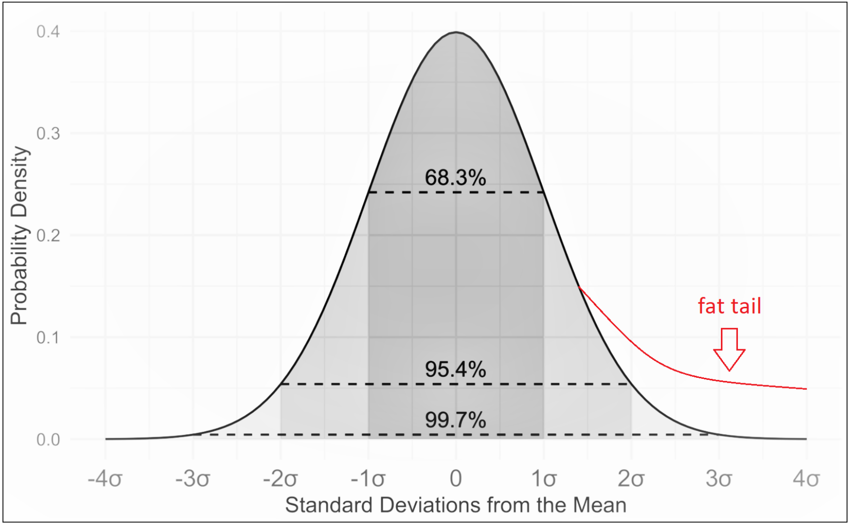
Wildfire: Uncontrolled fire that burns wildland vegetation such as forests, grasslands, savannas or other ecosystems.

- Beneficial ecosystem functions
- Utilized by communities
  - agricultural practices
  - landscape modification
- Societies and ecosystems adapt to near-normal conditions

$\Rightarrow$ Extremes cause the bulk of impacts (Strauss et al., 1989; Gill and Allan, 2008; Evin et al., 2018)

Methodology

Figure 3: Normal distribution.



Methodology

- Extreme Value Theory (EVT)
  - Specifically designed to model events in fat-tailed distributions
  - Suitable inferential tool (Holmes et al., 2008; Hernandez et al., 2015)
  - Globally applied e.g., Keyser and Westerling (2019); Jiang and Zhuang (2011)
- Point Process characterization
  - Occurrence and rate of exceedance
  - Above high threshold

Extremal Types Theorem

The maximum of a large number of i.i.d. random variables is distributed like one of the three limit type distributions **Gumbel**, **Fréchet** or **Weibull** independently of the parent distribution.

Data

- EFFIS burned area spatial data product
  - Primary source of harmonised data
  - MODIS satellite imagery
- Link with covariates
  - Fire Weather Index
  - Population density
  - Land cover types
- 2006 - 2019

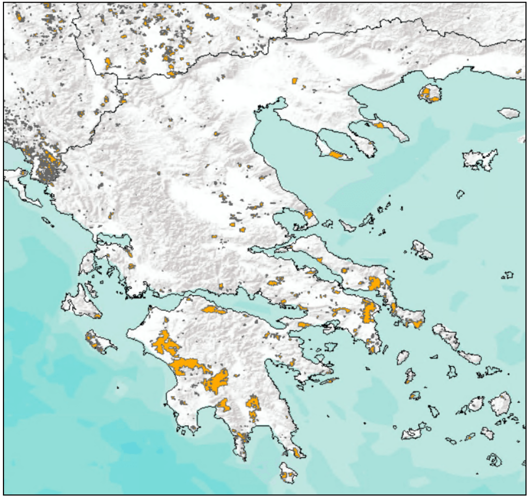


Figure 4: EFFIS burned area polygons Greece (2006-2019).

Results: Return Level Estimation

Table 1: Individual country return levels in ha for specific return periods.

country	5-year (CI)	10-year (CI)	20-year (CI)
Portugal	33'279 (30'062, 35'832)	50'338 (39'924, 58'557)	75'256 (53'038, 94'587)
Spain	18'080 (17'376, 18'822)	25'165 (23'391, 26'905)	34'017 (30'277, 39'079)
Italy	7'325 (6'149, 9'025)	8'966 (6'531, 12'842)	10'890 (6'944, 12'842)
Greece	20'687 (18'370, 22'372)	33'242 (28'298, 37'876)	51'764 (39'636, 64'261)

$\Rightarrow$ the T-year return level is exceeded in any year with probability 1/T

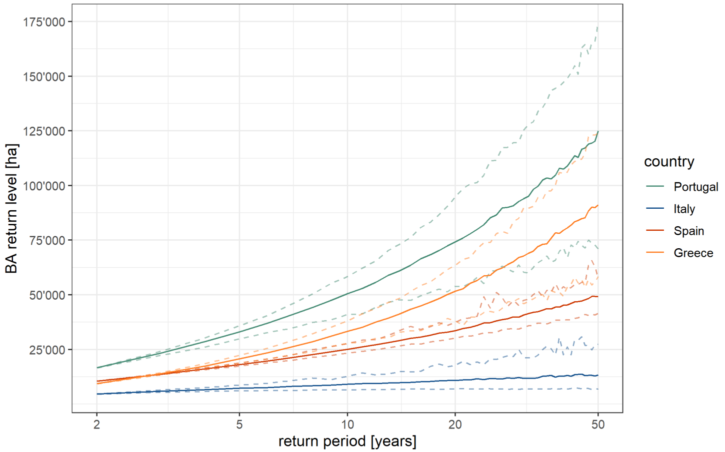
Ex. Portugal 10-year

- The probability that a wildfire burns $>$ 50'338 ha in any given year is 10%
- for $>>$ T $\rightarrow$ 50'338 ha is exceeded, on average, once every 10 years
- "10-year event"

Results: Return Level Plots

- Cross-country risk comparison
- Limit type ⏩ more
    - Fréchet: GR, PT, ES
    - Gumbel: IT

Figure 5: All countries return level plots.

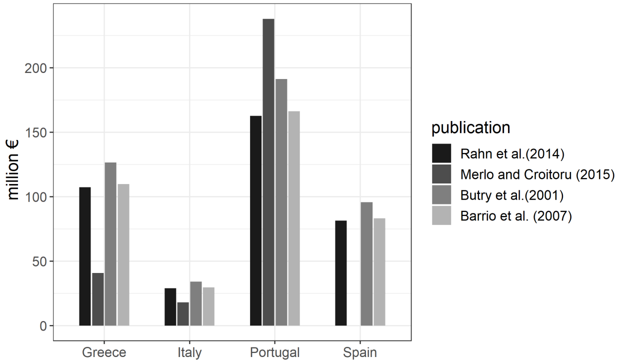


Results: Economic Valuation

⇒ Multiplication of our expected BA estimates with associated per ha monetary losses

- 4 publications ⏩ more
  - Rahn et al. (2014)
  - Butry et al. (2001)
  - Merlo and Croitoru (2005)
  - Barrio et al. (2007)
- Example 10-year event
  - Italy 18-34 million €
  - Portugal 162-230 million €

Figure 6: 10-year return level economic loss estimates.



Questions/Comments

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