Daily Forecasts of Meteorological Fire Danger in the Zambézia province of Mozambique

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Motivation

- Rural fires in Mozambique are responsible for an annual burning of **6 to 10 million hectares of forest** and 9 to 15 million hectares of other types of land cover;

- The vast majority of fires are due to **human activities** linked to farming, hunting and charcoal farming;

- The increase in these activities in the last decades has led to a breakdown of the balance between vegetation and human activity, which together with the climatic changes that have been affecting the country, has led to an increase in the number of uncontrolled fires with serious socioeconomic consequences and adverse impacts on natural ecosystems and biodiversity

- The aim of this work is to **model meteorological fire risk** with the aim of reducing the prevalence of fire in plantations, natural forests and inhabited areas of Zambezia Province of Mozambique.
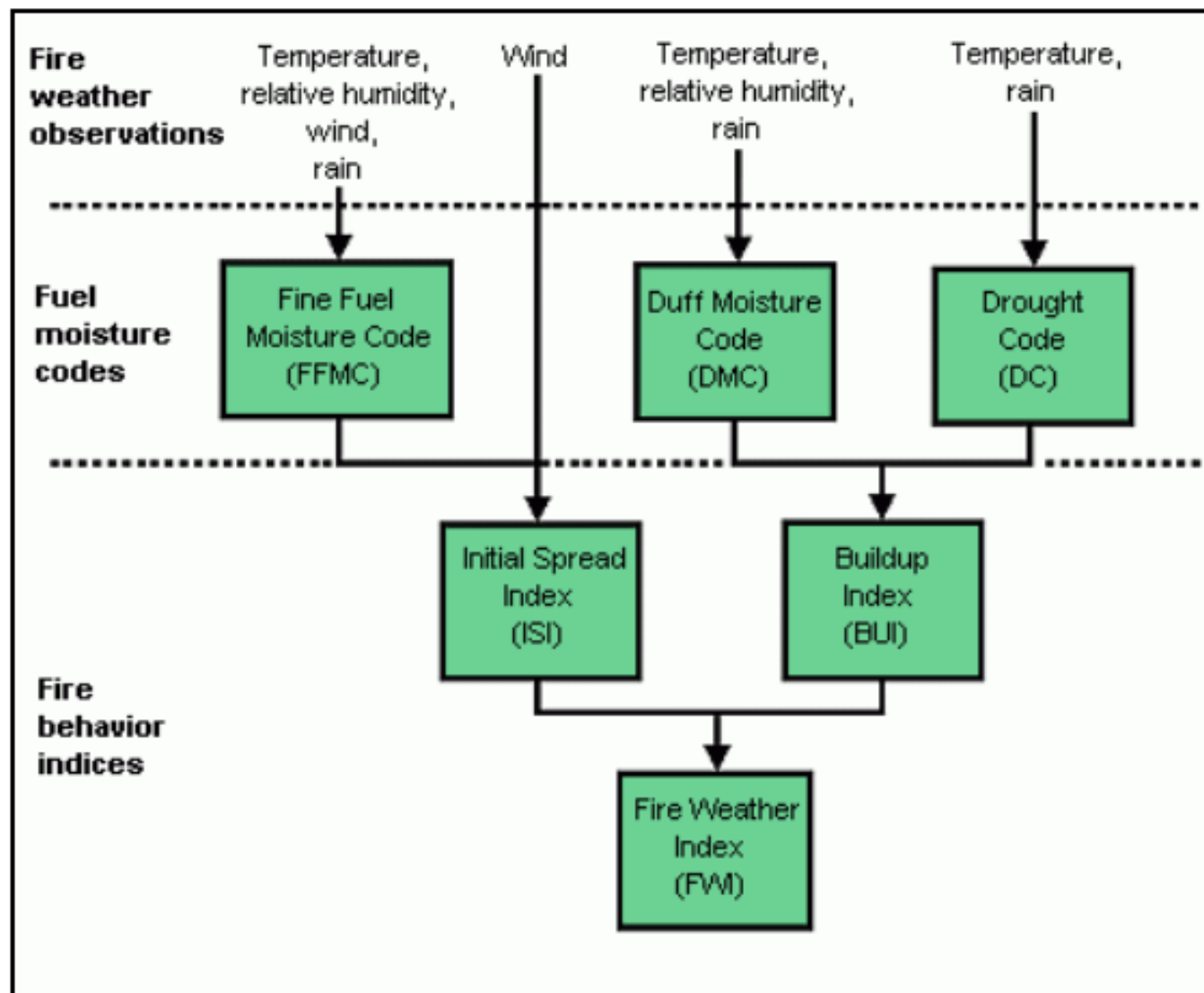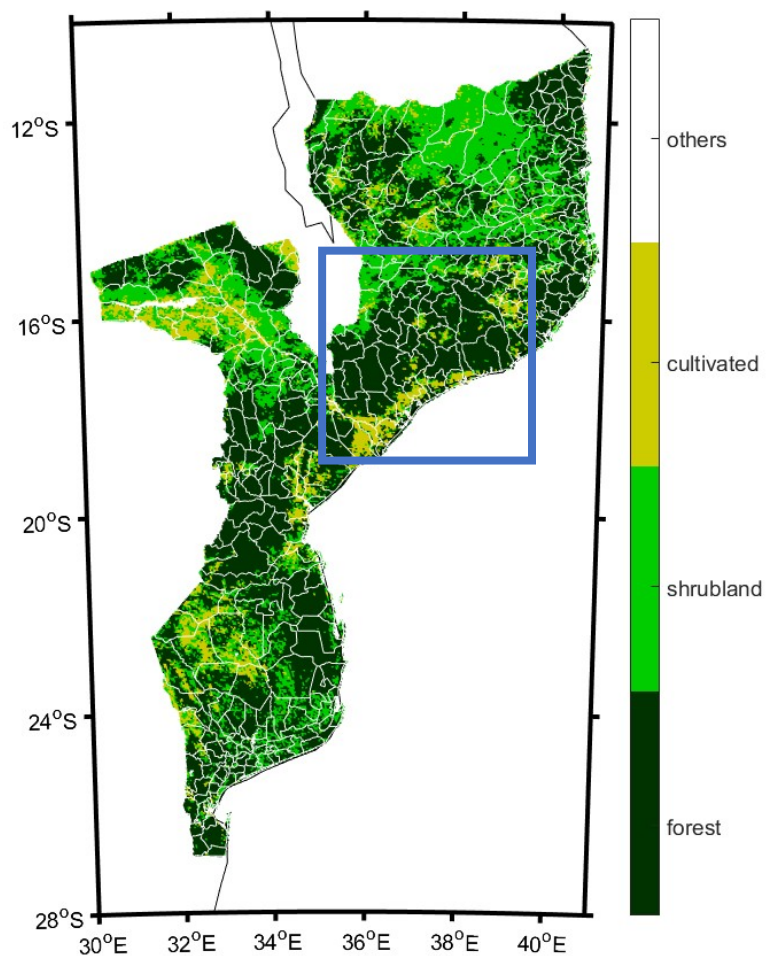
Study Area

MOZAMBIQUE

Zambézia

Gurue

Alto Molocue

Namarroi

Ile

Gile

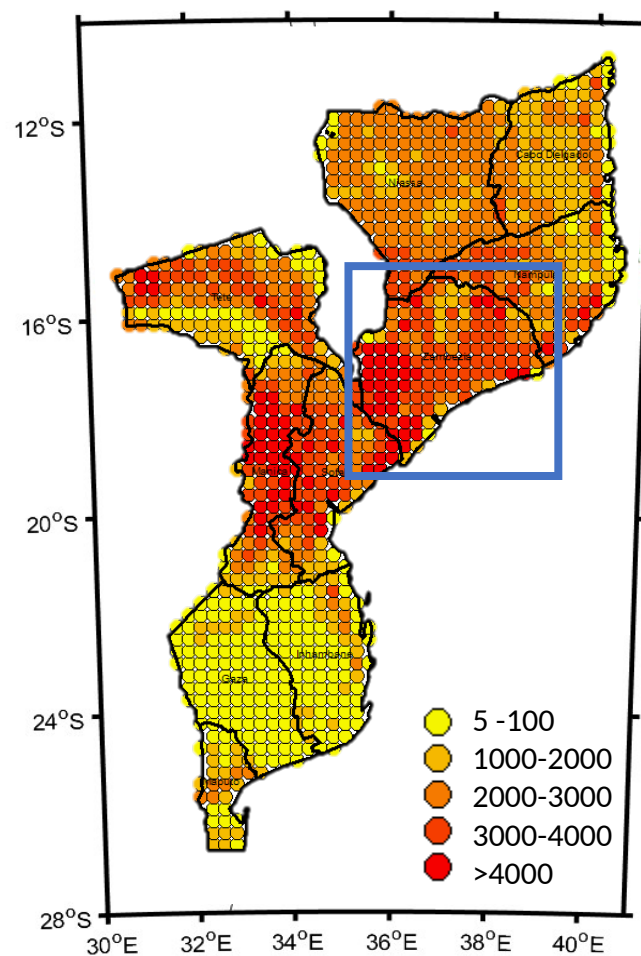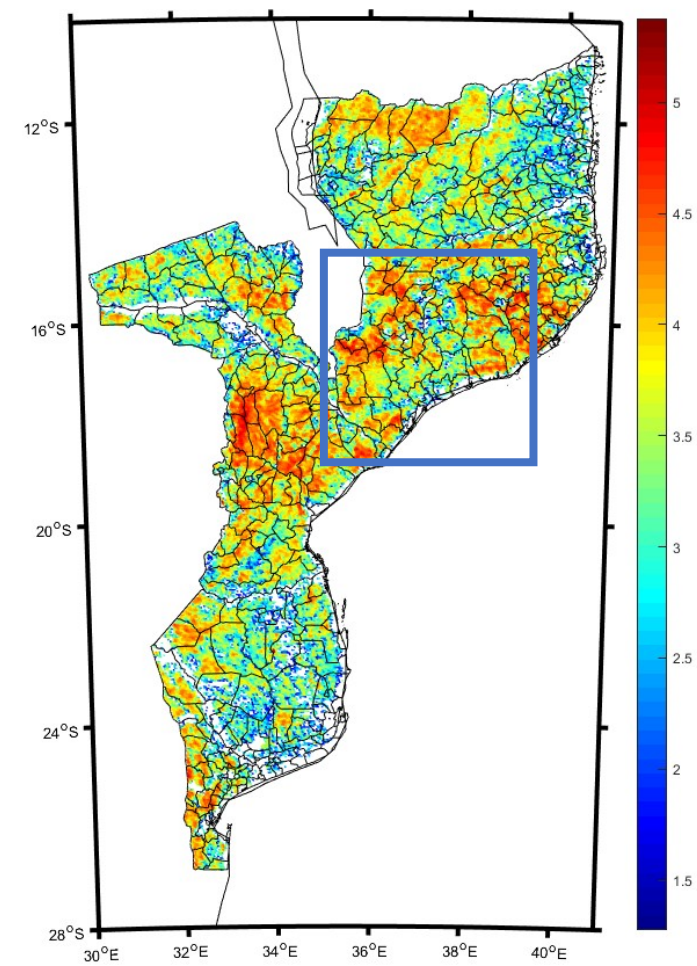Mocuba

Study Area

INSTITUTO
DOM LUIZ
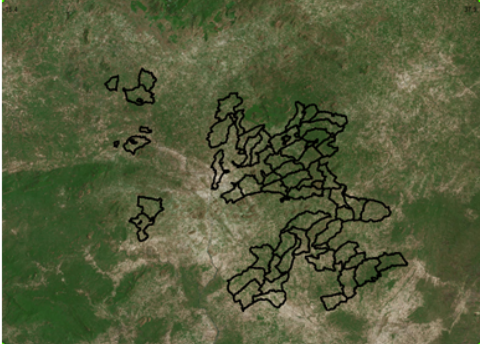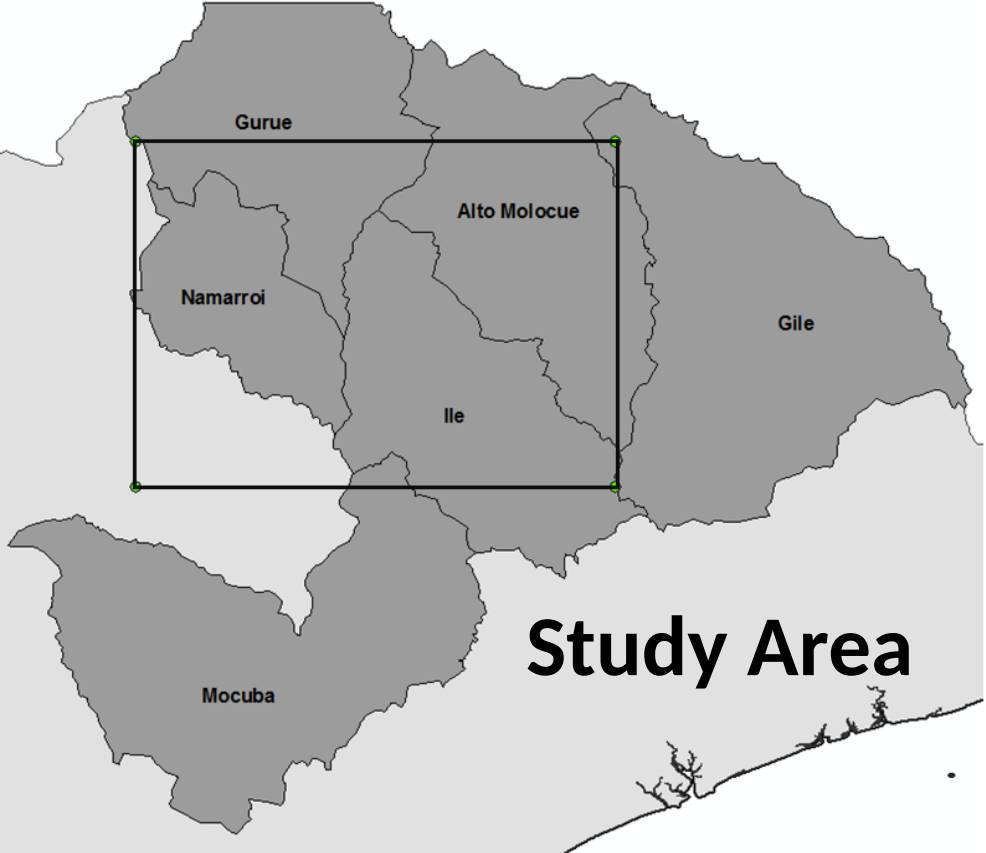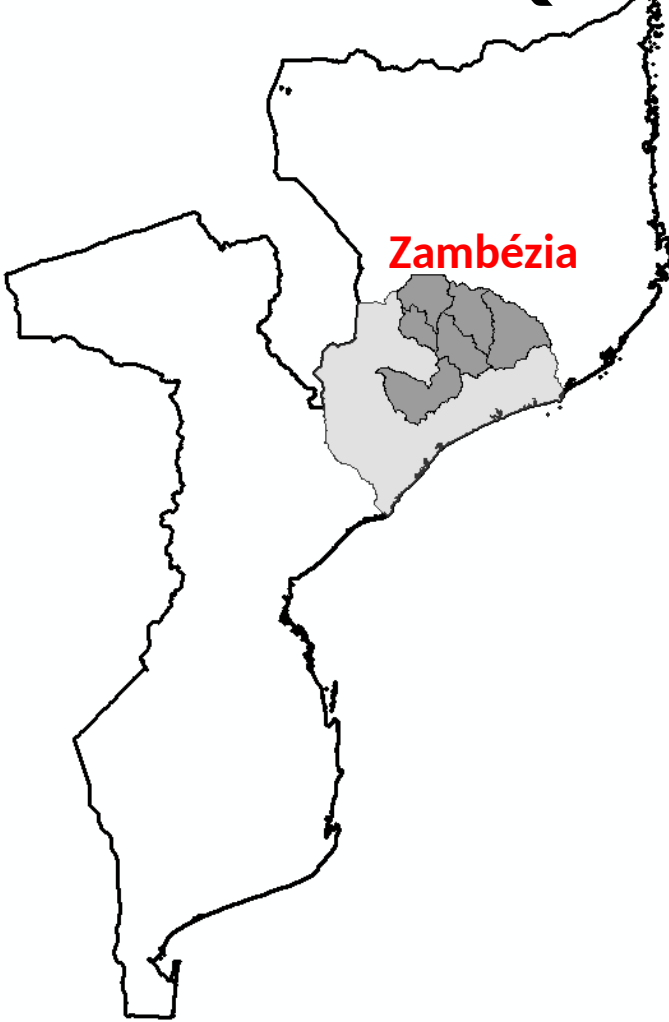
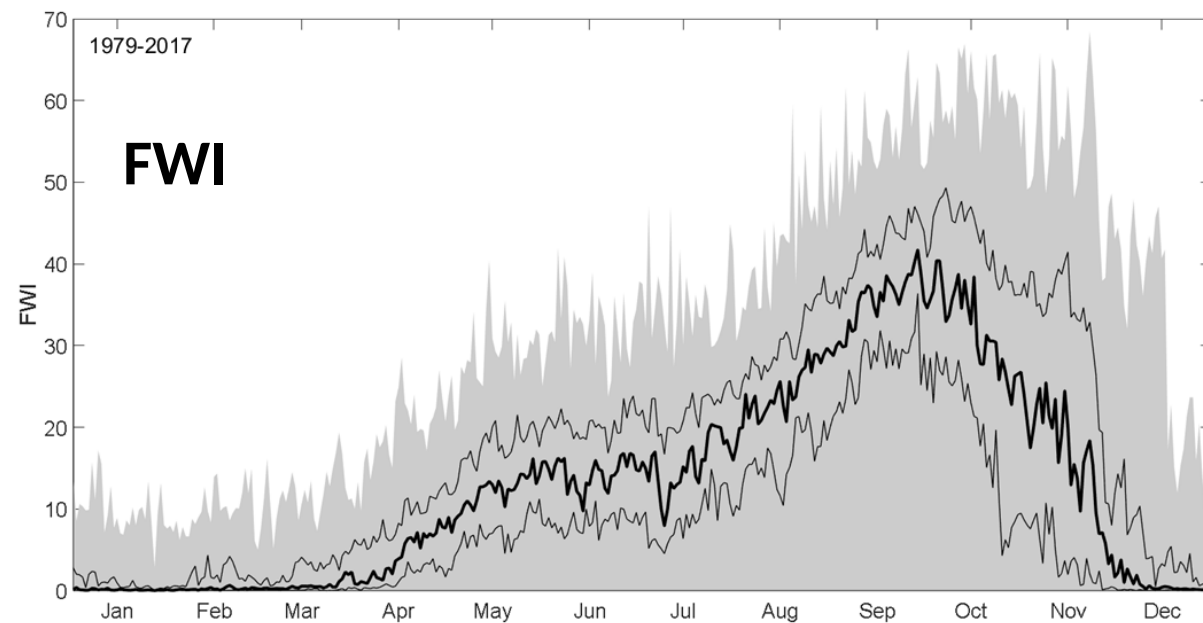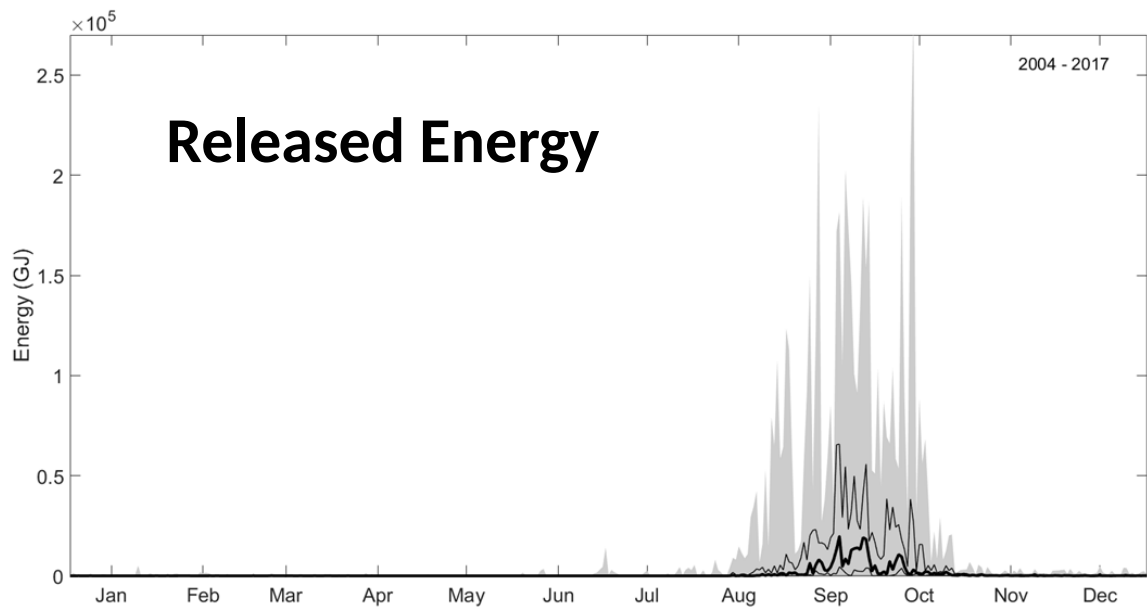# The Fire Weather Index System
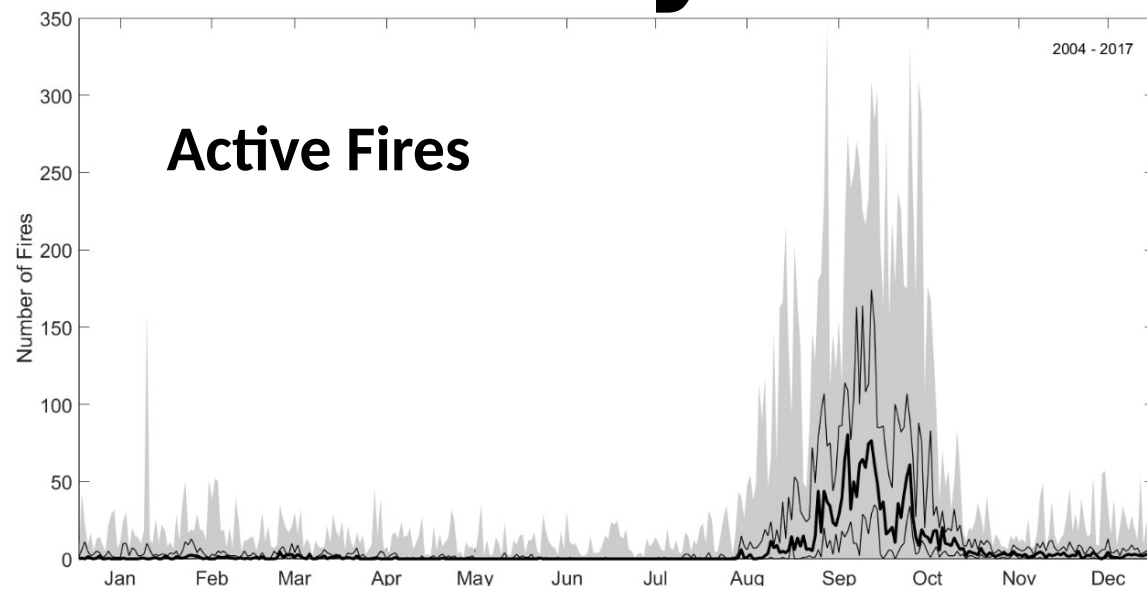
Mozambique & Zambézia
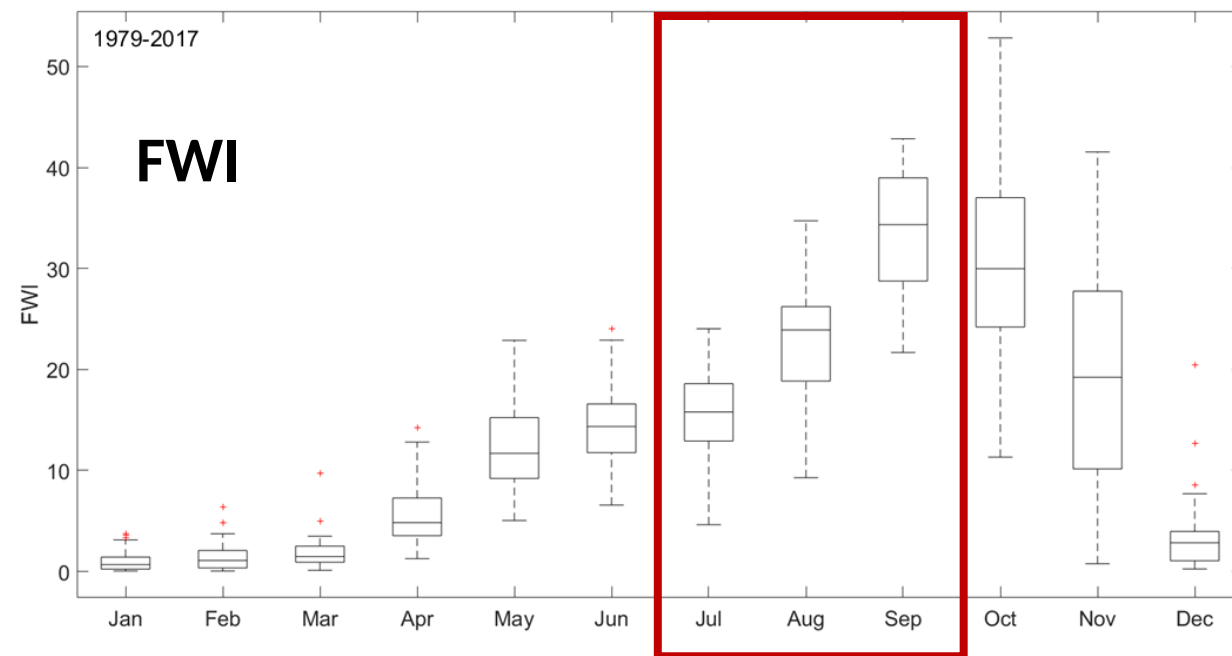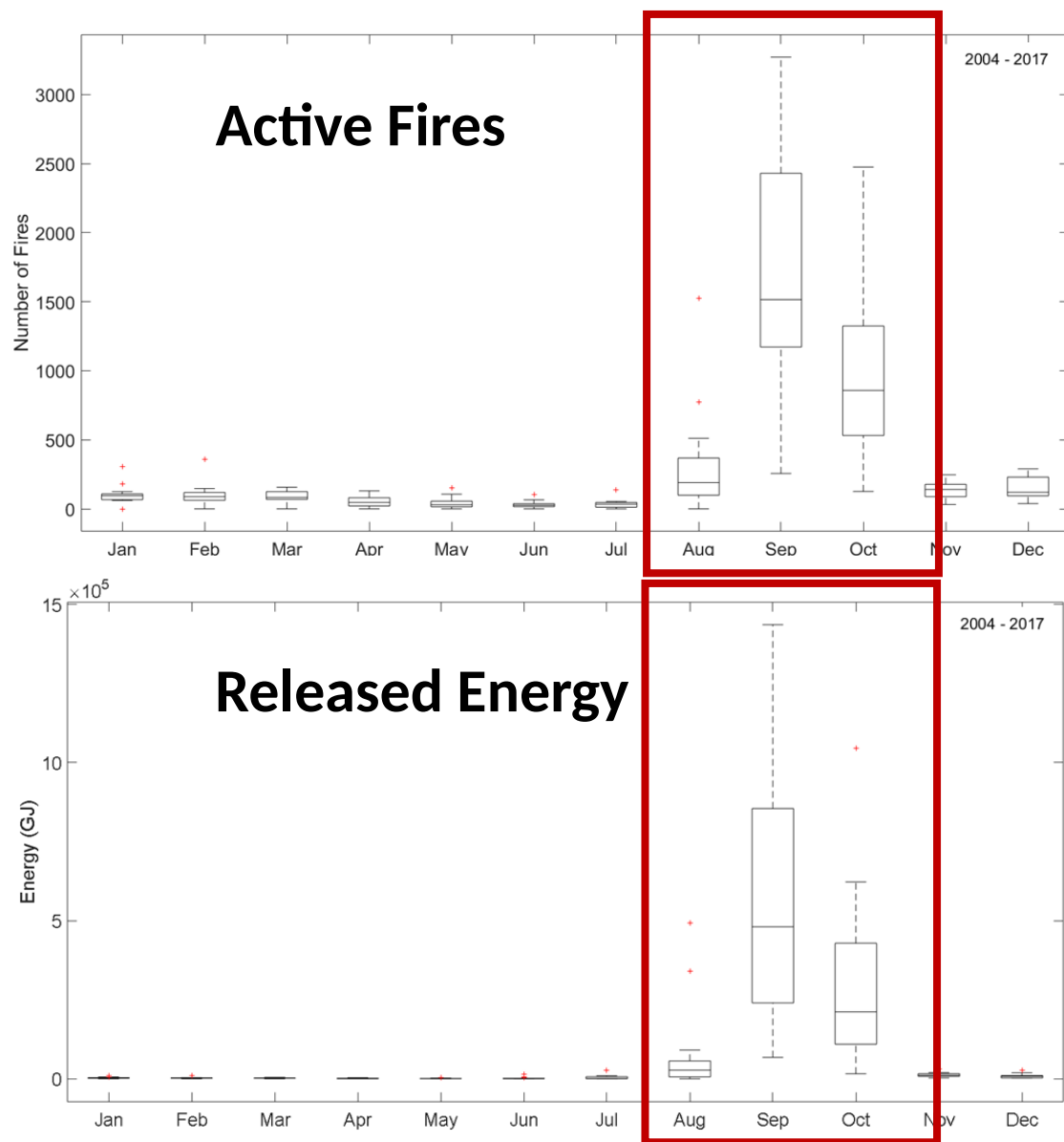
Vegetation Cover

Number of Fires

Fire Intensity

Fire activity & FWI

Fires activity & FWI

Fitting of Pareto distributions

$$g(x|\alpha,\sigma) = \frac{1}{\sigma}\left(1+\frac{\alpha}{\sigma}x\right)^{-1-\frac{1}{\alpha}}$$

$$G(x|\alpha,\sigma) = 1-\left(1+\frac{\alpha}{\sigma}x\right)^{-\frac{1}{\alpha}}$$

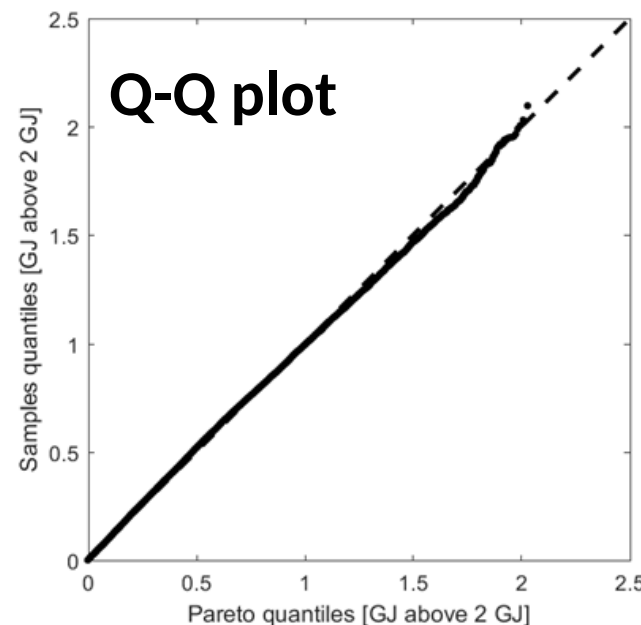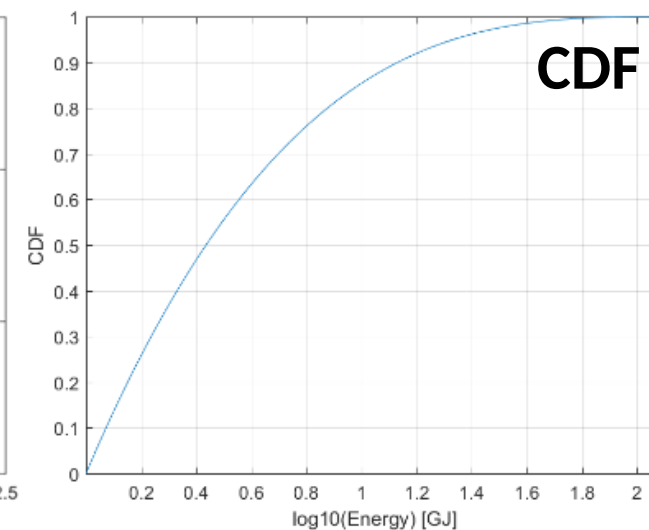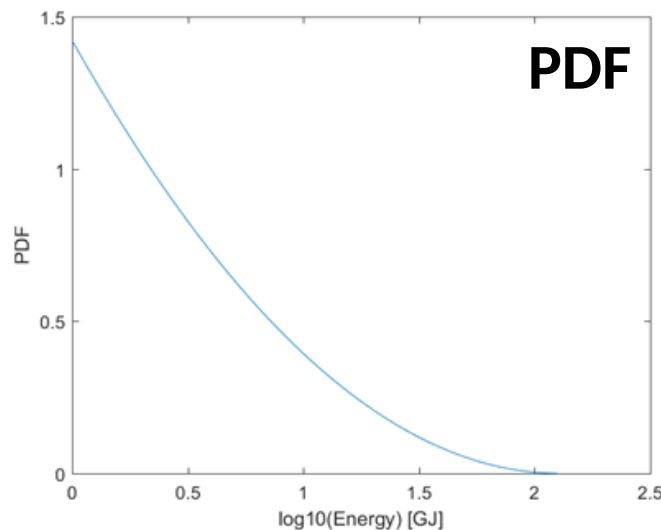$$x = \log_{10}(E/E_0) = \log_{10} E - \log_{10} E_0$$

Parameters to be estimated

E_0 = minimum threshold

α = shape parameter

σ = scale parameter

PDF

CDF

Q-Q plot

$$E_0 = 100\ GJ; \alpha = -0.33; \sigma = 0.70$$

original sample of **39 267** events is reduced to **20 173** (a reduction of $\approx 49\%$)

a negative value of the shape **parameter** implies that the **range of** x is upper **limited by**

$$x_{max} \cong 4$$

FWI as a covariate of the scale parameter

Model

$$G(x, FWI | \alpha, b, m) = 1 - \left(1 + \frac{\alpha}{b + m \times FWI} x\right)^{-\frac{1}{\alpha}}$$

with:

with:

.

and $\quad x = \log_{10}\left(\frac{E}{2}\right) = \log_{10} E - 2$, with E in GJ.

and

$$\alpha = -0.33; b = 0.05; m = 0.01$$

Classes of fire danger

$$p(FWI) = 1 - G(X, FWI | \alpha, b, m)$$

with:

$$X = 1.2$$

Classes and corresponding ranges of probability were set as follows:
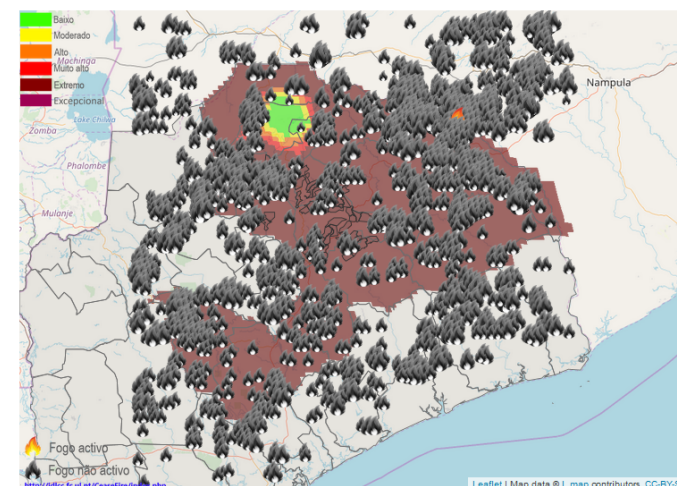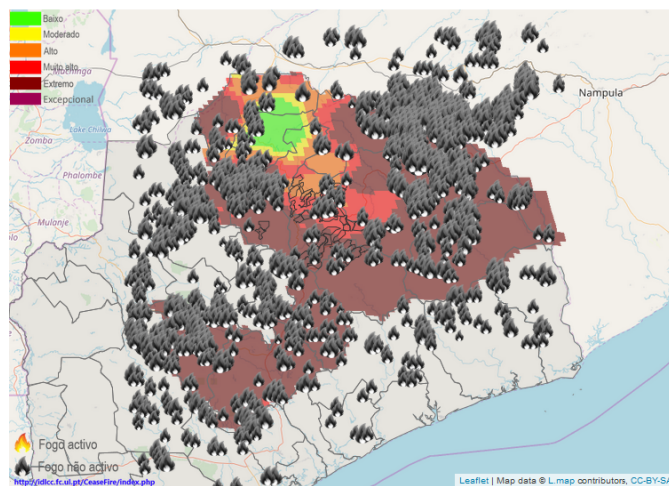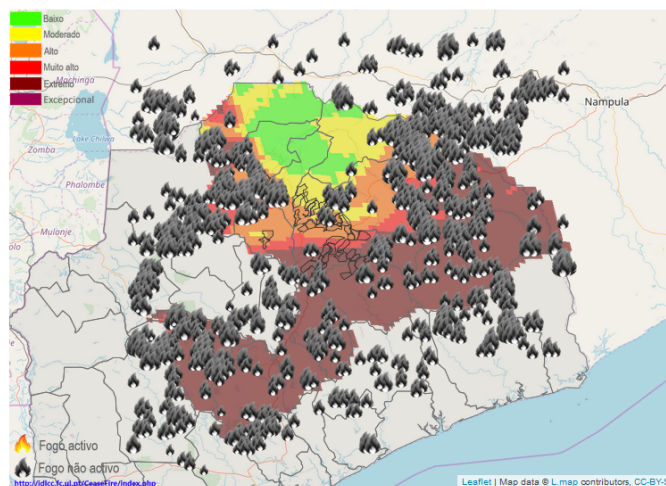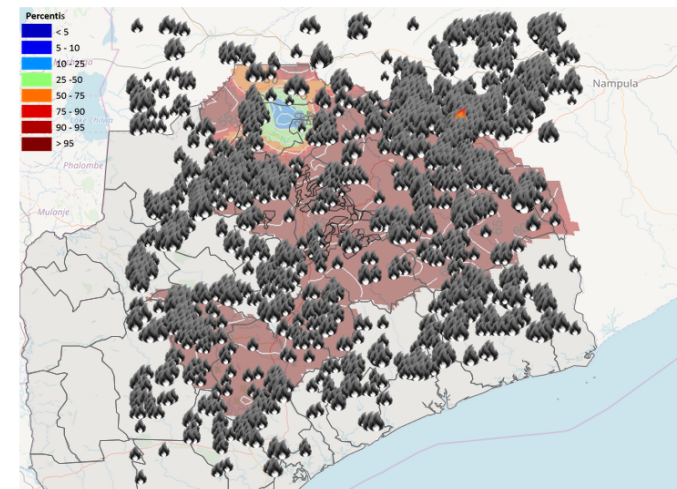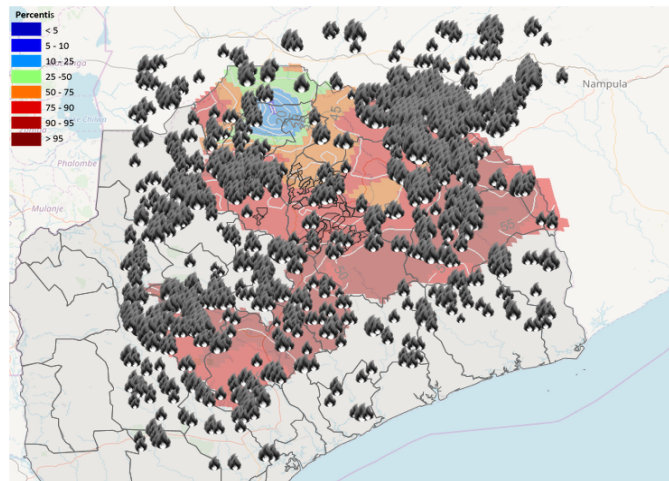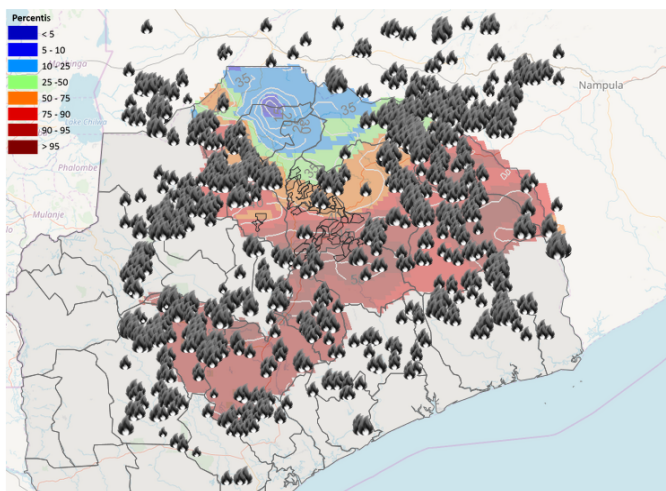
Very low danger: $p(FWI) < 0.05$

Low danger: $0.05 \leq p(FWI) < 0.10$

Moderate: $0.10 \leq p(FWI) < 0.15$

High danger: $0.15 \leq p(FWI) < 0.20$

Very high danger: $p(FWI) \geq 0.20$
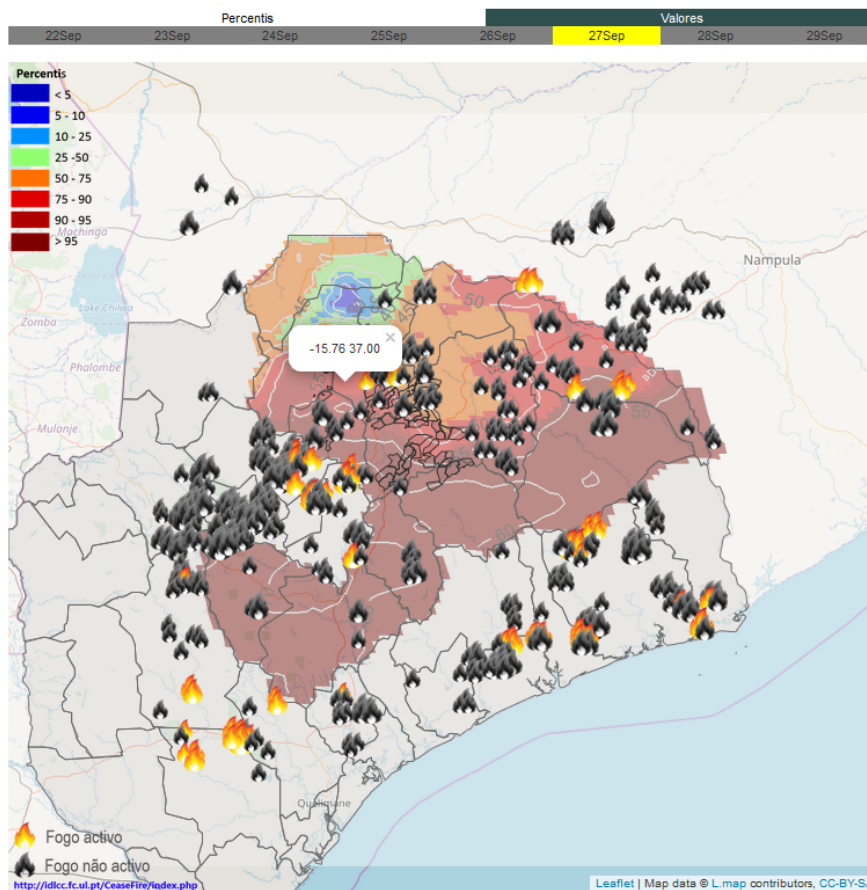
Model Validation

Model Validation

2004 - 2017

Energy (GJ)	Very Low		Low		Moderate		High		Very High		Total	
< 800	5735	[16%]	4465	[13%]	4733	[13%]	4571	[13%]	**16021**	**[45%]**	35525	[100%]
800 - 2000	165	[6%]	271	[10%]	290	[10%]	318	[12%]	**1679**	**[62%]**	2723	[100%]
>2000	38	[4%]	60	[6%]	81	[8%]	96	[9%]	**741**	**[73%]**	1016	[100%]
Total	5938		4796		5104		4985		**18441**			

2018

Energy (GJ)	Very Low		Low		Moderate		High		Very High		Total	
< 800	1113	[13%]	413	[5%]	453	[5%]	515	[6%]	**5764**	**[70%}**	8258	[100%]
800 - 2000	4	[1%]	13	[3%]	20	[4%]	33	[7%]	**429**	**[86%}**	499	[100%]
>2000	1	[1%]	0	[0%]	8	[5%]	8	[5%]	**152**	**[90%}**	169	[100%]
Total	1118		426		481		556		**6345**			

Operational Tool

http://idlcc.fc.ul.pt/CeaseFire/