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Wildfire dynamics in Russia: the FLAM approach

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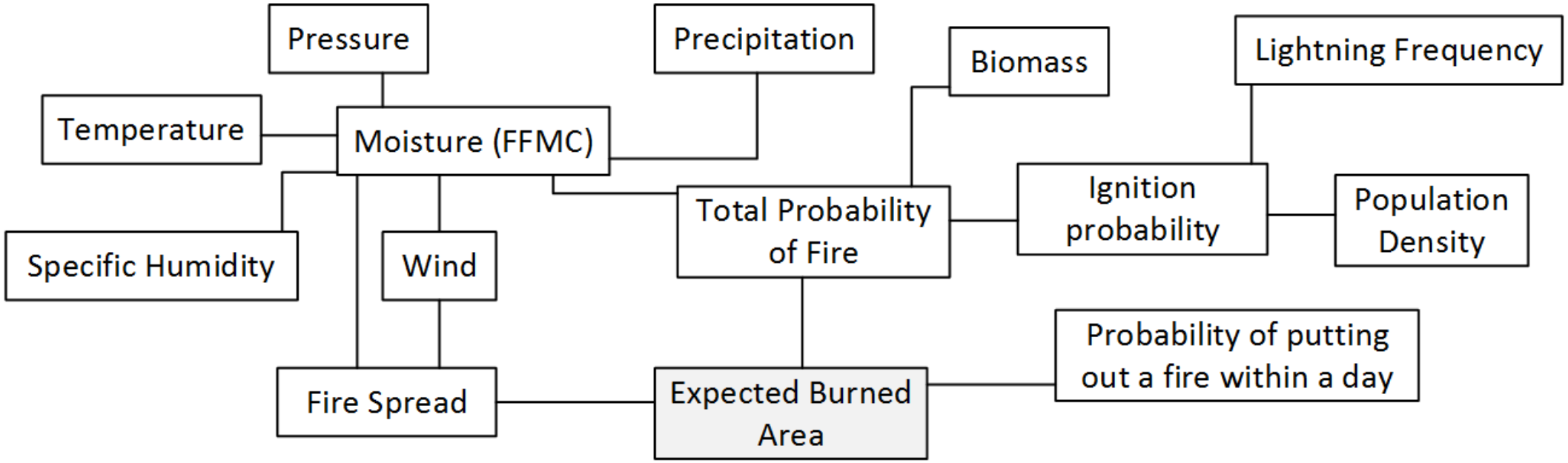
Ecosystems Services and Management (ESM) Program, IIASA

Cool forests at risk?

The critical role of boreal and mountain ecosystems for people, bioeconomy, and climate

17-20 September 2018 @ IIASA, Laxenburg, Austria

The wildfire climate impacts and adaptation model (FLAM)



FLAM operates with a daily time step on the grid cell of 0.25 arc degree, the same spatio-temporal resolution as in the Global Fire Emissions Database v4 (GFED)

Application of FLAM to European countries

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Regional aspects of modelling burned areas in Europe

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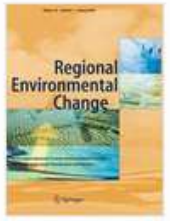

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Forest fires and adaptation options in Europe

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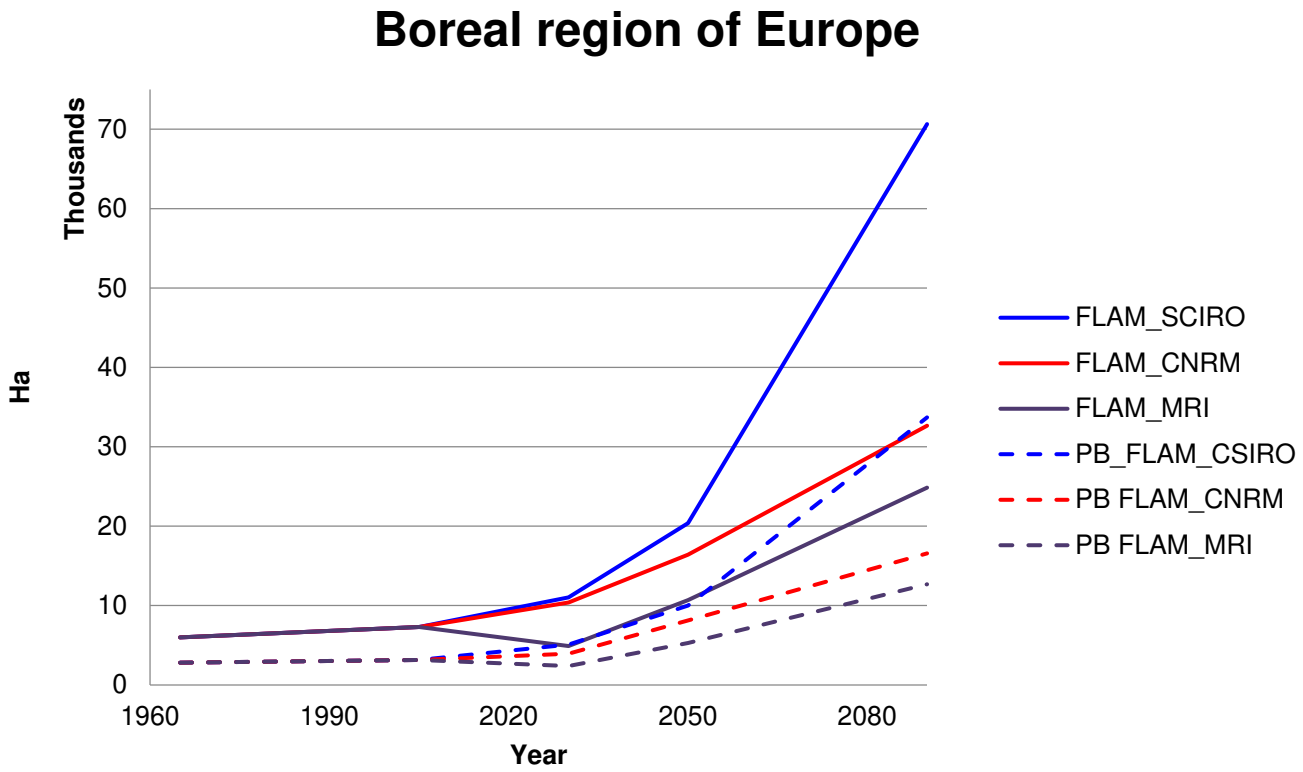
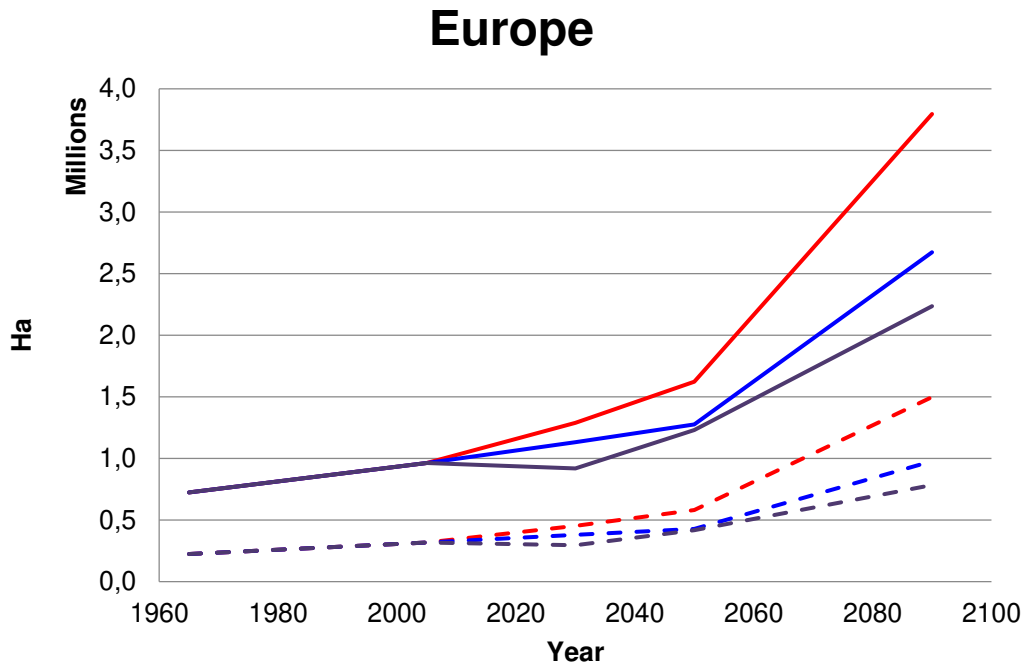
FLAM projections for boreal forests in Europe





Region	Countries involved
Boreal	Estonia, Finland, Latvia, Lithuania, Sweden

FLAM calibration approach

Cumulative burned area over any time period (for a grid pixel) is represented as:

$$A(q) = a\,(1-q)\,(2-q)/q^2$$

where the coefficient a reflects availability of fuel, ignition sources, and weather conditions, but is not a function of *q*.

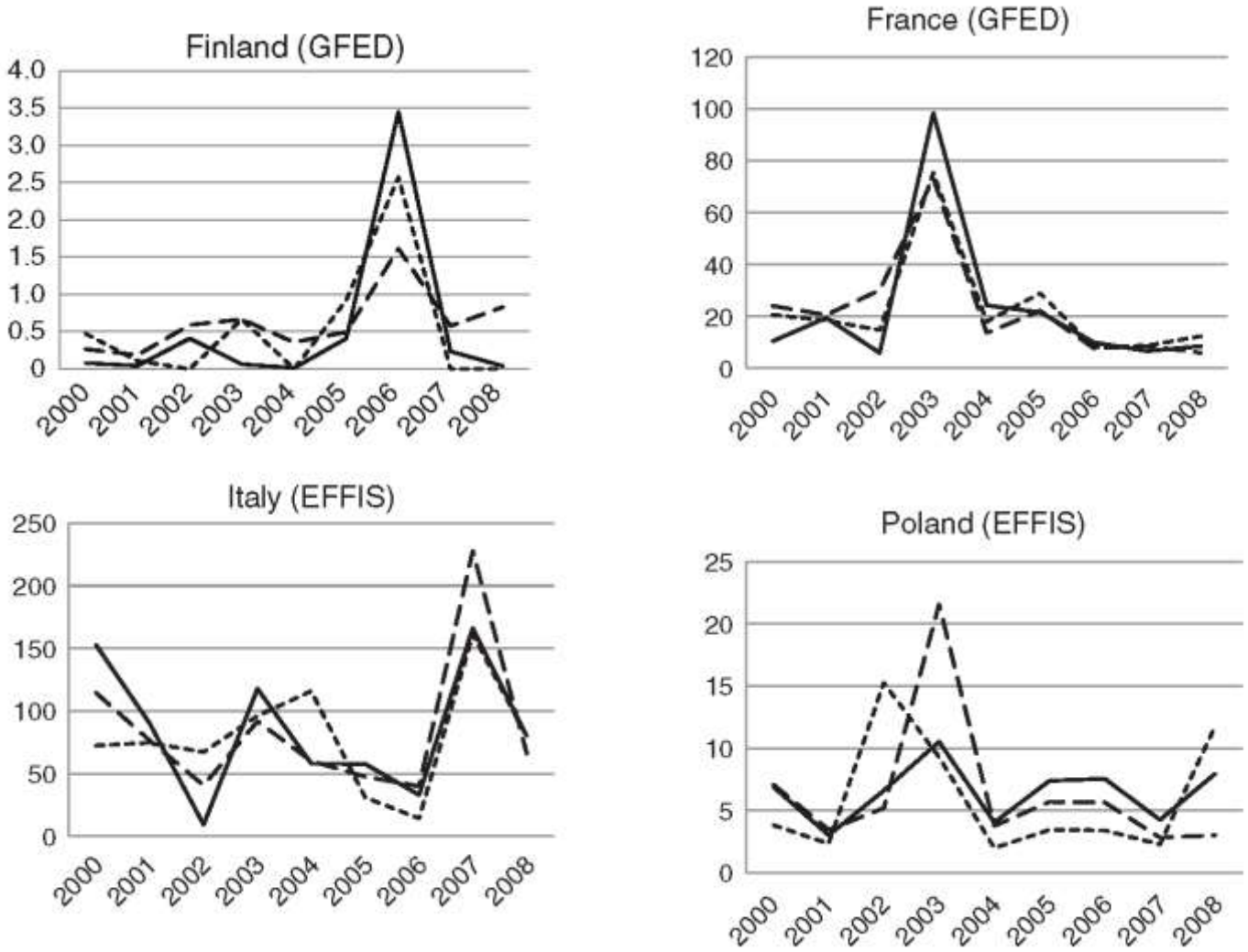
We find $q = q_c$, such that $A(q_c) = A_{obs}$, where A_{obs} is the observed cumulative burned area in a specific pixel over a given time period.

$$\beta = \frac{A_{obs}}{A(q_0)}(1-q_0)(2-q_0)/q_0^2, \qquad q_0 = 0.5.$$

$$q_c = \frac{-3+\sqrt{8\beta+1}}{2(\beta-1)}$$

q_c is used as a constant probability of suppression on each day.

FLAM calibration approach

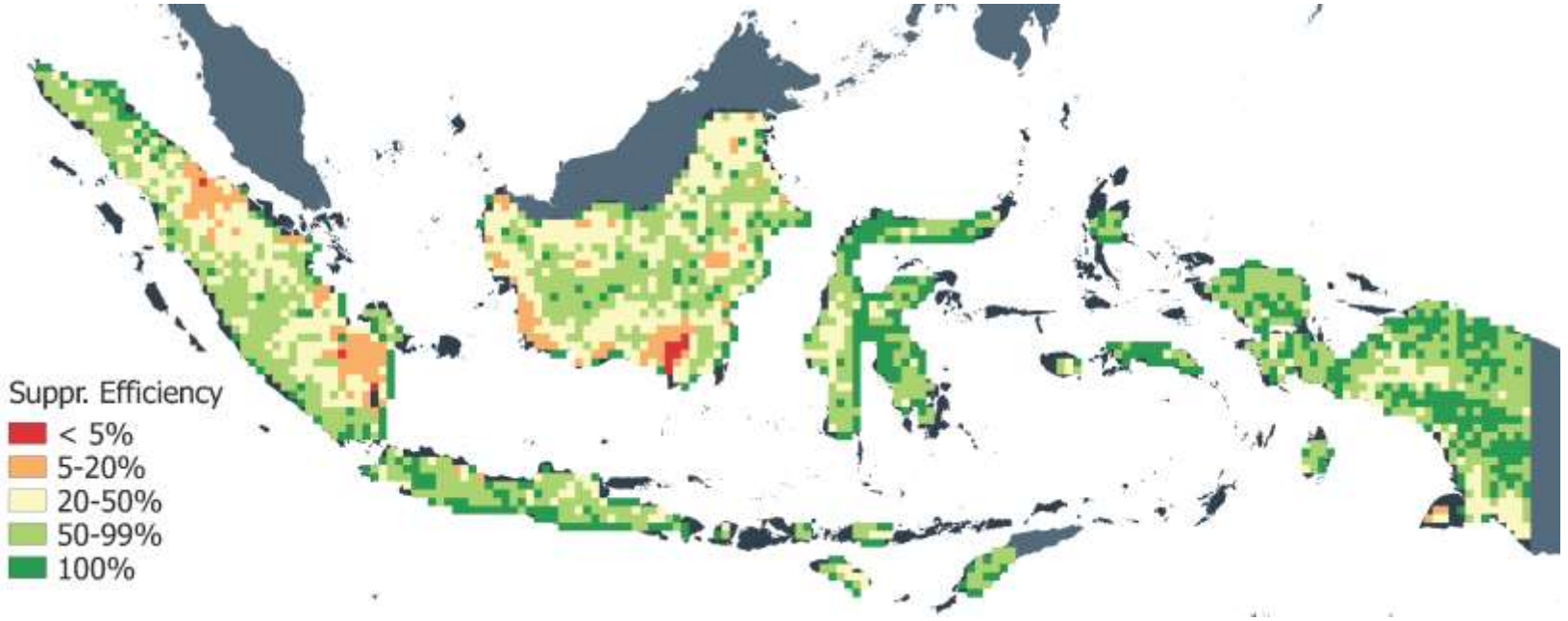


Annual burned areas by country as reported by GFED and EFFIS, and modelled by FLAM (in thousands of hectares).

The source of the data used for the calibration of FLAM is indicated in brackets on each plot.

GFED, Global Fire Emissions Database; EFFIS, European Forest Fire Information System; SFM, Standalone Fire Model.

FLAM spatial calibration approach - Indonesia



Spatial suppression efficiency calibrated in FLAM using burnt area reported in GFED for wildfire in Indonesia, accumulated over 2000-2009

Forests **2018**, *9*(7), 437; https://doi.org/10.3390/f9070437

Open Access Article

Modeling Burned Areas in Indonesia: The FLAM Approach

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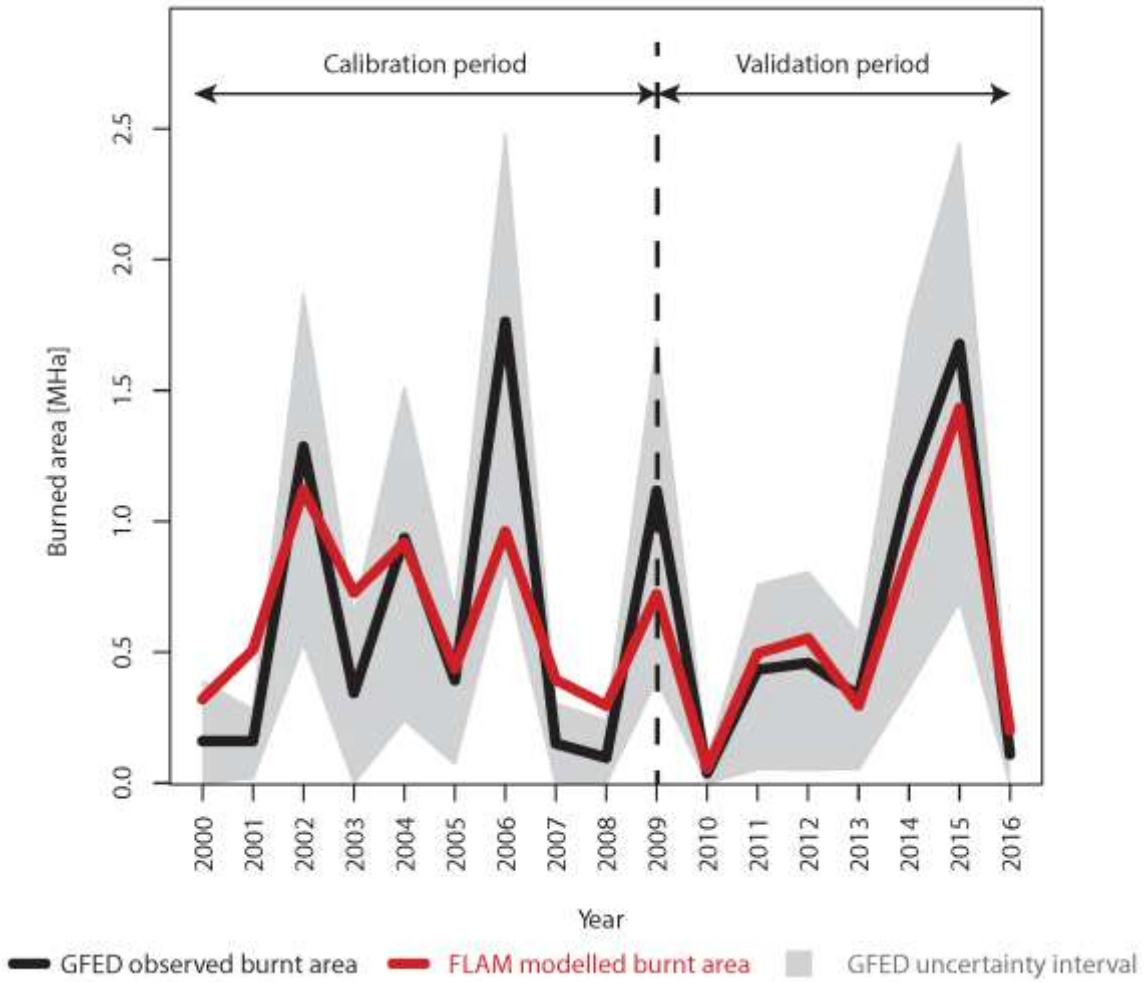
FLAM Validation – example of Indonesia

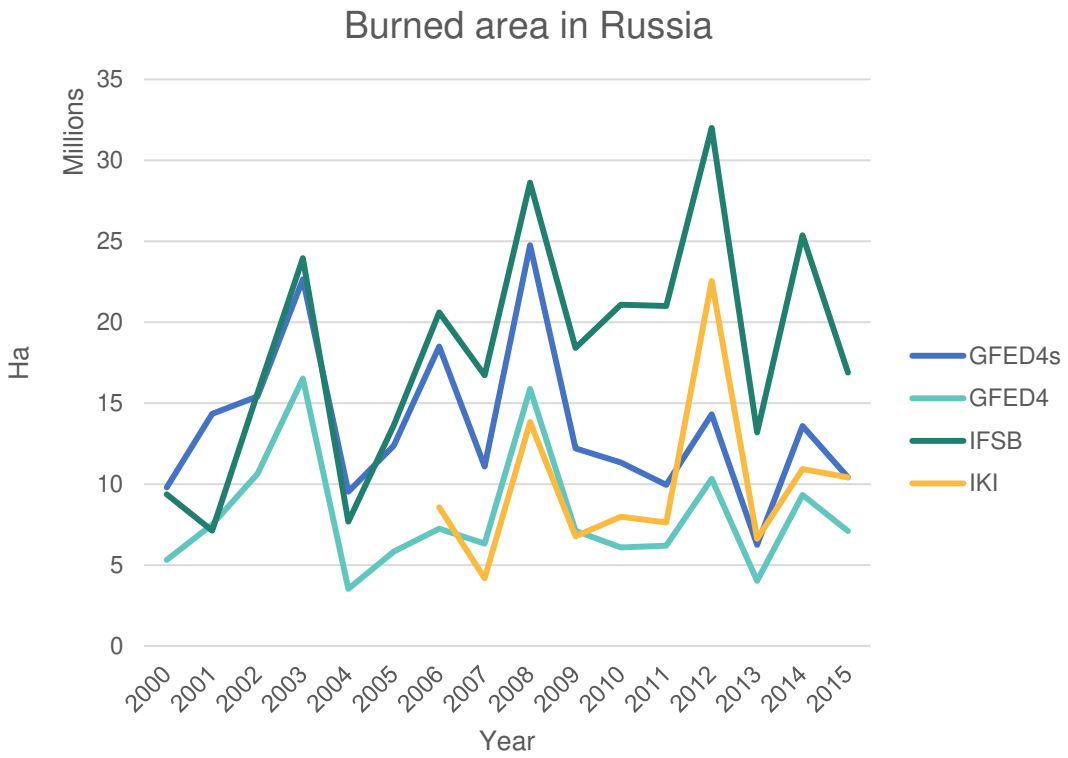


Annual dynamics of burnt area (wildfire) in Indonesia [MHa]. In calibration period GFED burnt area (black line), accumulated over 2000-2009, is used for FLAM calibration. In 2010-2016 GFED data is used for validation of the burnt area estimated by FLAM (red line). Grey area indicates GFED uncertainty.

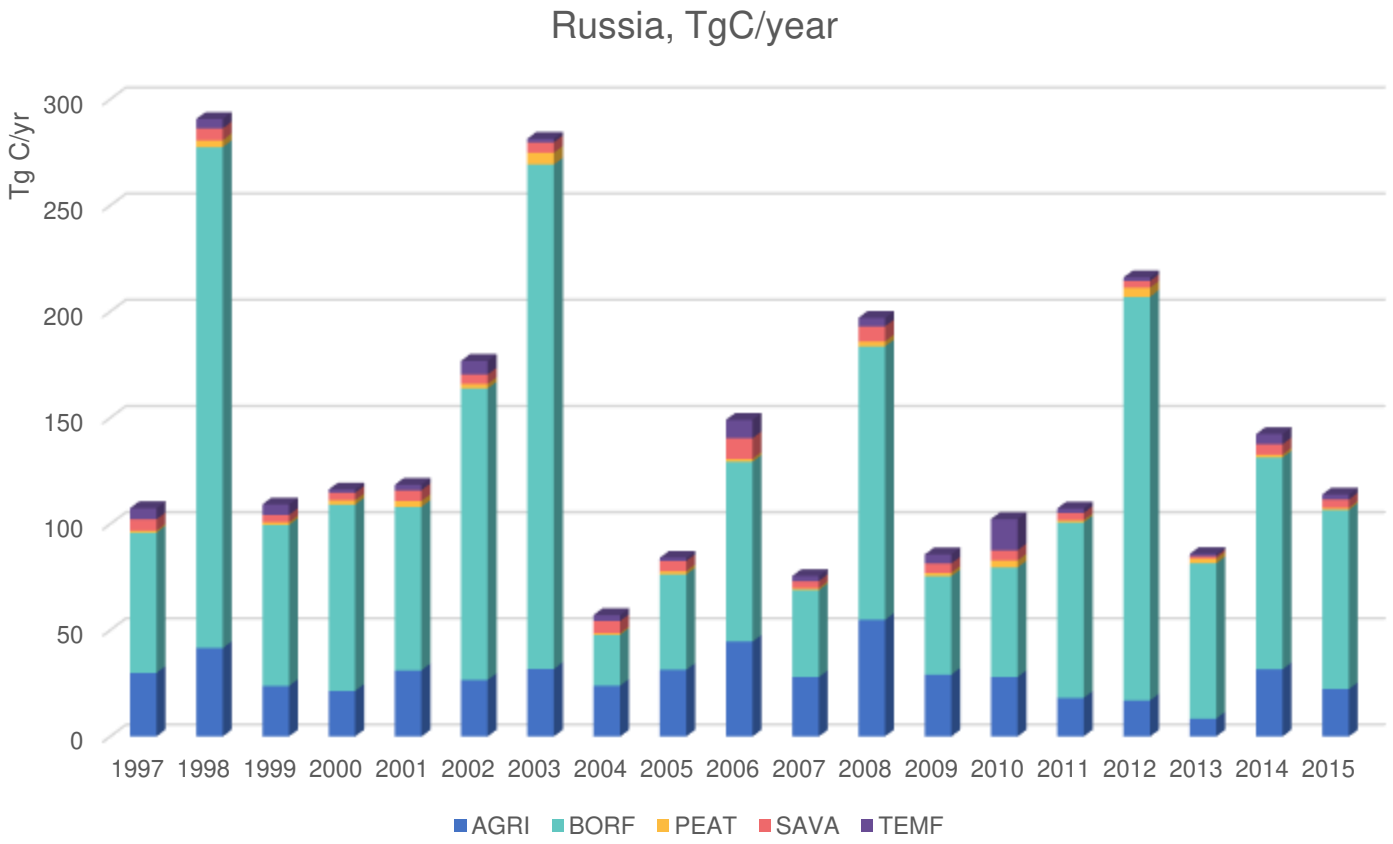
Table 1. Mean absolute error (MAE) and Pearson's *r* for annual country level burnt areas reported in GFED and modelled in FLAM for calibration period 2000-2009, and validation period 2010-2016.

Period	Calibration period (2000-2009)		Validation period (2010-2016)	
Type of fire	Peat fire	Wildfire	Peat fire	Wildfire
Pearson's *r*	0.857	0.865	0.988	0.988
MAE (thousands of ha)	169.25	257.93	35.56	106.71
MAE relative to average burnt area	47%	43%	11%	19%

Area burned in Russia



Uncertainty in historical area burned

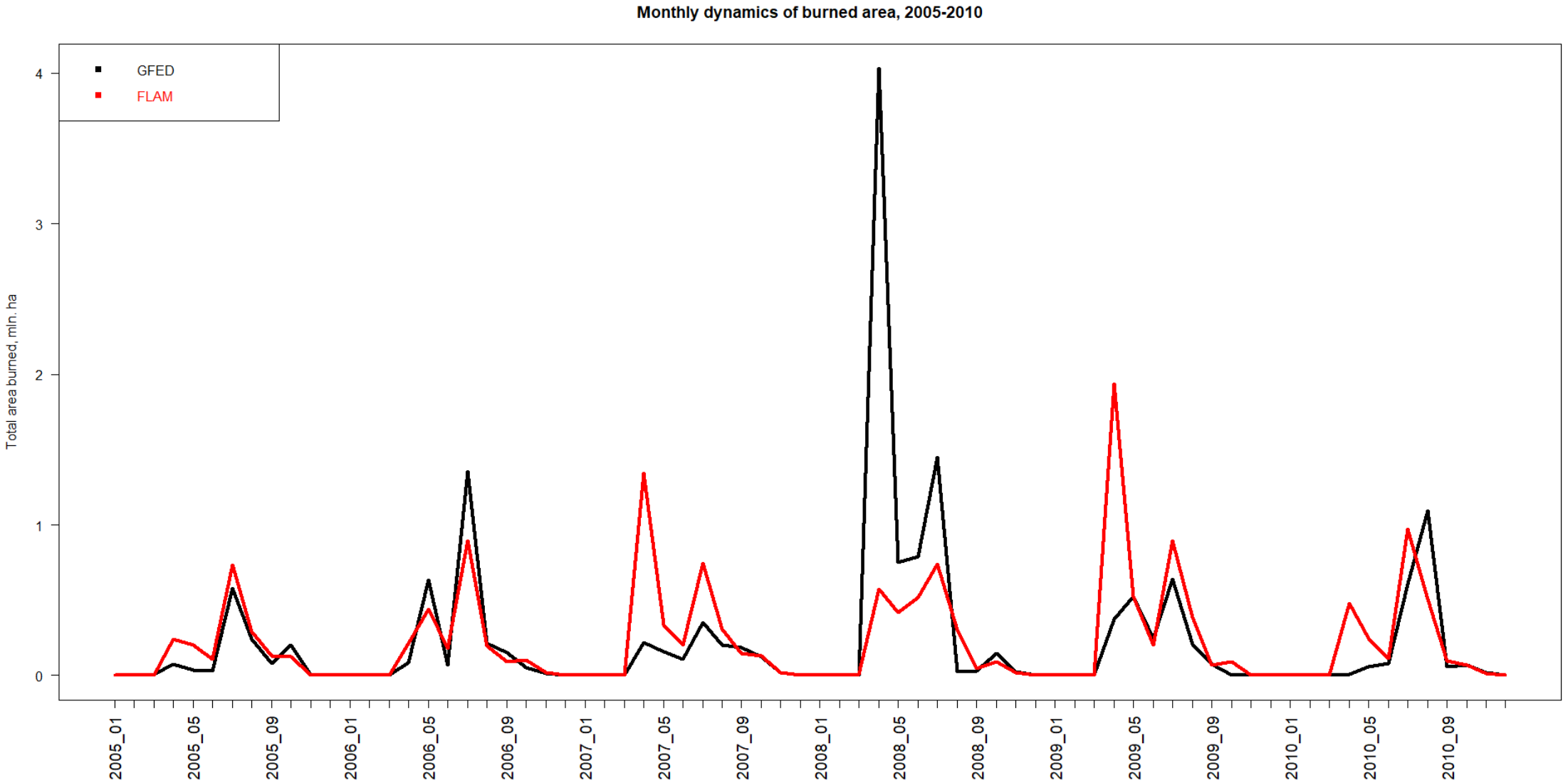


CO_2 emissions from fires as reported in GFED4.1s

FLAM input data

Variable	FLAM usage
Global fire weather database(GFWED) Fine Fuel Moisture Code – daily values based on the NASA MERRA-2	Daily moisture content, 2000-2016
Wind speed at 10 m – daily values from MERRA2	Daily fire spread rate, 2000-2016
NASA Lightning Imaging Sensor/Optical Transient Detector product (LIS/OTD) – monthly average	Daily probability of ignition conditional on lightning frequency
Russian biomass map; converted to gC/m^2 and separated into Litter and CWD by Schepaschenko et al., 2011.	Probability of ignition conditional on fuel availability
Gridded Population of the World, v4; 2000, 2005, 2010, 2015	Probability of human ignition /suppression, updated every 5 years

Monthly calibration approach – preliminary results



Next steps

- Reconciling available data for FLAM calibration and validation
- Using land cover maps, e.g. forest share, peatland
- Focusing on one of the regions of Russia
- Obtaining lightning data for Russia

  (NASA's OTD collected data from May 1995 to March 2000)
- Adjusting FLAM spatial resolution

Thank you for your attention!

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