Diagnosing spatial biases and uncertainties in global fire emissions inventories: Indonesia as regional case study [A.24]

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FIRECAM tool: https://globalfires.earthengine.app/view/firecam

Introduction

- Models of atmospheric composition, such as GEOS-Chem, use **emissions** estimates from **global fire inventories** as input
- Fire inventories are constructed primarily using the **bottom-up** (burned area-based) or **top-down** (fire energy-based) method
- The **choice of inventory** can bias model results spatially and temporally, but many studies use only one inventory

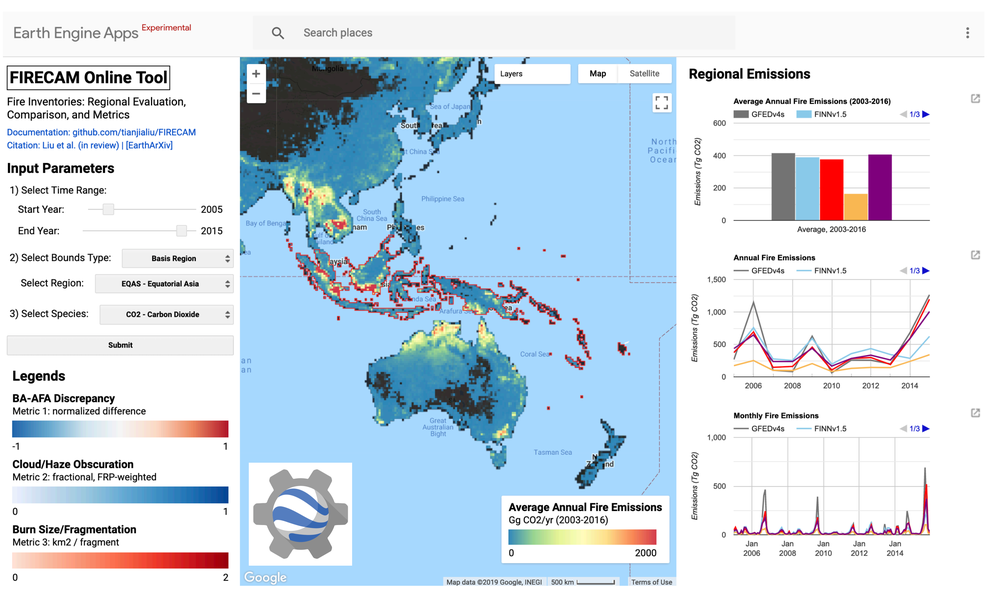
1. GFEDv4s
2. FINNv1.5
3. GFASv1.2
4. QFEDv2.5r1
5. FEERv1-G1.2

Key Questions

1. How can satellite-based metrics help **end-users** to understand **methodological differences** between five widely-used **global fire emissions inventories**?
2. What main factors drive differences in monthly modeled smoke $PM_{2.5}$ due to **Indonesian fires**?

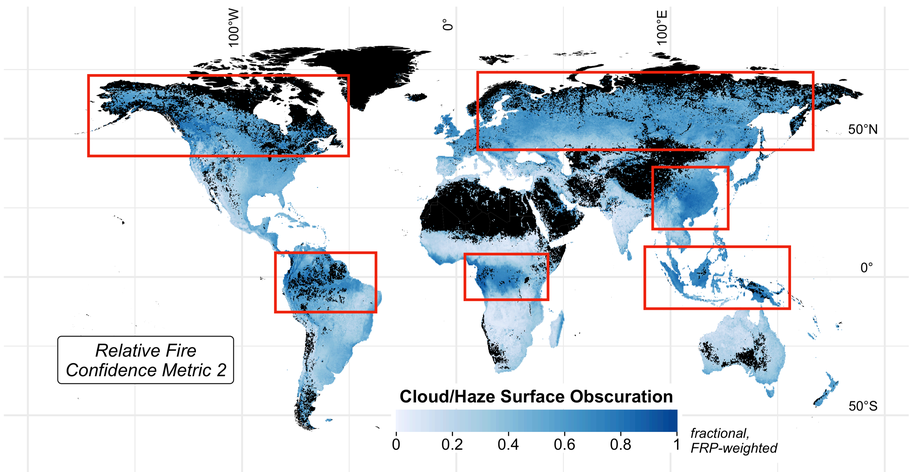
Conclusions

1. We devised five simple satellite-based **metrics**, available in the **FIRECAM** tool, to help end-users understand **regional differences** in emissions among **five global fire emissions inventories**
2. For **Indonesian fires**, delineation of **peatlands** and **cloud-gap adjustment** may explain the closer match of modeled smoke $PM_{2.5}$ with ground observations for GFAS compared to other inventories



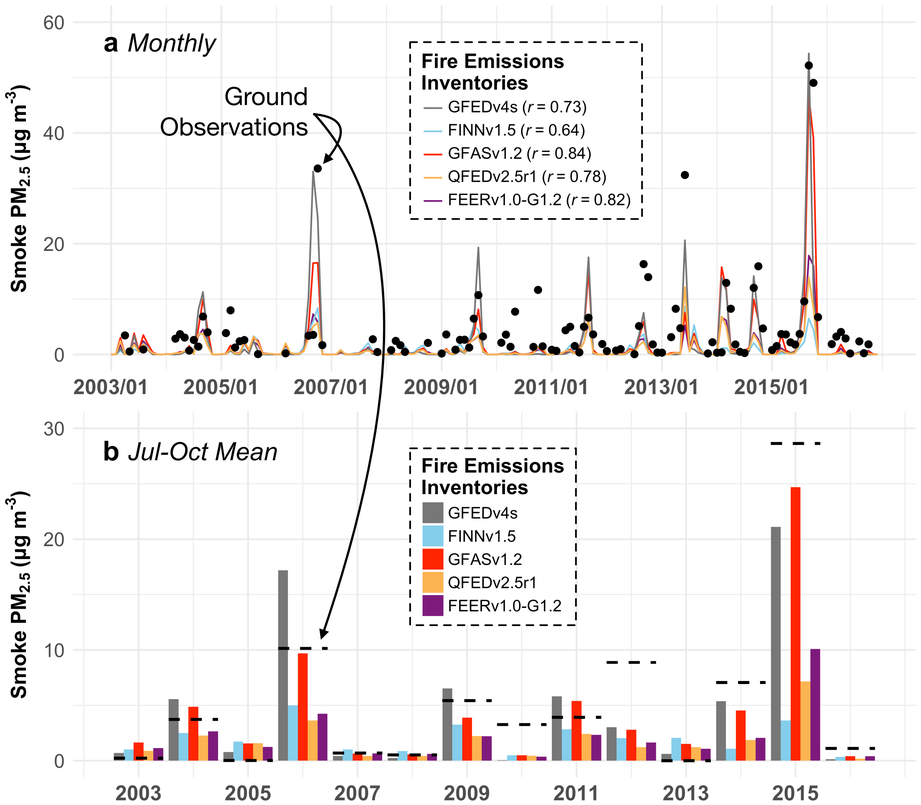
Results

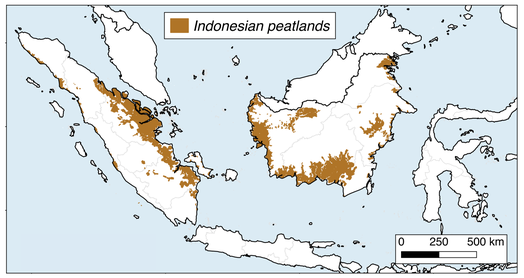
Metric 2: Clouds and haze can obscure fires from satellite detection



- We use **MODIS** fire, surface reflectance, and land cover datasets and **Google Earth Engine** to derive five **relative fire confidence metrics,** mapped globally and averaged from 2003-2017
- As an example, using metric 2 shows that end-users should be generally less confident in estimates of fire emissions in regions with a high fraction of **clouds/haze** obscuring fires from satellite detection (e.g. in tropical and boreal forests)

Comparison of modeled smoke $PM_{2.5}$ in Singapore





- Using the **GEOS-Chem adjoint**, we modeled monthly smoke $PM_{2.5}$ in **Indonesia, Singapore** (*shown left*), and **Malaysia** using the five inventories
- (a) The temporal correlation of observed $PM_{2.5}$ with results from the top-down inventories, which adjust for **cloud gaps**, is higher than for bottom-up inventories
- (b) Inventories that account for **peatlands** in Indonesia are better able to capture the magnitude of smoke $PM_{2.5}$ in high fire years (e.g. 2006, 2015)