



# ***BRAZILIAN FIRE-LAND-ATMOSPHERE SYSTEM (BrFLAS)***

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National Institute for Space Research (INPE)  
Center for Weather Forecasting and Climate Studies (CPTEC)  
Modeling of the Atmosphere and its Interfaces Group (GMAI)  
Satellite Monitoring of Vegetation Fires Group



# ***BRAZILIAN FIRE-LAND-ATMOSPHERE SYSTEM (BrFLAS)***

**FAPESP – FCT**

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National Institute for Space Research (INPE)

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University of Lisbon (IDL/FCUL)

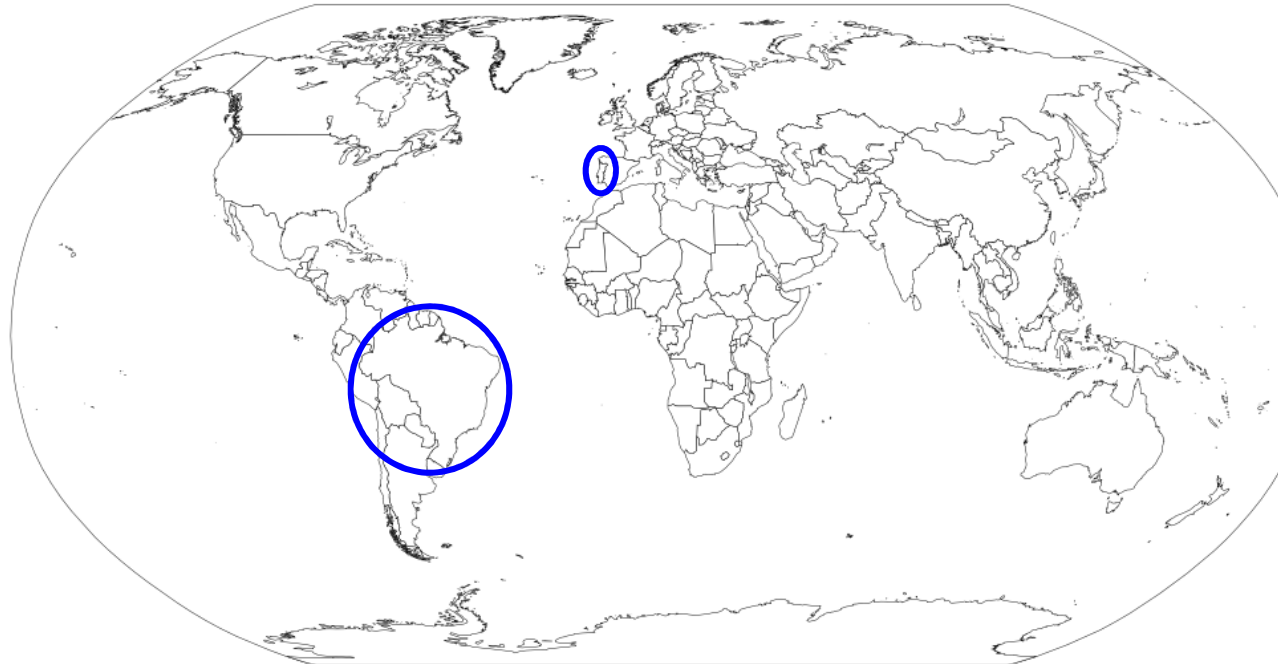
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Research Groups:



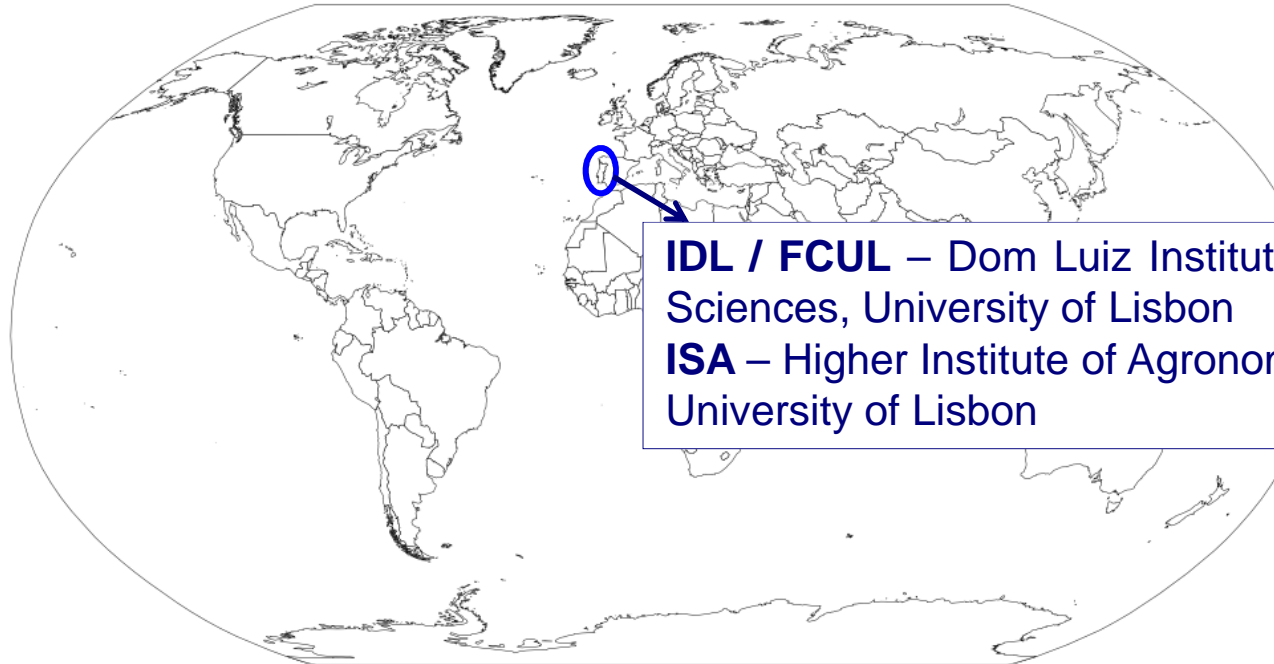
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Research Groups:



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Research Groups:



**IDL / FCUL** – Dom Luiz Institute / Faculty of Sciences, University of Lisbon  
**ISA** – Higher Institute of Agronomy, University of Lisbon

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Research Groups:



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Research Groups:



**INPE / CPTEC and OBT – National Institute for Space Research / Center for Weather Forecasting and Climate Studies and General Coordination of Earth Observation**

# **BRAZILIAN FIRE-LAND-ATMOSPHERE SYSTEM (BrFLAS)**

Research Groups:



**UFRJ – Federal University of Rio de Janeiro**

**INPE / CPTEC and OBT – National Institute for Space Research / Center for Weather Forecasting and Climate Studies and General Coordination of Earth Observation**



# **BRAZILIAN FIRE-LAND-ATMOSPHERE SYSTEM (BrFLAS)**

Research Groups:



**UFLA** – Federal University of Lavras  
**UFV** – Federal University of Viçosa  
**UFSJ** – Federal University of São João del Rei

**UFRJ** – Federal University of Rio de Janeiro

**INPE / CPTEC and OBT** – National Institute for Space Research / Center for Weather Forecasting and Climate Studies and General Coordination of Earth Observation



## *Introduction*

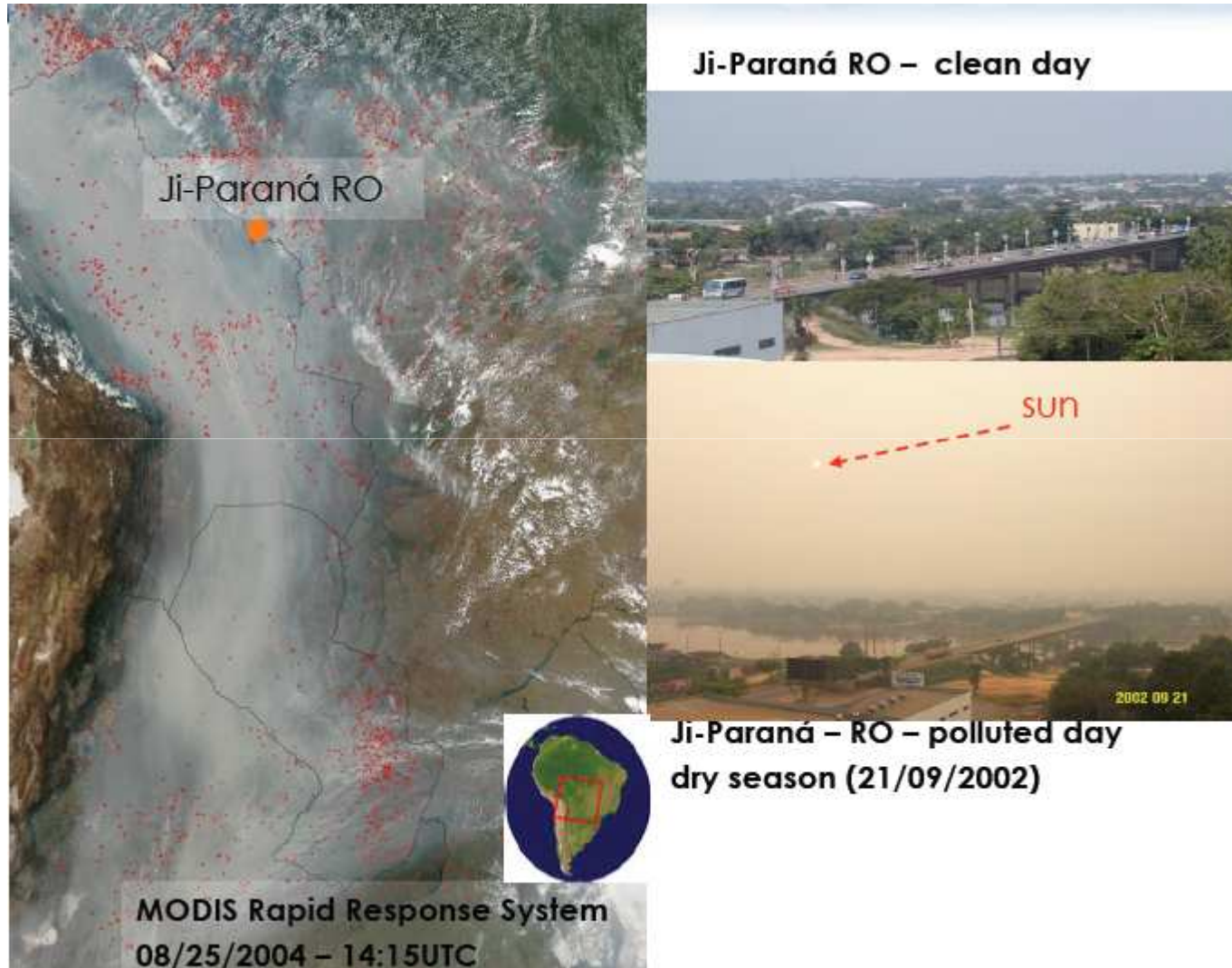
- Biomass burning is the principal source of anthropogenic greenhouse gases and aerosols to the atmosphere in South America



## *Introduction*

- Biomass burning is the principal source of anthropogenic greenhouse gases and aerosols to the atmosphere in South America
- In Brazil, activities related to agriculture and extensive livestock grazing contribute significantly to trace gas and particle emissions to the atmosphere, resulting from the use of fire as a land management practice and changes in natural emissions patterns due to changes in land use and land cover

# Introduction



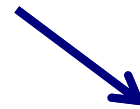
Biomass burning aerosol

# *Introduction*



Deforestation drivers in Amazon

# *Introduction*



Manual harvesting of sugarcane is an example of a current agricultural practice that uses fire



## *Goals*

Advance the scientific and technical knowledge regarding vegetation fires in Brazil, specifically in what concerns measuring areal and severity extent, estimating atmospheric emissions, determining relations to observed past conditions and inferring possible implications by future climate scenarios



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Advance the scientific and technical knowledge regarding vegetation fires in Brazil, specifically in what concerns measuring areal and severity extent, estimating atmospheric emissions, determining relations to observed past conditions and inferring possible implications by future climate scenarios

Improve the quality of the operational products of INPE's Fire System and air quality forecast system, benefiting users like government agencies, research groups, fire managers, NGOs





# *Work Packages*

- Burned area mapping



## *Work Packages*

- Burned area mapping
- Estimates of emissions from biomass burning



## *Work Packages*

- Burned area mapping
- Estimates of emissions from biomass burning
- Fire-vegetation-atmosphere relations



## *Work Packages*

- Burned area mapping
- Estimates of emissions from biomass burning
- Fire-vegetation-atmosphere relations
- Future climate scenarios



## *Work Package 1 - Burned area mapping*

### ➤ Goals:

Develop and implement regional algorithms for mapping burned areas in Brazil



## *Work Package 1 - Burned area mapping*

### ➤ Goals:

Develop and implement regional algorithms for mapping burned areas in Brazil

- Different spatial and temporal resolutions
- Data from various satellites



## *Work Package 1 - Burned area mapping*

### ➤ AQM (from “Área QueiMada”)

MODIS-based product

- Algorithm for **monthly** burned area mapping of Brazil derived from monthly composited MODIS daily data at **1km spatial resolution**, which incorporates active fire data from multiple sensors
- **Monthly burned area maps** of Brazil, from 2000 to present



## *Work Package 1 - Burned area mapping*

➤ AQM (from “Área QueiMada”)

PROBA-V-based product

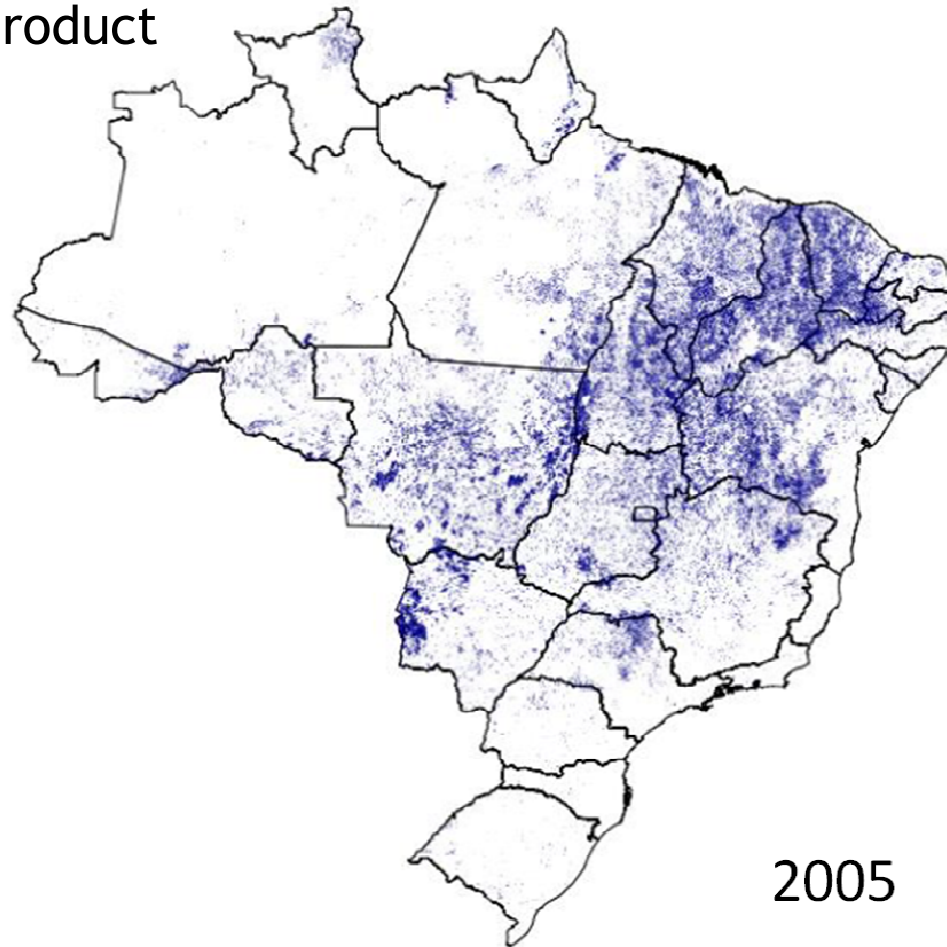
- Algorithm for **daily** burned area mapping of Brazil, derived from time series of daily PROBA-V data at **330m spatial resolution**, which incorporates MODIS active fire data
- **Daily burned areas maps** of Brazil, for 2016-2017



## *Work Package 1 - Burned area mapping*

### ➤ AQM

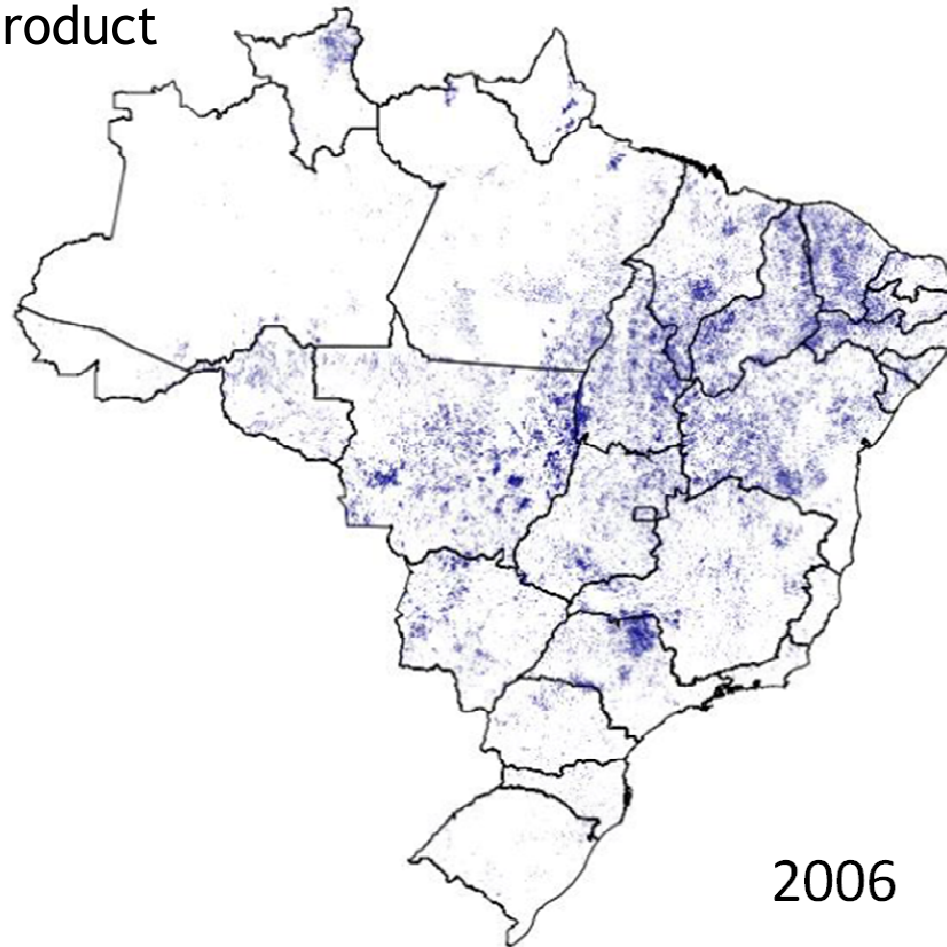
MODIS-based product



## *Work Package 1 - Burned area mapping*

### ➤ AQM

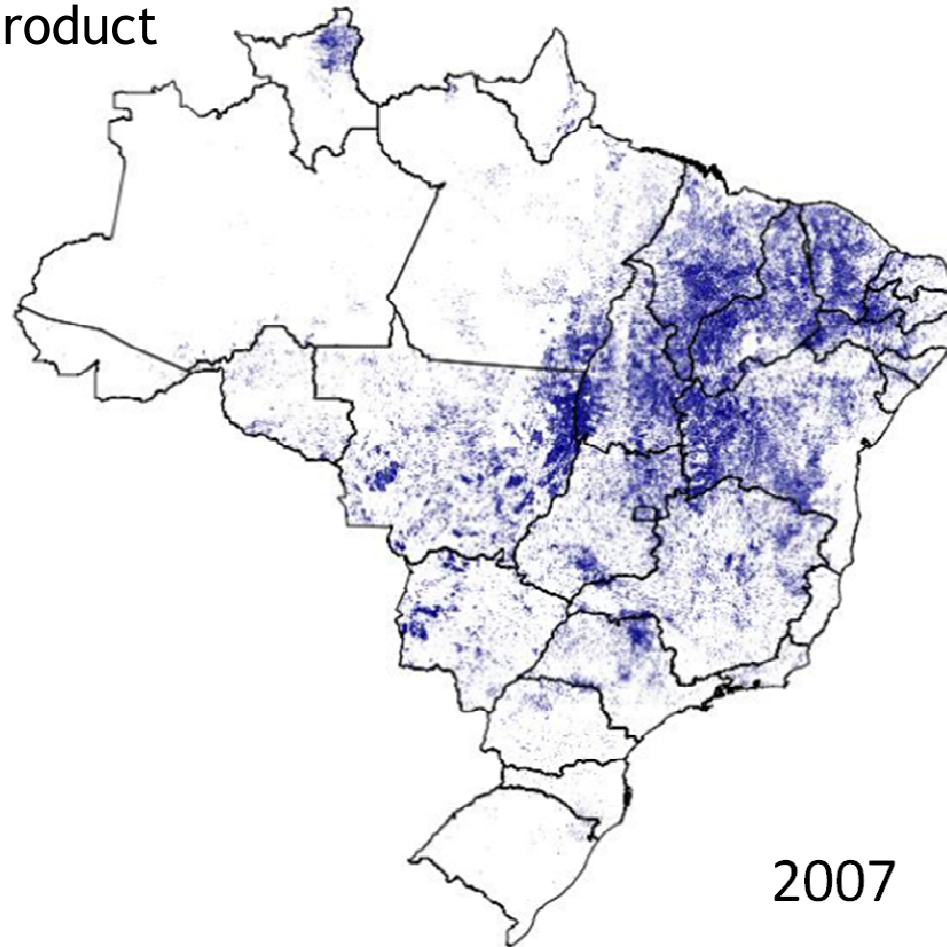
MODIS-based product



## *Work Package 1 - Burned area mapping*

### ➤ AQM

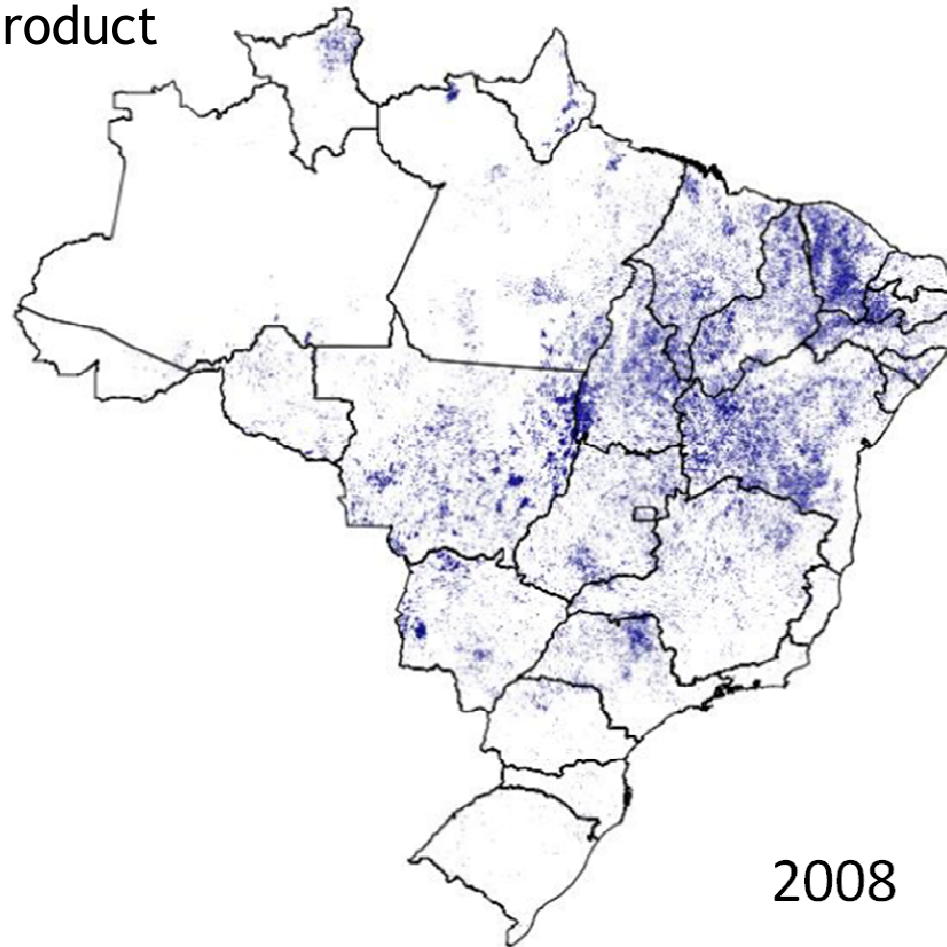
MODIS-based product



## *Work Package 1 - Burned area mapping*

### ➤ AQM

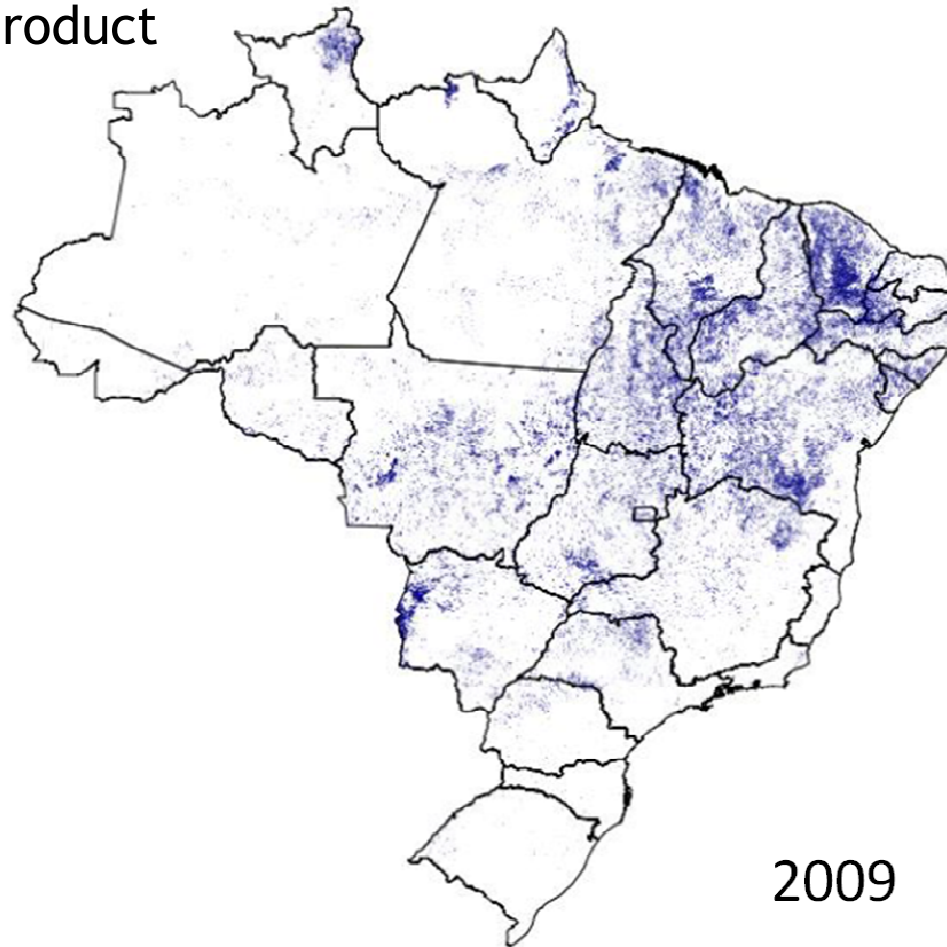
MODIS-based product



## *Work Package 1 - Burned area mapping*

### ➤ AQM

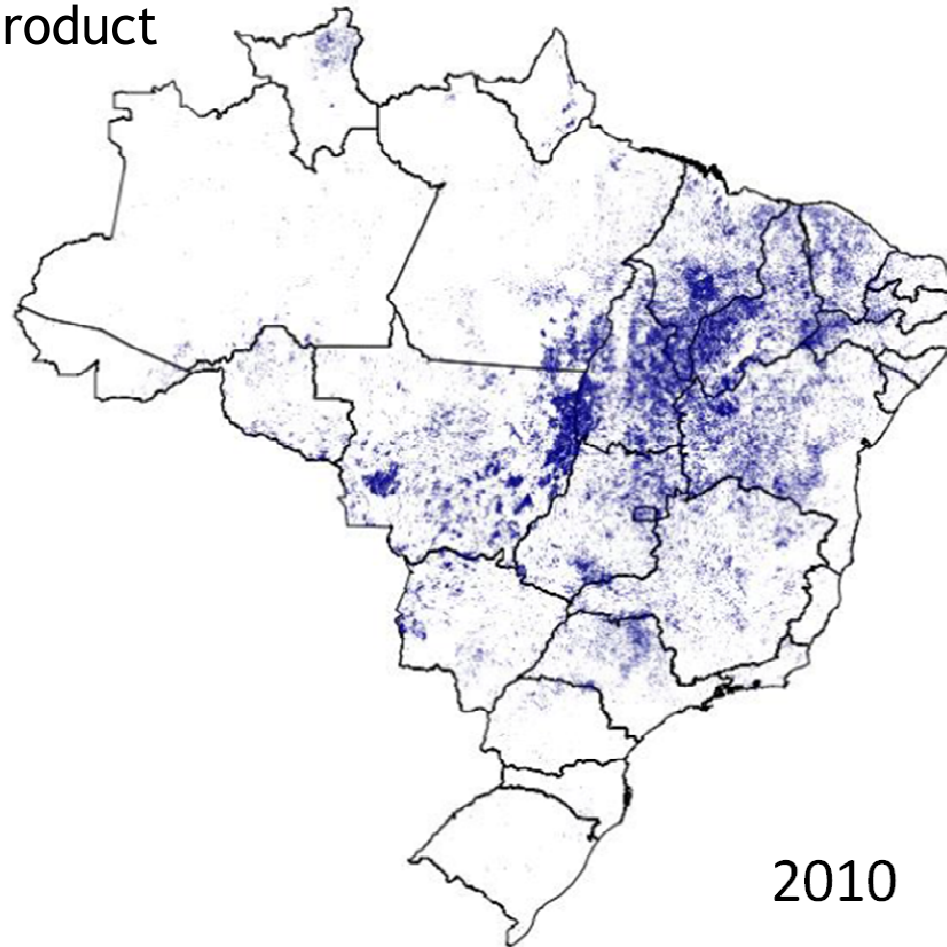
MODIS-based product



## *Work Package 1 - Burned area mapping*

### ➤ AQM

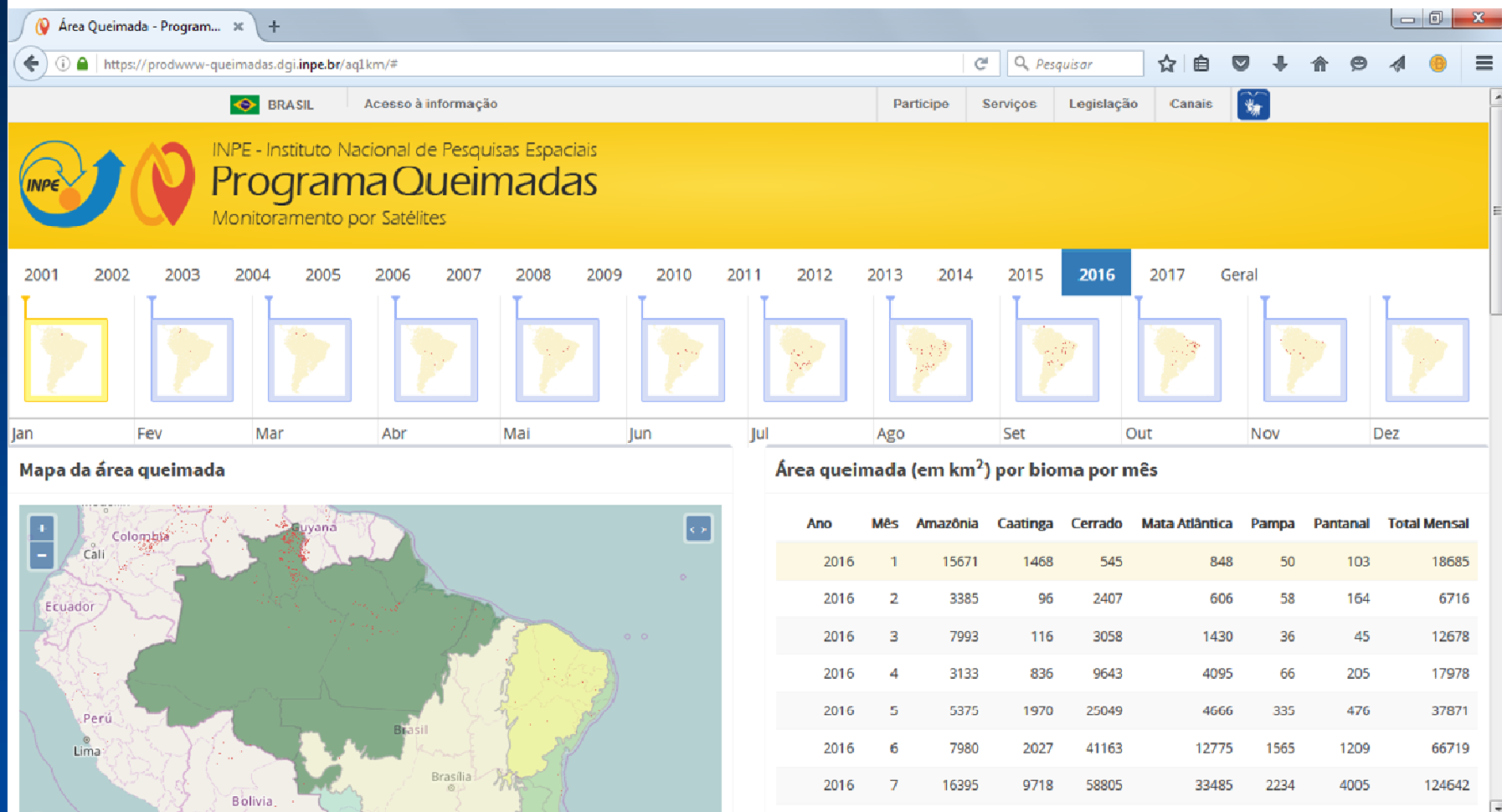
MODIS-based product





# Work Package 1 - Burned area mapping

## ➤ AQM Portal:





## *Work Package 2 - Estimates of emissions from active fires*

### ➤ Goals:

- Biomass burning emission estimates for South America
- Uncertainties





## *Work Package 2 - Estimates of emissions from active fires*

### ➤ PREP-CHEM-SRC

- Provides emissions fields of trace gases and aerosols for regional and global atmospheric chemistry models



## Work Package 2 - Estimates of emissions from active fires

### ➤ PREP-CHEM-SRC

#### ❑ 3BEM (*Brazilian Biomass Burning Emission Model, LONGO et al., 2010*)

$$M_{[\eta]} = \alpha_{veg} \cdot \beta_{veg} \cdot E_{f_{veg}}^{[\eta]} \cdot a_{fire}$$

$M_{[\eta]}$  = mass of the emitted tracer  $\eta$

$\alpha_{veg}$  = aboveground biomass fraction

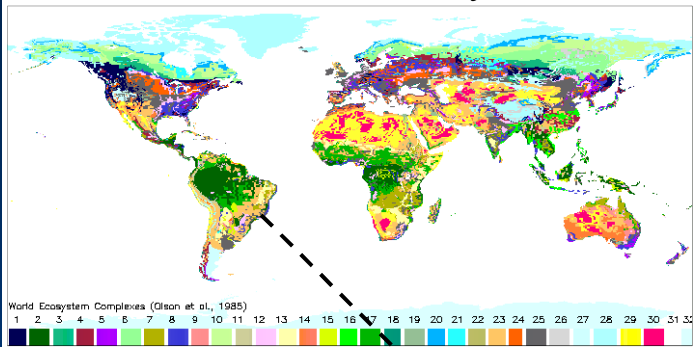
$\beta_{veg}$  = combustion factor

$E_{f_{veg}}^{[\eta]}$  = emission factor for each species  $\eta$

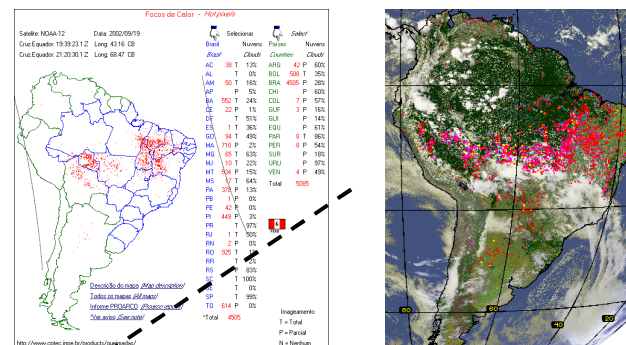
$a_{fire}$  = burned area

# Work Package 2 - Estimates of emissions from active fires

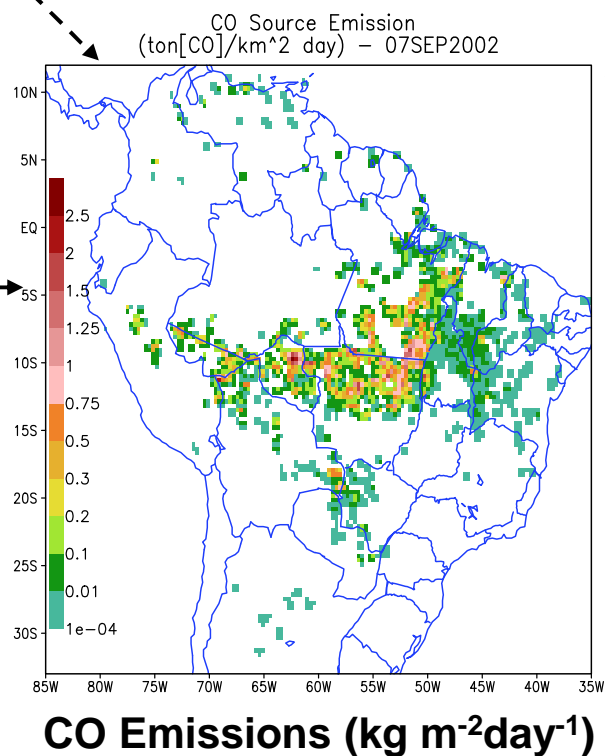
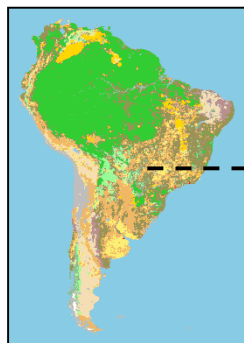
carbon density



fire counts

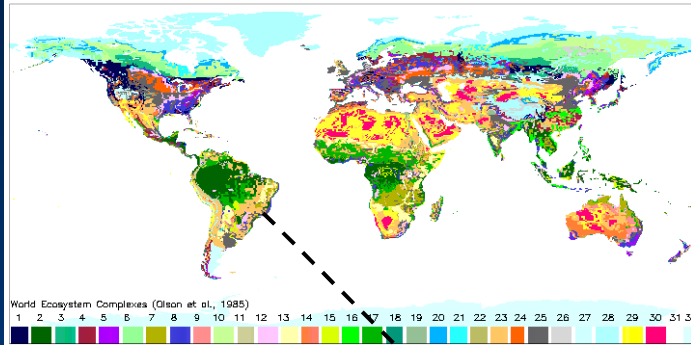


land use/cover

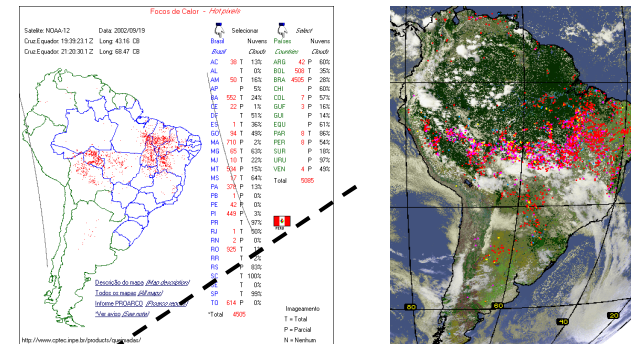


# Work Package 2 - Estimates of emissions from active fires

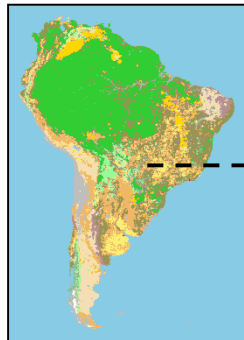
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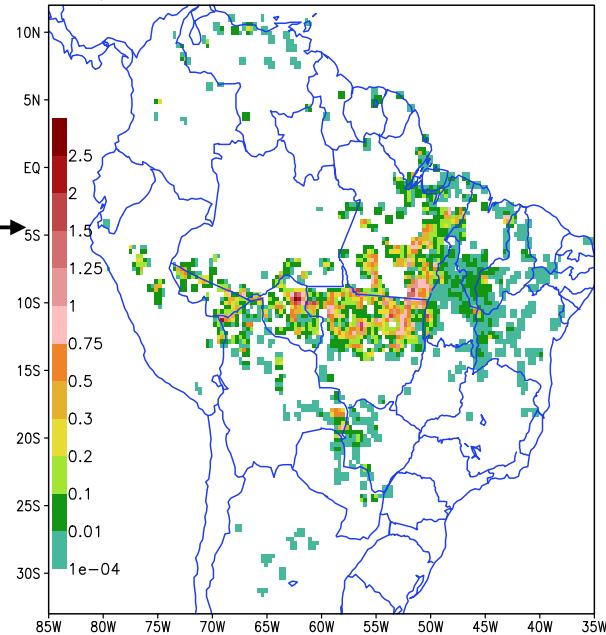
fire counts



land use/cover



CO Source Emission  
(ton[CO]/km<sup>2</sup> day) - 07SEP2002

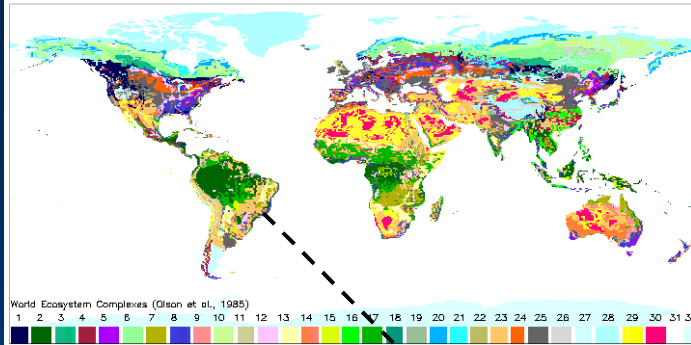


CO Emissions (kg m<sup>-2</sup>day<sup>-1</sup>)

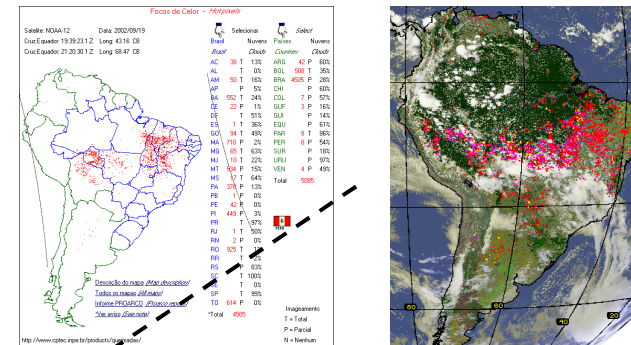
FRP

# Work Package 2 - Estimates of emissions from active fires

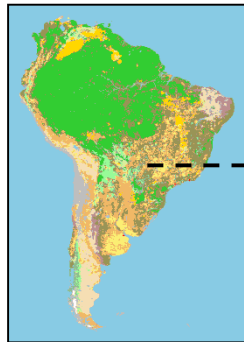
carbon density



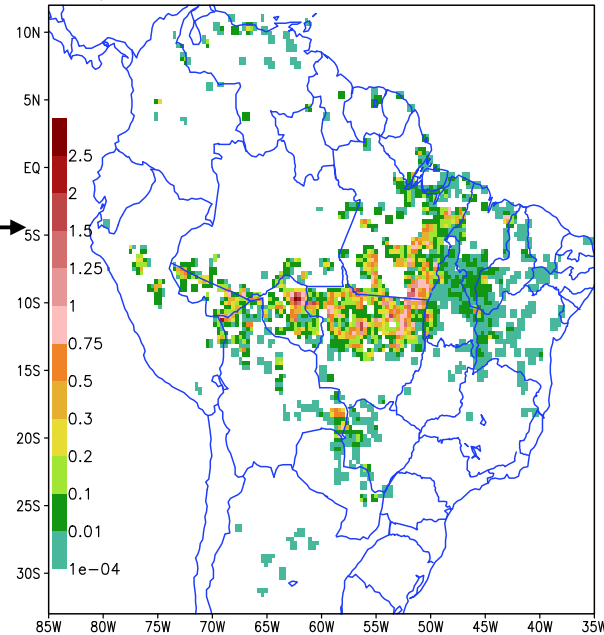
fire counts



land use/cover



CO Source Emission  
(ton[CO]/km<sup>2</sup> day) - 07SEP2002



CO Emissions (kg m<sup>-2</sup>day<sup>-1</sup>)

FRP

emission factors

combustion factors



## *Work Package 2 - Estimates of emissions from active fires*

### Data

➤ Fire counts products:

- **WFABBA - GOES**
- **MODIS Fire Products**
- **INPE System for Monitoring Vegetation Fires products**



## *Work Package 2 - Estimates of emissions from active fires*

### Data

➤ FRP (Fire Radiative Power):

- **WFABBA - GOES**

- **MODIS Fire Products**

- **Meteosat - SEVIRI**



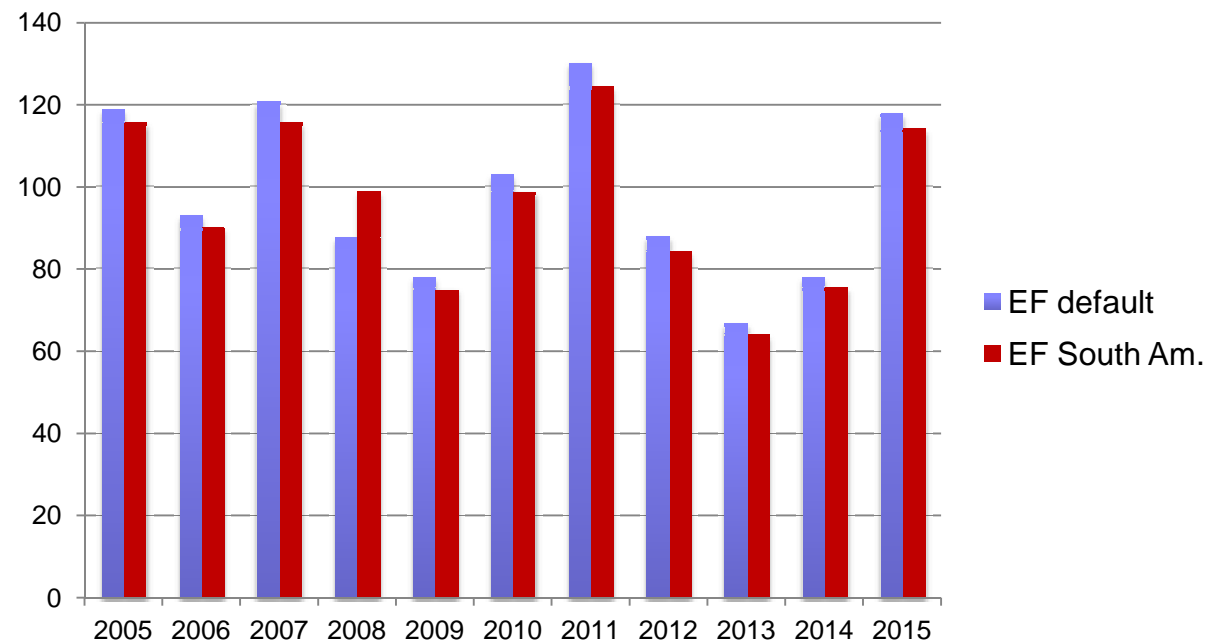
## *Work Package 2 - Estimates of emissions from active fires*

- ⇒ Emission inventories of CO, NO<sub>x</sub>, CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, PM<sub>2.5</sub> from 2005 to 2015
- ⇒ Fire counts
- ⇒ FRP



## Work Package 2 - Estimates of emissions from active fires

### Annual Emissions of CO from biomass burning in South America (Tg)



Emission inventories with 20 km x 20 km spatial resolution;  
PREP using fire counts



## *Work Package 2 - Estimates of emissions from active fires*

### Next steps:

- Intercomparison among annual inventories built from different approaches
- Uncertainty and sensitivity analysis
- Emission inventories to Brazilian Biomes

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## *Work Package 2 - Estimates of emissions from active fires*

### Applications

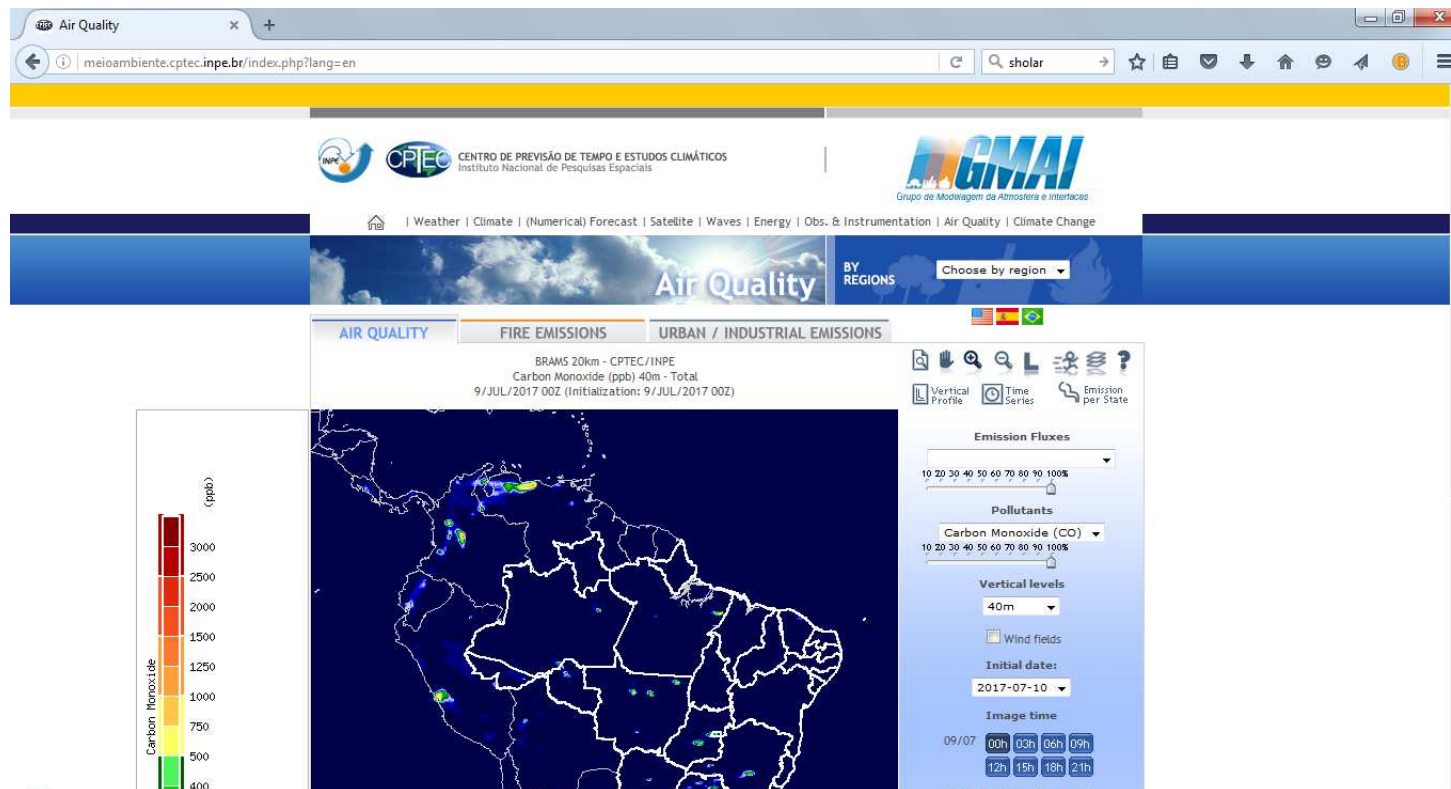
- Improve air quality numerical models

## Work Package 2 - Estimates of emissions from active fires

### Applications

- Improve air quality numerical models  
BRAMS (Freitas et al., 2017)

Operational products available at <http://meioambiente.cptec.inpe.br>





## *Work Package 2 - Estimates of emissions from active fires*

### Applications

- Improve air quality numerical models
- Information for health authorities



## *Work Package 3 - Fire-Vegetation-Atmosphere relations*

### ➤ Goals:

- Composite analysis of extreme years
- Models to predict area burned in Cerrado and rainforest



## *Work Package 3 - Fire-Vegetation-Atmosphere relations*

### ➤ Tasks:

- Spatial-temporal analysis of the occurrence of burned area in Brazilian biomes from 2005 to 2015 and its relation with climatic variables
- Characterization of fire risk in Brazil using data from the ERA-INTERIM reanalysis for the period 1979-2005





## *Work Package 4 - Future climate scenarios*

### ➤ Goals:

- Impact on fire regimes
- Impact on emissions



## *Work Package 4 - Future climate scenarios*

### ➤ Tasks:

- Analysis of fire risk to the Atlantic Forest biome in the period 1998-2010 through regional hydroclimatic reconstruction
- Future projections of fire occurrence in Brazil using modeling



*Thank you very much*

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