
Fire modeling development in ORCHIDEE

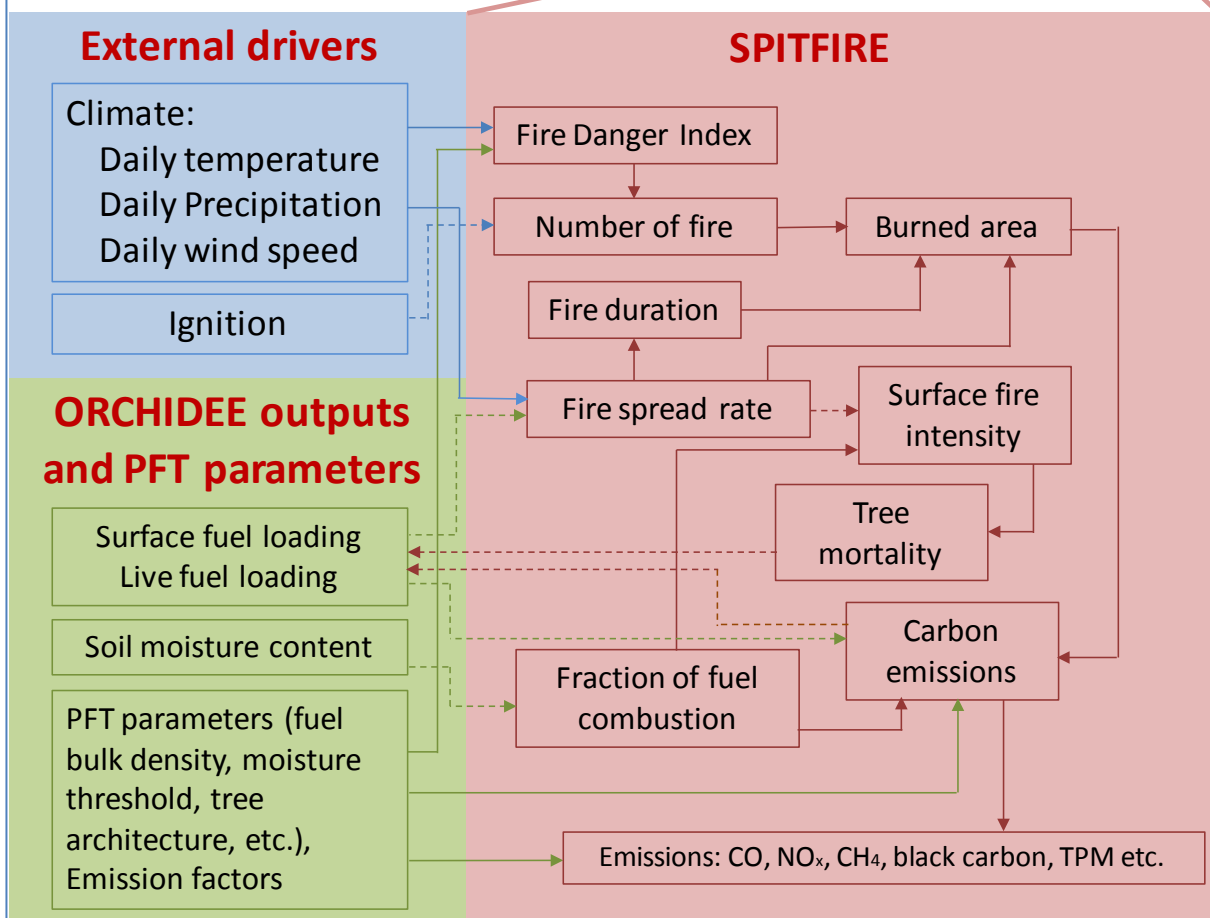
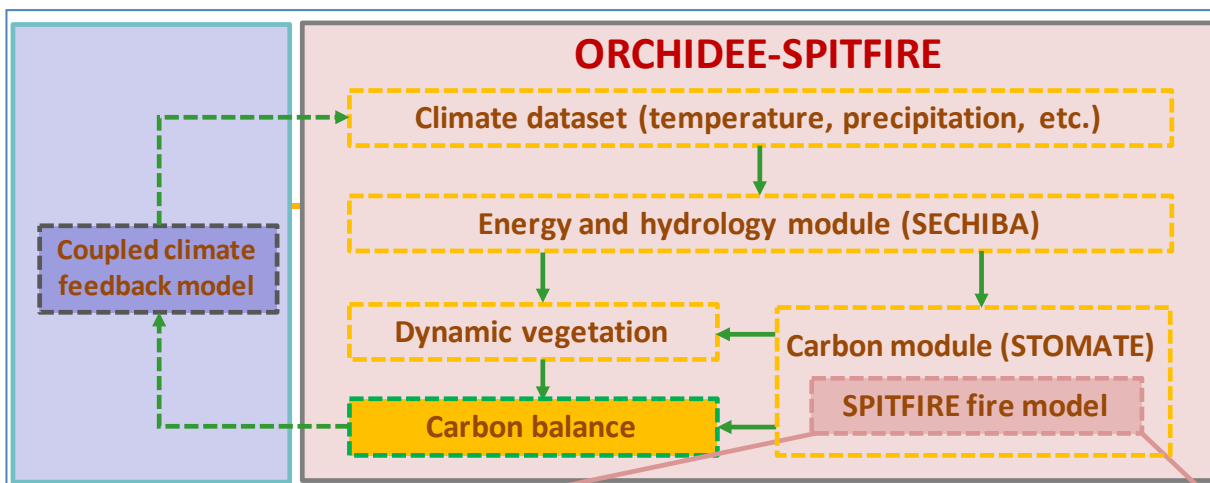
Chao Yue, Philippe Ciais, Patricia Cadule and
others

The impacts of fire in biophysical and biogeochemical cycles

- Carbon emission and other trace gases emissions (CO, CH₄, NO_x, O₃ precursors, etc.), and particles into the atmosphere and the radiative forcing effect
- Vegetation distribution change (eg., boreal forest and savanna)
- Energy flux pattern change after fire

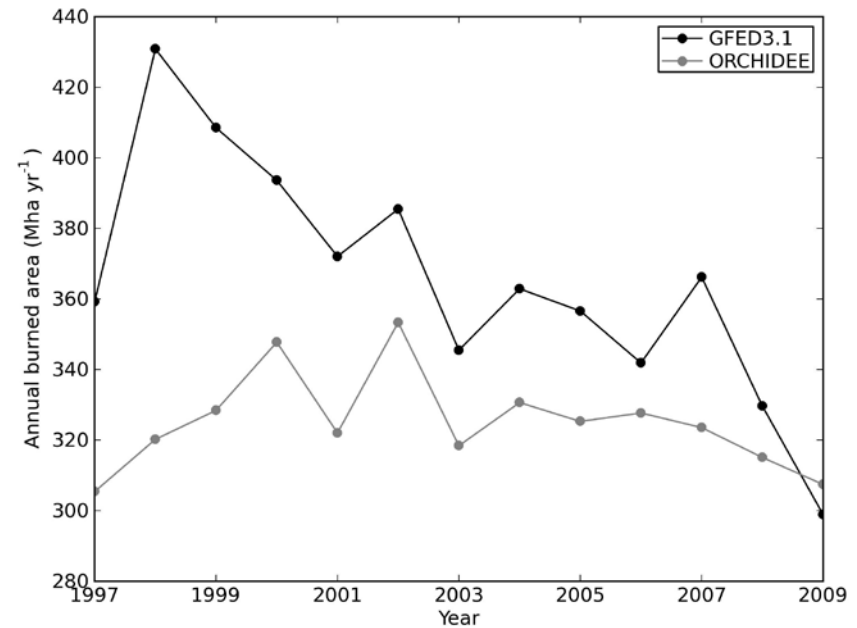
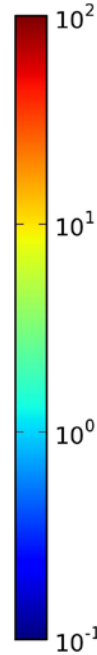
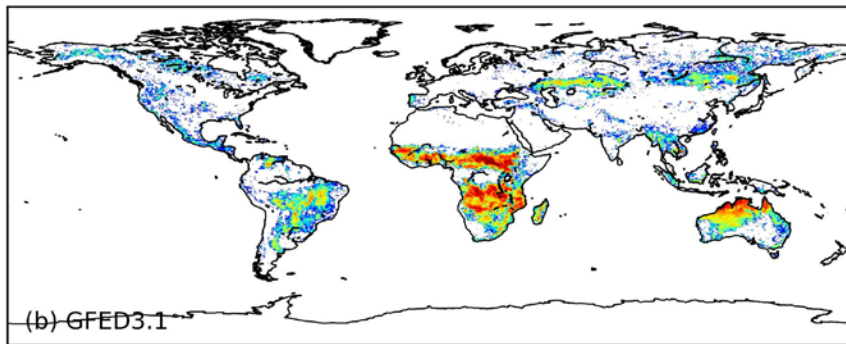
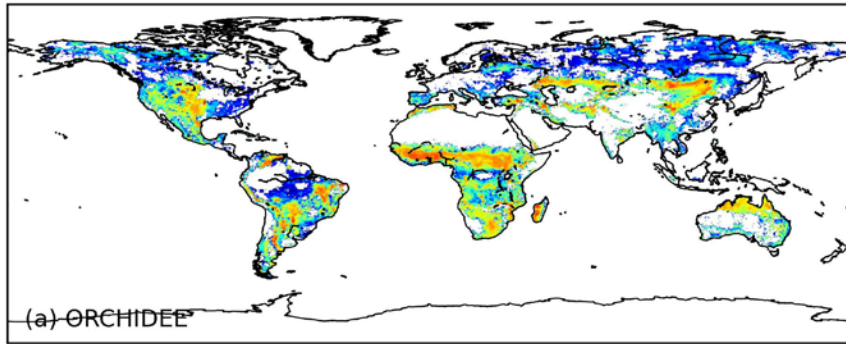
The ORCHIDEE-SPITFIRE model

SPITFIRE process



- daily step
- explicit ignitions
- fire spread
- fire intensity
- mortality

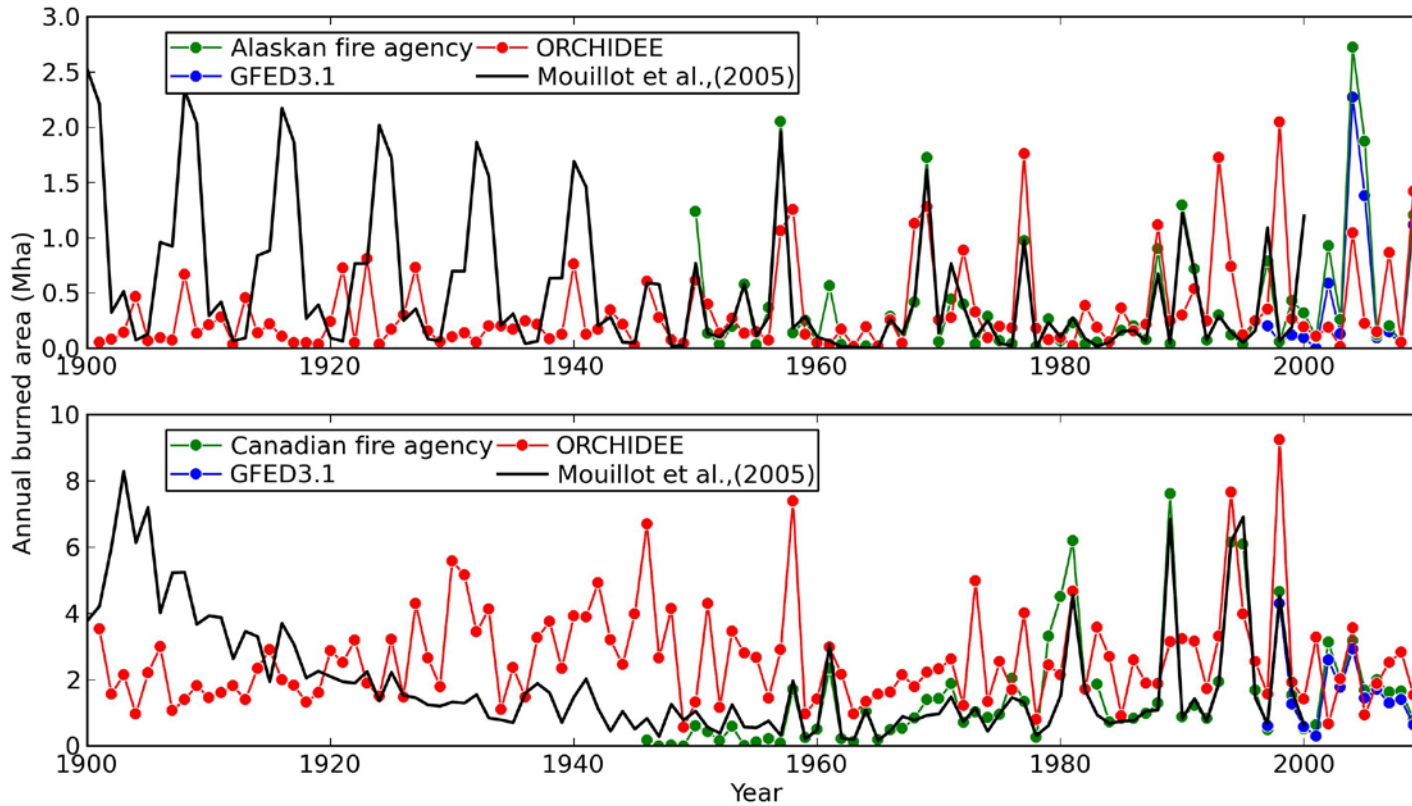
Simulated burned area (I)



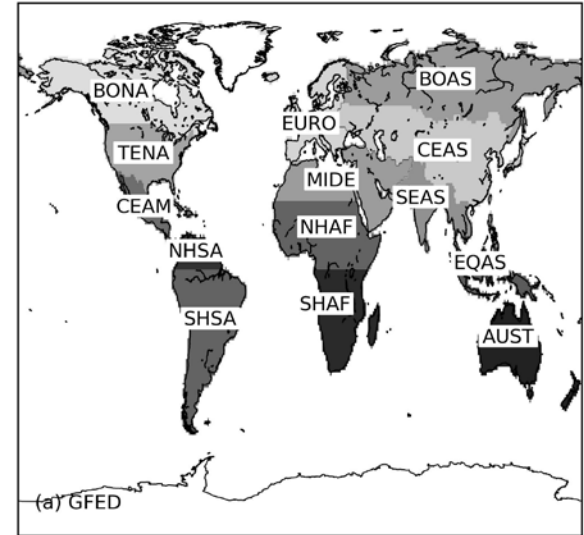
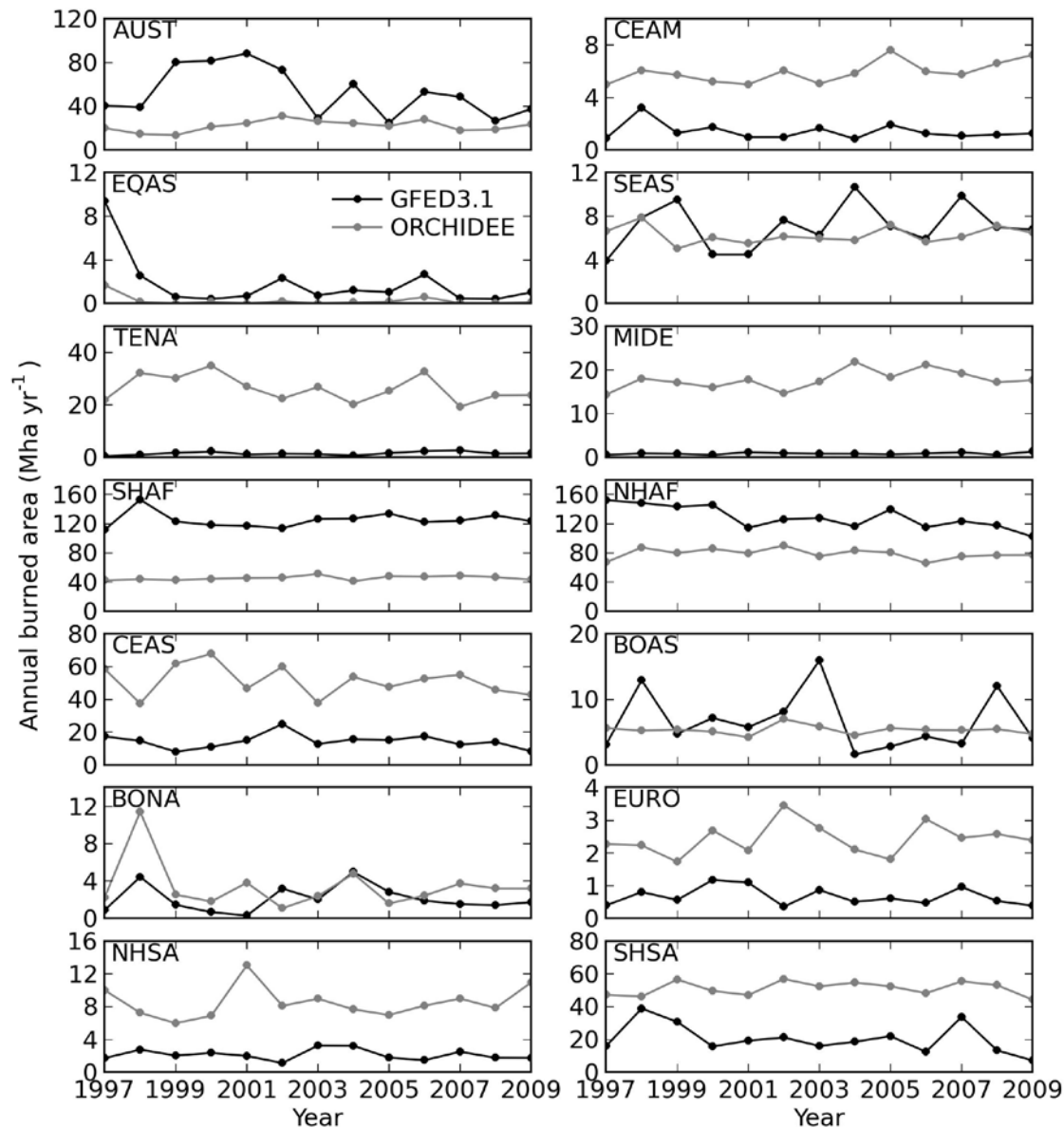
Global annual burned area by ORCHIDEE simulation and by GFED3.1 data for the period of 1997-2009.

Mean annual fire burned fraction (in percentage) over 1997-2009 as simulated by ORCHIDEE and reported by the GFED3.1 dataset.

Simulated burned area (II)

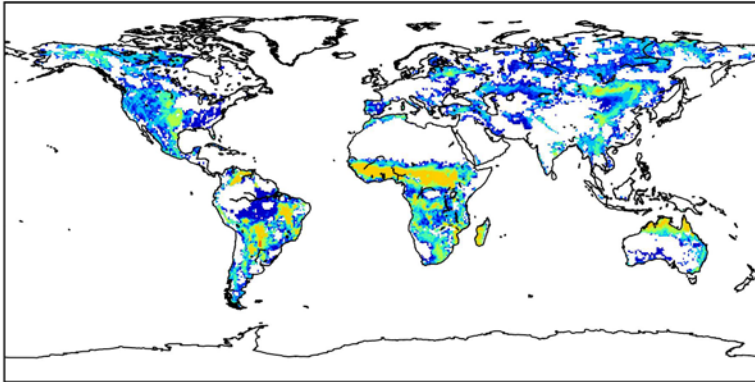


Simulated burned area (III)

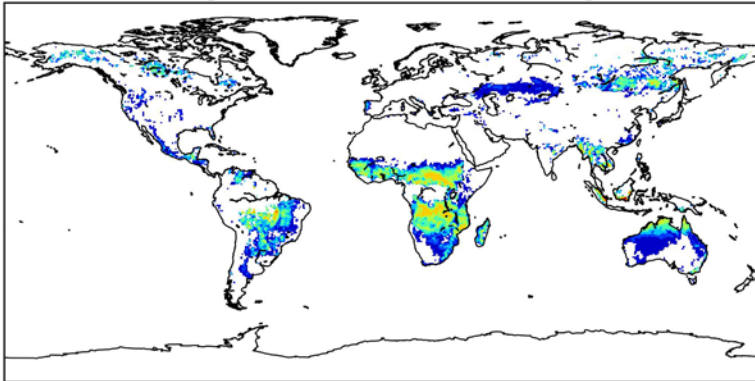


Simulated fire carbon emissions

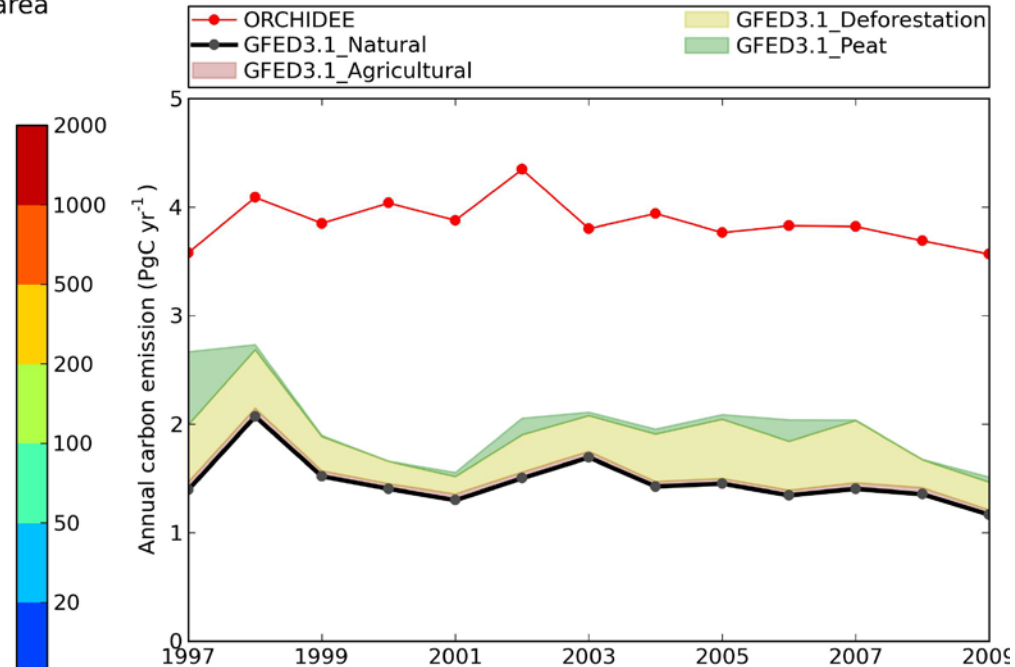
Mean annual fire carbon emissions (gCm⁻²yr⁻¹)
ORCHIDEE_SPITFIRE average over 1997-2009 based on gridcell area



Mean annual fire carbon emissions (gCm⁻²yr⁻¹)
GFED3 average over 1997-2009 based on gridcell area

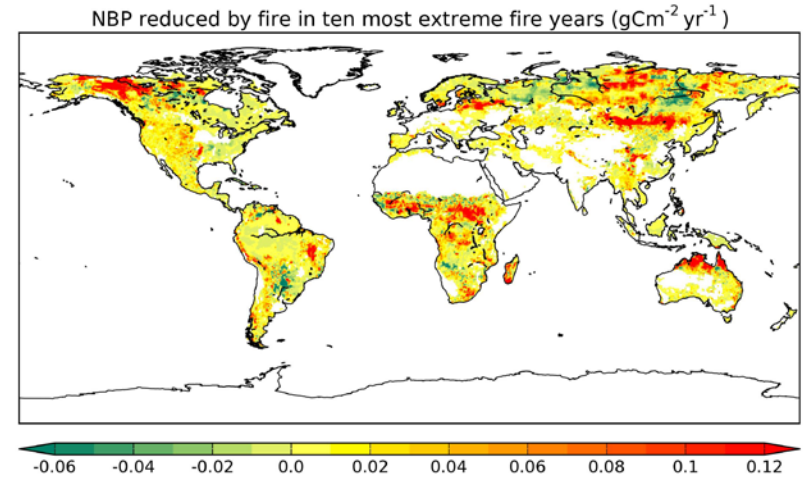
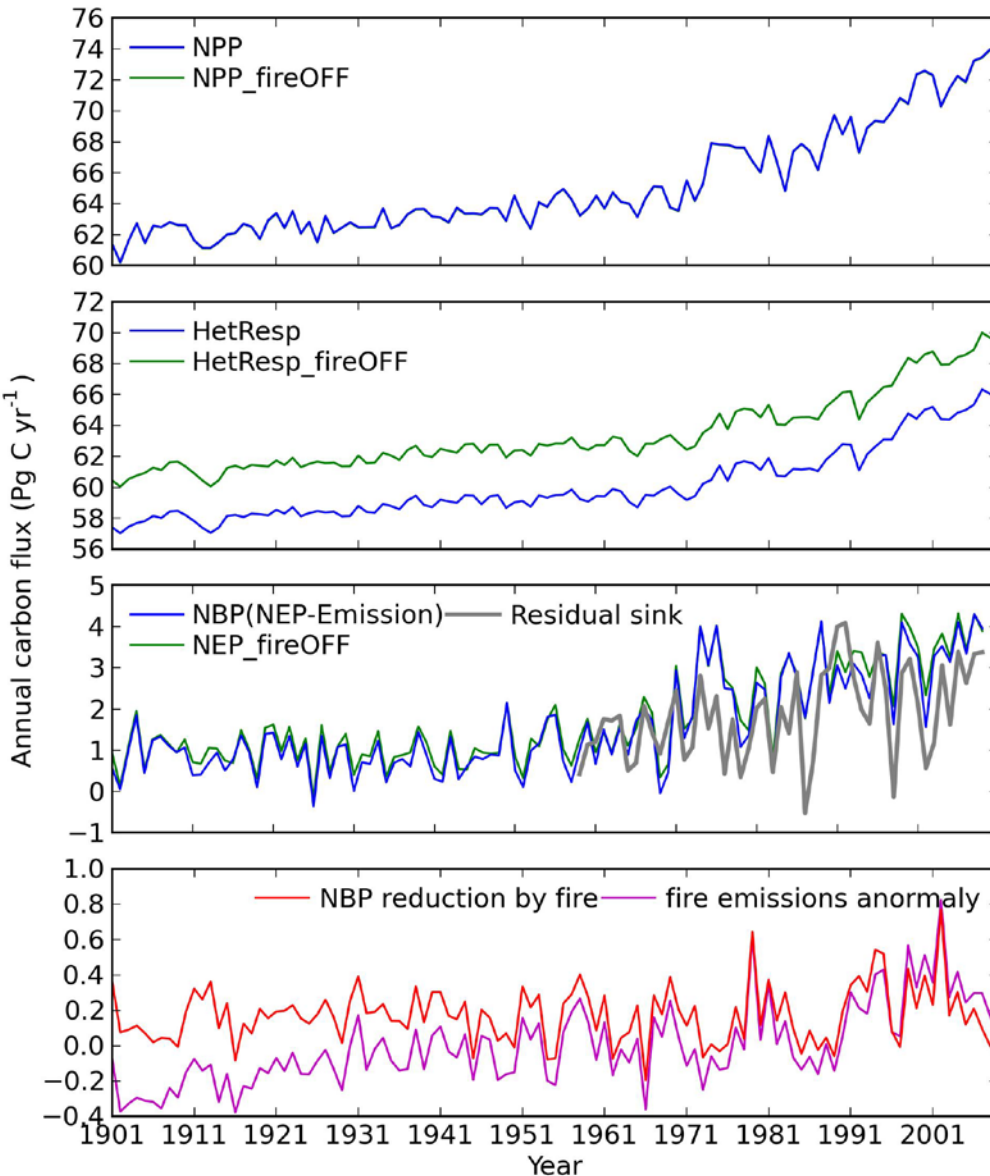


Mean annual carbon emissions (g C m⁻² yr⁻¹) for the period of 1997-2009 by (a) ORCHIDEE simulation and (b) the GFED3.1 data, based on the gridcell area.



Annual global total fire carbon emissions for the period of 1997-2009 by ORCHIDEE simulation (red), and by the GFED3.1 dataset in breakup of different sources.

The role of fire in terrestrial carbon balance



NBP reduced by fire (fireOFF-fireON) in ten most extreme fire years

The role of fire carbon emissions in relation to fire pyromes

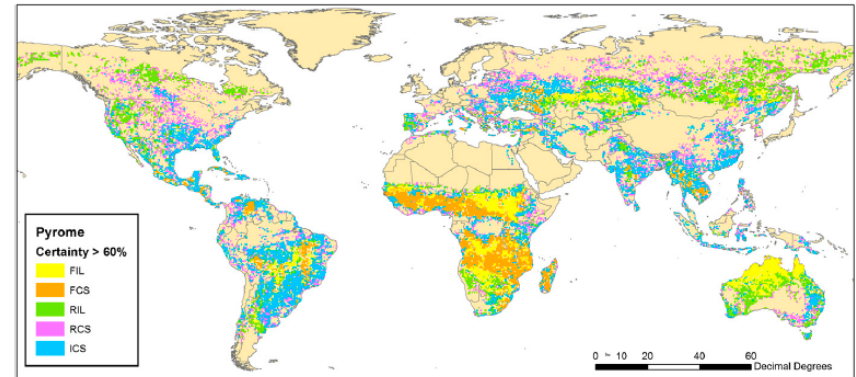
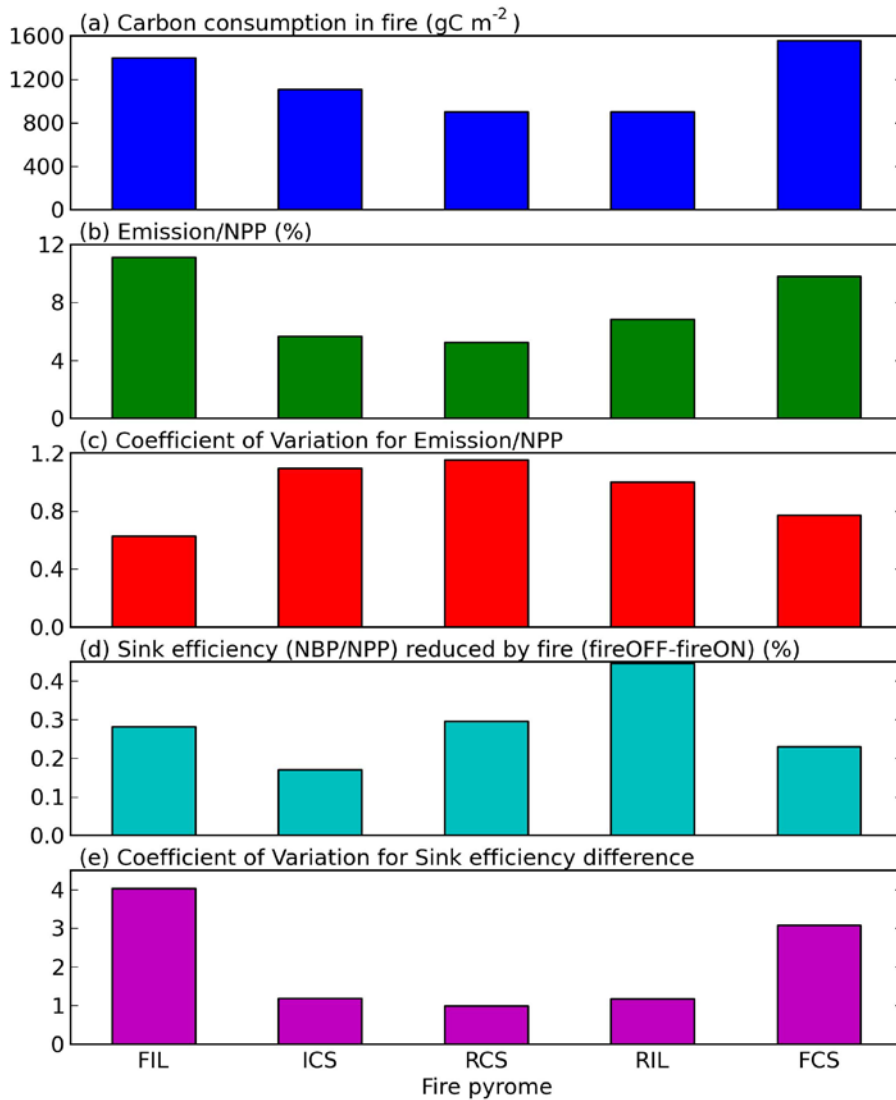


Fig. 2. Mapping the spatial distribution of pyromes. Produced from the five-cluster solution of a model-based expectation-maximization clustering algorithm. Pyromes represent regions of the globe that have similar fire frequencies, intensities, sizes, burned areas, and fire season lengths. Pixels with greater than 60% probability of being uniquely categorized are plotted (85% of the data).

Fire pyrome distribution by Archibald et al. (2013)

Fire characteristics by pyrome:

FIL: Frequent - Intense - Large

ICS: Intermediate - Cool - Small

RCS: Rare - Cool - Small

RIL: Rare - Intense - Large

FCS: Frequent - Cool - Small

Future improvements in fire modeling (I)

- Ignitions parameterization
- Fire spread rate, fire size, fire intensity evaluation
- The need to build consistent observation data on key parameters in the fire modeling for model evaluation purpose

Future improvements in fire modeling (II)

