

# Fire and the carbon cycle

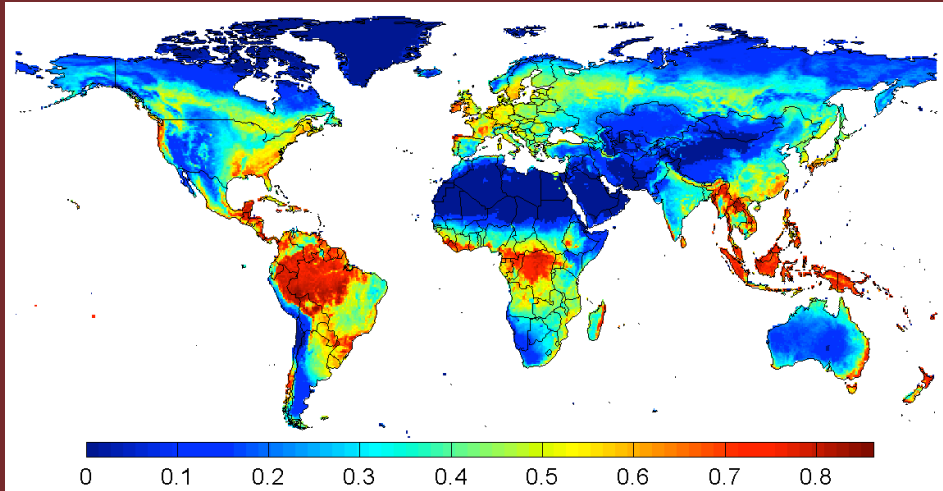
Guido van der Werf, Louis Giglio, Jim Randerson

ESF's "Improved quantitative fire description with multi-species inversions of observed plumes"  
exploratory workshop

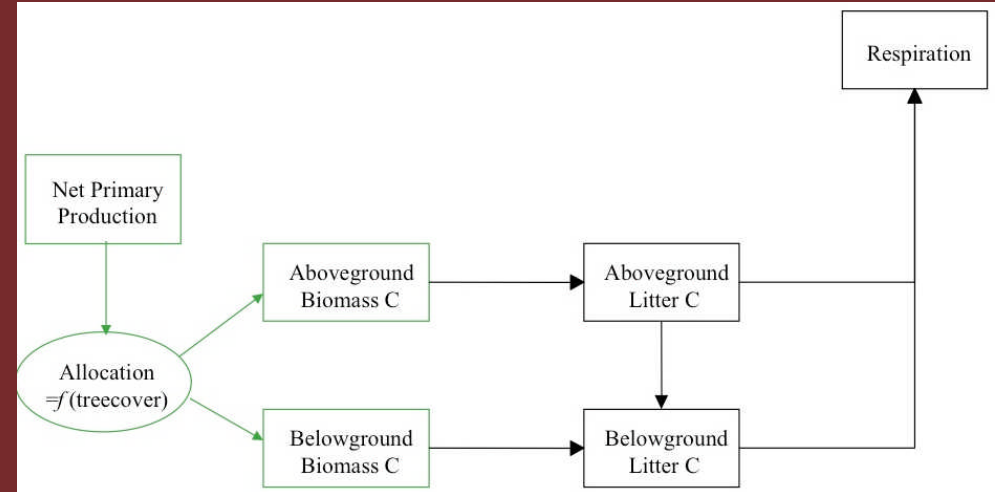
- Simulate the role of fire in the contemporary global carbon cycle using satellite-derived information on
  - fire location and timing
  - vegetation productivity
- Led to the global fire emissions database (GFED) based on
  - modeled fire carbon losses
  - emission factors (Andreae and Merlet, 2001, GBC + updates)

# 3 of 10: Approach

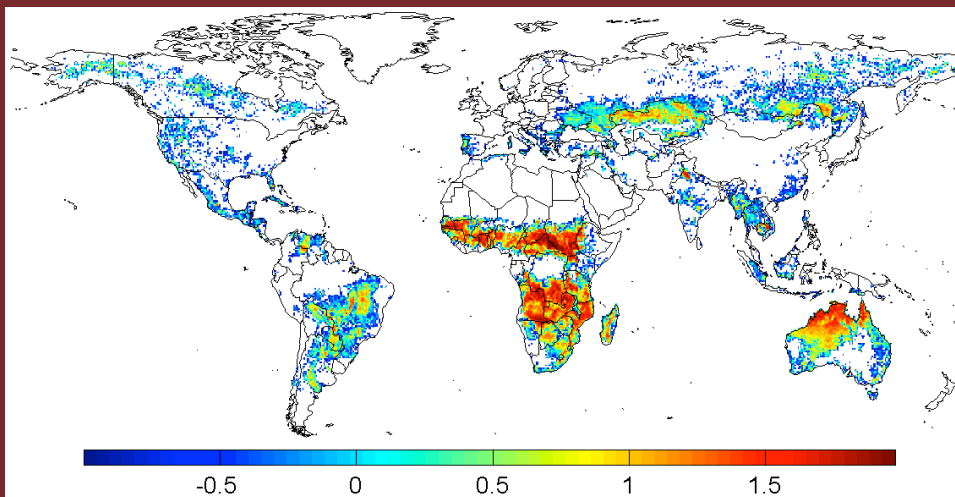
fAPAR (MODIS, AVHRR)



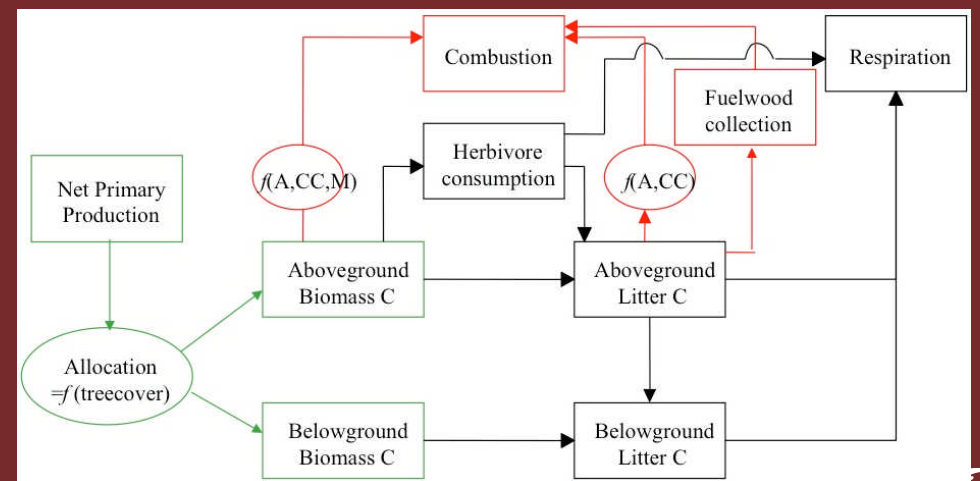
Biogeochemical model (CASA)



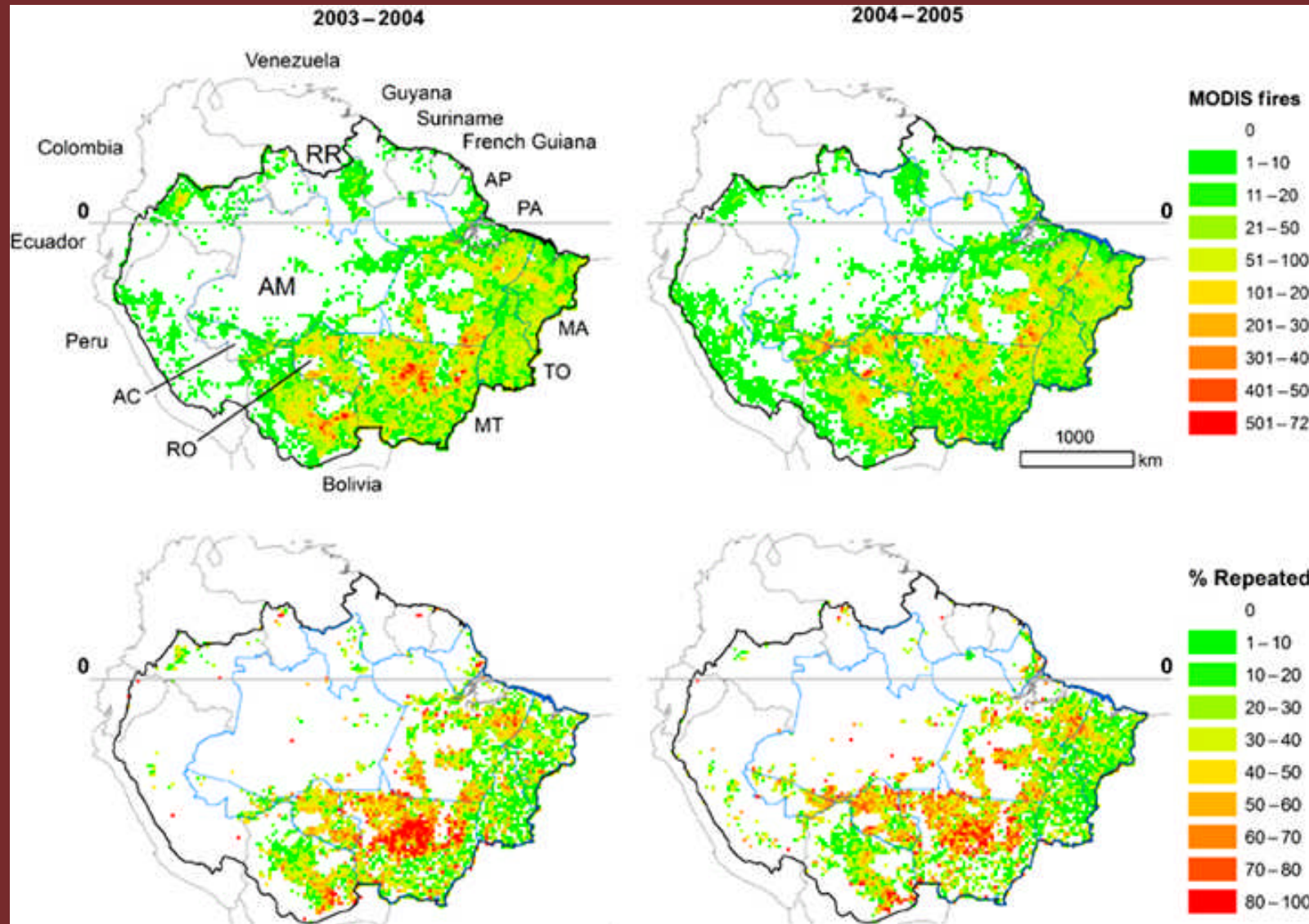
Burned area (log scale) MODIS, ATSR, VIRS



Biogeochemical model (CASA) with fire module



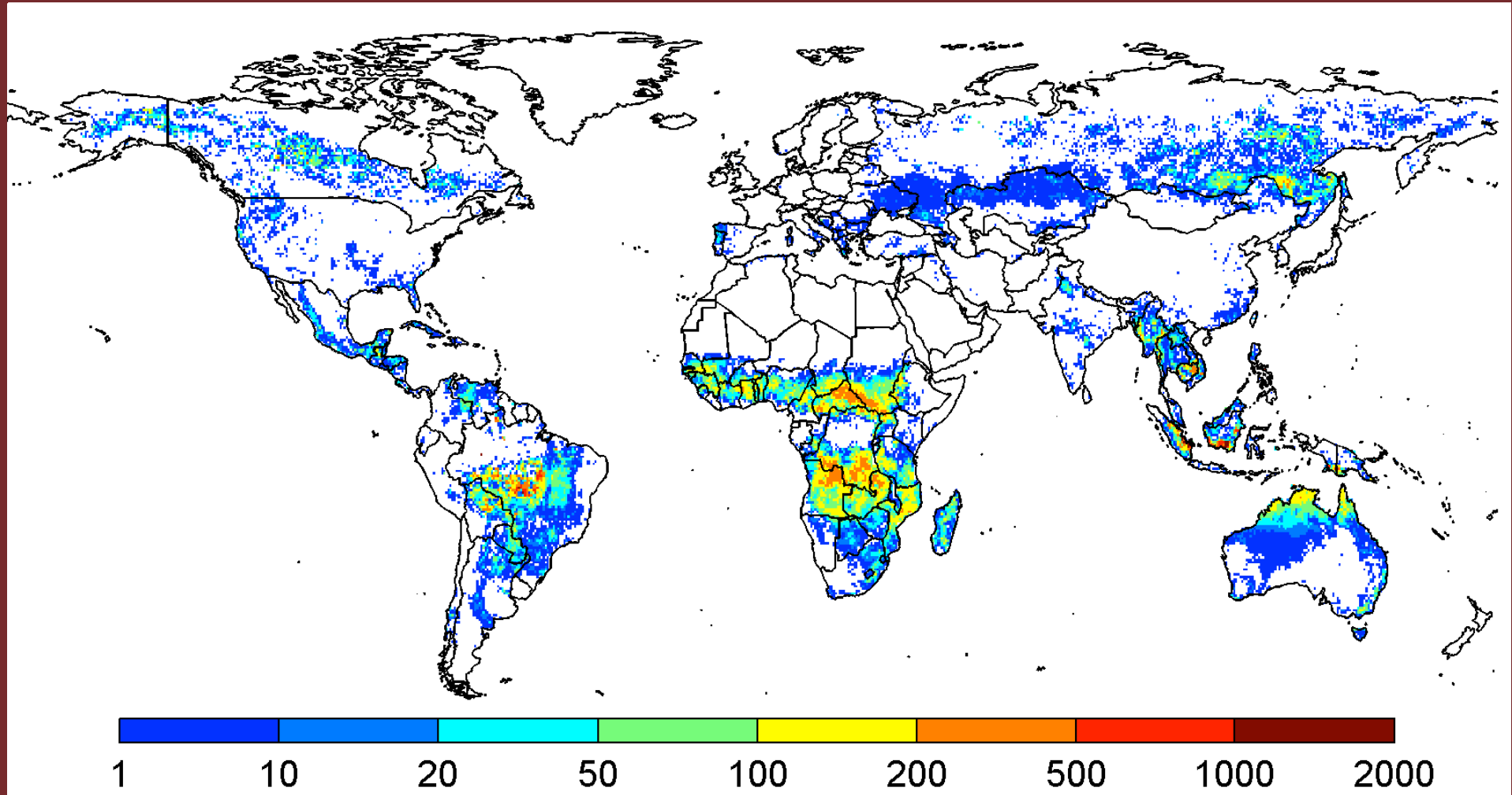
# 4 of 10: Separating deforestation fires from other fires



Morton et al, 2008, GCB

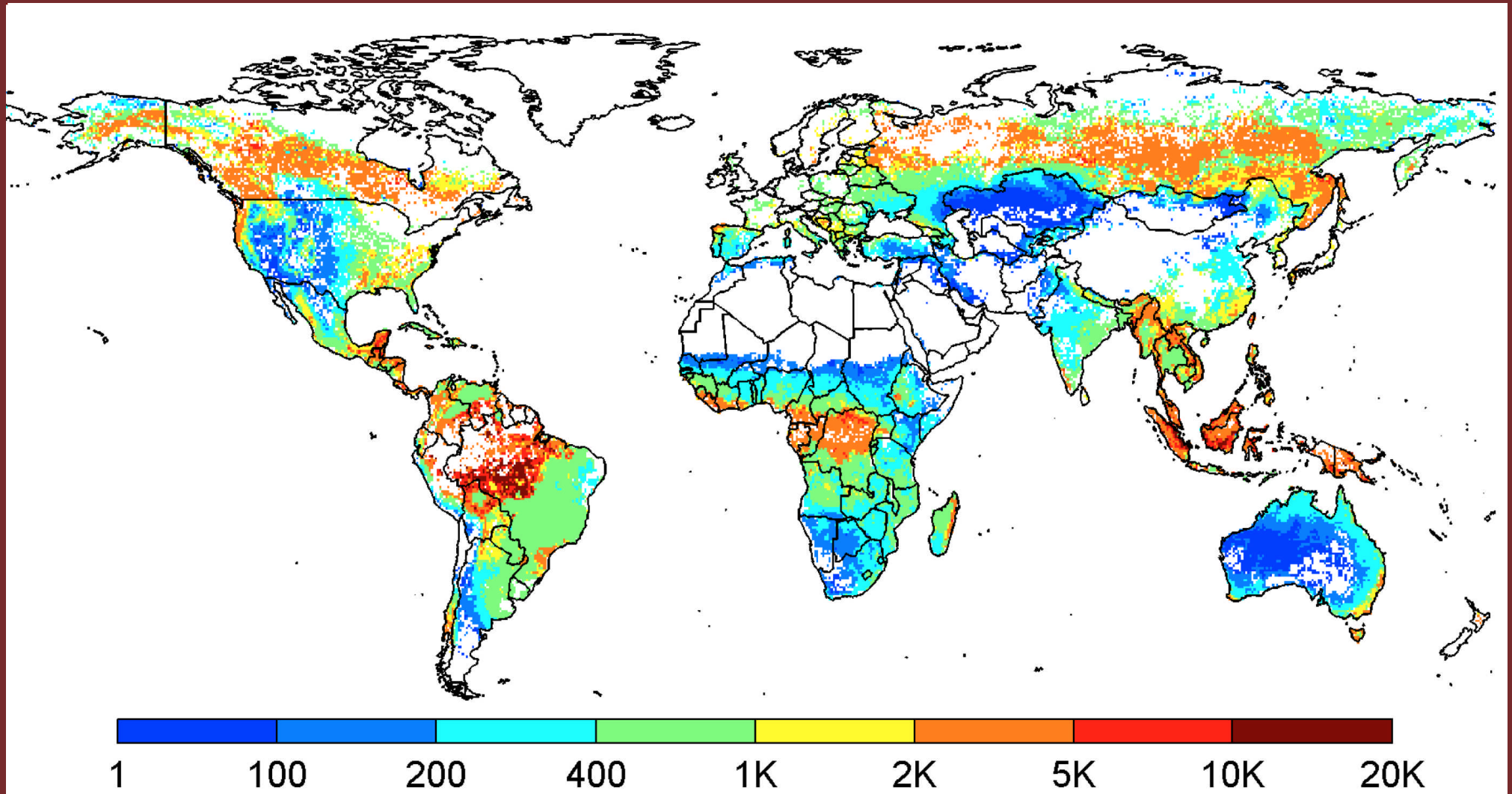


# 5 of 10: Emissions pattern (1997 – 2008)



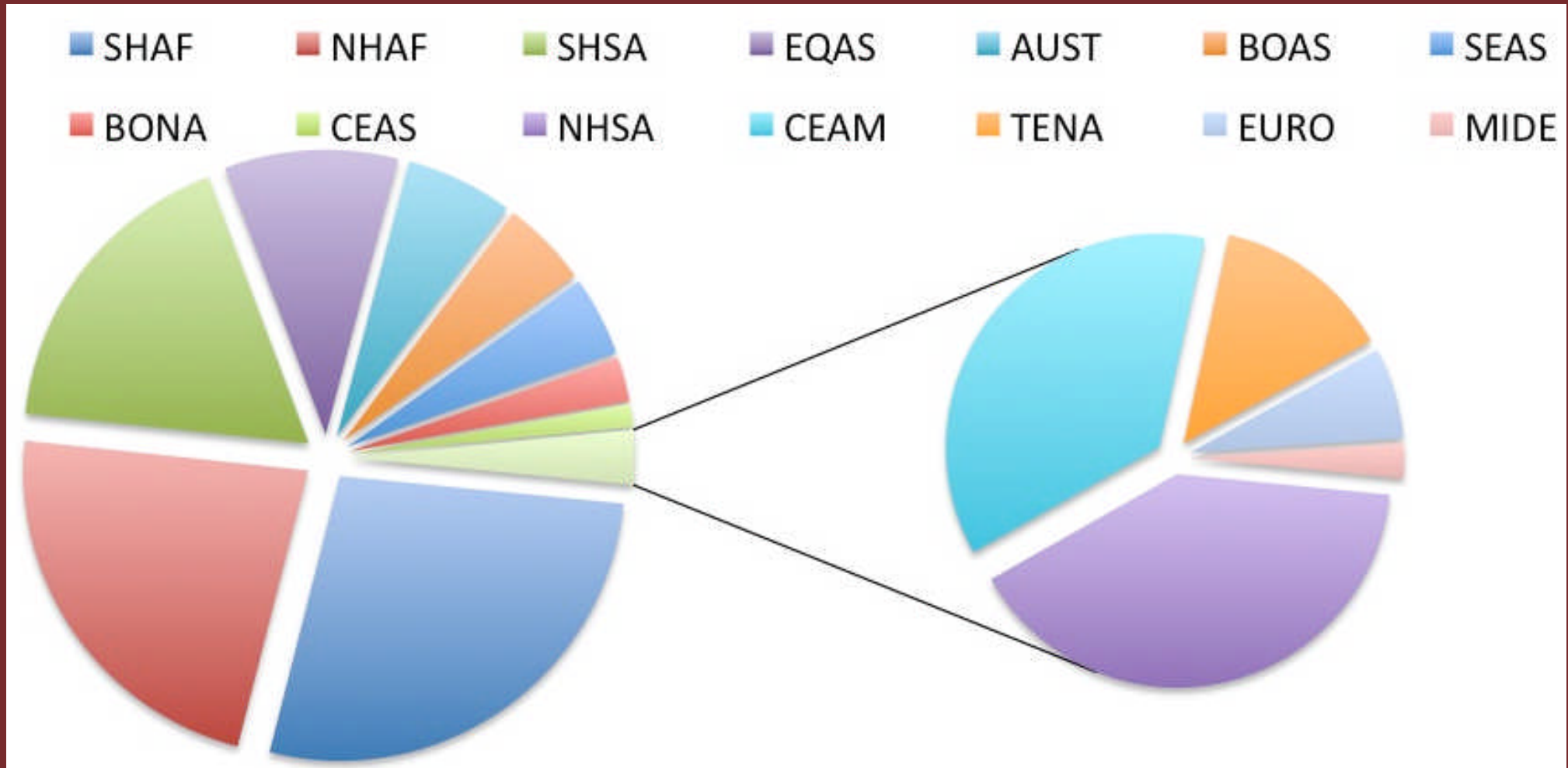
Global fire emissions database version 3, g C / m<sup>2</sup> / year

# 6 of 10: Fuel consumption pattern (1997 – 2008)



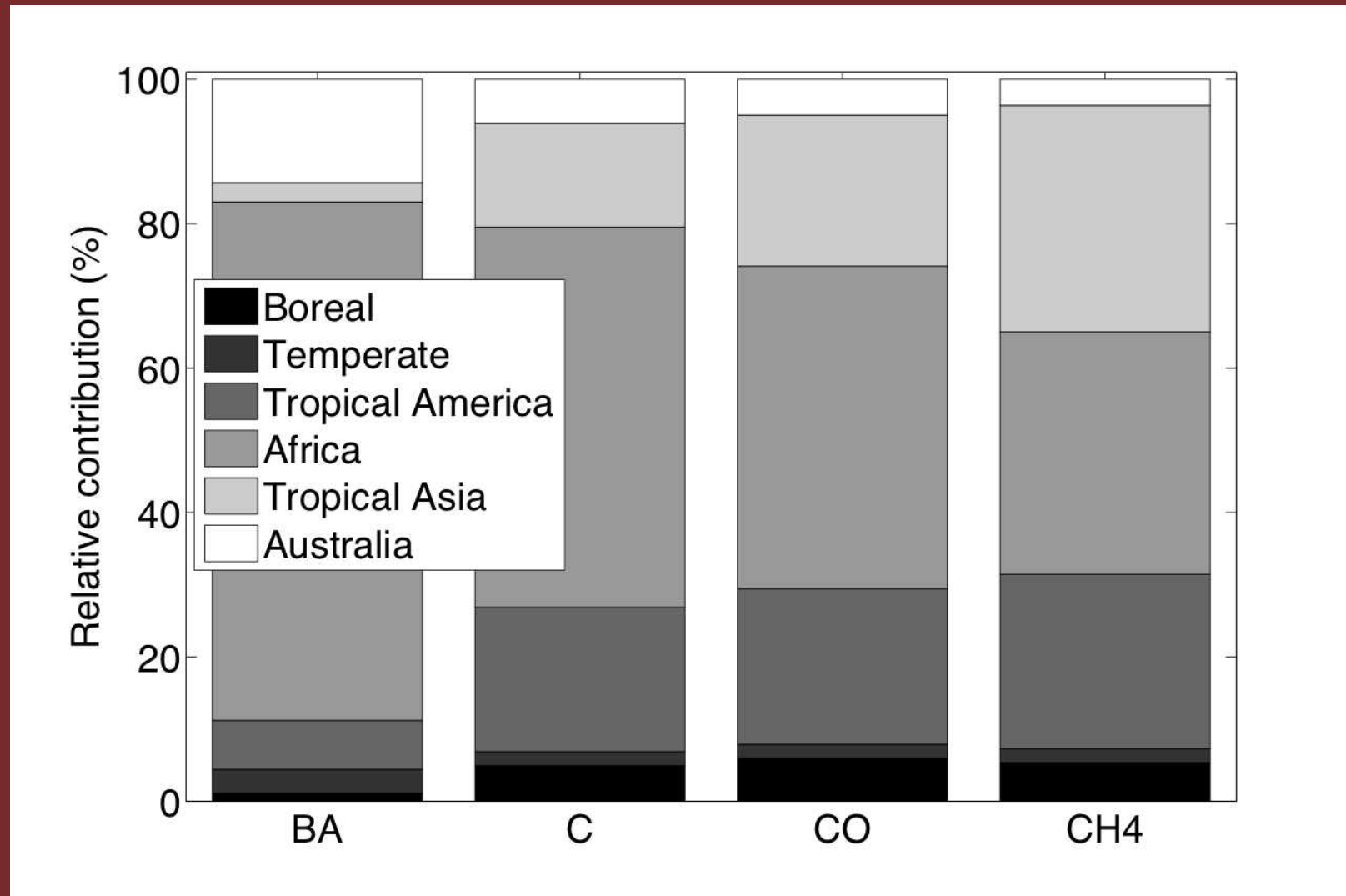
Global fire emissions database version 3, g C / m<sup>2</sup> burned / year

# 7 of 10: Regional contributions (2001 – 2008)



Global fire emissions database version 3, carbon losses

## 8 of 10: Regional contributions (II)

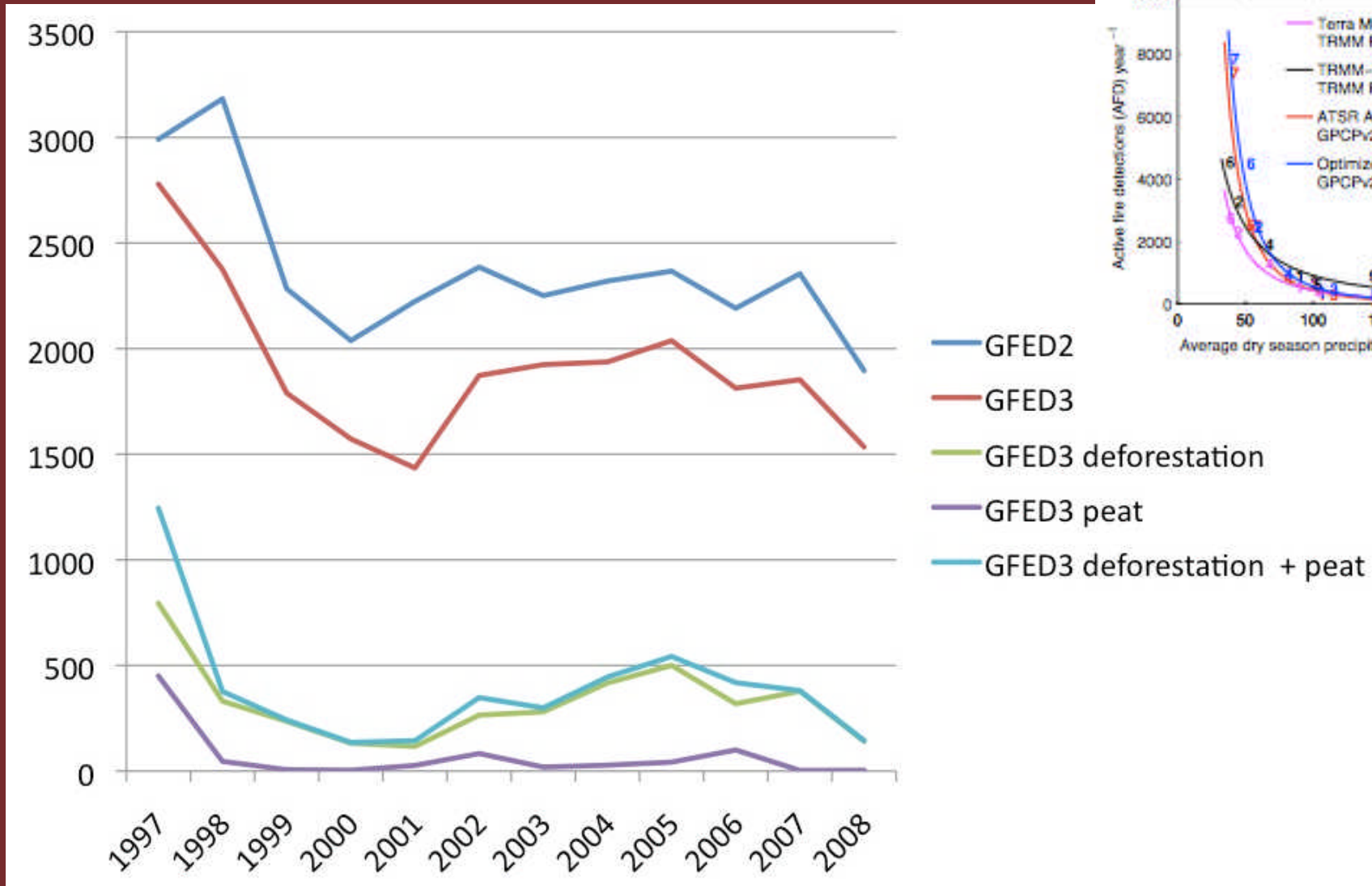


Global fire emissions database version 3, BA = burned area, C = carbon



# 9 of 10: Interannual variability (1997 – 2008)

Fire carbon losses, Tg C / year



Average ~ 1.9 Pg C / year (over 1997-2008 range of 1.4 – 2.8)  
 ±0.4 Pg C / year from deforestation and peat fires (net carbon losses)

# 10 of 10: (Future) uncertainties

Burned area  $\times$  fuel load  $\times$  combustion completeness  $\times$  emission factor

## *Burned area*

- New multi-year burned area (MODIS, L3JRC). Likely underestimate
- 500m or 1 $\times$ 1 km resolution, is that enough? Geo-location issues

## *Fuel load, CC*

- Current estimates compare reasonable against literature for fuel build-up
- Large uncertainty in depth of burning into soil (boreal region, peat areas)
- Heterogeneity: 0.5 $^{\circ}$  $\times$ 0.5 $^{\circ}$  not good enough (deforestation, grazing), but is 500  $\times$  500 meter? Input datasets? Parameterization?

## *Emission factors*

- Emission factors: large seasonal and spatial variability currently not taken into account. For several species dearth of measurements

**Yes**, bottom-up fire emissions estimates are improving (wrong for the wrong reason  $\rightarrow$  wrong for the right reason), *but imho emissions estimates on a global scale are unlikely to come within a 30% uncertainty range in the near future*





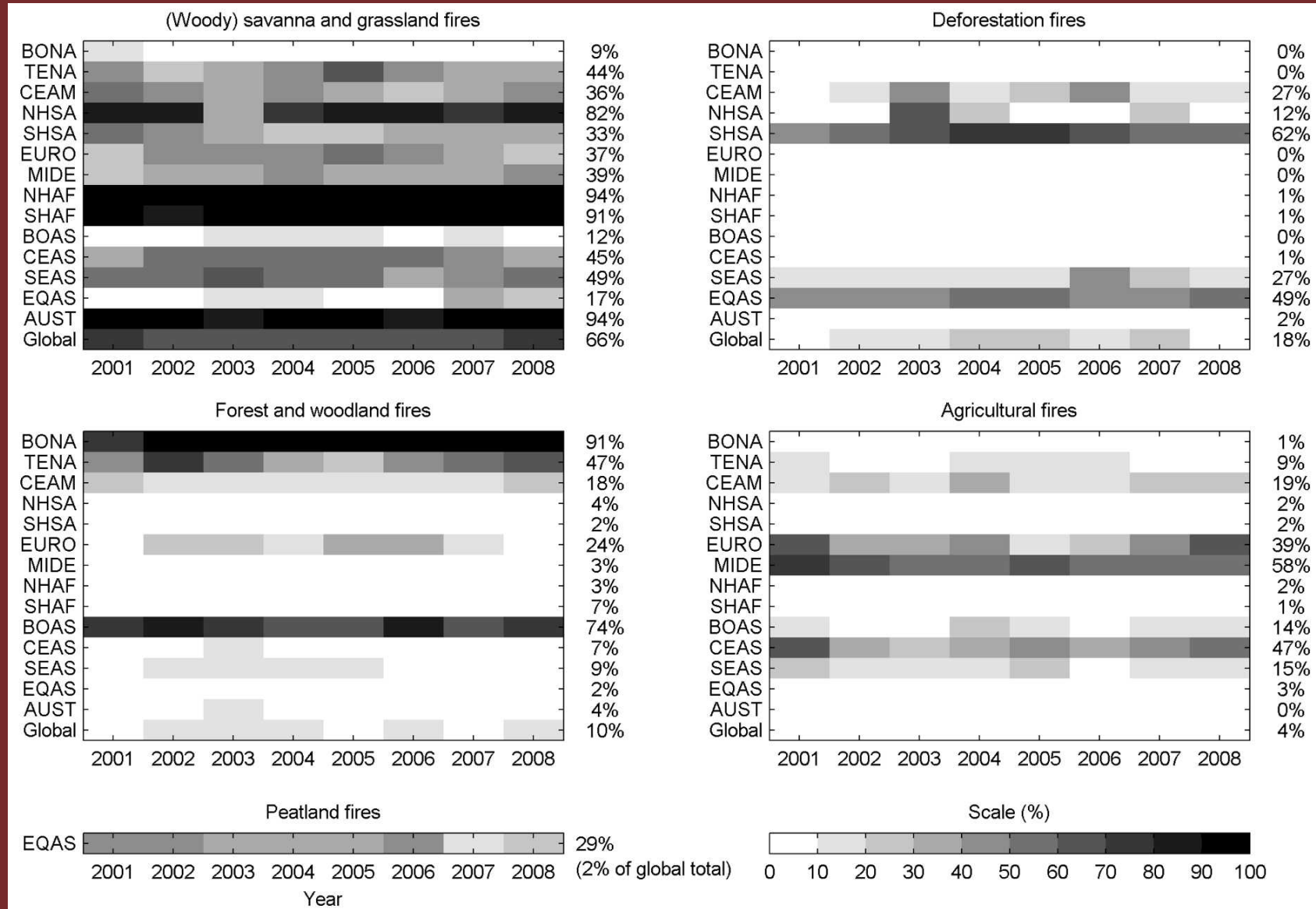
N720HT

720

HELICOPTER TRANSPORT SERVICES

NO SWIMMING  
NO LIQUOR  
WATER  
EXCEEDED

# 9 of 10: Interannual variability (1997 – 2008)



Global fire emissions database version 3, g C / m<sup>2</sup> burned / year