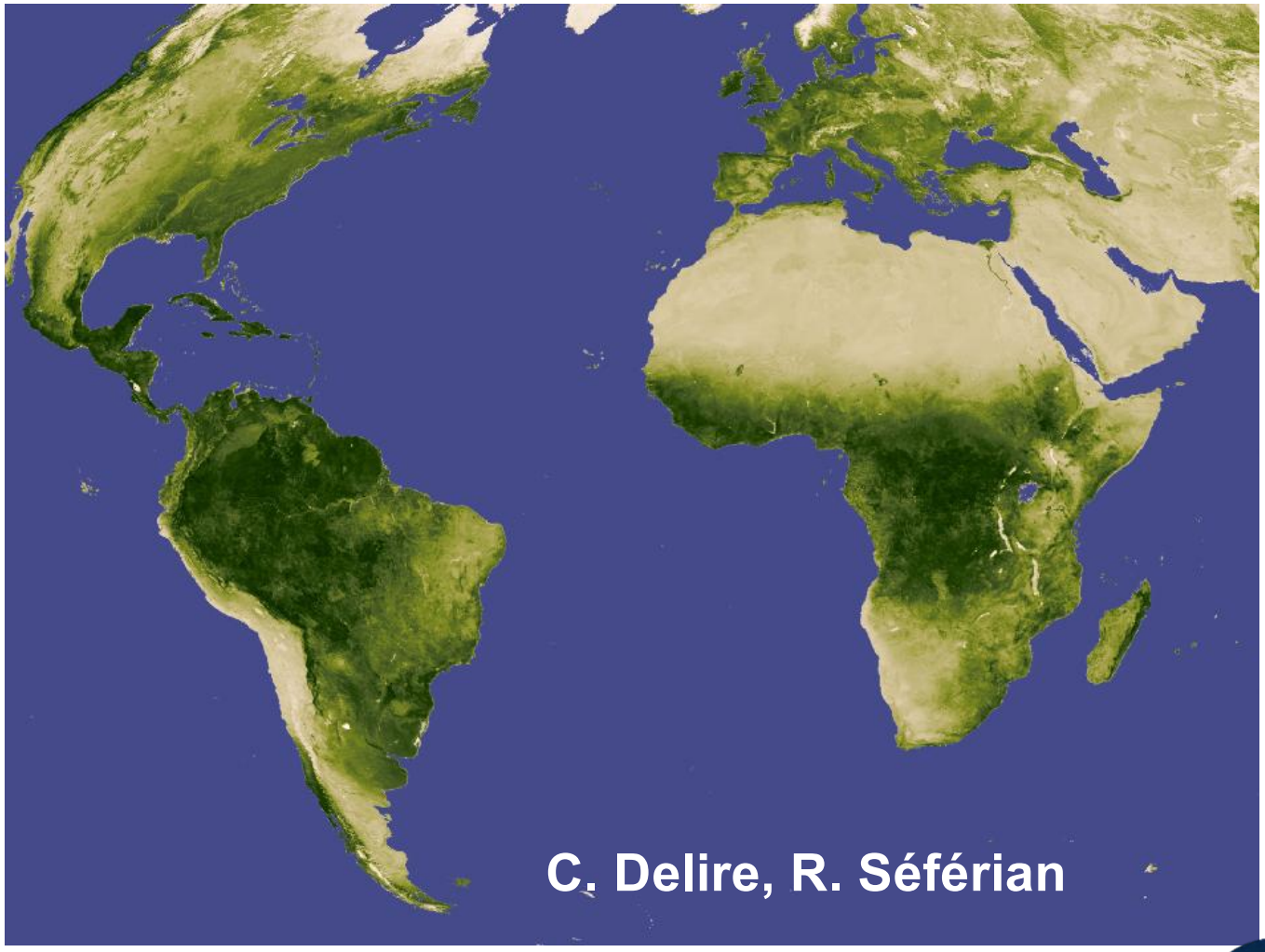
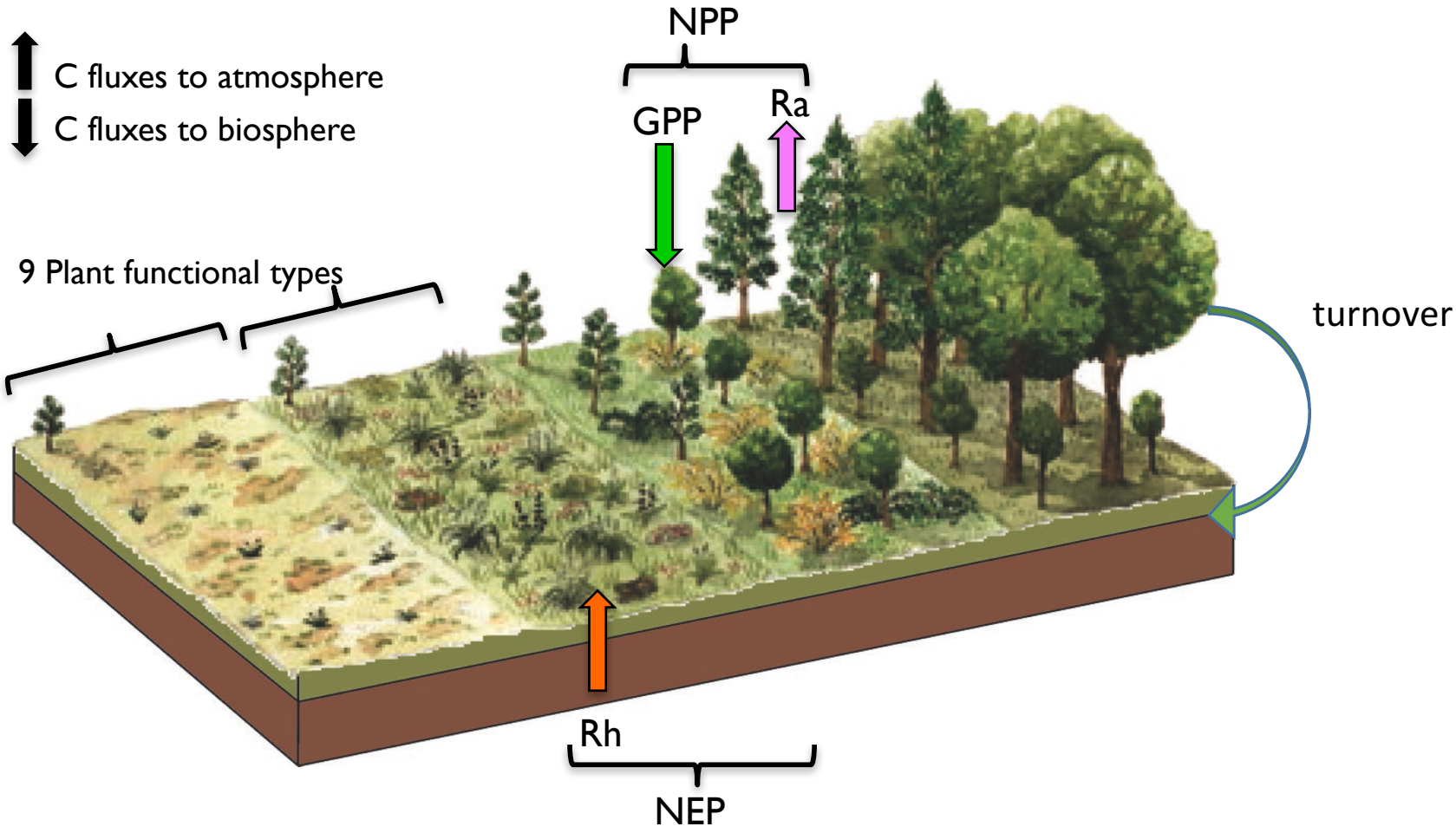
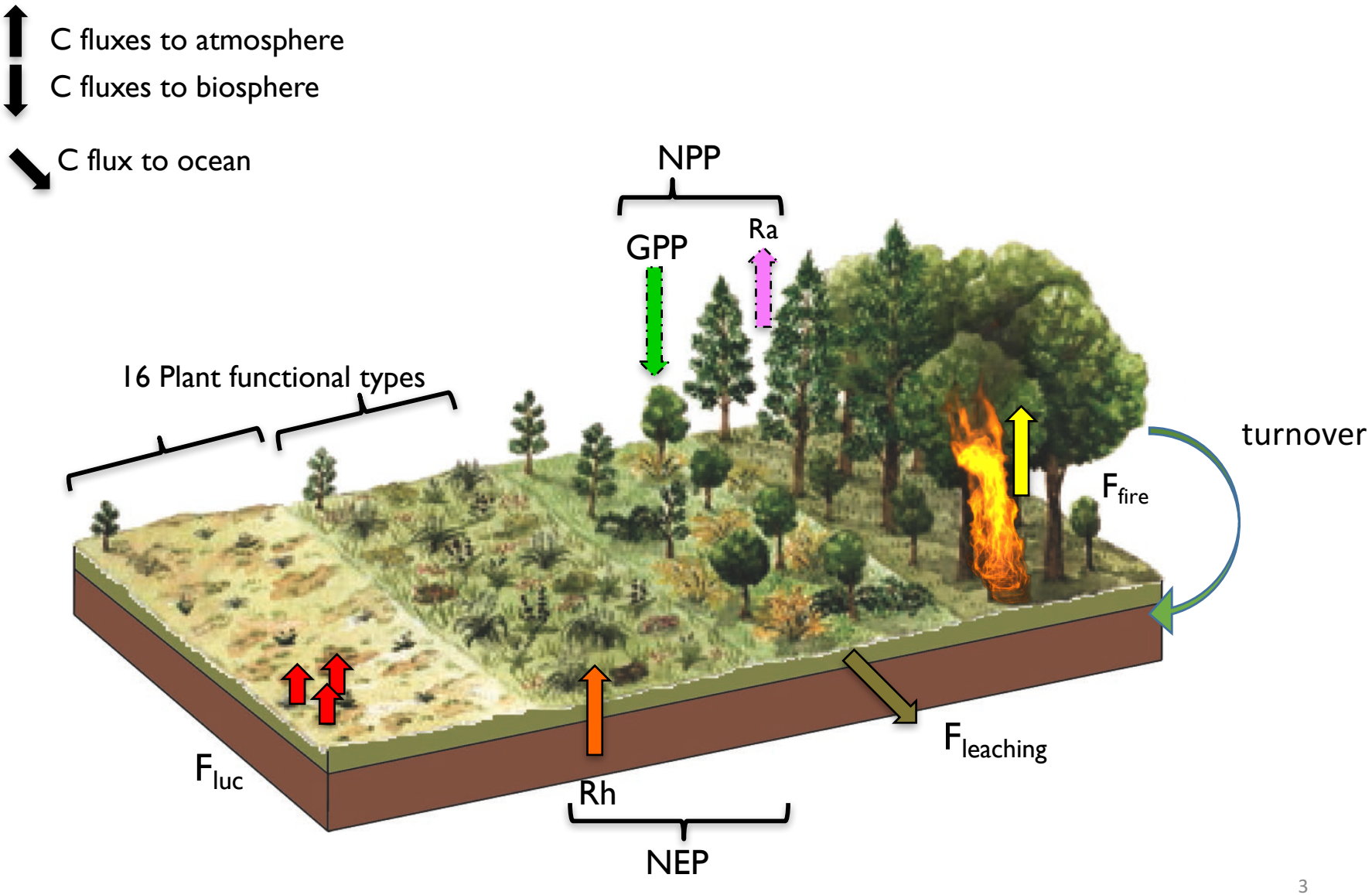
The updated land carbon cycle in SURFEXv8



Simulated processes in ISBA



Simulating major missing processes in ISBA



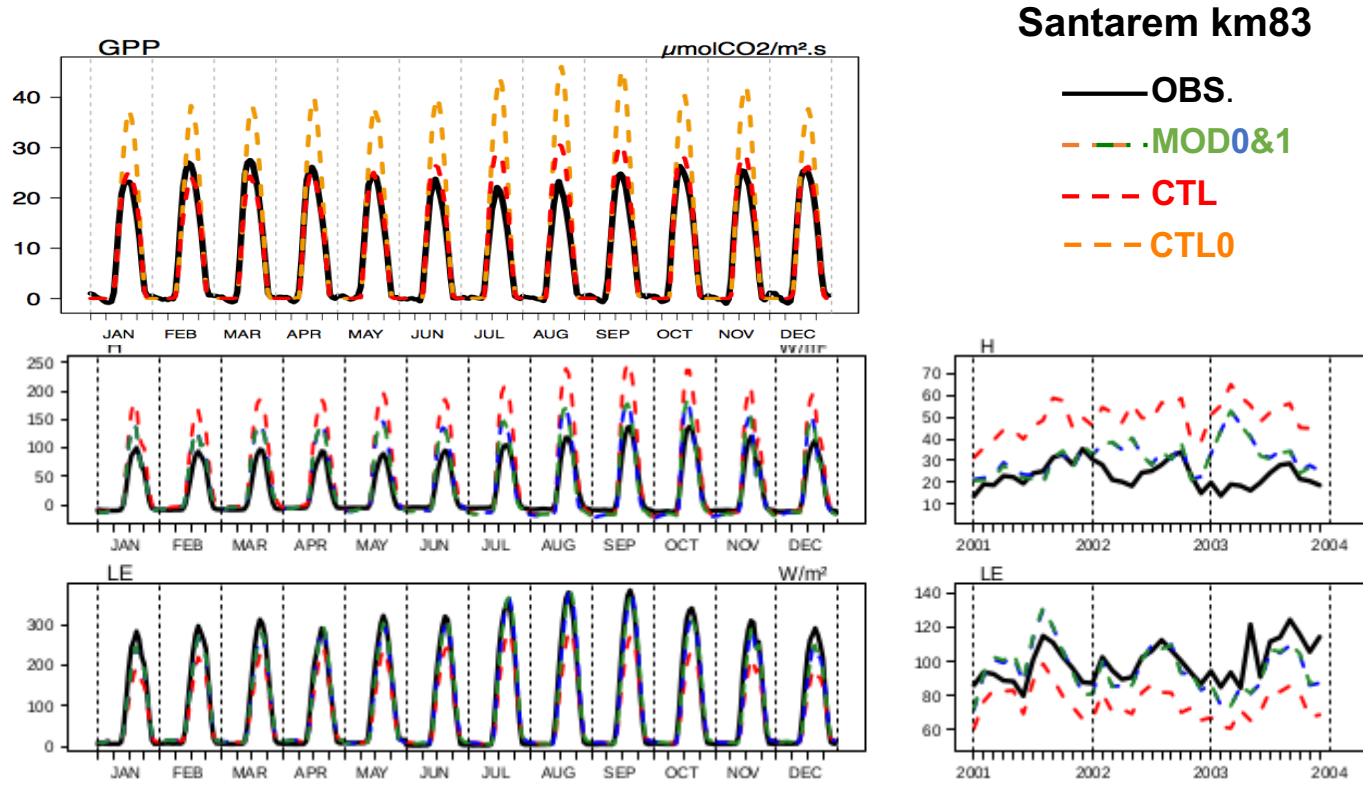
Updated Processes on major biomes of the world

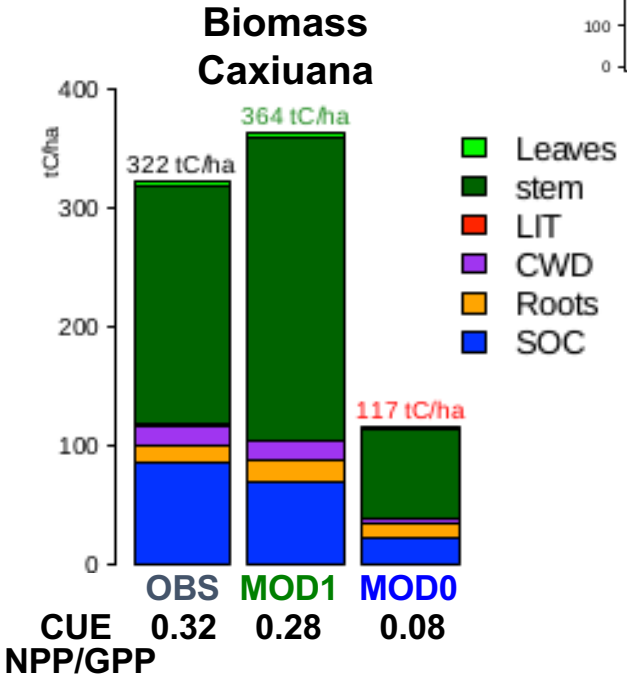
- rainforest (E. Joetzjer PhD, 2014)
- same approach with TRY database for other biomes, benchmarked with Fluxnet data

New processes

- New discretized soil C model, anaerobic decomposition, CH4 emissions, gas diffusion (Xavier Morel, previous talk, work in progress)
- 16 plant functional types instead of 9 (+ bare soil, rock, permanent snow/ice)
- land-use / land cover changes : yearly input maps
- C leaching to river → ocean
- Natural fires

Updated processes : Amazon forest *PhD E. Joetzjer (2014)*





ISBA

overestimation of GPP (CTL0)

- underestimation de LE
- underestimation living biomass and soil C
- strong overestimation of leaf respiration (CUE too small)

Joetzjer et al, GMD, 2015

Home About TRY Data Portal

Quantifying and scaling global plant trait diversi

TRY is a network of vegetation scientists headed by DIVERSITAS/IGBP, and the Max Planck Institute for Biogeochemistry, providing a global archive of curated plant traits.

5.6 million trait records
100,000 plant species
largely open access

Data Portal

PhotosyntheticPathway
Respiration LeafArea NfixationCapacity
SLA RegenerationCapacity PlantLifespan
WoodDensity GrowthForm
PhenologyType LeafN
LeafP LeafLongevity PhotosyntheticCapacity
MaxPlantHeight SeedMass

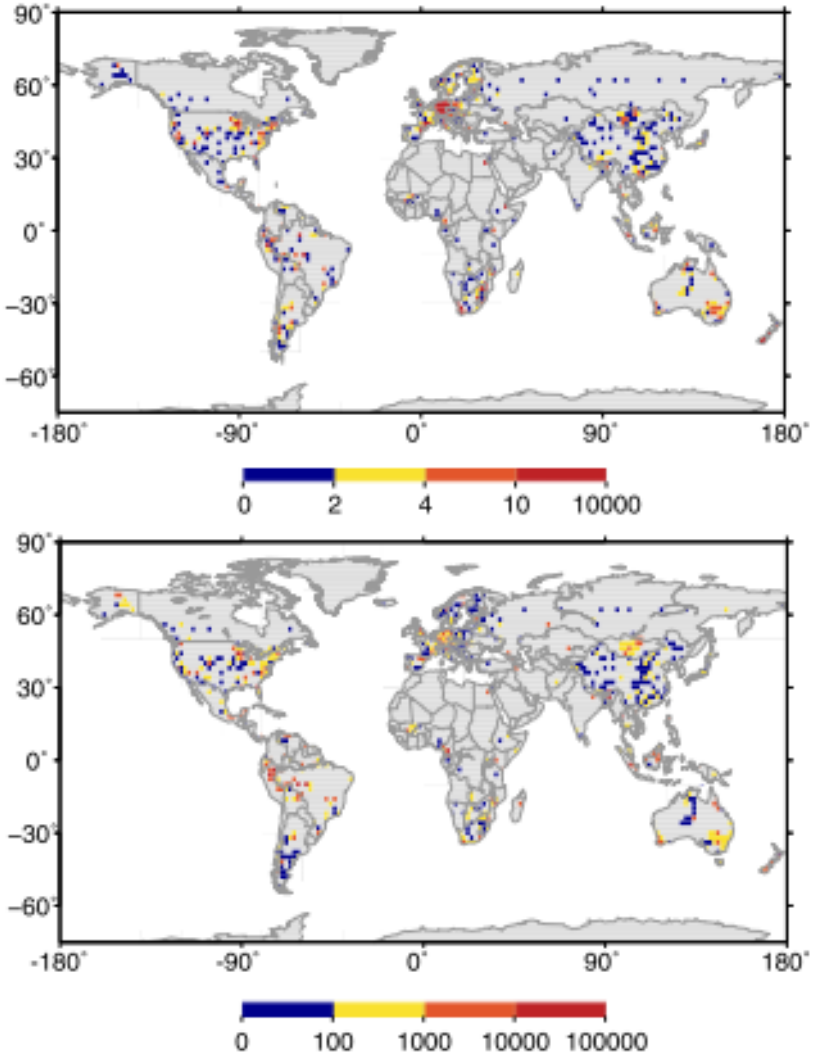


Fig. 2 Data density of georeferenced trait entries. Top, number of sites per $2 \times 2^{\circ}$ grid cell; bottom, number of trait entries per grid cell.

Kattge et al, 2011

Updated parameters / processes

Nm (leaf nitrogen content)	TRY *(Kattge et al., 2011)*
SLA (specific leaf area index)	TRY
gmes (unstressed mesophyll conductance)	*Vcmax** (TRY, *Kattge et al., 2009*)
f0 (unstressed ratio of intracellular to air CO2)	*Domingues et al, 2013* (TrBE)
Am,max (max assimilation rate)	*Vcmax** (TRY, *Kattge et al., 2009*)
leaf respiration	exponential decrease in canopy (*Bonan et al, 2011*)
sapwood respiration	added (*Kucharik et al, 2000*)
soil moisture stress	simplified for TrBE

* Comparison Farquhar / Jacob photosynthesis models :

gmes = initial slope of Rubisco limited assimilation rate in Farquhar 1980

Am,max = 0.5 * *Vcmax*

benchmarking with Fluxnet sites

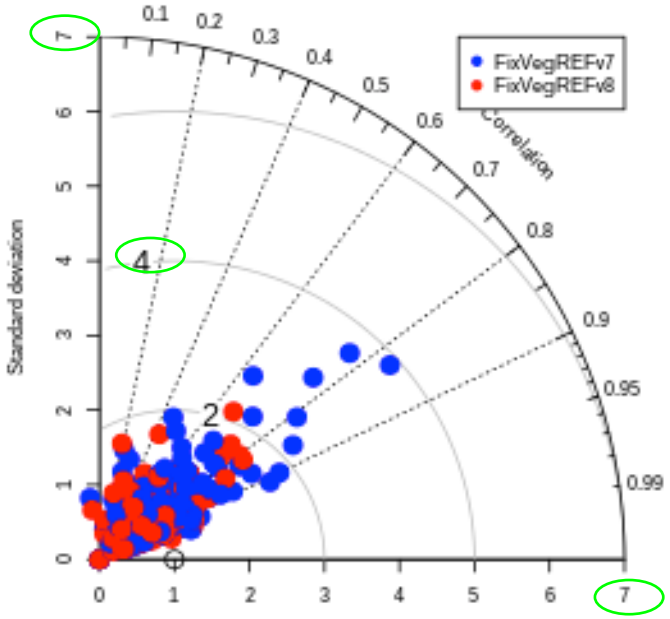
N. Laaiana, R. Séférian, initiated by S. Lafont,

	FluxNet	*ISBA*	*n*
Coniferous	*ENF*	TeNE, BoNE	37
Deciduous	*DBF*	TrBD, TeBD, BoBD	20
Evergreen	*EBF*	TrBE, TeBE	4
herbaceous	*GRA*	GRAS, BoGR, TroG	19
crop	*CRO*	C3, C4	15

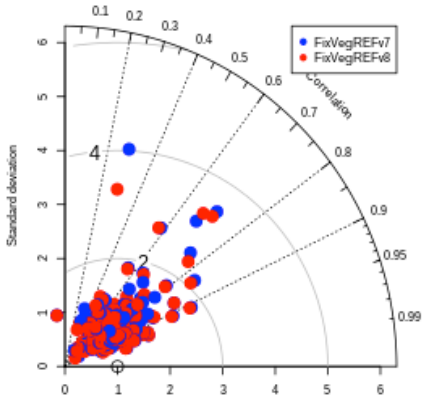
old

new

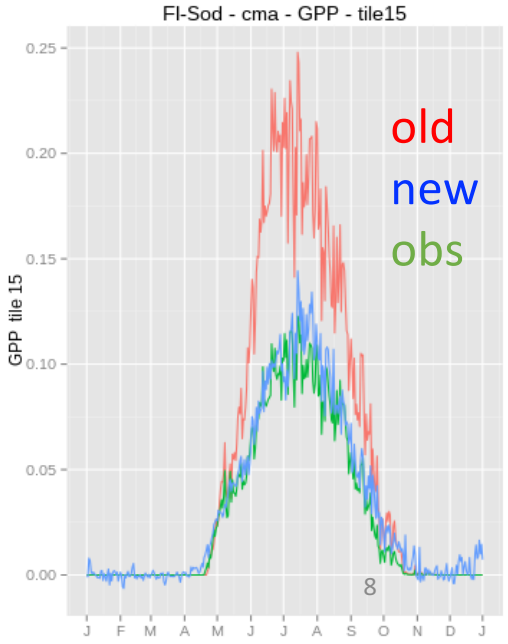
GPP



LE

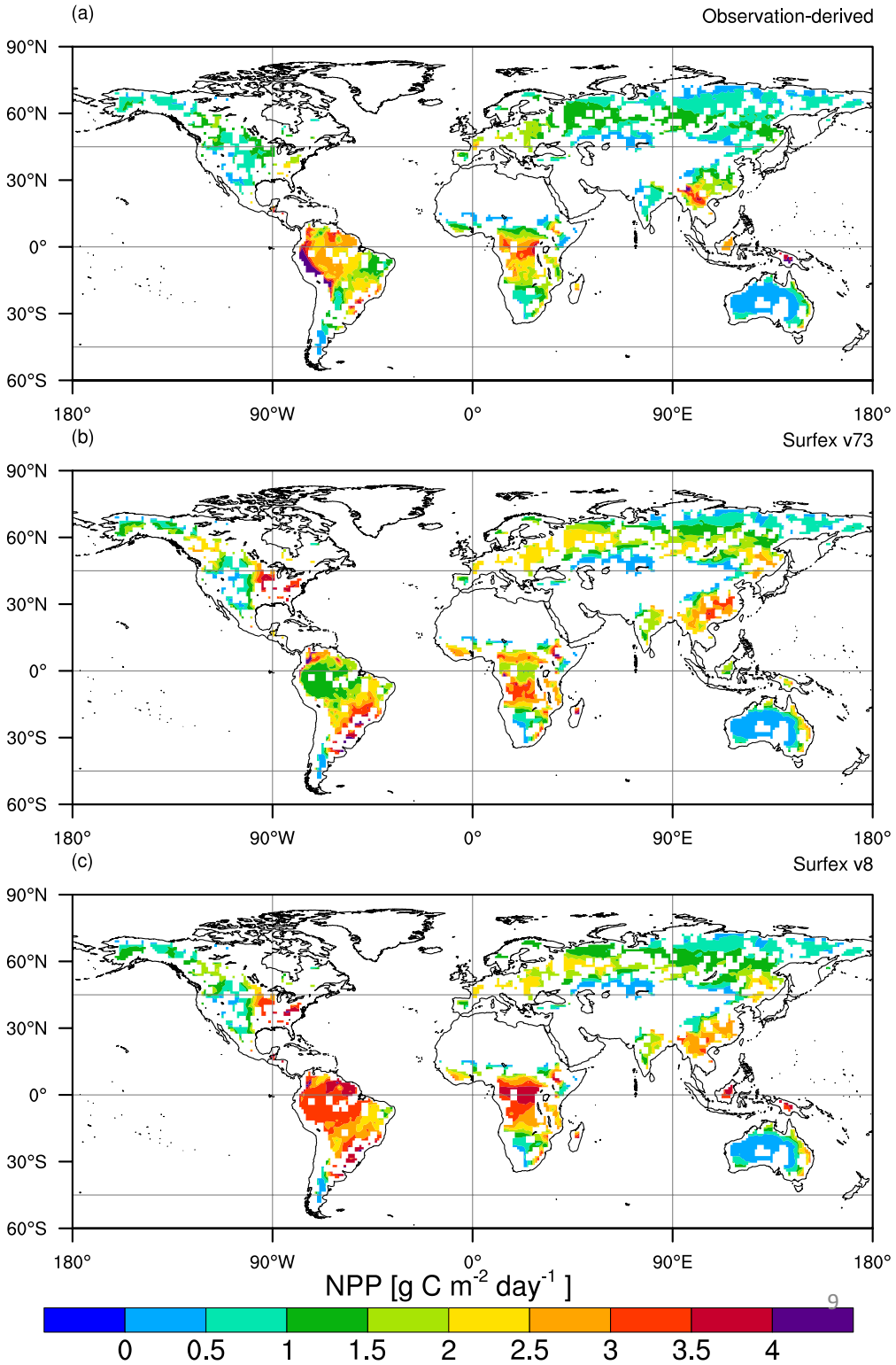


Coniferous



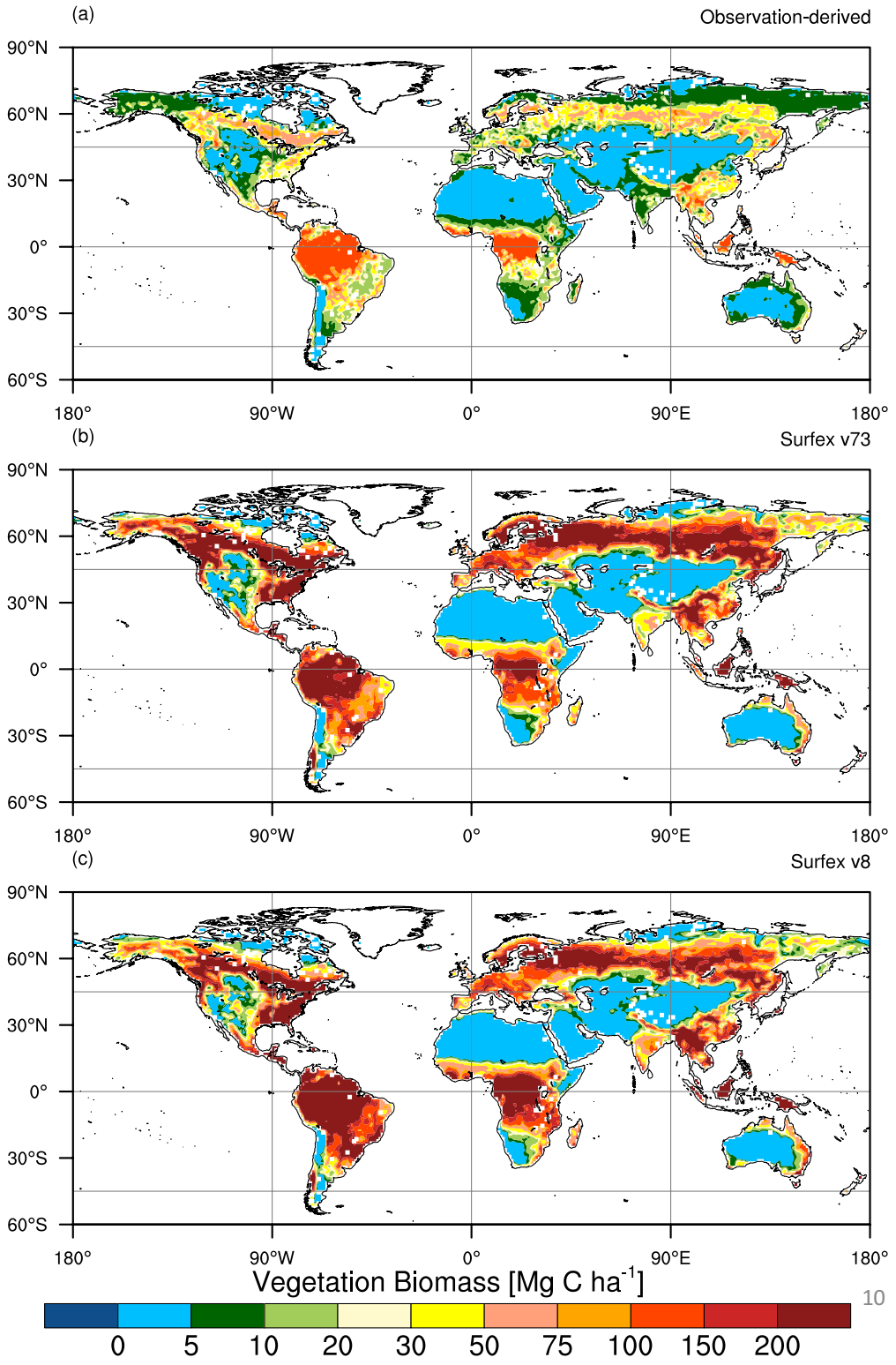
Net Primary Productivity

Running et al, 2003



Still work to do …

vegetation biomass



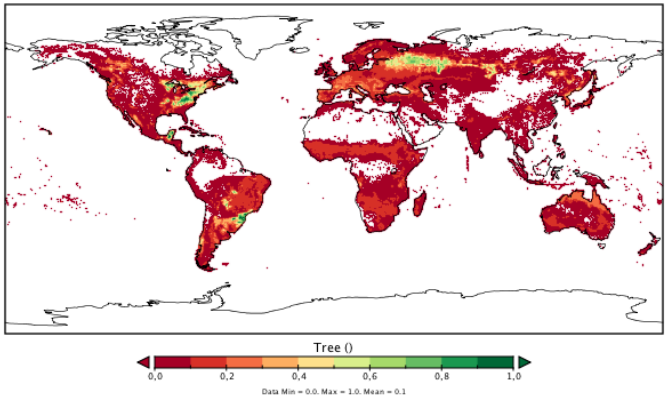
9 → 16 vegetation types *R. Alkama*

1. No
2. Rock
3. Permanent Snow/ice

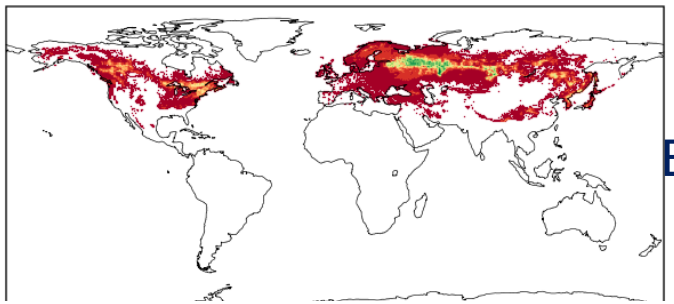
6. EVER -> TrBE Tropical Broadleaf Evergreen
7. C3 crop
8. C4 crop
9. C4 irrigated crop
11. TROG: Tropical grassland C4
12. PARK : Peat, Swamp, bog

4.TREE	16. BoBD : Boreal Broadleaf Deciduous trees
	4. TeBD : Temperate Broadleaf Deciduous trees
	13. TrBD : Tropical Broadleaf Deciduous
	14. TeBE : Temperate Broadleaf Evergreen trees
	19. SHRB : Shrub
5. CONI	5. BoNE Boreal Needleleaf Evergreen
	15. TeNE Temperate Needleleaf Evergreen
	17. BoND Boreal Needleleaf Deciduous
10 GRASS	10. C3 grassland
	18. Boreal grass

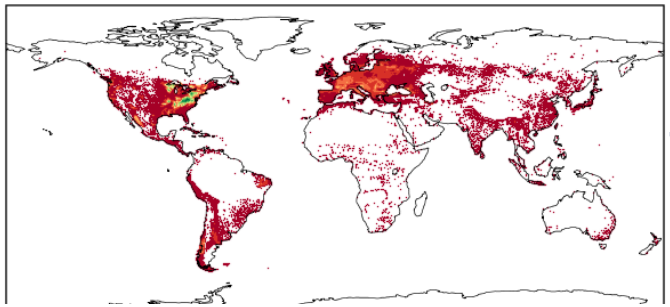
TREE



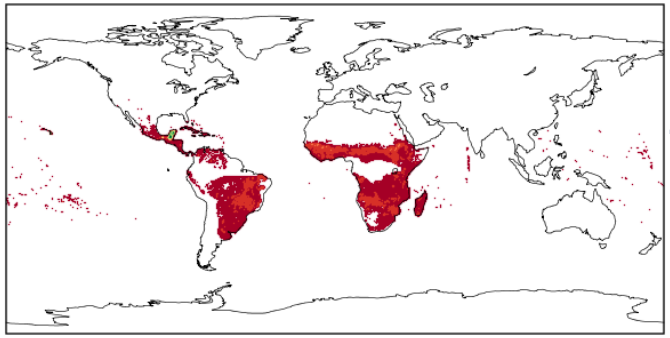
BoBD



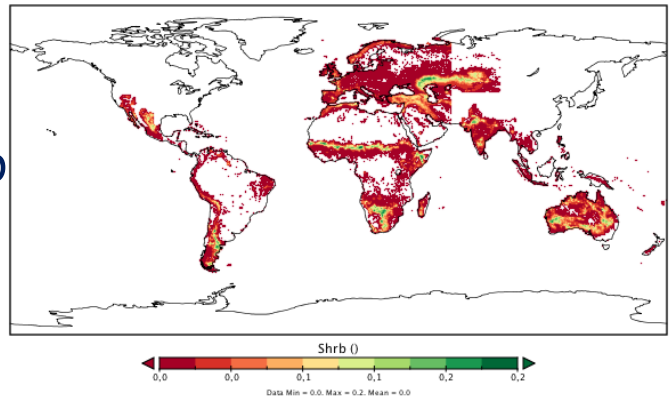
TeBD



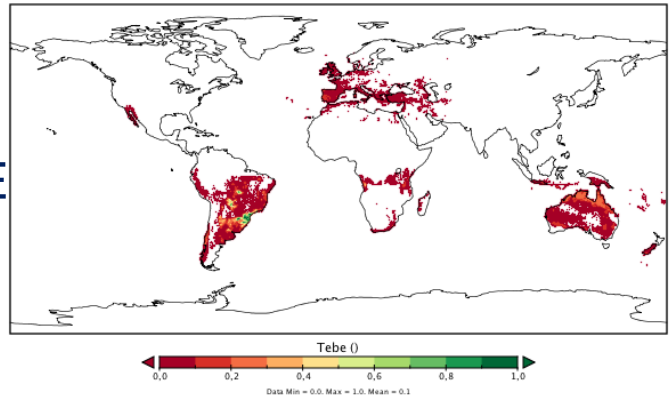
TrBD



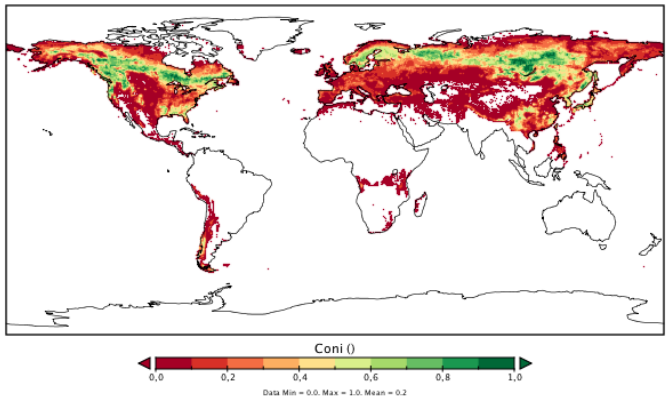
Shrub

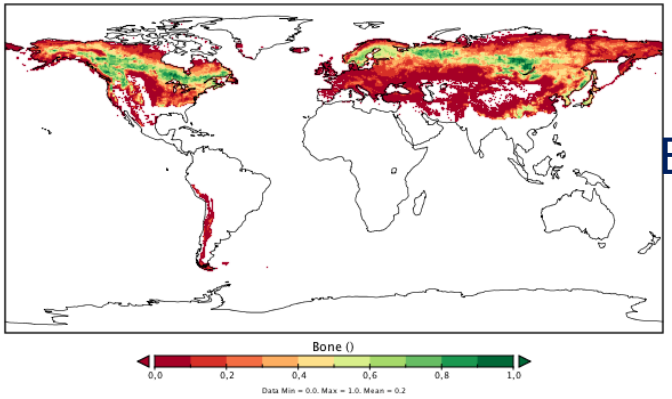


TeBE



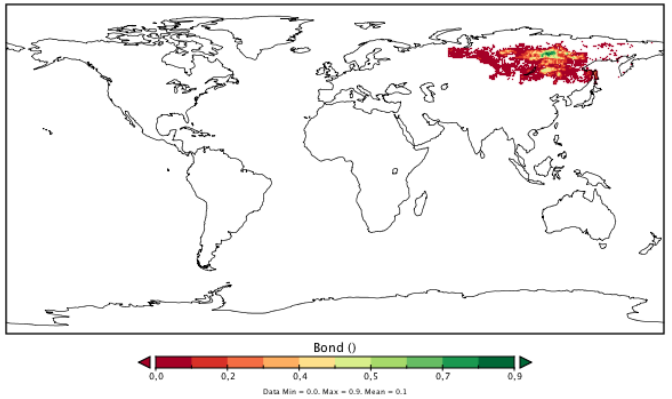
CONI

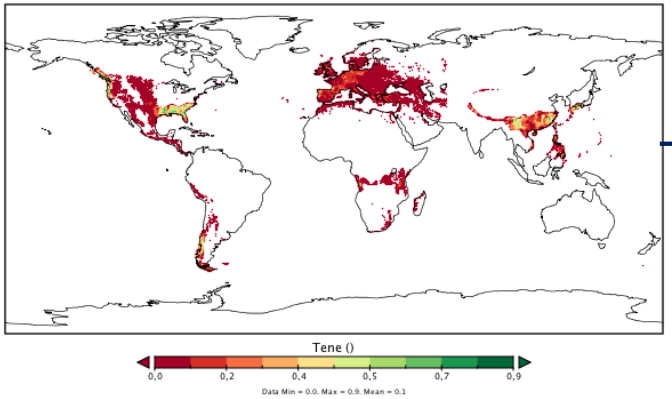




BoNE

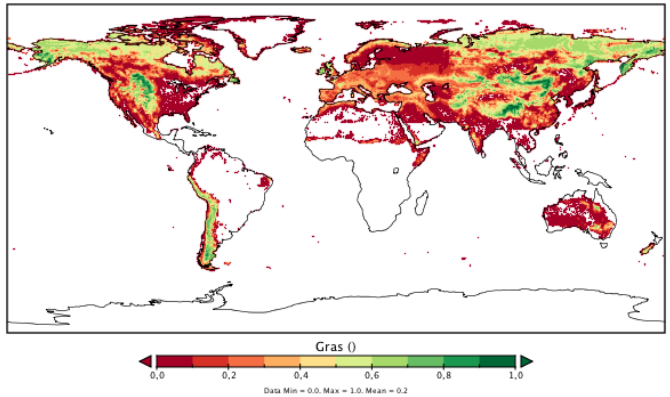
BoND



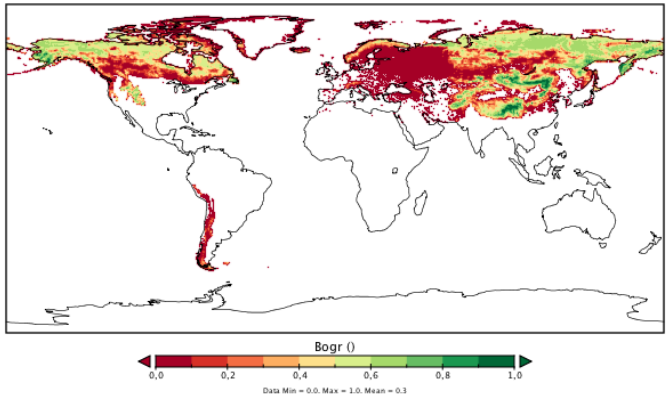


TeNE

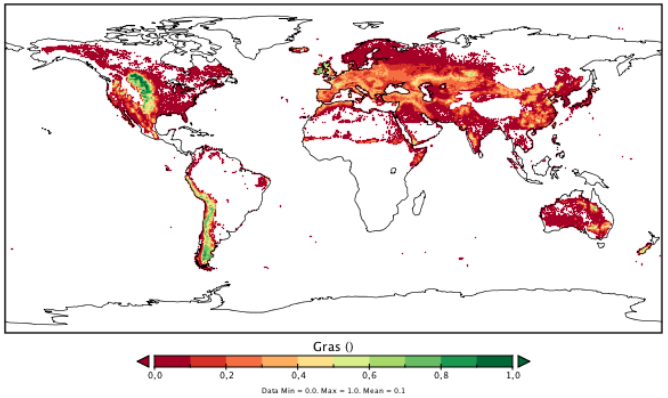
GRASS



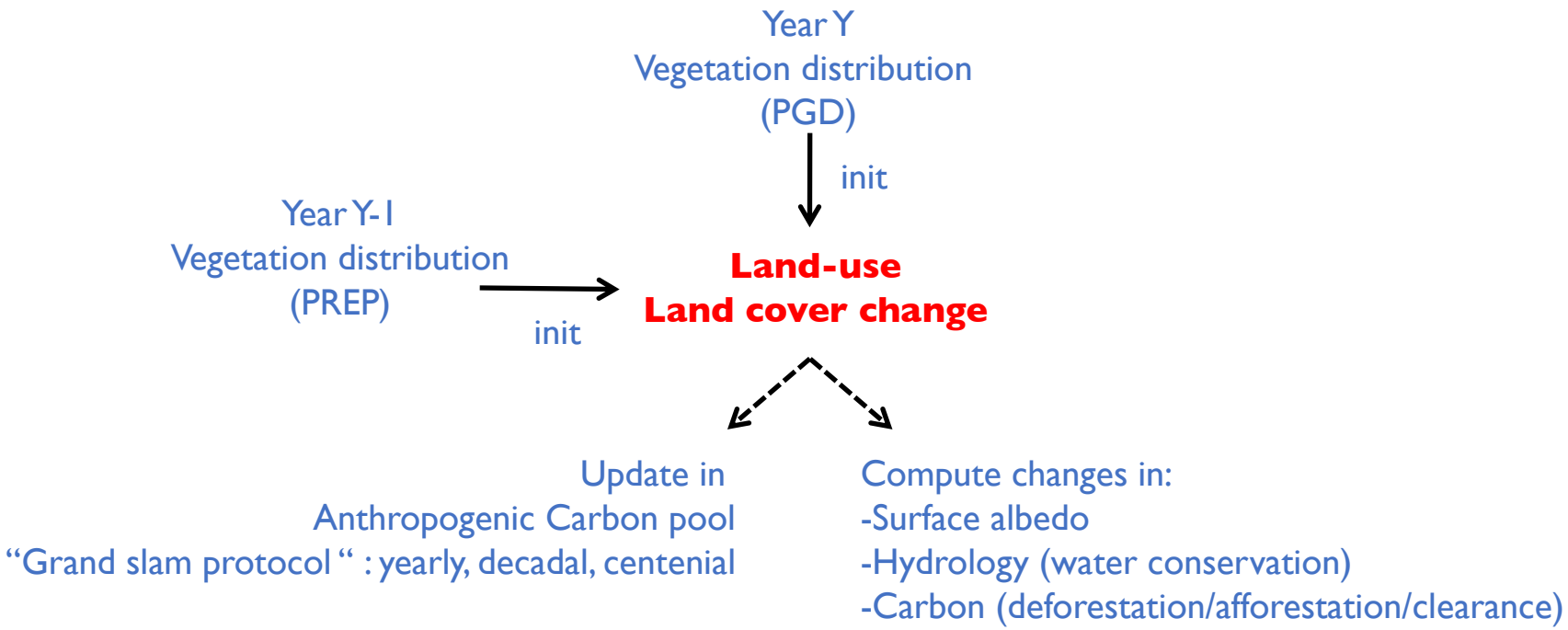
BoGR



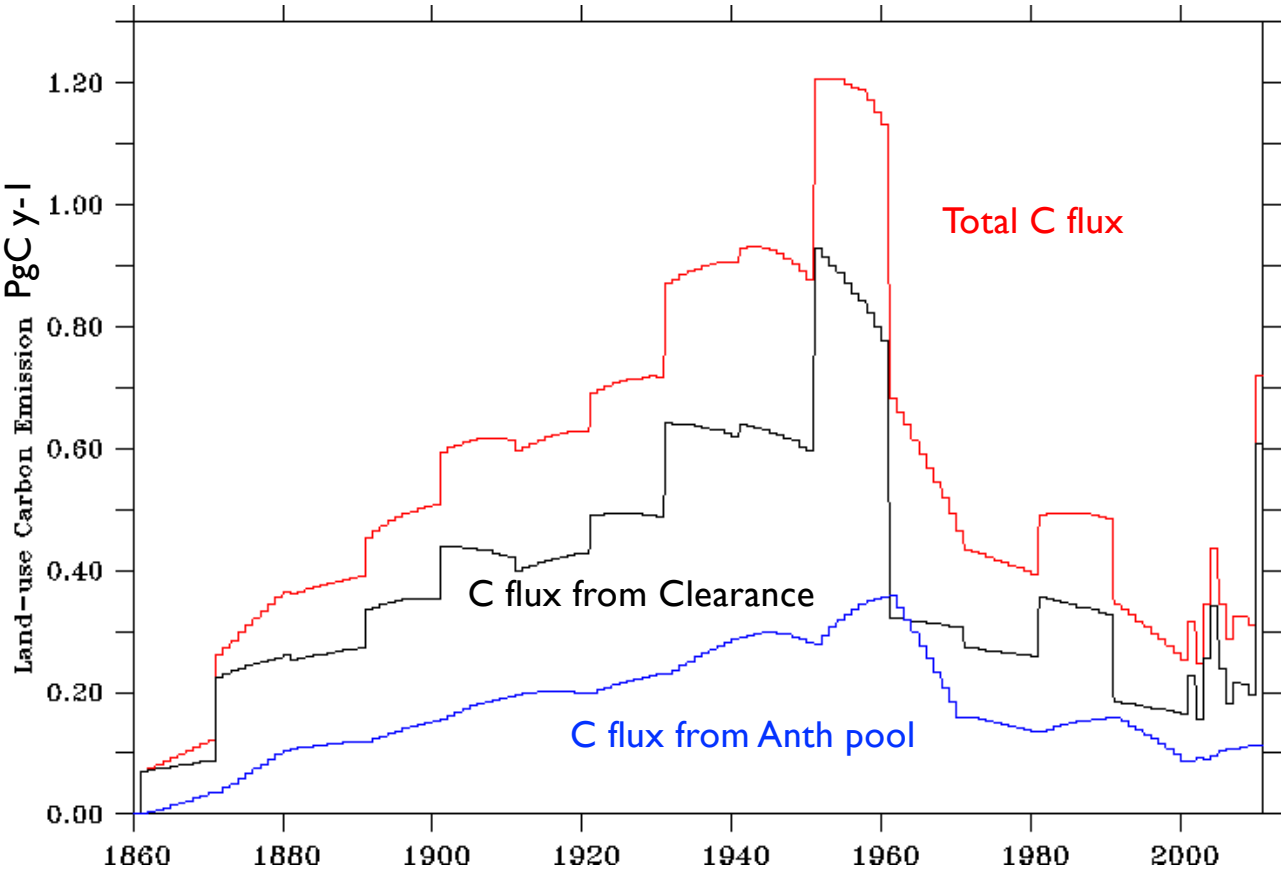
C3 Grass



Land-use module *(R. Séférian, initiated by R. Alkama, PhD M. Roche)*

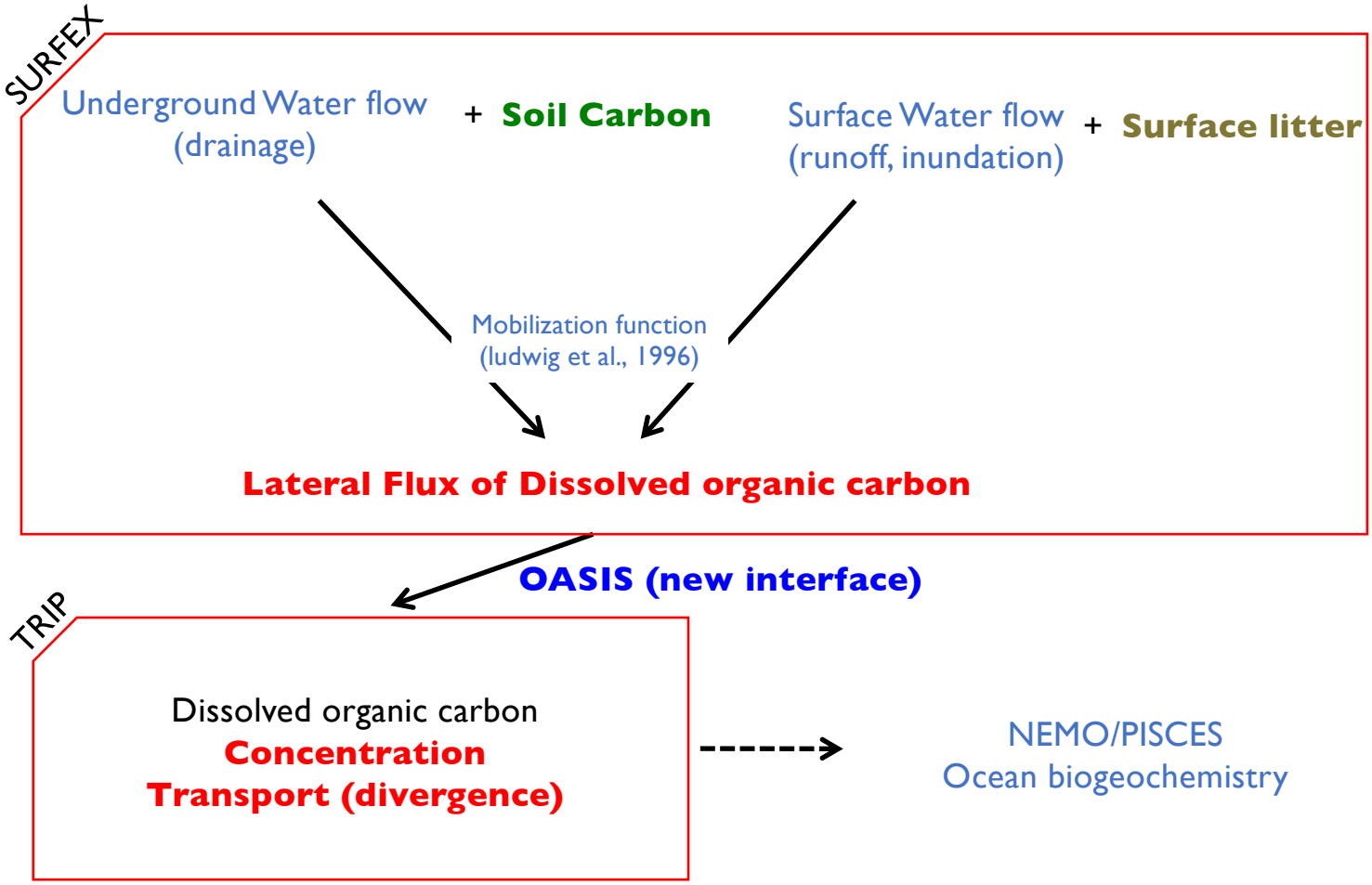


Some results:

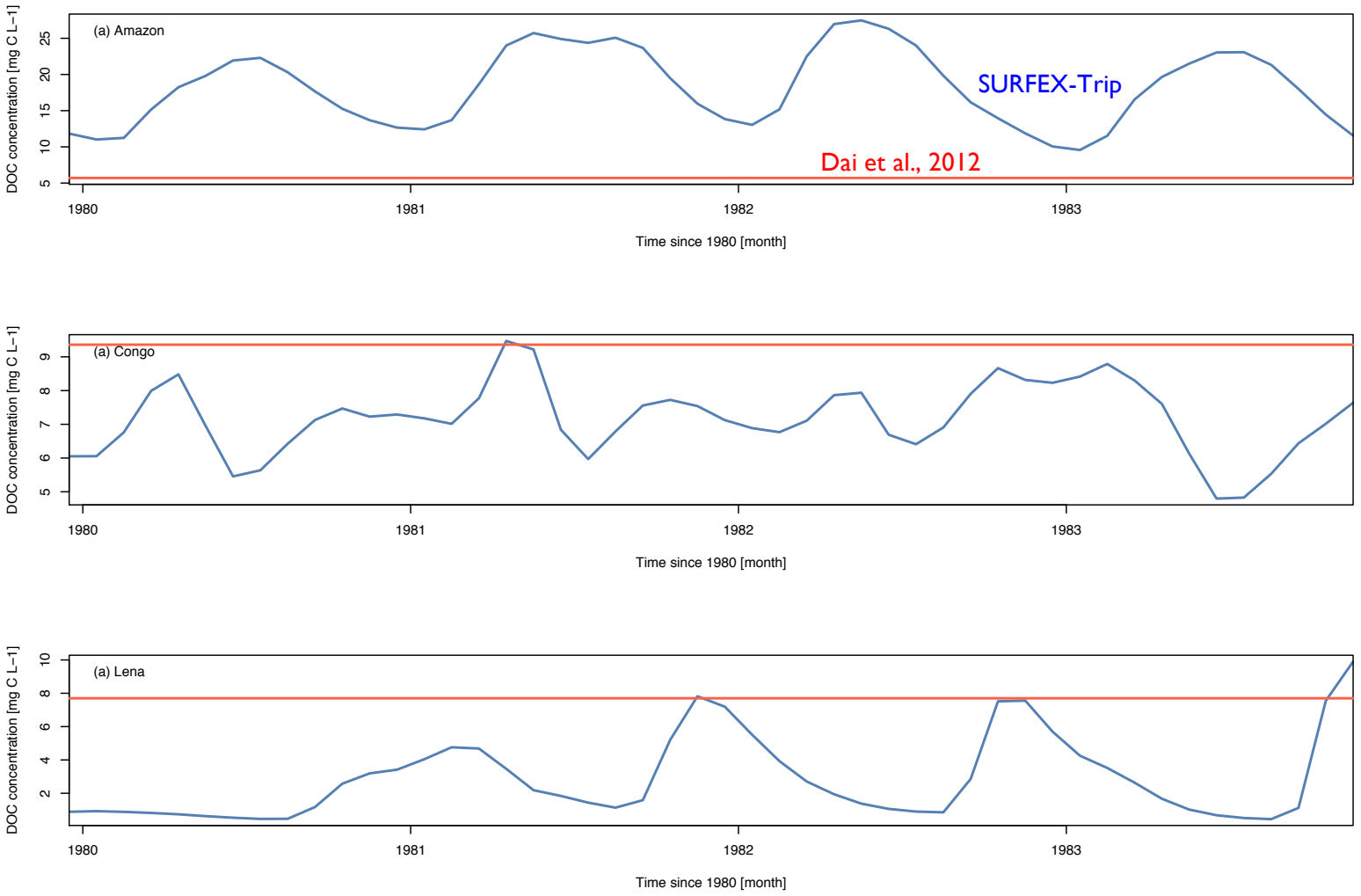


Global estimates: 1.0±0.5 PgC y-1 (Book-keeping/DGVMs, Le Quéré et al., 2015)

Carbon-leaching module *(R. Séférian, F. Guérin, B. Decharme)*

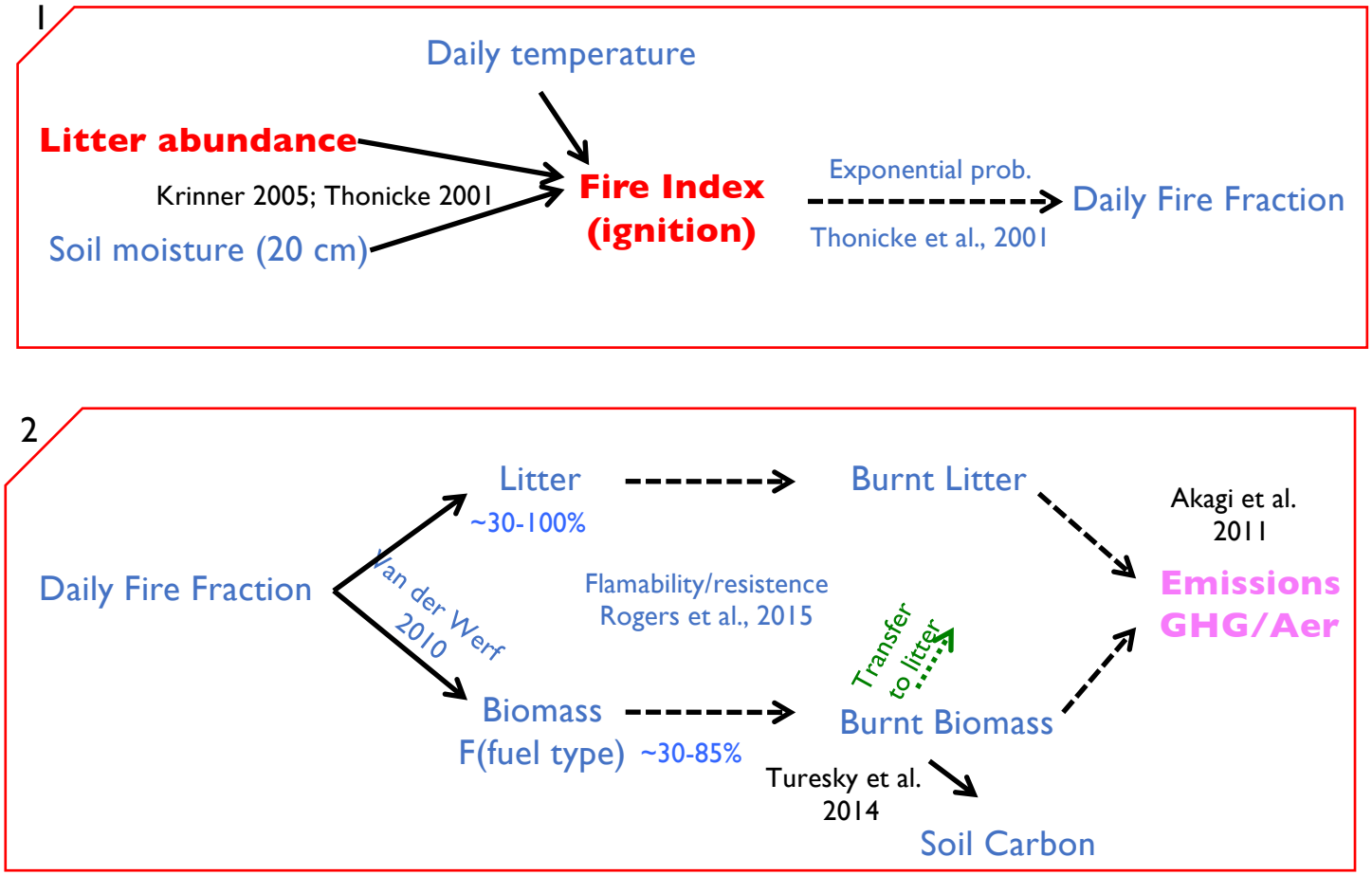


Some results: DOC export to the ocean



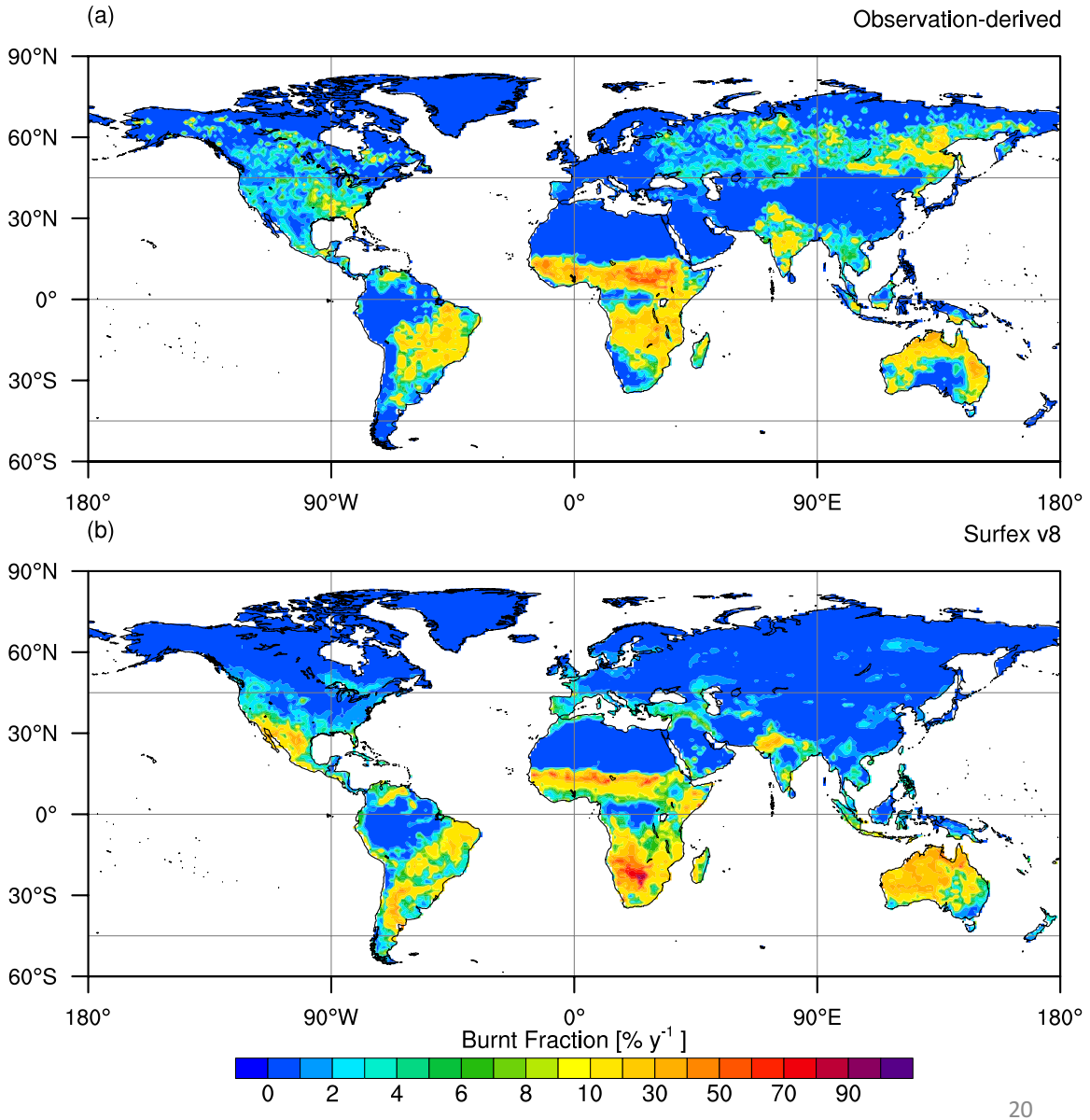
Fire module

R. Séférian & Internship C Porchier & S Jalladeau (2015)



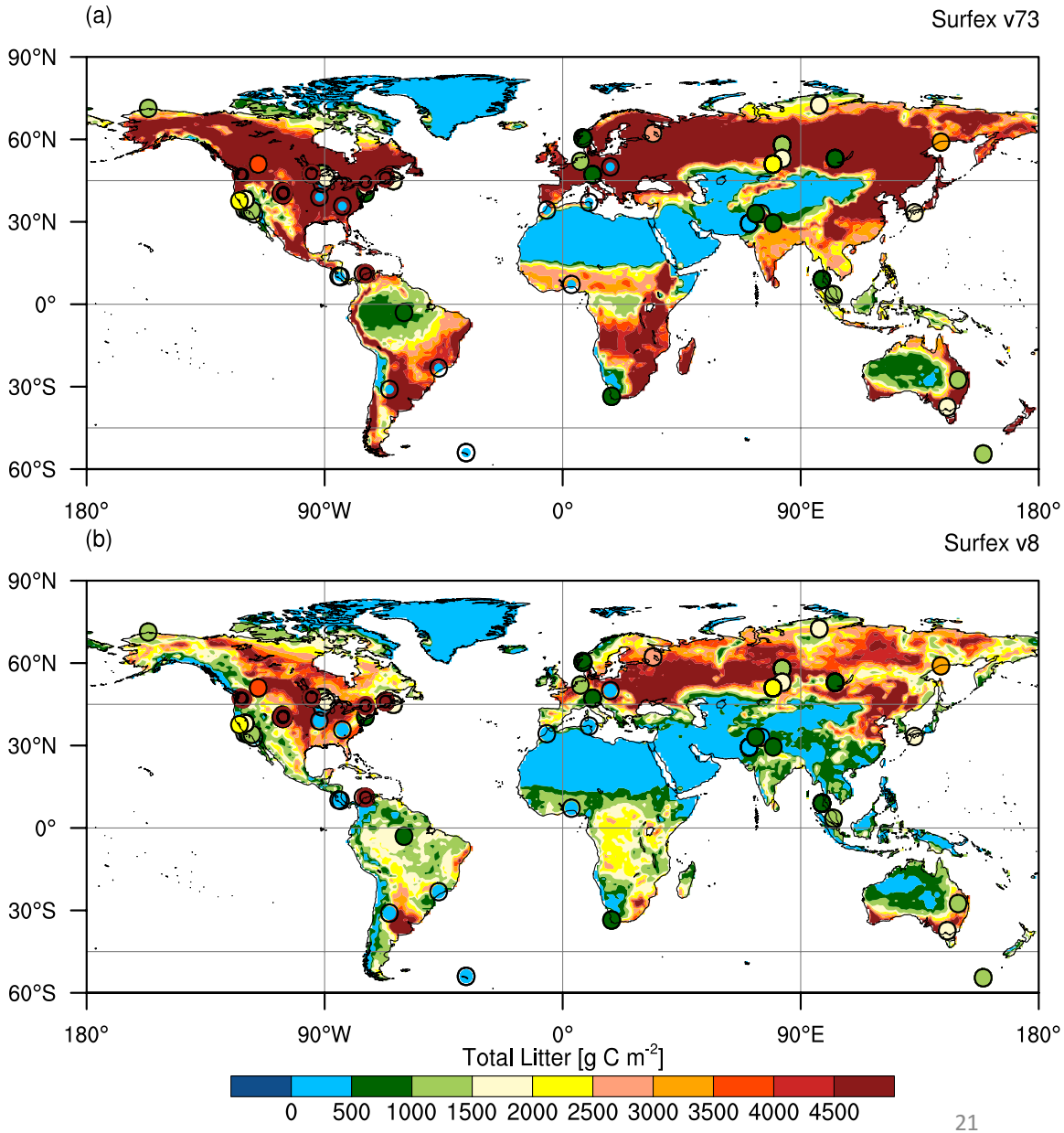
Burnt fraction

Mouillot et al, 2005

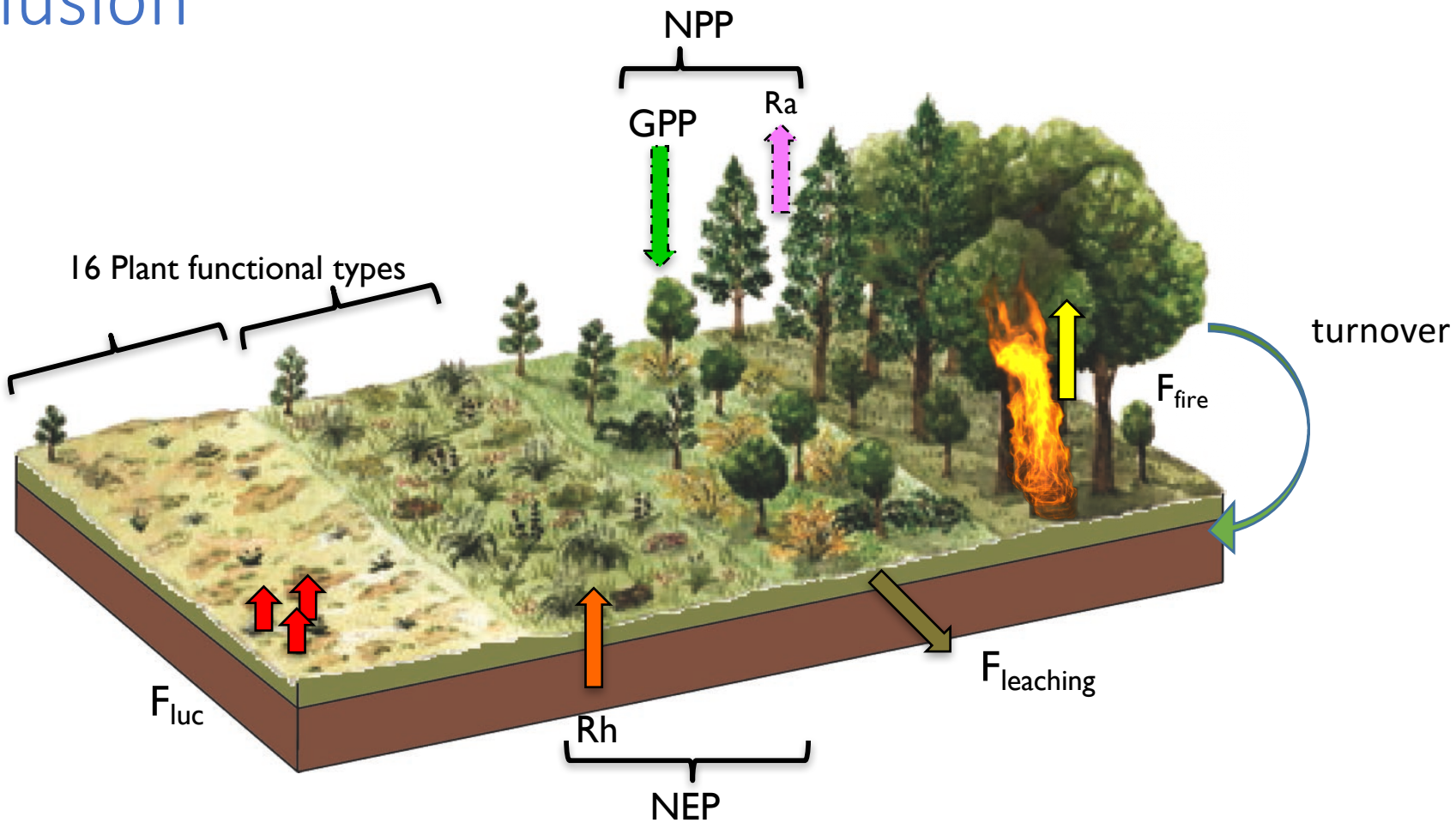


Litter

Holland et al, 2014



Conclusion



Future work :

- Test sensitivity to CO2 increase (FACE experiments)
- Coupling with MEB