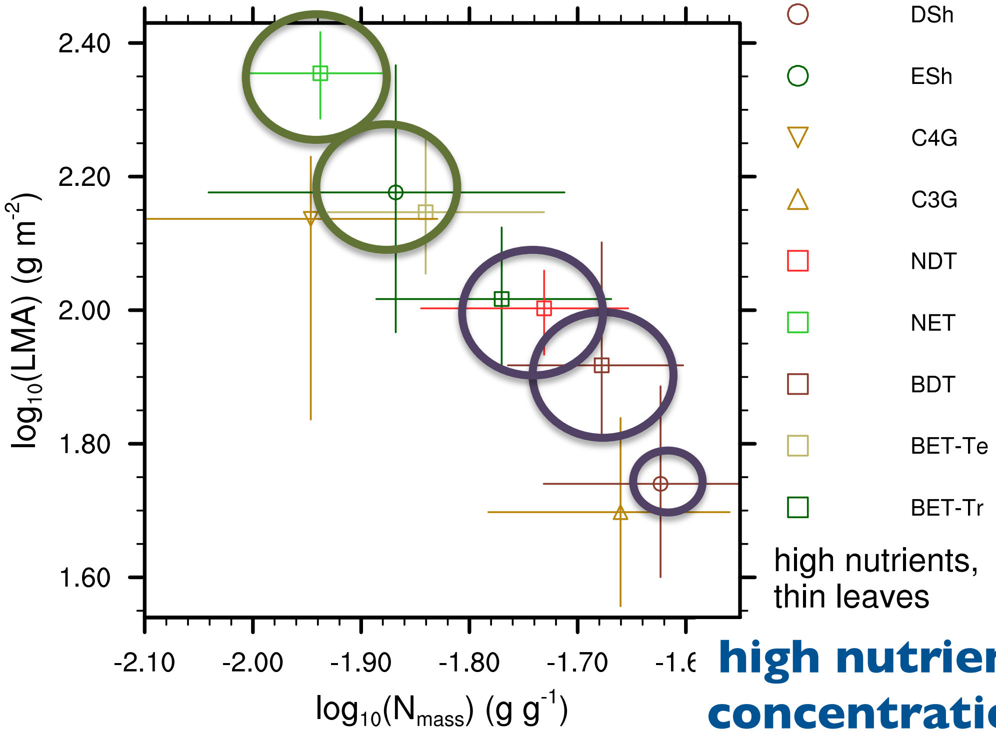
Motivation for trait-based physiology

low nutrient concentration thick leaves

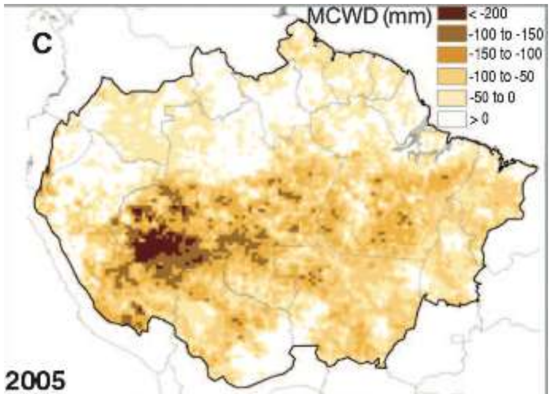


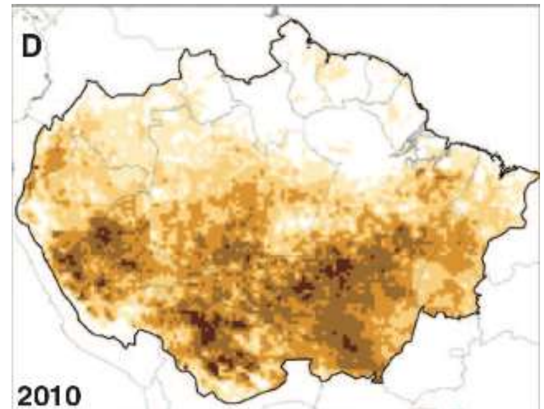
high nutrient concentration thin leaves

TRY database: Kattge et al. 2011

- Deciduous and evergreen plants invest nutrients differently in their leaves.
- Huge amount of new data. The new parameters are based on 6169 species-specific observations of leaf N, 5920 of leaf thickness, 1757 of V_{cmax}

Application: 2010 Amazon drought

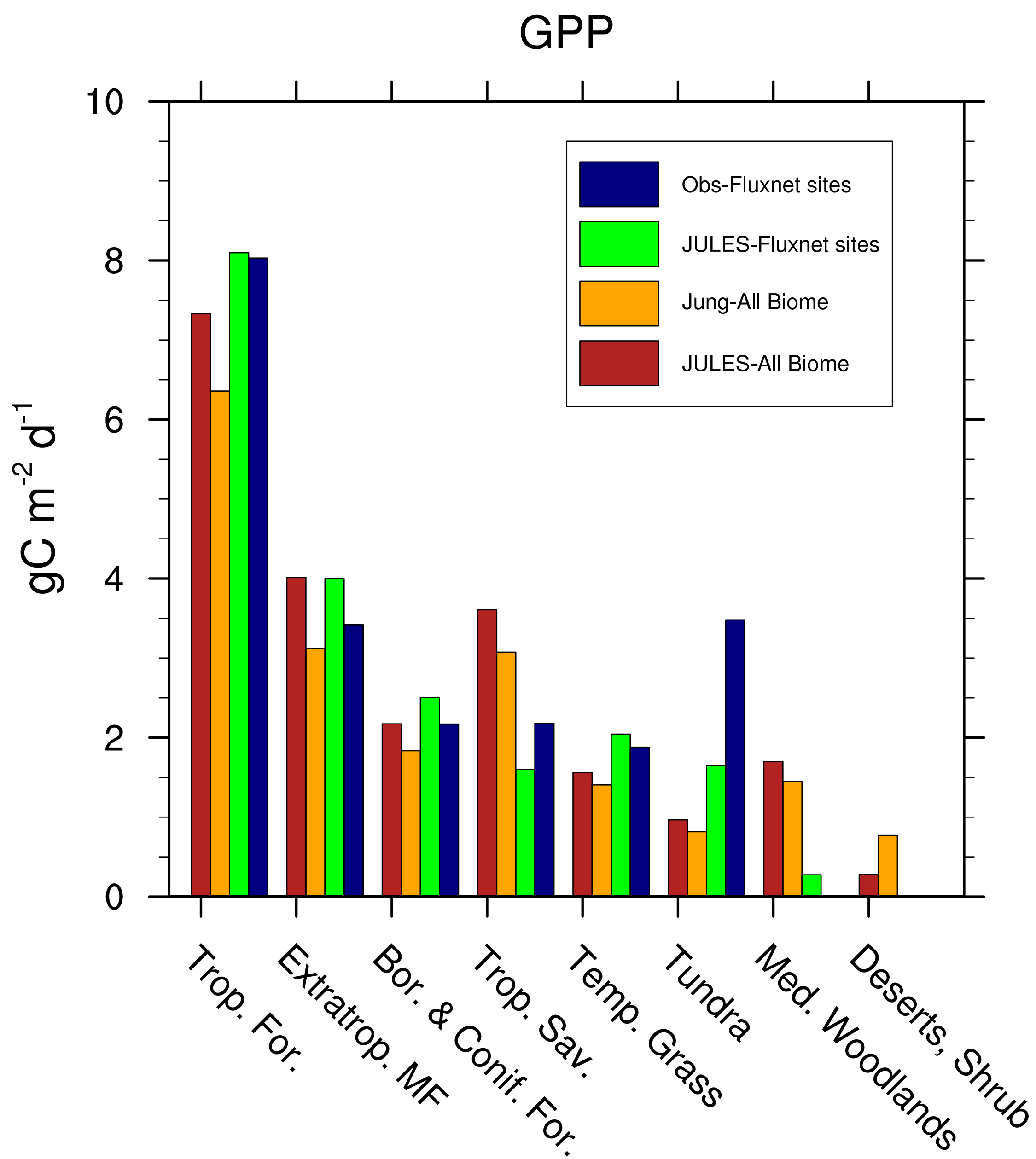




2.5 million km^2 affected
1.6 PgC lost
1-in-100 year event

3.2 million km^2 affected
2.2 PgC lost
1-in-100+ year event

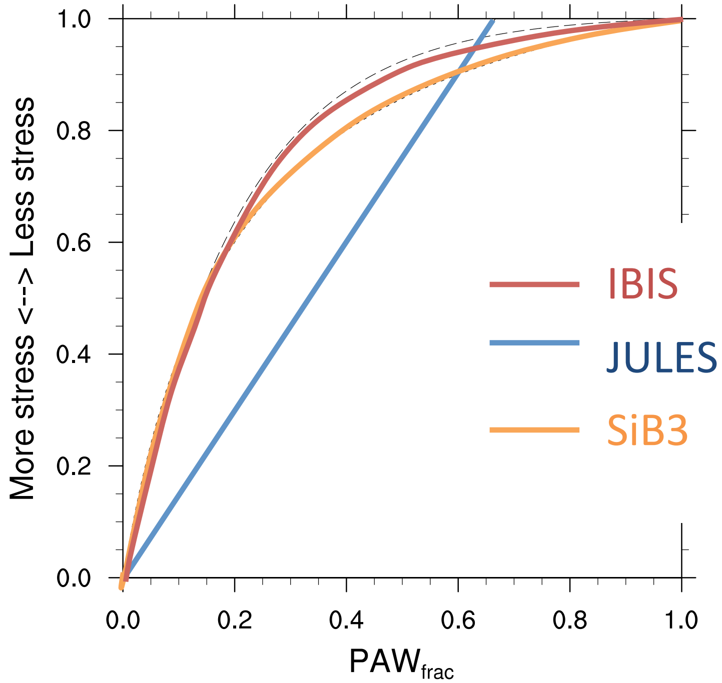
Lewis et al. 2011



GPP
gC m^{-2} d^{-1}
0
2
4
6
8
10
Obs-Fluxnet sites
JULES-Fluxnet sites
Jung-All Biome
JULES-All Biome
Trop. For.
Extratrop. MF
Bor. & Conif. For.
Trop. Sav.
Temp. Grass
Tundra
Med. Woodlands
Deserts, Shrub

Soil moisture stress & roots

- Use plant available water (in kg m^{-2}) instead of volumetric water content for calculating fsmc.
- Root depths from Zeng 2001
- Assume efficient tap roots can access lots of soil moisture despite low density (as long as water content is above the wilt pt):
    - Remove root-weighting of fsmc,
    - Remove the fsmc-weighting of water extraction



First observations of global and seasonal terrestrial chlorophyll fluorescence from space

J. Joiner[1], Y. Yoshida[2], A. P. Vasilkov[2], Y. Yoshida[3], L. A. Corp[4], and E. M. Middleton[1]

New global observations of the terrestrial carbon cycle from GOSAT: Patterns of plant fluorescence with gross primary productivity

Christian Frankenberg,[1] Joshua B. Fisher,[1] John Worden,[1] Grayson Badgley,[1] Sassan S. Saatchi,[1] Jung-Eun Lee,[1] Geoffrey C. Toon,[1] André Butz,[2] Martin Jung,[3] Akihiko Kuze,[4] and Tatsuya Yokota[5]

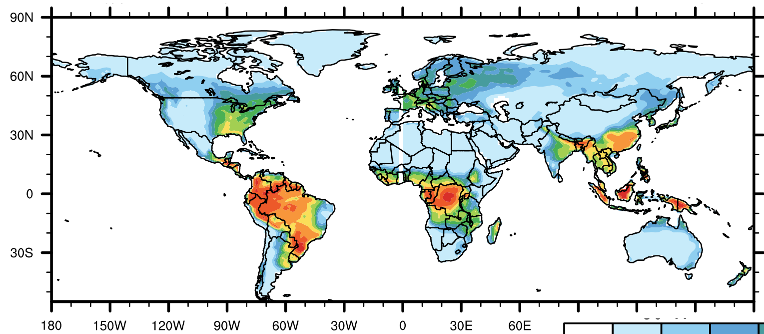
Interpreting seasonal changes in the carbon balance of southern Amazonia using measurements of XCO_2 and chlorophyll fluorescence from GOSAT

Nicholas C. Parazoo,[1,2] Kevin Bowman,[1,2] Christian Frankenberg,[1] Jung-Eun Lee,[1] Joshua B. Fisher,[1] John Worden,[1] Dylan B. A. Jones,[2,3] Joseph Berry,[4] G. James Collatz,[5] Ian T. Baker,[6] Martin Jung,[7] Junjie Liu,[1] Gregory Osterman,[1] Chris O'Dell,[6] Athena Sparks,[1] Andre Butz,[8] Sandrine Guerlet,[9] Yukio Yoshida,[10] Huilin Chen,[11,12] and Christoph Gerbig[7]

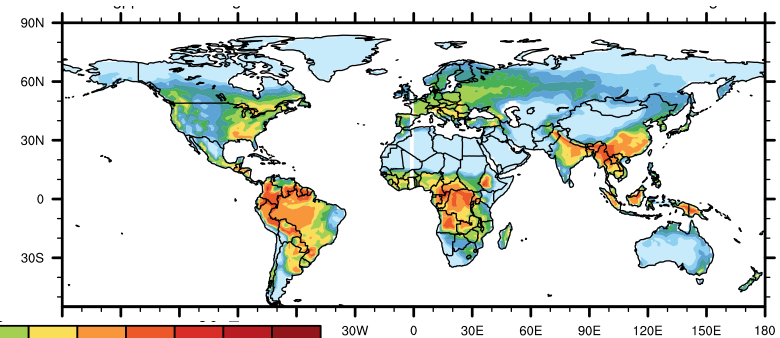
Terrestrial Gross Primary Production Inferred From Satellite Fluorescence and Vegetation Models, Parazoo et al. 2014, GCB

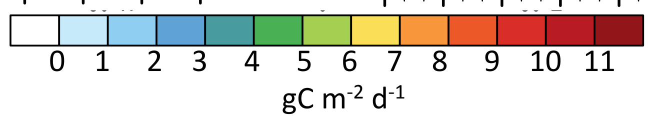
Global: Prescribed vegetation cover

JULES3.2 Old PFTs GPP, 1982-2012
Global = 131 GtC/yr

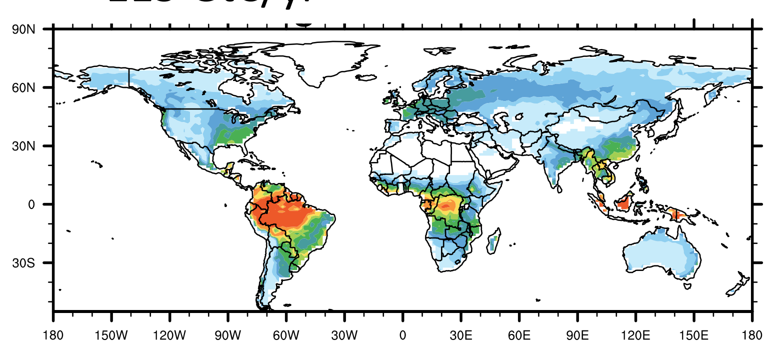


JULES3.2 New PFTs GPP, 1982-2012
Global = 165 GtC/yr



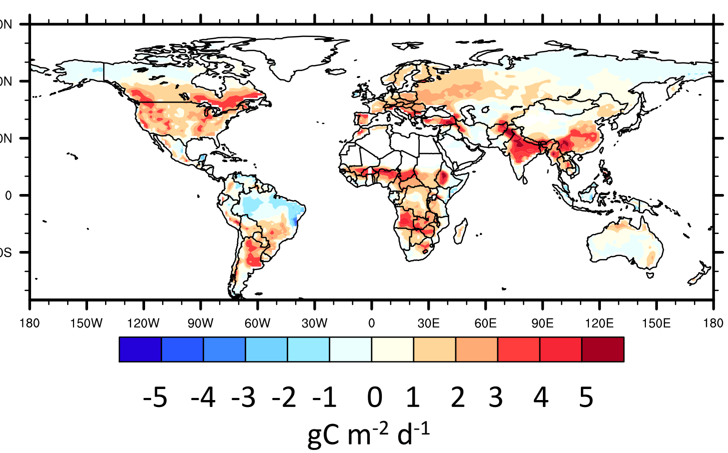


MTE GPP*, 1982-2012 Global = 115 GtC/yr



*Jung *et* al. 2011, *JGR*

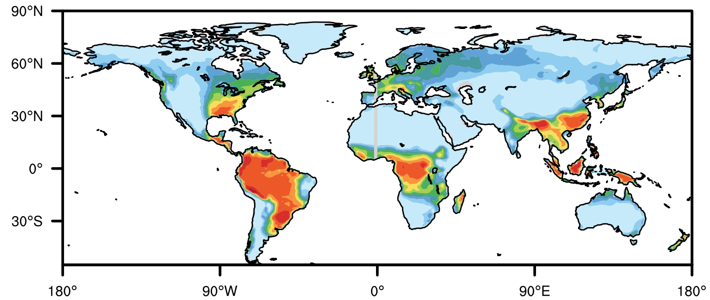
New PFTs - MTE GPP, 1982-2012



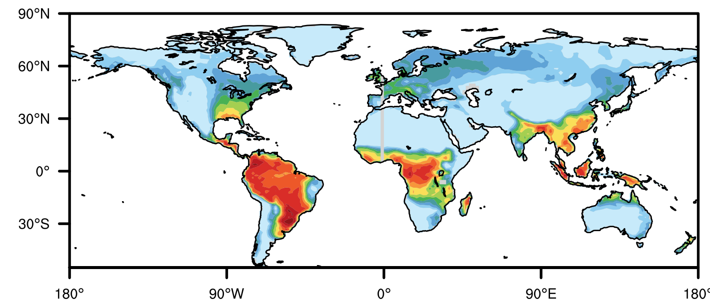
GPP & NPP

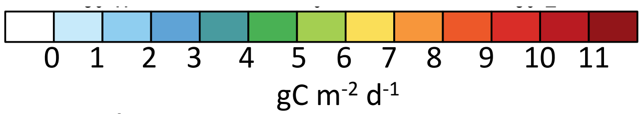
- Global NPP is closer to what we expect from observational constraints (50-60 GtC)
- NPP =64 GtC (Old PFTs)
- NPP= 52 GtC (New PFTs)
- But low carbon use efficiency (NPP/GPP) → R_{auto} is high.

JULES3.2 New PFTs GPP, 1982-2012 Global = 142 GtC/yr

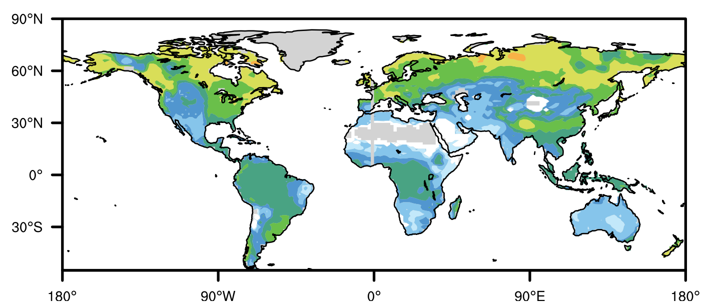


JULES3.2 GPP, 1982-2012 Global = 148 GtC/yr





JULES3.2 New PFTs NPP/GPP, 1980-2012 Global = 0.36



JULES3.2 Old PFTs NPP/GPP, 1980-2012 Global = 0.43