Universidad de Alcalá

Generation of al global fuel dataset using the Fuel Characteristic Classification System

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E. Chuvieco

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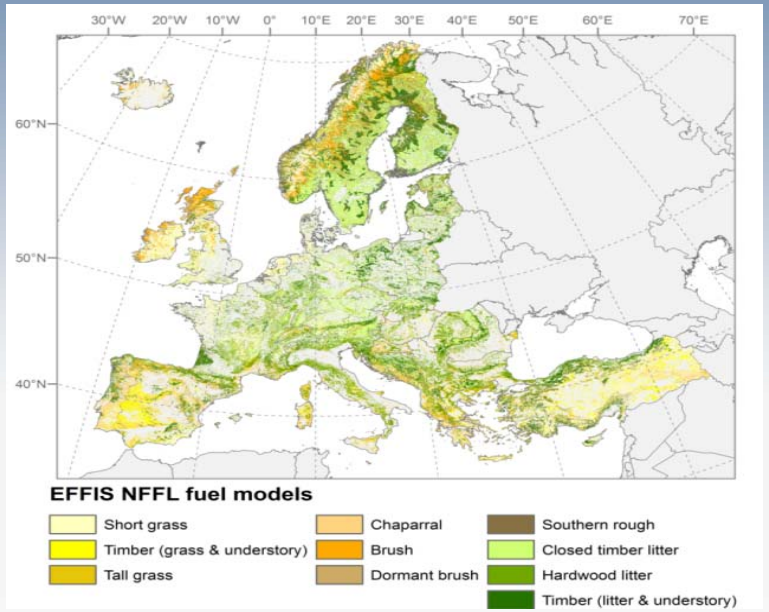
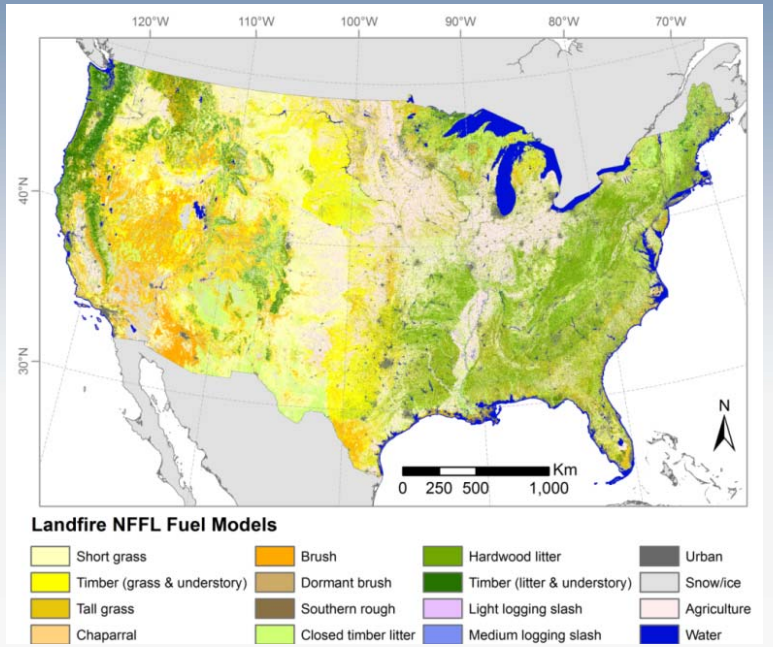
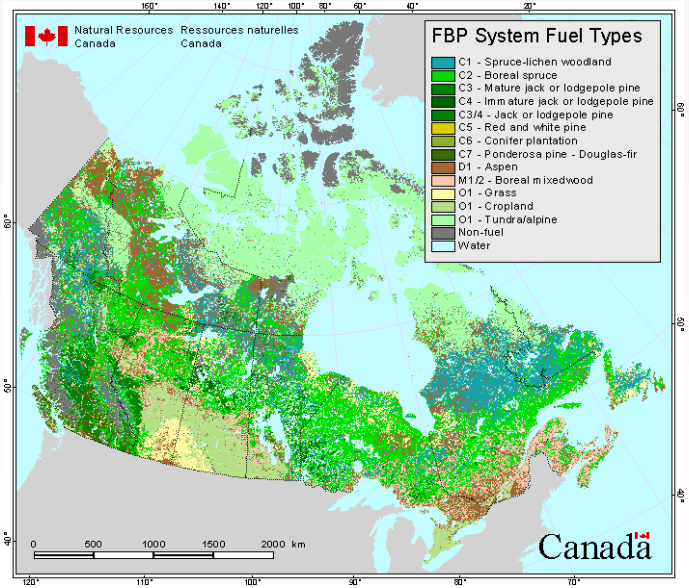
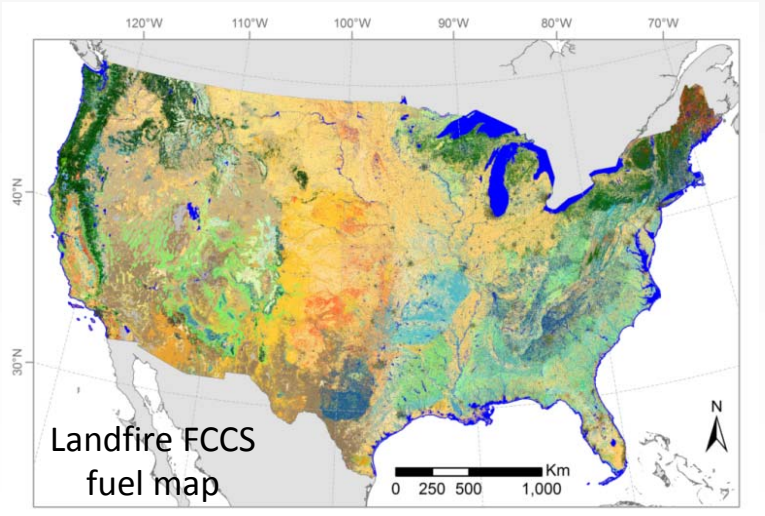
Regional Fuel Type Maps









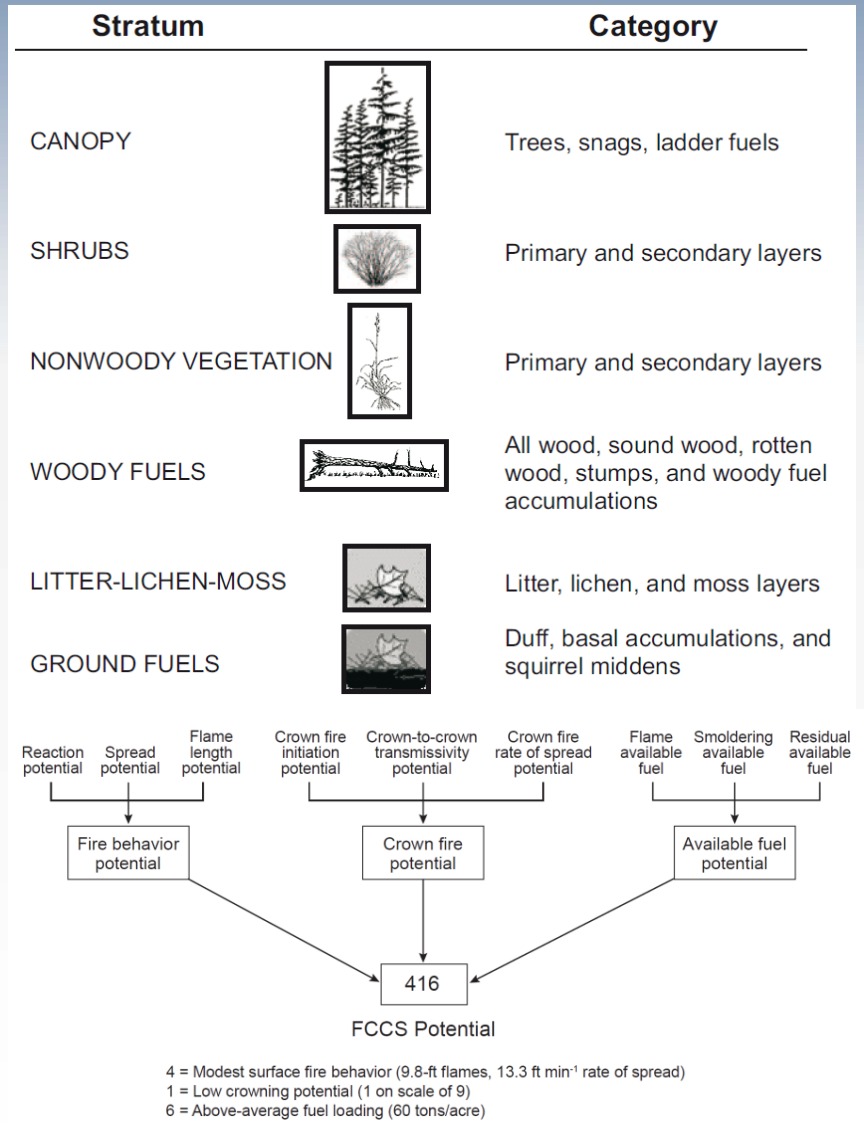
Objective: Develop a global fuel type map that could be used for fire danger and effects assessment.

- Use a uniform methodology worldwide
- Use as many global information as possible
- Include parameters for fire behavior and effects estimation

Fuel types classifications

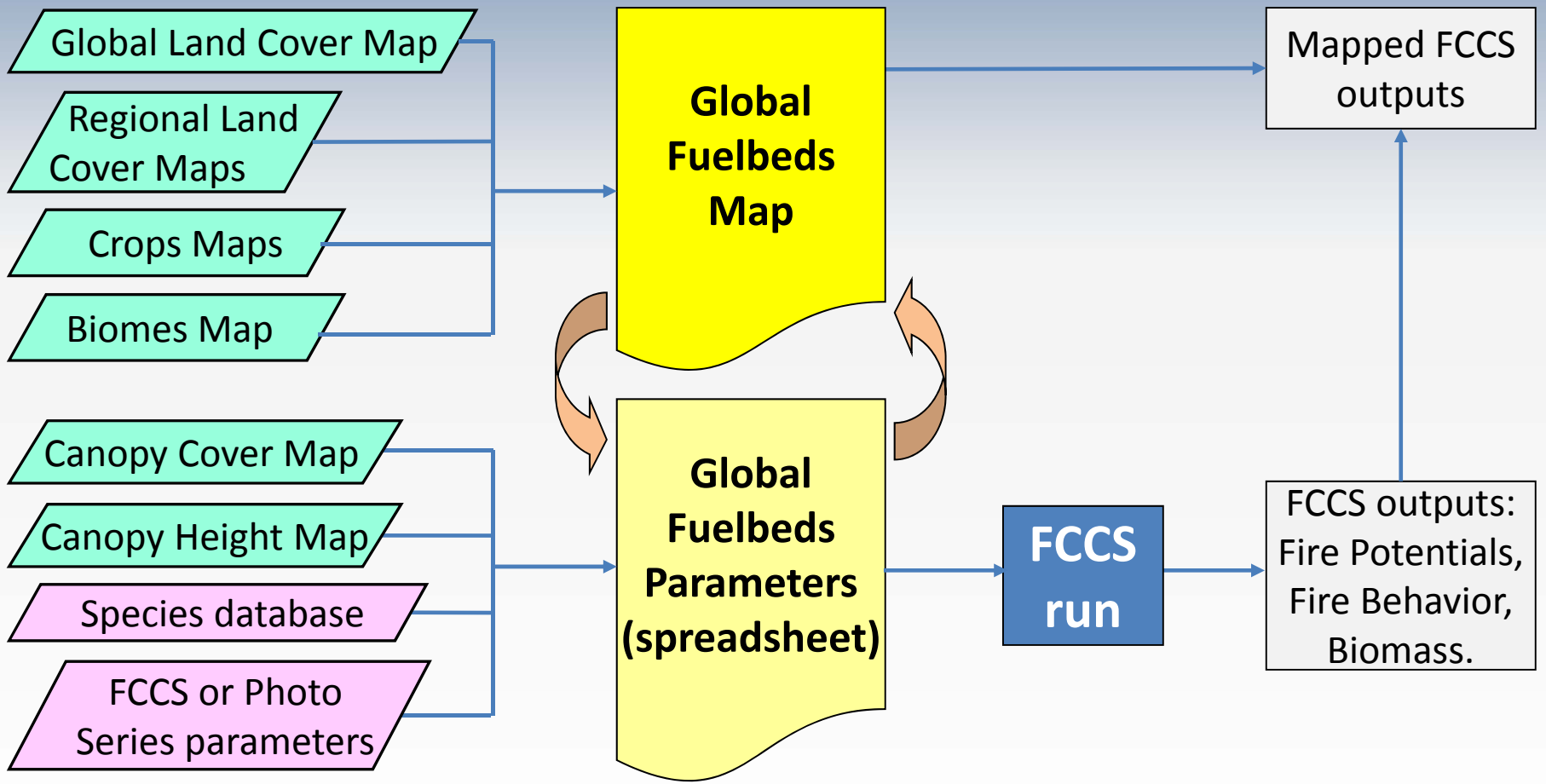
Classification	Fire Behavior	Fire Risk	Fire Effects
NFFL	X		
NFDRS		X	
Scott & Burgan	X		
FBP		X	
Prometheus		X	
FCCS	X	X	X

Fuel Characteristic Classification System (FCCS)

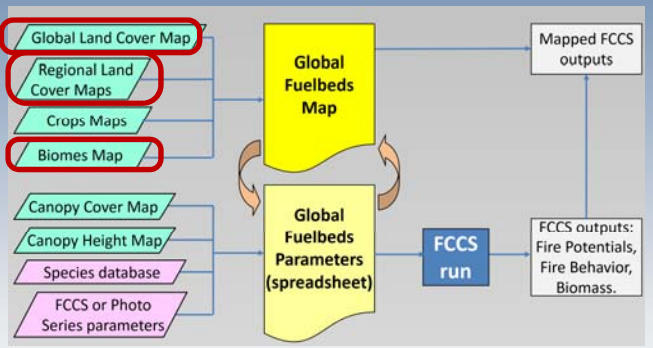


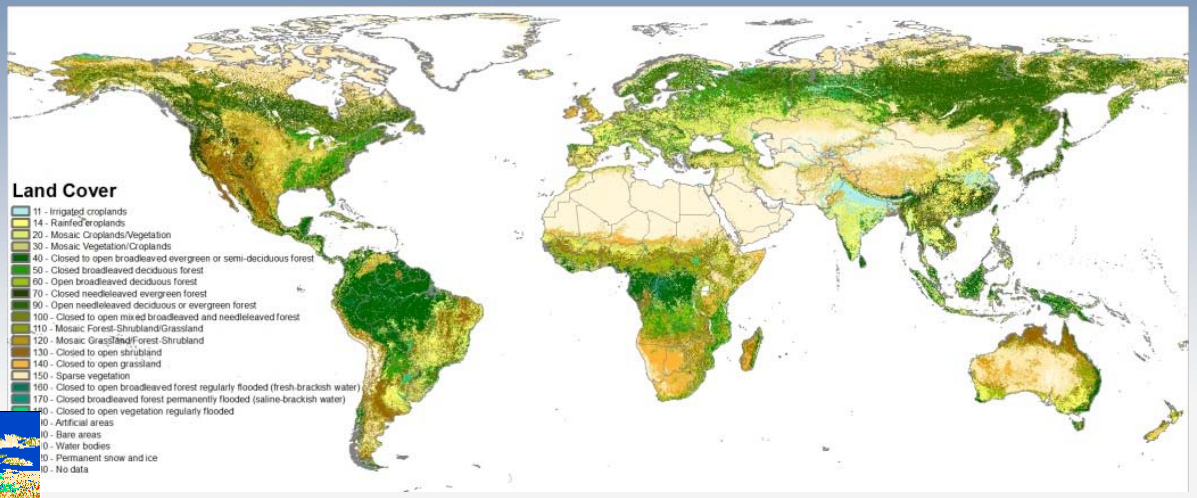
- As many classes as desired
- Parameters not only for fire behavior but also for fire potential and effects
- Software that calculates fire behavior and potentials

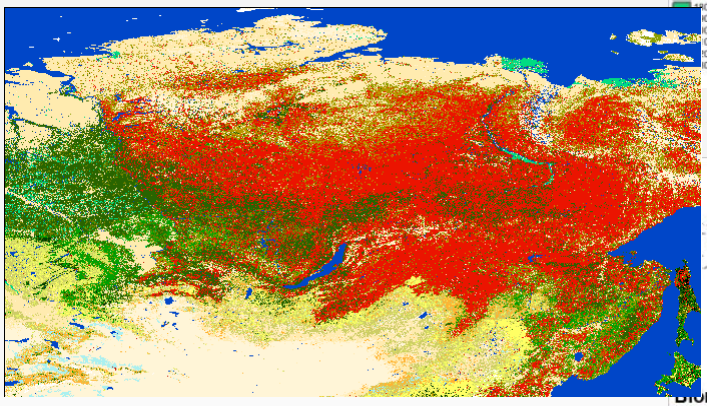
Methodology



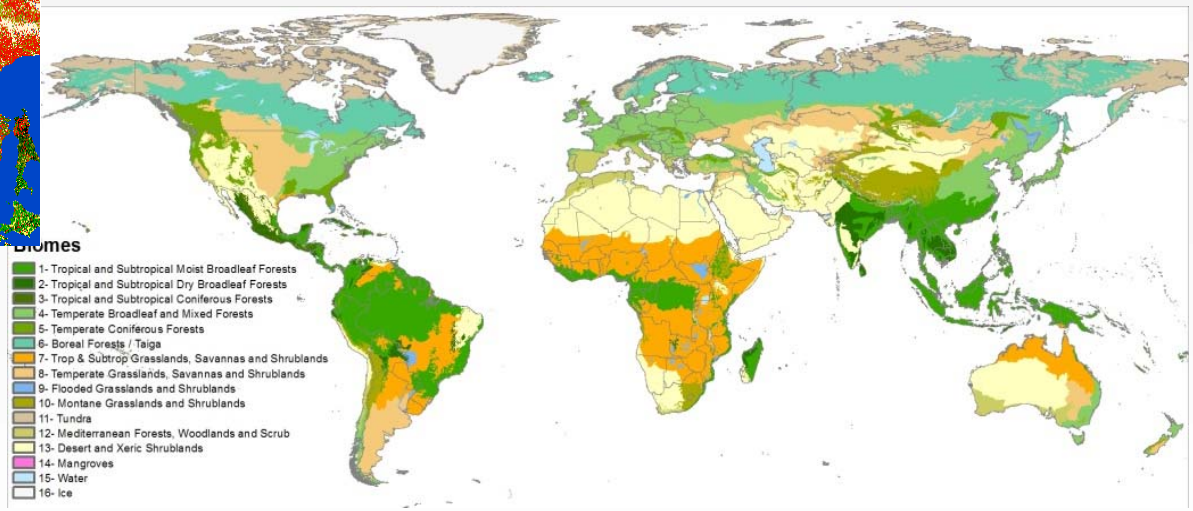
Generation of the fuelbeds





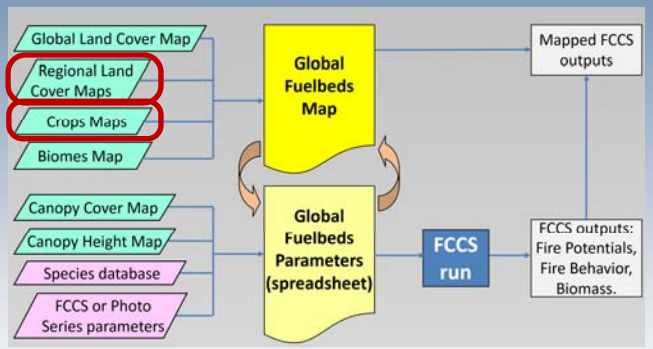


Globcover 2005 V2.2 (Arino et al. 2007)

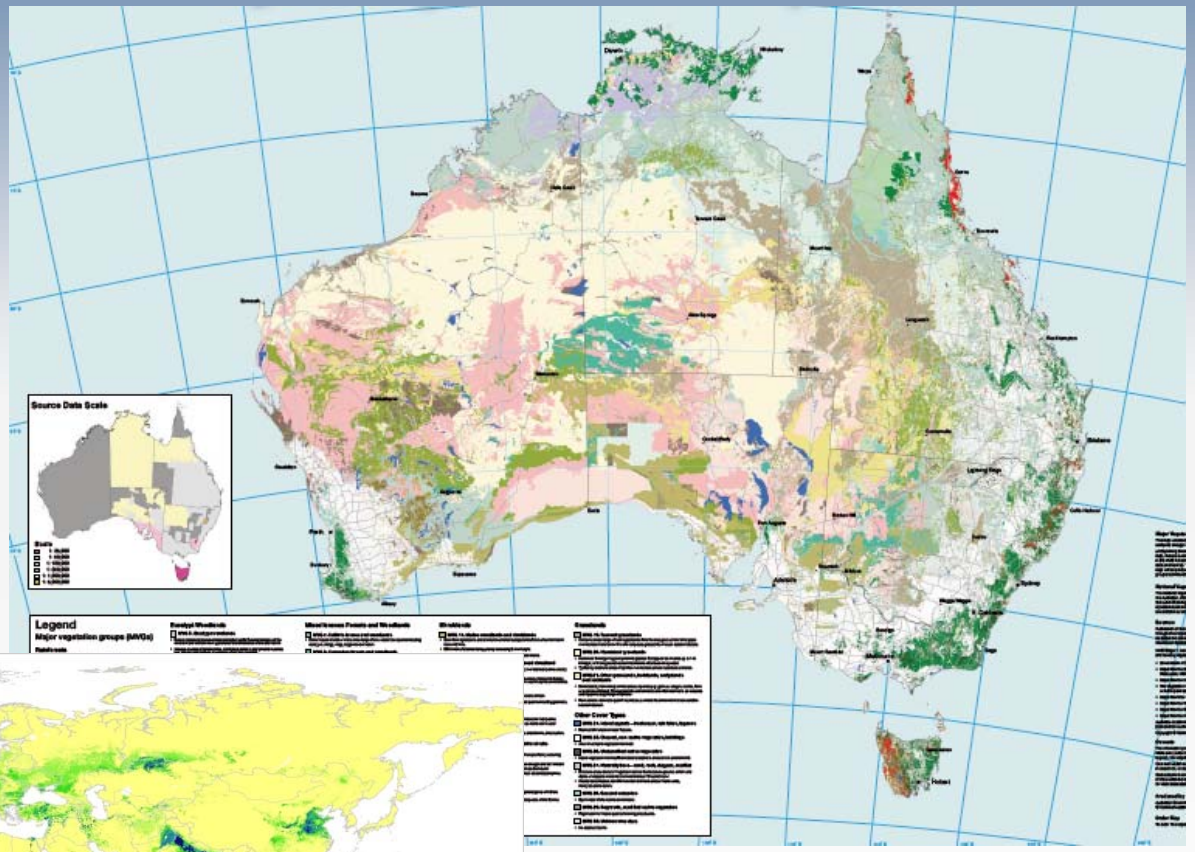


Map of Terrestrial Ecoregions (Olson et al. 2008)

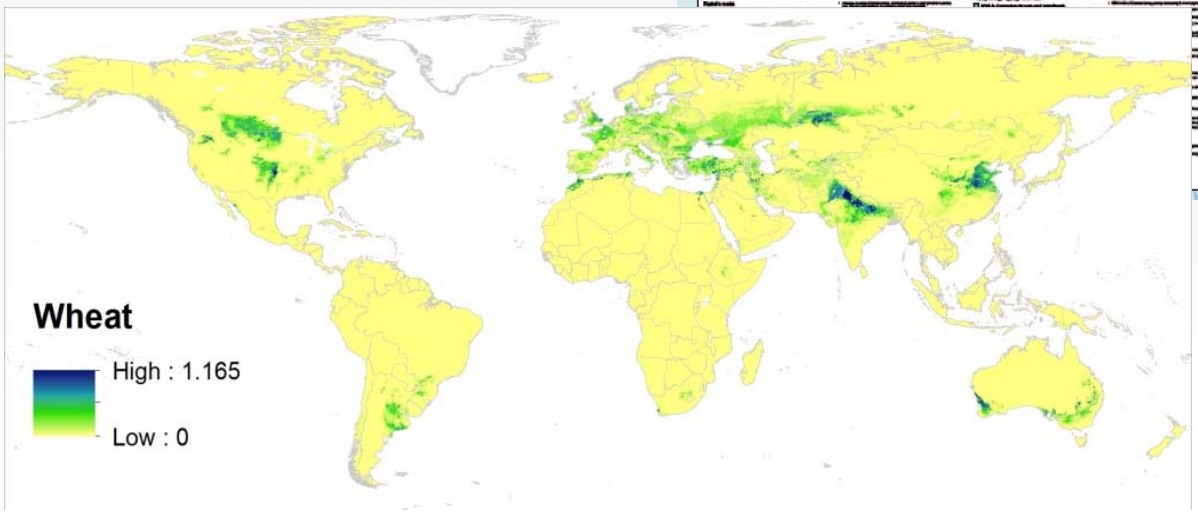
Generation of the fuelbeds



- Minimum area:
  - 0.01%
  - 14,900 km^2

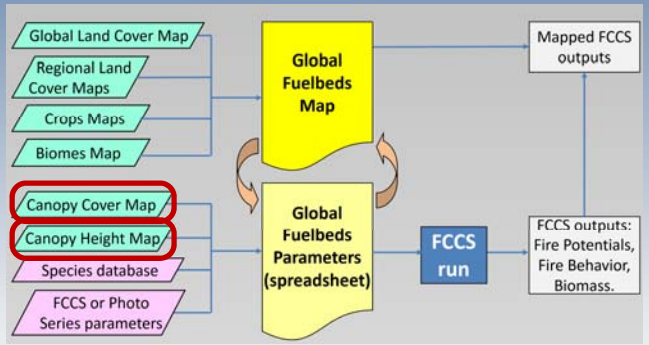


Major vegetation groups in Australia V3.0
(www.environment.gov.au)

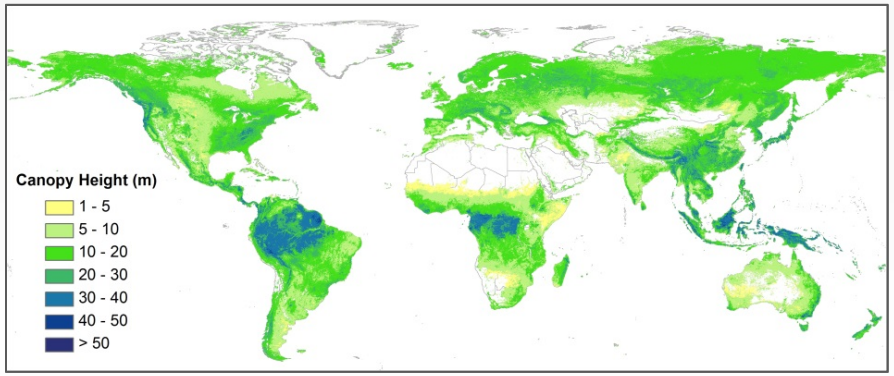


Harvested Area and Yield of 175 crops
(Monfreda et al. 2008)

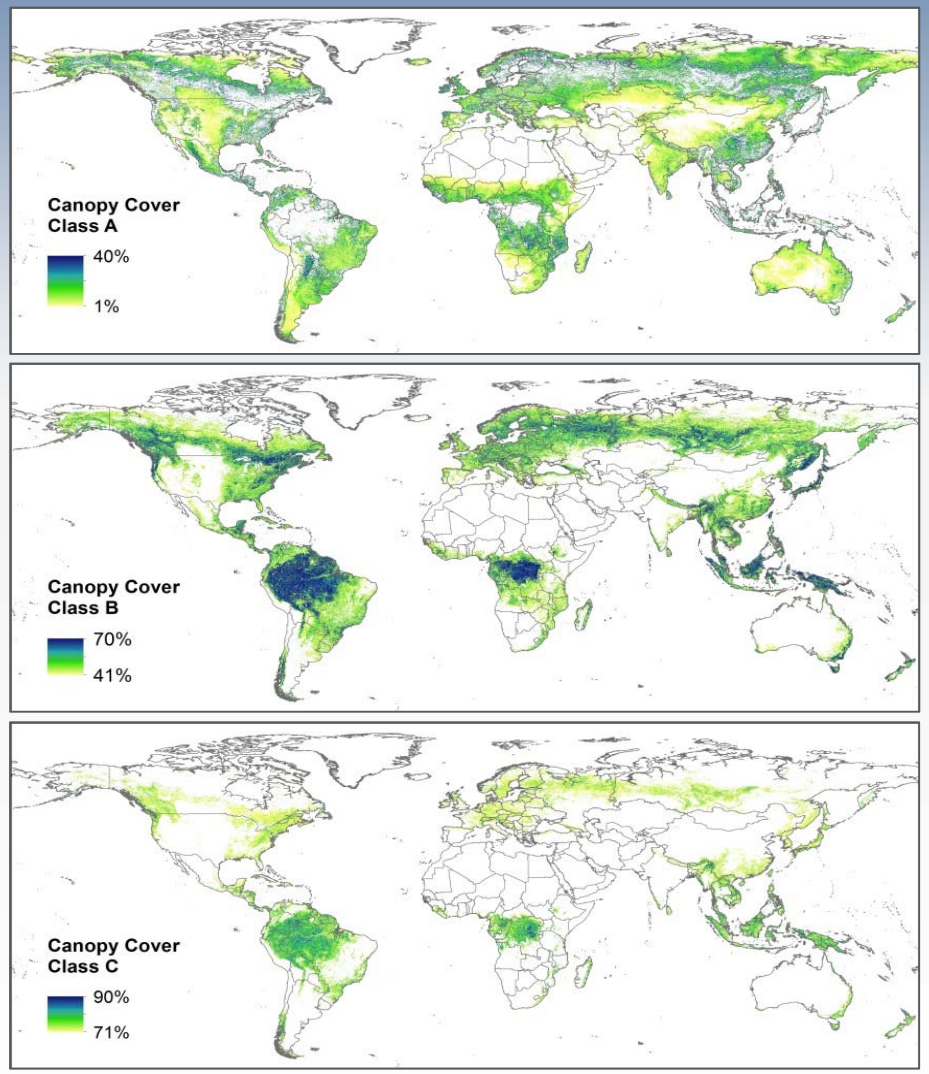
Parameterization of the fuelbeds



- Subdivision of FBs:
  - >0.01% area
- Mean values

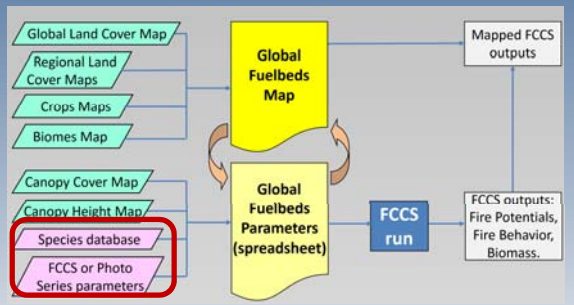


Canopy height map *(Simard et al. 2011)*



MODIS VCF Collection 5 *(Carroll et al. 2011)*

Parameterization of the fuelbeds



1. Plant species:
   - From the existing FCCS database
   - Representative species from the WWF database
2. Rest of parameters:
   - FCCS fuelbeds: USA
   - PhotoSeries: Mexico and Brazil
- Mean values from different fuel data

Fuelbed Editor

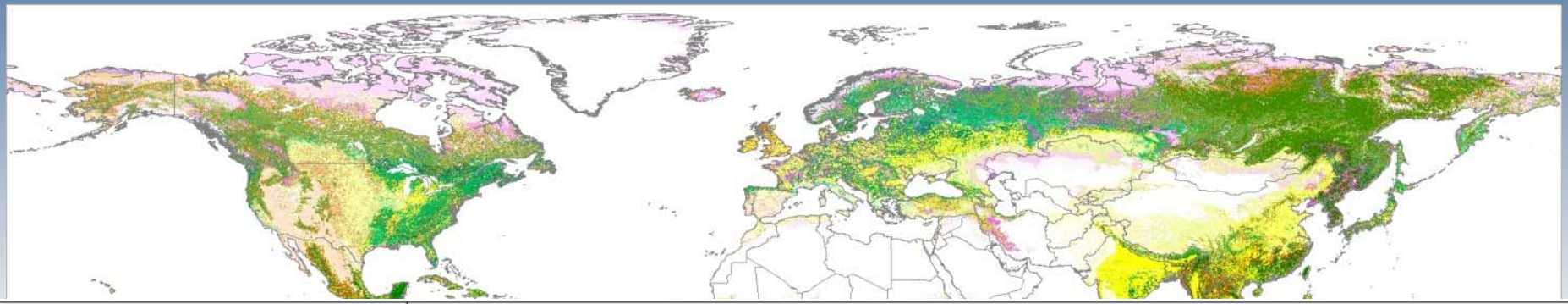
File View Help

General | Canopy | Shrub | Herb | Wood | LLM | Ground Fuel

Tree - Overstory | Tree - Midstory | Tree - Understory | Snag - Class 1 Foliage | Snag - Class 1 | Snag - Class 2 | Snag - Class 3 | Ladder Fuels

Fuelbed	Total canopy cover (%	Overstory cover (%)	Height (m)	HLC (m)	Density (#/ha)	DBH (cm)	Relative cover (%) / Species	Present
FB_0036_FCCS	20	20	6.09	3.04	98.84	35.30	46 = Quercus agrifolia 27 = Quercus douglasii 18 = Quercus chrysolepis 9 = Juglans californica	☑

Global Fuelbed map



Land Cover	Biomas											
	T/S Moist Broadleaf Forests	T/S Dry Broadleaf Forests	T/S Coniferous Forests	Temperate Broadleaf and Mixed Forests	Temperate Coniferous Forests	Boreal Forests/Taiga	T/S Grasslands, Savannas and Shrublands	Temperate Grasslands, Savannas and Shrublands	Tundra	Mediterranean Forests, Woodlands and Scrub	Desert and Xeric Shrublands	Mangroves
Cropland	1015	2015	3015	4015	5015		7015	8015		12015	13015	14015
Mosaic Cropland (50-70%) / Vegetation (20-50%)	1020	2020	3020	4020	5020		7020	8020-8023		12020-12023	13020	14020
Mosaic Vegetation (50-70%) / Cropland (20-50%)	1030	2030	3030	4030-4033	5030		7030	8030-8033		12030	13030	14030
Broadleaved evergreen or semi-deciduous forest	1040	2040	3040	4040-4043	5040		7040-7043	8043		12040-12043		
Broadleaved deciduous forest	1061	2061	3061	4061	5061	6061	7061	8061	11061	12061	13061	
Needleleaved evergreen forest	1091	2091	3091	4091	5091	6091	7091	8091	11091	12091	13091	
Needleleaved deciduous forest				4092	5092	6092		8092	11092			
Broadleaved/Needleleaved evergreen mixed forest				4100	5100	6100	7100	8100	11100	12100		
Broadleaved/Needleleaved deciduous mixed forest				4102		6102			11102			
Mosaic Forest (B/NE)-Shrubland (50-70%) / Grassland (20-50%)	1110	2110	3110	4110	5110	6110	7110-7113	8110-8113	11110	12110-12113	13110-13113	
Mosaic Forest (B/ND)-Shrubland (50-70%) / Grassland (20-50%)				4112	5112	6112		8112	11112			
Mosaic Grassland (50-70%) / Forest (B/NE)-Shrubland (20-50%)	1120	2120	3120	4120-4123	5120	6120	7120-7123	8120-8123	11120	12123	13120-13123	
Mosaic Grassland (50-70%) / Forest (B/ND)-Shrubland (20-50%)				4122	5122	6122		8122	11122			
Shrubland	1130	2130	3130	4130-4133	5130	6130	7130-7133	8130-8133	11130	12130-12133	13130-13133	
Grassland	1140	2140	3140	4140	5140	6140	7140	8140	11140	12140	13140	
Sparse vegetation				4150	5150	6150	7150	8150	11150	12150	13150	
Broadleaved forest regularly flooded (fresh-brackish water)	1160						7160					
Broadleaved forest-shrubland permanently flooded (saline water)												14170
Grassland/shrubland regularly flooded	1180			4180		6180	7180	8180	11180			

Global Fuelbed Spreadsheet

- 62 parameters for each fuelbed or sub-fuelbed

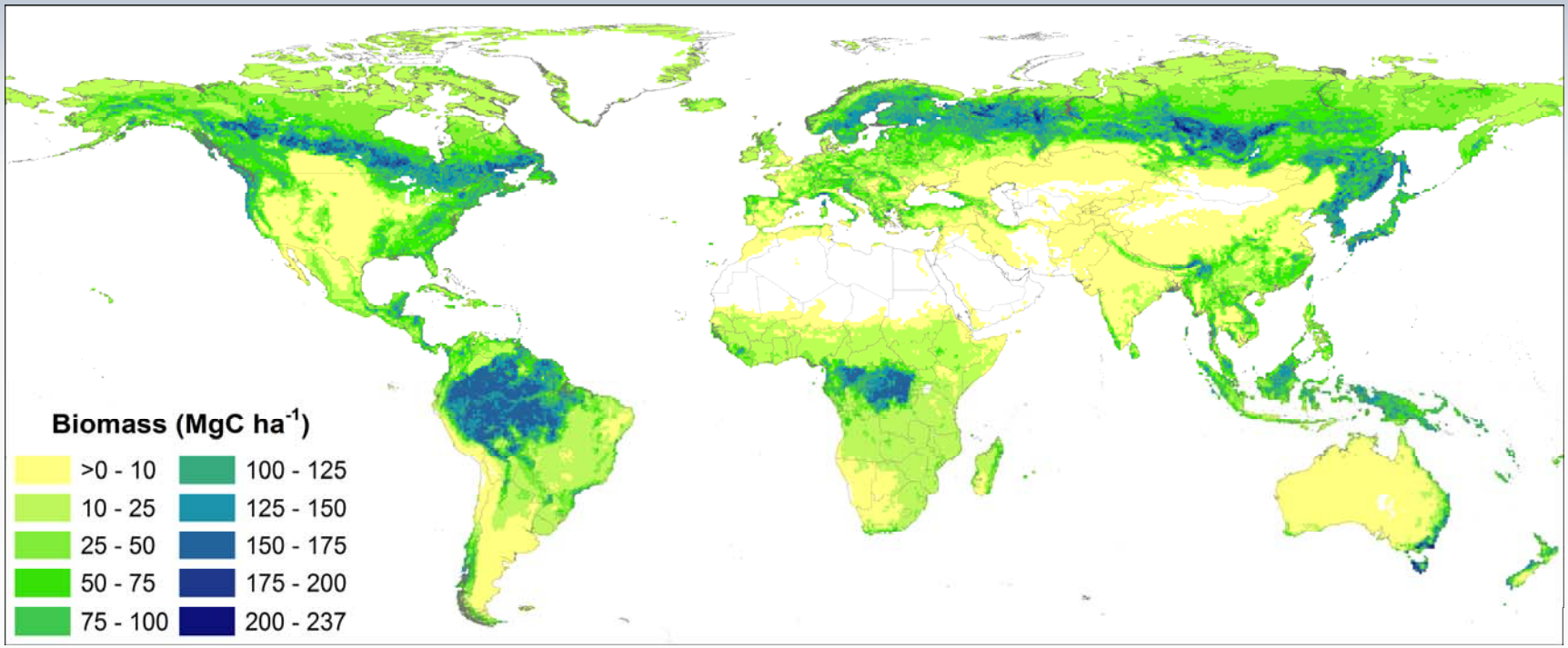
Stratum (and categories)	Parameter
Canopy (primary and secondary layers)	Percent cover Height Height to live crown (HLC) Tree density Diameter at base height (DBH) Existence of ladder fuels

Stratum (and categories)	Parameter
Herb (primary layer)	Percent cover Height Percent live Load Herb species and relative cover
	Percent cover

N	FUELE	JOIN_VA	Biome	LandCover	Tree Cover (%	TO_Cover (%	TO_Density (#/ha	TO_Height (m)	TO_HLC (m	TO_DBH (cm	TO_SppNum	TO_SppName	TO_RelCove
304	12010	12010	12 - Mediterranean Forest	10 - Crops: wheat, barley, sorgum	-3	-3	-3	-3	-3	-3	-3	-3	-3
305	12012	12012	12 - Mediterranean Forest	12 - Crops: maize	-3	-3	-3	-3	-3	-3	-3	-3	-3
306	12018	12018	12 - Mediterranean Forest	18 - Crops: forage	-3	-3	-3	-3	-3	-3	-3	-3	-3
307	12020	12020	12 - Mediterranean Forest	20 - Mosaic Crops/Vegetation: wheat	5	5	14	10	0	30	19276	Quercus spp.	100
308	12022	12022	12 - Mediterranean Forest	22 - Mosaic Crops/Vegetation: maize	16	16	42	15	1	45	19276	Quercus spp.	100
309	12028	12028	12 - Mediterranean Forest	28 - Mosaic Crops/Vegetation: forage	9	9	25	11	1	33	19276	Quercus spp.	100
310	12030	12030	12 - Mediterranean Forest	30 - Mosaic Vegetation/Crops: wheat	4	4	10	11	1	33	19276	Quercus spp.	100
311	12035	12035	12 - Mediterranean Forest	35 - Mosaic Vegetation/Crops: cotton	6	6	15	12	1	37	19276	Quercus spp.	100
312	12036	12036	12 - Mediterranean Forest	36 - Mosaic Vegetation/Crops (Australi	3	3	1	7	4	23	27189	Eucalyptus glob	100
313	12043a	9112043	12 - Mediterranean Forest	43 - Broadleaf evergreen or semidec. Tr	12	12	4	8	5	25	27189	Eucalyptus glob	100
314	12043b	9212043	12 - Mediterranean Forest	43 - Broadleaf evergreen or semidec. Tr	51	51	22	17	10	50	27189	Eucalyptus glob	100
315	12061a	9112061	12 - Mediterranean Forest	61 - Broadleaf deciduous trees	20	20	54	19	1	56	19276	Quercus spp.	100
316	12061b	9212061	12 - Mediterranean Forest	61 - Broadleaf deciduous trees	54	54	143	22	2	65	19276	Quercus spp.	100
317	12091a	9112091	12 - Mediterranean Forest	91 - Needleleaf evergreen trees	22	22	110	10	4	25	18035	Pinus spp.	100
318	12091b	9212091	12 - Mediterranean Forest	91 - Needleleaf evergreen trees	53	53	259	22	8	51	18035	Pinus spp.	100
319	12100	12100	12 - Mediterranean Forest	100 - Mixed broadleaf and needleleaf tre	41	41	36	21	9	80	18035	Pinus spp.	100
320	12110	12110	12 - Mediterranean Forest	110 - Mosaic trees-shrubs/grasses	7	7	6	12	5	46	18035	Pinus spp.	100
321	12113	12113	12 - Mediterranean Forest	113- Mosaic trees-shrubs/grasses (Aust	5	5	2	6	4	20	27189	Eucalyptus glob	100
322	12123	12123	12 - Mediterranean Forest	123 - Mosaic grasses/trees-shrubs (Aus	8	8	2	6	3	20	27189	Eucalyptus glob	100
323	12130	12130	12 - Mediterranean Forest	130 - Shrubs	-3	-3	-3	-3	-3	-3	-3	-3	-3
324	12133	12133	12 - Mediterranean Forest	133 - Shrubs (Australia)	-3	-3	-3	-3	-3	-3	-3	-3	-3
325	12140	12140	12 - Mediterranean Forest	140 - Grasses	-3	-3	-3	-3	-3	-3	-3	-3	-3
326	12150	12150	12 - Mediterranean Forest	150 - Sparse vegetation	-3	-3	-3	-3	-3	-3	-3	-3	-3

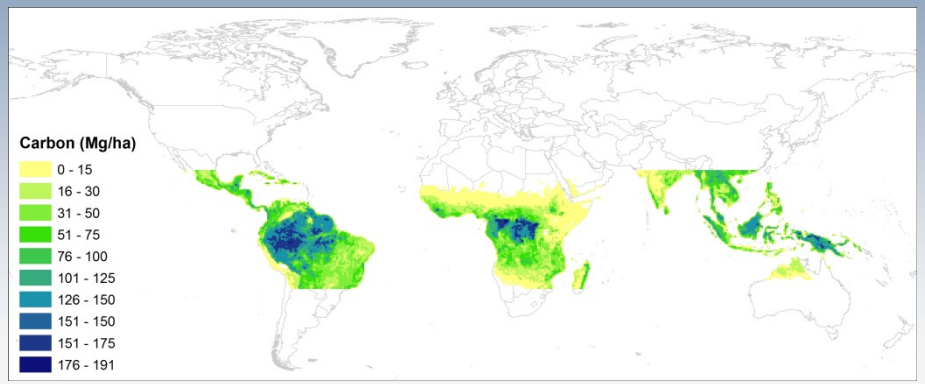
Fuelbeds Assessment: Biomass

- Aggregated to 0.5 degree cells
- Comparison of biomass results of homogeneous LC (>80%)

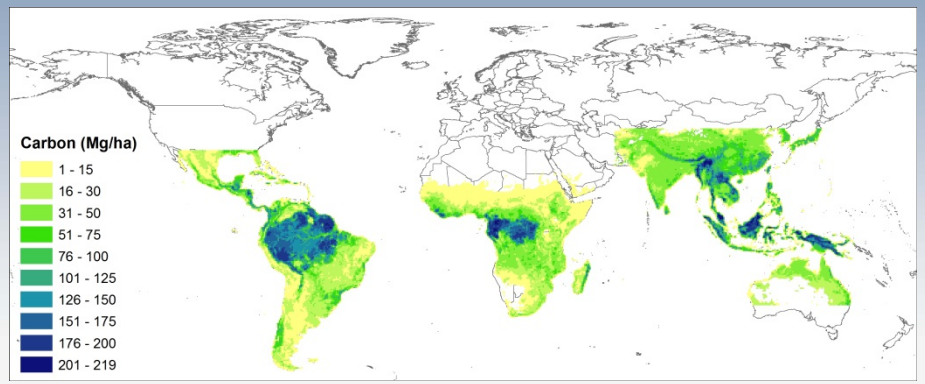


- Highest biomass (>200 Mg/ha):
  - Tree biomass: in Temperate and Mediterranean biomes
  - Ground fuels: in Mangroves, Temperate ND and Boreal biomes

Biomass products compared

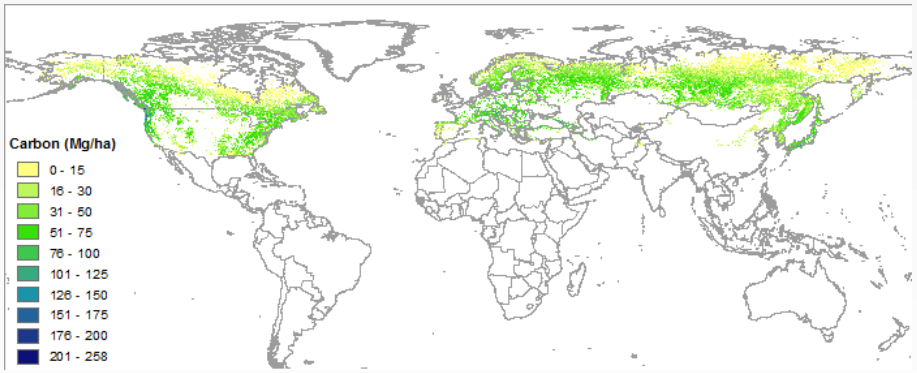


(Baccini et al. 2012)



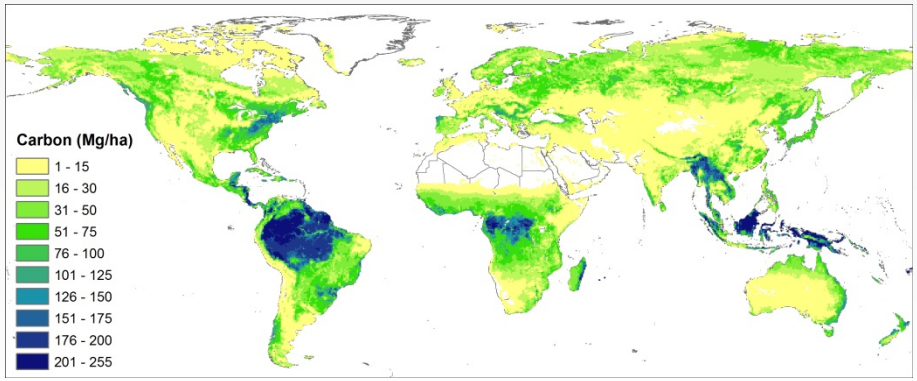
(Saatchi et al. 2011)

LiDAR data from ICESat GLAS



(Thurner et al. 2014)

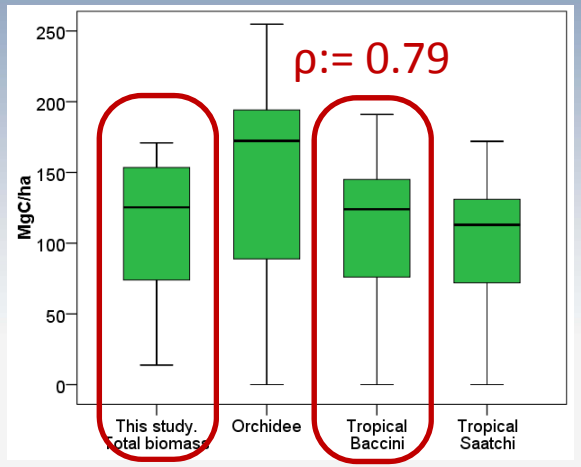
Biomasar II - ENVISAT ASAR data



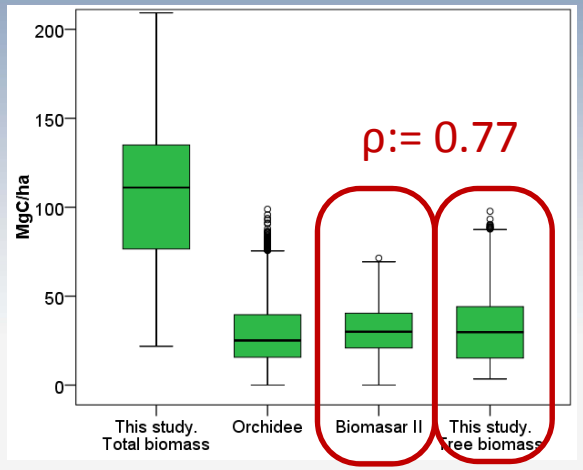
(Yue et al. 2015)

ORCHIDEE Dynamic Global Vegetation Model

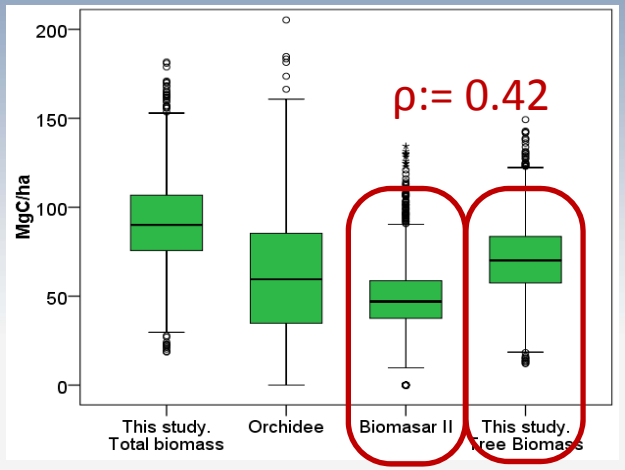
Biomass Comparisons



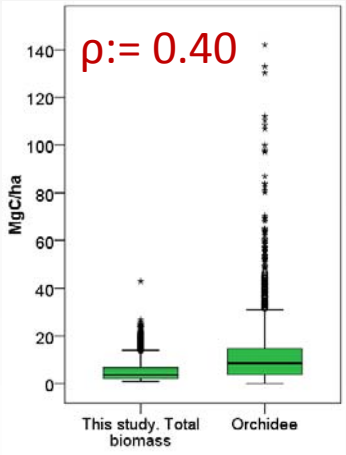
Tropical Forests



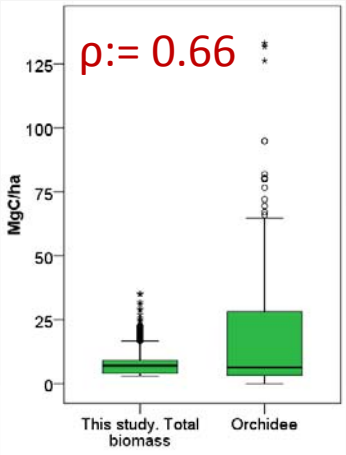
Boreal Forests



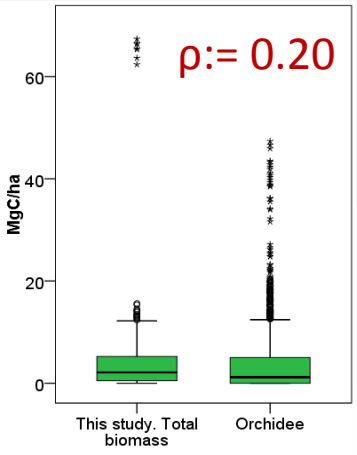
Temperate Forests



Crops



Savanna + Shrub



Grasses

Conclusions

- First global fuel dataset
- Reasonable agreement between biomass outputs and other biomass products
- Limitations:
  - FBs and PSs represent American ecosystems
  - Simplification of fuelbeds
  - Uncertainties of input maps
- Possible applications:
  - Include fuel component in fire risk assessment
  - Estimate fuel consumption and emissions

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Abstract. This study presents the methods for the generation of the first global fuel data set, containing all the parameters required to be input in the Fuel Characteristic Classification System (FCCS). The data set was developed from different spatial variables, both based on satellite Earth observation products and fuel databases, and is comprised by a global

plant types while promoting others, thus creating flammable ecosystems where other vegetation would exist based solely on climate or soil (Pausas and Keeley, 2009). Fire is also an important source of atmospheric gases and aerosol particles, including gasses such as CO_2, CO, and CH_4 (Schultz et al., 2008).