Constituency: Mapping the Areas that Flux Towers Represent Best

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Introduction

This analysis is the opposite of our usual approach. Until now, we have quantified how well the environmental conditions at a geographic network of flux towers represents all of the environmental conditions within the greater map that contains it. If the combination of environmental conditions at a particular location were very different from the most similar existing flux tower, we mapped that location as being poorly represented by the existing tower network.

But AmeriFlux is supposed to act as a national network. In this sense, every location must be represented (even if poorly) by measurements made at one of the existing flux towers. For each location in the lower 48 United States, one can find the existing flux tower whose environmental conditions are most similar to the combination of conditions at that spot. Coloring each map cell by the tower whose measurement best represents it shows the areas that each tower "stands for" (top map). Borrowing a political term, we call this the tower's "constituency," since that tower, like an elected representative, stands for those cells (at least more so than any other tower).

Unlike our prior network analyses, constituency shows what the network currently has, rather than what the network theoretically needs. It is an realized rather than a theoretical quantity. The area being "served" by each tower indicates the amount of "work" that that tower is forced to do under the current network configuration. We can also quantify how well each location is represented by "its" tower, and can map this actual degree of representativeness for all locations within the lower 48 United States (bottom map).

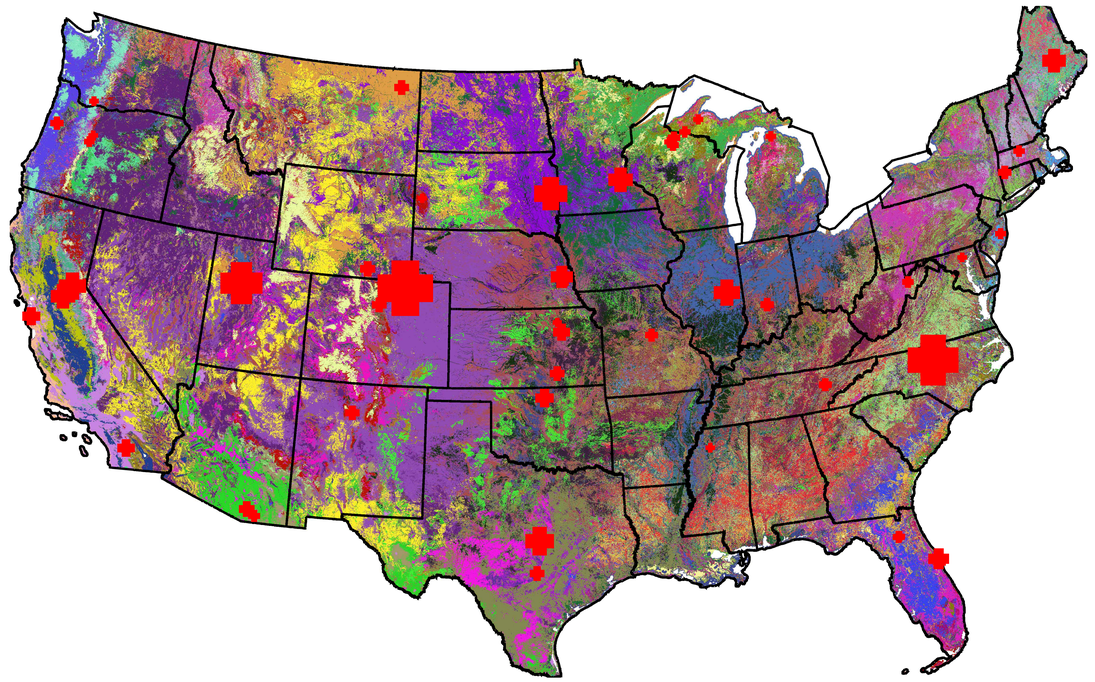
The top map shows the location and extent of the constituency of each existing flux tower as a unique color. The color used for each of the 96 flux towers is shown in the legend below. Some flux towers have large constituencies, while others have smaller ones. Because it is based on multivariate similarity, a single tower's constituency need not be spatially contiguous; indeed, most of the constituencies shown here are disjoint. The size of each tower icon is proportional to the total area of the map cells in its constituency. Towers having larger icons are currently "trying" to represent more areas in the map, whether they can adequately do so or not.

The bottom map uses shades of gray to indicate how similar the environment at the tower is to the environment at each location within that tower's constituency. White areas have environments that are similar to the environment at their tower, while black areas are poorly represented. This actual or realized map is much darker than the theoretical site representativeness map calculated earlier, since many of the locations are only poorly represented by the most similar existing tower site. The Central Plains and Prairie Penninsula are best represented (whitest), because of their relatively uniform grassland and agriculture, respectively.

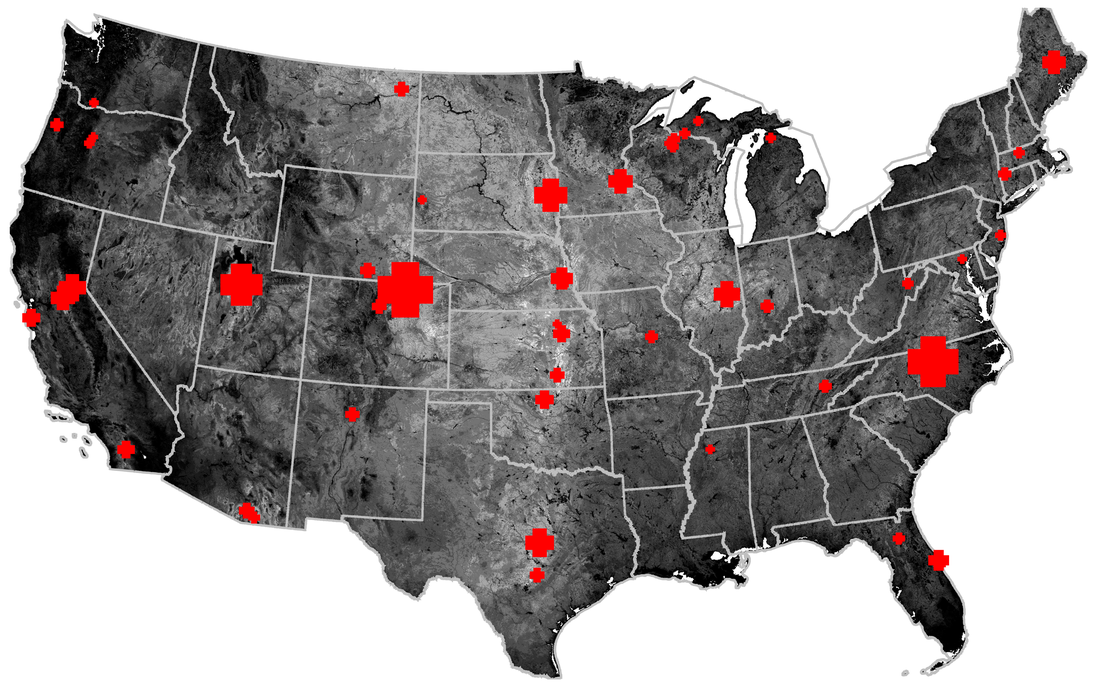
Sadly, our funding is ending, so this represents the culmination of our work.

Tower Color Legend

- Fir_site
- Little_Prospect_Hill
- Metolius_–_new_young_pine
- Bondville_(companion_site)
- Freeman_Ranch_Woodland
- Santa_Rita_Mesquite
- Valles_Caldera_National_Preserve
- CRP_minimum–till
- CRP_ungrazed
- Goodwin_Creek
- Audubon_Research_Ranch
- Northern_Michigan_Jack_Pine_Stand
- Howland_Forest_(main_tower)
- Fort_Peck
- Gainesville_(Donaldson)
- Cedar_Bridge
- Utah_Sagebrush
- Florida–Kennedy_(scrub_oak)
- Duke_Forest_–_loblolly_pine
- Konza_Prairie_LTER
- Bondville
- Willow_Creek
- Park_Falls/WLEF
- Wind_River_Crane_Site
- Gainesville_(Austin_Cary)_slash/longleaf
- Niwot_Ridge_Forest
- Tonzi_Ranch
- Jasper_Ridge
- Duke_Forest–open_field
- Cub_Hill_(Baltimore)
- Mead_–_rainfed_site
- Mead_–_irrigated_site
- Metolius_–_intermediate_ponderosa_pine
- Manhattan_(cedar_forest_30_km_N)
- Rannells_Ranch_(ungrazed)
- Brookings
- J–17_Savanna
- Metolius_–_Eyerly_burn
- Freeman_Ranch_Transition
- Freeman_Ranch_Grassland
- Rosemount
- Missouri_Ozark_Site
- CRP_grazed
- Chestnut_Ridge
- Canaan_Valley
- Harvard_Forest_hemlock_site
- Howland_Forest_(west_tower)
- Harvard_Forest_Main_Tower
- Univ._of_Mich._Biological_Station
- Florida–Kennedy_(slash_pine)
- Utah_Crested_wheatgrass
- Utah_Juniper_woodland
- SGP_Lamont_ARM_site
- Walnut_River_Watershed
- Morgan_Monroe_State_Forest
- Glacier_Lake
- Sylvania_Wilderness_Area_(Watersmeet)
- Lost_Creek
- Walker_Branch_Watershed
- Niwot_Ridge_Forest_(2)
- Vaira_Ranch
- Sky_Oaks_Biological_Station
- Blodgett_Forest
- Duke_Forest–hardwoods
- Great_Mountain_Forest
- Mead_–_irrigated/rotation_site
- Howland_Forest_(harvest_site)
- Black_Hills
- Rannells_Ranch_(grazed)

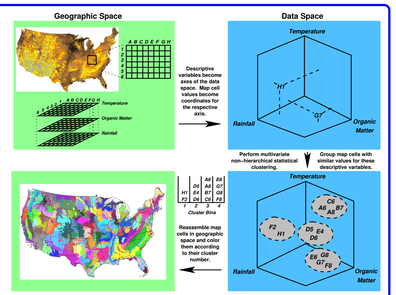


Size of red cross indicates constituency area for this AmeriFlux site

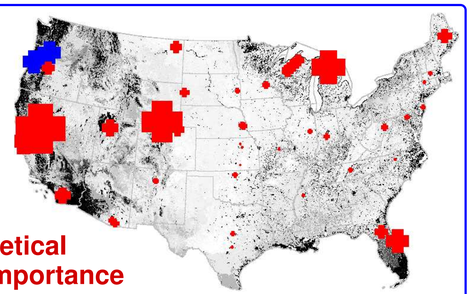


Darker areas are more poorly represented

Multivariate Geographic Clustering



Prior Theoretical Site Importance



List of Input Maps

Map Layer or Variable Name	IA	IB	IC	IIA	IIB	IIC	IIIA	IIIB	IIIC
Degree-days heat sum above 42°F from daytime land surface temperature during the local growing season	✓	✓		✓	✓		✓	✓	
Degree-days cold sum below 42°F from nighttime land surface temperature during the local non-growing season	✓		✓	✓		✓	✓		✓
Number of days above 90°F during the local growing season	✓	✓		✓	✓		✓	✓	
Number of days below 32°F during the local non-growing season	✓		✓	✓		✓	✓		✓
95th percentile of maximum diurnal surface temperature difference during the local growing season	✓	✓		✓	✓		✓	✓	
95th percentile of maximum diurnal surface temperature difference during the local non-growing season	✓		✓	✓		✓	✓		✓
Precipitation sum during the local growing season	✓	✓		✓	✓		✓	✓	
Precipitation sum during the local non-growing season	✓		✓	✓		✓	✓		✓
Number of days with measurable precipitation during the local growing season	✓	✓		✓	✓		✓	✓	
Number of days with measurable precipitation during the local non-growing season	✓		✓	✓		✓	✓		✓
Depth of mineral soil	✓	✓	✓	✓	✓	✓	✓	✓	✓
Depth to water table	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil Kjeldahl nitrogen to 50 cm depth	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil organic matter to 50 cm depth	✓	✓	✓	✓	✓	✓	✓	✓	✓
Soil plant-available water holding capacity to 1.5 m	✓	✓	✓	✓	✓	✓	✓	✓	✓
Compound Topographic Index (CTI)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Total solar insolation during the local growing season, including clouds, aerosols, slope and aspect physiography	✓	✓		✓	✓		✓	✓	
Total solar insolation during the local non-growing season, including clouds, aerosols, slope and aspect physiography	✓		✓	✓		✓	✓		✓
Enhanced Vegetation Index (EVI) integrated over the local growing season				✓	✓		✓	✓	
Enhanced Vegetation Index (EVI) integrated over the local non-growing season				✓		✓	✓		✓
Fraction of Photosynthetically Active Radiation (FPAR) absorbed by vegetation integrated over the local growing season				✓	✓		✓	✓	
Fraction of Photosynthetically Active Radiation (FPAR) absorbed by vegetation integrated over the local non-growing season				✓		✓	✓		✓
Leaf Area Index (LAI) integrated over the local growing season				✓	✓		✓	✓	
Leaf Area Index (LAI) integrated over the local non-growing season				✓		✓	✓		✓
Percent tree cover				✓	✓	✓	✓	✓	✓
Percent bare cover				✓	✓	✓	✓	✓	✓
Gross Primary Production (GPP) integrated over the local growing season							✓	✓	
Gross Primary Production (GPP) integrated over the local non-growing season							✓		✓
Respiration Index (RI) integrated over the local growing season							✓	✓	
Respiration Index (RI) integrated over the local non-growing season							✓		✓

Sorted Constituency

AmeriFlux Site	Constituency
CRP grazed	784981
Mead – irrigated/rotation site	702822
Utah Juniper woodland	560641
CRP minimum-till	407986
Brookings	406731
J-17 Savanna	327151
Mead – rainfed site	302881
Bondville (companion site)	286874
Rosemount	261628
Duke Forest-hardwoods	259788
Fort Peck	244471
Manhattan (cedar forest 30 km N)	222992
Duke Forest – loblolly pine	192999
Walnut River Watershed	159002
Chestnut Ridge	157557
Great Mountain Forest	149249
Cub Hill (Baltimore)	140107
Glacier Lake	137296
Konza Prairie LTER	135718
Santa Rita Mesquite	113459
Park Falls/WLEF	104365
Gainesville (Donaldson) – slash pine (mid-rotation)	95278
Morgan Monroe State Forest	94777
Freeman Ranch Grassland	94723
Sky Oaks Biological Station	91943
Rannells Ranch (grazed)	86659
Valles Caldera National Preserve	85518
Black Hills	72695
Willow Creek	71228
Fir site	70054
Howland Forest (harvest site)	65724
Missouri Ozark Site	60156
SGP Lamont ARM site	59641
Vaira Ranch	59119
Utah Crested wheatgrass	56611
Gainesville (Austin Cary) – 65yr naturally regenerated slash/longleaf pine	55423
Freeman Ranch Transition	54104
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