

# Exploring the Ameriflux Data

## Trends and Relationships

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Upscaling Group Meeting

July 13, 2017

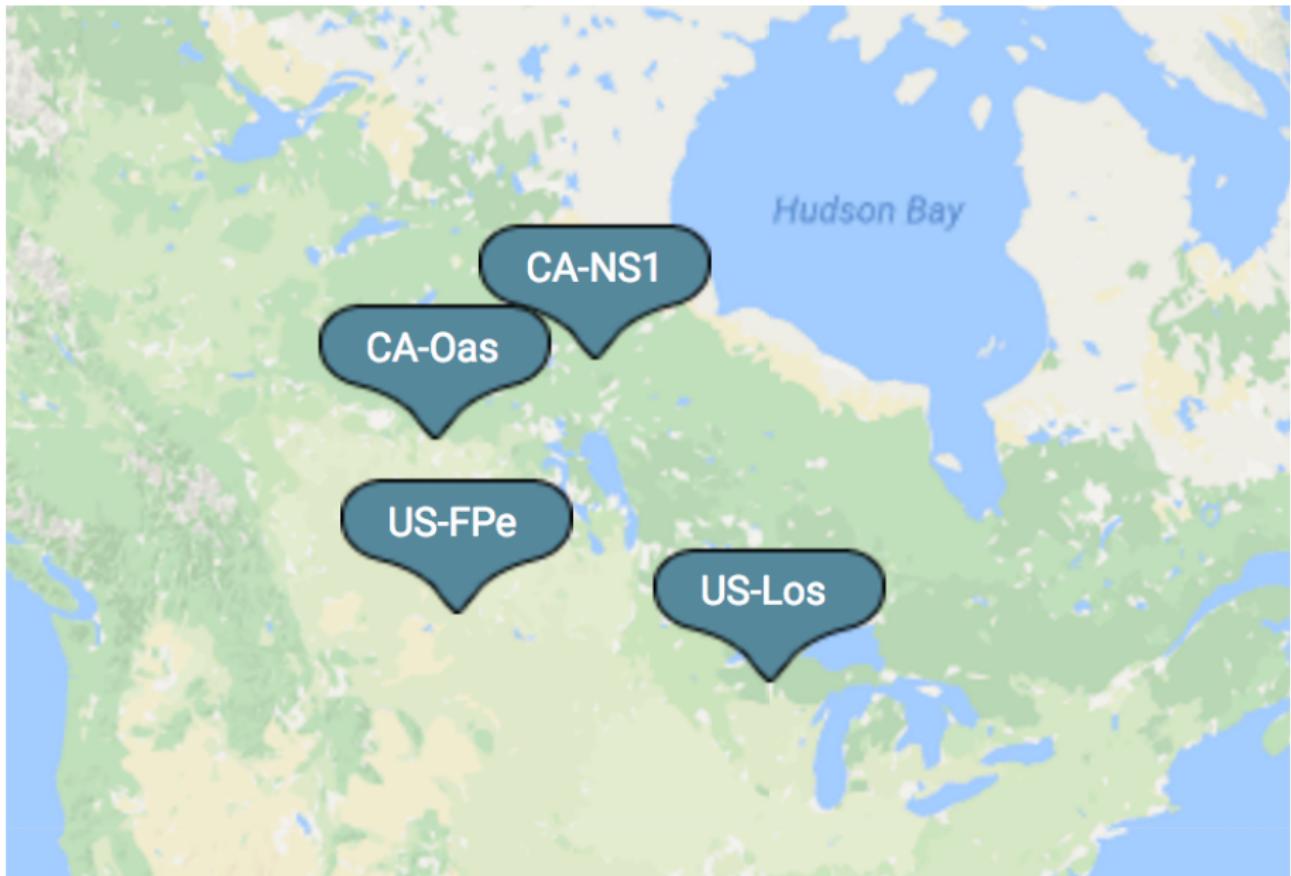
## Sites

Name	Climate	Type	Mean T, C	Mean P, mm
CA-NS1	Dfc	ENF	-2.89	500.29
CA-NS6	Dfc	OSH	-3.08	495.37
CA-Oas	Dfc	DBF	0.34	428.53
US-FPe	Bsk	GRA	5.48	334.8
US-Los	Dfb	WET	4.08	828

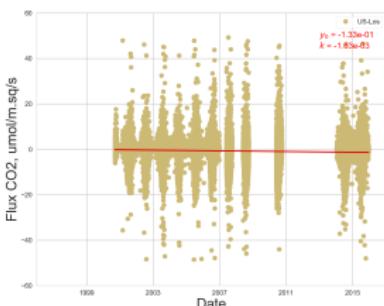
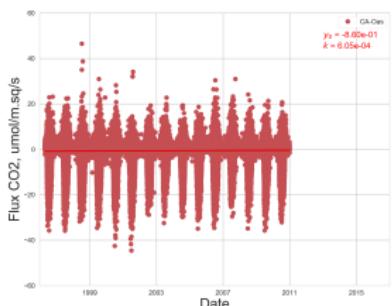
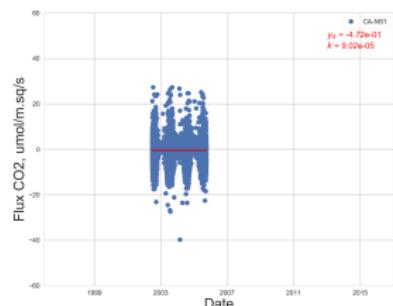
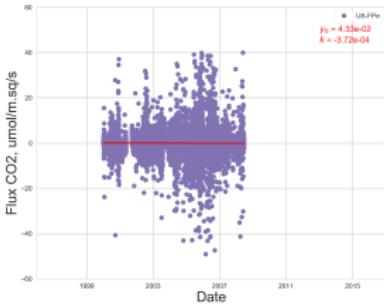
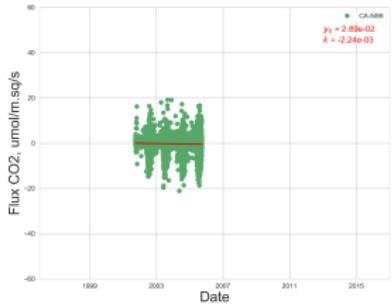
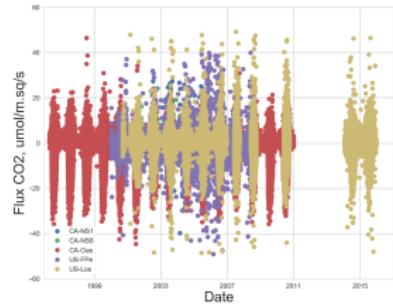
**Climate:** Dfc - Subarctic: severe winter, no dry season, cool summer; Bsk - Cold semi-arid climate, steppe, warm winter; Dfb - Warm Summer Continental: significant precipitation in all seasons.

**Vegetation:** ENF - Evergreen Needleleaf Forests; OSH - Open Shrublands; DBF - Deciduous Broadleaf Forests; GRA - grassland; WET - Permanent Wetlands.

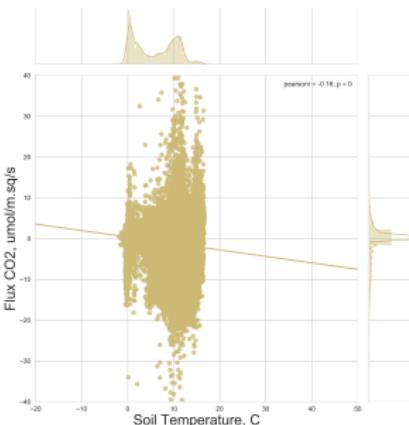
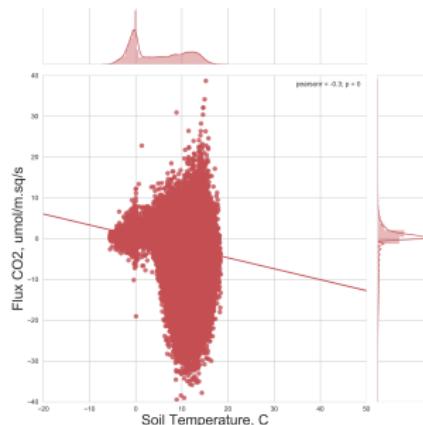
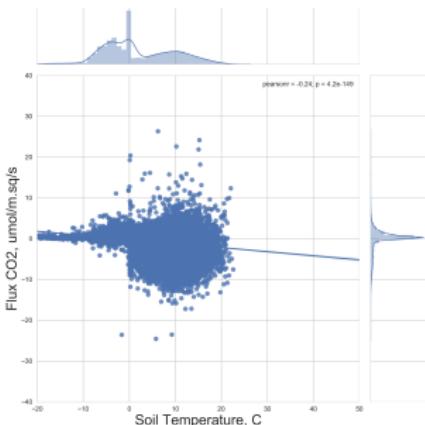
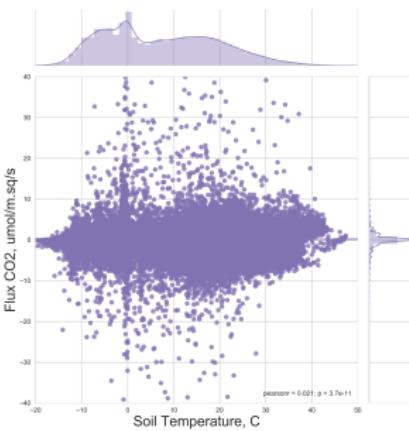
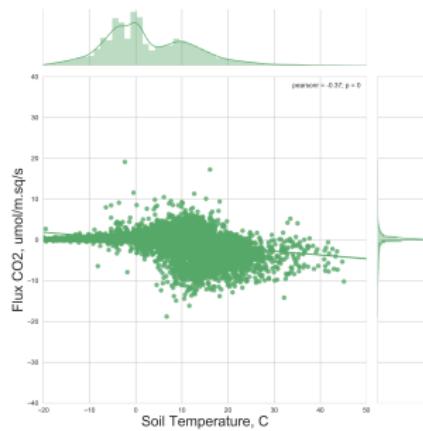
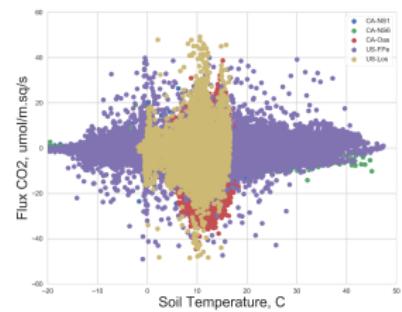
# Sites



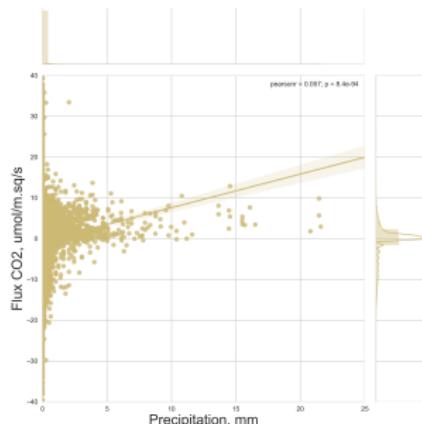
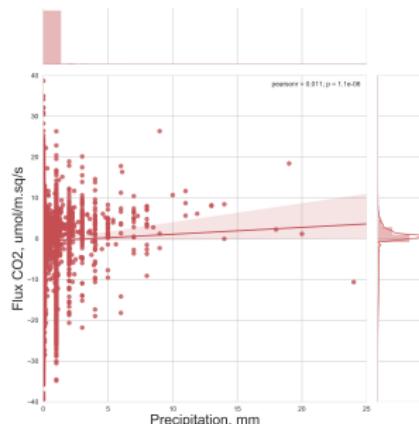
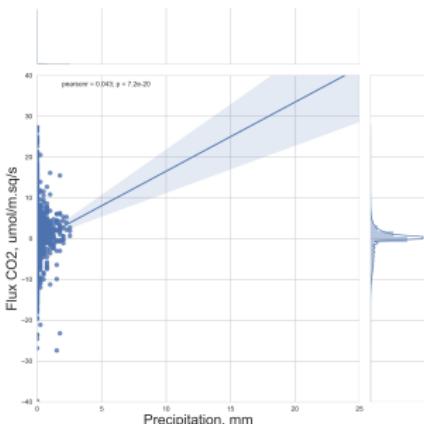
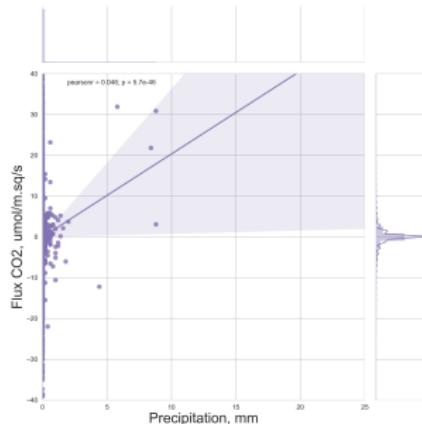
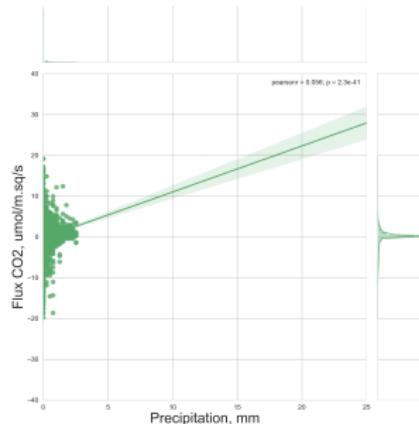
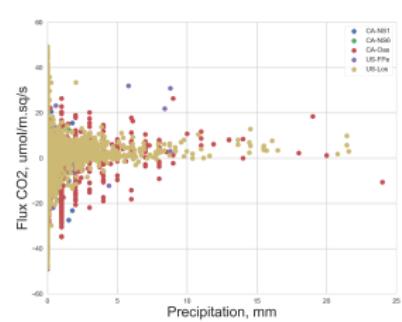
# Flux in Time



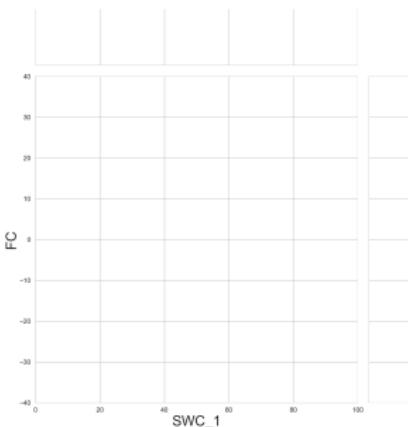
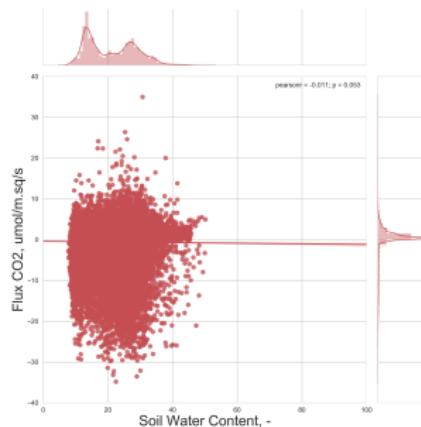
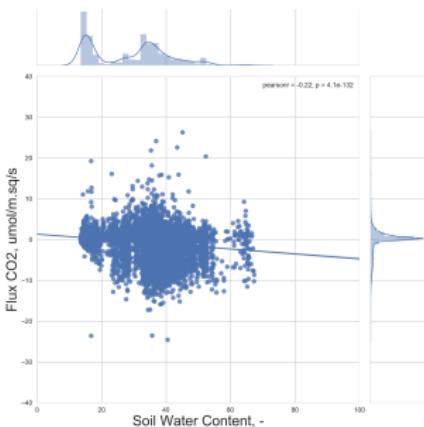
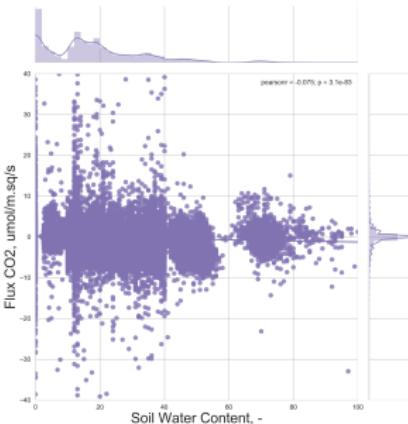
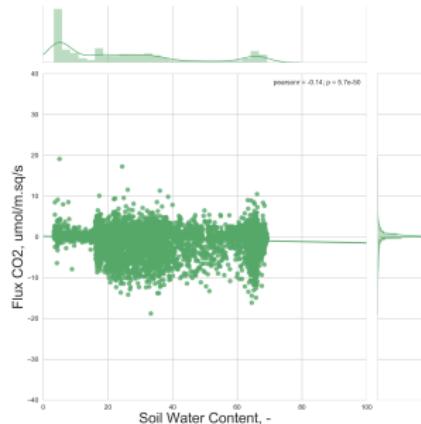
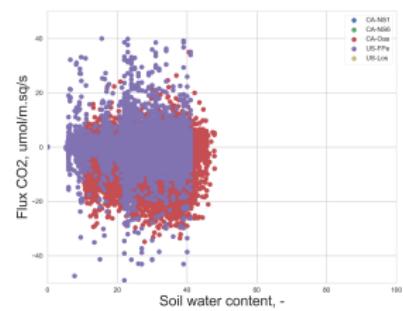
# Flux vs Soil Temperature



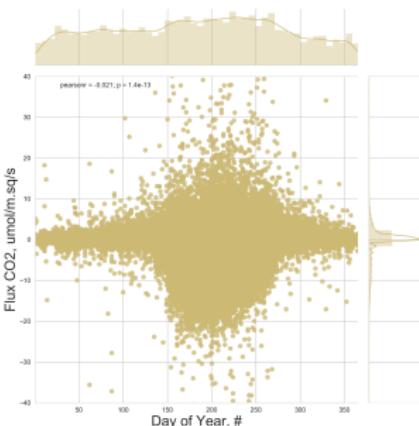
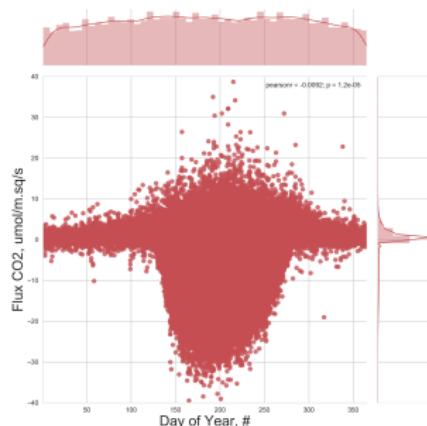
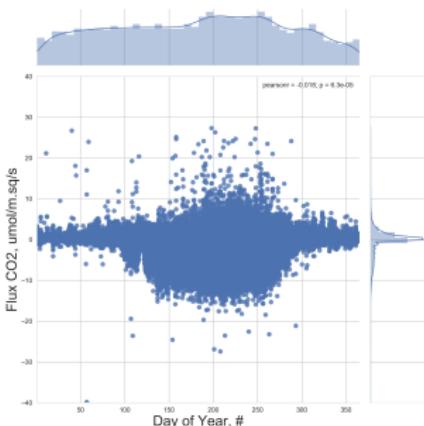
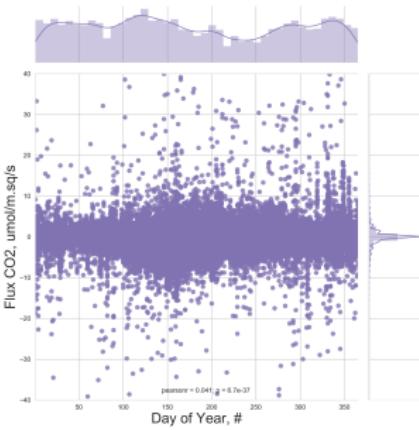
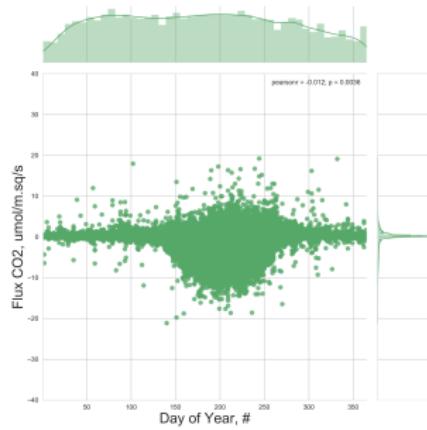
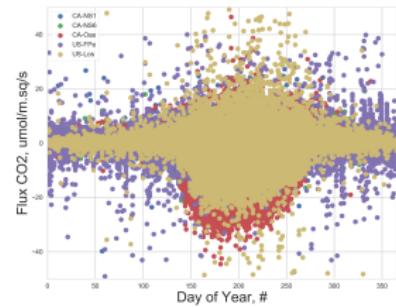
# Flux vs Precipitation



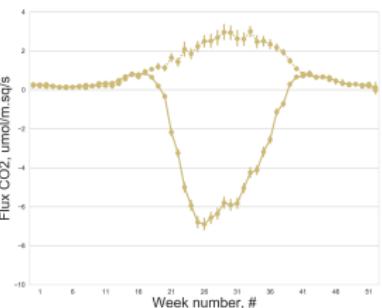
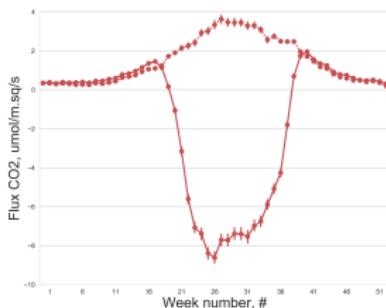
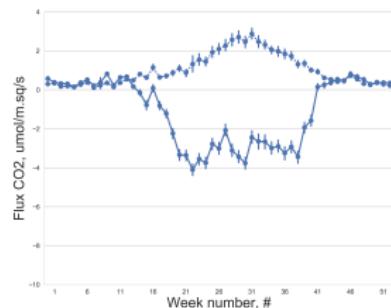
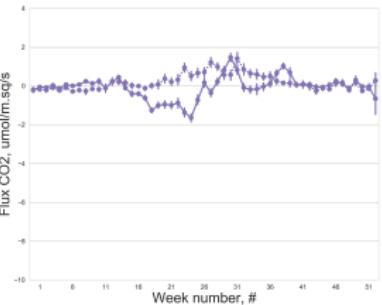
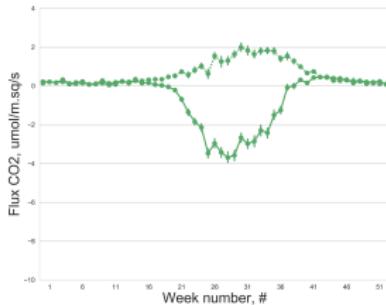
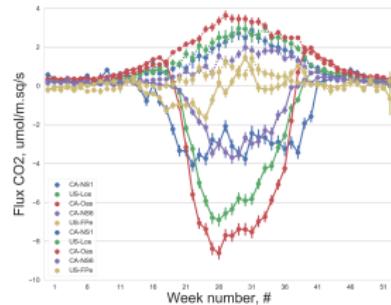
# Flux vs Soil Water Content



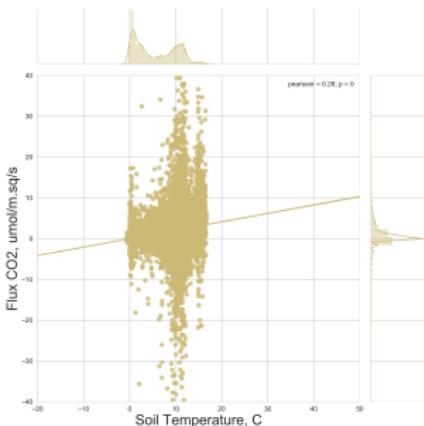
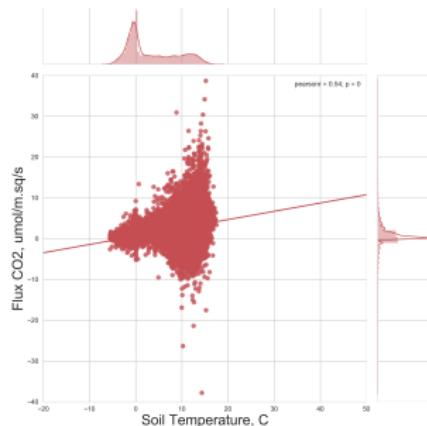
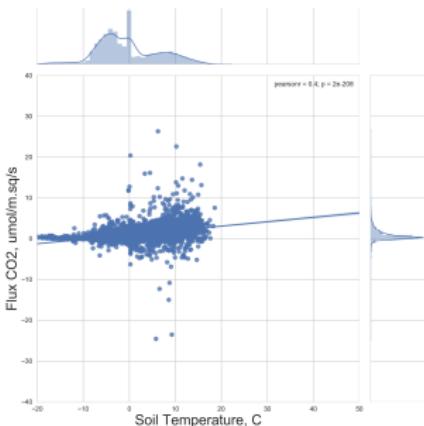
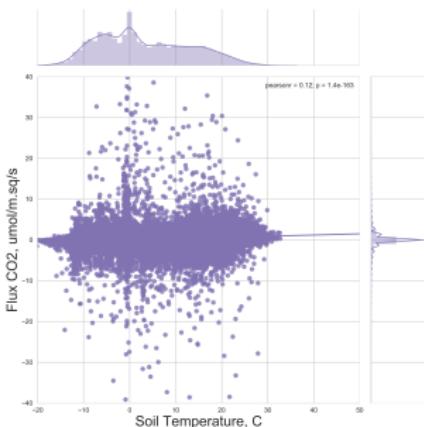
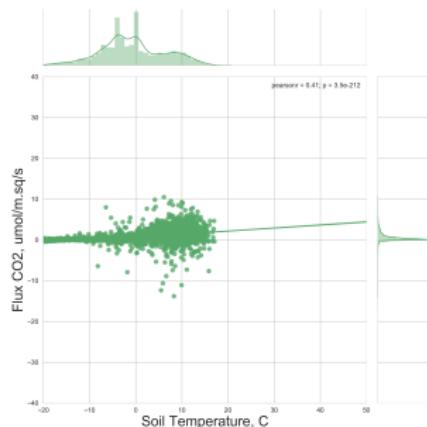
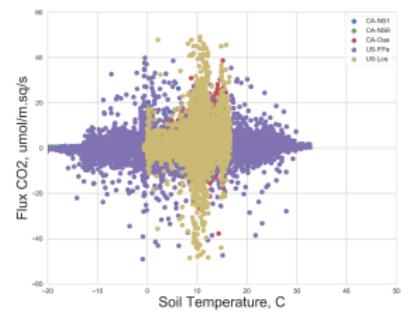
# Flux on Yearly scale



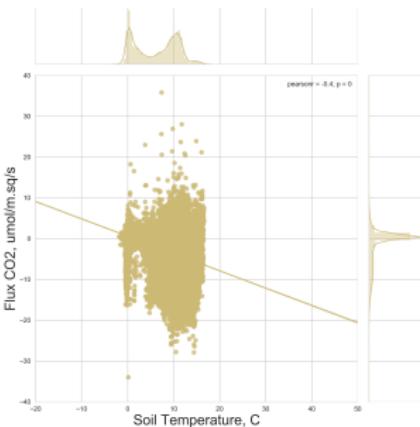
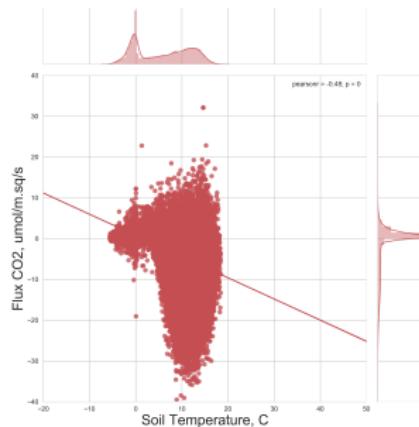
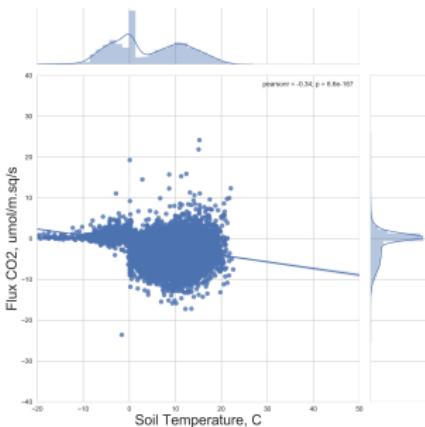
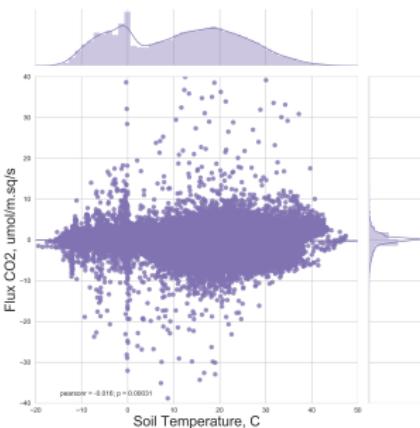
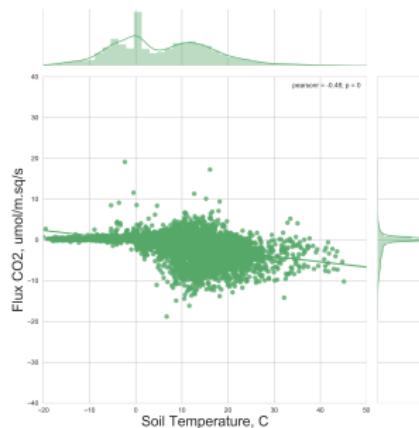
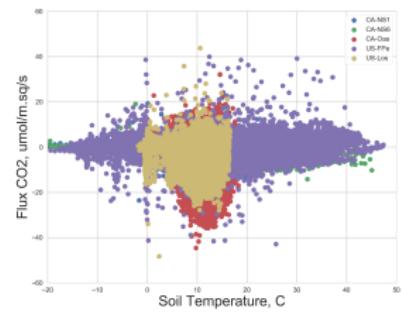
# Weekly average: Day/Night



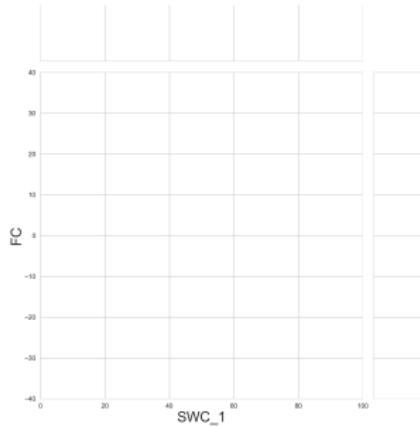
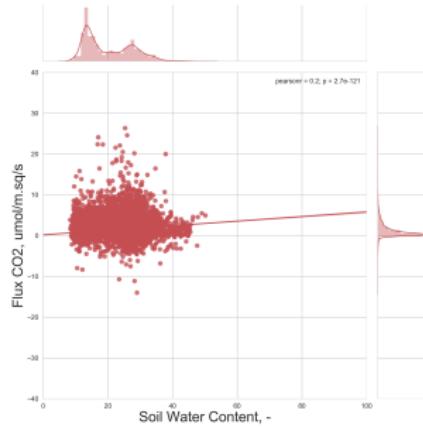
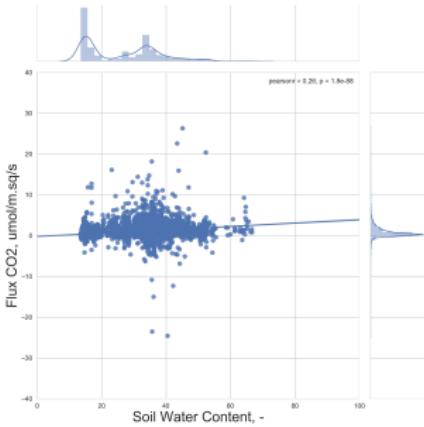
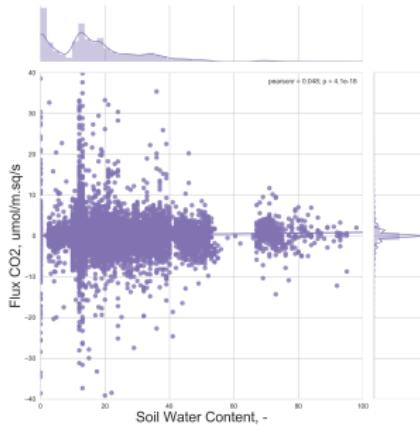
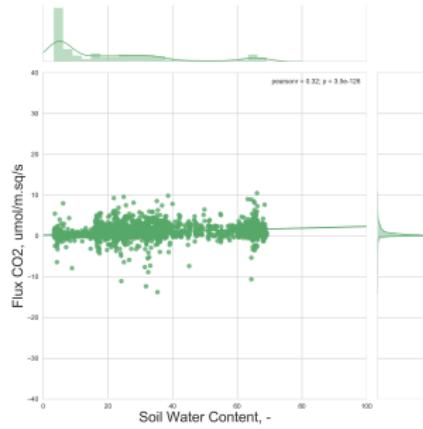
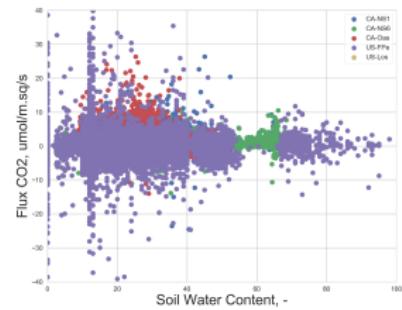
# Flux vs Temperature at Night



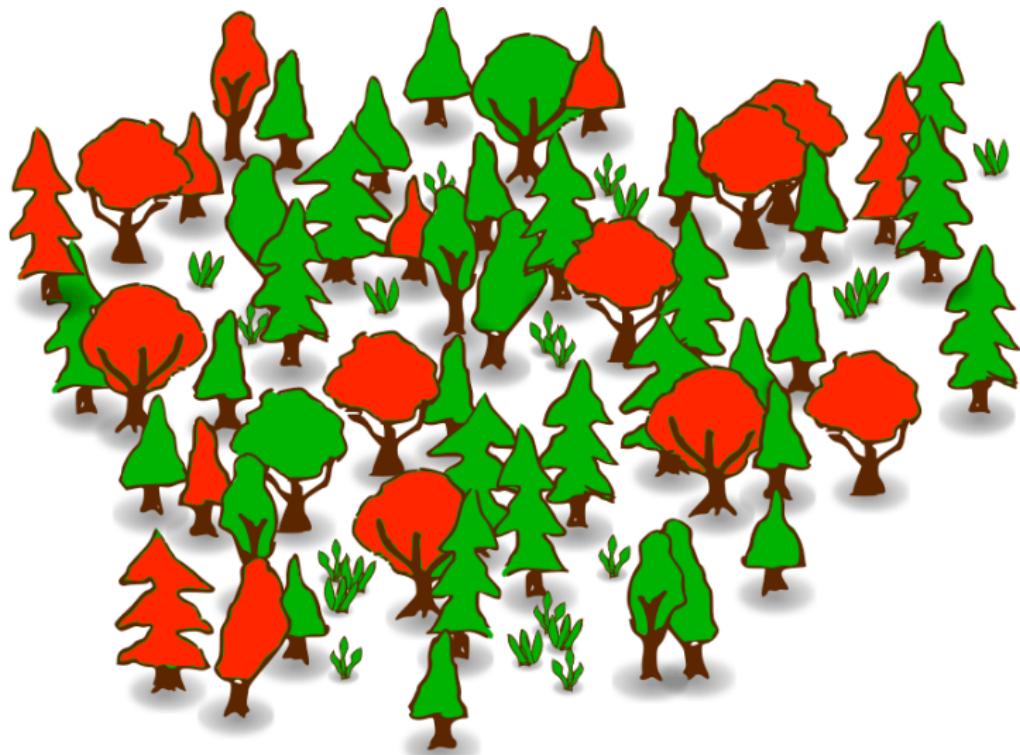
# Flux vs Temperature during Daylight



# Flux vs Soil Water Content at Night

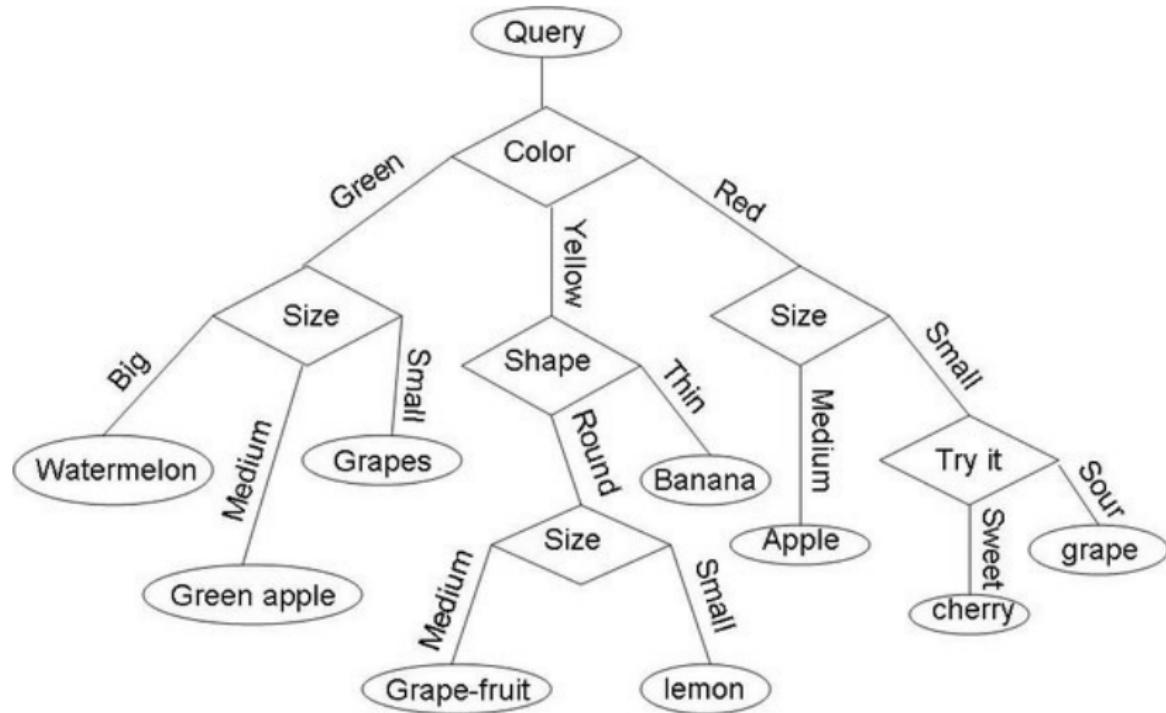


# Machine Learning: Random Forests<sup>1</sup>



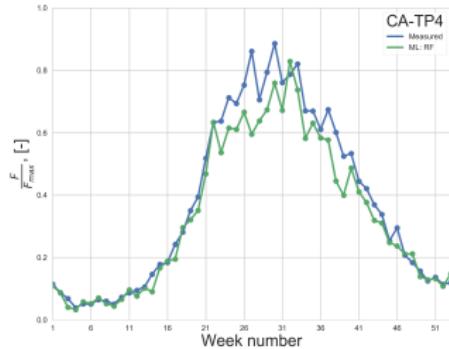
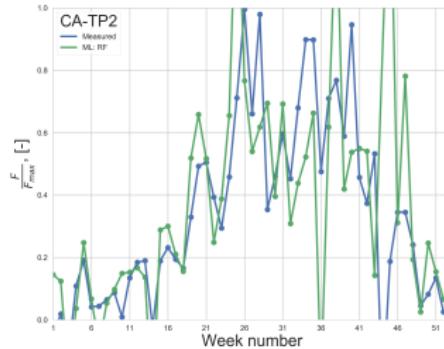
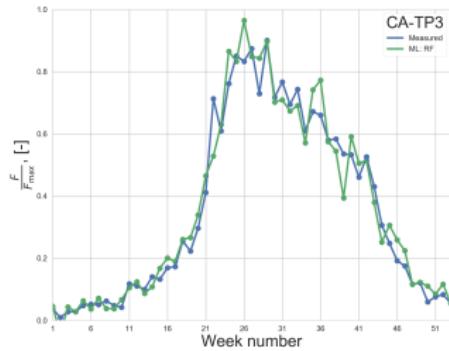
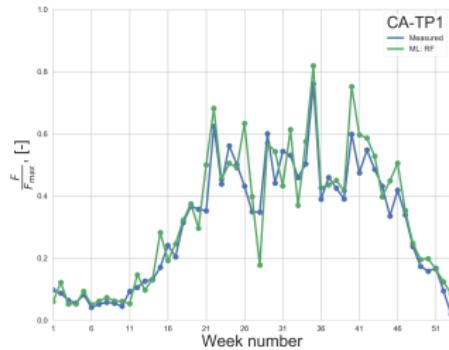
<sup>1</sup>Breiman, L. *Machine Learning* (2001) 45:5. doi:10.1023/A:1010933404324.

# Machine Learning: Random Forests



# Random Forests Algorithm: Predicted vs Measured (Night)

Features: Train only on Temperature; Vegetation type: Evergreen Needleleaf Forests

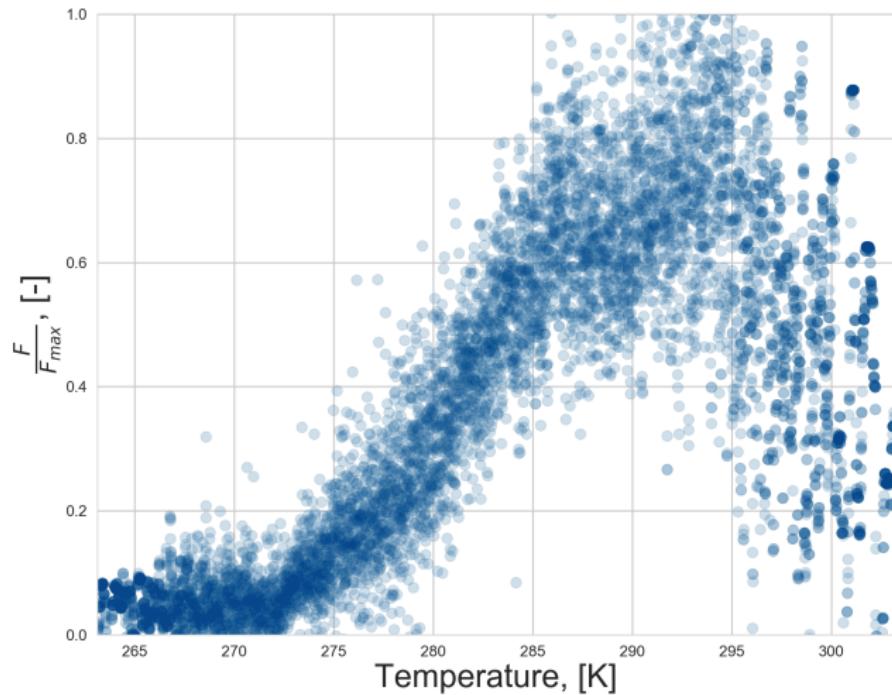


# Reverse Engineering of Random Forests Algorithm

$T = [-10; +30]$  with  $\Delta T = 0.001$

# Reverse Engineering of Random Forests Algorithm

T dependence (Night)



# Reverse Engineering of Random Forests Algorithm

## T dependence (Night)

Modified Arrhenius equation for optimum T:

$$\frac{F}{F_{max}} = \frac{\exp\left[\frac{-E_a}{RT_0}\left(1 - \frac{T_0}{T}\right)\right]}{1 + \exp\left[\frac{ST-H}{RT}\right]} \quad (1)$$

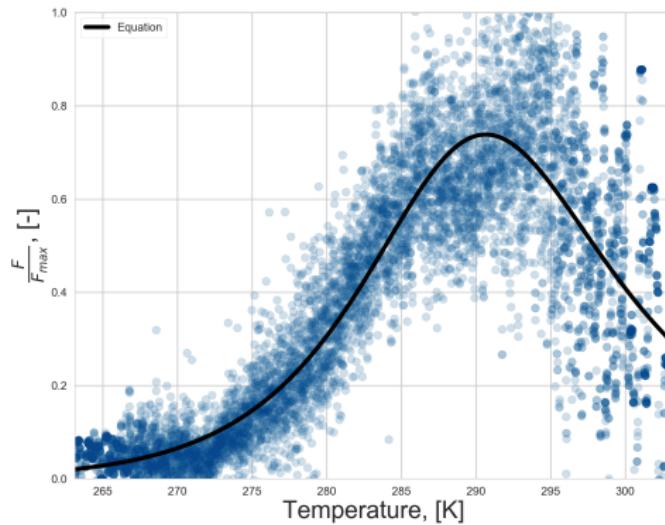
Fitting params:

$$T_0 = 287.5 \text{ K} \quad (2)$$

$$E_a = -99.8 \text{ kJ/mol} \quad (3)$$

$$S = 653.5 \text{ J/mol/K} \quad (4)$$

$$H = 189.7 \text{ kJ/mol} \quad (5)$$



# Reverse Engineering: Measured vs ML:RF vs Eq. 1

ML:RF - Machine Learning: Random Forests Algorithm

