



# Phenology modelling

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**[https://geco-bern.github.io/  
handfull\\_of\\_pixels/](https://geco-bern.github.io/handfull_of_pixels/)**

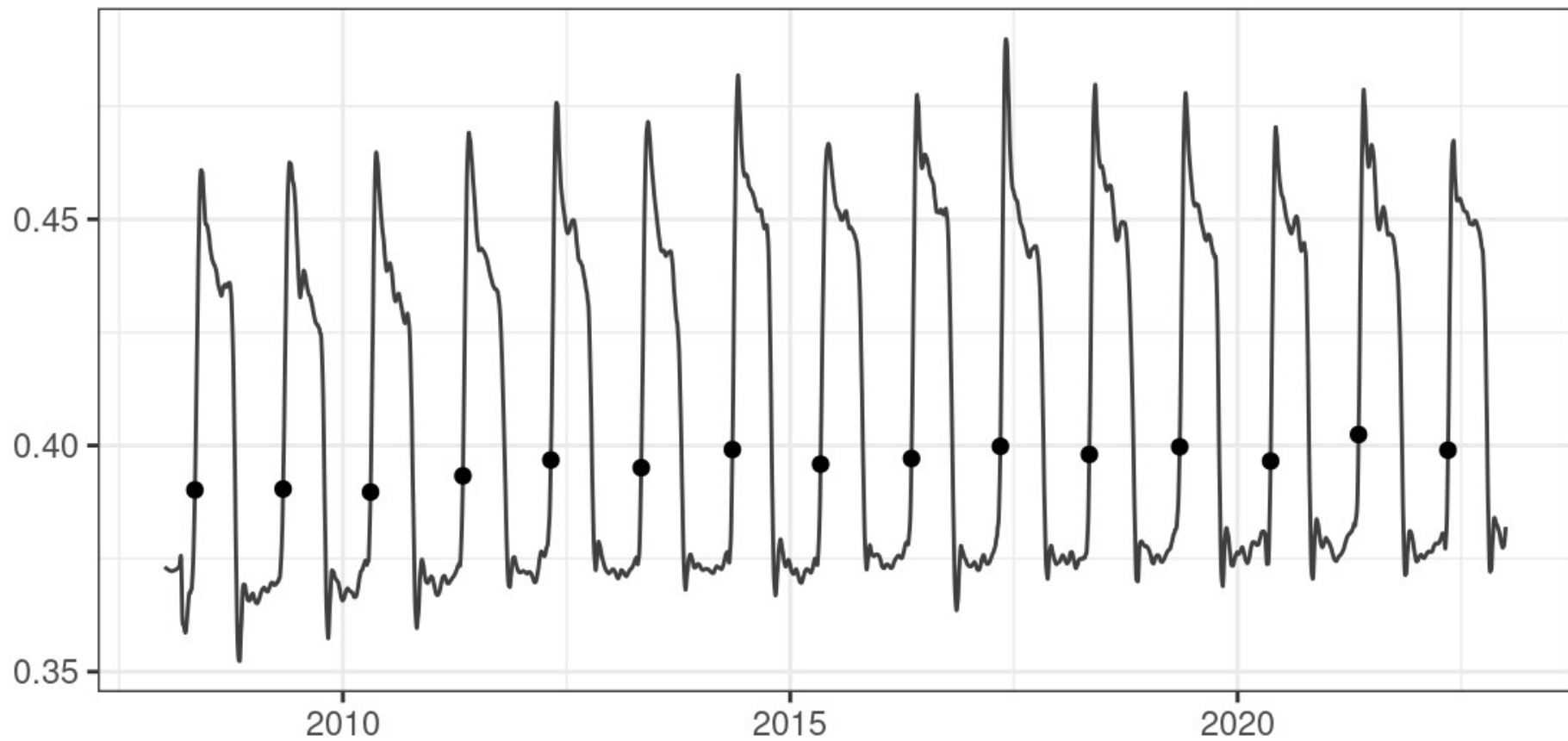
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**Phenology has a profound impact on carbon and water exchange between the biosphere and atmosphere**

Harvard Forest Barn Tower DCP NetCamSC Wed May 07 07:46:34.434 2014  
Exposure: 1/631 (76) Frame: 334143



GCC



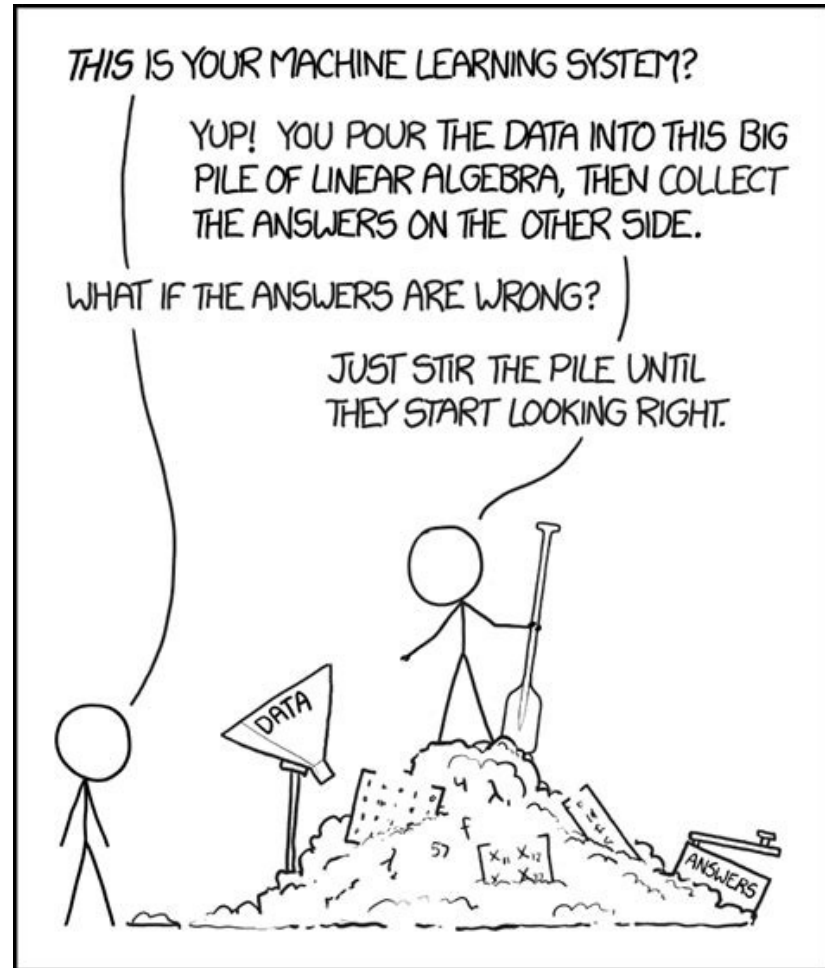


## Why phenology?

- The importance of the process
- The pseudo-mechanistic modelling approach

# Machine Learning

(<https://xkcd.com/1838/>)





# Machine Learning ~ mechanistic modelling

## **ML**

- The model structure has no or limited physical meaning
- Complex and undefined (physically speaking)

## **Mechanistic**

- Built in (physical) assumptions
- Domain knowledge
- Not fully deterministic
  - free parameters remain





# Machine Learning

$$Y = a + b * X$$



## Mechanistic modelling

$$Y = f(X, \mathbf{a}, \mathbf{b})$$

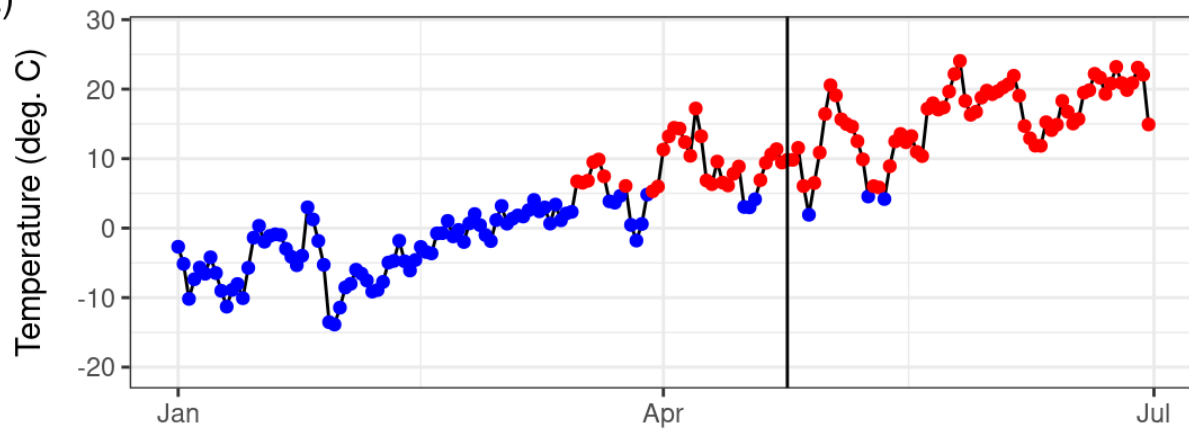
**f = custom model**

Growing degree days are defined as the cumulative sum of temperatures above a specified threshold ( $T_0$ , most commonly  $T_0 = 5^\circ\text{C}$ ).

$$\text{GDD}_{T_0,j} = \sum_{i=M}^j \max(T_i - T_0, 0).$$

$M$  is the date at which the summation is initiated, and  $\text{GDD}_{T_0,M-1} = 0$ . In [R](#), this can be implemented as shown below.

(a)



(b)

