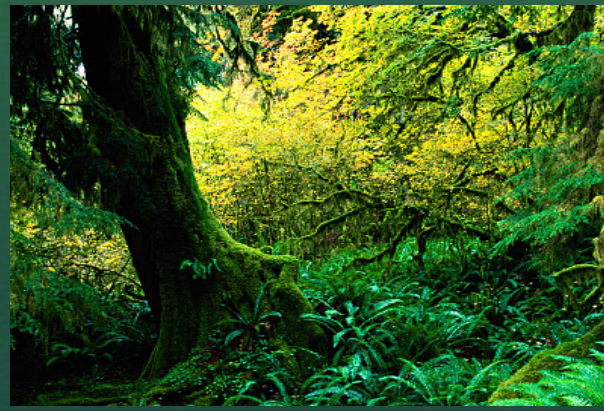


Effects of vegetation structure on biomass in a coupled water-carbon-energy balance model

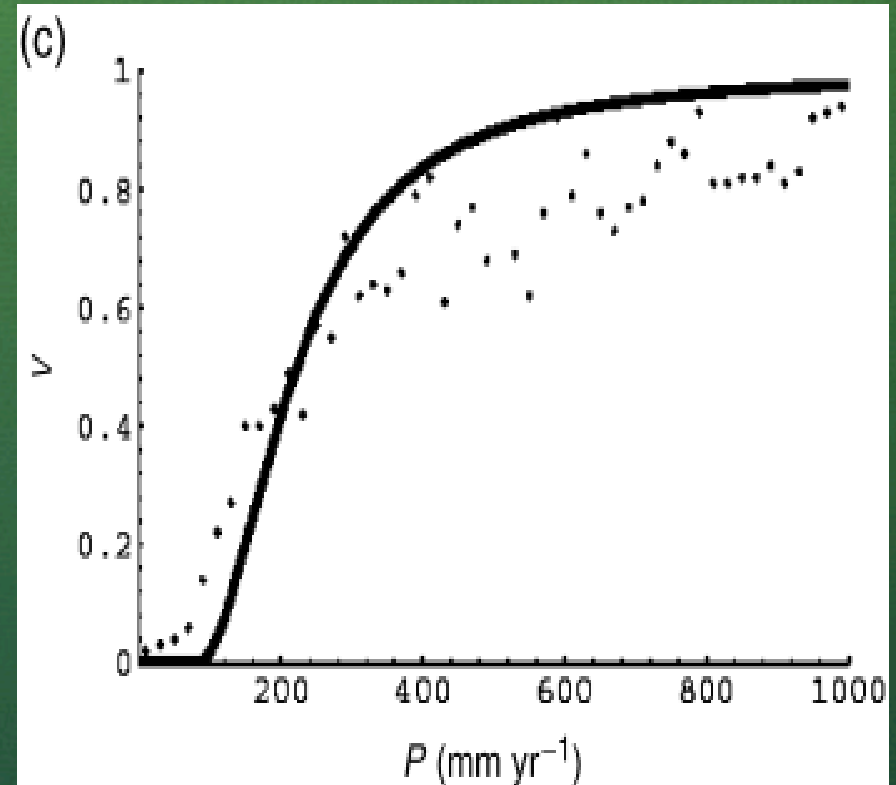
Z. Yin, S.C Dekker, B.J.J.M. van den Hurk, H.A. Dijkstra

Precipitation ? woody cover



Precipitation and woody cover

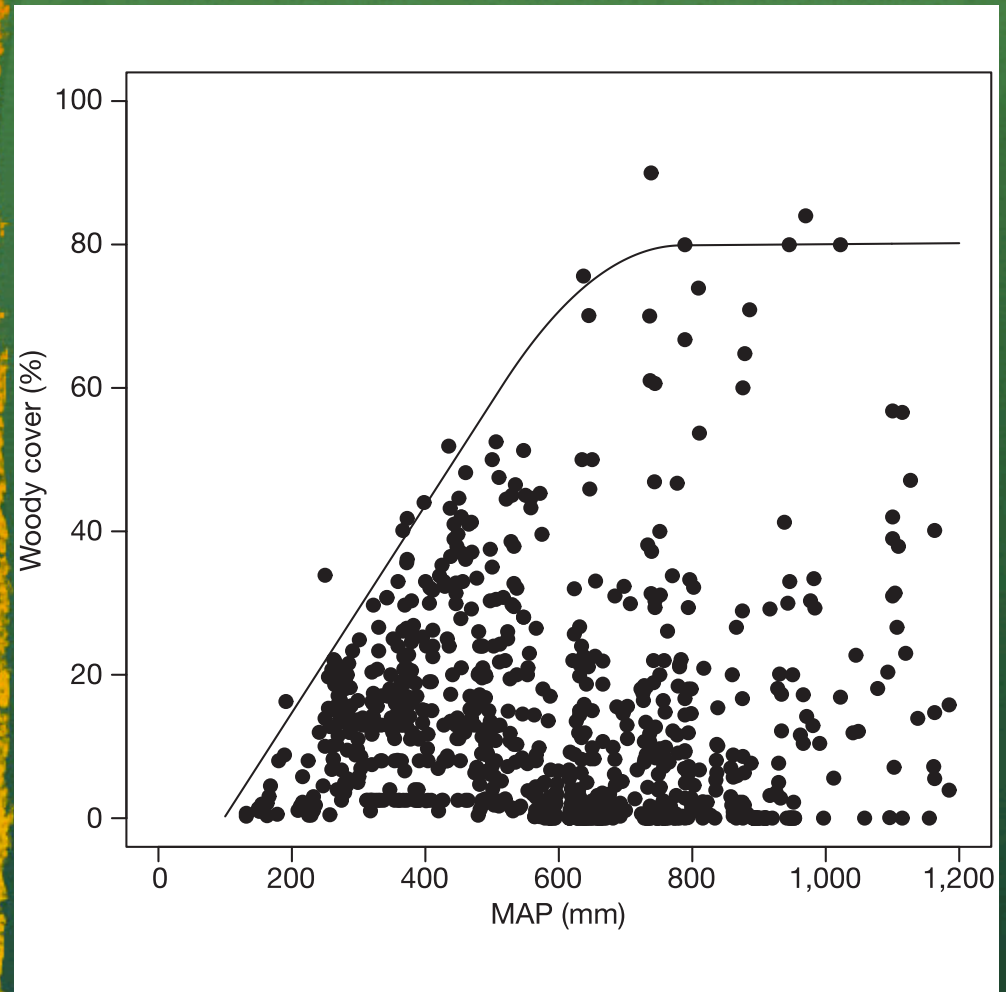
- Simple **positive** relation



Scheffer et al. 2005

Precipitation and woody cover

- Maximum woody cover increases with mean annual precipitation.
- Huge variation of woody cover from 0 to maximum.

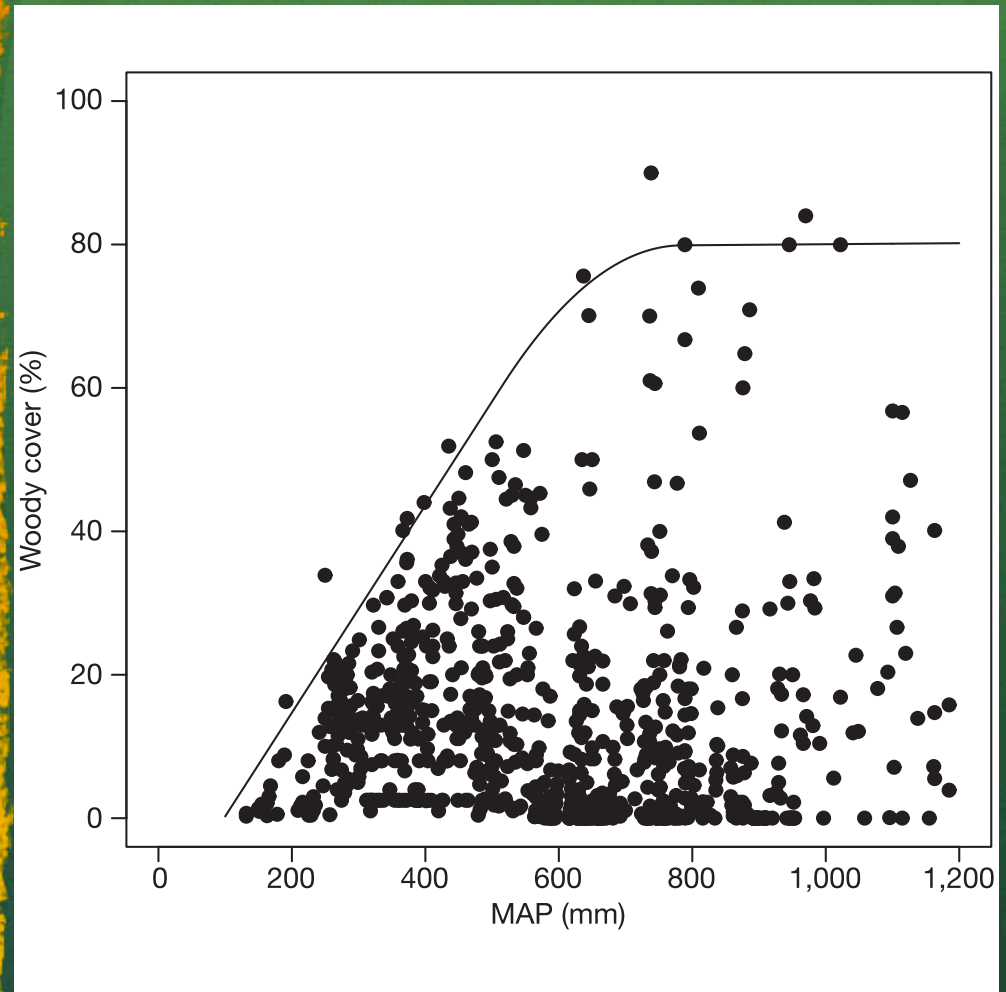


Shakaran et al. 2005

Motivations

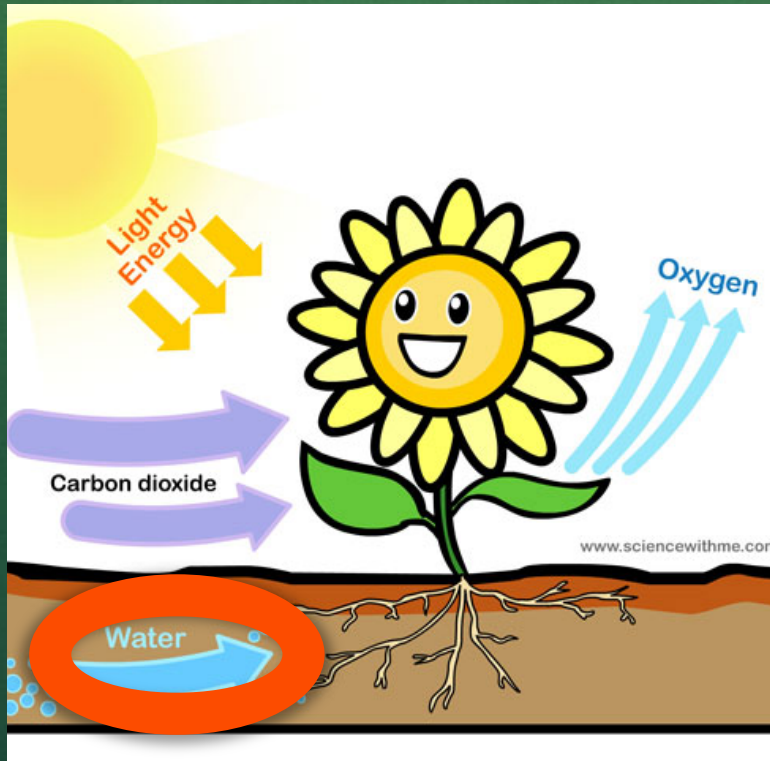
What **factors** lead to **huge difference** of woody cover and biomass with certain precipitation?

What **type** of vegetation can reach the **maximum** coverage or biomass?

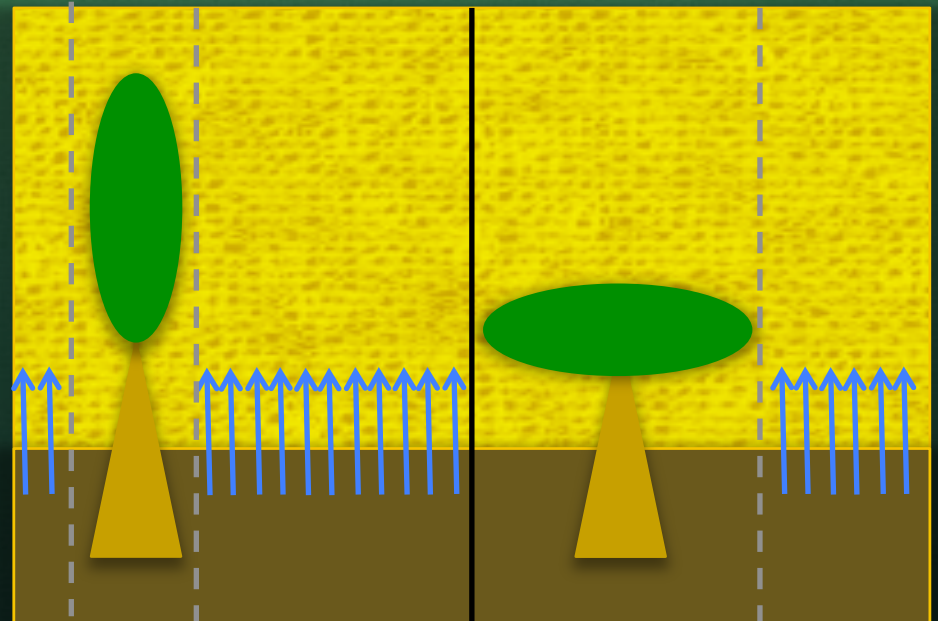


Shakaran et al. 2005

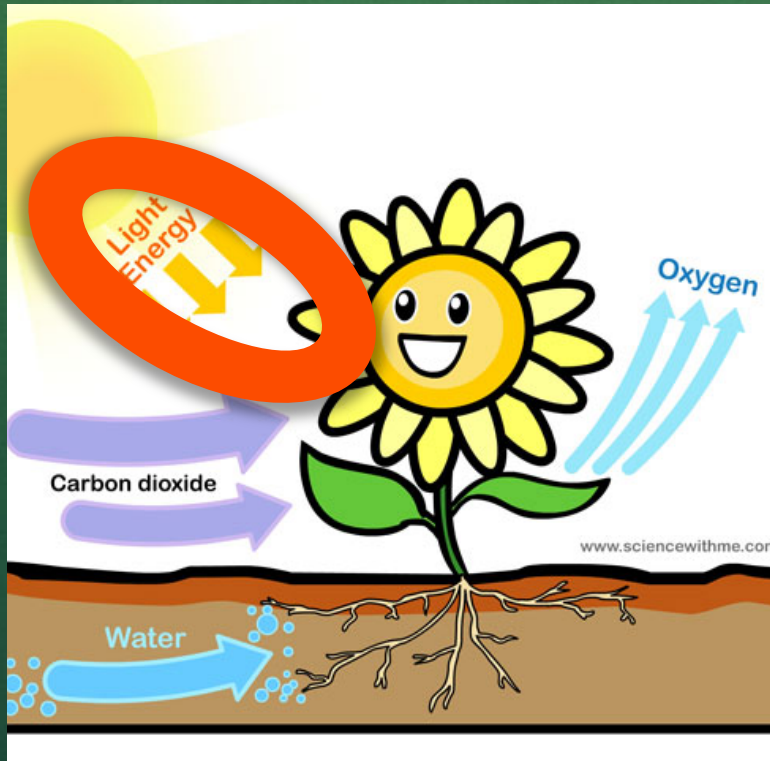
Vegetation VS. Bare soil



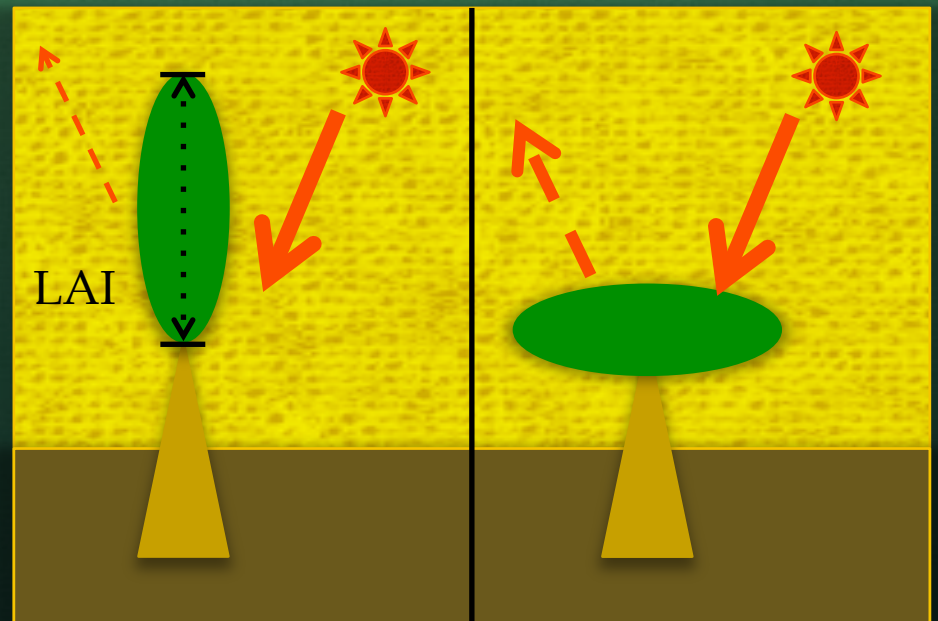
- Leaf coverage (fc)



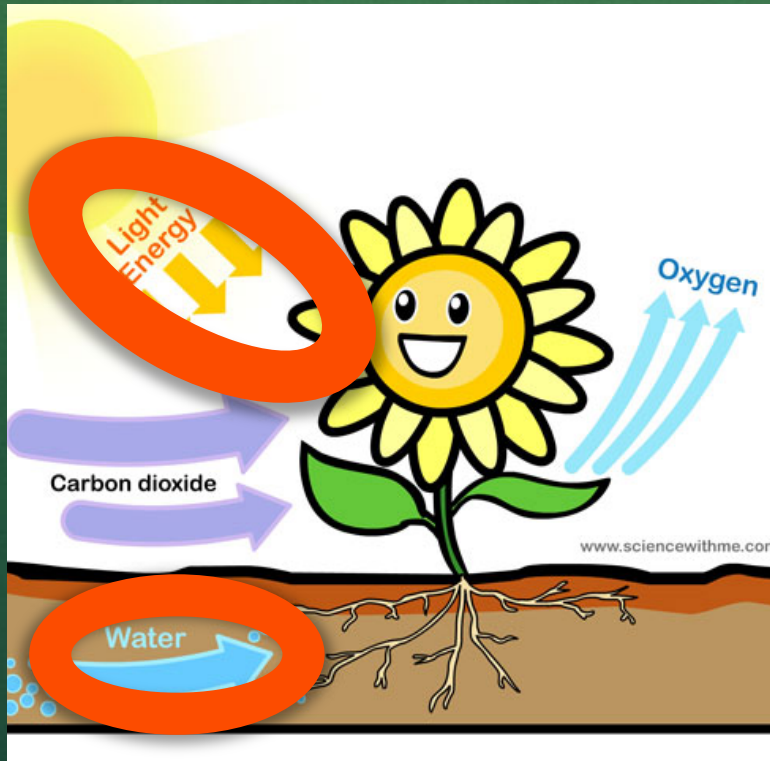
Light absorption



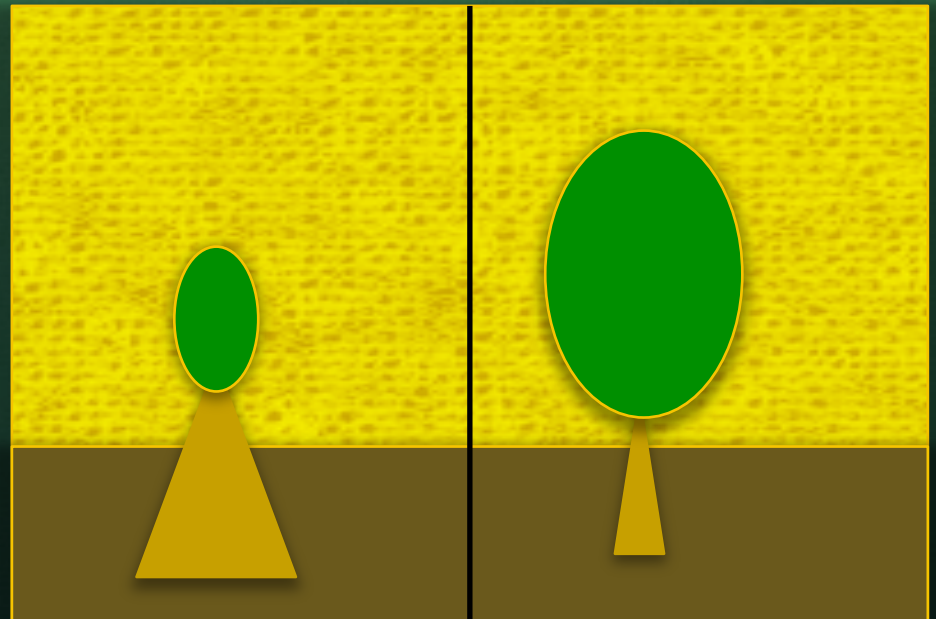
- Leaf Area Index (LAI)



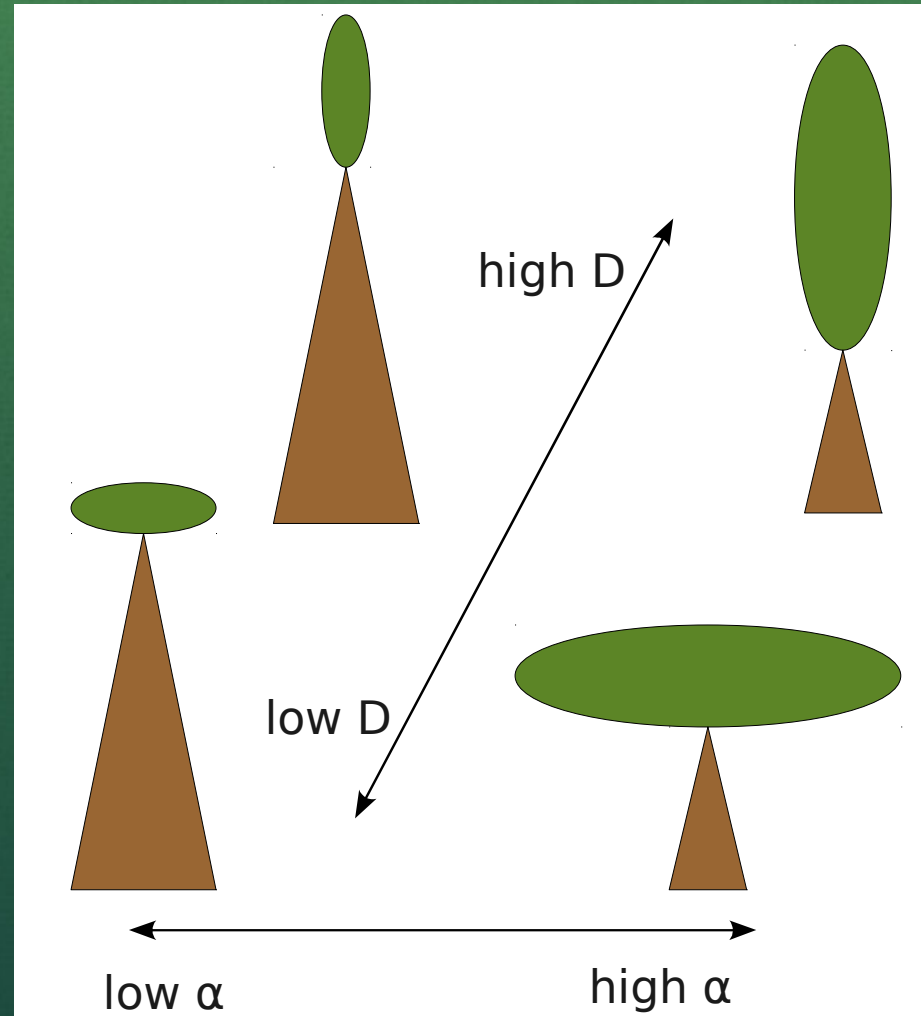
More energy? Or more water?



- Shoot-root ratio (α)

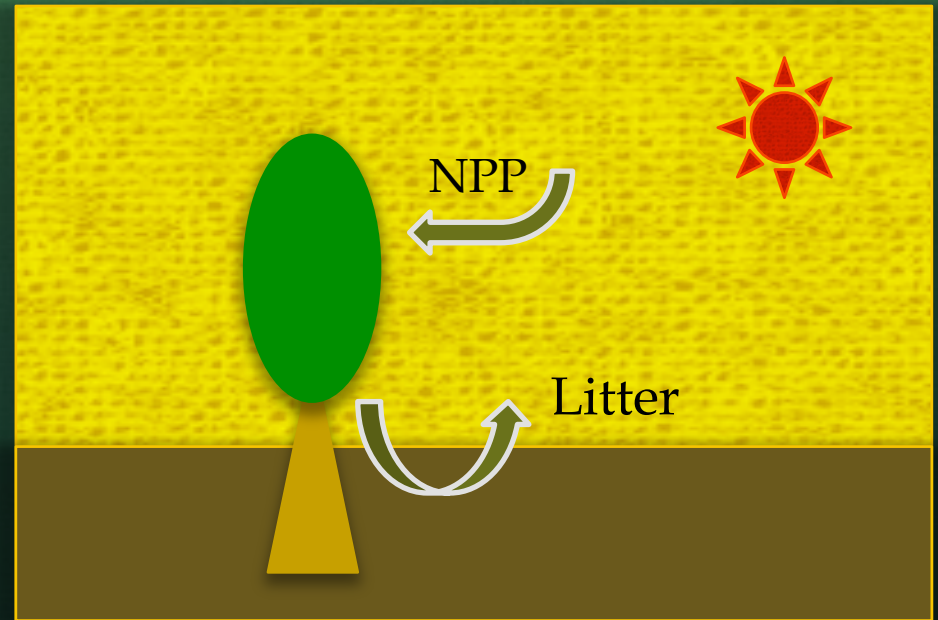


Vegetation structures



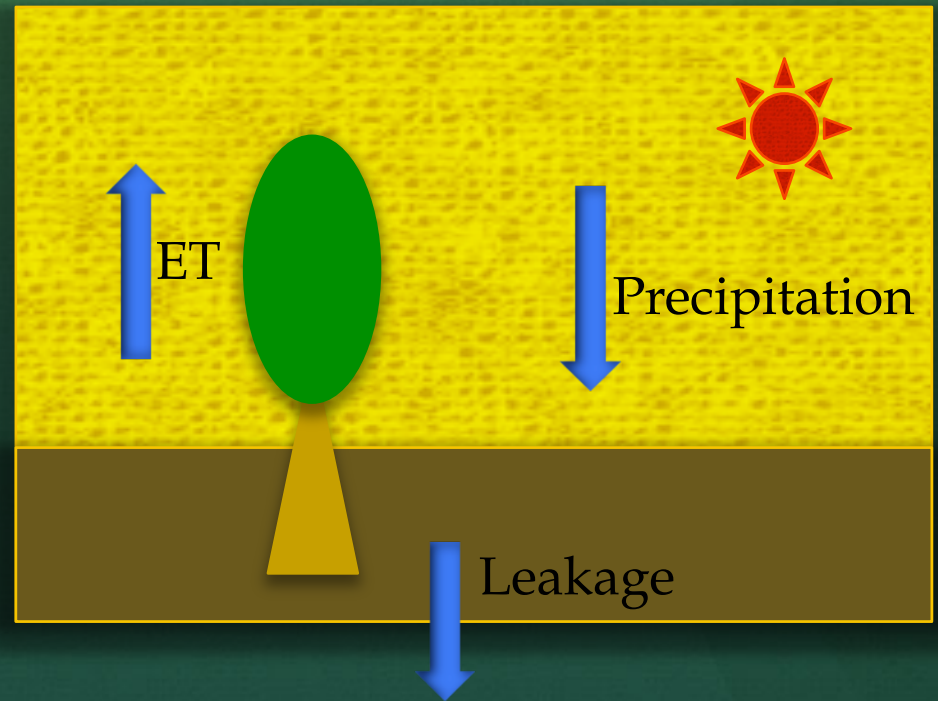
Carbon-water-energy coupled model

$$\frac{dC_{veg}}{dt} = NPP - LIT$$



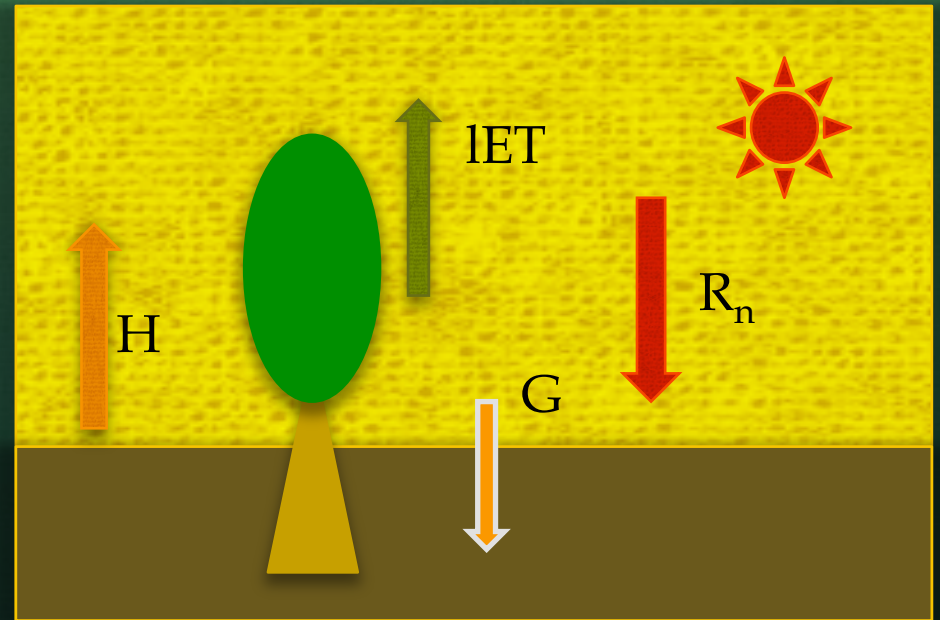
Carbon-water-energy coupled model

$$\frac{dW}{dt} = P - Leak - ET$$



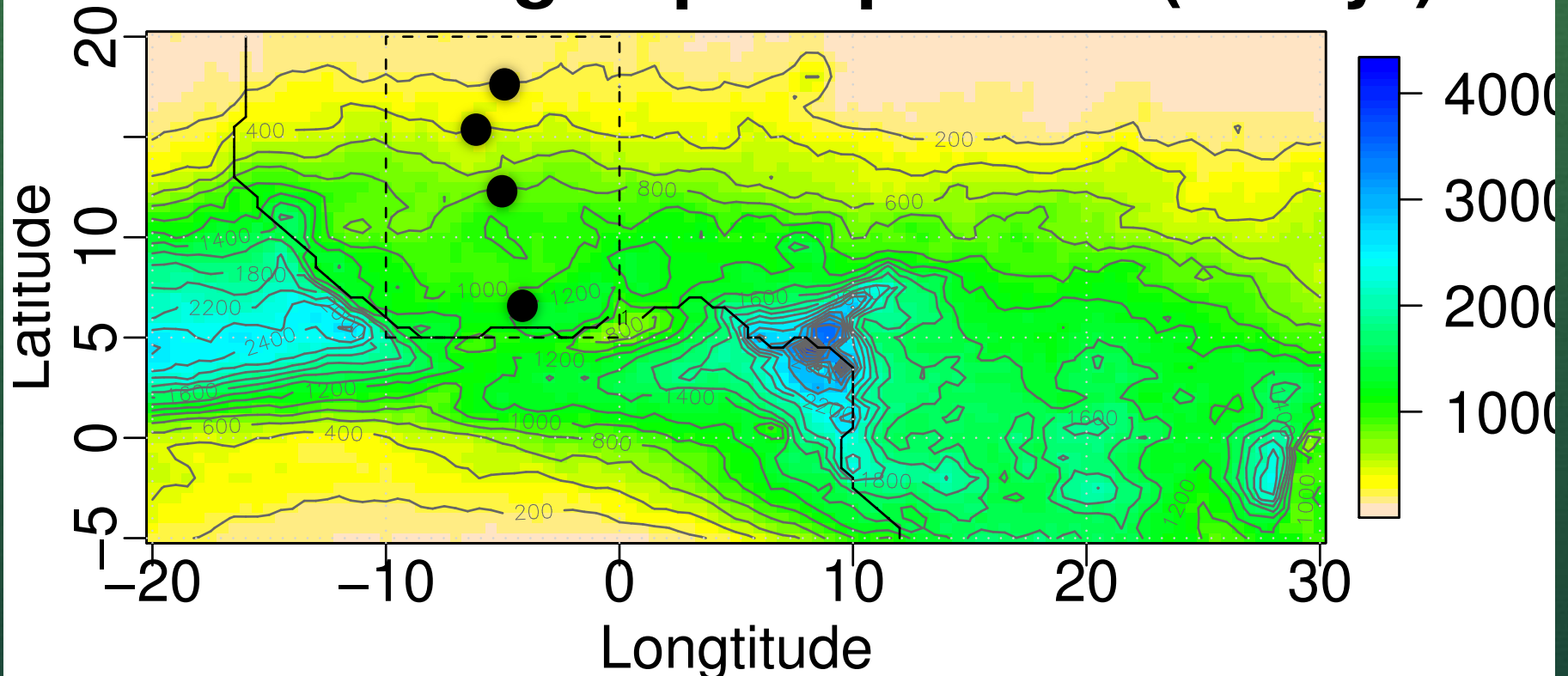
Carbon-water-energy coupled model

$$R_n = H + lET + G$$

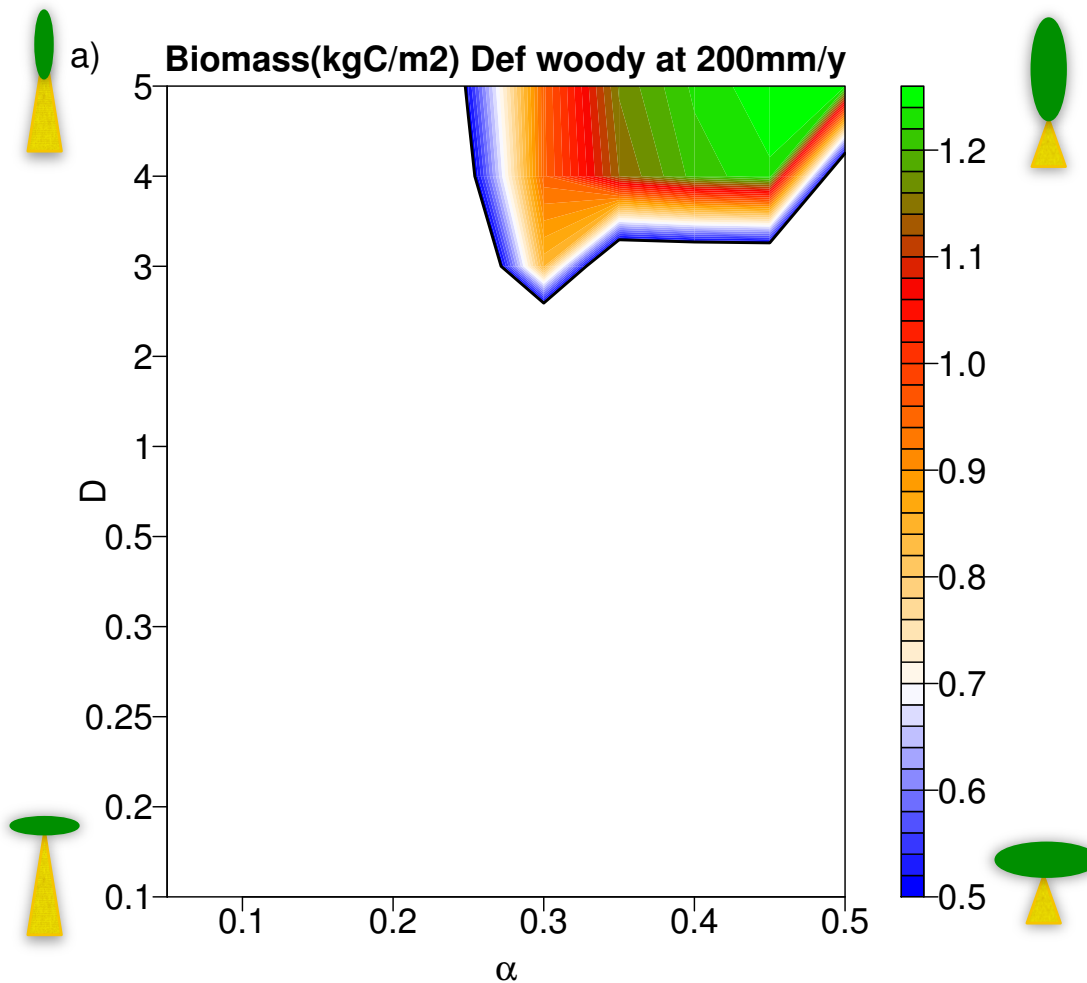


Exp I: Sensitivity analysis of vegetation structures

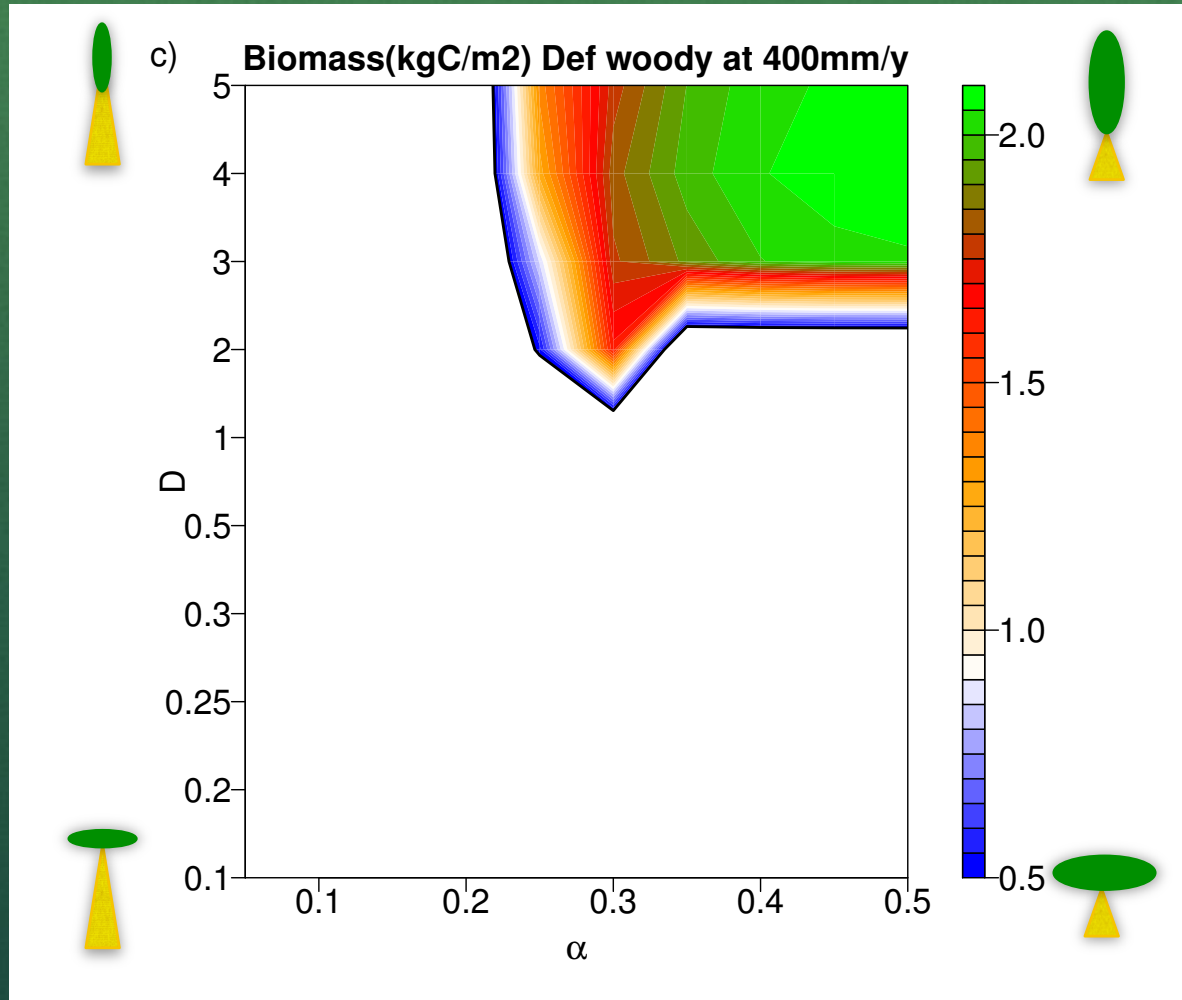
Annual averaged precipitation (mm/yr)



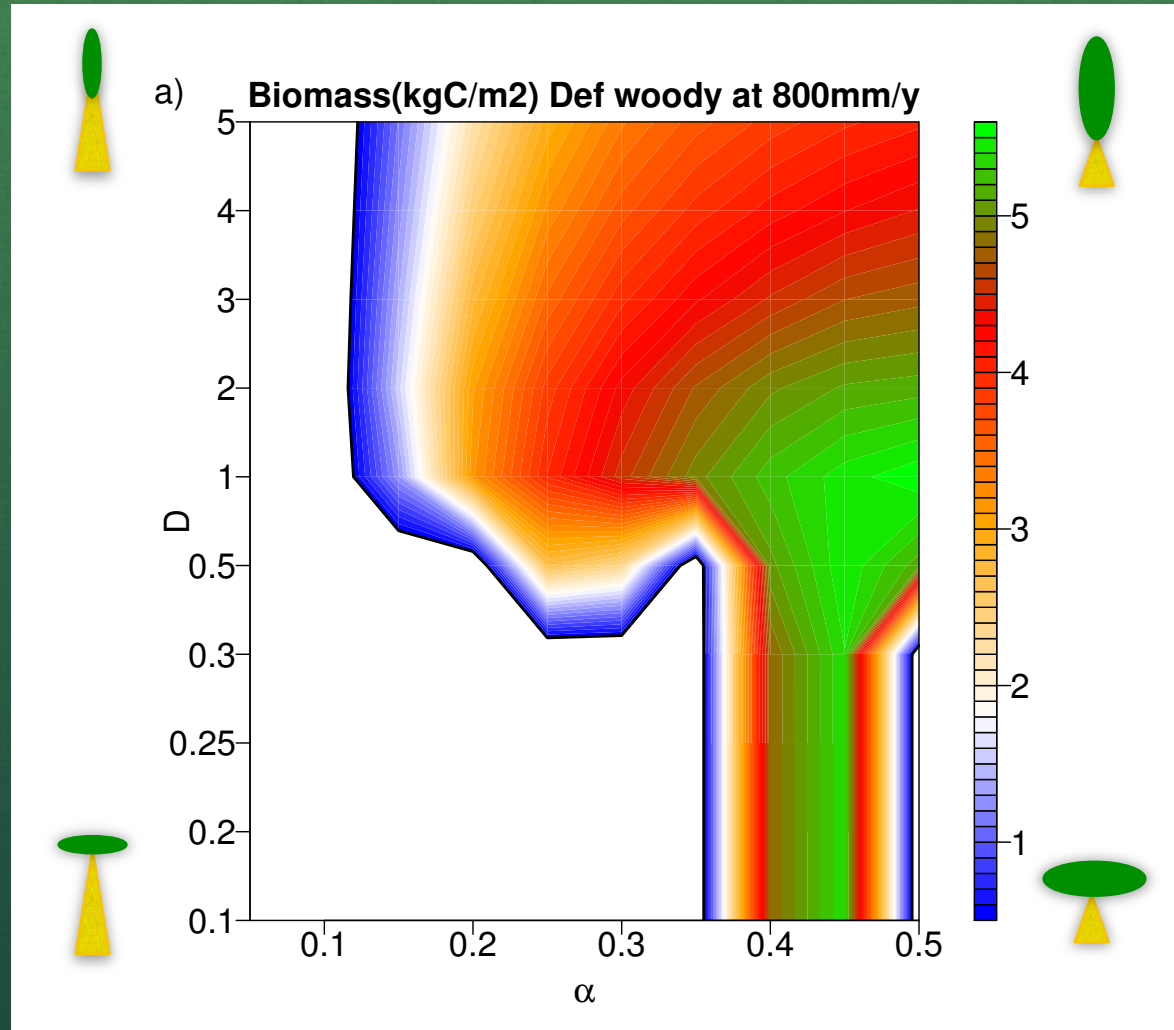
MAP:200mm/yr



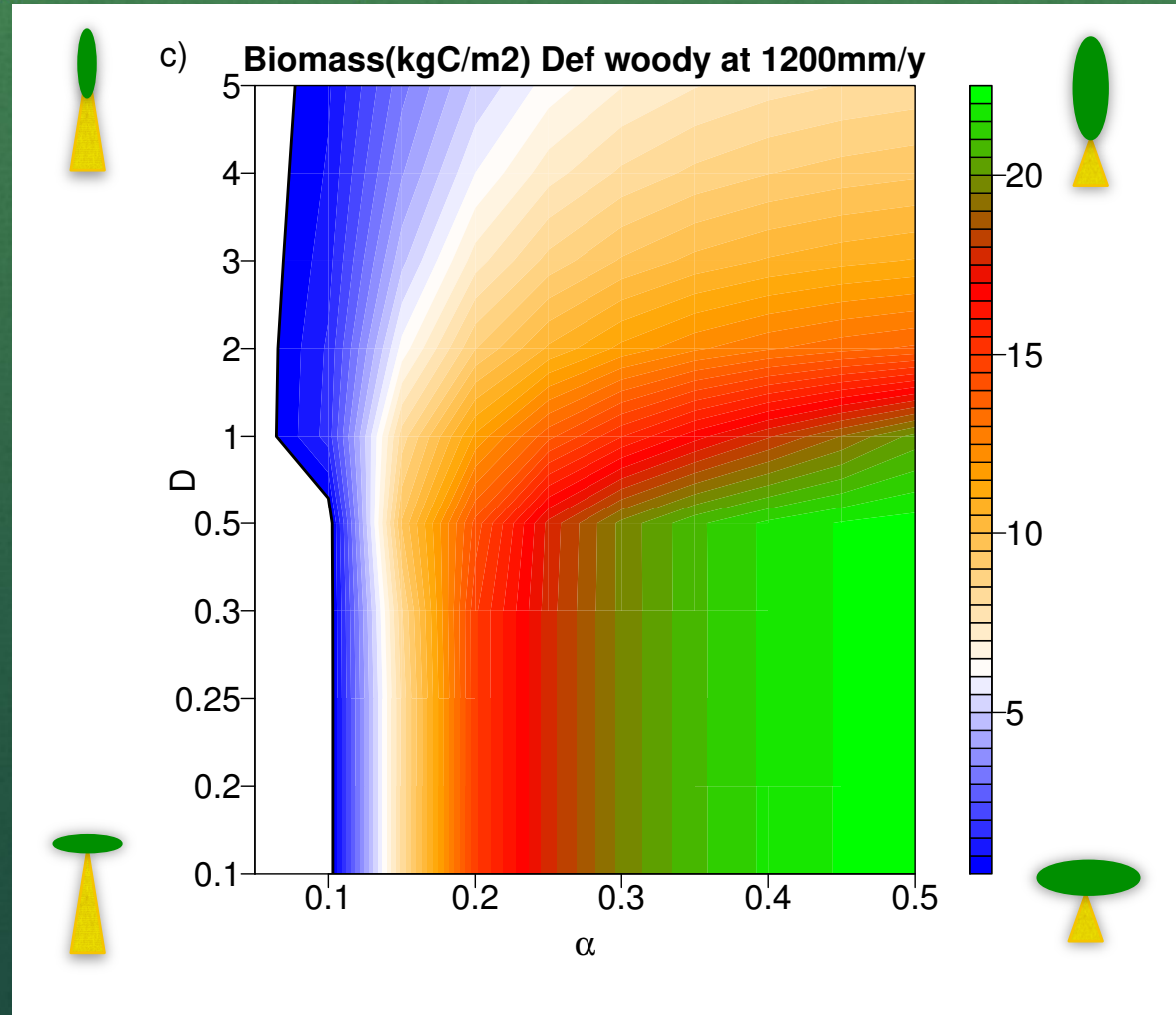
MAP:400mm/yr



MAP:800mm/yr

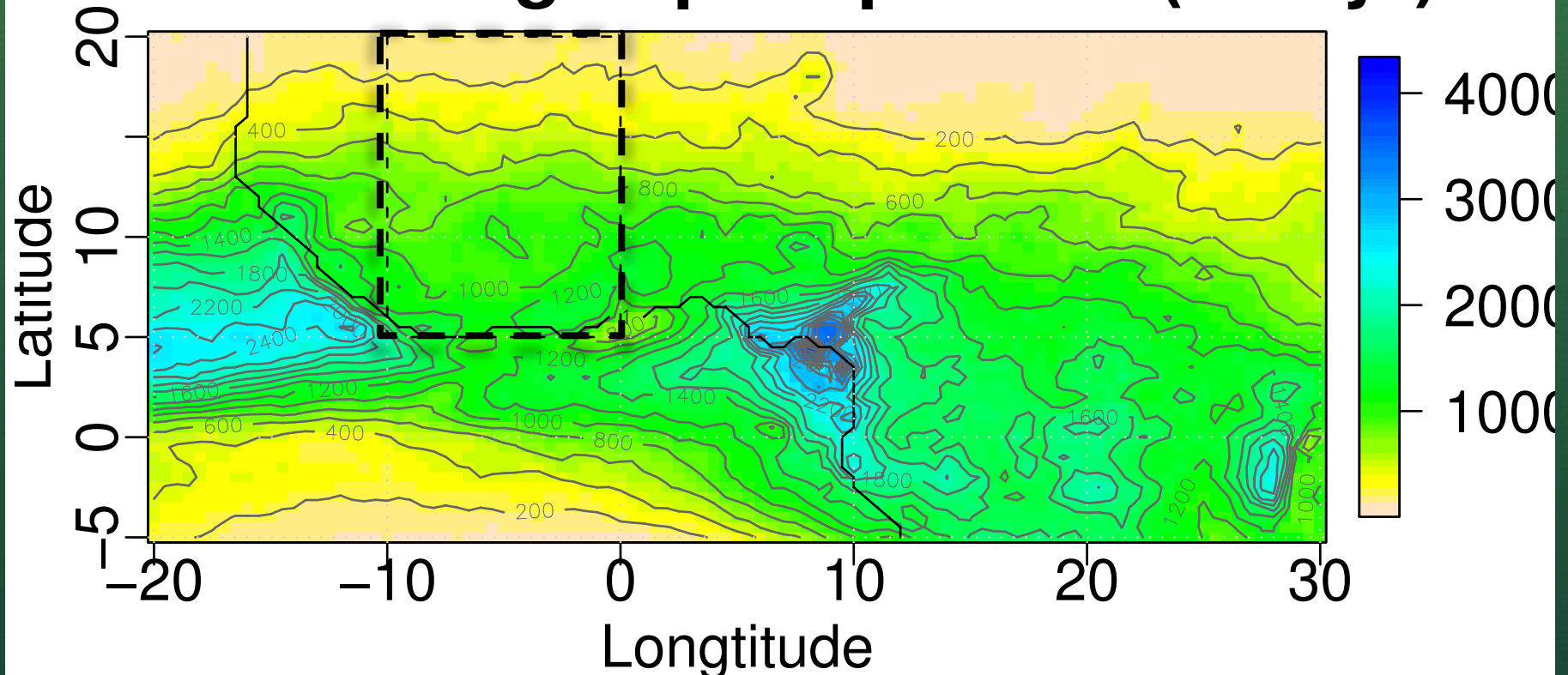


MAP:1200mm/yr

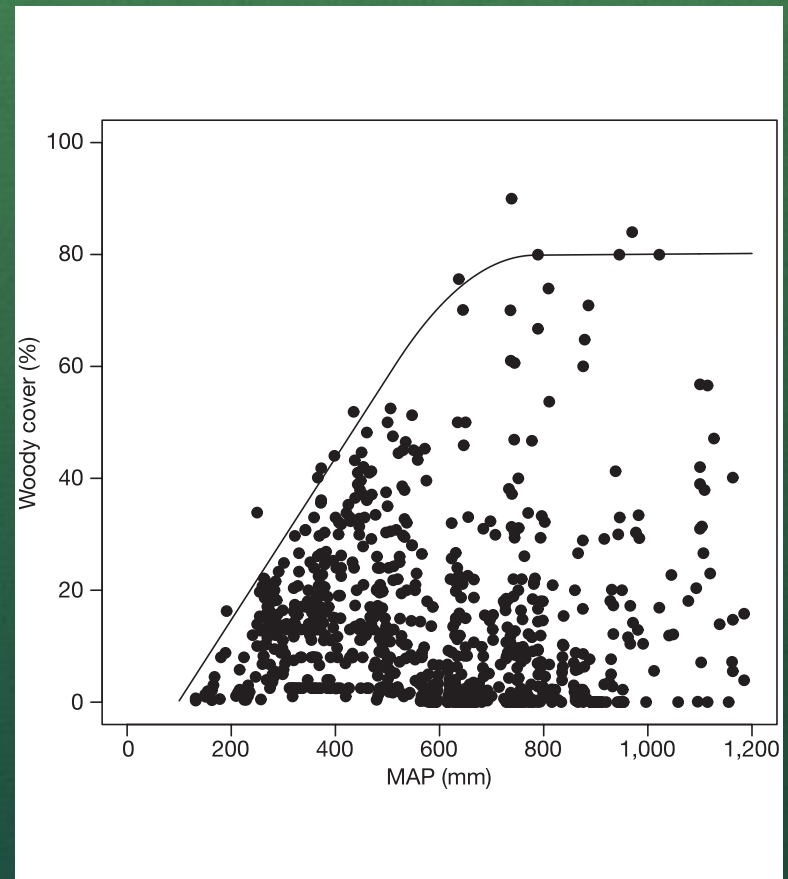
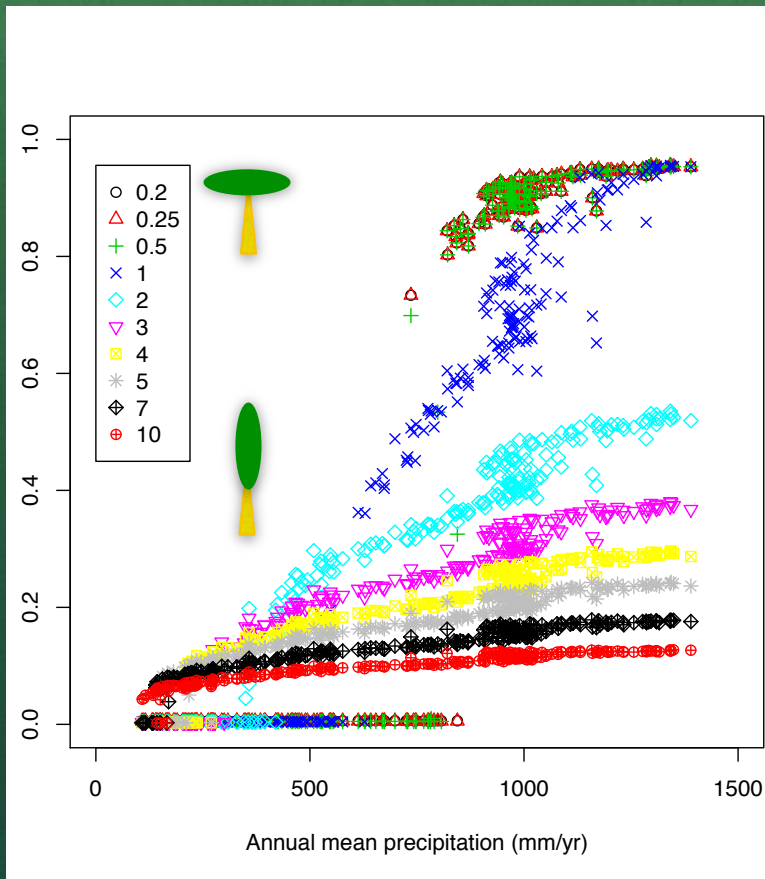


Exp II: Rainfall-woody cover with 10 canopy structures

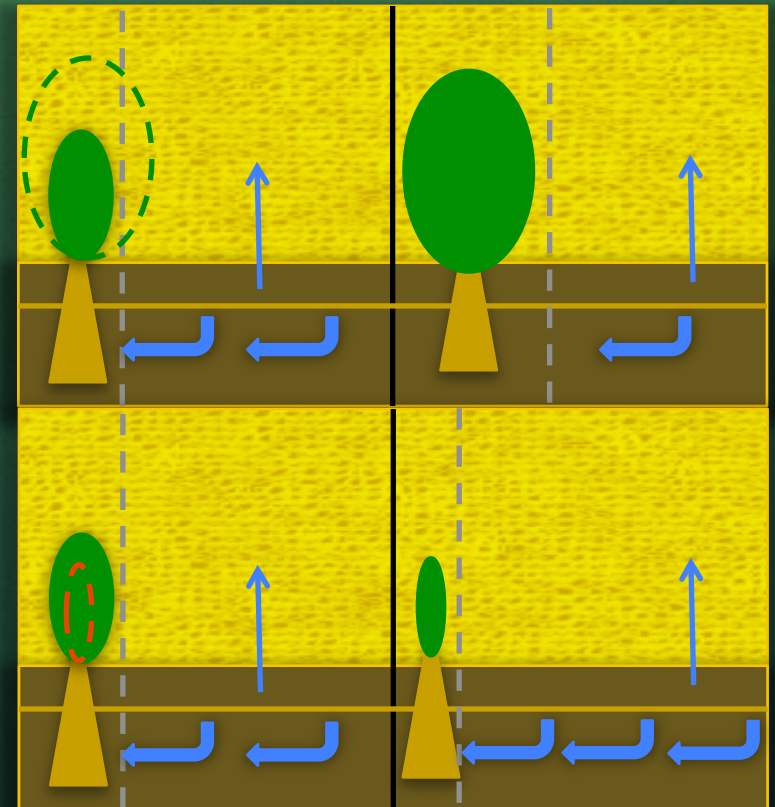
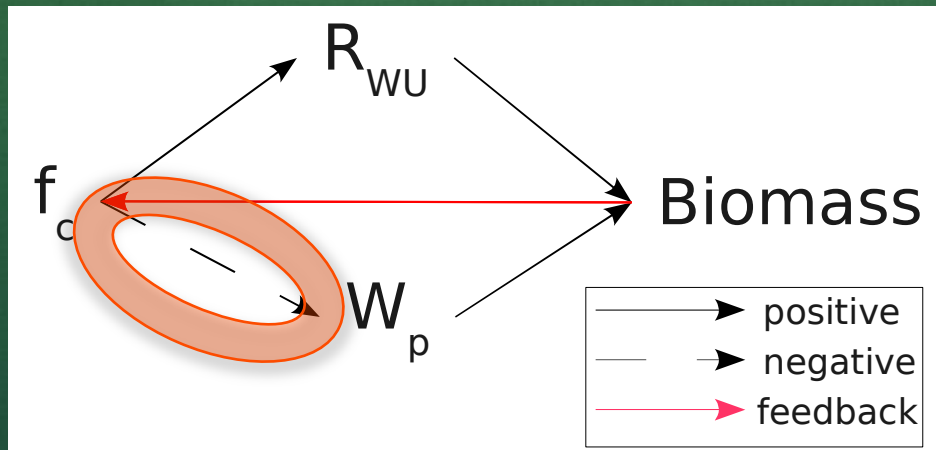
Annual averaged precipitation (mm/yr)



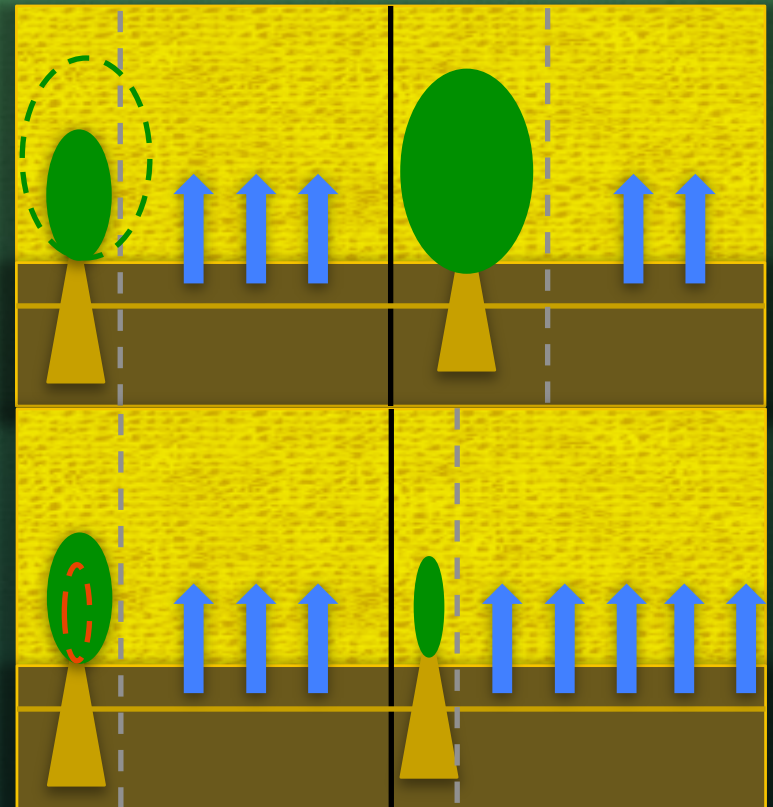
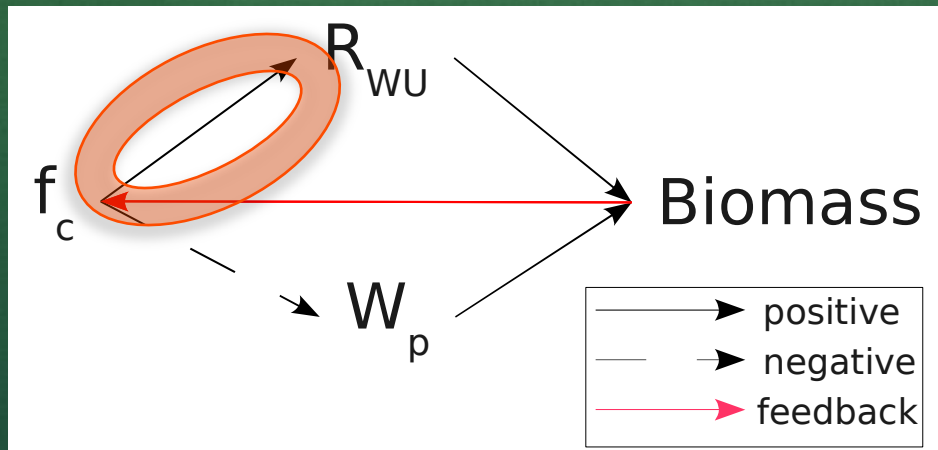
AMP VS. Woody Cover



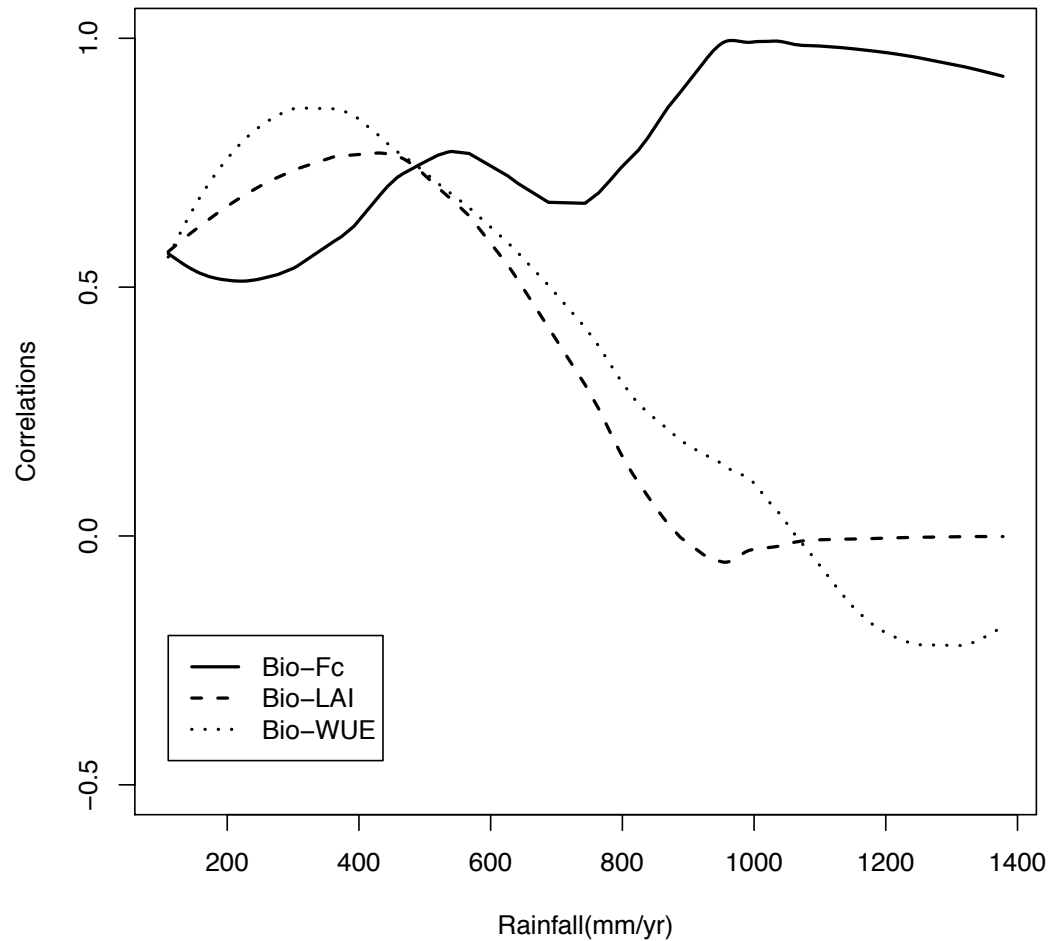
Two feedbacks: Negative feedback



Two feedbacks: Positive feedback

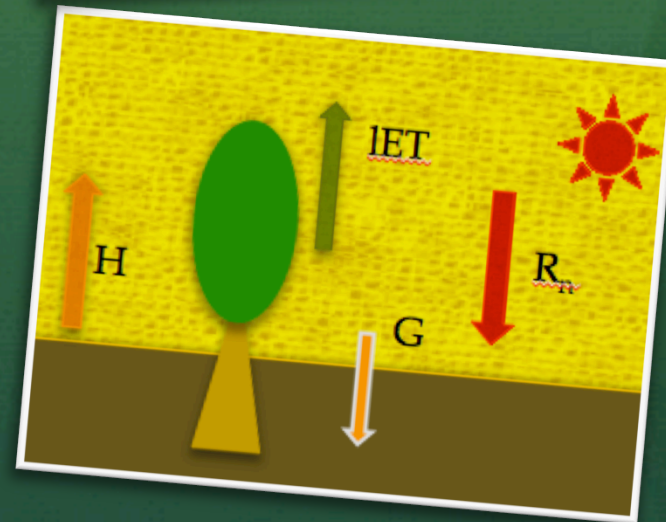
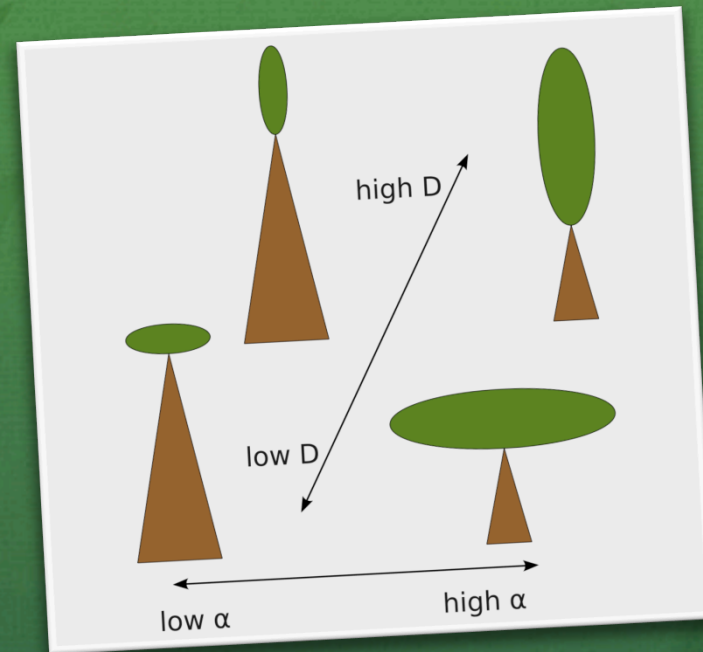


Dominant factor change with precipitation



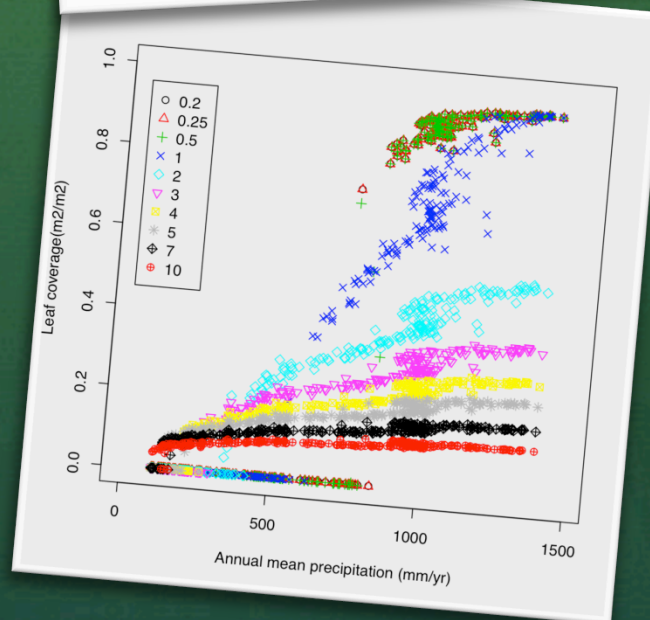
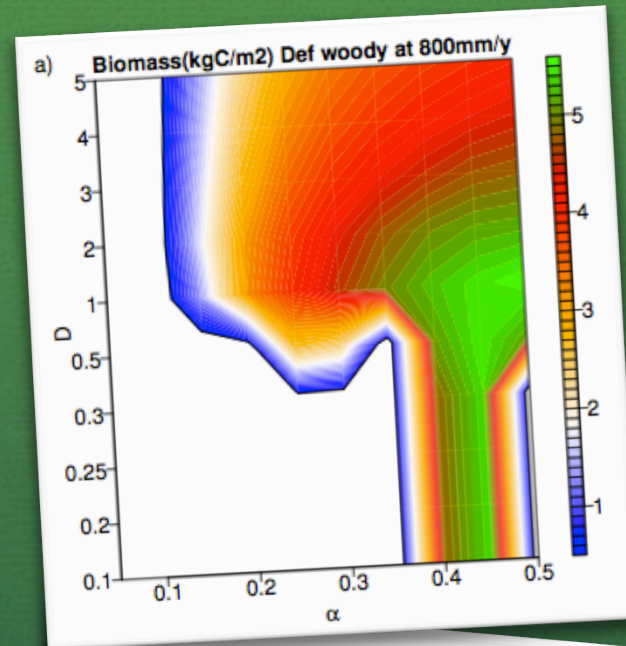
Reviews I

- Vegetation structures definition.
- Develop a carbon-water-energy coupled model



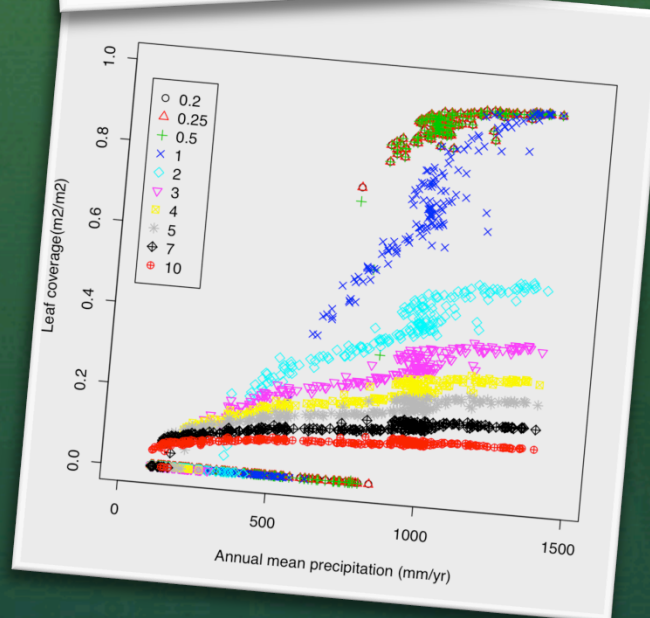
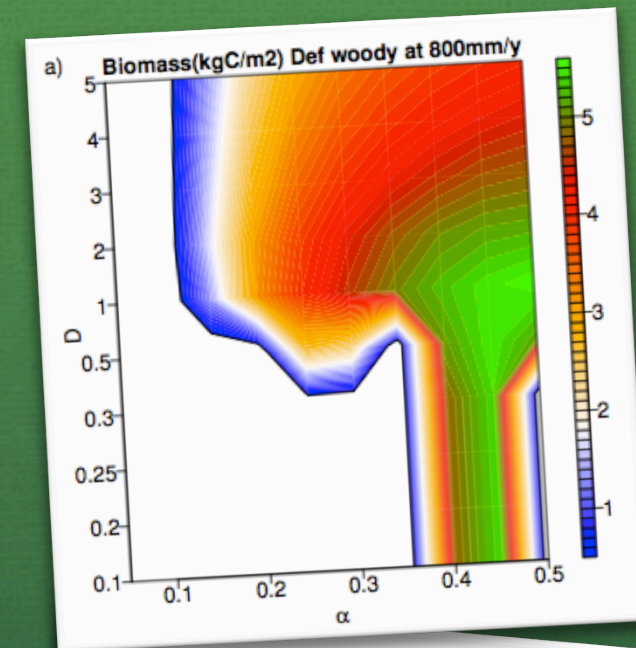
Reviews II

- EXP I: Sensitivity analysis of vegetation structure
- EXP II: Tree cover change with precipitation



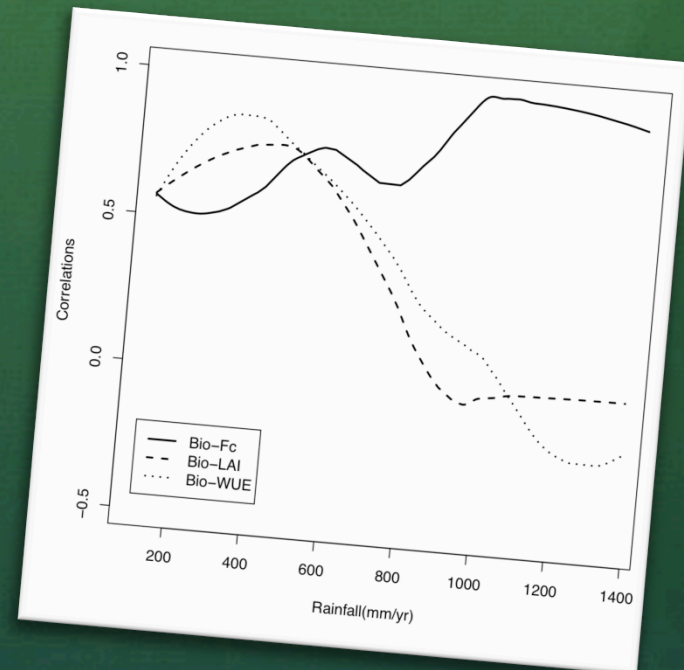
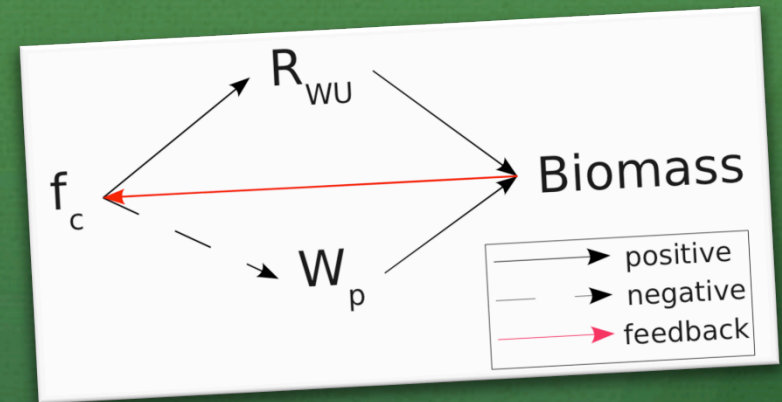
Conclusions I

- Vertical structure:
- Easy \rightarrow Survive
- Hard \rightarrow High Biomass
- Horizontal structure:
- Hard \rightarrow Survive
- Easy \rightarrow High Biomass



Conclusions II

- Two feedbacks.
- **Negative** feedback:
- Dominate \rightarrow Arid
- State \rightarrow Stable
- **Positive** feedback:
- Dominate \rightarrow Wet
- State \rightarrow Unstable



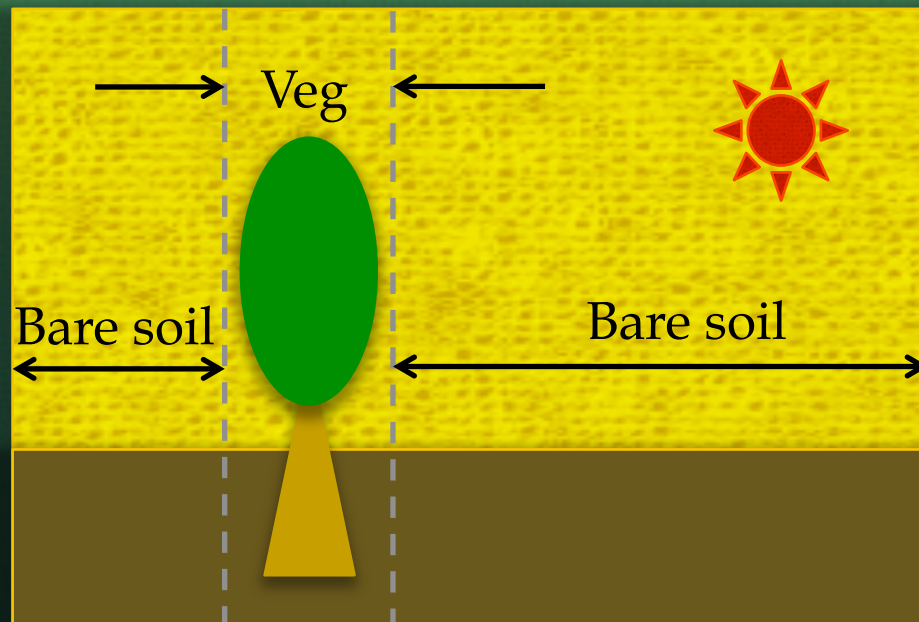
Thanks



Email: Z.YIN@uu.nl



Tiling method



Two-soil layer theme

