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Wind sensing and thigmomorphogenetic as a major contributor to the trait of in a beech forest.



enhancement of secondary growth biomechanical resistance to wind

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Context

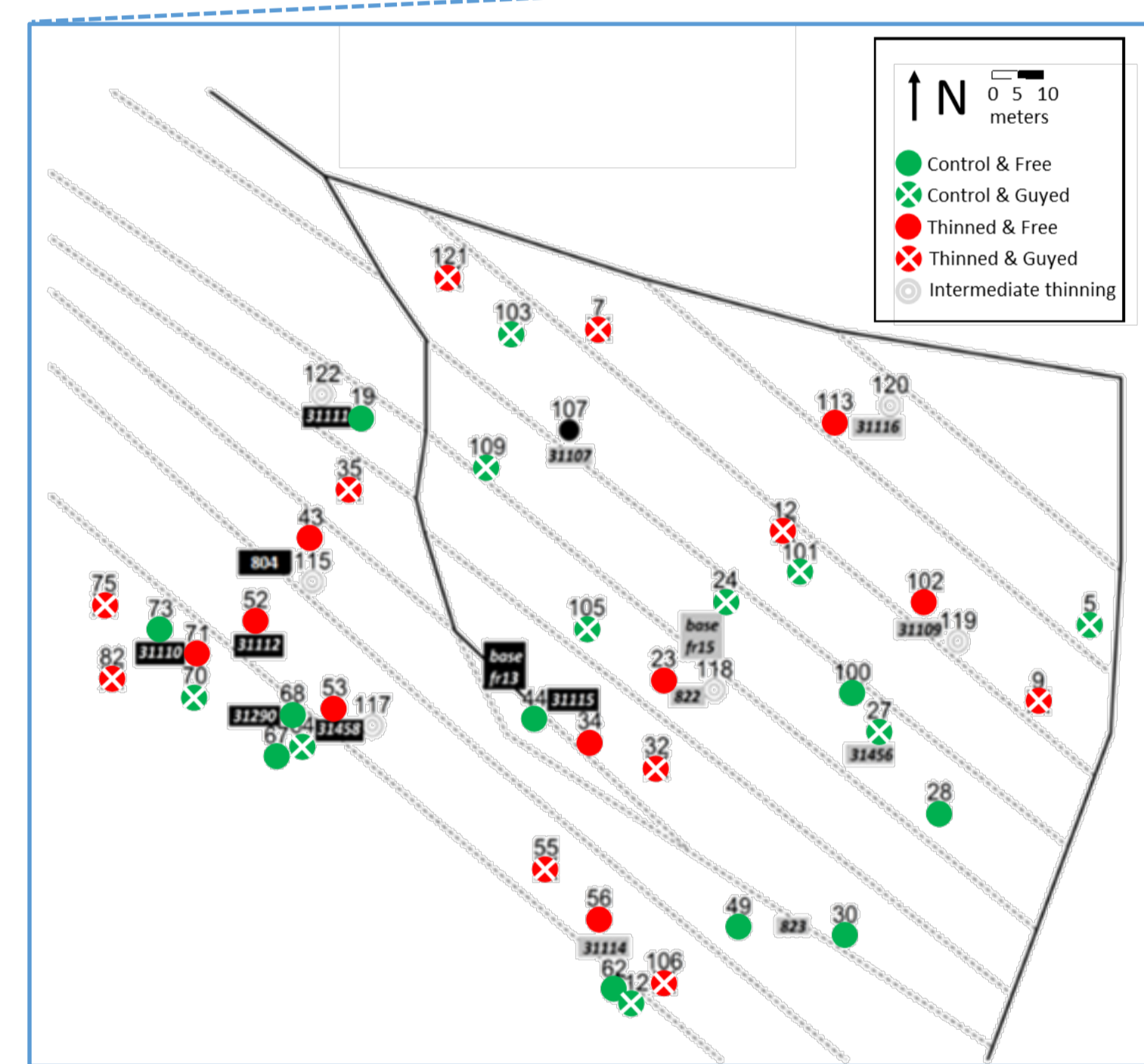
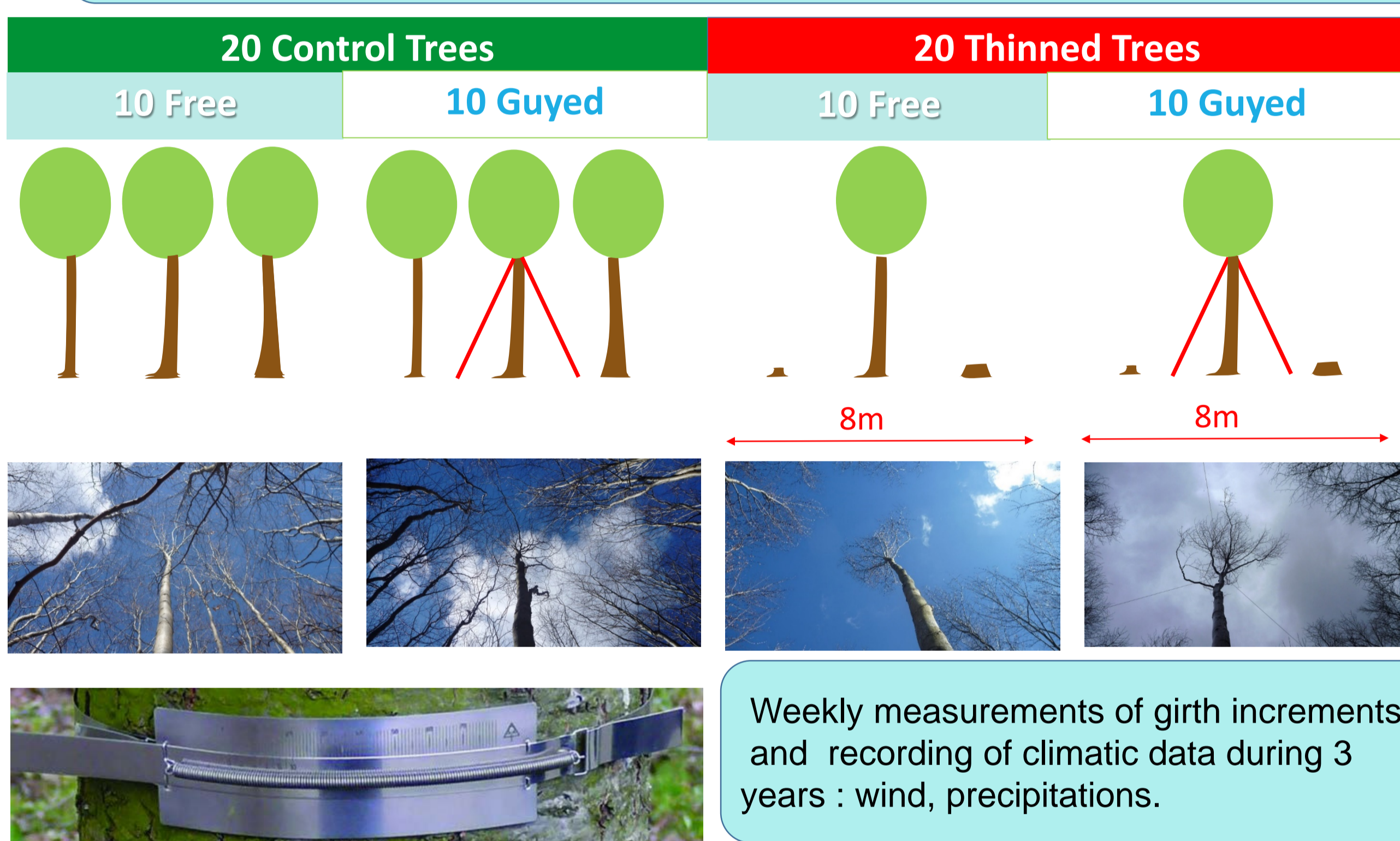
Keep an erected habit is essential requirement for the tree ability to survive and perform photosynthetic function. The mechanism responsible for acclimation of trees to mechanical cues induced by wind is called thigmomorphogenesis. Stimulations perceived by trees as a result of swaying are the longitudinal strains - elongation or compression - of wood living cells. In reaction to these stimuli, a tree modulates the spatial distribution of wood biomass to secure itself against the wind load by increasing its diameter growth to boost its stem resistance to breakage, by limiting its height growth to reduce the wind load, and, by developing its root system to improve its anchorage. (Telewski 1986, Coutand 2009).

Objectives

- Provide a quantification of the rôle of thigmomorphogenesis in a silvicultural context, and more particularly during the reaction due to thinning since besides a better light exposure and lower competition, the thinned tree is also more exposed to wind with less support from its neighbors.
- Focus on one of the most important hardwood species in Europe, knowing that works concerning thigmomorphogenesis were mainly carried out on conifers except for laboratory studies on poplar trees.

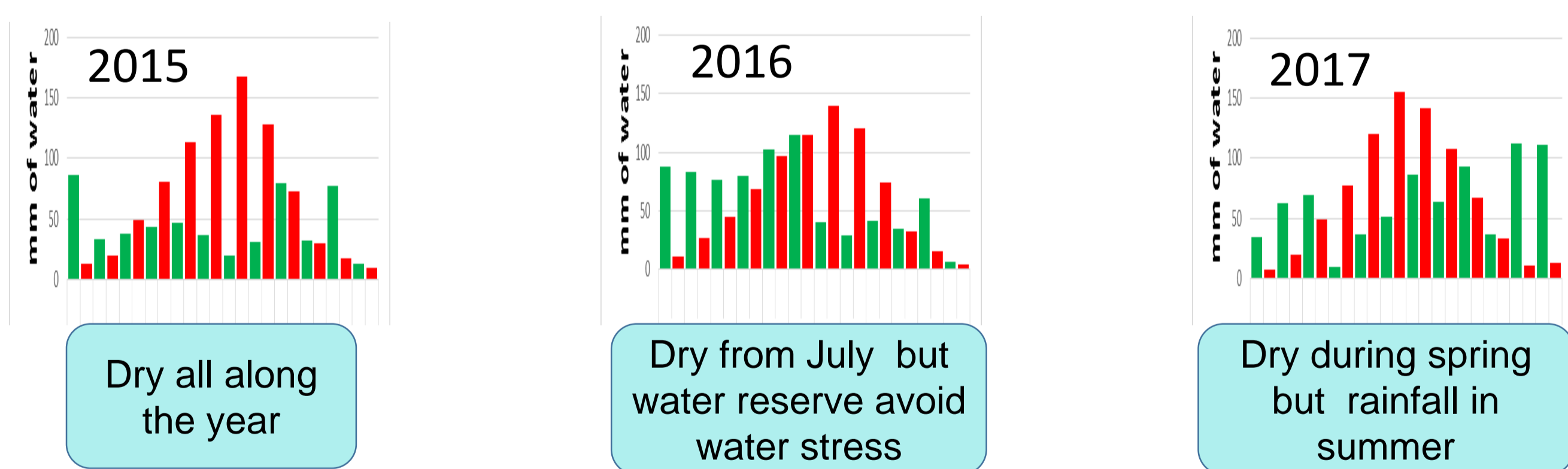
Materials and Methods

In the Haye State Forest close to Nancy, a stand of beech poles with a rather high density was selected at the end of 2014 (DBH ~13 cm, Ho ~ 13 m, RDI = 0.87, Age ~30 years) 40 well-conformed trees were selected and split into 4 groups representative of the within-stand variation of trees size, as follows:

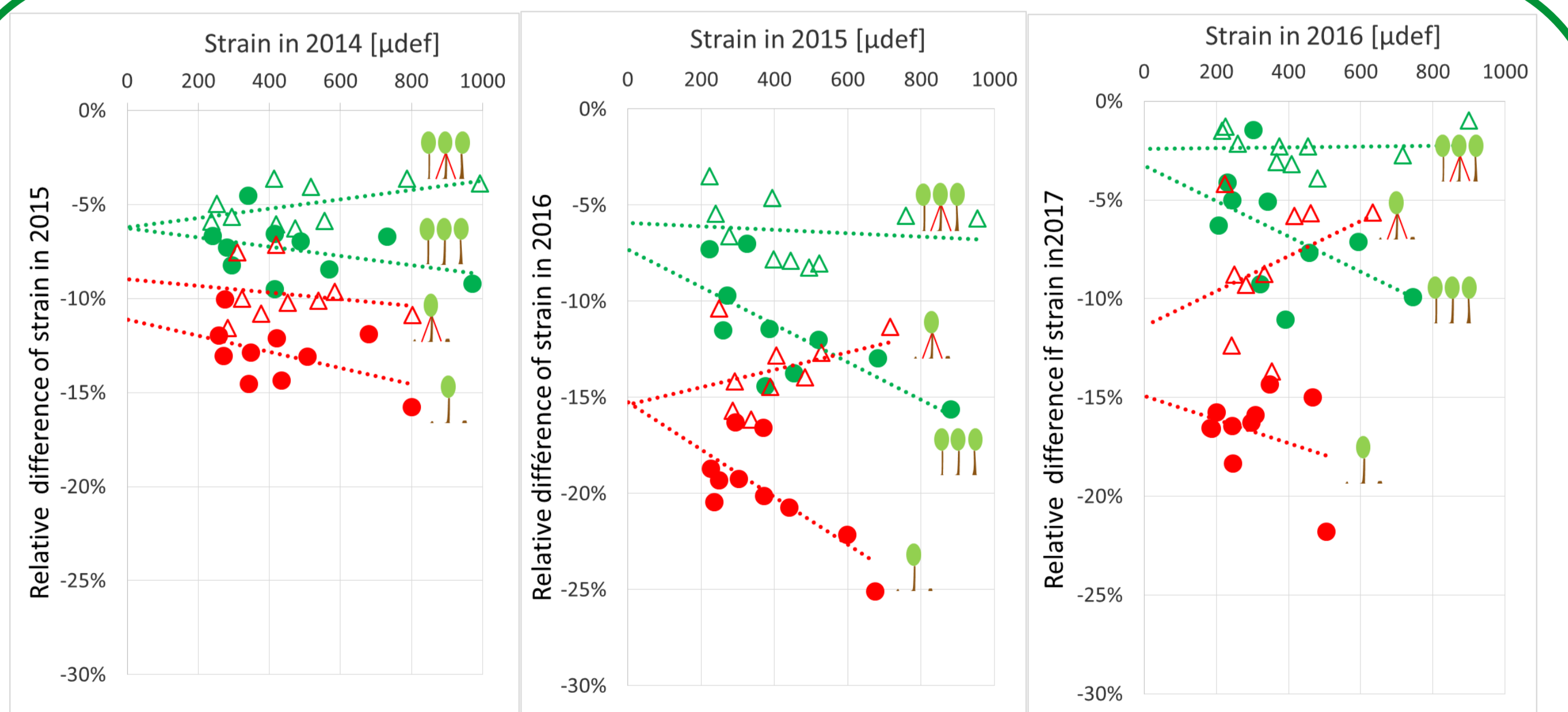
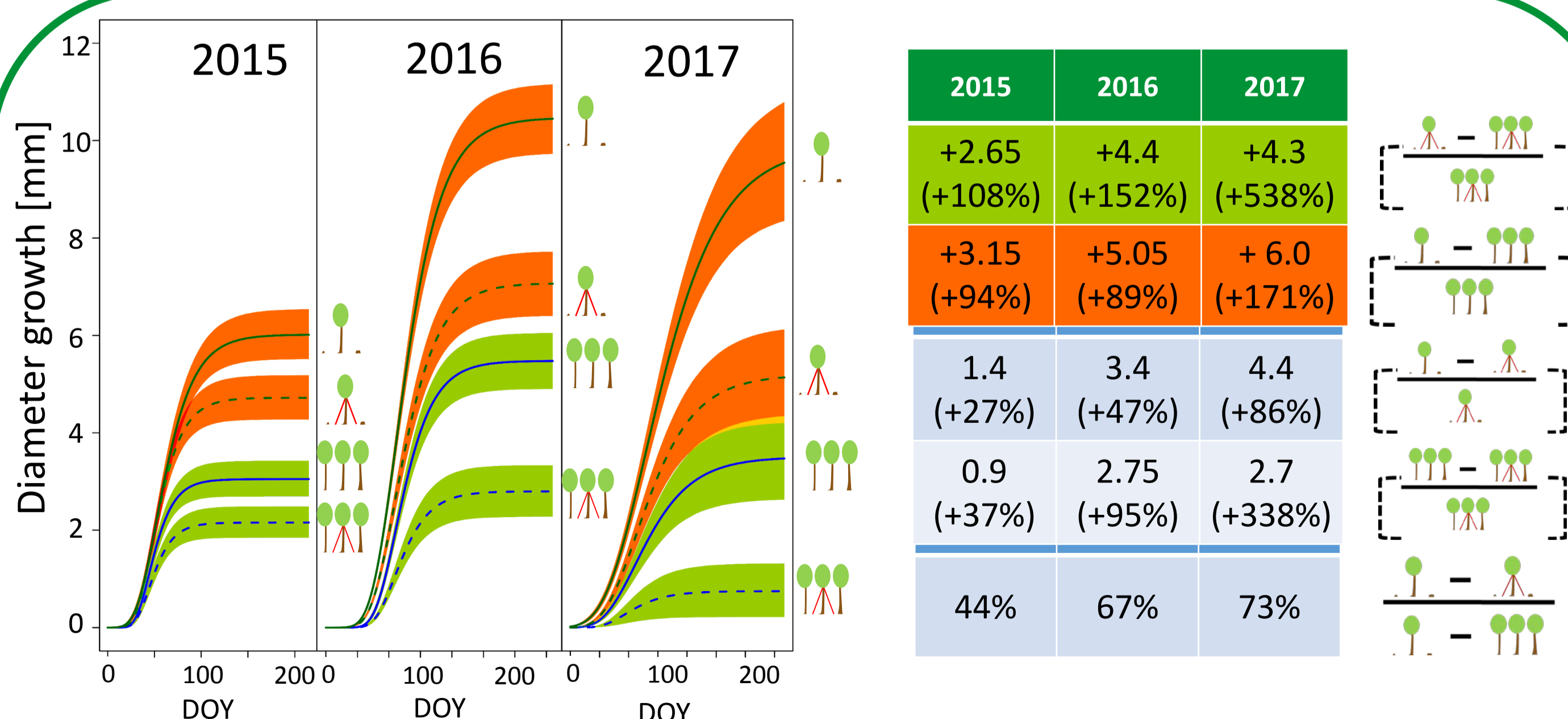
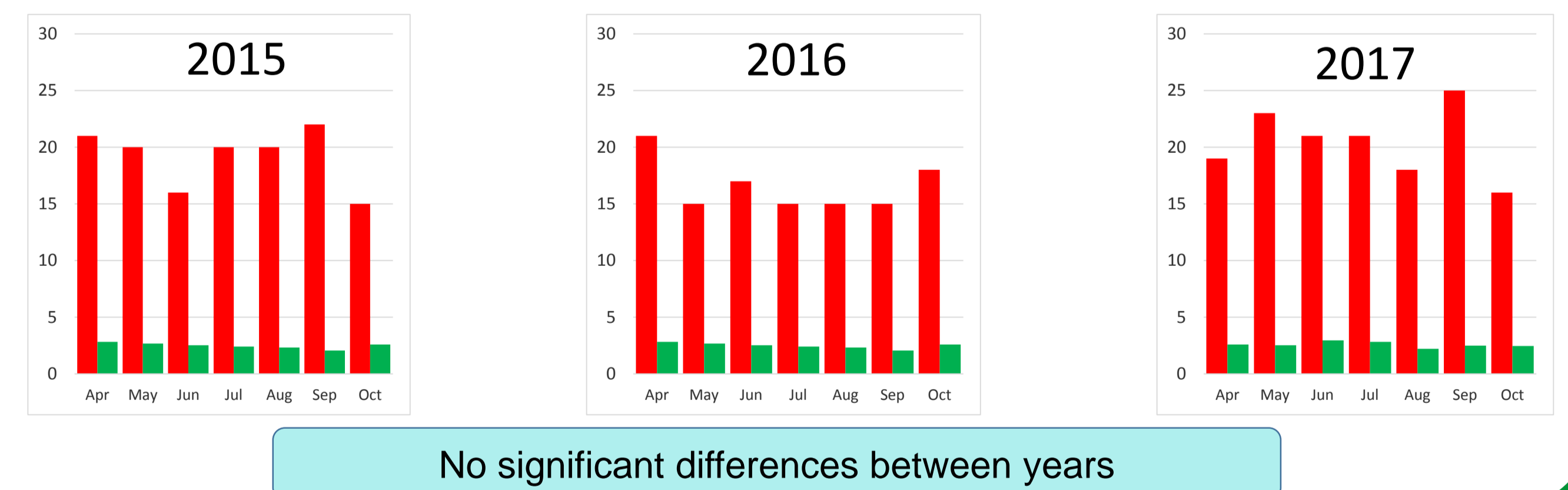


Results and Discussion

Evaporation and Precipitations Data [mm of water]



Wind Speed Data [m.s⁻¹] Max & Mean / month



The positive effect of thinning on diametral growth is more pronounced for free to sway trees than for guyed trees. The limitation of tree motion always decreases diametral growth with a more pronounced effect for thinned trees. The ability to move under wind corresponds to 45% to 73% of the annual diametral increment resulting from thinning.

Assuming the occurrence of the same flexural moment, the simulation of the reduction of strains induced by the annual diametral increment revealed a trend to linear relationships with the preceding year strains : small trees seem more responsive to mechanical cues, and when mechanical signals were impeded, the reduction tend to decrease, resulting in a more risky situation.