# Transpiration Regulation of silver firs during and after severe droughts in relation to soil properties

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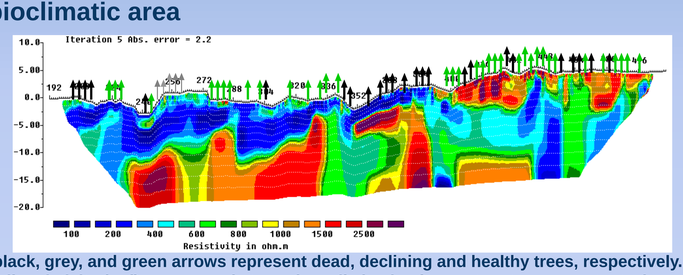
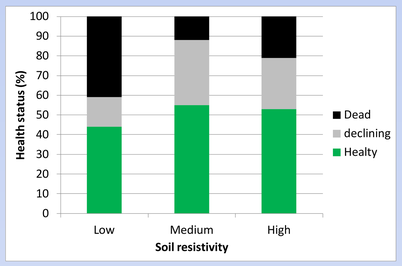
## CONTEXT

After several droughts ➔ Silver fir (*Abies alba* Mill.) mortalities were observed at the southern boundary of their bioclimatic area




(black, grey, and green arrows represent dead, declining and healthy trees, respectively. High soil resistivity (red) corresponds to rocky soils having low water storage content whereas low resistivity (blue) corresponds to soil having larger resistivity).

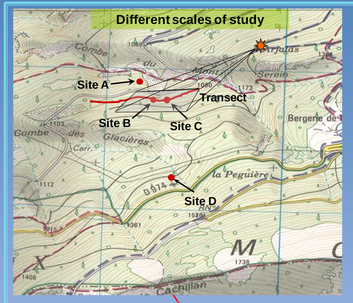
**Soil characteristics have an impact on mortality rate and surprisingly the tree vulnerability is the lowest on soil having a low water storage capacity**



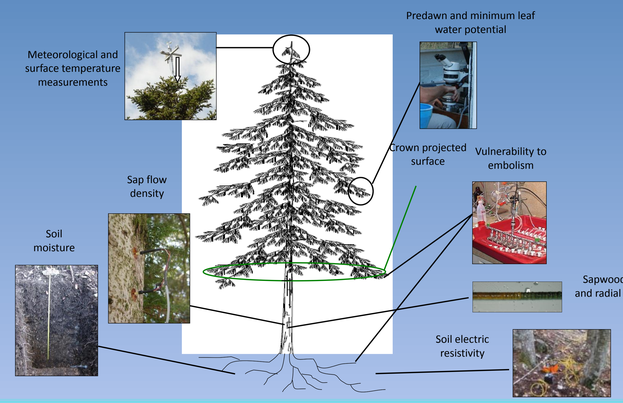

## OBJECTIVES

- Assess the main factors involved in the transpiration regulation of silver firs
- Analyse the link of between the variability of water stress intensities and soil properties
- Long term impact of drought

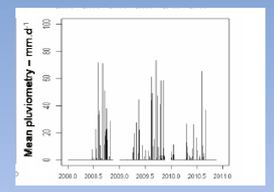
## STUDY SITE AND MEASUREMENTS



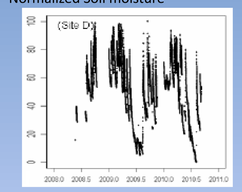

Mont-Ventoux

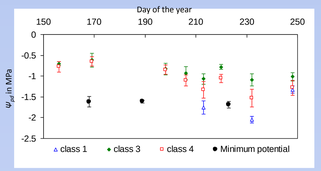

| Tree ID | age | Diameter (cm) | LAI, Height (m) | Altitude (m) | Soil water storage capacity |
|---|---|---|---|---|---|
| A1 | 72 | 41.1 | 7.7, 19 | 1020 | Low |
| A2 | 83 | 40.6 | 7.2, 19 | 1020 | Medium |
| A3 | 76 | 40.9 | 7.6,19 | 1020 | Medium |
| B1 | 80 | 17.4 | 3, 13 | 1100 | Low |
| C1 | 82 | 21.0 | 3.5, 13 | 1100 | High |
| D1 | 157 | 48.2 | 7.6, 17.5 | 1360 | medium |
| D2 | 159 | 42.5 | 4.6, 17.5 | 1360 | Medium |
| D3 | 146 | 28.9 | 5.2, | 1360 | Medium |
| D4 | 161 | 29.1 | 3.7, | 1360 | Medium |

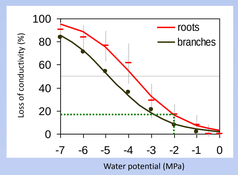



Normalized Soil moisture



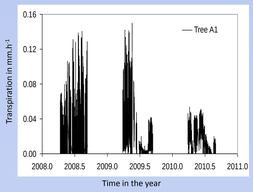

## WATER POTENTIAL AND EMBOLISM VULNERABILITY

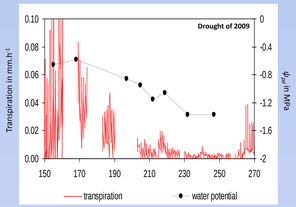



- Tree on soil with high soil water storage capacity suffered the highest stress ➔ difficulty of exploring additional water ressource by a limited root systems.
- Expected loss of conductivity in root : 16 %

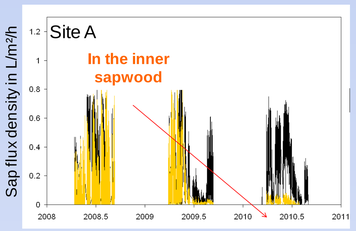
## TRANSPIRATION DYNAMIC



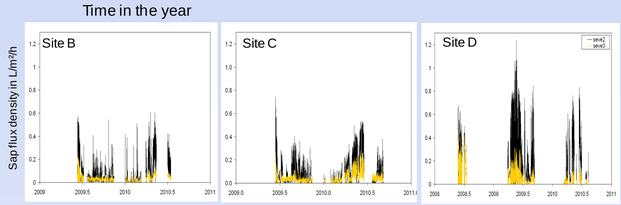




- Low transpiration rate (smaller than reported in the littérature
- Strong regulation of the transmiration during drougth
- Strong post drought effects

## POST DROUGHT EFFECT ON SAP FLOWS WITHIN ACROSS THE SAPWOOD




- Sap flow in the inner sapwood (related to deep roots?) were strongly limited after the drought., even after rewetting the Whole soil (strong precipitations during the 2009/2010 winter)
- Sap flow recovery in the inner sapwood is possible as shown with tree C1 which is located on a rocky soil ➔ Recovery of surface root functionning occured first.




## CONCLUSIONS

- **Silver Fir transpiration is strongly regulated by the stomatal closure. Embolism remains limited in the conditions of the experiment and mainly affect the root system (with an estimated loss of conductivity of 16% after a severe drought)**
- **The Transpiration flow are low . An adjustment of silver firs may occurred after the successive drougths of the last decade.**
- **Trees on soils having a strong soil water storage capacity presented the highest water stress (consistently with the observations of mortality vulnerability)**
- **Strong post drought effect was observed. Deep root seems to be the most impacted. This feature is not taken into account in ecophysiological model used to assess climate change impacts**

Paper under review : Nourtier M., Cailleret M., Yingge X., Chanzy A., Huc R. and Davi H., submitted. Regulation of silver fir (Abies alba Mill.) transpiration during drought in relation to soil characteristics. submitted to Ann. For. Sci.: pp.

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