Project Database of ICP Forests
PROJECT DESCRIPTION

PROJECT INFORMATION

Project title: Growth and defoliation across European forests: continental patterns and trends of tree vitality

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Current climate warming and increased climate variability are challenging our understanding of European forest responses to those drivers. First, contrasting responses to climate warming are expected along biogeographical gradients encompassing different forest biomes. For instance, ongoing temperature rises should enhance growth of boreal and subalpine forests but exacerbate water scarcity through increased evapotranspiration in Mediterranean forests. Second, climate extremes are very relevant events to understand forest responses to climate. Extreme events as severe droughts or heat waves increase the vulnerability of forests once a resistance threshold is surpassed (tipping point). For instance, the 2003 heat wave caused a severe reduction of growth and productivity across temperate Central European forests, whereas recent droughts are triggering dieback events across Circum-Mediterranean forests.
Forest dieback illustrates well how vulnerable are many forests when facing climate warming combined with climate extremes. During drought-induced dieback several proxies of tree vitality rapidly change in response to water shortage, rising temperatures and elevated vapor pressure deficit. Usually, the dieback is characterized by high defoliation levels, abnormal primary growth (e.g. production of epicormic shoots), reduction of radial growth and increased mortality rates. In addition, secondary factors such as opportunistic organisms (e.g., insects, fungi, mistletoe) can also contribute to final tree death by weakening already vulnerable trees. Those responses contribute to decrease productivity and the ability of forests to capture carbon in persistent pools as wood. However, we lack a good understanding on the links between those vigor proxies of forests. We do not fully comprehend how these variables respond to observed climate variability and how could they react to forecasted climate warming under drier conditions. Here we propose collecting and relating that information on forest vitality to characterize those links between vigor proxies, paying special attention to forest dieback in response to droughts which are a widely studied example of climate extremes. In this proposal we aim to combine and relate European defoliation data from the ICP Forests (levels I and II networks) with radial-growth data of neighboring and similar forests. Radial growth data for European forests will be

obtained from the International Tree-Ring Data Bank (ITRDB, http://www.ncdc.noaa.gov/dataaccess/paleoclimatology-data/datasets/tree-ring). In the case of Spain we will compare the downloaded tree-ring width series with data available collected by our team and collaborators (Univ. Barcelona) across the country. Our specific aims are:

1. To identify common patterns and trends of growth and defoliation data across European forests encompassing several biomes (boreal, temperate and Mediterranean biomes);
2. To determine the climatic drivers of defoliation and growth;
3. To use the responses of growth and defoliation to droughts as a tool to develop and map vulnerability indices for European forest.

We expect to obtain maps of vulnerability for European forests based on the individual or combined responses of defoliation and growth data to either long-term climate or to punctual climate extreme events, i.e. specific droughts.