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Assessing the knowledge base on long-term trends in forest growth, mortality and Water Use Efficiency in Europe using a multi-scale approach

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The increasing frequency and intensity of extreme climate events threaten the continued provision of forest ecosystem services. Large-scale mortality events and changes in growth and Water Use Efficiency (WUE) in European forest ecosystems have already been observed in response to stressors such as droughts and climate-related outbreaks in tree pests and diseases. Long-term changes in mean temperature and precipitation are also expected to drive forest growth, mortality and WUE in the coming decades. The need for European forest ecosystems to adapt to climate change comes at a time when these ecosystems are still recovering from the impacts of elevated sulphur and nitrogen deposition, with many still exposed to the latter. Sulphur and nitrogen deposition were observed as key drivers of forest growth and mortality in Central Europe in the 1980s, with the impacts on soil chemistry still evident today.

As part of the WG2 activities in the COST Action CA21138 CLEANFOREST - Joint effects of CLimate Extremes and Atmospheric depositioN on European FORESTs- we are conducting a systematic review on trends in European forest growth, mortality and water use efficiency (WUE). The direction of trends in forest growth, mortality and WUE as observed between 1990-2023 by a range of methods, from dendrochronology, ecosystem fluxes, to remote sensing, were extracted from published literature alongside a wealth of information on forest type and characteristics, covering >1100 observations from >500 papers.

The produced database provides the opportunity to evaluate agreement between spatial scales and identify needs for integration to understand mechanisms underpinning forest responses to changes in atmospheric deposition and extreme climatic events. We will broadly discuss opportunities to connect existing long-term monitoring networks with new approaches to fill knowledge gaps.