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Drivers and responses of ecosystem processes at the Collelongo beech forest: main results and lessons learned over 30 years of research and monitoring in a period of changes

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The long-term research and monitoring site of Collelongo - Selva Piana has been established in 1991 (Abruzzo Region, Central Italy, 1560 m elevation) in the framework of a project on ecology and silviculture of European beech. In 1993, the site was the first forest in Europe where canopy fluxes started to be measured with the eddy covariance technique. Since then, the site has been involved in several of the most important networks and projects, including ICP Forests, Euroflux, CarboEurope-IP, FluxNet and, in 2006, joined the Long Term Ecological Research network (LTER).

Measurements at the Collelongo site bridge two centuries, starting right at the end of the WMO and IPCC climate reference period (1961-1990) and extending, in continuous, over a period of great changes (the three warmest ever decades occurred since then), including a number of extreme events (heat waves, droughts, late frost). During these thirty years, more than 50 researchers from different parts of the world performed direct measurements at the site, flux datasets from the site (code IT-Col) had more than 1500 unique downloads and it is estimated that more than 300 people used the data for producing more than 150 ISI papers.

We will briefly present the main results on different ecosystem processes (Phenology, Net Primary Production, Carbon Allocation, Net Ecosystem Exchange, Nutrient and Water Cycling) emphasizing responses to drivers, including legacies from the past. Over these thirty years, the growing season

length increased significantly (1.33 day yr-1 from 2000 to 2015), the studied beech forests absorbed between 120 and 150 tC ha-1 and showing plasticity and resilience to changing climatic conditions. However, increasing warming, drought and extreme events may impair adaptation capacity. In this respect, modelling offers a tool to evaluate long-term responses, including possible management options to increase both adaptation and resilience capacities.