Summary

Over the past few decades, there has been a significant increase in the occurrence of natural hazards worldwide, including floods, droughts, fires, and landslides, impacting both urban and natural environments. The pivotal catalyst propelling climate change is the escalating concentration of greenhouse gases (GHG) in the Earth's atmosphere, predominantly characterized by the surge in carbon dioxide (CO2) levels. The intensification of atmospheric GHGs, attributed mainly to human activities such as industrial processes, deforestation, and the burning of fossil fuels, acts as a potent force amplifying the natural greenhouse effect and leading to global warming.

Monitoring natural resources is essential in guiding political decisions toward optimal practices for preserving these resources. This need is particularly critical as natural resources play a primary role in absorbing carbon dioxide; specifically, forests act as fundamental natural carbon reservoirs, absorbing carbon dioxide from the atmosphere during the process of photosynthesis. However, forest monitoring activities are traditionally time and resource-consuming. Nevertheless, nowadays, the scientific community can rely on the most recent technological innovations, which allow to acquire information about increasingly large

areas with a greater level of detail and less time. Remote Sensing techniques need to be supported by automatic processing methodologies in order to manage the amount of data produced efficiently; different approaches have been developed depending on the data type.

This research focuses on the acquisition and processing of LiDAR point clouds, which represent a well-established acquisition technique in the field of Remote Sensing and provide detailed mapping of the scene. More specifically, the aim is to propose a methodology for extracting forest parameters through LiDAR techniques and automated procedures. The final goal is to assess woody aboveground biomass and the carbon dioxide stocked in it according to different LiDAR acquisition techniques and evaluate temporal variations caused by climate changes or the natural growth of various tree species. The methodology is tested for three case studies: the first scenario concerns a multi-temporal analysis of aerial datasets before and after an ice storm occurred in the Dinaric Forest (Southwest Slovenia); the second scenario consists of a comparison of several terrestrial sensors in a post-forest fire scenario in the Italian Western Alps; the last case study delves into the processing of oblique point cloud datasets through a multitemporal approach under undisturbed conditions in the Hyytiälä boreal forest in Southern Finland.