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Encroachment analysis of the invasive tree species Ailanthus altissima in Sicily (Italy) through an ecohydrological cellular automata model

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Plant species diversity is fundamental for the stability and resilience of ecosystems, and the well-being of the entire planet. Healthy and diverse ecosystems also contribute to air and water pollution removal, climate regulation and flood prevention. In the last century, plant biodiversity has been facing severe threats, such as habitat destruction and fragmentation due to increasing urbanization, deforestation, agricultural expansion, wildfires, and pollution. In addition, changes in climate pose significant threats to plants biodiversity conservation and native species preservation. All these natural and anthropic disturbance factors are profoundly modifying the competitive dynamics among plant species, often favouring the establishment and spread of some invasive plants, and exacerbating the biodiversity loss of native ecosystems.

A well-known invasive alien species is *Ailanthus altissima*, a tree native to East Asia and introduced to various regions around the world, including North America and Europe. It is characterized by rapid growth, high reproductive capacity, and ability to thrive in a wide range of environmental conditions, where it can significantly modify ecosystems by altering soil characteristics, releasing allelopathic chemicals that may inhibit the growth of other plants, and forming dense thickets that reduce the space available and development chance of native vegetation. *Ailanthus* has been recognized as the most widespread and invasive alien tree species in Sicily (Italy), with a capillary presence over the entire regional territory, where it poses a serious threat to the biodiversity of the local Mediterranean ecosystems.

Ecohydrological models can simulate vegetation dynamics and predict *Ailanthus* encroachment mechanisms also in presence of disturbance effects and under climate change. In this work, the CATGraSS, an ecohydrological Cellular Automata model (Zhou et al., 2013), has been used for simulating spatio-temporal dynamics of *Ailanthus altissima* in a specific site of "Vallone di Piano della Corte" Nature Reserve, in the Erei mountains in central Sicily (Italy). The study area has a surface of approximately 1 km^2 and it is characterized by a relevant nucleus of *Ailanthus* that has been growing rapidly in recent years. The study aims to reconstruct *Ailanthus altissima* spatio-temporal evolution in the study area over the last century. The model has been

calibrated using the current *Ailanthus* distribution maps, obtained by classifying high-quality satellite images, collected by PlanetScope constellation, exploiting modern remote sensing techniques, together with field surveys.