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Reconstructing Mediterranean land cover using data-model integration.

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Mediterranean land cover has changed substantially over the last 12,000 years as a result of both changing climate and human impact. These land cover changes would have had implications for the hydrologic cycle and soil quality, which are likely in turn to have influenced patterns of human activity. Furthermore, Holocene land cover change may have influenced the climate of the Mediterranean itself through biophysical and biogeochemical feedbacks to the atmosphere.

In order to investigate the impact of these changes, quantitative Holocene land cover reconstructions are needed. Previously, this has been largely based on site-specific reconstructions using pollen data, or maps based on either linear interpolation of pollen data or vegetation models driven by GCM simulations. These methods involve a number of problems, since simple interpolation of pollen data produces misleading results because of the discontinuous nature of vegetation, changing topography, soils and climate. Data-model comparisons also suggest problems with Holocene GCM simulations, indicating significant discrepancies particularly over the Mediterranean region.

Here we propose a new method for mapping land cover based on an innovative synthesis of palaecological data, land suitability modelling, and the latest generation of dynamic global vegetation model (DGVM). The DGVM is used to map past potential natural land cover using modern soils and climate, driven by palaeoclimate anomalies generated from the pollen data. This is then combined with maps of potential anthropogenic land use intensity based on a model of land suitability, incorporating estimates of deforestation based on population and technological progress, and crop climatic limits based on the pollen-derived palaeoclimate record. Evaluation and optimization of these maps is possible through comparison with the anthropogenic land-use record from the pollen data.

The combination of potential land cover and anthropogenic land-use intensity mapping using this model based approach allows us to produce high resolution maps which incorporate estimates of land cover change at locations far from pollen sites, which are often remote from areas of maximum human impact. This will allow us to address a number of research questions, including the time history of human impact at locations in relation to conservation, biodiversity, and land degradation; and the impact of land cover change on terrestrial hydrology and carbon and nutrient cycling.