Geophysical Research Abstracts
Vol. 15, EGU2013-6399, 2013
EGU General Assembly 2013

Inverse dendroecological modelling : a new approach to paleoclimate reconstruction from multi-proxy tree ring archives.

Etienne Boucher (1), Joel Guiot (2), Pierre-Alain Danis (3), and Philippe Dussouillez (2)

(1) GEOTOP, UQAM, Montreal, Canada (boucher.etienne@uqam.ca), (2) CEREGE, Aix-en-Provence, France (guiot@cerege.fr), (3) Onema-Irstea, Aix-en-Provence, France (pierre-alain.danis@onema.fr)

Over the last decades, the set of mathematical rules representing the many ecophysiological processes that occur within trees were incorporated into various dendroecological models (eg. MAIDENiso). Such models use simple meteorological variables (precipitation, temperature, CO_2) and simulate tree growth parameters that may be readily compared to observations (tree ring widths, stable isotope ratios). Here, we present a novel paleoclimate reconstruction method that uses such ecophysiological model, but in an inverse mode, ie. observed dendroecological variables are used as inputs and climatic variables are retrieved as outputs to produce reconstructions that have strong and sound ecophysiological basis. This novel method represents a significant scientific advance comparing to more conventional (regression-based) transfer function that cannot take into account the array of causal processes linking tree growth to climate. We tested our method on a dataset originating from the Fontainebleau forest, near Paris, France, from which 15 oak trees were sampled for tree ring and stable isotope (13C and 18O) analysis. The method makes use of the Metropolis-Hastings random-walk algorithm to determine the optimal combination of precipitation and temperature that best simulates tree growth parameters in Fontainebleau. Our procedure was first tested on the calibration period (1956-2000). For instance, our analysis suggests that, at the Fontainebleau site, the inverse modeling approach performs better at reconstructing precipitation signals than it does for temperature variations. This is not surprising considering that water stress is a dominant control for oak's growth in the area. We strongly believe that our inverse modeling approach holds great promise to perform ecophysiologically sound reconstructions of past precipitation / water availability in the area and elsewhere.