

Modeling primary production using a 1 km daily meteorological data set

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ABSTRACT: The availability of daily meteorological data extended over wide areas is a common requirement for modeling vegetation processes on regional scales. The present paper investigates the applicability of a pan-European data set of daily minimum and maximum temperatures and precipitation, E-OBS, to drive models of ecosystem processes over Italy. Daily meteorological data from a 10 yr period (2000 to 2009) were first downscaled to 1 km spatial resolution by applying locally calibrated regressions to a digital elevation model. The original and downscaled E-OBS maps were compared with meteorological data collected at 10 ground stations representative of different eco-climatic conditions. Additional tests were performed for the same sites to evaluate the effects of driving a model of vegetation processes, BIOME-BGC, with measured and estimated weather data. The tests were carried out using 10 BIOME-BGC versions characteristic for local vegetation types (Holm oak, other oaks, chestnut, beech, plain/hilly conifers, mountain conifers, Mediterranean macchia, olive trees, and C3 and C4 grasses). The experimental results indicate that the applied downscaling performs best for maximum temperatures, which is the most decisive factor for driving BIOME-BGC simulation of vegetation production. The downscaled data set is particularly suitable for the modeling of forest ecosystem processes, which could be further improved by the use of information obtained from remote sensing imagery.

KEY WORDS: Meteorological data set · E-OBS data set · Locally calibrated regression · BIOME-BGC model · Gross primary production modeling · Italy

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1. INTRODUCTION

Gross primary production (GPP) corresponds to the amount of carbon fixed by vegetation through photosynthesis and is a key component of ecosystem carbon fluxes. It is therefore a fundamental variable for studying the effects of global climate change on terrestrial ecosystems (Waring & Running 2007). GPP is traditionally measured in the field by portable instruments (e.g. CIRAS-1, see www.ppsystems.com), which can only provide instantaneous and point measurements. At the ecosystem level, the eddy-correlation technique is applied to collect continuous measurements of net carbon fluxes (Aubinet et al. 2000) and

indirectly estimate GPP by flux partitioning (Reichstein et al. 2005). Eddy covariance towers, however, perform local measurements that are related to the so-called footprint area, an area extending upwind of the observation point as a function of atmospheric stability, wind speed, and surface properties (Vesala et al. 2008). The footprint distance can extend up to few hundred meters, but the measured fluxes cannot be directly attributed to wider areas.

The estimation of GPP on a regional scale therefore requires the use of different instruments and methodologies, such as those based on remotely sensed data and biogeochemical models (e.g. Prince 1991, Veroustraete et al. 2002). In all cases, meteorological

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