Reply to Eastaugh (2011) on "Use of BIOME-BGC to simulate Mediterranean forest carbon stocks"

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The current note responds to the critical contribution of Dr. Eastaugh on Chiesi et al. (2011). That paper did not aim at applying BIOME-BGC to simulate stand growth, which requires a thorough modification of the model functions. In contrast, only a parameter setting was changed in order to adjust the predicted carbon storages during the simulation of quasi-equilibrium conditions. The adjustment was calibrated on volume statistics derived from the Tuscany forest inventory and is suitable for regional scale applications.

Keywords: Mediterranean forest, BIOME-BGC, Forest volume, Current annual increment

The critical contribution of Dr. Eastaugh is welcome and testifies to the widespread interest in this important research field (Eastaugh 2011). We have, however, the impression that he has not fully addressed the objectives of our study (Chiesi et al. 2011), as well as the assumptions used. Our investigation, in fact, was not aimed at modifying BIOME-BGC simulation of stand growth, as seemingly asserted by Dr. Eastaugh. As clearly highlighted in the paper introduction and conclusions, our objective was to adjust the carbon storages predicted by the model during its simulation of quasi-equilibrium (or steady state) conditions.

BIOME-BGC, at least in its original configuration, is not a growth model, since it does not simulate stand development and ageing, and trees are not individually represented (Churkina et al. 2003, S.W. Running - personal communication). The simulated ecosystems are composed of plants in various growing phases which mimic the age distribution of forests in natural conditions. More precisely, BIOME-BGC was developed to simulate the processes of natural biomes based on some key simplifying assumptions usable on regional levels (Tatarinov & Cienciala 2006).

This property is maintained in our approach. The BIOME-BGC versions used still simulate forests in steady state conditions. The modification proposed is only aimed at reducing long-term carbon accumulation in stems and coarse roots, which was found to be unreasonably high for some forest species (see also Maselli et al. 2010). This modification was based on both volume values taken from local literature and volume measurements derived from the Tuscany regional forest inventory. In this latter case, no information was available about tree age distribution in the inventoried stands, which were likely uneven-aged. Thus, we simply used the statistical assumption that stands with maximum volumes approached quasi-equilibrium conditions, and these volumes were taken as corresponding to 90-95% of the potential ones.

Consequently, the new BIOME-BGC versions obtained are almost identical to the original ones, with the exception of the carbon accumulated in more stable tree compartments. These versions work with the same logic of the original model, and are therefore unsuited to simulate actively growing stands.

The strategy to account for departures from these potential conditions is based on a different rationale, which is fully exposed and discussed in Maselli et al. (2009). That strategy still applies to forest ecosystems characterised by heterogeneous age distributions, and is not suited to simulate the growth and ageing of specific stands. To this aim, more complex modifications must be applied to the model functions, as is correctly done by other research groups (*e.g.*, Thornton et al. 2002, Pietsch & Hasenauer 2002, Pietsch et al. 2005).

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