

## ***Interactive comment on “Estimating the carbon dynamics of South Korean forests from 1954 to 2012” by J. Lee et al.***

### **Anonymous Referee #2**

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The authors have prepared a forest carbon budget for South Korea for the period 1954 to 2012 using a combination of forest inventory data and a model they developed. Although some of the methods are insufficiently or not clearly explained, the study seems to follow generally standard procedures and yields results that are of both scientific and policy interest. With a few, mostly minor improvements (see below), the study is acceptable for publication. The one major point appears to be a confusion in terminology: the authors report different values for Net Biome Production (NBP) and forest sinks. NBP is a measure of the net carbon balance of forests, i.e. as the authors state NEP minus losses from disturbances (and leaching losses which are often not quantified). Therefore where NBP is positive it should be the same value as the “sink”. It could be that the authors are using the term NBP to refer to the flux density ( $\text{g C m}^{-2} \text{ yr}^{-1}$ ) and the term sink for the country-level summary of NBP, but if that is what they did it needs

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to be explained more clearly. However, I would advise to follow the terminology defined in Chapin et al. 2006 and not differentiate between NPB and forest sink (or source). For example on page 5024 line 19, the authors state that “Compared to forests in other countries and global forests, the annual C sink rate of South Korean forests was much lower, but the NBP was much higher.” This statement is confusing. Is the low “sink” here because Korea’s forest area is small compared to that of other countries? It is also of interest to note that the NBP estimates reported by the authors (436.6 g C m<sup>-2</sup> yr<sup>-1</sup> in 2012) are an order of magnitude greater than any of the values cited in the literature (Table 3). This is not inconceivable, however, because of the very unusual situation of having large forest areas with high growth rates and very low disturbances. It would be useful if the authors could provide further support for these very high estimates. For example, what are the corresponding estimates of NPP and Rh, and what are the corresponding stemwood volume growth rates obtained from KFRI yield tables. Note that 436 g C m<sup>-2</sup> yr<sup>-1</sup> if accumulated in stemwood only would require an AVERAGE growth rate of about 16 m<sup>3</sup> ha<sup>-1</sup> yr<sup>-1</sup>. How much C is transferred annually by harvest? The authors only included harvest as a disturbance regime. Can you address in the discussion that the omission of other disturbances such as fires, insects, windstorms etc. can be ignored by providing a simple statement about the extent of such disturbances in Korea? There is no need to revise the analyses but the reader should be placed in the position to understand that these other disturbance types are not significant in area. Lastly, the authors conclude that large-scale reforestation would contribute to mitigation of climate change – which is a well-known fact. However, few countries are in the situation Korea was in the 1950s with severely destroyed or degraded forests. Please address the issues above (and below) revise the terminology used, and please provide further evidence in support of the very high estimate of NBP.

Minor suggested revisions and corrections: P5024, L8 “a retrospective study . . . is still insufficient” – replace insufficient with “lacking”. P5024, L26 – the Kyoto Protocol did not “establish the function of forest as sink” but instead provided incentives to manage, report and account for the carbon balance of forests as sink or sources. 5025, L11

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– not necessarily taking into DOM C – missing word “taking into ACCOUNT DOM C...” P5025, L16 – dynamics ... has varied – should be “have varied”. P5025, L28 – determine the net C change IN BIOMASS – add “in biomass” for clarification. P5026 L23 – here or elsewhere you need to explain the relationship between the sampling points and the total forest area. How did you scale up from the sample points to the entire forest? P5027 L11 – in the first part of this paragraph you introduced the concept of five dead organic matter (DOM) compartments, but here you state that biomass becomes input to soils – should this not become input to DOM pools. P5028, L14 – This equation is unclear, where is the = sign? P5028, L17 – If you emphasize elsewhere that the relationships between biomass pools change with stand age, why do use this static relationship for hardwood fine:coarse root ratios? P5029, L26 – How many grid cells are there? How did you scale to the entire Korean forests? P5031 L2 – Can you please clarify whether harvest includes partial cutting (thinning) or only final clearcut logging? What is the time series of assumed harvest rates? P5032 L20 – Are these BEFs used by Choi and Chang (2004) species specific? P5044 Table 3 – please correct the units in Table 3 for NBP – these should be  $\text{g C m}^{-2} \text{ yr}^{-1}$ . Also clarify your distinction between sink and NPB as stated above. P5047, Fig 1 – caption – “The carbon pools consist” (not consists). P5048 Fig 2a – the diagram shows a very large drop in biomass associated with harvest, but a very small corresponding increase in DOM pools. This increase is insufficient to account for the biomass of coarse roots and stumps which are left behind after logging even if all other harvest slash were removed from the site (which is unlikely). Is there another C pool not shown in that figure which would account for the remaining C on site? P5049, Fig 3 – it would be helpful to also show the breakdown of DOM pools into the IPCC categories.

References cited: Chapin FS, Woodwell GM, Randerson JT, et al. (2006) Reconciling carbon-cycle concepts, terminology, and methods. *Ecosystems*, 9, 1041-1050.

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