Response to Reviewer 2 Comments: Reviewer comments are in **bold**, our response in normal text.

I agree with the first reviewer who suggests that a schematic would be very helpful to compare what carbon fluxes are included or ignored for the three different accounting approaches, with some additional attention paid to how the inclusion of fluxes vary between country. For example, the manuscript notes that the Mexican inventory is missing cropland harvest products and that the Canadian inventory is missing unmanaged forests.

The schematic will also be helpful for readers to understand in more detail on why the three different approaches disagree from one another. Again, for example, the top-down approach 'senses' all carbon inputs and outputs, whereas the terrestrial biosphere and inventory approaches make large assumptions for ignoring lateral carbon fluxes, the representation of disturbance, and also forest management and regrowth.

The schematic has been added as Figure 1 with attention to the points made by reviewer (and Reviewer 1).

A more detailed discussion on disturbance and its effects on carbon losses is needed for the manuscript – referring to estimates and issues presented in Kasischke et al. 2013, "Impacts of disturbance on the terrestrial carbon budget of North America" would be appropriate.

The following paragraphs on disturbance and reference to the work of Kasischke et al. has been added to the Discussion at line 10 of page 11044. Cited references have been added to the References.

Disturbance, natural and human, plays an important role in determining North America's net land-atmosphere CO_2 exchange (Kasischke et al., 2013; King et al., 2012). Indeed, much if not most of the early 21st Century North American land sink can be attributed to the recovery of forests from earlier disturbance, primarily human clearing and harvesting in the United States (Goodale et al., 2002; Hayes et al., 2012; Huntzinger et al., 2012; King et al., 2012; Myneni et al., 2001; Pacala et al., 2007; Pan et al., 2011). On annual to decadal time scales, the contributions from disturbance are generally greater than those from enhanced GPP with rising atmospheric CO_2 or in response to variations in weather (Luyssaert et al., 2007). The variety of disturbance types, heterogeneity in the spatial and temporal characteristics of disturbance regimes and disturbance intensity, and the many ways disturbance can impact terrestrial ecosystem processes in North America (Kasischke et al., 2013), lead to complexity in quantifying the specific contribution of disturbance to net land-atmosphere exchange. The source-sink consequences of disturbance change over time (Amiro et al., 2010; Liu et al., 2011). For example, a forest fire releases CO_2 to the atmosphere during combustion (a source), the reduction in canopy results in an imbalance between GPP and Re which can reduce the sink represented by a formerly aggrading forest or convert the landscape to a source while Rh exceeds NPP with lags between Re and Rh (Harmon et al., 2011). Over time, as the forest recovers, NPP exceeds Rh, and the regrowing forest is a sink for atmospheric CO_2 (Kurz et al., 2013).

The three approaches for estimating net land-atmosphere CO_2 exchange differ in how they perceive or represent contributions from disturbance. Atmospheric inversion modeling captures the influence of disturbance contributions to patterns in atmospheric CO_2 concentrations, but cannot generally attribute those changes to disturbances or disturbance types without additional effort involving carbon monoxide or other atmospheric gases, carbon isotopes, or structured attribution analyses (Keppel-Aleks et al., 2014;

Randerson et al., 2005). Inventory-based estimates capture the impact of disturbance on changes in carbon stock but the carbon accounting might (e.g., the Canadian forest inventory) or might not (e.g., the U.S. and Mexico forest inventories) explicitly consider disturbances. In the US, knowledge from other sources about areas burned (and other disturbances) can be used to inform GHG emissions estimates and allow for at least some attribution of specific disturbance to changes in carbon stocks even when disturbances are not explicitly accounted. Terrestrial biosphere modeling can attribute land-atmosphere CO_2 exchange to specific disturbances, but only those which the model explicitly represents and the models differ considerably in which disturbance types they include and how they represent those disturbances and the consequences for CO_2 exchange with the atmosphere (Hayes et al., 2012; Huntzinger et al., 2012; Liu et al., 2011; Sitch et al., 2013). For example some models include fire as an internal prognostic variable, others as an external forcing and some not at all (Huntzinger et al., 2012; Sitch et al., 2013). Incomplete or mis-representation of disturbances by the TBMs likely contributes to differences between the TBM estimate and the AIM and inventory-based estimates. Williams et al. (2012) used information on age structure from U.S. forest inventory data to parameterize the disturbance and recovery processes of a carbon cycle model similar to the TBMs reported on here. They found a much smaller net carbon sink for conterminous U.S. forests than previous estimates using those inventory data in stock-change approaches like those of the inventory-based estimates here (Williams et al., 2012). The same source of data used in different methods can yield different results. Particulars of how disturbance is represented in inventories are also likely responsible for some portion of the difference between AIM and inventory-based estimates of net-atmosphere CO_2 exchange.