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A comprehensive synthesis of anthropogenic and natural sources and sinks of Australasia carbon budget (2010-2019)

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Accurate national carbon budget assessments allow nations to evaluate their progress in cutting carbon emissions and therefore be aligned with the Paris Climate Agreement goals. To support the initiative of The REgional Carbon Cycle Assessment and Processes (RECCAP-2), we built a synthesis of the Australasia (Australia and New Zealand) terrestrial carbon budget for 2010-2019 based on top-down and bottom-up approaches. Major carbon flux components in the bottom-up budget (e.g., net primary productivity and heterotrophic respiration) were simulated by CABLE model, Biome-BGC model and Cewn simulations. In addition, this budget include carbon flux components from the land-ocean aquatic continuum, such as inland waters, estuaries, blue carbon ecosystems, and continental shelves and carbon fluxes embodied in trade (export and import) of crops, woods, livestock and fossil fuel. We reconciled Australia and New Zealand bottom-up budgets separately with fluxes derived from regional and global OCO-2, GOSAT flux inversions, as well as fluxes obtained from in-situ measurement only (CarbonWatchNZ). We found that annual mean budgets for Australia agree relatively well (within the uncertainty range) with regional and global top-down GOSAT and OCO-2 flux estimates. New Zealand's annual bottom-up carbon budget also agrees relatively well with fluxes derived from CarbonWatchNZ inversion and GOSAT but disagrees with global flux estimates from OCO-2.