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Improving the LPJ-GUESS modelled carbon balance with a particle filter data assimilation technique

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The recent increases in anthropogenic carbon dioxide (CO_2) emissions have disrupted the equilibrium in the global carbon cycle pools with the ocean and terrestrial pools increasing their respective storages to accommodate roughly half of the anthropogenic increase. Dynamic global vegetation models (DGVM) have been developed to quantify the modern carbon cycle changes. In this study, a particle filter data assimilation technique has been used to calibrate the process parameters in the DGVM LPJ-GUESS (Lund-Potsdam-Jena General Ecosystem Simulator). LPJ-GUESS simulates individual plant function types (pft) as a competitive balance within high resolution forest patches. Thirty process parameters have been optimized twice, using both a sequential and iterative method of particle filter. The iterative method runs the model for the full time period of thirteen years and then evaluates the cost function from the mismatch of observations and model results before adjusting the parameters and repeating the full time period. The sequential method runs the model and particle filter for each year of the time series in order, adjusting the parameters between each year, then loops back to beginning of the series to repeat. For each particle, the model output of NEP (Net Ecosystem Productivity) is compared to eddy flux measurements from ICOS flux towers to minimize the cost function. A high-resolution regional carbon balance has been simulated for central Sweden using a network of several ICOS flux towers.