Figure S1a: TEM-Hydro overview. TEM-Hydro considers interactions between the atmosphere, vegetation, and soil. Carbon fluxes between the atmosphere and vegetation include GPP (gross primary productivity) and growth and maintenance respiration (Rg, Rm). LRTC and LTRN are the carbon and nitrogen litterfall rates, respectively, from vegetation to soil. Heterotrophic respiration (Rh) represents microbial soil decomposition, and Nuptake represents the uptake of inorganic nitrogen from the soil. Soil evaporation and plant transpiration are considered separately. The carbon and nitrogen in vegetation is further divided between four structural pools (fine roots, leaves, sapwood, and heartwood), and a labile pool for storage (see text).
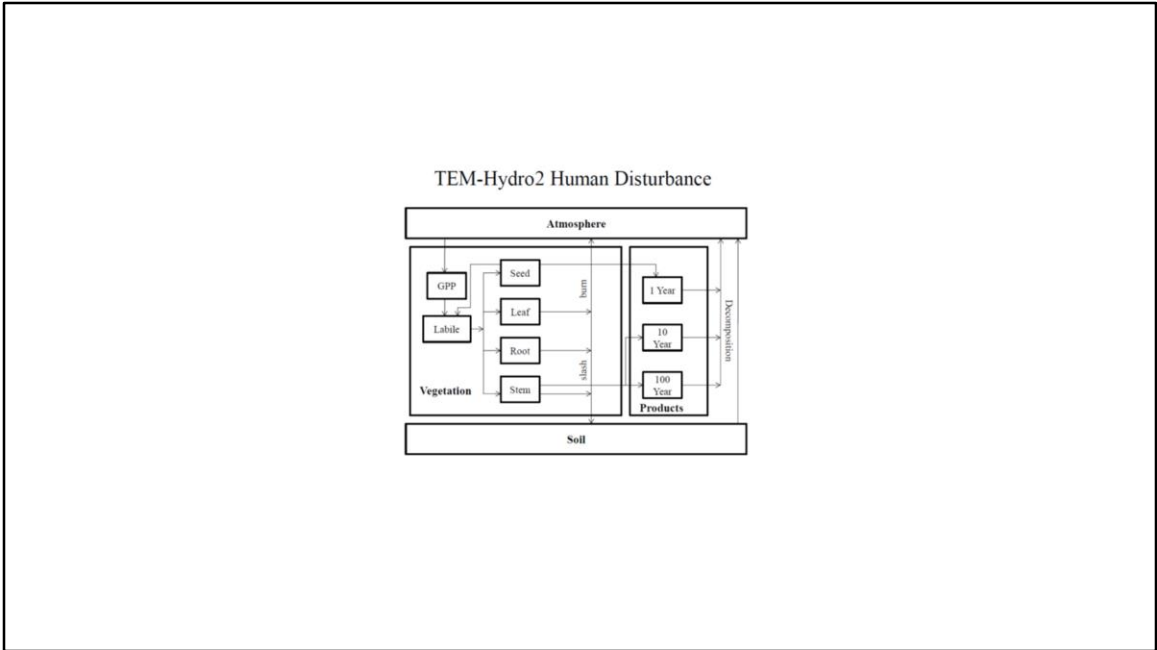
Figure S1b: Treatment of carbon in human disturbance (agriculture, timber harvest) in TEM-Hydro2. CO_2 enters vegetation through Gross Primary Productivity (GPP) into the labile carbon pool, and then gets allocated into structural pools. Stem biomass from timber harvest is distributed between the 10- and 100-year product decomposition pools, while harvested biomass (seeds) goes into a 1-year product decomposition pool. During clearance for agriculture, some biomass is burned, while some goes into the timber product decomposition pools.
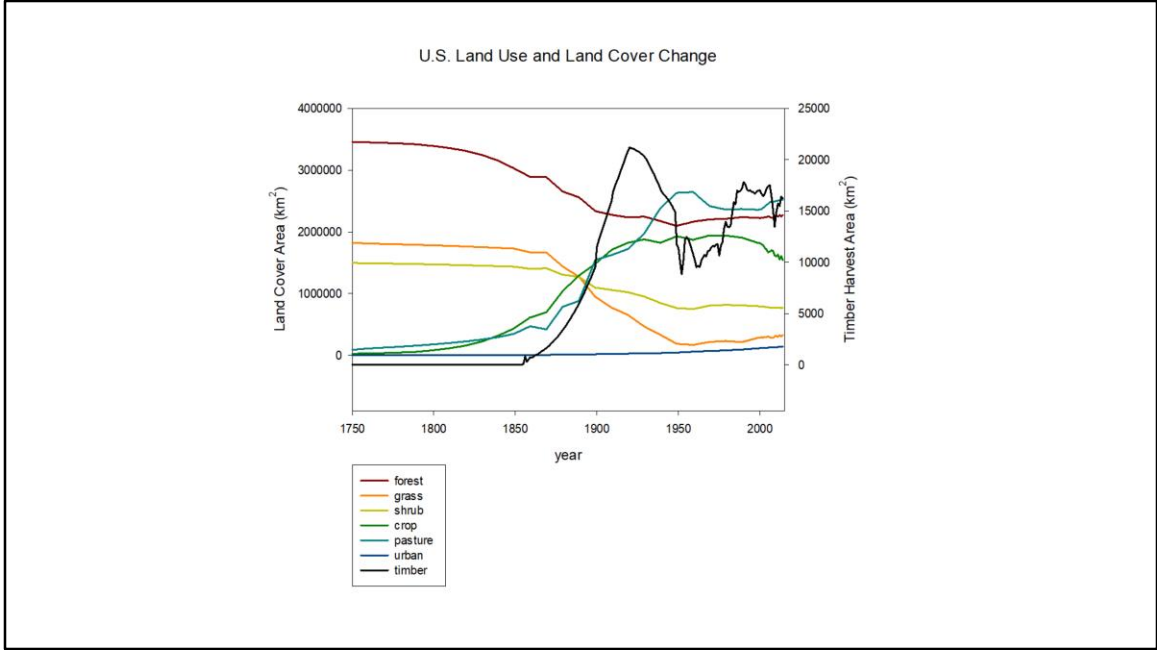
Figure S2a: Historical land use and land cover change in the conterminous U.S. from 1750 to 2014 based on Hurtt et al. (2020 land use transitions.
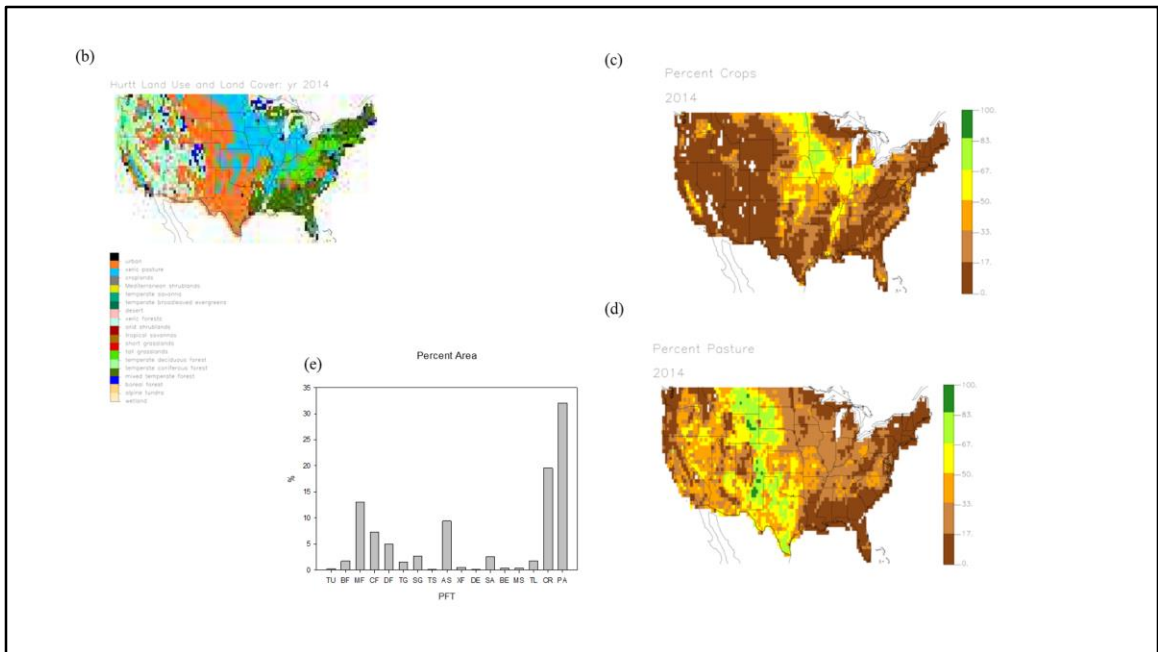
Figure S2: b) Resulting land cover in 2014 based on the Hurtt et al., (2020) land use transitions, showing only the dominant PFT for each grid, c) percent crops, d) percent pasture, e) percent area of each PFT. . PFTs are:TU = tundra, BF = boreal forest, MF = mixed temperate forest, CF = temperate coniferous forest, DF = temperate deciduous forest, TG = tall grasslands, SG = short grasslands, TS = tropical savanna, AS = arid shrublands, XF = xeric forests and woodlands, DE = deserts, SA = temperate savannas, BE = temperate broadleaved evergreen forests, MS = Mediterranean shrublands, TL = turflawn, PA = pasture, CR = crops.
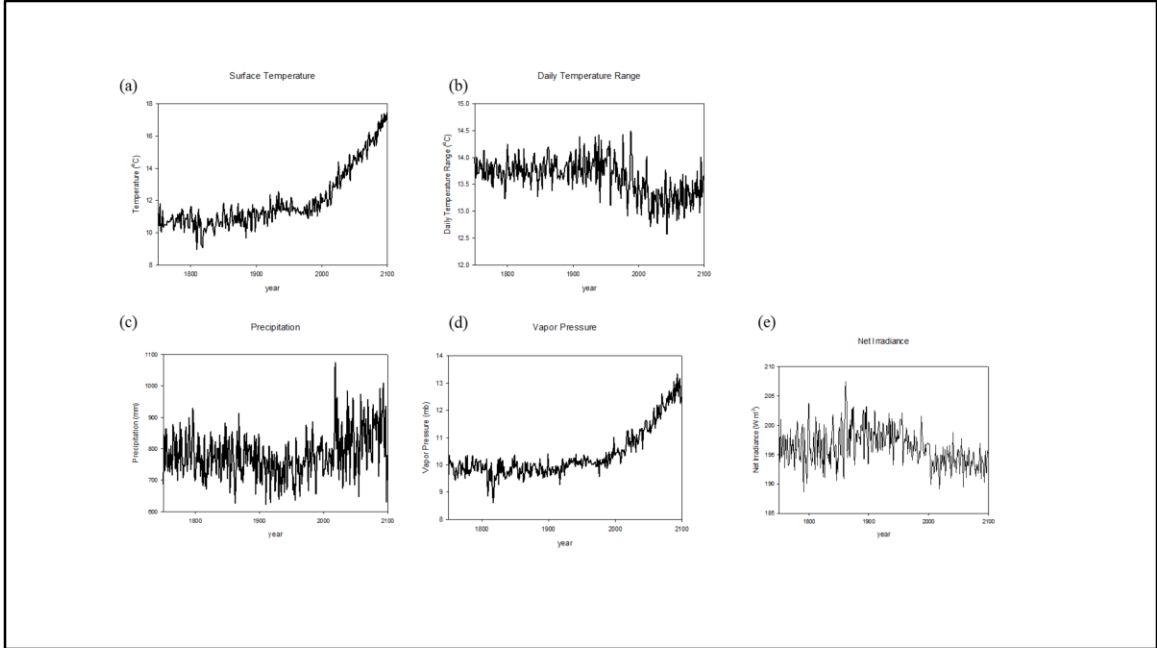
Figure S3: Millennial and historical data were downscaled and bias-corrected using delta/ratio approach. Millennial run (1750-1849) and historical (1850 to 1900) are from the MPI-ESM-P mode (Schmidt et al., 2014)l, while the historical period 1901-2014 is from the Climatic Research Unit (CRU) (Harris et al., 2014). Future runs from 2015-2099 are from the CCSM4 rcp8.5 downscaled and bias-corrected from MACA r6i1p1 (Abatzoglou and Brown, 2012). Input data for millennial and historical were clouds (consistent with CRU), but net irradiance for future. TEM-Hydro cloud scheme converts from clouds to net irradiance – clouds were bias corrected to match correct net irradiance at start of rcp8.5 run (based on 5-year averages).
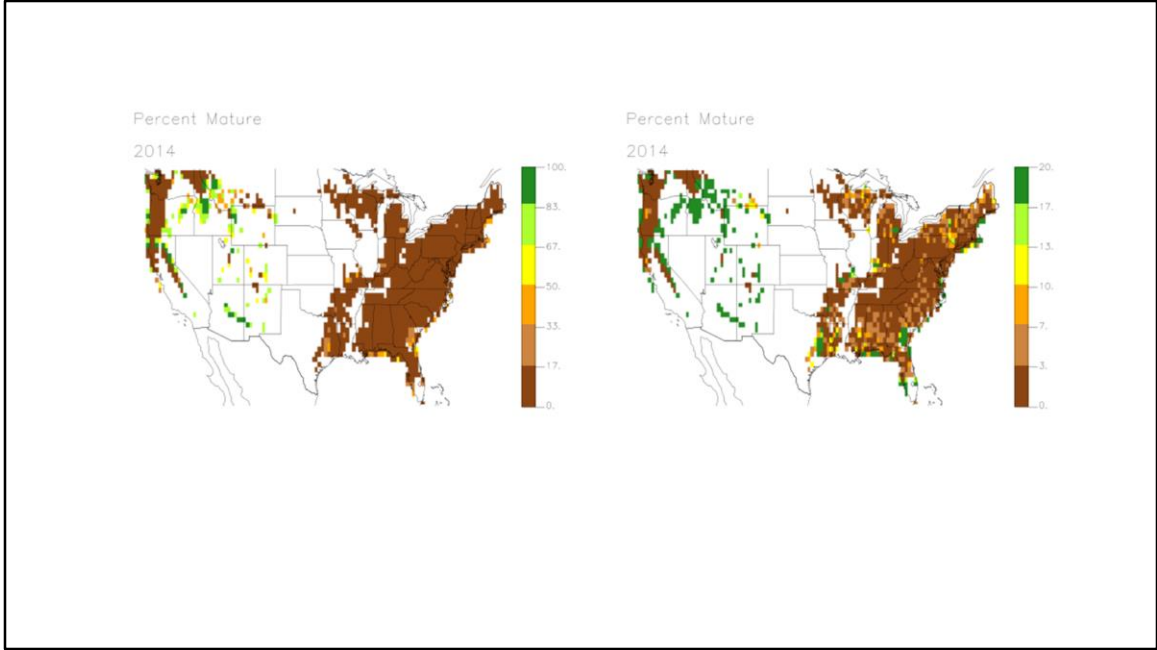
Figure S4: Percent mature forest, with white signifying values of 0, a) maximum 10%, b) maximum 20%.
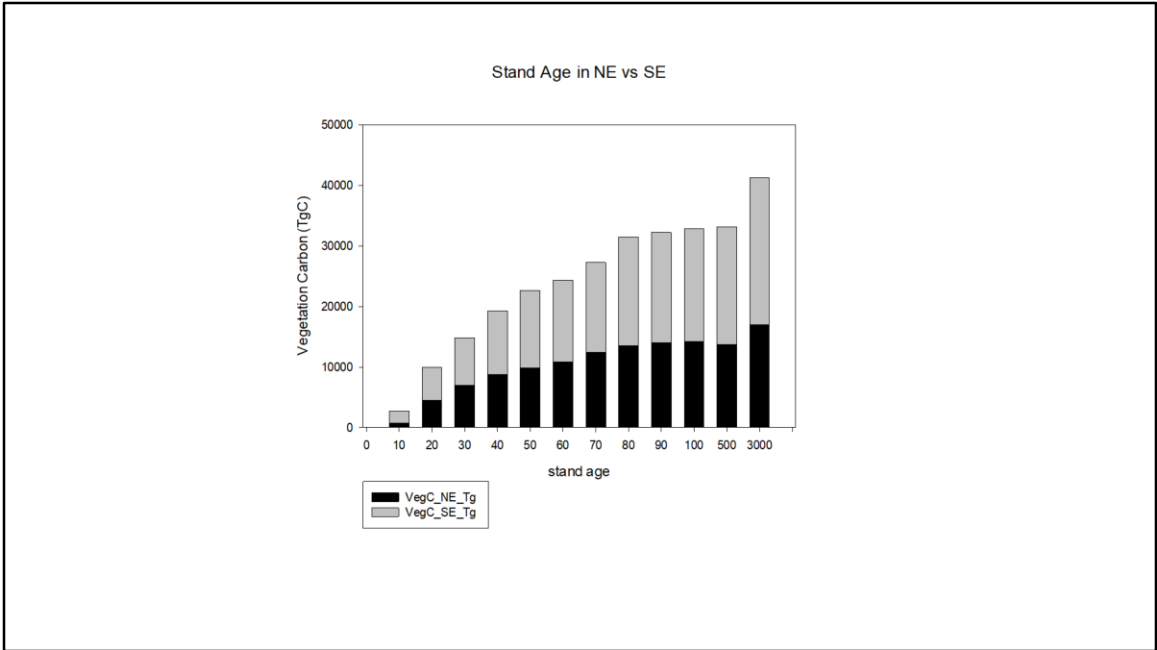
Figure S5: Vegetation carbon partitioned between the Northeast and Southeastern U.S. (West of -105º and 40º latitude dividing line).