Regrowth and LUC-Emission: traps behind the plausible consistency in net CO₂ flux in TRENDY-v8 models

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Although the existence of large carbon sink in terrestrial ecosystems is well established, the detailed information and components of **INTRODUCTION** this sink remain uncertain. In order to study the global scale ecosystem carbon cycle and budget, several dynamic global vegetation models (DGVMs) have been developed and considered to be the most suitable way. However, almost all the estimates of carbon fluxes based on each model vary widely. Among them, the net CO₂ flux (i.e., NBP) seems to have a plausible consistency. Therefore, in this study, the differences between different models of the net CO₂ flux were analyzed in detail to figure out Whether this consistency is true and what facts are behind it.

MATERIAL AND METHODS

Simulations of the global dynamic vegetation models (DGVMs) used in this study are from the TRENDY v8.

CABLE-POP; CLASS-CTEM; CLM5.0; DLEM; ISBA-CTRIP; ISAM; JSBACH; JULES-ES; LPX-Bern; ORCHIDEE; ORCHIDEE-CNP; SDGVM; VISIT.

Forcing dataset:

Global atmospheric CO₂: 1700-2018 annual time-series, derived from ice core CO₂ data merged with NOAA annual resolution from 1958 onwards. Land use change (LUC): ~1950 LUH2 v2h; 1950-2019 based on new inputs from HYDE, and new FAO data for the national wood harvest demands. CRU Climate forcing: 0.5 degree CRU monthly historical forcing over 1901-2018 S2 NBP = (S2 NBP - S1 NBP) + S1 NBP CRU-JRA climate forcing: 0.5 degree CRU-JRA55 6-hourly historical forcing over 1901- 2018 CO₂ effect **Simulation protocol:** S1: variability in CO₂ (time-invariant "pre-industrial" climate and land use mask) Climate effect AF_{CO2+Clin} 82: variability in CO₂ and climate (time-invariant "pre-industrial" land use mask) **S3:** variability in CO₂, climate and LUC (all forcing time-varying) NBP = (S3 NBP - S2 NBP) + S2 NBP**∆**F_{Net} Regrowth flux Net LUC flux LUC emissions Negative sign (+): a net sink to the land AFUE Positive sign (-): a net source to the atmosphere (S3 NBP - S2 = (S3_NEP - S2_NEP) + (S3_NBP - S3_NEP) - (S2_NBP - S2_NEP) Fig.1 Sign Convention for Net CO2 Flux Fig.2 Descriptions of Flux Terminologies

RESULTS AND DISCUSSION

Fig.6 Time-series of forest cover rate in two hotspot regions

45°W 135°W 90°W 45°E 90°E 135°E 180 180 And Another 345.2 2 der mehr ŝ CAPARE PARTY PERMIT (PUCY-2 Č. ACLES NO. ΔF Pro-- 2145 ž di sana 950s 1960s 1970s 1980s 1990s 2000s 2010s ΔF reg Decides Fig.3 Plotbox of $\triangle F_{net}$ estimates of each model 135°W 90°W 45°W 135°E 45°F 90°E 180 180 AF LLO Ē CO2-Gride ΔF 3 C all la⊢_{U Ca}− A Standard Deviation Seg ∆F_{LUCe} 1950 1980 (gCinkar) p 1970 -\$80 1990 2000 2010 2018 5 10 15 20 45 60 80 100 110 120 130 140 150 160 180 200 250 300 400 1 Time (year) Fig.4 Time-series of fluxes' standard deviation Fig.5 Spatial distribution of fluxes' standard deviation of 1950-2018 100 CABLE-POP rate CLM5.0 DLEM ISAM JSBACH JULES-ES LPX-Bern ORCHIDEE SDGVM VISIT ISBA-CTRIP Carbon (kgC/m²) CLASS-CTEM ORCHIDEE-C 6 cover 94 9 ŝ non-cropland or grazing 0 88 ^{cp} 1950 2018 (a) Region3 -NPP -- NEP -- NBP -- eVeg % --CPP 8 CLM5.0 DLEM JSBACH JULES-ES CABLE-POI ISAM LPX-Bern ORCHIDEE SDGVM VISIT Carbon (kgC/m²) 6 ISBA-CTRI ORCHIDEE-C 9 76 Region3 ŝ 0 2001 2011 1961 1971 1981 1991 2018 1950 2018 -GPP-NPP-NEP-NBP-cVeg Time (year)

Fig.7 Accumulated Carbon flux and carbon in vegetation during the last 7 decades over two hot spot regions