Regrowth and LUC-Emission: traps behind the plausible consistency in net CO_2 flux in TRENDY-v8 models

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INTRODUCTION

Although the existence of large carbon sink in terrestrial ecosystems is well established, the detailed information and components of 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 CO_2 flux (i.e., NBP) seems to have a plausible consistency. Therefore, in this study, the differences between different models of the net CO_2 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 CO_2:** 1700-2018 annual time-series, derived from ice core CO_2 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
- **CRU-JRA climate forcing:** 0.5 degree CRU-JRA55 6-hourly historical forcing over 1901- 2018

Simulation protocol:

- **S1:** variability in CO_2 (time-invariant “pre-industrial” climate and land use mask)
- **S2:** variability in CO_2 and climate (time-invariant “pre-industrial” land use mask)
- **S3:** variability in CO_2, climate and LUC (all forcing time-varying)

Negative sign (+): a net sink to the land
Positive sign (－): a net source to the atmosphere

Fig.1 Sign Convention for Net CO_2 Flux

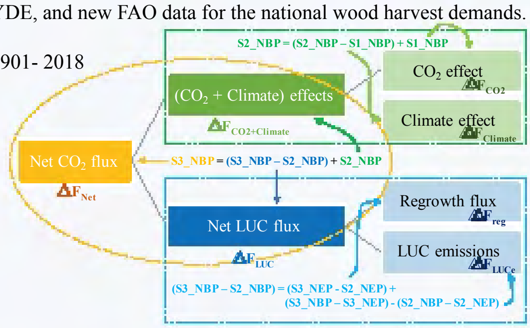

Fig.2 Descriptions of Flux Terminologies

RESULTS AND DISCUSSION

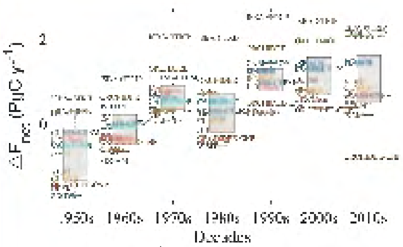

Fig.3 Plotbox of $\triangle F_{net}$ estimates of each model

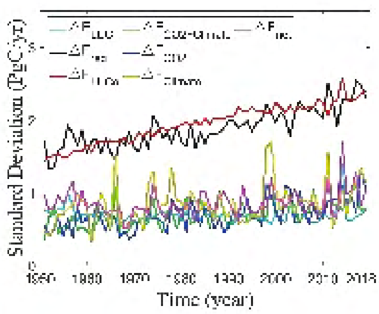

Fig.4 Time-series of fluxes' standard deviation

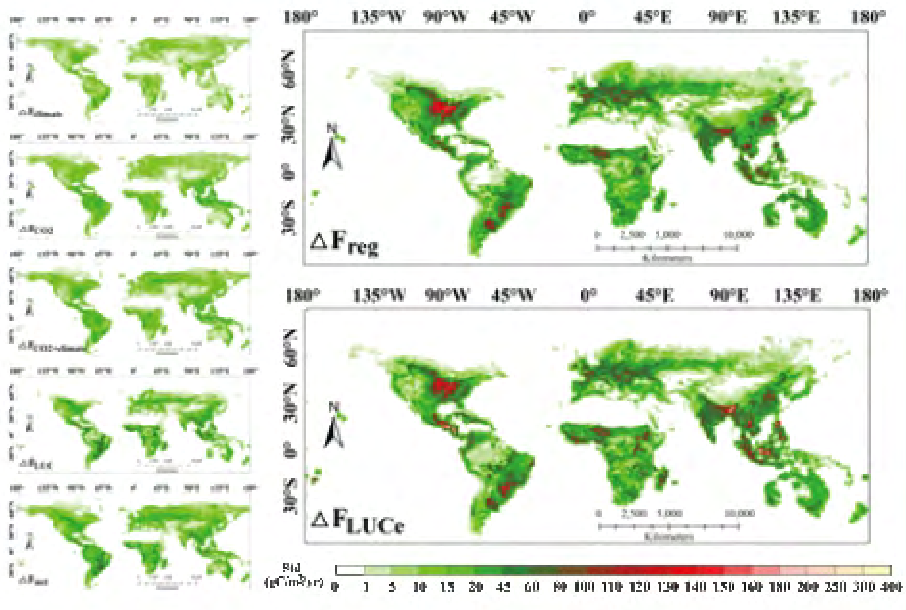

Fig.5 Spatial distribution of fluxes' standard deviation of 1950-2018.

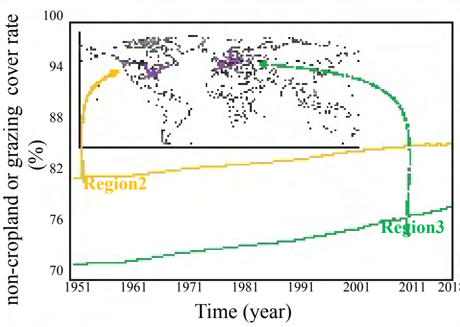

Fig.6 Time-series of forest cover rate in two hotspot regions.

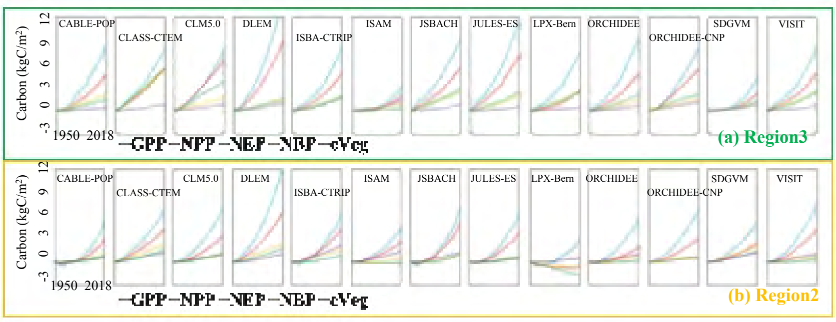

Fig.7 Accumulated Carbon flux and carbon in vegetation during the last 7 decades over two hot spot regions.