RECENT TRENDS AND DRIVERS IN GROSS PRIMARY PRODUCTION

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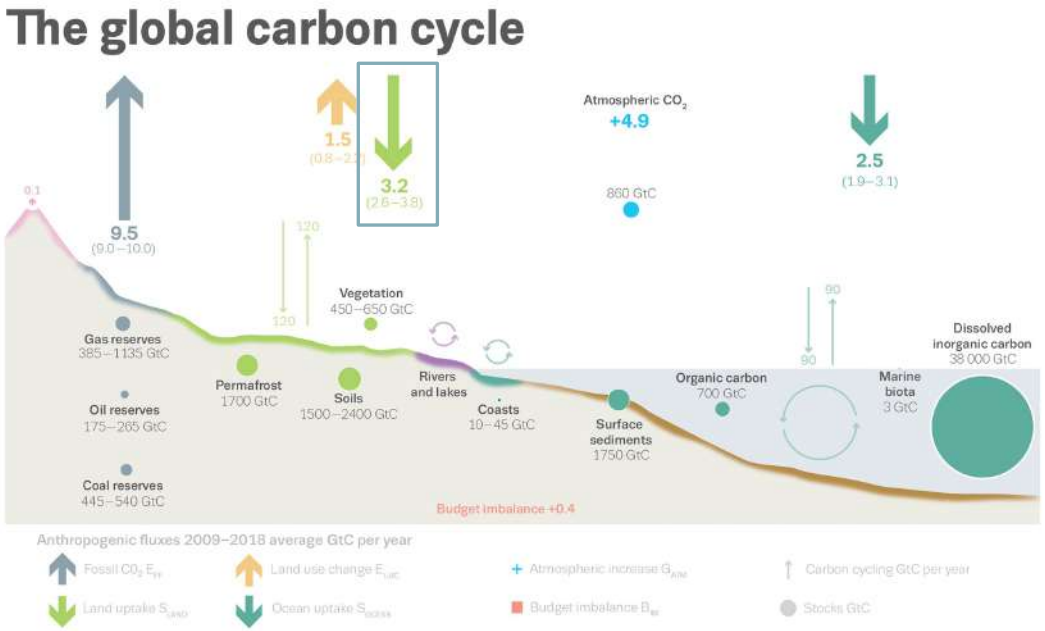
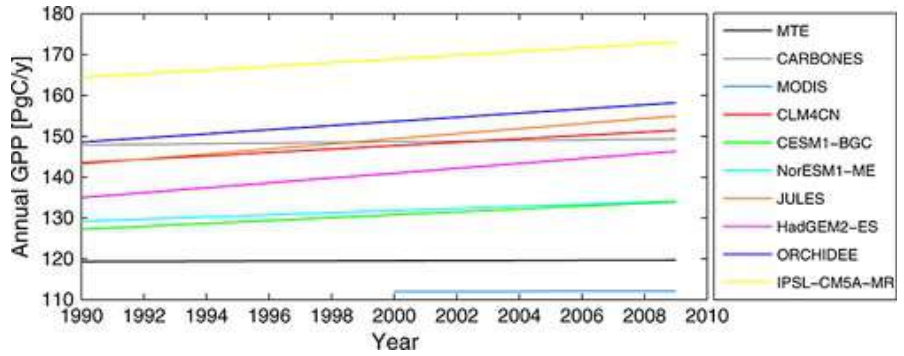
BACKGROUND

- Gross primary production – total carbon uptake by terrestrial plants via photosynthesis
- Photosynthesis is regulated by CO_2 levels and climate
- Current models diverge on historical records of GPP as well as projection of GPP under climate change, which necessitates models with robust theoritical basis and transparent parameterization





METHOD

$$GPP = IPAR \times fAPAR \times LUE$$

Incident energy absorbed by plants

C_3 Plants

$$GPP = \varphi_{0(C_3)} I_{abs} m \sqrt{\left[1 - (c^*/m)^{2/3}\right]}$$

$$m = (c_a - \Gamma^*) / \left\{ c_a + 2\Gamma^* + 3\Gamma^* \sqrt{[1.6\eta^* D_0 \beta^{-1} (K + \Gamma^*)^{-1}]} \right\}$$

Environmental control in biochemical cycle

C_4 Plants

$$GPP = \varphi_{0(C_3)} I_{abs} m \sqrt{\left[1 - (c^*/m)^{2/3}\right]}$$ with m=1

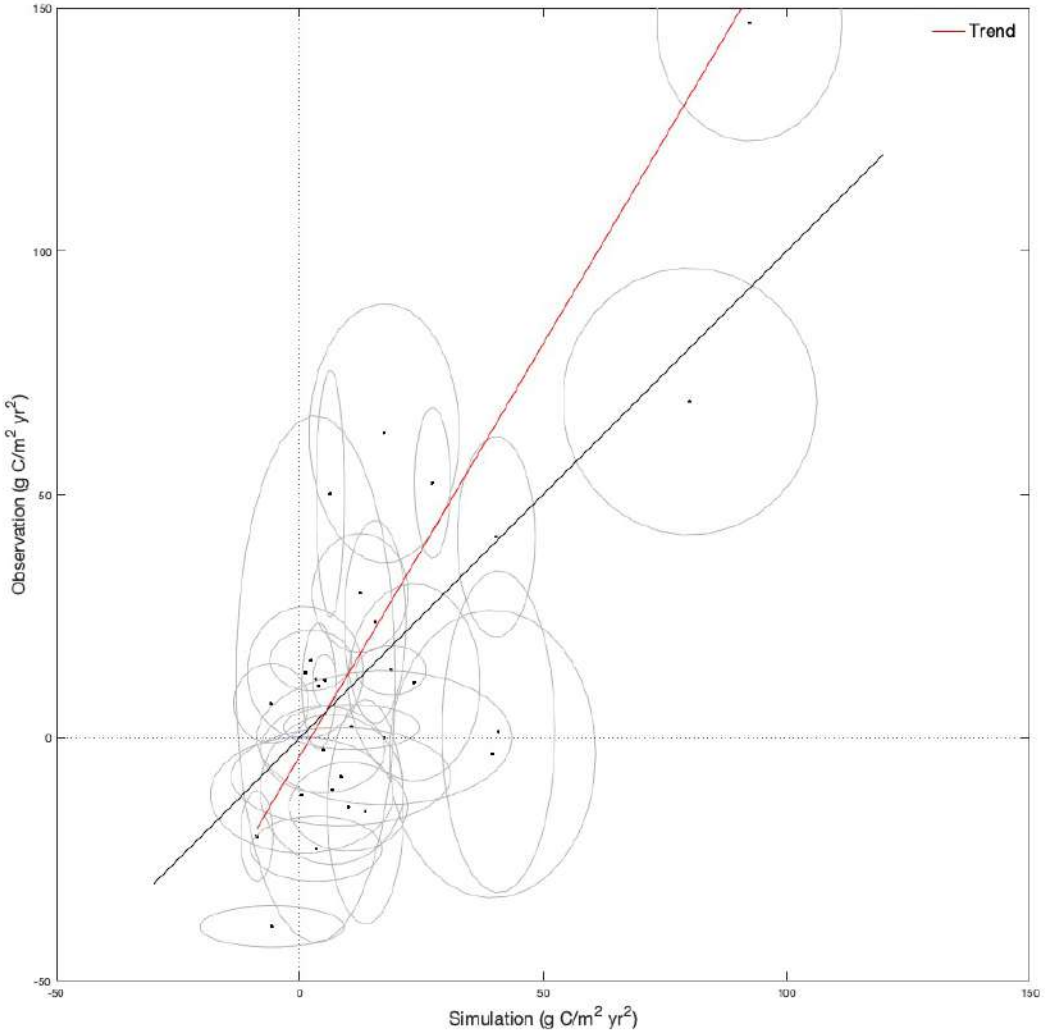
Additional effect of:

1. Soil moisture stress
2. Temperature dependence of ϕ_0

- CO_2 concentration
- Temperature
- Water vapour pressure
- Elevation

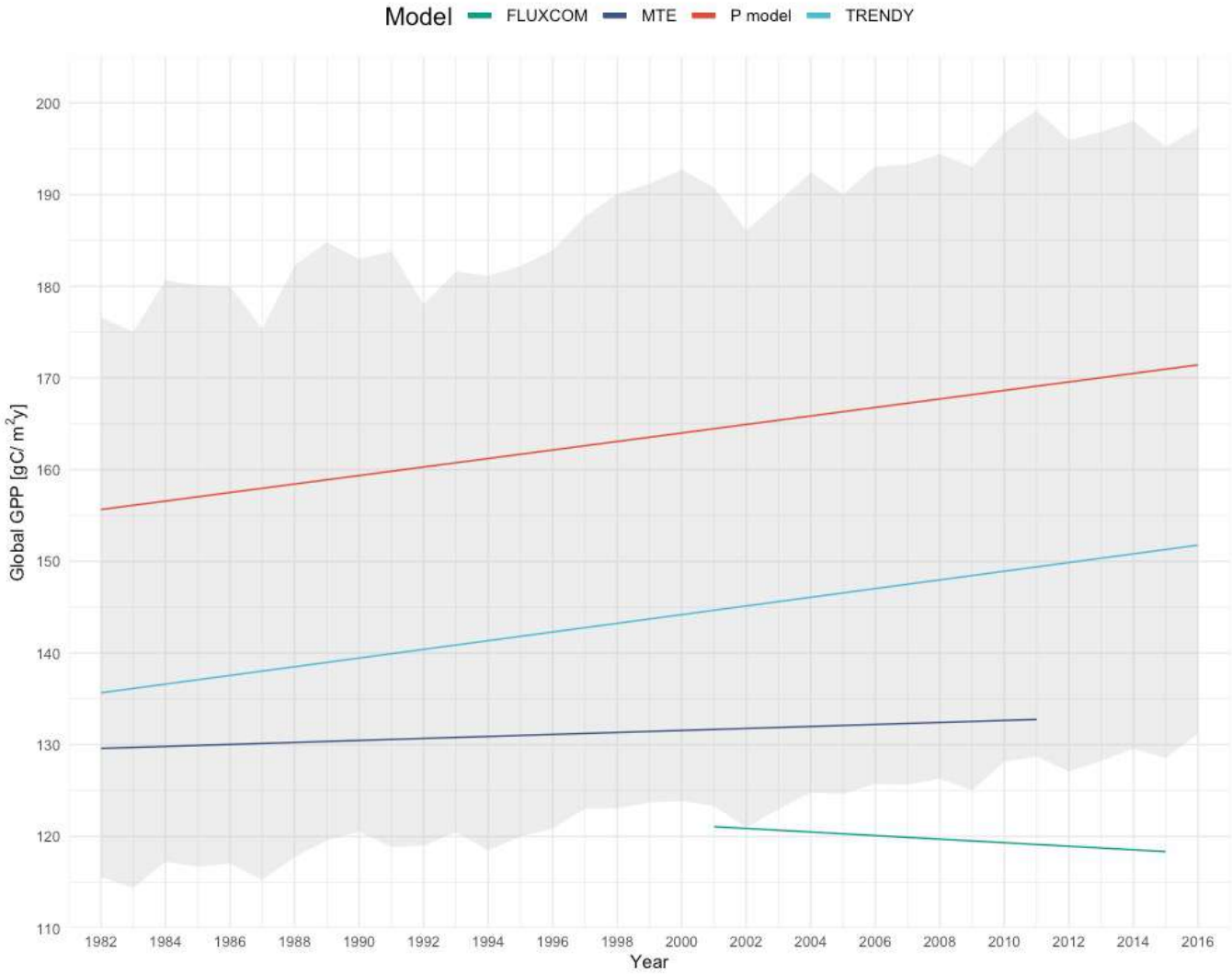
SITE EVALUATION

Simulation of site GPP trend against GPP derived from FLUXNET2015 dataset



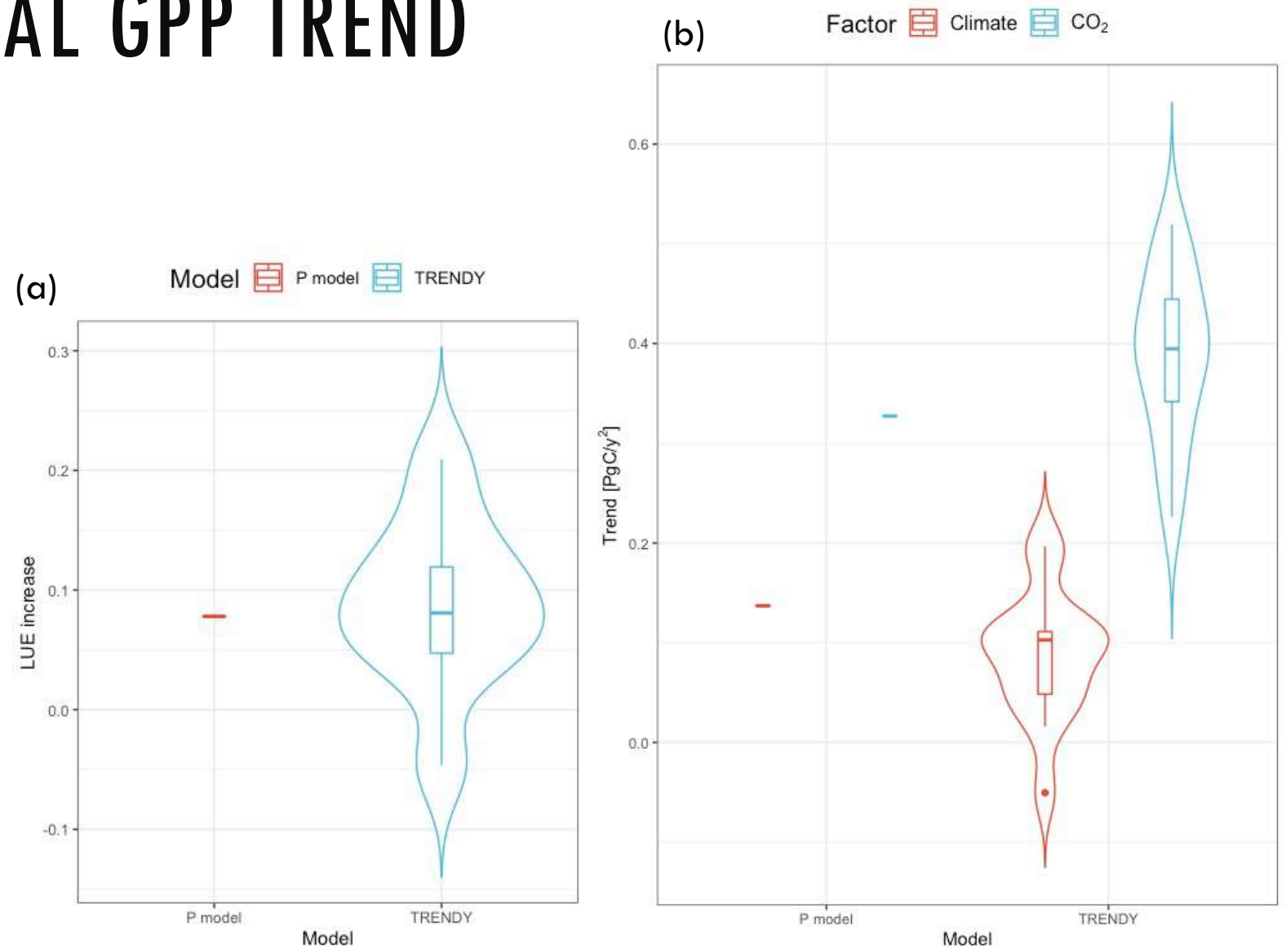
GLOBAL SCALE GPP AND TREND

- ✓ P model simulated GPP trend consistent with that derived from TRENDY ensembles
- ✓ Both data-driven models has nearly zero even negative GPP trend
  - ✓ Lack of CO_2 fertilization effect
  - ✓ Relatively short time period



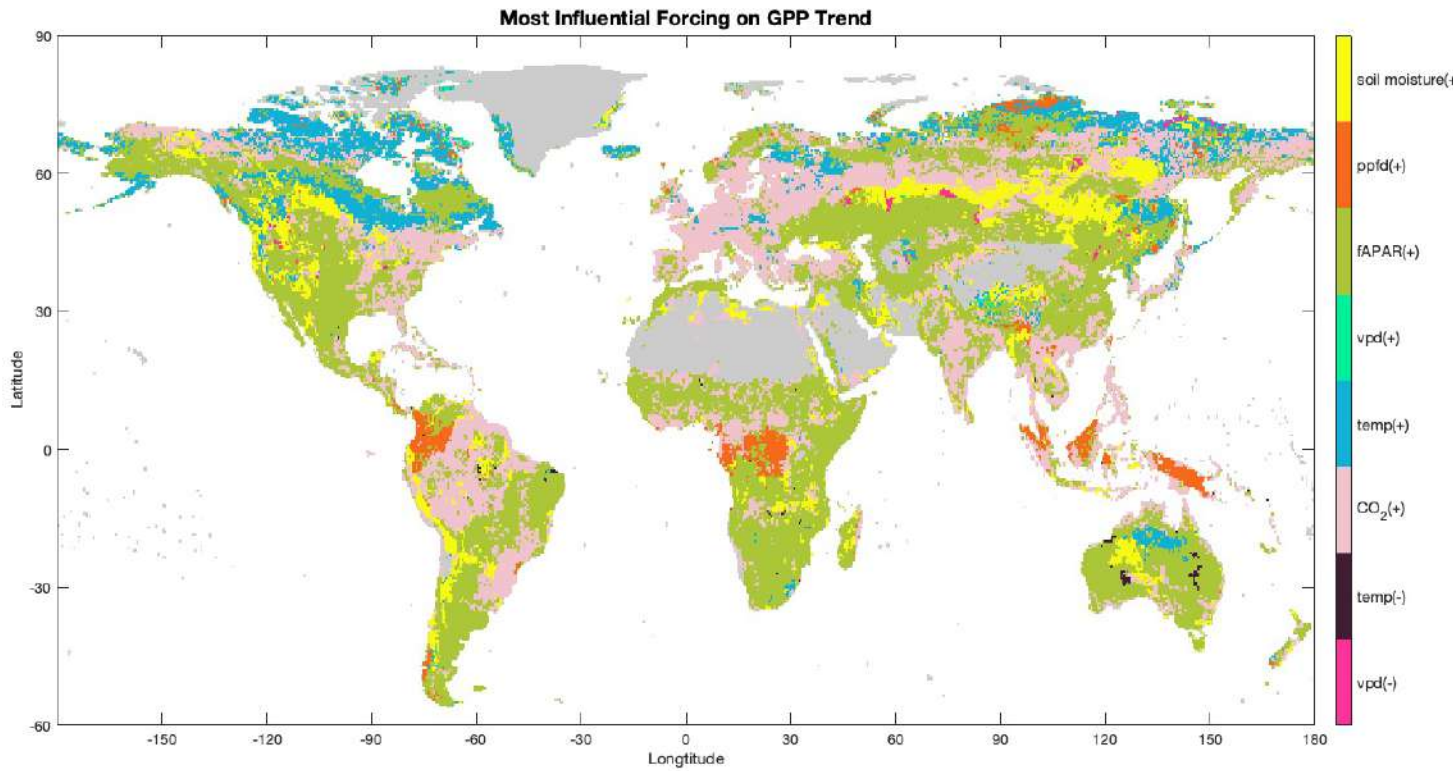
DRIVERS OF GLOBAL GPP TREND

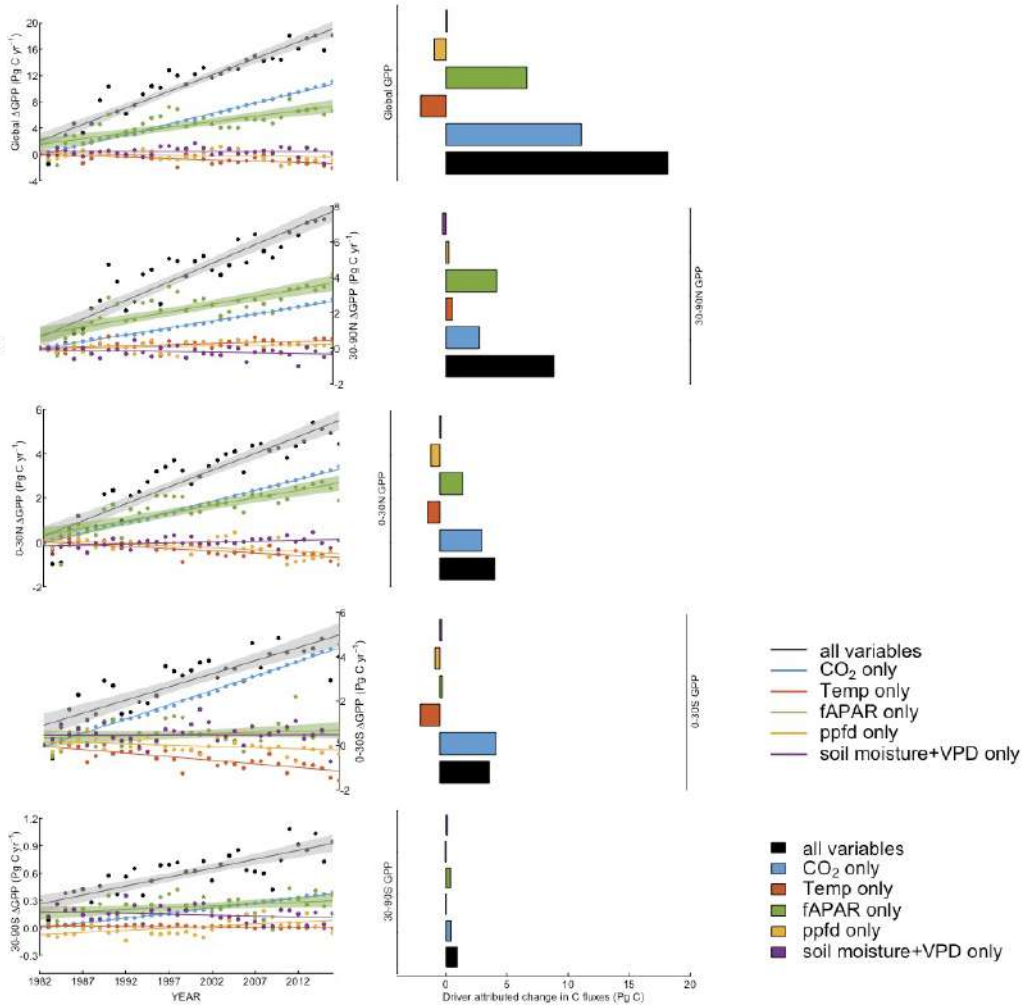
- ✓ P model simulate similar LUE increase as derived from TRENDY ensembles
- ✓ Contribution of CO_2 and climate on GPP trend is consistent between P model and TRENDY models



DRIVERS OF GLOBAL GPP TREND

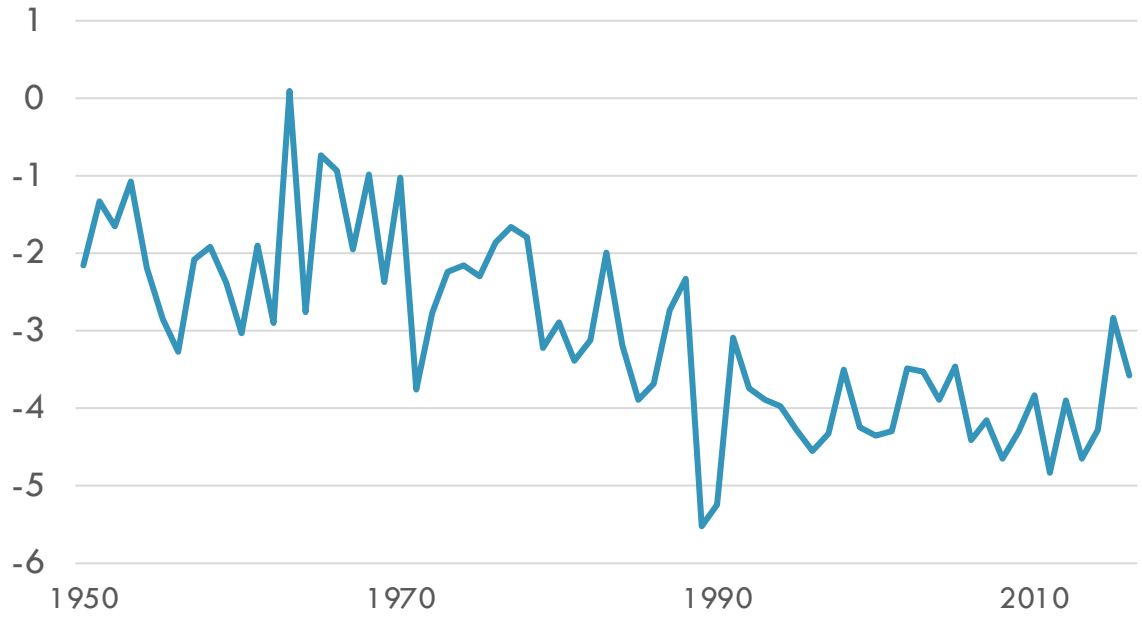
- ✓ CO2 is the most important factor accounting for GPP change, with 'greening' comes the next

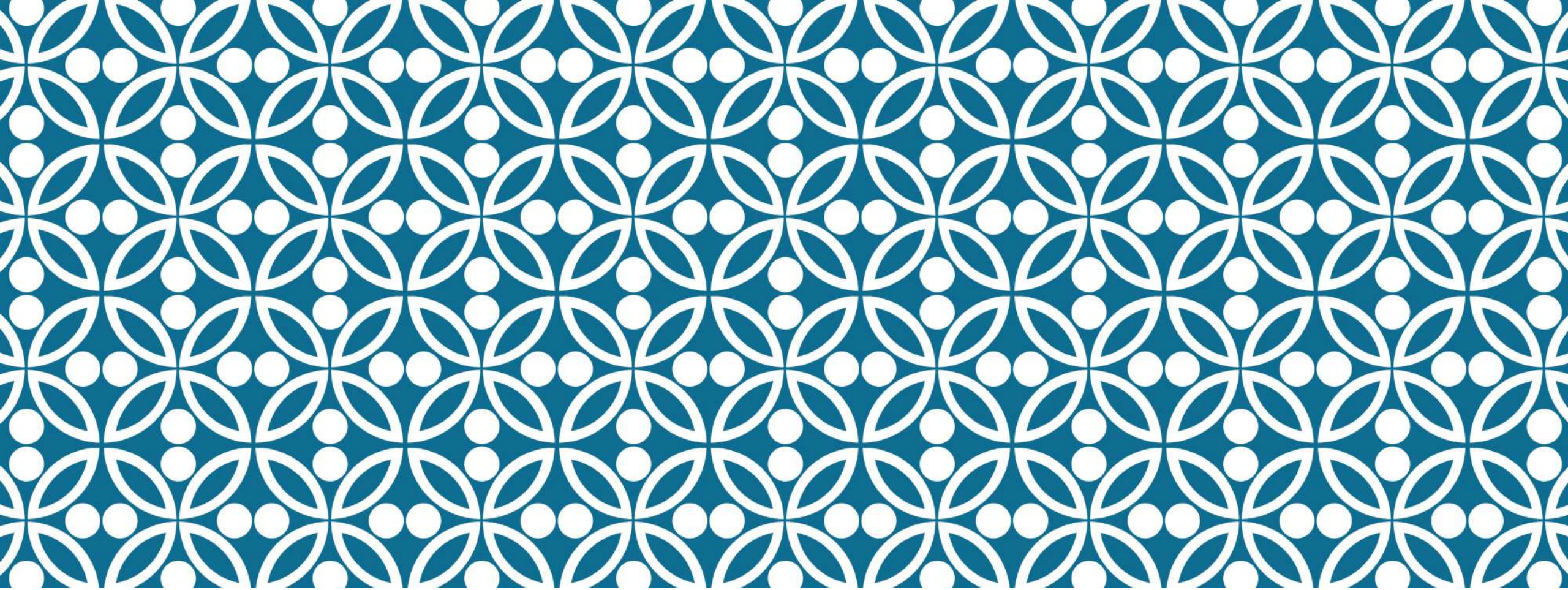




NEXT STEPS

- Starting with GPP:
  - Simulating autotrophic respiration (Ra) using biomass production efficiency (BPE)
  - Simulating heterotrophic respiration (Rh) following TRENDY protocol
- Simulating NEE as the difference between GPP and ecosystem respiration (Reco = Ra + Rh)
- Simulating seasonal CO_2 amplitude using TM3 (in process)





THANK YOU!

Questions?