New numerical approach improves the coupling of land carbon and water fluxes in CLM

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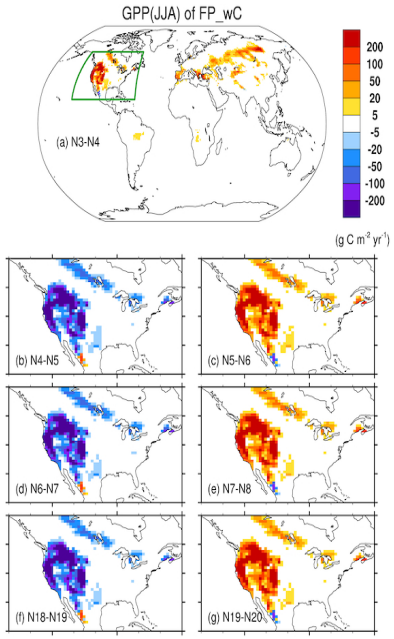
Objective

- Identify the cause of numerical instability in the calculated carbon and water fluxes in land surface models (LSMs)
- Develop and implement a new approach to overcome the numerical instability in the Community Land Model (CLM)

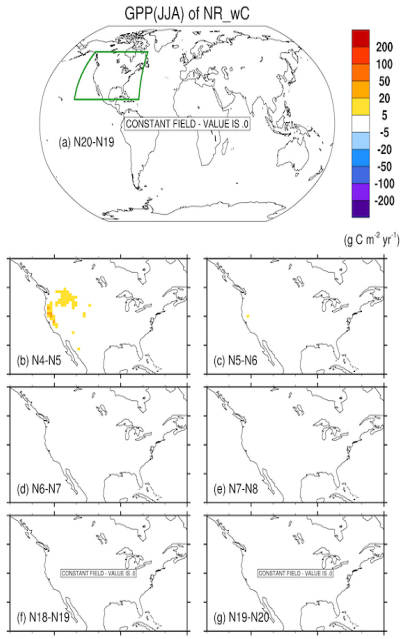
New Science

- The numerical solutions of the coupled carbon and water fluxes in the CLM do not converge for large portions of global land surface
- The failure to convergence results in ~ 3 Pg C yr^{-1} overestimation of global gross primary production with regional biases up to ~ 30%.
- A computationally efficient Newton-Raphson approach is proposed and implemented in CLM and is shown to overcome the numerical issue identified

CLM results with instability



Revised Results with new approach



Significance

- The coupling of carbon and water fluxes is key to simulating the response and feedbacks of global and regional carbon and hydrological cycles to climate change
- The finding of this study is expected to improve the performance of climate models

Citation: Sun Y, Gu, L, & Dickinson RE (2012) A numerical issue in calculating the coupled carbon and water fluxes in a climate model. JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 117, D22103, doi:10.1029/2012JD018059, 2012