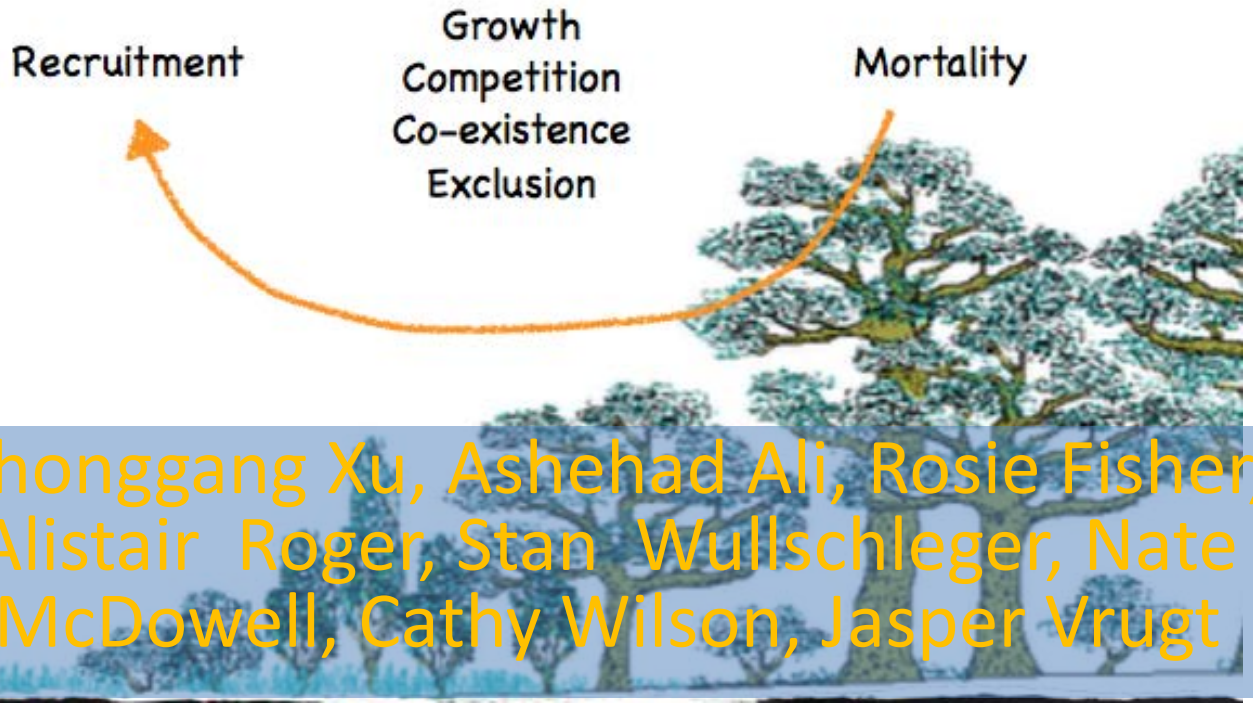
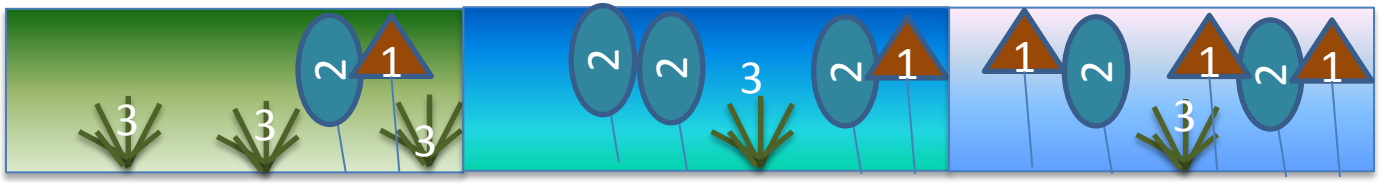
A Mechanistic Photosynthetic Capacity Model for CLM/CLM(ED)



Chonggang Xu, Ashehad Ali, Rosie Fisher, Alistair Roger, Stan Wullschleger, Nate McDowell, Cathy Wilson, Jasper Vrugt



15 year-old forest 50 year-old forest 150 year-old forest

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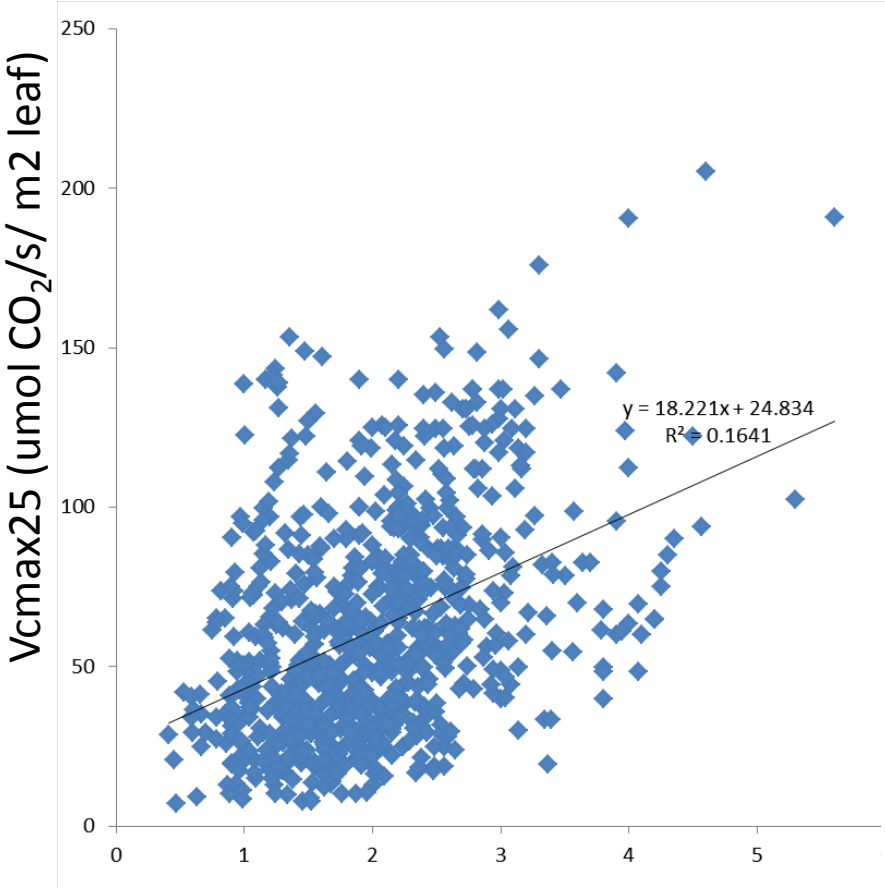
NCAR NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
OAK RIDGE National Laboratory
THE UNIVERSITY OF CALIFORNIA IRVINE

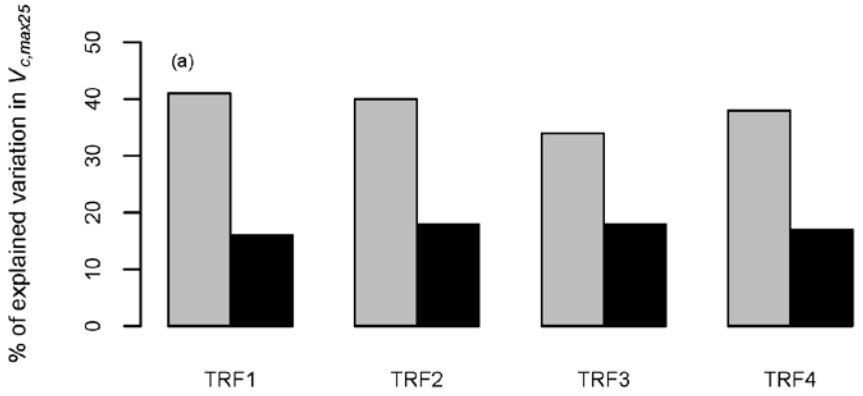
Motivations

$V_{c,max25}$: maximum carboxylation rate at 25°C

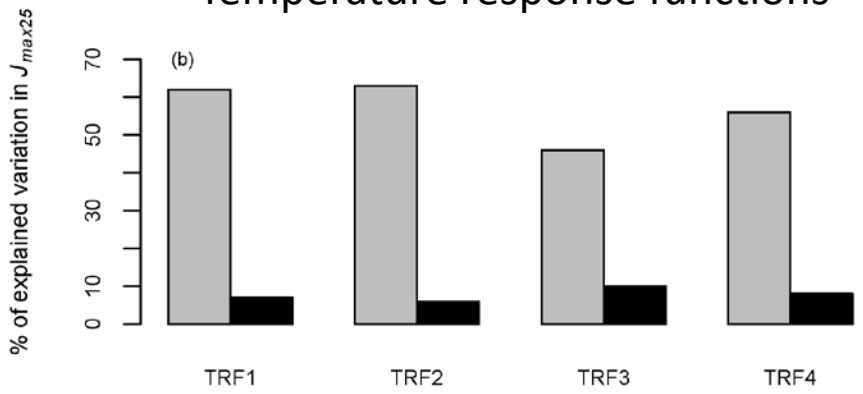
J_{max25}: maximum electron transport rate at 25°C



Leaf nitrogen content (g N/ m2 leaf)



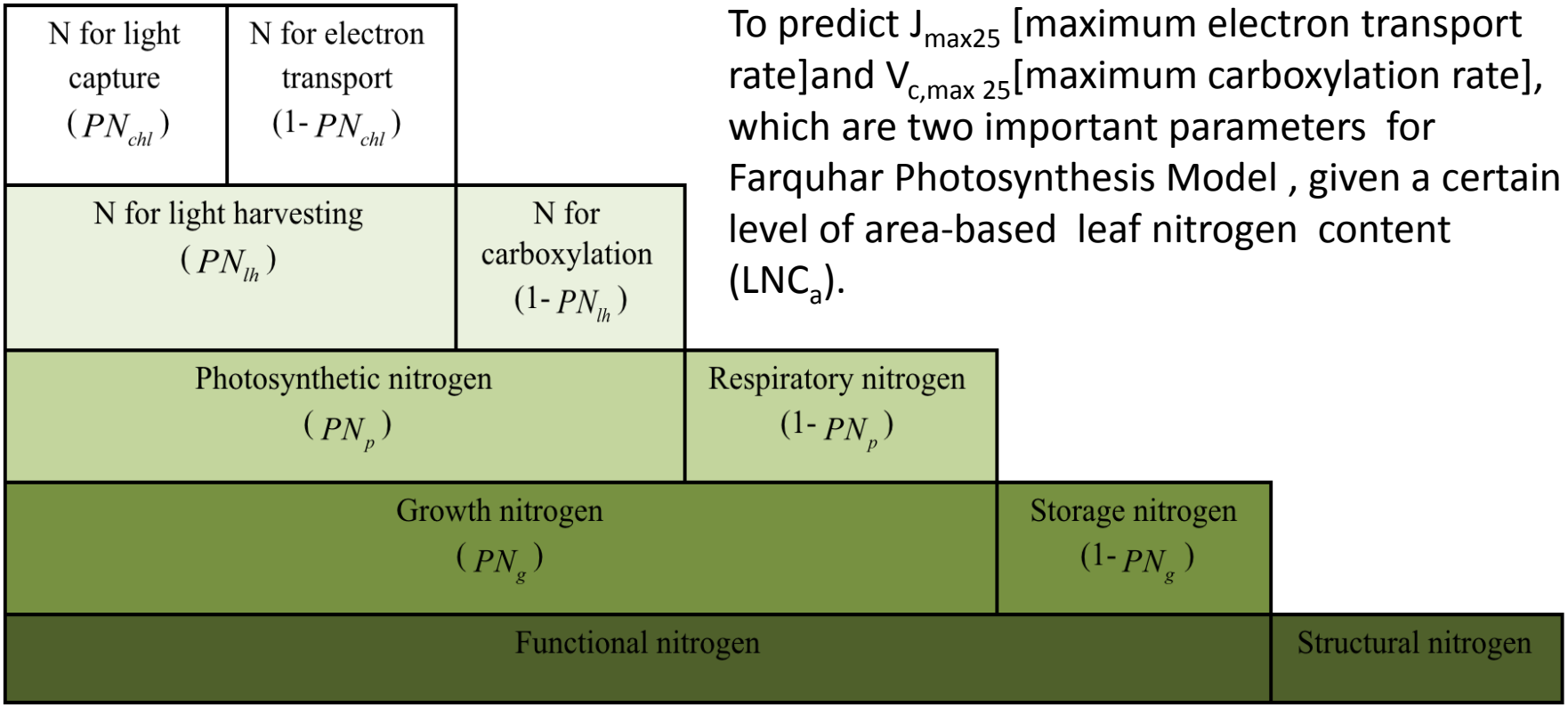
Temperature response functions



Temperature response functions

Ali et al. In Revision.

A mechanistic nitrogen allocation model

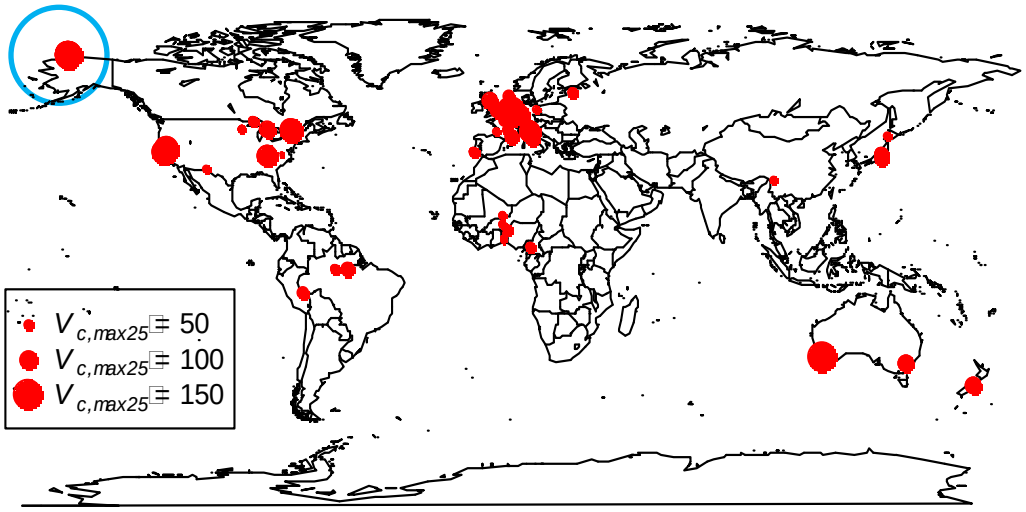


To predict J_{max25} [maximum electron transport rate]and $V_{c,max\ 25}$[maximum carboxylation rate], which are two important parameters for Farquhar Photosynthesis Model , given a certain level of area-based leaf nitrogen content (LNC_a).

Xu et al. 2012. Plos One, 7: e37914

Global survey of $V_{c,max25}$

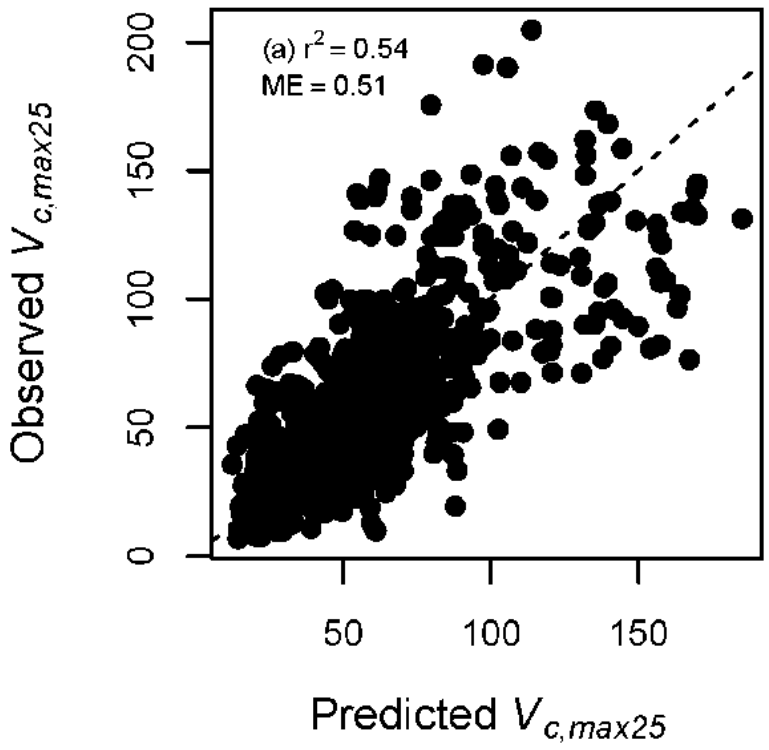
Number of field studies: 57

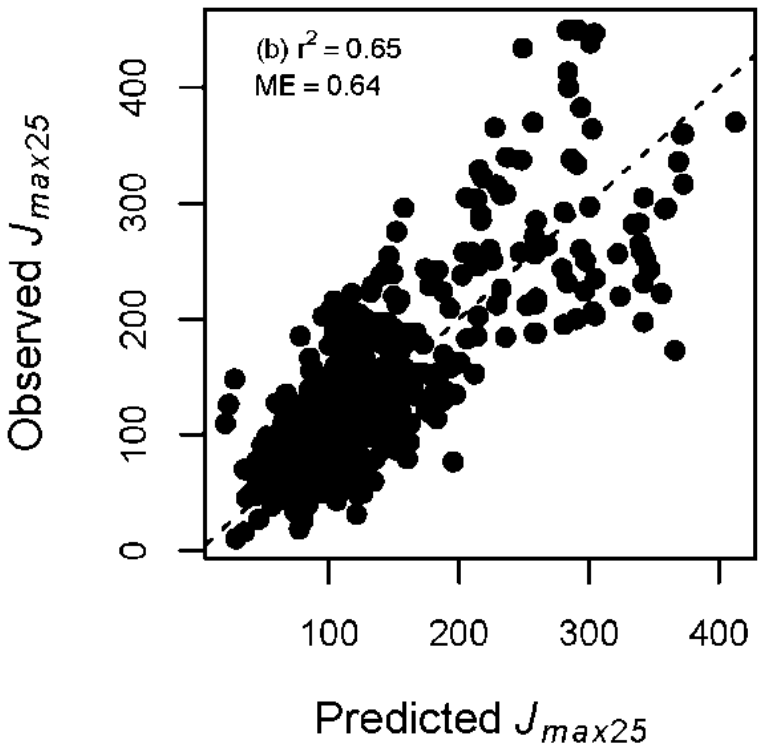


Number of observations:831 Number of species:121 Time range: 1989-2013

Ali, Xu et al. In Review.

Nitrogen allocation model fitting (DREAM)

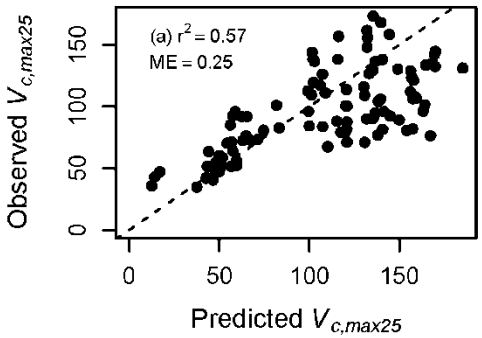


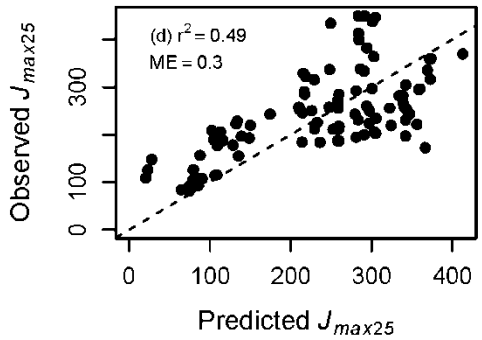


Ali et al. In Prep.

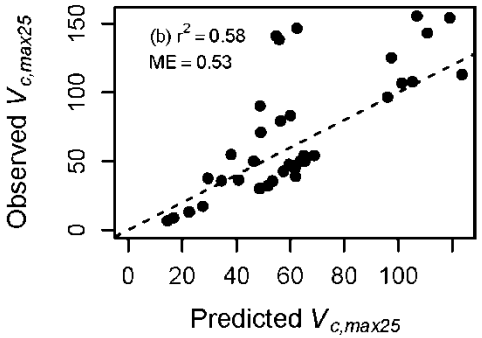
Nitrogen allocation model fitting for PFTs(DREAM)

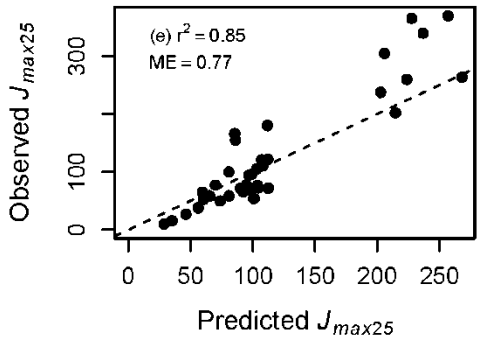
Shrub



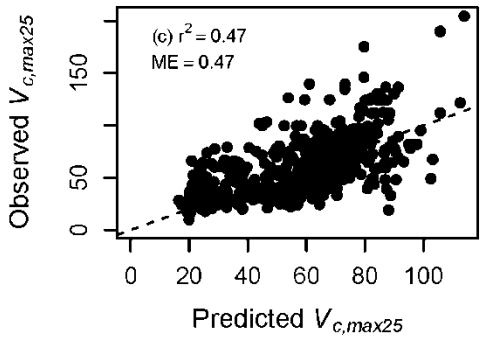


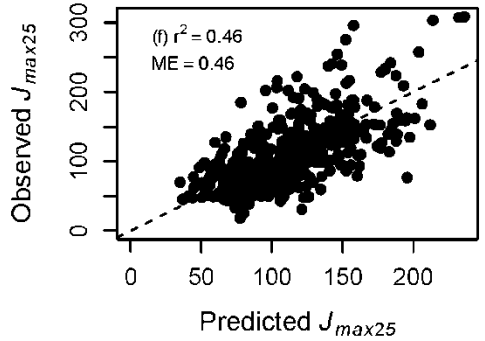
grass



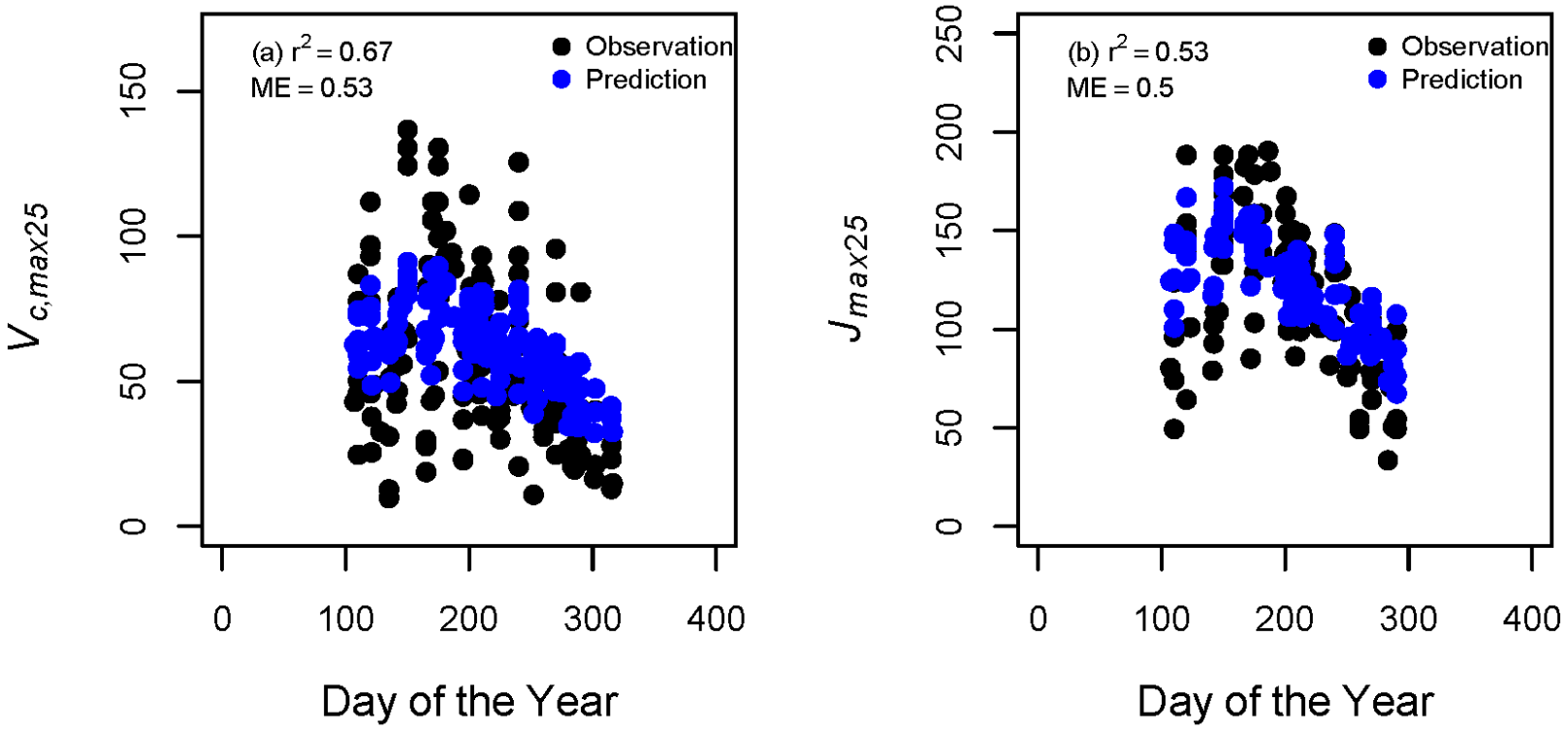


trees

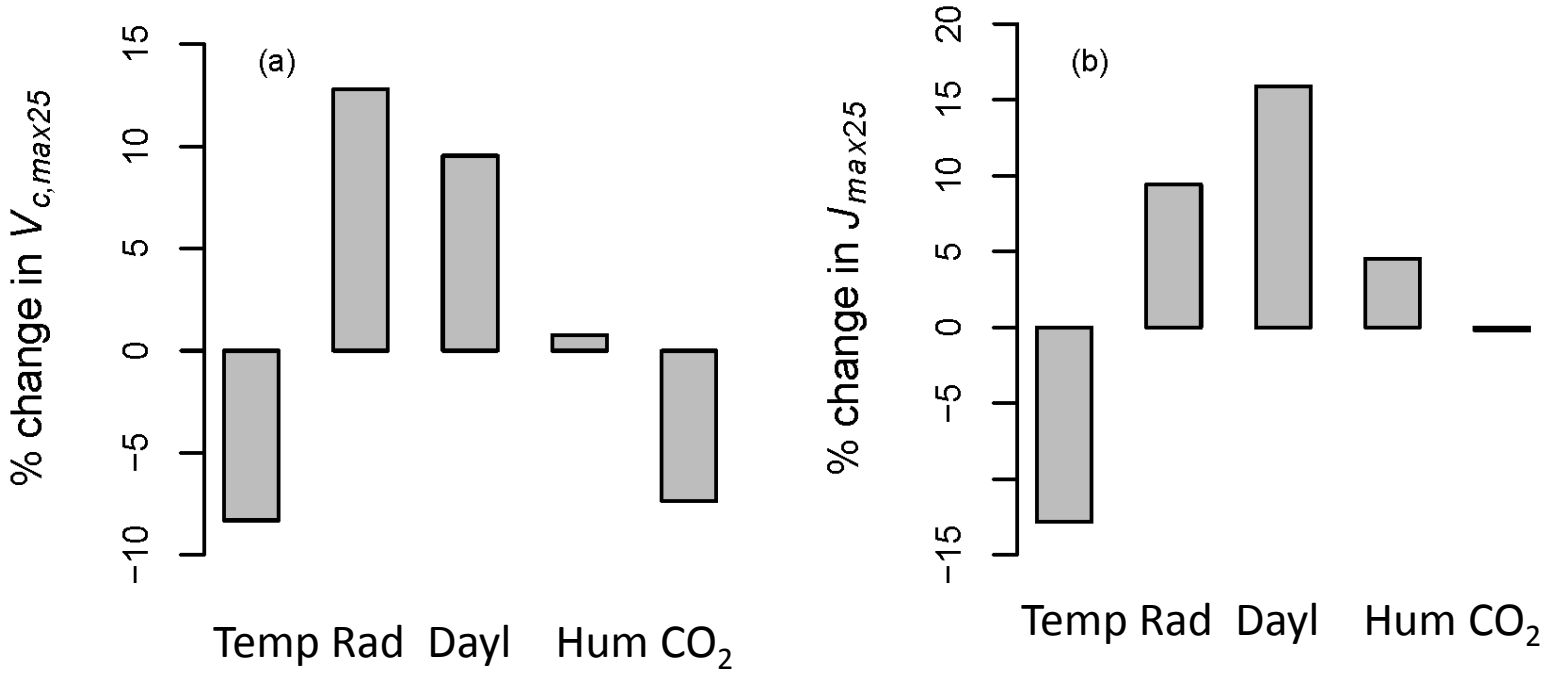




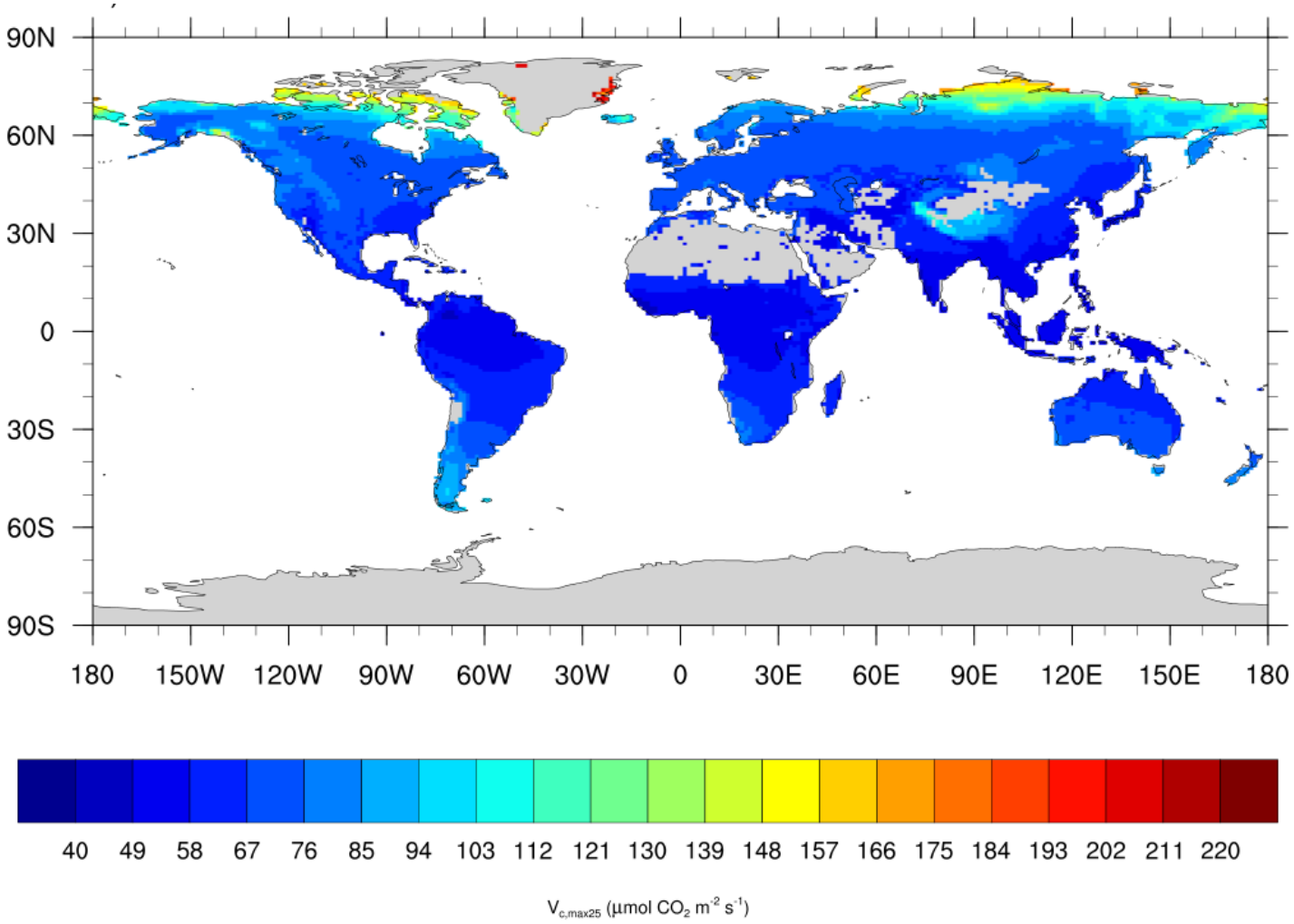
Nitrogen allocation model fitting for seasonal data (DREAM)



Model Sensitivity Analysis



Global pattern of $V_{c,max25}$

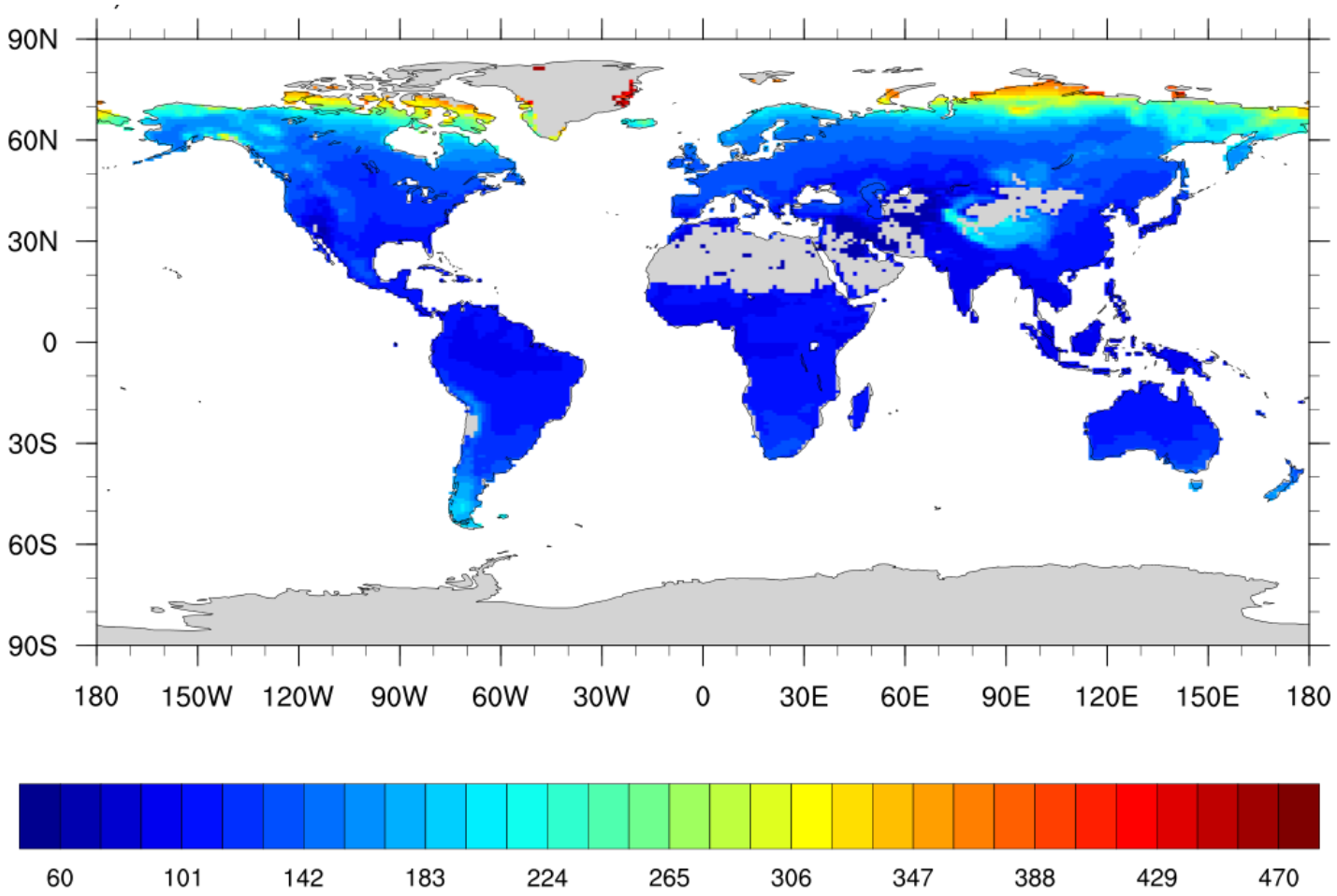


Historical climate (1995-2004)

Growing season (JJA in the north and DJF in the south) Vc,max25 for the top leaf layer (umol/m2/s)

Ali et al. In Prep.

Global pattern of J_{max25}

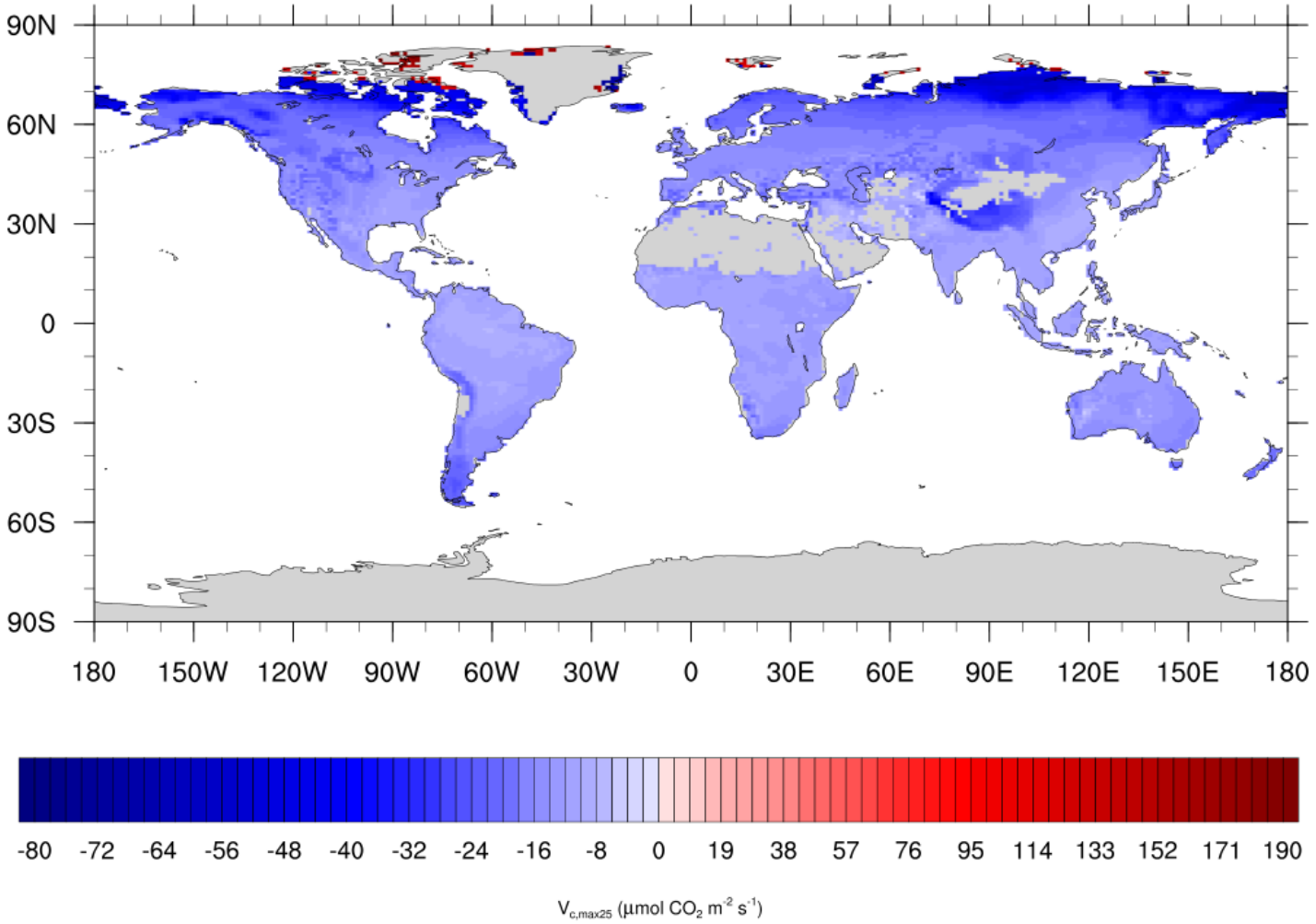


Historical climate (1995-2004)

Growing season (JJA in the north and DJF in the south)
Jmax25 for the top leaf layer (umol electron/m2/s)

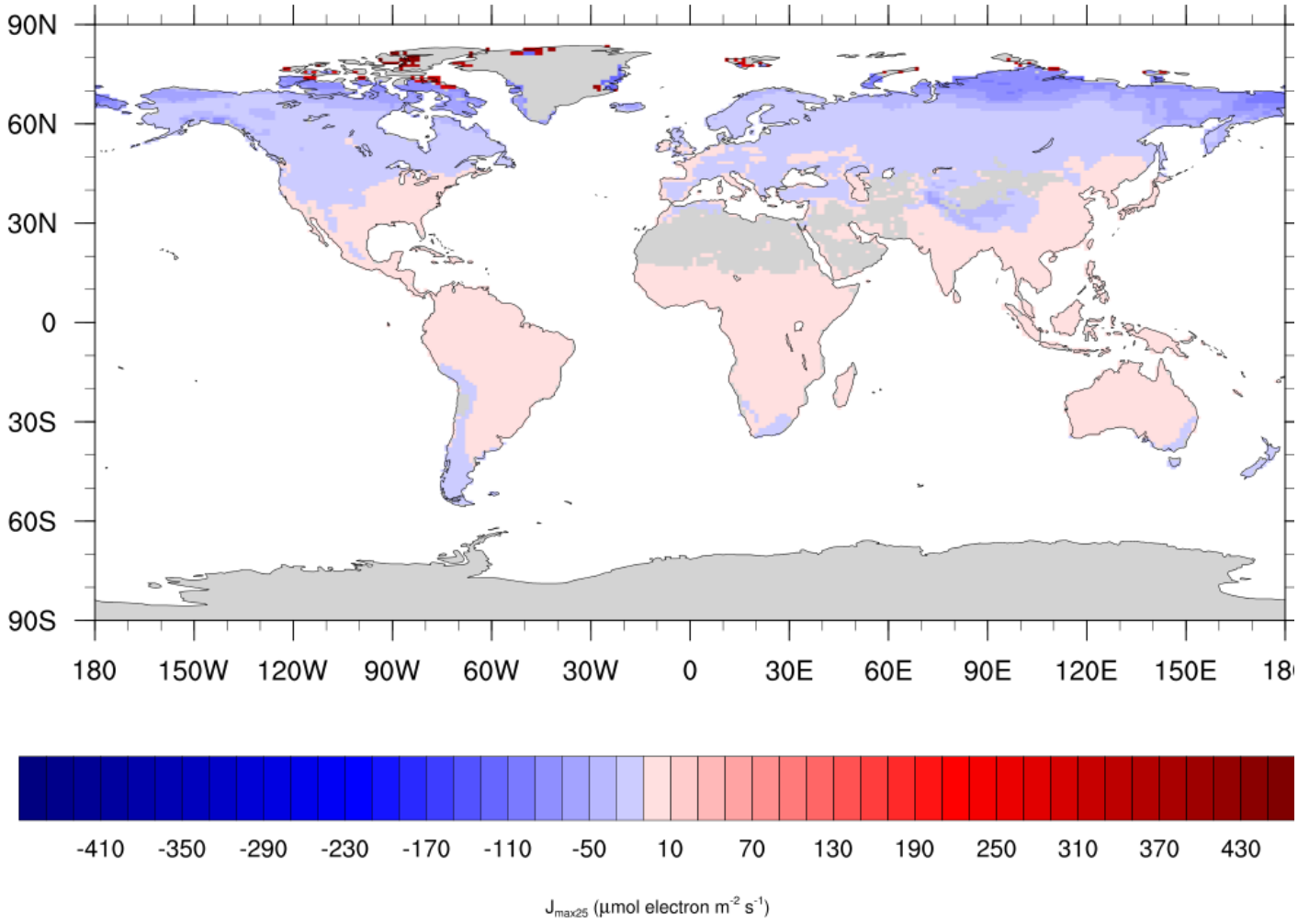
Ali et al. In Prep.

Growing season $V_{c,max25}$ Change in future for top leaf layer



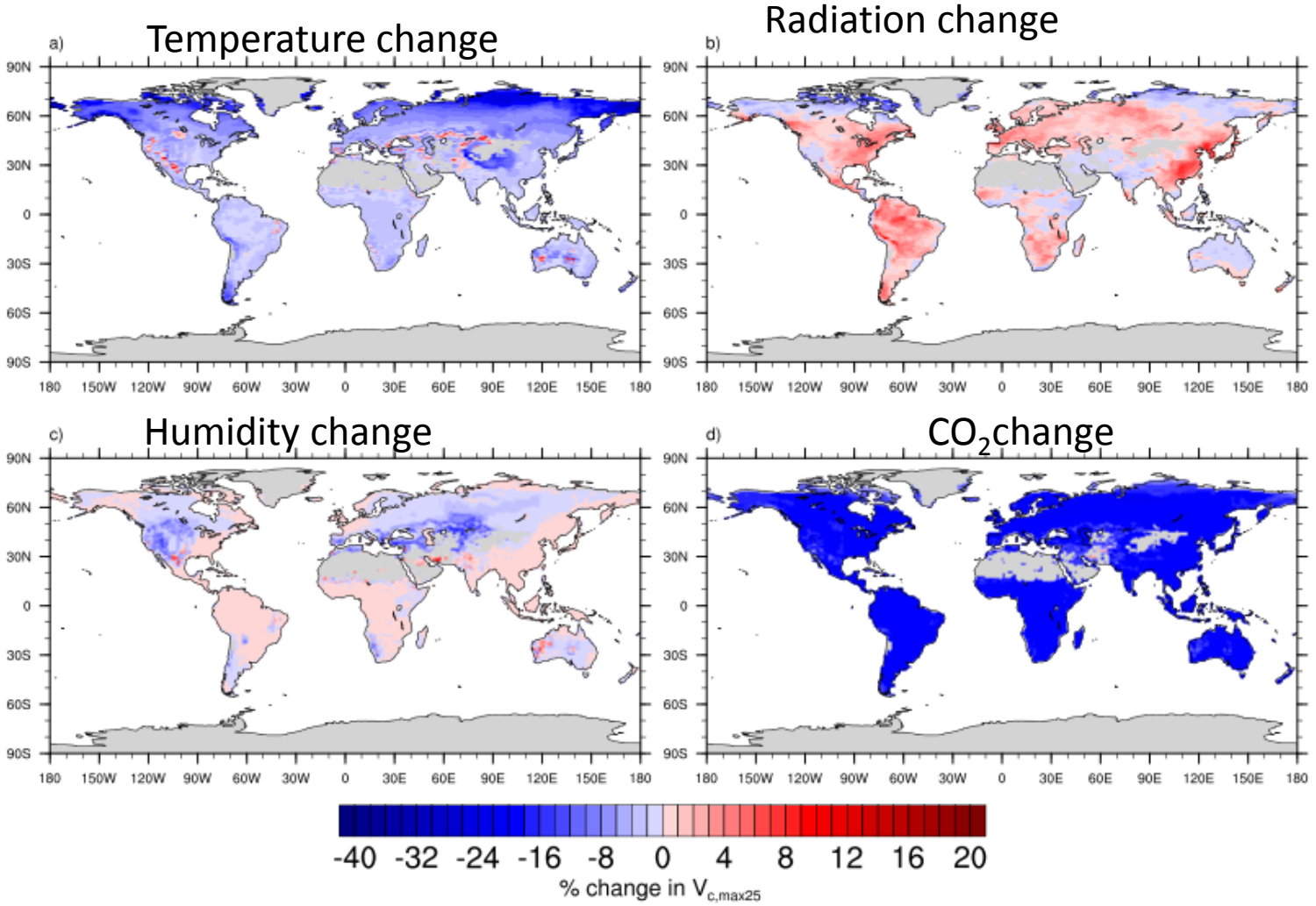
Vc,max25 under future climate (2090-2099) predicted by CESM-CAM5 with RCP 8.5 compared to that under historical climate (1995-2004)

Growing season J_{max25} Change in the Future for top leaf layer

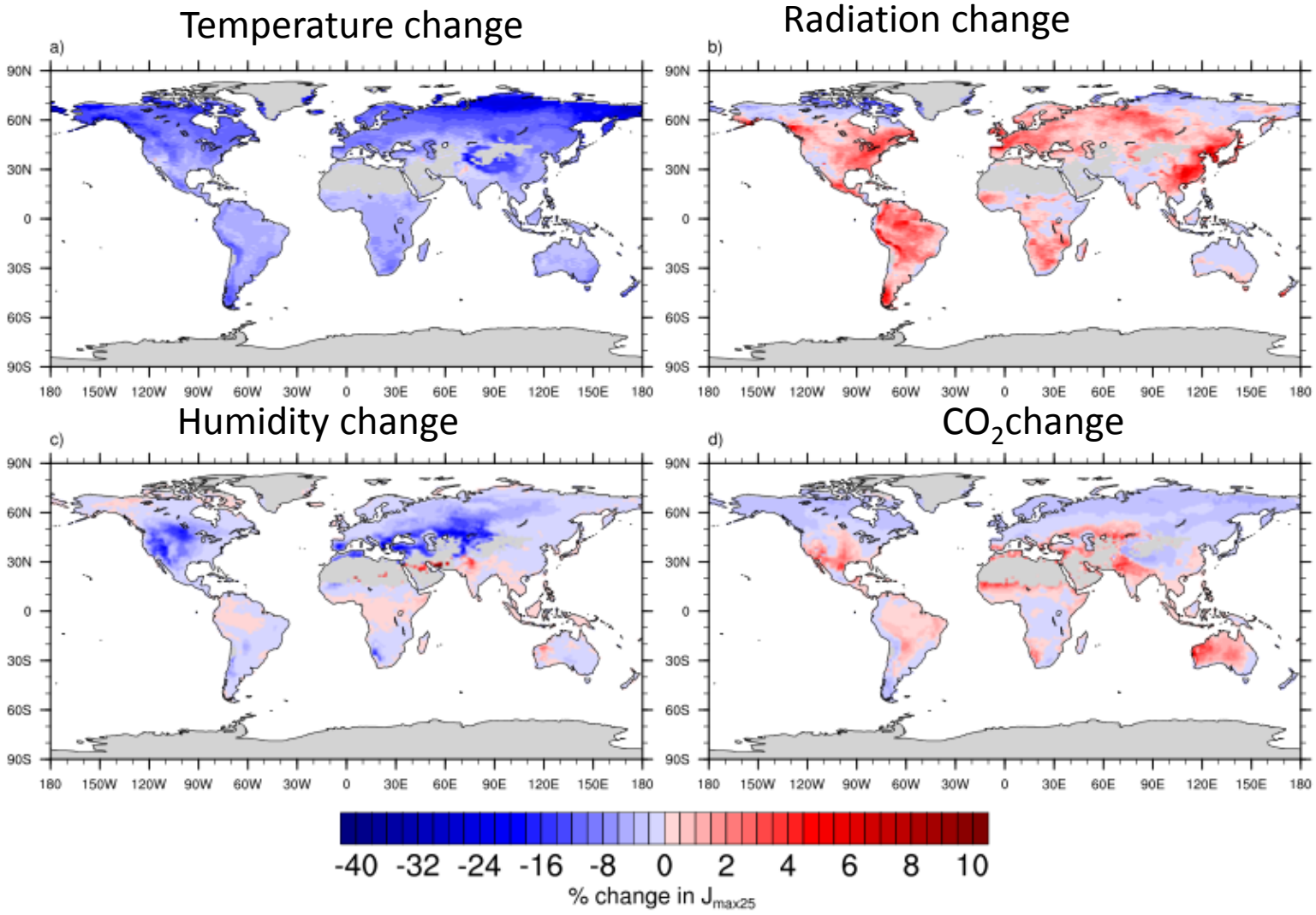


Jmax25 under future climate (2090-2099) predicted by CESM-CAM5 with RCP 8.5 compared to that under historical climate (1995-2004)

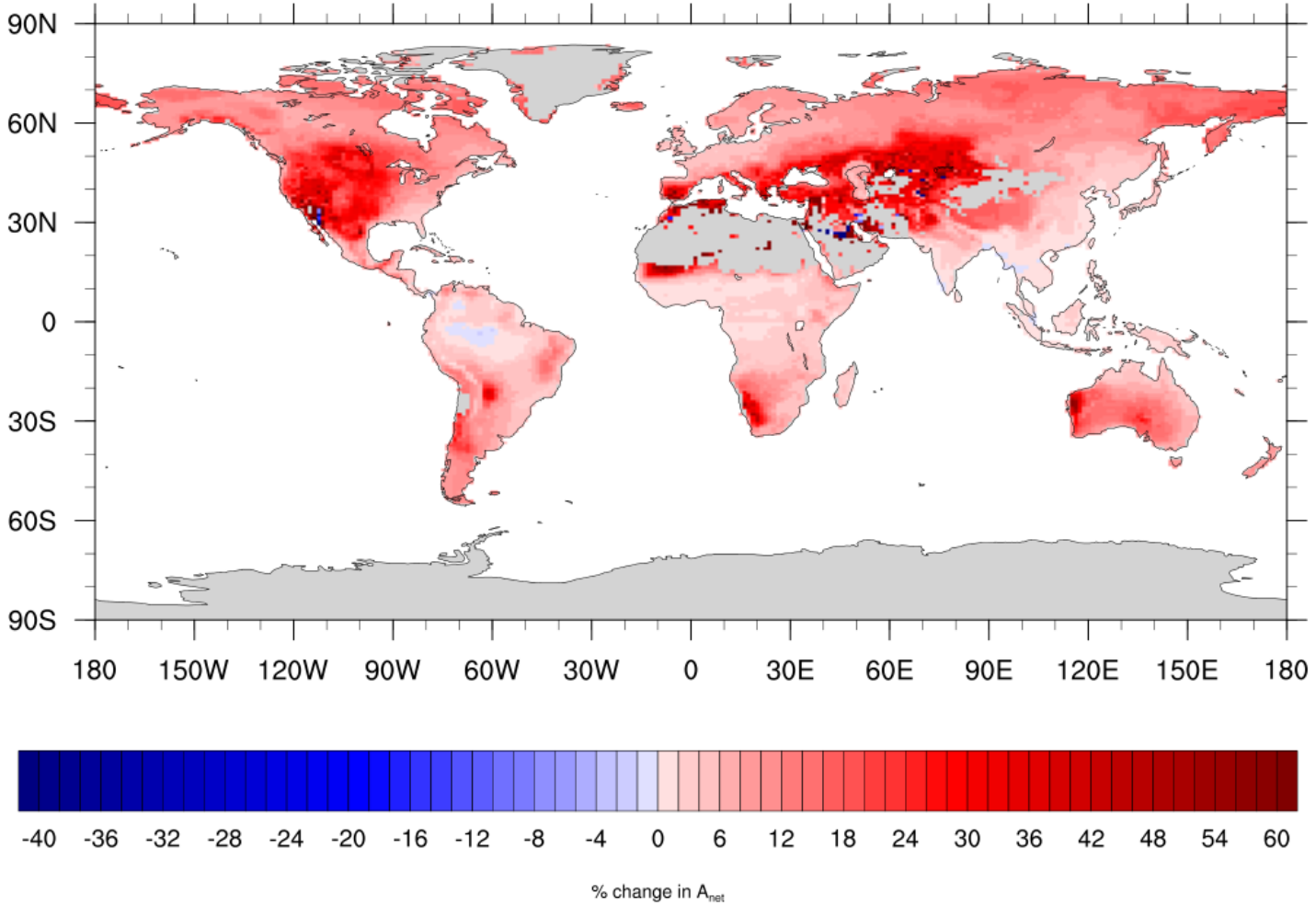
Cause of $V_{c,max25}$ change



Cause of J_{max25} change



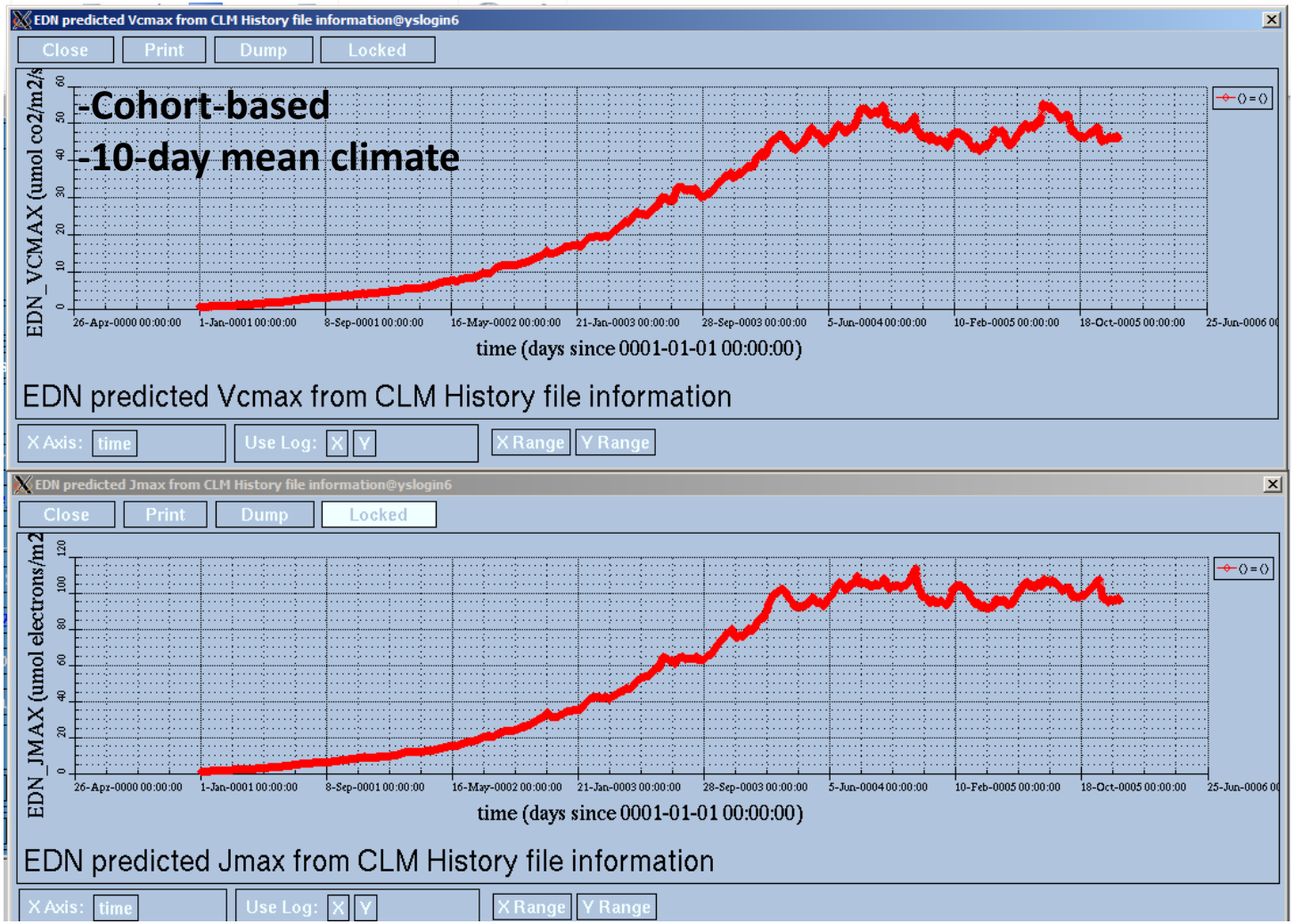
Potential impact on future net photosynthetic rate on the top leaf layer



Global overestimation of A_{net} at the top canopy layer is about **9.4%.**

Percentage change of Anet by using Vcmax25 and Jmax25 as it is in the past compared to that predicted by our model using future climate conditions

Nitrogen allocation model in CLM(ED)



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- **Key collaborators:** Rosie Fisher (NCAR), Stan Wullschleger(ORNL), Alistair Roger (BNL), Peter Reich (ORNL), Belinda Medlyn (Macquarie University), Jasper Vrugt (UCI), Josh Fisher (JPL)