

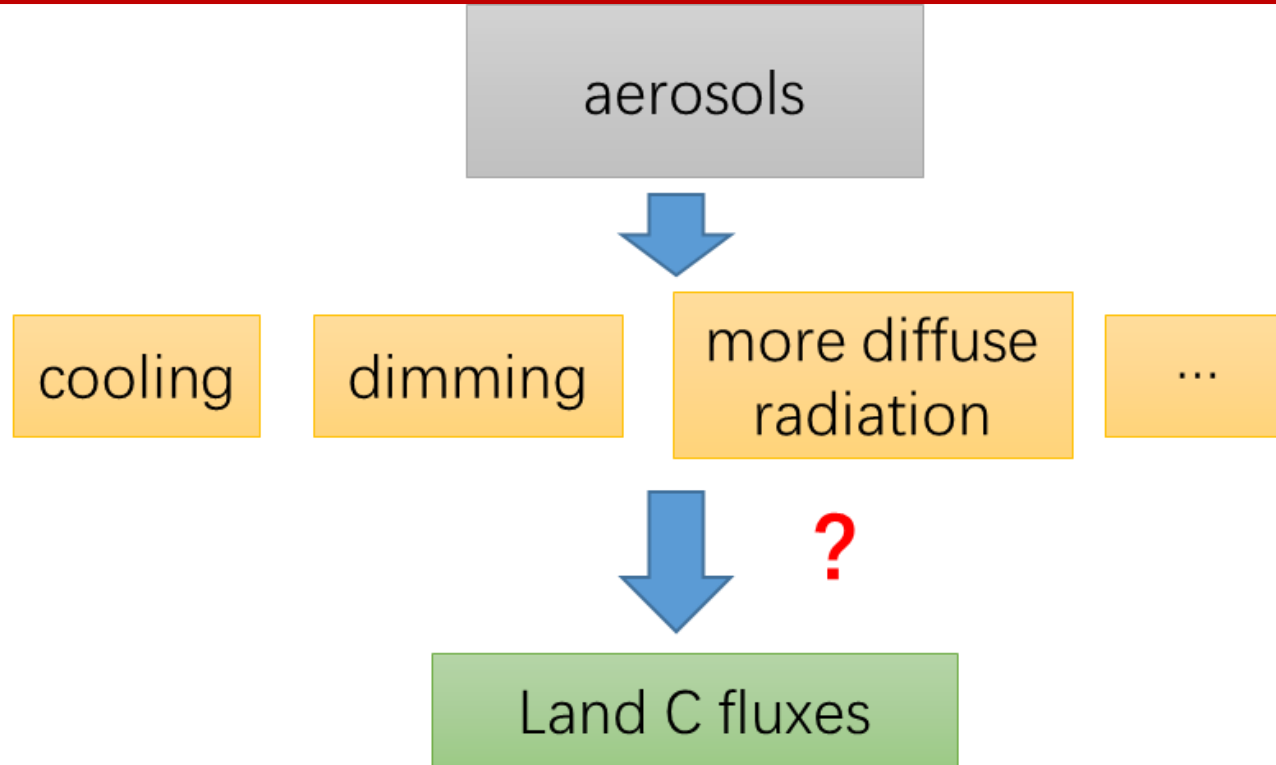


Disentangling the impacts of anthropogenic aerosols on terrestrial carbon cycle during 1850-2014

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Introduction

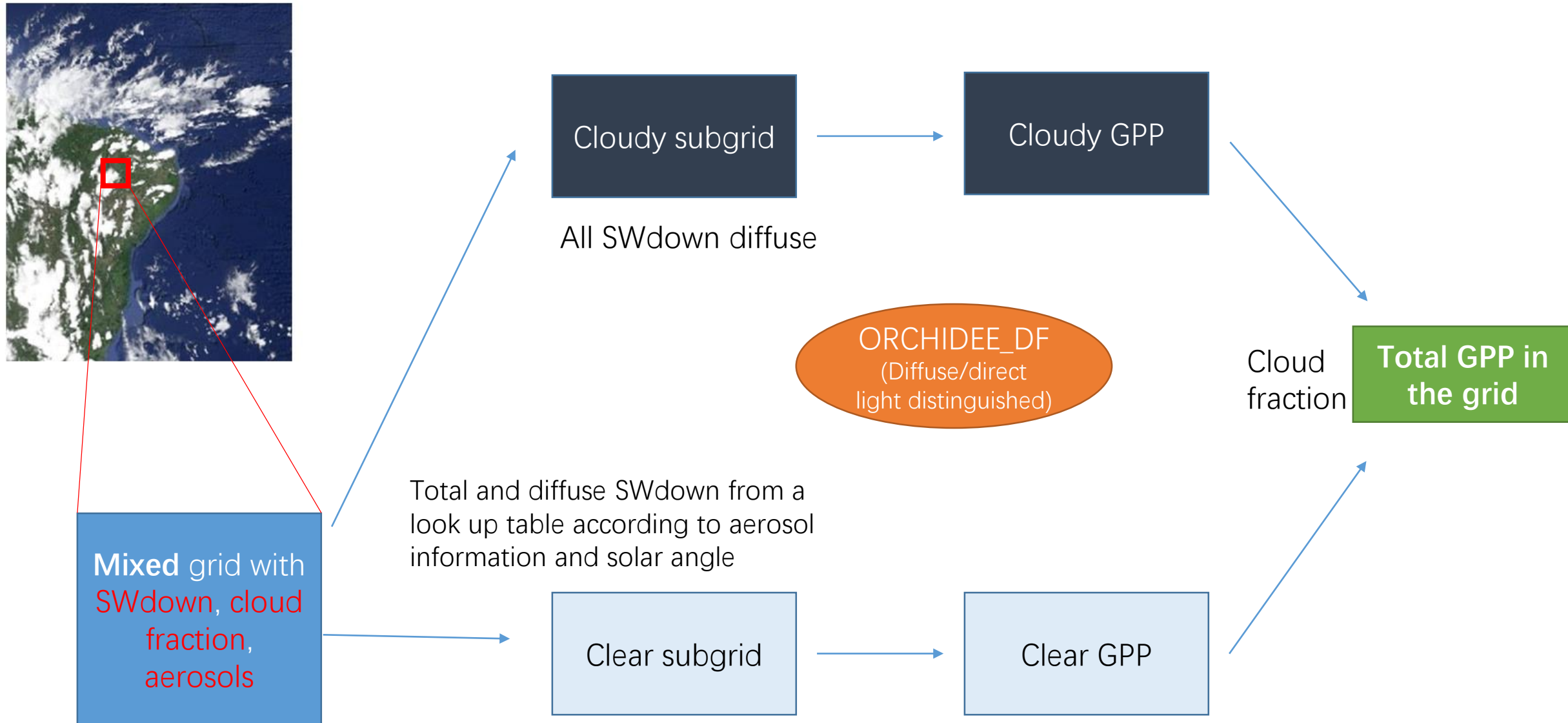


- Aerosols can affect land C fluxes through different pathways.
- The role of different factors remains poorly known at global scale.

Questions to answer:

- How much did anthropogenic aerosols (AA) affect land C fluxes since the industrial revolution?
- Which factors played the major roles in changing C fluxes?

Sub-grid calculation of GPP



Factorial simulations

Forcing data: IPSL-CM6A-LR

historical (hist) experiment

histNoAA (NoAA) experiment

Name	Factor to study	Tair	Precip	SWdown	Trop_AOD (SW partition)	Cloud	Trop_AOD (Fdf_clear)	Strat_AOD	Others
<i>WithAero</i> <i>(hist)</i>	Control								
NoAA	All								
NoAASW	All radiation								
NoAAprecip	Precipitation								
NoAATair	Temperature								
NoAARqlt	Diffuse light fraction								
NoVA	Volcanic aerosols								

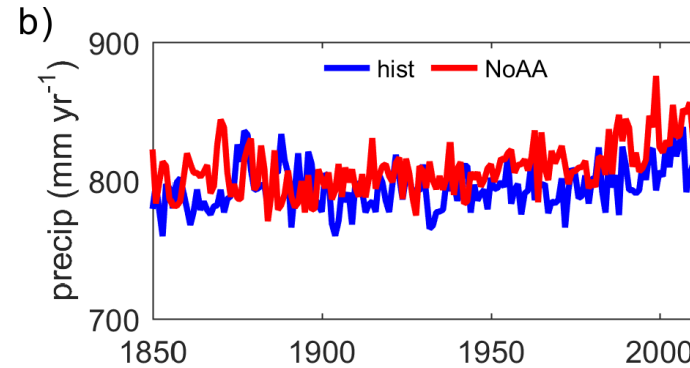
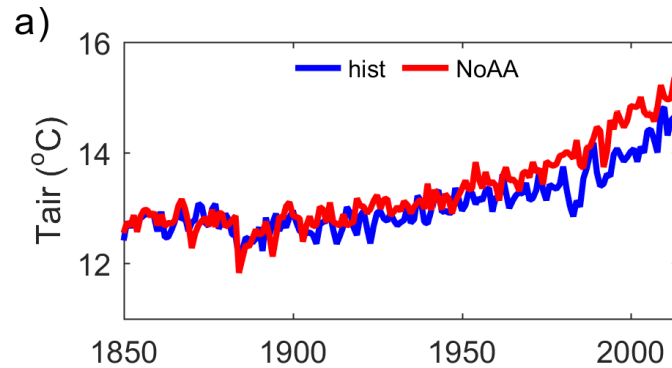
hist forcing

NoAA forcing

Low level

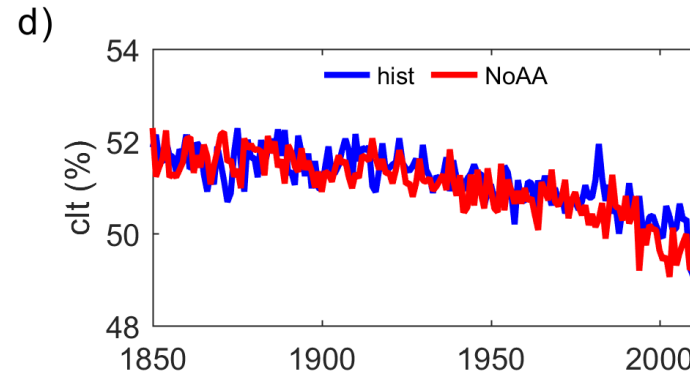
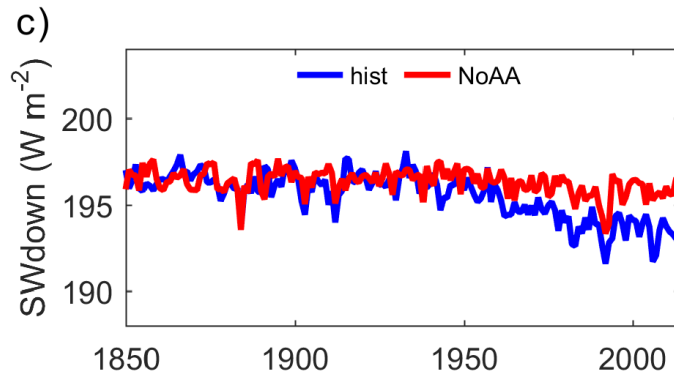
Climate changes caused by aerosols

Cooling

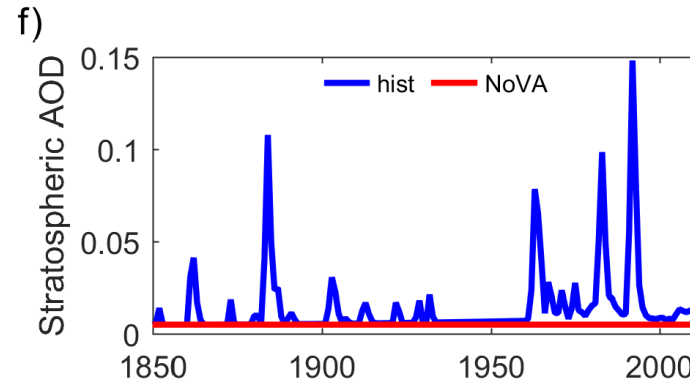
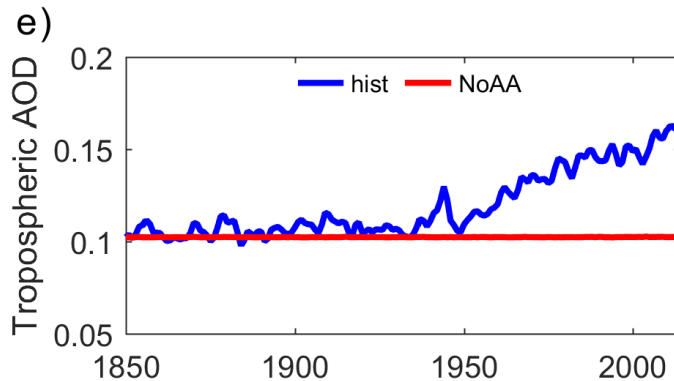


Not very significant
changes in global
precipitation and
cloud fraction

Dimming

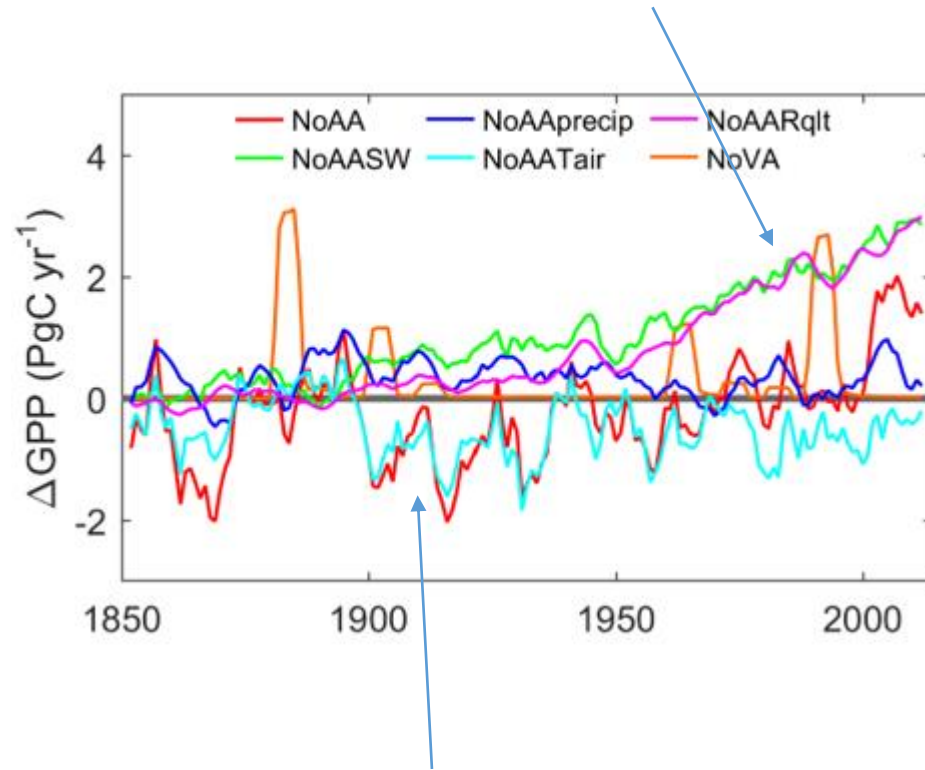


Large AOD
difference after
the 1950s



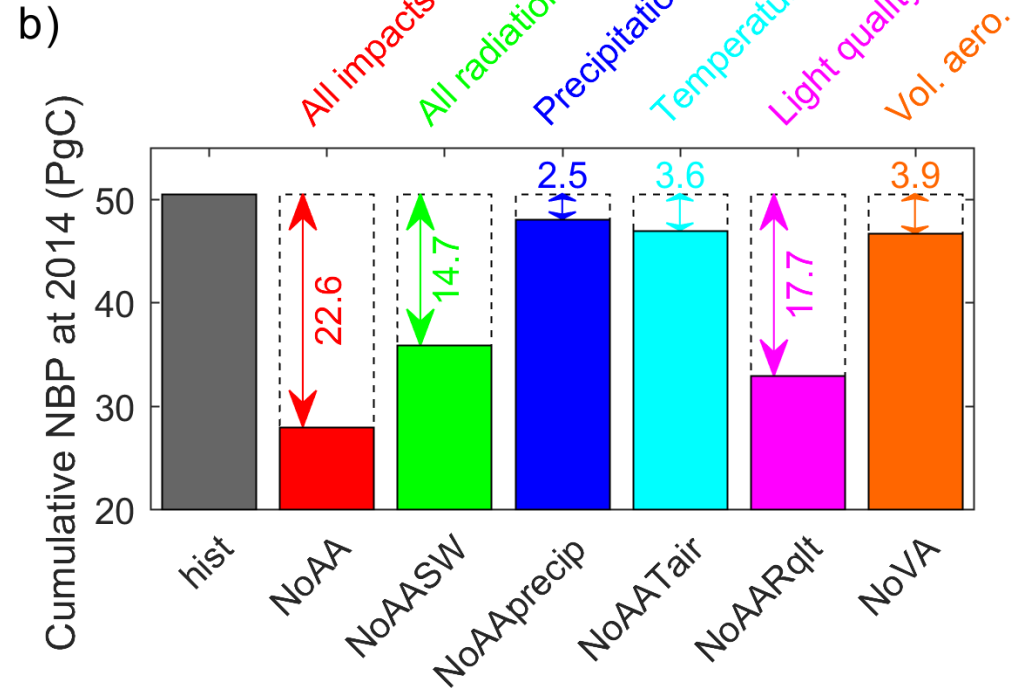
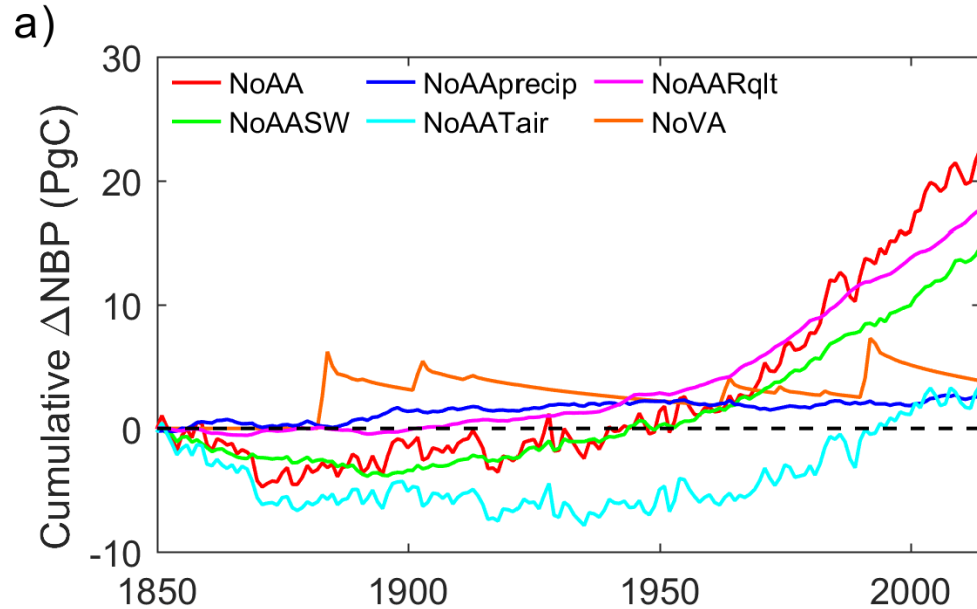
Impacts on GPP

Large impact from radiation quality changes after the 1950s



Temperature dominates before the 1950s

Impacts on NBP

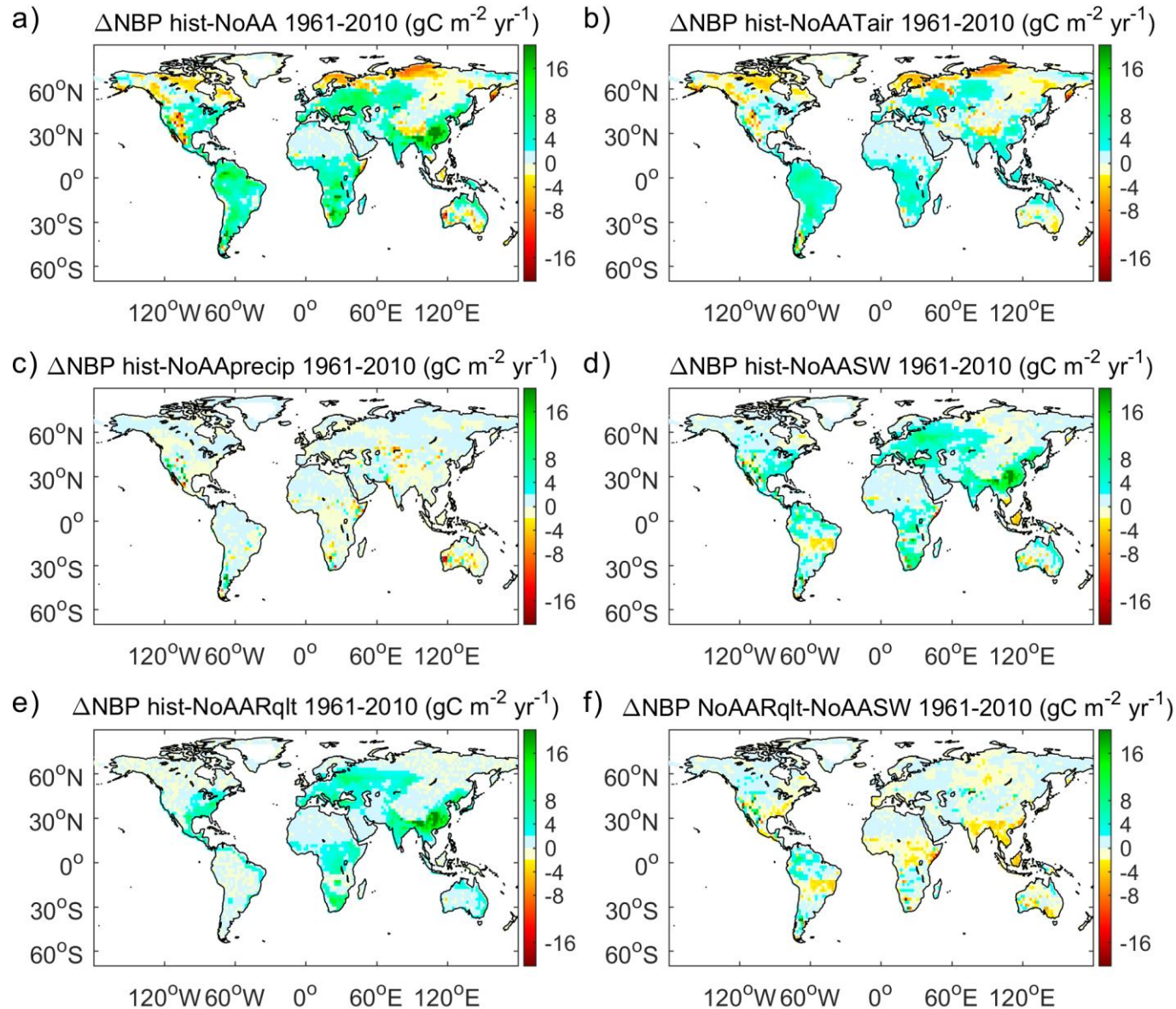


Radiation quality changes explained the largest part of anthropogenic aerosol impact

Temperature impact changes during different periods

Volcanic aerosol impact lasts for long time

Patterns of NBP responses

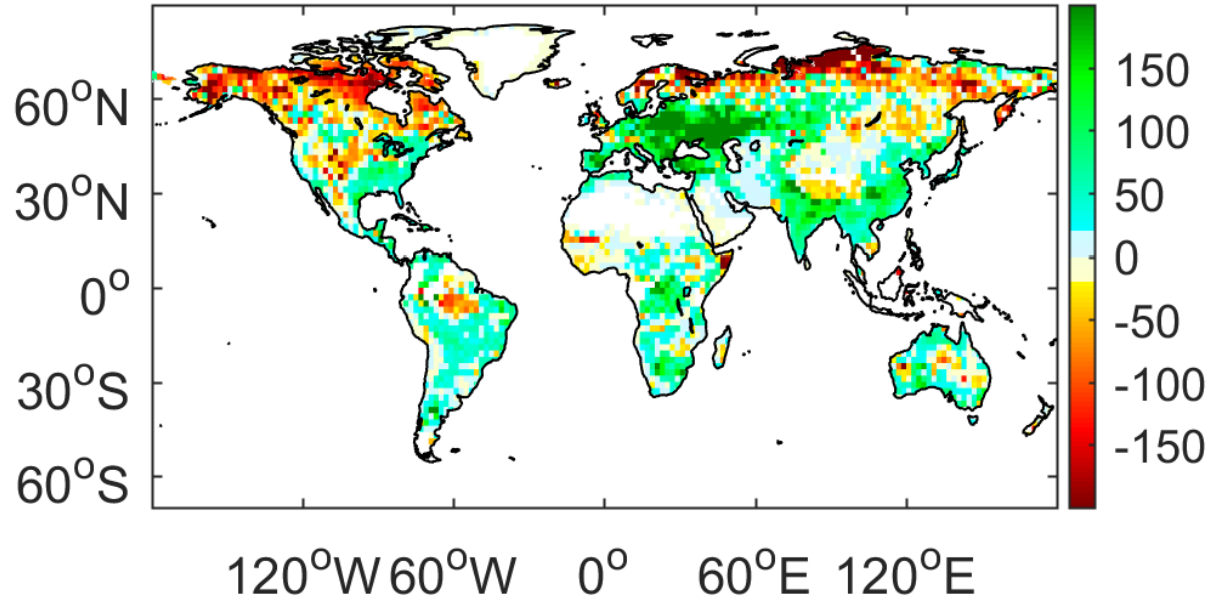


Pattern of AA impacts on GPP mainly explained by Tair and radiation quality

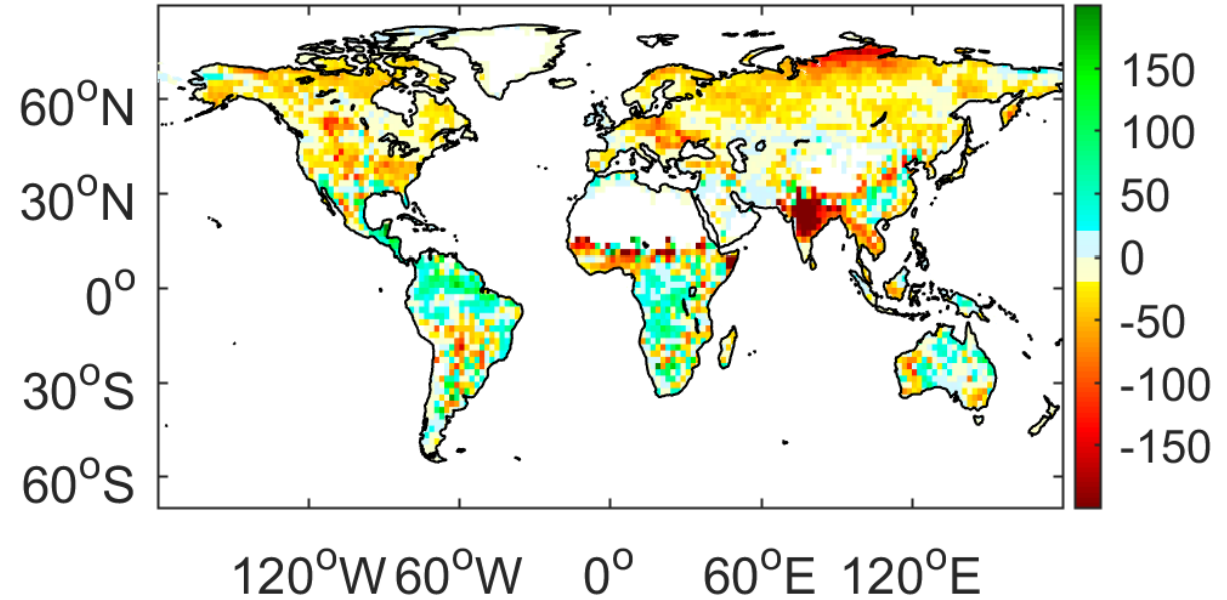
AA-induced radiation quality change has stronger impact on GPP than radiation quantity change

Different impact during clear and cloudy days

a) ΔGPP clear days ($\text{gC m}^{-2} \text{yr}^{-1}$)



b) ΔGPP cloudy days ($\text{gC m}^{-2} \text{yr}^{-1}$)



The impacts of aerosols are different in clear/cloudy days

Summary

- Anthropogenic aerosols increase land C sink by 22.6 PgC since 1850.
- Aerosol-induced radiation quality changes are more important than quantity changes during the historical period.
- Radiation quality changes account for 78% of the C sink enhancement. Cooling significantly increases the C sink in low latitudes but decreases the C sink in high latitudes and slightly increase the land C sink at the global scale.
- Volcanic aerosols have short impact on GPP but the long impact on land C balance.
- Aerosols mainly affect GPP under sunny conditions.