

Idealised

Aerosol effects in global km-scale simulations

Pan-GASS Meeting

Understanding and Modeling Atmospheric Processes

Monterey, USA

25/07/2022

Ross Herbert, Philipp Weiss, Andrew Williams, Duncan Watson-Parris, **Philip Stier** (University of Oxford)

Guy Dagan (Hebrew University of Jerusalem)

Daniel Klocke (Max Planck Institute for Meteorology)



Aerosol effects in global km-scale simulations

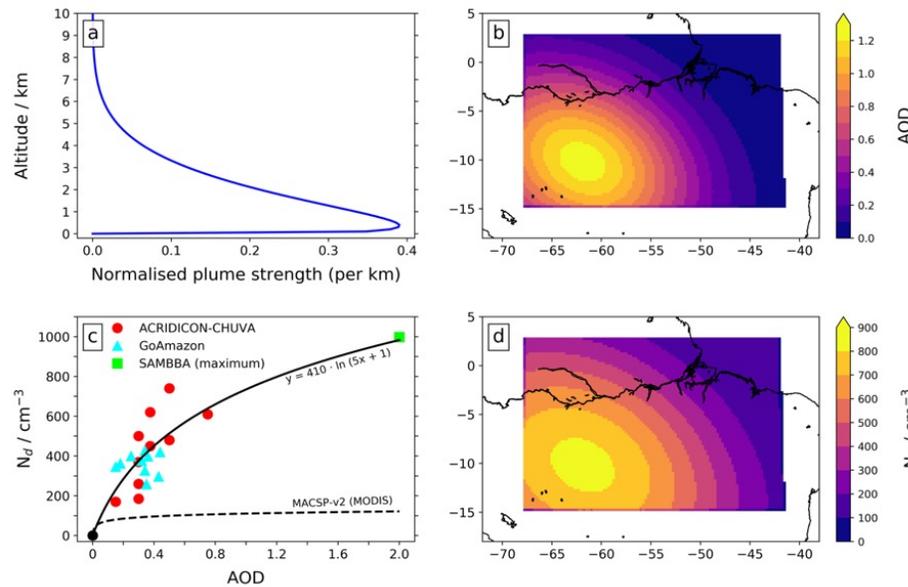
Philip Stier



Aerosol effects on deep convective cloud fields

Regional ICON CRM simulations (double-moment MP) over the Amazon:

- Domain: 3000 x 2000 km, 1500 m resolution, 75 vertical levels
- Aerosol: Anthropogenic radiative and microphysical perturbations using MACv2-SP

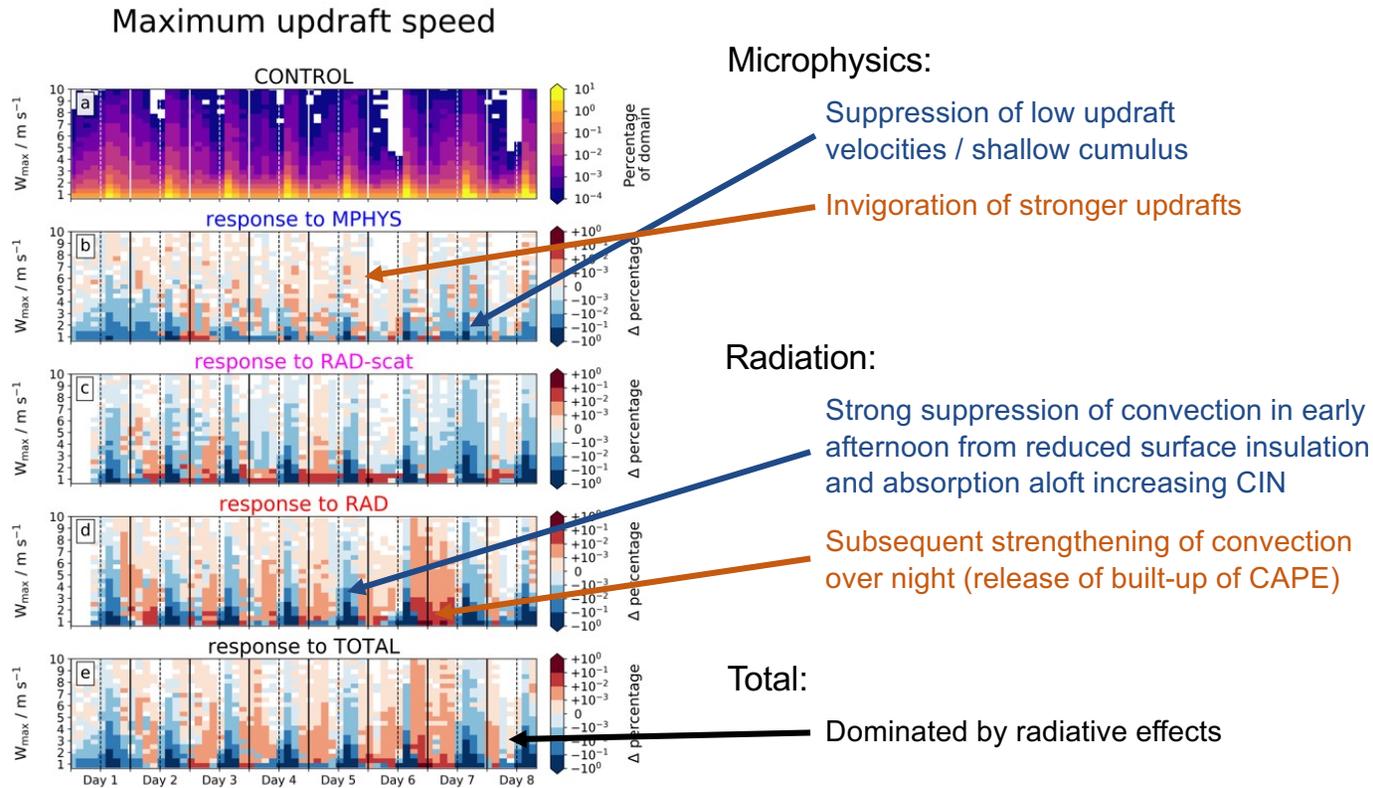


Microphysical and radiative perturbations using MACv2-SP

(Herbert et al., JGR, 2021)



Aerosol effects on deep convective cloud fields

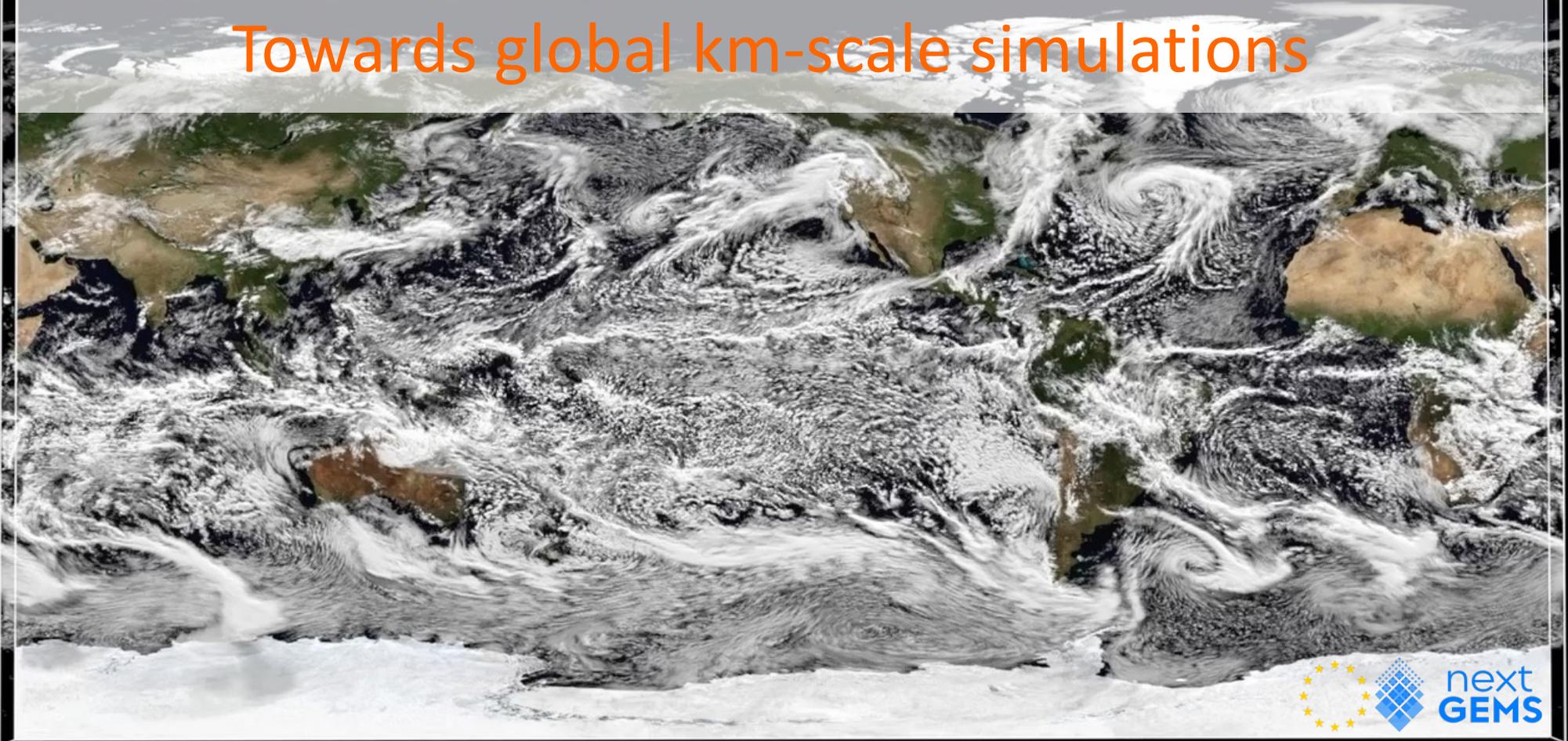


Microphysical and radiative perturbations using MACv2-SP

(Herbert et al., JGR, 2021)



Towards global km-scale simulations



05/02/2020 15:00

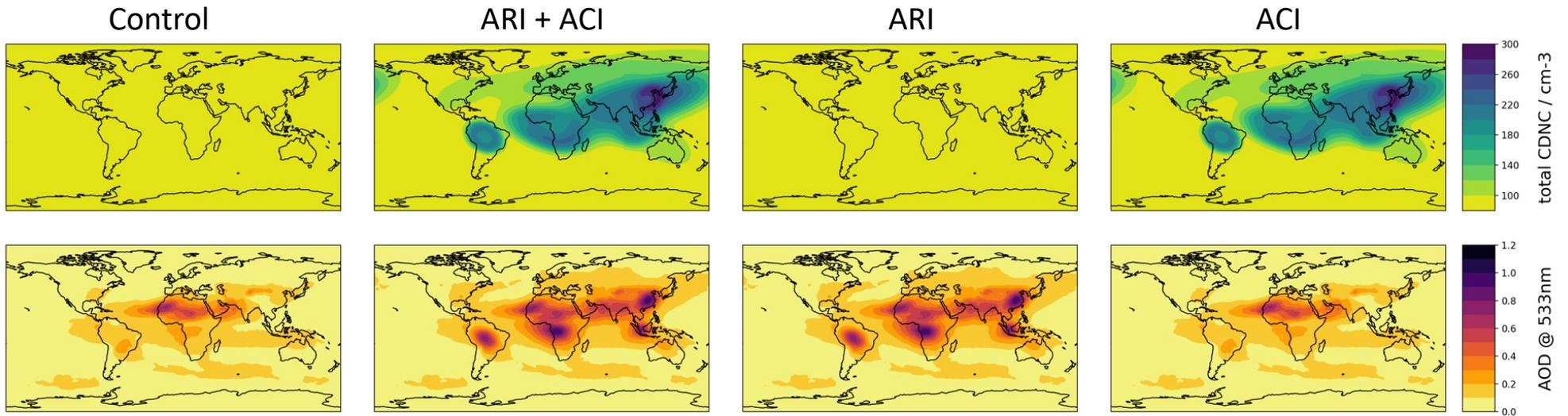
Aerosol effects in global km-scale simulations

Sum of cloud water and ice (kg kg^{-1})

Philip Stier

(C) CEN/MPI-M/UHH

Idealised anthropogenic aerosol perturbations

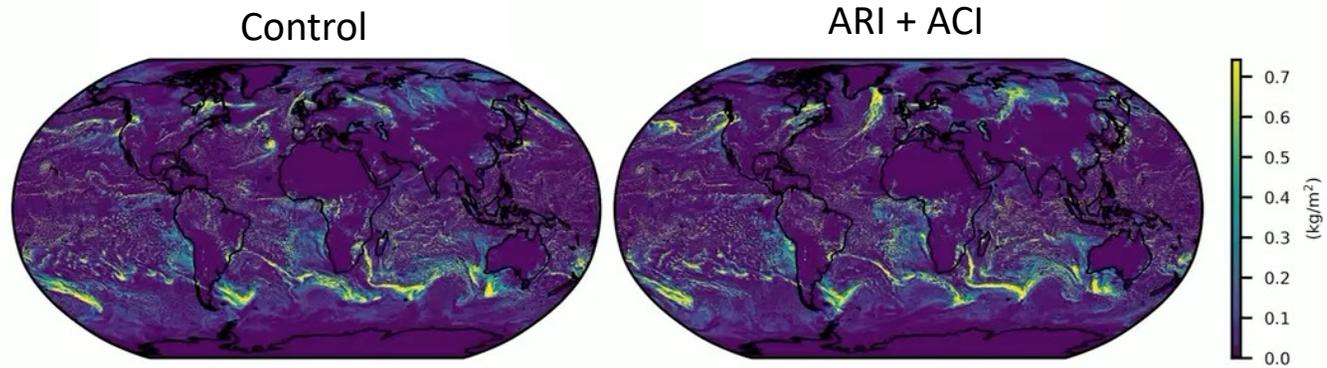


Simulations

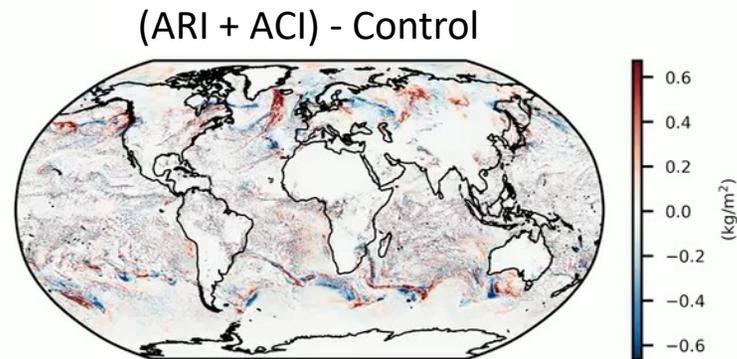
ICON CRM global simulations:

- Domain: 5km equivalent grid spacing
90 vertical levels
- Period: 40 days during biomass burning season
- Clouds: **Single-moment microphysics**
- Aerosols: Idealised radiative and microphysical perturbations using MACv2-SP

Results

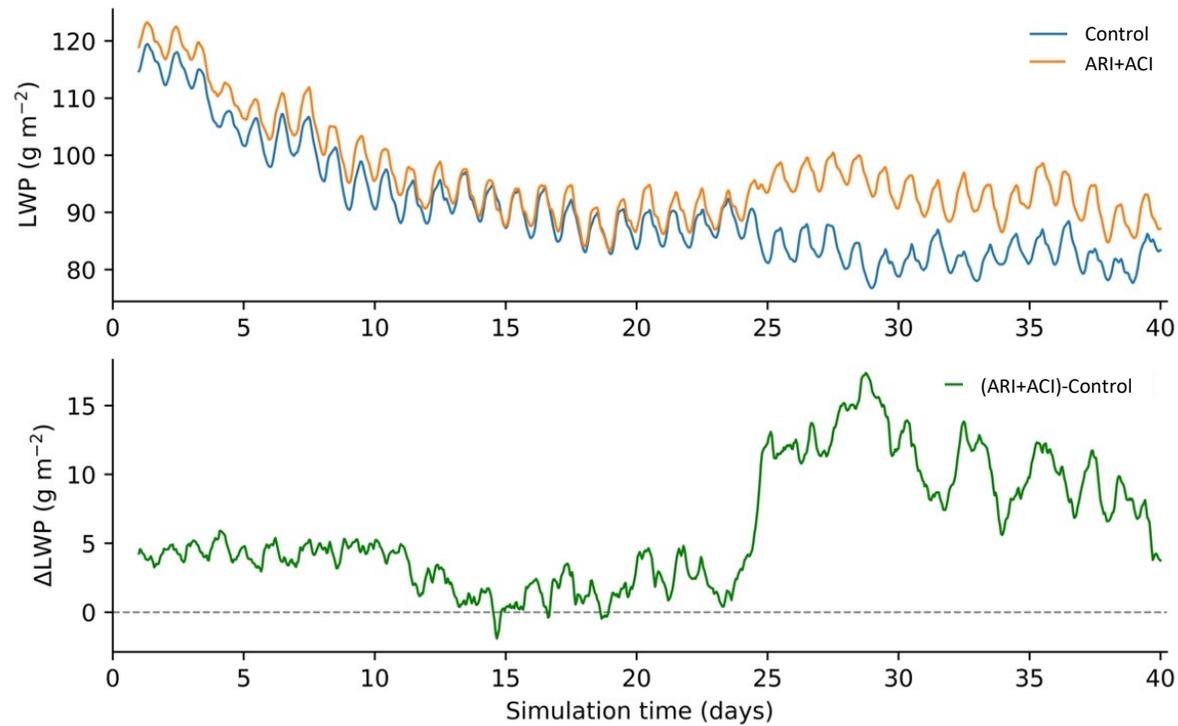


Liquid water path
(after 10-day spin-up)



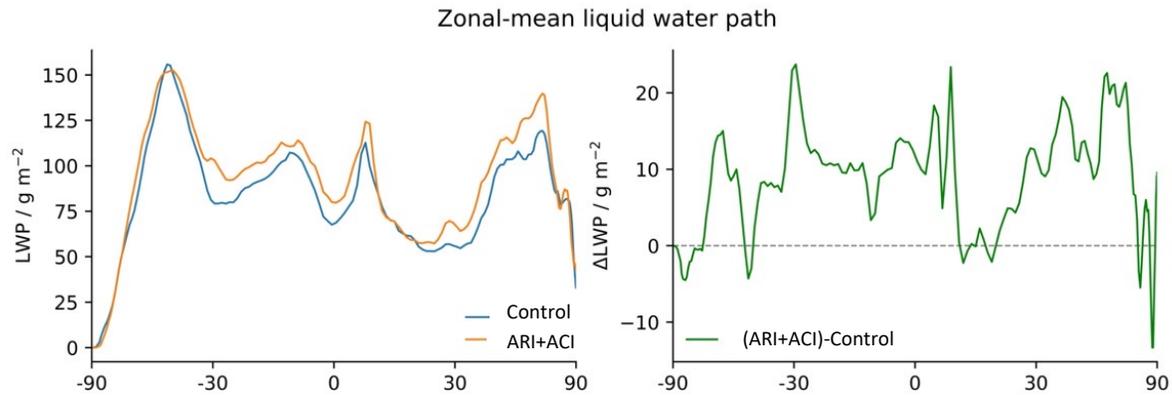
Results

Global mean liquid water path (after 10-day spin-up)

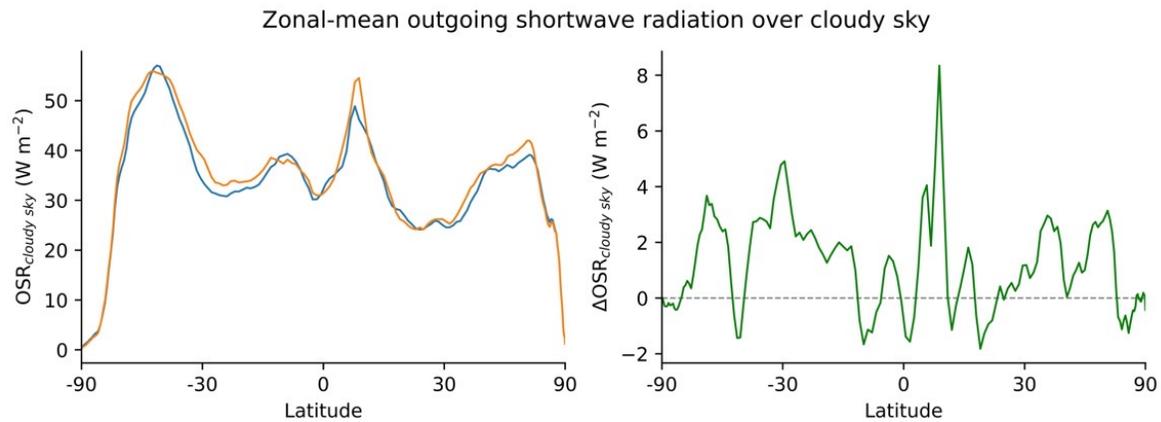


Results

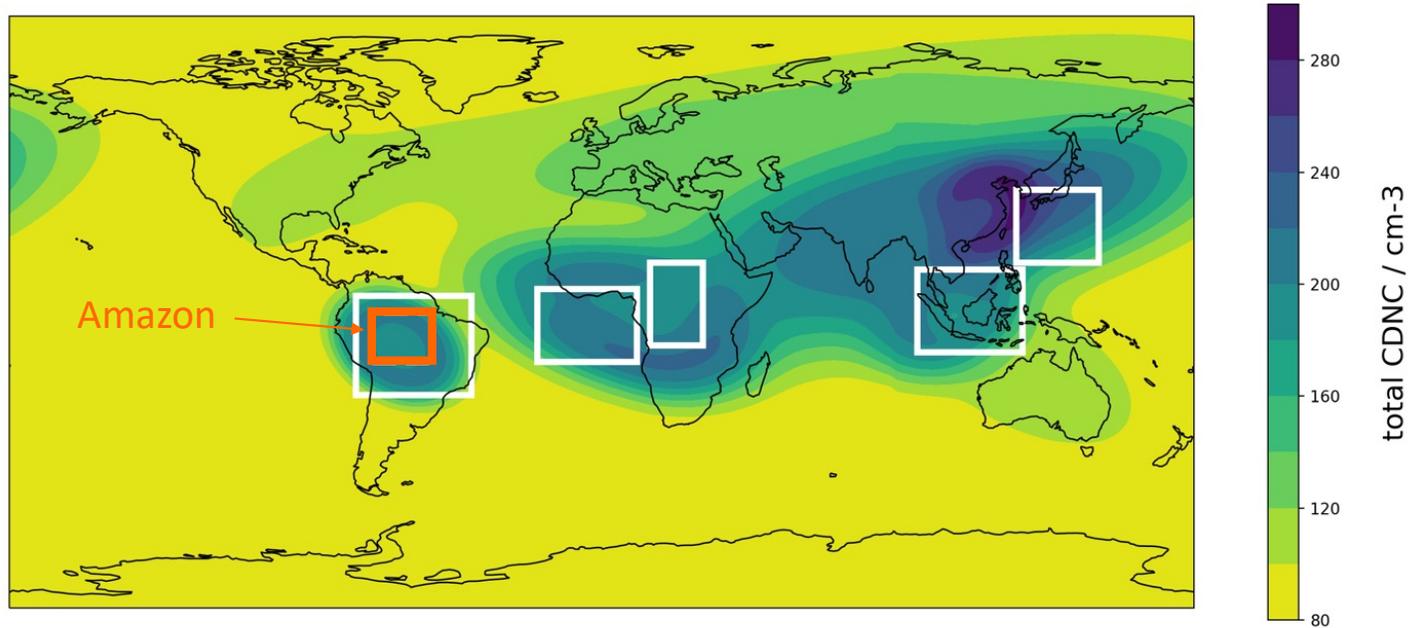
Liquid water path



Outgoing shortwave radiation (cloudy-sky)

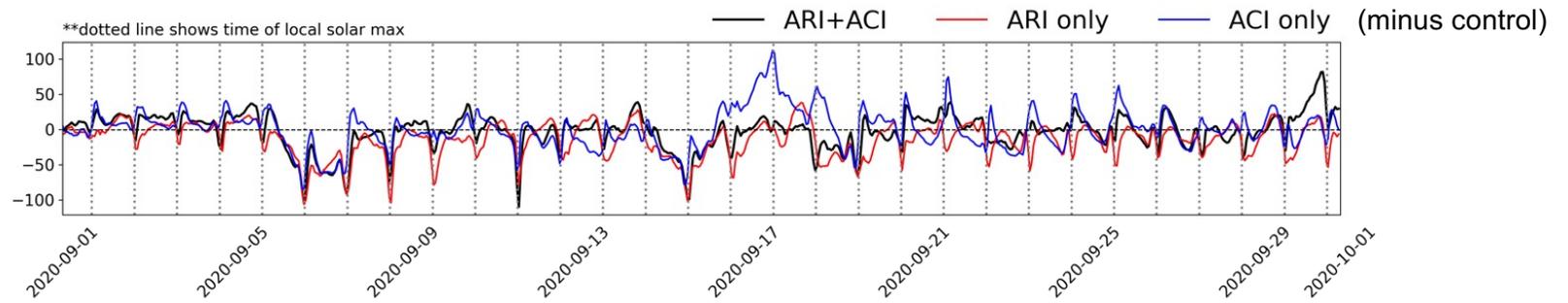


Regional Effects: Amazon



Regional Effects: Amazon

Decomposed timeseries of LWP / g m⁻²



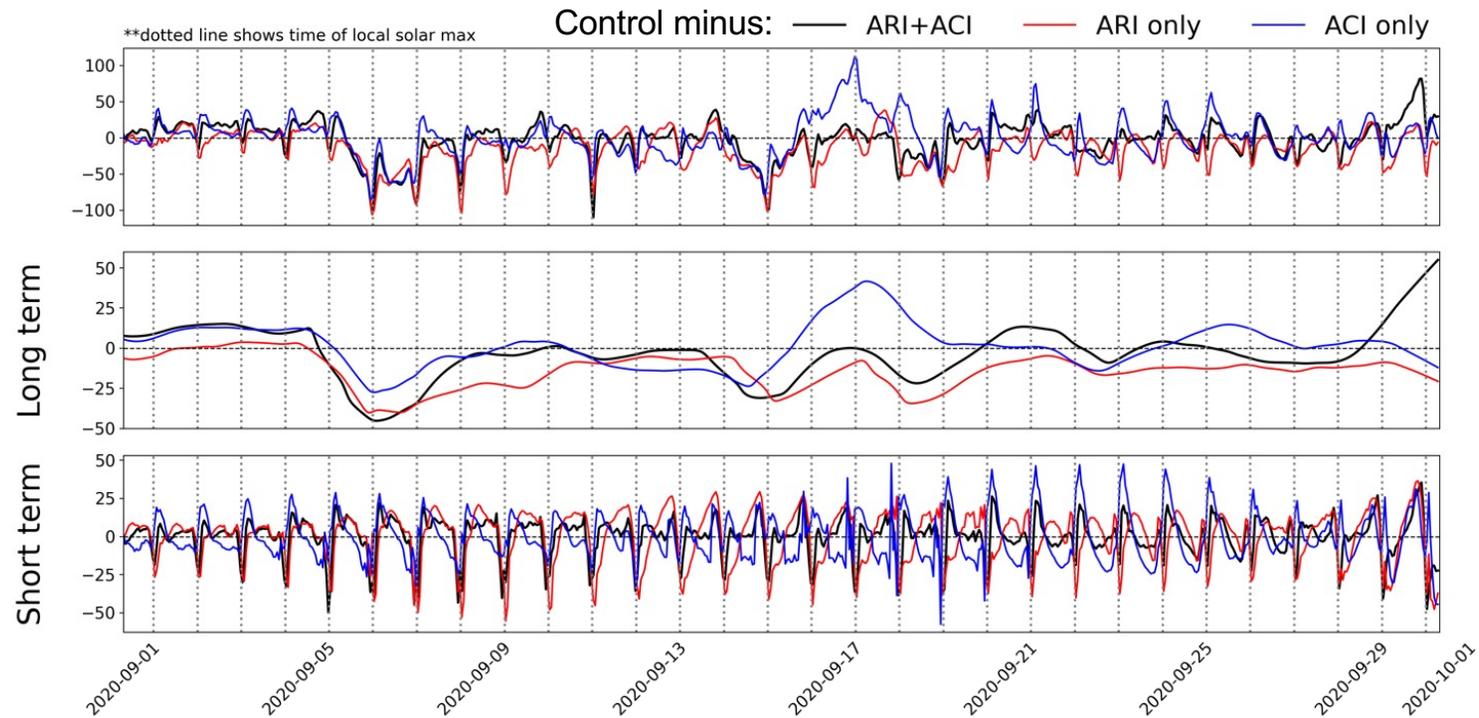
Aerosol effects in global km-scale simulations

Philip Stier

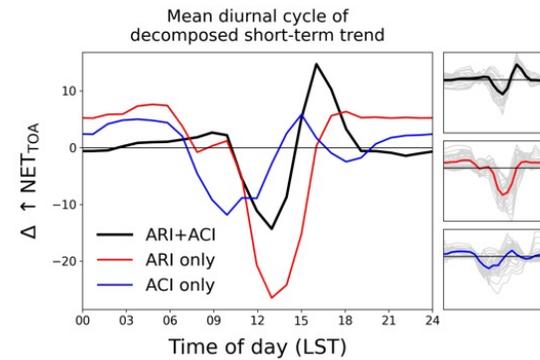
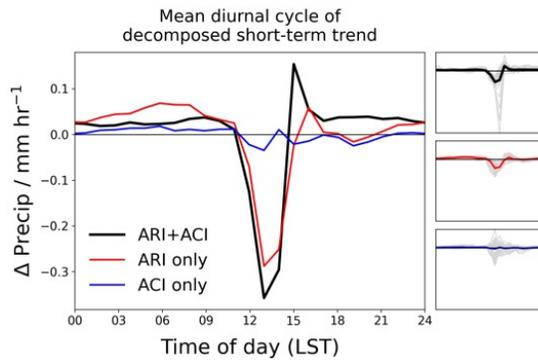
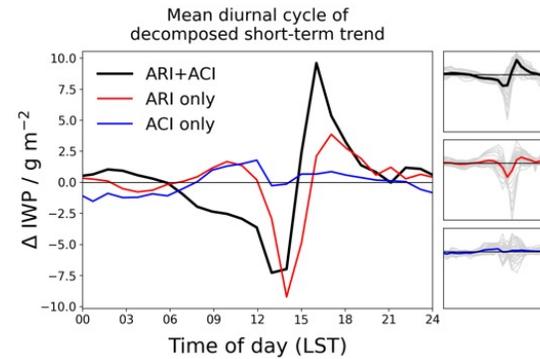
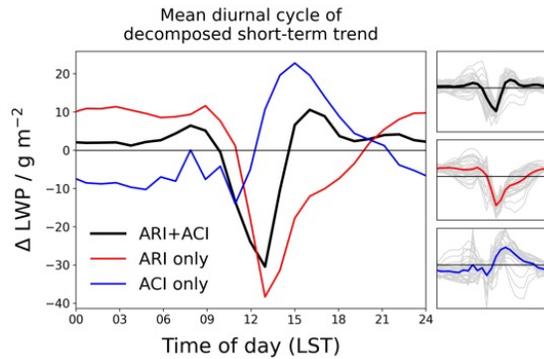


Regional Effects: Amazon

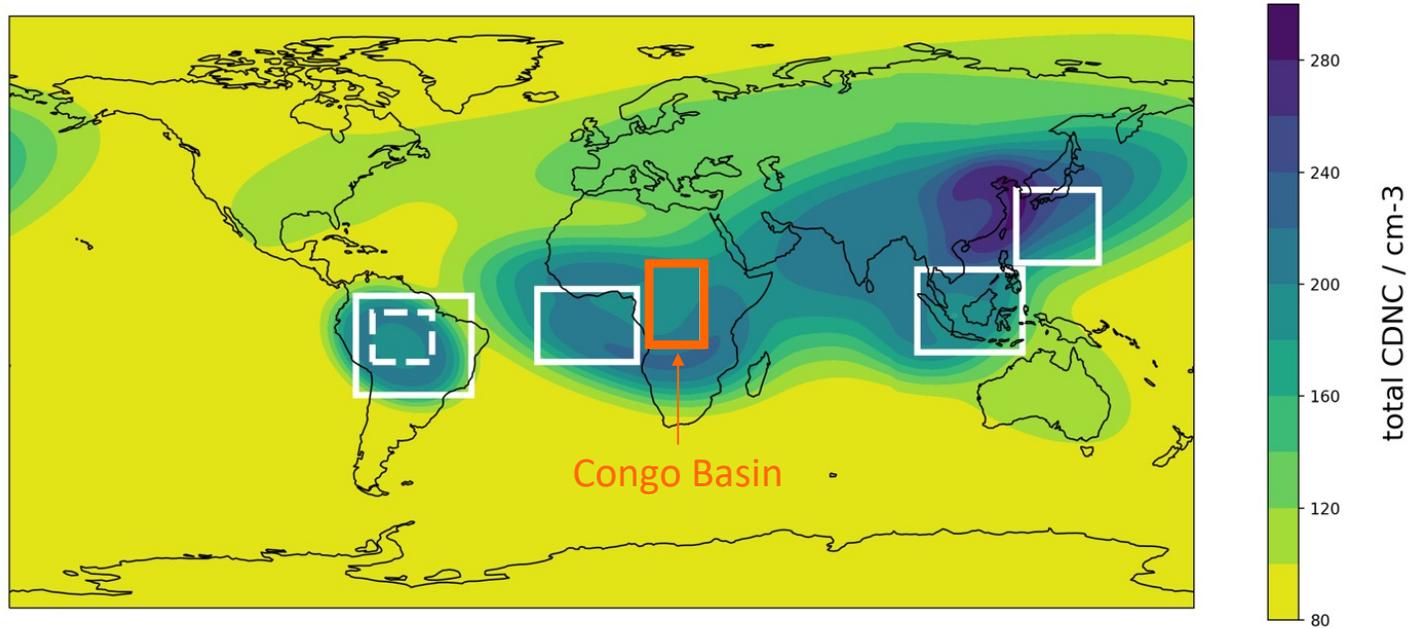
Decomposed timeseries of LWP / g m⁻²



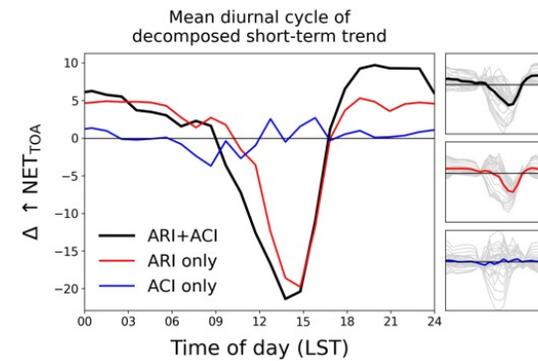
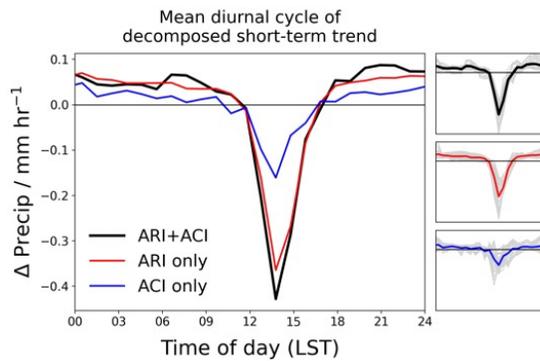
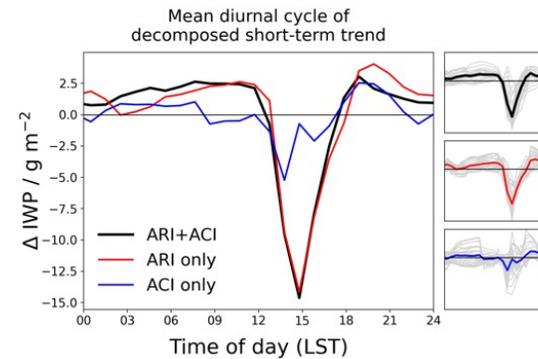
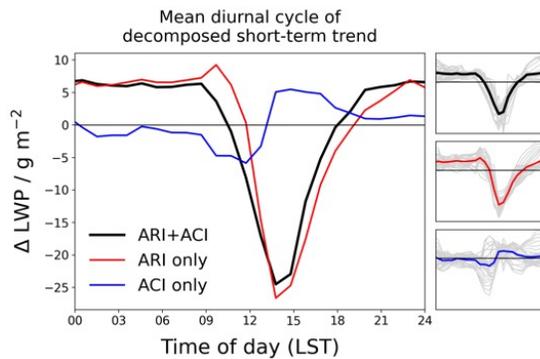
Regional Effects: Amazon



Regional Effects: Congo Basin

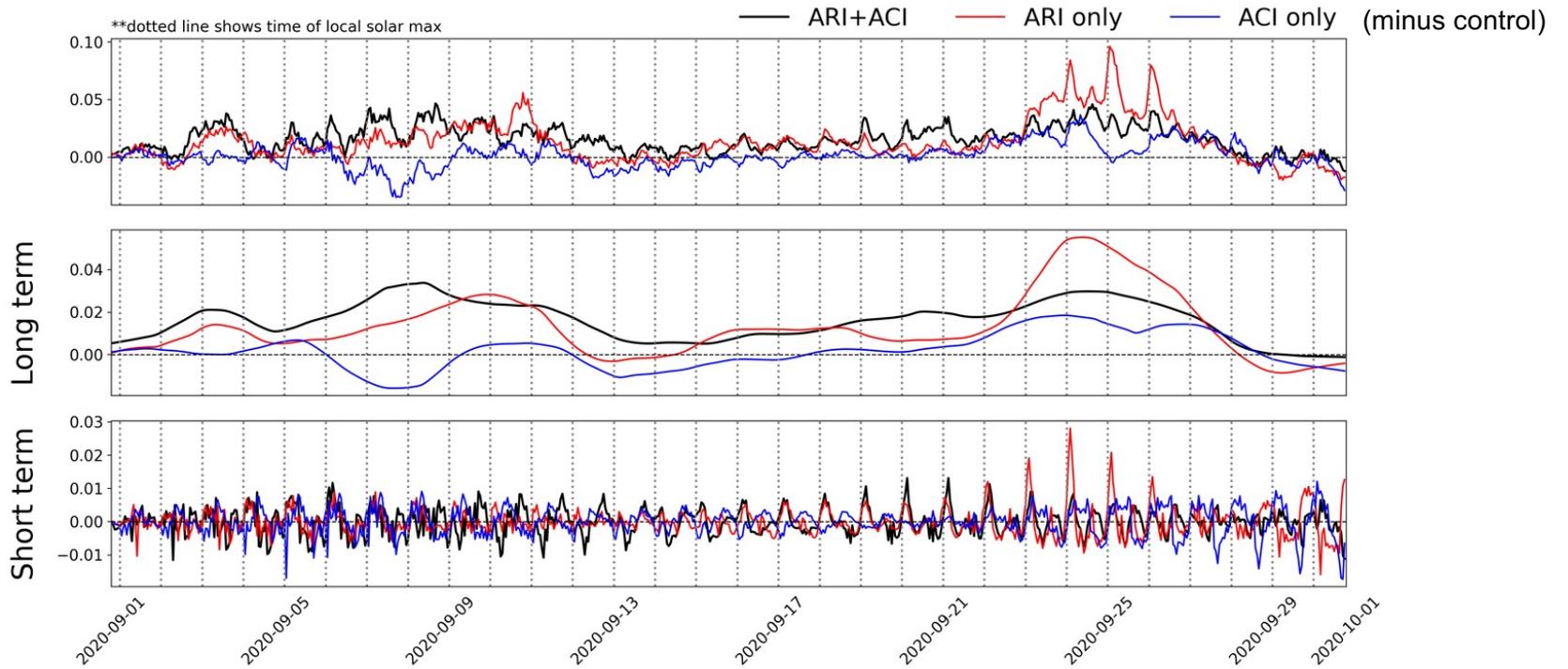


Regional Effects: Congo Basin



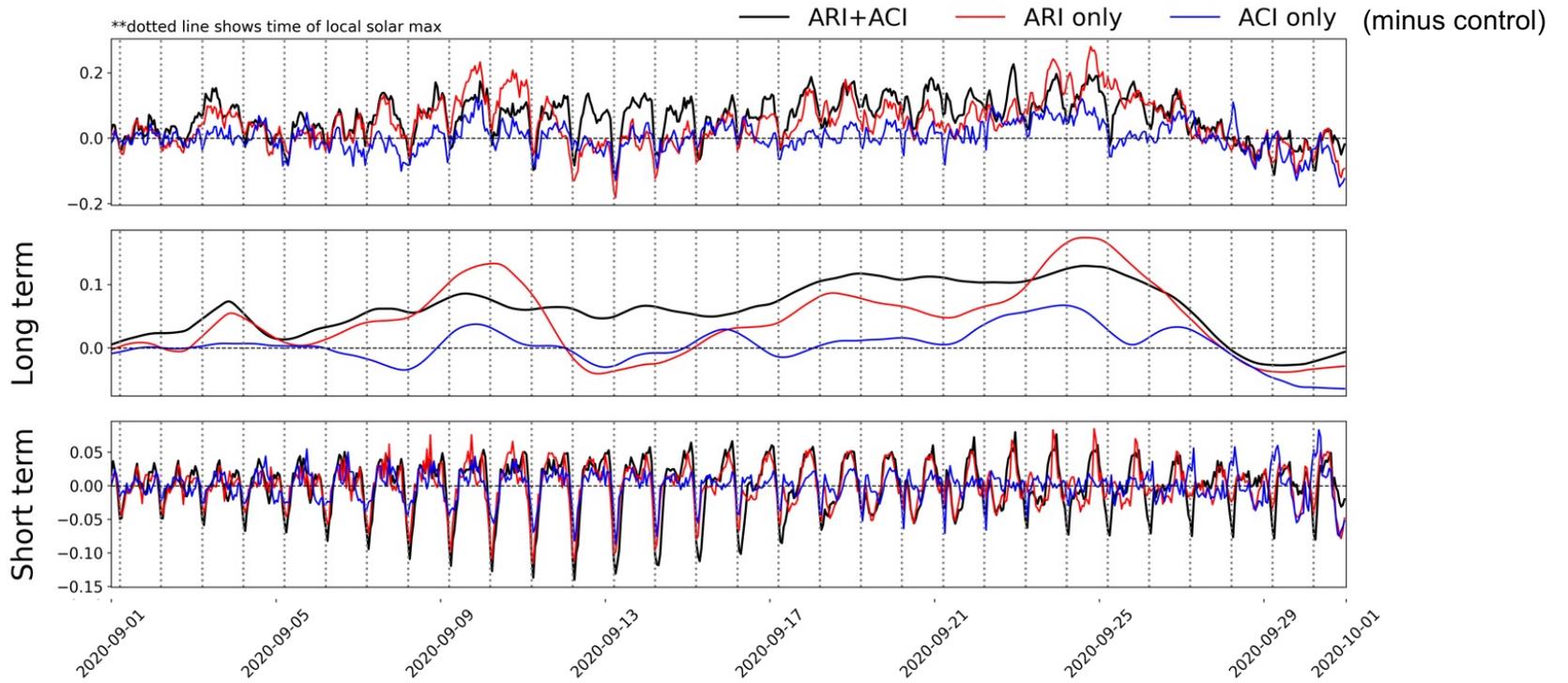
Regional Analysis: Indonesia

500hPa mass flux [$\text{kg m}^2 \text{s}^{-1} (\times 10^{-6})$]



Regional Analysis: Indonesia

Precipitation [mm hr⁻¹]



Conclusions

- Introduced a protocol for global km-scale simulations with idealized aerosol perturbations
- First results from 40-day 5km ICON simulations:
 - Weather noise significant (unsurprisingly)
 - Decomposition into longer-term trends and diurnal response reveals clear effects on convection and large-scale circulation
- Proposed DYAMOND-GAP intercomparison:
 - *Join breakout group tomorrow at 11:00!*

