Met Office | NERC SCIENCE OF THE ENVIRONMENT | Joint Weather & Climate Research Programme – a partnership in weather and climate research | UKESM | University of Reading

An analysis of the UKESM1 historical ensemble

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2 July 2019

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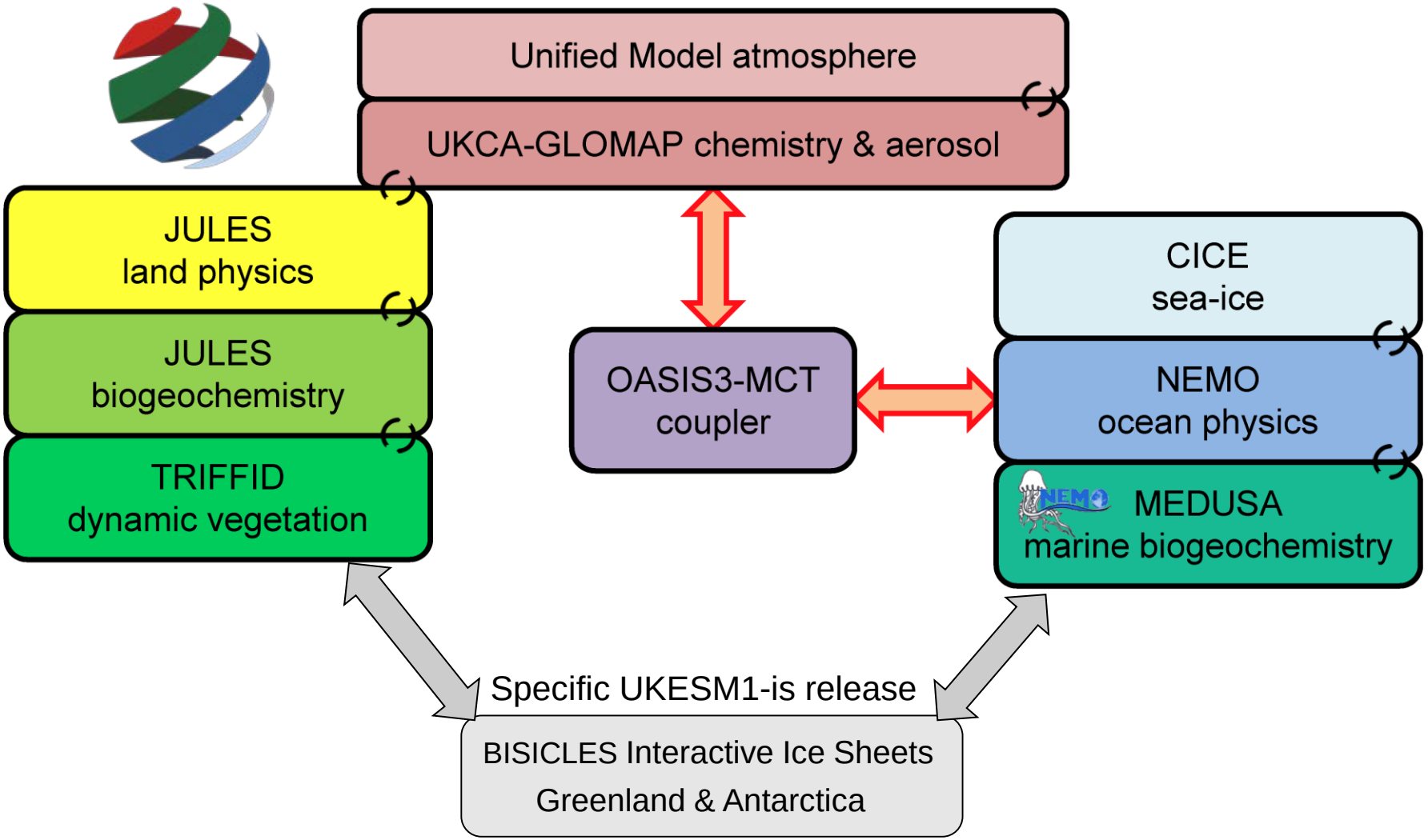
UKESM1: Components and structure



UKESM1: 1400 years of pre-industrial simulation

A stable climate with internal variability

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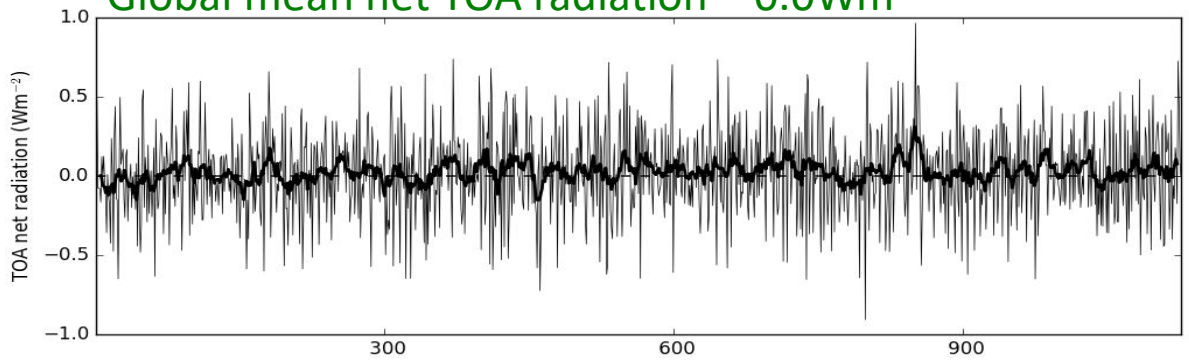
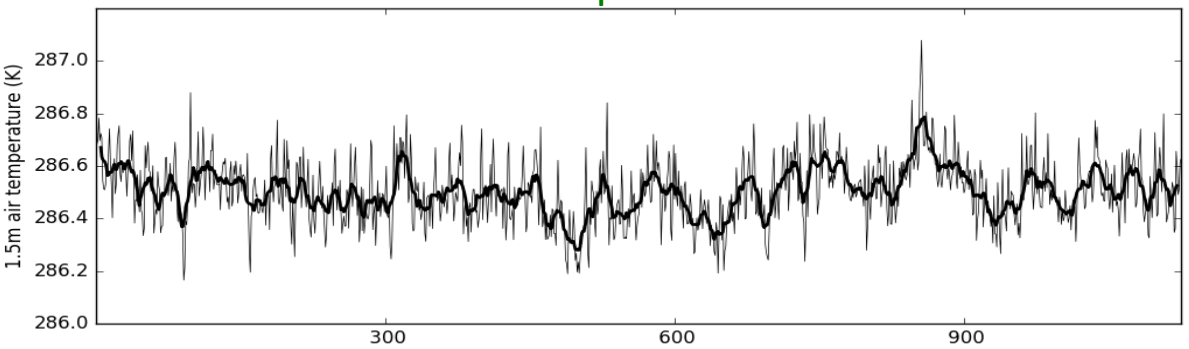
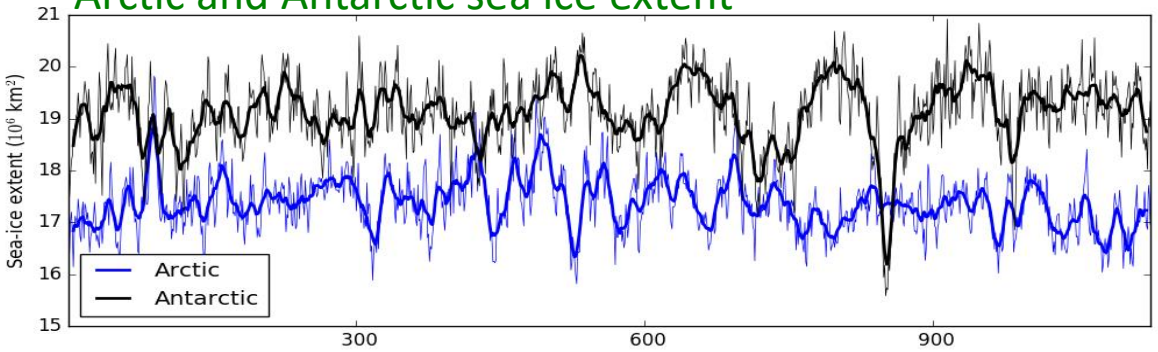
Global mean net TOA radiation ~ 0.0Wm^{-2}



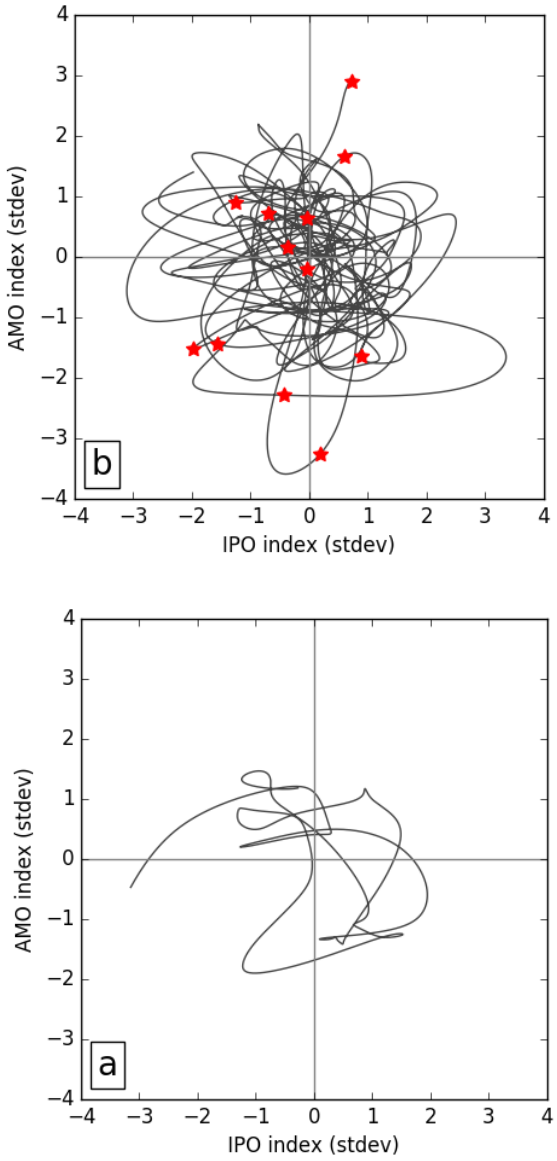
Global mean surface temperature



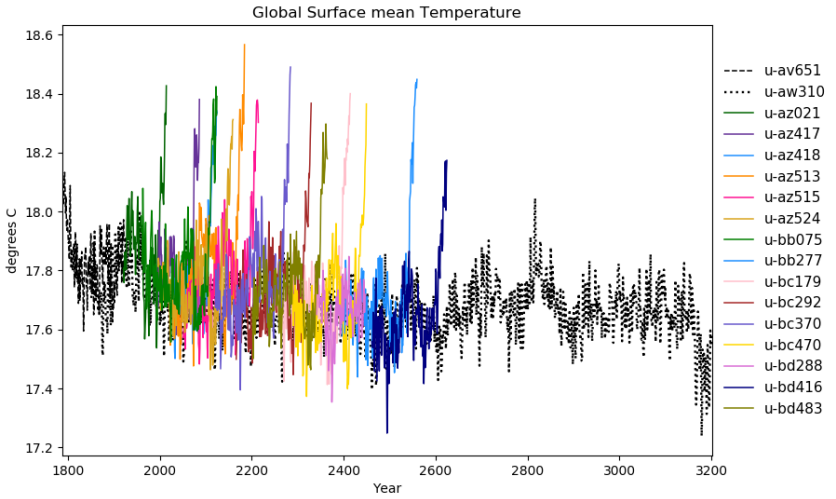
Arctic and Antarctic sea ice extent



Historical simulations and initial conditions

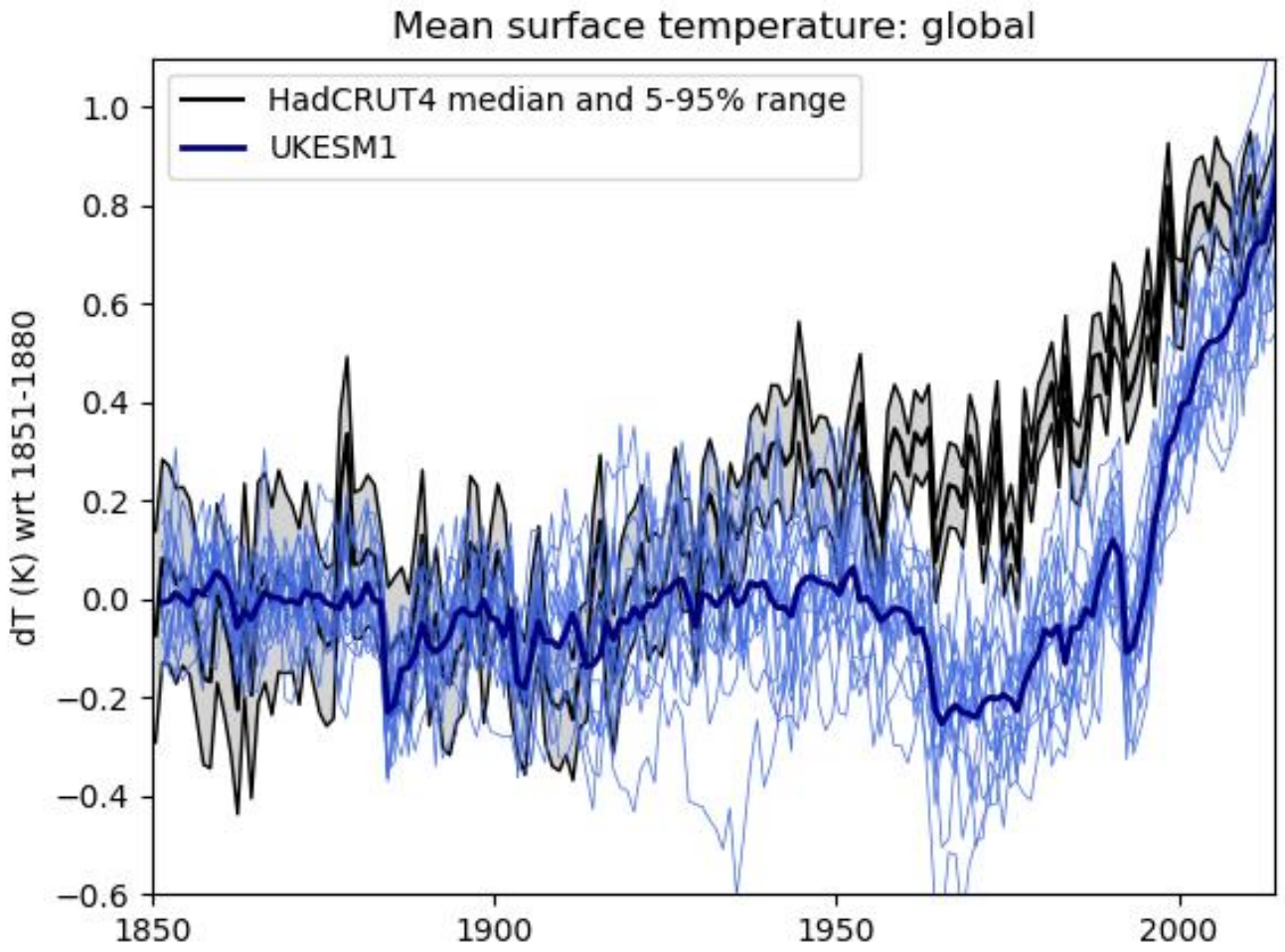


- 16 historical simulations finished so far
- 3 more currently run by KMA

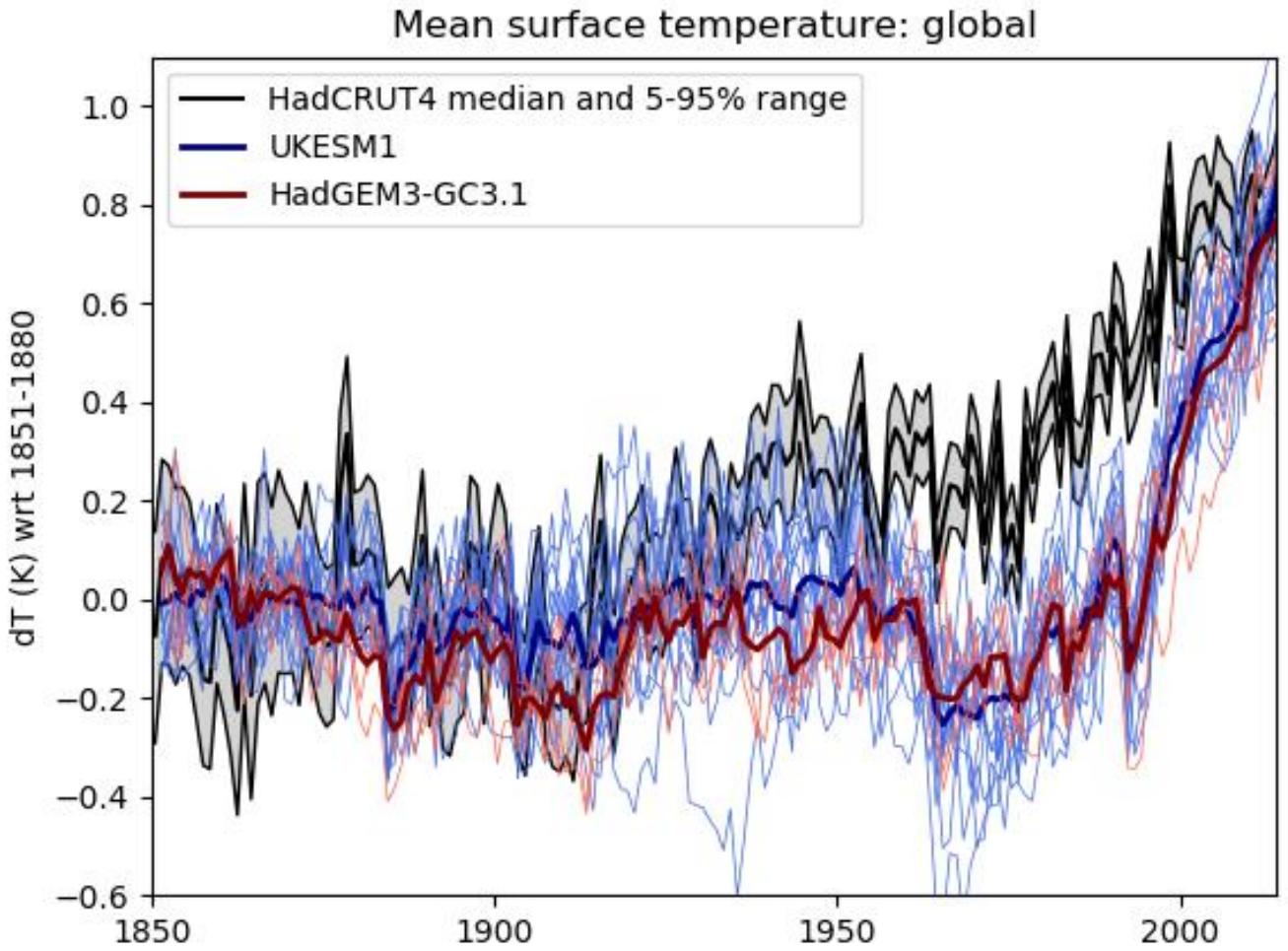


- Initial conditions drawn from the joint distribution of AMV and IPO

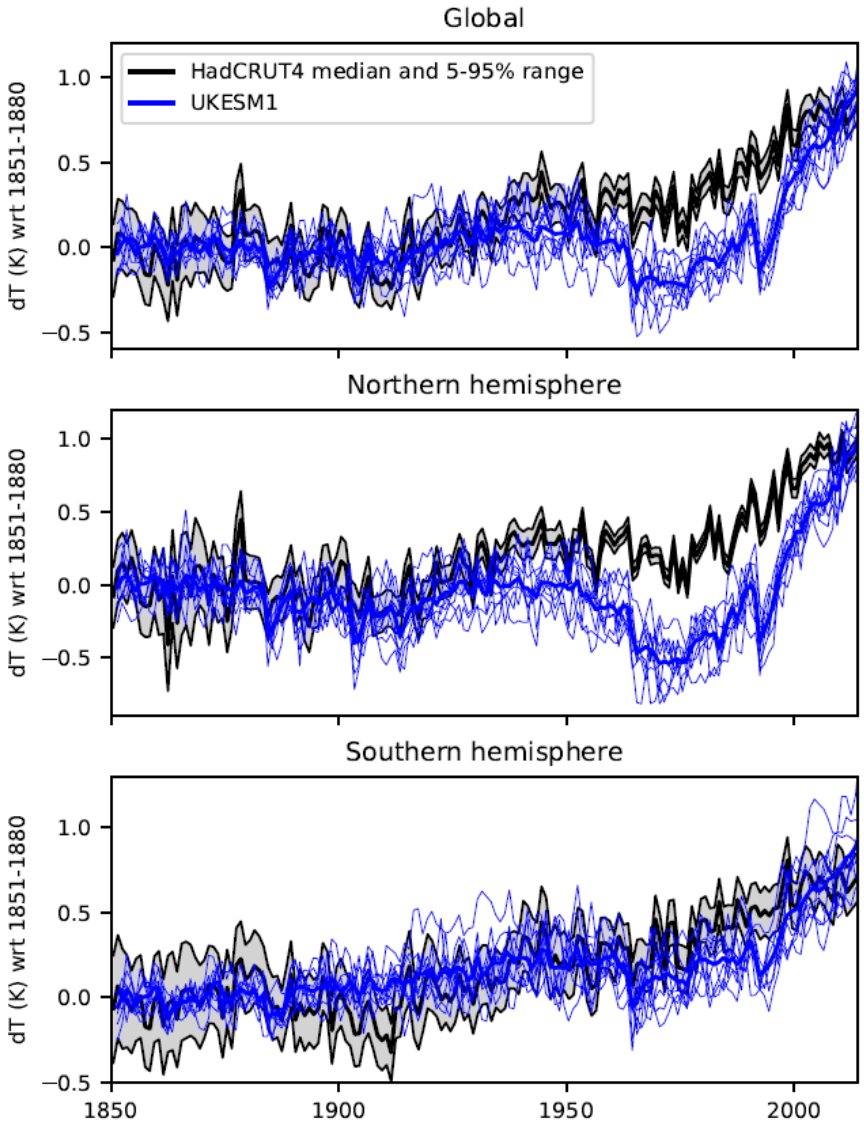
Global mean surface temperature

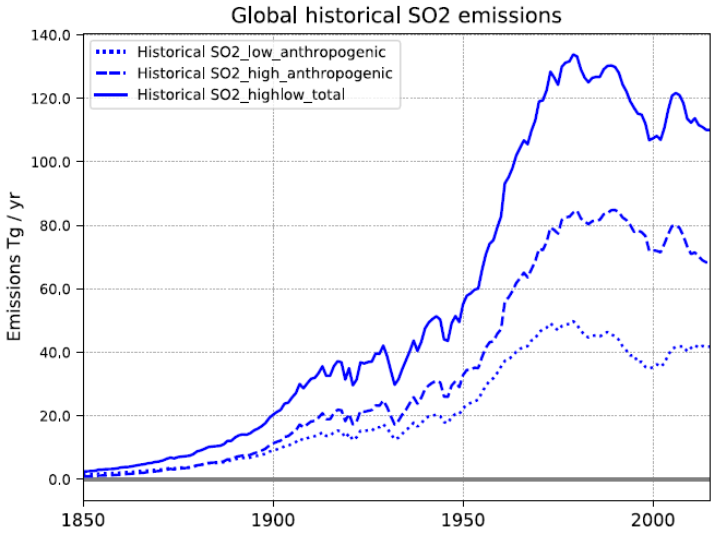


Global mean surface temperature comparison with HadGEM3-GC3.1

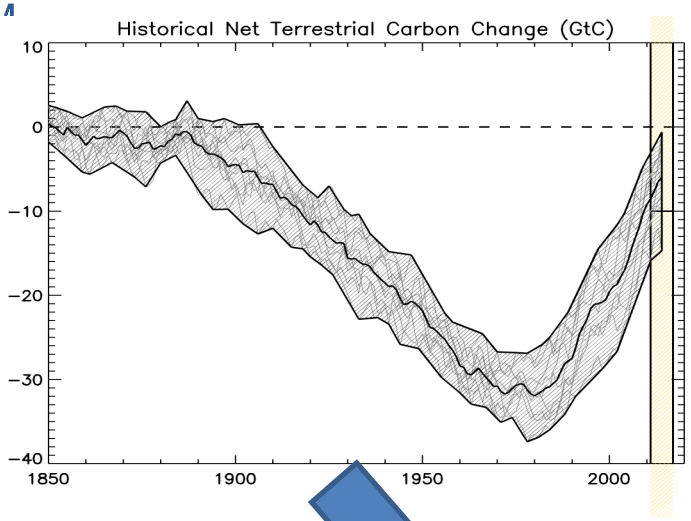


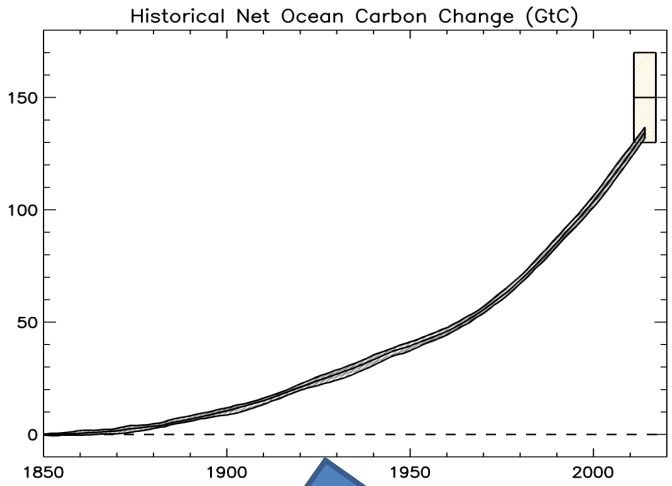
Global/Hemispheric mean surface temperature anomaly relative to 1851-1880 mean: **UKESM1** and **HadCRUT4**



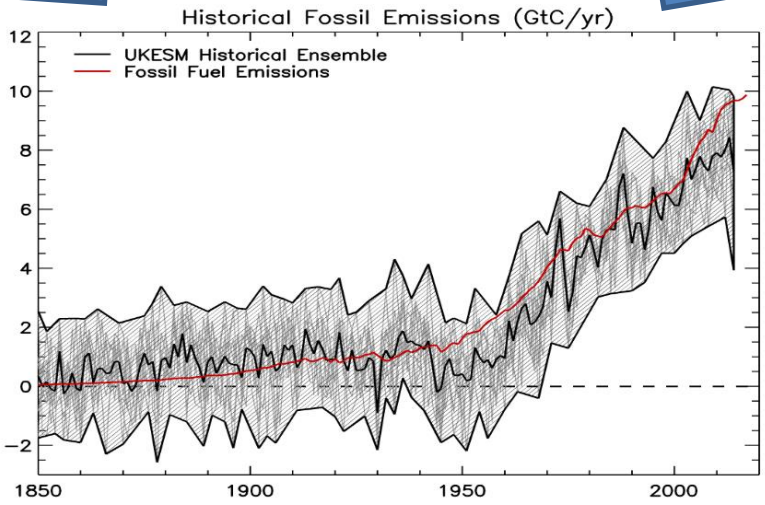


UKESM1 : Simulating the global carbon cycle





Prescribed atmospheric CO_2 concentrations combined with model simulated carbon exchanges allows diagnosis of UKESM1 historical emissions compatible with the prescribed atmospheric CO_2



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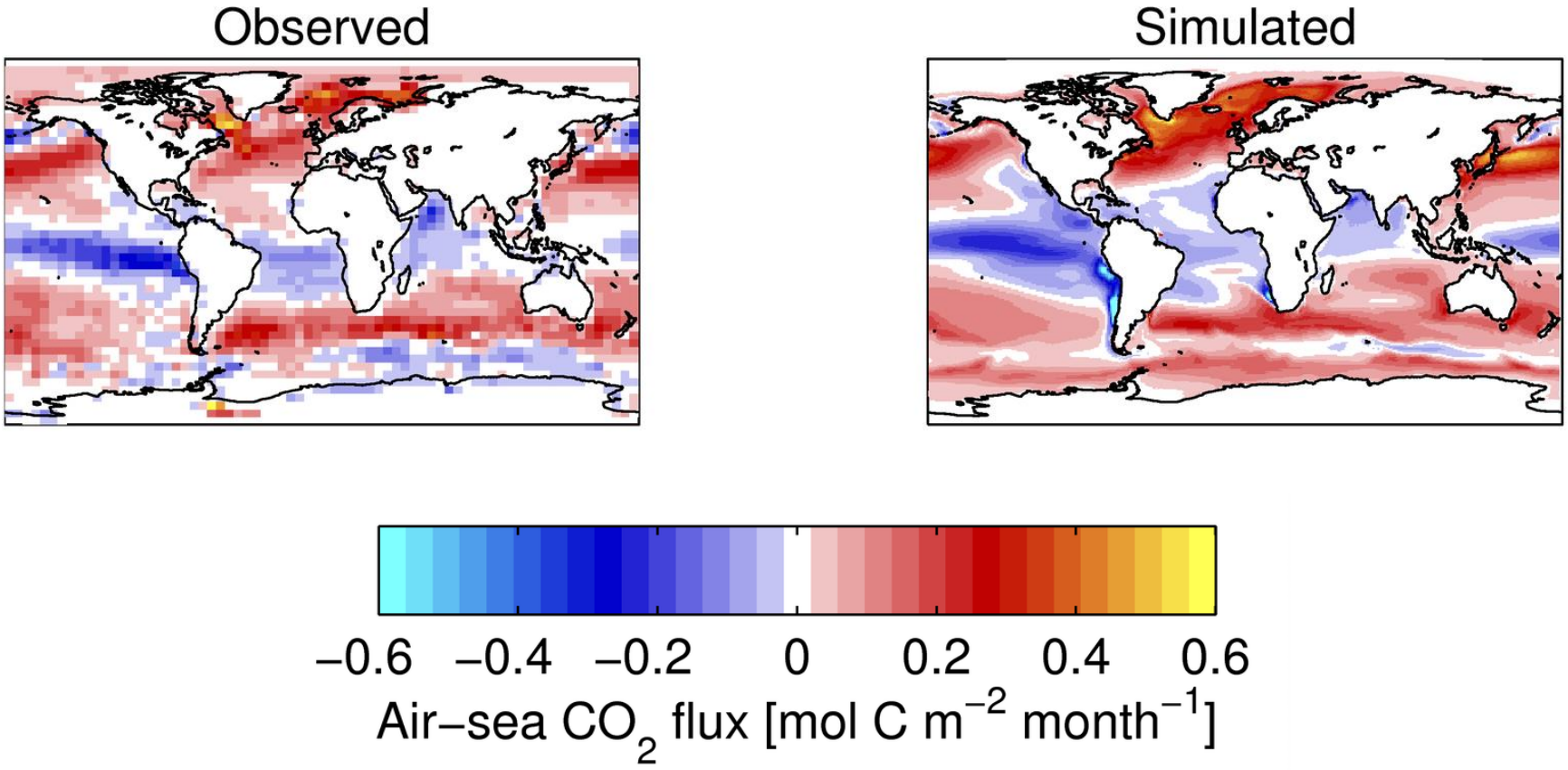
UKESM1 mean air to sea CO_2 flux 2000 – 2014



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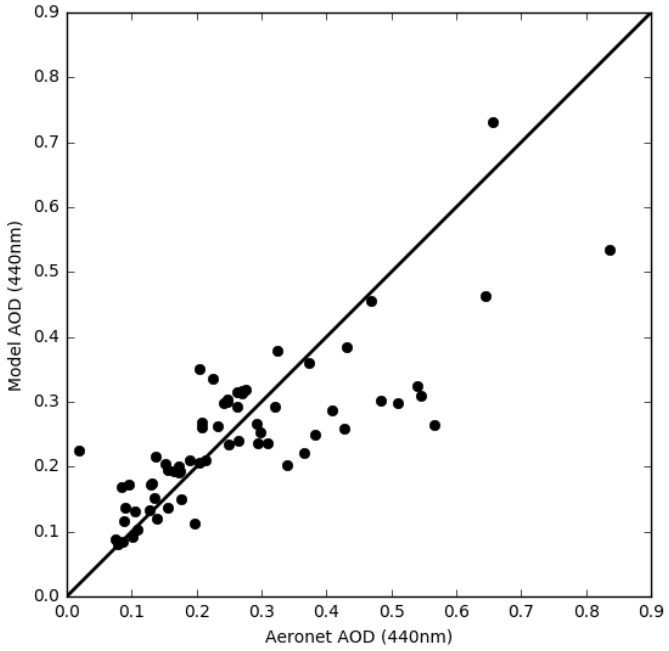
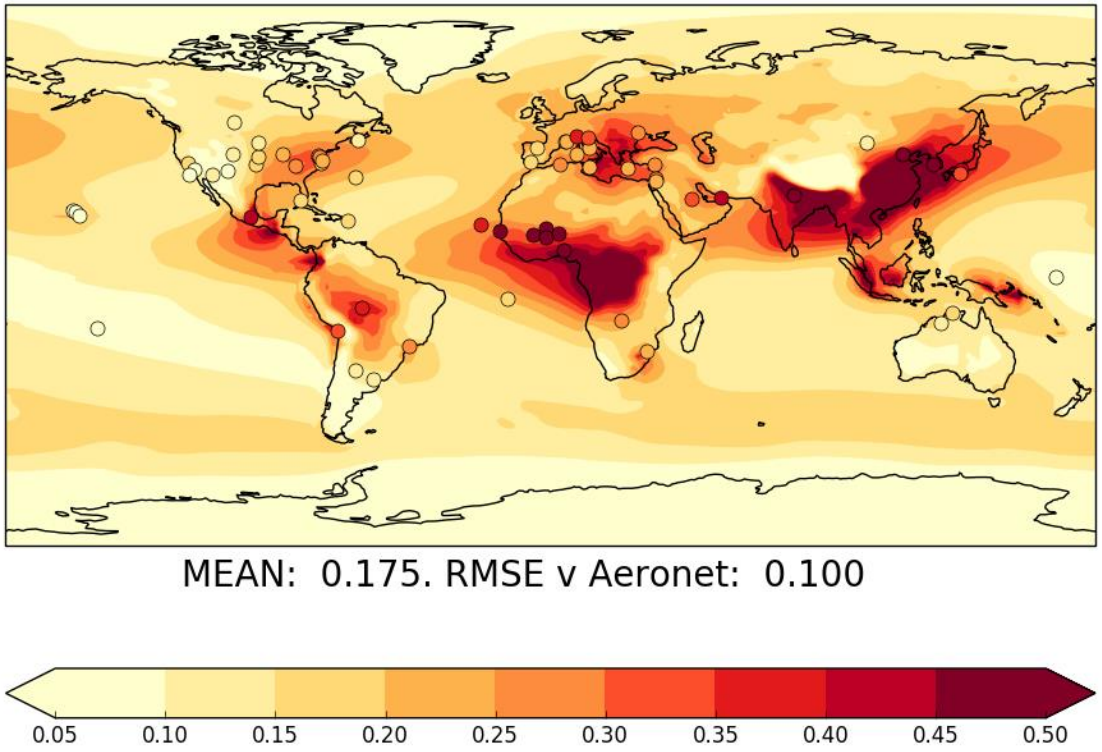
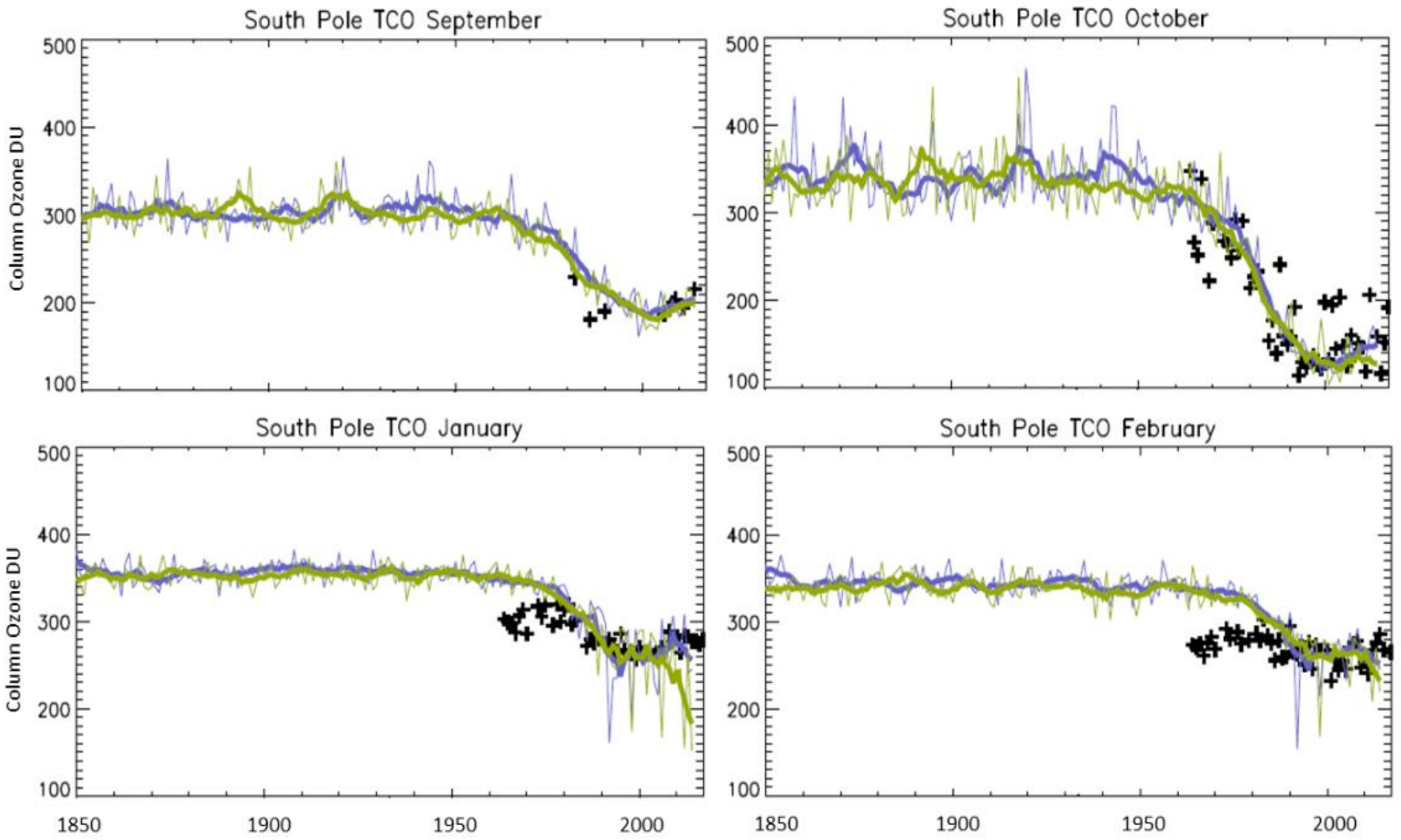
Simulated and observed Aerosol Optical Depth (AOD)
UKESM1 (colour contours) and Aeronet observations (coloured points)
Left plot shows a UKESM1 v OBS scatter plot of mean AOD for the Aeronet sites



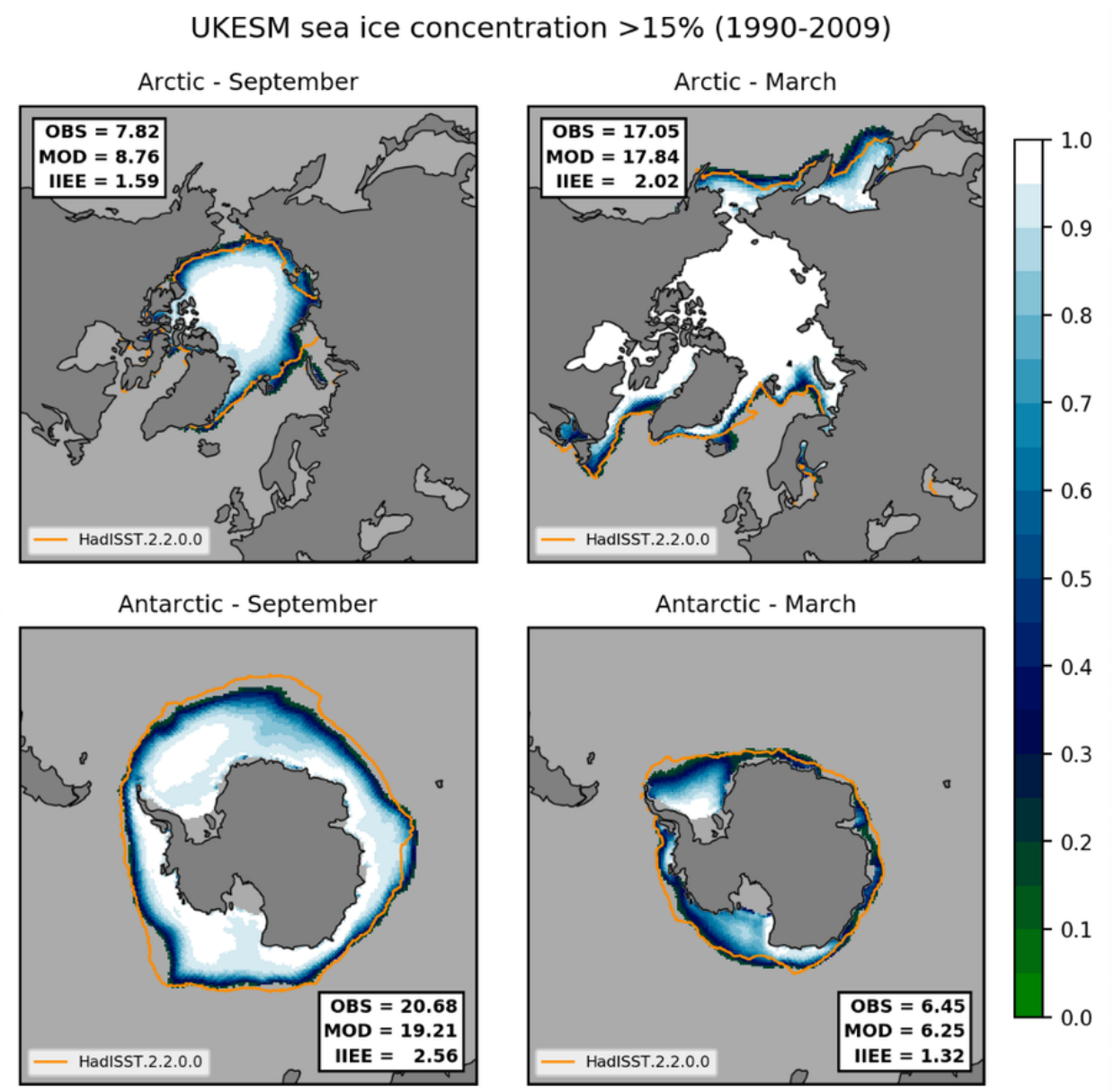


The Antarctic ozone hole

Monthly column ozone at the South pole observed (from 1964) & simulated in the UKESM1 Historical run (Southern Hemisphere spring -> summer)

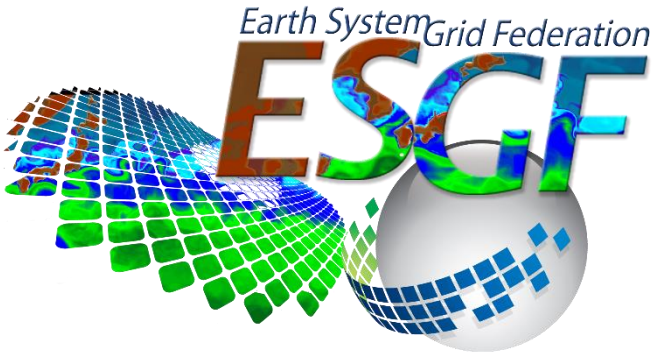


Sea ice concentration simulated in UKESM1 ensemble
Orange line shows the limit of observed sea ice



Data availability

- Some UKESM1 CMIP6 simulations are already available on the **ESGF** (not all variables)
  - piControl
  - 9 historical simulations
  - DECK
  - scenarioMIP tier1
- Available on **JASMIN** in the raw data format (pp, netCDF; monthly means):
  - piControl
  - 9 historical simulations
  - scenarioMIP simulations, tier 1, 5 members each



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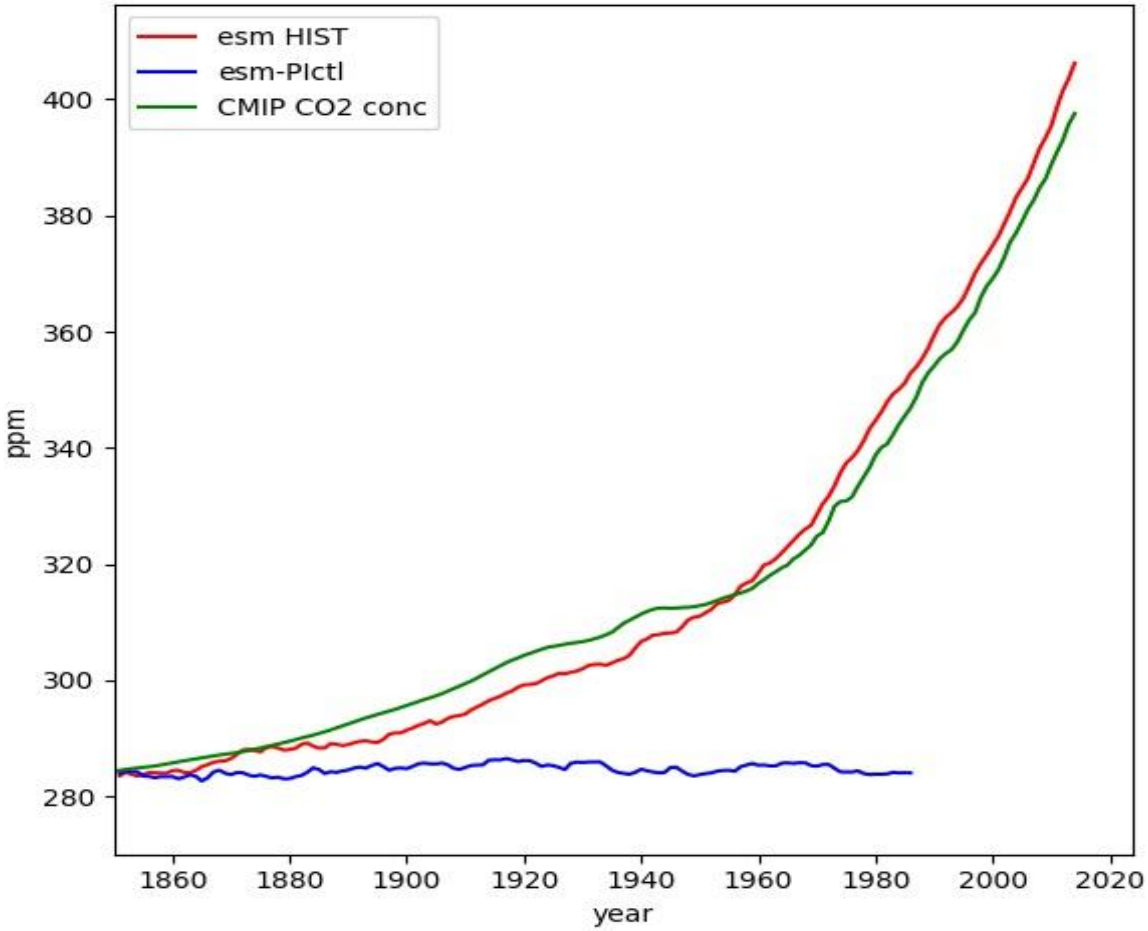
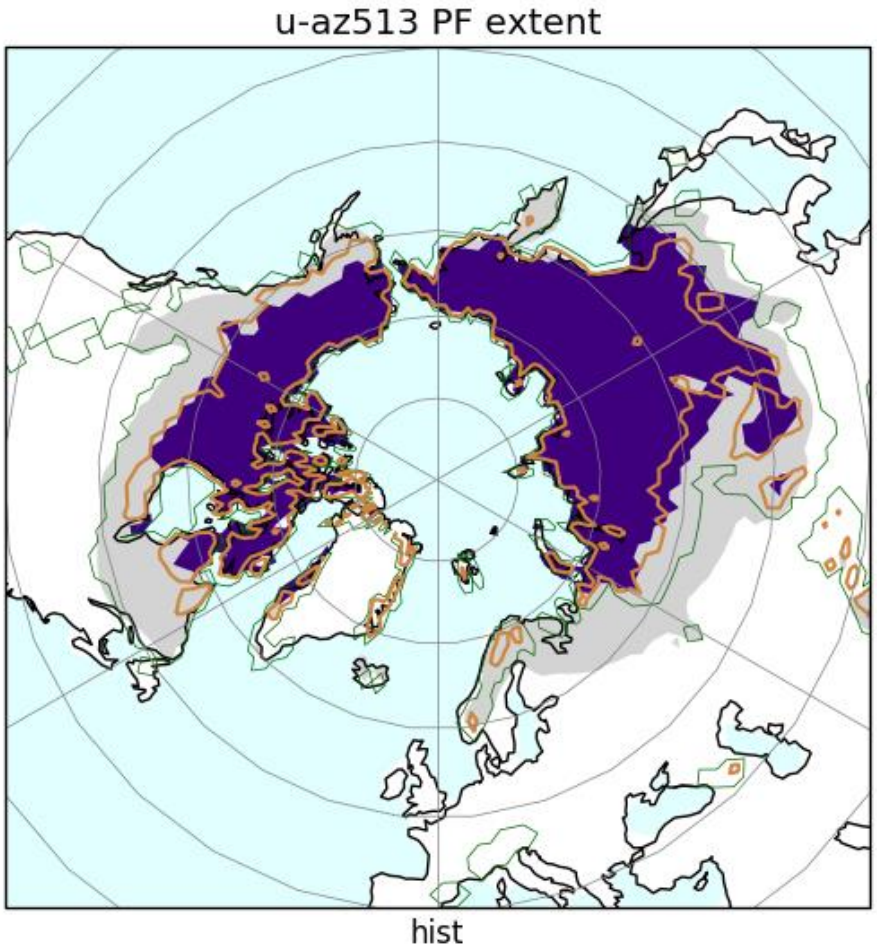
We now have a CO_2-emission driven version of UKESM1

This accurately reproduces the historical evolution of atmospheric CO_2 suggesting climate-carbon cycle interactions are accurately simulated

UKESM1-e Historical Global mean atmospheric CO2 concentration

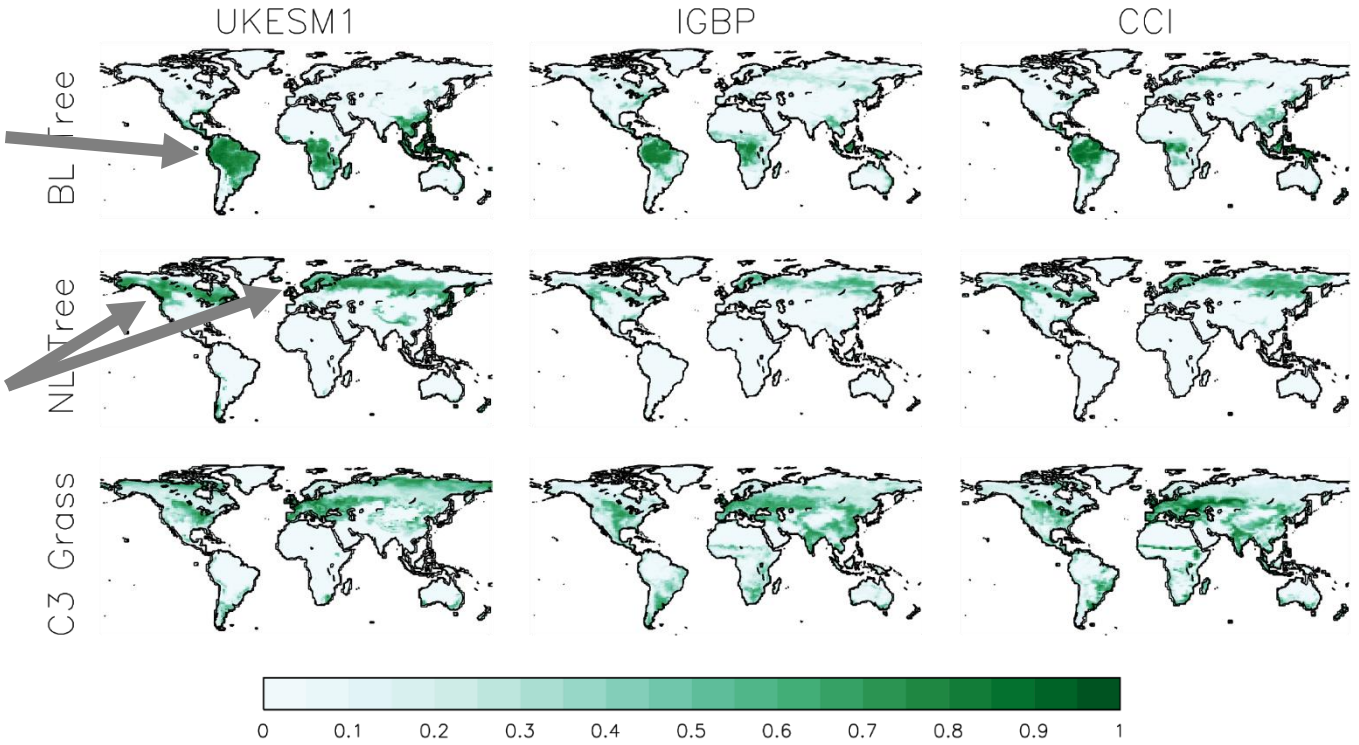


Permafrost extent: Purple area shows permafrost diagnosed from UKESM1 grid points where maximum monthly-mean soil temperature at 2m depth is below 0 C for the period 1990-2009. Grey regions are where UKESM1 annual mean air temperature is below 0 C. The green and orange lines are, the limits of continuous and discontinuous permafrost from Brown et al observed data.



Vegetation distribution

- More tropical broadleaf tree than observations
- Boreal tree cover is good (was low in HadGEM2-ES)



Vegetation distribution

- Bare soil fraction important for dust emissions
- Too much bare soil in India (see Martin & Levine 2012).
- Australian bare soil fraction is good