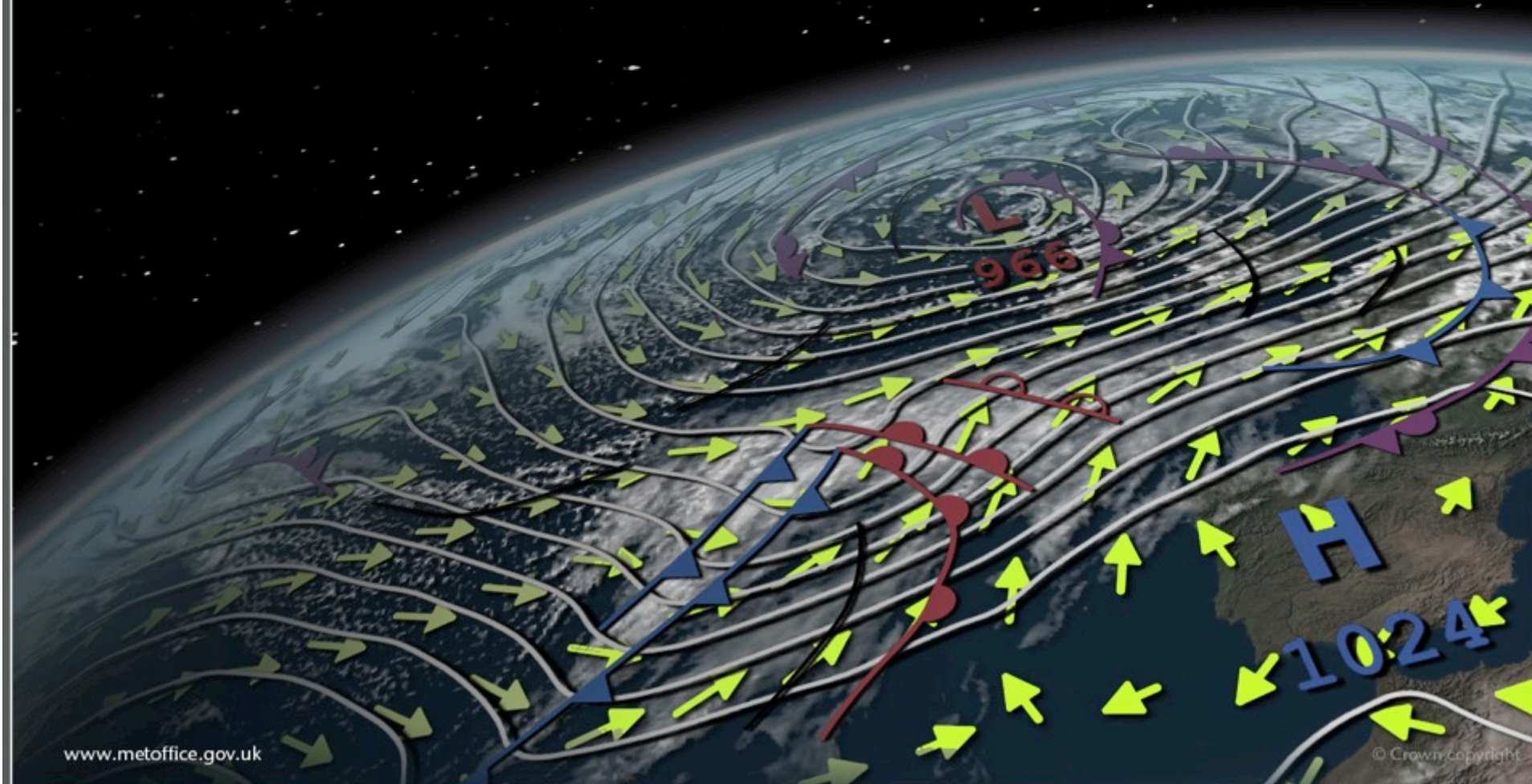
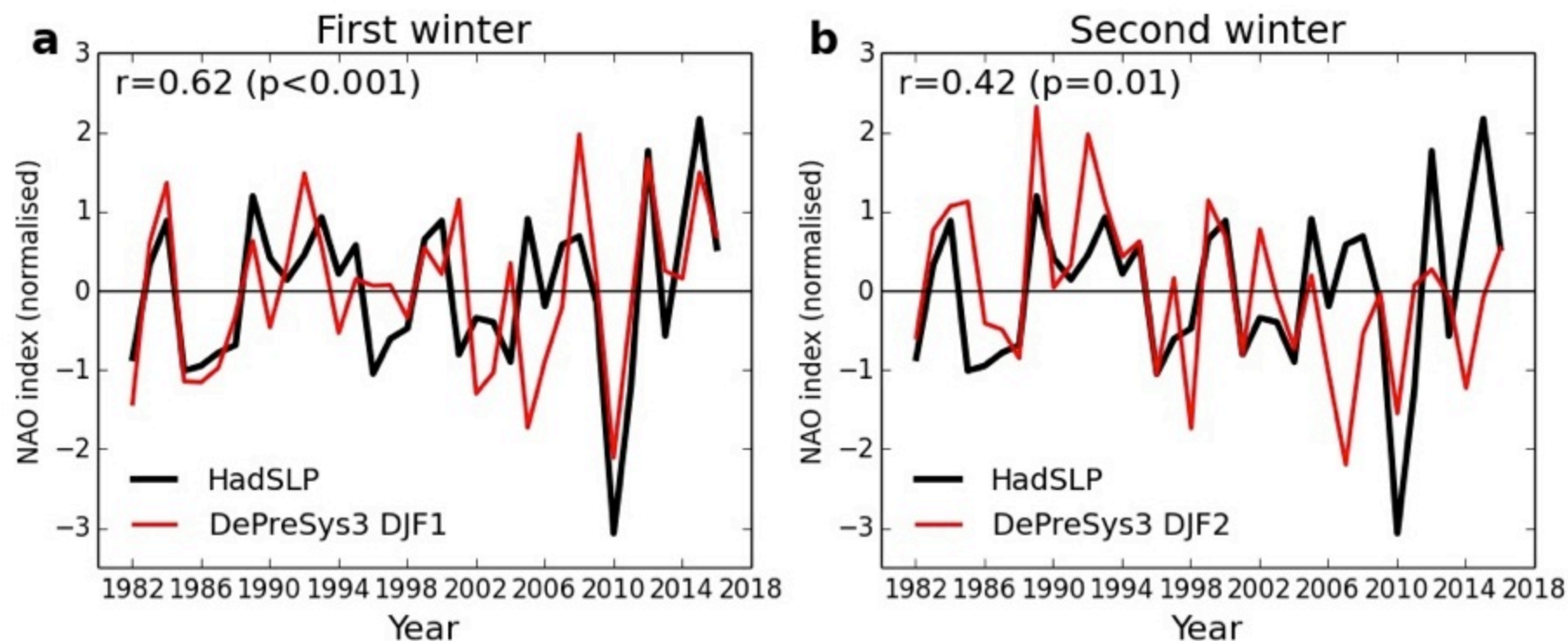


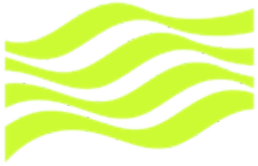
Met Office Decadal Activities



Skilful predictions of NAO

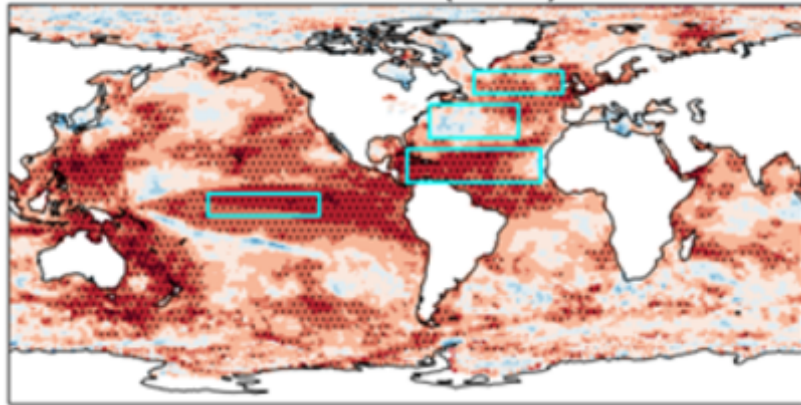


- Skill extends over the whole satellite era since 1980
- Recent large signals are captured
- Significant skill from more than a year ahead

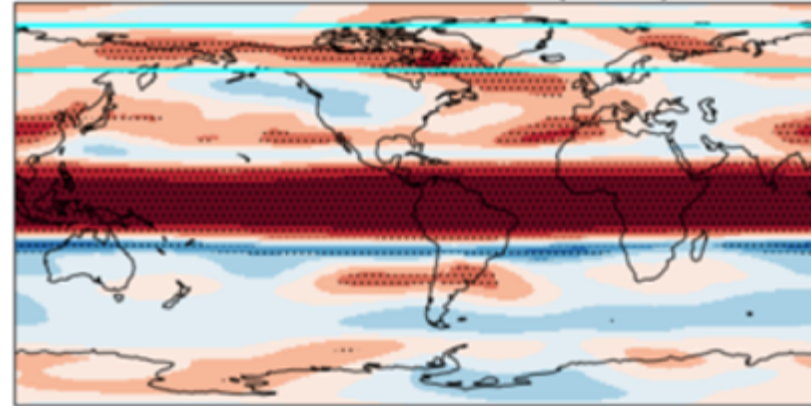


Sources of NAO skill

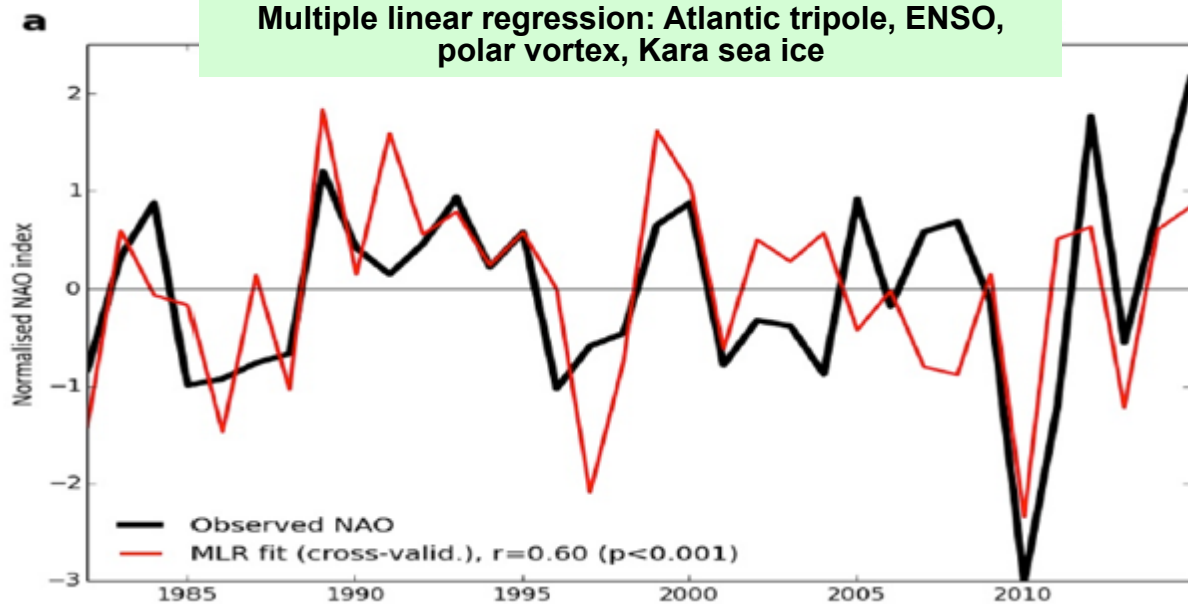
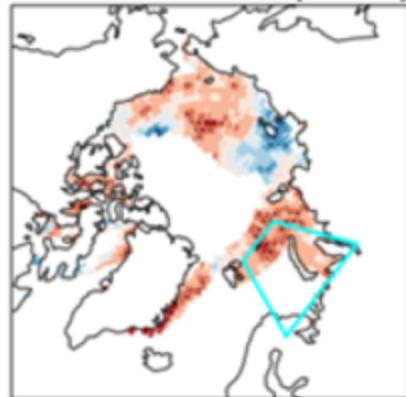
SST skill (SON)

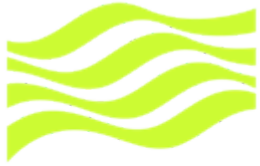


U wind 50hPa skill (SON)



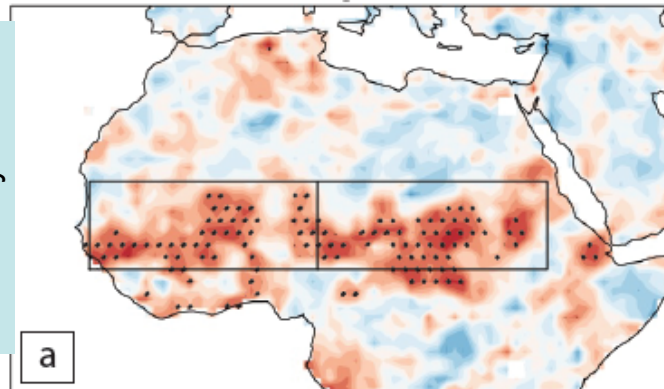
Ice area skill (SON)



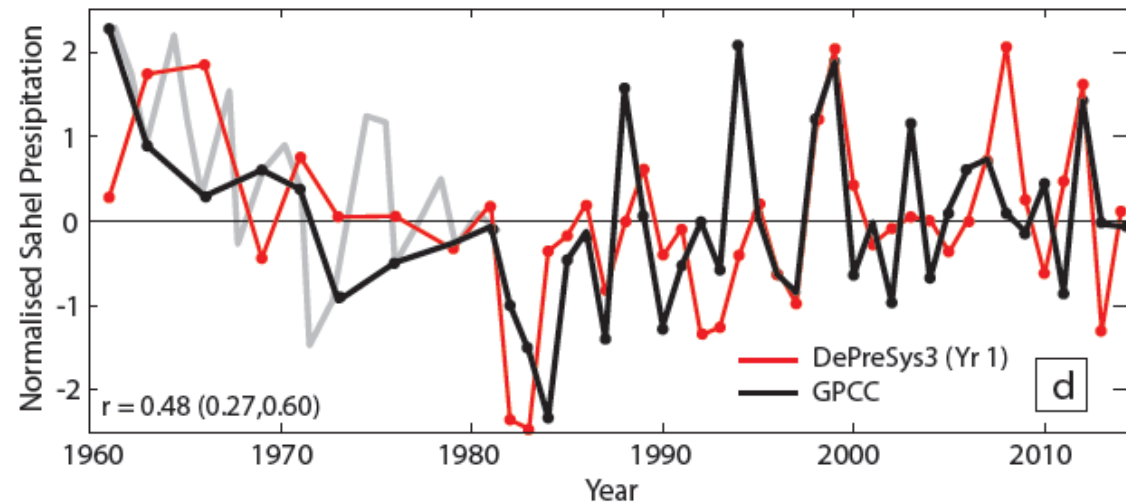
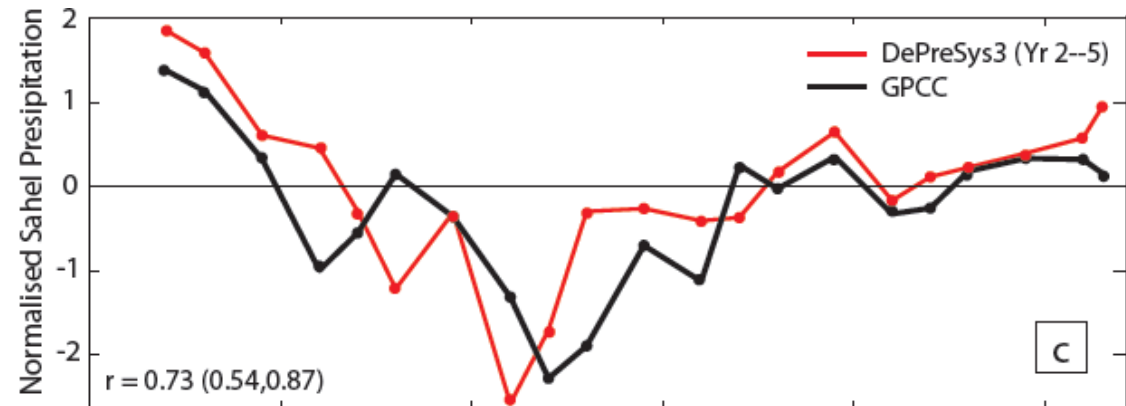
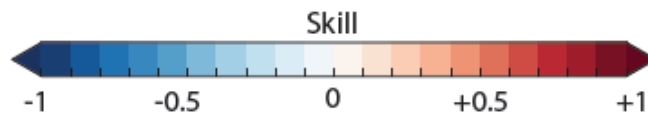
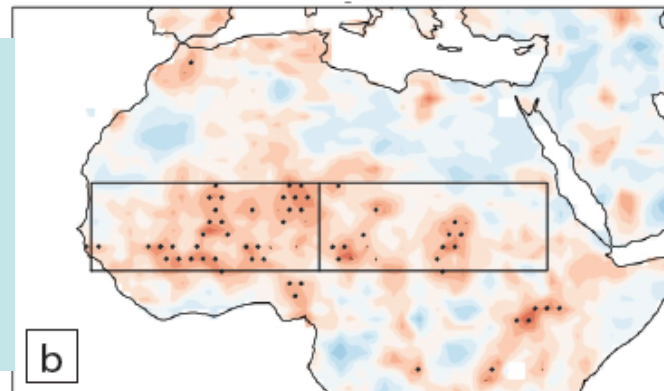


Sahel rainfall

Multiyear



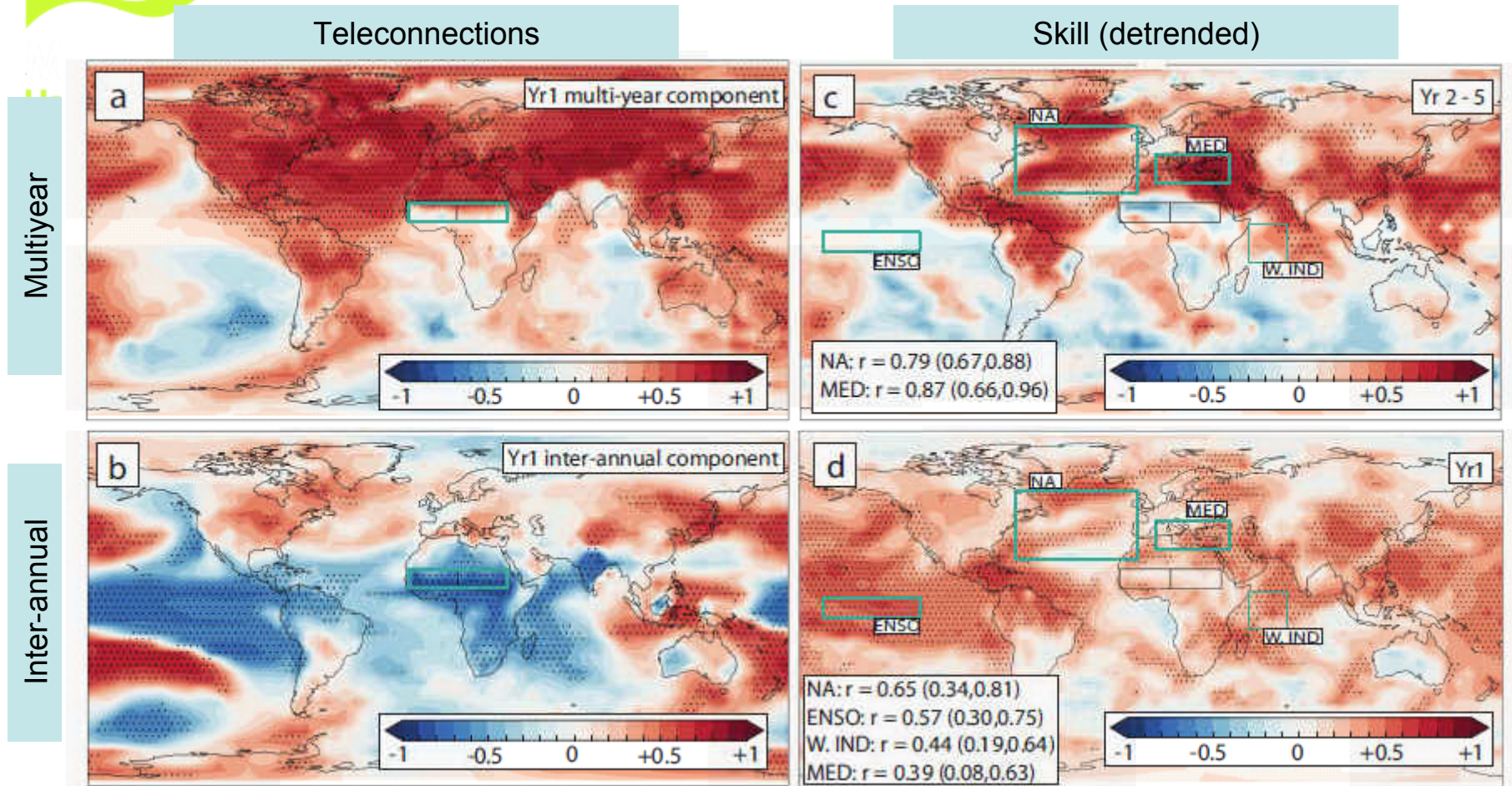
Inter-annual



- Significant skill for both multiyear (years 2 to 5, top row) ...
- ... and inter-annual at 8 month lead (bottom row)

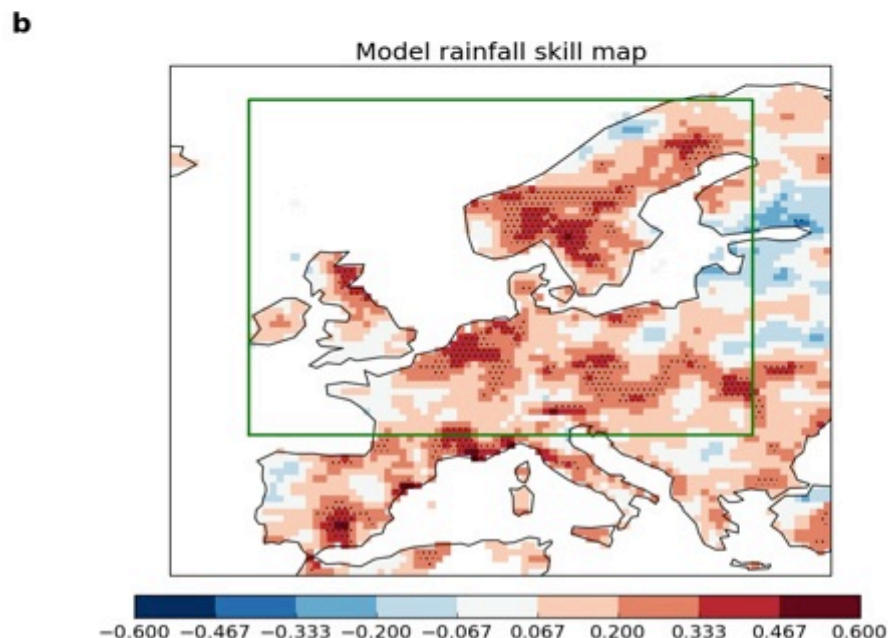
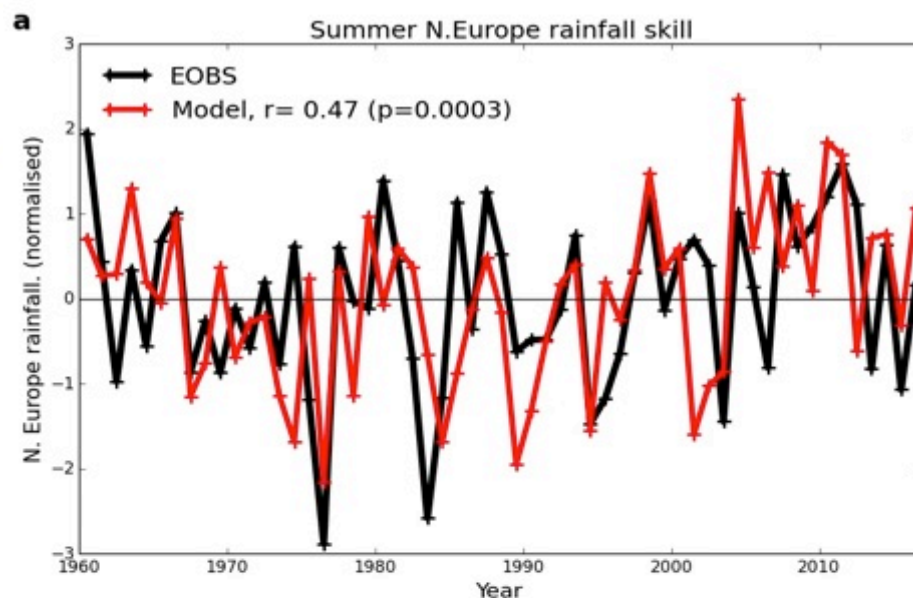


Sources of Sahel rainfall skill



- Multiyear driven by hemispheric temperature gradient which shifts the ITCZ
 - anomalous Hadley (meridional) circulation
- Interannual driven mainly by ENSO
 - anomalous Walker (zonal) circulation

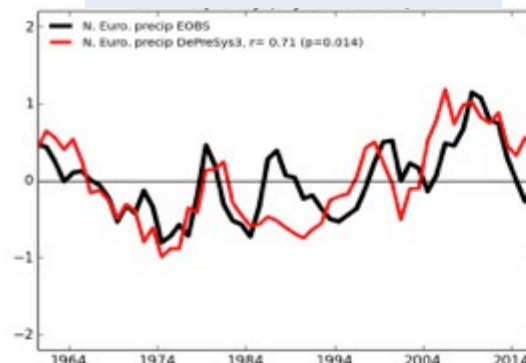
European summer rainfall



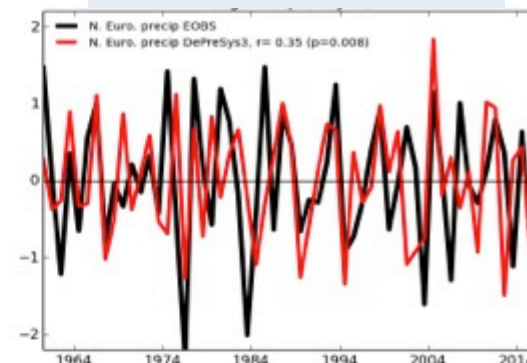
- 80 ensemble members (40 each from May and Nov)
- Every year from 1961
- $r=0.47$
- Captures some extreme years (e.g. 1976) and some low frequency variations (e.g. wet years 2007-2012)
- Also some skill for southern Europe ($r=0.39$)

European summer rainfall

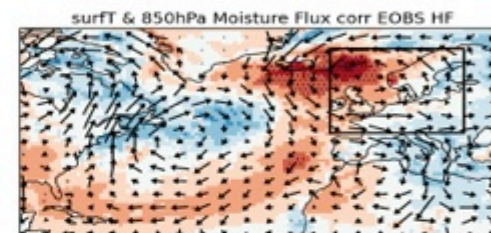
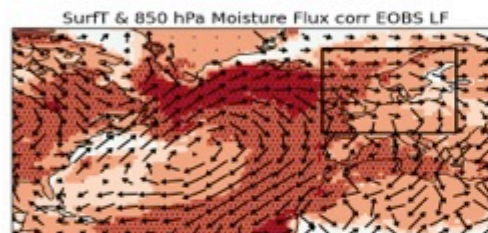
Low frequency



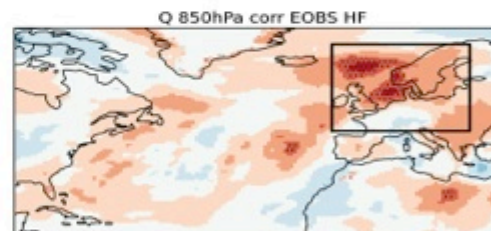
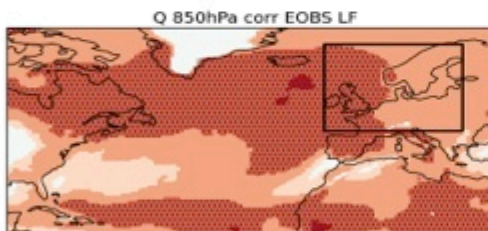
High frequency



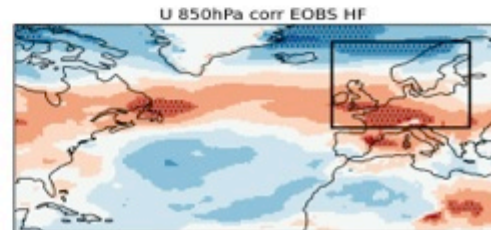
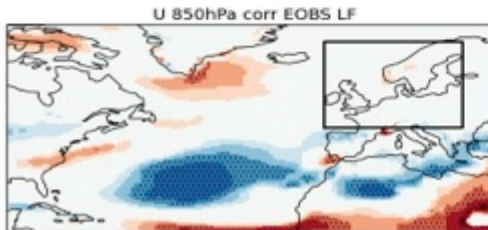
Correlation between obs
European rainfall and forecast T
(colours) and moisture flux
(arrows)



Correlation between obs
European rainfall and forecast Q



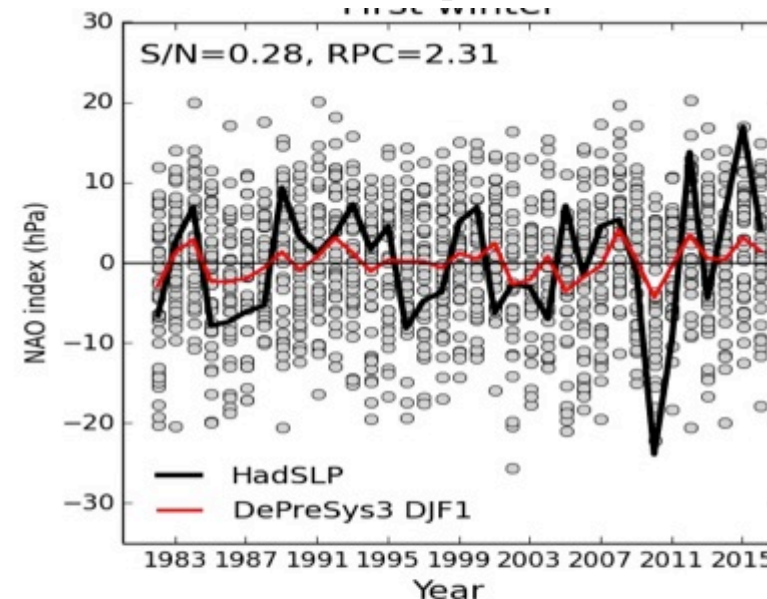
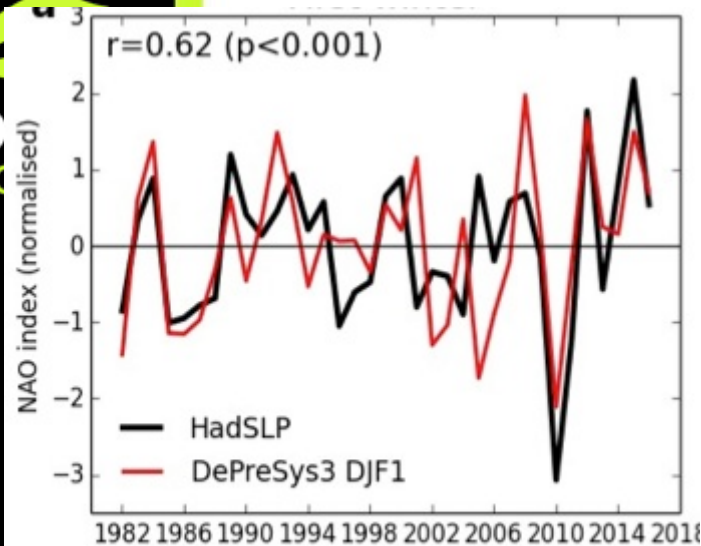
Correlation between obs
European rainfall and forecast U



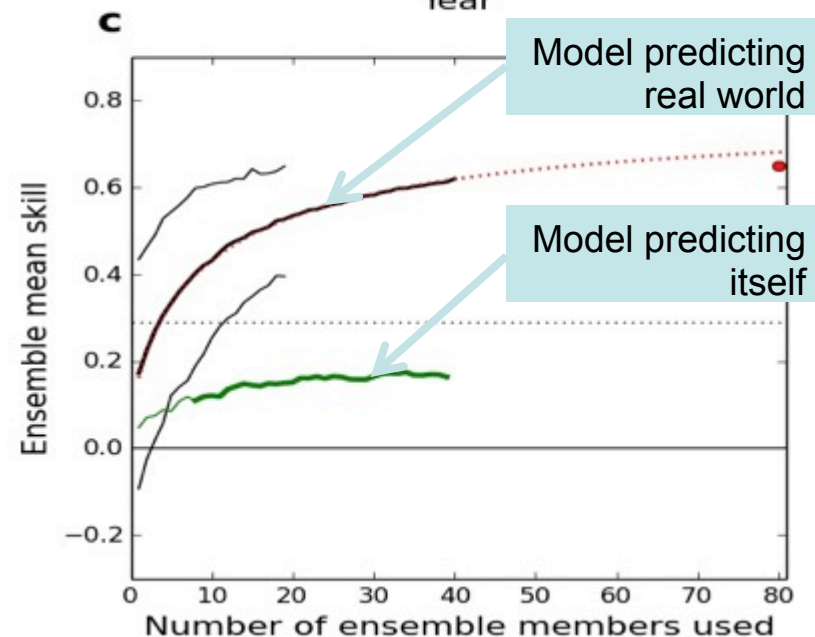


Met Office
Hadley Centre

The signal to noise paradox



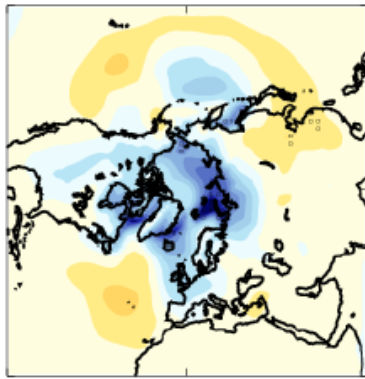
- Skill (anomaly correlation) of seasonal forecasts of the NAO (DJF from Nov)
- Model ensemble mean predicts the real world better than individual model members!
- High skill despite low signal to noise in model → **“the signal to noise paradox”**
- **N.B.** You will not see this if you have a low skill score...



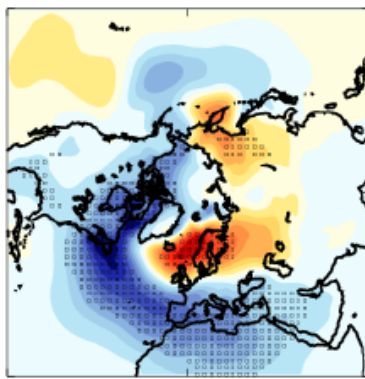


Met Office

Atmosphere model

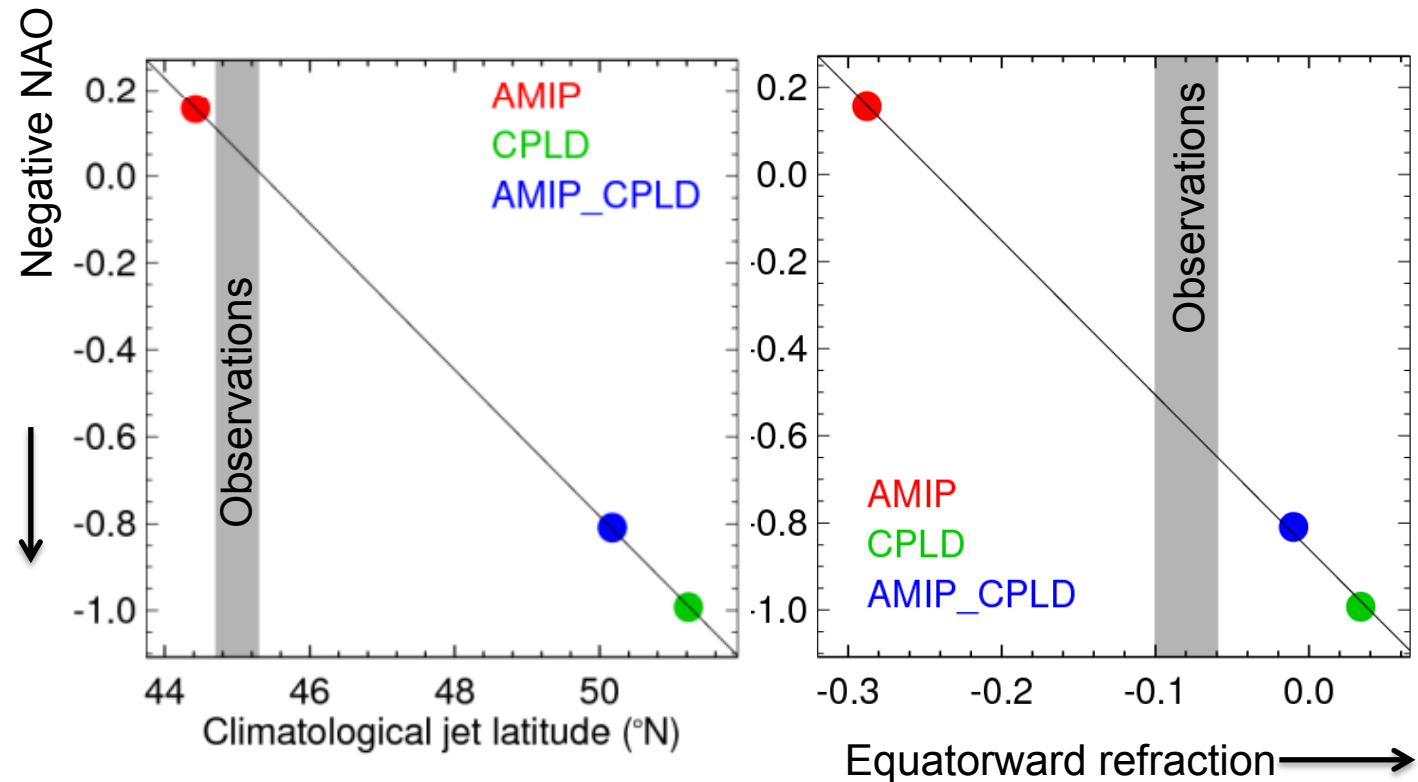


Coupled model



www.metoffice.gov.uk

Will the melting Arctic sea ice promote cold European winters?



- Reduced ice → reduced Equator to pole temperature gradient → less wave activity
- Response depends on wave propagation, and hence background refractive index
- Observations (grey shading) suggest -ve NAO response
- Need more models → coordinated multi-model experiments
- New CMIP6 MIP, Polar Amplification MIP, to investigate the causes and consequences of polar amplification

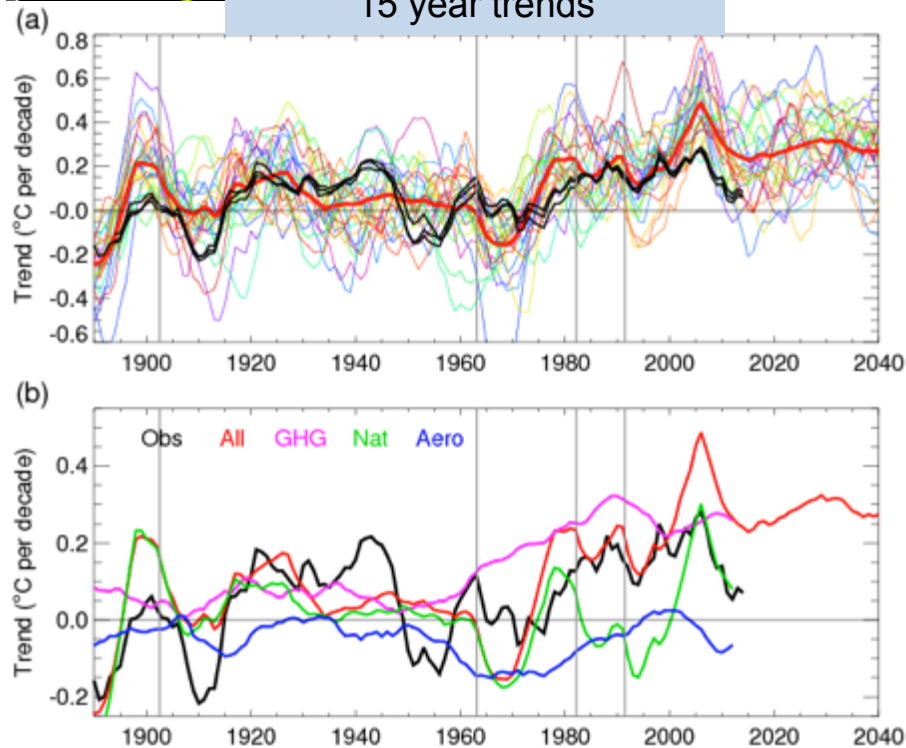
(Smith et al. 2017)



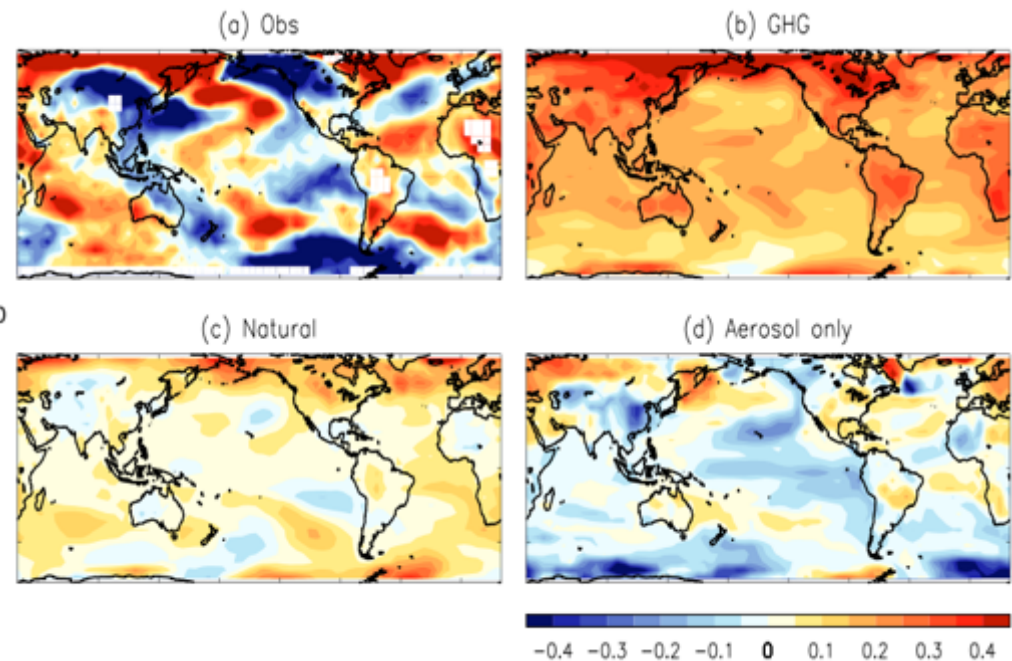
Met Office
Hadley Centre

Global warming slowdown: role of anthropogenic and volcanic aerosols

15 year trends



15 year trend 1998-2012

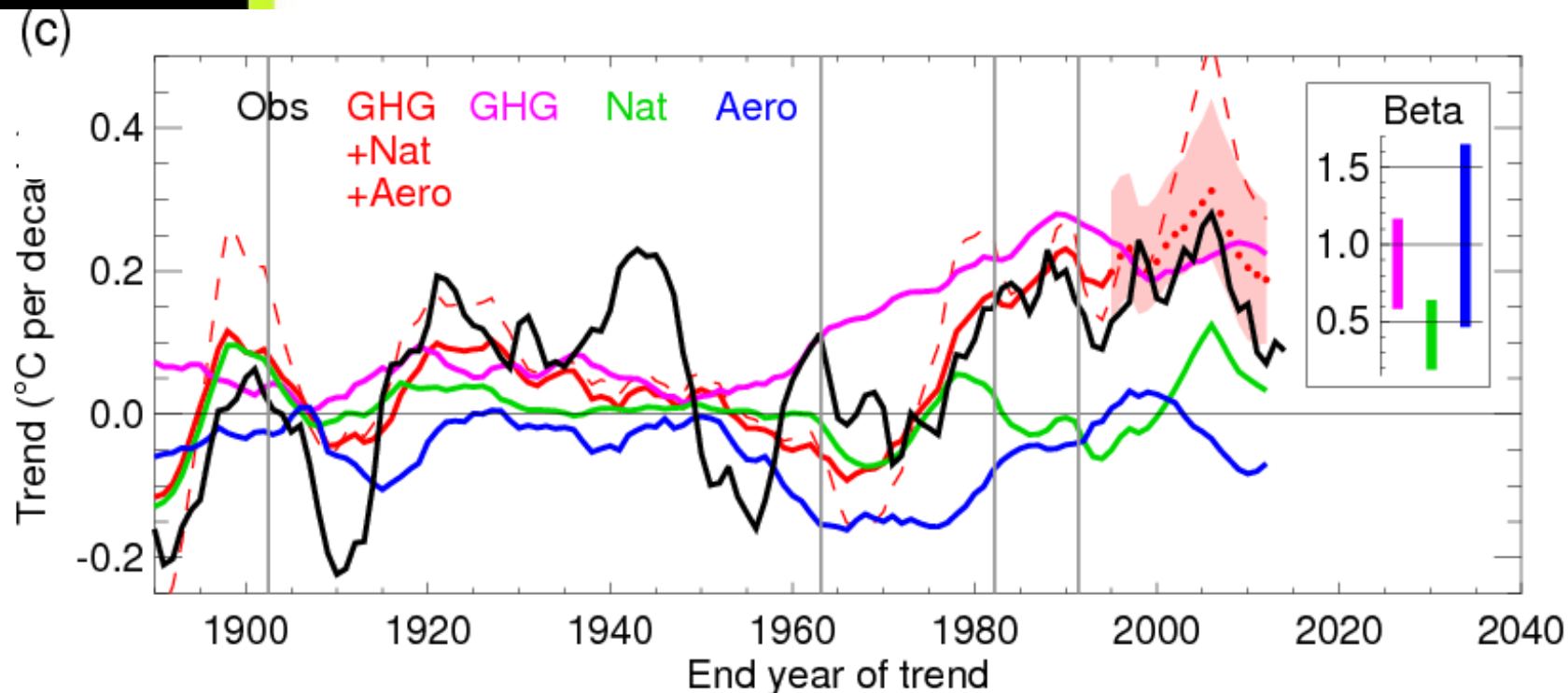


- Recent decrease in 15 year trends is simulated by CMIP5 models → externally forced
 - Partly recovery from Pinatubo
- But anthropogenic aerosols produce cooling trend over most recent 15 years
 - Pattern matches obs in many regions including the Pacific → negative PDO
 - Slowdown was potentially externally forced by aerosols



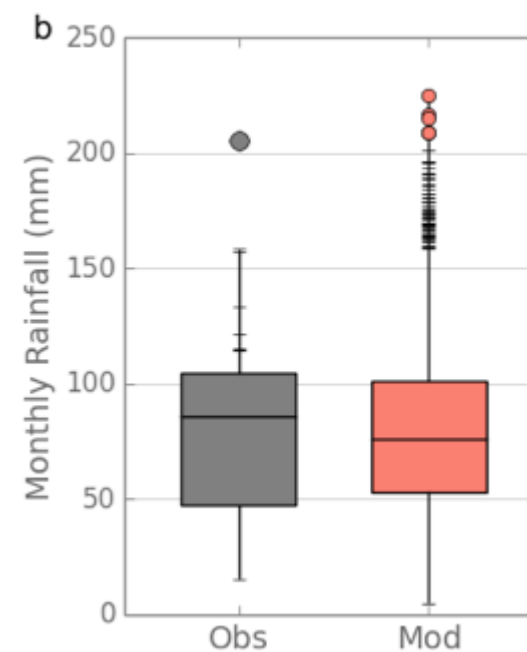
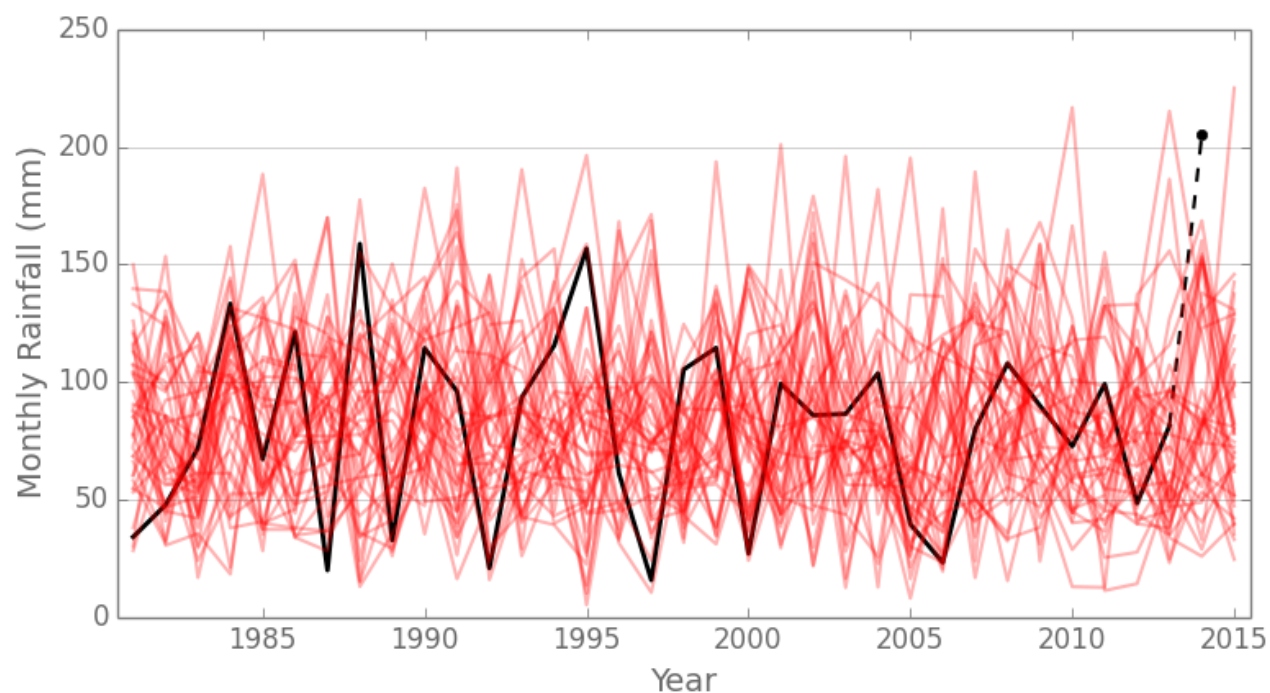
Slowdown in surface warming: recalibration of models

M
Ha

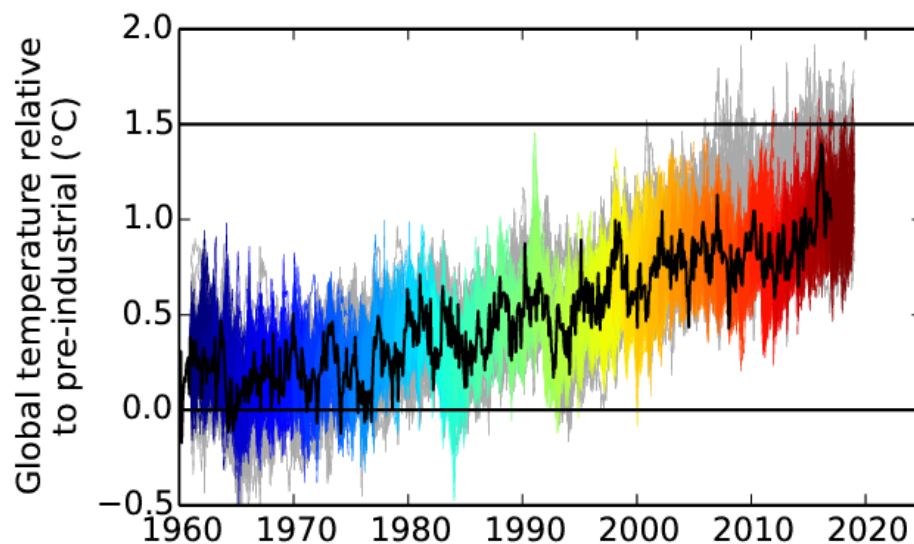


- Detection and attribution analysis to obtain scaling factors (beta)
- Use data before 1995
- Scaling for Nat significantly less than one → models over-sensitive to volcanoes
- Scaled projection (red dotted) in much better agreement with obs than unscaled (red dashed)
- Need to understand response to external forcing better even for near term predictions

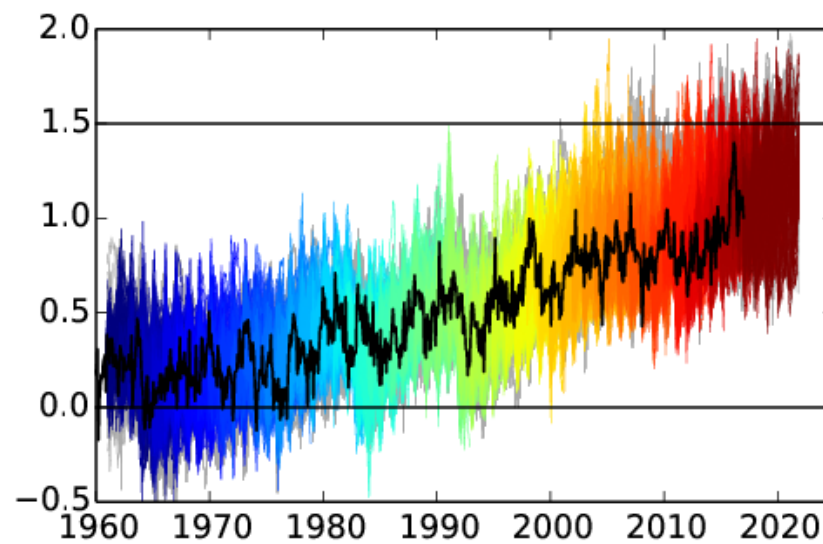
UNSEEN: Unprecedented Simulated Extremes in ENsembles



Risk of exceeding 1.5°C



- Coming 2 years
- 4% (initialised) vs 25% (uninitialised)



- Coming 5 years
- 43% (initialised) vs 34% (uninitialised)