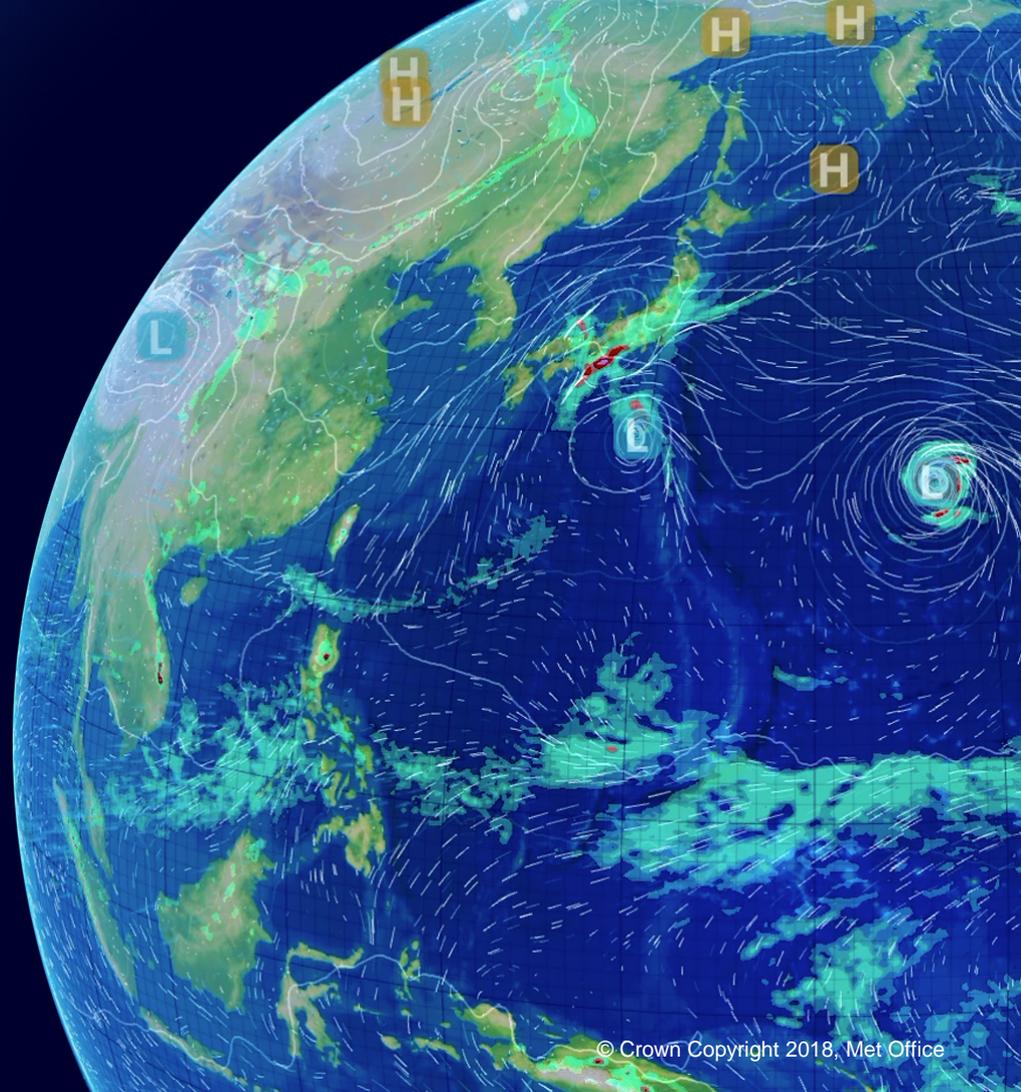
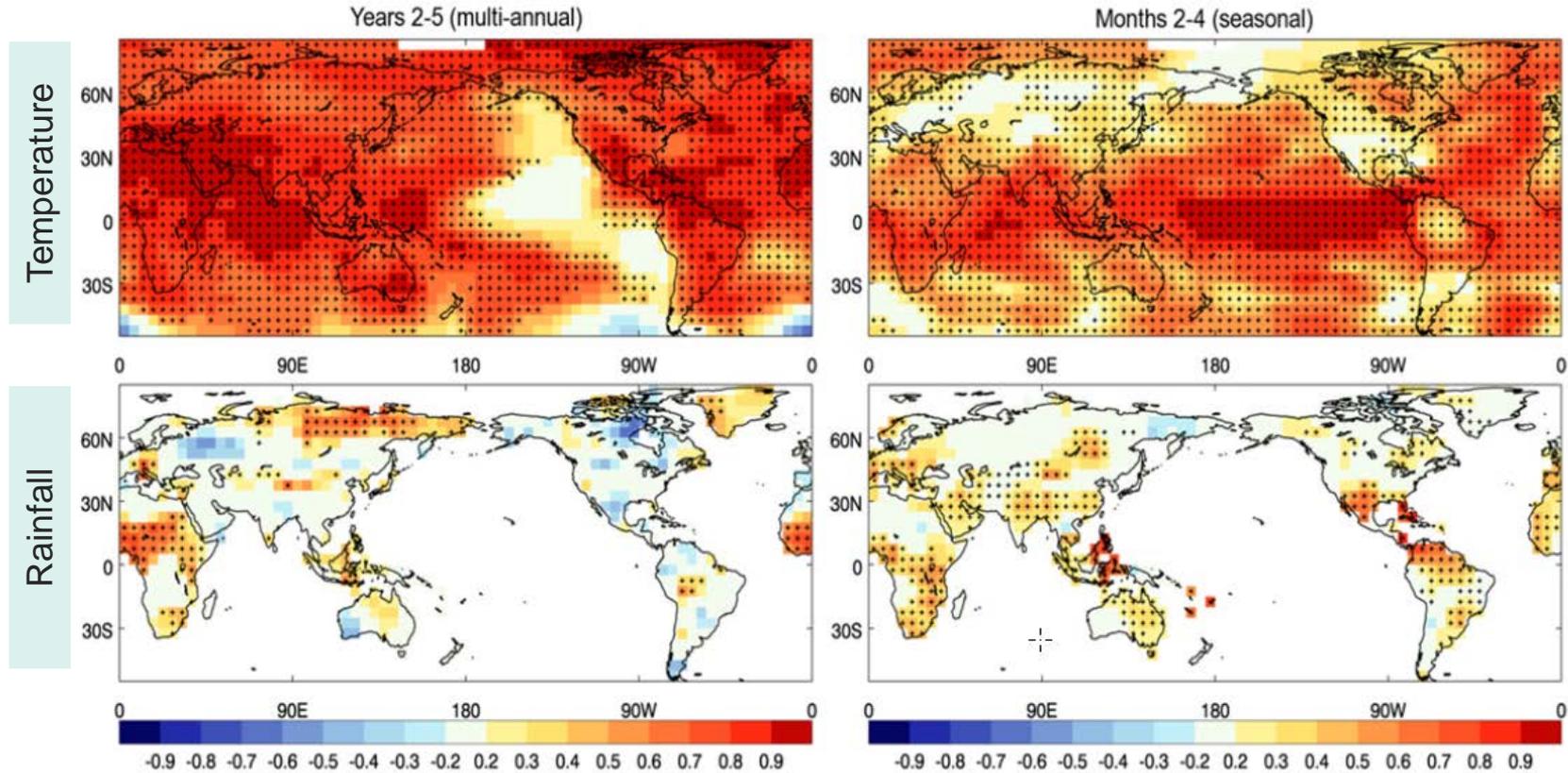


Decadal Prediction

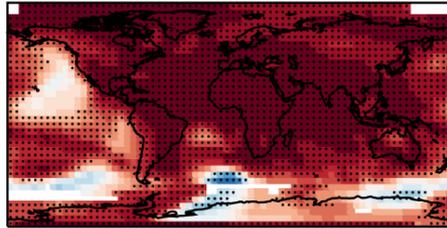


Skill is comparable to seasonal forecasts

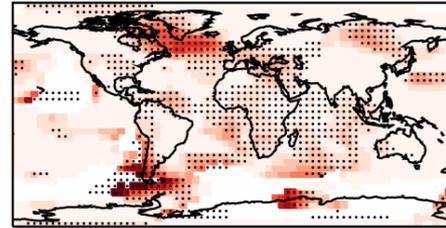


Significant benefit from initialisation

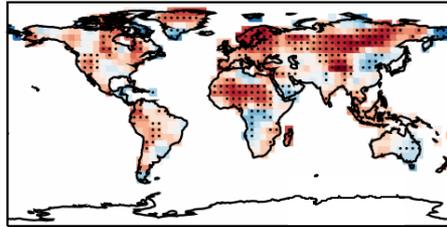
Total skill
(a) Temperature



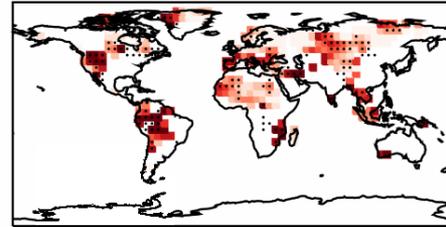
Fraction from initialisation
(b) Temperature



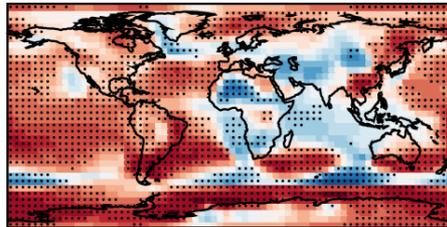
(c) Precipitation



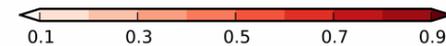
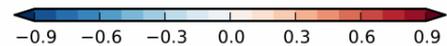
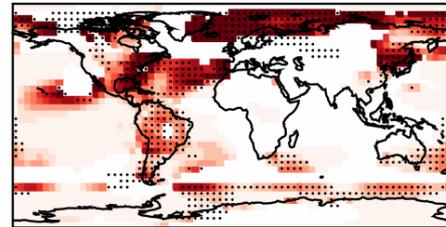
(d) Precipitation



(e) Pressure

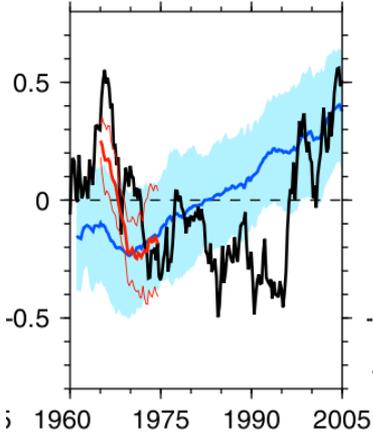


(f) Pressure

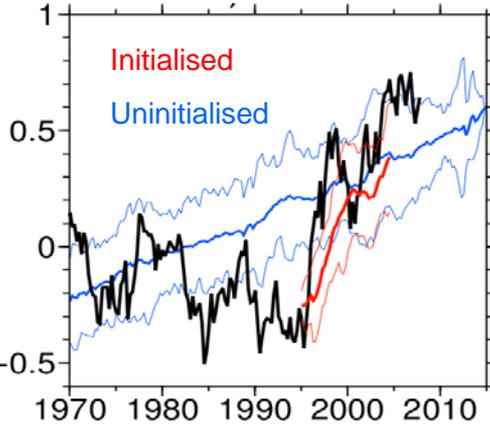


North Atlantic

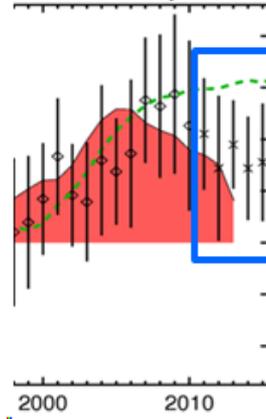
1960s cooling



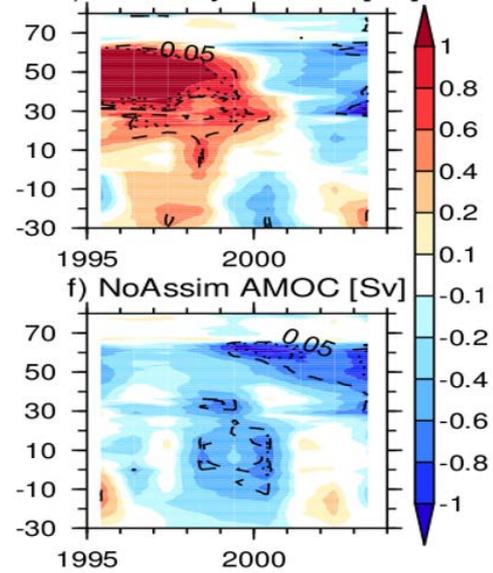
1990s warming



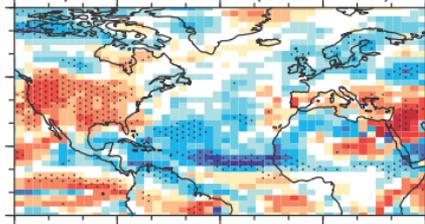
Forecast cooling



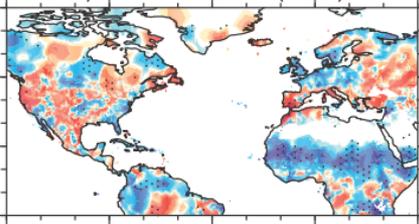
Improved skill due to
initialisation of ocean
dynamics



e) JJA PRECIP (DeP-NoA)

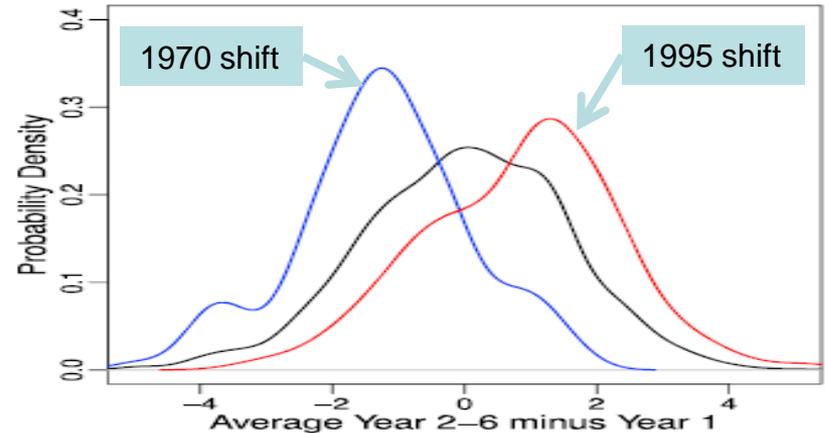
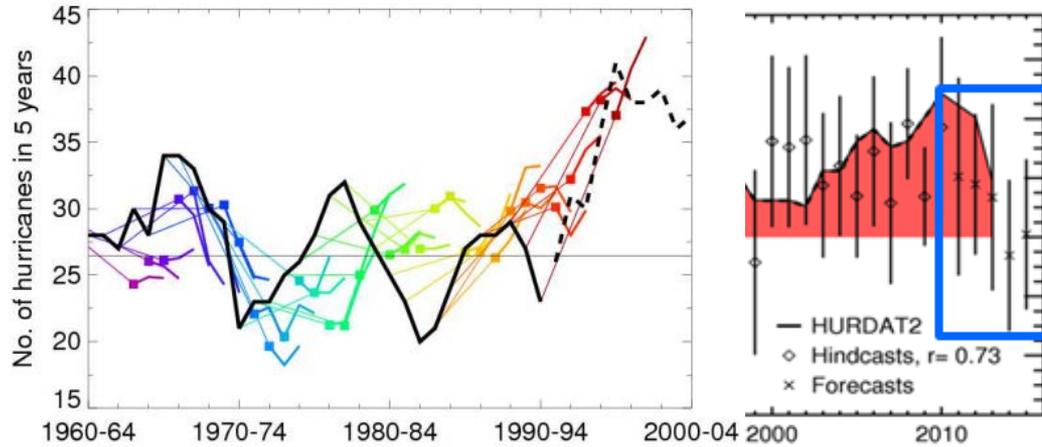


f) JJA PRECIP (Obs)

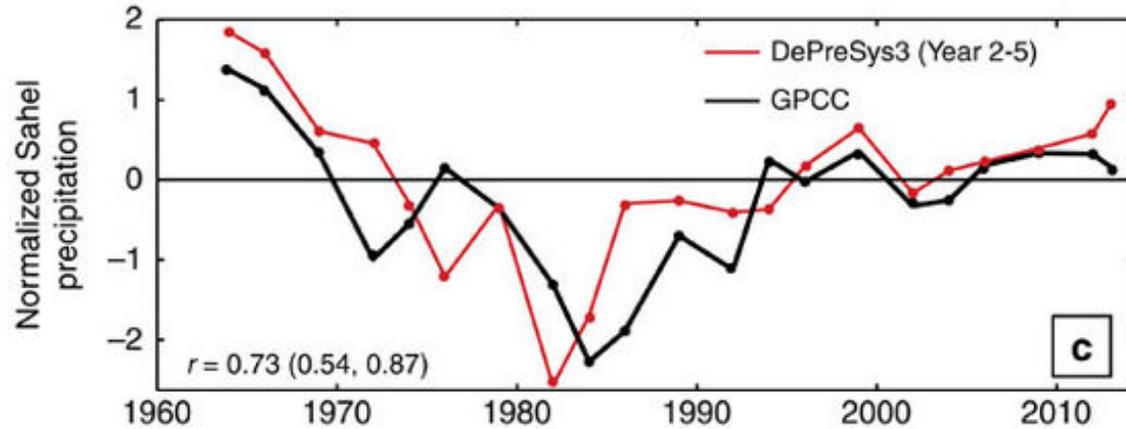


Summer rainfall
changes after Atlantic
warming

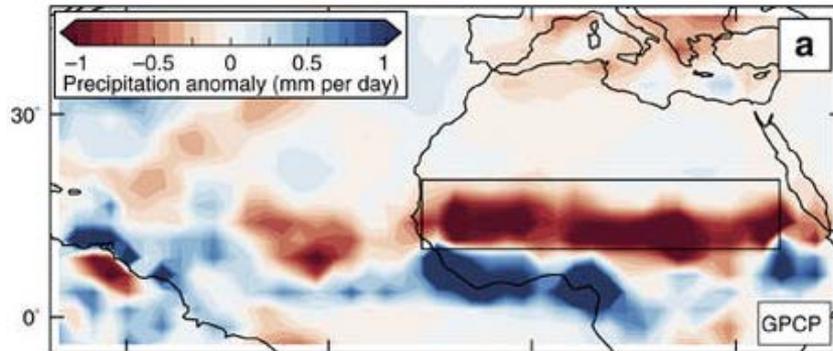
Atlantic hurricane frequency



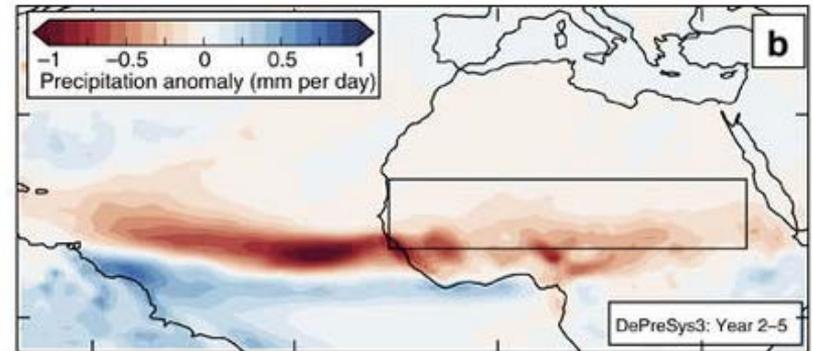
Sahel rainfall



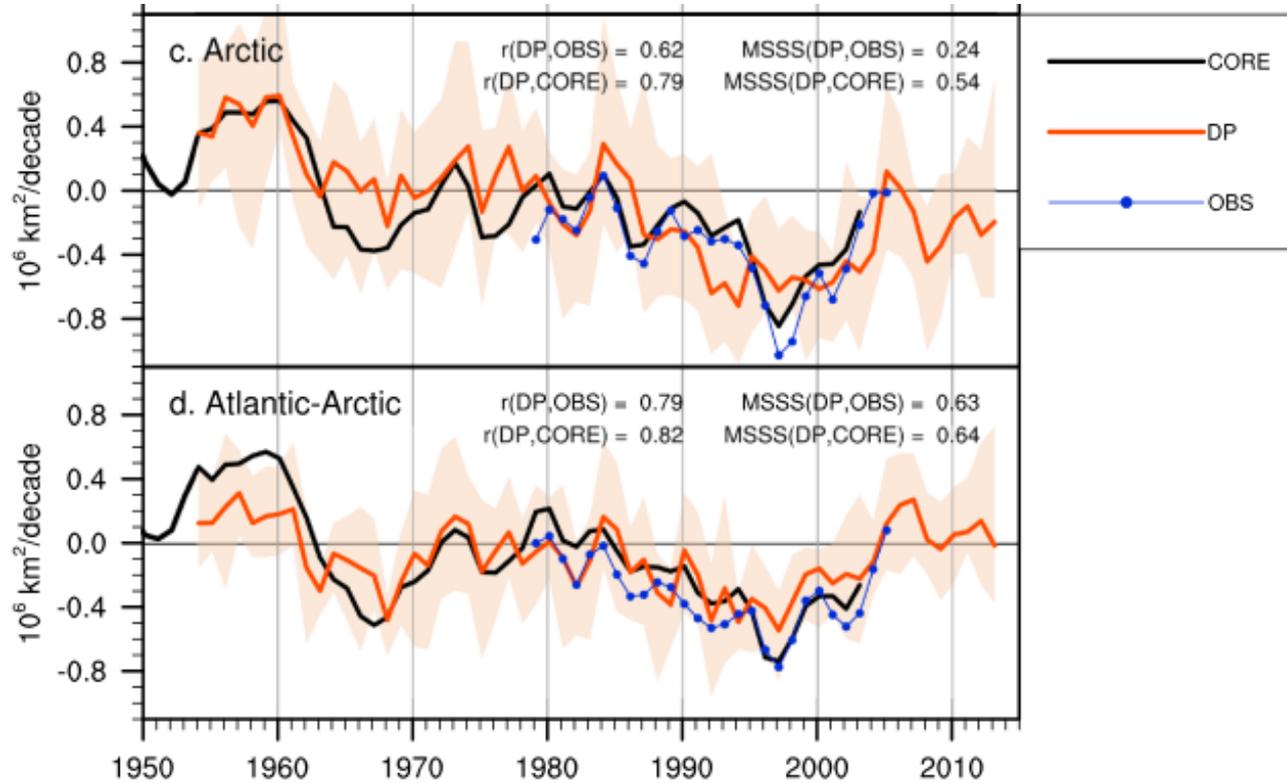
1970s and 80s drought: obs



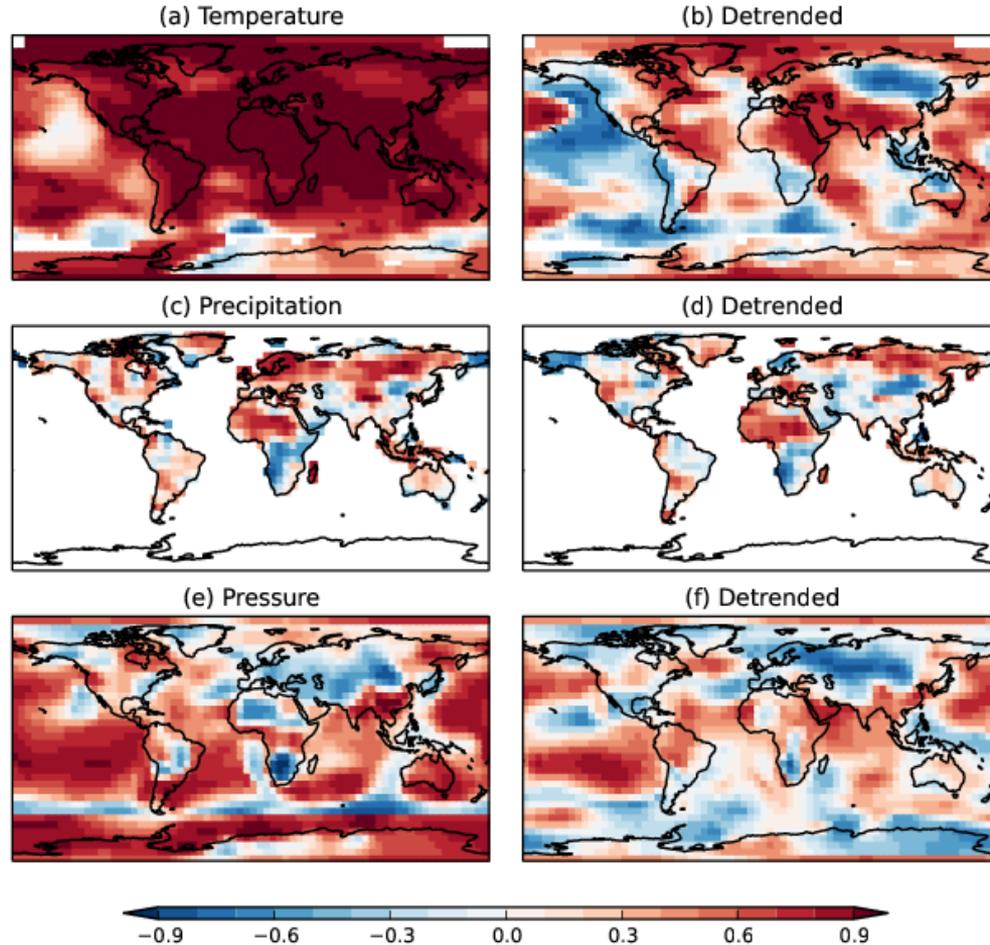
1970s and 80s drought: forecasts



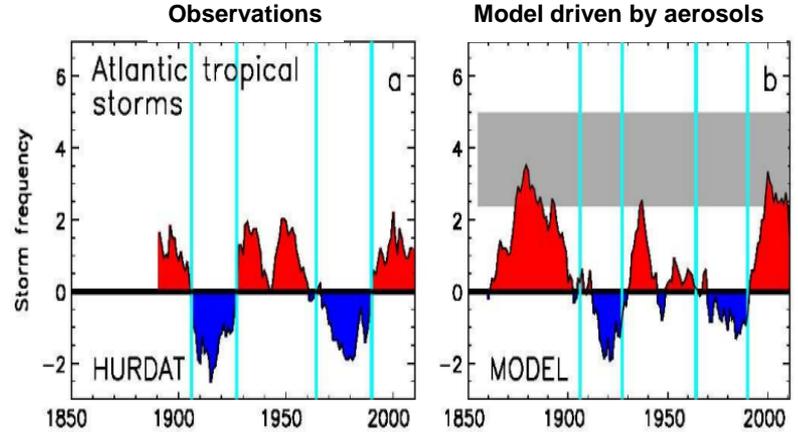
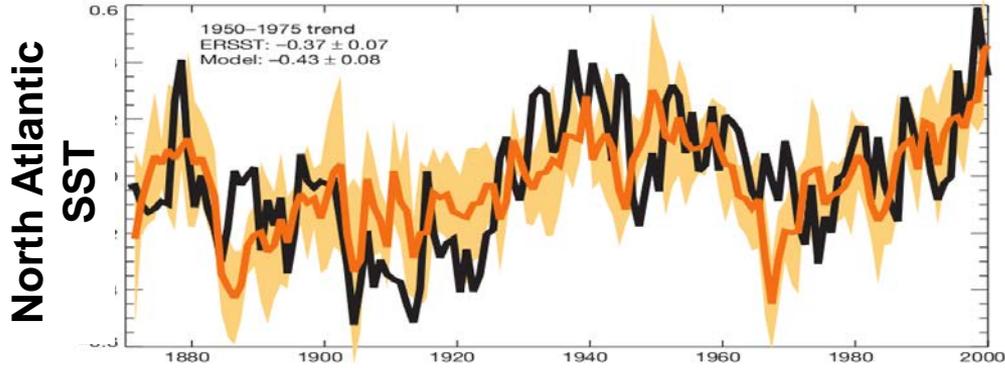
Arctic sea ice trends



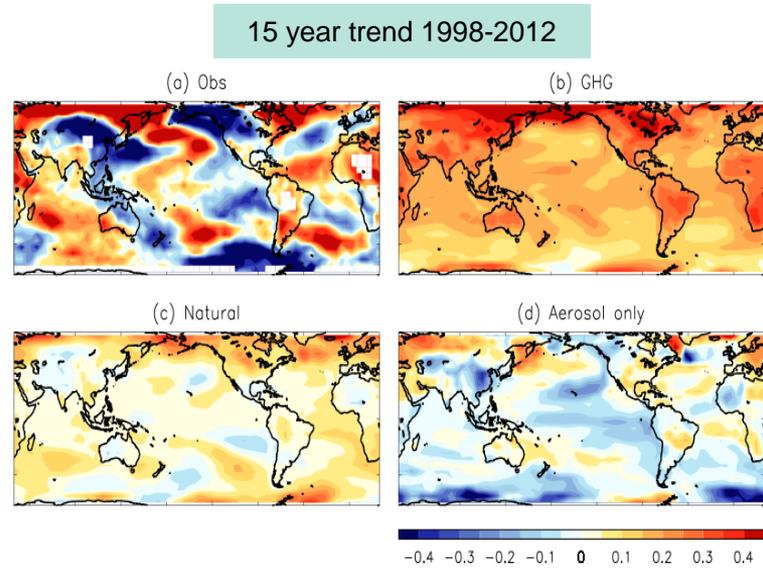
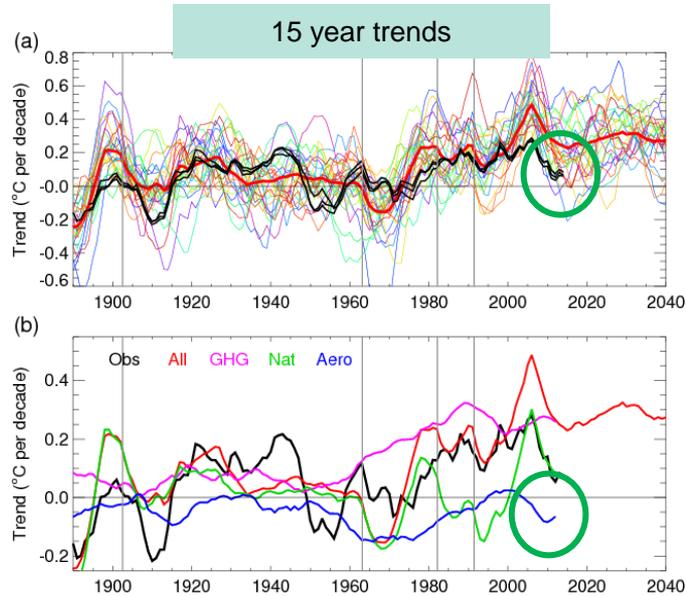
Important role of external forcing



Aerosols: Atlantic



Aerosols: Pacific

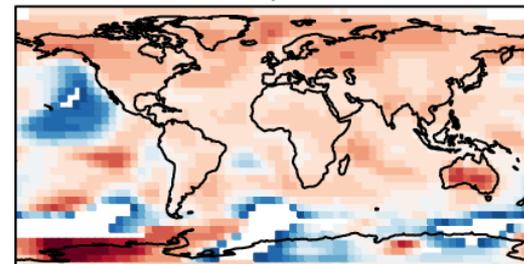


- Recent decrease in 15 year trends is simulated by CMIP5 models → externally forced
- Partly recovery from Pinatubo
- But anthropogenic aerosols produce cooling trend over most recent 15 years
- Pattern matches obs in many regions including the Pacific → negative PDO
- Slowdown was potentially externally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

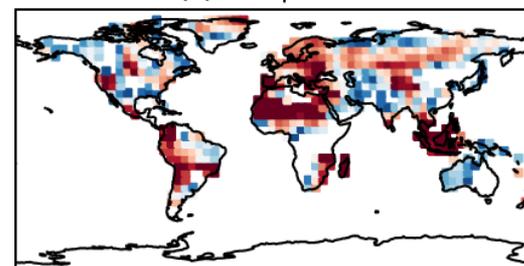
Signal to noise paradox

RPC: years2-9

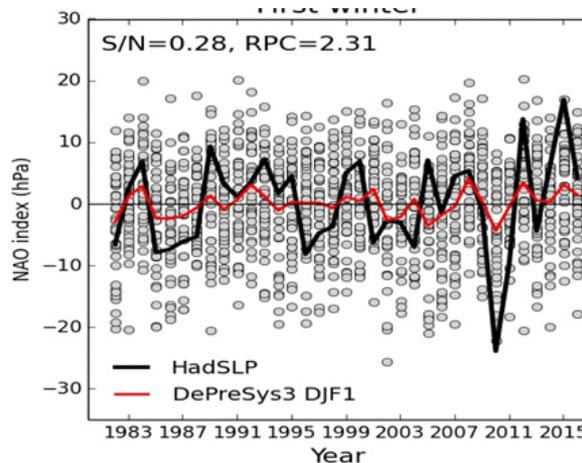
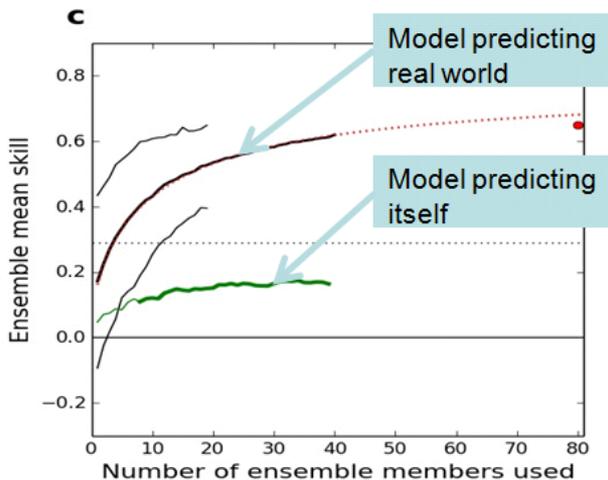
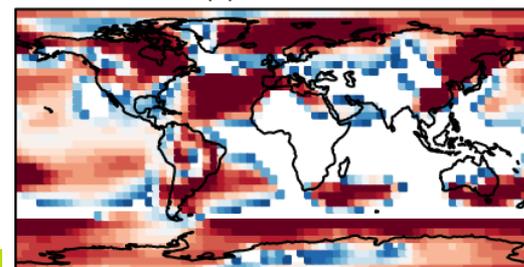
(a) Temperature



(b) Precipitation



(c) Pressure



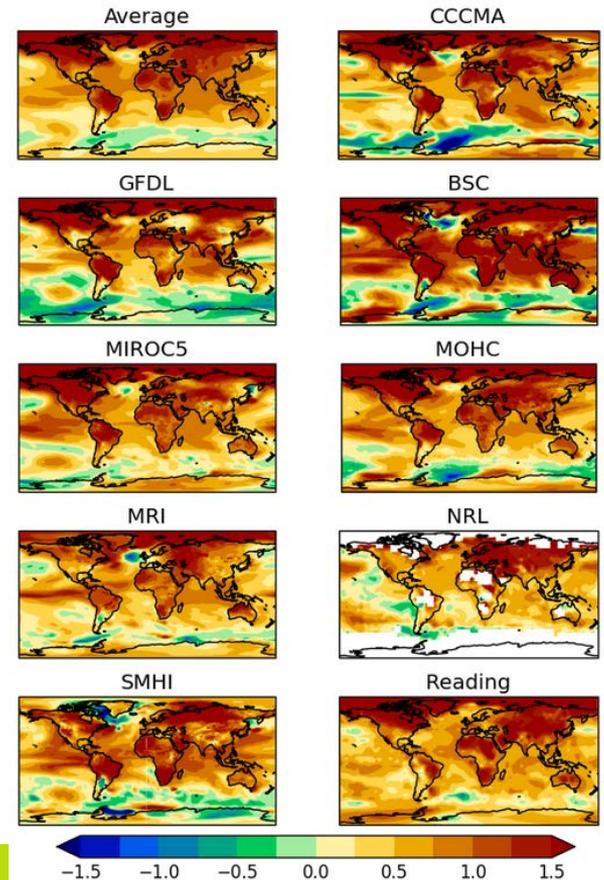
- Ratio of predictable components $RPC = r(\text{model-obs}) / r(\text{model-model})$
- $RPC > 1$
 - Skilful forecasts possible using mean of large ensemble
 - but variability too small – post processing required
 - skill measures of amplitude (e.g. rmse, msss, probabilistic measures based on raw ensemble members) will underestimate skill

'Operational' decadal predictions

- Informal exchange of decadal predictions coordinated by Met Office
- Updated every year since 2010
- Temperature, rainfall, pressure, Atlantic overturning circulation
- About 10 international centres participating
- Forecasts published on web

<https://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/long-range/decadal-multimodel>

- 2017: WMO endorsed Met Office as Lead Centre for Annual to Decadal Climate Prediction (ADCP)
- 2018: Applications for Global Producing Centres for ADCP



Annual to decadal climate update

- Produce the outlook document headed by a 1 page executive summary, but provide supplementary information (e.g. forecasts from individual models) on a website
- **Current observations:** highlight recent events and describe the current situation regarding the major modes of variability. Also include information on the current and projected forcings.
- **Indices:** global average temperature, AMV/SPG, AMOC, PDV, ENSO, Arctic and Antarctic sea ice extent, AO, SAM, QBO, monsoons, tropical cyclones. Include obs from 1960s, uncertainties, take account of hindcast skill, include uninitialized simulations?
- **Maps:** near surface temperature, precipitation, sea level pressure, upper level flow?, AMOC (latitude-depth section), Arctic and Antarctic sea ice concentration, OHC
 - Year 1
 - The average of years 1 to 5 (also years 6 to 10?)
 - Multi-model ensemble mean (individual models in supplementary info)
 - Something on uncertainties – upper/lower ranges, tercile probabilities?
 - Observations: for previous one and 5 year means
- **Skill:** maps for multi-model ensemble mean
 - Verification of previous forecasts
 - Anomaly correlation
 - Something on uncertainties – e.g. ROC scores, reliability diagrams, rank histograms?
 - Further assessment will be developed over time, in liaison with WMO recommendations

Summary

- Decadal predictions are already skilful – rainfall and pressure as well as temperature
- Significant improvement from initialisation
- Large contribution from external forcing – especially anthropogenic aerosols
- Signal to noise paradox – forecasts must be adjusted
- New WMO LC and GPCs
- ADCU – first draft this year