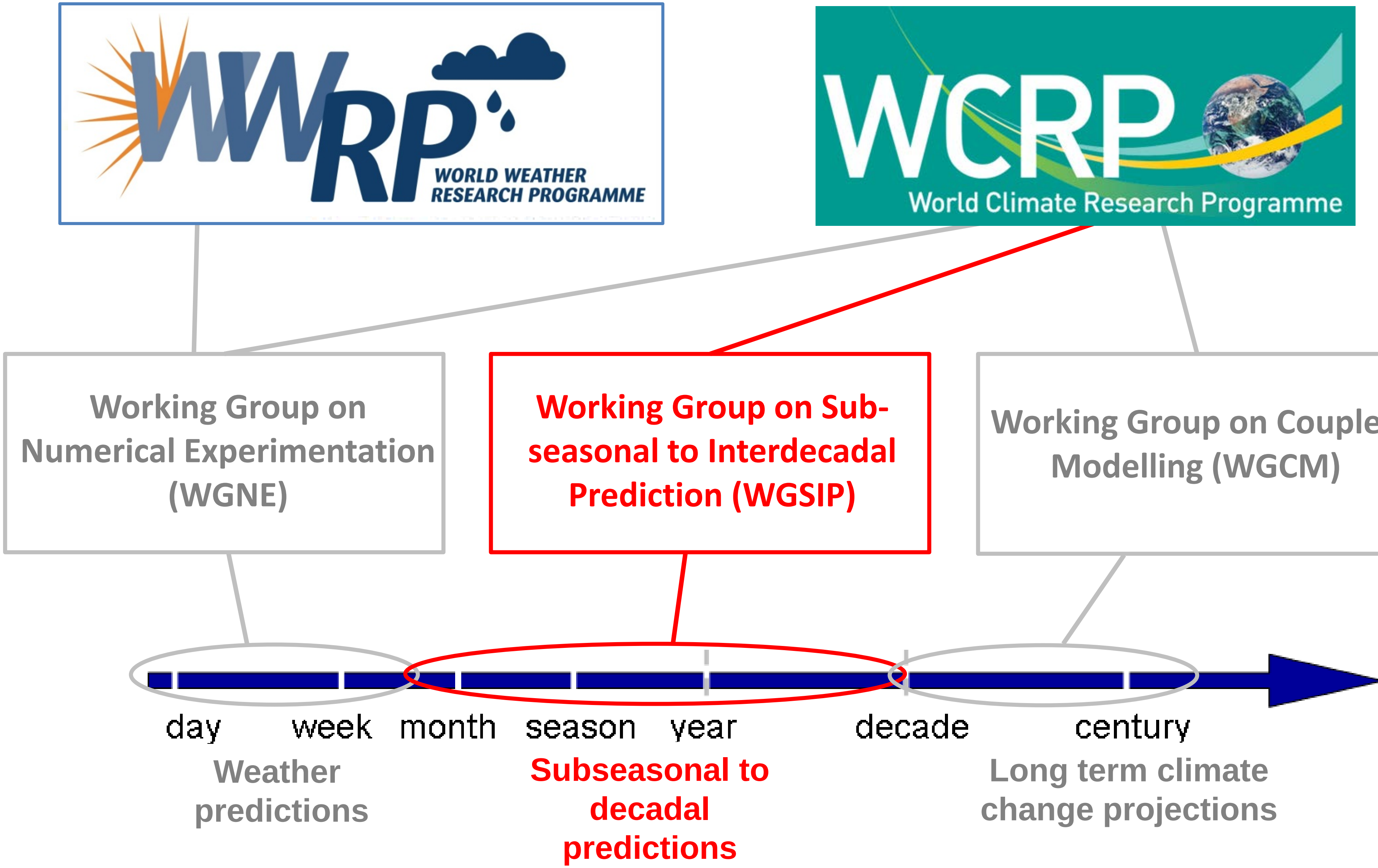
WGSIP/DCPP

Project achievements and future plans

Bill Merryfield and Doug Smith

WGSIP co-chairs

WCRP Working Groups



Current WGSIP Projects

- **SNOWGLACE**
  - study impacts of snow initialization on forecast skill
  - 8 participating centers
  - poster in session A5

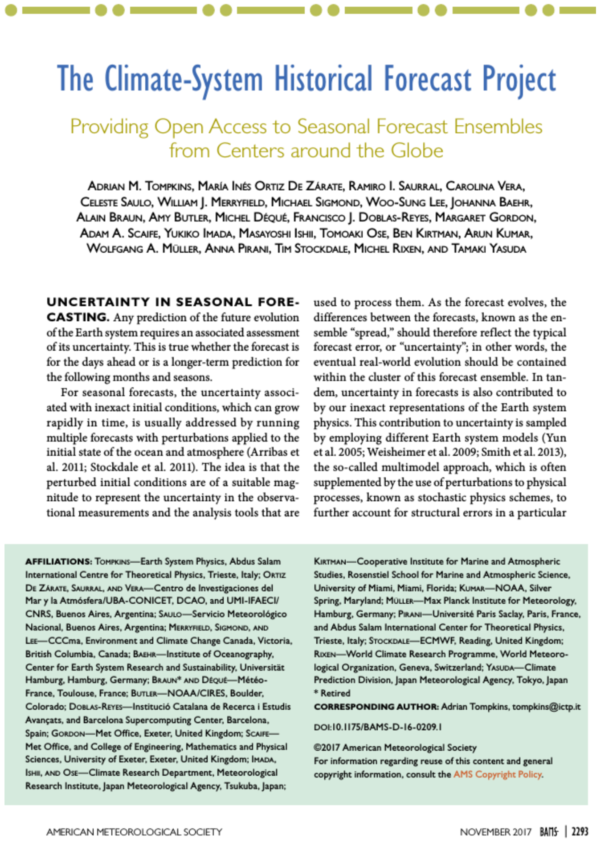
- **Long-Range Forecast Transient Intercomparison Project**
  - intercompare shocks/drifts in archived hindcast climatologies
  - 6 subseasonal, 19 seasonal, 15 decadal prediction models
  - two posters in session C1

- **Teleconnections**
  - role of tropical rainfall in driving teleconnections to extratropics
  - multi-model skill in predicting seasonal tropical rainfall anomalies
  - Scaife et al., *Int. J. Clim.* (2018)

www.wcrp-climate.org/wgsip-projects

Ongoing WGSIP Project

- CHFP - established following 2007 WCRP Workshop on Seasonal Prediction
- Envisaged as "CMIP for climate forecasting"
- Hindcast data from > 20 seasonal forecasting systems → *always seeking more!*
- Served at CIMA in Argentina
- ~200 registered users
- ~10^5 files downloaded in 2017
- Featured in recent BAMS article →



The Climate-System Historical Forecast Project

Providing Open Access to Seasonal Forecast Ensembles from Centers around the Globe

Adrian M. Tompkins, María Inés Ortiz De Zárate, Ramiro I. Saurral, Carolina Vera, Celeste Saulo, William J. Merryfield, Michael Sigmond, Woo-Sung Lee, Johanna Baehr, Alain Braun, Amy Butler, Michel Déqué, Francisco J. Doblas-Reyes, Margaret Gordon, Adam A. Scaife, Yukiko Imada, Masayoshi Ishii, Tomoaki Ose, Ben Kirtman, Arun Kumar, Wolfgang A. Müller, Anna Pirani, Tim Stockdale, Michel Rixen, and Tamaki Yasuda

UNCERTAINTY IN SEASONAL FORECASTING. Any prediction of the future evolution of the Earth system requires an associated assessment of its uncertainty. This is true whether the forecast is for the days ahead or is a longer-term prediction for the following months and seasons.

For seasonal forecasts, the uncertainty associated with inexact initial conditions, which can grow rapidly in time, is usually addressed by running multiple forecasts with perturbations applied to the initial state of the ocean and atmosphere (Arribas et al. 2011; Stockdale et al. 2011). The idea is that the perturbed initial conditions are of a suitable magnitude to represent the uncertainty in the observational measurements and the analysis tools that are used to process them. As the forecast evolves, the differences between the forecasts, known as the ensemble "spread," should therefore reflect the typical forecast error, or "uncertainty"; in other words, the eventual real-world evolution should be contained within the cluster of this forecast ensemble. In tandem, uncertainty in forecasts is also contributed to by our inexact representations of the Earth system physics. This contribution to uncertainty is sampled by employing different Earth system models (Yun et al. 2005; Weisheimer et al. 2009; Smith et al. 2013), the so-called multimodel approach, which is often supplemented by the use of perturbations to physical processes, known as stochastic physics schemes, to further account for structural errors in a particular

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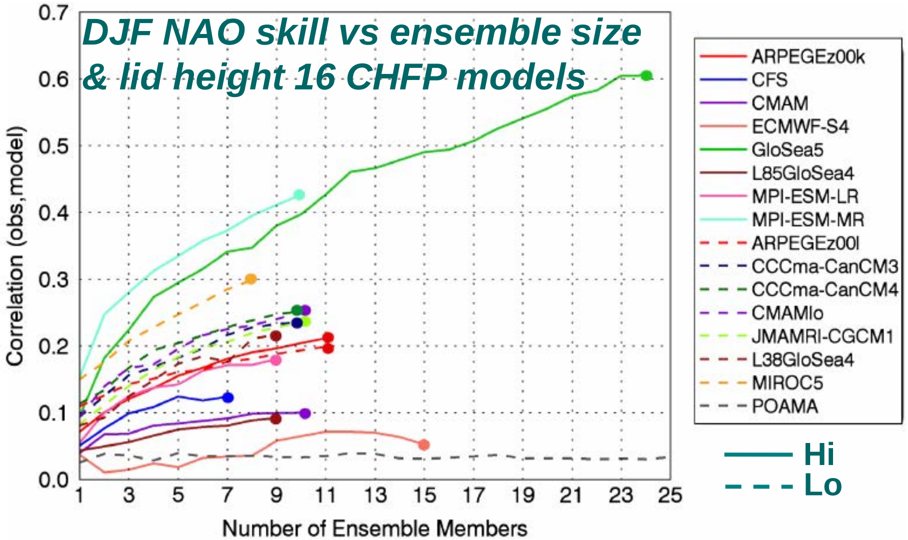
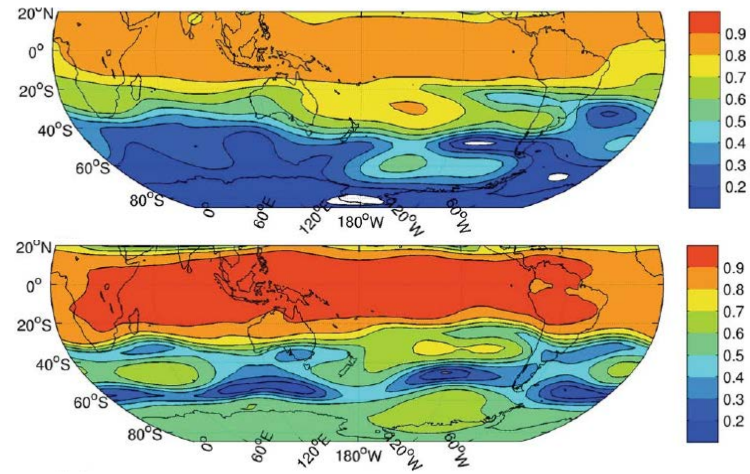
CHFP-based analyses

DJF NAO skill vs ensemble size & lid height 16 CHFP models



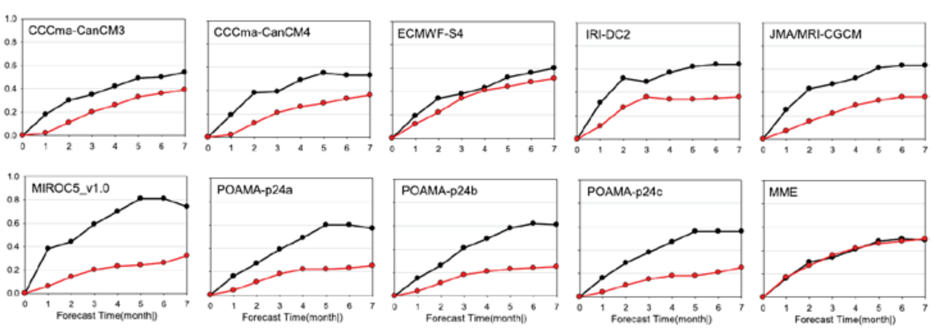
Butler et al., QJRMS (2016)

Predictability of 500 hPa height in JJA (top) and DJF (bot) based on 11 CHFP models



Osman et al., Clim. Dyn. (2016)

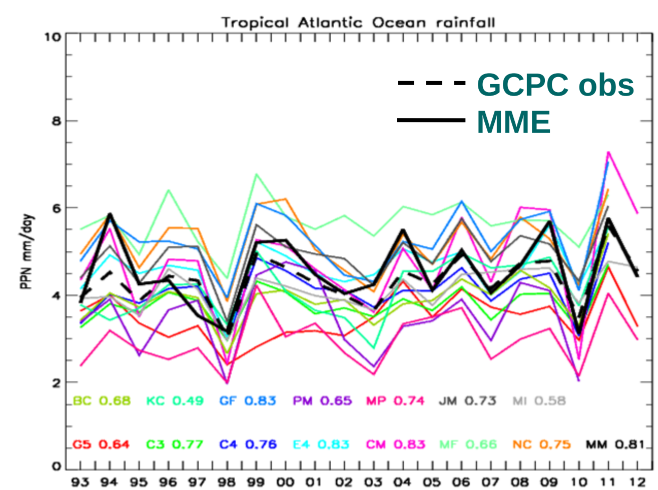
Nino3.4 **RMSE** *vs* *ensemble standard deviation for 9 CHFP models plus MME*



Multi-model ensemble (MME) more reliable than single models

Tompkins et al., BAMS (2017)

Winter tropical Atlantic rainfall predictions and skills for 12 CHFP models and MME



Scaife et al., Int. J. Climatology (2018)

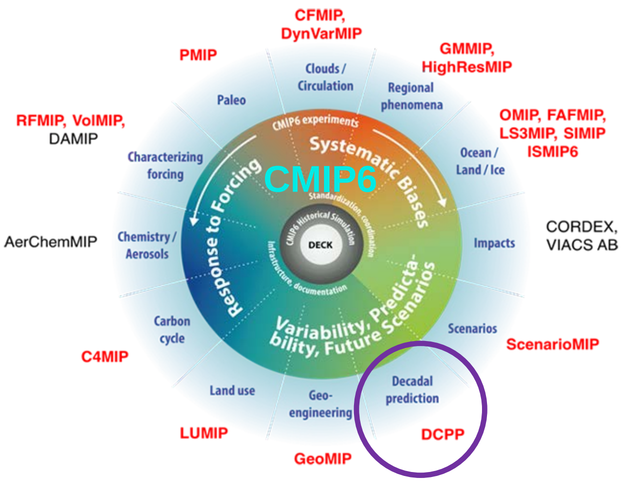
Additional WGSIP activities & plans

- Working with WMO to enhance knowledge flow between research & operations (R2O, O2R)
  - ➢ 2nd WMO Workshop on Operational Climate Prediction, May 2018
  - ➢ Contributing to writing & review of WMO guidance document for operational climate prediction + other publications linking research, ops
  - ➢ This meeting
- Coordination of current projects focusing on aspects of land initialization
- Next full WGSIP meeting May 2019, Moscow
  - ➢ Scope next cycle of WGSIP projects (community input welcome)
  - ➢ Further develop R2O, O2R activities
  - ➢ Climate prediction school for young researchers

WGSIP role in decadal prediction

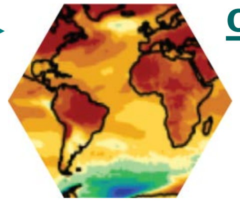
WGSIP

Decadal Climate Prediction Project (DCPP)



research-driven hindcast experiments + ongoing ~real-time predictions

WCRP Grand Challenge on Near-Term Climate Prediction

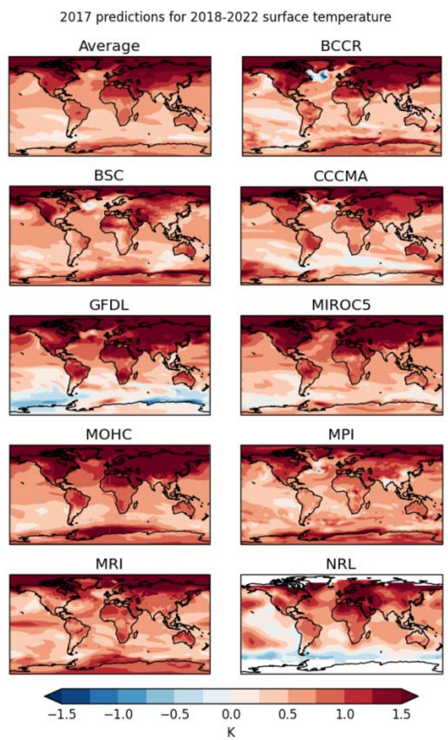


science & technical standards for Lead Centre + Annual to Decadal Climate Update

WMO Lead Centre for Annual to Decadal Climate Prediction

Met Office

operational multi-model forecasts for WMO services



Decadal Climate Prediction Project (DCPP)

- Society is vulnerable to climate variability and change
  - ➢ food security
  - ➢ freshwater availability
  - ➢ spread of pests and diseases
  - ➢ extreme events (heat waves, droughts, floods, cyclones, and wildfires)
  - ➢ energy supply and demand
  - ➢ transport
  - ➢ migration
  - ➢ conflict
- Decadal predictions needed to support
  - ➢ Global Framework for Climate Services
  - ➢ UN Sustainable Development Goals
  - ➢ Sendai Framework for Disaster Risk Reduction



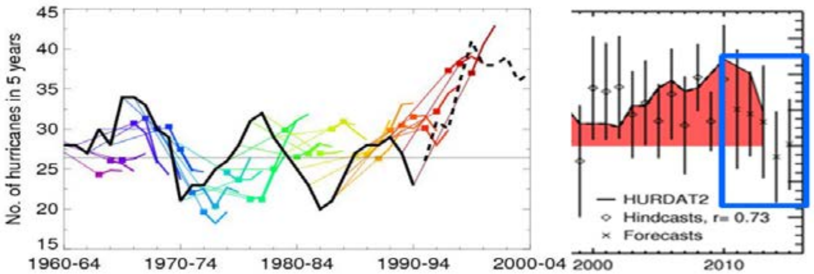


Images courtesy of Global Framework for Climate Services website

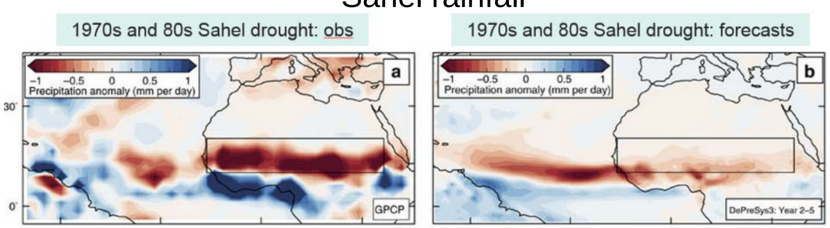
DCPP Component A: Hindcasts

- Assess skill and mechanisms
  - start each year 1960-present
  - 10 ensemble members
  - [CMIP5: start every 5 years, 3 ensemble members]

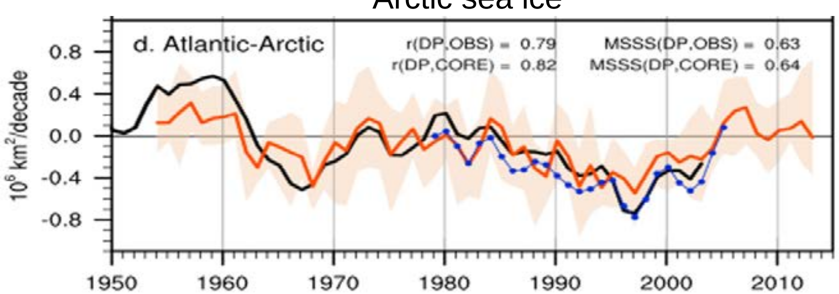
Hurricane numbers



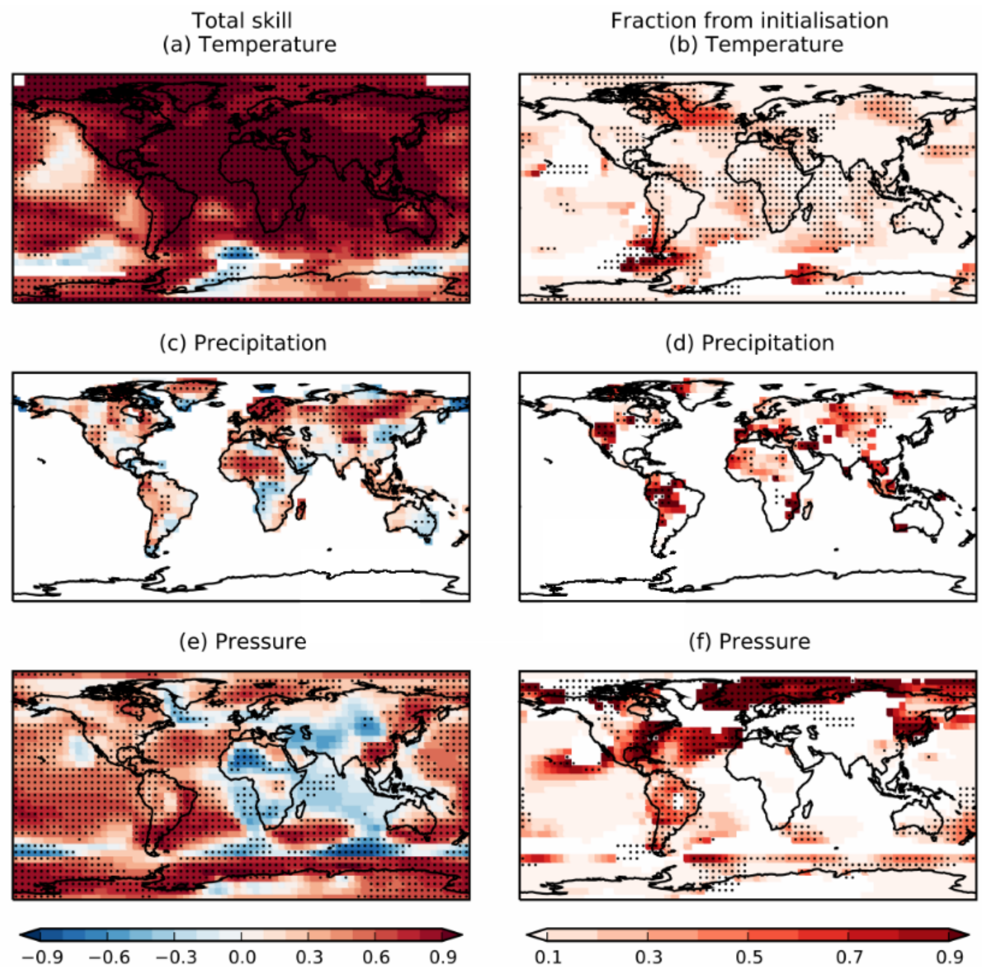
Sahel rainfall



Arctic sea ice



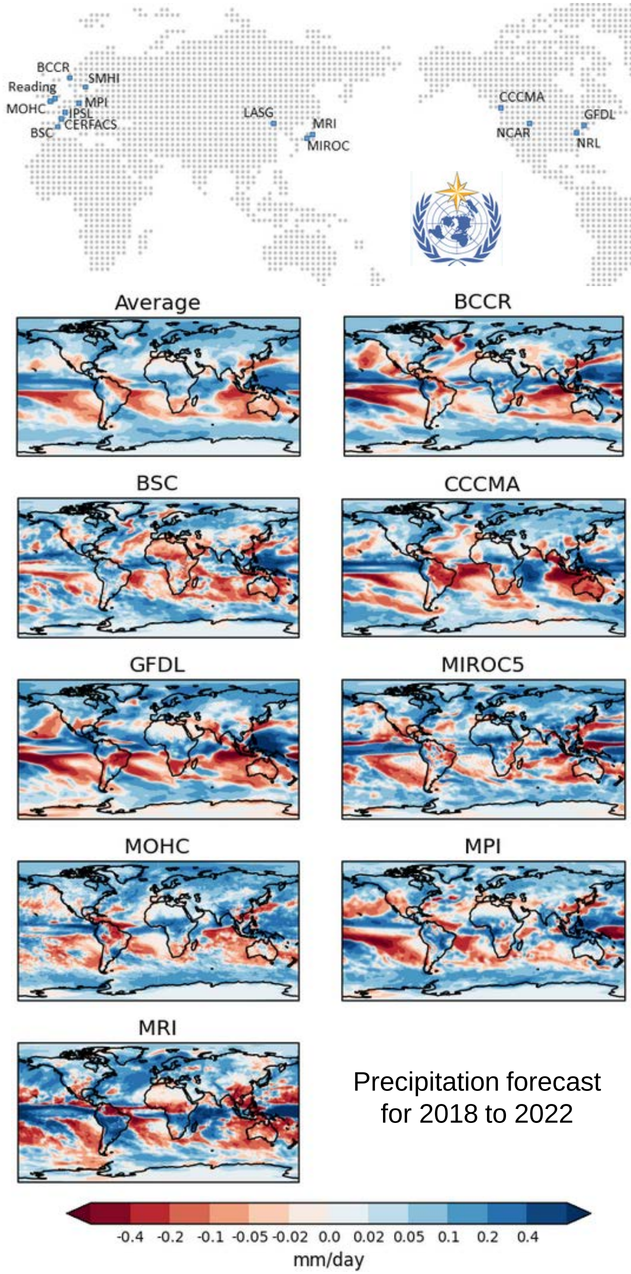
Years 2-9, multi-model, 71 member mean



|Boer et al 2016; Smith et al 2010; Hermanson et al 2014; Caron et al 2015; Sheen et al 2017; Yeager et al 2015

DCPP Component B: Ongoing forecasts

- Informal exchange of decadal forecasts every year since 2010
- 2017/18: endorsed by WMO
  - Lead Centre and four Global Producing Centres for Annual to Decadal Climate Prediction
  - Forecasts available from www.wmolc-adcp.org
- Support WCRP Grand Challenge on Near Term Climate Prediction
  - Paper: Towards Operational Predictions of the Near-Term Climate, Kushnir et al, submitted
  - Document: standards, verification methods and guidance
  - Annual to Decadal Climate Outlook to be produced each year



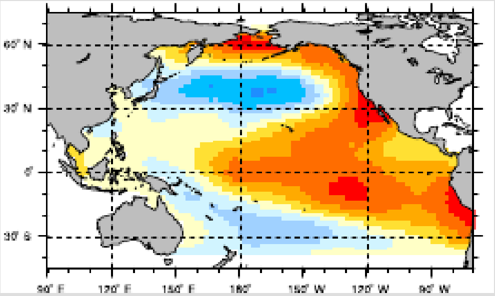
Precipitation forecast for 2018 to 2022

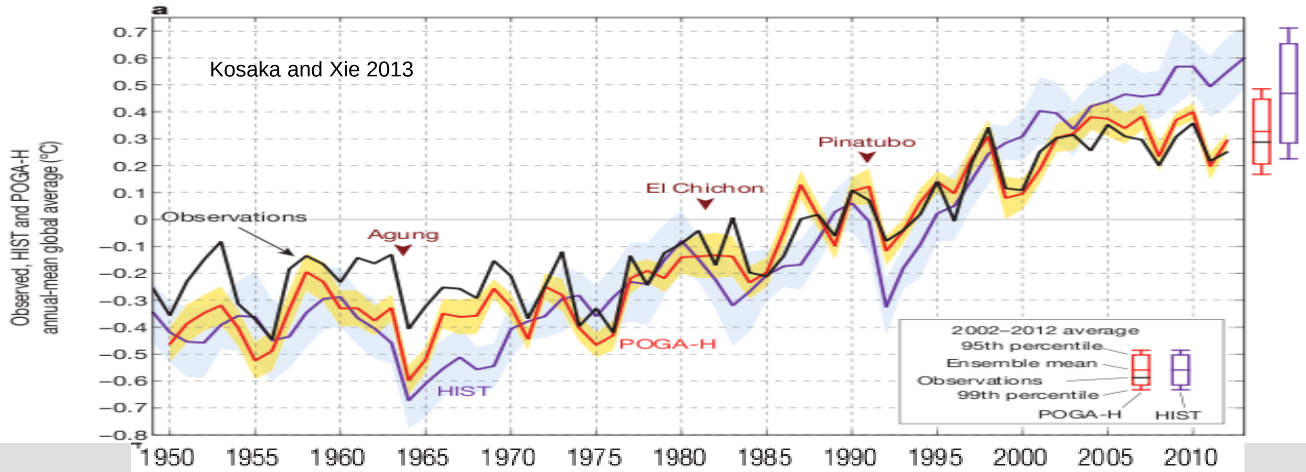
DCPP Component C: Mechanisms

- Investigate the global impacts and mechanisms of Atlantic and Pacific decadal variability

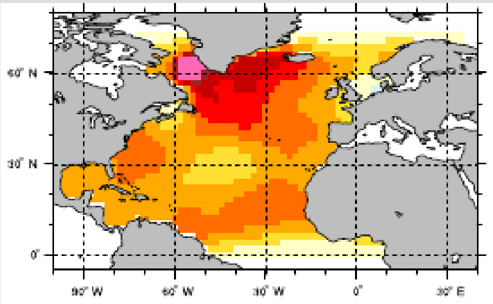
➢ Idealized experiments
➢ Pacemaker experiments
➢ Data withholding experiments

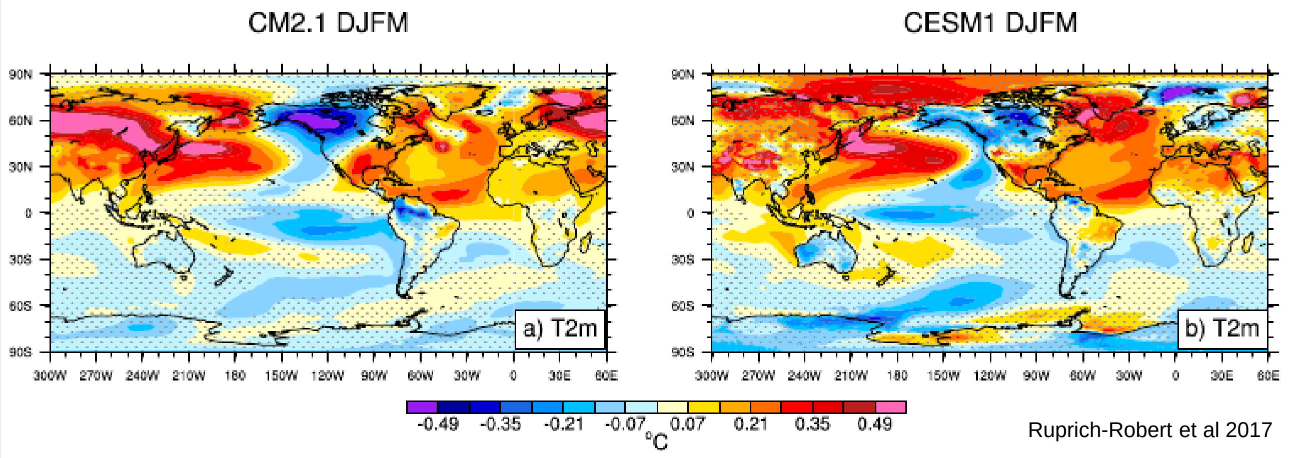
Pacific





Atlantic

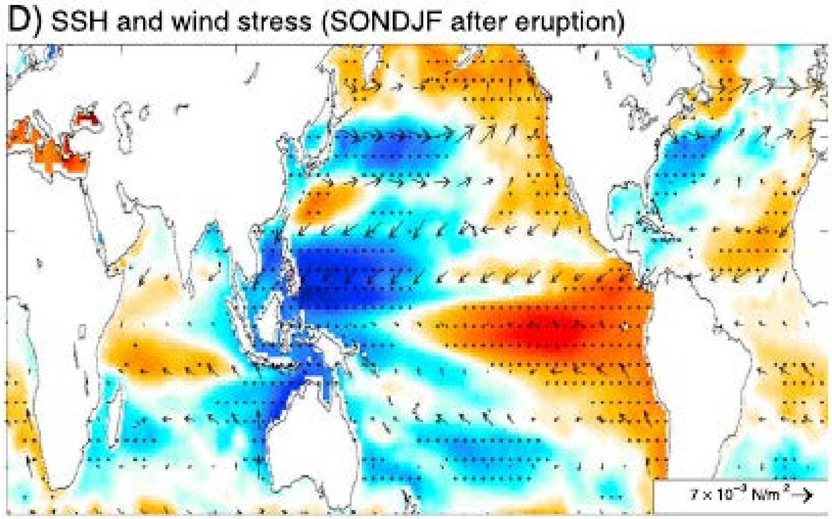




DCPP Component C: Volcanic impacts

- Repeat hindcasts but omit volcanoes
  - 1963 (Agung)
  - 1982 (El Chichon)
  - 1991 (Pinatubo)
- Repeat 2015 forecast but include fictitious eruption (Pinatubo, El Chichon, Agung)

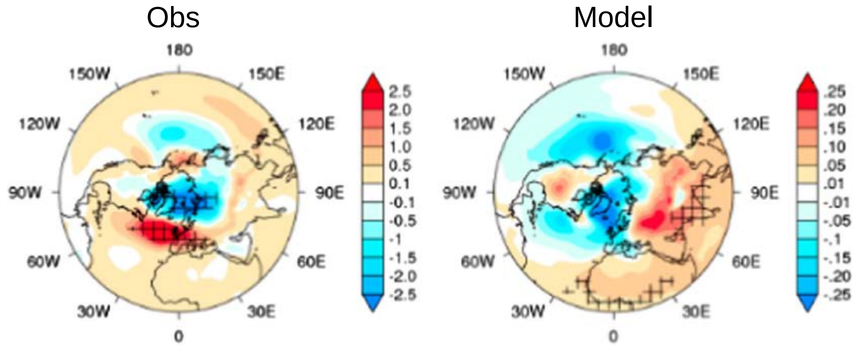
Impact on ENSO



Maher et al 2015

- Run a new forecast as soon as possible after the next eruption
  - SPARC SSiRC to monitor and collect forcing data
  - Multi-model forecast (BSC, CCCMA, MPI, MOHC,…)

Impact on NAO
(Note: Model much weaker than obs)



Driscoll et al 2012