

# More fun with the NMME: Climatology!

Climatology? Is? Fun?

- The forecast of last resort?
- The no-skill forecast?
- A 30-year average?
- Why models?

Climatological distribution

- Probability of everything, all at once
- Observational record insufficient for:
  - Extreme/rare events
  - Compound/correlated events
  - Unprecedented events

Reforecast datasets provide:

- Many more weather/climate realizations than in the historical record
- Short-lead forecasts that are similar to what actually occurred (skillful!)
- Long-lead forecasts that are less similar, more independent of what actually occurred (low skill is good!)

Usual caveat of model fidelity

# Answering “climatology” questions with reforecasts

## High risk of unprecedented UK rainfall in the current climate

[Vikki Thompson](#) [✉](#), [Nick J. Dunstone](#), [Adam A. Scaife](#), [Doug M. Smith](#), [Julia M. Slingo](#), [Simon Brown](#) & [Stephen E. Belcher](#)

*Nature Communications* **8**, Article number: 107 (2017) | [Cite this article](#)

10k Accesses | 106 Citations | 729 Altmetric | [Metrics](#)

### Abstract

## Record-breaking rainfall

In winter 2013/14 a succession of storms hit the UK leading to record rainfall and flooding in many regions including south east England. In the Thames river valley there was widespread flooding, with clean-up costs of over £1 billion. There was no observational precedent for this level of rainfall. Here we present analysis of a large ensemble of high-resolution initialised climate simulations to show that this event could have been anticipated, and that in the current climate there remains a high chance of exceeding the

## What is the variability in US west coast winter precipitation during strong El Niño events?

[Arun Kumar](#) & [Mingyue Chen](#) [✉](#)

*Climate Dynamics* **49**, 2789–2802 (2017) | [Cite this article](#)

713 Accesses | 29 Citations | [Metrics](#)

### Abstract

## Strong El Niño & CA prcp

Motivated by the fact that the spatial pattern of the observed precipitation anomalies during 2015/16 winter (a year of strong El Niño) over the west coast of the US and that of the El Niño composite precipitation pattern had considerable differences, the variability in the winter precipitation during strong El Niño events is assessed. The analysis is based on a set of hindcasts (1982–2011) and real-time forecasts (2012–2015) from NCEP Climate Forecast System version 2 (CFSv2), and the following aspects for seasonal mean precipitation

## Current events question: El Niño + warm MDR = ?

## Prediction Challenges From Errors in Tropical Pacific Sea Surface Temperature Trends

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Models in the North American Multi-Model Ensemble (NMME) predict sea surface temperature (SST) trends in the central and eastern equatorial Pacific Ocean are more positive than those observed over the period 1982–2020. The

## Using UNSEEN trends to detect decadal changes in 100-year precipitation extremes

[T. Kelder](#) [✉](#), [M. Müller](#), [L. J. Slater](#), [T. I. Marjoribanks](#), [R. L. Wilby](#), [C. Prudhomme](#), [P. Bohlinger](#), [L. Ferranti](#) & [T. Nipen](#)

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4615 Accesses | 30 Citations | 17 Altmetric | [Metrics](#)

### Abstract

## 100-year rainfall

Sample sizes of observed climate extremes are typically too small to reliably constrain return period estimates when there is non-stationary behaviour. To increase the historical record 100-fold, we apply the UNprecedented Simulated Extreme ENsemble (UNSEEN) approach, by pooling ensemble members and lead times from the ECMWF seasonal prediction system SEAS5. We fit the GEV distribution to the UNSEEN ensemble with a time covariate to facilitate detection of changes in 100-year precipitation values over a period of 35 years (1981–2015).

## Likelihood of unprecedented drought and fire weather during Australia's 2019 megafires

[Dougal T. Squire](#) [✉](#), [Doug Richardson](#), [James S. Risbey](#), [Amanda S. Black](#), [Vassili Kitsios](#), [Richard J. Matear](#), [Didier Monselesan](#), [Thomas S. Moore](#) & [Carly R. Tozer](#)

*npj Climate and Atmospheric Science* **4**, Article number: 64 (2021) | [Cite this article](#)

4219 Accesses | 14 Citations | 84 Altmetric | [Metrics](#)

## Drought & fire weather

Between June 2019 and March 2020, thousands of wildfires spread devastation across Australia at the tragic cost of many lives, vast areas of burnt forest, and estimated economic losses upward of AU\$100 billion. Exceptionally hot and dry weather conditions, and preceding years of severe drought across Australia, contributed to the severity of the wildfires. Here we present analysis of a very large ensemble of initialized climate simulations to assess the likelihood of the concurrent drought and fire-weather conditions

## Skill, Predictability, and Cluster Analysis of Atlantic Tropical Storms and Hurricanes in the ECMWF Monthly Forecasts

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## Atlantic TC

ABSTRACT: In this paper we analyze Atlantic Ocean hurricane activity in the European Centre for Medium-Range Weather Forecasts (ECMWF) monthly hindcasts for the period 1998–2017. The main climatological characteristics of Atlantic tropical cyclone (TC) activity are considered at different lead times and across the entire ECMWF ensemble using three diagnostic variables: the number of tropical cyclones, the number of hurricanes, and the accumulated cyclone energy. The predictability of a combined ensemble of hindcasts is examined using a skill score metric.

## from El Niño–Southern Oscillation (ENSO) and the Arctic Oscillation

[Michael K. Tippett](#) [✉](#), [Chiara Lepore](#), and [Michelle L. L'Heureux](#)

## La Nina, AO- & US severe t-storms

El Niño–Southern Oscillation (ENSO) modulates severe thunderstorm activity in the US, with increased activity expected during La Niña conditions. There is also evidence that severe thunderstorm activity is influenced by the Arctic Oscillation (AO), with the positive phase being associated with enhanced activity. The combined ENSO–AO impact is relevant for situations such as in early 2021, when persistent, strong positive and negative AO events occurred during La Niña conditions. Here we examine the relation of a spatially resolved tornado environment index (TEI) with ENSO and the AO in climate model forecasts of February, March, and April conditions over North America. Bivariate composites on Niño 3.4 and AO indices show that TEI predictability is

# Another use for climatology? Cat models

## Climatological distribution of **hazard**

- Hurricane, tornado, hail, etc.
- Includes:
- Intensity, footprint



## Climatological distribution of **losses**

- Average annual loss
- Probable maximum loss
- Exceedance Probabilities

## Engineering/**damage**

- How much does the weather break your stuff

## **Exposure**/portfolio

- What/where is your stuff
- What is your deductible

## Why synthetic event sets?

- Too few high-end events in historical record, never  $\neq$  impossible
- Average loss  $\neq$  average weather

“the best ... model for a cat is another, or preferably the same cat”

—The Role of Models in Science  
A. Rosenblueth & N. Wiener, 1945

# Future reforecast dataset thoughts

Not strictly limited to what will be forecast or what is predictable

- Large (ensembles, models, leads)
- Accessibility (cloud, server-side analysis)
- Variables of interest
  - At the time resolution of interest
- Long enough (starts) to capture trends
- Diversity of models
- Derived quantities?
  - MJO indices
  - TC tracks
  - High-frequency statistics? Heat, etc.