UNSEEN: using hindcasts to estimate unprecedented events

Leon Hermanson
Two studies using the same methodology, but different applications:

**LETTER • OPEN ACCESS**

*Current chance of unprecedented monsoon rainfall over India using dynamical ensemble simulations*

Shipra Jain¹,², Adam A Scaife³,⁴, Nick Dunstone³, Doug Smith³ and Saroj K Mishra¹
Published 3 September 2020 • © 2020 The Author(s). Published by IOP Publishing Ltd

*Environmental Research Letters, Volume 15, Number 9*

Citation Shipra Jain et al 2020 Environ. Res. Lett. 15 094095

**LETTER • OPEN ACCESS**

*What chance of a sudden stratospheric warming in the southern hemisphere?*

L Wang¹,²,³, S C Hardiman⁴,⁵, P E Bett⁴,⁵, R E Comer⁴, C Kent⁴ and A A Scaife⁴,⁵
Published 24 September 2020 • © 2020 The Author(s). Published by IOP Publishing Ltd

*Environmental Research Letters, Volume 15, Number 10*

Citation L Wang et al 2020 Environ. Res. Lett. 15 104038
Jain et al - Data and methods

- 113 years of observed rainfall (1901—2013)
- Uses hindcast data from Climate-system Historical Forecast Project (CHFP)
- 8 seasonal forecast models, hindcasts initialised around 1 May
- Five models pass the model fidelity test and are used in the study
- A total of 1669 years of simulated rainfall
Multi-model ensemble can be used to estimate the probability of rarer events than observations alone.

Observations appear to underestimate the chance of rainfall extreme.

The record flood year was 1988 with JJA rainfall exceeding ~16%, the chance of exceeding this is 2.6%.

The record drought year was 1972 with JJA rainfall showing ~23% rainfall deficit, the chance of larger deficit is 1.6%.

There is an estimated chance that a 30% rainfall deficit could occur around once in two centuries, which is far beyond the current record.
There has only been one observed Southern Hemisphere stratospheric sudden warming in 40 years (September 2002)

GloSea5: 23 years of hindcasts x 112 members per year = 2576

Model fidelity estimated from 10 hPa 60°S zonal mean zonal wind
  - Standard deviation, skewness, and kurtosis fall within observations
  - Mean winds are too strong so are bias corrected – this bias may underestimate the chances of a SH SSW

There are 96 SH SSW events in this data set

The chance of a SH SSW is 1 in 25 years or 4%
Precipitation is anomalously high over 35–50°S and anomalously low poleward and equatorward of this band.

Australia, Brazil, and South Africa are drier than normal, whereas Northern Argentina, southern central Africa are wet.

The Antarctic continent and southern South America experience a warmer than average spring.
The UNSEEN method

• There are now many papers based on the UNSEEN method
• Makes good use of the thousands of hindcasts that have been run
• Can be used for much more than estimating probabilities
  • Composites show impacts and drivers
  • Mechanisms can be studied to increase confidence in forecasts