Climate Change, Historical Data and Catastrophe (Cat) Modelling

Richard Dixon PhD

Director, CatInsight

Visiting Research Fellow, Department of Meteorology, University of Reading

EGU 2020 Online Session

Thursday 7th May 2020

Credits and Thanks

- **Sam Franklin (Institute for Environmental Analytics)**
  - **Responsible for most of the data manipulation**

- **Debbie Clifford (Institute for Environmental Analytics)**
- **Len Shaffrey (Dept. of Meteorology)**

- **Thanks to Lighthill Risk Network and Climate-KIC for funding**
- **Thanks to PERILS for exposure data, DTU for roughness data**

What We've Done

- **Converted ensemble climate model output into insurance losses**

Calculate Hazard

6000 yrs of max daily wind speed: 100 ensembles of 1951-2011 forced by historical SSTs, greenhouse gases

Define portfolio

PERILS data converted to the model grid by population weighting inside each country

Calculate Damage

Single "cube of wind speed" damage curve for all of Europe
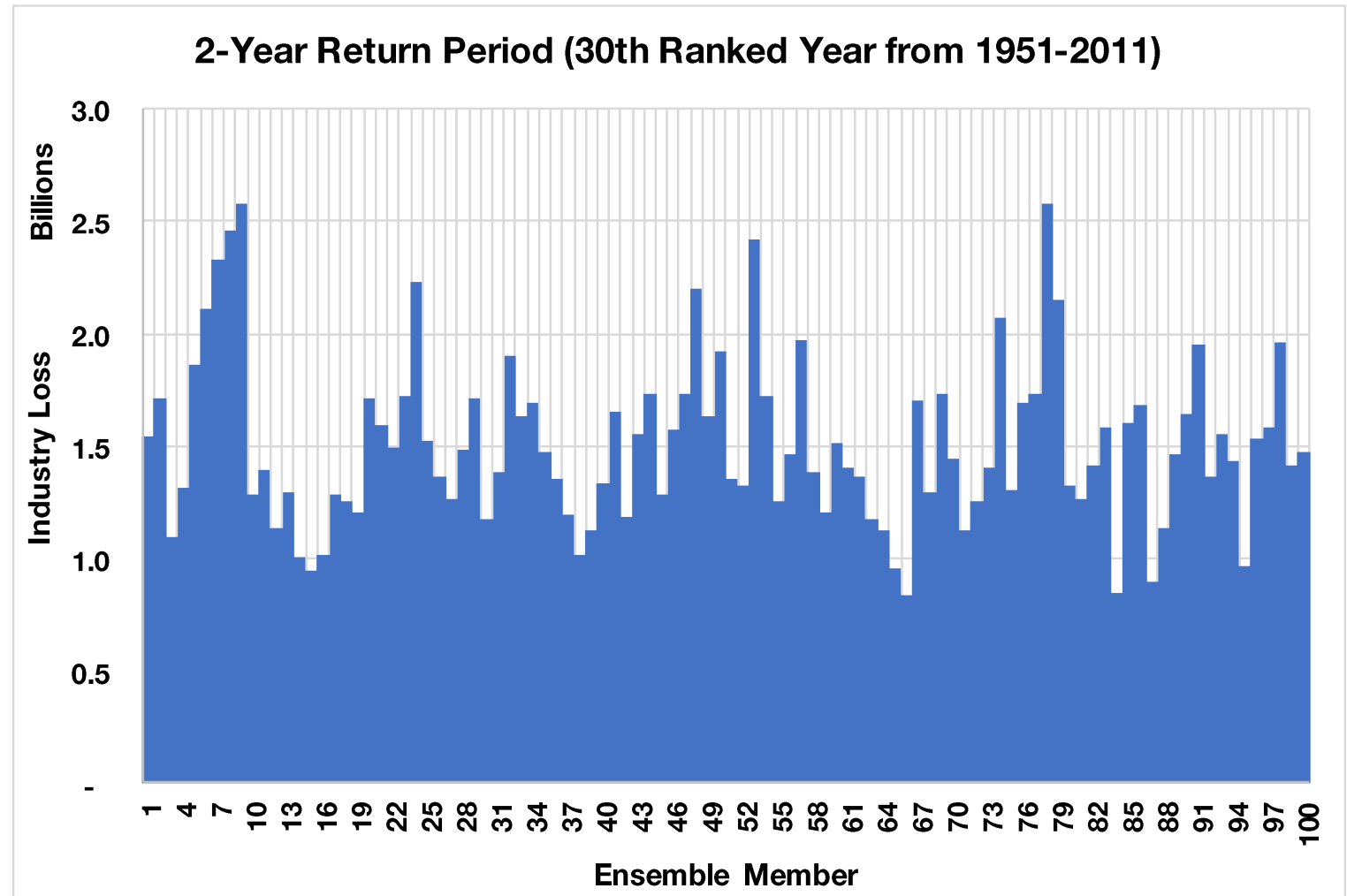
Loss

Loss matching catastrophe models for annual mean loss, 30 and 200 year RPs

Cat Modelling Metrics by Ensemble

- **30th ranked year by loss in each of the 100 60-year simulations of "history"**

- **Shows how variable the 2-year return period loss is in the simulations**

- **How much should we trust an individual historical record for target metrics for catastrophe models?**

2-Year Return Period (30th Ranked Year from 1951-2011)

Ensemble Loss Trend

- **Example of Ensemble #1**

- **Yearly total aggregate losses**

- **Downward trend similar to decreasing windstorm activity seen in historical observations**
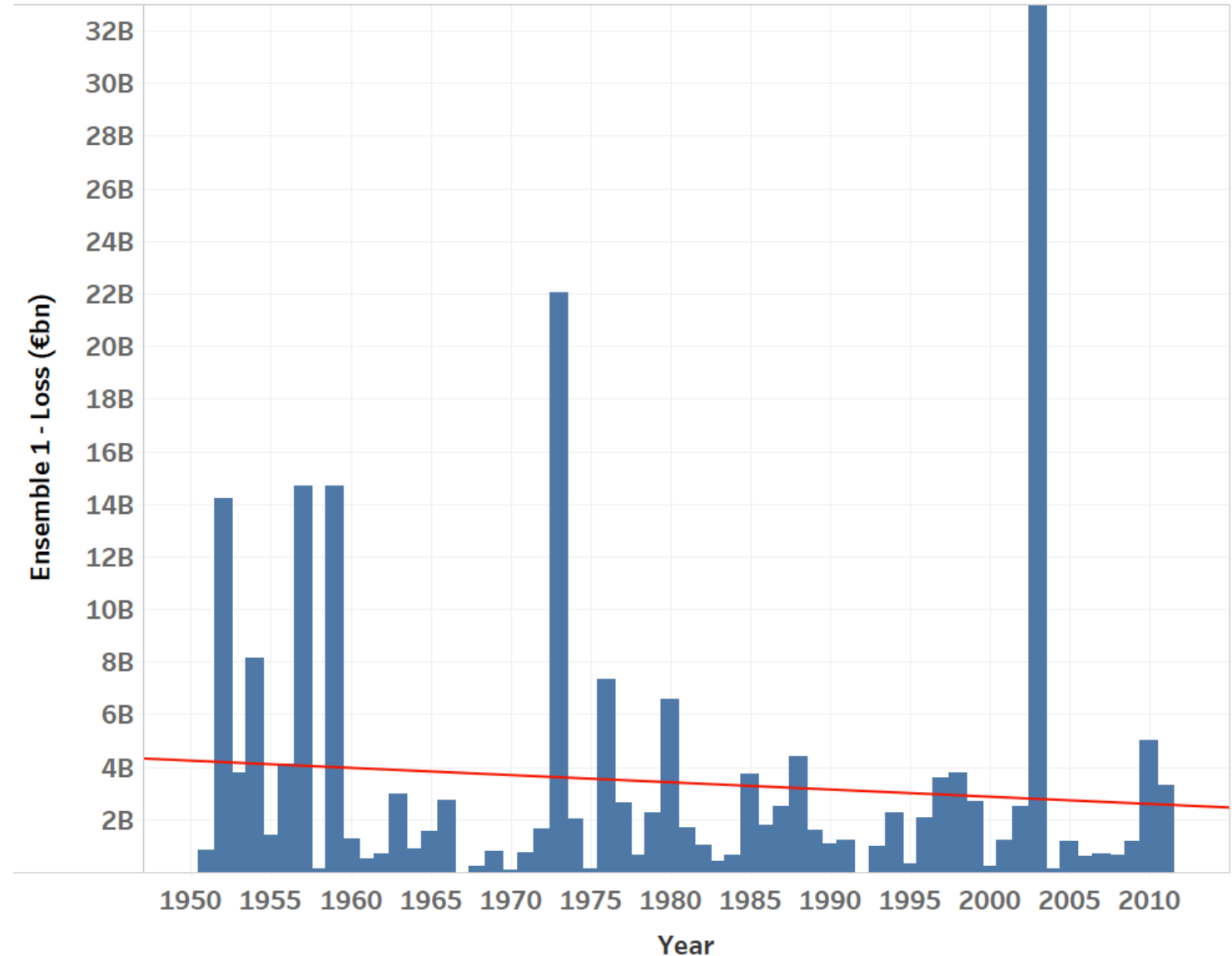
But What About Trends in 100 Ensembles?

- **Output from 20 ensembles**

- **Arrows indicate linear trend in each ensemble**

- **Some go up, some go down**

- **Shows how variable trends *could* be in historical data**

- **How dangerous is it to infer a trend from a single (historical) dataset?**
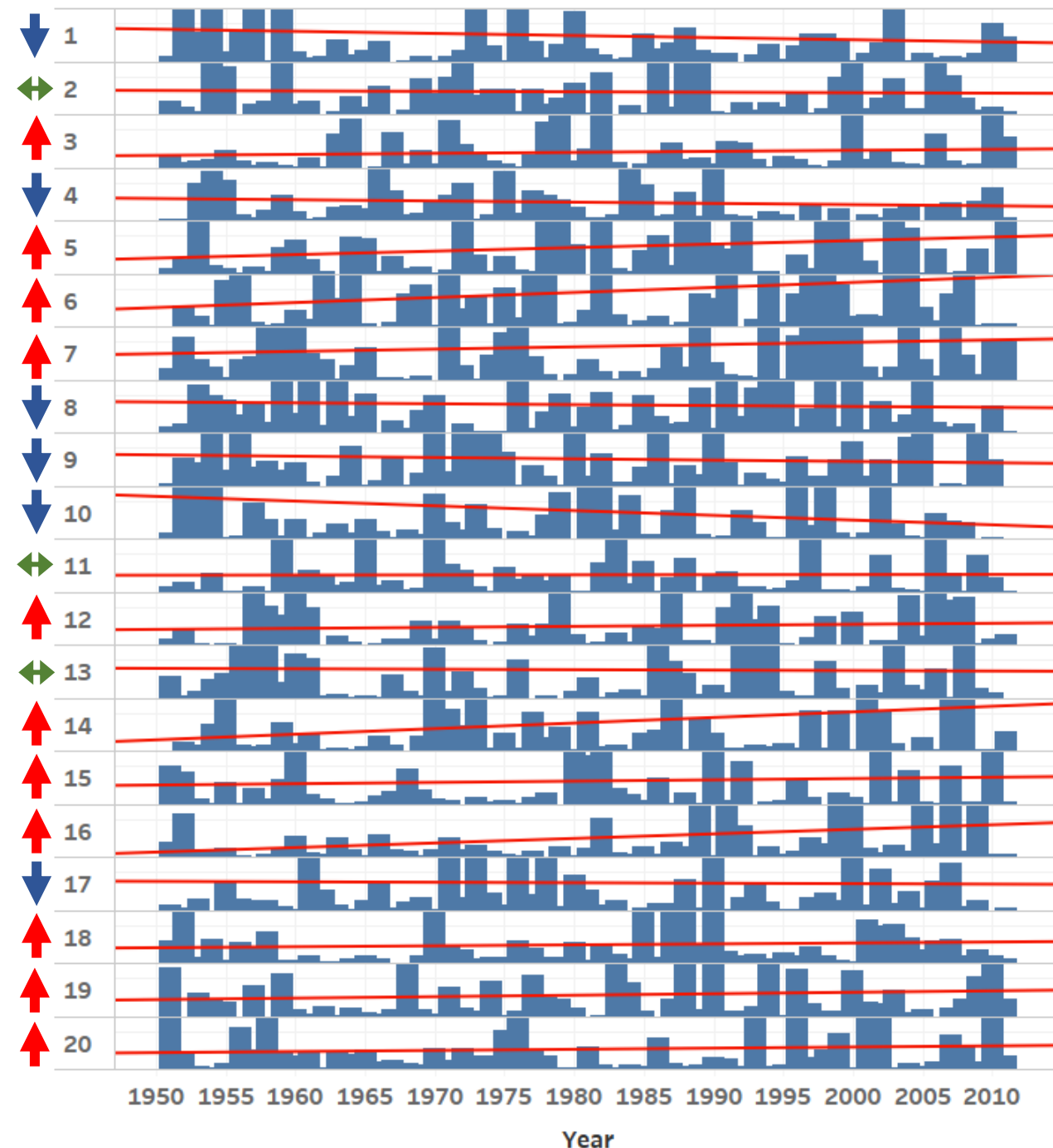
What If We Add All 100 Ensembles Together?

- Showing total loss across all 100 simulations

- Does this highlight a background subtle increasing trend in the risk?

- Many of our single historical ensemble simulations failed to recognise this upward shift in risk

- Will we frequently struggle to spot subtle trends like this in historical data?
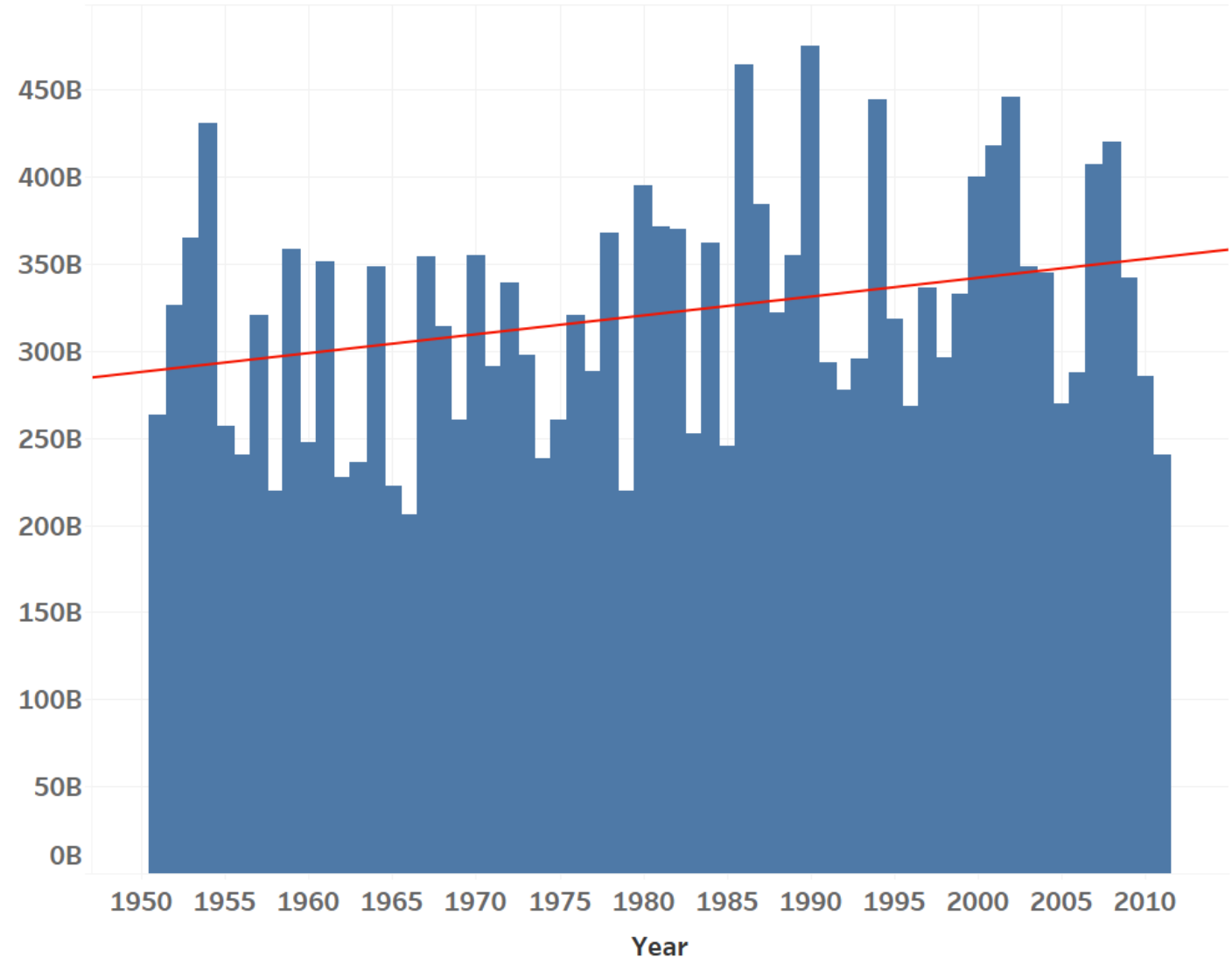
How Relevant is "History"?

- **2001-2010 data versus 1951-2010 data across all 100 runs**

- **If data has a background trend, how far back should we be looking for "today's" risk?**

- **Is using historical data too far back in time in a warming climate misinforming us?**

- **Does data here suggest that a warming climate is only subtly impacting windstorm risk?**
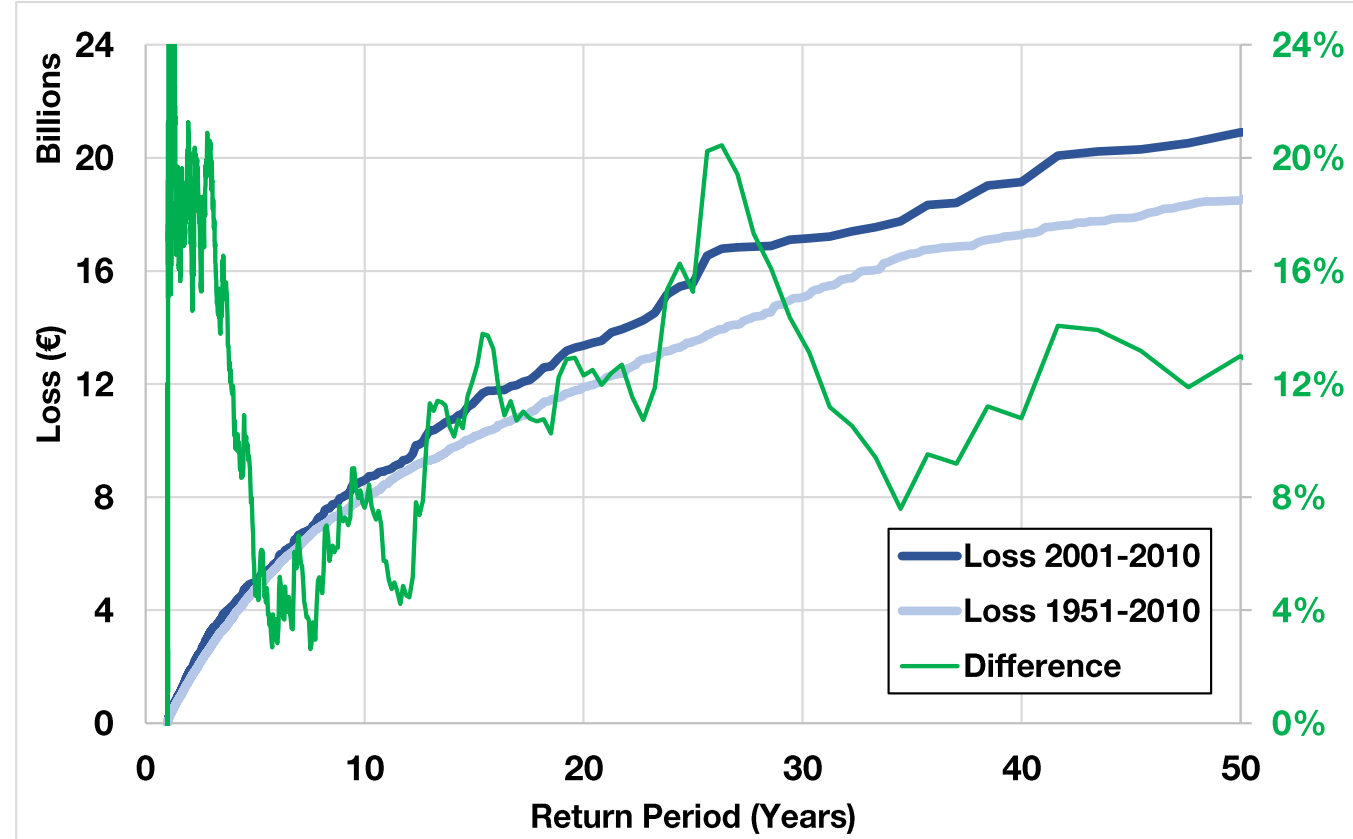
Should We Trust Climate Models?

- **Ensemble mean Dec-Mar North Atlantic Oscillation (NAO) index vs. Hurrell NAO index**

- **Hint that model has more positive NAO in recent years**

- **Issues with model's sea ice or vertical resolution that might lead to misrepresentation of storm climate?**

- **Or is our history an "outlier" in recent years?**
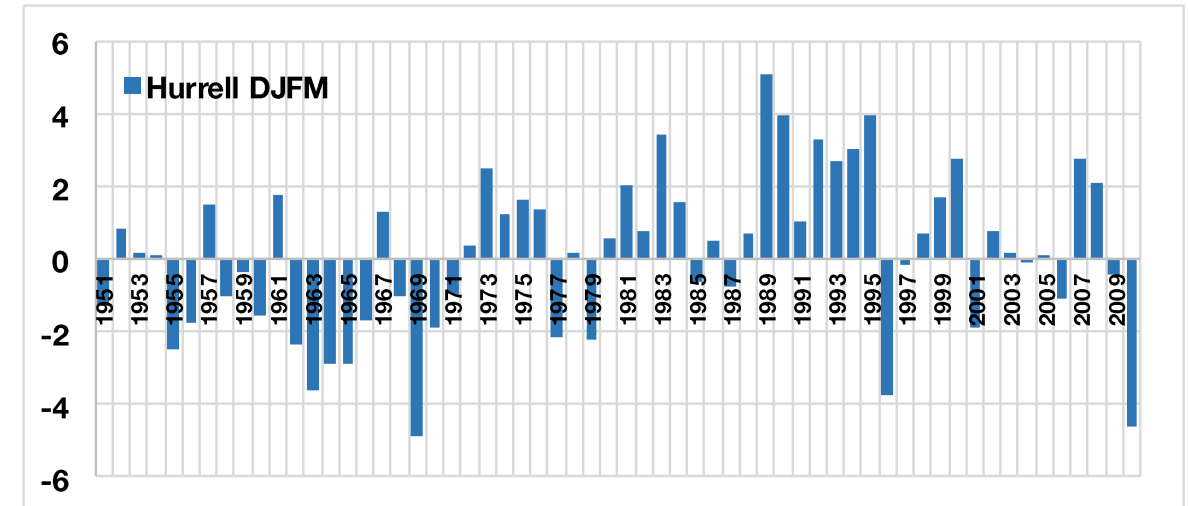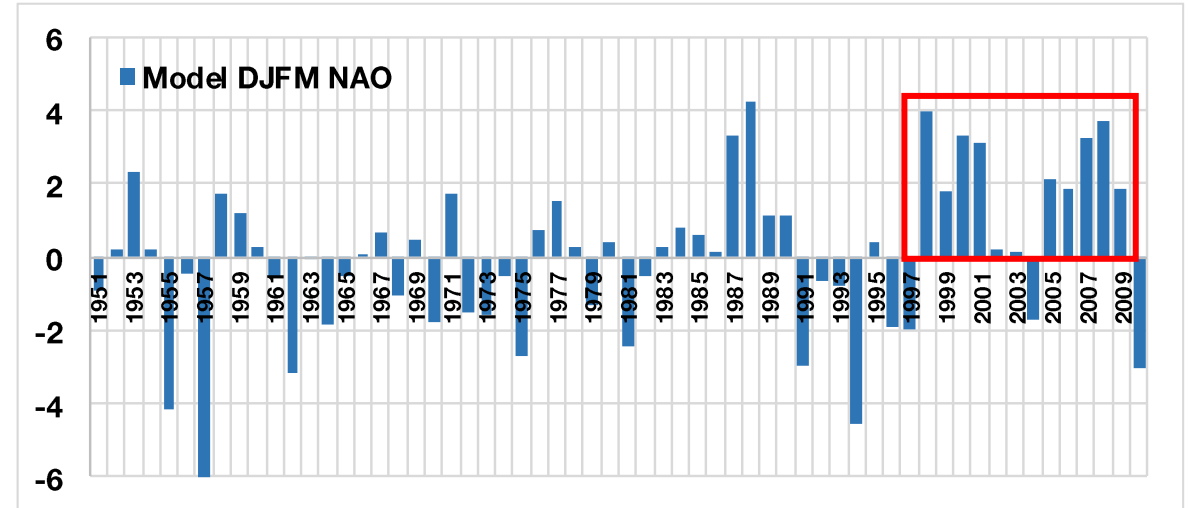
- **How much can we trust a single, short historical dataset to provide a target for catastrophe models?**

- **Should we trust subtle trends in individual historical datasets to inform present-day views of risk, especially when single datasets may not point to the "correct" underlying trend in risk?**

- **Should we be leaning more on multiple simulations of recent history to understand present-day risk in a warming climate?**

- **On the other side of the coin, how far should we trust output such as this from climate models, as informative as it may seem?**

Catastrophe Modelling Balancing Act

HISTORY DICTATES MODEL RATES AND TRENDS

HISTORICAL CLIMATE MODEL ENSEMBLES HIGHLIGHT UNCERTAINTY IN RATE AND UNDERLYING TRENDS