

# Extreme Event Attribution (EEA)

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# Motivation

- More extreme events?
- More intense?
- **Role of human activities?**



# Extreme Events

- Society and some eco-systems are more sensitive to a few **extreme events** than **slow climate variations**
- Extreme phenomena are by essence **rare**, and require an ad hoc methodology for
  - analyses
  - modelling
  - simulation

# Definitions of Extremes

- Mathematics & statistics
  - Annual maximum, peak over thresholds, rare values...
- Physics
  - Typology of events: heatwaves, cold spells, storms, droughts...
- Society & impacts
  - Losses, damages...
  - Risk & vulnerability

# Physical definitions

- What variable?
  - Tx, Tm, Tg, Precipitation, wind speed?
- What time scale?
  - Hours, days, seasons?
- What spatial scale?
  - City, region, country, continent?
- What data?
  - Observations, climate model simulations?

# Examples



Cold, hot, wet,  
dry...



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## Extreme events

- Black swan
  - Evénement qui devient
  - E.g. SII (?)

## • Dodos

- Evénements extrêmes “habituels”, mais qui disparaissent dans le futur
- E.g. vagues de froid extrêmes (?)

Les dernières simulations « historiques » prolongées en 2030 et « futures »  
Dernière version du modèle de l'IPSL, IPSL-CM6A-LR  
IPSL – Climate Modeling Center

Températures estivales France (°C, Moyenne Juin-Juillet-Août)



17,4°C ± 1.5

Reconstruction

Projection

Fig. F. Hourdin, mai 2019



# Special Extremes (2)

- *Perfect storms (or compound events)*
  - Combination of two or more events without serious consequences, when taken individually, but with a devastating sum
  - E.g., Warm winter in 2015/2016, followed by wet spring in 2016 leading to record low crop yield in France.



# Challenges (1)

- Scientific questions
  - Are (climate) extreme events like normal events, but just more intense? (see S.F. Fitzgerald, on *The Great Gatsby*)
  - Have they become more intense?
  - Do they occur more often?
  - What is the role of forcings?
    - Natural
    - Anthropogenic

# Challenges (2)

- **Non** scientific questions:
  - Was a specific extreme event (e.g. 2019 summer heatwave) caused by climate change?
  - Do extreme events prove/disprove climate change?