Karlsruhe Institute of Technology

HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

ATMO RU-1

European Hail Hazard and Risk Assessment

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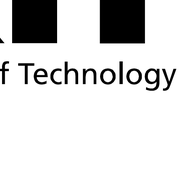
How often does hail occur?

Satellite-based method [1]
+ coverage, homogeneity

Overshooting in convective cloud tops as hail proxy



Meteosat 2nd generation
Detection of cold cloud tops in IR imagery 2004 – 2014

Radar-based method [2]
+ accuracy, detail

Radar Hail criterion (Waldvogel), Hailstorm tracks from Trace3D

Radar network of the German Weather Service 2005 – 2011

Does hail frequency change?

Model data method [3]
+ past and future long term analysis

Combination of a number of **hail-related parameters**
PHI = Number of potential days with hail

Logistic Hail Model

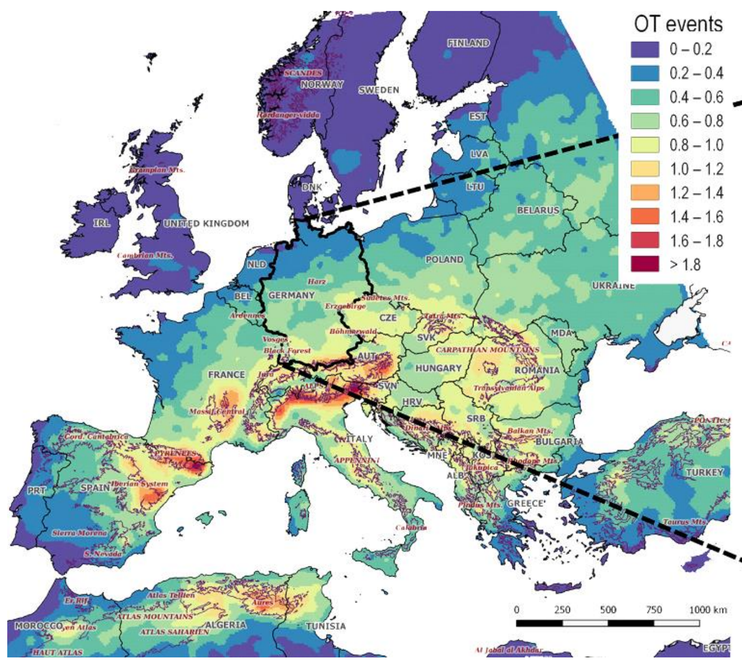
$$p_{hail} = \frac{1}{1 + e^{-g_{hail}(x)}} \quad \text{with } 0 \le p(x) \le 1$$

$$g_{hail} = \beta_0 + \beta_1 \cdot \mathrm{SLI} + \beta_2 \cdot \mathrm{T}_{min} + \beta_3 \cdot \mathrm{T}_{2m}$$

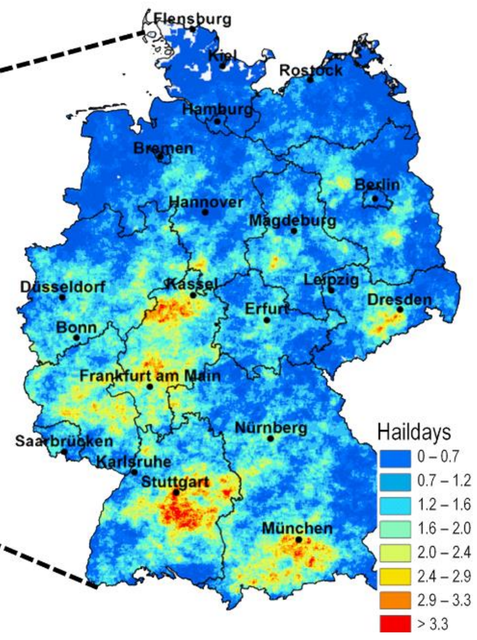
Moisture content: Minimum temperature in the morning
Atmospheric stability: Surface Lifted Index
Boundary condition: Surface temperature

coastDatII downscaled NCEP–NCAR1 Reanalysis

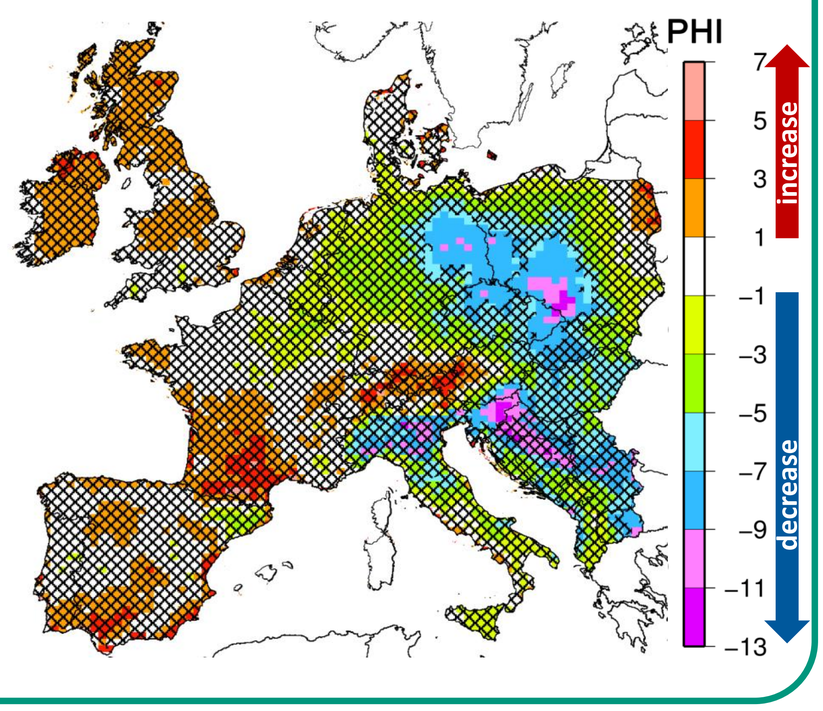
Hail frequency, satellite-based



Hail frequency, radar-based



Trend: Potential hail days 1951 – 2010

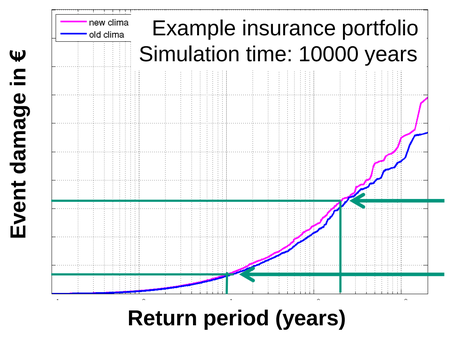


Application

Hail risk modelling for insurance

Hail Risk Model:

Probable maximum loss curves (PML200)



Past loss events:

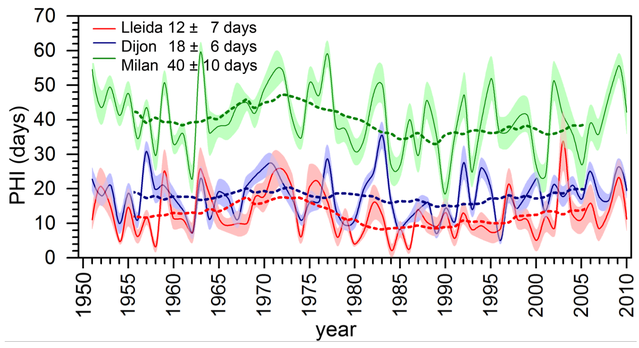
28 July 2013

29 June 2006

Understanding inter-annual variability [3,4]

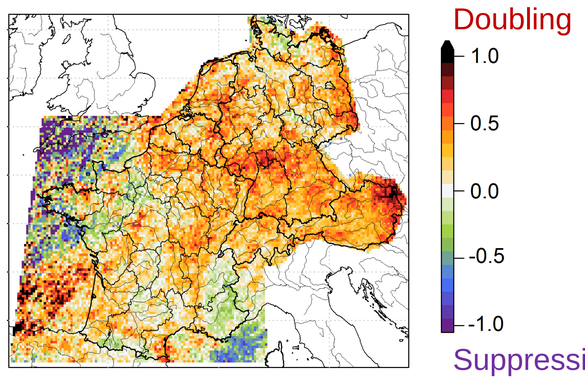
Variability of the hail potential:

Time series correlated across Europe



Thunderstorm frequency in Central Europe:

Increased in NAO negative phase



[1] Punge, H.J. et al., Atmos. Res., 2017
[2] Puskeiler, M. et al., Atmos. Res., 2016
[3] Mohr, S. et al., Geophys. Res. Lett., 2015
[4] Piper, D. and Kunz, M. Nat. Hazards Earth Syst. Sci., 2017

REKLIM Helmholtz-Verbund Regionale Klimaänderungen