Winterstürme und ihre Eintrittswahrscheinlichkeiten

P.Hoffmann

P I K

Forschung am PIK

RD1

EARTH SYSTEM ANALYSIS

Atmosphere, Ocean, Ice Sheet & Vegetation

RD3

SUSTAINABLE SOLUTIONS

Global Adaption Strategies, Policy Assessment

Multi-sector Impacts and Climate Extremes

CLIMATE IMPACTS AND VULNERABILITIES

RD2

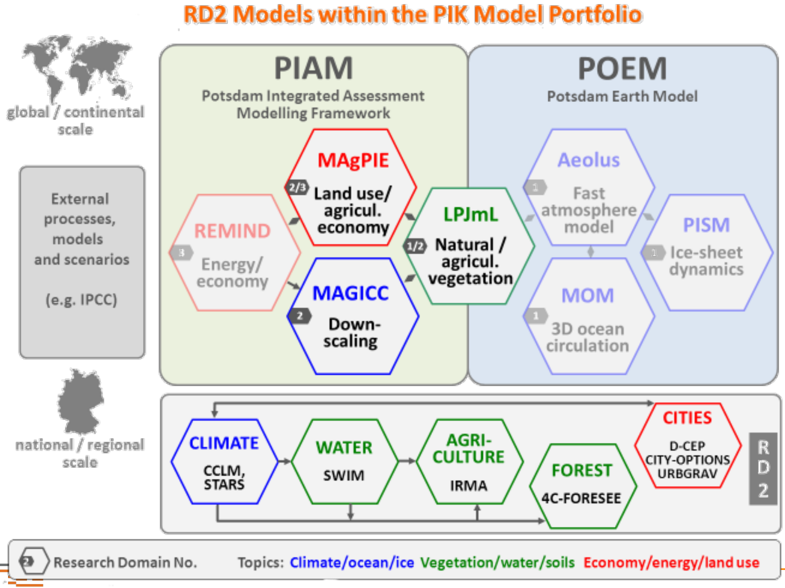
Complex Networks and Visualization

TRANSDISCIPLINARY CONCEPTS & METHODS

RD4

PIK

Klimawirkung und Vulnerabilität (FB2)



Forschungsprojekt 2010 (Phase I): Auswirkung des Klimawandels auf die Schäden in der deutschen Versicherungswirtschaft

Partner: FU-Berlin, Uni-Köln, PIK

- Auswertung von Schadensdaten
- Auswahl und Validierung von Regionalmodellen
- Reproduzierbarkeit von Sturmschäden
- Abschätzung zukünftiger Sturm-/Hagelschäden

Wetter & Klima Diagnostik

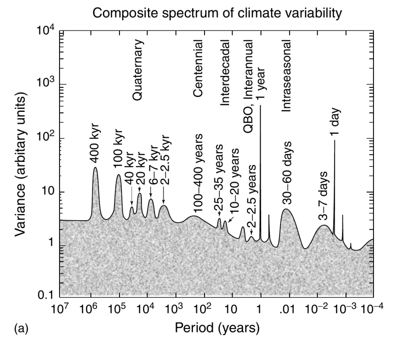
- Auswertungen von Großwetterlagen über Europa
- Analyse von Wetterlagen in Klimamodelle (Europa)
- Entwicklung empirischer Modelle zur Jahreszeitenvorhersage (PCA / Regression)

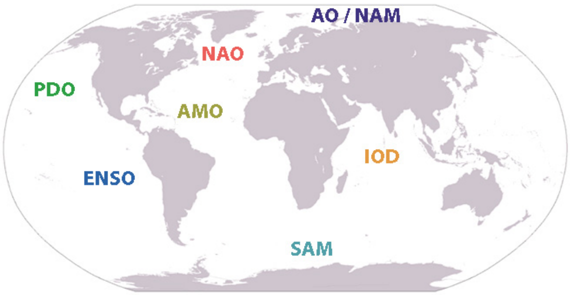
Daten und Werkzeuge

- Reanalysen (1979-2015): $50 \times 50km$
- globale Wetter- und Jahreszeitenvorhersage (GFS/CFS): $50 \times 50km$
- Modellläufe globaler Klimamodell (CMIP5): $100 \times 100km$
- Modellläufe regionaler Klimamodelle (Cordex): $12 \times 12km$
- Python & R Programme zur Extremwertstatistik
  - Wiederkehrintervall, Perzentilregression
  - Spektralanalysen
  - Robustheitsanalysen von Ensembles

Natürliche Klimavariabilität

Schwingungen	Phasen

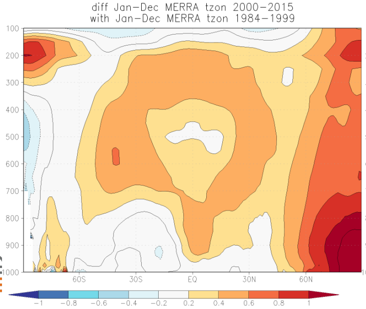


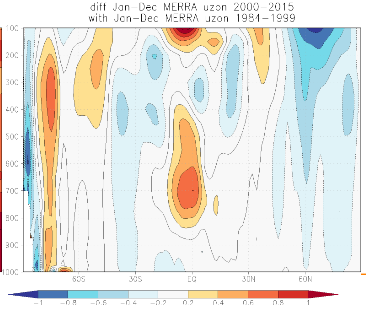


Mechanismus: Baroklinität

$$\Gamma = \frac{f}{N}\frac{\partial \overline{u}}{\partial z} = -\frac{g}{N}\frac{1}{\overline{\overline{T}}}\frac{\partial \overline{T}}{\partial y}$$

- meridionaler Temperaturgradient ($\frac{\partial \overline{T}}{\partial y}$)
- statische Stabilität der Atmosphäre (N)
- vertikale Windscherung ($\frac{\partial \overline{u}}{\partial z}$)





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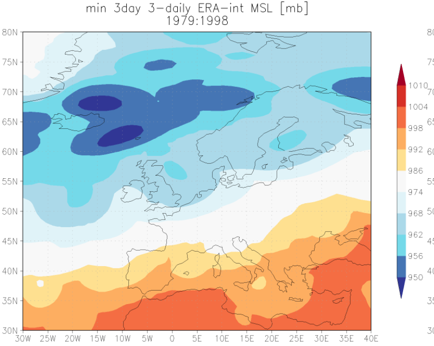
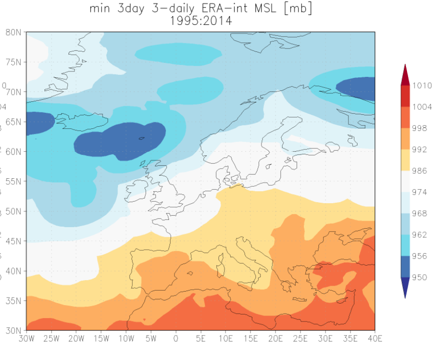
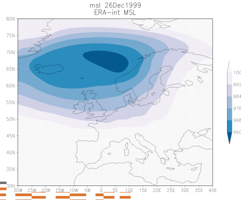
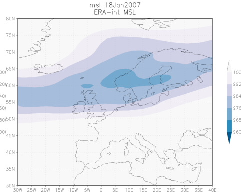
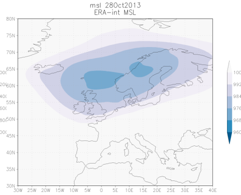
Climate Explorer: Niedrigste SLP

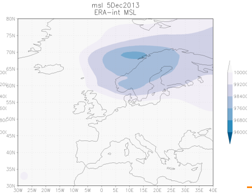












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NAO, Stürme und Wiederkehrintervale

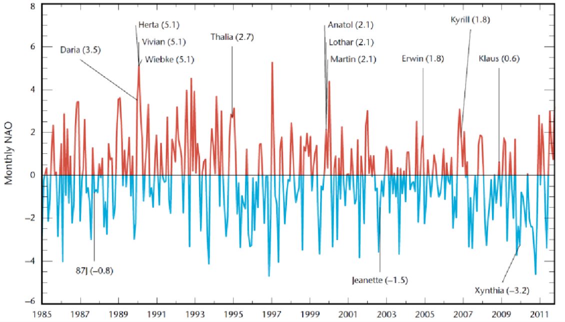

Fig 3: Normalised NAO timeseries from 1985 – early 2012. Major storms affecting EU are indicated ©Met Office 2012

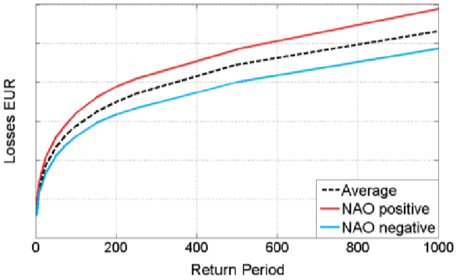

Fig 1: Effect of positive and negative NAO phases on aggregate EUWS losses, based on Willis EUWS Index ©Willis Re

Willis GLOBAL ANALYTICS NEWSLETTER October 2012

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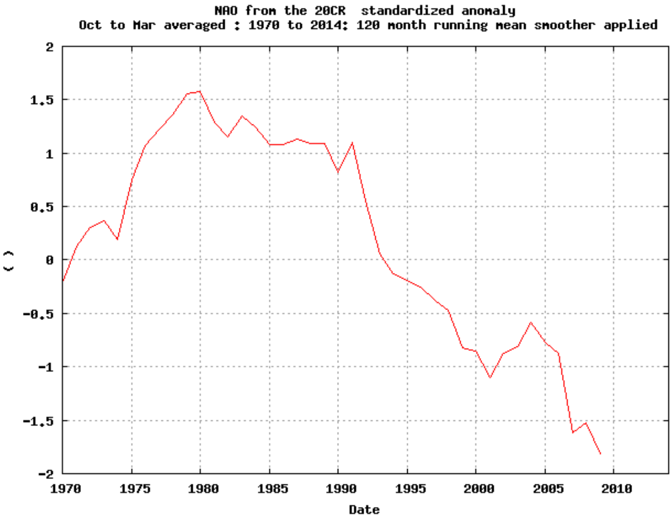
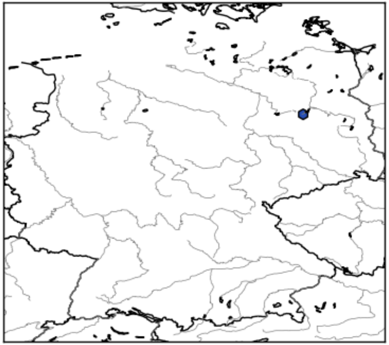
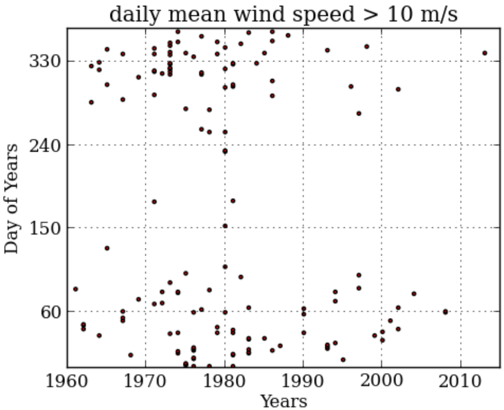
NAO: Entwicklung (negative Phase häufiger)



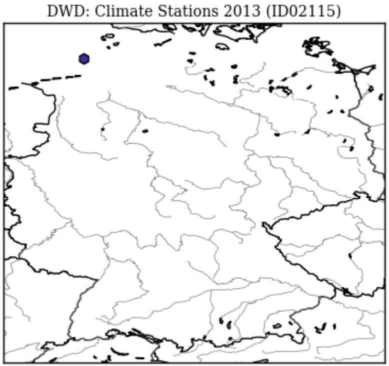
DWD: mittlere Windgeschwindigkeit (Potsdam)

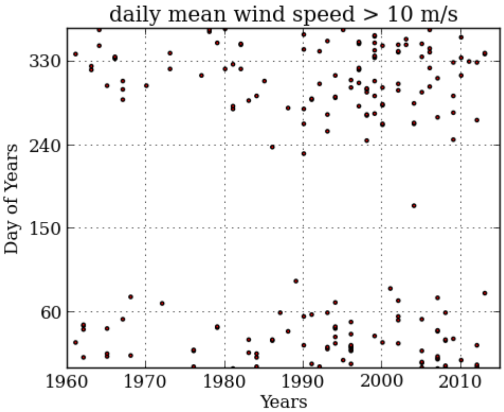




weniger Tage mit Mittelwind ($> 10m/s$)

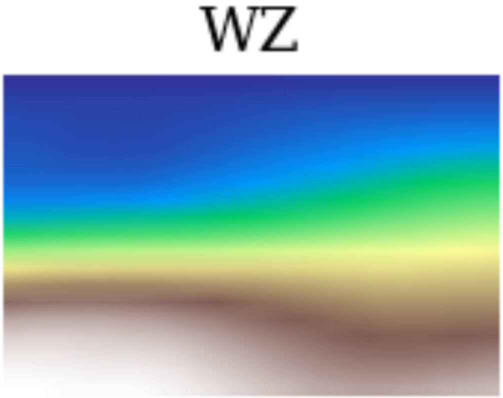
DWD: mittlere Windgeschwindigkeit (Helgoland)

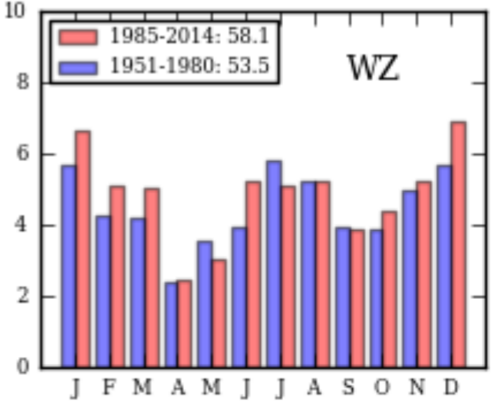




mehr Tage mit Mittelwind ($> 10 m/s$)

Grosswetterlage: West-Zyklonal (WZ)





Zunahme im Winterhalbjahr

Zuordnung vergangener Sturmereignisse nach Wetterlagen

Sturm	Datum	Wetterlage
Zeljko	2015-07-24	WZ
Niklas	2015-03-29	NWZ
Alexandra	2014-12-07	TRW / WZ
Xaver	2013-12-05	WA / NWZ
Christian	2013-10-28	SWZ / WZ
Kyrill	2007-01-18	WZ
Lothar	1999-12-26	WS

Winterstürme: Eady Kinetic Energy (EEK)

$$EEK = 0.5 \cdot (u'^2 + v'^2)$$

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IOP Publishing
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Future changes in extratropical storm tracks and baroclinicity under climate change

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Abstract
The weather in Eurasia, Australia, and North and South America is largely controlled by the strength and position of extratropical storm tracks. Future climate change will likely affect these storm tracks and the associated transport of energy, momentum, and water vapour. Many recent studies have analyzed how storm tracks will change under climate change, and how these changes are related to atmospheric dynamics. However, there are still discrepancies between different studies on how storm tracks will change under future climate scenarios. Here, we show that under global warming the CMIP5 ensemble of coupled climate models projects only little relative changes in vertically averaged mid-latitude mean storm track activity during the northern winter, but agree in projecting a substantial decrease during summer. Seasonal changes in the Southern Hemisphere show the opposite behaviour, with an intensification in winter and no change during summer. These distinct seasonal changes in northern summer and southern winter storm tracks lead to an amplified seasonal cycle in a future climate. Similar changes are seen in the mid-latitude mean Eady growth rate maximum, a measure that combines changes in vertical shear and static stability based on baroclinic instability theory. Regression analysis between changes in the storm tracks and changes in the maximum Eady growth rate reveal that most models agree in a positive association between the two quantities over mid-latitude regions.

Online supplementary data available from stacks.iop.org/ERL/9/084002/mmedia

Keywords: storm tracks, baroclinicity, climate change

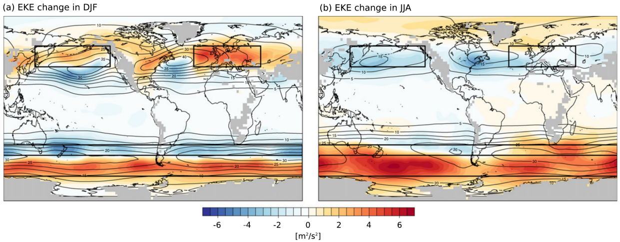

Figure 1. Projected storm track changes under future climate conditions represented by the difference in multi-model mean EKE (m^2/s^2) between the end of the 21st century (2081–2100) and the 20th century (1981–2000) for (a) DJF season and (b) JJA season. Contours of the 20th century EKE are shown in black, and regions of land higher than 1 km have been masked. Four regions of large EKE changes have been framed with black rectangles.

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Winterstürme: Wiederkehr

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RMetS
Royal Meteorological Society

The return period of wind storms over Europe

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[b] *Partner Reinsurance Company, Zurich, Switzerland*

ABSTRACT: Accurate assessment of the magnitude and frequency of extreme wind speed is of fundamental importance for many safety, engineering and reinsurance applications. We utilize the spatial and temporal consistency of the European Centre for Medium Range Forecasts ERA-40 reanalysis data to determine the frequency of extreme winds associated with wind storms over the eastern North Atlantic and Europe. Two parameters are investigated: 10-m wind gust and 10-m wind speed. The analysis follows two different view-points: In a spatially distributed view, wind-storm statistics are determined individually at each grid-point. In an integral, more generalized view, the wind-storm statistics are determined from extreme wind indices (EWI) that summarize storm magnitude and spatial extent. We apply classical peak over threshold (POT) extreme value analysis techniques (EVA) to the EWI and grid-point wind data. As a reference, a catalogue of the 200 most prominent European storms has been compiled based on available literature. The EWI-based return periods (RP) estimates of catalogue wind storms range from approximately 0.1 to 300 years, whereas grid-point-based RP estimates range from 0.1 to 500+ years. EWIs sensitive to the absolute magnitude of wind speed rank the RP of wind storms in the 1989/1990 and 1999/2000 extended winter season similarly to the RP derived from the distributed approach. The RP estimates derived from EWIs are generally higher when calculated using only land grid-points compared to RPs derived using whole domain. Both the uncertainties in EWIs and grid-point-based RPs show a greater dependence on the wind parameter used than on the uncertainty associated with the EVA for RPs less than 10 years, whereas for RPs greater than 10 years the effect of the different datasets is lower. The EWIs share up to approximately 50% of the variability of the local grid-point RPs. Copyright © 2008 Royal Meteorological Society

KEY WORDS return period extreme wind; wind storm; climatology; extreme value analysis; wind gust speed; wind speed; Europe

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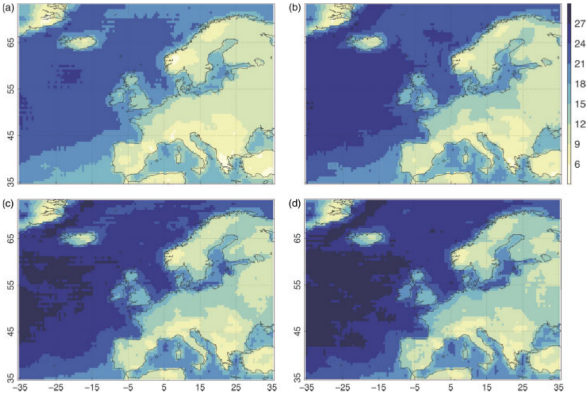

ure 9. The RL (ms^{-1}) of WS10 at each grid-point for RPs of 1 year (a), 5 years (b), 20 years (c), and 50 years (d). Note that actual RL magnitude is not representative of absolute (in-situ) wind speed at the surface. This figure is available in colour online at www.interscience.wiley.com/ijoc

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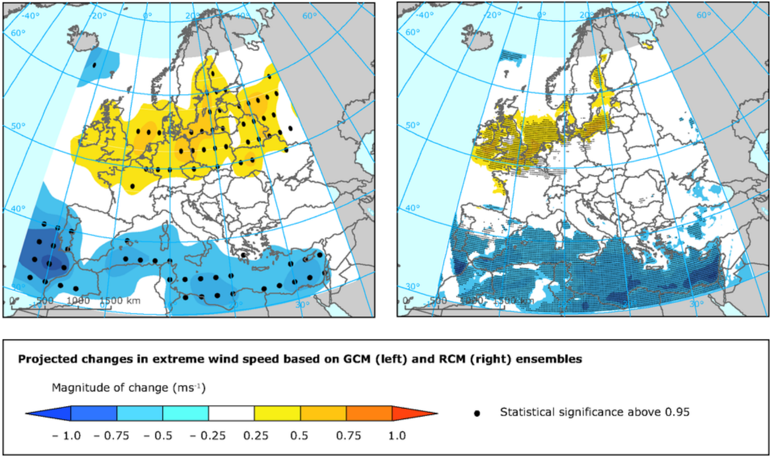
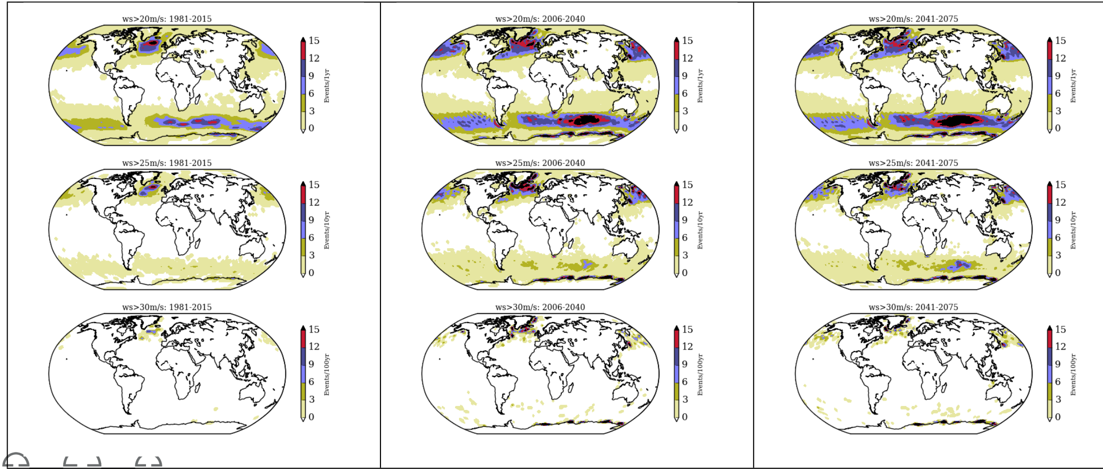
Winterstürme: Projektionen



http://www.eea.europa.eu/data-and-maps/figures/trends-in-the-extreme-wind

Häufigkeiten:

NCEP (1981-2015)	MPI (2006-2040)	MPI (2041-2075)



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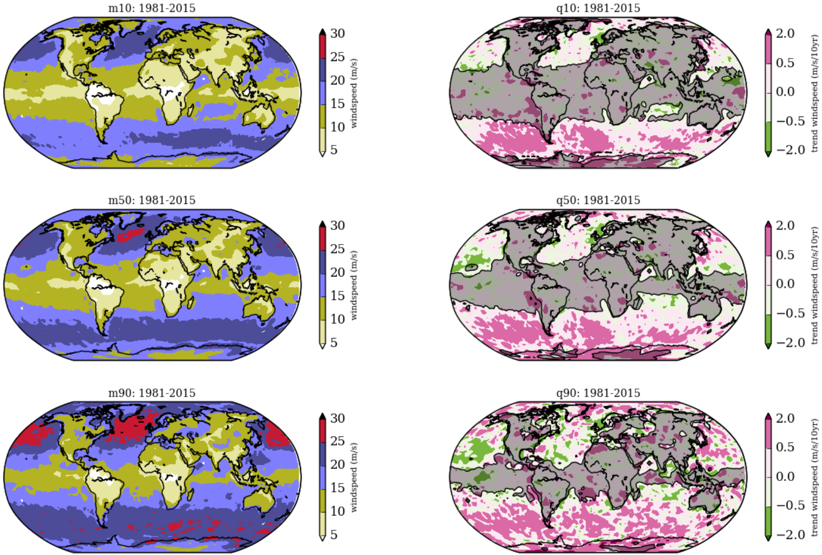
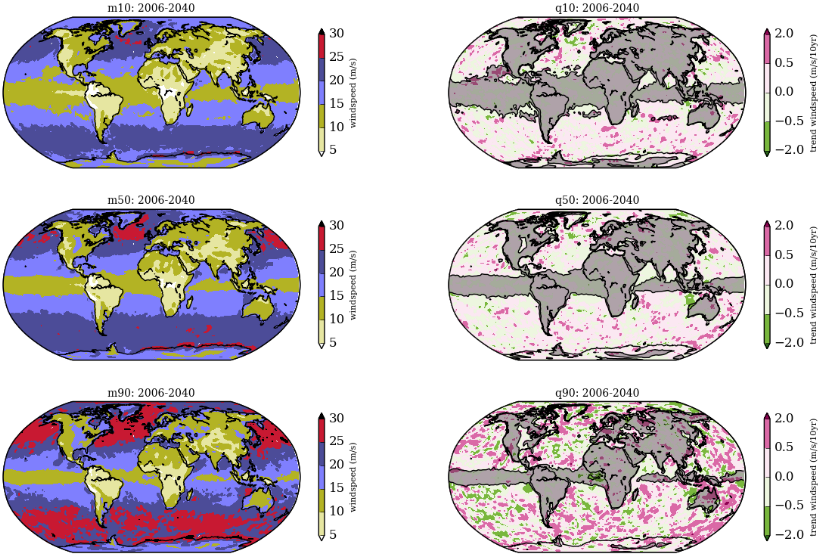
QuantilReg.: NCEP (ws_{max}, 1981-2015)



QuantilReg.: MPI-ESM-MR (2006-2040, rcp8.5)



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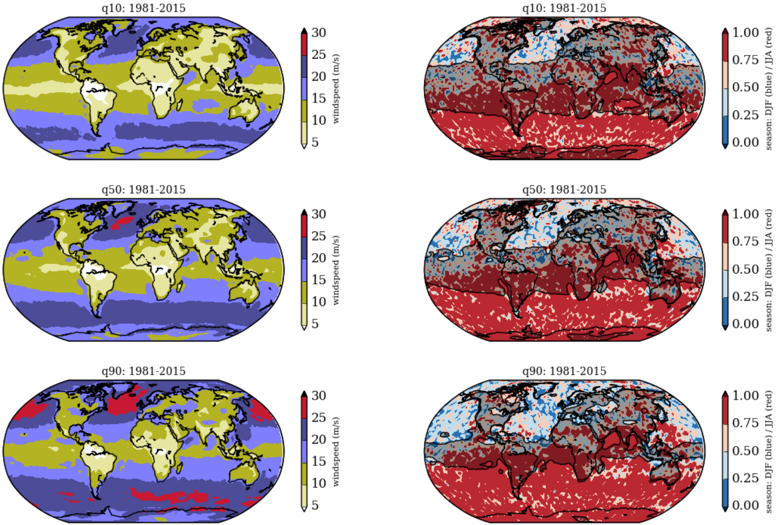
Jahreszeiten der Stürme



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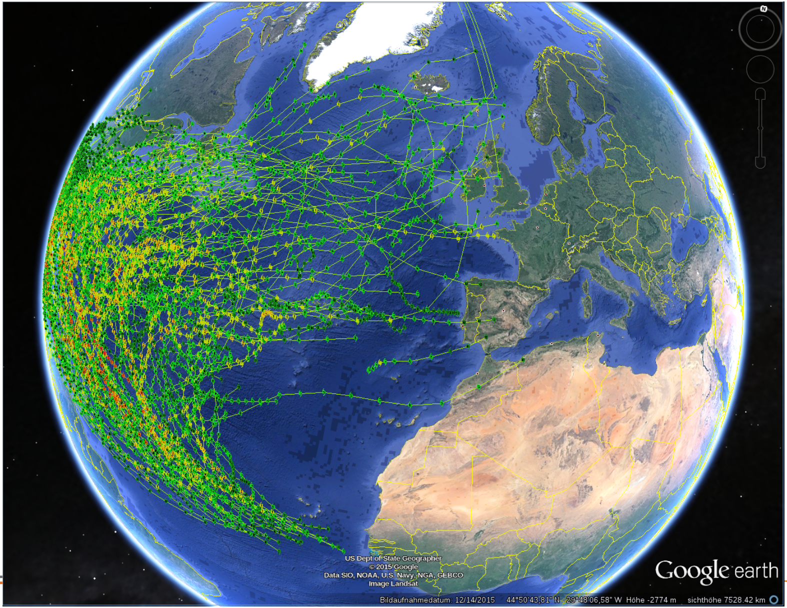
Atlantic Hurricanes 1990-2006: Google Earth



Themenbereiche

- Eintrittswahrscheinlichkeit von Stürmen weltweit in Abhängigkeit von ihrer Stärke
- Entwicklung von Stürmen unter Berücksichtigung des Klimawandels
  - Aktualisierung von Standortbewertungen
- Zusammenhang zw. Flutereignissen und Stürmen
- öffentlich zugängliche Informationen
  - Kosten für öffentlich zugängliche Informationen (Auftrag and PIK)

Projektidee

Phase1: Häufigkeiten & Wiederkehrintervalle von Stürmen in Reanalysen und Beobachtungen (Extremwertstatistik)

Phase2: Indikatoren für Stürme (Telekonnektionen, Vorhersagbarkeit)

Phase3: Unsicherheitsanalyse der Entwicklung von Stürmen im Klimawandel (Globale- & Regionale Klimaszenarien)

Phase4: Risikobewertung von weltweiten Standorten