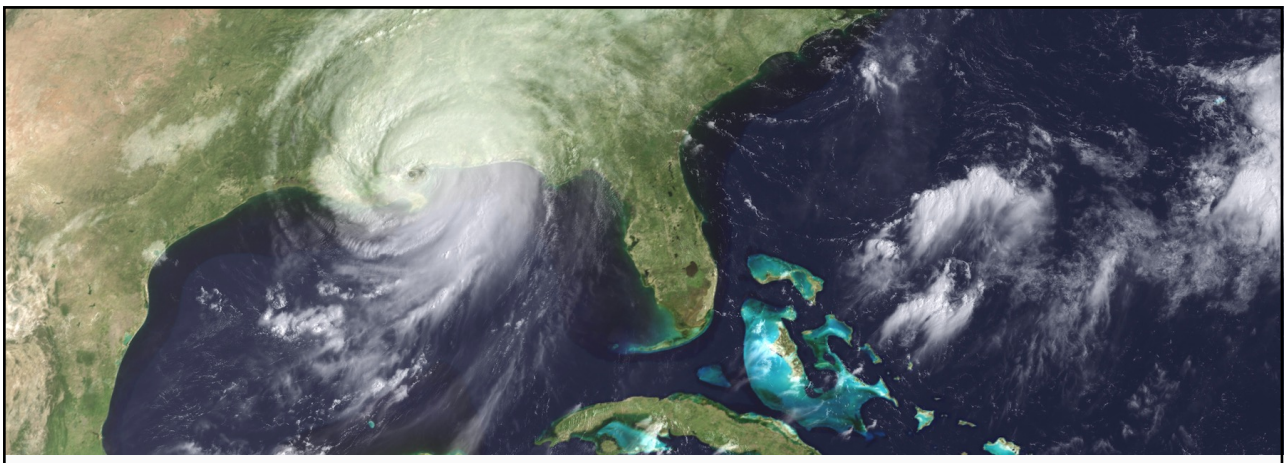


Geo-Analysen im Risiko-Management von Naturgefahren in der Lehre

ESRI eduGIS-Chat, 09. März 2022

Dipl.-Geogr. Andreas Siebert
SiRisCon, Seehausen, Germany

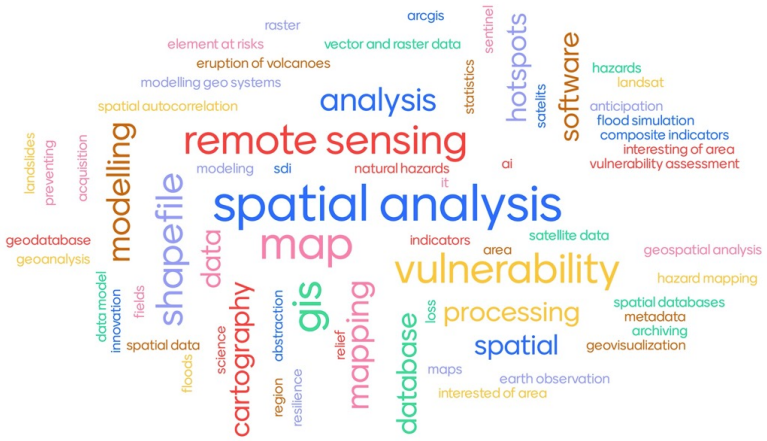
0

Agenda

- Schadenpotenziale und wirtschaftliche Auswirkungen von Naturgefahren
- Methodik & Terminologie rund um Katastrophen-Risiko-Management
- Bedeutung von Geo-Informationen im Risiko-Management-Prozess
- GIS-Anwendungen für Pre- und Post-Disaster-Betrachtungen
- Entwicklungen & Trends

1

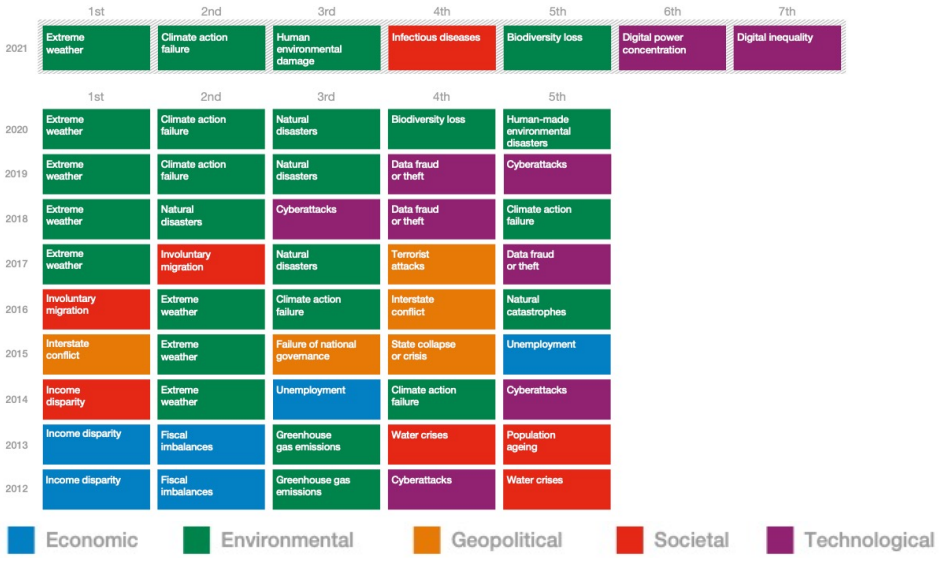
Schlüsselbegriffe Geo-Analysen



2

3

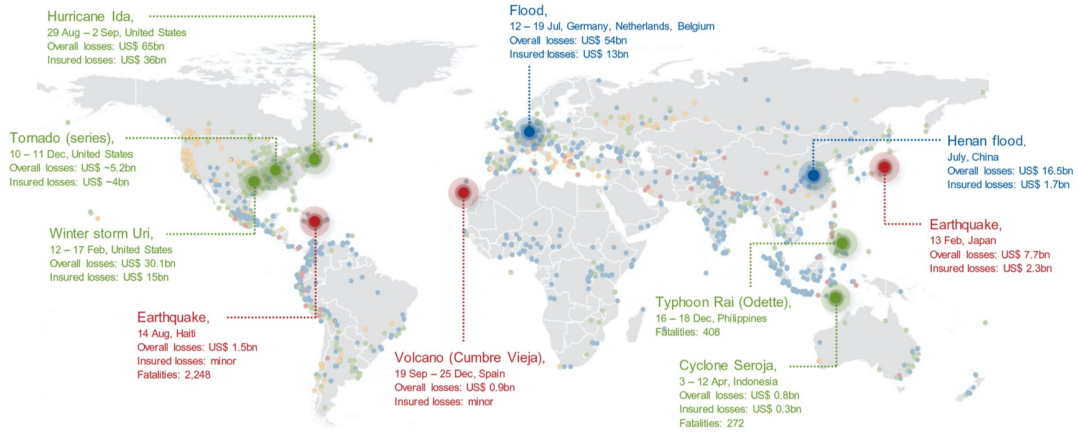
Globale Risikolandschaft 2012 - 2021
Entwicklungen in der Ereignis-Wahrscheinlichkeit



Quelle: World Economic Forum, 2021

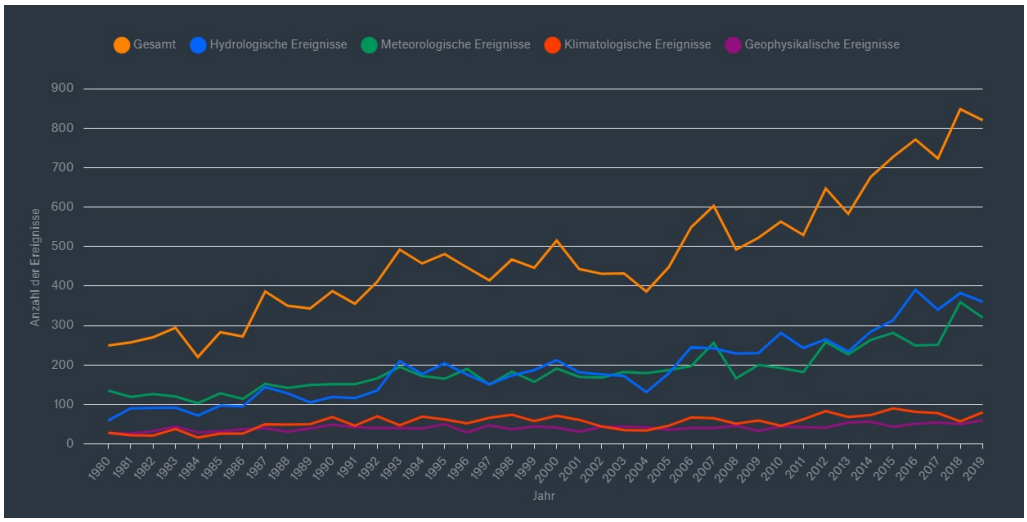
4

Monitoring von weltweiten Naturkatastrophen seit 1980



5

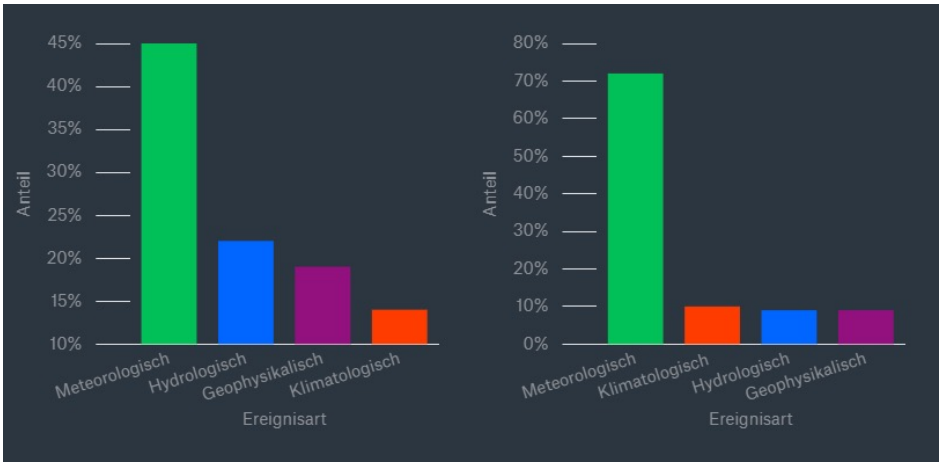
Naturkatastrophen nehmen zu
Anzahl der relevanten Schadenereignisse von 1980 – 2019



https://www.munichre.com/de/risiken/naturkatastrophen-schaeden-nehmen-tendenziell-zu.html

6

Meterorologische Ereignisse dominieren die weltweiten Gesamtschäden (L) und die versicherten Schäden (R)



https://www.munichre.com/de/risiken/naturkatastrophen-schaeden-nehmen-tendenziell-zu.html

7

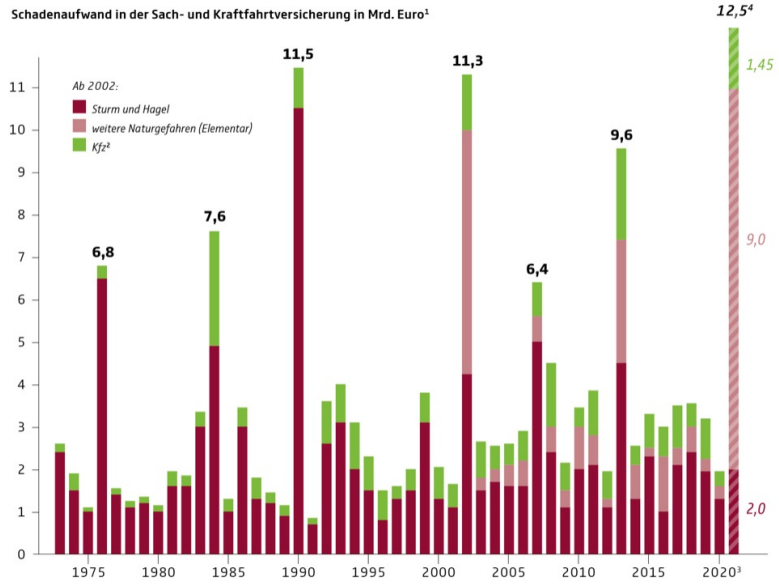
Weltweite Naturkatastrophen 2021

	The figures of the year 2021	The figures of the year 2020 (Losses in original values)	The figures of the year 2019 (Losses in original values)
Overall losses in US$ m	280,000	210,000	166,000
Insured losses in US$ m	120,000	82,000	57,000
Fatalities	9,200	8,200	9,435

Date	Country/Region	Event	Fatalities	Overall losses US$ m	Insured losses US$ m
29.8-2.9.2021	United States, Canada	Hurricane Ida	114	65,000	36,000
12-19.7.2021	Europe	Flood, flash floods	228	54,000	13,000
12-17.2.2021	United States	Winter storm, cold wave frost	235	30,100	15,000
July 2021	China	Flood	302	16,500	1,700
13.2.2021	Japan	Earthquake	1	7,700	2,300

8

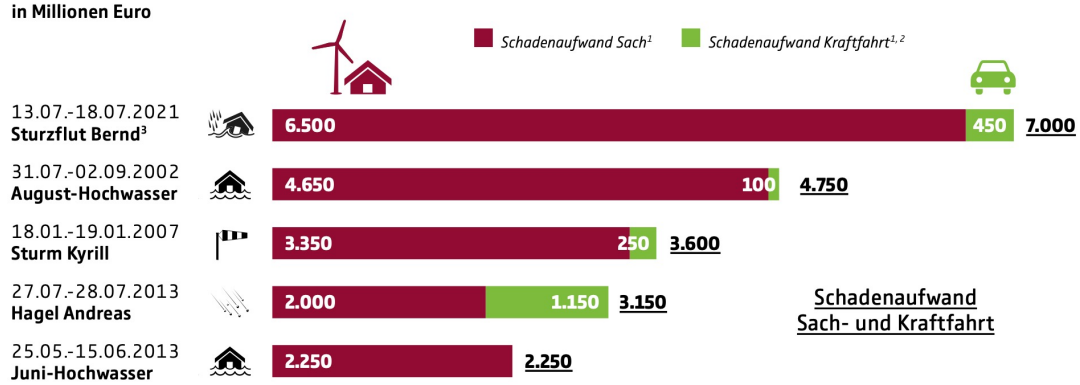
Deutschland: Schadenaufwand in der Sachversicherung für Sturm, Hagel und weitere Naturgefahren (Elementar)



Quelle: GDV.de, 2021

9

Deutschland: Die verheerendsten Naturkatastrophen in Schadenaufwand (2002 – 2021)



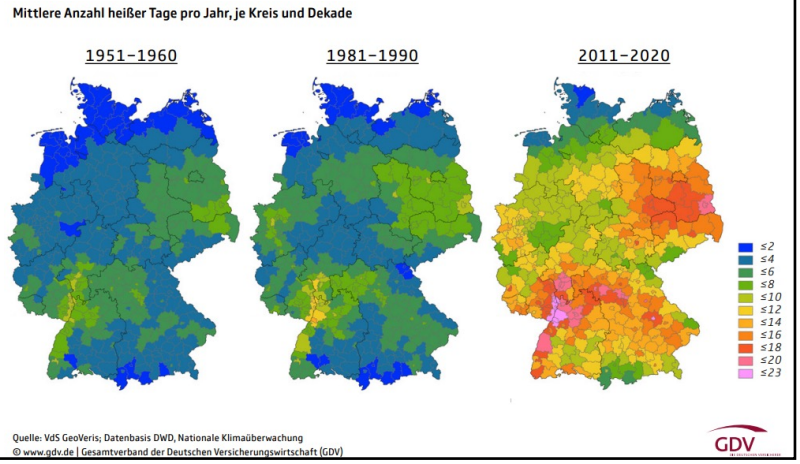
Quelle: GDV – Naturgefahrenreport, 2021

10

Deutschland: Mitteilung des deutschen Versicherungsverbandes (GDV) vom 07.10.2021

Klimawandel: Zahl der Hitzetage seit den 1950er Jahren verdreifacht

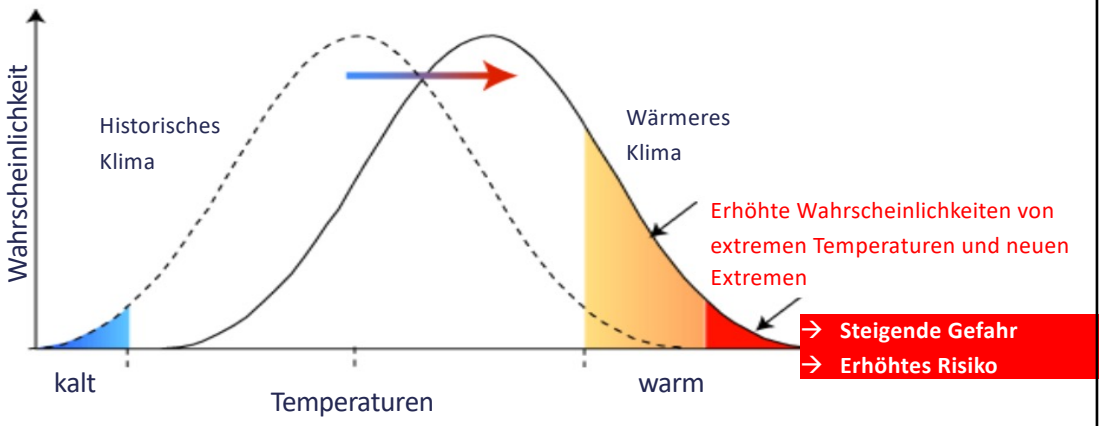
Es gibt in Deutschland immer mehr heiße Tage mit Temperaturen über 30 Grad. "Die Zahl der Hitzetage hat sich in den vergangenen Jahrzehnten verdreifacht", sagt Jörg Asmussen, Hauptgeschäftsführer des Gesamtverbandes der Deutschen Versicherungswirtschaft (GDV).



Quelle: VdS GeoVeris; Datenbasis DWD, Nationale Klimaüberwachung
© www.gdv.de | Gesamtverband der Deutschen Versicherungswirtschaft (GDV)

11

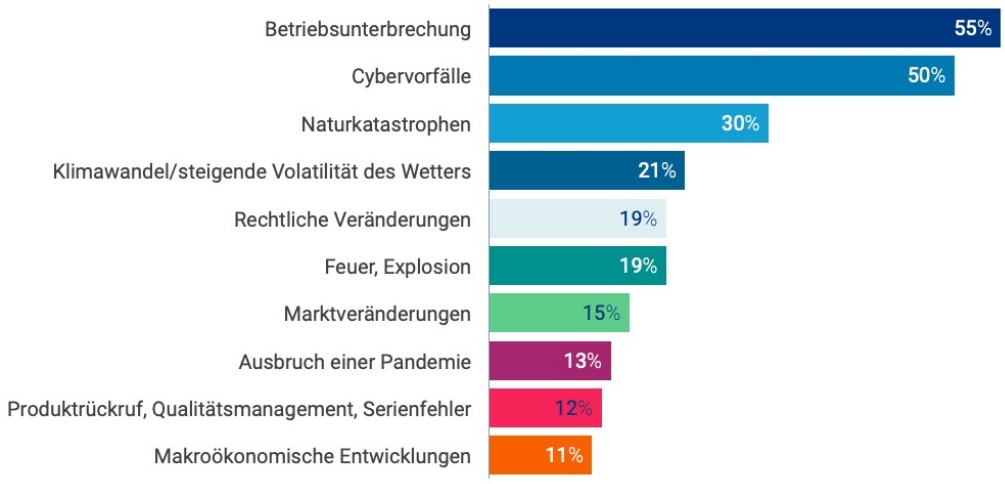
Klimawandel: Veränderte Wahrscheinlichkeiten
Kleiner Anstieg der Durchschnittstemperaturen –> großer Anstieg der Extreme



Quelle: IPCC 2001

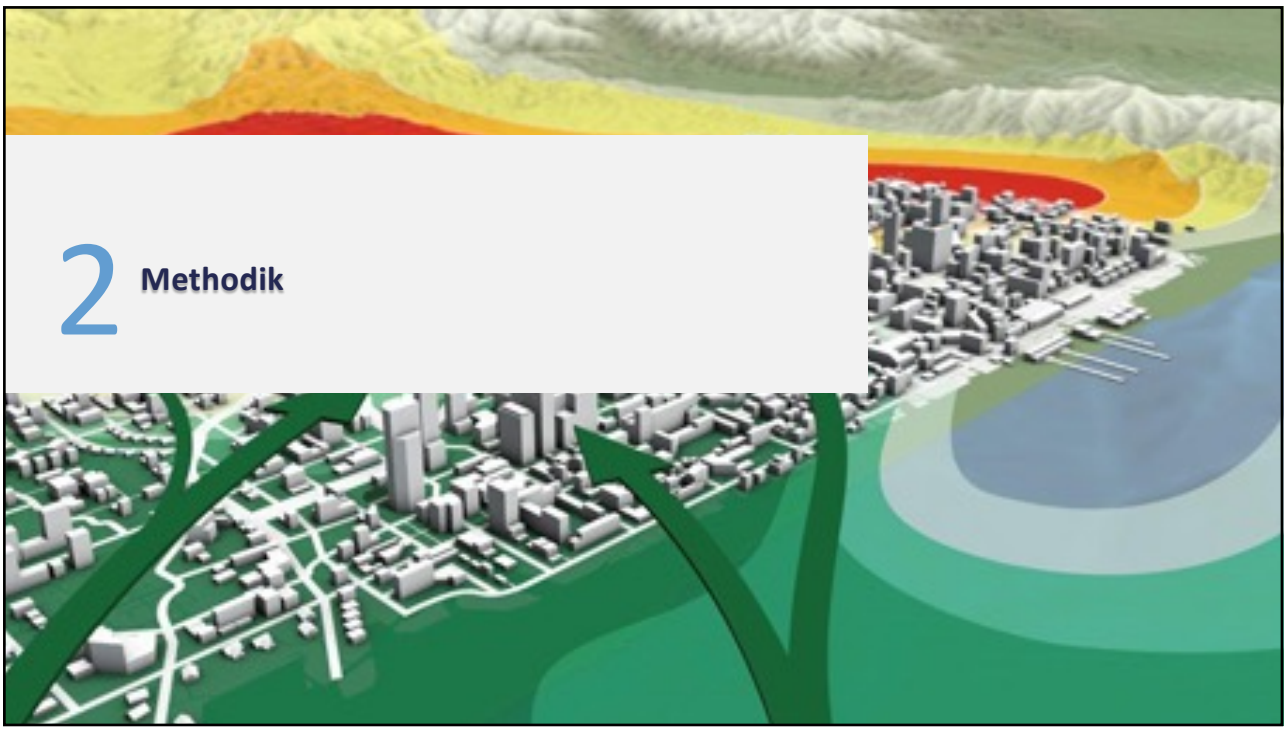
12

Die wichtigsten Geschäftsrisiken in Deutschland 2022



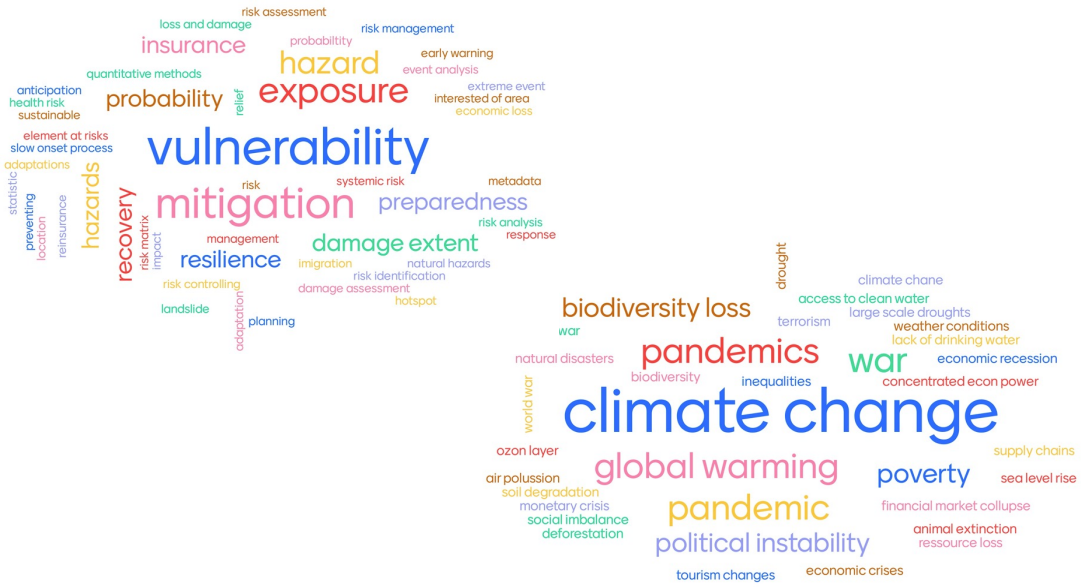
Quelle: Allianz Global Corporate & Speciality (AGCS) – Allianz Risk Barometer 2022

13



14

Schlüsselbegriffe zu „Risiko“



15

Terminologie
Von der Gefahr zum Risiko

Source: https://scimoms.com/hazard-risk/, 2018

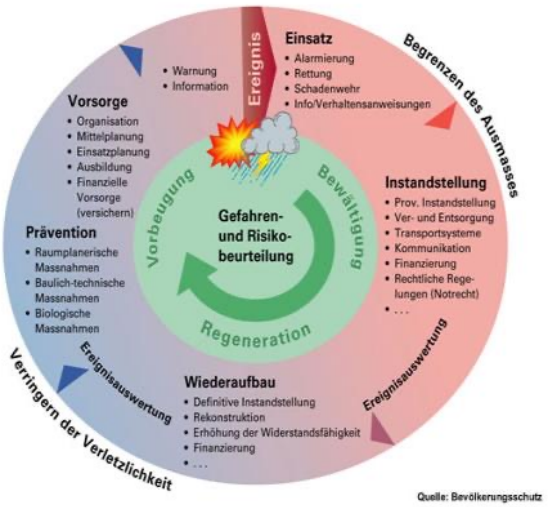
16

4-Phasenmodell
Disaster risk management cycle

Source: https://www.disaster.qld.gov.au/dmg/Pages/DM-Guideline.aspx#1.3

17

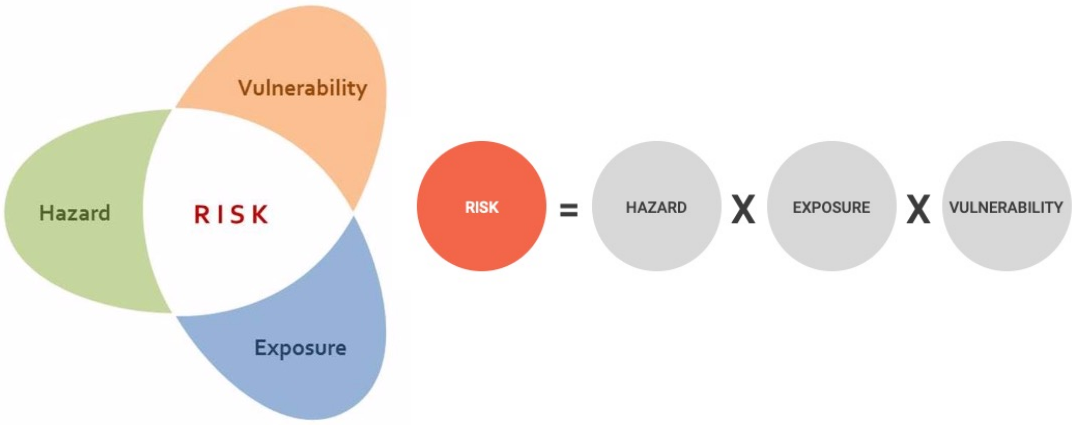
Disaster risk management cycle
Emergency management phases



Source: www.planat.ch, Strategie Naturgefahren Schweiz, 2007

18

Terminologie
Risiko-Formel



Source: http://www.un-spider.org/risks-and-disasters/disaster-risk-management, 2020

19

Klassifizierung von Naturgefahren (hazards, perils)

Disaster Group	Disaster Subgroup	Definition	Disaster Main Type
Natural	Geophysical	A hazard originating from solid earth. This term is used interchangeably with the term geological hazard.	Earthquake
			Mass Movement (dry)
			Volcanic activity
	Meteorological	A hazard caused by short-lived, micro- to meso-scale extreme weather and atmospheric conditions that last from minutes to days.	Extreme Temperature
			Fog
			Storm
	Hydrological	A hazard caused by the occurrence, movement, and distribution of surface and subsurface freshwater and saltwater.	Flood
			Landslide
			Wave action
	Climatological	A hazard caused by long-lived, meso- to macro-scale atmospheric processes ranging from intra-seasonal to multi-decadal climate variability.	Drought
			Glacial Lake Outburst
			Wildfire
	Biological	A hazard caused by the exposure to living organisms and their toxic substances (e.g. venom, mold) or vector-borne diseases that they may carry. Examples are venomous wildlife and insects, poisonous plants, and mosquitoes carrying disease-causing agents such as parasites, bacteria, or viruses (e.g. malaria).	Epidemic
			Insect infestation
			Animal Accident
	Extraterrestrial	A hazard caused by asteroids, meteoroids, and comets as they pass near-earth, enter the Earth's atmosphere, and/or strike the Earth, and by changes in interplanetary conditions that effect the Earth's magnetosphere, ionosphere, and thermosphere.	Impact
			Space weather

Source: https://www.emdat.be/classification

20

Klassifizierung von Exposure (elements-at-risk)

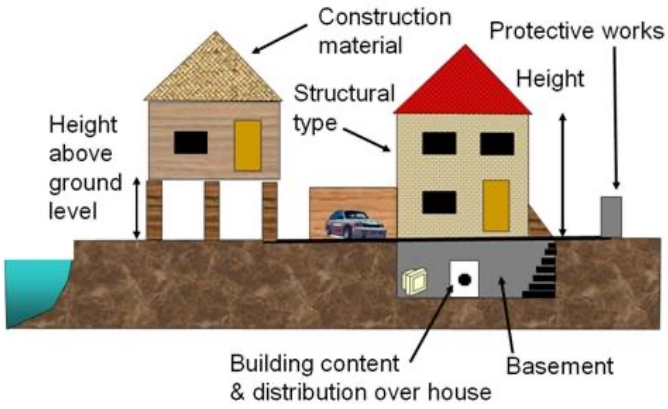
Physical elements Buildings: Urban land use, construction types, building height, building age, total floor space, replacement costs. Monuments and cultural heritage	**Population** Density of population, distribution in space, distribution in time, age distribution, gender distribution, handicapped, income distribution
Essential facilities Emergency shelters, Schools, Hospitals, Fire Brigades, Police,	**Socio-economic aspects** Organization of population, governance, community organization, government support, socio-economic levels. Cultural heritage and traditions.
Transportation facilities Roads, railway, metro, public transportation systems, harbor facilities, airport facilities.	**Economic activities** Spatial distribution of economic activities, input-output table, dependency, redundancy, unemployment, economic production in various sectors.
Life lines Water supply, electricity supply, gas supply, telecommunications, mobile telephone network, sewage system.	**Environmental elements** Ecosystems, protected areas, natural parks, environmentally sensitive areas, forests, wetlands, aquifers, flora, fauna, biodiversity.

Sources: charim.net

21

Elements-at-risk
Gebäude-Charakteristika

RISK = HAZARD X EXPOSURE X VULNERABILITY



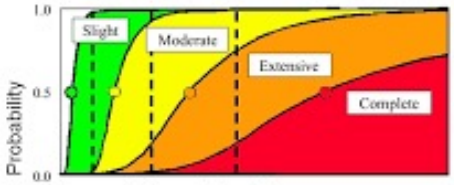
Sources: http://www.charim.net/methodology/52

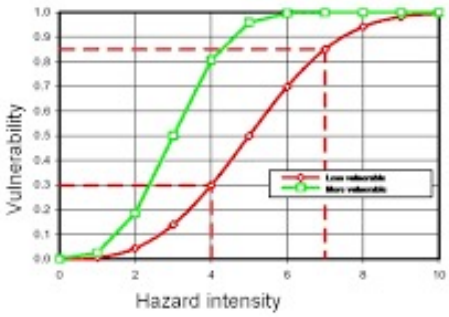
22

Vulnerabilität
Einflussfaktoren

RISK = HAZARD X EXPOSURE X VULNERABILITY

Physical factors
Poor design and construction of buildings, unregulated land use planning. Inadequate building practices and regulations.
Social factors
Poverty and inequality, marginalisation, social exclusion and discrimination by gender, social status, disability and age (amongst other factors) psychological factors. The absence of warning systems and lack of public awareness.
Economic factors
The uninsured informal sector, vulnerable rural livelihoods, dependence on single industries, globalisation of business and supply chains, etc.
Environmental factors
Poor environmental management, overconsumption of natural resources, decline of risk regulating ecosystem services, climate change, etc.

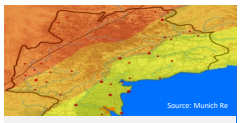




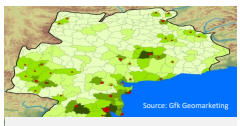
Source: preventionweb.net, 2020

23

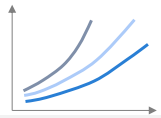
Risiko-Modellierung



HAZARD



EXPOSURE



VULNERABILITY

Geowissenschaften & Forschung

Spezifische Exponierung

Schaden-Erfahrung

Szenarios

Statistik

Risiko

Erwartete Schäden & Wahrscheinlichkeiten

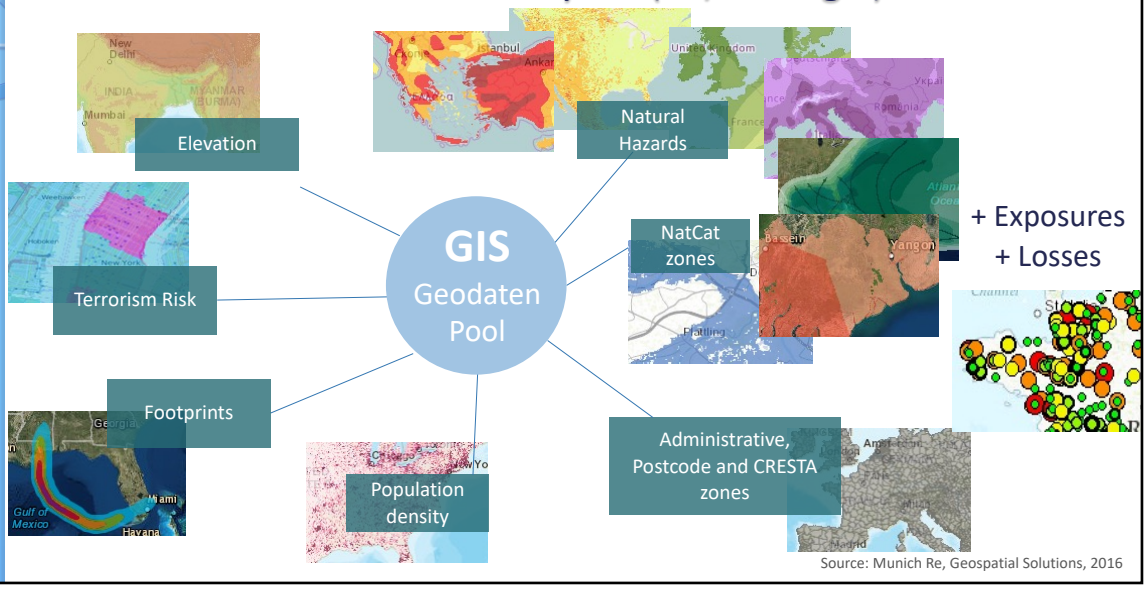
Source: Munich Re

24

3 Daten & Informationen

25

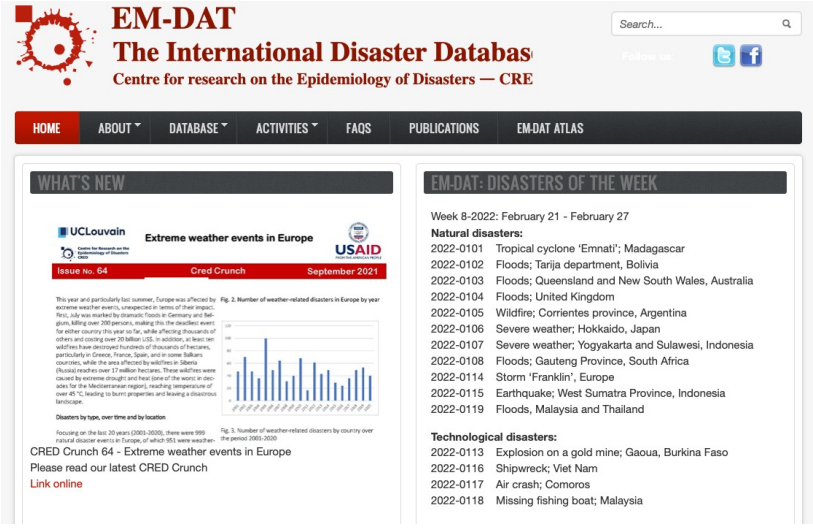
Geo-Daten
Der “Treibstoff” für die Analysen (80/20-Regel)



Source: Munich Re, Geospatial Solutions, 2016

26

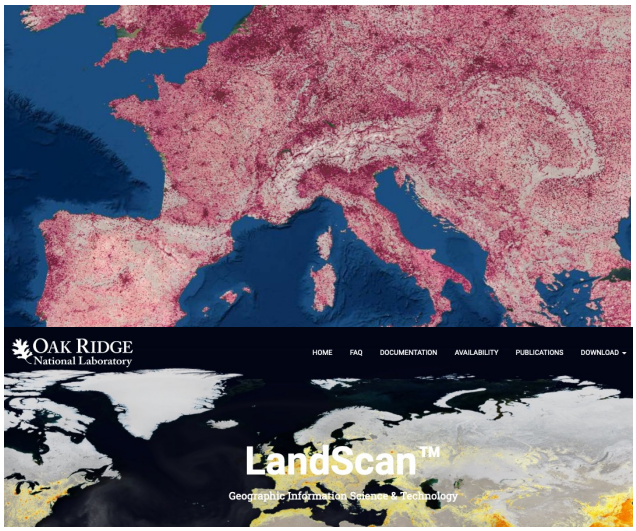
Disaster and catastrophe catalogues
EM-DAT by CRED



Source: https://www.emdat.be

27

Exposure data sets & catalogues
Global Population Database



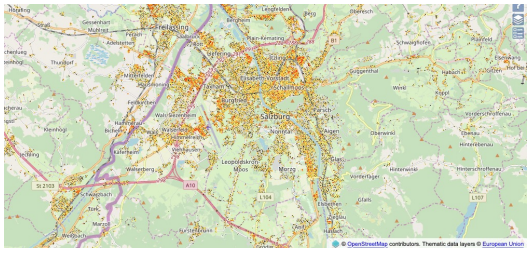
Source: https://www.eastview.com/resources/e-collections/landscan, 2020

LandScan™ Global Population Database was developed by the Department of Energy's Oak Ridge National Laboratory. Using an innovative approach and the latest technologies, LandScan is the industry standard for global population distribution. As the world's most accurate spatially referenced population distribution model and finest resolution global population database, LandScan is a valuable application in research, humanitarian and corporate settings.

Scope: global (1 km grid)
Access: academic for free (Commercial users via East View)
Website: https://landscan.ornl.gov
https://www.eastview.com/resources/e-collections/landscan/

28

Exposure data sets & catalogues
Global Human Settlement Layer (European Commission)



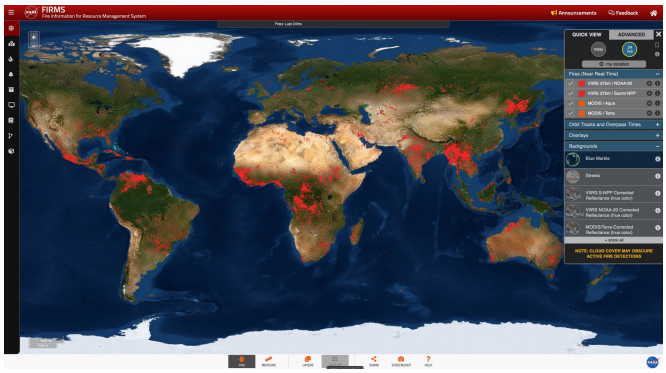
Source: https://ghsl.jrc.ec.europa.eu/index.php, 2021

The Global Human Settlement Layer (GHSL) project produces global spatial information about the human presence on the planet over time. This in the form of built-up maps, population density maps and settlement maps. This information is generated with evidence-based analytics and knowledge using new spatial data mining technologies.
The GHSL processing framework uses heterogeneous data including global archives of fine-scale satellite imagery, census data, and volunteered geographic information. The data is processed fully automatically and generates analytics and knowledge reporting objectively and systematically about the presence of population and built-up infrastructures.

Scope: global (resolution: 20-1000m)
Access: open data
Website: https://ghsl.jrc.ec.europa.eu/faq.php

29

Climatological hazard data sets & catalogues
Fire Information by NASA



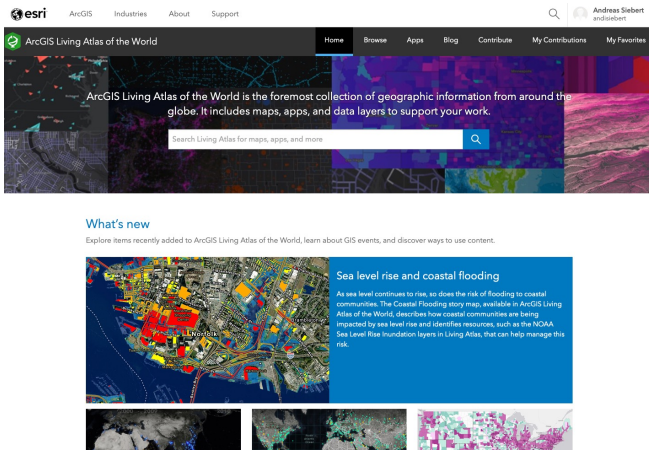
About the Fire Information for Resource Management System NASA FIRMS uses satellite observations from the MODIS and VIIRS instruments to detect active fires and thermal anomalies and deliver this information in near real-time to decision makers through email alerts, analysis ready data, online maps and web services.

Scope: global
Access: open
Website:
https://firms2.modaps.eosdis.nasa.gov/map

Source: https://firms2.modaps.eosdis.nasa.gov/map

30

Collection of geographic information
ArcGIS Living Atlas of the world by ESRI Redlands (Ca.)



The ArcGIS Living Atlas of the World is the foremost collection of geographic information from around the globe. It includes maps, apps, and data layers to support geoanalytics work.

Scope: global
Access: open (fee) for ESRI users
Website:
https://livingatlas.arcgis.com/en/home/

Source: https://livingatlas.arcgis.com/en/home/, 2021

31

Socio-economic data sets & catalogues
UN Statistics Division by United Nations

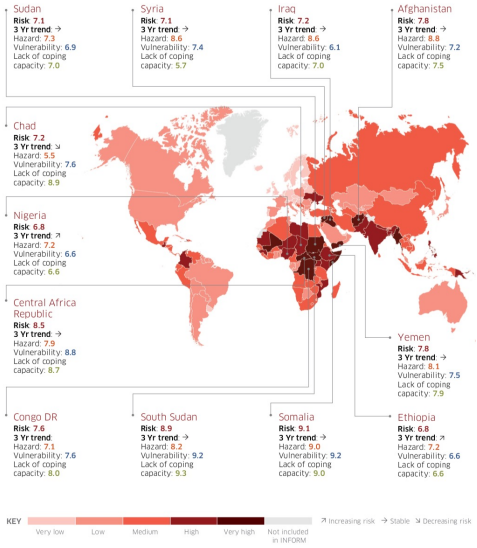
The Statistics Division compiles and disseminates global statistical information and develops standards and norms for statistical activities. UNSD features official demographic statistics (Demographic Yearbook data collection system), it contains data related to the population and housing censuses, and the activities under the civil registration and vital statistics programme.

Scope: global
Access: open
Website: https://unstats.un.org/unsd/demographic-social

Source: https://unstats.un.org/unsd/demographic-social, 2021

32

Risk assessment for humanitarian crises
INFORM – Global Risk Index 2019



Source: https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Risk-Facts-Figures

33

Remote sensing data
Satellite missions, instruments and hazard types

Hazard type

-Drought

Operators

- Any -

Launch year

-Year

Apply

MetOp-C

Hazard types: Drought, Extreme Temperature, Flood, Severe Storm
Applications: Providing weather data services to

Sentinel-3B

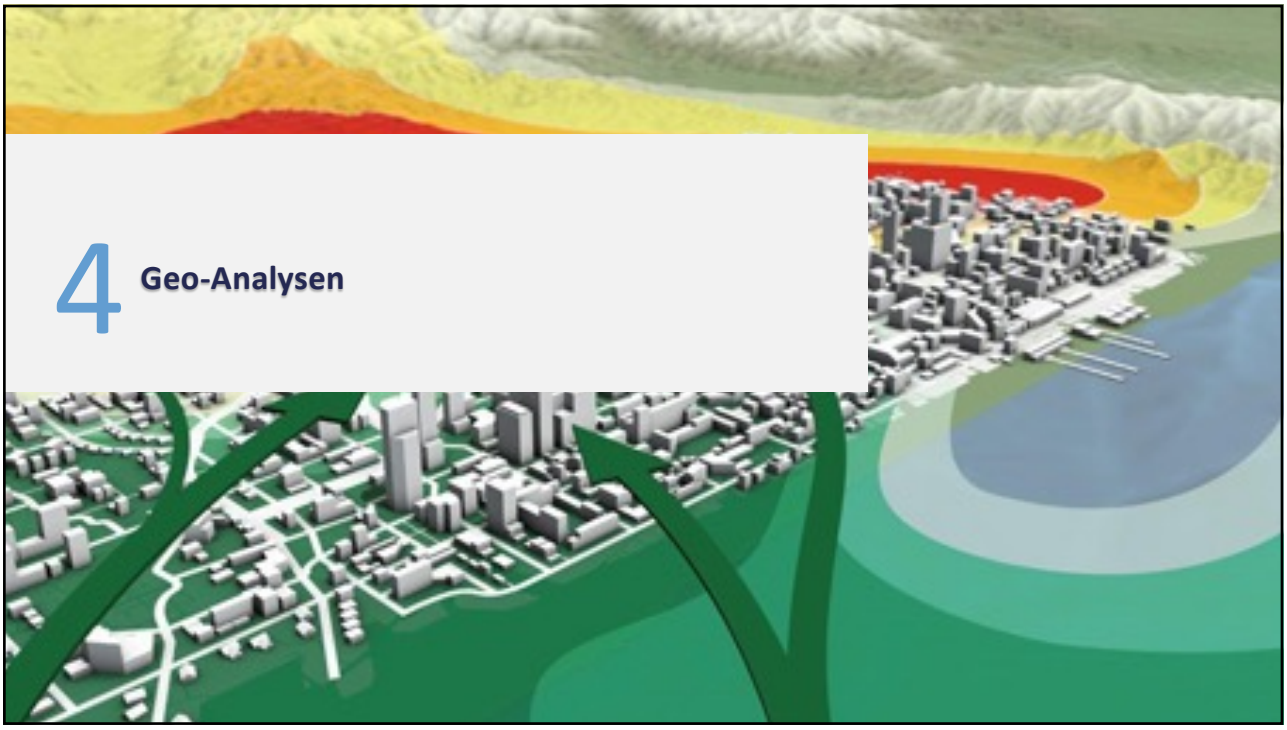
Hazard types: Drought, Earthquake, Extreme Temperature, Flood, Forest Fire, Mass Movement, Severe Storm, Tsunami, Volcanic Eruption

GOES-17

Hazard types: Drought, Extreme Temperature, Severe Storm
Applications: Meteorology (primary mission), search and

Source: http://www.un-spider.org/space-application/satellite-technology, 2021

34



35

Geoanalysen im Risikomanagement
Pre- und Post-Disaster

PRE-Disaster Risiko-Einschätzung

POST-Disaster Schaden-Analysen

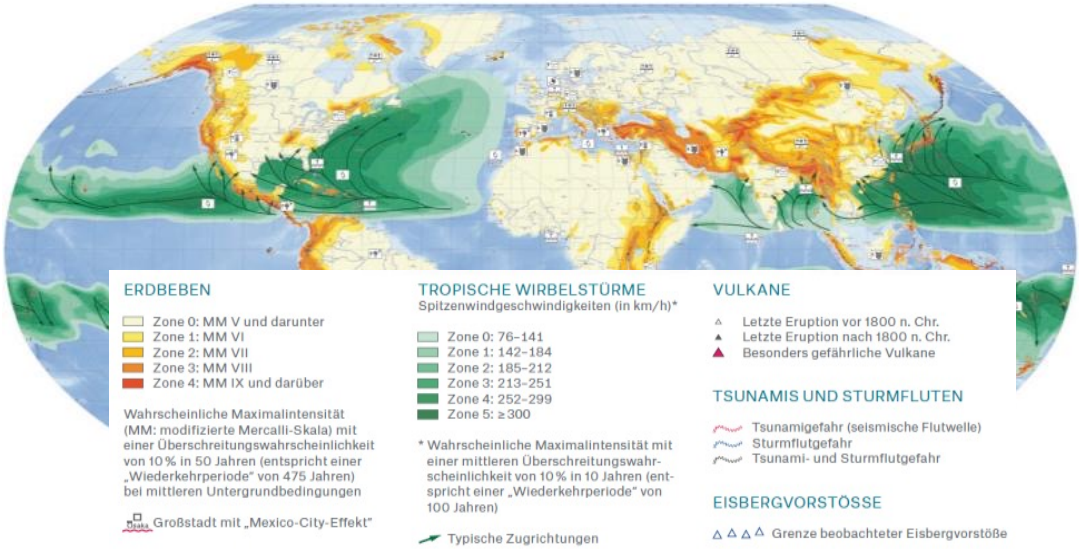
- Risiko-Erkennung
- Risiko-Bewertung
- Portfolio Management
- Modellierung & Tarifierung
- Kumul-Kontrolle
- „Real-time“ Alarme & Monitoring

- „Footprint“-Analysen
- Schnelle Schadenschätzung
- Steuerung Schadenschätzer
- Erkennung von Schadenmustern und Empfindlichkeiten
- Mitigation & Vorsorge

Quelle: Andreas Siebert, 2020

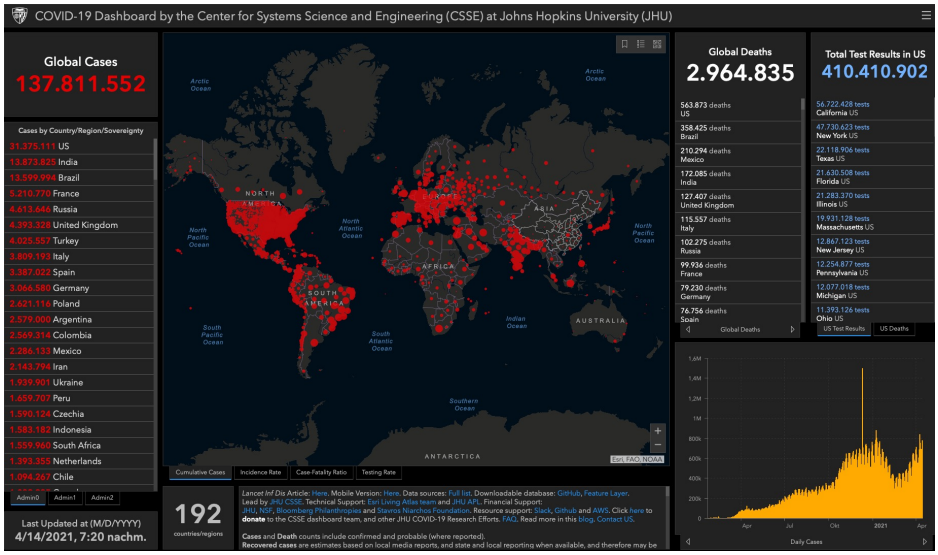
36

Global risks – Worldmap of Natural Hazards



37

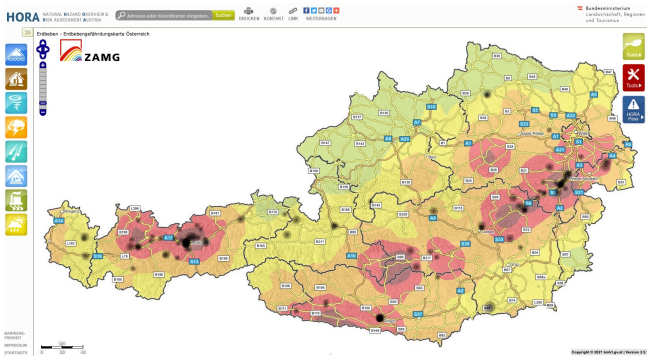
Global risks – Worldmap of COVID-19 pandemic 2021
State-of-the-art access to information via dashboards



Source: Johns Hopkins University, 2021

38

National Risk assessment platforms
HORA – Natural **H**azard **O**verview & **R**isk Assessment **A**ustria



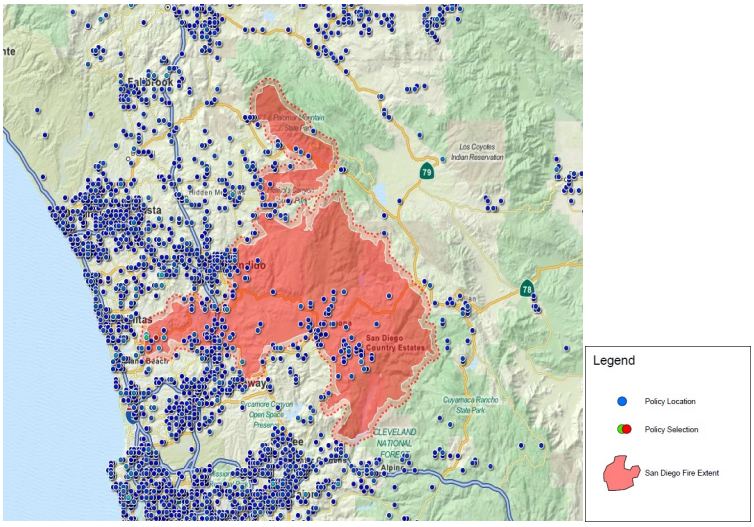
HORA is a multi-hazard risk assessment tool for Austria. This success story starts in 2006 giving unrestricted access to risk information for authorities and public.
HORA is an initiative between the BMLRT (Ministerium für Landwirtschaft, Regionen und Tourismus) and the Austrian Insurance Association (VVO) to mitigate and reduce losses.
In Germany there is a similar tool available, called ZÜRS (Zonierungssystem Überschwemmung, Rückstau und Starkregen). Both solution had initially their focus on flood and are multi-hazard tool today.

Scope: Austria
Access: free
Website: http://www.hora.gv.at/

Source: http://www.hora.gv.at

39

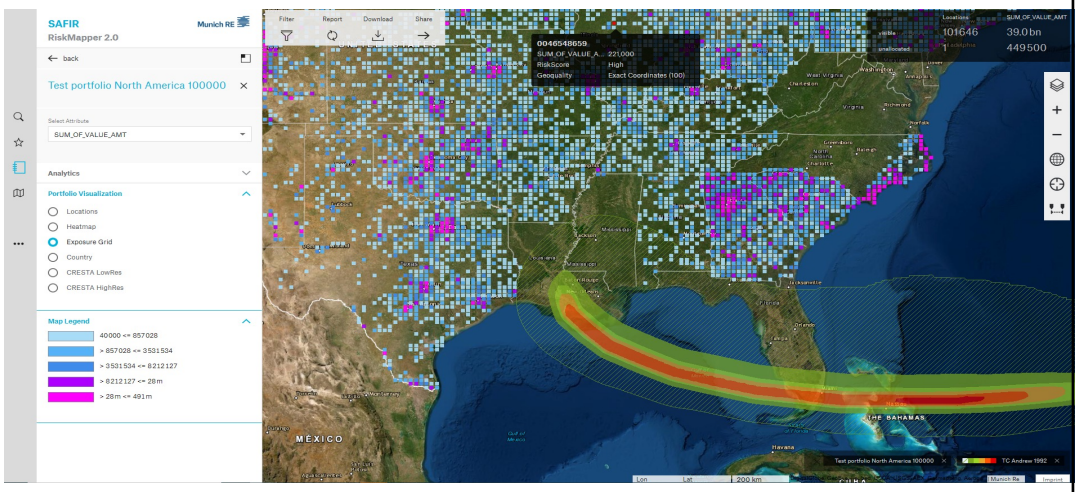
Post-disaster analytics
Claims management – Generating footprints for alerts



Source: Munich Re, Geospatial Solutions, 2018

40

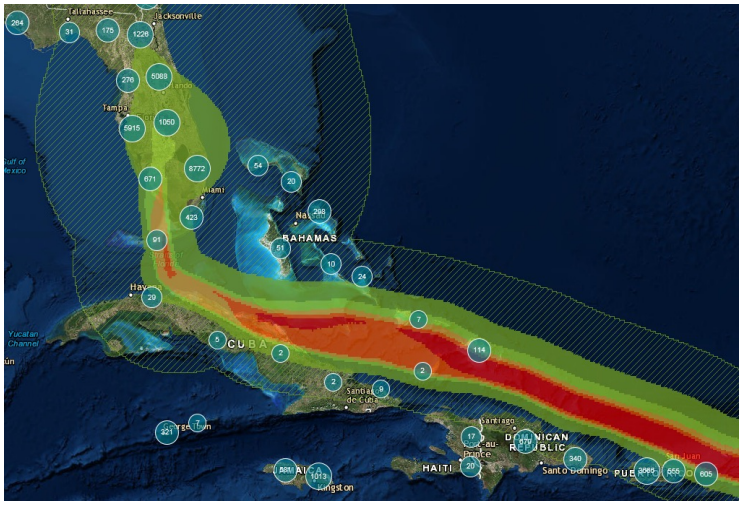
Post-disaster analytics
Real-time data supports „predictive analytics“



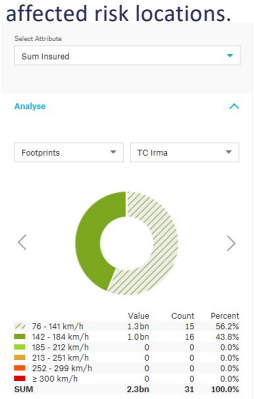
Quelle: Munich Re – Geospatial Solutions, 2020

41

Post-disaster analytics
Loss estimation after hurricane event



Exposure overlay with real-time event footprints to get a short-term estimation of affected risk locations.



Source: https://www.rms.com/solutions/catastrophe-modeling, 2020

42

Risk communication
Story maps to pitch and communicate analytical results

Source: Munich Re, Geospatial Solutions, 2016

43

44

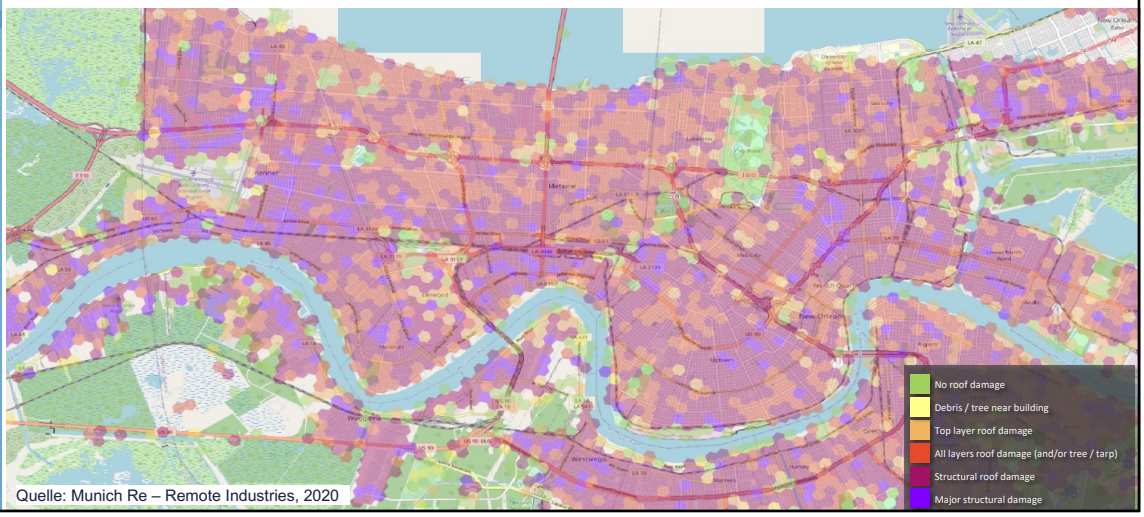
Emerging risks
Top 10 emerging risk

1. Climate Change
2. Cybersecurity Risks
3. Geopolitical Instability
4. Social Discontent and Local Conflicts
5. Natural Resources Management
6. Artificial Intelligence and Big Data
7. Pollution
8. Pandemics and Infectious Diseases
9. New Threats to Security
10. Macroeconomic Risks

Source: AXA, Emerging Risk survey, 2019

45

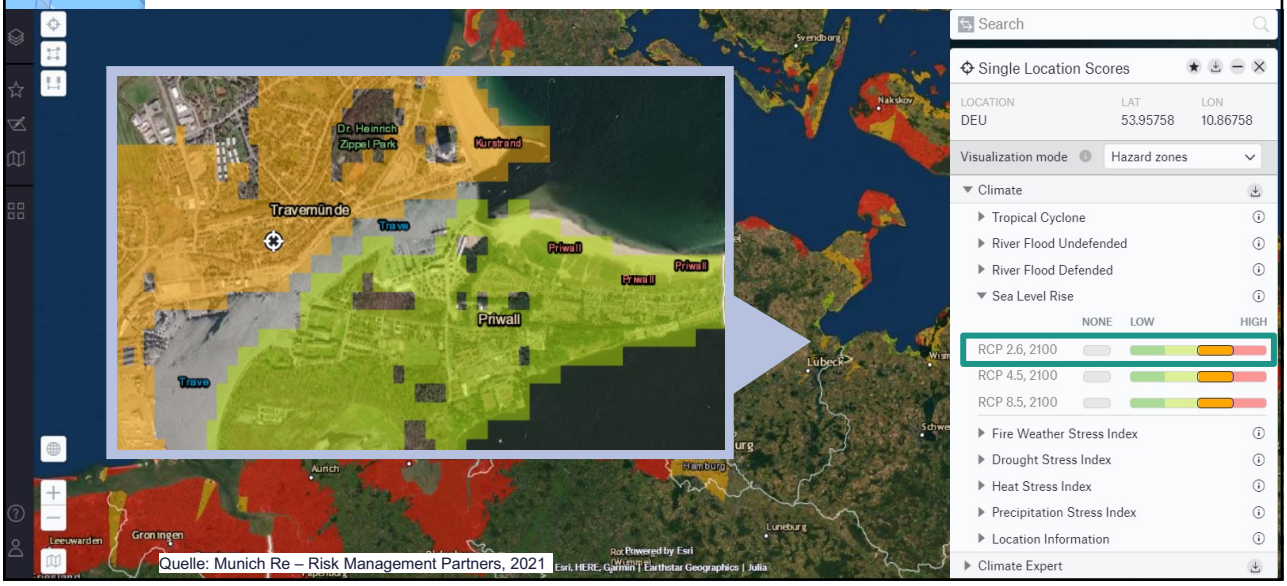
Methodik: AI-gestützte Klassifizierung von Gebäudeschaden
Heatmap zur Optimierung der Ressourcensteuerung vor Ort



Quelle: Munich Re – Remote Industries, 2020

46

Daten-Erweiterungen
Klima-Risikobewertung: erwarteter Meeresspiegelanstieg



Quelle: Munich Re – Risk Management Partners, 2021

47

Bedeutende Geo-Analyse-Trends für das Risiko-Management

- Daten: Genauere Daten für das „Klima-Modul“ und mehr Echtzeit-Analysen
- Zugriff: WebServices (APIs) erweitern den Nutzerkreis erheblich
- Methoden: Künstliche Intelligenz, Machine Learning
- Analytics: Dashboards mit Karten-Komponenten und Management-View
- Innovation: Internet of Things, BIM, ESG
- Integration: Business & Location Intelligence + Data Analytics „verschmelzen“

GIS-Technologien sind heute ein substantieller Bestandteil im Risiko-Management. Die Verbindung mit Data Analytics und Geo AI ist der nächste logische Schritt.

48

Master Student Training
Disaster Risk Management with Geo-Analytics

Modul 1: Core information on disaster risk management
- Terminologies and basic concepts of risk management and geoanalytics
- The importance of spatial data and solutions
- Risk landscape: A global view on risk awareness, assessment and changes
- Disaster management cycle (process and steps)

Modul 2: Geospatial information technology and data for disaster risk management
- Elements-at-risk: what is exposed to hazards?
- Overview of geospatial data and sources for risk management (incl. free and open source tools)
- Classification of natural hazards and man-made disasters
- Global catastrophe statistics and trends in losses (facts & figures)

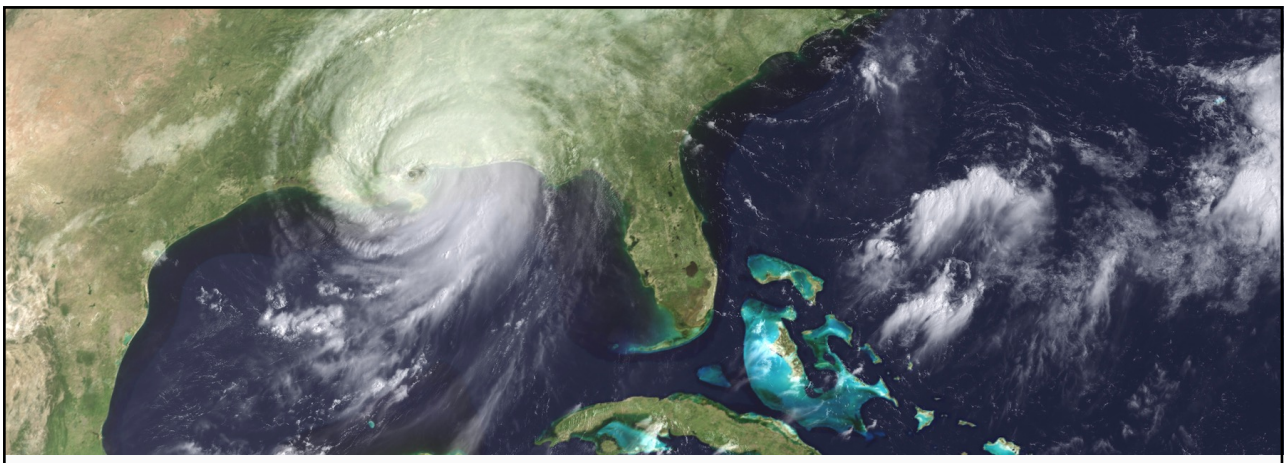
Modul 3: Risk management of natural hazards with geospatial information
- Pre-disaster risk assessment (risk identification, vulnerability and evaluation)
- Post-disaster impacts and damage analysis
- Real-time alerts and emergency response
- Multi-hazard risk assessment

Modul 4: Economic impact of disasters
- Stakeholders and roles in the risk management process
- Geospatial solutions and requirements from (re)insurance industry
- The risk management framework
- Cost-benefit analysis
- Risk communication and mitigation (resilience)
- Emerging risks and expected trends with geospatial components

EsriKon 2021 – Interview Andreas Siebert
https://www.youtube.com/watch?v=XG5u-uN8zP4

Source: Andreas Siebert, 2022

49



Besten Dank für Ihre Aufmerksamkeit !

Andreas Siebert
Email: Andreas.Siebert@siriscon.com
Linkedin: https://de.linkedin.com/in/andreassiebert

50