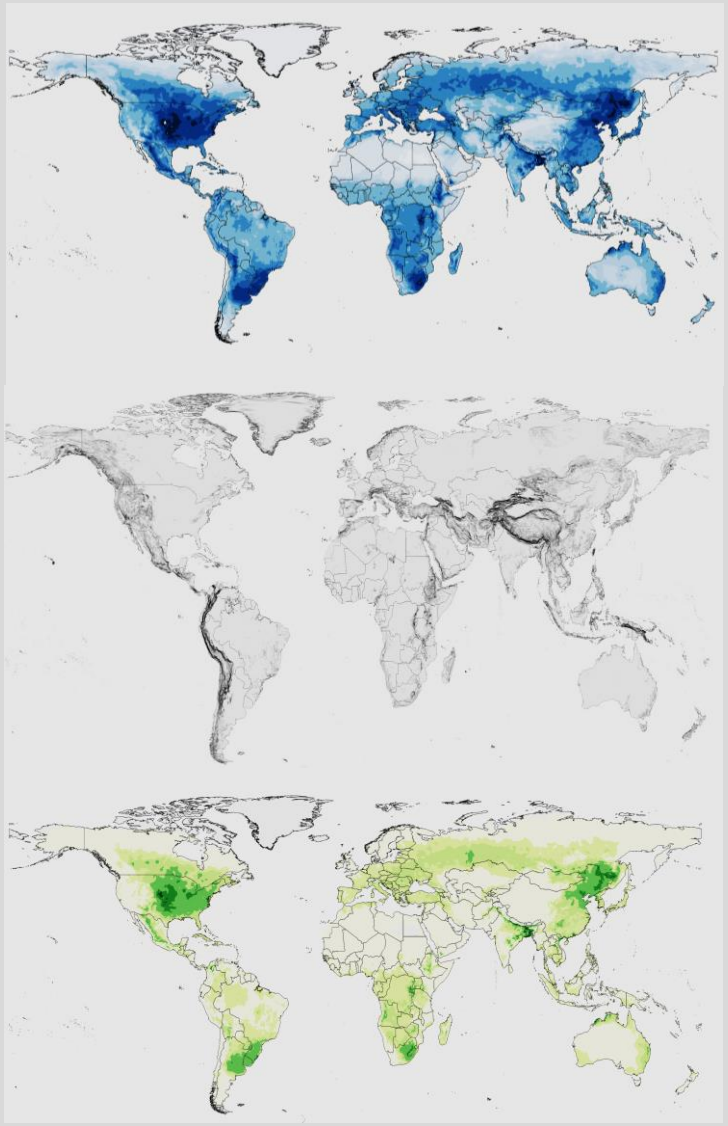


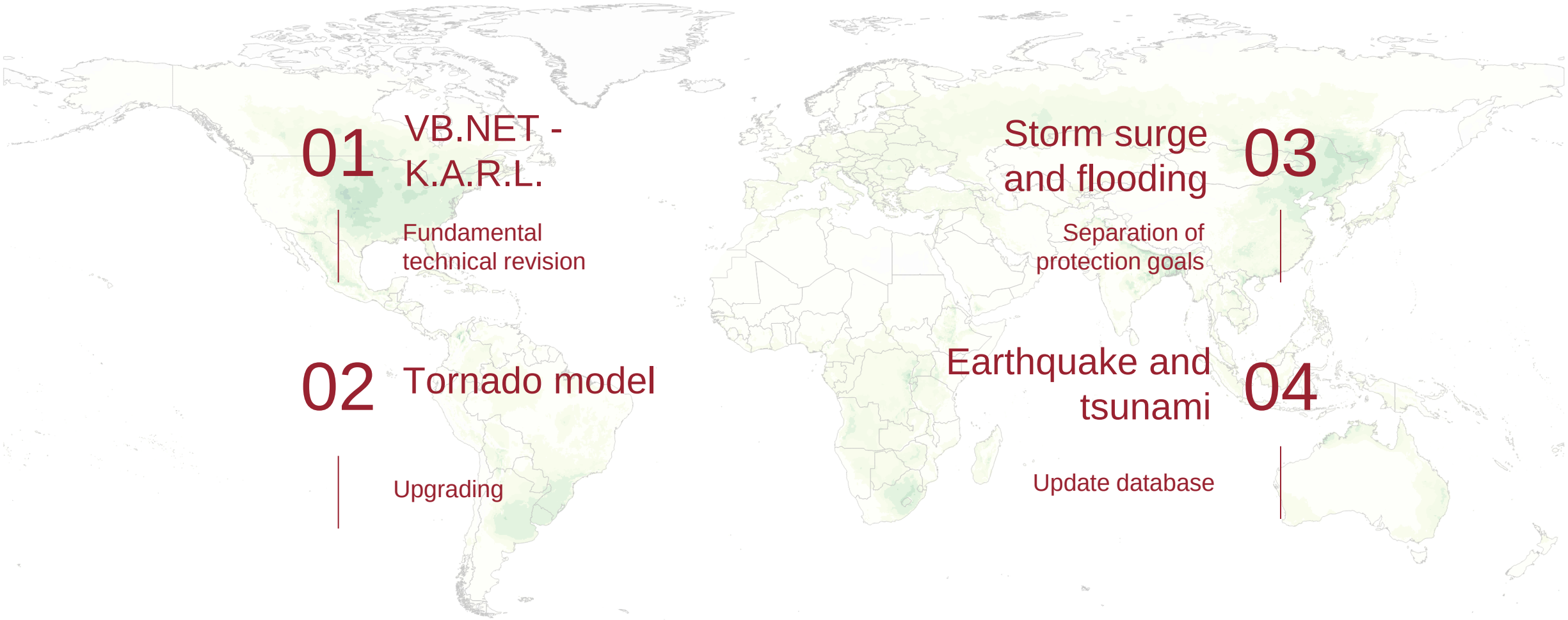
KA Köln.Assekuranz Agentur

Ein Unternehmen der ERGO

K.A.R.L.®
Release

April 2022

Agenda



01 VB.NET - K.A.R.L.

Fundamental technical revision

02 Tornado model

Upgrading

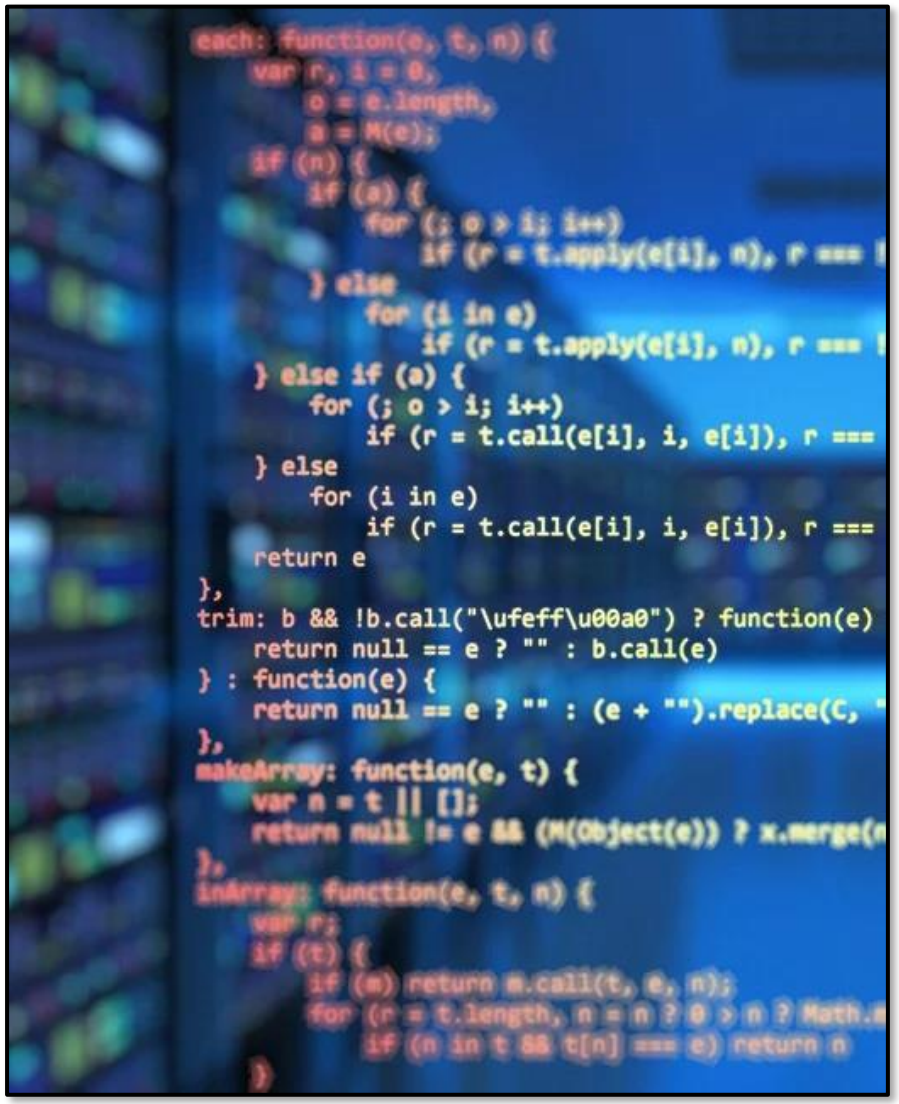
Storm surge and flooding 03

Separation of protection goals

Earthquake and tsunami 04

Update database

Fundamental technical revision of K.A.R.L.



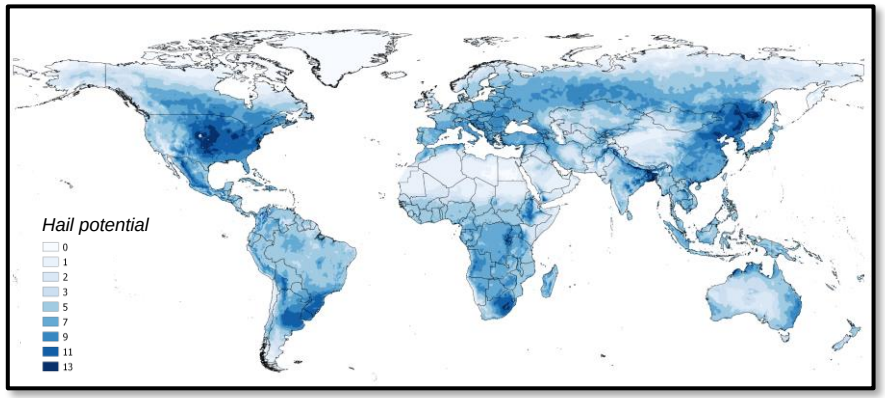
- Conversion of the K.A.R.L. source code from Visual Basic Classic 6.0 (year of publication 1991) to Visual Basic.NET (technical status 2021)
- The changeover eliminates minor rounding errors (effect on risks in the 4th decimal place range) that are based on an error in the Visual Basic 6.0 compiler
- Ensuring the future viability of the K.A.R.L. computing core in the longer term
- The system becomes more maintenance-friendly overall, which leads to shorter release cycles
- Compilation as 64-bit application for better memory management and thus higher processing speed

Tornado model

K.A.R.L.'s tornado model is roughly based on two assumptions

Hail potential

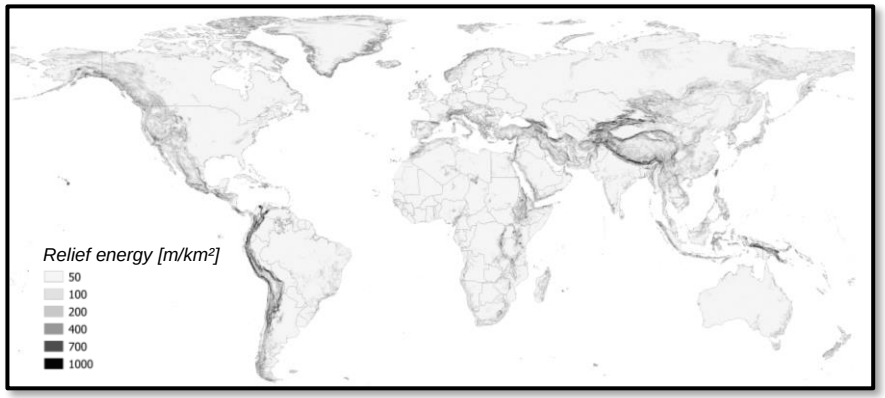
Tornado frequency correlates with the frequency of hail events.



Hail potential - Unitless indicator representing different probabilities for the occurrence of hail events.

Relief energy

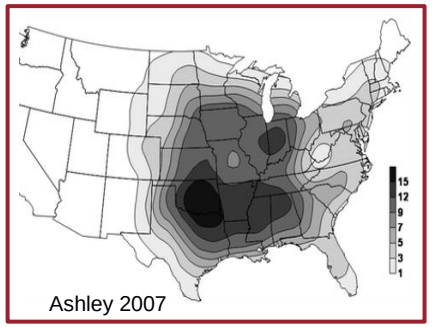
The frequency of tornadoes depends on the relief energy.



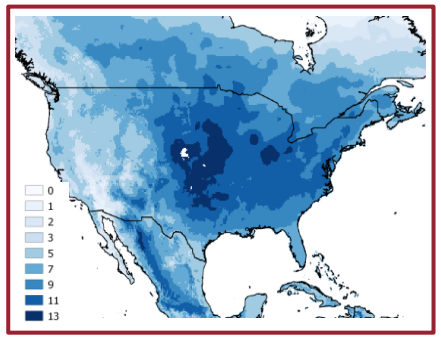
Relief energy - Relative height differences of a terrain - independent of the absolute height above sea level. Potential energy of terrain forms in m/km².

With the help of these two assumptions, worldwide tornado frequencies can be estimated.

Revision of the Tornado model

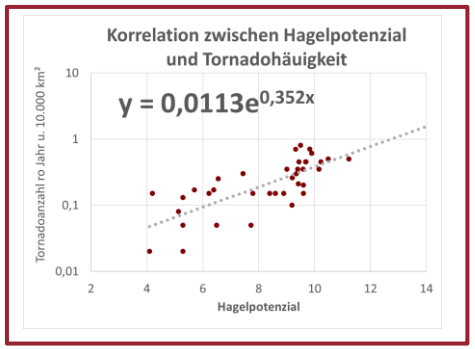


Tornado frequencies in the USA



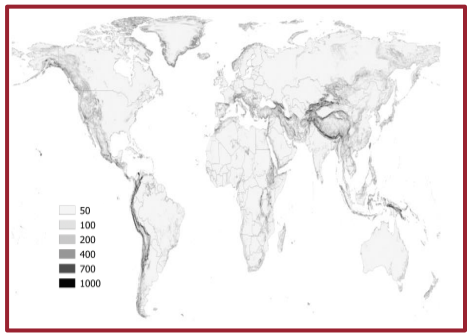
K.A.R.L. hail potential in the USA

1. Correlation analysis



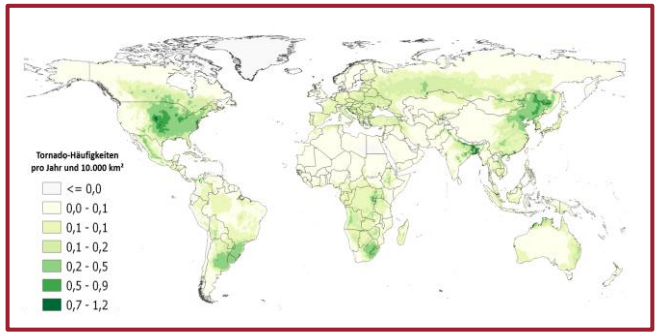
Correlation between hail potential and tornado frequencies in the U.S.

2. Adjustment to relief energy



Relief energy

3. Results

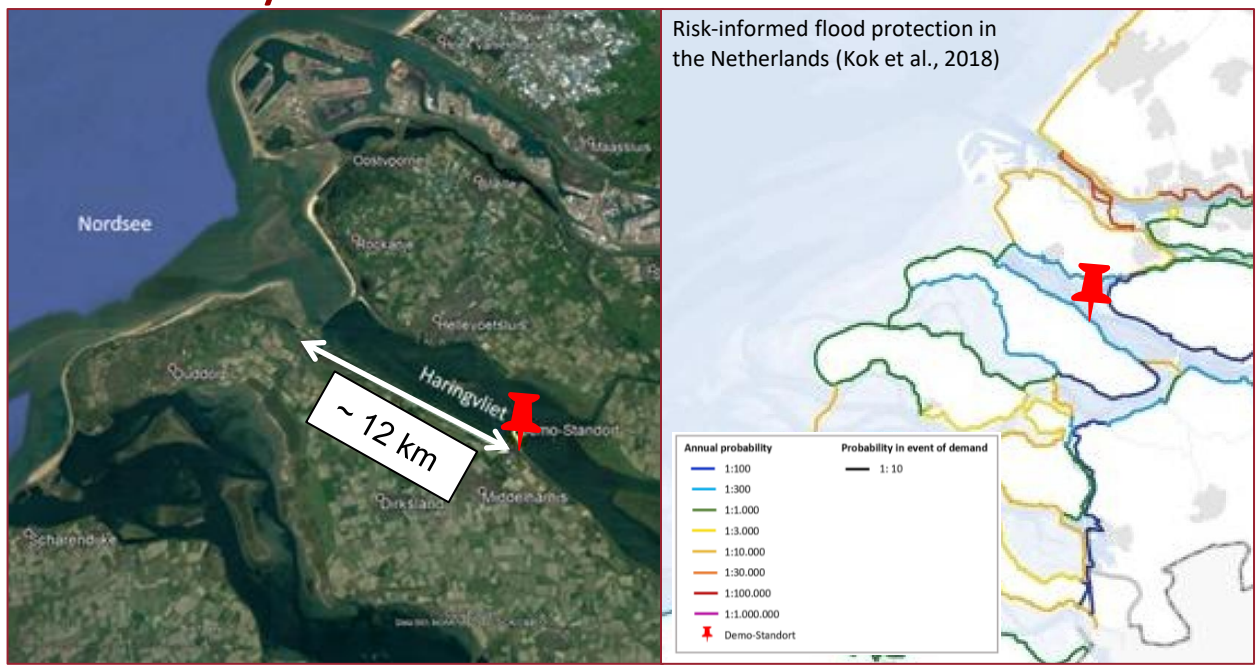


Global tornado frequencies

Separation of the protection goals for storm surge and flooding

By separating the protection goals for storm surge and river flood, different protection goals can now be taken into account for sites that are exposed to both flood and storm surge hazards.

Case study at the Dutch North Sea coast



Flood risk before release: : **0.0348 % p.a.**

Assumption of a **1000-year protection goal** (derived from storm surge protection goal)

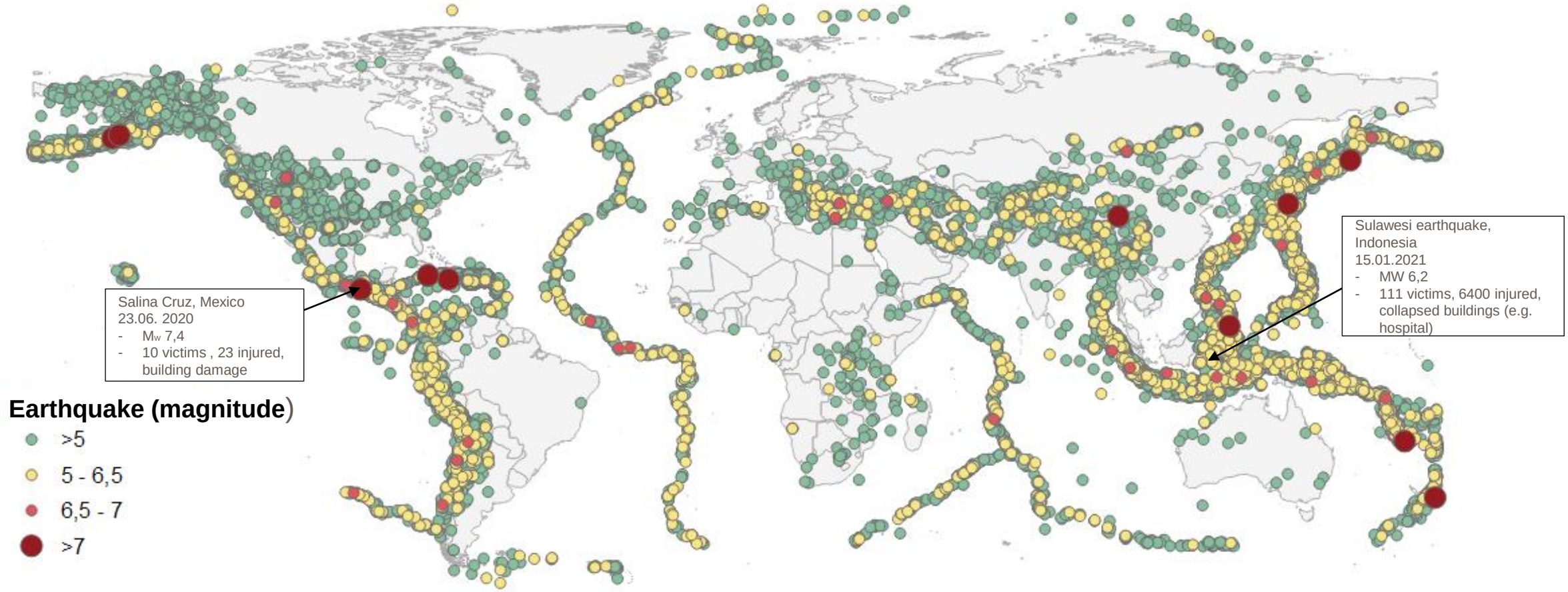
Flood risk of new **K.A.R.L.**:

0.065 % p.a.

Assumption of a **300-year protection goal**

Update earthquake database

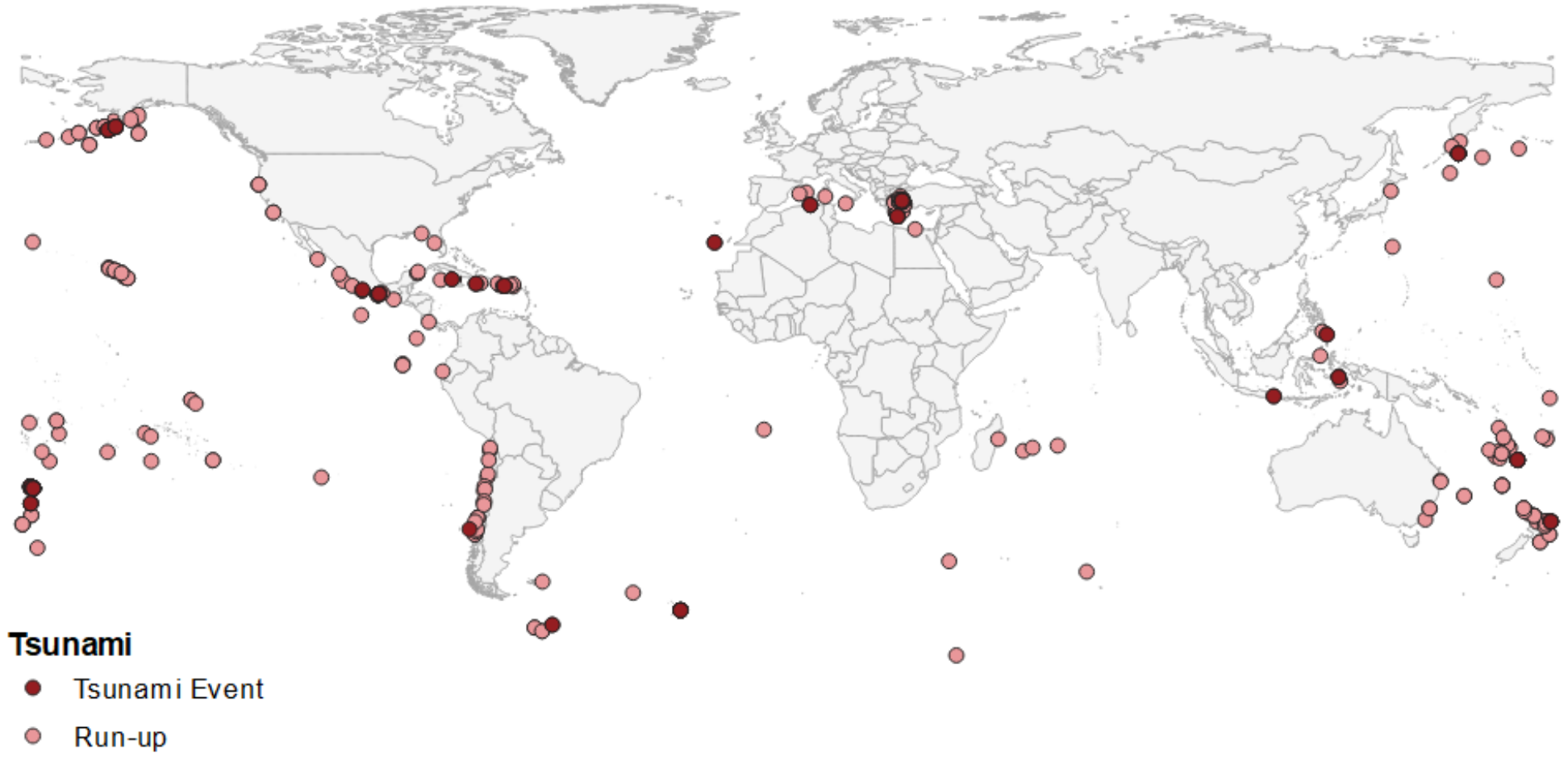
Recorded earthquakes since the last release in 2019
Database: U.S. Geological Survey



Update Tsunami database

Recorded tsunamis since the last release in 2019

Database: NOAA (National Centers for Environmental Information)



Impressum

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