Risk workflow for **CAS**cading and **CO**mpounding hazards in **CO**astal urban areas

- CASCO -

Cecilia I. Nievas[1], Laurens M. Bouwer[2], **Morelia Urlaub**[3], Alexey Androsov[4], Andrey Babeyko[1], Christian Berndt[3], Fabrice Cotton[1], Juan Camilo Gomez-Zapata[1], Jens Karstens[3], Heidrun Kopp[3], Danijel Schorlemmer[1], Hui Tang[1]

23 May 2022

[1] GFZ, [2] GERICS (HEREON), [3] GEOMAR, [4] AWI

GFZ Helmholtz Centre Potsdam GEOMAR Helmholtz-Zentrum hereon AWI HELMHOLTZ

GFZ Helmholtz Centre Potsdam

GEOMAR

Helmholtz-Zentrum hereon

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

HELMHOLTZ

GFZ Helmholtz Centre Potsdam

GEOMAR

Helmholtz-Zentrum hereon

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

HELMHOLTZ

GFZ Helmholtz Centre Potsdam
GEOMAR
Helmholtz-Zentrum hereon
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ

M_w 6.6 Samos earthquake
30 October 2020

Anadolu Agency/Getty Images

M_w 7.1 Messina earthquake
28 December 1908

Borg et al. (2015)

EARTHQUAKE

Mt. Etna, southern Italy

GFZ Helmholtz Centre Potsdam

GEOMAR

Helmholtz-Zentrum hereon

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

HELMHOLTZ

GFZ Helmholtz Centre Potsdam
GEOMAR
Helmholtz-Zentrum hereon
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ

Michael Svarnias/AP

Samos tsunami
30 October 2020

EARTHQUAKE

TSUNAMI

LANDSLIDE

Mt. Etna, southern Italy

GFZ Helmholtz Centre Potsdam

GEOMAR

Helmholtz-Zentrum hereon

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

HELMHOLTZ

Heat wave in Sicily
August 2021

Italy's news in English
THE LOCAL it
Covid-19 Practical tips Learn about Italy Italian language Jobs

CLIMATE

SHARE COPY LINK

HEATWAVE: Italy set to report new European record high temperature at 48.8C

Regional authorities in Sicily recorded a temperature reading of 48.8 degrees Celsius (119.8 Fahrenheit) on Wednesday, amid an extreme heatwave dubbed "Lucifer".

Published: 11 August 2021 18:32 CEST

HEAVY RAINFALL and/or HEAT WAVE

EARTHQUAKE

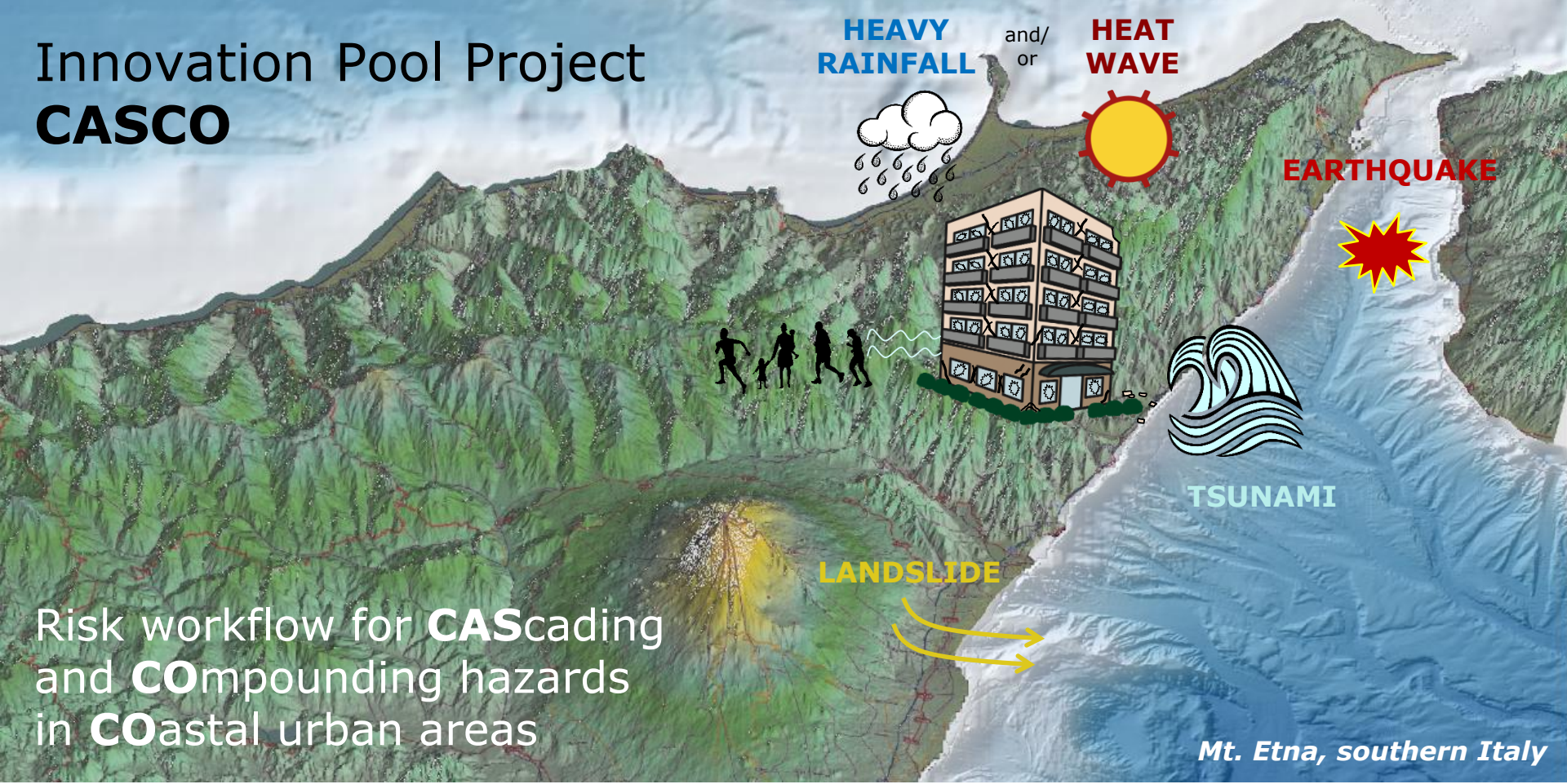
TSUNAMI

LANDSLIDE

Mt. Etna, southern Italy

GFZ Helmholtz Centre Potsdam
GEOMAR
Helmholtz-Zentrum hereon
AWI ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ

Innovation Pool Project
CASCO



Risk workflow for **CAS**cading and **CO**mpounding hazards in **CO**astal urban areas

Mt. Etna, southern Italy

GFZ Helmholtz Centre Potsdam | GEOMAR | Helmholtz-Zentrum hereon | ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG | HELMHOLTZ

Innovation Pool Project
CASCO

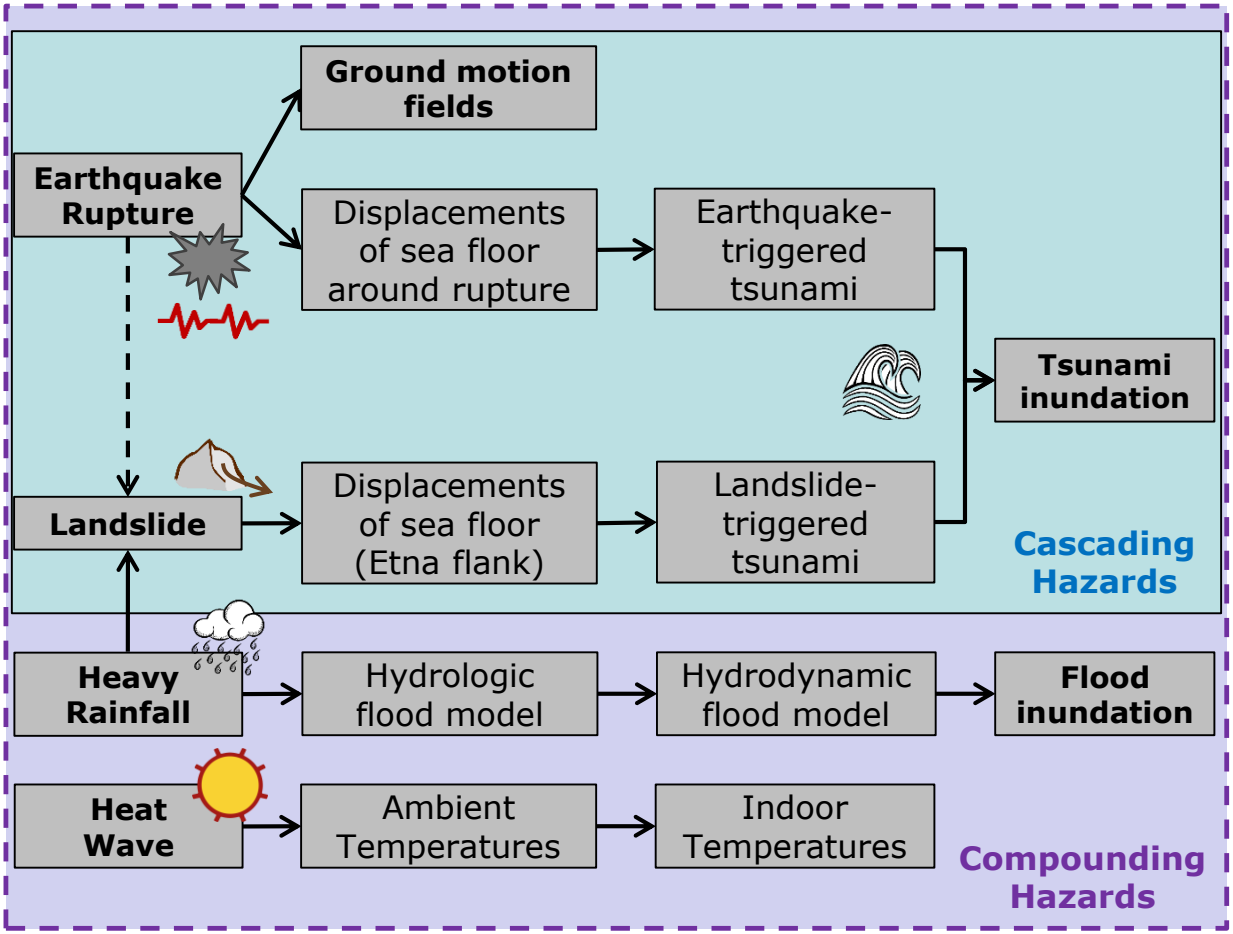
Our central research question:

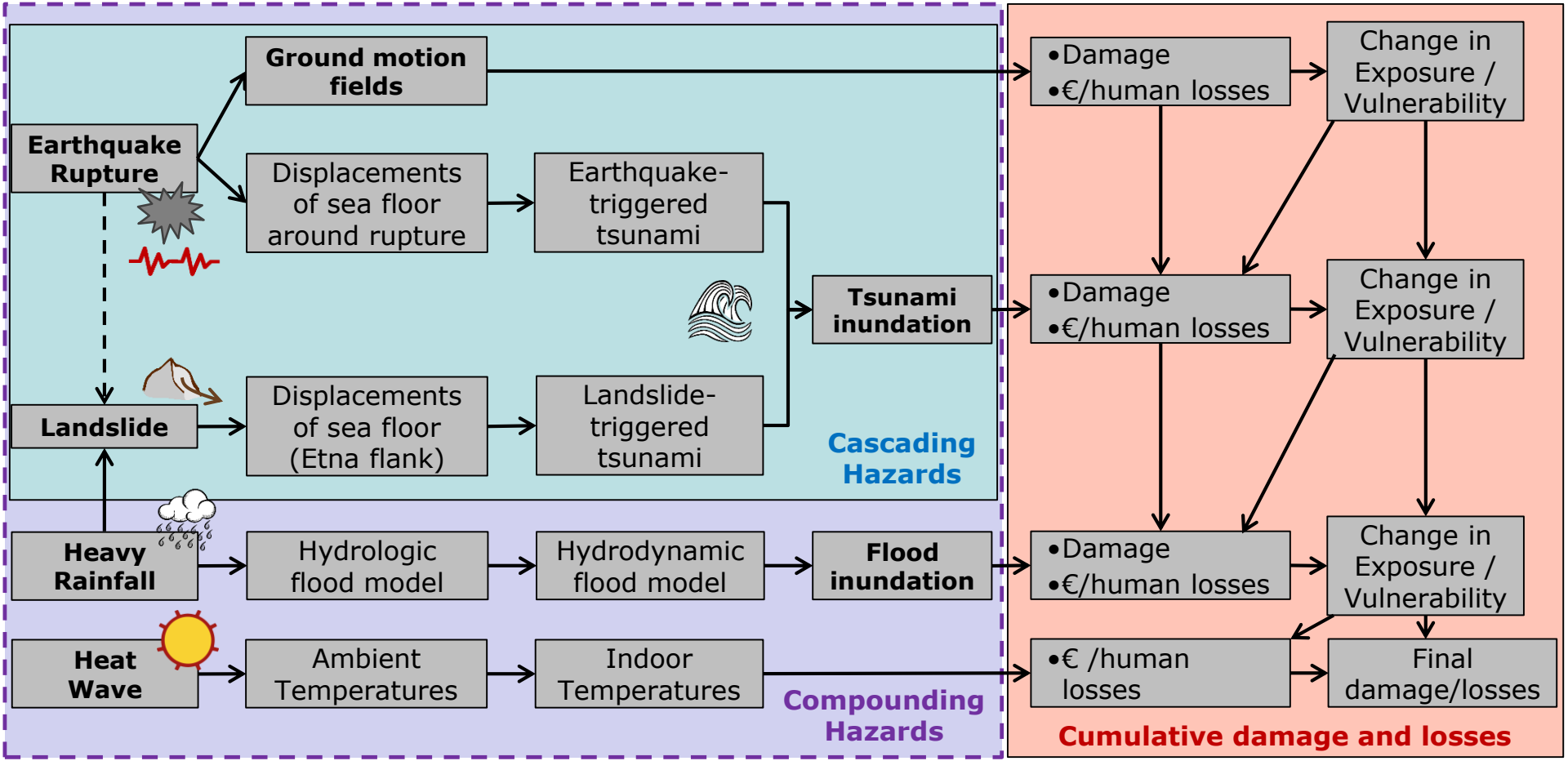
*How can a **single workflow** be defined*

*that simulates the **full risk chain**—*
*from geophysical and climatic **hazards***
***to impacts and responses**—*

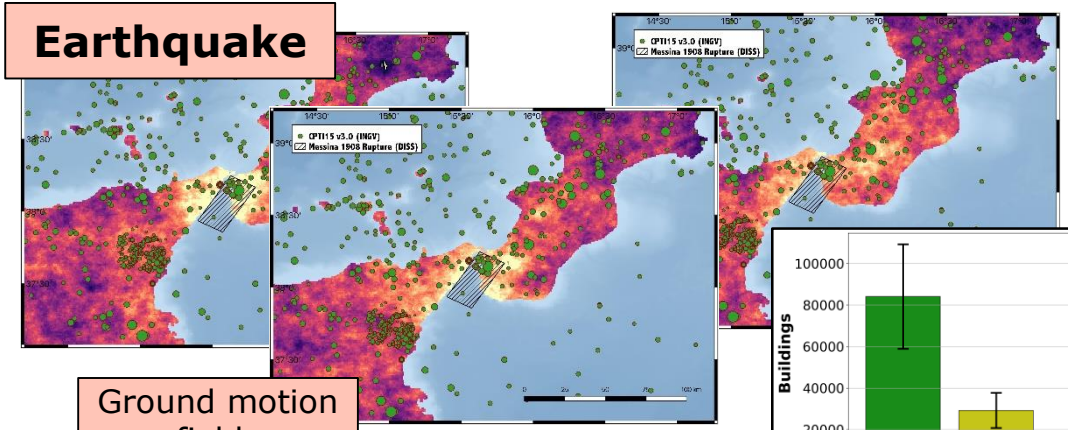
*to provide comprehensive insights on the **effects of***
extreme compounding and cascading events
***and their cumulative impacts** in urban areas?*

GFZ Helmholtz Centre Potsdam
GEOMAR
Helmholtz-Zentrum hereon
ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ

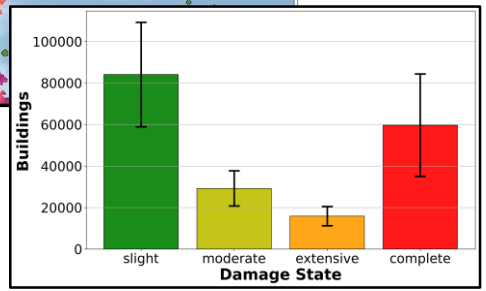

Ground motion fields
Earthquake Rupture
Displacements of sea floor around rupture
Earthquake-triggered tsunami
Tsunami inundation
Landslide
Displacements of sea floor (Etna flank)
Landslide-triggered tsunami
Cascading Hazards
Heavy Rainfall
Hydrologic flood model
Hydrodynamic flood model
Flood inundation
Heat Wave
Ambient Temperatures
Indoor Temperatures
Compounding Hazards


Ground motion fields
Earthquake Rupture
Displacements of sea floor around rupture
Earthquake-triggered tsunami
Tsunami inundation
Landslide
Displacements of sea floor (Etna flank)
Landslide-triggered tsunami
Cascading Hazards
Heavy Rainfall
Hydrologic flood model
Hydrodynamic flood model
Flood inundation
Heat Wave
Ambient Temperatures
Indoor Temperatures
Compounding Hazards
•Damage
•€/human losses
Change in Exposure / Vulnerability
•Damage
•€/human losses
Change in Exposure / Vulnerability
•Damage
•€/human losses
Change in Exposure / Vulnerability
•€ /human losses
Final damage/losses
Cumulative damage and losses

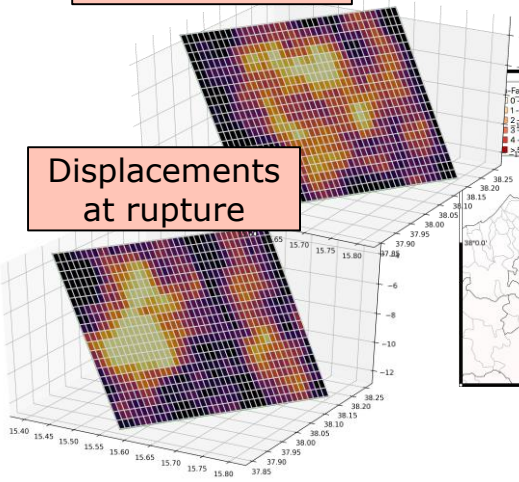
Earthquake

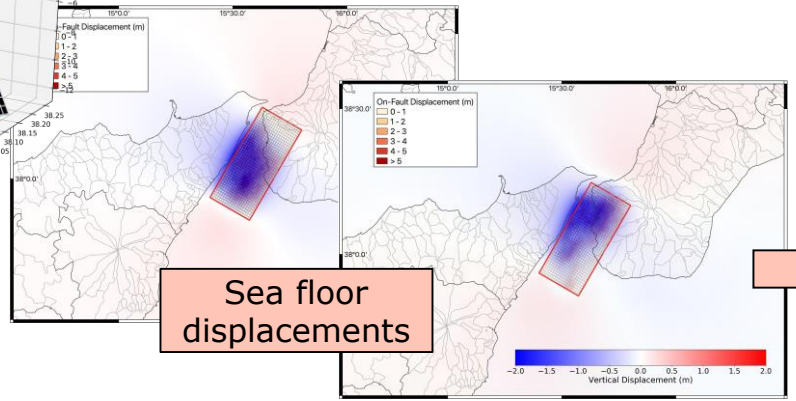


Ground motion fields



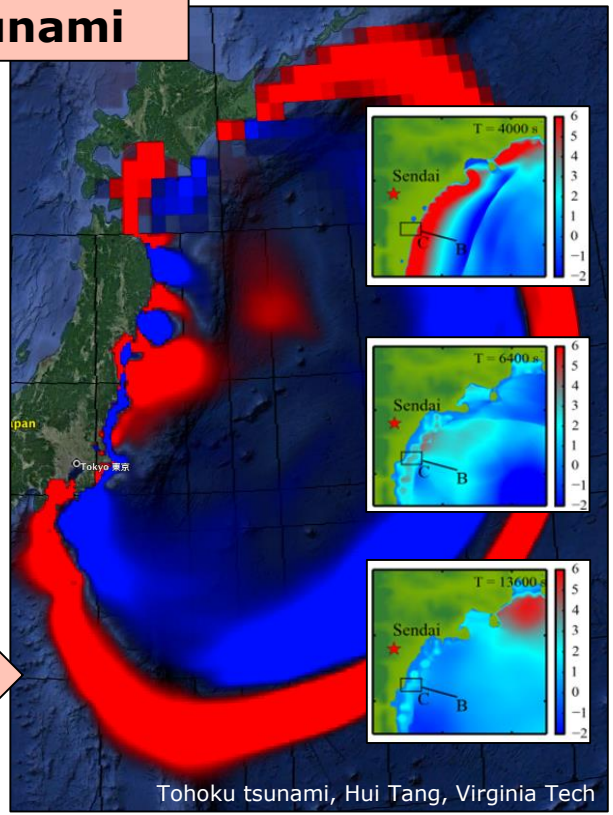
Displacements at rupture





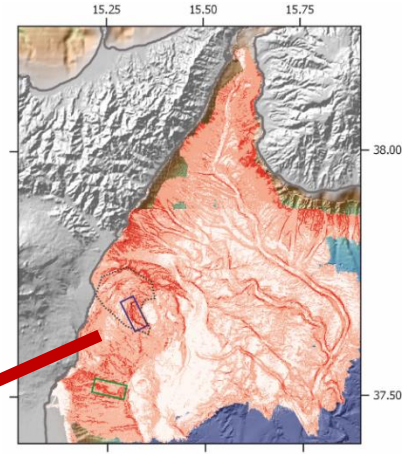
Sea floor displacements

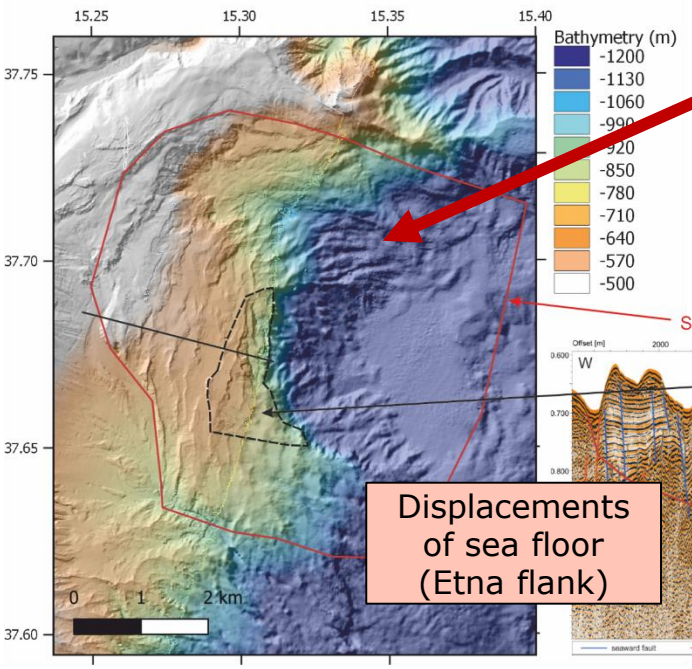
Earthquake -triggered Tsunami

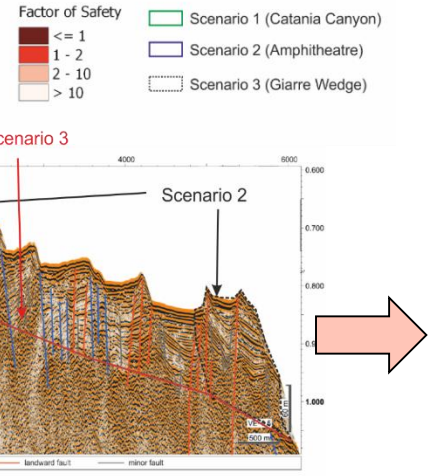


Landslide

Scenarios based on factor of safety

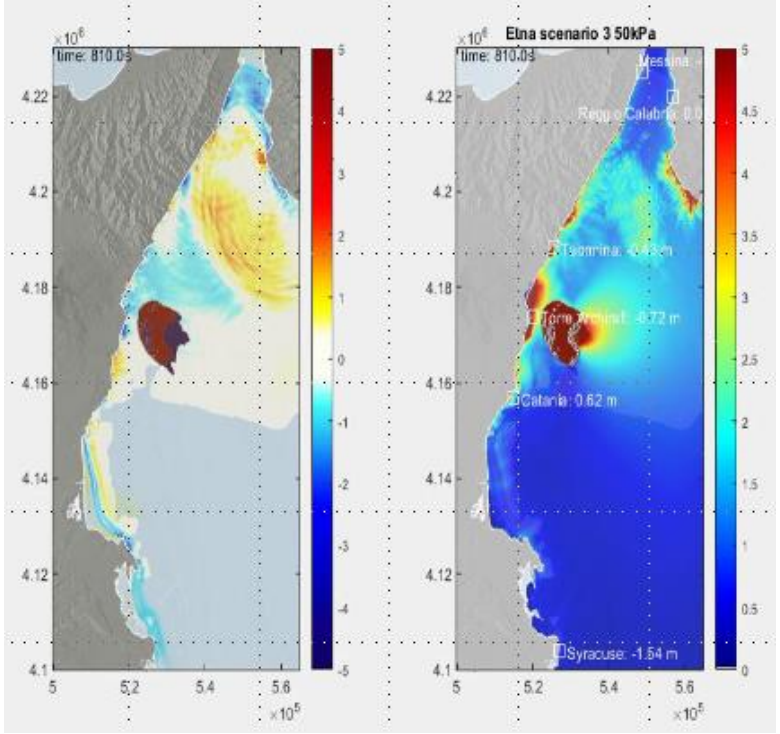






Displacements of sea floor (Etna flank)

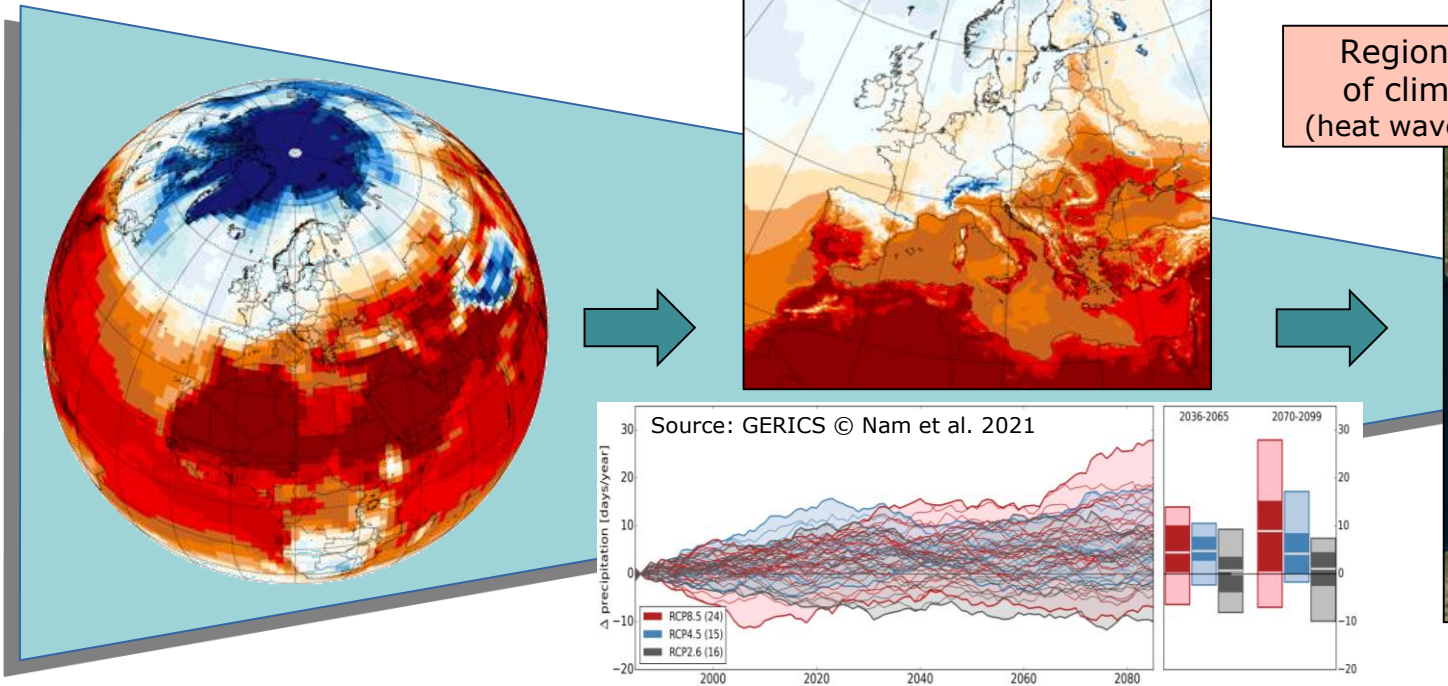
Landslide -triggered Tsunami



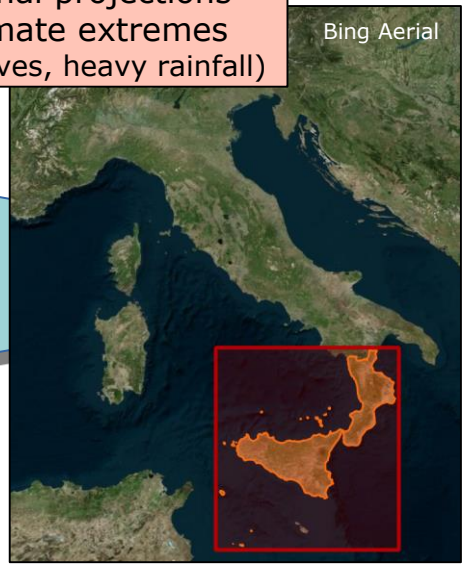
GEOMAR
GFZ Helmholtz Centre Potsdam
AWI
Helmholtz-Zentrum hereon
ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
HELMHOLTZ

Climate Extremes

GERICS Climate Service Center Germany



Regional projections of climate extremes (heat waves, heavy rainfall)



Global climate simulations (CMIP)

~200 km resolution

Regional climate simulations (EURO-CORDEX)

~12.5 km resolution

CASCO domain: Sicily and Calabria

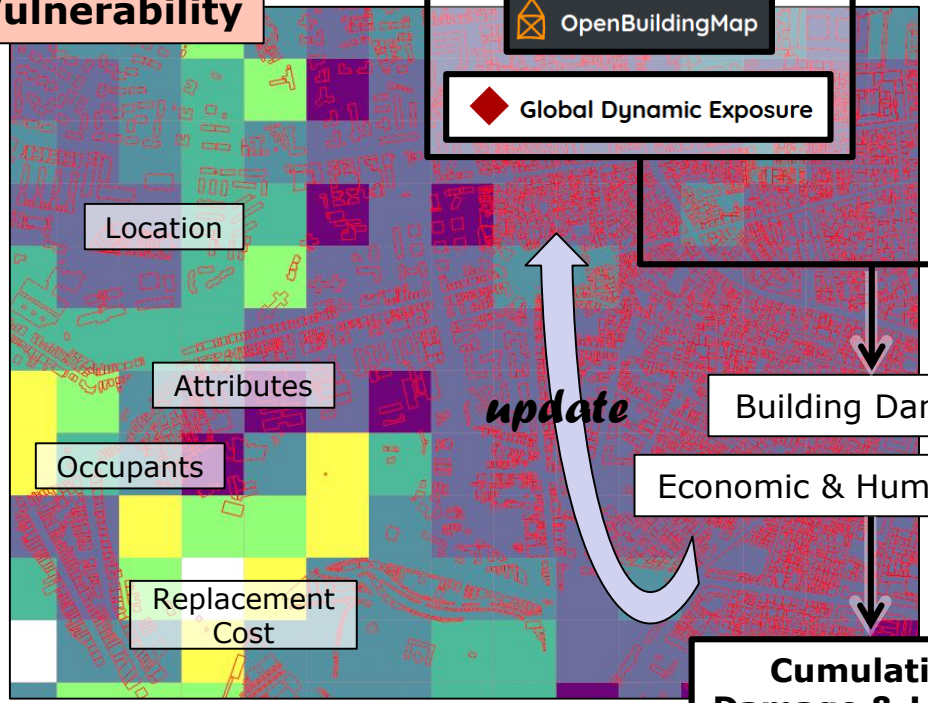
GFZ Helmholtz Centre Potsdam · GEOMAR · Helmholtz-Zentrum hereon · AWI Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung · HELMHOLTZ

Consequence Modelling

GFZ Helmholtz Centre Potsdam

GERICS Climate Service Center Germany

Exposure & Vulnerability



Exposure Dataset

OpenBuildingMap

Global Dynamic Exposure

Fragility/ Vulnerability Models

update

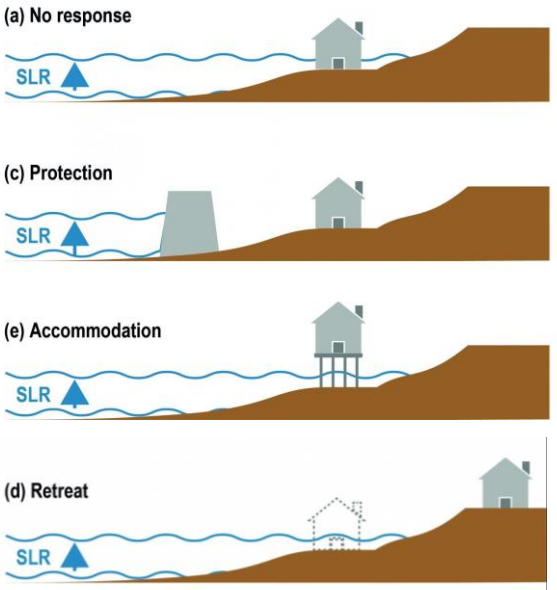
Building Damage

Economic & Human Losses

update

Cumulative Damage & Losses

Medium- to Long-Term Response



Source: IPCC SROCC (Box 4.3), 2019

GFZ Helmholtz Centre Potsdam · GEOMAR · Helmholtz-Zentrum hereon · AWI Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung · HELMHOLTZ

Our Innovative Points

Estimating consequences due to the occurrence of compounding geophysical and climatic events.

Working on extreme event scenarios that are not commonly studied, going past classical earthquake-only, earthquake-plus-tsunami, or climatic-only scenarios.

Our Innovative Points

Estimating consequences due to the occurrence of compounding geophysical and climatic events.

Working on extreme event scenarios that are not commonly studied, going past classical earthquake-only, earthquake-plus-tsunami, or climatic-only scenarios.

Characterising exposure and vulnerability for multi-hazard applications, accounting for cumulative effects.

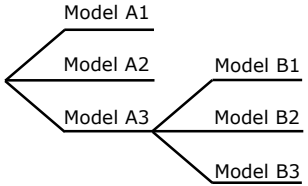
Our Innovative Points

Estimating consequences due to the occurrence of compounding geophysical and climatic events.

Working on extreme event scenarios that are not commonly studied, going past classical earthquake-only, earthquake-plus-tsunami, or climatic-only scenarios.

Characterising exposure and vulnerability for multi-hazard applications, accounting for cumulative effects.

Propagating uncertainties along the whole risk chain.



Thank you!

GFZ Helmholtz Centre Potsdam

GEOMAR

Helmholtz-Zentrum hereon

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

HELMHOLTZ