A Global Landslide Non-Susceptibility Map

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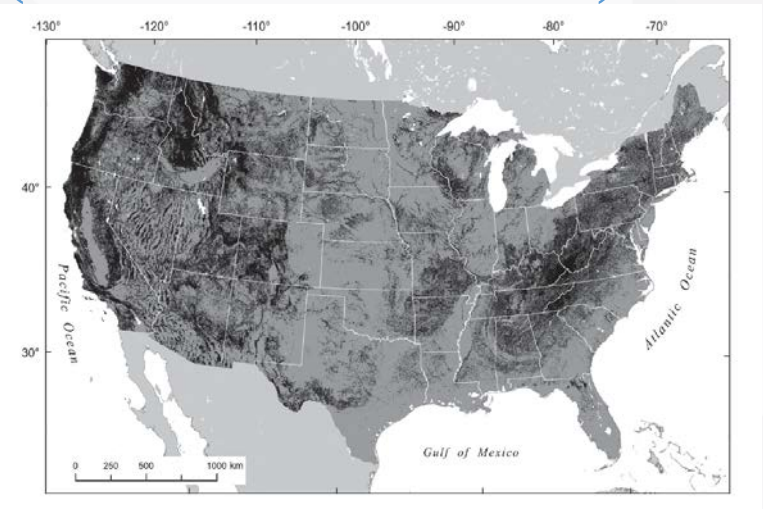
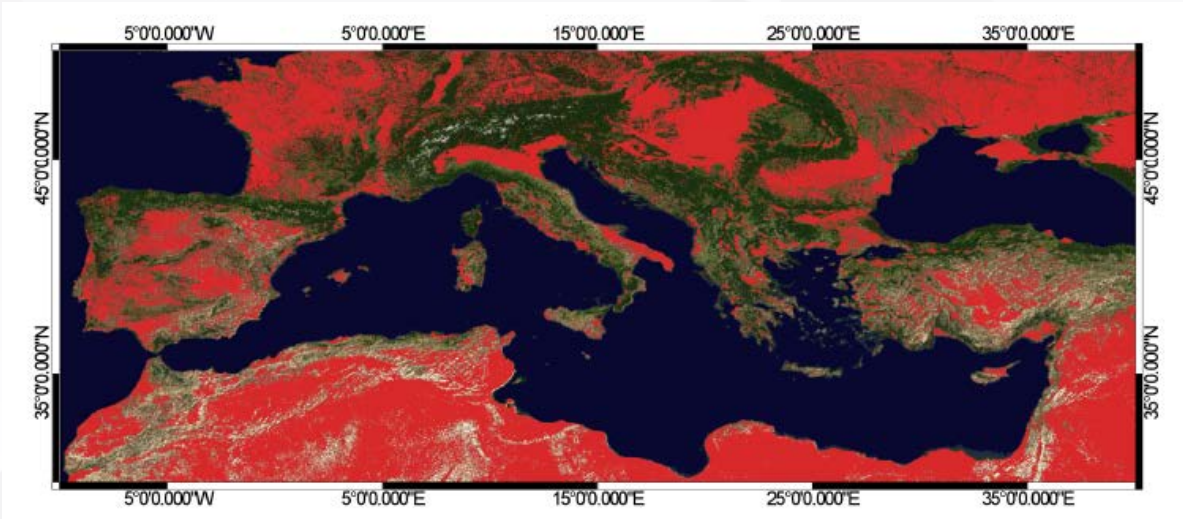
EGU2020-10285

1. What is non-susceptibility?

- To define the areas with negligible likelihood of landslide occurrence (Godt et al. 2012)
- To define the areas where susceptibility to landslides is expected to be “negligible” (Marchesini et al. 2014)



Non-non-susceptibility map in the USA
Derived from Godt et al. (2012)

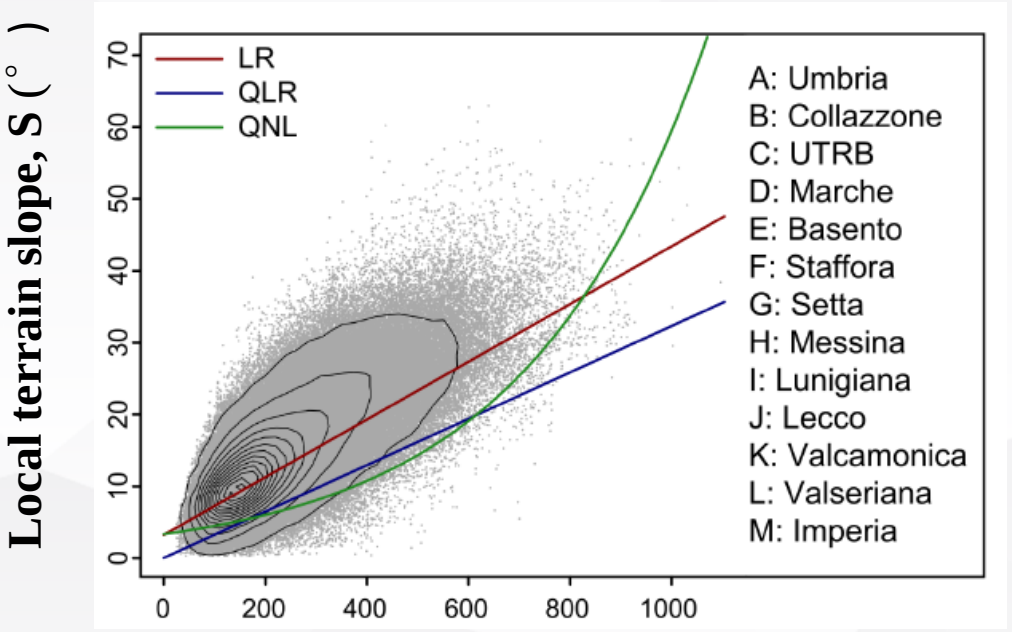


Non-non-susceptibility map in the Mediterranean region
Derived from Marchesini et al. (2014)

- Non-susceptibility analyses are simple only by using morphometric information and could be a practical proxy for susceptibility analysis.

2.1 The quantile non-linear non-susceptibility (QNL) model

➢ proposed by Marchesini et al. (2014) and validated with ~6% false positive rate by using a relatively complete Italy landslide inventory



Derived from Marchesini et al. (2014)

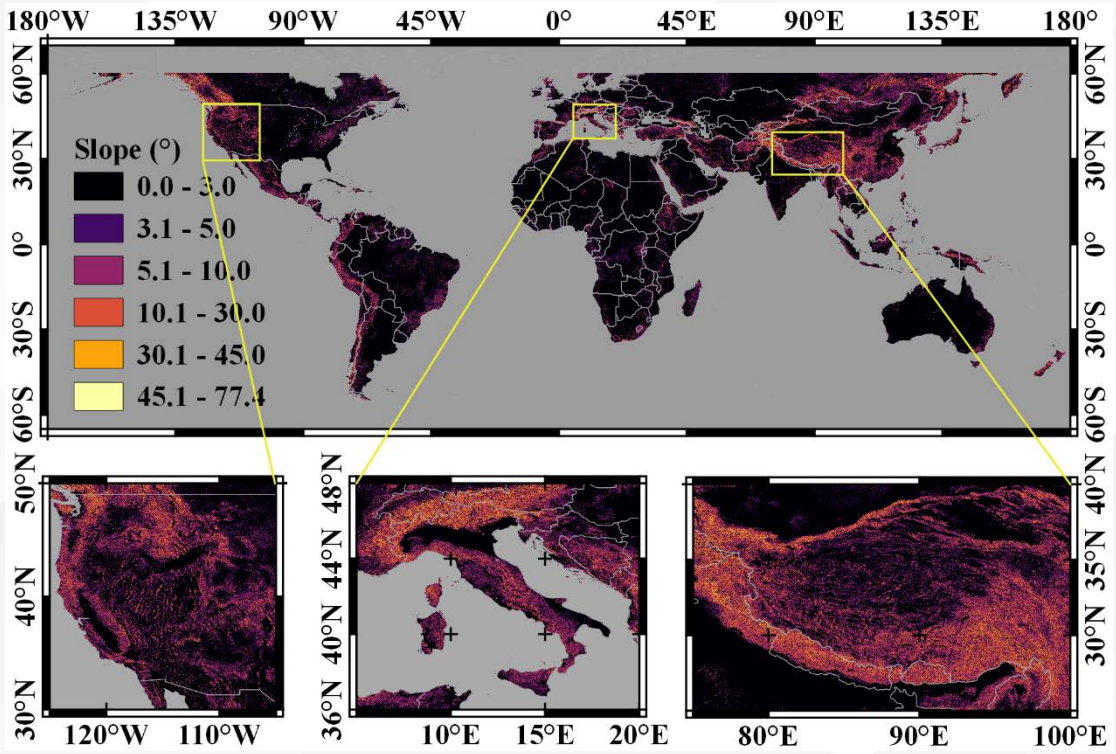
➢ Relief and slope are calculated based local analyses from DEM data.

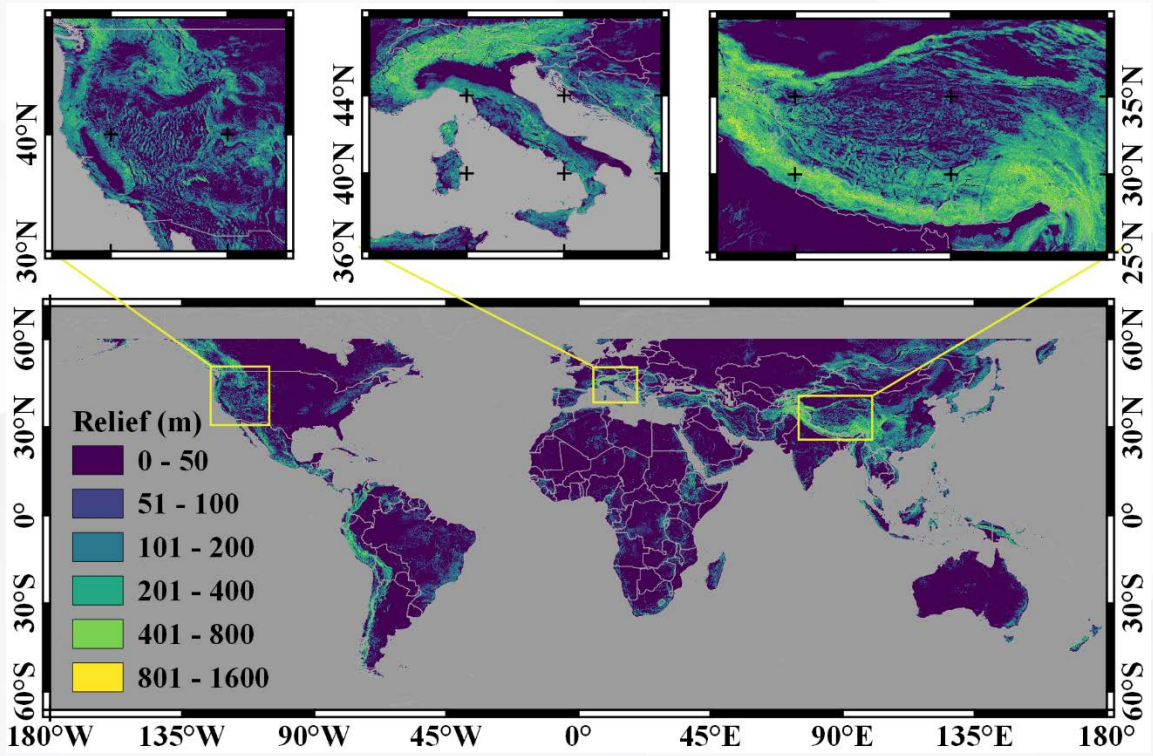
- ◆ Slope: considering the different sizes of DEM pixels and calculated based on latitude and longitude
- ◆ Relief: derived within about ~1km×1km window (15 ×15 pixels)
- ◆ The maximum threshold of slope is set as 40° (modification based on the validation)

2.2 The quantile non-linear non-susceptibility (QNL) model

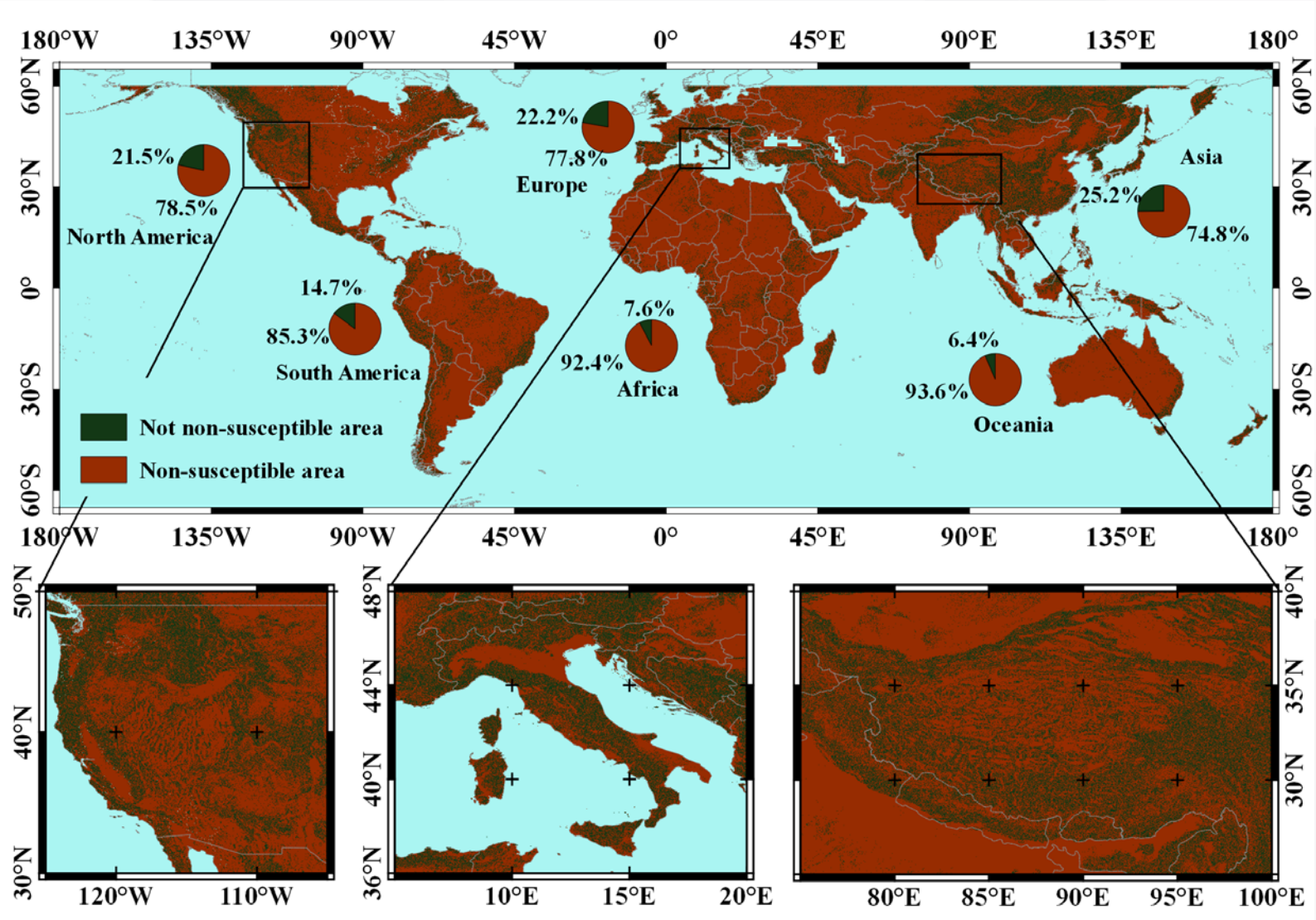
- Input data: 90-m Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM) data (version 4.1)

Global relief and slope map





3.1 Global Landslide Non-Susceptibility Map



- Non-susceptible areas
  - ◆82.9% of the world
- High percentages for:
  - Oceania
  - Africa
  - South America

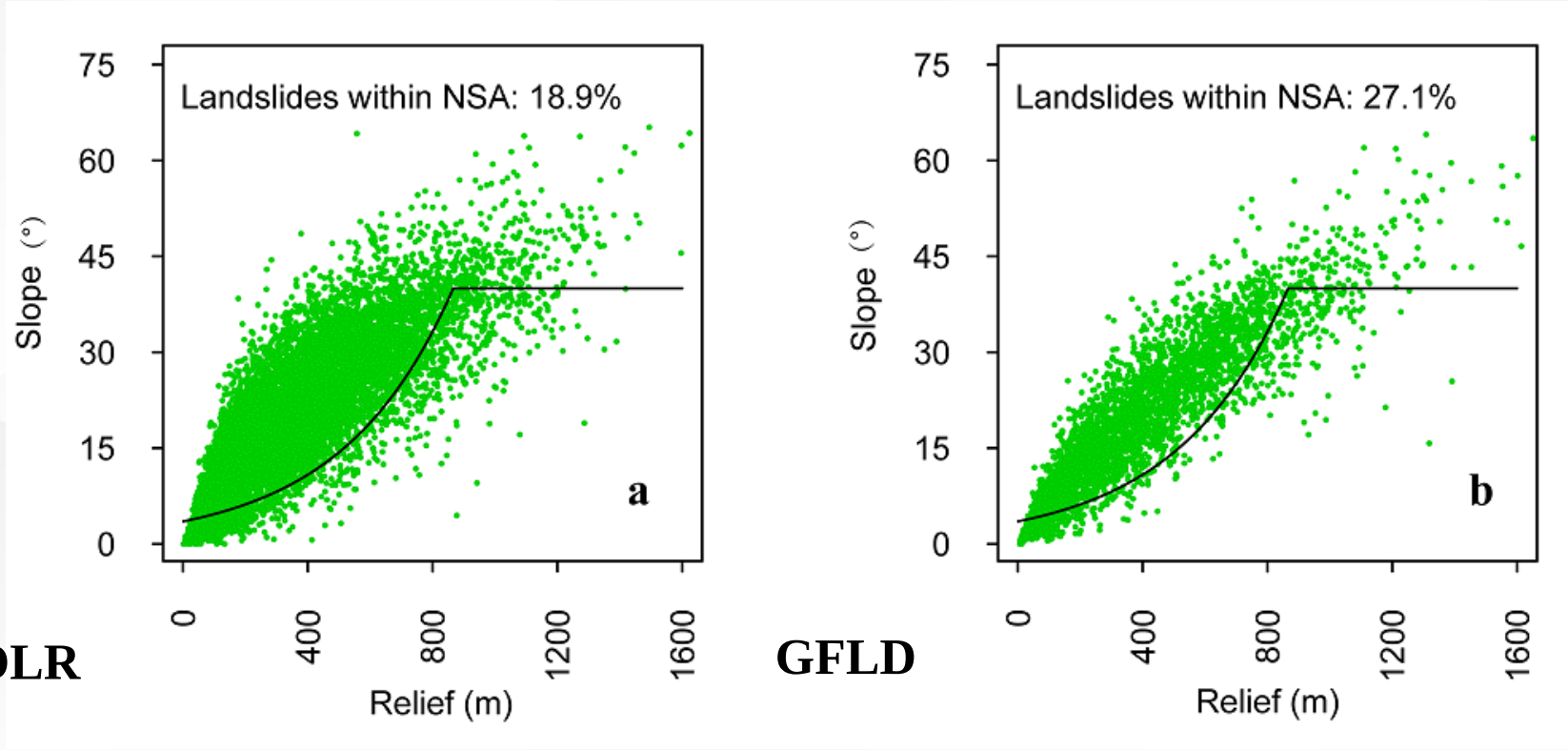
3.2 Validation with some regional landslide datasets

Extent	Landslide datasets/Region	Types of datasets	Number of record	Data period	Reference
Global	COOLR	point	12,187	2007-2019	Juang et al., 2019
	GFLD	point	5,490	2004-2017	Petley and Froude, 2019
National	Australia	point	19,74	(updated in 2018)	Geoscience Australia, 2012
	China	point	16,35	1949-2011	Li et al., 2016
	Ireland	point	2,778	(updated in 2020)	Creighton, 2006
	Zealand	point	3,484	1901-2015	Rosser et al., 2017
Regional	Arizona, USA	polygon	6,374	---	AGS, 2015
	Guangdong, China	point	1,315	2000-2015	GDPMC, 2017
	Koshi, Nepal	polygon	3,407	(updated in 2010)	ICIMOD, 2014
	Missouri, USA	point	206	---	MSDISOD, 2018
	Oregon, USA	point	13,994	1928-2018	SLIDO, 2009
	Utah, USA	polygon	2,383	(updated in 2018)	UGS, 2018
	Washington, USA	polygon	3,328	pre 2017	WGS, 2018
	Yunnan, China	point	453	1991-2015	YDPMC, 2016

3.2 Validation with some regional landslide datasets

- For each dataset, we intersected the landslide vector maps with global relief and slope maps. Each landslide event may cover many pixels. Thus, we selected the 90 quantile morphological values in each landslide area as the most prone case. For landslide points, we used a 1km buffer polygon as the intersected landslide vector maps owing to their uncertainties of occurrence location.

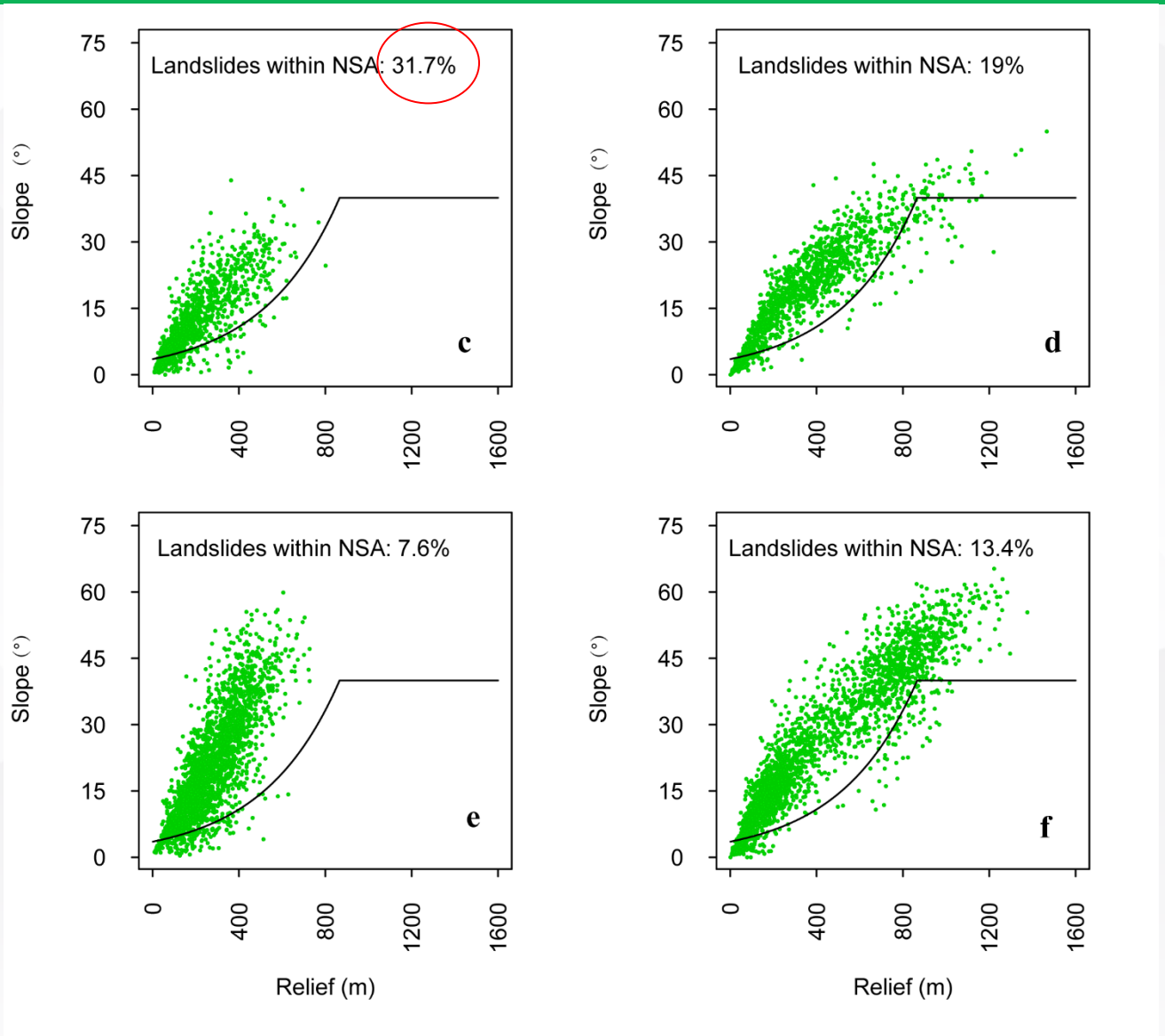
Global landslide datasets



COOLR **GFLD**

◆NSA represents non susceptible areas

3.2 Validation with some regional landslide datasets



National landslide datasets

Australia

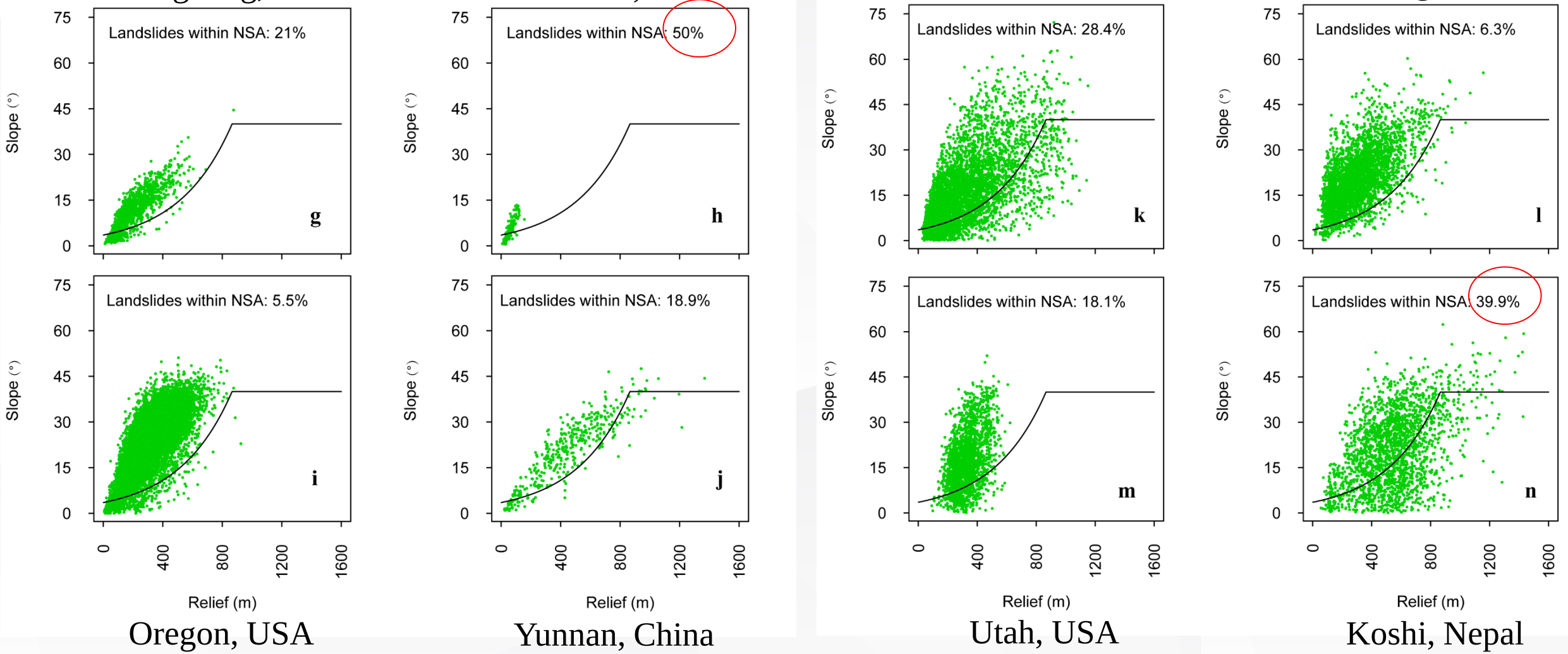
China

Ireland

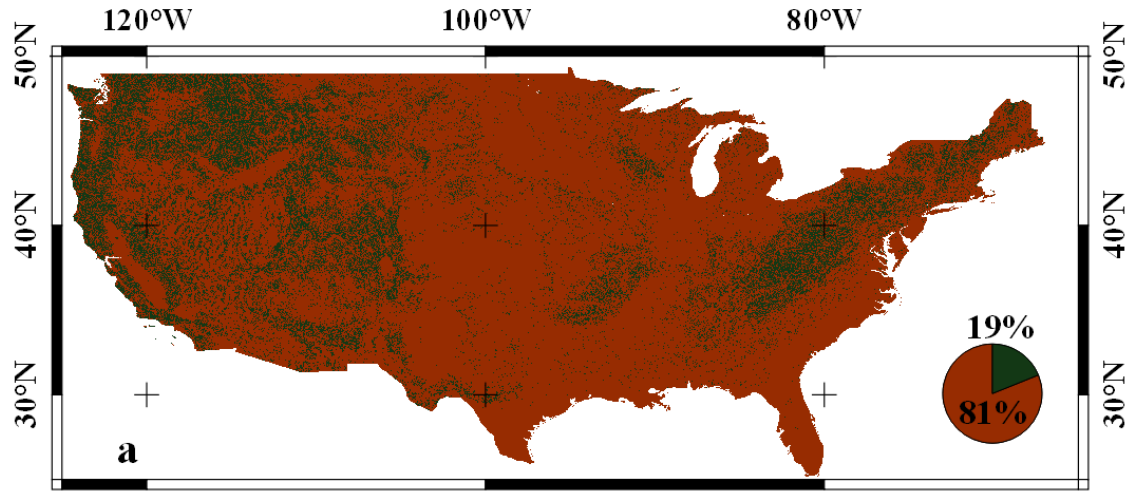
Zealand

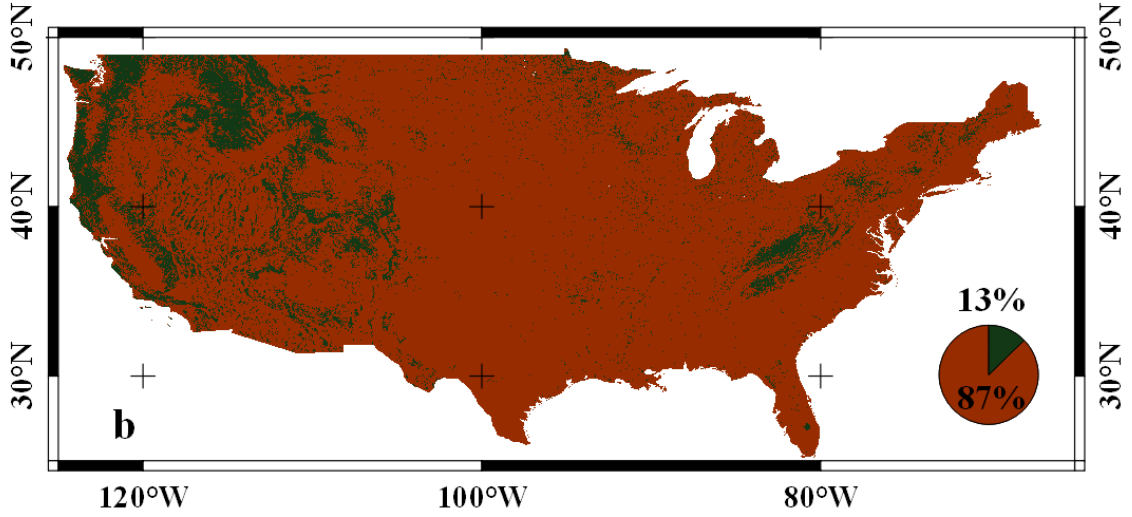
3.2 Validation with some regional landslide datasets

Regional landslide datasets



3.3 Compared with regional non-susceptibility maps





a USA Non-susceptibility map based on QNL model;

b USA Non-susceptibility map based on the linear model and methods in Godt et al. 2012

- Some slight differences in the central and eastern USA

Summary and conclusions

- The quantile non-linear non-susceptibility (QNL) model works for most of the validation landslide datasets.
- We made a modification for high slope (over 40 degree). Some modification for low slope are needed (Missouri, USA, and Australia).
- For high mountains in Himalaya, it seems less effective (Koshi, Nepal).

Main references

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Great thanks for the co-authors and producers of the available datasets.

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EGU2020-10285