The Global RApid-post-disaster Damage Estimation Approach

WORLD BANK GROUP
Social, Urban, Rural & Resilience

D-RAS
DISASTER RISK RESILIENCE ANALYTICS AND SOLUTIONS
KNOWLEDGE SILO BREAKER

CATDAT
risklayer
Integrated Historical Global Catastrophe Database

KIT
Karlsruhe Institute of Technology

Ecuador Earthquake Apr 2016

Hurricane Maria Sep 2017

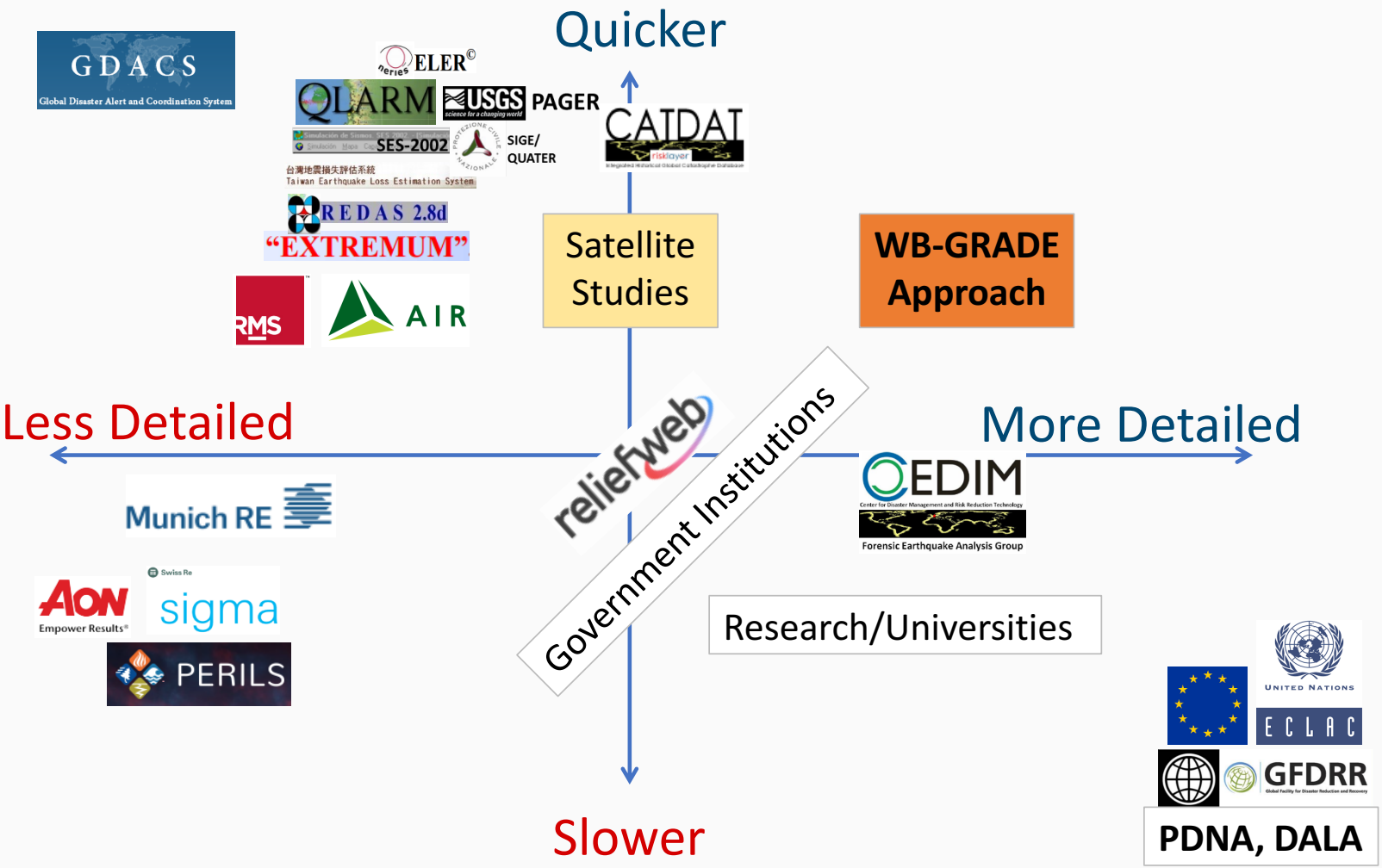
The day after, Government grappled with questions such as:

How do we assess damages?

Where are the damages distributed?

What is the socio-economic impact?

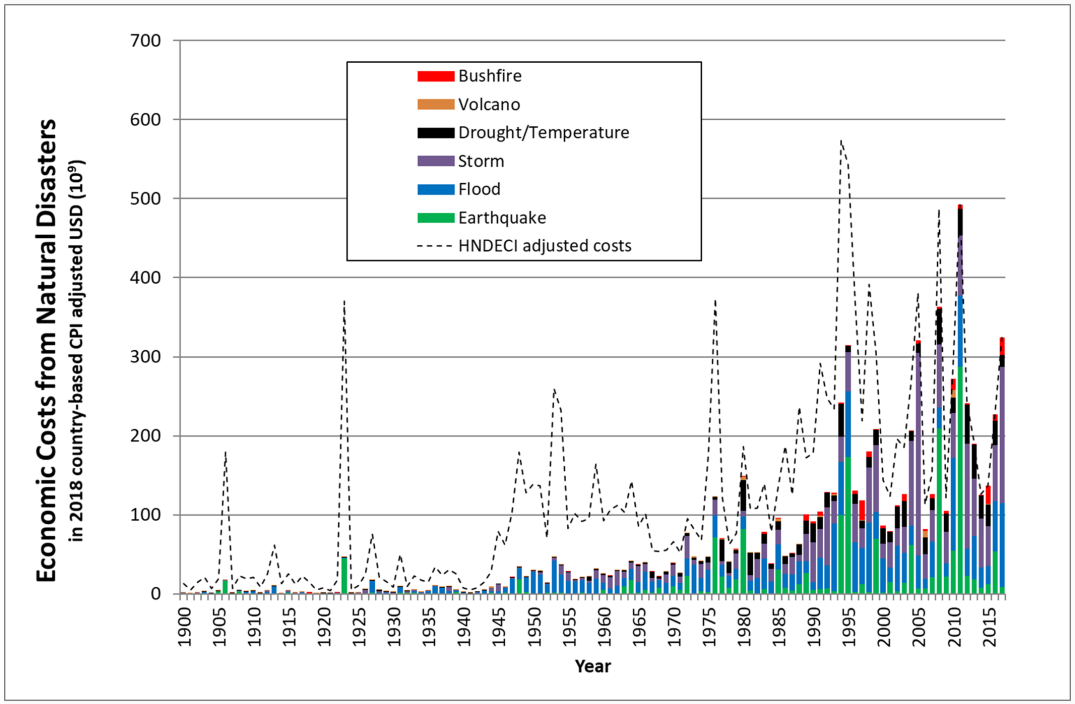
Existing Post-Disaster Tools

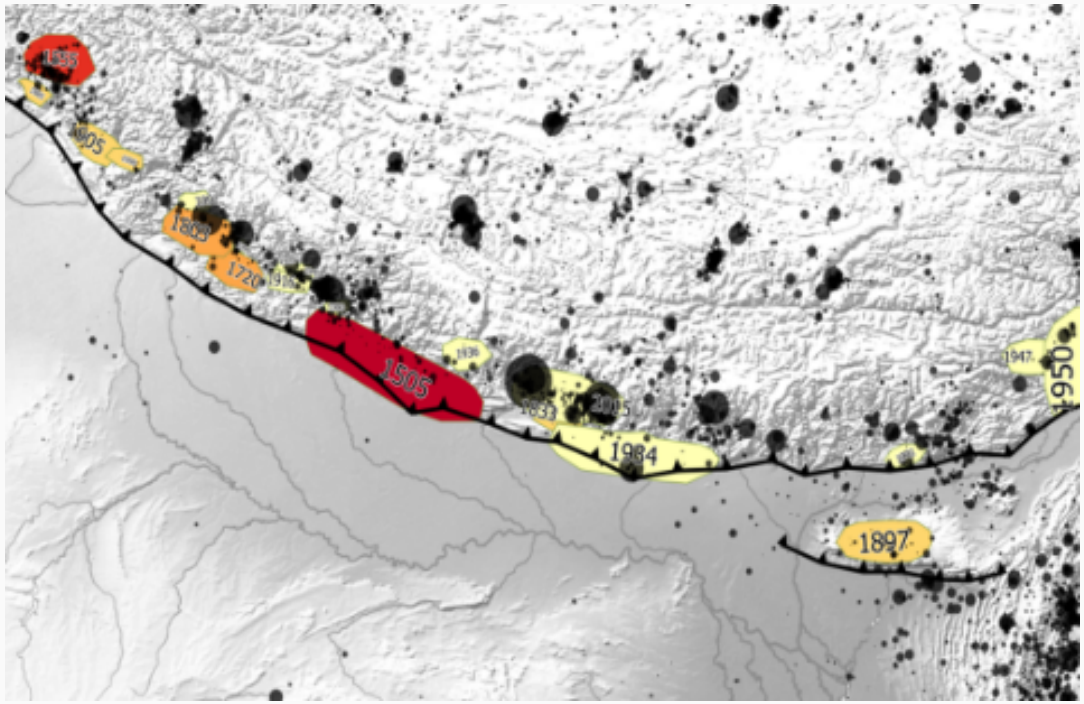


The Solution:

Global **Rapid** Post disaster damage assessment (GRADE)

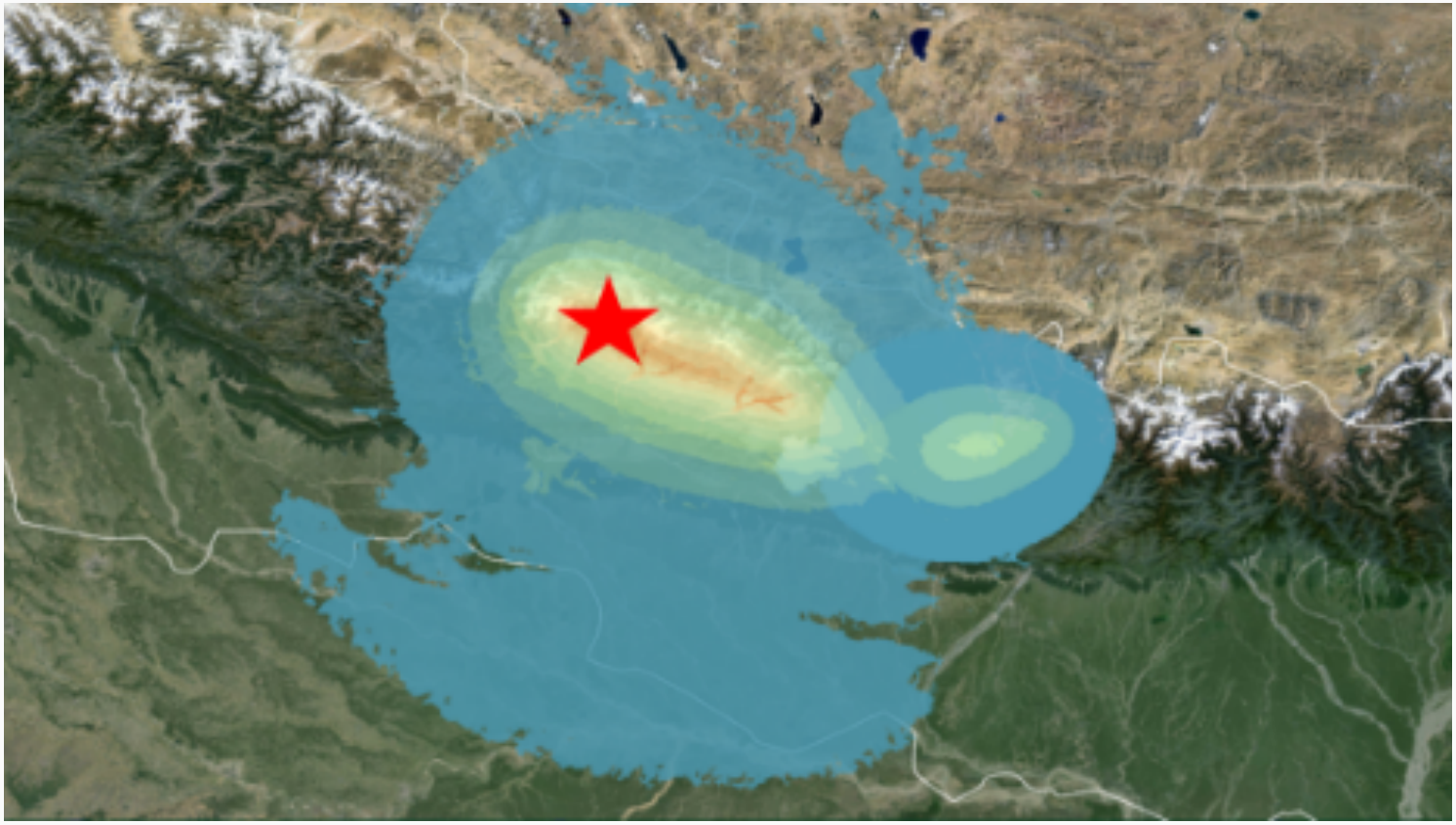
GRADE uses big data and leverages WB expert knowledge





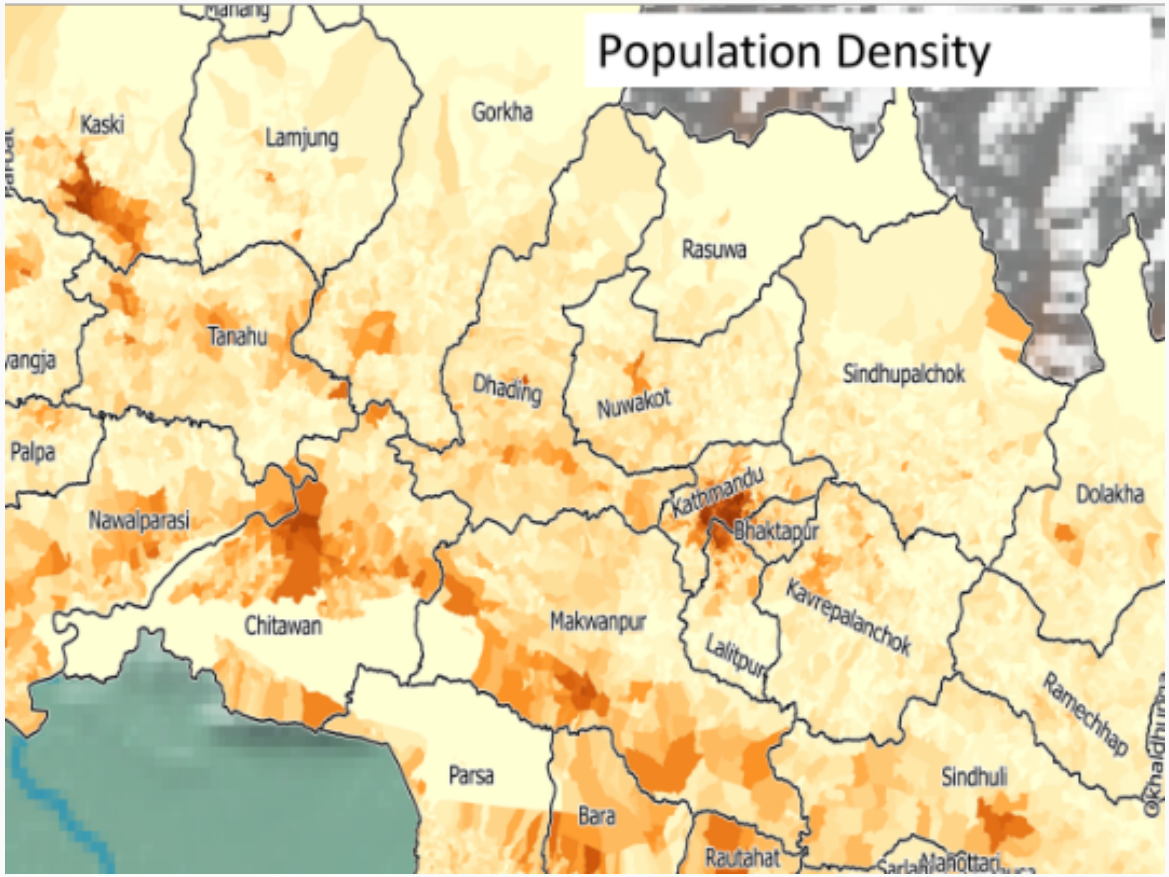
Historical damage data

GRADE uses big data and leverages WB expert knowledge



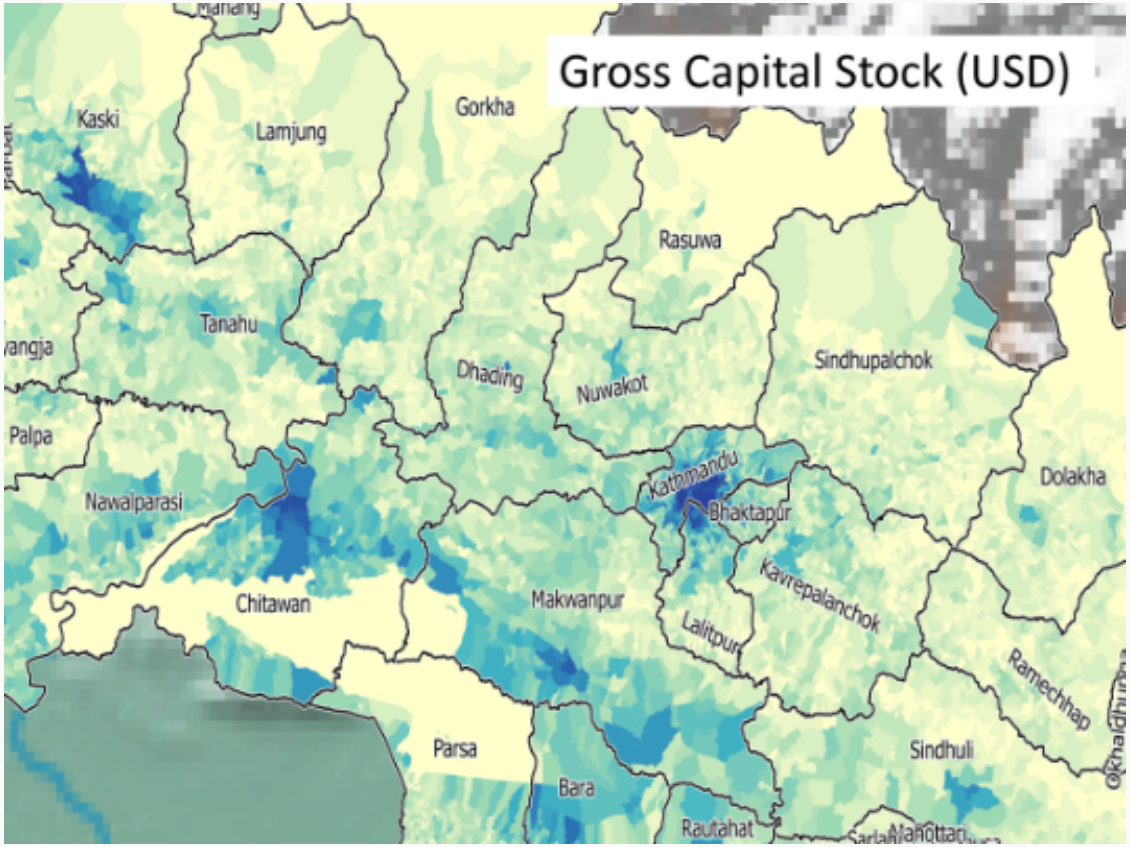
Event scientific data

GRADE uses big data and leverages WB expert knowledge



Census data

GRADE uses big data and leverages WB expert knowledge

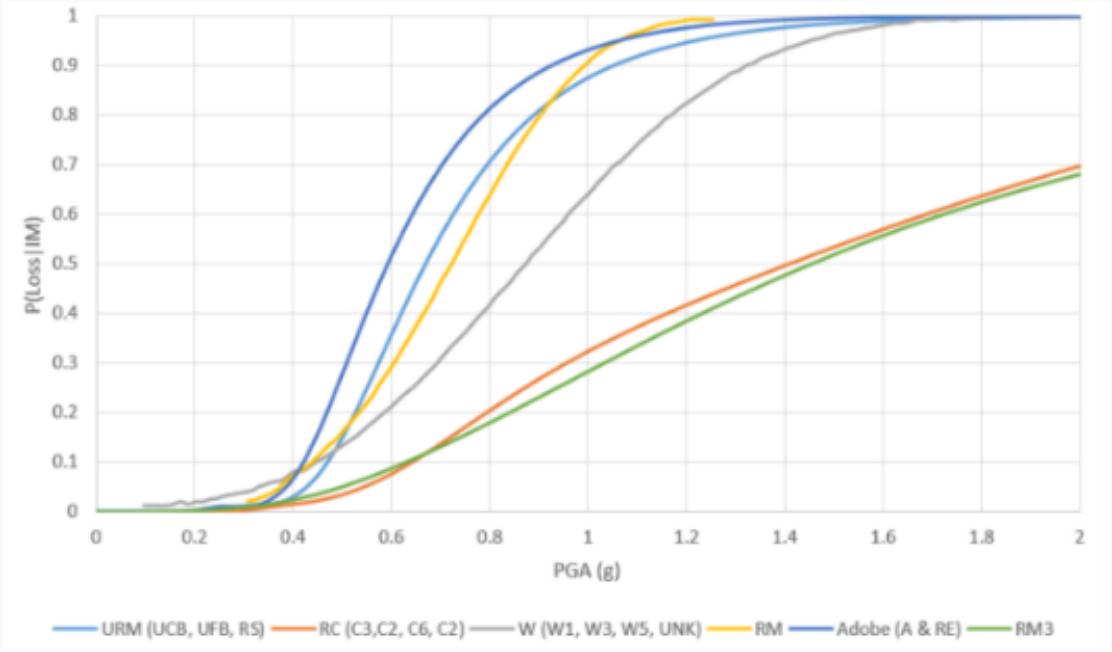


Socioeconomic data

GRADE uses big data and leverages WB expert knowledge

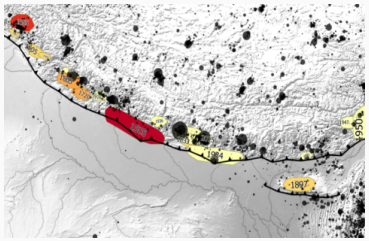
Remotely-sensed data / Social Media

GRADE uses big data and leverages WB expert knowledge

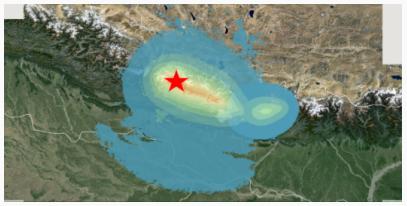


Analysis - Vulnerability/Built Data

GRADE Skill is in its Analysis



Historical damage data



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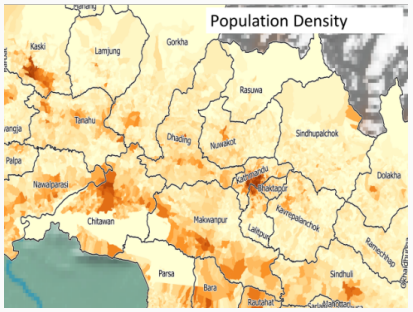

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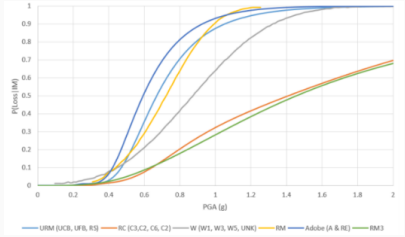
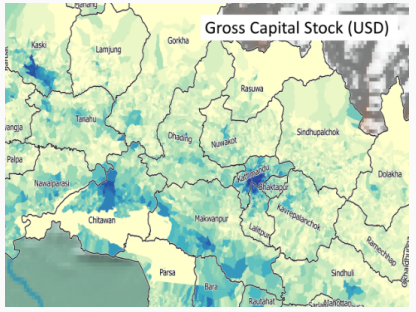


Vulnerability/Built Data

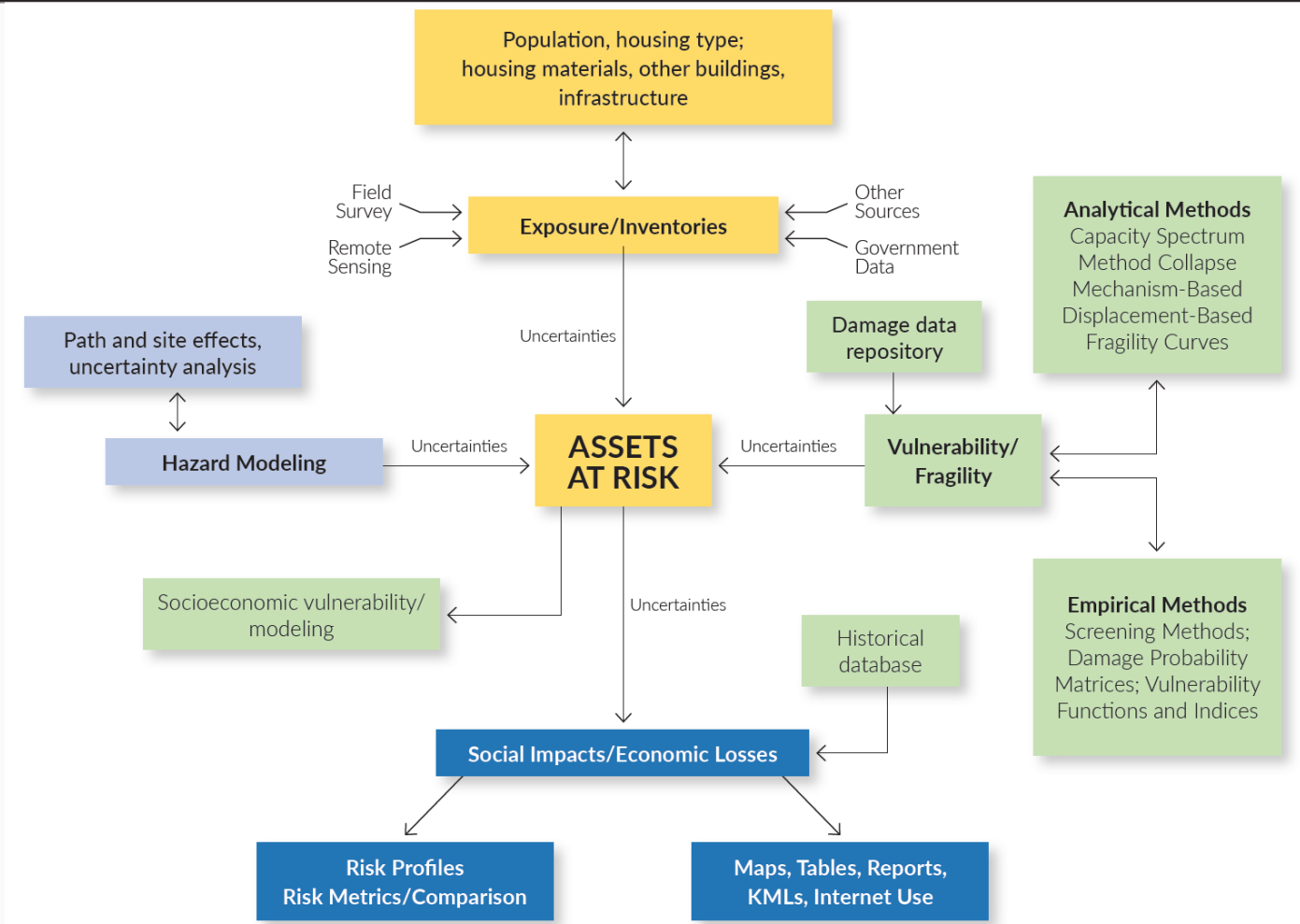
Expert knowledge

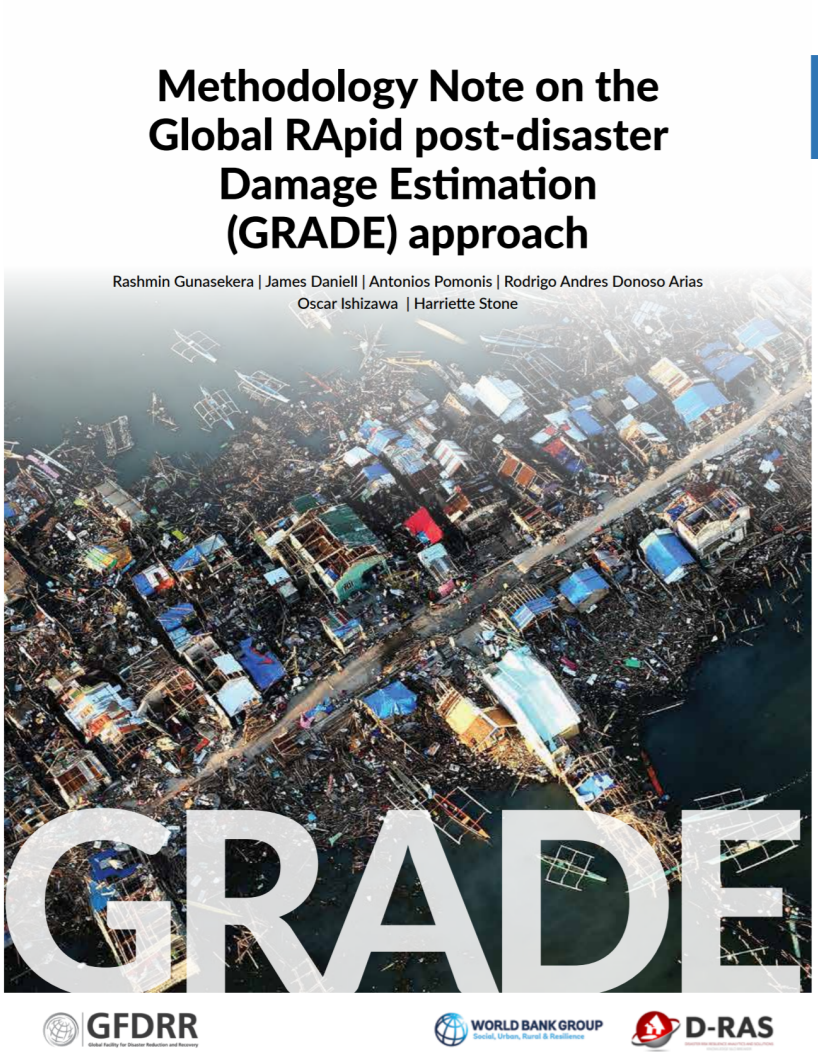
Remotely-sensed data / Social Media



Socioeconomic data

The GRADE approach!

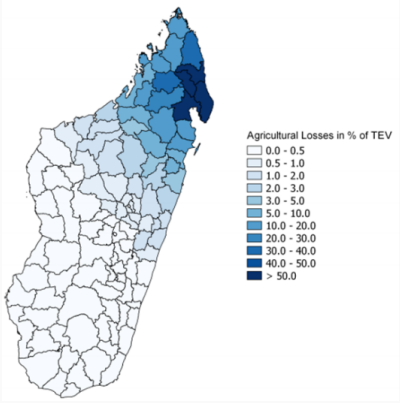


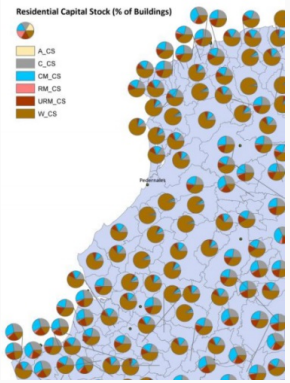


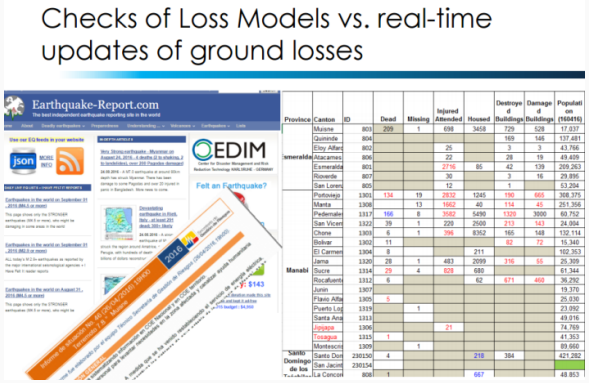
Report Available Online at:
https://www.preventionweb.net/publications/view/57947

GRADE Product

- Sector based economic impacts of physical damage **– informs decision making**
- Remote desk-based rapid analysis (ca. 2 weeks) – **speed**
- Calibrated against econometric and actual damage data – **increased accuracy and detail**
- **Complementary to other approaches** (e.g. MIRAs and PDNAs)

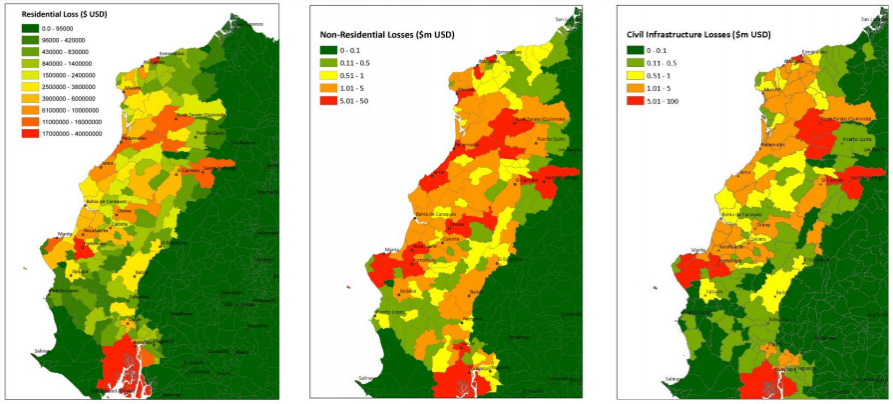


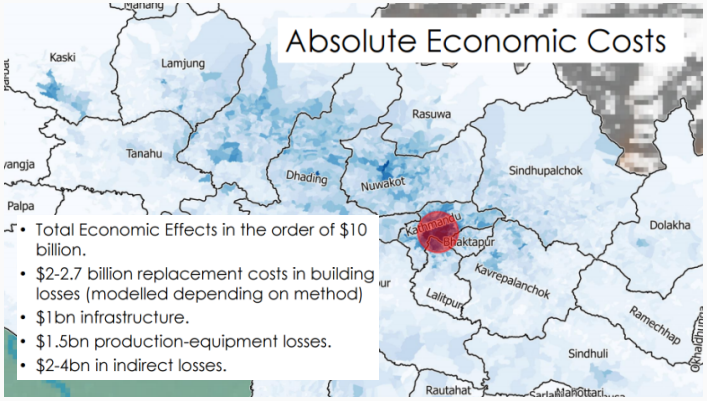




Outputs and applications

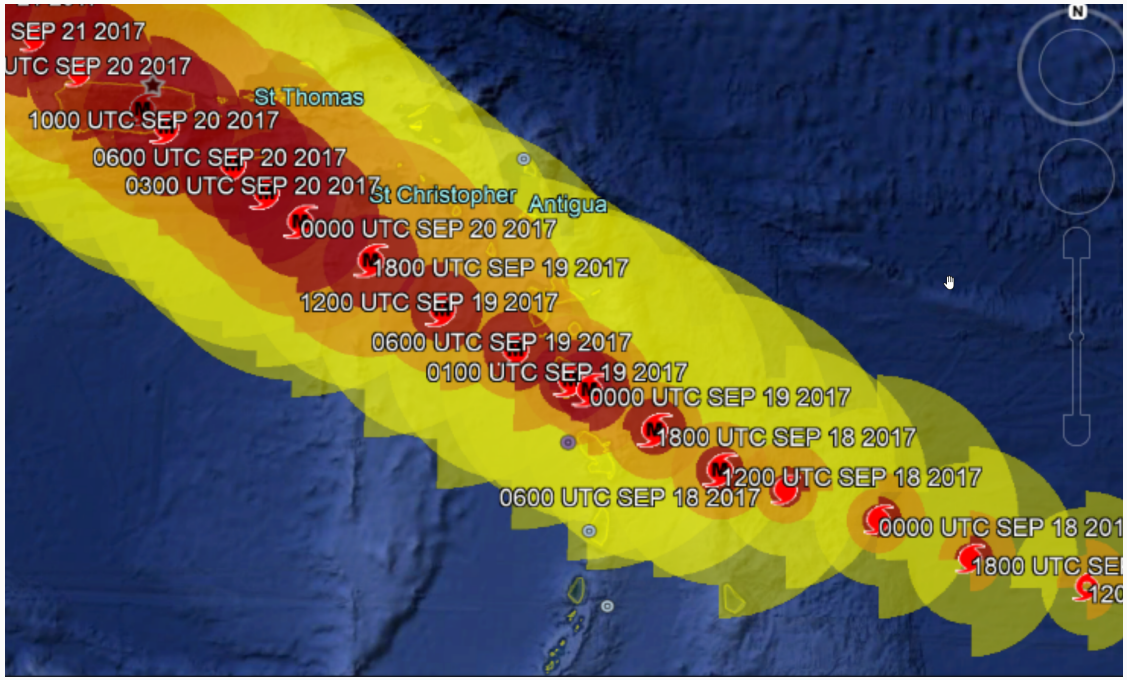
- **Economic loss** estimation report and analytical tables and maps relating to physical damage (of key sectors such as housing)
- Sectoral **baseline** information
- Assessment of vulnerability and **damage distribution**



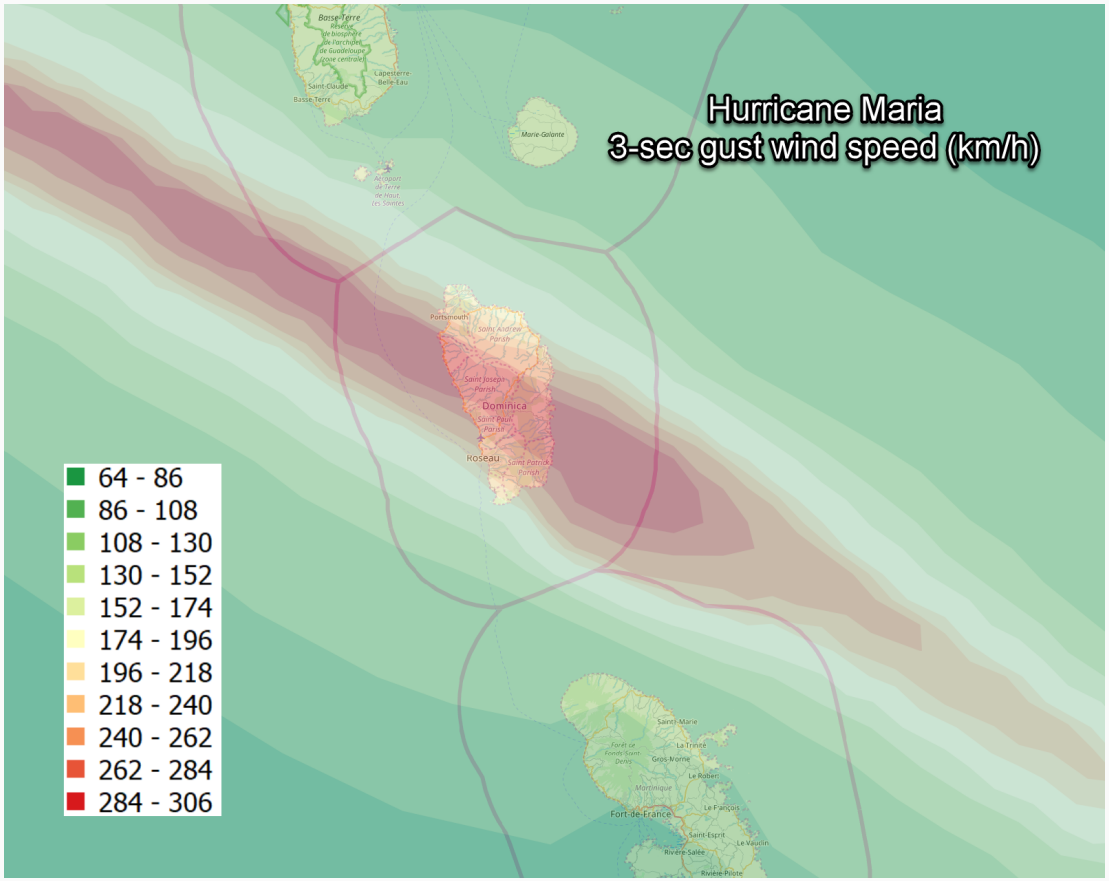


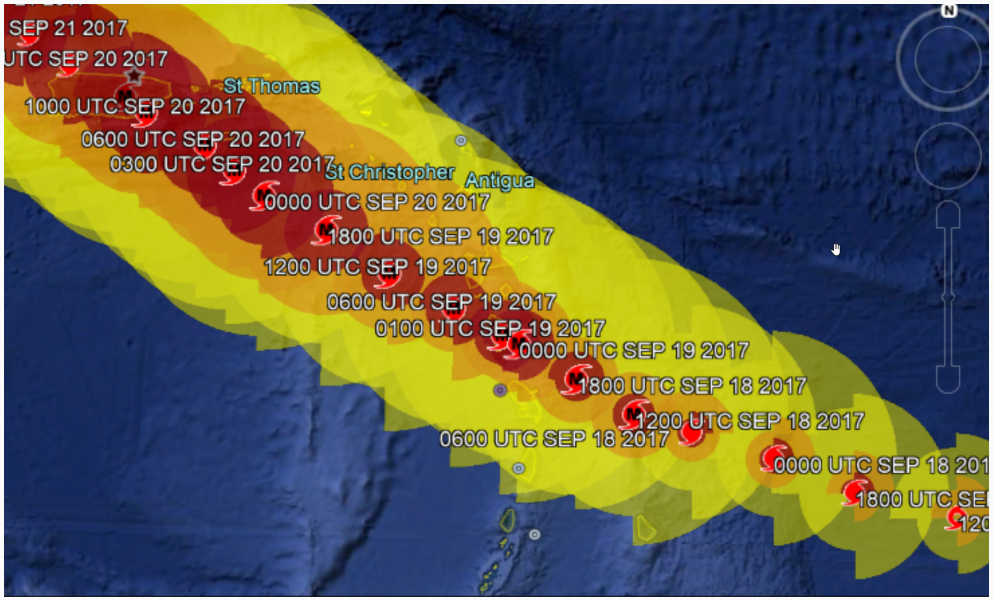
Case Study:
Hurricane Maria, Dominica

- Sep. 18/19, 2017
- Cat 5 over Dominica
- 31 dead, 37 missing
- 4700 destroyed housing units
- 23500 damaged housing units
- $1 billion + damage



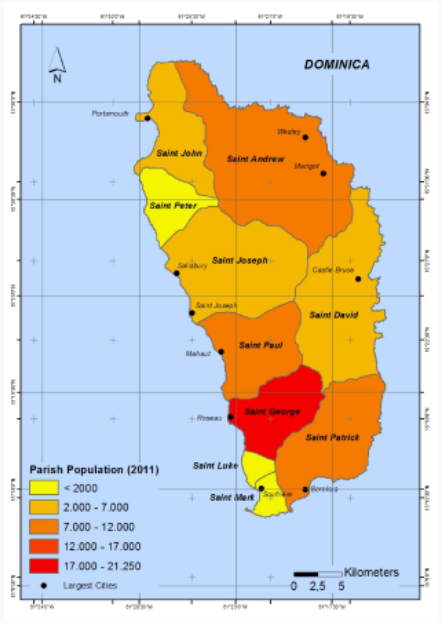
Hazard modelling

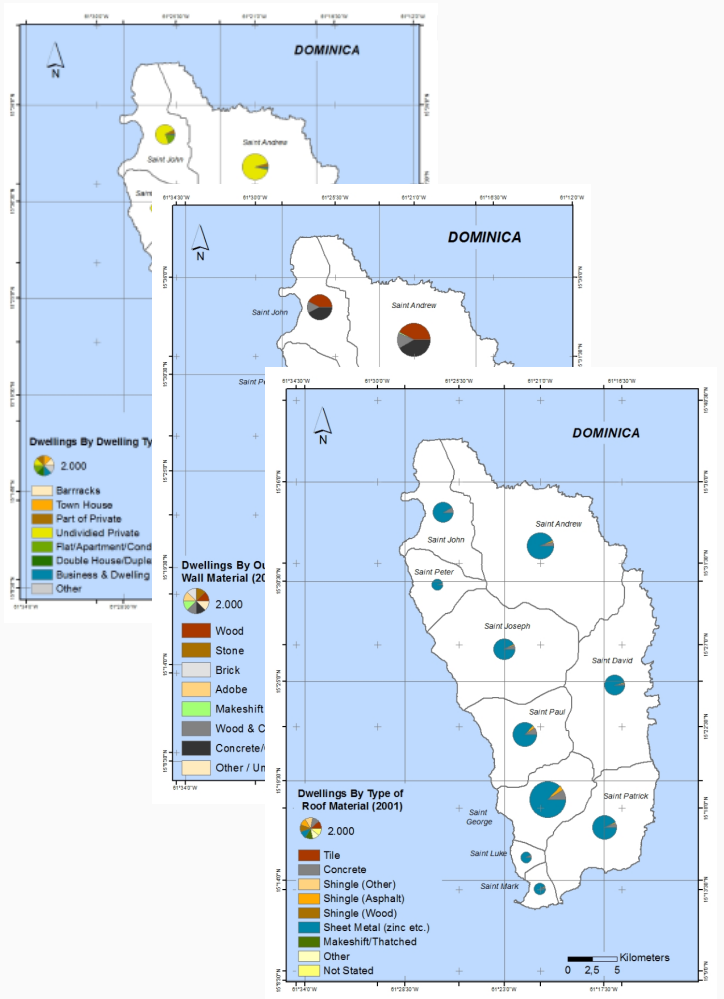




Use of Satellite imagery: Exposure Modelling (post disaster charter activation)

- Historical census data
- CHARIM Geonode (Dominode)
- Parish level data of building stock, non-residential etc.
- Building Asset data
- Infrastructure distribution
- All formatted from various archives to GIS and Excel to use with our models in Matlab, Python etc.





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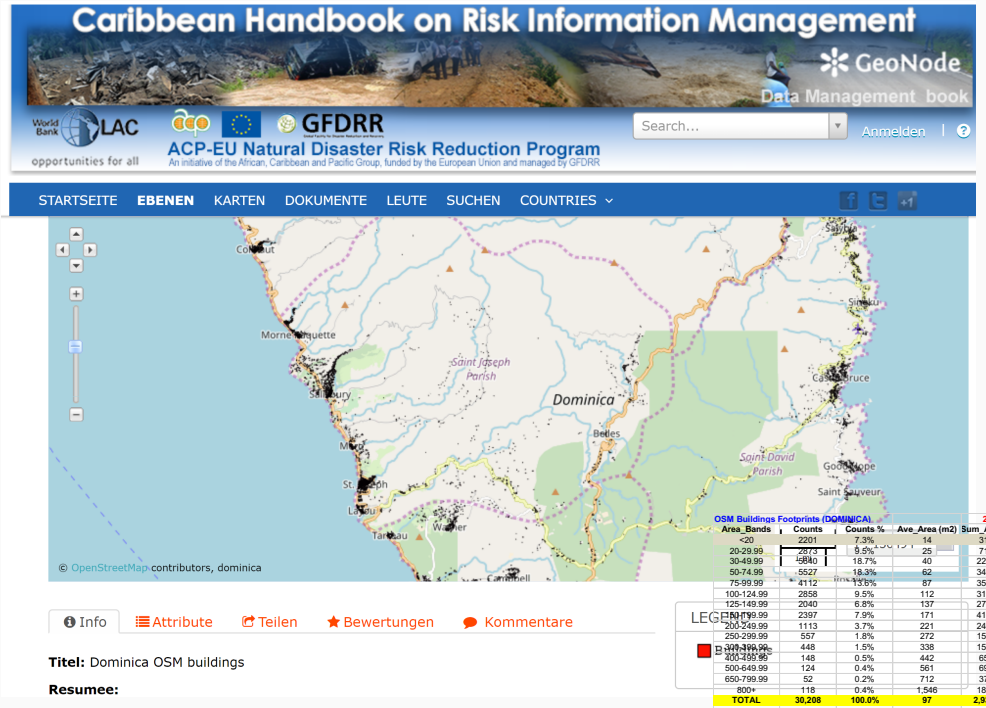


OSM Buildings Footprints (DOMINICA) — 2015

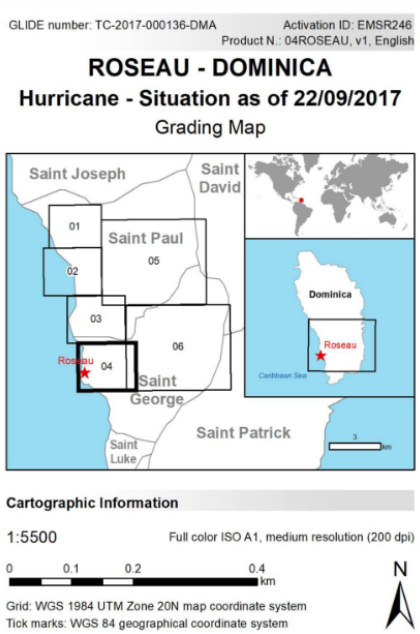
Area_Bands	Counts	Counts %	Ave_Area (m2)	Sum_Area (m2)	Area %
<20	2201	7.3%	14	31,564	1.1%
20-29.99	2873	9.5%	25	71,921	2.4%
30-49.99	5640	18.7%	40	223,763	7.6%
50-74.99	5527	18.3%	62	342,496	11.7%
75-99.99	4112	13.6%	87	357,102	12.1%
100-124.99	2858	9.5%	112	319,022	10.9%
125-149.99	2040	6.8%	137	279,286	9.5%
150-199.99	2397	7.9%	171	410,943	14.0%
200-249.99	1113	3.7%	221	246,462	8.4%
250-299.99	557	1.8%	272	151,349	5.1%
300-399.99	448	1.5%	338	151,298	5.1%
400-499.99	148	0.5%	442	65,425	2.2%
500-649.99	124	0.4%	561	69,547	2.4%
650-799.99	52	0.2%	712	37,041	1.3%
800+	118	0.4%	1,546	182,483	6.2%
TOTAL	30,208	100.0%	97	2,939,702	100.0%

Buildings Footprints (Dominica_Polys.shp) — 2016-17

Area_Bands	Counts	Counts %	Ave_Area (m2)	Sum_Area (m2)	Area %	extra footprints %	extra footprints m2	# new footprints
<20	3,548	9.2%	14	49,674	1.4%	1,612	18,110	1,347
20-29.99	4,068	10.5%	25	101,744	2.8%	1,416	29,823	1,195
30-49.99	7,168	18.5%	40	283,193	7.9%	1,271	59,430	1,528
50-74.99	6,715	17.4%	62	415,534	11.6%	1,215	73,038	1,188
75-99.99	5,115	13.2%	87	444,761	12.4%	1,244	87,659	1,003
100-124.99	3,556	9.2%	112	396,876	11.1%	1,244	77,854	698
125-149.99	2,493	6.4%	137	341,189	9.5%	1,222	61,903	453
150-199.99	2,912	7.5%	172	500,656	13.9%	1,215	89,713	515
200-249.99	1,392	3.6%	222	309,011	8.6%	1,251	62,549	279
250-299.99	672	1.7%	271	182,391	5.1%	1,206	31,041	115
300-399.99	516	1.3%	339	174,872	4.9%	1,152	23,574	68
400-499.99	190	0.5%	442	84,021	2.3%	1,284	18,596	42
500-649.99	141	0.4%	561	79,091	2.2%	1,137	9,544	17
650-799.99	56	0.1%	719	40,278	1.1%	1,077	3,238	4
800+	124	0.3%	1,508	186,964	5.2%	1,051	4,482	6
TOTAL	38,666	100%	93	3,590,256	100%	1,280	650,555	8,458

Use of EO Grading Maps

Grading Maps checked in GRADE's hazard & vulnerability modules at the stage of model calibration/validation



		Destroyed	Highly Damaged	Moderately Damaged	Negligible to Slight Damage	Total Affected
Residential	JIMMIT	33.54%	27.44%	29.27%	9.76%	100.00%
Residential	CAMPBELL	31.58%	34.65%	23.46%	10.31%	100.00%
Residential	MAHAUT	23.81%	31.49%	41.59%	3.11%	100.00%
Residential	FOND CANI	13.86%	20.96%	37.71%	27.47%	100.00%
Residential	LA PLAINE	61.61%	22.32%	12.05%	4.02%	100.00%
Residential	GRAND FOND	74.78%	4.78%	16.96%	3.48%	100.00%
Residential	ROSEAU	14.66%	43.54%	32.59%	9.21%	100.00%
Residential	CANEFIELD	33.54%	27.44%	29.27%	9.76%	100.00%
Residential	**DOMINICA**	**24.80%**	**33.84%**	**31.62%**	**9.74%**	**100.00%**

Building typology distribution & vulnerability

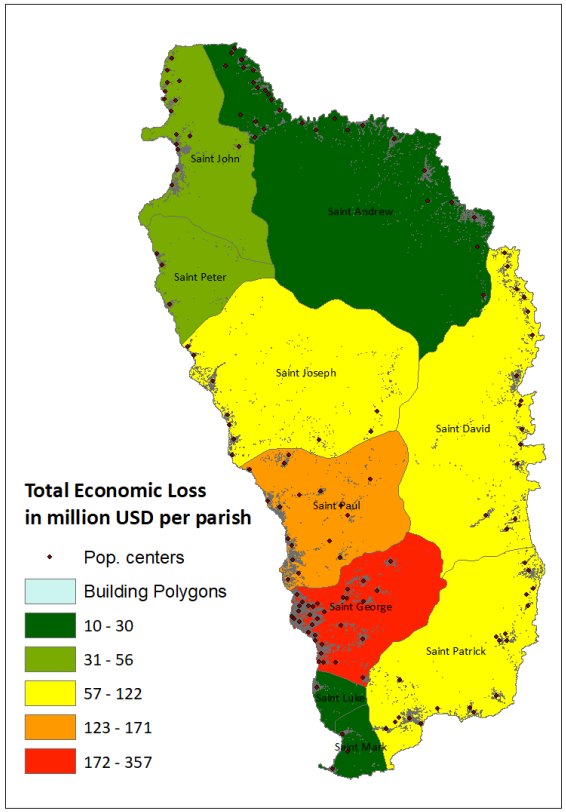
Remotely-sensed data / Social Media

Building typology distribution & vulnerability

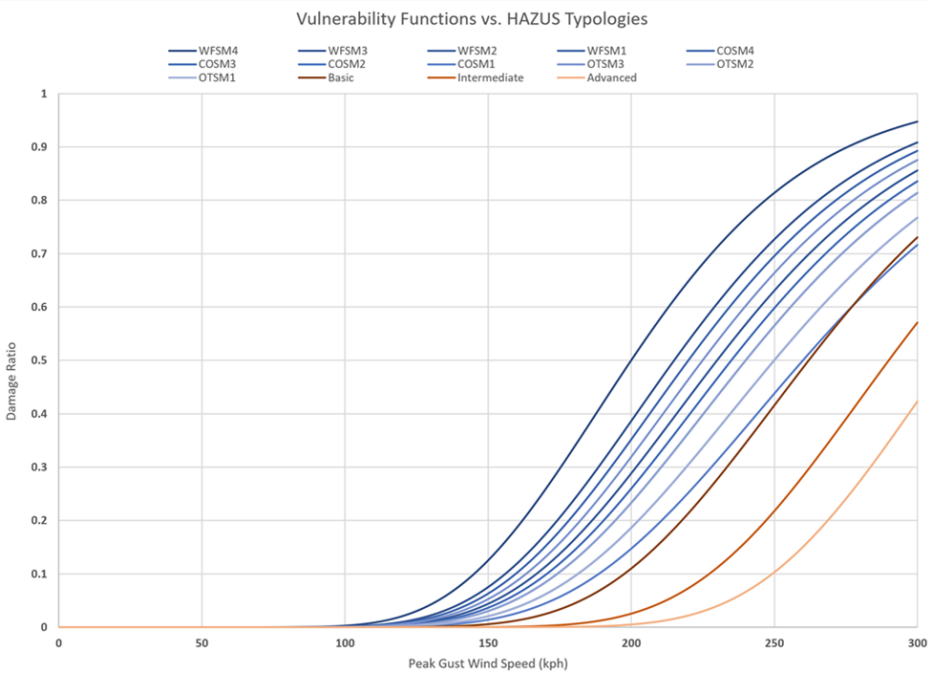
Use of Aerial and drone Imagery

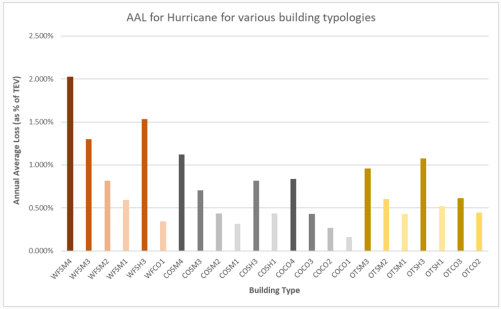
Model Validation: UNOSAT & COPERNICUS real-time updates of ground losses vs. other

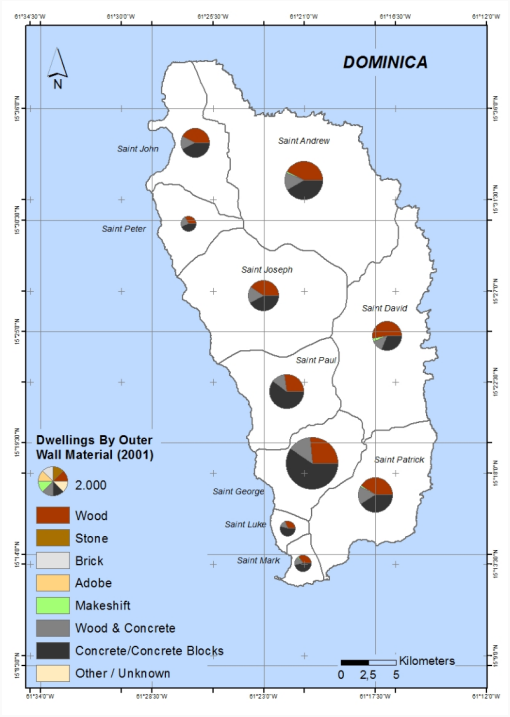
Checks against satellite imagery derived losses from UNITAR (UNOSAT product) i.e. for Roseau

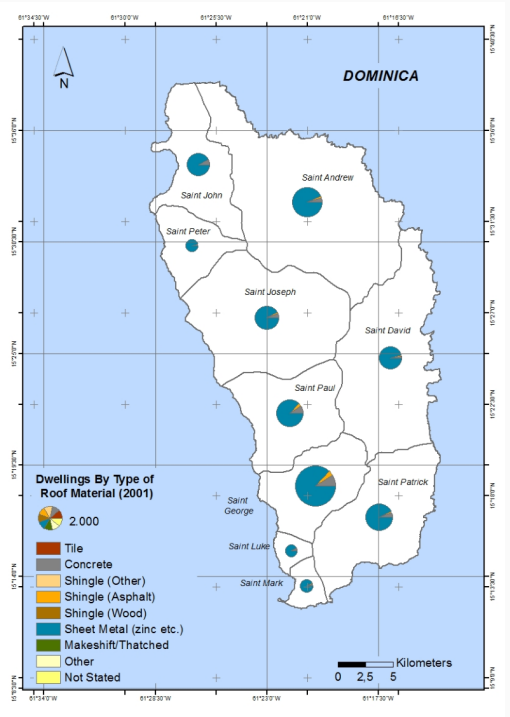


The loss ratio depends on vulnerability

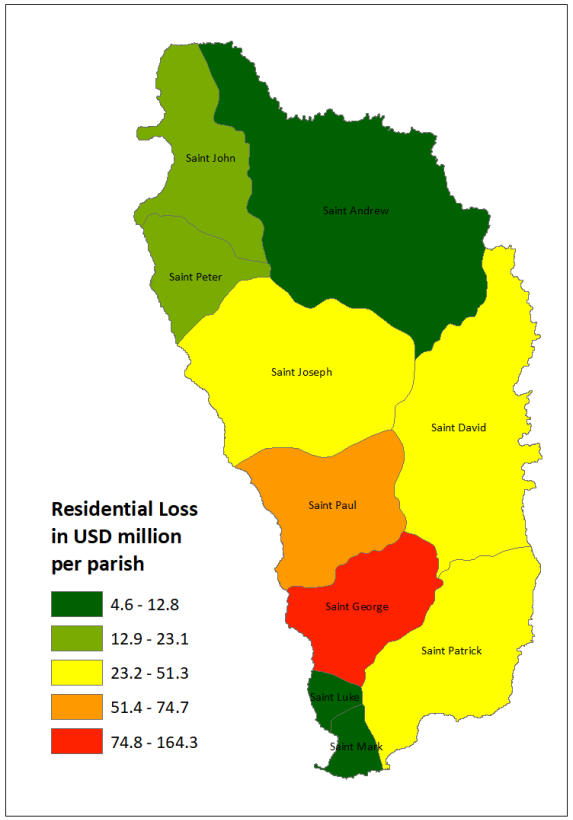


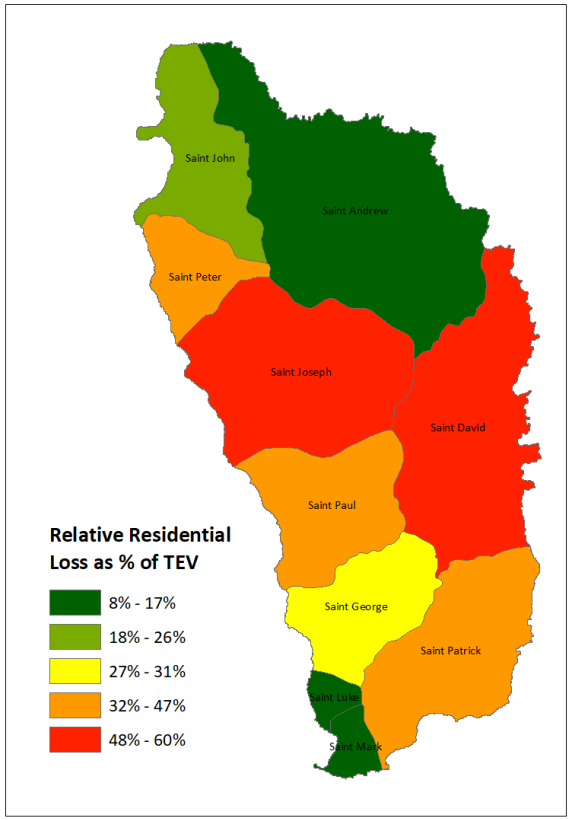


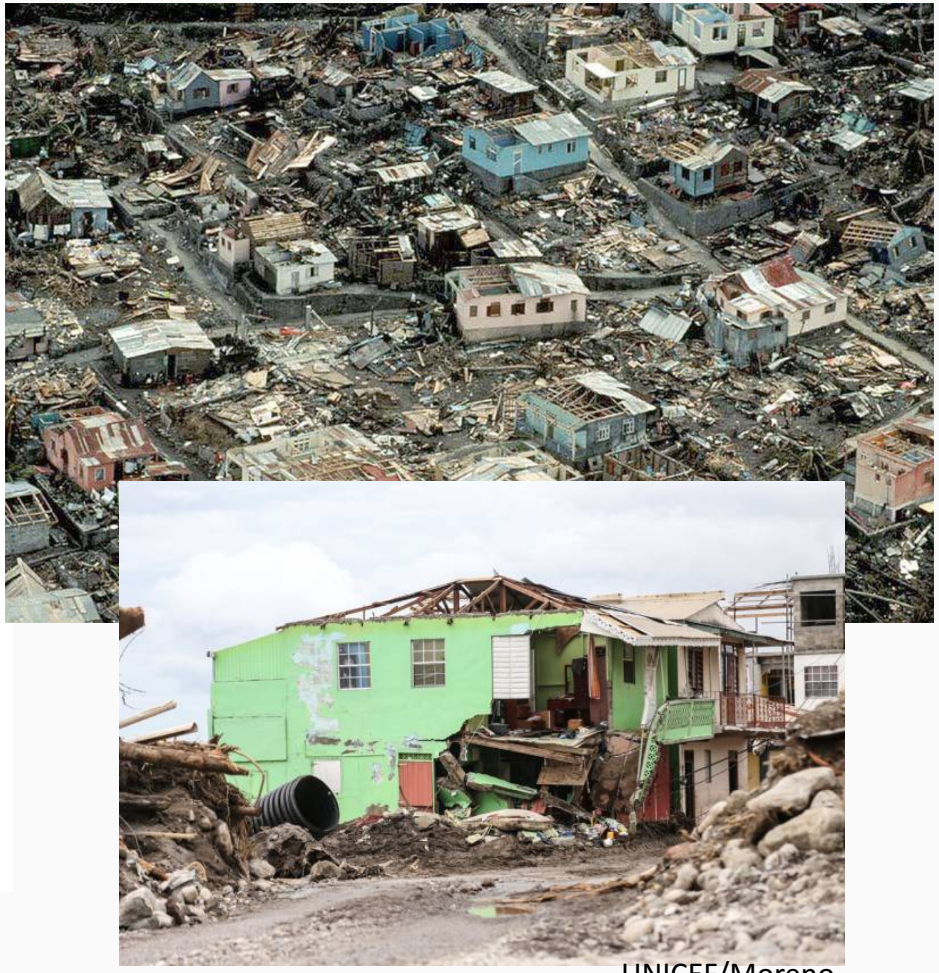




Absolute & Relative Loss (Residential)

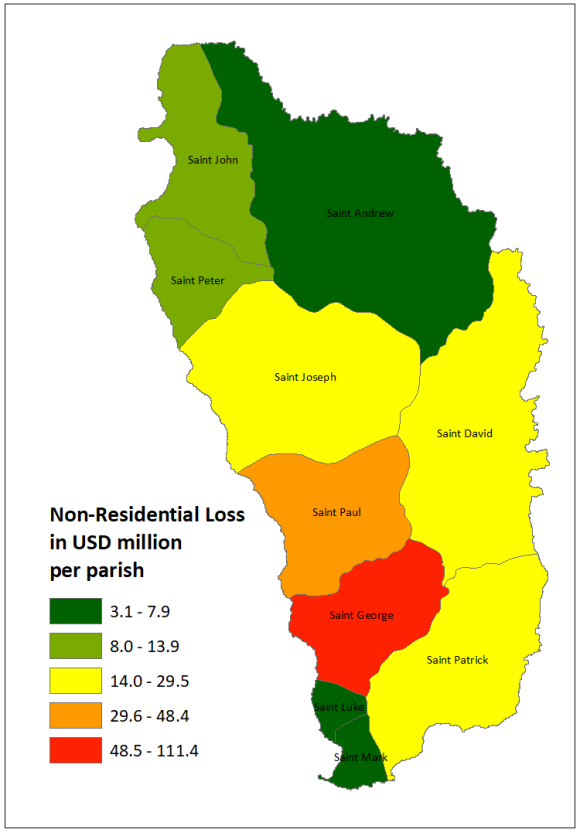


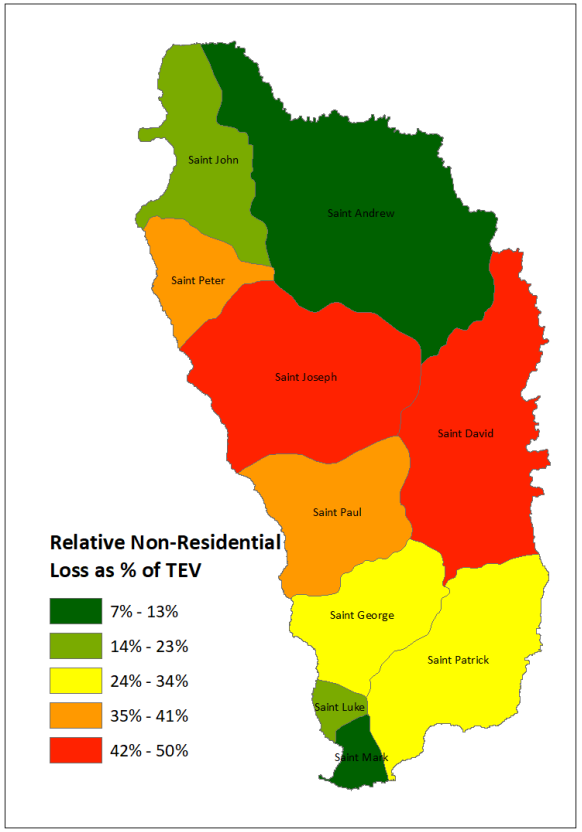




UNICEF/Moreno

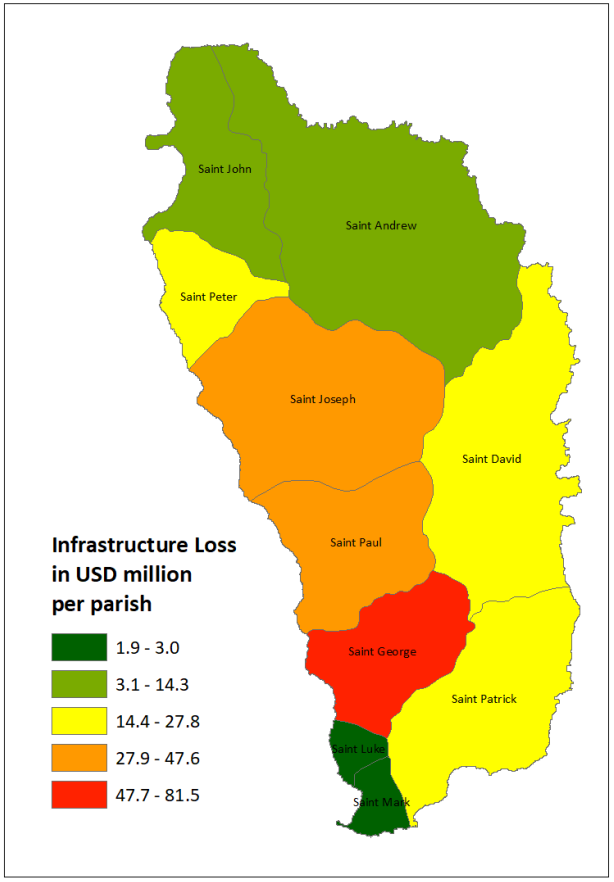
Absolute & Relative Loss (Non-Residential)

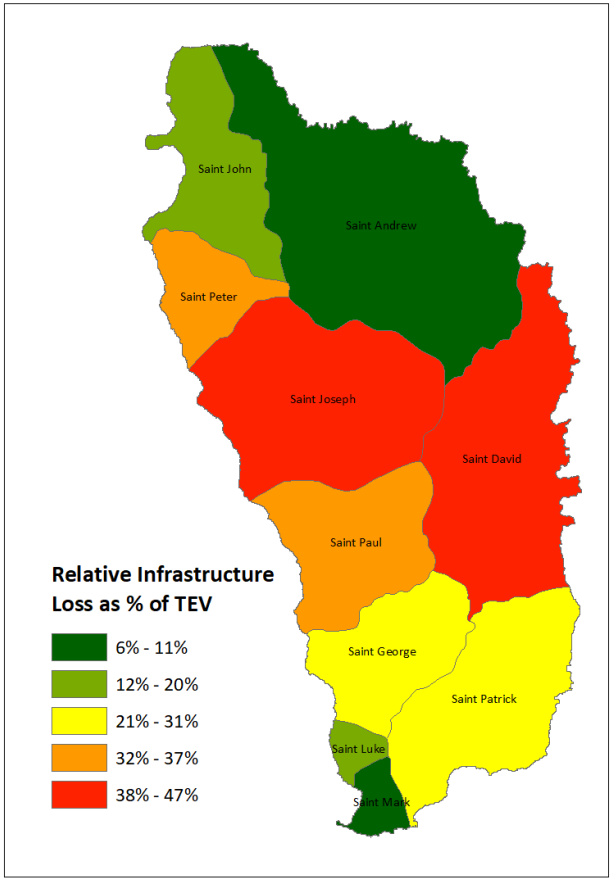




@shuyleresprit

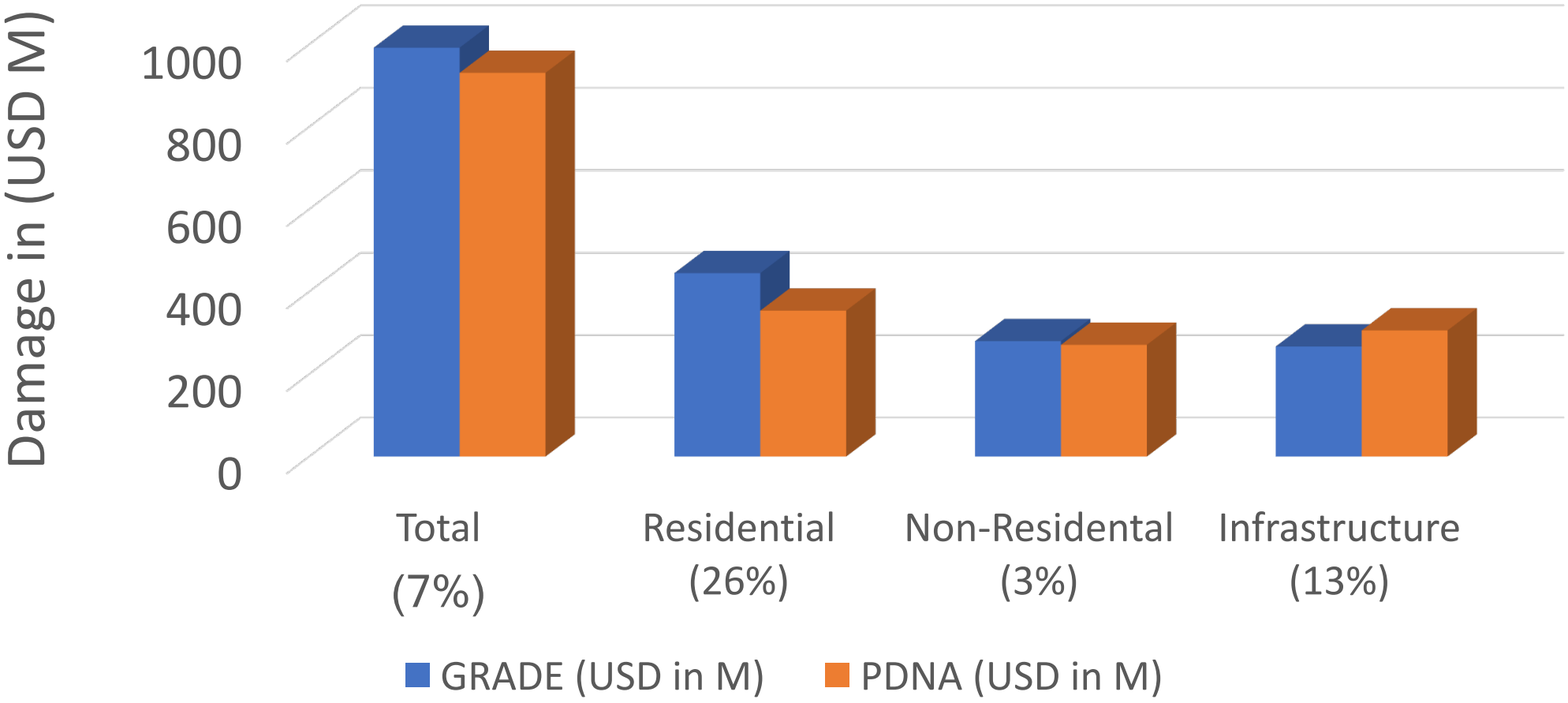
Absolute & Relative Loss (Infrastructure)



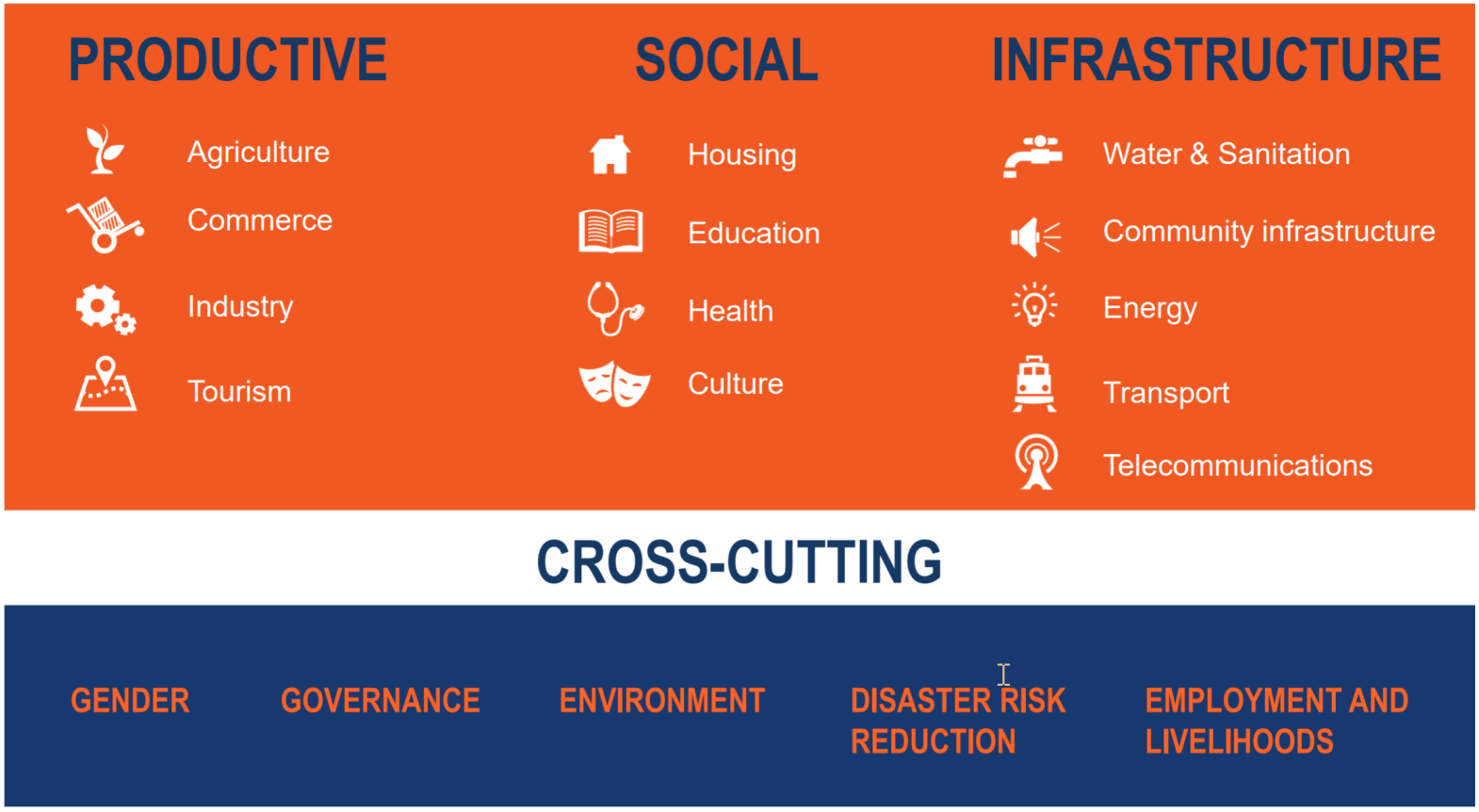


CNNPHOTO

Dominica - HU Maria – Sept 18th 2017
GRADE (**6 days**) vs PDNA (**58 days**)



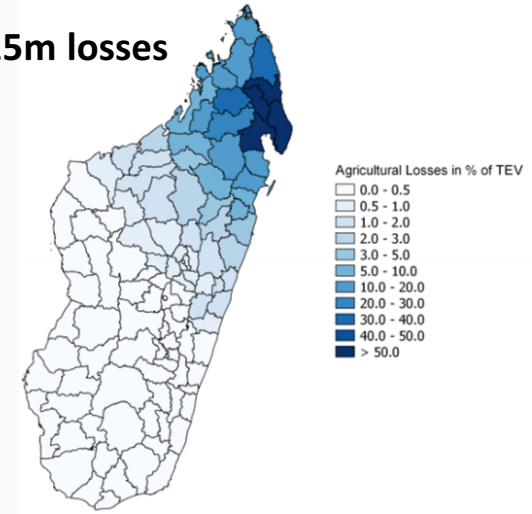
Depending on the disaster – where possible each PDNA sector is calculated



GRADE Product (Cyclone Enawo and Ava)

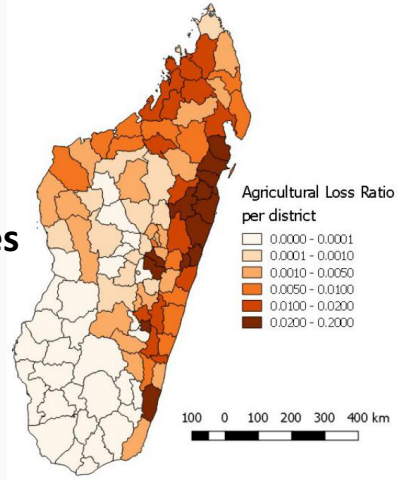
	Popul. Affected	Popul. Displaced	Killed	Missing	Houses Destroyed	Houses Damaged
TC Enawo (2017)	295,950	84,660	81	18	40,520	69,654
TC Ava (2018)	161,000	55,000	51	22	3,231	11,951
TS Eliakim (2018)	15,772	6,282	17	0	648	1,522

~US$415m losses

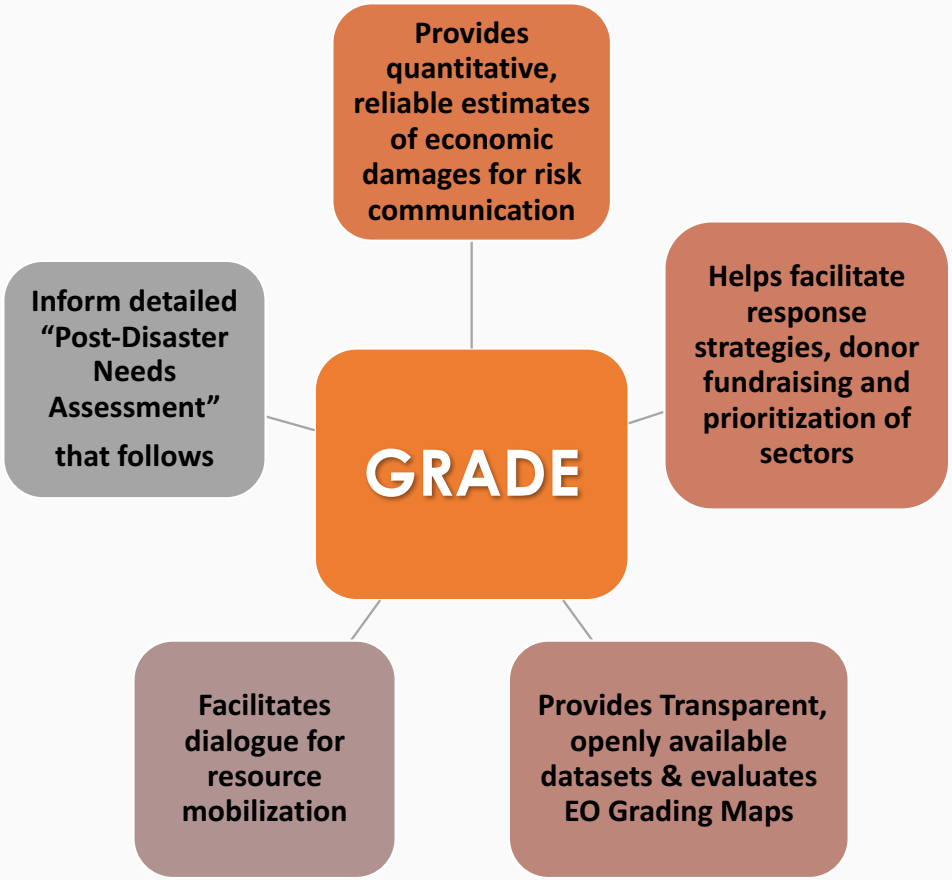


vanilla counted for 40% of losses

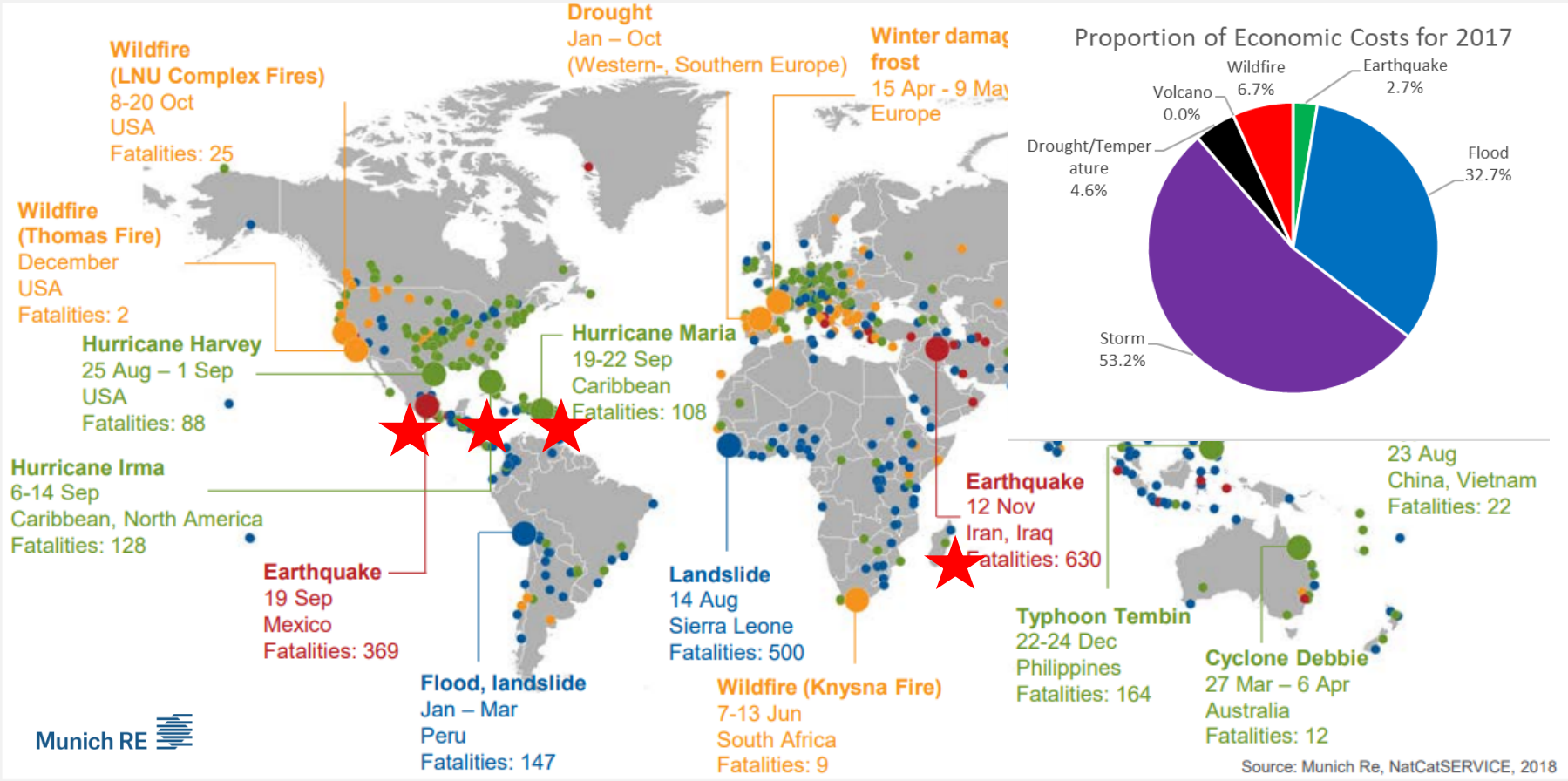
~US$195m losses



The uses of GRADE approach



2017 Events



- **Geophysical events** (Earthquake, tsunami, volcanic activity)
- **Meteorological events** (Tropical storm, extratropical storm, convective storm, local storm)
- **Hydrological events** (Flood, mass movement)
- **Climatological events** (Extreme temperature, drought, wildfire)

○ **Loss events**

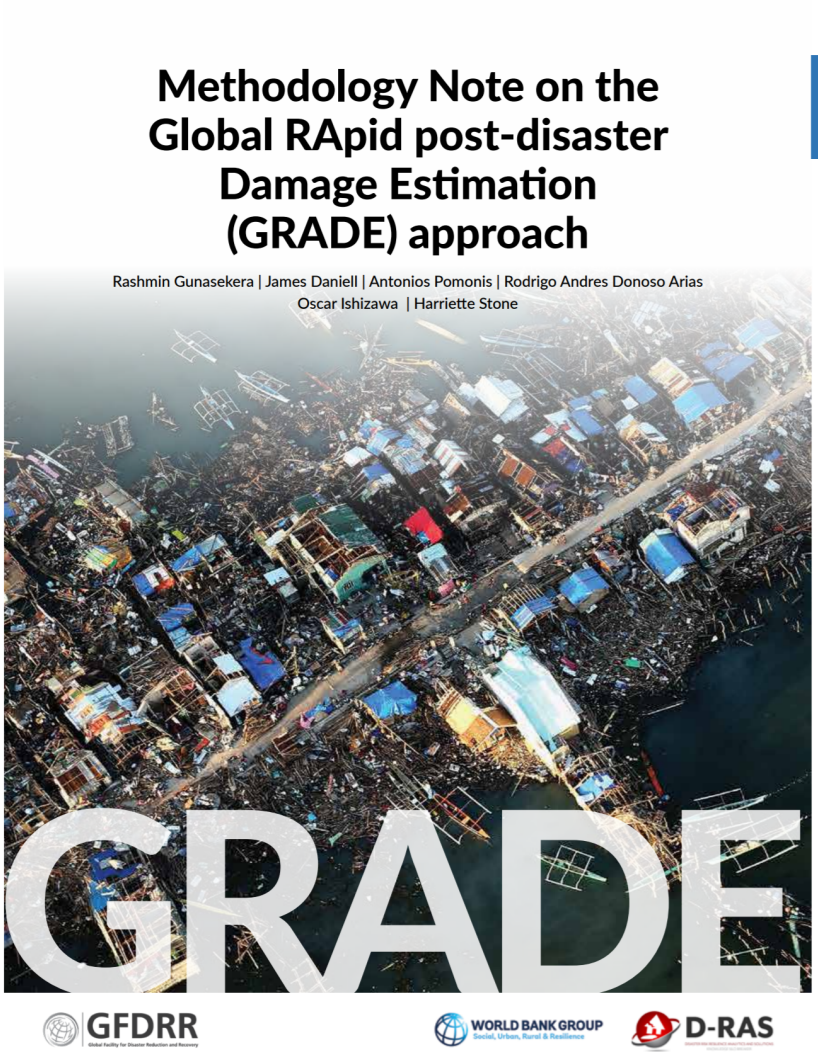
◯ **Selection of catastrophes**

Source: Munich Re, NatCatSERVICE, 2018

Next steps:

- Regional experts
- CEDIM/CATDAT repository of data
- Training workshops
- Collaboration with Private sector
- University/Research Institution Partners – YOU?

Thank you!



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