esa
European Space Agency

Disaster Risk Financing & Insurance Program
SUPPORTED BY WORLD BANK GROUP

Global Risk Financing Facility
Supporting Early Action to Climate Shocks, Disasters, and Crises

Earth Observation and Big Data for Improved Financial Resilience

Webinar Series (Part I): November 23, 8:00 AM -9:30 AM EST

How latest technology can support innovative risk financing solutions for climate shocks and other complex risks

Earth Observation & Big Data for improved Financial Resilience

Insurance Development Forum

What and who is the IDF?

The IDF is a public/private partnership led by the insurance industry and supported by international organisations.

The IDF aims to optimise and extend the use of insurance and its related risk management capabilities to build greater resilience and protection for people, communities, businesses, and public institutions that are vulnerable to disasters and their associated economic shocks.

- Over 250 experts and practitioners from industry, governments, international institutions, NGOs and academia
- 5 Working Groups
  - Risk Modelling
  - Law, Regulation & Resilience Policies
  - Sovereign & Humanitarian
  - Inclusive Insurance
  - Investment

The Protection Gap

The **insurance protection gap** is the difference between economic losses caused by disasters, and the amount of those losses covered by insurance coverage.

$162.5bn

The size of the global insurance protection gap. Emerging economies account for $160bn (96%) of this.

Lloyd's World At Risk report, Oct 2018
www.lloyds.com/worldatrisk

1%

The percentage of natural disaster losses in developing countries 1980-2004 that were insured. This compares to c.30% in developed countries.

Dag Hammarskjöld Foundation and UNDP 2019
Financing the UN Development System: Time for Hard Choices

$4tn

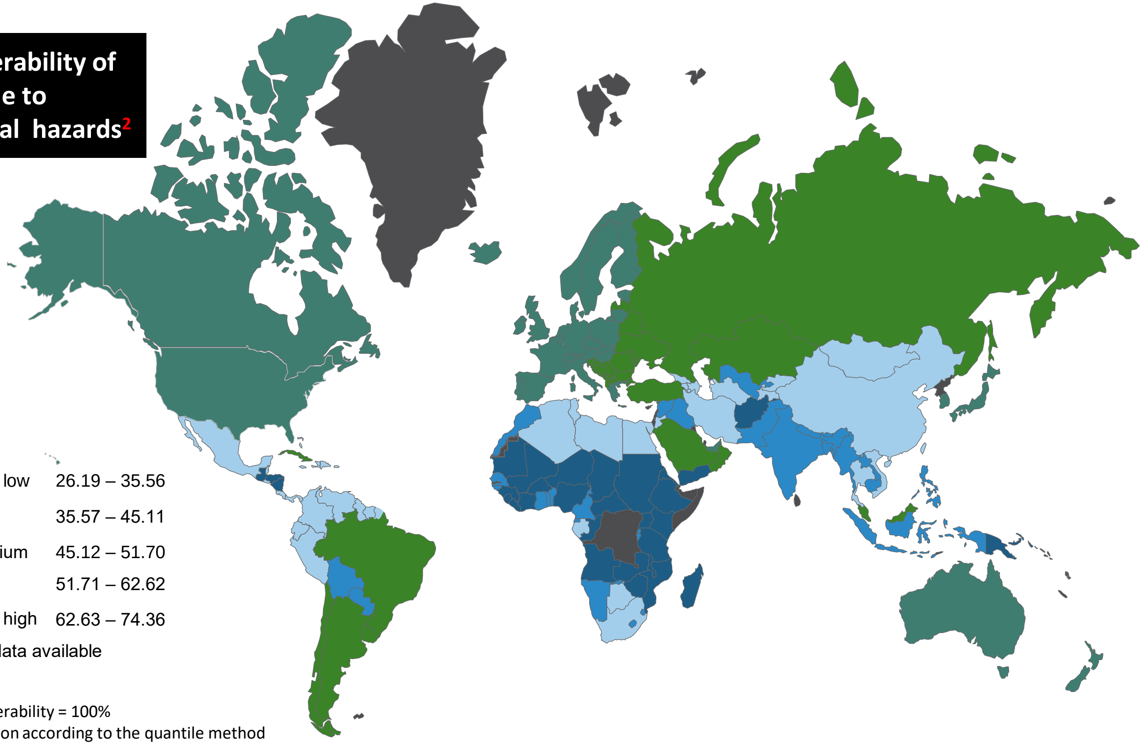
The estimated figure lost to extreme natural disaster events globally over the past 40yrs, US $2.9 trillion of which was uninsured.

Swiss Re database of natural catastrophes

Insurance Development Forum

THOSE IN MOST NEED OF PROTECTION ARE UNINSURED

Vulnerability of people to natural hazards[2]



very low	26.19 – 35.56
low	35.57 – 45.11
medium	45.12 – 51.70
high	51.71 – 62.62
very high	62.63 – 74.36
No data available	

Max. vulnerability = 100%
Classification according to the quantile method

Coastal flooding exposure in Asia[1]

2005 – 1 Asian city in top 10

2070 – 8 Asian cities in top 10

What is driving the exposure?

- **Socio-economic growth**
- **Urbanization**
- **Population growth**

Africa very vulnerable

13 **of the** 15 **countries with the highest vulnerability ratings are in Africa.**[2]

1- Allianz Global Corporate & Speciality (2015), Storm exposures: The changing landscape in Asia (based on OECD analysis - 2008)
2- World Risk Index (2017)

Allianz

Technology as part of the solution

Technology may hold the key to bridging the protection gap but not a panacea

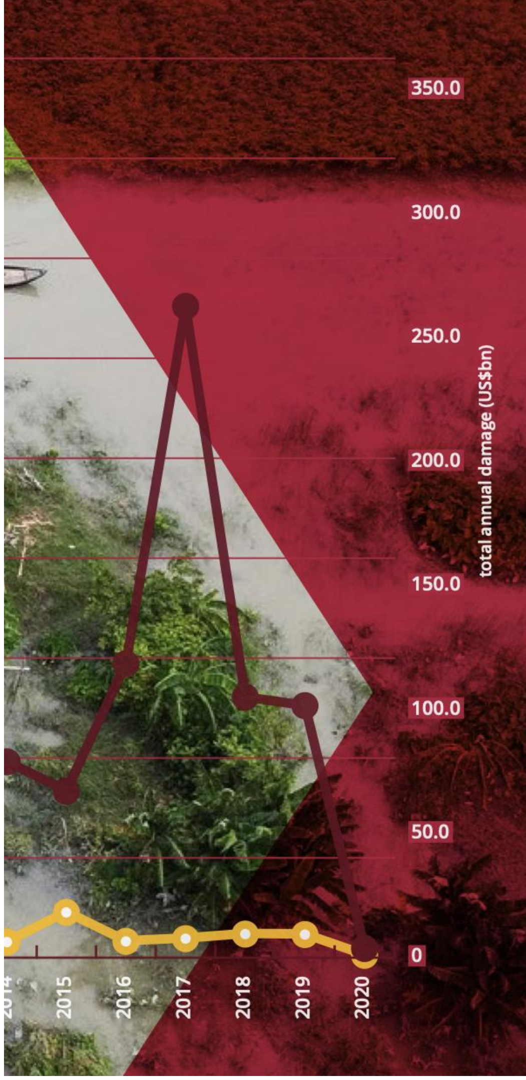
- 3 closely interrelated categories of technological advancements that are contributing to a more detailed understanding of natural hazard and weather risks:
    - **increasing availability of data** (earth observation (EO), the internet of things (IoT), crowdsourcing etc.);
    - **increasing capacity to process that data** (artificial intelligence (AI – Machine Learning), cloud computing, etc.); and
    - **new tools for communicating risk data and mitigation advice** (including insurance distribution)

Earth Observation & Big Data: Application

- Building a historical record of events
- Early warning
- Post event assessment
- Understanding exposure

Benefits

- Advances in satellite technology and data analysis expand the potential reach of insurance policies to rural areas previously considered uninsurable
  - Avoid the pitfalls of high transaction costs
  - Enabling new distribution channels
  - Reducing cost of sales
  - Improving client on boarding
  - Understanding client needs
  - Underwriting
  - New product development
  - Gathering premium and paying claims
  - Building trust, knowledge and engagement
  - Streamlining claims handling and verification



COMPLEX CONDITIONS

Challenging situation

- Lack of accessible historical loss data despite frequent floods.
- Patchy hazard and exposure data; flood risk not quantified.
- Out-dated public assets registry
- Challenges with waste management; blocked drains.

Understanding the risk

- Updated public assets registry (geo-referenced).
- Hazard and exposure analysis with risk profile of all public assets.
- Cost-benefit analysis of identified risk reduction measures.
- Flood risk app to improve awareness and support for waste management awareness.

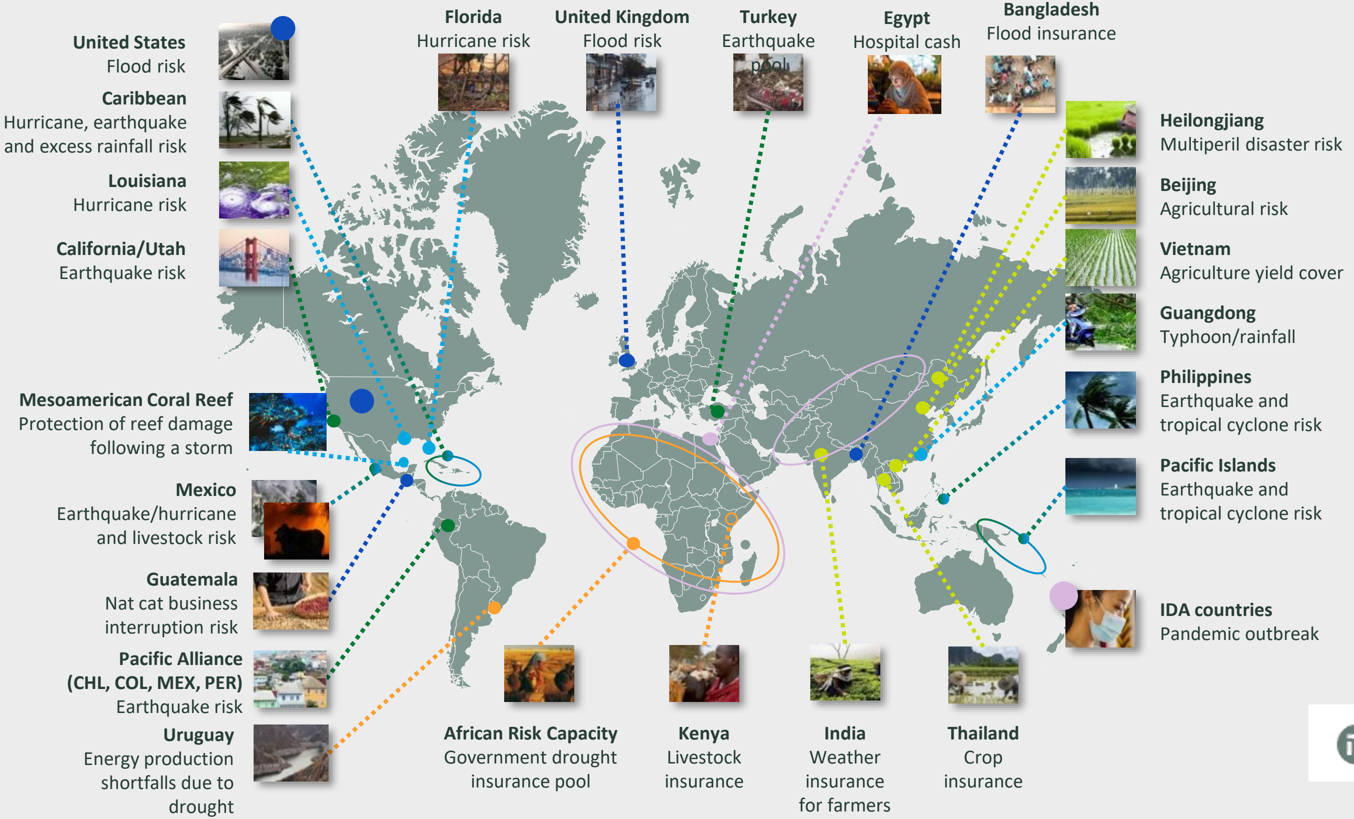
Towards insurability

To provide affordable, accessible, and reliable solution:

- Invest in risk reduction (e.g. waste management, drain expansion, etc.)
- Improve risk awareness and attitude towards risk in general
- Public sector support/local ownership needed to implement these measures

Allianz

Enabling the creation of innovative services and products to help governments understand natural hazard risks and design systems to protect their citizens and infrastructure.

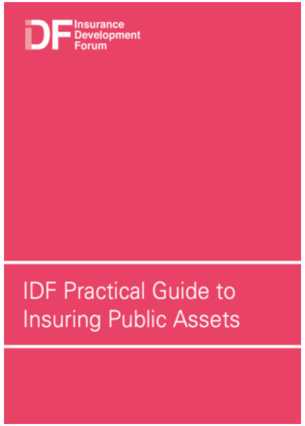


Some reflections

- **Overwhelming quantity of data**
  - How can low-income countries be expected to ingest, curate and analyse it?
  - The private sector can potentially help
    - Apart from global organisations, part of the answer may well be in the vast number of start-ups that are springing up with clever algorithms focused on specific risk problems.

- **Potentially a bewildering number of approaches and data formats.**
  - Justification for data standards, interoperability and use of open platforms that support these standards.
  - **Necessary for any sensible modelling for financial resilience**, because they enable:
    - Less labour-intensive comparison and validation
    - Shared views of risk across sectors

IDF Reports



IDF reports explore a number critical issues

Insurance Development Forum

Thank you

www.insdevforum.org

@Insdevforum

Earth Observation Data to support Risk and Disaster Management

Driss EL HADANI
Director - Royal Centre for Remote Sensing - Morocco

World Bank / ESA Webinar
“EO & BIG DATA for for improved financial resilience"
23 Nov 2020

المركز الملكي للاستشعار البعدي الفضائي

Centre Royal de Télédétection Spatiale

Value Added Services provided by CRTS to Support User Community

- ✓Ministry of Interior
- ✓Ministry of Finance / Treasury / Public Solidarity Fund
- ✓Royal Police
- ✓Regional Governorates
- ✓Civil Protection Department

- ✓Ministry of Agriculture
- ✓Irrigation Agencies

- ✓Ministry of land Management
- ✓Urban Planning Agencies
- ✓Local Authorities
- ✓Private companies

- ✓Ministry in charge of fisheries
- ✓National Agency of Aquaculture
- ✓National Agency of Harbors
- ✓Fisheries National Office

- ✓High Authority in charge of Forest resources
- ✓Regional Direction

- ✓Ministry of Water Resources
- ✓Basin Agencies
- ✓Waters

Data -> Products -> Services

Preparedness — P

- Early Warning System
- Forecasting/Nowcasting
- Event scenario

Emergency Response — ER

- Disaster extent
- Monitoring
- Damage assessment

Recovery — R

- Damage assessment (ctd)
- Logistics and infrastructure analysis

Mitigation — M

- Hazard assessment
- Exposure mapping
- Vulnerability assessment
- Risk scenarios
- Emergency plans

hours

weeks

years

First responders

Disaster managers

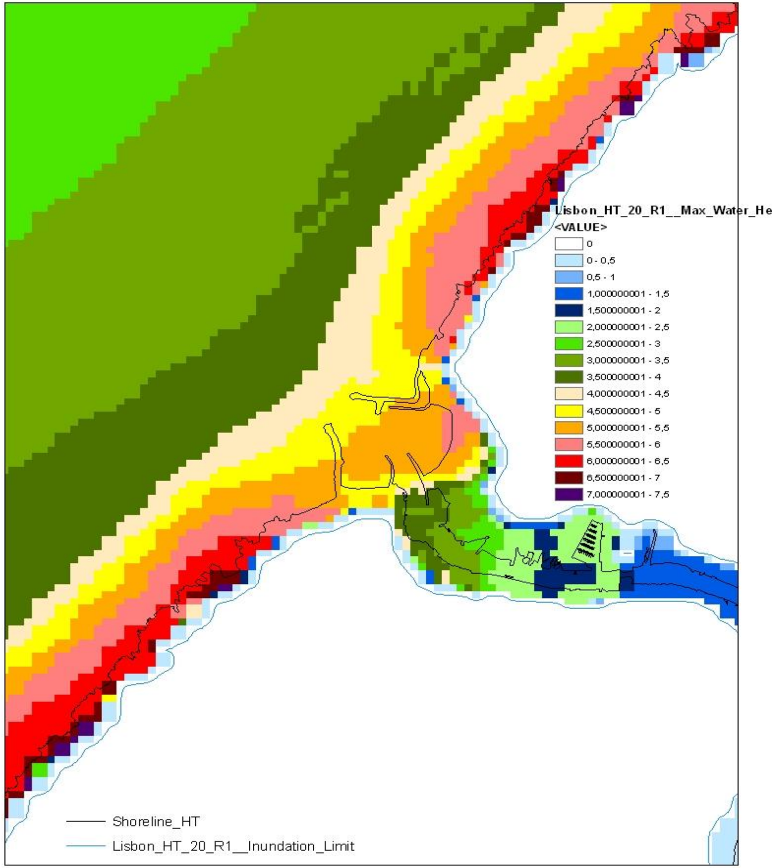
Local Authorities

National Decision makers

Scientist
s

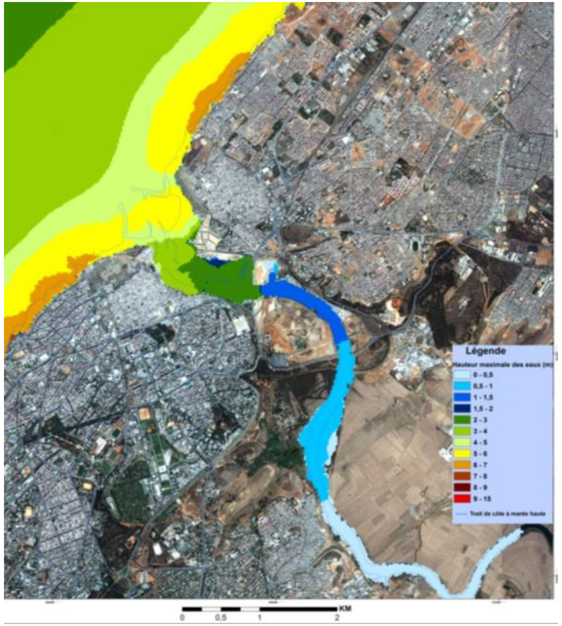
Modeling of tsunami-induced floods

Flood maps based on the modeled tsunami scenario

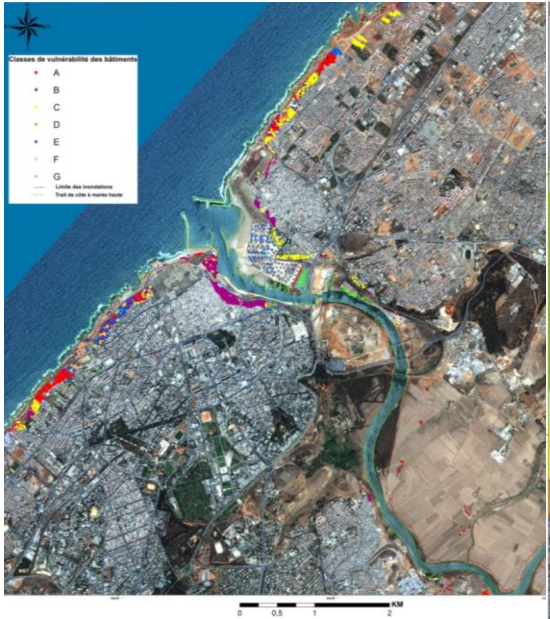


Building Damage Modeling Approach to TSUNAMI Risk

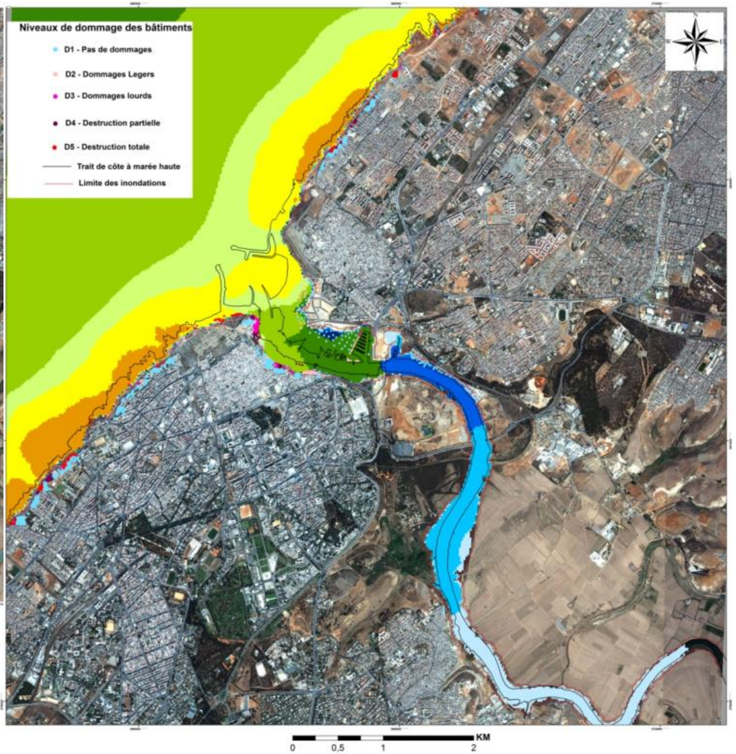
Hazard Map



Vulnerability Map

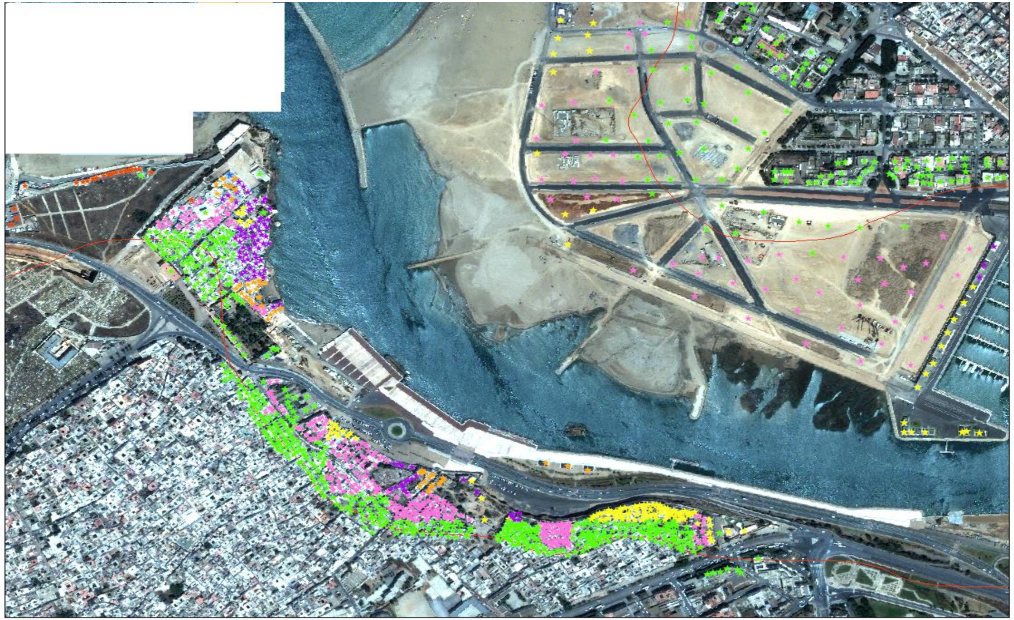


Damage Map

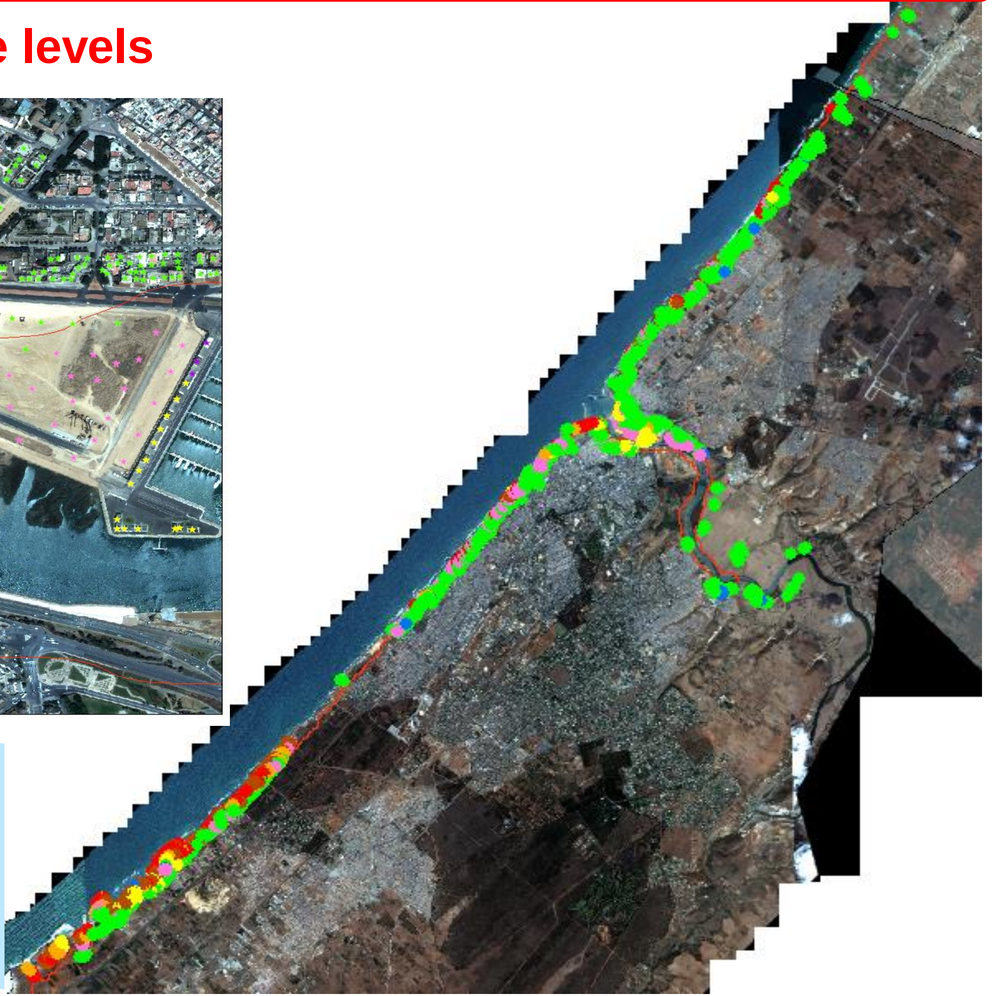


Users: civil protection, regional planning department, local authorities

Estimation of building damage levels



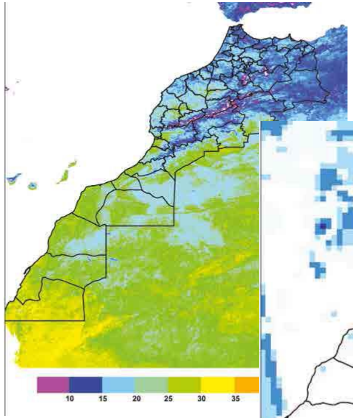
Vallée du Bouregreg



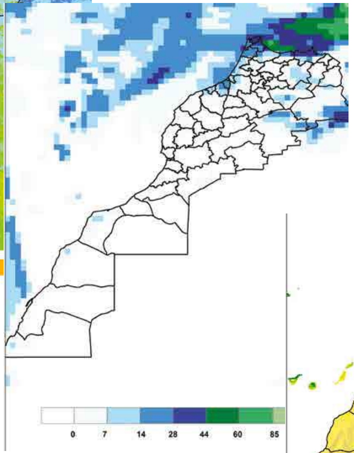
★	Hors zone risque
★	Bâti non classé
★	D1
★	D2
★	D3
★	D4
★	D5

Risks of Desert Locust invasion

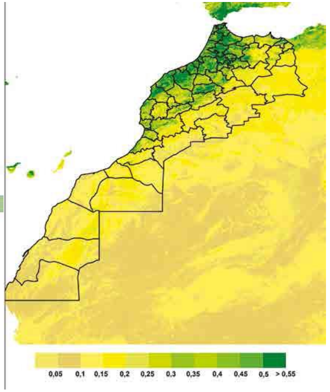
Weekly surface temperature map (December 19, 2016)



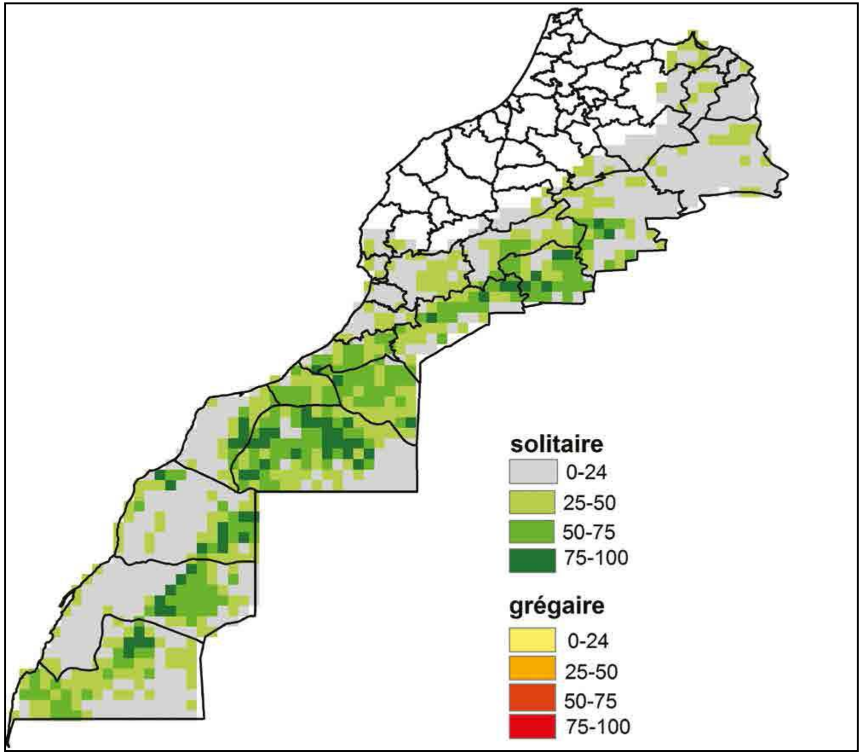
Monthly cumulative precipitation map (December 2016)



Bi-weekly vegetation index map (December 19, 2016)



Map of the probability of the presence of the desert locust in Morocco, from January 01 to February 10, 2017



Users: Ministry of Agriculture, CLNAA, CLCPRO (FAO)

Wildfires: mapping of burnt areas and damage evaluation

Région de Ouazzan, August, 2004

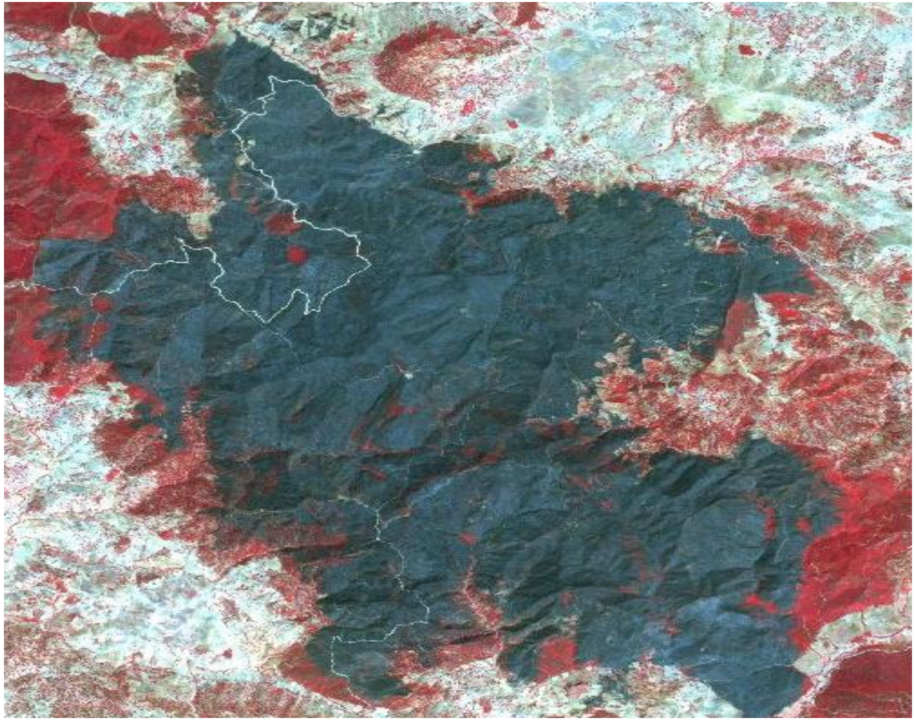
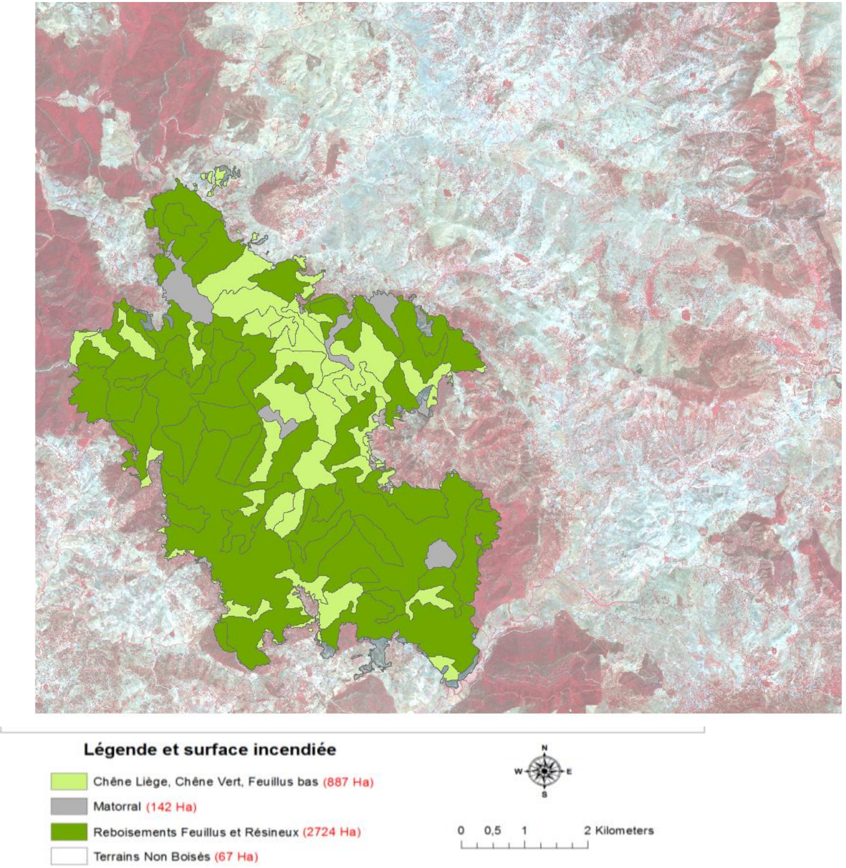
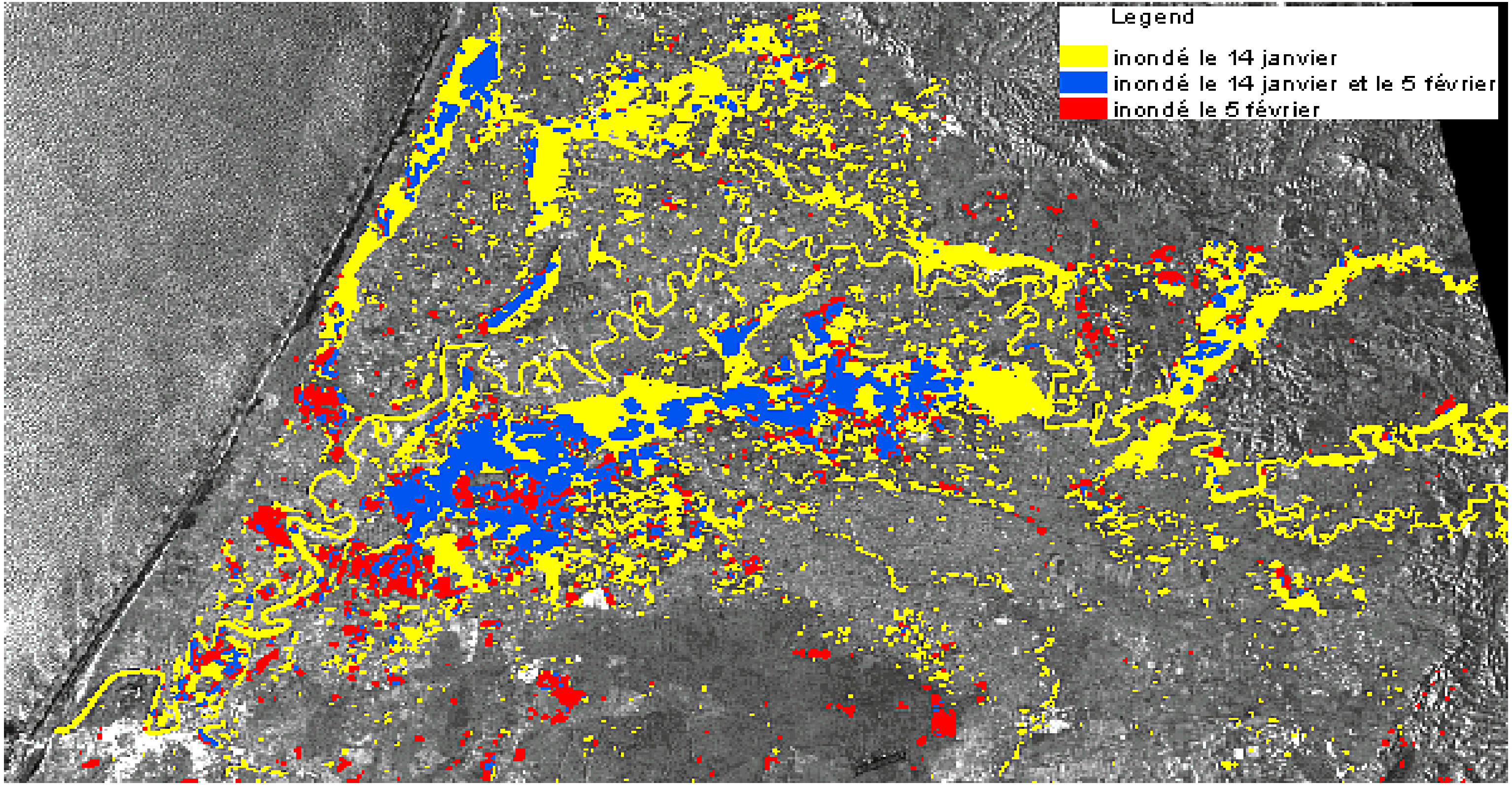


Image SPOT-XS acquise après le feu, Août 2OO4



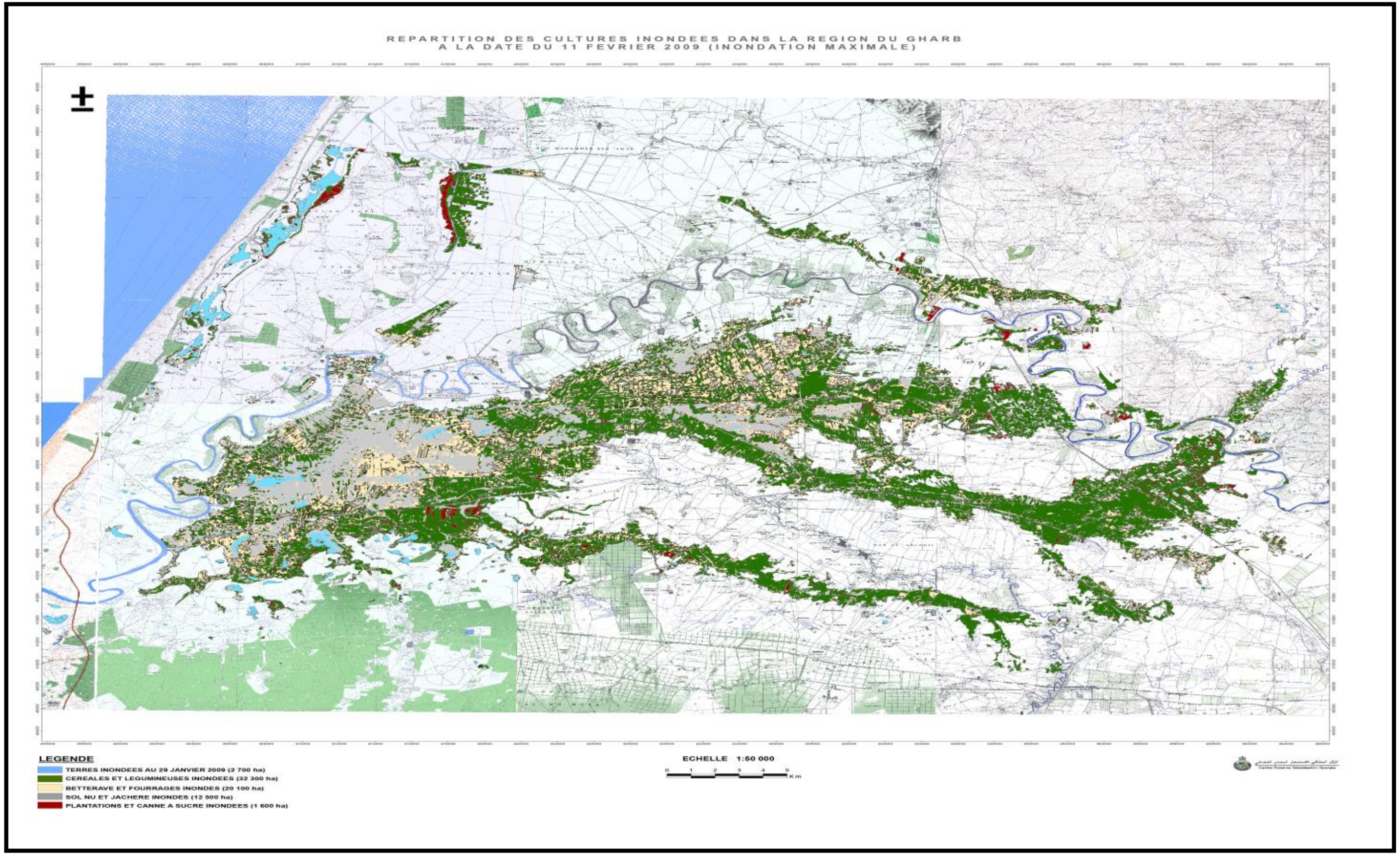
Mapping & Monitoring of flooded areas

Région du Gharb, Jan-Mars 2010



Mapping flood extent by crop type (damage evaluation)

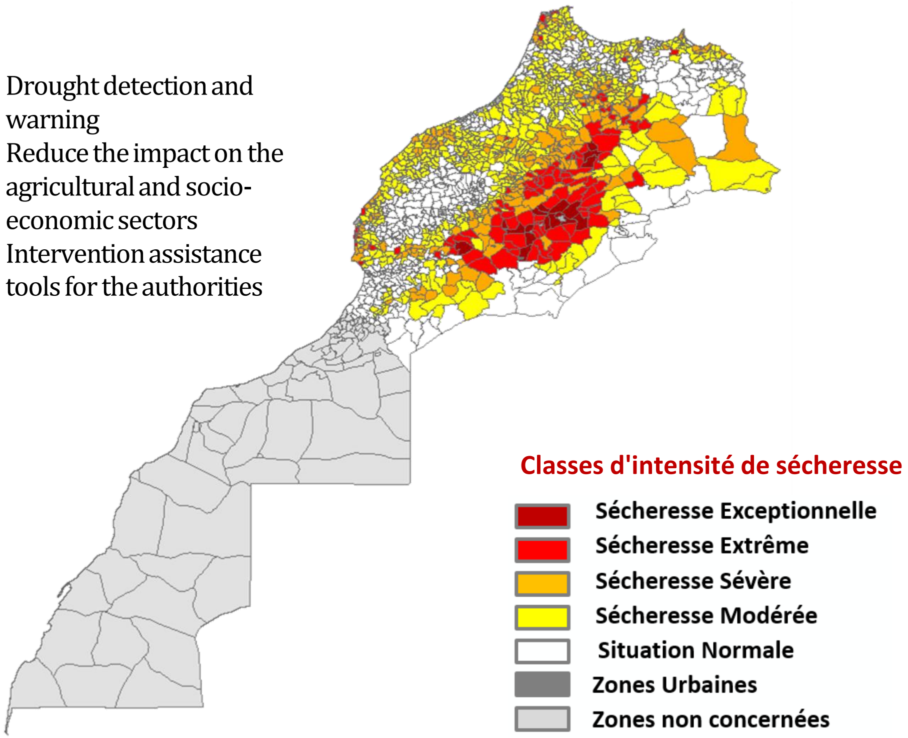
Région Gharb, Février 2009



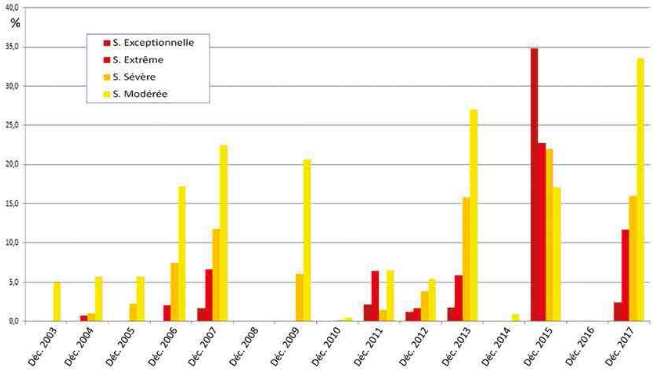
Composite Drought Index (CDI)

December 2017

- Drought detection and warning
- Reduce the impact on the agricultural and socio-economic sectors
- Intervention assistance tools for the authorities



Evolution de L'ICS - Entre Décembre 2003 et Décembre 2017 -



Statistiques Régionales de L'ICS - Entre Octobre et Décembre 2017

Régions	Périodes	Sécheresse Exceptionnelle	Sécheresse Extrême	Sécheresse Sévère	Sécheresse Modérée	Situation Normale
Tanger-Tétouan	Octobre 2017	0%	0%	0%	1,9%	96%
	Novembre 2017	4,1%	17,2%	39,9%	32,5%	4,1%
	Décembre 2017	0%	4,3%	9,5%	45,7%	40,5%
Oriental	Octobre 2017	2,8%	24,2%	19,7%	35,7%	17,4%
	Novembre 2017	70,6%	18%	10,8%	0,4%	0%
	Décembre 2017	0%	1,0%	18,1%	37,9%	43,0%
Fès-Meknès	Octobre 2017	0%	4,9%	10,1%	18,3%	65,9%
	Novembre 2017	33,3%	34%	26,8%	5%	0%
	Décembre 2017	0%	14,4%	28,9%	42,5%	14,2%
Rabat-Salé-Kenitra	Octobre 2017	0%	3%	12,8%	49,2%	32,5%
	Novembre 2017	3,8%	36,8%	45,6%	9,5%	1,7%
	Décembre 2017	0%	0%	2,3%	75,2%	22,5%
Casablanca-Settat	Octobre 2017	0%	0%	6,7%	34,6%	56,2%
	Novembre 2017	4,8%	34,5%	53,2%	5%	0%
	Décembre 2017	0%	0%	15,2%	67,2%	17,6%

Users: Ministère de l'Agriculture, INRA, HCEFLCD, département de Eau, département de l'environnement, Assurances, ANDZOA, BANQUES du MAROC, DMN

Earth Observation and Big Data for improved financial resilience

Matt Foote, Climate and Resilience Hub
Willis Towers Watson

Willis Re

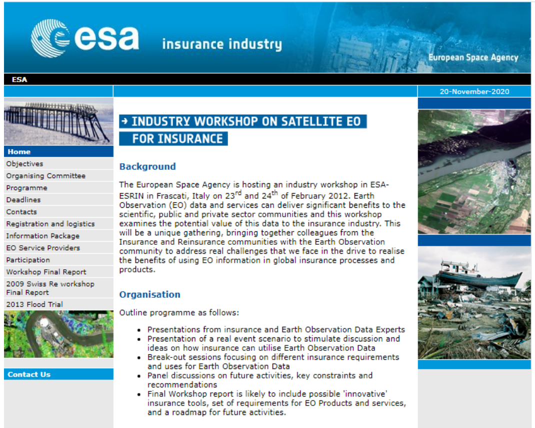
Climate Risk and Resilience – the critical role of EO

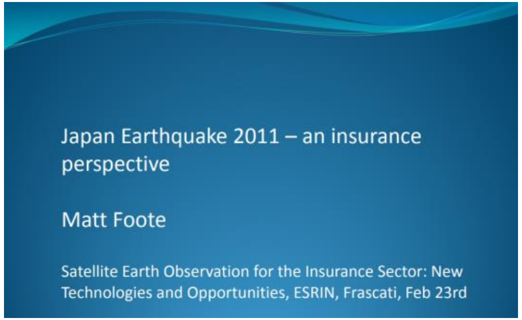
- **12th December 2020 - Paris Agreement 5th anniversary**
- Climate and resilience is now a global mainstream issue
- Requiring new sources of data to inform and support far reaching decisions – net zero, NDCs
  - Physical impacts- acute and chronic
  - Transition – fundamental impacts on energy, industry and services at every scale
- Global, collaborative action to reduce GHG emissions – investment, risk financing, development
- Critical need for accurate, consistent and granular data
  - Climate futures
  - Infrastructure and societal assets
  - Monitoring and response

Where have we come in a decade?

How to unlock and exploit latent EO potential for DRF?

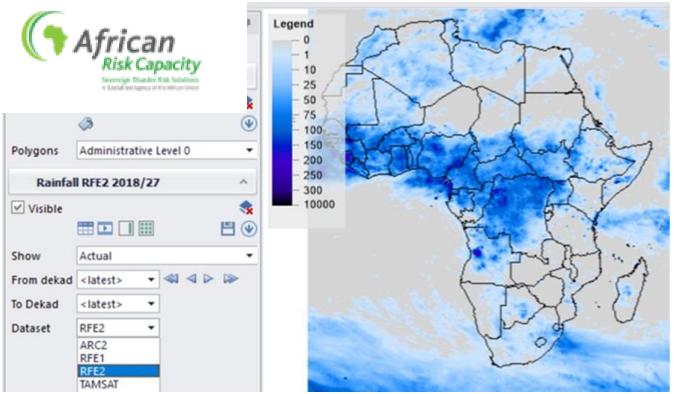
- **2012** – ESA workshop on use of EO for insurance
- ‘unprecedented’ global losses from catastrophes – many unmodelled, or poorly represented
- At the start of the Sentinel programme – most useable data behind paywalls or unavailable
- Fewer platforms in orbit
- Low level of uptake, or expertise within industry or public sector
- Most re/insurance products indemnity based
- **Potential** for innovation and DRF

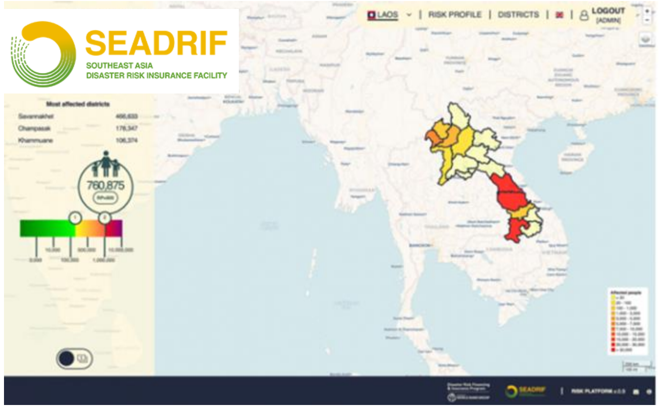




In 2020…

- EO data now being directly applied to arrange of innovative DRF initiatives
- Parametric insurance triggers
- Regional scale data capture
- High overpass frequencies
- SAR / visible
- Sentinel / NASA open access data
- Improving catastrophe model calibration:
  - Hazard
  - Exposure
  - Vulnerability





To the future…

- Ongoing investment in open access multi-sensor platforms
- Sentinel 6 Michael Freilich – Sea level Rise and coastal risks
- CHIME Hyperspectral platform – agriculture / crop yield, senescence monitoring, natural assets, biodiversity – parametric insurance product triggers?
- Increased collaboration between EO agencies and role of commercial entities
- Democratisation of data and role of local expertise and application

GOST
Geospatial Operational Support Team

DEC Analytics and Tools (DECAT)

WORLD BANK GROUP
Geospatial Operational Support Team

Clara Ivanescu - Geographer

Statement Problem

- Hundreds of millions of people around the world live in extreme poverty.
- Reducing poverty and boosting shared prosperity need measurement and monitoring.

- Minority groups, women and the poor are at greater risk to financial emergencies than the rest of the population.
- Moreover, many of these people live in countries that are constantly vulnerable to large natural disasters

- So when disaster strikes, we need to know **where to target our intervention** = **where are the people/ assets at risk located?**



GOST

GOST brings geospatial insight to World Bank operations while reducing costs and waste. GOST advises operational teams, brings analysis in house, gives geospatial data a home, shares it and coordinates investment with external partners.

Advise

Analyze

Share

Coordinate

Advice: Satellite imagery | | Derivative Products

Landsat 8

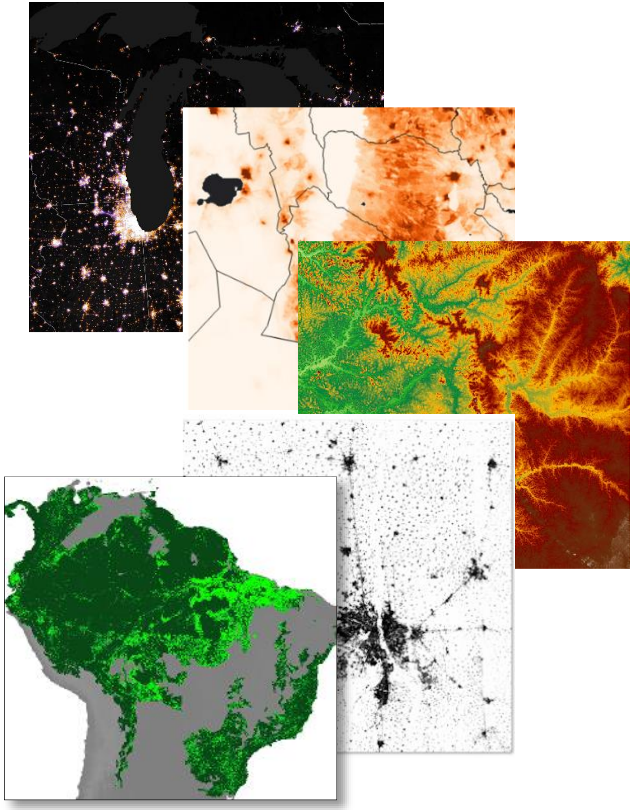
Planet (PlanetScope)

Sentinel 2 A/B

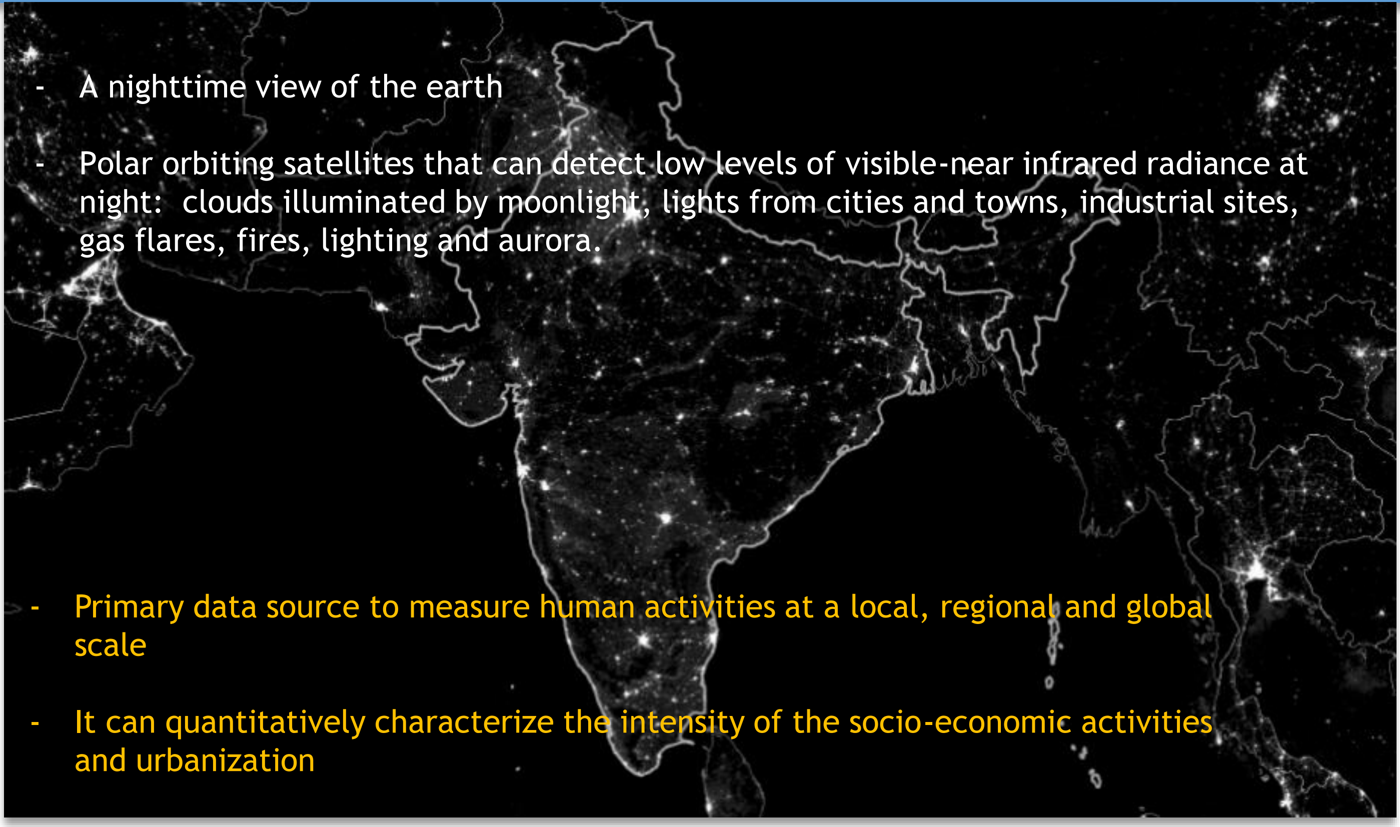
Planet

Sentinel 1A/B (Radar)

Maxar (WorldView)



NightTime Lights: a proxy for economic development



- A nighttime view of the earth
- Polar orbiting satellites that can detect low levels of visible-near infrared radiance at night: clouds illuminated by moonlight, lights from cities and towns, industrial sites, gas flares, fires, lighting and aurora.

- Primary data source to measure human activities at a local, regional and global scale
- It can quantitatively characterize the intensity of the socio-economic activities and urbanization

NightTime Lights - applications

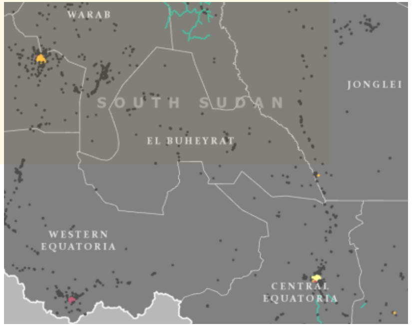
Current projects:

- Open Nighttime Lights Archive - will make the global nightly repository open and available in the public domain

- NTL is widely used in Energy Access projects

- Commonly used in studies of urban productivity

- Novel uses in poverty estimation

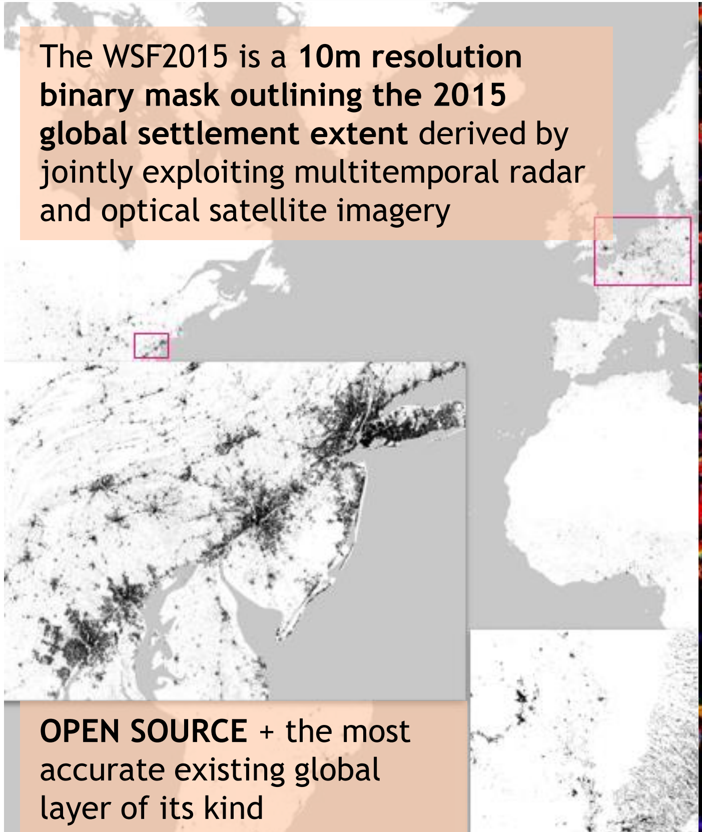


Past projects:

- Spatio-Temporal Dynamics of Urban Growth in Latin American Cities : An Analysis Using Nighttime Lights
- ImageryAnalysis of nighttime lights over five South Asian Cities
- Tracking Electrification in Vietnam Using Nighttime Lights
- Twenty Years of India Lights web application

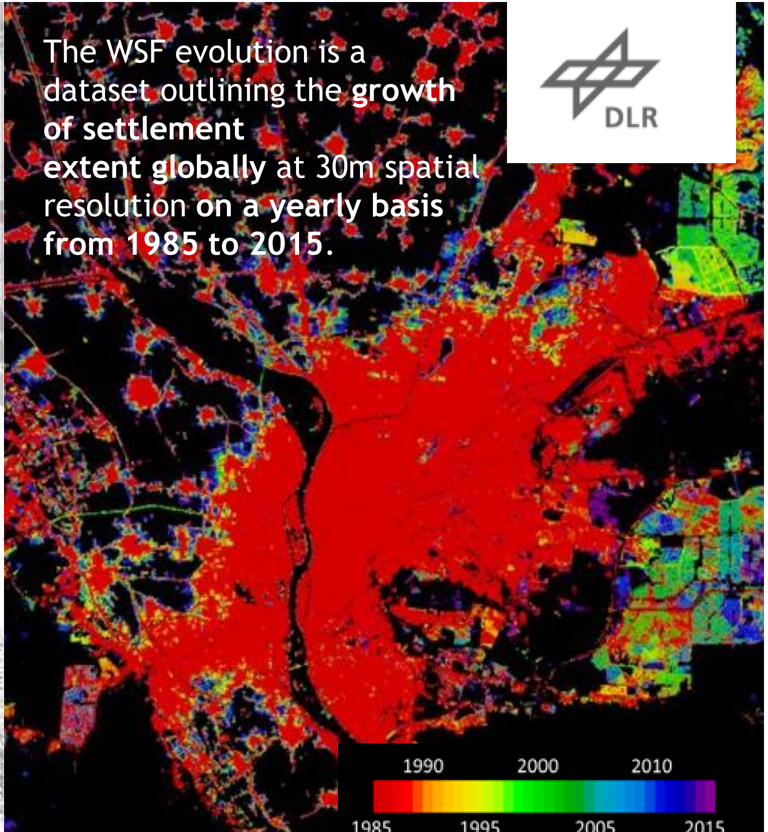
World Settlement Footprint (2015)

The WSF2015 is a **10m resolution binary mask outlining the 2015 global settlement extent** derived by jointly exploiting multitemporal radar and optical satellite imagery

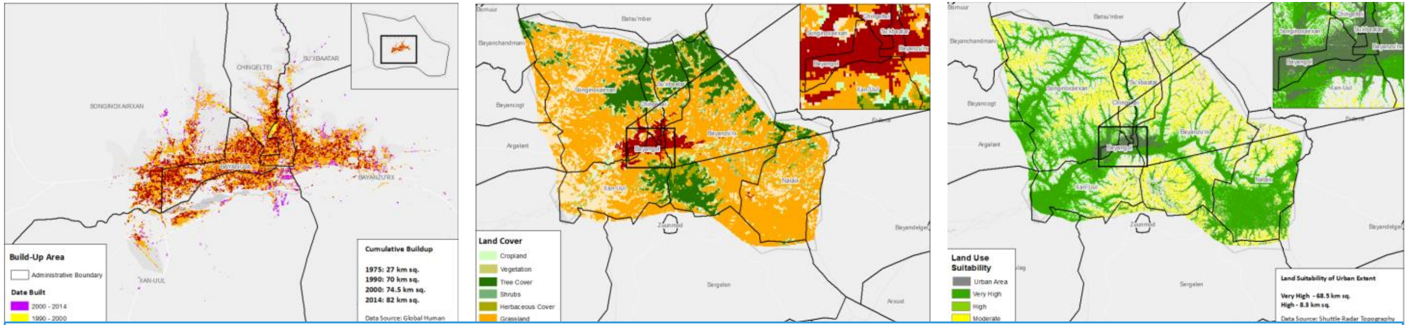


OPEN SOURCE + the most accurate existing global layer of its kind

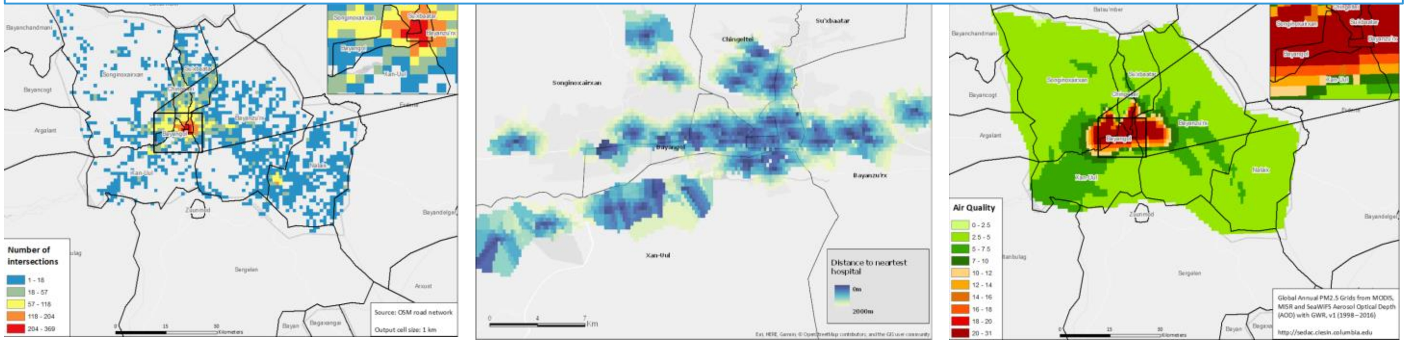
The WSF evolution is a dataset outlining the **growth of settlement extent globally** at 30m spatial resolution **on a yearly basis from 1985 to 2015.**



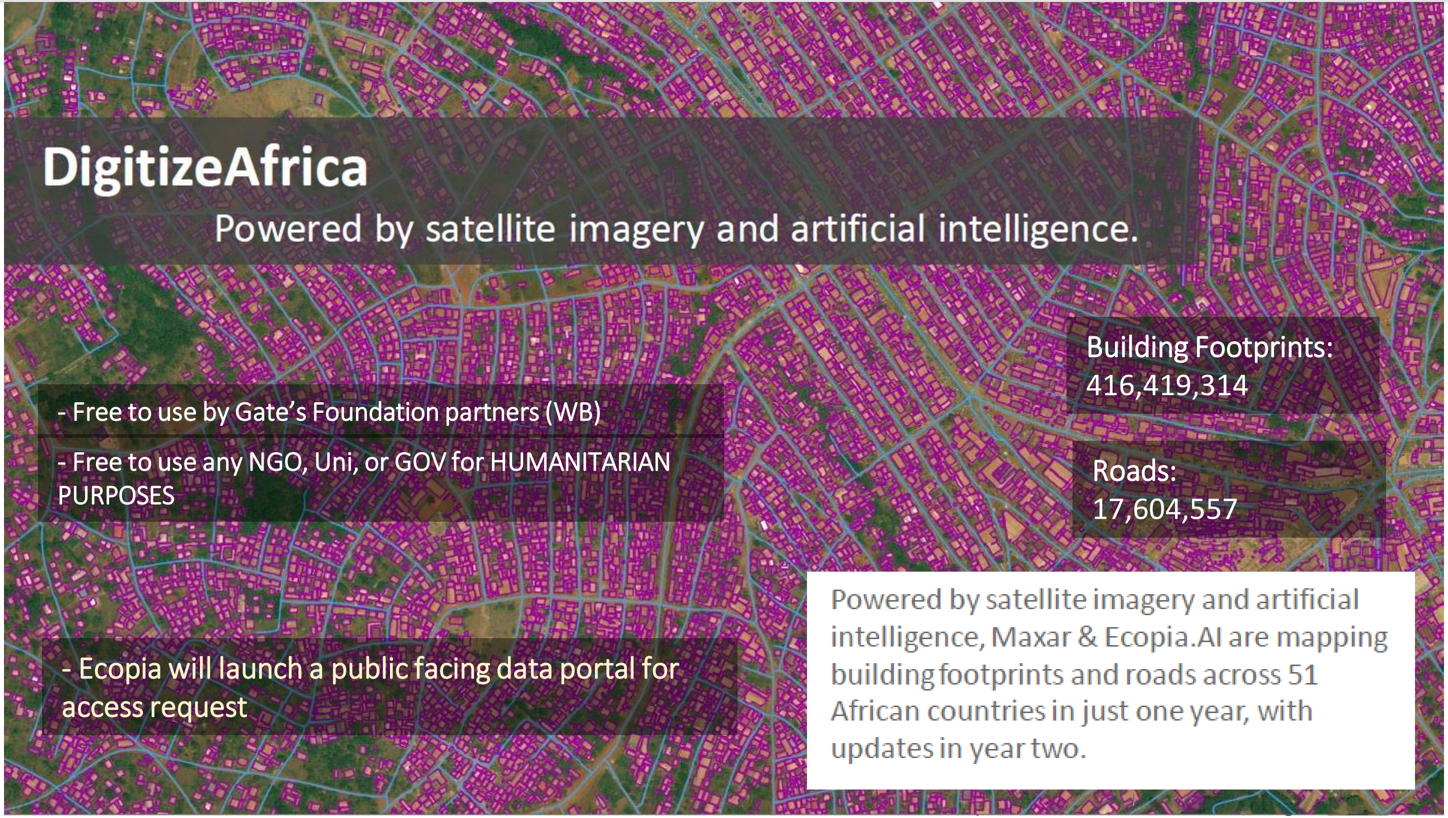
WSF - applications



[Urban landscape expansion index]: LEI measures change in urban extent; used to assess urban planning policies and design improved land allocation systems



Digitize Africa



Digitize Africa - applications

- World Bank projects:

- Census support: work with client country census cartography unit to improve methodology.

- Input to estimations of economic activity and subnational poverty analysis: South Sudan| Eritrea

- Exposure of population to floods: Niger| Sierra Leone| Sudan

- Prioritization of rural roads: Comoros | Uganda

- Least cost electrification plans: Zimbwawe| South Sudan| Djibouti| Kenya

World Pop – population density estimates

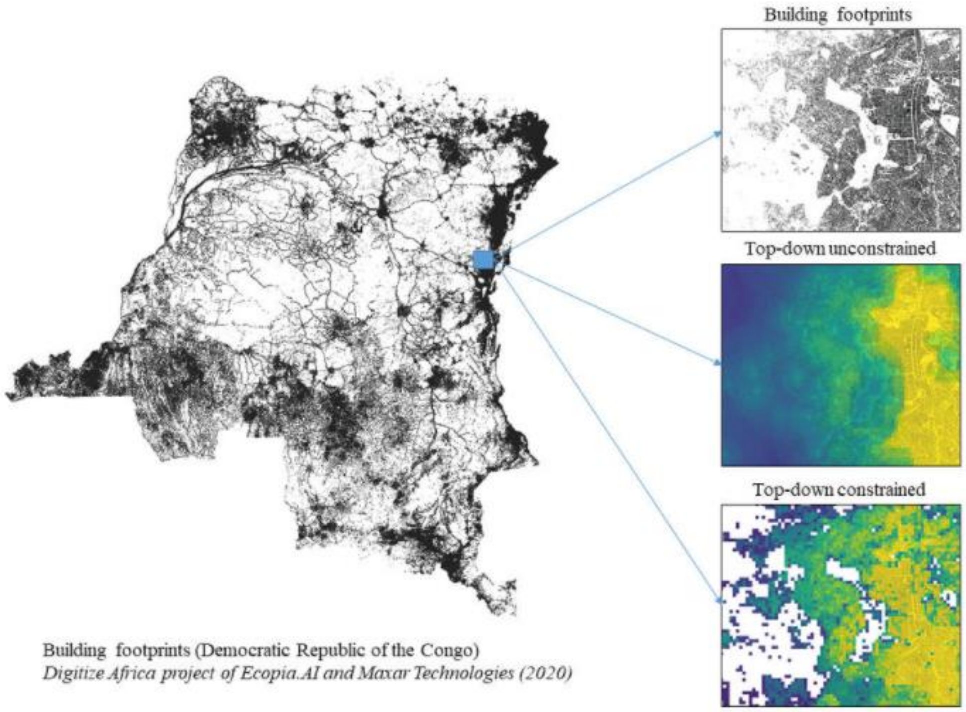
- New constraints based on **DigitizeAfrica** buiding footprints

-> [a more accurate population distribution](#)

- **100 m resolution**

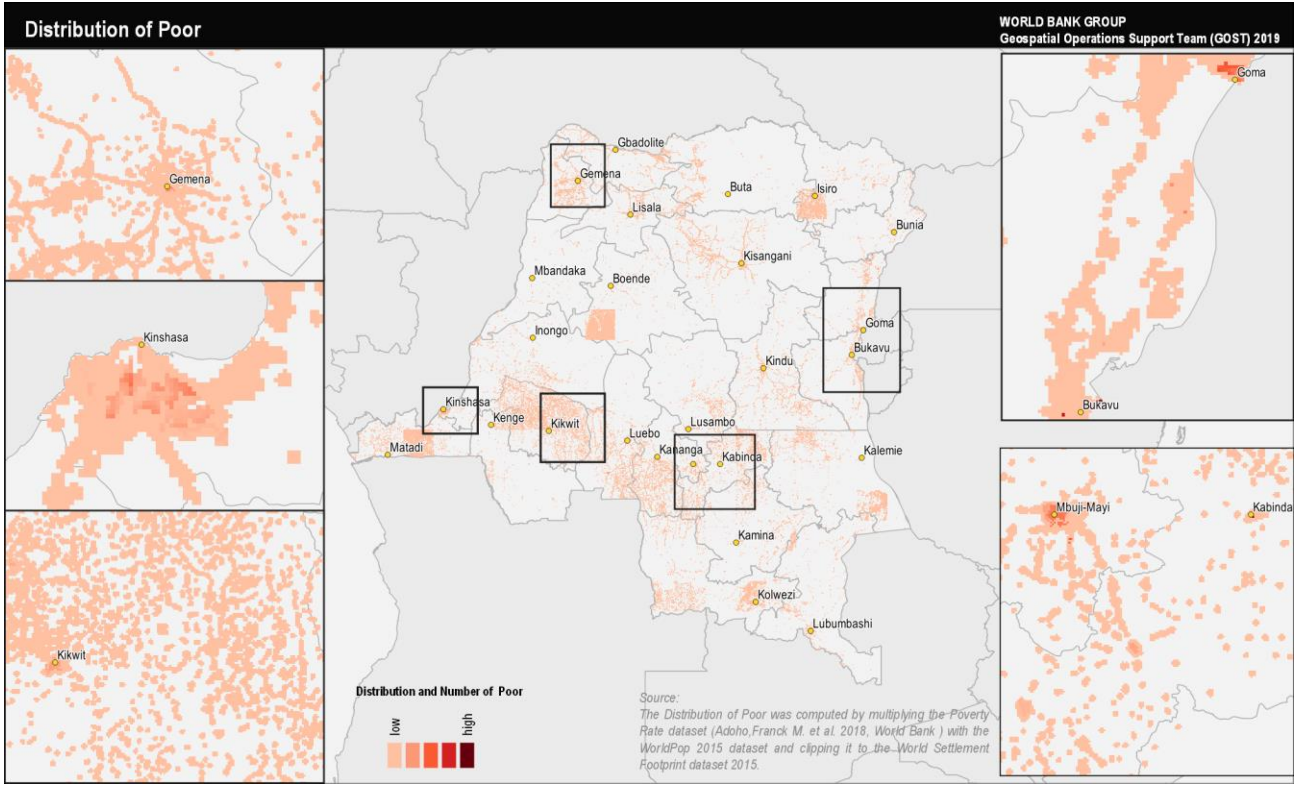
- **UN adjusted**

- **Age and Sex structures**



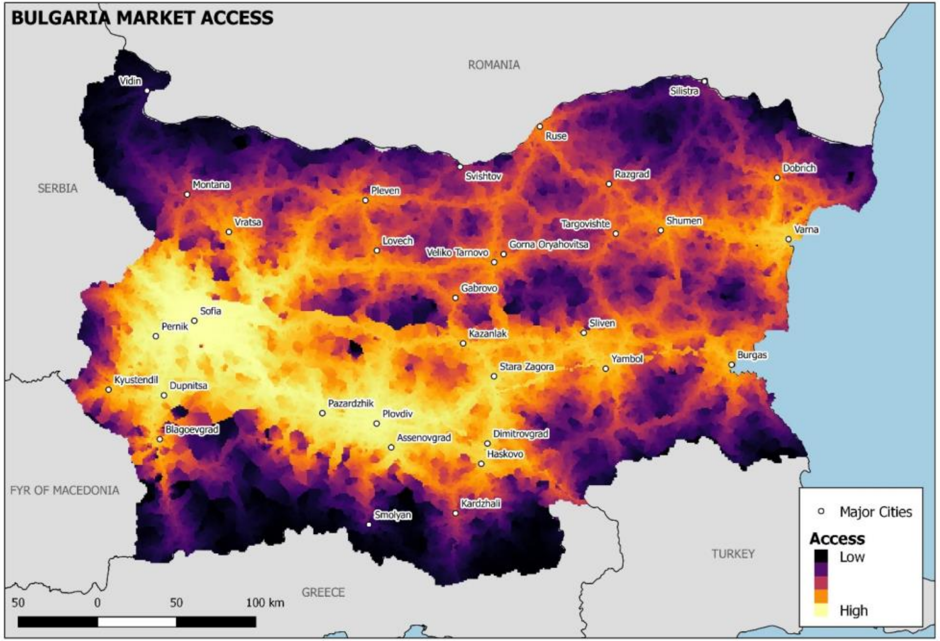
Building footprints (Democratic Republic of the Congo)
Digitize Africa project of Ecopia.AI and Maxar Technologies (2020)

World Pop - applications



WSF & World Pop - applications

Market Accessibility



Markets

Schools?

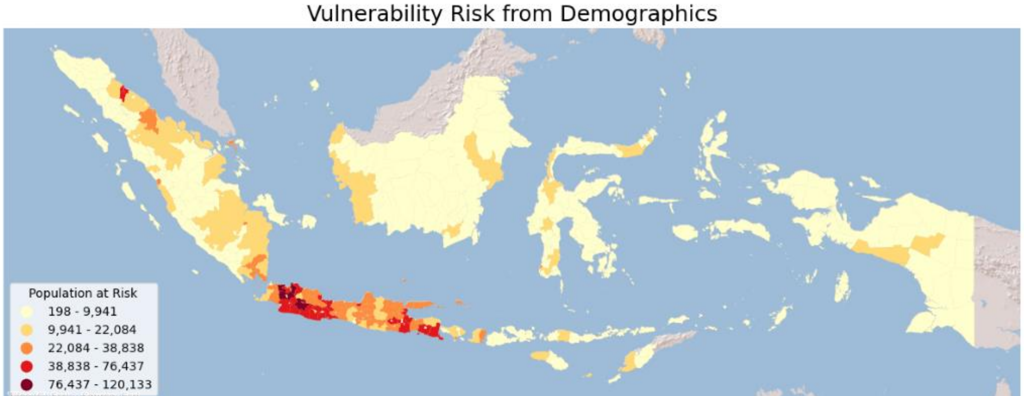
Hospitals?

Fire Stations?

COVID-19 response

<u>Health Intervention Planning and Monitoring Data Support</u>

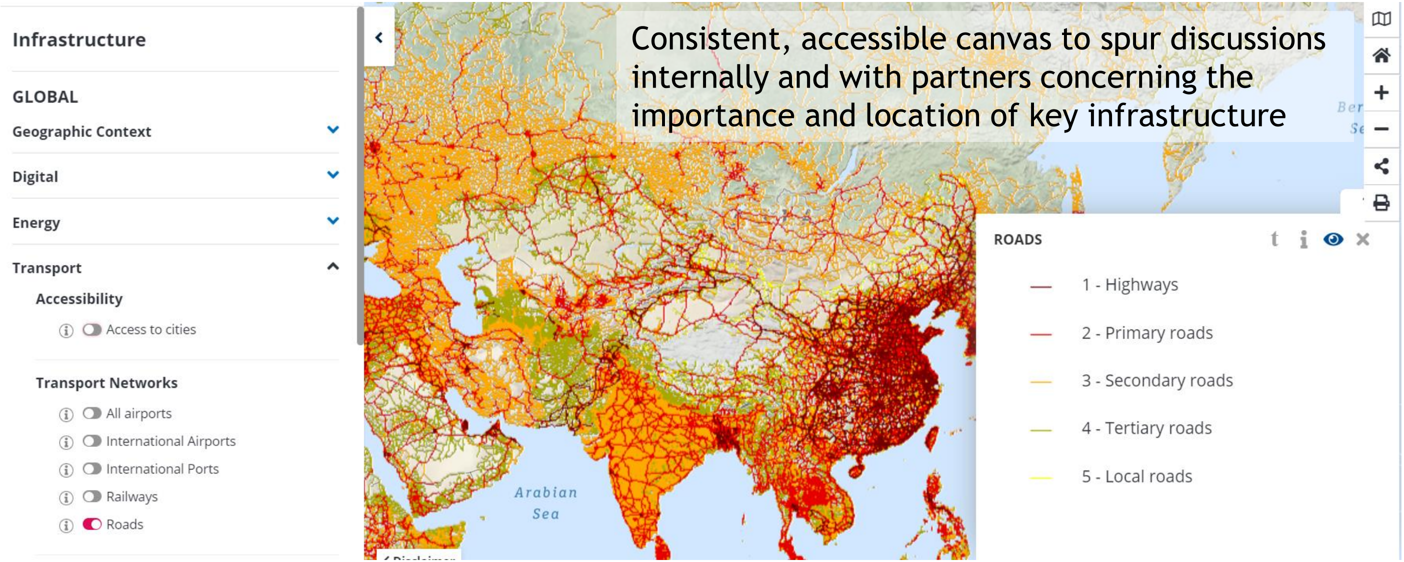
- Visualizing distributions at various national or sub-national aggregations,
- Locating, quantifying populations at risk due to age and comorbidity factors,
- Identifying access to health facilities and critical care capacity,
- Quantifying availability of response supplies, facilities, and front-line workers,
- Mapping local case counts, testing, and fatalities,
- Assessing the secondary effects on the local economy, the safety of individuals and the environment.



Infrastructure Toolkit

- The Global Infrastructure Map provides an unprecedented global scale compilation of ~60 layers of high quality, hyper-local geospatial data depicting infrastructure assets, networks and service flows, as well as related economic and geographic features.

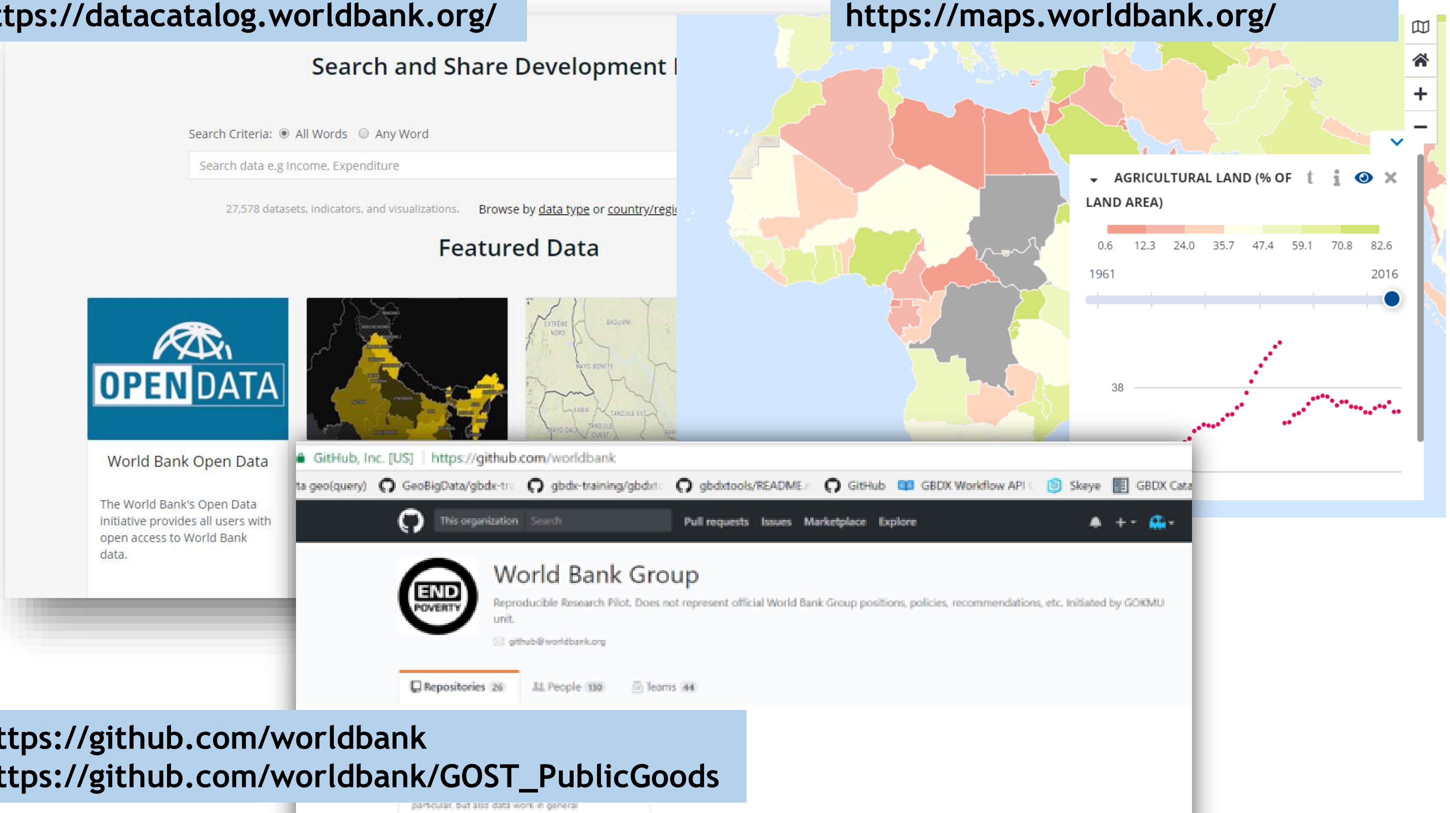
- https://www.worldbank.org/en/data/datatopics/infrastructure



Share: Open Tools “free and fit for purpose”

https://datacatalog.worldbank.org/

https://maps.worldbank.org/



https://github.com/worldbank
https://github.com/worldbank/GOST_PublicGoods

GOST (WB)

Thank you

Nowcasting disaster-related business ***downtime*** through social media data

Robert Eyre,
Flavia De Luca,
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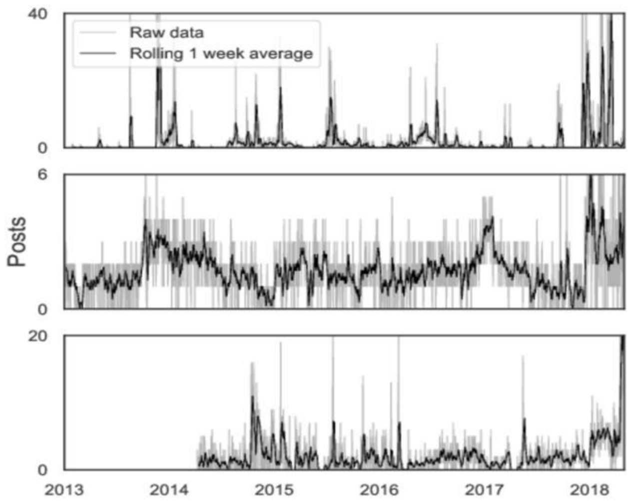
University of BRISTOL

Our approach

Goal: determine the recovery status of small businesses in real time through the analysis of their posting activity on Facebook.

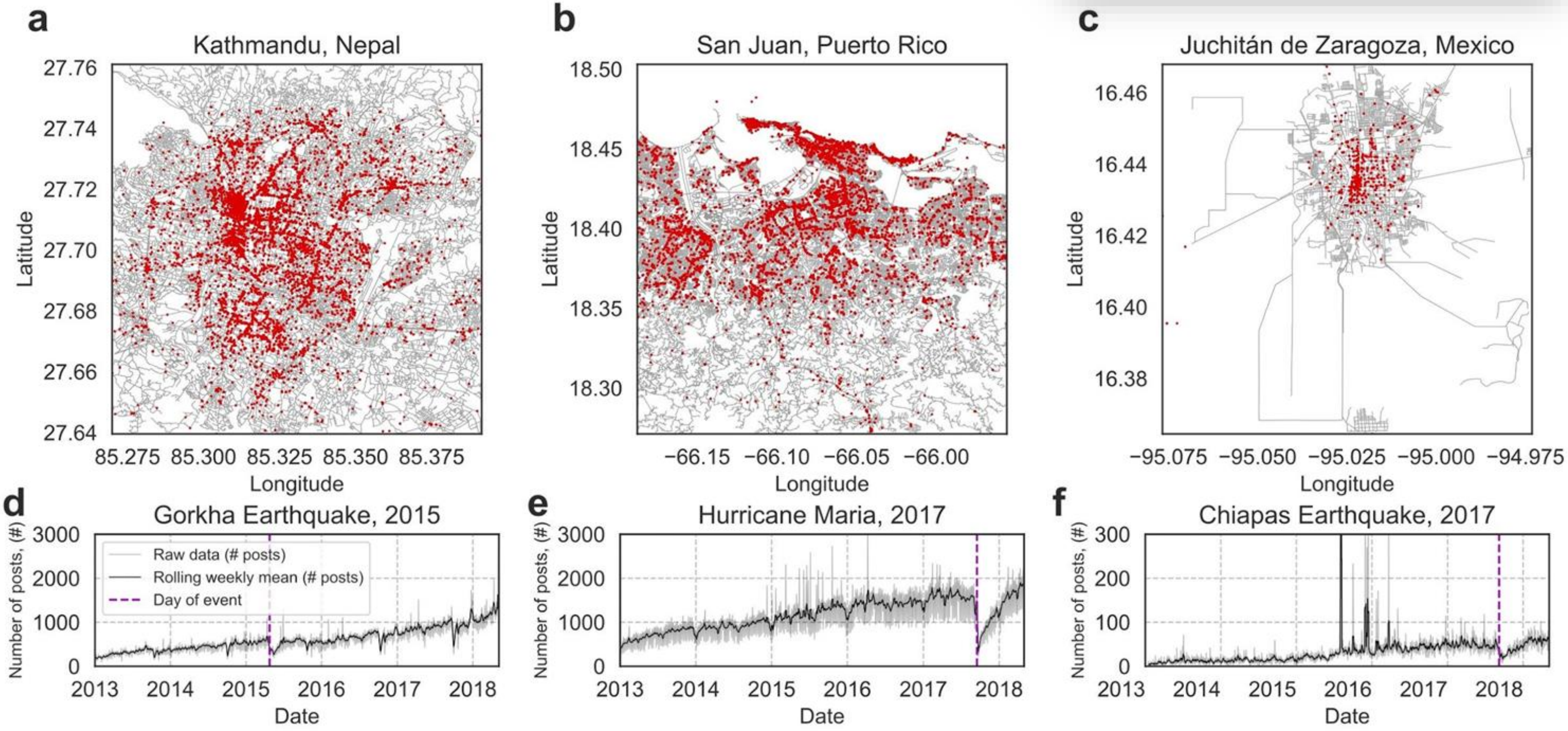


How: comparing the businesses' posting activity after the event with the typical posting activity before the event.

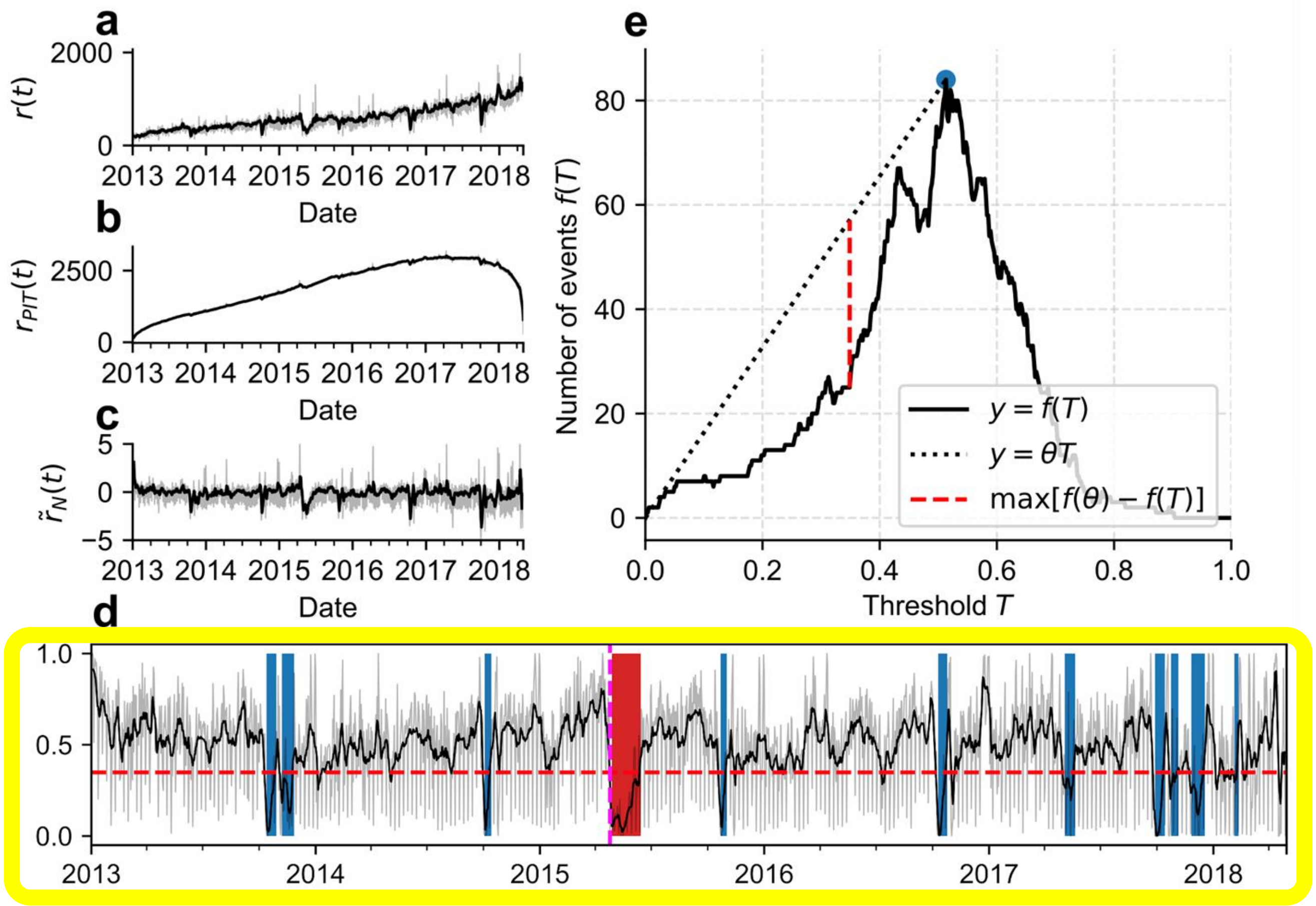
Assumption: businesses tend to publish more posts when they are open and fewer when they are closed.

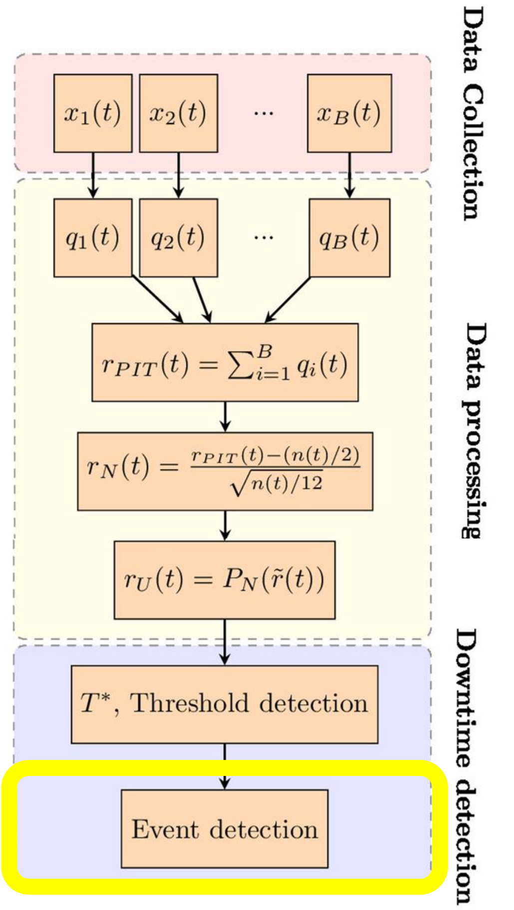
Aggregated posting activity

Region	Number of businesses	Number of posts
Kathmandu, Nepal	11,818	1,182,878
San Juan, Puerto Rico	10,894	2,258,872
Juchitán de Zaragoza, Mexico	1,728	62,999

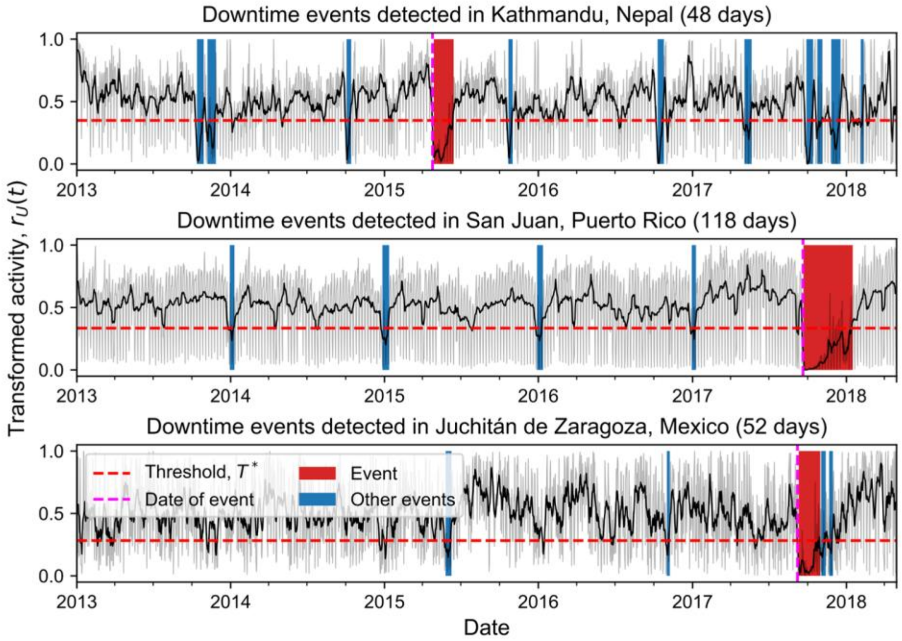


Event detection





Downtime estimates & Validation



Region and Event	Source	Downtime Length
Kathmandu, Nepal Gorkha Earthquake	**Estimated downtime**	**48 days**
	Business surveys, from [12]	41 days
	Kathmandu Post Disaster Needs Assessment [38]*	37 days
	Mobile phone data, from [24]	56 days
	Facebook posts text analysis (n = 299)	51 days
San Juan, Puerto Rico Hurricane Maria	**Estimated downtime**	**118 days**
	Satellite imagery, from [11, 39]	134 days
	Puerto Rico Tourism Company[1]	97 days
	U.S. Energy Information Administration[2]	128 days
	Facebook posts text analysis (n = 755)	71 days
Juchitán de Zaragoza, Mexico Chiapas Earthquake	**Estimated downtime**	**52 days**
	Facebook surveys (n = 16)	63 days
	Facebook posts text analysis (n = 19)	55 days

Conclusions

- The posting activity of small businesses on social media can be used to accurately estimate the recovery status of regions hit by natural disasters in real time.

- The methodology works for different types of natural disasters (earthquakes and hurricanes) and in both developed and developing countries.

- The methodology is generally applicable to detect anomalies in non-stationary aggregated time series.

Paper describing the methodology has been published in Nature Communications:
https://www.nature.com/articles/s41467-020-15405-7