

Resilience to natural disasters

Jose A. Marengo

CEMADEN

jose.marengo@cemaden.gov.br

www.cemaden.gov.br

Finding solutions for urban resilience to nature's challenges

Brazilian – Finnish Workshop

Sao Paulo, SP

November, 28 and 29 2016



Cemaden
Centro Nacional de Monitoramento
e Alertas de Desastres Naturais

Weather and climate extremes: During the last decade Brazil has been impacted by climate extremes, with subsequent impacts on natural and human systems

Drought in Amazônia in 2005, 2010, 2015



Floods in Amazonia in 2009, 2013 and 2014

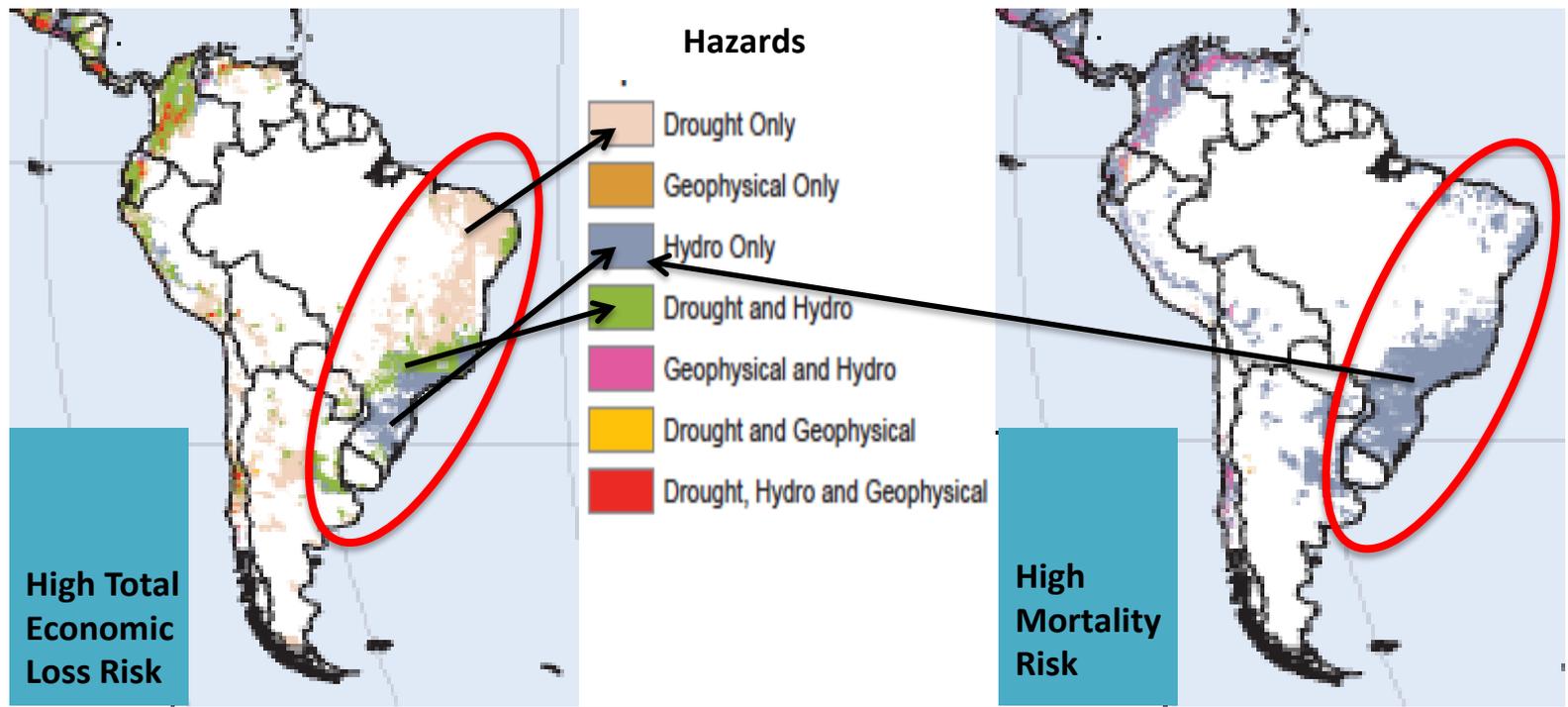


Drought and water crisis during 2014-15

Drought in semiarid Northeast Brazil since 2012



Distribution of Highest Risk Disaster Hotspots by Hazard Type in South America



Hydrological hazards include floods, cyclones, and landslides.

Source: Center for Hazards and Risk Research/The Earth Institute at Columbia University-www.ideo.columbia.edu/chrr/research/hotspots-

Distribution of natural disasters in Brazil

- Floods and landslides = 69% of occurrences
- Highest number of fatalities = landslides

Triggers of Natural Disaster

- Intense/prolonged rains, storms
- Windstorms, hail
- Temperature and humidity of air extremes
- Surfs



Types of Natural Disasters

- Landslides in slopes
- Floods, flashfloods, floodings
- Collapse of subsistence crops
- Vegetation fires
- Coastal erosion
- Acute episodes of pollution of air and water
- Collapse of water supply
- Epidemics

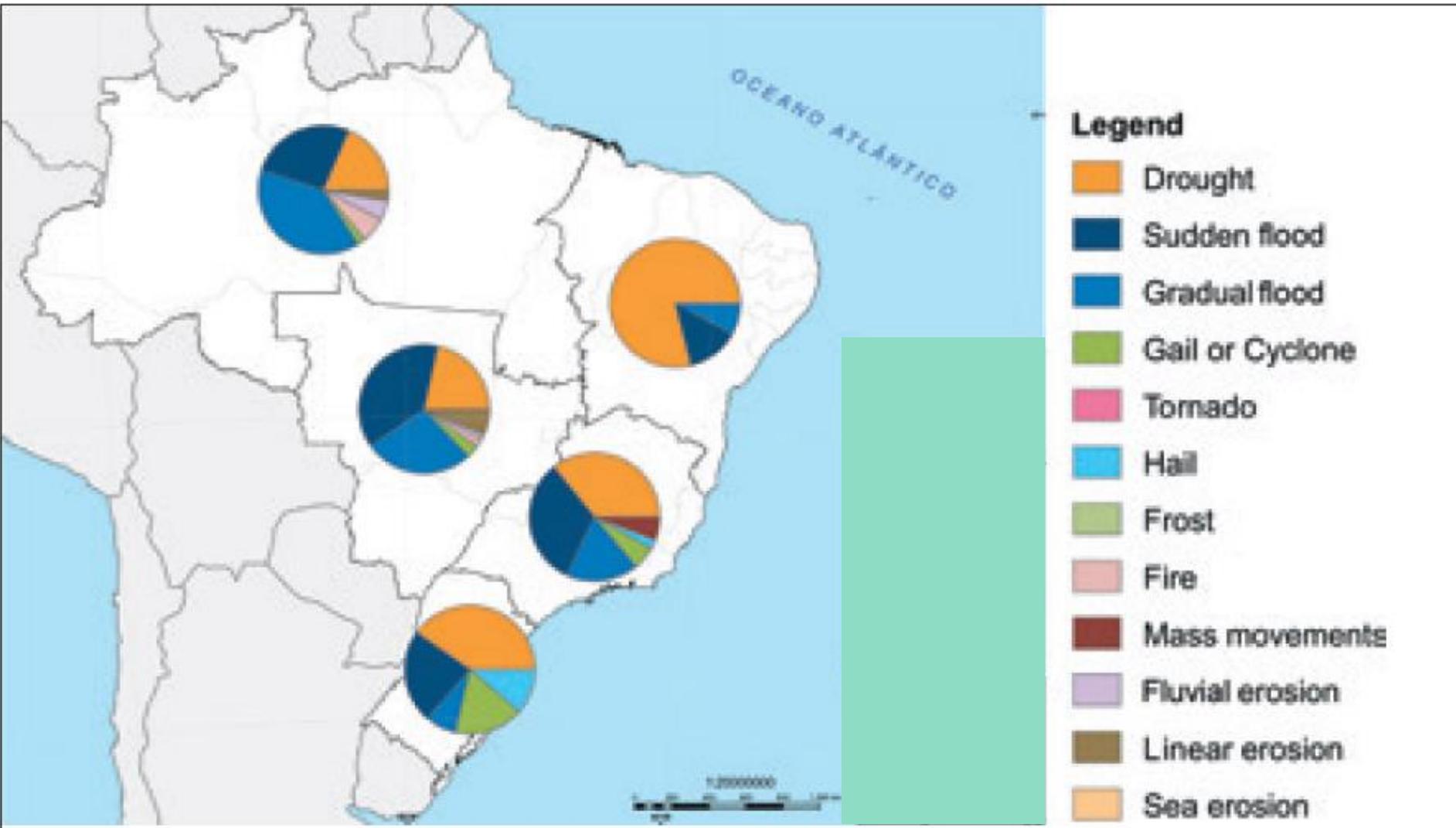
To manage disasters could save money in Brazil

-An assessment of four natural disasters occurred in Brazil between 2008 and 2011 estimates the country lost as much as US \$ 9 billion. In addition, the drought in SE Brazil in 2014 did cost US \$ 5 billion. The cost of drought in NE Brazil from 2012-2016 is still unknown.

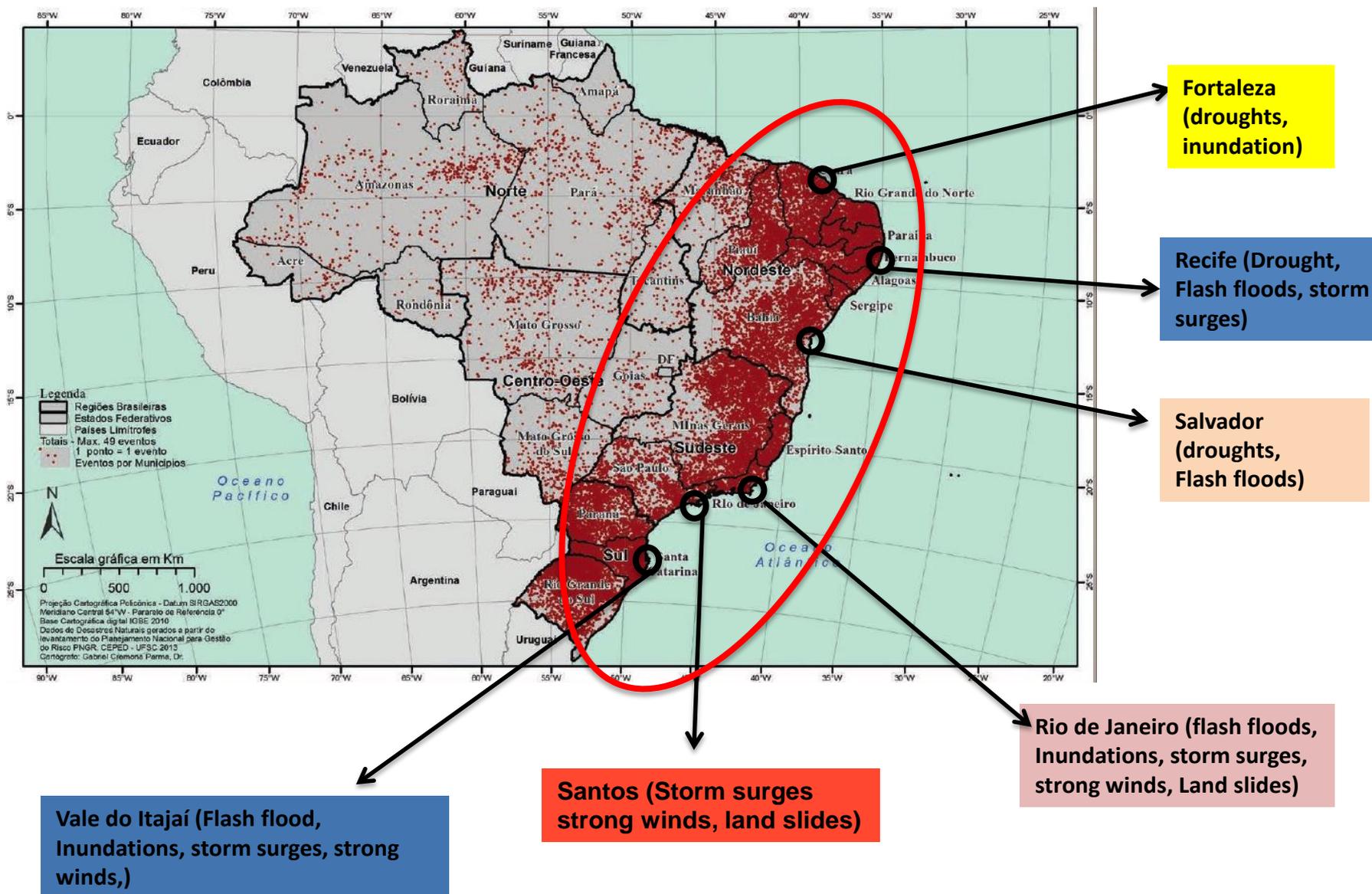
-Santa Catarina floods in 2008: landslide killed 100 people; Alagoas and Pernambuco showed the worse rainy season in 20 years affecting 1 million people; Rio de Janeiro 2011 flash floods and landslides killed 1000 people; drought in SE Brazil generated the worse water crises in Sao Paulo in decades; drought in NE Brazil still affects millions in the semiarid region.

-Only recently has the importance of disasters risk management gained visibility in Brazil. Setting preventive measures takes urban and financial planning and a long term commitment.

Distribution of natural disasters per Brazilian region. Source: UFSC CEPED (2012).



Natural disasters in Brazil 1991-2013-Impacts in coastal cities



About Resilience:

-One way to reduce the impacts of disasters on the nation and its communities is to invest in enhancing resilience.

-Resilience is *the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events*. Enhanced resilience allows better anticipation of disasters and better planning to reduce disaster losses—rather than waiting for an event to occur and paying for it afterward.

-However, **building the culture and practice of disaster resilience is not simple or inexpensive**. Decisions about how and when to invest in increasing resilience involve short- and long-term planning and investments of time and resources prior to an event.

Policies that make people more resilient—and so better able to cope with and recover from the consequences of disasters that cannot be avoided—can save \$100 billion a year (World Bank 2016).

Poor people suffer disproportionately from natural hazards. Natural disasters hit poor people particularly hard for five reasons: Overexposure, Higher vulnerability, Less ability to cope and recover, Permanent impacts on education and health, Effects of risk on saving and investment behavior

Action **on risk reduction has a large potential**, but **not all disasters can be avoided.**

Expanding financial inclusion, disaster risk and health insurance, social protection and adaptive safety nets, contingent finance and reserve funds, and universal access to early warning systems would also reduce wellbeing losses from natural disasters.

If all countries implemented these policies in the proposed “**resilience package**,” the gain in well-being would be equivalent to a \$100 billion increase in annual global consumption.

The four elements of a resilience framework

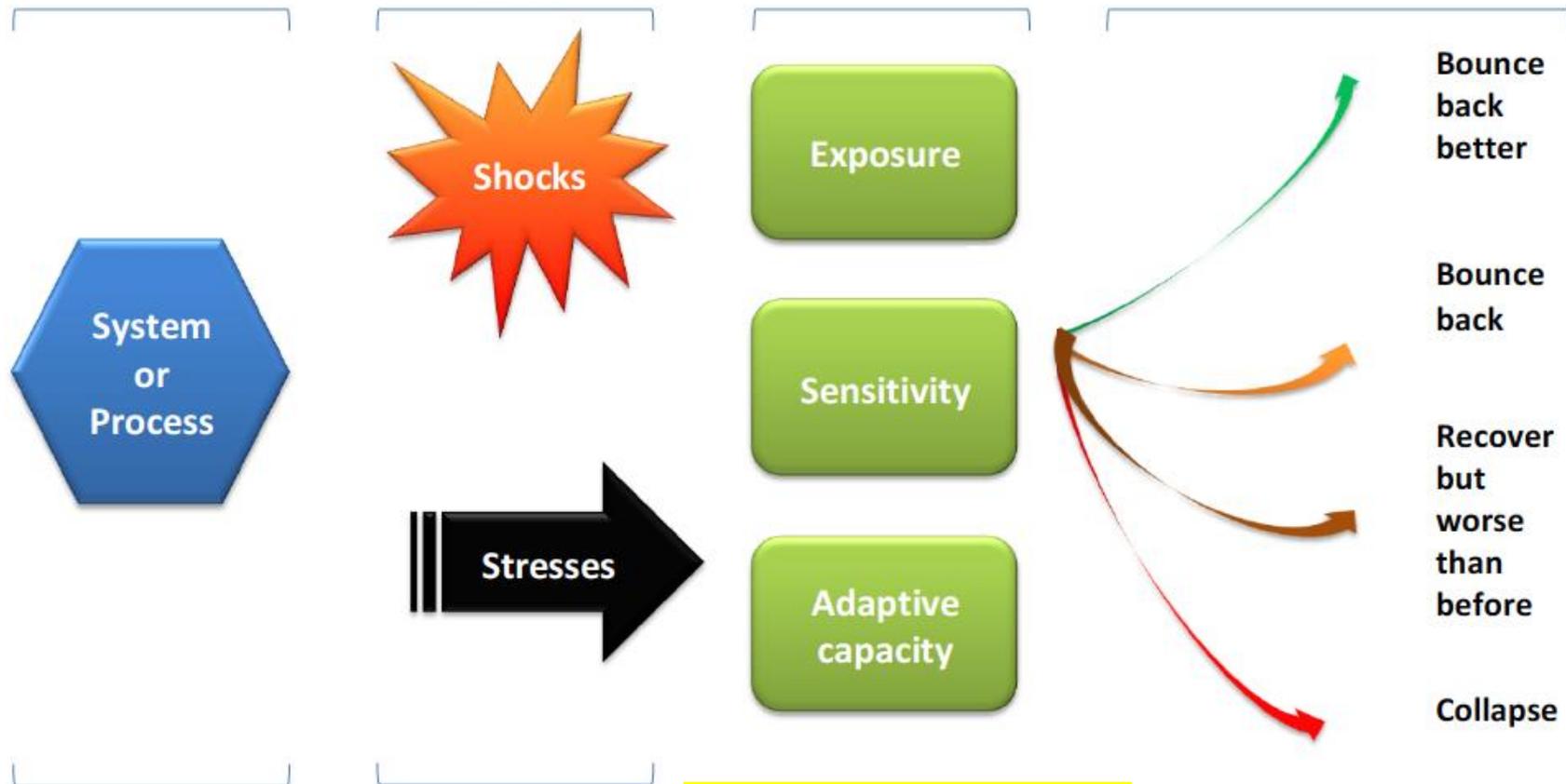
UK DFID (2011)

1. Context
e.g. social group,
region, institution.

2. Disturbance
e.g. natural
hazard, conflict,
insecurity, food
shortage, high fuel
prices.

**3. Capacity
to deal with
disturbance**

**4. Reaction to
disturbance**
e.g. Survive, cope,
recover, learn,
transform.



Resilience of
what?

Semiarid NE Brazil

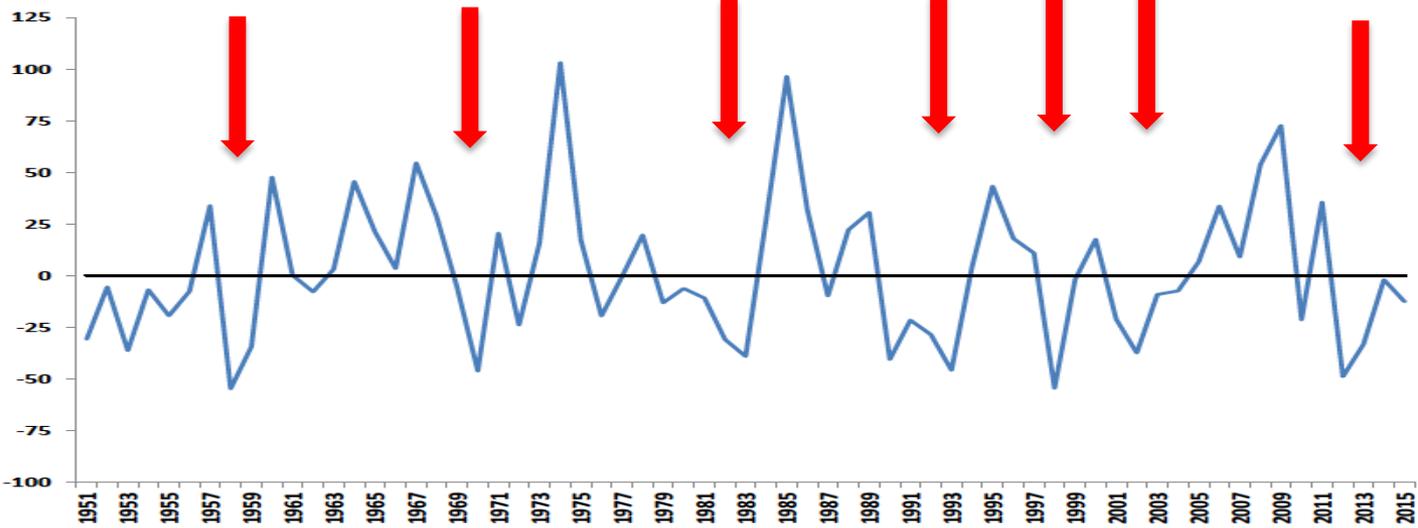
Resilience to
what?

Drought

High exposition,
sensitivity
Low adaptive capacity

Water and food insecurity
temporary solutions,
recurrent problem

Is the Semiarid Northeast Brazil resilient to drought?



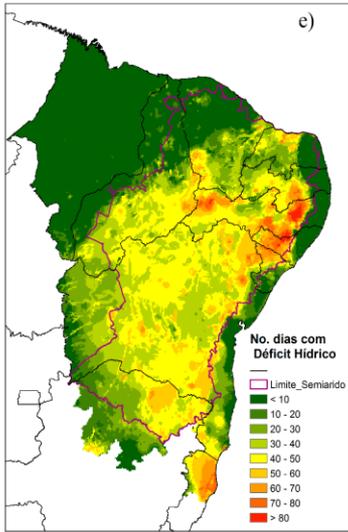
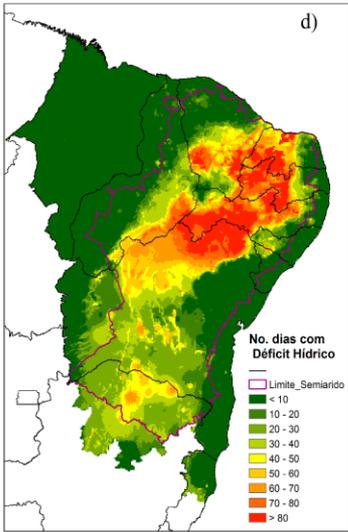
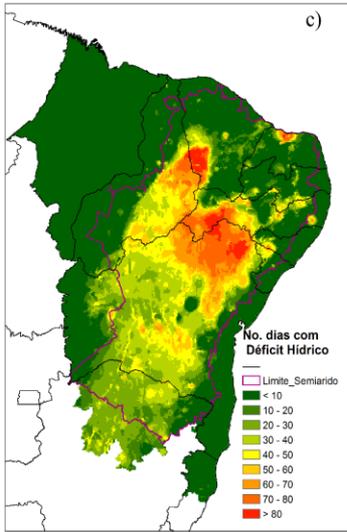
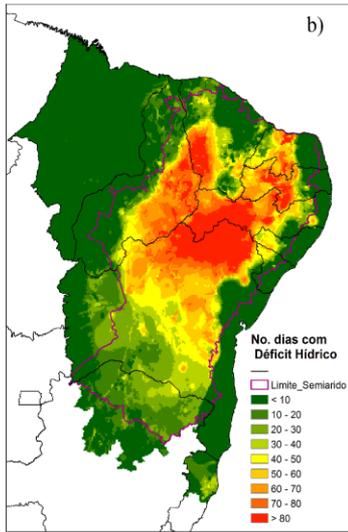
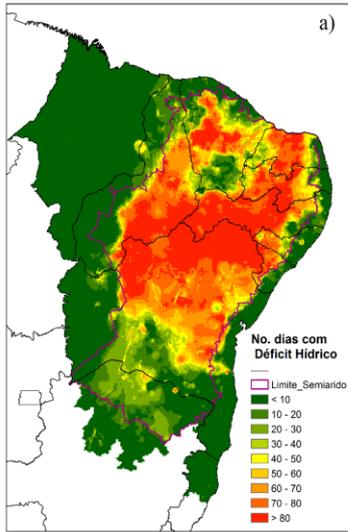
2011-12

2012-13

2013-14

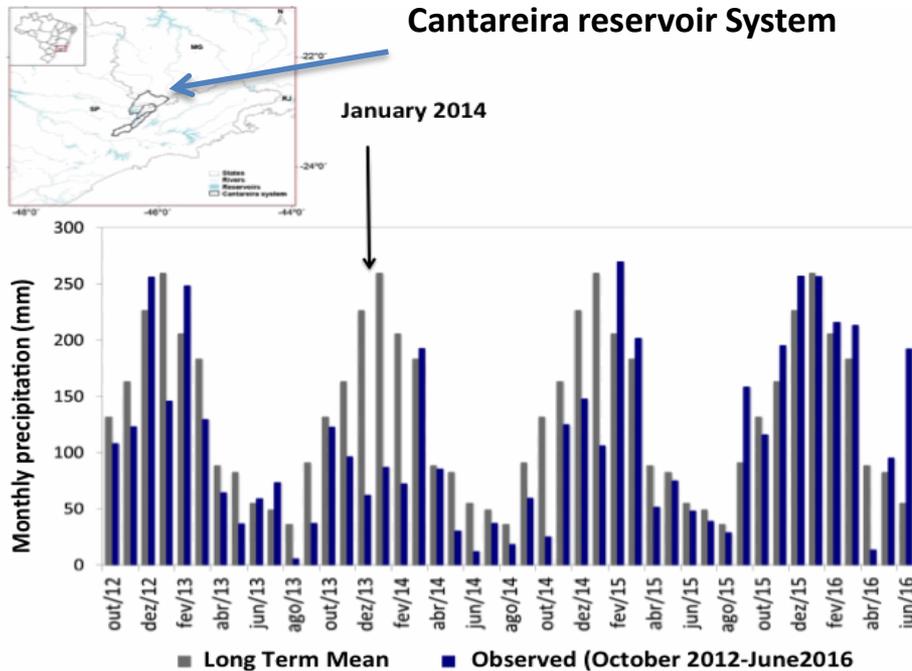
2014-15

2015-16



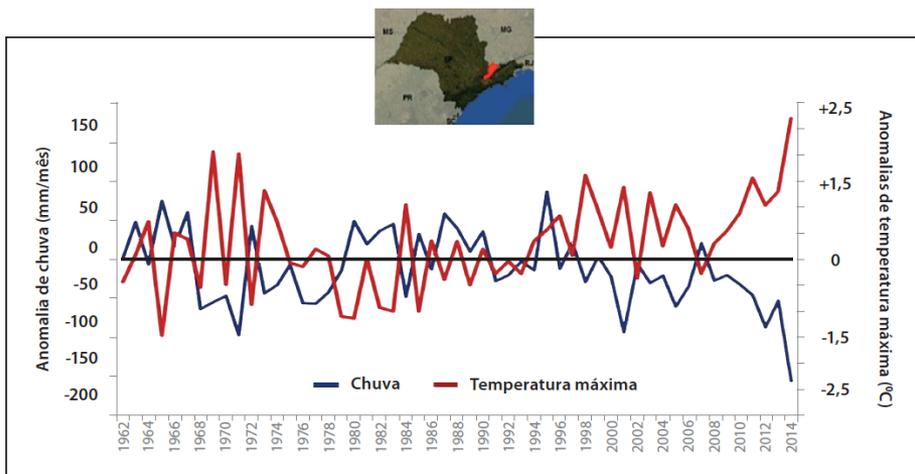
Number of days with water deficit in NE Brazil

Is the Metropolitan Region of Sao Paulo resilient to drought?



Analysts see the crisis as a relatively short-term stressor but believe that it has the potential to be the "catalyst" to solve specifically São Paulo's water problems.

Short term solutions include drilling more wells and more recycling of water. Long term solutions include the transfer of more water from additional river basins. Thus, a new 15 km connection has been authorized to be built to bring water from the Paraíba do Sul river basin to the Cantareira system.



Marengo et al 2016, Nobre et al 2015

Also, repair of leaking pipes is estimated to save 6% of total municipal water consumption in São Paulo.

An example on coastal vulnerability assessment in the UK, US and Brazil: The METROPOLE project



METROPOLE

METROPOLE: An Integrated Framework to Analyze Local Decision Making And Adaptive Capacity to Large-Scale Environmental Change: Community Case Studies in Brazil, UK and the US

- The hypothesis of the **METROPOLE Project** is that the understanding and perception of risks associated with climate change are best assimilated when co-produced with scientific basis allied to a social, political and cultural context, and with a strong participation of local communities on decision making.
- With a strong applicative component, the study was developed in three coastal areas, each one representing one of the three countries involved: **City of Santos, São Paulo (Brazil)**, Selsey/Chichester, West Sussex (United Kingdom) and Broward County, Florida (United States).
- **Santos is a big industrial city, and home to the largest port on South America's Atlantic Coast.**



Cemaden
Centro Nacional de Monitoramento
e Alertas de Desastres Naturais



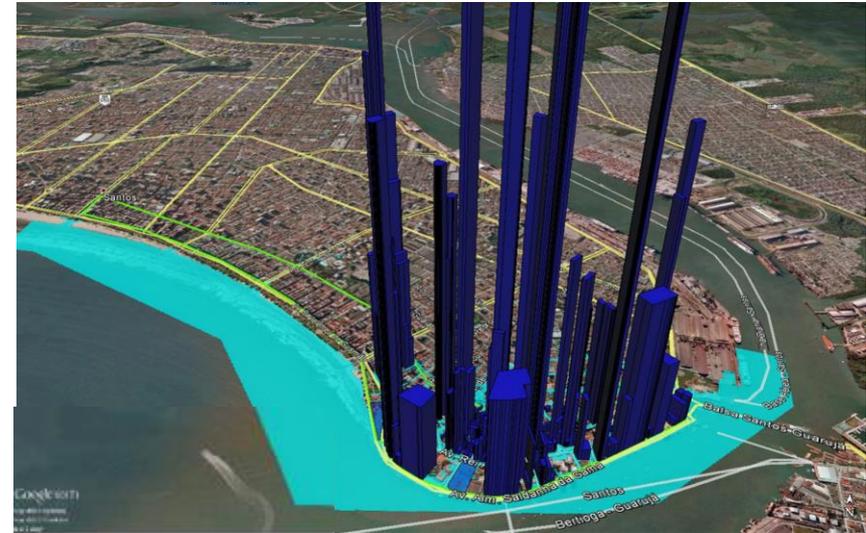
NSF Award #1342969



Is the city of Santos Resilient to coastal floods and SLR?



2050 (High SLR: 0.23 m + 1.60 m)
Lost asset value



2100 (High SLR: 0.45 m + 1.66 m)
Lost asset value

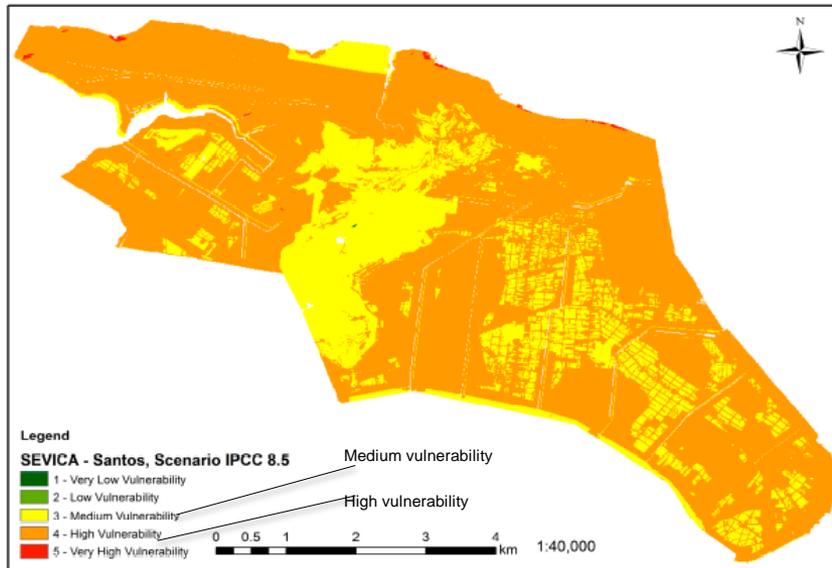
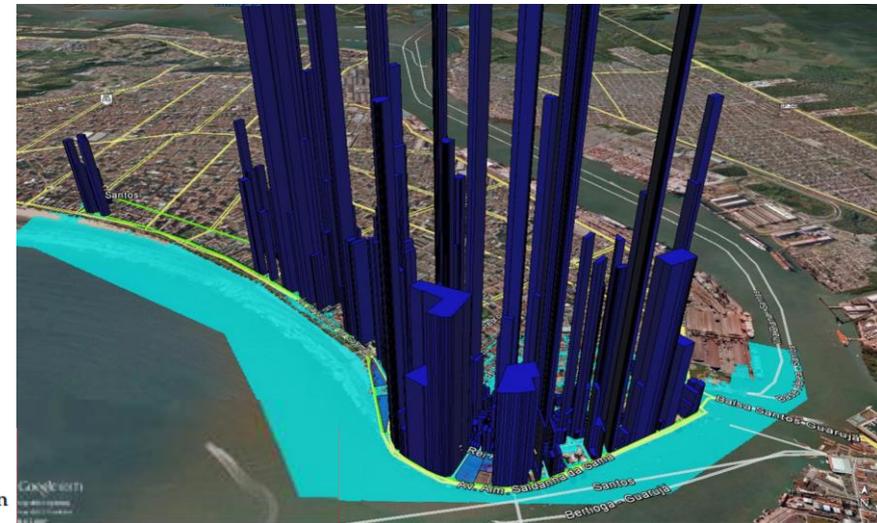


Figure 4. Vulnerability of Santos under scenario IPCC 8.5 (0.38 m sea-level rise projection) based on the SEVICA index.

Zanetti et al (2016)

Marengo et al (2016)

Adaptation to SLR-EbA and infrastructure: Experiences in Santos, SP



dredging works

Beach nourishment + dune restoration



Structural enforcement and improvement of existing walls

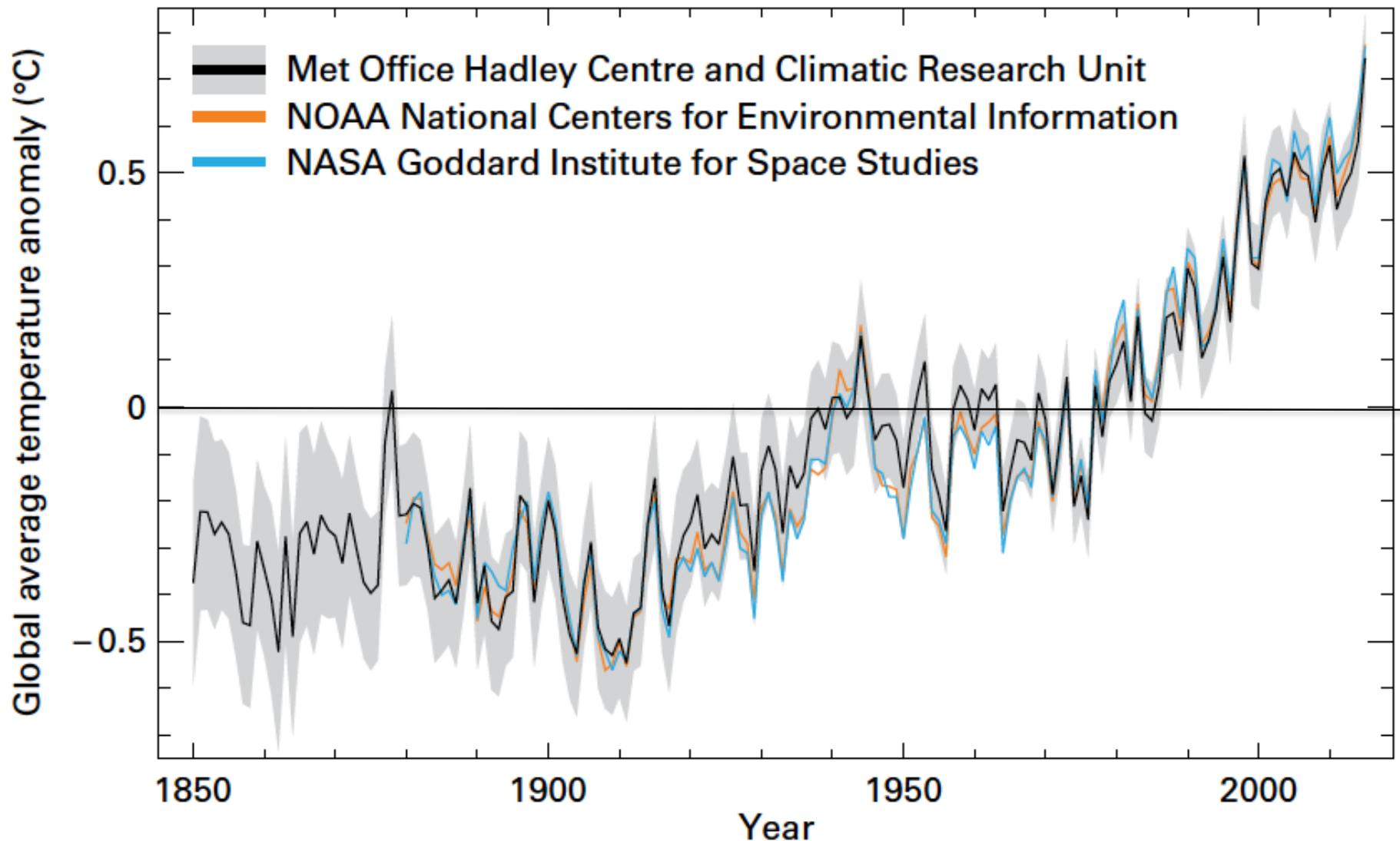


Mangrove preservation, Restoration, recuperation



Options selected by Santos population: Fortification,
Less favorite: Relocation

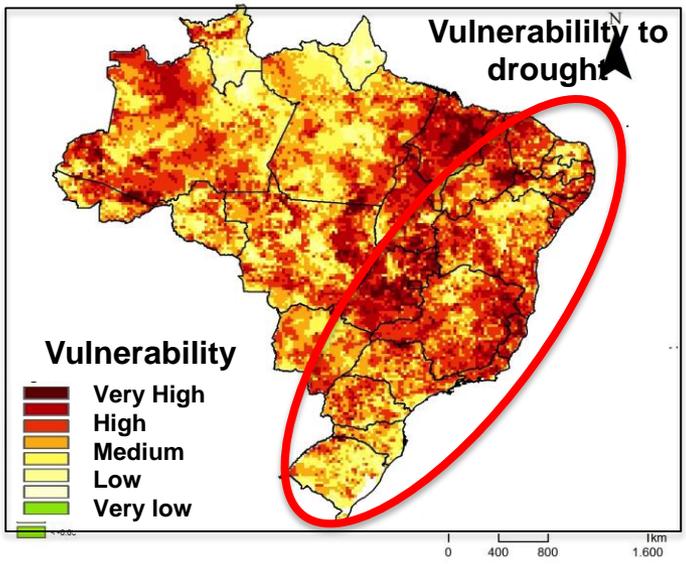
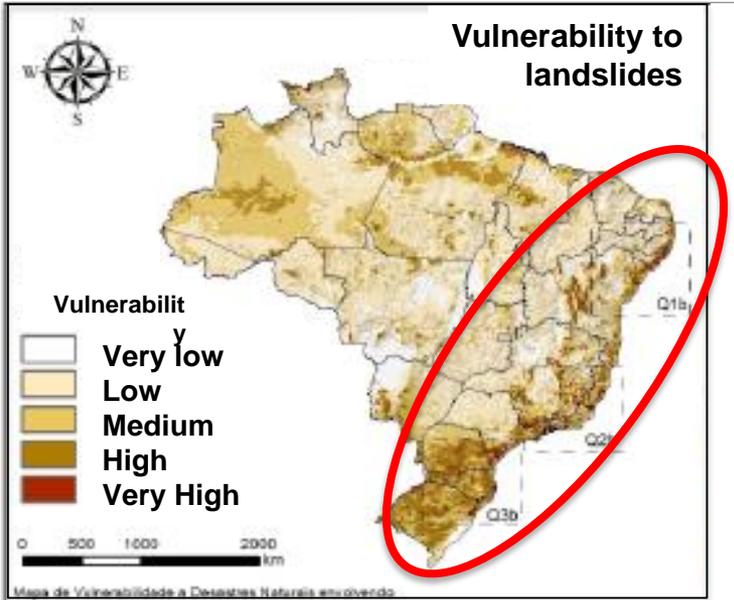
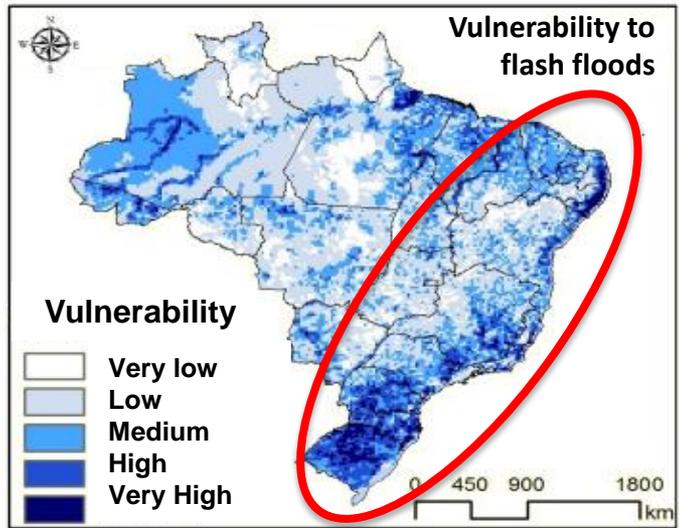
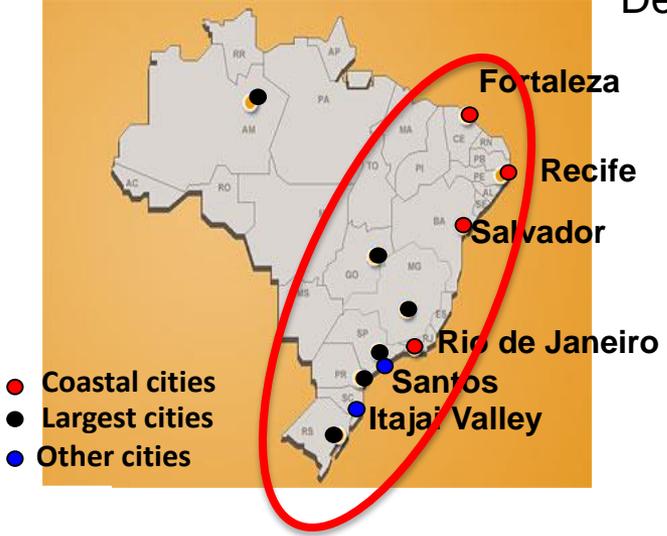
THE WORLD'S WARMEST FIVE-YEAR PERIOD ON RECORD



The period 2011–2015 was the warmest five-year period on record globally. Using the mean of three major global datasets, temperatures for the period were 0.57 C above the average for the standard 1961–1990 reference period (WMO 2016)

Future vulnerability to natural disasters in Brazil (2071-2100, RCP 8.5, Eta-HadGEM2 ES 20 km)

Debortoli et al 2016



Urban resilience: Helping vulnerable cities to adapt to natural disasters and climate change

- As cities expand, **weather and climate extremes and related natural disasters compounds the stress on poor communities** living in risk areas, highly exposed to flash floods and landslides
- The **people bearing the heaviest burdens for climate related disasters are often the poor and marginalized** (not always true...)
- We need to know **what strategies will protect vulnerable people**, their communities and their livelihoods from these environmental crises.
- We need to identify specific actions that cities can take to reduce climate risks and take advantage of opportunities (e.g. through various options) so their resiliency would increase: **Better forecasting of extremes and their impacts, better communication of climate risks, addressing climate variability and change impacts, assessing poverty, define contribution of political and administrative authorities to local adaptation to climate change.**



MANAGING THE UNAVOIDABLE



**Risk can be reduced
by improving resilience.**

No matter how much countries try to reduce people's exposure to natural hazards or to make their assets more resistant to hazards such as earthquakes and floods, natural risk cannot be reduced to zero. Disasters will continue to inflict damage, and so it is critical to supplement actions on exposure and vulnerability with improvements in the ability of people to cope with the shocks that cannot be avoided.

Resilience in Brazil

- A fresh approach to the collation, co-ordination and **analysis of natural disaster information and research is fundamental** to the prioritization of mitigation decisions that will help strengthen and safeguard our communities.
- Crucial natural disaster information is difficult to access**, often incomplete or out of date and frequently duplicated across sources.
- We suggest to **promote resilience to the center of government decision-making**; Consider a comprehensive, national and state co-ordinated approach; and to Commit to a long-term annual pre-disaster resilience fund.
- By centralizing decision-making and funding, and establishing a national research agenda, **Government will be better able to co-ordinate and prioritize resilience activities across relevant departments and levels of government.**
- Governments, businesses, academia, and communities need to be aware of the risks they face.** Access to timely relevant data will enable communities **to better prepare for natural disasters and to build a safer and more productive and resilient society.**