

# Sort-out Drought!



*DWD, LfULG Saxony, JRC  
and NOAA Collaboration  
Workshop*



## **Drought Exposure, Vulnerability and Risk: JRC Assessment at the Global Scale**

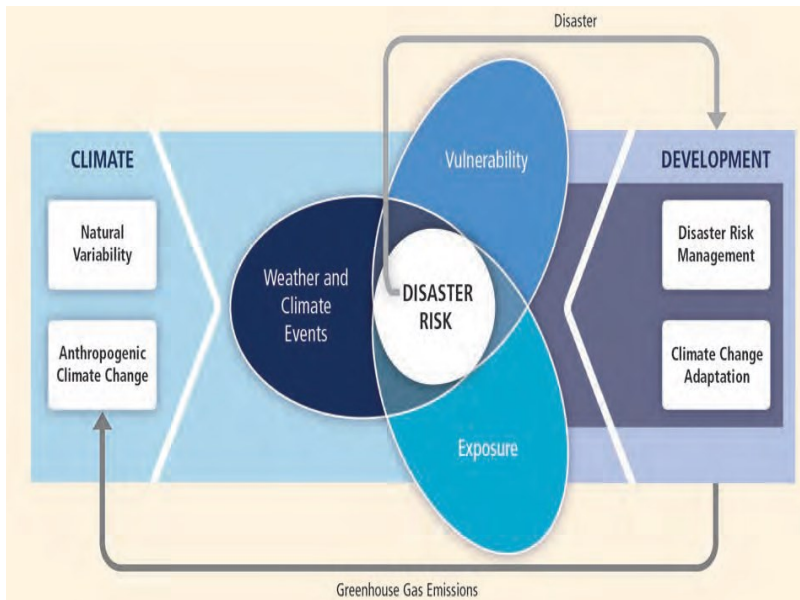
Hugo Carrão, Gustavo Naumann  
and Paulo Barbosa

*Disaster Risk Management Unit  
Directorate Space Security and Migration*

**17th November 2016, Dresden-Pillnitz**

Joint  
Research  
Centre

- **Previous work...**
  - DEWFORA (2011-2014, EU FP7 research project)
  - EUROCLIMA II (started in 2014, Administrative Arrangement DG DEVCO)
  - Global Drought Observatory (started in 2015, Administrative Arrangement DG ECHO)
- **A framework for modelling Global Drought Risk**



Relative statistic suitable for ranking regions: comprehensive picture of locations where the likelihood of drought impact is highest (lowest);

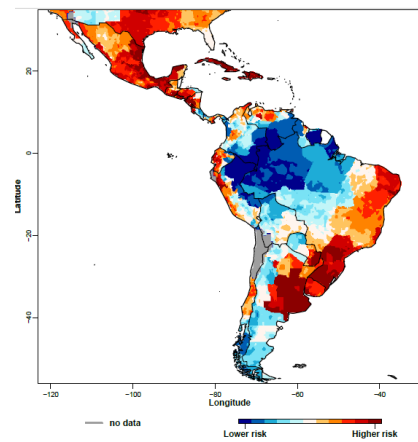
Not to be confounded with an absolute measure of economic loss or damage to human health or the environment: applicable to different social and economic contexts.

# Risk or Likelihood of Drought Impact

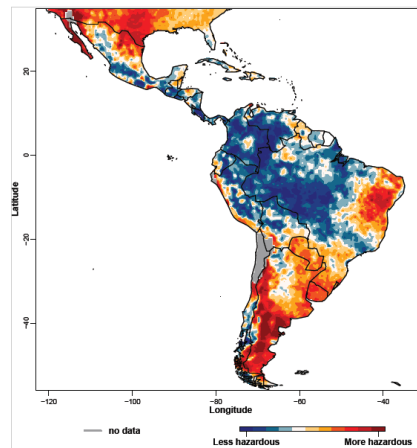


## The case study for South-Central America

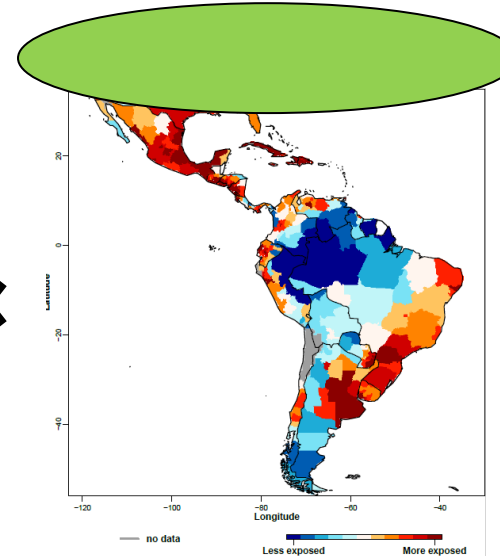
**Risk**



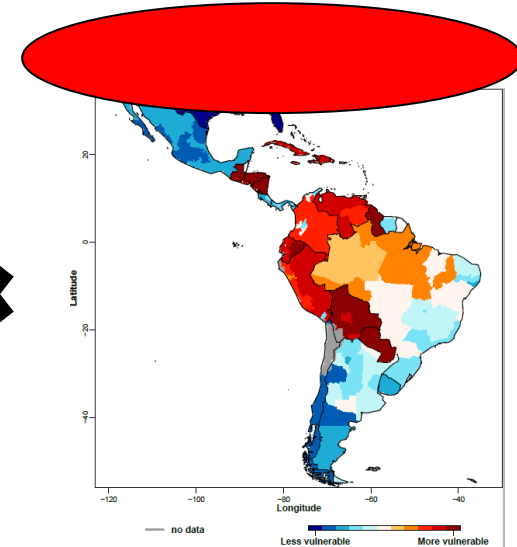
**Hazard**



×



×



Likelihood of drought impact at **sub-national administrative regions**.

Probability of exceeding a drought event with a certain severity.

Amount of population, livelihoods, assets, resources, services and/or... that could be directly and/or indirectly affected by a drought event.

Propensity of individuals, groups and/or nations to suffer adverse effects when impacted by a drought event.

- Normalized statistics: 0 (min) – 1 (max);
- The legend breaks are statistical thresholds: percentiles of geographic distribution.



## Socioeconomic drought:

The concept of *socioeconomic* impact recognizes the relationship between the lack of goods and services, and the amount of human demands.

## Croplands, 2000: Global

Global Agricultural Lands

Global Croplands in 2000 map the proportion of each 5 minute (10km) grid cell land areas that is under cropland. Dark shaded areas denote higher proportion of areas under cropland. Data from Moderate Imaging Spectroradiometer (MODIS) land cover product and Statistics For Observation of the Terre (SPOUT) Vegetation's Global Land Cover 2000 product were combined with UN Food and Agriculture (FAO) agricultural statistics to generate the data set.

Percent grid cell area under cropland

- Less than 10%
- 10.01% - 20%
- 20.01% - 50%
- 50.01% - 75%
- 75.01% - 100%

Center for International Earth Science Information Systems  
Columbia University, 61 Rte. 9W, Palisades, NY 10964  
© 2003 Center for International Earth Science Information Systems  
Columbia University, 61 Rte. 9W, Palisades, NY 10964  
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage or retrieval system, without prior written permission from the Center for International Earth Science Information Systems, Columbia University.

Publication Project

## Population Density Grid, 2000: Global

Gridded Population of the World, Version 4 (GPWv4)

WGS84 Pseudo-Cylindrical

Map Credit: CIESIN, Columbia University, 2000

Persons per km<sup>2</sup>: <1 1-5 5-25 25-250 250-1,000 1,000+

Gridded Population of the World, Version 4 (GPWv4) Population Density consists of estimates of human population density based on counts consistent with national censuses and population registers, for the years 2000, 2005, 2010, 2015, and 2020. A proportional allocation procedure is employed, utilizing approximately 12.5 million national and sub-national administrative units, in order to assign population values to 30 arc-second (~1 km) grid cells. The population density grids are derived by dividing the population count grids by land area grids. The pixel values represent persons per square kilometer.

**Center for International Earth Science Information Network**  
 Population Density, Patterns, and Trends  
 © 2016, The Trustees of Columbia University in the City of New York

**Cattle density map – 2005** [*census data*]

AGRICULTURE AND CONSUMER PROTECTION DEPARTMENT  
Animal Production and Health Division

Number per square km

<1	5-10	100-250	Water
1-5	10-20	>250	Unsuitable for ruminant
	50-100		

## BASELINE WATER STRESS

Total annual water withdrawals (municipal, industrial, and agricultural) expressed as a percentage of the total annual available blue water. Higher values indicate more competition among users.

**BASELINE WATER STRESS**  
withdrawals / available flow

- Less than 10%
- 10% to medium (10-30%)
- Medium to high (30-40%)
- High (40-60%)
- Extremely high (60-80%)
- Less than 10% water use
- No data

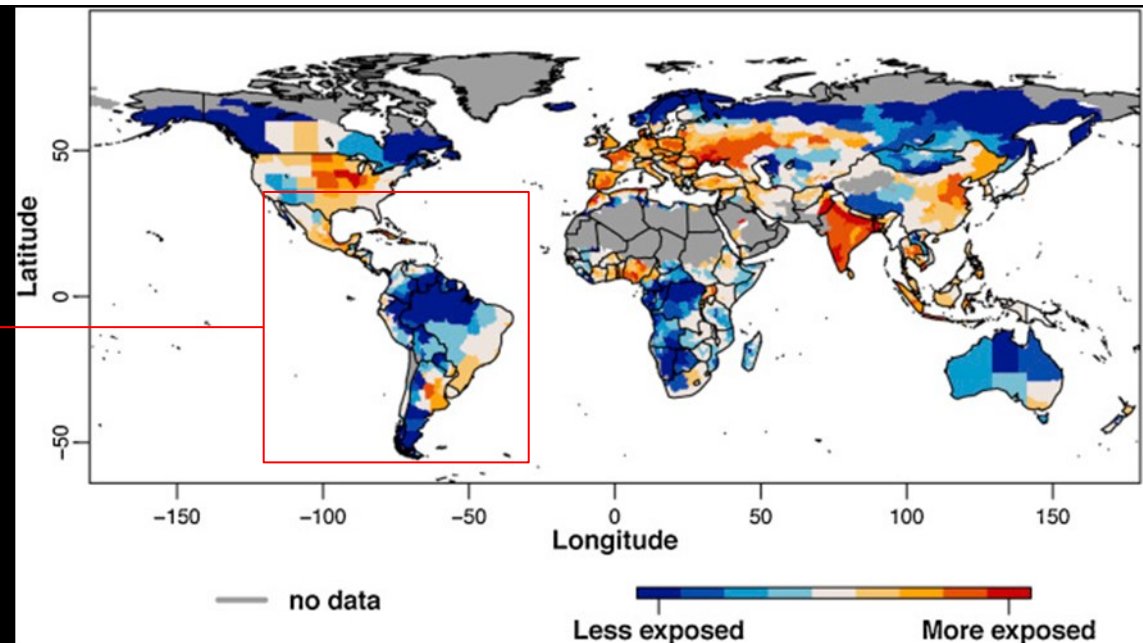
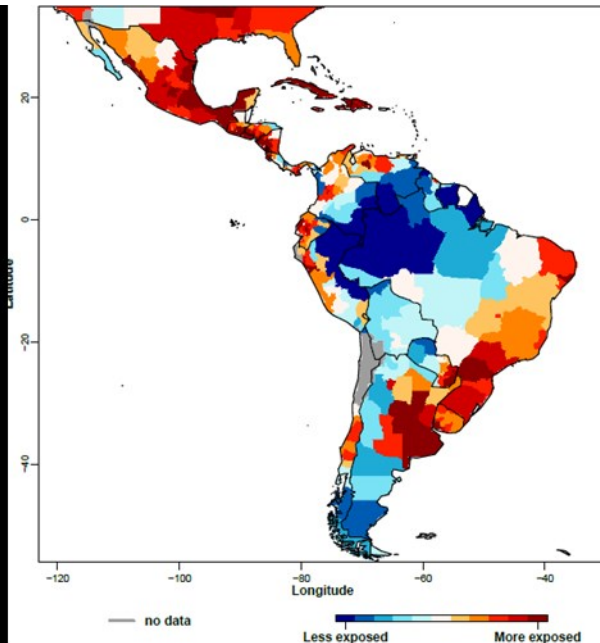
Data Sources:  
Global Waterways Baseline Systems, National Institute for Environmental Studies  
Global Land-Water Institutional Systems, IAHN & Global Water, who have  
worked with the British, French and American Governments, and  
Commission of the European Communities  
Contributors: Dan Borman, 1993-1994 and 1995-1996

**AQUEDUCT** WORLD RESOURCES INSTITUTE

Data on offtake water rates in relation to the normal operations of several systems (i.e. domestic, industrial, irrigated agricultural).

**Slow onset hazard:** comprehends entities that can be adversely impacted at different stages of the same hydro-meteorological anomaly.

# Composite Measure of Drought Exposure



- Multi-scale approach: the output maps are a focused measure, zooming on the selected regions of interest.

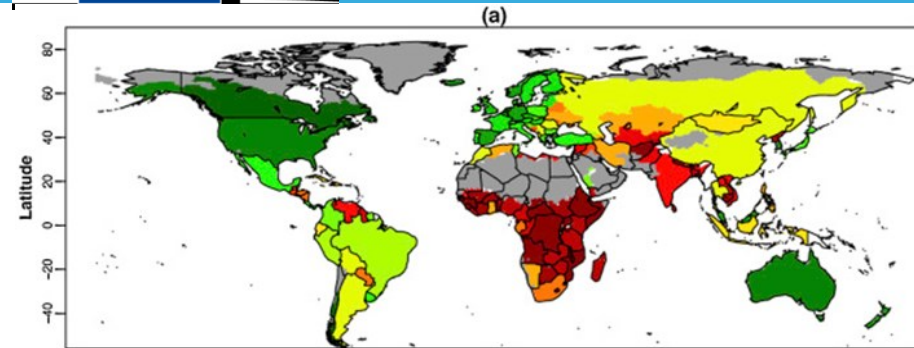
# Proxy Indicators of Vulnerability Factors



$$dv_i = \frac{Soc_i + Econ_i + Infr_i}{3}$$

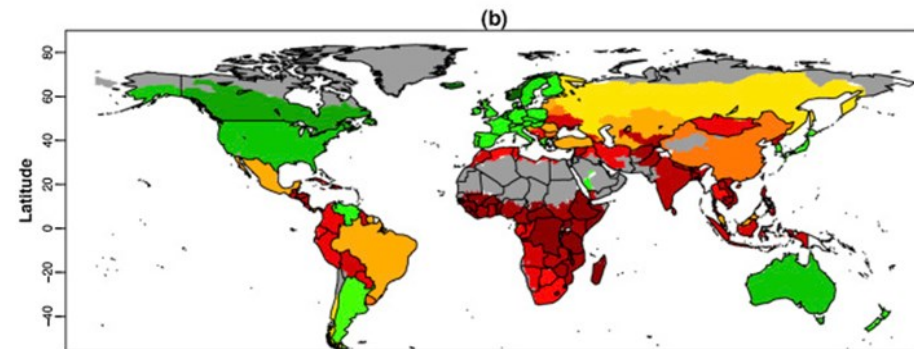
## Social Factor:

Level of well-being of individuals and communities



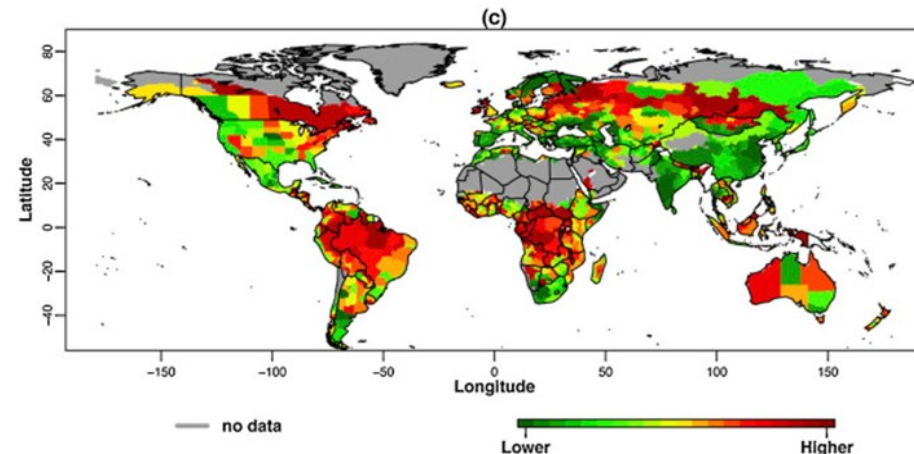
## Economic Factor:

Economic status of individuals, communities and nations

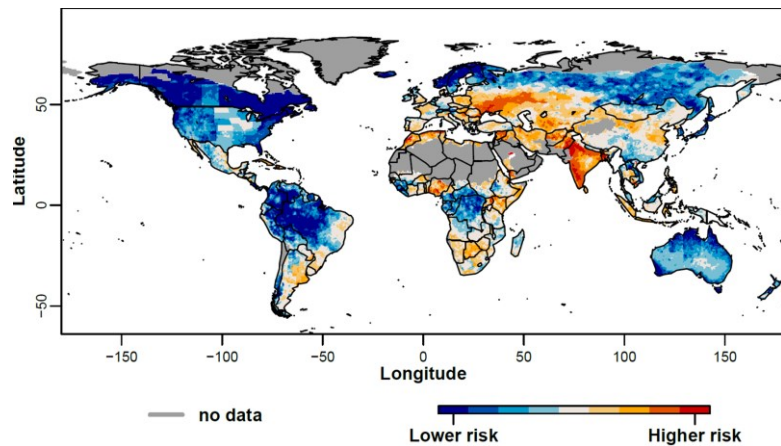


## Infrastructural Factor:

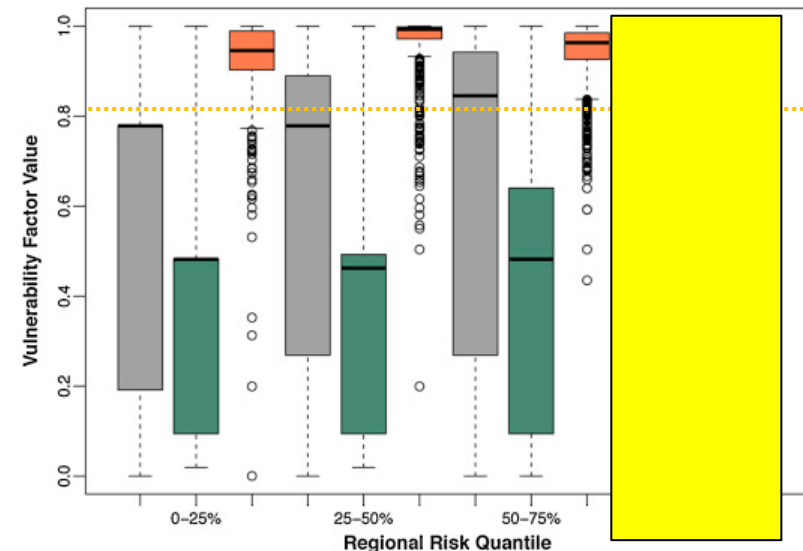
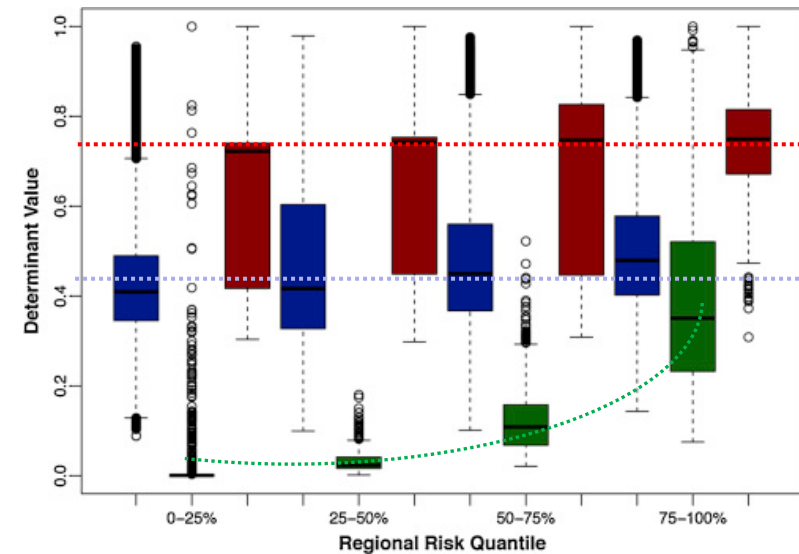
Infrastructures needed to support the production of goods and sustainability of livelihoods



# Global Drought Risk: Some key outputs



- Likelihood of drought impact is mainly driven by the regional magnitude of exposure;
- **Infrastructural capacity** is relatively low for all risk classes and most exposed regions;
- Extreme likelihood of drought impact exhibits a relationship to economic wealth stronger than to **social progress**: most exposed locations are the poorest.



# The way forward... Operational setting at GDO



## The user interfaces:

Definition/optimization of  
**thresholds and triggers**

**Weighting and aggregation**  
of indicators based on  
**expert judgment**

JOINT RESEARCH CENTRE  
GDO - Global Drought Observatory

European Commission > JRC Science Hub > GDO > Global Drought > LDI v.2 Details > Define Exp Vuln LDI v.2

GLOBAL DROUGHT

Define tables Exposure and Vulnerability for LDI v.2

**EXPOSURE\_CLASSES**

COLOR	ID	NAME	MINVAL	MAXVAL	UPDATED_WHEN	UPDATED_BY	ACTIONS
CL	Exceptionally Low	0	0	03-AUG-2016	10.0.2.2		
XL	Extremely Low	0	.0001	26-JUL-2016	Diego Magni		
VL	Very Low	.0001	.001591861	04-AUG-2016	My name		
L	Low	.001591861	.01321501	26-JUL-2016	Diego Magni		
M	Medium	.01321501	.04884863	28-JUL-2016	10.0.2.2		
H	High	.04884863	.129725	26-JUL-2016	Diego Magni		
VH	Very High	.129725	.3147335	26-JUL-2016	Diego Magni		
XH	Extremely High	.3147335	1	26-JUL-2016	Diego Magni		
CH	Exceptionally High	1	1	03-AUG-2016	10.0.2.2		

0: Null - CL: Exceptionally Low - XL: Extremely Low - VL: Very Low - L: Low - M: Medium - H: High - VH: Very High - XH: Extremely High - CH: Exceptionally High

**VULNERABILITY\_CLASSES**

**HAZARD\_CLASSES**

**EXP\_VULN\_MATRIX**

**RISK\_MATRIX**

**EXP\_VULN\_MATRIX**

Exp \ Vuln	CL	XL	VL	L	M	H	VH	XH	CH
CL	0	0	0	0	0	0	0	0	0
XL	VL	VL	VL	VL	VL	VL	L	L	L
VL	VL	VL	VL	VL	L	L	L	M	M
L	VL	VL	VL	VL	L	L	M	M	M
M	VL	VL	VL	L	L	M	M	H	H
H	VL	VL	L	L	M	M	H	H	H
VH	VL	L	L	L	M	H	H	H	VH
XH	L	L	L	M	M	H	H	VH	VH
CH	L	L	M	M	M	H	VH	VH	VH

0: Null - CL: Exceptionally Low - XL: Extremely Low - VL: Very Low - L: Low - M: Medium - H: High - VH: Very High - XH: Extremely High - CH: Exceptionally High

**RISK\_MATRIX**

**Dynamic drought risk:**  
Hazard estimates from current rainfall,  
soil moisture, and vegetation greenness.



Thank you for your  
attention!

**More information:**

<http://edo.jrc.ec.europa.eu/scado/>  
[hugo.carrao@jrc.ec.europa.eu](mailto:hugo.carrao@jrc.ec.europa.eu)

**Uyuni, Bolivia**

Photo credit Carlos Cruz