European Commission

JRC TECHNICAL REPORT

INDEX FOR THE EU GLOBAL CLIMATE CHANGE ALLIANCE *plus* Flagship Initiative

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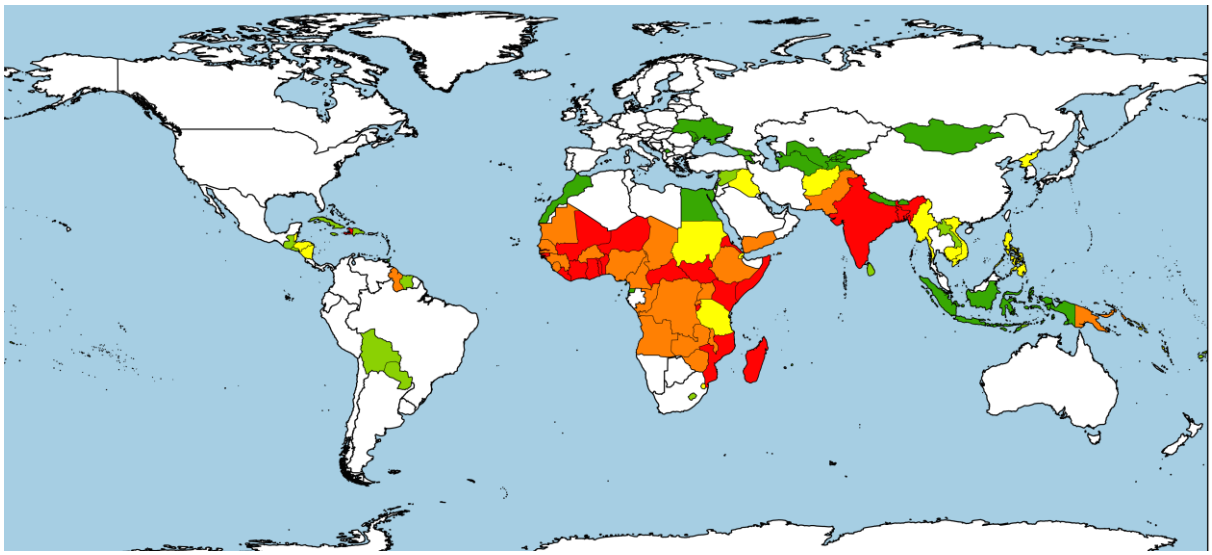

2015

Joint Research Centre

EUR 27480 EN

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JRC Science Hub
https://ec.europa.eu/jrc

JRC97772

EUR 27480 EN

ISBN 978-92-79-52050-1 (PDF)
ISBN 978-92-79-52049-5 (print)

ISSN 1831-9424 (online)
ISSN 1018-5593 (print)

doi:10.2788/145779 (print)
doi:10.2788/516387 (online)

How to cite: Miola A, Papadimitriou E, Mandrici A, McCormick N, Gobron N. INDEX FOR THE EU GLOBAL CLIMATE CHANGE ALLIANCE plus flagship Initiative. EUR 27480. Luxembourg (Luxembourg): Publications Office of the European Union; 2015. JRC97772

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Acknowledgements
The authors would like to thank Michela Nardo for her help in carrying out the quantitative analysis and the sensitivity and robustness analysis

Executive Summary

This report proposes an index to identify those countries most vulnerable to climate change and to rank them according to their eligibility for funding within the context of the EU Global Climate Change Alliance plus Flagship Initiative (GCCA+). The report is organised as follows.

Chapter 1 describes the four components (natural hazards, exposure, vulnerability and capacity) used to classify the selected indicators in accordance with the goals of the GCCA + programme.

The final list of the 34 'fit-for-purpose' country-level indicators is proposed in Chapter 2.

Chapter 3 introduces briefly the methodology applied to calculate the GCCA+ index. The results of ranking the countries by the GCCA+ Index are shown in maps and tables. The index is applied to five different samples of countries.

Chapter 4 concludes by proposing the application of the approach of the GCCA+ index to build a web knowledge platform on low-carbon and climate-resilient development within the context of the new Sustainable Development Goals (SDGs).

Four Annexes complete the information of the report as follows.

Annex I describes the results of the Index in terms of components, scores and ranks for each sample of countries considered in this exercise.

Annex II describes each indicator in terms of relevance, measuring unit, indicator creation method, data source, periodicity, missing data and geographical distribution in the sample of countries for the latest available year.

Annex III provides detailed information on the results of the robustness and sensitivity analysis of the GCCA+ index to evaluate whether the GCCA+ composite indicator is statistically well-balanced in its objectives and in its issue areas within an objective.

Annex IV proposes the application of the Earth Observation Satellite Data to assess and monitor the negative impacts of climate change on land vegetation in developing countries.

1. Introduction

The EU Communication '*Building a Global Climate Change Alliance between the EU and poor developing countries most vulnerable to climate change'* COM(2007)540 defines the context for EU support to developing countries in five priority areas: (i) adaptation to climate change; (ii) reducing emissions resulting from deforestation and degradation (REDD); (iii) enhancing participation in the global carbon market and the Clean Development Mechanism (CDM); (iv) promoting Disaster Risk Reduction (DRR); and (v) integrating climate change into poverty reduction efforts. The GCCA+ Flagship Initiative began, in line with the European Commission's new Multi-annual Financial Framework (2014-2020). The GCCA+ continues to support those countries most vulnerable to climate change through two mutually reinforcing pillars:

- Under the first pillar, the GCCA+ serves as a platform for dialogue and cooperation between the EU and developing countries.
- Under the second pillar, the GCCA+ acts as a source of technical and financial support for climate-vulnerable developing countries and regions, especially LDCs and SIDS.

This report proposes an index to allow an *ex-ante* evaluation of the structural features of vulnerability to climate change for the countries identified by the GCCA+ Flagship Initiative.

2. GCCA+ index: Components and Indicators

It is clear from the overarching goals of the GCCA+ programme, that to rank the countries according to eligibility for funding the following issues need to be considered: vulnerability to climate change, adaptive capacity, climate change mitigation action, disaster risk, and a (political) commitment to respond to climate change and poverty reduction.
On the basis of the screening process described by the theoretical framework defined by the Joint Research Centre (JRC) Scientific report 'Climate resilient development index: theoretical framework, selection criteria and fit-for-purpose indicators.' ([1]) We propose to build the GCCA+ index classifying the selected indicators along one of the four components (Figure 1) characterised as follows:

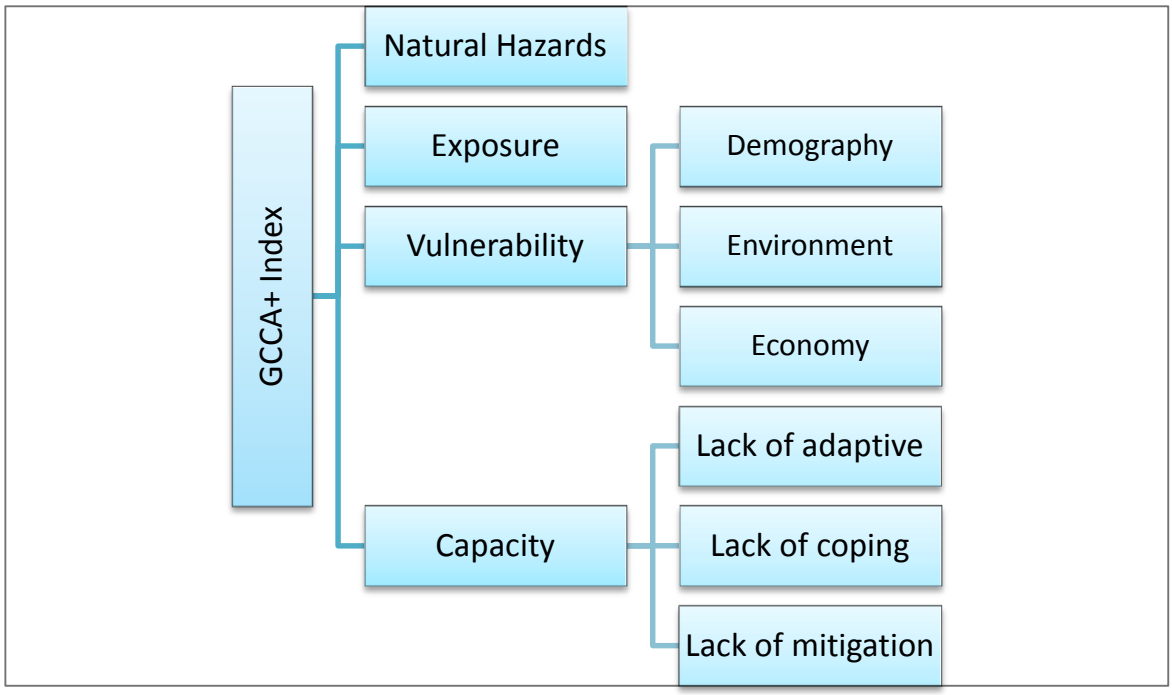
1. **Natural hazards.** This refers to the occurrence of climate-related and weather-driven hazards, flooding, storms, droughts, and sea-level rise.
2. **Exposure.** This refers to the consequences for people and assets of the occurrence of such events.
3. **Vulnerability**. This captures the socioeconomic and environmental factors that are likely to influence vulnerability. It includes indicators on

([1]) In this report we do not recall such elements, but we invite the reader to refer to the above-mentioned report for more information on the theoretical framework.

sensitivity, which can be considered as the dependence on sectors sensitive to natural resources such as agriculture.

4. **Capacity:** This recalls economic, social and environmental factors that make a country more resilient to climate change, therefore reducing the impacts of climate-related events. It also describes conditions that should be met to ensure that development is climate resilient.
    - **Adaptive capacity** encompasses the features that determine the ability to adapt of a local community including ecosystem services.
    - **Coping capacity** captures the ability of a country to cope with disasters in terms of formal, organised activities.
    - **Mitigation capacity** refers to the factors that ease implementation of actions reducing greenhouse gases.

Figure 1 — Proposed structure of the GCCA+ index



A list of 300 country-level indicators with a global coverage has been compiled by reviewing the relevant literature on climate change, development, disaster risk and the application of vulnerability and resilience indicators. The main focus has been on peer-reviewed contributions, and on indicators used to compute global development, vulnerability and risk indexes. In particular, on human development, the Human Development Index (HDI) and its indicators, the Millennium Development Goals (MDGs) and the new SDGs have been considered. ([2])

Other indicators used for international assessment and monitoring purposes, like those used for the Adaptation Fund and the Hyogo Assessment Framework (both the Hyogo Framework for Action 2005-2015 ones and those proposed in Sendai Conference 2015), have been reviewed. Moreover, further indicators have been identified by looking at the relevant literature on determinants of vulnerability and adaptive capacity, and on social and economic vulnerability.

A final list of 34 'fit-for-purpose' indicators for the GCCA+ programme has been compiled (Table 1) on the basis of their relevance with the GCCA+ programme, and the compliance with the following criteria: reliable, open source, consistent, scientifically robust, with global coverage, and based on data which are in the public domain.

Fact sheets for each of these indicators are given in ANNEX II.

The indicators cover the social, economic and environmental aspects of each of the components under which they have been classified (Figure 2).

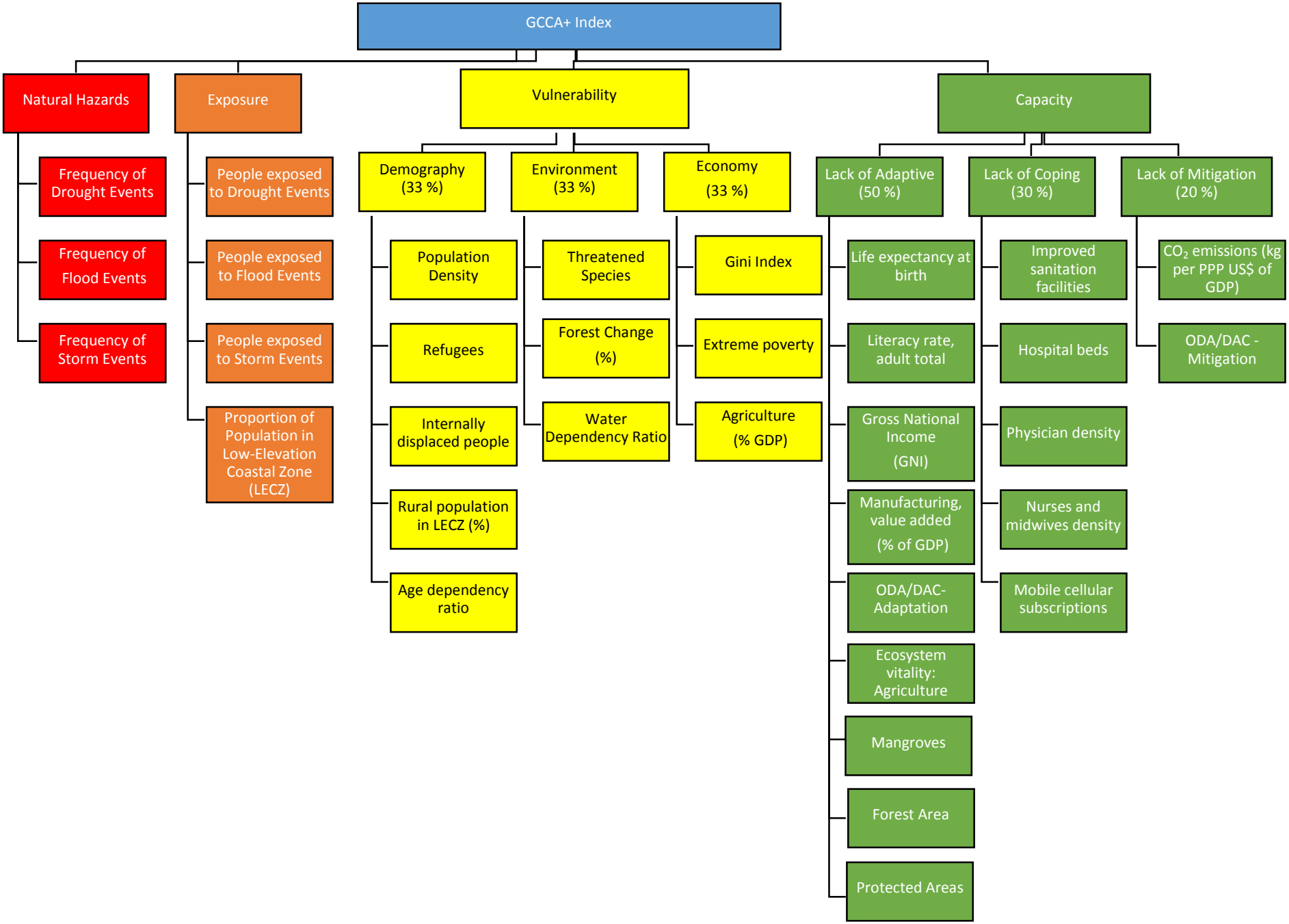
([2]) The new Sustainable Development Goals were approved in September 2015 'TRANSFORMING OUR WORLD: THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT.
https://sustainabledevelopment.un.org/content/documents/7891Transforming %20Our %20World.pdf.
In this report we consider the List of Indicator Proposals of 11 August 2015 of The Inter-agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGS) http://unstats.un.org/sdgs/iaeg-sdgs/open-consultation.html.

Table 1 — List of the GCCA+ indicators

N.	Indicator Name	Definition
1	**Frequency of drought events**	Frequency of drought events is defined as the number of events over the period 1995-2014 (cumulative) divided by this period.
2	**Frequency of flood events**	Frequency of flood events is defined as the number of events over the period 1995-2014 (cumulative) divided by this period.
3	**Frequency of storm events**	Frequency of storm events is defined as the number of events over the period 1995-2014 (cumulative) divided by this period.
4	**People exposed to drought events**	Relative number of people affected yearly by droughts.
5	**People exposed to flood events**	Relative number of people affected yearly by floods.
6	**People exposed to storm events**	Relative number of people affected yearly by storms.
7	**Proportion of population in Low-Elevation Coastal Zone (LECZ)**	Percentage of total population living in Low-Elevation Coastal Zones. LECZ is defined as the contiguous area along the coast that is less than 10 metres above sea level.
8	**Population density**	Population density is the number of people per sq. km of land area.
9	**Refugees**	Number of refugees per place of residence.
10	**Internally displaced people**	Number of internally displaced people.
11	**Rural population in LECZ**	The share of rural LECZ population over the total rural population.
12	**Age dependency ratio**	Percentage of working-age population. Ratio of the population <15 and >65 years of age to the population between 19 and 65 years of age.
13	**Threatened species**	Number of species assessed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) are referred to as 'threatened' species. They consist of birds, fish, mammals and plants.
14	**Forest change**	The change in the percentage of total forest area over the period of 1995-2012.
15	**Water dependency ratio**	Indicator expressing the percentage of total renewable water resources originating outside the country.
16	**Gini index**	The Gini index gives an estimate of inequality as it measures the extent to which the actual income distribution differs from an equitable distribution.
17	**Extreme poverty**	Poverty headcount ratio at USD 1.25 a day (PPP) (% of population).
18	**Agriculture % of GDP**	Agriculture corresponds to International Standard Industrial Classification (ISIC) divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.
19	**Life expectancy at birth**	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life. (World Data Bank)
20	**Literacy rate**	Percentage of people aged 15 and above who can read and write a short simple statement on their everyday life.
21	**Gross National Income (GNI)**	The total value of all final goods and services produced within a nation in a particular year, plus income earned by its citizens (including income of those located abroad).
22	**Manufacturing, value added (% of GDP)**	Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. (World Data Bank)

N.	Indicator Name	Definition
23	**ODA/DAC-Adaptation total costs**	Overall DAC with aid activities marked adaptation as principal objective (Commitment in 2013).
24	**Ecosystem vitality: Agriculture**	Ecosystem vitality measures ecosystem protection and resource management.
25	**Mangroves (% of land)**	Percentage of land covered by mangroves.
26	**Forest area**	Percentage of land under natural or planted stands of trees of at least five metres, whether productive or not, excluding tree stands in agricultural production systems (% of land area).
27	**Protected areas (% of total area)**	The sum of terrestrial and marine protected areas. Terrestrial protected areas are totally or partially protected areas of at least 1 000 hectares that are designated by national authorities as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes, and areas managed mainly for sustainable use. Marine protected areas are areas of inter-tidal or sub-tidal terrain — and overlying water and associated flora and fauna and historical and cultural features — that have been reserved by law or other effective means to protect part or all of the enclosed environment.
28	**Improved sanitation facilities (% of population with access)**	Improved sanitation facilities comprise flush toilets, piped sewer systems, septic tanks, flush/pour flush to pit latrines, ventilated improved pit latrines, pit latrines with slab and composting toilets.
29	**Hospital beds**	Hospital beds include inpatient beds available in public, private, general, and specialised hospitals and rehabilitation centres. In most cases beds for both acute and chronic care are included.
30	**Physician density (per 1 000 people)**	Physicians (per 1 000 people).
31	**Nurses and midwives density (per 1 000 people)**	Nurses and midwives (per 1 000 people).
32	**Mobile cellular subscriptions (per 100 people)**	Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and pre-paid subscriptions are included.
33	**CO_2 emissions**	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (kg per PPP USD of GDP).
34	**ODA/DAC climate change mitigation**	Overall DAC with aid activities marked climate change mitigation as principal objective (Commitment in 2013).

Figure 2 — GCCA+ index: scheme, components and indicators



3. Calculation of the GCCA+ index

The GCCA+ index has been built by searching the last available year for each data set of all the indicators composing the index. Data sources quoted in the original study have been checked to ensure that the most up-to-date information is used.
The proposed index is based on the last available data sets without a common reference year among the indicators. The data of the last year are chosen as a 'preliminary' indicator.
Missing data are filled in with the last available year while in cases of countries with no data at all other imputation methods are searched.
Some of these missing data are concentrated in specific indicators, mostly Gini index, Extreme Poverty, Agriculture (% GDP), Literacy Rate, Manufacturing (% GDP), CO_2 Emissions, and in specific countries, i.e. Kosovo, Cook Islands, Nauru and South Sudan.
Generally, the group of Small Island Developing States (SIDS) has a lot of missing data in the vulnerability sub-component economy.
In cases where there are no data, data from alternative and globally available data sets generated by different UN Agencies are used if available.
Annex II provides detailed information per each indicator.
A logarithmic transformation has been applied when necessary, then the data have been normalised using the max-min normalisation method ([3]).

Figure 3 — Normalisation formula

Max-Min formula

$$\mathbf{Index}_{\mathbf{Norm}} = (\mathbf{Index}_{\mathbf{Value}} - \mathbf{Min}) / (\mathbf{Max} - \mathbf{Min})$$

with Max, maximum of the series and Min the minimum value of the series

The direction of the indicators and the signs of the correlations have been treated considering as positive the polarity of the indicators included in hazard, exposure and vulnerability components.
The polarity of the indicators included in capacity has been considered as negative and the information of such indicators has been transferred into the reverse information on the lack of coping, adaptive and mitigation capacity.

Each single component of the GCCA+ index has been calculated individually. The natural hazards and the exposure components have been aggregated by geometric average.

([3]) The Max-min method normalises indicators to have an identical range (0, 1) by subtracting the minimum value and dividing by the range of the indicator values. Extreme values or outliers could distort the transformed indicator (Source: OECD/JRC (2008), Handbook on Constructing Composite Indicators, p.28).

The vulnerability and capacity components have been aggregated by arithmetic average at sub-component level and then aggregated at component level weighting the sub-component as indicated in Table 2.

Table 2 — Normalisation and aggregation at sub-components and components level

Component	Sub-components	Normalisation	Aggregation at sub-component level	Aggregation at component level
Hazards		Max-Min	Arithmetic average	Hazard*Exposure (geometric average)
Exposure		Max-Min	Arithmetic average	
Vulnerability	Demography	Max-Min	Arithmetic average	Equally weighted arithmetic average (33 %)
	Environment	Max-Min	Arithmetic average	
	Economy	Max-Min	Arithmetic average	
Capacity	Lack of Adaptive	Max-Min	Arithmetic average	Weighted arithmetic average as follows: 50 % Lack of Adaptive, 30 % Lack of Coping and 20 % Lack of Mitigation
	Lack of Coping	Max-Min	Arithmetic average	
	Lack of Mitigation	Max-Min	Arithmetic average	

A governance component is proposed. It includes the indicators as described in Table 3.

This component is not aggregated in the final index, but it could be used as a filter when additional analysis of the country profile will be needed with regard to: (1) the country's public sector in terms of quality, budgetary efficiency, revenue, transparency and quality of administration, (2) the country's participation in United Nations Framework Convention on Climate Change (UNFCCC) fora, and (3) the country's dependency on ODA financial aid for climate finance.

Table 3 — Governance Indicators

Public sector management	Cluster of four indicators on Country Policy and Institutional Assessment: (1) quality of budgetary and financial management, (2) efficiency of revenue mobilisation, quality of public administration, (3) transparency, accountability, and (4) corruption in the public sector.
Participation in UNFCCC fora	Submitted National Communications from non-Annex I Parties as a proxy of the country's participation in UNFCC fora.
Disaster Risk Report (DRR)	The indicator for the DRR activity in the country comes from the score of Hyogo Framework for Action (HFA) self-assessment progress reports.
National Adaptation Plans (NAPAs) total costs USD and number of projects	Submitted NAPAs (total costs and number of planned projects).
ODA/DAC-Adaptation per Capita	Overall DAC with aid activities marked adaptation as principal objective (total costs and per capita).
ODA/DAC Climate Change Mitigation per Capita	Overall DAC with aid activities marked climate change mitigation as principal objective (total costs and per capita).

3.1 Aggregation of the components of GCCA+ Index

Once each single component of the GCCA+ index has been calculated, the common index has been developed by aggregating the components using the following mathematical formula (1):

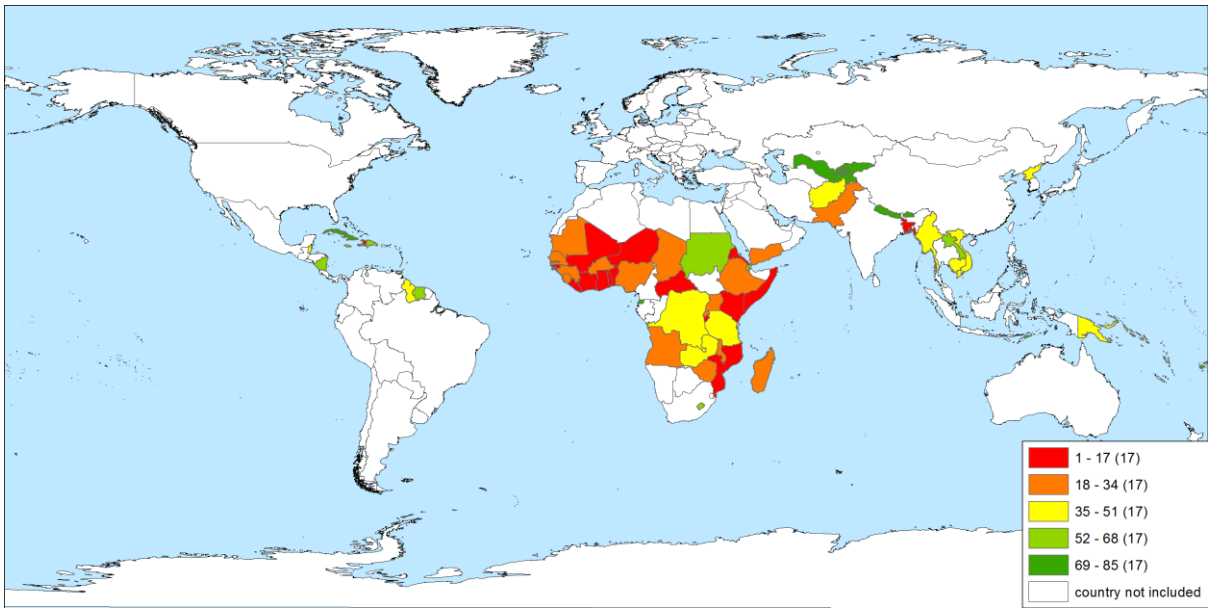
(1) GCCA+ score = [(Hazard*Exposure)+Vulnerability+(1-Capacity)]/3

The geometrical section of this formula, hazard*exposure, captures the climate change risk element since the countries affected by climate and/or weather events receive the highest score for this component.
The linear aggregation of all the components applies a development policy perspective where the climate change risk is integrated within the context of a climate resilient development approach aiming at reducing the vulnerability of a country.

The following maps and tables show the results of the GCCA+ Index for the following samples of the countries: (1) LDCs and SIDS, (2) LDCs, (3) SIDS, (4) extended list, (5) African, Caribbean and Pacific States (for more information refer to the Annex III). The lowest rank is the highest score for the objective of the index and it indicates the countries the most vulnerable to climate change.

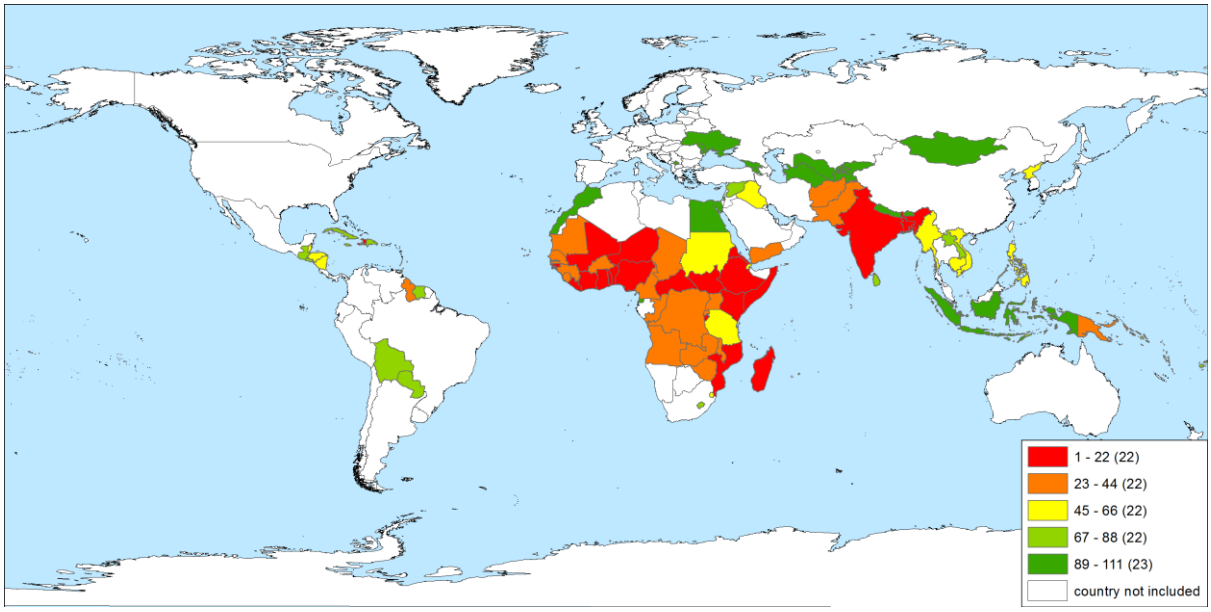
Finally, the Figure 4 shows the correlation of the GCCA+ score with each component of the index. The main component of the proposed index is the vulnerability whose R coefficient is 0.70.

Map 1 — GCCA+ Index rank for the sample of countries including LDCs and SIDs

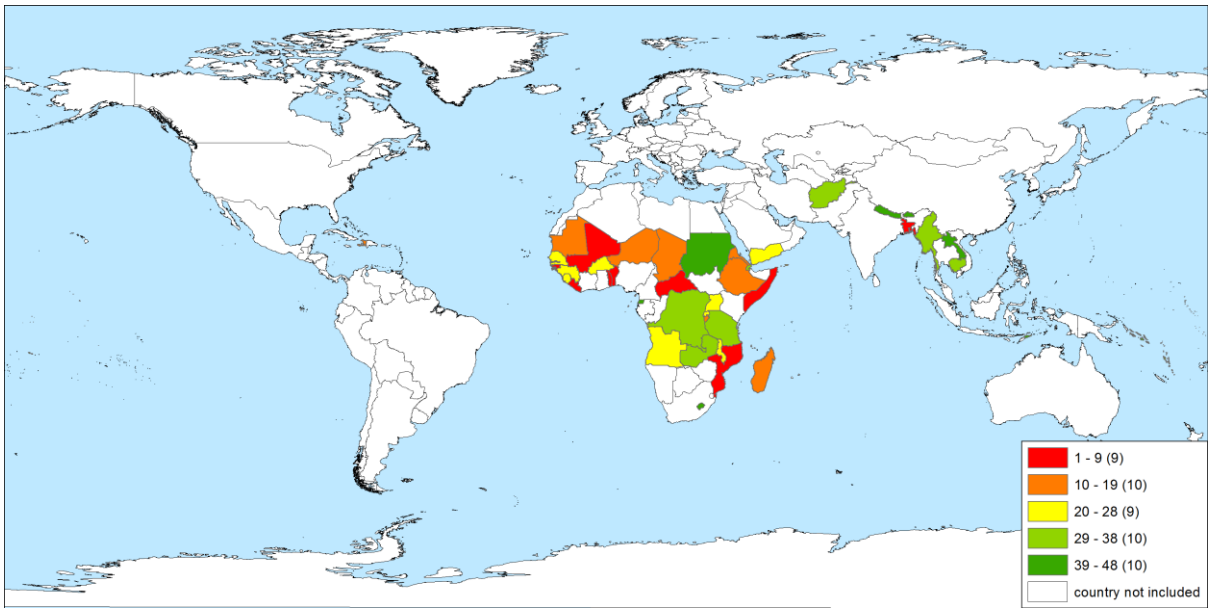


The lowest rank is the highest score for the objective of the index and it indicates the countries most vulnerable to climate change

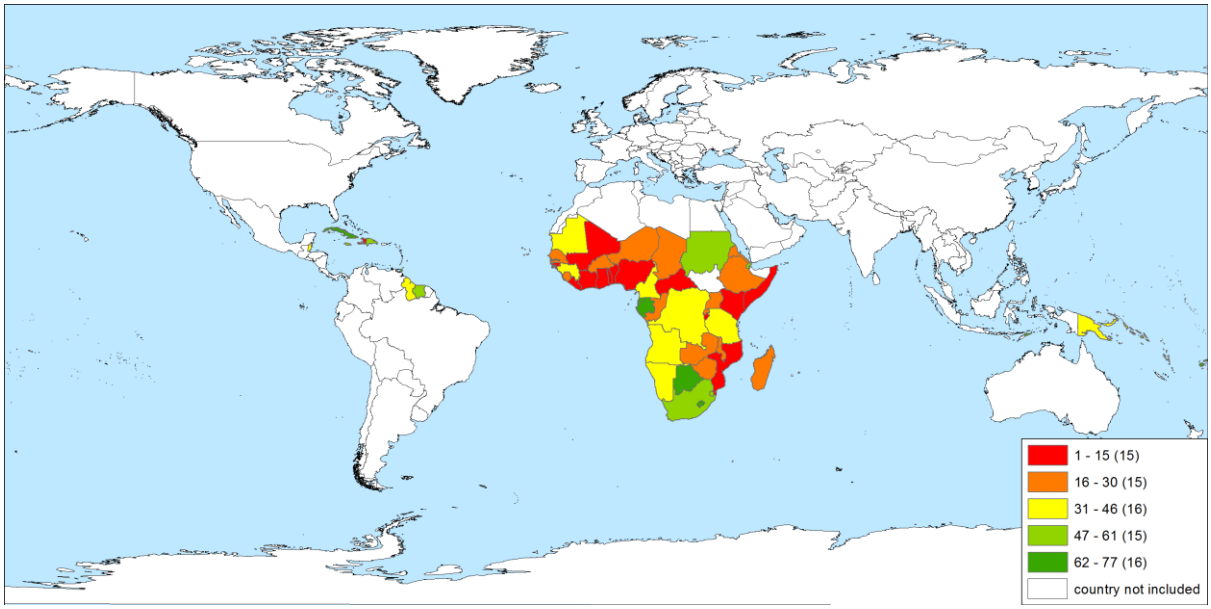
Map 2 — GCCA+ Index rank for the sample of countries including LDCs, SIDS, low-income countries and lower-middle-income countries, and territories from the OECD's Development Assistance Committee (DAC) list of Official Development Assistance (ODA) Recipients (excluding Tokelau, Singapore, and Bahamas)



Map 3 — GCCA+ Index rank for the sample of countries including LDCs



Map 4 — GCCA+ Index rank for the sample of African, Caribbean and Pacific Group of States



Map 5 — GCCA+ Index rank for the sample of countries including SIDs

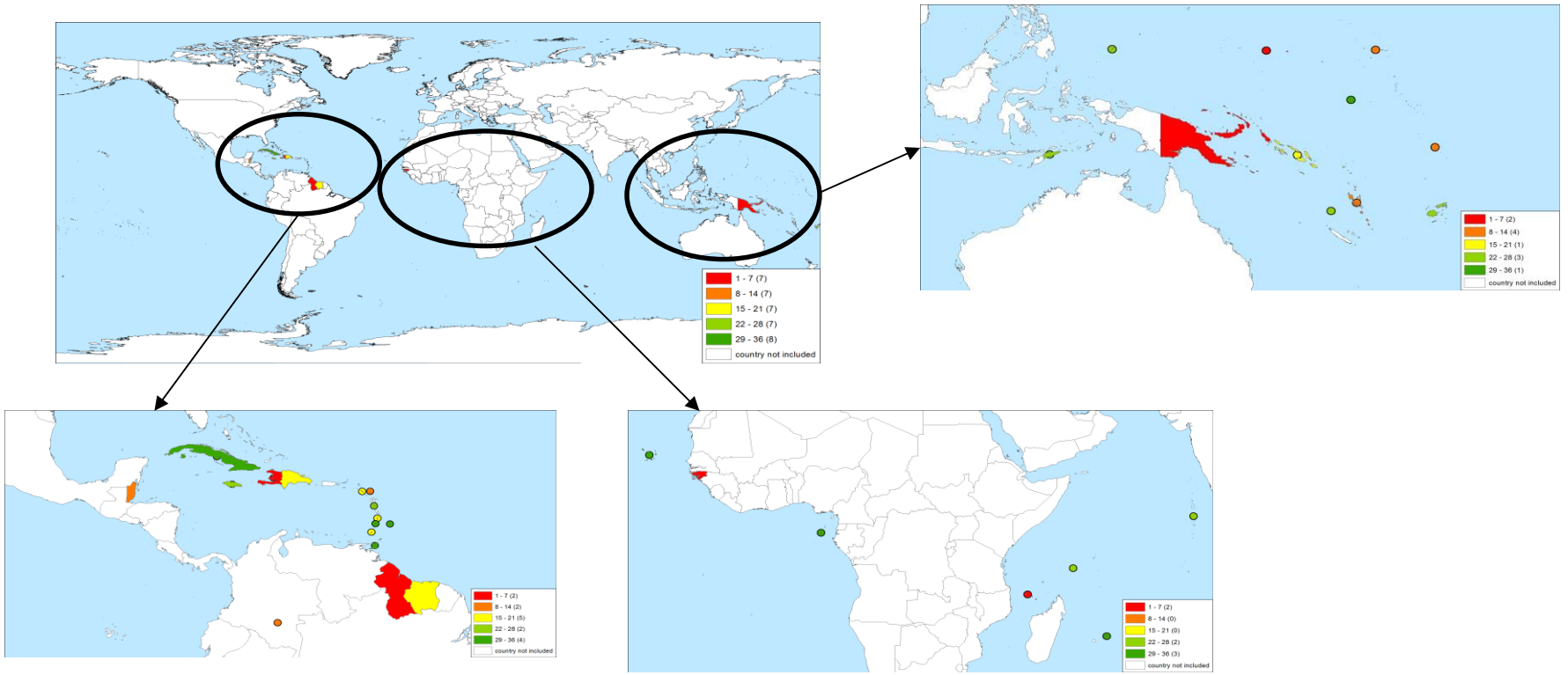
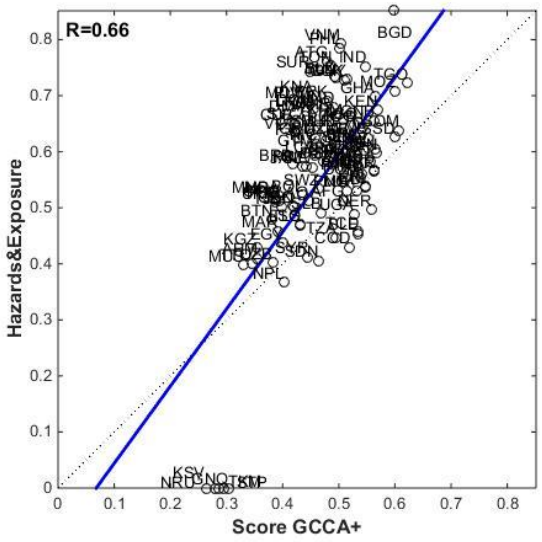
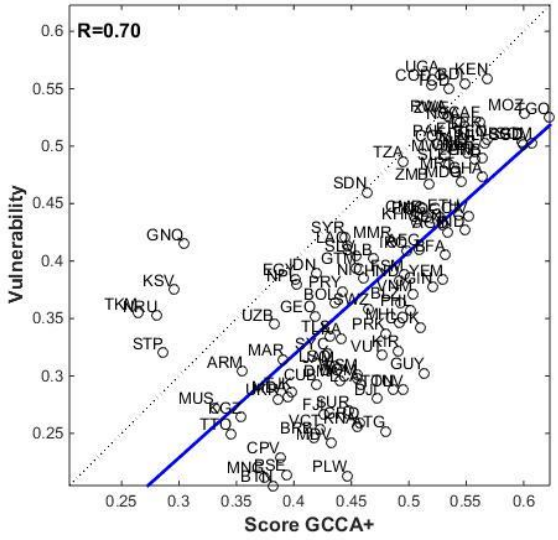


Figure 4 — GCCA+ Scores correlations

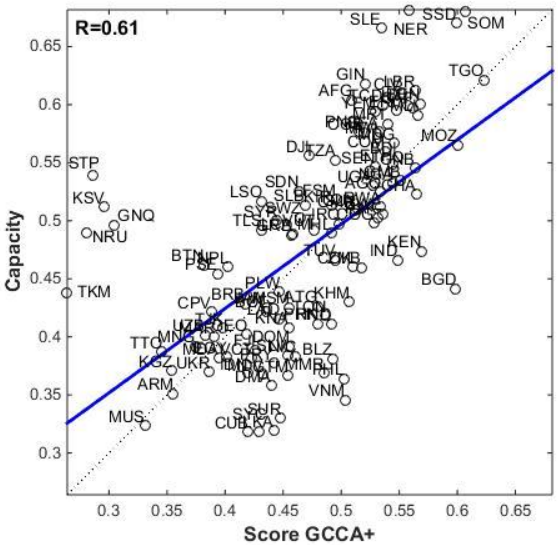
GCCA+ Score vs. Hazards*Exposure



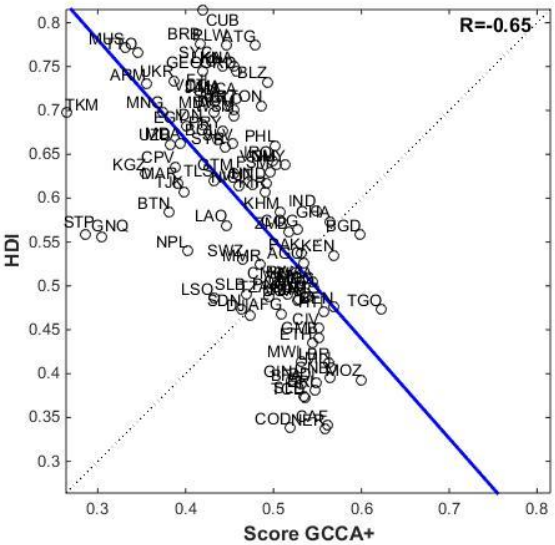
GCCA+ Score vs. Vulnerability



GCCA+ Score vs. Capacity



GCCA+ Score vs. HDI



4. Conclusions

This report proposes an index to allow an *ex-ante* evaluation of the structural features of vulnerability to climate change for the countries identified by the GCCA+ Flagship Initiative.
It ranks the countries according to the eligibility for funding as designed by the five priority areas and the two pillars of the GCCA+ Flagship Initiative.
Some of the GCCA+ indicators can be useful for an *ex post* monitoring and evaluation (M&E) of the supported projects. It should be stressed that the M&E is an *ex post* activity, and indicators are needed mainly to capture the progress made towards achieving project objectives. The indicators used for M&E purposes mainly cover the dynamic component of climate-resilient development.
A further analysis on M&E indicators for GCCA+ projects can be defined.

Finally, all the information related to the index (methodology, indicators, data sets, etc.) can be visualised through a web knowledge platform. It is consistent with the two pillars of the GCCA+programme and increases the transparency of the index.

References

Adger, W.N., 'Vulnerability', *Global Environmental Change*, 16, 2006, pp. 268-281.

Anbarci, N., Escaleras, M., and Register, C. A., Earthquake fatalities: the interaction of nature and political economy, *Journal of Public Economics*, 89, 2005, pp. 1907-1933.

Babier, L., Climate Change Impacts on Rural Poverty in Low-Elevation Coastal Zones Climate Change and Poverty Conference, 9-10 February 2015 World Bank Group Headquarters, Washington, D.C.

Birkmann, J., 'Measuring vulnerability to natural hazards: towards disaster resilient societies', — *UNU-EHS Expert Working Group on Measuring Vulnerability*. (Ed.). New York: United Nations University, 2006.

Briguglio et al.,'Economic Vulnerability and Resilience. Concepts and Measurements', *Research Paper No 2008/55.* World Institute for Development Economics Research, 2008.

Brooks, N., Adger, N. W., Kelly, M. P., 'The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation', *Global Environmental Change* 15, 2005, pp. 151-163.

Costa, S., *Government repression and the death toll from natural disasters,* CESIifo Working Paper No 3703. Münchener Gesellschaft zur Förderung der Wirtschaftswissenschaft — CESifo GmbH (Munich Society for the Promotion of Economic Research), Munich, Germany, 2012.

CUTTER, S. L., BORUFF, B. J. & SHIRLEY, W. L., 'Social Vulnerability to Environmental Hazards', *Social Science Quarterly,* 84, 2003, pp.242-261.

De Groeve, T., Poljansek K., Vernaccini, L., *Index For Risk Management InfoRM: Concept and Methodology, EUR 26528* — JRC IPSC — Luxembourg Publications Office of the European Union 201 4 \194, pp. – 21.0x 29.7 EUR Scientific and Technical series — ISSN 1831 -9424 (online) ISBN 978-92 -79 33669, 2014.

De Oliveira Mendes, J., Social vulnerability indexes as planning tools: beyond the preparedness paradigm. *Journal of Risk Research* Volume 12, Issue 1, 2009, pp. 43-58 DOI:10.1080/13669870802447962.

Dwyer, A., Zoppou, C., Day, S., Nielsen, O. and Roberts, S., *Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards*, Geoscience Australia Technical Record 2004/14, GA, Canberra, 2004.

European Commission, '*Building a Global Climate Change Alliance between the EU and poor developing countries most vulnerable to climate change'* COM(2007)540.

Fussel H.M.,(2007) 'Vulnerability: A generally applicable conceptual framework for climate change research', *Global Environmental Change* 17, 2007, pp. 155-167.

Füssel H.-M., 'How inequitable is the global distribution of responsibility, capability, and vulnerability to climate change: a comprehensive indicator-based assessment', *Global Environmental Change* 10/2010; 20(4):597-611. DOI:10.1016/j.gloenvcha.2010.07.009, 2010.

Hallegatte, S., Przyluski, V., *The economics of natural disasters: Concepts and methods,* World Bank Policy Research Working paper, Series 5507, 2010.

Hallegatte S., *Economic Resilience. Definition and Measurement,* Policy Research Working Paper 6852. http://econ.worldbank.org, 2014.

Halsnaes, K. and Verhagen, J., 'Development based climate change adaptation and mitigation. Conceptual issues and lessons learned in studies in developing countries', *Mitigation and Adaptation Strategies for Global Change*, 12(5), 2007, pp. 665-684.

Hahn, M.B., Riederer, A.M., Foster, S.O., 'The livelihood vulnerability index: a pragmatic approach to assessing risks from climate variability and change—a case study in Mozambique', *Global Environmental Change* 19 (1), 2009, pp. 74–88.

Kahn, M.E., 'The death toll from natural disasters: the role of income, geography, and institutions', *The Review of Economics and Statistics,* 87, 2005, pp. 271-284.

Kellenberg, D.K. and Mobarak, A.M., (2008) 'Does rising income increase or decrease damage risk from natural disasters?', *Journal of Urban Economics,* 63(3), 2008, pp. 788-802.

Intergovernmental Panel on Climate Change (IPCC), 'Climate Change 2007: Impacts, Adaptation and Vulnerability', Contribution of Working Group II to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E., Eds., Cambridge University Press, Cambridge, UK, 2007, pp. 976.

IPCC, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation,* A Special Report of Working Groups I and II of the IPCC, Cambridge University Press, Cambridge, UK, and New York, USA, 2012.

IPCC, 'Climate Change 2013: The Physical Science Basis- Summary for Policy Makers', Working Group I Contribution to the *Fifth Assessment Report of the Intergovernmental Panel on Climate*, Cambridge University Press, New York, http://www.ipcc.ch/report/ar5/wg1/, 2013.

IPCC, 'Climate Change 2014: Impacts, Adaptation, and Vulnerability', IPCC Working Group II Contribution to *AR5* http://ipcc-wg2.gov/AR5/, 2014.

International Monetary Fund (IMF), *Natural Disasters Hitting More People, Becoming more costly,* http://www.imf.oeg/externba/pubs/ft/survey/so/2012/new101012a.htm, 2012.

Li, B. S. Y., Stewart, M.G., 'Social Vulnerability index for Coastal Community at risk to Hurricane Hazard and a Changing Climate', *Natural Hazards*, 59 (2) , 2011, pp. 1055-1075.

Miola A., Simonet C., Task 1a of the Administrative arrangement N. DCI-ENV/2013/336-378 Update on the current Global Climate Change Alliance index: new formula of aggregation and new data sets, European Commission, 2014, JRC90727.

Miola A., Simonet C., *Concepts and Metrics for Climate Change Risk and Development — Towards an index for Climate Resilient Development*, EUR 26587, Luxembourg (Luxembourg), Publications Office of the European Union, 2014, JRC89538.

Miola A., Paccagnan, V., Papadimitriou, E., Mandrici A., (2015) Climate resilient development index: theoretical framework, selection criteria and fit-for-purpose indicators, Luxembourg: Publications Office of the European Union,2015 –191 pp. — 21.0 x 29.7 cm EUR — Scientific and Technical Research series –ISSN 1831-9424 (online) ISBN 978-92-79-46012-8 (PDF) doi: 10.2788/07628.

OECD, *Handbook on the OECD-DAC Climate Marker*s, 2011.

OECD, European Commission, and Joint Research Centre (JRC), *Handbook on Constructing Composite Indicators: Methodology and User Guide*. OECD Publishing, Paris, 2008, available at http://www.oecd.org/std/42495745.pdf.

OECD, *Handbook on the OECD-DAC Climate Markers (2011*), OECD Publishing, Paris, 2011, http://www.oecd.org/dac/stats/rioconventions.htm.

OECD, *Climate resilience and economic growth in developing countries* — Expert Workshop, 24 April 2013, OECD Headquarters, Paris.

Polsky, C., R. Neff, and Yarnal, B., 'Building comparable global change vulnerability assessments: the vulnerability scoping diagram.' *Global Environmental Change* 17(3-4), 2007, pp. 472-485.

United Nations – Economic & Social Affairs (UNDESA), *Handbook on the Least Developed Country Category: Inclusion, Graduation and Special Support Measures*, 2008, ISBN 978-92-1 — 104574-1, UN, New York.

United Nation University — Institute for Environment and Human Security, 'The Nature Conservancy', *The World Risk Report 2014, Focus on the city as risk area*, UNU-EHS, Bonn, 2012, http://i.unu.edu/media/ehs.unu.edu/news/4070/11895.pdf.

United Nation University — Institute for Environment and Human Security, The Nature Conservancy, *The World Risk Report 2012. Focus on Environmental degradation and disasters*, UNU-EHS, Bonn , 2012, http://www.ehs.unu.edu/file/get/10487.pdf.

United Nations University, *World Risk Report 2012*, United Nations University Institute for Environment and Human Security, 2012, UNU, Bonn.

University of Notre Dame , *ND-Global Adaptation Index Detailed Methodology Report*, 2013.

University of Notre Dame, *ND-Global Adaptation Index Detailed Methodology Report*, 2014, http://index.gain.org.

UNISDR, *Development of the Post-2015 Framework for Disaster Risk Reduction* (Co-chairs' pre-zero draft), 2014, http://www.wcdrr.org/preparatory/post2015.

UNISDR, *Progress and challenges in disaster risk reduction: a contribution towards the development of policy indicators for the post-2015 framework for disaster risk reduction*, 2014, http://www.preventionweb.net/english/professional/publications/v.php?id=40967.

UNISDR, *Sendai Framework for Disaster Risk Reduction 2015 — 2030* , 2015, http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf.

List of Acronyms

ACP — African Caribbean and Pacific Group of States
CPIA — Country Policy and Institutional Assessment
DAC — Development Assistance Committee
DEVCO — European Commission DG Development and Cooperation
EPI — Environmental Performance Index
EVI — Environmental Vulnerability Index
FAO — Food and Agriculture Organisation
GCCA — Global Climate Change Alliance
GDP — Gross Domestic Product
GHG — Green House Gases
GNI — Gross National Income
HDI — Human Development Index
INFORM — Index for Risk Management
IPCC — Intergovernmental Panel on Climate Change
JRC — Joint Research Centre
LDC — Least Developed Countries
MDG — Millennium Development Goals
ND-GAIN — University of Notre Dame Global Adaptation Index
ODA — Official Development Assistance
OECD — Organisation for Economic Cooperation and Development
PPP — Purchasing Power Parity
REDD — Reducing emissions from deforestation and forest degradation
SDGs — Sustainable Development Goals
SIDS — Small Island Developing States
SREX — Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change
UN — United Nations
UNDP — United Nations Development Programme
UNEP — United Nations Environmental Programme
UNFCCC — United Nations Framework Convention on Climate Change
USAID — United States Agency for International Development
VA — Vulnerability Assessment
WHO — World Health Organisation

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Annex I — GCCA+ index, Components, Scores and Rank

Table Annex I 1 – GCCA+ index, sample of countries (LDCs and SIDS)

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Togo	0.72	0.52	0.62	0.62	1
Somalia	0.64	0.50	0.68	0.61	2
Mozambique	0.71	0.53	0.56	0.60	3
Bangladesh	0.85	0.50	0.44	0.60	4
Kenya	0.67	0.56	0.47	0.57	5
Benin	0.60	0.51	0.60	0.57	6
Mali	0.60	0.50	0.59	0.57	7
Ghana	0.70	0.47	0.52	0.56	8
Guinea-Bissau	0.66	0.49	0.55	0.56	9
Liberia	0.56	0.51	0.61	0.56	10
Central African Rep.	0.57	0.52	0.60	0.56	11
Niger	0.50	0.50	0.68	0.56	12
Haiti	0.58	0.49	0.60	0.56	13
Côte d'Ivoire	0.61	0.44	0.61	0.55	14
Gambia	0.62	0.49	0.53	0.55	15
Burundi	0.54	0.55	0.55	0.55	16
Eritrea	0.54	0.51	0.59	0.55	17
Madagascar	0.60	0.47	0.57	0.55	18
Nigeria	0.58	0.52	0.53	0.54	19
Ethiopia	0.64	0.44	0.55	0.54	20
Mauritania	0.56	0.48	0.58	0.54	21
Comoros	0.55	0.50	0.56	0.54	22
Chad	0.46	0.55	0.60	0.54	23
Zimbabwe	0.57	0.53	0.51	0.54	24
Sierra Leone	0.45	0.48	0.67	0.53	25
Angola	0.65	0.43	0.52	0.53	26
Rwanda	0.56	0.53	0.51	0.53	27
Burkina Faso	0.61	0.41	0.58	0.53	28
Malawi	0.53	0.49	0.57	0.53	29
Pakistan	0.59	0.51	0.50	0.53	30
Yemen	0.61	0.38	0.59	0.53	31
Senegal	0.61	0.43	0.55	0.53	32
Uganda	0.49	0.56	0.53	0.53	33
Guinea	0.57	0.38	0.62	0.52	34
Congo, Dem. Rep.	0.43	0.55	0.58	0.52	35
Zambia	0.63	0.47	0.46	0.52	36
Papua New Guinea	0.53	0.44	0.58	0.52	37
Guyana	0.73	0.30	0.51	0.51	38
Afghanistan	0.51	0.41	0.60	0.51	39
Cambodia	0.66	0.43	0.43	0.51	40
Vietnam	0.79	0.37	0.35	0.50	41
Micronesia, Federated States	0.58	0.39	0.52	0.50	42
Tanzania	0.45	0.49	0.55	0.50	43
Tuvalu	0.73	0.29	0.47	0.50	44
Belize	0.73	0.36	0.38	0.49	45

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Marshall Islands	0.64	0.35	0.49	0.49	46
Kiribati	0.64	0.32	0.51	0.49	47
Tonga	0.75	0.29	0.42	0.49	48
Myanmar	0.67	0.42	0.37	0.49	49
Antigua and Barbuda	0.76	0.25	0.43	0.48	50
Korea, Dem. Rep.	0.69	0.34	0.41	0.48	51
Vanuatu	0.62	0.32	0.49	0.48	52
Djibouti	0.58	0.28	0.56	0.47	53
Solomon Islands	0.49	0.40	0.51	0.47	54
Sudan	0.41	0.46	0.53	0.46	55
Nicaragua	0.61	0.38	0.38	0.46	56
St. Lucia	0.59	0.29	0.49	0.46	57
Grenada	0.62	0.26	0.49	0.46	58
Samoa	0.64	0.30	0.43	0.46	59
Dominican Republic	0.68	0.30	0.39	0.46	60
St. Kitts-Nevis	0.70	0.26	0.41	0.45	61
Suriname	0.74	0.27	0.33	0.45	62
Laos	0.51	0.41	0.42	0.45	63
Palau	0.69	0.21	0.44	0.45	64
Dominica	0.66	0.30	0.36	0.44	65
Jamaica	0.57	0.31	0.42	0.44	66
Maldives	0.69	0.24	0.37	0.43	67
Lesotho	0.47	0.31	0.52	0.43	68
Timor-Leste	0.47	0.33	0.49	0.43	69
Seychelles	0.65	0.32	0.32	0.43	70
Fiji	0.62	0.27	0.39	0.43	71
St. Vincent and Grenadines	0.63	0.25	0.38	0.42	72
Cuba	0.65	0.29	0.32	0.42	73
Barbados	0.58	0.25	0.43	0.42	74
Nepal	0.37	0.38	0.46	0.40	75
Tajikistan	0.50	0.29	0.41	0.40	76
Cabo Verde	0.51	0.23	0.42	0.39	77
Uzbekistan	0.40	0.34	0.40	0.38	78
Bhutan	0.48	0.20	0.46	0.38	79
Kyrgyz Rep.	0.43	0.26	0.37	0.35	80
Trinidad and Tobago	0.40	0.25	0.39	0.35	81
Mauritius	0.40	0.27	0.32	0.33	82
Equatorial Guinea	0.00	0.42	0.50	0.30	83
São Tomé and Príncipe	0.00	0.32	0.54	0.29	84
Nauru	0.00	0.35	0.49	0.28	85

Table Annex I 2 — GCCA+ index, sample of countries (LDCs)

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Togo	0.72	0.52	0.62	0.62	1
Somalia	0.64	0.50	0.68	0.61	2
Mozambique	0.71	0.53	0.56	0.60	3
Bangladesh	0.85	0.50	0.44	0.60	4
Benin	0.60	0.51	0.60	0.57	5
Mali	0.60	0.50	0.59	0.57	6
Guinea-Bissau	0.66	0.49	0.55	0.56	7
Liberia	0.56	0.51	0.61	0.56	8
Central African Rep.	0.57	0.52	0.60	0.56	9
Niger	0.50	0.50	0.68	0.56	10
Haiti	0.58	0.49	0.60	0.56	11
Gambia	0.62	0.49	0.53	0.55	12
Burundi	0.54	0.55	0.55	0.55	13
Eritrea	0.54	0.51	0.59	0.55	14
Madagascar	0.60	0.47	0.57	0.55	15
Ethiopia	0.64	0.44	0.55	0.54	16
Mauritania	0.56	0.48	0.58	0.54	17
Comoros	0.55	0.50	0.56	0.54	18
Chad	0.46	0.55	0.60	0.54	19
Sierra Leone	0.45	0.48	0.67	0.53	20
Angola	0.65	0.43	0.52	0.53	21
Rwanda	0.56	0.53	0.51	0.53	22
Burkina Faso	0.61	0.41	0.58	0.53	23
Malawi	0.53	0.49	0.57	0.53	24
Yemen	0.61	0.38	0.59	0.53	25
Senegal	0.61	0.43	0.55	0.53	26
Uganda	0.49	0.56	0.53	0.53	27
Guinea	0.57	0.38	0.62	0.52	28
Congo, Dem. Rep.	0.43	0.55	0.58	0.52	29
Zambia	0.63	0.47	0.46	0.52	30
Afghanistan	0.51	0.41	0.60	0.51	31
Cambodia	0.66	0.43	0.43	0.51	32
Tanzania	0.45	0.49	0.55	0.50	33
Tuvalu	0.73	0.29	0.47	0.50	34
Kiribati	0.64	0.32	0.51	0.49	35
Myanmar	0.67	0.42	0.37	0.49	36
Vanuatu	0.62	0.32	0.49	0.48	37
Djibouti	0.58	0.28	0.56	0.47	38
Solomon Islands	0.49	0.40	0.51	0.47	39
Sudan	0.41	0.46	0.53	0.46	40
Samoa	0.64	0.30	0.43	0.46	41
Laos	0.51	0.41	0.42	0.45	42
Lesotho	0.47	0.31	0.52	0.43	43
Timor-Leste	0.47	0.33	0.49	0.43	44
Nepal	0.37	0.38	0.46	0.40	45
Bhutan	0.48	0.20	0.46	0.38	46
Equatorial Guinea	0.00	0.42	0.50	0.30	47
São Tomé and Príncipe	0.00	0.32	0.54	0.29	48

Table Annex I 3 — GCCA+ index, sample of countries (SIDs)

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Guinea-Bissau	**0.66**	**0.49**	**0.55**	0.56	**1**
Haiti	**0.58**	**0.49**	**0.60**	0.56	**2**
Comoros	**0.55**	**0.50**	**0.56**	0.54	**3**
Papua New Guinea	**0.53**	**0.44**	**0.58**	0.52	**4**
Guyana	**0.73**	**0.30**	**0.51**	0.51	**5**
Cook Islands	**0.73**	**0.34**	**0.46**	0.51	**6**
Micronesia, Federated States	**0.58**	**0.39**	**0.52**	0.50	**7**
Tuvalu	**0.73**	**0.29**	**0.47**	0.50	**8**
Belize	**0.73**	**0.36**	**0.38**	0.49	**9**
Marshall Islands	**0.64**	**0.35**	**0.49**	0.49	**10**
Kiribati	**0.64**	**0.32**	**0.51**	0.49	**11**
Tonga	**0.75**	**0.29**	**0.42**	0.49	**12**
Antigua and Barbuda	**0.76**	**0.25**	**0.43**	0.48	**13**
Vanuatu	**0.62**	**0.32**	**0.49**	0.48	**14**
Solomon Islands	**0.49**	**0.40**	**0.51**	0.47	**15**
St. Lucia	**0.59**	**0.29**	**0.49**	0.46	**16**
Grenada	**0.62**	**0.26**	**0.49**	0.46	**17**
Samoa	**0.64**	**0.30**	**0.43**	0.46	**18**
Dominican Republic	**0.68**	**0.30**	**0.39**	0.46	**19**
St. Kitts-Nevis	**0.70**	**0.26**	**0.41**	0.45	**20**
Suriname	**0.74**	**0.27**	**0.33**	0.45	**21**
Palau	**0.69**	**0.21**	**0.44**	0.45	**22**
Dominica	**0.66**	**0.30**	**0.36**	0.44	**23**
Jamaica	**0.57**	**0.31**	**0.42**	0.44	**24**
Maldives	**0.69**	**0.24**	**0.37**	0.43	**25**
Timor-Leste	**0.47**	**0.33**	**0.49**	0.43	**26**
Seychelles	**0.65**	**0.32**	**0.32**	0.43	**27**
Fiji	**0.62**	**0.27**	**0.39**	0.43	**28**
St. Vincent and Grenadines	**0.63**	**0.25**	**0.38**	0.42	**29**
Cuba	**0.65**	**0.29**	**0.32**	0.42	**30**
Barbados	**0.58**	**0.25**	**0.43**	0.42	**31**
Cabo Verde	**0.51**	**0.23**	**0.42**	0.39	**32**
Trinidad and Tobago	**0.40**	**0.25**	**0.39**	0.35	**33**
Mauritius	**0.40**	**0.27**	**0.32**	0.33	**34**
São Tomé and Príncipe	**0.00**	**0.32**	**0.54**	0.29	**35**
Nauru	**0.00**	**0.35**	**0.49**	0.28	**36**

Table Annex I 4 — GCCA+ index, sample of Countries: (LDCs, SIDS, low-income countries and lower-middle-income countries, and territories from (DAC) list of (ODA) Recipients)

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Togo	0.72	0.52	0.62	0.62	1
Somalia	0.64	0.50	0.68	0.61	2
Mozambique	0.71	0.53	0.56	0.60	3
South Sudan	0.63	0.50	0.67	0.60	4
Bangladesh	0.85	0.50	0.44	0.60	5
Kenya	0.67	0.56	0.47	0.57	6
Benin	0.60	0.51	0.60	0.57	7
Mali	0.60	0.50	0.59	0.57	8
Ghana	0.70	0.47	0.52	0.56	9
Guinea-Bissau	0.66	0.49	0.55	0.56	10
Liberia	0.56	0.51	0.61	0.56	11
Central African Rep.	0.57	0.52	0.60	0.56	12
Niger	0.50	0.50	0.68	0.56	13
Haiti	0.58	0.49	0.60	0.56	14
Côte d'Ivoire	0.61	0.44	0.61	0.55	15
Gambia	0.62	0.49	0.53	0.55	16
India	0.75	0.43	0.47	0.55	17
Burundi	0.54	0.55	0.55	0.55	18
Eritrea	0.54	0.51	0.59	0.55	19
Madagascar	0.60	0.47	0.57	0.55	20
Nigeria	0.58	0.52	0.53	0.54	21
Ethiopia	0.64	0.44	0.55	0.54	22
Mauritania	0.56	0.48	0.58	0.54	23
Comoros	0.55	0.50	0.56	0.54	24
Chad	0.46	0.55	0.60	0.54	25
Zimbabwe	0.57	0.53	0.51	0.54	26
Sierra Leone	0.45	0.48	0.67	0.53	27
Angola	0.65		0.52	0.53	28
Rwanda	0.56	0.53	0.51	0.53	29
Burkina Faso	0.61	0.41	0.58	0.53	30
Malawi	0.53	0.49	0.57	0.53	31
Pakistan	0.59	0.51	0.50	0.53	32
Yemen	0.61	0.38	0.59	0.53	33
Senegal	0.61	0.43	0.55	0.53	34
Congo, Rep.	0.65	0.44	0.50	0.53	35
Uganda	0.49	0.56	0.53	0.53	36
Guinea	0.57	0.38	0.62	0.52	37
Congo, Dem. Rep.	0.43	0.55	0.58	0.52	38
Zambia	0.63	0.47	0.46	0.52	39
Papua New Guinea	0.53	0.44	0.58	0.52	40
Guyana	0.73	0.30	0.51	0.51	41
Cameroon	0.59	0.44	0.51	0.51	42
Cook Islands	0.73	0.34	0.46	0.51	43
Afghanistan	0.51	0.41	0.60	0.51	44
Cambodia	0.66	0.43	0.43	0.51	45
Vietnam	0.79	0.37	0.35	0.50	46
Philippines	0.78	0.36	0.36	0.50	47
Iraq	0.59	0.41	0.50	0.50	48

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Micronesia, Federated States	0.58	0.39	0.52	0.50	49
Tanzania	0.45	0.49	0.55	0.50	50
Tuvalu	0.73	0.29	0.47	0.50	51
Belize	0.73	0.36	0.38	0.49	52
Marshall Islands	0.64	0.35	0.49	0.49	53
Honduras	0.68	0.38	0.41	0.49	54
Kiribati	0.64	0.32	0.51	0.49	55
Tonga	0.75	0.29	0.42	0.49	56
Myanmar	0.67	0.42	0.37	0.49	57
Antigua and Barbuda	0.76	0.25	0.43	0.48	58
Korea, Dem. Rep.	0.69	0.34	0.41	0.48	59
Vanuatu	0.62	0.32	0.49	0.48	60
Djibouti	0.58	0.28	0.56	0.47	61
Solomon Islands	0.49	0.40	0.51	0.47	62
Swaziland	0.53	0.36	0.50	0.47	63
Sudan	0.41	0.46	0.53	0.46	64
Nicaragua	0.61	0.38	0.38	0.46	65
St. Lucia	0.59	0.29	0.49	0.46	66
Grenada	0.62	0.26	0.49	0.46	67
Samoa	0.64	0.30	0.43	0.46	68
Dominican Republic	0.68	0.30	0.39	0.46	69
St. Kitts-Nevis	0.70	0.26	0.41	0.45	70
Guatemala	0.60	0.39	0.37	0.45	71
El Salvador	0.57	0.41	0.38	0.45	72
Suriname	0.74	0.27	0.33	0.45	73
Laos	0.51	0.41	0.42	0.45	74
Palau	0.69	0.21	0.44	0.45	75
Syria	0.41	0.42	0.50	0.44	76
Paraguay	0.57	0.37	0.38	0.44	77
Sri Lanka	0.67	0.33	0.32	0.44	78
Dominica	0.66	0.30	0.36	0.44	79
Bolivia	0.52	0.36	0.42	0.44	80
Jamaica	0.57	0.31	0.42	0.44	81
Maldives	0.69	0.24	0.37	0.43	82
Lesotho	0.47	0.31	0.52	0.43	83
Timor-Leste	0.47	0.33	0.49	0.43	84
Seychelles	0.65	0.32	0.32	0.43	85
Fiji	0.62	0.27	0.39	0.43	86
St. Vincent and Grenadines	0.63	0.25	0.38	0.42	87
Cuba	0.65	0.29	0.32	0.42	88
Indonesia	0.50	0.39	0.37	0.42	89
Georgia	0.50	0.35	0.40	0.42	90
Barbados	0.58	0.25	0.43	0.42	91
Nepal	0.37	0.38	0.46	0.40	92
Egypt	0.44	0.38	0.38	0.40	93
Tajikistan	0.50	0.29	0.41	0.40	94
Moldova	0.52	0.28	0.38	0.39	95
West Bank and Gaza Strip	0.51	0.21	0.45	0.39	96
Morocco	0.46	0.31	0.40	0.39	97

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (rank)
Cabo Verde	**0.51**	**0.23**	**0.42**	0.39	**98**
Ukraine	**0.51**	**0.28**	**0.37**	0.39	**99**
Uzbekistan	**0.40**	**0.34**	**0.40**	0.38	**100**
Bhutan	**0.48**	**0.20**	**0.46**	0.38	**101**
Mongolia	**0.52**	**0.21**	**0.39**	0.37	**102**
Armenia	**0.41**	**0.30**	**0.35**	0.36	**103**
Kyrgyz Rep.	**0.43**	**0.26**	**0.37**	0.35	**104**
Trinidad and Tobago	**0.40**	**0.25**	**0.39**	0.35	**105**
Mauritius	**0.40**	**0.27**	**0.32**	0.33	**106**
Equatorial Guinea	**0.00**	**0.42**	**0.50**	0.30	**107**
Kosovo	**0.00**	**0.38**	**0.51**	0.30	**108**
São Tomé and Príncipe	**0.00**	**0.32**	**0.54**	0.29	**109**
Nauru	**0.00**	**0.35**	**0.49**	0.28	**110**
Turkmenistan	**0.00**	**0.35**	**0.44**	0.26	**111**

Table Annex I 5 — GCCA+ index, sample of countries (ACP Group of States)

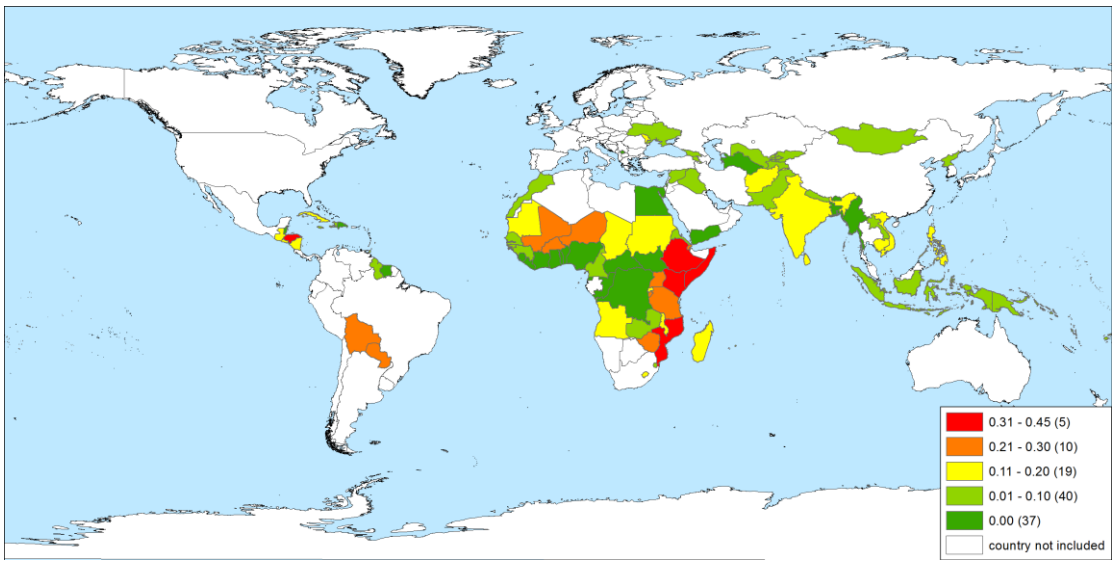
Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (Rank)
Togo	0.78	0.58	0.62	0.66	1
Somalia	0.69	0.51	0.69	0.63	2
Mozambique	0.77	0.56	0.55	0.63	3
Kenya	0.73	0.62	0.45	0.60	4
Ghana	0.76	0.52	0.53	0.60	5
Benin	0.65	0.53	0.61	0.60	6
Guinea-Bissau	0.71	0.52	0.55	0.60	7
Mali	0.66	0.53	0.59	0.59	8
Liberia	0.61	0.57	0.60	0.59	9
Haiti	0.64	0.54	0.59	0.59	10
Côte d'Ivoire	0.66	0.49	0.62	0.59	11
Central African Rep.	0.61	0.55	0.59	0.58	12
Nigeria	0.63	0.58	0.53	0.58	13
Gambia	0.68	0.52	0.54	0.58	14
Burundi	0.58	0.61	0.54	0.58	15
Niger	0.54	0.49	0.69	0.57	16
Eritrea	0.59	0.53	0.59	0.57	17
Rwanda	0.61	0.59	0.50	0.57	18
Madagascar	0.65	0.49	0.56	0.57	19
Zimbabwe	0.62	0.58	0.50	0.57	20
Burkina Faso	0.67	0.45	0.57	0.56	21
Senegal	0.66	0.48	0.54	0.56	22
Ethiopia	0.70	0.46	0.53	0.56	23
Malawi	0.58	0.54	0.56	0.56	24
Comoros	0.60	0.53	0.55	0.56	25
Sierra Leone	0.49	0.50	0.67	0.56	26
Zambia	0.68	0.52	0.46	0.55	27
Uganda	0.53	0.62	0.51	0.55	28
Chad	0.50	0.57	0.59	0.55	29
Congo, Rep.	0.70	0.45	0.50	0.55	30
Guyana	0.80	0.35	0.51	0.55	31
Mauritania	0.61	0.47	0.58	0.55	32
Angola	0.71	0.42	0.52	0.55	33
Cook Islands	0.79	0.37	0.48	0.55	34
Congo, Dem. Rep.	0.46	0.61	0.56	0.54	35
Guinea	0.62	0.39	0.62	0.54	36
Cameroon	0.64	0.48	0.50	0.54	37
Papua New Guinea	0.58	0.46	0.57	0.54	38
Namibia	0.75	0.44	0.41	0.53	39
Belize	0.79	0.41	0.39	0.53	40
Tuvalu	0.80	0.31	0.47	0.53	41
Tanzania	0.49	0.54	0.55	0.52	42
Micronesia, Federated States	0.63	0.41	0.52	0.52	43
Kiribati	0.70	0.34	0.51	0.51	44
Marshall Islands	0.70	0.36	0.48	0.51	45
Antigua and Barbuda	0.82	0.27	0.44	0.51	46
Tonga	0.82	0.31	0.40	0.51	47
Vanuatu	0.67	0.33	0.49	0.50	48

Country	Haz*Exp	Vulnerability	Capacity	GCCA+ score	GCCA+Index (Rank)
Swaziland	**0.58**	**0.40**	**0.50**	0.50	**49**
Djibouti	**0.63**	**0.30**	**0.55**	0.49	**50**
Solomon Islands	**0.54**	**0.42**	**0.51**	0.49	**51**
St. Kitts-Nevis	**0.76**	**0.27**	**0.42**	0.48	**52**
Dominican Republic	**0.73**	**0.32**	**0.39**	0.48	**53**
St. Lucia	**0.64**	**0.31**	**0.49**	0.48	**54**
Grenada	**0.68**	**0.28**	**0.48**	0.48	**55**
Samoa	**0.69**	**0.31**	**0.43**	0.48	**56**
Suriname	**0.81**	**0.28**	**0.34**	0.48	**57**
Palau	**0.74**	**0.23**	**0.45**	0.47	**58**
Sudan	**0.44**	**0.45**	**0.52**	0.47	**59**
South Africa	**0.56**	**0.44**	**0.41**	0.47	**60**
Jamaica	**0.62**	**0.33**	**0.43**	0.46	**61**
Dominica	**0.72**	**0.31**	**0.35**	0.46	**62**
Seychelles	**0.70**	**0.35**	**0.32**	0.46	**63**
Gabon	**0.63**	**0.32**	**0.40**	0.45	**64**
Lesotho	**0.51**	**0.33**	**0.51**	0.45	**65**
Fiji	**0.68**	**0.28**	**0.39**	0.45	**66**
Timor-Leste	**0.51**	**0.35**	**0.48**	0.45	**67**
St. Vincent and Grenadines	**0.69**	**0.27**	**0.38**	0.45	**68**
Cuba	**0.71**	**0.31**	**0.31**	0.44	**69**
Barbados	**0.63**	**0.26**	**0.42**	0.44	**70**
Botswana	**0.48**	**0.38**	**0.45**	0.44	**71**
Cabo Verde	**0.56**	**0.25**	**0.41**	0.40	**72**
Trinidad and Tobago	**0.43**	**0.27**	**0.39**	0.36	**73**
Mauritius	**0.43**	**0.29**	**0.31**	0.34	**74**
Equatorial Guinea	**0.00**	**0.43**	**0.51**	0.31	**75**
Nauru	**0.00**	**0.39**	**0.49**	0.29	**76**
São Tomé and Príncipe	**0.00**	**0.33**	**0.54**	0.29	**77**

ANNEX II Indicators Fact sheets

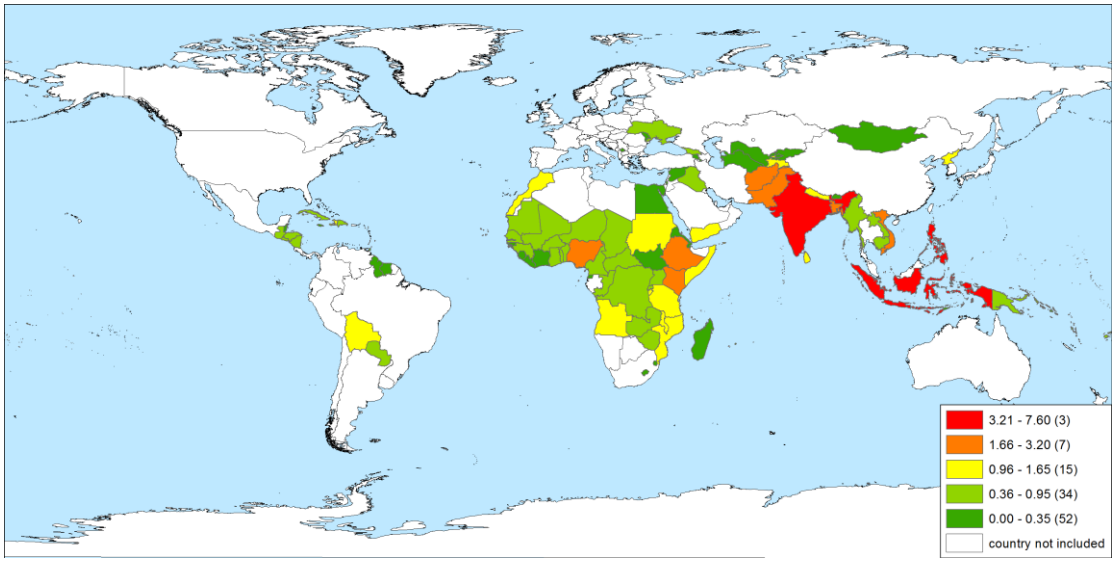
Name	Frequency of Drought Events
Definition	Frequency of drought events is defined as the number of events over the period 1995-2014 (cumulative) divided by this period.
Rationale	Climate-related and weather-driven hazards.
References	Hahn et al., 2009; Costa, 2012, Kellenberg and Mobarak, 2008.
Creation method	Number of drought events over the period 1995-2014 (cumulative) divided by 20 (the number of years). Reference period 1995-2014.
Measurement unit	Percentage (%).
Missing data	Two countries, Kosovo and Nauru, do not exist in EM-DAT country list. As on-line research shows no events in these countries for the same period, we used the value 0.00001 in order to be able to perform the aggregation.
Data Provider	CRED / EM-DAT.
URL	http://www.emdat.be/database.

Map ANNEX II 6 — Frequency of droughts events (%)



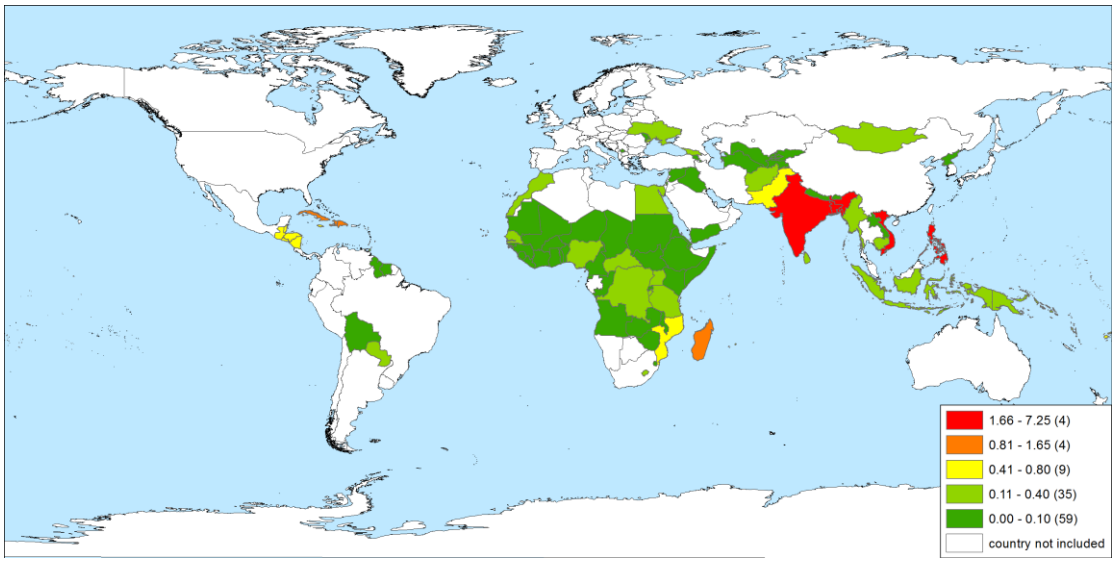
	Frequency of Flood Events
Definition	Frequency of flood events is defined as the number of events over the period 1995-2014 (cumulative) divided by this period.
Rationale	Climate-related and weather-driven hazards.
References	Hahn et al., 2009; Costa, 2012, Kellenberg and Mobarak, 2008.
Creation method	Number of flood events over the period 1995-2014 (cumulative) divided by 20 (the number of years). Reference period 1995-2014.
Measurement unit	Percentage (%).
Missing data	Two countries, Kosovo and Nauru, do not exist in EM-DAT country list. As on-line research shows no events in these countries for the same period, we used the value 0.00001 in order to be able to perform the aggregation.
Data Provider	CRED / EM-DAT.
URL	http://www.emdat.be/database.

Map ANNEX II 7 — Frequency of Flood Events (%)



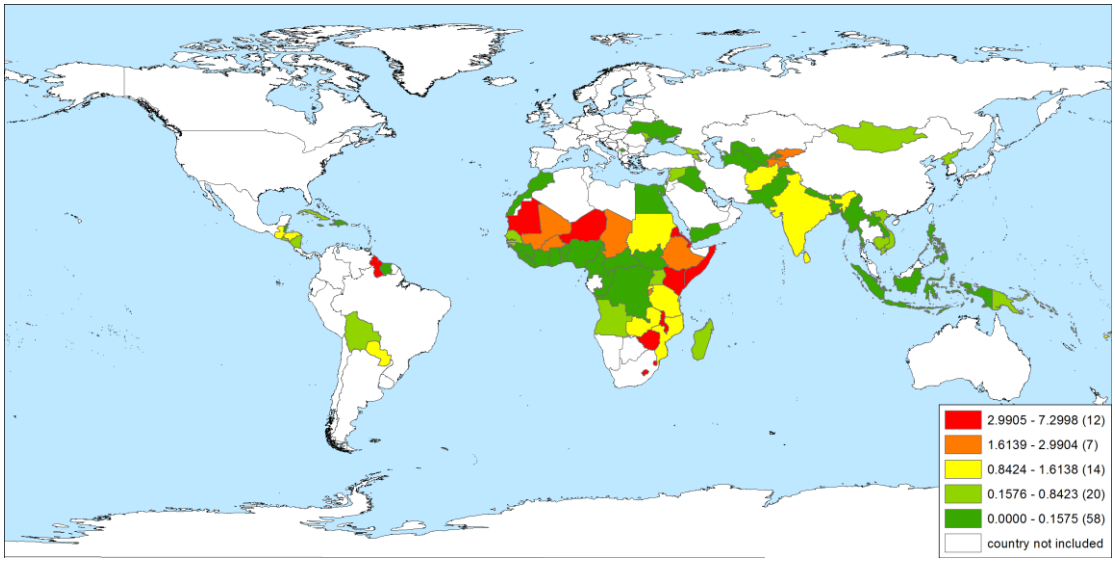
	Frequency of Storm Events
Definition	Frequency of storm events is defined as the number of events over the period 1995-2014 (cumulative) divided by this period.
Rationale	Climate-related and weather-driven hazards.
References	Hahn et al., 2009; Costa, 2012, Kellenberg and Mobarak, 2008.
Creation method	Number of storm events over the period 1995-2014 (cumulative) divided by 20 (the number of years). Reference period 1995-2014.
Measurement unit	Percentage (%).
Missing data	Two countries, Kosovo and Nauru, do not exist in EM-DAT country list. As on-line research shows no events in these countries for the same period,, we used the value 0.00001 in order to be able to perform the aggregation.
Data Provider	CRED / EM-DAT.
URL	http://www.emdat.be/database.

Map ANNEX II 8 — Frequency of Storm Events (%)



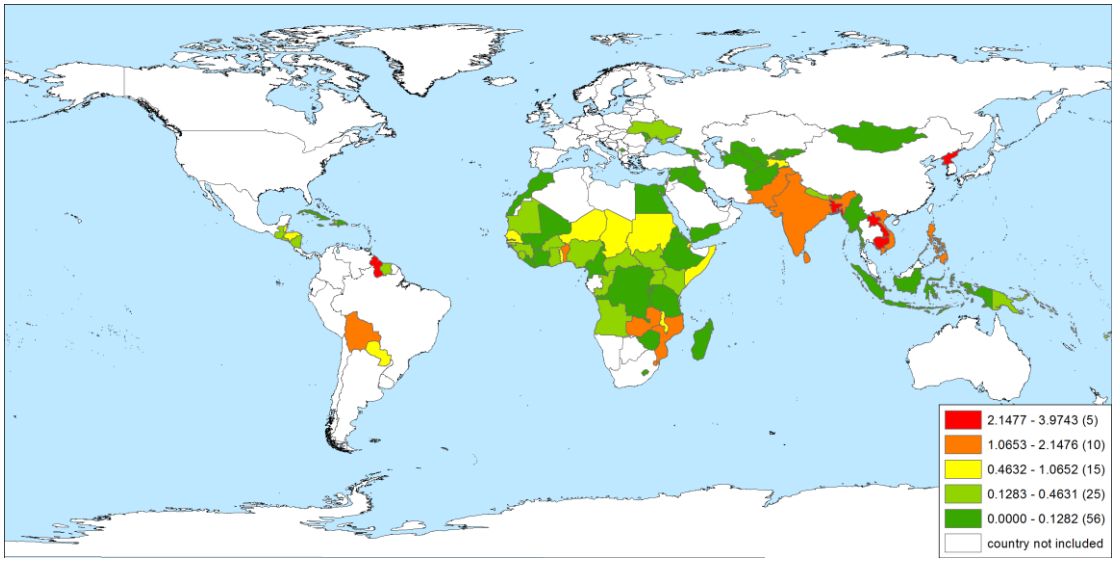
	People exposed to drought events
Definition	Relative number of people affected yearly by droughts.
Rationale	The knowledge of the population exposed is fundamental to raising awareness and developing protection measures (e.g. identification of suitable shelters) and evacuation strategies (e.g. development of evacuation routes).
References	Target 1.5 and Target 11.5 of the SDGs
Creation method	The total number of people affected by drought over the period 1995-2014 (cumulative) was divided by 20 (the number of years) and then by each country's population in order to achieve the relative annual average.
Measurement unit	Percentage (%).
Missing data	Two countries, Kosovo and Nauru, do not exist in EM-DAT country list. As on-line research shows no events in these countries for the same period, we used the value 0.00001 in order to be able to perform the aggregation.
Data Provider	CRED / EM-DAT.
URL	http://www.emdat.be/database.

Map ANNEX II 9 — People exposed to drought events (%)



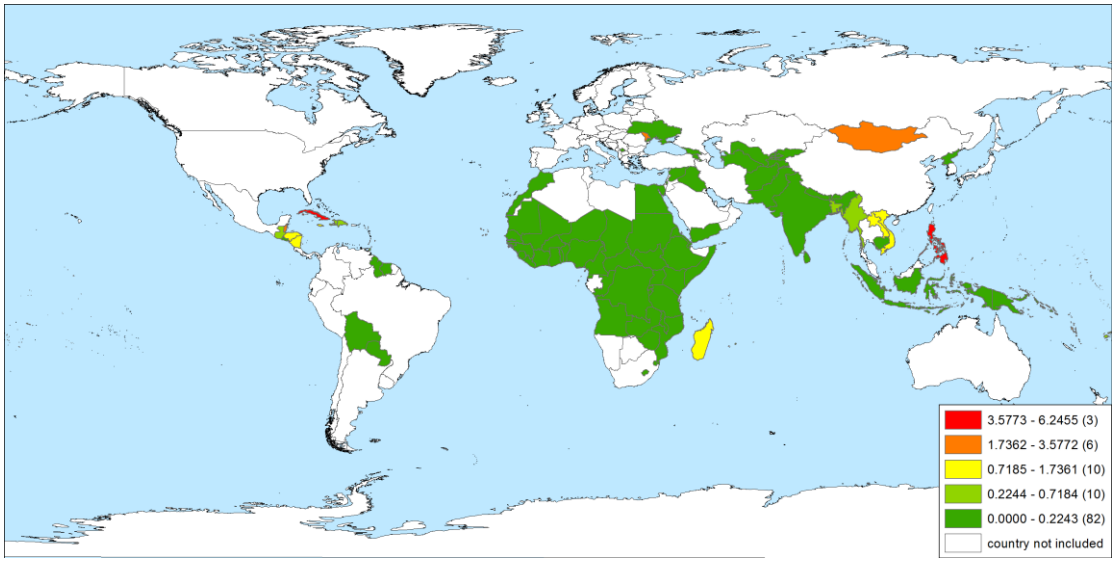
	People exposed to flood events
Definition	Relative number of people affected yearly by floods.
Rationale	The knowledge of the population exposed is fundamental to raising awareness and developing protection measures (e.g. identification of suitable shelters) and evacuation strategies (e.g. development of evacuation routes).
References	Target 1.5 and Target 11.5 of the SDGs
Creation method	The total number of people affected by floods over the period 1995-2014 (cumulative) was divided by 20 (the number of years) and then by each country's population in order to achieve the relative annual average.
Measurement unit	Percentage (%).
Missing data	Two countries, Kosovo and Nauru, do not exist in EM-DAT country list. As on-line research shows no events in these countries for the same period, we used the value 0.00001 in order to be able to perform the aggregation.
Data Provider	CRED / EM-DAT.
URL	http://www.emdat.be/database.

Map ANNEX II 10 — People exposed to flood events (%)



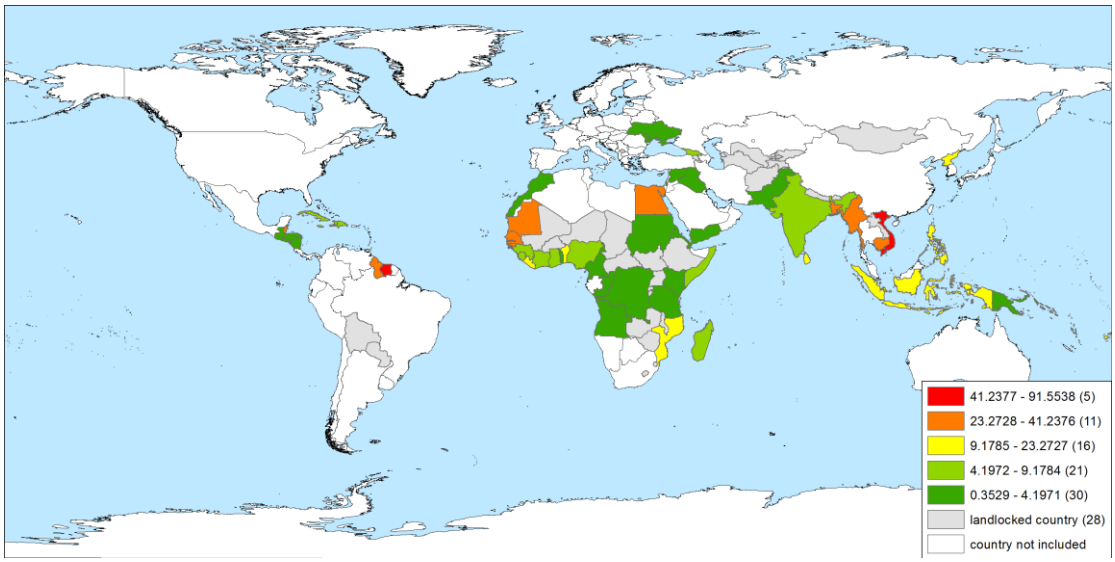
	People exposed to storm events
Definition	Relative number of people affected yearly by storms.
Rationale	The knowledge of the population exposed is fundamental to raising awareness and developing protection measures (e.g. identification of suitable shelters) and evacuation strategies (e.g. development of evacuation routes).
References	Target 1.5 and Target 11.5 of the SDGs
Creation method	The total number of people affected by storms over the period 1995-2014 (cumulative) was divided by 20 (the number of years) and then by each country's population in order to achieve the relative annual average.
Measurement unit	Percentage (%).
Missing data	Two countries, Kosovo and Nauru, do not exist in EM-DAT country list. As on-line research shows no events in these countries for the same period, we used the value 0.00001 in order to be able to perform the aggregation.
Data Provider	CRED / EM-DAT.
URL	http://www.emdat.be/database.

Map ANNEX II 11 — People exposed to storm events (%)



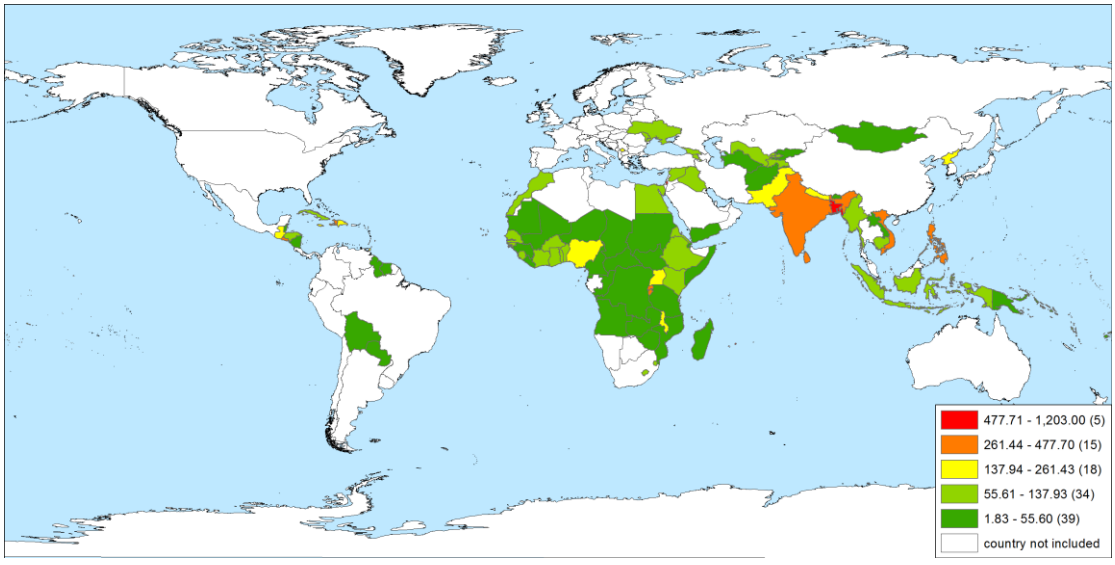
	Proportion of population in Low-Elevation Coastal Zone (LECZ)
Definition	Percentage of total population living in LECZs. LECZ is defined as the contiguous area along the coast that is less than 10 metres above sea level.
Rationale	Proxy to indicate how many people are sensitive to risks arising from sea-level rise and storm surges.
References	Füssel, 2010; Sub-indicator of sensitivity in ND-GAIN Index, 2014.
Creation method	Elevation data used to generate the LECZs come from the SRTM3 Enhanced Global Map developed by ISCIENCES. The ISCIENCES digital elevation model was created using NASA's Jet Propulsion Laboratory Shuttle Radar Topography Mission data processed to three arc-seconds (SRTM3). Population counts in low-elevation coastal zones in the year 2010 derived from the application of United Nations 2000-2010 national growth rates to year 2000 population data from GRUMPv1 and the percentage of total country population year 2010 was calculated (CIESIN/Columbia University). Reference year used: 2010.
Measurement unit	Percentage (%).
Missing data	No missing values.
Data Provider	SEDAC-CIESIN/Columbia University.
URL	http://sedac.ciesin.columbia.edu/data/set/lecz-urban-rural-population-land-area-estimates-v2.

Map ANNEX II 12 — Proportion of Population in LECZ (%)



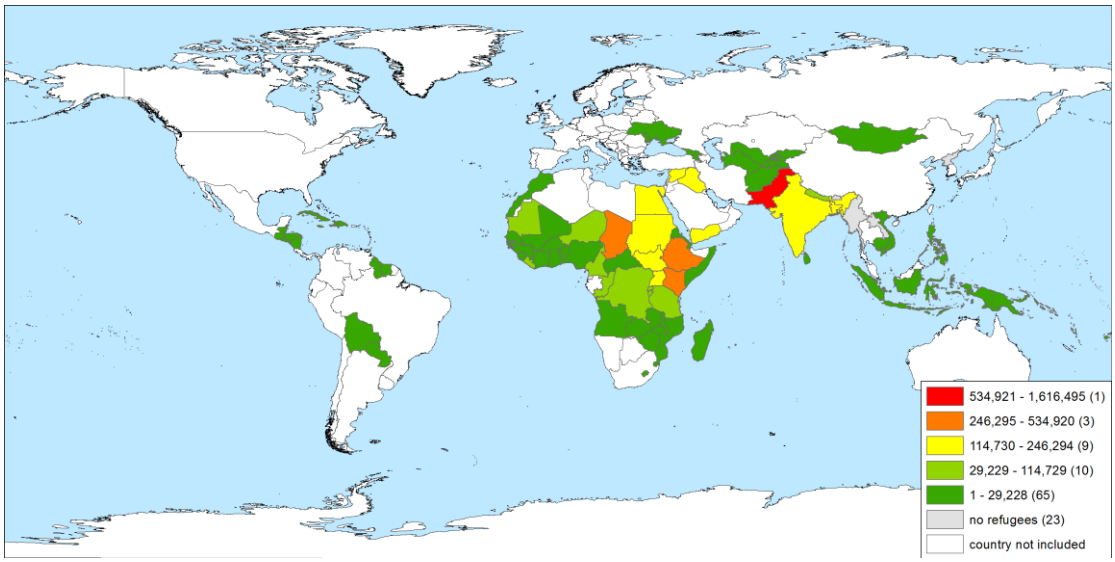
	Population density
Definition	Population density is the number of people per square kilometres of land area.
Rationale	Greater numbers of people increase pressure on the environment for resources. Relative flood mortality is higher in less populated than in densely populated countries.
References	Birkmann, 2006; de Oliveira Mendes, 2009, Khan, 2005, Brooks et al., 2005.
Creation method	'Population density is midyear population divided by land area in square kilometres. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship — except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin. Land area is a country's total area, excluding area under inland water bodies, national claims to continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes'. (World Data Bank)
Measurement unit	Number of people per square kilometre of land area.
Missing data	Initially three: Missing values for Cook Islands and Nauru were filled by the values found in the corresponding UN Country profile pages (https://data.un.org/CountryProfile.aspx?crName=Nauru). For South Sudan, the value was found in the webpage of UN, Department of Economic and Social Affairs (http://esa.un.org/unpd/wpp/Excel-Data/population.htm). Remaining 0.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/EN.POP.DNST.

Map ANNEX II 13 — Population Density (Number of people per sq. km of land area)



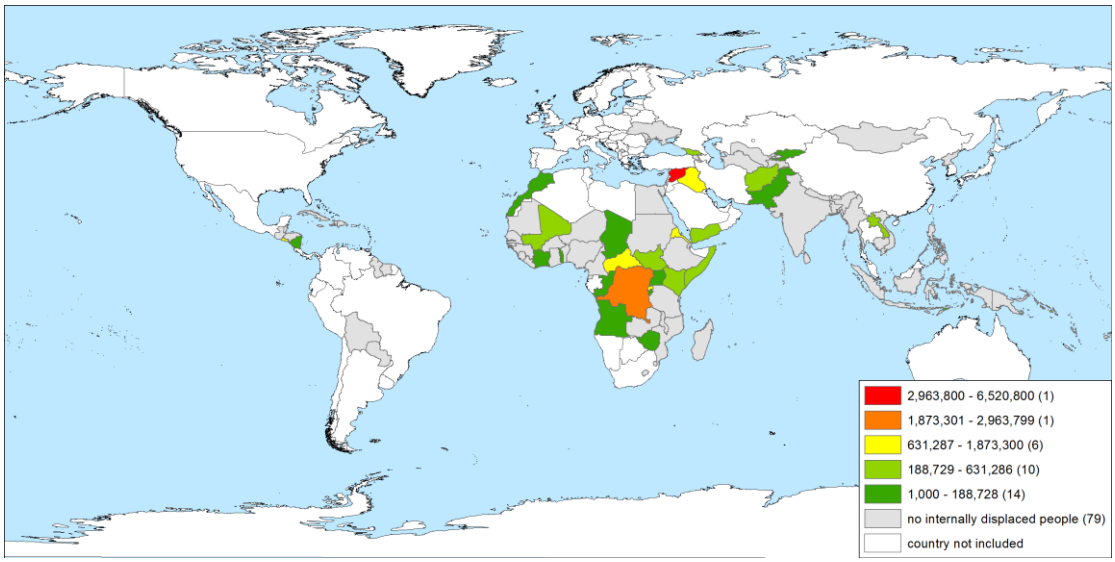
	Refugees
Definition	Number of refugees per place of residence.
Rationale	Refugees are normally a particularly at-risk group and are more likely to live in vulnerable conditions in hazard-prone areas, with less access to basic services than low-income households in general.
References	
Creation method	Refugees include individuals recognised under the 1951 Convention relating to the Status of Refugees; its 1967 Protocol; the 1969 OAU Convention Governing the Specific Aspects of Refugee Problems in Africa; those recognised under the UNHCR Statute; individuals granted complementary forms of protection; or those enjoying temporary protection. The refugee population also includes people in a refugee-like situation (UNHCR, 2013).
Measurement unit	Total number of people.
Missing data	No missing values. According the UNHCR, 'The UNHCR mandate covers all refugees'. The data extracted from their webpage concern only the countries where refugees are residing so we could say that in all other countries there are no refugees residing.
Data Provider	UNHCR Population Statistics Database.
URL	http://popstats.unhcr.org/PSQ_TMS.aspx.

Map ANNEX II 14 — Refugees (number of refugees)



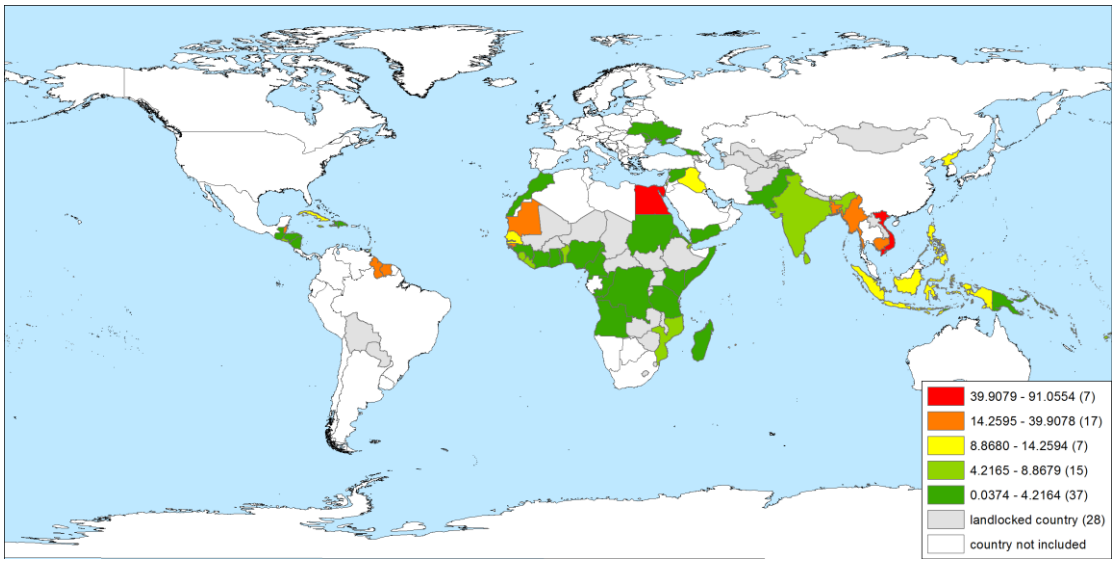
	Internally displaced people
Definition	Number of internally displaced people.
Rationale	Displaced people are normally a particularly at-risk group and are more likely to live in vulnerable conditions in hazard-prone areas, with less access to basic services than low-income households in general.
References	Post 2015 HFA (UNISDR, 2014).
Creation method	Internal refugees (1 000s) scale by population. The data are generally provided by Governments, based on their own definitions and methods of data collection. (UNHCR, Reference year used: 2013 and last available year.)
Measurement unit	Total number of people.
Missing data	No missing values. According the UNHCR 'The UNHCR mandate covers all refugees'. The data extracted from their webpage concern only the countries where refugees are residing so we could say that in all other countries there are no refugees residing.
Data Provider	UNHCR Population Statistics Database.
URL	http://popstats.unhcr.org/PSQ_TMS.aspx.

Map ANNEX II 15 — Internally displaced people (number of people)



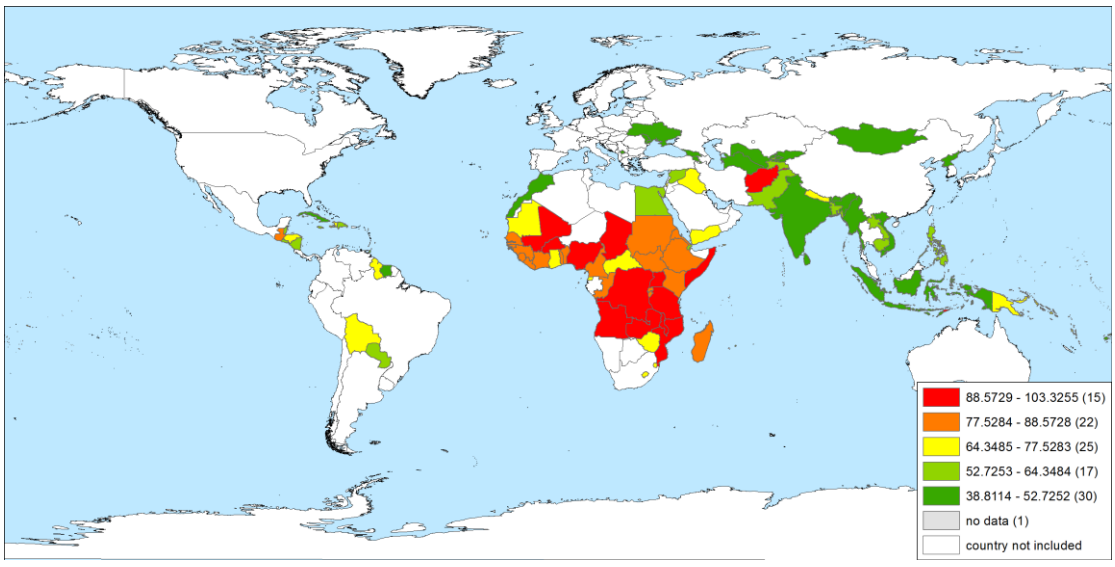
	Rural population in LECZ
Definition	The share of the rural LECZ population over the total rural population.
Rationale	High dependence on exploiting marine and coastal resources: collection of products from local forests, such as mangroves, and small- scale fishing.
References	Babier, 2015.
Creation method	The share of the rural LECZ population as part of the total rural population was calculated by dividing the number of people in rural LECZ and the total number of people in rural areas of the country. Elevation data used to generate the low-elevation coastal zones came from the SRTM3 Enhanced Global Map developed by ISCIENCES. The ISCIENCES digital elevation model was created using NASA's Jet Propulsion Laboratory Shuttle Radar Topography Mission data processed to three arc-seconds (SRTM3). Population counts in low-elevation zones in the year 2010 derived from the application of United Nations 2000-2010 national growth rates to year 2000 population data from GRUMPv1 and the percentage of the country's total population year 2010 was calculated. (CIESIN/Columbia University) Reference year used: 2010.
Measurement unit	Percentage (%).
Missing data	No missing values.
Data Provider	SEDAC-CIESIN/Columbia University.
URL	http://sedac.ciesin.columbia.edu/data/set/lecz-urban-rural-population-land-area-estimates-v2.

Map ANNEX II 16 — Rural population in LECZ (%)



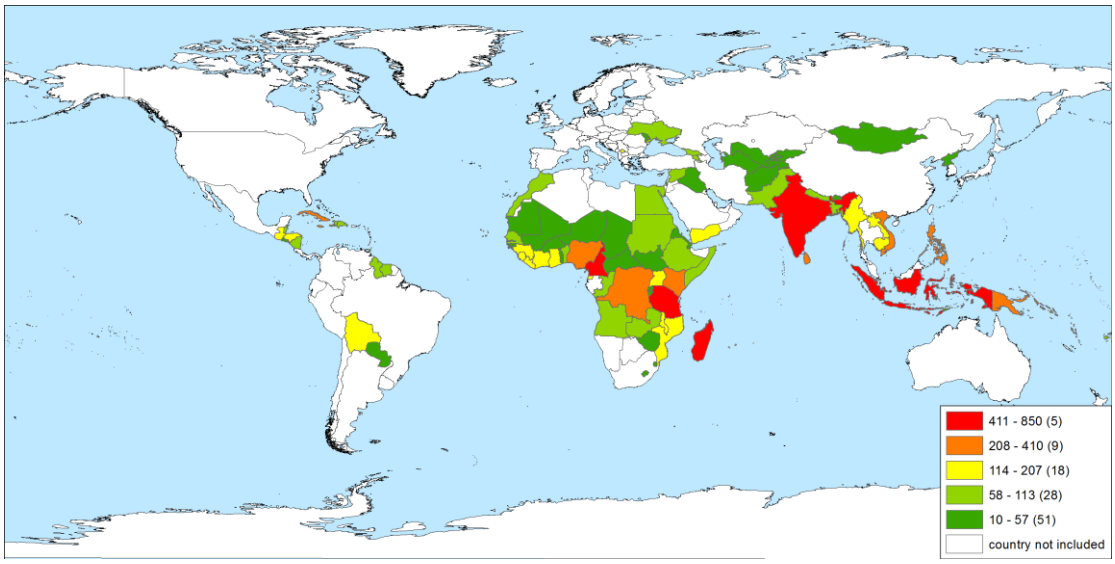
	Age-dependency ratio
Definition	Percentage of working-age population. Ratio of the population <15 and >65 years of age to the population between 19 and 65 years of age.
Rationale	The direct effects of extreme weather may disproportionately affect the old and the young. A high age-dependency ratio means a high proportion of children and elderly people compared to the working-age population. This lowers resilience, particularly in the case of death or injury of a working-age adult.
References	Susceptibility in World Risk Index; Resilience in post 2015 HFA; Sensitivity in ND-GAIN.
Creation method	World Bank staff estimates from various sources including census reports, the United Nations Population Division's World Population Prospects, national statistical offices, household surveys conducted by national agencies, and ICF International. (World Bank, Reference year used: 2013.)
Measurement unit	Percentage (%).
Missing data	Initially 7: Missing values for Cook Islands, Dominica, Marshall Islands, Nauru, Palau and Tuvalu were filled by our estimates based on the values found in the corresponding UN country profile pages (https://data.un.org/CountryProfile.aspx?crName=Nauru). We created a proxy, using the total population, the population aged 0-14 years (%), and the population aged 60+ years and the sex ratio (as population was provided by gender). Data not found for St. Kitts-Nevis, thus one remaining missing.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/SP.POP.DPND.

Map ANNEX II 17 — Age-dependency ratio (%)



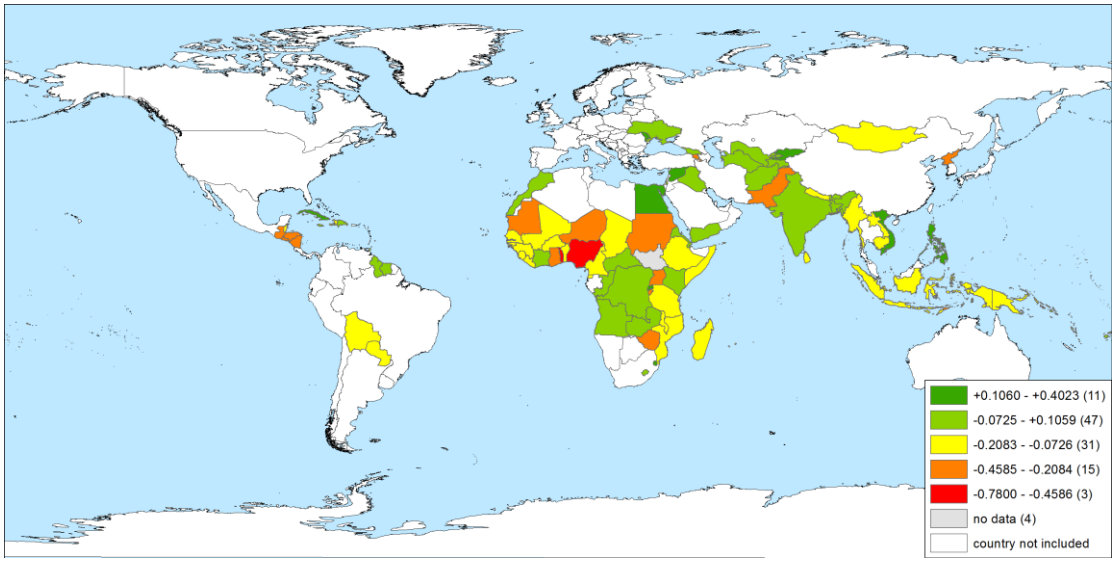
Name	Threatened species
Definition	Species assessed as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) are referred to as 'threatened' species. They consist of birds, fish, mammals and plants.
Rationale	Number of species that may be exposed to extreme events.
References	Target 14.4 and Target 15.5 of the SDGs
Creation method	Calculated as the sum of threatened of birds, fish, mammals and plants. The International Union for Conservation of Nature (IUCN) Red List of Threatened Species collects and disseminates information on globally threated species. The proportion of threatened species is only reported for the more completely evaluated groups (i.e. >90 % of species evaluated). Also, the reported percentage of threatened species for each group is presented as a best estimate within a range of possible values bounded by lower and upper estimates: Lower estimate = % threatened extant species if all Data Deficient species are not threatened, i.e. (CR + EN + VU) / (total assessed — EX); Best estimate = % threatened extant species if Data Deficient species are equally threatened as data sufficient species, i.e. (CR + EN + VU) / (total assessed — EX — DD); Upper estimate = % threatened extant species if all Data Deficient species are threatened, i.e. (CR + EN + VU + DD) / (total assessed — EX). (World Bank, Reference year used: 2013.)
Measurement unit	Total number of species.
Missing data	Initially 3: Missing values for Cook Islands, Nauru were filled by the values found in the corresponding UN Country profile pages (https://data.un.org/Coun-tryProfile.aspx?crName=Nauru). For Kosovo we used the value found in the Country briefing of the EEA (http://www.eea.europa.eu/soer-2015/countries/kosovo).
Data Provider	World Data Bank.
URL	http://wdi.worldbank.org/table/3.4.

Map ANNEX II 18 — Threatened Species (total number of species)



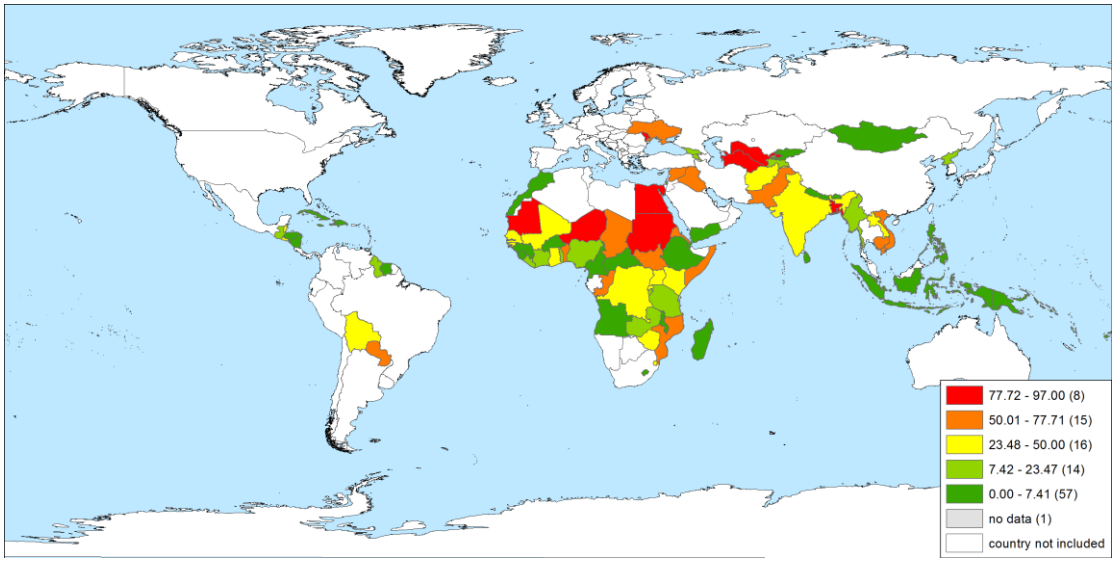
	Forest change
Definition	The change in the percentage of total forest area over the period of 1995-2012.
Rationale	Reduction in the extent of forest cover has significant negative implications for ecosystem services and habitat protection. Forests are carbon sinks that help combat global climate change and regulate the hydrological system.
References	Sub-indicator of the World Risk Index 2014; post 2015 HFA (UNISDR, 2014) and Environmental Vulnerability Index.
Creation method	Change of forest area: (initial value — final value) divided by initial value. Forest area is land under natural or planted stands of trees of at least five metres *in situ*, whether productive or not, and excludes tree stands in agricultural production systems (for example, in fruit plantations and agroforestry systems) and trees in urban parks and gardens. (FAO) Reference period used: 1995-2012.
Measurement unit	Percentage (%).
Missing data	4 missing values.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/AG.LND.FRST.ZS.

Map ANNEX II 19 — Forest Change (%)



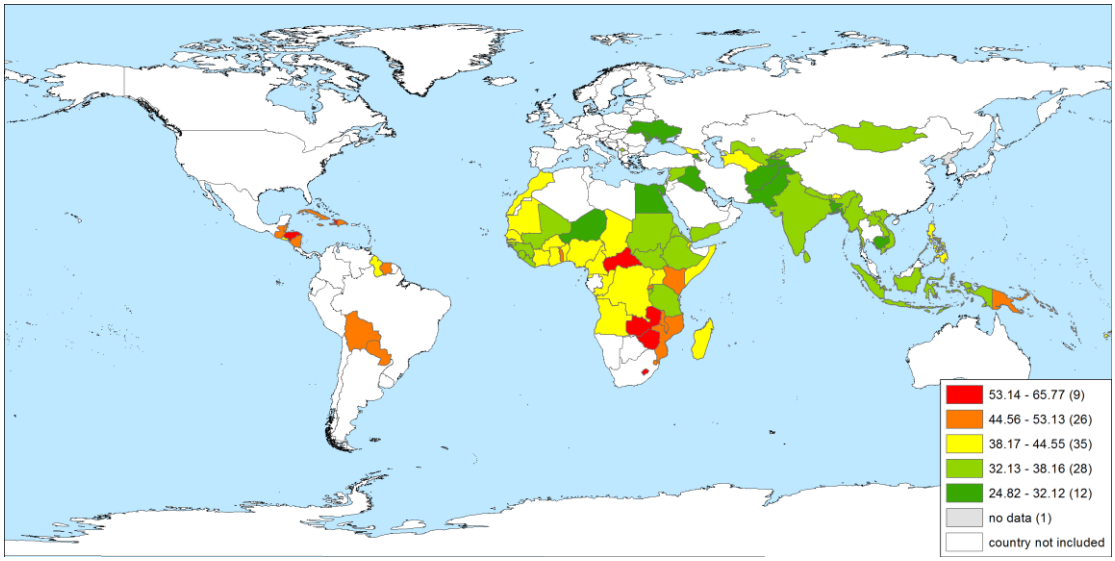
	Water dependency ratio
Definition	Indicator expressing the percentage of total renewable water resources originating outside the country.
Rationale	High dependency on foreign water resources exacerbates water insecurity due to climate change.
References	Sub-indicator of the ND-GAIN Index, 2014.
Creation method	[Dependency ratio] = 100*([Surface water: accounted inflow&lang=en">Surface water: accounted inflow]+[Groundwater: accounted inflow&lang=en">Groundwater: accounted inflow])/([Surface water: accounted inflow&lang=en">Surface water: accounted inflow]+[Groundwater: accounted inflow&lang=en">Groundwater: accounted inflow]+[Total internal renewable water resources (IRWR)]). (FAO AQUASTAT, Reference period used: 2013-2017).
Measurement unit	Percentage (%).
Missing data	One missing value.
Data Provider	Food and Agriculture Organization of the United Nations (FAO), AQUASTAT database.
URL	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en .

Map ANNEX II 20 — Water Dependency Ratio (%)



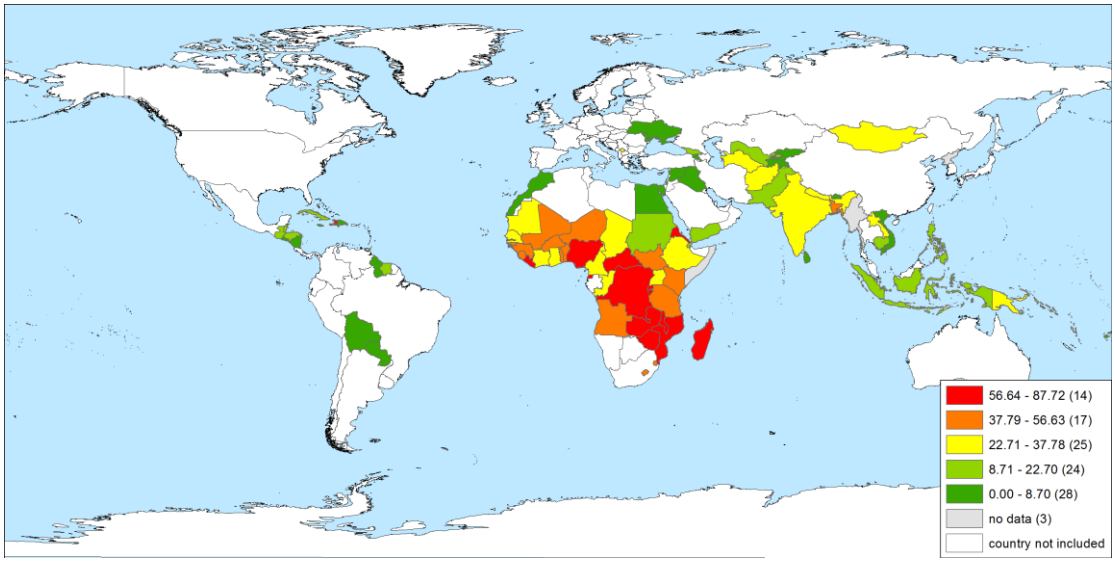
	Gini Index
Definition	The Gini index gives an estimate of inequality as it measures the extent to which the actual income distribution differs from an equitable distribution.
Rationale	Resilience is likely to be lower in countries with a high degree of income inequality.
References	Hallegatte, 2014, Anbarci et al., 2005 and Kahn, 2005, Brooks et al., 2005; Sub-indicator of the World Risk Index, 2014; post 2015 HFA (UNISDR, 2014); Target 10.1 of the SDGs
Creation method	A Lorenz curve plots the cumulative percentages of total income received against the cumulative number of recipients, starting with the poorest individual or household. The Gini index measures the area between the Lorenz curve and a hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. Thus a Gini index of zero represents perfect equality, while an index of 100 implies perfect inequality. (World Bank data, Reference year used: 2013 and last available year.)
Measurement unit	Index (0-100).
Missing data	Initially 28: for Trinidad and Tobago, and Zimbabwe, we used the values found in FAO, Statistical Yearbook 2007-2008, Table F.5. As too much data were missing, we imputed them by using the mean of some countries of the same geographical area and income group. That was done mostly for SIDs (small islands developing countries). Remaining missing 1. See notes for the details.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/SI.POV.GINI.

Map ANNEX II 21 — Gini Index (Index (0-100))



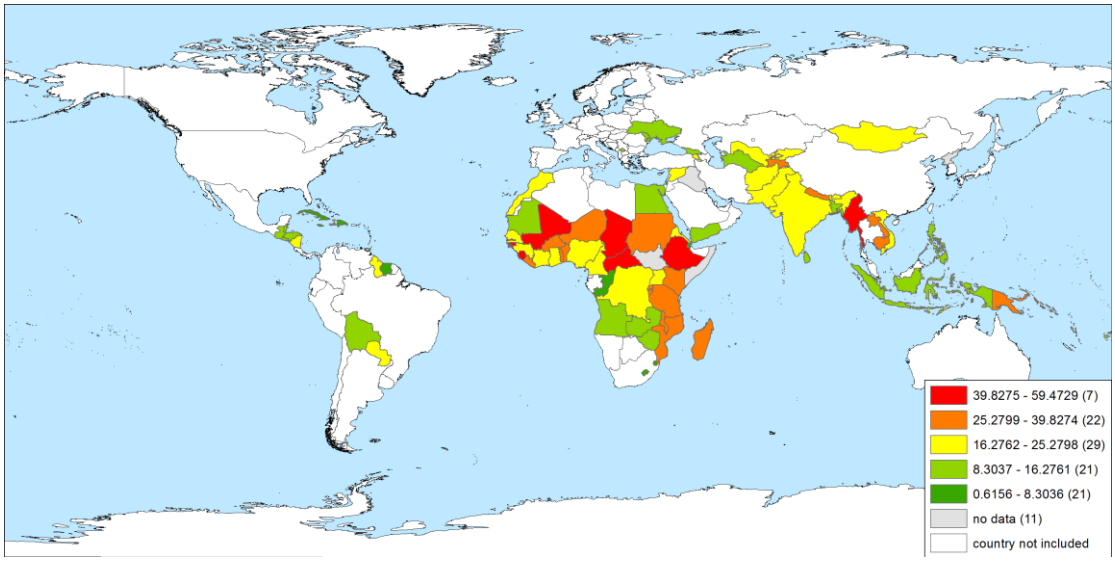
	Extreme poverty
Definition	Poverty headcount ratio at $1.25 a day (PPP) (% of population).
Rationale	Poor people are more susceptible to the impacts of natural hazards, as they tend to live in hazard-prone areas (e.g. in unsafe buildings, on floodplains, etc.) and continuously have to cope with various shocks related to hazards, in dire conditions with limited assets. The more diversified the energy sources, the less likelihood of power interruption if a given source is affected by disaster.
References	Bjarnadottir et al., 2011, Sub-indicator of Susceptibility in the World Risk Index 2014 and MDGs (UN 2005); Target 1.1 of the SDGs
Creation method	Population below $1.25 a day is the percentage of the population living on less than $1.25 a day at 2005 international prices. As a result of revisions in PPP exchange rates, poverty rates for individual countries cannot be compared with poverty rates reported in earlier editions. (World Data Bank) Reference year used: 2013 and last available year.
Measurement unit	Percentage (%).
Missing data	Initially 28: As too many data were missing we used as a proxy the Poverty headcount ratio at national poverty lines (% of population): http://databank.worldbank.org/data/views/reports/tableview.aspx. In that way data was calculated for Afghanistan, Eritrea, Equatorial Guinea, Kosovo, Mongolia, Solomon Islands, South Sudan, Uzbekistan and Zimbabwe. Data for Trinidad and Tobago was found in UNDP Country Info page (UNDP http://www.tt.undp.org/content/trinidad_tobago/en/home/countryinfo/) . For the rest, the same methodology as in Gini was applied: we imputed by using the mean of some countries of the same geographical area and income group. Remaining missing 3.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/SI.POV.DDAY.

Map ANNEX II 22 — Extreme poverty (%)



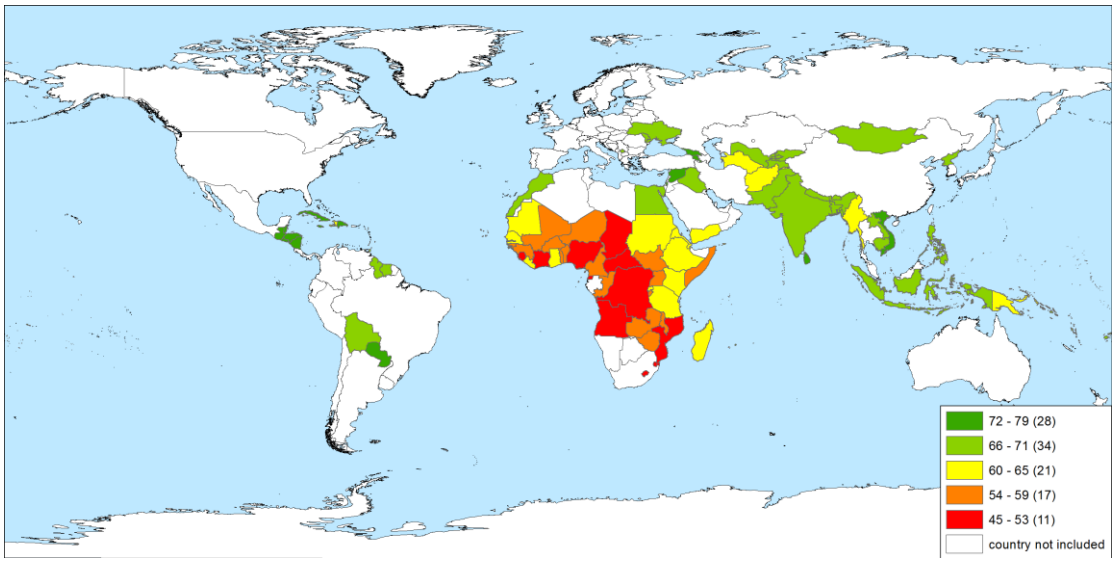
	Agriculture — % of GDP
Definition	Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs.
Rationale	Agriculture is considered a climate sensitive sector.
References	IPCC, 2014.
Creation method	It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. The origin of value added is determined by the ISIC, revision 3. NB: for VAB countries, gross value added at factor cost is used as the denominator (World Bank data, Reference year used: 2013 and last available year).
Measurement unit	Percentage (%).
Missing data	11 missing data.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/NV.AGR.TOTL.ZS.

Map ANNEX II 23 — Agriculture, % of GDP



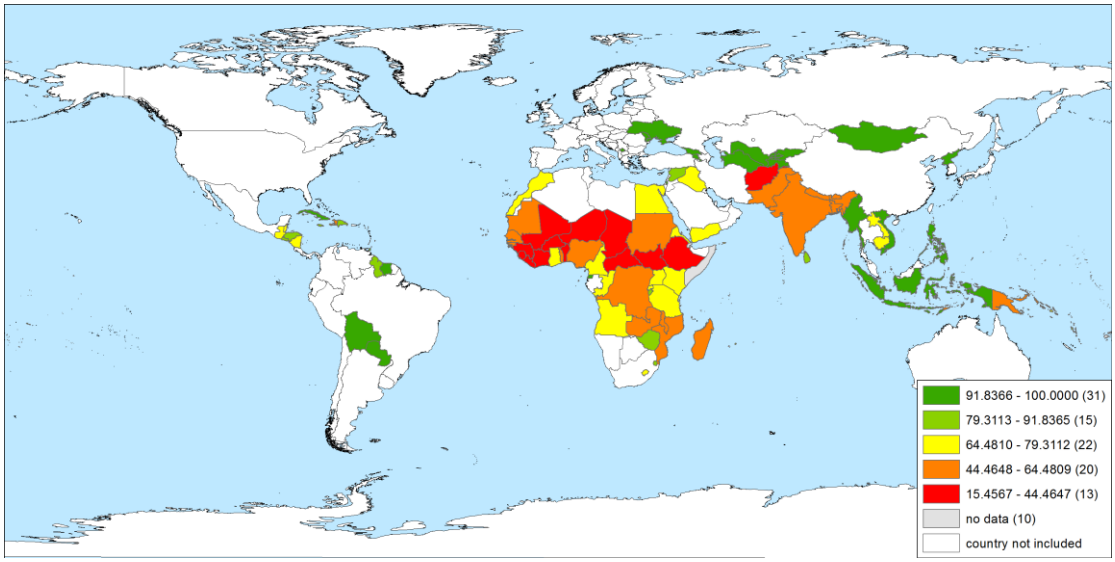
	Life expectancy at birth
Definition	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life (World Data Bank).
Rationale	This indicator also reveals the general health standards of a country..
References	Briguglio et al., 2008, Brooks et al., 2005, Sub-indicator of HDI and World Risk Index 2014 and post 2015 HFA (UNISDR, 2014).
Creation method	Years of individual life expectancy (Procedure: 0.25*Log (log (85/Years of individual life expectancy)). Reference year used: 2012.
Measurement unit	Total number of years.
Missing data	Initially three missing data. Values for Cook Islands, Nauru and Tuvalu were found in UNData, in the database originated from WHO (http://data.un.org/Data.aspx?d=WHO&f=MEASURE_CODE %3aWHS9_85). 0 remaining.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/SP.DYN.LE00.IN.

Map ANNEX II 24 — Life expectancy at birth (total number of years)



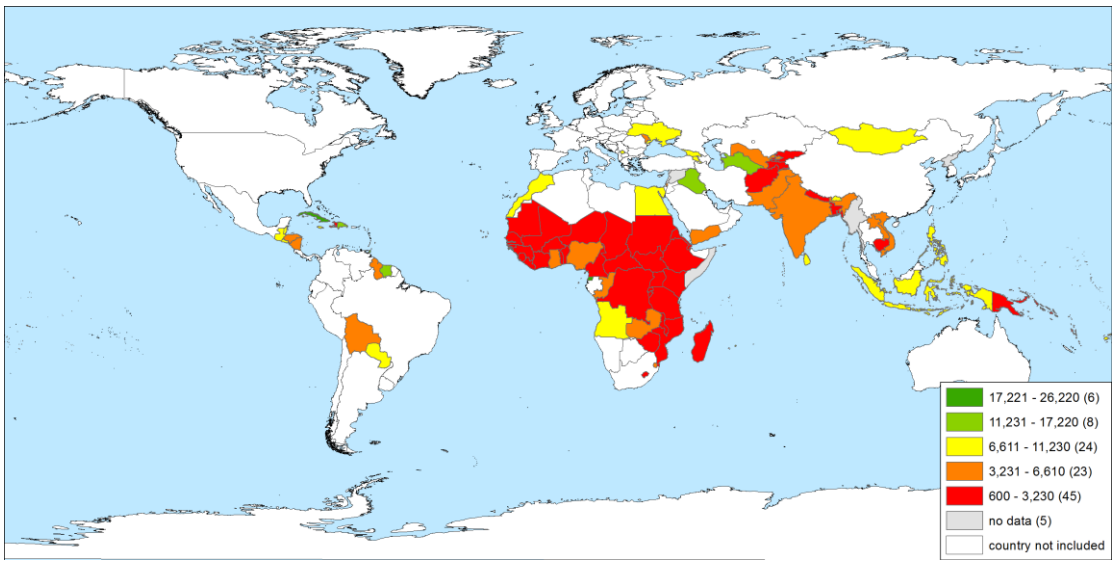
	Literacy rate
Definition	Percentage of people aged 15 and above who can read and write a short simple statement on their everyday life.
Rationale	Literacy could be an essential indicator, when empowering people in hazard risk reduction.
References	Brooks et al., 2005; Sub-indicator of adaptive capacity in the World Risk Index 2014; MDG 2.3 (UN 2005); post 2015 HFA; Target 4.6 of the SDGs
Creation method	Adult (15+) literacy rate (%). Total is the percentage of the population aged 15 and above who can, with understanding, read and write a short, simple statement on their everyday life. Generally, 'literacy' also encompasses 'numeracy', the ability to make simple arithmetic calculations. This indicator is calculated by dividing the number of literates aged 15 and above by the corresponding age group population and multiplying the result by 100. Reference year used: 2013 and last available year.
Measurement unit	Percentage (%).
Missing data	Initially 18 missing data. Values for Cook Islands, Fiji, Micronesia, Kiribati, Marshall Islands, Nauru and Tuvalu were found in WHO (http://www.wpro.who.int/health_services/service_delivery_profile_kiribati.pdf). Serbia's data were used for Kosovo and South Sudan from CIA (https://www.cia.gov/library/publications/the-world-factbook/fields/2103.html). Eight remaining.
Data Provider	World Data Bank/ UNDP.
URL	http://hdr.undp.org/en/content/adult-literacy-rate-both-sexes-ages-15-and-older and http://data.worldbank.org/indicator/SE.ADT.LITR.ZS.

Map ANNEX II 25 — Literacy rate (%)



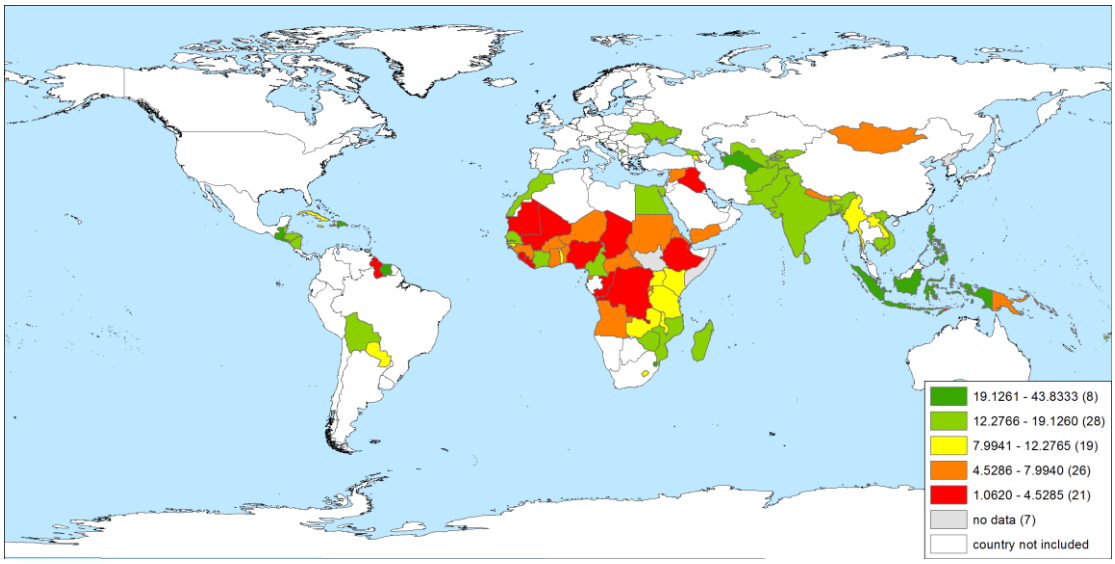
	Gross National Income (GNI)
Definition	The total value of all final goods and services produced within a nation in a particular year, plus income earned by its citizens (including income of those located abroad).
Rationale	Resilience is likely to be higher in countries with high income.
References	Adger, 2000, Cutter et al., 2003, Dwyer et al., 2004, Brooks et al., 2005, Polsky et al., 2007, Ojerio et al., 2011, Khan et al., 2011, Sub-indicator of HDI.
Creation method	GNI per capita (2005 PPP International USD, using natural logarithm) expressed as an index using a minimum value of USD 100 and maximum value USD 60,000. (UNDP, Reference year used: 2013.)
Measurement unit	Index (min value of USD 100 max value USD 60,000).
Missing data	Initially six missing data. Value for Cook Islands was found in the UN Country profile web page. (http://data.un.org/CountryProfile.aspx?crName=Cook %20Islands). Five remaining.
Data Provider	UN Statistics.
URL	http://data.un.org/Data.aspx?d=WDI&f=Indicator_Code %3aNY.GNP.PCAP.PP.CD.

Map ANNEX II 26 — Gross National Income (GNI)



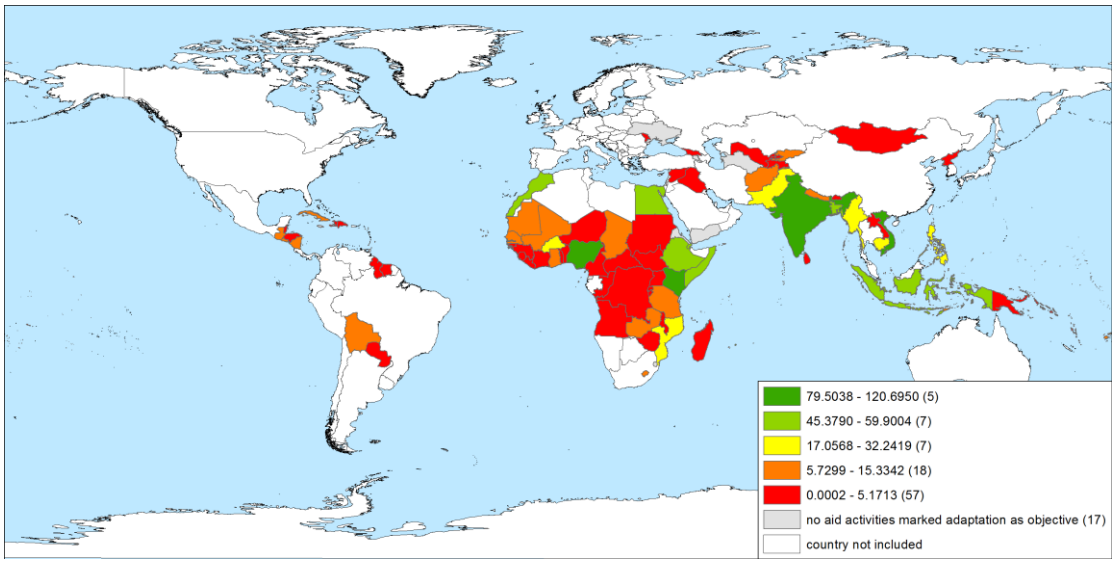
	Manufacturing, value added (% of GDP)
Definition	Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. (World Data Bank)
Rationale	Sector less climate sensitive.
References	IPCCC, 2014, Hallegate, 2014; Target 9.2 of the new SDGs
Creation method	Manufacturing refers to industries belonging to ISIC divisions 15-37. Value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs. (World Bank data, Reference year used: 2012 and last year available.)
Measurement unit	Percentage (%).
Missing data	Initially Seven missing data. Value for Cook Islands was found in the UN Country profile webpage. (http://data.un.org/CountryProfile.aspx?crName=Cook %20Islands). Six remaining.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/NV.IND.MANF.ZS.

Map ANNEX II 27 — Manufacturing, value added (% of GDP)



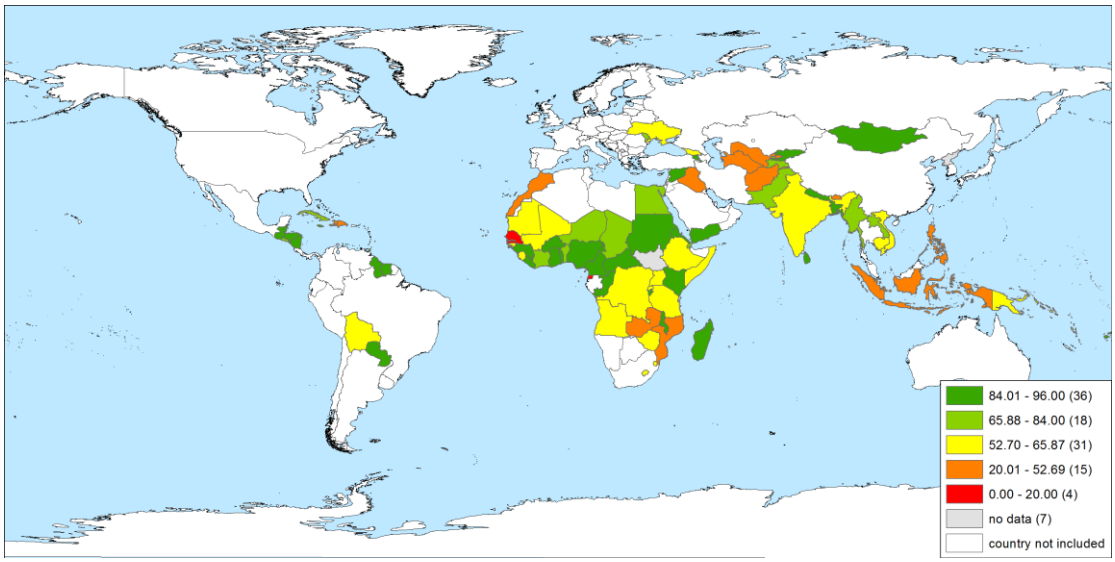
	ODA/DAC-Adaptation Total Costs
Definition	Overall DAC with aid activities marked adaptation as principal objective (Commitment in 2013).
Rationale	Financial support of OECD Countries for the activity classified as adaptation-related (score principal) if it intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience.
References	
Creation method	Total money in US dollars for adaptation as Principal objective. Reference year used: 2013.
Measurement unit	USD current prices (million).
Missing data	0 missing data.
Data Provider	OECD.
URL	http://www.oecd.org/dac/stats/.

Map ANNEX II 28 — IODA/DAC-Adaptation Total Costs (USD Million)



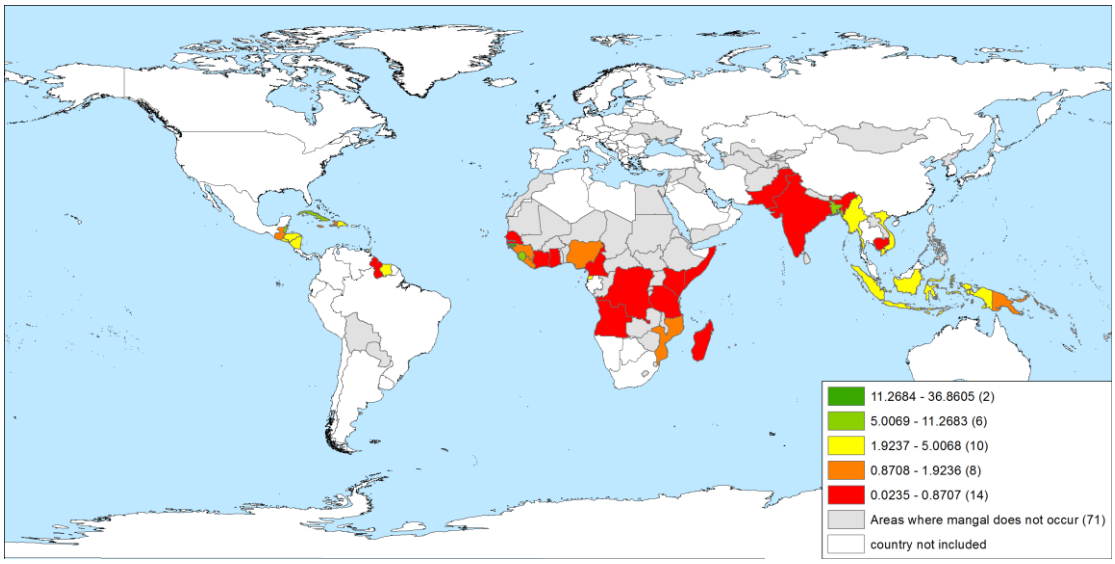
	Ecosystem vitality: Agriculture
Definition	Ecosystem vitality measures ecosystem protection and resource management.
Rationale	Healthy ecosystems providing regulatory ecosystem services moderate many weather and climate-related hazards; agriculture is one the economic activities that has the most impact on ecosystems.
References	Adaptive capacity in WRI 2014.
Creation method	Ordinal scale with a range from 0 (very poor environmental performance) to 100 (excellent environmental performance), aggregated from two performance indicators: Agricultural Subsidies (AGSUB) and Pesticide Regulation (POPs) (source YCELP — CIESIN). Reference year used: 2012.
Measurement unit	Index (0-100).
Missing data	Seven missing data.
Data Provider	YCELP and CIESIN — Columbia University.
URL	http://epi.yale.edu/.

Map ANNEX II 29 — Ecosystem vitality: Agriculture — Index (0-100)



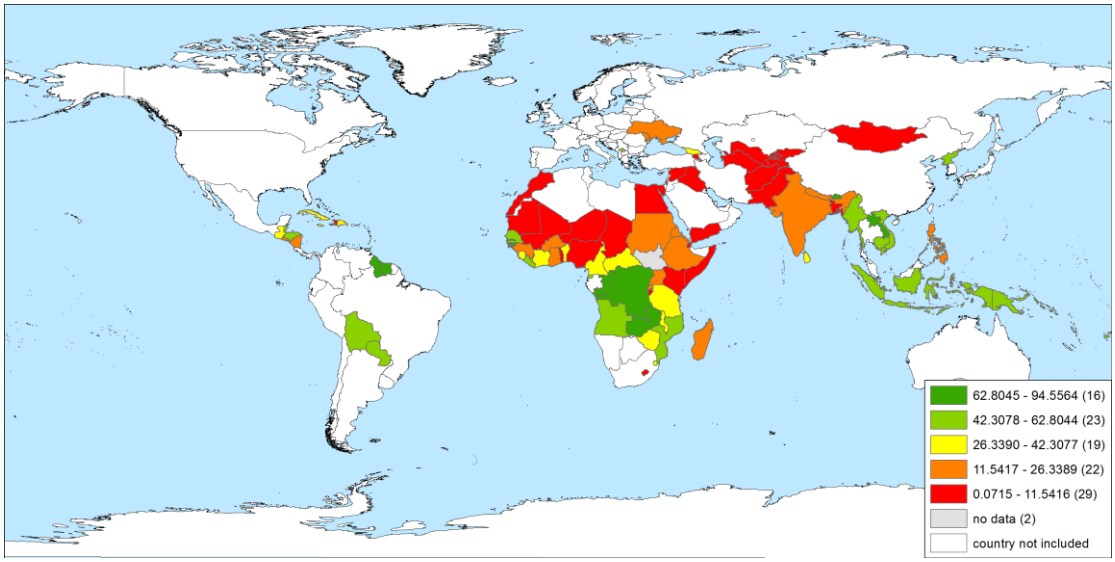
	Mangroves (% of land)
Definition	Percentage of land covered by mangroves.
Rationale	To restore valuable coastal systems; protecting coastlines and populations from risks posed by damaging storms.
References	Babier, 2015.
Creation method	Global Biomes data were obtained from the World Wildlife Fund (WWF) Terrestrial Ecoregions of the World dataset, in Feb 2006. The data depict global terrestrial vegetation biodiversity patterns for the world's 825 ecoregions and 14 biomes. (CIESIN) Reference year used: 2012.
Measurement unit	Percentage (%).
Missing data	0 missing data.
Data Provider	SEDAC-CIESIN/Columbia University.
URL	http://sedac.ciesin.columbia.edu/data/set/nagdc-population-landscape-climate-estimates-v3/data-download.

Map ANNEX II 30 — Mangroves (% of land)



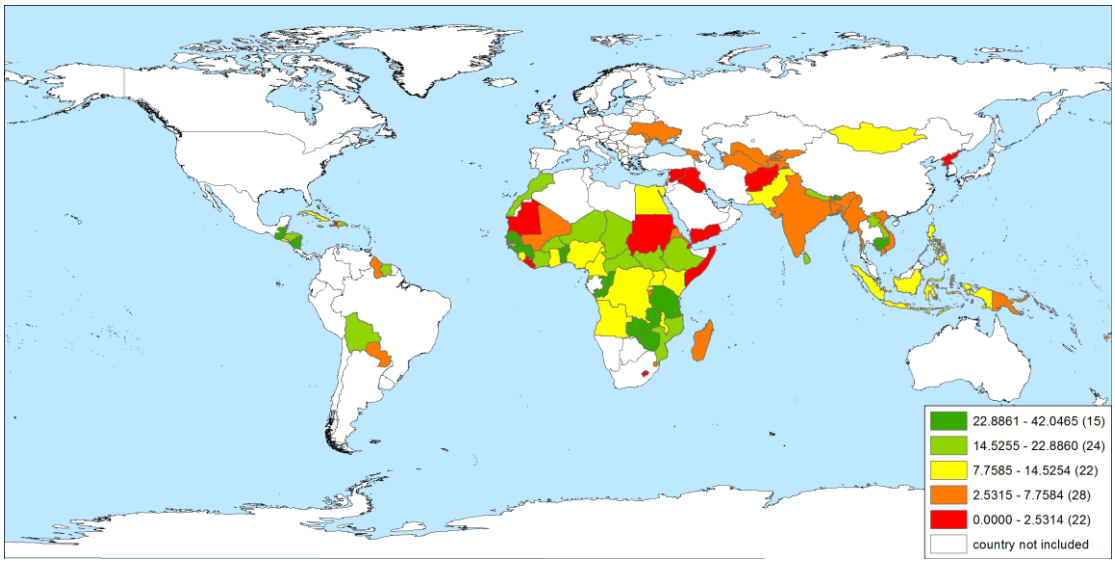
	Forest Area
Definition	Percentage of land under natural or planted stands of trees of at least five metres, whether productive or not, excluding tree stands in agricultural production systems (% of land area).
Rationale	Proxy for ecosystem adaptation actions.
References	Brooks et al., 2005; Target 15.1 of the new SDGs
Creation method	Forest area is land under natural or planted stands of trees of at least five metres *in situ*, whether productive or not, and excludes tree stands in agricultural production systems (for example, in fruit plantations and agroforestry systems) and trees in urban parks and gardens. (FAO) Reference year used: 2012.
Measurement unit	Percentage (%).
Missing data	Initially four missing data. Value for Cook Islands was filled by the data from the UN Country Profile (UN Data/Country profile: https://data.un.org/Coun-tryProfile.aspx?crName=Cook %20Islands). Two missing values remaining.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/AG.LND.FRST.ZS.

Map ANNEX II 31 — Forest Area (%)



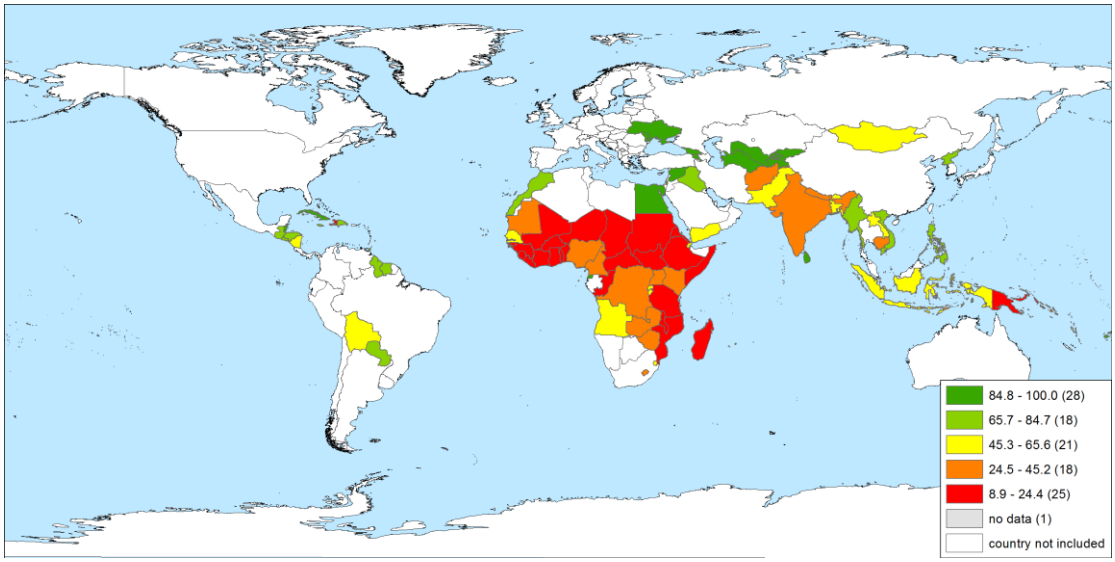
	Protected areas (% of total area)
Definition	The sum of terrestrial and marine protected areas. Terrestrial protected areas are totally or partially protected areas of at least 1 000 hectares that are designated by national authorities as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes, and areas managed mainly for sustainable use. Marine protected areas are areas of intertidal or sub-tidal terrain — and overlying water and associated flora and fauna and historical and cultural features — that have been reserved by law or other effective means to protect part or all of the enclosed environment.
Rationale	Habitat protection is a necessary but not sufficient condition for the conservation of biodiversity and ecosystem services that are critical to sustaining human life and well-being.
References	Sub-indicator of the World Risk Index, 2014; Target 14.5, Target 15.1; and Target 15.4 of the SDGs
Creation method	This indicator is calculated using all the nationally designated protected areas recorded in the World Database on Protected Areas (WDPA) whose location and extent is known. The WDPA database is stored within a Geographic Information System (GIS) that stores information about protected areas such as their name, type and date of designation, documented area, geographic location (point) and/or boundary (polygon).Reference year used: 2012.
Measurement unit	Percentage (%).
Missing data	Initially 11 missing data. Values of Cook Islands, Maldives, Nauru Sudan, South Sudan and São Tomé and Príncipe, were filled by the data from the Digital Observatory for Protected Areas (DOPA)/JRC website — Dubois, G., Bastin, L., Martinez-Lopez J., Cottam, A., Temperley, H., Bertzky, B., Graziano, M. (2015). The DOPA Explorer 1.0. EUR 27162 EN. Publications Office of the European Union, Luxembourg, 53 p. For Kosovo the value found in the Country briefing of the EEA was used (http://www.eea.europa.eu/soer-2015/countries/kosovo). Remaining missing: One.
Data Provider	World Data Bank.
URL	http://wdi.worldbank.org/table/3.4.

Map ANNEX II 32 — Protected Areas (% of total area)



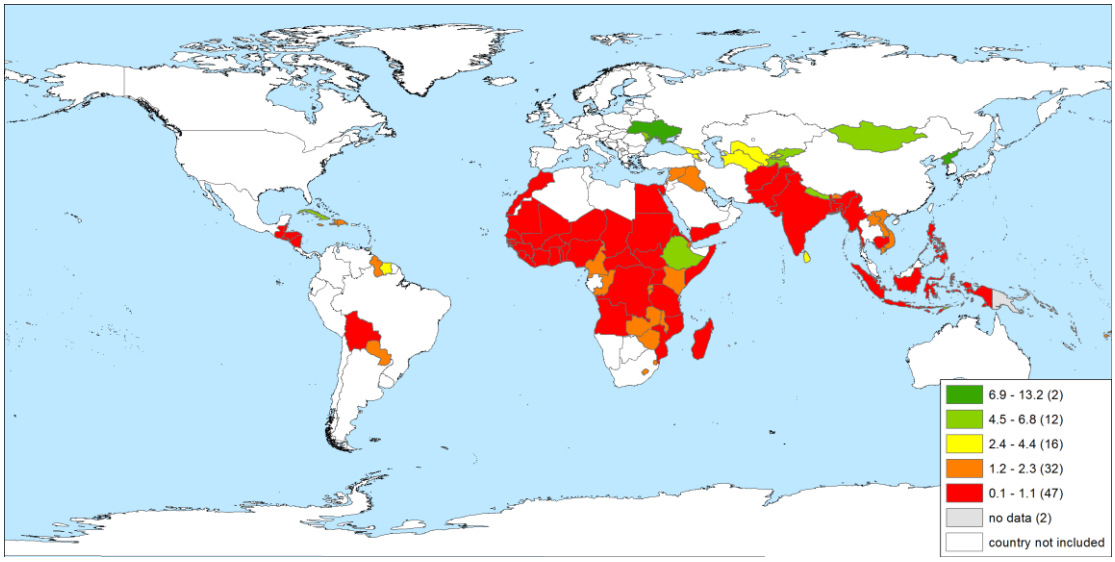
	Improved sanitation facilities (% of population with access)
Definition	Improved sanitation facilities comprise flush toilets, piped sewer systems, septic tanks, flush/pour flush to pit latrines, ventilated improved pit latrines, pit latrines with slab and composting toilets
Rationale	Access to sanitation is particularly crucial to build up preparedness to various natural disasters exacerbated by climate change. People without improved sanitation are susceptible to diseases and can become more vulnerable following a hazard.
References	Füssel, 2010, Brooks et al., 2005; Sub-indicator of adaptive capacity in the ND-GAIN index 2014, Sub-indicator of Susceptibility in the World Risk Index 2014, MDG7.9; (UN 2005) and WDIs and sub-indicator of Lack of coping capacity in INFORM 2014; Target 6.2 of the SDGs
Creation method	Coverage estimates are based on data from household surveys and censuses performed at national level. For each country, survey and census data are plotted on a timescale from 1980 to the present. A linear trend line, based on the least-squares method, is drawn through these data points to provide estimates for all years between 1990 and 2012 (wherever possible). The total estimates are population weighted average of the urban and rural numbers. Countries with missing data are assigned regional averages when generating regional and global estimates. (WHO/Unicef JMP) Reference year used: 2012 and last available year.
Measurement unit	Percentage (%).
Missing data	One missing data
Data Provider	WHO/Unicef Joint Monitoring Programme for Water Supply and Sanitation..
URL	http://www.wssinfo.org/data-estimates/tables/.

Map ANNEX II 33 — Improved sanitation facilities (% of population with access)



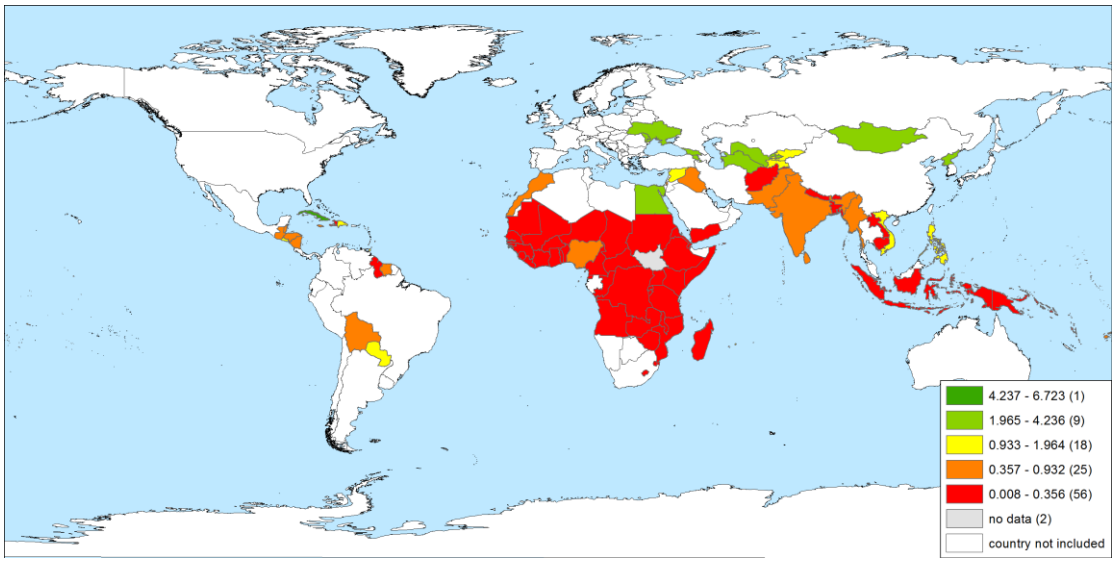
	Hospital beds
Definition	Hospital beds include inpatient beds available in public, private, general, and specialised hospitals and rehabilitation centres. In most cases beds for both acute and chronic care are included.
Rationale	Hospital beds indicate the capacity of the medical care infrastructure to help or support societies in the case of a mass emergency or disaster with respective treatment.
References	Sub-indicator of the World Risk Index, 2014.
Creation method	Availability and use of health services, such as hospital beds per 1 000 people, reflect both demand- and supply-side factors. In the absence of a consistent definition this is a crude indicator of the extent of physical, financial, and other barriers to healthcare. Reference year used: 2012 and last available year.
Measurement unit	Total number per 1000 people.
Missing data	Initially five missing data. Values for Cook Islands and Nauru was filled by the data from the UN Country Profile (UN Data/Country profile: https://data.un.org/CountryProfile.aspx?crName=Cook %20Islands). Data for South Sudan filled by data for former Sudan. Two missing values remaining.
Data Provider	World Bank data.
URL	http://data.worldbank.org/indicator/SH.MED.BEDS.ZS.

Map ANNEX II 34 — Hospital beds (Total number per 1,000 people)



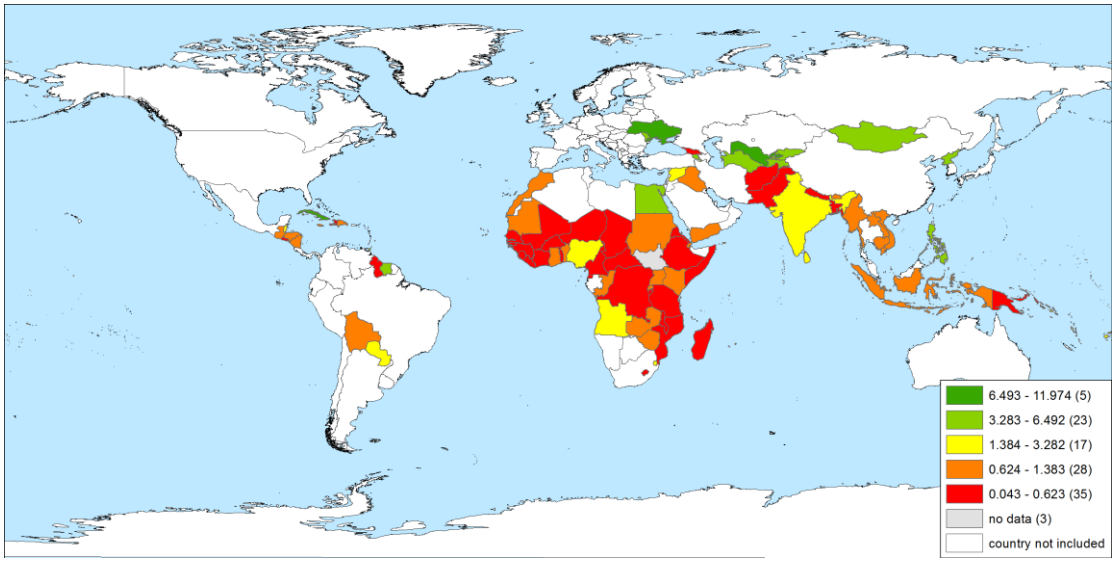
	Physician density (per 1 000 people)
Definition	Physicians (per 1 000 people).
Rationale	The number of medical staff, including physicians, nurses and midwives, reflects the capacity of a country to cope with exacerbated health risks brought on by climate change. Physicians, nurses, and midwives have similar weighting.
References	Halsnæs and Verhagen, 2007; Sub-indicator of the World Risk Index 2014 and the ND-GAIN index, 2014 and Lack of Coping capacity in INFORM 2014; post 2015 HFA (UNISDR, 2014).
Creation method	Data on health worker (physicians, nurses and midwives, and community health workers) density show the availability of medical personnel. Reference year used: 2012 and last available year.
Measurement unit	Total number per 1000 people.
Missing data	Initially four missing data. Values for Cook Islands and Nauru was filled by the data from the UN / WHO database. (http://data.un.org/Data.aspx?d=WHO&f=MEASURE_CODE %3aHRH_26). Two missing values remaining.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/SH.MED.PHYS.ZS.

Map ANNEX II 35 — Physician density (total number per 1,000 people)



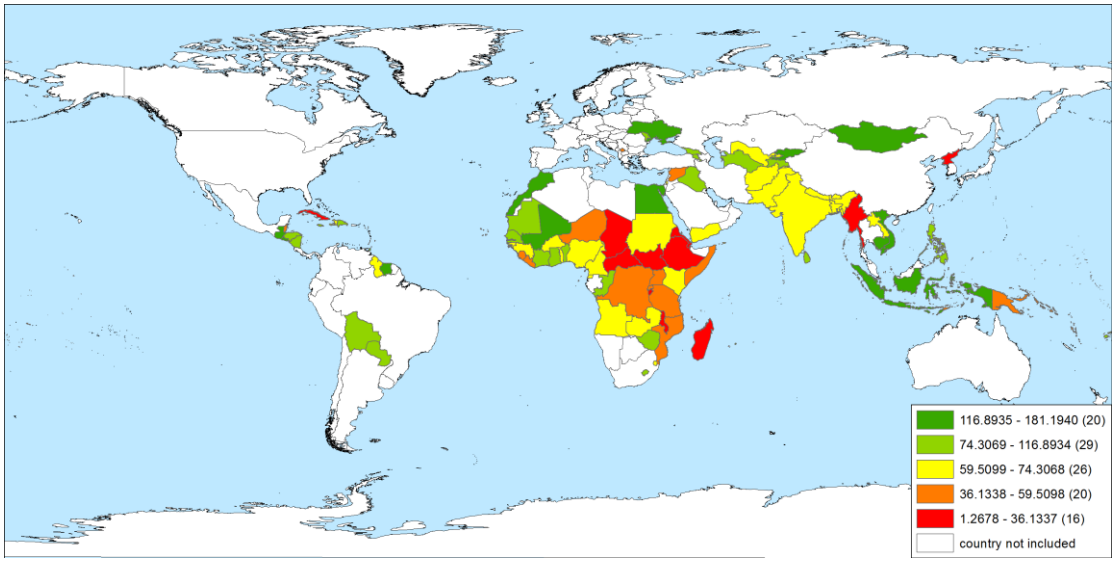
	Nurses and midwives density (per 1 000 people)
Definition	Nurses and midwives (per 1 000 people).
Rationale	The number of medical staff, including physicians, nurses and midwives, reflects the capacity of a country to cope with exacerbated health risks brought on by climate change. Physicians, nurses, and midwives have similar weighting.
References	Halsnæs and Verhagen, 2007; Sub-indicator of the World Risk Index 2014 and the ND-GAIN index 2014 and Lack of Coping capacity in INFORM 2014; post 2015 HFA (UNISDR, 2014).
Creation method	Data on health worker (physicians, nurses and midwives, and community health workers) density show the availability of medical personnel. Reference year used: 2012 and last available year.
Measurement unit	Total number per 1000 people.
Missing data	Initially five missing data. Values for Cook Islands and Nauru was filled by the data from the UN / WHO database. (http://data.un.org/Data.aspx?d=WHO&f=MEASURE_CODE %3aHRH_26). Three missing values remaining.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/SH.MED.NUMW.P3.

Map ANNEX II 36 — Nurses and midwives density (total number per 1 000 people)



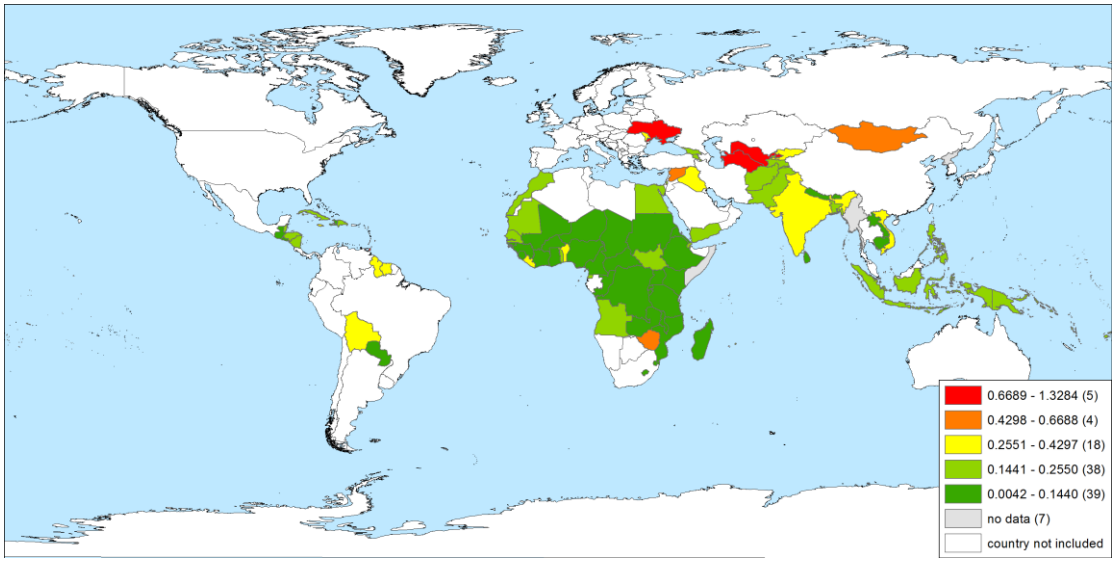
	Mobile cellular subscriptions (per 100 people)
Definition	Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network (PSTN). Post-paid and prepaid subscriptions are included. (World Data Bank)
Rationale	
References	Target 5b and Target 9c of the new SDGs
Creation method	Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology. The indicator includes (and is split into) the number of post-paid subscriptions, and the number of active prepaid accounts (i.e. that have been used during the last three months). The indicator applies to all mobile cellular subscriptions that offer voice communications. It excludes subscriptions via data cards or USB modems, subscriptions to public mobile data services, private trunked mobile radio, telepoint, radio paging and telemetry services. (World Data Bank) Reference year used: 2013 and last available year.
Measurement unit	Total number per 100 people.
Missing data	Initially Three missing data. Values for Cook Islands and Nauru was filled respectively by the data from the UN Country Profile (UNData/Country profile: https://data.un.org/CountryProfile.aspx?crName=Nauru) and UN / WHO database. (http://data.un.org/Data.aspx?d=WHO&f=MEASURE_CODE %3aHRH_26). Data for Kosovo were filled by http://kosovoforests.org/wp-content/uploads/2013/04/20141008-kosovo-progress-report_en.pdf. 0 missing remaining.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/IT.CEL.SETS.P2/countries/1W?display=map.

Map ANNEX II 37 — Mobile cellular subscriptions (total number per 100 people)



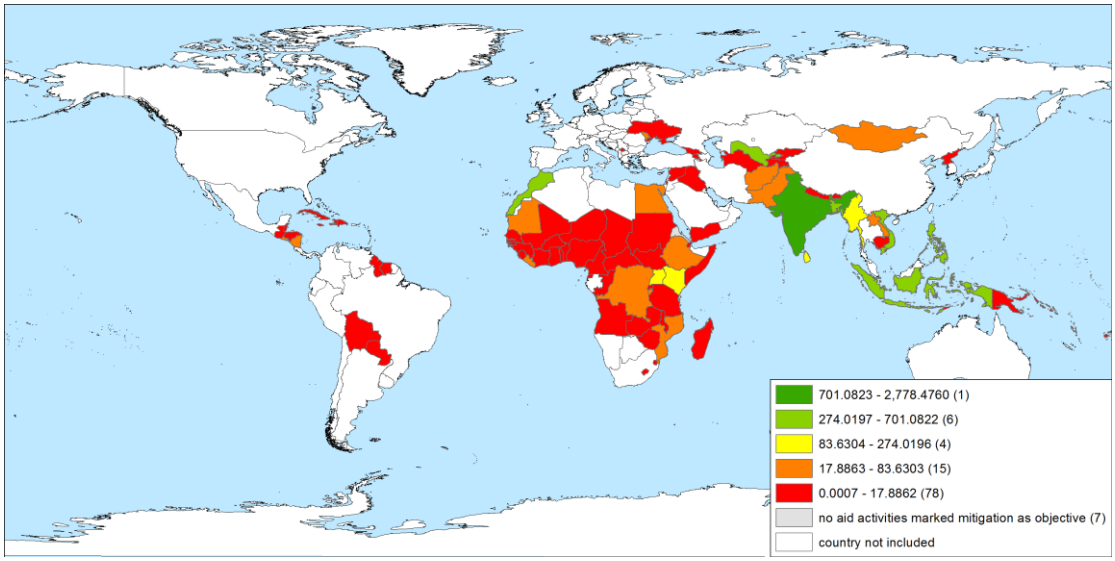
	CO_2 emissions
Definition	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. (Kg per PPP US$ of GDP).
Rationale	Countries with a significant or growing CO_2 emissions are likely to be less committed to mitigating global climate change.
References	MDG7.2 (UN 2005); Post 2015 HFA (UNISDR, 2014); Target 2.4 of the SDGs
Creation method	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. (World Data Bank) Reference year used: 2011 and last available year.
Measurement unit	Kg per PPP USD of GDP.
Missing data	Initially nine missing data. Value for Syria was filled from the UN/MDG webpage (http://data.un.org/Data.aspx?d=MDG&f=seriesRowID %3A788) and for South Sudan, data from Sudan was used. Remaining seven missing.
Data Provider	World Data Bank.
URL	http://data.worldbank.org/indicator/EN.ATM.CO2E.PP.GD.

Map ANNEX II 38 — CO_2 emissions (kg per PPP USD of GDP)



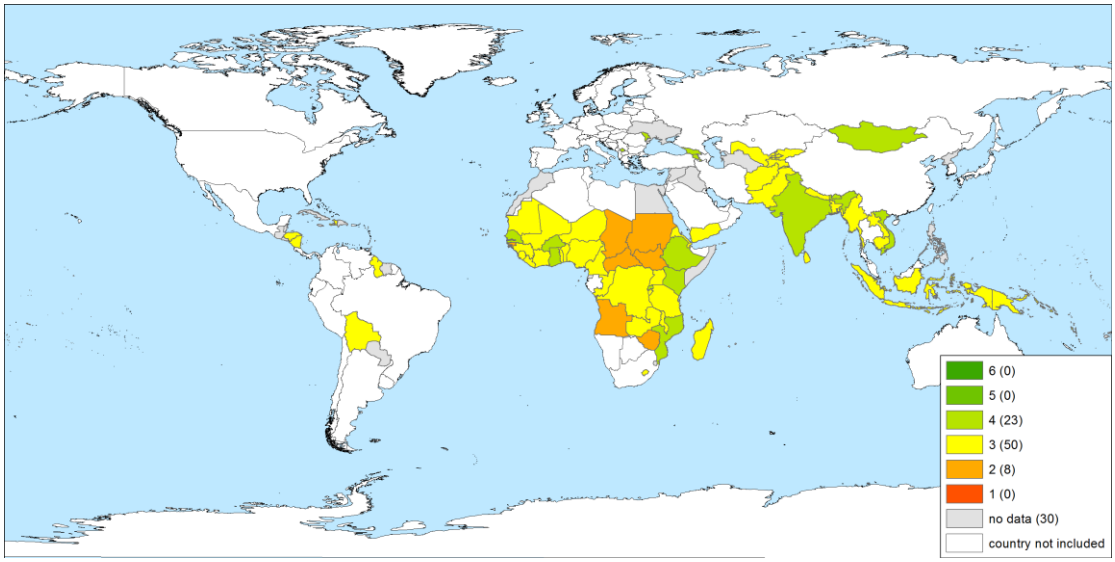
	ODA/DAC climate change mitigation
Definition	Overall DAC with aid activities marked climate change mitigation as principal objective (Commitment in 2013).
Rationale	Financial support of OECD Countries for the activity classified as mitigation-related (score principal) if it intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience.
References	
Creation method	Total money in USD for climate change mitigation as principal. Reference year used: 2013.
Measurement unit	USD current prices (million).
Missing data	Initially 27 missing data. 20 countries were filled with the values of 'Mitigation Significant' so remaining seven missing values.
Data Provider	OECD.
URL	http://stats.oecd.org/Index.aspx?datasetcode=TABLE2A#.

Map ANNEX II 39 — ODA/DAC Climate Change Mitigation (USD current prices — million)



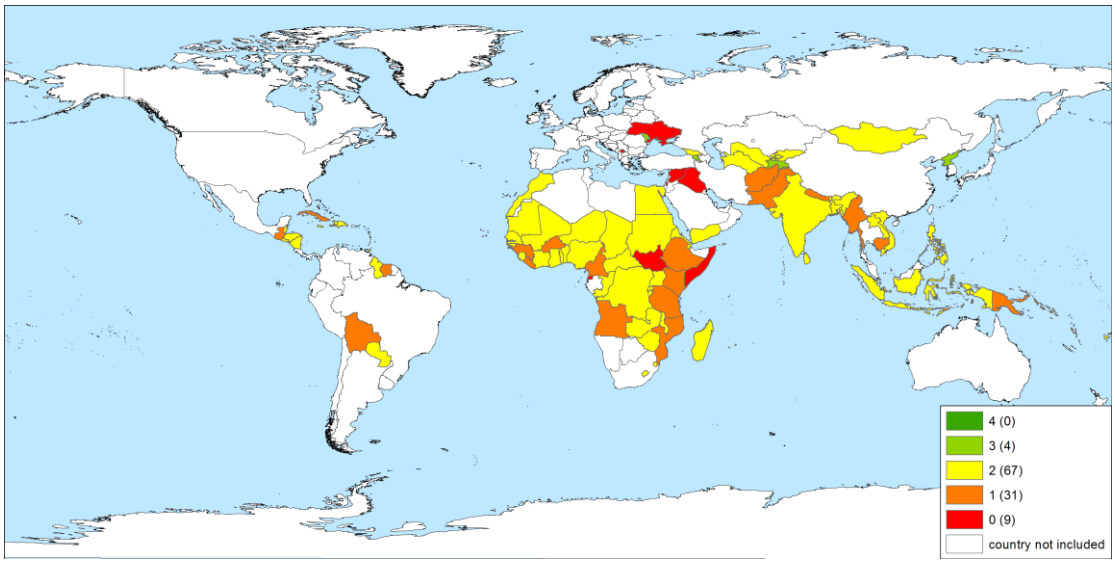
	Public sector management
Definition	Cluster of four indicators on CPIA quality of budgetary and financial management, CPIA efficiency of revenue mobilisation, CPIA quality of public administration, CPIA transparency, accountability, and corruption in the public sector. (World Data Bank)
Rationale	Weak Institutions may be an obstacle for the implementation of climate risk management actions.
References	
Creation method	The Public Sector Management Indicator was created by taking the arithmetic average of the four World Bank CPIA indicators: quality of budgetary and financial management, efficiency of revenue mobilisation, quality of public administration, transparency, accountability, and corruption in the public sector. Since those four were measured on a scale of (1=low to 6=high), the resulting indicator is also measured in the same scale of (1=low to 6=high). However, in the countries we selected, the maximum round value is 4. Reference year used: 2013.
Measurement unit	Index (1=low to 6=high).
Missing data	30 missing data.
Data Provider	World Data Bank.
URL	http://wdi.worldbank.org/table/5.9.2.

Map ANNEX II 40 — Public sector management



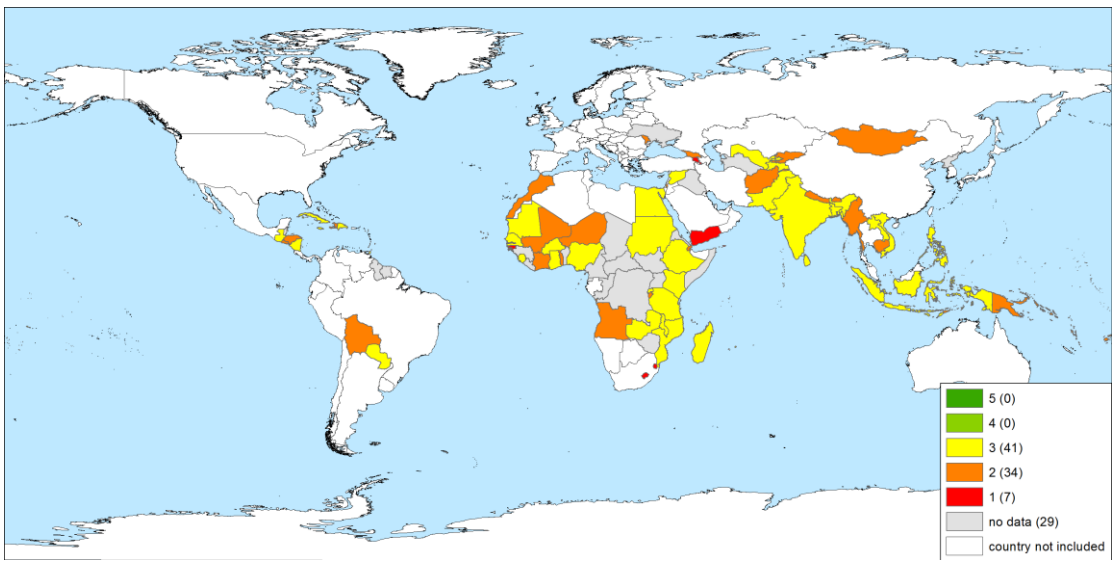
	Participation in UNFCCC fora
Definition	Submitted National Communications (NC) from non-Annex I Parties as a proxy of the country's participation ino UNFCC fora.
Rationale	National Communications (NCs) provide information on greenhouse gas (GHG) inventories, measures to mitigate and to facilitate adequate adaptation to climate change, and any other information that the Party considers relevant to the achievement of the objective of the Convention. NCs are submitted every four years.
References	Target 13 of the SDGs
Creation method	Our elaboration giving scores as follows: 0=no report, 1= Initial national communication, 2 = Initial national communication + Second national communication, 3= Initial national communication + Second national communication + Third national communication. Reference year used: 2014.
Measurement unit	Index (0 — 4).
Missing data	Missing data 0.
Data Provider	UN Framework Convention on Climate Change.
URL	http://unfccc.int/national_reports/non-annex_i_natcom/submitted_natcom/items/653.php.

Map ANNEX II 41 — Participation to UNFCCC for a — Index (0 — 4)



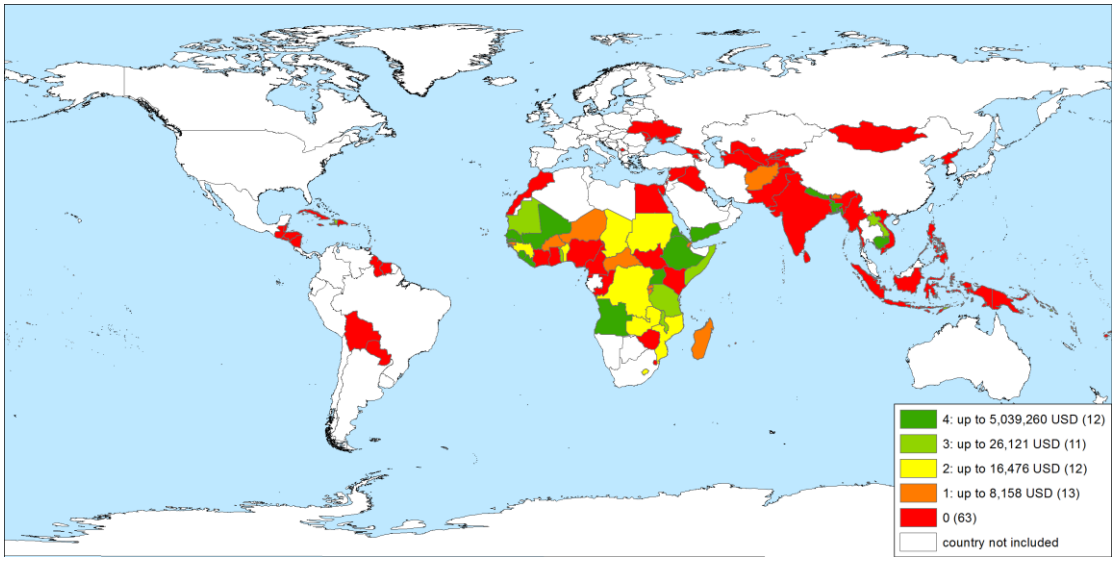
Name	Disaster Risk Report (DRR)
Definition	The indicator for the DRR activity in the country comes from the score of Hyogo Framework for Action (HFA) self-assessment progress reports of the countries. HFA progress reports assess strategic priorities in the implementation of disaster risk reduction actions and establish baselines on levels of progress achieved in implementing the HFA's five priorities for action (source INFORM, 2015).
Rationale	The indicator quantifies the level of implementation of DRR activity.
References	HFA; Inform, 2015: Institutional Category-Disaster Risk Reduction Component.
Creation method	For each of the five priority actions, the average of the scores of the underlying indicators has been calculated. The final score is the average of the five priority action scores. We considered the latest national progress report available for each country (Source de Groeve et al 2014)
Measurement unit	Index (1-5).
Missing data	29 missing data
Data Provider	ISDR, INFORM.
URL	http://unfccc.int/files/cooperation_support/least_developed_countries_portal/napa_project_database/application/pdf/napa_index_by_country.pdf.

Map ANNEX II 42 — Disaster Risk Report (DRR) — Index (1-5)



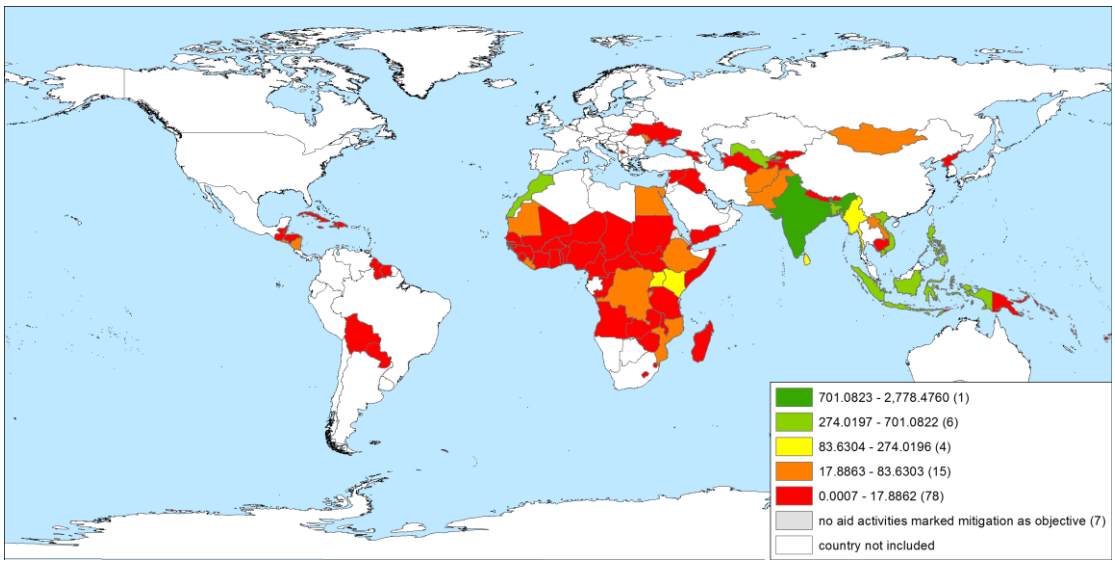
	National Adaptation Plans (NAPA) total costs USD and number of projects
Definition	Submitted NAPAs. Total costs and numbers of the planned projects.
Rationale	NAPAs contain a list of ranked priority adaptation activities and projects. The proposed indicator is based on the total project costs and number of projects by country.
References	
Creation method	The total costs in USD for NAPAs have been distributed in four equal size classes, constructed using the distribution's quartiles. In that way an index (0-4) has been created: 0: no projected submitted 1: up to 8 158 USD +one case with one project under evaluation 2: up to 16 476 USD 3: up to 26 121 USD 4: up to 5 039 260 USD.
Measurement unit	Index (0-4).
Missing data	0 missing data.
Data Provider	UN Framework Convention on Climate Change
URL	http://unfccc.int/files/cooperation_support/least_developed_countries_portal/napa_project_database/application/pdf/napa_index_by_country.pdf.

Map ANNEX II 43 — NAPAs Total costs USD and number of projects



	ODA/DAC climate change mitigation per capita
Definition	Overall DAC with aid activities marked climate change mitigation as a principal objective per capita.
Rationale	Financial support of OECD Countries for the activity classified as mitigation-related (score principal) if it intends to reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience. Countries heavily dependent on ODA will likewise be more dependent on ODA decisions to finance recovery and reconstruction.
References	
Creation method	Total money in US dollars for climate change mitigation as principal divided by each country's population. Reference year used: 2013.
Measurement unit	USD current prices (million).
Missing data	Initially 27 missing data. 20 countries were filled with the values of 'Mitigation Significant' so remaining seven missing values.
Data Provider	OECD.
URL	http://stats.oecd.org/Index.aspx?datasetcode=TABLE2A#.

Map ANNEX II 44 — ODA/DAC Climate Change Mitigation per Capita (USD current prices — million)



ANNEX III Robustness and sensitivity analysis

Introduction

Developing a composite indicator includes some stages based on subjective judgements. Thus, an evaluation of the confidence in the model is very important in order to: (1) assess the uncertainties associated with the modelling process and the subjective choices taken, and (2) to quantify the overall uncertainty in country rankings.

According to JRC/OECD (2008) a combination of uncertainty and sensitivity analysis can contribute to:

- evaluating the robustness of the composite indicator ranking,
- increasing its transparency,
- identifying those countries which are favoured or weakened under certain assumptions, and
- framing a debate around the index.

Our tests are focused on identifying whether the GCCA+ composite indicator is statistically well-balanced in its objectives and in its issue areas within an objective and we concentrate on two areas: Firstly, we eliminate one issue area at a time and, then, we compare the resulting ranking with the original ranking. Secondly, we introduce weight uncertainty allowing the weights of the three GCCA+ components to vary uniformly in an interval and check what happens to the countries' results.

1: Eliminating one issue area at a time and comparing the resulting ranking with the original ranking

The analysis has been held in three levels.

- Level 1: Each of the three components (Hazards*Exposure, Vulnerability, Capacity) of the composite indicator has been eliminated and the procedure of the construction of the index has been followed as normal.
- Level 2: Each of the eight sub-components (Hazards, Exposure, Demographic Vulnerability, Environment Vulnerability, Economy Vulnerability, Adaptive Capacity, Coping Capacity and Mitigation Capacity) of the composite indicator has been extracted and the procedure of the construction of the index has been followed as normal.
- Level 3: Each of the 35 base indicators of the composite indicator has been extracted and the procedure of the construction of the index has been followed as normal.

In each case, the rank of the countries has been calculated and also the shift in the country's rank from the GCCA+ index rank, which is used as reference.

For each level of analysis, the various ranks have been put together and studied. The median of ranks for each country has been calculated and as a confidence

interval has been used the range between the 5th and the 95th percentiles (Saisana et al., 2005).
Additionally, the average shift in countries' ranks, $\bar{R}_S$, has been calculated. This statistic captures in a single number the relative shift in the position of the entire system of countries. It can be quantified as the average of the absolute differences in countries' ranks with respect to a reference ranking (in our case the GCCA+ Index Ranking) over the countries (Saisana et al., 2005).

Level 1: Components' Elimination

Table 2 reports the GCCA+ country ranks along with the stimulated median values and 95 % confidence intervals in order to better appreciate the robustness of the results to the elimination of each component.
Confidence intervals wider than 45 are highlighted in red.
From the results we can see that there are 26 countries that have a confidence interval wider than 45 and 11 countries have them wider than 60.
These are Vietnam, Philippines, Antigua and Barbuda, Dem. Rep. of Congo, Sierra Leone, Belize, Suriname, Equatorial Guinea, Tonga, Palau, Tuvalu with the first three having really wide CI above 70.
Specific caution should be taken in these countries as their ranking is highly dependent on the elimination of one component.
Looking closer at the case of Vietnam, it ranks 85 if the hazards&exposure component is eliminated. Its rank is 34 if the vulnerability component is eliminated.
Finally, it ranks 7 if the capacity component is eliminated.
That means that it scores high in the hazards&exposure component but as it shows really good capacity it gets a rather good balance. Excluding capacity, it climbs really high in the chart.
Using as a measure of robustness the average absolute shift in rank (over the set of countries) with respect to the benchmark (GCCA+), we see that the hazards&exposure component produces the bigger shifts in countries' ranks.

Table ANNEX III 1 – Average shift in countries' ranks per missing component

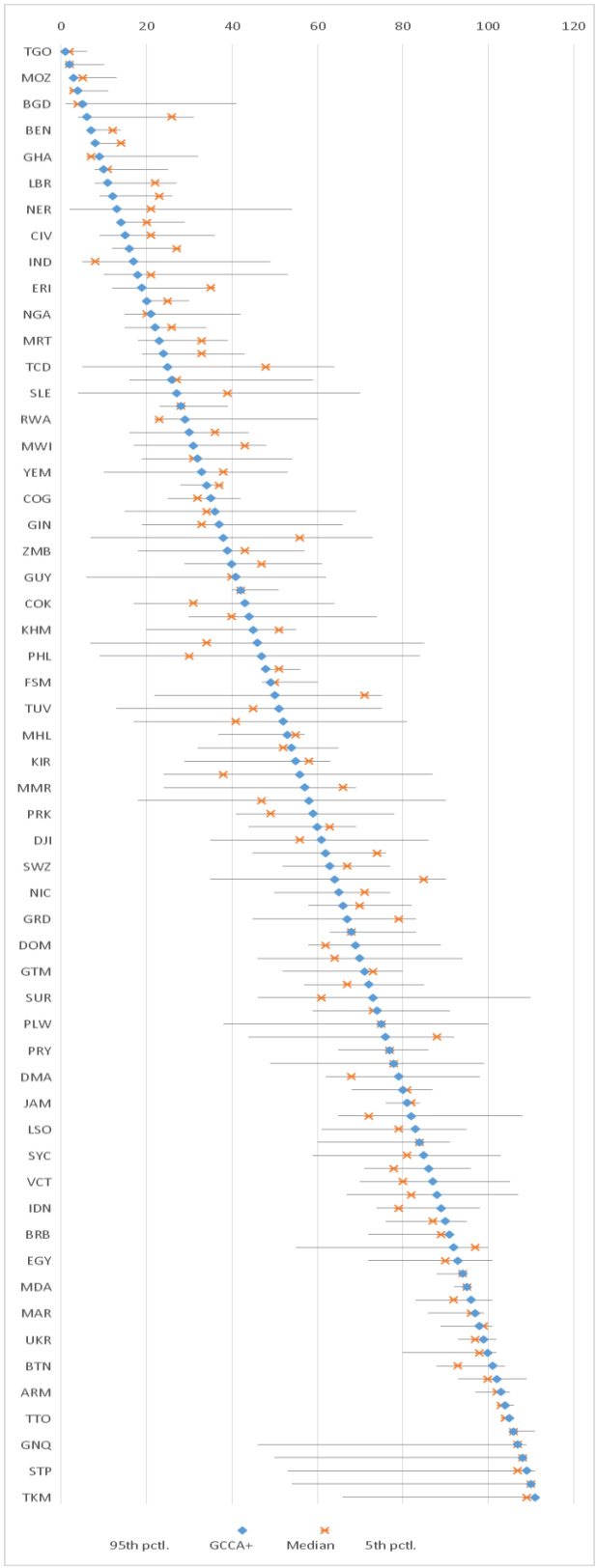
Missing component	Average shift in countries' ranks
Hazards*Exposure	14.6
Vulnerability	12.1
Capacity	11.1

Table ANNEX III 2 – Results of Robustness Analysis showing the GCCA+ index, the median and the corresponding 5th and 95th percentile (bounds) of the distribution of ranks for the 111 countries. The countries are ordered according to their GCCA+ values.

Country	GCCA+	Median	CI	Country	GCCA+	Median	CI	Country	GCCA+	Median	CI
Togo	1	2	[1,6]	Congo, Dem. Rep.	38	56	[7,73]	Palau	75	75	[38,100]
Somalia	2	2	[1,10]	Zambia	39	43	[18,57]	Syria	76	88	[44,92]
Mozambique	3	5	[3,13]	Papua New Guinea	40	47	[29,61]	Paraguay	77	77	[65,86]
South Sudan	4	3	[3,11]	Guyana	41	40	[6,62]	Sri Lanka	78	78	[49,99]
Bangladesh	5	4	[1,41]	Cameroon	42	42	[40,51]	Dominica	79	68	[62,98]
Kenya	6	26	[4,31]	Cook Islands	43	31	[17,64]	Bolivia	80	81	[68,87]
Benin	7	12	[11,14]	Afghanistan	44	40	[30,74]	Jamaica	81	82	[76,84]
Mali	8	14	[13,14]	Cambodia	45	51	[20,55]	Maldives	82	72	[65,108]
Ghana	9	7	[6,32]	Vietnam	46	34	[7,85]	Lesotho	83	79	[61,95]
Guinea-Bissau	10	11	[8,25]	Philippines	47	30	[9,84]	Timor-Leste	84	84	[60,91]
Liberia	11	22	[8,27]	Iraq	48	51	[48,56]	Seychelles	85	81	[59,103]
Central African Rep.	12	23	[9,26]	Micronesia, Federated States	49	50	[47,60]	Fiji	86	78	[71,96]
Niger	13	21	[2,54]	Tanzania	50	71	[22,75]	St. Vincent and Grenadines	87	80	[70,105]
Haiti	14	20	[16,29]	Tuvalu	51	45	[13,75]	Cuba	88	82	[67,107]
Côte d'Ivoire	15	21	[9,36]	Belize	52	41	[17,81]	Indonesia	89	79	[74,98]
Gambia	16	27	[12,28]	Marshall Islands	53	55	[37,57]	Georgia	90	87	[76,95]
India	17	8	[5,49]	Honduras	54	52	[32,65]	Barbados	91	89	[72,91]
Burundi	18	21	[10,53]	Kiribati	55	58	[29,63]	Nepal	92	97	[55,100]
Eritrea	19	35	[12,36]	Tonga	56	38	[24,87]	Egypt	93	90	[72,101]
Madagascar	20	25	[24,30]	Myanmar	57	66	[24,69]	Tajikistan	94	94	[88,94]
Nigeria	21	20	[15,42]	Antigua and Barbuda	58	47	[18,90]	Moldova	95	95	[92,96]
Ethiopia	22	26	[15,34]	Korea, Dem. Rep.	59	49	[41,78]	West Bank and Gaza Strip	96	92	[83,101]
Mauritania	23	33	[18,39]	Vanuatu	60	63	[44,69]	Morocco	97	96	[86,99]
Comoros	24	33	[19,43]	Djibouti	61	56	[35,86]	Cabo Verde	98	99	[89,101]
Chad	25	48	[5,64]	Solomon Islands	62	74	[45,76]	Ukraine	99	97	[93,102]
Zimbabwe	26	27	[16,59]	Swaziland	63	67	[52,77]	Uzbekistan	100	98	[80,102]
Sierra Leone	27	39	[4,70]	Sudan	64	85	[35,90]	Bhutan	101	93	[88,104]
Angola	28	28	[23,39]	Nicaragua	65	71	[50,77]	Mongolia	102	100	[93,109]
Rwanda	29	23	[22,60]	St. Lucia	66	70	[58,82]	Armenia	103	102	[97,105]
Burkina Faso	30	36	[16,44]	Grenada	67	79	[45,83]	Kyrgyz Rep.	104	103	[103,106]

Malawi	31	43	[17,48]	**Samoa**	68	68	[63,83]	**Trinidad and Tobago**	105	104	[104,106]
Pakistan	32	31	[19,54]	**Dominican Republic**	69	62	[58,89]	**Mauritius**	106	106	[105,111]
Yemen	33	38	[10,53]	**St. Kitts-Nevis**	70	64	[46,94]	**Equatorial Guinea**	107	107	[46,109]
Senegal	34	37	[28,37]	**Guatemala**	71	73	[52,80]	**Kosovo**	108	108	[50,108]
Congo, Rep.	35	32	[25,42]	**El Salvador**	72	67	[57,85]	**São Tomé and Príncipe**	109	107	[53,111]
Uganda	36	34	[15,69]	**Suriname**	73	61	[46,110]	**Nauru**	110	110	[54,110]
Guinea	37	33	[19,66]	**Laos**	74	73	[59,91]	**Turkmenistan**	111	109	[66,111]

Figure ANNEX III 1: Countries' confidence interval in ranking, eliminating each component



Level 2: Sub-components' elimination

Table 4 shows the results of the elimination of each sub-component.
The confidence intervals (CI) wider than 30 are highlighted in red. 27 countries have a CI >30.
Eight Countries of this group are in the 40-48 range with Dem. Rep. of Congo, Iraq and Nepal being in the widest range of 44-48.
Dem. Rep. of Congo shows a really different ranking when exposure is missing (and it climbs to rank 3) compared to when Hazards is missing and it goes to rank 51.
In the end the combined component hazards&exposure gives the country some balance.
Table 3 shows the results of the average absolute shift in rank (over the set of countries) with respect to the benchmark (GCCA+).

Table ANNEX III 3 — Average shift in countries' ranks per missing sub-component

Missing sub-component	**Average shift in countries' ranks**
Hazards	5.2
Exposure	9.0
Vulnerability demographic	5.2
Vulnerability environment	5.5
Vulnerability economy	6.8
Lack of Adaptive capacity	5.0
Lack of Coping capacity	6.2
Lack of Mitigation capacity	3.5

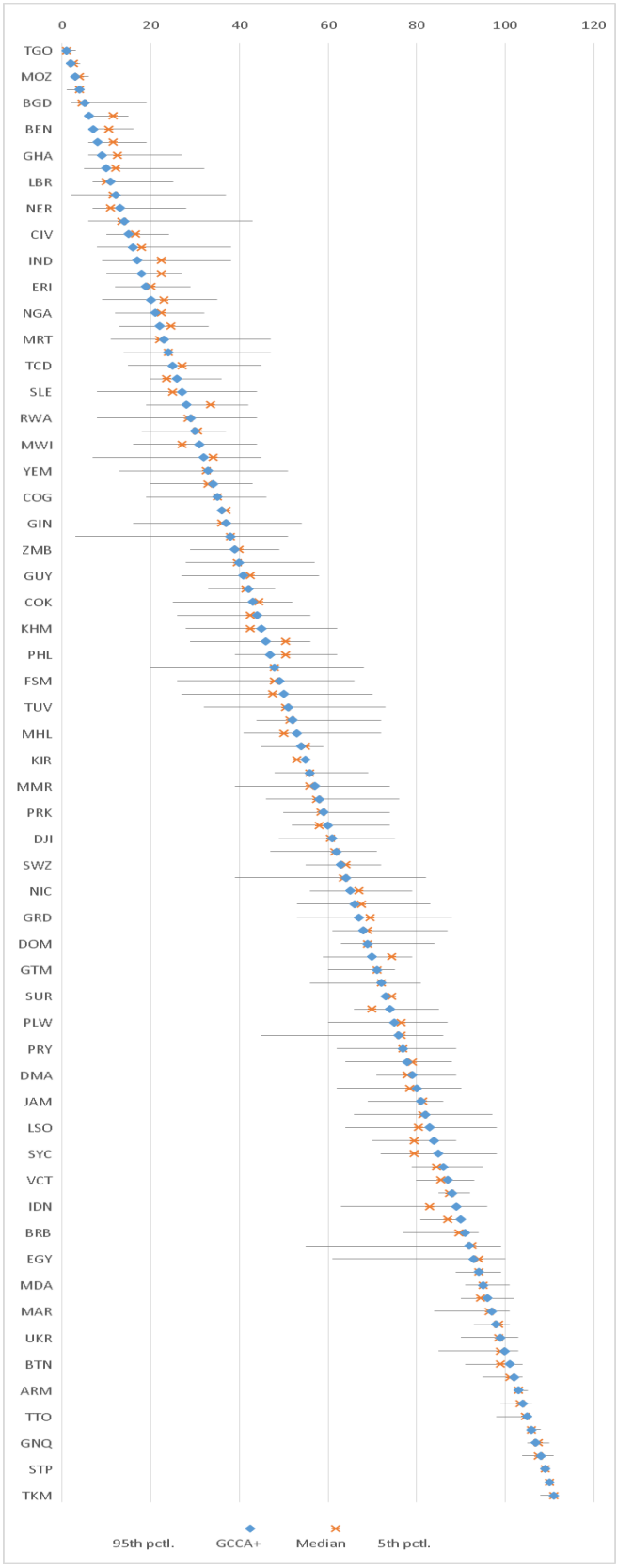
It becomes obvious that the exposure sub-component is responsible for the bigger changes in rank (Rs=9.0) while, on the other hand, the lack of mitigation doesn't contribute to major changes (Rs=3.5).

Table ANNEX III 4 – Results of Robustness Analysis showing the GCCA+ index, the median and the corresponding 5th and 95th percentile (bounds) of the distribution of ranks for the 111 countries. The countries are ordered according to their GCCA+ values.

Country	GCCA+	Median	CI	Country	GCCA+	Median	CI	Country	GCCA+	Median	CI
Togo	1	1	[1,3]	**Congo, Dem. Rep.**	38	38	[3,51]	**Palau**	75	77	[60,87]
Somalia	2	3	[1,4]	**Zambia**	39	40	[29,49]	**Syria**	76	77	[45,86]
Mozambique	3	4	[2,6]	**Papua New Guinea**	40	40	[28,57]	**Paraguay**	77	77	[62,89]
South Sudan	4	4	[1,5]	**Guyana**	41	43	[27,58]	**Sri Lanka**	78	79	[64,88]
Bangladesh	5	5	[2,19]	**Cameroon**	42	42	[33,48]	**Dominica**	79	78	[71,89]
Kenya	6	12	[7,15]	**Cook Islands**	43	45	[25,52]	**Bolivia**	80	79	[62,90]
Benin	7	11	[6,16]	**Afghanistan**	44	43	[26,56]	**Jamaica**	81	82	[69,86]
Mali	8	12	[6,19]	**Cambodia**	45	43	[28,62]	**Maldives**	82	82	[66,97]
Ghana	9	13	[6,27]	**Vietnam**	46	51	[29,56]	**Lesotho**	83	81	[64,98]
Guinea-Bissau	10	12	[5,32]	**Philippines**	47	51	[39,62]	**Timor-Leste**	84	80	[70,89]
Liberia	11	10	[7,25]	**Iraq**	48	48	[20,68]	**Seychelles**	85	80	[72,98]
Central African Rep.	12	12	[2,37]	**Micronesia, Federated States**	49	48	[26,66]	**Fiji**	86	85	[79,95]
Niger	13	11	[7,28]	**Tanzania**	50	48	[27,70]	**St. Vincent and Grenadines**	87	86	[80,93]
Haiti	14	14	[6,43]	**Tuvalu**	51	51	[32,73]	**Cuba**	88	88	[85,92]
Côte d'Ivoire	15	17	[10,24]	**Belize**	52	52	[44,72]	**Indonesia**	89	83	[63,96]
Gambia	16	18	[8,38]	**Marshall Islands**	53	50	[41,72]	**Georgia**	90	87	[81,91]
India	17	23	[9,38]	**Honduras**	54	55	[45,59]	**Barbados**	91	90	[77,94]
Burundi	18	23	[10,27]	**Kiribati**	55	53	[43,65]	**Nepal**	92	93	[55,99]
Eritrea	19	20	[12,29]	**Tonga**	56	56	[48,69]	**Egypt**	93	94	[61,100]
Madagascar	20	23	[9,35]	**Myanmar**	57	56	[39,74]	**Tajikistan**	94	94	[89,99]
Nigeria	21	23	[12,32]	**Antigua and Barbuda**	58	58	[46,76]	**Moldova**	95	95	[91,101]
Ethiopia	22	25	[13,33]	**Korea, Dem. Rep.**	59	59	[50,74]	**West Bank and Gaza Strip**	96	95	[90,102]
Mauritania	23	22	[11,47]	**Vanuatu**	60	58	[52,74]	**Morocco**	97	97	[84,101]
Comoros	24	24	[14,47]	**Djibouti**	61	61	[49,75]	**Cabo Verde**	98	99	[93,101]
Chad	25	27	[15,45]	**Solomon Islands**	62	62	[47,71]	**Ukraine**	99	99	[90,103]
Zimbabwe	26	24	[20,36]	**Swaziland**	63	64	[55,72]	**Uzbekistan**	100	99	[85,103]
Sierra Leone	27	25	[8,44]	**Sudan**	64	64	[39,82]	**Bhutan**	101	99	[91,104]
Angola	28	34	[19,42]	**Nicaragua**	65	67	[56,79]	**Mongolia**	102	101	[95,104]
Rwanda	29	29	[8,44]	**St. Lucia**	66	68	[53,83]	**Armenia**	103	103	[102,105]
Burkina Faso	30	31	[18,37]	**Grenada**	67	70	[53,88]	**Kyrgyz Rep.**	104	104	[99,106]
Malawi	31	27	[16,44]	**Samoa**	68	69	[61,87]	**Trinidad and Tobago**	105	105	[98,106]

Pakistan	32	34	[7,45]	**Dominican Republic**	69	69	[63,84]	**Mauritius**	106	106	[105,108]
Yemen	33	33	[13,51]	**St. Kitts-Nevis**	70	75	[59,79]	**Equatorial Guinea**	107	108	[105,110]
Senegal	34	33	[20,43]	**Guatemala**	71	71	[60,75]	**Kosovo**	108	108	[104,111]
Congo, Rep.	35	35	[19,46]	**El Salvador**	72	72	[56,81]	**São Tomé and Príncipe**	109	109	[108,110]
Uganda	36	37	[18,43]	**Suriname**	73	75	[62,94]	**Nauru**	110	110	[106,111]
Guinea	37	36	[16,54]	**Laos**	74	70	[66,85]	**Turkmenistan**	111	111	[108,111]

Figure ANNEX III 2 — Countries' confidence interval in ranking, eliminating each sub-component



Level 3: Indicators' elimination

In the case of indicator elimination, the rank shifts, as expected, are smaller. Confidence intervals wider than 16 are highlighted in red. 23 countries are included in the range (16-26).

The countries with the wider CIs (that range from 21 to 26) are Mauritania, Dem. Rep. of Congo, Syria, Chad, Comoros, Vietnam, Sudan and Sierra Leone. For these countries there are some indicators that are important. For instance in the case of Mauritania, when the water dependency ratio indicator is absent, the country's rank is 40 instead of 23 that is its GCCA+ rank. Going deeper into the results, that is normal since there is a 96 % water dependency of the country.

Using as a measure of robustness the average absolute shift in rank (over the set of countries) with respect to the benchmark (GCCA+), we conclude that the indicators that produce major shifts in ranking are mostly hazards&exposure, along with the economic vulnerability ones and the water dependency ratio. That result agrees also with the results in sub-component and component level.

Table ANNEX III 5 – Average shift in countries' ranks per indicator

Missing indicator	Average shift in countries' ranks	Missing indicator	Average shift in countries' ranks
ID1	3.7	ID18	3.2
ID2	3.2	ID19	1.5
ID3	3.2	ID20	1.6
ID4	4	ID21	1.3
ID5	4.3	ID22	1.4
ID6	4.9	ID23	1.5
ID7	4.9	ID24	1.6
ID8	2	ID25	1.1
ID9	2.5	ID26	1.9
ID10	2.9	ID27	1.8
ID11	2.3	ID28	1.6
ID12	1.9	ID29	1.4
ID13	3.7	ID30	1.1
ID14	2.8	ID31	0.9
ID15	4.6	ID32	1.5
ID16	3.1	ID33	3.3
ID17	3.2	ID34	3.6

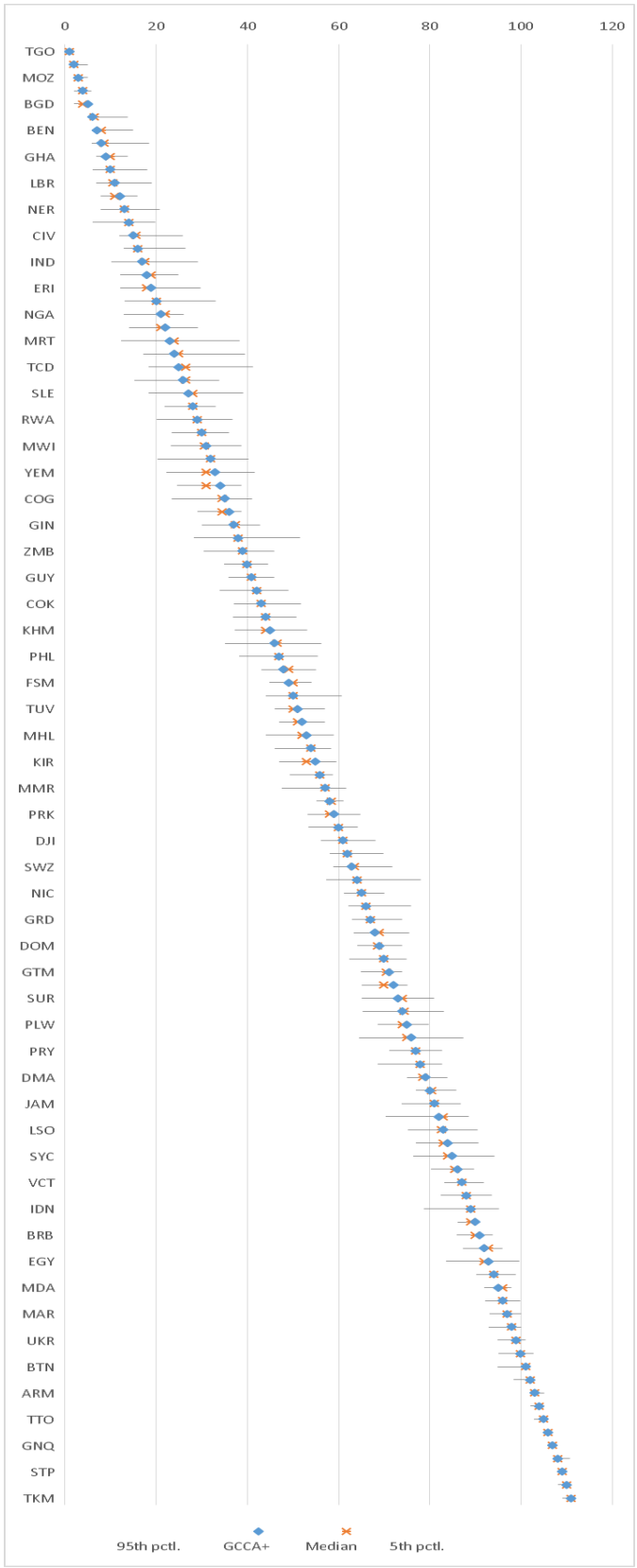
As a general remark, we should add that the major shifts in ranking are not seen in countries at the top or the bottom of the ranking. It is the countries in the middle whose positions alter most. Another important note is that in all cases the original GCCA+ values are within the confidence bounds.

Table ANNEX III 6 – Results of Robustness Analysis showing the GCCA+ index, the median and the corresponding 5th and 95th percentile (bounds) of the distribution of ranks for the 111 countries. The countries are ordered according to their GCCA+ values.

Country	GCCA+	Median	CI	Country	GCCA+	Median	CI	Country	GCCA+	Median	CI
Togo	1	1	[1,2]	**Congo, Dem. Rep.**	38	38	[28.4,51.6]	**Palau**	75	74	[68.6,79.8]
Somalia	2	2	[1,5]	**Zambia**	39	39	[30.4,45.8]	**Syria**	76	75	[64.6,87.4]
Mozambique	3	3	[2.2,5]	**Papua New Guinea**	40	40	[35,44.6]	**Paraguay**	77	77	[71.2,82.6]
South Sudan	4	4	[2,5.8]	**Guyana**	41	41	[36,45.8]	**Sri Lanka**	78	78	[68.6,82.6]
Bangladesh	5	4	[2,5]	**Cameroon**	42	42	[34,49]	**Dominica**	79	79	[75,83.8]
Kenya	6	7	[5,13.8]	**Cook Islands**	43	43	[37.2,51.8]	**Bolivia**	80	81	[77,85.8]
Benin	7	8	[6,15]	**Afghanistan**	44	44	[37,50.8]	**Jamaica**	81	81	[74,86.8]
Mali	8	9	[6,18.4]	**Cambodia**	45	44	[37.4,53]	**Maldives**	82	83	[70.4,88.6]
Ghana	9	10	[7,13.8]	**Vietnam**	46	47	[35.2,56.2]	**Lesotho**	83	83	[75.2,90.4]
Guinea-Bissau	10	10	[6.2,18]	**Philippines**	47	47	[38.2,55.4]	**Timor-Leste**	84	83	[77,90.6]
Liberia	11	11	[7,19]	**Iraq**	48	49	[43.2,55]	**Seychelles**	85	84	[76.4,94.2]
Central African Rep.	12	11	[8,15.8]	**Micronesia, Federated States**	49	50	[45,54]	**Fiji**	86	86	[80.4,89.6]
Niger	13	13	[8,20.8]	**Tanzania**	50	50	[44.2,60.6]	**St. Vincent and Grenadines**	87	87	[83.2,91.8]
Haiti	14	14	[6.2,19.8]	**Tuvalu**	51	50	[46,57]	**Cuba**	88	88	[82.4,93.6]
Côte d'Ivoire	15	16	[12,25.8]	**Belize**	52	51	[47,57]	**Indonesia**	89	89	[78.8,95.2]
Gambia	16	16	[13,26.4]	**Marshall Islands**	53	52	[44.2,59]	**Georgia**	90	89	[86.2,91]
India	17	18	[10.2,29.2]	**Honduras**	54	54	[46,58.4]	**Barbados**	91	90	[86,93.8]
Burundi	18	19	[12.2,24.8]	**Kiribati**	55	53	[47,59.6]	**Nepal**	92	93	[87.4,96]
Eritrea	19	18	[12.2,29.8]	**Tonga**	56	56	[49.4,58.8]	**Egypt**	93	92	[83.6,99.6]
Madagascar	20	20	[13.2,33]	**Myanmar**	57	57	[47.6,61.6]	**Tajikistan**	94	94	[90.2,98.8]
Nigeria	21	22	[13,26]	**Antigua and Barbuda**	58	59	[55.2,61]	**Moldova**	95	96	[92,97.8]
Ethiopia	22	21	[14.2,29.2]	**Korea, Dem. Rep.**	59	58	[53.2,64.8]	**West Bank and Gaza Strip**	96	96	[92.2,99.8]
Mauritania	23	24	[12.4,38.2]	**Vanuatu**	60	60	[53.4,64.2]	**Morocco**	97	97	[93.2,100]
Comoros	24	25	[17.2,39.4]	**Djibouti**	61	61	[56.2,68]	**Cabo Verde**	98	98	[93,100]
Chad	25	27	[18.4,41.2]	**Solomon Islands**	62	62	[58.2,69.8]	**Ukraine**	99	99	[95,101]
Zimbabwe	26	27	[15.4,33.8]	**Swaziland**	63	64	[59,71.8]	**Uzbekistan**	100	100	[95.2,102.8]
Sierra Leone	27	28	[18.4,39]	**Sudan**	64	64	[57.4,78]	**Bhutan**	101	101	[95,102]
Angola	28	28	[22,33]	**Nicaragua**	65	65	[61.2,70]	**Mongolia**	102	102	[98.4,102]
Rwanda	29	29	[20.2,36.8]	**St. Lucia**	66	66	[62.2,75.8]	**Armenia**	103	103	[103,105]
Burkina Faso	30	30	[23.4,36]	**Grenada**	67	67	[63,74]	**Kyrgyz Rep.**	104	104	[102.2,105]

Malawi	31	31	[23.2,38.6]	**Samoa**	68	69	[63.4,75.4]	**Trinidad and Tobago**	105	105	[103,105.8]
Pakistan	32	32	[20.4,40.2]	**Dominican Republic**	69	69	[64.2,74]	**Mauritius**	106	106	[105.2,106]
Yemen	33	31	[22.4,41.6]	**St. Kitts-Nevis**	70	70	[62.4,74.8]	**Equatorial Guinea**	107	107	[106.2,108]
Senegal	34	31	[24.6,38.6]	**Guatemala**	71	71	[65,74]	**Kosovo**	108	108	[107,110.8]
Congo, Rep.	35	35	[23.4,41]	**El Salvador**	72	70	[65.2,75]	**São Tomé and Príncipe**	109	109	[108,110]
Uganda	36	35	[29.2,38.6]	**Suriname**	73	74	[65.2,81]	**Nauru**	110	110	[108.2,110]
Guinea	37	38	[30.2,42.8]	**Laos**	74	75	[65.4,83]	**Turkmenistan**	111	111	[109.2,111]

Figure ANNEX III 3 — Countries' confidence interval in ranking, eliminating each indicator



2: WEIGHT UNCERTAINTY

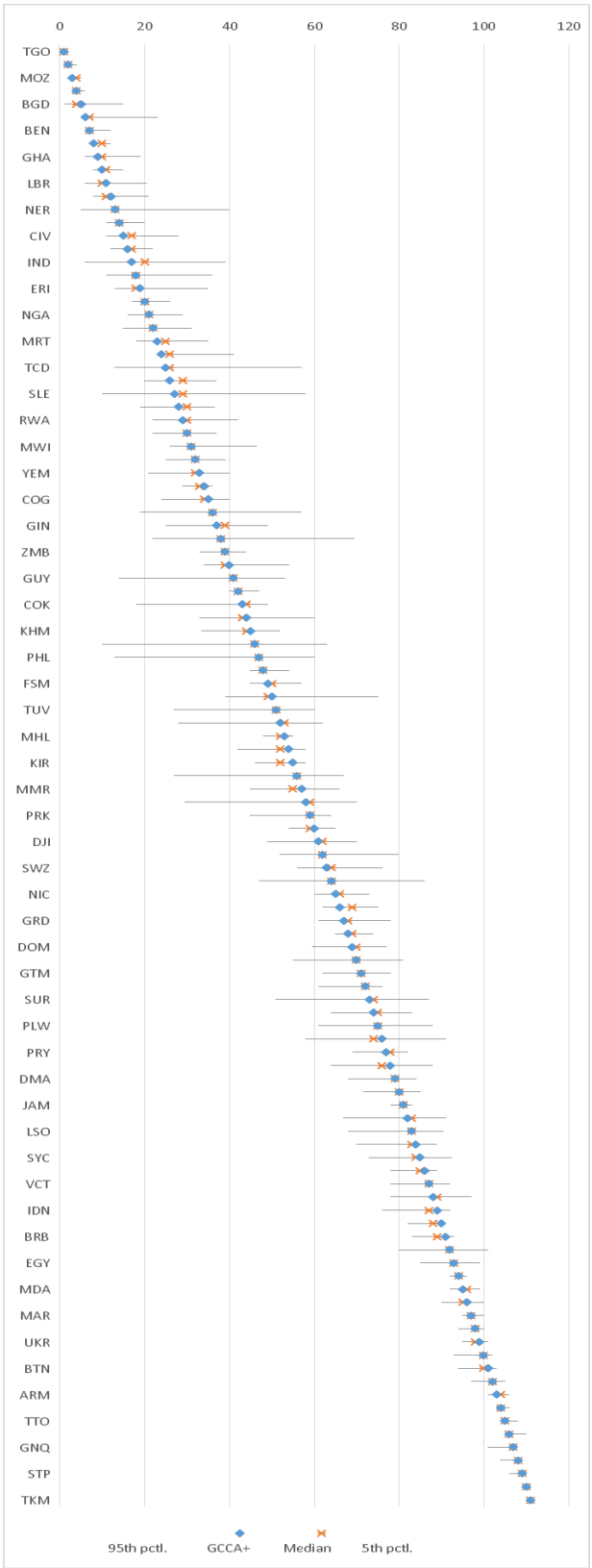
We have allowed the weights of the three GCCA+ components to vary in the interval (0.20, 0.55) without altering the weight distributions at the sub-component or at the indicator level. We have generated a sample of 1 000 random weight-triplets, distributed uniformly in the above-mentioned interval. Using these weights, the country GCCA+ scores are calculated.

Table ANNEX III 7 — Results of RA showing the GCCA+ index, the median and the corresponding 5th and 95th percentile (bounds) of the distribution of ranks for the 111 countries. The countries are ordered according to their GCCA+ values.

Country	GCCA+	Median	CI	Country	GCCA+	Median	CI	Country	GCCA+	Median	CI	
Togo	1	1	[1,2]	**Congo, Dem. Rep.**	38	38	[22,69.5]	**Palau**	75	75	[61,88]	
Somalia	2	2	[1,4]	**Zambia**	39	39	[33,44]	**Syria**				
Mozambique	3	4	[2,5]	**Papua New Guinea**	40	39	[34,54]	**Paraguay**				
South Sudan	4	4	[3,6]	**Guyana**	41	41	[14,53]	**Sri Lanka**				
Bangladesh	5	4	[1,15]	**Cameroon**	42	42	[40,47]	**Dominica**				
Kenya	6	7	[6,23]	**Cook Islands**	43	44	[18,49]	**Bolivia**				
Benin	7	7	[6,12]	**Afghanistan**	44	43	[33,60]	**Jamaica**				
Mali	8	10	[7,12]	**Cambodia**	45	44	[33.5,52]	**Maldives**				
Ghana	9	10	[6,19]	**Vietnam**	46	46	[10,63]	**Lesotho**				
Guinea-Bissau	10	11	[8,15]	**Philippines**	47	47	[13,60]	**Timor-Leste**				
Liberia	11	10	[6,20.5]	**Iraq**	48	48	[45,54]	**Seychelles**				
Central African Rep.	12	11	[8,21]	**Micronesia, Federated States**	49	50	[45,57]	**Fiji**				
Niger	13	13	[5,40]	**Tanzania**	50	49	[39,75]	**St. Vincent and Grenadines**				
Haiti	14	14	[11,20]	**Tuvalu**	51	51	[27,60]	**Cuba**				
Côte d'Ivoire	15	17	[11,28]	**Belize**	52	53	[28,62]	**Indonesia**				
Gambia	16	17	[12,22]	**Marshall Islands**	53	52	[48,55]	**Georgia**				
India	17	20	[6,39]	**Honduras**	54	52	[42,58]	**Barbados**				
Burundi	18	18	[11,36]	**Kiribati**	55	52	[46,58]	**Nepal**				
Eritrea	19	18	[13,35]	**Tonga**	56	56	[27,67]	**Egypt**				
Madagascar	20	20	[17,26]	**Myanmar**	57	55	[45,66]	**Tajikistan**				
Nigeria	21	21	[16,29]	**Antigua and Barbuda**	58	59	[29.5,70]	**Moldova**				
Ethiopia	22	22	[15,31]	**Korea, Dem. Rep.**	59	59	[45,64]	**West Bank and Gaza Strip**				
Mauritania	23	25	[18,35]	**Vanuatu**	60	59	[54,65]	**Morocco**				
Comoros	24	26	[23,41]	**Djibouti**	61	62	[49,70]	**Cabo Verde**				
Chad	25	26	[13,57]	**Solomon Islands**	62	62	[52,80]	**Ukraine**				
Zimbabwe	26	29	[20,37]	**Swaziland**	63	64	[56,76]	**Uzbekistan**				
Sierra Leone	27	29	[10,58]	**Sudan**	64	64	[47,86]	**Bhutan**				

Angola	28	30	[19,36.5]	**Nicaragua**	65	66	[60,73]	**Mongolia**
Rwanda	29	30	[22,42]	**St. Lucia**	66	69	[62,75]	**Armenia**
Burkina Faso	30	30	[22,37]	**Grenada**	67	68	[61,78]	**Kyrgyz Rep.**
Malawi	31	31	[26,46.5]	**Samoa**	68	69	[65,74]	**Trinidad and Tobago**
Pakistan	32	32	[25,39]	**Dominican Republic**	69	70	[59.5,77]	**Mauritius**
Yemen	33	32	[21,40]	**St. Kitts-Nevis**	70	70	[55,81]	**Equatorial Guinea**
Senegal	34	33	[29,36]	**Guatemala**	71	71	[62,78]	**Kosovo**
Congo, Rep.	35	34	[24,40]	**El Salvador**	72	72	[61,76]	**São Tomé and Príncipe**
Uganda	36	36	[19,57]	**Suriname**	73	74	[51,87]	**Nauru**
Guinea	37	39	[25,49]	**Laos**	74	75	[64,83]	**Turkmenistan**

Figure ANNEX III 4 — Countries' confidence interval in ranking, using a sample of N=1000 random weights, uniformly distributed in the interval (0.20, 0.55)



In all cases, the original GCCA+ ranks are inside the confidence interval and really close to the stimulated median.
Again, the first and last countries in ranking do not have wide ranges, but by contrast the confidence intervals are really tight, although the model is highly stressed as we allow for wide variance in the weights.
The widest CIs are noted in the upper/middle countries considering their original GCCA+ rank. There are 23 cases of a CI range of at least 25 that are highlighted in red. Seven countries, Vietnam, Sierra Leone, Dem. Rep. of Congo, Philippines, Chad, Antigua and Barbuda and Tonga have a CI range from 40 to 53.
The primary factor behind the wide confidence intervals for these countries is uneven performance in the three components.
For instance, in the original GCCA+, Vietnam's rank for hazards&exposure was 2, while for vulnerability it was 62 and and for lack of capacity 106.
The corresponding figures for Sierra Leone, Dem. Rep. of Congo and Philippines are respectively (95, 27, 4), (98, 4, 20) and (3, 66, 103). Therefore, even small changes in the weights of the three components will result in an arithmetic average that is substantially different from that of the original GCCA+ ranking.

CONCLUSIONS

At all levels of the analysis, the original GCCA+ values are within the confidence bounds.
The major shifts in the ranking of a country affect mostly countries that are in the middle of the original GCCA+ classification. In most cases, the first and last countries in ranking don't have wide ranges- but by contrast the confidence intervals are really tight. Finally, countries that show different performance in the three components are mostly affected by weight changes.

REFERENCES

2014 EPI –JRC analysis and recommendations
OECD/EC JRC, *Handbook on Constructing Composite Indicators: Methodology and User Guide.* Paris: OECD, 2008.
Paruolo, P., Saisana, M. and Saltelli, A. 2013. 'Ratings and Rankings: voodoo or science?', *Journal of the Royal Statistical Society* A176(3), 2013, pp. 609-634.
Saisana, M., Saltelli, A. and Tarantola, S., 'Uncertainty and sensitivity analysis techniques as tools for the analysis and validation of composite indicators', *Journal of the Royal Statistical Society* A168(2), 2005, pp. 307-323.

ANNEX IV — Assessment and Monitoring of the Negative Impacts of Climate Change on Land Vegetation in Developing Countries, using Earth Observation (EO) Satellite Data

Summary

In this study, the vulnerability of 108 developing countries to the impact of climate change has been assessed, using a 12-year time series of EO satellite data to map the area of each country affected annually by vegetation stress due to climate-related environmental problems (e.g. rainfall anomalies and forest loss). As part of the analysis, the JRC's global database of satellite-measured Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) was used to develop a new indicator, Annual Vegetation Stress (AVS).

A detailed analysis of six countries (Nicaragua, Equatorial Guinea, Samoa, Timor-Leste, Cambodia, and India) shows good correspondence between high values of AVS and the occurrence of climatic extremes (droughts) and anthropogenic disturbance (deforestation). The results for Equatorial Guinea, for example, suggest that the recent trend of large-scale droughts and negative rainfall anomalies that has been observed in central and western Africa (as documented for example by Asefi-Najafabady and Saatchi, 2013), contributes to increased vegetation stress in the region's tropical rain forests. In the case of Timor-Leste, there is also evidence of a 'biological lag' effect, whereby the main impact of drought on the growth of tropical dry forests, is delayed until the year following the climate event.

In conclusion, the methodology is shown to be an effective means of quantifying the negative impacts on land vegetation of climate-related natural hazards. When combined with other publicly available global meteorological and land use databases, for example, the methodology can provide a powerful tool for assessing and monitoring the vulnerability to the effects of climate change of major land-use sectors, such as agriculture and forestry, for any geographic regions of interest.

1. Introduction and objectives of study

A central goal of the EU's Global Climate Change Alliance/GCCA initiative (which has recently expanded to GCCA+, covering the period 2014-2020) is to provide technical support, through various regional and national programmes worldwide, for initiatives aimed at enhancing the capacity of vulnerable developing countries to adapt to the adverse effects of changing climate patterns ([4]). Many of the developing countries covered by the GCCA/GCCA+ are affected by similar climate-related environmental problems, including reduced agricultural production due to droughts, and increased carbon emissions and greater susceptibility to flooding caused by unsustainable land-use practices such as deforestation.

([4]) http://www.gcca.eu

The aim of this study is to develop a methodology for mapping and monitoring the negative impacts of climate-related weather anomalies (e.g. droughts) and anthropogenic disturbance (e.g. deforestation) on the health and growth status of land vegetation (mainly agricultural crops and forestry), using EO data. The methodology, which includes a newly developed EO-based indicator of relative vegetation health, the AVS, is easily applied for any selected countries or geographic region worldwide, and for any given year. Because the methodology is based on EO data, the results are standardised and directly comparable across countries and regions.

2. Data and methodology

As part of Europe's Copernicus Earth Observation Programme, data from EO satellites as well as *in situ* sensors are collected, processed and used to provide reliable and up-to-date information in six major thematic areas, including climate change. There are by now many well established, operational applications for using EO satellite data to assess and monitor global environmental impacts and vulnerabilities related to climate change. Indeed, the existing wealth of high-resolution EO satellite data for global land applications has been significantly enhanced with the recent launch (on 23 June 2015) of the Sentinel-2 satellite, developed as part of Copernicus by the European Space Agency (ESA) ([5]).

The Global Climate Observing System (GCOS) has defined a list of 50 'Essential Climate Variables' (ECVs) that are considered to be both feasible for global climate observation, and important to support the work of the UNFCCC and the IPCC ([6]). One of the ECVs defined for the terrestrial domain is the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), which is a biophysical parameter, derived from EO satellite data, that measures the fraction of solar radiation incident on land vegetation which is absorbed by live green leaves for photosynthesis activity (Gobron et al., 2004).

Values of FAPAR vary in space and time, depending on vegetation type, abundance, and phenology, and on adverse environmental conditions such as limited water availability, temperature extremes, storms, disease, fire, as well as anthropogenic interventions. High FAPAR values are associated with favourable conditions for vegetation, while low FAPAR values are related to stress and disturbance.

In this study, the climate-related changes in the health and growing conditions of land vegetation (i.e. agriculture crops, grassland, forest cover, natural vegetation) in 108 developing countries of interest (listed in Annex 1) during 2003-2014, are assessed and compared, based on a country-by-country analysis of annual anomalies in FAPAR for the period 2003-2014.

An overview of the input datasets that were used for the analysis carried out in this study, is presented in Table 1. Each dataset is described in more detail below.

([5]) http://en.wikipedia.org/wiki/sentinel-2
([6]) http://www.eohandbook.com/eohb2011/climate_variables.html

A database of global, multiannual FAPAR values, mapped by EO satellites, has been developed by the JRC of the European Commission. ([7]) For the purposes of this study, for each year in the time period of interest (2003-2014) the 12-monthly global FAPAR maps were averaged into a single 'annual FAPAR' map, which was then used to compute the annual FAPAR anomalies, calculated as the difference between the annual FAPAR values and the average FAPAR values for the entire time series (i.e. January 2003 to December 2014).

For any given year, therefore, an image pixel with a negative annual anomaly (implying an annual FAPAR value lower than the pixel's long-term mean value), will indicate conditions of relative vegetation stress during that year. Conversely, an image pixel with a positive annual anomaly (implying an annual FAPAR value higher than the pixel's long-term mean value), will indicate relatively favourable vegetation growth conditions during that year. The annual FAPAR anomaly map for 2014, for example, is shown in Figure 1.

In order to enable a country-by-country analysis and comparison of climate-related vegetation stress, for each year in the time series (2003-2014) the annual FAPAR anomaly data were aggregated by computing, for each of the 108 countries of interest, the percentage of pixels with negative anomalies (i.e. vegetation stress) relative to the estimated total vegetation area (given by the total number of FAPAR pixels). For the remainder of this report, this computed value is referred to as the area of AVS.

Table ANNEX IV 1 – Input global spatial datasets, derived from Earth Observation (EO) satellite data.

EO-derived dataset	Description
Global annual FAPAR anomaly ([7])	▪ Contents: Annual anomalies of the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR), derived from SeaWiFS (NASA) and MODIS (NASA) satellite images from 2003 to 2014. ▪ Coverage: Global. ▪ Spatial resolution: 0.05 degrees (~ 5 km). ▪ Temporal resolution: Annual, 2003-2014. ▪ Responsible institution: European Commission's JRC — FAPAR project. ▪ Scientific reference: Gobron et al., 2004.
Global forest extent and change ([8])	▪ Contents: Maps of forest extent and change, for 2000-2013, based on high-resolution Landsat satellite images. ▪ Coverage: Global. ▪ Spatial resolution: 1 arcsecond (~ 30 metres). ▪ Temporal resolution: Annual, 2000-2013. ▪ Responsible institution: University of Maryland — Global Forest Cover Change project. ▪ Scientific reference: Hansen et al., 2013.
Global land cover ([9])	▪ Contents: Three global land cover maps (2000, 2005, 2010), based on the UN Land Cover Classification System (LCCS). ▪ Coverage: Global. ▪ Spatial resolution: 0.002778 degrees (~ 300 metres). ▪ Temporal resolution: 3 'epochs' — 2000, 2005, 2010. ▪ Responsible institution: ESA — Climate Change Initiative (CCI). ▪ Scientific reference: Bontemps et al., 2012.

([7]) http://fapar.jrc.ec.europa.eu/
([8]) http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.1.html
([9]) http://www.esa-landcover-cci.org/

Two other sources of EO-derived spatial information that were used, as described below, for the purposes of this study are 'global forest extent and change', from the University of Maryland's Global Forest Cover Change project (Hansen et al., 2013), and 'global land cover', from the ESA's CCI (Bontemps et al., 2012). The two databases are shown in Figure 2 and Figure 3. A further source of information was the World Bank indicators related to climate change ([10]), which have been used in this study to derive, for example, change in area of forest cover during the period 2003-2012 (Figure4).

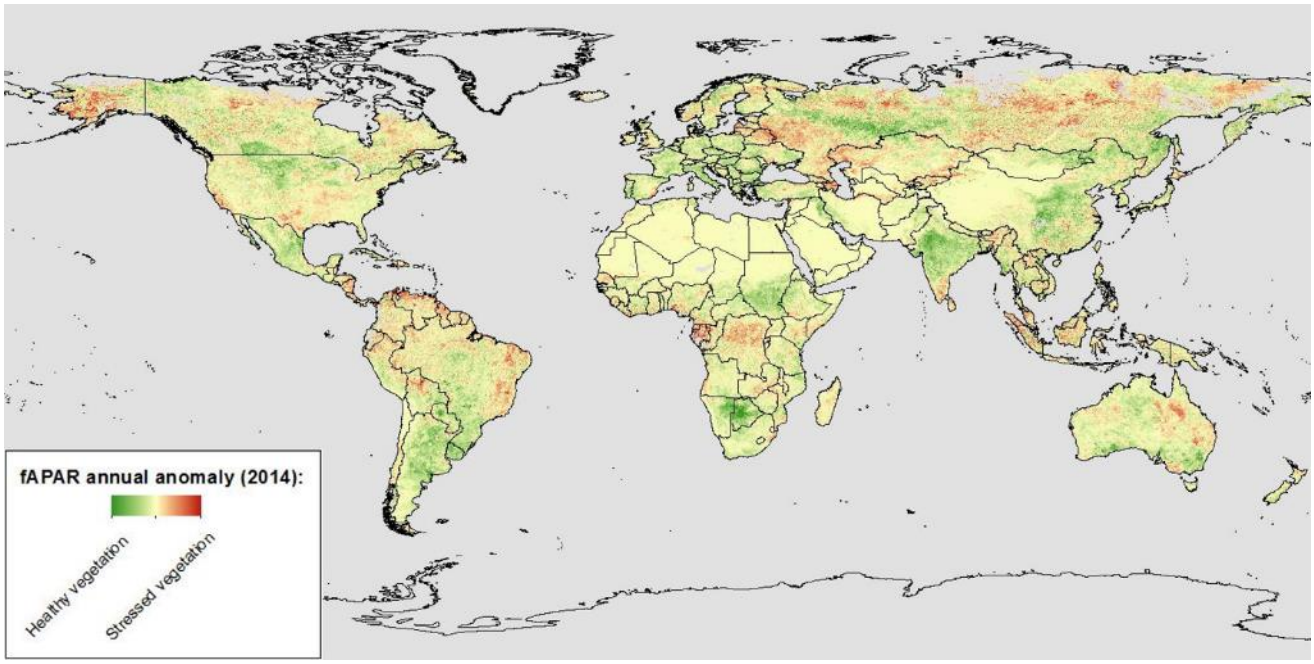


Figure ANNEX IV 1 — Example of JRC's annual FAPAR anomaly product for 2014 (green = healthy vegetation, red= vegetation stress) ([7])

([10]) http://data.worldbank.org/indicator

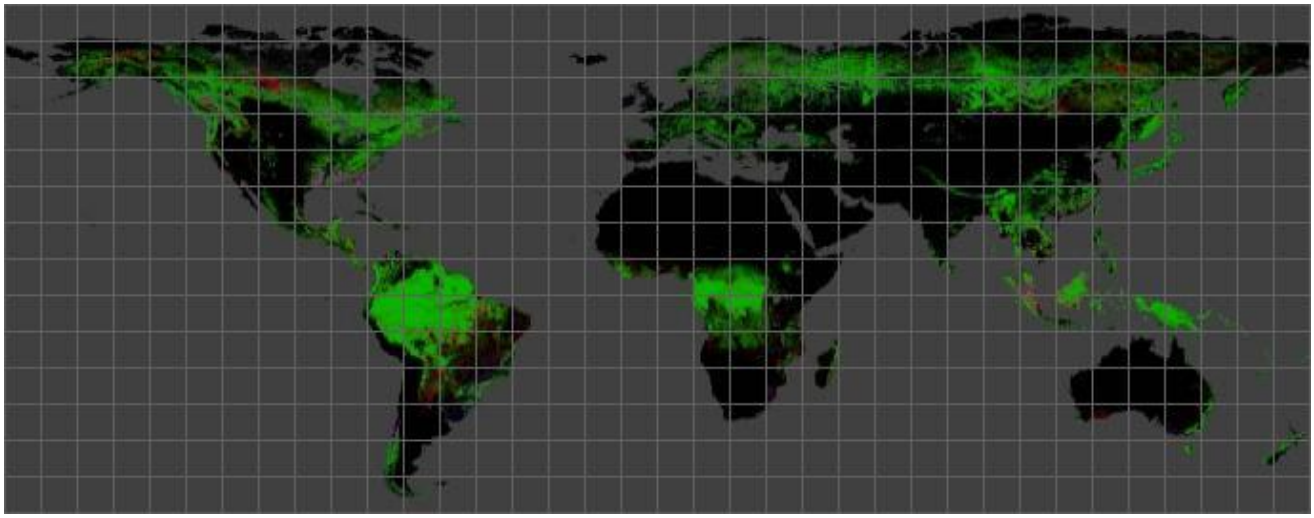
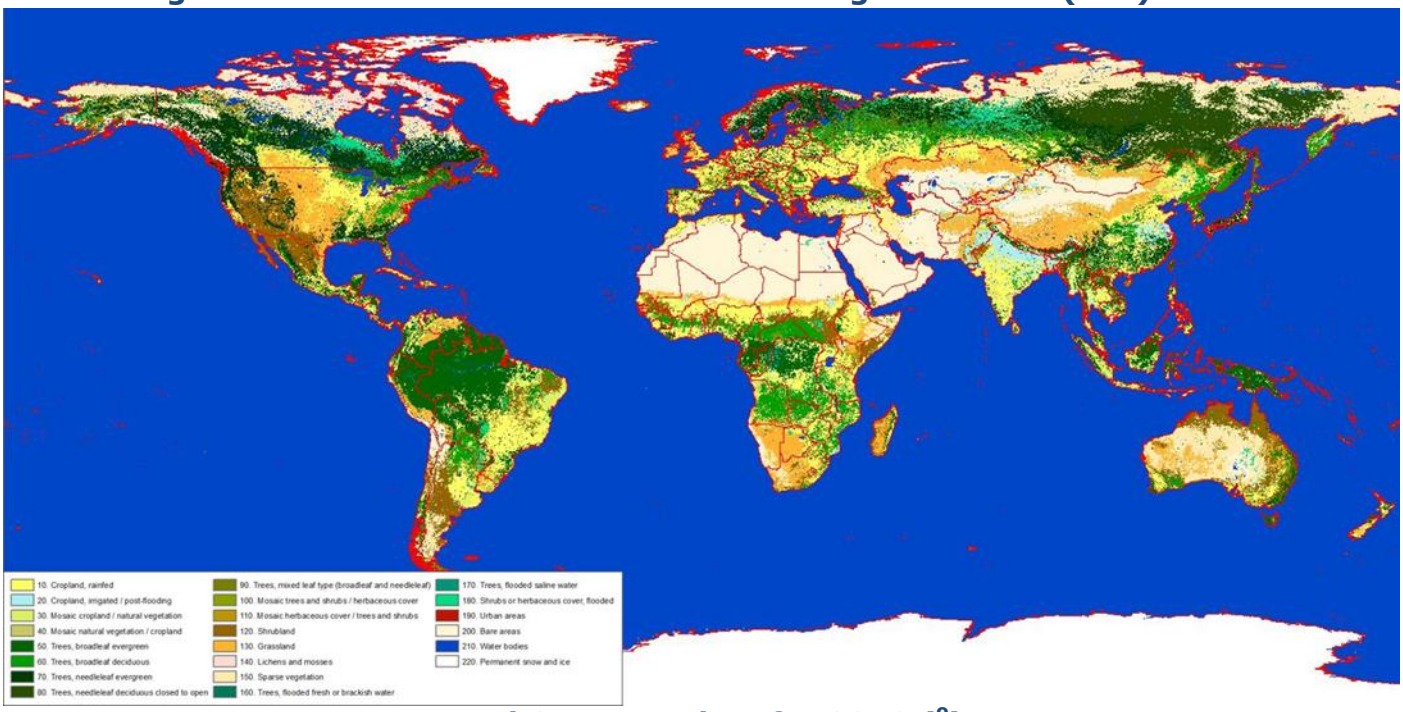


Figure ANNEX IV 2 — All 10 by 10 degree 'granules' (504 in total) of high-resolution EO-based global forest extent (2000 and 2013) and forest change (2001-2013) ([8])

Figure ANNEX IV 3 — + ESA's Climate Change Initiative (CCI) Global



Land Cover product for 2010 ([9])

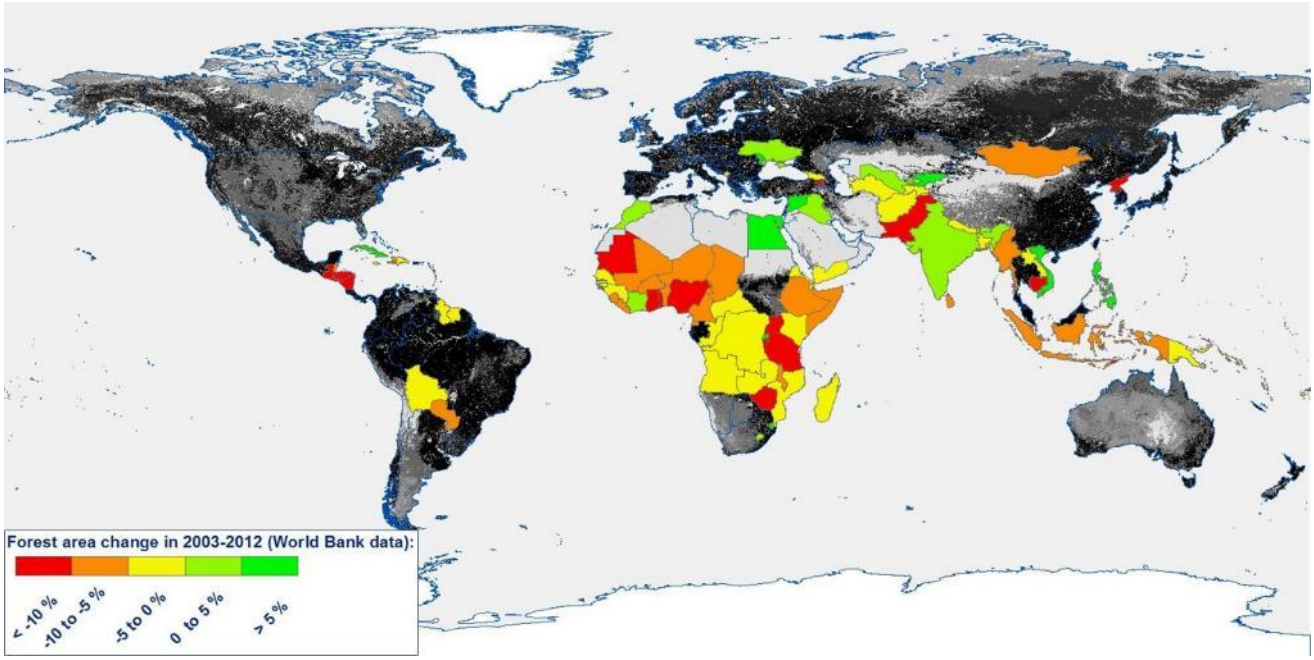


Figure ANNEX IV 4 — Change in forest area in 108 countries of interest during 2003-2012 (from World Bank statistics) ([10])

3. Results and discussion

Figure 5 shows the area of AVS computed for 2014, expressed as a percentage of each country's total vegetated area, for all countries of interest. Figure 6 shows the area of AVS averaged over the entire available time series (2003-2014). As can be seen from the legends, countries with lower AVS values are highlighted in green and those with higher AVS values are highlighted in red.

The full list of the 108 countries, ranked in decreasing order of average area of AVS for 2003-2014, is presented in Annex 2. Also included in the table in Annex 2 are each country's reported change in forest cover during 2003-2012, derived from World Bank statistics as described previously (see Figure 4) and the area of the three main vegetation types (forest cover, agricultural crops and natural vegetation), computed from ESA's Climate Change Initiative (CCI) land cover data for 2010 (Figure3)

Clearly, countries with the highest average AVS values for 2003-2014 (as shown in Annex 2 and Figure 6) may be considered particularly vulnerable in terms of climate impacts on vegetation. In order to explore this further, six of the countries with the highest average area of AVS (and therefore, in theory, the most vulnerable to vegetation stress), were selected for more detailed analysis. The six countries are Nicaragua, Equatorial Guinea, Samoa, Timor-Leste (or East Timor), Cambodia and India, with average AVS values of 15.5 %, 27 %, 15 %, 16 %, 18 %, and 14 %, respectively. Figure 7 and Figure 8 show, for these six countries, the inter-annual variation in the area of AVS throughout the entire time series (2003-2014). The results for each of the six countries are analysed below.

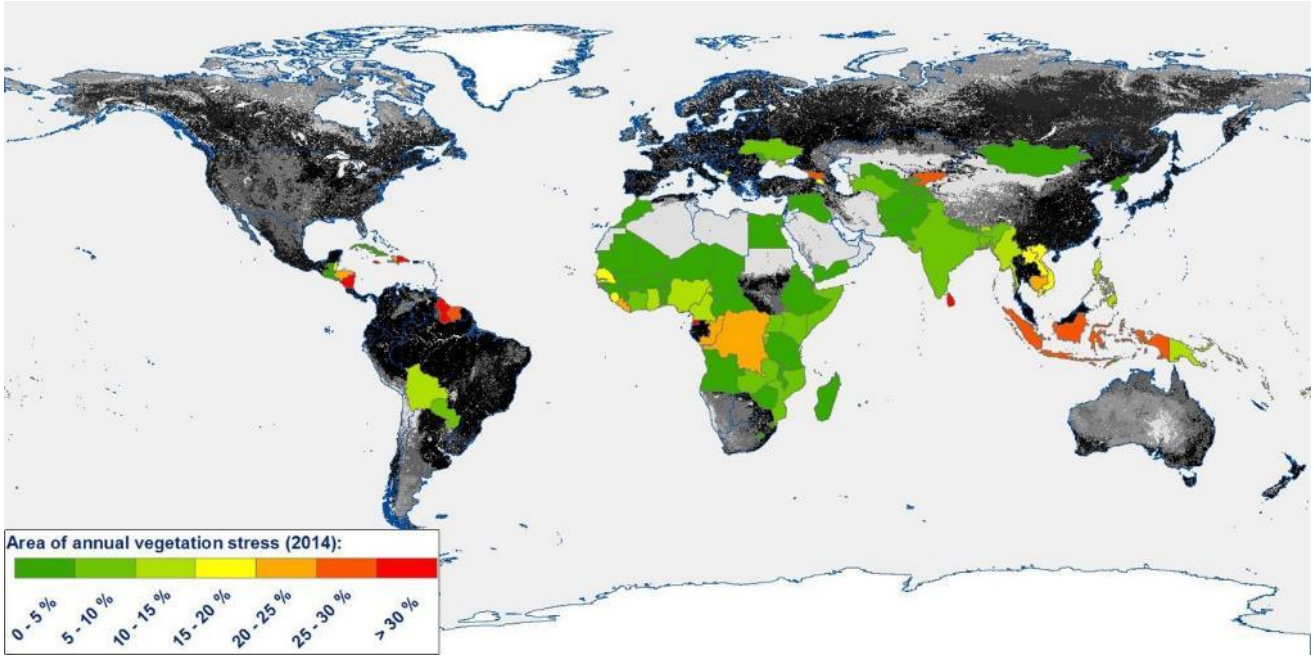


Figure ANNEX IV 5 — Area of annual vegetation stress (AVS) computed for 2014, for all countries of interest (green = low AVS values, red = high AVS values)

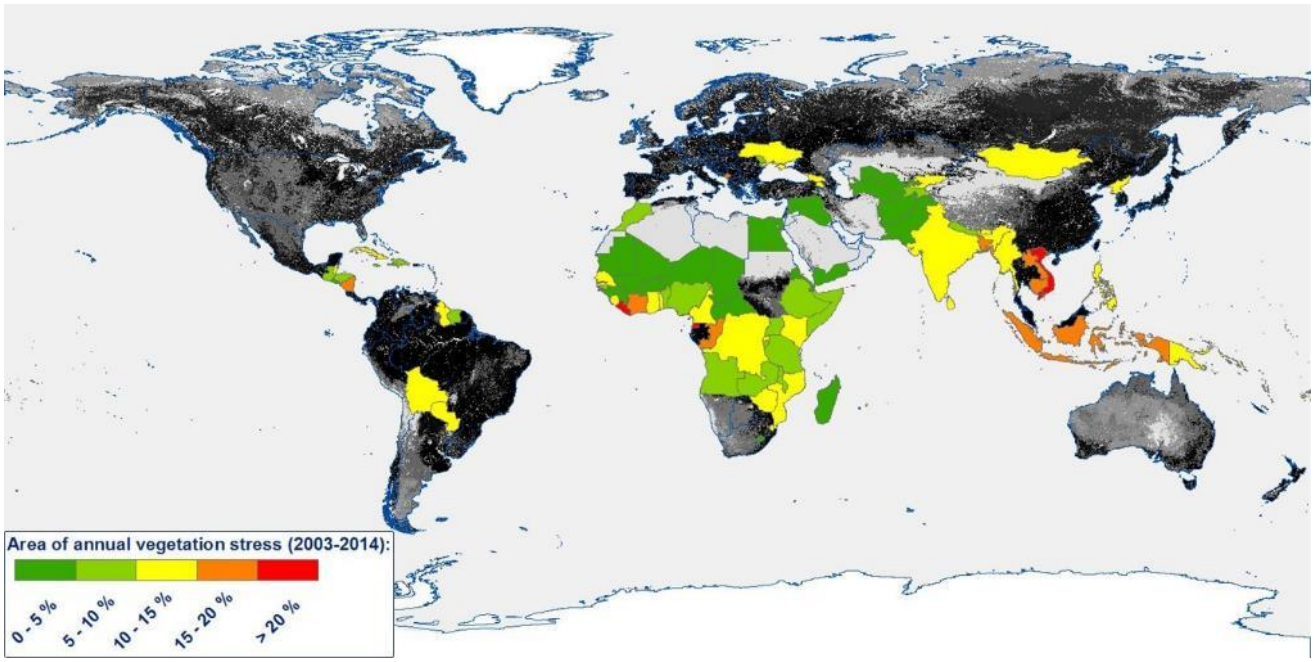


Figure ANNEX IV 6 — Area of annual vegetation stress (AVS) averaged for entire available time series (2003-2014), for all countries of interest (green = low AVS values, red = high AVS values)

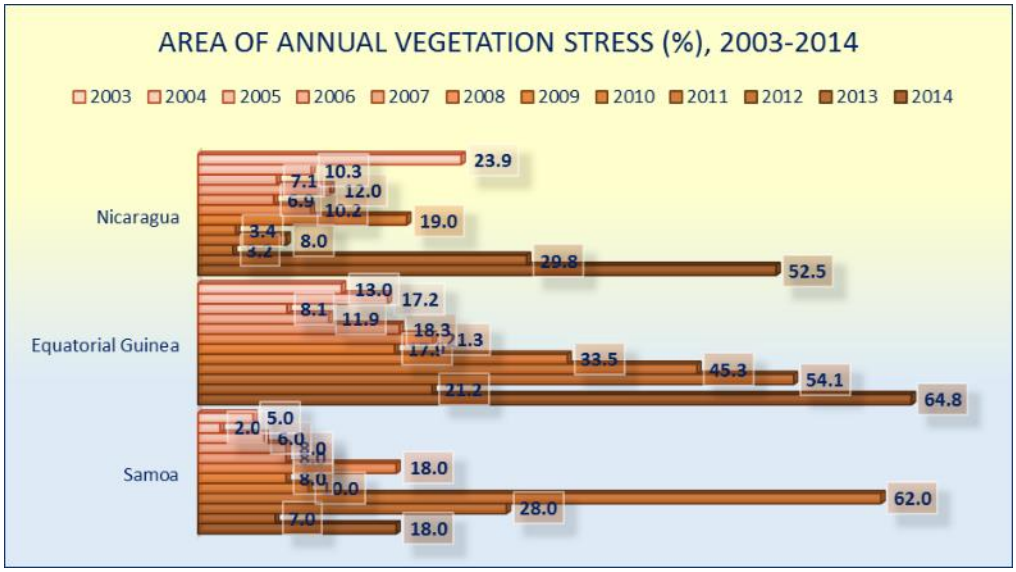


Figure ANNEX IV 7 — Inter-annual variation of area of annual vegetation stress (AVS) during 2003-2014, for Nicaragua, Equatorial Guinea and Samoa

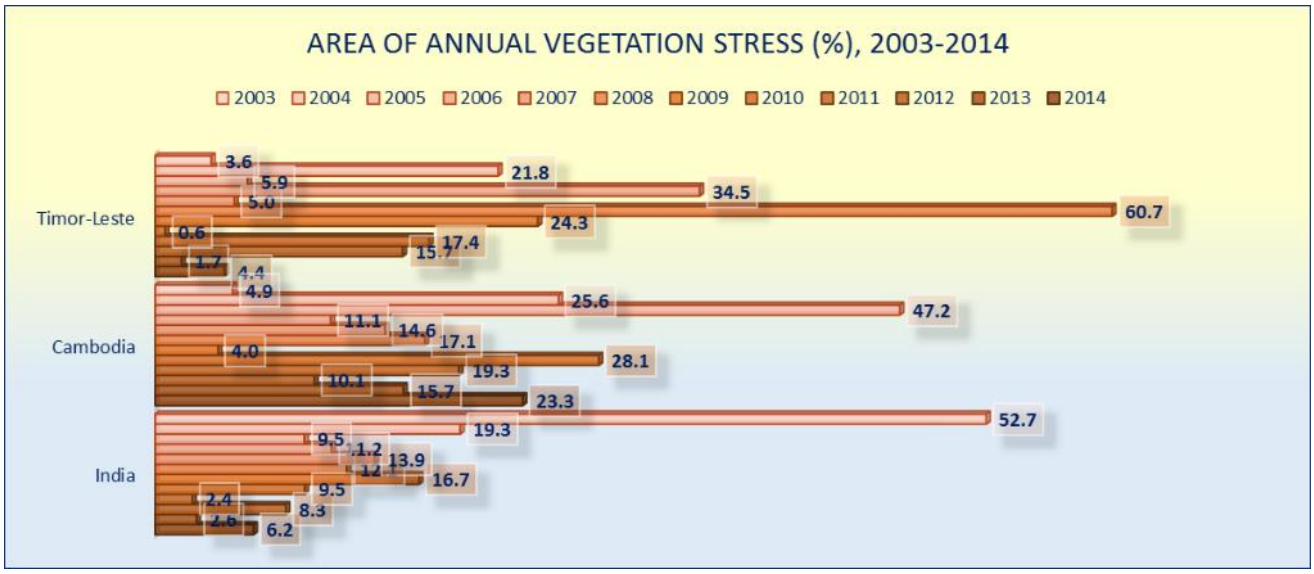


Figure ANNEX IV 8 — Inter-annual variation of area of annual vegetation stress (AVS) during 2003-2014, for Timor-Leste (East Timor), Cambodia and India

3.1 Analysis of Annual Vegetation Stress results for Nicaragua

Nicaragua, the largest country in Central America, has a tropical climate, with a wet season from May to November, and has some of the most extensive rainforests in Central America. The dominant land cover types, based on analysis of 2010 ESA CCI land cover data (Annex 2), are agricultural crops (50 %) and forest cover (34 %). The main environmental issues in Nicaragua include deforestation, soil erosion, and water pollution, while it is also susceptible to hurricanes, earthquakes, volcanoes, and landslides ([11]).

Deforestation, caused by clearance for agriculture and cattle grazing, commercial logging, and forest fires, is a major problem in Nicaragua. Figure 9 summarises the results from a study by Kim et al. (2015) in which high-resolution EO satellite data were used to measure the change in deforestation rates from 1990s to 2000s, for 34 tropical countries. As can be seen, the rate of deforestation in Nicaragua was shown to have increased by 296 % (equal to 92 000 hectares/year) between the 1990s and 2000s ([12]).

As is evident in Figure 7, the average area of AVS for Nicaragua (15.5 %) is largely influenced by one year (2014) with an exceptionally high AVS value (52.5 %). While Nicaragua's high rate of deforestation (see Figure 9) undoubtedly contributes, the extremely high value for 2014 is clearly related to the severe four-month drought in Nicaragua during the 2014 wet season, which reportedly affected agricultural production in two thirds of the country, and is considered the worst drought in Nicaragua for 32 years ([13]). When the prolonged drought ended in late August, much of Nicaragua was badly affected by flash floods ([14]).

([11]) http://www.eoearth.org/view/article/154847/
([12]) http://news.mongabay.com/2015/0225-tropical-forest-loss.html
([13]) https://www.wfp.org/stories/images-drought-crisis-nicaragua
([14]) http://www.theguardian.com/global-development/2014/dec/10/climate-change-nicaragua-farming-drought-flood

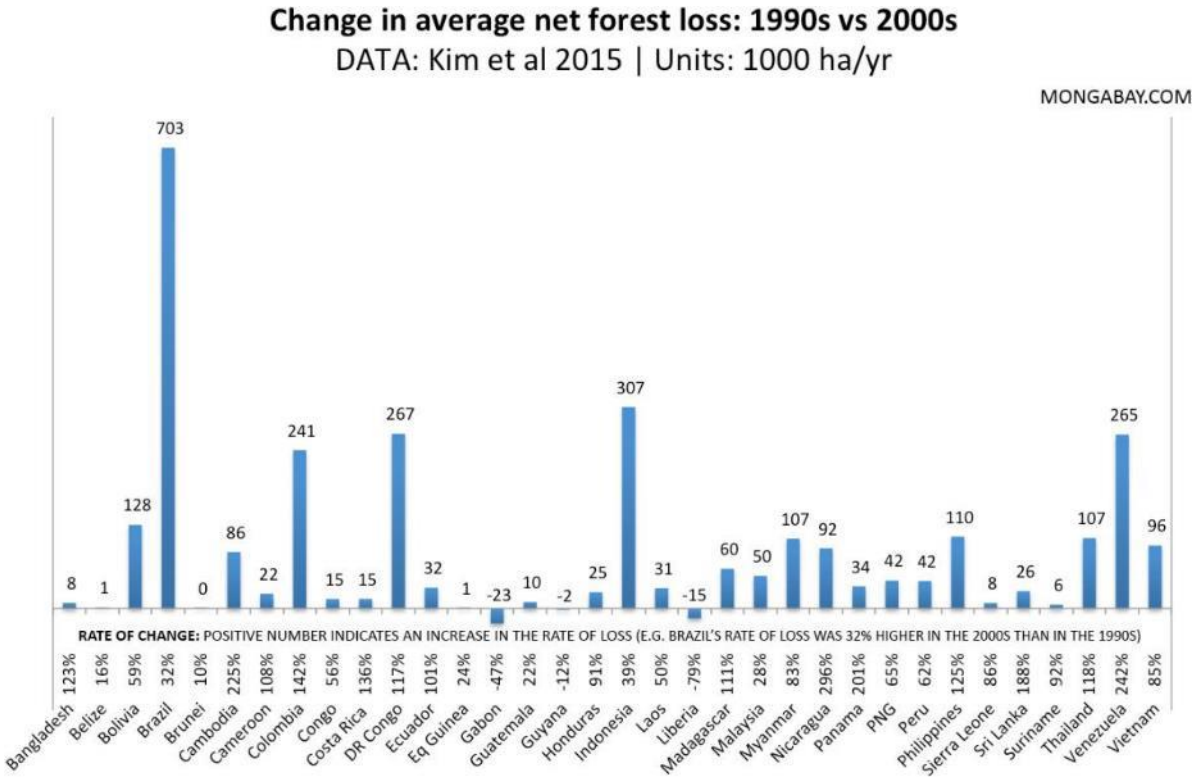


Figure ANNEX IV 9-Change in deforestation rates between 1990s and 2000s, for 34 tropical countries.[12]

3.2 Analysis of Annual Vegetation Stress results for Equatorial Guinea

Equatorial Guinea on the west coast of Central Africa, is one of Africa's smallest countries. It has a typically equatorial or tropical climate, with high temperatures all year, heavy rainfall and dense cloud cover for most of the year. The wet seasons in general are from February to June and from September to December, with the wettest period generally between April and October. Forests cover roughly 98 % of the total national land area of Equatorial Guinea, providing services and sustenance to hundreds of thousands of the country's inhabitants ([15]). Equatorial Guinea's most significant environmental problems are deforestation, water pollution, desertification, and the preservation of wildlife. The forests are threatened by agricultural expansion, fires and grazing. The country is also vulnerable to violent windstorms and flash floods ([16]).

Figure 10 shows the long-term average monthly rainfall data for Equatorial Guinea over 20 years, from 1990 to 2009 ([17]). Figure 11 shows the six-month rainfall data for Africa for the period April to October 2014, produced by NOAA's National Weather Service ([18]). As can be seen, during this six-month period the entire country of Equatorial Guinea (and most of Cameroon and Nigeria to the north) experienced strong to very strong negative rainfall anomalies. In fact, the

([15]) http://www.wri.org/blog/2013/11/equatorial-guinea-increases-protected-forests-63-percent-shows-new-atlas
([16]) http://www.eoearth.org/view/article/51cbedc07896bb431f693a85/
([17]) http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&thisregion=africa&thisccode=gnq
([18]) http://www.cpc.ncep.noaa.gov/products/global_monsoons/african_monsoons/precip_monitoring.shtml

below-average rainfall in Equatorial Guinea in 2014 can be considered as a continuation of the trend of strong negative water deficit (WD) anomalies in West and Central Africa that were observed during 1998-2011, as described by Asefi-Najafabady and Saatchi (2013).

Deforestation is a major environmental problem in Equatorial Guinea. In the study by Kim et al. (2015) that was mentioned earlier, the rate of deforestation in Equatorial Guinea was shown to have increased by 24 % (equal to 1 000 hectares/year) between the 1990s and 2000s (see Figure 9). Hansen et al. (2013) describe another recent study in which high-resolution (30 by 30 metres) EO satellite images have been used to map global forest extent and change, for the period 2000-2012. The resulting high-resolution global maps of forest cover extent and change — which were subsequently updated to include also forest changes during 2013 — are publicly available via internet ([8]).

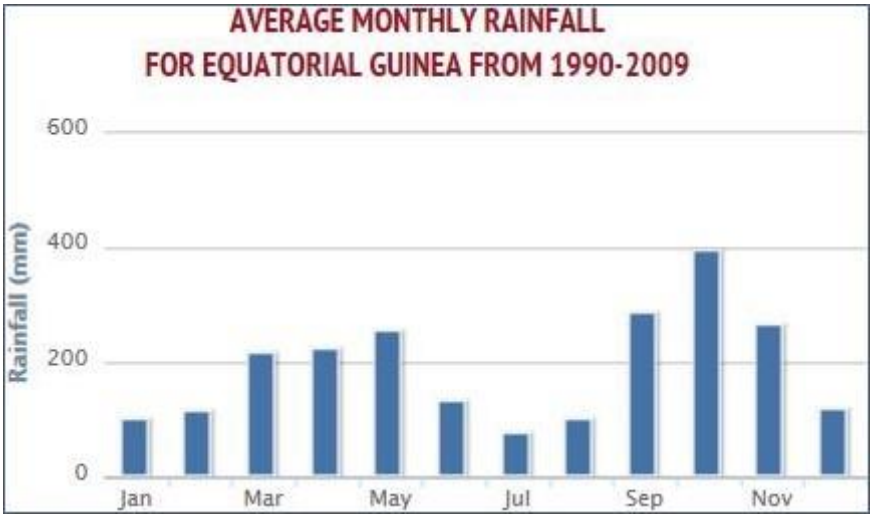


Figure ANNEX IV 10 — Average monthly rainfall for Equatorial Guinea from 1990 to 2009 ([17])

In order to assess the likely contribution of deforestation to the area of AVS in Equatorial Guinea, output data produced by the aforementioned study on global forest extent and change were downloaded and analysed. Specifically, maps of forest extent and density for a reference year (2000), and forest change for each of the years 2001-2013, were downloaded for a 20 by 20 degree area (~ 24 000 square kilometres) covering Equatorial Guinea and surrounding Central and West African countries.

Figure 12 shows the distribution, for the area of interest, of the various forest density types (defined as percentage canopy closure for all vegetation taller than five metres in height) in 2000, while Table 2 shows the forest cover and forest density information aggregated for each country. As can be seen, Equatorial Guinea has both the highest proportion (98 % of its land area) of forest cover and the highest proportion (88 %) of the most dense forest type.

In order to identify the specific years in which forest loss occurred in the area of interest, the maps of annual forest change were analysed, and the results are summarised in Figure 13. As can be seen, of the total deforestation that occurred during 2001-2013, Equatorial Guinea experienced a higher proportion (over 70 %) between 2008 and 2013, than any of the other countries.

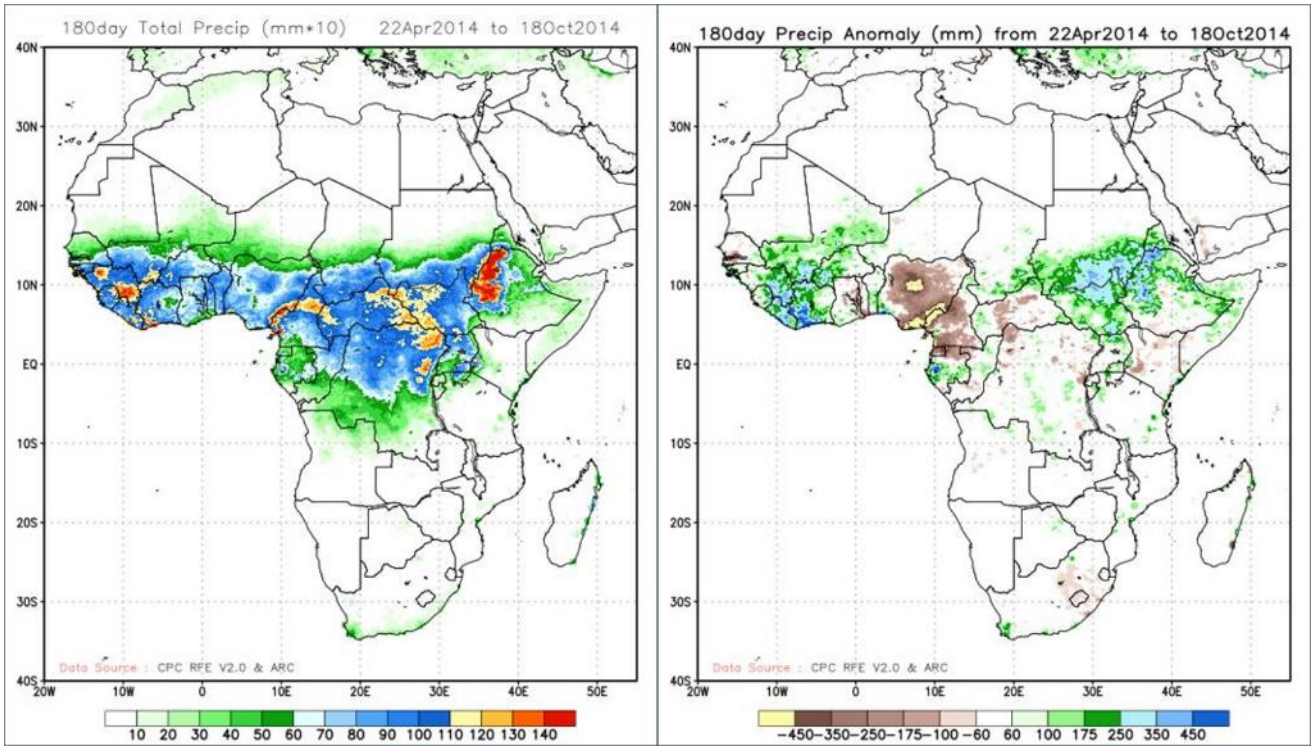


Figure ANNEX IV 11 — six-month rainfall data for Africa, showing below-average rainfall in Equatorial Guinea from April to October 2014 ([18])

From Figure7 it is evident that during the second half of the study period (i.e. 2009-2014) the AVS for Equatorial Guinea generally increased, culminating in an exceptionally high AVS value (65 %) in 2014. This pattern is entirely consistent with both the negative rainfall anomalies and the high annual deforestation rates that occurred in Equatorial Guinea during this period, as analysed here.

Table ANNEX IV 2 — Forest extent and forest density information, aggregated for each country

Country	Total area (km^2)	Forest area (%)	Forest density types (% canopy closure)				
			0-20 %	20-40 %	40-60 %	60-80 %	80-100 %
Equatorial Guinea	28 050	98.0	0	0	3	9	88
Gabon	257 670	94.7	4	2	2	5	87
Central African Republic	622 980	92.2	8	17	53	9	13
Congo, the Democratic Republic of the	2 267 050	87.7	11	19	19	12	39
Congo	341 500	85.9	13	13	7	7	61
Angola	1 246 700	84.1	15	24	40	11	11
Cameroon	472 710	81.6	18	16	17	14	35
Nigeria	910 770	28.2	71	14	13	2	0
Ghana	227 540	20.2	77	11	12	0	0
Togo	54 390	18.9	81	12	7	0	0
Benin	112 760	14.2	86	14	1	0	0
São Tomé and Príncipe	960	12.4	9	3	11	15	62
Chad	1 259 200	9.6	90	9	1	0	0

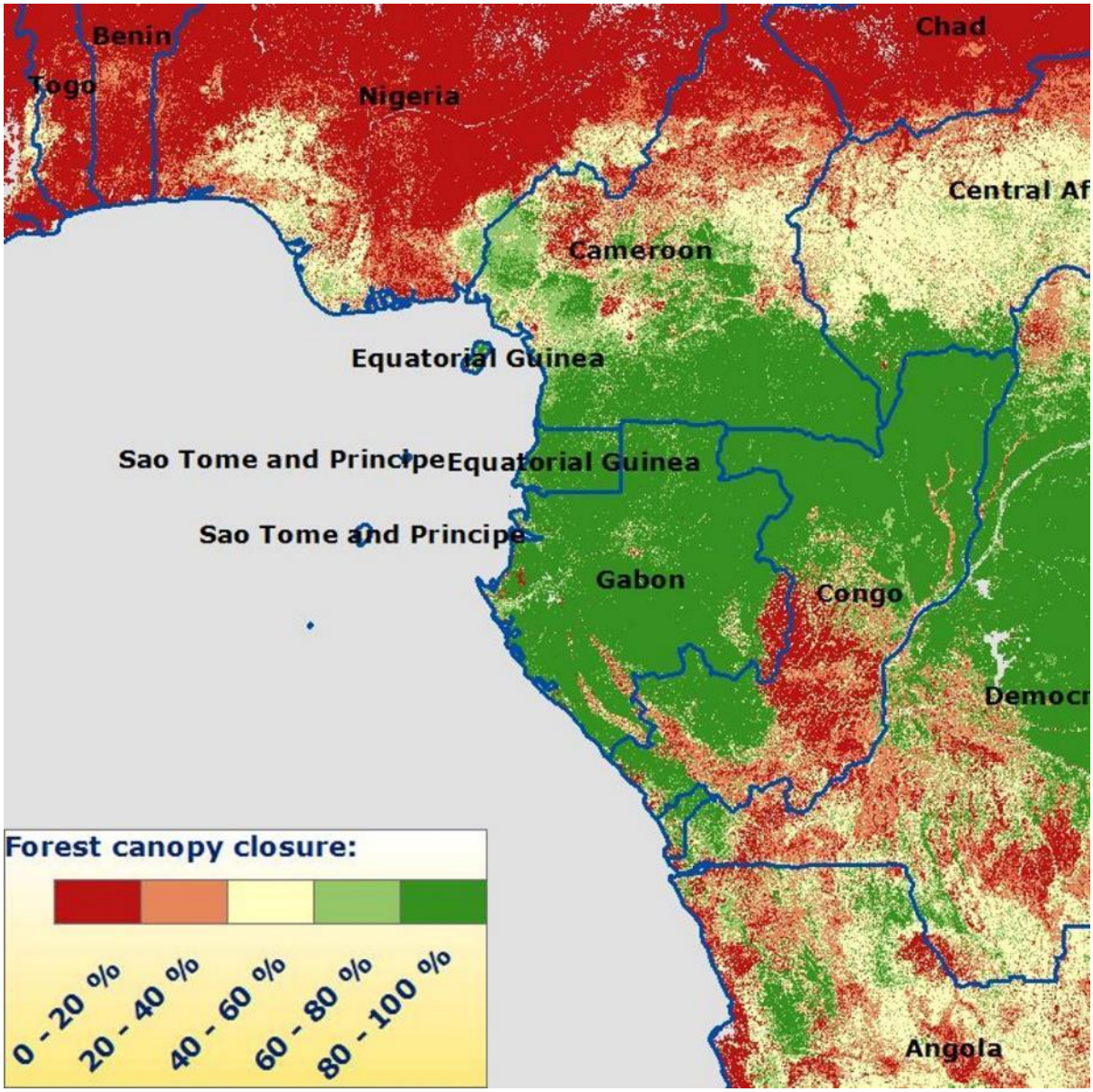


Figure ANNEX IV 12 — Forest density types for 20 by 20 degree (~ 2,400 square kilometres) area of Central and West Africa (red = 0-20 % canopy closure, green = 80-100 % canopy closure)

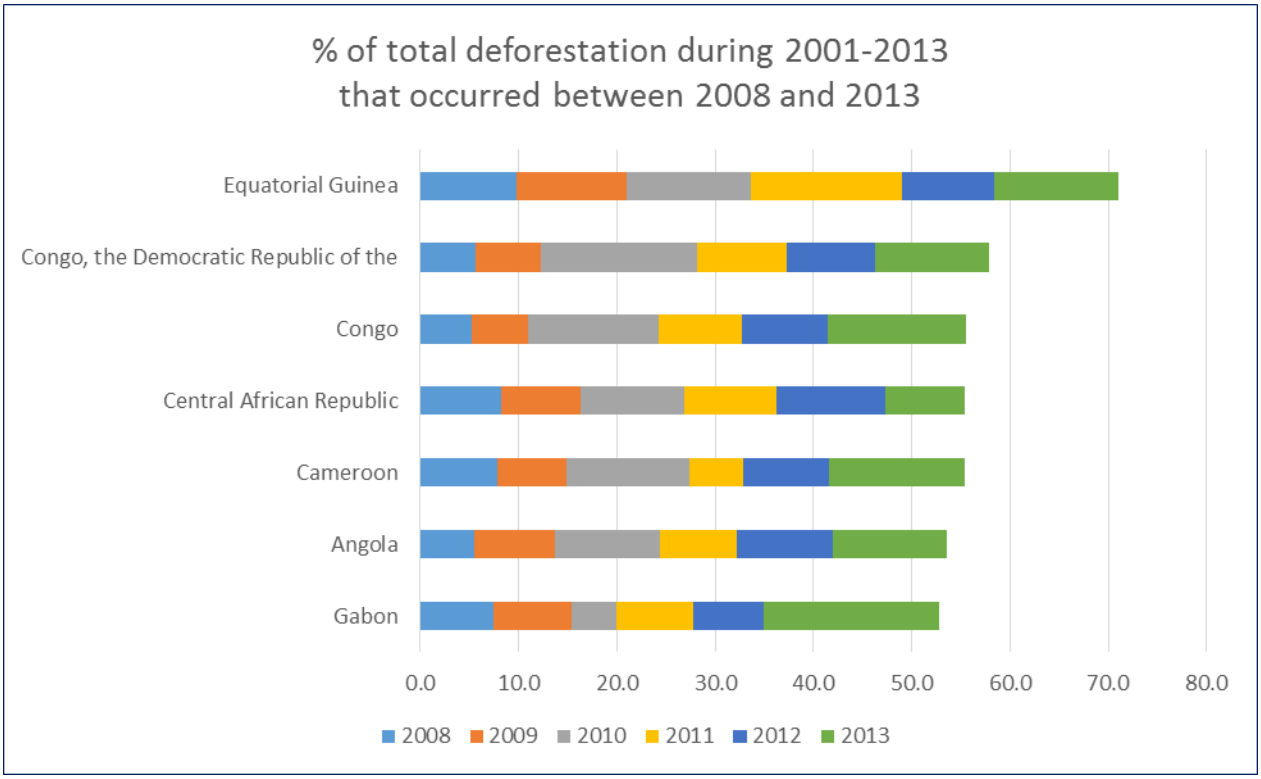


Figure ANNEX IV 13 — Analysis of specific years in which forest loss (deforestation) occurred

3.3 Analysis of Annual Vegetation Stress results for Samoa

The country of Samoa, which mainly comprises the two Polynesian islands of Upolu and Savai'I in the south Pacific Ocean, has a warm, typically equatorial/monsoonal tropical climate, with a rainy season from November to April. Samoa is included within the Samoan tropical moist forests ecoregion, and its dominant land cover types, based on the 2010 ESA CCI land cover data (see Annex 2), are agricultural crops (57 %) and forest cover (28 %). Samoa's main environmental issues are listed as soil erosion, deforestation, invasive species, and overfishing, while the country is also susceptible to occasional typhoons ([19]).

As can be seen in Figure 7, the average area of AVS for Samoa is again largely influenced by one year (2011) with an exceptionally high AVS value (62 %). This is clearly due to the crippling five-month drought in 2011, caused by the La Niña weather pattern, which affected large parts of the central Pacific in 2011 and which hit Samoa particularly badly, resulting in its driest period for many years ([20]) ([21])'.

([19]) http://www.eoearth.org/view/article/172752/
([20]) http://reliefweb.int/report/samoa/rains-signal-hope-drought-stricken-samoa
([21]) http://www.radionz.co.nz/international/pacific-news/200702/samoa-still-concerned-at-impact-of-drought

3.4 Analysis of Annual Vegetation Stress results for Timor-Leste (East Timor)

The country of Timor-Leste (or East Timor) in maritime Southeast Asia has a tropical climate, with a wet season from November to May and a dry season from June to October. Forests comprise 48.4 % of the total land area of Timor-Leste (based on World Bank statistics for 2012 ([10])), and there was a 12 % decrease in forest cover during 2003-2012 (see Annex 2). The major environmental issues in Timor-Leste include widespread use of slash and burn agriculture which has led to deforestation and soil erosion ([22]).

Timor-Leste is highly vulnerable to recurrent natural hazards, in particular flash floods, landslides and erosions resulting from the combination of heavy monsoonal rain, steep topography and widespread deforestation ([23]). Drought conditions affect many parts of the country, especially during the El Niño cycle of weather fluctuations. Timor-Leste experiences agricultural and hydrological droughts approximately once every four years. For example, the drought in 2007, caused by the El Niño event of that year, contributed to a 30 % reduction in cereal yields in the country. In early to mid-January and mid-February 2008, two active phases of extreme monsoonal storm activity associated with La Niña produced localised winds, flooding and landslides, impacting agriculture, roads, bridges and private homes in all 13 districts of Timor-Leste. In the 2008 wet season, 3 600 houses were destroyed across all the districts ([24]) ([25]) ([26]).

In Figure 8 it can be seen that the average area of AVS for Timor-Leste (16.3 %) is largely influenced by one year (2008) with an exceptionally high AVS value (61 %). In contrast, the AVS value for the preceding year (2007), which corresponds to the above-mentioned severe drought caused by El Niño, is quite low (5 %). While it is unlikely to be coincidental that the AVS value for the year immediately after a severe drought is so high, nonetheless the biological mechanism whereby the impact of the 2007 drought on the computed annual vegetation stress was effectively delayed until 2008, should be explained.

Almost all tropical rain forests are evergreen, and overwhelmingly broadleafed. Evergreen forests are characterised by so-called 'continuous' (or indeterminate) growth, in which formation of 'buds' (newly formed leaves or flowers, not yet unfolded) and extension of 'shoots' (new leaves) proceed uninterrupted through a plant's vegetative life. Deciduous forests, on the other hand, are those that have a prolonged bare period between shedding leaves and flushing new leaves. This type of growth, which is termed 'fixed' (or determinate) growth, is quite uncommon in the humid tropics (Ng, 1988).

Ecologically, Timor-Leste is within the 'Timor and Wetar deciduous forests' ecoregion, where the natural vegetation is tropical dry broadleaf forests. Although these forests occur in climates that are warm year-round, and may receive several hundred centimetres of rain per year, they have long dry seasons lasting several months. Deciduous trees predominate in most of these

([22]) http://www.eoearth.org/view/article/51cbf2a17896bb431f6aa20a/
([23]) http://ec.europa.eu/echo/files/policies/dipecho/presentations/est_timor.pdf
([24]) http://sdwebx.worldbank.org/climateportalb/home.cfm?page=country_profile&ccode=tls&thistab=naturalhazards
([25]) https://weadapt.org/knowledge-base/small-islands-and-climate-change/timor-leste-east-timor
([26]) https://www.wfp.org/news/news-release/one-fifth-timor-population-needs-food-assistance-un-report-says

forests, and during the dry season, a leafless period occurs, which varies with species type. Because trees lose moisture through their leaves, the shedding of leaves allows trees to conserve water during dry periods ([27]).

In fixed growth (i.e. deciduous) tree species, the formation of shoots is a two-year process involving the development of buds in the first year, and the extension of the parts within the buds in the second year. In such tree types, the environmental conditions in the first year (bud formation) will have a greater effect on the following year's shoot length than the environmental conditions in the year of shoot expansion. In fixed growth trees, for example, drought during the year of bud formation decreases the number of new leaves formed in the bud, and thus influences the number of leaves, leaf surface area, etc. the following year when those buds expand (Coder, 1999; Breda et al., 2006).

It can be quite reasonably conjectured, therefore, that a similar 'biological lag' effect between bud formation in Timor-Leste's tropical dry broadleaf forests during the drought year of 2007, and the subsequent flushing and development of new leaves, contributes to the exceptionally high area of AVS computed for Timor-Leste in 2008, as shown in Figure 8.

3.5 Analysis of Annual Vegetation Stress results for Cambodia

Cambodia, in mainland Southeast Asia, has a tropical climate, with a rainy, monsoon season from May to November. Its landscape is dominated by irrigated rice fields ('paddies') and forests, and its main land cover types, based on the 2010 ESA CCI Land Cover data (see Annex 2), are agricultural crops (52 %) and forest cover (39 %). Cambodia's main environmental issues are listed as: illegal logging activities throughout the country and strip mining for gems in the western region, which have resulted in habitat loss and declining biodiversity (in particular, destruction of mangrove swamps threatens natural fisheries); soil erosion; in rural areas, access to drinkable water; declining fish stocks because of illegal fishing and overfishing. Cambodia is also susceptible to monsoonal rains (June to November), flooding ([28]). The country also experiences frequent droughts, and widespread droughts occurred in 1986-1987, 1994, 1997-1998, 2002, and 2005 (Alimullah Miyan, 2015).

As can be seen in Figure 8, during the time period of this study (2003-2014), Cambodia experienced one year (2005) with a very high area (47 %) of AVS. This clearly reflects the severe drought that occurred in Cambodia in 2005. According to Cambodia Disaster Statistics, the historical droughts of 1994, 2002, and 2005 seriously affected 5.0, 0.65 and 0.6 million people respectively, with a total economic loss of 138 million US dollars (Alimullah Miyan, 2015).

3.6 Analysis of Annual Vegetation Stress results for India

India is one of the major nations of the world, and has the second largest population (after China). The country has a wide range of varied ecoregions with important biodiversity, and its climate varies from tropical monsoon in the south

([27]) http://en.wikipedia.org/wiki/Tropical_and_subtropical_dry_broadleaf_forests
([28]) http://www.eoearth.org/view/article/51cbf26a7896bb431f6a9336/

to temperate in the north. Forests cover 22.8 % (or 677 000 square kilometres), and include both tropical (95 %) and sub-tropical (5 %) types. India's other major land cover types include arable land (48.8 %) and permanent crops (2.8 %). India's major environmental issues include: deforestation; soil erosion; overgrazing; desertification; air pollution; water pollution (from raw sewage and run-off of agricultural pesticides and herbicides); tap water is not drinkable throughout the country; its huge and growing population is overstraining natural resources. India is susceptible to droughts, flash floods and widespread and destructive flooding from monsoonal rains, severe thunderstorms, and earthquakes ([29]) ([30]).

Tropical rainforests in India are concentrated mainly in three regions: the greater Assam region in the north-east; the Western Ghats (along the Arabian Sea); and the Andaman and Nicobar Islands (Figure 14). Small remnants of rainforest are also found in Odisha state. Semi-evergreen rainforest is more extensive than evergreen, and there are substantial differences in both flora and fauna between the three major rainforest regions.

The Western Ghats monsoon forests occur both on the western (coastal) margins of the Ghats and on the eastern side where there is less rainfall. The tropical vegetation of north-east India has evergreen and semi-evergreen rainforests, moist deciduous monsoon forests, riparian forests, swamps and grasslands. Evergreen rainforests occur in the Assam Valley, the foothills of the eastern Himalayas and the lower parts of the Naga Hills, Meghalaya, Mizoram and Manipur, where annual rainfall exceeds 2 300 mm.
The monsoon forests are mainly moist deciduous forests, which occur widely in this region.
The Andaman and Nicobar Islands have tropical evergreen rainforests and tropical semi-evergreen rainforests as well as tropical monsoon forests ([31]). Tropical dry forests are found in central India ([27]).

([29]) http://www.eoearth.org/view/article/51cbee367896bb431f6962ee/
([30]) http://rainforests.mongabay.com/deforestation/archive/India.htm
([31]) http://en.wikipedia.org/wiki/tropical_rainforests_of_india

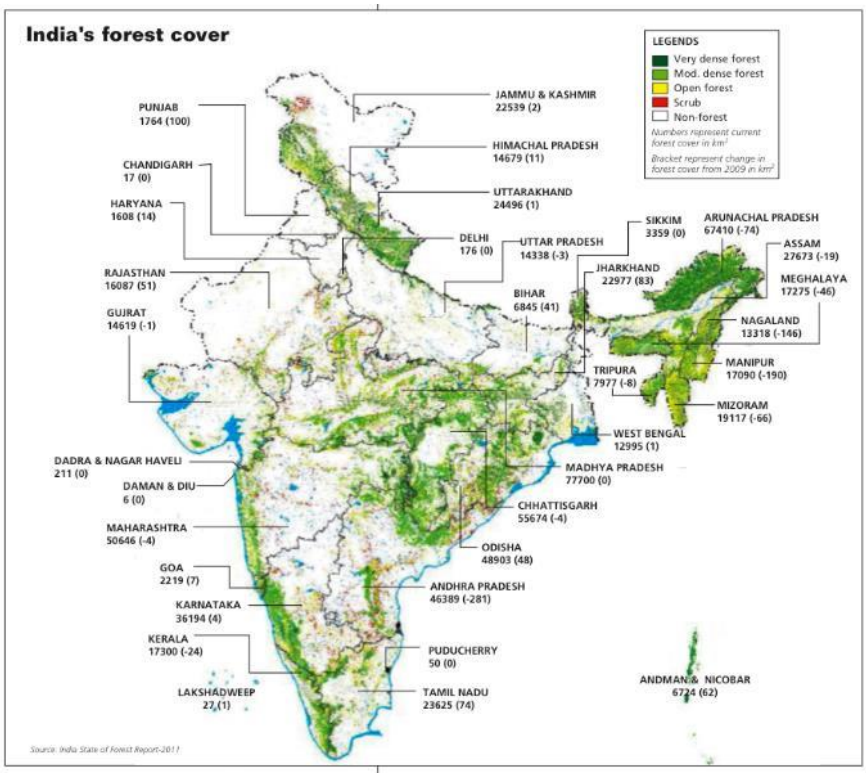


Figure ANNEX IV 14 — Forest cover map of India ([32])

([32]) http://www.downtoearth.org.in/content/india-s-forest-cover-declines

Plant growth in India depends almost entirely on the strength of the annual monsoon. When the monsoon rains fail, so too do the country's crops. Good rains provide bumper crops. Beyond controlling the fate of agriculture in India, changes in the Indian monsoon helped scientists recognise the far-flung impact of the oscillating Pacific Ocean phenomena El Niño and La Niña ([33]). An El Niño episode results in a drier-than-average summer monsoon season in India.

In 2002, the June-September monsoon season for all of India was characterised by large-scale disastrous drought, with seasonal rainfall 19 % below normal ([34]). It is estimated to have affected 300 million people, and caused damage of 910 722 000 US dollars ([35]). In fact, 2002 was defined as an 'all-India drought year', with rainfall deficiency for the whole country as a whole amounting to 19 % and drought conditions impacting 29 % of its total area, of which 10 % was under 'severe drought' (rainfall deficiency greater than 50 %) and the remaining under 'moderate drought' (rainfall deficiency of 26-50 %) ([36]). The largest rainfall anomalies occurred in the western parts of India (Bhat, 2006).

In Figure 8 it can be seen that the average area of AVS for India (13.7 %) during 2003-2014 is dominated by one year (2003) with an exceptionally high value (53 %). The available time series of EO satellite data that were used to compute AVS did not include 2002. However it can be reasonably assumed that the high area of AVS for 2003 reflects the fact that vegetation growing conditions in India in 2003 were still recovering from the 2002 drought disaster. It is also likely that the very high AVS value computed for India in 2003 includes a 'biological lag' effect related to the impact of the 2002 drought on India's tropical deciduous forests, similar to that described earlier for Timor-Leste.

4. Conclusions

In this report, a methodology for using EO data to assess and monitor areas of climate-related vegetation stress, for any selected countries or geographic regions worldwide, has been described. The methodology can provide a powerful tool for assessing and monitoring the vulnerability of developing countries in terms of the potential impacts of climate change on major land use sectors, such as agriculture and forestry, particularly when combined with other publicly available global meteorological and land-use databases, such as the Global Climate Reanalysis datasets of the European Centre for Medium-Range Weather Forecasts/ECMWF (Berrisford et al., 2011) ([37]) or the Global Forest Cover Change database of the University of Maryland (Hansen et al., 2013) ([8]).

([33]) http://visibleearth.nasa.gov/view.php?id=8717
([34]) http://www.noaanews.noaa.gov/stories/s1075.htm
([35]) http://www.emdat.be/result-disaster-profiles?disgroup=natural&dis_type=drought&period=1900$2013
([36]) http://www.thehindubusinessline.com/2002/10/05/stories/2002100502840300.htm
([37]) http://apps.ecmwf.int/datasets/data/interim-full-daily/

5. References

Alimullah Miyan, M., 'Droughts in Asian Least Developed Countries: Vulnerability and sustainability', *Weather and Climate Extremes*, Volume 7, March 2015, pp. 8-23.

Asefi-Najafabady, S. and Saatchi, S., Response of African humid tropical forests to recent rainfall anomalies. Phil Trans R Soc B 368: 20120306, 2013. http://dx.doi.org/10.1098/rstb.2012.0306

Berrisford, P., Dee, D., Poli, P., Brugge, R., Fielding, K., Fuentes, M., Kallberg, P., Kobayashi, S., Uppala S. and Simmons, A., The ERA-Interim archive Version 2.0. European Centre for Medium-Range Weather Forecasts (ECMWF). ERA Report Series, Volume 1, 2011, P. 23.

Bhat, G. S., 'The Indian drought of 2002- a sub-seasonal phenomenon?', *Q.J.R. Meteorol. Soc*., 132, 2006, pp. 2583–2602, doi: 10.1256/qj.05.13. http://onlinelibrary.wiley.com/doi/10.1256/qj.05.13/abstract

Bontemps S., Herold, M., Kooistra, L., van Groenestijn, A., Hartley, A., Arino, O., Moreau, I. and Defourny, P., 'Revisiting land cover observation to address the needs of the climate modeling community', *Biogeosciences*, 9, 2012, pp. 2145–2157. http://www.biogeosciences.net/9/2145/2012/. doi:10.5194/bg-9-2145-2012

Breda, N., Huc, R., Granier, A., Dreyer, E., 'Temperate forest trees and stands under severe drought: a review of ecophysiological responses, adaptation processes and long-term consequences', *Annals of Forest Science*, Springer Verlag (Germany), 2006, 63 (6), pp. 625-644. https://hal.archives-ouvertes.fr/hal-00884012

Coder, K.D., *Drought Damage to Trees*, Daniel B. Warnell School of Forest Resources, University of Georgia, 1999, http://www.caes.uga.edu/extension/cobb/anr/documents/droughtdamagetotrees.pdf

Gobron N., Pinty, B., Taberner, M., Melin F., Widlowski, J.-L., Verstraete, M., Monitoring FAPAR over land surfaces with remote sensing data. Proc. SPIE 5232, Remote Sensing for Agriculture, Ecosystems, and Hydrology V, 2004, doi: 10.1117/12.510725

Hansen, M. C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O. and Townshend, J.R.G., 2013. 'High-Resolution Global Maps of 21st-Century Forest Cover Change.' *Science* 342 (15 November), 2013, pp. 850-53. Data available online from: http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.1.html

Kim, D.-H., Sexton, J.O., and Townshend, J.R., 'Accelerated deforestation in the humid tropics from the 1990s to the 2000s', *Geophys. Res. Lett*., 42,2015, doi: 10.1002/2014GL062777

Ng, F.S.P. 'Forest Tree Biology', In: Earl of Cranbrook (ed.), Key Environments: Malaysia., 1988, pp. 102-25. Oxford: Permagon Press.

Annex 1: List of all 108 developing countries of interest

#	108 countries of interest	ISO code	UN code	Area (km^2)	FAPAR pixels
1	Afghanistan	AFG	4	652,860	24,619
2	Angola	AGO	24	1,246,700	41,483
3	Antigua and Barbuda	ATG	28	440	17
4	Armenia	ARM	51	28,470	1,255
5	Bangladesh	BGD	50	130,170	4,932
6	Barbados	BRB	52	430	14
7	Belize	BLZ	84	22,810	754
8	Benin	BEN	204	112,760	3,659
9	Bhutan	BTN	64	38,117	1,413
10	Bolivia, Plurinational State of	BOL	68	1,083,300	36,502
11	Burkina Faso	BFA	854	273,600	9,064
12	Burundi	BDI	108	25,680	882
13	Cabo Verde	CPV	132	4,030	116
14	Cambodia	KHM	116	176,520	6,062
15	Cameroon	CMR	120	472,710	14,869
16	Central African Republic	CAF	140	622,980	20,230
17	Chad	TCD	148	1,259,200	42,615
18	Comoros	COM	174	1,861	58
19	Congo	COG	178	341,500	10,051
20	Congo, the Democratic Republic of the	COD	180	2,267,050	75,684
21	Cook Islands	COK	184	240	8
22	Côte d'Ivoire	CIV	384	318,000	10,502
23	Cuba	CUB	192	106,440	3,835
24	Djibouti	DJI	262	23,180	715
25	Dominica	DMA	212	750	28
26	Dominican Republic	DOM	214	48,320	1,666
27	Egypt	EGY	818	995,450	35,976
28	El Salvador	SLV	222	20,720	690
29	Equatorial Guinea	GNQ	226	28,050	701
30	Eritrea	ERI	232	101,000	4,076
31	Ethiopia	ETH	231	1,000,000	37,075
32	Fiji	FJI	242	18,270	650
33	Gambia	GMB	270	10,120	362
34	Georgia	GEO	268	69,490	3,028
35	Ghana	GHA	288	227,540	7,694
36	Grenada	GRD	308	340	16
37	Guatemala	GTM	320	107,160	3,671
38	Guinea	GIN	324	245,720	8,085
39	Guinea-Bissau	GNB	624	28,120	1,140
40	Guyana	GUY	328	196,850	6,722
41	Haiti	HTI	332	27,560	929
42	Honduras	HND	340	111,890	3,774
43	India	IND	356	2,973,190	110,300
44	Indonesia	IDN	360	1,811,570	59,485
45	Iraq	IRQ	368	434,320	16,858
46	Jamaica	JAM	388	10,830	374
47	Kenya	KEN	404	569,140	18,936
48	Kiribati	KIR	296	810	33
49	Korea, Democratic People's Republic of	PRK	408	120,410	5,178
50	Kyrgyzstan	KGZ	417	191,800	8,194
51	Lao People's Democratic Republic	LAO	418	230,800	7,873
52	Lesotho	LSO	426	30,360	1,142
53	Liberia	LBR	430	96,320	3,125
54	Madagascar	MDG	450	581,795	20,444
55	Malawi	MWI	454	94,280	3,946
56	Maldives	MDV	462	300	3
57	Mali	MLI	466	1,220,190	42,308
58	Marshall Islands	MHL	584	180	4
59	Mauritania	MRT	478	1,030,700	35,495
60	Mauritius	MUS	480	2,030	72

61	Micronesia, Federated States of	FSM	583	700	22
62	Moldova, Republic of	MDA	498	32,860	1,602
63	Mongolia	MNG	496	1,553,560	73,575
64	Montenegro	MNE	499	13,450	611
65	Morocco	MAR	504	446,300	15,421
66	Mozambique	MOZ	508	786,380	26,807
67	Myanmar	MMR	104	653,290	23,247
68	Nauru	NRU	520	21	1
69	Nepal	NPL	524	143,350	5,266
70	Nicaragua	NIC	558	120,340	4,273
71	Niger	NER	562	1,266,700	37,906
72	Nigeria	NGA	566	910,770	28,843
73	Pakistan	PAK	586	770,880	31,625
74	Palau	PLW	585	460	15
75	Papua New Guinea	PNG	598	452,860	14,896
76	Paraguay	PRY	600	397,300	14,081
77	Philippines	PHL	608	298,170	9,781
78	Rwanda	RWA	646	24,670	819
79	Saint Kitts and Nevis	KNA	659	260	10
80	Saint Lucia	LCA	662	610	20
81	Saint Vincent and the Grenadines	VCT	670	390	14
82	Samoa	WSM	882	2,830	100
83	São Tomé and Príncipe	STP	678	960	17
84	Senegal	SEN	686	192,530	6,563
85	Seychelles	SYC	690	460	17
86	Sierra Leone	SLE	694	72,180	2,388
87	Solomon Islands	SLB	90	27,990	935
88	Somalia	SOM	706	627,340	20,815
89	Sri Lanka	LKA	144	62,710	2,173
90	Suriname	SUR	740	156,000	4,729
91	Swaziland	SWZ	748	17,200	617
92	Syrian Arab Republic	SYR	760	183,630	7,419
93	Tajikistan	TJK	762	139,960	5,176
94	Tanzania, United Republic of	TZA	834	885,800	30,802
95	Timor-Leste	TLS	626	14,870	478
96	Togo	TGO	768	54,390	1,778
97	Tonga	TON	776	720	29
98	Trinidad and Tobago	TTO	780	5,130	168
99	Turkmenistan	TKM	795	469,930	19,644
100	Tuvalu	TUV	798	30	1
101	Uganda	UGA	800	199,810	7,851
102	Ukraine	UKR	804	579,320	29,393
103	Uzbekistan	UZB	860	425,400	18,915
104	Vanuatu	VUT	548	12,190	426
105	Viet Nam	VNM	704	310,070	10,672
106	Yemen	YEM	887	527,970	14,314
107	Zambia	ZMB	894	743,390	25,134
108	Zimbabwe	ZWE	716	386,850	13,380

Annex 2: Computed average area of AVS during 2003-2014, for all countries of interest, with additional information on change in forest area during 2003-2012 (derived from World Bank statistics ([10])) and major land cover types in 2010 (computed from ESA CCI land cover data ([9]))

#	**108 countries of interest** (ranked by average annual vegetation stress, 2003-2014)	**AVS, 2003-2014 (% area)**	**Forest change, 2003-2012 (% area)**	**Forest cover, 2010 (% area)**	**Agricultural crops, 2010 (% area)**	**Natural vegetation, 2010 (% area)**
1	Equatorial Guinea	27.2	-6.2	69.9	26.8	1.4
2	Liberia	21.3	-5.9	51.2	47.4	0.5
3	Viet Nam	20.0	12.4	28.7	46.1	21.6
4	Cambodia	18.4	-11.0	38.7	51.9	6.1
5	Indonesia	18.4	-5.5	51.7	37.2	7.2
6	Timor-Leste	16.3	-12.3	12.2	39.1	44.1
7	Bangladesh	16.3	-1.6	5.8	74.9	11.1
8	Lao People's Democratic Republic	16.1	-4.3	55.0	19.9	24.3
9	Congo	15.6	-0.5	60.9	14.3	23.5
10	Nicaragua	15.5	-17.5	33.7	50.2	7.2
11	Côte d'Ivoire	15.4	0.3	37.3	57.4	3.7
12	Montenegro	15.1	0.0	48.8	38.4	8.1
13	Samoa	15.0	0.0	27.8	56.9	0.0
14	Georgia	14.8	-0.8	51.0	27.1	16.8
15	Papua New Guinea	14.8	-4.3	81.0	13.2	2.0
16	Ghana	14.1	-18.1	21.1	59.2	15.3
17	Vanuatu	14.1	0.0	65.5	15.3	0.0
18	Armenia	14.0	-13.0	13.8	34.6	43.1
19	Sierra Leone	14.0	-6.2	15.7	75.9	6.9
20	Philippines	13.9	6.8	22.0	69.2	1.2
21	Solomon Islands	13.7	-2.2	81.1	2.4	0.4
22	India	13.7	2.9	11.0	74.8	8.9
23	Myanmar	13.7	-8.2	44.5	35.4	18.0
24	Zimbabwe	13.5	-16.4	29.7	58.7	10.3
25	Kenya	13.4	-2.8	1.9	35.1	56.3
26	Swaziland	13.4	7.5	49.8	37.2	12.2
27	Korea, Democratic People's Republic of	13.0	-17.4	75.5	18.2	2.4
28	Paraguay	13.0	-8.5	57.2	25.5	15.8
29	Cabo Verde	12.9	3.2	0.0	16.9	33.5
30	Congo, the Democratic Republic of the	12.6	-1.8	55.0	37.1	6.1
31	Trinidad and Tobago	12.5	-2.8	37.7	43.6	3.4
32	Saint Lucia	12.5	0.3	44.6	35.3	0.0
33	Guyana	12.1	0.0	88.9	1.9	8.4
34	Ukraine	12.0	2.2	12.9	80.2	0.8
35	Micronesia, Federated States of	11.7	0.4	42.5	5.2	8.7
36	Cameroon	11.6	-9.2	70.7	23.5	4.8
37	Bolivia, Plurinational State of	11.5	-4.5	57.0	5.7	25.5
38	Mozambique	11.4	-4.7	44.7	42.3	10.6
39	Sri Lanka	11.3	-8.1	25.4	48.9	19.0
40	Bhutan	11.2	3.1	74.7	2.6	15.5
41	Cuba	11.1	13.4	14.6	65.7	13.5
42	Rwanda	11.0	23.4	8.2	83.1	1.8
43	Mongolia	10.4	-6.4	7.0	18.0	25.6
44	Belize	10.3	-5.9	76.8	9.9	6.9
45	Senegal	10.3	-4.2	5.3	38.0	54.6
46	Togo	10.2	-37.3	25.8	52.0	21.1
47	Kyrgyzstan	10.2	14.2	2.1	24.3	36.2
48	Nigeria	9.7	-31.0	17.6	66.7	14.1
49	Suriname	9.4	-0.2	94.2	0.8	3.7
50	Moldova, Republic of	9.3	13.8	5.1	89.3	0.1
51	Tanzania, United Republic of	9.0	-10.0	26.6	55.4	11.1
52	Honduras	8.9	-17.9	47.5	43.8	6.7
53	Comoros	8.5	-64.5	38.7	37.7	6.3

54	Fiji	8.4	3.1	65.9	18.6	1.7
55	Benin	8.3	-9.2	28.1	29.8	41.2
56	Jamaica	8.3	-1.1	40.2	49.0	1.9
57	Guatemala	8.2	-12.4	54.2	38.7	5.6
58	Angola	8.2	-1.9	50.8	26.7	20.2
59	Dominican Republic	8.1	0.0	18.8	68.2	7.5
60	Dominica	8.0	-5.2	78.1	8.2	0.1
61	Ethiopia	7.4	-9.5	5.1	42.0	44.3
62	Uganda	7.4	-22.0	6.3	65.8	12.0
63	Haiti	7.2	-6.8	1.3	76.5	16.0
64	Tonga	7.2	0.0	23.3	27.2	0.2
65	Mauritius	7.1	-3.8	13.2	66.4	0.7
66	Guinea-Bissau	7.0	-4.3	25.6	48.0	21.3
67	Burundi	7.0	-10.3	10.0	81.2	1.2
68	Morocco	6.9	1.9	0.5	30.4	31.7
69	Somalia	6.6	-9.5	0.2	8.3	77.9
70	Gambia	6.4	3.6	0.2	72.0	23.2
71	Zambia	5.7	-3.0	52.4	31.6	13.8
72	Nepal	5.6	-2.8	44.9	30.7	17.3
73	Tajikistan	5.2	0.0	1.5	29.8	33.4
74	Malawi	5.1	-8.6	15.5	57.0	6.8
75	Guinea	4.9	-4.8	41.5	29.1	28.8
76	El Salvador	4.5	-12.6	15.8	78.1	2.7
77	Madagascar	4.5	-4.0	15.6	13.6	68.8
78	Pakistan	4.3	-19.5	2.3	36.8	31.8
79	Uzbekistan	4.1	0.2	0.0	17.0	5.4
80	Turkmenistan	3.8	0.0	0.0	19.4	2.5
81	Syrian Arab Republic	3.5	11.9	0.2	17.8	25.0
82	Burkina Faso	3.3	-8.9	1.3	77.7	20.2
83	Central African Republic	3.3	-1.2	82.4	4.3	13.0
84	Lesotho	2.9	4.2	0.5	20.9	78.2
85	Iraq	2.9	0.3	0.0	9.5	22.0
86	Afghanistan	2.1	0.0	0.5	22.5	45.5
87	Chad	1.9	-5.9	3.1	20.8	21.3
88	Mali	1.6	-5.5	0.3	21.7	18.7
89	Eritrea	1.0	-2.5	0.0	30.3	21.7
90	Djibouti	0.5	0.0	0.0	0.1	0.9
91	Mauritania	0.4	-19.2	0.0	2.8	13.7
92	Niger	0.3	-8.6	0.0	11.9	16.1
93	Egypt	0.2	11.6	0.0	3.8	2.1
94	Yemen	0.2	0.0	0.0	2.7	20.6
95	Kiribati	0.0	0.0	0.0	6.9	0.1
999	Antigua and Barbuda		-0.8	10.6	31.1	10.6
999	Barbados		0.0	3.4	69.2	1.7
999	Cook Islands		0.0	18.9	9.6	0.0
999	Grenada		0.0	19.7	40.3	2.8
999	Maldives		0.0	0.0	0.5	0.0
999	Nauru		0.0	0.0	43.8	0.0
999	Marshall Islands		0.0	0.0	0.0	0.0
999	Palau		0.8	29.4	18.5	6.0
999	Saint Kitts and Nevis		0.0	27.1	28.8	1.3
999	Saint Vincent and the Grenadines		2.6	36.8	35.3	0.3
999	São Tomé and Príncipe		0.0	36.3	40.3	0.0
999	Seychelles		0.0	3.4	19.9	8.6
999	Tuvalu		0.0	0.0	0.0	0.0

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doi:10.2788/516387

ISBN 978-92-79-52050-1