Global Risk And Vulnerability Index Trends per Year (GRAVITY)

Phase IV: Annex to WVR and Multi Risk Integration

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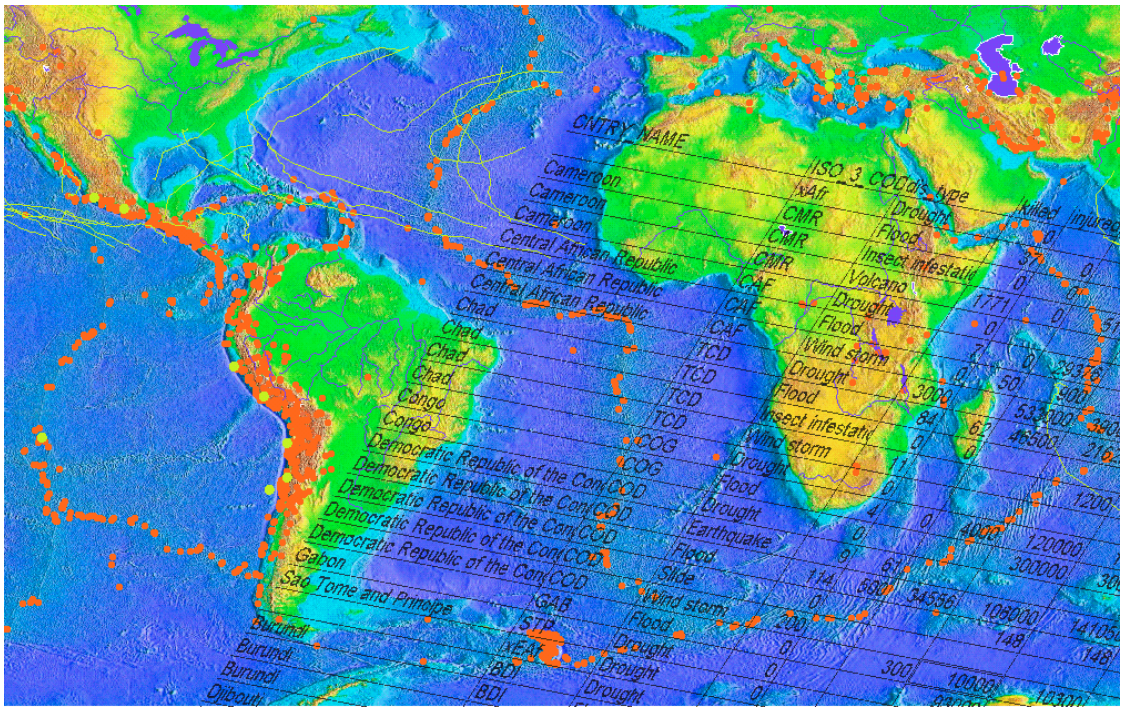

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Disclaimer

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Table of acronyms

AGR_{EMP}	Percentage of labour force in agricultural sector
BCPR	Bureau for Crisis Prevention and Recovery
CRED	Centre for Research on Epidemiology of Disasters
FAO	Food and Agriculture Organisation
GDP_{AGR}	Percentage of agriculture's dependency for GDP
GDP_{CAP}	Gross Domestic Product per capita
GEO	Global Environment Outlook
GIS	Geographical Information System
GLASOD	Human Induced Soil Degradation
GRAVITY	Global Risk And Vulnerability Index Trend per Year
HDI	Human Development Index
HPI	Human Poverty Index
IFRC	International Federation of the Red Cross
IRI	International Research Institute for Climate Prediction
ISDR	International Strategy of Disaster Reduction
PhExp	Physical Exposure (if not specified, for drought)
$U5_{MORT}$	Under five years old mortality rate
UNDP/BCPR	United Nation Development Programme, Bureau for Crisis Prevention and Recovery
UNEP/GRID	United Nation Environment Programme, Global Resource Information Database
WAT_{RUR}	Percentage of population having access to improved water supply in rural area
WAT_{TOT}	Percentage of population having access to improved water supply
WAT_{URB}	Percentage of population having access to improved water supply in urban area

Technical annex

Foreword

This technical annex describes the concepts, data and methods applied to achieve the Disaster Risk Index (DRI).

Results of the different analysis are presented in chapter IV.

A set of recommendations is also provided at the end of the annex on the appropriate use of the DRI as well as suggested future improvements to the methodology.

1 WORKING DEFINITIONS AND FORMULAE

1.1. Hazards, vulnerability and risk, definitions and concepts

The terminology used in this study is based on UN and other experts. The definitions of the concepts are provided in the following paragraphs:

- **Risk** : *"The term risk refers to the expected losses from a particular hazard to a specified element at risk in a particular future time period. Loss may be estimated in terms of human lives, or buildings destroyed or in financial terms"* [UNDRO 1979; in Burton et al. 1993, p.34].

  Specificity in this research : The term "risk" is used to describe potential human losses (casualties) resulting from expected future hazard.

- **Hazard** : *"The hazard can be defined as a potential threat to humans and their welfare*" [Smith, 1996]. The hazardous events varies in terms of magnitude as well as in "*frequency, duration, area extent, speed of onset, spatial dispersion, and temporal spacing"* [Burton et al. 1993, p.34].

  Specificity in this research : Only frequencies and area extent are considered in the model. The magnitude is taken into account indirectly when possible.

- **Natural Hazards** : *"Represents the potential interaction between humans and extreme natural events. It represents the potential or likelihood of an event (it is not the event itself)*" [Tobin & Montz 1997].

  Specificity in this research : Four types of natural threats are included in the model (floods, earthquakes, cyclones and droughts).

- **Physical Exposure** : **"***Elements at risk, an inventory of those people or artefacts which are exposed to the hazard"* [Coburn et al. 1991, p. 49].

  Specificity in this research : Computation of population exposed to a given hazard type. In this research the element at risk is the population.

- **Vulnerability** : *"Reflects the range of potentially damaging events and their statistical variability at a particular location*" [Smith, 1996]. *"The degree of loss to each element should a hazard of a given severity occur"* [Coburn et al. 1991, p. 49].

  Specificity in this research : The discrepancies of casualties induced by different vulnerabilities are used to identify socio-economical indicators reflecting such vulnerabilities

- **Disasters** : *"A sudden calamitous event producing great material damage, loss and distres"*. [Webster's Dictionary. Found in : Carter 1991]

Specificity in this research : A disaster occurs when the high vulnerability of an exposed population intersects a hazardous event of a relatively strong magnitude.

By UN definition [UNDRO, 1979], the risk is resulting from three components:

*"**Hazard occurrence probability**, defined as the probability of occurrence of a specified natural hazard at a specified severity level in a specified future time period, **elements at risk**, an inventory of those people or artefacts which are exposed to the hazard and **vulnerability**, the degree of loss to each element should a hazard of a given severity occur"* [Coburn et al. 1991, p. 49].

1.2. Formula and method for estimating risk and vulnerability

The formula used for modelling risk combines the three components of the UNDRO definition [UNDRO 1979]: the risk is a function of hazard occurrence probability, element at risk (population) and vulnerability. The following hypothesis was made for modelling the risk: **the three factors explaining risk are multiplying each other**. This was introduced because, if the hazard is null, then the risk is null:

0 (hazard) x population x vulnerability = 0 (Risk)

The risk is also null if nobody lives in an area exposed to hazard (population = 0), same situation if the population is invulnerable, (vulnerability = 0, induce a risk = 0). Following the definition from UNDRO and the stated hypothesis the Equation 1 was derived:

Equation 1: Simplified equation of risk[1]

$$R = H \cdot Pop \cdot Vul$$

Where:
R is the risk, i.e. the expected human impacts (number of killed people).
H is the hazard, which depends on the frequency and strength of a given hazard,
Pop is the population living in a given exposed area.
Vul is the vulnerability and depends on socio-politico-economical context of this population.

From the previous discussion the physical exposure is defined as the *combination of both frequency and population exposed* (see p.1) to a given magnitude for a selected type of hazard. The hazard multiplied by the population can then be replaced by the physical exposure:

Equation 2: Simplification of risk evaluation using physical exposure

$$R = PhExp \cdot Vul$$
