Increasing Flood Risk in Africa: A climate signal?

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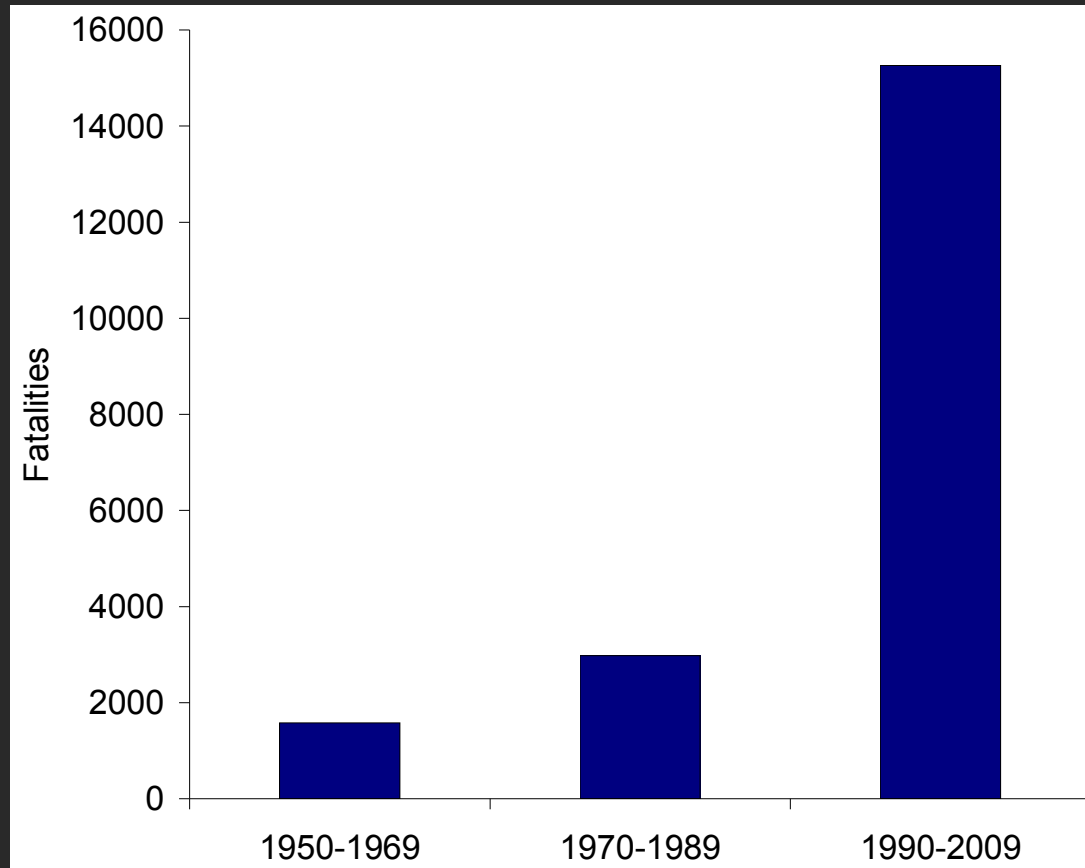[2] University of Bologna, Italy
[3] U.S. Geological Survey, United States
[4] National Technical University of Athens, Greece
[5] Vienna University of Technology, Austria

Increasing flood risk in Africa

Flood fatalities have increased about one order of magnitude (1950-2009)

(EM-DAT, 2010)

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A climate signal?

Global perception: severity and frequency of floods have increased

Is this perception supported by observations?

It is difficult (if not impossible) to separate out
the effects of climatic fluctuations from human impacts

Legend: 0 - 1 | 1 - 10 | 10 - 20 | 20 - 30 | 30 - 40 | 40 - 60 | 60 - 80 | 80 - 100 | No Data
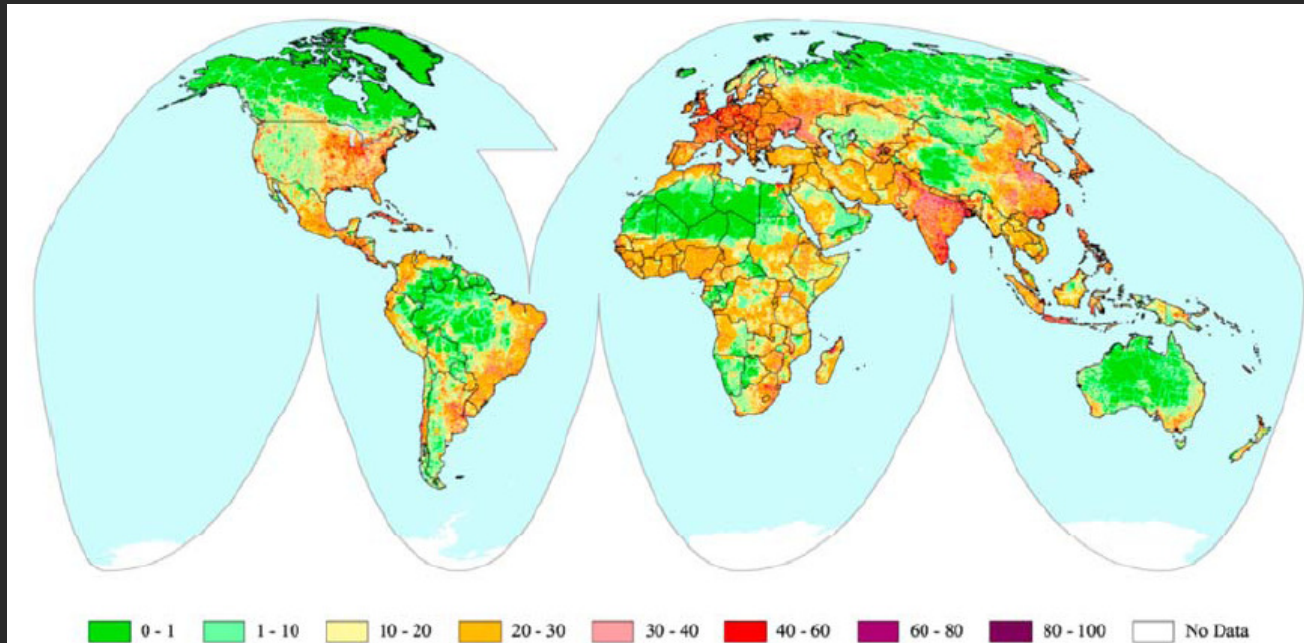
(Human Footprint; Sanderson et al., BioScience, 2002; Wagener et al., WRR, 2010)

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A climate signal?

Individual river basins > "Hydrologist's paradox"

"A recent large flood in a catchment will often lead to funding a study on the flood history of that catchment, which will find there was a large flood at the end of the record"
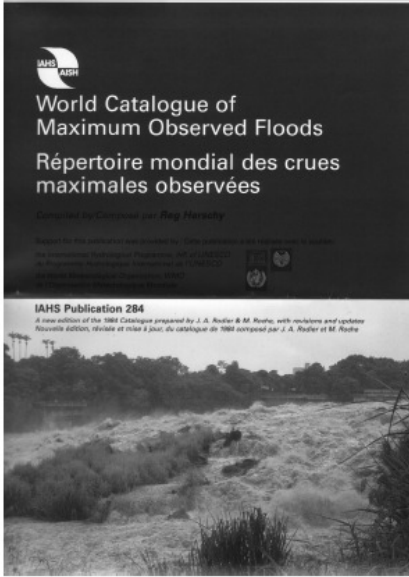(Blöschl and Montanari, Hydrol. Process., 2010)

To detect climatic signals (and avoid "self-fulfilling prophecies"),
we need:

- many catchments (randomly selected) in a large region
- natural river basin conditions
- reliable flood data

Flood dataset

We investigate changes in annual maximum discharge
using a large, consistent and quality-assured database (IAHS, 2003)
from 79 river gauging stations in Africa

World Catalogue of Maximum Observed Floods
Répertoire mondial des crues maximales observées

Compiled by/Composé par Reg Herschy

IAHS Publication 284
A new edition of the 1984 Catalogue prepared by J. A. Rodier & M. Roche, with revisions and updates
Nouvelle édition, révisée et mise à jour, du catalogue de 1984 composé par J. A. Rodier et M. Roche

World Catalogue of Maximum Observed Floods

Compiled by Reg Herschy

A new edition of the 1984 catalogue prepared by J. A. Rodier and M. Roche, with revisions and updates
IAHS Publ. 279 (December 2003) ISBN 1-901502-47-3; 320 pp. Price £80.00, Members' price £60.00

Support for this publication was provided by:
IHP, the International Hydrological Programme of UNESCO

the World Meteorological Organization, WMO

Data are listed for 120 countries. For most countries there are three data sets:

1   *The location of the flood flow observation sites, and background information about the drainage basins for which flood data are available (e.g. climate regime, mean annual precipitation and mean annual discharge, if known);*

2   *the maximum instantaneous discharge observed during the events, plus any available, ancillary information about the event (e.g. the antecedent rainfall, flood duration);*

3   *for certain observation sites in some countries, series of annual maximum instantaneous discharge data are also available.*
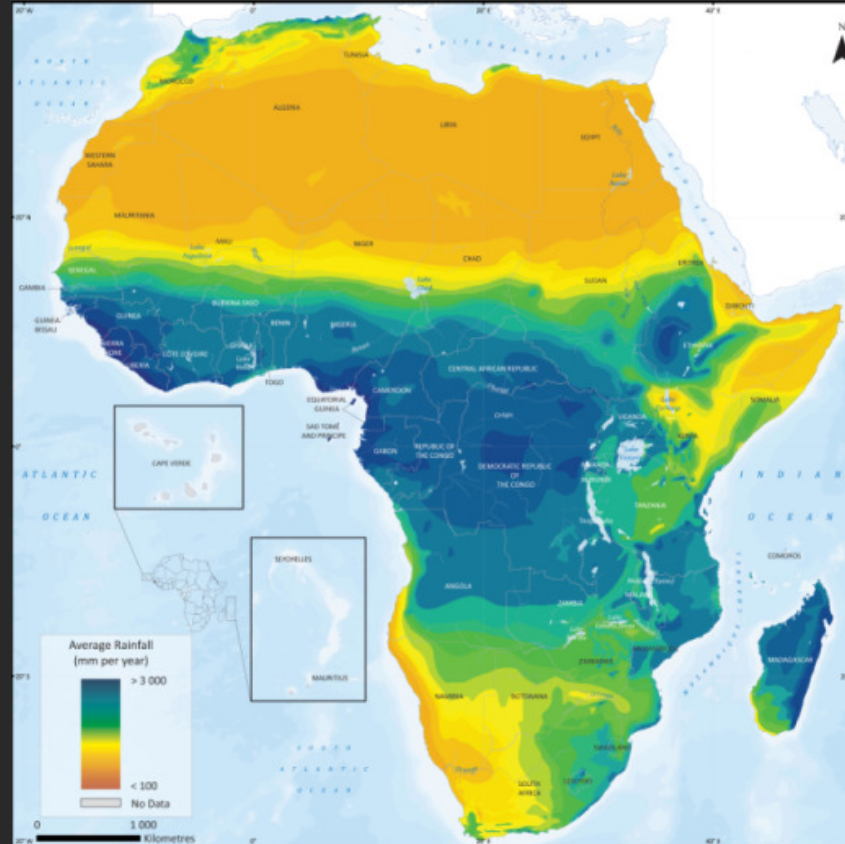
Available at: http://www.iahs.info/redbooks/284.htm

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African river basins

African river basins remain largely undisturbed

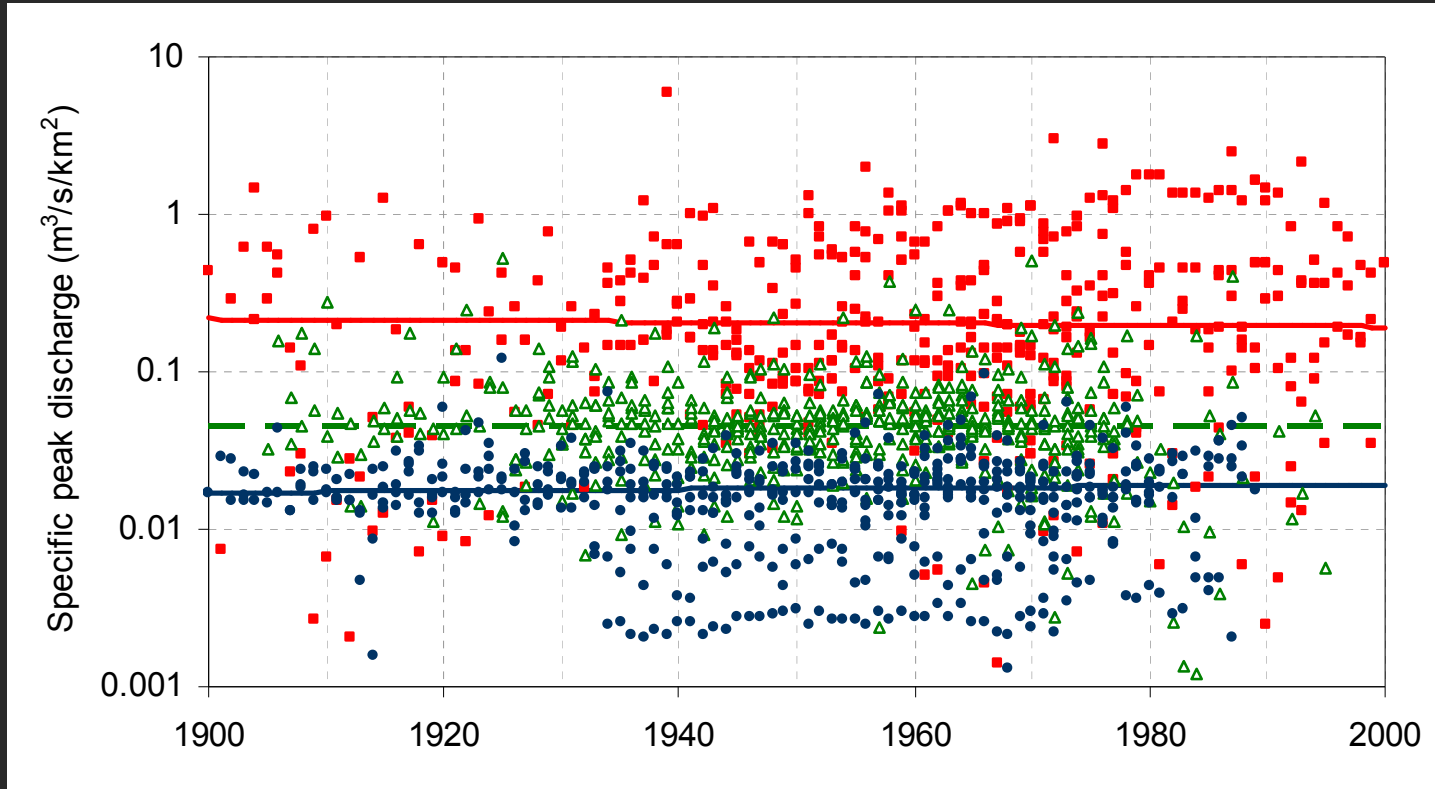Representative of diverse hydro-climatic conditions

(UNESCO, 1984; UNEP, 2010)

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African continent (flood regimes)

Annual maxima of specific discharge (1900-2000) and quantile regression

These changes are not statistically significant ($p \leq 0.05$)

High flood rate (>0.08 $m^3/s/km^2$)

Medium flood rate

Low flood rate (< 0.03 $m^3/s/km^2$)

(Di Baldassarre et al., Geophysical Research Letters, 2010)

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Flood trend analysis (at-site regression)

Statistically significant (p≤0.05) changes:

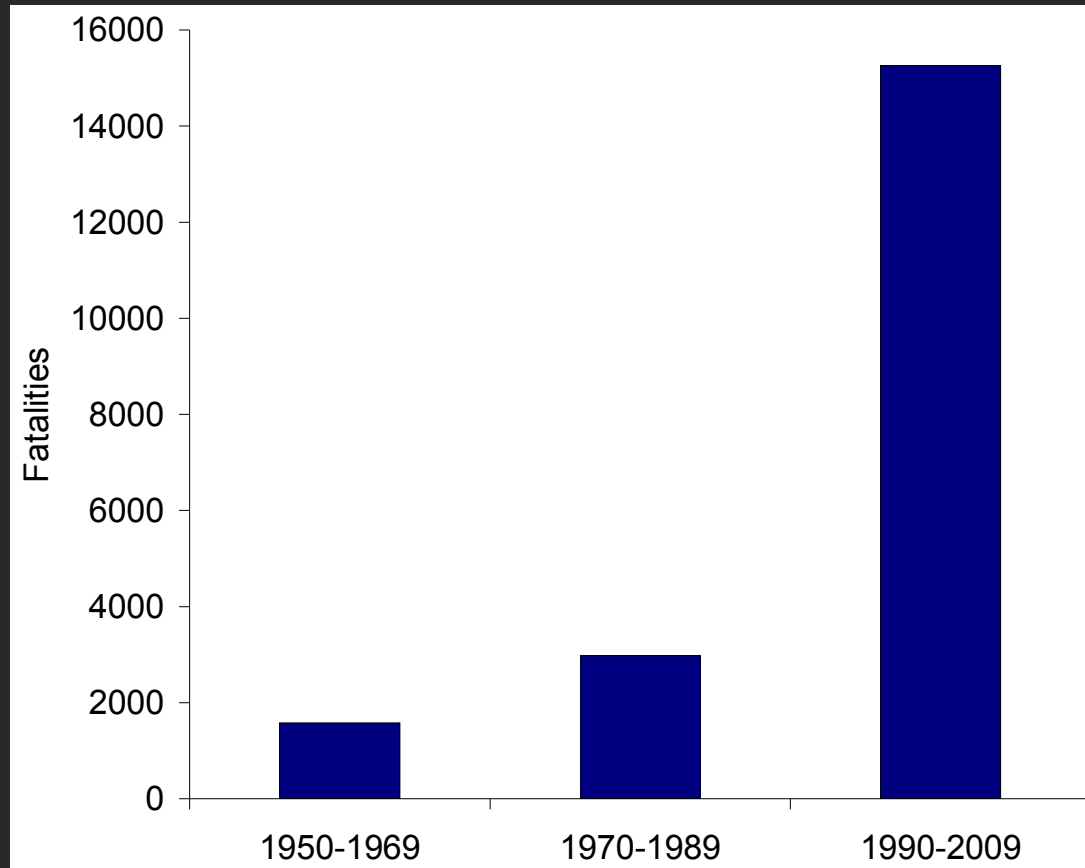Out of 79 time series:

Positive   **4**
Negative   **10**
No trend   **65**

(Di Baldassarre et al., Geophysical Research Letters, 2010)

So, WHY?

Flood fatalities have increased about one order of magnitude

(source: EM-DAT, 2010)

Flood Risk

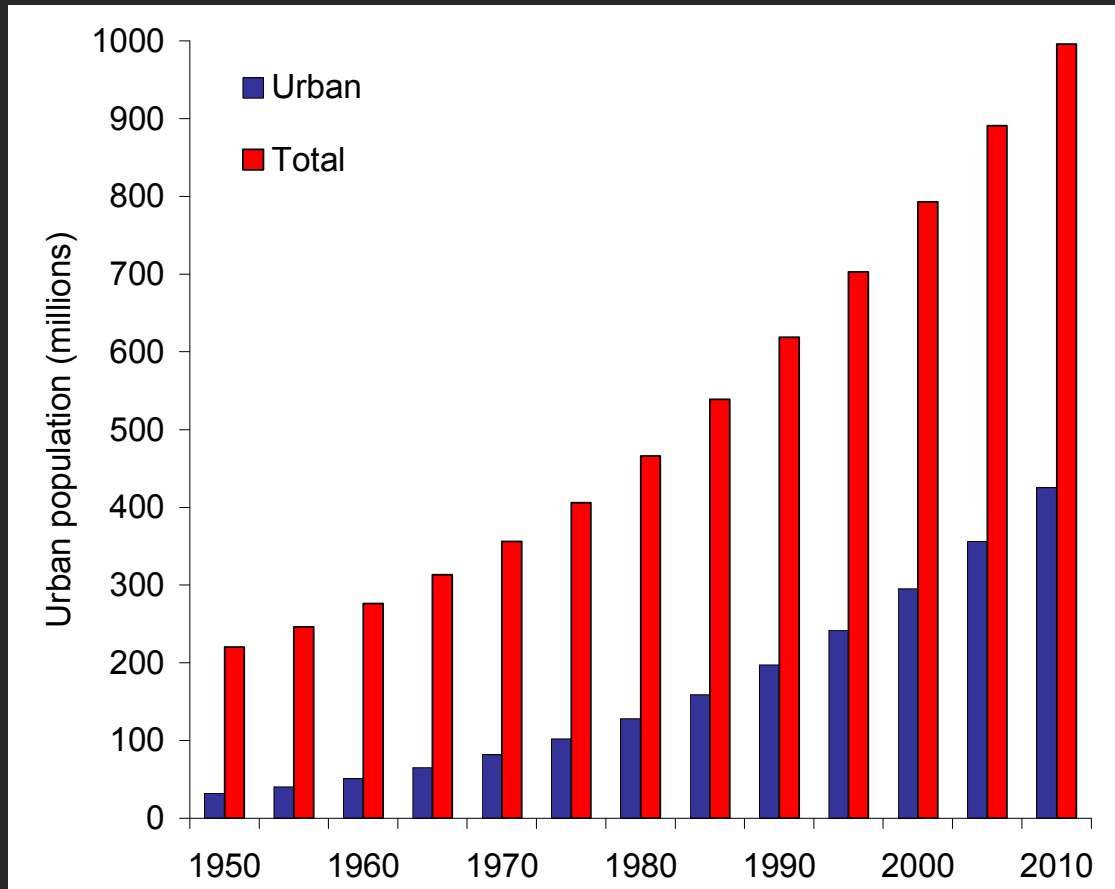Flood Risk = Probability * Consequences

Demographic changes > increased human vulnerability

(EC Floods Directive, 2007; Di Baldassarre et al., Natural Hazards, 2009)

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Population growth

Total and urban population in Africa (1950-2010)

Total   (x 4)
Urban   (x 10)

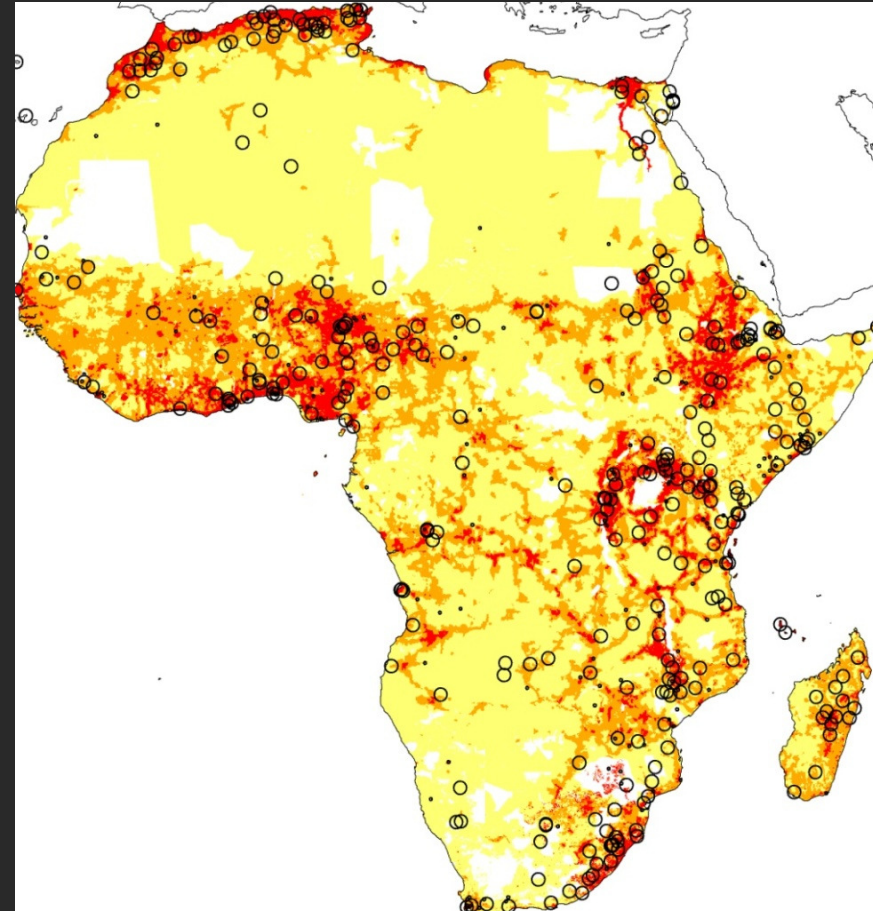*(Di Baldassarre et al., Geophysical Research Letters, 2010)*

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Population dynamics

Population growth (1960-2000) in Africa
(0, yellow, 100, orange, 1000, red)

Recent (since 1985)
- Floods, dots
- Deadly floods, circles

(Di Baldassarre et al., Geophysical Research Letters, 2010)

Human settlement in flood prone areas

Example 1: Dakar, Senegal

(World Bank, 2010)

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Human settlement in flood prone areas

Example 2: Lake Victoria (1960-2000)
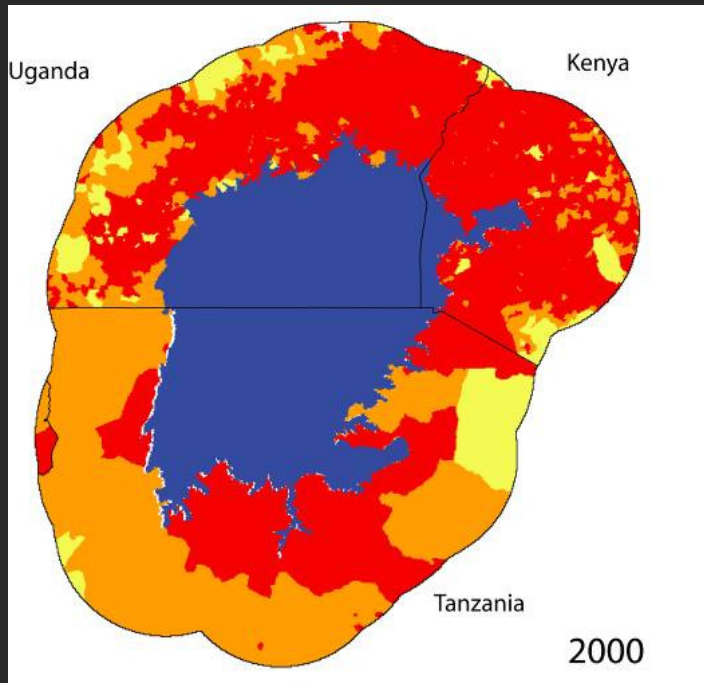
(Africa Water Atlas, UNEP, 2010)

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Conclusions

Population trends have increased flood risk in Africa

Human settlements in flood prone areas

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Future African Population
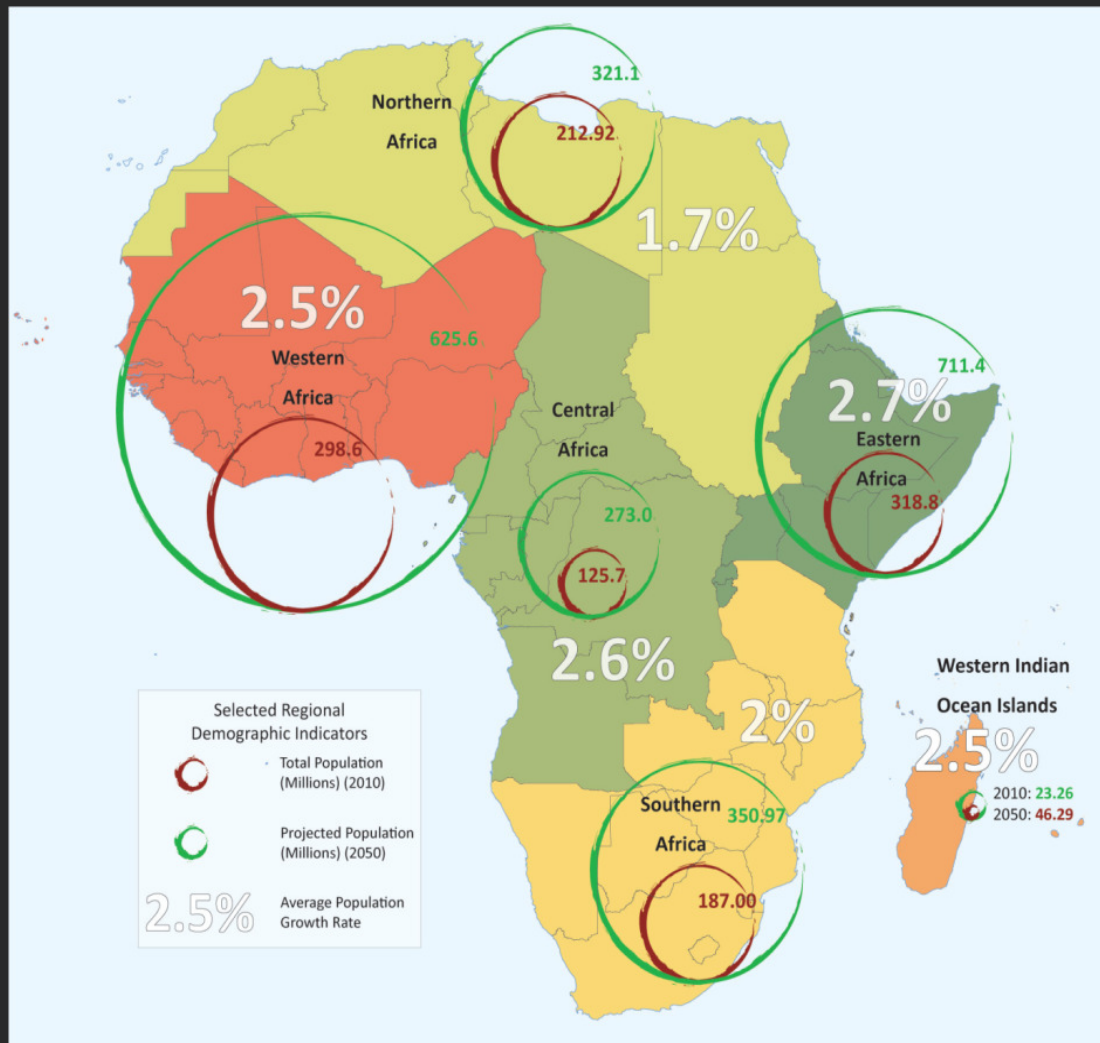
(Africa Water Atlas, UNEP, 2010)

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Sustainable Actions

What?
Local institutional capacities
Awareness and Preparedness
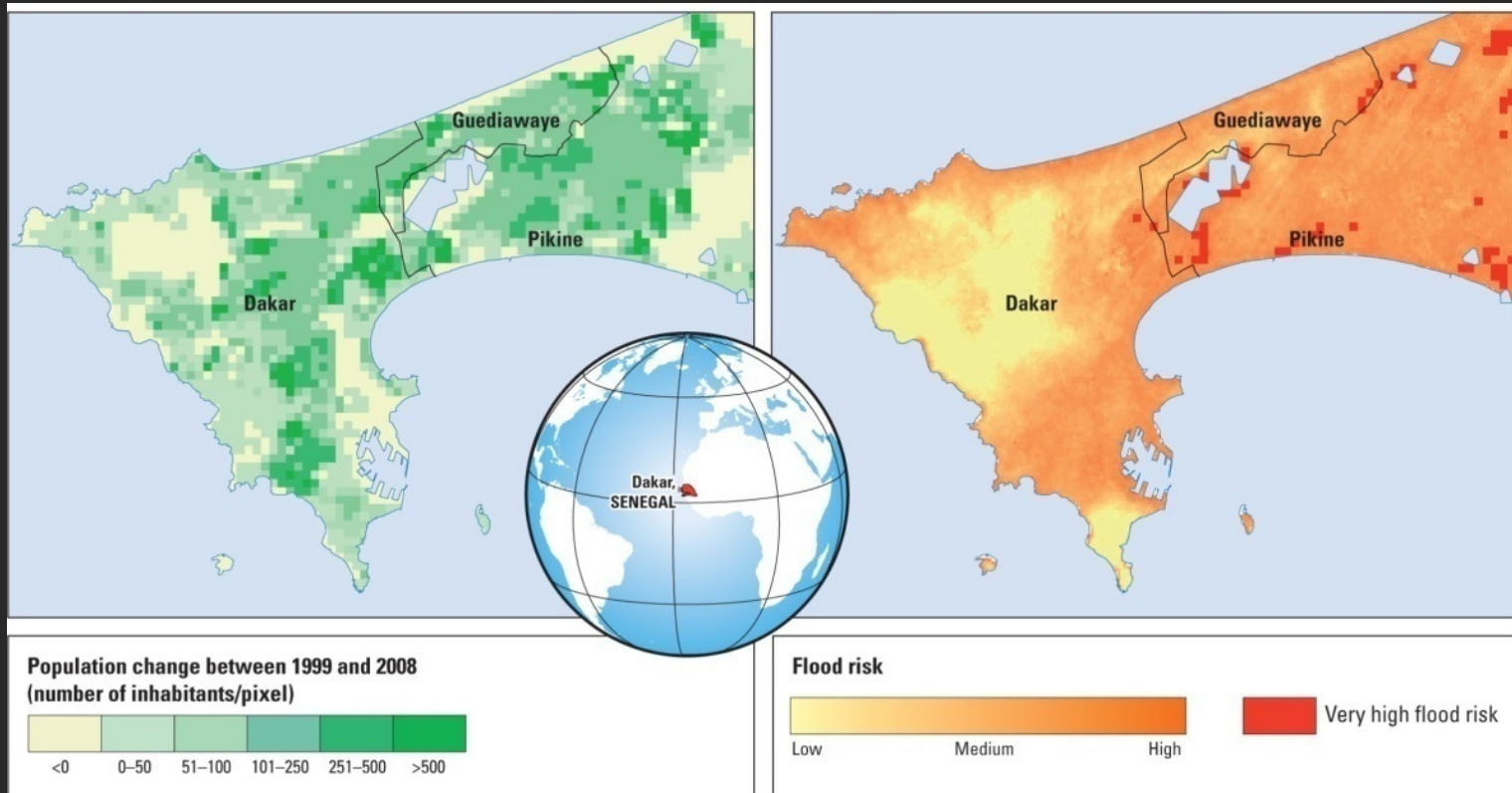Discourage urban expansions in flood prone areas

How?
Early warning systems
Floodplain mapping

(Di Baldassarre et al., Geophysical Research Letters, 2010)

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Perspectives

Globally and freely available space-borne data?

(NASA's SRTM; ESA's ENVISAT ASAR; Schumann et al., WRR, 2010; Padi et al., PCE, 2011)

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Discussion Blogs

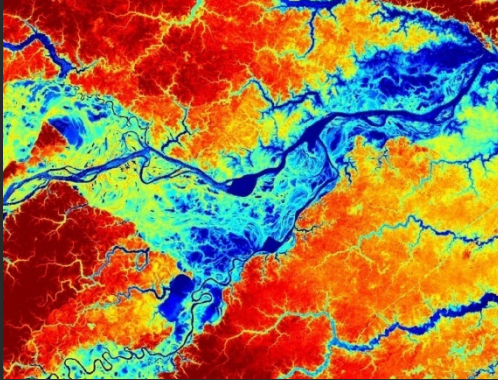GEOPHYSICAL RESEARCH LETTERS, VOL. 37, L22402, doi:10.1029/2010GL045467, 2010

Flood fatalities in Africa: From diagnosis to mitigation

Giuliano Di Baldassarre,[1] Alberto Montanari,[2] Harry Lins,[3] Demetris Koutsoyiannis,[4] Luigia Brandimarte,[5] and Günter Blöschl[6]

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[1] Flood-related fatalities in Africa, as well as associated economic losses, have increased dramatically over the past half-century. There is a growing global concern about the need to identify the causes for such increased flood damages. To this end, we analyze a large, consistent and reliable data-set of floods in Africa. Identification of causes is not easy given the diverse economic settings, demographic distribution and hydro-climatic conditions of the African continent. On the other hand, many African river basins have a relatively low level of human disturbance and, therefore, provide a unique opportunity to analyze climatic effects on floods. We find that intensive and unplanned human settlements in flood-prone areas appears to be playing a major role in increasing flood ri... during the last 50 years. These nu... urgent actions, for the planning ... understand the reasons why flood ... in Africa.

[3] Flood risk is determined by ... flood may occur and (b) the poten... [European Parliament and Counc... 2007]. Therefore, herein we inves... matic signals, which may have inc... well as the land use, economic a... that may have led to increased hum... hydro-meteorological conditions. ...

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15 OCTOBER 2010

Population trends, not climate, causing increased flood fatalities in Africa

Posted by mjvinas

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Fatal Floods In Africa

Human settlement patterns, not climate change, are responsible for an increase in deaths.

Dec 15, 2010

By Phillip F. Schewe
Inside Science News Service

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Fatal floods in Africa
December 16, 2010 By Phillip F. Schewe

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The yellow-to-red areas on this map of Africa show population growth over the period 1960-2000. The location of floods over the period 1985 to 2009 are denoted by dots and deadly floods by black circles. Credit: Courtesy Giuliano Di Baldassarre

Enlarge

When natural disasters claim human lives, it's important to determine whether the problem is geophysical or cultural. A new study shows that the large upswing in flood deaths in Africa over past decades is chiefly the result of population settlement patterns, and is not a consequence of changing climate.

Giuliano Di Baldassarre
EGU Conference, April 2011, Vienna

THANK YOU VERY MUCH!