Managing ecosystem services in agricultural systems: the African challenges

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Preview

- Growing demand for ecosystem services
  - Ecological footprint structure and human development
  - Africa's population transition
- Factors affecting supply of ecosystem services
  - state-factors (climate, potential organisms, topography, parent material, soil, time ...)
  - Lake Victoria
- The (unknown) dynamics of collapse and recovery
  - managing ecosystem resilience

Ecological footprints (in “global hectares” per person) in 2001

	Cropland	Forest	Pasture	Fishing grounds	Built space	Carbon	EF
Sub-Saharan Africa	0.4	0.05	0.09	0.04	0.1	0.4	1.1
Countries w. HDI* > 0.8	0.8	0.8	0.3	0.3	0.2	4.1	6.4
Countries w. HDI 0.5 - 0.8	0.5	0.1	0.2	0.1	0.1	0.9	1.9
World	0.5	0.2	0.1	0.1	0.1	1.2	2.2

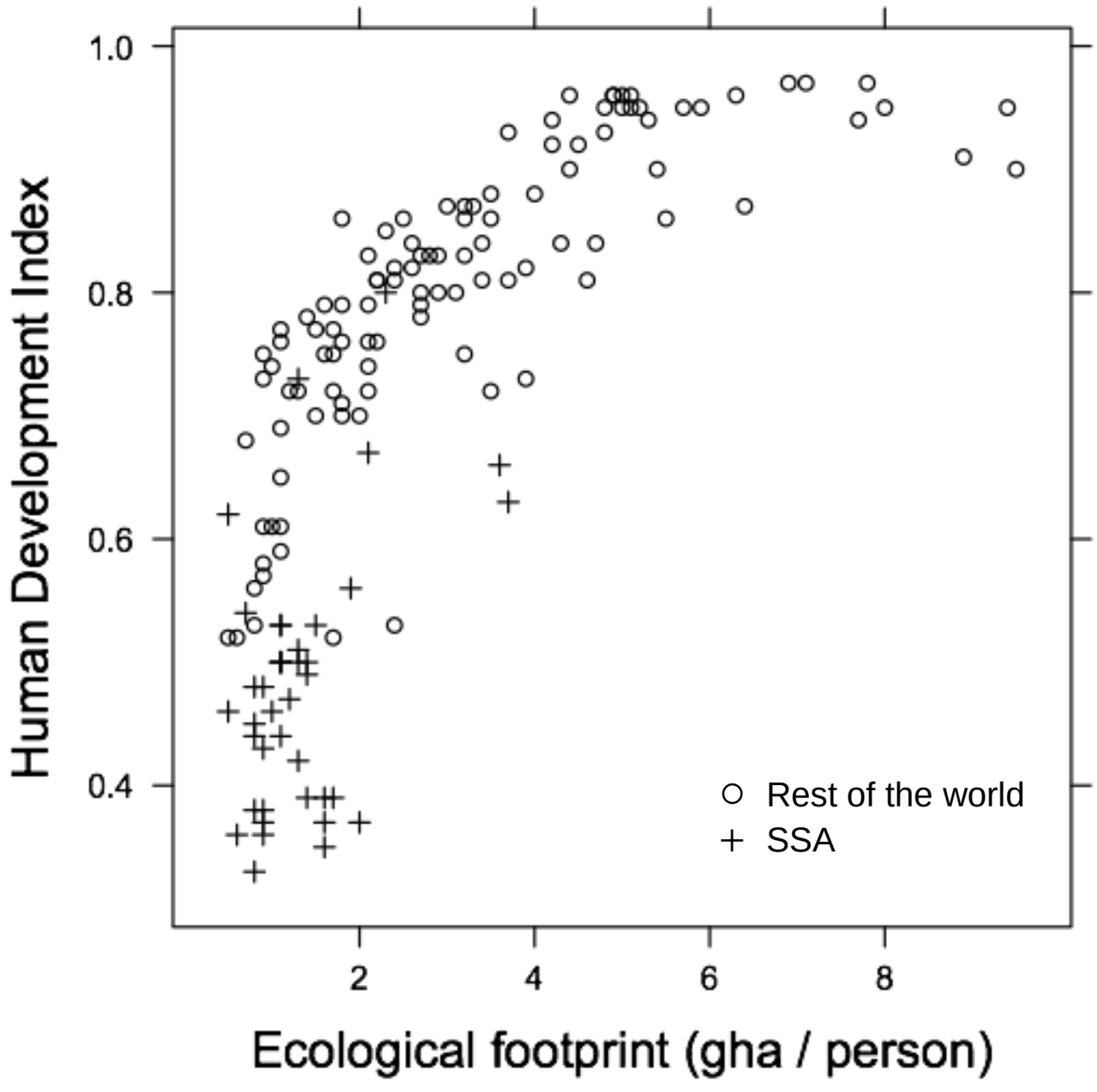
* HDI = Human Development Index

data: www.footprintnetwork.org

QuickBird satellite view of Kibera in Nairobi, 2005.

Photo: Google Earth

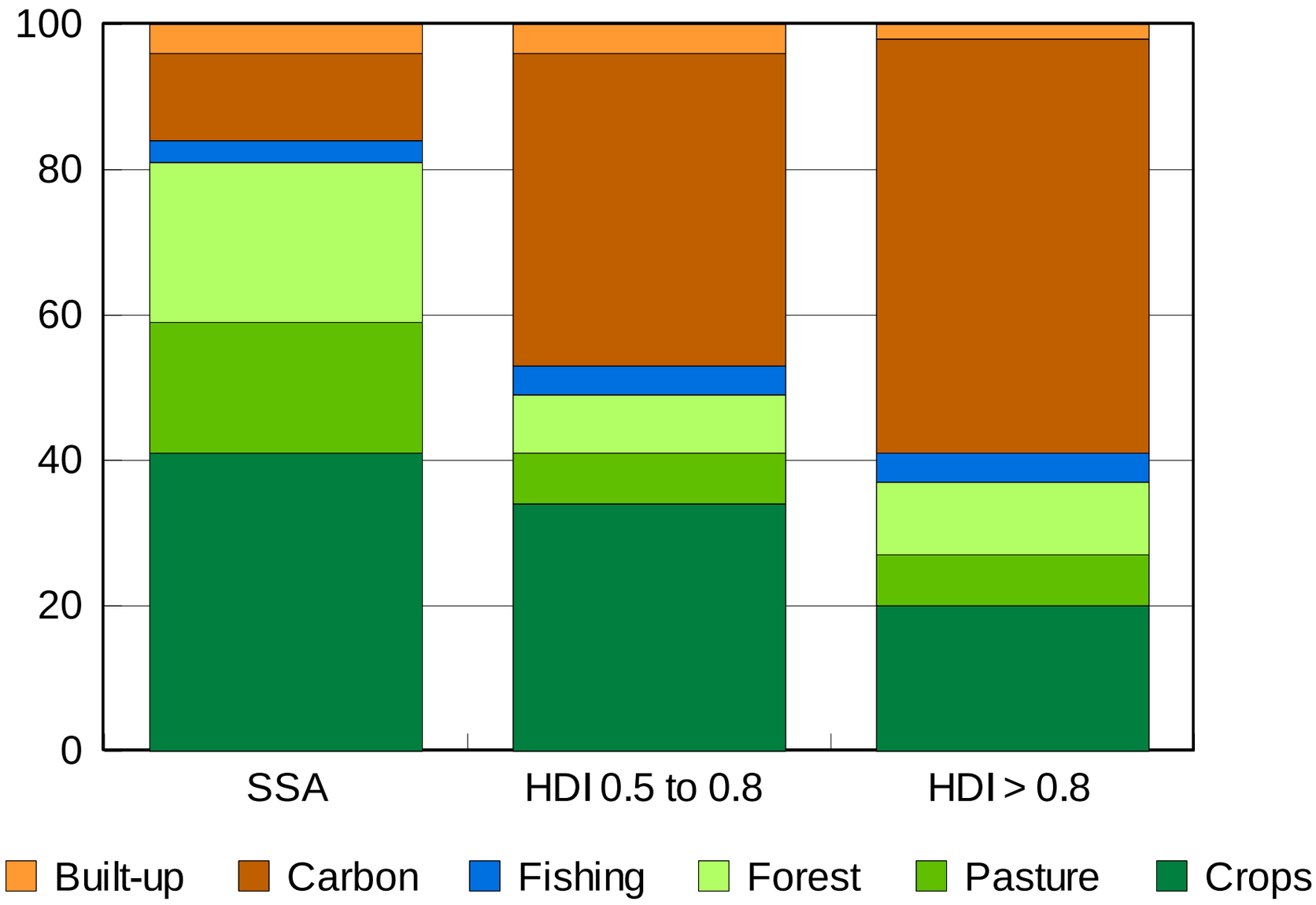
Ecological footprints vs Human Development Index in 2005



SSA = Sub-Saharan Africa

data: www.footprintnetwork.org & undp.org

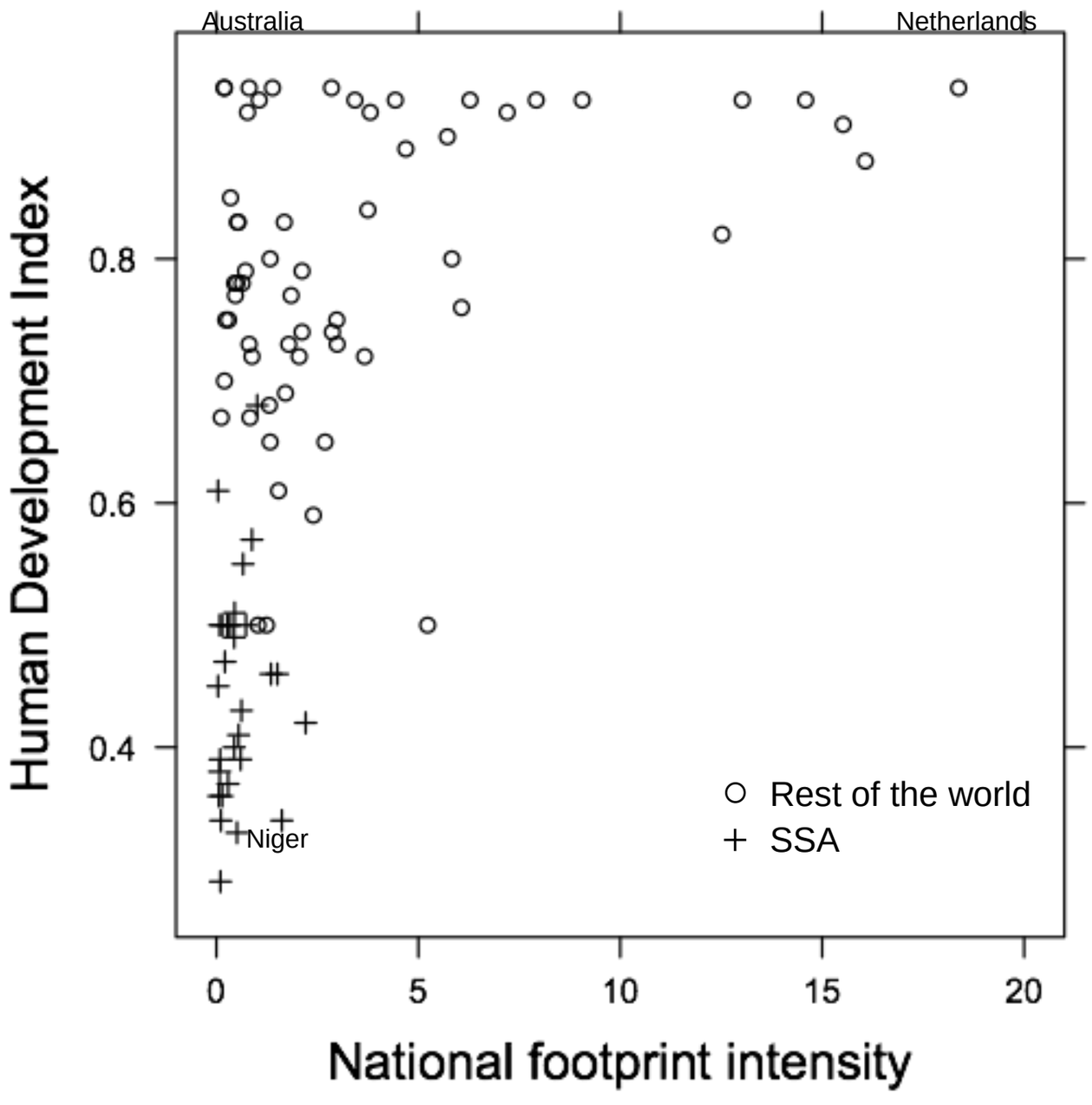
Ecological footprint structure 2005



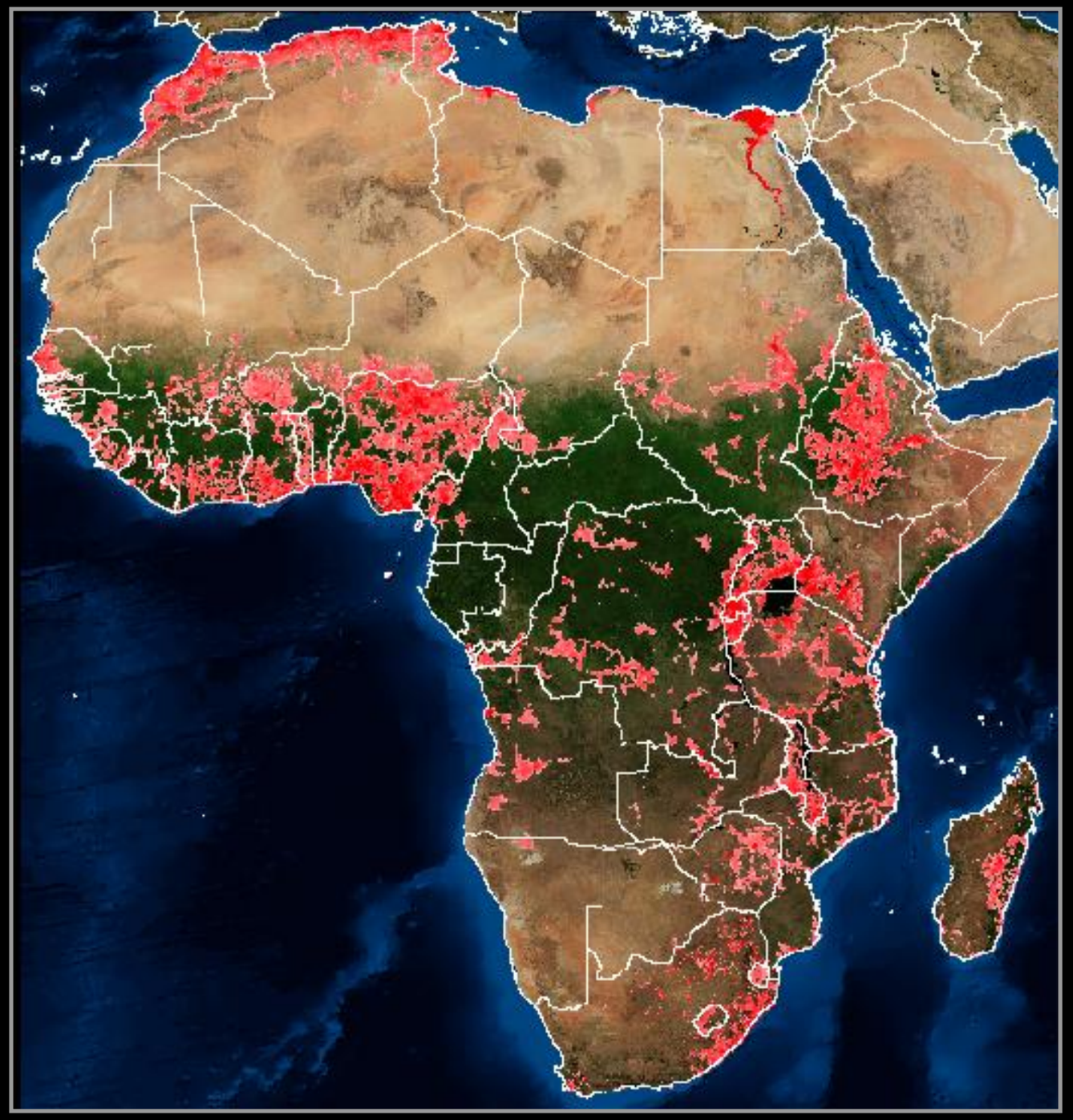
data: www.footprintnetwork.org & undp.org

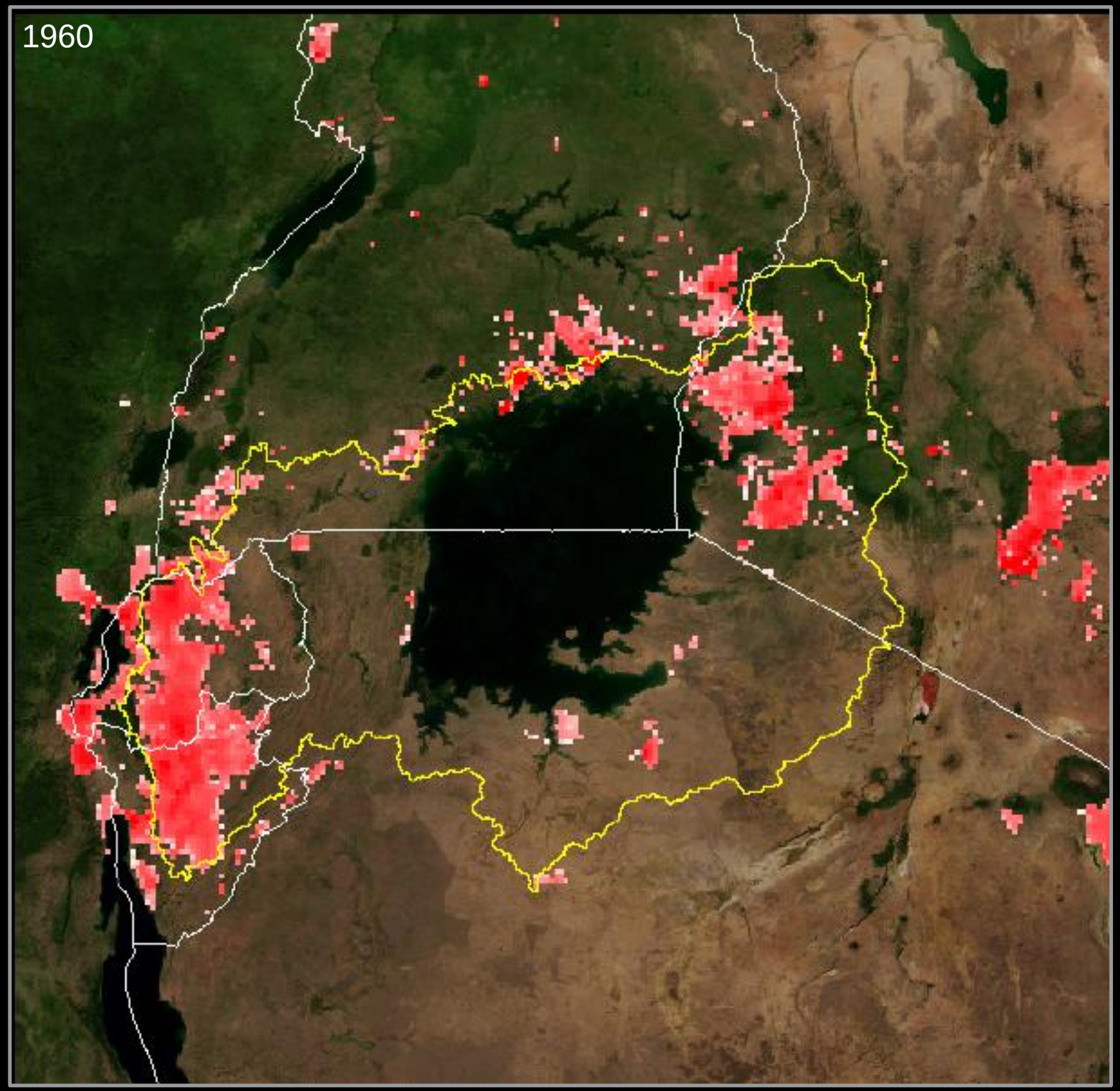
National footprint intensities (NFI) vs HDI in 2005

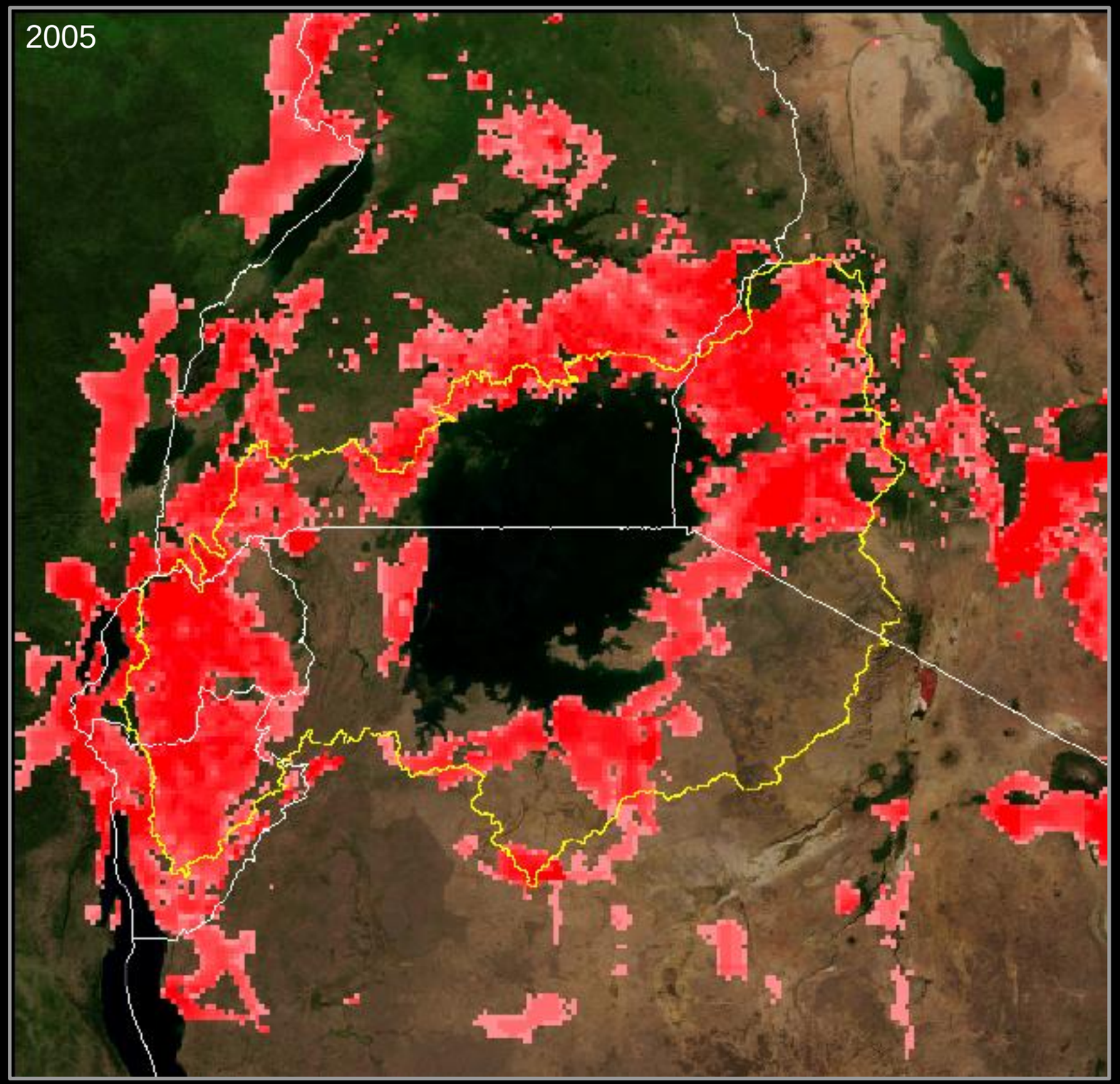
(NFI = Population × EF / Area)



Areas with probable ecological footprint intensities of more than 1 in 2005.



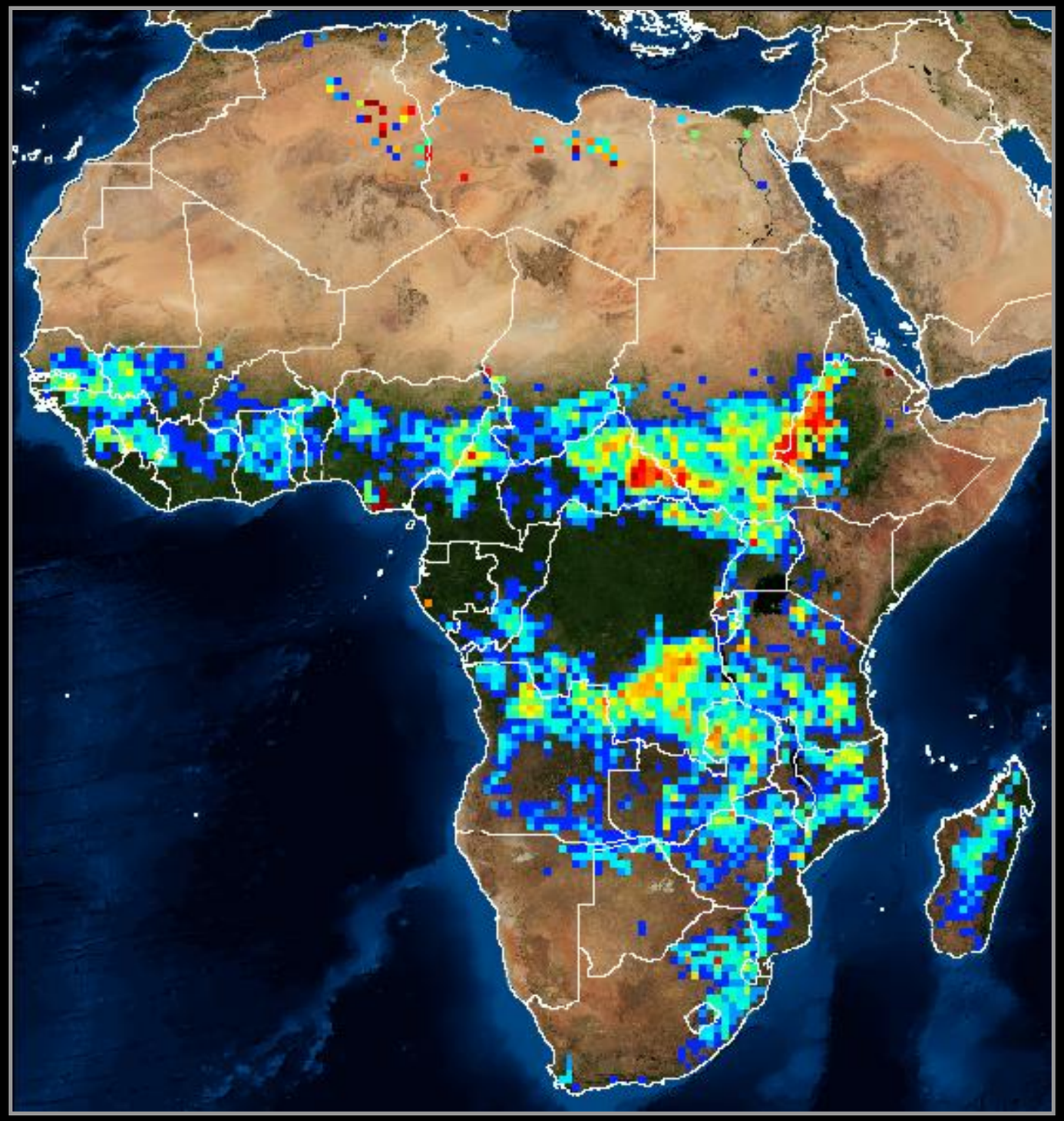

1960


2005

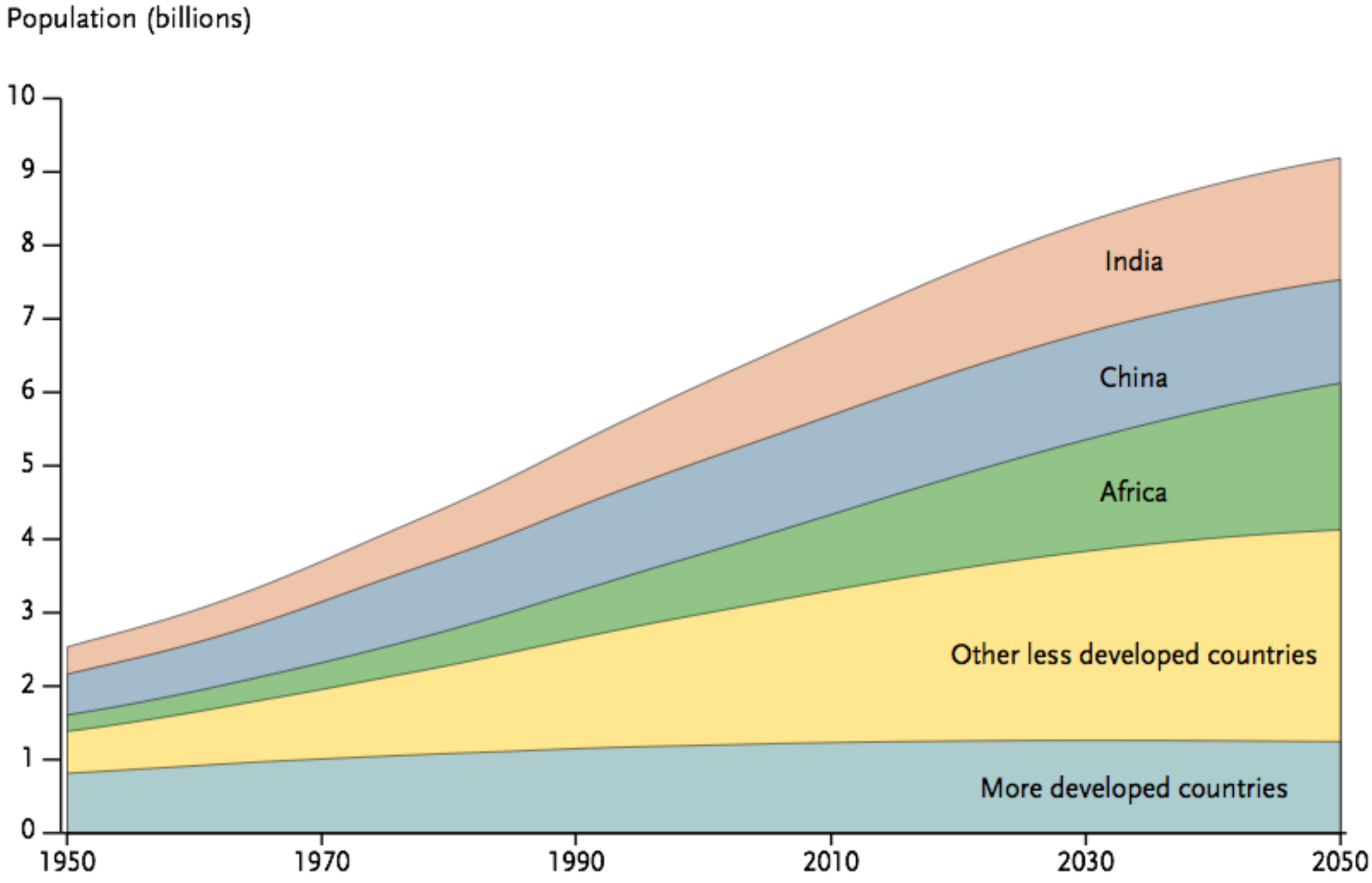
Gully erosion, Kisongo, Tanzania (2009).

Bush clearing, Tete province, Mozambique (2006).

Median annual fire density (1996-2008).

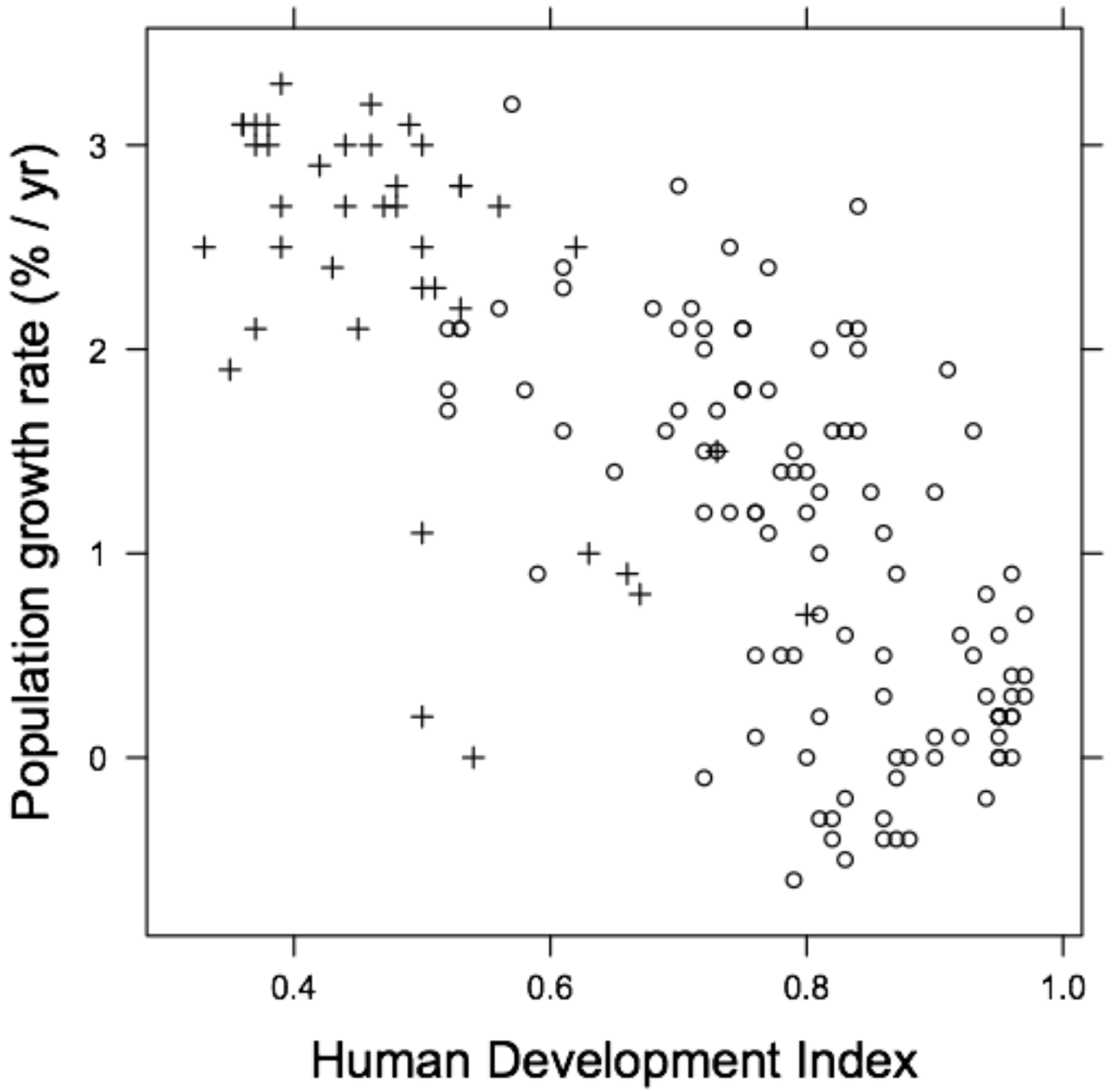


Projected human population growth to 2050



graphic: PRB.org

Population growth vs Human Development Index in 2005



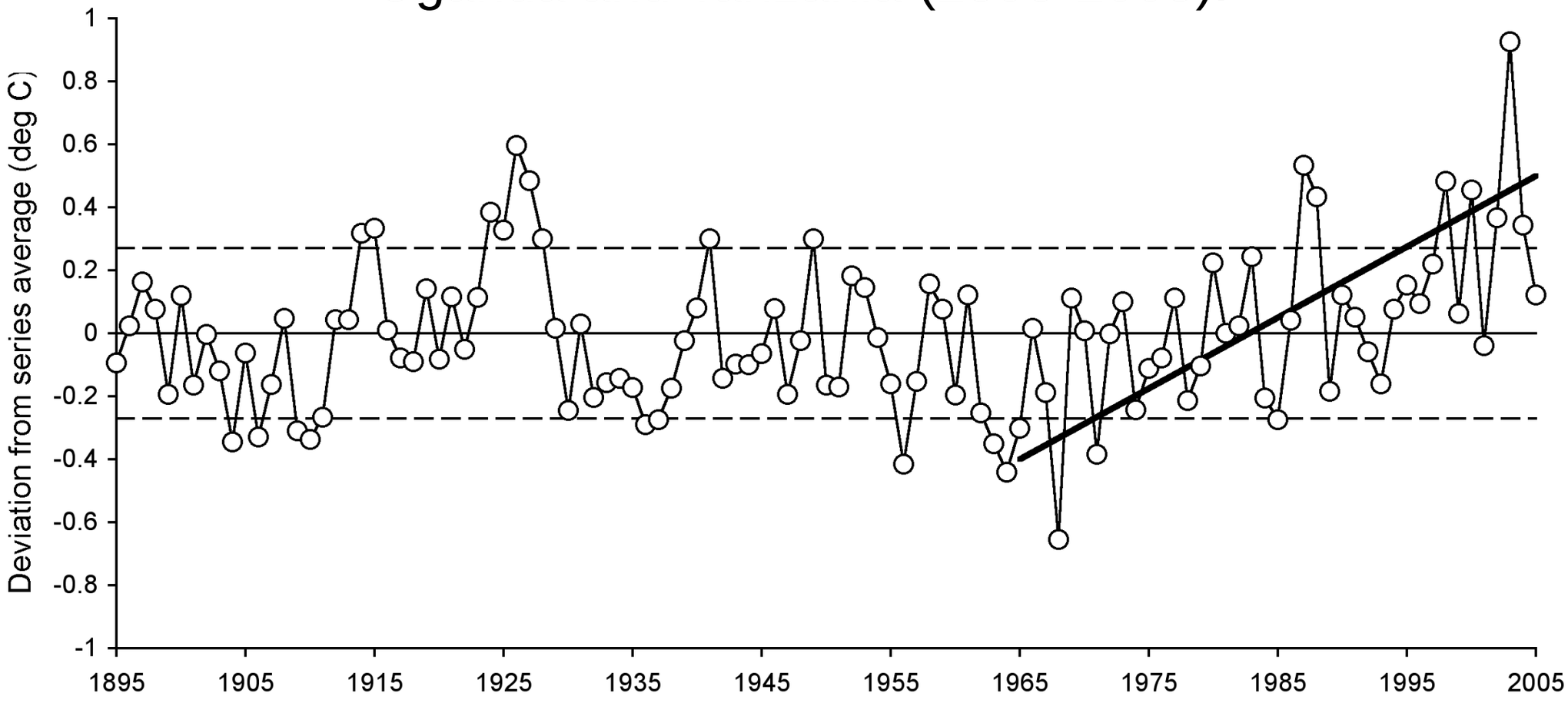
data: PRB.org & undp.org

Glacial retreat Mt. Kilimanjaro.

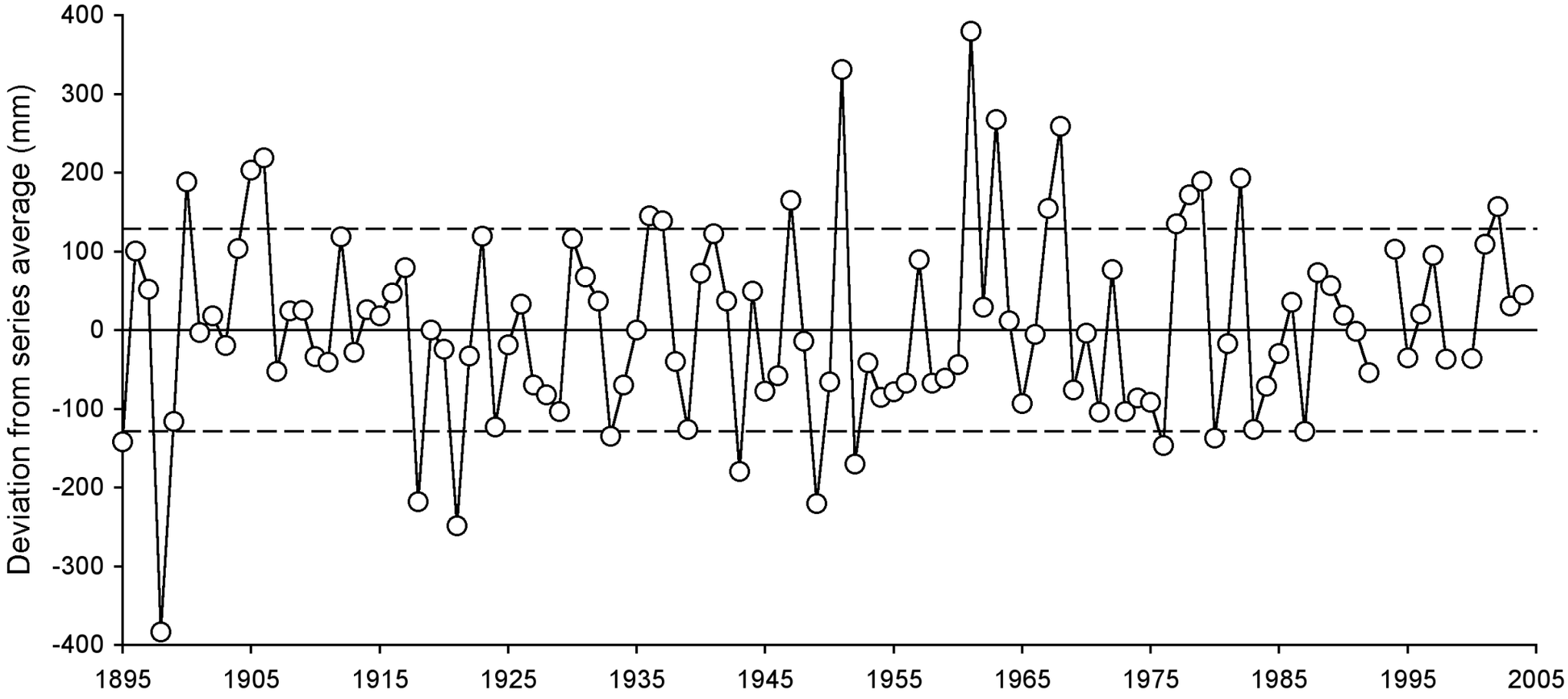
Photo: Tor Vagen

Photo: NASA

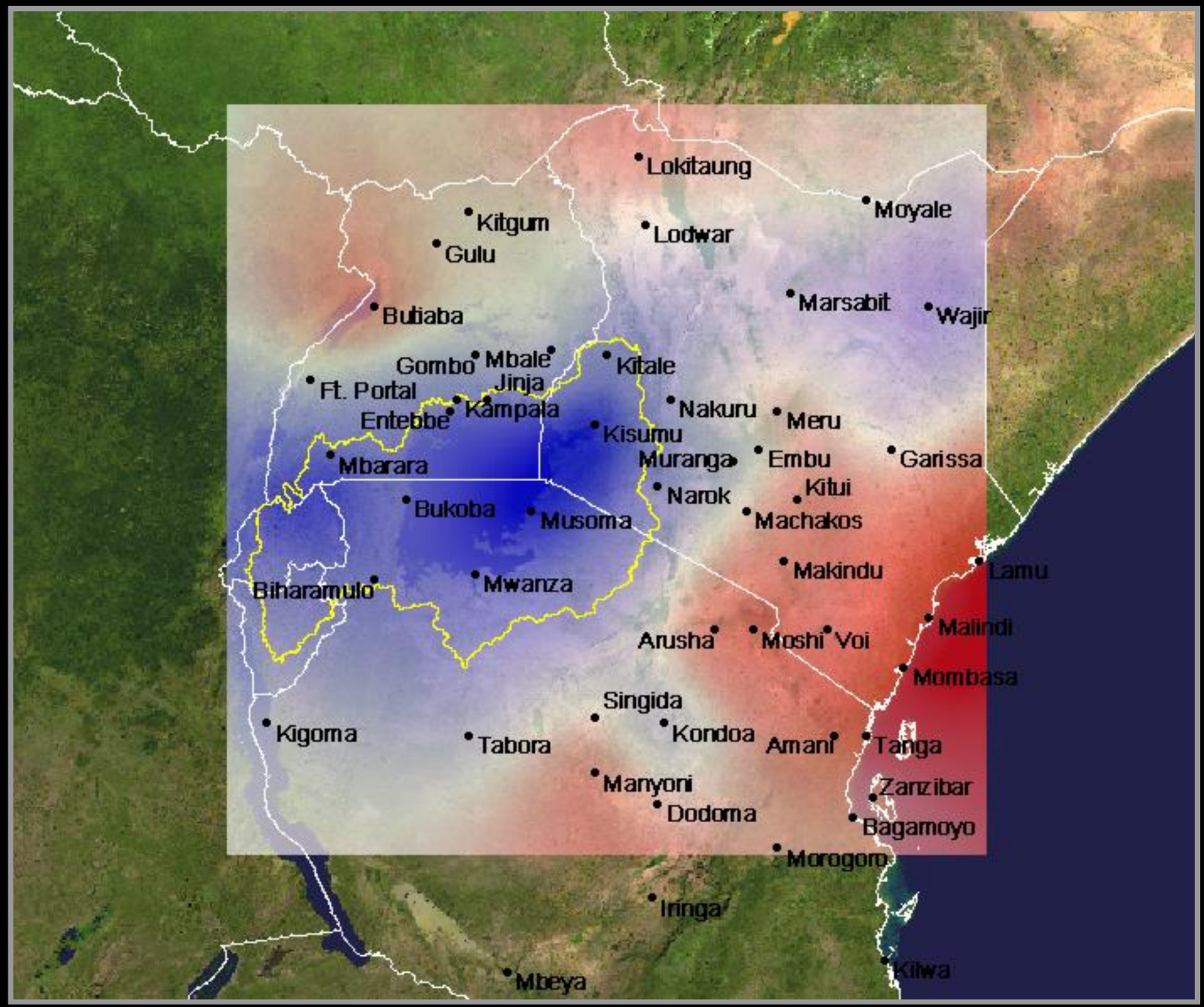
Mean surface air temperature anomalies for Kenya, Uganda and Tanzania (1895-2005).



Annual rainfall anomalies for Kenya, Uganda and Tanzania (1895-2005).

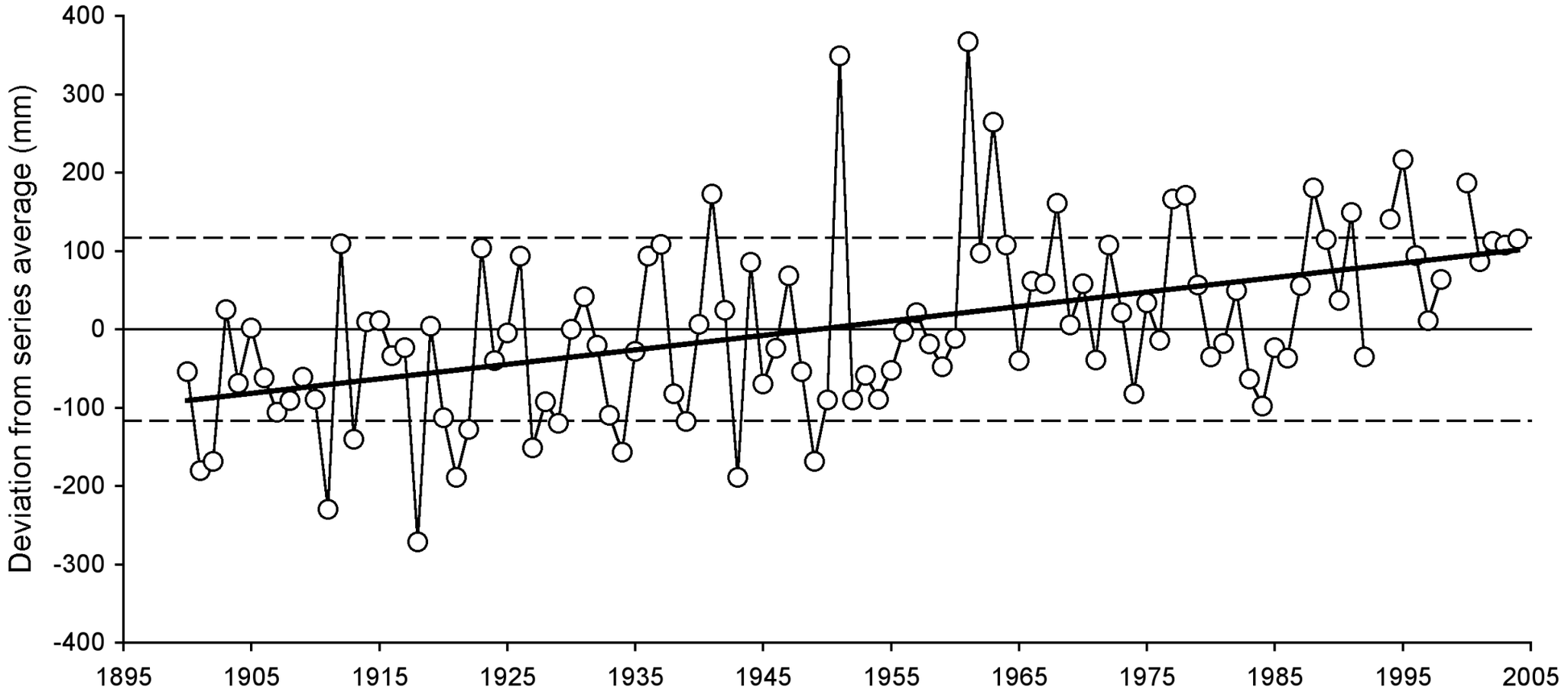


20th Century annual rainfall trends for East Africa.



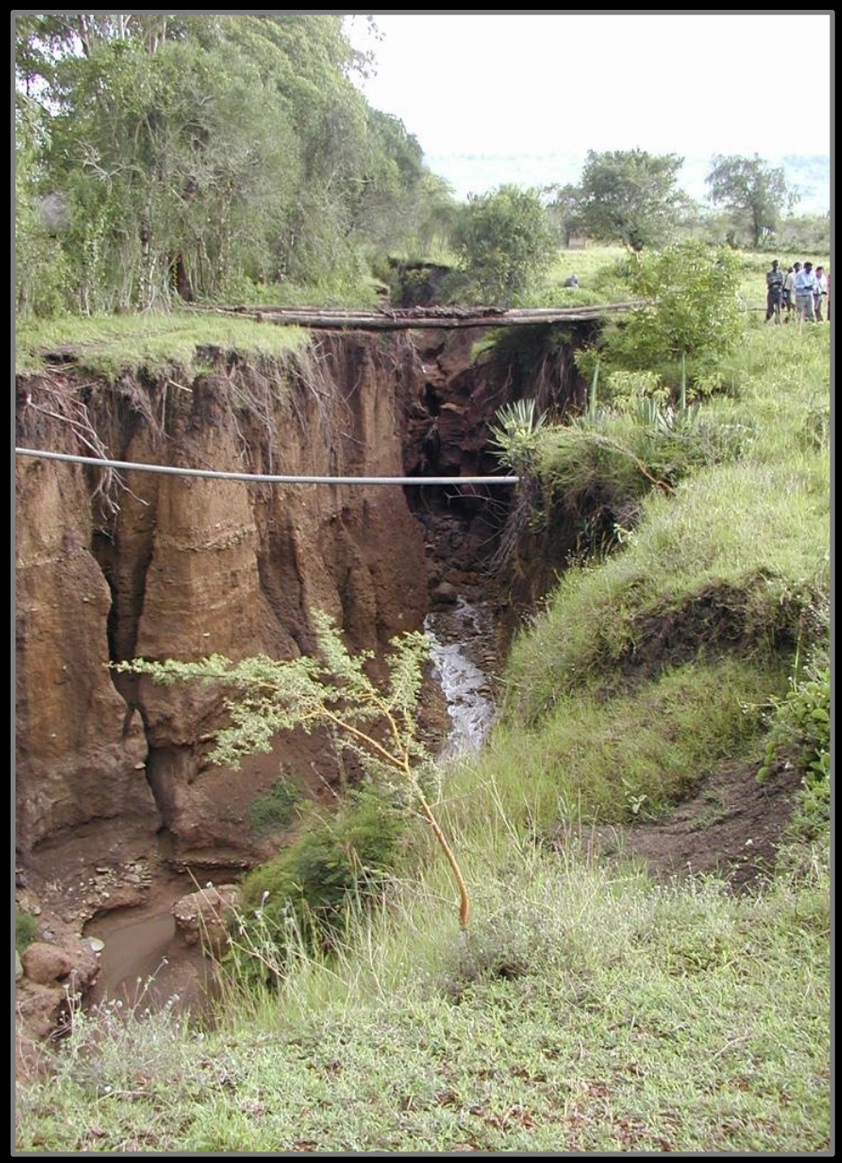
Drying Wetting

Annual rainfall anomalies for the Lake Victoria Basin (1900-2004).

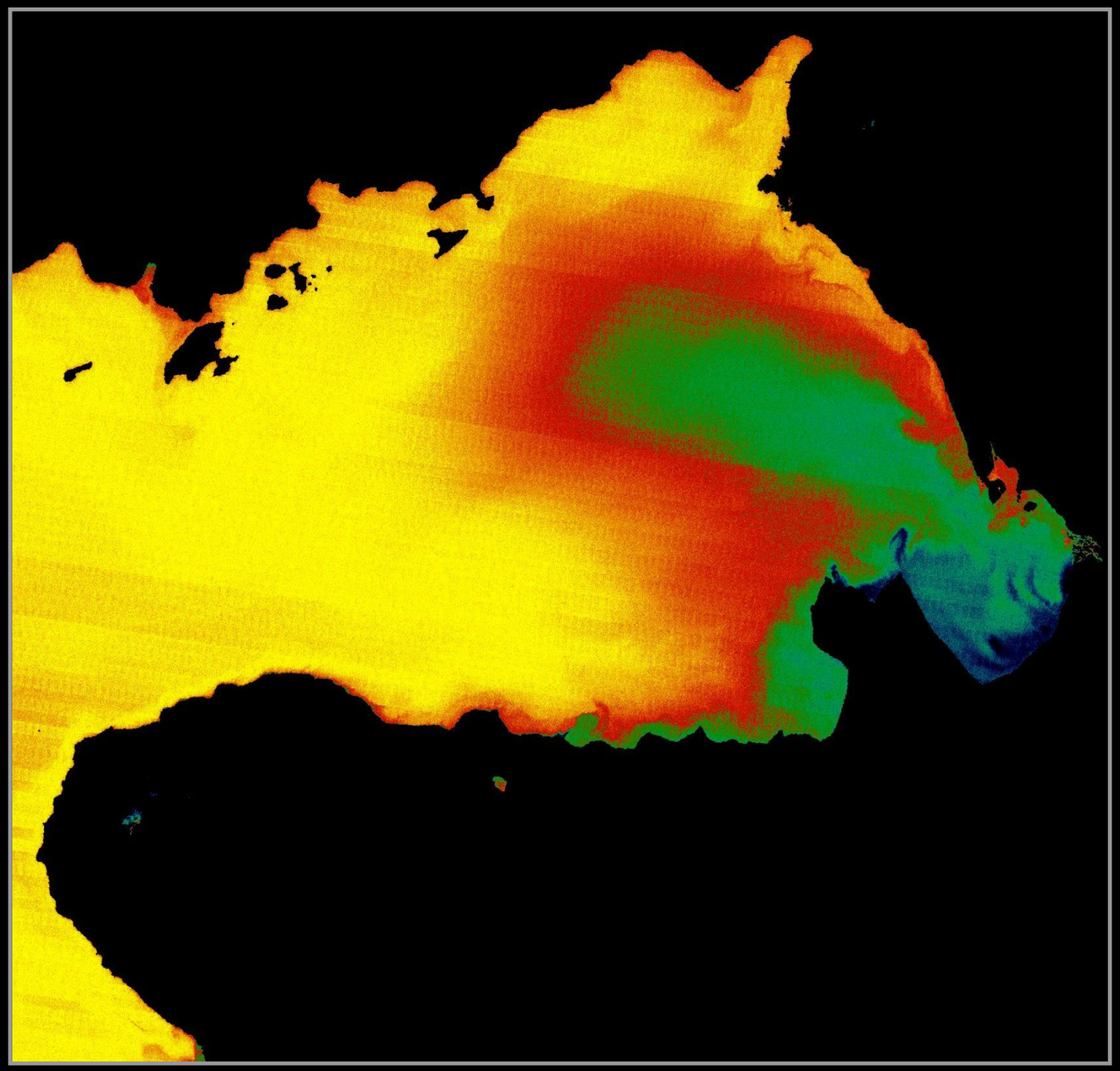


Flooding, Nyando River Basin, W. Kenya (2007).

Gully erosion, Katuk-Odeyo, W. Kenya (2006).



Nyando River sediment plume in Lake Victoria (2000).



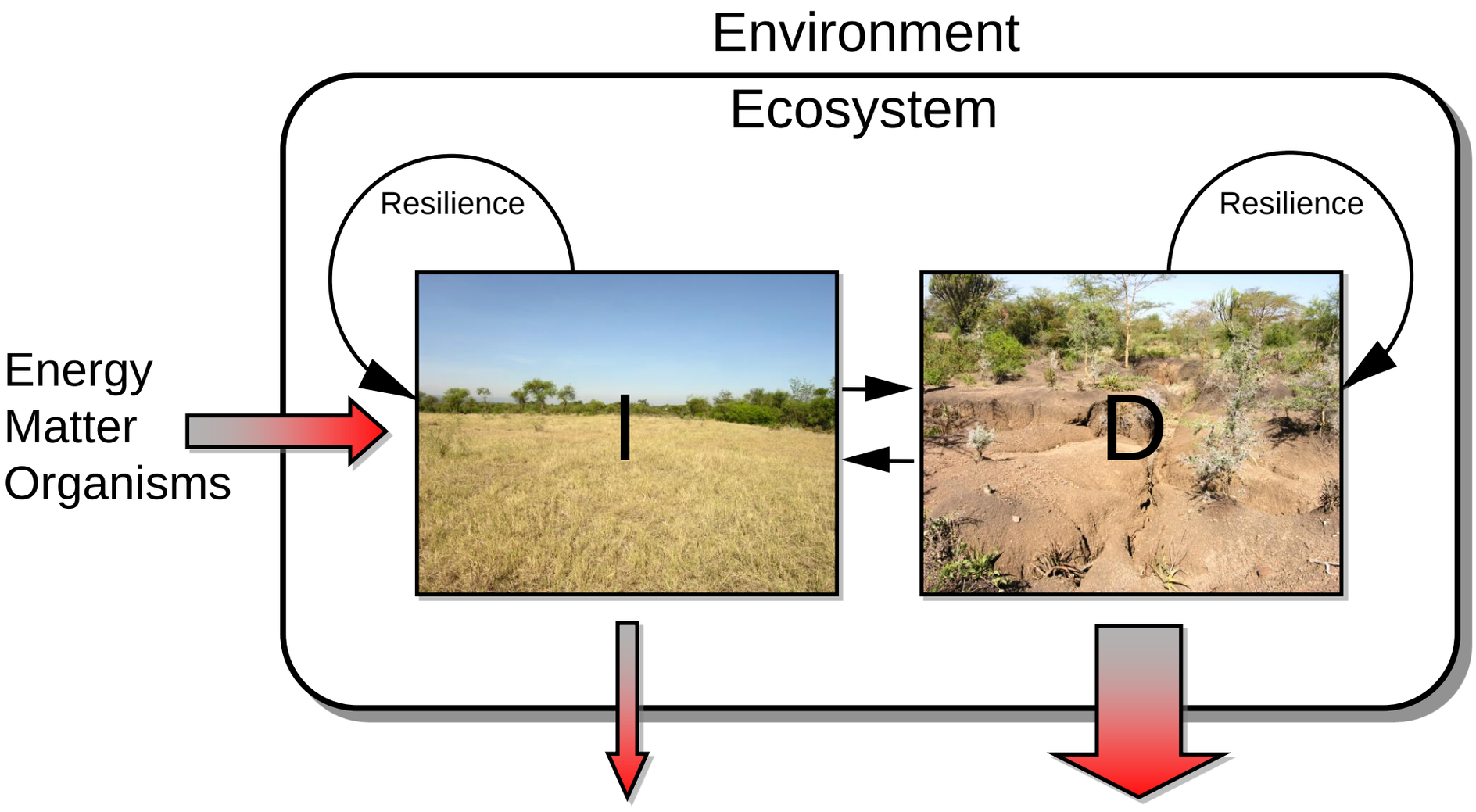
Eichornia crassipes, Kisumu Bay, Kenya (2006).

Algal bloom, Kisumu Bay, Lake Victoria, Kenya (2006).

Migingo Island, Lake Victoria, Kenya (2009).

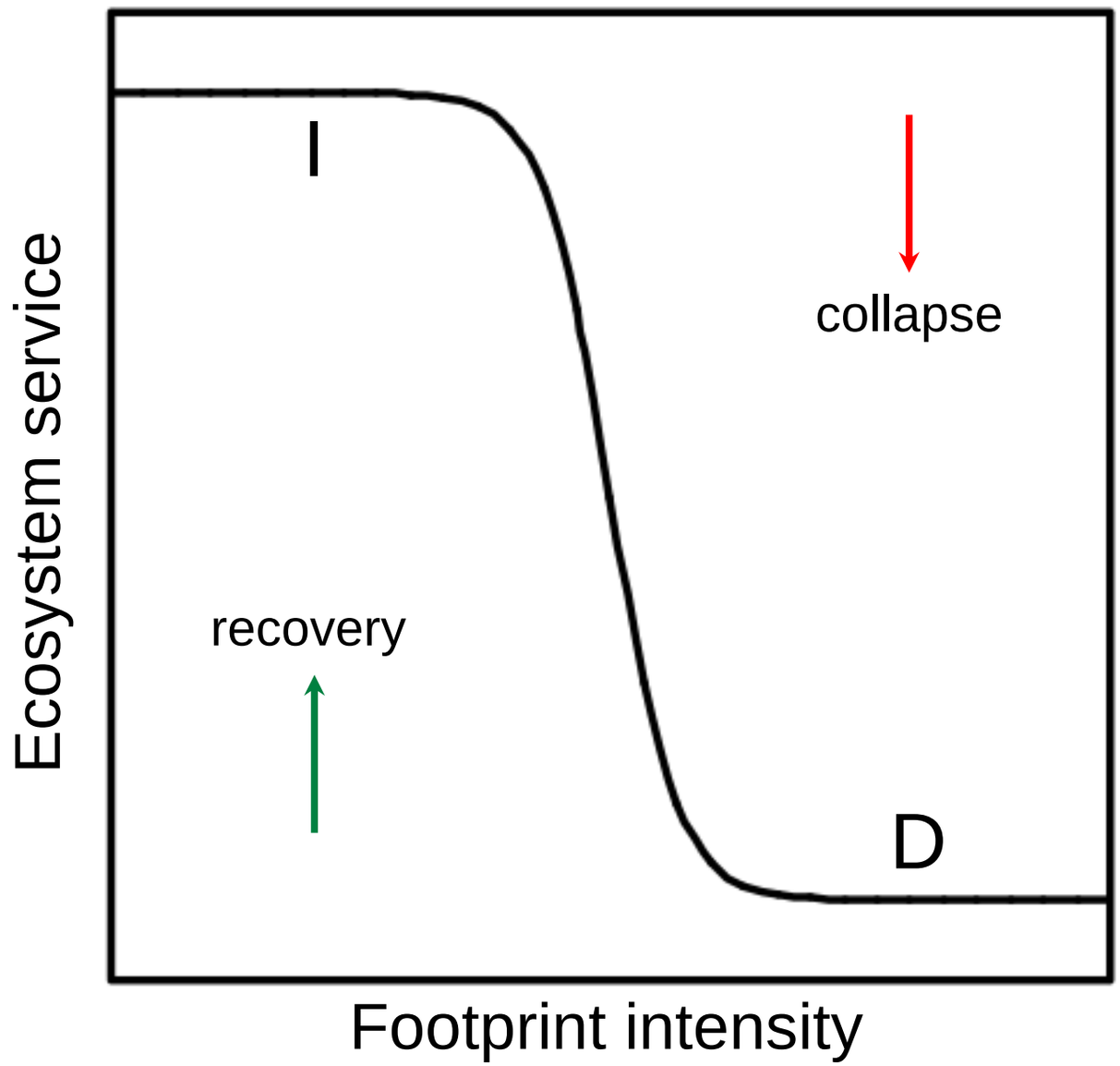
Photo: Daily Nation

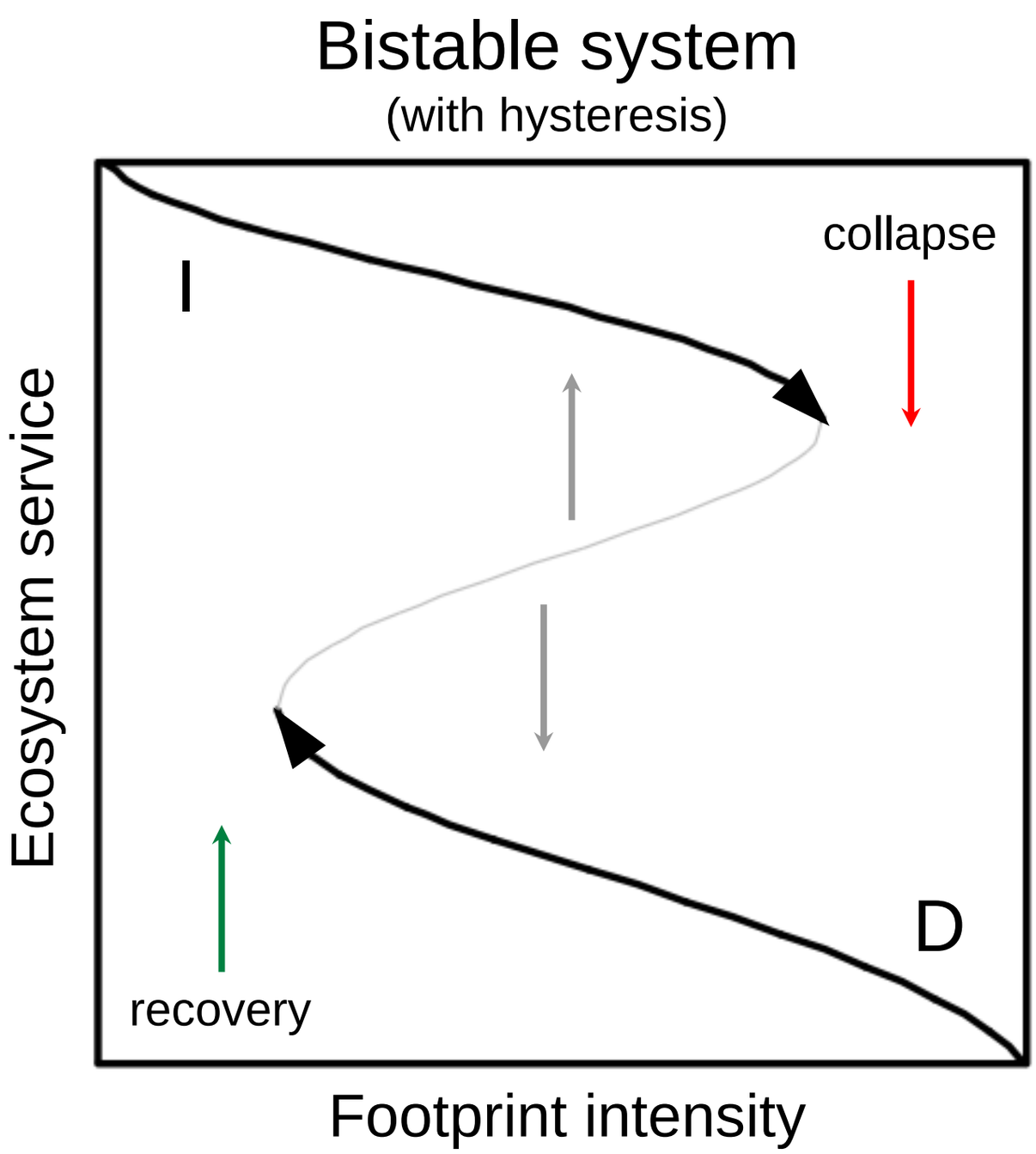
Ecosystem state & transition diagram



Bistable system

(with single equilibrium threshold)




Bistable system
(with hysteresis)
collapse
I
D
recovery
Ecosystem service
Footprint intensity

Fully functional Rendille “Gob” in Marsabit District, Kenya

Photo: H.J. Schwartz

Impoverished but socially functional Rendille “Gob” in Marsabit District

Photo: H.J. Schwartz

Dysfunctional, opportunistic settlement of destitute pastoralists.

Photo: H.J. Schwartz

Permanent famine relief camp for destitute pastoralists

Photo: H.J. Schwartz

Some of what's needed?

- Greater scientific understanding and consideration of the trade-offs between provisioning (i.e. agricultural) and other (e.g. regulating & supporting) ecosystem services.
- Better inventory, assessment and monitoring of e.g. systems near tipping points. Where are these in Africa, what are they going to look like as population doubles over the next 25-30 years?
- Raised awareness the possibility / probability of a scenario of increasing ES demand coupled with decreasing supply for the next generation of African's. Can we avoid widespread socio-ecological collapse, if so how and at what cost?
- Need to act on these gaps now, and that just requires a bit of political will!