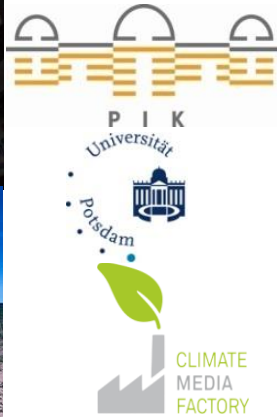


Climate Change & Development: is it desirable that human development converges?

Prof. Dr. Jürgen P. Kropp
Potsdam Institute for Climate Impact Research (PIK)
Head: Urban Transformations

Potsdam University, Dept. Geo- and Environmental Science
Climate Change & Sustainable Development

Director/CEO Climate Media Factory (CMF), Potsdam



Sahel Zone/Africa



New Delhi
Infrastructure 2008



European drought 2003



Amazon drought
2005



Soil Erosion Morocco 2006



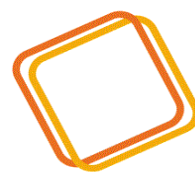
Cyclon Nargis/Myanmar
2008



Sea Level Fiji 2008



Hyderabad 2010



Policy
Forum on
Development


Brussels/Belgium
14. March 2019

Why climate matters!

It shapes our livelihood conditions



Adequate Temperatures ← Energy



Freshwater Supply ← Evaporation

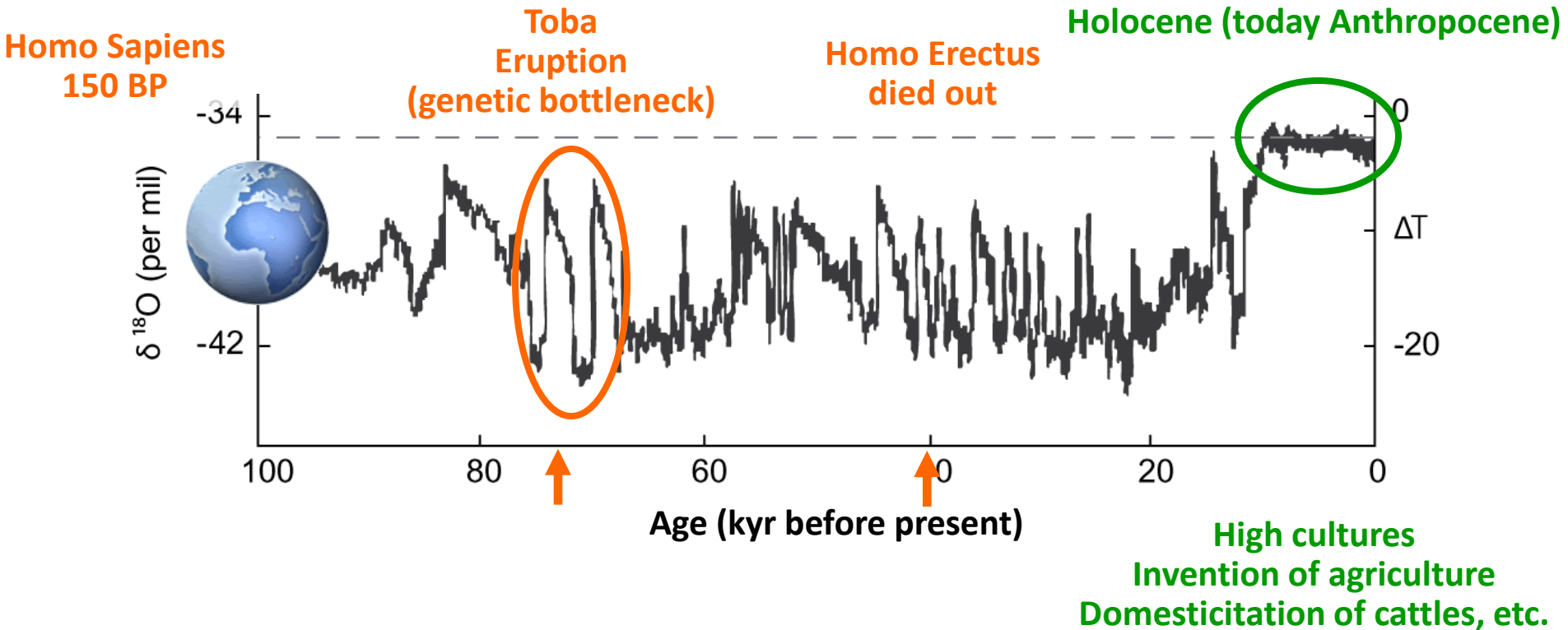


Biomass/Food ← Photosynthesis

Incoming Solar Radiation



The Holocene: *From Glacial Chaos to "Climate Paradise"*



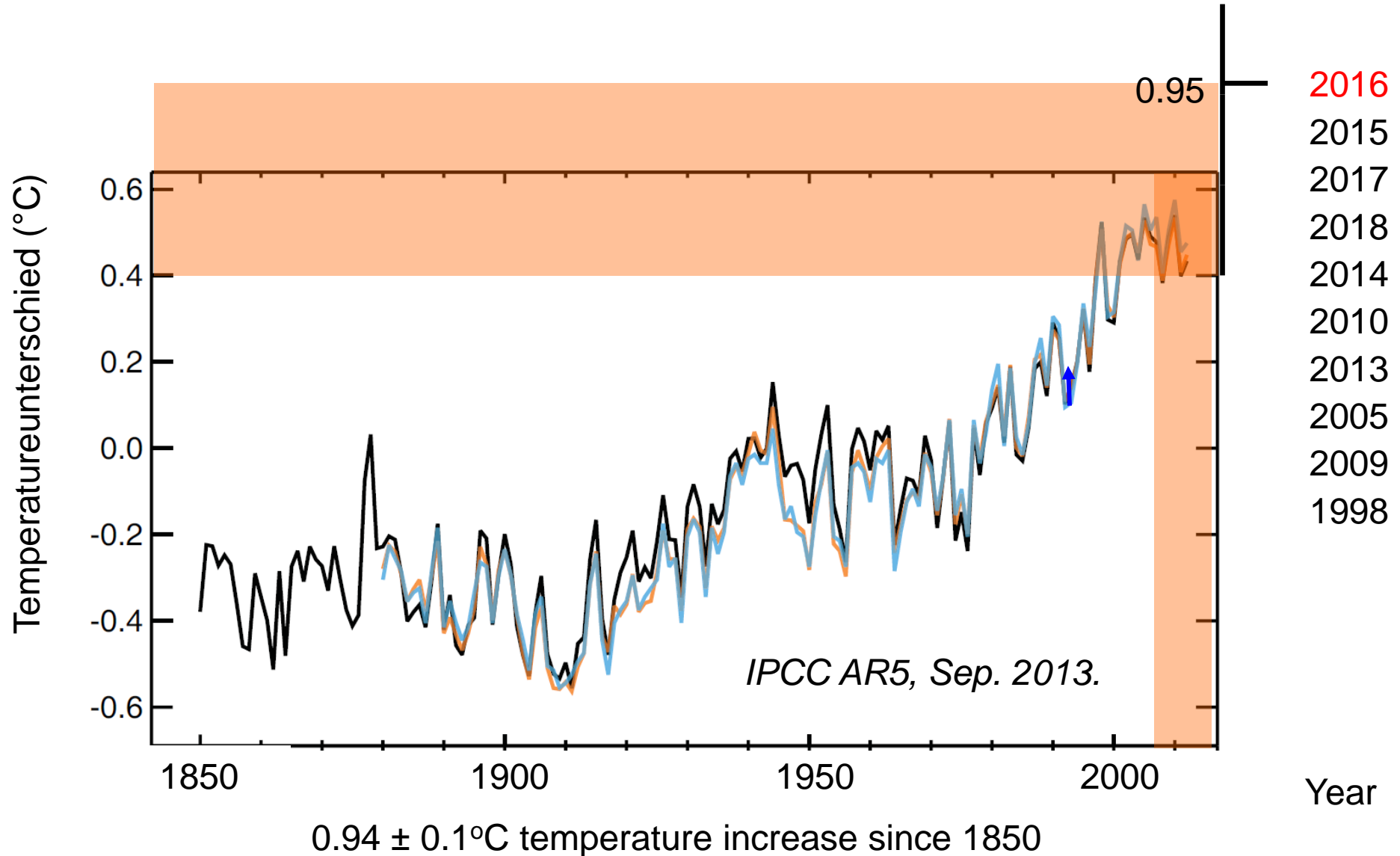


Climate Change – State of Play

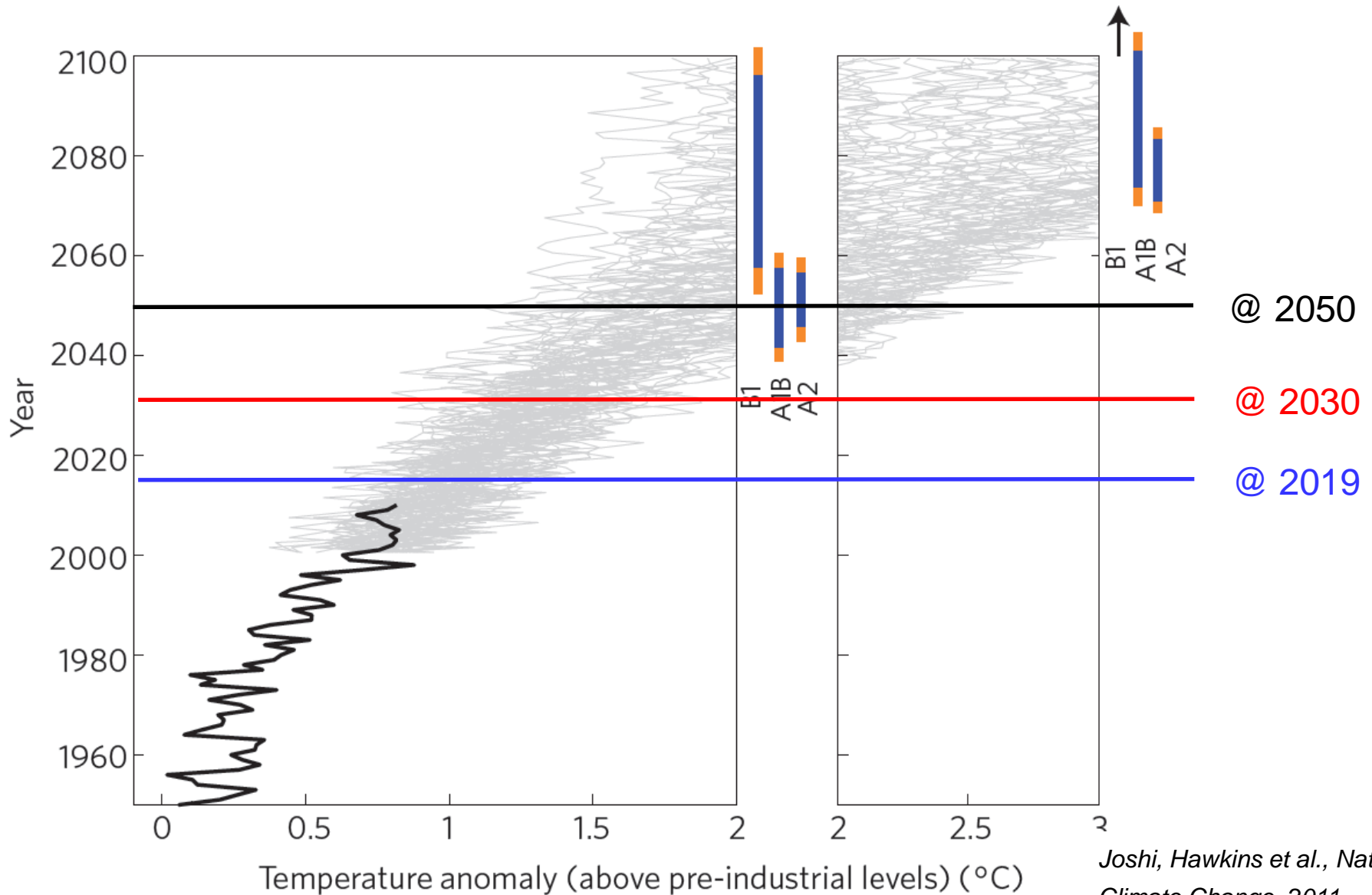


Earth is warming

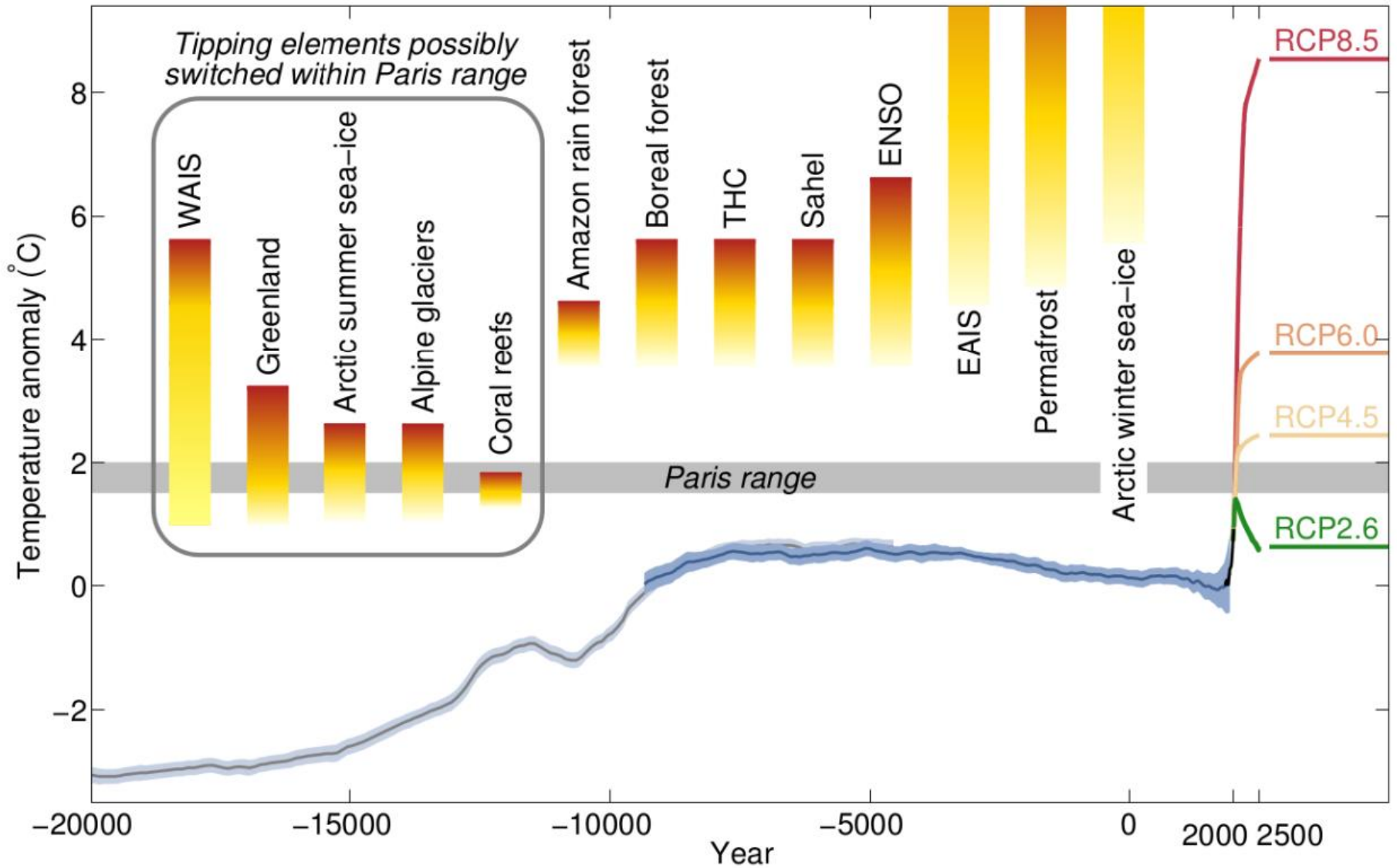
2008-2019 warmest decade, since 1850



When do we reach 2 degrees ?

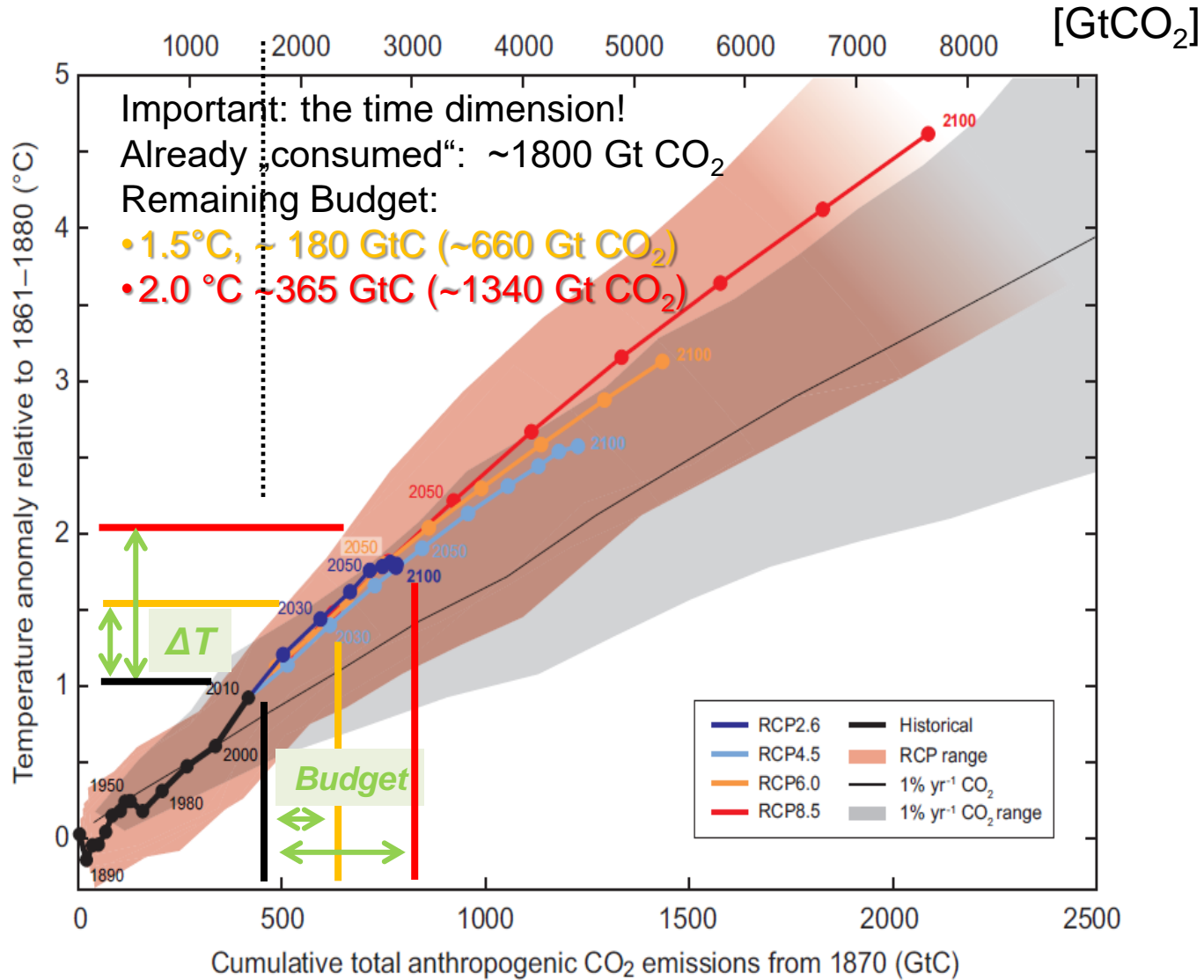


Climate Change & Activated Tipping Points will counteracts development achievements



The urgency: Linearity between warming and emissions

2°C
1,5°C





The warming threatens the achievement of development goals!

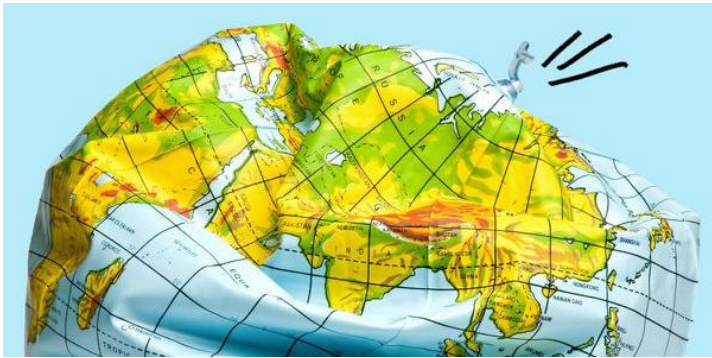




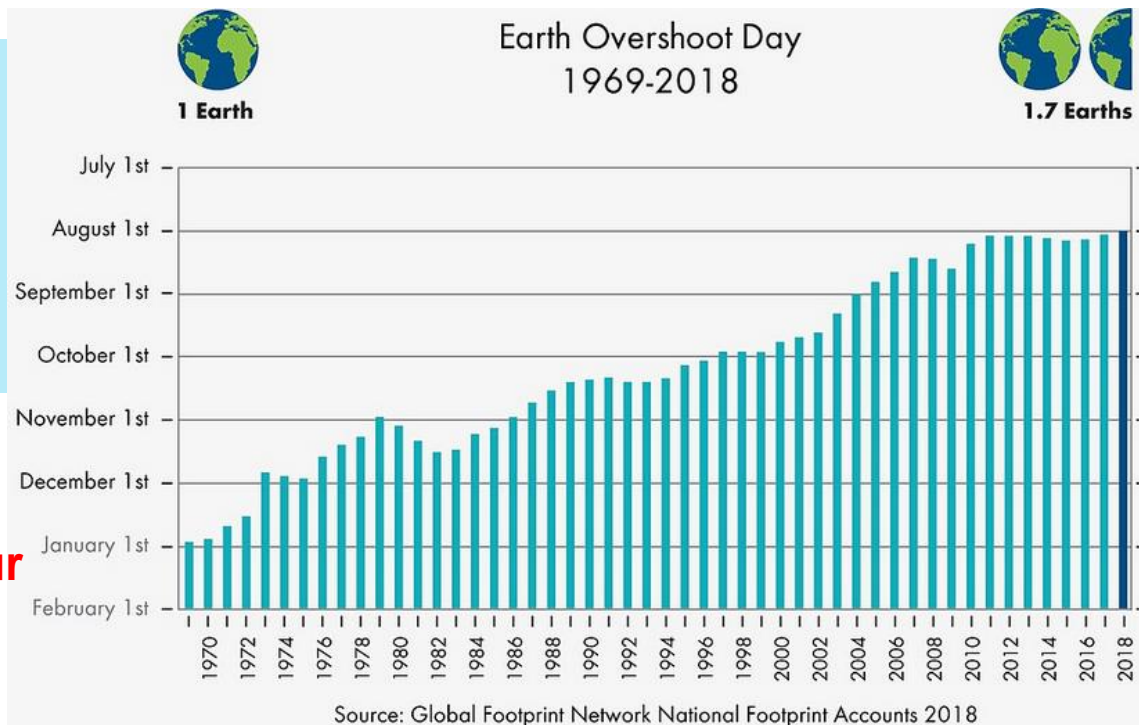
„Earth Overshoot Day“

Humanity consumed resources which can be supplied by the entire Earth within 7 month 1 day in 2018!

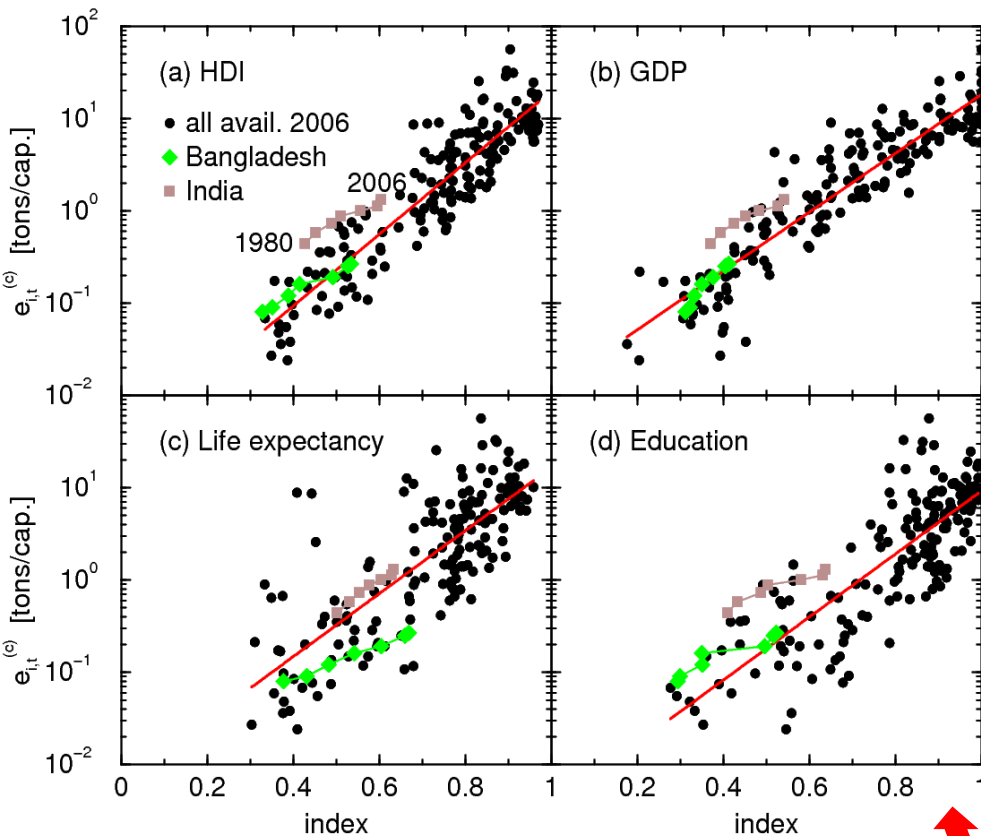
- Halving food waste would delay OD by 11 days!
- Halving CO₂-emissions by 89 days! verschieben.



Root cause: individual behaviour



Our current "Fossil Fuel Dependency"



Per capita emissions in the countries

$$e_{cap i,t}^{(c)} = e^{h_i d_{i,t} + g_i}$$

depend on development level !

Model approach based on empirics!

The crux in the „system“ lies here!

OPEN ACCESS Freely available online

PLoS one

A Human Development Framework for CO₂ Reductions

Luís Costa*, Diego Rybski, Jürgen P. Kropp

Potsdam Institute for Climate Impact Research, Potsdam, Germany

Abstract

Although developing countries are called to participate in CO₂ emission reduction efforts to avoid dangerous climate change, the implications of proposed reduction schemes in human development standards of developing countries remain

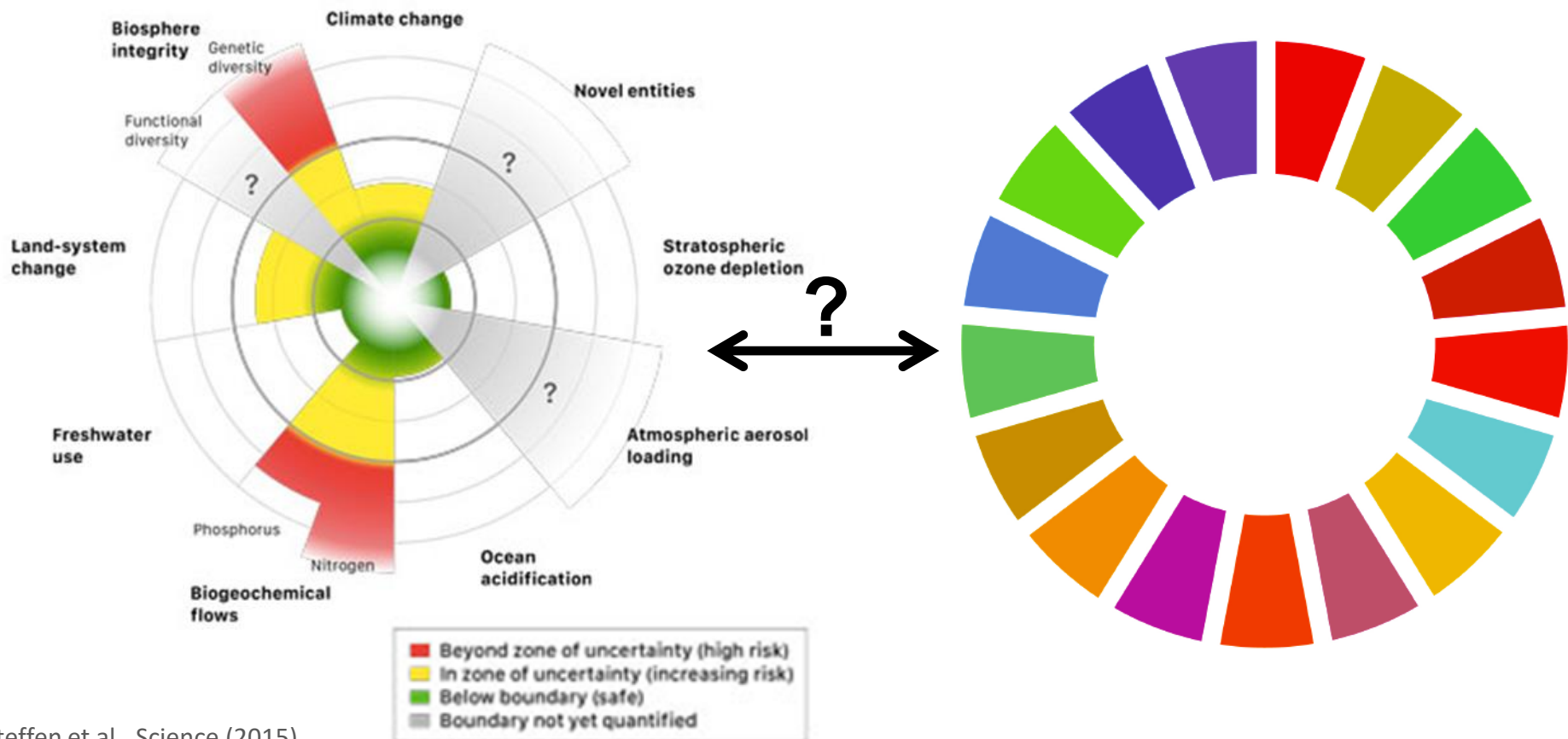
The role of Sustainable Development Goals



Compatibility of Planetary Boundaries and SDGs?

- Attempt to underpin it scientifically
- Systemic thinking approach

- Political 2030 Agenda
- Indicator based (> 120)
- Very different goals



The crux with SDGs!

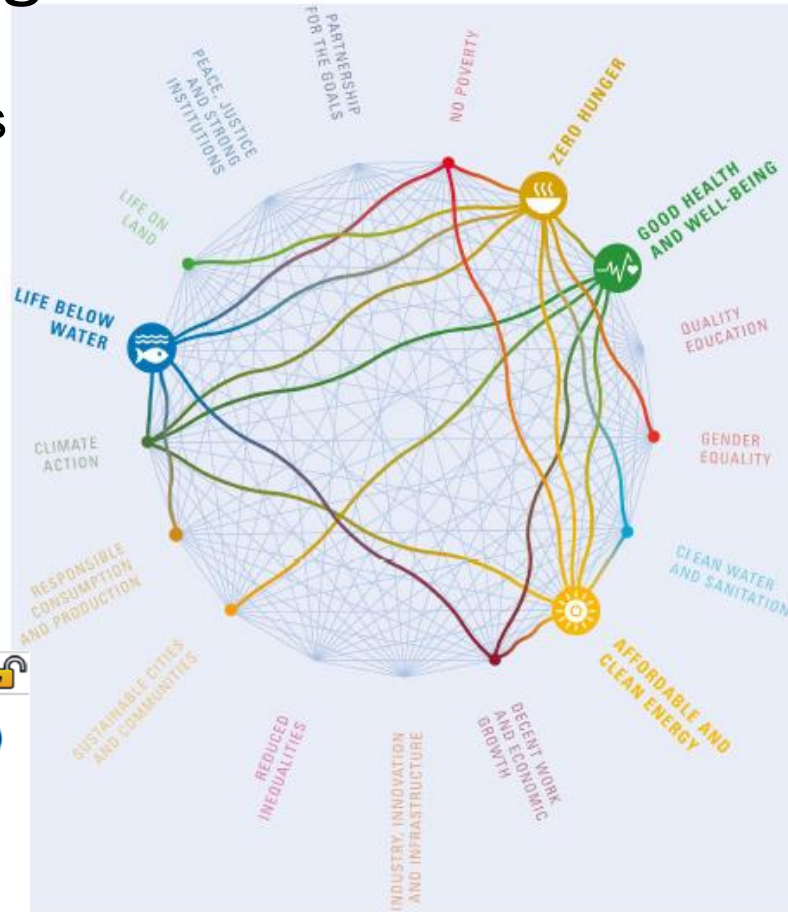
- approx. 120 indicators: no systematic understanding is lacking
- Not always time series (approx. 80), for 227 countries
- International coherence is still missing
- Trade-offs and synergies mostly qualitatively discussed



....indicator information should be used to shape policy making, but not without a sound underpinning otherwise you will could create many trade-offs!

Systematic Understanding of SDG interactions: process knowledge!

1. order attempt: empirical correlation analysis



(ICSU 2017)

Earth's Future

RESEARCH ARTICLE

10.1002/2017EF000632

A Systematic Study of Sustainable Development Goal (SDG) Interactions

2017

Prajal Pradhan¹, Luís Costa¹, Diego Rybski¹, Wolfgang Lucht^{1,2}, and Jürgen P. Kropp^{1,3}

¹Potsdam Institute for Climate Impact Research (PIK), Member of the Leibniz Association, Potsdam, Germany,

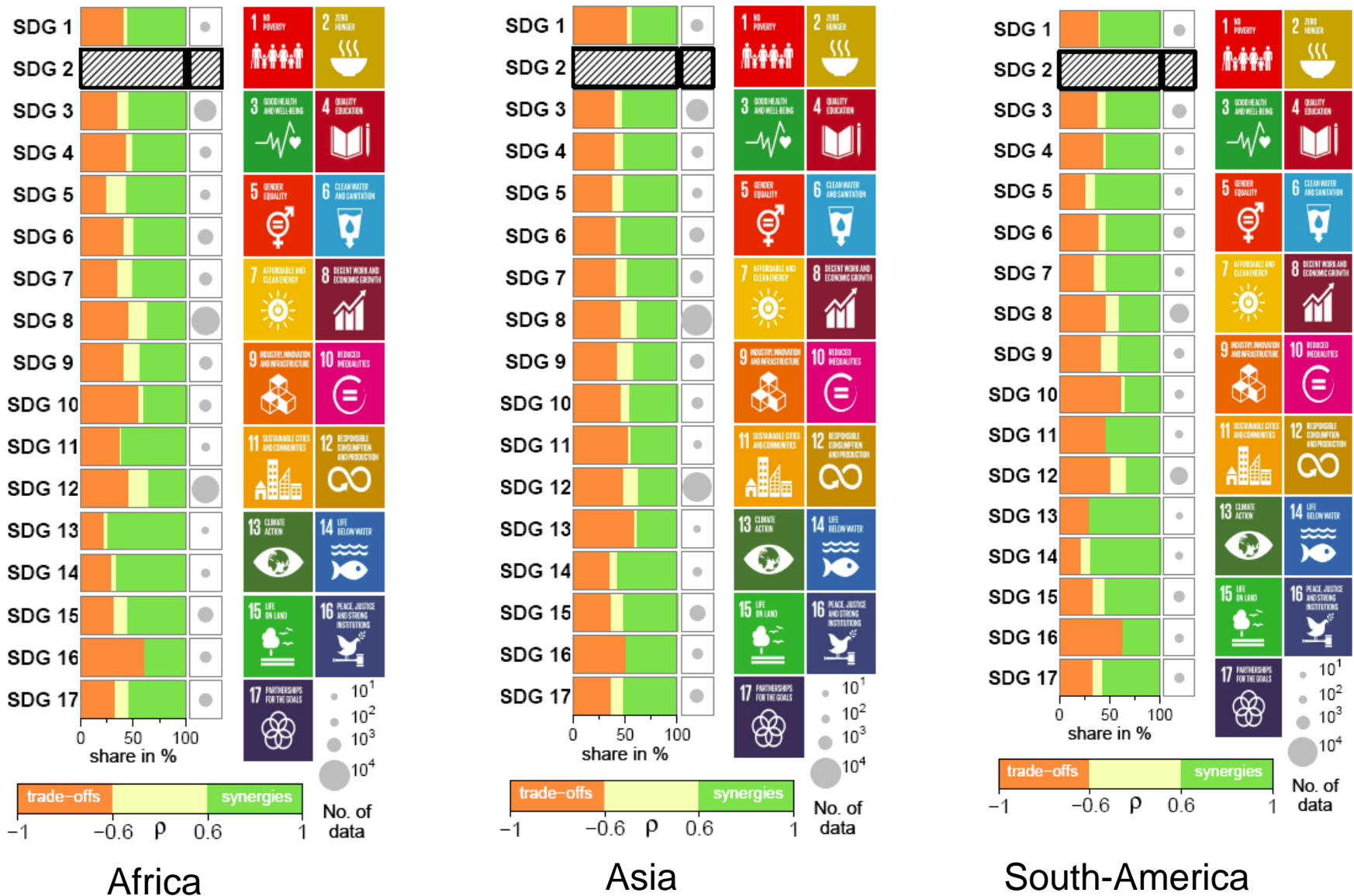
²Department of Geography, Humboldt University Berlin, Berlin, Germany, ³Department of Geo- and Environmental Sciences, University of Potsdam, Potsdam, Germany

Key Points:

- Synergies, defined by positive correlations between indicator pairs, outweigh trade-offs (negative correlations) for most sustainable development goals (SDGs) and countries
- SDG 1 depicts synergies with most goals while SDG 12 shows trade-offs; SDG 3 has synergies with other SDGs in most countries and populations
- For attaining the SDGs, the synergies can be leveraged and the trade-offs need to be overcome by deeper changes in the current strategies

Abstract Sustainable development goals (SDGs) have set the 2030 agenda to transform our world by tackling multiple challenges humankind is facing to ensure well-being, economic prosperity, and environmental protection. In contrast to conventional development agendas focusing on a restricted set of dimensions, the SDGs provide a holistic and multidimensional view on development. Hence, interactions among the SDGs may cause diverging results. To analyze the SDG interactions we systematize the identification of synergies and trade-offs using official SDG indicator data for 227 countries. A significant positive correlation between a pair of SDG indicators is classified as a *synergy* while a significant negative correlation is classified as a *trade-off*. We rank synergies and trade-offs between SDGs pairs on global and

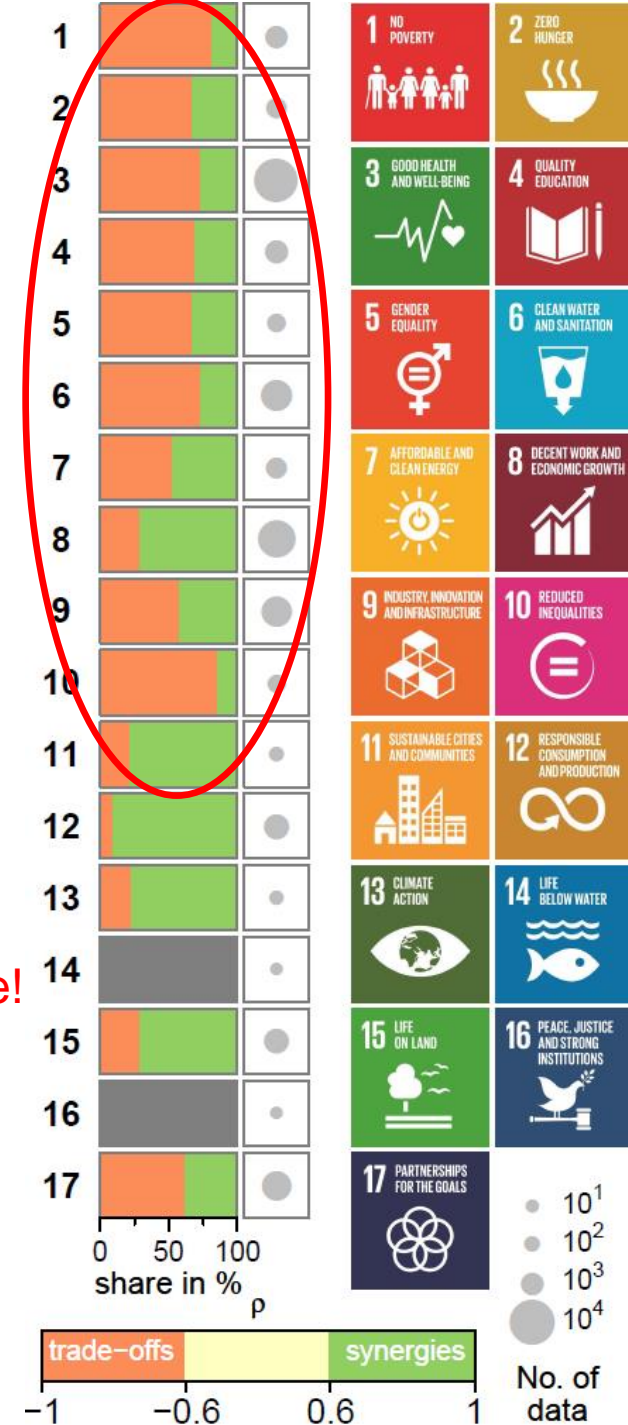
Continental correlations: SDG2 -



Global Results (SDG12)

SDG 12 (*Responsible Consumption & Production*) is usually linked with trade-offs across SDGs.

Root cause of global environmental and climate change!



Global Results: we are not performing well!

Among the SDGs both co-benefits and trade-offs can be observed.

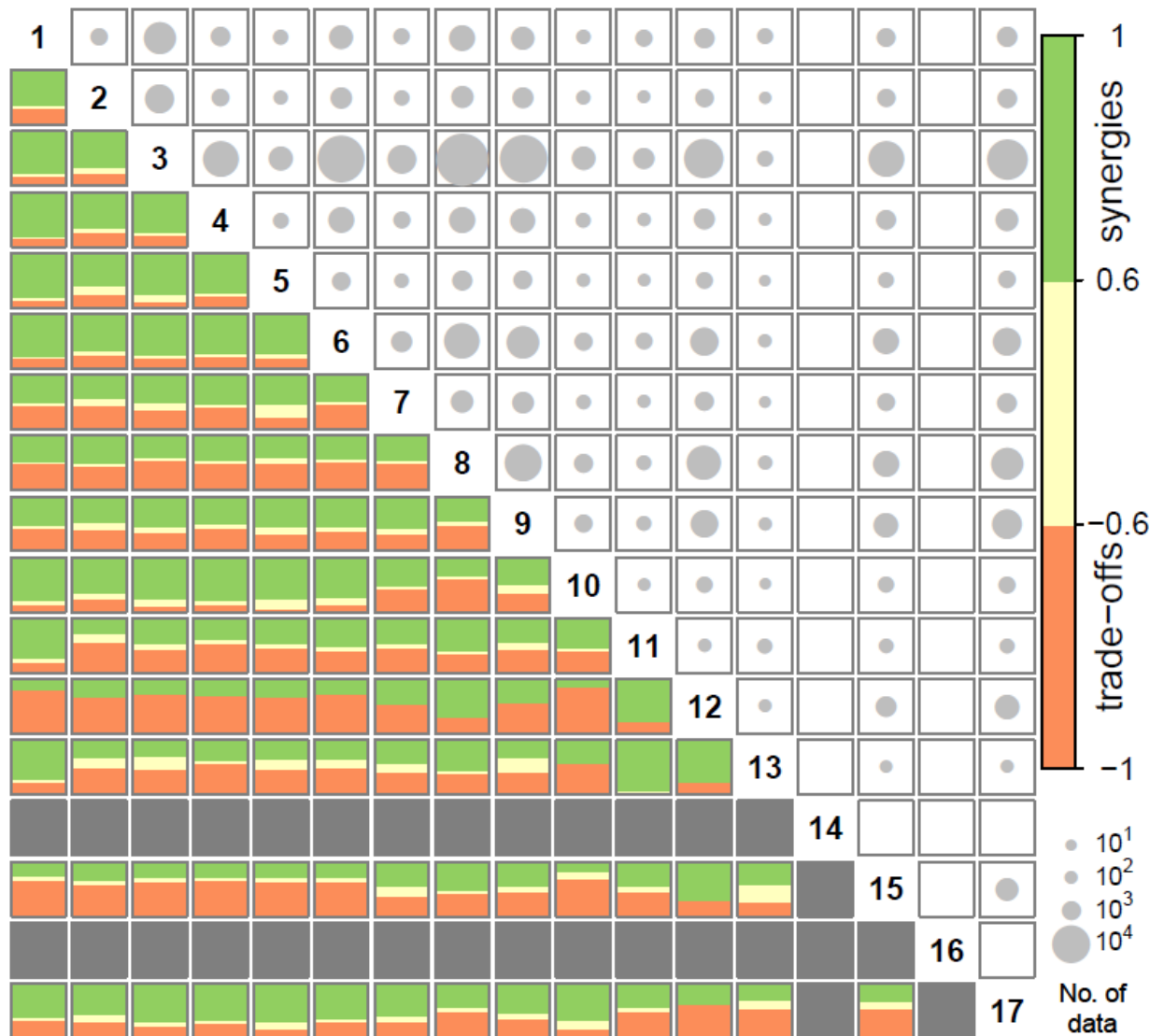
Decent work and growth →

Sustainable Cities →

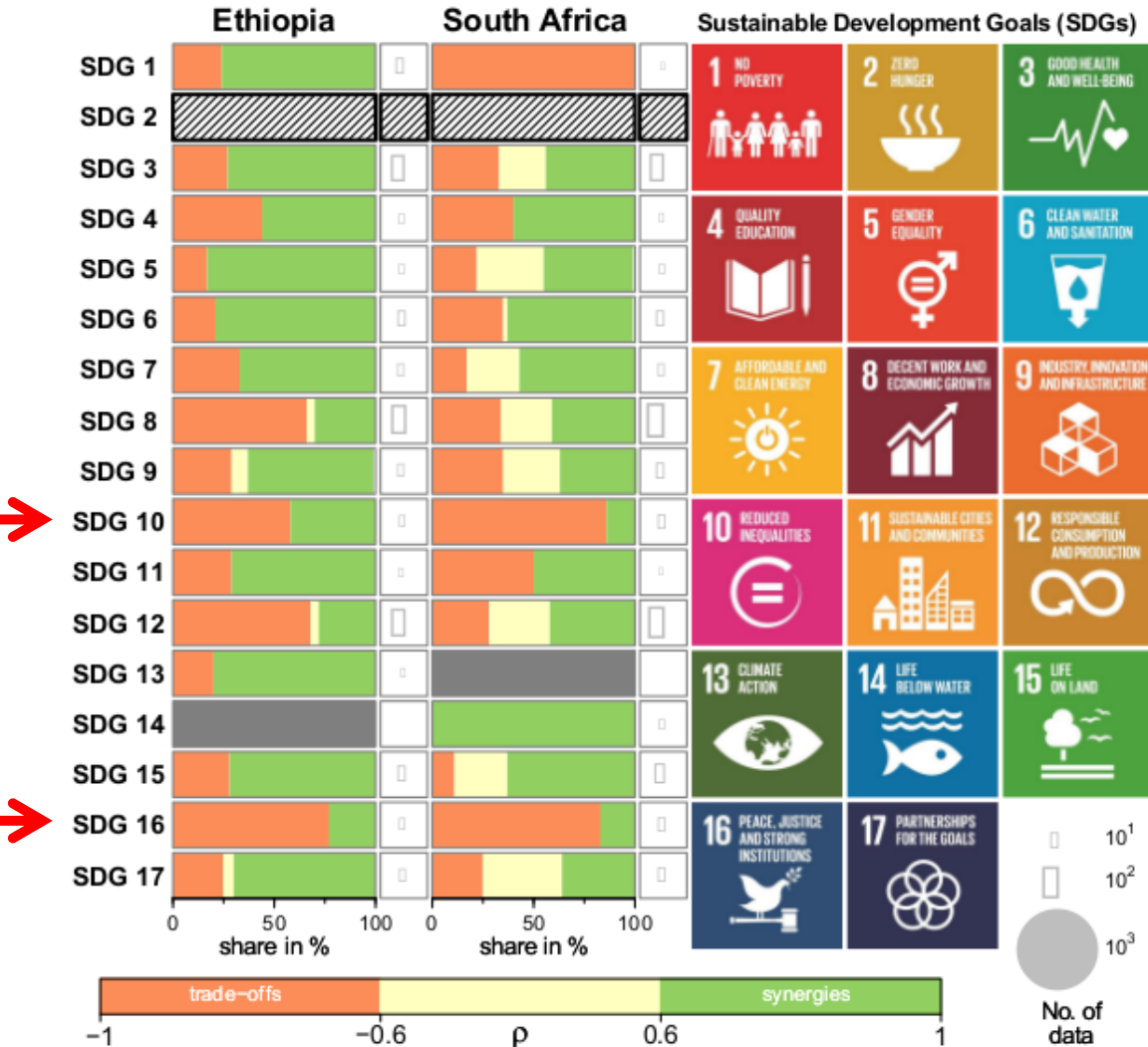
Responsible Consumption →

Climate Action →

Life on Land →



National Comparisons: example South Africa, Ethiopia



SDG10,16: positive trends in agriculture i.e. food self-sufficiency does not lead to an automatic enhancement of political participation, equality and poverty eradication.

Agricultural policy in SA does not affect poverty eradication, while in Ethiopia this is the case

Further details can be examined if you go into the details of SDGs

Allows to shape policies

Pradhan/Costa/Rybski/Lucht/Kropp (2017): Earth's Future

WHY CITIES?



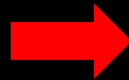
Ending of Climate Change begins in cities

Largest emitter

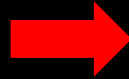
Centers of human creativity

Urban Life: SDG 3 (health) vs. SDG 11 (sustainable cities)

year	Global Population	urban fraction	
1950	2.5bn	30%	0.8bn
2015	7.3bn	52%	3.8bn
2050	9.7bn	66%	6.4bn

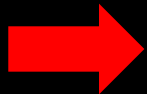


**cities built:
0.46bn/decade**



**cities to be constructed:
0.74bn/decade**

**New urban areas for
2.6bn people!**



In the coming decades nearly all world population (95%) growth will take place *in cities in low, middle income and emerging countries.*



Is this the full story?



....unfortunately not, as there are many target conflicts, which also affects emissions!

A “Trivial Response” to the Sustainability Challenge: Re-densification

Less land consumption
Less traffic,
Less emissions,
Less energy demand
More flats,
.....

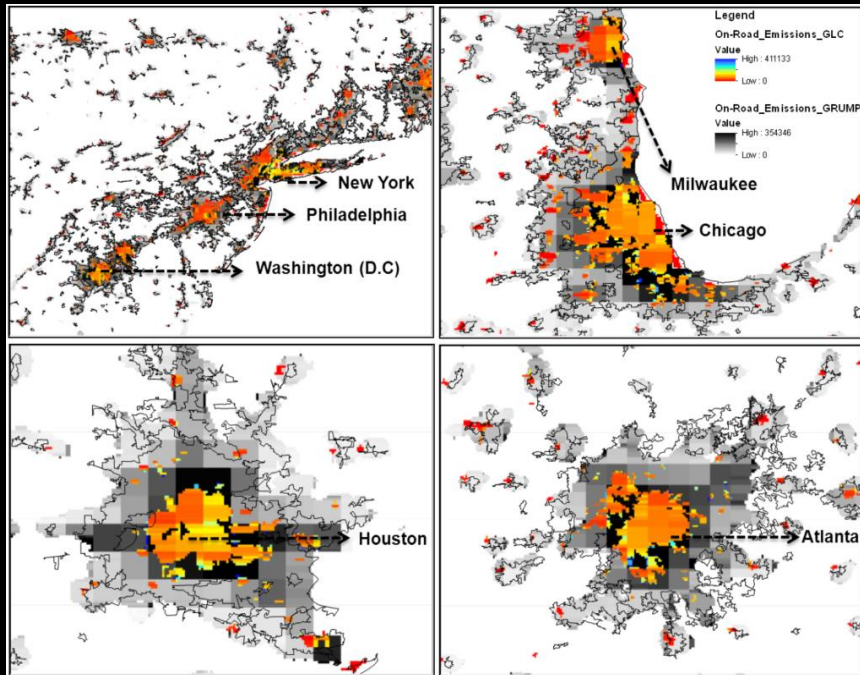
But is this all?



City density and CO₂ emissions

Standardized analytical approach applied to NA cities, i.e. combination of

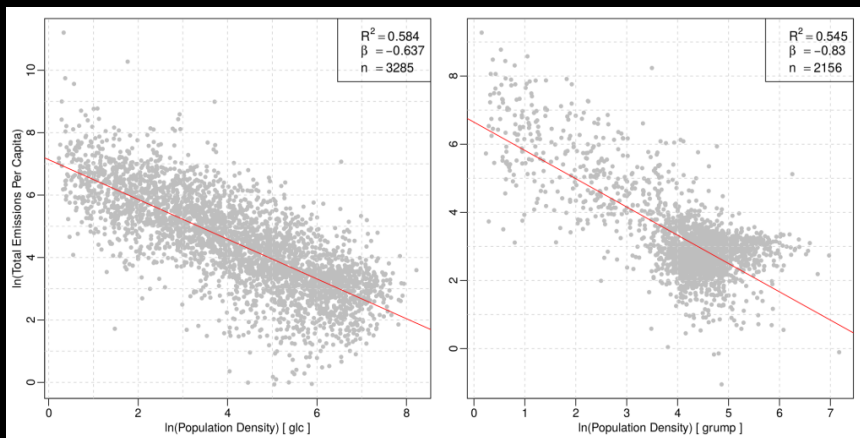
- 1.) remote sensing/land use data
- 2.) population data
- 3.) gridded emission data
- 4.) city clustering algorithm



Emission profile differs for cities

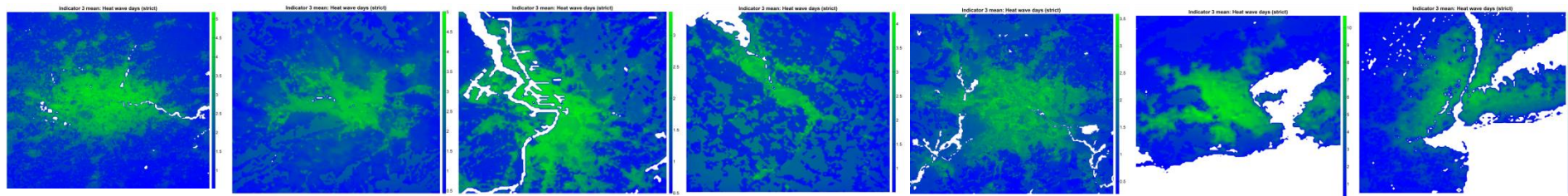
- On-road emissions correlate with density
- Housing emissions correlates with density & climate

.....denser cities emit less (theoretically up to 40%)!



Urban heat burden in the future

1986-2005: under present conditions, cities experience twice as many heat wave days than nearby rural areas



London

Skopje

Antwerp

Bilbao

Berlin

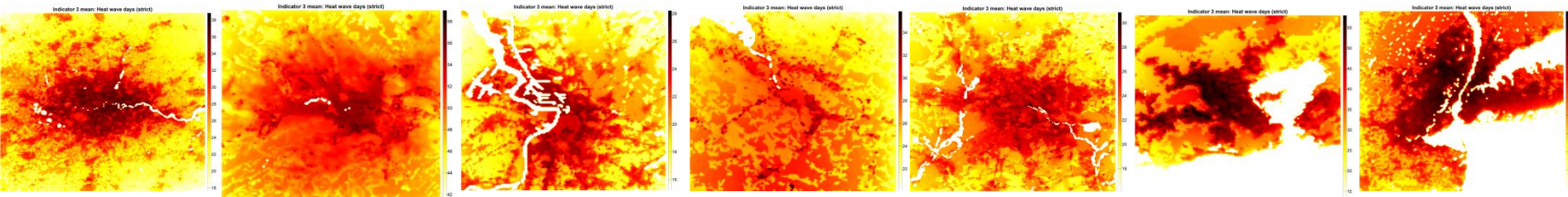
Rio Janeiro

New York

Zhou et al. 2015, VITO/RAMSES project 2015



2081-2100 (RCP8.5): the number of heat wave days is projected to increase by a factor of ten, to nearly 30 heat wave days per year

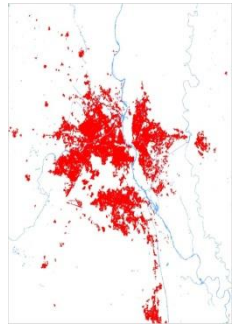


RAMSES

Science for cities in transition

Urban form and density matters for heat burden:

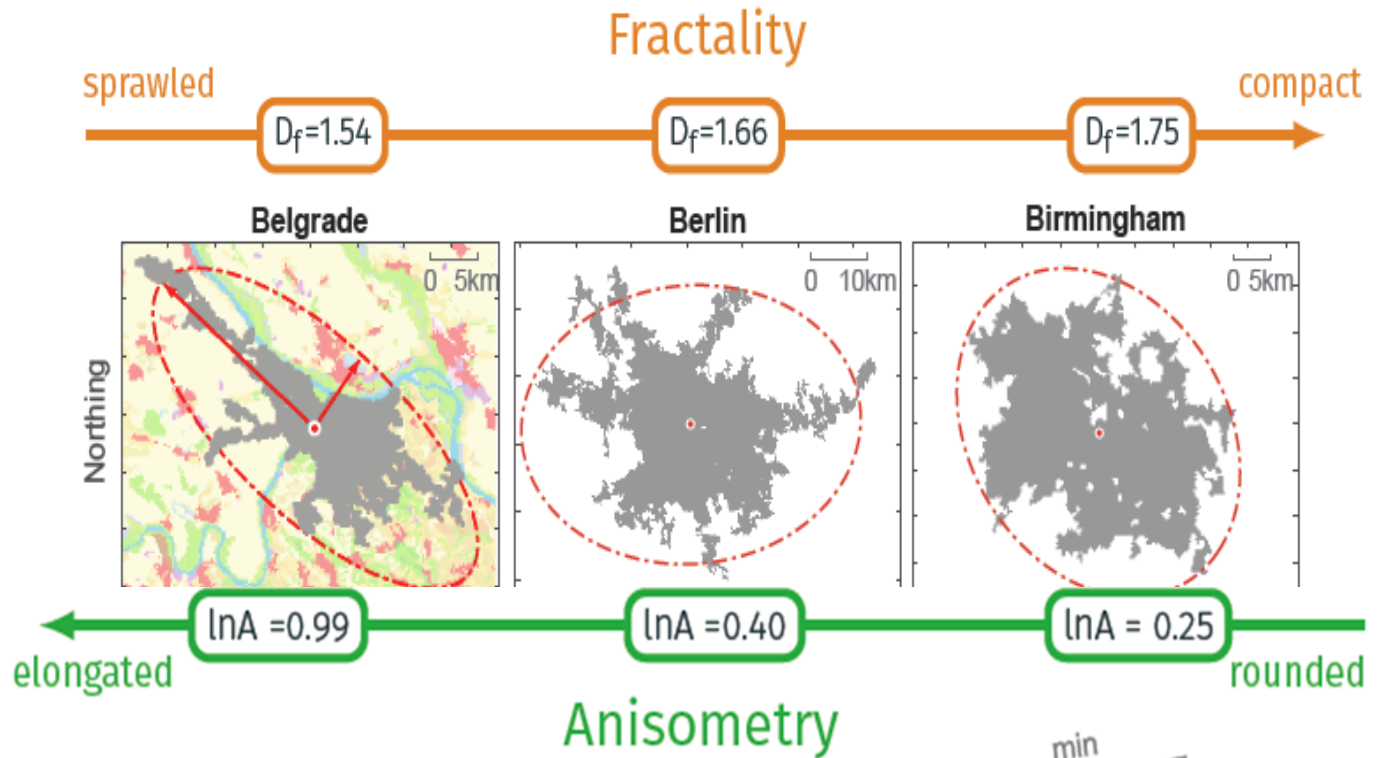
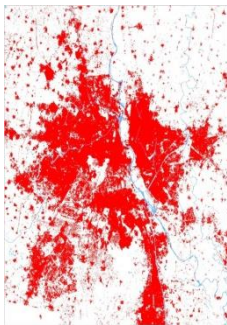
build stretched and scattered cities!



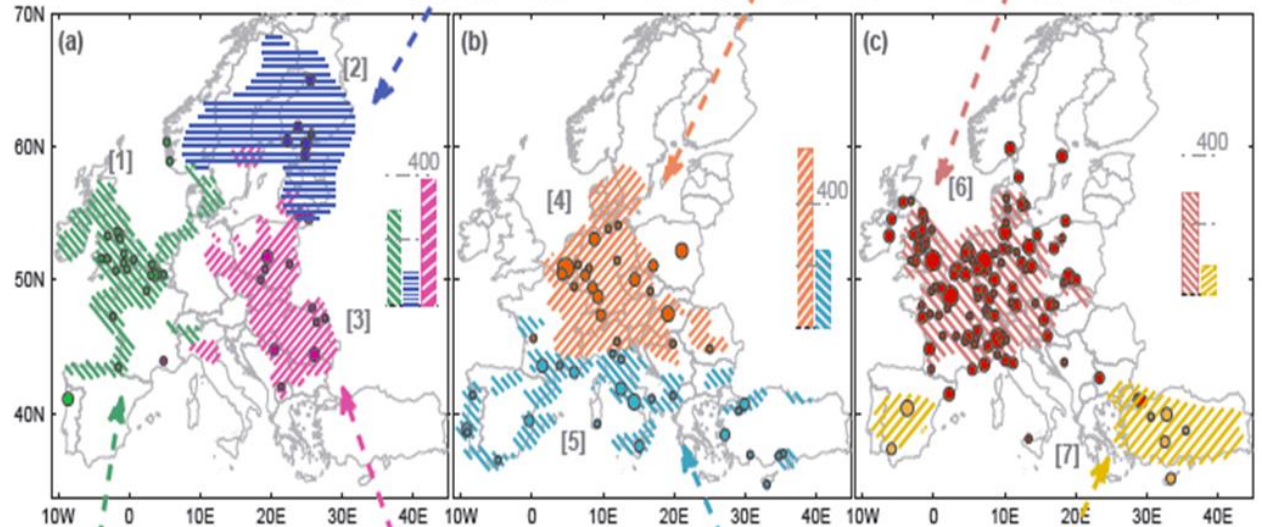
1988

Delhi

2010



100,000 villages/cities: 7 different types of heat islands

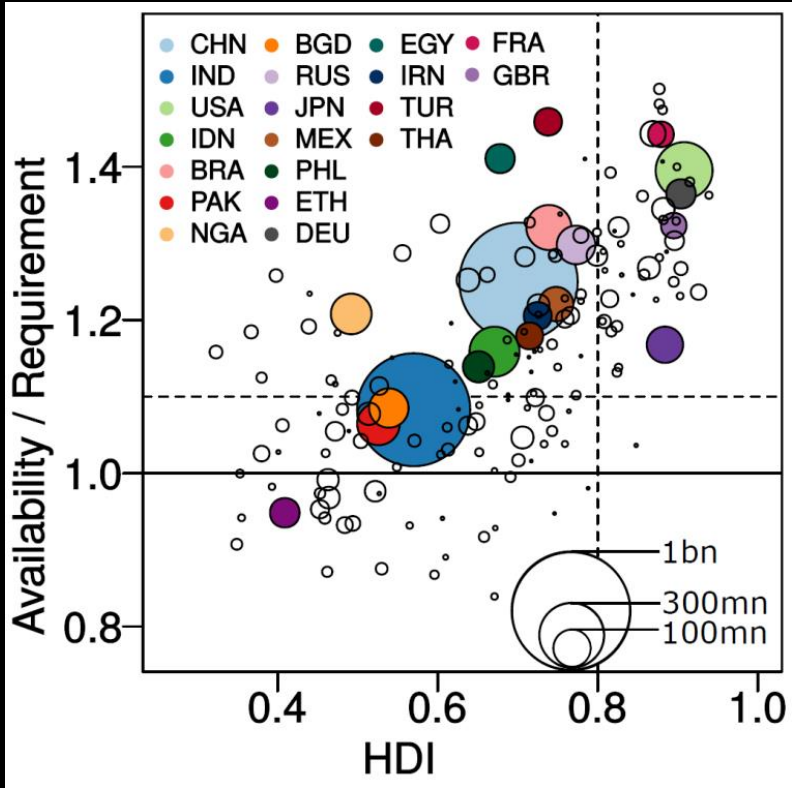




Solutions imply
trade-off
analyses!

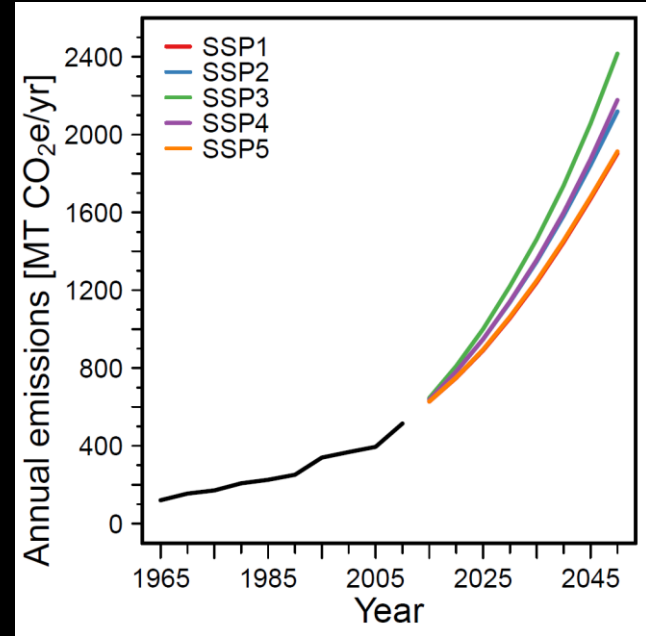
Food waste: SDG2 (no hunger) vs. 12 (responsible consumption, production)

Human development index (HDI) and food surplus/deficit (2010)



20% more food than required on in 2010!
 Global food surplus: 500 kcal/cap/d
 US: 1000 kcal/cap/d
 China: 600 Kcal cap/d

Available GHG emissions



Reducing waste not only improves the local food self-sufficiency of countries, but also avoids emissions.

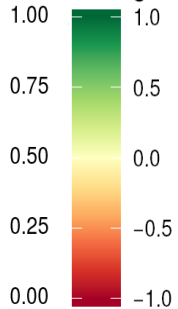
10-12% of agricultural emissions can be avoided if food waste would be reduced completely!

Real sustainability needs an understanding of urban-hinterland systems: e.g. Local Food Selfsufficiency

Presumptions:

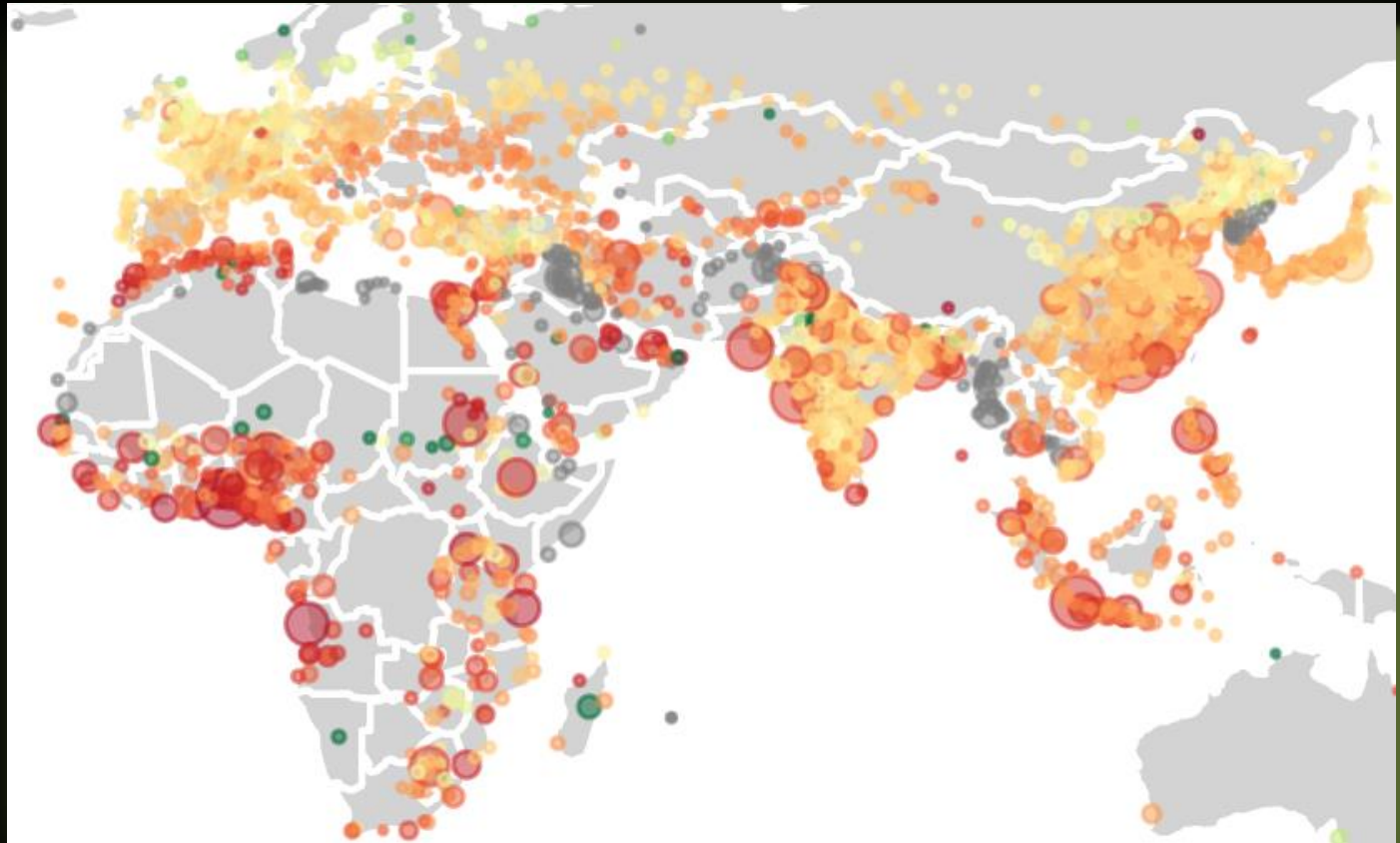
- Peri-urban 0.1ha_{\min}
- Land Use Shares
- Urban growth
- Diet changes
- RCP_{8.5}

Potential/Change

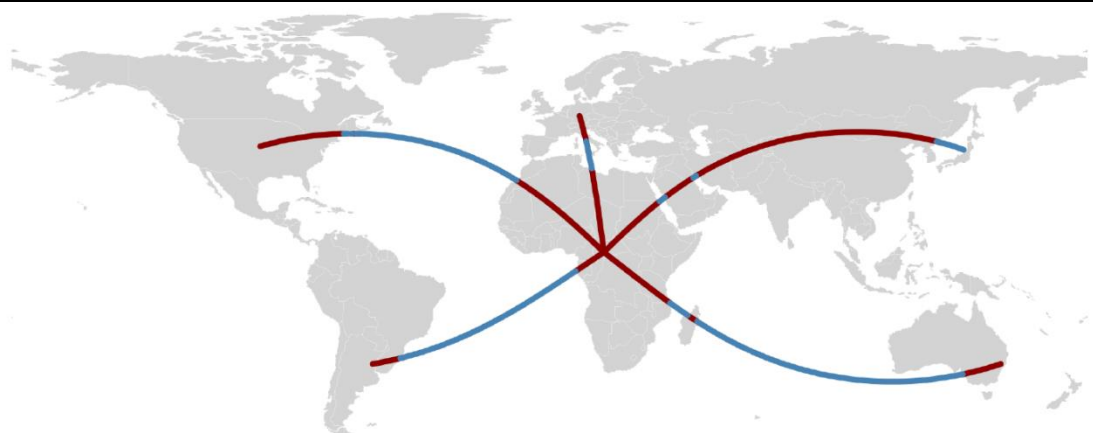


Population

- $1\text{e}+06$
- $5\text{e}+06$
- $1\text{e}+07$



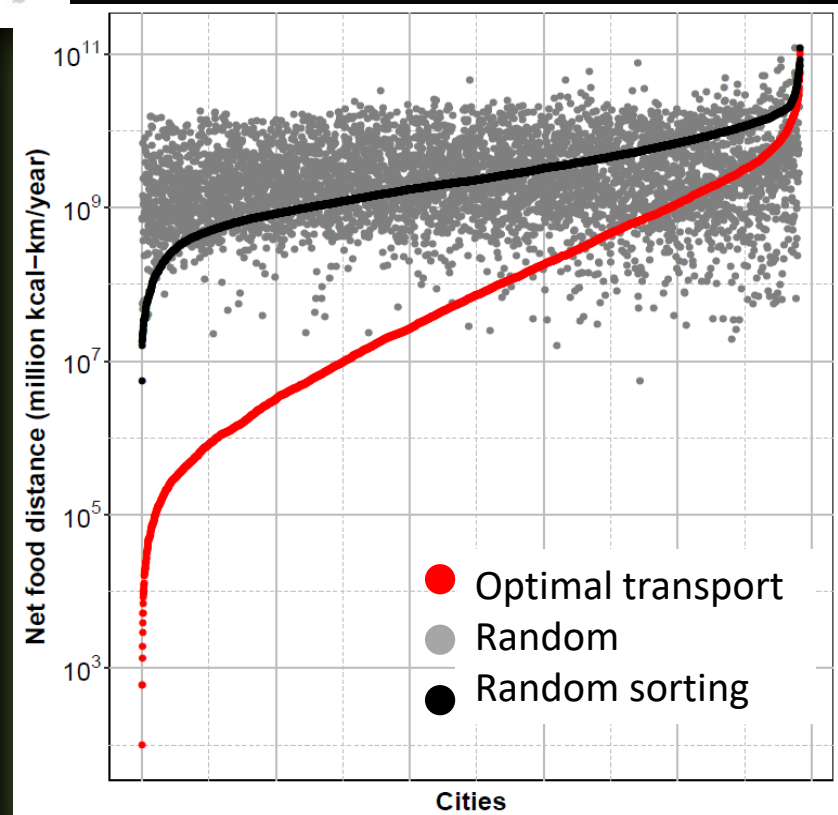
What's about international food transport?



- Great circle distance between production and consumption cell
- Different emission factors for ship and land transport

Dependency on more trade, more food transport in the future

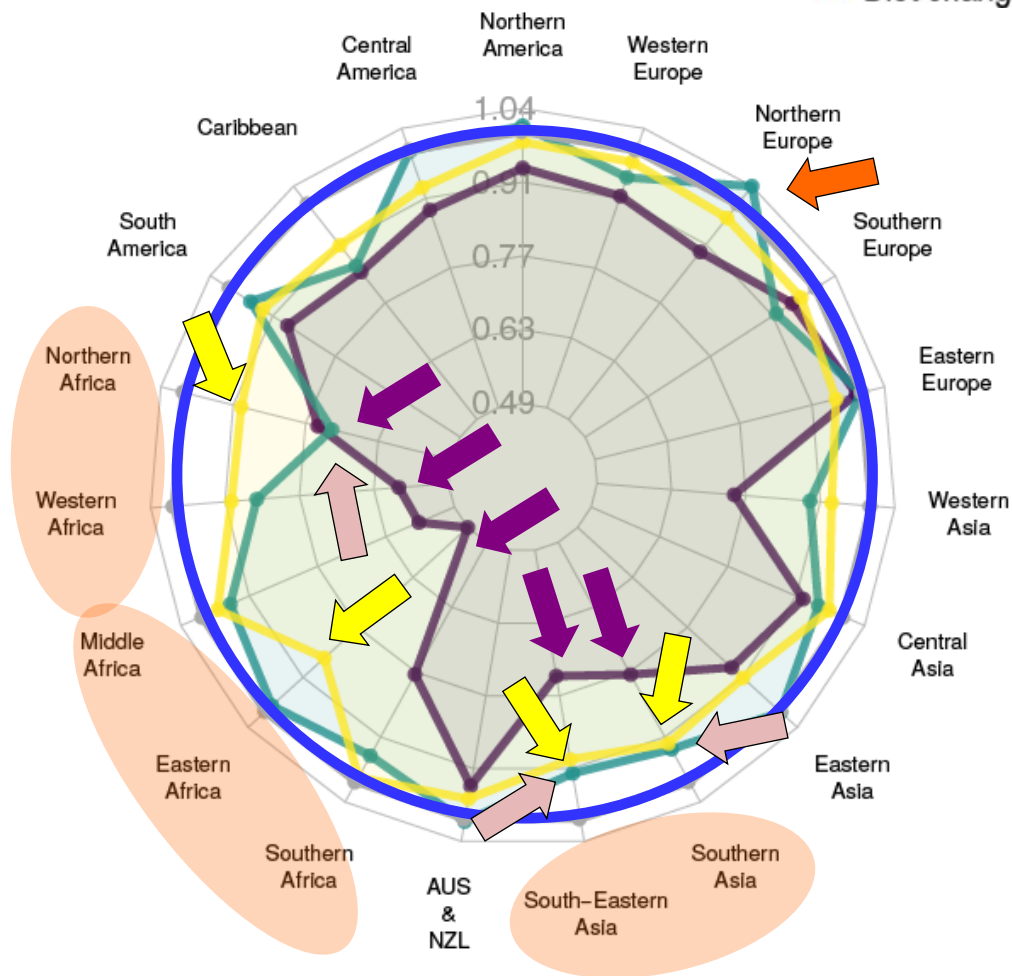
Optimization of food supply for cities can halve today's food related transport emissions (~7-8% of all transport emissions)!



Most influential factors ?

- Demographic growth 2050
- Climate change RCP 8.5 2050
- Diet change 2050

Baseline: 



Urban Growth:

Western, Eastern, Middle Africa, SE & Southern Asia

Life Style changes:

Mainly Southern Asia, Northern & Western, Eastern Africa

Climate Change:

Negative: Caribbean, Northern Africa, Western Africa, Western, Southern Asia;

positive: Northern Europe


Life- and production styles matter!

Food Self-Sufficiency across Scales: How Local Can We Go?

Prajal Pradhan,^{*,†} Matthias K. B. Lüdeke,[†] Dominik E. Reusser,[†] and Juergen P. Kropp^{†,‡}

[†]Potsdam Institute for Climate Impact Research, Potsdam 14473, Germany

[‡]University of Potsdam, Department of Geo- and Environmental Sciences, Potsdam 14469, Germany

 Supporting Information

ABSTRACT: This study explores the potential for regions to shift to a local food supply using food self-sufficiency (FSS) as an indicator. We considered a region food self-sufficient when its total calorie production is enough to meet its demand. For future scenarios, we considered population growth, dietary changes, improved feed conversion efficiency, climate change, and crop yield increments. Starting at the 5' resolution, we investigated FSS from the lowest administrative levels to continents. Globally, about 1.9 billion people are self-sufficient



OPEN ACCESS

IOP PUBLISHING

Environ. Res. Lett. 8 (2013) 044044 (10pp)

ENVIRONMENTAL

doi:10.1088/17

Embodied crop calories in animal products

Prajal Pradhan¹, Matthias K B Lüdeke¹, Dominik E Reusser¹ and Jürgen P Kropp^{1,2}

¹ Potsdam Institute for Climate Impact Research, Potsdam, Germany

² Department of Geo- and Environmental Sciences, University of Potsdam, Potsdam, Germany

E-mail: pradhan@pik-potsdam.de

Received 13 June 2013

Accepted for publication 1 November 2013

Published 2 December 2013

Online at stacks.iop.org/ERL/8/044044

Local production can sustain people to a large extent, but not in any place!

Dietary pattern change will make food security more dependent on international trade: climate change will exacerbate this effect!

On average we need 4 kcal cereals for 1 kcal meat.

Traditional vs. Modern Cities: How do we like to live?



Bilat Sayt/Oman



Nizwa/Oman



Ghadames/Libyen



Kuwait



Dubai

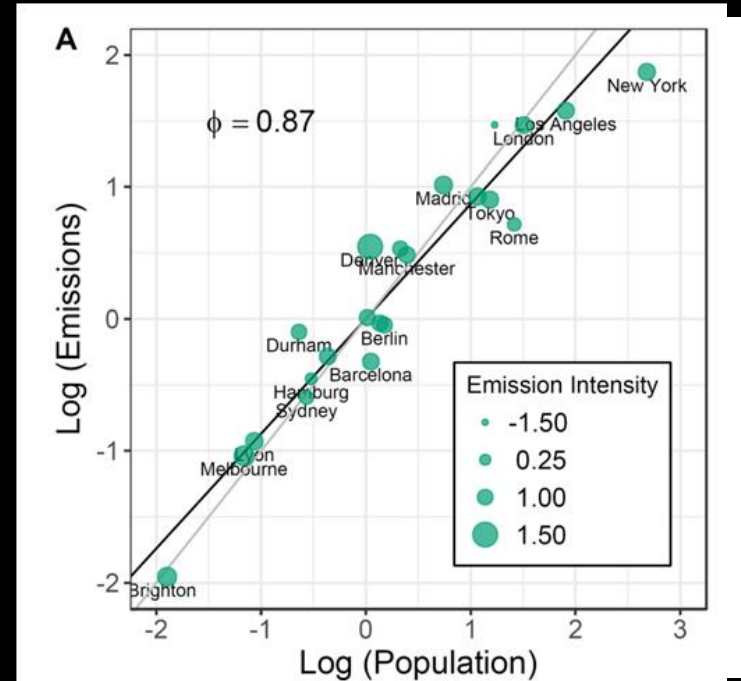
There is a Leapfrogging Potential!

Example OECD

Employing an „Urban Kaya Identity“
 $(CO_2 = pop * GDP/cap * Energy/GDP + CO_2/Energy)$

$CO_2 \sim Pop^\phi$ $Energy \sim GDP^\alpha$
 $GDP \sim Pop^\beta$ $CO_2 \sim Energy^\gamma$

„Sublinear“ growth for OECD cities, $\phi = 0.87$
 Superlinear growth for Developing Countries, $\phi = 1.31$

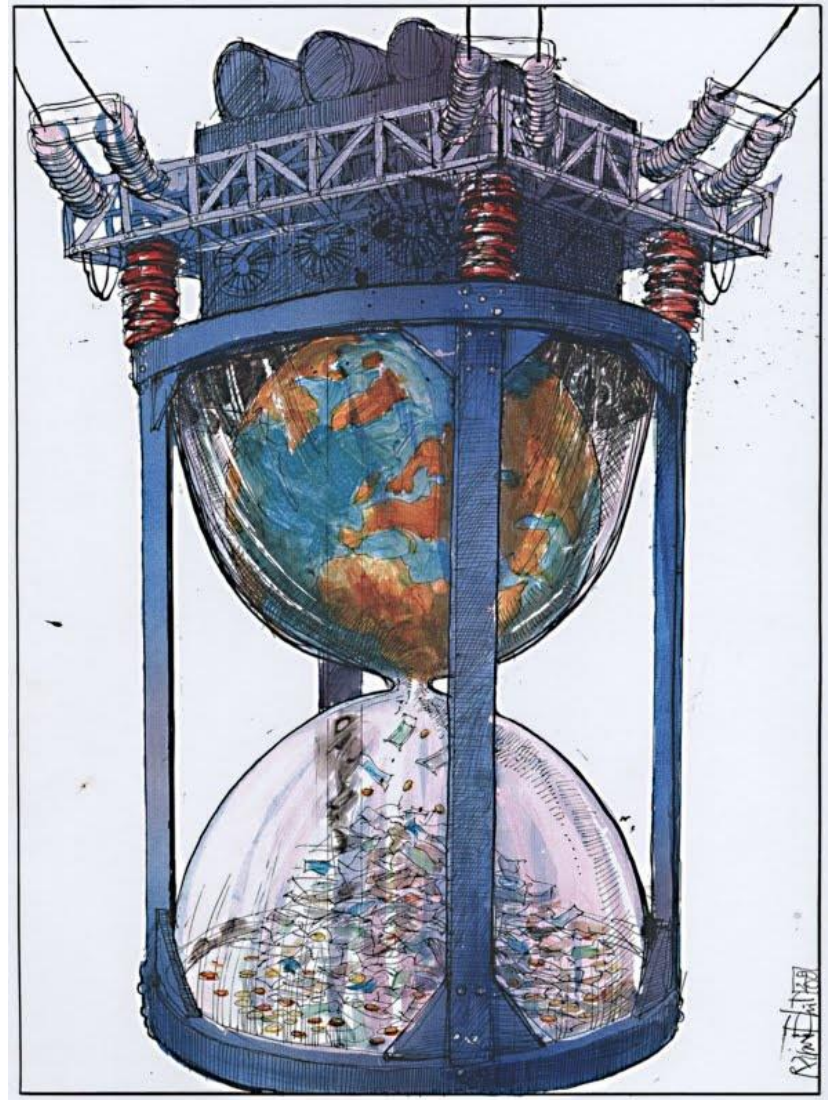


OECD: if GDP doubles, also energy consumption doubles: lifestyles changes, infrastructure lock-ins

Developing if GDP doubles, energy will not double: leapfrogging potential!

	CO_2/Pop_ϕ	GDP/Pop_β	$Energy/GDP_\alpha$	$CO_2/Energy_\gamma$
All Cities	1,02 →	1,16 ↗	0,89 ↘	0,96 →
OECD	0,87 ↘	1,04 →	0,99 →	0,79 ↘
Developing	1,31 ↗	1,40 ↗	0,78 ↘	1,16 ↗

Better Information
(does not mean that
something changes,
but make clear
challenges, show
alternatives...)





RAMSES

Science for cities in transition on-urban-resilience.eu



Adaptation and Transformation Guidance



deep dive



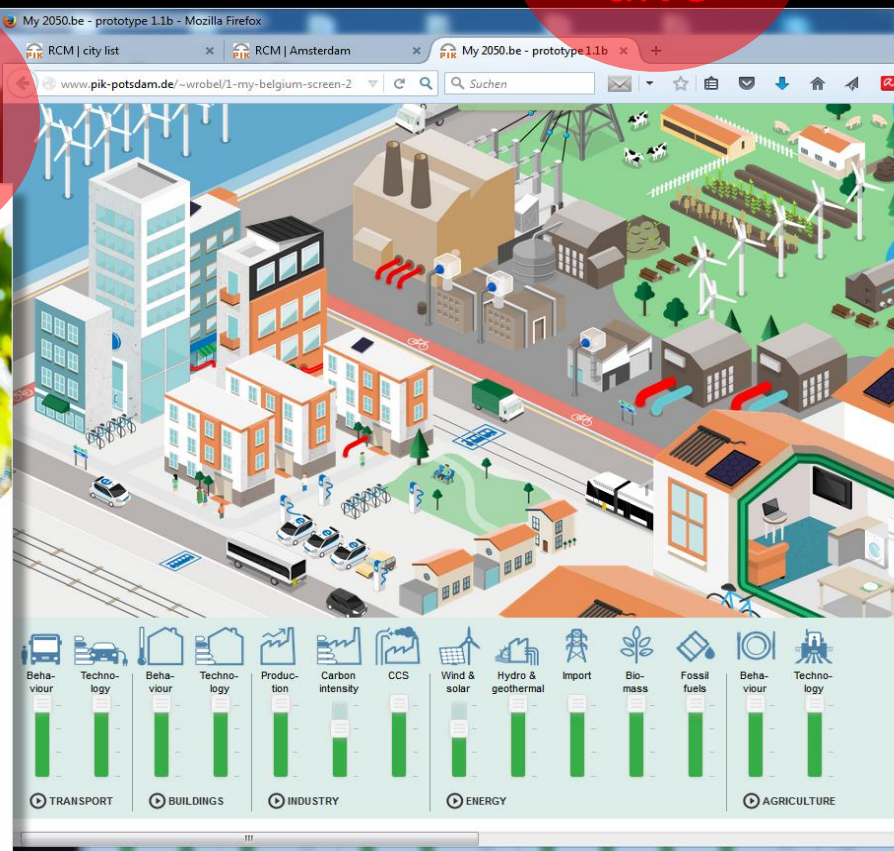
enter

process

RAMSES
Science for cities in transition

Transition Handbook

Training Package



www.ramses-cities.eu/toolbox/

RAMSES SLIDEDECK

Reconciling Adaptation, Mitigation and Sustainable Development for Cities

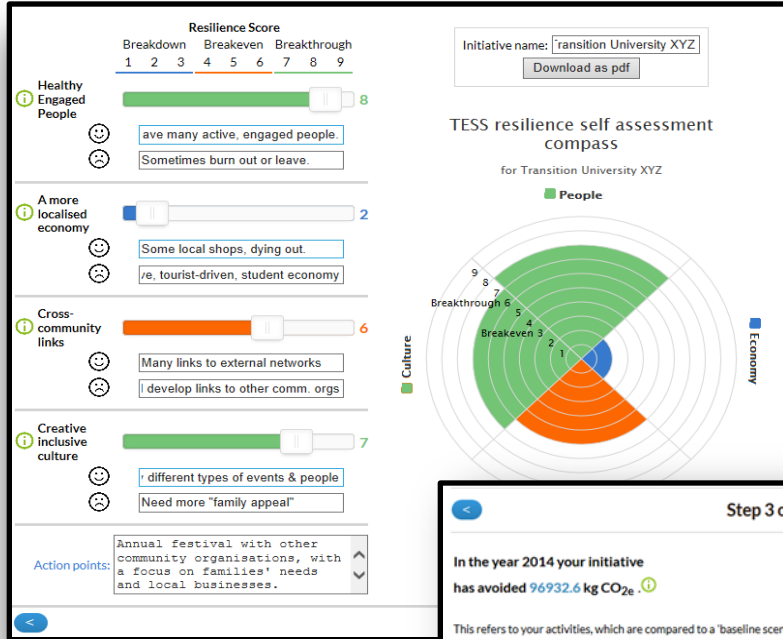
involve

www.my2050.be

Impact of „grassroot initiatives“ on emission mitigation and social innovation

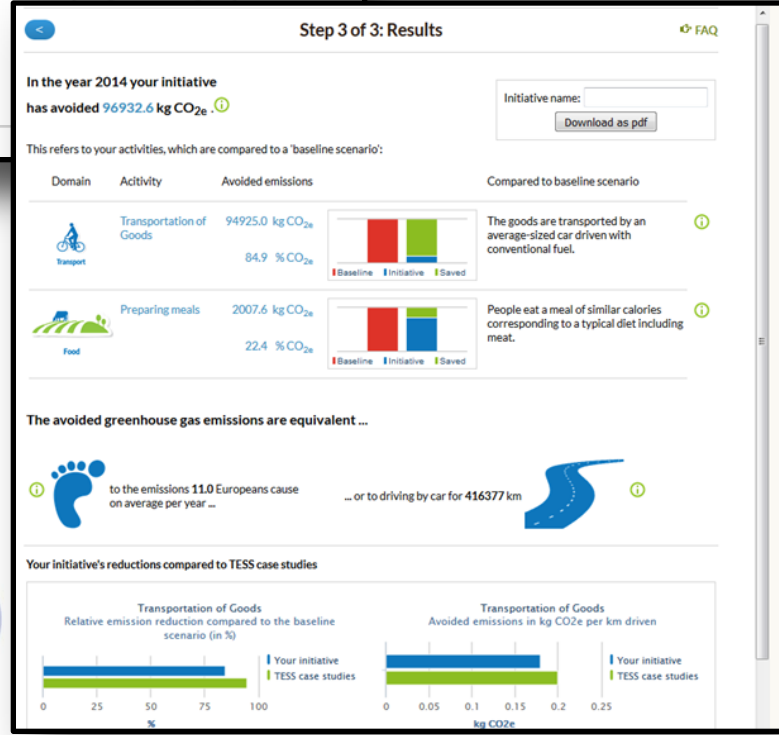
Final publishable summary report

Kropp et al 2017



Resilience Compass

Trackit!



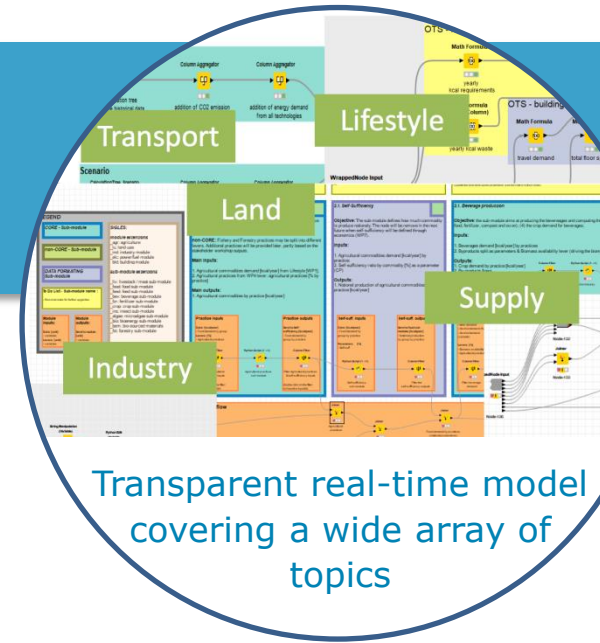
If 5% of all European Citizens would be involved in such initiatives European emission reduction targets would be easily achievable by 2020!

<http://www.tess-transition.eu/tools/>

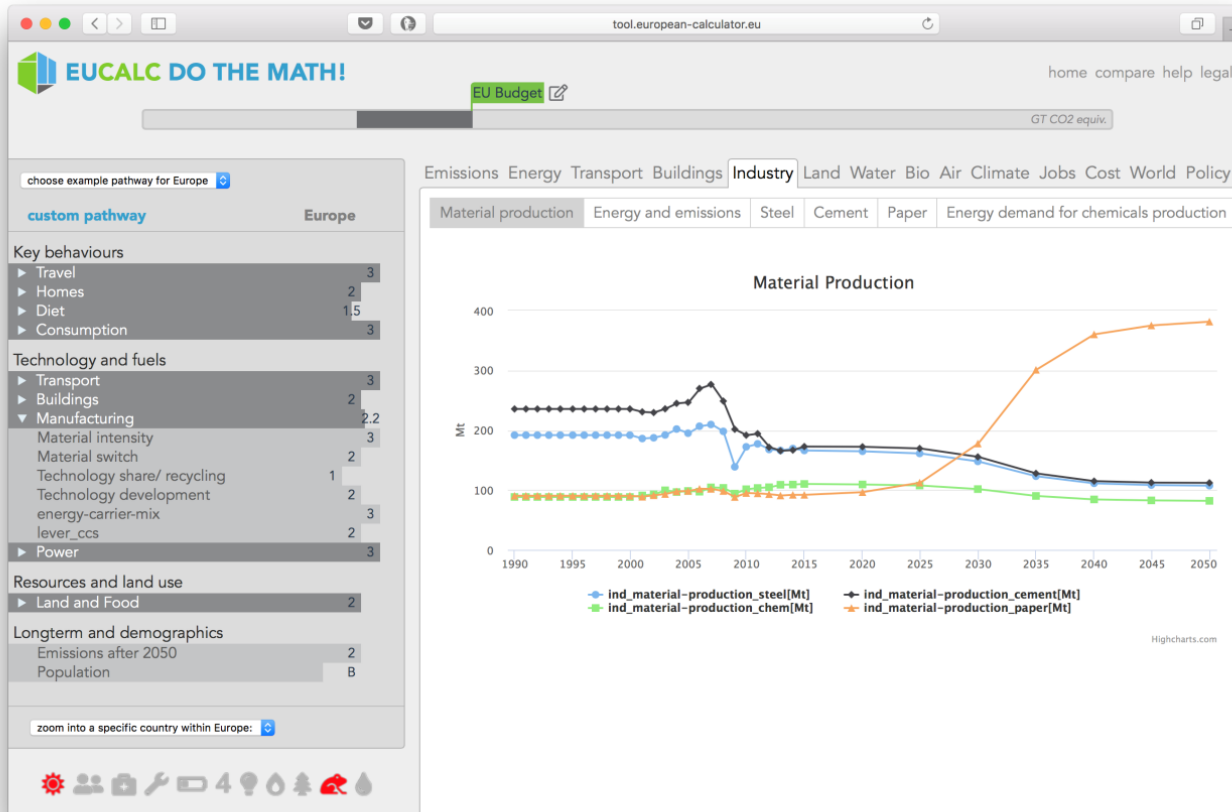


EU CALC – slim, fast, comprehensive

Modelling tool enabling non-modellers to create pathways towards low-carbon European societies and showing potential trade-offs.



Transparent real-time model covering a wide array of topics

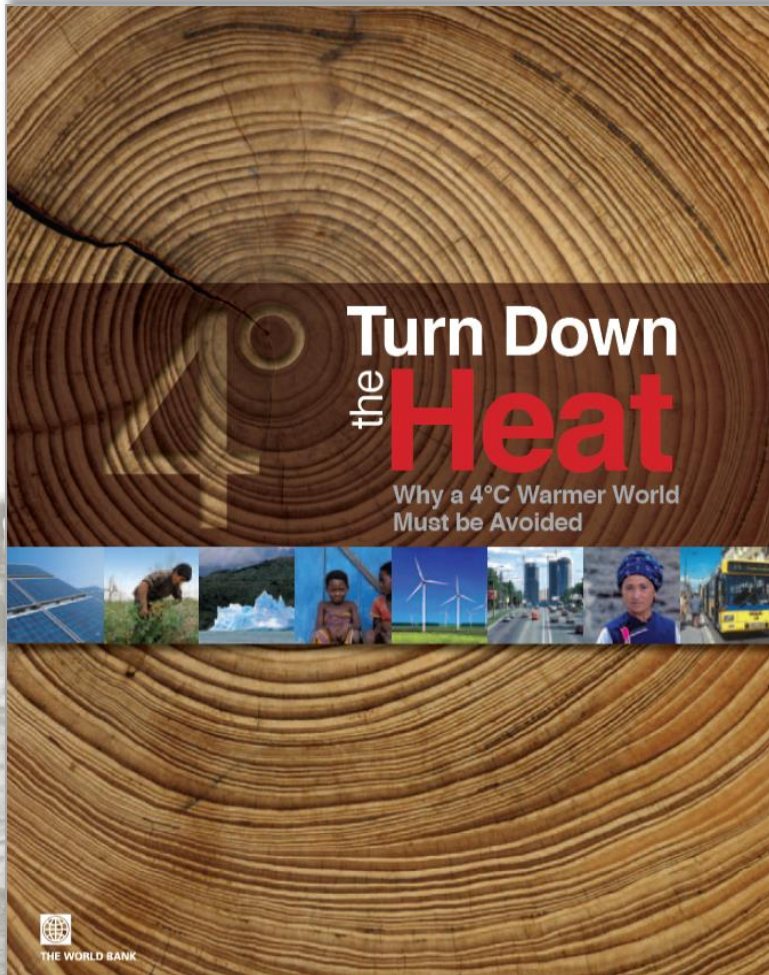


new model design and alignment

results are explorable and useful for decision maker



Superimposed by several side-effects



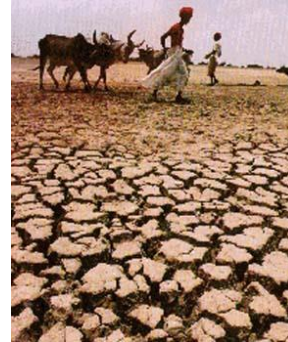
ACT TODAY - FREE TEXT EVEN TO 70064
Evening Standard, 11/4/2014

- Poverty
- Vulnerability
- Ethics
- Adaptive Capacity
- Time dimension
- Property rights
- culture
- Financial capacities

Adaptation needs are easy to define, they exist everywhere!

Resilience (adaptation and mitigation combined) need to consider **trade-offs, co-enefits, time & spatial scales!**

Models of Development



1. Stages of Growths: *from agriculture to industry to sustainability?*
2. International Dependence: *lack of understanding of DC, wealth gap can be perpetuated by rich nations only*
3. Market based: *neoclassical price based approaches/free markets?*
4. Structural Changes: *technological innvation, investments into wealth?*



Financial instruments

- economic vs. qualitative growth?
- green bonds
- insurance solutions
- direct funds
- tax reallocation, green taxes
- public/private investments (or mixtures)
- IPR handling
- '



Summary

- Anthropogenic Climate change is the most challenging threat for humanity
- Human Development shows a strong linear relationship to environmental damages
- More concerted action, policy shaping starts at the core of a problem
- Local partners have problems to access information, external partners often do not have a suitable in depth understanding
- More scientific underpinning, solutions which help to leapfrog
- Reconcile development dynamics with climate action
- Frameworks: „success“ and „target criterias“ are of urgent need!
- Use education as the key to change attitudes (edutaining!)

Contact us



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CEO/Director: Climate Media Factory

Founding Dean: Environmental Management
Berlin School for Sustainable Futures
University of Applied Sciences (in formation)

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