Turn Down The Heat: Why a 4ºC World Must Be Avoided

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Towards Collective Action by 2015

College des Bernardins, Lexington Room

20, rue de Poissy, Paris

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Turn Down the Heat

Why a 4°C Warmer World Must be Avoided

WORLD BANK

November 2012

A Report for the World Bank
by the Potsdam Institute for
Climate Impact Research and
Climate Analytics

4°C – World Bank Report

- **Observed**
  - **Ten times more area experiences extreme heat compared to 40 years ago**
  - **Significant economic damages on the poorest countries from high temperatures over last few decades**
  - **Rate of sea level rise now well above range projected in IPCC AR4 and TAR assessment reports**
  - **Regional sea-level rise since 1950s higher than the global mean in Pacific**

4°C – World Bank Report

- **Projected (World Bank: 4°C report)**
  - **Warming >3°C by 2100 and possibly >4°C by 2100**
    - **One in five chance with present pledges of above 4°C**
  - **One metre of sea level rise by 2100**
    - **Further rise of several metres in following centuries**
  - **Regional sea-level rise about 20% larger in tropical oceans than global mean**

4°C – World Bank Report

- Warming more pronounced over land
  - **Regional projections >6°C** in Africa, the Middle East, & Amazon)
- Warming of 2+°C projected to lead to severe and widespread droughts over many densely populated areas
  - e.g. Europe, eastern USA, South East Asia, and Brazil
- Ocean acidification rises to levels **higher than known from Earth history leading to major damages to ocean food production**

4°C – World Bank Report

- **Dramatic increase in intensity and frequency of high-temperature extremes**
  - **All tropical islands in the Pacific**, tropical South America, central Africa likely to regularly experience heat waves of **unprecedented magnitude and duration.**
  - Coolest summer months in 2080–2100 in most continental regions substantially hotter than the warmest experience today

4°C – World Bank Report

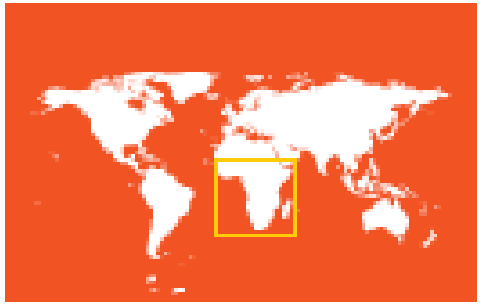
Societal and ecosystem impacts: Poor affected most

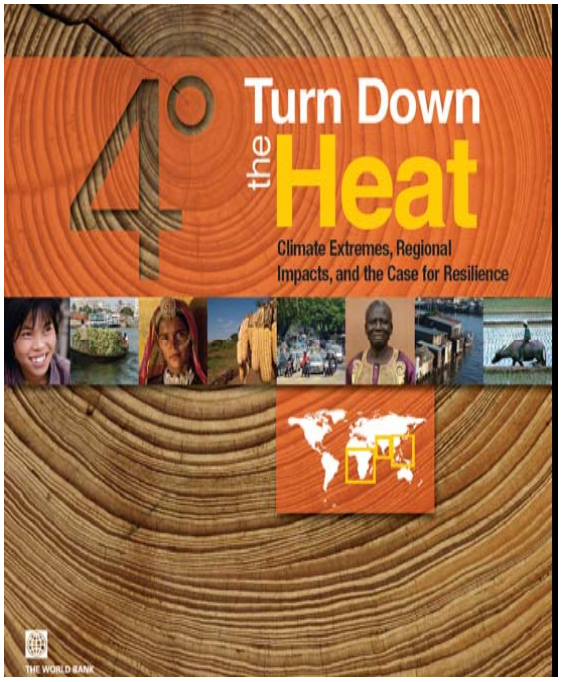
- Sea-level rise potentially severe for small island states and cities highly vulnerable to extreme flooding
- Water scarcity substantially amplified
  - (particularly Northern & Eastern Africa, Middle East, & South Asia)
- Significant risk for global food security:
  - large negative crop yield impacts anticipated in India, Africa, but also United States & Australia

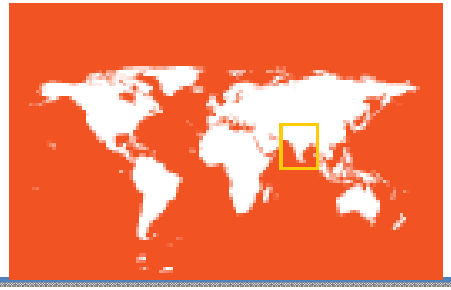
4°C – World Bank Report

- **Societal and ecosystem impacts:**
  - Ocean acidification and warming leads to regional extinction of entire coral reef ecosystems:
    - impacts on coastal and fishing communities and tourism
  - Likely large-scale biodiversity loss: dramatic reduction in ecosystem services.

Results from World Bank Study of three regions: focus on Africa







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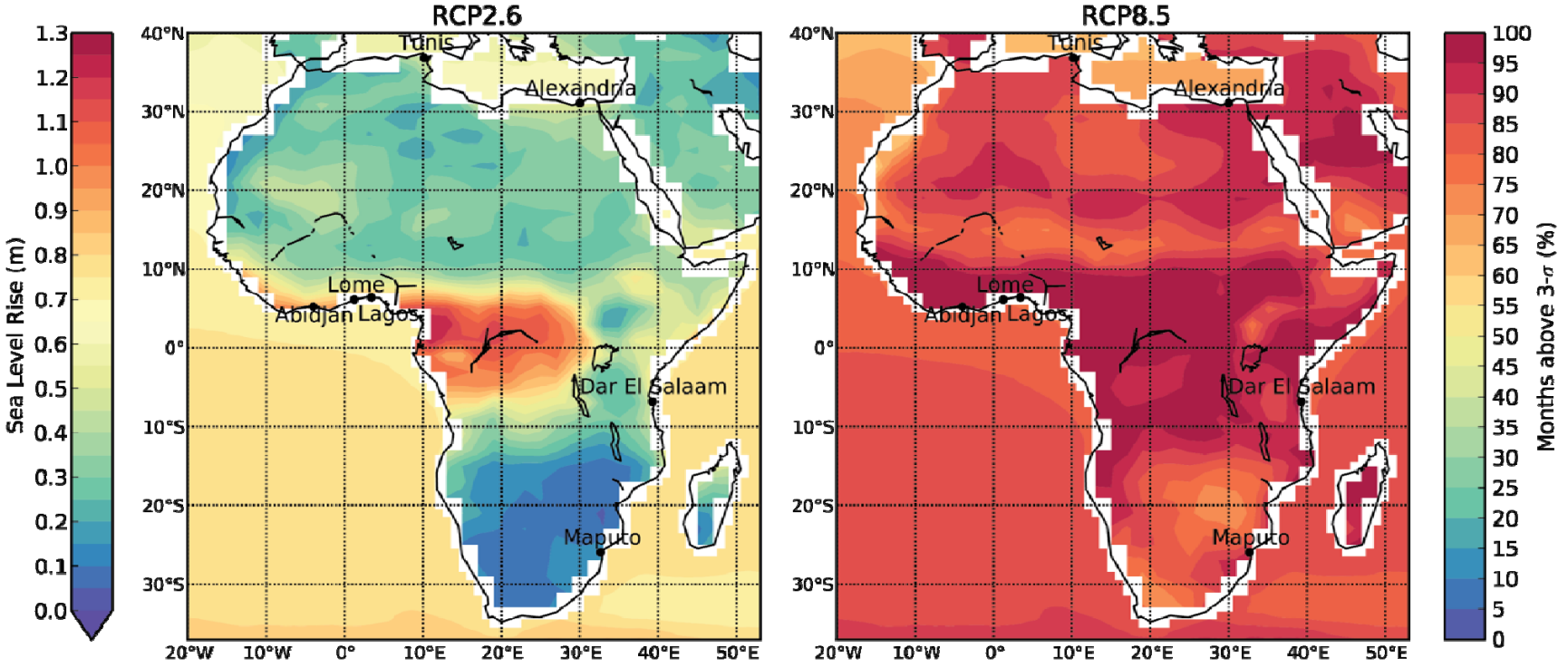
Sea-level rise and the frequency of extreme heat in 2°C and 4°C warming scenarios



Projections for sea-level rise above present-day levels (ocean – left legend) and warming compared to present-day extremes (land – right legend) for 2100. The 2°C warming scenario (RCP2.6) is shown on the left; the 4C warming scenario (RCP8.5) is shown on the right.

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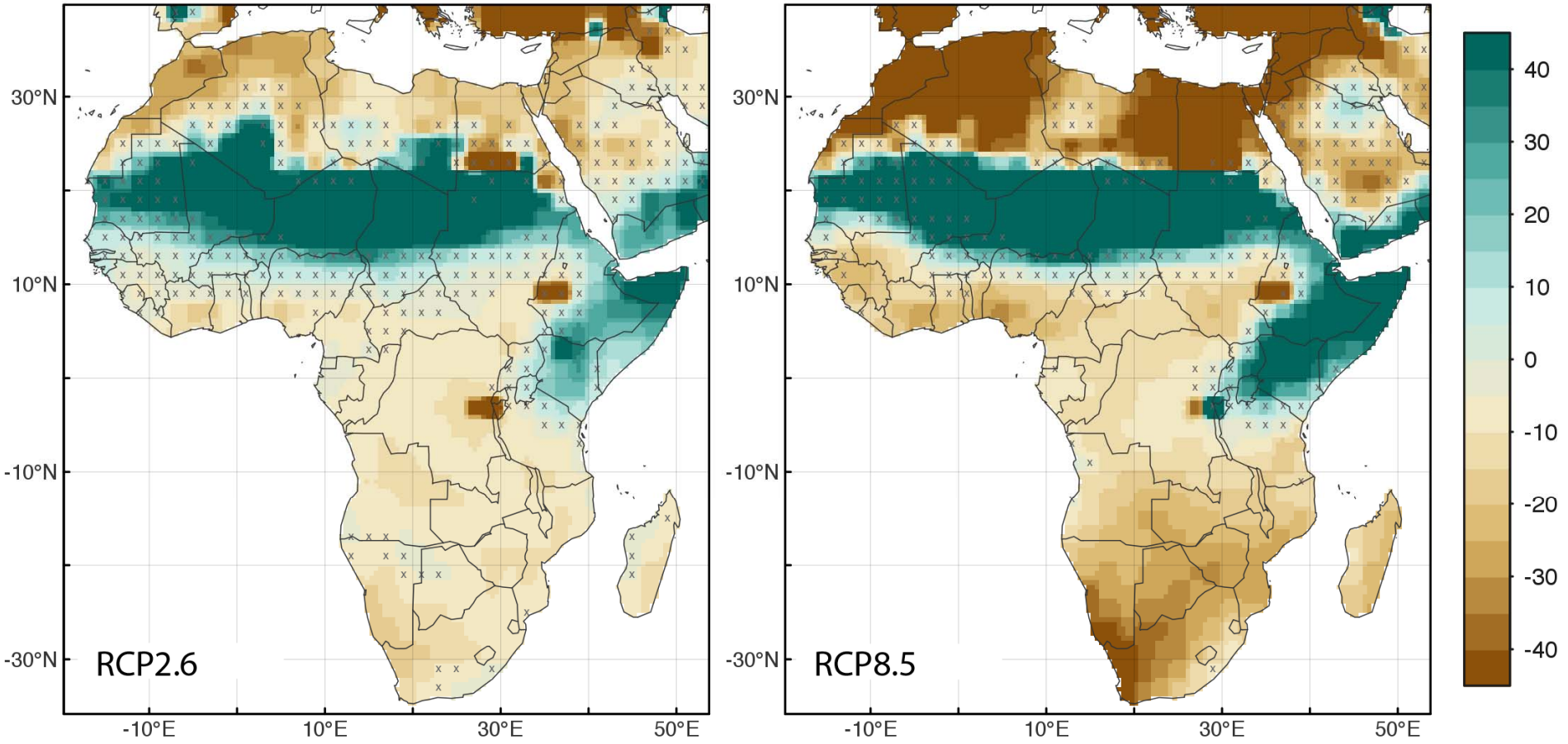
Warming + Modified precipitation pattern = Increased aridity

2°C temperature increase (RCP2.6)

4°C temperature increase (RCP8.5)



Percentage change in aridity index by 2071-99 relative to 1951-80

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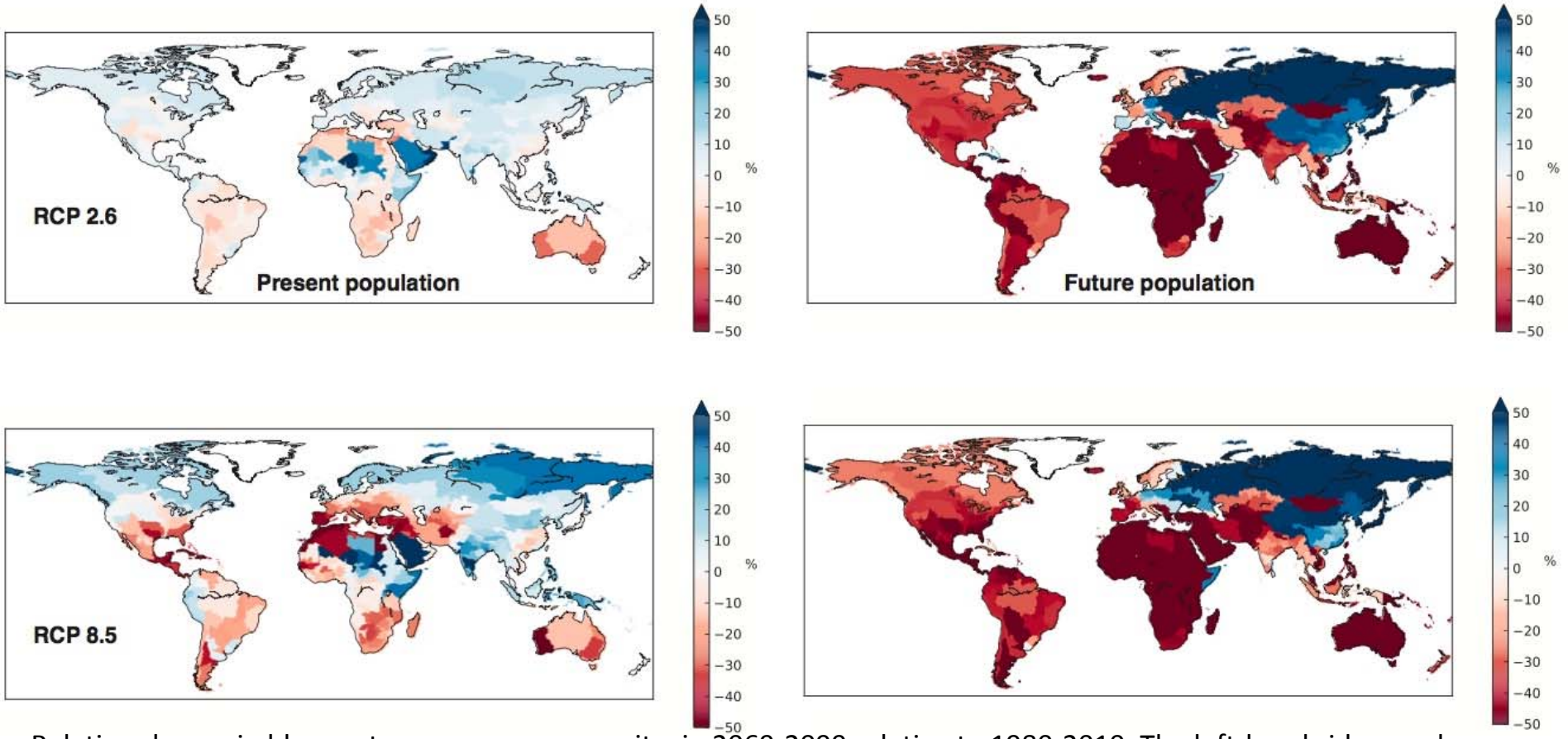
Sub-Saharan African terrestrial ecosystems

- Warming of a few degrees brings major ecosystem shifts
  - Fundamentally altering species compositions and leading to the extinction of some species.
- By 2030s (1.2-1.3°C warming), some ecosystems in Africa projected to experience maximum extreme temperatures well beyond their present range.
  - All African eco-regions experience maximum extreme temperatures well beyond their present range by 2070 (2.1-2.7°C warming).
  - Savannah ecosystems are projected to shift from grasses to woody plants, as CO_2 fertilization favors the latter

Food & Water security at risk?

- Threats to water security
- A vulnerable agricultural system:
  - Livestock production
  - Crop production and agriculture

Threats to water security



Relative change in blue-water resources per capita, in 2069-2099 relative to 1980-2010. The left-hand side panel population is assumed constant and in right-hand side panel, global population reaches 10 billion people by 2100.

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Livestock production

Potentially impacted through:

- Heat stress
- Water availability
- Quantity and quality of feed
- Livestock diseases

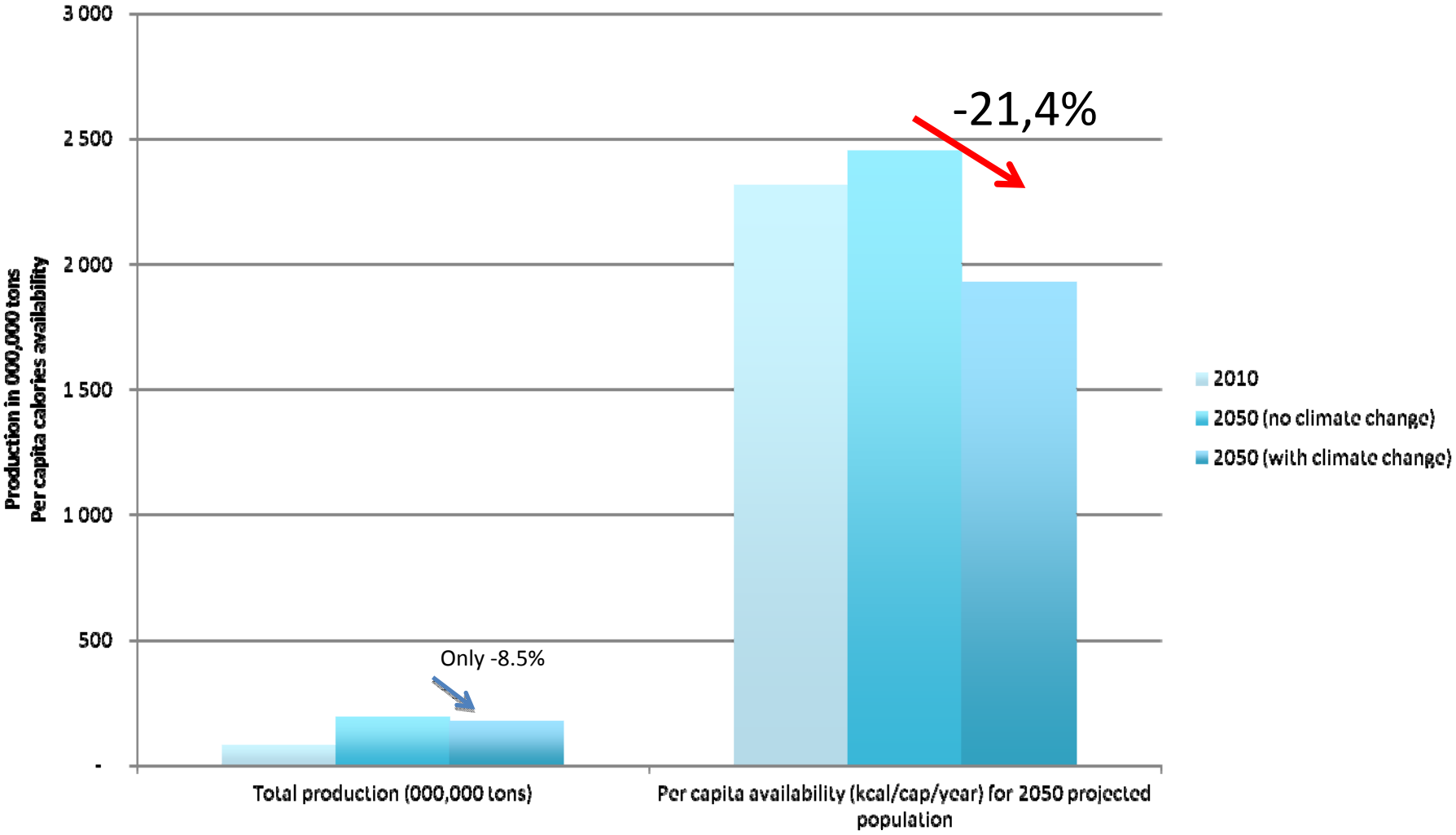
For example: in Ferlo, a Sahelian region of Senegal, a 15% decrease in rainfall in combination with a 20% increase in rainfall variability, is projected to lead to a 30% reduction in the optimum stocking density.

Sub-Saharan African agricultural production affected in the near term

- Significant yield decreases of 5 to 15% are expected even in the near term under relatively modest levels of warming (1.5°C to 2.5°C)
- For 1.5°C warming, 55-60% of current productive crop areas would no longer be suitable for maize, millet and sorghum
- At 2°C warming this increases to 85%
- Total crop production could be reduced by 10% under less than 2°C by the 2050s
- **Diversification options for agro-pastoral systems** are likely to dwindle
- **Shifts in African ecosystems** could result in the extent of savannah grasslands being reduced.

SSA Food security threatened:

Severe decrease in per capita calories availability



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Poverty & Development Implications

- Childhood stunting and associated consequences
- Increased vulnerability of urban poor

Childhood stunting and associated consequences

- Price of agricultural commodities on international market projected by approx. double fuelling food insecurity
- Childhood stunting projected to increase by 35 percent by 2050 compared to a scenario without climate change
  - Projected increased in children under 5 with malnutrition
  - Childhood stunting resulting from malnutrition is associated with reduced cognitive ability and school performance

Increased vulnerability of urban poor

- Poor consumers, often located in urban areas, and urban-wage earners are projected to be the most vulnerable to staple food price increase and extreme weather events
- Population living below poverty line could increase by 5% in Africa due to this combination (extremes and price increase) by the 2080s
    - More specifically, poverty rates in some non-agricultural household groups projected to rise by 20–50% in parts of Africa by 2030 due to staple food price increase

Health expected to be significantly affected by climate change

- In Africa, rates of undernourishment are already high, ranging between 15% and 65%, depending on the sub-region.
  - Proportion of the population undernourished is projected to increase for warming levels 1.2-1.9°C by 2050.
- **Climate change could exacerbate the existing development challenge of ensuring that the educational needs of all children are met**
  - Undernourishment, childhood stunting, malaria and other diseases, undermine childhood educational performance.
  - Projected increase in extreme monthly temperatures within the next few decades may have an adverse effect on learning conditions.

Sub-Saharan Africa: Food Production at Risk

- **Water availability** differences across the region to become more pronounced. In Southern Africa, precipitation projected to decrease by up to 30% (under a 4°C warming) and groundwater recharge to decrease by 50-70% in Southern and west Africa
- **Aridity** projected to spread due to changes in temperature and precipitation. Under a 4°C warming total hyper-arid and arid areas projected to expand by 10% (compared to 1986-2005 period)
- **Agricultural yield and nutritional quality** projected to decrease by around 15-20% across all crops and sub-regions for a global warming above 2°C/
  - Diversification options for agro-pastoral systems likely to decline
- **Population undernourished** as a consequence of climate change projected to increase by 25-90% compared to present with warming between 1.2-1.9°C by 2050
- **Exacerbation of existing development challenges**: undernourishment, childhood stunting, malaria and other diseases projected to undermine educational performance

A UNEP report prepared by Climate Analytics

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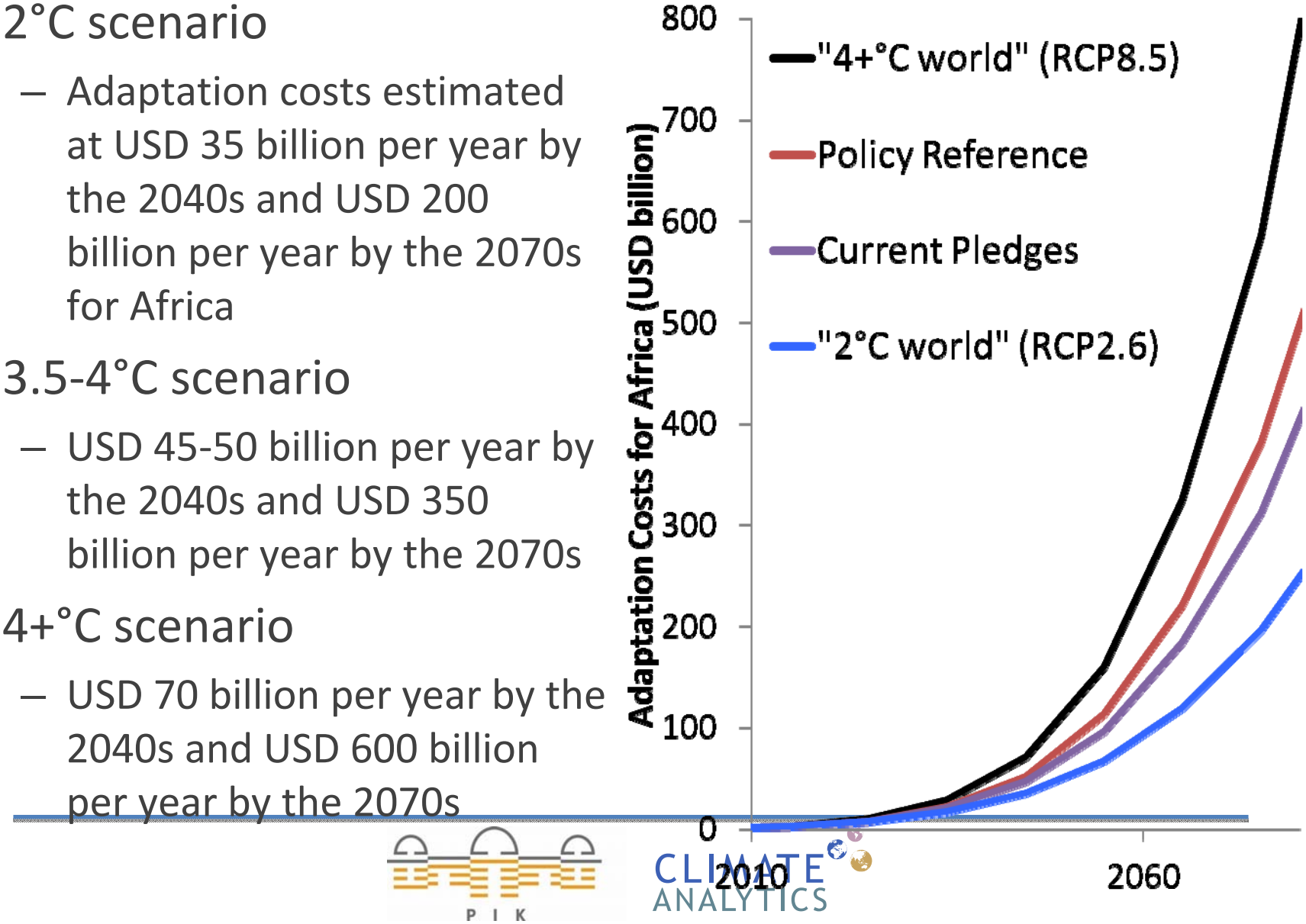
Nairobi, October 15 2013

How much will it cost for Africa to adapt?

- 2°C scenario
  - Adaptation costs estimated at USD 35 billion per year by the 2040s and USD 200 billion per year by the 2070s for Africa
- 3.5-4°C scenario
  - USD 45-50 billion per year by the 2040s and USD 350 billion per year by the 2070s
- 4+°C scenario
  - USD 70 billion per year by the 2040s and USD 600 billion per year by the 2070s



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Key Findings Across the Regions

- **Unusual and unprecedented heat extremes** projected to increase substantially, with adverse effects on humans and ecosystems
- **Water availability** expected to decline by 20% for many regions under a 2°C warming and 50% under a 4°C warming
- **Agricultural yield and nutritional quality** projected to decrease in the three regions studied under a 1.5-2°C world, with negative influences on economic growth and poverty eradication

Diapositive 25

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Florent Baarsch; 24/10/2013

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Agricultural and Nutritional Quality

- Warming above 1.5-2°C increases risk of reduced crop yields and production losses in Sub-Saharan Africa and South Asia.
  - Likely strong, adverse repercussions on food security and negative influence on economic growth and poverty reduction in impacted regions.

Diapositive 26

4 Same

Florent Baarsch; 24/10/2013

Climate shocks roll back development

- Climate shocks (for example droughts or cyclones) have the potential to drive poor households into poverty traps
  - Wealthy households - with higher coping capacity (access to funding, education, or networks) - projected to recover faster
- Climate shocks could potentially increase social inequalities and roll back development progress

4°C – World Bank Report

Conclusions:

- **No certainty that adaptation to a 4°C world is possible**
- **Warming of 4°C can still be avoided:** studies show technically and economically feasible pathways to hold warming likely below 2°C.

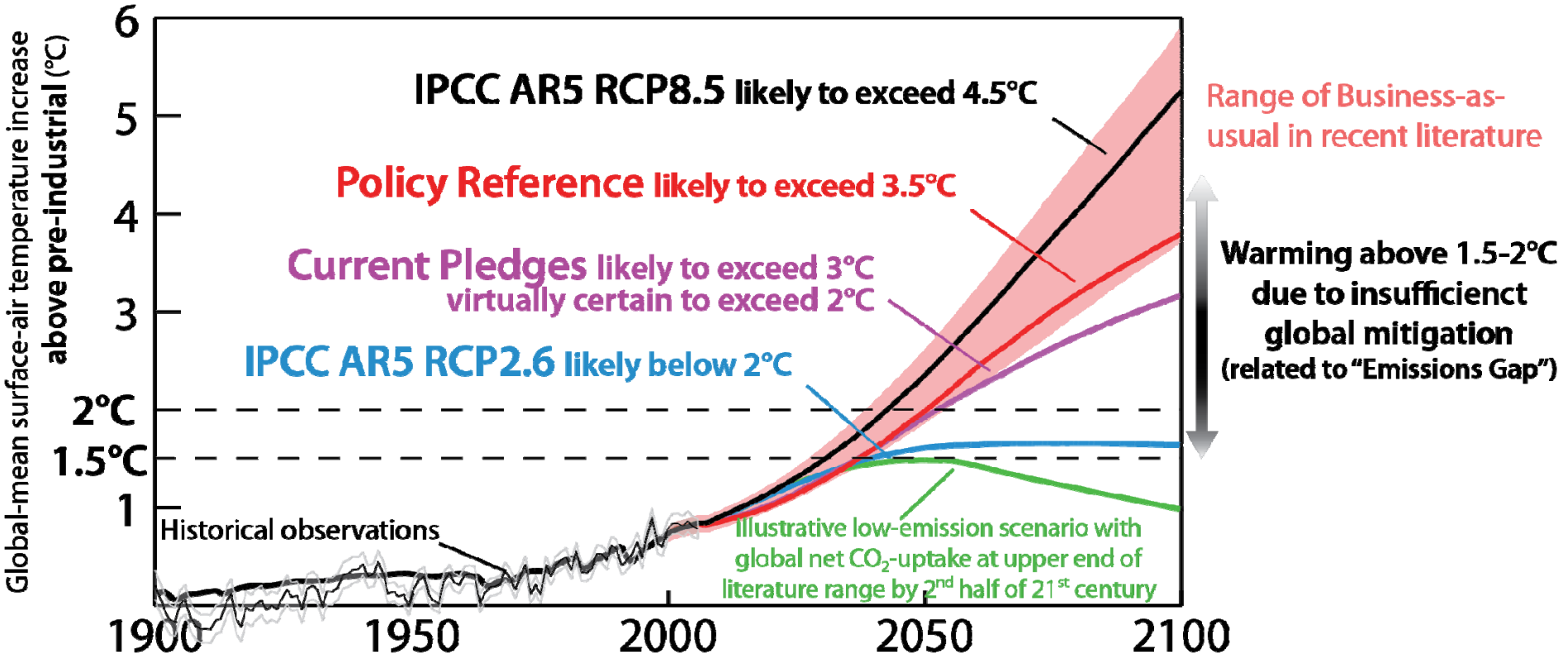
IPCC AR5: Warming can be limited below 2°C

- Lowest of the WGI scenarios (RCP2.6) indicates global warming can be limited below 2°C above pre-industrial levels
  - Emission reduction by 2050 of average 50% (range 14– 96%) relative to 1990 levels needed (RCP2.6)

Heading towards 4°C

- Recent greenhouse gas emission trends and recent emission projections imply higher 21st century emission levels
  - Projections based on the International Energy Agency's 2012 assessment indicated that in **the absence of further mitigation action** there is a 40% chance of warming exceeding 4°C by 2100.
    - a 10% chance of exceeding 5°C

Context: Global Emissions Gap



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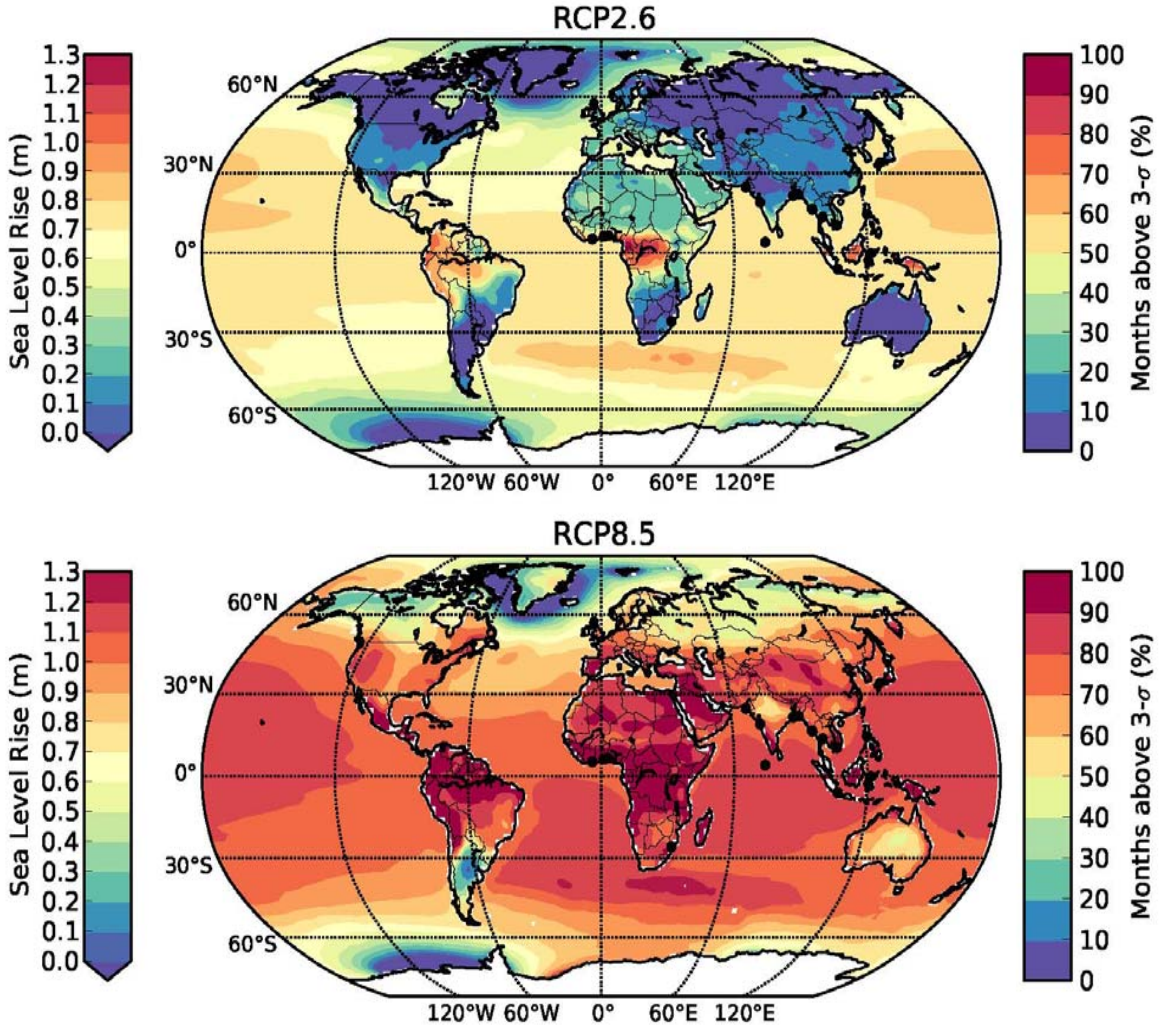
Climate Analytics

Science based policy
to prevent dangerous climate change

Mission: Synthesize and advance scientific knowledge in the area of climate change and on this basis provide support and capacity building to stakeholders. By linking scientific and policy analysis, we provide state-of-the art solutions to global and national climate change policy challenges.

Additional Material

Projected sea-level rise and heat extremes



2°C World

4°C World

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Biophysical drivers of impacts in Africa

- Temperature increase and heat extremes,
- Sea-level rise and heat extremes
- Modified rainfall precipitation patterns
- Overall increased aridity
- Rapid demographic increase

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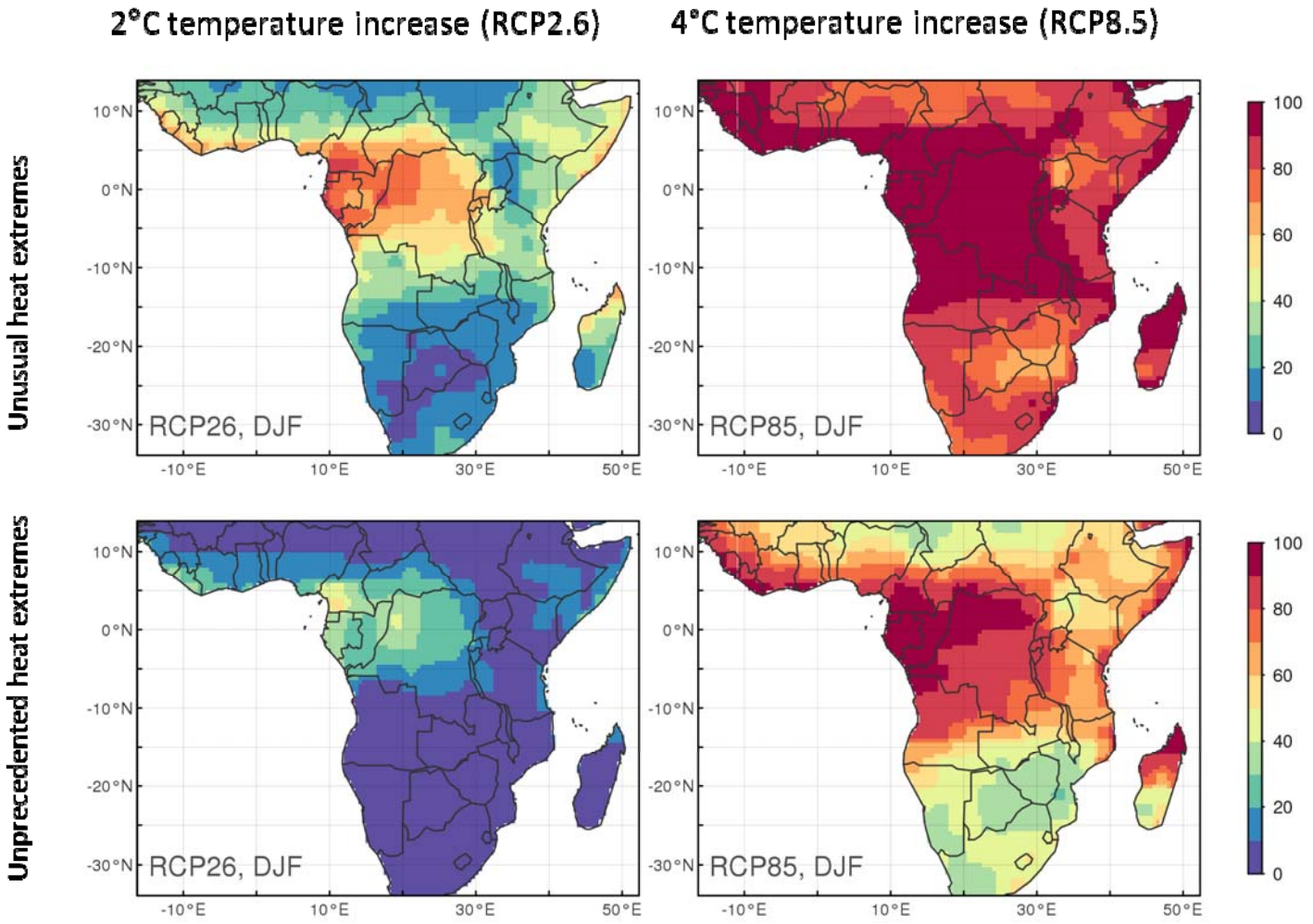
Temperature increase and heat extremes



Percentage of months in the time period 2071-2099 experiencing heat extremes

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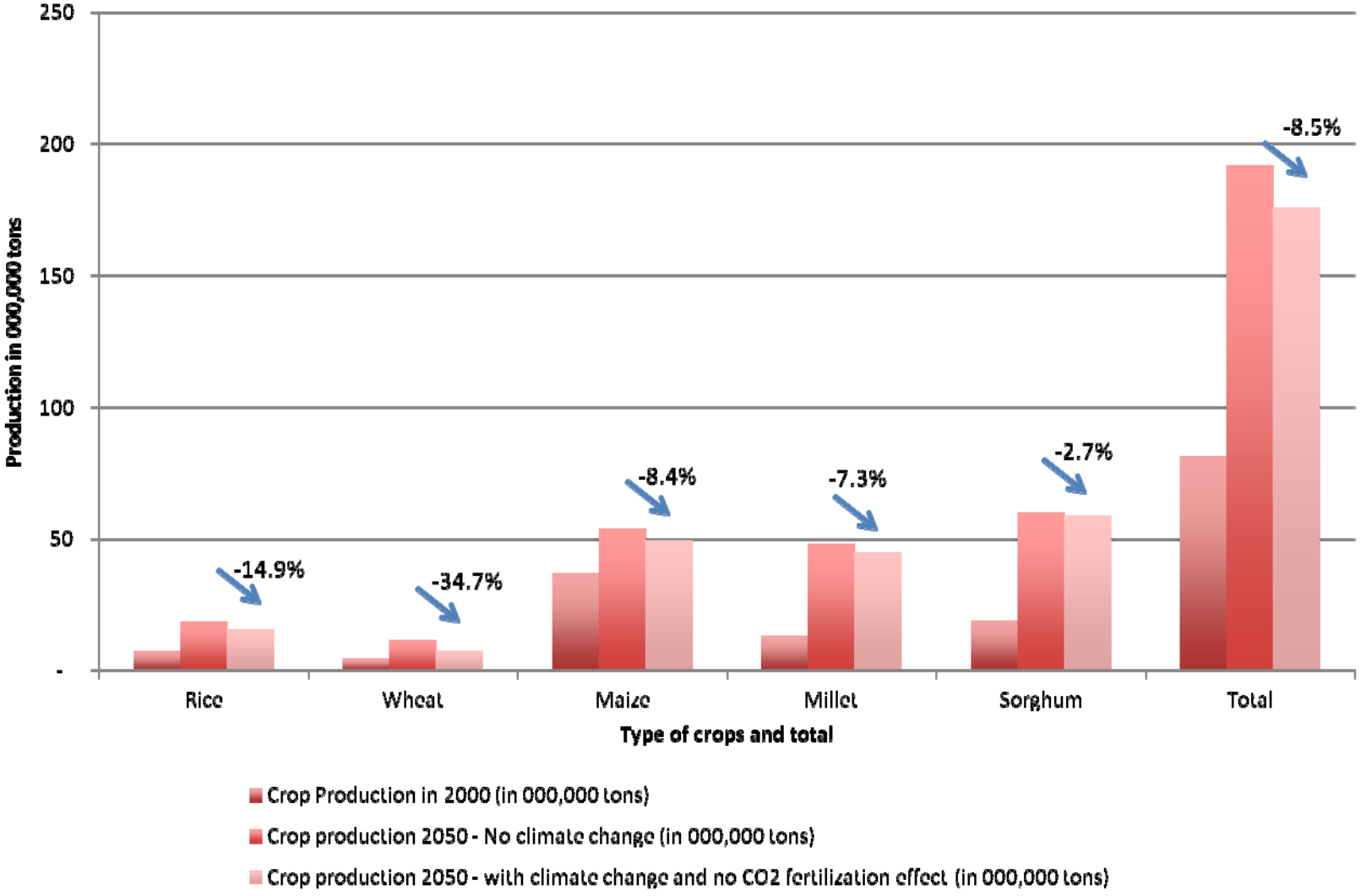
Diapositive 36

2 I would delete this one and only keep the second one that Dim and team did for the UNEP report

Florent Baarsch; 24/10/2013

Crop production projected to decrease



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Defining the adaptation gap

The adaptation gap is defined as the **difference** between the resources – including funding and capacity – that are **required** to adapt to the impacts of climate change, and those that are **available**

Adaptation Gap exists with zero Emissions Gap AND it grows with bigger Emissions Gap

If the mitigation is inadequate to stay below 2°C, impacts will rapidly grow larger, adaptation costs rise higher and the Adaptation Gap between required and available resources will grow

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Development Implications

- **Sub-Saharan Africa**´s food production systems are increasingly at risk
  - Significant yield reductions under 2°C warming, strong adverse repercussions on food security
- **South East Asian** rural livelihoods are faced with mounting pressures as sea levels rise and important marine ecosystem services lost.
- **South Asian** populations exposed to increasing risks
  - Disturbances to the monsoon system and rising peak temperatures put water and food resources at severe risk.
  - In deltaic areas, populations exposed to multiple threats of increasing tropical cyclone intensity, sea-level rise, heat extremes and extreme precipitation.
  - Multiple impacts can have severe negative implications for poverty eradication in the region.

Diapositive 39

5 Same

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