



Macroeconomic and higher order effects of climate change adaptation policies.

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ADAPTACE NA ZMĚNU KLIMATU V ČESKÉ REPUBLICĚ
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Aims and overview

Offer a «macro (economic)» picture of adaptation emphasizing its large-scale implications

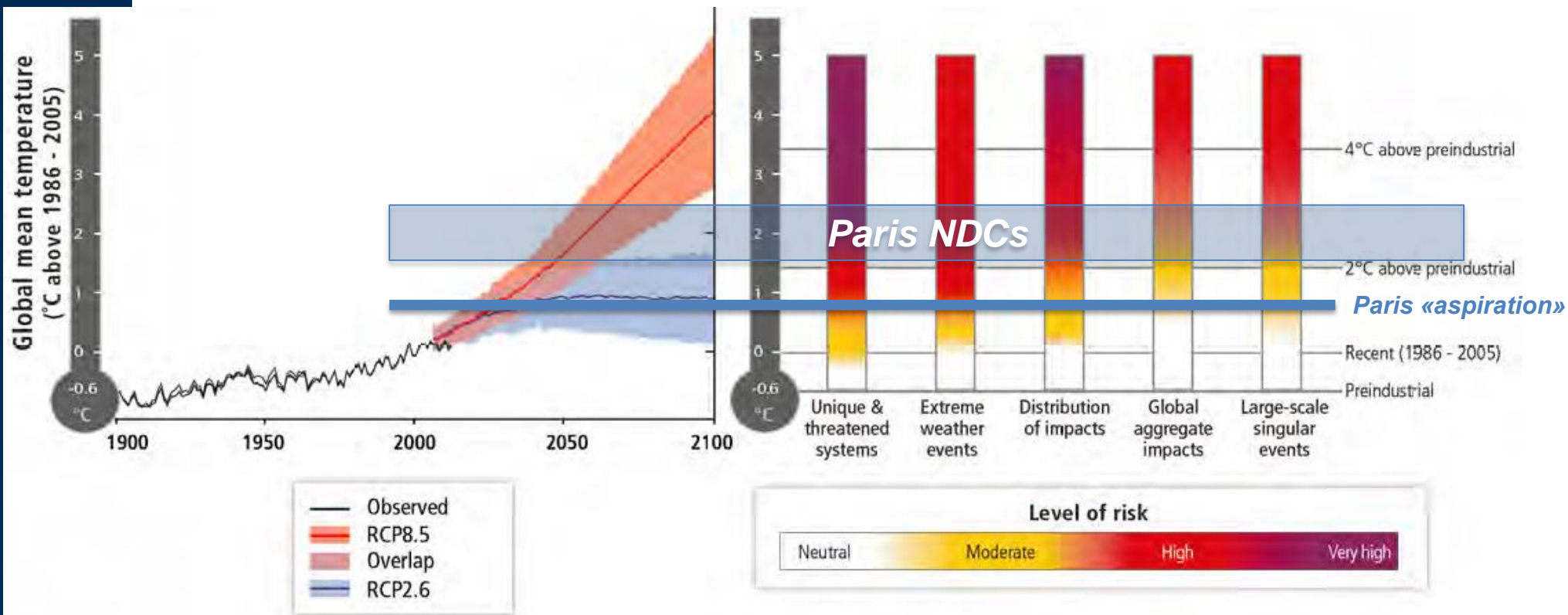
- ✓ Introduction: adaptation is necessary, it is also an elusive concept though, «some history»
- ✓ The cost and financing of adaptation
- ✓ Interaction with mitigation
- ✓ Two and a half examples of large scale effects triggered by adaptation: coastal protection, irrigation, conflicts

Adaptation: an elusive concept

“Adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli, and their effects or impacts. [...] refers to changes in processes, practices or structures to moderate or offset potential damages or to take advantages of opportunities associated with changes in climate” (IPCC TAR, 2001)

“Changes in a system in response to some force or perturbation, in our case related to climate” (Smithers and Smit, 1997)

A well known fact



Source: IPCC AR5 WG II (2014)

The recent Paris NDCs, or even a fully successful post-Paris mitigation process will still leave unavoidable climate change impacts → our societies have to «adapt»

A long way to adaptation

UNFCCC (1992) - Art. 3.3: “The Parties should take precautionary measures to anticipate, prevent or minimise the causes of climate change and **mitigate its adverse effects**” + Art. 4.1(b) and 4.1(e)

Concept iterated in the **1996 Kyoto Protocol** art 10 and 12 (financing)

However until the end of the '90s main policy & research focus was on mitigation (e.g. see 1995 IPCC SAR) → the 2001 IPCC TAR was the first with important mention to adaptation.

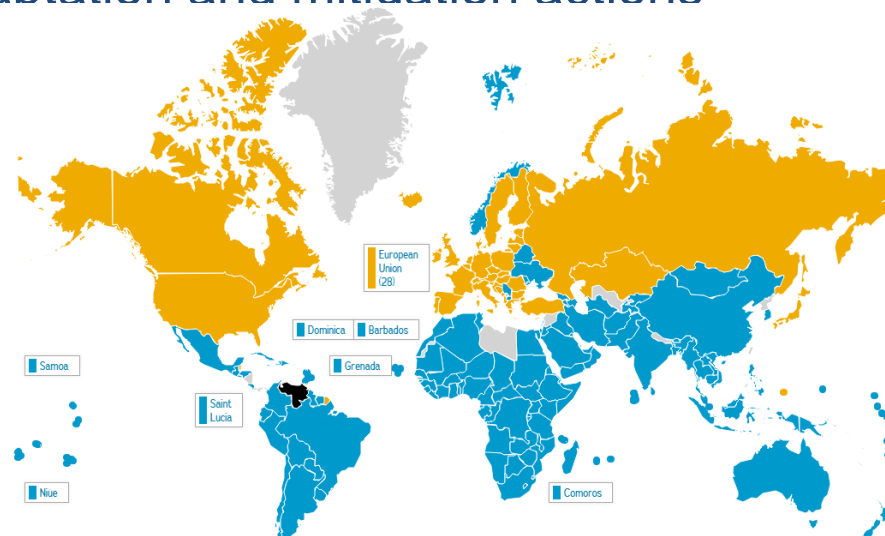
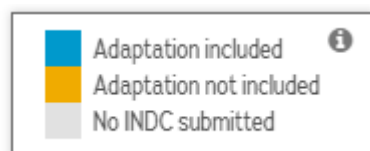
Marrakech (2001) adaptation fund, **Bali (2007)** operationalization of the fund, **Copenhagen (2009)** resources, ...

Adaptation «in Paris & INDCs»

Art 7: Global goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change:

- Link with mitigation strategies: “adequate adaptation response in the context of the temperature goal”;
- All Parties expected to undertake adaptation planning and actions and submit and update periodically an adaptation communication.

Art 11: Enhance the capacity and ability of developing country Parties... to implement adaptation and mitigation actions

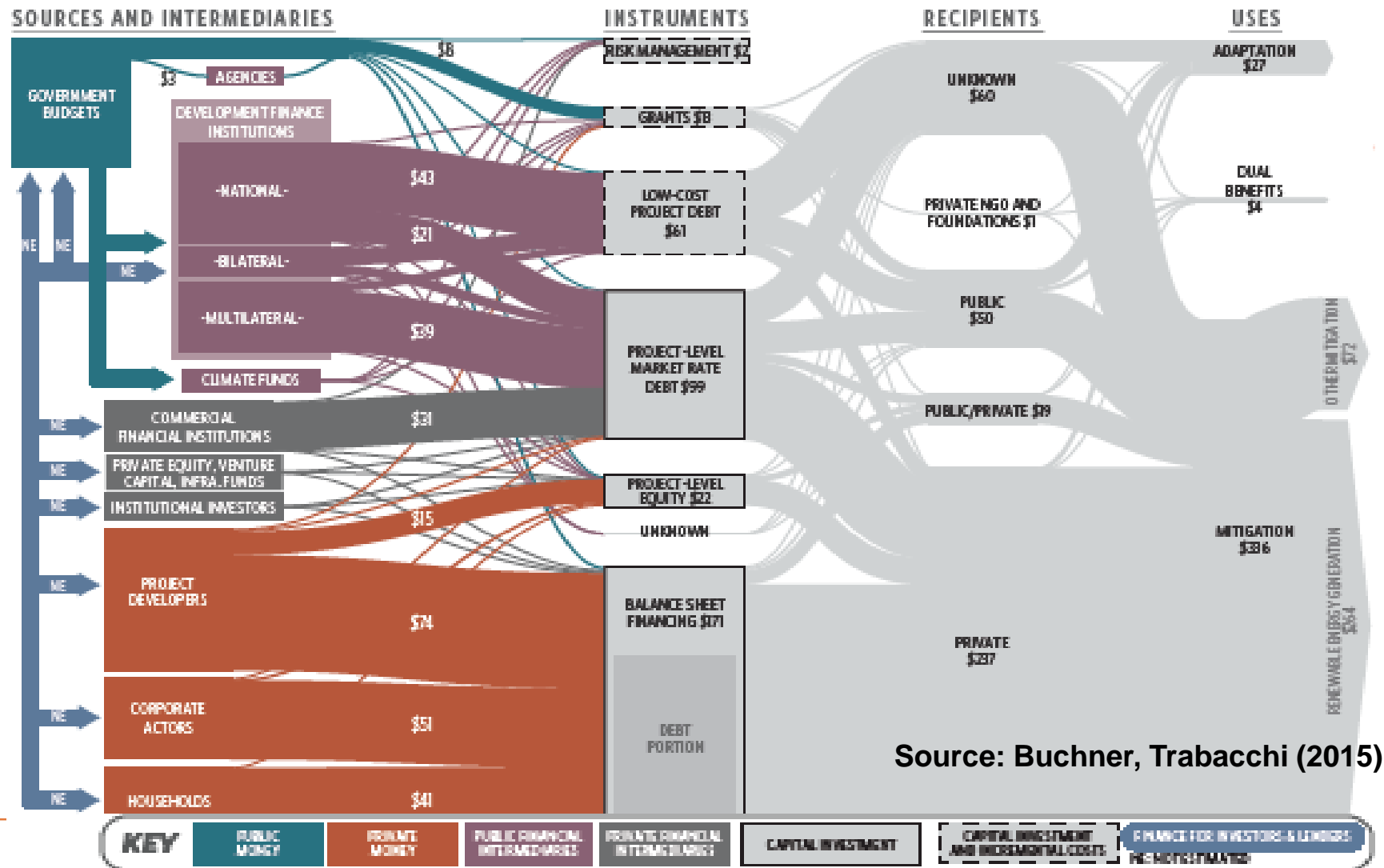


Source: CAIT Climate Data Explorer

Financing adaptation

Paris: \$ 100 Bln/Y adaptation+mitigation...

Global climate finance 2013-2014



Source: Buchner, Trabacchi (2015)

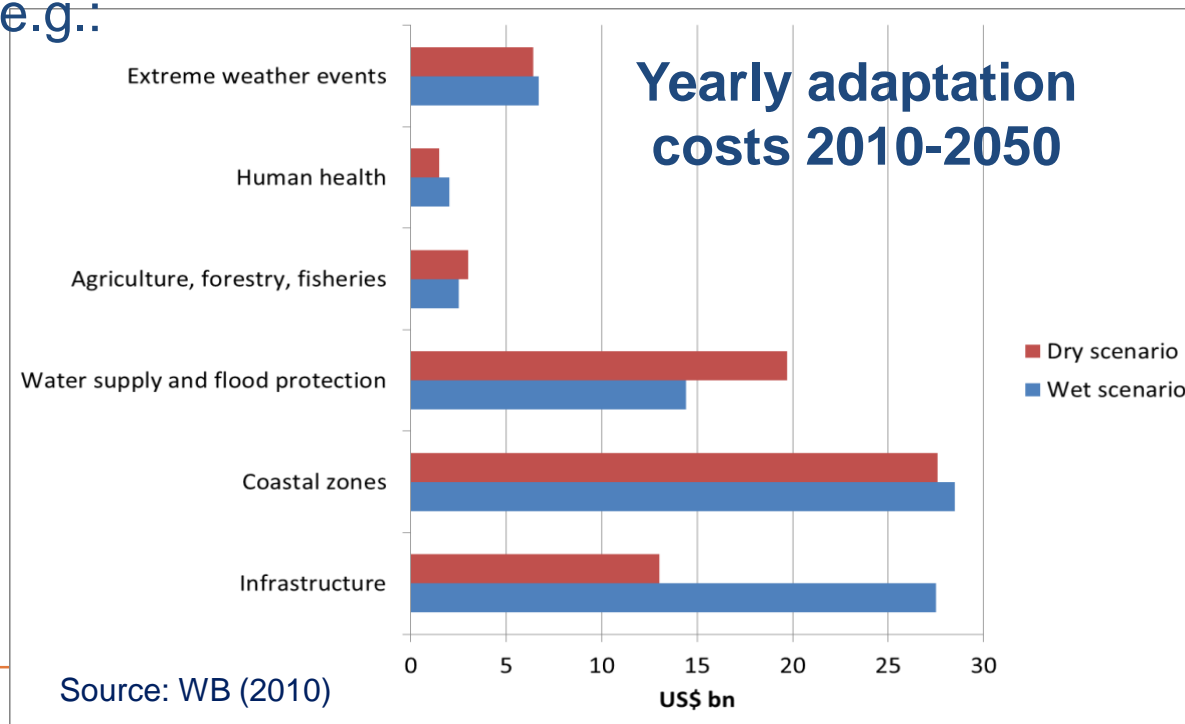
Adaptation is not «cheap»

«Netting» all the uncertainties and difficulties to assess adaptation costs and effectiveness, i.e.

- ✓ it is difficult to delimitate
- ✓ It comprises extremely diversified actions and measures
- ✓ It is highly local/sector specific
- ✓ It requires different implementation frameworks

at the beginning of an «open» debate on adaptation (basically with the 2001 IPCC TAR), adaptation was considered relatively «cheap» compared with mitigation

e.g.:



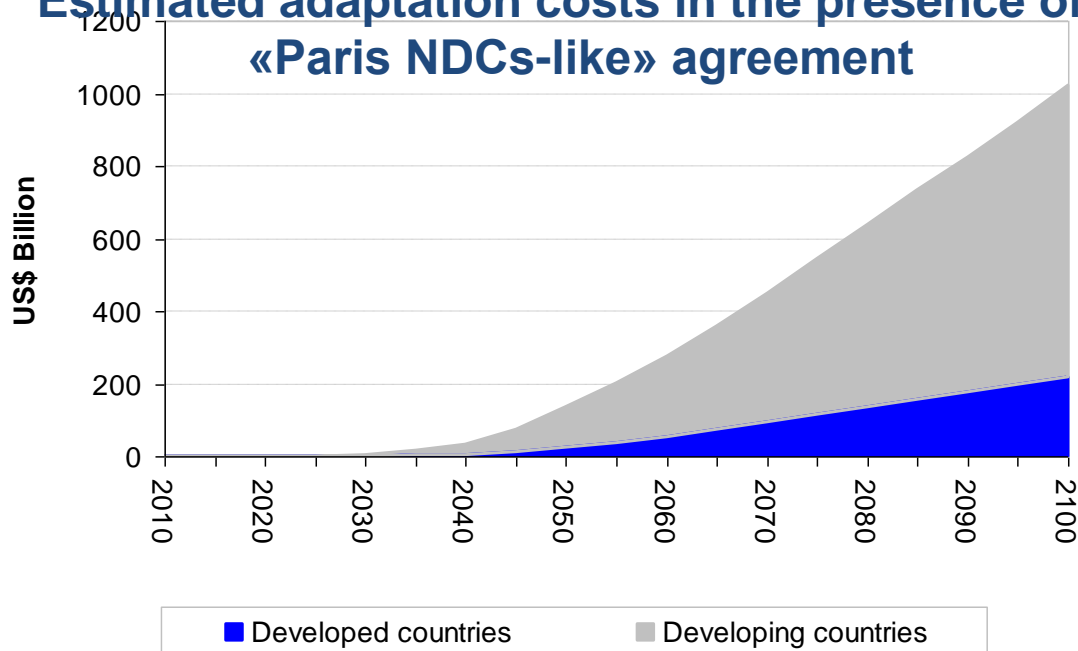
➔ Around \$ 100-140 B/year in the first half of the century globally

Adaptation is not «cheap»

More recent works and evidence show that adaptation costs can:

- ✓ Anyway rump up rapidly once «low hanging fruits» are reaped
- ✓ Fall disproportionaltely on developing countries
- ✓ Remain manageable if and ony if mitigation is substantive

Estimated adaptation costs in the presence of a «Paris NDCs-like» agreement

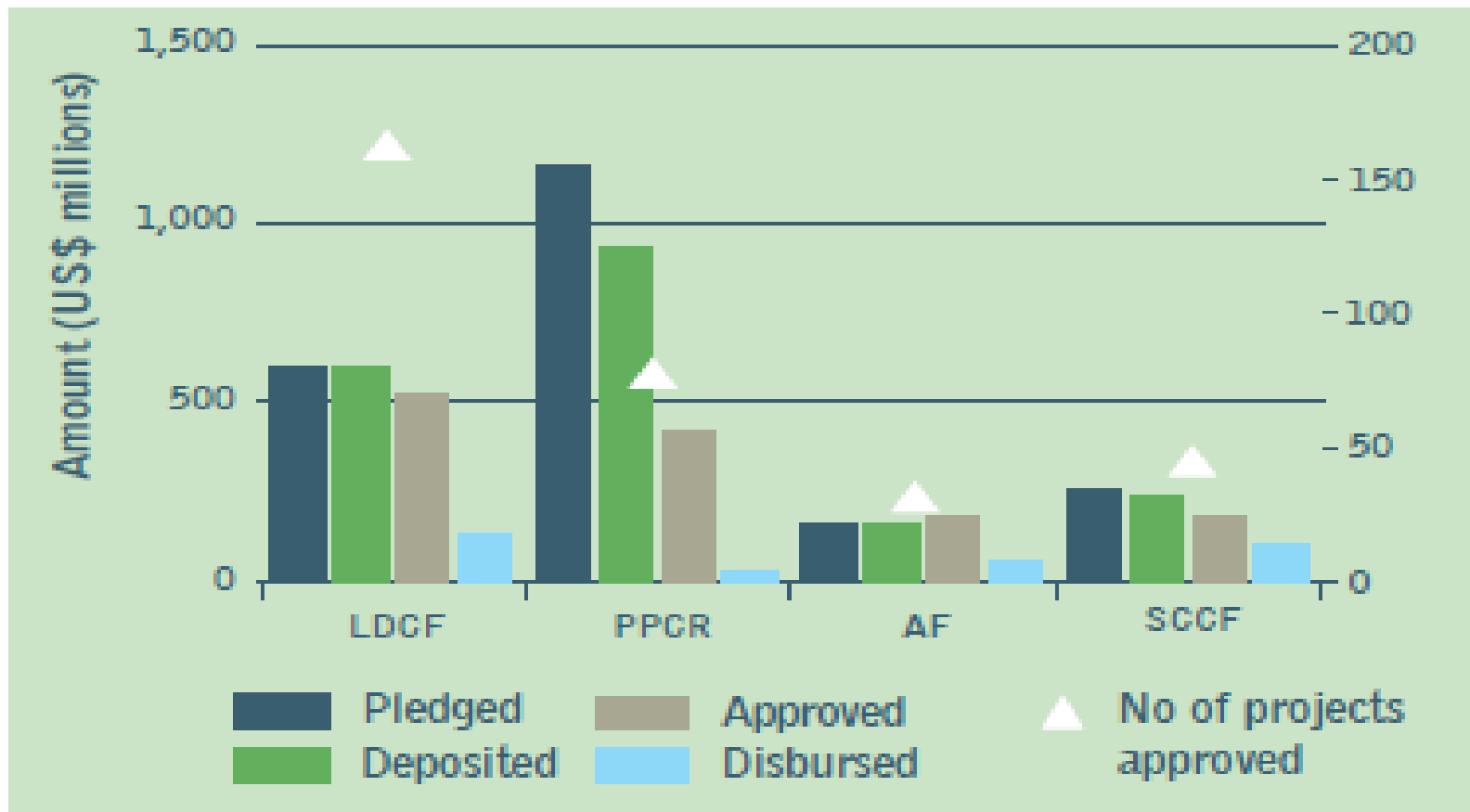


With mitigation “on”
Developing countries are expected to spend on adaptation about:

- US\$ 112 Billion in 2050
- US\$ 800 Billion in 2100

On an **annuitized basis** developing countries would need about US\$ 260 Billion for adaptation against the US\$ 70 Billion of the developed ones

The issue of transaction costs



In the 2003-2013 period only 15% of funds pledged for adaptation translated into effective disbursements. \$315 M vs \$ 2169 M (Nakooda et al. 2013).

Just one slide on Adaptation vs Mitigation in cost benefit

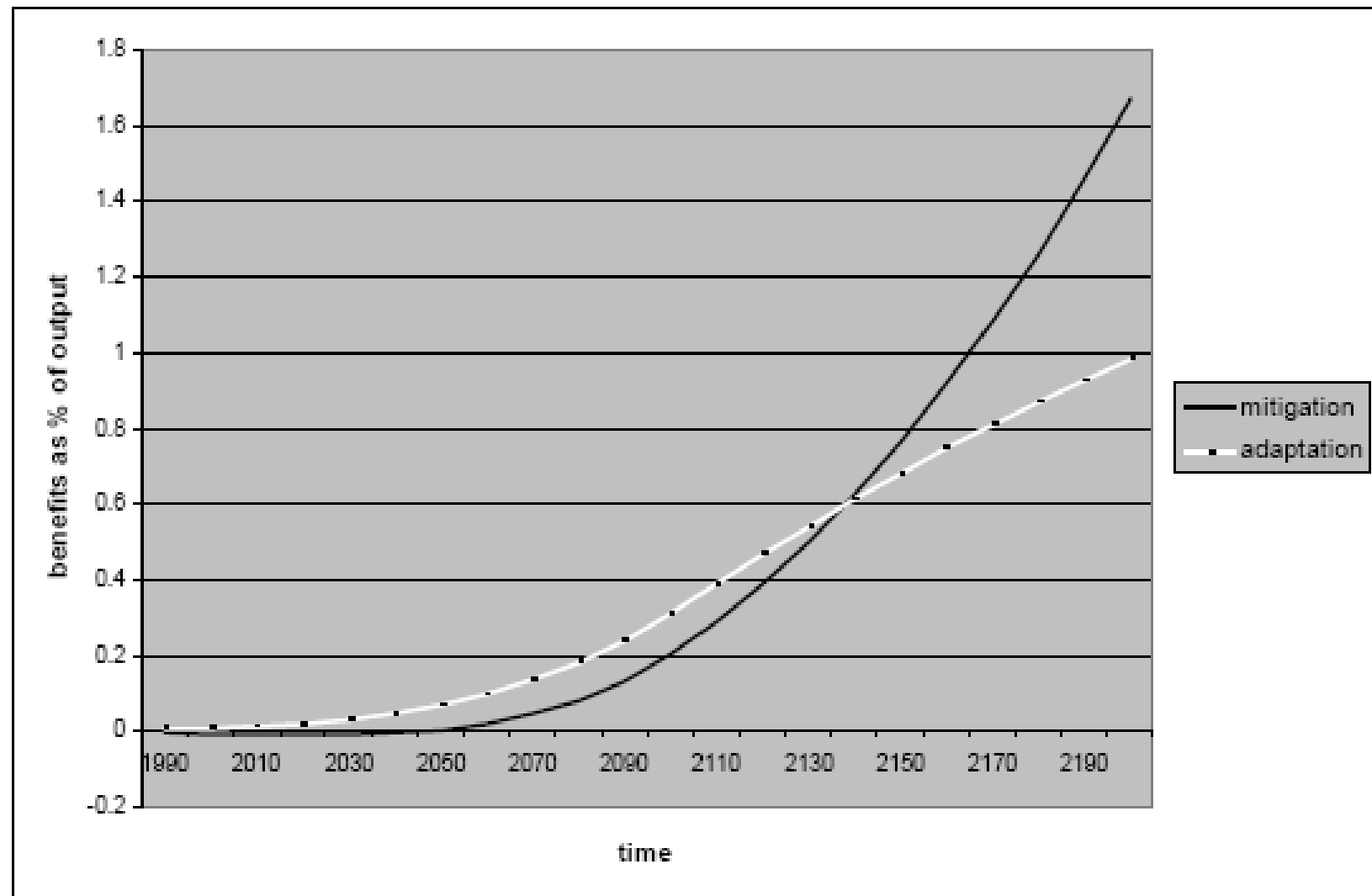


Figure 9: net benefits of optimal adaptation and optimal mitigation over time.

Source de Bruin et al 2007

Comparing further adaptation with mitigation

In addition to the obvious that: «mitigation acts on causes and adaptation on effects» there is a subtler, but fundamental difference:

- ✓ *mitigation is costly, but it can also produce revenues as it is usually implemented through taxes or auctioned permits.*
- ✓ *Cap and emission trading, at least in principle, allow to address the efficient – equitable distribution of mitigation efforts.*

This is much more difficult with adaptation:

- how to finance it especially in times of tight public budget constraints? (There is also a compensation issue)

Furthermore: mitigation is «global» and adaptation is «local», but can't adaptation trigger global effects anyway?

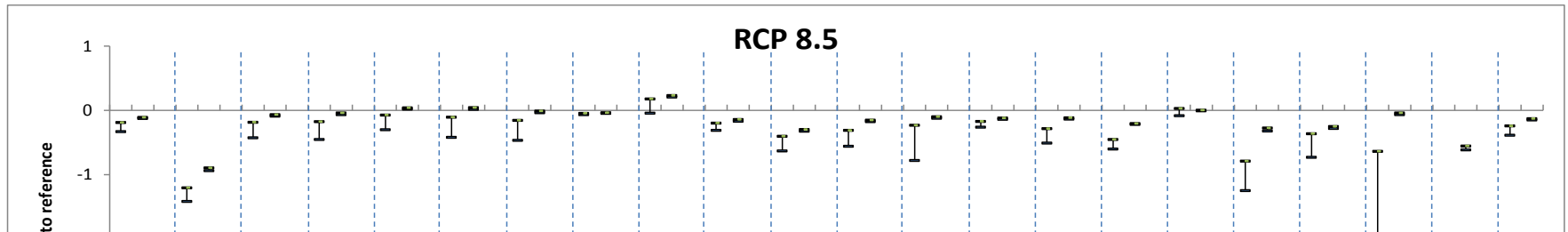
In what follows, two examples and a reflection on the macroeconomic “side” effects of climate change adaptation.

They are conducted using a **computable general equilibrium** analysis/model, i.e. trying to capture the second-order effects and systemic interactions (price + intersectoral/international trade effects) triggered by adaptation actions within economic systems

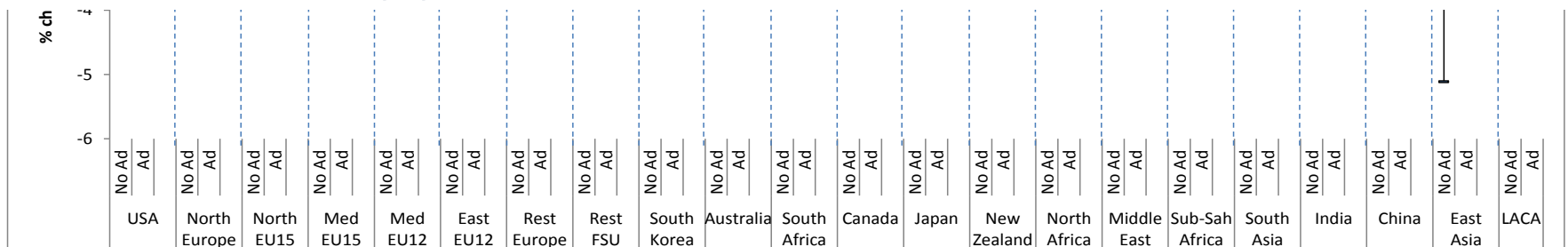
Ex. 1: Adaptation and public budgets. Sea-Level Rise

Sea-level rise can entail huge capital, infrastructure and land losses with negative implication for GDP world-wide. Coastal protection is an effective way to contrast it reducing those GDP losses.

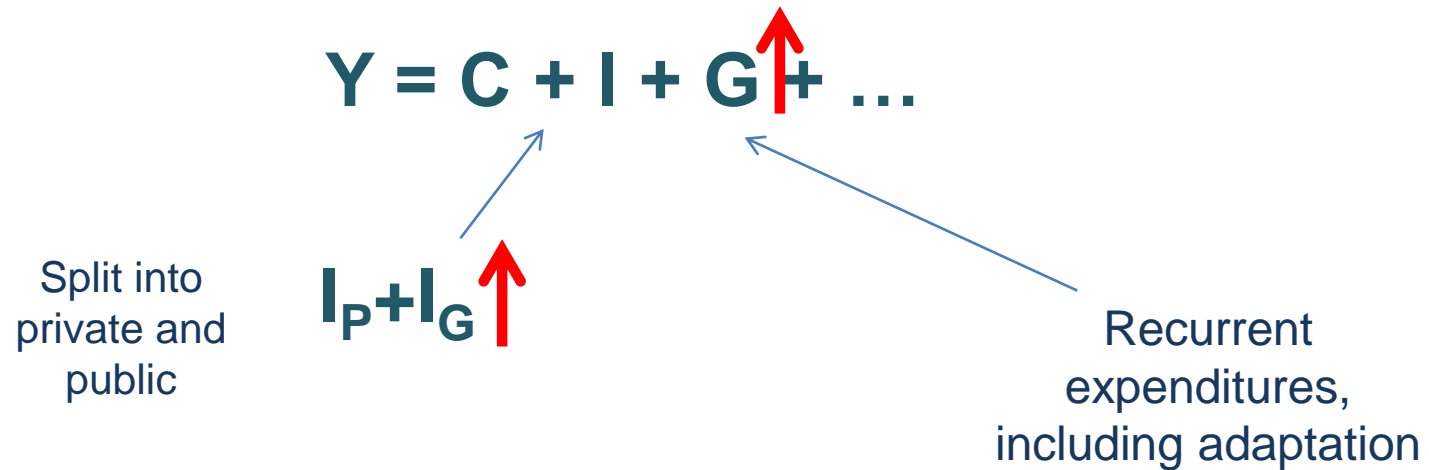
GDP impact of SLR: CC with and without improved coastal protection vs baseline in 2050



But coastal protection is very costly. Where to find resources? Suppose it is financed issuing govt. bonds rather than with taxes...



Ex. 1: Adaptation and public budgets. Sea-Level Rise



$$G + I_G - T = \text{net gvt borrowing}$$

(budget deficit)

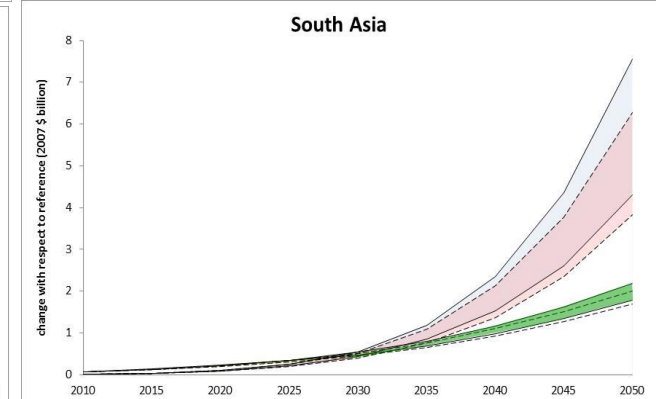
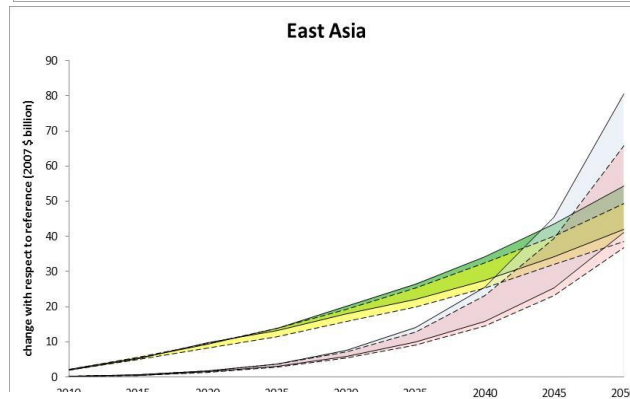
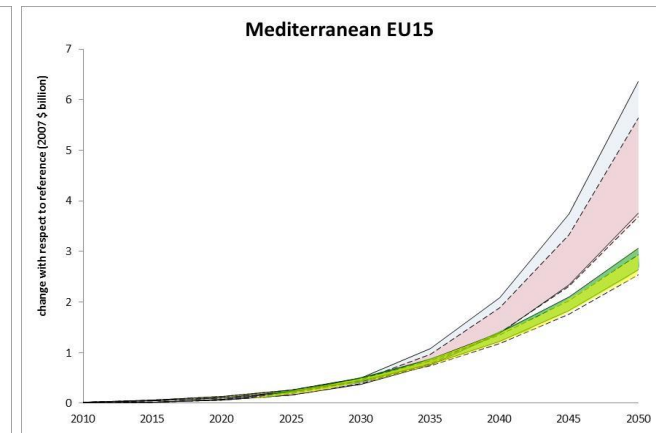
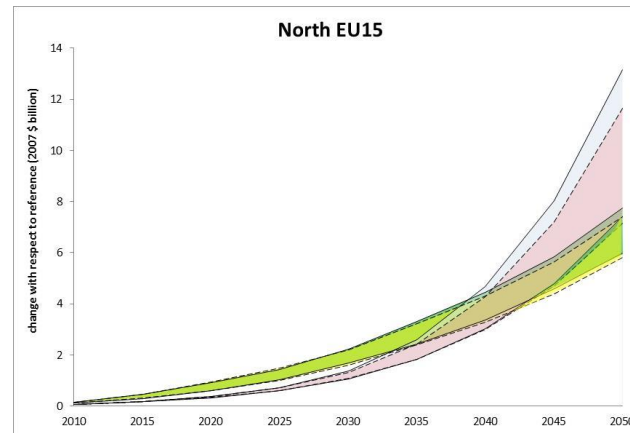
Adaptation affects deficit, impacts debt, and through interests payments debt servicing, furthermore given that g.vt borrows from h.holds savings, it also redistributes Y from I to current gvt consumption

Ex. 1: Adaptation and public budgets. Sea-Level Rise

Even in this case in a sufficiently long period public deficit (and debt) decrease... 2 effects:

- lower GDP contraction => higher revenues from pre existing taxes
- Higher preventive expenditure today < reactive expenditure tomorrow

Public sector deficit.
CC vs baseline in
selected regions
with and without
coastal protection
financed with bonds



--- RCP2.6-NoAd --- RCP2.6-Ad

— RCP8.5-NoAd — RCP8.5-Ad

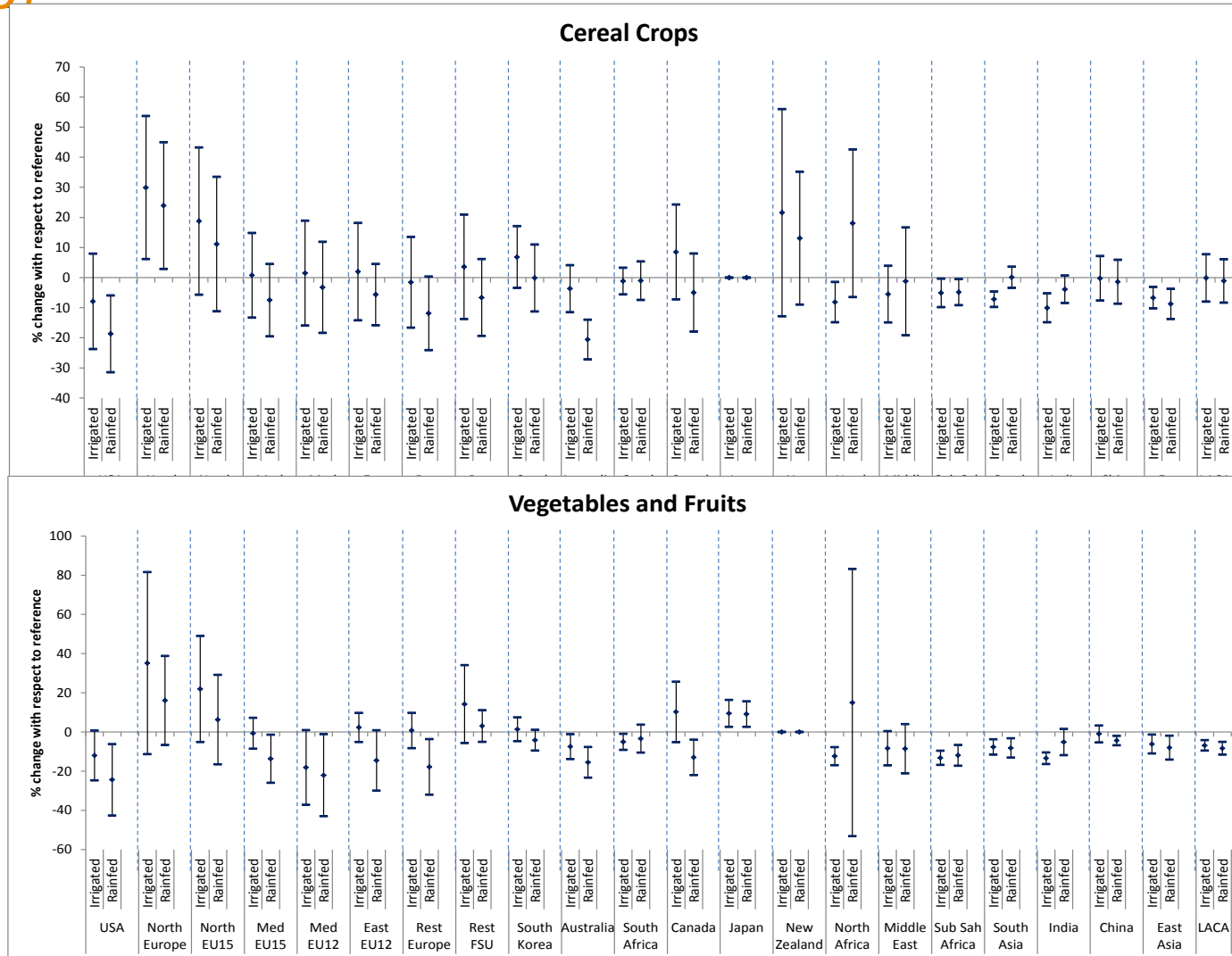
Ex. 2 irrigation

- **Reference Scenario:** Shared Socio-Economic Pathways (O'Neill et al. 2012)
 - SSP2 (“middle of the road”)
 - Projections for population (IIASA) and GDP growth trends (OECD).
- **No adaptation case:** Fixed Irrigated land and rainfed land as in the reference scenario.
- **Adaptation case:** Irrigable land and rainfed land adjust according to farmers demand.

Climate change scenarios

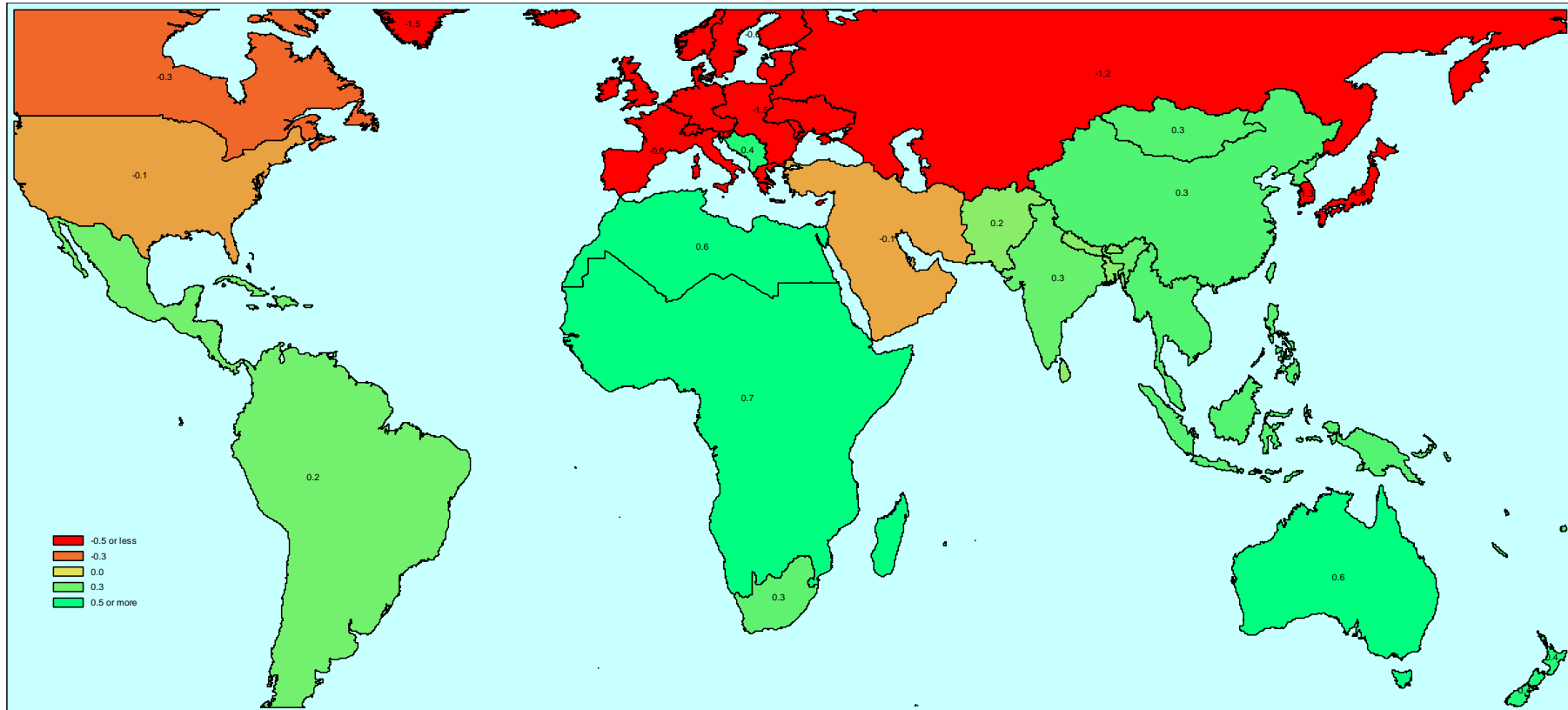
- Four RCPs: 2.6, 4.5, 6.0, and 8.5
- GCM: HadGEM2-ES
- Five crop Models from the Global Gridded Crop Model Intercomparison Project (AgMIP): **EPIC, GEPIC, LPJmL, LPJ-GUESS, pDSSAT**
- Climate impact on yields
 - Differentiated by rainfed and irrigated land
 - No CO₂ fertilization effect

Climate change Impacts on yields by region in 2050 (RCP 8.5)



- Lower latitude countries are those most negatively affected, rainfed land more than irrigated

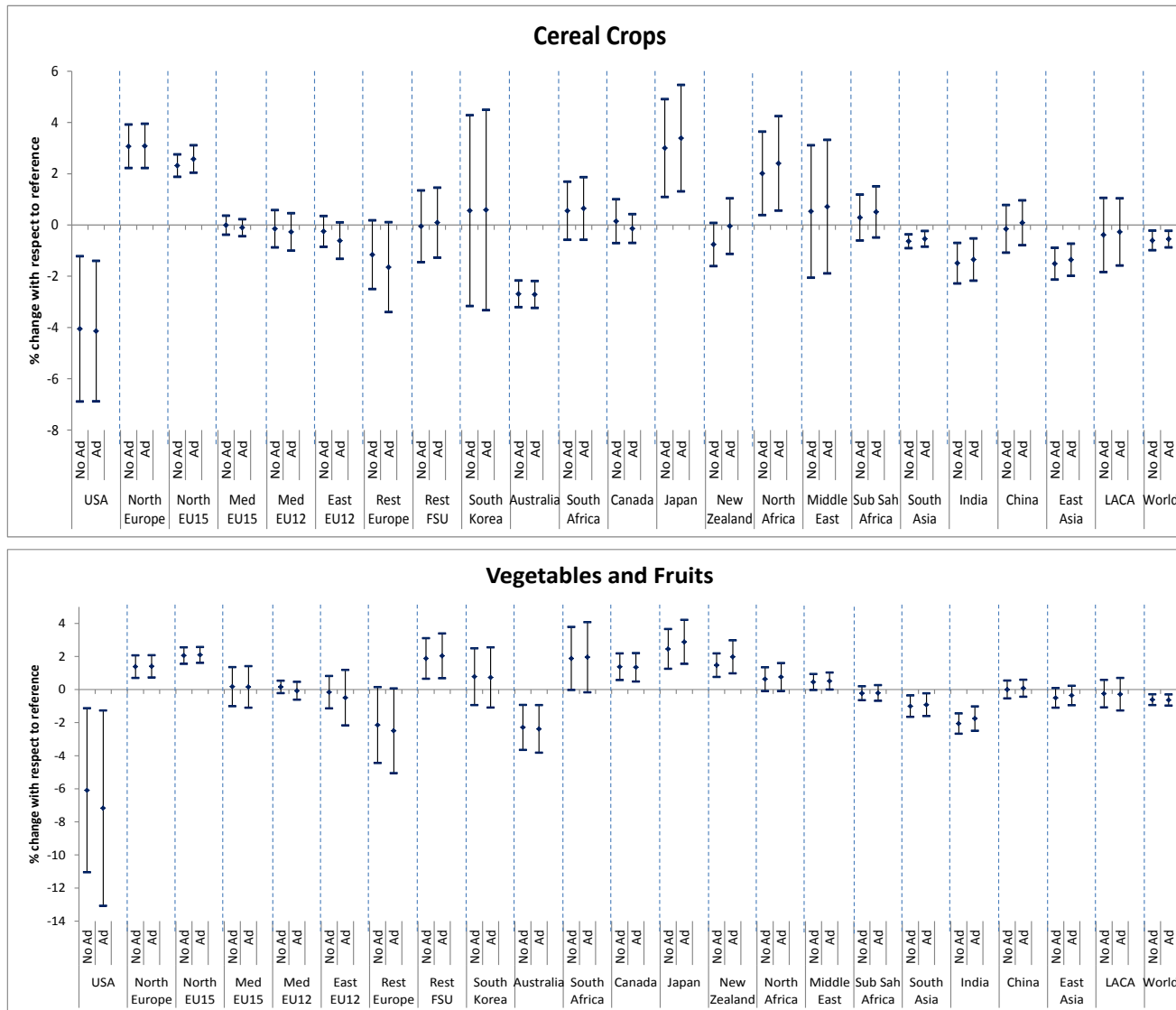
Changes in irrigated land by region in 2050 (RCP8.5)



Source: ECONADAPT project - Parrado et al. (2016)

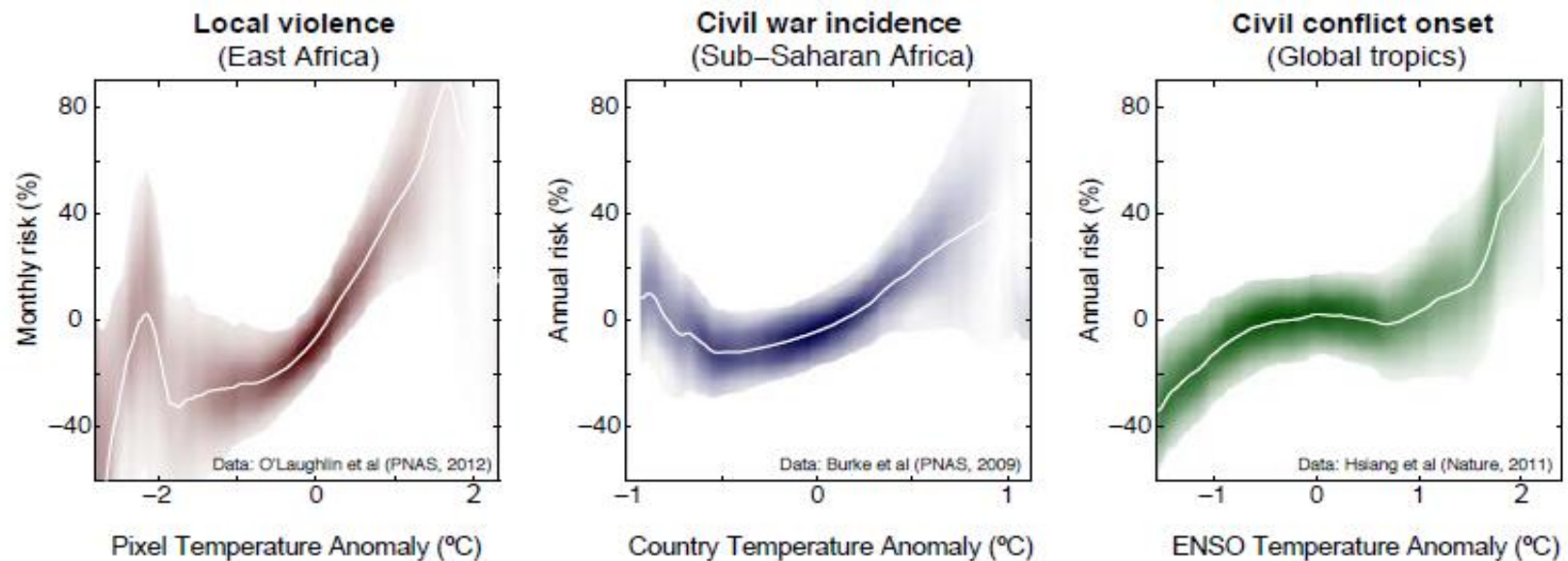
Although irrigation allows to recover yield losses «everywhere», irrigation expansion is observed in developing countries only (and Australia)

Impacts on crop production by region in 2050 (RCP 8.5)



Irrigation entails a redistribution of crop production from D.ed to D.ing Cs. The latter are becoming relatively more competitive as starting from low level of irrigated areas exploit initial lower irrigation expansion costs and lower crop prices

Ex. 3: Suggestive HP. climate change, adaptation and conflicts



Source: Burke et al. 2015

“Each 1σ increase toward warmer temperatures increases the frequency of contemporaneous interpersonal conflict by 2.4% and of intergroup conflict by 11.3%” (Burke et al 2015)

Various explanations: more struggle for resources (water, food) impaired by climate change, mass migration movements triggered by climate crises (e.g. droughts driven), more inequality triggered by disproportionate climate change impacts on weaker components of the society...

IF SO, adaptation can be an important inequality and social conflict smoothing factor

Thank you!

Framing the issue: the two-way relation adaptation-development

Adaptation

Direct: lower negative CC impacts => lower “losses” and lower negative impact on economic activity and “welfare”

Indirect: adaptation often consists in *productive investments* (no pure costs) strengthening *existing* not necessarily climate change-oriented measures E.g.: coastal defence, irrigation, health care, landscape management and risk reduction programs that can spur *economic development, employment, technological innovation, and ultimately budgetary gains and social conflict reduction in addition to direct benefits*

Development

The “richer” you are, the higher is your resource availability to anticipate/cope with adverse consequences of climate change. Or: the more you care about climate impacts (“environment “as a luxury good) “Shelling Conjecture” (Shelling, 1992)