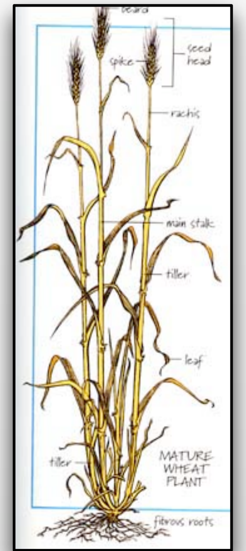
Climate Change & Food Prospects

A peak at the 80s..., the 2080s



?

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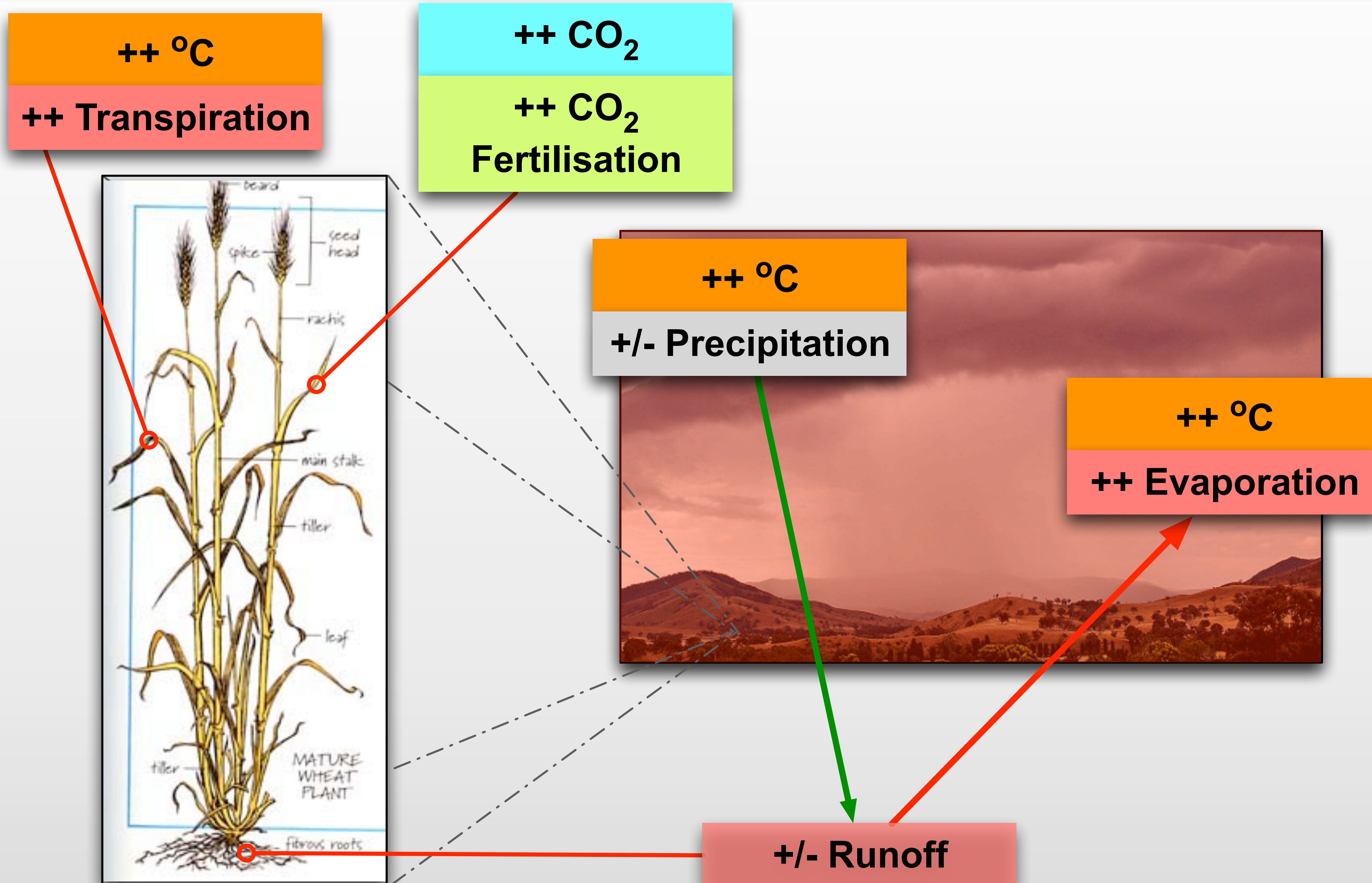
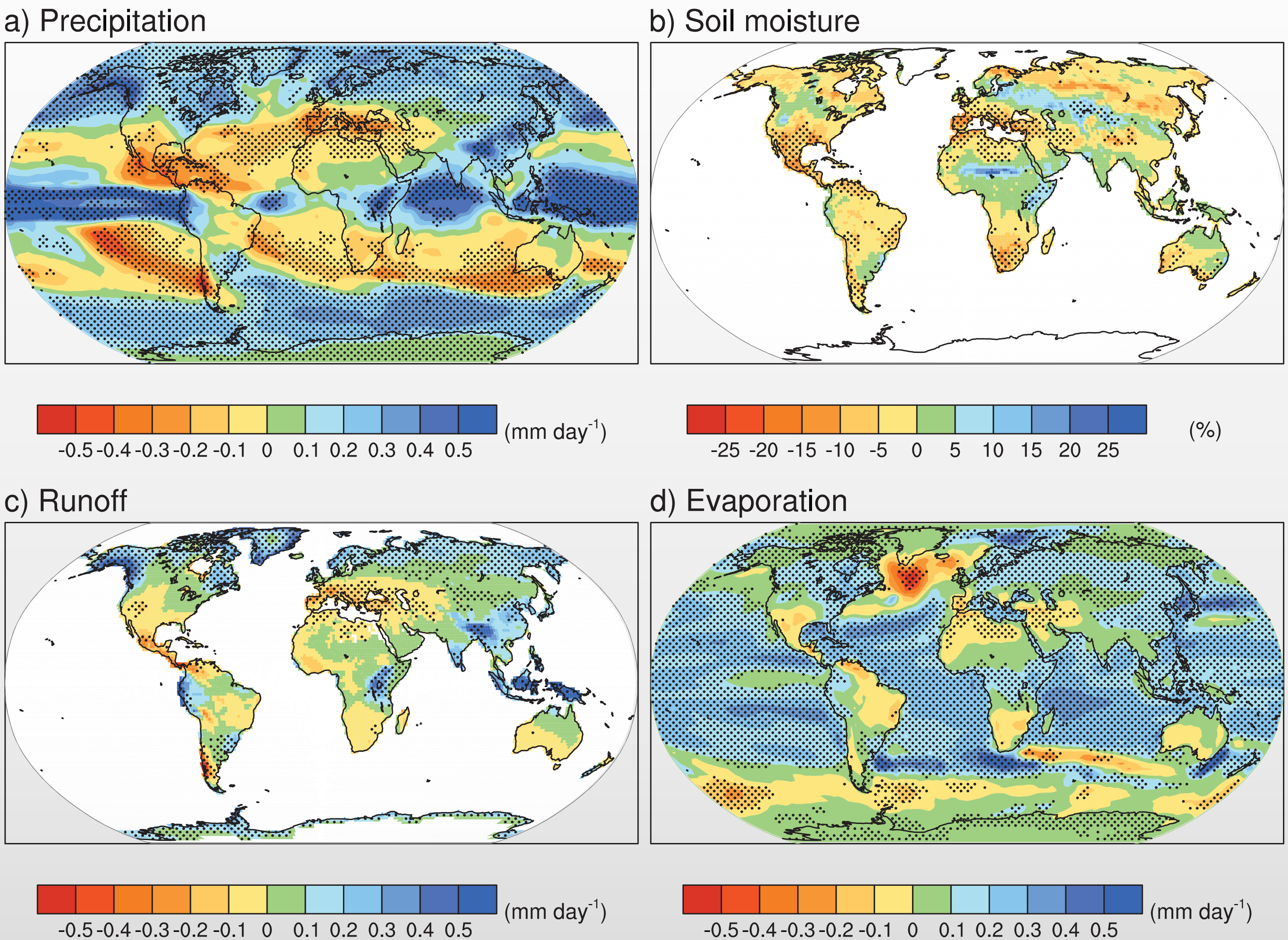
Next fight: *Evapotranspiration* vs *Precipitation*



Preciptation, Soil Moisture, Runoff, Evaporation

Variations between 2080-2100 and present



Source: IPCC AR4 (The Physical Science Basis), Ch 10, p.769 (2007)

It's not *who* you are, but *where* you are

How countries fare

Whether the impact of climate change is projected by economic or agronomic models, nearly all countries suffer.

(percent change in agricultural productivity)

***Without** Carbon Fertilisation (CF)*

***With** Carbon Fertilisation (CF)*

	Ricardian model[1]	Crop model[1]	Weighted average	
			Without CF	With CF
Argentina	–4	–18	–11	2
Brazil	–5	–29	–17	–4
United States	5	–16	–6	8
Southwest plains	–11	–59	–35	–25
India	–49	–27	–38	–29
China	4	–13	–7	7
South central	–19	–13	–15	–2
Mexico	–36	–35	–35	–26
Nigeria	–12	–25	–19	–6
South Africa	–47	–20	–33	–23
Ethiopia	–31	–31	–31	–21
Canada	0	–4	–2	12
Spain	–4	–11	–9	5
Germany	14	–11	–3	12
Russia	0	–15	–8	6

Source: Cline (2007).

Note: Ricardian models statistically infer the contribution of temperature and precipitation to agricultural productivity by examining the relationship of land price to climate, whereas crop models relate farm output to land quality, climate, fertilizer inputs, and so on.

[1]Without carbon fertilization (CF) effects.

Source: Cline W.R., "Global Warming and Agriculture", (2008) Finance & Development, 45(1), p.25.

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[1]Without carbon fertilization (CF) effects.

The World-wide Perspective

(percent change in agricultural output potential)

	Without CF[3]	With CF[4]
World		
Output-weighted	–16	–3
Population-weighted	–18	–6
Median by country	–24	–12
Industrial countries	–6	8
Developing countries[5]	–21	–9
Median	–26	–15
Africa	–28	–17
Asia	–19	–7
Middle East and North Africa	–21	–9
Latin America	–24	–13

Source: Cline (2007).

[1]Temperature is average daily in °C.

[2]Precipitation is measured in millimeters per day.

[3]Assumes no benefit to crop yields from increased carbon dioxide in atmosphere (carbon fertilization, CF).

[4]Assumes a positive impact on yields from carbon fertilization.

[5]Excludes Europe.

Source: Cline W.R., "Global Warming and Agriculture", (2008) Finance & Development, 45(1), p.25.

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Source: Cline (2007).

Note: Ricardian models statistically infer the contribution of temperature and precipitation to agricultural productivity by examining the relationship of land price to climate, whereas crop models relate farm output to land quality, climate, fertilizer inputs, and so on.

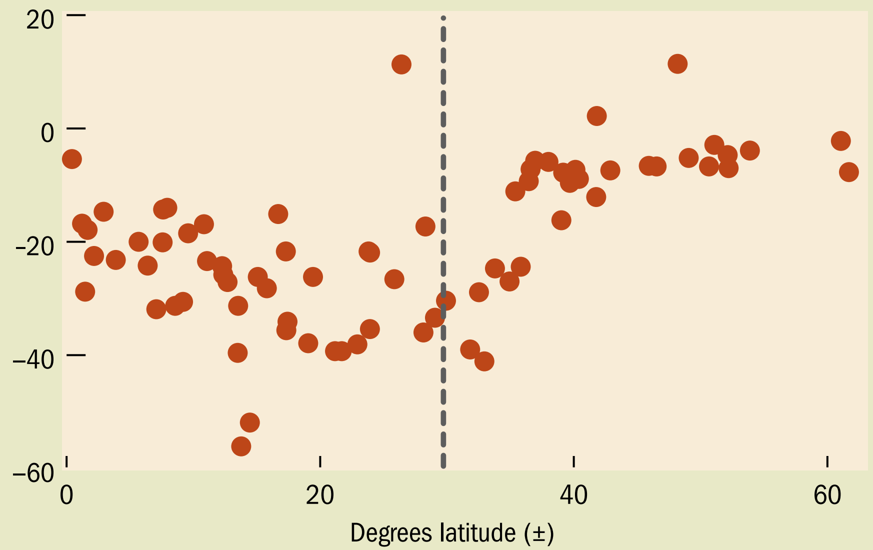
[1]Without carbon fertilization (CF) effects.

India: - 29% (22 º North)
China: + 7% (38 º North) (same as USA)

Paying the price for sun

The closer a country is to the equator, the more likely it is that its agriculture will suffer from global warming.

(change in agricultural output potential, percent)



Source: Cline (2007).
Note: Each dot represents a country.

Source: Cline W.R., "Global Warming and Agriculture", (2008) Finance & Development, 45(1), p.25.

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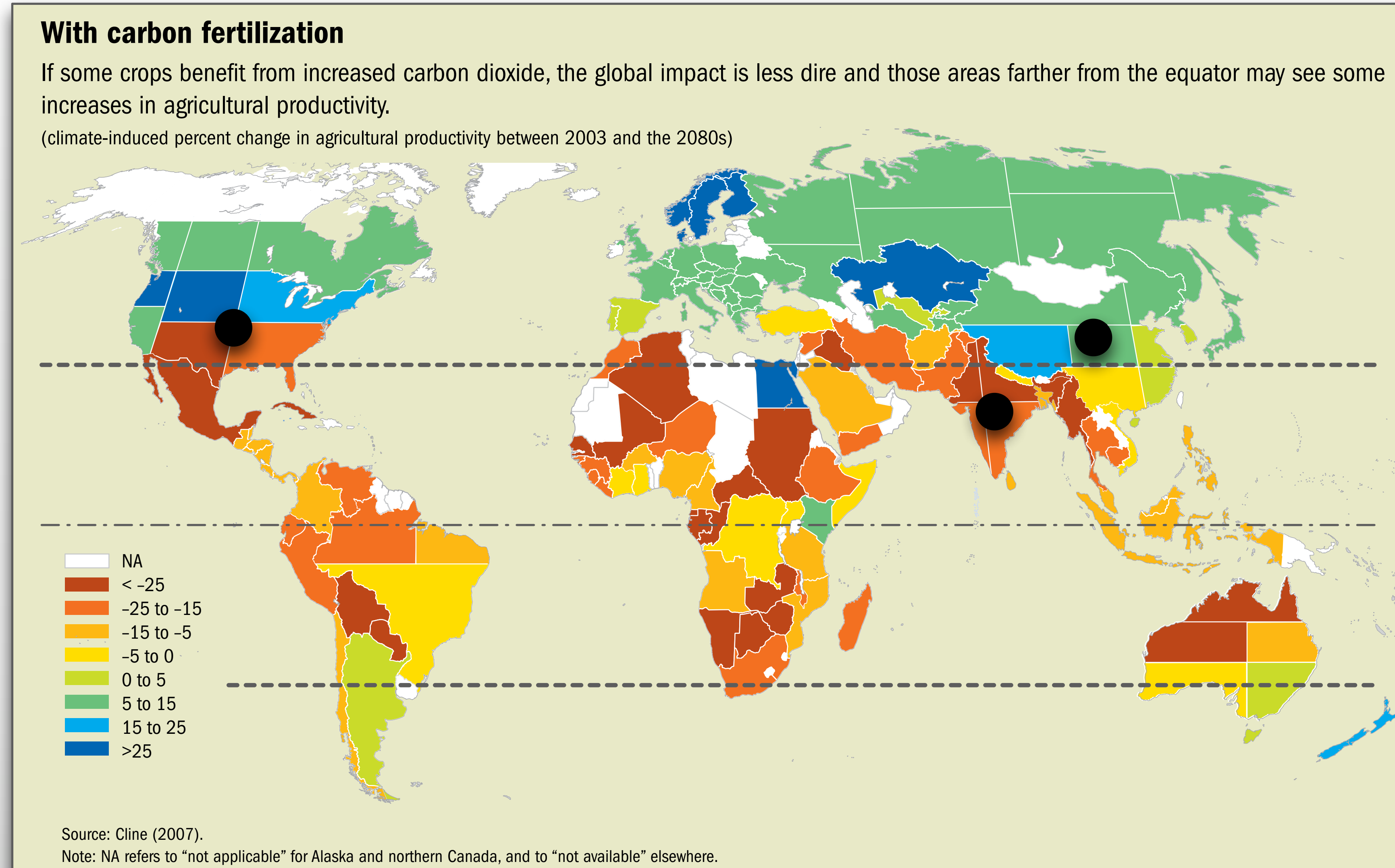
Why China is not the same as India in 2080s



Source: Cline W.R., "Global Warming and Agriculture", (2008) Finance & Development, 45(1), p.27

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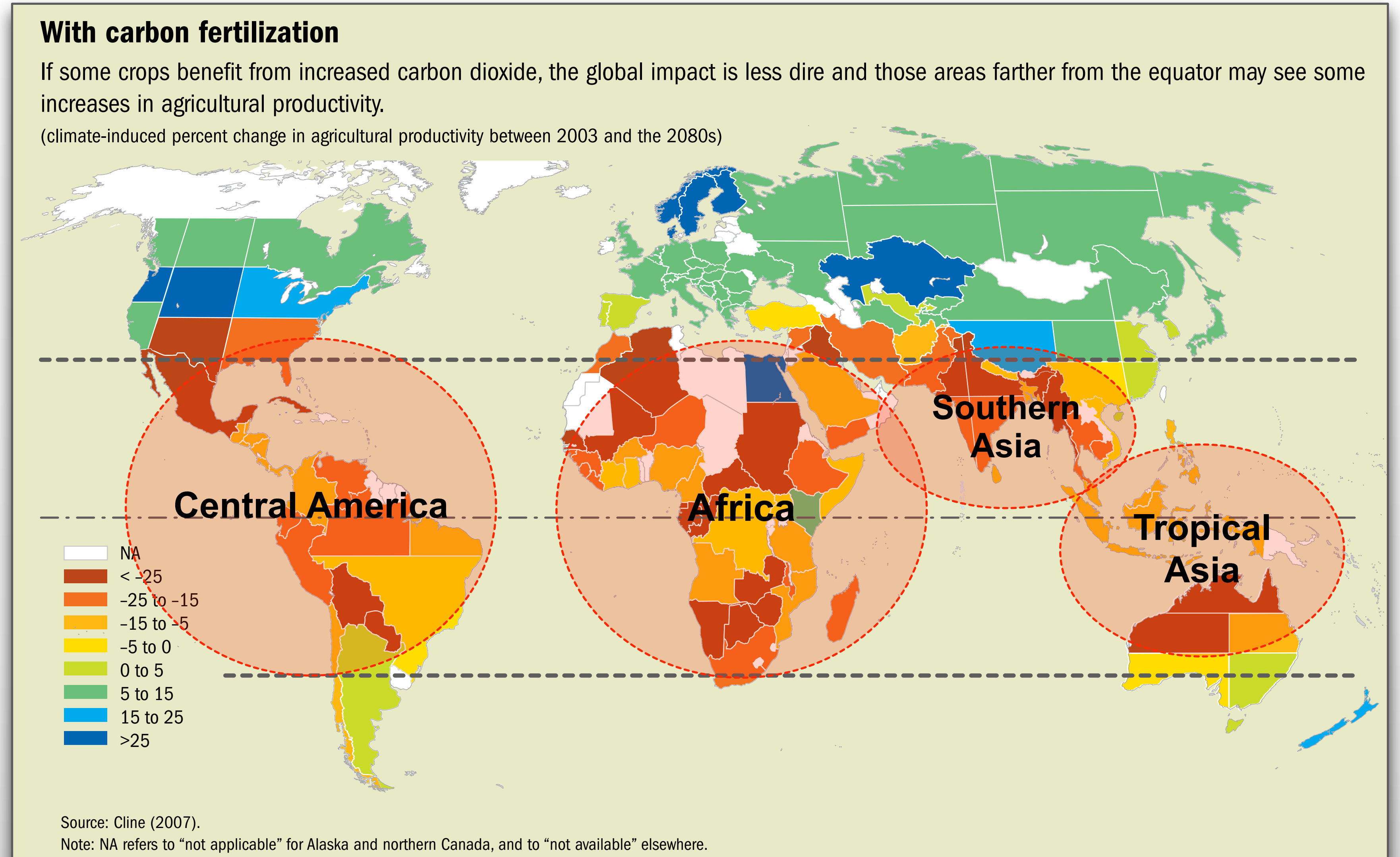
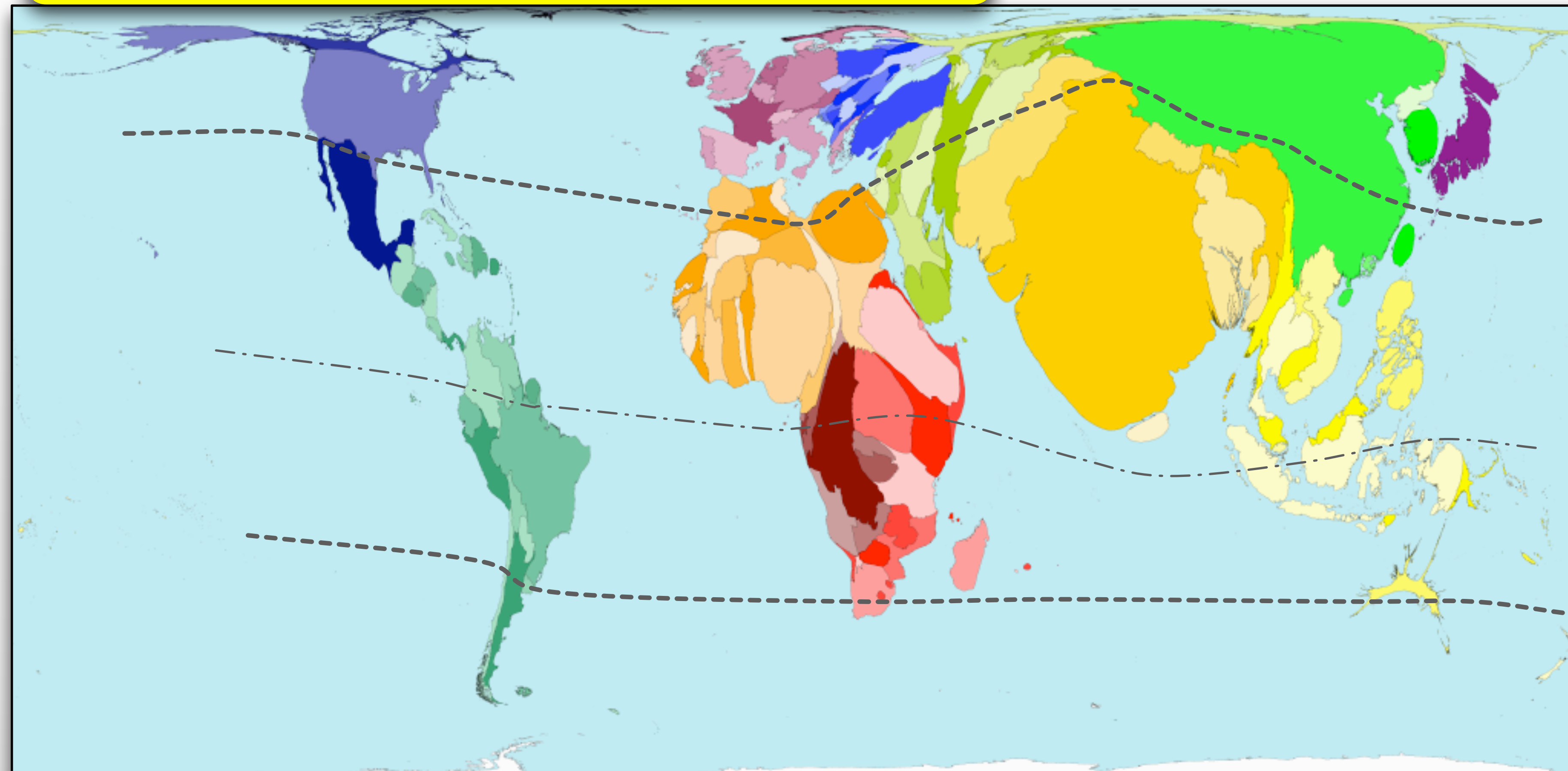
Curse of the Tropics in the 2080s



Source: Cline W.R., "Global Warming and Agriculture", (2008) Finance & Development, 45(1), p.27

World population in 2050: 9.07 billion

Fraction of the world population living in each country (2050, projected)



Source: The Worldmapper Project (http://www.worldmapper.org/)

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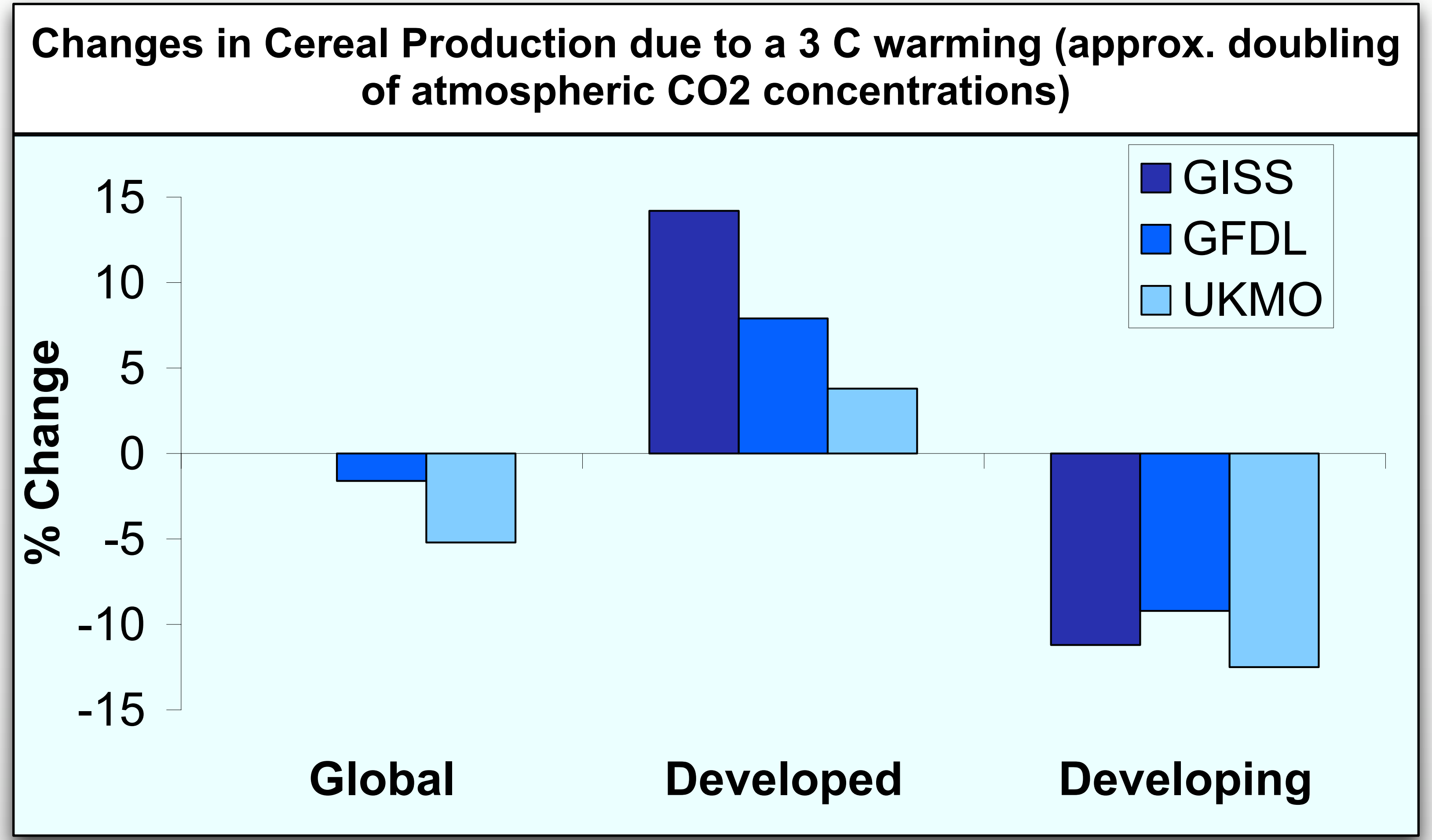
Summing it up



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Source: Stern Report, 2007 (p.71)

Figure 6.1. Cumulative CO_2 Emissions, 1850–2002

Country	% of World	(Rank)
United States	29.3	(1)
EU-25	26.5	(2)
Russia	8.1	(3)
China	7.6	(4)
Germany	7.3	(5)
United Kingdom	6.3	(6)
Japan	4.1	(7)
France	2.9	(8)
India	2.2	(9)
Ukraine	2.2	(10)
Canada	2.1	(11)
Poland	2.1	(12)
Italy	1.6	(13)
South Africa	1.2	(14)
Australia	1.1	(15)
Mexico	1.0	(16)
Spain	0.9	(20)
Brazil	0.8	(22)
South Korea	0.8	(23)
Iran	0.6	(24)
Indonesia	0.5	(27)
Saudi Arabia	0.5	(28)
Argentina	0.5	(29)
Turkey	0.4	(31)
Pakistan	0.2	(48)
Developed	**76**	
Developing	**24**	

Source: WRI, CAIT.

Figure 2.1. Top GHG Emitting Countries
CO_2, CH_4, N_2O, HFCs, PFCs, SF_6

Country	$MtCO_2$ equivalent	% of World GHGs
1. United States	6,928	20.6
2. China	4,938	14.7
3. EU-25	4,725	14.0
4. Russia	1,915	5.7
5. India	1,884	5.6
6. Japan	1,317	3.9
7. Germany	1,009	3.0
8. Brazil	851	2.5
9. Canada	680	2.0
10. United Kingdom	654	1.9
11. Italy	531	1.6
12. South Korea	521	1.5
13. France	513	1.5
14. Mexico	512	1.5
15. Indonesia	503	1.5
16. Australia	491	1.5
17. Ukraine	482	1.4
18. Iran	480	1.4
19. South Africa	417	1.2
20. Spain	381	1.1
21. Poland	381	1.1
22. Turkey	355	1.1
23. Saudi Arabia	341	1.0
24. Argentina	289	0.9
25. Pakistan	285	0.8
Top 25	**27,915**	**83**
Rest of World	**5,751**	**17**
Developed	**17,355**	**52**
Developing	**16,310**	**48**

Notes: Data is for 2000. Totals exclude emissions from international bunker fuels and land use change and forestry.

Source: Baumert et al. 'Navigating the Numbers Greenhouse Gas Data and International Climate Policy', World Climate Institute, (p.12,32)

Discussion

Running the numbers ...

Won't technology/farming-improvements save the day?   ... No!

Yield improvements

(year/year) approx. 1.5%

(peak in 1960s/70s of 2.7%, currently at about 1.6%)

Population growth: 1%

(based on approx. stabilisation around 9 billion)

Food Demand

Population growth + Income growth = 1.4%

(approx. = tripling of current demand by 2080s)

... ***Food balance:*** **Supply - Demand = 1.5 - 1.4 = + 0.1% (zero?)**

Climate Change likely to reduce productivity by a median of 12% !! (by 2080s)

Discussion

Some policy points ...

Climate Change will exacerbate the present food 'zero-margin' game

The effects will be worse for Developing Countries

What will prevent increases in hunger and starvation?

- Sharing of food production technologies
- Investment and training by the Industrialised world (us!) for the Developing World (especially the 30/30 group)
- Readiness to alleviate one-off mass starvation events
- (Free trade in agricultural products)
- Significant and timely action to reduce emissions of GHGs by industrialised (and newly industrialised) countries

Where does that leave us, today in 2009?

World Vision and VGen and me and you

Step 1: Read

Get *informed*, communicate the linkage between climate change and `classic' poverty alleviation/economic development issues

Step 2: Lead

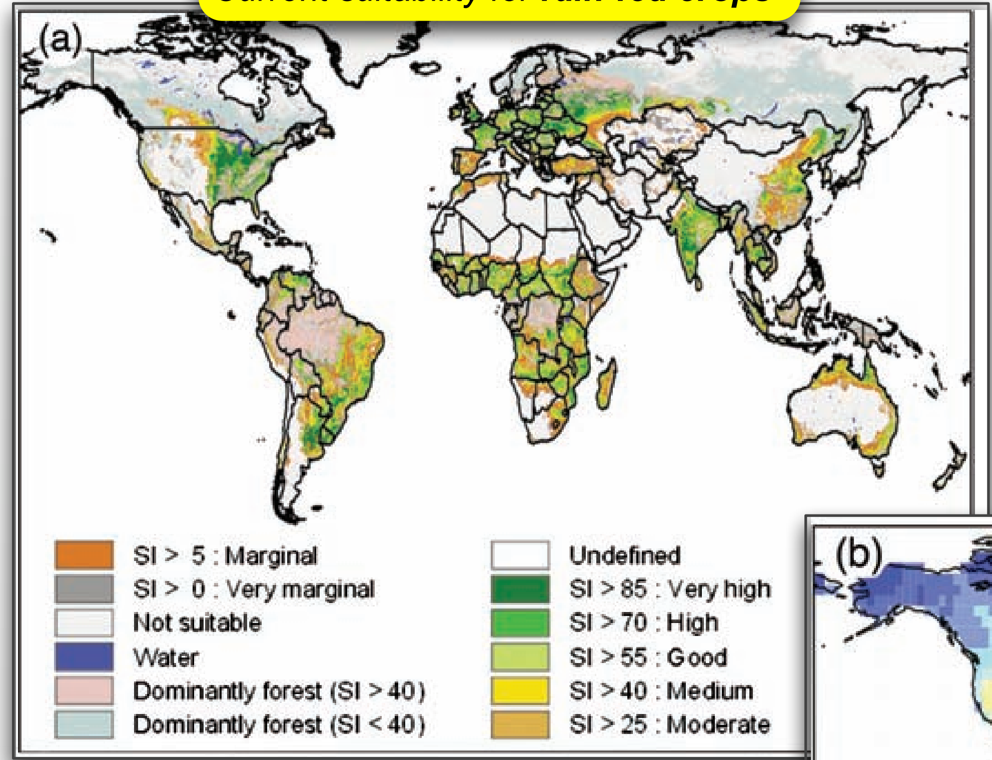
Be a leader in your own life -- take personal steps (public transport, CO_2 audits, energy (mis)use, `stuff' reduction, advocacy and organisation ... !)

Step 3: Achieve (bleed?)

Realise what a `gem' you have .. buff it up! (patience, deliberate action, getting organised)

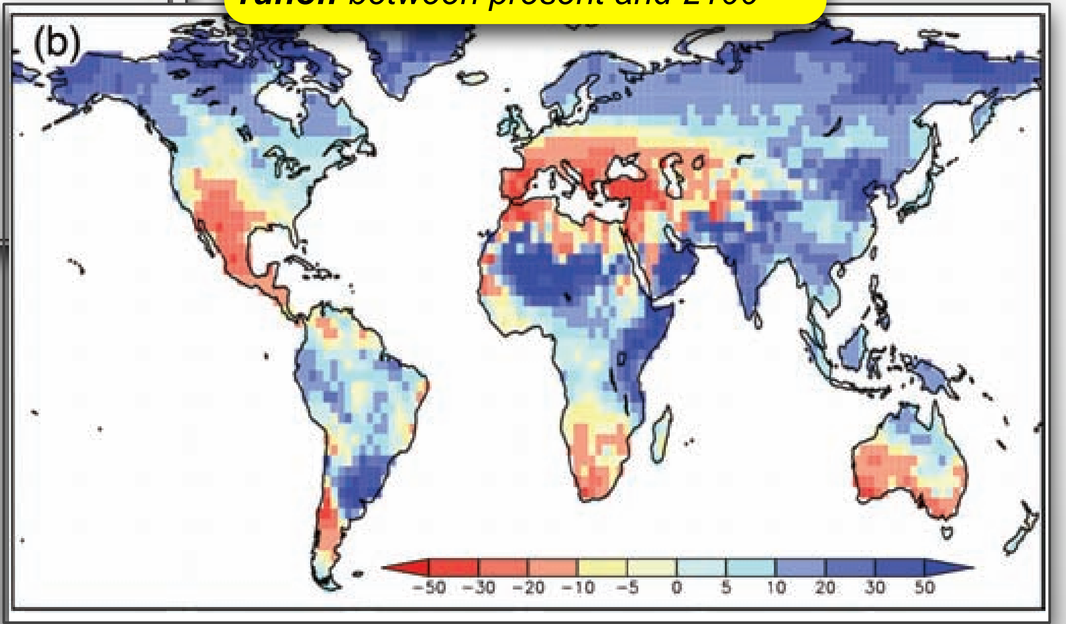
Present Crop Suitability & Future Runoff

*Current suitability for **rain-fed crops***



Runoff will be strongly affected in Southern Africa, Southern Europe and Mexico (also: flooding events in southern Asia)

*Mean % Change in **annual mean runoff** between present and 2100*



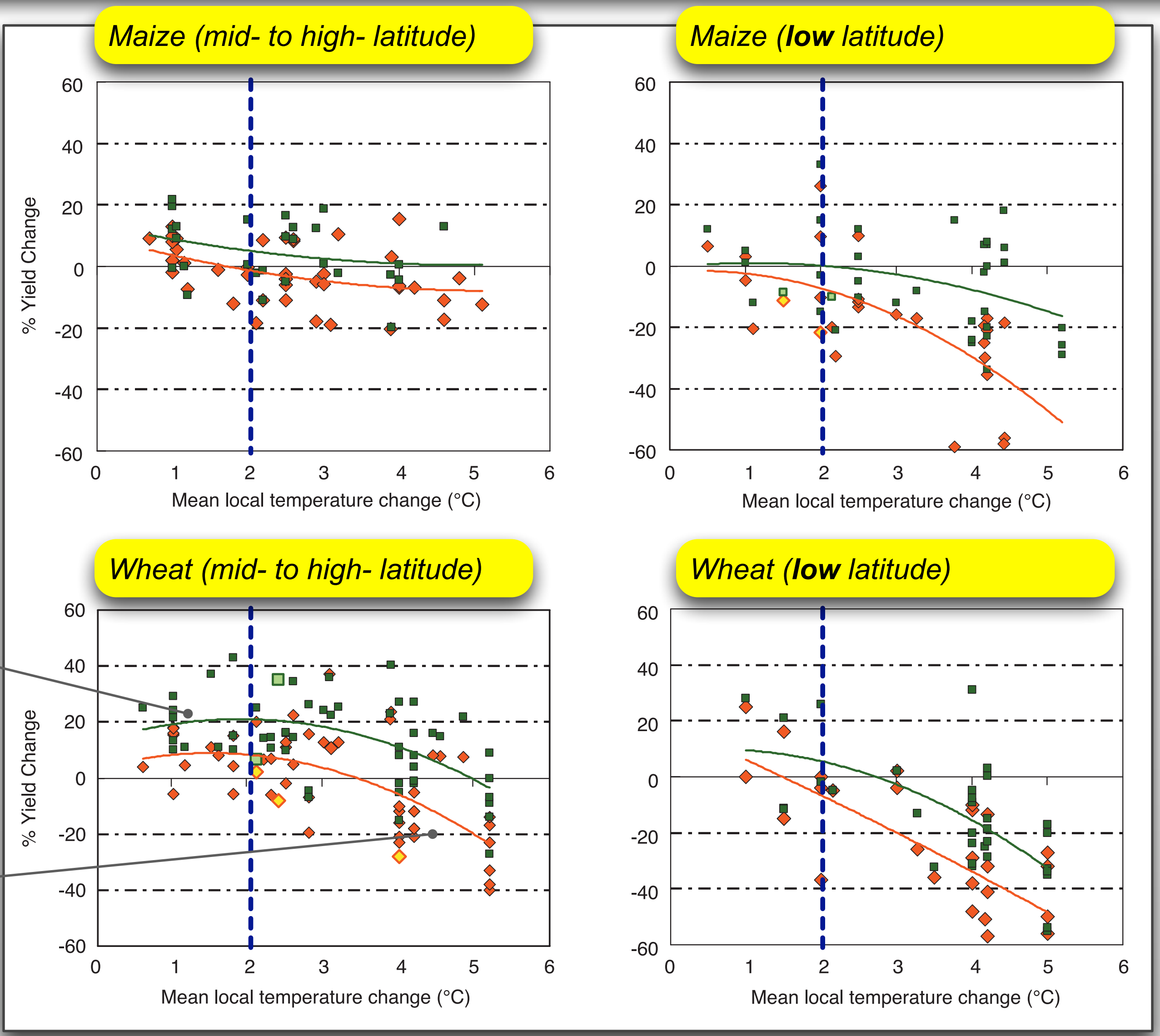
Source: IPCC AR4 (Impacts, Adaptation & Vulnerability), Ch 5, p.280 (2007)

Major Cereal Sensitivities to Temperature

Low latitudes *(close to the equator) are most at risk of drops in yield*

*Sensitivity **with** adaptations in farming practices (e.g. planting, cultivars, rain-fed to irrigated shifts)*

*Sensitivity **without** adaptations in farming practices*



Source: IPCC AR4 (Impacts, Adaptation & Vulnerability), Ch 5, p.286 (2007)

Food production 2050 Overview

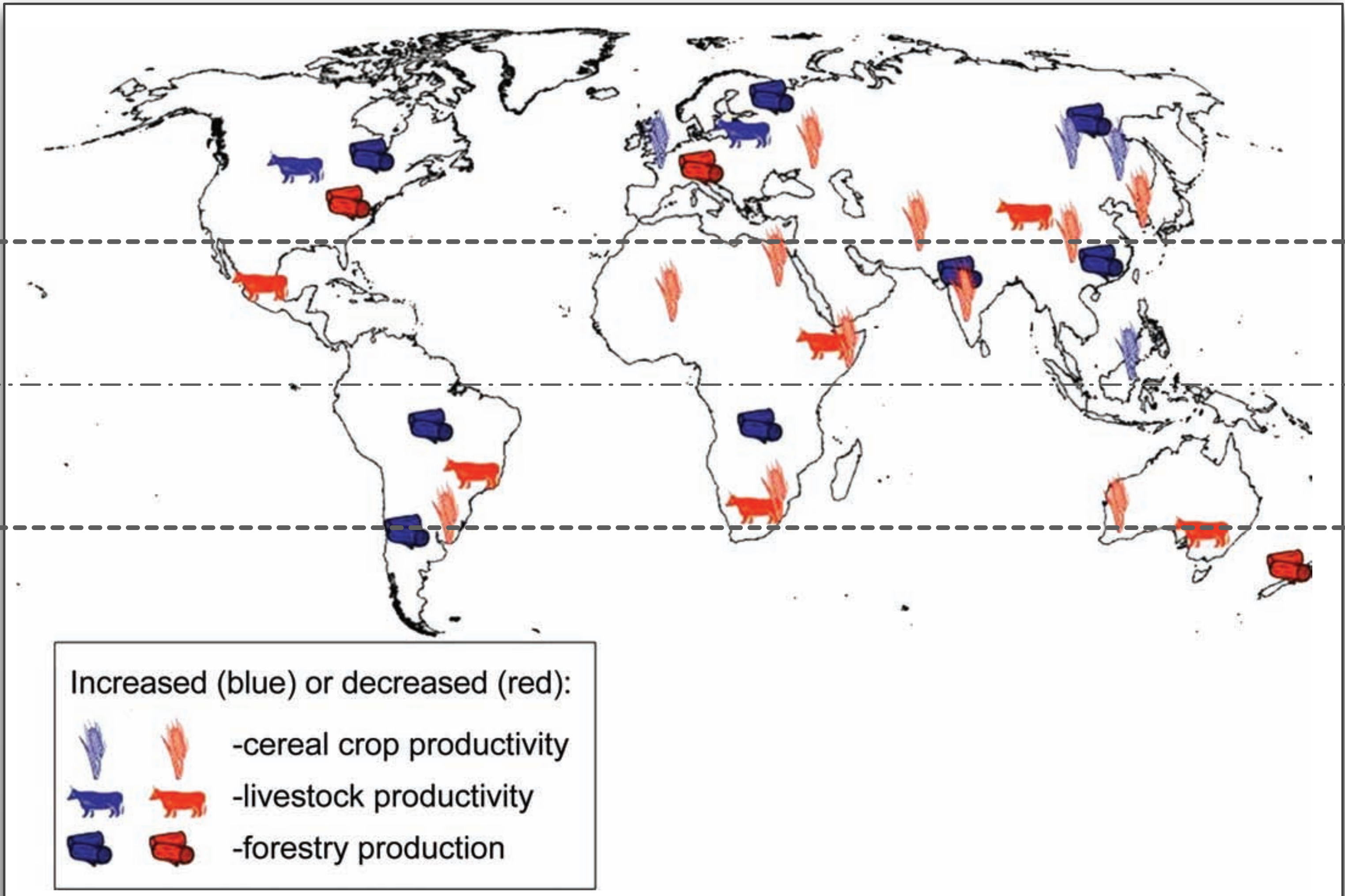


Figure 5.4. *Major impacts of climate change on crop and livestock yields, and forestry production by 2050 based on literature and expert judgement of Chapter 5 Lead Authors. Adaptation is not taken into account.*

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Source: IPCC AR4 (Impacts, Adaptation & Vulnerability), Ch 5, p.302 (2007)