# *Droughts and dust storms in a changing climate:*
## *Remarks based on the IPCC reports*

**Jean-Pascal van Ypersele**

**(Université catholique de Louvain, Belgium)**
**Former IPCC Vice-Chair (2008- oct. 2015)**

**Twitter: @JPvanYpersele**

**5th Regional Conference on Climate Change, Tehran, 25-01-2016**

**Thanks to the Belgian Federal Science Policy Office (BELSPO) and to my team at the Université catholique de Louvain for their support**

# Why the IPCC ?

## Established by WMO and UNEP in 1988

to provide **policy-makers** with an **objective source of information** about

- causes of climate change,
- potential environmental and socio-economic impacts,
- possible response options (adaptation & mitigation).

WMO=World Meteorological Organizatior

UNEP= United Nations Environment Programme




**What is happening in the climate system?**

**What are the risks?**

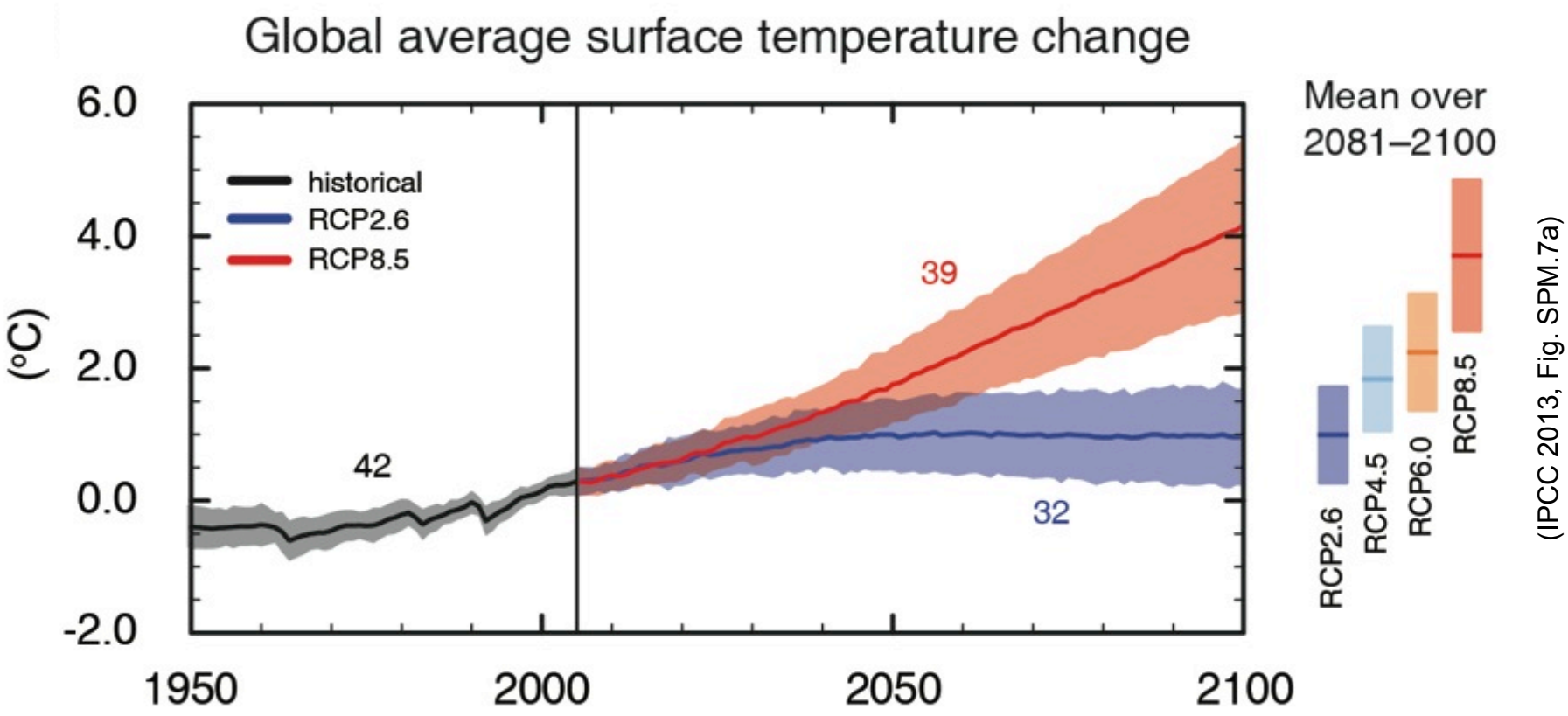
**What can be done?**

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

# The IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

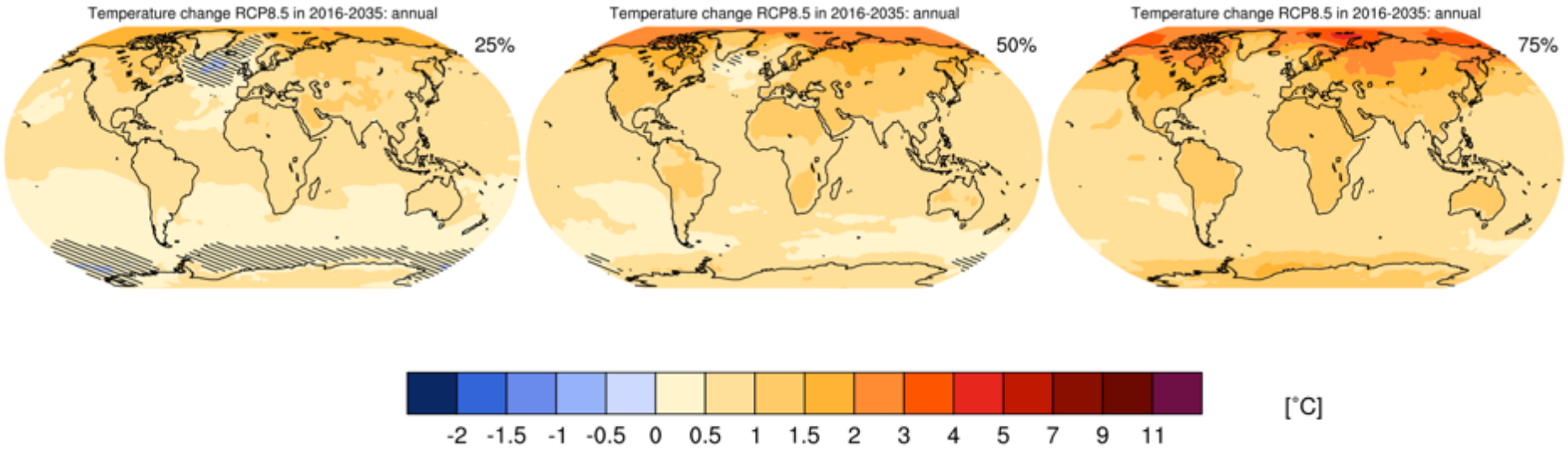
ipcc
INTERGOVERNMENTAL PANEL ON climate change




(IPCC 2013, Fig. SPM.7a)

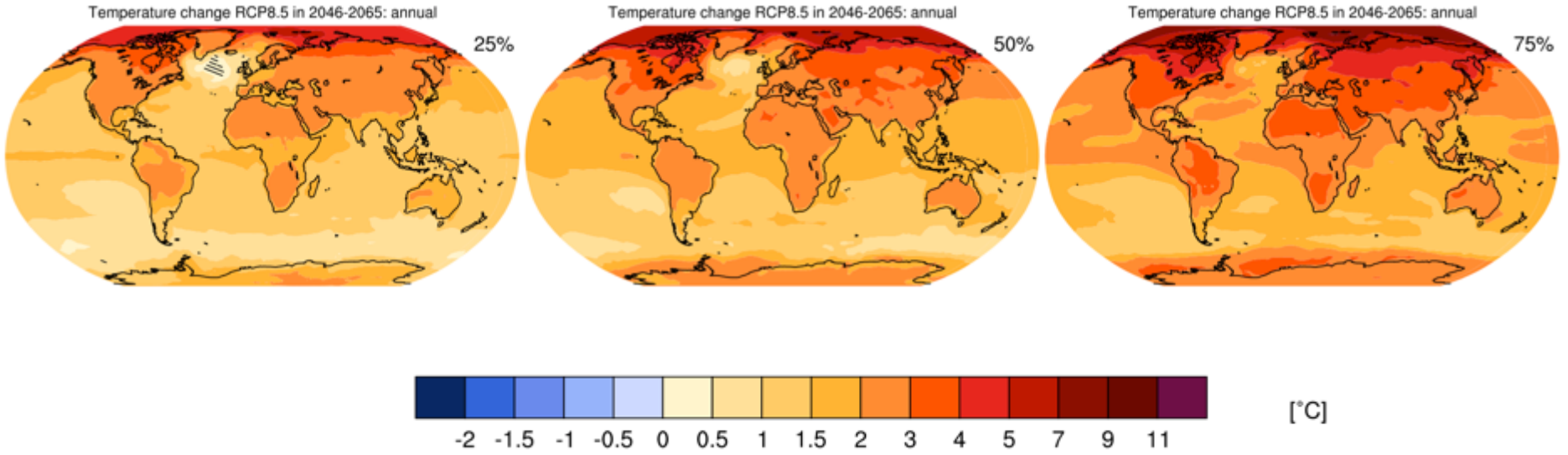
Only the lowest (RCP2.6) scenario maintains the global surface temperature increase above the pre-industrial level to less than 2°C with at least 66% probability

# Maps of temperature changes: 2016-2035 with respect to 1986–2005 in the RCP8.5 scenario



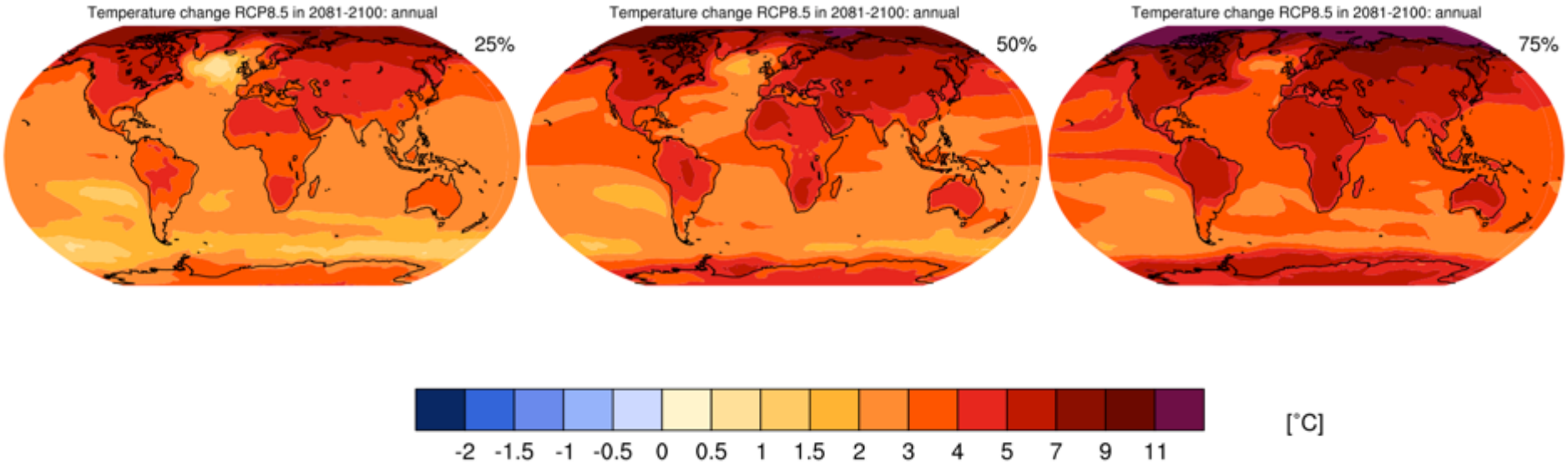

IPCC WG1 Fifth Assessment Report (Final Draft)

# Maps of temperature changes: 2046-2065 with respect to 1986–2005 in the RCP8.5 scenario




IPCC WG1 Fifth Assessment Report (Final Draft)

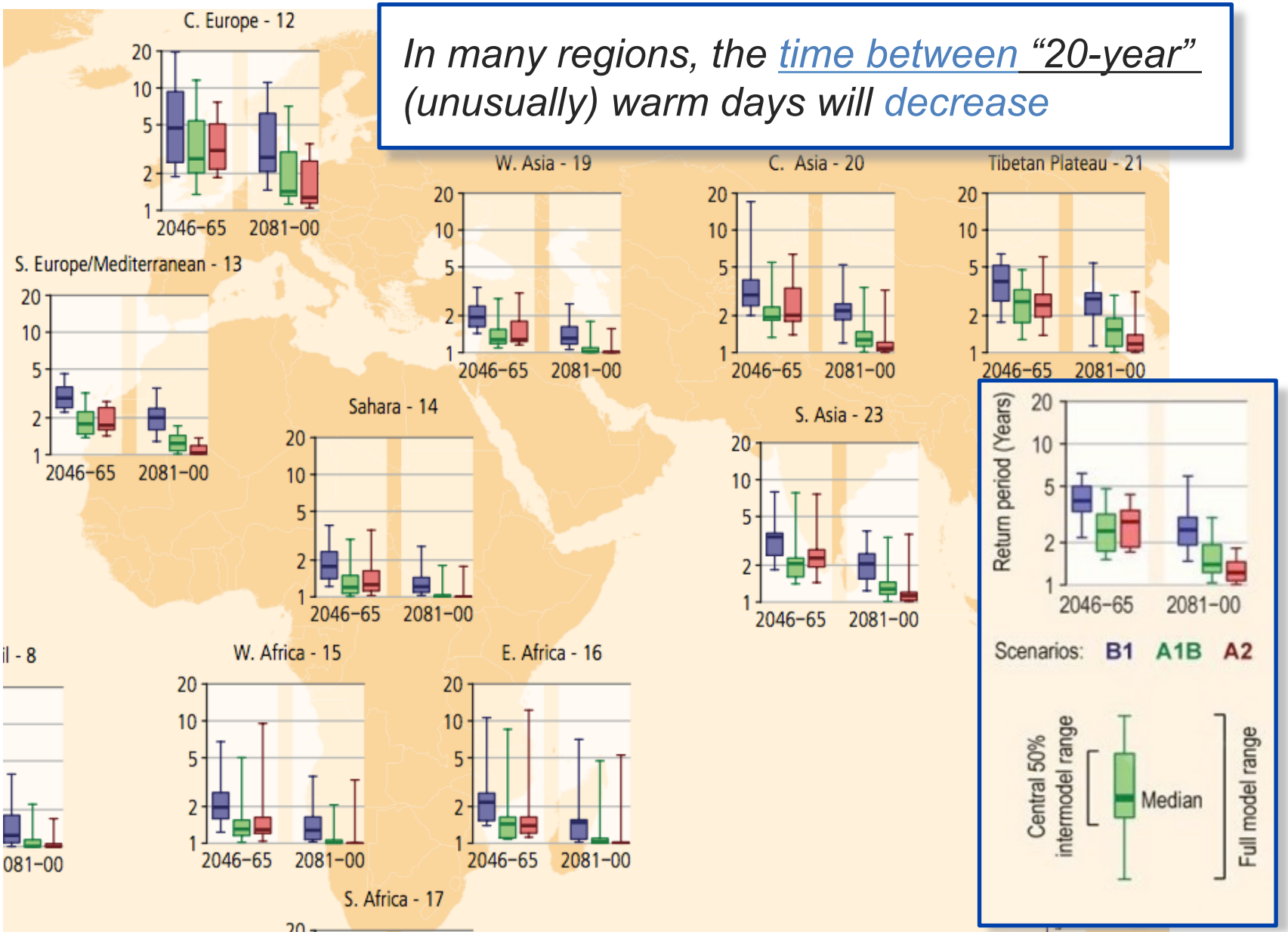
# Maps of temperature changes: 2081-2100 with respect to 1986–2005 in the RCP8.5 scenario



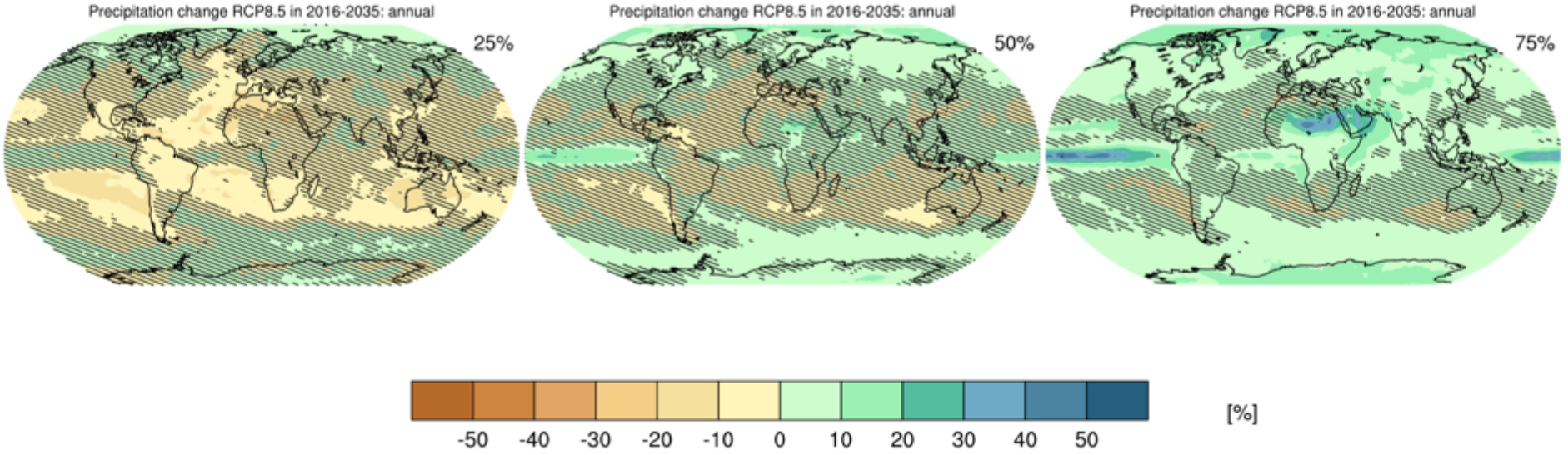

IPCC WG1 Fifth Assessment Report (Final Draft)

# Climate models project more frequent hot days throughout the 21st century

*In many regions, the time between "20-year" (unusually) warm days will decrease*

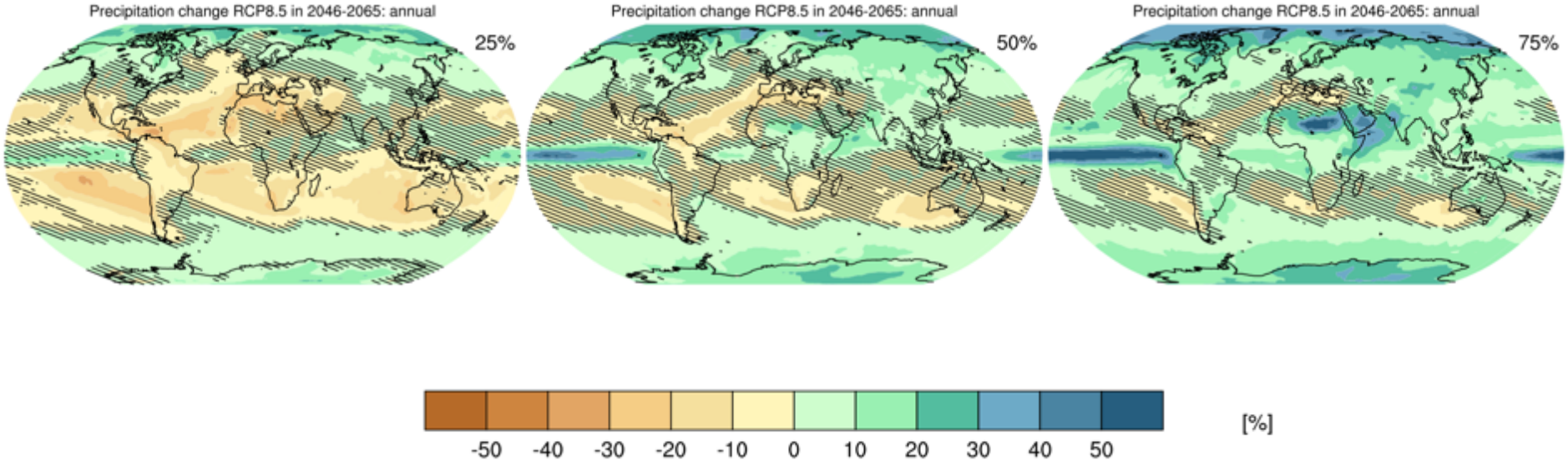


# Maps of precipitation changes in : 2016–2035 with respect to 1986–2005 in the RCP8.5 scenario



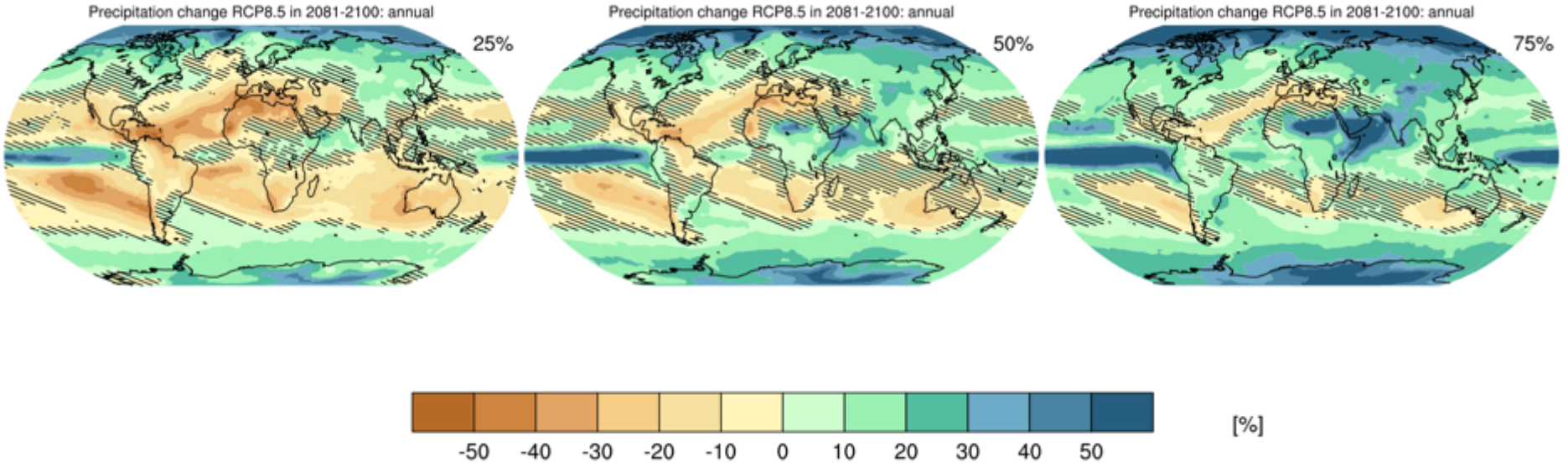

IPCC WG1 Fifth Assessment Report (Final Draft)

# Maps of precipitation changes in : 2046–2065 with respect to 1986–2005 in the RCP8.5 scenario




IPCC WG1 Fifth Assessment Report (Final Draft)

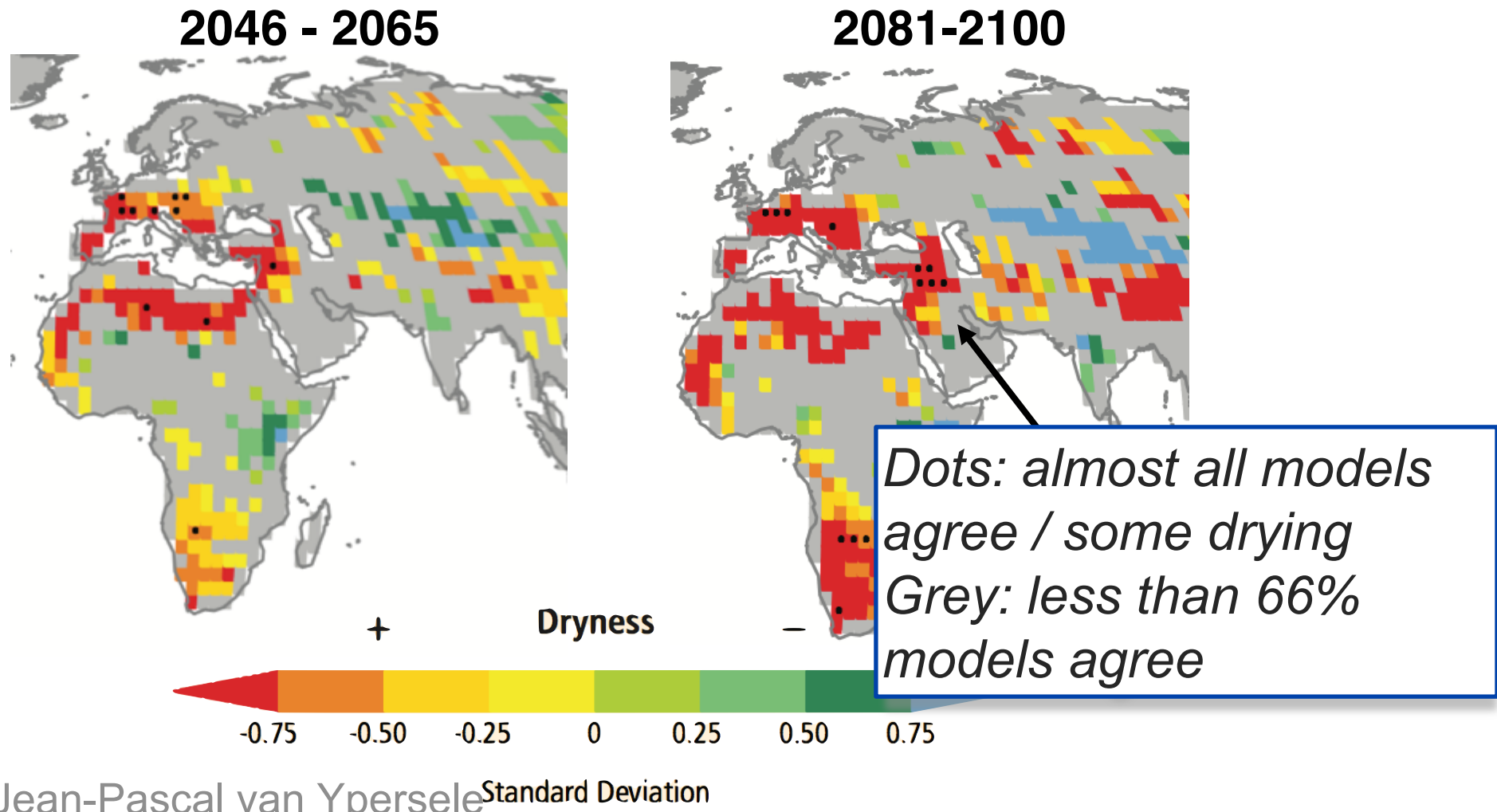
# Maps of precipitation changes in : 2081–2100 with respect to 1986–2005 in the RCP8.5 scenario




IPCC WG1 Fifth Assessment Report (Final Draft)

# Changes in soil moisture

## Changes from 1980-1999, scenario SRES A2




Source : IPCC SREX figure SPM.5; models: CMIP3

Jean-Pascal van Ypersele
(vanyp@climate.be)

# Impacts from weather and climate events depend on:

***nature and severity of event***

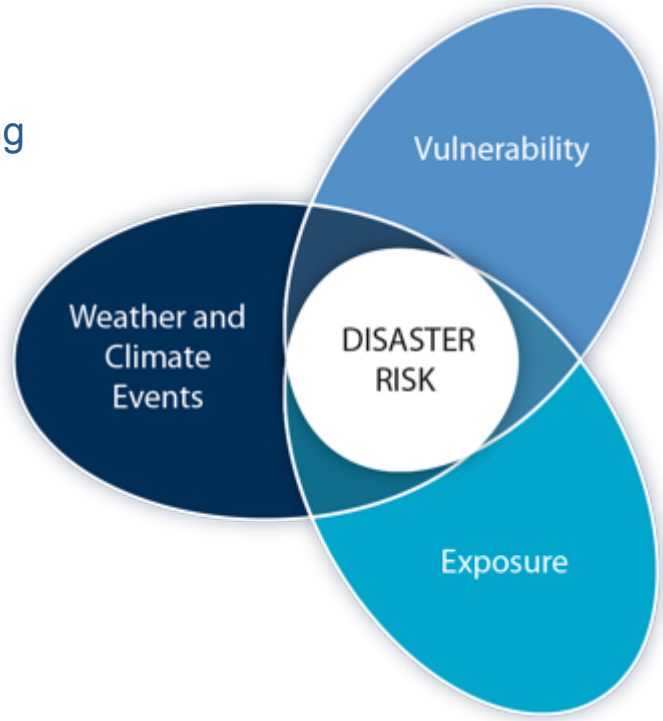
***vulnerability***

***exposure***

# Information on vulnerability, exposure, and changing climate extremes can together inform adaptation and disaster risk management

- poverty reduction
- better education and awareness
- sustainable development

- improved forecasting for warning systems
- reduction of greenhouse gas emissions



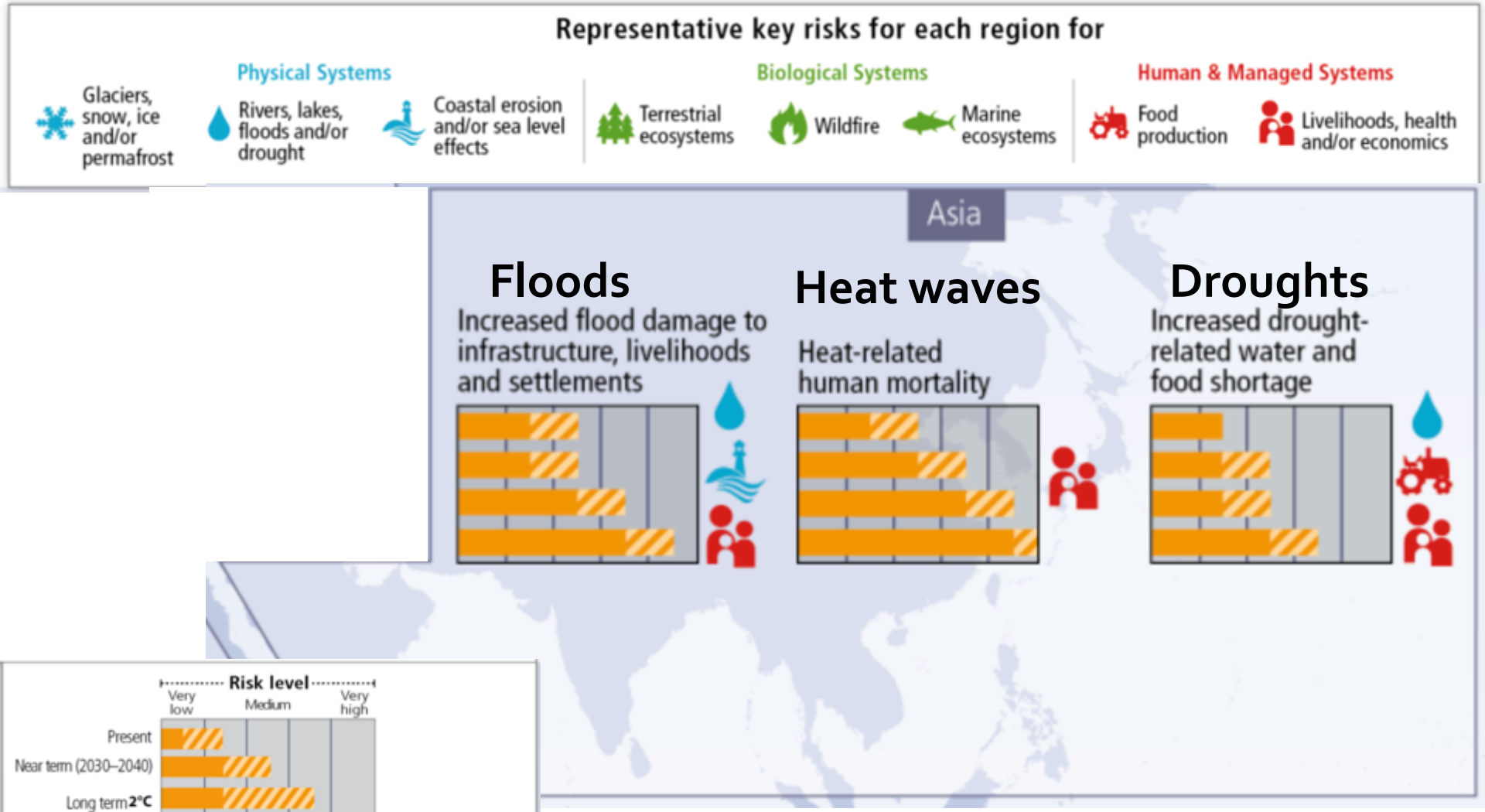

- asset relocation
- weather-proofing assets
- early warning systems

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

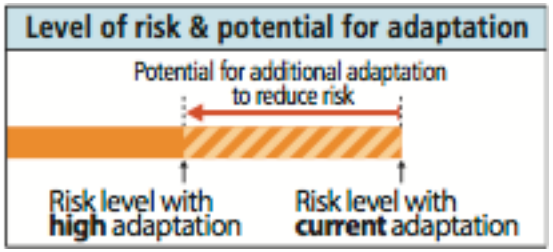

RISKS OF
CLIMATE CHANGE
INCREASE
WITH CONTINUED
HIGH EMISSIONS
ipcc
INTERGOVERNMENTAL PANEL ON climate change

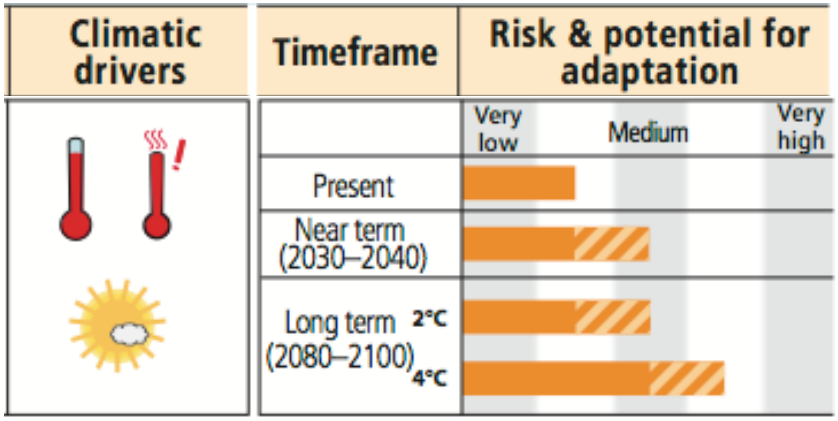
# Regional key risks and potential for risk reduction: Asia (IPCC, AR5, SPM, Figure SPM.8)

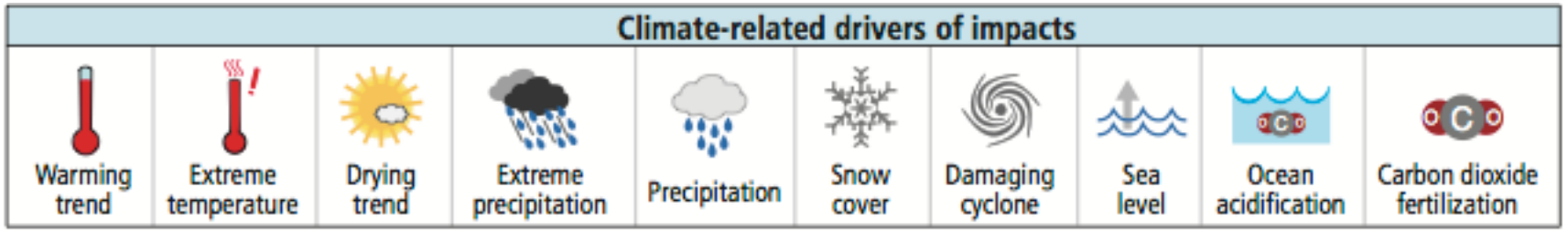


# Key Risk for Asia

## Increased risk of drought-related water and food shortage causing malnutrition (high *confidence)*




IPCC, AR5, WG II, SPM, p. 22

# Adaptation issues and prospects

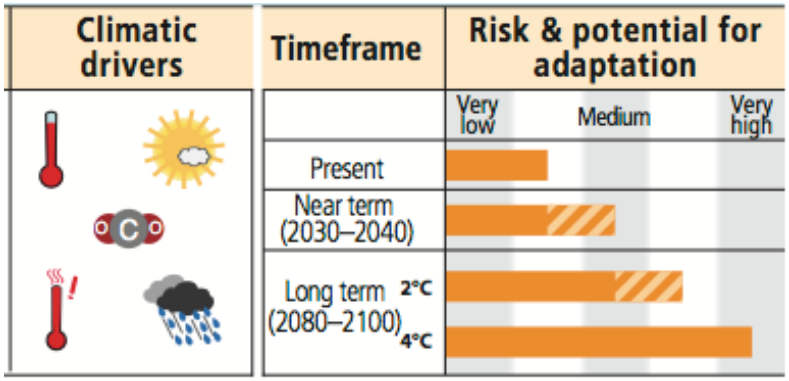
1. Disaster preparedness including early-warning systems and local coping strategies
2. Adaptive/integrated water resource management
3. Water infrastructure and reservoir development
4. Diversification of water sources including water re-use
5. More efficient use of water (e.g., improved agricultural practices, irrigation management, and resilient agriculture)

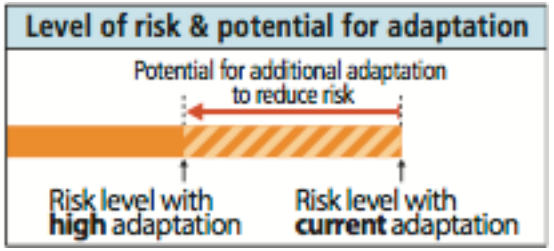
ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

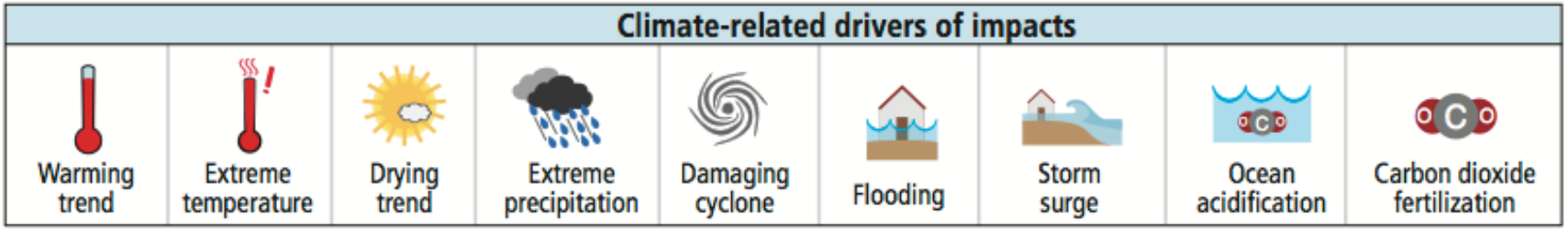
IPCC, AR5, WG II, SPM, p. 22

# Key risk

## Negative impacts on average crop yields and increases in yield variability due to climate change (high *confidence)*



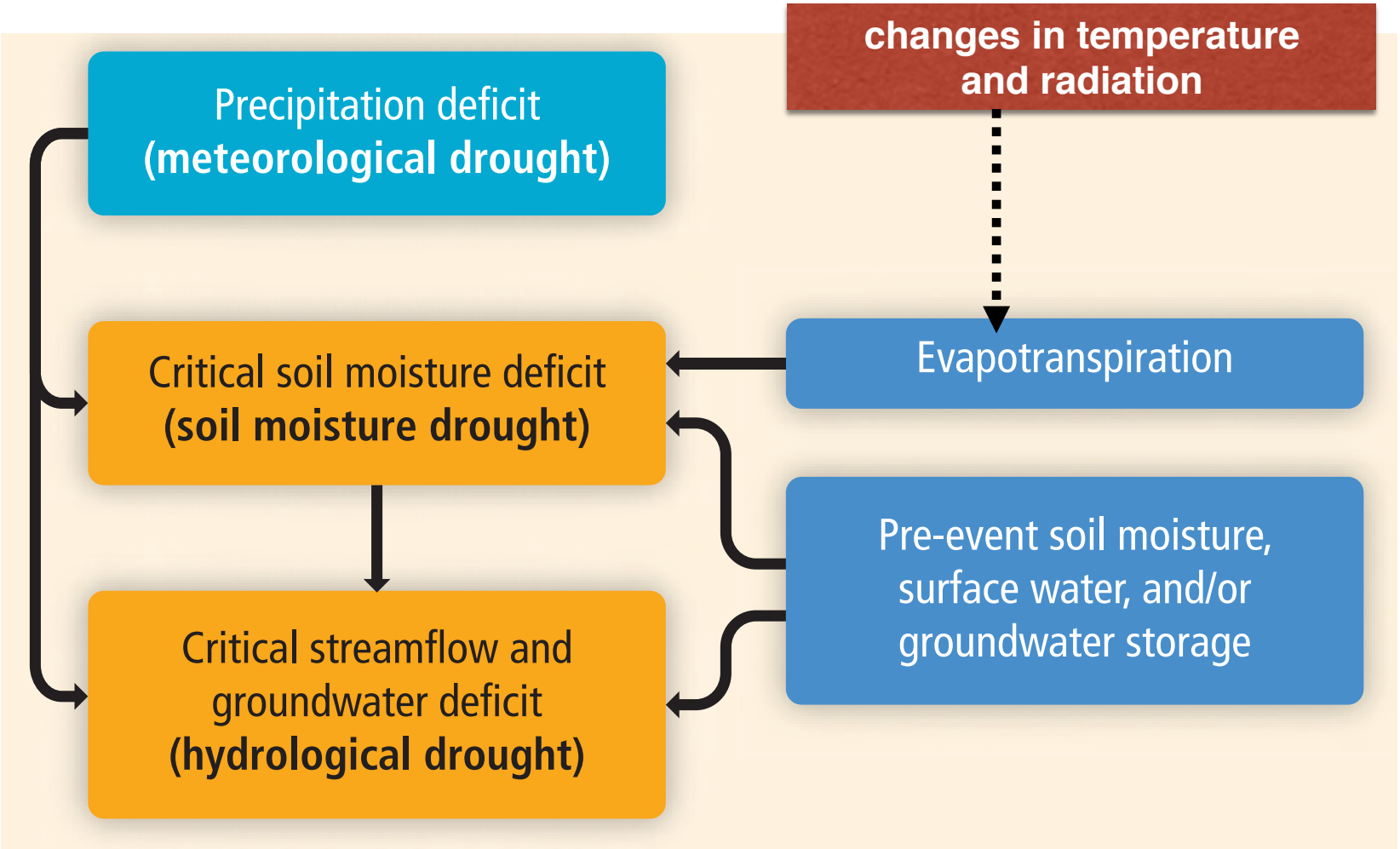

IPCC, AR5, WG II, TS, p. 64

# Adaptation issues and prospects

**Projected impacts vary across crops and regions and adaptation scenarios, with about 10% of projections for the period 2030–2049 showing yield gains of more than 10%, and about 10% of projections showing yield losses of more than 25%, compared to the late 20$^{th}$ century. After 2050 the risk of more severe yield impacts increases and depends on the level of warming**

IPCC, AR5, WG II, TS, p. 64

# Drought definitions and drivers




Jean-Pascal van Ypersele
(vanyp@climate.be)

Source : SREX Box 3.3 - drought definition and drivers

# Drought (AR5 WGI)

- Increases in intensity and/or duration of drought :
  - reduced precipitation and/or increased evapotranspiration
  - **since 1950**: drought *likely* increased in the Mediterranean and West Africa regions; low confidence in attribution to human activities
  - **late 21st century**:
    Decreased soil moisture and increased agricultural drought likely in presently dry regions (high confidence in likely surface drying in region such as the Mediterranean under RCP 8.5)

Jean-Pascal van Ypersele
(vanyp@climate.be)

Source: AR5 WGI table SPM.1

# Impacts of droughts (SREX)

- Effects of droughts include
  - reduced water security,
  - reduced food security through reduction of agricultural production
  - a contribution to human-ignited forest fires (which can lead to widespread deforestation and carbon emissions) (SREX 4.3.6)

Jean-Pascal van Ypersele
(vanyp@climate.be)

# Impacts of droughts (SREX)

- One of the main consequences of multi-year drought periods is **severe famine**, such in the Sahel in the 1980s, causing many casualties and important socioeconomic losses.
- In Syria, more than 1 million people were affected by 2011, accelerating **migration to urban areas** and increasing levels of **extreme poverty** (case study in SREX, section 9.2.3)

Jean-Pascal van Ypersele
(vanyp@climate.be)

# Examples of adaptation to drought (SREX)

- **multi-hazard risk assessment** (e.g. case study in Syria)
  **seasonal forecasting** (e.g. case study in South Africa)
- **Insurance schemes**
- drought preparedness and mitigation
  such as development and use of **drought-tolerant cultivars, shifting cropping seasons, upgrading irrigation practices**
  flood and drought control techniques in water management (SREX box 7-3)
- Building resilience through knowledge, advocacy, research, and training by **making information on drought risk accessible** (case study Syria)

Jean-Pascal van Ypersele
(vanyp@climate.be)

# WGI - Dust aerosols

- Anthropogenic sources of mineral aerosols:
  land use change, water use change, climate change
- Dust emissions to the atmosphere are poorly quantified (range x5); it depends on
  - surface wind speed
  - soil-related factors such as its texture, moisture and vegetation cover
- Estimates of the related impact on climate trough radiative forcing are highly uncertain
- Future change of dust loading:
  projections include either increasing or decreasing dust emissions because the atmosphere and vegetation may respond in different ways (e.g. $CO_2$ increase can reduce water loss in plants, resulting in reduced desert extent and dust emission is some studies)

Jean-Pascal van Ypersele
(vanyp@climate.be)

Sources : IPCC AR5 WGI Ch 7 and 14

# Sand and Dust Storms (SREX 3.5.8.)

- In summary, there is **low confidence in projecting future dust storm changes**, although **an increase could be expected where aridity increases**. There is a **lack of data and studies on past changes**. There is also a lack of understanding of processes such as the relative importance of different climate variables affecting dust storms, as well as a high uncertainty in simulating important climate variables such as soil moisture, precipitation, and wind that affect dust storms.

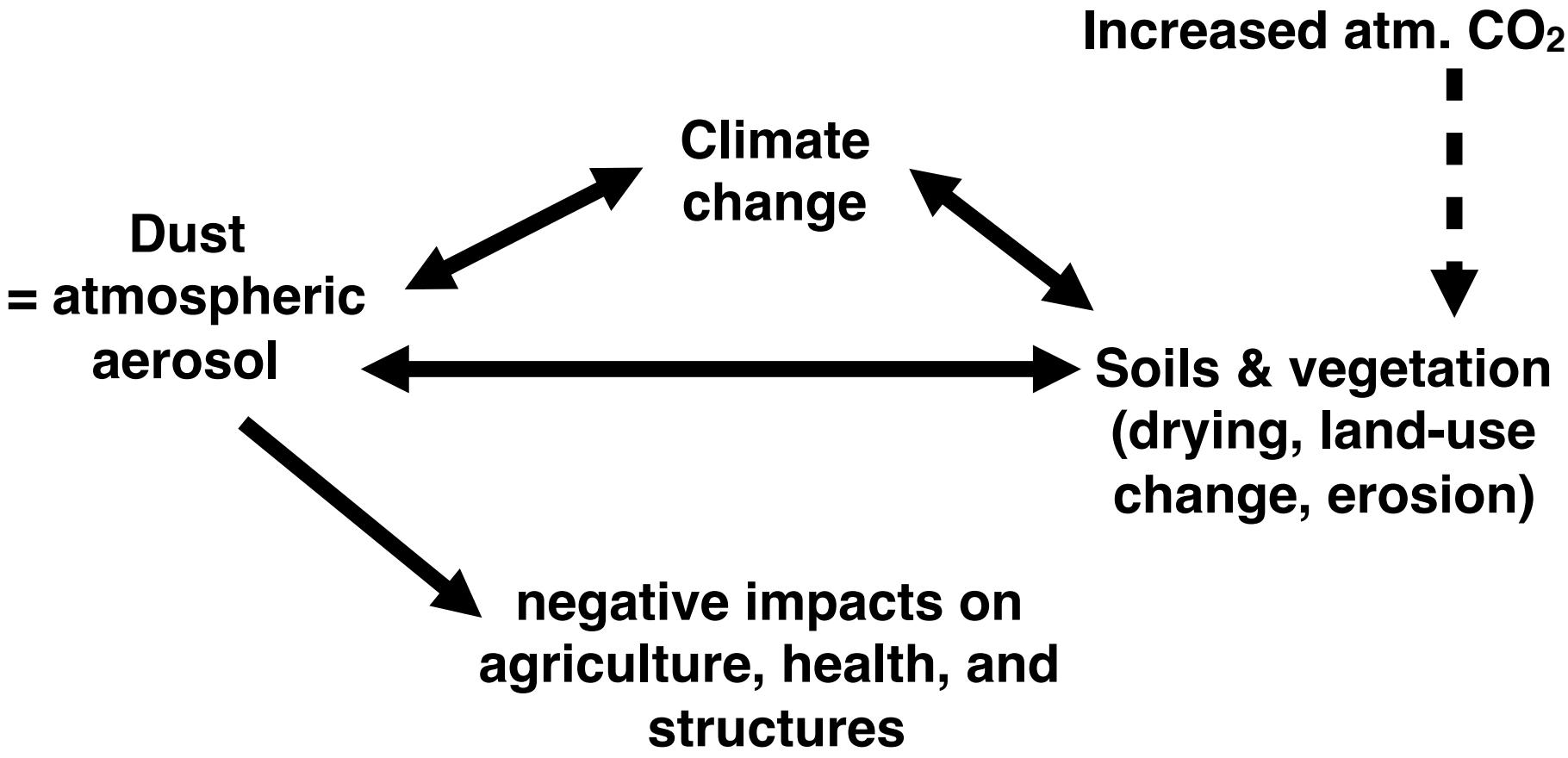
Jean-Pascal van Ypersele
(vanyp@climate.be)

# Impacts of dust Storms (SREX 4.4.2.4)

- Dust storms have negative **impacts on agriculture, health, and structures**.
  - They erode fertile soil; uproot young plants; bury water canals, homes, and properties
  - They cause respiratory problems (worsen asthmatic conditions), as well as skin and eye irritations;
    meningitis transmission is associated with dust in semi-arid conditions and overcrowded living conditions

Jean-Pascal van Ypersele
(vanyp@climate.be)

# Links between dust storms, climate, and impacts




Jean-Pascal van Ypersele
(vanyp@climate.be)

Based on IPCC AR5 and SREX (figure not from IPCC)

# Useful links:

- www.ipcc.ch : IPCC (reports and videos)
- www.climate.be/vanyp : my slides and other documents
- www.skepticalscience.com: excellent responses to contrarians arguments
- **On Twitter: @JPvanYpersele and @IPCC_CH**