# Climate Change and Food Security

# Climate change…

- What will be the impacts of climate change on food security?
- What are the spatial impacts of food insecurity resulting from climate change?
- Responses to climate-related food insecurity?

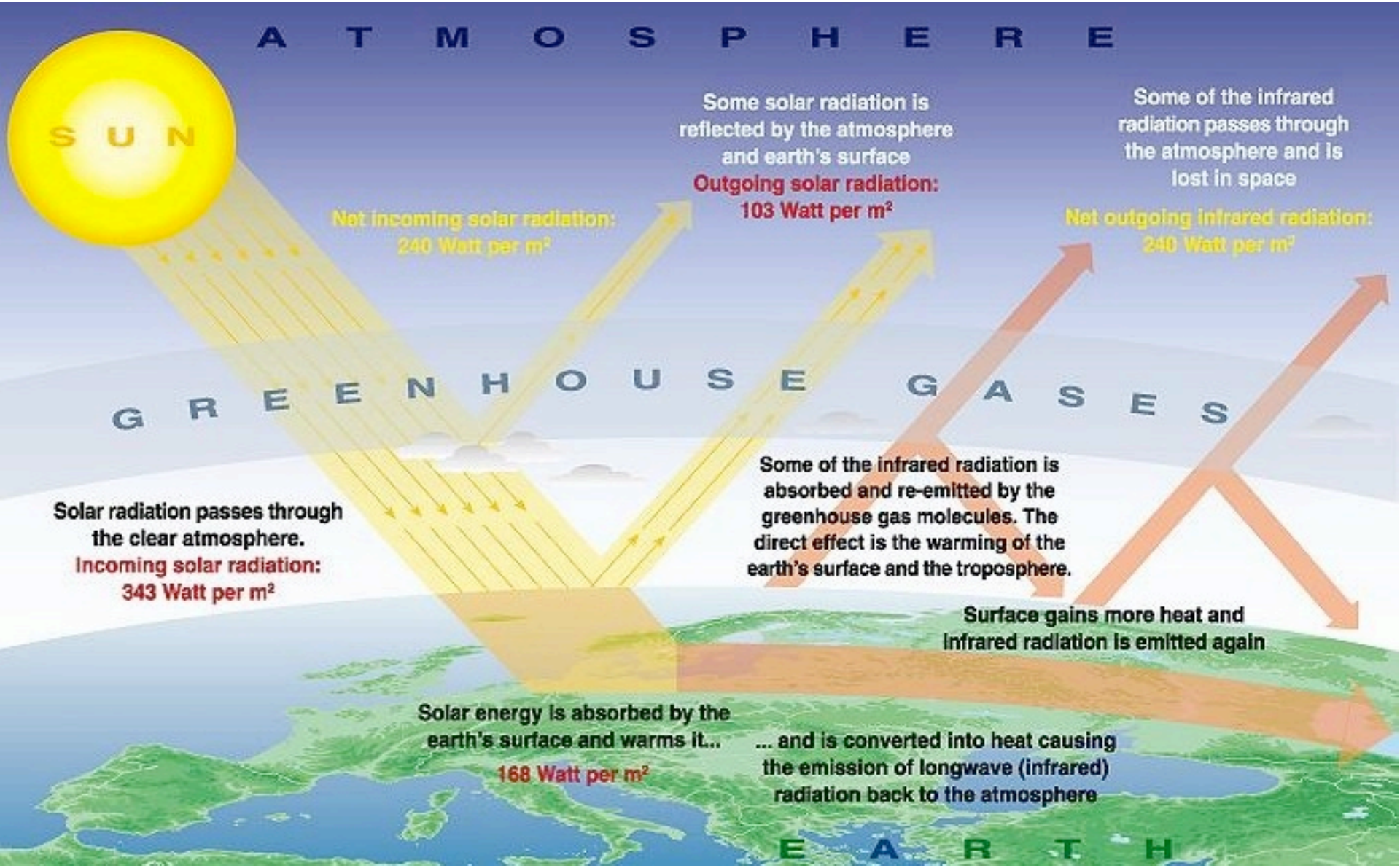
# Outline

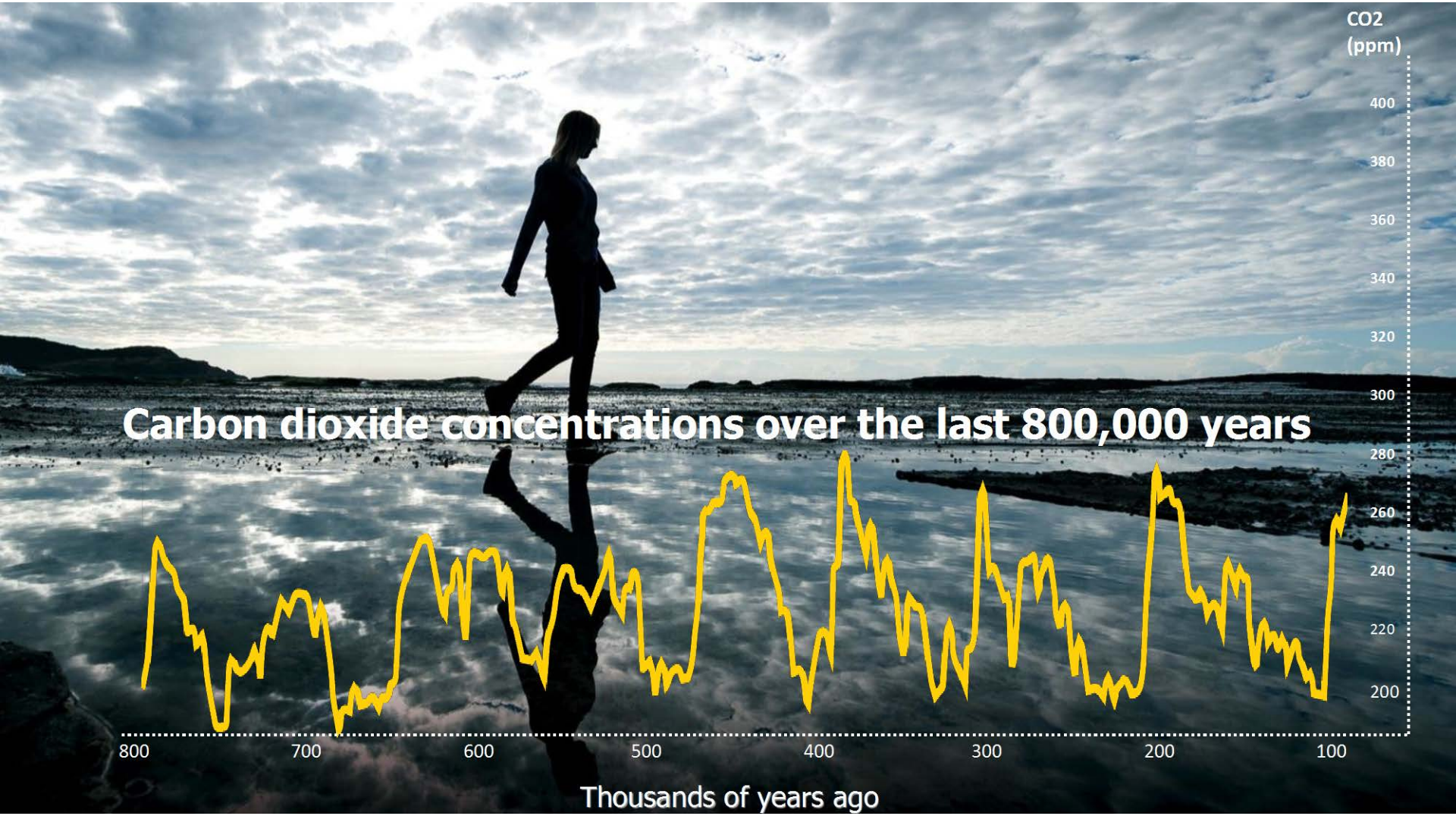
- Global Climate Change
  - Observations, Predictions, Impacts
- Climate Change and Food Security
  - Food production, Access to Food, Food Utilisation
- Climate and Food – global issues and systems approach
- Solutions
- Conclusions

# Global Climate Change

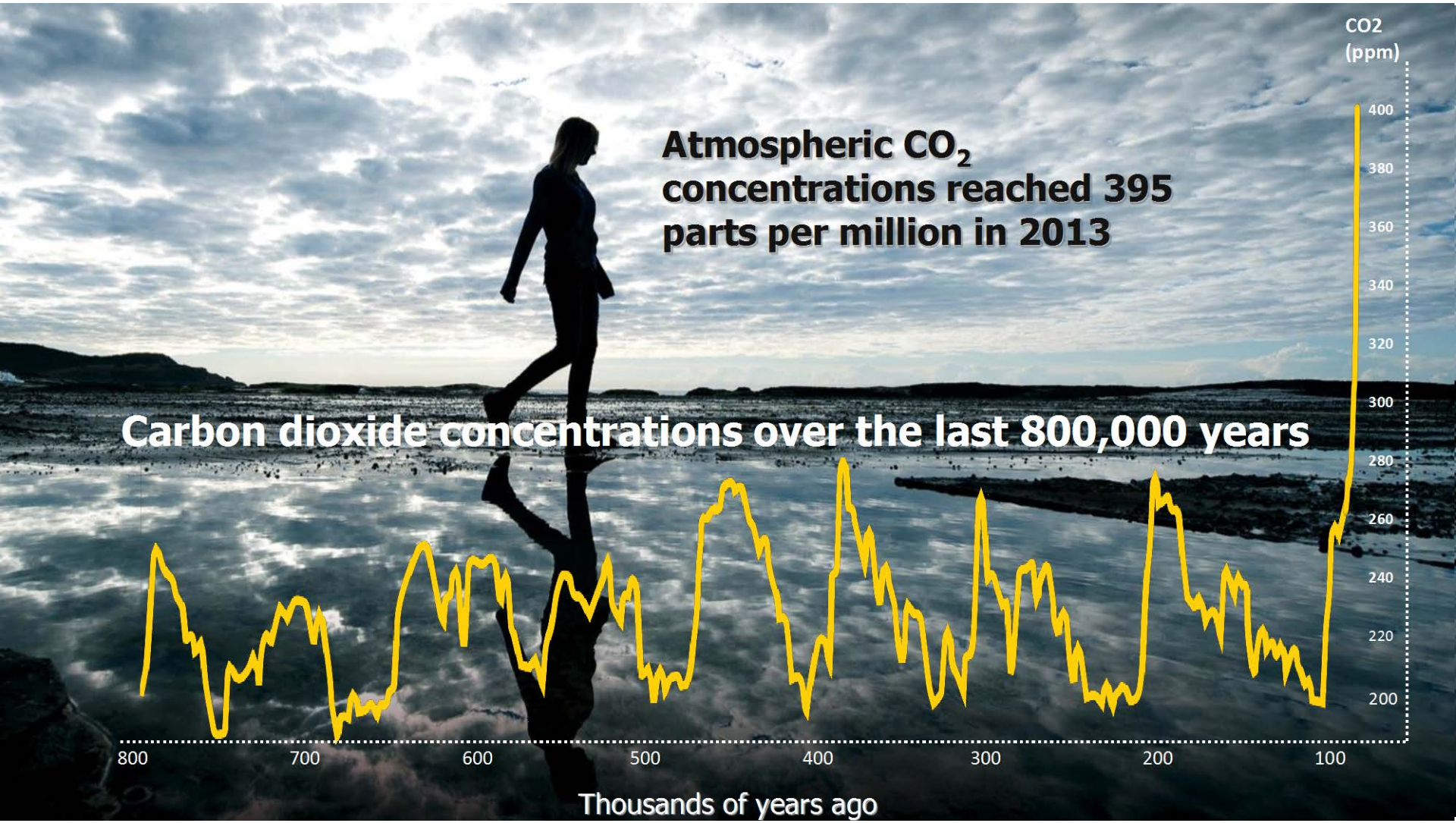
# IPCC AR5

The increase of CO2, CH4 and N2O is caused by anthropogenic emissions from the use of fossil fuel as a source of energy and from land use and land use change, in particular agriculture.


ATMOSPHERE
SUN
Some solar radiation is reflected by the atmosphere and earth's surface
Outgoing solar radiation:
103 Watt per m²
Some of the infrared radiation passes through the atmosphere and is lost in space
Net outgoing infrared radiation:
240 Watt per m²
Net incoming solar radiation:
240 Watt per m²
GREENHOUSE GASES
Some of the infrared radiation is absorbed and re-emitted by the greenhouse gas molecules. The direct effect is the warming of the earth's surface and the troposphere.
Solar radiation passes through the clear atmosphere.
Incoming solar radiation:
343 Watt per m²
Surface gains more heat and infrared radiation is emitted again
Solar energy is absorbed by the earth's surface and warms it...
168 Watt per m²
... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere
EARTH




Source: BOM 2014

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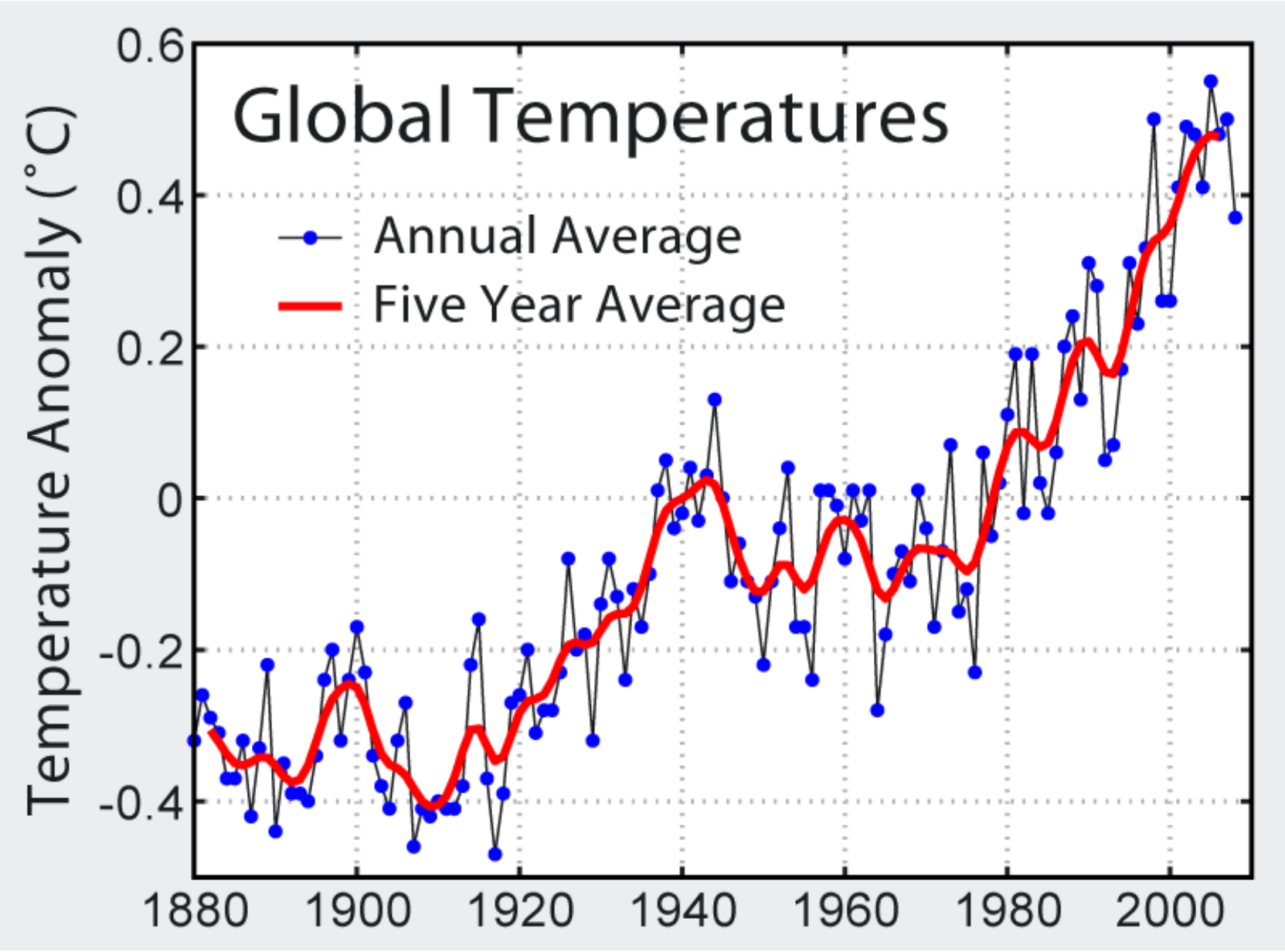



Changes in climate & environment observed

# Global Climate Change

## Global average warming of 1.4 - 5.8$^{o}$C

- 450 ppmv CO2e = 2$^{o}$C warming by ~2050
- atmospheric concentration of 650 ppmv CO2e equivalent is very likely = at least 4$^{o}$C warming before the end of the century

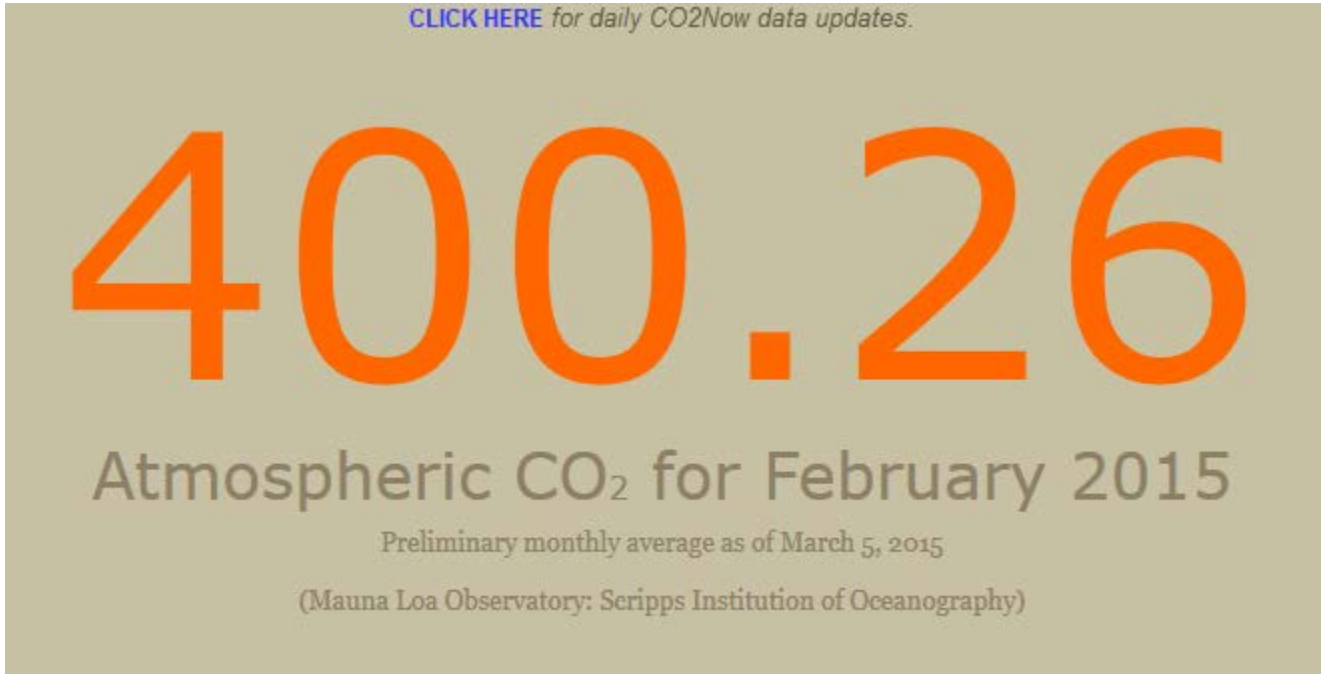
## Sea-level rise

May be up to 1.4 meters

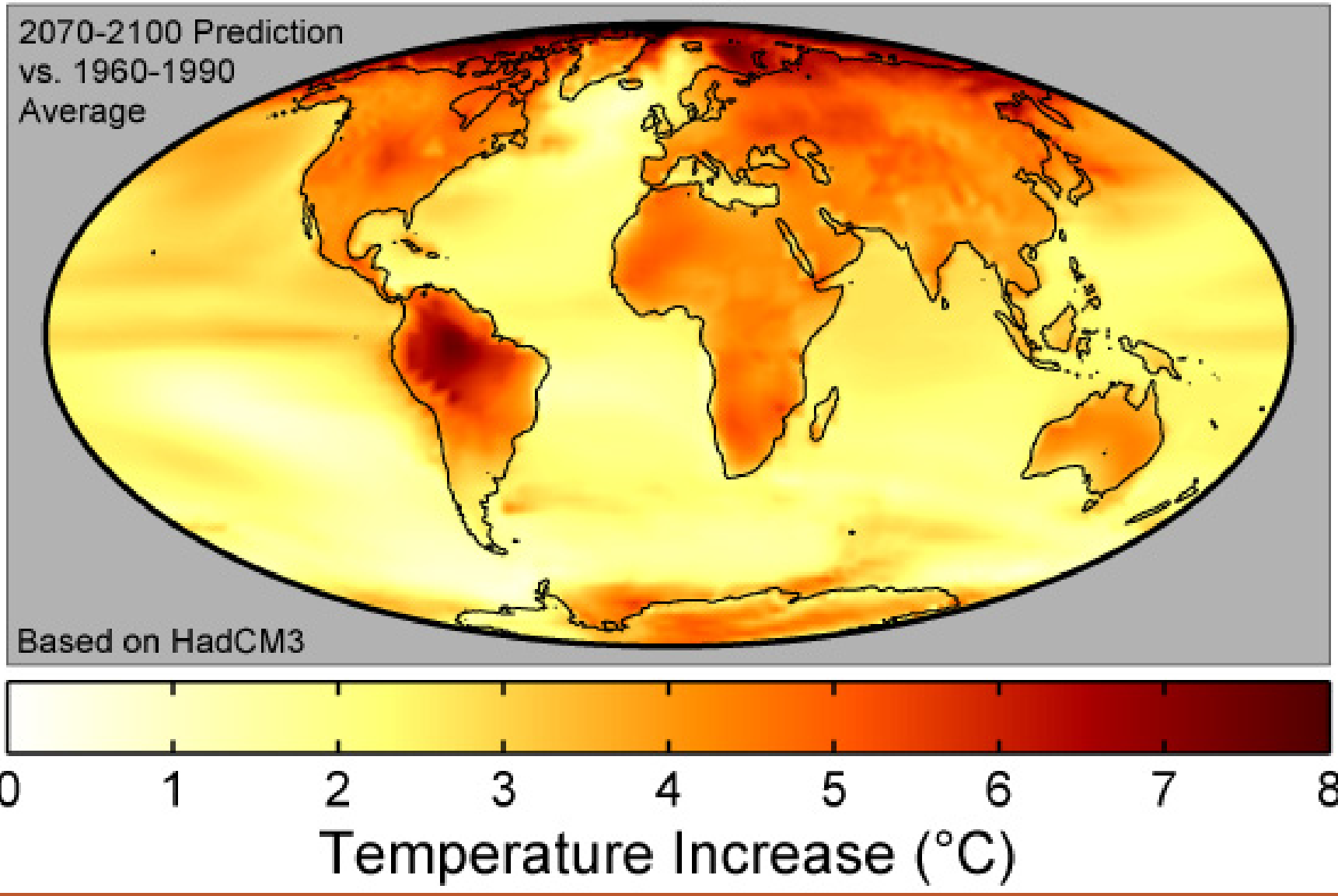
- WAIS melting = 5m slr, Greenland = 7m slr

450ppm was considered safe, then revised to 350ppm…now?

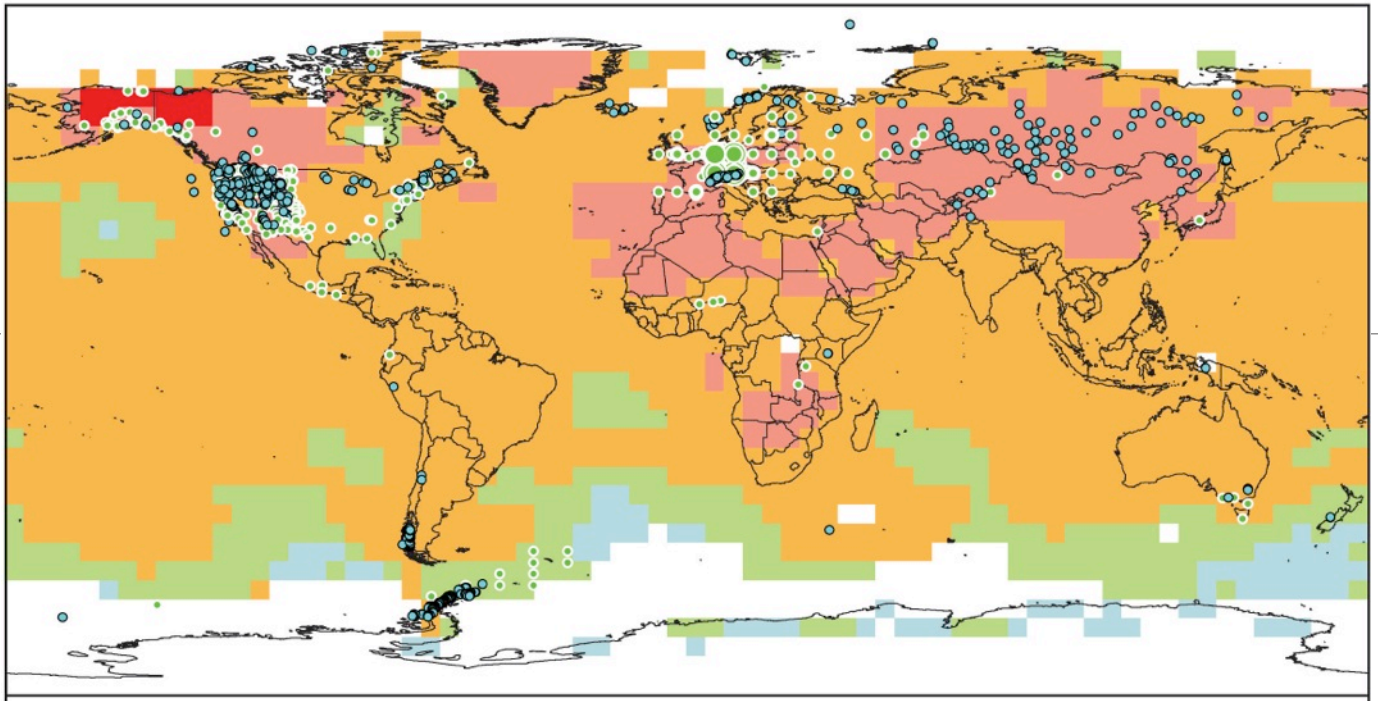
Current PPM?


CLICK HERE for daily CO2Now data updates.
400.26
Atmospheric CO2 for February 2015
Preliminary monthly average as of March 5, 2015
(Mauna Loa Observatory: Scripps Institution of Oceanography)

# Global Warming Predictions



Changes in physical and biological systems and surface temperature 1970-2004



| NAM | | LA | | EUR (28,115) | | AFR | | AS | | ANZ | | PR* | | TER (28,586) | | MFW** | | GLO (28,671) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 355 | 455 | 53 | 5 | 119 | | 5 | 2 | 106 | 8 | 6 | 0 | 120 | 24 | 764 | | 1 | 85 | 765 | |
| 94% | 92% | 98% | 100% | 94% | 89% | 100% | 100% | 96% | 100% | 100% | – | 91% | 100% | 94% | 90% | 100% | 99% | 94% | 90% |

Observed data series

- Physical systems (snow, ice and frozen ground; hydrology; coastal processes)
- Biological systems (terrestrial, marine, and freshwater)

| Europe *** |
|---|
| 1-30 |
| 31-100 |
| 101-800 |
| 801-1,200 |
| 1,201 -7,500 |

Temperature change °C
1970-2004

-1.0 -0.2 0.2 1.0 2.0 3.5

| Physical | Biological |
|---|---|
| Number of significant observed changes | Number of significant observed changes |
| Percentage of significant changes consistent with warming | Percentage of significant changes consistent with warming |

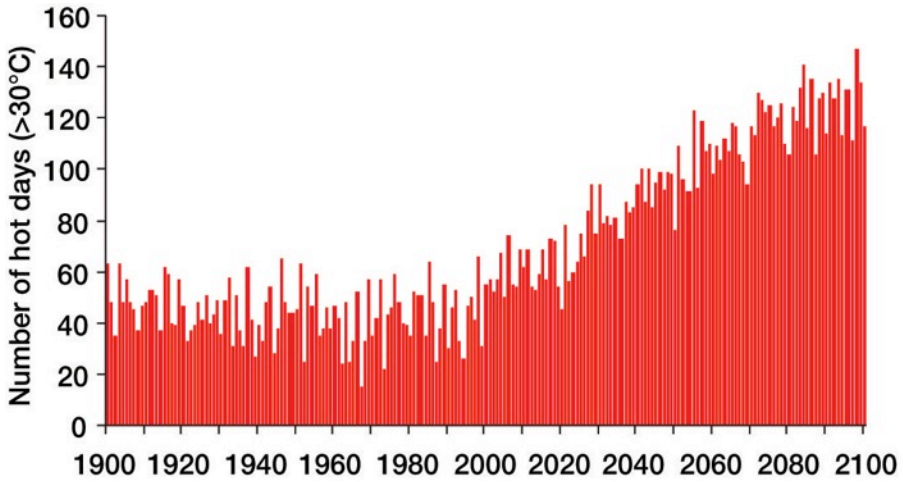
* Polar regions include also observed changes in marine and freshwater biological systems.

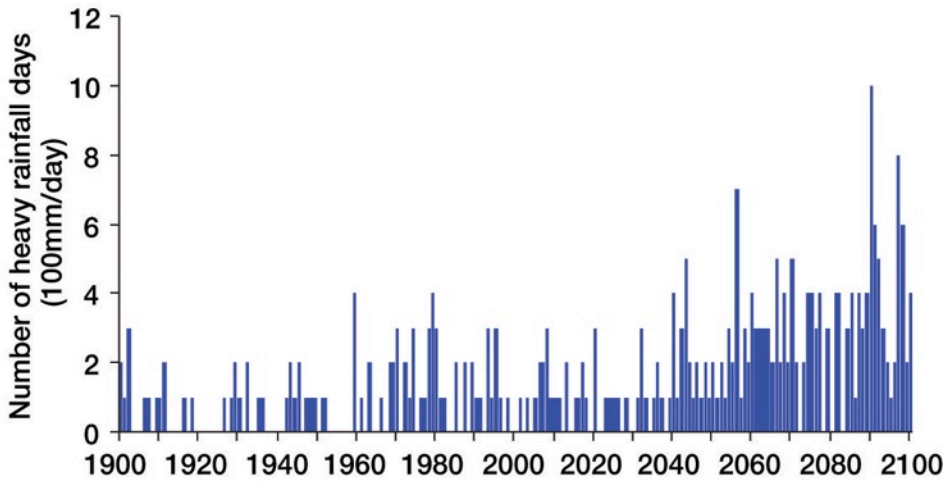
** Marine and freshwater includes observed changes at sites and large areas in oceans, small islands and continents. Locations of large-area marine changes are not shown on the map.

*** Circles in Europe represent 1 to 7,500 data series.

Changes in climate extremes:

- heat events
- drought
- flood
- storms



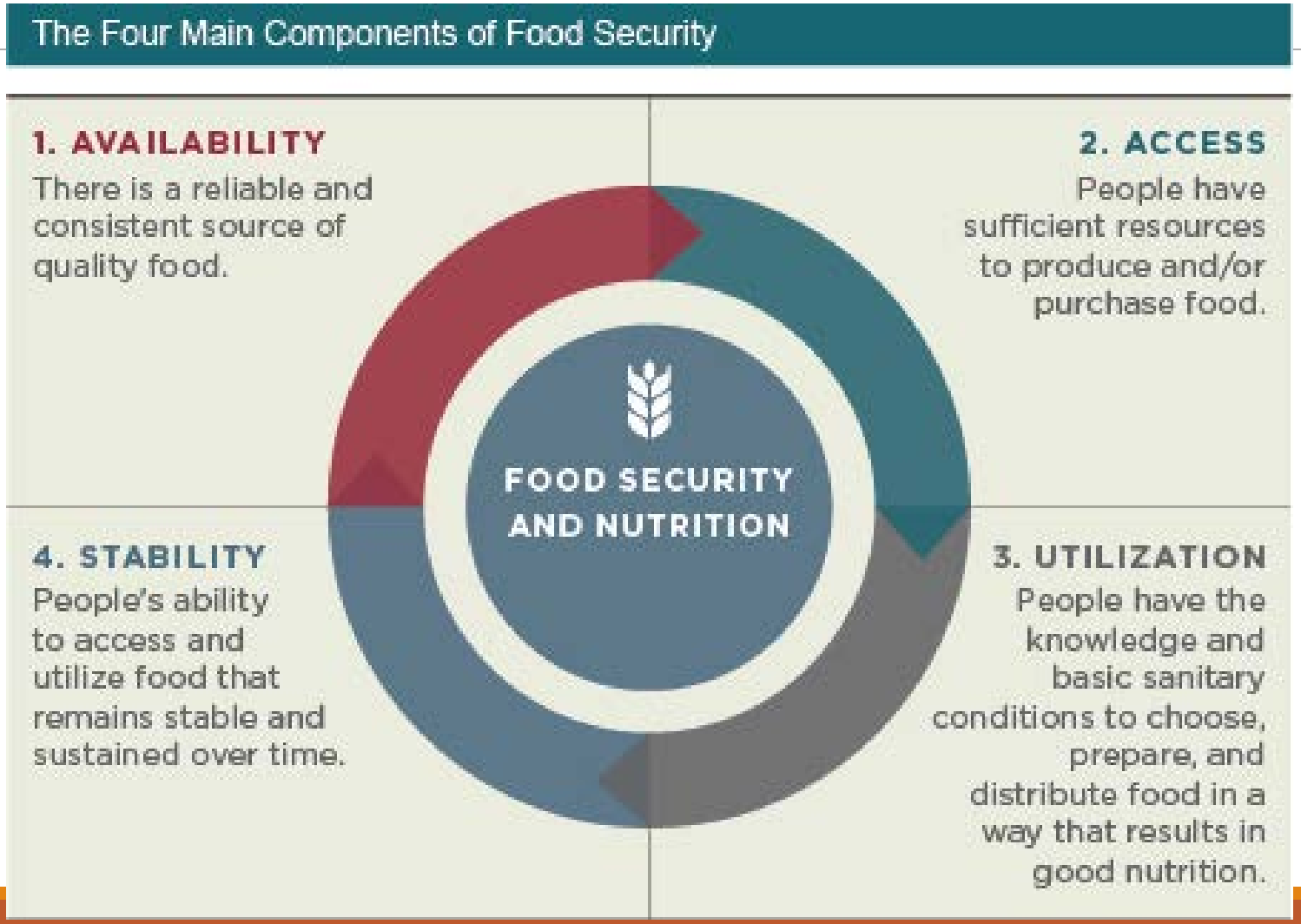
# Climate Change and Food Security

# Climate Change and Food Security

- Climate change will affect many of the determinants of food security

1. Food Production
2. Access to food
3. Food utilisation
4. Stability

# Climate Change and Food Security




Source: Feed the Future Guide, USAID, May 2010

# Food production transport and storage

1. Food production, transport and storage

- Medium term impact is low
- Above 3$^{O}$C, adverse affects likely  everywhere

# Climate Change and Food Security

1. Food production, transport and storage

- temperate and polar regions - increased agricultural production
- tropical and subtropical regions -agricultural losses

| Region | Reference 1961–1990 (1,000 ha) | Relative to reference 1990 | 2020 | 2050 | 2080 |
|---|---|---|---|---|---|
| North America | 358,202 | 102 | 110 | 121 | 141 |
| Eastern Europe | 124,935 | 103 | 101 | 96 | 96 |
| Northern Europe | 45,462 | 101 | 109 | 113 | 116 |
| Southern Europe | 38,524 | 98 | 94 | 94 | 91 |
| Western Europe | 63,267 | 100 | 98 | 98 | 97 |
| Russian Federation | 243,898 | 105 | 124 | 148 | 164 |
| Central America & Caribbean | 51,505 | 99 | 105 | 109 | 99 |
| South America | 653,060 | 102 | 104 | 105 | 102 |
| Oceania & Polynesia | 115,310 | 102 | 102 | 102 | 88 |
| Eastern Africa | 316,282 | 99 | 98 | 100 | 96 |
| Middle Africa | 254,500 | 102 | 104 | 106 | 102 |
| Northern Africa | 11,782 | 106 | 97 | 62 | 25 |
| Southern Africa | 31,316 | 88 | 55 | 48 | 54 |
| Western Africa | 178,095 | 99 | 101 | 100 | 96 |
| Western Asia | 23,561 | 105 | 112 | 94 | 101 |
| South-East Asia | 97,831 | 100 | 98 | 103 | 104 |
| South Asia | 189,132 | 101 | 101 | 99 | 97 |
| East Asia & Japan | 149,694 | 102 | 99 | 108 | 110 |
| Central Asia | 12,908 | 111 | 117 | 147 | 153 |
| Developed | 993,529 | 102 | 110 | 119 | 128 |
| Developing | 1,965,735 | 101 | 101 | 103 | 100 |
| World | 2,959,264 | 101 | 104 | 108 | 109 |

*Source:* Fischer *et al.* (2002: 64).

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# Climate Change and Food Security

1. Food production transport and storage

Likely to amplify problems in places and societies that are already food insecure

- Sub-Saharan Africa
- India

# Climate Change and Food Security

1. Food production transport and storage

- Crop productivity in Asia
  - Especially crops that rely on winter rain (e.g. winter wheat)
  - 0.5$^{o}$C rise in temp = 20% decline in crop productivity of wheat in India
  - In aggregate, cereal production across Asia is expected to decline
  - Also changing agro-climatic zones
    - changes in rural livelihoods
    - upward pressure on food prices

# Climate Change and Food Security

1. Food production transport and storage

## Fisheries and aquaculture

- Increasing variability in migratory patterns
- Decreased productivity of pelagic species
- Decreased productivity of near shore fisheries
- Increasing frequency and intensity of coral bleaching
- Aquaculture at risk

# Climate Change and Food Security

## 1. Food production transport and storage

Storms and coastal incursions damage to infrastructure necessary to move and store food:

- Wharves for handling imports
- Roads, rail and bridges, especially in rural areas dependent on single routes
- Boats
- fuel storage facilities
- food processing facilities

Create bottlenecks in supply

# Climate Change and Food Security

2. Access to Food

- IPCC AR5: “increases in the frequency of droughts and floods are projected to affect local production negatively, especially in subsistence sectors at low latitudes.”

# Climate Change and Food Security

2. Access to Food

- responses to climate change drives up food prices
- speculation in food markets, hoarding, scarcity

# Climate Change and Food Security

2. Access to Food

- globally declining number of malnourished people despite climate change,
- but beyond 2050 localised food crises and increases in malnutrition likely
- disaster-induced scarcities

i.e. distribution theory

# Climate Change and Food Security

## 2. Access to Food

- 80–125 million people at risk of hunger by the 2080s, mainly in Africa (Parry et al 1999)
- Increased rates of malnutrition (WHO 2002)

# Climate Change and Food Security

## 2. Access to Food

Economic production and employment impacts

- Coastal protection costs
- Losses from disasters
- Primary industry impacts
- Health costs

# Climate Change and Food Security

2. Access to Food

Models also suggest that climate change effects may be offset by

- Economic growth
- Population stabilisation

‘hunger – though negatively affected by climate change – would become a much less prevalent phenomenon than it is today’ (Fischer et al. 2002: 115).

“Malthusian optimism” Amartya Sen (1986): where adequate aggregate food supplies conceal “entitlement failures” for certain groups

A favourable outcome at the global level does not imply favourable outcomes for all regions and all countries

# Climate Change and Food Security

3. Food Utilisation

Water availability for cooking and cleaning

More scarce in many parts of Asia and Sub-Saharan Africa

Decreased flows

--> decreased flushing

--> water borne diseases

# Climate Change and Food Security

3. Food Utilisation

- Energy for cooking
- Increasing supply in developing countries
- Biomass sources less available

# Climate Change and Food Security

## 3. Food Utilisation

- Human health
- Increasing secondary malnutrition due to:
- Increased risk of cholera, malaria, dengue fever, fish poisoning, diarrhea, respiratory illnesses, heat stress, giardia, salmonella
  - Some models show 50% increase in exposure to dengue fever in India and China

# Conclusions

In the absence of good policies, climate change is likely to cause:

a) decreasing production in some places

+

b) short term scarcity problems due to disasters (production as well as transport and storage system)

+

c) rising prices and risks to income

+

d) water, energy, and health problems (secondary malnutrition)

= multiple drivers of food insecurity

# Climate and Food – global issues and systems approach

# Climate Change and Food security

Effective systems underpin food security

Affected by certain stressors

- Conflict, health (HIV/AIDS)
- Environmental change… Climate change
- Combination (e.g. water, energy availability)

Direct and indirect effects

Relative effects: Different for different regions

Multiple socio-economic and bio-physical factors = uneven impact of climate change on food security

# Horn of Africa

- In 2011 two consecutive failed rainy seasons
- successive seasons with very low rainfall
- Drought more frequent
- Intensity and frequency of hot days increasing
- But no statistically significant trends in rainfall
- What does this mean?

# Horn of Africa

- Hard to ‘prove’
- Need reliable long term weather data
- Data doesn’t exist in parts of Africa
- Drought = lack of rainfall; famine = man-made

# Solutions?

# Solutions?

**Increasing resilience**

Help farming communities prepare for increasing climate variability

Climate Change Adaptation (CCA) strategies and tools

- explore and test new technologies and management
- Mainstream climate change into sectoral planning

# Solution?

Find opportunities for more market integration

‘Improve’ globalisation

More Trade

Carbon trading

# Solutions?

Rework the politics?

Power shifted due to intensification and agricultural output *from* farmers *to* retailers

Power in who gets food in the hands of a few

# World Bank

Win win win?

http://www.youtube.com/watch?v=fzzOrnobook

# Conclusions

# Conclusions – climate and food

Long term and shocks effects

Exacerbate uneven development

Part of a much bigger picture

# Conclusions – climate and food

With good policies – still uneven outcomes

In the absence of good policies serious impacts with complex interactions:

a) decreasing production

b) short term scarcity

c) rising prices and risks to income

d) water, energy, and health problems (secondary malnutrition)

= multiple drivers of food insecurity

# Conclusions – climate and food

Next lecture: wrap up

# Quickpoll: Climate change

http://qp.unimelb.edu.au/schandr

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Climate change:

A. Will be the major driver of food insecurity

B. Will not be an issue, (bio)technology can overcome it

C. Is not an issue; population is the key issue here

D. Will improve food security because Canada and Russia will grow more and provide more food

E. None of the above