Impact of climate change on microbial safety of pre-harvest leafy green vegetables

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SEVENTH FRAMEWORK PROGRAMME

veg-i-trade
safe food for a changing world

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Outline

- Research objective
- Climate change is happening
- Conceptual framework
- Scenario analysis
- Climate impacts
- Summary

Research objective

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Review and synthesise

major impacts of climate change

(temperature increases and precipitation pattern changes) on

contamination sources and pathways of

foodborne pathogens

(focussing on *E. coli* O157 and *Salmonella* spp) on

pre-harvested leafy green vegetables

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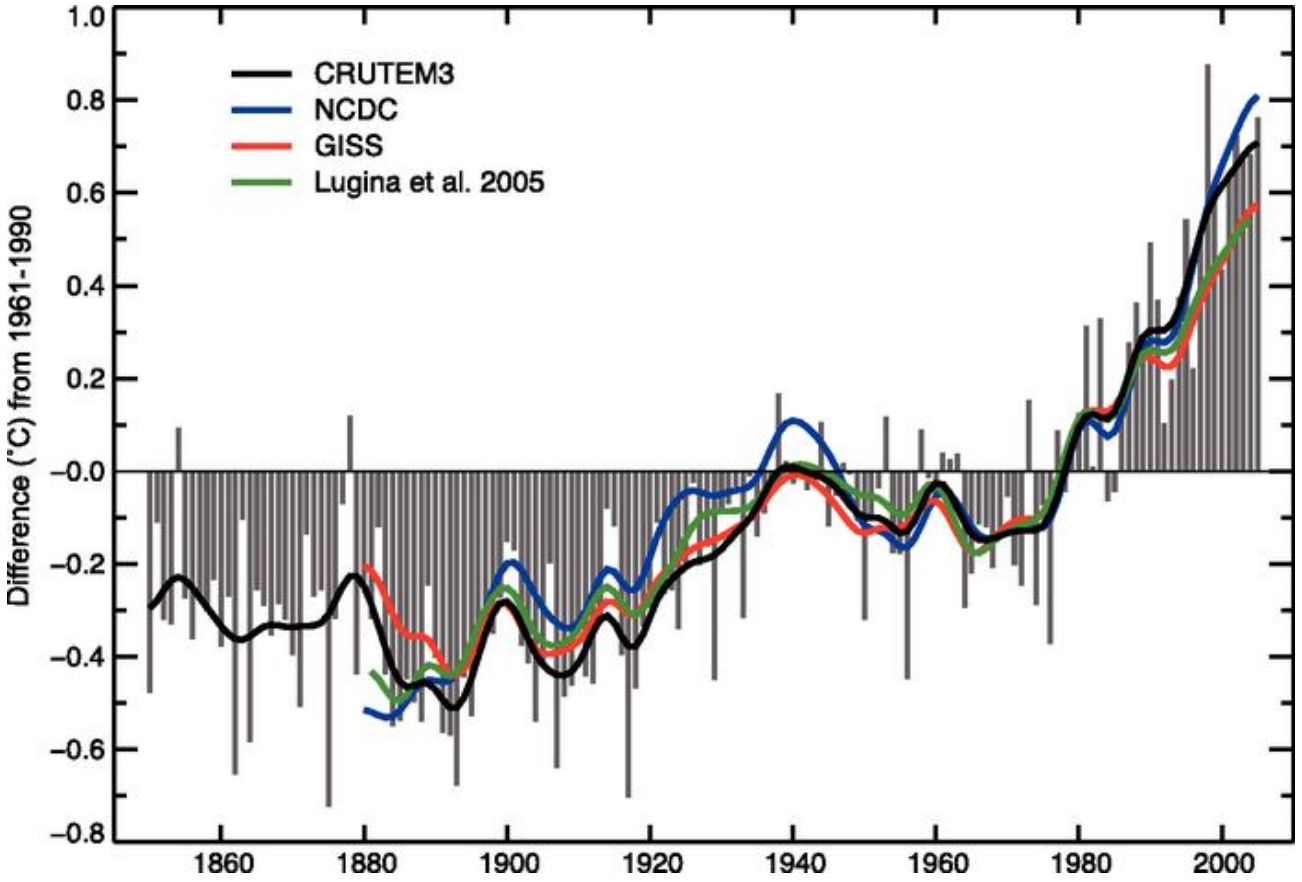
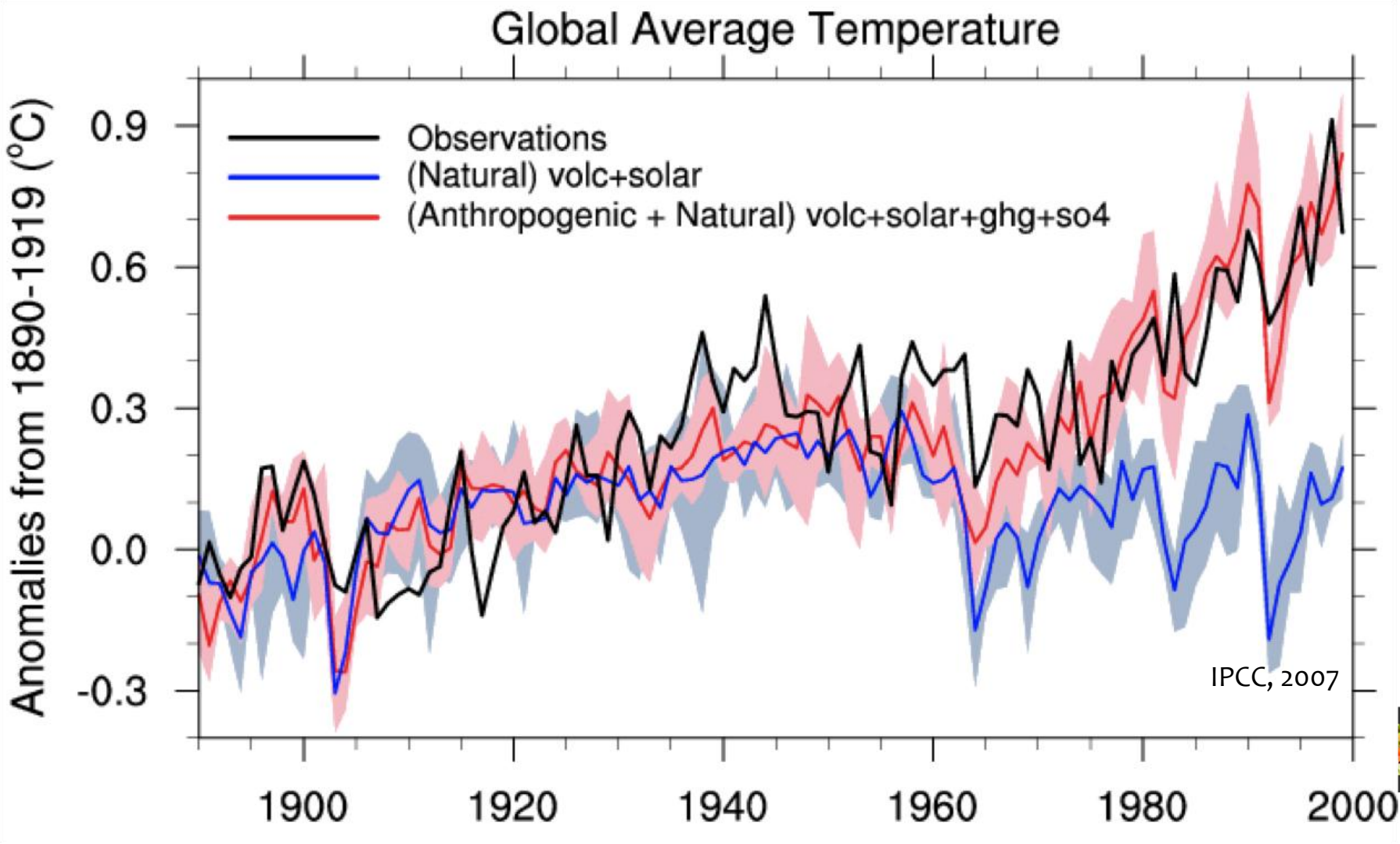
Climate change is happening



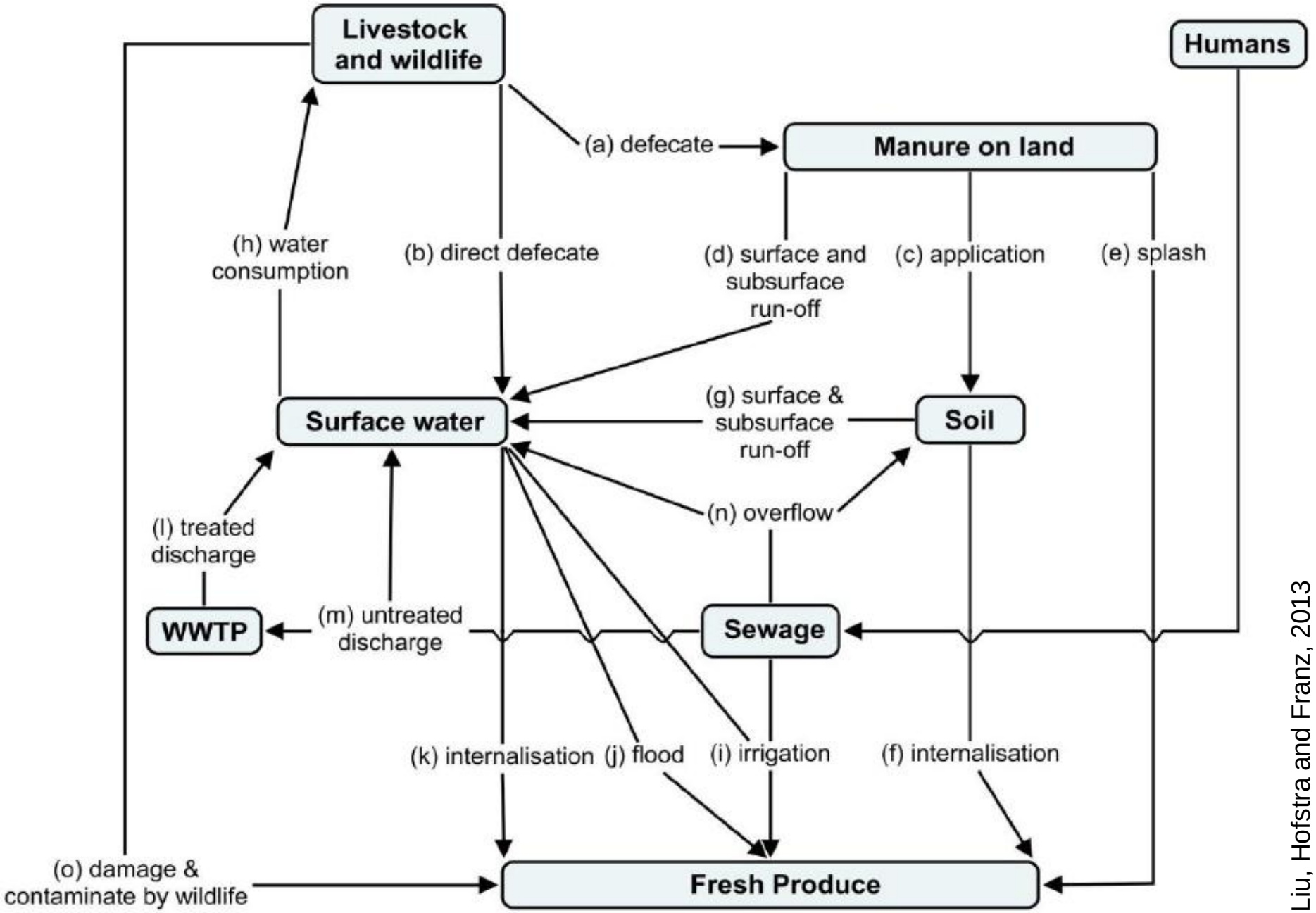
IPCC, 2007

Climate change is attributed to human emissions



Conceptual Framework

Sources and pathways of pathogenic bacteria on leafy green vegetables



Liu, Hofstra and Franz, 2013

Methods for studying future impacts

Scenario analysis: definition

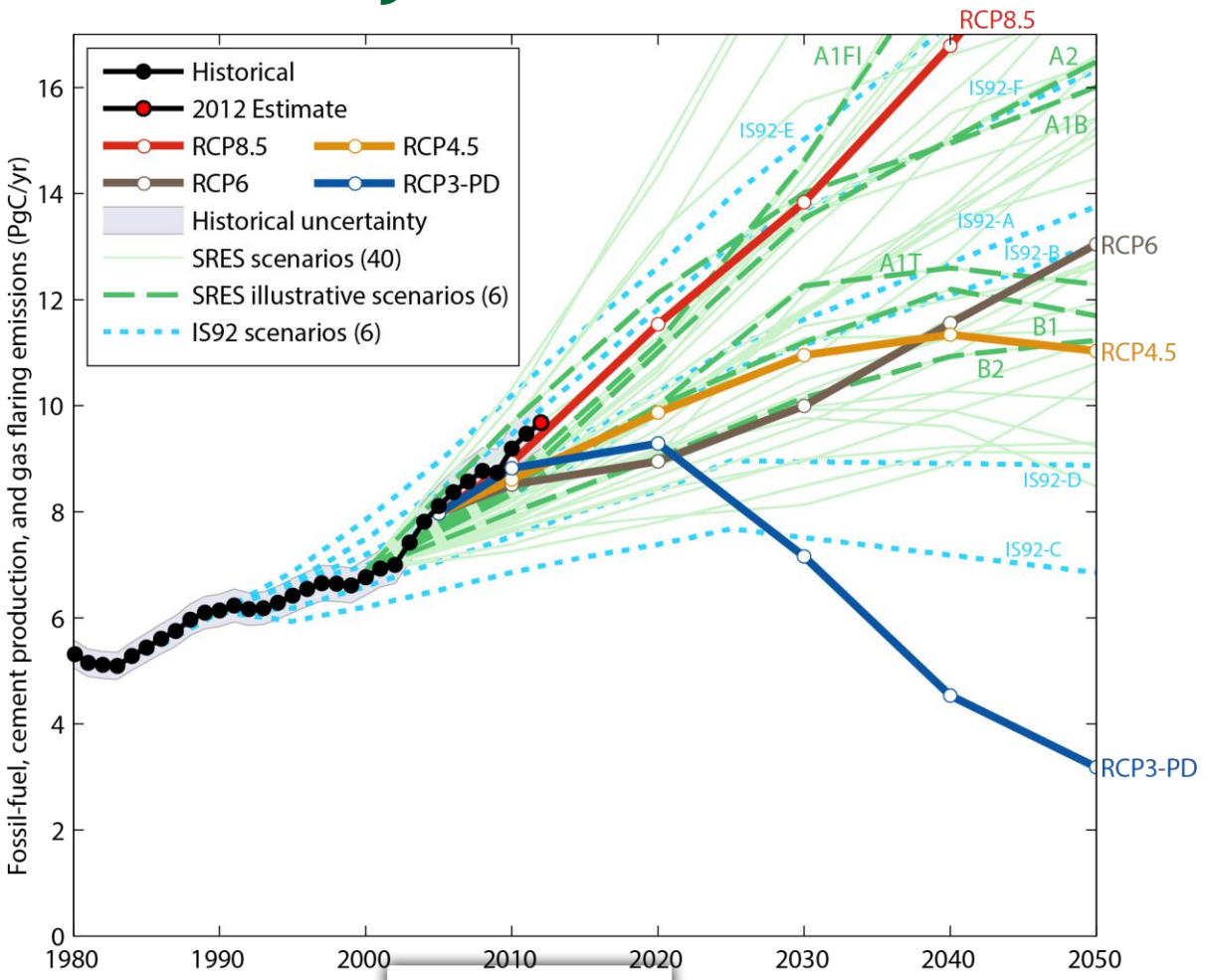
A plausible description of how the future may unfold based on 'if-then' propositions.

A typical scenario includes a representation of the initial situation and a sequence of events that describe the key driving forces and the changes that lead to an image of the future.

What they are *not:*

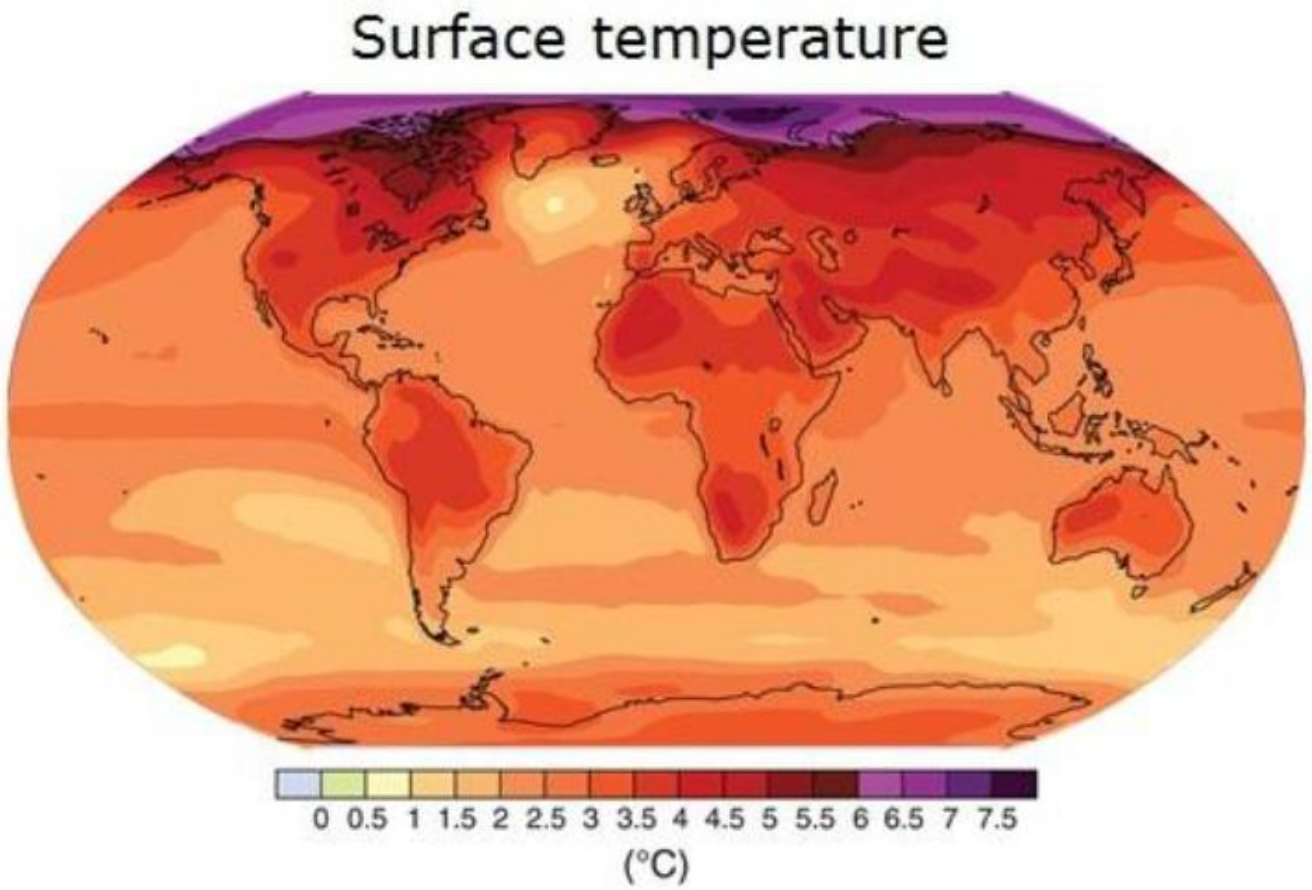
Extrapolations (trends), predictions (probability)

Summary RCP emissions



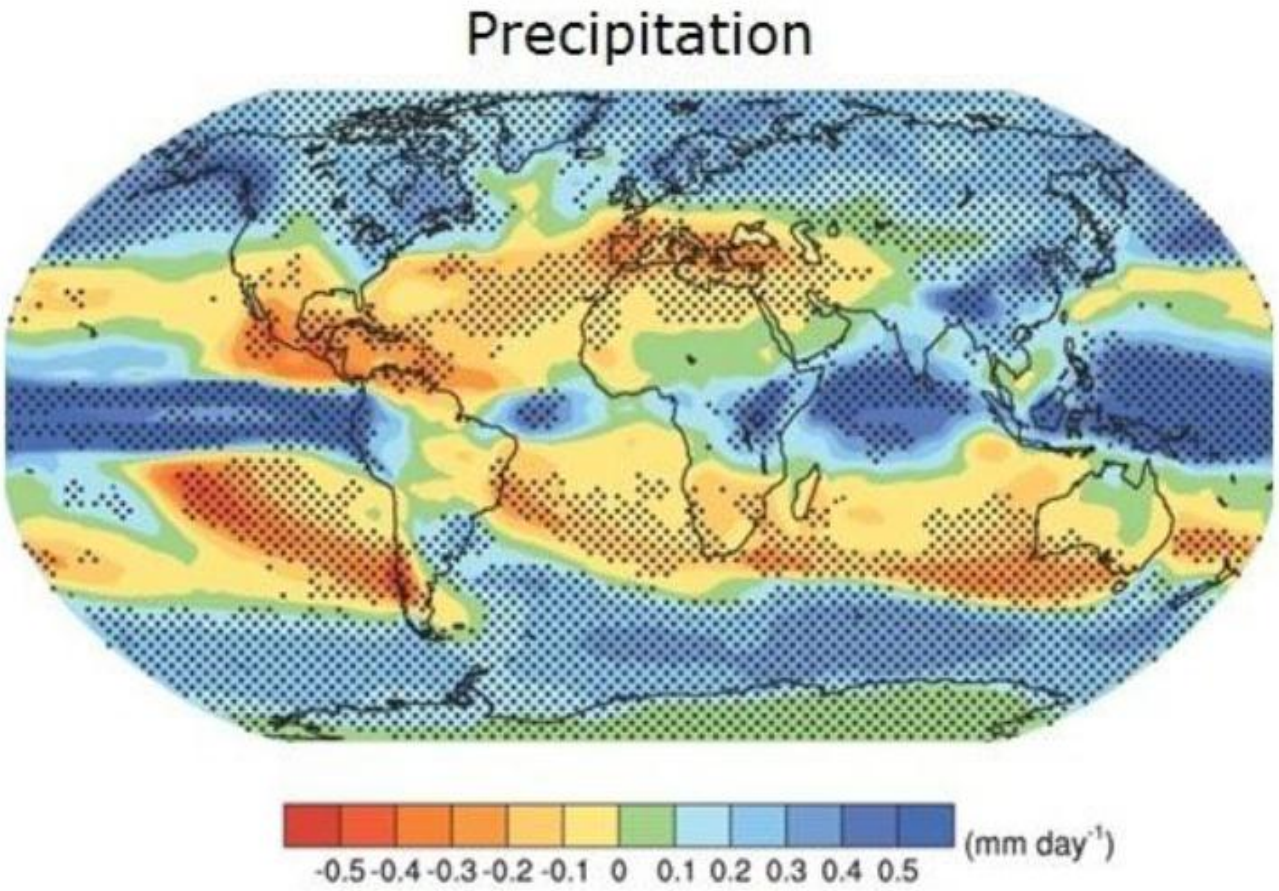
Main periods of use: SA90 (1990-1992, not shown), IS92 (1992-2000), SRES (2000-2012), RCPs (2012+)
Source: Peters et al. 2012a; Global Carbon Project 2012

Projected temperature changes (SRES)



Scenario A1B
2090-2099 – 1980-1999
Ensemble mean

Projected precipitation changes (SRES)



Scenario A1B
2090-2099 – 1980-1999
Ensemble mean

Climate influences

Climatic changes	Relation	Variables	Reference
Precipitation increase	+	surface and subsurface run-off	
	+	chance of splash	Cevallos-Cevallos et al., 2012, Franz et al., 2008b, Madden et al., 1996
	+	chance of flood	Donnison and Ross, 2009, Orozco et al., 2008
	+	chance of sewer overflow	Tierney et al., 1977, Watkins and Sleath, 1981
	-	amount of irrigation water required	
	-	concentration/percentage of waste water in surface water stream	Hofstra, 2011, Senhorst and Zwolsman, 2005
Precipitation decrease	-	surface and subsurface run-off	
	-	chance of splash	Cevallos-Cevallos et al., 2012, Franz et al., 2008b, Madden et al., 1996
	-	chance of flood	Donnison and Ross, 2009, Orozco et al., 2008
	-	chance of sewer overflow	Tierney et al., 1977, Watkins and Sleath, 1981
	+	amount of irrigation water required	
	+	concentration/percentage of waste water in surface water stream	Hofstra, 2011, Senhorst and Zwolsman, 2005

Climate influences

Climatic changes	Relation	Variables	Reference
Temperature increase	-	survival of pathogens in manure, soil and surface water	Danyluk et al., 2008, Himathongkham et al., 1999, Kudva et al., 1998, Mukherjee et al., 2006, Semenov et al., 2007, Wang et al., 1996, Wang, 1998
	+	use of manure	Franz et al., 2008a
	+	amount of irrigation water for fresh produce	

Assumption:

- positive influences > negative influences
- climate change will increase the microbial risks of fresh produce contamination

Summary

- Temperature likely increases everywhere, but precipitation patterns differ largely by region. Already arid regions are expected to become drier, whilst wet regions are expected to become wetter. Extreme precipitation events are expected to occur more often worldwide.
- Contamination sources and pathways vary depending on the practical farming management in different parts of the world. In general, manure amended soil and irrigation water are better studied sources.
- Need for quantitative modelling approaches with scenario analyses to understand the net impact of climate change on the contamination of pre-harvested LGVs.
- Additional laboratory experiments, such as splash tests for both pathogens and LGVs and contamination of LGVs after irrigation with contaminated surface water