

# Could research infrastructures be a solution for managing the risk of global change?

Dr. Abad Chabbi

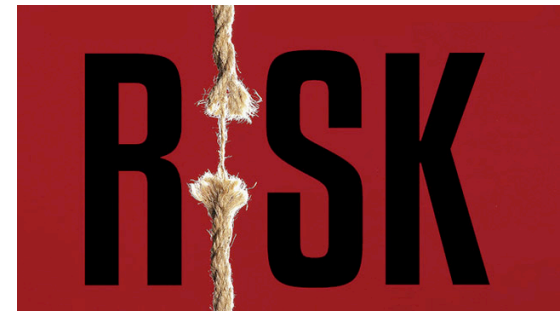
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For water resources  
and food production



For ecosystems



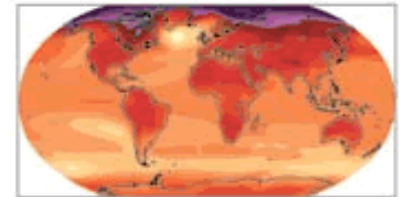
For people

# Outline

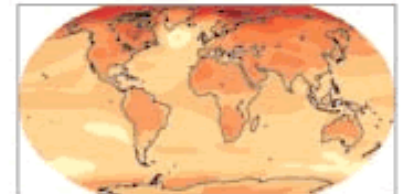
- Adapting science to ensure food security in the face of climate change
- RIs and global cooperation as tools in facing the the urgency of this challenge
- Why RIs are so essential – key messages



Scenario A2



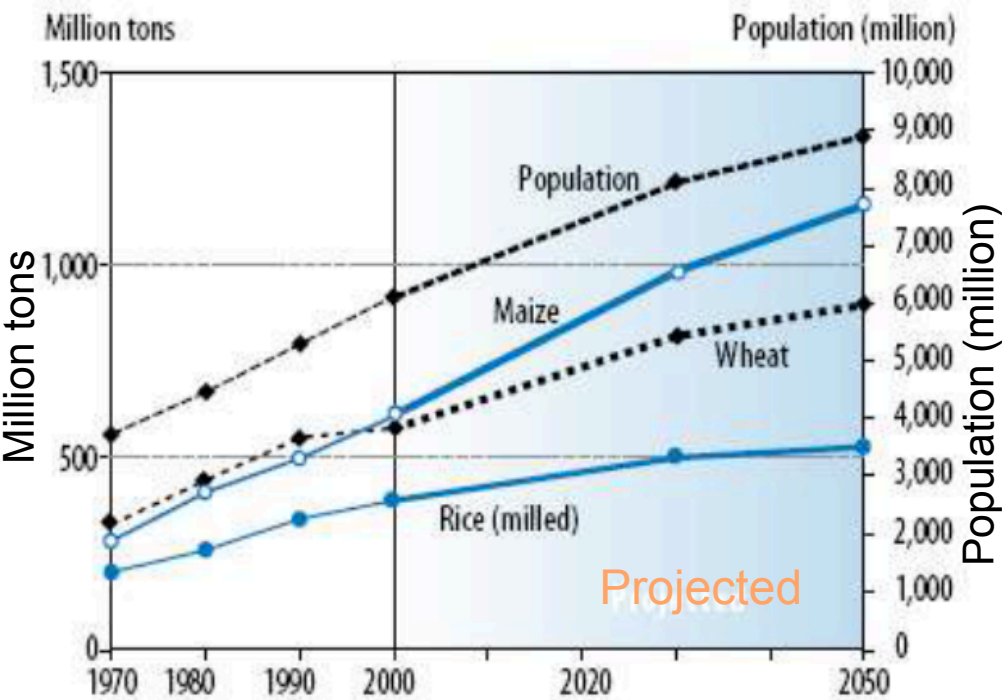
Scenario B1





# Adapting science to ensure food security in the face of climate change

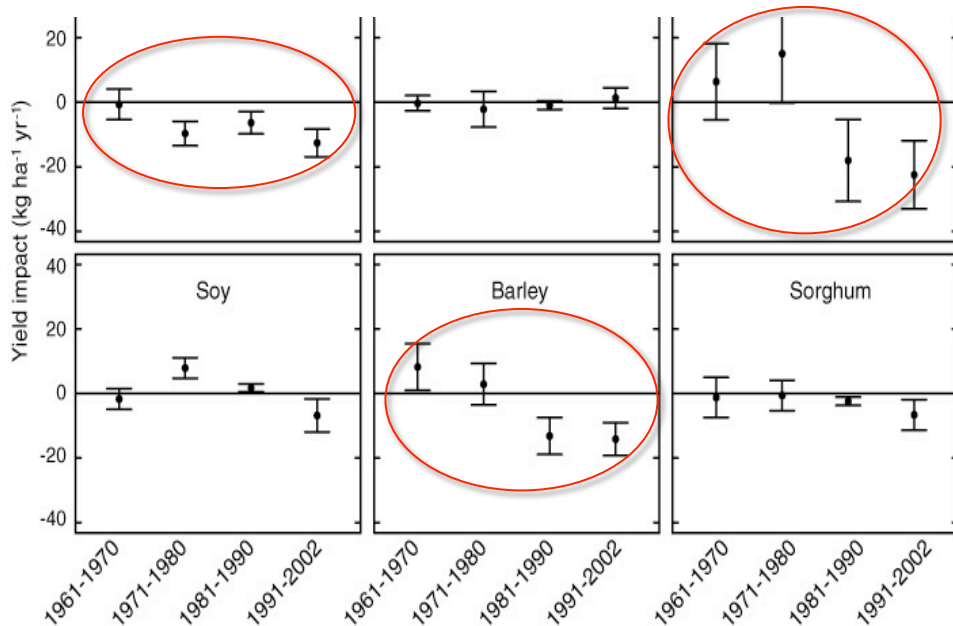
# Global demand for cereals (wheat, maize, rice) will almost double by 2050 (FAO)



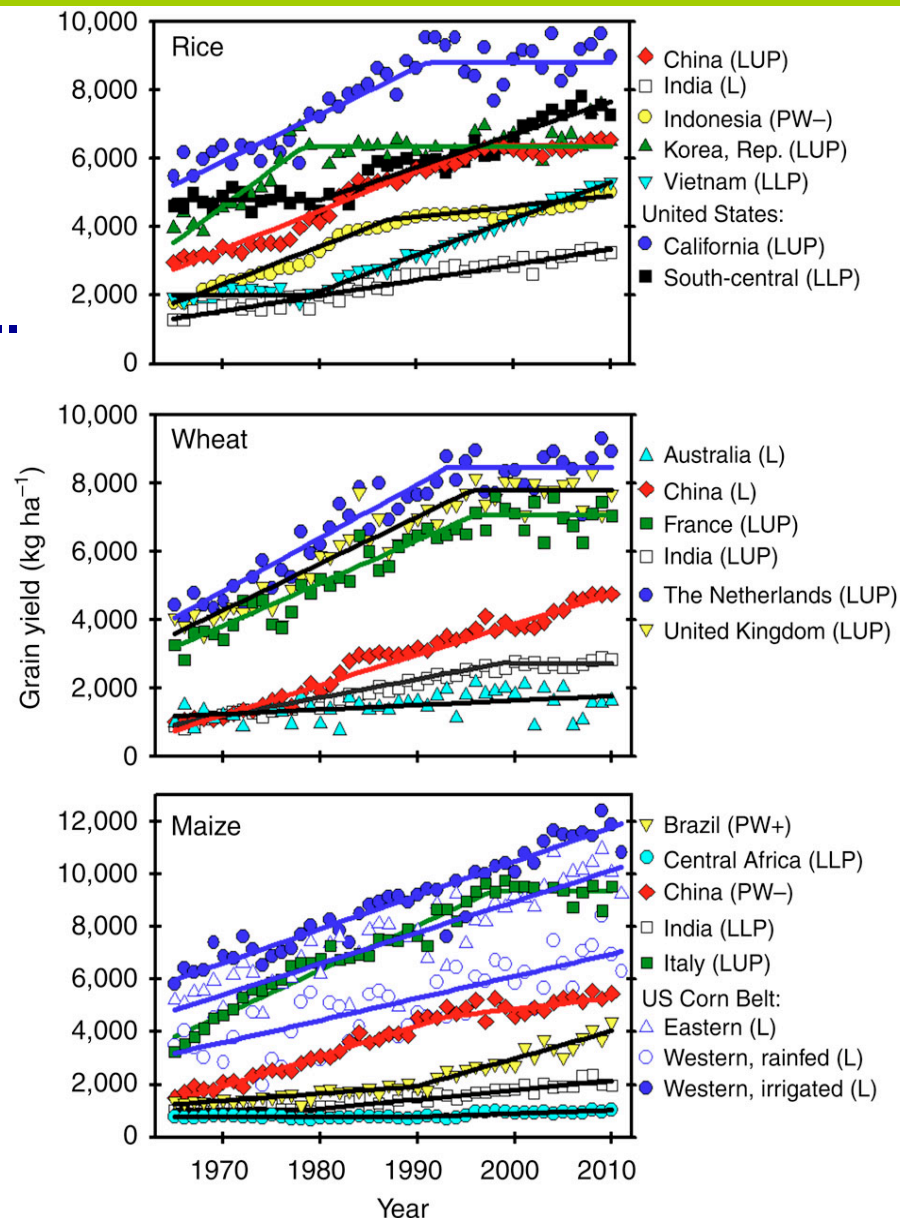
**Lies, Damn Lies...**  
The false facts about food production

**Demand for food is projected to increase by 50% by 2030 and double by 2050**

**but.....**



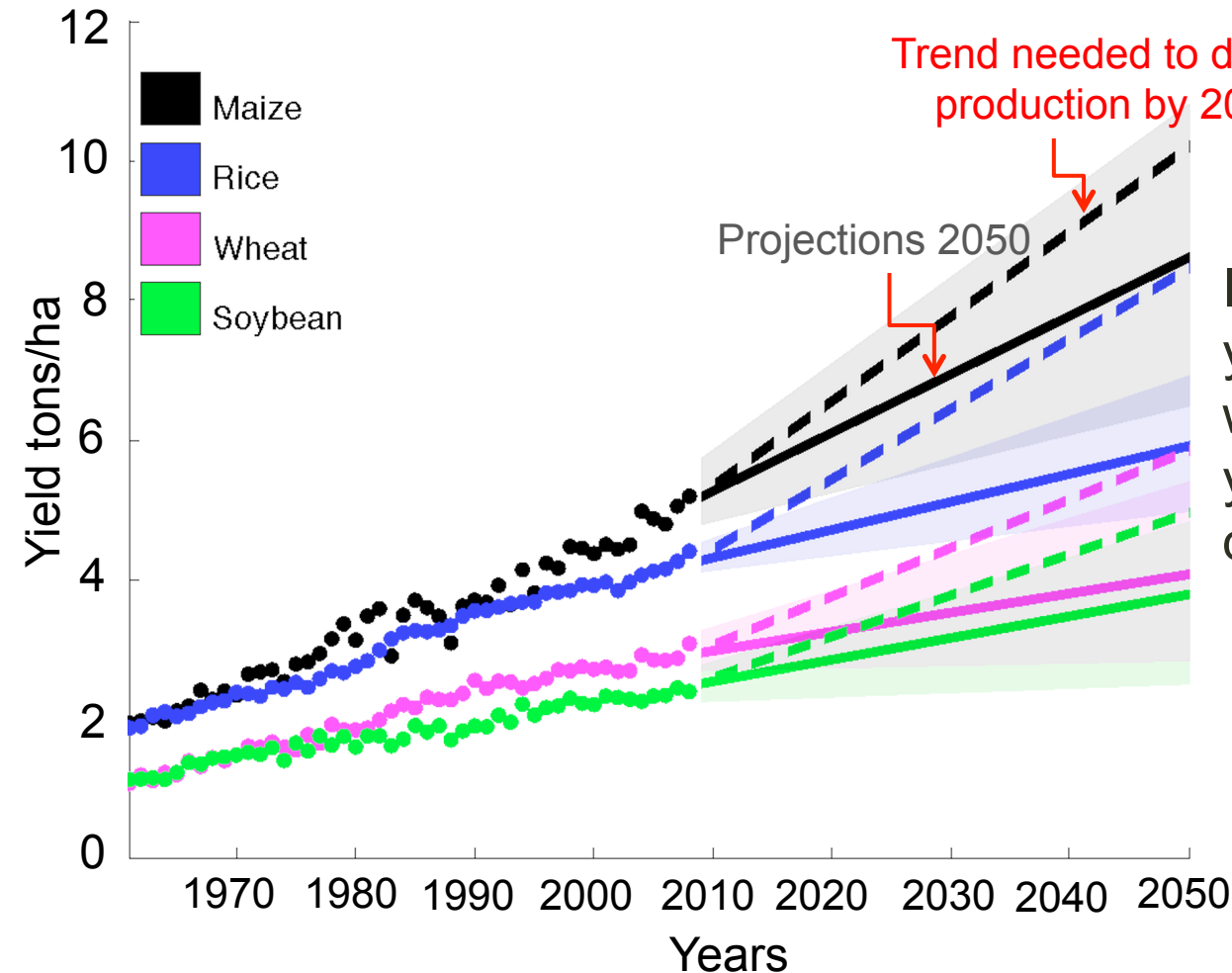
**Estimated yield impacts of climate trends by decade (Lobell & Field, 2007)**



**Trends in grain yield of the three major cereal crops since the start of the green revolution in the 1960s (Grassini et al. 2013)**



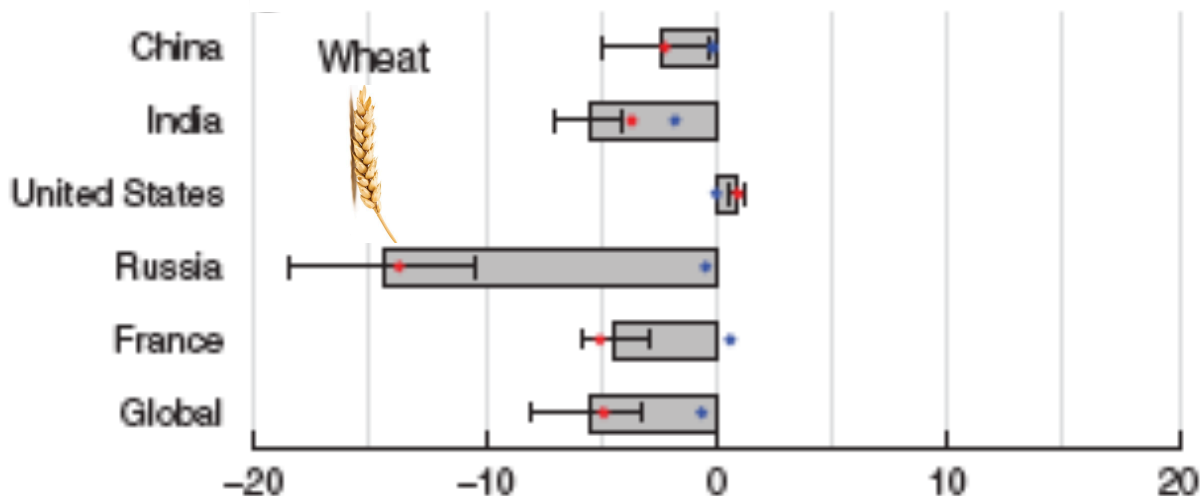
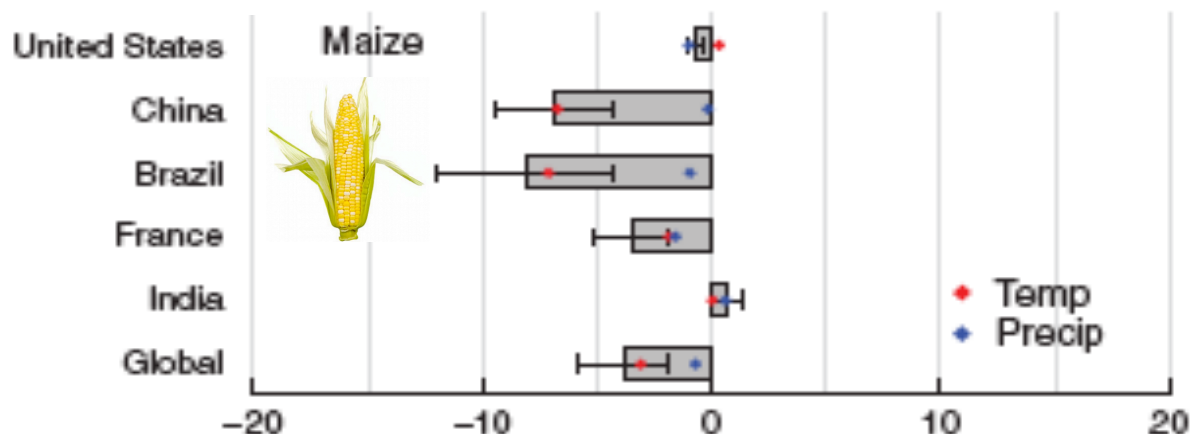
# Yield trends are insufficient to double global crop production by 2050



Increase 0.9 and 1.6% per year rate which is far below what is needed (2.4% per year) to meet projected demands in 2050.

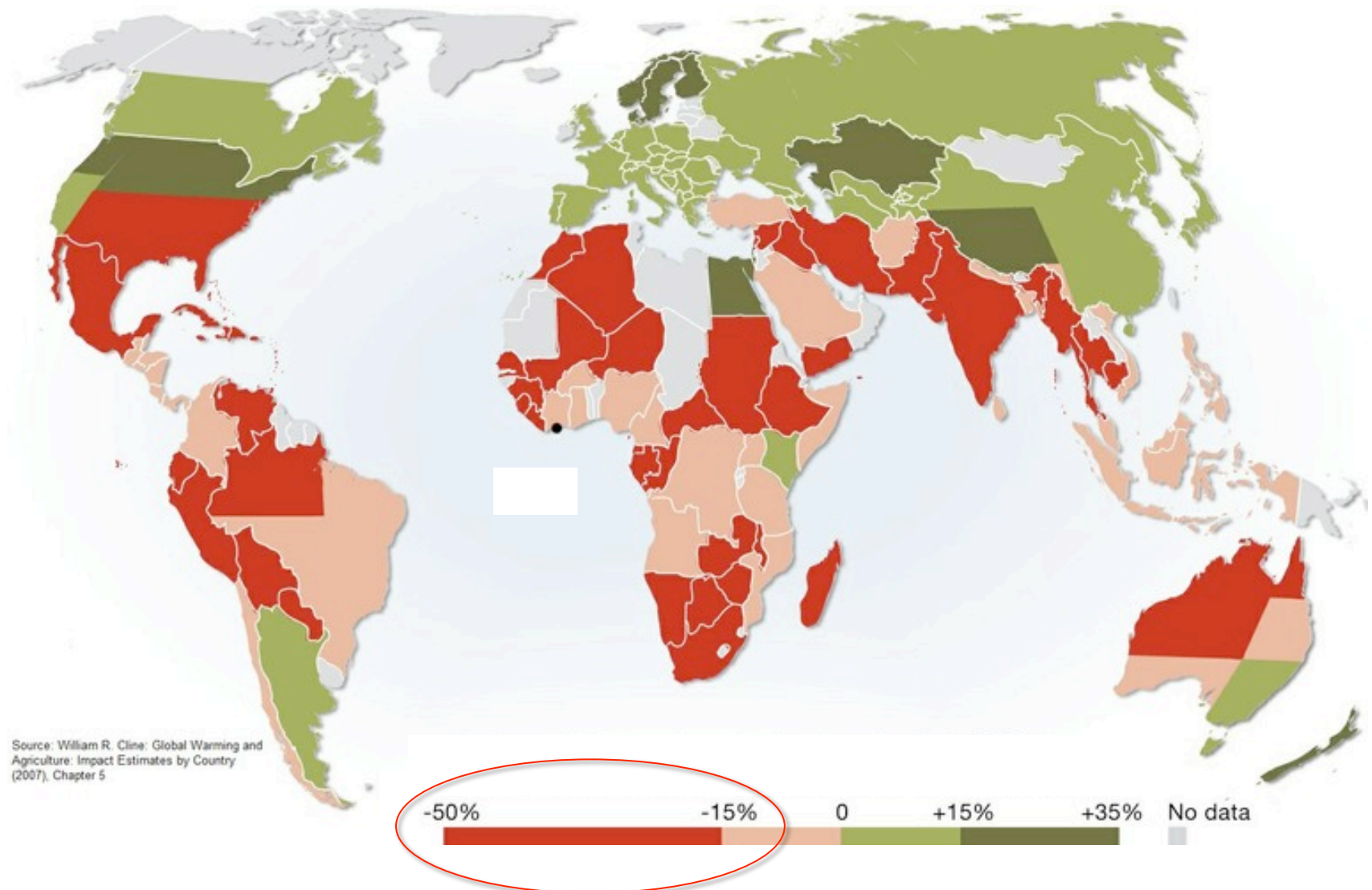
# The effect warmer climate (1980-2008) on cereal production globally (models simulation)

Food security is a real and serious consequence of climate change.



Lobell et al. 2011



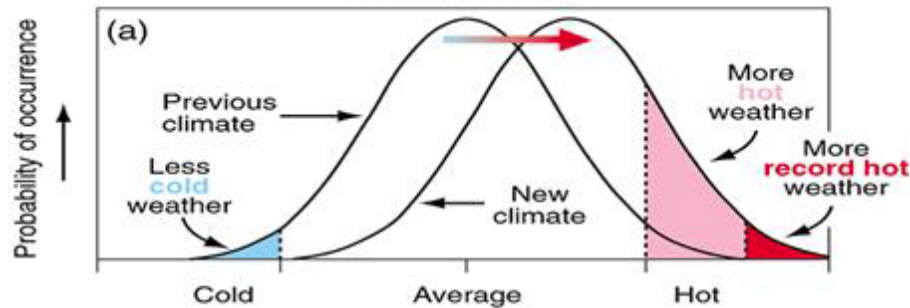


## Projected changes in agricultural production Due to climate change-2080

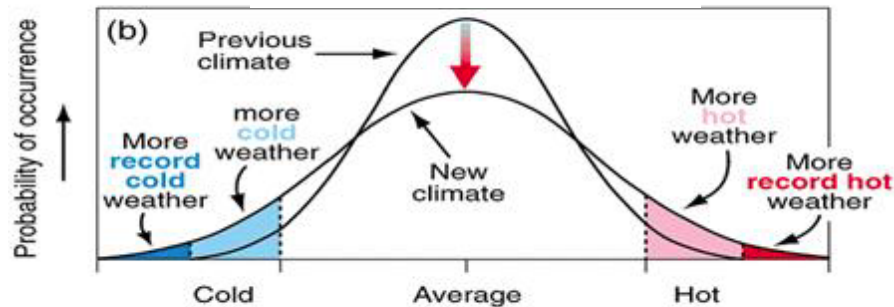
Source: William R. Cline: Global Warming and agriculture: Impact estimates by country (2007), Chapter 5



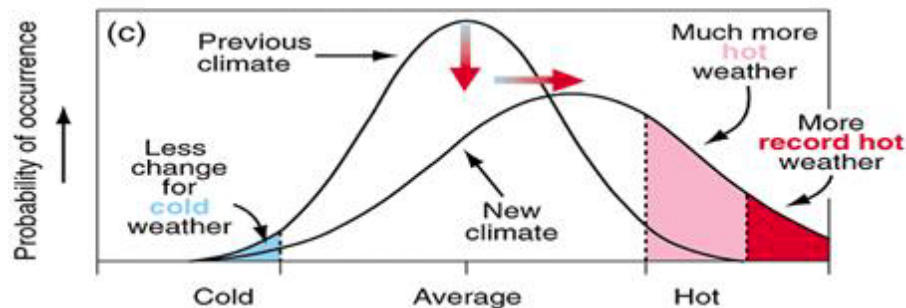
### Increase in mean



### Increase in variance



### Increase in mean and variance



Significant climate change will inevitably lead to significant changes in extremes,

**Could we fix the earth's climate?**



The background image of the cover shows a group of people, including children and adults, standing in shallow, clear water. They are engaged in planting small green mangrove saplings. One person in the foreground is wearing a large straw hat and a red shirt, using a long pole to assist with the planting. The water is calm, and the sky is overcast with grey clouds. The scene is set in a coastal or estuarine environment.

# CLIMATE CHANGE 2014

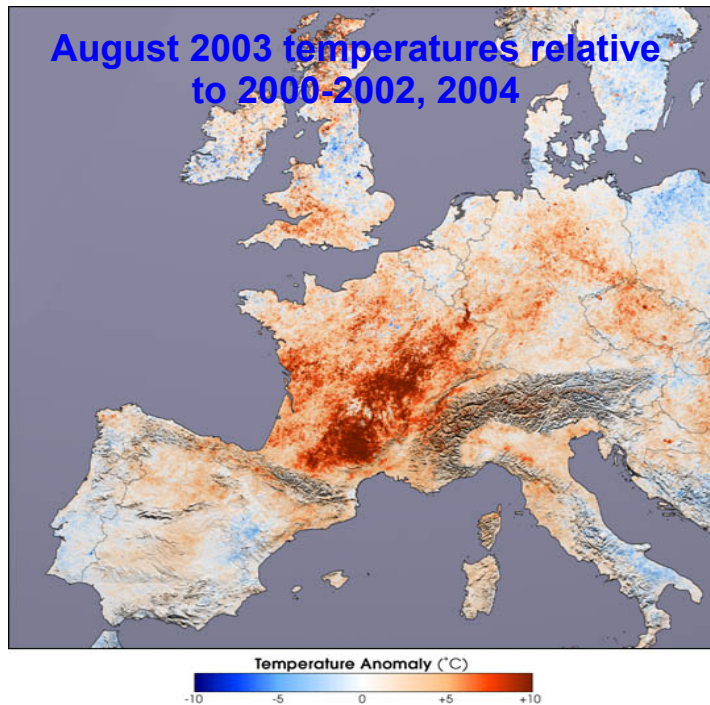
## *Impacts, Adaptation, and Vulnerability* *Volume I: Global and Sectoral Aspects*

WG II

WORKING GROUP II CONTRIBUTION TO THE  
FIFTH ASSESSMENT REPORT OF THE  
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

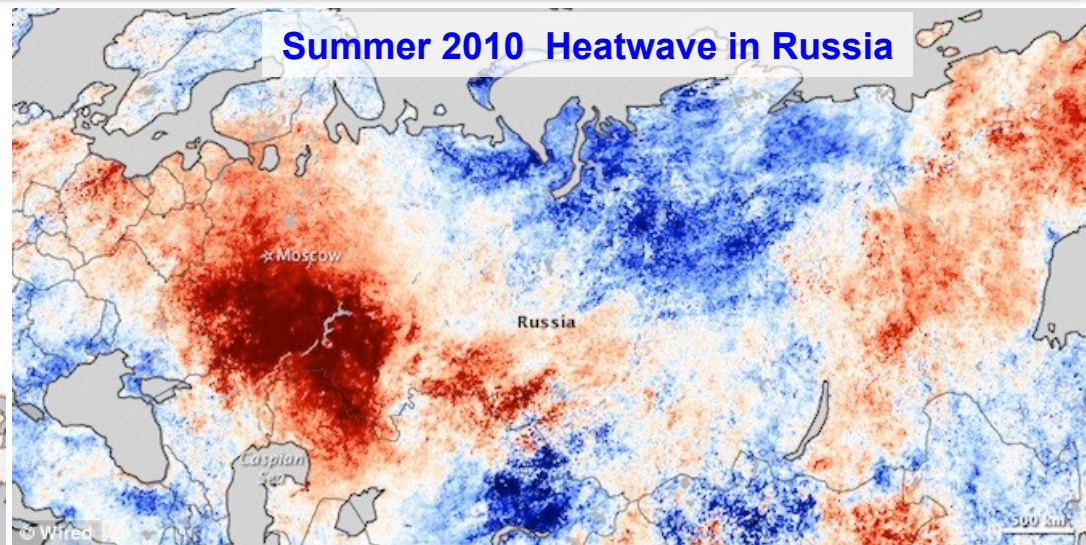


## Great European Heatwave 2003

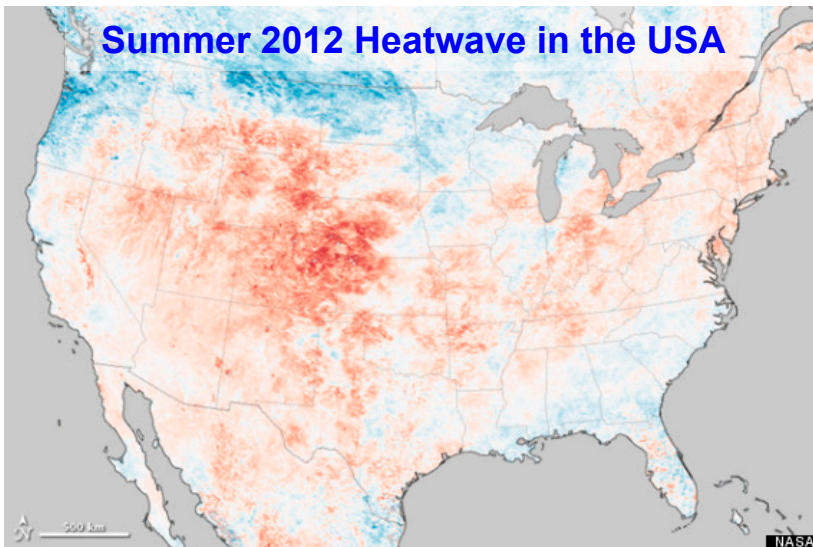


**Agriculture damage of US\$ 12 billion**

**An unprecedented heatwave that struck an unprepared society**



**Summer 2012 Heatwave in the USA**



**Huge area with forest fire in Russia**

**Dramatic air quality conditions**

**Excess mortality estimated at 55000**

**On a continental scale, even hotter than the "Great European Heatwave" (Barriopedro et al. 2011)**



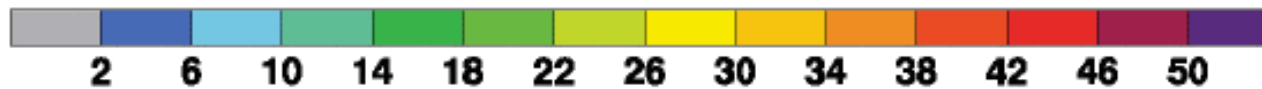
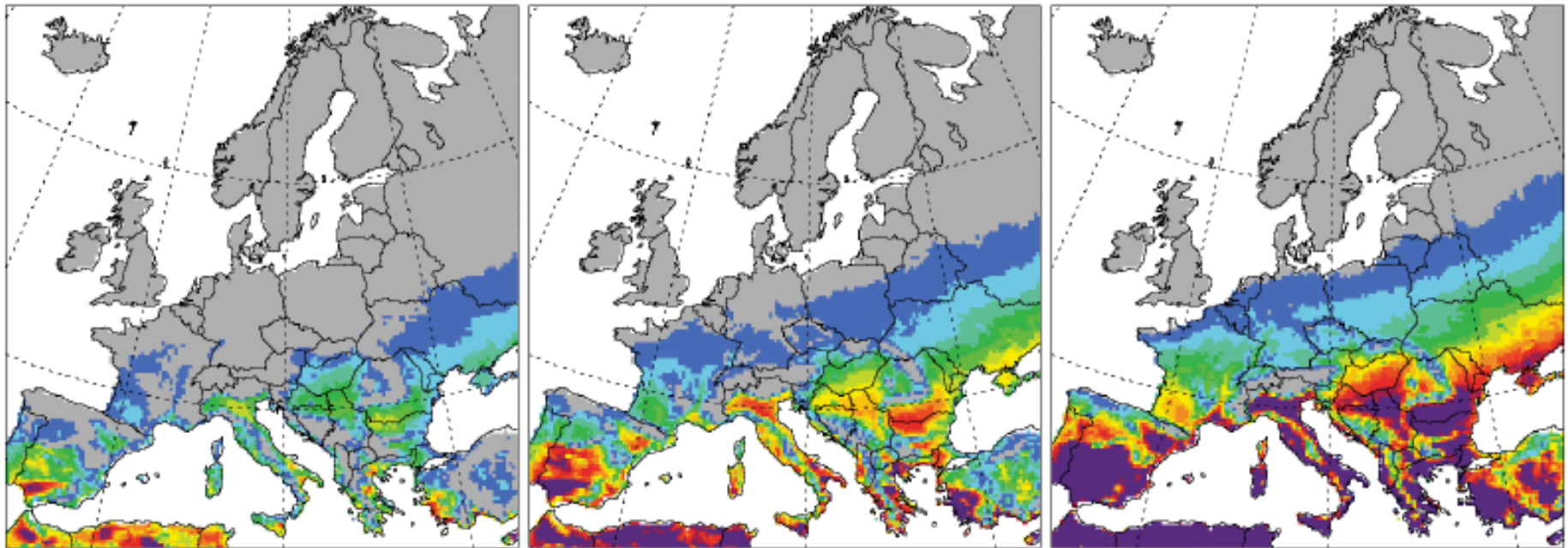


# Hot days and tropical nights

1961-1990

2021-2050

2071-2100



Number of days with  $T_{max} > 35^{\circ}\text{C}$  and  $T_{min} > 20^{\circ}\text{C}$

**Dramatic increases in low-altitude Mediterranean (river basins and coasts)**

Ensembles, mean of 6 models, scenario A1B  
Fischer and Schär 2010 Nature Geoscience



## Climate change

is much more certain than some people believe!

The **impacts of climate change**  
are greater than most people believe

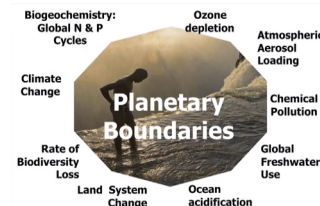
- The growing relevance of “extreme heat”
  - Exposure to extreme heat, particularly during key growth phases such as the reproductive period
- The declining relevance of models that ignore extreme heat
  - Risk of underestimating crop yield losses - application of incorrect policies for coping with climate change
  - Uncertainty of future yield trends
  - Uncertainty on the evolution of farming systems
  - Uncertainty regarding the potential yields and yield gaps



**Agriculture caught between  
a rock and a hard place**

Which science for adapting  
agriculture in a warmer world?

# RIs and global cooperation as tools in facing the the urgency of this challenge

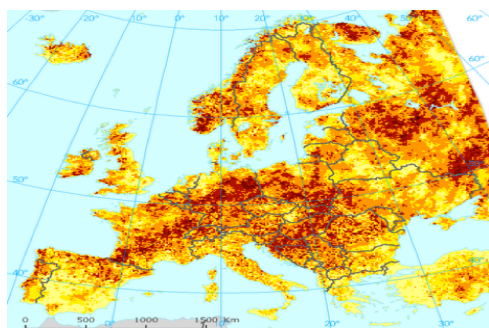
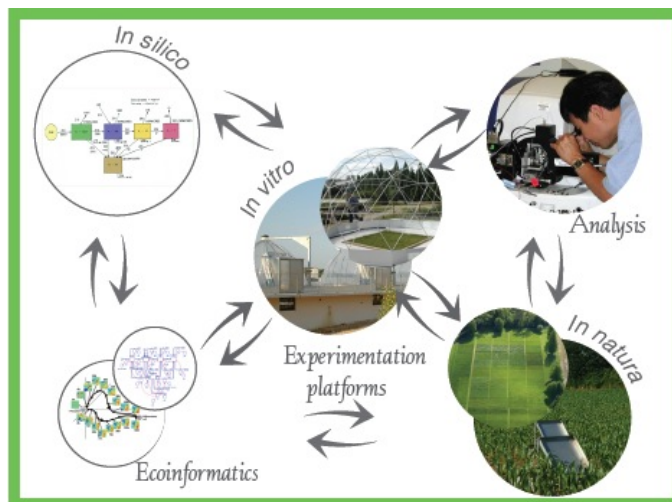




# ANAEE - Infrastructure for Analysis and Experimentation on Ecosystems



**10 Participating countries**



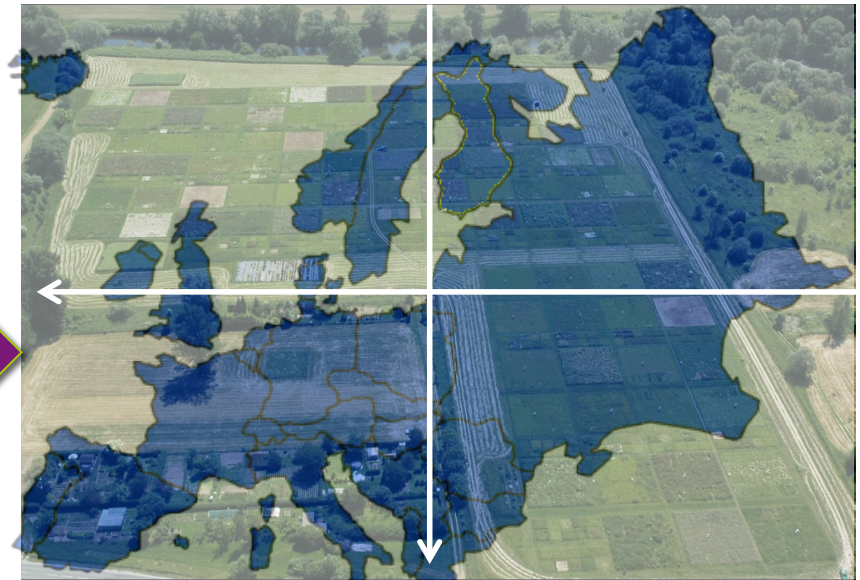
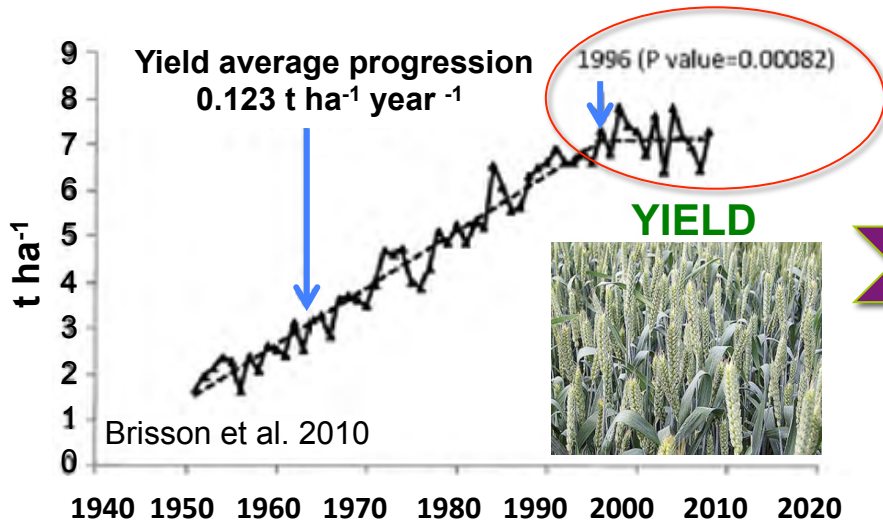
# What could AnaEE RI provide?

## ➤ **Process understanding and model validation**

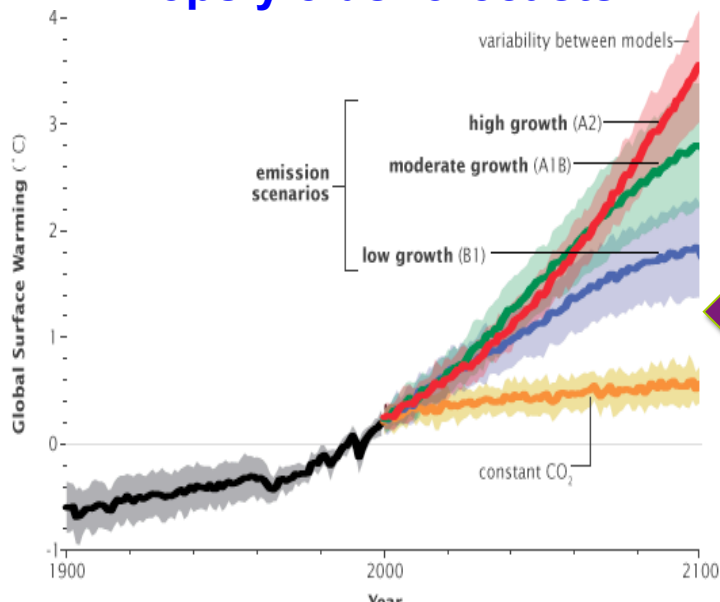
- Network of experimental climate change studies on crop and grassland systems:
  - Better understand and get a handle on processes, as well as the manner in which interactions occur
  - Increase comprehension of factors that allow for greater production with same inputs and the risks and factors that could endanger this production
- Monolith studies (intact soil blocks) transplant experiments across sites
  - Anticipating the effects of climate change on agriculture e.g. understanding of crop responses to extremely high temperatures

## In natura experimentation

### Hypothesis/observation testing



### Crops yields forecasts

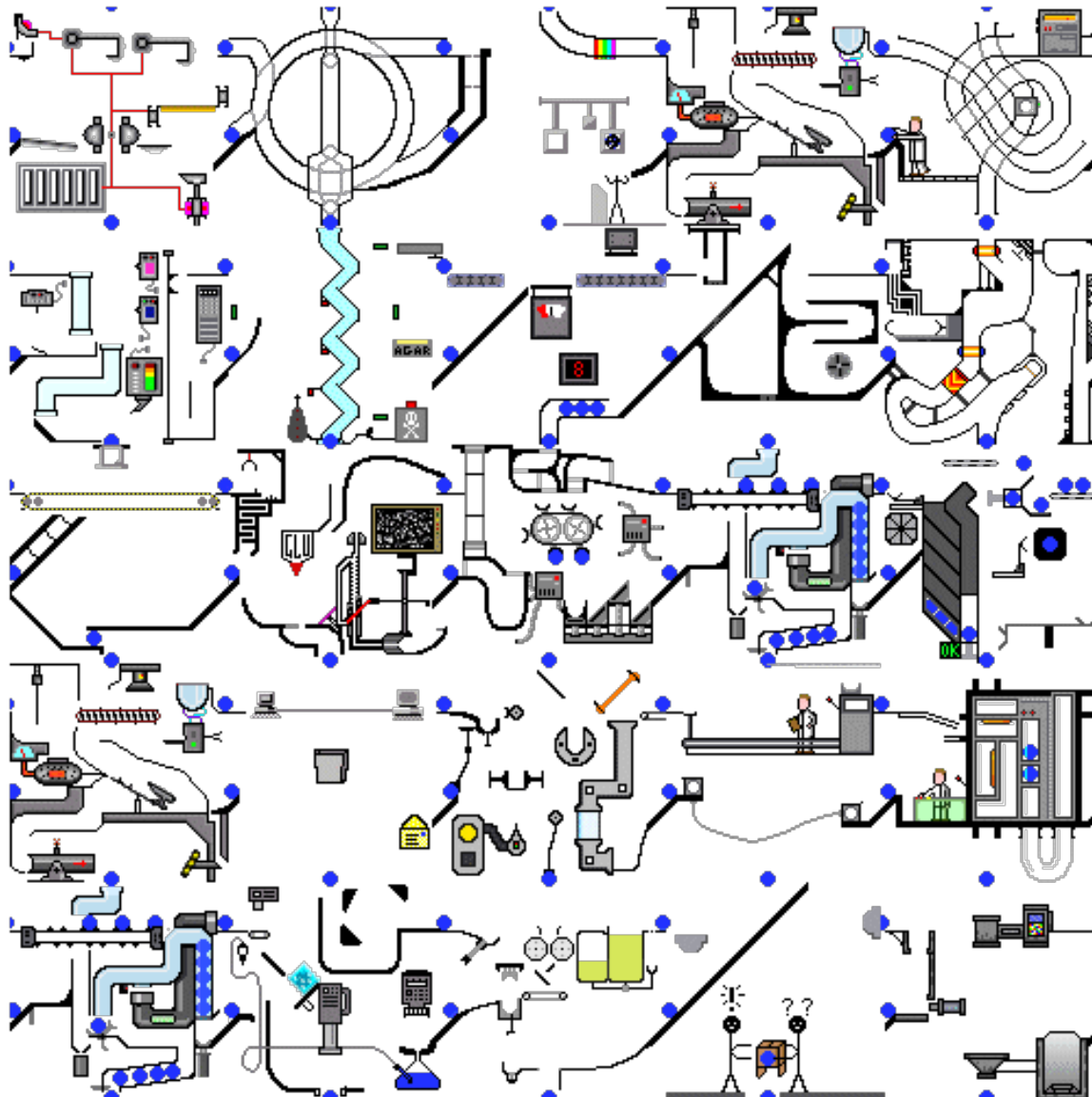


### In vitro experimentation

THE EUROPEAN MONTPELLIER ECOTRON



# Working together in Europe and in the world



Climate smart agriculture  
is now a top priority of the  
World Bank



# The Joint Programming Initiative on Agriculture, Food Security and Climate Change **FACCE-JPI**

## 21 Participating countries



**FACCEJPI**

[www.faccejpi.com](http://www.faccejpi.com)



Agriculture Food Security and Climate Change



Austria



Belgium



Czech Republic



Denmark



Estonia



Finland



France



Germany



Ireland



Israel



Italy



The Netherlands



Norway



Poland



Romania



Spain



Sweden



Switzerland



Turkey



UK



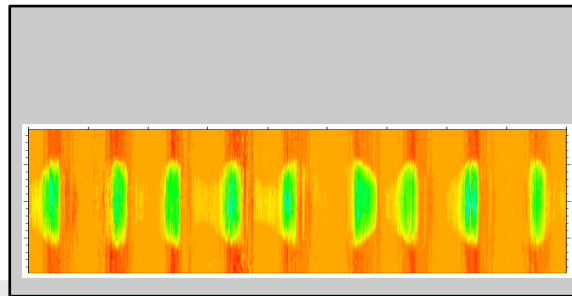
Cyprus

# Links with global networks





# Why RIs are so essential – key messages



# Key messages

- RIs will offer coordinated experiments across Europe on crops, climate (including extreme events) and soil data resources that will allow researchers to focus on underlying science
- RIs such as “AnaEE” should help clarify the limits of our ability to forecast agricultural impacts of climate change on crop production and associated food security as well as to evaluate potential for adaptation

**Many thanks for your attention!**