

# Use of regional/local climate information in impact assessment and adaptation work: present knowledge and future needs

**Timothy Carter**

**Finnish Environment Institute, SYKE  
Climate Change Programme**

# Flashback

# Bridging the gap between climate information and impact/adaptation application

**Timothy Carter**

Finnish Environment Institute, SYKE  
Research Programme for Global Change

## What has science been able to deliver?

- Large numbers of new climate projections using cutting edge models
- Improved databases of climate observations and projections
- New approaches for downscaling projections from global models
- Preliminary attempts at representing uncertainties within a probabilistic framework
- Scientific assessments and some synthesis of the above developments (e.g. by IPCC)

## What is still needed

- Continued scientific analysis at all scales
- Derived, low volume information and tools for delivering the latest science to non-specialists
- Contextual information for framing uncertainties
- Guidance for users on applying scientific knowledge within a consistent framework
- Regionalisation of the delivery of new information
- Evaluation of data and scenario delivery systems – robustness, effectiveness, uptake, guidance
- Evaluation of interpolated observational datasets

# Fast forward

# So what's new, 16 months later?

- **The IAV community is organising**
- **Ensemble and probabilistic projections are now more widely available for use in IAV assessment**
- **New scenarios are under development**
- **Climate services are endorsed by WMO**
- **New outlets for scientific dissemination**
- **Some integrated modelling is going local**

# IAV researchers are mobilising

# Possible themes for a research programme

Organizational nuclei agreed at IAV networking meeting, NCAR, Jan 2009

1. Harmonized multi-scale impact assessments
2. Investigation of risk uncertainty and decision making
3. Storyline and scenario development
4. Adaptation: past, present and future
5. Processes interacting with vulnerability
6. Costing and valuation: monetary and non-monetary
7. Observations of changes and historical human/environmental interactions
8. Integration of IAV with mitigation and across regions
9. Extreme events, thresholds and key vulnerabilities



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Climate Adaptation



2010 International Climate Change Adaptation Conference  
**Climate Adaptation Futures**  
Preparing for the unavoidable impacts of climate change  
**DRAFT PROGRAM**



29 June – 1 July 2010, Gold Coast Convention Centre, Gold Coast, Queensland, Australia

**There are new outlets for publishing  
for IAV and other climate researchers**

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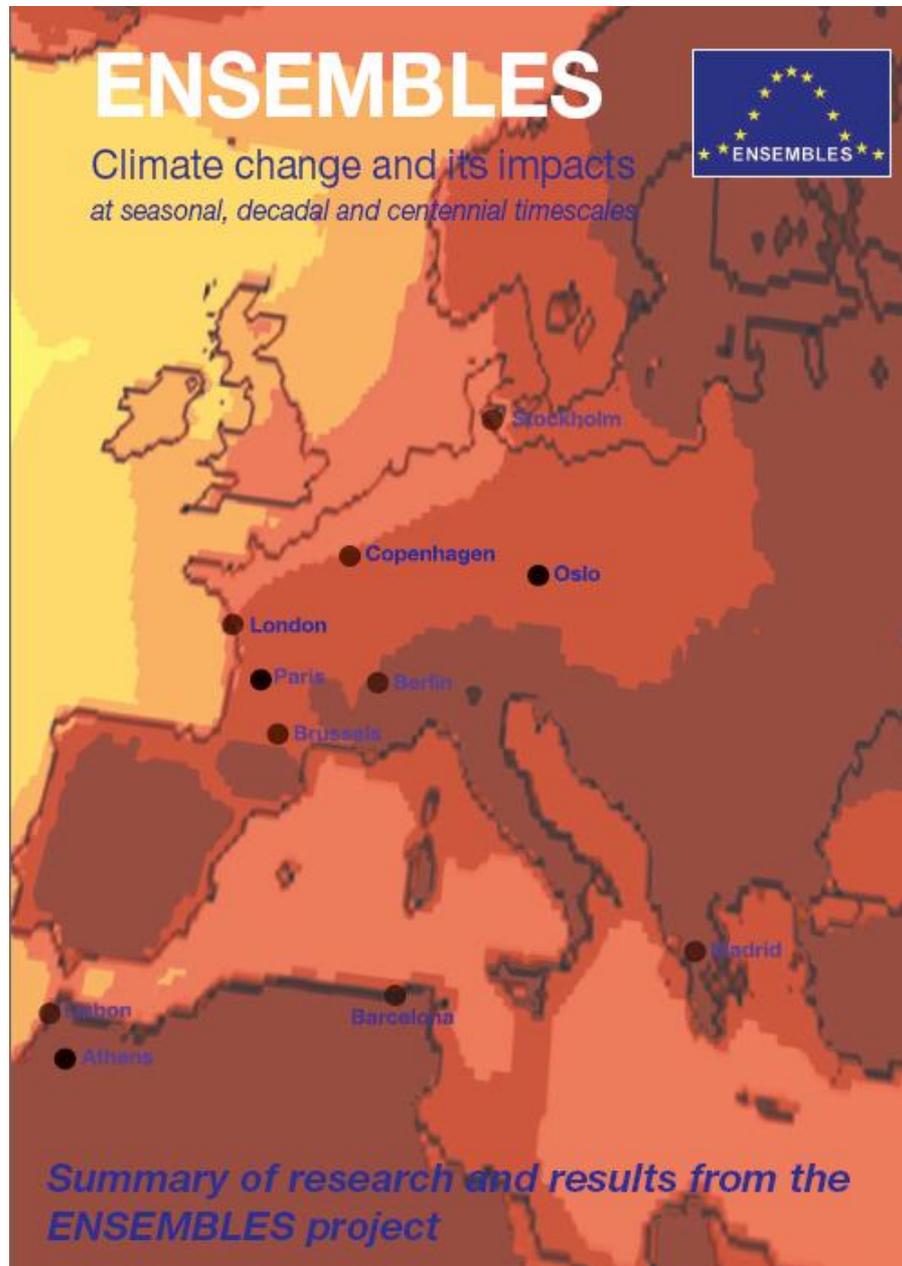
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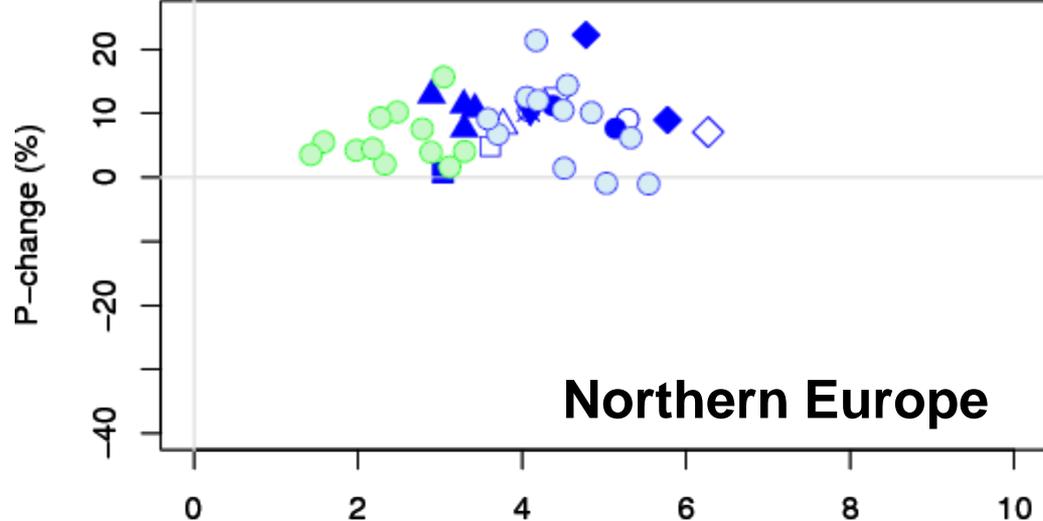
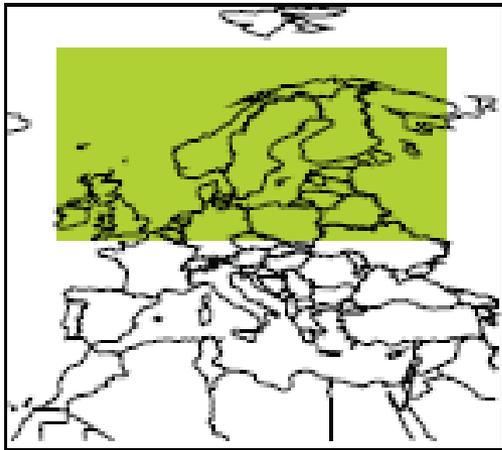
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# How are IAV analysts coping with multi-model ensembles and probabilistic climate projections?





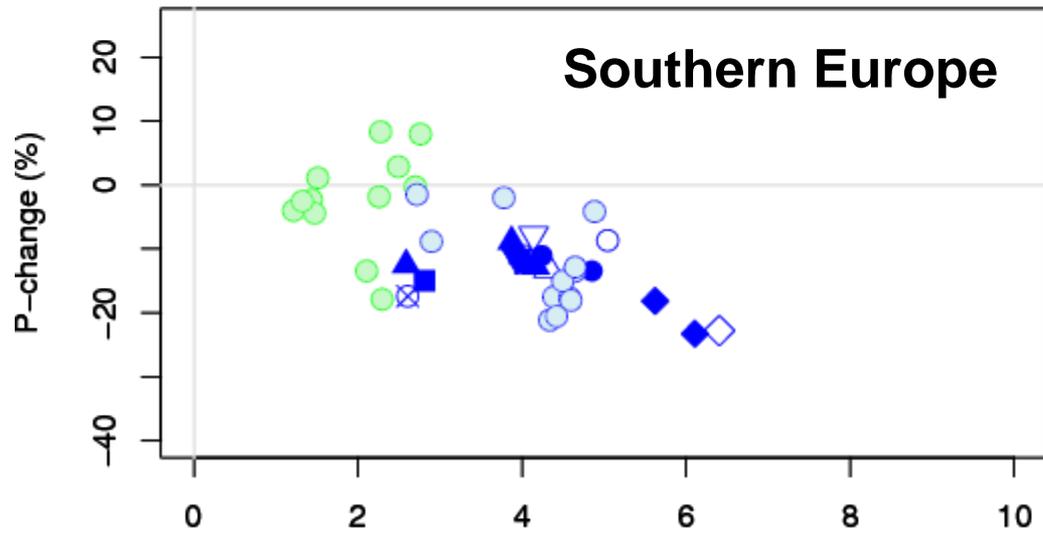
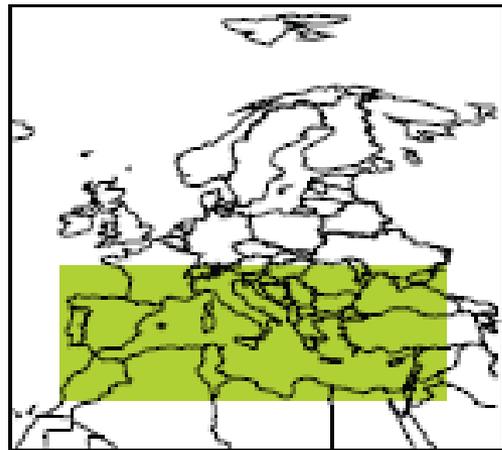
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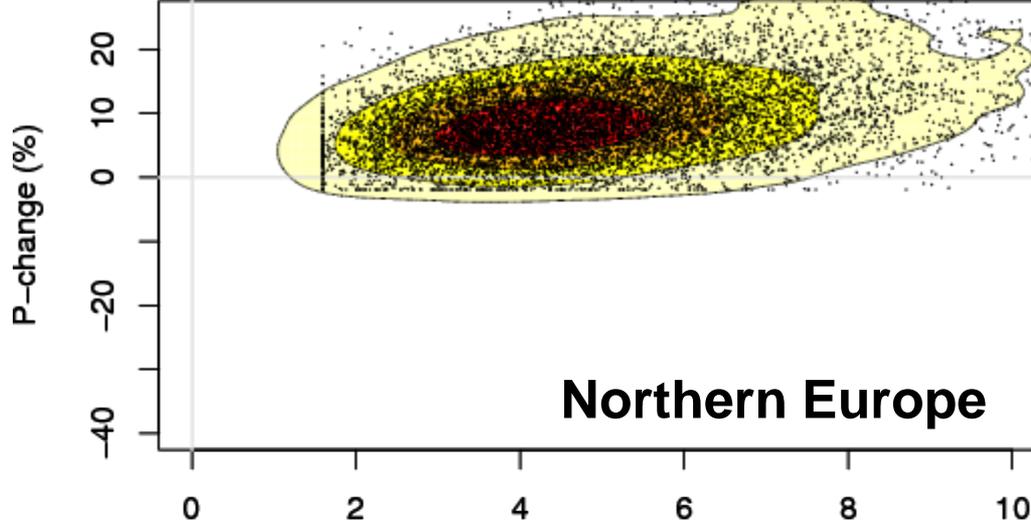
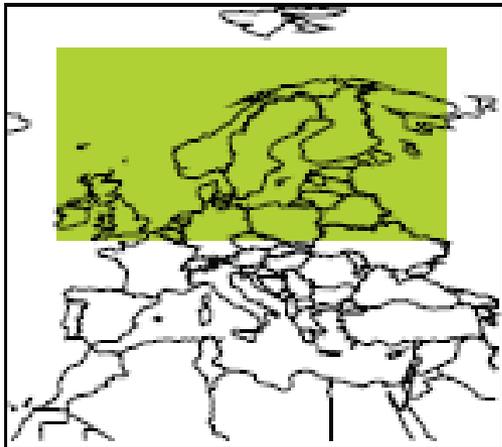
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2080-2100



$\Delta T$  (°C)



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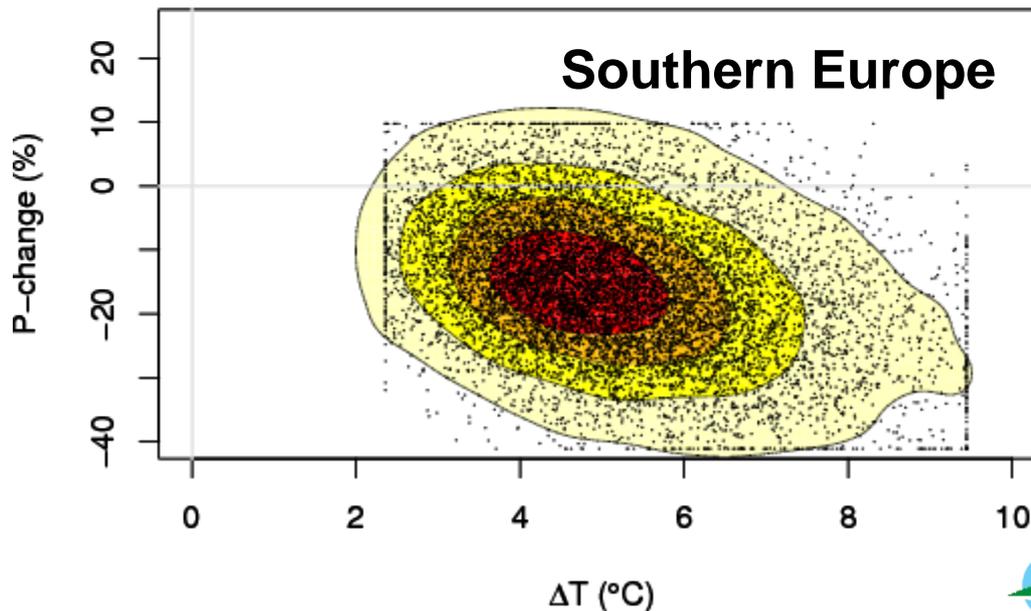
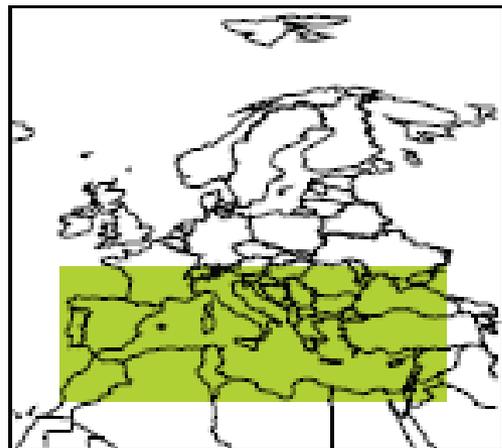
Grand ensemble, A1B

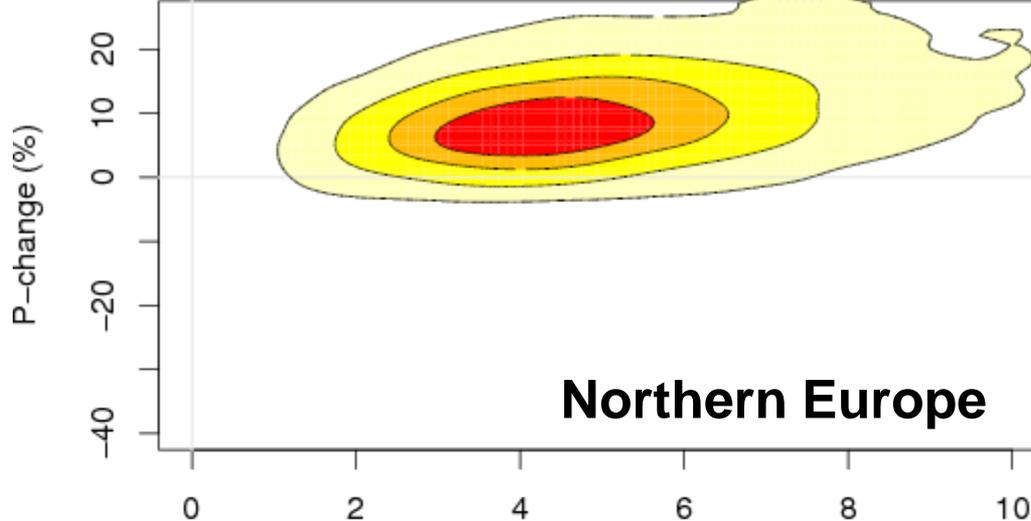
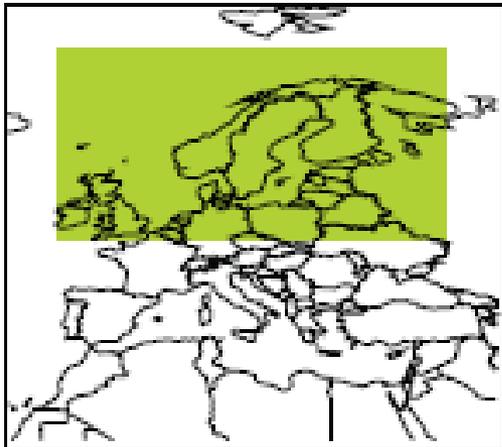
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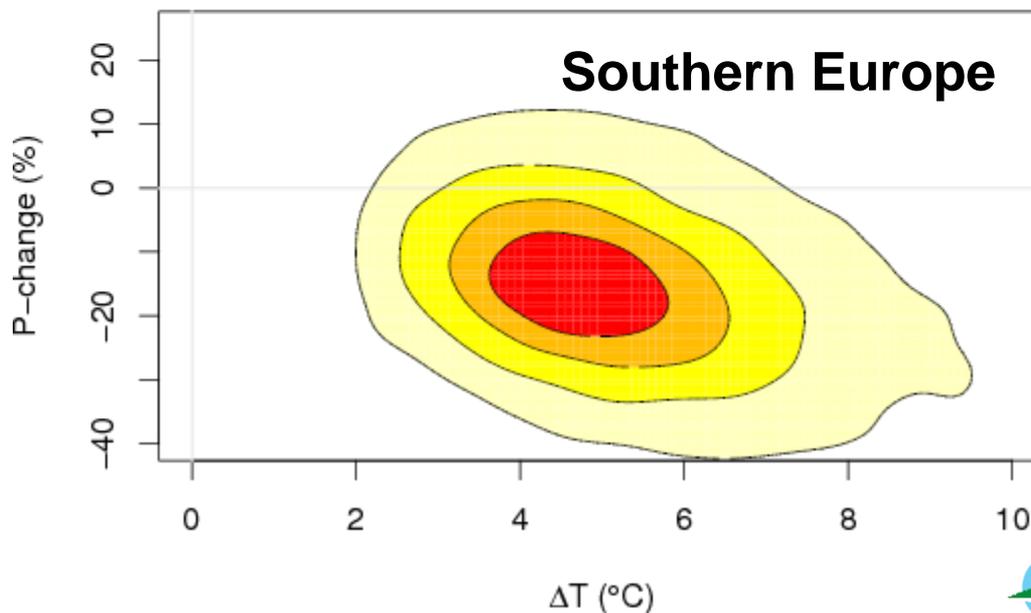
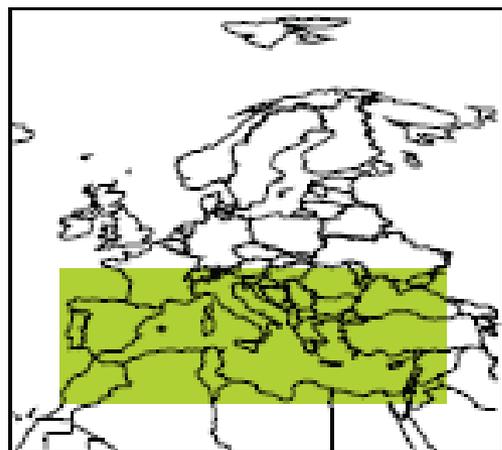
Grand ensemble, A1B

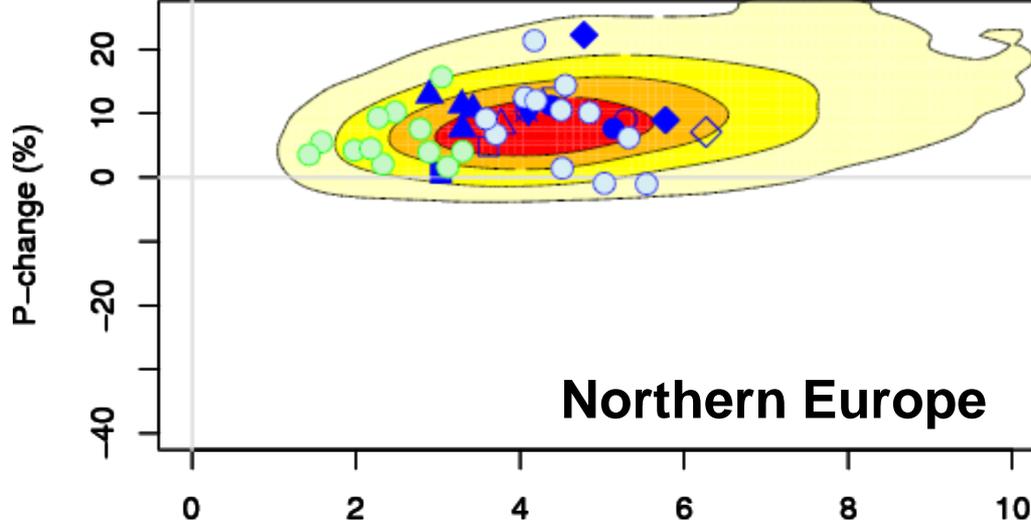
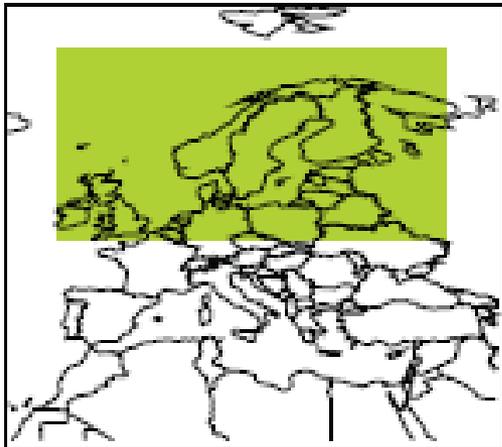
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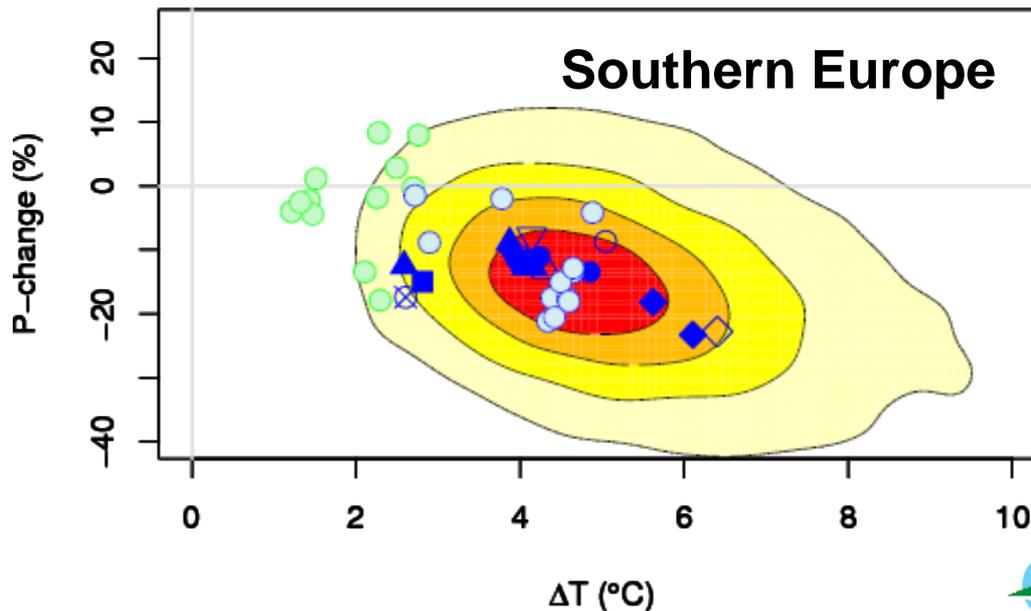
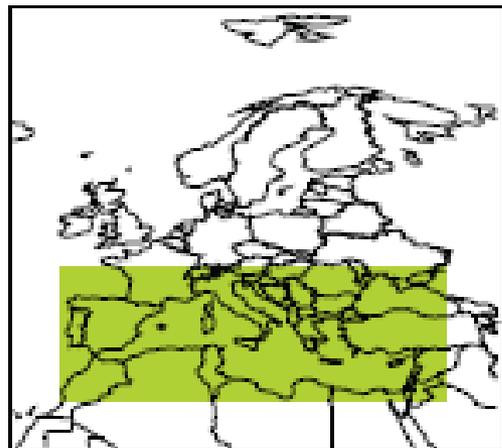
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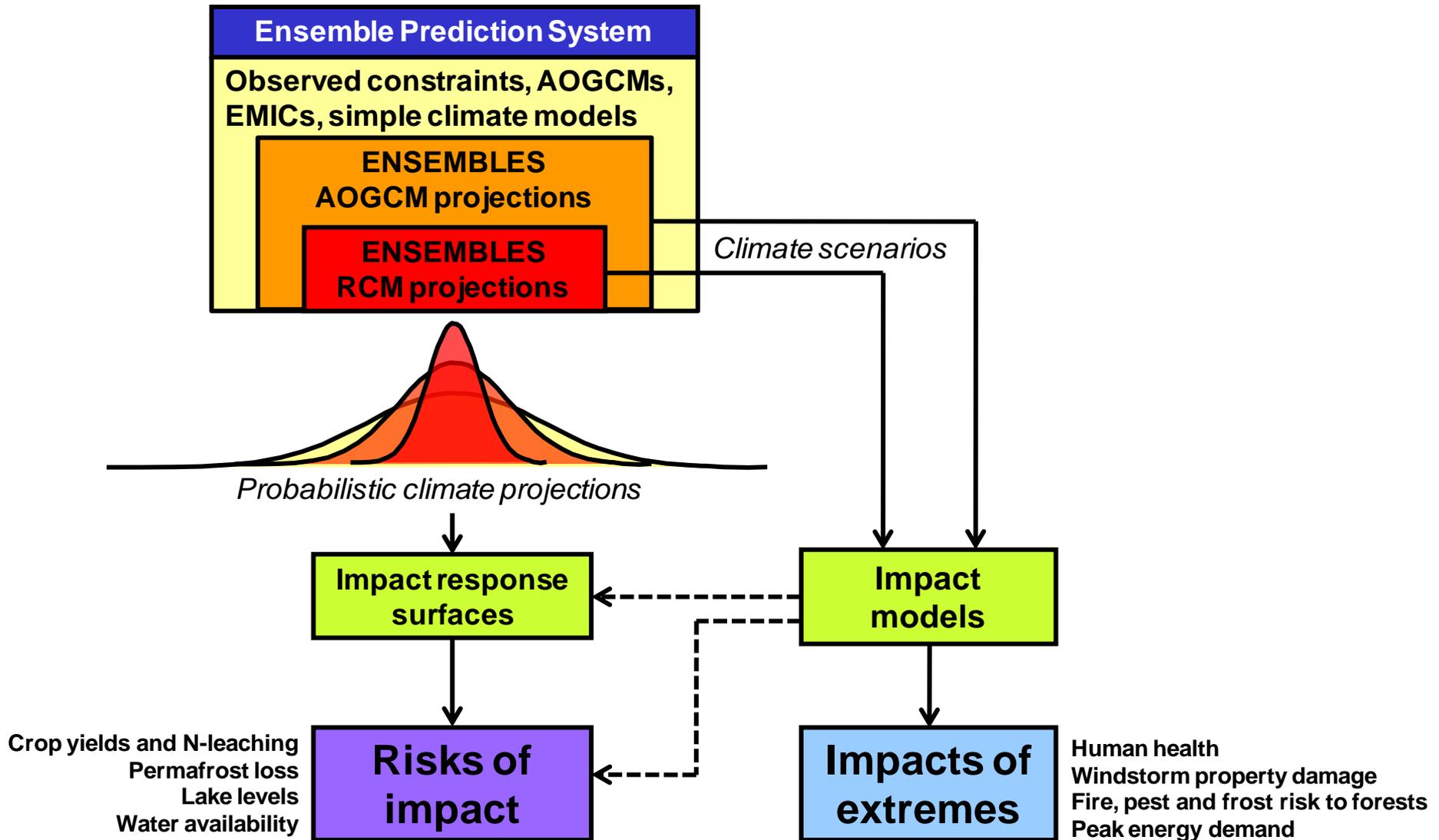
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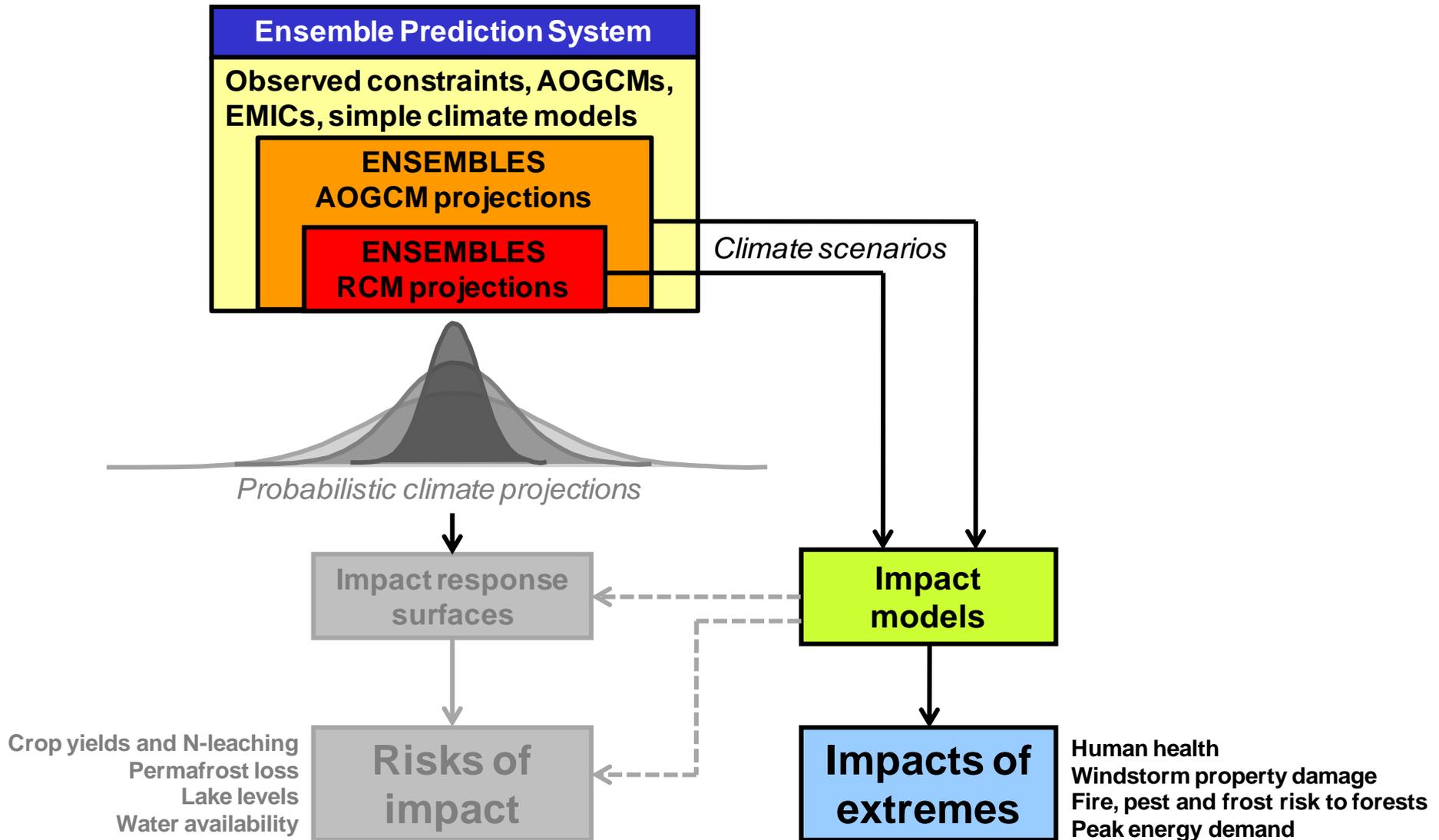
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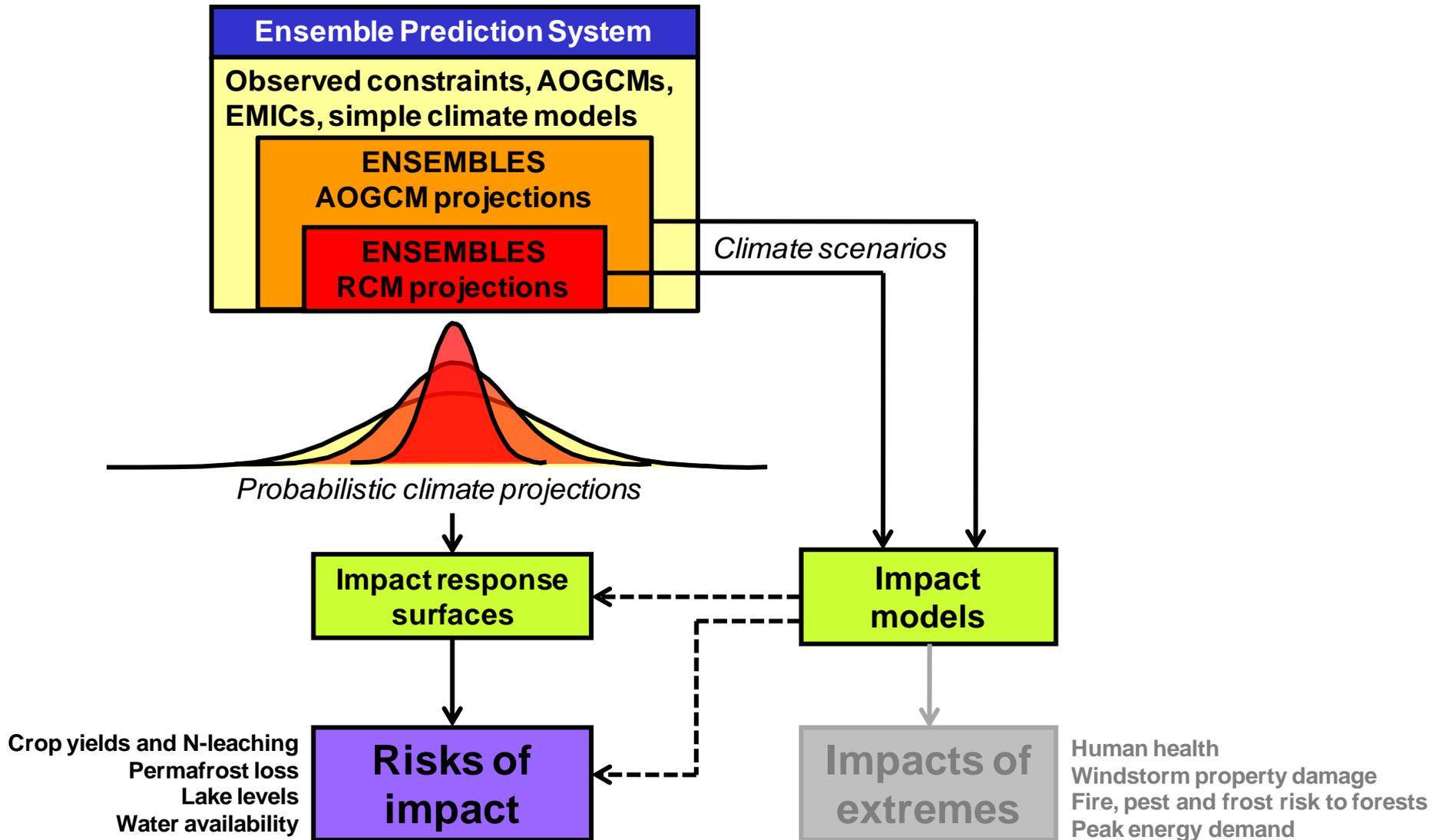
# European ENSEMBLES project: climate projections and some applications in impact studies



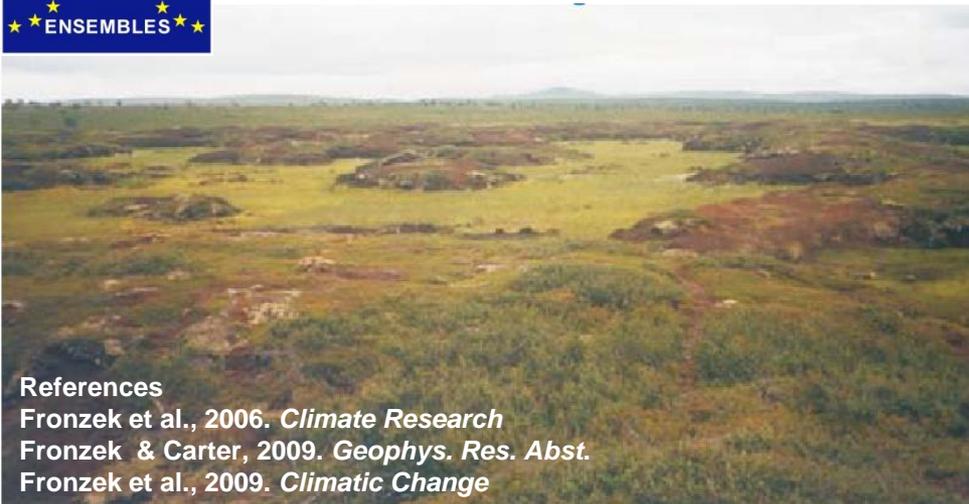
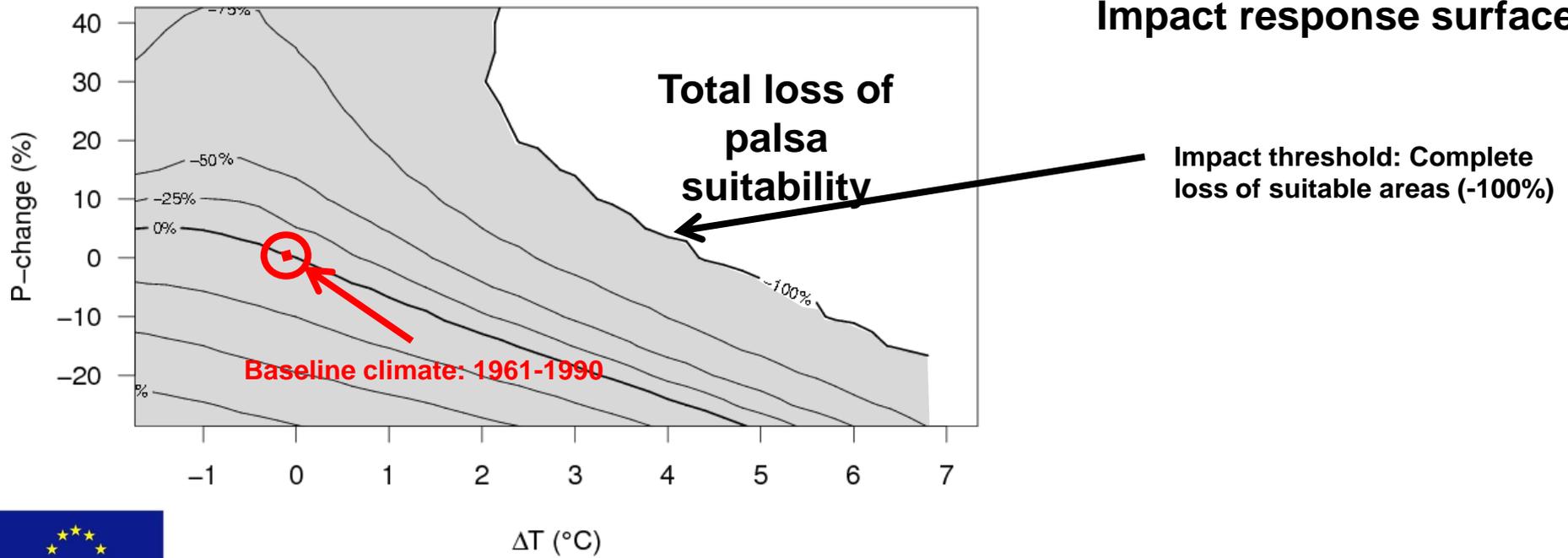
# Assessing impacts: conventional approach



# Assessing impacts: risk-based approaches

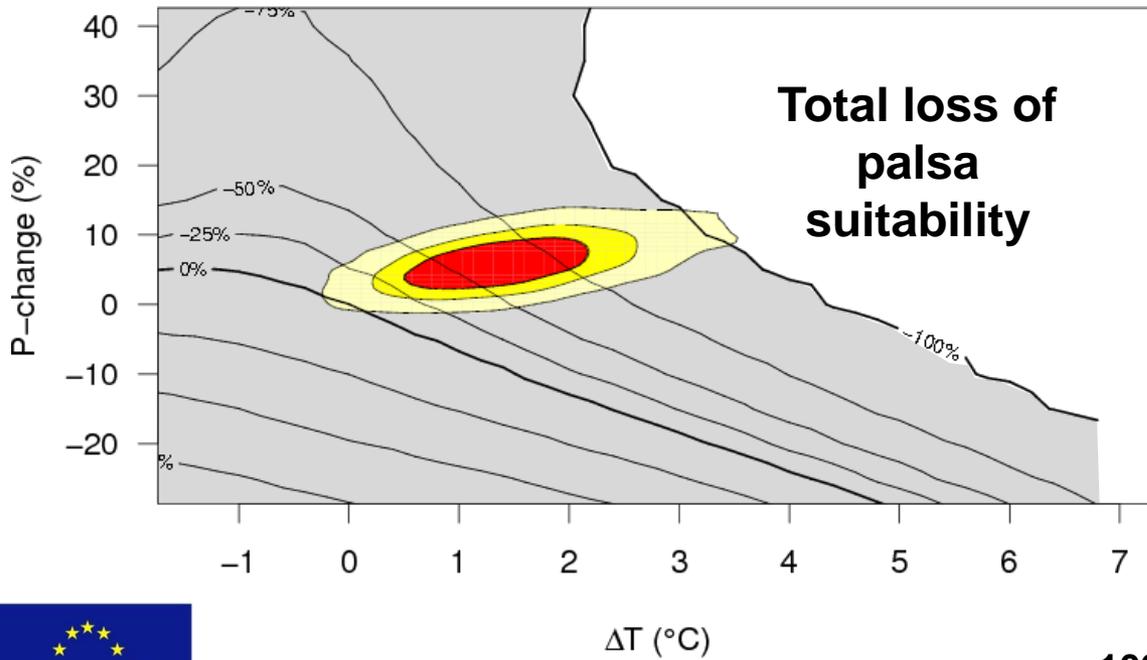


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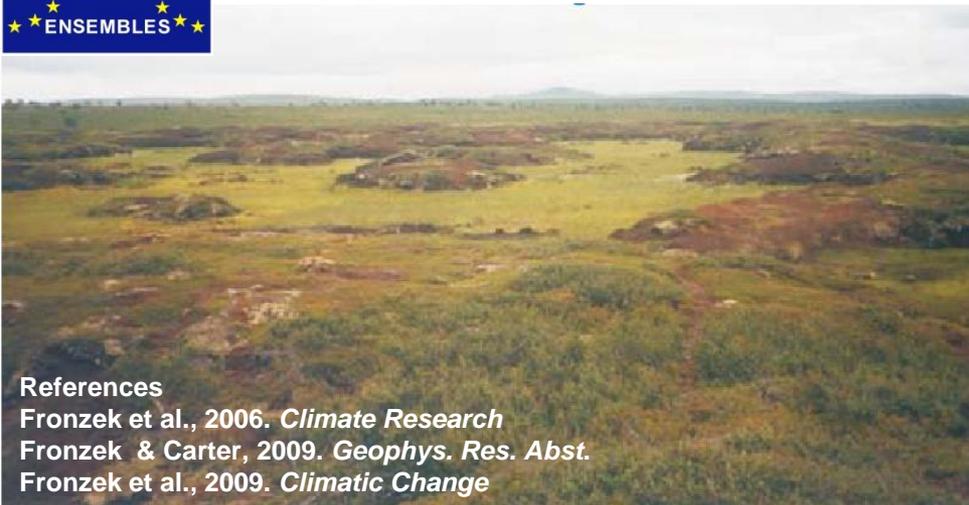
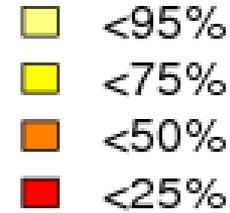


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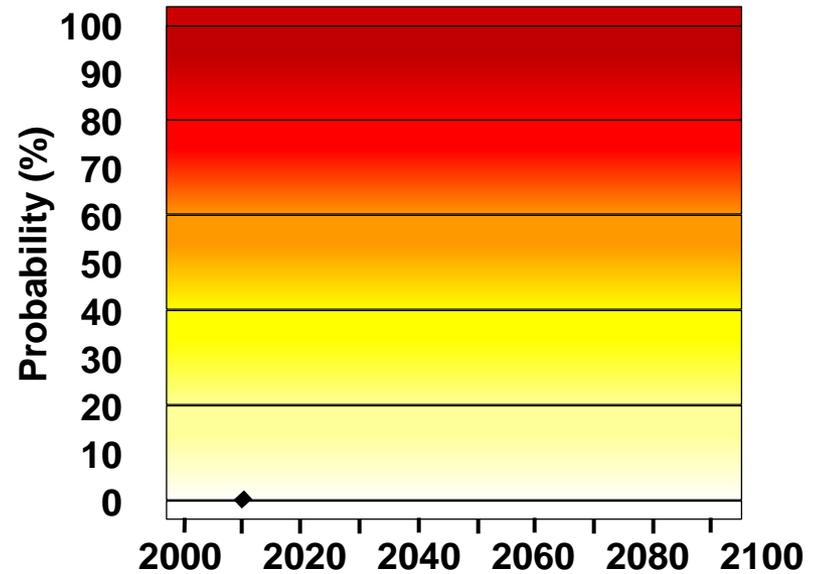
# 2000-2020



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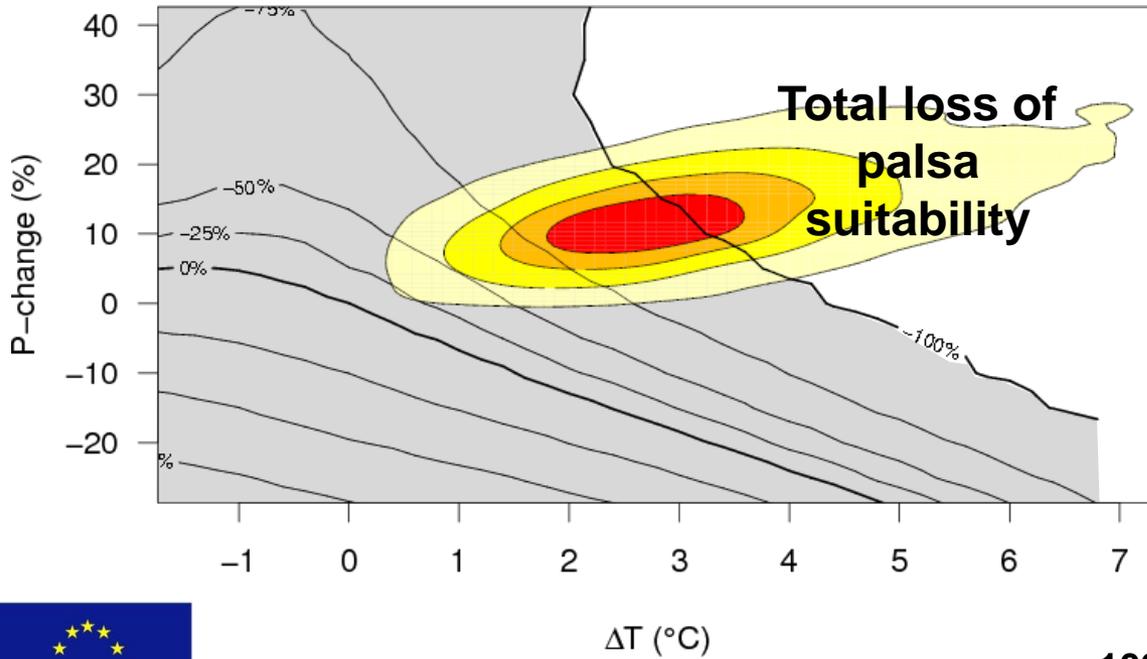


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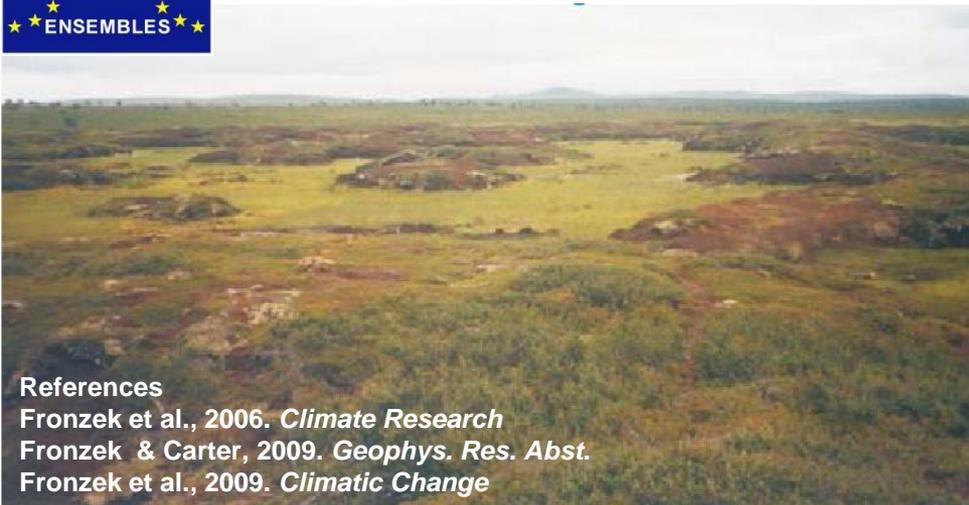
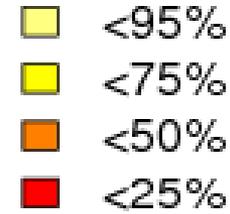


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 Fronzek & Carter, 2009. *Geophys. Res. Abst.*  
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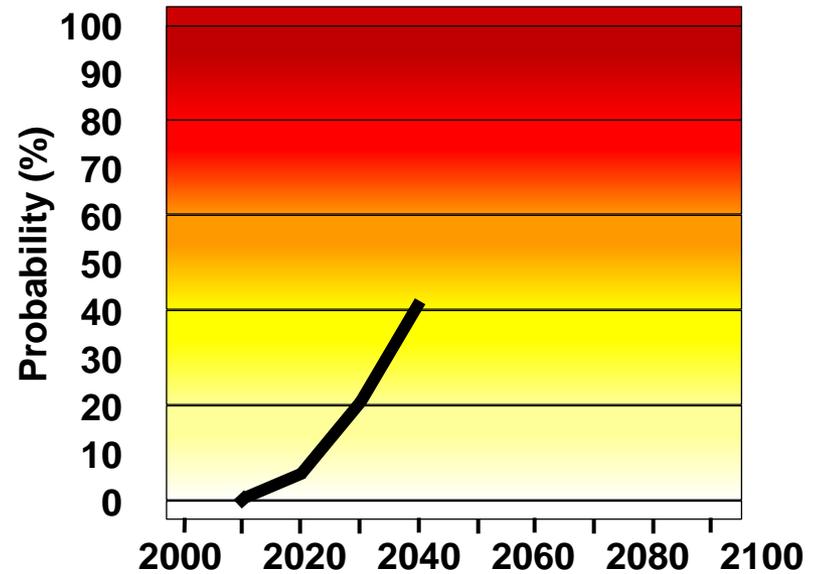
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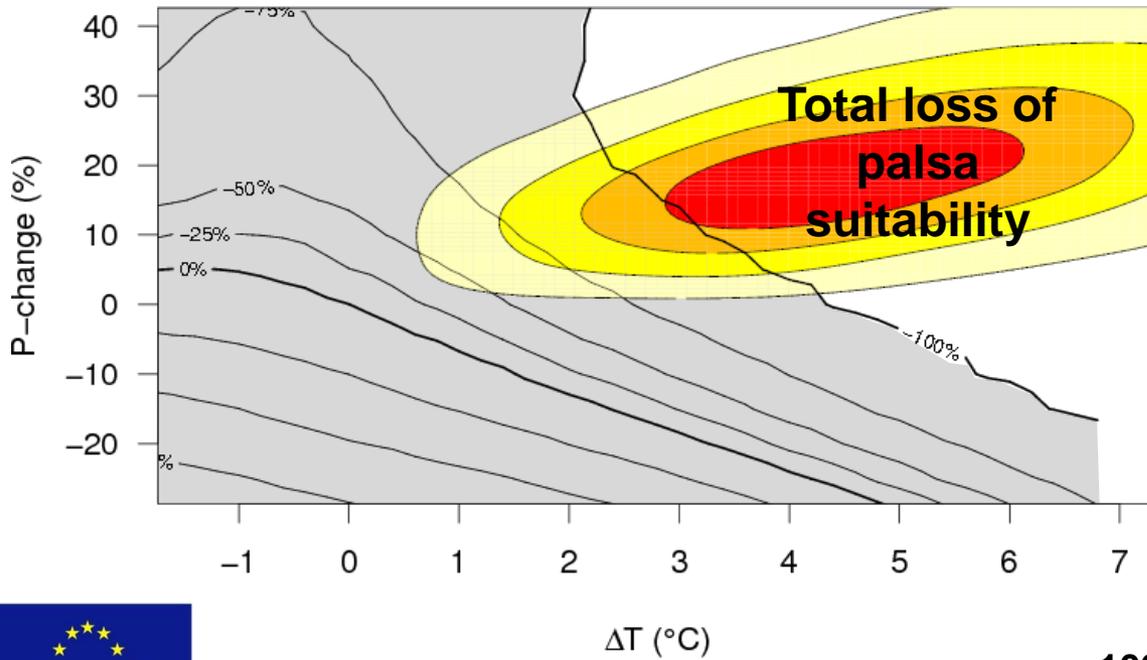


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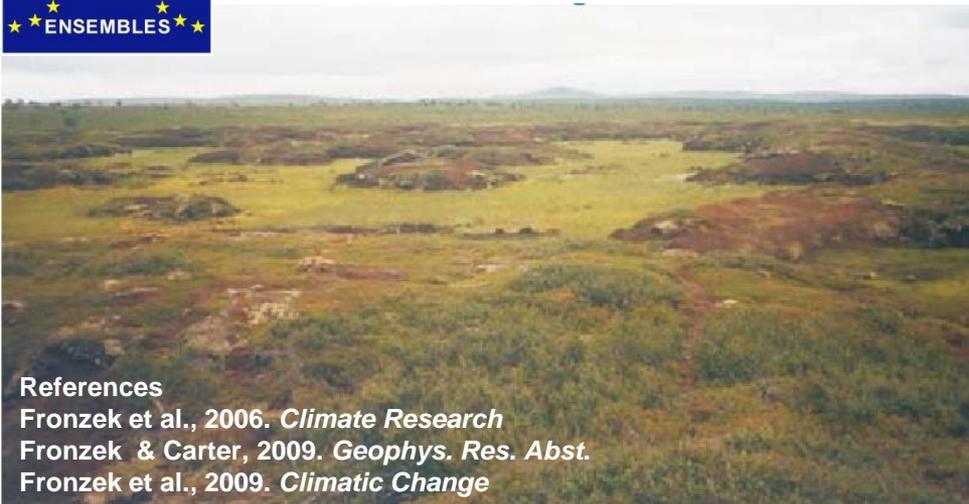
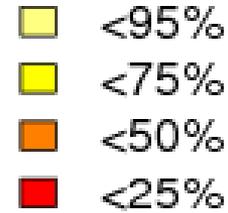


References  
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 Fronzek & Carter, 2009. *Geophys. Res. Abst.*  
 Fronzek et al., 2009. *Climatic Change*

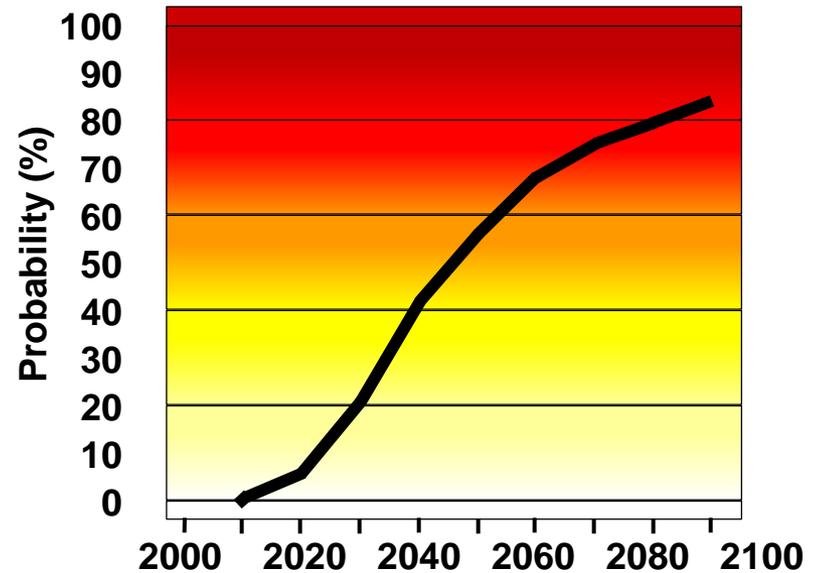
# 2080-2100



## Impact response surface and climate PDF (A1B)



## Probability of palsa mire loss



### References

- Fronzek et al., 2006. *Climate Research*
- Fronzek & Carter, 2009. *Geophys. Res. Abst.*
- Fronzek et al., 2009. *Climatic Change*

1 **Good Practice Guidance Paper on “Assessing and Combining Multi Model Climate Projections”**

2 In: Meeting Report of the Intergovernmental Panel on Climate Change Expert Meeting on MME [Stocker,  
3 T.F. et al. (eds.)]. IPCC Working Group I Technical Support Unit, University of Bern, Bern, Switzerland.

4 Core writing team: Knutti, R., G. Abramowitz, M. Collins, V. Eyring, P. J. Gleckler, B. Hewitson, and L.  
5 Mearns

6 Draft 8, April 19, 2010

7 **Executive Summary**

8 Climate model simulations provide a cornerstone for climate change assessments. This paper summarizes the  
9 discussions and conclusions of the joint Expert Meeting of Working Group I and Working Group II of the  
10 Intergovernmental Panel on Climate Change (IPCC WGI/WGII) on “Assessing and Combining Multi Model  
11 Climate Projections”, which was held in Boulder, USA on 25-27 January 2010. It seeks to briefly summarize  
12 methods used in assessing the quality and reliability of climate model simulations and in combining results  
13 from multiple models. It is intended as a guide for future IPCC Lead Authors as well as scientists using  
14 results from model intercomparison projects. This paper provides recommendations for good practice in  
15 using multi-model ensembles for detection and attribution, model evaluation and global climate projections  
16 as well as regional projections relevant for impact and adaptation studies. It illustrates the potential for, and  
17 limitations of, combining multiple models for selected applications. Criteria for decision making concerning  
18 model quality and performance metrics, model weighting and averaging are recommended. This paper does  
19 not, however, provide specific recommendations regarding which performance metrics to use, since this will  
20 need to be decided for each application separately.

21 **1. Key terminology**

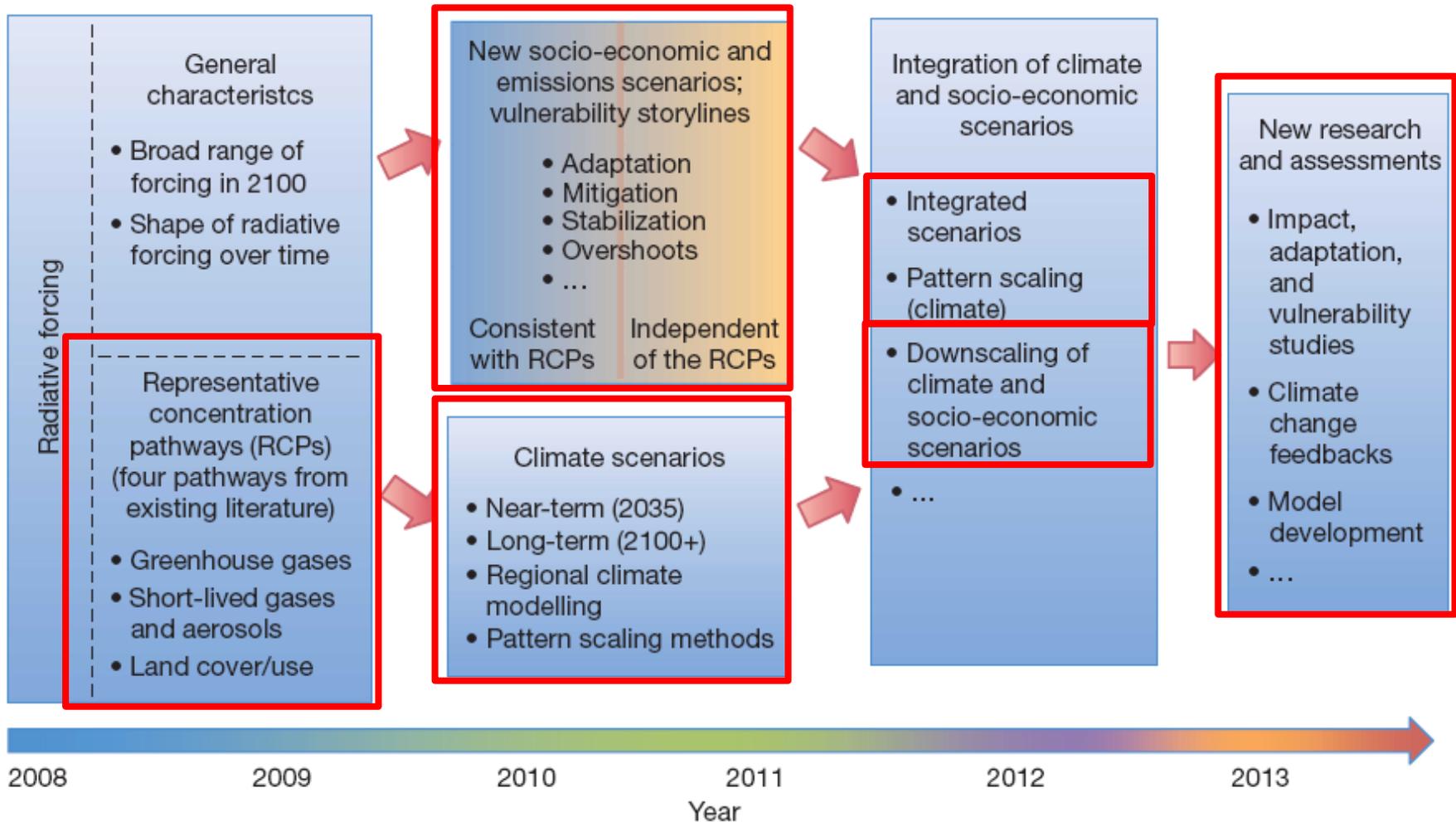
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# Representative Concentration Pathways (RCPs)

- Who's running them – CMIP5
- Who's contextualising them – IAMs
- Who's downscaling them – CORDEX
- Who's classifying them?
- Who's going to be using them – IAV and all

Challenge: Reconciling RCPs with SRES

# New scenarios for climate change research



Source: Moss et al. (2010)

# Climate Services

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**DO 1** We, Heads of State and Government, Ministers and Heads of Delegation present at the High-level Segment of the World Climate Conference-3 (WCC-3) in Geneva, noting the findings of the Expert Segment of the Conference;

**OP 1** *Decide* to establish a Global Framework for Climate Services (hereafter referred to as "the Framework") to strengthen production, availability, delivery and application of science-based climate prediction and services;

**OP 2** *Request* the Secretary-General of WMO to convene within four months of the adoption of the Declaration an intergovernmental meeting of member states of the WMO to approve the terms of reference and to endorse the composition of a task force of high-level, independent advisors to be appointed by the Secretary-General of the WMO with due consideration to expertise, geographical and gender balance;

**OP 3** *Decide* that the task force will, after wide consultation with governments, partner organizations and relevant stakeholders, prepare a report, including recommendations on proposed elements of the Framework, to the Secretary-General of WMO within 12 months of the task force being set up. The report should contain findings and proposed next steps for developing and implementing a Framework. In the development of their report, the taskforce will take into account the concepts outlined in the annexed [Brief Note](#);

**OP 4** *Decide* further that the report of the task force shall be circulated by the Secretary-General of WMO to Member States of the WMO for consideration at the next WMO Congress in 2011, with a view to the adoption of a Framework and a plan for its implementation; and

**OP 5** *Invite* the Secretary-General of WMO to provide the report to relevant organizations, including the UN Secretary-General.

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- UKCP09 Course 2: CDFs, PDFs, joint probabilities & raw data
- UKCP09 Course 3: Marine
- UKCP09 Course 4: Weather Generator

To keep up to date with new courses, events and more, [sign up for UKCIP enews](#). For details of the full range of UKCIP courses, go to the [UKCIP website](#).

## Online learning resources

To support your application of the case studies to your own work, it is important to understand how the outputs were created and how they can be interpreted. The UKCIP online learning resources website houses a range of guides and exercises that have been developed to support your use of UKCP09. The resources include:

[Start page](#)[My jobs](#)[My details](#)[UI manual](#)[UKCP09 website](#)[Helpdesk](#)

You are here: > [Request Builder](#) > [Variable selection](#)

**Logged in as:**

tim.carter@ymp...

[Logout](#)**Logged in users:**

1

You have no  
pending jobs.

See [My Jobs](#) for  
previously run jobs.

**Request Status:****Request Summary:**

### Starting by selecting a climate variable

This page is intended for novice users of the UI who are primarily interested in a single climate variable. A list of climate variables <sup>1</sup> is displayed below. On selecting a variable you will see a list of data sources <sup>1</sup> for which that variable is available. In some cases you will also be asked whether you should select future climate change only <sup>1</sup> of future absolute climate values <sup>1</sup> where both are available.

[Read about how to using the variable start page in the UI Manual.](#)

**Variable**

- Mean air temperature <sup>1</sup>
- Mean daily maximum temperature <sup>1</sup>
- Mean daily minimum temperature <sup>1</sup>
- Temperature of the coolest day <sup>1</sup>
- Temperature of the warmest day <sup>1</sup>
- Temperature of the coldest night <sup>1</sup>
- Temperature of the warmest night <sup>1</sup>
- Precipitation <sup>1</sup>
- Precipitation on the wettest day <sup>1</sup>
- Mean sea level pressure <sup>1</sup>
- Total cloud cover <sup>1</sup>
- Relative humidity <sup>1</sup>
- Specific humidity <sup>1</sup>
- Net surface longwave flux <sup>1</sup>
- Net surface shortwave flux <sup>1</sup>
- Total downward surface shortwave flux <sup>1</sup>
- Standard Weather Generator Variables (mandatory) <sup>1</sup>



- Start page
- My jobs
- My details
- UI manual
- UKCP09 website
- Helpdesk

You are here: > Request Builder > Location selection

Logged in as:  
tim.carter@ymp...  
[Logout](#)

Logged in users: 1

You have no pending jobs.  
See [My Jobs](#) for previously run jobs.

Request Status:

Request Summary:

### Selecting your UK location first

This page is intended for novice users of the UI who know what location they are interested in. This page should be used as follows:

- Step 1: Click on a point on the map (or type in the latitude/longitude coordinates and click "Select".
- Step 2: Select a data source of interest from the list that appears on the right.
- Step 3: Select the variable you are interested in and click the "Next" button.

You can search by place name or postcode using the box on the right-hand side. Note that clicking a result re-centres and zooms the map to the new location but does not make a selection.

Selections on this page are restricted in that only a single location may be selected. Weather Generator simulations and Marine Model Simulations are not available from this start point.

[Read about starting your request by making spatial selections in the UI Manual.](#)



[Next](#)

Search place name or postcode to re-centre map:  [Search](#) [Clear](#)

Results

---

Select by Latitude / Longitude by:

Latitude:

Longitude:

[Select](#)

---

**Step 2: Select a data source**

At your chosen location, there is data for following data sources (clicking an option will highlight the selected location on the map adjacent):

---

**Step 3: Select a variable**

Please choose one of the following variables. [1](#)

[Next](#)

[Climate](#) [Socio-economy](#) [International](#) [Research](#) [Cases](#) [Newsletter](#) [Publications](#) [About us](#)

Frontpage

[Coast](#) [Buildings](#) [Water](#) [Energy](#) [Agriculture](#) [Forest](#) [Fisheries](#) [Planning](#) [Health](#) [Preparedness](#) [Nature](#)

Climate change influences many areas of our lives. This portal contains knowledge about climate change and provides ideas on how we can adapt to it.

## Citizens

Are you prepared for climate change?

## Municipalities

Danish municipalities and climate change

## Businesses

Danish enterprises and climate change

What does climate change mean for Danish enterprises?



## Danish Strategy

- [Read the Danish strategy for adaptation to a changing climate](#)

## Latest news in English:

- [Newsletter #1](#)

## Cases

- [New storm surge scheme to promote climate change adaptation actions](#)
- [No more overloaded sewer systems](#)
- [Can the roads cope with more water?](#)

[> View all](#)

## Climate change

Climate change means changes in temperatures, precipitation and other extremes.



- [Read about the future climate](#)

## FAQ

- [How is the risk of flooding and coastal erosion assessed?](#)
- [Will climate change bring new diseases to Denmark?](#)
- [What will a more humid climate mean for the indoor climate?](#)
- [How can forests be adapted to climate change?](#)

# Climate Systems Analysis Group

Data Dissemination System



HOME

DOCUMENTATION

DATA ACCESS

REGISTER

RESOURCES

Please browse the documentation on this page. At other places in the site you will see a link to "documentation" which will take you to context sensitive documentation.

## Preamble

The data provided on this portal are the result of many years of research by climatologists within the **Climate Systems Analysis Group (CSAG)** at the **University of Cape Town (UCT)** in collaboration and in parallel with research into the **Global Climate Models (GCMs)** which form the basis for much of the data. Additional ideas and discussions from international collaborators have also been key in the development of data and procedures. This portal was implemented in response to the large demand from the varied stakeholder community for these data, and in an effort to promote further research, as well as the application of the data for adaptation planning and risk management.

## Table of Contents

1. Status and Future Developments
  1. Conclusion of Pilot Phase
  2. Future Developments
2. Data Interpretation Issues
3. Guidance Documentation and Supporting Material
  1. Station Locations
4. Usage Policy
  1. Commercial Usage
  2. Academic Usage

## Status and Future Developments

### Conclusion of Pilot Phase

The initial pilot phase of the portal, which took place during the past 10 months, has proven to be successful in terms of

### Climate News

End of pilot phase (26 Nov 2009)  
We have reached the end of the pilot phase of this development. Registrations are now closed. Currently registered users will receive an email shortly describing the exciting new development that will be launched in early 2010. Please see the documentation page for more details.

# EU White Paper (2009)



COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 1.4.2009  
COM(2009) 147 final

## WHITE PAPER

**Adapting to climate change: Towards a European framework for action**

{SEC(2009) 386}

{SEC(2009) 387}

{SEC(2009) 388}

# Proposed European Clearing House on Climate Change Impacts, Vulnerability and Adaptation

## Climate change observations and scenarios

*Comprehensive EU wide dataset on CC scenarios and indicators*

- GMES - Essential climate variables
- ENSEMBLES
- Link with GFCS + regional / national centers

## Impacts & Vulnerability

*Integration information on climate, land-use, water, ecosystems, socio-economic variables*

- Exposure to impacts, sensitivity and adaptive capacity
- Detailed geographical and sectoral perspective
- Vulnerability indicators, policy-oriented

## Adaptation plans and strategies

- Information on existing adaptation strategies, key institutions and stakeholders
- Joint activities between MS and third countries (research, adaptation measures)
- Practical tools for the development of adaptation policy

## Adaptation measures, actions

*Extended database of measures*

- Typology
- Assessment of their environmental, social, economic impacts
- Identifying no-regret measures

Source: Jacques Delsalle, European Commission, DG Environment  
<http://www.circle-era.net/fileadmin/upload/documents/Delsalle.pdf>

# IPCC Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA)

## From the TGICA mandate:

### 3. Activities

**3.1 The TGICA coordinates a Data Distribution Centre (DDC) which provides data sets, climate and other scenarios, and other materials (e.g., technical guidelines on use of scenarios).**

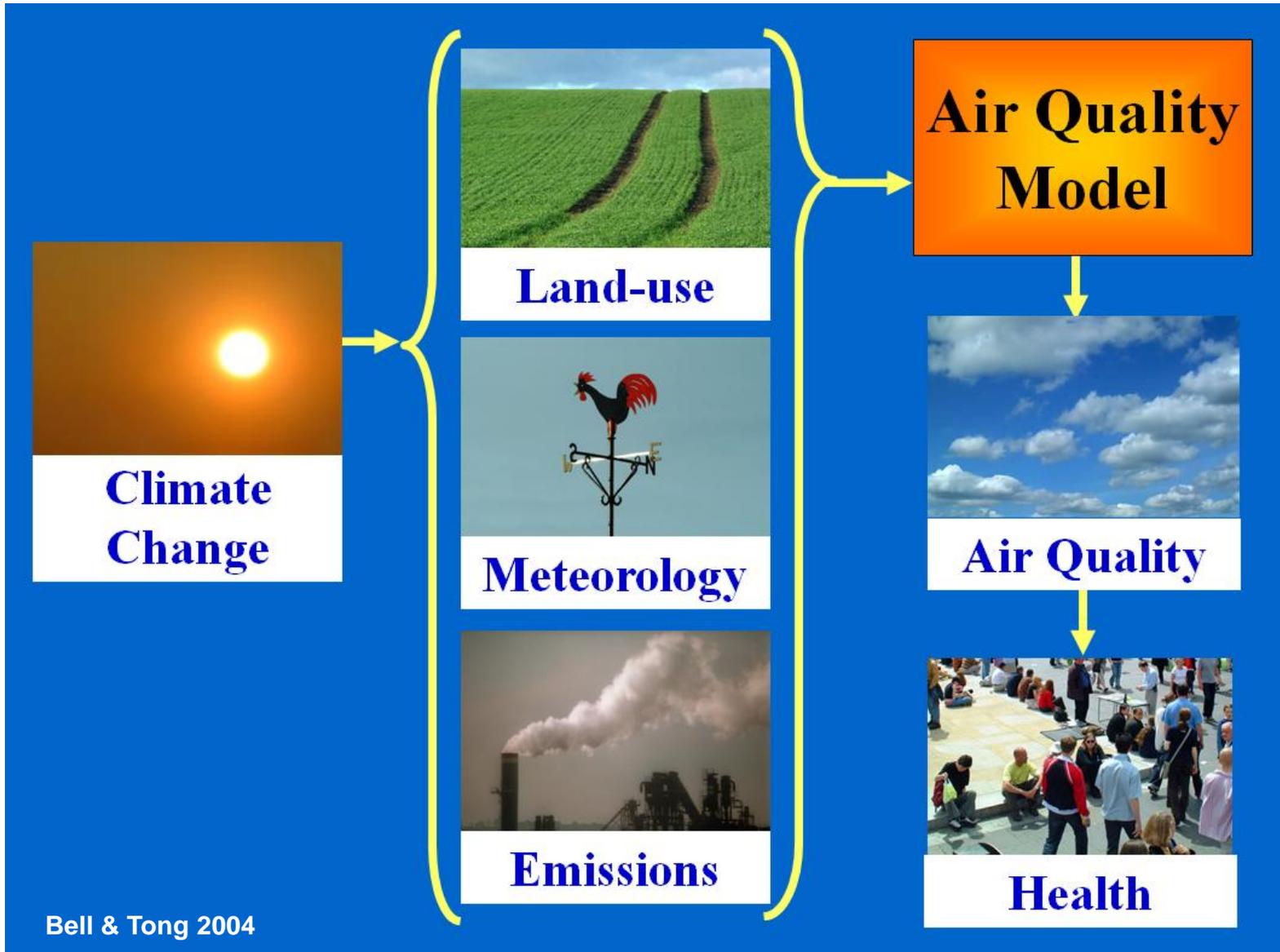
**3.2 The TGICA identifies information needs in support of IPCC work, facilitates research on climate impacts, adaptation, and mitigation, and makes related recommendations on cross-cutting issues. These activities will be carried out in consultation with the three Working Group Co-Chairs. The TGICA will also solicit feedback from user communities.**

**3.3 The TGICA contributes to building capacity in the use of data and scenarios for climate-related research in developing and transition-economy regions and countries. TGICA works with organizations and activities that have training as their core mandate but does not develop training programs on its own.**

**3.4 The TGICA may convene expert meetings on an as needed basis.**

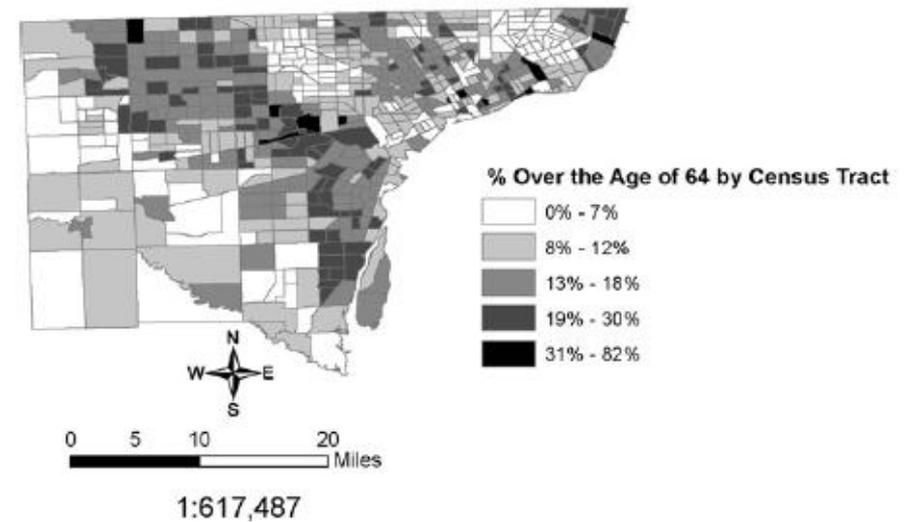
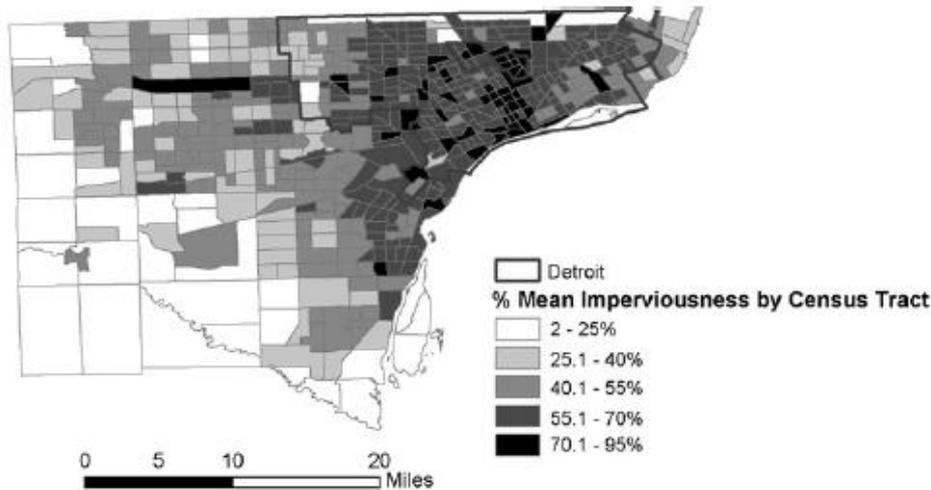
Co-Chairs	Members		Ex officio
Jose Marengo, Brazil Richard Moss, USA	Daniel Bouille, Argentina Mercedes Bustamante, Brazil Timothy R. Carter, Finland Stewart J. Cohen, Canada Suraje Dessai, UK Mariane Diop-Kane, France Seita Emori, Japan Bruce Hewitson, South Africa Gregory E. Insarov, Russia Kejun Jiang, China Tom Kram, Netherlands	Volker Krey, Austria Won-Tae Kwon, South Korea Jason Lowe, UK Francisco Meza, Chile Andy Reisinger, New Zealand Fredrick Semazzi, USA Claudia Tebaldi, Canada Allison Thomson, USA Rachel Warren, UK Arthur Webb, Fiji Fernanda Zermoglio, Sweden	Martin Juckes (DDC, BADC) Michael Lautenschlager (DDC, MPI) Robert Chen (DDC, CIESIN) Pauline Midgley (IPCC, WG1 TSU) Kristie Ebi (IPCC, WG2 TSU) Patrick Matschoss (IPCC, WG3 TSU) Karl Taylor (PCMDI) Xianfu Lu (UNFCCC)

# Local IAV assessments increasingly require integrated approaches



Bell & Tong 2004

# Two candidate indicators of vulnerability to heat mortality and morbidity in Wayne County, MI, USA



Percentage mean impervious surface by census tract (2001 National Land Cover Data)

Percent non-white population, 2000 Census (highly correlated with socio-economic disadvantage in the U.S.)

O'Neill et al. 2009

# Example of the types of local adaptive responses (labelled mitigation activities) that might require quantitative information at local scales to inform decisions

Costs and benefits	Mitigation activities					
	Tree planting	Cooling centers	Reflective paving	Reflective roofing	Increased air conditioning	Heat health warning system
Heat exposure reduction (°C)	-3	-5	-4	-3	-5	-3
Air pollution (e.g., PM <sub>10</sub> , in µg/m <sup>3</sup> )	-5	+5	-1	-1	+7	+1
Mortality reduction (% drop per °C)	-3	-5	-4	-3	-5	-3
Health cost savings in dollars	4	5	3	2	6	7
Energy cost or savings in dollars	5	-2	2	2	-5	-1
Net cost or benefit <sup>a</sup>						

<sup>a</sup> This would be calculated by combining the above variables and other informations for each activity based on local conditions. Numbers shown are just for the purpose of illustrating potential estimates.

O'Neill et al. 2009

# Flashback

# Conclusions

- **There is already considerable "bottom-up" activity providing climate information to support adaptation decisions**
  - National web portals
  - Analytical tools for processing climate information
  - Observational datasets
- **These initiatives should be evaluated by the IPCC**
- **The large volume of climate data anticipated from the AR5 scenario process demands creative approaches to data analysis and delivery (e.g. using probabilistic methods)**
- **A programme of systematic downscaling from global model outputs in different world regions will add to the volume of data, but:**
  - would provide fine resolution data to regions hitherto deprived, including many of the most vulnerable
  - can offer new information on extreme weather events
  - presents a regional focus of direct relevance to regional scientists and policy makers

# Fast forward

# Conclusions

## Present knowledge

Vast body of information on recent and projected climate though with regional gaps in data provision and IAV access

Excellent global pool of expertise in climate science, but uneven regionally and constrained disciplinarily

Operational weather services with *ad hoc* climate advice; TGICA inactive

Climate scenarios gradually being superseded by scenario-based predictions

New scenarios designed to frame climate uncertainties

IAV community organised only during IPCC assessment cycle; largely reactive

## Future needs

More even global coverage; improved quality control and interpretation; ready access to data for IAV

Spread capacity regionally; share experiences across disciplines; explore synergies and integration

Operational climate services; TGICA linking and facilitating role?

Probabilistic projections are challenging to interpret and apply in IAV assessment

New storylines to contextualise climate and non-climate scenarios

IAV research community internationally organised and proactive

# How the knowledge is used is another matter!



# Notice

**Colleagues are welcome to incorporate these slides into their own presentations, assuming they are correctly acknowledged. However, the author would also appreciate being informed prior to the extensive use of this material in public meetings.**