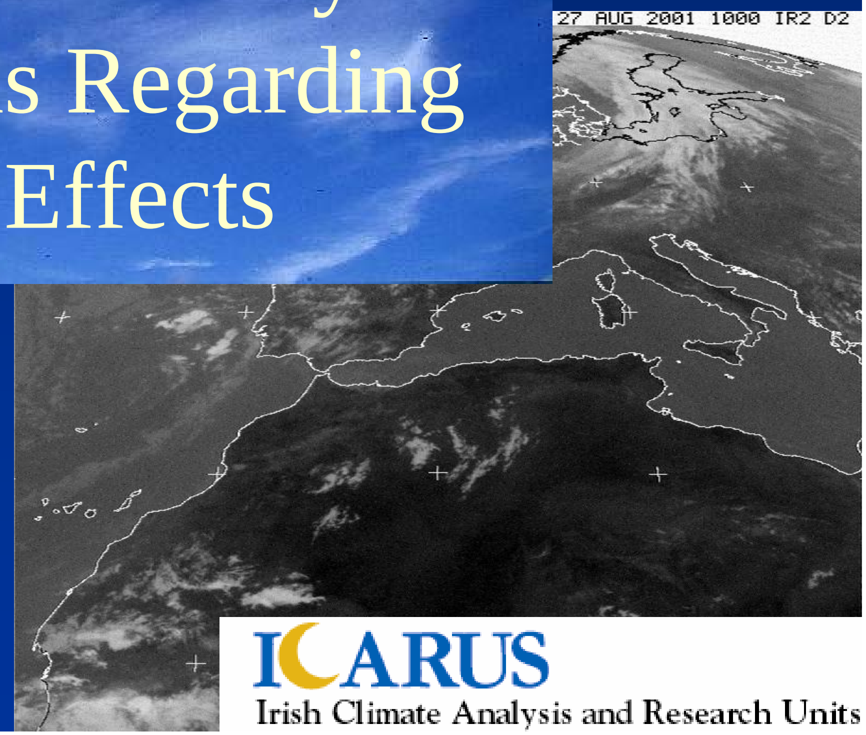
HEALTHY CITIES

Belfast

Friday 1st February

Climate Change in Ireland: Scenarios, Impacts and Some Preliminary Observations Regarding Health Effects

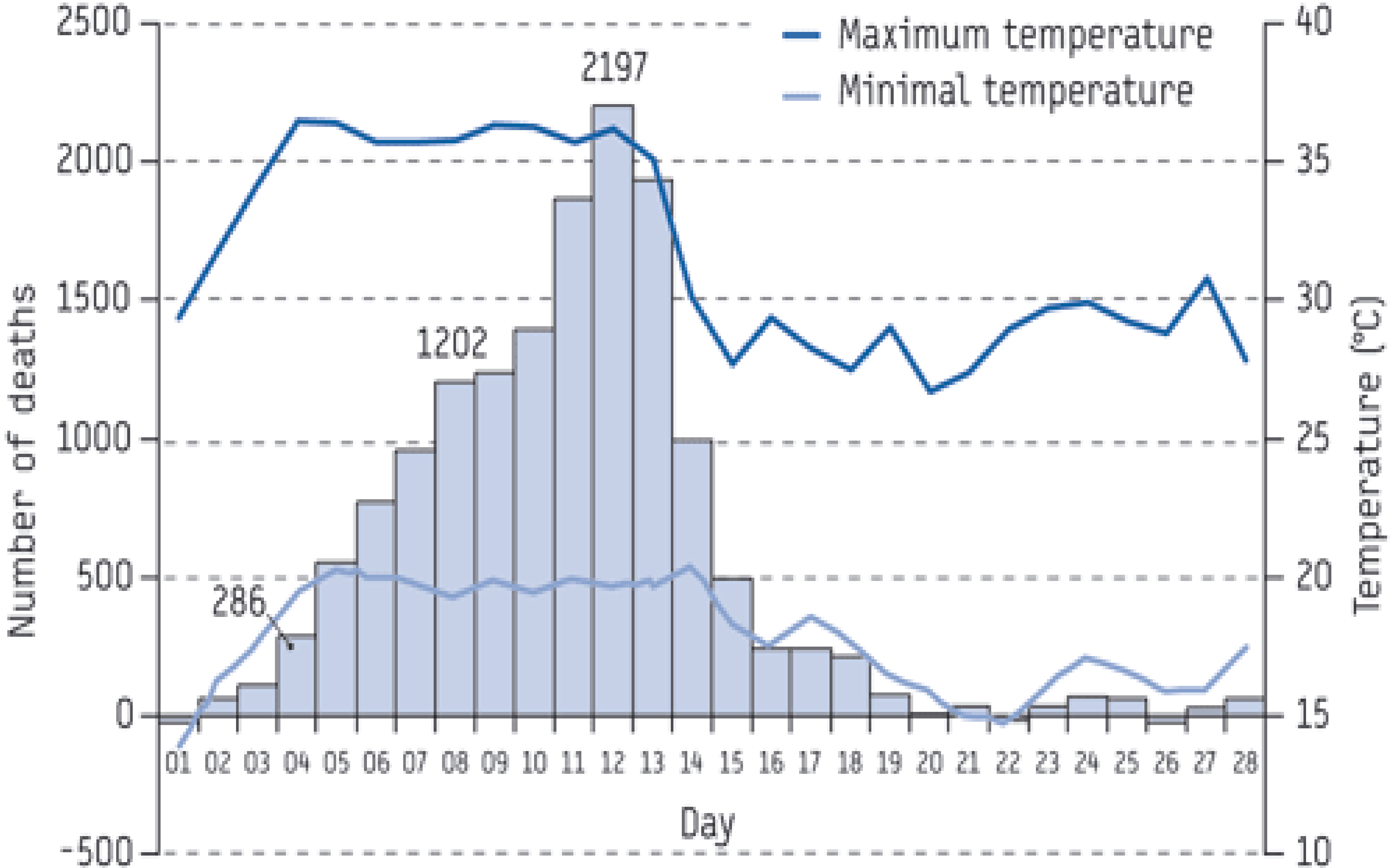


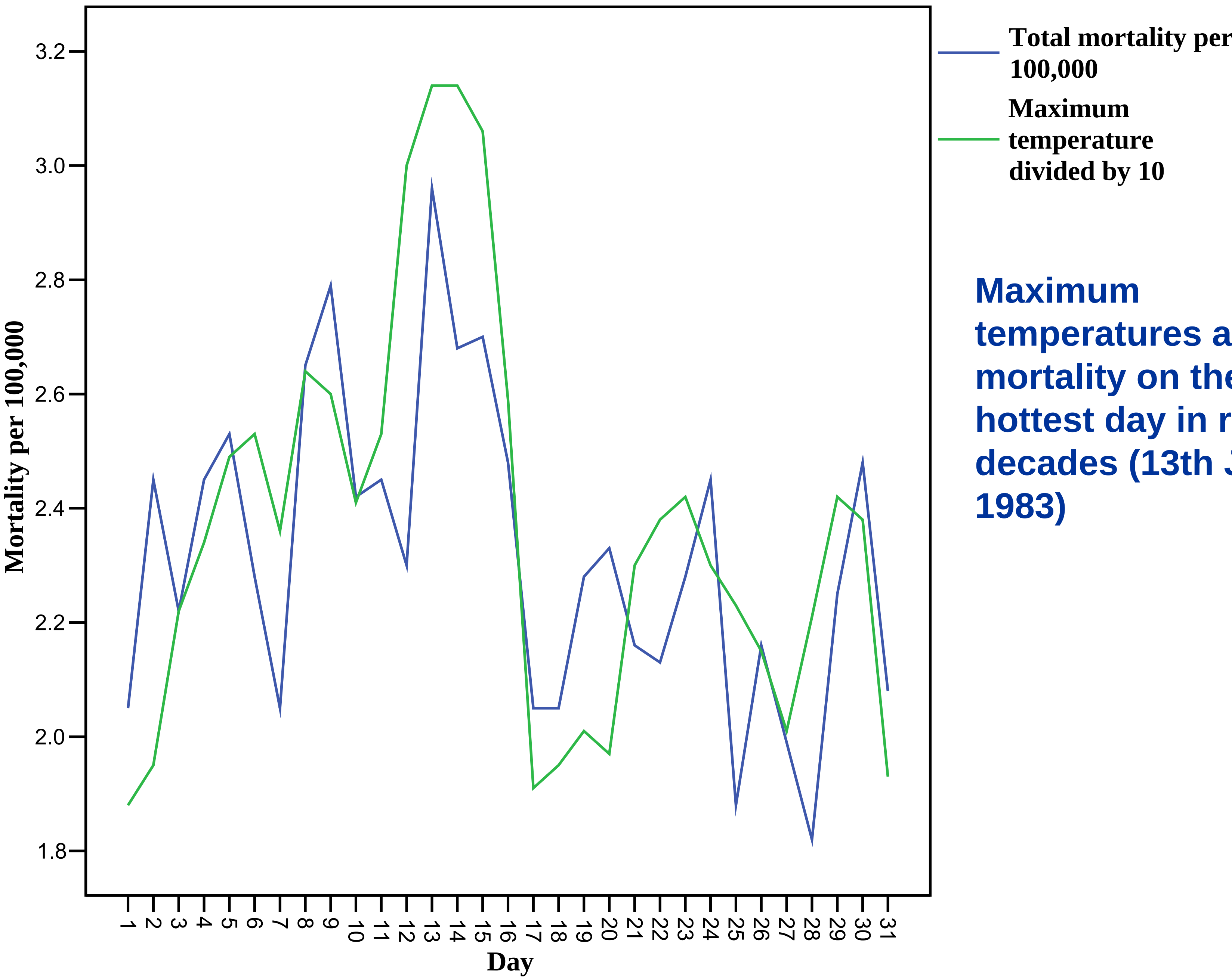
John Sweeney,
NUI,Maynooth

NUI MAYNOOTH
Ollscoil na Éireann Má Nuad

ICARUS
Irish Climate Analysis and Research Units

Daily excess of deaths during August 2003 and minimal and maximal daily temperatures, France





Maximum temperatures and total mortality on the hottest day in recent decades (13th July 1983)

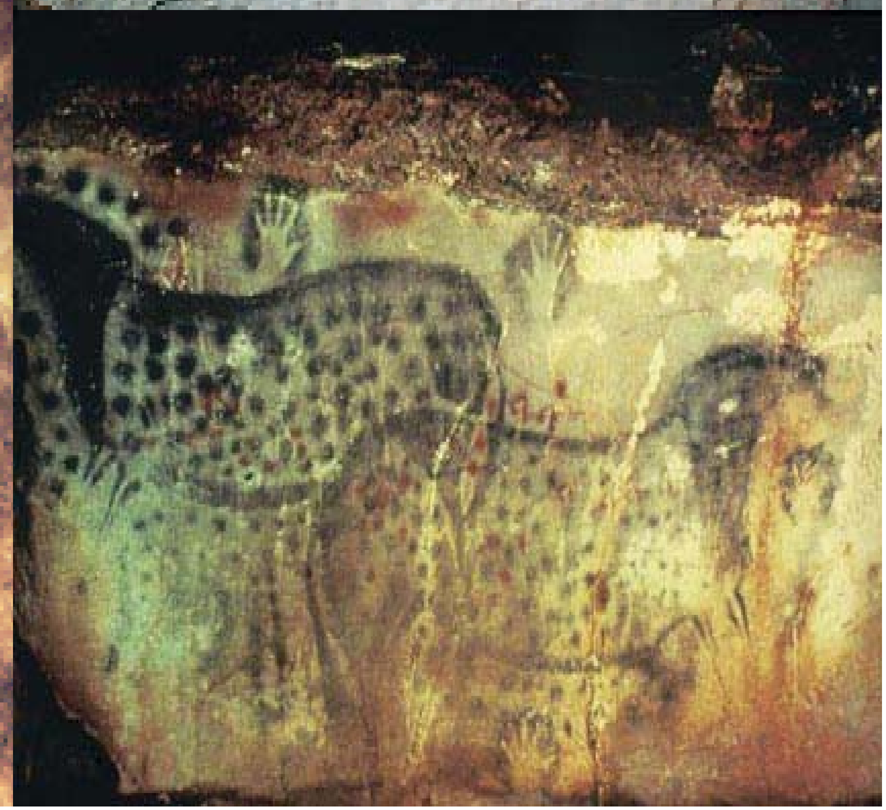
Source: E. Cullen

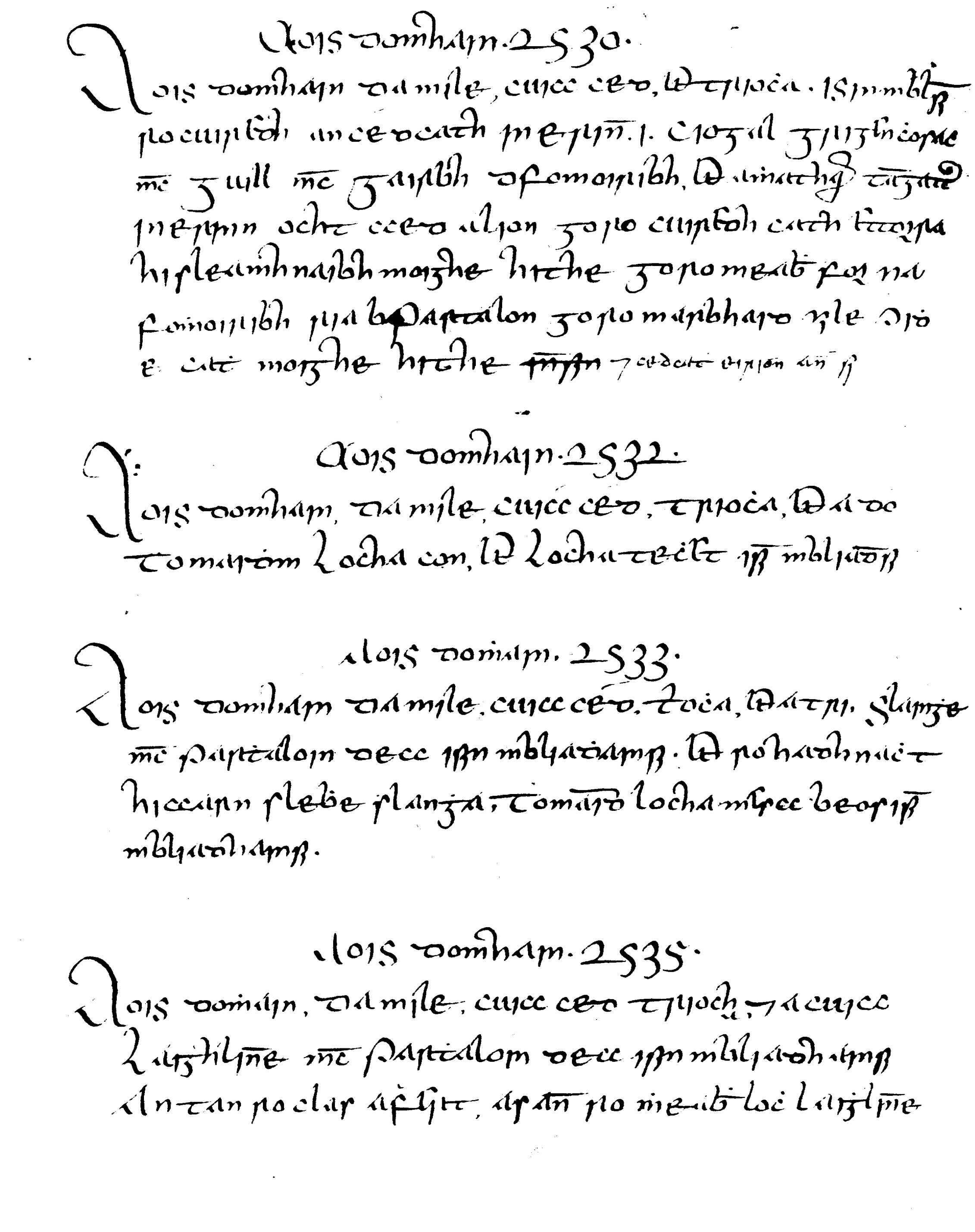
John Constable : The Haywain 1821

The Landscape of the Haywain 1821

The Landscape of the Haywain as it is today







The first written account of a weather event in Ireland or Britain.

From the Annals of the Four Masters it tells of a flood on Lough Conn, allegedly in 2668 B.C.

The 'Night of the Big Wind' in Ireland, 6-7 January 1839

Lisa Shields and Denis Fitzgerald

Meteorological Service,
Dublin 9.

ABSTRACT

The notorious storm of 6-7 January 1839 is re-examined, and its effect on Ireland outlined. The country-wide damage as reported by contemporary newspapers and observers is described, source material is listed, and consideration is given to the social and cultural legacy of the storm. The meteorological situation of the night of 6-7 January has been reconstructed from the available data, and displayed in map form. A comparison with the recent storm of 9 February 1988 is made. The much greater damage caused by the 1839 storm suggests that there could have been thundery or even tornado-type activity in places at the height of the storm.

Key Index Words: Wind storms, historical weather maps, folk tradition, newspaper reports.

Unexpected Meteorological Extremes: The Limerick Tornado of 1851

John Tyrrell
Department of Geography,
National University of Ireland, Cork

ABSTRACT

An analysis of contemporary documentary sources and meteorological observations show that a T4 tornado event occurred in Limerick during October 1851 ahead of a cold front in unstable air. The path of the tornado through the city is reconstructed and its impacts are described. Although the scientific community in Ireland was engaged during 1851 in a nation-wide experiment to define the monthly and seasonal patterns of weather, it saw no significance in this event beyond its curiosity value. In the search for order, regularity and scientific laws, extreme meteorological conditions appear to have sustained little scientific interest.

Key Index Words: t

FLOODING IN BELFAST

D. B. PRIOR and N. L. BETTS

Department of Geography
Queen's University, Belfast

Introduction

The city of Belfast has many paradoxes, not the least of which concerns the availability of water. In recent years, Belfast has suffered from severe shortages of domestic and industrial water supply (Prior and Betts, 1973). By contrast, parts of the city are frequently subject to the ... flooding. This ...
condit
which
occasic
system
occurre
the ma
hitherto
tion of
obtaine
City En
countere
tion con
have bee
always st
floods or

A MUDSLIDE ON THE ANTRIM COAST, 24th NOVEMBER 1974

D. B. PRIOR

Department of Geography
Queen's University, Belfast

Introduction

The steep Antrim coastal slopes possess a wide variety of mass-movement phenomena. Large slump blocks of basalt and chalk represent slope instability of late-Pleistocene age while mudslides, mudflows, debris flows and rockfalls are very important active slope processes (Prior *et al.*, ...8; 1971). These cause considerable damage to the Antrim coast road ...localities between Ballygalley and Waterfoot. For example, ...slides at Minnis North and Straidkilly Point periodically ... large volumes of Liassic clay which can move ... Stephens, 1972; Hutchinson, Prior and ... the overhanging chalk cliffs at ... of the road away from the

A summer outbreak of whirlwind phenomena from Dublin Bay to the Shannon Estuary

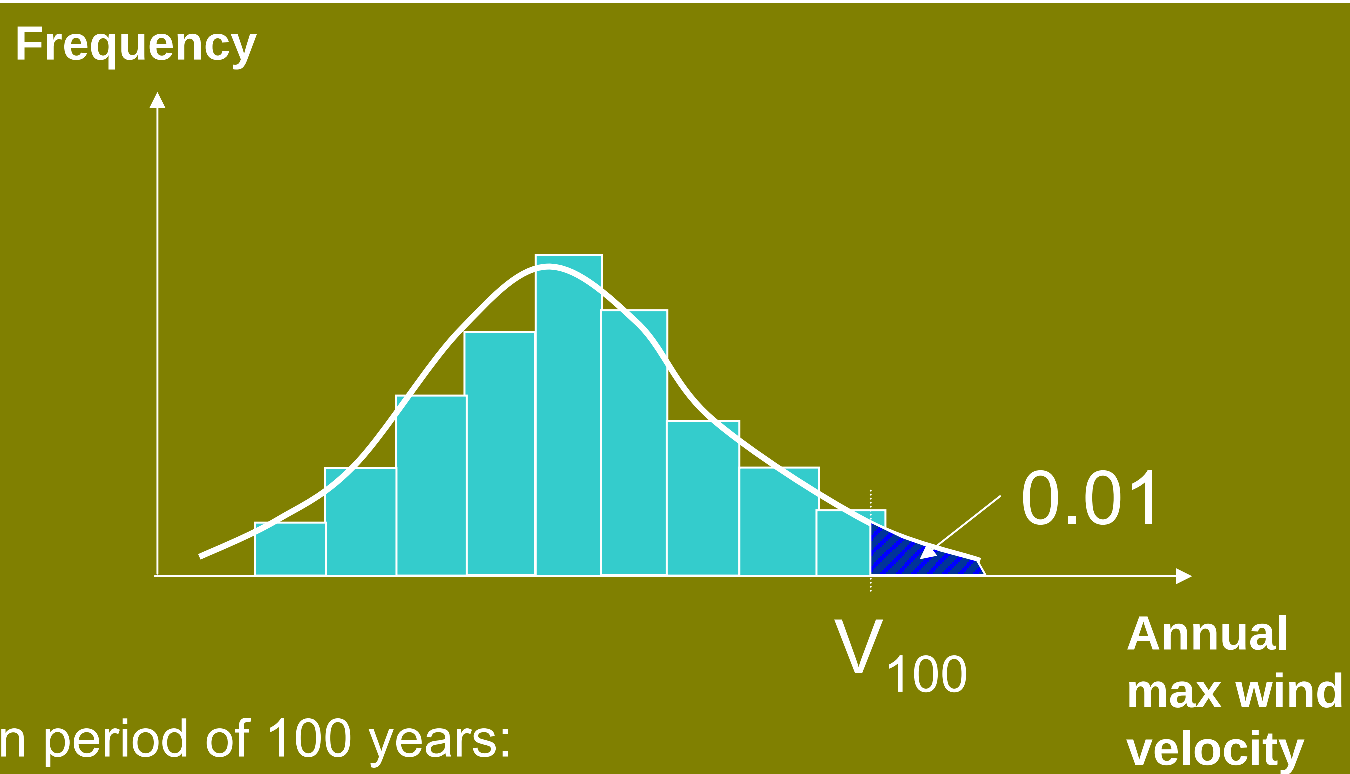
John Tyrrell
Department of Geography, National University of Ireland, Cork

ABSTRACT

The conditions giving rise to a series of whirlwind phenomena that occurred across Ireland on 16-17 August 2001 are examined. Surface and upper air data, together with indices derived from upper air soundings (CAPE and LIFT) are used to analyse the roles of wind shear, instability and vertical moisture boundaries. While these showed some moderate wind shear, the potential instability was quite weak and vertical moisture contrasts were not strong. Despite this, one tornado, up to three waterspouts, two funnel clouds and an eddy whirlwind were reported over little more than a twenty four hour period. It is demonstrated that the most significant condition associated with their formation was probably vertical wind shear, in a weakly unstable, moist atmosphere.

Key index words: whirlwinds, tornado, waterspouts, Dublin, Shannon.

Example



Design for return period of 100 years:

p = 1/100 = 0.01

$$\therefore P(V < V_{100}) = 0.99$$

$\therefore$ **V_{100} = e.g. 150.6 kph**

What are the implicit assumptions in this process?

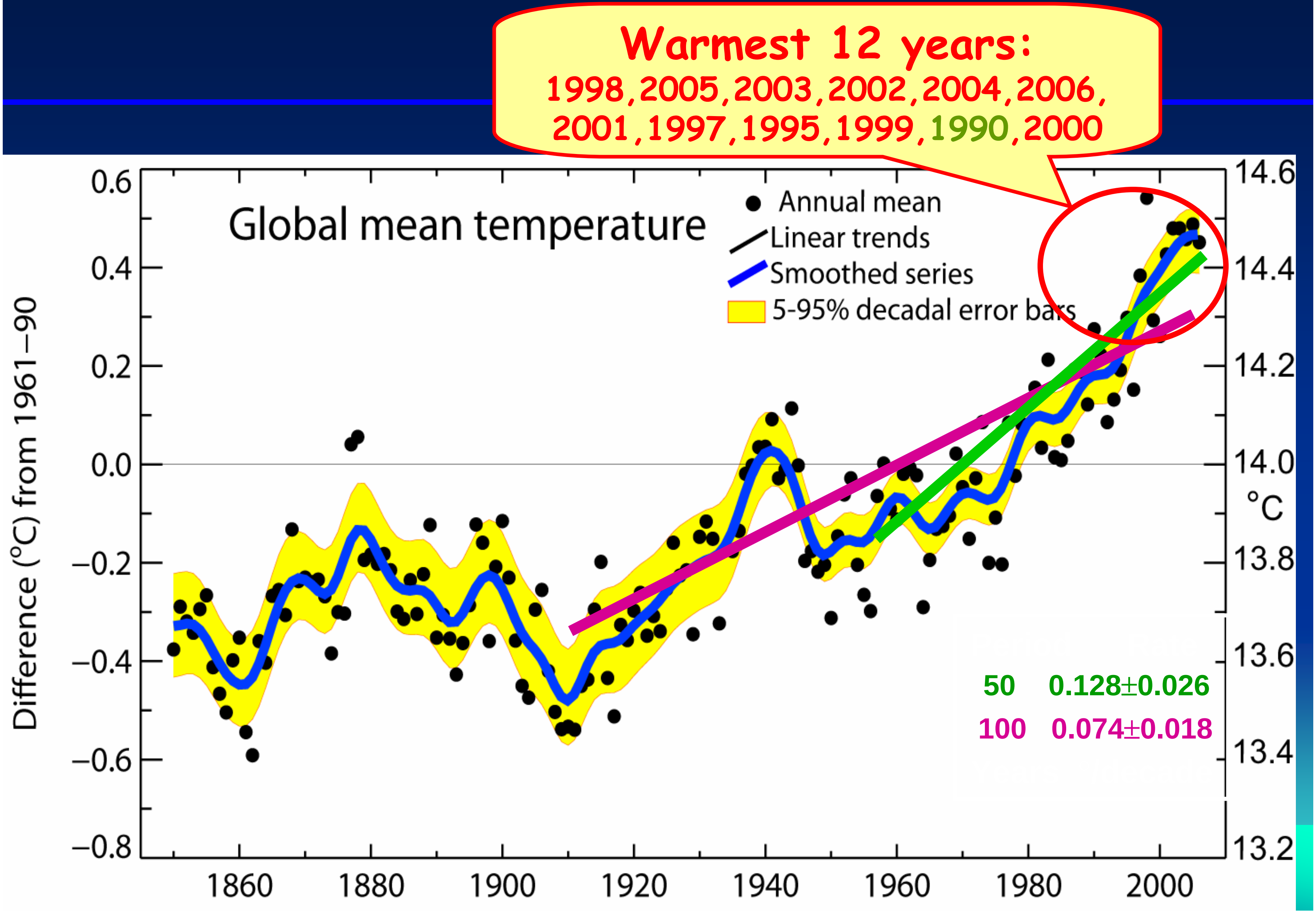
- The probability function has captured the extremes in a realistic manner
- The available data is appropriate for the location concerned
- That 30 years of climate data provides a basis for extrapolation
- **That the climate series is stationary………!**

Direct Observations of Recent Climate Change

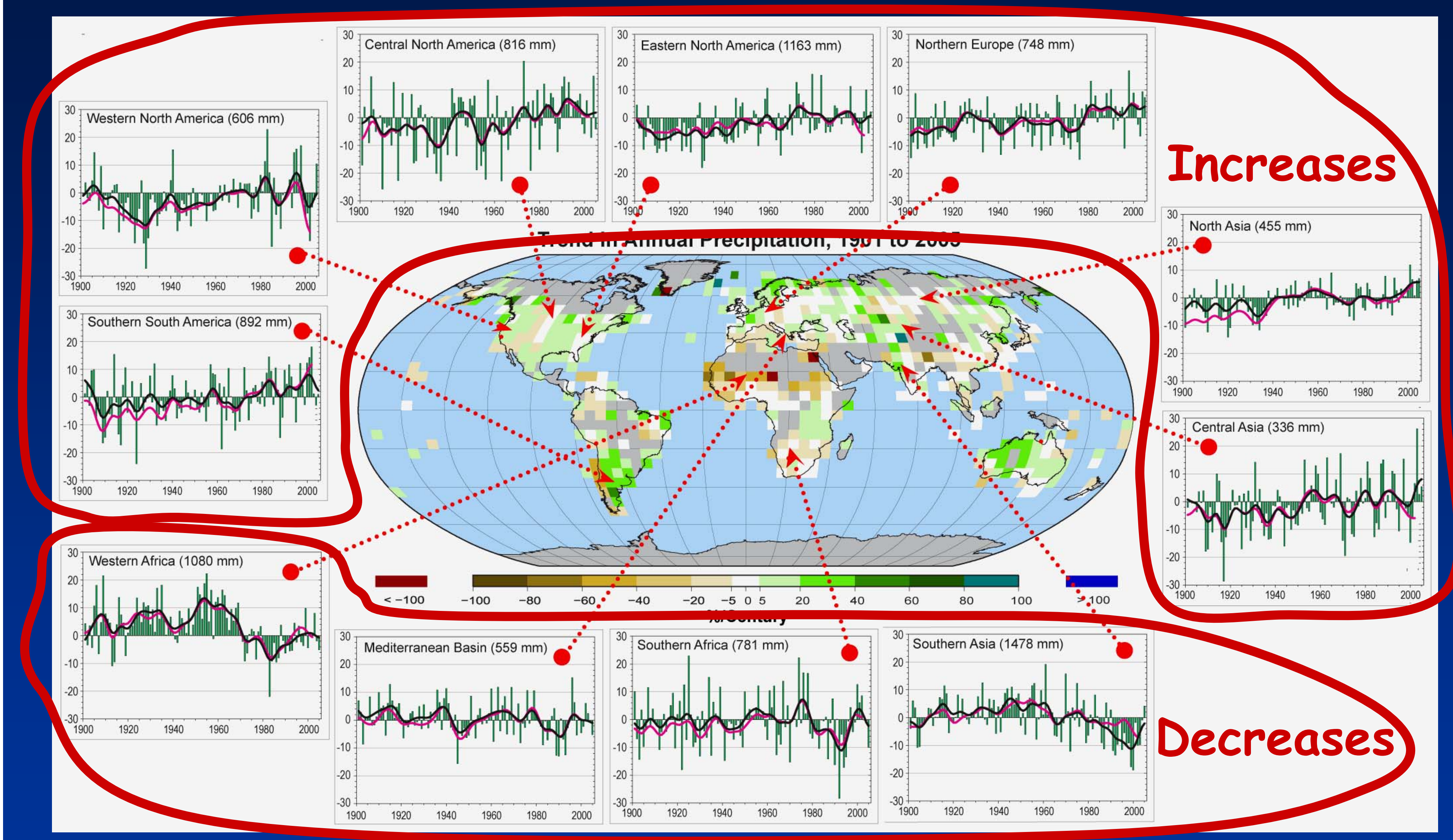
Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.

IPCC (2007)

Global mean temperatures are rising faster with time

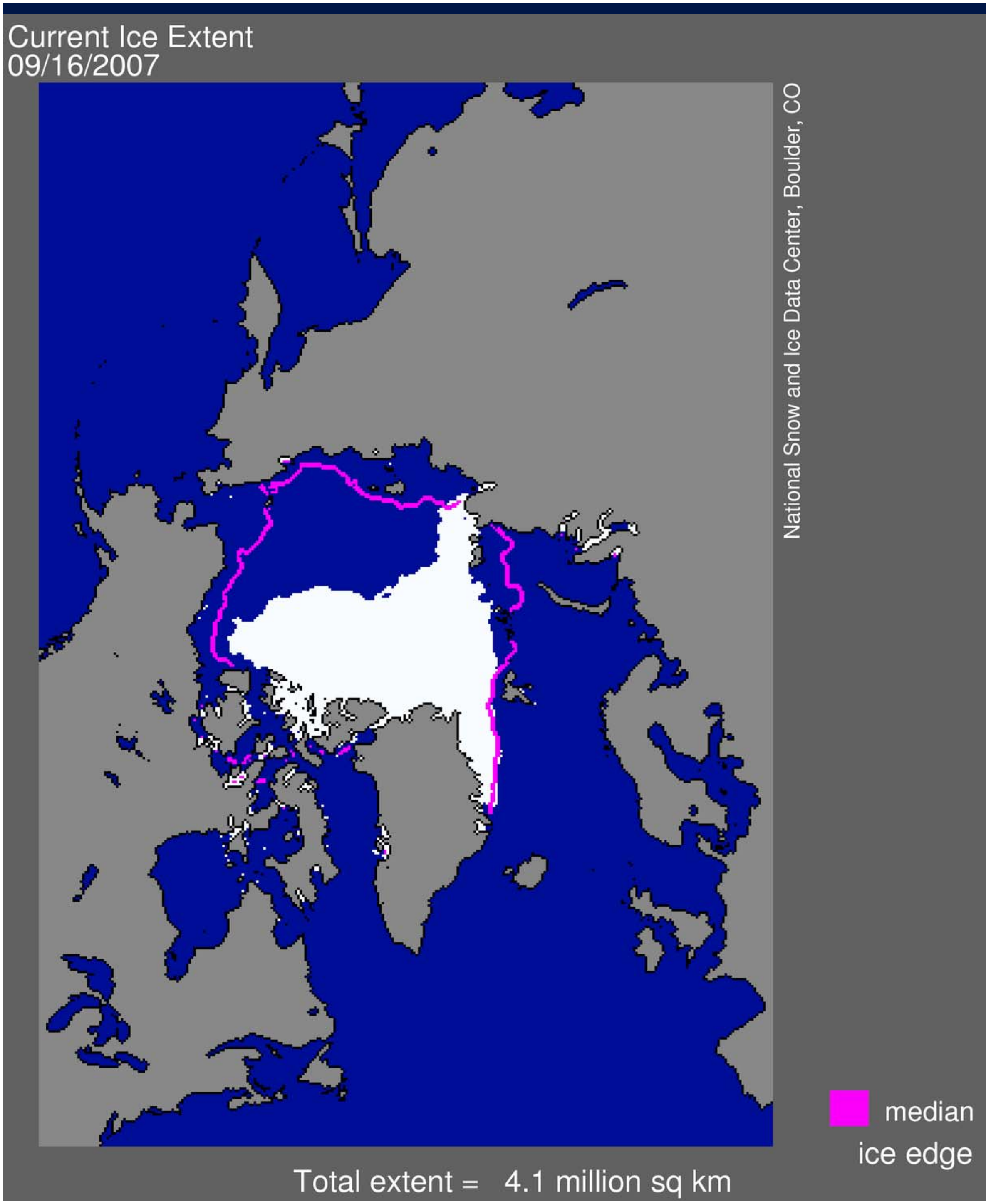


Land precipitation is changing significantly over broad areas



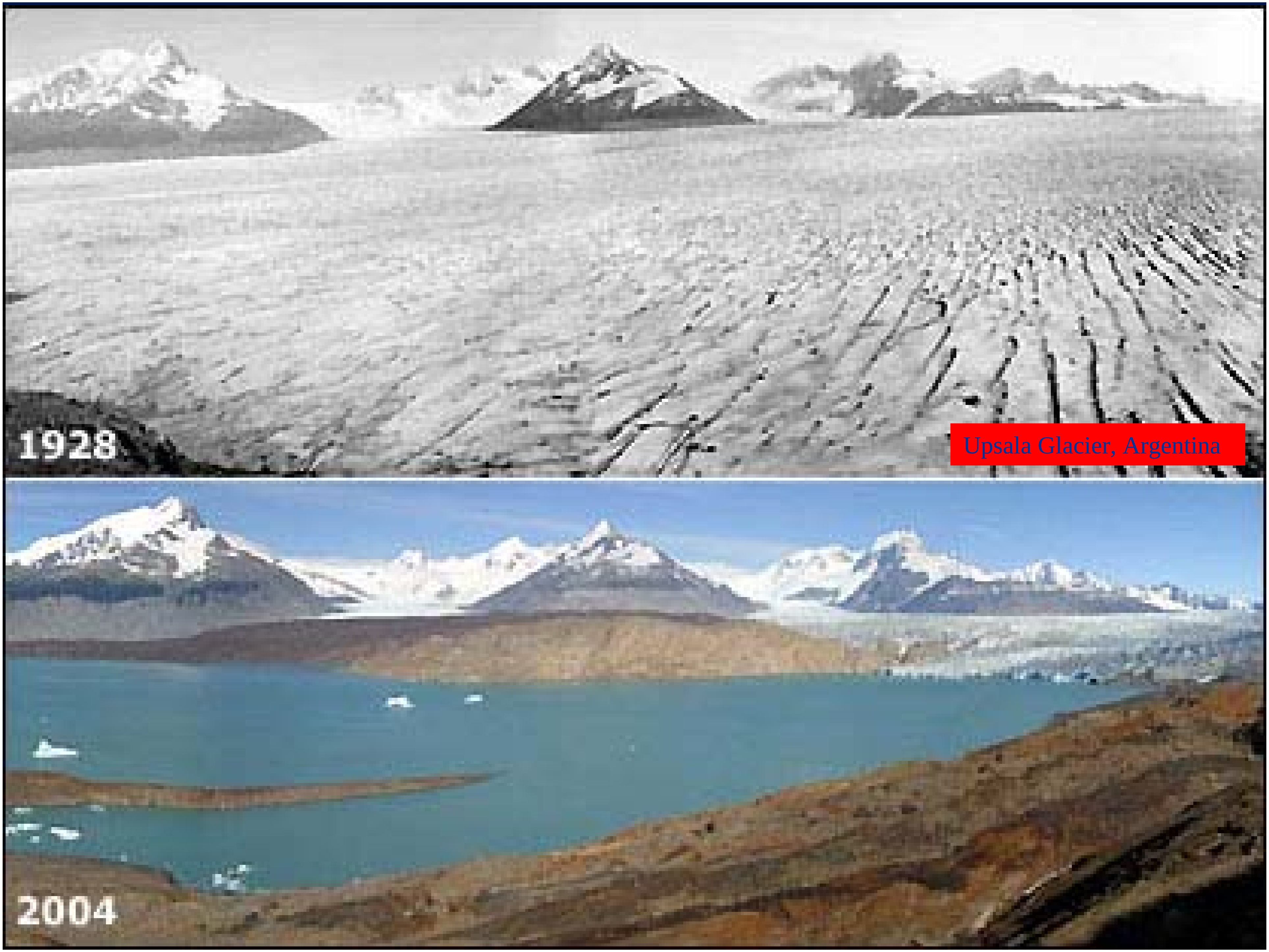
Smoothed annual anomalies for precipitation (%) over land from 1900 to 2005; other regions are dominated by variability.

September 2007 saw the least Arctic sea ice on record

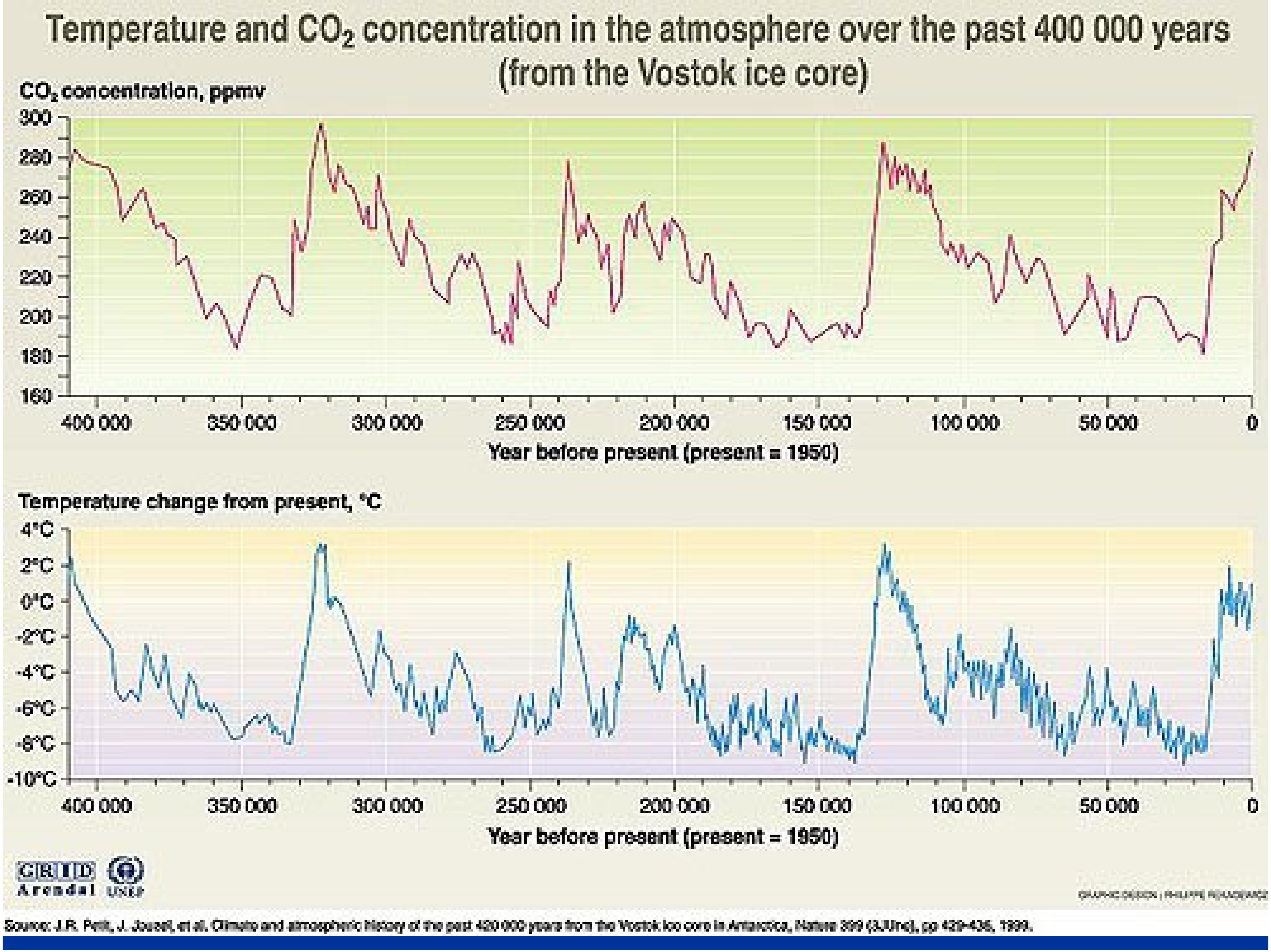



1985
2002
Mount Hood

Valais Glacier



Upsala Glacier, Argentina

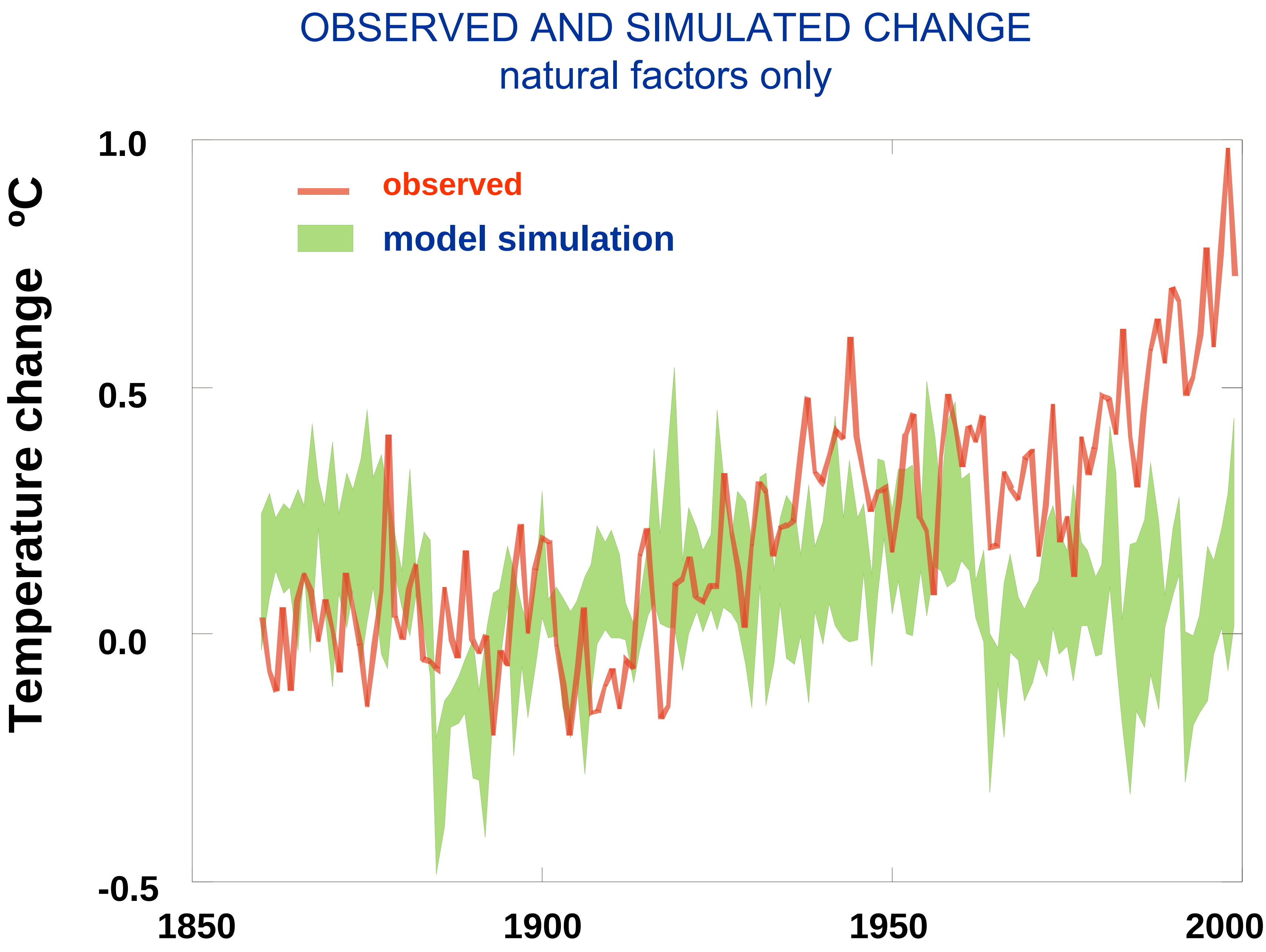

Temperature and CO2 concentration in the atmosphere over the past 400 000 years
(from the Vostok ice core)
CO2 concentration, ppmv
300
280
260
240
220
200
180
160
400 000
350 000
300 000
250 000
200 000
150 000
100 000
50 000
0
Year before present (present = 1950)
Temperature change from present, °C
4°C
2°C
0°C
-2°C
-4°C
-6°C
-8°C
-10°C
400 000
350 000
300 000
250 000
200 000
150 000
100 000
50 000
0
Year before present (present = 1950)
GRID Arendal
UNEP
Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, Nature 399 (3June), pp 429-436, 1999.

Attributing Climate Change to Human Factors

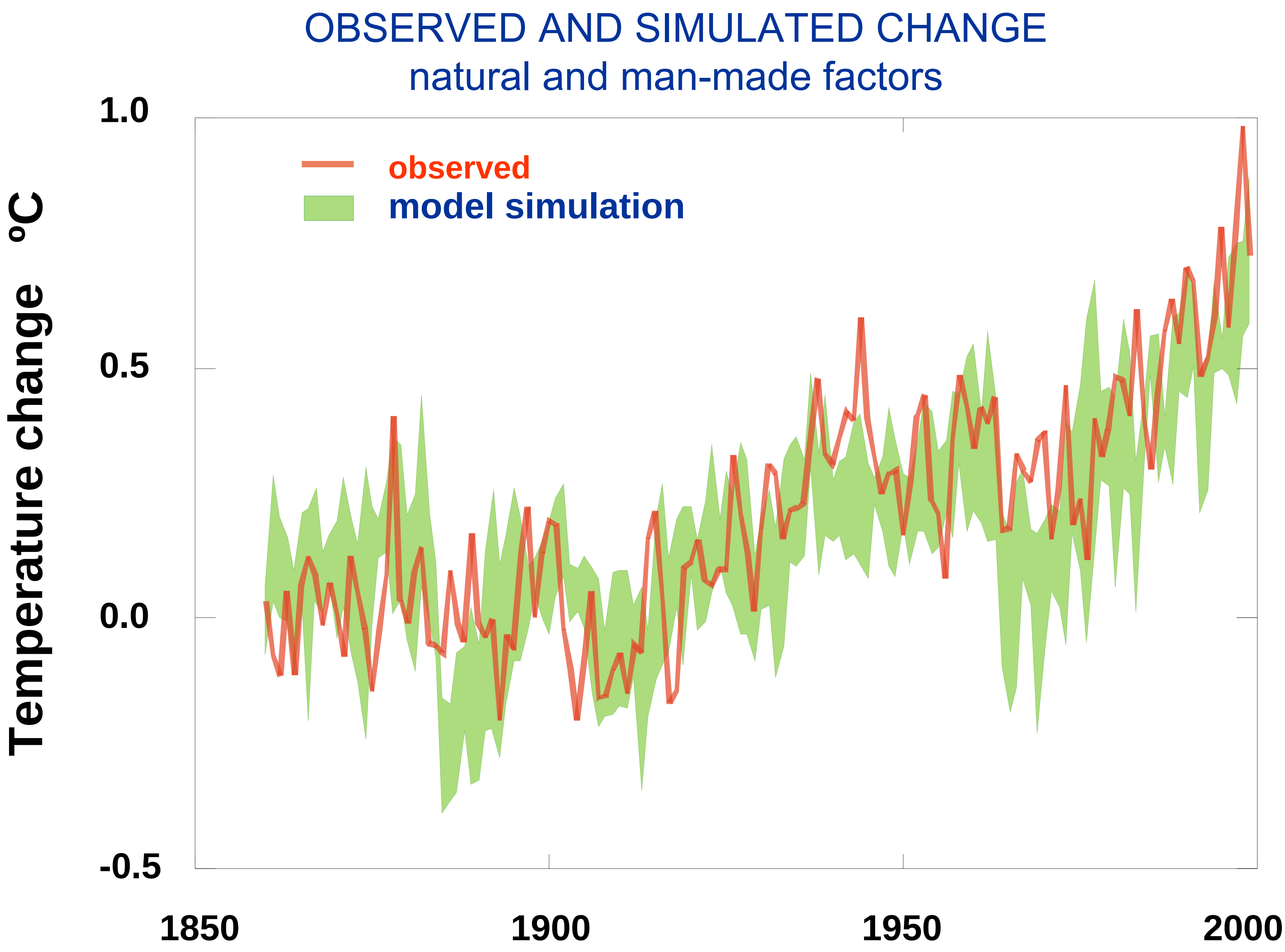
- Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely* due to the observed increase in anthropogenic greenhouse gas concentrations.
- Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns

*(‘very likely’ = 90%)

IPCC (2007)



OBSERVED AND SIMULATED CHANGE
natural factors only
observed
model simulation
Temperature change °C
1.0
0.5
0.0
-0.5
1850
1900
1950
2000



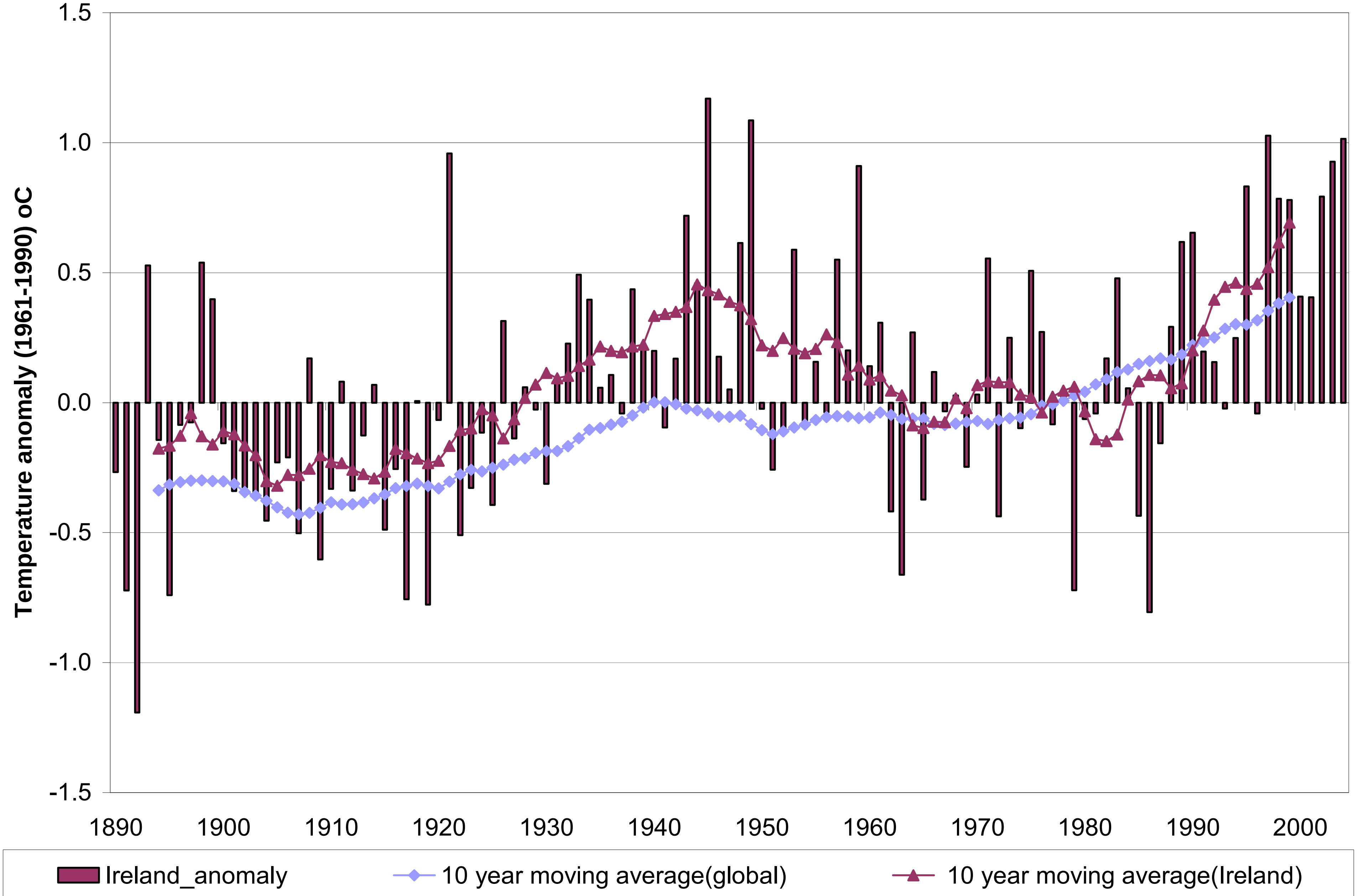
OBSERVED AND SIMULATED CHANGE
natural and man-made factors
observed
model simulation
Temperature change °C
1.0
0.5
0.0
-0.5
1850
1900
1950
2000

What does all this mean for Ireland?

1. We need to establish a future climate scenario for Ireland which offers a confident projection of temperature and rainfall conditions exists.
2. We need to use these scenarios to project how the Irish environment and landscape will alter under changed climate conditions and what impacts this will have on us in areas such as health.
3. We need to consider how we can as an island adapt to the changing environmental conditions.

What are major indicators of climate change are currently observable in Ireland?

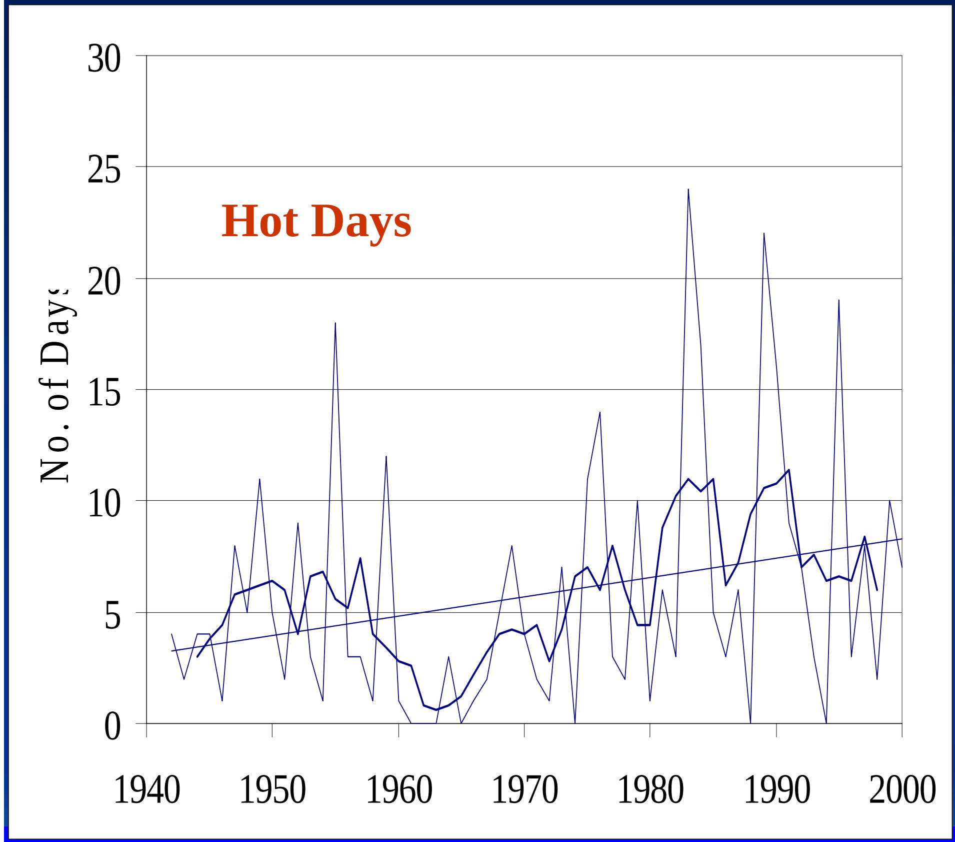
Global and Irish mean temperature

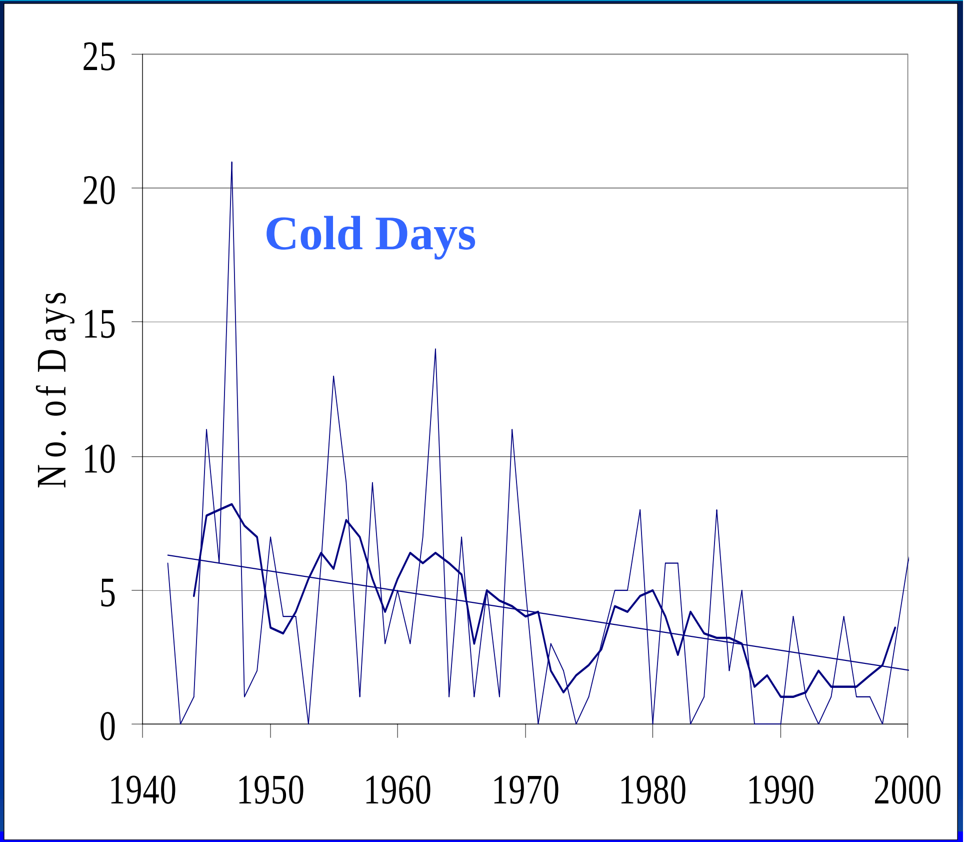


Differences in Seasonal Warming

1961-2005	Spring Max	Spring Min	Summer Max	**Summer Min**	Autumn Max	Autumn Min	**Winter Max**	Winter Min
Valentia	**0.68***	**1.05***	**0.43**	**1.20****	**0.54**	**0.87***	**1.17****	**1.34***
Shannon	**1.27****	**1.58****	**1.18***	**1.70****	**1.01***	**1.28****	**1.50****	**1.83****
Malin	**0.75***	**1.18****	**0.63**	**1.13****	**0.47**	**0.84****	**1.04***	**1.20****
Belmullet	**1.40****	**1.21****	**1.30****	**1.39****	**1.16****	**0.80***	**1.44****	**1.23***
Phoenix Park	**1.41****	**0.88***	**1.43****	**0.92****	**0.84***	**0.41**	**2.52****	**0.85**
Clones	**1.27****	**1.33****	**1.36****	**1.63****	**0.92****	**1.04***	**1.33****	**1.41***
Rosslare	**1.06****	**1.28****	**1.12****	**1.19****	**0.97****	**1.02****	**1.62****	**1.32****
Claremorris	**1.32****	**1.19****	**1.25****	**1.49****	**0.92***	**0.84***	**1.22****	**1.32***
Kilkenny	**1.40****	**1.18****	**1.22***	**1.46****	**0.95***	**1.21****	**1.52****	**1.40****
Casement	**1.05****	**1.27****	**0.83***	**1.40****	**0.55**	**1.15****	**1.61****	**1.36***
Birr	**1.18****	**0.95***	**0.98***	**1.21****	**0.77***	**0.77**	**1.44****	**1.14***

Frequency of 'hot' and 'cold' days at Dublin Airport



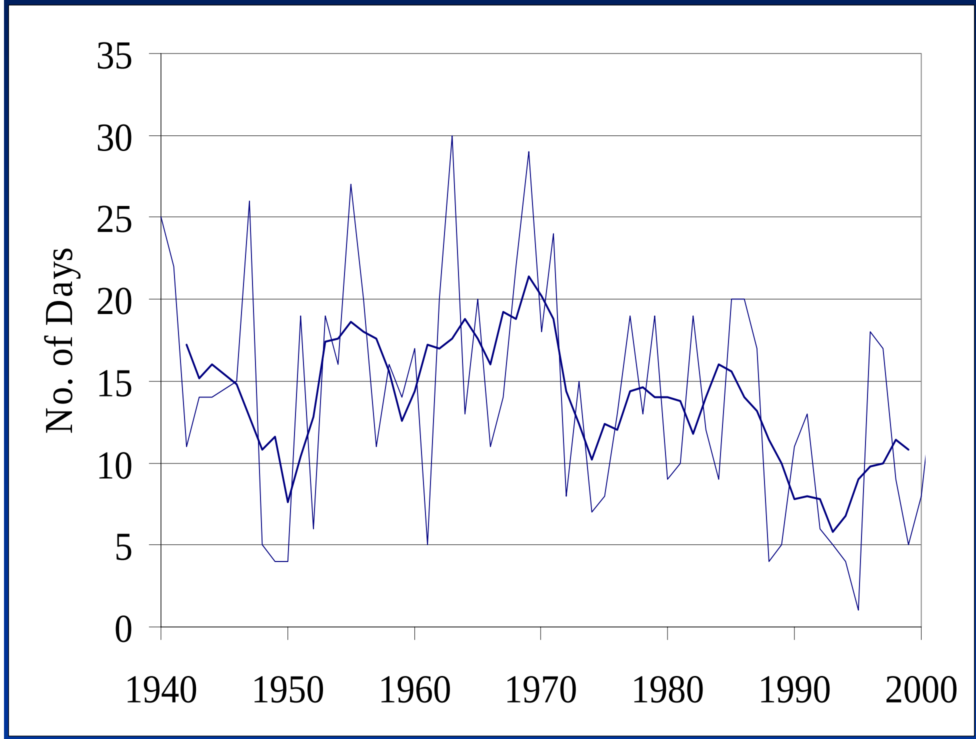


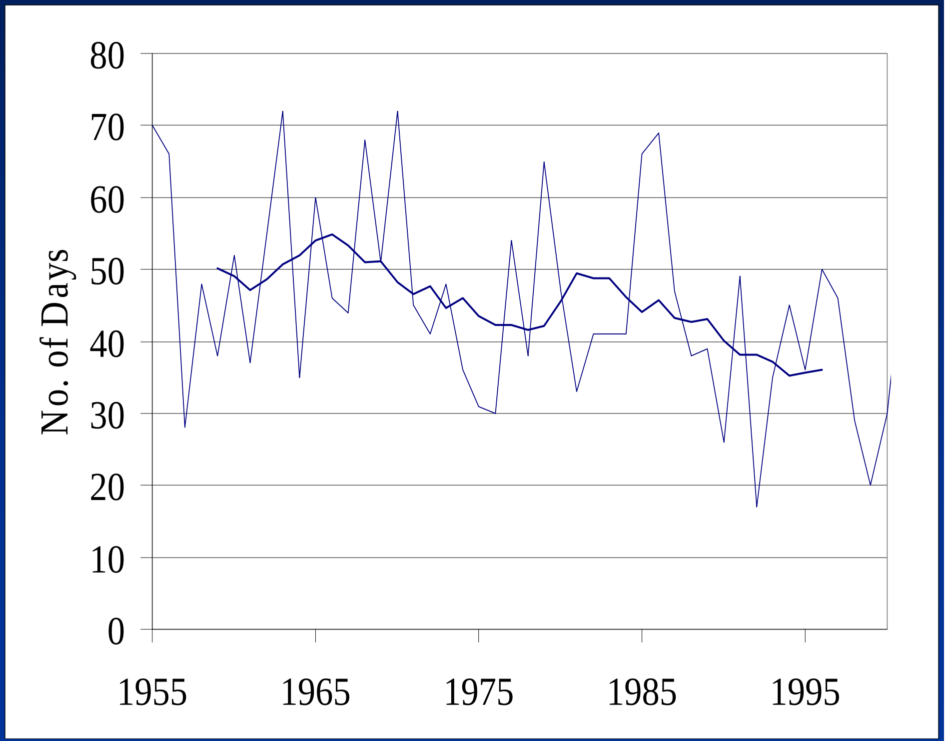
'Hot' day = mean temperature > 18°C

'Cold' day = mean temperature < 0°C

The average annual number of hot days in eastern Ireland has doubled, and cold days have halved over the past 40 years

Frequency of 'frost' days
Valentia & Birr



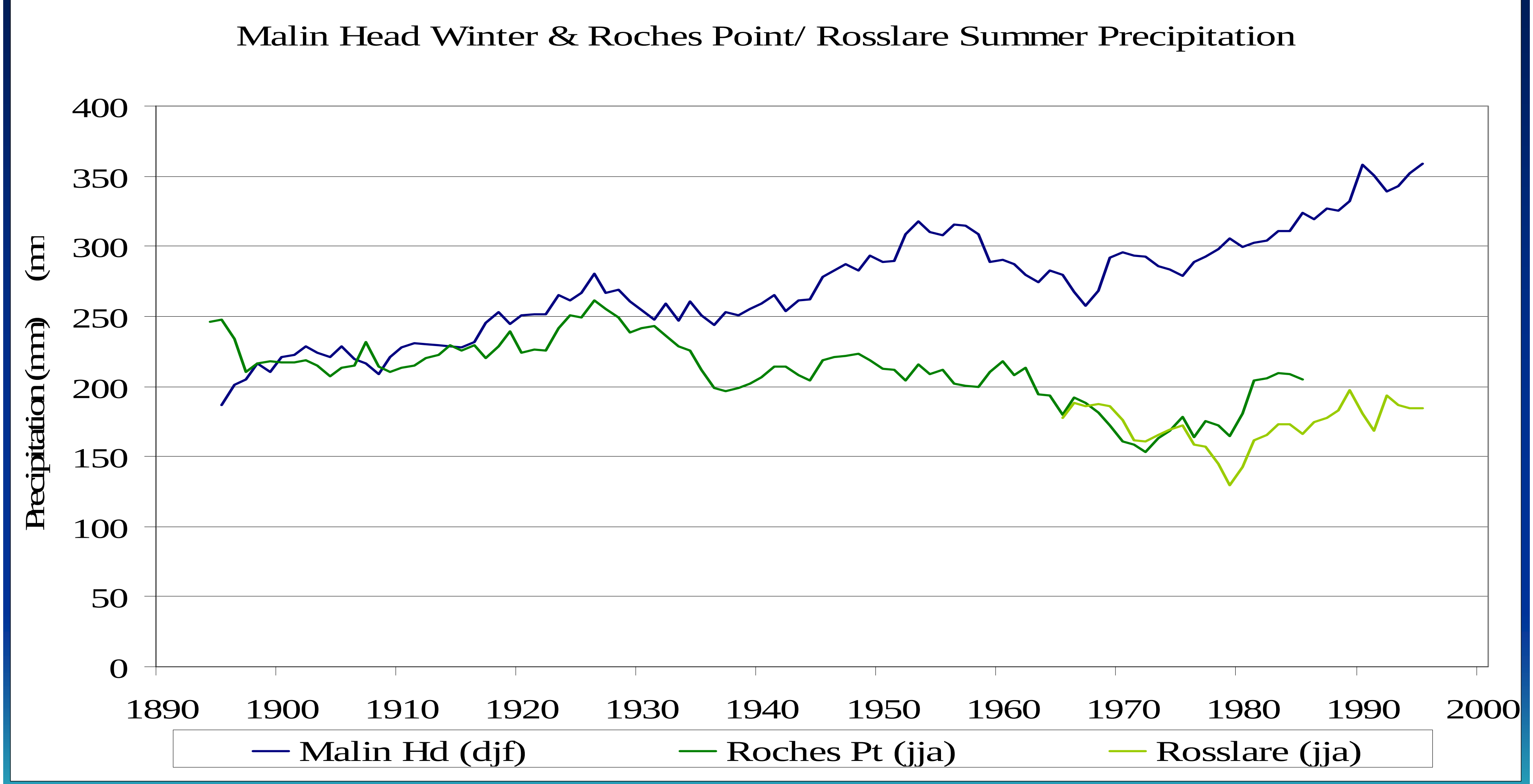


- Frost Day = minimum temperature < 0°C

A typical winter in the south west now has less than half the frosts of 20 years ago

Smaller reductions have occurred in the midlands

Geographical & Seasonal differences



Winters in the north west are getting wetter

Summers in the south east are getting drier

What information do we need to project future climate?

- How much fossil fuel will we burn over the next few decades?

  Emissions Scenario

  Concentration Scenario

- How will the climate system respond to increased greenhouse gas concentrations?

  Modelling

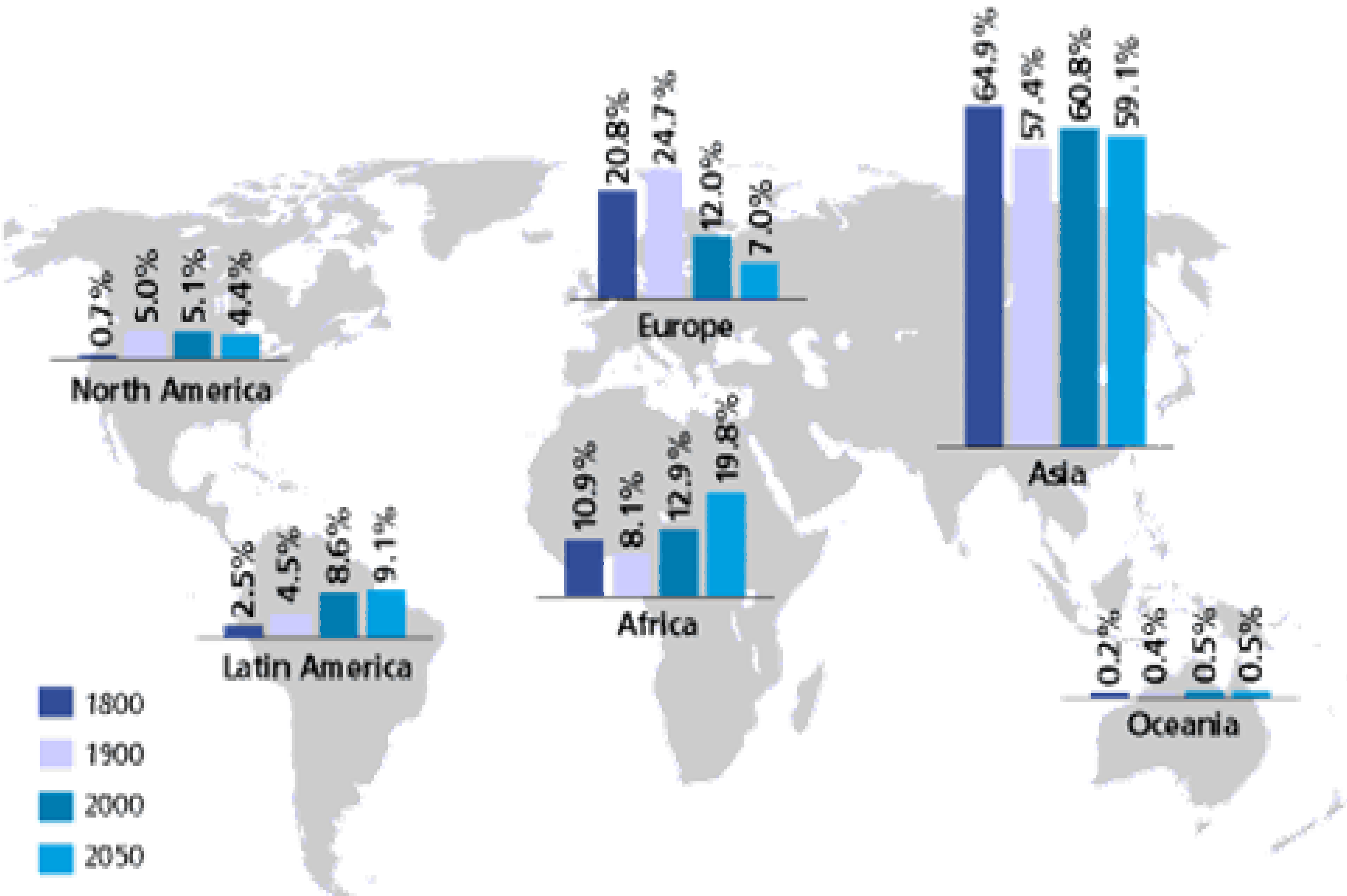
- How can uncertainties in these aspects be handled?

Emission Scenarios

- Based on assumptions regarding population, energy use, technological development

The Future: A more crowded world

Changing Distribution of the World's Population



How will these changes affect Food Production?

25,000 die daily from starvation

815m suffer from malnutrition

Freshwater resources are increasingly critical

By 2020, reserves of fresh water for drinking and irrigation will fall 30%.

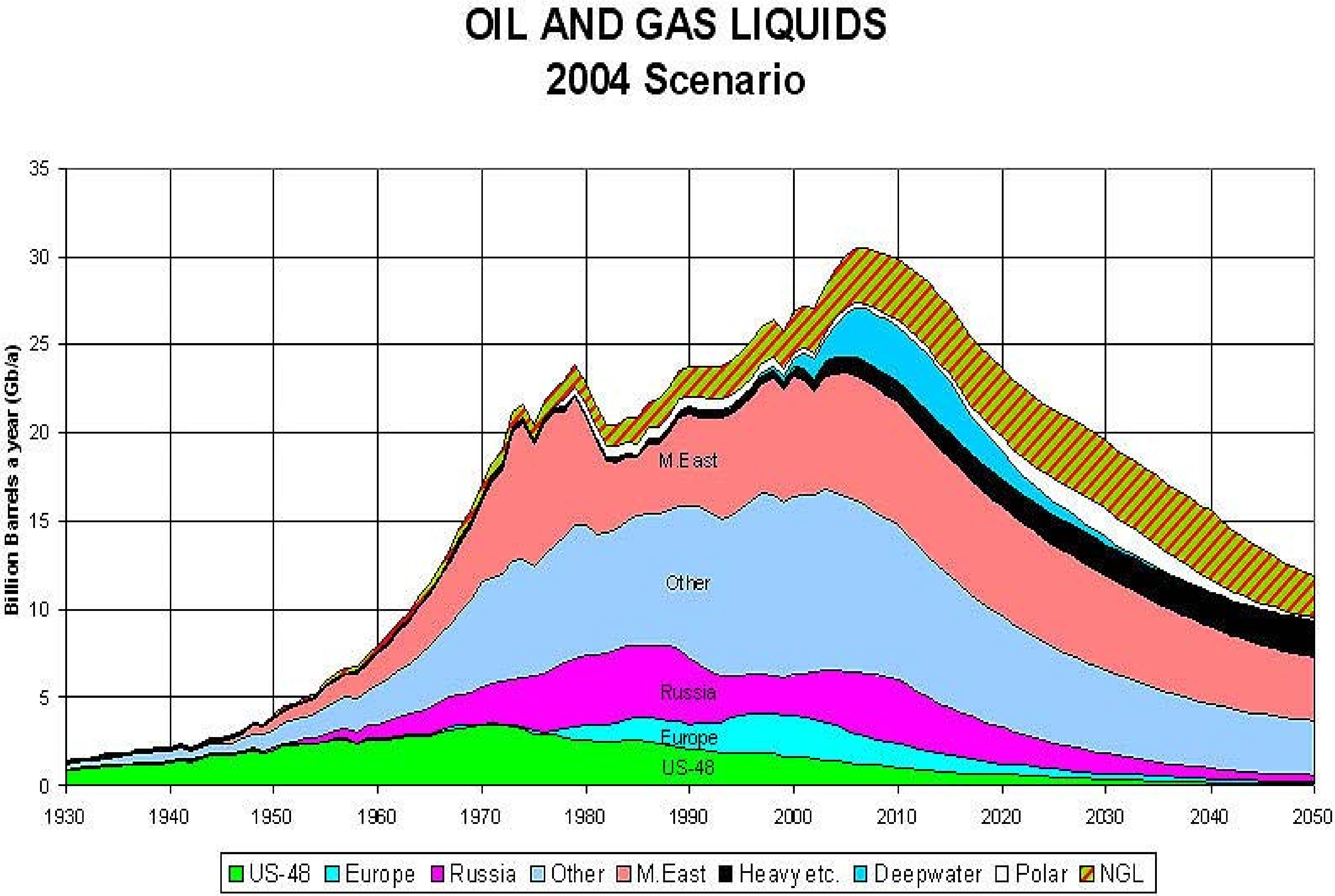
Consumption has doubled since 1950.

Much is polluted.

6,000 die daily from diarrhoea.

Will the world have enough energy?

Global oil production has peaked or is close to its peak



Countries at the end of the supply chain/pipeline are most vulnerable

Electricity Prices € cent/kWh

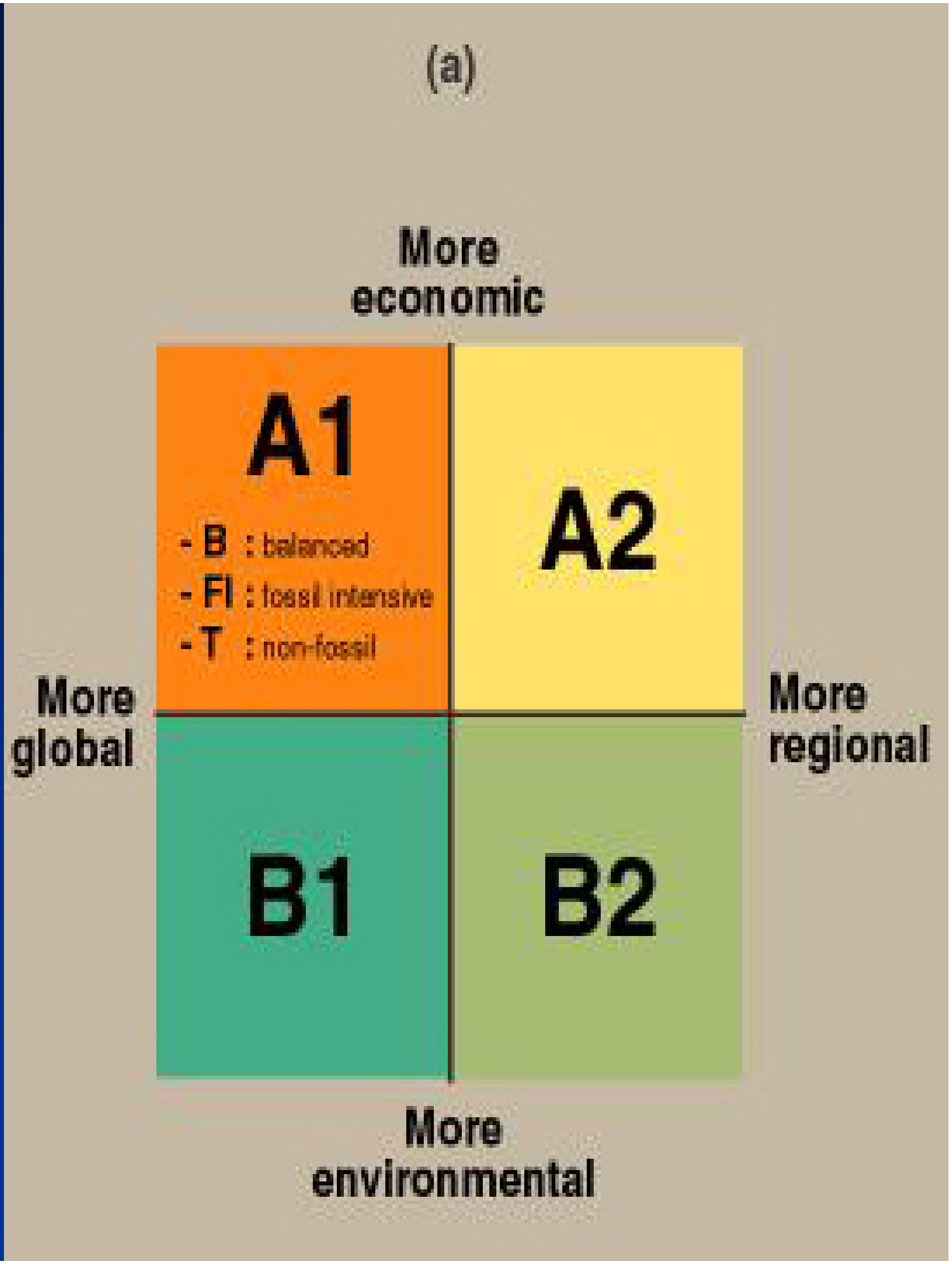
Country	Domestic	Industrial
EU	14.16	8.63
Denmark	23.62	8.01
Northern Irl.	18.47	19.92
Ireland	16.30	12.72-19.35
France	12.05	5.78
Finland	10.78	5.63
UK	10.20	8.22
USA	4.8	4.38

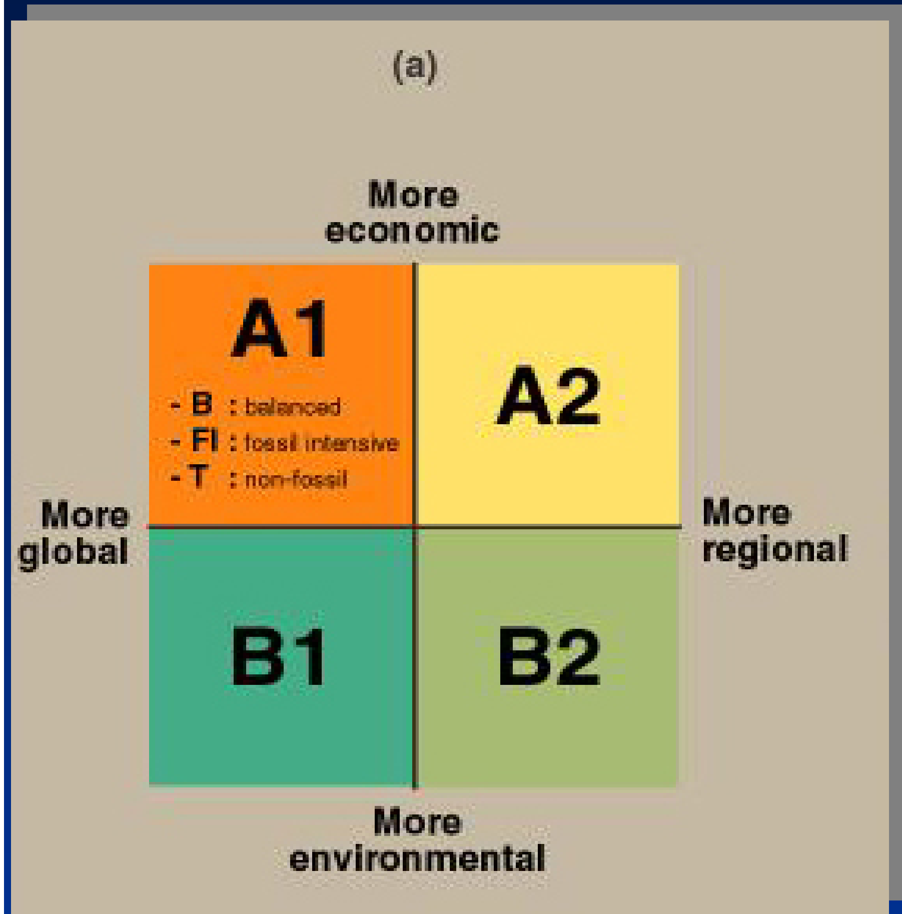
A1: A world of rapid economic growth and rapid introductions of new and more efficient technologies

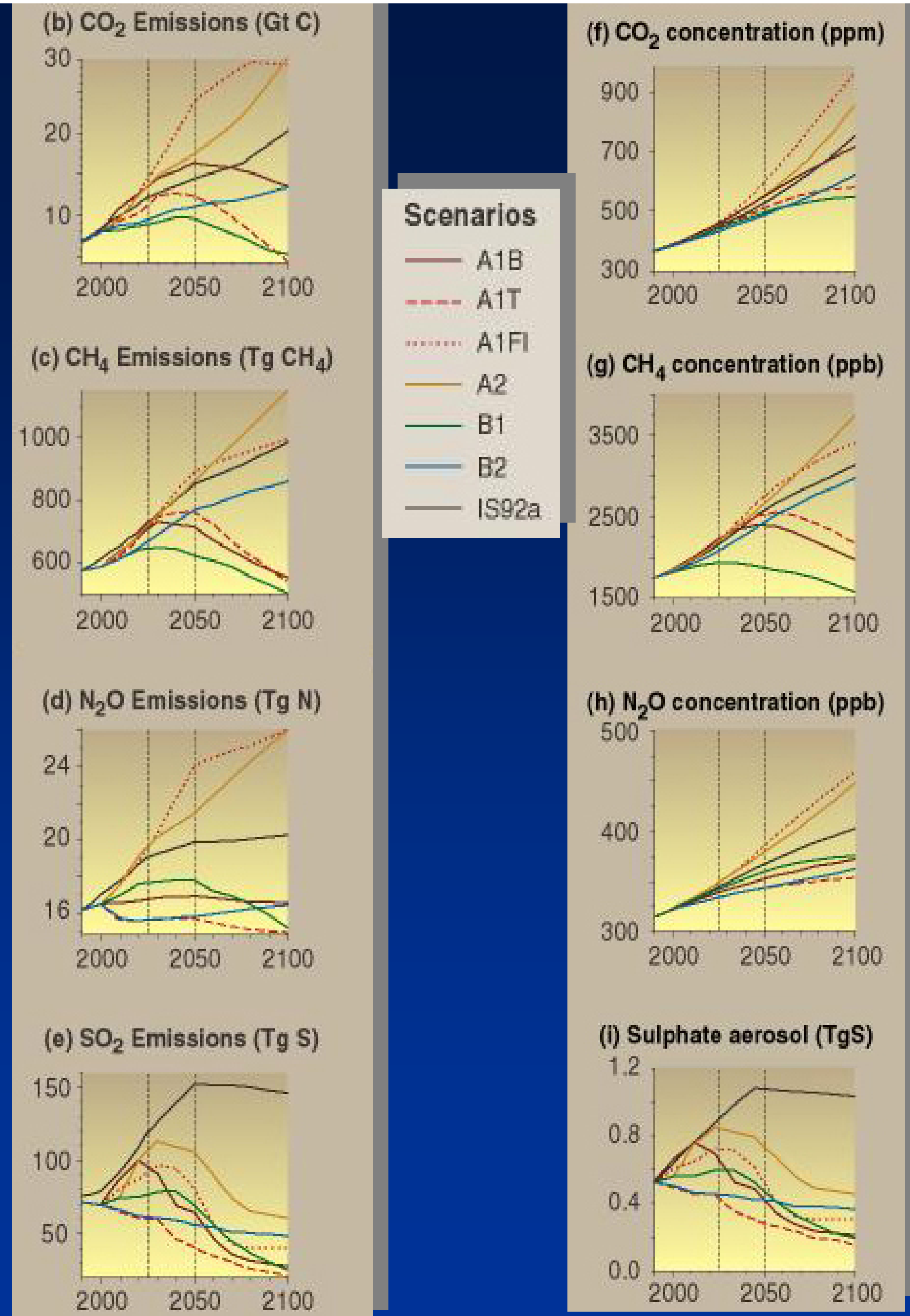
A2: A very heterogenous world with an emphasis on family values and local traditions

B1: A world of „dematerialisation“ and introduction of clean technologies

B2: A world with an emphasis on local solutions to economic and environmental sustainability





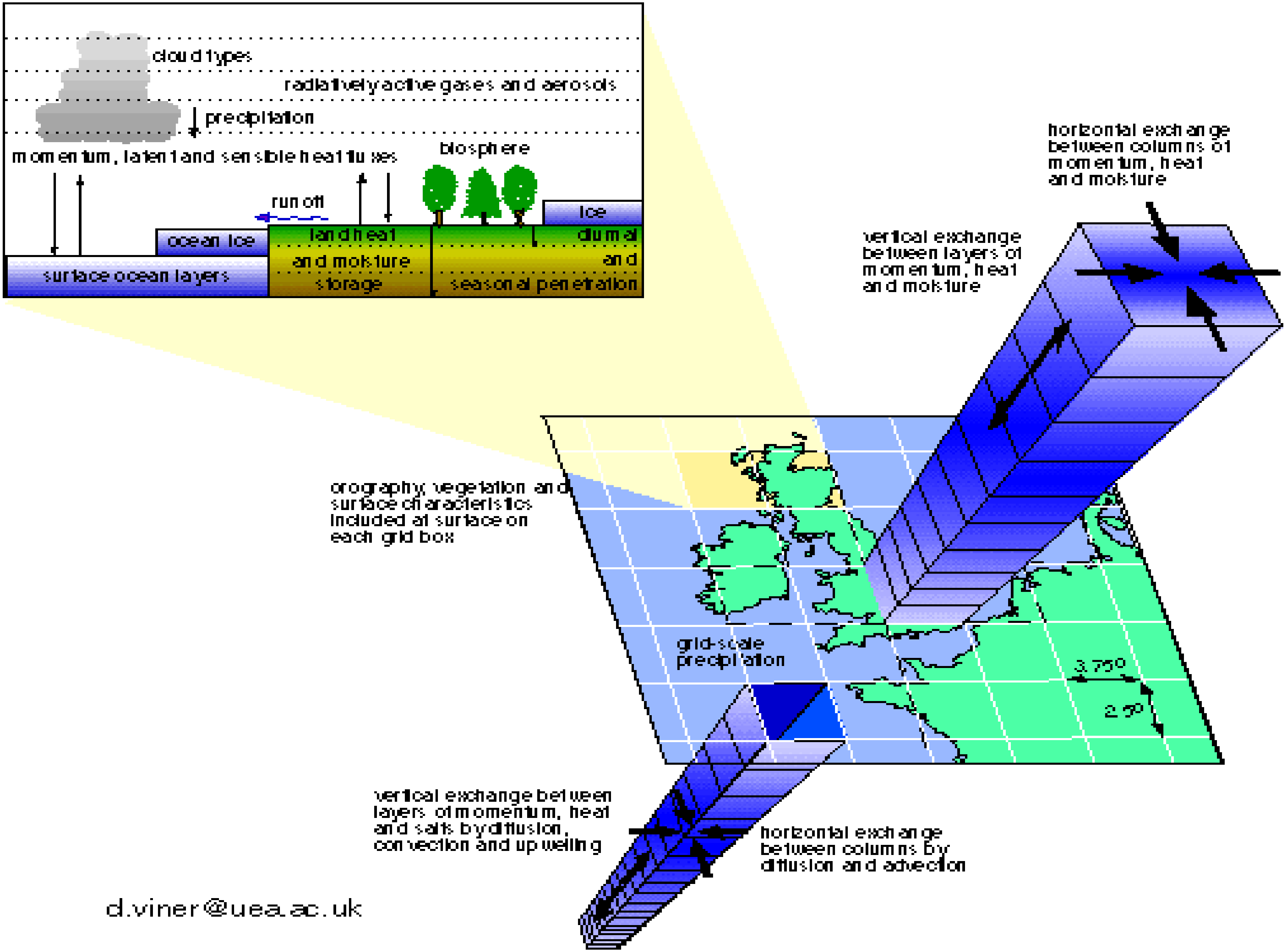


The SRES marker emission scenarios and the resulting change in concentration

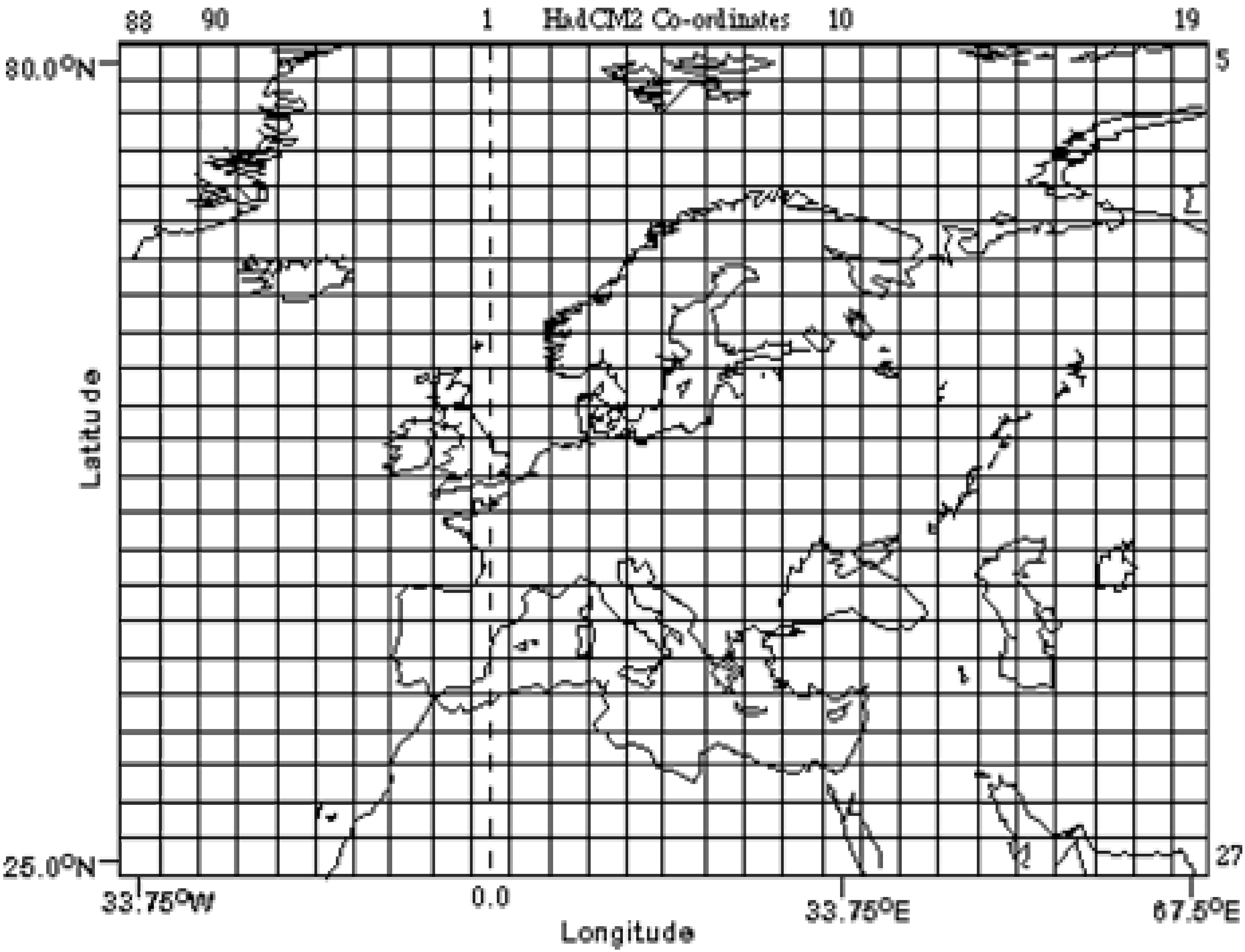
Emissions **Concentrations**

Global Climate Modelling

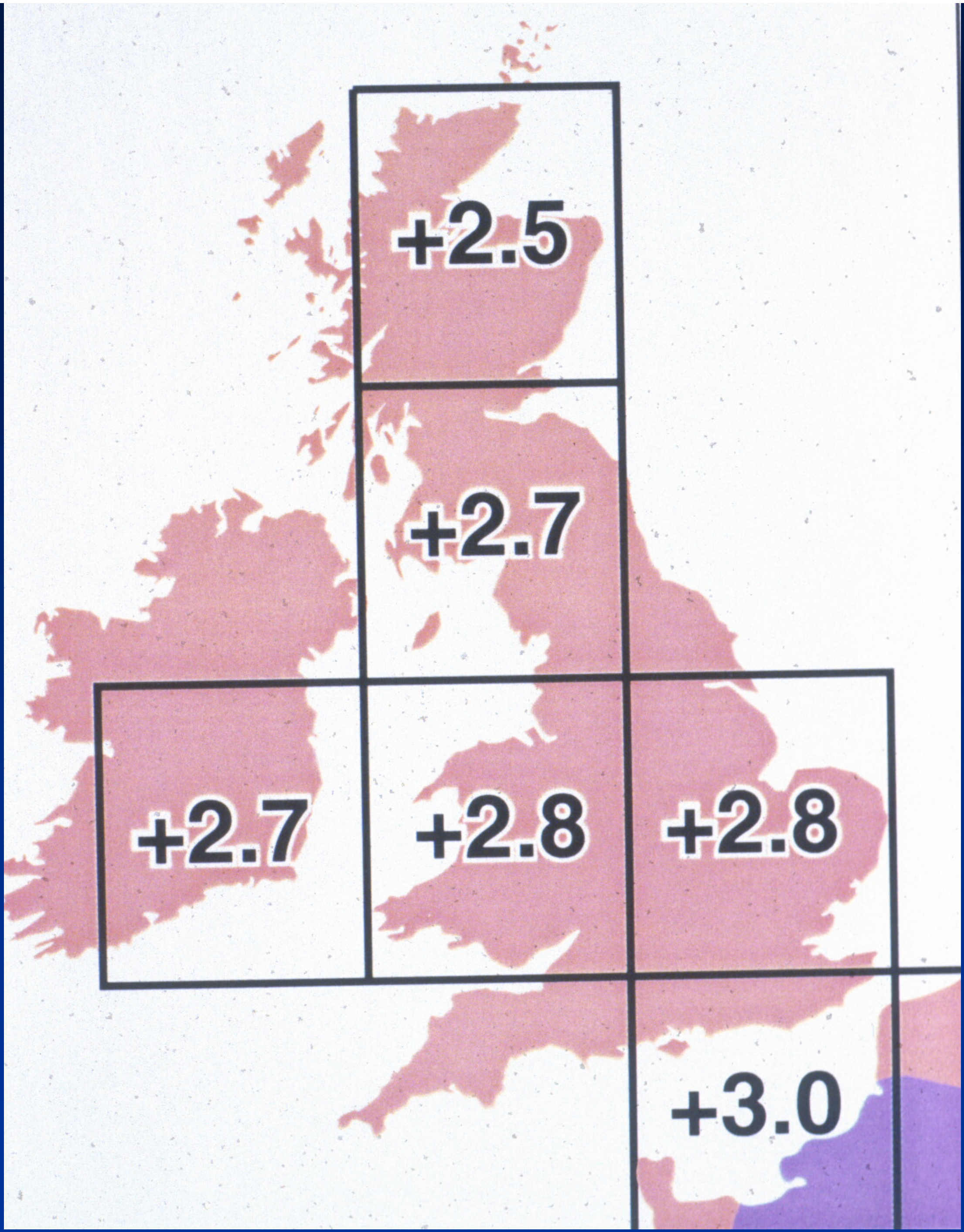
- Emission scenarios can be used as inputs to derive atmospheric greenhouse gas concentrations and in turn to drive global climate models



d.viner@uea.ac.uk



88
90
1
HadCM2 Co-ordinates
10
19
80.0°N
25.0°N
5
27
Latitude
33.75°W
0.0
33.75°E
67.5°E
Longitude


+2.5
+2.7
+2.7
+2.8
+2.8
+3.0

Global Climate Model scales are not useful for water resource management purposes

Some form of downscaling must therefore be employed.

Statistical Downscaling

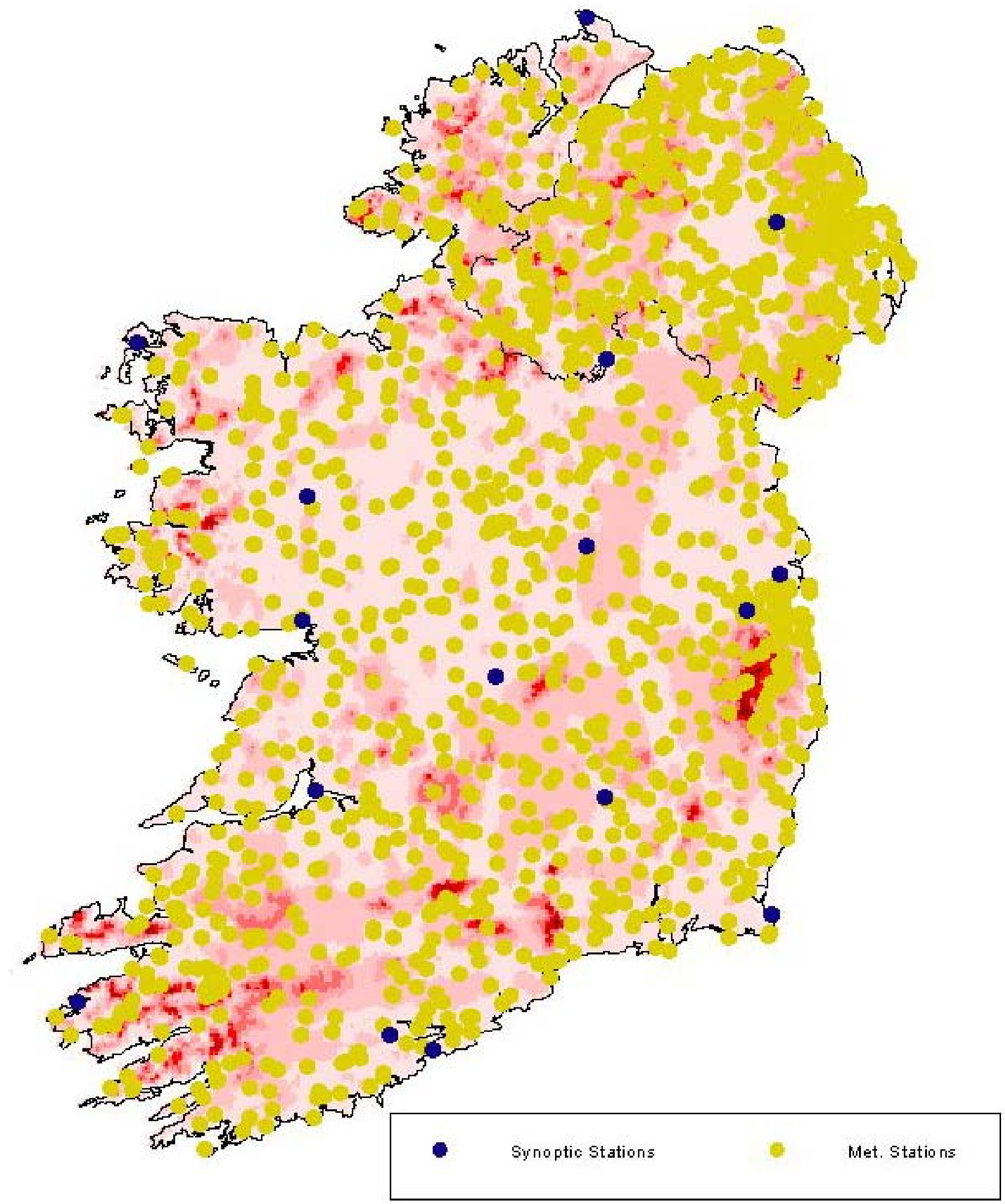
- Involves establishing relationships between mesoscale data, such as upper air observations and local surface observations.

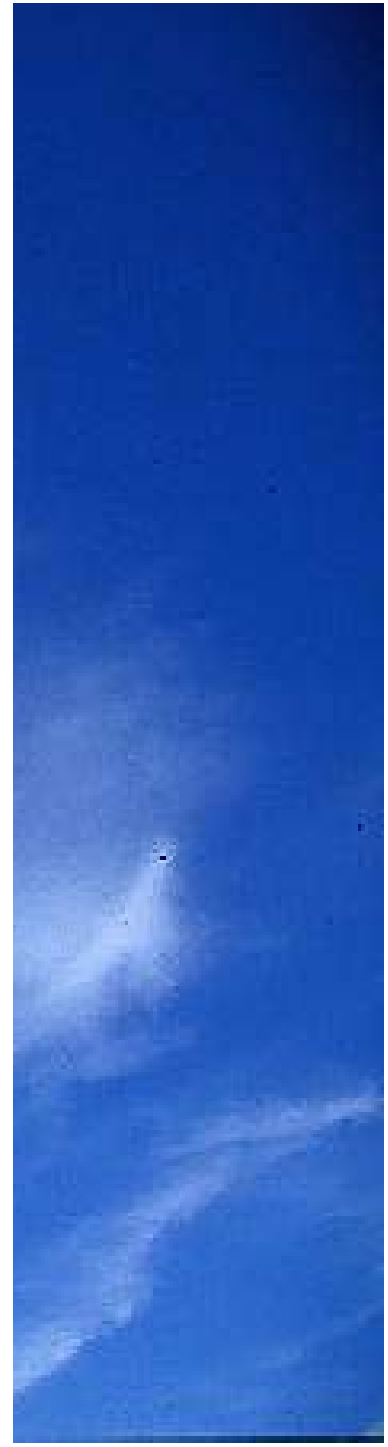
- The relationship is initially established using present day observational data, which are then ‘forced’ using GCM output in order to derive climate scenarios for future time-slices.

- Transfer functions are derived for point locations for both current and future model runs; the difference is then applied to the observed data.

- Statistical downscaling assumes that the derived relationships will remain robust enough in a changing climate situation

Stations Measuring Precipitation 1961-1990





Downscaled Scenarios

Empirical statistical downscaling was employed to develop future scenarios of climate change, utilising the HadCM3 GCM to 'drive' the transfer functions.

The technique is based on the assumption that GCMs simulate mesoscale aspects of climate better than surface variables such as temperature and precipitation.

The transfer functions were derived from NCEP/NCAR Reanalysis data and the observed variable of interest for all stations for the period 1961-1990 - observed current

The resulting transfer functions were then 'forced' using the upper air variables extracted from the grid location which corresponds to Ireland from the HadCM3 GCM. These transfer functions were applied to approximately 250 stations for precipitation and 60 stations for temperature covering the periods

1961-1990 - Modelled Current,

2041-2070 - Modelled Future 2055,

2061-2090 - Modelled Future 2075.

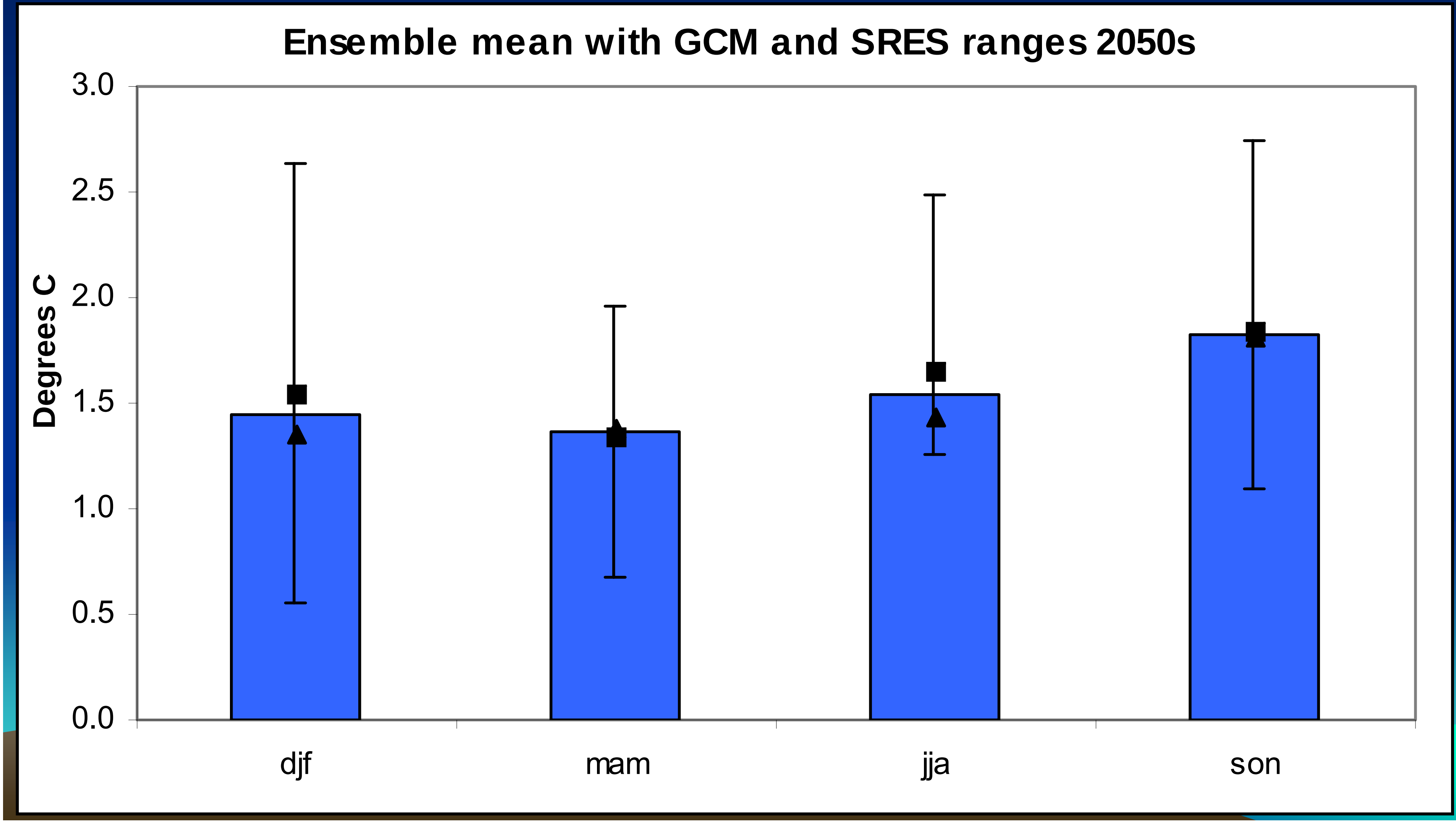
Global Climate Models used in statistical downscaling for Irish synoptic stations

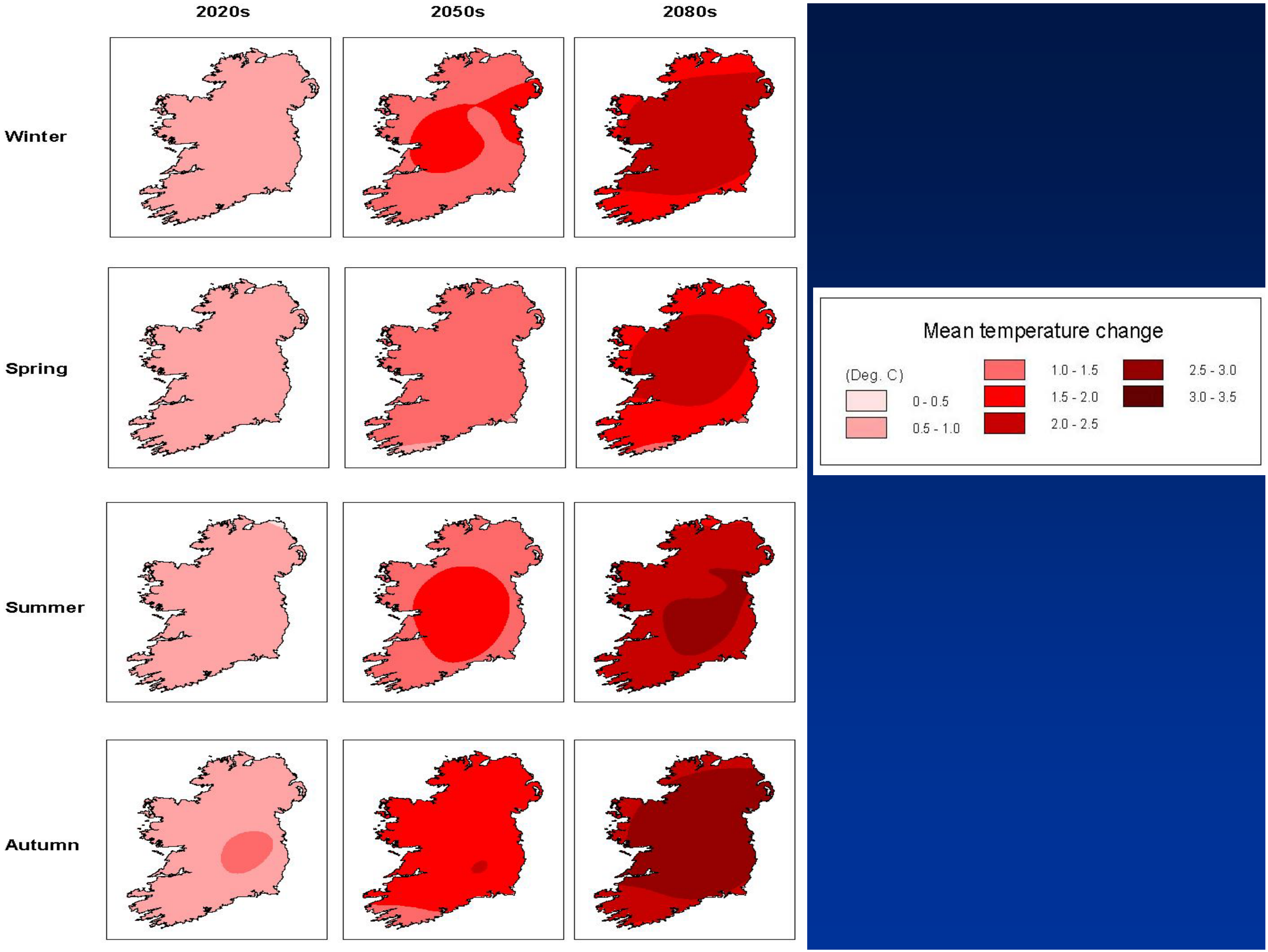
• HadCM3	UK
• CGCM2	Canada
• CSIRO Mark 2	Australia

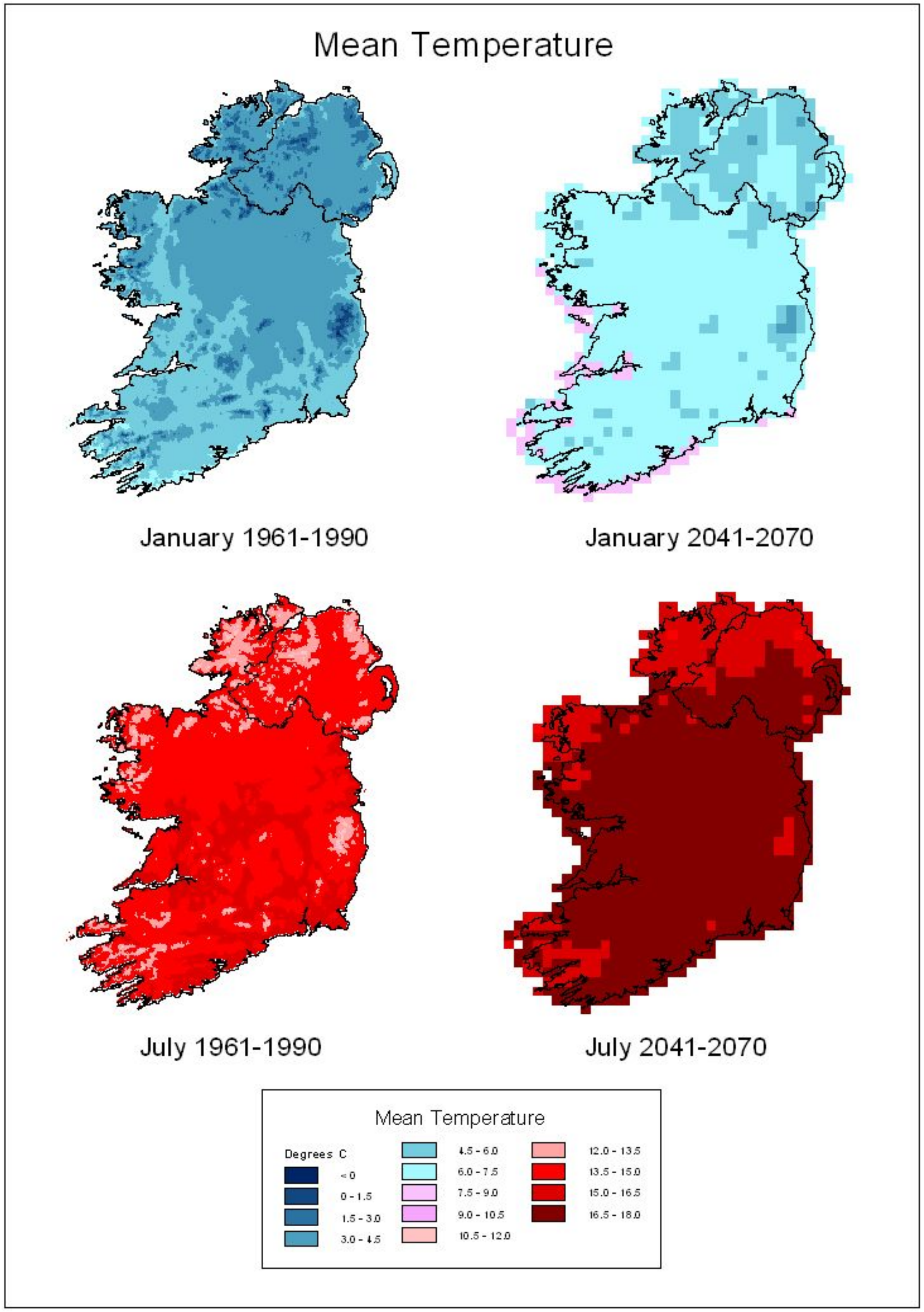
- A2 and B2 SRES Emissions Scenarios

Ensemble mean temperature for the 2050s produced from the weighted ensemble of all GCMs and emissions scenarios (bars). Upper and lower ranges (lines) are the results from the individual GCMs and emissions scenarios.

Ensemble A2 scenario (■) and B2 scenario (▲)




2020s
2050s
2080s
Winter
Spring
Summer
Autumn
Mean temperature change
(Deg. C)
0 - 0.5
0.5 - 1.0
1.0 - 1.5
1.5 - 2.0
2.0 - 2.5
2.5 - 3.0
3.0 - 3.5



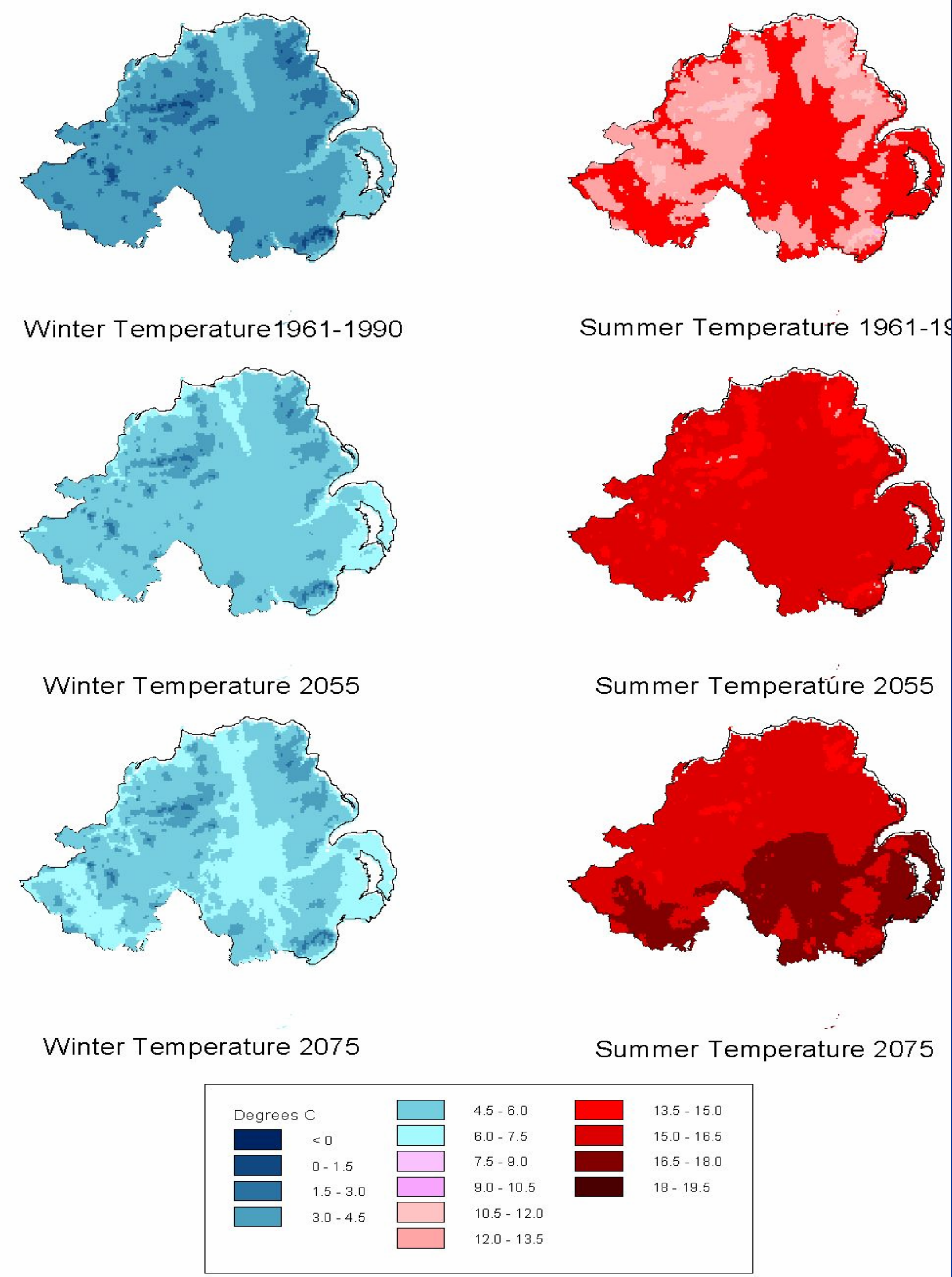
Warming relative to 1961-90

Mean January figures are predicted to increase by 1.5ºC by mid century with a further increase of 0.5ºC-1.0ºC by 2075.

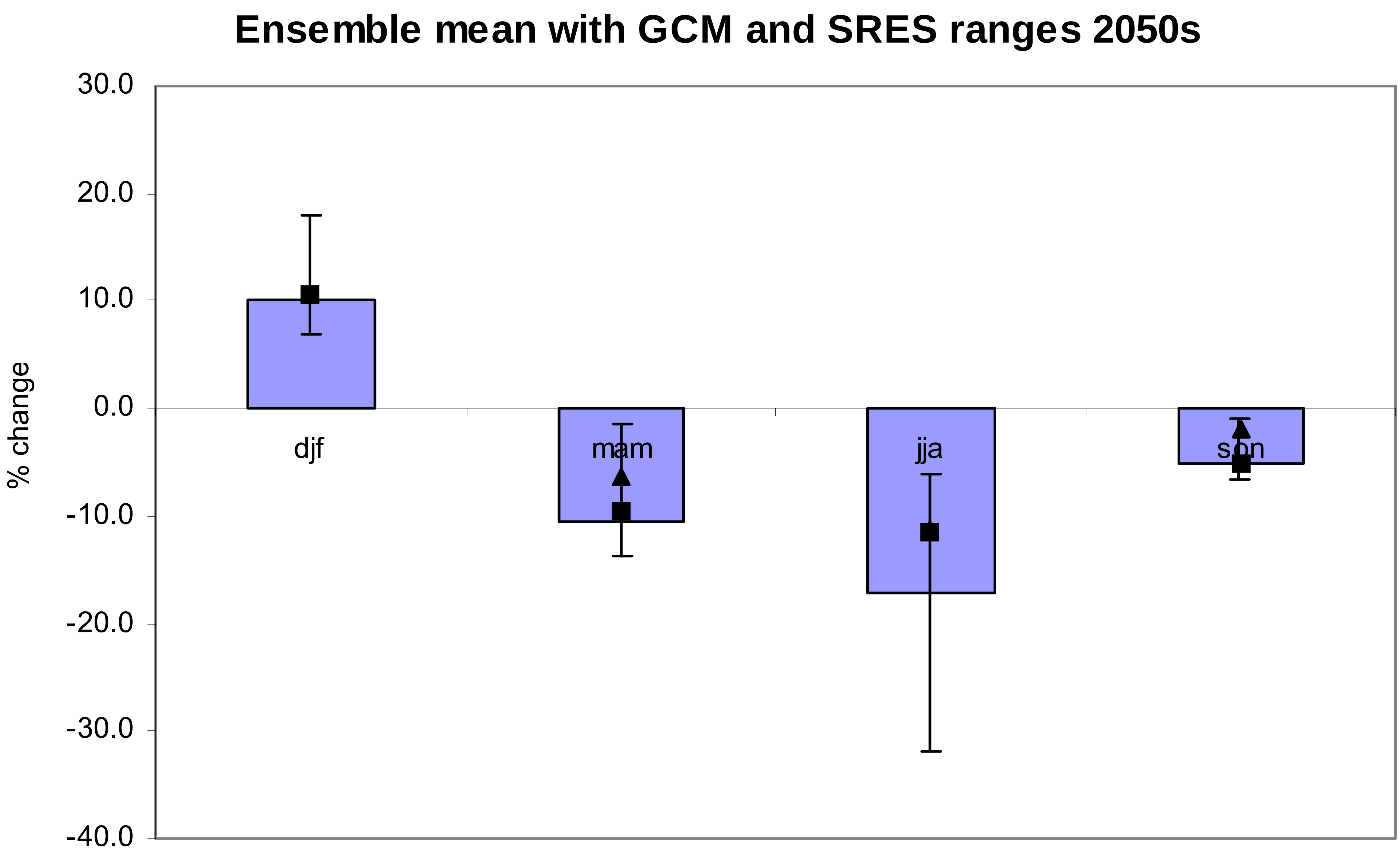
By 2050, the extreme south and south west coasts may have a mean January temperature of 8.0ºC. By then, winters in Northern Ireland and in the north Midlands will be similar to those presently experienced along the Cork/Kerry coast.

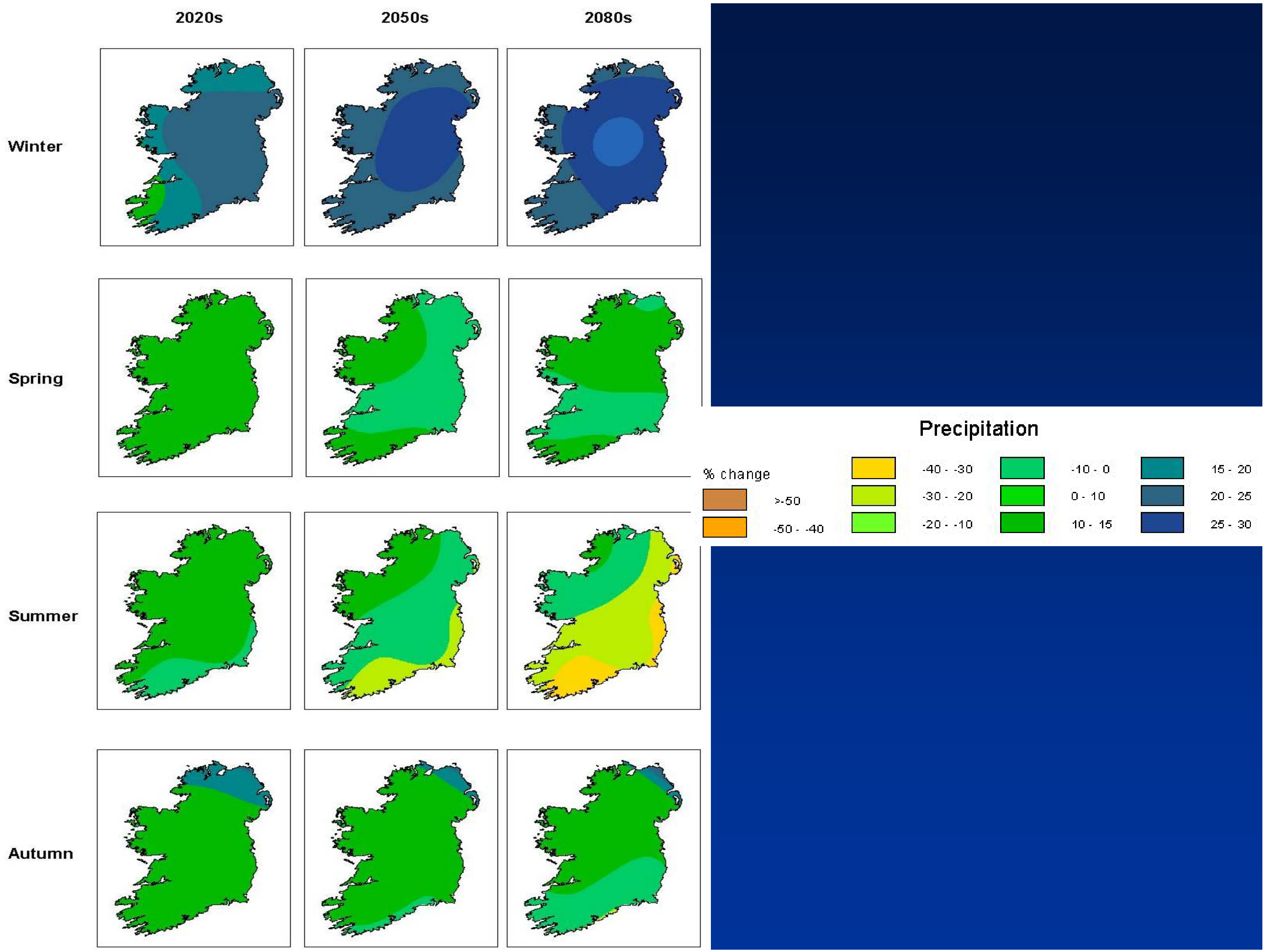
July temperatures will increase by 2.5ºC by 2050 and a further increase of 1.0ºC by 2075 can be expected. Maximum July temperatures of the order of 22.5ºC will prevail generally with areas in the central Midlands experiencing maximum July temperatures of 24.5ºC.

Temperature projections for Northern Ireland 2055, 2075

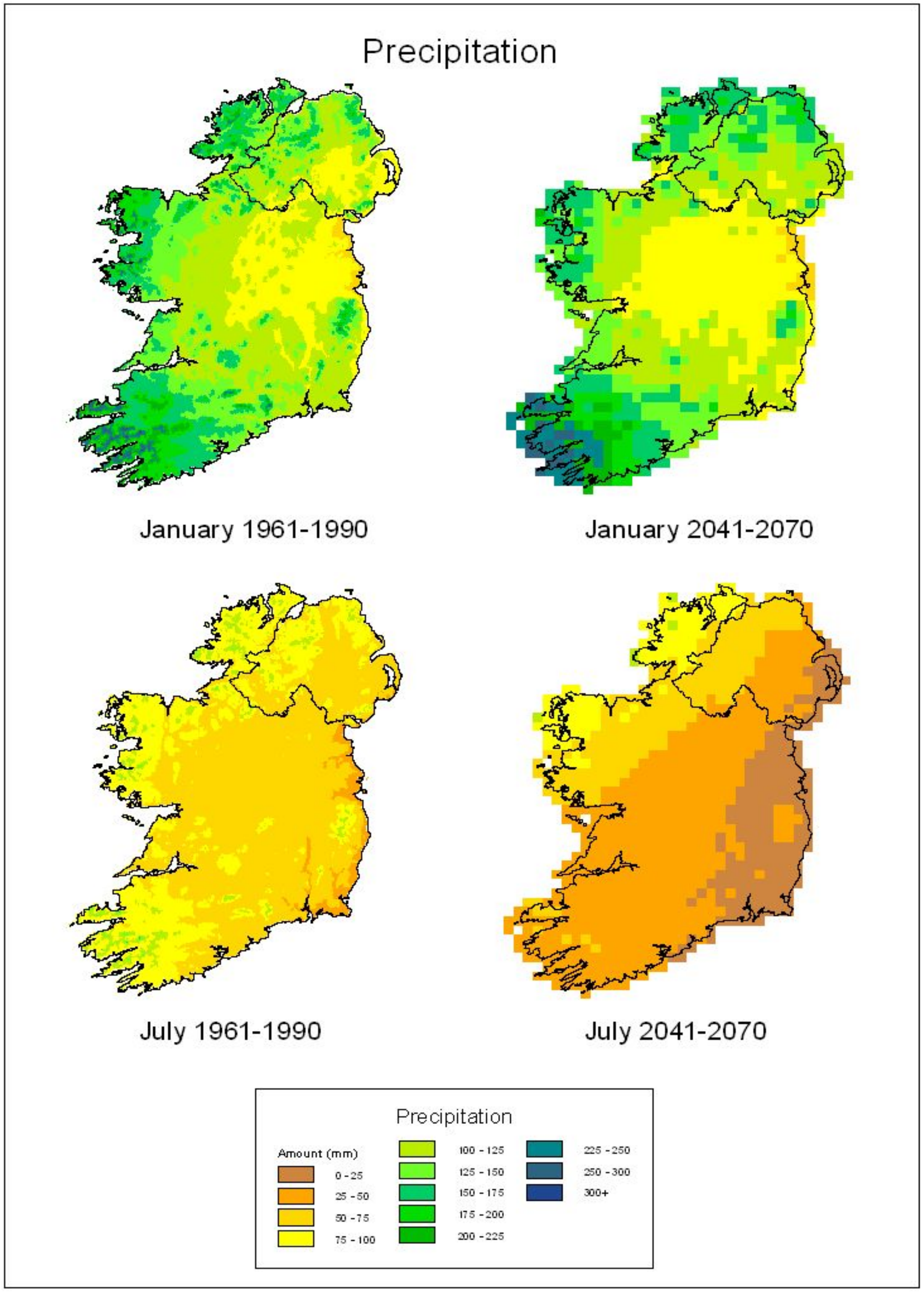


Ensemble mean precipitation for the 2050s produced from the weighted ensemble of all GCMs and emissions scenarios (bars). Upper and lower ranges (lines) are the results from the individual GCMs and emissions scenarios. Ensemble A2 scenario (■) and B2 scenario (▲).





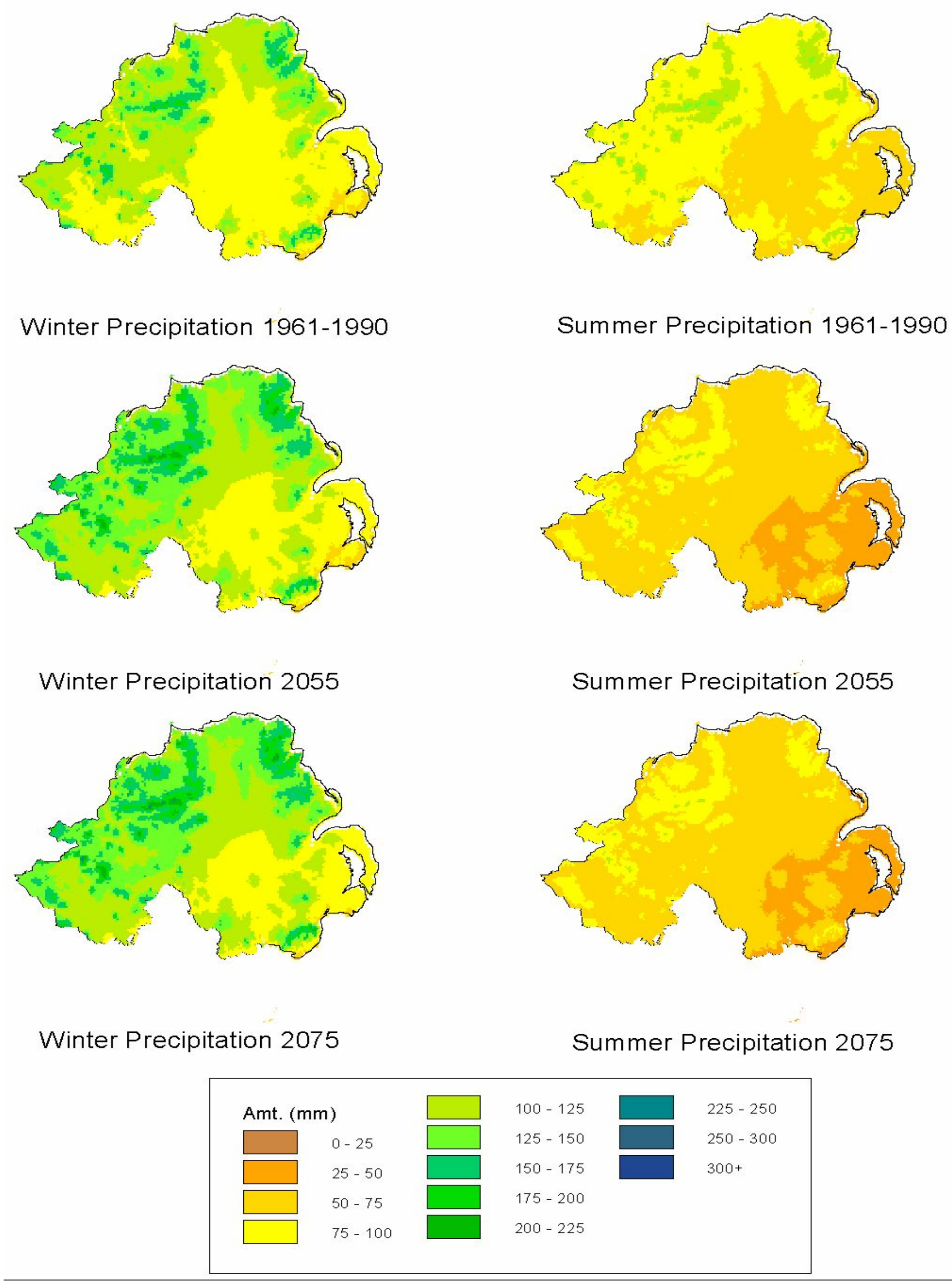
2020s
2050s
2080s
Winter
Spring
Summer
Autumn
Precipitation
% change
>-50
-50 - -40
-40 - -30
-30 - -20
-20 - -10
-10 - 0
0 - 10
10 - 15
15 - 20
20 - 25
25 - 30



Rainfall relative to 1961-90

Overall increases in precipitation are predicted for the winter months of December- February. On average these amount to 11%. The greatest absolute increases are suggested for the north west.

Marked decreases in rainfall during the summer and early autumn months across eastern and central Ireland are predicted. Nationally, these are of the order of 25% with decreases of over 40% in some parts of the south-east.

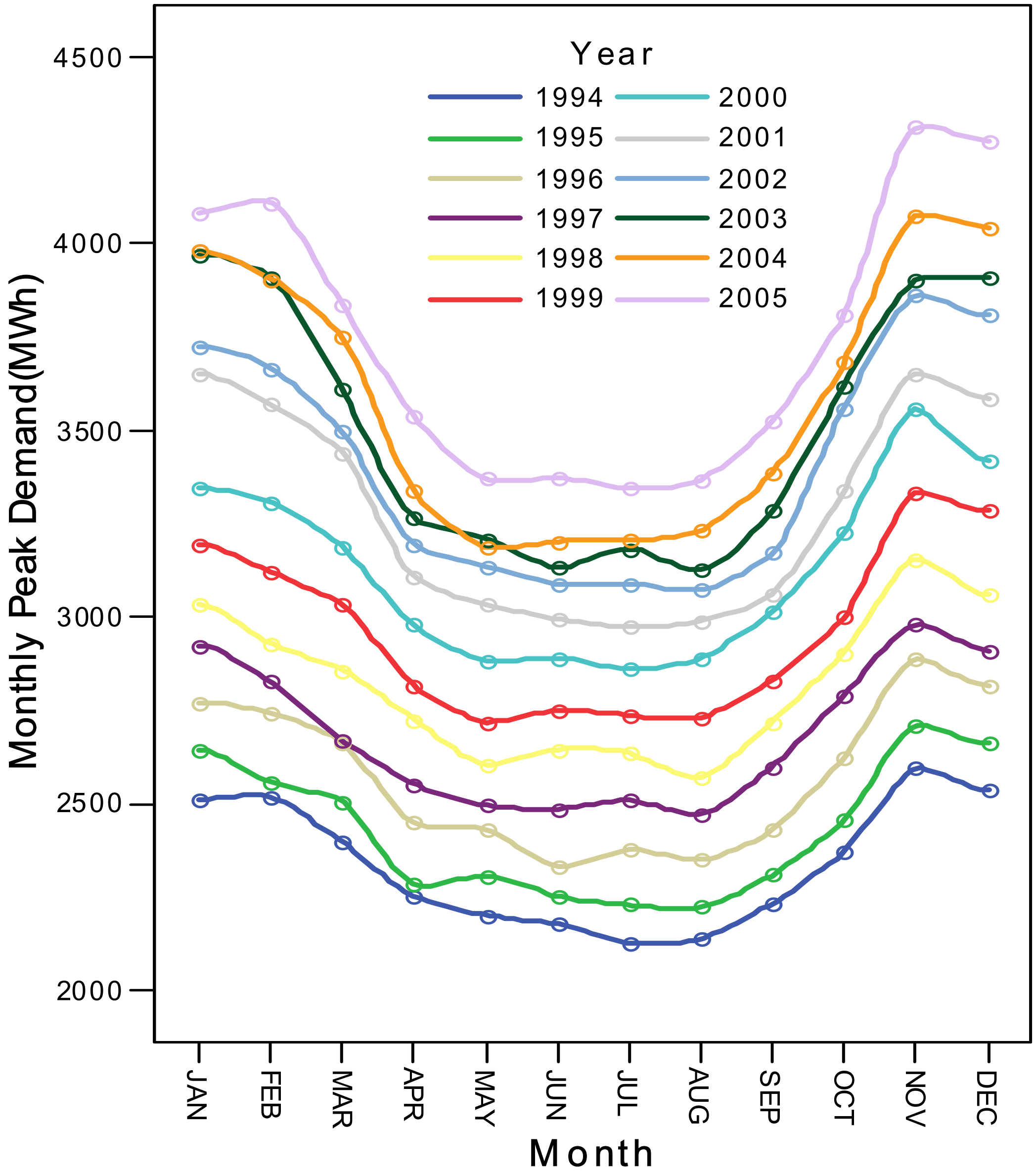


Rainfall projections for Northern Ireland 2055, 2075

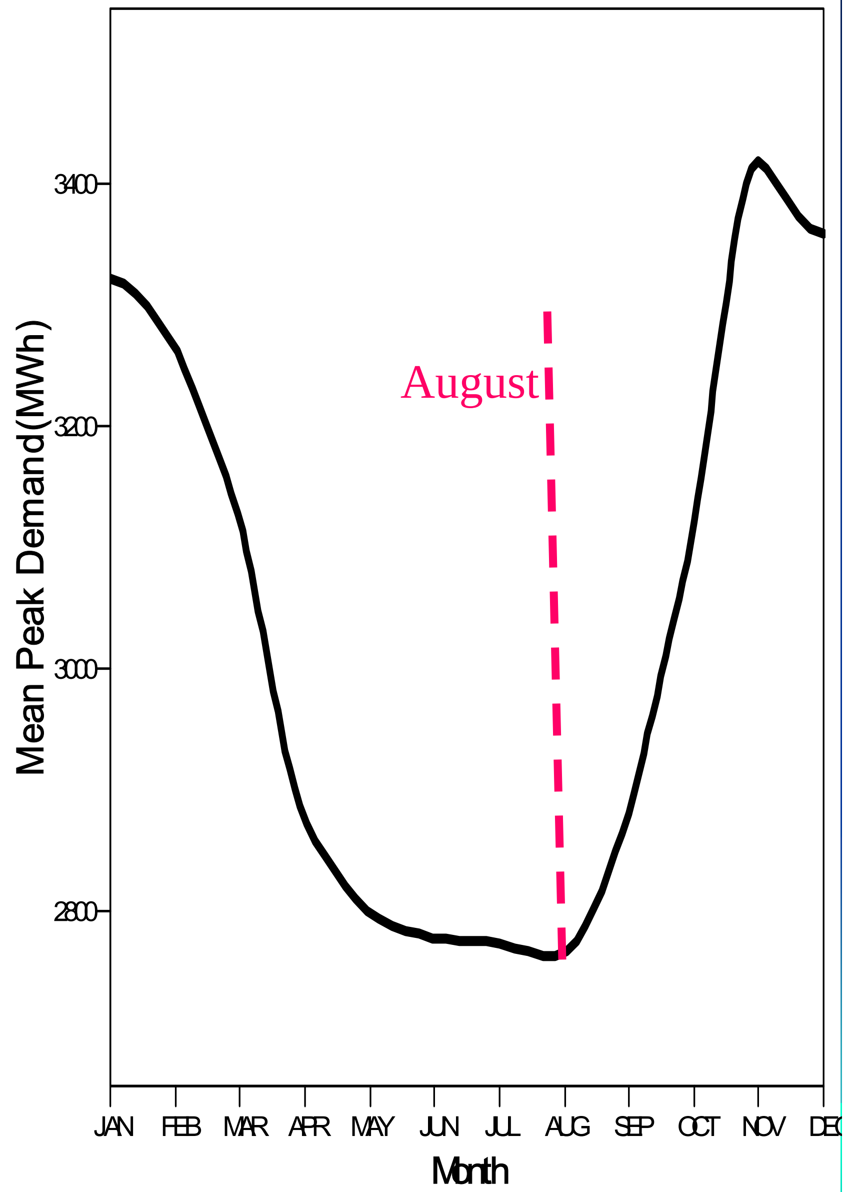
Energy Demand Impacts

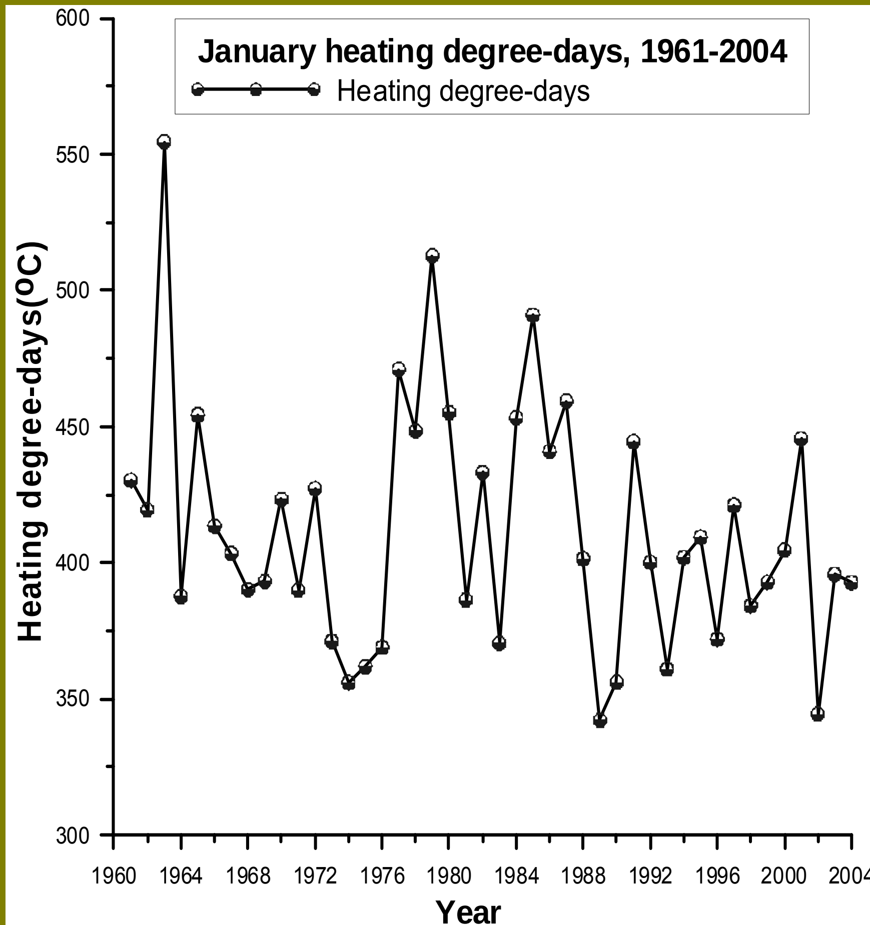
Seasonal Electricity Peak Demand - Republic of Ireland

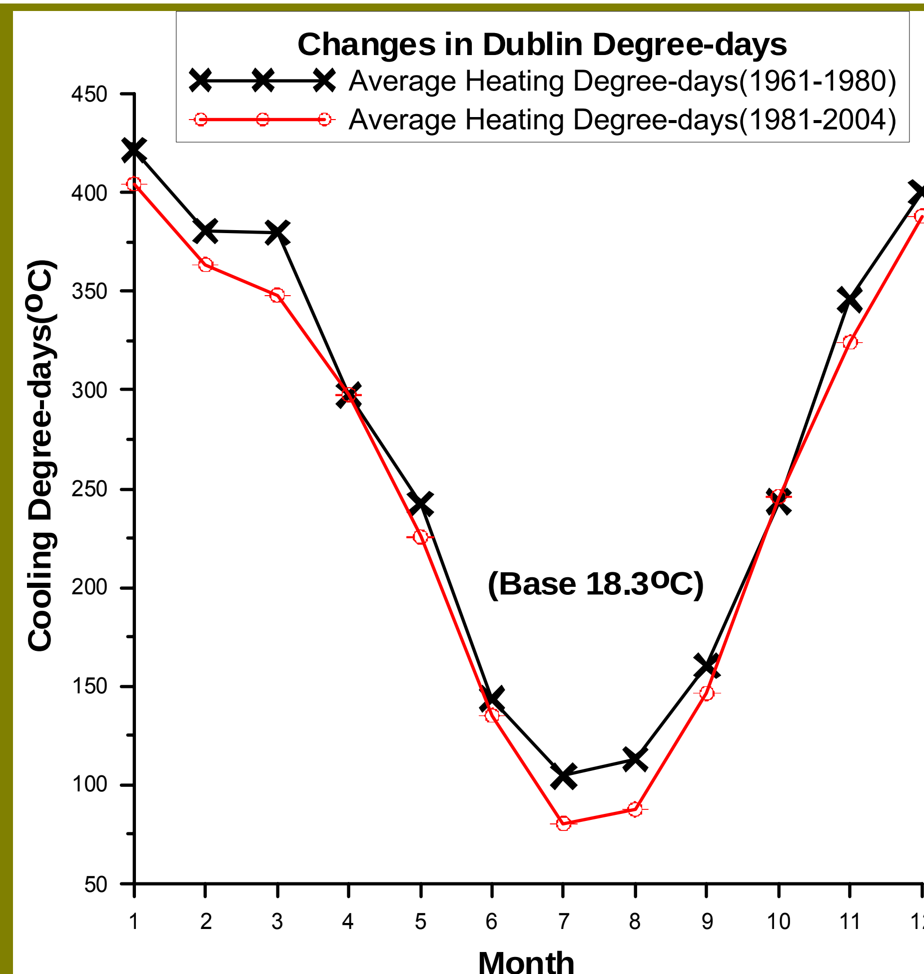
Monthly electricity peak demand, 1994-2005



Mean monthly electricity peak demand, 1994-2005





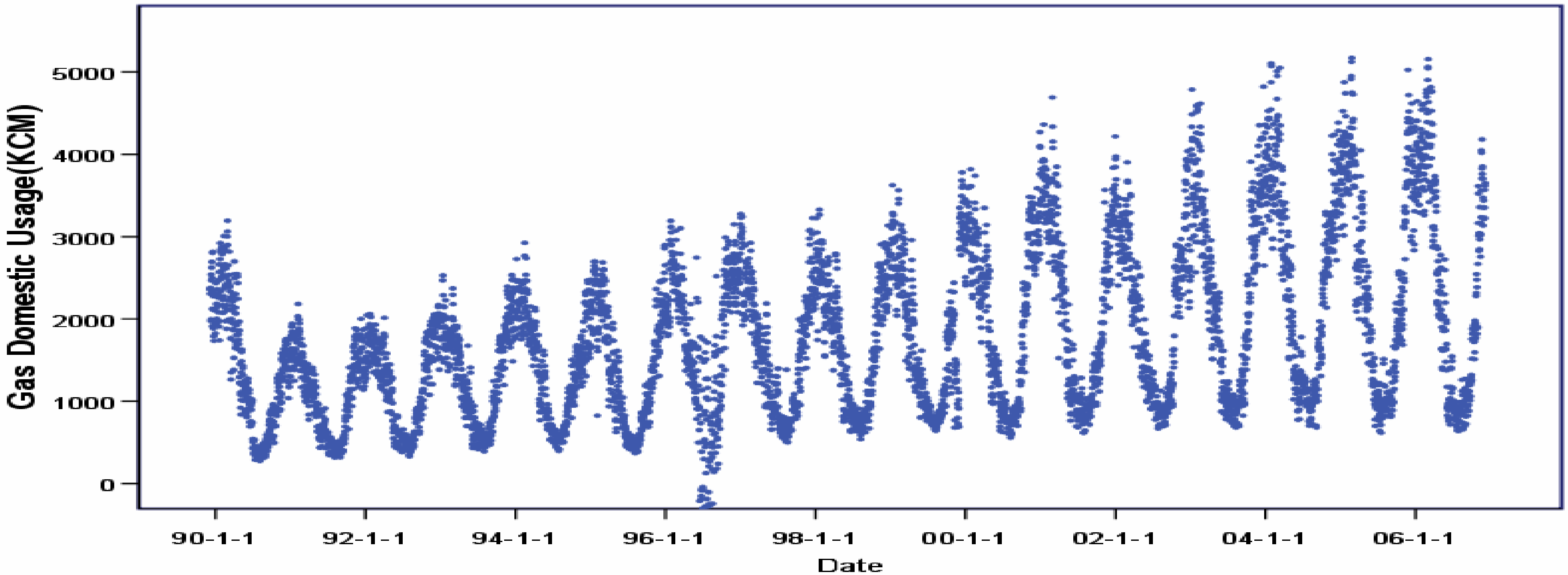


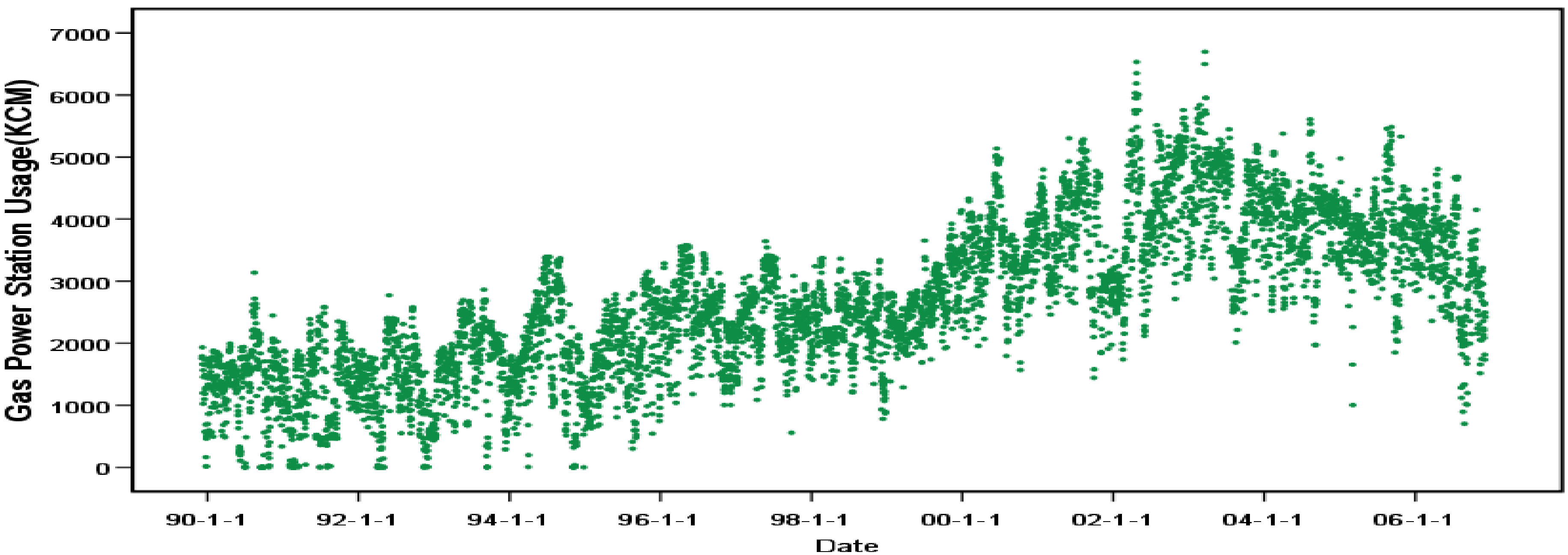
January Heating Degree-days Trend in Dublin, 1961-2004

Monthly Heating Degree-days Changes in Dublin, 1961-2004

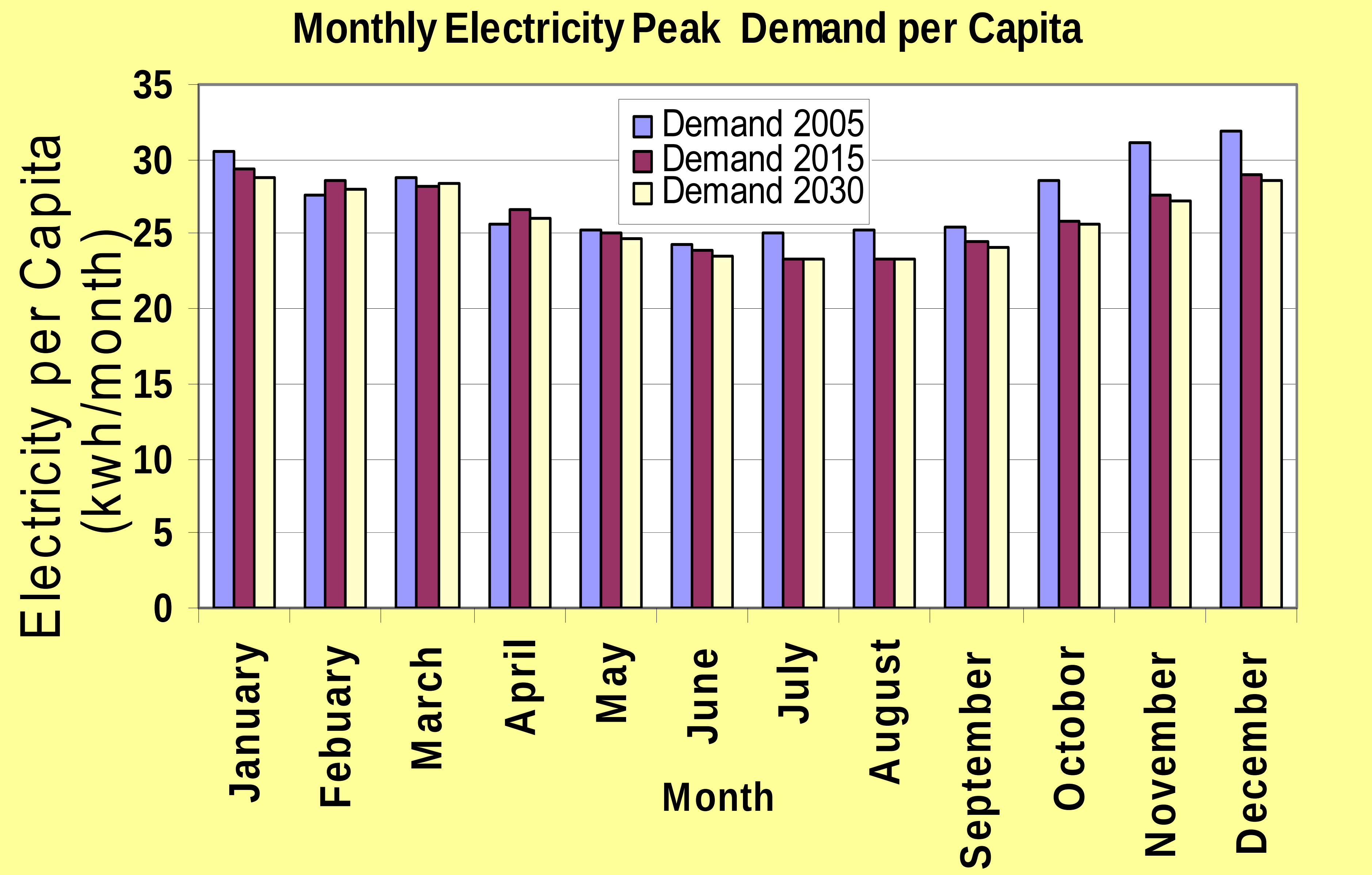
Mean temperature increasing

Dublin Domestic Daily Gas Use and Dublin Power station Daily Gas Use(1990-2006)



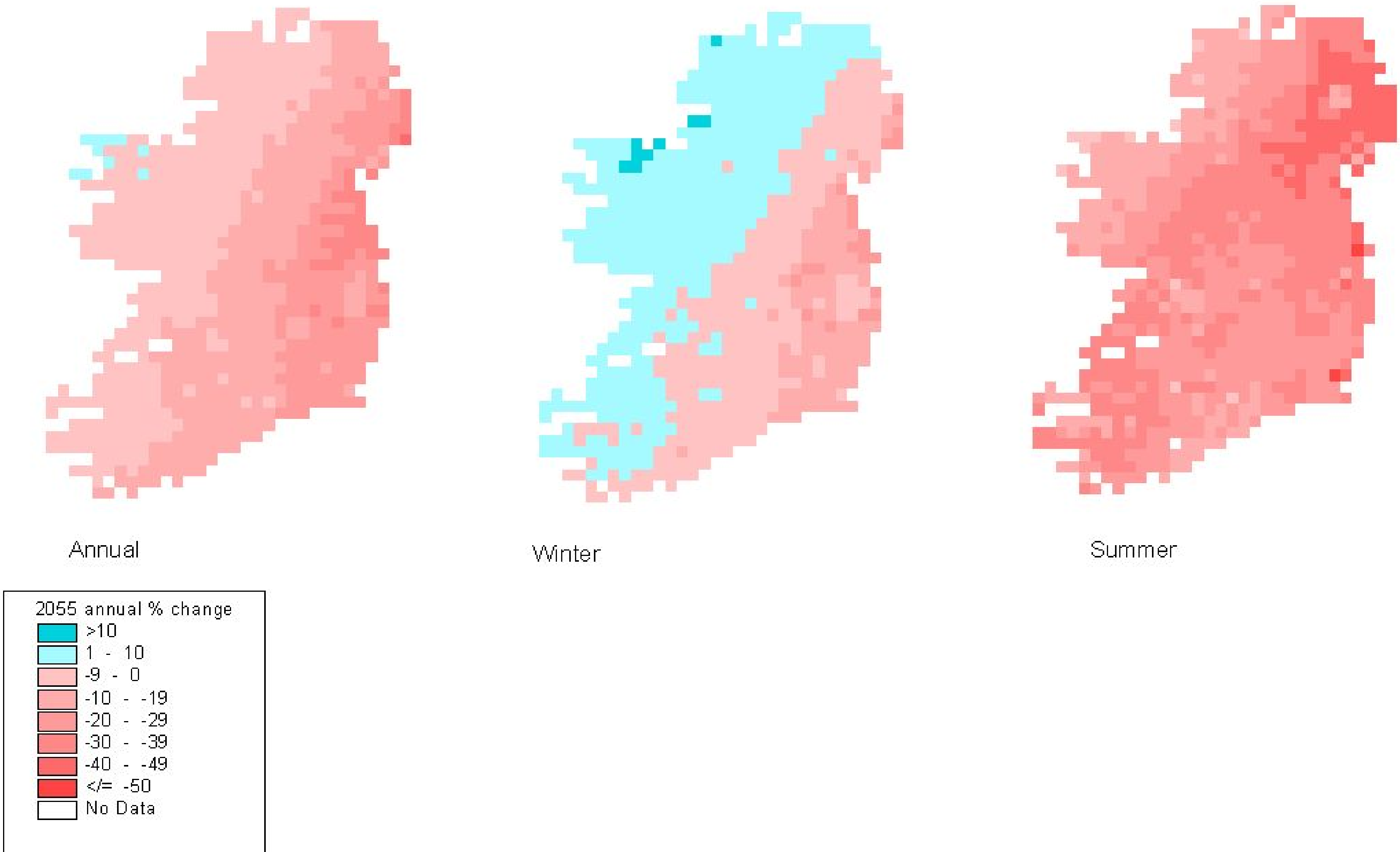


Projected Decrease in Winter Monthly Energy demand for the Greater Dublin region



Hydrological Impacts

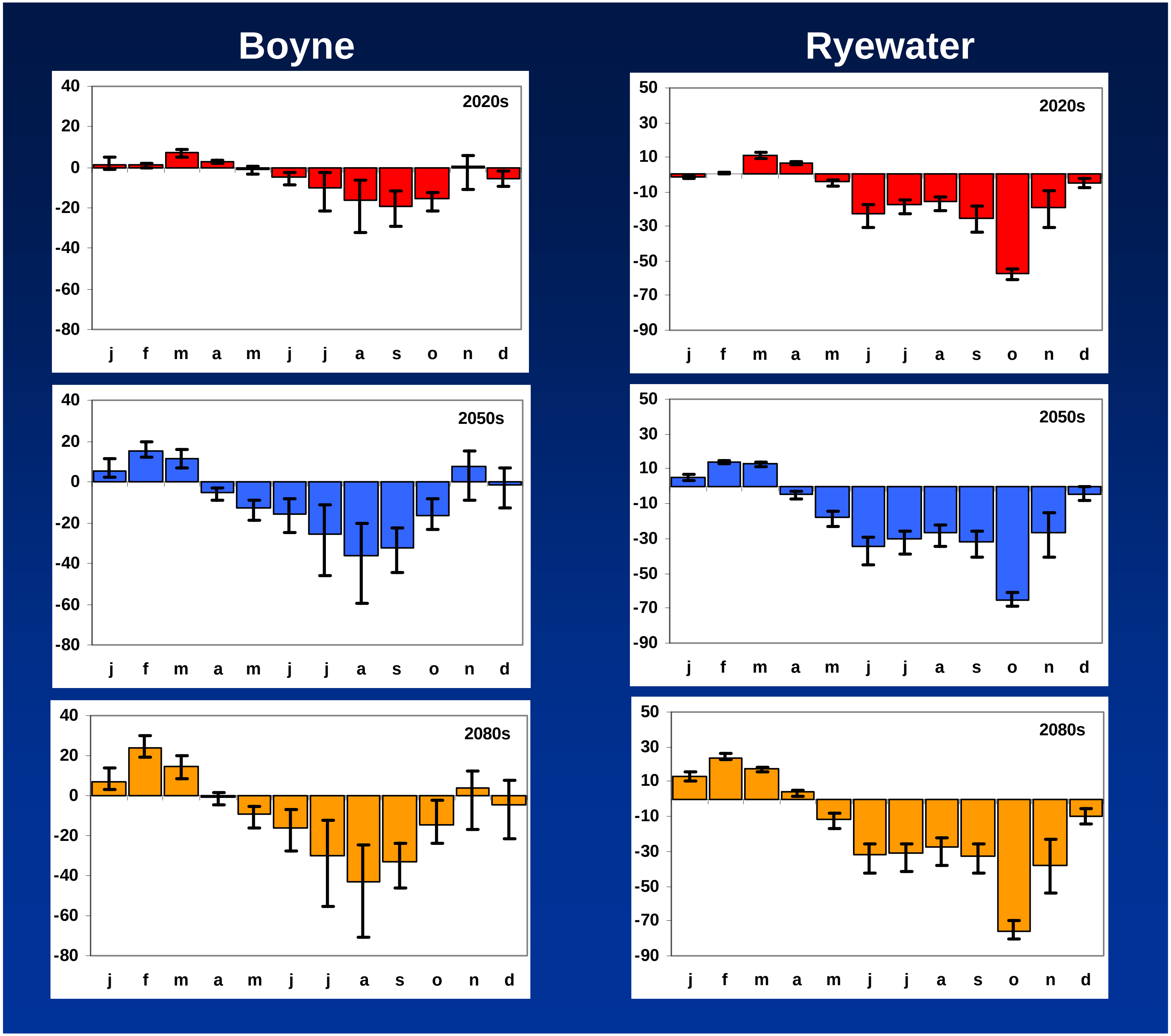
% Change 2041-70



Changes in Runoff as a % of 1961-90 averages

			Barrow	B'water	Boyne	Brosna	Inny	Moy	R'water	Suck	Suir
T2	A_2	20s	1.8	1.8	1.9	2.1	2.5	1.6	1.6	1.5	1.8
		50s	1.6	1.5	1.4	1.5	1.4	1.5	1.4	1.4	1.7
		80s	1.3	1.4	1.2	1.3	1.2	1.3	1.5	1.2	1.5
	B_2	20s	1.8	1.5	1.4	1.8	1.6	1.4	1.4	1.4	1.8
		50s	1.6	1.5	1.4	1.4	1.3	1.4	1.7	1.4	1.8
		80s	1.5	1.5	1.3	1.3	1.3	1.4	1.6	1.4	1.6
T10	A_2	20s	4.8	3.6	7.1	13.9	12.7	4.2	3.4	4.4	4.4
		50s	4.8	4.2	3.4	3.4	4.5	4.4	3.3	4.5	6.9
		80s	3.4	3.4	1.8	2.0	2.0	2.2	4.1	2.1	3.2
	B_2	20s	3.7	2.6	2.3	4.0	4.1	2.2	3.5	2.4	4.1
		50s	4.0	2.6	3.5	3.0	3.5	4.6	5.5	5.5	4.1
		80s	2.9	3.8	2.2	2.1	2.3	3.9	5.4	4.6	2.8
T25	A_2	20s	8.3	5.1	15.1	39.3	26.4	7.7	5.3	8.8	6.5
		50s	10.1	7.3	5.6	4.9	7.5	8.5	5.5	9.7	16.9
		80s	6.7	5.3	2.3	2.8	2.7	3.1	6.9	3.0	4.7
	B_2	20s	5.5	3.2	3.0	5.6	6.6	3.0	6.4	3.5	5.8
		50s	7.7	3.4	6.9	4.5	6.1	10.3	11.0	14.2	5.8
		80s	4.6	6.6	3.2	2.6	3.2	8.2	12.8	13.8	3.7

Changes in the frequency of floods of a given magnitude for each future time period. Results are based on the HADCM3 GCM using both A2 and B2 emissions scenarios.

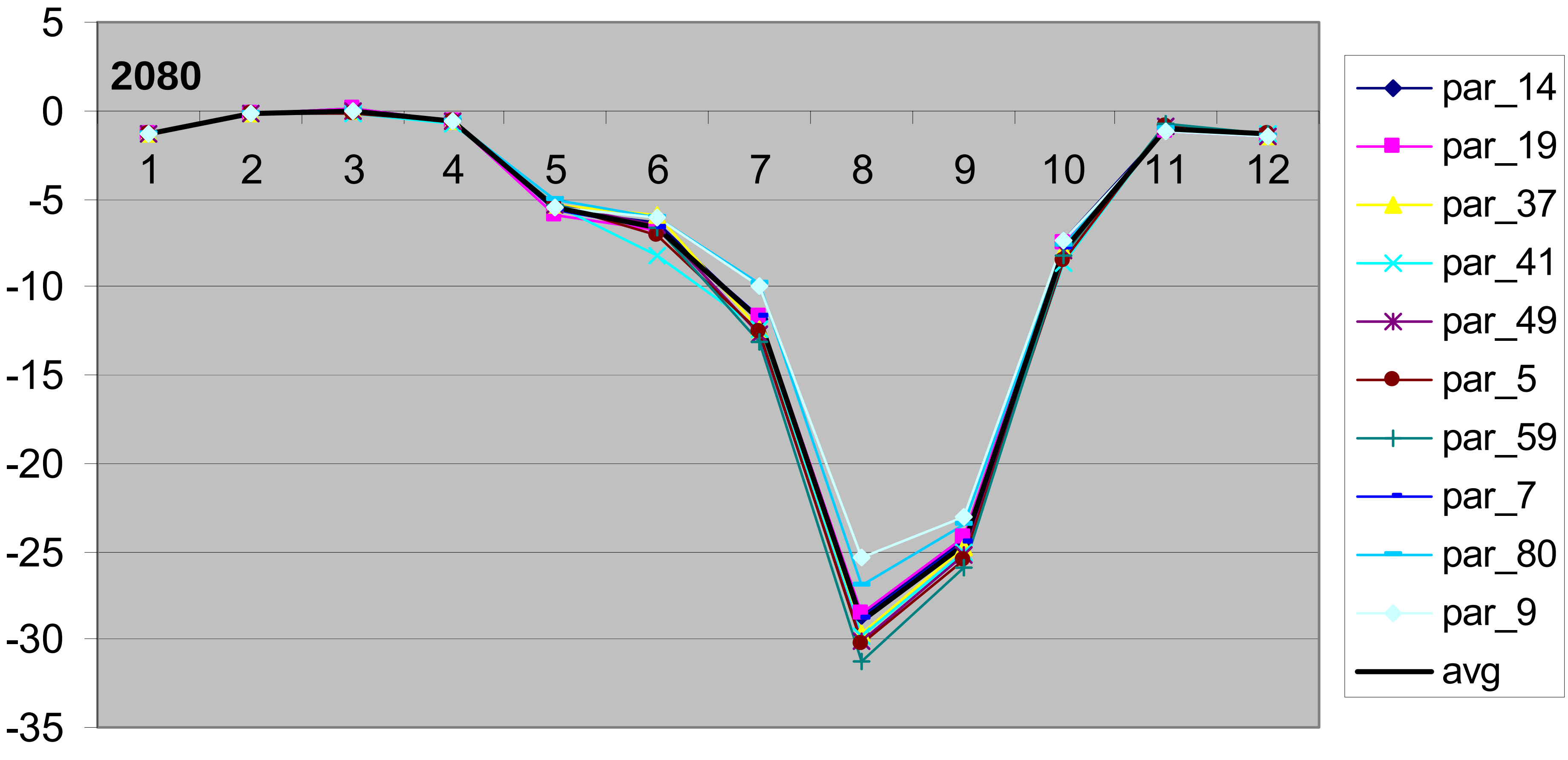


% Change in monthly streamflow

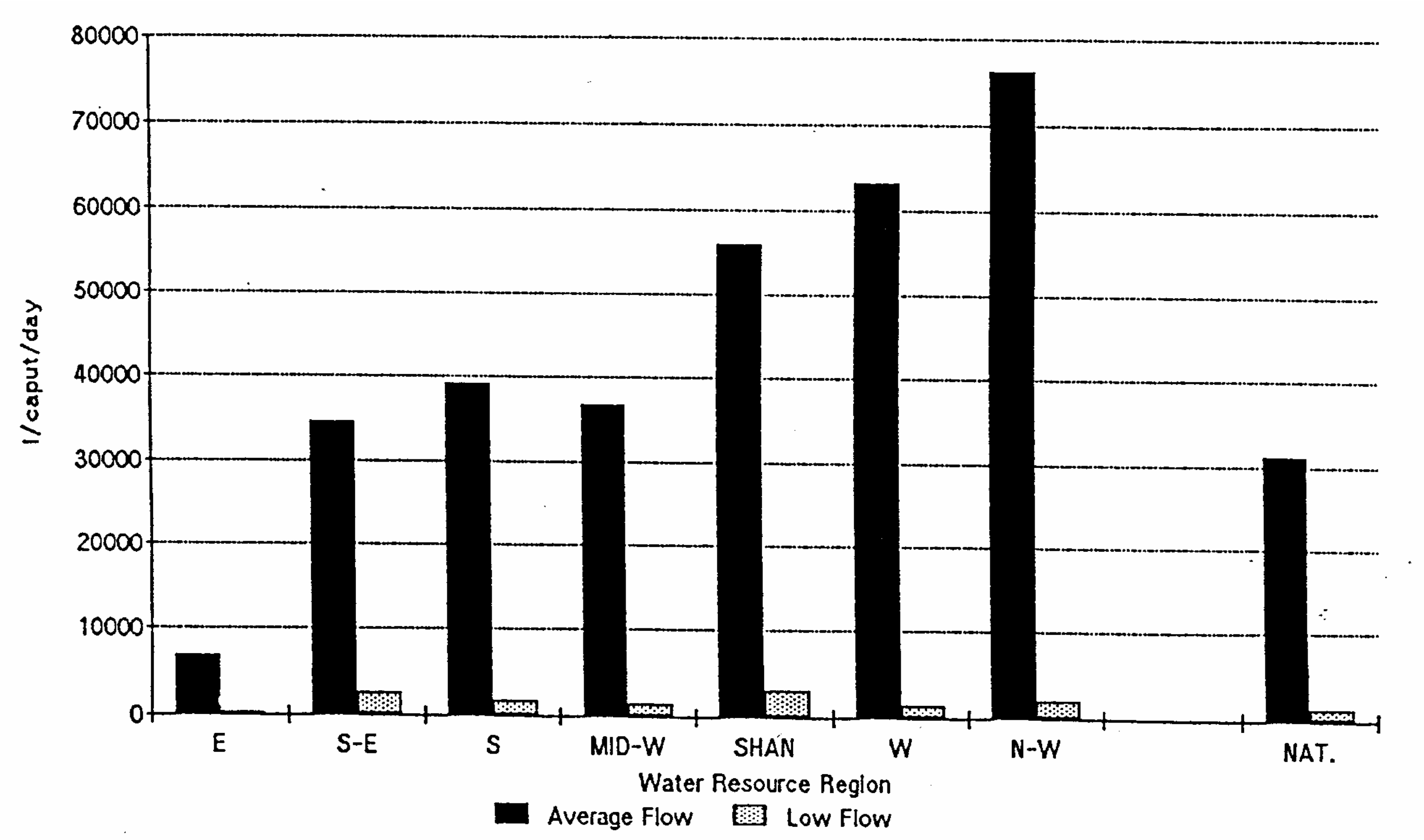
Irish Climate Analysis and Research Units

ICARUS
Irish Climate Analysis and Research Units

Percent change in simulated **Upper Soil Storage** Boyne HADCM3 A2



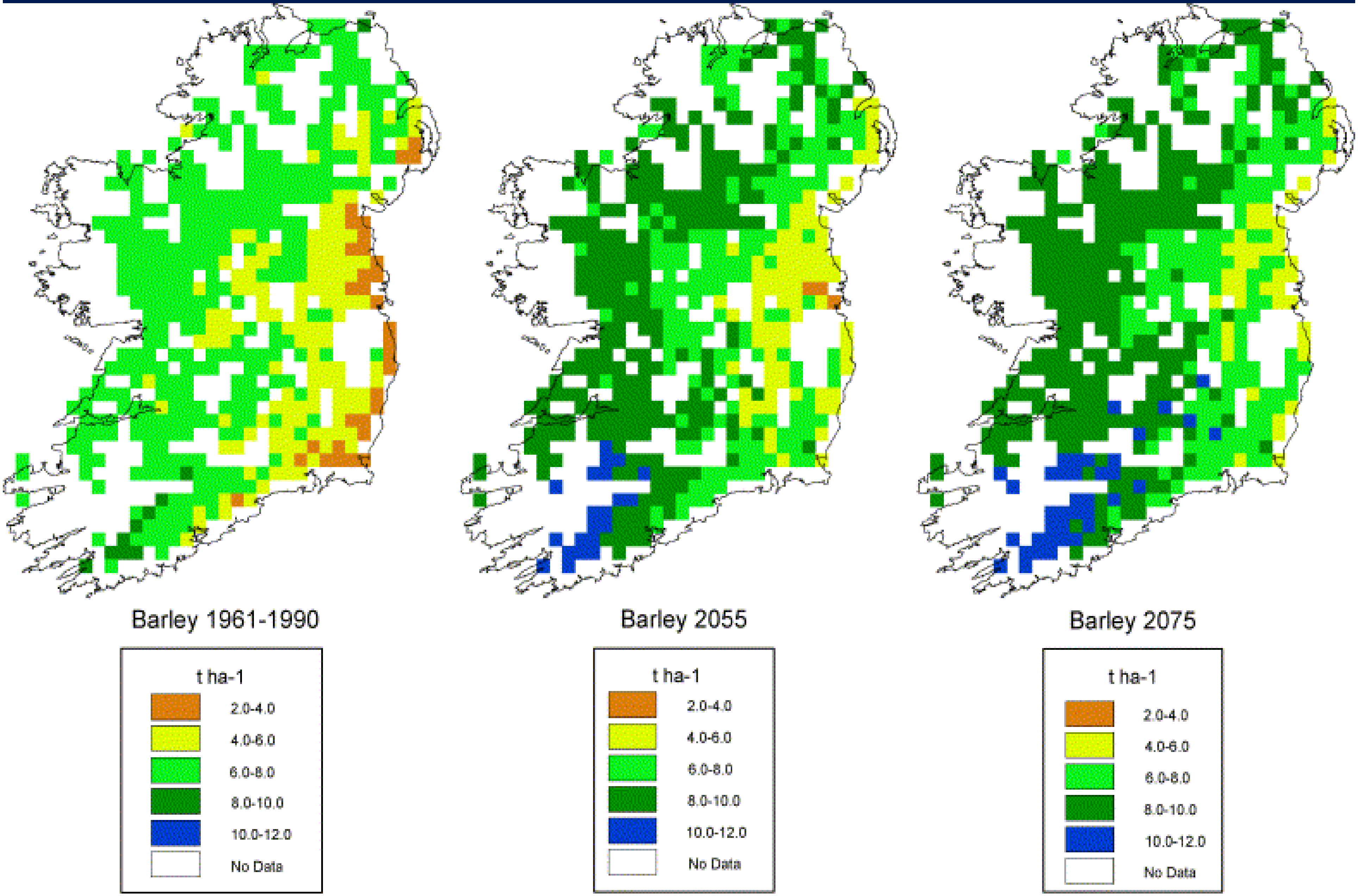
Regions with low per capita availability may experience the greatest reductions in water availability; especially during summer months



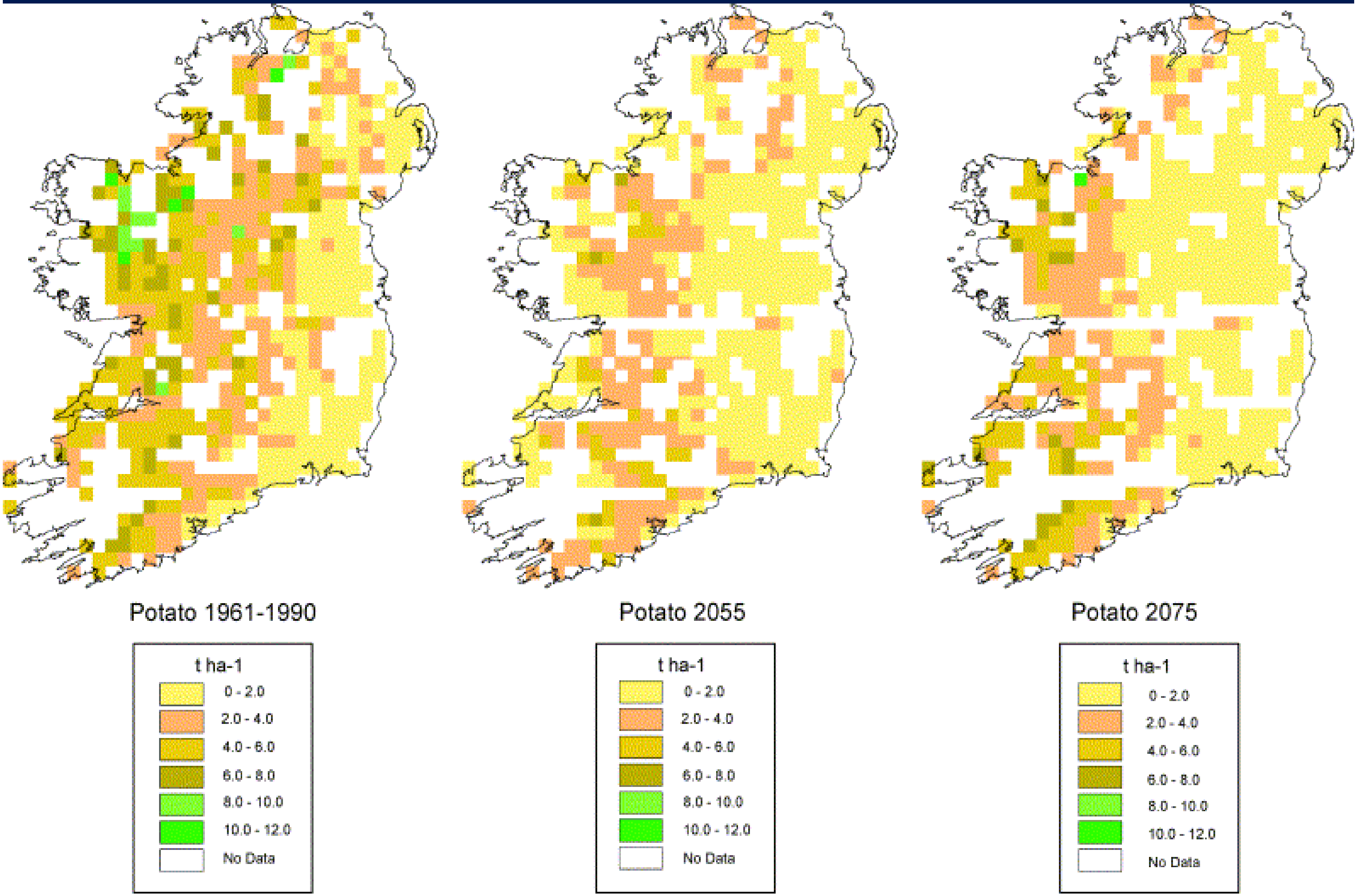
Impacts of Climate Change on Irish Agriculture

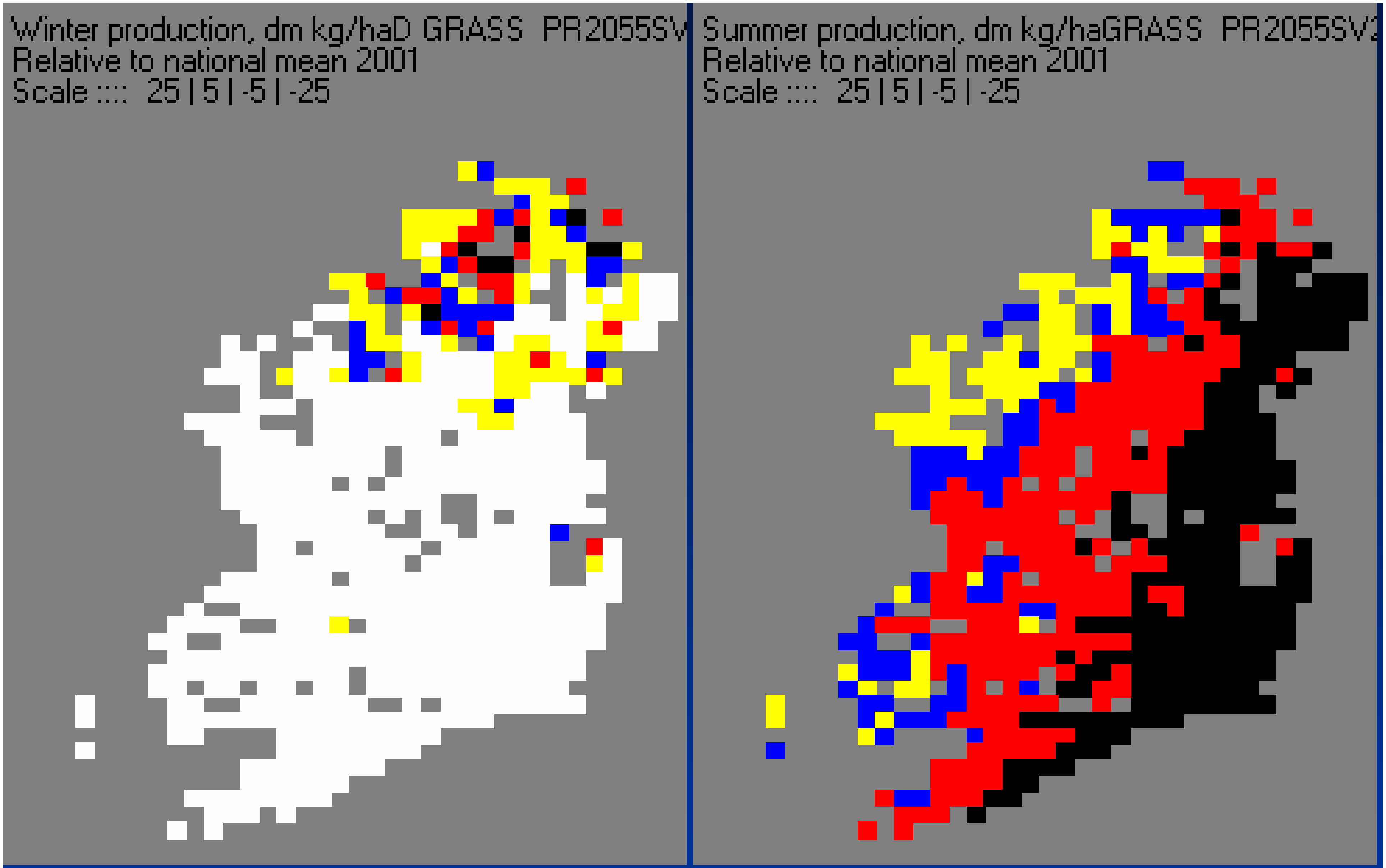
- Drive crop models with high spatial resolution monthly climate scenario data
- Drive farm management systems with low spatial resolution daily climate scenario data

Barley yield in Ireland under baseline (1961–1990) climate, and the change for the 2041–2070 and 2061–2090 scenarios



Potato yield in Ireland under baseline climate, and the change for the 2041–2070 and 2061–2090 scenarios

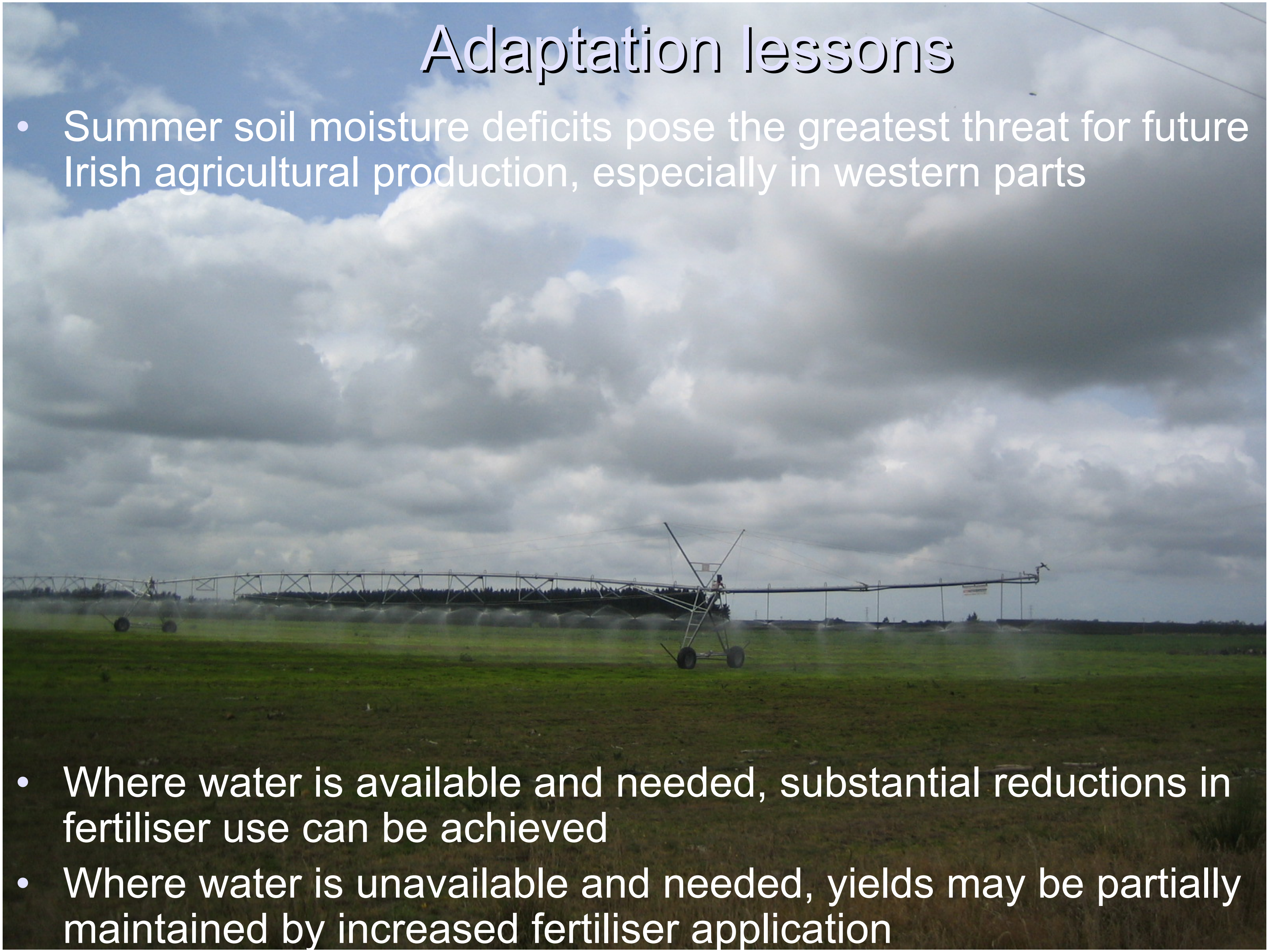




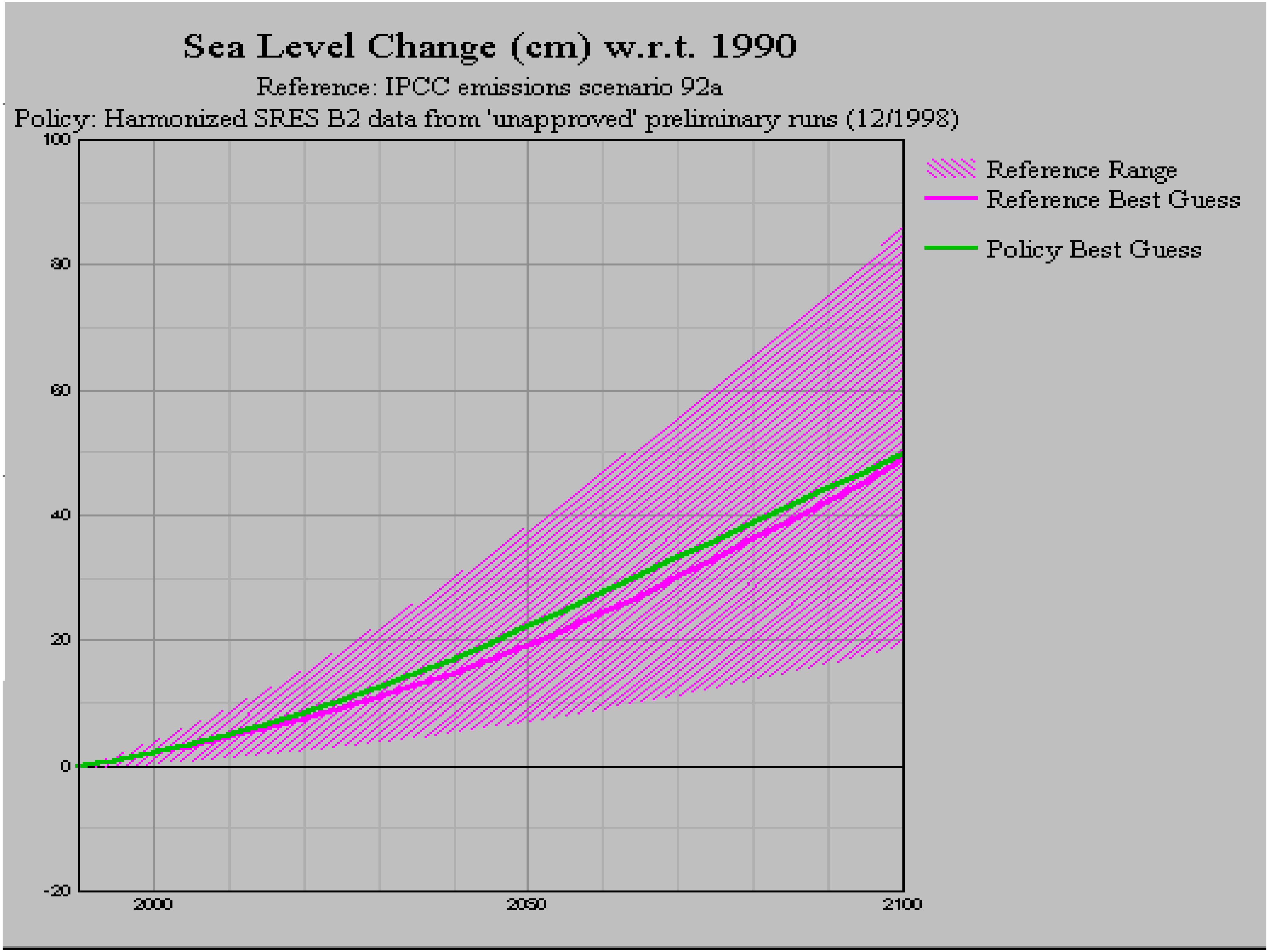
Grass yield in Ireland: winter and summer relative change with the 2055 scenario. Black: <25%; red: 25 to 100%; blue: 100 to 200%; yellow 200 – 300% and white >300%

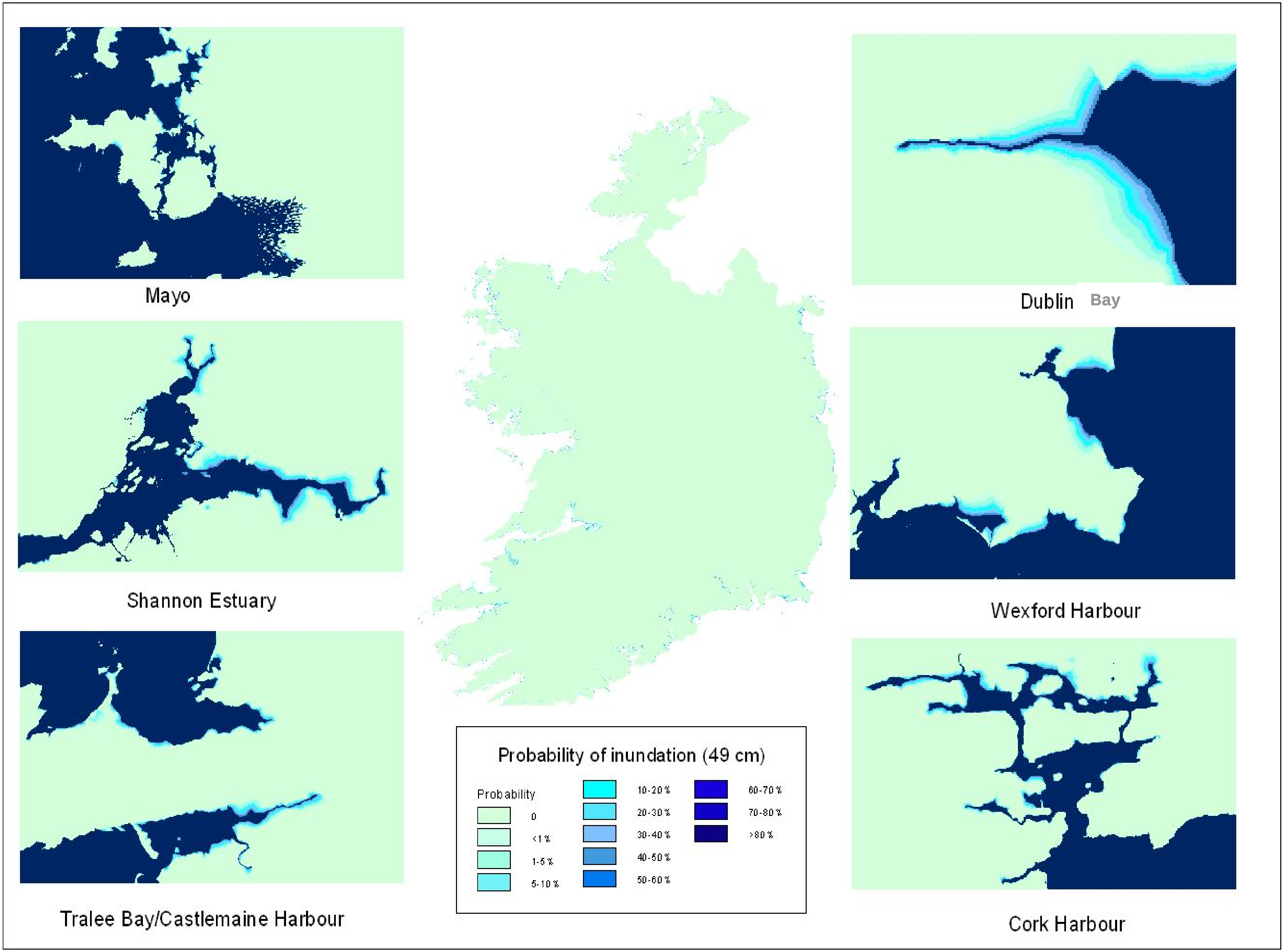
Adaptation lessons

- Summer soil moisture deficits pose the greatest threat for future Irish agricultural production, especially in western parts

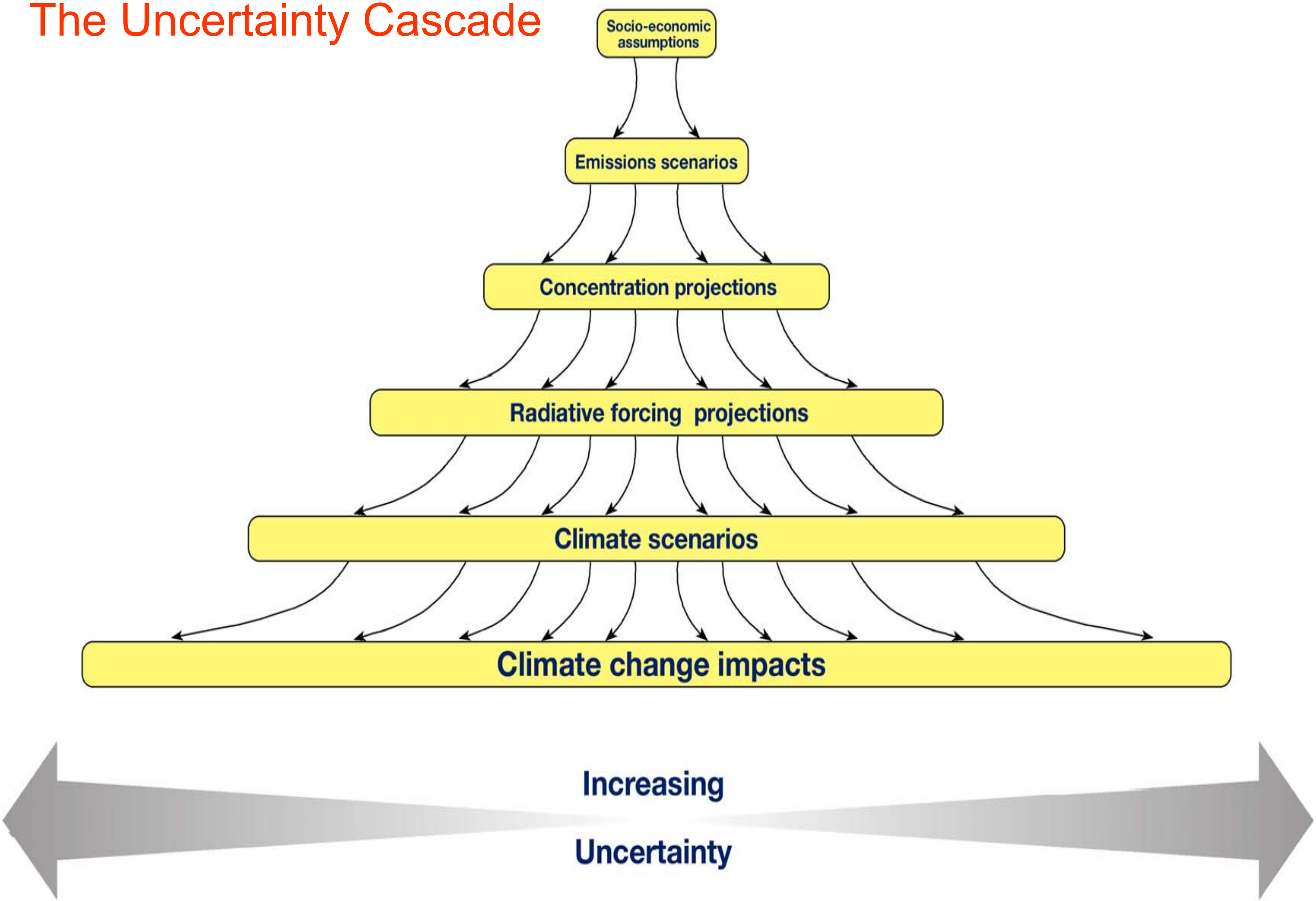


- Where water is available and needed, substantial reductions in fertiliser use can be achieved
- Where water is unavailable and needed, yields may be partially maintained by increased fertiliser application


Sea Level Change (cm) w.r.t. 1990
Reference: IPCC emissions scenario 92a
Policy: Harmonized SRES B2 data from 'unapproved' preliminary runs (12/1998)
100
80
60
40
20
0
-20
2000
2050
2100
Reference Range
Reference Best Guess
Policy Best Guess

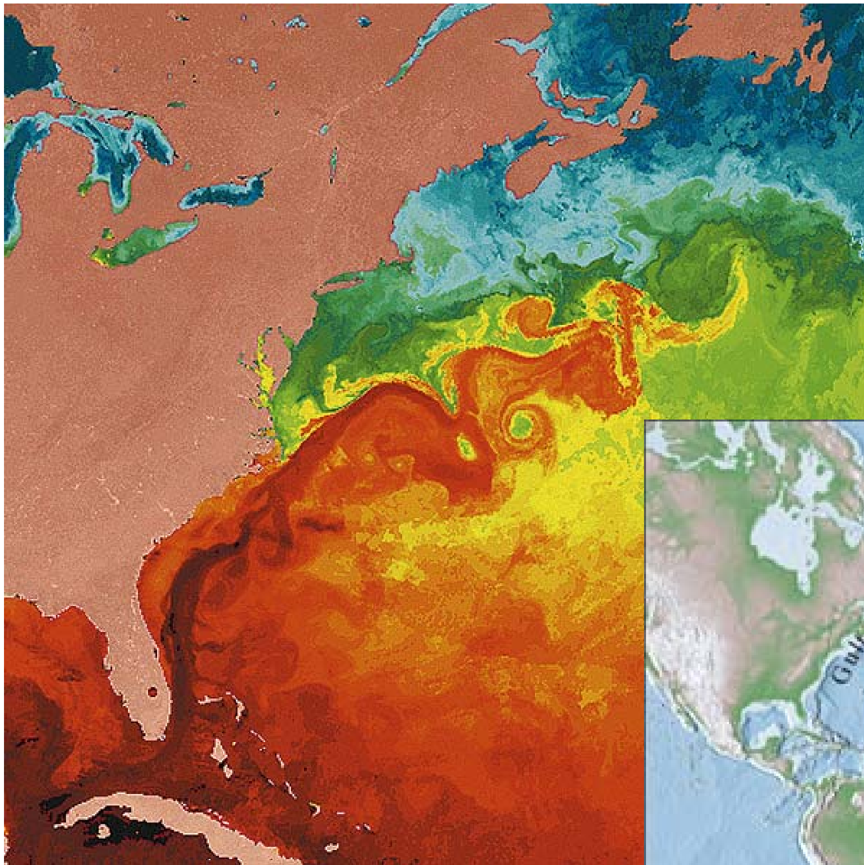

Mayo
Shannon Estuary
Tralee Bay/Castlemaine Harbour
Dublin Bay
Wexford Harbour
Cork Harbour
Probability of inundation (49 cm)
Probability
0
<1 %
1-5 %
5-10 %
10-20 %
20-30 %
30-40 %
40-50 %
50-60 %
60-70 %
70-80 %
>80 %

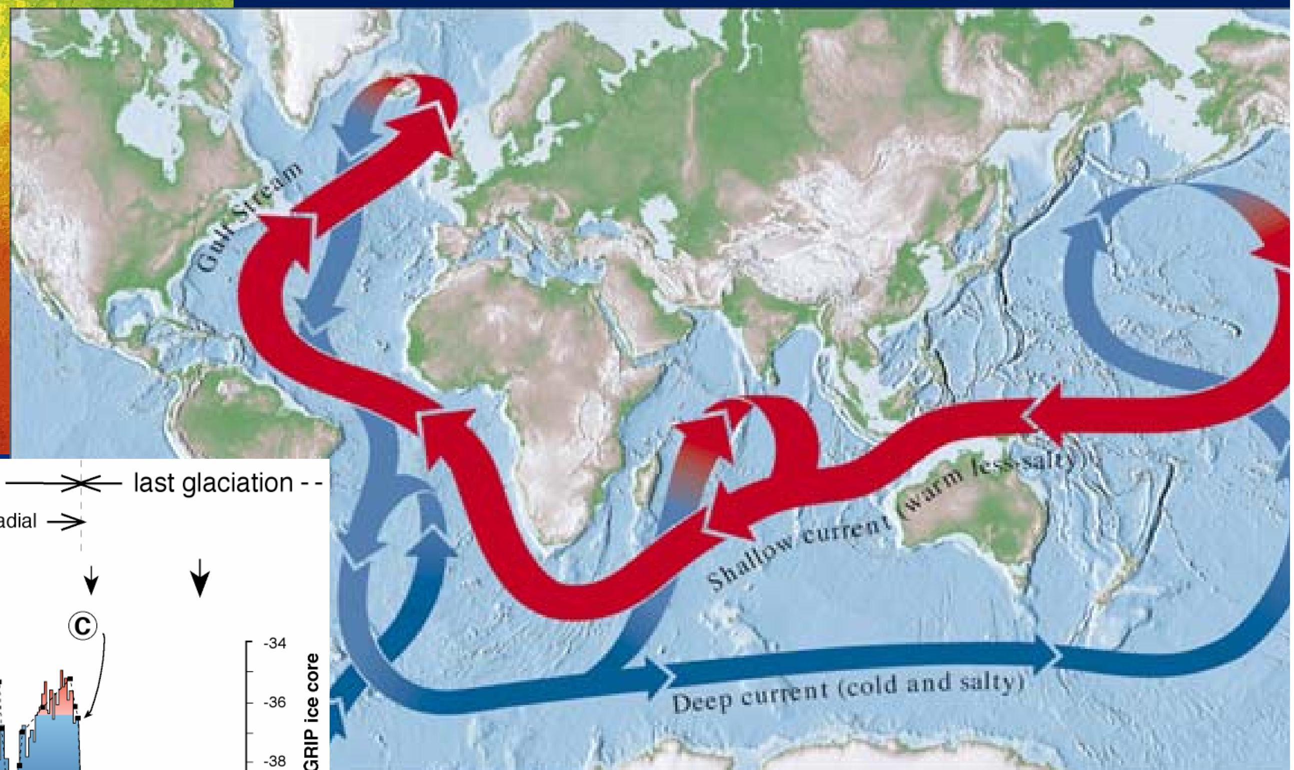
The Uncertainty Cascade

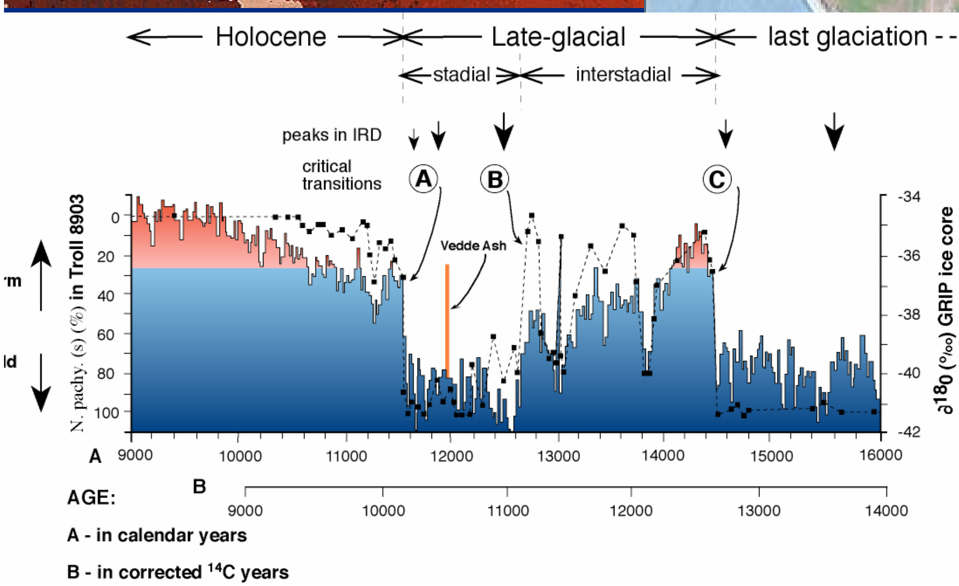


External Uncertainties

- Changes in the Thermohaline Circulation
- Changes in the biosphere’s contribution to atmospheric carbon
- Changes in the ocean’s ability to sequester carbon




Gulf Stream
Shallow current (warm less salty)
Deep current (cold and salty)

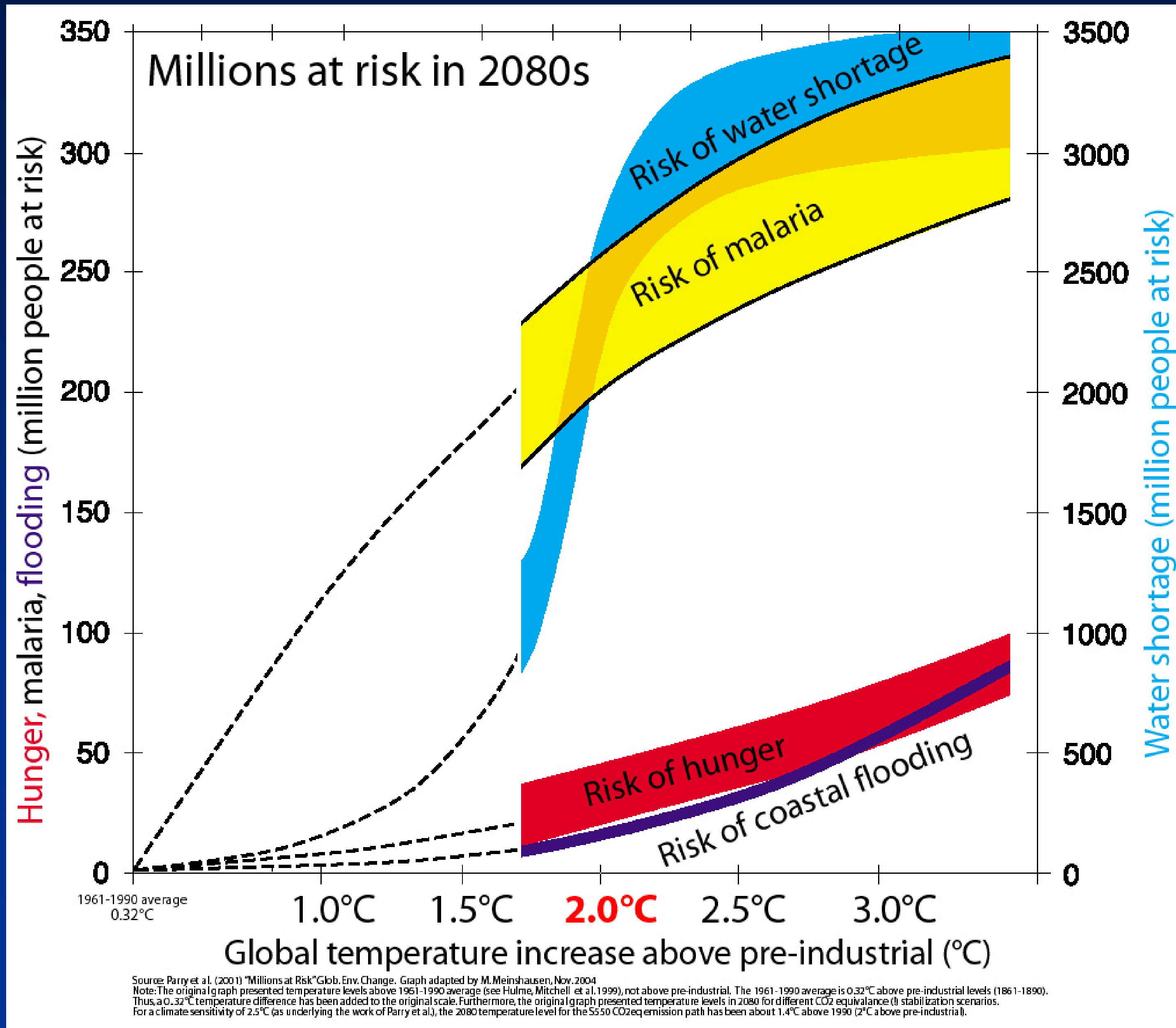

Holocene
Late-glacial
last glaciation
stadial
interstadial
peaks in IRD
critical transitions
A
B
C
Vedde Ash
N. pachy. (s) (%) in Troll 8903
δ18O (‰) GRIP ice core
0
20
40
60
80
100
-34
-36
-38
-40
-42
A 9000 10000 11000 12000 13000 14000 15000 16000
B 9000 10000 11000 12000 13000 14000
AGE:
A - in calendar years
B - in corrected 14C years

EU's 2°C target

"[...] the Council believes that global average temperatures ***should not exceed 2 degrees above pre-industrial level*** *[...]"* (1939th Council meeting, Luxembourg, 25 June 1996)

"REAFFIRMS that, with a view to meeting the ultimate objective of the United Nations Framework Convention on Climate Change [...] to prevent dangerous anthropogenic interference with the climate system, overall global annual mean surface temperature increase ***should not exceed 2°C above pre-industrial levels*** *in order to limit high risks, including irreversible impacts of climate change; RECOGNISES that 2°C would already imply significant impacts on ecosystems and water resources [...]"* (2610th Council Meeting, Luxembourg, 14 October 2004 Council 2004, 25-26 March 2004)

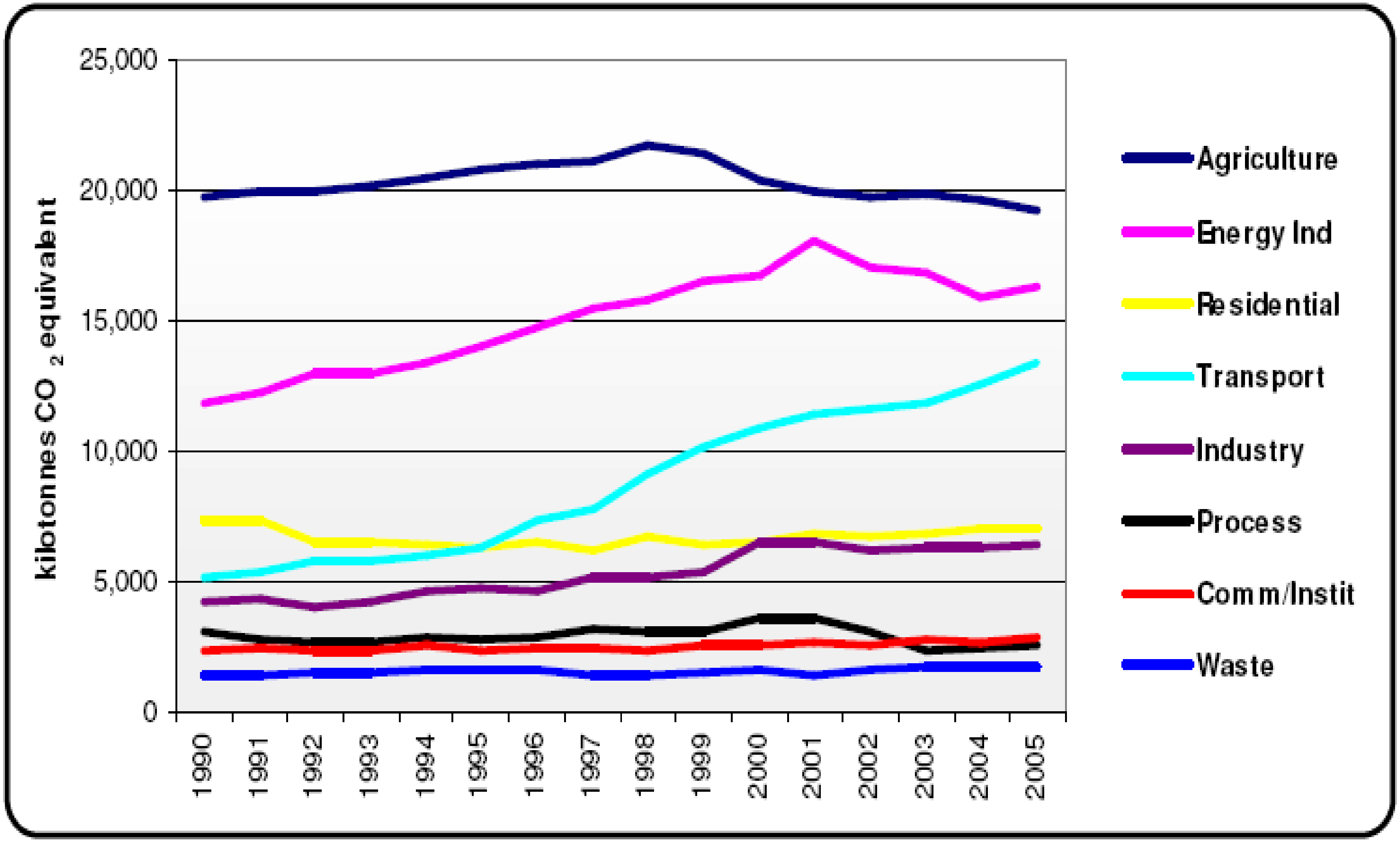
Millions at Risk (Parry et al., 2001)



The EU on February 20th 2007 undertook unilaterally to cut greenhouse gas emissions by 20% on 1990 levels within 13 years

- Burden sharing proposals were announced on 23rd January 2008
- Ireland with the 2nd highest per capita gdp in the EU will be required to cut ghg emissions relative to 2005 by 20%

Irish Greenhouse Gas Emissions

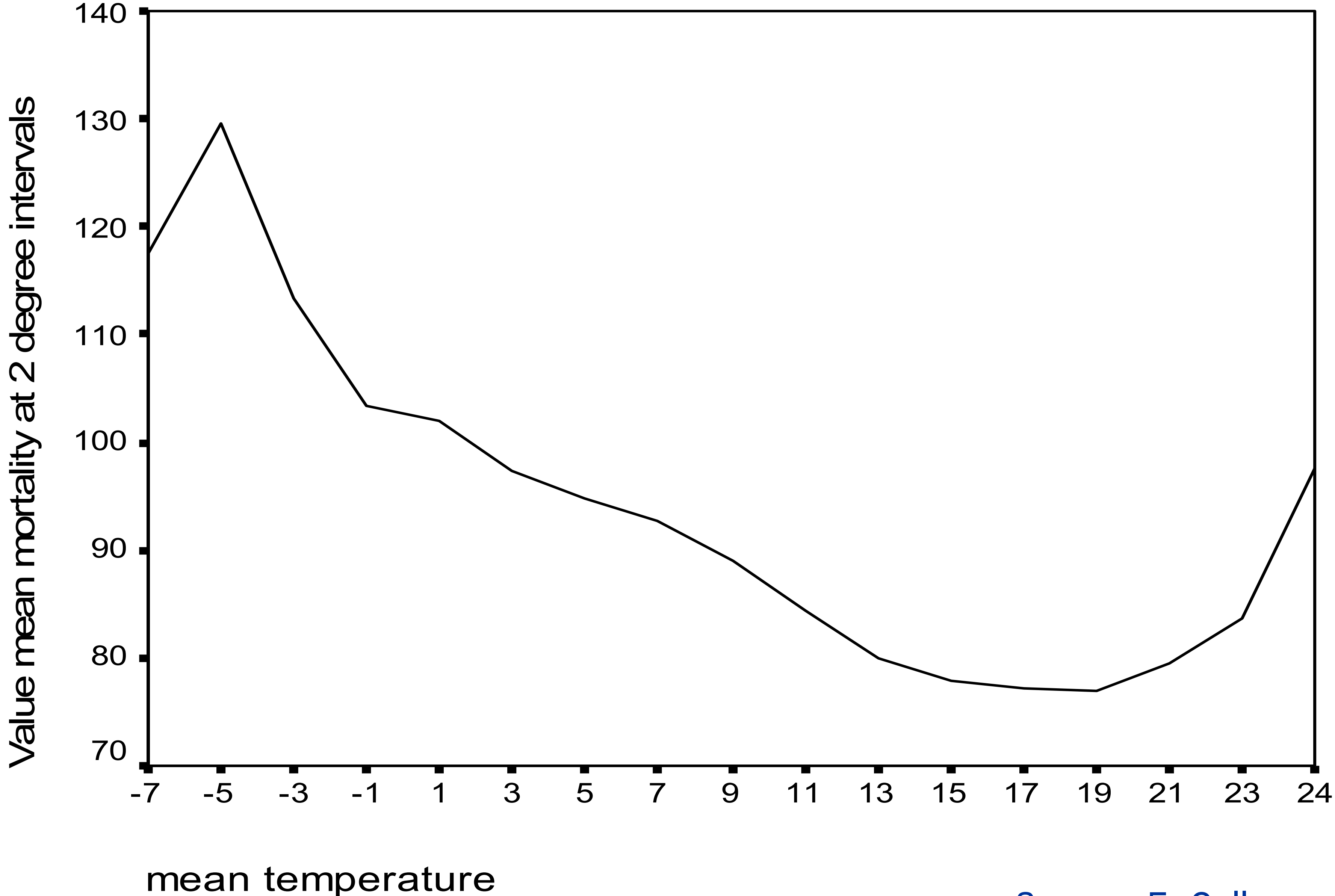


Increasing Car Dependency

- 56% of Dublin commuters drive to work
- 80% less schoolchildren cycle to school in the Dublin area than in 1991
- One in three school pupils who live less than a mile from school travel by car each day
- Average bus speeds in Dublin have dropped below 13kph. Comparable figures for London are 26kph, Stockholm 28kph, Copenhagen 24kph.

What does climate change mean for environmental health in Ireland?

Temperature/Mortality in Ireland



Source: E. Cullen

Reduced winter deaths

2-3% reduction in winter deaths with 2-2.5 C increase in temperature (2050)

Milder winters

Reduced hospital admissions

Impact of hot summers

Increased Heat-related deaths are likely

- Hot weather increase daily mortality though less than in most EU countries
- Elderly particularly vulnerable
  - >80 years
  - Bedridden
  - Heart disease
  - Diabetes
- Reduction in winter cold mortality will greatly exceed any increase in summer heat mortality

Some infectious diseases are likely to increase in incidence

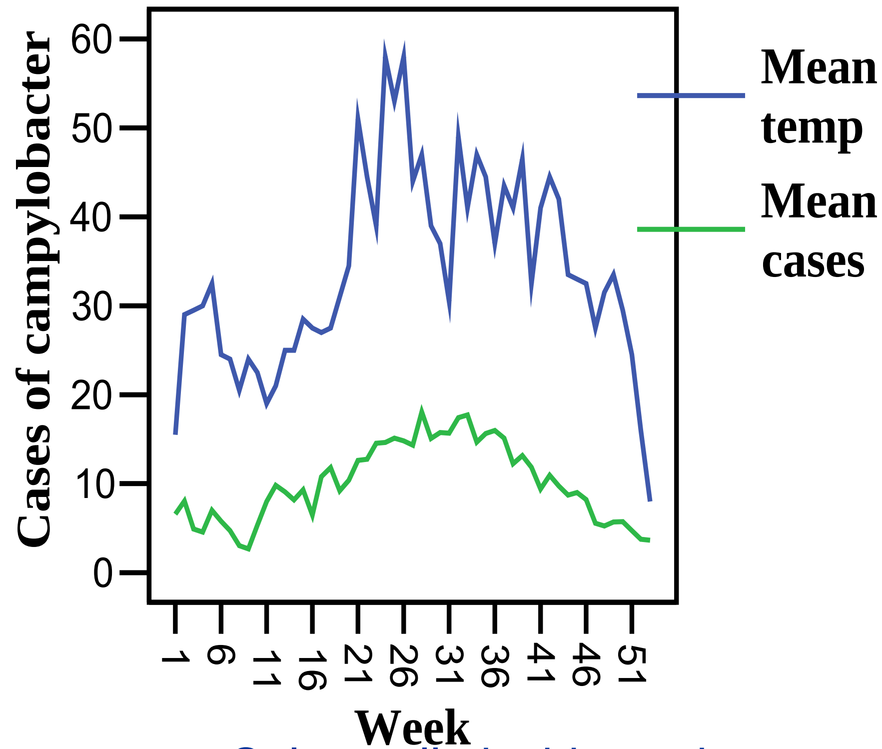
- Food poisoning
- Water borne disease
- Malaria?
- Tick borne disease?

Salmonella

- Approximately 500 cases per annum in Ireland
- August maximum 5 times higher than February minimum
- Highly significant correlations with maximum temperature

Salmonella

Country	Threshold temperature ^{0}C	% change per degree ^{0}C rise above threshold
Poland	6	8.7
Scotland	3	4.7
Denmark	15	1.1
England and Wales	5	12.4
Estonia	13	18.3
The Netherlands	7	9.3
Czech Republic	-2	9.5
Switzerland	3	8.8
Slovak Republic	6	2.5
Spain	6	4.9
Ireland	**2.7**	**7.4**



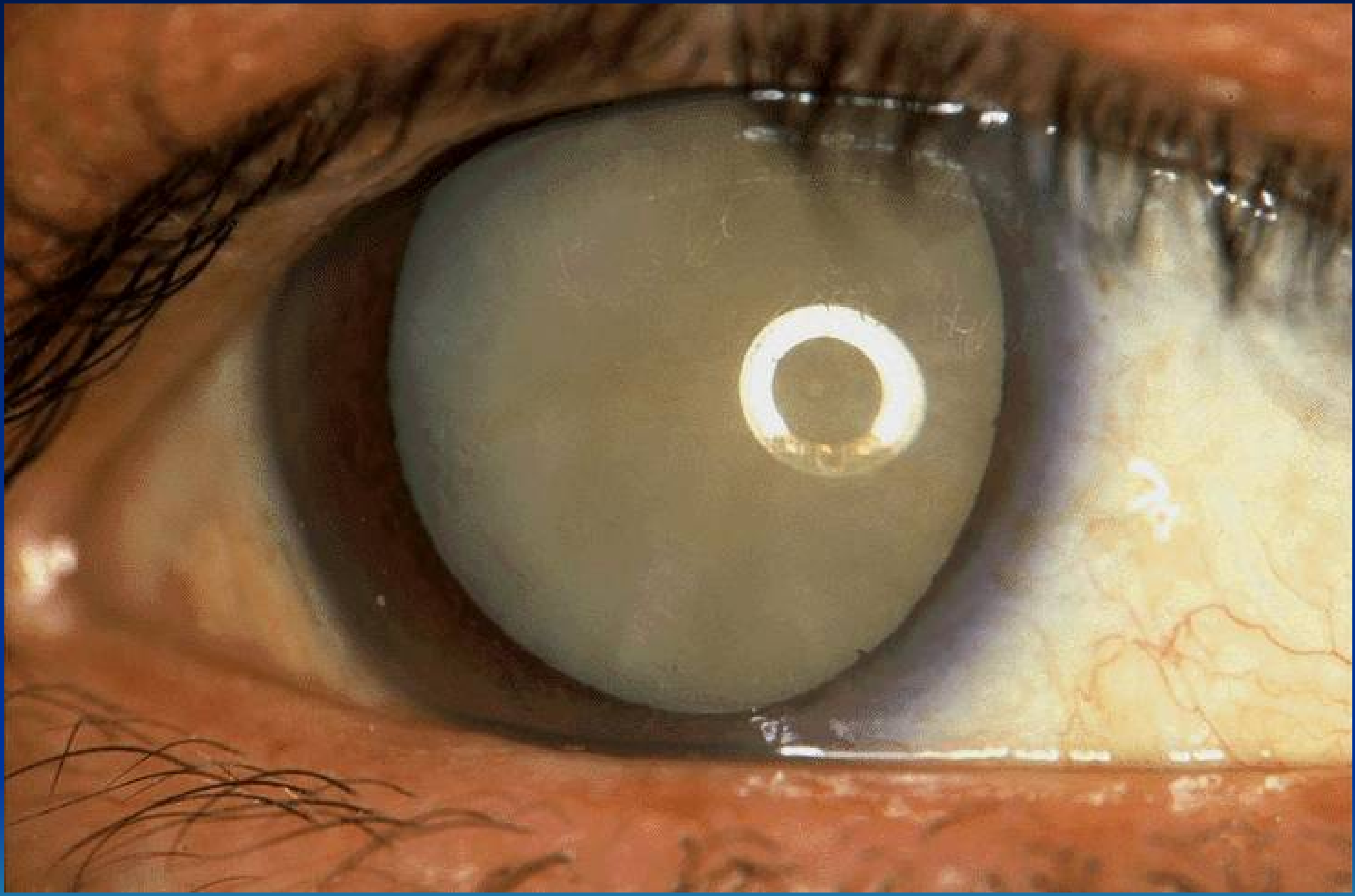
Salmonella incidence in Republic of Ireland

(Sources: Kovats, Cullen)

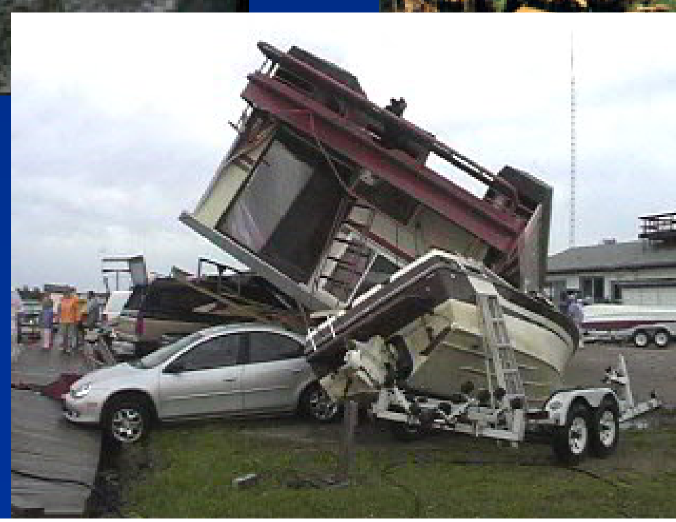
Vector-borne and Water borne Diseases

- Local outbreaks of malaria may occur by mid century, though it is considered unlikely that the most dangerous strains are unlikely to become established in Ireland
- Tick borne diseases are not likely to become major concerns before mid century
- Cholera and typhoid are not likely to become a problem in Ireland
- Decreased dilution water in rivers may pose problems for public water quality, however.

Increased UV exposure



Extreme weather conditions also have Public Health Consequences

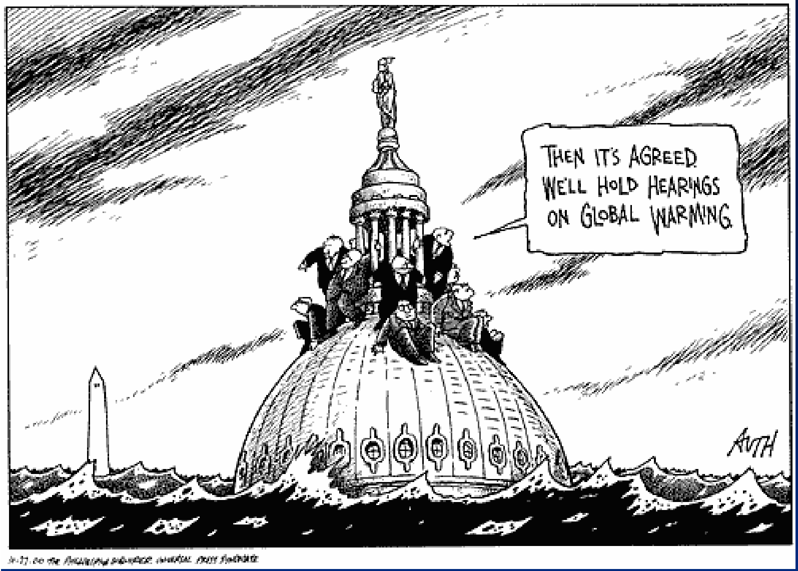


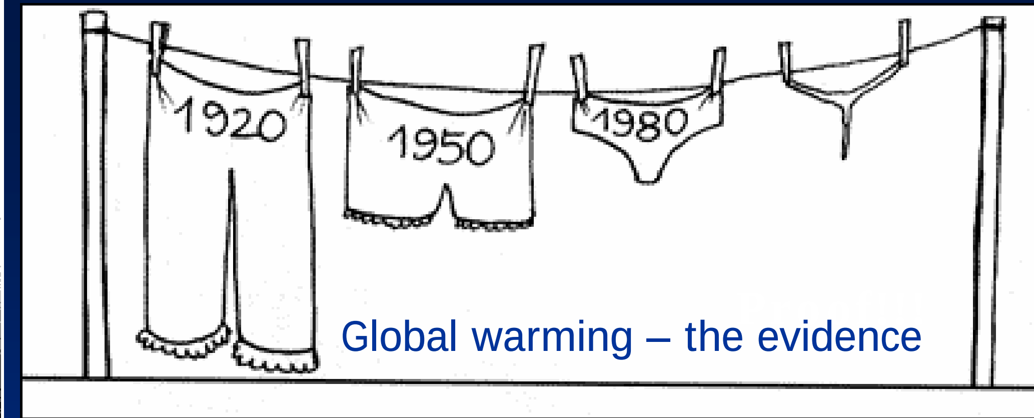
More Environmental Health intervention will be necessary

- Increased monitoring of food
- Health impact assessments to identify and develop adaptation strategies for vulnerable sectors
- Interdisciplinary research

Environmental Health Actions for Coping with Climate Change in Ireland

- Raise awareness of health implications of climate change in Ireland
- Raise awareness of potential health benefits of action to reduce impact of climate change





"A day will come when our children and grandchildren will look back and they'll ask one of two questions: They will ask, 'What in God's name were they doing?' or they may look back and say, 'How did they find the uncommon moral courage to rise above politics and redeem the promise of American democracy?'"

Al Gore: 21st March 2007

IN THE FUTURE, WARS WILL BE FOUGHT OVER WATER