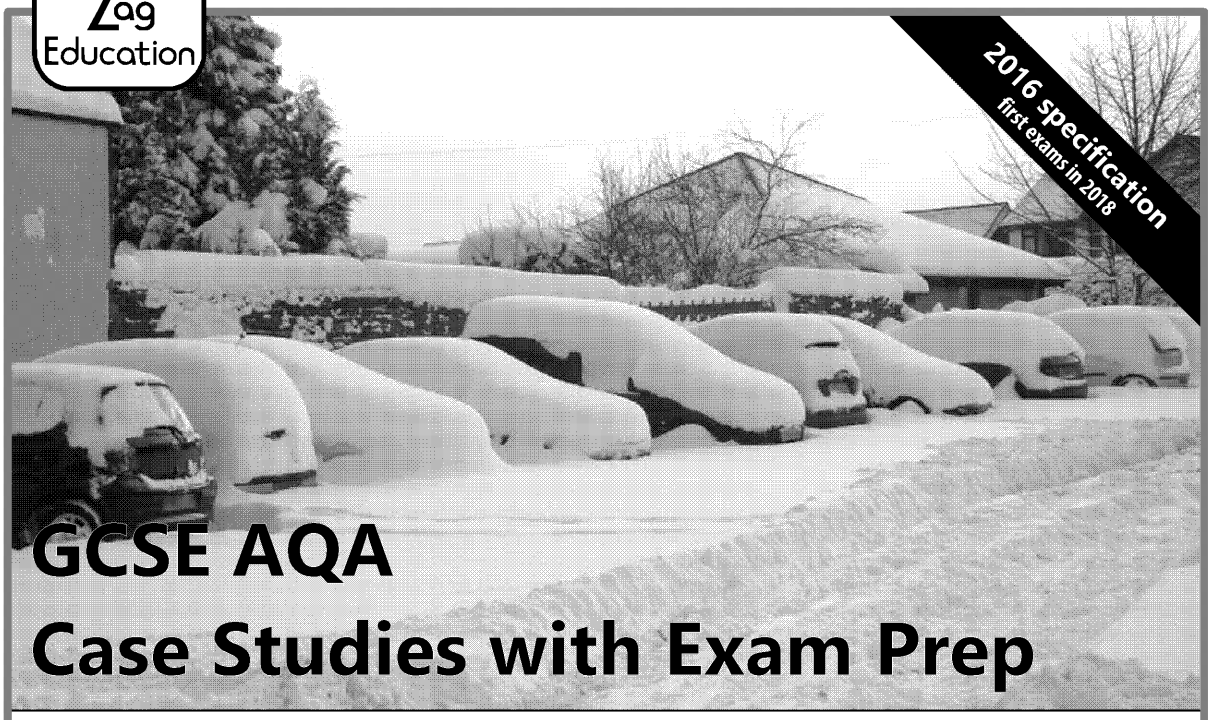
Zig Zag Education

Geography

GCSE (9–1)| AQA | 8035



GCSE AQA
Case Studies with Exam Prep

The Challenge of Natural Hazards: Weather Hazards

Extreme Cold in the UK: November – December 2010

zigzageducation.co.uk

POD 8790

Contents

Teacher's Introduction

This resource has been developed to provide case studies and exam preparation material to support the GCSE AQA specification (8035) **Section A: The challenge of natural hazards; Theme 3.1.1.3 – Weather Hazards**.

This detailed case study is on **Extreme Cold, UK (2010)**.

The case study includes a main content section which can be used as part of a lesson plan or distributed to students for self-guided research; a selection of ICT interactive links to further students' research around each topic and a set of Springboard Images and discussion questions (also available as a PPT file accessible by digital download) which makes a fantastic starter activity.

*A webpage containing all the links listed in this resource is conveniently provided on ZigZag Education's website at **zzed.uk/8790***

You may find this helpful for accessing the websites rather than typing in each URL.

The exam preparation section which follows the case study contains a summary table, bringing together all of the key facts and figures relating to the case study; rapid-fire revision questions (with answers) to help recall and retention of the main points; and an exam-style question and mark scheme, written in the style of the AQA sample material, so that students can practice answering questions relating to case studies and applying relevant knowledge in their answers.

The resource may be used as a source of reference for the required case studies for individual study, or for group work leading to discussion or debate. Subheadings in the information sections are designed to enable tabulated comparisons of social, economic and environmental impacts.

Other case study resources are available for this topic area which can be used to compare and contrast between different UK extreme weather events:

- South-eastern Drought, UK (2004–2006)
- Flooding in Morpeth, UK (2008)
- Winter Storms, UK (2013–2014)
- Heatwave, UK (2015)

A PowerPoint presentation containing the Springboard Images starter activity to accompany this resource is available as a free digital download. Just register for free updates using the link below to download all available content for your school or purchasing site.

November 2018

Part 1 – Case Study

Content

Causes and Prior Weather Conditions

The winter of 2010–2011 [illegible] December was the coldest in 100 years (since records began in 1910) and the coldest month in the UK since 1986 (the coldest month in 100 years for Northern Ireland). Usually, December's average temperature is +4.8 °C (1981–2010 period) – but in 2010, the monthly average was -1 °C. The coldest day on average was 1st December – the average temperature was -8.7 °C! The month also witnessed the most air frosts in 50 years. The month was unusually dry and sunny – the driest December since 1963, with 116% of the average sunshine hours for December. The cold winter was not unusual [illegible] the time – [illegible] warm winters, the winter was the third cold winter in a row. The cold spell ended with a particularly warm February 2011.

The first cold snap lasted from 25th November to 9th December, closely followed by a second cold spell on 16th December, which brought travel chaos across the UK in the run-up to Christmas, ending just after the festive season. The causes of the two cold snaps are slightly different, and, therefore, are covered separately. The warmer interlude caused snow [illegible] the south, but [illegible] persisted in the north, [illegible] added to by the second snap. In total, some areas saw up to 1.5 metres of snow settle!

Figure 1: Satellite image from NASA image courtesy of Jeff Schmaltz, MOD GSFC.

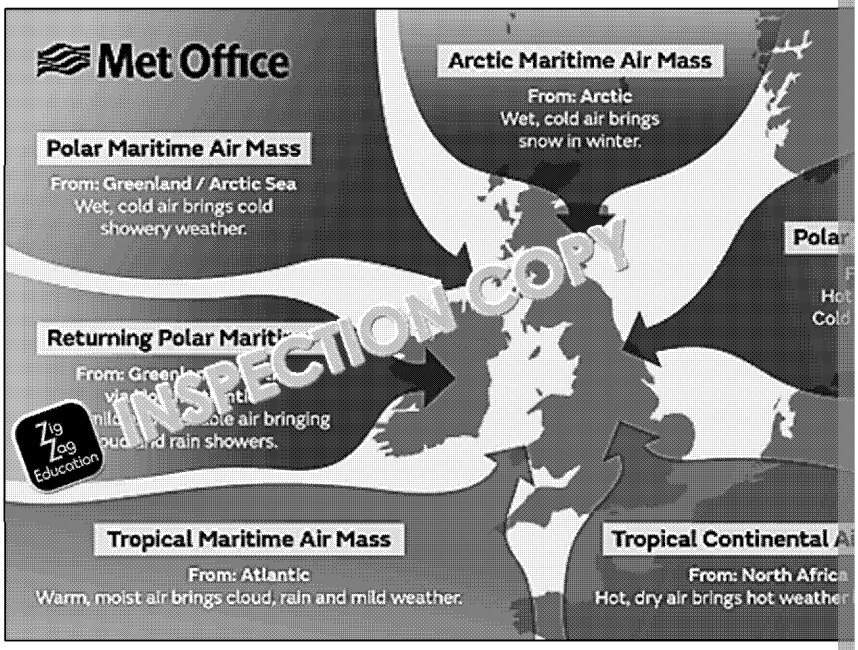


Figure 2: The air masses which affect the UK

The first cold snap – 25th November to 9th December

A cold spell this early in the winter is rather unusual (the maximum temperature was below freezing) – this period saw the most snow since November 1965. So what caused it?

- A blocking area of high pressure near Greenland caused the jet stream to split.
- A cold front moved across Siberia to the UK.
- Winds came from Siberia and northern Europe in a northerly direction and an easterly direction. Can you identify which air mass affected the UK using the diagram above?
- As the air passed across the North Sea, moisture was picked up, resulting in heavy snowfall, initially in the north-east of England and eastern Scotland at the end of November (starting with snow showers in the late evening of 24th November).
- Clear skies and still winds between 27th and 28th November in Powys (Wales) resulted in temperatures of -18 °C.
- Winds remained in the same direction for a long time – which allowed snow to accumulate. On high ground, over 50 cm accumulated. At Balmoral in Scotland, 58 cm.
- On 1st December, easterly winds from Europe brought snow to much of eastern England and further afield, including Land's End and the Channel Islands. The high winds increased the wind chill.
- A low of -11.3 °C was recorded in Scotland on 2nd December. Night-time temperatures of -10 °C, and -20 °C in Northern Ireland.
- Daytime temperatures were just above freezing.
- Between 4th and 5th December, Scotland saw increased rainfall, while the

Figure 3: These cars won't be

The second cold snap – 16th December to 26th/27th December

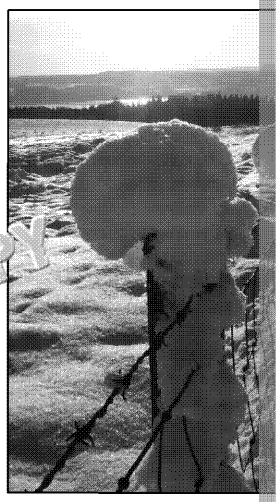


Figure 4: Hea

- Temperature rapidly dropped as 'bitterly cold' air moved down from the Arctic following a cold front (the Arctic Maritime air mass shown on the diagram).
- The west and north of the UK saw snow showers on 17th December; the so[illegible] Wales received heavier snow on [illegible] 17th, 20 cm fell in the sou[illegible] 30 cm in Betws-y-Coed [illegible]
- There [illegible]ry little snow in the UK after 18th December, but the snow persisted on the ground until it melted on the 26th/27th, when the polar airflow stopped.
- Once again, days were sunny, and remained below freezing for much clear and freezing, with heavy frosts. These conditions are associated w systems – called (in winter) winter anticyclones.
- A low of -20.8 °C was recorded in the Scottish Highlands on 23rd Decem Northern Ireland – the lowest ever recorded temperature there!

Social Impact

Transport was severely affected by snow and ice – which caused travel dis great Christmas getaway) across all forms of transport. Roads became gridl increased traffic accidents, motorists faced ro[illegible]os[illegible]es and requests to st

A selection of travel disruptions [illegible] below:

Road

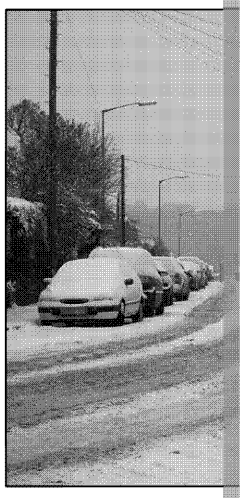


Figure 5: Snow-

- The A[illegible] cl[illegible]ed in Scotland on 29th November, strandi[illegible]ers overnight.
- The M25 was closed overnight on 1st December, stranding 400 lorries. The M1 was also closed.
- Travel was disrupted in Scotland on 6th December – for example, on the M8.
- Travel disruption also took place around Christmas – for example, the A38 was closed near Exeter.

Rail

- Rail cancellations occurred due to heavy snowfall, such as on 1st December.
- The Eurostar was disrupted between 19th and 2[illegible] December, including cancellati[illegible]s which caused delays and backlogs
- On 21st December, the [illegible] Mainline was closed due to damaged

Air

- Gatwi[illegible]ort closed on 1st and 2nd December; Edinburgh also closed
- Edinburgh and Glasgow airports closed on 6th December.
- On 18th December, Heathrow closed, as well as several other airports a remained closed until 20th December.

Other impacts included the following:

- Burst pipes affected water supplies to 40,000 houses, especially in Northern Ireland.
- There was increased fuel expenditure – more heating was required than usual.
- Schools were closed temporarily, such as in north-east England on 29th November, with widespread closures of schools on 2nd December, especially in Northern Ireland and Scotland.
- Travel and social activities were affected.
- There were a number of reported deaths (approximately 16, both direct and indirect) – caused by hypothermia and falling through ice, and by road
- Sporting events were cancelled due to frozen pitches.
- Excess winter deaths (the extra deaths each winter, compared to the su 2010–2011 in England and Wales were almost identical to the previous 25,810 during the winter of 2009–2010).

Figure 6: Snow affected

Economic Impact

- Overall, the damage to the economy was £13 billion.
- The winter weather significantly affected the economy, seeing a drop in GDP of 0.5%.
- It was estimated that the economic cost due to road disruption amounted to £280 million per day.
- Retail was significantly affected in the run-up to Christmas, seeing a 20% fall in sales from the same period of the previous year. Sales of de-icer and cough mixture did increase, however.
- There were more hospital visits – due to falls on icy paths and pavements.
- The NHS appealed for blood donations because stocks ran low.
- Businesses were affected by the loss of water supply in areas affected.
- There was concern that parcels wouldn't be delivered on time. The Roy Sunday delivery to clear the backlog.
- There was a shortage of heating oil.

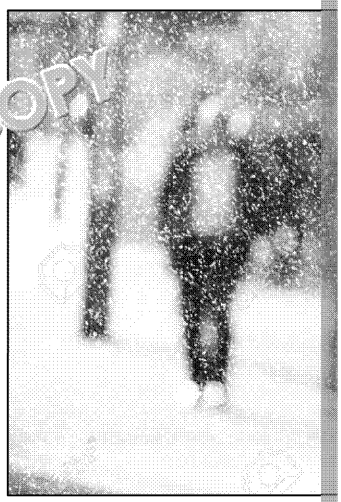


Figure 7: Retail sales fell by 20% up to

Environmental Impact

- Higher mortality.
- Increased CO_2 emissions from the increased use of fossil fuels.

Management to Reduce Risk and Long-term Suggestions

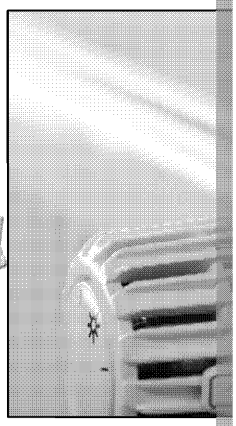


Figure 8: People turn

- The previous winter (2009–2010) had also been cold. Therefore, the government was well prepared. During the year, the government had commissioned a report on how to improve transport, published in October. An audit was provided on 21st December on how the country coped with the transport during the first cold snap.
- To inform the public about the winter weather, the Met Office issued severe weather warnings, which were communicated via the media and TV weather reports. On 17th December, an extreme weather warning was issued for North Wales and Northern Ireland, w predicted. The Met Office reported that its website was heavily traffick
- The Met Office also provided data to the government and planners. H always as accurate as hoped for. It was estimated that improvements i produce more accurate decadal forecasts would amount to £10 million.
- In October 2010, 'Code Snow' was published by the Department of Tra homeowners to clear paths on their property to reduce the risk of slipping and falling.
- Farmers were allowed to clear snow using red diesel (cheaper fuel with lower taxes).
- Roads were gritted for safety, but the AA was still busy.
- In November 201 NHS publis first cold weather plan for Eng – which set out measures to reduce the number of excess winter deaths (because the UK has a higher percentage of winter deaths than many other countries in Northern Europe). The plan called for improved planning and preparedness, warning and advice to the public, and incre

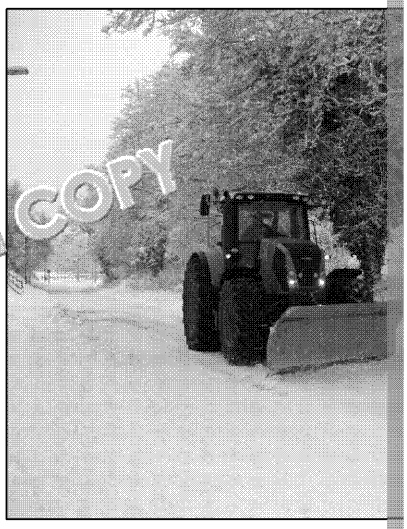


Figure 9: Farmers were allowed to

Long-term Suggestions

The following suggestions have been put forward to reduce the risk associa

- Better planning and advice for transport in local communities, and inc motorists. More emphasis on the differing levels of severity – e.g. not ju social engagements, but also include other activities such as only trav
- Increase the resilience to snow cover, e.g. more gritting of roads.
- Clear pavements of snow and ice, not just roads.
- Improve the electrification equipment used on railways so that it is less as well as improving overall preparedness.
- Improve the preparedness and planning at airports, and ensure that all (which they sometimes weren't during the winter of 2010–2011).
- Tackle the issue of fuel poverty.

Evidence for More Extreme Weather

This was the third cold winter in a row – after a run of eight warm winters! T
ended with a much warmer than usual February. This may be seen as part o
climate is defined as the long-term weather average – usually 30 years. Ther
would have helped average out the preceding warm winters. The month wa
setting many records for both coldest winter and coldest month (for exampl
records began, the coldest UK month since 1986 in the UK, and the coldest m
Northern Ireland).

That said, climate change is predicted to reduce the number of cold winters

Fact Table

Weather rankings:	Co re Co 19 Di
Average temperature:	-1
Average temperature on 1st December:	-8
Percentage of sunshine hours in D[illegible]er:	11
Temperature recorded i[illegible]nd on 2nd December:	-2
Amount [illegible]w[illegible] in some regions:	1.
Number o[illegible]rries stranded overnight on the M25 on 1st December:	40
Number of houses affected by burst pipes:	4,(
Number of schools closed on 2nd December:	7,(
Number of deaths:	Ap
Cost of damages:	£1
Percentage the GDP reduced by:	0.
Losses made by travel disruption:	Es
Percentage of fall in retail sales from previous year:	20
Estimate cost of improving forecasting abil[illegible]e [illegible]he Met Office:	£1

Key Terms

Look up the following terms and complete your own definitions

- Air Mass
- Blocking High
- Cold Front
- Excess Winter Deaths (excess mortality)
- Fuel Poverty
- Jet Stream

ICT Interactive Page

Rather than type out these web

Videos

Channel 4 News – 1st December 2010:

- **https://www.youtube.com/watch?v=kkrTWoa7aPA**

BBC News – Travel disruption with video:

- **http://www.bbc.co.uk/news/uk-11883714**

News Stories

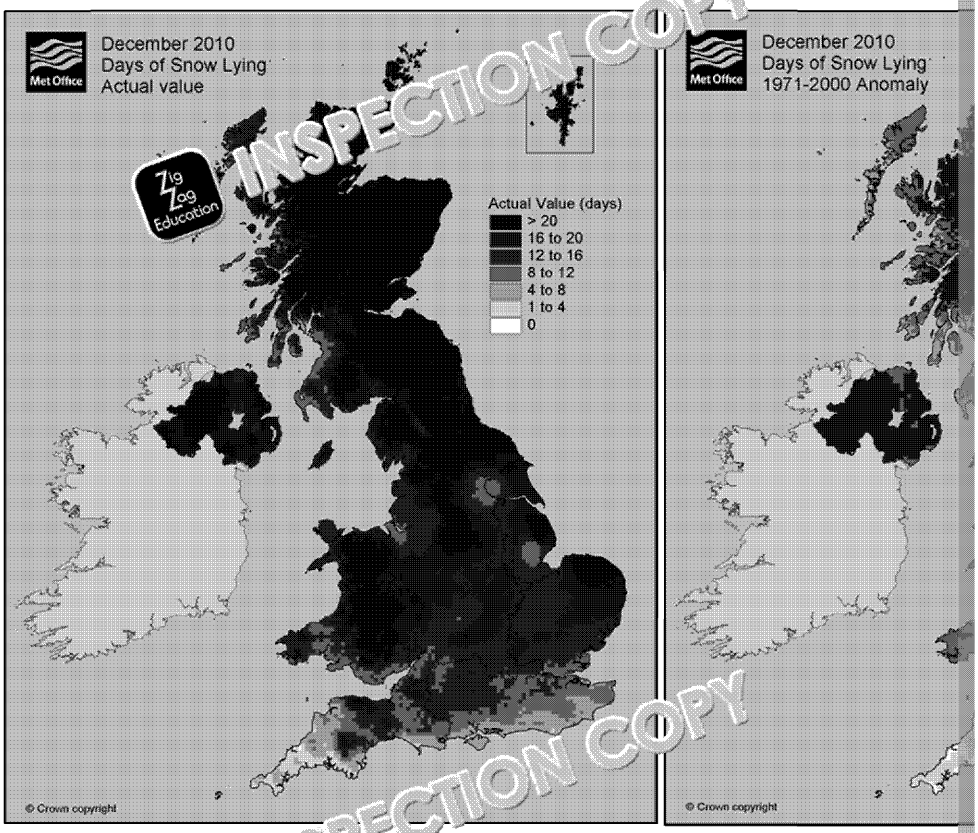
Christmas travel chaos:

- **https://www.theguardian.com/uk/2010/dec/18/uk-snow-travel-disrup**

Why was the winter so cold?

- **https://www.theguardian.com/uk/2010/dec/20/why-so-cold-winter**

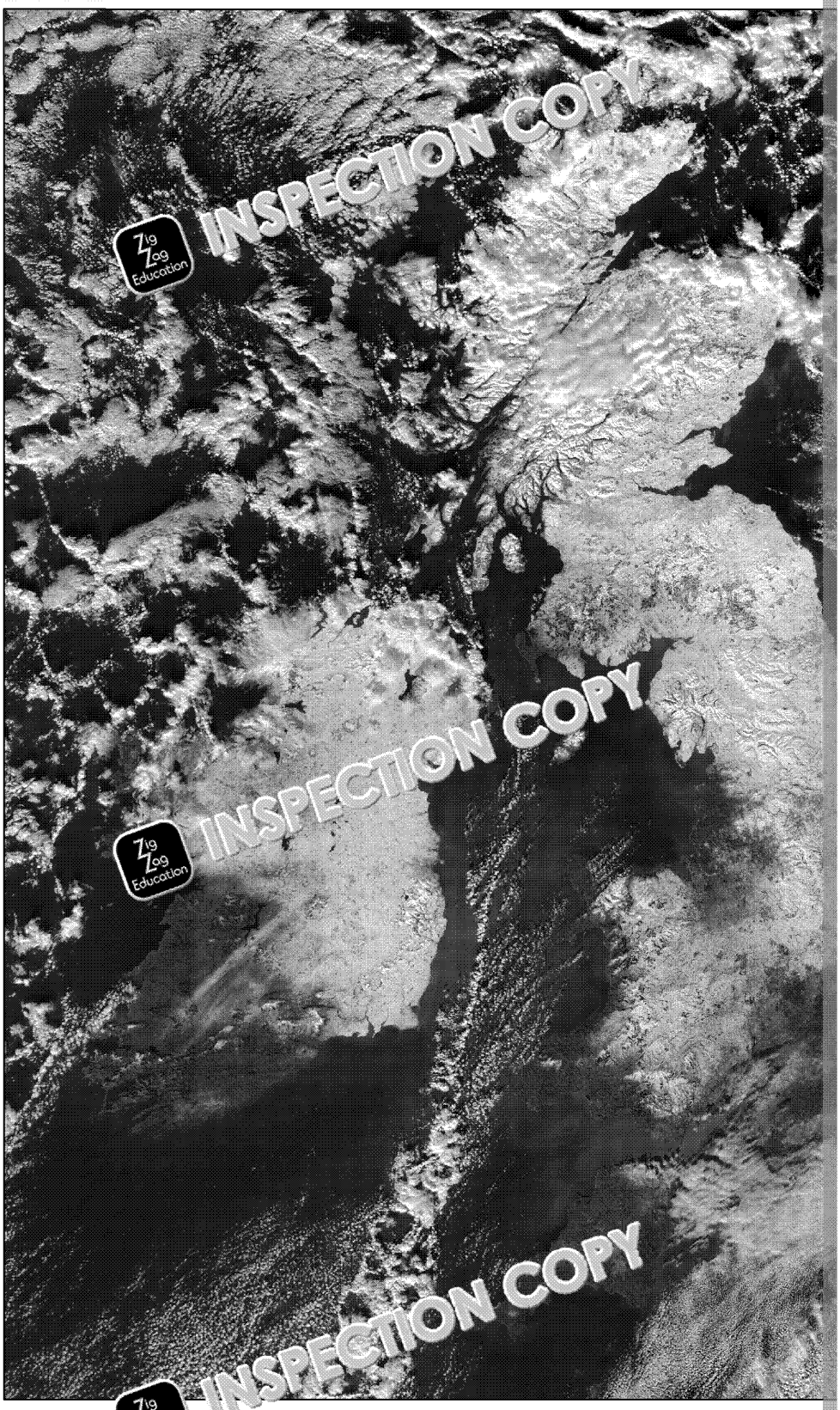
Springboard 1



1. Describe and explain the distribution of days of snow lying.

2. How did the number of days of snow lying compare to the 1971–2000 a

3. Suggest how travel disruption affected people and the economy.



1. Suggest when this photograph was taken.

2. What possible injuries could have been caused by the extreme cold?

3. Suggest how transport could be made more resilient to cold winters in

Springboard Suggested Answers

Springboard 1

1	• The darkest shading on the choropleth maps shows that the hig cover (more than 20) was located across much of Scotland, Nort of England (including East Anglia), Mid and North Wales and a Cumbria and the Pennines. • Eastern areas were most affected because of the wind direction; the North Sea. • Areas of high ground accumulated deep snowdrifts and were c remained for longer. • Areas in the south had fewer days of lying snow, because of the cold periods – melting didn't occur in the north, and, therefore, ground.
2	• The second choropleth map shows that the whole of the UK rec than average. Only small areas in the south-west are white, whi day anomaly – which could mean that even these areas were sn • The shading in the two maps appears to tally fairly well – the m actual snow cover, the more days there were above average.
3	• Disruption to personal travel affected leisure services and retail industry itself – people couldn't travel, were discouraged fro shops and services were hit, as well as travel operators – such a • Goods and services couldn't be provided, or not in a timely fash were shortages of heating oil as tankers were delayed, and the p failed, experienced delays at a very busy time of year.

Springboard 2

1	• This photo shows that there was snow cover across Wales, Nort northern England. • This shows that there either hasn't been snowfall yet in the sout the south. • Therefore, allow a date either near the end of November or from when the snow melted in the south. • This photo was taken on 8th December, during the warmer inter
2	• Hypothermia; for example, from falling outside and being unab through ice on a frozen lake or pond. • Broken bones, grazes, bruising, etc., from slipping on snow and • Car crashes on slippery roads for drivers, passengers and pedestri
3	• Improved planning for the rail and air industries. • Increased salting and gritting. • Increased warning to drivers. • Improved rail electrification.

Exam Preparation

Summary

UK Extreme Cold

Question	
Since when was December 2010 the coldest December on record?	
Since when was December the coldest month in the UK?	
What was the lowest December temperature?	
Was December wet or dry?	
How many cold snaps occurred between November and December 2010?	
How much combined snowfall settled during the two months (worst affected)?	
Where was the area of blocking high pressure at the end of November?	
Where did the cold air come from?	
Where did the moisture come from?	
Why was there so much snowfall?	
When did the second cold snap arrive?	
Where did the cold air originate?	
What temperature was recorded in the Highlands on 23rd December?	
How many lorries were stranded on the M25?	
Which link to Continental Europe was temporarily affected, and shut down at times?	
Which London-based airports were affected?	
How many schools were affected by burst pipes?	
How many roads closed on 2nd December?	
Was the number of excess winter deaths significant?	
How were some of the deaths caused?	
What was the total economic damage caused by the cold weather?	
How much did GDP fall by?	
How was retail affected?	
Why did the NHS appeal for blood?	
Which fuel was there a shortage of?	
How did the Met Office assist?	
What did 'Code Snow' encourage?	
How were farmers encouraged to clear snow?	
Why were roads gritted?	
Which motorists' organisation reported more call-outs than normal?	

Question	
Since when was December 2010 the coldest December on record?	*Since records began in*
Since when was December the coldest month in the UK?	*1986*
What was the average December temperature?	*-1 °C*
Was December wet or dry?	*Dry – the driest since 1*
How many cold snaps occurred between November and December 2010?	*Two*
How much combined snow fall settled during the two months (where affected)?	*Up to 1.5 metres*
Where was the area of blocking high pressure at the end of November?	*Near Greenland*
Where did the cold air come from?	*Siberia and northern E*
Where did the moisture come from?	*The North Sea*
Why was there so much snowfall?	*Winds blew from the sa*
When did the second cold snap arrive?	*16th December*
Where did the cold air originate?	*The Arctic*
What temperature was recorded in the Highlands on 23rd December?	*-20.8 °C*
How many lorries were stranded on the M25?	*400*
Which link to Continental Europe was temporarily affected, and shut down at times?	*Eurostar*
Which London-based airports were affected?	*Gatwick and Heathrow*
How many households were affected by burst pipes?	*40,000*
How many schools closed in December?	*7,000*
Was the number of excess winter deaths significant?	*No – the figure was ve*
How were some of the deaths caused?	*Hypothermia and fallin (because the roads were*
What was the total economic damage caused by the cold weather?	*£13 billion*
How much did GDP fall by?	*0.5%*
How was retail affected?	*Sales were 20% lower t previous year*
Why did the NHS appeal for blood?	*Fewer people donated b*
Which fuel was there a shortage of?	*Heating oil*
How did the Met Office assist?	*Provided weather forec*
What did 'Code Snow' encourage?	*Residents to clear their prevent falls*
How were farmers encouraged to clear snow?	*They were allowed to u red), which has lower t*
Why were roads gritted?	*To melt ice, and stop it*
Which motorists' organisation reported more call-outs than normal?	*The AA*

Quick-fire Questio

1	Why was the cold [illegible] beginning in November unusual?	
2	Suggest [illegible]e December was dry, despite the significant snowfall.	
3	How do air masses affect the weather?	
4	Suggest why night-time temperatures were so low.	
5	What allowed up to 1.5 metres of snow to settle?	
6	Why did the second cold spell end?	
7	The cold weather occ[illegible] and during Christmas. How did this affect both pe[illegible]nd [illegible]ses?	
8	How we[illegible]er supplies affected?	
9	Why was there an increase in traffic accidents?	
10	Why was the government more prepared for the cold winter than it might otherwise have been?	
11	How did the Met Office assist with the pr[illegible]at[illegible]n?	
12	Suggest whether the clearan[illegible]of pa[illegible]s and pavements could reduce injuries.	

Quick-fire Answers

1	Why was the cold snap [illegible] in November unusual?	*Most winters*
2	Suggest [illegible] December was dry, despite the significant snowfall.	*The month wa in many areas was very little*
3	How do air masses affect the weather?	*Air masses br depending on particular wi*
4	Suggest why night-time temperatures were so low.	*Nights were o long-wave inf*
5	What allowed up to 1.5 metres of snow to settle?	*The month wa accumulated snowfall.*
6	Why did the second cold [illegible]?	*The airflow ch meaning that*
7	The col[illegible]er occurred before and during Christmas. How did this affect bo[illegible]ple and businesses?	*Shops received delivery compa customers in t*
8	How were water supplies affected?	*When water fr and leaked.*
9	Why was there an increase in traffic accidents?	*Roads were ic were gritted.*
10	Why was the government more prepared for the col[illegible]er than it might otherwise have been?	*This was the t learnt, which*
11	How did the Met Office assist [illegible] preparation?	*The Met Office*
12	Suggest whether the cl[illegible] paths and pavements could reduce injuries.	*Yes – paths ca that people are*

Extension Questions

1. Outline why the timing of the cold weather was significant to retailers, passengers alike.

2. Describe the onset of the two cold spells during November and Dece

3. Evaluate the economic impact of the cold weather.

Extension Answers

1. The cold spell occurred during and in the run-up to Christmas. This is an imp
couriers, some of whom generate a significant amount of their yearly income
previous year, sales fell by 20%. Travel disrup[illegible]led to concerns that de
time for Christmas, and social events w[illegible]led. Disruption to travel affe
important and busy time of y[illegible] many people visit and stay over with
annual holiday, som[illegible]ad.

2. The fir[illegible]spell which began at the end of November was caused by a cold
Siberia [illegible]northern Europe which picked up moisture from the North Sea. In
Scotland were heavily affected, with more widespread snowfall on 1st Decemb
Several days later, the southern part of the UK began to thaw, before a second
month that brought snowfall just prior to Christmas. In the interlude of warm
the northern parts of the UK, allowing an even greater depth during the secon

3. The cold weather brought significant economic impact – estimated at £13 billi
pushing the UK closer to a recession. Retail and transport were both heavily a
dropped by 20% from the same period of the previous year, and the cost of re
£280 million each day.

Exam-style Question

With r[illegible]nc[illegible] to an extreme weather event in the UK, assess the ma[illegible]ment strategies were successful in reducing the ri

Level Mark Scheme

Level	Mark	Description
1	1–3	• The student evidences basic knowledge (AO1) • The student evidences limited understan exist between places, environments and • A limited ability to evaluate is evidenced knowledge and understanding. (AO3)
2	[illegible]–6	• The student evidences some knowledge o • The student evidences good understandi exist between places, environments and • A reasonable ability to evaluate is eviden application of knowledge and understandi
3	7–9	• The student evidences thorough knowledg (AO1) • The student evidences a firm understandi exist between places, environments and • A strong ability to evaluate is evidenced knowledge and understanding. (AO3)

Indicative Content:

- The student should offer an evaluation of the extent to which the mana extreme UK weather event were successful in reducing the risk.
- The student should clearly identify the successes and failures of the m reducing the risk of the weather event.

Suggested Content:

Successful:

- The Met Office [illegible] severe weather warnings that were communicate
- ‘Code [illegible] was produced in October 2010 to encourage homeowners t
- Farmers [illegible] allowed to clear snow using red diesel (cheaper fuel with
- The number of winter deaths was around the same as the previous yea and management were able to reduce the risk of deaths from the extre

Unsuccessful:

- The lack of management on the roads (such as clearing the snow and l major travel disruptions across the country.
- Weather estimates from the Met Office were not always as accurate as

Spelling and Grammar (SPaG) – total of 3 marks

For 1 mark:

- Student shows some ability to spell and punctuate correctly.
- Student shows limited use of grammar to convey their argument.
- Student utilises a basic range of geographical phrases.

For 2 marks:

- Student generally [illegible] spelling and punctuation throughout.
- Student [illegible] accurate use of grammar to convey their argume
- Student [illegible]es an adequate range of geographical phrases.

For 3 marks:

- Student uses correct spelling and punctuation throughout.
- Student shows accurate use of grammar to clearly convey their argum
- Student utilises a broad range of geographical phrases.