Understand how different levels are achieved and how to interpret the mark scheme.

Example responses
Paper 1: Physical Geography
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Section A

Question 1: Water and carbon cycles

AO1 – 4 marks

Outline flows within the water cycle operating on a hill slope.

Flows are a movement of energy/matter from one store to another in the hill slope. Flows include: interception, the movement of water into the soil, percolation, the movement of water into underground rock storage, stem flow, flows of water on vegetation, for example moving down a tree trunk or stem, overground flow, the flow of water on the ground surface, this may be due to saturated ground surfaces or impermeable materials preventing water moving down into the ground. Flows will influence the size of stores in the hill slope water cycle.

Flows are clearly understood and explained, though interception appears to have been confused with infiltration in this AO1 response. There are four relatively straightforward marks here. Knowledge questions such as this have two ways of scoring credit: four separate points or points which have developed ideas. This has three points with one developed idea (related to overland flow).

4 marks
Figure 1 shows rainfall data, a measured hydrograph and a simulated hydrograph for Taguibo Watershed in Mindanao Island, southern Philippines. The data were collected from 13 to 17 April 2007. The simulated hydrograph is a computer-generated prediction of discharge.

Analyse the data shown in Figure 1. [6 marks]

AO3 – 6 marks

The data shows the Taguibo watershed experiencing low amounts of discharge, around 1.5m³/s unit it receives rainfall of up to 2mm/10 minutes. There is a relatively short lag time as peak discharge occurs quickly after. Discharge increases quickly after rainfall reaching 9m³/s in the measured hydrograph, up only around 8m³/s on the stimulated hydrograph. Later rainfall results in a longer lag time before it is reflected in the watershed by another peak in discharge (around 6.5m³/s on the measured hydrograph). The data shows that there is a similarity between the measured hydrograph and the stimulated hydrograph, however the stimulated hydrograph underestimates the level of discharge during peaks (for example any measuring 7.8m³/s as the peak discharged, yet the measured hydrograph showed peak discharge to be above 9m³/s. Furthermore the stimulated hydrograph suggests the watershed responds slower to rain events, as it shows a longer lag time – a longer time to reach peak discharge in the river.

This response offers detailed AO3 analysis and exemplifies the way students manipulate data without needing to bring in additional knowledge and understanding. It considers both the simulated and actual hydrograph and compares the two, picking out useful data to support the analysis. There are overarching statements and some manipulation of data. It identifies key extremes as well as differences between the two hydrographs.

Level 2, 6 marks
Figure 2a shows two maps indicating the changing vegetation cover in the Taguibo Watershed in Agusan del Norte province, north-eastern Mindanao Island, Philippines, from 1976 and 2001. The third map shows how the area could be rehabilitated with natural vegetation.

Figure 2b shows the possible impact of a storm in 2007 upon the runoff volume in the Taguibo Watershed for each of the situations shown in Figure 2a.

Using Figure 2a, Figure 2b and your own knowledge, assess the potential impact of changing vegetation cover upon the runoff in this area.

AO1 – 2 marks
AO2 – 4 marks

Increasing vegetation cover can result in decreased rates of runoff. Runoff is the water that 'runs off' the surface and is not infiltrated into the ground/soil below. Increasing vegetation will reduce runoff, as it increases interception (the water trap on plants), meaning less will reach the ground and infiltrate the soil, meaning a decrease in the saturation of the soil, unsaturated soils encourage infiltration rather than runoff, as more water moves down in the soil/ground and hold in vegetation stores rather than contribute to runoff. This can be seen in the data, in zone 6, this area has faced deforestation and seen an increase in grassland, reducing vegetation cover in 2001. Figure 2b shows a large volume of runoff under 60 \((10^3\text{m}^3)\) compared to its vegetated counterparts, both 1976 and the rehabilitated condition, showing zone 6 having more vegetation cases and as a result has lower runoff rates around 35/40 \((10^3\text{m}^3)\). Exceptions to this include zones 1 consistently has high amounts of vegetation cover, and equally high levels of runoff, however this may be due to other factors such as impermeable nature of the underlaying rocks which can result in high runoff rates. Overall increasing vegetation cover will reduce runoff rates.

Application of knowledge to the context of the resource is sometimes difficult to pick out. Here the student makes overarching statements about the data with accurate interpretation. The student also backs this up with secure AO1 knowledge. The student shows awareness of how the processes may be accounting for the patterns shown in the resource. In contrast to the previous 6 mark question, using and manipulating data on its own is not credited in this question as it is AO1 and AO2 that are being tested, not AO3.

Level 2, 6 marks
## 20 mark questions

### Mark scheme – level descriptors

<table>
<thead>
<tr>
<th>Level and marks</th>
<th>Description</th>
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| **Level 4 16-20** | • Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2).  
• Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).  
• Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).  
• Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).  
• Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1).  
• Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1). |
| **Level 3 11-15** | • Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (AO2).  
• Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).  
• Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).  
• Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).  
• Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1).  
• Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1). |
| Level 2 6-10 | • Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places.  
• Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).  
• Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).  
• Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).  
• Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies (AO1).  
• Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1). |
| Level 1 1-5 | • Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question.  
• Interpretation is basic (AO2).  
• Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).  
• Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).  
• Very limited relevant knowledge and understanding of place(s) and environments (AO1).  
• Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies. (AO1).  
• Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1). |
| 0 | • Nothing worthy of credit. |
To what extent does an understanding of feedback systems in the carbon cycle help with attempts to mitigate the impacts of climate change?

[20 marks]

A01 – 10 marks
A02 – 10 marks

Climate change has had several impacts on the carbon cycle, as climate change has arisen from increased GHG emissions, resulting in an increased magnitude of carbon in the atmosphere, which imparts the cycle as a whole, understanding feedback systems can largely help mitigate these impacts. Feedback cycles describe the processes where a change in a system leads to a cyclical sequence of changes which either accelerate or reverse the original change – altering the systems dynamic equilibrium.

Understanding positive feedback cycles can help mitigate climate change impacts. Positive feedback cycles are when a change in the carbon cycle leads to a sequence of changes that accelerates the initial change. An example is deforestation, which results in the release of carbon into the atmosphere as forests are turned from carbon sinks into carbon sources, this will increase the impacts from climate change, as it leads to the greenhouse effect – inevitable trapping the sun’s radiation, this in turn leads to the increased frequency/intensity of draughts, further killing more trees/vegetation, and so on. This accelerates original change and worsens the impacts of climate change, for example leading to the enhanced greenhouse effect, and worsens environmental stability. Understanding positive feedback systems can educate and alert us, on extremely damaging anthropogenic activities such as deforestation and as a result more mitigation strategies can be implemented. For example setting environmental laws to control deforestation and therefore limit the impacts of climate change. In Brazil, the Brazil forest code stated landowners must keep 88% of their land as forest.

Understanding negative feedback cycles can also help mitigate against the effects of climate change. Negative feedback cycles is when original change leads to cyclical events which reverse or decrease the original change leading to a dynamic equilibrium in the carbon cycle, and more environmental stability. Negative feedbacks are hugely important as they can suggest methods to reverse the original change and mitigate the impacts of climate change. An example of negative feedback cycle is in the Amazon rainforest the increased emissions has resulted in more productivity and encourages faster growth, resulting in more photosynthesis, absorbing more carbon. Biomass in the Amazon has increased by 0.5% in the past year. This can help suggest methods such as afforestation/replanting to reduce the impacts of climate change.

In conclusion, understanding feedback systems in the carbon cycle is largely important in mitigating the impacts of climate change, as positive feedback systems can show what activities are increasing damaging and need to be stopped, whilst negative feedback system show what can help reverse climate change and can suggest methods to mitigate. However as negative feedback systems show natural responses to change eg increased plant productivity, feedback systems may not help with physical/technological methods to mitigate climate change. Furthermore, the processes acting in feedback systems act at a slow pace/takes a long time to
mitigate, it may be quicker and more effective for physical/man-made mitigation projects to be studied/utilised such as the use of carbon capture and storage technology.

This is a well written response which deals with all aspects of the question. There is secure knowledge which is well applied. The response shows awareness of feedback systems in the carbon cycle and how these affect the carbon cycle. The knowledge is then used to consider how mitigation could reduce the potential damage of increasing carbon in the atmosphere ie by understanding how positive feedback has to be reduced and negative feedback further exploited. Both AO1 and AO2 are evidenced at full marks.

Level 4, 20 marks
To what extent does an understanding of feedback systems in the carbon cycle help with attempts to mitigate the impacts of climate change?

[20 marks]

A01 – 10 marks
A02 – 10 marks

A feedback system is a cyclical process of events that either enhance the initial process (positive feedback) or reduce it (negative feedback). There are various feedback systems within the carbon cycle, however natural systems are preferred to be negative feedback systems as this would result in a state of balance – dynamic equilibrium. Examples of feedback systems include: when temperatures increase, ice sheets and glaciers melt releasing various gases such as methane and carbon dioxide into the atmosphere (permafrost). Both these gases are greenhouse gases and therefore enhance the greenhouse effect. This causes global warming, and the ice sheets and glaciers will further melt. This is considered a positive feedback system as the initial raise in temperature further results in a raise in temperatures.

An example of a negative feedback system would be when temperatures rise, vegetation works more effectively. This means vegetation will absorb more carbon dioxide through the process of photosynthesis, releasing oxygen as a key-product. Therefore less carbon dioxide (a greenhouse gas) will be in the atmosphere so less global warming will occur and temperatures will increase less significantly or decrease.

In Indonesia, 80% of the area was initially rainforest. However, immense deforestation occurred for pulp, plywood, paper and palm oil, leaving less than 50% of the rainforest left. One method for deforestation was ‘slashing and burning’ by which the people essentially burnt the forest down as it was time efficient and cheap. This released incredible amounts of carbon dioxide into the atmosphere causing Indonesia to be the 3rd greatest carbon emitter behind China and the USA, and increased levels of global warming. The further increased temperatures may then result in more forest fires therefore illustrating a positive feedback loop. Clearly, the Indonesian community did not understand feedback systems and will therefore suffer immensely as a result.

There are various methods used in attempt to mitigate the effects of climate change, for example education by which communities are informed by the long term consequences of their actions, use of natural energy e.g solar wind, etc. By understanding feedback systems, not only will the public consider their actions and how it will further affect the climate but they will also mitigate themselves and thus I think understand feedback systems within the carbon cycle is greatly important in mitigating against climate change.
This response shows awareness of the concept of positive and negative feedback but the description of this is arguably too long. It exemplifies at the expense of using the knowledge and understanding in the context of the question, ie this one falls down on application of knowledge. The Indonesia case study is useful but again is only used in context of AO1 – knowledge and understanding is evident but not applied. The final part does attempt to link back to the theme of the question but never quite gets there with any degree of sophistication. Overall stronger on AO1 than AO2.

Level 3, 13 marks
Section B

Question 2: Hot deserts and landscapes

Outline sources of energy in hot desert environments. [4 marks]

AO1 – 4 marks

There are three sources of energy in hot desert environments. Insolation is the main source, this is energy from the sun's radiation, this is very strong and present in deserts due to the lack of cloud cover, which does little to restrict insolation/light energy coming from the sun. Wind is another source, which is a result of the atmospheric circulation system. Wind energy can result in aeolian transportation and erosion and result in the formation of aeolian landforms. Runoff water is also a source of energy (it may be from exogenous ephemeral rivers) or from irregular conventional rainfall. Although water is scarce in deserts, it is very powerful can result in erosional processes and the formation of fluvial landforms such as alluvial fans.

This is response is clearly aware of the role of insolation and water as sources of energy in deserts in this AO1 response. It was not felt that the response did enough on the role of wind to justify credit. It is the variation in pressure or pressure gradient which generates the winds, and this was not clearly stated. The response recovered on the role of water. So, for this response there were two points made and two developed points.

4 marks
Figure 3a shows the primary productivity in five study areas of northern China which are at different stages of aeolian desertification. Figure 3b shows the percentages of soil particle size in the same five study areas.

Analyse the data shown in Figure 3a and Figure 3b. [6 marks]

AO3 – 6 marks

This data shows a positive correlation between soil particle size and risk of desertification. Areas at “very severe desertification” have finer particles, around 80% course sand, and no clays and silts, whilst areas with only a “potential for desertification” having around 70% course sand, with a small percentage of clays and silts. The other graph shows a rough correlation between productivity and desertification. VSD areas have a very low level of primary productivity below ground (and overall productivity) around 10g/m², whilst PD areas have higher underground primary productivity of 240g/m² overall, and 300g/m². This can suggest some correlation between the two, with areas of finer sand/soil particles being less productive and more prone to desertification. An exception is PD and LD areas which have similar soil compositions but LD has higher productivity than the PD area. The definitions of the desertification in different areas is vague, making it a bit harder to capture data accurately to levels of desertification.

This response shows strong overall awareness of the relationship between the two resources. Data is used effectively in support. The response is also aware of anomalies particularly around ‘LD’. All criteria are met for full marks on this AO3 response.

Level 2, 6 marks
‘The fragile inter-relationship between climate, soils and vegetation in arid regions is becoming increasingly affected by human activity.’

How far do you agree with this view?

[20 marks]

AO1 – 10 marks
AO2 – 10 marks

The climate in arid regions is extremely hot and dry due to lack of precipitation and cloud cover. As a result it is difficult for many species of vegetation to grow in these regions due to the lack of moisture, this also affects soils which lack organic material, due to the lack of leaf litter and dead vegetation, and are often thin, have poor water retention and are sandy/saline; this is because the soils lack water which is needed for soil development. The poor soils also struggle to support vegetation. This fragile interrelationships is worsen by human activity, as climate change and deforestation has meant an increase in draughts/desertification, which worsens soils and exacerbates vegetation growth.

Climate change, resulting from anthropogenic activity such as combustion of fossil fuels) has meant there is increasing temperatures and more irregular rainfall patterns. The Atacama desert is currently the driest desert in the world receiving less than 15mm a year of rainfall – these climatic conditions may be exacerbated by climate change and the Atacama desert region may become more dry and hot – which impacts the soil and 500 species of vegetation, many of which may die as a result of the new climate, showing how human activity can make the inter-relationship between climate, soils and plans, more fragile. However, an argument against this is that many plants have adapted to live in the desert climate, and human activity increasing climate change may just lead to further adaptions to survive. For example, the Echinopsis cactus in the Atacama has a waxy skin to reflect insulation, spikes to reduce surface area for transpiration, and a log/shallow root system to maximise water uptake, these types of plants are known as xerophytes and are adapted to survive drought, thus meaning climate change, may not largely impact desert vegetation, due to their adaptations, presenting the inter-relationship between soils, climate and plants.

Human activity such as overgrazing, over cultivation and deforestation are activities which result in the loss of biological potential of the land and results in desertification. This impacts soils and plants in the desert due to the loss of the organic material/fertility of the soil, which can now support less vegetation. The quality of the soil decreases, and may become thinner and more saline. Furthermore there may be an increase in desert like conditions across the world – to where they should not occur, worsening the hot sand climates and increasing the fragility of the inter-relationships. However there are many anthropogenic mitigation methods which have been implemented to reduce desertification, and replant vegetation and improve the biological potential of the land. For example, one initiative is known as the Great Green wall and involves planting a 8000km, 15km wide swathes of trees passing through 20 countries of the southern border of the Sahara desert, This will help restore fertility in the soil, through leaf litter and helps future plant growth. This type of human activity will help improve the inter-relationships between climate, plants and soils.
To conclude, whilst some human activity exacerbates climate conditions in desert regions, which hinders vegetation growth and soil development as environmental issues are increasingly brought to our attention, this will increase human mitigation methods such as replanting/afforestation in helping plants to adapt to more extreme arid climates – this type of human activity, which is set to increase in the future, will be beneficial and help improve the inter-relationships in the desert regions. So whilst climate, soils and vegetation are becoming increasingly affected by human activities, this affect is more positive.

From the outset the inter-relationships are dealt with. This showed solid subject knowledge. The response then considers anthropogenic change in relation to climate change and factors contributing to this. This is a valid approach in terms of considering human activity. It then considers some really specific example material and uses this well in the context of the question. Other activities such as overgrazing and deforestation are also considered appropriately in the context of the question. It even considers human activity which might support the inter-relationships. This is a full and well supported response which has secure knowledge (AO1) and this is well used to answer the question (AO2).

Level 4, 20 marks
‘The fragile inter-relationship between climate, soils and vegetation in arid regions is becoming increasingly affected by human activity.’

How far do you agree with this view?

[20 marks]

AO1 – 10 marks

AO2 – 10 marks

The interrelationship relies on a number of factors that keep one open system of the desert in some sort of harmony. Human activity appears to be threatening this by accelerating desertification which UNESCO described as the drying and degradation of land due to human activity and climate change.

To that extent I tend to agree with this statement. Factors like rapid population growth in the Sahel, from 60 million in 2010 to an expected 100 million in 2020, puts added pressure on the environment in order to meet rising demands. It has, for example, led to the introduction of cash crops like Maize in places like Burkina Faso which are water intensive and deplete nutrients in the soil in order for greater crop yields to meet the food shortage. Clearly this will effect the soil and vegetation as nutrient-poor soil that is baked in the high daytime temperatures of up to 50°C in the region will not be conducive to growing plants. An increased greenhouse effect caused by more people requiring fuel may only increase the daytime temperatures which could make the land inhospitable to even desert vegetation like Thale Cress. People in the Sahel may cause this by burning more wood for fuel with deforestation potentially reducing vegetation significantly and with no trees to breathe wind the relatively nutrient-rich top soil may be eroded.

There are also likely to be natural factors that play a part such as natural variations in climate during inter-glacial periods and events like El Nino which are a change in climate patterns. This could lead to desert bloom and increase vegetation cover although human needs appear to be growing faster than ever and more of the 10 countries in the Sahel belt continue to grow. It is worth noting that human activity is also working to restore some sort of harmony between the three once more. For example, using Magic stones in Burkina Faso is a more sustainable method of farming where stones laid on field contours trap/slow water when it does rain to enrich the soil and encourage growth.

Due to the sporadic nature of many natural variations in deserts I tend to fully agree with the statements due to the significant impact human activity has clearly had and not just by local people as climate is most severely affected by anthropogenic climate change (that increases the greenhouse effect) from the high levels of emissions from developed counties. As human life continues to thrive in the region the impact of the over-abstraction of water from aquifers that will take millions of years to recharge, will severely impact on the relationship and particularly on soil and vegetation as water is the most fundamental need for both people and the environment.
This response starts with some secure knowledge which sets the scene well. It continues to offer plenty of examples of human activity and its impact on the delicate inter-relationship. This response puts more emphasis on the role of human activity and its consequence, than it does on detail around the specific impact on the inter-relationships. However, there is enough for full marks.

Level 4, 20 marks
Section B
Question 3: Coastal systems and landscapes

Explain the development of saltmarsh environments. [4 marks]

A01 – 4 marks

Saltmarsh environments generally occur in sheltered areas, where freshwater and seawater meet or at the sides of estuaries. They form when mud builds up in an area by flocculation (when mud particles bind together so their mass is great enough to allow them to sink). Once a fair quantity of mud is present, pioneer species such as eelgrass will colonise in the marsh (these species are better adapted to the harsh conditions such as very salty water). When these species die, organic matter enters the mud which allows more species – less adapted to the conditions – to form. Eventually a rich biodiversity of vegetation and aqualife will be present and the salt marsh would have reached its climatic climax.

This question is about demonstrating the sequence in the development of a saltmarsh. Four sequentially valid points need to be made. This one actually does a lot more than that and could have scored more marks if more were available. It is fully aware of the sequence of development of a saltmarsh.

4 marks
Figure 6 is a photograph of stretch of coastline in the Mahia Peninsula, North Island, New Zealand.

Note: In New Zealand, there is a variety of coastal dune landforms. The dunes in Figure 6 are relatively small shore-parallel foredunes located immediately behind the beach. Dunes can be made up of a variety of surface dune types. They can form hills and ridges which can rise to a hundred metres or more above the shoreline and represent long-term accumulations of large volumes of sand.

Using Figure 6 and your own knowledge, assess the role of vegetation in the development of this landscape.

[6 marks]

A01 – 2 marks
A02 – 4 marks

As shown by figure 6, vegetation can colonise sand dunes. They play a key role in binding the sediments together. Pioneer plants like marram grass have long roots, which can extend beyond 17mm and hold sediment together. Furthermore, the widespread presence of vegetation shown in figure 6 exemplifies the importance of organic matter which can help build soil and aid vegetation succession (psammosere) However, supply of sediment and strong winds is crucial in forging these shapes. Foredunes, as shown in Figure 6, can reach up to 1m in height and are 80% exposed sand deposition of this sand is a fundamental driver of this process, for it forges the sand into its distinct shape. Furthermore, sand dunes are formed when wind blows sand, which are deposited when reaching an obstacle at the beach. Therefore, whilst vegetation plays a heavy role in colonising the land and holding the sediment together, a steady supply of sediment and wind are the biggest drivers in developing this distinct coastal feature.

This response assesses the role of vegetation in the formation of sand dunes at the outset. It is clearly aware of the role of vegetation and well supported with the marram grass exemplification, bringing own knowledge to the resource. It also considers other factors and therefore comfortably deals with the assessment element of the question.

Level 2, 6 marks
Shoreline management/integrated coastal zone management can effectively tackle the expected eustatic sea level change and associated threat to coastal landscapes over the coming decades.

To what extent do you agree with this view?

[20 marks]

AO1 – 10 marks

AO2 – 10 marks

On the one hand, shoreline management can provide sustainable plans for coastlines, to effectively tackle eustatic sea level change and associated threats. For example, along the Holderness coast, the shoreline management plan (SMP) posits a hold the line approach along areas like Hornsea. 11.4km of this stretch of coastline is protected by coastal defenses such as sea walls and groynes. SMPs are effective because they outline the plan for beyond 50 years, and are continually updated to take into account any dangers. For example, erosional levels are as high as 10m along the Holderness coast, such as in Hornsea. This is projected to be exacerbated by sea level rise. Therefore, the SMP suggests higher sea walls to reflect this. However, its effectiveness is limited by disparities. Less populated areas are relatively neglected. This can be seen in a small town in West Somerset which has been assigned a ‘no active intervention policy’ whereas Minehead a more economically viable area has a hold the line policy. Therefore, the effectiveness of shoreline management plans in tackling sea level rise and associated hazards is limited.

On the other hand, residence and community action can also be effective tackling sea level change. For example, in the Sundarbans, a coastal zone in Bangladesh, mangrove forests act as a defence against eustatic sea level change. Mangrove forests even dissipate wave energy, as a density of 30 trees per 0.01ha can reduce the destructive of a tsunami by 90%. This reflects the effectiveness of natural deforestation protecting the coastline. 30,000 in the Sundarbans have recovered training by USAID on sustainable agricultural techniques to mitigate and prepare for sea level rose. In this aspect, community action and natural defences can act effectively where there is no management plan.

LICs are most at risk from flooding. Relatively weak and sometimes corrupt governments mean that strategies like SMPs are not applicable. Therefore, it can be argued that the projected impacts of eustatic sea level rise cannot be tackled effectively everywhere. Thermal expansion is a central cause of eustatic sea level rise. A 10c increase in temperatures can result in sea levels rising by up to 0.7m. In the last 30 years 7,000 people in the Sundarbans have been displaced due to sea level rise and erosion. Therefore, it can be argued that cohesive strategies such as SMPs may not be applicable to LICs, who lack to infrastructure to adopt such practices. In this aspect, SMPs cannot effectively tackle eustatic sea level change and associated hazards such as erosion.

Ultimately, whilst shoreline management plans may provide effective plans for life in the UK, LICs are most at risk. The lack of infrastructure and funding therefore means that shoreline management plans are very difficult to adopt. Therefore, the
effectiveness of shoreline management plans in tackling sea level rise and associated risks like erosion is limited; SMPs are not widely applicable and other forms of community preparation can be highly effective, as these make up localized responses, that can be applied to that specific place.

A well supported response which considers the SMP of Holderness and offers a comparable case study. Argument is evident and there is plenty of AO1 case study detail in support. It then uses a contrasting case study to show how other factors are important in managing the threat of flooding and erosion. Also makes an HIC/LIC contrast and uses the material coherently to further that argument. Both AO1 and AO2 were convincing and this was awarded full marks.

Level 4, 20 marks
Section B

Question 4: Glacial systems and landscapes

Explain the formation of rôches moutonnées. [4 marks]

Rôches moutonnées are formed when a glacier is moving down a valley and encounters an obstacle. The glacier slows down as it approaches the obstacle causing the pressure to build up. This results in melting and the meltwater lubricates the glacier allowing it to move over the obstacle. This creates the stoss side which is smooth with striations from glacial sediment. As the glacier moves over the obstacle the pressure reduces and the glacier freezes again. This creates a plucking effect and creates a rocky side known as the ‘lee’.

This question required an understanding of the sequence leading to the formation of the rôches moutonnées. The response showed a clear understanding of the process from start to finish and could have accessed more marks if they were available. More than four relevant points in the sequence are referenced.

Level 4, 4 marks
Figure 8 shows a periglacial landscape near Tuktoyaktuk, Northwest Territories, Canada.

Note: The aerial photograph was taken in late summer, near Tuktoyaktuk. It shows a largely flat area, in a coastal region near the Beaufort Sea in the Canadian Arctic. The mound in the image rises up to 36 metres above sea level. Local climate has had a powerful impact on the landscape, which is characterised by a high water table and the presence of numerous lakes.

Using Figure 8 and your own knowledge, assess the role of frost action in the development of this landscape. [6 marks]

AO1 – 2 marks
AO2 – 4 marks

In figure 8 I can see ice wedges, a pingo and pattered ground, all which are developed by frost action. The pingo is formed when ice water seeps into the ground with discontinuous permafrost and the water then freezes and expands causing the ground to be pushed up resulting in the pingo. This shows frost action and shows it was important. Pattered ground or stone polygons are formed when frostheave occurs. Water under stores in the ground freezes and expands and pushes the stores upwards. When the stores are pushed out of the ground they roll down the mound and surround it. Frost heave is very important in this process.

This response immediately engages with AO2 by identifying features in the resource. However, it then drifted into AO1 by largely describing processes not clearly linked to the figure. This is still creditworthy under AO1 but the AO2 element was held back somewhat. It really missed the opportunity to consider evidence presented in the resource. Just into Level 2.

Level 2, 4 marks
With reference to a glaciated landscape from beyond the UK, assess the impact of human activity upon the natural systems and physical landscape.

[20 marks]

AO1 – 10 marks
AO2 – 10 marks

Alaska is a glaciated landscape which is rich in natural resources. For example, mining in Prudhoe Bay is increasing with resources being exploited. This means that the physical landscape is damaged as well as preventing resources from being used in the future more sustainably.

Additionally, human activity becoming more popular in glaciated landscapes like Alaska, the area is more at risk of damage and erosion. For example, oil spills have become more common in Alaska killing some species and disrupting food chains therefore damaging the natural environment. Additionally, overfishing has increased also disrupting food chains.

As well as this, with humans increasingly contributing to global warming, fluvialglacial processes are more likely to occur. With an increase in meltwater, the landscape will begin to change rapidly with glaciers being more active. This also can cause increased rate of ablation because of increased temperatures, therefore reducing the amount of landscape which is glaciated.

This response is rather limited. There is some AO1 in terms of case study and knowledge of broad impacts but not much is applied to the context of the question and support lacks detail.

Level 2, 7 marks
Section C

Question 5: Hazards

05.5 Figure 9a shows data related to the eruption of Kīlauea Volcano, Hawai’i, USA, on 24 May 2018.

Figure 9b shows a satellite image of the same eruption.

Using Figure 9a and Figure 9b, analyse the data shown. [6 marks]

A03 – 6 marks

The data shows the eruption of Kīlauea Volcano which happened on the east of the island Hawaii. Figure 9a shows it largely impacted the large majority of the south east on the island, with a large amount of lava flows, the majority of the flow occurred resulting from the eruption, whilst it expanded a little two weeks after. The map shows the lava entering the ocean at two main active ocean entries and covering many minor roads as well as the major road 137. The figure also shows past lava flow, but this eruption appears to have taken place below previous. Figure 9b shows how for the ejected material travelled, the material projected travelled south westerly then in a westerly direction, suggesting this is the direction of the prevailing wind. The figure also shows as the material travels further away from the volcano, the height in the atmosphere falls from up to 3m to around 0m. The first figure showed the eruption produced less lava than previous, yet the second figure shows an incredibly large spread of ejected material, very high in the atmosphere 1-3m for large amounts of area, suggesting its quite a powerful eruption.

This response interprets the map evidence fairly well from the outset, identifying the location as well as the areas affected. The student could have made a bit more use of the past lava flows. It makes an interesting connection to the prevailing wind but that is strictly application of knowledge as this is not presented in the data. There were minor errors on the units which were not penalised. The student tries to link the sources in the final few lines and does this with reasonable geographical skill.

Level 2, 5 marks
To what extent do you agree that the impact of volcanic activity can be mitigated against more effectively than tropical storms? [9 marks]

AO1 – 4 marks

AO2 – 5 marks

On the one hand, the impact of volcanic activity can be mitigated against because they can be monitored. For example, before the eruption of Chances peak in Montserrat, on 28th June 1997, the Montserrat Volcano Observatory predicted the eruption in 1995. Therefore, this allowed the impacts to be minimised, as evacuation of the south including Plymouth began. 213 of the island was made into a ‘Red Zone’. Whereas, tropical storms are more difficult to predict. The USA uses computer models like SLOAN to predict the nature of storm surges created by storms. This is only +/- 20% accurate. Additionally, storms can be unpredictable. This can be seen by the circuitous track of Cyclone Winston, which exemplifies the barriers to mitigation. In this aspect, volcanic activity is easier to mitigate against more effectively, because it can be monitored, whereas tropical storms are more difficult to predict.

On the other hand, mitigation for tropical storms can be characterised by investment in infrastructure. For example, 700 cyclone shelters were built following Cyclone Winston in February 2016. Similarly, 230 shelters were under construction in the Sundarbans Bangladesh in 2013 by the World Bank. Conversely, it is more difficult to mitigate against the impacts of volcanic activity which can be catastrophic and rapid. For example, following the eruption of Mount Pelée in 1902, 30,000 were killed instantly by pyroclastic flows. This exemplifies the difficulty of mitigating against the impact of volcanic activity.

Therefore, whilst storms may be difficult to predict, mitigation is easier as infrastructure can support mitigation attempts, such as through cyclone shelters. Whereas, volcanic activity is harder to mitigate against based on the severity and rapid nature of its impacts. Therefore, tropical storms are easier to mitigate against effectively.

This response starts with a viewpoint, hence the AO2 credit. Then it uses a case study to support the position, i.e., Montserrat. This is a useful strategy. It then makes a comparison with storms but questions the accuracy of this. Next, it considers mitigation strategies and shows how mitigation can be difficult with volcanoes compared to storms. Support offers some detail. Sophistication comes in how the response considers differences in prediction and other aspects of mitigation. The response offers some detail in support and clearly engages with the question.

Level 3, 9 marks
Assess the relative usefulness of the Park Model and the Hazard Management Cycle in understanding the impact of seismic events.

AO1 – 10 marks
AO2 – 10 marks

Models are commonly used in geography as a visual representation to, in this case, show the sequence of events a place may go through following a seismic hazard. The Park model shows the deterioration and later the improvement of the quality of life in a place whilst the Hazard Management Cycle shows the four stages (Mitigation, Preparation, Response and Adaptation) a place may go through during a seismic event.

The Park Model was useful to show the deterioration in quality of life following the Haiti earthquake. The 7mms earthquake killed over 23,000 people in 2010 and left 1.5 million homeless with a further 4.3 million on food rations. This represented the deterioration in quality of life which helped give the area an idea of the sort of damage to expect which saw 5,000 schools destroyed. However, the flow of the model was exposed during the rehabilitation and reconstruction phase as the improvement the model suggested was far too rapid. As an LIC with GDP on just $660 per person, Haiti struggled to recover even with the exogenous support if NGOs like the Red Cross with just 2% of the $1.1bn raised being released and even 6 months after the earthquake, 98% of the rubble remained which shows how one Park Model may be too generalised for some areas.

The Hazard Management Cycle is probably more useful in understanding the impact as there are clear stages with no set temporal scale meaning countries like Haiti, that are still largely in the response section even today, know exactly what the future impacts are. The cycle lists a number of key features in terms of the impact of seismic events like the closing of infrastructure and the destruction of buildings but again, this is likely aimed at more developed countries. Haiti’s lack of development, with a literary rate of just 58.61, and economic means meant that before the earthquake hit there were few transport links and communication links that the cycle stated would be destroyed. The cycle also references bout the control of the impacts like hygiene to stop the spread of disease but again with a lack of medical supplies this proved tricky to control.

Clearly both these models are effective in showing the general impact of seismic events on a place and suggesting the degradation that will occur to both the physical and natural environment. However, as proven by the example of Haiti, it is clear that they are perhaps to general for many poorer countries, in particular, who are forced to respond in a different way due to various limitations. So in terms of ‘relative usefulness’ perhaps these models aren’t so useful although the nature of the models means they should generally be applicable to a variety of situations which the cycle, which does not have a timescale, is.
This response starts with a definition of models in Geography – this is not really much more than scene setting so adds little value. It then shows the basic difference between the two models so now starts to achieve credit under AO1. It then uses Haiti as a case study to support the response. No credit is lost by the error on number of fatalities. It then tries to consider a limitation of the model in that it does not account for HIC/LIC status. However, there is something useful around consideration of the generalised nature of the model. It then contrasts with the HMC (AO2) and considers temporal differences between the models. This is a reasonable argument. It also considers the relative usefulness but just lacks the detailed argument to access Level 4.

Level 3, 15 marks
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