IUCN Conservation Outlook Assessment 2014 **(archived)**
Finalised on 07 November 2014

Please note: this is an archived Conservation Outlook Assessment for Dorset and East Devon Coast. To access the most up-to-date Conservation Outlook Assessment for this site, please visit https://www.worldheritageoutlook.iucn.org.

Dorset and East Devon Coast

SITE INFORMATION

Country:
United Kingdom of Great Britain and Northern Ireland (UK)
Inscribed in: 2001
Criteria:
(viii)

Site description:
The cliff exposures along the Dorset and East Devon coast provide an almost continuous sequence of rock formations spanning the Mesozoic Era, or some 185 million years of the earth's history. The area's important fossil sites and classic coastal geomorphologic features have contributed to the study of earth sciences for over 300 years. © UNESCO

SUMMARY

2014 Conservation Outlook

Good

Geological and paleontological values of the site have remained well preserved since the inscription and are very robust against most current and potential threats. The protection and management of the site is mostly effective to highly effective overall, with several examples of international best practice in World Heritage management. The overall conservation outlook for the property is good, because of the robustness of its values against anthropogenic impact, adequate boundaries and effective conservation management.

Current state and trend of VALUES

Good
Trend: Stable

The state of the geological, palaeontological and geomorphological values of the site was assessed as good at the time of inscription. It has remained in good condition and stable since.

Overall THREATS

Low Threat

The OUV of the property is very robust against most current and potential threats other than the need for coastal sea defences. The proposed Navitus Bay Wind Park may have some impact on the OUV of the site by reducing the magnitude of erosion on a certain area under certain conditions, even though the threat is from outside the site and the impacts are likely to be very low. This proposal, should it go forward, would also impact on the presentation of the site, which is a more significant concern.

Overall PROTECTION and MANAGEMENT

Highly Effective

The protection and management of the site is mostly effective to highly effective overall, with several examples of international best practice in World Heritage management.

FULL ASSESSMENT

Description of values

Values

World Heritage values

- **Globally significant rock record, fossil localities and geomorphological features**
  Criterion:(viii)

  The coastal exposures along the Dorset and East Devon coast provide an almost continuous sequence of Triassic, Jurassic and Cretaceous rock formations spanning the Mesozoic Era and document approximately 185 million years of Earth's history. The property includes a range of globally significant fossil localities – both vertebrate and invertebrate, marine and terrestrial – which have produced well preserved and diverse evidence of life during Mesozoic times. It also contains textbook exemplars of coastal geomorphological features, landforms and processes (SoOUV, 2010).

Other important biodiversity values

- **Wide range of coastal temperate ecosystems with their associated flora and fauna**

  There is a variety of important coastal ecosystems within the property, particularly on land-slipped cliffs and cliff-top grasslands. These support rare and threatened plant species such as Purple Gromwell Lithospherum purpureocaeruleum, Coastal Ash Fraxinus excelsior, Spider Orchid Ophrys sphegodes, and Early Gentian Gentianella anglica. There are also bio-diverse beach ecosystems such as Chesil Beach (with Sea Kale Crambe maritime and

Yellow-horned Poppy Glaucium flavium, among others), and the coastal lagoon of the Fleet, with its extensive aquatic macrophyte communities (UNEP-WCMC, 2011), and a European importance for Stoneworts (Plantlife 2012a). Studland area has 363 species of lichens (Plantlife 2012b). Among the fauna, noteworthy species include wintering Brent Geese Branta bernicla bernicla and Slavonian Grebe Podiceps auritus. There are also important invertebrate communities, both terrestrial and intertidal (UNEP-WCMC, 2011). The property overlaps with the Exe Estuary Special Protection Area (a Ramsar site – Wetlands International, 2012), the WWF Global 200 priority marine ecoregion “Northeast Atlantic Shelf Marine” (WWF, 2012), the Important Bird Area of European Importance “Chesil Beach and the Fleet” (BirdLife Internatioal, 2012b), and the Important Plant Areas of “Dorset Coast – Isle of Portland to Sudland Cliffs” (Plantlife, 2012b) and “Chesil Beech and the Fleet” (Plantlife, 2012a). It does not overlap with any WWF/IUCN Global Centre of Plant Diversity (WWF and IUCN, 1994), Endemic Bird Area (BirdLife International, 2012a), or Conservation International Global Biodiversity Hotspot (CI, 2012).

Assessment information

Threats

Current Threats

Very Low Threat

The OUV of the site is not threatened significantly currently, and its biodiversity values are also well preserved. However, there is a need to continue to manage visitors in a way that minimizes path and vegetation erosion as well as to monitor fossil collecting and its impact.

► Tourism/ visitors/ recreation

Very Low Threat

The high visitation may also lead to disturbance of wildlife, but key wildlife areas within the property seem to be rather well protected by its various PAs

(Protected Planet, 2012). Therefore, this is considered a very low threat only.

► War, Civil Unrest/ Military Exercises

Very Low Threat
Inside site

The Lulworth Firing Range inside the property has restricted access, but there are several sign-posted paths open for more than 130 days per year, including most weekends and public holidays (UNEP-WCMC, 2011). Since there is no threat to the OUV, and since the significant but localized threat to additional biodiversity values is partly outweighed by the PA function of the firing range, this threat is considered very low.

► Other Activities

Low Threat
Inside site

Pressure from fossil collecting is high (mainly local collectors and visitors) but is well regulated by policies, which are effectively implemented (Jurassic Coast World Heritage Site, 2009).

► Erosion and Siltation/ Deposition

Very Low Threat
Inside site

Tourist impact on the Site itself is minimal, but is more noticeable on the setting.

Potential Threats

Low Threat

The need for coastal sea defences is the largest ongoing threat to the site and climate change will exacerbate it. The proposed Navitus Bay Wind Park may have some impact on the OUV of the site by reducing the magnitude of erosion on a certain area under certain conditions, even though the threat is from outside the site and the impacts are likely to be very low. This proposal, should it go forward, would also impact on the presentation of the site, which is a more significant concern.

► Mining/ Quarrying

Low Threat
Inside site
Outside site

Planning permission for two quarrying areas inside the current boundaries of the property was granted in 1951, but two modification areas plus the resulting reduced economic viability of quarrying operations in the remaining areas make it extremely unlikely, according to the State Party, that any quarrying will go ahead at these sites. This is in spite of the fact that there were attempts to go initiate quarrying in 2007. Quarrying could compromise not only the property, but also coastal landscapes and a nationally designated Special Area of Conservation (UNEP-WCMC, 2011).

► Oil/ Gas exploration/development

Low Threat
Inside site
Outside site

The proximity of the shipping lanes of the English Channel and the precedent of the MSC Napoli intentional emergency beaching in 2007 (Wainwright, 2007), which luckily had not major consequences for the OUV of the property (WHC 2007), show that shipping accidents and resulting spills in the vicinity may well affect its territory. The shingle beaches, and their behavior, would be impacted in the case of significant oil spill – this could lead to a breach of Chesil bank and impacts at other locations that are protected by shingle beaches.

► Other

High Threat
Inside site
Outside site

Climate change might in the long term affect coastal stability and ecosystem distribution (Zacharioudaki and Reeve, 2011), increase coastal erosion and create a need for strengthened coastal defenses along the property, which would compromise its erosion/deposition dynamics, aesthetic value and accessibility (Jurassic Coast World Heritage Site, 2009). The need for coastal sea defences is the largest ongoing threat to the site and climate change will

exacerbate it.

▶ Renewable Energy

High Threat
Outside site

The proposed Navitus Bay Wind Park may have some impact on the OUV of the site by reducing the magnitude of erosion on a certain area under certain conditions, even though the threat is from outside the site and the impacts are likely to be very low. This proposal, should it go forward, would also impact on the presentation of the site, which is a more significant concern.

Protection and management

Assessing Protection and Management

▶ Management effectiveness

Highly Effective

No formal management effectiveness assessment has been conducted for the site, but the original management plan was adapted in 2003 and an extensive review of the progress since inscription in 2001 was published in 2006. Management during the 2001-2006 period in the areas of OUV and landscape conservation, visitation, interpretation and education, gathering and dissemination of scientific information as well as integration of the site with sustainable regional development was overall rated as successful (Jurassic Coast World Heritage Site, 2009).

▶ Relationships with local people

Highly Effective

Local people were involved intensively in the development and consultation of the management plan of the property. Local landowners (through Country Land and Business Association) and planning authorities (District Councils) as well as several regional NGOs are also represented in the World Heritage Steering Group, the key coordinating and decision making body for the property, and management is carried out partly by local stakeholders

(Jurassic Coast World Heritage Site, 2009).

▶ Legal framework and enforcement

Highly Effective

The property is protected under national nature conservation legislation by 13 Sites of Special Scientific Interest (SSSI) which encompass both geological and biological interests. The setting is protected by two Areas of Outstanding Natural Beauty (AONBs) (IUCN Category V Protected Landscape/Seascape), a national landscape designation. Further protection is provided by 3 SAC, 2 SPA and 2 Ramsar intenational site, 2 National Nature Reserves and the adjacent Lyme Bay Marine Protection Area. Legal protection was considered effective at the time of inscription (IUCN, 2001).

▶ Integration into regional and national planning systems

Highly Effective

The management plan of the property explicitly refers to the integration of the OUV management of the site into the UK planning system at the regional and national level, particularly to integration into Local Development Frameworks and Regional Spatial Strategies (Jurassic Coast World Heritage Site, 2009).

▶ Management system

Highly Effective

The 2014-2016 Management Plan is currently being finalized, thus management of the site is currently guided by its 2007-2012 management plan, which is aimed at protecting and conserving the site, improving understanding of its OUV, improved realization of benefits and access, awareness raising and the demonstration of good World Heritage management. These aims are pursued through a set of management principles and policies, a dedicated management structure with World Heritage Steering Group as main coordinating body, and specific actions (Jurassic Coast World Heritage Site, 2009). There are also specific management plans for many of the component PAs that make up the site (Protected Planet, 2012, UNEP-WCMC, 2011).

▶ Implementation of Committee decisions and recommendations

Highly Effective

The only relevant Committee decision on the property since inscription was Decision 31 COM 7B.33 (WHC, 2007), which dealt with the emergency response to the MSC Napoli accident. It is likely that the two requests expressed in this decision (keep World Heritage Centre informed and consider designation of Area to be Avoided and/or Particularly Sensitive Sea Area under the International Maritime Organization) were met by the State Party.

▶ Boundaries

Highly Effective

The property's boundaries are considered adequate because they are based on the spatial distribution (and national protective designations) of OUV throughout 13 Sites of Special Scientific Interest (which encompass 66 Geological Conservation Review sites), are consistent with British legislation (e.g. regarding seaward boundary), and were set following a lengthy consultation process. A buffer zone is considered unnecessary, because of the overall effective conservation and management regime around the property. Protection of the setting is mostly fulfilled by the East Devon and Dorset AONBs (Jurassic Coast World Heritage Site, 2009).

▶ Sustainable finance

Mostly Effective

Funding of the property is provided on a partnership basis. In 2008-9, the property received a total of ca. USD 670,000, from Dorset County Council, Devon County Council and Natural England. This was supplemented by contributions and project funding from various sources including some larger land owners of the property, and is overall considered sufficient (UNEP-WCMC, 2011). Current government funding cut backs, particularly for local authorities and government organizations, could impact the property, therefore potential long term effects of these cuts should be monitored.

▶ Staff training and development

Data Deficient

Exact staff numbers of the property are difficult to ascertain because of its partnership management structure. About 40 wardens and rangers were employed by Devon and Dorset County Councils upon inscription alone (UNEP-WCMC, 2011). Staff training and development are likely to be conducted by the individual management partners, but detailed information is not available.

► Sustainable use

Mostly Effective

The property occupies an extended narrow strip of coastal cliffs, beaches and intertidal areas and is not of great interest for natural resources use. No problems with the sustainable use have been reported (IUCN, 2001, Jurassic Coast World Heritage Site, 2009, UNEP-WCMC, 2011)

► Education and interpretation programs

Highly Effective

Six of the eight aims of the property’s management plan are directly linked to education. An extensive education programme is implemented at the property. An education work group was established in 2002, a “Jurassic Textbook” was published in 2003 and an Education Coordinator was hired in 2004. Particular emphasis is put onto cooperation with primary and secondary schools, as well as on informal education through visitor centres. On a higher level, a high-quality field studies centre is being planned for Lyme Regis (Jurassic Coast World Heritage Site, 2009).

► Tourism and interpretation

Mostly Effective

Aims 5 and 6 of the property’s management plan focus on improving access and the offer for visitors to the coast, respectively. A wide range of publications have been produced and visitor interpretation centres established or improved since inscription (e.g. the Charmouth and Beer centres and Dorset Country Museum). Transport infrastructure has been improved (e.g. X53 Jurassic Coast Bus) and the site has been awarded the Tourism for Tomorrow Destination Management Award 2005. At the same time, progress in this direction has been uneven and there is room for further

improvement in some areas (Jurassic Coast World Heritage Site, 2009).

▶ Monitoring

Highly Effective

There is a detailed monitoring programme and state of conservation report is published annually for the site. The implementation of the management plan is also being monitored (Jurassic Coast World Heritage Site, 2009).

▶ Research

Mostly Effective

The property has supported geological and palaeontological knowledge generation for the last 200 years (Brunsden and Edmonds, 2010, UNEP-WCMC, 2011), and continues to host a wide range of research projects. Development of a more focused research strategy was commissioned to the University of Plymouth in 2007, to better direct and coordinate research at the property. A Science and Conservation Advisory Group and Network support the site (Jurassic Coast World Heritage Site, 2009).

Overall assessment of protection and management

Highly Effective

The protection and management of the site is mostly effective to highly effective overall, with several examples of international best practice in World Heritage management.

▶ Assessment of the effectiveness of protection and management in addressing threats outside the site

Mostly Effective

The main outside threats to the property are pollution by oil or other chemical spills and infrastructure development in its immediate surroundings (e.g. Portland area). These cannot be fully controlled but so far have been addressed effectively, as in the MSC Napoli accident in 2007 (WHC, 2007), or regarding quarrying concessions in the vicinity of the property. The main outside threats to the property are pollution by oil or other chemical spills and infrastructure development in its immediate surroundings (e.g. Portland

area). These cannot be fully controlled but so far have been addressed effectively, as in the MSC Napoli accident in 2007 (WHC, 2007), or regarding quarrying concessions in the vicinity of the property. The proposed Navitus Bay Wind Park may have some impact on the OUV of the site by reducing the magnitude of erosion on a certain area under certain conditions, even though the threat is from outside the site and the impacts are likely to be very low. This proposal, should it go forward, would also impact on the presentation of the site, which is a more significant concern.

► Best practice examples

1. Close involvement of local people and interest groups in the management planning and implementation process
2. Collaborative management setup building on existing local and regional authorities and organizations
3. Extensive visitation, interpretation and education programmes which deal with a very large number of visitors and include innovative approaches, such as the use of the arts in interpretation and education
4. Fossil collecting management working collaboratively with local collectors, land owners, conservation agencies and the research community

State and trend of values

Assessing the current state and trend of values

World Heritage values

► Globally significant rock record, fossil localities and geomorphological features

Good
Trend:Stable

The state of the geological, palaeontological and geomorphological values of the site was assessed as good at the time of inscription (IUCN, 2001). It has remained stable since, according to the State Party (Jurassic Coast World Heritage Site, 2009), which also identified some small local areas of unfavorable conservation state. It is hence assessed as of low concern, and

stable.

Other important biodiversity values

► Wide range of coastal temperate ecosystems with their associated flora and fauna

There is a variety of important coastal ecosystems within the property, particularly on land-slipped cliffs and cliff-top grasslands. These support rare and threatened plant species such as Purple Gromwell Lithospherum purpureocaeruleum, Coastal Ash Fraxinus excelsior, Spider Orchid Ophrys sphegodes, and Early Gentian Gentianella anglica. There are also bio-diverse beach ecosystems such as Chesil Beach (with Sea Kale Crambe maritime and Yellow-horned Poppy Glaucium flavium, among others), and the coastal lagoon of the Fleet, with its extensive aquatic macrophyte communities (UNEP-WCMC, 2011), and a European importance for Stoneworts (Plantlife 2012a). Studland area has 363 species of lichens (Plantlife 2012b). Among the fauna, noteworthy species include wintering Brent Geese Branta bernicla bernicla and Slavonian Grebe Podiceps auritus. There are also important invertebrate communities, both terrestrial and intertidal (UNEP-WCMC, 2011). The property overlaps with the Exe Estuary Special Protection Area (a Ramsar site – Wetlands International, 2012), the WWF Global 200 priority marine ecoregion “Northeast Atlantic Shelf Marine” (WWF, 2012), the Important Bird Area of European Importance “Chesil Beach and the Fleet” (BirdLife Internatioal, 2012b), and the Important Plant Areas of “Dorset Coast – Isle of Portland to Sudland Cliffs” (Plantlife, 2012b) and “Chesil Beech and the Fleet” (Plantlife, 2012a). It does not overlap with any WWF/IUCN Global Centre of Plant Diversity (WWF and IUCN, 1994), Endemic Bird Area (BirdLife International, 2012a), or Conservation International Global Biodiversity Hotspot (CI, 2012).

Summary of the Values

► Assessment of the current state and trend of World Heritage values

Good

Trend: Stable

The state of the geological, palaeontological and geomorphological values of

the site was assessed as good at the time of inscription. It has remained in good condition and stable since.

▶ **Assessment of the current state and trend of other important biodiversity values**

Low Concern

Trend: Stable

The Factsheets for the two Important Plant Areas and for the Important Bird Area that overlap with the property do not indicate any specific impairments of their conservation status since inscription (BirdLife International, 2012b, Plantlife, 2012a, b). The same is true for the 2010 State of Conservation Report of the property (Jurassic Coast World Heritage Site, 2010). Additional information may be available from the UK biodiversity monitoring system and from Natural England on the condition of SSSIs.

Additional information

Key conservation issues

▶ **Potential impact of strengthened flood defenses on the property**

Local

Large-scale construction of artificial flood defence structures, e.g. in response to climate change, would compromise the erosion/deposition regime along the property and might also restrict access to the OUV of the property. However, the area of the property is much less developed than other coastal areas in Britain where this has been discussed in the past, and any such establishment of defence structures would be subject to a lengthy consultation and EIA process (Jurassic Coast World Heritage Site, 2009). The management plan suggests a pragmatic approach to such developments, which is supported.

▶ **Damage through poorly conducted fossil collection, poor rate of acquisition of fossils of high value by the property, and other issues related to fossil collection**

Local

The property has a fossil collection Code of Conduct which in general is effectively implemented, and which was under review in 2010. However, it appears that too few specimens make it into the collections associated with the property, and this may impair the effectiveness of interpretation and education at the site. A successful grant bid (£230,000) supported the 'Collecting Cultures Jurassic Life' project which enabled the acquisition, conservation and display fossils from the Jurassic Coast in local museums. (Jurassic Coast World Heritage Site, 2010).Targeted fundraising and continued implementation of the Code of Conduct, (following its review and implementation of the recommendations of this review) is needed to address this issue.

Benefits

Understanding Benefits

► Is the protected area valued for its nature conservation?

The considerable nature conservation values are reflected by its designation as Area of Outstanding Natural Beauty (IUCN Category V Protected Landscape/Seascape), and of parts of it as Sites of Special Scientific Interest and a large National Nature Reserve (IUCN Category IV). The site also overlaps with areas designated as being of international importance for wildlife, either as a Special Conservation Area or PA under European Community Directories (Jurassic Coast World Heritage Site, 2009).

► Does management of the site provide jobs (e.g. for managers or rangers)?

The number of jobs provided by the property is difficult to ascertain, because of its partnership management structure. Ca. 40 wardens and rangers are employed by Dorset and Devon County Councils alone (UNEP-WCMC, 2011). In addition, a significant number of jobs (hundreds of jobs in tourism) indirectly benefit from the attractiveness of the OUV, landscapes and biodiversity of the property.

► Outdoor recreation and tourism

There are 14 million visitors to the property annually, with an increasing

contribution of international visitors, and nature based tourism is practiced at a high intensity (UNEP-WCMC, 2011).The site offers a unique opportunity to experience not only its OUV but also the coastal landscapes of southern England in general. This contributes significantly to income generation and the socio-economic development in the property's vicinity.

► Importance for research

The site has critically contributed to the scientific understanding of geology, palaeontology and coastal geomorphology since the early 19th century, and continues to support extensive scientific research and publications (UNEP-WCMC, 2011). In addition, new know-how on the management of World Heritage and other natural areas is generated and tested by the institutions managing the property.

► Contribution to education

Based on the site's immense importance for palaeontological and geological knowledge generation and its exemplary visitor and educational facilities, it also functions as a living museum, which helps people understand how life has evolved throughout Earth's history, and how coastal landscapes continue developing today (Jurassic Coast World Heritage Site, 2009).

Summary of benefits

The main benefits of the property are knowledge generation, education and nature based tourism with the immense socio-ecomomic benefits that depend on them, but the property also offers significant nature conservation benefits.

Projects

Compilation of active conservation projects

№	Organization/ individuals	Project duration	Brief description of Active Projects
1	Jurassic Coast Trust		Various fundraising projects in support of the management of the property

№	Organization/ individuals	Project duration	Brief description of Active Projects
2	South Devon and Dorset Coastal Advisory Group		Projects for sustainable shoreline management in the property’s area
3	Arts Council England, South-west		Jurassic Coast Arts Programme, part of the interpretative and educational activities at the property
4	The National Trust		Nature conservation projects on NT areas overlapping with the property
5	British Geological Survey		Geological, palaeontological and geomorphological research projects on the property
6	Natural England		Manages Axmouth to Lyme Regis Undercliffs National Nature Reserve

REFERENCES

№	References
1	BirdLife International (2012a). ‘Datazone: Endemic Bird Area Search’. [Electronic reference] . Accessed 23 June 2012.
2	BirdLife International (2012b). ‘Datazone: Factsheet Chesil Beach and the Fleet Important Bird Area, UK’. [Electronic reference] . Accessed 23 June 2012.
3	Brunsden, D. and Edmonds, R. (2010). ‘The Dorset and East Devon Coast: England’s Geomorphological World Heritage Site’. In: P. Migon (ed.) Geomorphological Landscapes of the World. Pp. 211-221. Berlin: Springer.
4	Conservation International (2012). ‘The Biodiversity Hotspots’. [Electronic reference] . Accessed 23 June 2012.
5	Dugan, E. (2008). ‘Huge landslide hits Dorset’s Jurassic Coast’. The Independent, 8 May 2008. [Electronic reference] . Accessed 23 July 2012.
6	IUCN (2001). ‘World Heritage Nomination – IUCN Technical Evaluation: Dorset and East Devon Coast (United Kingdom). Gland: IUCN. [Electronic reference] . Accessed 23 June 2012.
7	Jurassic Coast World Heritage Site (2010). ‘State of Conservation Report – Summary and Table to June 2010’. Electronic reference] . Accessed 23 June 2012.
8	Jurassic Coast World Heritage Site (2012). Website. [Electronic reference] . Accessed 23 July 2012.
9	Jurassic Coast World heritage Site (2009). ‘Management Plan’. Electronic reference] . Accessed 23 June 2012.
10	PlantLife (2012a). ‘IPA Factsheet – Chesil Beach and The Fleet’. [Electronic reference] . Accessed 23 June 2012.
11	PlantLife (2012b). ‘IPA Factsheet – Dorset Coast – Isle of Portland to Studland Cliffs’. [Electronic reference] . Accessed 23 June 2012.
12	Protected Planet (2012). ‘Dorset and East Devon World Heritage Site’. [Electronic reference] . Accessed 23 June 2012.

№	References
13	UNEP-WCMC (2011). ‘Dorset and East Devon Coast, United Kingdom’. UNEP-WCMC World Heritage Information Sheets. [Electronic reference] . Accessed 23 July 2012.
14	WWF (2012). ‘List of Priority Global 200 Ecoregions’. [Electronic reference] . Accessed 23 June 2012.
15	WWF and IUCN (1994). ‘Centres of Plant Diversity: a Guide and Strategy for their Conservation’. Gland, Switzerland and Cambridge, UK: World Wide Fund for Nature and IUCN. Volume 1: Europe, Africa, South West Asia and the Middle East.
16	Wainwright, M. (2007). ‘Fears mount along with debris from container ship’. The Guardian, 17 February 2007.
17	Wetlands International (2012). ‘Ramsar Sites Information Service’. [Electronic reference] . Accessed 23 July 2012.
18	World Heritage Committee (2007). ‘Decision 31 COM 7B.33’. [Electronic reference] . Accessed 23 July 2012.
19	World Heritage Committee (2010). ‘Decision 10/34.COM/8E.Add’. [Electronic reference] . Accessed 23 July 2012.
20	Zacharioudaki, A. and Reeve, D. E. (2011). ‘Shoreline evolution under climate change wave scenarios’. Climatic Change 108(1-2): 73-105.