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Teaching Atmospheric Hazards in the Climate Change Context—Environmental Didactic Proposals in the Mediterranean Region for Secondary Schools

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Abstract: The political sphere is starting to take an interest in how the teaching of atmospheric risks at pre-university stages can be improved. This interest has arisen due to the fact that, as stated in the 2030 Agenda, education is an important factor for reducing the effects of natural hazards within the context of current climate change. However, in developed countries education has not played a prominent role in the design of risk prevention policies. The purpose of this study was to identify the principal deficiencies that characterise the study of natural risks in non-university education and then to propose didactic activities for improving the teaching of the main processes associated with climate change (episodes of intense rains and droughts) that already affect the Spanish Mediterranean region. Their implementation in the classroom seeks, first, to correct the deficiencies in the knowledge of the students in terms of the sources from which they obtain information, and second, to raise awareness about the importance of education in the prevention and mitigation of climate risks. These proposals are intended to serve as a guide to activities to be implemented in classrooms in other international areas, taking into account their geographical characteristics and the availability of data.

Keywords: atmospheric hazards; climate change; didactic proposals; Mediterranean region; education; geography

Citation: Morote, Á.-F.; Olcina, J.; Hernández, M. Teaching Atmospheric Hazards in the Climate Change Context—Environmental Didactic Proposals in the Mediterranean Region for Secondary Schools. *Environments* **2022**, *9*, 29. https://doi.org/10.3390/environments9020029

Academic Editor: Yu-Pin Lin

Received: 17 December 2021
Accepted: 10 February 2022
Published: 13 February 2022

1. Introduction

In recent years, the information related to climate change and its atmospheric risks has gained relevance in both daily life and in the academic world [1,2]. Some researchers [3,4] indicate that addressing this topic is difficult due to the wide range of variables that intervene. The explanations in the school textbooks are not always well-focused and often use excessively catastrophic and sensationalist messages [5,6]. They frequently abuse stereotypes [6] and the "fake news" published by the media [7,8] in order to explain phenomena and processes that have a complex causality and a huge social impact [9,10].

The political sphere is starting to take an interest in improving how atmospheric risks are taught at pre-university stages of education. An example was the United Nations Conference on Climate Change (COP25 Madrid 2019, Spain). In this conference, the Spanish Ministry of Education, Culture and Sport announced the inclusion of a subject on this topic in the reform process of non-university education as a specific embodiment in the school curricula. These contents, however, are already taught in certain subjects of Compulsory Secondary Education and Baccalaureate (Geography and/or Social Sciences) [5]. There is also a need to define scientifically rigorous objectives, competencies and evaluation criteria for this topic, particularly in teacher training programmes. Morote and Olcina

[5] indicate that the information on this subject matter ("climate change") is "scarce and it may be necessary to place greater emphasis on increasing the relevance and scientific rigour of these contents in order to provide more and better training to teachers (current and future) rather than creating new subjects" (p. 174).

The need for rigorous teaching in atmospheric risks has been recently endorsed by the United Nations with its promotion of education in climate change and extreme weather events as a basic action to achieve the so-called Sustainable Development Objectives (SDGs) (2030 Agenda), specifically Objective nº 13 "Climate Action" [11]. Furthermore, in its Fifth Report, the Intergovernmental Panel on Climate Change [12] stated that education was one of the fundamental actions for adapting society to climate change. This report affirms that a society that is better educated in these issues will be more resilient to the consequences of the current process of global warming.

According to climate modelling, the current global warming process will have different effects depending on the territory and recipient society [13]. The Mediterranean basin is a geographical area that is highly exposed to the effects of this process. This is indicated in the Sixth Report of the IPCC [14] and other recent studies [15]. The convergence in this geographical space of a high level of climate hazard with an intense occupation of the territory, particularly the coastal strip, explains its high risk, which has increased in recent decades [16]. In this respect, there are authors who indicate that, over several decades, this area has become a risk region at a global level [17].

With respect to climate, the effects of global warming are already visible on the Mediterranean coast: (1) the climate is less thermally comfortable, with extreme temperatures and a greater regularity of night-time heat (significant increase in "tropical nights", that is, nights when the temperature does not drop below 20 °C) and a greater irregularity in the development of extreme wind and precipitation events (droughts and floods) [18]; (2) an evolution in the regularity of rainfall patterns has been observed in southern Europe [19] and the variation in the intensity of rains, which is particularly notable in the Spanish Mediterranean area [20]; (3) a reduction in snowfalls [21]; and (4) an increase in DANA episodes (Isolated Depression at High Levels) since the 1990s [22]. With respect to the development of drought sequences, the research indicates: (1) a progressive reduction in the volume of total annual rainfall [19]; (2) the intensification of dry periods [23]; and (3) since the beginning of the twenty-first century, shorter and more intense periods have been recorded, in contrast with the second half of the twentieth century, when the droughts were characterised as being longer [24].

The Sixth Report of the IPCC [14] identifies the Mediterranean region as a hotspot of climate change at a global level. It also indicates that this region is significantly affected by water stress and frequent extreme weather events (droughts and floods). These are regional effects of the warming process, closely related to the increase in the temperature of the Mediterranean Sea [18], which gives greater intensity and energy to the atmospheric processes [25]. This is what some authors have called the "Mediterraneanisation" of climate change [26].

The teaching of climate risk seeks to equip students so they are able to interpret and understand the different factors (natural and human) that interact in the territory. This will result in a society that is aware of the complexity of its causes and effects, and provide arguments for individual mitigation and adaptation actions [27]. The interest in this issue in the school environment has increased because climate change is one of the principal challenges of the twenty-first century [28,29] and also because its causes and consequences are complex to explain and analyse. Therefore, teaching climate change constitutes a challenge for teachers due to the responsibility of training the youngest cohorts in their understanding and adaptation [30]. However, we should point out that the concepts and arguments have to be explained (known as didactic transposition) [31] in a simple way in accordance with the cognitive level of the students. Furthermore, correct definitions should be used, avoiding errors or stereotypes or allowing the influence of the media [32].

At an international level (specifically in the school context), in recent years' different research studies have been carried out that analyse atmospheric risks such as flood risk (Objective 1) and droughts (Objective 2). For example, studies have been published that address how flood risk is taught in schools [33], such as those conducted in the USA [34,35], Asia [36–43] or Africa [44]. In Europe, we can refer to the studies carried out by Bosschaart et al. [45], Lechowicz and Nowacki [46], or Williams et al. [47]. In the Mediterranean region, studies have been recently published both on didactic proposals based on the use of field trips [48,49] and those that analyse the social representations of teachers and students [50–52]. With respect to droughts (from the Social Sciences and/or Geography) there are very few studies. Some contributions are those by Morote [53], Chiwara and Lombard [54], or Little et al. [55].

This study is of interest due to the following reasons: (1) The territorial significance of atmospheric risk on the Mediterranean coastline and the necessity to address it through education [12]. (2) The stereotypes and conceptual mistakes related to this topic made by students [56,57] and teachers [58,59], and those appearing in the school textbooks that continue to constitute the main resource used in Social Science and/or Geography classes [6,60]. (3) The consideration of studying these issues, taking into account the school stages contemplated in this study (Secondary Education—12 to 16 years; Baccalaureate—17 to 18 years). (4) The need to propose activities to explain this topic in the classroom, given the low academic level of the textbooks, which continue to take an encyclopaedic and informative approach with a low critical and interpretative vision of the territory [5,6]; it is therefore necessary to provide a correct but also simple explanation of these phenomena that takes into account ordinary phenomena that are linked to the environment. (5) Education as one of the most important non-structural factors for the adaptation to weather extremes (although not always contemplated) and the expected consequences of the evolution of the climate in a high-risk region such as the Mediterranean coastline [12].

The objective of this study is to propose didactic activities for teaching about the main atmospheric risks (floods and droughts), and their intensification due to climate change, which are already affecting the Mediterranean region. These didactic activities should be incorporated into the subjects of Geography in Secondary Education and Baccalaureate studies. These activities seek to serve as a guide in the classrooms, which can also be implemented in other territories, taking into account their geographical features and the availability of data. Thus, the ultimate aim is to implement educational practices that are different to those usually included in the school textbooks and enhance the education factor to achieve a society more resilient to the effects of climate change.

2. Materials and Methods

In order to fulfil the objectives, first we consulted the current Secondary Education and Baccalaureate curricula (Royal Decree 1105/2014, of 26 December) [61]. In Spain, the responsibility for teaching the educational contents is transferred to the autonomous regions, which include them in their own curricula. As the proposals in this work are not exclusive to specific regions, we took the national curricula into account in their design. Therefore, each teacher must adapt the content to their school year or course.

The contents related to climate change and atmospheric risks in the subject of Geography are aimed at the 1st cycle of Secondary Education (1st and 3rd; 12–13 year olds and 15–16 year olds) and the second year of Baccalaureate (17–18 year olds). With respect to the proposals of activities that have been designed, we took into account the contents, evaluation criteria and learning standards of the Royal Decree (see Table 1). In relation to the contents on climate change, we should indicate that no directly related term is included in the first cycle. However, it is understood that the topic should be addressed in Block 1 "the physical environment" in the explanations on climatology and environmental problems, and in Block 2 "The human space" (contents on sustainable development and environmental problems) (Table 1). It is particularly interesting to point out that this

phenomenon is considered within the more social area of Geography, as traditionally climate change has been addressed in topics related to Physical Geography.

Table 1. Contents on atmospheric risks and climate change included in the Secondary Education and Baccalaureate curricula (subject of Geography, Spain).

Year	Content	Evaluation criteria	Learning standards
First Cycle of Secondary Education (1st and 3rd). Block 1 "The physical environment"	-Physical environment: Spain, Europe and the world: Relief; hydrography; climate; elements and diversity of landscapes; bioclimatic areas; natural environment; environmental areas and problems.	-To know, describe and evaluate human actions on the environment and their consequences.	-To search for printed and digital media referring to current environmental problems and locate web pages and resources directly related to them.
First Cycle of Secondary Education (1st and 3rd). Block 2 "The human space"	-Human activities: producing areas of the world. -Exploitation and future of natural resources. Sustainable development.	-To learn and analyse the environmental problems and challenges in Spain, their origin and the possible ways of addressing these problems. -To understand the idea of "sustainable development" and its implications.	-To compare Spanish humanised landscapes in accordance with their economic activity. -To define "sustainable development" and describe fundamental concepts related to it.
Second Year of Baccalaureate. Block 3 "The diversity of the climate and vegetation"	-Geographical factors and climate elements. -Spanish Climate domains: their problems.	-To obtain and select information about the geographical content relating to Spanish climate diversity, using the available sources, both from the Internet and the media or bibliography.	-To analyse how climate change affects Spain. -To use graphs and statistics that reflect the torrential rains to extract environmental conclusions.
First Year of Baccalaureate. Block 4 "Hydrography"	-The exploitation of water resources: the incidence of drought and torrential rains.	-To analyse the exploitation of water resources in Spain, including the characteristics of drought and torrential rains of the climate.	- To locate the large reservoirs on the Spanish hydrographic network map. To deduce consequences by analysing the climate characteristics. -To analyse and comment on graphs and statistics that reflect drought periods in relation to a map of rainfall regime types of the rivers of Spain. To draw conclusions.

Source: Ministry of Education, Culture and Sport [61]. Own elaboration.

With respect to the second year of Baccalaureate, according to the Royal Decree, the contents related to climate change can be found in Block 3 "The diversity of the climate and vegetation" and Block 4 "Hydrography". These provide: "The possibility to analyse and make overall, systematic and integrated interpretations of the territorial reality and to identify the territorial units, the landscapes, the results of the human activity in order to know and understand the space" [61] (p. 138). In this way, the main objective of the subject of Geography in this academic year is to provide a holistic and interrelated interpretation of each geographic phenomenon and offer the mechanisms to respond to and explain Spanish territorial problems.

After analysing the contents that must be addressed, different didactic proposals were contemplated. Their objective is to highlight the most significant aspects taking place

over the last few decades in relation to the development of extreme atmospheric episodes that manifest the influence of the current process of global warming on the Spanish Mediterranean coast. The proposals for Secondary Education and Baccalaureate have been designed taking into account the main atmospheric risks that affect the Mediterranean region (Figure 1): (1) increase in episodes of intense rainfall; and (2) increase in drought periods.

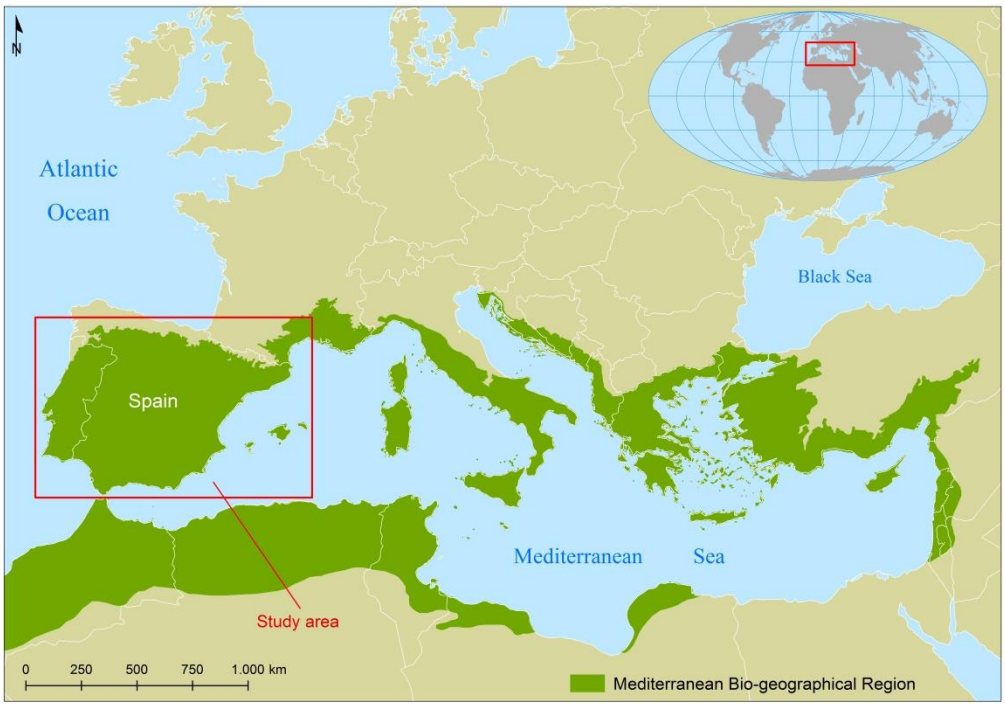

Figure 1. Mediterranean basin**.** Source: own elaboration.

The proposals are designed so that students can undertake them individually or in groups and either in the classroom or at home. Furthermore, as mathematical exercises and trend analyses are included, these activities can be carried out transversally with the subject of Mathematics. This opportunity has arisen in Spain as a result of the effects of COVID-19, with the introduction of working in subject areas. We should also bear in mind that the activities proposed have the objective of serving as a guide and model for teachers to implement in other geographical areas of the Mediterranean for which there is a sufficiently broad series of data available (at least 30 years) in order to carry out trend analyses. Therefore, in order to perform the activities, it may be interesting to consult climate series of observatories, and comparing between different statistical periods.

For a better understanding of the topic of atmospheric risks and of climate change as a process that stimulates their intensity and frequency, it is necessary for teachers to consult reports on climate change and the web portals of international and Spanish organisations (IPCC; NOAA; Copernicus-ECMWF; Climtate4you; Adaptecca; AEMET; *Oficina de Cambio Climático de Cataluña; Centro de Estudios Ambientales del Mediterráneo*, [CEAM]), which are detailed in this issue (Appendixes A and B). Furthermore, these official meteorological or environmental bodies provide information on atmospheric phenomena and processes on their social networks (basically Twitter and Facebook), which can be of interest for use in the classroom. For the Spanish case, the National Geographic Institute (NGI) also has interesting material for practical lessons in the classroom regarding the physical environment, including aspects related to natural hazards (see Appendix A).

3. Results—Proposals for Addressing Atmospheric Hazards on the Mediterranean Coast in the School Geography (Secondary Education and Baccalaureate)

3.1. Increase in Episodes of Rainfalls with an Intense Hourly Volume

In Spain, the current global warming process is modifying rainfall patterns, which is manifested in: (1) changes in quantity, with a decreasing trend in the annual volume in all Spanish regions (Figure 2), with the exception of the Cantabrian coast, where this trend is not observed [19]; (2) changes in seasonality, occurring mainly in the eastern half of the Iberian peninsula, where a decrease in spring rains and a decrease in autumn rains has been observed since 1980 [62,63]; (3) changes in the intensity of the rains, particularly in the Spanish Mediterranean coast, where highly intense storms have been recorded in recent years (more than 60 mm/hour), generating severe floods [20,64]; and (4) decrease in precipitations in the form of snow [21]. This process is occurring throughout the whole of the northern hemisphere, and the Iberian Peninsula is no exception, where the frozen mountain surfaces have decreased significantly.

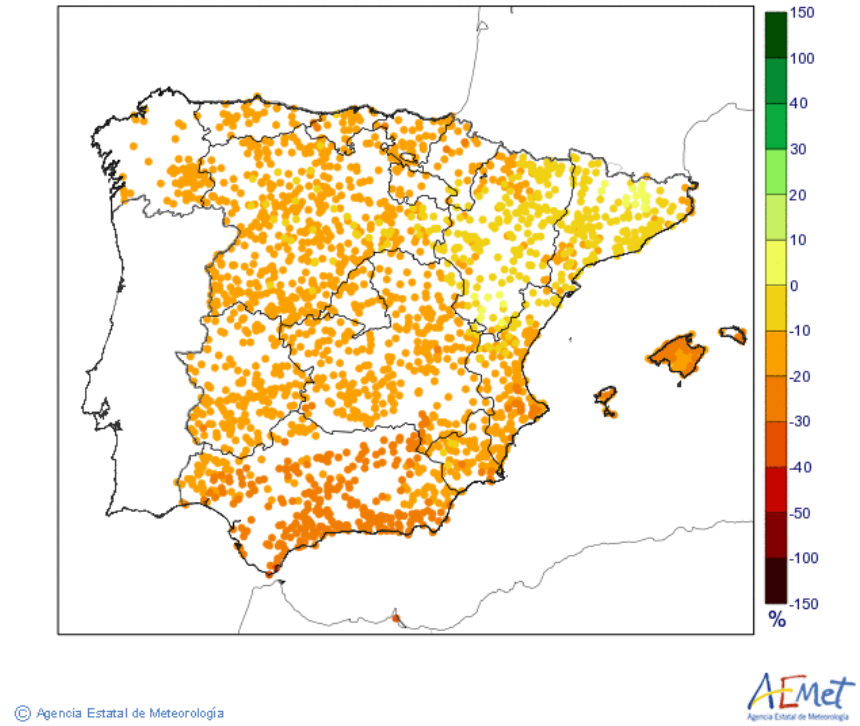

Figure 2. Evolution of the precipitations in the Iberian Peninsula for the horizon 2081–2100 (RCP 8.5. Annual). Source: AEMET [65]. Note: map elaborated in accordance with the models of the Fifth Report of the IPCC.

Furthermore, an increase in the wave configuration frequency of the atmospheric circulation in the higher layers of the atmosphere is also taking place, constituting the origin of these alterations observed at mid-latitudes (Figure 3). From the beginning of the twenty-first century, convective precipitations have been recorded with the "gotas frías" (cold fronts) occurring in medium-high layers of the troposphere. These have a greater synoptic prominence than the frontal rainfall of the Atlantic. This indicates that changes in the atmospheric circulation are taking place. An increasing number of studies are being conducted [22] that indicate that the loss of speed of the polar jet stream of the Northern Hemisphere is giving rise to a significant increase in extreme episodes in mid-latitudes. In Europe, taking the level of 200 hPa as a reference, the number of DANAs per year in the period 1960–1990 remained stable, with around 30 episodes/year. By comparison, since 1990, a considerable increase has been recorded, and this figure currently stands at 35–40 events (an increase of 33.3%). One of the causes seems to be the current global

warming process, because it has been shown that the jet stream is moving towards the poles, in the same way as the Hadley cell and the Inter-Tropical Convergence Zone. In addition, we should also remember the contraction of the polar vortex and the cooling of the stratosphere. A lower thermal gradient between the latitude ranges resulting from global warming translates into a reduction in the speed of the jet stream. With a wavier jet stream, blockings appear, favouring the emergence of weaker subtropical and polar branches. This is closely connected to the increase in cold fronts observed in Europe [66].

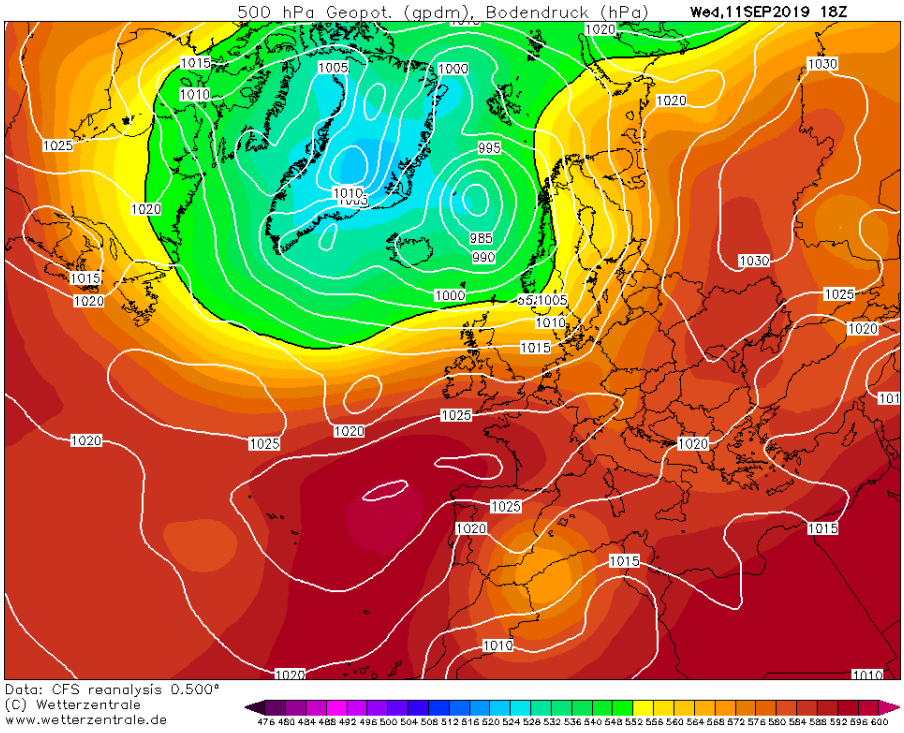

Figure 3. Atmospheric situation causing the cold front of 11th September 2019, with floods in the south-eastern part of the Iberian Peninsula. Source: Wetterzentrale [67].

In the school textbooks, the floods caused by intense and torrential rains deserve special attention due to their significant impact on the Spanish coast (Figure 4) [60]. Within these sections, or in the parts on natural risks, specific parts are dedicated to explaining the climate varieties (3rd, Secondary Education). In the second year of Baccalaureate, the school textbooks include a more detailed explanation of the causes and consequence of the risks of flooding in the topics on the hydrology of Spain or in the specific sections on natural risks in the Spanish regions [68]. The explanation of the changes experienced in the rains on the Spanish Mediterranean coast may contemplate the following didactic activities in Secondary Education (Table 2) and Baccalaureate (Table 3), which include Geography subjects or environmental topics.

Table 2. Activities proposed for teaching the changes recorded in the precipitation of the Mediterranean coast (1st and 3rd of Secondary Education).

Evaluation criteria	✓ To learn about the trend in the annual precipitations recorded over the last few decades in a specific climate observatory (AEMET) (Figure 5). ✓ To analyse the evolution of the records of episodes of intense rain (more than 60 mm/hour) for the chosen observatory. ✓ Propose solutions on a regional or local scale to flood problems.
Activities	✓ Commenting on graphs of annual rainfall measurements and the elaboration of trend graphs. Subsequently, the students will

Assessable learning standards	comment and describe the trends and calculate, for example, the percentage of variation (positive, stable, negative) between decades. ✓ Commenting on graphs of the volume of precipitation recorded for the episodes of more than 60 mm/hour and the elaboration of trend graphs. Subsequently, the students will comment and describe the trends and calculate, for example, the percentage of variation (positive, stable, negative) between decades. ✓ Viewing of videos on intense precipitations and flash floods (using free downloads on the Internet and social networks). ✓ Synthesis activity in which students (individually or in groups) propose solutions from their near territory (village or region) to flood problems. ✓ To learn about the evolution in the annual precipitation records of a specific observatory. ✓ To understand the trend in the episodes of more than 60 mm/hour in the chosen observatory. ✓ To propose solutions to the problem of flooding in their territory.

Source: own elaboration Note: Teachers should adapt the activities to the age of the students (1st or 3rd of Secondary Education).

Table 3. Activities proposed for teaching the changes recorded in the precipitation of the Mediterranean coast (2nd of Baccalaureate).

Evaluation criteria	✓ To learn about the trend in the annual precipitations recorded over the last few decades in the main observatories of the Spanish Mediterranean (AEMET). ✓ To analyse the evolution of the records of episodes of intense rain (more than 60 mm/hour) in these observatories. ✓ Using these data, to compare the main episodes of floods recorded in Spanish Mediterranean coastline in recent decades by consulting news reports in the press and the social networks of official organisations (AEMET, AVAMET). ✓ Propose solutions on a regional or local scale to flood problems.
Activities	✓ Analysis of the trend in the annual precipitation recorded in the principal observatories on the Mediterranean coast. ✓ Interpretation and comparison of the information about the causes and consequences of the main episodes of intense rain in the Spanish Mediterranean area based on the records of rain days of more than 60 mm/hour and news reports in the press. ✓ Viewing of videos on the functioning of the La Marjal Floodable Park in the city of Alicante by using the internet and social networks [48]. ✓ Synthesis activity in which students (individually or in groups) propose solutions from their near territory (village or region) to flood problems.
Assessable learning standards	✓ To recognise and compare the evolution of the annual precipitation recorded in recent decades of the principal observatories on the Spanish Mediterranean coast. ✓ To identify the main flood episodes in the Spanish Mediterranean based on the records of more than 60 mm/hour (Figure 4) and news reports in the press.

✓ To propose solutions to the problem of flooding in their territory.

Source: own elaboration.

Figure 4. Flood in the Vega Baja of the Segura River (Alicante, Spain), 11–14 September 2019. Source: Generalitat Valenciana [69].

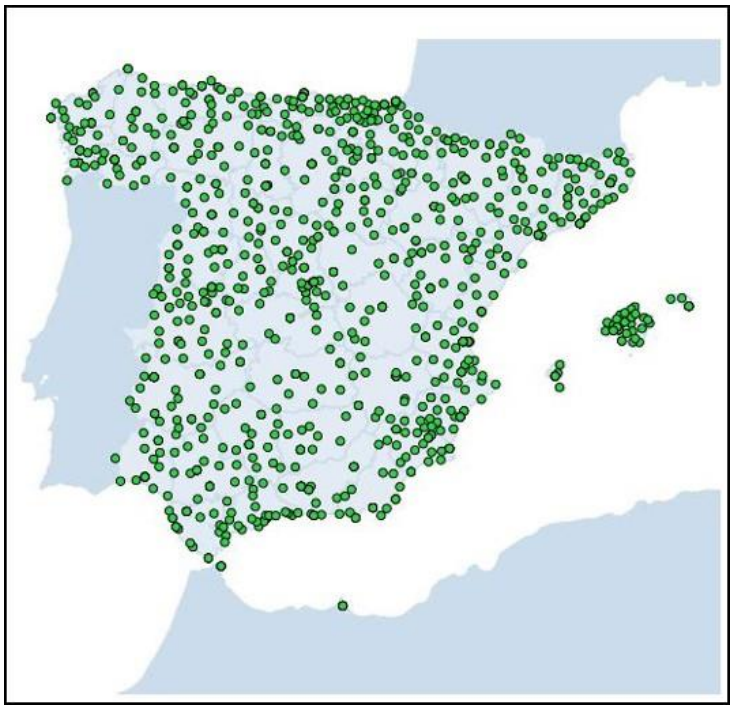

Figure 5. Map of the basic meteorological observation network in Spain. Source: AEMET [65].

3.2. Increase and Intensity of Drought Episodes

With respect to the drought periods, the studies point to an increase in these events [23]. More specifically, since the beginning of the twenty-first century, it has been observed that drought periods are becoming more intense and shorter, but, as indicated by Olcina and Biener [24], there are no long drought periods such as those of the second half of the twenty-first century. This reinforces the idea previously indicated of a greater dynamism in the jet streams at the mid-latitudes of the northern hemisphere, with the more usual expansion of masses of cold air derived from the melting of the Arctic towards lower

latitudes. This would prevent the consolidation of the persistent phases with anticyclonic ridges that characterise the long drought sequences in eastern Spain.

After analysing the contents of the school textbooks, one of the aspects that should be explained correctly is the definition of drought. The causes and different types of drought occurring in Spain are over-simplified in these resources [53]. A "drought" is a phenomenon that generates a temporary reduction in precipitation, but the causes (atmospheric and human), the rainfall thresholds that allow it to be defined, the different effects on the Spanish territory, or the possible solutions to adopt to minimise its impacts are not explained [53]. This latter aspect constitutes a topic for debate and activities in the classroom, particularly in the second year of Baccalaureate [48]. Furthermore, drought is unambiguously linked to "desertification", as a process that favours the transformation of the environment into a "desert" [53].

With respect to the definition, different academic studies provide simple explanations that may complement the information in the school textbooks. For example, Wilhite [70] explains that drought is a natural phenomenon that translates into a transitory anomaly with values of precipitation lower than normal in a specific area during a prolonged sequence of time. According to La Calle [71], this phenomenon is a situation of scarcity caused by a reduction in the amount of rain with an unusual duration ("rainfall drought"). This should not be confused with the concept of aridity, or usual and natural scarcity of certain areas, or the shortage due to the human exploitation of water resources ("hydrological drought"). This last explanation is decisive, as, traditionally, "water scarcity" and "aridity" are often confused with drought and this phenomenon is usually associated with regions of scare rainfall. In order to provide a correct explanation, we should take into account: (1) that there could be semi-arid areas, but without a scarcity of water resources; this will depend on the characteristics of water supplies (supply and demand); and (2) regions of humid climates affected by drought due to the increase in demand and/or improper use and wastage of water, coinciding with periods of rainfall scarcity. The activities proposed (Tables 4 and 5) seek to explain drought as a phenomenon that is characteristic of the Mediterranean climate, and the effect that human beings have on the increase in this risk. Therefore, the aim is for the students to evaluate the degree of adaptation, or not, to the present and future scenarios of climate change. Another aspect is the effect on human beings of hazards (vulnerability), which is not usually included in the school textbooks [53].

Table 4. Activities proposed for teaching about drought on the Mediterranean coast (1st and 3rd, Secondary Education).

Evaluation criteria	✓ To understand that drought is a natural phenomenon that is characteristic of the Mediterranean climate. ✓ To recognise the difference between "drought" (circumstantial) and erosive or desertification processes (structural). ✓ To analyse the evolution of the drought periods recorded by a specific observatory over the last few decades. ✓ Propose solutions on a regional or local scale to drought problems.
Activities	✓ Commenting on graphs of the evolution of the volume of annual precipitation in recent decades recorded by a nearby observatory (Figure 5). ✓ Analysis of news reports in the press on the consequences of the principal droughts occurring in the Iberian peninsula in the last few decades.

Assessable learning standards	✓ Synthesis activity in which students (individually or in groups) propose solutions from their near territory (village or region) to droughts problems. ✓ To learn about the trend in the drought periods over the last few decades in a specific observatory. ✓ To understand that drought is a natural phenomenon that is characteristic of the Mediterranean climate. ✓ To propose solutions to the problem of drought in their territory.

Source: own elaboration. Note: Teachers themselves should adapt the activities to the age of the students (1st or 3rd, Secondary Education).

Table 5. Activities proposed for teaching about drought on the Mediterranean coast (2nd year of Baccalaureate).

Evaluation criteria	✓ To learn the definition of drought and the difference between rainfall and hydrological drought. ✓ To learn about the principal measures for adapting to drought that are being implemented in Spain in terms of the management of the demand and supply of water. ✓ Propose solutions on a regional or local scale to drought problems.
Activities	✓ Activity in which the students analyse and describe the annual precipitation records of the principal observatories in Mediterranean Spain between the periods 1992–1995 and 2014–2018 (the last two main droughts in the Iberian peninsula). ✓ Students search for news in the press in order to analyse the consequences of these two periods in the Mediterranean region and the measures adopted to mitigate this risk. ✓ Students search for data and reports on the social networks of the official organisations related to droughts and their recent evolution in Spain (AEMET, CEDEX). ✓ Synthesis activity in which students (individually or in groups) propose solutions from their near territory (village or region) to droughts problems.
Assessable learning standards	✓ To understand that, apart from being a natural phenomenon, droughts are also aggravated by human causes (demand for water, over-exploitation of water resources in drought situations, etc.) (Figure 6), and by the evolution of the climate (higher frequency and intensity of these episodes). ✓ To assess the degree of adaptation of the Spanish Mediterranean region in recent decades in order to mitigate the risk of drought. ✓ To propose solutions to the problem of drought in their territory.

Source: own elaboration.

Figure 6. Increase in irrigated areas in the *Campo de Cartagena* (Spain). Source: Murcia Diario [72]. Note: The *Campo de Cartagena* (south-east Spain) is one of the Spanish regions in which the demand for water has increased the most in recent decades due to the creation of irrigated crops and urban-tourism uses.

4. Discussion

In order to teach about climate hazards at classroom, it is important to highlight the atmospheric processes that have been taking place in recent decades on the Mediterranean coast. The activities proposed in this study seek to present the reality of the data that substantiate these processes and compare their presentation with the information provided in the school textbooks and the media in order to identify successes and errors. The overall aim is to provide a series of simple proposals for teaching weather extremes in the classroom [73]. These proposals are supported by the data and the rigour of the analyses and the research carried out by the geographic discipline in the fields of Climatology and Hydrography, or the territorial analysis of processes. Figure 7 analyses the fundamental aspects to be addressed at classroom.

These processes, which are addressed for the Mediterranean coastline as a whole, have district or regional nuances [14]. However, in non-university teaching it is necessary to offer an overall view, enabling students to extract clear ideas that are backed by the data. In this way, the students will not get lost in nuances or specific points that may lead to a lack of understanding and interest. However, teachers should know these specific territorial characteristics, which, particularly in Baccalaureate (17–18 years old; pre-university stage), can contribute to arousing a desire for knowledge that may guide the academic or professional future of the students [68].

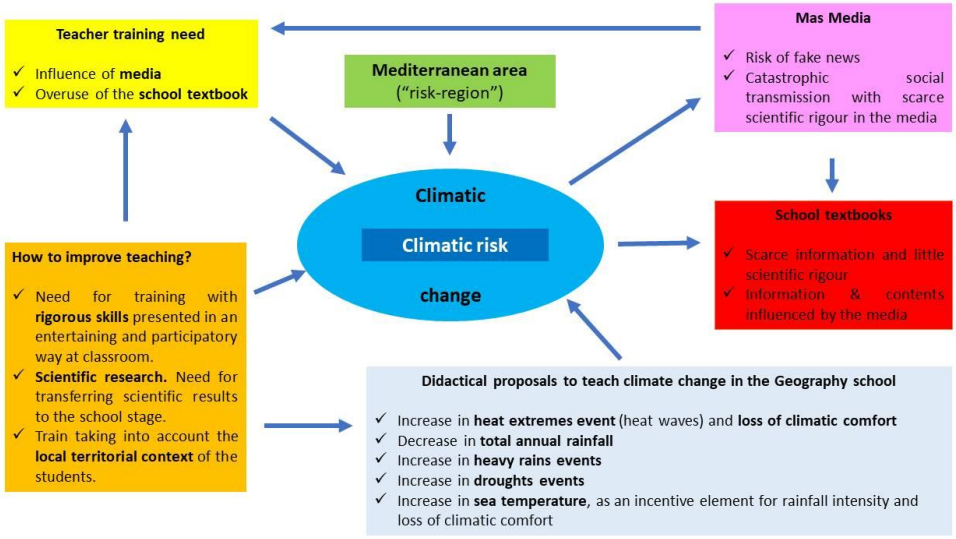

Figure 7. Fundamental aspects for teaching atmospheric risks in Secondary Education and Baccalaureate. Source: own elaboration.

With respect to the didactic proposals for teaching about flood risk, we should point out that, in the Mediterranean region, studies have been carried out in recent years on field trips. For example, Morote [48] explains the didactic potential of the La Marjal Floodable Park (Alicante, Spain) and surrounding area in order to teach this phenomenon from a historical perspective, and how human beings have increased this risk and the solutions that have been proposed. Similarly, Morote and Pérez-Morales [49] propose and describe the experience of a field trip in a high-risk territory that highlights the vulnerability of society to climate change scenarios. With respect to other international contexts, in Taiwan we can refer to the study by Tsai et al. [42] on gamification for teaching about floods. These authors highlight that disaster education is one of the most effective processes in disaster management. However, traditional educational methods have been proved to be insufficient to attract the interest of students. Therefore, these previous studies identify the need for new didactic methods adapted to the profiles of today's students. Taking into account the relevance of digital competences, these authors explain that game-based learning is a more engaging educational method. Moreover, this methodology could be implemented for disaster prevention education in order to develop students' disaster prevention skills, and their interest in learning, self-awareness and sense of civic responsibility.

This study presents different proposals for addressing atmospheric risks in the subject of Geography in schools (Secondary Education and Baccalaureate). Two processes of extreme atmospheric events occurring on the Mediterranean coast were analysed (episodes of intense rains and periods of drought). This is a region that has already experienced the effect of global warming in its climatic elements [74]. It is important to explain these processes in the classroom at non-university levels, as citizens with knowledge about climate risk can lead to the better functioning of society, particularly in the Mediterranean area in the coming decades. This is embodied in the recent climate change law in Spain (May 2021) which, for the first time refers to this phenomenon from an educational perspective (Title VIII "Education, Research and Innovation in the fight against climate change and energy transition") [75]. The presentation of these episodes in the classroom is principally based on explaining their hazard, but also the socio-economic and territorial effects that they entail (vulnerability and exposure). The objective is to provide an integrated perspective of the risk for each level based on classroom activities. Therefore, in order to explain them in class, a series of assessable activities that have specific learning objectives were proposed that can also be adapted to different territories in the

Mediterranean basin or to those with a similar climate and urban characteristics (areas of Australia, USA, etc.).

Putting these activities into practice and possibly adapting them would improve the explanation of climate risks in the classroom as a topic of interest at Secondary Education and Baccalaureate levels. Therefore, it would contribute to a better training of the citizens who live in areas of natural risk as a useful strategy for reducing vulnerability and exposure [35,41,43]. This is the result of an amalgam of problems related to how these phenomena are addressed in the subject of Geography in schools: (1) The lack of scientific rigour or information and excessive catastrophism in the Social Science and/or Geography school textbooks [5]. Although the use of these resources has diminished in recent years, they continue to play a decisive role in school education and this practice is not likely to be altered with the introduction of new digital media [76]. Even with the COVID-19 pandemic, online classes and blended learning have not led to a decrease in the use of school textbooks [77]. (2) The low level of training of the current teachers on this topic [51,58], which would require the development of specific courses through teacher training centres. (3) The influence of the media with respect to these phenomena in the social representations of the teachers [59] and in the textbooks [5]. (4) The little time available to teachers at these levels when planning problem-solving activities and exercises other than those included in the textbooks [6].

A fundamental aspect for understanding natural hazards is the incorporation of the vulnerability factor (action of human beings, exposure, resilience, etc.). In this respect, Morote and Olcina [5] observed the absence of this variable in the school textbooks. Practically none of the books consulted cite this factor in the increase of risk, with hazard being the main cause of natural disasters. This situation contrasts with the SDG nº 13 concerned with adopting urgent measures to combat climate change and its effects. According to the principal reports on the impacts of this phenomenon, there is an urgent need to give greater importance to this factor (vulnerability) because it is a first-order issue for adapting to climate change and the predicted increase in the European territory of natural risks until the end of the twenty-first century [78].

The vulnerability factor in the proposals of activities contemplated in this study plays a primary role, specifically with respect to the evolution of the climate and its consequences for the territory. The designed activities seek to provide materials and guidelines for explaining atmospheric risks in order to improve the current training of teachers in this subject matter. As noted by Morote and Souto [52], the lack of scientific rigour of the textbooks and the absence of training (in this case on flood risk) received by teachers may mean that this topic is not addressed in the classroom or done so with a lack of rigour. Other authors have also reached these conclusions, such as Morgan [79], who finds that the majority of teachers do not feel sufficiently prepared to address this topic due to the low level of training received.

With respect to the impact of the media on teaching, the study by Morote et al. [59] finds, for the case of the future teachers of Primary Education, that the main information received on climate change is from the media (54.9% from the Internet and 31.3% from television) as opposed to just 5.3% from academic studies (from university). This influence can also be observed in the school textbooks. García-Francisco et al. [34] observe how in these resources there is a predominance of external references principally related to Internet addresses as a means to expand knowledge or develop certain activities, with the risk that this entails if the information is not verified. In this regard, more than a decade ago, Martín-Vide [80] highlighted the importance and risk involved in using information taken from the media due to the manipulation and falsification of news.

In relation to the training of the students, critical thinking should be promoted regarding the interpretation of information and it should be ensured that students have a more accurate knowledge about the issues of climate change and its associated risks [56]. Serantes [81] indicates that it is vitally important to include activities for resolving problems related to climate change and extreme weather events, and activities with local

content, in the textbooks. In Europe, this is something that has already being implemented in the United Kingdom by the Geographical Association, which, for several decades, has provided analysis of case studies on both natural risks [82] and climate change [83]. Teaching about atmospheric risks from this didactic perspective would constitute an opportunity to achieve a critical society with the capacity to interpret the data relating to the territory [84]. In this respect, also in the United Kingdom, specialist teachers on these issues have recently been incorporated into Primary and Secondary Education centres. In this way, it has become the first country in the world to have teachers accredited by the United Nations to teach courses and classes on climate change [85].

Finally, we should also note that publications are emerging that address the current process of climate change both simply and rigorously. For example, the study by Nelles and Serrer [2] which, with a logical sequence from the physical factors to the human aspects, and abundant and clear graphic material, explains the different elements that comprise a complex process affecting the entire environment (the Earth's climate, climate change, oceans, extreme events, ecosystems and human beings). Furthermore, Scharmacher-Schreiber and Stephanie [27] propose a question–answer method: Is the climate becoming warmer? Can the difference of one degree be felt? This study on climate change is aimed at basic teaching levels, although it is also valid for the public in general.

5. Conclusions

The explanation in the classroom of issues relating to atmospheric hazards is essential for the training of safer and more resilient societies. On the Mediterranean coast, a high-risk region at a European scale, extreme events related to atmospheric behaviour have occurred more frequently and intensely in recent decades. This fact highlights the effect, already demonstrated with the instrumental data, of the global warming process in the atmospheric circulation in general, and its specific dynamics in some regions of the world, such as the Mediterranean basin. Furthermore, according to the reports, the future scenarios of climate change forecast more frequent and intense extreme atmospheric events. Hence, there is a need to raise awareness and train our present and future society.

Based on the activities proposed in this study, an important challenge is presented for teaching climate risks and their relationship with the current process of global warming on the Mediterranean coast, which could serve as an example for its application to other international contexts. These activities should be considered in the school textbooks, as a cognitively complex element and a teaching innovation, and closely linked to the environment; that is, they should contemplate the consequences of these phenomena in the daily lives of the students.

Due to the risk derived from the dependency of teachers on the school textbooks, we propose that these activities are incorporated in the next editions, given that some studies have found a lack of rigour in the information and stereotypes in terms of, for example, climate change. We should point out that the teaching reality in the classrooms depends, almost exclusively, on the ability of the teachers to impart this knowledge. This aspect has not been addressed in this study, and constitutes a challenge for future research, as does promoting these proposals in schools.

The passing of laws on climate change and educational reform (LOMLOE 3/2020), which include specific sections on education and training on climate change, opens up new possibilities for teaching about risks and climate change to school children at different educational levels. The topic of atmospheric risks and climate change will be prominent in the agendas of governments in the next few decades, given that the territories and their societies must prepare for the effects forecast in climate modelling. Therefore, education plays a fundamental role in this context for generating more informed citizens who are better prepared to adapt to extreme processes that will become more frequent, as indicated by the scientific data, in the near future.

Author Contributions: Conceptualization, methodology, formal review, and investigation, Á.-F.M., J.O. and M.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: The study did not require ethical approval.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Resources and Teaching Materials for Teachers and Students (Spain)

✓ **State Meteorological Agency (AEMET). Climate data from official observatories, reports on the state of the climate, climate modelling:**
✓ http://www.aemet.es/es/serviciosclimaticos/datosclimatologicos (accessed on 12 November 2021).
✓ http://www.aemet.es/es/conocermas/recursos_en_linea/publicaciones_y_estudios/estudios/detalles/informe_clima_2019 (accessed on 12 November 2021)
✓ http://www.aemet.es/es/serviciosclimaticos/datosclimatologicos (accessed on 12 November 2021)
Centre for Environmental Studies of the Mediterranean (CEAM). Reports on evolution of see temperature in the Mediterranean Sea:
✓ http://www.ceam.es/ceamet/SST/index.html (accessed on 12 November 2021)
National Geographic Institute (IGN). Didactic resources, maps and figures of interest to explain this topic:
✓ https://www.ign.es/web/ign/portal/recursos-educativo (accessed on 12th November 2021)
✓ **Climate Change Office in Catalonia. Climate change report in Catalonia (Spain):**
✓ http://cads.gencat.cat/web/.content/Documents/Publicacions/tercer-informe-sobre-canvi-climatic-catalunya/Sintesis/CC_Sintesi-CASTELLA_web.pdf (accessed on 12 November 2021)
Websites of associations of meteorology fans:
✓ https://www.meteoclimatic.net (accessed on 12 November 2021)
✓ https://redmeteo.ametse.es (accessed on 12 November 2021)
✓ https://www.avamet.org/ (accessed on 12 November 2021)
National Plan for Adaptation to Climate Change (AdapteCCa). Official website for modelling climate change in Spain:
✓ http://escenarios.adaptecca.es/#&model=multimodel&variable=tasmax&scenario=rcp85&temporalFilter=YEAR&layers=AREAS&period=MEDIUM_FUTURE&anomaly=RAW_VALUE (accessed on 12 November 2021)
United Nations Program for the Mediterranean. Reports on climate change and atmospheric extremes in the Mediterranean basin:
✓ https://ufmsecretariat.org/wp-content/uploads/2019/10/MedECC-Booklet_EN_WEB.pdf (accessed on 12 November 2021)
✓ **Notification System for Singular Atmospheric Observations (SINOBAS). Web of extreme meteorological events in Spain:**
✓ https://sinobas.aemet.es (accessed on 12 November 2021)

Source: own elaboration.

Appendix B. Resources and Teaching Materials for Teachers and Students (International Scope)

Intergovernmental Panel on Climate Change (IPCC). Official reports on climate change. Monographic reports on specific aspects (seas, ice):
✓ https://www.ipcc.ch (accessed on 12 November 2021).
Intergovernmental Panel on Climate Change (UN). The different official reports published by this body from 1990 to 2021 are included:
✓ www.ipcc.ch (accessed on 12 November 2021)
NOAA US Official Website on Climate Change:
✓ https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature (accessed on 12 November 2021)
Official website of the European Commission on climate change, with scientific support from the European Centre for Medium-Range Prediction (ECMWF):
✓ https://climate.copernicus.eu (accessed on 12 November 2021)
Website with information (data, graphics) on atmospheric aspects and climatic trends, worldwide:
✓ https://www.climate4you.com (accessed on 12 November 2021)
Wetterzentrale. Website where you can download satellite images of Europe:
✓ https://www.wetterzentrale.de (accessed on 12 November 2021)

Source: own elaboration.

References

1. Masters, M. *123 Curiosidades que Todo el Mundo Debería Conocer Sobre el Clima*; Geoplaneta: Barcelona, Spain, 2000.
2. Nelles, D.; Serrer, C. *El Pequeño Manual del cambio Climático*; Grijalbo: Barcelona, Spain, 2020.
3. Ferrari, E.; Anne-Marie Ballegeer, A.M.; Fuertes, M.A.; Herrero, P.; Delgado, L.; Corrochano, D.; Andrés-Sánchez, S.; Bisquert, K.M.; Garcia-Vinuesa, A.; Meira, P.; et al. Improvement on Social Representation of Climate Change through a Knowledge-Based MOOC in Spanish. *Sustainability* **2019**, *11*, 6317. https://doi.org/10.3390/su11226317.
4. Olcina, J. Clima, cambio climático y riesgos climáticos en el litoral mediterráneo español. Oportunidades para la geografía. *Doc. Anàl. Geogr.* **2020**, *66*, 159–182. https://doi.org/10.5565/rev/dag.629.
5. Morote, A.F.; Olcina, J. El estudio del cambio climático en la Educación Primaria: Una exploración a partir de los manuales escolares de Ciencias Sociales de la Comunidad Valenciana. *Cuad Geogr.* **2020**, *59*, 158–177. http://dx.doi.org/10.30827/cuad-geo.v59i3.11792.
6. Morote, A.F.; Olcina, J. Cambio climático y sostenibilidad en la Educación Primaria. Problemática y soluciones que proponen los manuales escolares de Ciencias Sociales. *Sosten. Econ. Soc. Ambient.* **2021**, *3*, 25–43. https://doi.org/10.14198/Sos-tenibilidad2021.3.02.
7. Brisman, A. Representing the "invisible crime" of climate change in an age of post-truth. *Theor. Criminol.* **2018**, *22*, 468–491.
8. Kažys, J. Climate change information on internet by different Baltic Sea Region languages: Risks of disinformation & misinter-pretation. *J. Secur. Sustain. Issues* **2018**, *7*, 685–695.
9. Kurup, P.M.; Levinson, R.; Li, X. Informed-Decision Regarding Global Warming and Climate Change Among High School Students in the United Kingdom. *Can. J. Sci. Math. Technol. Educ.* **2021**, *21*, 166–185. https://doi.org/10.1007/s42330-020-00123-5.
10. Roussel, D.; Cutter-Mackenzie-Knowles, A. A systematic review of climate change education: Giving children and young peo-ple a voice and a hand in redressing climate change. *Children's Geogr.* **2020**, *18*, 191–208. https://doi.org/10.1080/14733285.2019.1614532.
11. United Nations. Sustainable Development Goals. UNDP, Sustainable Development Agenda. 2015. Available online: https://www.undp.org/content/undp/es/home/sustainable-development-goals/resources.html (accessed on 27 November 2021).
12. Intergovernmental Panel on Climate Change [IPCC]. Climate Change 2013 and Climate Change 2014 (3 Vols.). 2014. Available online: http://www.ipcc.ch/ (accessed on 27 November 2021).
13. Arnell, N.W.; Lowe, J.A.; Challinor, A.J.; Osborn, T.J. Global and regional impacts of climate change at different levels of global temperature increase. *Clim. Change* **2019**, *155*, 377–391. https://doi.org/10.1007/s10584-019-02464-z.
14. Intergovernmental Panel on Climate Change [IPCC]. Climate Change 2021. The Physical Science Basis. https://www.ipcc.ch/re-port/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf (accesed on 12 November 2021).

15. Pausas, J.G.; Millán, M.M. Greening and browning in a climate change hotspot: The Mediterranean Basin. *BioScience* **2019**, *67*, 143–151. https://doi.org/10.1093/biosci/biy157.
16. Pérez, A.; Gil, S.; Quesada, A. Do we all stand equally towards the flood? Analysis of social vulnerability in the Spanish Mediterranean coast. *BAGE* **2021**, *88*, 1–39. https://doi.org/10.21138/bage.2970.
17. Calvo, F. *Sociedades y Territorios en Riesgo*; Ediciones del Serbal: Barcelona, Spain, 2021.
18. Pastor, F.; Valiente, J.A.; Khodayar, S. A Warming Mediterranean: 38 Years of Increasing Sea Surface Temperature. *Remote Sens.* **2020**, *12*, 2687. https://doi.org/10.3390/rs12172687.
19. Centros de Estudios y Experimentación de Obras Públicas [CEDEX]. *Evaluación del Impacto del Cambio Climático en los Recursos Hídricos y Sequías en España*; Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente y Ministerio de Fomento: Madrid, Spain, 2017.
20. Serrano, R. *Reconstrucción Climática Instrumental de la Precipitación Diaria en España: Ensayo Metodológico y Aplicaciones*; Universidad de Zaragoza: Zaragoza, Spain, 2017.
21. Morán, E.; Herrera, S.; López, J.I.; Revuelto, J.; Beniston, M. Evolución reciente de las condiciones de humedad y temperatura en las montañas españolas y su relación con la cubierta nivosa. In *Asociación Española de Climatología. VIII Congreso Internacional Asociación Española de Climatología: Cambio climático*; Asociación Española de Climatología: Salamanca, Spain, 2012; pp. 891–898.
22. Muñoz, C.; Schultz, D.; Vaughan, G. A Midlatitude Climatology and Interannual Variability of 200- and 500-hPa Cut-Off Lows. *J. Clim.* **2020**, *33*, 2.201–2.222.
23. Cramer, W.; Guiot, J.; Fader, M.; Garrabou, J.; Gattuso, J.P.; Iglesias, A.; Lange, M.A.; Lionello, P.; Llasat, M.C.; Paz, S. Climate change and interconnected risks to sustainable development in the Mediterranean. *Nat. Clim. Change* **2018**, *8*, 972–980. https://doi: 10.1038/ s41558-018-0299-2.
24. Olcina, J.; Biener, S. ¿Está cambiando el clima valenciano? Realidades e incertidumbres. In *Climas y Tiempos en el País Valencià*; Olcina, J., Moltó, E.A., Eds.; Publicaciones de la Universidad de Alicante: Alicante, Spain, 2019; pp. 162–170.
25. Tamayo, J.; Núñez, J.A. Precipitaciones intensas en la Comunidad Valenciana: Análisis, sistemas de predicción y perspectivas ante el cambio climático. In *Riesgo de Inundación en España: Análisis y Soluciones para la Generación de Territorios Resilientes*; López Ortiz, M.I., Melgarejo Moreno, J., Eds.; Universitat d'Alacant: Alicante, Spain, 2020.
26. Olcina, J. Cambio climático y riesgos en el ámbito mediterráneo. La necesidad de adaptación. *Territorium* **2021**, *28*, 5–12.
27. Scharmacher-Schreiber, K.; Stephanie, M. *¿Cuánto calor es 1 grado más? ¿Qué pasa con el cambio climático?* Loguez Ediciones: Salamanca, Spain, 2020.
28. Shepardson, D.P.; Hirsch, A.S. Teaching Climate Change. What Educators Should know and Can do. American Educator, (Winter 2019-20), 4-13. 2020. Available online: https://www.aft.org/ae/winter2019-2020/shepardson_hirsch (accessed on 27 November 2021).
29. Singh, S.A. Climate change education: Knowing, doing and being. *Int. Res. Geogr*. **2020**, *29*, 362–365. https://doi.org/10.1080/10382046.2019.1703318.
30. Eklund, S. *Climate Change Education with a Bright Horizon?: Pedagogical Reflections on Teacher Training for Climate Education that Aims to Empower Students*; Stockholm University: Stockholm, Sweden, 2018.
31. Chevallard, Y. *La Transposition Didactique du Savoir Savant au Savoir Enseigné*; La Pensée Sauvage Editions: Grenoble, France, 1991.
32. Allen, D.E.; McAleer, M.; McHardy-Reid, D. Fake news and indifference to scientific fact: President Trump's confused tweets on global warming, climate change and weather. *Scientometrics* **2018**, *117*, 625–629.
33. Duman, N. Determination of Misconceptions in Disaster Education with Concept Cartoons: The Case of Flood and Overflow. *Int. J. Environ. Sci*. **2018**, *13*, 831–843.
34. García-Francisco, J.; Pardo, P.; Rebollo, L.F. La desertificación y otros problemas ambientales en los libros de texto de geografía de educación secundaria en España. In *Geografía, Territorio y Paisaje. El Estado de la Cuestión: Actas del XXI Congreso de Geógrafos Españoles;* Pillet, F., Cañizares, M.C., Ruiz, A., Eds.; Asociación de Geógrafos Españoles: Ciudad Real, Spain, 2009; pp. 1757–1772.
35. Lee, Y.; Kothuis, B.B.; Sebastian, A.; Brody, S. Design of transformative education and authentic learning projects: Experiences and lessons learned from an international multidisciplinary research and education program on flood risk reduction. In Proceedings of the 126th ASEE Annual Conference and Exposition: Charged Up for the Next 125 Years, ASEE 2019, Tampa, FL, USA, 15–19 June 2019.
36. Chang, C.H.; Pascua, L. The curriculum of climate change education: A case for Singapore. *J. Environ. Educ*. **2017**, *48*, 172–181.
37. Chang, C.H.; Irvine, K.; Wu, B.S.; Seow, T. Reflecting on field-based and technology-enabled learning in geography. In *Learning Geography Beyond the Traditional Classroom*; Springer: Singapore, 2018; pp. 201–212.
38. How, V.; Azmi, E.S.B.; Zaki, N.F.B.M.; Othman, K.B. Integrating Flood Education Miniature and Interactive E-Learning in a Prototype of Flood Learning Kit for Knowledge Resilience Among School Children. In *An Interdisciplinary Approach for Disaster Resilience and Sustainability*; Springer, Singapore, 2017; pp. 355–368.
39. Irvine, K.N.; Seow, T.; Leong, K.W.; Cheong, D.S.I. How high's the water, Mama? A reflection on water resource education in Singapore. *HSSE Online* **2015**, *4*, 128–162.
40. Meera, P.; McLain, M.L.; Bijlani, K.; Jayakrishnan, R.; Rao, B.R. Serious game on flood risk management. In *Emerging Research in Computing, Information, Communication and Applications*; Springer: New Delhi, India, 2016; pp. 197–206.

41. Shah, A.A.; Gong, Z.; Ali, M.; Sun, R.; Naqvi, S.A.A.; Arif, M. Looking through the Lens of schools: Children perception, knowledge, and preparedness of flood disaster risk management in Pakistan. *Int. J. Disaster Risk Reduct.* **2020**, *50*, 101907.
42. Tsai, M.H.; Chang, Y.L.; Shiau, J.S.; Wang, S.M. Exploring the effects of a serious game-based learning package for disaster prevention education: The case of Battle of Flooding Protection. *Int. J. Disaster Risk Reduct.* **2020**, *43*, 101393 10.1016/j.ijdrr.2019.101393.
43. Zhong, S.; Cheng, Q.; Zhang, S.; Huang, C.; Wang, Z. An impact assessment of disaster education on children's flood risk perceptions in China: Policy implications for adaptation to climate extremes. *Sci. Total Environ.* **2021**, 757, 143761. https://doi.org/10.1016/j.scitotenv.2020.143761.
44. Mudavanhu, C. The impact of flood disasters on child education in Muzarabani District, Zimbabwe. *Jamba J. Disaster Risk Stud.* **2015**, *6*, 138.
45. Bosschaart, A.; Van der Schee, J.; Kuiper, W. Designing a flood-risk education program in the Netherlands. *J. Environ. Educ.* **2016**, *47*, 271–286.
46. Lechowicz, M.; Nowacki, T. School education as an element of natural disaster risk reduction. *Pr. Stud.* **2014**, *55*, 85–95.
47. Williams, S.; McEwen, L.J.; Quinn, N. As the climate changes: Intergenerational action-based learning in relation to flood education. *J. Environ. Educ.* **2017**, *48*, 154–171.
48. Morote, A.F. El Parque Inundable La Marjal de Alicante (España) como propuesta didáctica para la interpretación de los espacios de riesgo de inundación. *Didáctica Geográfica* **2017**, *18*, 211–230.
49. Morote, A.F.; Pérez, A. La comprensión del riesgo de inundación a través del trabajo de campo: Una experiencia didáctica en San Vicente del Raspeig (Alicante). *Vegueta Anuario de la Facultad de Geografía e Historia* **2019**, *19*, 609–631.
50. Morote, A.F.; Hernández, M. Social Representations of Flooding of Future Teachers of Primary Education (Social Sciences): A Geographical Approach in the Spanish Mediterranean Region. *Sustainability* **2020**, *12*, 6065. https://doi.org/10.3390/su12156065.
51. Morote, A.F.; Hernández, M.; Olcina, J. Are Future School Teachers Qualified to Teach Flood Risk? An Approach from the Geography Discipline in the Context of Climate Change. *Sustainability* **2021**, *13*, 8560. https://doi.org/10.3390/su13158560.
52. Morote, A.F.; Souto, X.M. Educar para convivir con el riesgo de inundación. *Estud. Geogr.* **2020**, *81*, e036. https://doi.org/10.3989/estgeogr.202051.031.
53. Morote, A.F. La explicación del riesgo de sequía en la Geografía escolar. Una exploración desde los manuales escolares de Ciencias Sociales (Educación Primaria). *BAGE* **2021**, *88*, 1–32. https://doi.org/10.21138/bage.3047.
54. Chiwara, P.; Lombard, A. Mitigation the impact of drought in Namibia: Implications for social work practice, education and policy. In *The Routledge Handbook of Green Social Work*; Routledge: London, UK, 2018; pp. 293–306.
55. Little, P.; Aboud, A.; Lenachuru, C. Can formal education reduce risk for drought-prone pastoralist? A case study from barringo district, Kenya. *Hum. Organ.* **2009**, *68*, 154–165.
56. Calixto, R. Propuesta en educación ambiental para la enseñanza del cambio climático. *Rev. Electrón. Diálogos Educ.* **2015**, *15*, 54–68.
57. Escoz, A.; Gutiérrez, J.; Arto, M.; Meira, P.A. La representación social del cambio climático en el alumnado universitario español de Ciencias e Ingeniería. *Enseñanza de las Ciencias: Revista de Investigación y Experiencias Didácticas* **2017**, *Extra*, 1765–1770.
58. Morote, A.F.; Moreno, J.R. La percepción de los futuros docentes de Educación Secundaria sobre las implicaciones territoriales del cambio climático en destinos turísticos del litoral mediterráneo. *Grand Tour. Rev. Investig. Tur.* **2021**, *23*, 261–282.
59. Morote, A.F.; Campo, B.; Colomer, J.C. Percepción del cambio climático en alumnado de 4° del Grado en Educación Primaria (Universidad de Valencia, España) a partir de la información de los medios de comunicación. *REIFOP* **2021**, *24*, 131–144. https://doi.org/10.6018/reifop.393631.
60. Olcina, J. La enseñanza del tiempo atmosférico y del clima en los niveles educativos no universitarios. Propuestas didácticas. In *Enseñanza y Aprendizaje de la Geografía para el Siglo XXI*; Sebastiá, S., Tonda, E.M., Eds.; Universidad de Alicante: Alicante, Spain, 2017; pp. 119–148.
61. Ministerio de Educación, Cultura y Deporte. *Real Decreto 1105/2014 de 26 de Diciembre, por el que se Establece el Currículo Básico de la Educación Secundaria Obligatoria y del Bachillerato*. 2021. Available online: https://boe.es/buscar/pdf/2015/BOE-A-2015-37-consolidado.pdf (accessed on 27 November 2021).
62. De Luis, M.; Brunetti, M.; Gonzalez-Hidalgo, J.C.; Longares, L.A.; Martín-Vide, J. Changes in seasonal precipitation in the Iberian Peninsula during 1946–2005. *Glob. Planet. Change* **2010**, *74*, 27–33.
63. González, J.C.; López, J.A.; Stepanek, P.; Martín-Vide, J.; De Luis, M. Monthly precipitation trends on the Mediterranean façade of the Iberian Peninsula during the second half of the 20th century (1951–2000). *Int. J. Climatol.* **2009**, *29*, 1415–1429.
64. Monjo, R.; Martín-Vide, J. Daily precipitation concentration around the world according to several indices. *Int. J. Climatol.* **2016**, *36*, 3828–3838. https://doi.org/10.1002/joc.4596.
65. Agesncia Estatal de Meteorología (AEMET). Mapa de la Red Básica de Observación Meteorológica en España. 2021. Available online: https://aemetblog.es/2016/11/28/la-observacion-en-aemet/ (accessed on 28 November 2021).
66. Mann, M.E.; Rahmstorf, S.; Kornhuber, K.; Steinman, B.A.; Miller, S.K.; Petri, S.; Coumou, D. Projected changes in persistent extreme summer weather events: The role of quasi-resonant amplification. *Sci. Adv.* **2018**, *4*, eaat3272. https://doi.org/10.1126/sciadv.aat3272 .
67. Wetterzentrale. *Archivo, CFSR (1979-)*. 2021. Available online: https://www.wetterzentrale.de/ (accessed on 28 November 2021).
68. Morote, A.F.; Olcina, J. Riesgos atmosféricos y cambio climático: Propuestas didácticas para la región mediterránea en la enseñanza secundaria. *Investig. Geogr.* **2021**, *76*, 195–220. https://doi.org/10.14198/INGEO.18510.

69. Generalitat Valenciana. Plan Vega Rehace. Una Estrategia Integral para la Resiliencia de la Comarca de la Vega Baja del Segura. 2020. Valencia, Dirección General de Análisis y Políticas Públicas. Available online: http://www.presidencia.gva.es/es/web/vega-renhace (accessed on 28 November 2021).
70. Wilhite, D.A. *Drought: A Global Assessment*. Vols. 1 and 2; Routledge: New York, NY, USA, 2007.
71. La Calle, A. *Sequía y Adaptación de la Directiva Marco del Agua. La Sequía en España. Directrices para Minimizar su Impacto*; Ministerio de Medio Ambiente: Madrid, Spain, 2007.
72. Murcia Diario. Fundación Ingenio: "La nueva ley no salvará el Mar. Menor, pero destruirá la agricultura y el empleo". Available online: https://murciadiario.com/art/22659/fundacion-ingenio-la-nueva-ley-no-salvara-el-mar-menor-pero-destruira-la-agricultura-y-el-empleo (accessed on 23 July 2020).
73. Díez-Herrero, A. Buscando riadas en los árboles: Dendrogeomorfología. *ECT* **2015**, *23*, 272–285.
74. Miró, J.; Olcina, J. Cambio climático y confort térmico. Efectos en el turismo de la Comunidad Valenciana. *Investigaciones Turísticas* **2020**, *20*, 1-30. https://doi.org/10.14198/ INTURI2020.20.01.
75. Gary, G.; Allred, S.; Lo Giudice, E. An extension education program to help local governments with flood adaptation. *J. Ext.* **2014**, *52*, 4IAW6.
76. Bel, J.C.; Colomer, J.C.; Valls, R. Alfabetización visual y desarrollo del pensamiento histórico: Actividades con imágenes en manuales escolares. *Educación XX1* **2019**, *22*, 353–374. http://doi.org/10.5944/educXX1.20008.
77. Diario Información (04.09.2021). *La Digitalización Educativa no Puede con los Libros de Texto en Papel*. Available online: https://www.informacion.es/sociedad/2021/09/04/digitalizacion-educativa-libros-texto-papel-56933740.html (accessed on 28 November 2021).
78. European Environment Agency (EEA). Climate Change, Impacts and Vulnerability in Europe 2016. An Indicator-Based Report. 2017. Luxemburgo. Available online: https://www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016 (accessed on 28 November 2021).
79. Morgan, A. Me as a Science Teacher': Responding to a Small Network Survey to Assist Teachers with Subject-Specific Literacy Demands in the Middle Years of Schooling. *Aust. J. Teach. Educ.* **2012**, *37*, 73–95. http://dx.doi.org/10.14221/ajte.2012v37n6.6.
80. Martín-Vide, J. Diez verdades y diez mentiras en relación al cambio climático. *ECT* **2009**, *17*, 120–127.
81. Serantes, A. Como abordan o Cambio Climático os libros de texto da Ensinanza Secundaria Obligatoria na España. *Ambital-MENTE sustentable* **2015**, *20*, 249–262. https://doi 10.17979/ams.2015.2.20.1609.1603.
82. Aspin, V. A week of rain.... *Prim. Geogr.* **2018**, *96*, 24–25.
83. Greenwood, H. A climate change assembley. *Prim. Geogr.* **2018**, *96*, 22–23.
84. Souto, X.M. La geografía escolar: Deseos institucionales y vivencias de aula. *BAGE* **2018**, *79*, 1-31. http://dx.doi.org/10.21138/bage.2757.
85. Ecoinventos. *Reino Unido Incorpora a sus Colegios a Profesores Especialistas en el Cambio Climático*. Ecoinventos. Available online: https://ecoinventos.com/reino-unido-incorpora-a-sus-colegios-a-profesores-especialistas-en-el-cambio-climatico/?fbclid=IwAR1bsdJD3MwOIFc0g4wYK9JRMZmVp3xPSeos9U-57iWDI3JNWk0GAkCH1WI (accessed on 28 November 2021).