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CLIMATE SERVICES AND HUMAN HEALTH: A NICHE OF OPPORTUNITIES FOR ECONOMIC GROWTH

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Abstract: Climate services are the result of an interdisciplinary approach to the study of the interaction between atmosphere and human beings. Climate change and weather variability are causing real impacts on people health at all levels. It has been admitted that health risks have an atmospheric component. Biometeorological forecasting tries to anticipate the impacts of the atmosphere on people health. Instead of uncertainties about climate change, many studies based on biometeorological approaches are being developed and massive bio-early warning systems are available already. The access and use of the new information and communication technologies (ICTs) has opened a niche of opportunities for the development of personalised climate services but further research is needed to achieve a diagnosis for each weather related disease and person.

Keywords: *biometeorology, hazard, risk, uncertainty, apps, climate services*.

I. INTRODUCTION

The study of the interaction between physical factors and human beings is classic in natural science. Most human activities, from agricultural work to leisure activities, are related to climate. Ecosystem changes can be due to natural events or to human activities. Extreme changes can provoke extreme impacts on environmental equilibrium. Emission of pollutants to the atmosphere or rivers, fires in the tropical rainforest or radioactive emissions from industries have made headlines in the newspapers and mass media over the past decades. The specific issue of climate change has increased global awareness on the environmental threats.

United Nations Environment Program (UNEP) has defined several big domains to study environment such as resource efficiency, harmful substances, ecosystems management, environmental governance, disasters and conflicts management and climate change. Global environmental change relates to demographic, economic, social, cultural, geophysical and technological issues. Overpopulation, ageing, food and water shortage, deforestation, air and water pollution, soils loss or global health have become a big concern for people nowadays. Under this wide umbrella of issues, climate change has become one of the most popular topics.

Many scientific disciplines have found an excellent frame for their own development under the umbrella of climate change. Biometeorology has studied the interaction between the atmosphere and living organisms for more than fifty years in three different research lines: animal, plants and human biometeorology. The International Society of Biometeorology (ISB) was founded in 1956 at the UNESCO, in Paris, France. It has brought scientists together from all around the world and from many different disciplines. ISB has active Commissions and Study Groups on Phenology, Climate Tourism and Recreations, Universal Thermal Climate Index (UTCI), Animal Biometeorology or Climate and Human Health. The definition and validation of biometeorological indexes and health warning systems (HWS) based on biometeorological forecasting are more related than ever to the new concept of Climate Services (CS) (fig. 1).

Fig.1 From Biometeorology to climate services

The Global Framework for Climate Services (GFCS) tries to "*enable better management of the risks of climate variability and change and adaptation to climate change, through the development and incorporation of science-based climate information and prediction into planning, policy and practice on the global, regional and national scale*". The development of the GFCS was set in motion by Heads of the States and government ministers in 2009 at the World Climate Conference-3 (WCC-3) in which decided "*to establish a Global Framework for Climate Services (hereafter referred to as the Framework) to strengthen production, availability, delivery and application of science-based climate prediction and services*".

Afterward, the Climate Services Partnership (CSP) was formed at the First International Conference on Climate Services which was held at the University of Columbia, in New York, in 2011. This is a platform for knowledge sharing and collaboration to advance climate service capabilities around the world. International Research Institute for Climate and Society (IRI) has played an important role in its creation. Multiple case studies are recorded through this initiative. The European Climate Services Initiative has also been addressed through the European FP7 Environment Programme. Projects such as ECLISE (Enabling Climate Information Services for Europe) and CLIM-RUN (Climate Local Information in the Mediterranean Region: responding to user needs) are two examples of it. Global Framework for Climate Services development can be considered an intellectual rebirthing of the traditional study of the interaction between living organism and the atmosphere. Several factors have been especially relevant in the development of the new idea of CS:

- Technological and digital revolution has increased enormously the availability and quality of climatological data. Real time access to daily meteorological data through the new Information and Communication Technologies (ICTs) has been a key issue in this process. The Internet has become the main source of meteorological information all over the world. Temporal and spatial resolution of climate related data has also increased radically. The development of Remote Sensing and Geographic Information Technologies (RS & GIT) applied to Climatology and Meteorology has universalized the cartographic representation of atmospheric variables.
- Scientific and statistical development is also much linked to the official creation of the GFCS. Meteorological forecasting and climate modeling have improved greatly. Prediction and projections based on statistical and mathematical models are allowing scientific community to reduce uncertainties in relation to future scenarios of extreme events or climate change.
- National meteorological offices progression is also a relevant factor. The number of personnel focused on collecting and storing meteorological data has been reduced dramatically in many places due to the automatic weather stations and the use of new technologies and practices (WMO, 2011). On contrast, new recruitment of technologically highly qualify people is taking place. In this sense, an added value must be taken out from the datasets to offer them to the citizen as new services. Innovation is a must in this process and interdisciplinary work is the way to achieve it.
- Economic and financial interest on the idea of climate/weather related risks and welfare. Climate related risks have a much extensive economic component than in the past. Services has become the thickest layer in the economic sectors for

most of the developed countries being climate services today a wide high-quality niche market for economic growth (fig. 2). Private companies are willing to develop and offer these services to big corporations such as insurance companies. The huge economic component of the climate/weather relate risk is creating a new stock market itself based on weather derivatives (Dutton, 2002) at a financial level. Weather derivatives refer to how money can change hands in the stock markets depending on a specific meteorological variable goes up or down one unit.

In this context, climate related services can be linked to water availability, agriculture, energy production, transport, leisure activities, insurance and financial markets, cooperation actions and services such as human health.

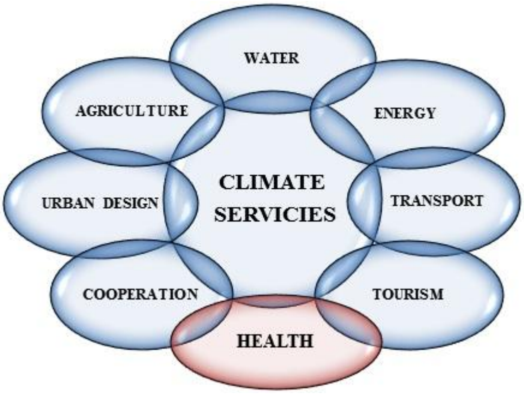

Fig. 2 Climate services and socio economic sectors

II. ATMOSPHERE AND HEALTH RISK

II.1. Atmosphere

Weather is defined as the state of the atmosphere in a particular moment in a specific location on the Earth. It is characterized by variability being weather forecasting related to a temporal scale of a few days. Consistent with the World Meteorological Organization (WMO) , climate refers to a much longer period of time being defined as the average state of the atmosphere in a specific region of the Earth for a period of 30 to 40 years at least. Climate change can happen because of natural reasons or human activity.

Weather and climate are linked to environmental problems through complex mechanisms (fig. 3). Agricultural activities, the leisure industry, cattle farming production, energy sectors, fishing activities, the transport sector and services such as health provision are climate/weather related economic activities.

Meteorological extreme events can be explained through extreme variability in the atmospheric processes. According to different Intergovernmental Panel on Climate Change different (IPCC) Reports, the number, the frequency and the intensity of extreme events in the near future will increase because of climate change. Climate change has the ability to transform ecosystems rapidly and provoking new emerging diseases in new environments. In both cases uncertainty play a key role in the comprehension and definition of climate/weather related health risks.

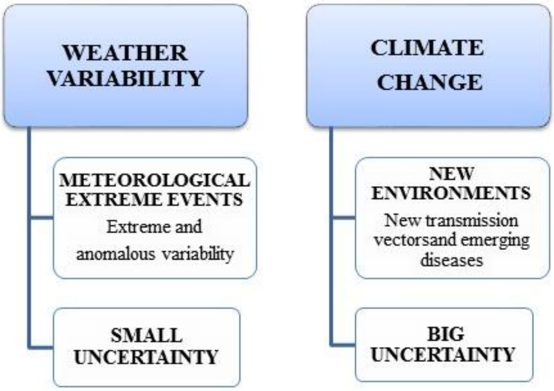

Fig. 3 Weather, climate and uncertainties

The concept of uncertainty on Meteorology is associated with the ability of human beings to forecast. Uncertainties in relation to climate change are much bigger. Anticipating the effects of climate changes on ecosystems for long periods of time is a complex task. In the first case, this vagueness has been widely reduced by weather forecasters in daily and extreme events forecasting. Nevertheless, uncertainty is still very high on climate/weather related human health risk. From a biometeorological point of view, the concept of uncertainty still plays an important role in relation to the lack of confidence we have about how weather variability distresses to each person´s health. The identification and management of human health risks associated with weather variability and climate change should include the human component in the analysis.

II.2 Hazards, risk and vulnerability

Hazards are threats with the potential to harm people and places. They are usually caused by natural systems (landslides, flooding, earthquakes, tsunamis, hurricanes, severe storms, wildfires…) affecting negatively people and properties. A climate related sanitary risk can be defined statistically as the probability of causing damage on people´s health. From an economic point of view, the risk becomes the probability of occurrence multiplied by the cost of the consequences of occurrence (Dutton, 2002). In any case, climate/weather related health risk depends on how many people are exposed to the hazard and how people are exposed to it. People vulnerability becomes a key issue in order to estimate the risk which is linked to the vulnerability of each person to the atmospheric threats (atmosphere as source of damage in fig. 4).

From a public health point of view, vulnerability can be defined as the susceptibility of a given population exposure to the hazard to react to or recover from its impact (Mantilla, 2013). Vulnerability refers to how much "meteo-sensitive" a person or a group of people are to weather variability and to climatic changes. The definition of the biometeorological profile (Fdez-Arroyabe and Lecha, 2008) of each person is essential to estimate the atmospheric related health risks.

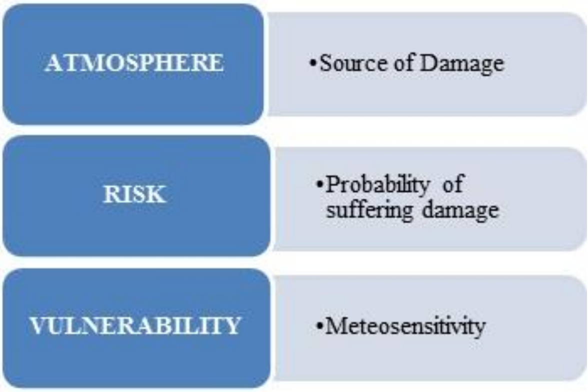

Fig. 4 Hazard, risks and vulnerability in Biometeorology

The economic cost of the climate and weather-related health risk in economic sectors is an interesting issue to be considered. One-third of private industry activities, representing annual revenues of $3 trillion, have some degree of weather and climate related risk (Dutton, 2002). Thinking about climate/weather related health risks is important to consider how much money would be save on health facilities if biometeorological services were developed and provided. Fig. 5 shows how atmosphere is acting as a human health hazard at different levels:

- Health risks as outcomes from climate change. It is difficult to make economic estimations because of the wide spectrum of uncertainties involved. Many of the research activities around the world are focused on this field nowadays because of its enormous relevance.

- Health risks induced by meteorological extreme events. Insurances companies are used to estimate these costs that affect properties and people. Extreme events have happened before climate change made headlines in the news.
- Health risk due to anomalous weather normal variability. In this particular case, no estimations have been made yet because this level of analysis has not been traditionally considered and a small number of studies have been carried out.

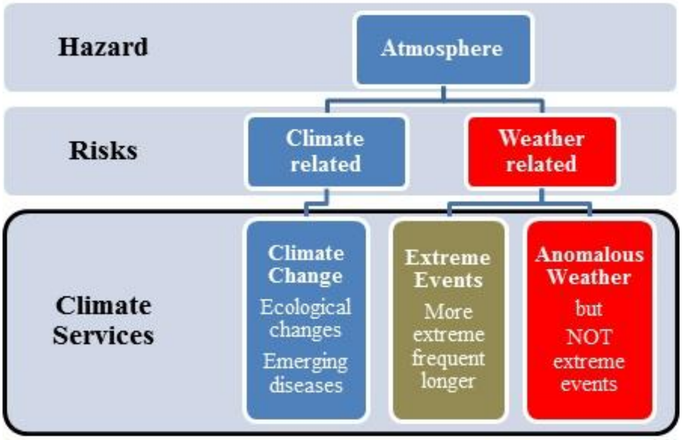

Fig. 5 Atmospheric related health risks and climate services

III. CLIMATE RELATED HEALTH RISKS

III.1. Climate change

Climate related health risks are associated with ecological changes in the ecosystems. Mitigation, adaptation or migration can be the solutions to avoid the risk (Glantz et al., 2009). From a climate change perspective, researchers are focused on the idea of anticipating future emerging diseases in new environments and the study of abrupt changes on ecosystems and societies.

Mathematical and statistical models are required to define climate change human health related risks. This can only be done using global climate models (GCM) based on the study of atmospheric patterns where temporal and spatial variability are highly complex. Projections and predictions for long-term periods are generated and statistical and dynamical downscaling methods are used (Camus et al., 2009) to model future impacts at a local level in relation to issues such as water availability and global warming. These approaches have an important biogeographic component and are full of uncertainties.

Many vector, water and air borne diseases are indirectly related to climatic drivers. In these cases in which transmission vectors of infectious diseases appear, health risk becomes clearly a public health matter. Cholera, malaria, dengue, are attached to water availability. By contrast, meningitis is linked to drought and dusty conditions (WHO, 2012).

Global models of atmospheric pressure centers and wind activity are associated to the transport of pathogens and microorganism from their original places to other regions around the world. Seasonality keeps acting as a start for migrations of birds and flowers blooming which can be linked to the spreading of specific parasites. It is important to point out that some basic relationships between atmospheric variables and human being´s health are well known.

Some of these relationships have scientifically been proved. However, emergency protocols that advice and protect people from the potential climate/weather related health risk have not been defined as it happens with other natural hazards.

In other cases, more research is needed to find out how meteorological factors and diseases are connected and to define biometeorological warning systems based on scientific evidences.

Climate change studies are plenty of uncertainties. This makes it difficult to implement climate related health risks warning systems in the security protocols. Mitigation strategies have been globally defined in order to alleviate potential impacts on health.

III.2. Extreme events

Extreme meteorological events are at the top of natural hazards. More than 80 percent of all documented disasters from natural hazards in the first decade of XXI century were floods, droughts, tropical cyclones, heat waves and severe storms. The impacts on lives and property vary immensely depending on the country studied.

Health risks related to meteorological extreme events depend on geographical location, socio-economic development and how the population is prepared for such an event. For instance, a hurricane in the Caribe area can be forecasted several days in advance and the impact on human beings health from this extreme event can be greatly minimized. Health risks will be low because the forecasting will launch different emergency protocols and actions from local, regional and national governments to mitigate the impacts. Knowledge about the event makes people less vulnerable.

In the cases of flooding, there is a direct impact. According to the WHO reports, Pakistan´s 2010 flood damaged or destroyed directly more than 500 hospitals and clinics. Nevertheless, the strongest effect on human health will take place after the event has occurred. Access to basic services, (drinkable water, food, electricity, medicine) becomes then an unsolved problem in many countries. The risk for epidemic outbreaks (cholera, intestinal diseases, malaria) increases dramatically after the extreme event. This is, in many cases, the main concern of public services and NGOs working in the area. Sanitary risks are usually lower in the developed countries while they are much higher in the non-developed ones.

Drought is another example of an extreme meteorological event that can kill directly and indirectly thousands of people in the poorest countries, international assistance being insufficient in many cases. Poverty and inadequate land use increase vulnerability to drought. The lack of harvesting because of severe drought can provoke big famines. Moreover, some diseases such as meningitis need a dry season and dust concentration for their development as it happens in the *meningitis belt* in Africa from December to February.

Meteorological extreme events in developed countries behave differently. The cost of lost properties vary from low to very high depending on the forecasting accuracy, the event intensity, the existence of proper urban planning, the education level of population in relation to the risk, the emergency protocols before the event or the infrastructural and technological development of the country. In many cases, insurance companies are able to transfer the economic impact of extreme events to other insurance markets. Because of these and other factors, the number of victims is lower than in the less developed countries.

Some modern events, such as heat waves, provoke vast risks because of the number of people they affect. Morbidity and mortality rates in Europe, in summer 2003 confirm this statement. Between 35000 and 70000 people died in this event according to different sources. But also we should not forget demographic, social, cultural and economic factors that are even more relevant in the outcomes than the weather itself. Experienced firemen have confirmed that many elderly people who died were living alone and nobody assisted them in the hottest period. Isolation and lack of assistance can kill more than the weather.

One of the main concerns of the international community is that these kind of future extremes events such as heat waves, floods or hurricanes can be particularly risky in the poorest regions of the Earth.

III. 3 Anomalous weather

Anomalous weather, not extreme, has also influenced human health for long period of time**.** The creation of proverbs or popular sentences related to weather is a consequence of the accumulated personal experience of these anomalous meteorological variances. Nevertheless, little attention has been offered to its impacts on human health by scientific communities. For meteorologists, anomalous weather refers to specific atmospheric conditions that are unusual. Normal conditios are usually defineb by a baseline. Human biometeorologists, try to establish links between these anomalies and the biometeorological history and profile of each person. Extreme values, abrupt changes or unusual persistence of meteorological factors can affect, in relative terms, human health. These relative changes can take place for short periods of time (seconds) to seasonal or decadal variability.

A biometeorological anomaly should be defined considering the human vulnerability factor based on each personal biometeorological profile. The relevance of this concept of anomalies is supported by two facts: some anomalies have a much higher frequency than extreme events and their geographical scope is also wider. The economic impact of these repited anomalies on wellbeing, morbidity and mortality has not been properly estimated yet.

Anomalous weather related health risks have a multicomponent dimension based on climate drivers and people biometeorological background. High levels of ultraviolet sun radiation has been linked to an increase in the number of skin cancers (Mc Gregor, 2011); extreme high temperatures are clearly associated to dermatitis, edemas, sunburns, sun strokes, heat syncope, exhaustion or stroke, anomalous morbidity and mortality in some groups of people; extreme low temperatures can be associated to frostbites, hypothermia or fractures (Camara, 2008). Headaches, migraines and some coronary diseases or spontaneous pneumothorax have been associated with sudden or unusual changes on atmospheric pressure. Cold winds affect to the sympathetic system and hot and dry winds can act as stimuli of the parasympathetic one. A number of cases of asthma due to mites and pollens can be explained in relation to air humidity. Rainfall and car accidents are also a clear example of how weather and health are indirectly associated. Indoor environments in which positive ions are abundant are not considered healthy places because of the effect these environments have on the human immune system. Anomalous variability of some meteorological parameters can act as triggers of health problems to specific persons or as outbreaks of epidemics (Fdez-Arroyabe, 2013).

Management of health risks associated to weather variability requires (a) a detailed meteorological forecasting on time and space of different atmospheric variables and (b) the definition of the biometeorological profiles for each person or groups of people. Identification of meteorological anomalies depends on the temporal scale in which meteorological information is recorded. For instance, Fig. 6 shows temperature registered by a data logger for a person moving in a village of Northern Spain in October 11th 2013. There is a record of temperature every 5 seconds from 13:00 pm to 16:00 pm. The thermic amplitude was around 5 Celsius degrees. In this context, it can be said that, in relative terms, there was an extreme event between at 14:00 and before 17:00 in relation to temperature. Health risk at this level can only be defined by the vulnerability of each person to this specific variation.

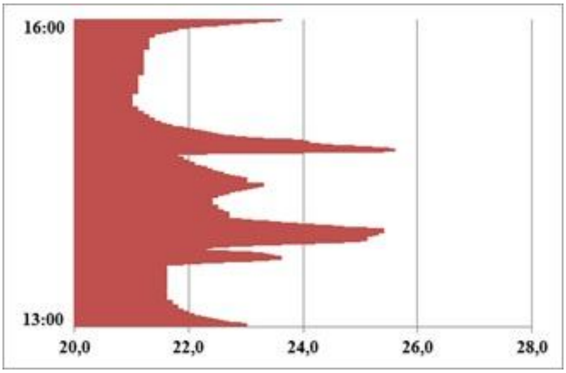

Fig. 6 Time series of temperature registered every five seconds by a person moving in Northern Spain (October 11th 2013, between 13:00 and 16:00 pm)

Biometeorological profiles can be grouped in three levels in relation to the impact that a person can suffer from anomalous weather: weak, medium and strong. Life expectancy is much higher than few decades ago in industrialised countries and biometeorological profiles of elderly people are usually weaker. In this scenario the weather related health risks become a serious problem. Behind this fact there is also an enormous potential to develop specific climate services for this group of people.

Secondly, urban development is a fact. Rural areas and customs have been left behind forgetting that this rural environment is probably the closest one to natural cycles. At the same time social factor such as changes on the configuration of families and individualism can be considered key issues to explain climate related mortality and morbidity peaks. Physiological functions of the elderly do not work properly and many of them have chronic diseases. These are cofactors that increase enormously weather related health risks.

Health risk levels in relation to atmospheric variability (normal, anomalous, and extreme) and human vulnerability are presented in Fig. 7. In the case of extreme events*, risk level varies extensively depending on the geographic location. A period of high and persistent temperatures in Europe can have a higher risk, in terms of public health, than an extreme event in Florida.

ATMOSPHERIC VARIABILITY	BIOMETEORLOGICAL PROFILE HUMAN VULNERABILITY			RISK LEVELS
	LOW	MEDIUM	HIGH	
Normal variability	Base level	Level 1	Level 2	Level 5 Level 4
Anomalous variability	Level 2	Level 3	Level 4	Level 3 Level 2
Extreme Events*	Level 3	Level 4	3 | 4 | 5	Level 1 Base level

Fig. 7 Health risk levels in relation to atmospheric variability and human vulnerability

Any achievement at this scale of the study of the interaction between atmospheric factors and human health can be useful for the definition of mitigation strategies at a climate change scale. As it has been mentioned by World Bank the study of climate change adaptation should not only be focused on future climate projections.

IV. CLIMATE SERVICES AND HEALTH

IV.1. Background

The development of Climate Services (CS) started when first records of meteorological data were empirically collected. These data became more than numbers when they were associated to issues such as crops production, frozen periods, traffic accidents or the occurrence of different plagues and diseases… The digital edition of contour maps (temperature and rainfall) based on empirical datasets has helped researchers to evaluate the spatial component of meteorological factors. Nowadays, collection of meteorological data is carried out by national meteorological offices and international scientific institutions and also by private companies through remote sensors, radar and satellites images with varied aims. Meteorological forecasting is given to citizen daily through the weather reports. In this historical process, some biometeorological indexes related to human health have also been recently included in the forecasting such as pollen allergens density at specific locations or the level of ultraviolet radiation in specific seasons and countries. The existing links among meteorological factors and diseases, morbidity and mortality offer an excellent chance to generate new climate services in the health sector.

IV.2. Meteorological data and biometeorological indexes

Access to meteorological data is essential to develop biometeorological studies and climate services. Automatic weather stations networks have facilitated real time access to meteorological data. Initiatives such as the Climate Information for Public Health Action Network (CIPHAN), from the International Research Institute for Climate and Society (IRI), have contributed to facilitate access to global climatic, demographic and environmental datasets. The Data Library of IRI (Corral et al., 2012) is an extraordinary example of how sharing global climatic data can be very useful in the health sector.

The use of climate information is demanded more often by public health professionals each day but availability of medical data is difficult due to the private condition of this information. In many cases, access is only available to aggregated medical data with low temporal and spatial resolution what makes more difficult the development of detailed biometeorological studies at local and daily levels.

On contrast, the use of the International Classification of Diseases (ICD) to register medical diagnostics is a positive point for the development of multidisciplinary research on this field and makes easier the development of comparative analysis.

Human biometeorologists (Tromp, 1963), (Rodriguez et al., 1985), (Jendritzky, 2000), (Matzarakis et al., 2010) have studied the interactions between atmospheric processes and human health for decades. One of their main outcomes in this field has been the creation of biometeorological indexes that express the human thermal comfort (Physiological Equivalent Temperature (PET), Wind Chill Index (W), Actual Thermal Sensation Votes (ACS), Temperature-Humidity Index (TH), Weather Stress Index (WSI), Universal Thermal Climate Index (UTCI), using for it one or more combined meteorological variables

The definition of different Weather Types Classifications (WTC) based on synoptic approaches has also contributed to carry out studies about the impact of weather on human health. Weather types have been defined at meteorological stations level (Sheridan, 2002), (Kalkstein et al., 1996) and applied for specific regions of the world considering nodes of global grids. Meteorological forecasting has been widely developed for daily forecast and extreme events due to the improvement of Numerical Weather Prediction (NWP) but very few biometeorological early warning systems (BIO-EWS) are still offered to citizens (fig. 8).

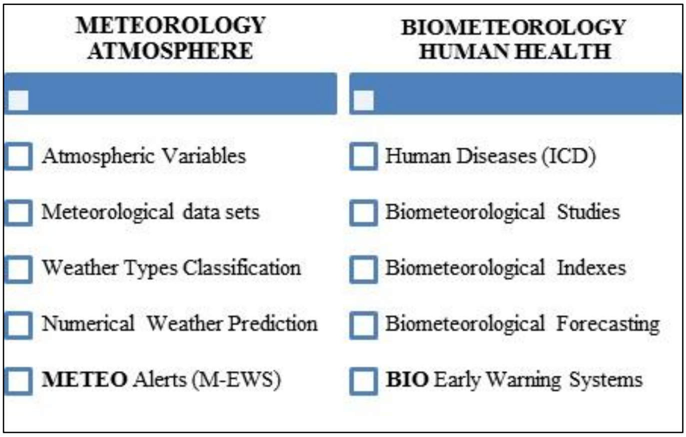

Fig. 8 From meteorological data to biometeorological services

IV.3. Biometeorological early warning systems

Bio-Early Warning Systems work with a biometeorological concept of human health. Health is an aptitude of each human being to conciliate their vital functions with climatic and meteorological variability and change, without compromising his or her own well-being (Fdez-Arróyabe, 2013).

These early warning systems try to cover a wide range of different diseases, from heat waves impacts to infectious diseases outbreaks, and they are framed under the umbrella of new climate services based on the analysis of daily, weekly or seasonal variability.

An example of a Bio-EWS, developed by Lecha et al. (2011), is the DOA index, based on the study of the variation of the amount of oxygen in the atmosphere. It defines hyperopia and hypoxia conditions on inter daily basis for different regions of the world. These extreme situations have been linked to an increment on morbidity in different groups of diseases according to the International Classification of Diseases (ICD v.9 and v.10).

Other authors have chosen a different approach and attended to the impact of physical properties of air masses on human health (Kalkstein et al., 1996) and offered daily risk levels through a scale of colours that can be easily readable by citizens.

Another Bio-EWS refers to an infectious disease such as influenza which is originated by viruses whose main property is their instability. Complexity of this approach is very high. It is a system based on the idea of atmospheric contrast at a synoptic scale which has been applied for the Iberian Peninsula using a specific classification of atmospheric circulation patterns.

A theoretical cycle for the design, implementation, validation and improvement or rejection of any Biometeorological Early Warning Systems has been defined by members of the ISB - Climate and Humans Health Commission. Some of the principles of these Bio-EWS are:

- They should be based on meteorological information easily accessible according to the national meteorological services procedures.
- They can be developed at a synoptic level but they should be scalable at a local one.
- They work with the idea of average biometeorological profiles in relation to human vulnerability.
- They should be able to transfer theoretical knowledge and the outcomes of scientific research into specific climate services.

IV.4. Health risks and customized climate services

The development of Customized Climate Services (CCS) is the result of the heterogeneity of physiological and psychological reactions of people to atmospheric variability and change. From high latitudes to equatorial line, meteorological distress affects living organism´s health differently. The meteorological history in which each person has developed his/her immune system is very important to understand the future response of this person to an anomalous atmospheric change. Definition of these particular conditions is essential to elaborate a proper biometeorological forecasting.

Biometeorological personal advice should be developed for specific users in relation to those diseases and health problems that are connected to meteorological parameters in the same way it is done by practitioners in relation to alimentation or the amount of physical exercise. It is frequent that people who are suffering meteo-impacts ask for advice to the ISB distribution list because they have experienced how weather changes and variability affects their psychological or physical balance. BIO-Early Warning Systems have been useful for some of them because through the forecasting they are able to anticipate the impact on their health and can mitigate it in advance.

Many of these services can be offered today in terms of the probability of suffering a biometeorological impact. There is a new health market based on the development of these new services which can be easily implemented through the information and communication technologies. Starting this process can give to the designer of the services the chance to evaluate the warning system through the users and improve them progressively on a customized way.

V. CONCLUSIONS

Meteorological impacts on health can be assessed through biometeorological studies. Public sector can incorporate the scientific outcomes of these studies into the management of the risk to make decisions. Public health services are essential in this process because they are used to generate protocols and procedures to confront crisis situation based on the existence of surveillance. Nowadays, many of these procedures are based on statistical outcomes and do not consider climatic factors that are known to be linked to the diseases or even act as triggers of them.

The definition of biometeorological risk requires a multidisciplinary approach and its management should be based not only on biometeorological forecasting but also in public health procedures.

The study of vulnerability of people through the definition of biometeorological profiles in relation to meteorological factors is an unexplored field for researching. This can be a profitable area for the creation of new companies oriented to the design of health-related personalized climate services. These new services can be offered through social networks, mobile phones, Apps or through e-health platforms. This is a new era plenty of opportunities for weather and climate services development in relation to health. There is a great niche of opportunities for economic growth based on the development and implementation of new customized climate services based on the new information and communication technologies.

The economic impact of the use of climate services on health sector is unknown. Many companies are willing to consider the climate-related costs in their economic balances. Further than the importance of the economy, human health can be considered itself enough reasons to develop new climate services in the health sector.

Acknowledgement

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