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Article

The communicative process of weather forecasts issued in the probabilistic form

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ABSTRACT: One of the main purposes of weather forecasting is that of protecting weather-sensitive human activities. Forecasts issued in the probabilistic form have a higher informative content, as opposed to deterministic one, since they bear information that give also a measure of their own uncertainty. However, in order to make an appropriate and effective use of this kind of forecasts in an operational setting, communication becomes significatively relevant.
The present paper, after having briefly examined the weather forecasts concerning Hurricane Charley (August 2004), tackles the issue of the communicative process in detail.
The bottom line of this study is that for the weather forecast to achieve its best predictive potential, an in-depth analysis of communication issues is necessary.

Introduzione

In August 2004, the National Hurricane Center (NHC), which studies hurricanes in the US, provided correct forecasts on the route of Hurricane Charley (Figure 1) 28 hours in advance. However, the hurricane killed 15 people and caused heavy damage. The public misinterpreted the weather forecasts as imprecise. But what actually happened?

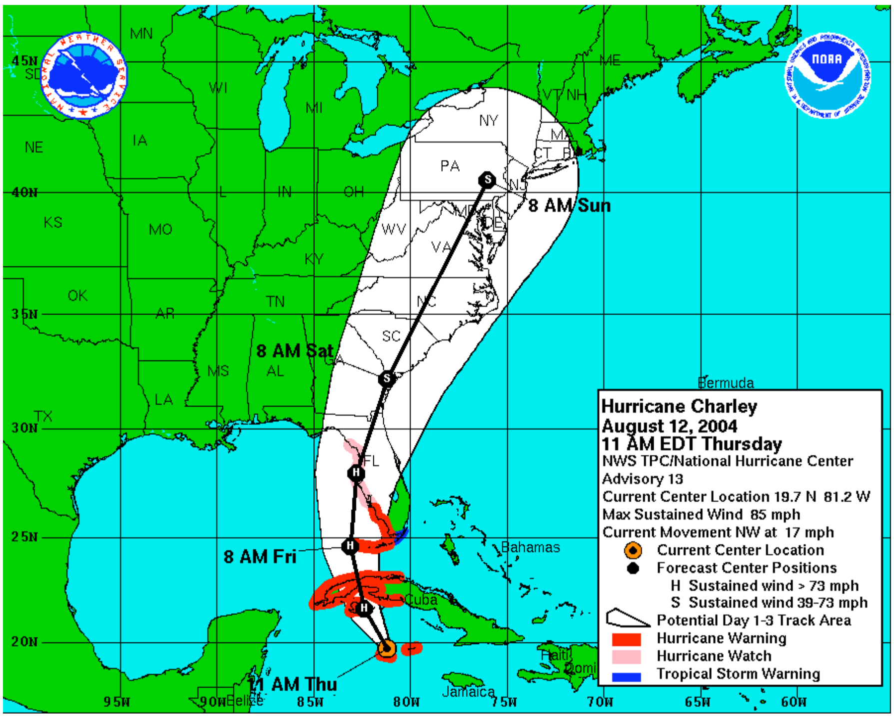

Figure 1. "The cone of uncertainty" of Hurricane Charley issued 28 hours before it struck Florida. Taken from [30], pag.12.

Weather forecasts are public goods, as they are primarily aimed at protecting all the various weather-sensitive human activities. Their outcome is immediately tangible, at least in the context where people live and operate. As any other scientific observation, forecasts are subject to errors. However, the nonlinearity of primitive equations (the differential equations which are the basis for weather forecast models) which is the cause for the so-called "butterfly effect", and errors due to "technical" reasons can be kept under control. Furthermore, it is possible to provide the public with information on the uncertainty associated to forecasts.[1]

That weather forecasts often appear as wrong cannot be ascribed to scientific issues, because this field is not much different from other scientific fields; it can be ascribed to shortcomings in the communication process instead.[2]

The better reliability of forecasts was followed by more widespread awareness on their social and economic value, as Lamarck understood already two hundred years ago, and yet it has not been matched by an increased ability to use them rationally. The lack of a link between weather forecasters and the wider public, the conceptual difficulties, sometimes overestimated, concerning the use of probabilistic information, the faint awareness of dealing with scientific information and an awkward communication process are the reasons for the "underuse" of forecasts. Nobody can disagree with Murphy when he writes that "[…] *it should be evident that placing arbitrary restrictions on the content, format, etc., of forecasts may introduce inconsistencies that detract from their quality.*"[3]

This article focuses on some critical points existing in the communication process for weather forecasts. It also examines some methods to overcome them and issues that remain unsolved.

1. Defining a "good forecast"

It is not easy to define a "good forecast", as this issue neither regards nor is only the correspondence (neither easy to define) between events and forecasts. It concerns proper information implying a benefit to users. A good forecast is therefore strictly linked to the quality of the communication process to users.

The "*goodness in the weather forecast*" is defined by Murphy [27] through three parameters: *consistency*, *quality* e *value* (Figure 2). If "*The probability distributions represent, at any point in the solution, one's state of knowledge of the model*,"[4] then the expression of the forecasts in probabilistic terms "*reflect a forecasting system's (i.e., a forecaster's or a model's) true state of knowledge concerning future conditions*";[5] in other words, the forecast is *consistent* when it is the result of all the information possessed by the forecaster.

The quality regards the correspondence between forecasts and observations, whereas *the value* regards benefits to users; evidently, in probabilistic forecasts *the value* prevails on *the quality*. Without a doubt, as Murphy claims again "*from a forecaster's point of view, the goodness of a forecast is usually somehow related to the degree of correspondence between the forecast and the observed conditions. On the other hand, users are first and foremost interested in verifying whether the forecasts contribute some benefits in the context of their respective decision making issues. Besides, goodness has evidently many meanings within each of the two communities*."[6]

A good forecast therefore depends on a correct uncertainty communication by meteorologists and, possibly, on its correct interpretation by users.

[1] There are some exceptions such as the "burn storm" which hit the UK back in 1990 and which was not properly forecast. But these exceptions confirm the above statements, because they are extreme events whose forecast is subject to human errors which can be hardly estimated.

[2] "Current key knowledge gaps include understanding how people interpret weather forecast uncertainty and how to communicate uncertainty more effectively in real-world (rather than theoretical or idealized) settings." [24], pag. 975

[3] [27], pag. 288

[4] [11], pag. 67

[5] [28], pag. 12

[6] [27], pag. 281

TABLE 1. Names and short definitions of three types of goodness.

Type	Name	Definition
1	Consistency	Correspondence between forecasts and judgments
2	Quality	Correspondence between forecasts and observations
3	Value	Incremental benefits of forecasts to users

Figure 2. Taken from [27], pag. 291.

2. Meteorology like astrology?

The fast specialization process of meteorology occurred over the past fifty years has been enlarging the gap between meteorologists and users. Meteorology usually enjoys great popularity, "*Only to mention television, where audience ratings are reported minute by minute, allowing for a quite correct picture of the popularity of different TV shows, the situation is very simple: weather forecasts [...] are the most viewed TV broadcast of the day*",[7] both in Europe[8] and in the US,[9] but also weather-specialized websites have the largest numbers of users[10] (Figure 3 and Figure 4). But it is also true that usually the public is totally unaware of the complex scientific process that precedes the forecast broadcast and only enjoys the final product. It is nothing else but the content of the information released to the public and it is the result of a transfer which turns the forecaster's knowledge into media enjoyable knowledge.[11] Sometimes media turns it into "commercial information". Although weather information is indispensable for a number of economic players in the public, there is a widespread misconception (often involuntarily spread by mass media) that meteorologists are like magicians making prophecies. It is not by chance that many TV shows and national or international papers present weather forecasts next to horoscopes.

Figure 3. Google trends for the term "meteo" in the 2004-2008 time interval. The scale refers to the average traffic for the term. Taken from www.google.com/trend.

[7] [18], pag. 171
[8] High audience ratings are indirectly confirmed by the fact that in some European countries advertisements preceding and following weather forecasts are bought by large retail companies such as "El Corte Inglés" in Spain and "Darty" and "Carrefour" in France.
[9] Weather Channel had 2,500,000 viewers at its launch and 68 million viewers in 1998 [34].
[10] The words "*meteo*" and "*weather*" and those linked to weather events are among the 10 most googled words in many countries including France, Switzerland, Holland, Russia, Austria, Germany, Australia and Canada. Source: 2008 Year-End Google Zeitgeist
[11] "*When asked how he adapts, presents and makes forecasts accessible to the public, Alain Gillot-Pétré, presenter of prime-time weather forecasts on TF1 (the most popular private TV channel in France), answered [...] «I look for synonyms. If I had to use a technical language nobody would understand anything, save for meteorologists…»*" in [34], pag. 161.

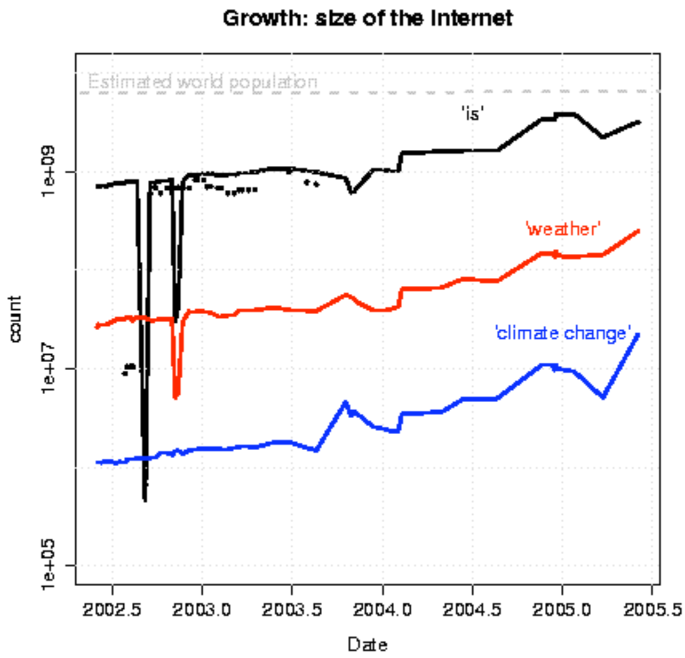

Figure 4. Growth in the internet search queries of terms "weather" and "climate change" compared to the growth in the weather websites. Taken from [4].

A confirmation of this paradox comes from the recent Eurobarometer report [12] on scientific research in media. The graph in Figure 5 shows that the European public is particularly interested in scientific news concerning medicine. This results is apparently contrasting with the popularity audience ratings attach to meteorology. However, the graph does not explicitly consider meteorology. Supposedly, it is included in the "environment" item (a container-term, in this case very undefined, for different types of scientific information), but its popularity is apparently underestimated if compared to the abovementioned data. Quite probably, the interviewees, if not the interviewers, did not consider as scientific news the weather forecasts they enjoy on a daily basis.

Given the variety of users and the complexity of the information involved, meteorologists necessarily have to use a polysemic type of communication in order to meet all needs. On the other hand, the media, which need high audience ratings, generally[12] simplify complex information. Thus, they disregard the needs of users that include that information in a wide-encompassing decision-making process. Thus, disregarding users needing the most weather information, they "please" the general public (as is the case with TV shows that contain meteorology and many internet sites), but it generates inconveniences and reinforces the misconception of meteorology as a non-scientific subject, which is reduced to mere "entertainment" or to a show.[13] So, the general public compares the "*Calendario di Frate Indovino*"[14] to scientific works and favors forecasts presented as a low-quality commercial product. It leads to a growth in the gap between meteorologists and users which was well described by Lamizet: "*Scientific meteorology is founded on a scientific project [...]. Popular meteorology is founded on myths and legends instead.*"[15]

[12] There are a few exceptions that prove the rule, such as the American *Weather Channel*. However, it is a specialized channel exploiting the spectacular effect as the following note reports.

[13] "*Looking for something exciting on TV tonight. Something with power, with passion. Weather is passionate, if you think about it. Insight drama. There is a mystery and art to it all. Something that tells you the whys and wonders. All this atmosphere tended to big show. It's exciting to watch. And what it all means to you and helps produce drama, passion. Tropospheric undulations, every night on Weather Center PM*". Promo for *Weather Channel*, American network broadcasting meteorology 24/7; quoted in [34], pag. 196.

[14] A popular calendar sold in Italy which contains references to traditional beliefs, religion and astrology (translator's note).

[15] [19], pag. 78.

The media-public relation with respect to weather forecasts can certainly improve in communication terms, if the information provided by the meteorologist is not distorted. Too often are the methods and the contents of communication directly managed by networks[16] or by the editorial staff, in the case of newspapers,[17] cutting information or rejecting probabilistic forecasts, fearing a decrease in audience ratings.[18]

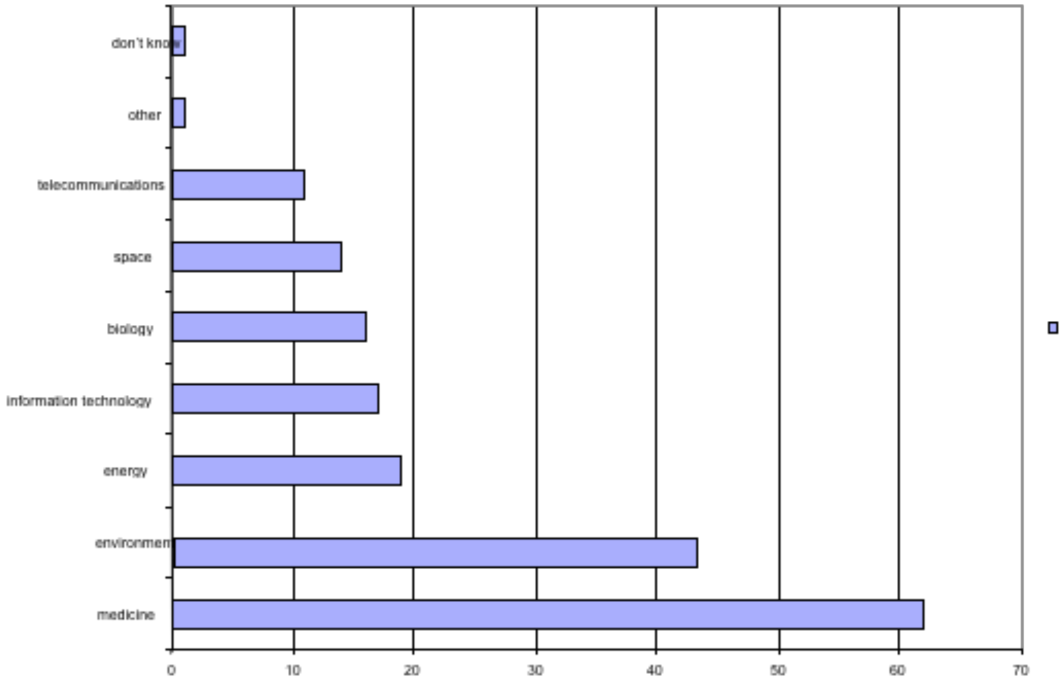

Figure 5. Fields of interest of the public for scientific news. Taken from [12], pag.9.

3. Usefulness of probabilistic forecasts

Probabilistic forecasts, in any case, offer the chance to protect economically disadvantaged groups from weather events, always considering that meteorologists cannot be aware of all the existing user categories and that correct information can promote awareness-raising among users in their decision-making processes, starting from the use of loss-cost ratio,[19] to more sophisticated computer models. However, opposition is frequently met, also among meteorologists, to communication of weather forecasts in a probabilistic form. This opposition is often explained by the public having difficulties in dealing with statistical information and the fact that goals are better achieved when information is categorical. However, authoritative studies[20] have reported that in the field of meteorology the public has difficulties especially in identifying the event to which a probabilistic information refers. Once the type of event has

[16] "*Including uncertainty information in a forecast may be viewed by some media industry managers and advertisers as a demonstration of weakness, hedging, lack of credibility, or lack of skill instead of as providing a better, scientifically sound, and more useful product. In fact, this is probably one of the main drivers of what might be called the "pretended determinism" that exists in many media presentations today. On the other hand, savvy media entities could regard the inclusion of uncertainty information in forecasts as a competitive advantage.*", [19] pag.183.

[17] "*Although it seems obvious that a weather forecast should be respected in its entirety, in practice this is not true. Time and space conditions, peculiar presentations, current affairs or even the suspicion of difficulties in understanding lead to cuts, deletions or changes (only formal in principle) in their texts*." [35].

[18] "*An Italian meteorologist explained that the media abhor uncertain predictions. When a meteorologist provides percentages, Italian journalists dichotomize the percentages into "it will rain or it will not rain."*" [14], pag. 627

[19] "*The most appropriate system seems therefore to be to leave to the clients concerned by the warning to form an idea of the value of a/b and to issue the warnings in such a form that the larger or smaller probability of the events gets clear from the formulation. The client may then himself consider if it is worthwhile to make arrangements of protections or to disregard a given warning.*" [2], quoted in [20], pag. 1232

[20] See also, [37],[26],[14],[24].

been understood by users, they are generally able to discern the difference between a 60% or a 20% probability for a given event to occur. In particular, Gigerenzer [14] claims that unsuitably educated users are not reached by the communication process also because, unable to correctly interpret events, they have no clue neither of the type of information they may need, nor of its usefulness. The graph in Figure 6 is about a survey carried out by Gigerenzer and collaborators in six cities on the meaning of the statement "a 30% chance of rain tomorrow". It shows that the majority of people interpreting it correctly (white column) was in the city (New York) where users have been dealing with probabilistic forecasts for decades.[21]

All of that implies a vicious circle so that the public "underuses" forecasts because of their presumed poor reliability and meteorologists do not try to create products suitable from a communication point of view because the public is not able to use forecasts in an appropriate way.

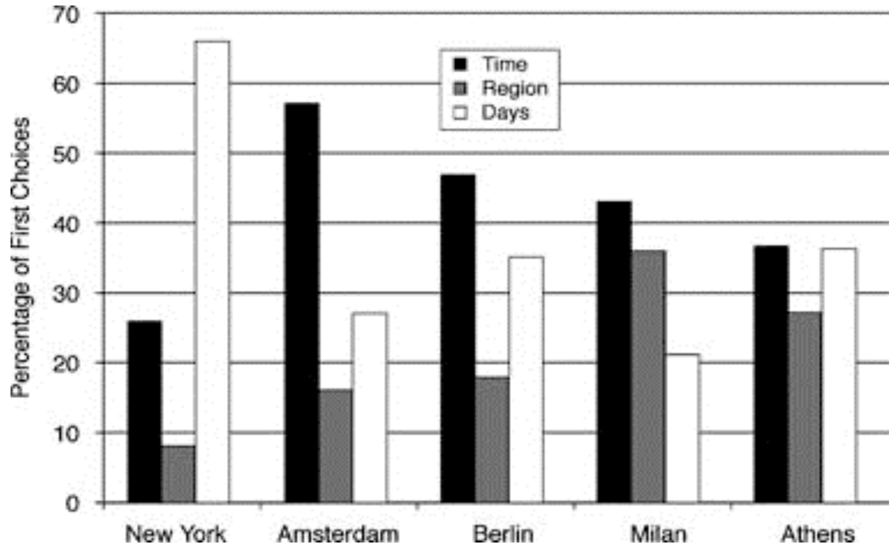

Figure 6. Interpretation of the statement "A 30% chance of rain tomorrow" (correct answers are counted in the white column[22]). Taken from [14], pag. 625

4. Linguistic ambiguities in statements used in communicating weather forecasts

Communicating weather information, whether probabilistic or categorical, in form of a verbal statement instead of a numerical one, implies a series of ambiguities in the information.

1. Information like the statement "*tomorrow it will probably rain*" (Italian: "*è probabile che domani piova*") is ambiguous first and foremost for the meaning of the word "*probably*". The Dizionario della Lingua Italiana [10] says that a probable event is an event "*we believe* […] *it may occur*" or also that "probable" is something that "*is next to truth or is apparently so, on the basis of reliable arguments, yet lacking absolute certainty*". There is an evident contrast with the meaning a meteorologist gives to the term, or with the scientific language. Consequently this communication is improper.[23]

[21] [24], through a survey in a large sample of American users, do not confirm the positive results found in [14] for New York, and also highlight some difficulties when probabilistic forecasts regard quantities which are not usually communicated in a probabilistic form or when information is conditioned by other events (the passage of a front). In the latter case, [24], highlight the public's need to understand the possible scenarios that may arise to better interpret the forecast.

[22] The quoted article says that interviewees where given three alternatives for the meaning of the statement "There is a 30% chance of rain tomorrow": "It will rain tomorrow for 30% of the time" (black column in the graph); "It will rain tomorrow in 30% of the region" (grey column in the graph); "It will rain on 30% of the days like tomorrow" (white column of the graph). The right answer is the third one. Note that the first two alternatives imply the certainty of rain in a given area or for a given period of time.

[23] The same ambiguity exists in English [15], but also in Spanish and in French. Please note that the same problem exists for the terms "uncertainty" [25], and "error".

2. The present form of communicating weather forecasts implies that the communication by the forecaster, regardless of methods, is not understood by the public, and that sometimes even forecasters themselves find ambiguous the meaning of the words used.[24] For example, typical statements of weather forecasts include "*Minimum temperatures: a slight increase* […]" (Italian: "*Temperature: minime in lieve aumento* […]"), the meaning of the term "*slight*"[25] is not always shared by forecasters.[26] Even more indefinite is the statement "*temperatures will see a tangible variation*" (Italian: "*temperature in sensibile variazione…*"); the term "tangible" is a synonym for "perceivable" (*percepibile*, [10]) which is an ambiguous term also because the temperature perceived is determined by humidity and wind. The frequent use of terms such as "*afternoon*", "*night*", "*in the early hours of the morning*", etc. do not allow in any way to identify precisely enough the time for an event. There is also a number of terms that concern different phenomena which are interpreted by the public as they were referred to the same phenomenon.[27] Finally, forecasts largely use words whose meaning is unknown to most part of the people, who often interpret them improperly (think of the association of the term "*anticyclone/high*" with "*good weather*") whose usefulness for the public itself appears to be irrelevant.[28] The words "*good weather*" themselves are full of ambiguities as confirmed by WMO "*Trying to define 'good' weather means to give raise to more questions than answers*."[29]
3. Verbal statements may also present ambiguities depending on recipients. Those ambiguities are basically linked to the impact a relevant event may have on the recipient's life also in relation to past experience of the event effects. The expression "*it is unlikely it will rain tomorrow*", for example, should be logically equivalent to "*it is very likely it will not rain tomorrow*". However, the perception of a listener may be different because in the first statement their attention is focused on the "*rain*" event, whereas in the second case it is focused on the event "*not rain*". A slight variation in the probability of an event may cause different reactions in accordance with the influence that the relevant event has on the routine of a listener's life: "[…] *people interpret a 'slight probability' of rain in London with a higher numeric probability than a 'slight probability' of rain in Madrid*."[30] Finally, it is necessary to consider a series of issues as the reactions provoked in users by two different statements with the same meaning, one expressed with a colloquial language and the other with a scientific language. It was discovered that, when a formal scientific language is used, the reaction of the public to an event implying some risks is less dependent on the emotional aspect and has a generally more reasonable, or orderly, response.

The World Meteorological Organization (WMO) itself is concerned with the "misunderstanding" issue of probabilistic information, as it highlights the chance of users confusing the probability of an event with the probability of damage. To overcome this problem, they suggest to match different intervals of probability with verbal statements as in the reports by the Intergovernmental Panel Climate Change [17]. I believe there are some objections that may be raised to this suggestion, some of which were already expressed by other authors.[31] It is not possible to transfer directly and *tout court* a method, and therefore a relatively unlikely damage, to the communication of information concerning meteorology and therefore to a more short-term risk. A more recent proposition put forward by WMO (Table 1), presented in a school of probabilistic forecasts[32] by an American weather forecast service researcher,[33] although an improvement to the previous one, confirms the ambiguities of the statements associated to specific probability intervals and generates confusion. The probability intervals corresponding to each statement are too large and users (but also meteorologists) do not clearly understand the relation between a certain

[24] Even when information is presented in a graphic form.
[25] The same applies to "*moderate*".
[26] An article [5] reporting on a survey carried out among meteorologists presenting weather forecasts on national TV networks in Spain states that a "slight" increase in temperature indicates an increase not over two degrees Celsius. After a conversation with one of the authors (Portela), I realized that there is a sort of implicit agreement among Spanish meteorologists on the meaning to be given to the word "slight".
[27] Consider the terms "downpour" (Italian: "*rovescio*") and "storm" (Italian: "*temporale*").
[28] Consider terms such as "*saccatura*", "*fronte*, etc. (English: "trough" and "front"), but also the ambiguity of terms such as "*scattered rain*" or "*heavy rain*" in English.
[29] [36], pag. 1
[30] [31], pag. 19.
[31] On this topic see also [21],[3],[1],[25].
[32] III Mediterranean School On Mesoscale Meteorology, 26-30 May 2008, Alghero, Italy.
[33] National Oceanic and Atmospheric Administration, NOAA.

numeric value of probability and a corresponding statement. In other words, the table suggests an association that cannot occur spontaneously without any training. That suggestion is still based on the prejudice that users are not able to understand probabilistic information in a numeric format when, as said above, the main difficulty depends on the misunderstanding of an event.

Alternatively to verbal information with an uncertain statements, the WMO presents different types of graphic representation of probabilistic information (Figure 7). However, also information in an iconic format may represent critical ambiguities. Though it can be more rapidly displayed, a graphic representation may give rise (without a shared standard) to completely different and unrelated interpretations unless it is matched by verbal or numeric explanations.

Finally, there are some studies in progress trying to summarizing the various communication methods, also in order to create an "intelligent" system able to generate and manage the whole process.[34] However, Michael Bond is right when he states in the pages of the New Scientist: "*weigh up all the facts and remember, when it comes to risks, feel the numbers*".[35]

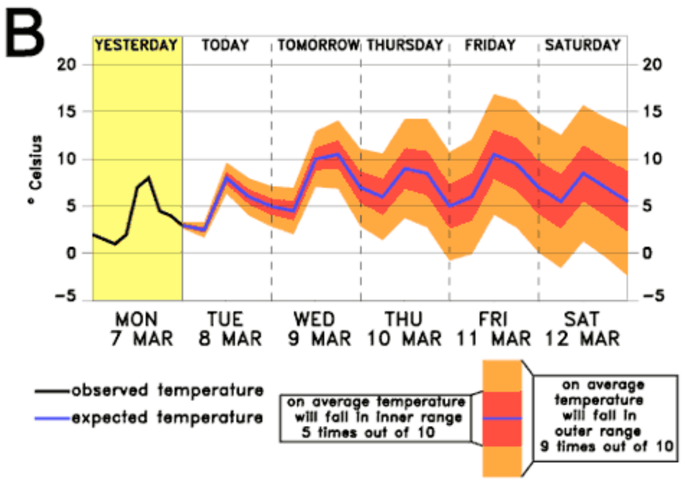

Figure 7. Graphic format of rainfall probabilistic forecast by Met Office (UK). Taken from [36], pag. 12.

Verbal statement	Event probability(p)
Extremely Likely	p>99%
Very Likely	90%<p<99%
Likely	70%<p<90%
Probable – more likely than not	55%<p<69%
Equally likely as not	45%<p<55%
Possible – less likely than not	30%<p<45%
Unlikely	10%<p<30%
Very Unlikely	1%<p<10%
Extremely Unlikely	p<1%

Tabe 1. WMO Likelihood Scale. Taken from [16].

[34] See for example [33],[38],[9].
[35] [7], pag. 34. This statement is confirmed in [24].

5. Hurricane Charley

When Hurricane Charley struck Florida, the national weather service issued a forecast with a "cone of uncertainty" (Figure 1). The most likely trajectory (black line) and the terminology used confused non-expert users. The phrase "*cone of probability*", given the abovementioned ambiguity of the term "probable" caused the people (although within the cone of uncertainty, but living outside the most probable trajectory) to minimize the risk, and great damage was suffered by humans and goods. The hurricane's trajectory, although still inside that said cone, did not correspond to the most probable trajectory, and this gave rise to the perception of a completely wrong forecast. Besides, the reaction from the public differed depending the terminology they heard. Terms used by the media such as "cone of death" or "cone of terror" drew the public's attention giving sometimes rise to emotional panic reactions, completely out of proportion. On the contrary, technical terms such as "cone of uncertainty", "cone of probability" and "cone of error" gave rise to a proper analytic reaction only in the public able to correctly interpret those terms. However, American researchers claim that, in general, the users perceived expressions such as "cone of uncertainty" or "cone of error" as if they expressed uncertainty and ignorance from the forecasters. The NRC itself points out that "*The failure of both end users and even the (presumably more sophisticated) media to correctly interpret the cone of uncertainty resulted, in the aftermath of Hurricane Charley, in such frustrated statements by members of NHC as: "if anything needs improvement, it is the interpretation skills of the local weather media" [...]. More important perhaps is the realizations that forecast products, either to end users or intermediaries, need to be designed with full defensive awareness of the limitations in numeracy and analytic processing skills that they may encounter.*"[36]

Conclusions

Weather forecasts are public goods aimed at safeguarding goods and lives and if related decisions on actions to be implemented depend from weather forecasts, evidently special care should be taken in the communication process. If attention is to be placed in the production of information from weather services, on the other hand the public should be given the tools to understand the information conveyed. Besides, considering the impending extreme phenomena possibly related to climate change, proper information on issues that concern vested interests at political and economic level may strengthen public control on a type of knowledge that can drive decisions makers. Some[37] may even want to patent it as already happened to biotechnologies.

Therefore, in-depth surveys[38] should be carried out on relevant samples of users and of meteorologists in order to understand what is the best way to communicate uncertainty. The starting point for such a research should be the works mentioned in this article.

However, there are at least two pending issues previously mentioned in this article.

1. How to use rationally forecasts should be discussed, given that their production and their use are related to a very complex decision-making process which also presents critical points that should carefully considered by those who work on the preparation and the spreading of weather forecasts. Individuals tend to simplify decision-making tasks according to their cognitive limitations conditioned, for example, by limited decision time or other relevant factors. Quite essentially, here the communication process is central again, because decisions are strongly conditioned by the methods used to categorize a risks, i.e. the methods through which decision-makers received information crucial in the decision-making process. In the relevant literature I have not find any work concerning decision-making process issues influenced by forecasters, except an article by Nicholls [28]. On the contrary, wide is the literature concerning decision-making of generic users. However, prescriptive theories concerning decision-making processes cannot completely grasp the reality which has so many facets and chances of success even when apparently incorrect paths are followed. Vice versa, descriptive theories cannot definitely describe reality. All in all, despite the existence of good prescriptive and descriptive arguments, theories on judgment and decision-making

[36] [29], pag. 24. this text includes an interesting discussion on the reaction of users at the time of Hurricane Charley. A more detailed report is in [8].

[37] On this issue please see [22],[23].

[38] A pending issue is who should carry out those surveys. For a possible solution see note 40.

are hardly exhaustive, although they are necessary because "*with the progress of civilization, whims of nature have grown less important and decisions by human beings have grown more important*".[39] For all that, the communication process, when it is to adapt to the viewpoint of users, needs collaboration from suitable professionals, as NRC recommends[40] ("*NOAA should acquire social and behavioral science expertise including psycholgist training in human cognition and human factors, with training in behavioral decision theory, statistical decision theory, survey design and sampling, and communication theory, with special focus on graphics and product development.*" [41]) in order to create a user-friendly communication of the scientific information issued by meteorologists. As rightly stated in the Guide for weather forecasts users published by the European Center[42] of Reading "*The road to introduce a rational understanding of the best way to make use of weather forecasts in general and probability forecast in particular will be long, but full of interesting challenges.*"[43]

2. The second pending issue concerns the training not only of forecasters, but also of users. As NRC recommends: "*The research and development of communicating uncertainty will include and lead to education and training of all parties participating in generating, communicating and using hydrometeorological forecasts. [...] Education initiatives [...] include a wide variety of participants – from elementary school teachers and students to emergency managers, media managers and communicators*".[44] And the (WMO) also states: "*For a warning or a forecast to be successful, in addition to its accuracy it has to be disseminated and presented in a way that allows the intended users to actually receive, understand, believe and act upon the information. An effective public weather services programme will always aim to enhance: User awareness […] User understanding […] User faith*".[45]

Translated by Massimo Caregnato

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[39] [36], pag.364

[40] Recently the US has seen the establishment of WAS*IS (Weather and Society*Integrated Studies), a consortium made up by NOAA, National Center for Atmospheric Research (NCAR), University Corporation for Atmospheric Research (UCAR) with other scientific institutions. An Australian branch was then founded. The purpose of the consortium, available at http://www.sip.ucar.edu/wasis/objectives.jsp, is: "To establish a framework for (a) building an interdisciplinary community of practitioners, researchers, and stakeholders - from the grassroots up - who are dedicated to the integration of meteorology and social science, and (b) providing this community with a means to learn about and further examine ideas, methods, and examples related to integrated weather-society work."

[41] [29], pag. 37

[42] European Center for Medium-range Weather Forecast (ECMWF)

[43] [34], pag. 84

[44] [29], pag. 87

[45] [35], pag. 3

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