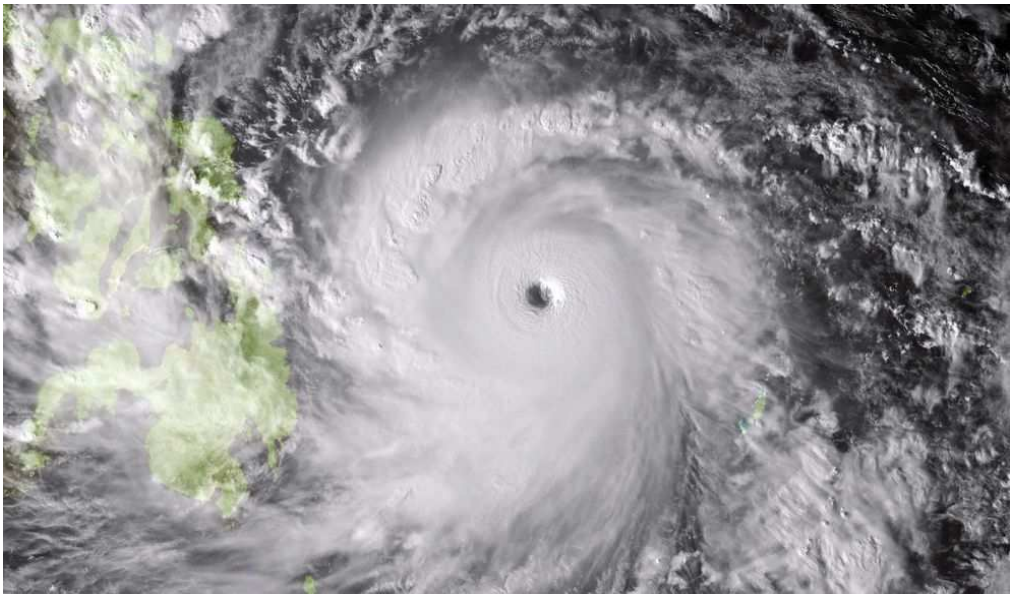
Typhoons, hurricanes and cyclones

The typhoon in the Philippines and the flood in Sardinia

On November 8, 2013 typhoon Haiyan (in the photograph) hit the Philippines with winds reaching 315 km/h on the ground, and waves over 5 m high.



An image of typhoon Haiyan crossing the Leyte Gulf, taken by the Japan Meteorological Agency. Credits: Zuma/rex

A destructive power unlike any other event recorded in the past, even if the Philippines are often stuck by this kind of natural calamity. Many people were evacuated from their homes, however most of the buildings in the archipelago were not able to stand up against the passage of such violent weather conditions and such strong winds and this strongly affected the final number of victims and missing people, and the damages caused by the action of Haiyan, which also included a long interruption in telecommunications. It was a fury that swept away all it met, as can clearly be seen in the images.

A survivor stands on the rubble left behind by the typhoon Haiyan at Tacloban, one of the cities that was hit most violently. Credits: Noel Celis/AFP Getty Images

An average of 20 typhoons a year hit the Philippines, besides a number of accidents caused by floods, and also by drought, earthquakes and tremors, and occasional volcanic eruptions, making the Philippines one of the countries that are most affected by natural calamities in the world.

With regard to Italy, a cyclone (that the media named Cleopatra) hit Sardinia on November 18, in particular in the provinces of Olbia and Nuoro. In only few hours 450 mm of rain fell in the area (450 litres per square metre, about half of the total annual rainfall in Sardinia, which amounts to 1000 mm), with gusts of wind reaching up to 100 km/h. The exceptional event provoked river flooding in the area, roads and houses were flooded, bridges collapsed and there were also electricity black-outs.

A house in the countryside hit by the floods in Sardinia (Credits: Ciro Fusco, Ansa)

The two events do not have a climatic and meteorological connection, however they have some common points.

First of all, what is the difference between typhoons, hurricanes and cyclones? And, how do they form?

Are they all the same ? Distinguish between typhoons, hurricanes and cyclones

Hurricanes, cyclones and typhoons belong to the same meteorological phenomenon and are classified as tropical cyclones, and the names change depending on the geographic origin of the phenomenon. In the Atlantic and in the North Eastern Pacific areas, we speak of hurricanes (as for example hurricane Sandy and hurricane Katrina), that derive from Hurrican, the Caribbean God of evil. In the North West Pacific area, instead, we speak of typhoons (as in the case of typhoon Haiyan), and the term has an uncertain origin, perhaps it derives from a Greek or Chinese word with a similar sound that indicated a tempest. And events with origin in the Indian Ocean are known as cyclones due to the circular shape of the phenomenon.

For a tempest to be classified a typhoon, hurricane or cyclone, the speed of the wind must be at least equal to 119 km/h. Besides the geographic area, also the period of the year in which these events can take place changes. From June 1, to November 30 you may encounter an Atlantic hurricane, from mid-May to the end of November, and from the end of June to the end of November, some events may occur in the North Eastern Pacific and North Western Pacific areas respectively; while the cyclone-season in the Indian Ocean stretches from April to December.

As in the case of earthquakes, there is a scale to classify the intensity of tropical cyclones, called the Saffir-Simpson scale, that was developed in 1969 by two scientists, Herbert Saffir and Robert Simpson. The scale is subdivided into 5 categories, from 1, minimum level to 5, disastrous intensity level, used for phenomena with winds blowing at a speed over 252 km/h, as for example, Haiyan.

Unlike earthquakes, however, in the case of typhoons the problem is not in the forecast, but in being able to react to the calamity. The arrival of a cyclone in fact, can be foreseen about 2-3 days before, and the probability that it may occur is 90-97%, while 10 days before the event the same probability drops to 70%. It is much more complicated to succeed in forecasting the path of a cyclone, due to the influence of local factors.

You must have noticed that cyclones always have a name. Who chooses the names, and how? Tropical cyclones are named with names of people in order to make communications easier among the meteorologists, and also for the public, as it is easier to remember a name than a technical term or a number. Experience has shown that using short distinguishing names makes written and oral communications easier and furthermore, there are minor possibilities of errors than with the old identification methods that used latitudes and longitudes. The choice of the name is made using an alphabetical list that has already been written by an international commission of the World Meteorological Organization. Six lists are used and rotated, and can be consulted here: (http://www.wmo.int/pages/prog/www/tcp/Storm-naming.html).

The only case in which a change in name is foreseen, is for extremely destructive phenomena, where future use of the same name is considered inappropriate due to public sensitivity.

How does a hurricane form?

So that the environmental conditions that are favourable for the formation of these violent phenomena are created, the following ingredients must coexist: sea water temperature above 26°C, intense evaporation, presence of a central low pressure area surrounded by high pressure areas and converging winds, and humidity. These conditions are necessary, but are not fully sufficient as the phenomena with these favourable characteristics do not always develop. Hurricanes draw their energy from hot, very humid air that can be found only in ocean areas in the tropical belt. When the air converges and rises, the weather front forms, and can grow till it becomes a hurricane. The convectional movement of the hot and humid air that rises and the descending cold, denser air generates an extensive whirlwind which forms a cone, surrounded by currents that move from down upwards in a spiral motion that carries the humid air to the higher altitudes. The favourable conditions to generate a cyclone can be found between the 8° and 20° latitudes, at a distance of 500 km from the Equator. Besides the circulating movement of the air from up downwards, there is also a rotating movement that determines the path of the phenomenon.

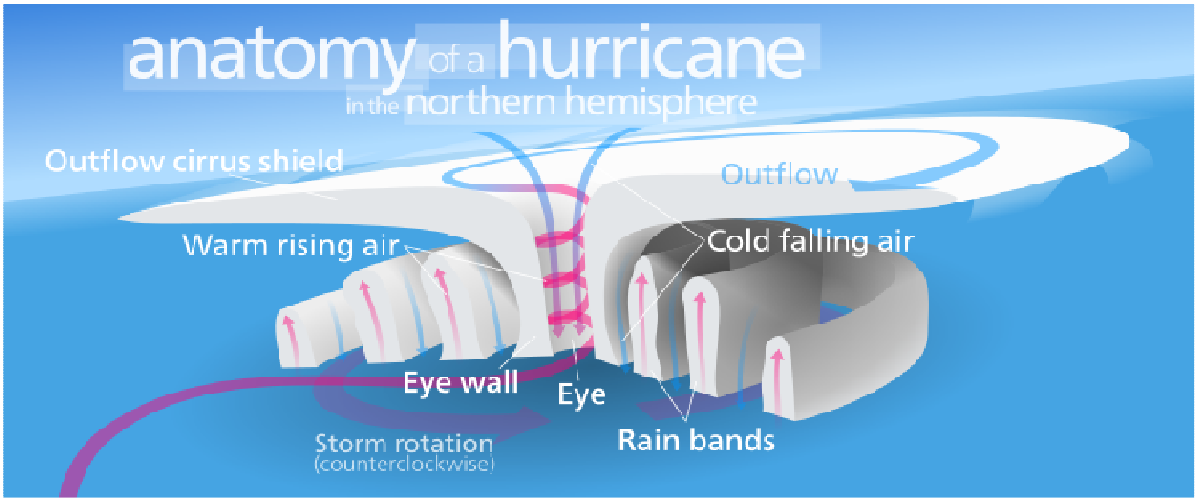


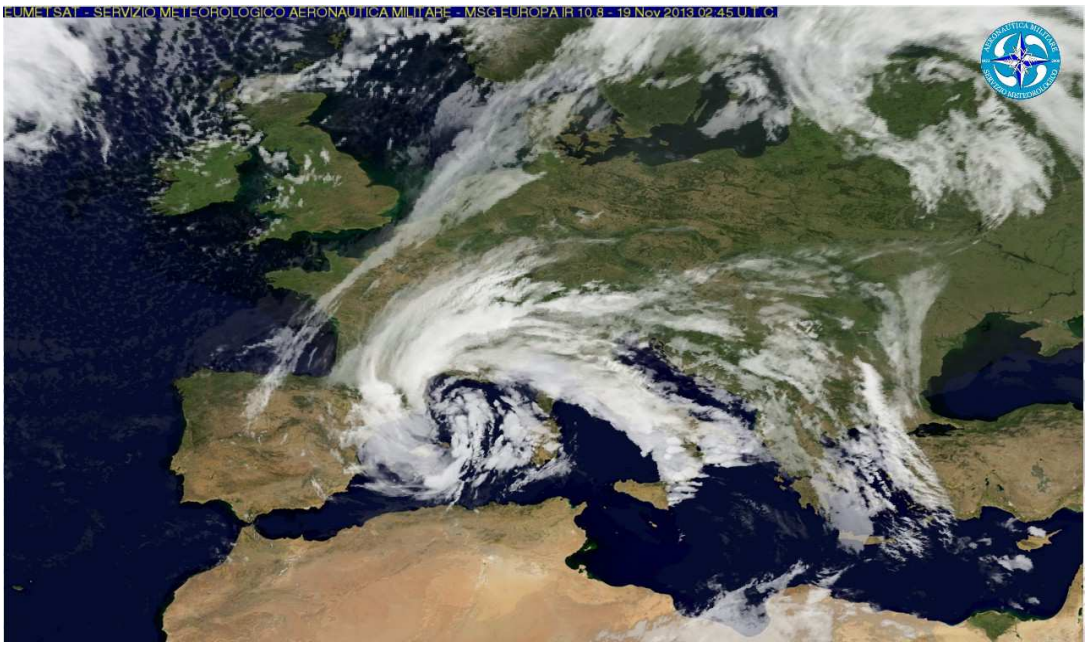
Diagram of a hurricane forming in the Northern Hemisphere. Credits: Kelvinsong (Own work) [CC-BY-3.0 (http://creativecommons.org/licenses/by/3.0)], via Wikimedia Commons

Inside the cone, is the eye of the cyclone, an area with an average diameter of 25 km, that is relatively calm and has no clouds due to the subsidence movement (falling downwards) of the air.

Have you ever heard someone say “to be in the eye of the cyclone”? This means someone who is in a difficult position or the most frantic moment of a situation. Around the eye, the entire system rotates in a spiral movement, and the edges consist of a very thick layer of clouds, a wall that extends from the surface right up to an altitude of 15 km, known as an eyewall.

Around the eye is a vast region with an average diameter of 500 km, where the tempest rages with gusts of wind over 200 km/h, very intense rain and lightning. As the hurricane moves towards and reaches the mainland, it loses intensity, however it leaves huge damages behind and the destruction of the coastal cities.

As mentioned above in the previous paragraph, the cyclone that hit Sardinia is not a real cyclone, it is defined a TLC – a Tropical Like Cyclone, which gathered force on the Mediterranean Sea. The satellite images show that this type of weather front has elements in common with cyclones, i.e. the presence of an eye around which the clouds rotate in a spiral, however they do not reach the same intensity and develop in environments that are drier, and with less humidity. Due to their geographic origin, they are known as medicanes, joining the words Mediterranean and hurricanes . Although the meteorologists are aware of the factors that are necessary for a medicane to develop, unfortunately these events are difficult to foresee, because they are conditioned by numerous processes and uncertainty factors.



A satellite image of the weather front that hit Sardinia.
Credits: Servizio Meteorologico dell'Aereonautica Militare (The Italian Military Aeronautics Meteorology Service)

Climate change, hydrogeological instability and extreme events.

Events of this type are part of the meteorological and climatic history of our planet, and in the 17th century, a missionary recorded the fury and the devastations produced by typhoons in the Philippines. Haiyan and the tempest in Sardinia are rare events, however they are not entirely exceptional, as they however occurred in a period of the year when these phenomena usually take place.

However, what the scientists have noted in the past years, is not so much an increase in the frequency, in other words the number of times these events occur in a year, but an increase in the intensity and the violence with which these weather conditions hit the areas. What is exceptional is not the event itself but the number of these extremely violent events.

The cause of this increase, both in the case of Haiyan and the event that occurred in Sardinia, is mainly the climate change that is taking place. Storms like hurricane Sandy last year, or Katrina, are no longer rare events of an exceptional intensity, they are almost becoming the rule. The fifth report of IPCC Intergovernmental Panel on Climate Change, the scientific body of the United Nations that studies climate change) confirmed that extreme events will probably be more frequent and more intense.

But how are these influenced exactly? Climatologists believe that climate change can influence these events in three ways. First of all global warming causes a rise in the sea level, which in turn amplifies the storm waves and floods associated with cyclones, hurricanes and typhoons. Secondly global warming increases the humidity content of the air, causing more rain and amplifying the floods during the hurricanes. Lastly an increase in the temperature of the ocean water implies the release of a greater amount of energy, which feeds the hurricanes.

Besides the intensification of these phenomena, another factor that is particularly important, that concerns extreme events is the hydrogeological instability of the areas in which the events occur. The cyclone, or better the medicane in Sardinia was not a novelty in the island, in fact extremely critical events have taken place almost yearly over the past 15

years. In the study carried out by the Italian Ministry for the Environment in 2008, *"Il rischio idrogeologico in Italia"* (The hydrogeological risk in Italy) the number of municipalities in Sardinia with a high hydrogeological risk is very large, a total of 306 municipalities, equal to 81% of the total. The situation therefore should be given great attention, however unfortunately not enough care has been taken in urban planning in the territory, i.e. the plans in which it is indicated where and how to build. The Sardinian coastal areas are highly urbanized and too much has been built up without taking the needs of the area into consideration sufficiently, furthermore some buildings have not been given permission and therefore are built unlawfully, and in some occasions have been condoned by new redevelopment programmes. Even though their influence is indirect, also human beings have an influence on these catastrophic events, it is very important to be aware and to acknowledge what is taking place so as to be able to face these emergences and to foresee them.

Prevention is better than cure

Prevention is better than cure! How many times have we heard this said in order to convince us to do something immediately, in order to draw greater benefits in the future? Also in this case, the proverb is perfectly fitting.

But, can hurricanes, typhoons and cyclones be foreseen? And what can we do to avoid bitter and expensive cures? Even though they are dramatic and disastrous, tempests are natural events and cannot be avoided. However, thanks to the progress made in meteorology, we can know, some days beforehand, with a small margin of error, when these natural calamities will strike. In the areas at risk it is possible to carry out a series of interventions before and after the event, in order to prevent very dramatic consequences. Mitigating interventions are subdivided into two main categories: Structural interventions, with the intention of reducing the frequency and severity of the danger (such as activities to carry out maintenance and consolidation of buildings or of the river banks), and Non-Structural interventions, which instead try to reduce the consequences (as in the case of intervention plans to help the civil population). An example of the success of this strategy in fact regards an area that is frequently hit by cyclones, the region of Orissa, in North East India. On October 29, 1999, a super cyclone hit the area with winds up to 260 km/h, torrential rains and floods. Thousands of people were wounded and died, and hundreds of thousands of houses were destroyed and the estimated damages amounted to 4.5 billion dollars. Considering the high risk of cyclones in Orissa, when faced with such a disastrous and dramatic event, the Authorities decided to intervene, in order to avoid similar damages occurring again. They studied an emergency plan that regarded Structural and Non-Structural interventions, such as: planning of evacuation paths, suitable shelters and supply of food, and also interventions in order to preserve the rural areas and a limit of 500 m for the development of the coastal areas. On October 13, 2013, a cyclone with similar characteristics and force, Cyclone Phailin, put these interventions to the test, and the results were excellent, the estimated damages dropped to 696 million dollars and the victims decreased drastically.

Unfortunately these interventions that are carried out beforehand are often very expensive or cannot be carried out practically, and therefore often actions are postponed and carried out only when the events have already taken place. According to the Italian environmentalist association Legambiente, the sum allocated by the Italian State for defence of the soil is about one third of the amount spent for the emergencies, with sums paid for isolated interventions on the Italian territory and not for more extensive prevention works . In the last years the scientific community has been studying new low-cost Non-Structural solutions that can be applied in the developing countries and in the developed countries. One of these systems is the Early Warning system, and the first applications have shown satisfactory results, reducing the risk connected with typhoons, hurricanes and cyclones.

Edited by Nadia Mirabella