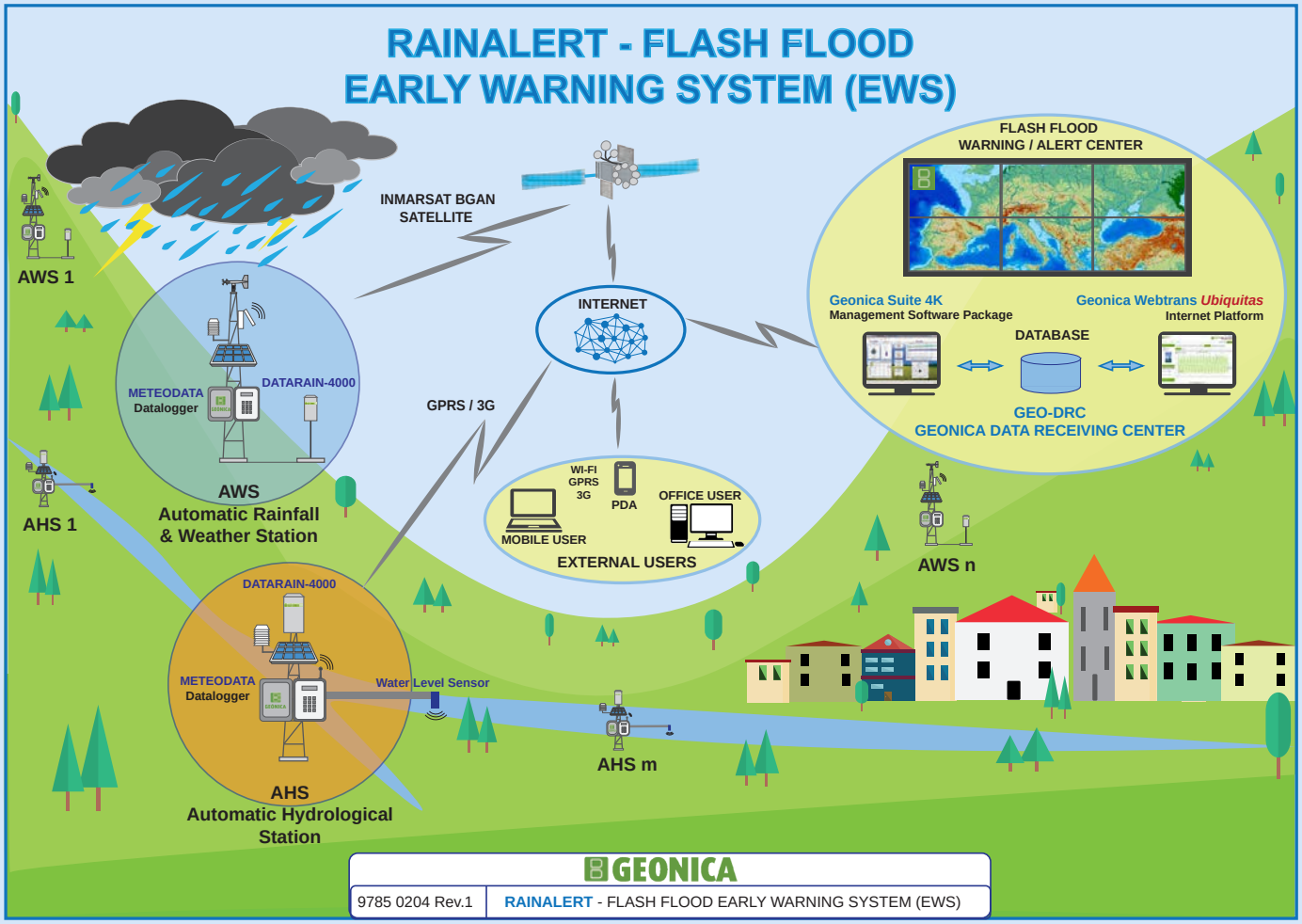
RAINALERT

Early Warning System (EWS) of Flash Floods & Heavy Rains



- REAL AND ACCURATE MEASUREMENT OF RAIN, WATER LEVELS & LIGHTNING
- IMMEDIATE PRE-ALERTS AND ALERTS
- CONTINUOUS AND AUTOMATIC MONITORING
- REAL TIME TRANSMISSION OF ALERTS, DATA AND IMAGES
- REAL INFORMATION FROM FIELD STATIONS, NOT PREDICTIVE
- RELIABILITY, ROBUSTNESS AND TOTAL AVAILABILITY OF THE SYSTEM
- ADAPTATION TO THE SPECIFIC CHARACTERISTICS OF EACH PROJECT

INTRODUCTION

RAINALERT System has been designed by **GEONICA** based on our advanced **HYDROMET** solution, in order to solve one of the most frequent emergency situations in a large number of urban and rural areas, road infrastructures, as well as for application in industrial plants, farms, etc., in which case, due to the terrain orography and proximity to rivers or streams, they have a high risk of flooding as a result of very intense and sudden rains, aggravated by the negative effects of climate change.

A **typical situation** of this type of emergencies usually occurs in cities or localities crossed by rivers whose flow comes from the confluence of a number of streams in mountainous zones located upstream that, as a funnel, concentrates the water flow towards the main river, causing a rapid and violent flood to the city.

RAINALERT Early Warning System (EWS) for heavy rains and flash floods supports the following main functions:

- **Continuous measurement of the precipitation in the basin and the level in the rivers and streams** that converge towards the main river crossing the city/location, as well as other environmental parameters, through the installation of a Hydro-Meteorological network covering the area of interest.

- **Recording all data** by the measurement stations and definition of the alert thresholds based on the evaluation of precipitation intensity trend and persistence, as well as rising rate of the level of rivers.

- **Automatic transmission of data and alerts to the Central Emergency Station**, managed by Local and Civil Protection authorities.

- **Dissemination of alerts to the population.**

DESCRIPTION OF THE SYSTEM

The **RAINALERT System** consists of a network of automatic meteorological stations to measure precipitation, covering the whole catchment area, plus other hydrometric stations to measure the level / velocity / water flow, in several strategic points of the river or stream to be monitored. That is, a certain number of Rainfall and Hydrometric Stations, equipped with an adequate data transmission system for sending immediately all the information to a Central Emergency Station, alerting about the event in time to the Local and Civil Protection Authorities, as well as to the population, for reducing as far as possible the impact of the damages, but above all, to avoid the loss of human lives.

If the intensity and persistence of the precipitations are sufficiently strong and lasting, then the drainage and sewage system of the city or locality will be totally insufficient, causing the flooding of the streets, houses, basements and garages, producing irreparable damages in furniture and appliances, vehicles, etc. This entails substantial economic losses, and in some cases, the unfortunate loss of human lives.

Frequently, these events occur in an extraordinarily fast way, so that the population is suddenly surprised by the flood, often during the night, reaching in a matter of 30 or 40 minutes, water levels up to several meters high with respect to the ground floor level of the houses, so that people are not able to react to such situations, unless it is decided to install an alert system such as the one proposed by **GEONICA**.

RAINALERT / HYDROMET Station with METEODATA Unit

The **RAINALERT System** must be configured according to the particular characteristics of each case. To this end, **GEONICA** analyzes the particular orography of the area, drawing up a technical-economic proposal well-adjusted to the specific features of each project.

Apart from the measurement of rainfall and the level of rivers and streams, the system can optionally incorporate the measurement of several other meteorological parameters, such as ambient temperature, relative humidity, wind and even the humidity saturation conditions of the ground. Also sensors and detectors of storms and lightning can be incorporated, as indicated in another section of this document.

It is very important to point out that the alerts generated by the **RAINALERT System** are not based on the meteorological information coming from predictive models fed with satellite data and other types of observation of the atmosphere, such as those used by the Meteorological Services of most of the countries and that are also reported on television, but in the monitoring in real time of the rain intensity and the rate of growth of the accumulated rainwater volume, as well as the rate of increase in water level.

Therefore, from the moment the event begins to occur, the **RAINALERT System** is already operational and able to start generating alerts in the form of pre-alerts and alerts of different risk levels. Hence its effectiveness in working with data and trends updated continuously and not with information from predictions that lack sufficient spatial and temporal resolution to determine the imminence of certain risk in a very specific area.

Obviously **RAINALERT** is not exclusive regarding the use of predictive models with data from satellite observations, or Meteorological Radars, etc., but in any case complementary. In fact **RAINALERT** allows the incorporation of short and medium range meteorological radars to monitor the intensity of rainfall, as well as the evolution and displacement of storms, in the vicinity of the risk zone.

CONFIGURATION OF AUTOMATIC MONITORING STATIONS

The measurement network of **RAINALERT System** is made up of a number of Automatic Measurement and Transmission Units, such as **GEONICA**'s datalogger model **METEODATA**, each of which supports the connection of the following sensors:

- **DATARAIN-4000 Electronic Weighing Digital Technology Precipitation Sensor** with very high resolution (0.01 mm), very high weighing accuracy (0.02%), large measuring range (0 to 2000 mm/h) and unlimited capacity, due to its patented automatic emptying solution.
- **RADAR Water Level Sensor** with measuring ranges of 8, 15 or 35 meters and accuracy of 2mm (1mm in averaged measurements).
- **Doppler sensor for velocity / water flow measurement** in rivers and channels.
- **DIGICAM-3K Digital Color Camera** with very low power consumption and direct connection to **METEODATA** station for taking color images.
- **Lightning detector and sensor** for determining the storm activity and risk of imminent discharge, respectively.
- **Other optional Meteorological sensors** for measuring Ambient Temperature, Relative Humidity, Pressure and Solar Radiation with **PTHR-4000 Multisensor,** Wind Speed and Direction, Soil Moisture, etc.

DATARAIN-4000
Electronic Weighing Precipitation Sensor

The description and technical features of each of these elements are available in the corresponding specific brochures.

OPERATING AUTONOMY OF THE AUTOMATIC STATIONS

METEODATA stations, are ultra-low power consumption dataloggers, with fully compact mounting in a robust outdoor cabinet (protection IP66 / IP67), inside the main electronic board is located, plus the GPRS / 3G / 4G modem, as well as the power supply unit, which includes the battery pack and the charge regulator circuit for connection to an external solar panel or to the mains 110-230 VAC when it is available in the site.
This configuration ensures a total operation autonomy of the station and sensors connected to it, of up to several days in case of lack of recharge due to grid drop or absence of solar radiation on totally cloudy days.

METEODATA station is also equipped with a complete set of protections against atmospheric discharges and other possible external electromagnetic inductions, so that its operation is guaranteed to a maximum degree.

COMMUNICATIONS AND TRANSMISSION OF DATA AND ALERTS

The Automatic field stations that are part of **RAINALERT**, have a bidirectional and redundant communications system. Normally, the data and alerts are transmitted by the stations through a built-in GPRS / 3G / 4G cellular modem.

Additionally the remote station is also equipped with a second bidirectional communications channel, the **INMARSAT BGAN** (Broadband Global Area Network) Satellite, essential in cases in which the GPRS / 3G / 4G cellular coverage does not exist or is deficient. Both communication channels can be used alternatively or redundantly.

INMARSAT BGAN Satellite Transceiver

In addition, **RAINALERT** bidirectional communications allow to manage from the Central Station, the operation of the remote measurement units, anticipate a possible incidence, avoiding it, as well as to perform a remote self-diagnostic test to check the correct functioning of the stations, thus reducing the number of journeys of maintenance technicians, which increases their efficiency and reduces the costs associated with the service.

Experience has shown that terrestrial communications using point-to-point radio links with or without intermediate repeaters, as well as mobile communications networks, present serious drawbacks, since in case of severe storms with strong electrical discharges, radio equipment can be seriously affected and even stop working, with the serious problem that this poses for emergency management.

To minimize the effects of communication failures, the **RAINALERT** system allows the implementation of automatic communications redundancy. The system monitors the communication channel that has been established by default (main channel) and in case of repeated communication failures, it automatically switches to a redundant communication system (secondary channel).

METEODATA
Data Acquisition and Transmission Unit (3G/GPRS, Line, Radio & Satellite)

The **RAINALERT** system allows the implementation of up to 3 redundant communication channels.

During the time in which the system continues working with the redundant communication channel, the main communication channel is still monitored to determine when it is operational again. After detecting that the main channel becomes operational again, **RAINALERT** changes back automatically to normal operation.

The main communication channel is usually configured by criteria of transmission cost, bandwidth and optimal coverage conditions at remote sites. Therefore the automatic recovery of this main communication system has important benefits for the customer in terms of costs and optimization of system operation.

IMMEDIATE TRANSMISSION OF ALERTS, DATA AND IMAGES

The transmission of the data and alerts by the remote stations is done in real time, by the indicated channels, to the Central Emergency Station. Based on all the information received, the local authorities and Civil Protection must manage this information and its dissemination to the population, applying the corresponding emergency protocols.

Apart from the previous scenario, automatic stations of **RAINALERT System** also generate by themselves **pre-alerts and alerts** that are immediately transmitted to certain authorities by SMS messages and emails, from the same moment in which the intensity and duration of rainfall, or the analysis of the evolution of the water level / velocity / flow, allow to establish a certain threshold of sudden flood risk.

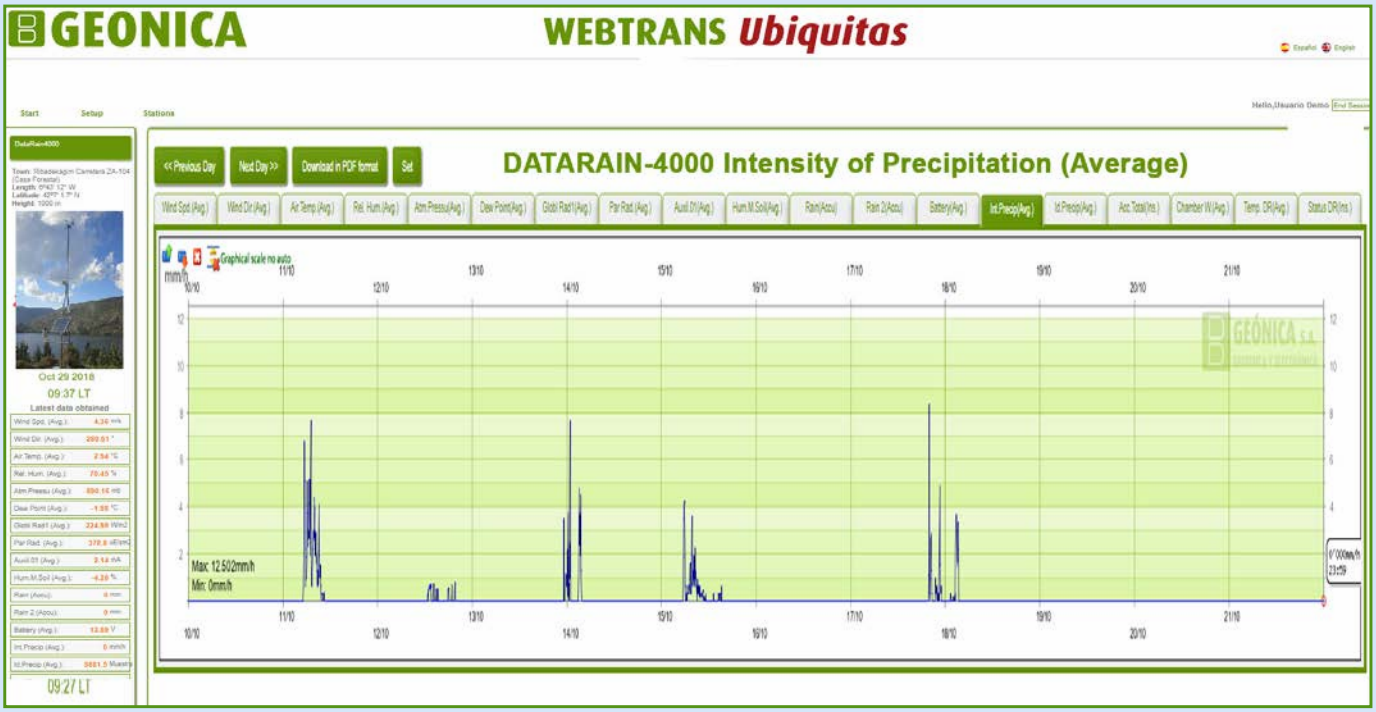
The continuous evaluation of the trend or evolution over time of the data, enables our system to carry out a monitoring of the risk situation permanently, so that its efficiency as an **Early Warning System** is guaranteed by using data in real time and not predictions, whose information is obviously subject to many uncertainties, because these events are usually very localized in space and time, so, in practice, predictive models, no matter how advanced, are shown unable to give an adequate response to these situations.

In certain locations, especially in the measuring points of the level of the rivers and streams, the **RAINALERT System** allows, optionally, to connect to **METEODATA** station a digital camera of very low power consumption, for taking images, for example of the river level, which they are transmitted by the same communication channels described above in an automatic/sequential mode. It is also possible to request the image by means of a manual command from the Central Emergency Management Center.

That is to say, the Local and Civil Protection Authorities immediately have the necessary information to alert the emergency brigades themselves, without relying on warnings from the meteorological institutions of each country, based generally on predictions that suffer from insufficient spatial resolution and a long time horizon of several hours, but not in perfectly localized and real-time data, as the **RAINALERT System** offers.

DISSIMINATION OF PRE-ALERTS & ALERTS TO THE POPULATION

With the information received in the Server of the Emergency Center, the **RAINALERT System** generates automatically and with real-time update, a database with all the information, including the alerts produced; all of which is made available to the Civil Protection Authorities in charge of emergency management for the dissemination of alerts to the population by the means they consider appropriate and based on the corresponding protocols.



Regardless of the alerts management carried out by the Civil Protection Authority, the **RAINALERT System** allows the optional use of the **WEBTRANS *Ubiquitas*** Internet Platform installed on the same Server. All the information in the database, such as rainfall, river levels and generated alerts, and even the images captured by the optional cameras, is uploaded to the **WEBTRANS *Ubiquitas*** Internet platform, in which said information is presented in numerical and graphical form, updated every 1, 2, 5 or 10 minutes (programmable).

Therefore, with the Internet Platform **WEBTRANS**, the information and optionally the images, is made available to the interested population, from any fixed or mobile device with Internet access. A demonstration of this platform can be seen at: http://demowebtrans.geonica.com

STORM AND LIGHTNING ALERTS

It is important to note that **LIGHTNING ALERT System** designed by **GEONICA** can also be integrated as part of **RAINALERT** solution.

The **LIGHTNING ALERT System** is based on a device that measures the intensity of electrostatic fields (high voltage gradients measured in volts/m) that occur in nature due to the accumulation of electrical charges in storm clouds.

The device is installed outdoors, integrated with the **RAINALERT System**, in such a way that, when a certain threshold of the electric field gradient is exceeded due to the accumulation of electric charge in the clouds to create a danger of falling lightning, a warning signal is transmitted to the Central Emergency Station, as well as by SMS messages to the corresponding authorities.

Likewise, **LIGHTNING ALERT System** can incorporate a detector device of the rays that are produced in an environment of tens of kilometers around the detector as well as the distance of the discharge to the measurement point, so that the tracking of the series of rays detected allows to assess the risk of the storm getting too close to the point or location to be monitored.

In short, **LIGHTNING ALERT System** is designed to determine when there are conditions that favor lightning strikes in the local area. On the other hand, the complementary use of a "detector" is an ideal method to confirm the stormy activity around the locality or point to be protected.

In addition to its integration in **RAINALERT**, the main applications of **LIGHTNING ALERT System** are the following:

- Military installations, such as deposits of explosives and powder kegs
- Power generation & distribution facilities: Power Plants Generation Plants, Electric Substations, etc.
- Quarry Blasting
- Aerospace
- Hazardous Materials Management
- Atmospheric Research
- Oil and Gas Storage and Transfer Facilities
- Deposits of pyrotechnic material
- Fixed Base Operations (FBO) and Land in Airports
- Golf courses and swimming pools
- Operations with Cranes / Heavy Equipment
- Constructions and Works
- Public Acts and Outdoor Recreation Activities