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*Al servicio  
de las personas  
y las naciones*

NUEVAS TECNOLOGÍAS Y  
PROGRAMAS INFORMÁTICOS  
PARA CAPTACIÓN,  
PROCESAMIENTO E  
INTERCAMBIO DE  
INFORMACIÓN PARA EL  
**SISTEMA DE ALERTA  
TEMPRANA (SAT).**



## **NEW TECHNOLOGIES AND COMPUTER PROGRAMS FOR CAPTURING, PROCESSING AND THE EXCHANGE OF INFORMATION FOR THE EARLY WARNING SYSTEM (EWS)**

FORSAT project: "Strengthening of the Hydro-meteorological Early Warning System in Zaza and Agabama basins", supports technologically and through knowledge management the meteorological services of INSMET and the exchange with the Meteorological Centers of Villa Clara and Sancti Spíritus, as well as the connection between the EWS actors of these territories.

One of the needs identified in the framework of this project is the strengthening of meteorological services in the country and in particular in the intervention areas. By acquiring an X-band polar orbiting satellite receiving station through FORSAT, it contributes to the most effective prediction of phenomena that cause natural disasters such as floods and drought. In this way, the efforts of the Institute of Meteorology with its territorial dependencies and international cooperation were joined to enhance meteorological monitoring.

There are other systems installed in the national headquarter, such as earth stations of geostationary satellite reception, which receive meteorological information from the Geonetcast Americas service and the GOES satellite. This information flow increases with the inclusion of the receiving earth station of the X-band polar orbit satellites: EOS Aqua & Terra and Suomi-NPP, used by the national meteorological service.

The satellite meteorological information obtained is a key element for the present weather observation system from any place on the planet. The satellites allow almost real-time tracking of extreme events with a spatial resolution of a few meters and a temporal resolution of few minutes anywhere on our planet.

This brochure addresses the technological features and products generated at the national and local level, associated to meteorological monitoring, where INSMET and the Provincial Meteorological Centers play a preponderant role:

- X-band polar orbiting satellite receiving station.
- Almenara platform.
- RLAN wireless network
- Web pages of the Provincial Meteorological Centers of Villa Clara and Sancti Spíritus.

### **X-band polar orbit satellite receiving station (VxEos)**

Helping to develop technologies for the prediction of disasters, the characterization and reduction of risks of forest fires, earthquakes, floods and droughts and to initiate the long-term monitoring of global climate change and environmental change, is one of the potentialities developed by this new technology, provided to INSMET by the FORSAT project.

VxEos is a ground station designed for the programming, reception, storage, processing and visualization of X-band satellite data from the EOS Aqua & Terra and Suomi-NPP polar orbiting satellites.

The scientific objectives to achieve with these satellites are:

- Help in the development of new technologies for disaster prediction, the characterization and reduction of risks of forest fires, volcanoes, floods and droughts.
- Begin long term monitoring of global climate change and environmental change.

- Provide global and seasonal measurements of the terrestrial system, including critical functions such as the biological productivity of land and oceans, snow and ice, surface temperature, clouds, water vapor and land cover.
- Improve the ability to detect human impacts on the terrestrial system and climate, identify the "fingerprint" of human activity on climate and predict climate change using the new global observations in climate models.

The system consists of several components:

- X band tracking antenna
- X band receiver
- X band data acquisition system
- X-band data processing system

VxEos is designed to be easily upgradable for future generations of X-band satellites, especially the JPSS satellites that will be launched from the end of 2017, and is based on the extensive experience of Eosphere, an English company providing ground stations for satellite data processing and reception. The VxEos system is a turnkey solution for the reception, processing, storage, broadcast and visualization of satellite data directly transmitted in the X band from the EOS Aqua & Terra and Suomi-NPP polar orbiting satellites.

#### ABOUT TECHNOLOGICAL TRANSFER

A training process accompanied the acquisition of the satellite reception system for Cuba, where INSMET specialists could exchange with Eosphere English provider. The training included on-the-factory training at CGC in England and its installation and starting in Havana, where the equipment was configured according to the needs of the national meteorological service.

As a continuation of the training program, different basic courses are designed with topics such as satellite reception, technical specifications for operation of the satellite images receiving station and possible applications in meteorology. A very important chapter will include the capabilities to monitor drought.

Around 60 specialists along the country are to be trained, among them computer engineers and meteorologists from INSMET, from Climate, Atmosphere Physics, Pollution, Agro-meteorology and Sea Meteorology Centers. The training will also reach the 14 meteorological centers in Cuba.

Thanks to the acquisition of this equipment, the information flow of INSMET is increased from the capture of satellite images that allow real-time monitoring of extreme events such as meteorological and agricultural drought and allows to evaluate the impact of heavy rains, hurricanes and flooding.

#### **Almenara Plataforma, EWS**

The Hydro-meteorological Early Warning System of Cuba has technologically strengthened thanks to the better accessibility and integration of the information that is distributed among the different actors involved throughout the country. This achievement has been possible thanks to a software platform developed in the INSMET capable of classifying, distributing, storing, processing and visualizing specialized products throughout the country and integrating the information generated in a disaster situation through all the nodes of the EWS.

This platform offers several benefits: it maximizes the automation of processes, minimizes errors and increases the immediacy of information, key factors when decision making about an extreme hydro-meteorological event. In addition, it provides a friendly graphical interface both for specialized users and

decision makers in which complex analysis can be carried out and conclusions can be reached in a very easy and intuitive way, and just few clicks away.

The platform, as its name implies, is designed to be the basis for the development of innumerable products aimed at improving decision making in the face of extreme events. The way to include new products and new data processing and distribution capabilities is very simple, and is documented.

This system currently generates products aimed at meteorologists (multispectral images), hydrologists (precipitation matrices), decision makers (monitoring of cold fronts, hurricanes, storms, etc.), and the general population (cloudiness images).

The products available on the platform at present are:

1. The measurements of temperature and humidity of the air, speed and direction of the wind, atmospheric pressure and accumulated precipitation, made by the network of automatic and manual meteorological stations from INSMET.
2. The accumulated precipitation measurements of the manual hydrological stations network of the INRH, as well as the measurements made in the reservoirs.
3. Estimates of precipitation intensity carried out with satellite data, as well as products of cloudiness, brightness temperature, cloud height, among others.
4. Maps of index and hazard of drought generated in INSMET.

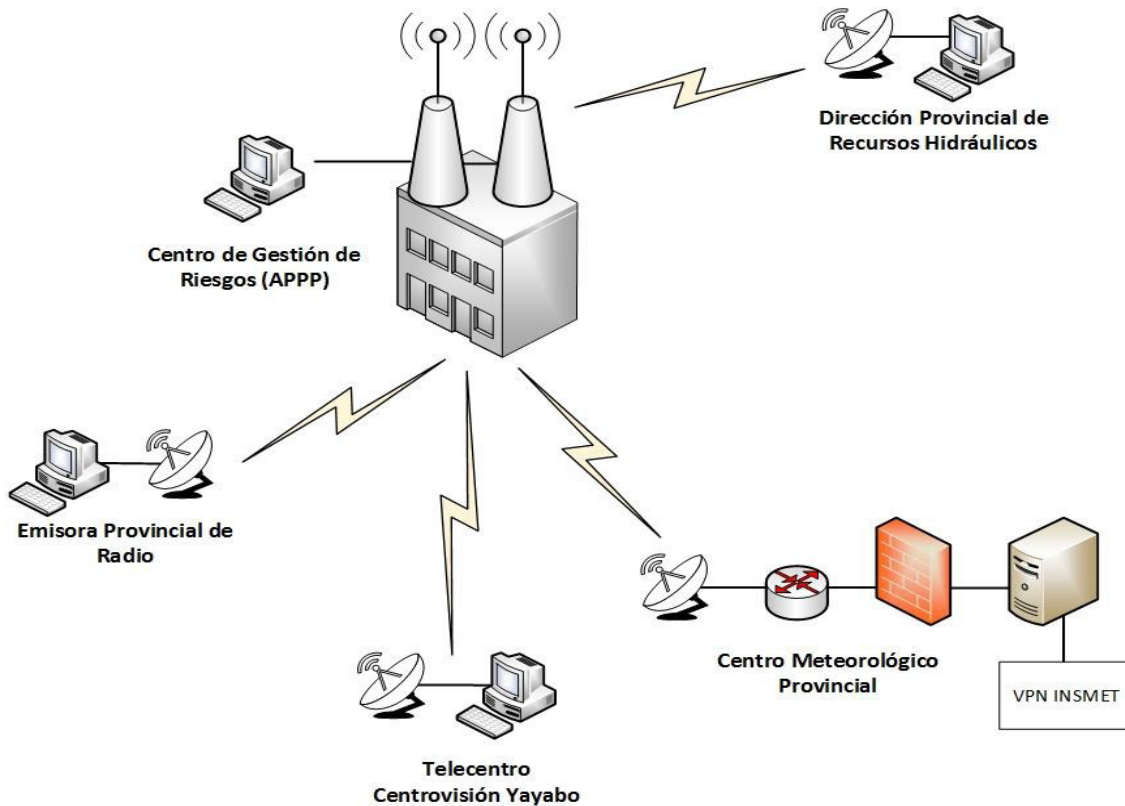
The web sites of the Provincial Meteorological Centers of the whole country are coupled to this. Particularly Villa Clara and Sancti Spiritus centers complement the information traffic from the links powered by FORSAT with the computing support designed specifically for the project (in webpages). The exchange among the EWS actors is done through the wireless network (RLAN), mainly linking the actors of the first component: monitoring.

### **Wireless Network (RLAN) (radio local area network, for its acronym in English)**

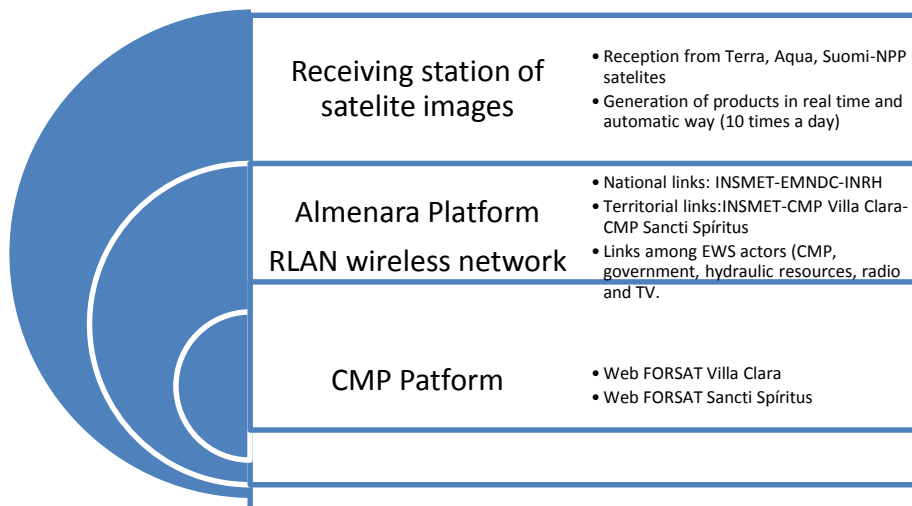
FORSAT promoted the acquisition and installation of a Wireless Network to link the main managers of the EWS and solve, from the technological point of view, the delivery and exchange of information, regardless of Internet services. As the project worked in two basins: Zaza and Agabama, from the provinces Villa Clara and Sancti Spíritus, the wireless network enabled an integration between both provinces to carry out the early warning notices in a consensual manner.

The network consists of five antennas: one sectoral, placed in the provincial government, and four directional antennas placed in the Provincial Meteorological Center, the Delegation of Hydraulic Resources, the Radio and the Television; all of them oriented towards the government (central node). Each point of the network has a computer that interconnects with the rest of the system. The administrator of this Network in both provinces is the PMC.

Connection scheme RLAN (Wireless network for information exchange among EWS actors).



Scheme of information transmission taking advantage of the benefits of the installed equipment: Products and means



### Connection and information exchange among EWS actors.

The information processing begins with the reception through the receiving antenna of meteorological satellites in the X band of the meteorological variables with a better spectral and spatial resolution. This new technology allows analysis and studies, not only of the behavior of weather and climate, but of other phenomena of an environmental nature.

All this information is processed and transmitted through different installed systems and information exchange platforms to different risk managers, namely:

- INSMET and PMC connected through the National Network (Private Data Network).
- INSMET, INRH and EMNDC connected through the ALMENARA EWS platform.

- PMC, Government, Hydraulic Resources, Radio and Television, connected through the Wireless Network (RLAN). Actors who exchange information through the web platforms of Villa Clara and Sancti Spiritus PMCs.

Monitoring data are shared between Meteorology and Hydraulic Resources. For example, data provided by pluviometer withing both, meteorological and hydrological services. The services provide rainfall estimated by satellite, this complements the collection of rain data in areas where there are no rain gauges. This information is shared through the installed systems.

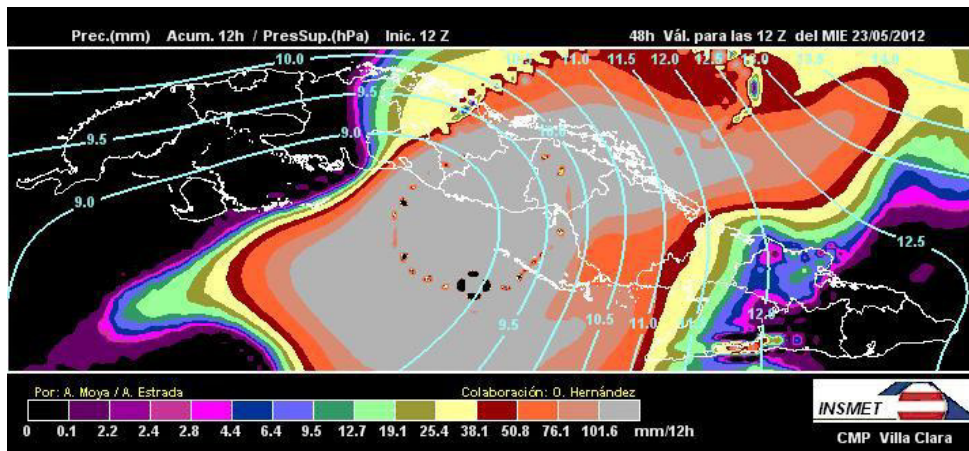
### Website PMC VILLA CLARA.

To share both meteorological and hydrological monitoring data from a central node that manages the Provincial Meteorological Center of Villa Clara, its specialists created a web page within the framework of FORSAT, specifically for users who will be connected to the wireless network (RLAN).



Initial view of the FORSAT web page from PMC Villa Clara

This page was designed in Joomla and provides a group of graphic and textual information to users about the main objectives of the FORSAT project. In this way, the precipitation forecasts of several meteorological models are shown: the MEC model, the MM5 and the WRF, all designed by specialists from the Meteorological Center of Villa Clara. The MEC model also provides information on the probability of severity occurrence in the area.



**Precipitation field Forecast of the MEC model.**

The Villa Clara platform is visible to other territories through the National Network of the Meteorology Institute (Private Data Network). This allows specialists and forecasters from the central region to access this website and use the information resulting from the models applied in Villa Clara and in Zaza and Agabama basins. This information is also feasible for Sancti Spíritus province.

### **Website PMC Sancti Spíritus**

The website arises from the need to display and publish hydro-meteorological information both in images and text, in a more interpretative way to the user, since the application or Platform software, was produced with the aim of emulating numerical data about maps.

This site is supported on the basis of a web server, which interprets several programming languages, always showing the most updated information hosted on it through the channels and connections corresponding to the Meteorological Center.

It displays numerical information, text and images, of them: weather forecasts, warnings and hydro-meteorological warnings, observations of automatic meteorological stations, manual meteorological observations, satellite images, radar images, analysis models, forecast models, newsletters; of satellite images already created and processed, coming from the satellite stations installed in the Meteorological Institute of the DIPECHO-FORSAT after Hurricane Sandy stroke eastern Cuba and FORSAT in the central part of the country.

The site has scope towards the 5 actors of the project: Hydraulic Resources, Risk Reduction Management Center, TV center, Radio and the Meteorological Center, through the RLAN and some of the products generated can be displayed to others users through the internet website of the Provincial Meteorological Center with international scope.

The PMCs are linked in the same way as with the Institute, through the Private Data Network, and through it the exchange of data such as images, texts, data files, and even services such as file transfer (FTP) , chat, takes place.

The INSMET information will reach the PMC through the communication channels corresponding to the Meteorology Institute Private Data Network, of national scope to all the PMCs.