



**MONITORING SYSTEM  
HYDROMETEOROLOGIC  
ELECTRIC DOWNLOADS AND EARLY  
AGRICULTURAL WARNING SYSTEMS**

# 1. Overview

Aviamet is a technological tool that supports decision-making, integrates information from hydrodynamic models, high-resolution regional weather models, satellite tracking Hydro meteorological stations and models based on artificial intelligence (AI), highly efficient computational tools that together with an interdisciplinary scientific support group 24 x7, help our clients plan and execute operations safely, providing analysis, early warnings, reports and forecasts of hydro meteorological conditions and value information for real-time decision-making, asset management and crops.alerts in an optimized manner for safe flight at different stages; Travel Planning, Pre-Flight, on route and Runway Operations. The Comprehensive solution includes up-to-date weather forecasts designed specifically for pilots, accompanied by alerts from safety, route recommendations, risk assessment information and flight profile created by professionals in the aviation industry. With all this AviaMet allows the aviation industry to have accurate forecasts to improve the operational results to reduce cancelled flights, increase the optimization of times and efficiency in the planning of their flights improving the safety in a comprehensive way.



## 2. AviaMET Architecture





## 4. Background

Climate change is increasing weather instability. Severe weather events such as extreme temperatures and prolonged periods of drought or heavy rains create increasing risks to the global agricultural market.

Agricultural technology has evolved rapidly from basic data management to true information useful for decision-making. Accurate and detailed agronomic and meteorological information is inherent in the success of precision agriculture. The best solutions should integrate weather data with a wide variety of agronomic models and contextual data that provide specific, timely and, more importantly, applicable information. To achieve this level of operational intelligence, Aviatek offers the AviaMET platform.

AviaMET offers an unmatched level of weather intelligence, predictions and information applicable in the agricultural industry, allowing farmers to maximize operational efficiency and crop potential, anticipating local temperature, rainfall and crop anomalies.





**AviaMET helps the agricultural sector obtain these benefits:**

- Improve accuracy in predicting precipitation, thunderstorms and temperature, which contributes to improving seed and crop selection, resource and work use, and application of chemical treatments.
- Obtain local weather predictions and detailed historical data that allow you to better understand the effect of environmental factors on crops and manage risks and insurance more effectively.
- Generation of timely alerts based on customized operational parameters to reduce risks and losses, allowing greater peace of mind for the farmer and insurers.
- Allows for more efficient resource allocation, such as when and Where to allocate workers and equipment.
- It improves performance, since it facilitates a more adequate and timely application of chemical products that implements management systems in Eco-efficiency, promoting the efficient use of resources that contribute to the progressive minimization of significant environmental impacts.
- Increases cost savings through more efficient use of water and energy, using strategic irrigation.

## 4.1. Data Sources

To avoid time, accuracy, and geographic errors, weather data must come from combined (interpolated) sources that can be:

- Official National Weather Services
- Private weather station networks
- Local weather stations
- Doppler Radars
- Weather satellites
- Atmospheric prediction models

Weather data is critical to understanding the climate situation and local weather behavior, which in turn is essential for deciding what and when to plant. While climate change is well documented, knowledge of how these changes manifest themselves at the local level is often not as detailed. This leads to the generation of more unstable weather patterns, resulting in slower or stagnant weather models that can cause severe droughts or floods. Recent climate trends show a propensity to increase extreme weather events with their consequent damage resulting in local weather disturbances that can only be measured and managed through accurate weather observations and local forecasts. It is essential to decide what and when to plant. While climate change is well documented, knowledge of how these changes manifest themselves at the local level is often not as detailed. This leads to the generation of more unstable weather patterns, resulting in slower or stagnant weather models that can cause severe droughts or floods. Recent climate trends show a propensity to increase extreme weather events with their consequent damage resulting in local weather disturbances that can only be measured and managed through accurate weather observations and local forecasts.



# AviaMET THE SOLUTION TO REDUCE METEOROLOGIC RISKS ON AGRICULTURE

Precision agriculture and weather technology have evolved to meet the demand for specific data on agricultural land, AviaMET integrates all the technology, knowledge and models to provide the sector with the following services:

- Accurate observations on temperatures, precipitation, winds, electric shocks and other atmospheric and soil variables.
- Accurate predictions for these parameters.
- Applications that incorporate this specific information to make it easier for farmers making decisions.



## Short Term Forecasts

Short-term forecast with numerical models such as Weather Research Forecasting - WRF adjusted to local and mesoscale scale conditions.

Aviatek has experience running the WRF model at 4 km spatial resolution and 72-hour forecast horizon. The model runs with the latest version and with the physical settings

- Frost forecast or surface ambient temperature (-2m) below 0°C.
- Forecast of hail and other types of precipitation (ice+ clear water; solid hail; semi-solid hail; among others)
- Forecast of strong surface winds (-10m) in a locality
- Precipitation forecast (liquid water).
- Solar radiation forecast (long wave and short wave): important variable for the topic of frost in crops.

## Data-driven analytical models

Some of the phenomena that affect agriculture such as frost or so-called radioactive temperature, because the phenomenon of low temperatures in the early morning depends on the radiation of the previous day. Therefore, with information from weather sensors it is expected to be able to find the patterns with other variables (e.g. solar radiation, wind speed and direction, temperature), which cause the phenomenon to be studied to be triggered.





## Seasonal climate prediction

Medium-term seasonal climate prediction models for use in agriculture. The information in these models is free for case studies such as: [https://www.ncdc.noaa.gov/data-access/model-data/model-data/sets/climate-forecast-system-version2-cfsv2-CFS%20Reanalysis%20\(CFSR\)](https://www.ncdc.noaa.gov/data-access/model-data/model-data/sets/climate-forecast-system-version2-cfsv2-CFS%20Reanalysis%20(CFSR)).

The proposed seasonal climate prediction scheme for decision-making is presented in Figure below, where the System is self-powered.

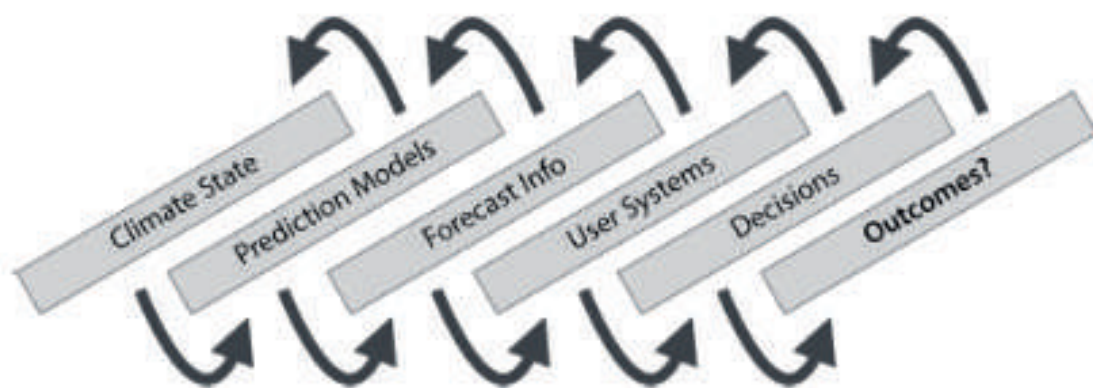


Figure 1. Relationship scheme of a decision-making system for hydro climatic risks. Source: Klem and Mac Patherson, 2017



Within climate modelling should have the appropriate resolution given local conditions such as topography, and soils. Therefore, in specialized literature there are models such as the following:

- Dynamic modeling - scale reduction: with dynamic models such as the WRF Model, forced with global climate models.
- Statistical modeling: with statistical relationships between global models and weather stations on land or with hybrid systems such as artificial neural networks.

Seasonal climate prediction models feed crop models, which focus on soil moisture dynamics and biotic interaction with plants (see Figure).

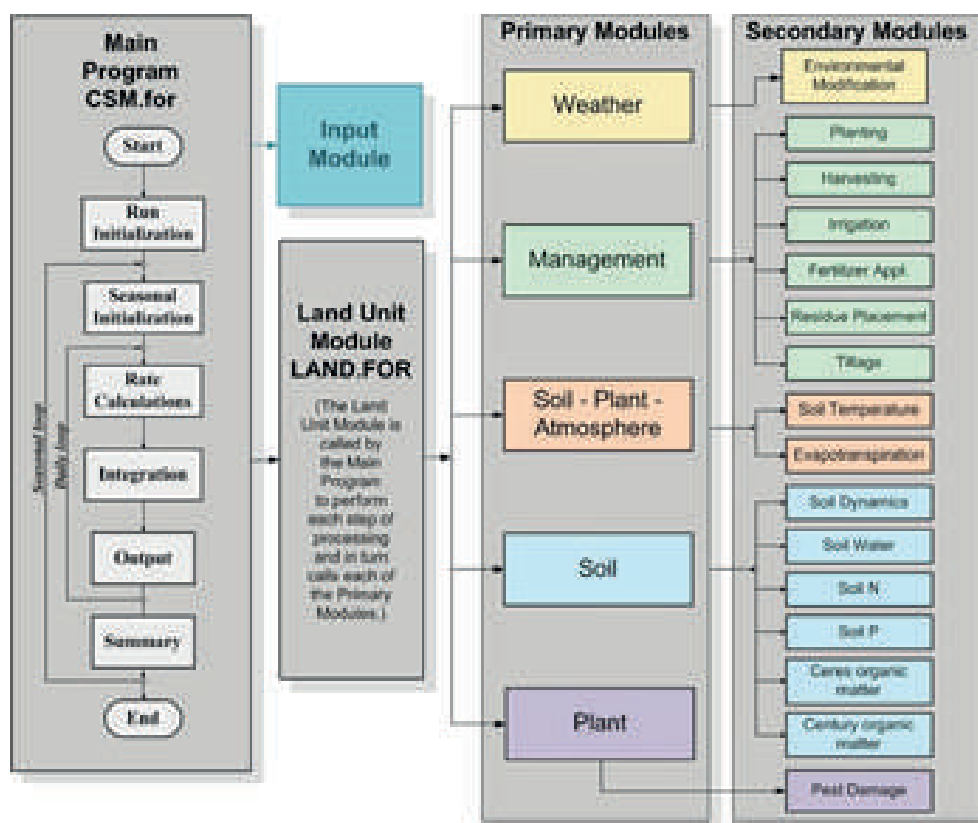



Figure 2. Crop model scheme.



## Telecommunications: macroclimatic indices..

One of the most important characteristics studied by agricultural meteorology is the amount of water contained in the surface layer of soil, in which most of the roots grow and develop, know the water availability in the soil and its distribution over time, allows to establish the irrigation and drainage needs, caused by the climatic component.

The way the large-scale climate or macro climate relationship is established to the local scale is with canonical indicators. Canonical correlation analysis is proposed as a tool for relating surface weather variables in Colombia and large-scale climatic oscillations. A methodology is proposed, which allows to generate knowledge about the climate and improve forecasts, in the long and medium term. It is performed for El Niño Southern Oscillation (ENSO), North Atlantic Oscillation (NAO), Quasi-Biennial Oscillation (QBO) and total monthly precipitation and maximum temperature values. The oscillations are represented by global climate indices and the variables used correspond to ground weather stations, located in the areas of interest of customers. The power of this statistical method is expected to identify associations through a multivariate approach where macro climate indices act as predictors.



# PRECIPITATION ESTIMATION WITH SATELLITE IMAGES USING THE HYDROSTIMATOR TECHNIQUE

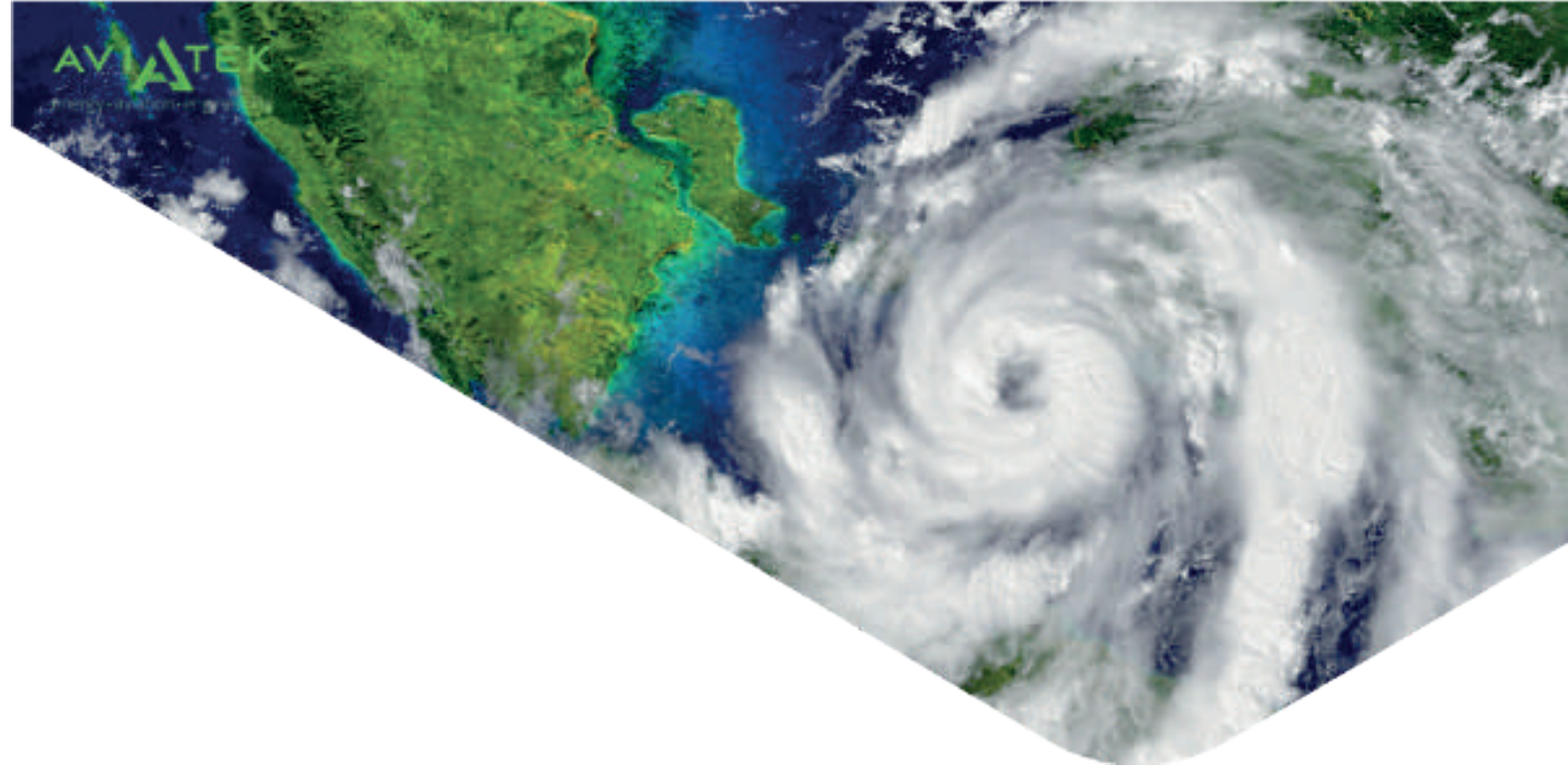
To make informed decisions throughout the growing season, real and model-derived weather parameters regarding soil moisture, traceability, potential evapotranspiration, GDD values, etc. are needed.

The Hydro estimator technique for estimating satellite precipitation was originally developed at the National Oceanic and Atmospheric Administration/National Environmental Satellite, Data, and Information Service (NOAA/NESDIS).

It uses images of the GOES satellite thermal infrared channel, CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data) and weather variable information from ground weather stations.

These Hydrostimators are based on a mathematical model that allows to relate satellite rain minimizing the impact of overestimation or underestimation of water resources.





# INTEGRAL MANAGEMENT RISK AND SAFETY

## Risk Management, Security, Integrity

Many companies present the need for better planning to preserve the integrity and safety of their crops in the different territories, thus being exposed to threats of different types that can affect their operation.

Aviatek has developed a system that allows different entities and companies to execute studies and risk management plans for incorporation into the territorial order focused on the integrity of their crops. With the solution developed, the different companies can carry out comprehensive analyses identifying climate risks, natural, physical-spatial and social risks, associated with agricultural activities, overflows, floods, droughts, forest fires, landslides, public order, social and economic. These Threats are increased by the presence of the aforementioned activities that are carried out in areas of special susceptibility where the crops and their assets are located, thus increasing vulnerability to the occurrence of phenomena that cannot be controlled.



The solution designed by Aviatek allows an analysis of the information available to carry out both the identification and delimitation of the types of threat present in the study area, under certain scenarios occurrence, such as the lifting of the exposed elements and the measure of their vulnerability. With this, it is possible to quantify and zoning the risk for each type of threat, and in this way, propose strategies for risk mitigation in order to be incorporated into the different land use, security and maintenance plans of crops.

Aviatek through the AviaMET platform®, which is a technological tool that integrates mathematical models, artificial intelligence (AI), integral risk management, asset management, natural and social threat management, security management and planning support. The service is based on an early warning system, where graphically and with support of georeferencing active data associated with a coordinate identification system, allows to analyze the information corresponding to risks and threats in real time for timely decision making.

### AviaMET® Integrates:

- Numerical models.
- Weather platform / WRF models.
- High resolution hydrodynamic models.
- Model of early detection of possible flood conditions and forecasts.
- Sliding susceptibility analysis models.
- Satellite tools and applications.
- Field sensors.
- GIS geographic information system.
- Comprehensive risk management models.
- Support equipment 24/7.

# Types of Threats that can be identified in the System

The platform is functional in mobile devices and desktop computers, allowing the visualization of all the client's geo-reference assets and crops on a virtual platform. This platform also allows to visualize in real time the security threats that are contained in the territory, which have a priority classification and generate automatic alerts to the emails designated by the customer. The system also allows you to load data associated with assets and crops, such as area, value, managers, size, financial and operational data that facilitate analysis in these areas.

AviaMET®, has the ability to report these alerts of these threats in real time using a simplified data update system, operating at all times

## **SECURITY THREATS:**

- 1.HARASSMENT
- 2.BOMBING
- 3.SUBVERSIVE ATTACK
- 4.ROAD BLOCKING
- 5.CONFRONTATION
- 6.COMBAT
- 7.EXPLOSIVE ARTIFACTS
- 8.EXTORTION
- 9.VACCINE
- 10.MASSACRE
11. SUBVERSION DISPLACEMENT
12. HOMICIDE



## NATURAL RISK THREATS

1. Hurricane
2. Tsunami Alert
3. Earthquake
4. Thunderstorms
5. Flooding
6. Volcanic eruption threat
7. Epidemiological Risk
8. Wildfires
9. Landslides
10. Heavy rains (above the historical low)

## OTHER FEATURES OF THE SOLUTION

1. Smaller-scale threat management
2. Multi-user access with different access and modification profiles information
3. Inclusion or disposal of assets as they are acquired or no longer part of the group
4. Inclusion of additional data on assets, such as: Number of employees, Commercial value of the asset.
5. Performance indicators
6. Personnel in charge for different types of risk.
7. Inclusion of legal threats, such as modification of TEPs or relevant national regulations (scanning permits)





## Some specific services Included:

- Installation and maintenance of automatic weather stations in customer-determined locations.
- Real-time and historical information of automatic weather stations on site after being installed.
- Download real-time information from installed stations and track atmospheric conditions, you will be able to access the download of text files with the information of the variables.
- Processing of data captured through the network of ray sensors and automatic stations.
- Early monitoring and alerts issued via emails, SMS messages, mobile application, and through a data visualization tool. This service includes real-time delivery of real-time data of electric shocks on the national territory of the Republic of Colombia or in real time of dangerous storms (DTAs) on the national territory of the Republic of Colombia or ground observations of automatic stations available within the Republic of Colombia (METAR, SYNOP, and stations at the service of Aviatek) that are part of our network.



- Real-time alerts electrical activity and precipitation within the chosen areas (winds, precipitation, frost, hail)
- Ground observations for locations where no nearby automatic stations are available derived from global forecast models, in 12.5km resolution grids and accessible through the Aviamet portal.
- Automatic Sensor and Station Network Services or Network Monitoring and Calibration from Aviatek headquarters.
- Services with lightning detection sensors with the ability to generate detailed Lightning information (Cloud-Cloud and Cloud Earth) which in turn can be used to track cells of convective storms and early warnings
- 24/7 monitoring of a given area with daily, weekly, monthly reports of the variables recorded in the chosen areas
- Daily Newsletters
- ENSO occurrence indices (El Niño South Oscillation)
- ENSO Diagnostic Discussion
- Drought Occurrence: Meteorology- Terrestrial Hydrology
- Identification of Crop Risks and Threats
- Risk Management Security and Integrity: Early Warnings Safety and Threats
- Risk Management Safety and Integrity Risk Management: Early Weather Alerts Security and Integrity: Early Weather Alerts

# FARMING

## STANDARD

## PROFESSIONAL

## INTEGRAL

### SERVICIO

Weather monitoring	✓	✓	✓
Measuring temperature variations	✓	✓	✓
Wind direction measurement	✓	✓	✓
Wind speed measurement	✓	✓	✓
Moisture measurement	✓	✓	✓
Measuring and monitoring the level of precipitation and rainfall	✓	✓	✓
Early warning systems issued through emails, SMS messages, mobile applications and through a data visualization tool	✓	✓	✓
Detailed monitoring and monitoring of electric shocks	✓	✓	✓
Delivery of real-time data of electric shocks on the national territory of the Republic of Colombia or in real time of dangerous storms (Dangerous Thunderstorm Alerts (DTAs) on the national territory of the Republic of Colombia or on land observations of automatic stations available within the Republic of Colombia (METAR, SYNOP and stations at the service of Aviatek) that are part of our network	✓	✓	✓
Real-time alerts of electrical activity 6 specified zones and the top 4 cities in Colombia	✓	✓	✓
Real-time alerts of precipitations in specific areas, 6 specific areas and the 4 main cities in Colombia	✓	✓	✓
Ground observations for locations where no nearby automatic stations are available derived from global forecast models, in 12.5 Km resolution grids and accessible through the AviaMET portal 12.5 Km y accesible a través del portal AviaMET	✓	✓	✓

	ESTÁNDAR	PROFESIONAL	INTEGRAL
24 /7 surveillance of a given area with daily, weekly and monthly reports of the variables recorded in the chosen areas	✓	✓	✓
Daily forecasts with 12-hour threshold, 6:00 and 18:00 hours, with user-suggested variables	✓	✓	✓
Weekly activity report of atmospheric variables in the monitored area	✓	✓	✓
Detailed report of intra-cloud and cloud-to-ground electric shocks within the monitored area.	✓	✓	✓
Accompaniment and support 24x7		✓	✓
Consultant accompaniment	✓	✓	✓
Automatic Sensor and Station Network Services or Network Monitoring and Calibration from Aviatek Headquarters	✓	✓	✓
"Early Warning" threat from mass movements, by slippage		✓	✓
Download information from automatic weather station history	✓	✓	✓
Download real-time information from automatic weather stations installed and track atmospheric conditions, download flat files with variable information	✓	✓	✓
Data processing captures through the network of lightning sensors and automatic stations	✓	✓	✓
Weather Forecast		✓	✓
Asset management			✓
Hydrological Forecast		✓	✓
Hydrodynamic modeling		✓	✓
Hydrological Modeling			✓



	ESTÁNDAR	PROFESIONAL	INTEGRAL
Climate change impacts			✓
Hydrological monitoring			✓
Air quality monitoring			✓
Hydrological Alerts			✓
Drones/Anti-Drones			✓
Hydrostimulator			✓
Fourteen (14) lightning detection sensors already installed in Colombia comprising the current network for service	✓	✓	✓
Six (6) lightning detection sensors that will be part of the service during contract time	✓	✓	✓
Six (6) automatic stations already installed in different regions	✓	✓	✓
Public stations (METAR and SYNOP) already installed and available in the different regions of the Republic of Colombia that are part of the service network	✓	✓	✓
Indices of occurrence of EN-SO (El Niño South Oscillation)			✓
EN-SO diagnostic discussion			✓
Occurrence of drought: Meteorology - Terrestrial Hydrology			✓
Forecast of frosts or surface ambient temperatures (-2m) below 0oC			✓
Hail forecast and other types of precipitation (ice + liquid water, solid hail, semi-solid hail, among others)			✓
Forecasts of strong surface winds (-10m) in a locality			✓

	ESTÁNDAR	PROFESIONAL	INTEGRAL
Precipitation forecast (liquid water)			✓
olar radiation forecast (long wave and shortwave): important variables for the topic of frost in crops			✓
Identification of crop risks and threats (Report)			✓
Risk, Security and Integrity Management: Early Security and Threat Alerts			✓
Risk Management, Safety and Integrity: Early Weather Alerts			✓

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