

Usable earth observation satellite and forecast data

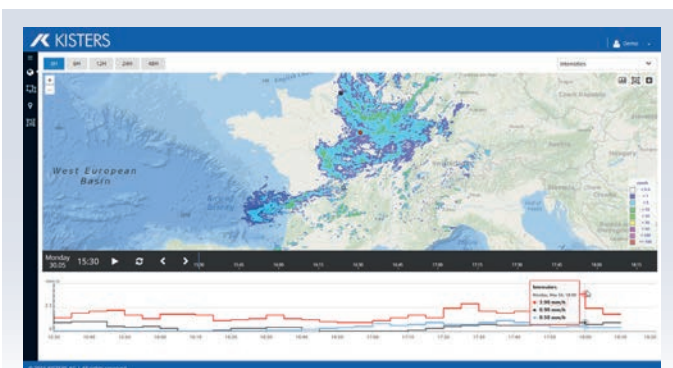
METEOROLOGY | CLIMATOLOGY | WATER QUALITY | ECOLOGY

Overview of KISTERS Raster DaaS

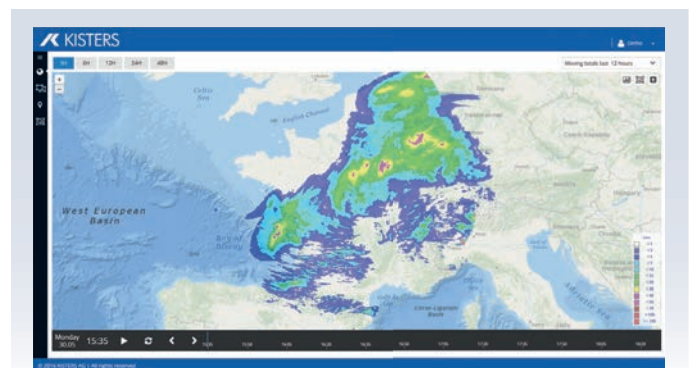
Accurate, precise and timely information is crucial for **real-time operations and warning systems** in the areas of drinking water and sewer services, stormwater management, irrigation, drought and flood forecasting. With the evolution of the full-spectrum of data accessible to 21st Century environmental resource managers, Raster Data Service makes gridded data *actionable*: KISTERS advanced technologies ingest, convert and process extremely large amounts of remote sensing imagery for integration with ground-based observations. Extensive algorithm libraries from KISTERS expertise in hydrometeorology, water quality and software development generate myriad data

products including hyper local daily totals, area precipitation, forecasts as well as modeling inputs. The solution features customizable automation, validation, and alert notification settings specific to each organization's needs.

Data visualization and interactive analysis occurs within KISTERS Web Portal framework, ensuring access and intuitive display via web browser. Animate meteorological data over monitoring networks. Focus on user-defined polygons or hotspots. Calibrate and efficiently maintain of in-situ devices or BMPs. Reporting options disseminated relevant information to specialists as well as the general public.



Raster DataViewer: intuitive design and navigation



High-resolution precipitation data in real time or post event

Put Gridded Data into Action

Satellite observations and supported data types Raster Data Service integrates the following parameters among others:

- Precipitation
- Air temperature
- Air pressure
- Cloud cover
- Dewpoint temperature
- Evaporation
- Relative humidity
- Solar radiation and sunshine duration
- Vapor pressure
- Wind speed and direction

Measured values and processed parameters from related fields can be entered and linked with the data in a meaningful way.

Data types

The solution manages both high-resolution measured values, totals, average and extreme values (min/max) and directional data from meteorological in-situ monitoring stations as well as radar rainfall data. It supports any spatial resolution of gridded data (e.g. 500m X 500m, 1000m X 1000m, 10,000m X 10,000m). Data types at higher resolutions can be configured as well. Data from **point and radar measurements are combined with data from forecasting systems** (including ensemble forecasting) and rounded out with data products such as daily totals or area precipitation. Aggregate data in **different temporal resolutions** (e.g. 1, 5, 10, 15, 30, 60-min. intervals; 6- and 12-hr values; or longer intervals such as daily, monthly and yearly). Since any start time can be defined for an interval,

hydrological years as well as weekly and daily start times can be viewed based on local conditions / requirements.



Automation

In terms of data exchange, Raster Data Service can be integrated with telemetry systems (KISTERS SODA or third-party providers) and SCADA systems. The solution retrieves data from file system directories (Windows, Linux, etc.), FTP/sFTP servers, emails and attachments, satellite data platforms, and third-party databases or information systems. Configure automation protocols for a **specific time interval or event-driven condition to initiate data retrieval and processing into specialized data formats**. Local or global standards are supported. These include WMO formats (BUFR, GRIB), OGC standards (WMS, WFS, WaterML2.0, netCDF) as well as those associated with national weather services such as DWD, MeteoFrance, (US) NOAA. Format converters & upgrades are available to the KISTERS' software user community. For initial inspection and data processing, rule-based tests are applied. Defined data derivations are applied after data import. Current data informs real-time alerts and data displays in the dashboard.

Processing of radar data

Raster Data Service performs all data processing stages: From raw measurements (reflectivities in polar coordinates per radar rotation with varying angles of elevation), the solution generates a radar image as a raster with Cartesian coordinates at a high spatial and temporal resolution. In the process, it **detects and eliminates artifacts in the measurement method** such as clutter or masks. Then, it processes raw data from all standard radar systems in C-, S- and X-bands and offers users the option to integrate complete radar products from various sources. Analysis and processing methods includes **calibration (adjustment or cross comparison with data from a ground monitor-**

ing networks) and short-term forecasts (nowcast for 1 to 3 hours into the future).

Raster Data Service extracts data from individual raster pixels, **aggregates the entire raster into maps of temporal distributions of precipitation amounts** and can **calculate statistics of pixels within any polygon**, i.e. catchment area.



Data inspection and data quality

For the highest data quality & reliable information, Raster Data Service offers extensive data validation options, including

- Minimum/Maximum
- Change rate
- Time interval
- Gap filling (interpolating, copying & adapting data from adjacent stations, rule-based merging of multiple data channels)
- Professional cross validations (e.g. adjusting precipitation for cloud cover or dewpoint temperature for air temperature)

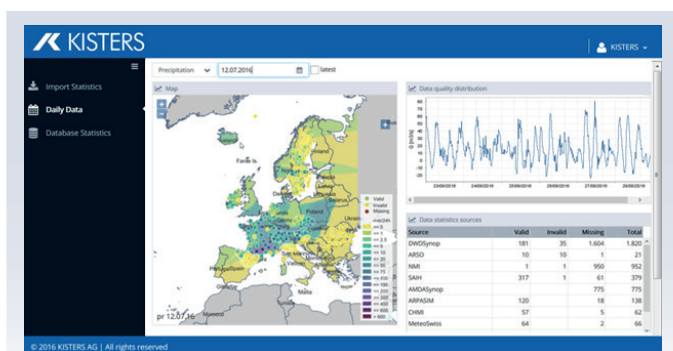
Quality attributes

Designate varying levels of measurement data quality.

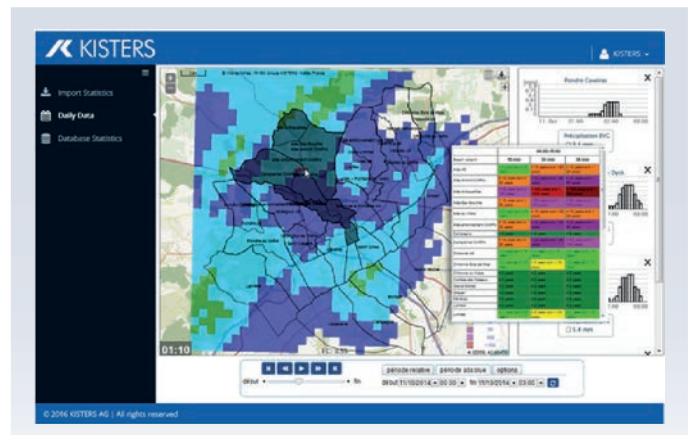
Up to 255 different data quality levels with linearly arranged significance can be defined, allowing qualitatively deficient data to be excluded from calculations. By default, the solution detects and identifies any and all edits to datasets. Changes to data can be traced back to the original state.

Calculations and analyses

Raster Data Service features an extensive calculations library for measurement point data, raster data and statistical analyses: Standard **calculations of point data** include the formation of totals and average values as well as the determination of maximum and minimum values for any given time interval. Perform multi-year analyses for any analysis period and statistical interval. For example, calculate the maximum 6-hour precipitation total for each month of a year over the last 30 years). In addition to calculations for fixed time intervals, creates flexible data products with moving averages (e.g. 6-hour totals recalculated every hour).



Combining data in space and time



Storm analysis: calculate return periods of a precipitation event per catchment

Preprogrammed statistical analyses and algorithms help to evaluate heavy rainfall, determine return periods for storm events of varying duration, and trend analysis of extreme weather events. Using **geostatistical methods** (e.g. Kriging or inverse distance), interpolate data for locations outside your monitoring network.

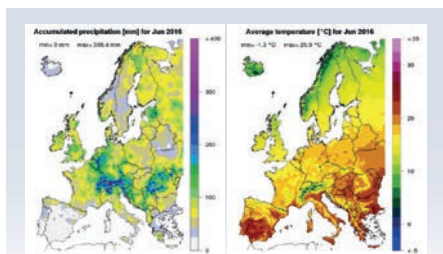
For spatial data (e.g. precipitation radar data), extensive analysis options are available, including

- Extraction of data from a raster pixel
- Statistics on the values of all pixels within a polygon (e.g. to calculate area precipitation)
- Temporal aggregation of the entire raster (e.g. adding up 5-min. radar images of precipitation intensities to create images with precipitation totals per rain event)

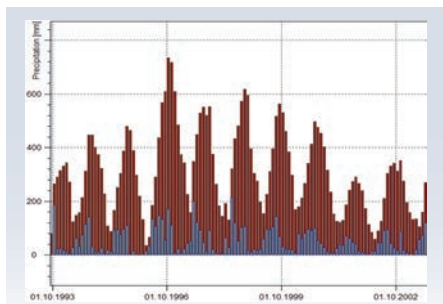
Raster Data Service can convert data from areas of intensity in a radar image into numeric quantities of rainfall. Algorithms adjust satellite data for the precipitation amounts measured on earth, performing verification or calibration processes. The solution can also forecast expected amounts of precipitation based on the horizontal motion profiles of the precipitation cells; nowcasting generates for 1 to 3 hours into the future.



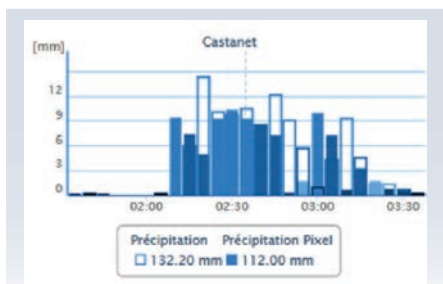
Information for every demand



Compare monthly statistics: rainfall and temperature



Monthly totals of precipitation



Compare values from radar and in-situ monitoring stations

Reporting

A wide range of templates ease creation and refreshment of daily, monthly, yearly or decade reports. Moreover, customer-specific reports can integrate agency logos or color schemes. Raster Data Service generates reports in formats common to MS Office, Adobe PDF, PostScript, etc.

Open interfaces for models, geospatial information systems and external data sources / suppliers

Web services and KISTERS REST API enable secure or controlled access to data collected and processed within this solution. These points of integration can automatically feed models with complete and validated inputs for more accurate, more precise modeling results. Reduce time-consuming and redundant data management tasks. Commonly supported modeling platforms including those by DHI, Innovyze and Deltares.

The flexible open interfaces also connect Raster Data Service to GIS platforms,

including Esri's Arc suite among others.

Time series data for areas, lines, or points can be analyzed within geospatial software of preference -- enabling the creation of new images, maps, forecasting tools and dashboards are the local level. KISTERS continues to work closely with ESRI, down-scaling its (US) National Water Model innovations for state and local agencies.

Raster Data Service supports integration and processing of data from external data sources such as national weather services or commercial suppliers like DTN.

Alerting

When certain critical values or conditions are reached, Raster Data Service can generate and issue alerts to user-defined target groups. Notifications can be sent via SMS/text, email, voice mail, and even Twitter. Configure messages to require confirmation of receipt; if the prescribed reaction isn't received, notification can be escalated to other recipients or groups in a defined chain.

About KISTERS

KISTERS is a group of IT companies with 500+ employees, headquarters in Aachen, Germany, and numerous national and international subsidiaries. KISTERS offers leading software solutions for the sustainable management of water, energy and air. Expertise, commitment and sector experience make KISTERS a much sought-after partner. KISTERS' Global Water Solution is a framework for building efficient customer solutions based on modern technology and in-depth understanding of application areas and markets. Solutions include, among others, surface and ground water monitoring, meteorology, water quality and urban drainage deployed at hundreds of customer sites with many thousands of licenses worldwide.

KISTERS North America
1520 Eureka Road, Ste 102
Roseville, CA 95661
USA

Tel: +1 916 723 1441
Fax: +1 916 774 1520

kna@kisters.net
www.kisters.net

