BARON

Critical Weather Intelligence®

HYDROLOGIC FORECAST MODELING & DECISION SUPPORT

Baron offers fully integrated, end-to-end hydrologic decision support for the advance detection and notification of potential flooding events. The following information provides an introductory description of Baron hydrologic capabilities, customizable and scalable for use throughout the world.

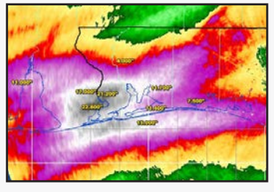
NHRPS (National/Basin Hydrologic Radar Processing System)

The NHRPS handles the integration of sparsely spaced surface hydrological and meteorological measurements with the high spatial resolution of remotely sensed radar and/or satellite-based quantitative precipitation estimates (QPEs). Radar sensors utilized can include both legacy and new Baron Gen3 Radar systems.

When possible, in-situ real-time measurements and historical accumulations are used to bias-correct and/or optimally blend with remotely sensed QP estimates.

Radar Futurecasting

Projects real-time radar imagery into the future, taking into account advection, growth and decay, allowing for an accurate 0-2 hour Quantitative Precipitation Forecast (QPF). This capability provides extremely accurate short-term forecasting—90% accurate over 15 minutes and 75% accurate over 30 minutes—vital for near-term flash flood forecasting.



Radar-based QPE Products

Generates a suite of derived 1km or finer hydrologic products from individual and composite radar base data, including 1, 3, 12 and 24-hour products. Estimated rainfall totals are produced every 5 minutes, with a 1-hour Quantitative Precipitation Estimate produced every 5 minutes.

Precipitation Mask

Differentiates between areas of snow, sleet, rain and mix. Produced in 1km resolution, with updated data available every 5 minutes.

Baron National/Basin Hydrologic Prediction System (BNHPS)

The BNHPS acquires data from the NHRPS, Numerical Weather Prediction (NWP) model(s), and stream gauge observations to produce stream/river, lake and reservoir discharge and overbank flooding and/or flash flood forecasts for the basins of interest to the client. A number of unique model classes enable clients to effectively address differing forecast problems and domains.

GIS-based Soils, Vegetation, and Terrain Database

The BNHPS incorporates best possible local soils, vegetation, terrain, and water body data in order to capture the most physically realistic basis for the hydrological models used in decision support. Typical resolutions are 30-100 meters.

High-Resolution NWP model(s) for Atmospheric Forcing

This system provides critical input data not available from real-time sensors to drive analysis and forecast versions of the hydrological modeling systems. The BNHPS is adaptable to client-preference for NWP-based inputs.

Quantitative Precipitation Estimation/Forecasting Module

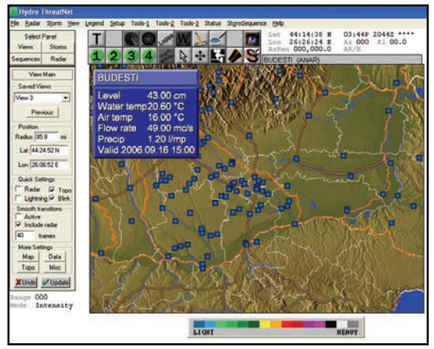
Allows users to adjust input QPE and/or QPF prior to making forecast or simulation runs of the hydrological models. This is especially useful in exploring what-if/scenario re-simulations of critical events.

Real-Time Hydrologic Models

Baron's comprehensive suite of hydrological models includes full dynamics distributed models, semi-distributed models for catchment applications, traditional lumped-modeling using the SAC/SMA and NWSRFS, flash-flood guidance using ARI extreme event statistics, and ensemble forecasting. The full dynamics models can provide inputs to HEC tools for water management applications, and can assimilate observed streamflow data for improved initial conditions. In addition, Baron is the leading commercial expert on the WRF-Hydro modeling system, recently deployed by NOAA as the first operational US National Water model. The hydrologic models are supported by a comprehensive set of calibration tools.

National Mosaic Hydro Data Server (NMHDS)

The NMHDS combines all the meteorological and hydrologic information from multiple radars, surface meteorological and stream gauge data, and hydrological model forecast hydrographs into nationwide digital image products for analysis and display. The data is also transmitted to regional hydrologic centers for use on workstations and briefing stations.



Hydro Mosaic

The Hydro Mosaic data product utilizes digital, composited imagery from the NHRPS radar processing system, making the same data available at specified times and resolutions to the briefing stations.

Heavy Rainfall and Flood Warning Notification System (HRFWNS)

Automated Alerting

Delivers site-specific alerting of heavy rainfall and official flash flood and flood warnings via e-mail, mobile devices and alert radios. Patented technology ensures that only subscribers in the threatened areas are alerted.

Baron Water Management Applications System (WMAS)

Allows the user to utilize BNHPS model discharge estimates and forecasts along with stream-gauge and related observations to input real-time data into managed reservoir operations toolsets like HEC/HMS. Customers that use the Delft FEWS software can integrate with Baron models through XML and/or NetCDF-CF interfaces.

National Hydrologic Research Archiving System (NHRAS)

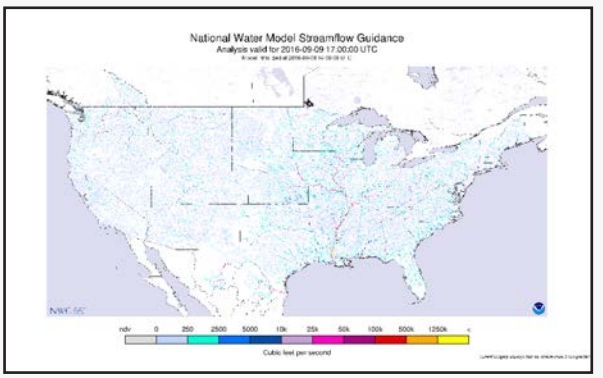
The NHRAS ingests data from the BNHPS and archives it for post-analysis and case-study re-runs. This enables model performance assessment and evaluation, enabling the customer to improve the modeling/forecasting system over time via additional calibration or bias-correction approaches.

- In August 2015, Baron was awarded a contract to provide hydrologic forecasting services to the U.S. Army Corps of Engineers (Seattle District).

MODELING EXPERTISE WITHIN A DECISION SUPPORT ENVIRONMENT

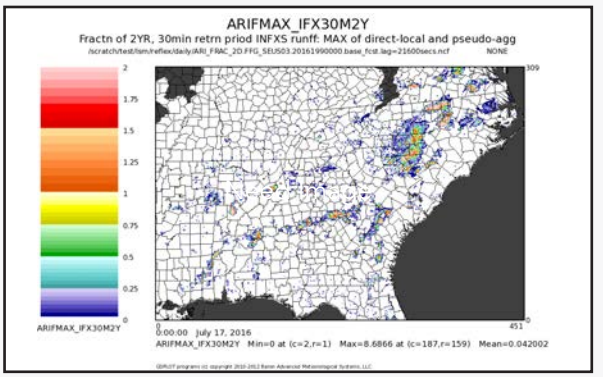
No other natural hazard has claimed more human lives, destroyed more homes and ruined more farmland over past decades than flooding. It is critical that the prediction and management of floods be a priority in order for organizations to ensure that both lives and property are secure.

Baron provides fully integrated, tailored, end-to-end hydrological forecast decision support systems for the advance detection and notification of potential flooding events. Our combined strengths in advanced dual-polarimetric radar systems and hydrometeorological modeling, high-performance computing, integrated displays, database applications, API's, and alerting systems make it the most complete organization from which to purchase a flexible, extensible, and sustainable hydrological forecast decision support system. Our singular focus on customer success drives our underlying philosophy.



WRF-Hydro/US National Water Model and the Baron LIS-NOAH-2 Explicit Distributed Modeling Systems

Through a partnership with the National Center for Atmospheric Research, Baron and NCAR modelers co-developed the WRF-Hydro modeling system. On the Baron side, the commercial version, known as LIS-NOAH-2 (LN2), implements WRF-Hydro science in an efficient multi-processor architecture. The LN2 also features a patented dynamic over-bankfull flood-inundation module, reservoir discharge and stream-gauge data-assimilation, and assimilation of NHRPS radar and VIIRS remotely-sensed green vegetation fraction data. Additionally, the LN2 can be deployed with no reliance on any commercial GIS system.

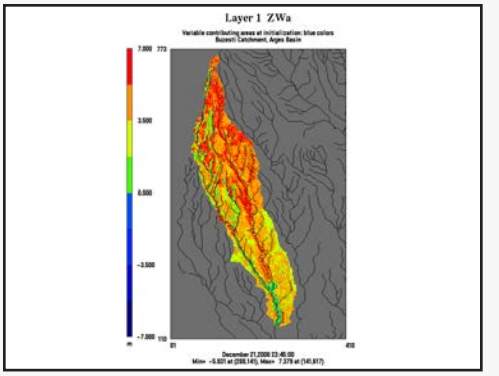


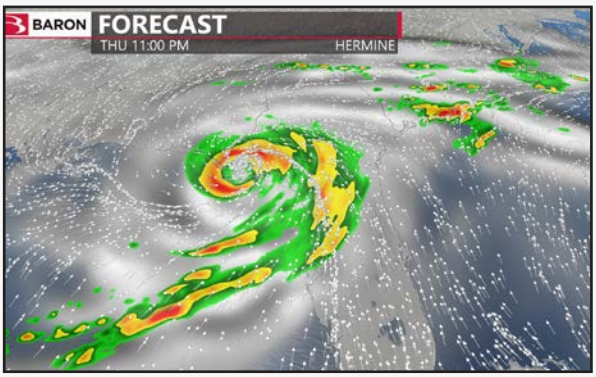
The Baron Rapid-Early Flash-Flood Examination System (REFLEX)

The Baron REFLEX Flash Flood alerting model uses extreme-event-statistics calculated from long-term historical re-simulations with land-surface model locally- outed runoff to estimate the likelihood (threat level) that a current / ongoing precipitation event will produce localized flash-flooding at the small-basin scale (~3km). Baron has found that REFLEX often provides advanced notice of flash-flood threats as compared to the timing of officially issued warnings.

The Baron TOPMODEL-Based Land-Atmosphere Transfer Scheme (B-TOPLATS)

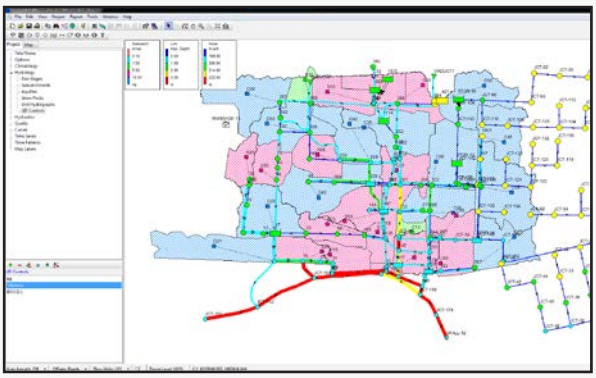
The Baron TOPLATS model implements the classic TOPMODEL integrated with a land-surface energy and water-balance model to provide small basin infiltration and saturation excess runoff estimates, local and average basin water-table depths, and water budget analyses. Routing is enabled with a tunable synthetic unit hydrograph. Typically this model is used for screening ungauged headwater or humid-zone basins as a source of potential downstream flooding.





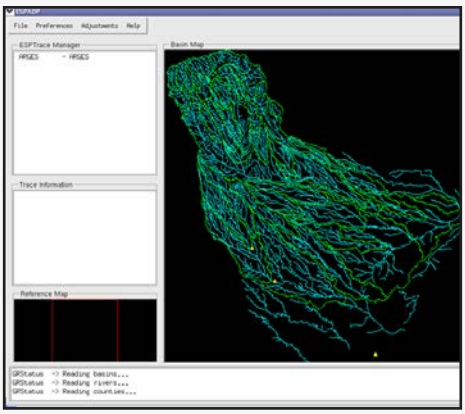
Baron NWP Expertise

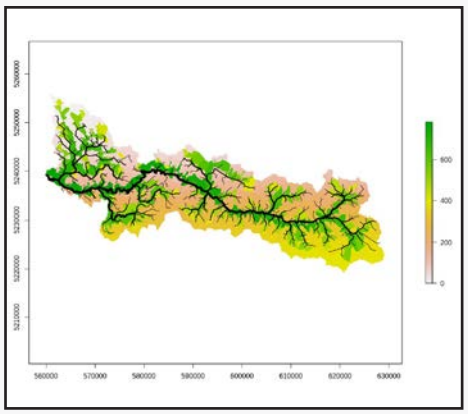
Baron implements high-resolution WRF and the older MM5-based NWP for operational hydrometeorological applications. WRF can be implemented with radar data-assimilation if the locally-available radar is of sufficient quality or a radar / network-of-radars running the unique CLEAN-AP™ algorithm is also being supplied to the customer. Baron is also comfortable implementing or working with a variety of other regional modeling systems, including COSMO.

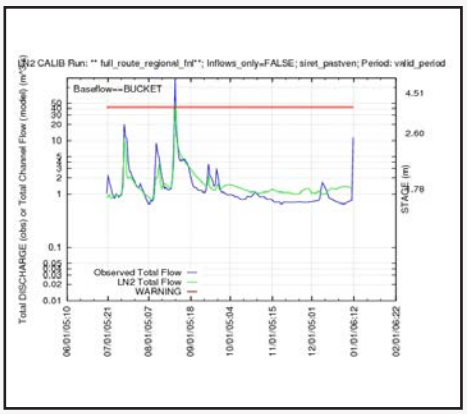


Working with Customer-based and Third-Party Models

Baron can implement industry-standard third-party models such as the USEPA SWMM model for urban flood forecast and emergency management applications. Furthermore, Baron can also implement turn-key water resource management solutions for accurate monitoring of reservoirs, streams and lakes. Baron also has expertise in the NASA Land-Information System (LIS) and its suite of models. Finally, Baron is happy to implement a customer's own model in real-time operations if so desired and cost-effective.







The Baron National Weather Service River Forecast and Ensemble Forecast Systems

Baron has operational implementation expertise with the classic NWSRFS and Ensemble Streamflow Prediction systems.

The Baron Distributed Hydrology-Soils-Vegetation Model

Baron has developed its own version of the University of Washington public-domain DHSVM modeling system, enabling it to run in continuous cycling for forecast operations as well as assimilate radar-based precipitation and stream-gauge data.

Model Calibration

The Baron LN2 and TOPLATS modeling systems contain complete software subsystems for model calibration including the PEST parameter estimation package.

SUSTAINABLE SOLUTIONS

Baron brings a strong commitment to long-term sustainable solutions to our customers. This commitment includes a deep level of high-performance computing experience and sizing for operational applications. Furthermore, system documentation / training modules and manuals are provided for each major deployed subsystem. By first discussing the desires and requirements of the customer, Baron will tailor a cost-effective solution to implement the most robust, flexible, and scalable hydrometeorological decision support system available within the constraints of the project budget.

INTEGRATED DISPLAYS AND TOOLS FOR DECISION SUPPORT

Baron display and analysis tools provide forecasters with a wealth of meteorological and hydrological information, including single-site and composite radar images, hydrographs and sensor observations.

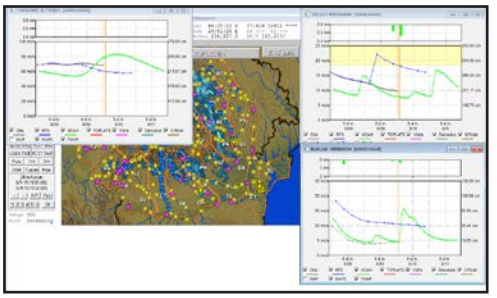
Both the Baron Hydro Threat Net (HTN) and Hydro Briefing Terminal (HBT) deliver easy-to-interpret situational awareness and model forecast information to operational hydro-meteorologists directly responsible for decision-making. Administrators and other non-forecast operations personnel can also use the display interfaces to assess current threats.

Model-output data is available in various formats that allow community-based visualization tools such as GrADS, NCL, VAPOR, R, python, PAVE, VERDI, gnuplot and many others to process, explore, and plot the data. Data-format interchange tools are also available for types of data that can be packed in GRIB2. Baron supports the ingest of model output data into ARC-GIS as well as open-source GIS tools, KML, and formats supported by GEOSS, as well as CSV and import for spreadsheet programs. Scripts drive these programs to produce customized plots for real-time decision-support and ingest into operational database applications.

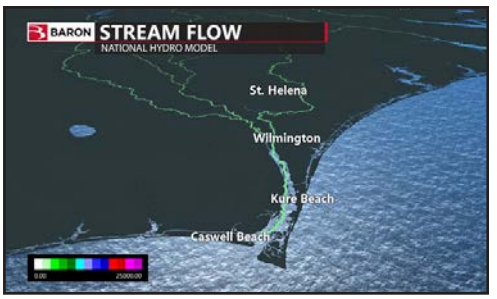
Organizations can automatically deliver hydrometeorological imagery and alerts to websites, emergency management officials, and smartphone-based alerting applications.

Briefing terminals allow authorized officials or the general public to easily access precision weather information for their areas.

Value-added data products, displayed on Baron's expert 2D and 3D workstations, or developed directly by the customer through community-based tools; provide critical weather intelligence to decision-makers, allowing them to make effective choices.



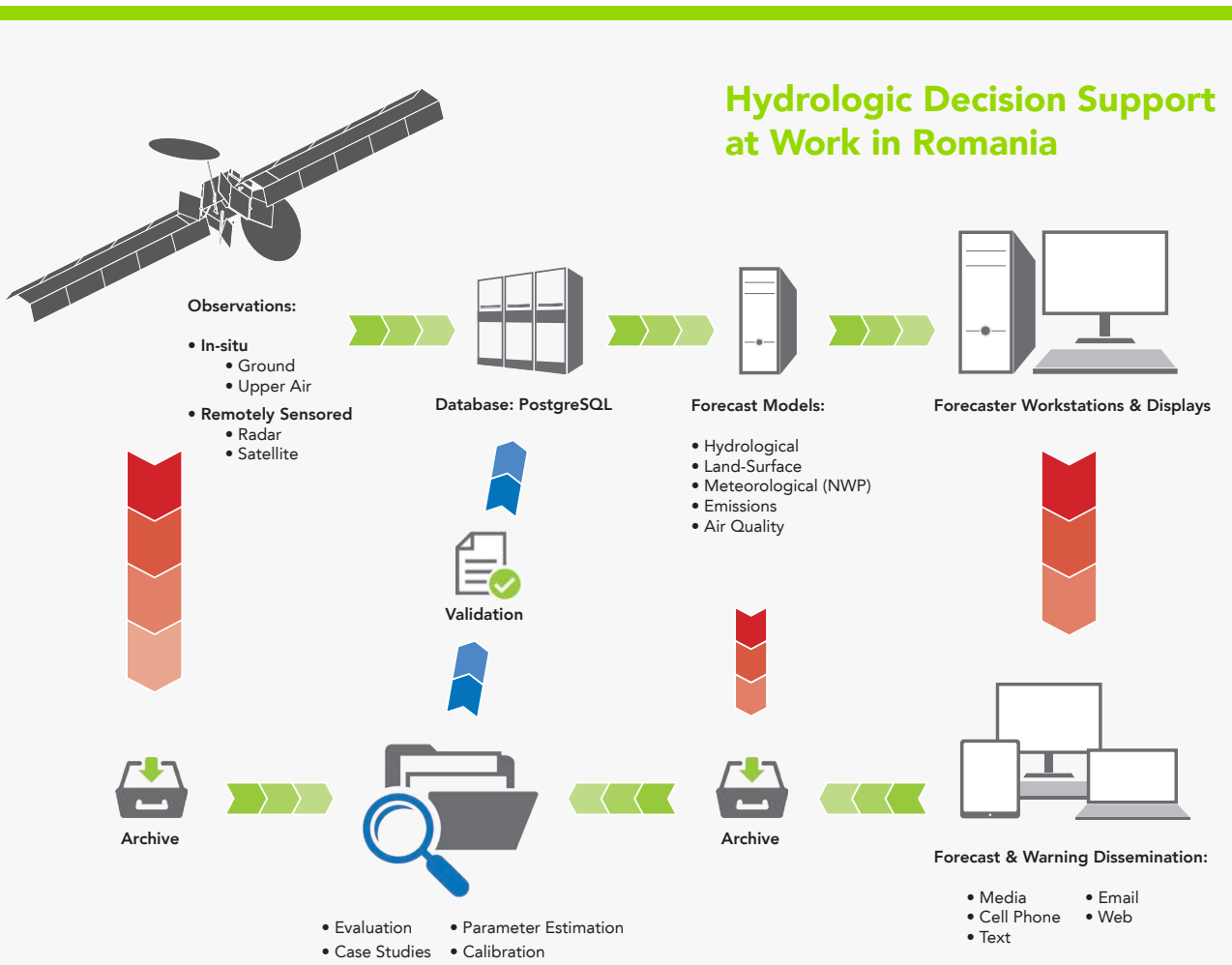
Hydrometeorological observations and model forecast data can be ingested by Baron's cutting-edge broadcast-quality display system, Baron Lynx.



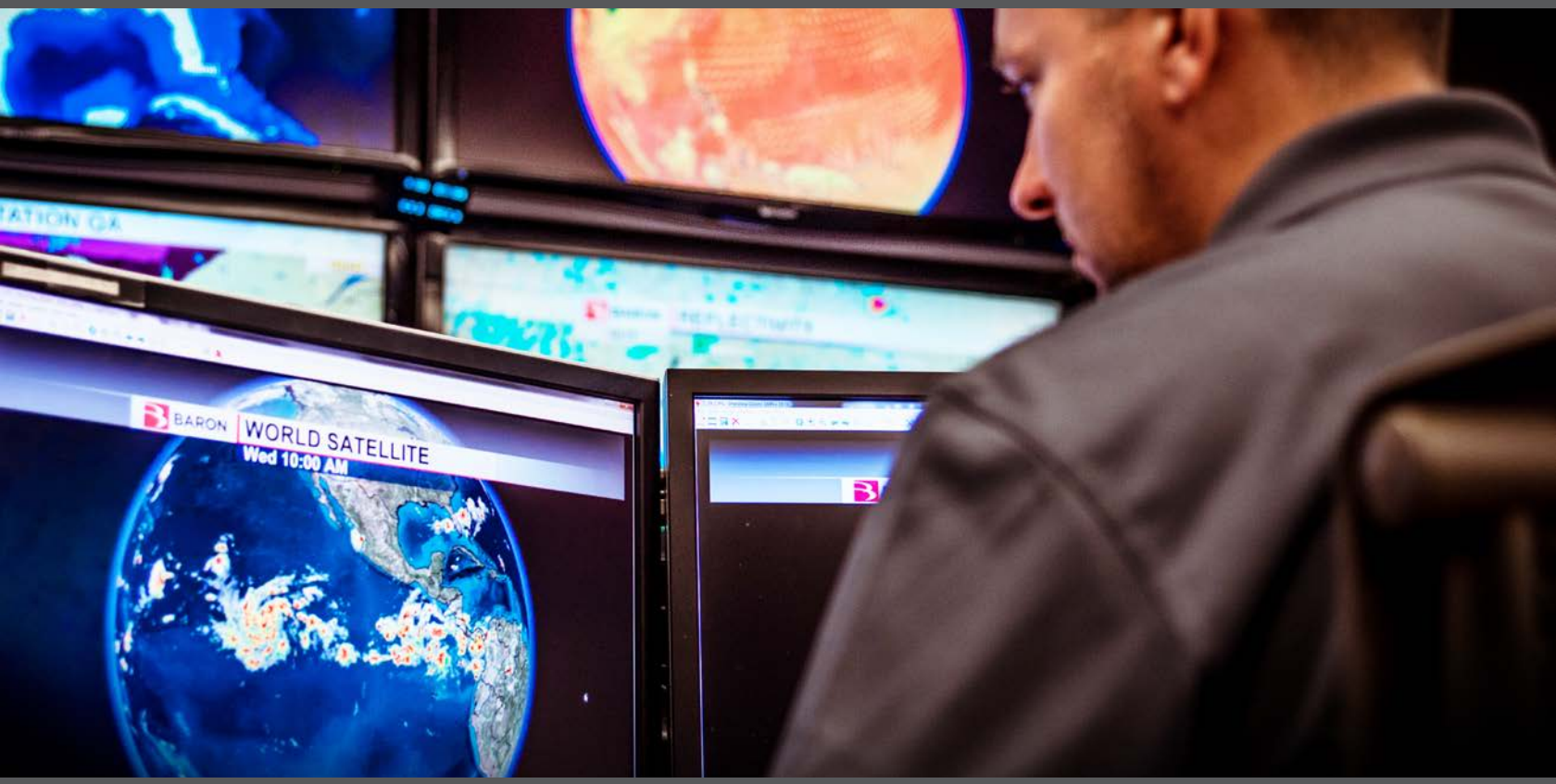
PROOF OF PERFORMANCE

Romania's rivers, mountains, and rolling hillsides contribute to a unique environment that makes flood forecasting and water management a constant challenge. Commissioned by Romania's Apele Romane water authority and the National Institute of Hydrology and Water Management, the DESWAT (DEStructive WATers) project implements a complete Baron hydrological decision-support system including the WRF-Hydro commercial version: the Baron LN2 model.

Baron provided the technology for DESWAT data acquisition, modeling, integration, and redistribution.
Due to the country's relatively large surface area and varied terrain, data collection and processing are distributed across a multi-tiered network. Integrated assets included more than 600 hydrological surveillance sensors, including automated hydrological sensor stations and water quality observations, deployed across Romania's river basins. Information is shared among 36 local sub-basin hydro service stations, 11 regional basin hydro service centers, and the central offices for National Forecast Operations and the Apele Romane water authority



High-level representation of Baron hydrologic monitoring and forecasting solution currently deployed in Romania.



CRITICAL WEATHER INTELLIGENCE

For 25 years, Baron has provided organizations with actionable information for accurate, effective decision support. Providing hydrometeorological capabilities, including weather radar, data fusion, forecast modeling, display, distribution/alerting, and the systems integration to tie these all into a single unified network, Baron ensures that users, stakeholders and the public receive critical weather intelligence that reduces loss of life and property during significant weather events.

BARON

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