NWS/OCWWS Directive 10-102 - New or Enhanced Products and Services

Product Description Document

Quantitative Precipitation Nowcasting for Flash Floods at WFOs

Part I - Mission Connection

A. Product Description

The prototype Flash Flood Potential (FFP) algorithm produces a suite of experimental WSR-88D based rainfall products, including short-term forecasts (nowcasts) of precipitation, for use by forecasters in evaluating future flash flood threat in the next one to several hours. The primary product from this initial prototype FFP version is a one-hour rainfall forecast map over a given WSR-88D radar umbrella updated every 5-10 minutes. There are other ancillary products that are produced in the process of generating these one-hour forecasts, such as past-1-hour rainfall, storm-total rainfall, local storm motion, and local storm growth and decay. Real-time gridded Flash Flood Guidance (FFG) from the River Forecast Centers is used in combination with radar-estimated and forecasted rainfall to compute gridded flash flood probabilities on a 4-km map grid.

This FFP algorithm is currently running in real-time mode for the Sterling, Virginia WSR-88D (KLWX) scanning domain on NWS Hydrology Laboratory (HL) computers, and its experimental products are displayed to the user via a web-based graphical user interface viewable within any web browser such as Netscape Navigator or Internet Explorer (Figure 1). The web address is:

http://hsp.nws.noaa.gov/oh/nomirror/ffp/pracc/pracc.htm

which is currently only accessible internally to the HL on a restricted web server. When this PDD document is formally approved, it will migrate to a widely-accessible web server at:

http://www.nws.noaa.gov/oh/nomirror/ffp/pracc.pracc.html.

The algorithm runs on a workstation computer using real-time data feeds available at HL. Future plans include expansion into the larger mid-Atlantic region through incorporation of adjacent radars surrounding KLWX. Additional details on future plans are documented in the help file linked from the web page.

B. Purpose/Intended Use

There is a need to provide forecasters at WFOs with short-term rainfall forecasts (out to 1-3 hours in the future) that can assist them in assessing developing local flash flood threat in their County Warning Area.   This is currently done at the WFOs through manual looping of current and recent-past radar or satellite images within AWIPS and subjective estimation of storm movement and intensity changes. Automated algorithms or techniques such as the FFP algorithm would permit this to be done automatically and provide forecasters with objective quantitative information on near-term future rainfall amounts and in what hydrologic basins that rain will fall. This can then be input as quantitative information to the AWIPS FFMP for comparison with FFG over hydrologic basins to assess flash flood threat or directly input into high-resolution hydrologic models such as the new HL-Research Modeling System (RMS), a prototype distributed hydrologic model being developed at the HL that uses high-resolution WSR-88D rainfall information as input. Knowledge of future rainfall in addition to rainfall up to the current time is necessary to provide additional lead time for flash flood warning to the public.

This development effort is funded through an Advanced Hydrologic Prediction Service (AHPS) initiative to improve NWS flash-flood forecasting capabilities.

C. Audience

The ultimate target audience for these quantitative precipitation nowcast products are forecasters at the Weather Forecast Offices. However, during this interim evaluation period, the audience includes the algorithm developers at HL and forecasters at the Baltimore-Washington Weather Forecast Office (WFO) since the algorithm is currently running using the local Sterling WSR-88D radar data as input which is in their County Warning Area. If additional radar data becomes available at HL from other WSR-88D radars, then the interim evaluation audience will be expanded to include those WFOs.

D. Presentation Format

The products are presented graphically in real-time to the user through an intuitive, custom-developed web interface that is hosted by a web server at the HL. The JPEG-formatted images can be viewed one at a time or can be looped in time. The images show state and county borders in the Maryland vicinity. The user interface permits zooming and other assorted functions. High-speed internet access is recommended for quickest download times. This web interface is only intended to be a temporary means to display products for evaluation purposes at the WFO and HL. Ultimately this algorithm is intended to be implemented within AWIPS and products displayed via the standard AWIPS user interface.

The purpose of the FFP products web page is to provide the developers and evaluators with easy real-time access to the products via a web browser prior to its full-scale national field deployment.   This allows the algorithm to be exercised and evaluated in a quasi-operational real-

time mode 24 hours-a-day 7 days-a-week so that its performance can be monitored and any perceived weaknesses identified and corrected before formal implementation within existing NWS computer systems such as the Advanced Weather Interactive Processing System (AWIPS). This is often called "alpha testing". It also allows forecasters access to new upcoming technology before it is deployed, allows them to gain an early understanding of the science and how the algorithm works, permits evaluation of its applicability to real-time forecast operations, and allows forecasters to provide feedback to the developers regarding desired enhancements to better suit their needs. The intention here is not to replace existing NWS algorithms or products, for example the existing Precipitation Processing System (PPS) algorithm running on the WSR-88D or the AWIPS Flash Flood Monitoring and Prediction (FFMP) system but to expand the capabilities of those systems beyond what they offer currently.

E. Feedback Method

Feedback from users to the developers is encouraged via e-mail. The e-mail address of the contact person at the HL is included on the web page. The evaluation period is expected to last two years.

Part II - Technical Description

A. Format and Science Basis

The scientific basis of the algorithm is described in greater detail in the help file located on the web page and the associated reference linked and downloadable from that page. However, in brief, the algorithm computes future storm motion and rainfall accumulation by extrapolating past motion of the storms derived from consecutive rainrate images spaced about 12 minutes apart and then integrating the future rain rates in time to produce forecasted accumulations. This storm motion is computed on a grid approximately 20 km on a side and thus produces gridded storm motion vectors every 20 km. An option exists within the algorithm to compute recent-past rate of growth or decay of the rain rates in a local lagrangian moving frame of reference and then using the computed local (~20 km grids) linear growth/decay rate to adjust future forecasted rain rates for individual storms.

B. Availability

The web-based products from the FFP are normally available 24 hours-a-day 7 days-a-week. However this can be impacted occasionally by unforseen problems with real-time access to KLWX WSR-88D radar data or other input data. Infrequent problems at HL with the unix computers where the algorithm runs or the web server can also impact real-time availability of products. Though there may be unavoidable gaps in the data and products, we strive to assure real-time availability around the clock. The algorithm itself has been running in real time for most of the past three years with great reliability and robustness and very rarely experiences

problems.

C. Additional Information

Additional detailed information on the algorithm, products, future plans and other relevant scientific references is documented in the "Algorithm and Product Description" link on the web page.

This development work on the FFP algorithm and its future enhancement is supported through the NWS Advanced Hydrologic Prediction Service (AHPS) program.
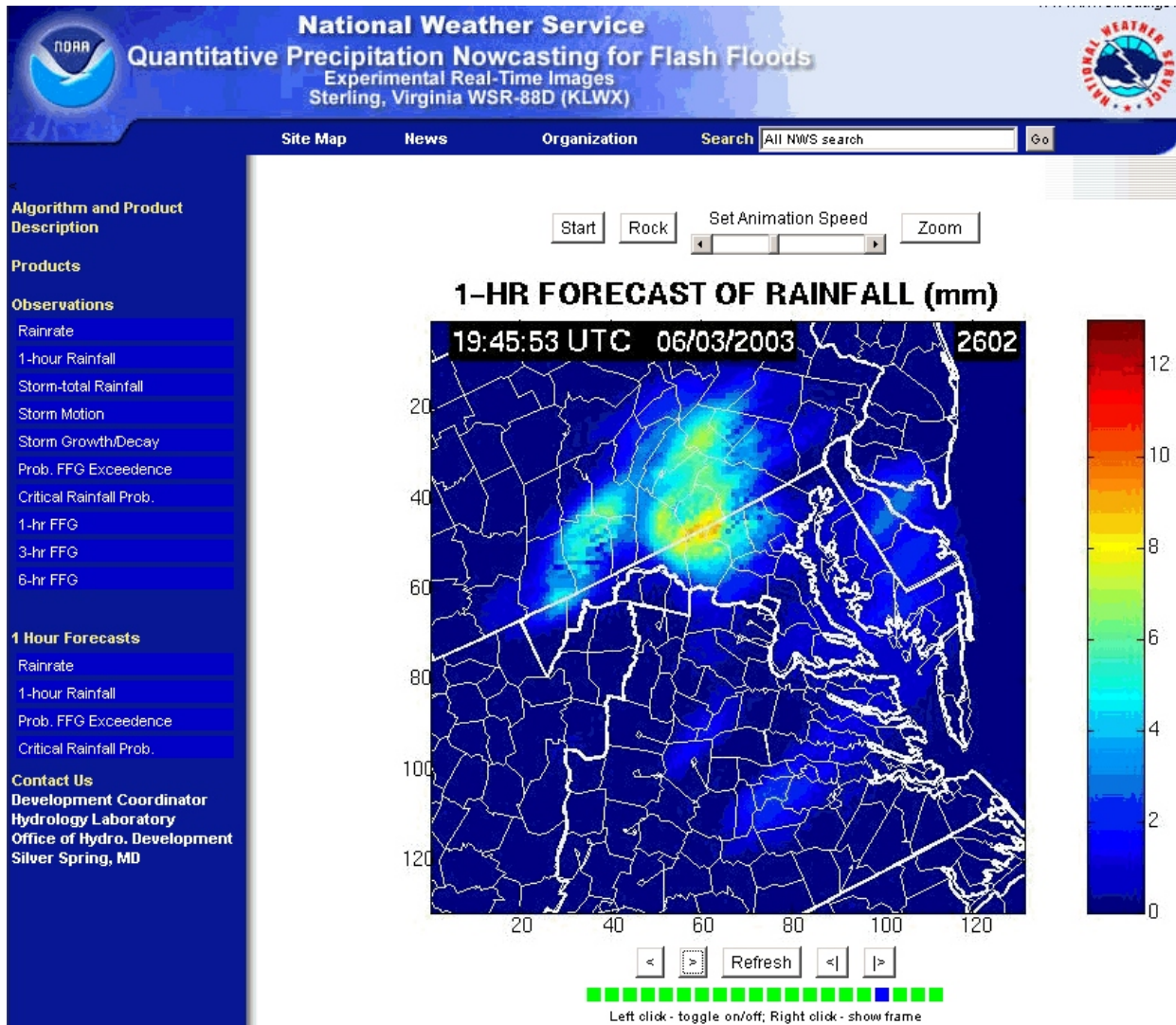

Figure 1. The Quantitative Precipitation Nowcasting web page graphical interface for the Sterling KLWX WSR-88D radar. The image shows forecasted 1-h rainfall accumulation from precipitation detected over West Virginia and western Maryland.