

FFMP: Flash Flood Monitoring and Prediction

Guide for Users

version **OB7.2**

January 3, 2007

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Introduction ←

The Flash Flood Monitoring and Prediction (FFMP) system is an integrated suite of multi-sensor applications which detects, analyzes, and monitors precipitation and generates short-term warning guidance for flash flooding automatically within AWIPS. FFMP will provide forecasters with accurate, timely, and consistent guidance and supplement forecaster event monitoring with multi-sensor, automated event monitoring. The intended benefits are:

- ☺ Longer lead times on warned events
- ☺ Fewer missed events
- ☺ Increased forecaster situational awareness
- ☺ Reduced forecaster fatigue during warning situations

FFMP conducts its precipitation analyses in a “basin world”, which means all of the calculations are done over the area of a small basin (an average of however many radar bins are above the small basin). It also ingests rain gages of various types in order to compare to the radar-based basin values. (See the Basin Trend section.)

Service Backup ←

FFMP was initially designed to conduct its analyses using data from only those radars defined as dedicated in AWIPS (ie: had a dedicated hard-line to the radar). Now, FFMP utilizes a text file to tell it which radars to acknowledge and which CWAs to analyze. This file is **\$FXA_DATA/tstorm/FFMPradarToCWA.txt** and contains explanations of its format.

If you want FFMP to analyze a radar that is **not** dedicated, **after** providing the radar’s identifier in the file, you must:

- Ensure that you have the small basin and bin shapefiles for the non-dedicated radar in the proper directory,
- Run a -scan localization after editing the FFMPradarToCWA file,
- Use the Radar Multi-Request (RMR) method of ingesting the DHR from other radars. You can find information on the RMR in the AWIPS User’s Manual.

This implies that you must know in advance what radar’s you think will be of interest, as FFMP will only **start** its accumulations when it begins to receive those RMR-requested data. It is understood that you cannot predict Service Backup incidents, so it would be prudent to set up your FFMPradarToCWA file with any potential radars, ensure all necessary shapefiles are properly available, and localizations have been successfully run. Then use the RMR any time an event is expected for a non-dedicated radar of interest.

Check on the FFMP web page for specific instructions on how to provide service Backup in FFMP. Look for the “FFMP Service Backup” Document.

This will effectively cover Service Backup CWAs that are within the Regional domain.

VGB Definition and Removal [←](#)

FFMP will query the Hydro data base to see what gages may be of interest. For each of these identified gages, FFMP determines which single radar bin (of the DHR radar product) overlies the gage for each radar of interest, and calls that bin a ‘virtual basin’ and treats it like any other of the hydrologic basins in FFMP, including accumulation rules and trending, but excluding monitoring. The intent is to provide a method to compare gage to radar, to evaluate how well the radar is doing when estimating precipitation from reflectivity.

If FFMP is including rain gages that you do not care about, you can remove the gages from FFMP consideration by adding the gage ID (one ID per text line) to the file `/data/fixa/tstorm/gageRemoved.txt` before localizing. If you **ever** change this list, you need to conduct a Forced Clean Localization for the changes to take effect. You can find Forced Clean Localization instructions on the FFMP web page.

What’s New in OB7.2? [←](#)

- [Service Backup](#): FFMP’s handling of Service Backup has been greatly improved. Among other things, we have removed its dependency on the WFO scale AWIPS geo-info. What this means is your FFMP localizations will be smoother, FFMP will be able to ‘see’ beyond the WFO scale, and FFMP is much more independent of your D2D’s localized WFO site.
- [ZoomX](#): The ZoomX feature has returned! When you use FFMP’s Zoom and Recenter function, the D2D will place a small white X at the center of the entity of interest. This X will stay at the desired lat/lon, no matter the map placement.
- [Forced FFG Graphical Emphasis](#): If you use the Forced FFG GUI to provide FFG values to FFMP, and those values have not expired, you will see them graphically emphasized in the Basin Table with an orange background for the FFG value cell..
- [Basin Trace fix](#): The initial version of the Basin Trace (new in OB6) had a bug in the way it determined its stipple resolution, which showed itself occasionally, depending on the basin and parameters chosen. This bug has been fixed. Now, your stippling should appear uniform and much more visible.
- **VGBs Return**: The VGBs (Virtual Gage Basins) were lost in the transition from Informix to PostGres, but now they have returned. You can once again use the Gage trend in the Basin Trend to evaluate radar precipitation estimation performance.
- [Guardian](#): FFMP now sends its monitor messages to Guardian, instead of the ‘FF’ button under the WarnGen button in the D2D. Check out the Guardian web page for details:

Requesting the FFMP Suite ←

Under the SCAN menu there are sections for each dedicated radar. Each of these radar sections has the available FFMP products (as well as other SCAN products).

FFMP consists of a flexible image display and a Graphical User Interface (GUI), called the Basin Table. To load FFMP, select “FFMP Image / Basin Table” for the radar of interest. This will load the FFMP Small Basin image in the D2D and load the Basin Table GUI (but will not load any FFG data). A small loading image will appear on the lower left part of the screen while the Basin Table GUI is being created. If there is no data to display, you will be informed and FFMP will not load.

Note that FFMP has several of its own **maps** under the D2D Maps menu. This includes the new Stream Links map, which shows realistic stream beds.

The D2D ←

Once FFMP is loaded, on the D2D you will see a county map. If sufficient precipitation has fallen in the specified time frame, the counties in the CWA will be color-filled. The small legend in the upper left corner of the pane will display the time frame (in hours) and attribute used to create the display. The Basin Table will appear on top of the D2D. ([See Figure 1](#))

The FFMP Basin Table Constituents: ←

[See Figure 1.](#)

The Menu/Information Bar

Contains the File Menu and information regarding the link to the D2D and the valid time of the FFMP Basin Table.

The File Menu

Retrieve Default Configuration	Retrieves and uses the default basin configuration file.
Retrieve Configuration...	Retrieves and uses a specified basin configuration file.
Save Configuration	Saves the basin configuration file.

Save Configuration As...

Saves the basin configuration file to a new file, defined by the user.

Link to Frame

Indicates whether the valid time in the FFMP Basin Table will always match the time in the D2D frame. If this button is activated and the user changes the frame in the D2D, the basin table will update to match the data shown on the D2D. If this is off, the data in the basin table will represent the *most recent inventory time*.

Ending Time

This displays the UTC time for which the data in the basin table is valid. This is the beginning of the volume scan for which the pertinent time duration ends.

The Options Buttons ←

Below the Menu/Information bar and above the body of the basin table.

Refresh D2D

This button will allow the D2D to see any changes made to the way data is displayed in the Basin Table, thus updating the D2D image to reflect the data in the Basin Table. For example, if you wish to change the duration in the D2D FFMP image, you first change the duration in the basin table (see below), then click the Refresh D2D button and the image in the D2D will change its duration to what was just selected in the Basin Table. This button will change color if something has changed in the Basin Table that would require the FFMP display in the D2D to be updated in order for the two display components to agree.

Display Rate

Normally, FFMP will display either precipitation accumulation or a comparison between the accumulation and FFG (see Thresh Type below), in the D2D. However, FFMP can also display ‘instantaneous’ rate data, according to county and basin. If you wish to view this, toggle the ‘Display Rate’ button on by clicking it, then click the ‘Refresh D2D’ button. Repeat these steps to turn it off.

Thresh Type

Both the basin trends ([see below](#)) and the D2D FFMP images are color-coded based on the type of threshold the user wants to view. The choices of threshold type are: precip (accumulation), diff (accumulation minus FFG), and ratio (accumulation divided by FFG). This button displays the current threshold type chosen. If you wish to change this, click on this button and make a different selection. The Basin Table will update. If you wish to have the D2D update as well, click the Refresh D2D button (as described [above](#)).

Data Sources

This menu button lists all precipitation data sources available for use in the table. The precipitation source selected is used in computing the ratio and difference values in the table. Digital Hybrid Reflectivity (DHR) radar product is the primary precipitation source for the FFMP table and display, but several other sources are available, including SCAN 1-Hour QPF, and several other QPF and QPE options. Note that the selection of these additional precip sources will not affect FFMP's background precipitation monitoring. FFMP will continue to tabulate precipitation totals based on the DHR product. Note also that, except for the SCAN 1-Hour QPF, the displays for these extra sources will not auto-update; they must be re-selected to refresh.

Ag Lvl

The Aggregation Levels button reflects what kind of data is being listed in the table and displayed in the D2D. In earlier versions of FFMP, there were only 2 display choices: County and Basin, and the Basin choice meant only those basins in a zoomed-in County. Now, all display choices are considered layers - aggregated layers - and when you choose the “All & Only Small Basins”, you will see just that in the D2D and Basin Table, all small basins and only small basins (no aggregation) no matter the zoom. In addition to these two basic choices, there are also several automatically aggregated layers, starting at the HUC level (large basins, much aggregation) and going down in spatial scale (smaller basins, little aggregation). This aggregation is automatic, hydrologically sound, and based on the Pfafstetter codification scheme. In the future, we expect to allow user-defined ARC GIS shapefiles and ingest them as user-defined aggregated layers.

Note: when you choose a layer, you do not have to click the “Refresh D2D” button, so choose with the expectation that the display may take a second or two to update itself.

Zoom Behavior

With the implementation of Auto-Aggregated Layers, we needed to provide a bit more flexibility, so we could sustain legacy functionality and provide additional customization. The best thing to do in order to learn how these settings behave is to play around with the “Maintain Layer” and “Only Basins in Parent” buttons. But if you want some guidelines, here they are:

Maintain Layer	Only Basins in Parent	Description
OFF	ON	These are the legacy settings, which means that the FFMP Zoom Behavior will be the same as it has been before the implementation of Auto-Aggregated Layers. When you click on an Area_Id in the Table Body , the Zoom and Recenter function will zoom into that area in the D2D and display only those small basins that exist in the parent area you just zoomed in on, but not any small basins outside that area of interest.

OFF	OFF	Both settings off means that when you zoom in on an area, you will see all small basins within the field of view. Take care in using this, as when you zoom in you may find it hard to see your landmarks (and county boundaries) and you may lose where you are.
ON	OFF	These settings mean, when you zoom in on an area, you will not see any small basins at all, but will see all areas of your chosen Aggregation Level in the field of view. You will continue to see whatever layer you have chosen from the Ag Lvls menu.
ON	ON	These settings are not really of any use. With these, when you zoom in on an area, you will only see that area and not any small basins.
<p>Override</p> <p>If you have chosen the “All & Only Small Basins” from the Ag Lvls menu, you will always see all and only small basins in the D2D and in the Basin Table, effectively overriding anything set in the “Maintain Layer” and “Only Basins in Parent” toggles.</p>		

Group Label

The wide button above the Area_Id column title is the Group Label button. This will tell you if you are viewing a Group List (a list of areas, be they counties, small basins, or a HUC Layer) or if you are viewing the small basins after executing a Zoom and Recenter action. For example: the user started with the County Layer (which is default) and has clicked on one county, which zooms and recenters in the D2D and displays a list of small basins in that chosen County. After they zoom and recenter, the Group Label will show the name of that county chosen and, if clicked, will zoom back out and return to that county list.

Durations

The raw FFG received from the RFCs exists for the one, three, and six hour time duration. From these base values, FFG can be interpolated or extrapolated to other time frames. A new time frame can be chosen by clicking on the “Duration” button and selecting one of the durations listed. Once one of the durations is selected, the current table will be updated to display the data only for the new requested duration without destroying the entire window. The current duration is printed on the “Durations” button.

Worst Case Display

Sometimes a user may want to see the averaged data for an entity in a certain layer and sometimes a user will want to see the worst values of all of the small basins inside that entity. As of OB3, the user can now choose, by setting the Worst Case Display Toggle. If it is on, then all values of an entity will represent the ‘worst’ value of all of the small basins inside that entity.

If it is off, averaging will be used to provide the values of that entity.

The Attribute Title Row ←

Shows (in black) what attributes are available for viewing. When the cursor is focused over these titles, a tip text pop-up will appear, describing what button click actions will trigger what functionality. See [Appendix A](#) for some additional information on these attributes.

Ranking By Attribute

Clicking on applicable attribute titles will sort the table data according to that attribute. A purple attribute button background color signifies that this attribute was the last attribute to be used for sorting the table data. Refer to [Appendix A](#) to see for which attributes the table can be ranked.

Changing the Attribute Color Thresholds

Clicking Button 3 on applicable attribute titles will bring up the Attribute Color Threshold (ACT) window. The ACT window allows the user to define value ranges of each applicable basin attribute. These value ranges are intended to reflect the degree of strength of the attributes, from green (weak) to yellow (moderate) to red (strong). Refer to [Appendix A](#) to see which attributes can be multi-colored.

The Table Body ←

Displays the basin or county information, including such attributes as precipitation estimate and comparisons to Flash Flood Guidance. If there is no rainfall over all geographic entities for the specified precipitation data source and time duration, the data presented in the table will have error values (ie: “na”). The values for the various basin attributes are displayed in the table body and color coded (when applicable) according to the attribute color thresholds defined in the ACT window. Also, when the cursor focuses over an area identifier, the full name of the area will appear in a text pop-up box. Refer to [Appendix A](#) for a list of all basin attributes available through FFMP.

Note as of OB7.2, the FFG boxes will have an orange background color if Forced FFG is currently active. (See [Figure 1](#))

Inspecting a Basin or County (ZoomX)

Clicking on an identifier in the ‘area_Id’ column will cause the D2D to zoom-and-recenter on that particular county or basin and place an “X” at the centroid of the entity zoomed in on. If the list is an aggregate layer list (like County of HUC2), the D2D will zoom in on that particular county and display the small basins based on the Zoom Behavior settings, and the data for the basins within that aggregate layer will be listed in the Basin Table. If the list is a basin list, the D2D image will zoom in further than the zoom for an aggregate layer, fill the Inspection Row with data for that basin, and highlight that basin’s identifier in the ‘area_Id’ column. The Inspection Row can be seen in [Figure 1](#).

The Inspection Row [←](#)

Duplicates the row in the table body for the basin that was last inspected (see the section on basin inspection under the [Table Body](#) topic for instructions on how to inspect a basin). This row emphasizes the data for the identified basin last inspected via the zoom-and-recenter method. The individual grid boxes in the Inspection Row have the same capabilities as the grid boxes in the table body, except clicking on the identifier box will zoom the D2D back out to the zoom level defined on the D2D menu bar. [See Figure 1.](#)

Zooming Back Out

Clicking on the identifier in the 'area_Id' column will cause the D2D to zoom back out (after zooming in on a basin) to the single-county view, but retain the basin listing in the Basin Table.

FFMP Basin Table Sub-GUIs in Detail [←](#)

Attribute Color Threshold (ACT) Window

Launched from the Attribute Title Row. The user can edit the color-coded strength values or the Cutoff/Filter value for any of the basin attributes displayed in the Attribute Title Row.

“Attribute:”	The user can switch to a different basin attribute. The units of the attribute will also appear on this button.
“Upper:”, “Mid:”, “Lower:”	The strength thresholds, corresponding to the attribute values that meet or exceed these threshold values.
“Cutoff Value”	The value used for removing weak records from the Basin Table, to reduce clutter and improve Basin Table performance. This is applied to the attribute being used for ranking/sorting.
“Apply”	The user accepts the changes just made and closes the window.
“Cancel”	The user can discard the changes just made.

Basin Trend Graph [←](#)

A Basin Trend Graph can be produced by clicking Button 3 on the basin identifier (for a basin list). It can also be produced by enabling the “FFMP Table Display” in the D2D (click Button 3 on the legend of the same title) and clicking Button 3 over a basin. The way the data is displayed in the Basin Trend Graph may take a bit of time to get used to. Here’s an example of interpretation for the “3.0” point on the x axis: the rate plot represents the instantaneous precipitation rate for the volume scan with beginning time of 3.0 hours in the past; the accumulation plot represents the amount of precipitation that has fallen in the past 3.0 hours; the FFG plot represents the Flash Flood Guidance valid for the 3.0-hour time frame. The gage plot represents comparable gage precipitation accumulation data (only for Virtual Gage Basins). The

colors under the accumulation plot represent the degree of urgency with which the basin should be investigated. The color thresholds and the attribute to which the thresholds will be applied are presented in the color legend at the bottom of the GUI and can be chosen via the ACT window and the Threshold Type Selector, both available in the Basin Table itself. See [Figure 2](#) for an example of a Basin Trend.

Basin Trace ←

A Basin Trace can be produced by enabling the “FFMP Table Display” in the D2D (click Button 2 on the legend of the same title) and clicking Button 3 over a basin in the D2D. You can define whether you want to see up or downstream or both. When you produce a Basin Trace, you will see the desired area (up and/or downstream from the basin selected) stippled in the FFMP color image in the D2D. See [Figure 5](#) for an example of a Basin Trace and the choice widgets.

Because both the Basin Trend and Basin Trace functionality are activated with the same button clicks, you will need to define which function those button clicks should enable. Also see [Figure 5](#) to see these choice widgets.

FFMP Flash Flood Guidance ←

The FFMP provides a D-2D display of the gridded Flash Flood Guidance data issued by the River Forecast Centers (RFCs). This is the same data that is currently available in the Surface menu (under “RFC FFG/QPE/QPF images”). While the Surface menu selection will let you choose FFG data from individual RFCs or a national mosaic, the FFMP display will mosaic data from all RFCs that have coverage over the local small stream basins. Instead of using a single inventory time, the FFMP display will mosaic the latest FFG data from the selected RFCs, even if the inventory times are different, provided that the data is no older than 36 hours.

FFMP Flash Flood Threat Indicator (FFTI) Monitor ←

A communication application called Guardian (General User Alert Display Panel) was delivered in OB7.2, with FFMP defined as a monitor. With Guardian’s default configuration, the FFTI is represented by the ‘FF’ button in the main Guardian GUI. The color of the FFTI will represent the ‘worst’ value of the chosen attribute/time frame sets. The attributes to choose from are: precipitation accumulation derived from the DHR radar product (“dhr”), the ratio of the precipitation accumulation to the FFG, and the difference between the precipitation accumulation and FFG. You may choose up to **3** attribute/time frame sets to monitor and the color threshold values used for the FFTI button by clicking on the “FF” button. This will bring up the FFTI Change GUI ([see Figure 3](#)). If you place the mouse cursor over this button, some text will pop-up, providing some additional information, such as what is being monitored and for what time frame.

The **default** colors, the Guardian Priorities, and what they represent are:

Color	Priority	Description
White	4	Indicates little or no activity in the CWA.
Green	3	Indicates precipitation in the CWA.
Yellow	2	Indicates moderate precipitation estimates in the CWA.
Red	1	Indicates heavy precipitation estimates in the CWA.
Gray	5	Indicates an invalid index number, which means the FFMP processor is not behaving properly or data is missing.

Note that Guardian allows considerable flexibility in its configuration, thus it is possible for users to change these colors, if they desire.

You may also define how old ‘too old’ is for FFG to be used in FFMP. Simply enter the number of hours in the provided entry field.

FFMP’s Forced Flash Flood Guidance GUI [←](#)

We have provided a GUI with which you can provide your own FFG values. The Forced FFG GUI has its own, separate User’s Guide.

Data Monitoring System (DMS) [←](#)

The FFMP Data Monitoring System (DMS) is a web browser-based, automated system for monitoring the status of the vital components of FFMP. It consists of a suite of HTML files, a Tcl/Tk Common Gateway Interface (CGI) script, and various supporting procedure, data, and image files. The system is housed on a web server, accessed through any browser that supports frames, and is updated using the CGI script. The following information is intended to give an overall description of the system display, defining the layout and components, and provide instructions for using the system.

DMS Display

[See Figure 4.](#)

The FFMP DMS display is divided into two frames. A small, static frame at the top of the page holds the title information and the button for updating the table information. The main frame below houses the data monitoring graphical elements.

Radar Products Information Table

The Radar Products Information table monitors the status of the DHR radar product for each dedicated radar. For each dedicated radar, the monitor reports whether or not the DHR product is on the Routine Products Set (RPS) list (Y for Yes, N for No), and gives the most recent GMT inventory time. If the DHR product is absent from the RPS list, the background of the table cell

containing the letter “N” will be colored red. If the DHR product is not available, meaning there is no data file in the directory where it is stored, the monitor reports “None” and colors the background of the table cell red. Similarly, if a data file time is old, the background of the cell is colored red. A file is determined to be old according to a formula derived from the VCP mode (twice the length of the volume scan plus 2 minutes). If the VCP mode is not available, the default threshold value of 22 minutes is used.

Flash Flood Guidance Information Table

The FFG Information table monitors the status of FFG products for each River Forecast Center (RFC) that has responsibilities within the WFO’s CWA. For each time period, and for each RFC, the monitor reports the most recent GMT inventory time. If the product is not available, meaning there is no data file in the directory where it is stored, the monitor reports “None” and colors the background of the table cell red. Similarly, if a data file time is old, the background of the table cell is colored red. A file is determined to be old if it is older than 36 hours.

Using the DMS

Loading the DMS

The file name to enter into the browser address line is http://as1f/infoPages/FFMP_DMS.html.

Updating the Information: Automatic and Manual

In the static frame at the top of the display, there is a blue button labeled “UPDATE INFO.” Clicking this button will refresh the information displayed in the lower frame. Also, for convenience, the DMS is equipped with an automatic update feature. This feature allows the user “hands-free” monitoring, updating the information automatically every two minutes.

Figures

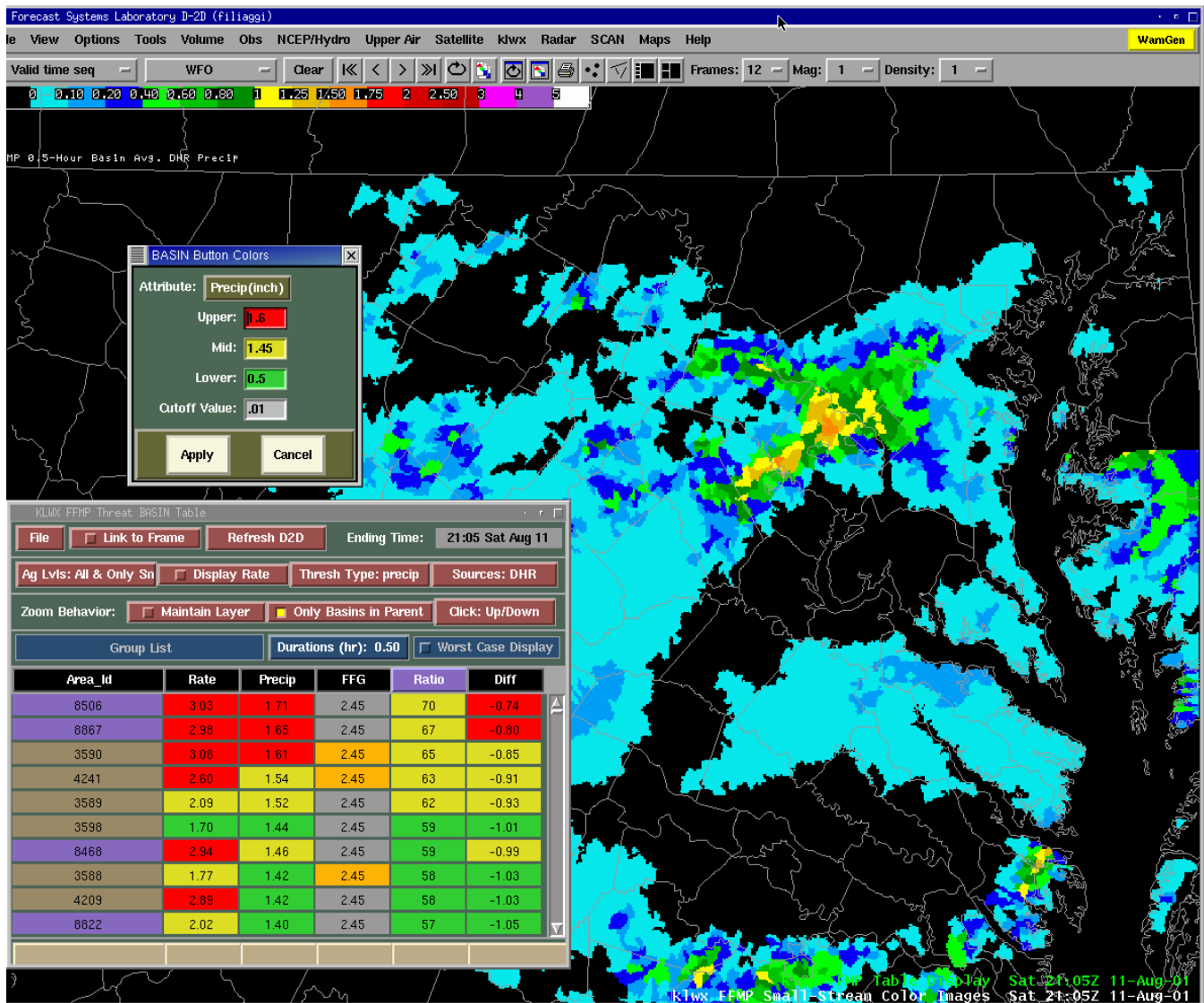


Figure 1 This shows the FFMP Basin Table and Button Color Threshold GUI with the D2D. The D2D shows the FFTI indicator below the WarnGen button. It also shows a view of the All & Only Small Basins layer.

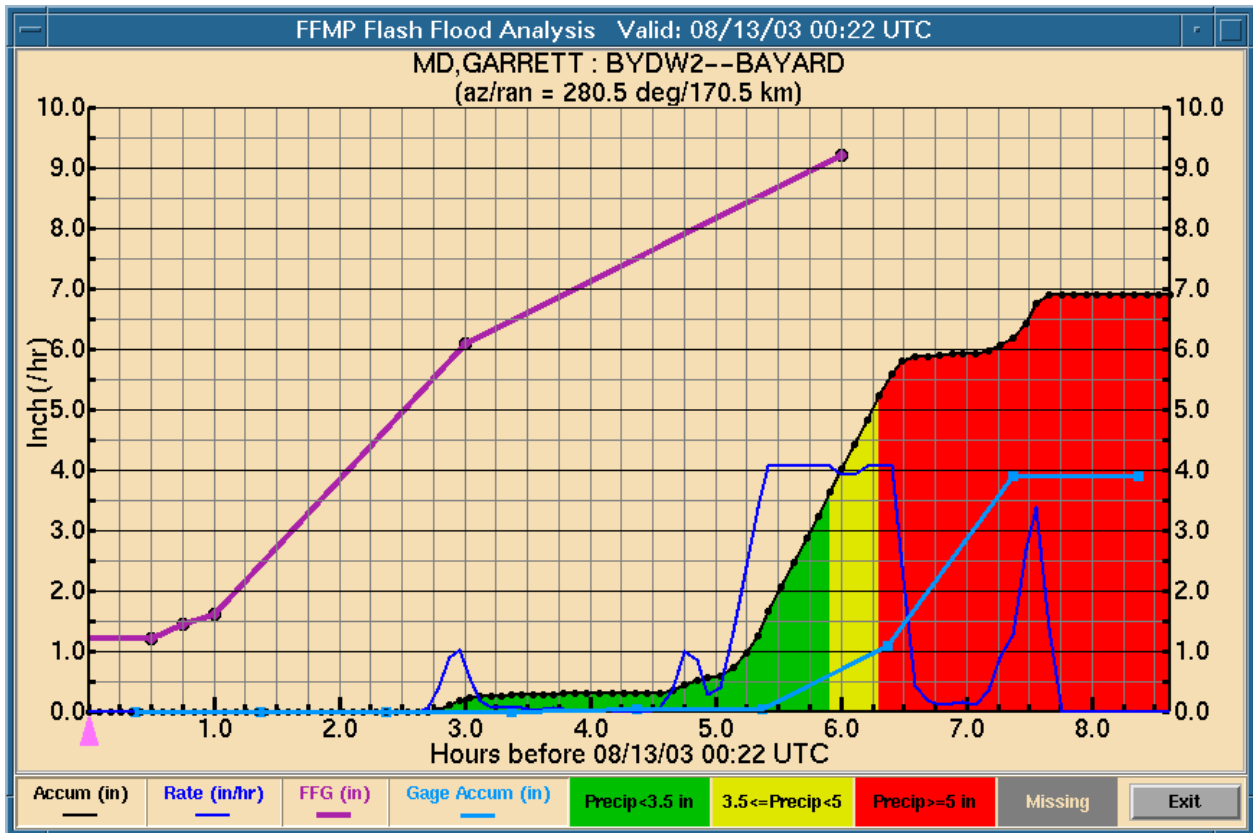


Figure 2 This is a Basin Trend. Please take time to examine this trend to fully understand what it is showing. The “Rate” plot represents the ‘instantaneous’ rate determined from the DHR radar products, backwards in time. The “Accum” plot represents the precipitation accumulation for the specified number of hours in the past to the most recent data time. The “FFG” plot is the valid Flash Flood Guidance for the specified time frame (not the number of hours in the past), thus the comparability to the accumulation plot. The “Gage Accum” plot is for a found gage in the basin and is provided in order to compare gage and radar precipitation estimates. Note that this image is for a Virtual Gage Basin. Regular Basin Trends would not contain a Gage Accum plot.



FFG Expiration Time

FFMP will not use FFG older than hours.

Setting 1 **Setting 2** **Setting 3**

Attribute that will be monitored

accum ratio diff

0.20 0.70 x100 %

Time frame that will be monitored (hours)

.5 .75 1 1.5 2 2.5 3 4 5 6

Figure 3 This is the FFTI Change GUI, rendered by clicking on the “FF” button below the WarnGen button on the D2D.

File Edit View Go Communicator Help

WebMail People Yellow Pages Download New & Cool Channels

Bookmarks Netsite: http://as1f/infoPages/FFMP_DMS.html What's Related

Welcome to the FFMP Data Monitoring System

UPDATE INFO

** The page will automatically update every 2 minutes*

Last Update Time: Aug 30, 2001 19:02:33 GMT

Radar Products		Dedicated Radar	
		KLWX	KAKQ
DHR	On RPS List?	Y	N
	Most Recent File*	20010830_1854	None

Flash Flood Guidance		River Forecast Centers
		MARFC
1 Hour	Most Recent File*	20010830_1200
3 Hour	Most Recent File*	20010830_1200
6 Hour	Most Recent File*	20010824_1200

* A red background indicates old data, or data that is not available (None).
 Radar data is "old" 22 minutes after the beginning of the volume scan (time shown).
 Flash Flood Guidance is "old" 36 hrs after the valid time.

Figure 4 The FFMP web Data Monitor, showing the availability of the DHR product and Flash Flood Guidance from all sending River Forecast Centers.

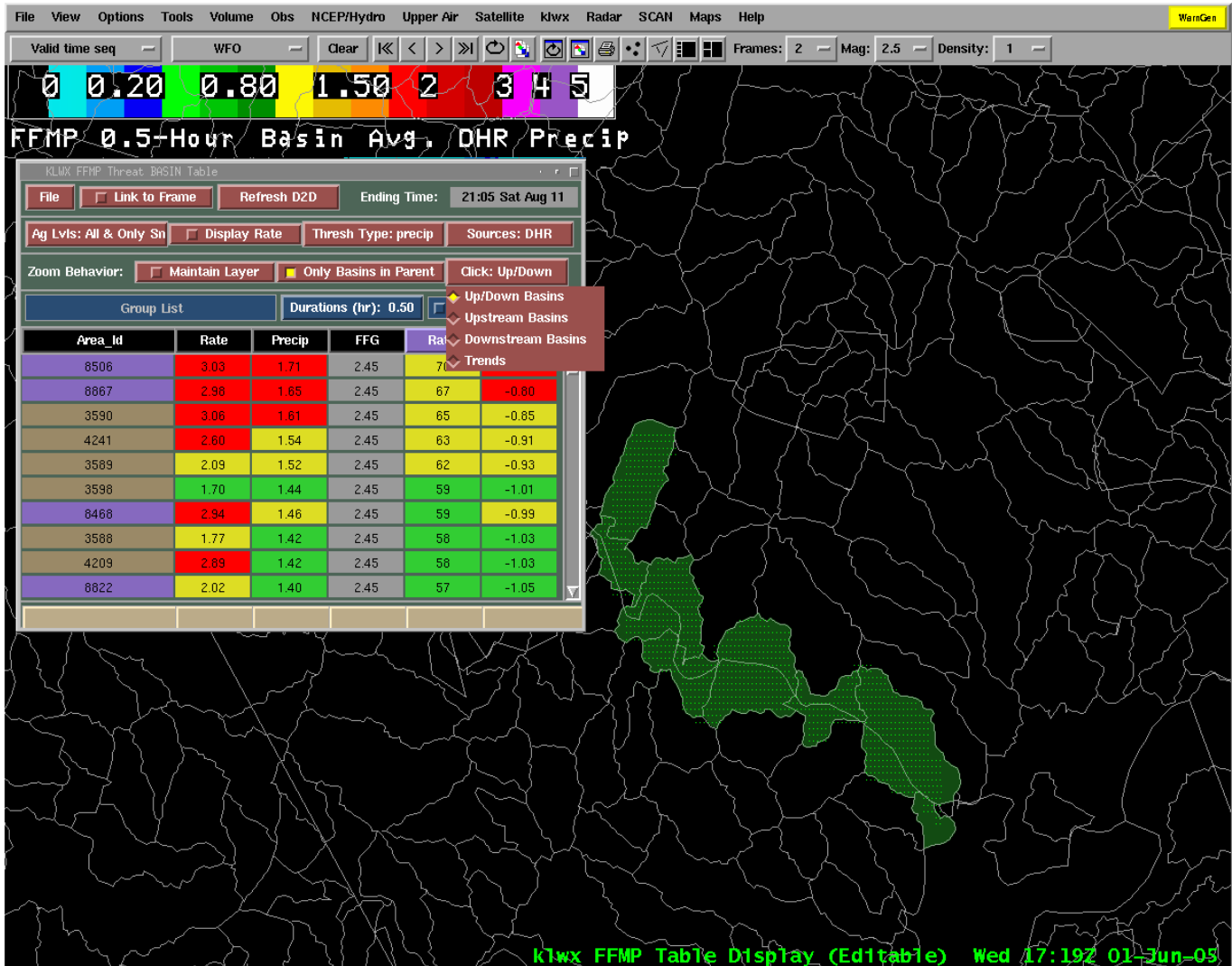


Figure 5 Basin Trace and Trend/Trace Choice. Note that this example was enhanced, as the standard stippling was not visible, transformed into this document.

Help ↩

Please check the FFMP web page for more detailed info at <http://www.nws.noaa.gov/mdl/ffmp>. To report problems or ask questions concerning the operation of FFMP in general, please send e-mail to the FFMP list server (awips-ffmp@infolist.nws.noaa.gov).

Glossary ↩

ACT - Attribute Color Threshold
CGI - Common Gateway Interface
CWA - County Warning Area
D2D - Display 2 Dimensions
DMS - Data Monitoring System
DHR - Digital Hybrid Reflectivity
FFMP - Flash Flood Monitoring and Prediction
FFTI - Flash Flood Threat Indicator
GUI - Graphical User Interface
RFC - River Forecast Center
RPS - Routine Products Set
VCP - Volume Coverage Pattern

Appendices [←](#)

Appendix A FFMP Table Attributes for Counties and Basins

Attribute	Definition	Units	Can be used for ranking?	Can be multi-colored?
area_Id	County or Basin or Virtual Gage Basin Identifier	up to 15 letter ID	Yes	No
rate	Single Volume Scan Precipitation Rate	Inches per Hour	Yes	Yes
precip	Average precip. for GeoArea.	Inches	Yes	Yes
ffg	Flash Flood Guidance	Inches	Yes	No
ratio	Ratio: precip. / FFG	%	Yes	Yes
diff	Difference: precip. - FFG	Inches	Yes	Yes