Storm Interrogation

AWOC Severe Track
ICSvr 3-IV-B

Effective Use of FFMP

Thanks to Matt Kelsch for helpful input and for reviewing this material.

Effective Use of FFMP

Objectives:

- Understand how to best use FFMP
- Understand the radar limitations for rainfall estimation that directly affect FFMP and thus flash flood detection

FFMP

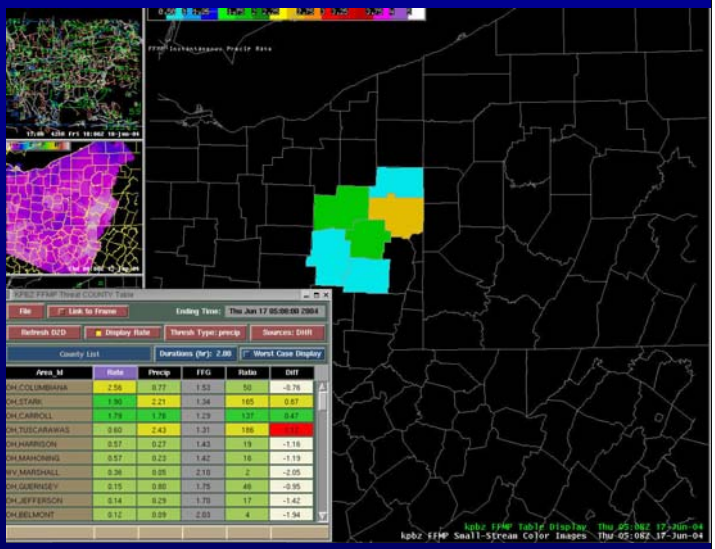
- Should have basins customized to very small scales already, and have the basics of FFMP well handled

- Refresher FFMP Presentation

If you haven't customized your basins already, its extremely important to do so as soon as possible. Because this is an AWOC presentation, the FFMP basics are not covered here but a link to FFMP basics is provided above.

FFMP: ABR Rate

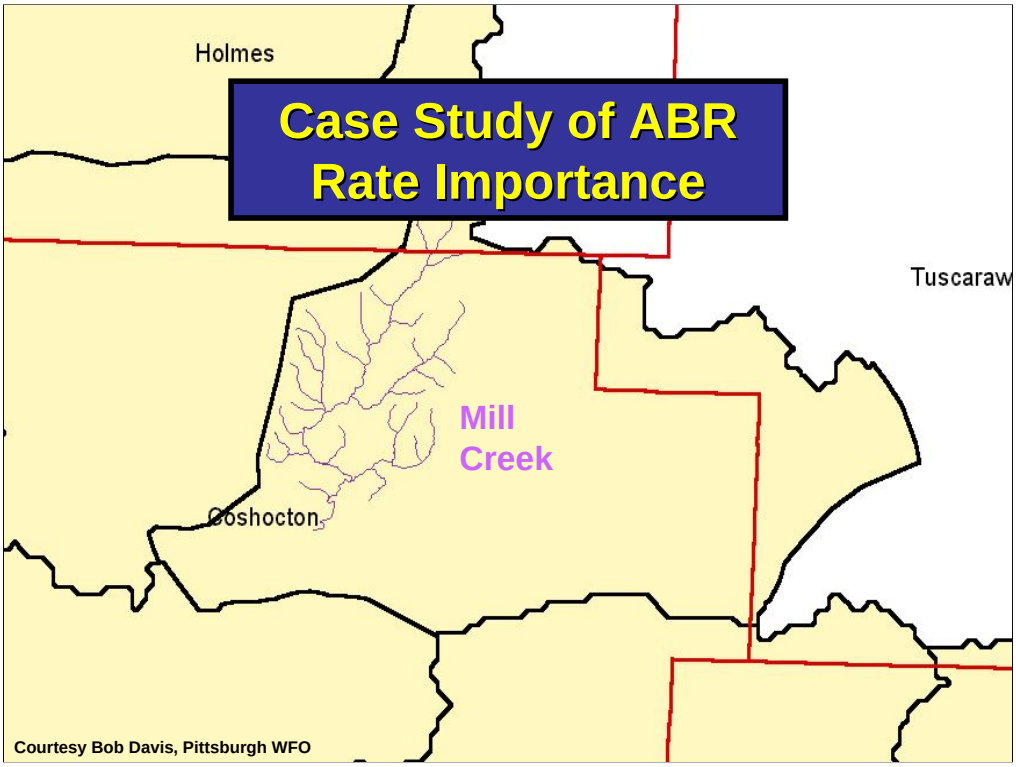
- Closely monitor ABR *rate* to assess flash flooding risk



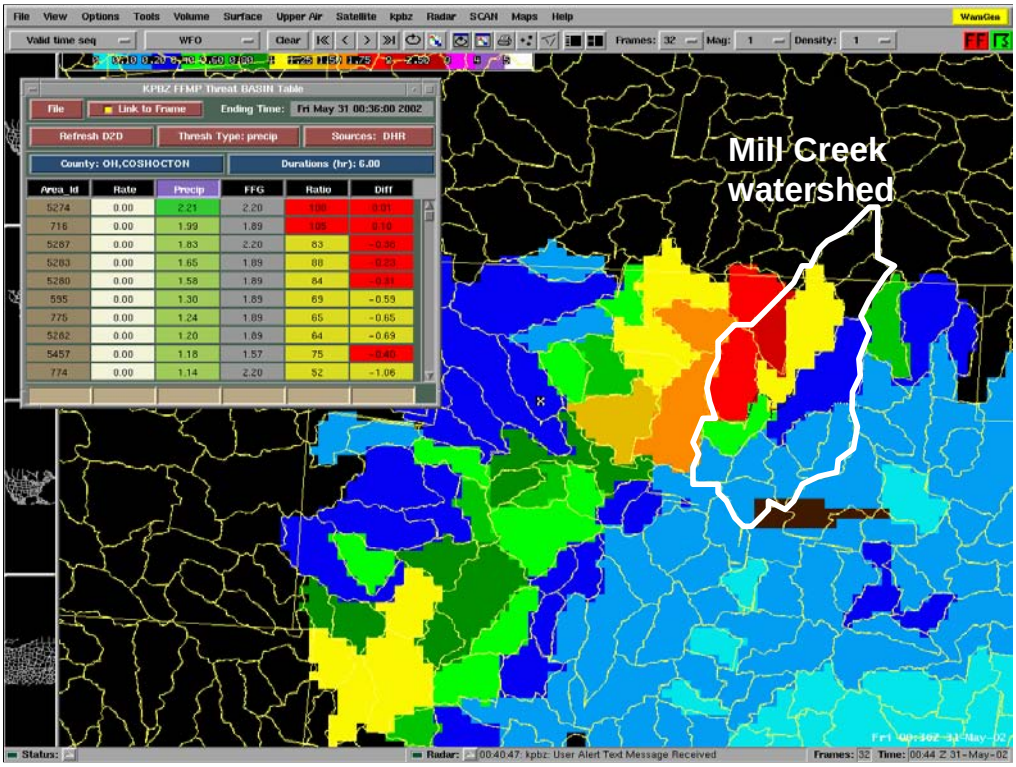
Rate MUST exceed 1-hr FFG to have any chance for flash flooding (provided FFG is accurate). Look for persistence of high ABR rates, especially for greater than 30 min. Monitoring rate gives you the best chance for significant lead time since rate shows a heightened flash flood threat well before any other parameter.

FFMP: ABR Rate Persistence

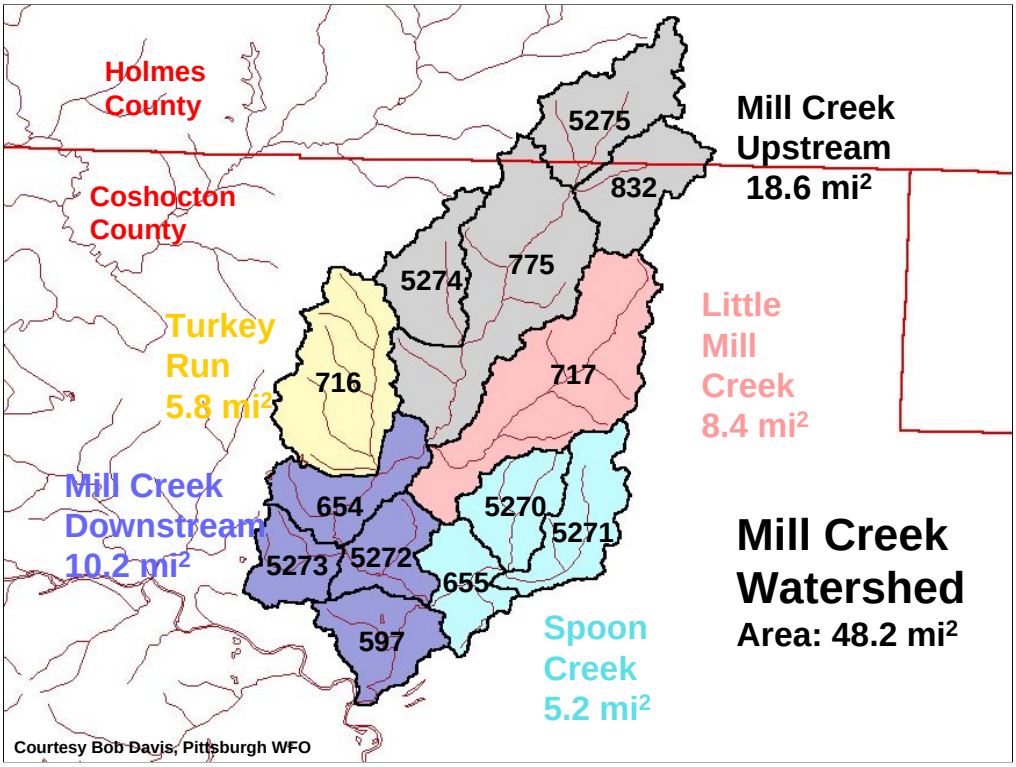
- When monitoring Rate, look for "rainfall bursts" of 3 or more volume scans with 1-5 in/hr rates
  - These bursts can be significant, and seldom last longer than 90 minutes
  - Focus on radar data to see if rainrates likely to continue



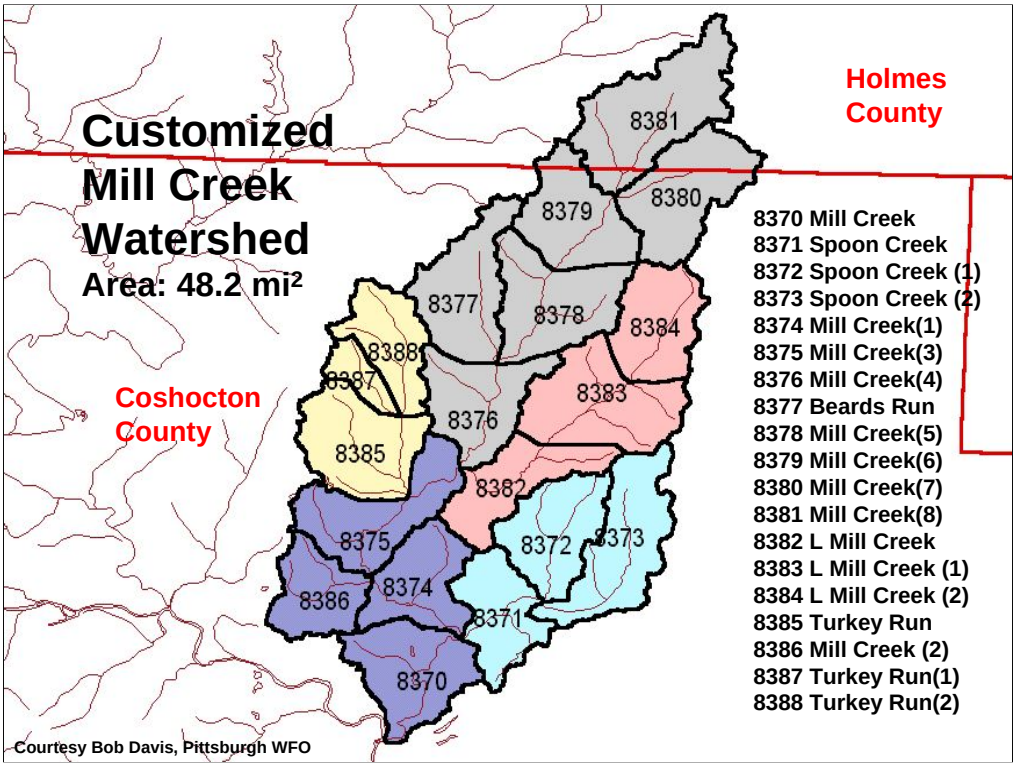
Mill Creek watershed in Ohio

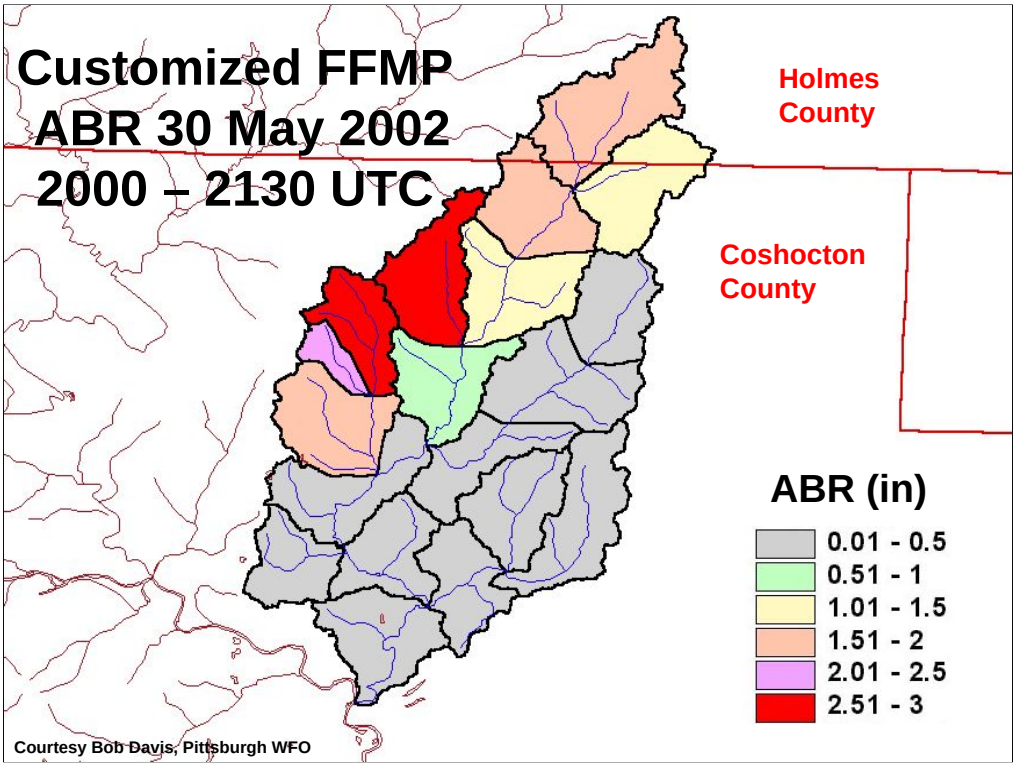


May 31, 2002 FFMP image from 00:44 UTC showing the Mill Creek Watershed with the smaller, customized basins.

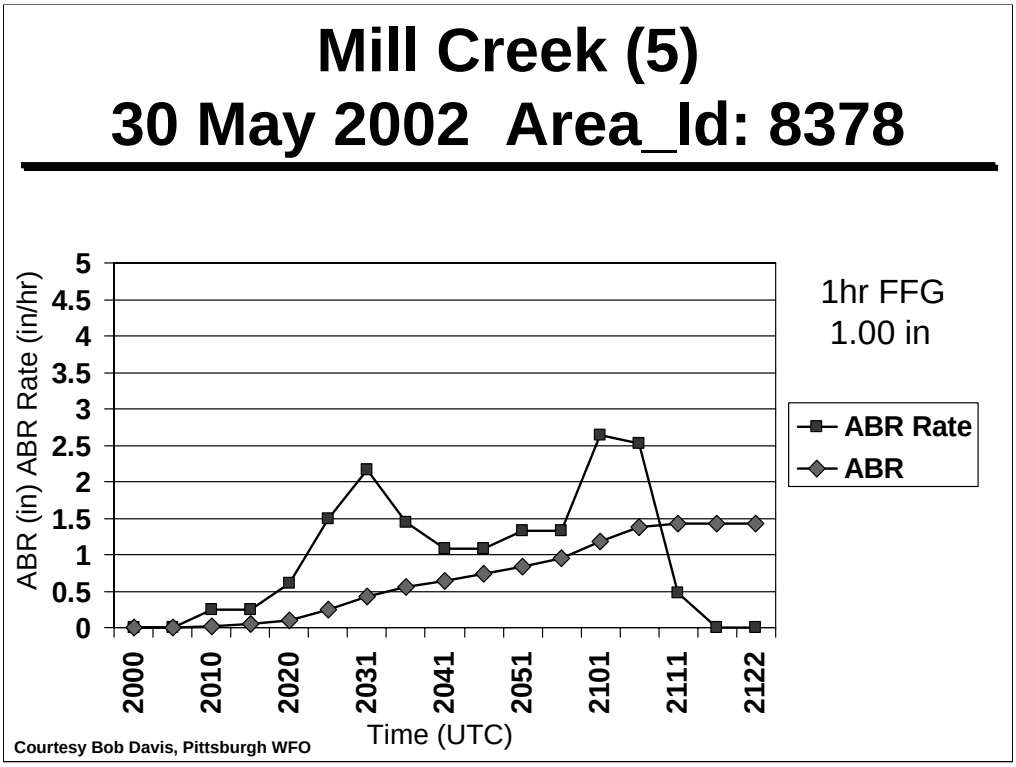


This is the customized basins within the Mill Creek Watershed.

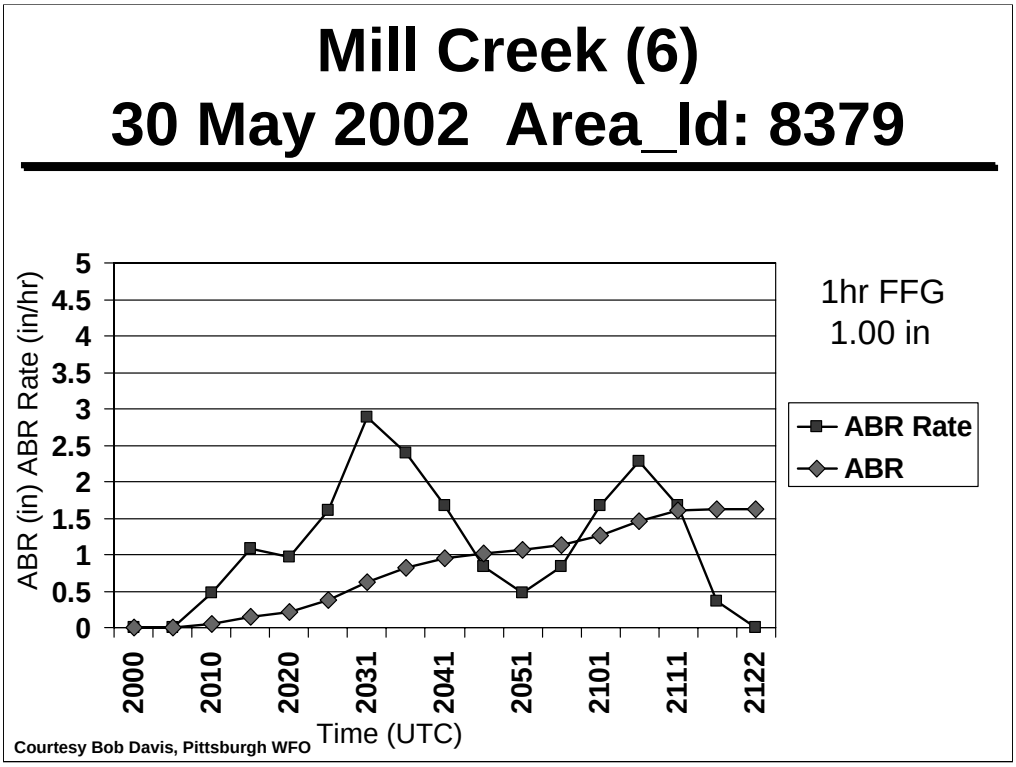

Customized
Mill Creek
Watershed
Area: 48.2 mi²
Holmes
County
Coshocton
County
8381
8380
8379
8377
8378
8384
8388
8387
8383
8376
8385
8382
8375
8372
8373
8374
8386
8371
8370
8370 Mill Creek
8371 Spoon Creek
8372 Spoon Creek (1)
8373 Spoon Creek (2)
8374 Mill Creek(1)
8375 Mill Creek(3)
8376 Mill Creek(4)
8377 Beards Run
8378 Mill Creek(5)
8379 Mill Creek(6)
8380 Mill Creek(7)
8381 Mill Creek(8)
8382 L Mill Creek
8383 L Mill Creek (1)
8384 L Mill Creek (2)
8385 Turkey Run
8386 Mill Creek (2)
8387 Turkey Run(1)
8388 Turkey Run(2)
Courtesy Bob Davis, Pittsburgh WFO



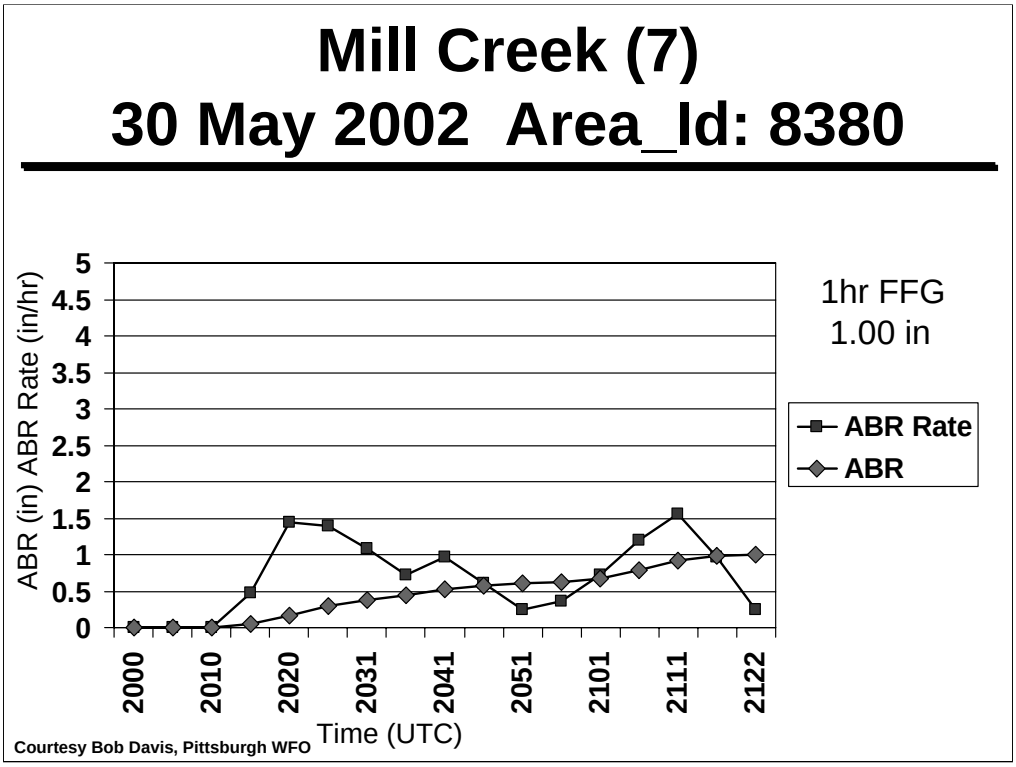
This is 90 minute ABR for the Mill Creek Bain, showing that 3 smaller basins, 2 of Turkey Run and the other Mill Creek (5) are significant 90 minute ABR



Notice the two “bursts” of heavy rainfall in this ABR plot from 2000-2122 UTC. 1 hour FFG was just 1 inch.

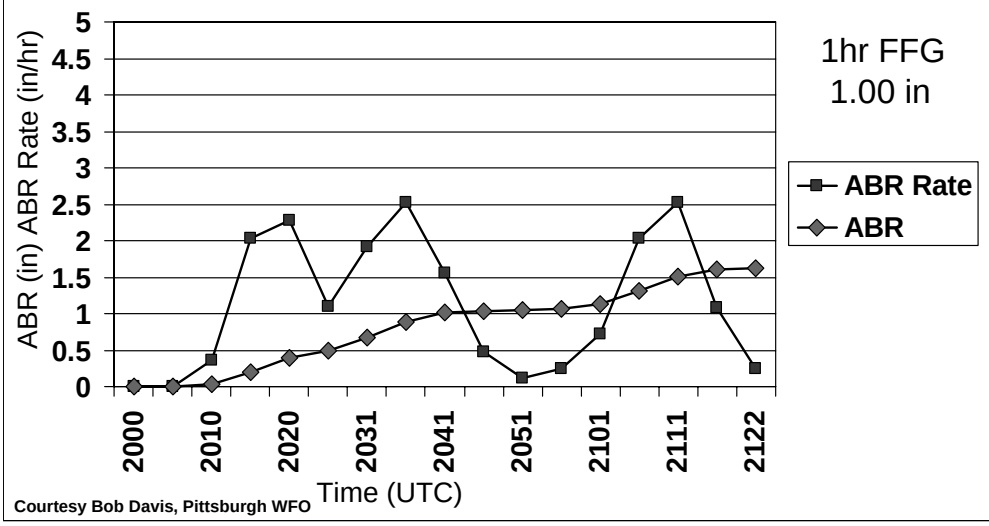


Two bursts, just as the other basin.

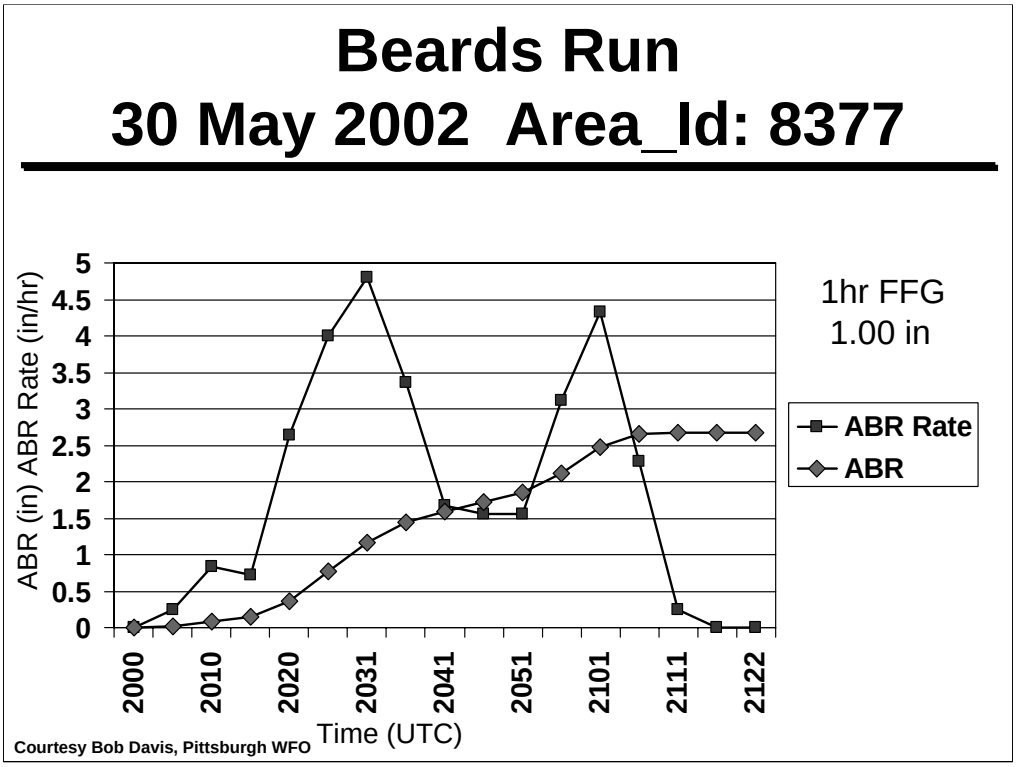


Mill Creek (7) had two bursts, but the intensity of those bursts were much less than the other basins, such as Mill Creek (5)

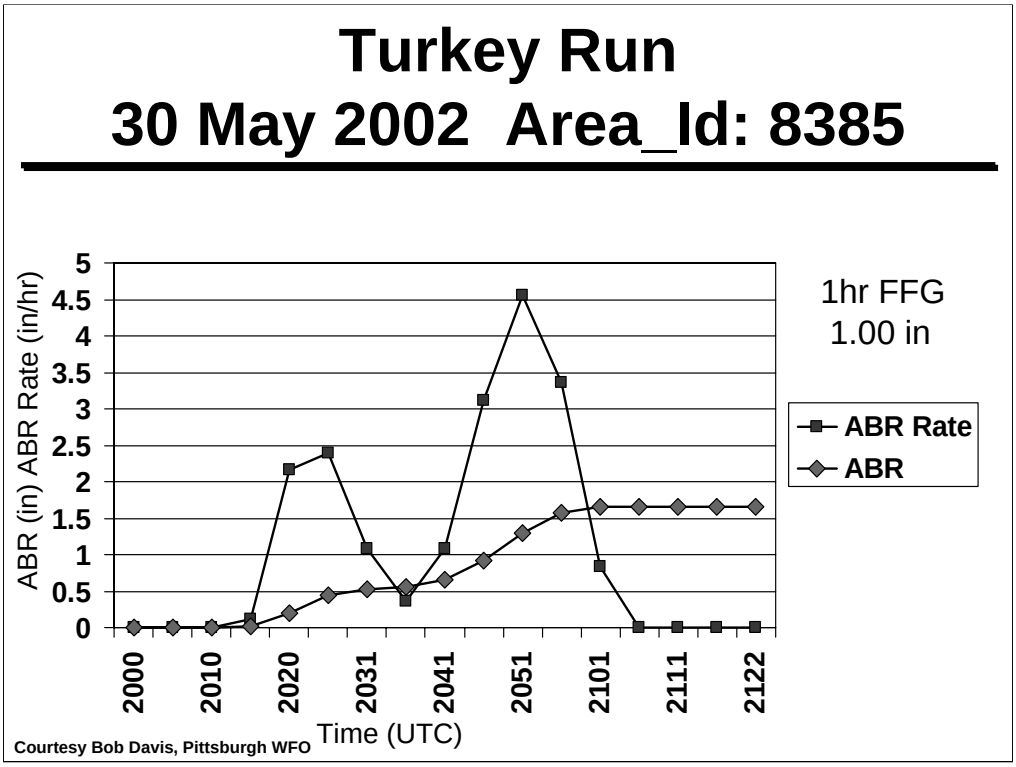
Mill Creek(8)
30 May 2002 Area_Id: 8381



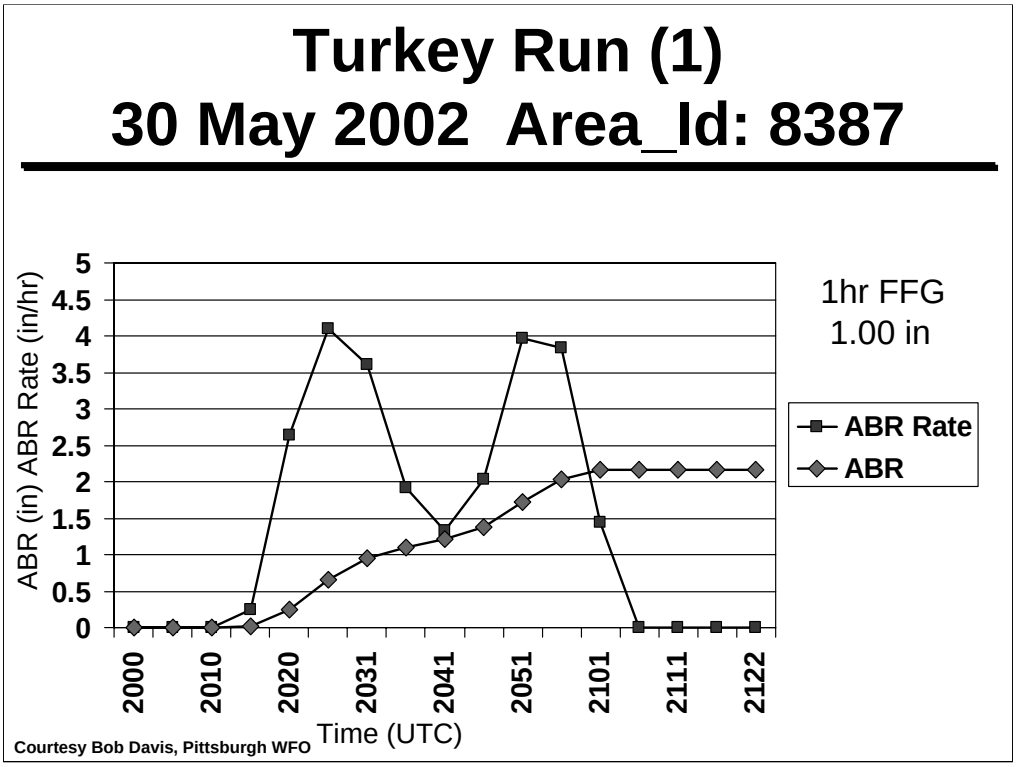
Courtesy Bob Davis, Pittsburgh WFO



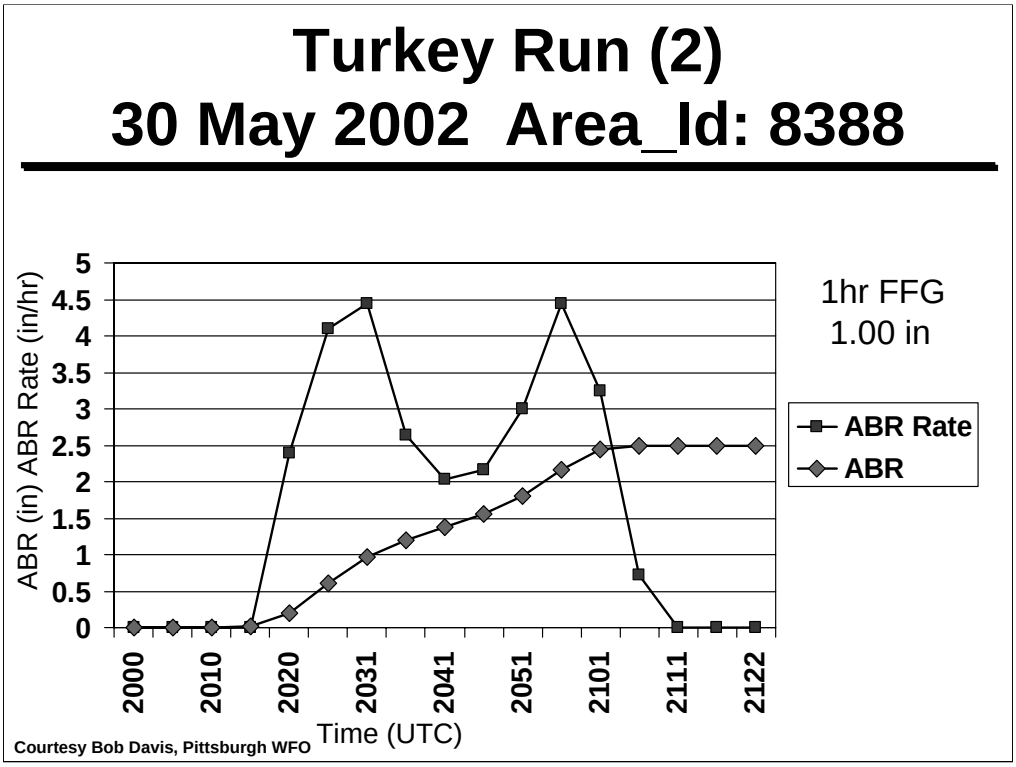
Beards Run had 2 very significant rainfall bursts, with 3 and 4 consecutive volume scans over 2 inches/hour rates.



This also shows 2 significant rainfall bursts, with the second burst of 3 volume scans over 3 in/hr.



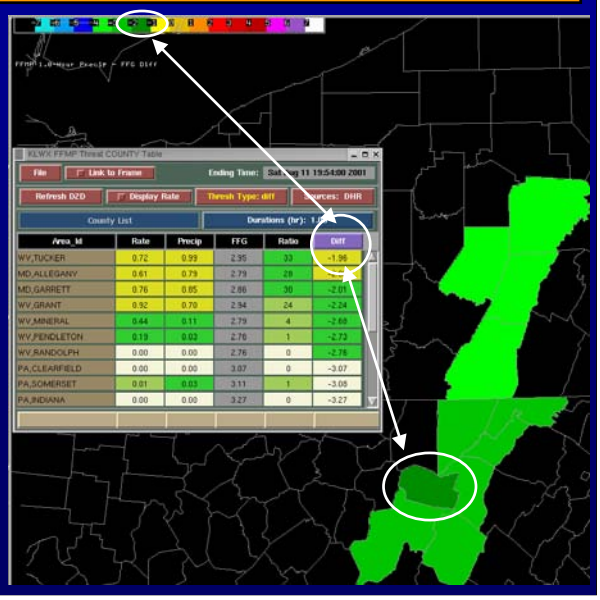
2 significant bursts.



Essentially the same as other Turkey run plots. The magnitude of the bursts made all the difference to the magnitude of the flash flooding, with the most significant flash flooding occurring in basins that had the intense bursts.

FFMP: DIFF vs Ratio

- The DIFF column far more important than RATIO
- Direct measurement of required rainfall to produce flooding, also magnitude of flooding



The DIFF column allows you to assess the flooding magnitude as this is the FF index number, with minor flash flooding at DIFF=1inch, serious flash flooding at DIFF=3 inches, and so on. It give you an idea of how much additional rainfall is required to reach FFG so you can closely monitor Rate and Accumulated precip.

WSR-88D Rainfall Estimation Limitations

- FFMP depends on 88D rainfall estimation: Any limitations in rainfall estimation are thus limitations of FFMP

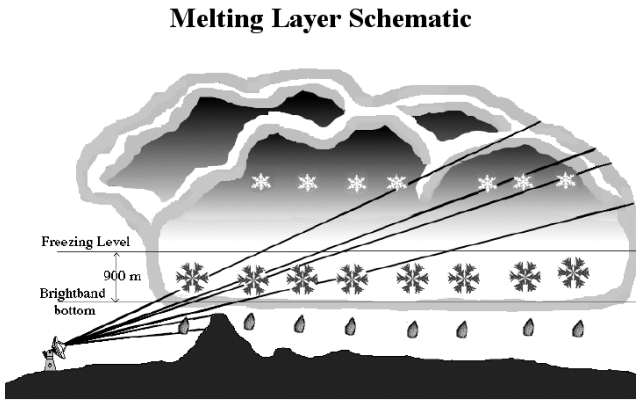
- Focus on errors significant to FFMP that may be overlooked

Rainfall Estimation Limitations for FFMP

- Brightband Contamination

→ Overestimate rainfall

→ But rare to affect convective flash flooding events

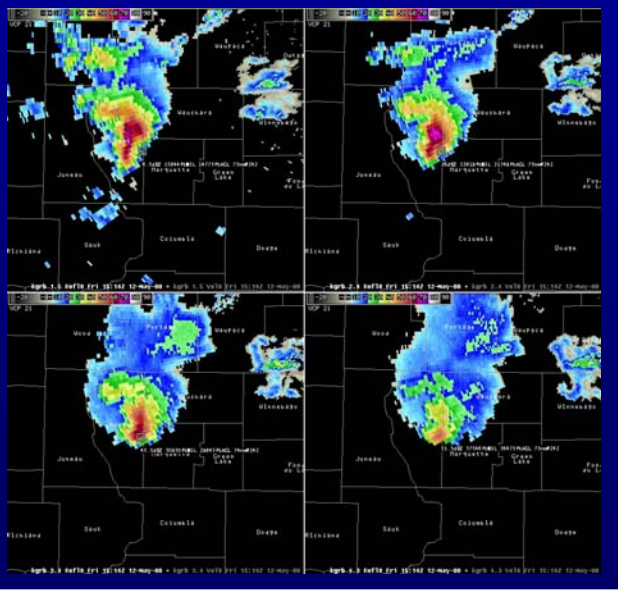


More difficult to identify bright band on FFMP than on precipitation products

Brightbanding occurs when frozen precip melts on it's way to the surface, becoming highly reflective and thus increasing reflectivity at a certain height above the radar level. This can lead to overestimation of rainfall amounts, which in turn affects the inputs into FFMP.

Rainfall Estimation Limitations for FFMP

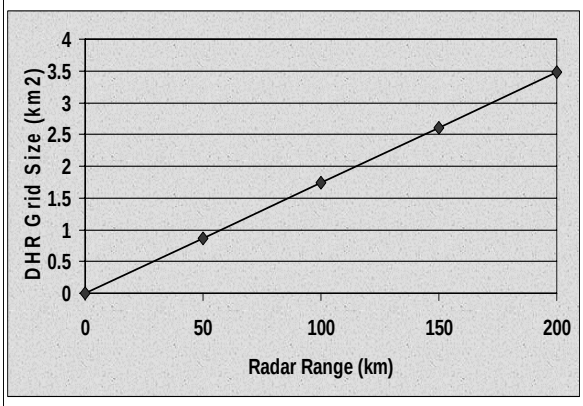
- Hail Contamination
  → can significantly overestimate rainfall, especially for high-end hailstorms like the one on the right



This can become a problem, especially with supercellular convection that has significant hail cores. However, often times hail contamination is not a problem. Comparing amounts to rain gage totals helps in this area.

Rainfall Estimation Limitations for FFMP

- Distance from Radar

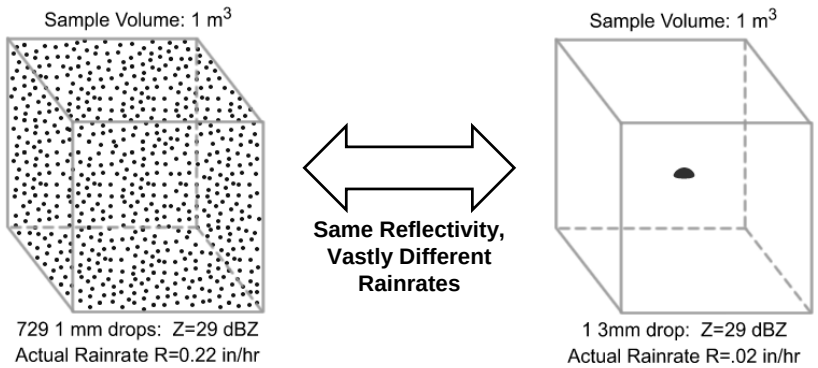


- Basin may include
  - Several 1 km (.54nm) x 1 degree bins
  - One 1 km (.54nm) x 1 degree bin
- Height of reflectivity used for calculation may be
  - Hundreds of feet
  - Over 10,000 feet

With height of beam above terrain, evaporation and advection of precipitation can both contribute to inaccurate rainfall tallies the further away from the radar the precipitation is.

Rainfall Estimation Limitations for FFMP

- Inaccurate Z/R relationship due to estimation of drop size distributions



Rainrate is dependent on the contributions from each drop within a radar volume, and diameter is raised to the 6th power. For rainrate, dependence is of the 3rd power of drop size diameter, hence the great potential for discrepencies. FFMP depends on the chose Z-R relationship. If that relationship is unrepresentative of the prevailing drop size distributions within the flash flood producing storms, then rainfall estimates will be inaccurate and FFMP will not be as effective.

Summary

- FFMP is by far the best tool for flash flood detection
- FFMP *RATE* and *DIFF* products should be closely monitored
- Limitations of radar rainfall estimation affect FFMP greatly, especially hail contamination, distance from radar, and Z/R relationships