Flash Flood Warning Operations Methodology

(Last updated: 2/21/19)

1. Familiarize with the environment using NSHARP, favorable parameters:

- Long, skinny CAPE (< 1000 J/kg)
- Moist vertical profile (Low/Mid RH > 70%)
- Above average PWs (> 75th percentile)
- Deep warm cloud layer (> 10 kft)
- Slow "LCL-EL (Cloud Layer)" wind (< 10 kt)
- Slow Corfidi Up/Down shear vectors (< 15 kt)

2. Familiarize with the antecedent soil conditions and topography

a. Become familiar with 1-, 3-, and 6-hr FFG values across your CWA
b. Consider topography and urban areas
c. Look at FLASH soil moisture to see recently saturated areas; where FFG may be too high

3. Choose your optimal precip source

a. Find nearest radar and assess Melting Layer to determine confidence in DP QPE
b. Assess first-guess QPE biases: BIAS/#G-R
    - Legacy biases in STP, DP biases in MPE Misc menu
    - **BIAS**: > 1: QPE under-estimating, < 1: QPE over-estimating
    - **#G-R**: num. of gauge-radar pairs used to calculate bias → more pairs = more confidence
c. Assess QPE biases at gauges: Compare QPE with observations at close to moderate ranges
    - Identify the precip source with the highest instantaneous precip rates
    - Compare 1-hr QPE to METARs (PXXXX = XX.XX inches)
        - *NOTE: Time-match QPEs and obs, zoom all the way in before sampling!*
    - Compare storm-total QPE to Mesonet gauges (note when Mesonets reset!)
d. Precip source options
    - DHR (Legacy): use when you want Legacy estimates, single Z-R
    - DPR (DP): good near the radar, use when you want Dual-Pol estimates, high spatial res
    - HPE (DP mosaic): use for DP + mosaic (consider DPR when there's beam blockage)
    - BHPE (DP mosaic w/ biases applied): use when you want DP and when biases help
    - MRMS (mosaic): unique precip type and Z-R calculations (no DP), high temporal res

4. Analyze heavy rainfall and streamflow signatures in radar, FFMP, and FLASH

Dual-Pol product	Values	Interpretation
Z	50-60 dBZ	Enhanced reflectivity/rainfall
ZDR	2.0-5.0 dB	Bigger drop size
CC	> 0.96	Uniform precip type
KDP	> 1.0 deg/km*	Increasing liquid water content

*KDP > 4.0 deg/km could indicate water-coated hail, so be wary of rain rates in these areas (use ZDR and CC to diagnose hail)

a. Use FFMP to diagnose basin threat, coverage, and timing
    - Set-up with "All & Only Small Basins" Layer and "Ratio" product (use County Layer to filter basins)
        - Ratio > 100% to identify areas of flash flooding (w/ consideration of biases found in #3)
        - Diff > 0 in. to assess severity of flash flooding
    - Look at 1-, 3-, and 6-hour durations (for both short-term and training potential)
    - Use All-hour basin trend graph to identify timing, storm training, and optimal durations for analysis
b. Use FLASH to assess flood threat, precip anomaly→ MRMS QPE-to-FFG Ratio, MRMS Precip Return Period
c. Use FLASH to analyze streamflow and rivers → CREST Unit Streamflow, SAC-SMA Unit Streamflow

5. Issue Flash Flood Warnings with proper criteria and routinely reassess

a. Duration: no less than 3 hours
b. Polygon size: small buffer around current threat, extend for threat evolution & couple basins for runoff
c. Text includes:
    - How much rain has fallen, how much more is expected over the warning duration, cities impacted, reports included, and 1-2 Call-to-Action statements

CREST Max Unit Streamflow	Action
< 100 cfs mi^{-2}	Monitor area for increasing FF potential
100-200 cfs mi^{-2}	Monitor closely; initial threshold for warning consideration
200-1000 cfs mi^{-2}	Higher confidence in warning issuance and impending FF impacts
> 1000 cfs mi^{-2}	Likely a significant FF event

Loading the FFMP Basin Trend Graph:

1. Right-click on basin name in FFMP Basin Table
2. FFMP text legend "editable", Click menu in FFMP table set to "Basin Trend", right-click on basin in D2D