Forecast Average Recurrence Interval (ARI) Precipitation Maps for the U.S.

A New Way of Communicating the Location and Magnitude of High Impact Precipitation Events

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Overview

• The ARI Concept
  – Method
  – Examples of Observed ARI
• Motivation for Forecast Mode ARI
• WDT Operational WRF System
• Forecast ARI Example
• Products and Applications
The ARI Concept

- Precipitation frequency (PF) estimates are depths of precipitation that are expected at different recurrence intervals (i.e. “return periods”).

- PF estimates are statistically calculated based on historical precipitation data.
  - Provided as gridded GIS files by the National Weather Service (NWS)

- The ARI represents a current precipitation event (amount per unit time) as the average number of years between equivalent events for a specific location.
The ARI Concept

• The ARI of precipitation is an objective means of conveying the rareness or commonness of precipitation, even without knowledge of the precipitation regime of a location.

• The ARI of precipitation is useful as a “Potential Flood Index”, communicating the likelihood that flooding may have or might occur. Note, however, that it does not imply the same ARI of flood
  – 100 year rain ≠ 100 year flood
The ARI Concept – Method

NWS 24-hour Precipitation Frequency Estimates

Gauge-adjusted Radar-estimated Precipitation or QPF

24-hour Average Recurrence Interval (ARI)

Tropical Storm Hermine – Texas September 7, 2010
The ARI Concept – Real-Time Example

• April 15, 2011
12:54 PM CDT
Motivation for Forecast ARI

• Mesoscale Numerical Weather Prediction (NWP) models provide state-of-the-science quantitative precipitation forecasts (QPF) out to a few days.

• WDT provides operational mesoscale NWP services based on the community WRF modeling system for a variety of applications, including QPF for hydromet application.

• Can we convert these gridded QPF values into ARI values?

• If so, do they provide a meaningful and/or more effective means of communicating precipitation forecasts?
Operational CONUS WRF Domain

- Advanced Research WRF Version 3.3
- Precipitation Physics Selections
  - Kain-Fritsch Conv. Parameterization
  - WSM6 Microphysics
- Unique LAPS+FDDA Data Assimilation
  - WDT 3D Quality-Controlled Radar Mosaics
  - GOES IR Image Channels and CDW
  - Wind Profilers
  - Conventional Observations
- 11.8-km grid cells
- 120-h forecast with 1-h output steps
- Updated every 6 hours (03, 09, 15, 21Z)
- Custom Post-Processing
  - GRIB2 produced concurrent with model execution
  - Selectable precipitation time accumulation
  - WDT algorithms for derived products
WDT WRF QPF Application Example

GIS processing converts gridded values to basin averages

WDT has been providing high-resolution WRF forecasts for quantitative precipitation forecasts. GIS post-processing remaps the gridded QPF values to basin averages. These forecasts are used to plan cloud seeding operations. WRF performs particularly well in forecasting onset and duration of precipitation events.
Forecast ARI Example

- Hurricane Irene – August 27-29, 2011

Forecast ARI Example (Cont.)

- Hurricane Irene – August 27-29, 2011

### Initial Forecast ARI Products & Applications

#### Initial Product Offerings

- **Every CONUS WRF Forecast**
  - Updated 4 times each day
- ** Converted to 0.1° Lat/Lon Grid**
- **6-h ARI**
  - 6-120 hours, 3-h time steps
- **24-h ARI**
  - 24-120 h, 12-h time steps
- **5-day Maximum 6-h and 24-h ARI**
- **Flexible Delivery Mechanism**
  - Interactive and Static Maps
  - Data Files (ArcASCII, NetCDF, etc.)
  - GIS Services (WMS and REST)
  - Image Tile Web Service

#### Application Examples

- **Media Outlets**
- **Emergency Managers**
- **Flood Control Districts**
- **Water Resource Managers**
- **Business Continuity**
- **Smart Grids (Hydroelectric Generation)**
- **Risk Management**
- **Insurance/Re-insurance**
- **DOTs**

Additionally, real-time ARI *analysis* products for 1, 3, 6, and 24-h periods are available.
Summary

• ARI is a revolutionary way to communicate precipitation information
  – Adds local context via climatology
  – Amenable to visual presentation

• Forecast ARI enhances value of mesoscale NWP-based QPF
  – Readily summarizes many “frames” of information
  – Provides situational awareness for upcoming events