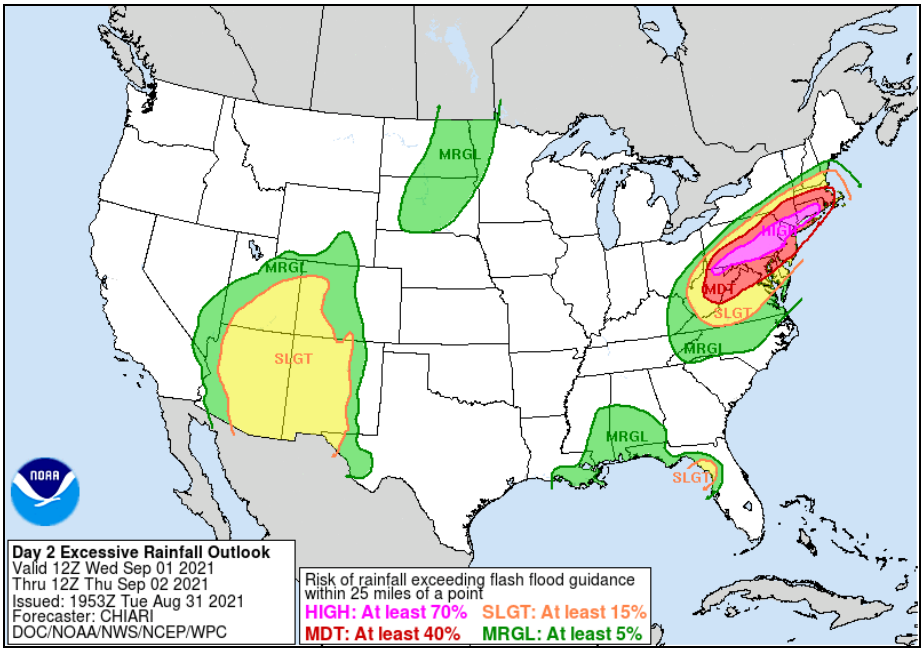
Excessive Rainfall Outlook (ERO)
Product Description Document (PDD)
April 2023

Part I - Mission Connection

a. <u>Product Description</u> – The ERO is a graphical map issued by the Weather Prediction Center (WPC) that forecasts the probability that rainfall will exceed flash flood guidance (FFG) within 25 miles (40 kilometers) of a point across the contiguous United States (CONUS). FFG is an estimate, based on current streamflow and soil moisture conditions, of the amount of rainfall required over a given area during a given duration to cause small streams to flood. Gridded FFG is produced by River Forecast Centers (RFCs). Excessive rainfall risk in the ERO is expressed in categories — Marginal, Slight, Moderate, and High — which have corresponding probabilities, shown in the table below.

Risk Category	Probability of Excessive Rainfall (within 25 mi)
Marginal	At least 5%
Slight	At least 15%
Moderate	At least 40%
High	At least 70%



The ERO is issued for the first five days of the forecast, referred to as Day 1, Day 2, Day 3, Day 4 and Day 5, each covering 24-hour periods that have their beginning and end times set to 1200 Coordinated Universal Time (UTC). The Day 1 outlook valid period becomes progressively shortened during the course of the day, as some of the 24-hour period has already passed, but the end time is always 1200 UTC the next day.

The High Risk category is only issued on Day 1, 2 and 3. Otherwise, the risk categories are produced and labeled for Day 4 and 5 in ways that are consistent with the Days 1 to 3, with the same definitions, colors, and nomenclature.

When no risk category is assigned for a given outlook, there will be a text label placed on the map that says “The probability of rainfall exceeding flash flood guidance is less than 5 percent.”

The issuance schedule is shown in the table below. The valid periods below are written as examples, assuming Day 1 begins at 12 UTC on a Monday, to avoid confusion with additional references to Day 1, 2, 3, 4 and 5. Please note that unscheduled, event-driven updates may be issued for Day 1 as needed.

Outlook	Issuance Type	Issuance Time	Valid Period (Examples) *(example assumes Day 1 starts at 12 UTC on a Monday)*
Day 1	Initial	0830 UTC	12 UTC Mon to 12 UTC Tue (*24hr*)
Day 1	Update	1600 UTC	16 UTC Mon to 12 UTC Tue (*20hr*)
Day 1	Update	0100 UTC	01 UTC Tue to 12 UTC Tue (*11hr*)
Day 2	Initial	0830 UTC	12 UTC Tue to 12 UTC Wed
Day 2	Update	2030 UTC	12 UTC Tue to 12 UTC Wed
Day 3	Initial	0830 UTC	12 UTC Wed to 12 UTC Thu
Day 3	Update	2030 UTC	12 UTC Wed to 12 UTC Thu
Day 4	Initial	0830 UTC	12 UTC Thu to 12 UTC Fri
Day 4	Update	2030 UTC	12 UTC Thu to 12 UTC Fri
Day 5	Initial	0830 UTC	12 UTC Fri to 12 UTC Sat
Day 5	Update	2030 UTC	12 UTC Fri to 12 UTC Sat

The Day 1-3 ERO forecast graphics are accompanied by a text discussion which details the forecaster’s thought processes and reasoning, and the text discussion is issued at

the same time as the accompanying graphic. The Day 4-5 ERO forecast graphics are accompanied by forecaster reasoning in the Extended Forecast Discussion (PMDEPD), which is linked from the ERO webpages, and excerpted on the “Excessive Rain” tab on the WPC home page, placed in the same location as the discussions for Days 1 to 3.

b. Purpose – The ERO acts as a situational awareness and planning tool as to where intense rainfall, which may lead to flash flooding, is most likely over the next several days. It is not an explicit forecast of a flash flood at any one location. Rather, it accounts for uncertainties in the placement and timing of intense rainfall, and summarizes the larger scale risk factors. Therefore, it helps translate the traditional rainfall forecast into terms that allow users to more easily understand where rainfall may lead to meaningful impacts on any given day.

c. Audience – The product is intended for a wide range of users to enhance decision making. This can include decision support services being provided to NWS core partners in federal, state, and local government and emergency management, forecast communication through media organizations, as well as general use by the public.

d. Presentation Format – The ERO is displayed on the WPC website through static image maps and a dynamic and interactive map display, along with the accompanying discussion, at the following link.

https://www.wpc.ncep.noaa.gov/qpf/excessive_rainfall_outlook_ero.php

The ERO is also available for download as Keyhole Markup Language (KML), shapefiles, gridded binary version two (GRIB2) files, and via an ArcGIS REST service, at the same link above.

Finally, WPC will continue to produce prototype zoomed static image maps centered on individual local NWS Weather Forecast Offices (WFOs), as well as each of the Lower 48 states. Those are available for the Day 1-3 EROs only, at the following link:

https://www.wpc.ncep.noaa.gov/exper/eromap/static.php

Zoomed maps for RFCs, NWS Regions, and Federal Emergency Management Agency (FEMA) Regions are available on request.

e. Feedback Method – Comments or questions regarding the ERO can be addressed to either or both of the following individuals:

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Part II – Technical Description

a. Format and Science Basis – The ERO is the national outlook product for excessive rainfall leading to flash flooding on Days 1 to 5. The ERO incorporates both meteorological aspects (rainfall rates) and hydrological inputs (RFC-provided FFG). The ERO is a highly collaborative product and benefits from the input of meteorologists and hydrologists among the WFOs, RFCs, and the National Water Center.

The ERO displays the probability of rainfall exceeding 1, 3, or 6-hour FFG over a 24-hour period from 12 UTC to 12 UTC. The FFG is provided in gridded format four times per day by each of the twelve RFCs that serve the CONUS.

The ERO utilizes a neighborhood probability definition (within 25 miles of a point), and this is presented using four risk categories. Marginal Risk indicates where the probability of rainfall exceeding FFG within 25 miles of a point is at least 5 percent; Slight Risk is at least 15 percent; Moderate Risk is at least 40 percent; and High Risk is at least 70 percent. The neighborhood probability definition helps account for the inherent uncertainty in precisely where the most intense rainfall will occur.

Sub-Marginal Risk areas are not explicitly depicted, but any blank area on the map may be presumed to carry probabilities of excessive rainfall ranging from zero to less than five percent. If the entire CONUS carries a risk that is sub-Marginal, the graphic and discussion simply read, “The probability of rainfall exceeding flash flood guidance is less than 5 percent.”

WPC estimates the probability of excessive rainfall by assessing environmental conditions, such as moisture content and steering winds, recognizing weather patterns

commonly associated with heavy rainfall, and using a variety of deterministic and ensemble-based numerical model tools that help evaluate a variety of hydro-meteorological factors.

At longer lead times, forecasters must account for increasing meteorological uncertainty, and how FFG may change in response to departing precipitation systems (FFG recovery) or incoming precipitation systems (lowering of FFG). Despite the uncertainties associated with FFG beyond the Day 1 forecast, verification shows that the ERO probabilities are fairly reliable at predicting rainfall exceeding FFG for longer lead time forecasts. Additionally, verification shows the ERO is similarly reliable using other proxies for "observed events," including rainfall exceeding a 5-year average annual recurrence interval, as well as flood and flash flood Local Storm Reports issued by NWS WFOs.

b. Availability – The ERO is provided externally to users through a WPC webpage at https://www.wpc.ncep.noaa.gov/qpf/excessive_rainfall_outlook_ero.php. KML files, shapefiles, GRIB2 files, and static image maps are also available.