Messaging Forecast Confidence

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Forecast Confidence

Meteorologists use the term **confidence** to indicate the strength of their belief that a forecast will be correct.

“Rain chances” typically are an expression of confidence.

The origins of confidence

NWS forecasters apply their intuition (education and personal experience), but modern forecasting depends heavily on computer models.

It is expected models **will disagree** on details at ***some*** scale.

Better agreement ***usually*** translates to higher confidence in a solution, but we still apply our intuition.

Model forecasts are “possible realities”

Computer models offer a glimpse into a *possible* future. They differ due to:

- Assumptions about how the atmosphere works
- Availability, detail of input data
- Ability to resolve weather features (grid spacing)

Several models running over the same period, producing forecasts for the same area, constitute a **model ensemble**.

Some of the possible realities have bigger impacts than others.

We often determine critical values of specific forecast elements based on:

- Scientific studies: *540 dam thickness contour tends to mark the rain-snow line*
- Partner needs: *A sharp increase in medical calls when heat index hits 105°*
- A delineator for a specific event: *Based on our soil moisture, 2.5” rain in 6 hours is likely to cause flash flooding*

How easily do the models get us to these critical values?

Ensemble Probabilities

Take our heat index scenario:

Say 8 out of 12 “possible realities” for today include heat index of at least 105° in our fair city.

8 ÷ 12 = 0.667

We might thus message a *67% probability of exceedance*.

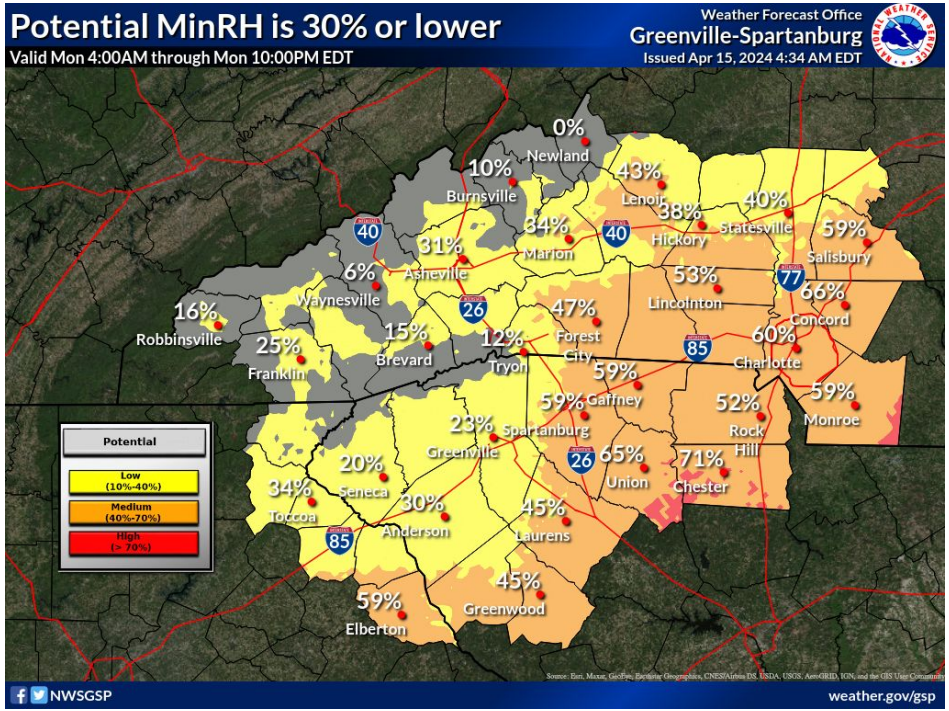
“Probability” vs. “confidence”

Percent rain chances *(“PoPs”)* in the first 12 hours or so often represent areal coverage, or the actual probability of rain.

Beyond the first 12 hours, PoPs likely represent confidence more than actual probability, but are interpreted the same.

We can interpret ensemble probabilities of other forecast elements as a numeric expression of confidence.

Example: Fire Weather probabilities



More to the story

What if we don’t have a specific threshold?

Or what if we want a more complete picture of what to expect… “ballpark figures?”

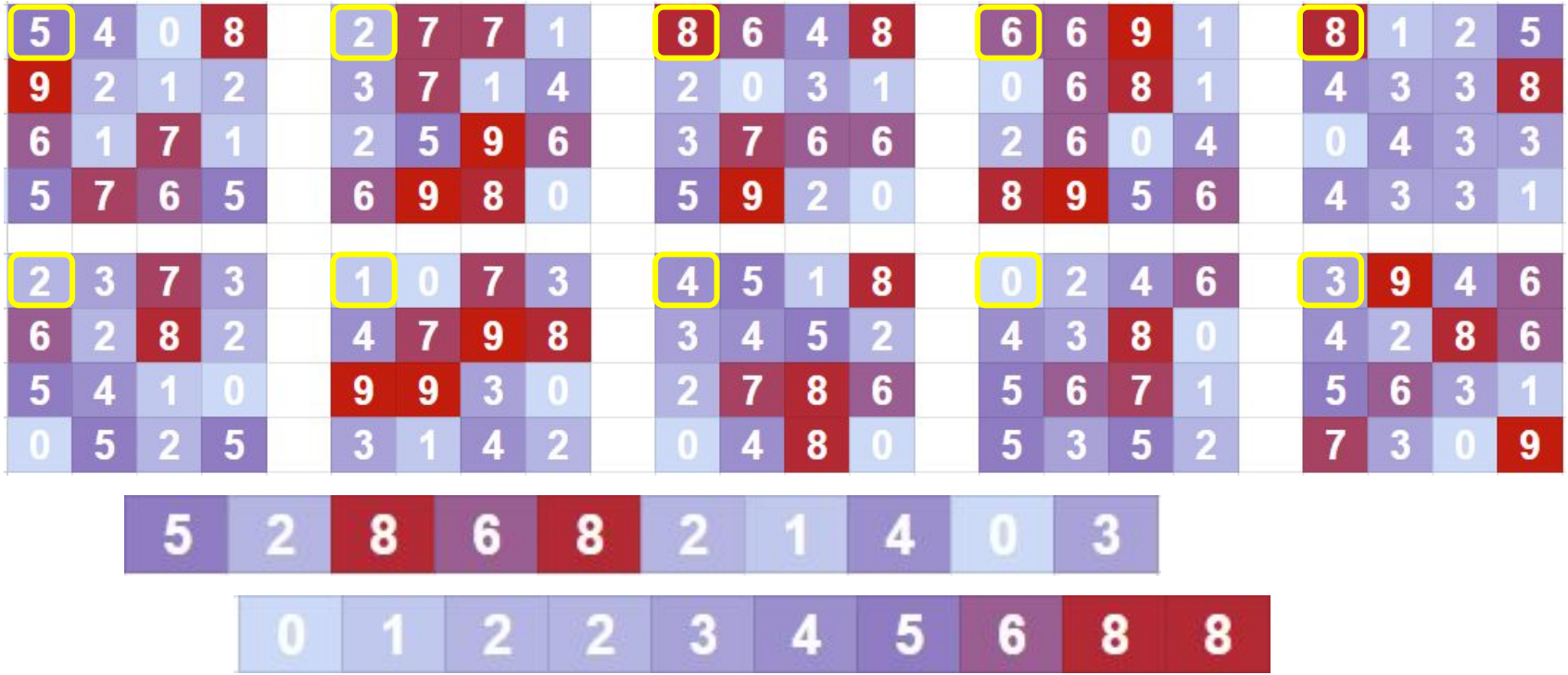
Ensemble Percentiles

A **percentile** is a statistical score representing where a given value falls within the range of possible values.

Taking ensemble values at a low or high percentile lets us show **“best” or “worst case” scenarios.**

Percentile Example

10 forecast members



In coming years, the NWS **will increasingly use probabilistic language to message our confidence** in the forecast.

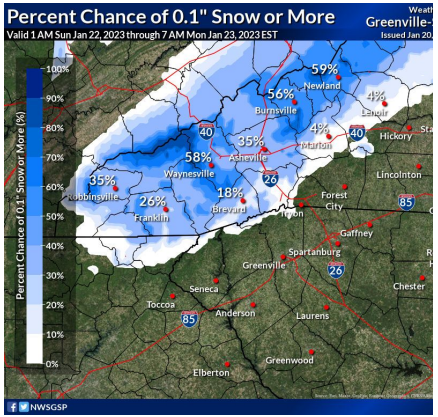
Snow Probs

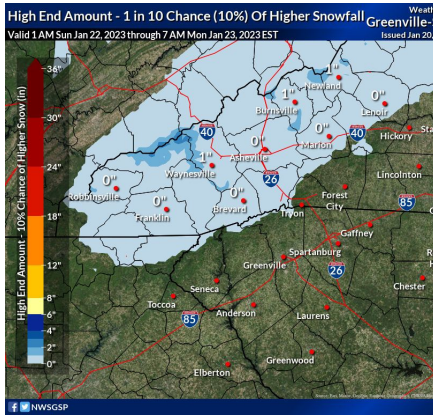
weather.gov/gsp/winter

Operational for several years and demonstrates use of percentiles and probability of exceedance

Applies the statistics of ensemble solutions to our official forecast

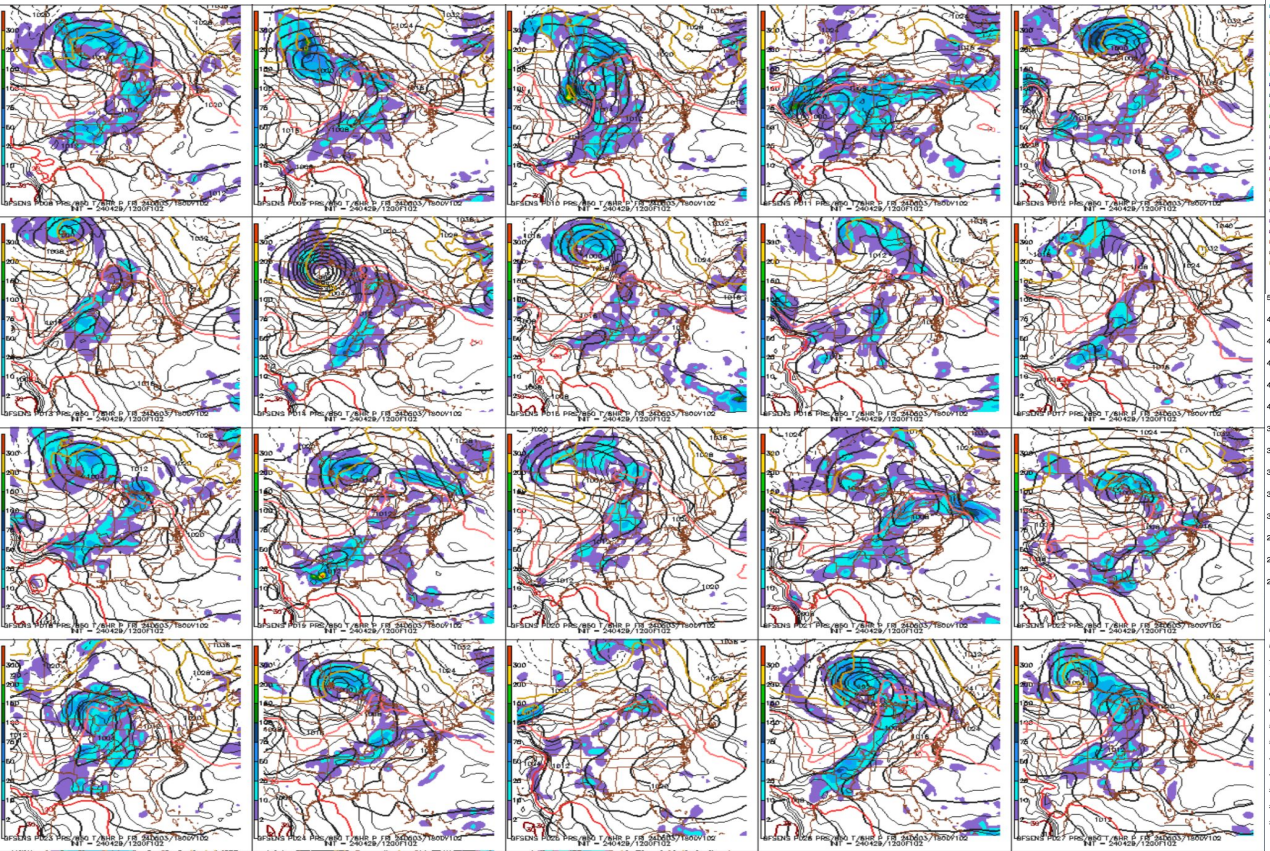
Allows us to message what we think is most likely to happen, but a judicious range of other possibilities

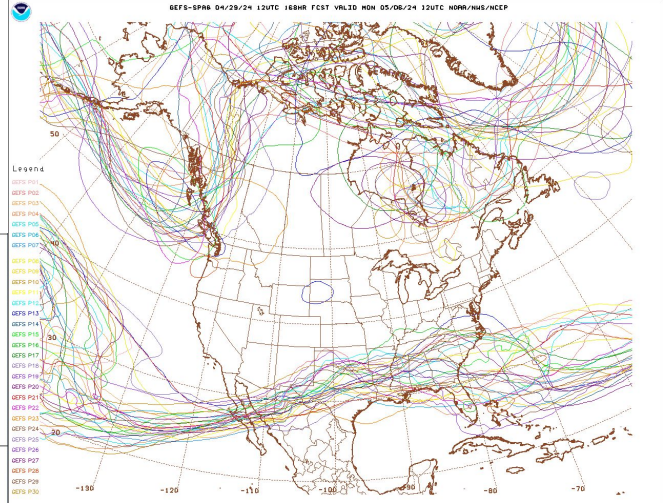


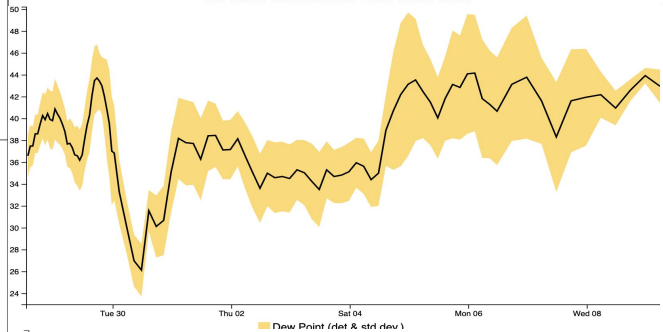


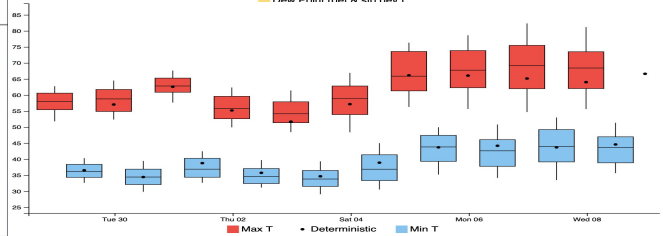
Snow Amount Potential			Chance of Seeing More Snow Than							
Low End Snowfall	Expected Snowfall	High End Snowfall	>=0.1"	>=1"	>=2"	>=4"	>=6"	>=8"	>=12"	>=18"
3	3	9	100%	99%	95%	70%	45%	25%	5%	0%
0	<1	8	88%	79%	69%	49%	32%	20%	6%	0%
<1	3	10	93%	88%	80%	62%	44%	29%	10%	1%
2	3	5	100%	100%	98%	41%	7%	0%	0%	0%
<1	1	6	95%	85%	70%	41%	20%	8%	1%	0%
2	3	6	99%	95%	85%	48%	18%	4%	0%	0%
3	4	9	100%	99%	94%	72%	46%	26%	5%	0%
2	3	10	100%	99%	94%	72%	50%	33%	10%	1%
1	1	4	100%	95%	59%	12%	1%	0%	0%	0%
2	2	6	100%	100%	90%	49%	20%	6%	0%	0%
0	<1	5	85%	69%	51%	23%	7%	2%	0%	0%
1	2	4	100%	97%	71%	24%	4%	0%	0%	0%
3	3	6	100%	100%	99%	55%	19%	4%	0%	0%
2	3	5	100%	100%	94%	42%	10%	1%	0%	0%

Ensemble output can appear overwhelming









DESI

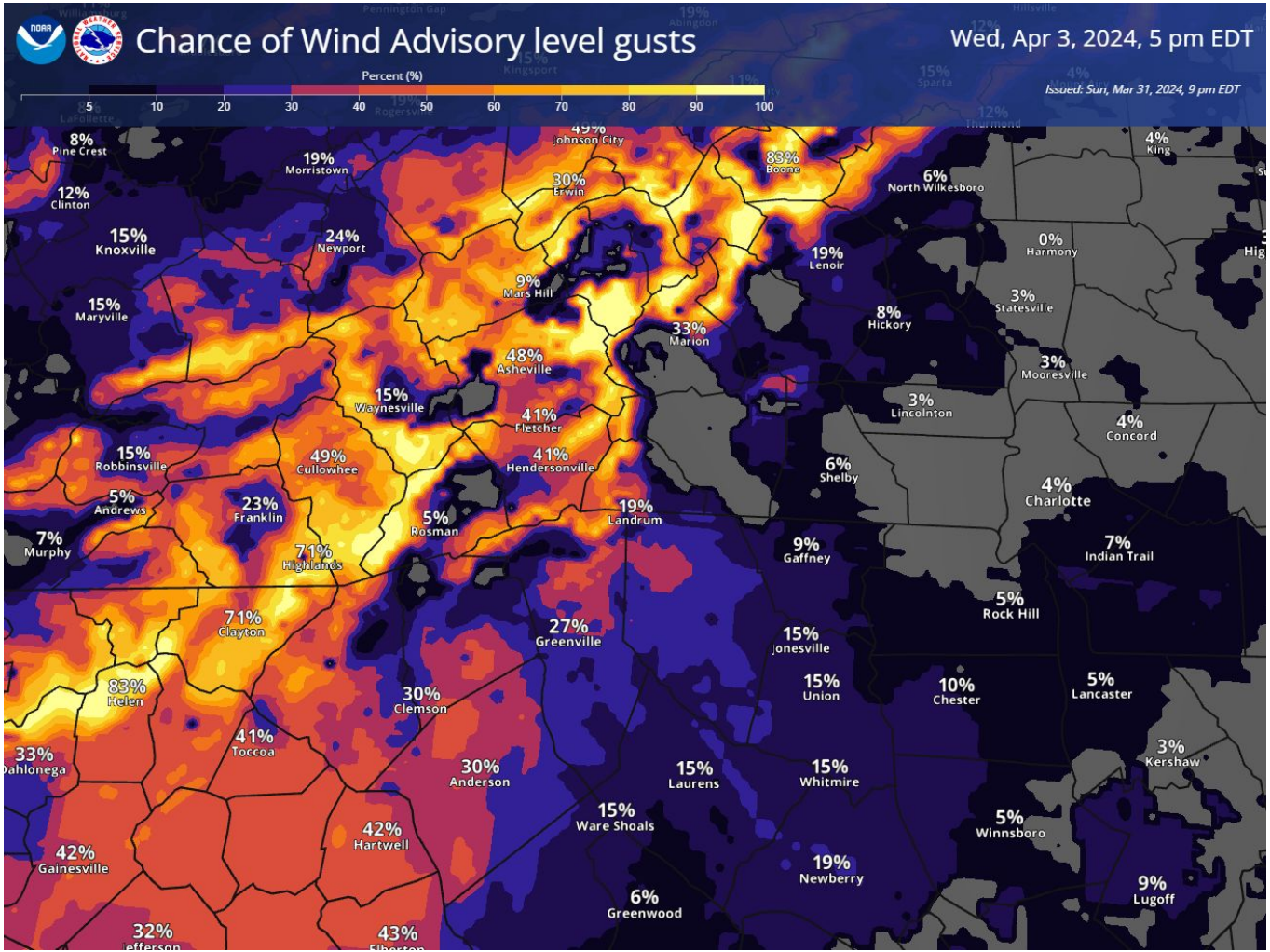
The NWS has invested resources in a cutting-edge tool aptly named **D**ynamic **E**nsemble-based **S**cenarios for **I**DSS

“Fast and meaningful interrogation of ensemble-based data that can be communicated to stakeholders”

DESI is a tool we can use to message confidence and depict alternate possibilities to aid in your decisionmaking.

DESI Capability:

High-quality maps depicting probabilistic forecasts

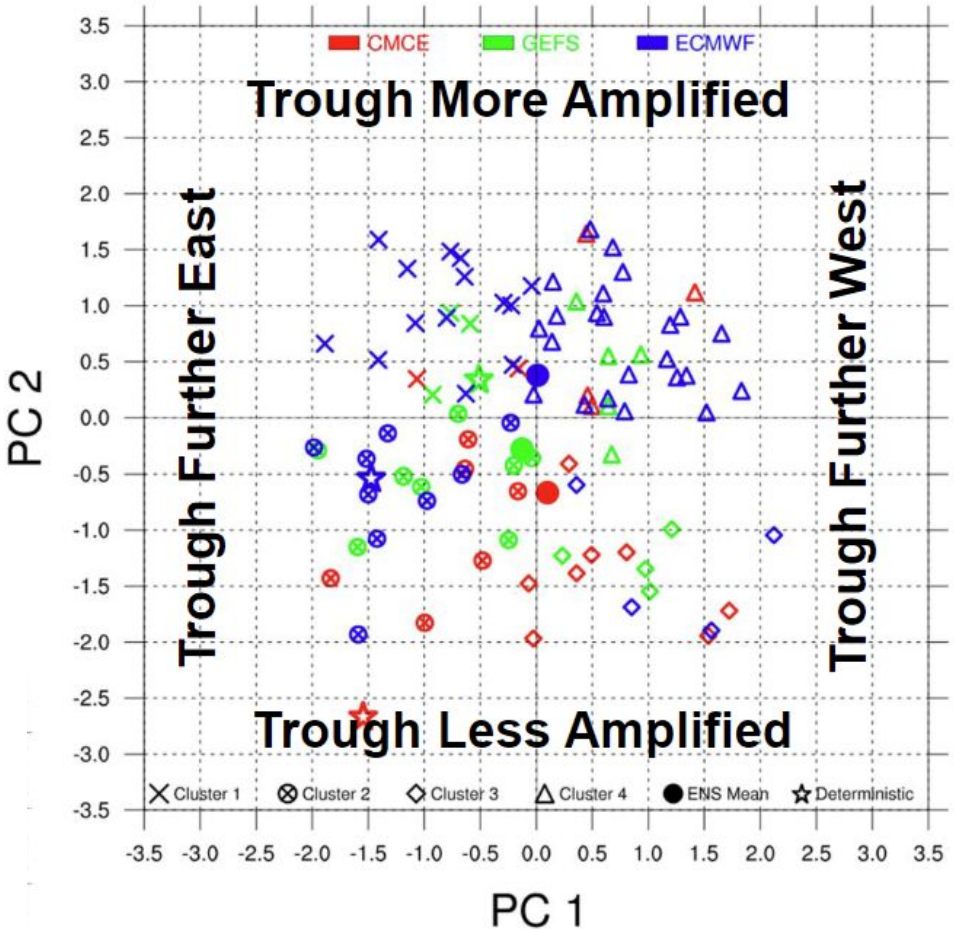


DESI Capability:

Ensemble Cluster Analysis

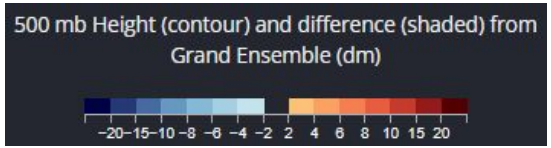
Filters out the 4 most likely outcomes among a wide range of ensemble forecasts

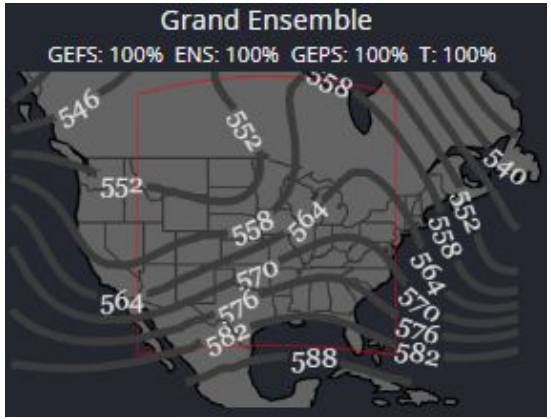
Generates a full range of forecast graphics for each of these outcomes

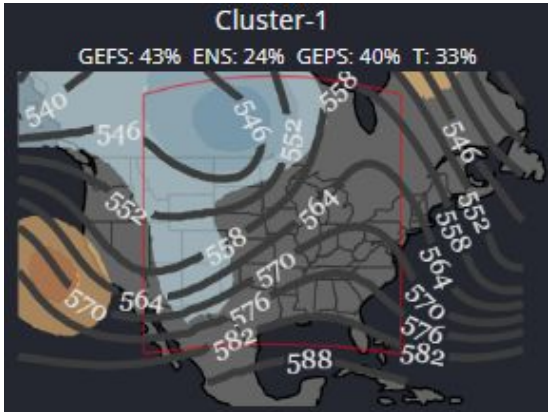


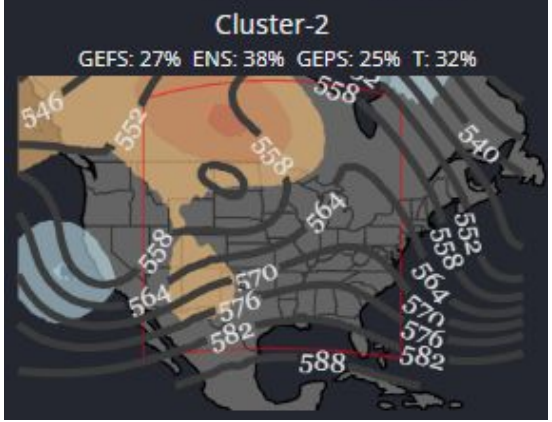
https://dtcenter.org/sites/default/files/events/2020/2-lamberson-bill.pdf

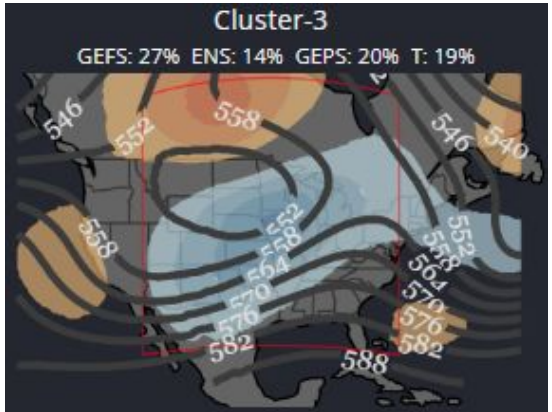
Cluster Example: It's the morning of April 1 and we are curious as to whether skies will be clear on April 8 so we can see the eclipse.

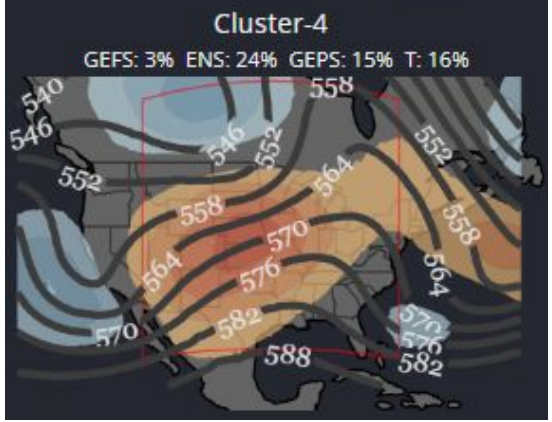


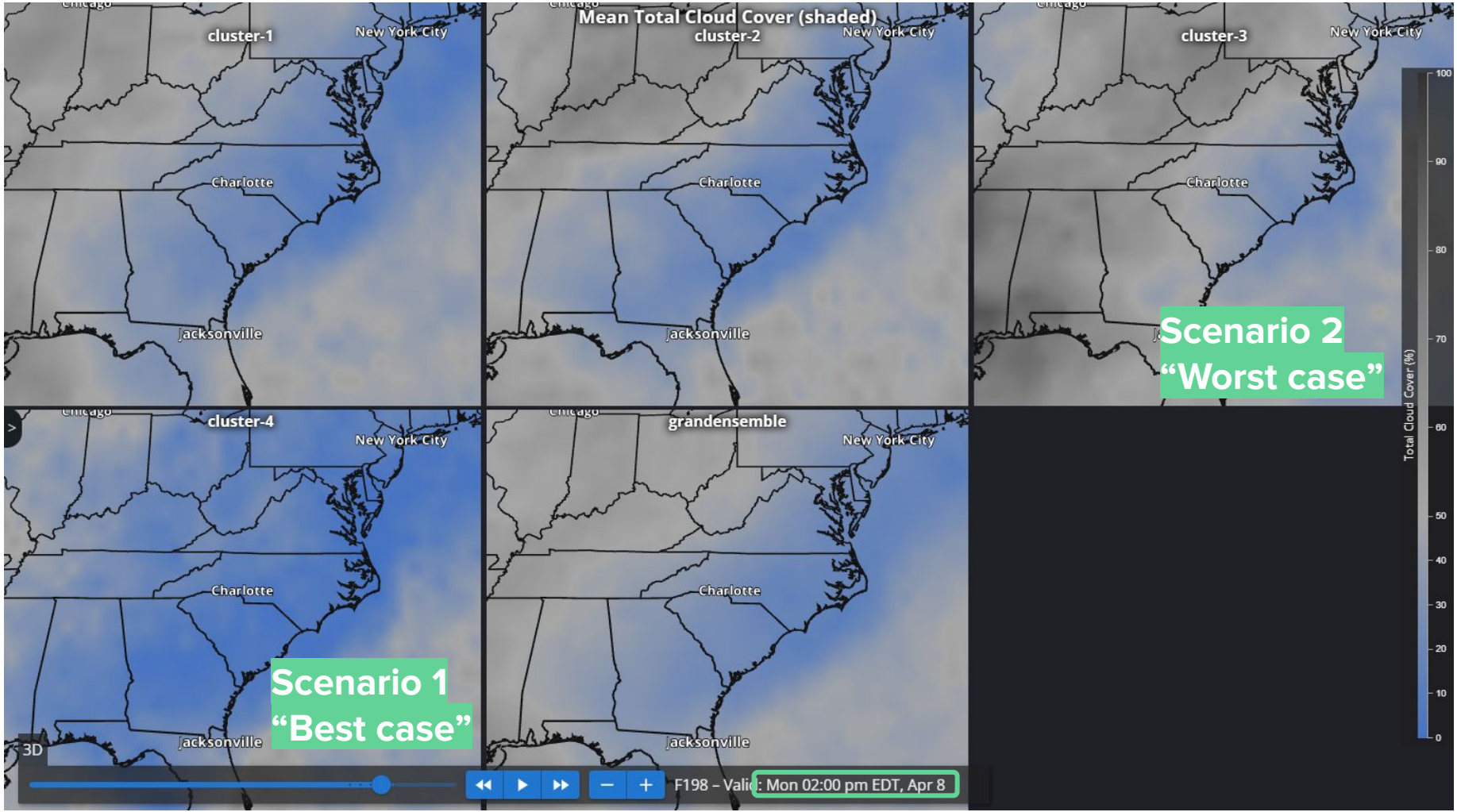


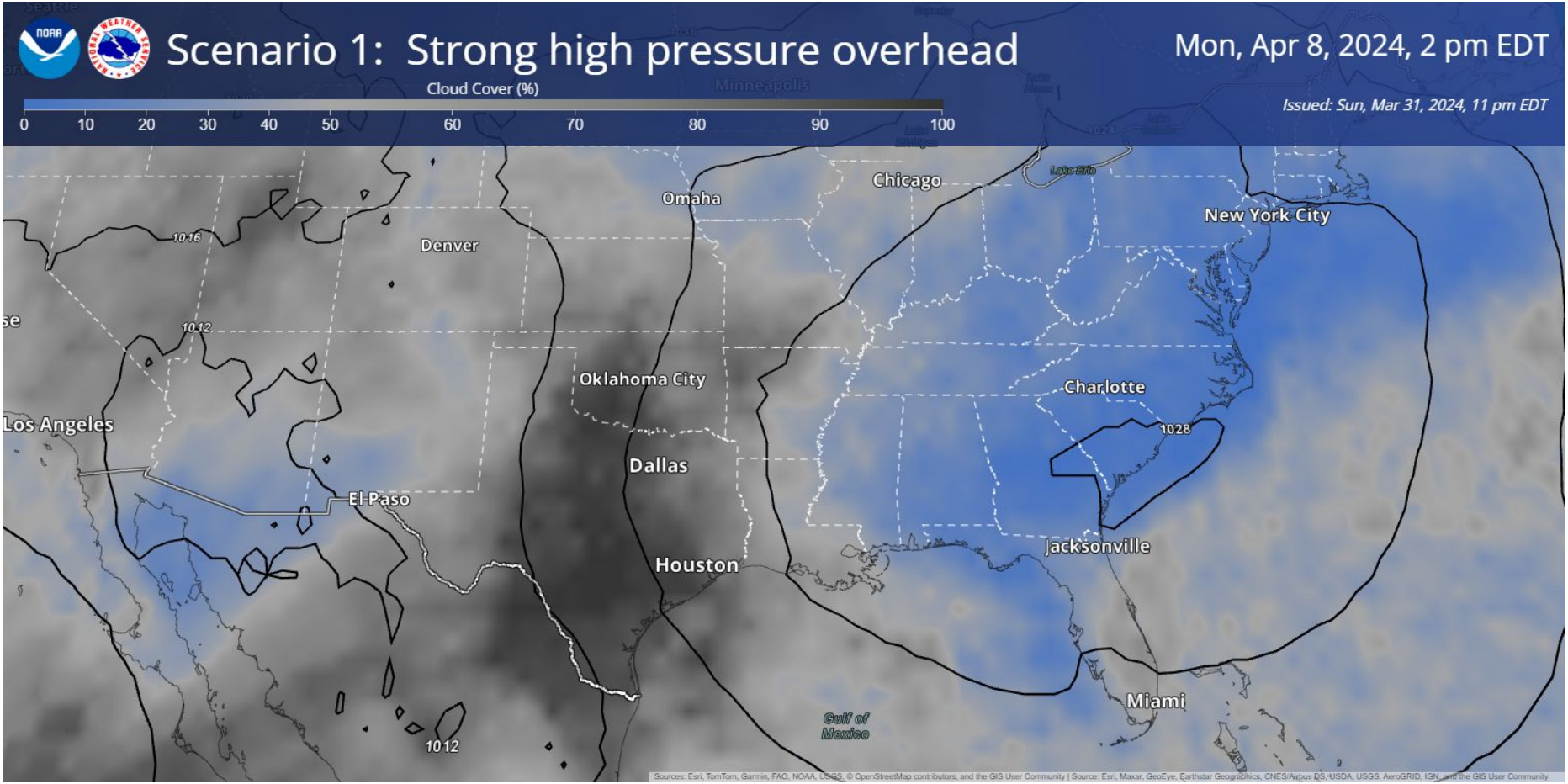









Mean Total Cloud Cover (shaded)
cluster-1
cluster-2
cluster-3
cluster-4
grandensemble
New York City
Charlotte
Jacksonville
Scenario 1
"Best case"
Scenario 2
"Worst case"
Total Cloud Cover (%)
100
90
80
70
60
50
40
30
20
10
0
3D
F198 – Valid: Mon 02:00 pm EDT, Apr 8


Scenario 1: Strong high pressure overhead
Mon, Apr 8, 2024, 2 pm EDT
Issued: Sun, Mar 31, 2024, 11 pm EDT
Cloud Cover (%)
0 10 20 30 40 50 60 70 80 90 100
Seattle
Minneapolis
Chicago
Lake Erie
Omaha
New York City
1016
Denver
1012
Oklahoma City
Charlotte
Los Angeles
1028
Dallas
El Paso
Jacksonville
Houston
Miami
Gulf of Mexico
1012
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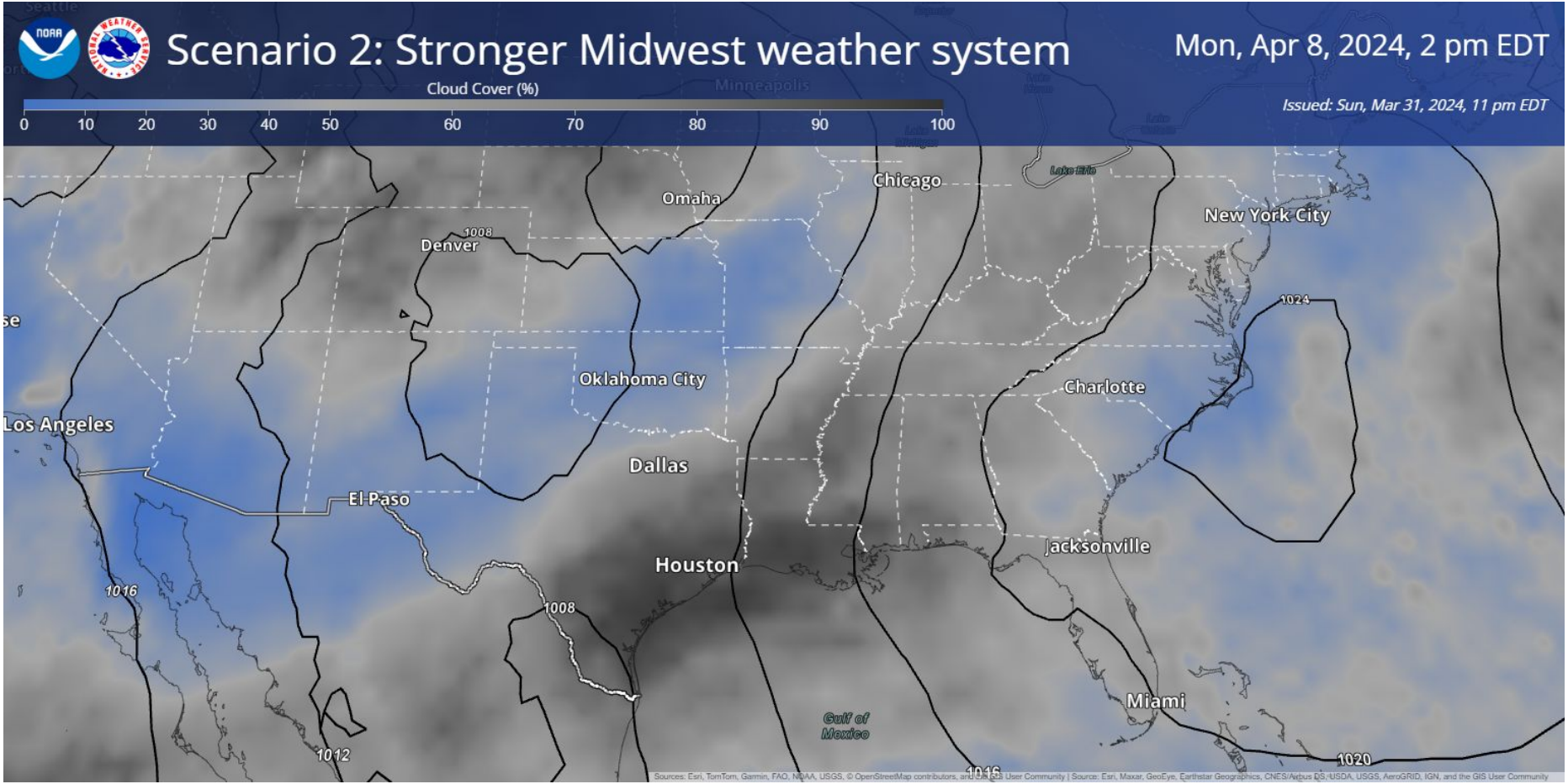
Scenario 2: Stronger Midwest weather system
Mon, Apr 8, 2024, 2 pm EDT
Issued: Sun, Mar 31, 2024, 11 pm EDT
Cloud Cover (%)
0 10 20 30 40 50 60 70 80 90 100
Seattle
Minneapolis
Omaha
Chicago
Lake Erie
New York City
Denver
1008
1024
Oklahoma City
Charlotte
Los Angeles
Dallas
El Paso
Houston
Jacksonville
1016
1008
Miami
Gulf of Mexico
1012
1016
1020
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community | Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

For the time being, probabilistic information **supplements our official forecast**, which we refer to as **“the most likely scenario.”**

Thanks for your attention!

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