AGUACEROWX IN-DEPTH GUIDE

Ensembles, probabilities and the NBM

An ensemble runs a model many times with small differences, so you see the range of outcomes instead of one forecast. Field Options turn a field from most ensembles into a mean, median or percentile, a spread, the chance of one or more conditions, or the first hour that chance is reached, and you can save any setup as your own variable. This guide also covers the NBM's published percentiles and chances, its winter and aviation fields, threshold sliders, anomaly types and member low tracks.

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BEFORE YOU START

- Field Options sit on the layer card on the **Edit Layers** tab, right under the layer's variable. They show on ensembles with member data or published percentiles: pick one from the model menu near the top of the sidebar. Press `F1` to open or close the sidebar.
- GEFS, GEPS, AI GEFS, REFS and the NBM are on the Free plan. ECMWF EPS, ECMWF AIFS EPS, ICON-EPS, ICON-EU-EPS, REPS, P-ETSS and P-Surge need Enthusiast or higher.
- Field Options, anomaly types, the threshold you pick on a slider and member low settings belong to the layer, so **Save Bundle** keeps them. Saved variables go to your account, so sign in to make them.
- Anomaly types also work on single-run models such as the GFS, ECMWF and HRRR.

01 Find Field Options and the models that have them

Field Options turn an ensemble field into a statistic, spread, probability or timing map. They sit on the layer card under the variable, on the ensembles listed here.

1. Click the model name near the top of the sidebar and click **Ensemble**. Global ensembles are under **Global**, REFS and the NBM under **Mesoscale**, REPS under **Canadian** and ICON-EU-EPS under **European**. ECMWF AIFS EPS and AI GEFS are in the **AI** menu, under **Ensemble**.
2. Pick an ensemble and a run.
3. Click the **Edit Layers** tab, click **Add Layer** and add a field, such as 2m Temperature or 24 Hour Precipitation. It draws as the ensemble mean (on the NBM, the blend).
4. On the layer card, find **Field Options** under the variable and open its menu: **Statistics**, **Spread**, **Probability** or **Timing**.

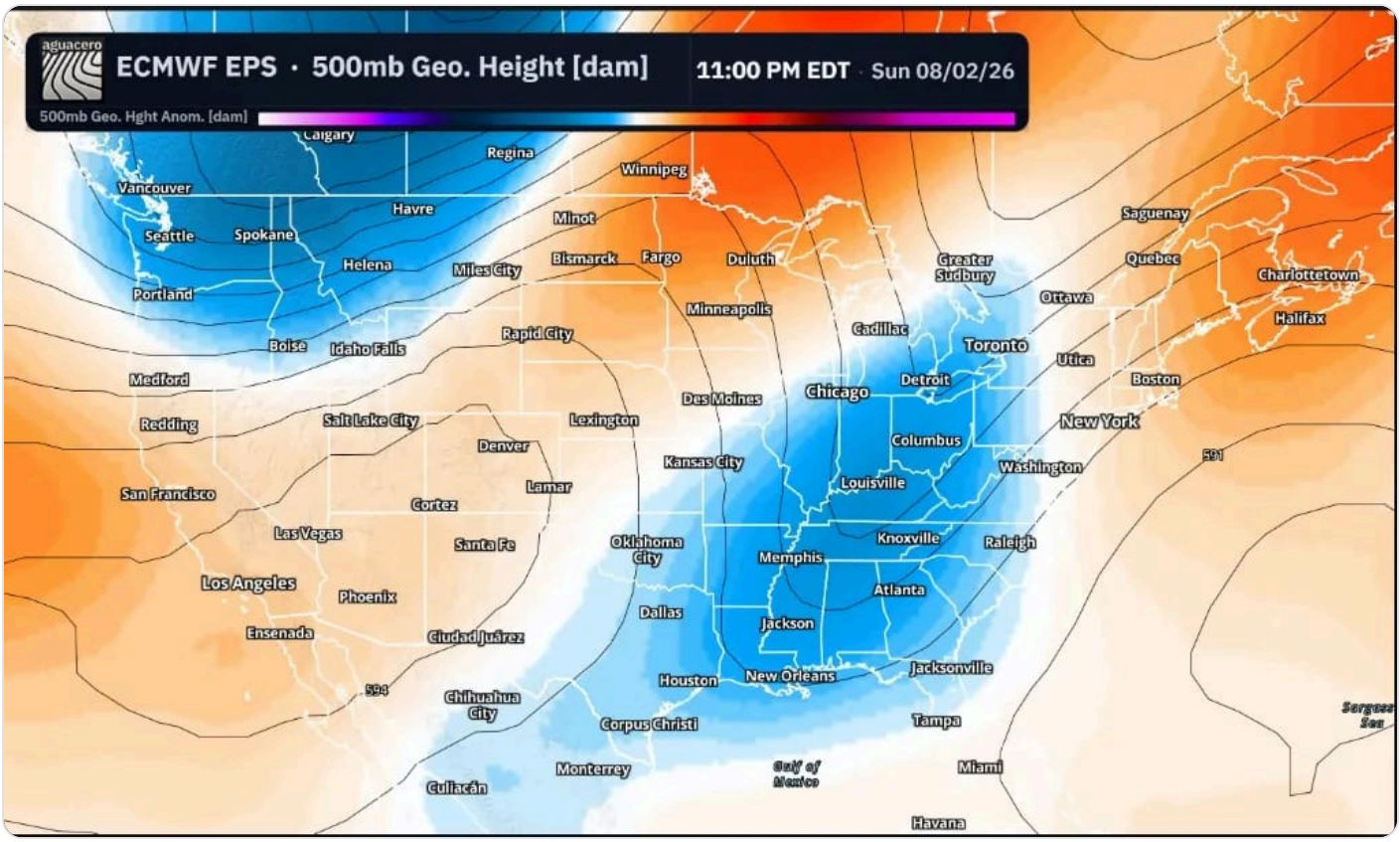
MODELS WITH FIELD OPTIONS

GEFS	31 members. Free.
GEPS	21 members. Free.
AI GEFS	31 members of NOAA's AI ensemble. Its members have no 2 m dew point or humidity, gust, cloud, CAPE or PWAT. Free.
REFS	14 members over the US. Free. See **REFS** below.

NBM	NOAA’s published percentiles, not members. Free. See **The NBM: percentiles and the blend** below.
ECMWF EPS	50 members. Enthusiast and up.
ECMWF AIFS EPS	50 members of ECMWF’s AI ensemble. Enthusiast and up.
ICON-EPS	40 members, near-surface fields only. Enthusiast and up.
ICON-EU-EPS	40 members. Enthusiast and up.
REPS	21 members. Enthusiast and up.
P-ETSS and P-Surge	NOAA’s storm surge statistics. Enthusiast and up. See **Storm surge ensembles** below.

TIPS

- Field Options show only on fields the ensemble’s members carry. Fields that are already a probability or a spread, precipitation-type reflectivity and wind direction never have them.
- NAEFS, MOGREPS-G and Hybrid GEFS have no Field Options; their fields draw as published.
- On the NBM and the storm surge models, the next to **Field Options** opens **About these Field Options**: where the numbers come from and which hours have them.



ECMWF EPS 500 mb height anomaly over North America.

02 The four modes, and how the layer is named

What each Field Options mode maps, its units, and how the legend and on-map title name it.

FIELD OPTIONS MODES	
Statistics	One statistic of the members at each point: the mean (the default), the median, a percentile, or the lowest or highest member. Same units and colors as the field.
Spread	How far apart the members are: standard deviation, variance, normalized spread, range or a percentile range. Units of the field, squared for variance and none for normalized spread.
Probability	The percent of members that meet up to four conditions, such as 24-hour precipitation of an inch or more. Units: %.
Timing	The earliest forecast hour when that probability reaches a level you set. Units: hours (h).

HOW THE TITLE AND LEGEND READ	
Statistics	The field name and the statistic, such as “24 Hour Precipitation — 90th pct” or “— Median”. The mean, and the NBM blend, keep the plain field name.
Spread	“— Std. dev.”, “— Variance”, “— Normalized spread”, “— Range”, “— IQR (25–75th pct)” or “— 10–90th pct range”.
Probability	“P(2m Temp < 32 °F)”, with more conditions joined by AND or OR.
Timing	“Earliest P(2m Temp < 32 °F) ≥ 50%”.
Point labels	Adds “points 10|90th pct” (or the pair you picked).
Anomaly types	“— Standardized” or “— Climo Percentile”.
Saved variable	Its name replaces the title while the layer still draws what you saved.

TIPS

- Each mode keeps its own colors on the layer. Restyle a probability map, switch to **Statistics** and back, and your probability colors return.
- Spread converts between units by scale only, so a 2 °C standard deviation reads 3.6 °F, not 35.6 °F.

03 Statistics: mean, median, percentiles, min and max

Draw a field as its ensemble mean, median, any of the 5th to 95th percentiles, or the lowest or highest member at each point.

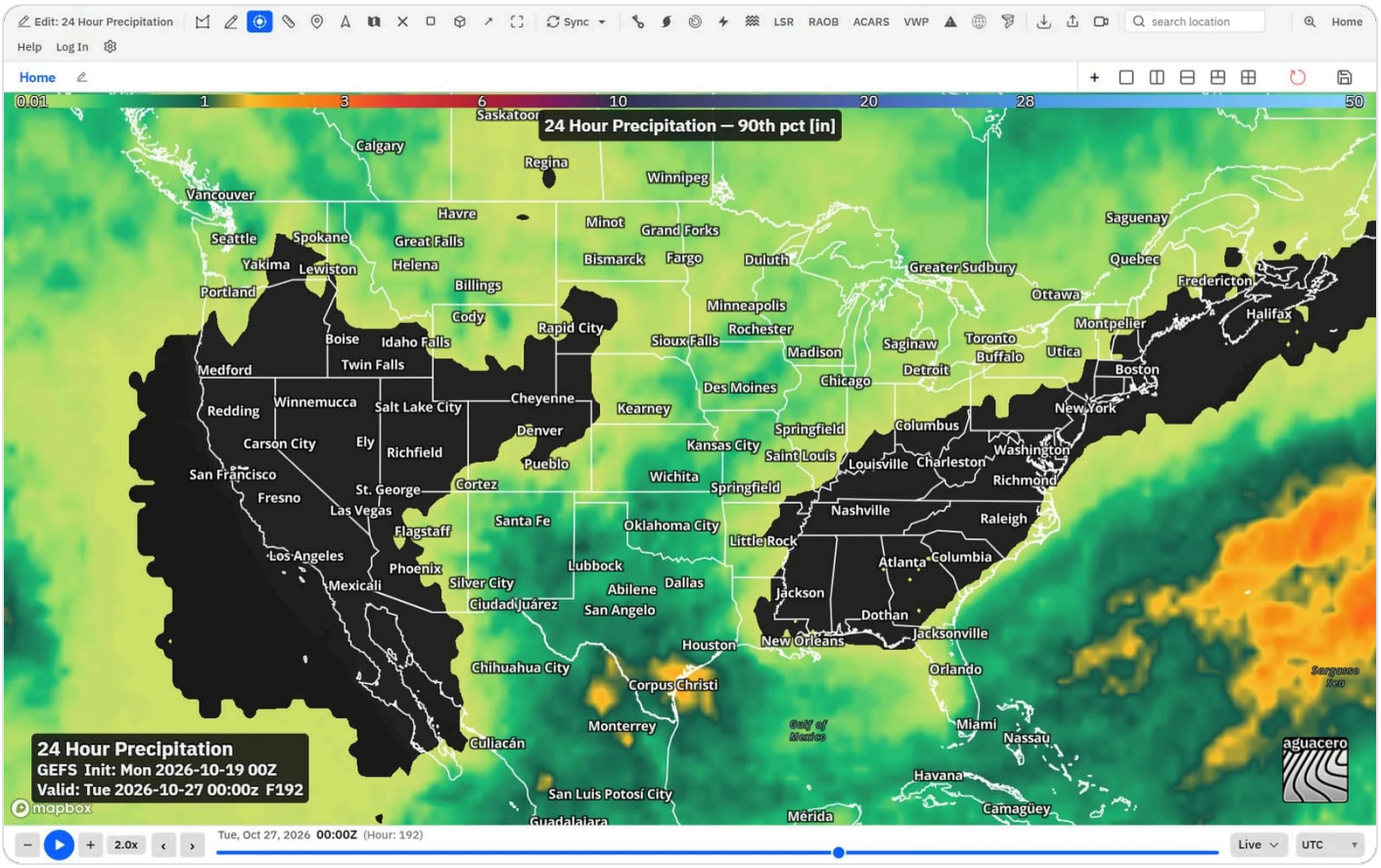
1. Under **Field Options**, keep **Statistics**.
2. Drag the **Statistic** slider, or click a number under it. The name of the stop shows on the right, such as **90th percentile**.
3. Let go to redraw the map.

STATISTIC STOPS ON MEMBER ENSEMBLES	
min	The lowest member at each point. Each point can come from a different member.
5, 10, 25	Low percentiles: 5%, 10% or 25% of members are at or below this value. Good for “at least this much” and best-case views.
50	The median (**Median (50th percentile)**): half the members are above it and half below.
mean	The average of all members. The default, and what the layer draws before you touch Field Options.
75, 90, 95	High percentiles: only 25%, 10% or 5% of members are above this value. Good for reasonable worst cases.
max	The highest member at each point.

Percentiles are worked out point by point, so a 90th percentile map isn’t any one member’s forecast. It shows, at each place, a high-end value that only 1 in 10 members beats.

TIPS

- The slider redraws when you let go, so dragging past several stops fetches only the last one. The arrow keys move one stop at a time.
- On the NBM the middle stop reads **Blend** (**NBM blend**), the regular NBM. Some NBM fields and the storm surge models have other stops; see their sections.
- **min** and **max** follow single members, so one outlier sets them. **5** and **95** are steadier.



GEFS 90th percentile 24-hour precipitation eight days out. Black areas are where at least 9 in 10 members stay dry.

04 Percentile ranges at points

Print a low and a high value at each point, such as the 10th and 90th percentiles, over the statistic you shade.

1. Keep **Statistics** under **Field Options** and pick the statistic to shade, such as **50** (the median).
2. Turn on the **Point** pill on the layer row.
3. Under **Point Labels**, pick a pair.
4. Read each point as low | high.

POINT LABELS	
Plotted statistic	One value per point: the statistic you shade. The default.
10th | 90th percentile	The range 8 in 10 members fall in.

25th | 75th percentile	The middle half of the members.
5th | 95th percentile	The range 9 in 10 members fall in.
Min | Max	The lowest and highest member.

TIPS

- **Point Labels** shows only in **Statistics** mode with the **Point** pill on.
- A field lists only the pairs it has. NBM snowfall, ice, snow ratio and snow level offer **10th | 90th percentile** and **5th | 95th percentile**; NBM CAPE and PWAT only **10th | 90th percentile**.
- Point spacing, font size and decimals are on the layer's **Point** tab.

05 Spread: where the members disagree

Map how far apart the members are, as a standard deviation, variance, normalized spread, full range or the gap between two percentiles.

1. Under **Field Options**, pick **Spread**.
2. Under **Spread**, pick a measure.
3. For **Percentile range**, pick the lower and upper percentiles under **Percentiles**, such as 10 to 90.

SPREAD	
Standard deviation	The typical distance of members from the mean, in the field's units. The default.
Variance	The standard deviation squared, in squared units such as °F².
Normalized spread	The member spread divided by the typical spread at this latitude and hour. 1 is typical; above 1 is more uncertain than usual. No units.
Range (max–min)	The highest member minus the lowest.

Percentile range	The upper percentile minus the lower one. It starts at 25 to 75, the interquartile range (IQR): the middle half of the members.

PERCENTILES (FOR PERCENTILE RANGE)	
Lower and upper	Pick each from 5, 10, 20, 25, 33, 50, 67, 75, 80, 90 and 95. Each menu lists only values below the upper (or above the lower), so the range never flips.

TIPS

- **Normalized spread** shows where this forecast is unusually uncertain for the place and hour, so it doesn't simply light up the stormy latitudes every day.
- **Range (max–min)** jumps with one outlier member. A percentile range such as 10 to 90 ignores the outer members.

Spread isn't offered on NBM snowfall, ice, snow ratio, snow level, snow depth, CAPE or PWAT. P-ETSS offers only **Range (max–min)**, and P-Surge none.

06 Probability: the chance of a threshold

The percent of members above or below a threshold you type, such as 24-hour precipitation of an inch or more, or temperatures below freezing.

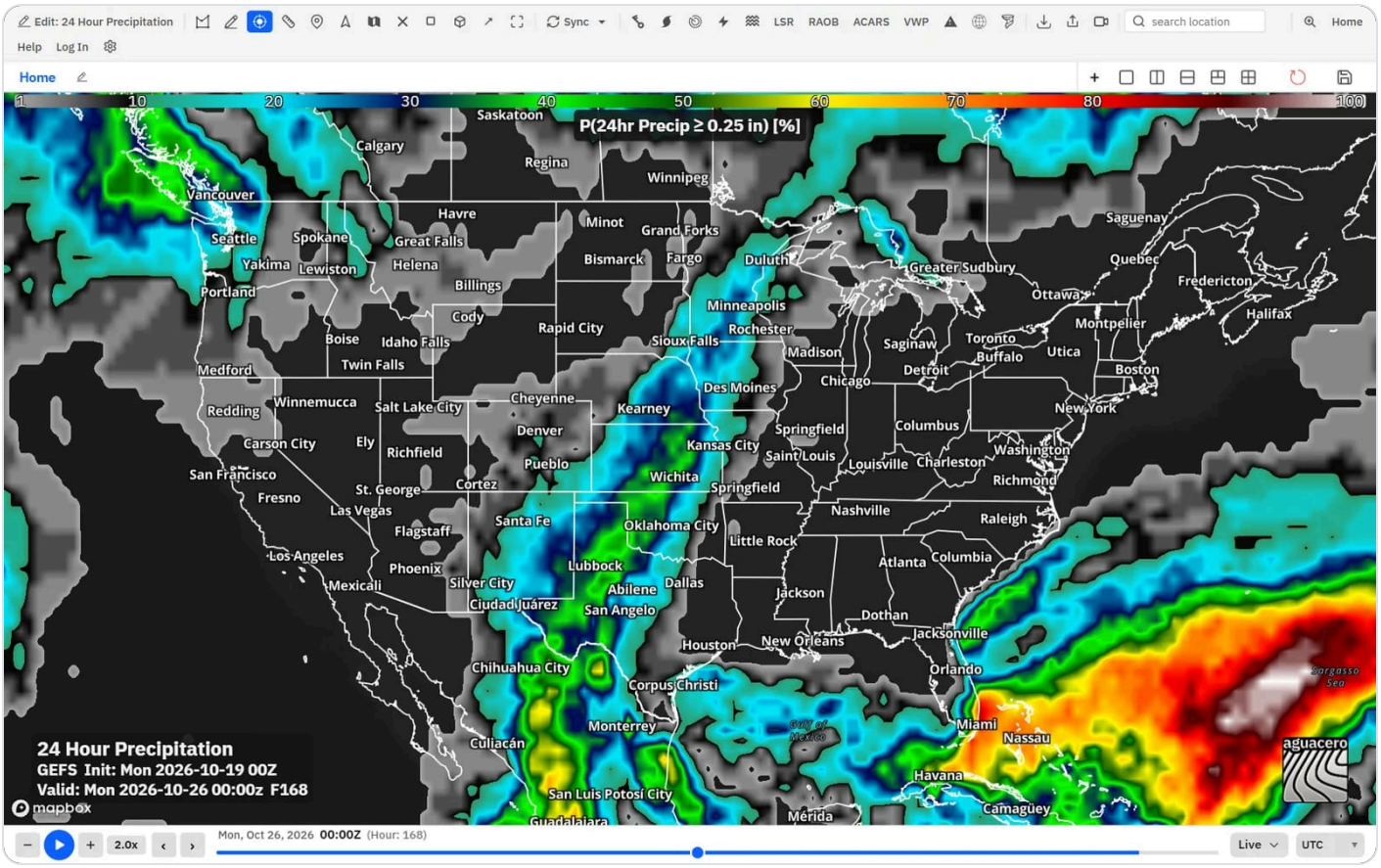
1. Under **Field Options**, pick **Probability**.
2. Under **Conditions**, click a comparison: **>**, **≥**, **<** or **≤**.
3. Type a threshold in the box, in the units shown beside it. The map redraws about half a second after you stop typing, or when you press `Enter` or click away.
4. Read the map as the percent of members that meet the condition. The line under the conditions says it in words, such as "Share of members where 24hr Precip ≥ 1.00 in."

A CONDITION ROW	
Variable	The first row is always the layer's own field and can't be changed or removed. For another field or window, such as 6-hour instead of 24-hour precipitation, change the layer's variable.
> ≥ < ≤	Above, at or above, below, at or below.
Threshold	Any number, including decimals and negatives.
Units	The first row uses the layer's units; change them with **Edit Layer** > **Units**. Rows you add have their own **Units** menu when the field has more than one unit.

WHERE A NEW CONDITION STARTS	
Temperature	Below freezing: < 32 °F (0 °C). Daily maximums start at ≥ 32 °F instead, and temperature changes and anomalies at ≥ 0.
Precipitation	≥ 0.10 in (2.5 mm). Snowfall starts at ≥ 1 in.
Wind	≥ 30 kt, 35 mph, 15 m/s or 50 km/h, by the field's own unit.
Severe fields	CAPE ≥ 1000 J/kg, CIN ≤ -50 J/kg, storm-relative helicity ≥ 150 m^2/s^2, supercell composite and EHI ≥ 1, Craven-Brooks ≥ 20, lapse rates ≥ 7.
Visibility	< 1 mi.
Percent fields	Humidity and other percent fields: ≥ 50%.
Anomalies	Height anomalies ≥ 6 dam and pressure anomalies ≥ 4 hPa.

TIPS

- Every member counts the same. On the GEFS (31 members) one member is about 3%, and on REFS (14 members) about 7%, so the map moves in steps of that size.
- Switch the layer to another ensemble and it keeps its conditions.



GEFS chance of 0.25 in or more of rain in 24 hours, a week out, along a front across the Plains.

07 Joint probabilities: AND and OR

Combine up to four conditions, such as at or below freezing AND precipitating, for the share of members that meet all of them, or any of them.

1. Set up a **Probability** or **Timing** layer.
2. Click **+ Add condition**. The new row starts on Total Precipitation when the members have it.
3. Click the new row's variable, type to search and pick a field, such as 2m Temperature or 10m Wind Speed.
4. Set its comparison and threshold.
5. Pick **AND** for members that meet every condition, or **OR** for members that meet at least one.
6. Click **×** on a row to remove it.

JOINT PROBABILITY CONTROLS	
+ Add condition	Adds a row, up to 4. Greyed out at 4 rows, and on the NBM, P-ETSS and P-Surge, which take one condition (point at it to see why).
Condition variable	Lists the fields this model's members carry, grouped by category, with a search box.
×	Removes the row (**Remove condition**). The first row has none.
AND	Members that meet every condition at the same forecast hour. The default.
OR	Members that meet at least one condition. **AND** or **OR** applies to every row; you can't mix them.

TIPS

- Each member is checked on its own, so "2m Temp ≤ 32 °F AND 6hr Precip ≥ 0.05 in" counts the members that are cold and wet at once. Multiplying two separate chances can't tell you that.
- A row on a field this model's members lack is dimmed and says **Not in this model's members; left out here and kept for models that have it.** It counts again when you switch to a model that has the field.
- On a model that takes one condition, the extra rows are hidden but stay on the layer, and come back on a member ensemble.

Joint probabilities need member data: GEFS, GEPS, AI GEFS, ECMWF EPS, ECMWF AIFS EPS, ICON-EPS, ICON-EU-EPS, REPS and REFS.

08 Timing: when a chance is first reached

Map the earliest forecast hour when the chance of your conditions reaches a level you set, such as the first hour with a 50% chance of freezing.

1. Under **Field Options**, pick **Timing**.
2. Set the **Conditions** the same way as for a probability, with **+ Add condition** and **AND** / **OR** if you need them.

3. Drag **Probability level** to the chance you want.
4. Read the map in forecast hours. Hover a point for its value.

SETTINGS	
Conditions	The same rows as **Probability**, starting from the same defaults.
Probability level	10% to 90% in steps of 10. Default 50%. The line under it reads, for example, “Earliest forecast hour when P(2m Temp < 32 °F) ≥ 50%”.

TIPS

- Places that never reach the level by the end of the run are left blank.
- Low levels, such as 20%, show when an event becomes possible; high ones, such as 70%, when it becomes likely.
- Timing counts in hours after the run started, so compare runs by valid time, not by the number alone.

09 Save Field Options as your own variable

Name a statistic, spread, probability or timing setup and pick it from Add Layer later, on any ensemble that can draw it.

1. Set up **Field Options** the way you want, such as a joint probability.
2. Click ☆ **Save as variable**.
3. Check the **Variable name**. It starts as the layer’s title, such as “P(2m Temp ≤ 32 °F AND 6hr Precip ≥ 0.05 in)”.
4. Pick or type a **Category** and **Subcategory**. They start as the field’s own, such as Surface and Temperature.
5. Click **Save variable**. The card now shows ★ and the name.
6. Later, click **Add Layer** > **Model** and open that category, or type the name in **Search variables...**. Your variable reads ★ and its name.

THE SAVE FORM AND A SAVED LAYER	
Variable name	Up to 200 characters.
Category / Subcategory	Up to 40 characters each. The lists offer your own categories and the app's. A new name makes a new category in **Add Layer**.
Save variable / Cancel	Saves, or closes the form. Editing an existing variable shows **Save changes** instead.
Edit	On a layer made from a saved variable: rename it or move it to another category.
Delete	Click once to arm it (**Delete?**), and again to delete the saved variable. Layers that use it keep drawing.
Update "name"	Shows when you change a saved layer's options: saves the change into the same variable. ☆ **Save as variable** keeps both.

TIPS

- ☆ **Save as variable** shows only once Field Options change the field, so the plain mean has nothing to save.
- A saved variable shows in **Add Layer** only on models whose members have every field it uses, and that can combine its conditions. A two-condition variable never shows on the NBM.
- Each layer keeps a full copy of the setup, so renaming or deleting a saved variable never breaks a bundle or workflow.
- Saved variables don't show in the **Add Layer** list while an archive is loaded.

MESSAGES YOU MAY SEE	
Sign in to save variables.	Saved variables live in your account.
You can save up to 100 variables. Delete one to save another.	The limit is 100 per account.

You already have a variable with this name here.	Names must differ within one category and subcategory.
Give the variable a name. / Pick or type a category.	Both are needed.
Could not save. Try again.	The save didn't reach the server; nothing changed.

10 The NBM: percentiles and the blend

The NBM has no members to count. Field Options read NOAA's published percentiles instead, and the middle stop is the blend itself.

The National Blend of Models runs every hour over the US. Pick it with the model name > **Ensemble** > **Mesoscale** > **NBM**. Its plain fields are the blend. On the fields below, **Field Options** reads the percentiles NOAA publishes with the NBM, so the stops differ from a member ensemble's.

NBM FIELDS WITH FIELD OPTIONS	
2m Temperature, 2m Dewpoint, 2m Relative Humidity, Apparent Temperature, 10m Wind Speed, Wind Gusts, 6, 12, 24 and 48 Hour Precipitation	Stops **min**, 5, 10, 25, 50, **Blend**, 75, 90, 95 and **max**, and all four modes with any threshold. From the NBM percentile runs at 00, 06, 12 and 18z, about 6 hours after the run; newer runs use the latest one valid at the same time.
1, 6, 12 and 24 Hour Snowfall, Total Snowfall	Stops 5, 10, 30, 50, **Blend**, 70, 90 and 95. See **NBM snowfall windows**.
6 Hour Freezing Rain [FRAM]	The same eight stops, plus NOAA's chances. See **NBM chances at NOAA's thresholds**.
Snow Liquid Ratio, Snow Level	The same eight stops, **Statistics** only. Percentiles run through hour 48 (every forecast hour on the 01, 07, 13 and 19z runs).
Snow Depth	The blend and NOAA's chances. No percentiles.
Surface Based CAPE, Precipitable Water	Stops 10, 50, **Blend** and 90, every forecast hour.

TIPS

- On the first group, **Probability** reads the chance off NOAA's percentiles. The line under it says "Chance that ..., from the NBM percentile distribution."
- The NBM takes one condition: "NBM publishes each variable on its own, so conditions can't be combined."
- Total Precipitation, 1 and 3 Hour Precipitation and the 12-hour highs and lows have no Field Options on the NBM.
- The next to **Field Options** tells you which percentiles a field uses and which hours have them.

The NBM is on the Free plan.

11 NBM chances at NOAA's thresholds

For snowfall, ice and snow depth, NOAA publishes the chance of more than a few fixed amounts. Probability on these fields shows NOAA's own chances.

1. On the NBM, add 1 Hour Snowfall, 6 Hour Snowfall, 6 Hour Freezing Rain [FRAM] or Snow Depth.
2. Under **Field Options**, pick **Probability**. The comparison offers only **>**.
3. Pick an amount from the threshold list. The line under it names every threshold and the hours that have them.

THRESHOLDS NOAA PUBLISHES	
1 Hour Snowfall	More than 0.1, 0.5, 1, 1.5, 2, 2.5, 3 or 4 in, through hour 48.
6 Hour Snowfall	More than 0.1, 1, 2, 4, 6, 8, 10 or 12 in, for the 6 hours ending 00, 06, 12 and 18Z, through about hour 54 (hour 263 on the 01, 07, 13 and 19z runs).
6 Hour Freezing Rain [FRAM]	More than 0.01, 0.1, 0.25, 0.5 or 1 in of ice, for the same 6-hour windows and hours.
Snow Depth	More than 0.1, 0.5 or 1 in on the ground, through hour 48 (every forecast hour on the 01, 07, 13 and 19z runs).

TIPS

- The list shows in the layer's units, so it reads in cm when the layer is in cm.
- A threshold carried over from another model snaps to the nearest one NOAA publishes and switches to **>**.
- These fields have no **Spread** or **Timing**, and **+ Add condition** stays greyed out.

12 NBM snowfall windows

NBM snowfall comes as five variables, one per window, each with a percentile slider. The time bar follows the hours NOAA publishes for the stop you pick.

1. On the NBM, click **Add Layer** > **Model** > **Precipitation** and pick 1 Hour Snowfall, 6 Hour Snowfall, 12 Hour Snowfall, 24 Hour Snowfall or Total Snowfall under **Snow**.
2. Under **Field Options**, drag **Statistic** to a percentile, or keep **Blend**.
3. To change the window, open the layer's variable menu and pick another snowfall variable.

WINDOWS

1 Hour Snowfall	Blend and percentiles through hour 48, plus NOAA's chances.
6 Hour Snowfall	Blend for the whole run. Percentiles through about hour 54 (hour 263 on the 01, 07, 13 and 19z runs), plus NOAA's chances for the 6 hours ending 00, 06, 12 and 18Z.
12 Hour, 24 Hour and Total Snowfall	Blend for the whole run, percentiles through about hour 54 (hour 263 on the 01, 07, 13 and 19z runs). **Statistics** only.

TIPS

- The 12-hour, 24-hour and total percentiles add up the hourly and 6-hour percentiles, so high percentiles run high and low ones run low.
- On a percentile stop the time bar ends where NOAA's percentiles end. Click **Blend** to get the whole run back.
- Older bundles that used the separate percentile snowfall variables still draw; those variables just left **Add Layer**.

13 NBM winter fields

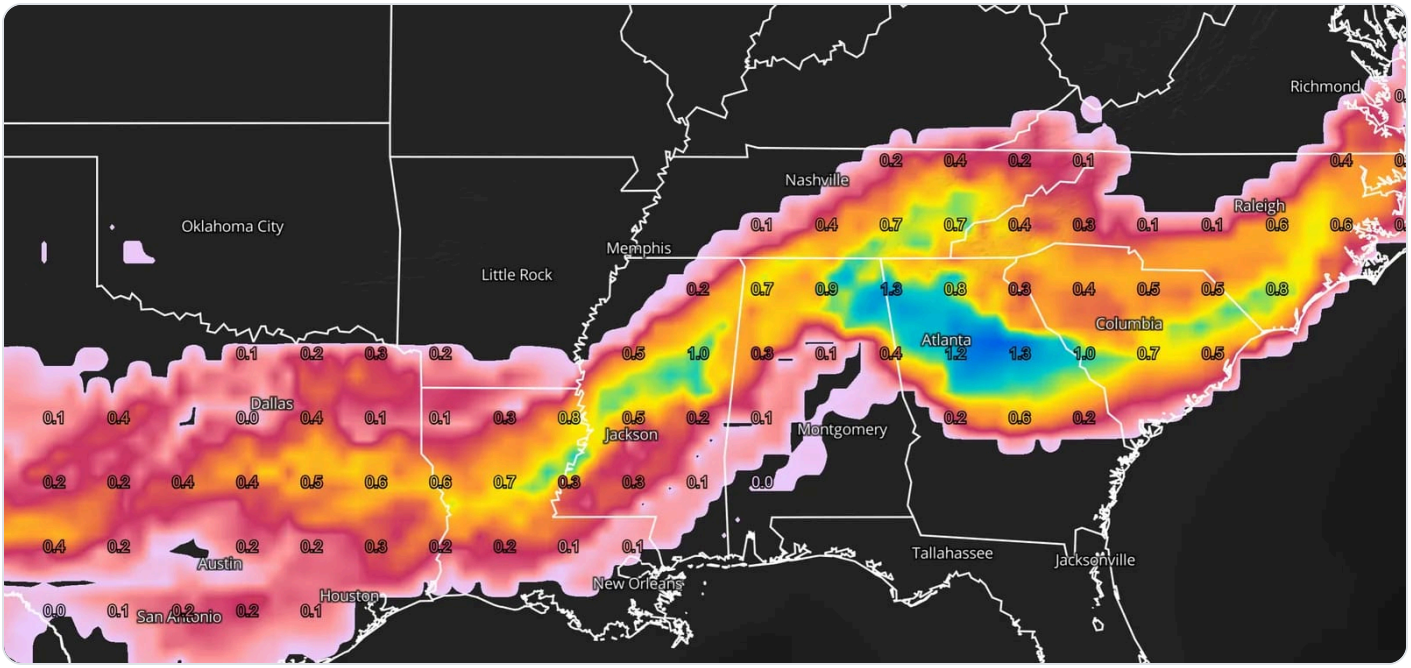
Snow-to-liquid ratio, FRAM ice accretion, the chance of each precipitation type, snow level and snow depth, with percentiles and NOAA's chances where it publishes them.

1. Switch the panel to the NBM.
2. On **Edit Layers**, click **Add Layer** and type a name in **Search variables...**, such as Snow Liquid, FRAM, Chance of, Snow Level or Snow Depth.
3. Click the field to add it, then use **Field Options** where it has them.

WINTER FIELDS	
Snow Liquid Ratio	Inches of snow per inch of liquid (Winter > Snow). Blend for the whole run; percentiles 5 to 95 through hour 48, or every forecast hour on the 01, 07, 13 and 19z runs.
1, 6, 12 and 24 Hour Freezing Rain [FRAM], Total Freezing Rain [FRAM]	Ice accretion from freezing rain (Winter > Freezing Rain [FRAM]). 1 Hour runs through hour 48. 6 Hour has percentiles and chances for the 6 hours ending 00, 06, 12 and 18Z; the others are the blend.
Chance of Rain, Chance of Freezing Rain, Chance of Snow, Chance of Sleet	The NBM's chance of each type at the hour (Winter > Precip Type Chance), for the whole run.
Snow Level	Height of the snow level (Precipitation > Snow). Blend for the whole run; percentiles through hour 48, or every forecast hour on the 01, 07, 13 and 19z runs.
Snow Depth	Snow on the ground (Winter > Snow Depth), with NOAA's chances of more than 0.1, 0.5 or 1 in. Through hour 48, or every forecast hour on the 01, 07, 13 and 19z runs.
1 and 6 Hour Snowfall chances	On the snowfall variables' **Probability** mode. See **NBM chances at NOAA's thresholds**.

TIPS

- The NBM also has 1 Hour and 3 Hour Precipitation under Precipitation > QPF.
- Pair **Snow Liquid Ratio** with 6 Hour Snowfall to see whether a high total comes from a wet or a fluffy snow.



FRAM ice accumulation with point values across the Southeast.

14 NBM aviation fields

Ceiling, cloud base and layers, sky cover, visibility, low-level wind shear and the chance of a low ceiling or visibility, for TAF-style planning.

1. Switch the panel to the NBM.
2. Click **Add Layer** > **Model** > **Aviation**, or search for Ceiling, Cloud Layer, LLWS or Prob.
3. Click a field to add it.

AVIATION FIELDS

Ceiling (AGL)	Height of the lowest broken or overcast layer; blank where there is no ceiling. Hourly through hour 36, then every 3 hours to about hour 82.

Lowest Cloud Base (AGL)	The lowest cloud layer, including FEW and SCT layers. Same hours as the ceiling.
Cloud Layer 1, 2 and 3 Base (AGL) and Coverage	Up to three layers with their base and sky coverage. The layers aren't sorted by height. Through hour 36.
Total Cloud Cover	Sky cover across all layers (Upper Air > Clouds), for the whole run. High Cloud Cover runs through hour 36.
Visibility	Surface > Visibility. Hourly through hour 36, then every 3 hours to about hour 75.
LLWS Wind Speed, LLWS Height (AGL)	The wind and height at the top of the low-level wind shear layer, as in a TAF WS group. Shown only where shear is forecast below 2,000 ft. Through hour 36.
Prob. Ceiling	Chance of a ceiling below 500, 1000, 2000, 3000 or 6600 ft, picked on a slider. See **Threshold sliders**.
Prob. Visibility	Chance of visibility below 1, 2, 3 or 5 mi, picked on a slider.

TIPS

- A ceiling below 1000 ft or visibility below 3 mi is IFR or lower. **Prob. Ceiling** starts at 1000 ft and **Prob. Visibility** at 3 mi.
- Past hour 36 most aviation fields are every 3 hours, so the time bar skips the hours in between.

15 Threshold sliders on NBM and REFS chances

Some chances come from NOAA at a few fixed thresholds. Add Layer lists each set as one variable, and a slider on the layer card picks the threshold.

1. Add one of the variables below, such as **Prob. Ceiling** on the NBM.
2. On the layer card, drag the slider under the variable, such as **Ceiling below**, or click a number under it. The value shows on the right, such as 1000 ft.
3. Let go. The layer switches to that threshold and keeps its colors.

VARIABLES WITH A THRESHOLD SLIDER	
Prob. Ceiling (NBM)	**Ceiling below** 500, 1000, 2000, 3000 or 6600 ft. Starts at 1000. The 2000 and 6600 ft chances run through hour 36, the others to about hour 75.
Prob. Visibility (NBM)	**Visibility below** 1, 2, 3 or 5 mi. Starts at 3. The 2 mi chance runs through hour 36; the others to about hour 75, or hour 48 on the 02, 05, 08, 11, 14, 17, 20 and 23z runs.
MLCape Probability (REFS)	**MLCAPE above** 500, 1000, 1500, 2000 or 3000 J/kg. Starts at 1000.
MLCIN Probability (REFS)	**MLCIN below** -400, -100 or -50 J/kg: a cap at least that strong. Starts at -100.
Reflectivity Probability (REFS)	**Reflectivity above** 10, 20, 30, 40 or 50 dBZ, NOAA's smoothed neighborhood chance. Starts at 40.
2-5km Max Updraft Helicity Probability (REFS)	**Updraft helicity above** 25, 75 or 150 m^2/s^2, NOAA's smoothed neighborhood chance. Starts at 75.
1 Hour 80m Max Wind Gust Probability (REFS)	**Gust above** 20, 30 or 40 kts in the hour (23, 35 or 46 mph with Imperial units). Starts at 30.

TIPS

- The □ beside the NBM sliders lists which thresholds run how far into the forecast.
- If the bundle still has its built-in name, such as Prob. Ceiling or the old threshold's title, it is renamed to the new threshold so the on-map name stays right. A name you typed is never changed.
- The other thresholds left **Add Layer**. Bundles that use them still draw and show the slider.

The slider picks among NOAA's fixed thresholds. For any threshold you like, use **Probability** under **Field Options** on an ensemble field.

16 REFS

NOAA’s 14-member short-range ensemble over the US. Field Options give its probabilities at any threshold, and a few of NOAA’s own probabilities stay as variables.

REFS counts 14 equal members: the RRFS, its five ensemble members and the HRRR, from this run and from the run 6 hours earlier. After hours 42, 48 and 54, where the HRRR and the earlier runs end, fewer members remain. Pick it with the model name > **Ensemble** > **Mesoscale** > **REFS**.

PROBABILITIES ON REFS	
Field Options	Any threshold on fields the members carry. For 2m Temperature, 2m Dewpoint, Precipitable Water, 1 Hour Precipitation, 850mb Wind Speed, 0-6km Bulk Shear Speed, 3km Storm Relative Helicity and Visibility, they replace NOAA’s ready-made probability variables, which give the same numbers. They also work on Mixed Layer CAPE and CIN and 2-5km Maximum Updraft Helicity.
Threshold slider variables	**MLCape Probability**, **MLCIN Probability**, **Reflectivity Probability**, **2-5km Max Updraft Helicity Probability** and **1 Hour 80m Max Wind Gust Probability** are NOAA’s own. See **Threshold sliders**.
1 Hour Snowfall Probability >1 in / >3 in	NOAA’s 1-hour snowfall chances, still two separate variables in **Add Layer**.
Spread variables	NOAA’s published spread, such as 2m Temperature Spread, Surface Based CAPE Spread and Mean Sea Level Pressure Spread.
AND instead of combinations	NOAA’s “Probabilistic” combination variables left **Add Layer**. Build the same idea with **AND** conditions, which count the members that meet them all.

TIPS

- NOAA’s reflectivity and updraft helicity chances are smoothed neighborhood chances: storms anywhere nearby count. A point chance from Field Options on updraft helicity reads differently.
- NOAA’s MLCAPE and MLCIN chances use each member’s published values. Field Options works some members’ values out from their profiles, so the two can differ by a few percent.
- Bundles that use the old REFS probability or combination variables still draw.
- REFS also has **Member Low Centers & Tracks**.

17 Storm surge ensembles (P-ETSS and P-Surge)

On P-ETSS and P-Surge, Field Options show NOAA's published surge statistics: exceedance heights, the chance of topping a height and when it is first reached.

NOAA publishes these ensembles only as statistics, so Field Options offer what NOAA publishes and take one condition. Pick them with the model name > **Marine** > **Storm Surge**.

SETTINGS	
P-ETSS Storm Tide	Statistics of 31 GEFS-driven runs, storm tide above datum, hourly. Stops **min**, 10, 50, **mean** (the default), 60, 70, 80, 90 and **max**. **Spread** offers **Range (max–min)**. **Probability** and **Timing** above 0 to 10, 13 and 16 ft; heights between are interpolated.
P-Surge Storm Tide	Stops 10, 50 (the default), 60, 70, 80 and 90. **Statistics** only.
P-Surge Storm Surge Inundation (Above Ground)	Water depth above ground, the highest in each 6-hour window. The same stops, plus **Probability** and **Timing** above 1 to 20 ft.

TIPS

- The 90th percentile is the water level with a 10% chance of being exceeded.
- A new condition starts at 3 ft. A threshold outside NOAA's range moves to the nearest end.

18 Anomaly types

Show an anomaly field as a departure, in standard deviations, as a climate percentile or as a percent of normal, on ensembles and single-run models alike.

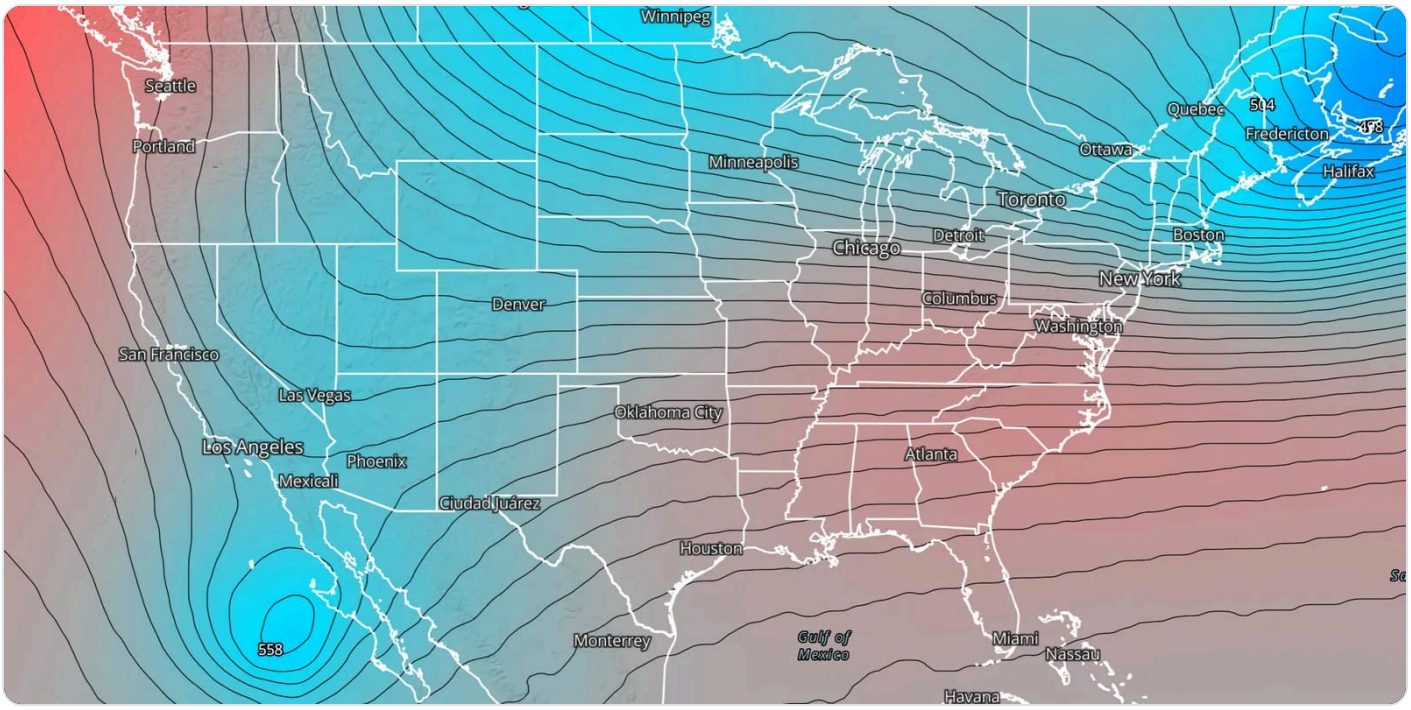
1. Click **Edit Layers**, then **Add Layer**, and type Anomaly in **Search variables...**.
2. Click a field, such as 2m Temperature Anomaly, 500mb Geopotential Height Anomaly or MSLP Anomaly.
3. On the layer card, under **Anomaly Type**, pick a type.

ANOMALY TYPE	
Anomaly	The departure from the 1990–2019 ERA5 average, in the field's units. The default.
Standardized (σ)	The departure in standard deviations for that place and time of year, so a 2 σ cold spell means as much in the tropics as in the Plains.
Climo Percentile	Where the value ranks among 1990–2019 ERA5 values for that day and hour, from 0 to 100. 99 means warmer, wetter or higher than 99% of past cases.
Relative Anomaly	The value as a percent of normal: 100% is normal. It switches the layer to the model's relative anomaly field.

WHICH FIELDS HAVE WHICH TYPES	
Standardized (σ), Climo Percentile	2 m temperature; 50, 100, 500, 700 and 850 mb temperature and height; 50 and 100 mb wind speed; MSLP; PWAT; the 700–500 mb lapse rate; and SST anomalies. Not on CFS Monthly, CanSIPS, NMME, SEAS5, ERA5, 20CR, CRW or ARMOR3D.
Relative Anomaly	2 m temperature; 500, 700 and 850 mb temperature and height; MSLP; PWAT; the lapse rate; SST and HDWI anomalies, where the model has the relative field.

TIPS

- **Anomaly Type** shows only when a field has more than one type, and lists only the types it has.
- On an ensemble, **Standardized (σ)** and **Climo Percentile** use the ensemble-mean anomaly, and **Field Options** hide. Switch back to **Anomaly** to get them again.
- With **Anomaly**, Field Options work on the anomaly itself: **Probability** on GEFS 2m Temperature Anomaly starts at ≥ 0, the chance of warmer than normal.
- The separate relative anomaly variables left **Add Layer** on models that have the anomaly; pick **Relative Anomaly** here instead.



A model anomaly field with contours over North America.

19 Member low centers and tracks

Every member's surface lows as a red L with its central pressure, and each member's track up to the time on the slider.

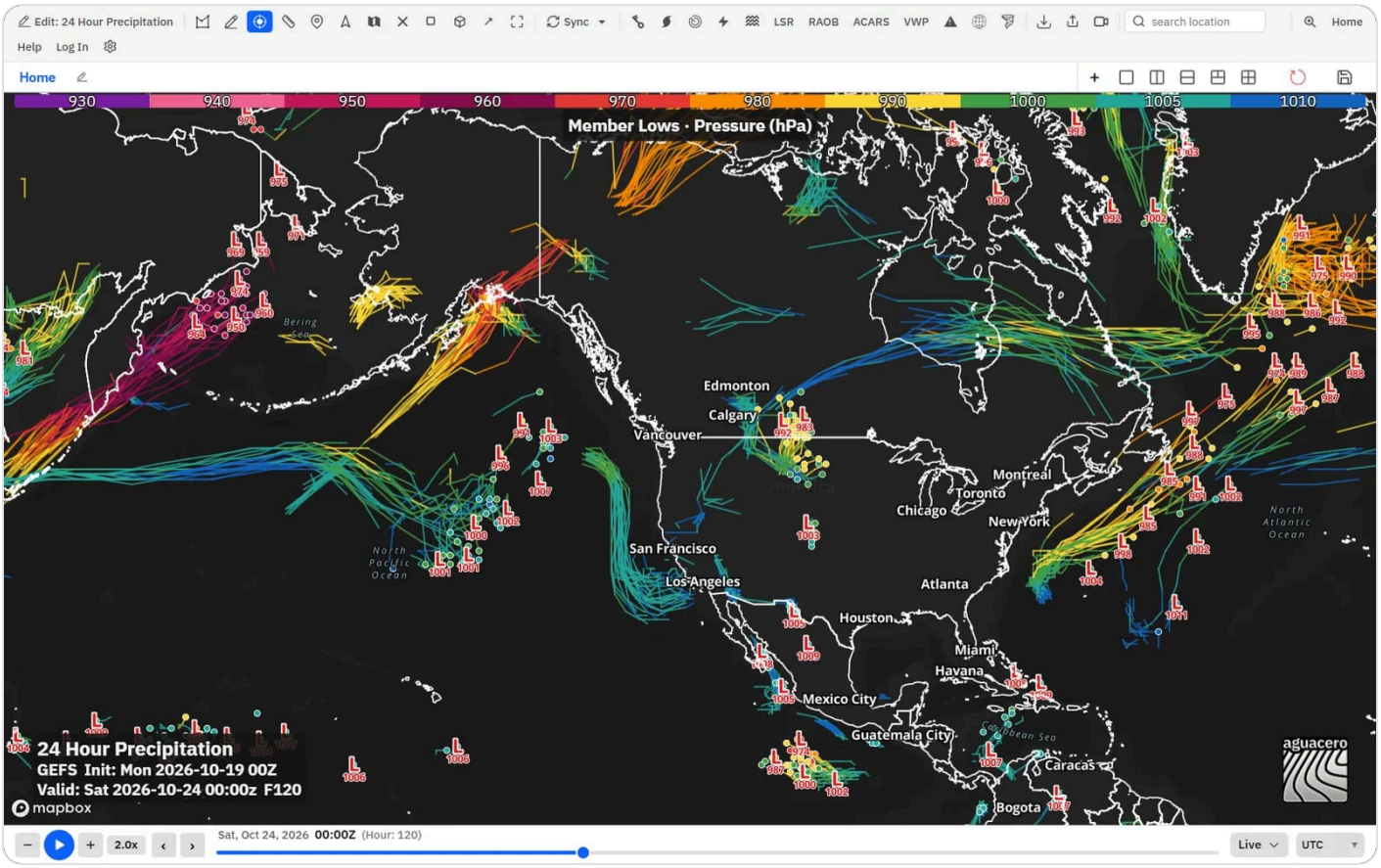
1. Switch the panel to GEFS, AI GEFS, GEPS, ECMWF EPS, ECMWF AIFS EPS or REFS.
2. On **Edit Layers**, click **Add Layer** > **Model** > **Surface**, then **Member Low Centers & Tracks** under **Mean Sea Level Pressure**. Or search for Member Low.
3. Step through time. Each member's track grows up to the slider time, with a dot and an L with the central pressure where its low is now.
4. Click **Edit Layer** on the card to change what's drawn.

MEMBER LOWS SETTINGS	
Tracks	Each member's track line. On by default.
Centers	The red L with the central pressure in hPa. Where Ls would overlap, the deepest low shows. On by default.

Dots	A dot on each member’s low at the slider time, in the track color. On by default.
Color style	**Intensity colormap** (the default) colors tracks by **Color by**; **Solid color** draws them all in **Track color**.
Color by	**Pressure (MSLP)** (the default), **Wind intensity** (the strongest 10 m wind within 500 km of the center), **Lead time (hours)** or **By member** (one color per member, no legend).
Units	With **Wind intensity**: kts (the default), mph, km/h or m/s.
Color stops	The scale under **Color by**, like the hurricane track colors. Click a stop to change its color. Not shown for **By member**.
Smooth colors	Blends between stops instead of stepping. Off by default.
Track color	With **Solid color**: the one color for every track.
Max pressure	Hides centers above this pressure, 850–1100 hPa. Default 1012 hPa.
Min track length	Hides tracks, and their centers, that last fewer hours: **Off**, 6, 12 (the default), 24 or 48 h. It clears out short-lived weak lows.

TIPS

- The Default library bundle **Member Low Centers & Tracks** also draws the ensemble-mean MSLP anomaly as a fill and the mean MSLP as black contours under the lows. On **Select Data**, keep the **Default** list and type Member Low in **Search bundles...**.
- The layer loads every hour of the run, so tracks fill in over a few seconds the first time.
- Lower **Max pressure** to 1000 hPa to keep only the deeper storms; raise **Min track length** to 24 h to hide brief lows.
- Member lows track lows only; there is no member highs layer.



GEFS member low tracks over the first five days, colored by central pressure.

Free on GEFS, GEPS, AI GEFS and REFS. ECMWF EPS and ECMWF AIFS EPS need Enthusiast or higher.

20 Every member at one point

Ensemble meteograms show every member at one place as box plots, plumes, member heatmaps and chances, including the NBM's percentiles.

Field Options map the whole area at one time. For one place over the whole run, right-click the map on an ensemble and click **Ensemble** under **Meteograms**.

21 Recipe: the chance of cold precipitation, and when it starts

Map the share of members that are at or below freezing and precipitating at the same time, save it, then map when it first becomes possible.

1. Switch the panel to GEFS (or ECMWF EPS) and add 6 Hour Precipitation.
2. Under **Field Options**, pick **Probability**. The first row reads ≥ 0.10 in; type 0.05.

3. Click **+ Add condition**. Click the new row's variable, search for 2m Temperature and pick it. It starts at < 32 °F; click **≤**.
4. Keep **AND**. The map shows the share of members that are at or below freezing and have at least 0.05 in in the 6 hours ending at that time.
5. Click ☆ **Save as variable**, name it, file it under Winter and click **Save variable**.
6. Switch **Field Options** to **Timing** and set **Probability level** to 30%: the map shows the first forecast hour when cold precipitation becomes possible.

TIPS

- For ice, start from 6 Hour Freezing Rain [QPF] on GEFS or ECMWF EPS instead.
- Swap 2m Temperature for 850mb Temperature to look for snow aloft.
- Your saved variable shows in **Add Layer** on every member ensemble that has both fields.

22 Recipe: a reasonable worst-case snow map

Show the middle of the pack, the high end and the range of snowfall at each point, then the chance of a big total.

1. Switch the panel to GEFS or ECMWF EPS and add Total Snow [Kuchera] (or Total Snow [10:1]).
2. Under **Field Options**, click **50** for the median.
3. Click **90**: the amount only 1 in 10 members beat at each point.
4. Turn on the **Point** pill and set **Point Labels** to **10th | 90th percentile** to print the low and high ends.
5. Switch to **Probability** and type 6 for the chance of 6 in or more.
6. Over the US, switch to the NBM and add Total Snowfall: its **90** stop is NOAA's 90th percentile.

TIPS

- **max** is one member's forecast at each point, often an outlier. **90** or **95** is the steadier high end.
- Kuchera scales snow by temperature, so it runs higher than 10:1 in cold air and lower near freezing.

23 Recipe: find where the ensemble disagrees

Shade the 500 mb height spread under the mean surface pattern and the member lows, to see which systems the members can’t agree on.

1. Switch the panel to ECMWF EPS or GEFS.
2. Add 500mb Geopotential Heights. It starts as lines; turn its **Fill** pill on and its **Line** pill off.
3. On that layer, set **Field Options** to **Spread** and pick **Normalized spread**.
4. Add MSLP and show it as lines (**Line** pill on, **Fill** off). On an ensemble it is the ensemble mean.
5. Add **Member Low Centers & Tracks** to see where the members put the surface lows.
6. Step through time. Areas above 1 are more uncertain than usual for that latitude and hour.

TIPS

- Pick **Standard deviation** instead for the spread in dam.
- **Add Layer** doesn’t offer a field that is already in the bundle, so to see one field’s spread beside its mean, split the board into two panels.

24 Plans, and what gets saved

Which plans have which ensembles, and where Field Options, sliders and saved variables are kept.

PLANS

Free	Field Options, point labels, saved variables and member lows on GEFS, GEPS, AI GEFS and REFS, Field Options and the winter and aviation fields on the NBM, and anomaly types on free models such as the GFS, ECMWF and HRRR.
Enthusiast and up	Adds ECMWF EPS, ECMWF AIFS EPS, ICON-EPS, ICON-EU-EPS, REPS, P-ETSS and P-Surge. On Free these show an **E** badge in the model menu, and clicking one opens the upgrade window.

WHERE SETTINGS ARE KEPT	
The bundle	The Field Options mode, statistic, spread and percentiles, conditions and AND / OR, probability level, point labels, anomaly type, the threshold picked on a slider, member low settings and each mode's colors. Click **Save Bundle** to keep them; workflows keep them too.
Your account	Saved variables, up to 100. Sign in to make and use them on every device.

25 Common questions

Answers to the ensemble and NBM questions we hear most.

Why is there no Field Options on my layer?

The model or field doesn't have them. Field Options are on GEFS, GEPS, AI GEFS, ECMWF EPS, ECMWF AIFS EPS, ICON-EPS, ICON-EU-EPS, REPS, REFS, the NBM, P-ETSS and P-Surge, and only on fields their members (or NOAA's percentiles) carry. They also hide while an anomaly layer is set to **Standardized (σ)** or **Climo Percentile**, and **Member Low Centers & Tracks** has its own settings under **Edit Layer**.

Why is one of my conditions dimmed?

This model's members don't carry that field, so the row is left out of the map. It stays on the layer and counts again on a model that has the field. AI GEFS, for example, has no 2 m dew point or gust.

Why can the NBM take only one condition?

The NBM has no members. NOAA publishes each variable's percentiles on its own, so there is no way to know how often two things happen together. **+ Add condition** is greyed out there; extra rows from another model are hidden and kept.

Why is the NBM threshold a list instead of a box, with only >?

For snowfall, ice and snow depth, NOAA publishes the chance of more than a few fixed amounts, and the app shows NOAA's own chances. Other NBM fields, such as temperature and precipitation, take any threshold and comparison.

Why is the map blank at some hours?

The field doesn’t exist then. A 24-hour total starts at hour 24, NBM percentiles end around hour 48 to 54 on most runs, NOAA’s 6-hour snow and ice chances exist only for windows ending 00, 06, 12 and 18Z, and many NBM aviation fields stop at hour 36. On a **Timing** map, blank means the level is never reached. Click **Blend** on the NBM to get the whole run back.

What is the IQR?

The interquartile range: the 75th percentile minus the 25th, the spread of the middle half of the members. It is the **Percentile range** default; pick other percentiles under **Percentiles**, such as 10 to 90.

Should I use the mean or the median?

The mean averages every member, so a few wet members pull it up and it spreads light precipitation everywhere. The median (**50**) is the middle member at each point and keeps sharper edges. For precipitation and snow, the median is often closer to what most members show.

Why doesn’t my saved variable show in Add Layer?

It shows only on models whose members have every field it uses and that can combine its conditions, so a two-condition variable never shows on the NBM, and one built on CAPE never shows on AI GEFS. Saved variables also hide while an archive is loaded, and you must be signed in.

Why is there no Save as variable button?

It appears once Field Options change the field. A layer still on the mean (or the NBM blend) has nothing to save. On a layer made from a saved variable, the card shows ★, **Edit** and **Delete** instead, or **Update “name”** after you change it.

Why does the NBM percentile map look the same on two runs in a row?

For temperature, dew point, humidity, wind, gust and 6- to 48-hour precipitation, NOAA publishes the NBM percentiles only from the 00, 06, 12 and 18z runs, about 6 hours later. Hourly runs in between use the latest of those valid at the same time. Snowfall, ice, snow ratio, snow level, CAPE and PWAT percentiles come with each run.

Why does the probability jump in steps?

Each member is one vote. With 31 GEFS members a step is about 3%; with 14 REFS members it is about 7%.

Why did my bundle’s name change when I moved a threshold slider?

It still had a built-in name, such as Prob. Ceiling or the old threshold’s title, so the app renamed it to the new threshold to keep the on-map name right. Names you typed are never changed.

Why do some member lows have no L?

Where Ls would overlap, only the deepest low shows; zoom in to separate them. **Max pressure** hides lows above its value (1012 hPa by default), and **Min track length** hides lows whose track is shorter than 12 hours by default.

Can I track member highs?

No. The member layer tracks low-pressure centers only.