Severe Weather Terms

TSC by James Keech

TOPICS

“K-index”

“Dew Point”

“Surface Cape”

“Updraft helicity”

“Significant Tornado Parameter (STP)”

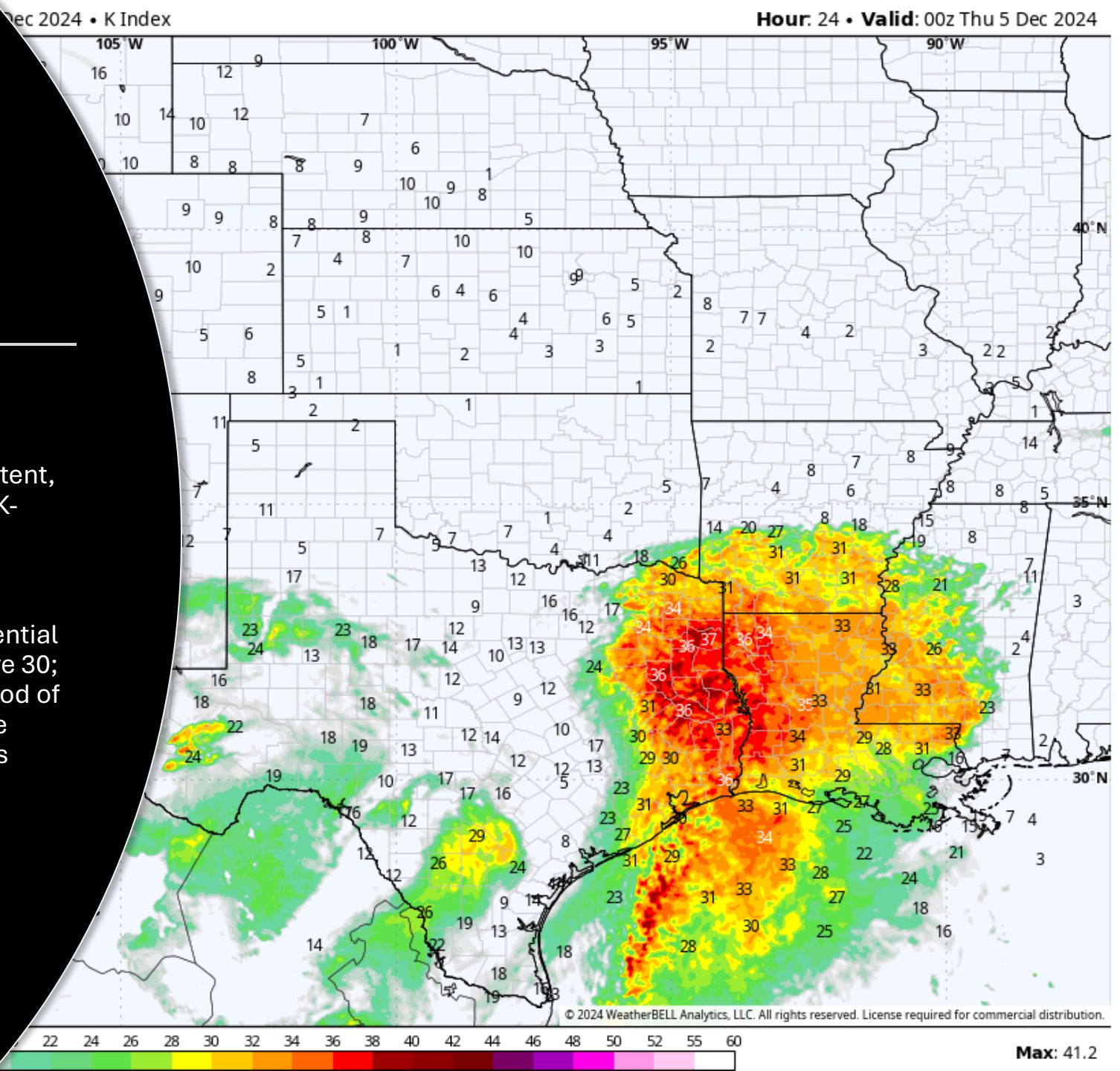
“Supercell Composite Parameter (SCP)”

“Wind Shear”

"K-INDEX "

- The K-index is a meteorological measurement of thunderstorm potential that uses a combination of factors, including the vertical temperature lapse rate, moisture content, and the vertical extent of moisture in the atmosphere. The K-index is also known as George's Index.

- A "K-index" value generally considered indicative of potential for severe weather, including during winter months, is above 30; with higher values like 35 or 40; indicating a greater likelihood of thunderstorms and heavy rain, potentially leading to severe weather scenarios depending on other atmospheric factors present.



“K-INDEX”

Key points about the K-index and severe weather.

What it measures:

The K-index is a calculation that considers the vertical temperature lapse rate and the amount of moisture in the lower atmosphere; essentially gauging the potential for convective instability, a key factor in thunderstorm development.

Interpretation:

Low K-index (below 30): Lowers the chance of thunderstorms, although heavy rain may still occur.

Moderate K-index (30-39): Increased potential for thunderstorms with heavy rain.

High K-index (40 or above): Significantly higher likelihood of severe thunderstorms with heavy rain.

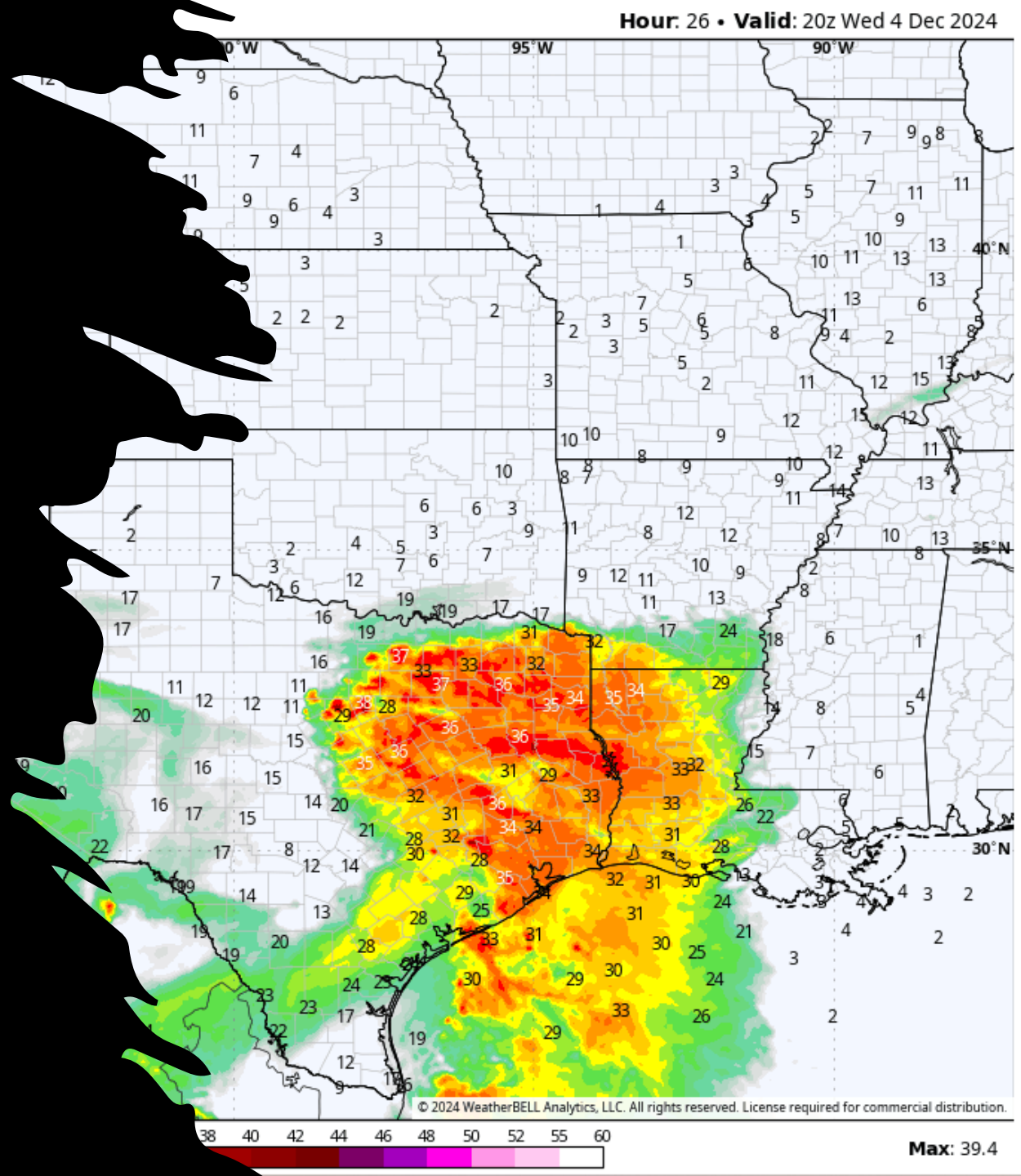
Important considerations:

Winter context:

While a high K-index is generally associated with summer thunderstorms, it can still indicate the potential for severe winter weather like thunderstorms with heavy snow or sleet, especially in situations with strong lifting mechanisms like fronts.

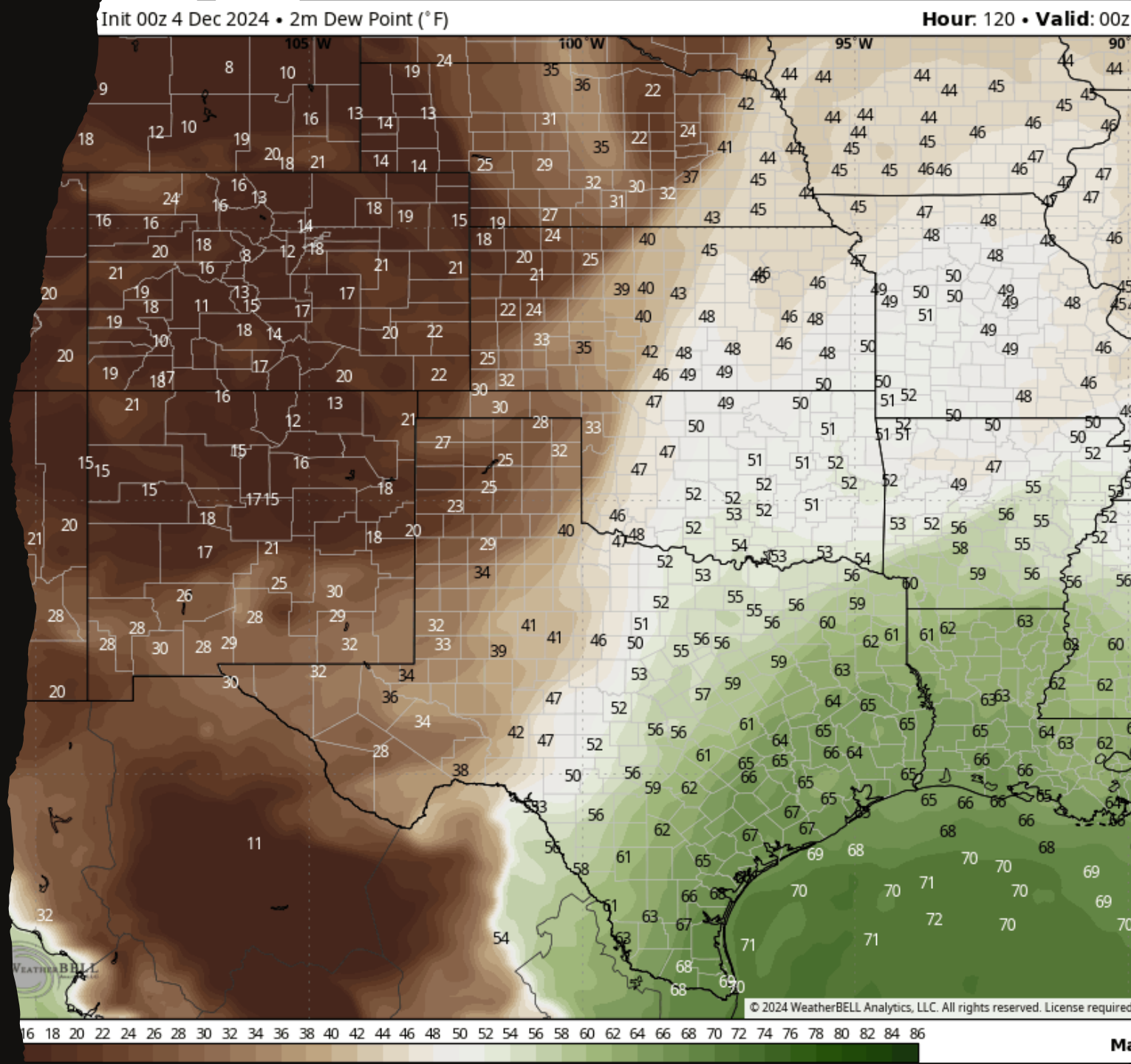
Other factors:

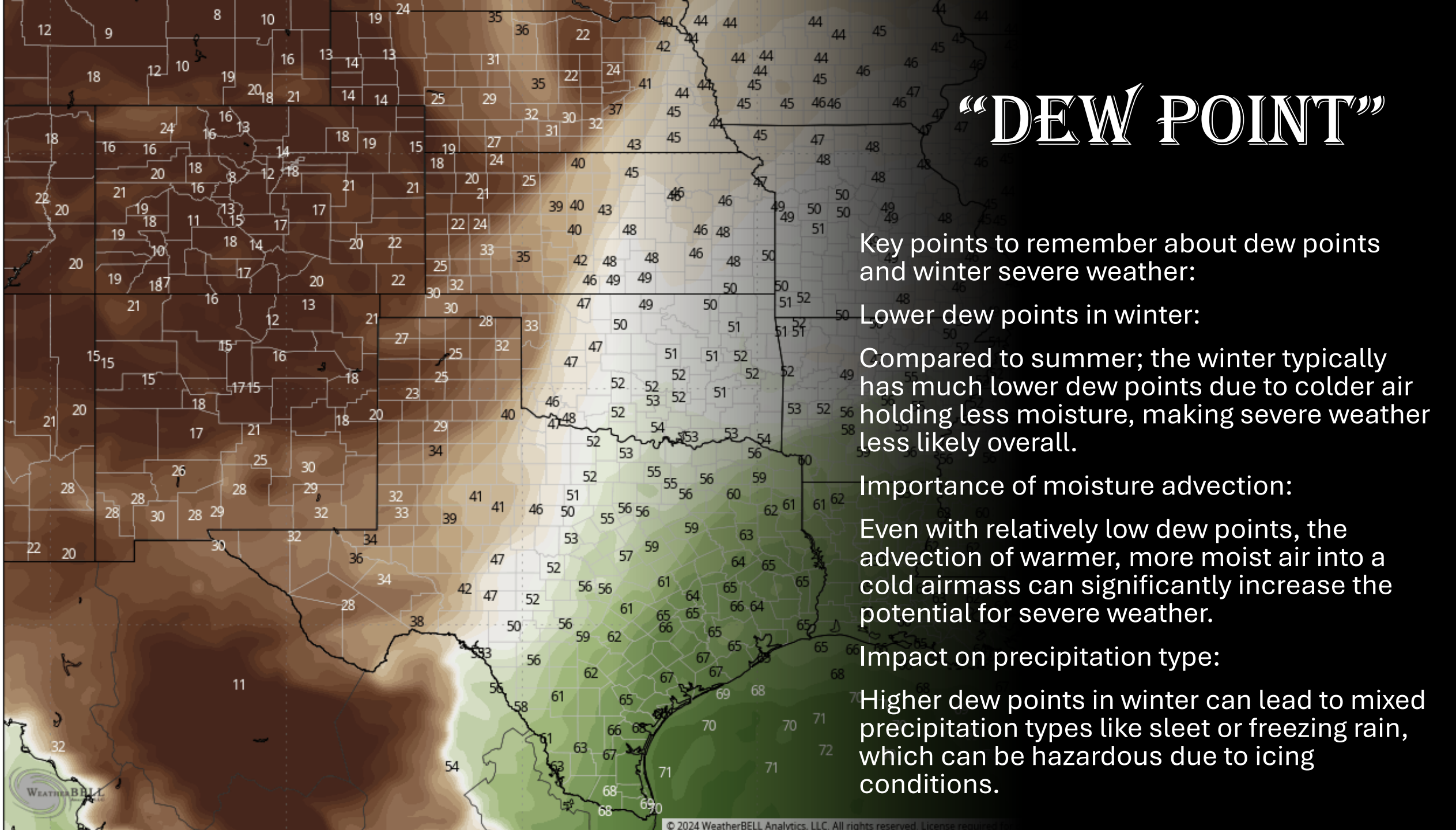
While the K-index is a valuable tool, other atmospheric parameters like CAPE (Convective Available Potential Energy), wind shear, and the lifted index are also crucial for assessing the full potential for severe weather.



"DEW POINT"

- The dew point is the temperature the air needs to be cooled to (at constant pressure) to achieve a relative humidity (RH) of 100%. At this point, the air cannot hold more water in the form of gas.
- In winter months, a dew point generally considered conducive to severe weather is around 55°F or higher at the surface level, as this indicates a significant amount of moisture in the atmosphere, which is crucial for the development of strong thunderstorms, even in colder conditions; however, the exact threshold can vary depending on the overall atmospheric profile and temperature.




"DEW POINT"
Key points to remember about dew points and winter severe weather:
Lower dew points in winter:
Compared to summer; the winter typically has much lower dew points due to colder air holding less moisture, making severe weather less likely overall.
Importance of moisture advection:
Even with relatively low dew points, the advection of warmer, more moist air into a cold airmass can significantly increase the potential for severe weather.
Impact on precipitation type:
Higher dew points in winter can lead to mixed precipitation types like sleet or freezing rain, which can be hazardous due to icing conditions.
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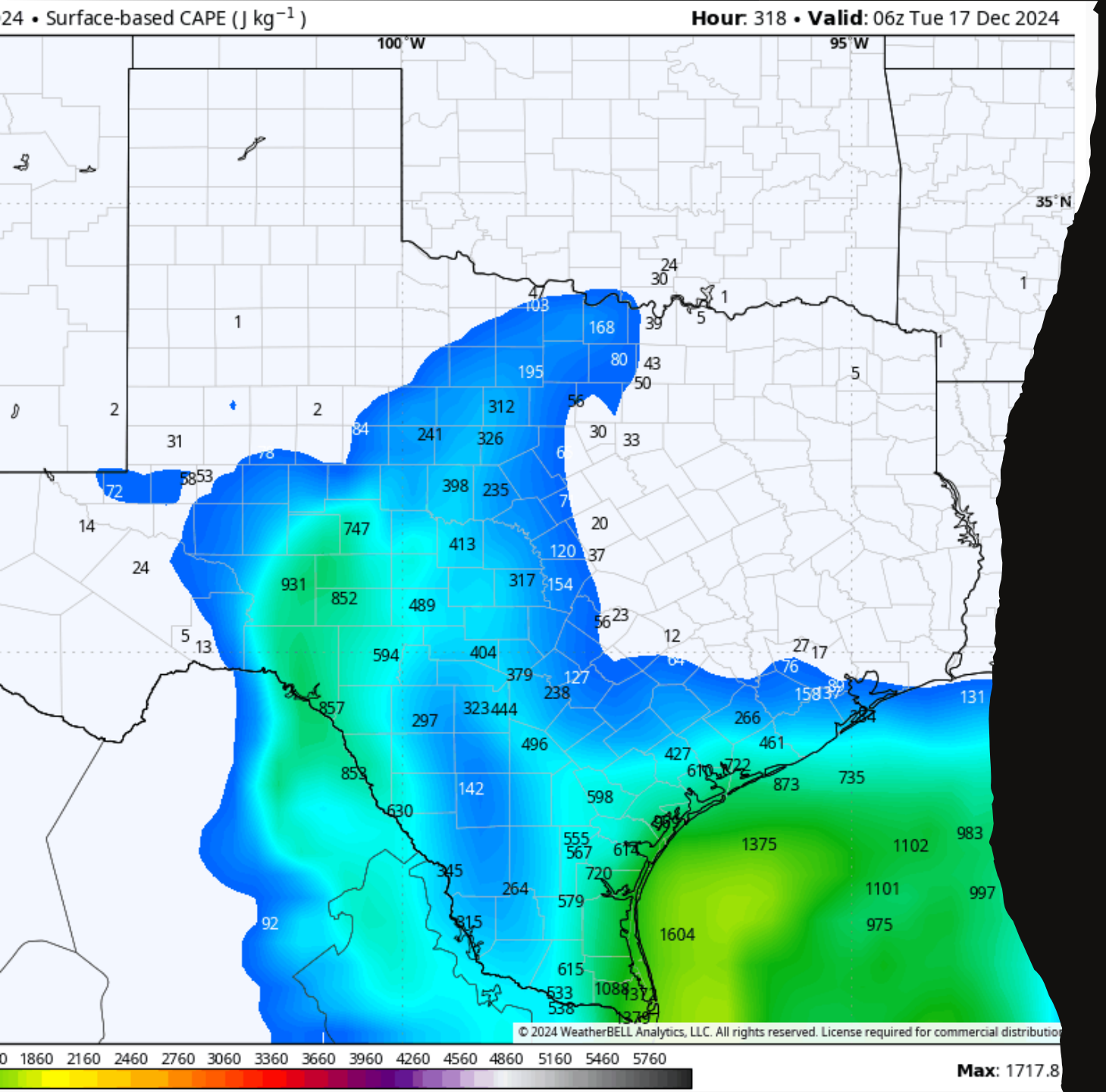


"SURFACE CAPE"

"Surface CAPE" in weather terminology stands for "Surface-Based Convective Available Potential Energy," which is a measure of the instability in the atmosphere specifically calculated using a parcel of air lifted from the ground level, indicating how much potential energy is available for thunderstorms to develop from the surface upward; essentially, it's a way to assess the potential for severe weather based on the instability near the ground.

In the winter months, a CAPE value generally considered indicative of the potential for severe weather is around 1000 J/kg or higher; however, this can vary depending on location and specific atmospheric conditions, with higher values (like 3000-4000 J/kg) signifying a significantly increased risk of extreme storms

"SURFACE CAPE"

Key points about Surface CAPE:

Meaning:

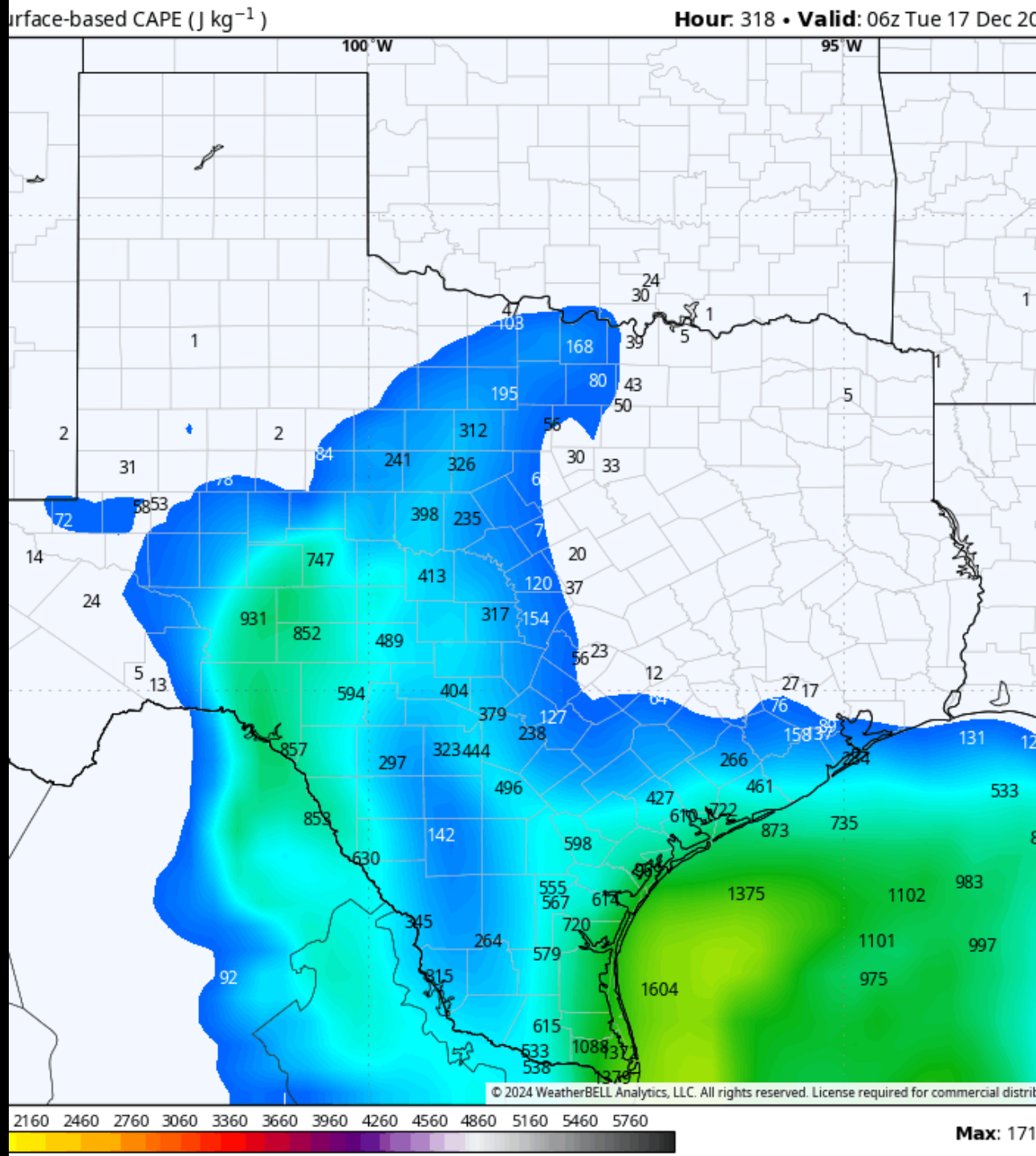
A higher Surface CAPE value signifies greater instability near the ground, which means there is more potential for strong updrafts and severe thunderstorms if other conditions are favorable.

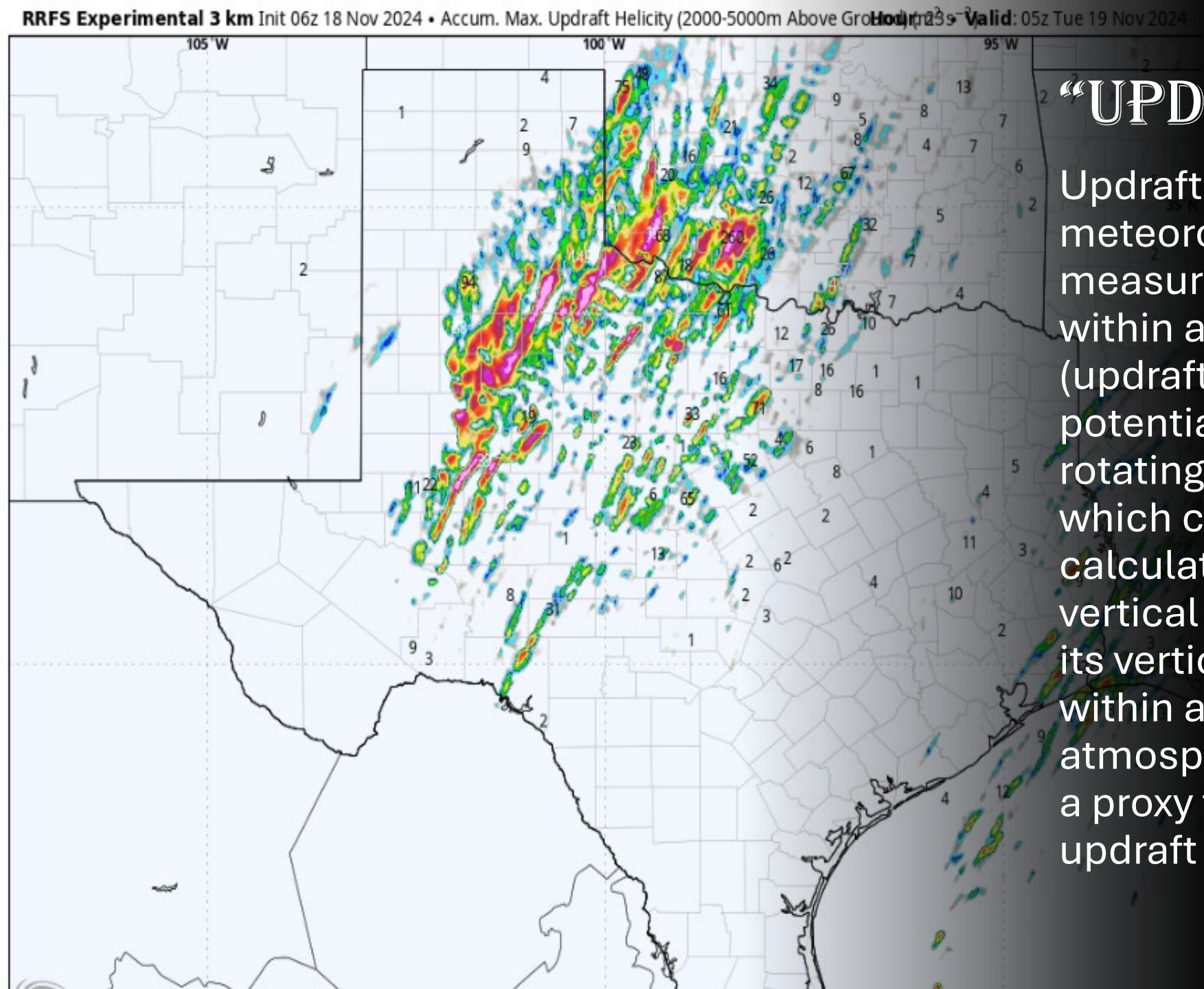
Calculation:

This value is determined by analyzing a theoretical parcel of air lifted from the surface and calculating the area on a weather diagram where the parcel is warmer than the surrounding air as it rises.

Importance for forecasting:

Meteorologists use Surface CAPE to identify areas with high potential for thunderstorms, especially when combined with other weather parameters like wind shear and moisture content.





"UPDRAFT HELICITY"

Updraft helicity is a meteorological term that measures the amount of rotation within a thunderstorm's rising air (updraft), essentially indicating the potential for a storm to develop a rotating structure like a supercell, which can produce tornadoes; it's calculated by combining the vertical velocity of the updraft with its vertical vorticity (rotation) within a specific layer of the atmosphere, essentially acting as a proxy for how "helical" the updraft is.

"UPDRAFT HELICITY"

Meaning of "helicity":

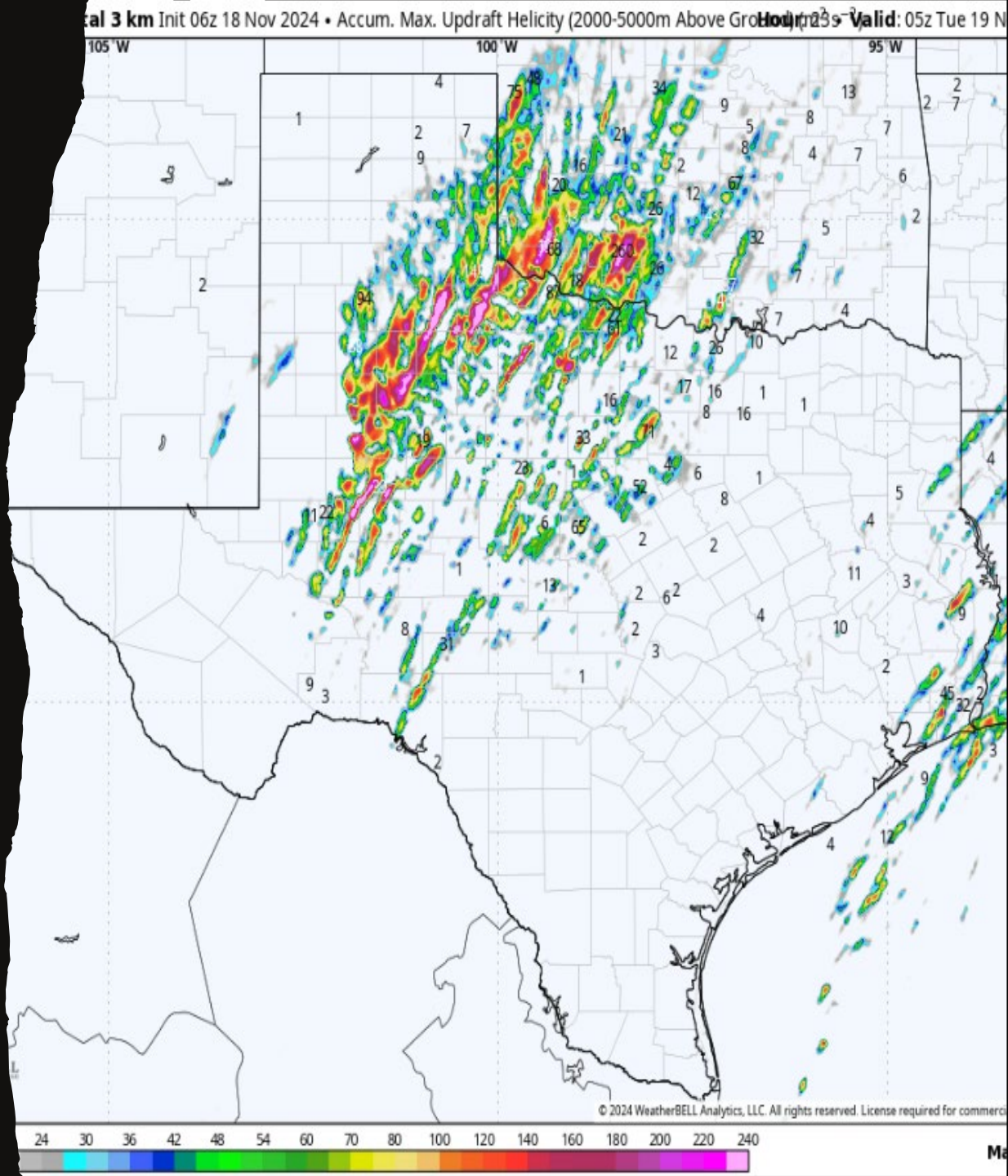
"Helicity" refers to the tendency of a fluid to rotate like a corkscrew, so a high updraft helicity means the rising air in a storm has significant rotation.

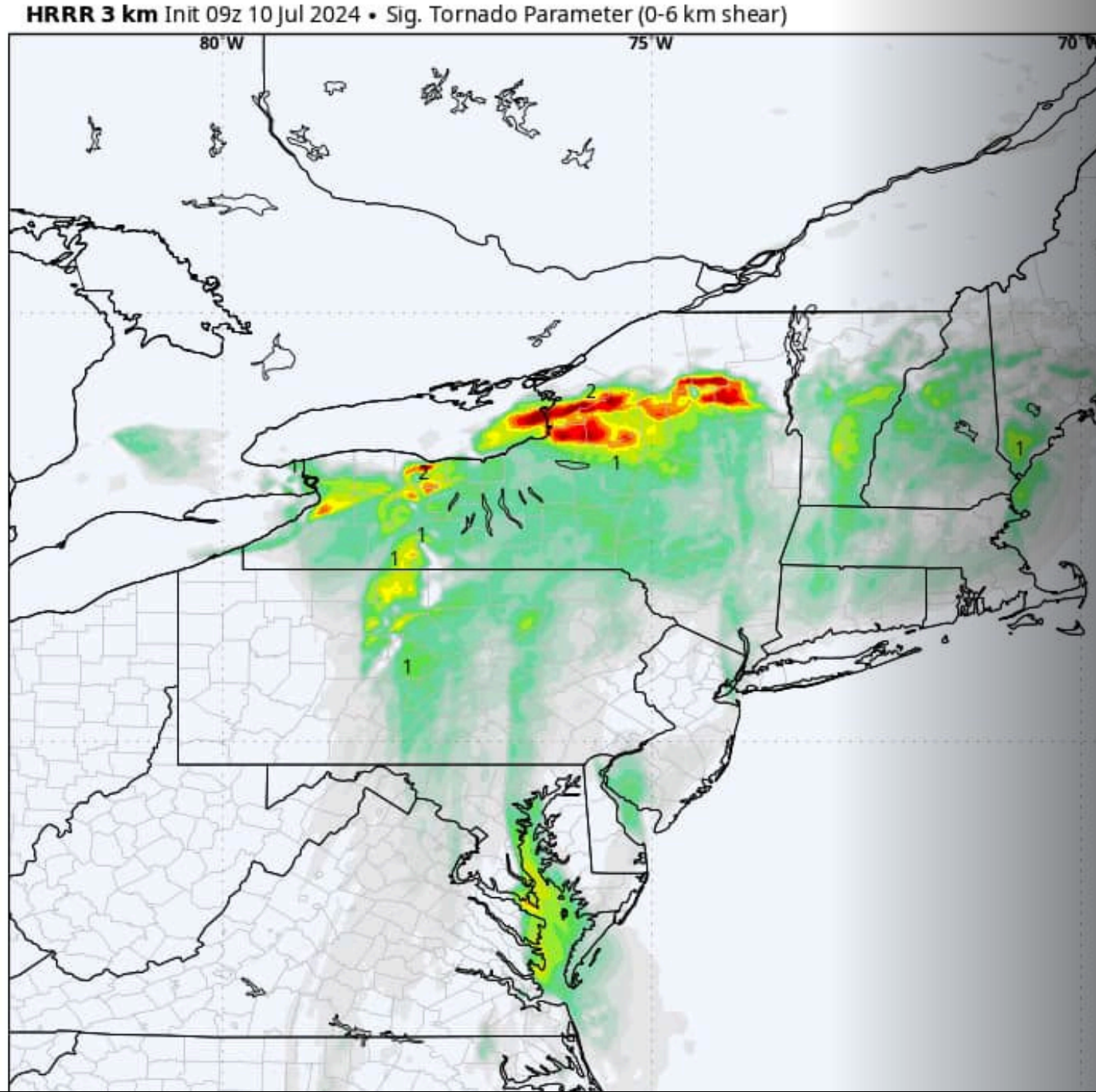
Importance for forecasting:

Meteorologists use updraft helicity to assess the potential for severe weather, particularly tornadoes, as a storm with high updraft helicity is more likely to develop a rotating structure.

Calculation:

Updraft helicity is calculated by integrating the product of vertical velocity and vertical vorticity within a specified layer of the atmosphere, usually focused on the mid-levels where supercells tend to rotate.





"Significant Tornado Parameter (STP)"

The Significant Tornado Parameter (STP) is a multi-parameter index that helps identify the conditions that favor the formation of right-moving supercells that can produce tornadoes

"Significant Tornado Parameter (STP)"

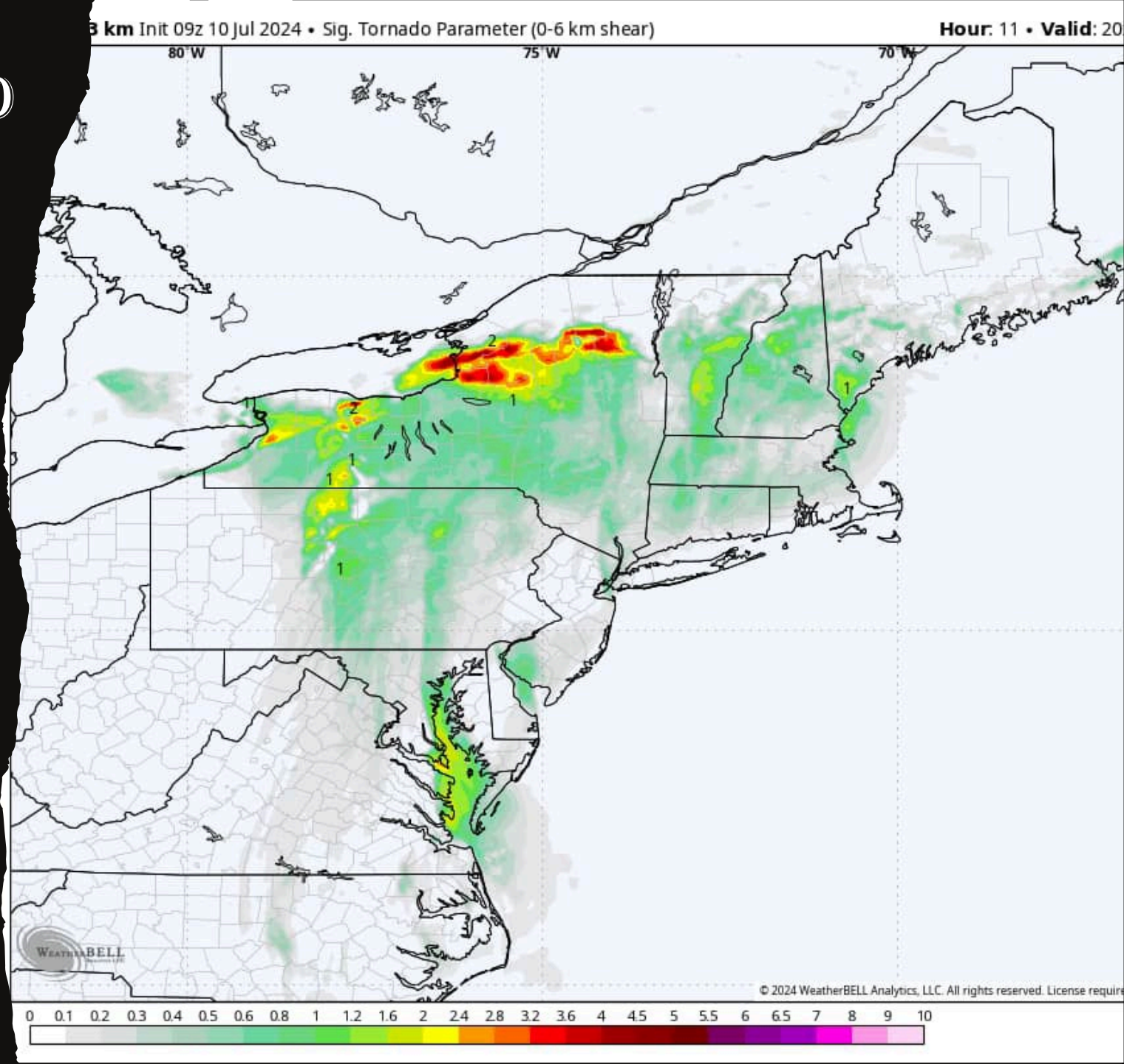
What it includes:
The STP includes effective bulk shear, effective SRH, 100-mb mean parcel CAPE, 100-mb mean parcel CIN, and 100-mb mean parcel LCL height

What it indicates:
A value of 1 or greater in the STP is associated with most significant tornadoes (F2 or greater damage)

How it's used:
The STP is a conditional probability that uses physical and mathematical calculations to indicate where strong tornadoes are more likely

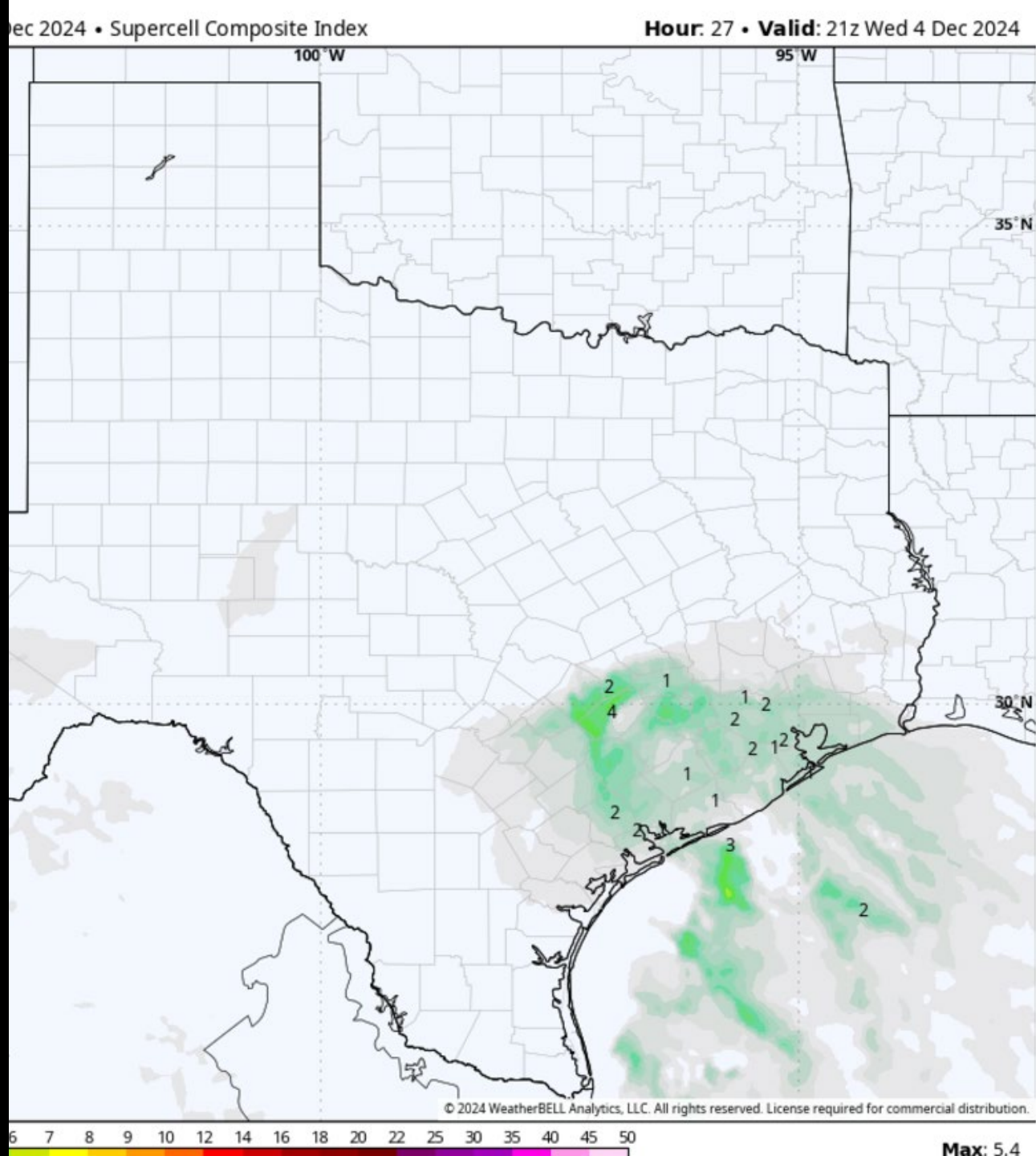
How it's refined:
The STP is still being refined as knowledge of tornadoes improves.

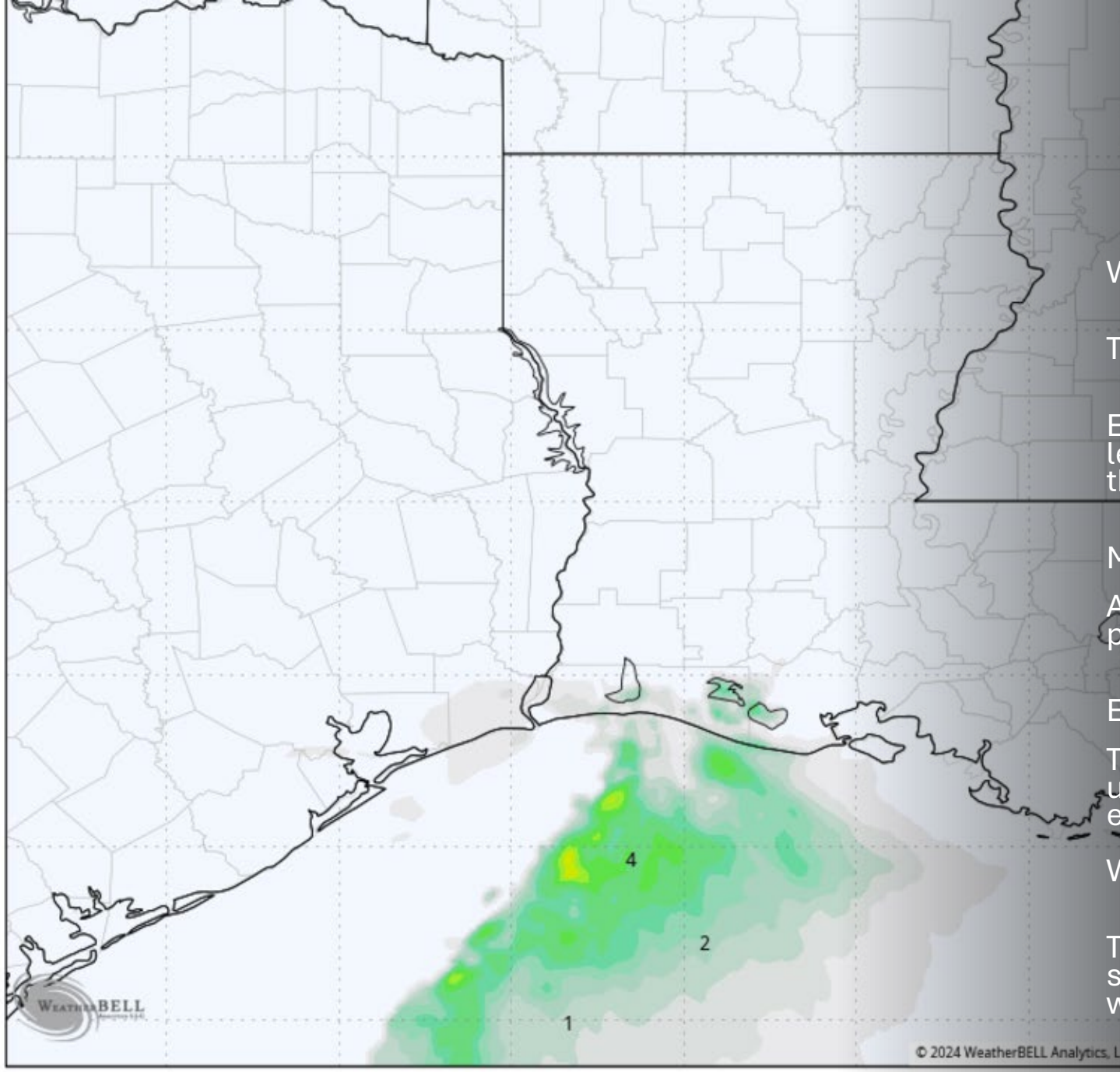
The STPC, or Significant Tornado Parameter (with CIN), is another related index that highlights the coexistence of ingredients that favor right-moving supercells. The STPC Stats graph can help identify significant environmental parameters and anticipate significant tornadoes.



"Supercell Composite Parameter (SCP)"

The Supercell Composite Parameter (SCP) is a multi-parameter index that helps identify environments where supercell thunderstorms are likely to develop.





"SUPERCELL COMPOSITE PARAMETER (SCP)"

What it's made of:

The SCP is a combination of three parameters:

Effective storm-relative helicity (ESRH): A measure of low-level wind shear relative to the movement of a thunderstorm.

Most unstable parcel CAPE (muCAPE):

A calculation of CAPE resulting from the most unstable air parcel in the lowest 300mb of the atmosphere.

Effective bulk wind difference (EBWD):

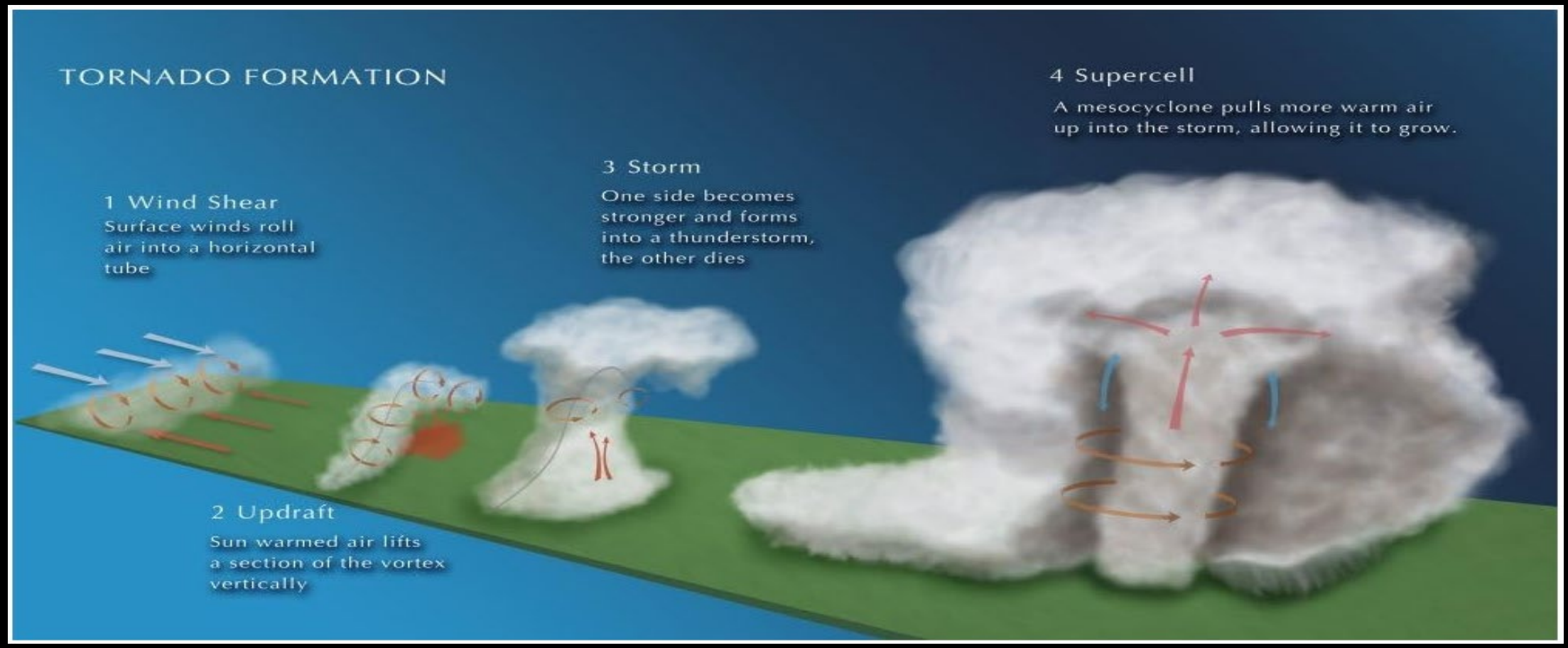
The value of the wind shear from the level of the most unstable air parcel up to a height equal to 40-60% of the equilibrium level

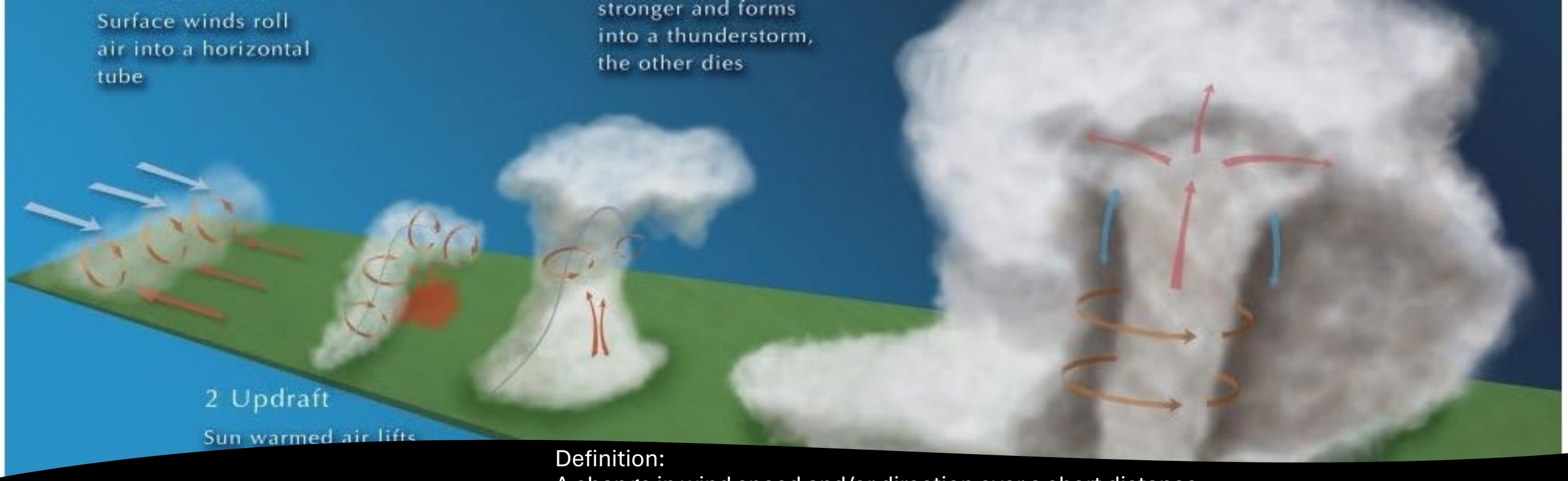
What it shows:

The SCP highlights the co-existence of ingredients that favor supercell thunderstorms. It can be used to show areas where supercell thunderstorms could exist.

“Wind Shear”

Wind shear in weather refers to a rapid change in wind speed and/or direction over a short distance, either vertically (with height) or horizontally, essentially meaning the wind is blowing at different speeds or directions within a close proximity to each other; it's particularly important for aviation as it can significantly affect an aircraft's flight path if encountered during takeoff or landing.





"Wind Shear"

Definition:
A change in wind speed and/or direction over a short distance.

Vertical vs. Horizontal:Wind shear can occur vertically (with height) or horizontally across a short distance.

Impact on weather:
Can significantly affect the development and structure of thunderstorms, impacting their intensity and potential for severe weather.

Aviation concern:
Considered a major safety concern for aircraft, especially during takeoff and landing due to sudden changes in airspeed and lift.

NEGATIVE TILT

A "negative tilt" in severe weather refers to an upper-level trough in the atmosphere that is tilted from northwest to southeast, which often indicates a developing or intensifying weather system and is considered a key factor in producing severe weather like strong thunderstorms, large hail, and tornadoes, due to the increased wind shear it creates in the atmosphere; essentially, when a trough tilts negatively, it can rapidly pull in moisture and energy, leading to more potent storm development.

Key points about negative tilt in severe weather:

Trough orientation:

A negatively tilted trough slants from northwest to southeast, unlike a positively tilted trough slants from southwest to northeast.

Wind shear:

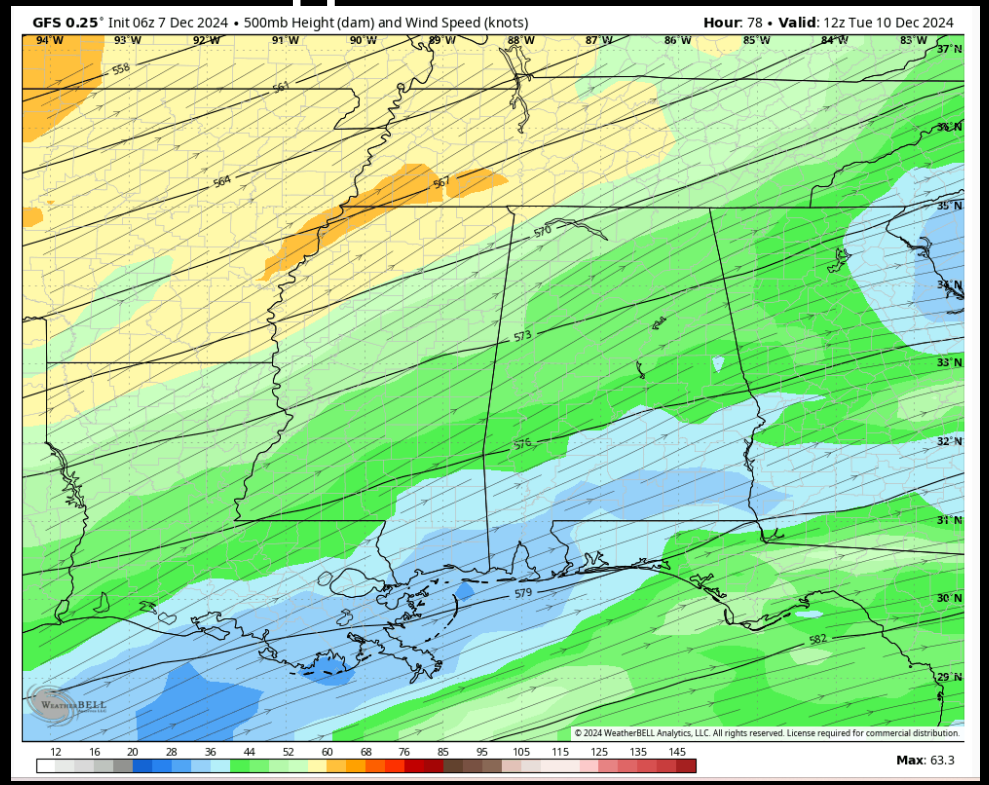
This tilt creates significant vertical wind shear, crucial for rotating thunderstorms and tornado formation.

Severe weather potential:

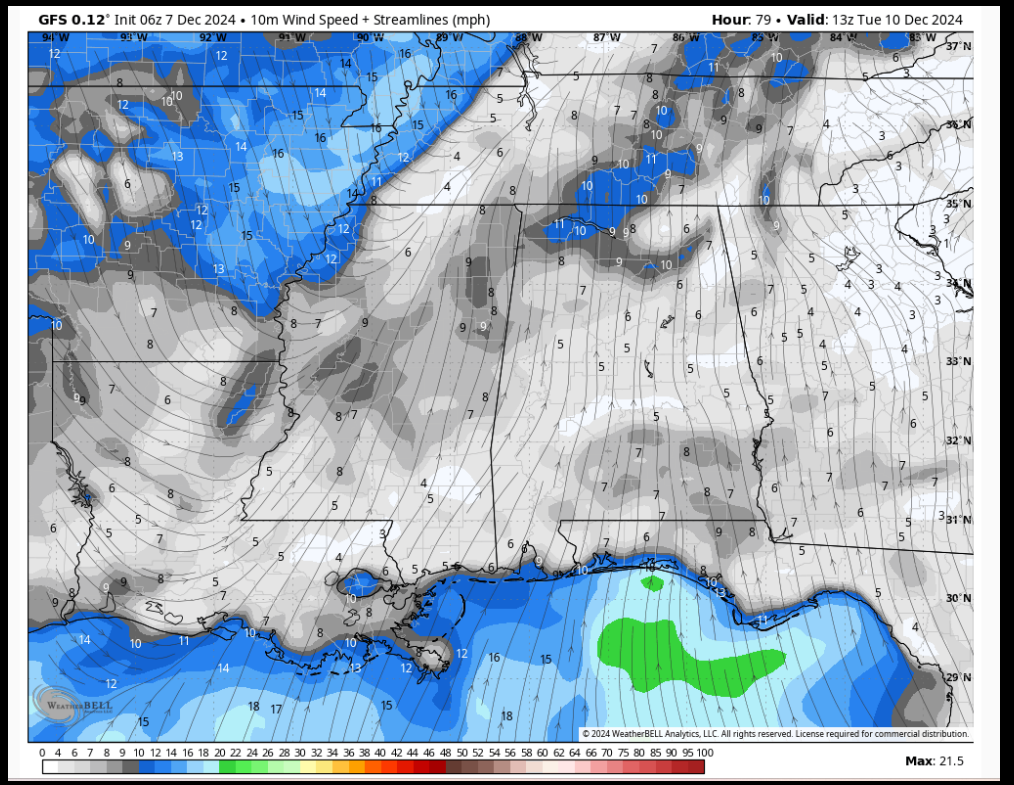
When a negatively tilted trough moves over a region with sufficient moisture and instability, it can trigger severe thunderstorms with strong winds, large hail, and tornadoes.

NEGATIVE TILT

Upper-Level winds



Lower-Level winds



Example scenario:
Developing storm system: A strong upper-level trough approaches a region with warm, moist air near the surface. As the trough moves eastward, it becomes negatively tilted, causing a significant change in wind direction with height, creating favorable conditions for severe thunderstorm development.

POSITIVE TILT

A "positive tilt" in severe weather conditions refers to a weather pattern where an upper-level trough in the atmosphere is tilted from northeast to southwest (in the Northern Hemisphere), which can lead to prolonged periods of rain or snow, particularly along a stationary frontal boundary, often resulting in flooding concerns, especially when this pattern persists for a long time; this is considered a positive tilt because the low pressure area is positioned to the northeast, pushing moisture towards the southwest.

Key points about a positive tilt in severe weather:

Impact on precipitation:

A positive tilt can bring extended periods of precipitation, like heavy rain or snow, due to the stationary front acting as a conveyor belt for moisture.

Flooding potential:

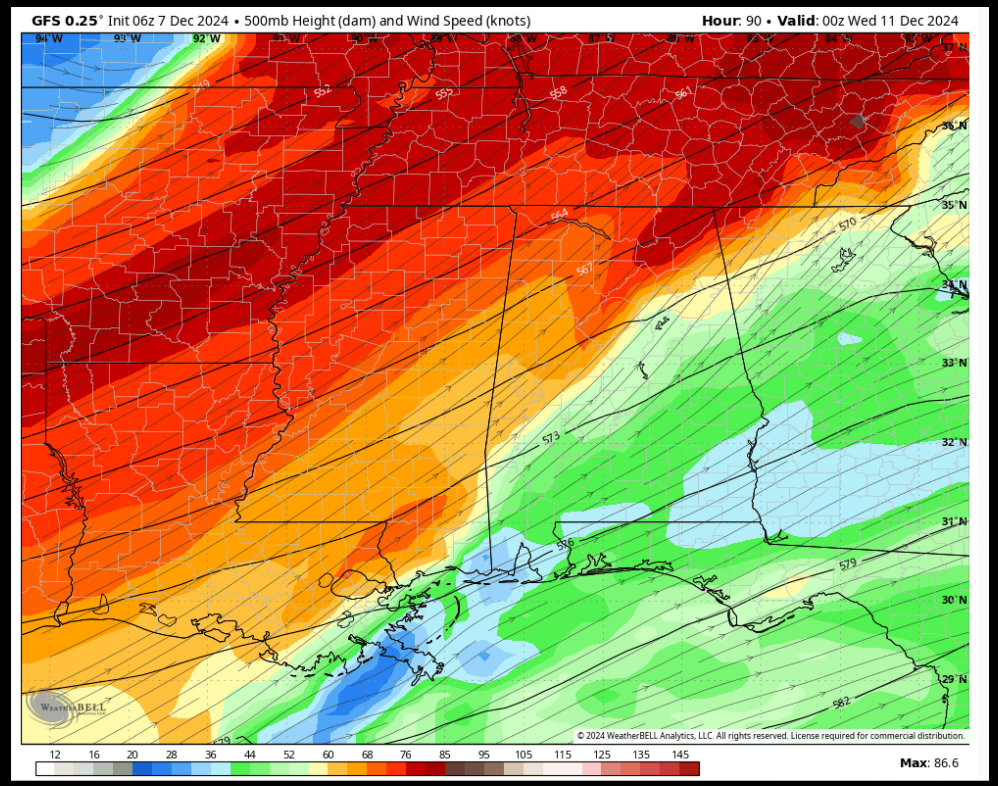
Because of the prolonged precipitation, areas along the frontal boundary are particularly vulnerable to flooding.

Ice storms in winter:

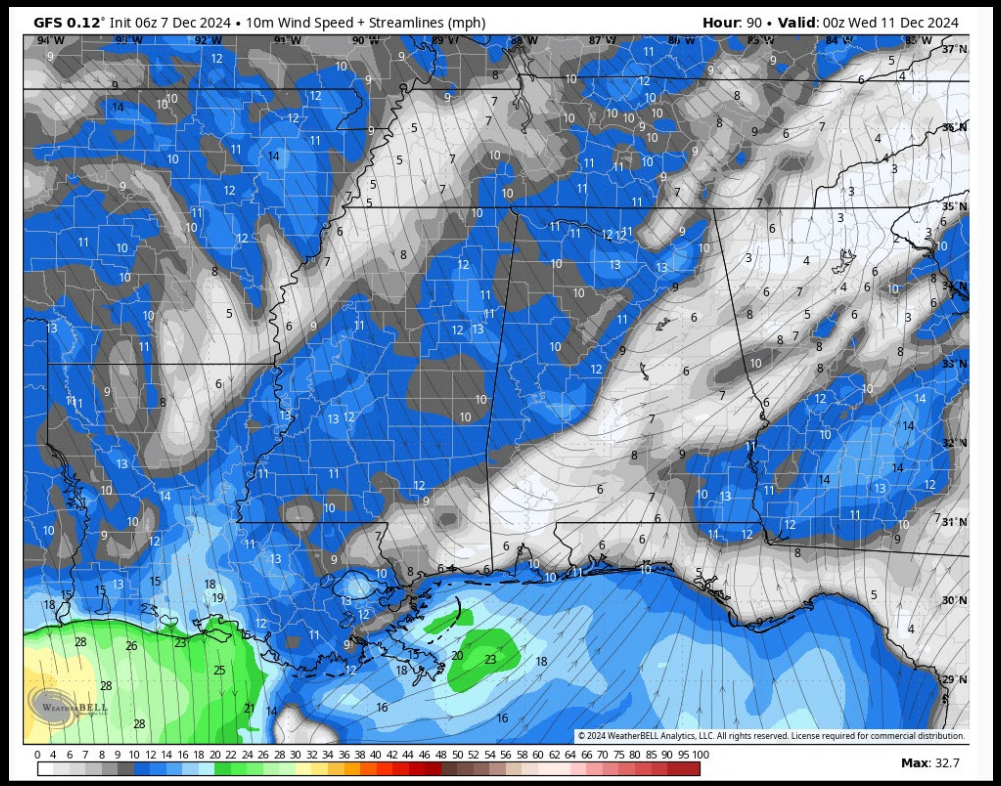
During colder months, a positive tilt can facilitate the formation of ice storms as moisture freezes on contact with surfaces.

POSITIVE TILE

Upper-Level Winds



Lower-Level winds



This is when the winds in the upper and lower levels move in the same direction.

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