New Mexico State Science Olympiad Workshop
November 1 2019

Description and Guidelines for Meteorology (B Division)

Kenneth Minschwaner
Department of Physics, New Mexico Tech

METEOROLOGY

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Teams will display their understanding of meteorological principles associated with **severe weather** through an analysis & interpretation of meteorological data, graphs, charts, & images.
   A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes
2. **EVENT PARAMETERS**:
   a. Each team may bring two **stand-alone non-programmable, non-graphing** calculators and **two** 8.5" x 11" sheets of paper, **which may be** in individual sheet protectors **sealed by tape** or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed.
   b. Teams will not be required to bring any additional supplies or materials for any hands-on task, demonstration or lab exercise.

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GENERAL RULES

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GENERAL RULES, CODE OF ETHICS, AND SPIRIT OF THE PROBLEM

The goal of competition is to give one's best effort while displaying honesty, integrity, and good sportsmanship. Everyone is expected to display courtesy and respect - see Science Olympiad Pledges. Teams are expected to make an honest effort to follow the rules and the spirit of the problem (not interpret the rules so they have an unfair advantage). Failure by a participant, coach, or guest to abide by these codes, accepted safety procedures, or rules below, may result in an assessment of penalty points or, in rare cases, disqualification by the tournament director from the event, the tournament, or future tournaments.

1. Actions and items (e.g., tools, notes, resources, supplies, electronics) are permitted, unless they are explicitly excluded in the rules, are unsafe, or violate the spirit of the problem.
2. While competing in an event, participants may not leave without the Event Supervisor's approval and must not receive any external assistance. All electronic devices capable of external communication as well as calculator applications on multipurpose devices (e.g., laptop, phone, tablet) are not permitted unless expressly permitted in the event rule or by an Event Supervisor. Cell phones, if not permitted, must be turned off. At the discretion of the Event Supervisor, participants may be required to place their cell phones in a designated location.
3. Participants, coaches, and other adults are responsible for ensuring that any applicable school or Science Olympiad policy, law, or regulation is not broken. All Science Olympiad content such as policies, requirements, rules clarifications/changes, and FAQs on www.soinc.org must be treated as if it were included in the printed rules.
4. All pre-built devices presented for judging must be constructed, impounded, and operated by one or more of the 15 current team members unless stated otherwise in the rules. If a device has been removed from the event area, appeals related to that device will not be considered.
5. Officials are encouraged to apply the least restrictive penalty for rules infractions - see examples in the Scoring Guidelines. Event Supervisors must provide prompt notification of any penalty, disqualification, or tier ranking.
6. State and regional tournament directors must notify teams of any site-dependent rule or other rule modification with as much notice as possible, ideally at least 30 days prior to the tournament.

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You may be running the same event for both Middle School (Division B) and High School (Division C) if the event is in both divisions. If this is the case, the rules for Division B and Division C are usually very similar. You might use the SAME event for both division, but make slight adjustments so that the event is appropriate for each level. In some cases, though the rules for the two divisions may be quite different. Please read the rules very carefully for each event that you will be supervising.

CATEGORIES, FORMATS, AND SCHEDULING

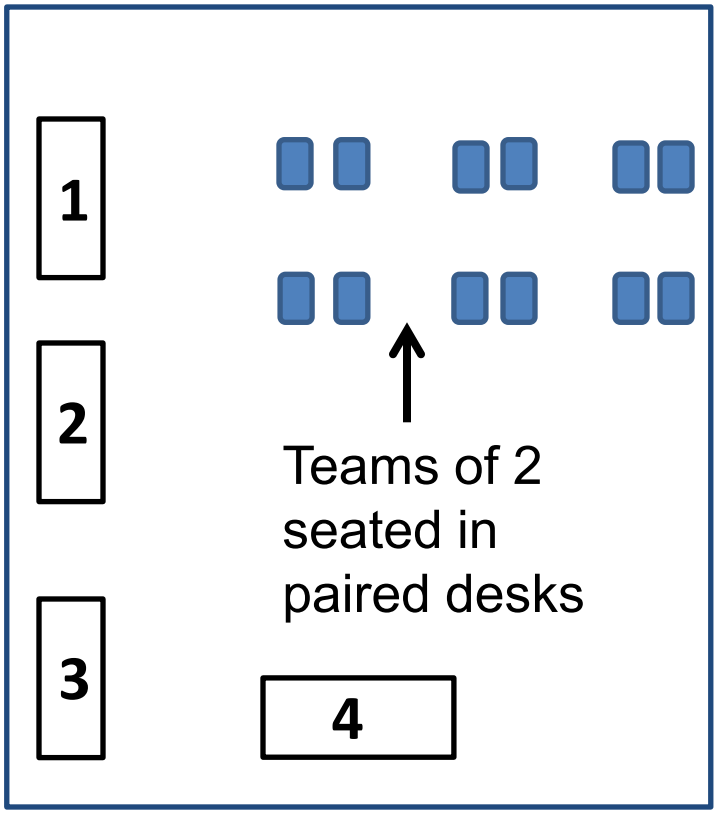
Science Olympiad events fall into three categories:

Construction events require devices are made before the competition and require special testing equipment, etc. (Helicopters, Mission Possible, Mousetrap Vehicle) Most construction events have their devices impounded the morning of the competition.

Content-based and/or hands-on lab-type events can be run as stations or individual test type events. (Road Scholar, Forestry, Chemistry Lab)

Onsite events where students build, test, or do something that is not prepared beforehand but is tested on site and may require special test equipment, usually less complex than the devices built ahead of time. (Battery Buggy, Write It Do It)

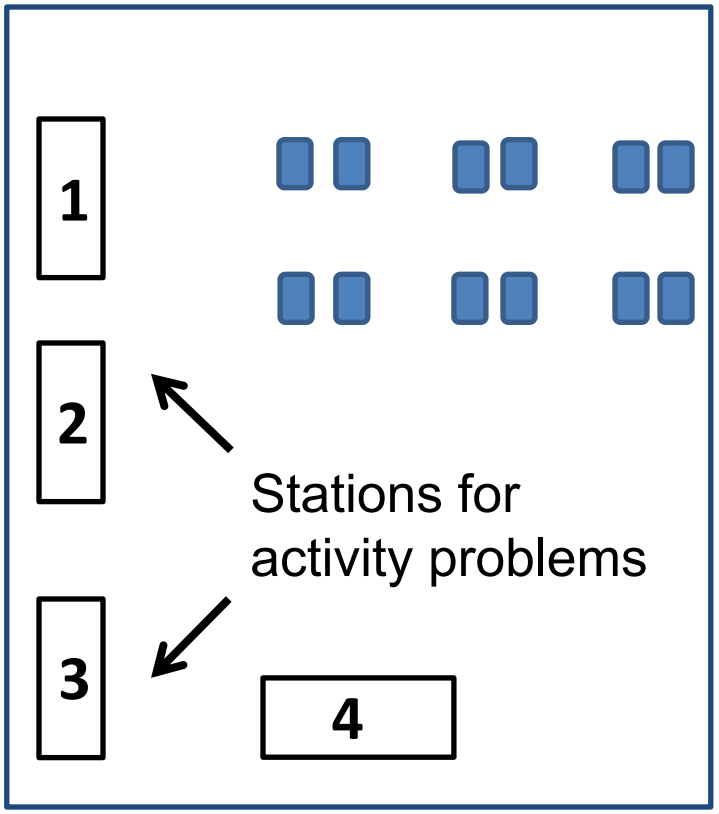
Typical Format



Two 50-minute sessions, beginning on the hour.

Weir Hall 202 (**subject to change in 2020**)

Typical Format



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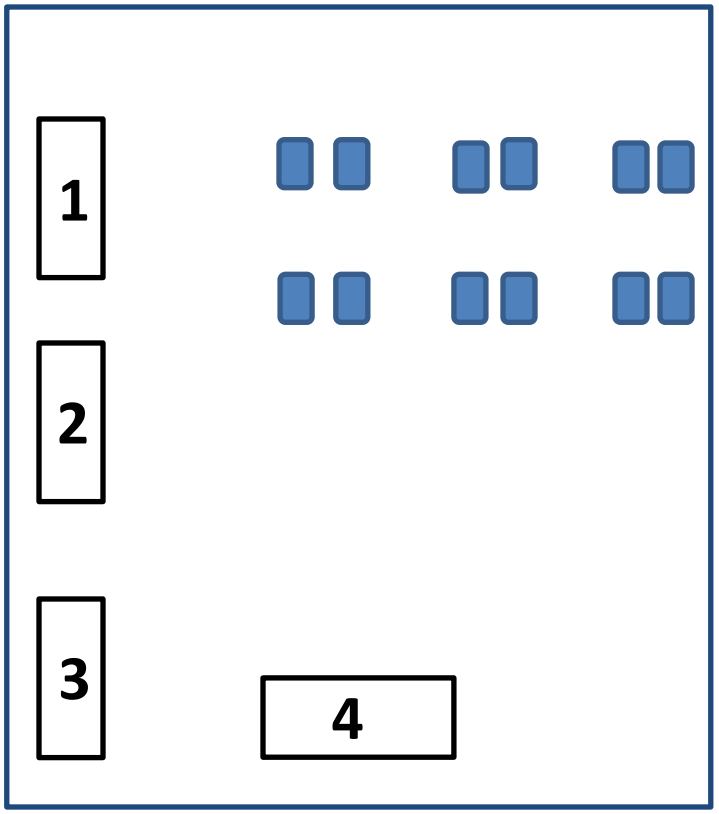

Weir Hall 202 (**subject to change in 2020**)

Typically about 10 written exercises, usually with multiple parts each. Teams work on these exercises from their seats.

Up to 4 activity problems where teams complete hands-on exercises or read large charts.

This is a lot of content!

3. **THE COMPETITION:**

The questions will address the following **Severe Weather and Storms topics:**

a. Environmental conditions leading to severe weather including large-scale circulation patterns, jet streams, atmospheric waves, atmospheric stability, and boundaries (i.e.; fronts & drylines).
b. Thunderstorms (such as air mass, multicell & supercell), life cycles, characteristics & structure
c. Identification & interpretation of cloud types and characteristics associated with severe weather events
d. Precipitation from severe storms: snow, hail, freezing rain/drizzle & rain and impacts of heavy precipitation, such as debris flow, mudslide, flash, river & urban flooding
e. Squall lines & mesoscale convective complexes
f. Straight line winds, katabatic winds, downdrafts, downbursts, gust fronts, micro & macrobursts, derechos & dust storms
g. Electrification of clouds, all types of lightning strikes and lightning direction finders/systems
h. Tornadoes & Waterspouts: life cycles, climatology, characteristics, structure, Fujita & E-Fujita Scales
i. Severe winter storms & characteristics: blizzards, nor'easters, lake effect snowstorms & freezing rain
j. Hurricanes, Typhoons and Cyclones: life cycles, climatology, characteristics, structure, origin/ distribution, Saffir-Simpson Scale & storm surge
k. Hazards from all of the above (a. – j.)
l. Observation technologies, including high-resolution surface-based station networks (e.g., mesonets), buoys, aircraft, satellite (particularly water vapor, visible & IR) imagery, Doppler radar & radiosondes
m. Data and information used to forecast & monitor severe events: surface & upper air (850, 700, 500, & 300 mb) maps, computer model predictions & Doppler radar images, including interpretation of severe features (e.g., such as bow echo, tornadic vortex signature (TVS), hook echo, debris ball)
n. Weather safety: NOAA warnings/watches, dependable weather information sources for preparedness & during severe weather (e.g., hail, flooding, winds, storm surges, avalanches, tornado outbreak)
o. Severe Weather Special Topics, Events and Cases: Hurricanes - Florence, Harvey, Irma, Maria, Michael & any major hurricanes in 2019, U.S. Blizzards of 2019 & 2020, Midwest & Other Floods of 2019, Tornado Outbreaks of 2018 & 2019.

4. **SAMPLE QUESTIONS/TASKS:**

a. Use surface and upper air maps to determine the most likely location of a severe weather.
b. Analyze storm damage, Doppler radar and satellite images relating to severe storms
c. Demonstrate knowledge of the life cycle of different severe storms and be able to associate those conditions with radar, station model data & fronts on weather maps
d. Relate specific hazardous conditions to different types of severe storms and interpret their significance (e.g., hurricanes, storm surges and straight-line damage from derechos vs. tornadic damage patterns)
e. Interpret the three-dimensional structure of severe storms using Doppler radar & satellite images

5. **SCORING**: High score wins. Points will be awarded for the quality of responses, the quality of supporting reasoning, and use of scientific technique. Pre-identified questions will be used as tiebreakers.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries the Meteorology CD, the Bio/Earth Science CD, and the *Audubon Weather* meteorology field guide; other resources are on the event page at soinc.org.

This event is sponsored by National Oceanic and Atmospheric Administration (NOAA)

- There are 15 topical areas and 12-14 questions, so not all topics will be covered in the test.

- For preparation, I suggest starting with the ones that the students might already know about, such as these 8 topics

c. Identification & interpretation of cloud types and characteristics associated with severe weather events
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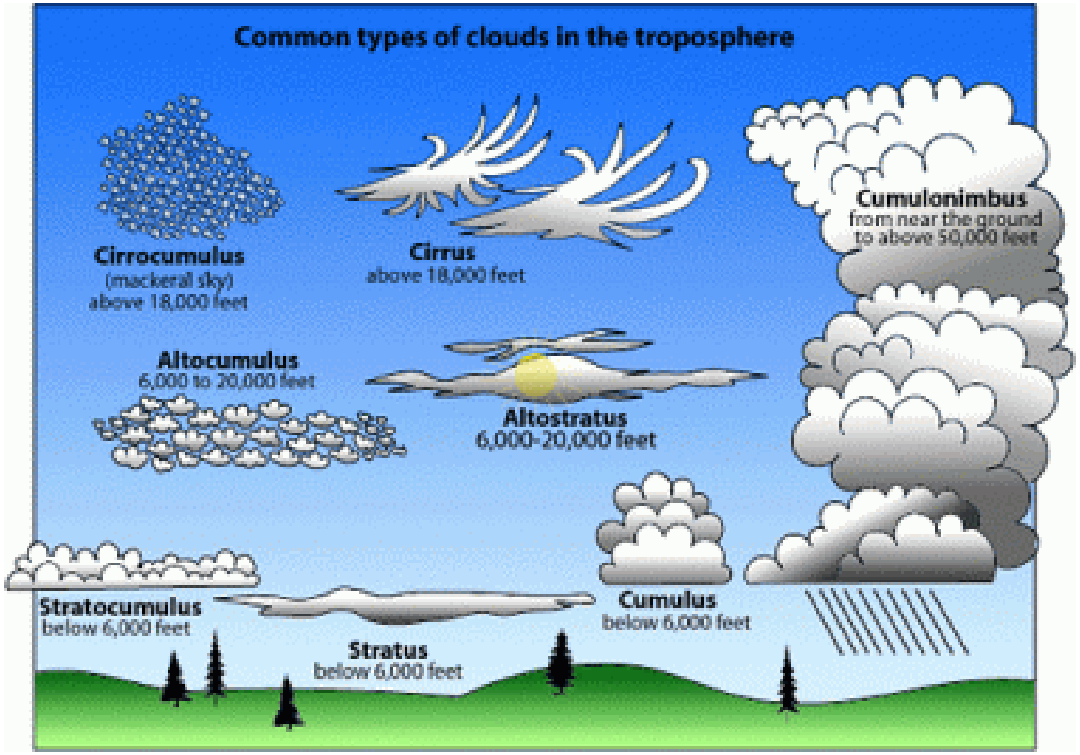

From the University Corporation for Atmospheric Research, Center for Science Education

https://scied.ucar.edu/resources

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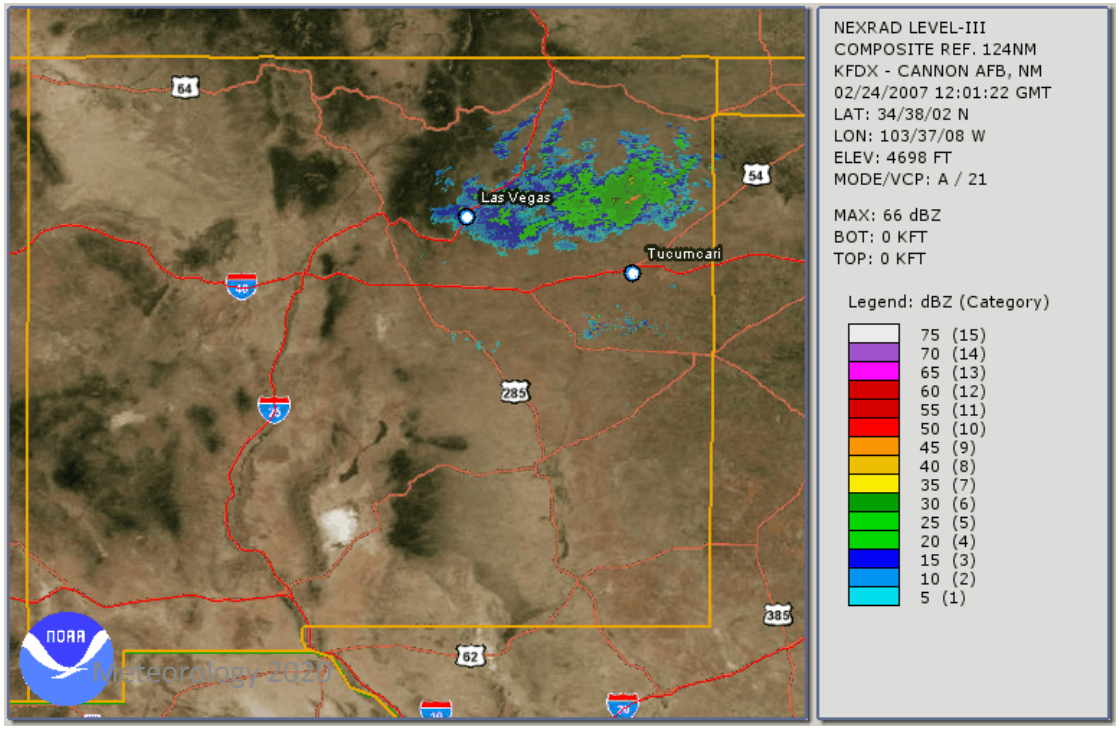
4. The computer projector shows a radar loop from February 24, 2007, starting at 5 AM local time and ending at 7 AM. The weather over New Mexico was being influenced by the passage of a low pressure trough.

(a) Which city had the higher total accumulation of precipitation over this time period, Las Vegas or Tucumcari? (2 points credit)

(b) At 6 AM, Las Vegas report a surface temperature of 28°F, while Tucumcari reported a surface temperature of 37°F. State whether you would expect snow or rain at each location. (4 points credit)

(c) Based on the direction of motion of the radar echoes, was the low pressure trough located to the east or to the west of New Mexico that morning? (2 points credit)



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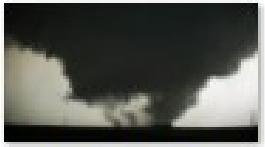
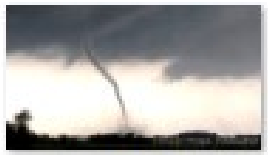
funnelcloud1.jpg


funnelcloud2.jpg

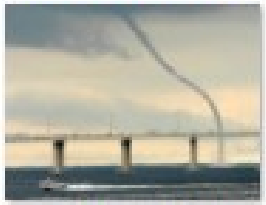

multivortex1.jpg


multivortex2.jpg

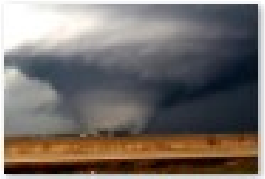

rope1.jpg


rope2.jpg


waterspout1.jpg


waterspout2.jpg


wedge1.jpg


wedge2.jpg

We've also asked questions matching images of structure damage to the Fujita scale

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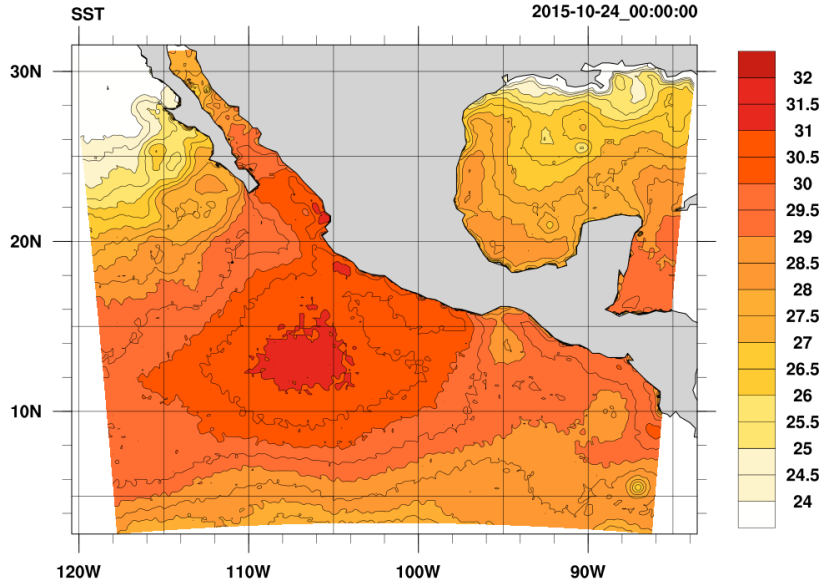
Students may be asked to plot the track of a hurricane using a pencil and ruler. They may be given information about the conditions and asked to estimate the storm category, or look at ocean temperatures to make a prediction of the intensity.

Date, Time	Latitude (°N)	Longitude (°W)
Oct 20, 12AM	13.5	93.0
Oct 20, 12PM	13.0	94.0
Oct 21, 12AM	13.0	95.0
Oct 21, 12PM	13.0	97.5
Oct 22, 12AM	13.5	100.0
Oct 22, 12PM	14.5	103.0
Oct 23, 12AM	15.5	105.0
Oct 23, 12PM	17.0	105.5
Oct 24, 12AM	19.5	105.0
Oct 24, 12PM	22.5	103.0



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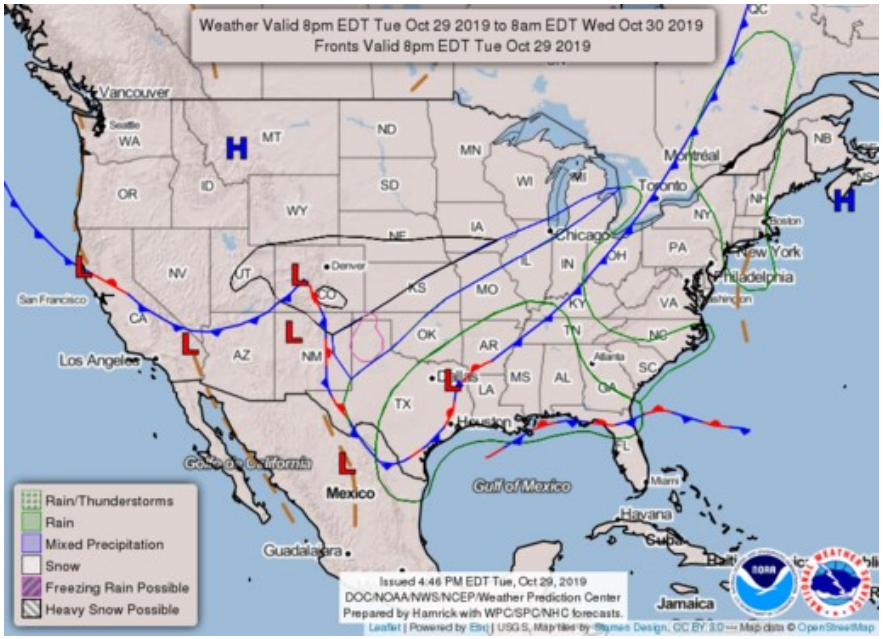
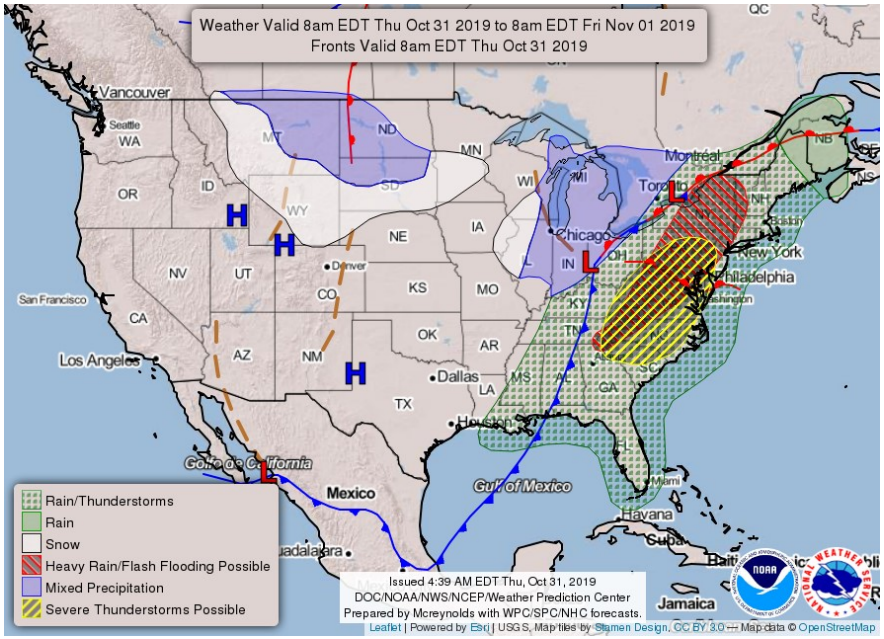
- Many of the other topics can be covered by keeping an eye on the weather in New Mexico and relating it to the larger national picture from surface maps, satellite data, and forecasts.

Wednesday's high-wind event and Thursday's cold





500 mb Heights (dm) / Isotachs (knots)