Overcome your Atmos-fears about Coaching Weather!

NC Science Olympiad Coaches Clinic

Meteorology (B)/Weather Permitting (A)

Friday, October 4, 2019

Breaking the Ice

Q: What must you do first if you want to play cards in a snowstorm?

A: First, you must shovel the deck!

lifewithdogs

Q: What type of frozen precipitation?

https://www.weather.gov/ilm/Feb2014WinterStorm

Agenda - 2 hr session

Introductions **(10 min)**

2020 Meteorology Event Structure and Rules Overview **(10 min)**

2020 Meteorology Severe Weather Topics: Some Basic Concepts **(30 min)**

********** **BREAK (15 min)** **********

Practice!

- Weather of The Day, monitoring events in real time with National Weather Service's weather.gov **(15 min)**
- Tornado demos **(10 min)**

Study resources and how to find more info **(10 min)**

Close **(5 min)**

Note: Most of this presentation benefits both Div A and B coaches and students. Portions of this presentation focus on topics for Div B only.

Look for Div letters in upper right of each slide.

A,B

Introductions

Who am I?

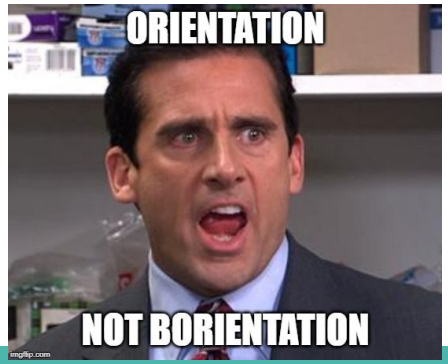
Once an earth science and outdoors nerd…
always an earth science and outdoors nerd

Photo Credit:
M.Hahnenberger

Who are you?

Please please please:

- ask questions
- throw ideas out there
- let's make this session not-a-boring-lecture!



2020 Event Structure and Rules Overview

Preparation BEFORE Competition Day

- Meteorology/Weather = mostly a study event
  - most costly thing for this event is time - start early, study often
- Study and ***KNOW*** the rules!
  - number of students on a team = 1 or 2
  - note sheets

    - most value is in building them as a prompt vs. on competition day itself
    - up to **two** 8.5” x 11” sheets of paper - use both sides
    - no extra “real estate” - e.g., post-its stuck on the 2 pages, or accordion sheets that fold out - that’s not allowed - see examples in this session
    - seal them prior to competing - sheet protectors + tape or laminate
  - calculators - a team may have **two** - *calculators on computers/mobile devices NOT allowed*
    - stand-alone, non-programming, non-graphing - see calc. guide in rules manual

B

2020 Event Structure and Rules Overview

Competition Day!

- possible event format(s) - NC has used both in the past:
  - **sit-down-and-take-a-test**
    - Pro: flexibility - students work through the test mostly however they want
    - Con: flexibility - students work through the test mostly however they want *(and can get stuck)*
  - **rotating stations**
    - Pro: students are usually made to visit more topics, less chance they get stuck in one area of test
    - Con: shuffling can be disorienting and disruptive

- what to bring:
  - writing utensils!!!!
  - calculator(s) - OPTIONAL
  - note sheet(s) - OPTIONAL
- Remember the rules!
  - Make sure:
    - note sheets comply
    - calculators comply
- Turn phones off or to silent when event starts

2020 Meteorology Event Topics: Basic Concepts

Condensed overview of selected (not all) topics from 2020 rules follows.

- Many graphics and materials are borrowed from the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS, which is part of NOAA).
- NOAA has great stuff, especially *JetStream* - https://www.weather.gov/jetstream.
  - Everything on JetStream is awesome!
  - Some topics might be overwhelming at first, but

(AND WE HAVE RESOURCES TO HELP YOU AND YOUR STUDENTS).

Not explicitly in the rules, but always important!

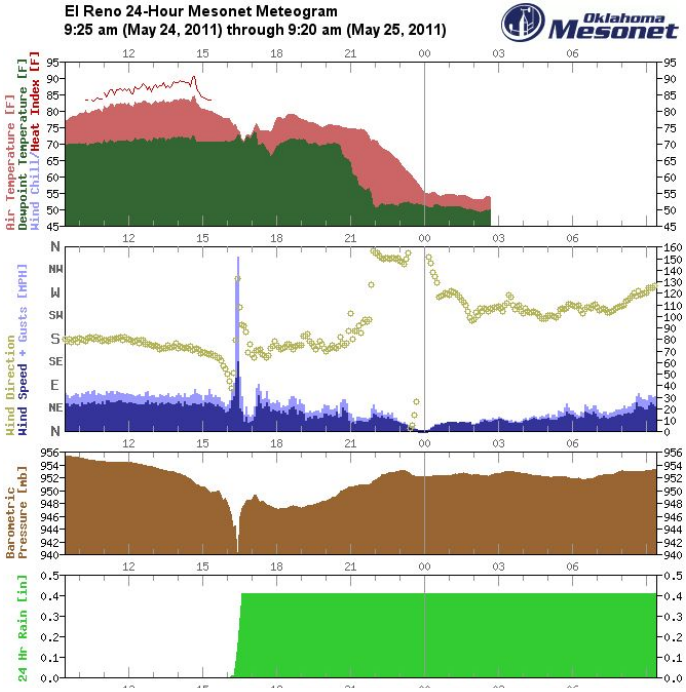
Practice basic geography!

- U.S. states and territories
- local geography - names of counties (or boroughs or parishes) in your state
- What the terrain is like across the world, and especially in the United States
  - Example: where are mountains and oceans, which can influence weather?
  - Simple and free ways to explore:
    - maps.google.com, turn on “Satellite” or “Terrain” background - or https://earth.google.com/web/
    - The National Map - https://viewer.nationalmap.gov/advanced-viewer/
    - USGS TopoView - https://ngmdb.usgs.gov/topoview/viewer/#4/39.98/-99.98
      - to more easily view topography layer, (A) go to Settings, turn off all four options, then (B) click “Terrain” in upper left hand corner

A,B

Not explicitly in the rules, but always important!

Practice reading and interpreting graphs, maps, charts, and images.



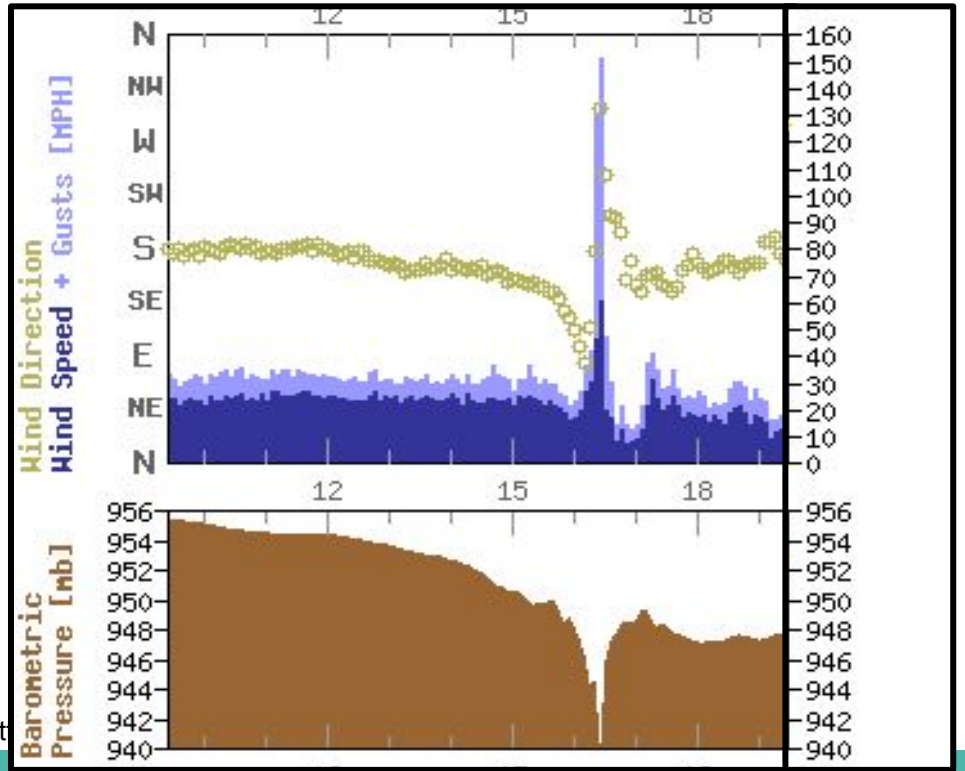
http://ticker.mesonet.org/select.php?mo=05&da=25&yr=2011

- Example is from the OK Mesonet (topic 3.l.).
- Oklahoma Climatological Survey Mesonet Ticker - ticker.mesonet.org
  - sign up for ~daily weather event summaries, notifications (& often bad puns!) - ticker.mesonet.org/ticksig_html.php
  - scientific (yet digestible) summaries of weather events!

A,B

Not explicitly in the rules, but always important!

Practice reading and interpreting graphs, maps, charts, and images.

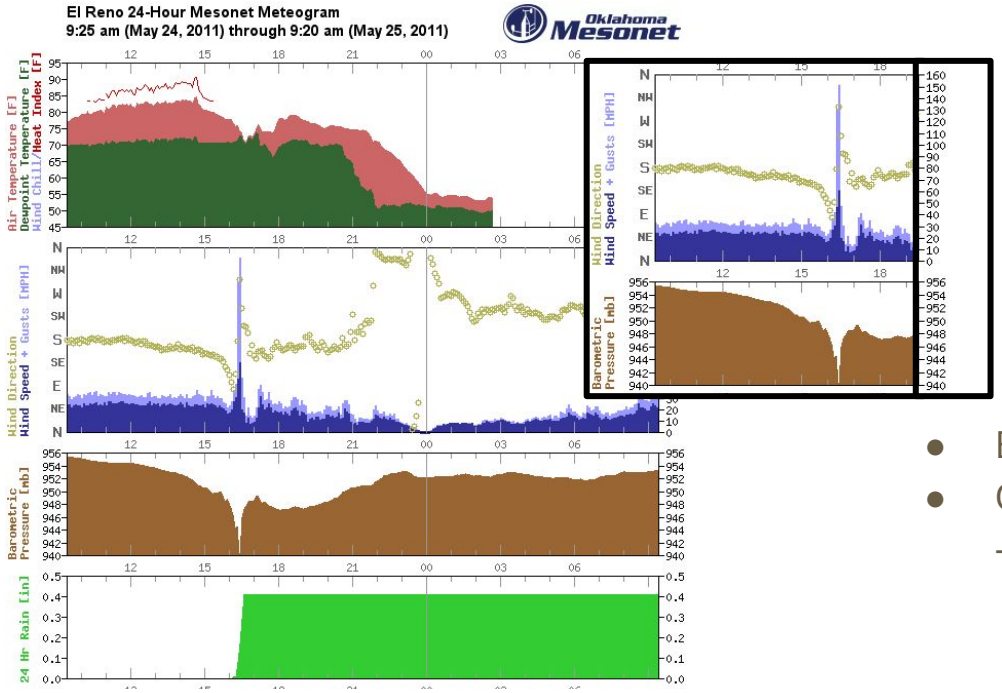


Example is from the OK Mesonet (topic 3.l.). Oklahoma Climatological Survey Mesonet Ticker - ticker.mesonet.org

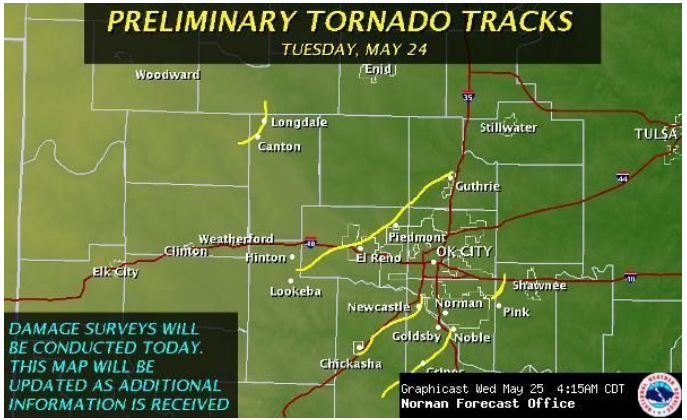
- sign up for ~daily weather event summaries, notifications (& often bad puns!) - ticker.mesonet.org/ticksig_html.php
- scientific (yet digestible) summaries of weather events!

Not explicitly in the rules, but always important!

Practice reading and interpreting graphs, maps, charts, and images.



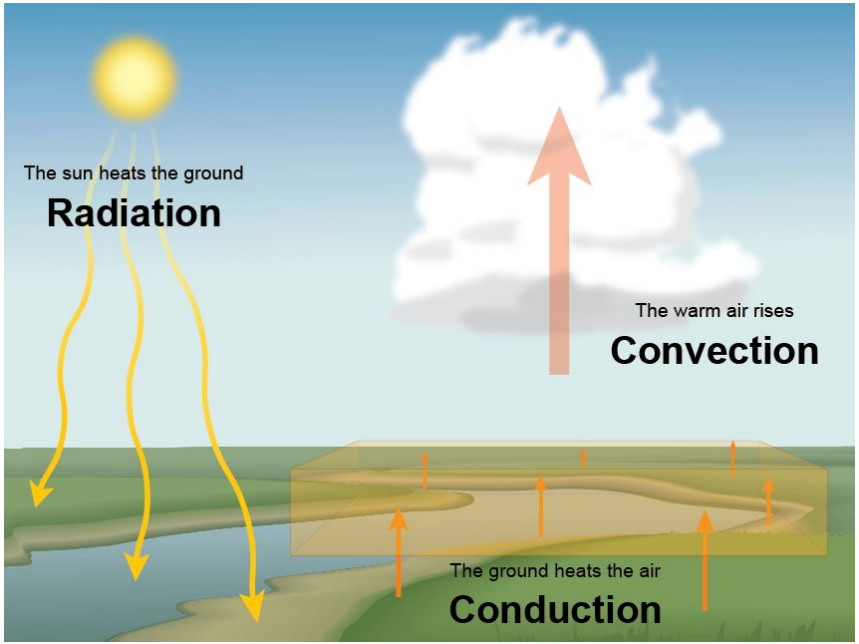
http://ticker.mesonet.org/select.php?mo=05&da=25&yr=2011

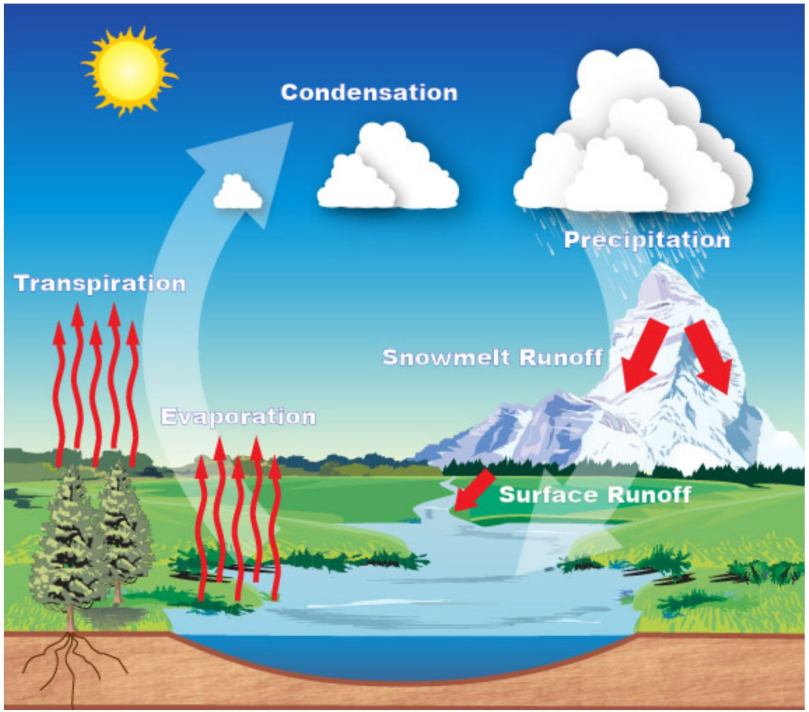


- Example is from the OK Mesonet (topic 3.l.).
- Oklahoma Climatological Survey Mesonet Ticker - ticker.mesonet.org
  - sign up for ~daily weather event summaries, notifications (& often bad puns!) - ticker.mesonet.org/ticksig_html.php
  - scientific (yet digestible) summaries of weather events!

3.a. Environmental conditions for Severe Weather

Severe weather (and all weather, actually) requires energy exchanges and water!





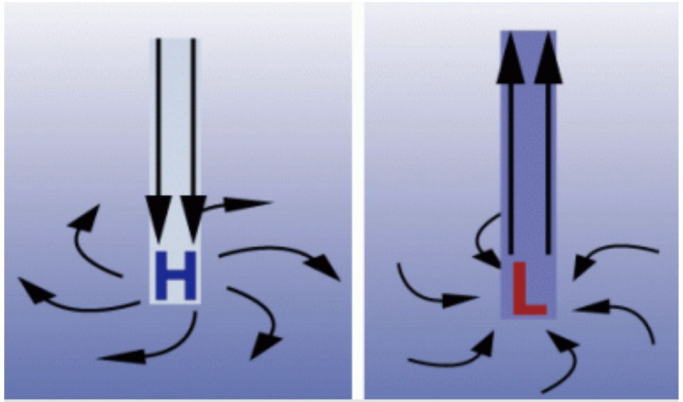
The basic hydrologic (water) cycle

https://www.weather.gov/jetstream/heat, https://www.weather.gov/jetstream/hydro

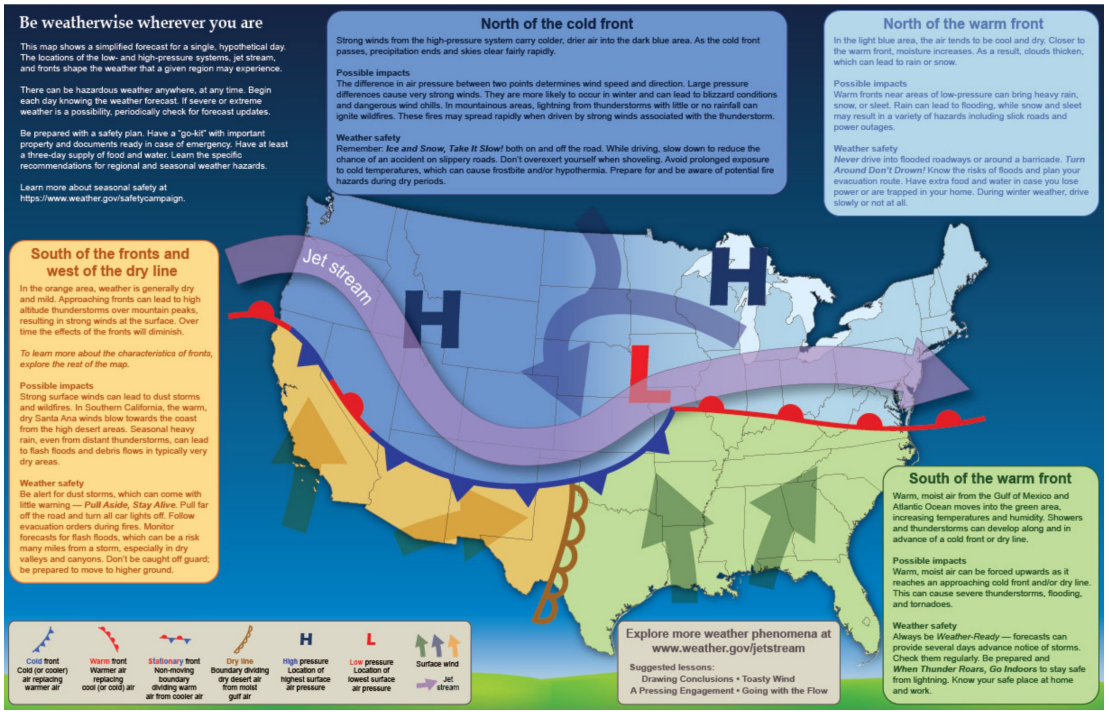
A,B

3.a. Environmental conditions for Severe Weather

High pressure systems, low pressure systems, boundaries, jet stream & more!



Air near the surface flows down and away in a high pressure system (left) and air flows up and together at a low pressure system (right).
Credit: NESTA

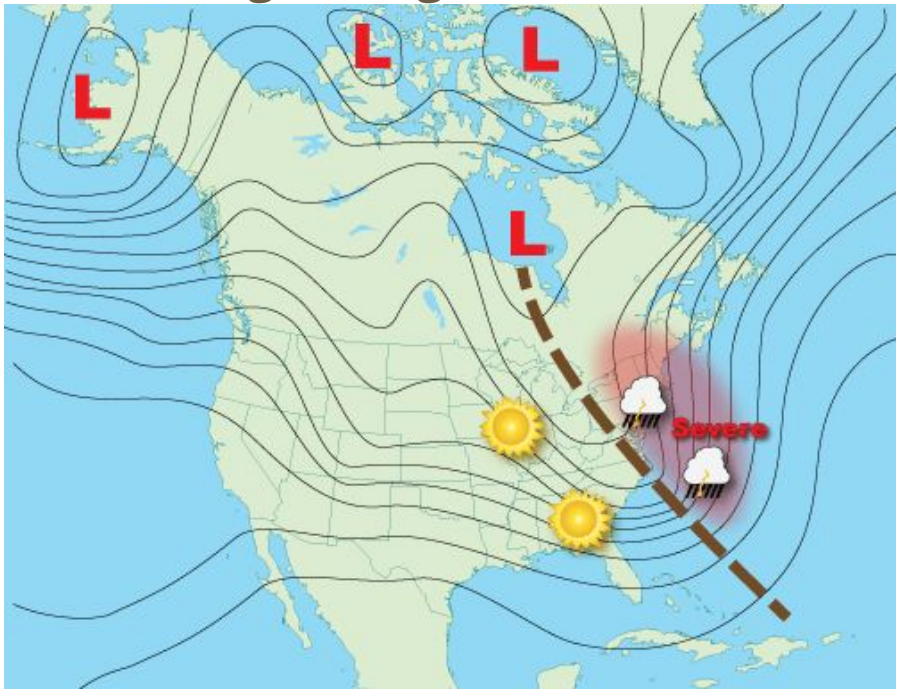


https://scied.ucar.edu/shortcontent/highs-and-lows-air-pressure, https://www.weather.gov/jetstream/NOAAwise

3.a. Environmental conditions for Severe Weather

Large-scale circulation patterns (highs/lows/troughs/ridges) that potentially produce severe weather:

- Negatively-tilted trough
  - large change in wind direction from the surface into the upper atmosphere (called wind shear) which aids in the formation of supercell thunderstorms
  - strong southerly surface wind with its warm air underneath the incoming cold air in the upper atmosphere creating unstable conditions

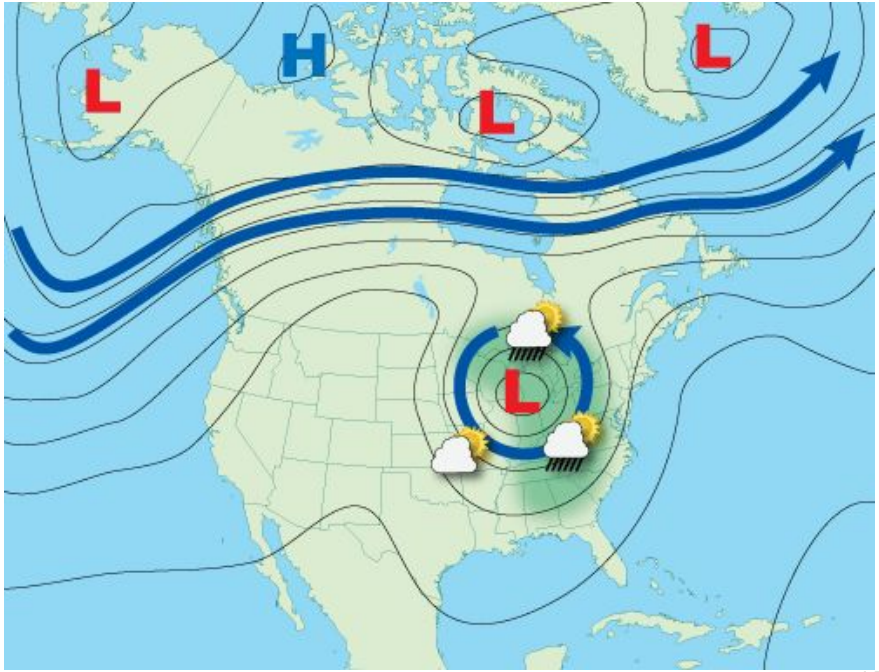


https://www.weather.gov/jetstream/basic

3.a. Environmental conditions for Severe Weather

Large-scale circulation patterns (highs/lows) that potentially produce flooding:

- Cut-off low
  - very slow-moving; drifts slowly/seemingly aimlessly
  - may dump lots of precipitation over the same area

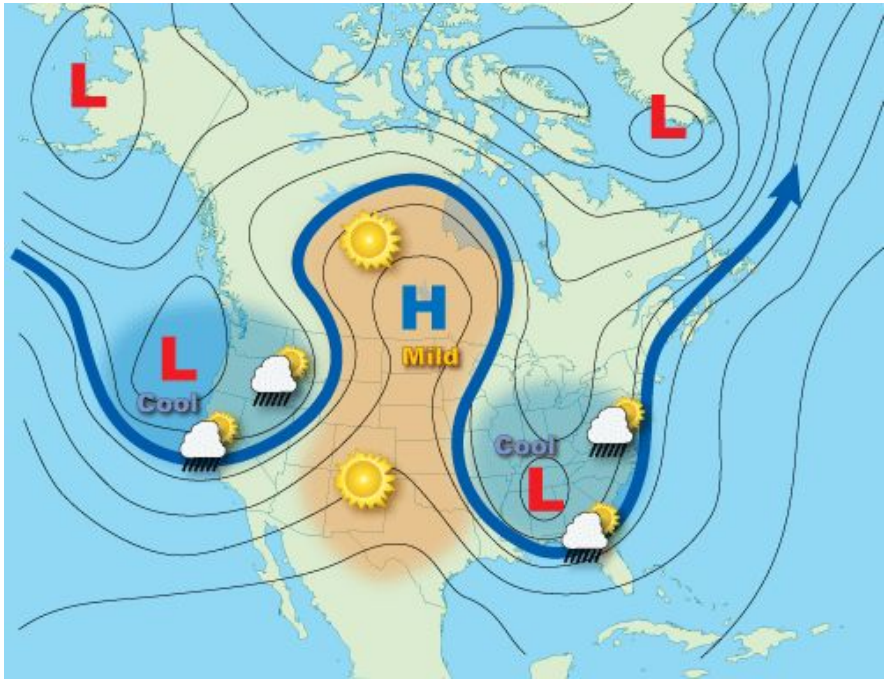


https://www.weather.gov/jetstream/basic

3.a. Environmental conditions for Severe Weather

Large-scale circulation patterns (highs/lows) that potentially produce flooding:

- Omega block
  - very stubborn and persistent atmospheric pattern
  - two cut-off lows, with a high sandwiched in between them

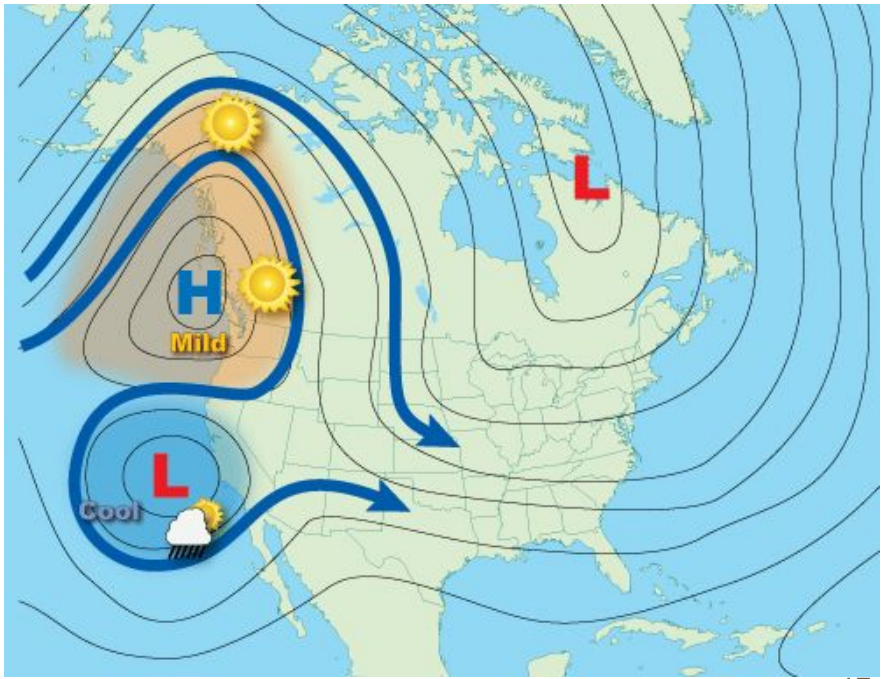


https://www.weather.gov/jetstream/basic

3.a. Environmental conditions for Severe Weather

Large-scale circulation patterns (highs/lows) that potentially produce flooding:

- Rex block
  - very stubborn and persistent atmospheric pattern
  - will remain nearly stationary until one of the height centers changes intensity, unbalancing the high-over-low pattern
  - can lead to flooding in the vicinity of the low



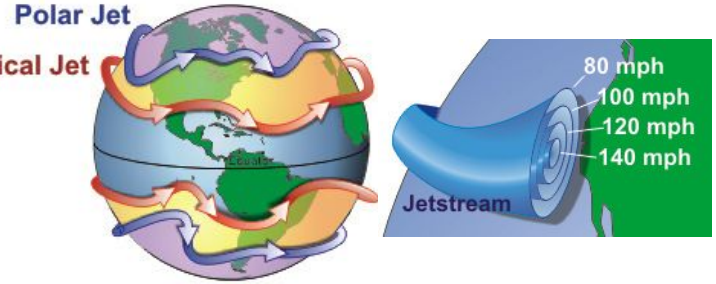
https://www.weather.gov/jetstream/basic

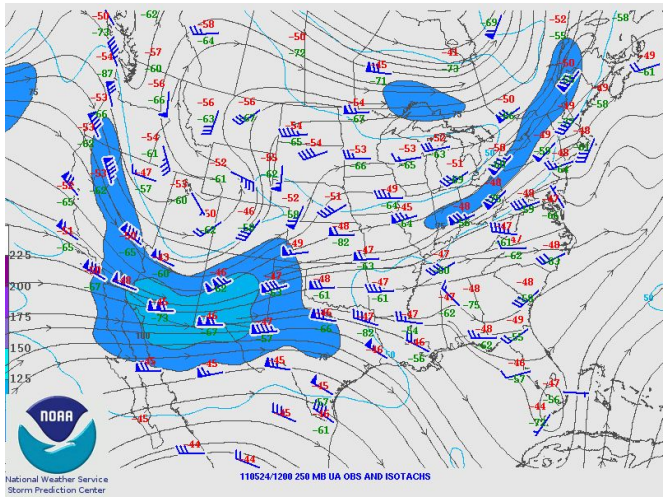
A,B
(mostly B)

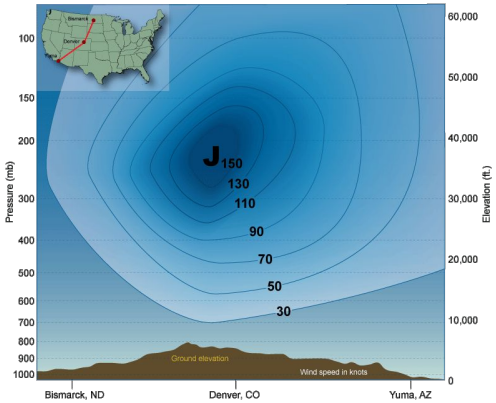
3.a. Environmental conditions for Severe Weather

Jet stream

- not only an awesome resource from NOAA!
- but also:
  - relatively narrow bands of strong wind in the upper levels of the atmosphere
  - follows the boundaries between hot and cold air







Jet stream usually visible on 250 and 300 mb upper air maps.

Jet stream = “storm highway”

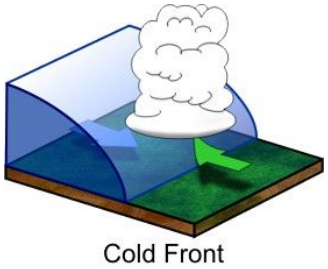
Speed maxima within the jet stream influence vertical motion in the atmosphere, surface pressure patterns, and the potential for severe weather

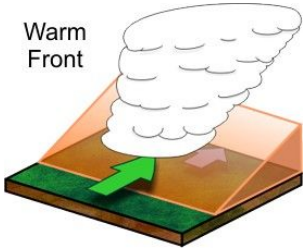
https://www.weather.gov/jetstream/jet, https://www.spc.noaa.gov/cgi-bin-spc/getuadata.pl?MyDate1=110524&Time1=12&MyDate2=&Time2=12&align=V&Levels=250

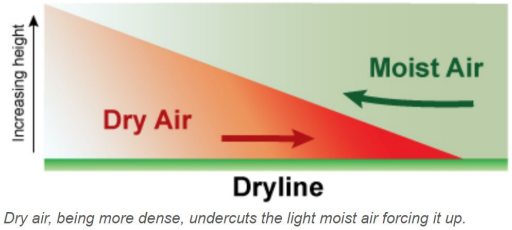
3.a. Environmental conditions for Severe Weather

Boundaries (i.e., fronts and drylines)

- Act as a forcing mechanism for vertical motion in the atmosphere (including uplift)

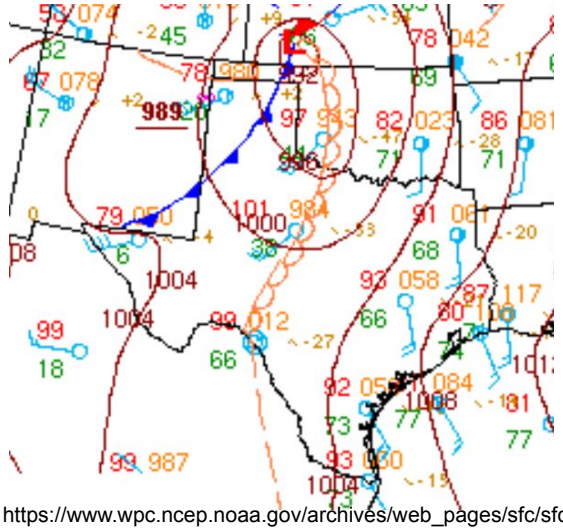






Dry air, being more dense, undercuts the light moist air forcing it up.

NOAA Weather Prediction Center (WPC) provides surface analyses, which include boundaries!
⇒ https://www.wpc.ncep.noaa.gov/html/sfc2.shtml
⇒ visit regularly to see current surface weather!



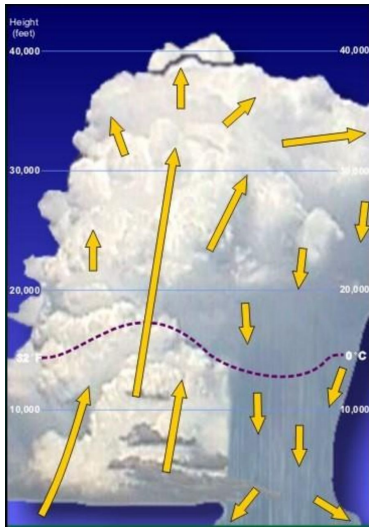
https://www.wpc.ncep.noaa.gov/archives/web_pages/sfc/sfc_archive_maps.php?arcdate=05/24/2011&selmap=2011052421&maptype=namussfc

More fronts and boundaries here: https://www.weather.gov/jetstream/wxmaps, https://www.weather.gov/jetstream/airmass

3.b. Thunderstorms

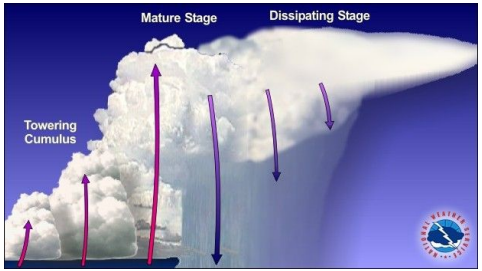
ordinary cell / single cell / pop-up / pulse

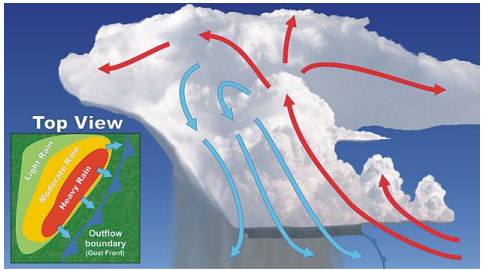
- brief existence - 30-60 min
- brief severe weather, if any



multi-cell (cluster or line)

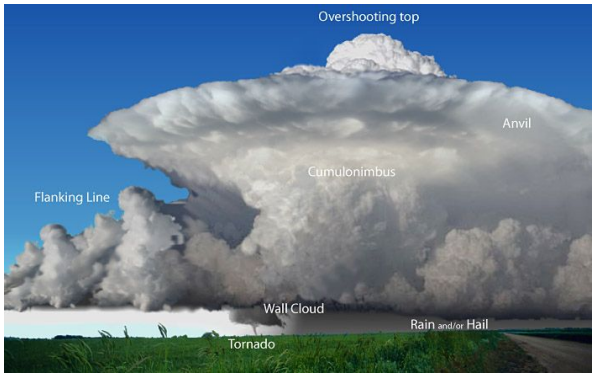
- lasts longer - single cells move downwind and are replaced by cells forming upstream
- severe weather more likely
- training storms, squall lines, derechos





supercell

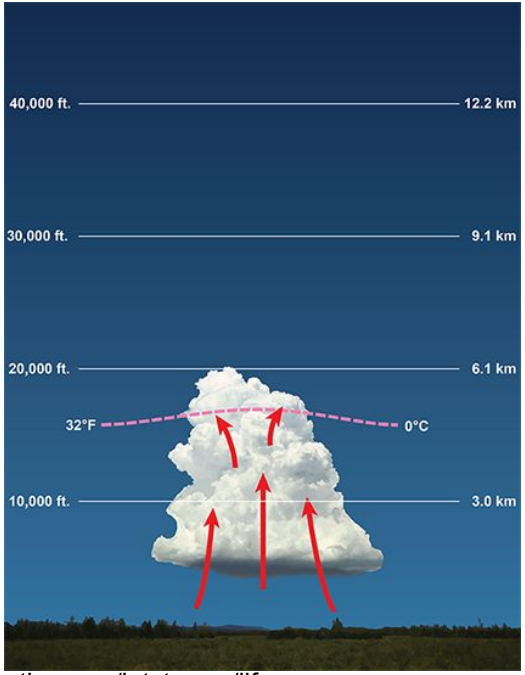
- lasts for hours
- severe weather most likely

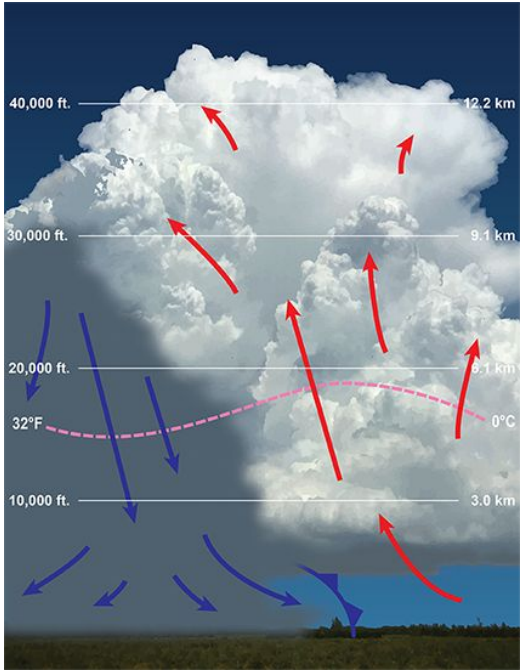


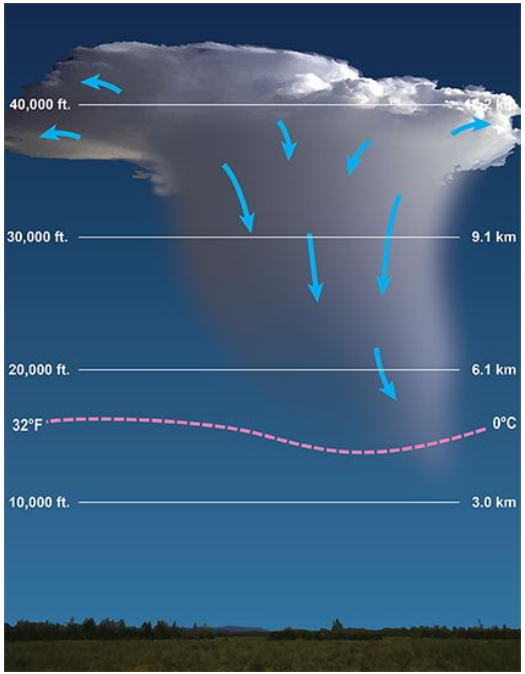
https://www.weather.gov/jetstream/tstrmtypes, https://www.weather.gov/media/lmk/soo/SingleCell-PulseStorm_Web.pdf

3.b. Thunderstorms

Life Cycle: Towering Cumulus → Mature Cumulus → Dissipating







https://www.weather.gov/jetstream/life

3.b. Cloud Types

cirrus - high, wispy clouds to first appear in advance of a low-pressure area such as a mid-latitude storm system or a tropical system such as a hurricane

cumulus - show vertical motion or thermal uplift of air taking place in the atmosphere. Usually dense in appearance with sharp outlines. Cloud bases are generally flat and occur at the altitude where the moisture in rising air condenses.

stratus - usually broad and fairly widespread appearing like a blanket. Result from non-convective rising air and tend to occur along and to the north of warm fronts. Edges of stratiform clouds are diffuse.

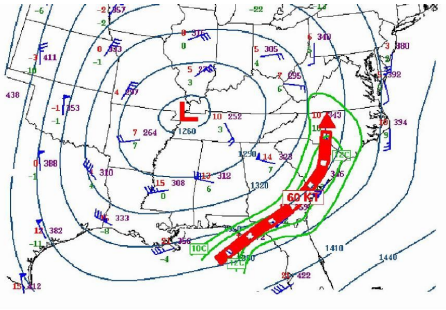
nimbo - special rainy cloud category. The vast majority of precipitation occurs from nimbo-form clouds and therefore these clouds have the greatest vertical height.

NOAA/NASA Cloud Chart:
https://www.weather.gov/jetstream/cloudchart

https://www.weather.gov/jetstream/corefour

3.d. Precipitation - Formation

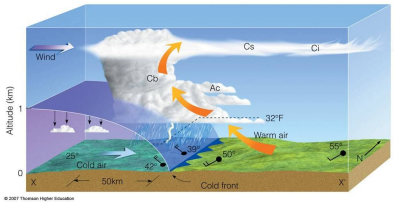
Water Vapor / Moisture
- sources
- transportation



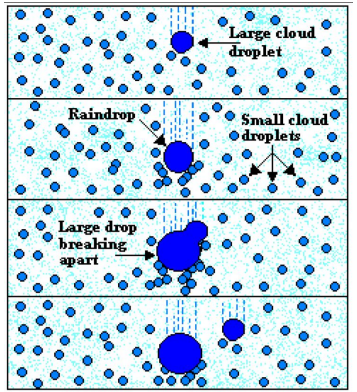
https://projects.ncsu.edu/atmos_collaboration/nwsfo/storage/cases/19840328/
http://apollo.lsc.vsc.edu/classes/met130/notes/chapter11/cf_xsect.html

https://www.weather.gov/jetstream/precip

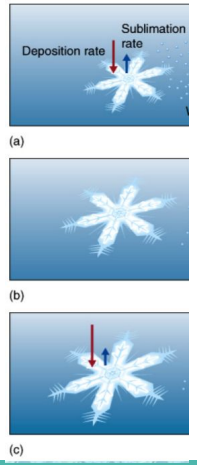
Clouds
- water vapor
- forcing mechanism to lift air



Precipitation
- cloud droplets and ice crystals too light to fall → need larger and heavier drops
- drops or ice crystals get bigger by
  - interacting with other droplets
  - deposition of water vapor on ice crystals



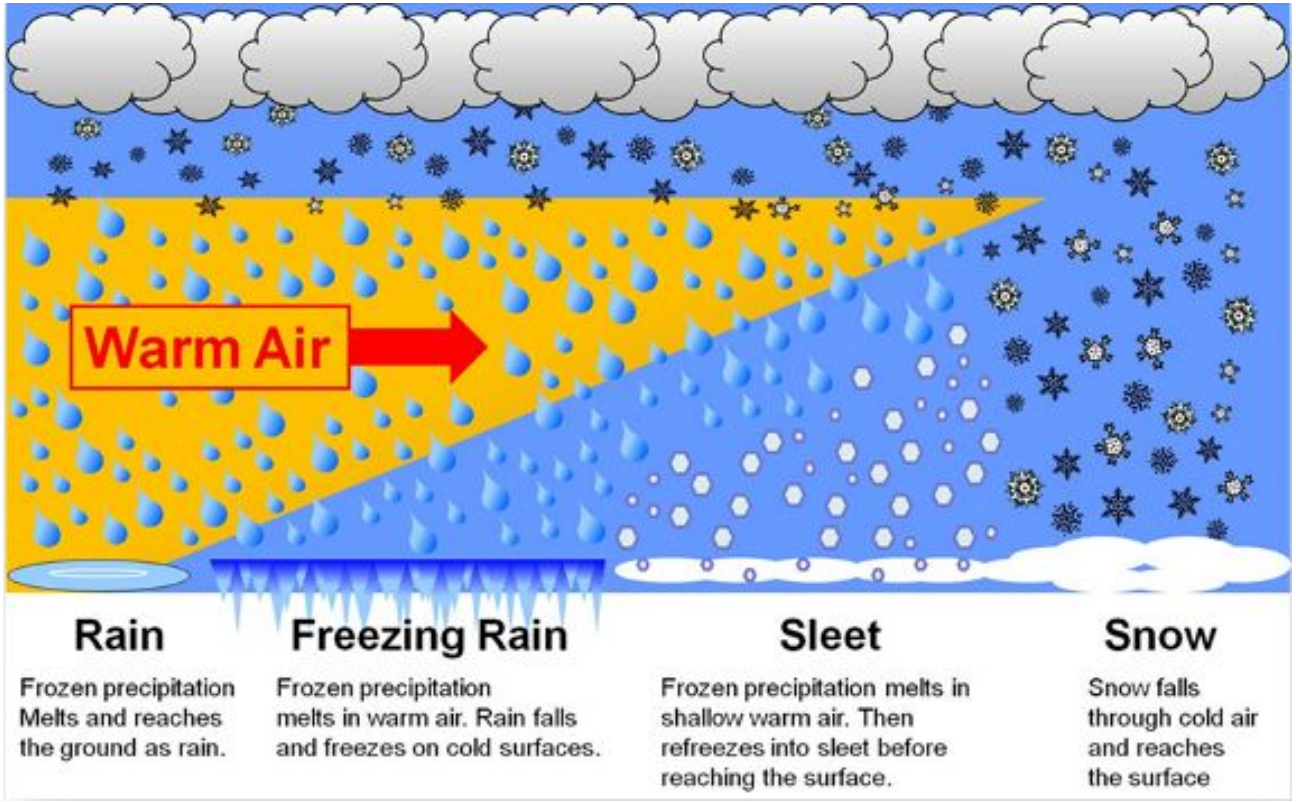
Collision-coalescence process



https://owd.tcnj.edu/~magee/171/slides/clouds

http://www.atmo.ttu.edu/schroeder/ATMO_1300/Notes/chapter7.pdf

3.d. Precipitation - Types

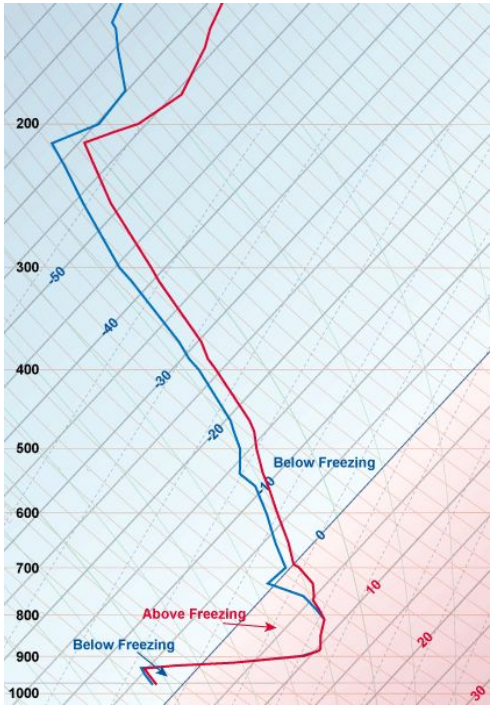


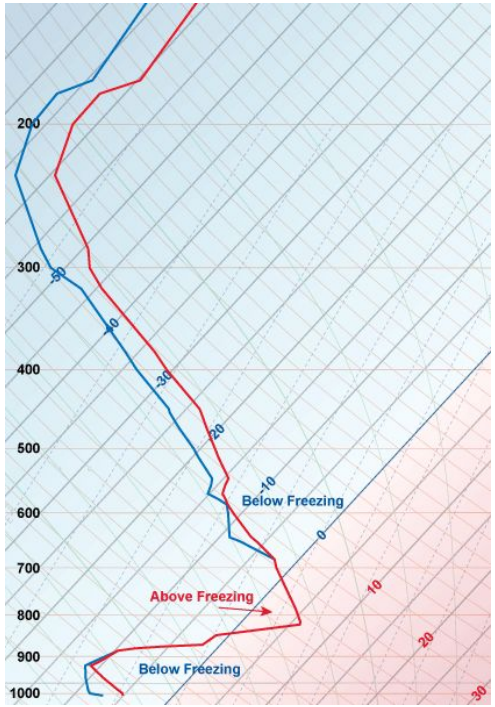
https://www.weather.gov/rnk/Measure_Icing

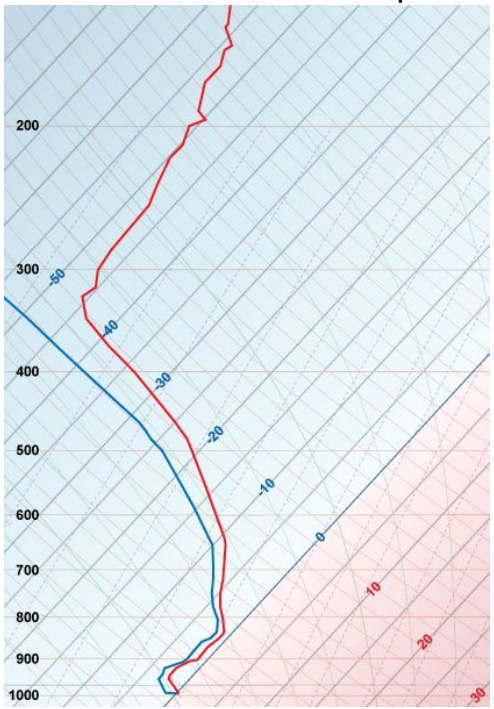
A,B

3.d. Precipitation - Types

What type of instrument collected these vertical profiles and is shown in the photos?

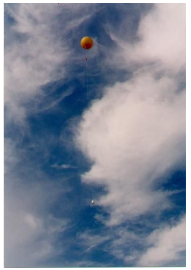






Freezing Rain | Sleet | Snow

https://www.weather.gov/jetstream/skewt_samples

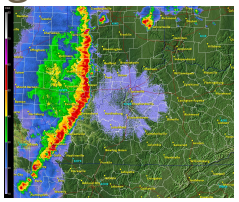


https://www.weather.gov/lwx/onlinetour_uprair1

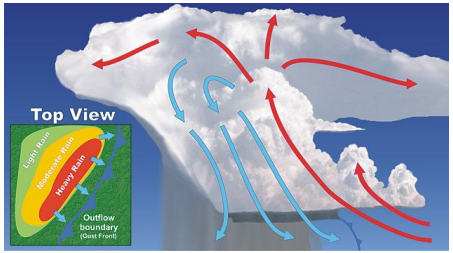
3.e. Squall lines, mesoscale convective complexes

Squall line

- multi-cell t-storms in a line
- updrafts (& new cells) continually re-form at leading edge of system with rain and hail following behind
- primary hazards
  - straight-line winds
  - hail
  - occasionally tornadoes

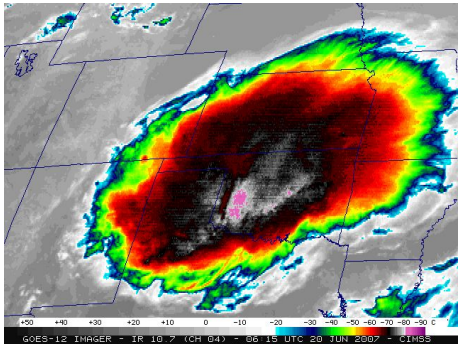


- long-lived squall line is called a derecho (3.f.)



Mesoscale convective complex (MCC)

- multi-clarge, circular, long-lived cluster of showers and thunderstorms
- identified by satellite
- often emerges out of other storm types during late-night and early-morning hours
- can cover an entire state
- primary hazards at peak intensity:
  - heavy rain
  - flooding

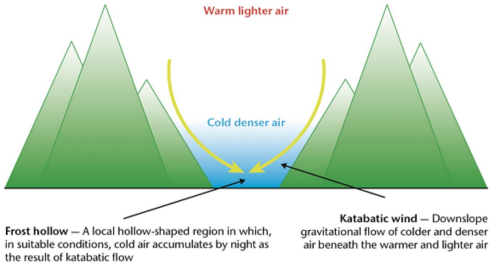


http://weather.gov/jetstream/tstrmtypes, https://www.nssl.noaa.gov/education/svrwx101/thunderstorms/types/, https://forecast.weather.gov/glossary.php?letter=m, http://cimss.ssec.wisc.edu/goes/blog/archives/date/2007/06/19

3.f. Winds

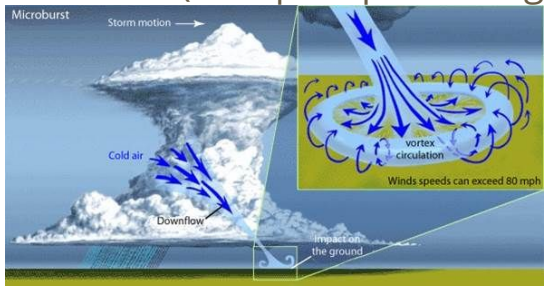
katabatic wind

- most widely used in mountain meteorology
- downslope flow driven by cooling at the surface, during periods of light larger-scale winds
- also prevalent in Antarctica



microburst

- small concentrated downburst that produces an outward burst of strong winds at or near the surface
- small — less than 4 km across — and short-lived, lasting only 5-10 minutes
- wind speeds sometimes exceeding 100 mph
- wet (with precip reaching surface) or dry



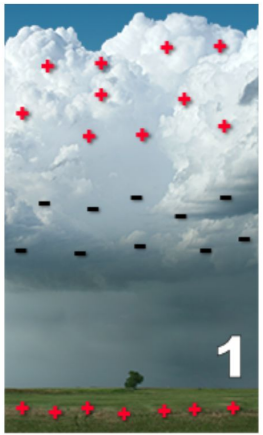
http://glossary.ametsoc.org/wiki/Katabatic_wind, https://twitter.com/metoffice/status/574200347712864258, https://scientistatwork.blogs.nytimes.com/2010/12/15/katabatic-winds-of-antarctica/, http://www.bbc.com/earth/story/20151009-where-is-the-windiest-place-on-earth, https://www.nssl.noaa.gov/education/svrwx101/wind/types/, https://www.weather.gov/bmx/outreach_microbursts, https://www.weather.gov/bro/2014event_aug13midvalleymburst

A,B

3.g. Lightning

- **We know more about conditions needed for lightning to form than exactly how lightning forms.**
  - Leading theories -
    - separation of electric charge
    - generation of an electric field within a thunderstorm
  - Recent studies also indicate that ice, hail, and semi-frozen water drops known as graupel are essential to lightning development
    - Storms that fail to produce large quantities of ice usually fail to produce lightning.
- **Scientists are working on it!**

Separated charges in a thunderstorm



Thunderstorm gathers another pool of positively charged particles.

Negatively charged area in the storm will send out a charge.

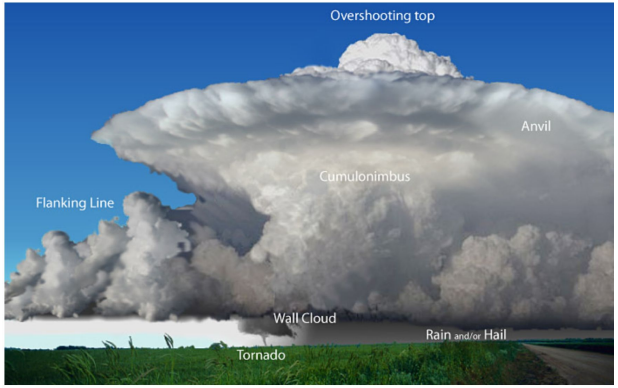
Lightning channel develops

https://www.weather.gov/jetstream/lightning

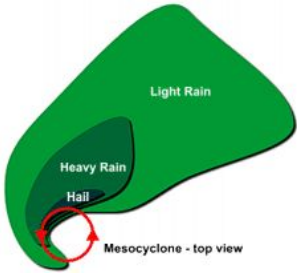
3.h. Tornadoes

Some tornado ingredients:

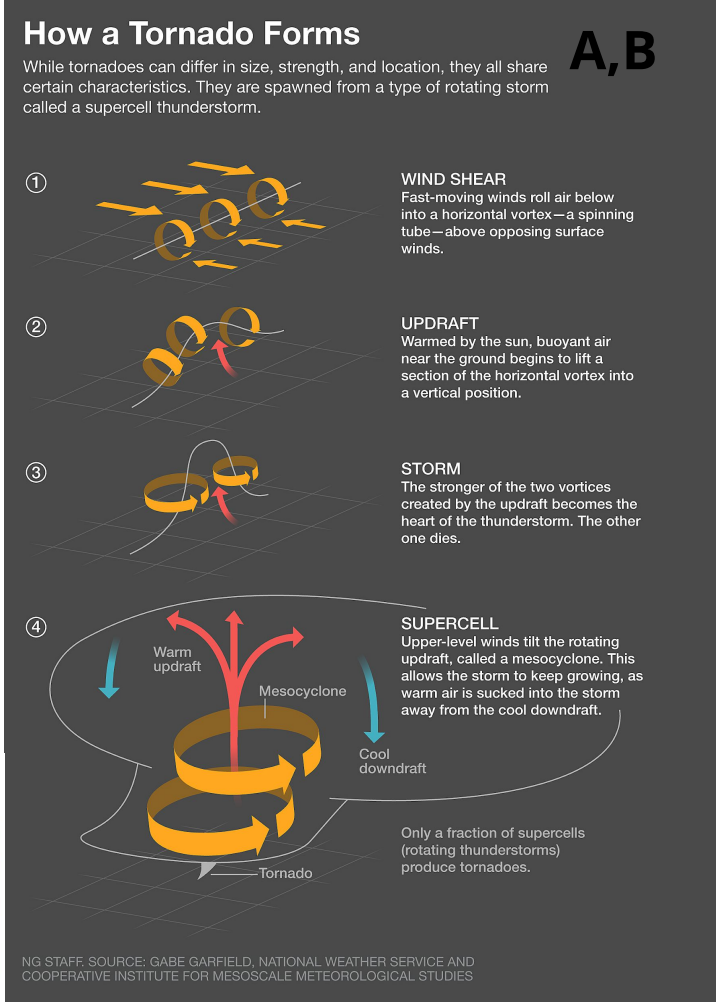
- shear - changes in wind direction and speed with height
- thunderstorm with strong updraft and rotation (most likely a supercell)
- mesocyclone



An idealized supercell.




The condensation funnel may not be visible all the way to the ground.



https://www.weather.gov/jetstream/tstrmtypes,
https://www.weather.gov/jetstream/tornado

https://www.nationalgeographic.com/news/2015/05/150511-tornadoes-storms-midwest-weather-science/

3.h. Tornadoes

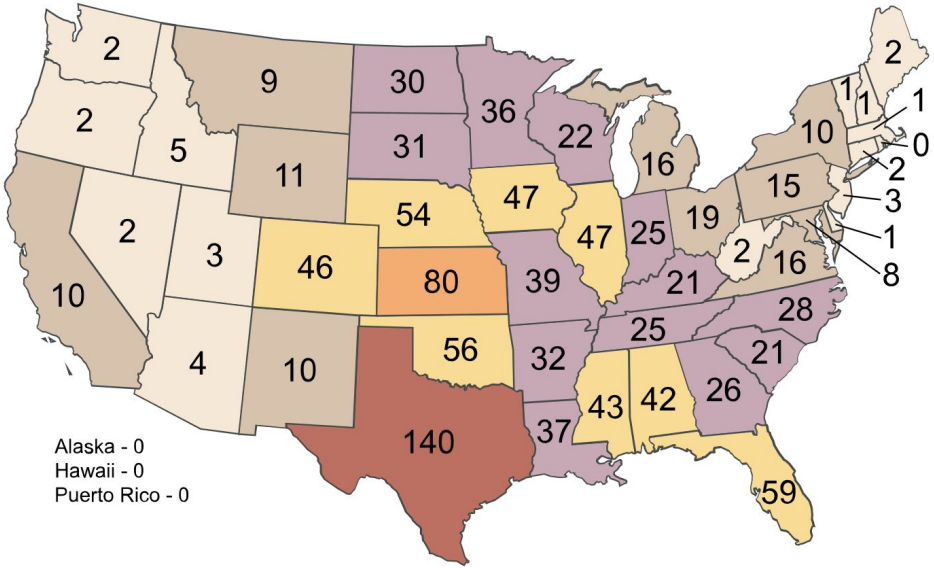
Classifying tornadoes for comparison and analysis

A,B

The Enhanced F-Scale

EF-Scale wind speeds

EF scale	Class	Wind speed		Description
		mph	km/h	
EF0	weak	65-85	105-137	Gale
EF1	weak	86-110	138-177	Moderate
EF2	strong	111-135	178-217	Significant
EF3	strong	136-165	218-266	Severe
EF4	violent	166-200	267-322	Devastating
EF5	violent	> 200	> 322	Incredible



Annual average number of tornadoes by state (1985-2014).

Some NOAA severe weather research labs and forecasting agencies located in Norman, Oklahoma, for good reason!

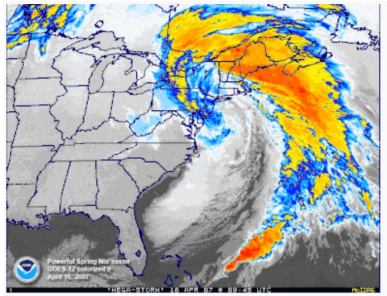
- Storm Prediction Center - www.spc.noaa.gov
- National Severe Storms Lab - www.nssl.noaa.gov

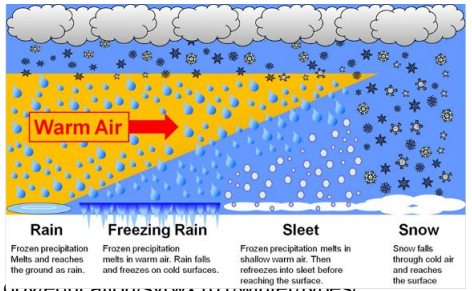
https://www.weather.gov/jetstream/tornado

https://www.nssl.noaa.gov/education/svrwx101/tornadoes/

3.i. Winter Storms

- **blizzards**: snow + wind
  - Winds over 35mph with snow and blowing snow, reducing visibility to 1/4 mile or less for at least 3 hrs
- **nor'easter** -
  - low-pressure area off the Carolina coast strengthens and moves north
  - storm taps the Atlantic Ocean's moisture-supply and dumps heavy snow
  - cold air gets trapped in mountain valleys, rain may fall on to cold surfaces, becoming ice
- **ice** storms
  - vertical profiles of temperature, precip type = important



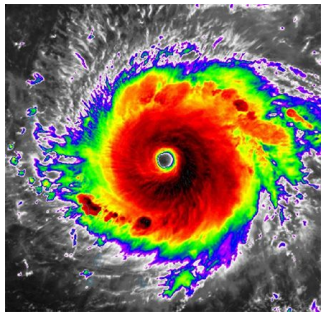


https://www.noaa.gov/media-release/january-2016-blizzard-ranked-category-4-on-northeast-snowfall-scale, https://www.nssl.noaa.gov/education/svrwx101/winter/types/, https://www.nssl.noaa.gov/education/svrwx101/winter/forecasting/

3.j. Hurricanes (typhoons, cyclones, depending on where you are in the world)

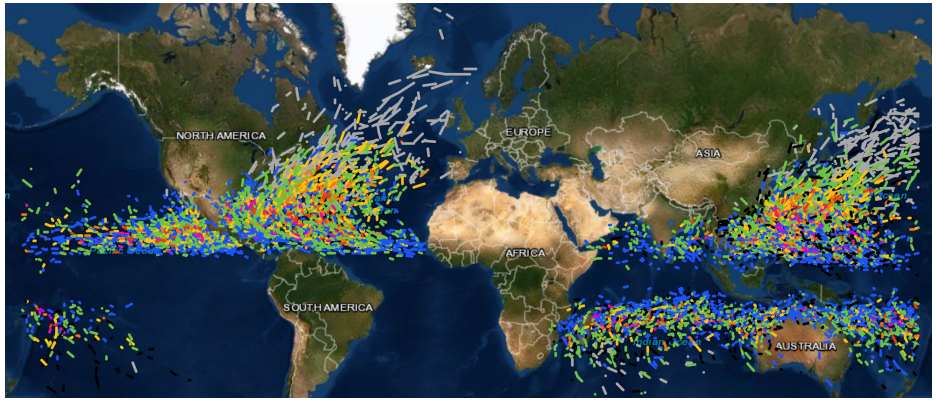
Favorable conditions for tropical cyclone formation

- **Warm ocean waters** (at least 80°F / 27°C) throughout a depth of about 150 ft. (46 m).
- An **atmosphere** which cools fast enough with height such that it is **potentially unstable** to moist convection.
- Relatively **moist air near the mid-level** of the troposphere (16,000 ft. / 4,900 m).
- Generally, a minimum distance of at least **300 miles (480 km) from the equator**.
- A pre-existing near-surface **disturbance**.
- **Low values (less than about 23 mph / 37 km/h) of vertical wind shear** between the surface and the upper troposphere. Vertical wind shear is the change in wind speed with height.



https://www.weather.gov/jetstream/tc,
https://coast.noaa.gov/hurricanes/

Historical hurricane tracks (NOAA):
https://coast.noaa.gov/hurricanes/



A,B

3.j. Hurricanes (typhoons, cyclones, depending on where you are in the world)

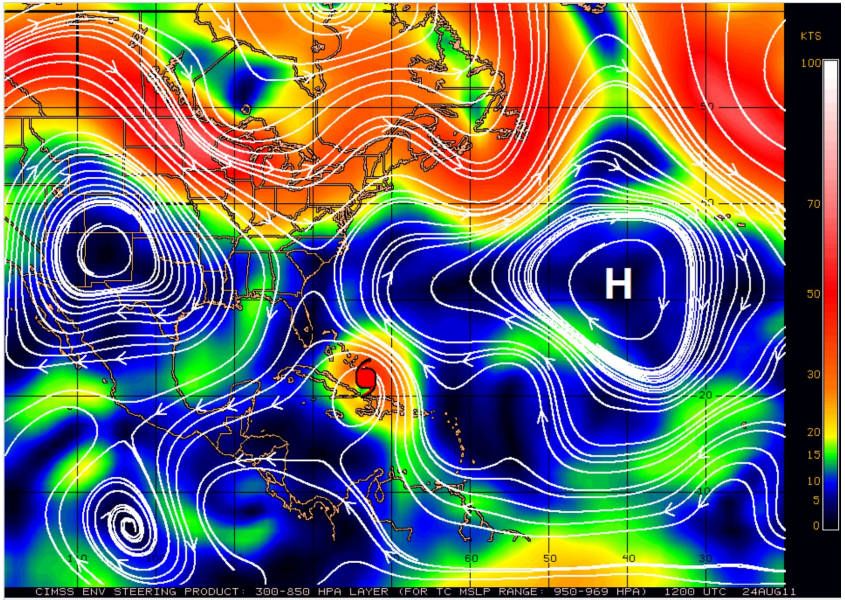
Tropical cyclones (mostly) don't steer themselves!

- 80-90% of a tropical cyclone's movement is driven by "steering currents"

Many Atlantic tropical cyclones travel around the southern and western periphery of the Atlantic subtropical high (the "Bermuda High").

Credit: NOAA

https://www.e-education.psu.edu/meteo3/node/2275

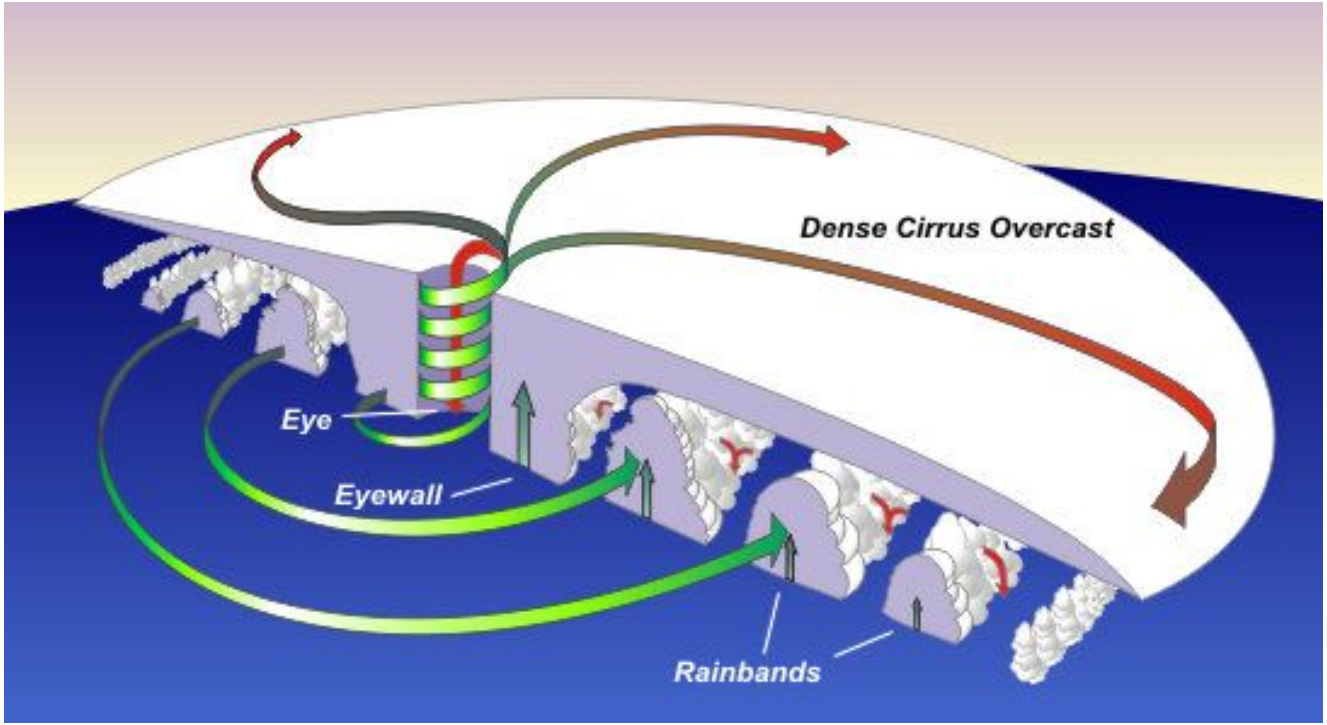


The 12Z analysis of the mean wind (white streamlines with arrows to depict direction) through a deep layer of the troposphere on August 24, 2011. Speeds of the mean wind in this layer are color-coded in knots. Irene was being steered toward the northwest at this time by the mean winds in this layer.

Credit: CIMSS

3.j. Hurricanes (typhoons, cyclones, depending on where you are in the world)

Structure

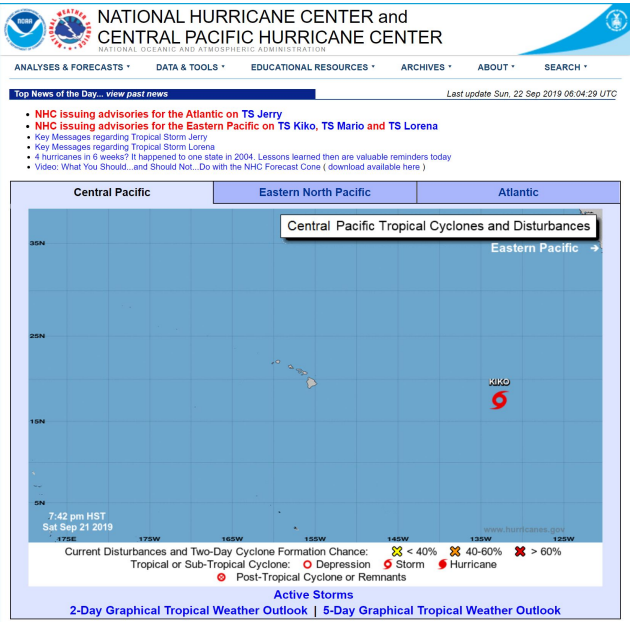


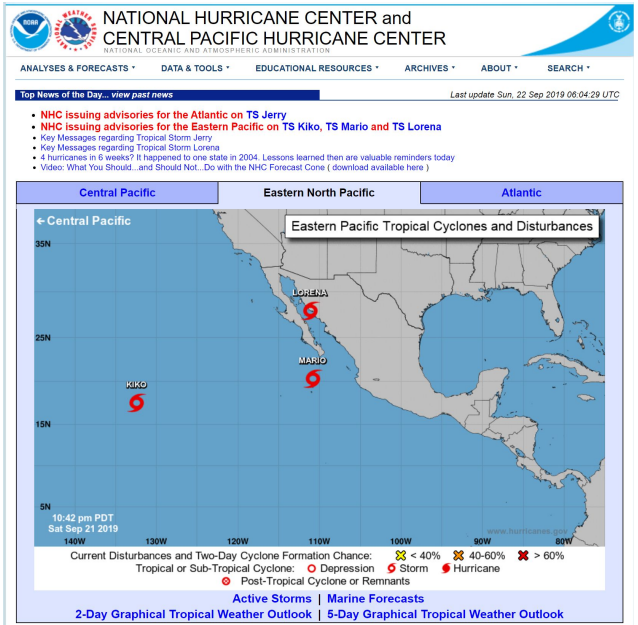
https://www.weather.gov/jetstream/tc

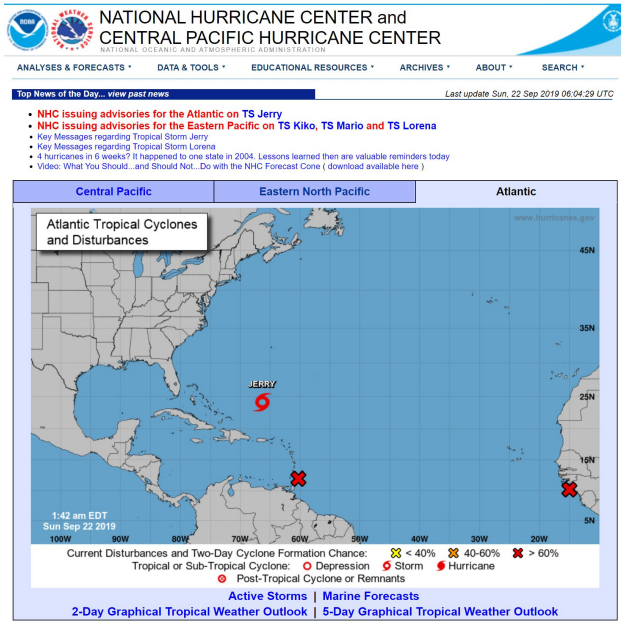
A,B

3.j. Hurricanes (typhoons, cyclones, depending on where you are in the world)

NOAA centers for tropical cyclone forecasts



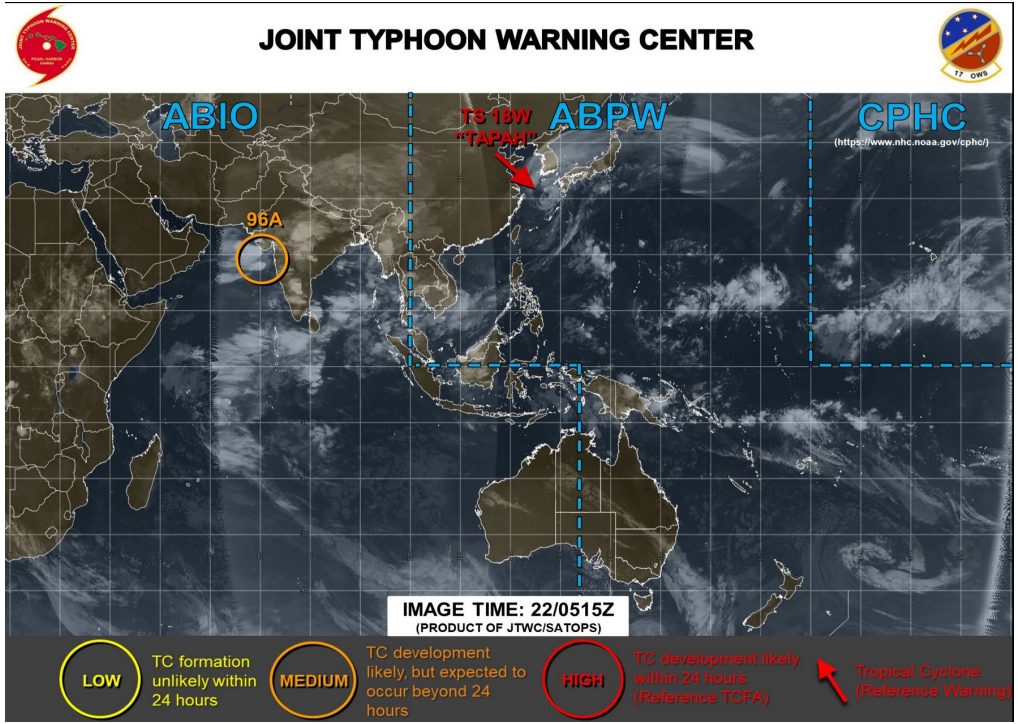




https://www.nhc.noaa.gov

3.j. Hurricanes (typhoons, cyclones, depending on where you are in the world)

US Navy center for tropical cyclone forecasts



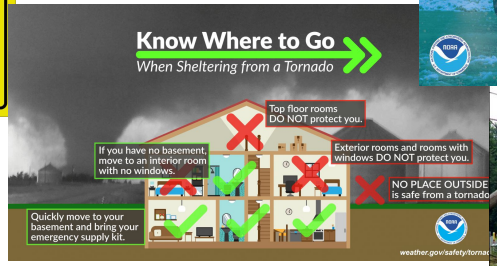
https://www.metoc.navy.mil/jtwc/jtwc.html

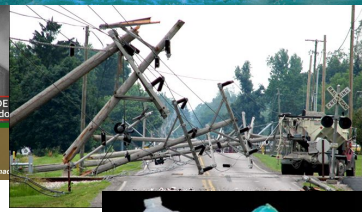
3.n. Weather Safety

A,B

Make a plan before you actually need it!

Ed Ou/NBC News





← **https://www.weather.gov/safety/**

- includes info on differences between NWS warnings & watches
- dependable sources of info
  - NOAA/NWS
    - preparedness info @ www.weather.gov/safety/
    - main weather.gov web page to monitor events
  - NOAA Weather Radio
  - local media meteorologists
  - emergency management offices
  - social media accounts of the above sources
    - check the original source of information if it's a shared post!

Break! Yay!

https://i.redd.it/gkynuztdtu231.jpg

Practice!

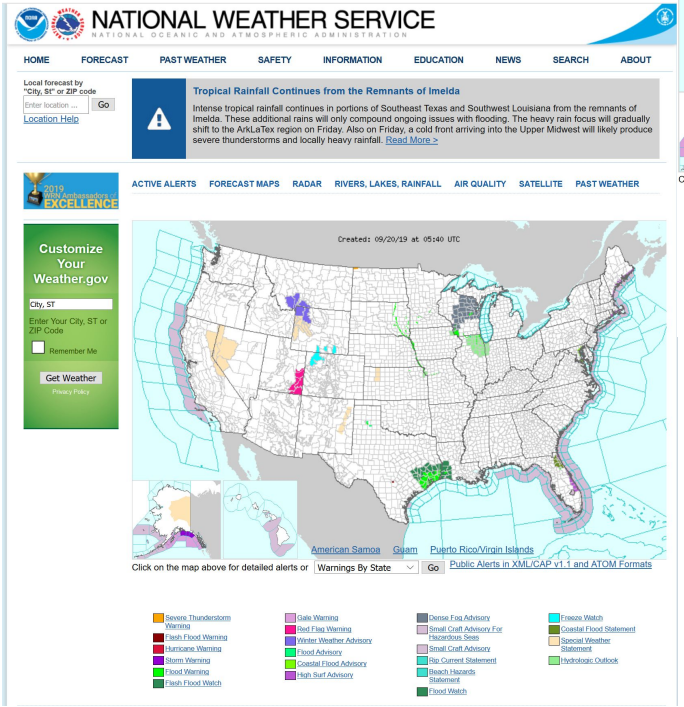
Weather of The Day

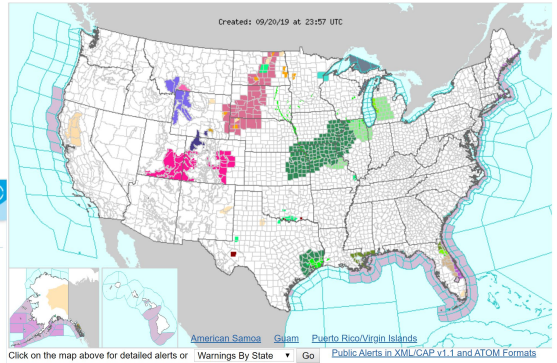
- Monitor events with NOAA National Weather Service's weather.gov
- Less structured for students (and us!) but very fun learning
  - Makes meteorology a little more real to people, including students
  - Depends on the weather!
  - The weather is always changing, and it's always interesting!
- Examine the map of weather alerts at weather.gov as often as possible (including today!)
  - lower 48 states, and beyond! ⇒ so much interesting weather, so many possibilities for exploration!!

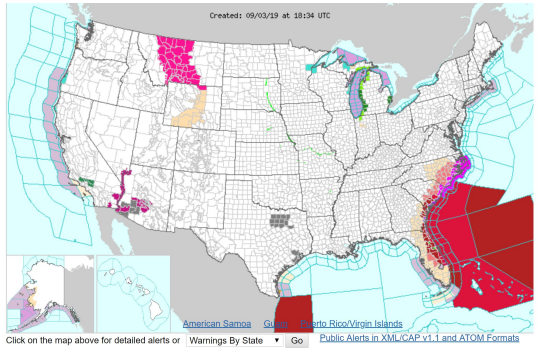
A,B

Weather of the Day - What's up?

- NOAA/NWS's weather.gov
  - visit now (if internet is available), for October 4 or 5, 2019!
  - look when you get home
  - get your students in the habit of looking every day
- What weather events, watches and/or warnings are active?



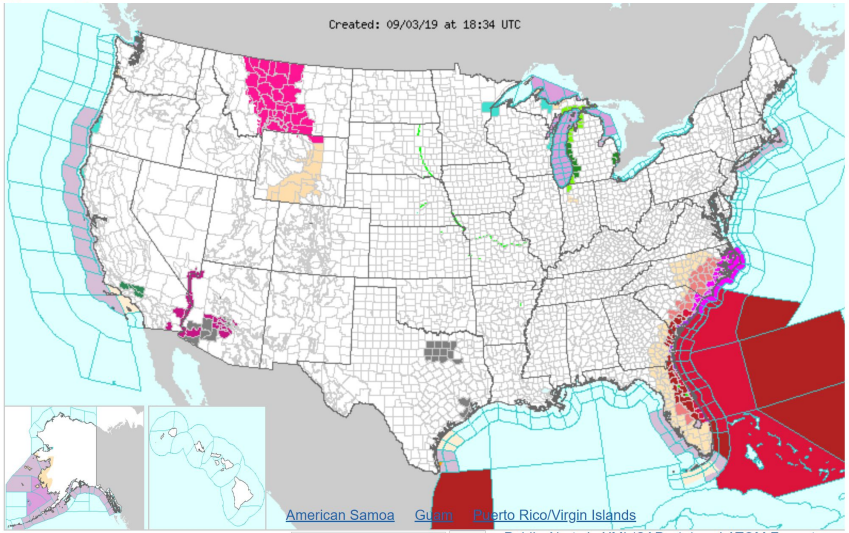




A,B

Practice! - Example #1 of weather.gov Exploration

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



Click on the map above for detailed alerts or Warnings By State ▾ Go

Public Alerts in XML/CAP v1.1 and ATOM Formats

- Storm Surge Warning
- Hurricane Warning
- Special Marine Warning
- Tropical Storm Warning
- Coastal Flood Warning
- Lakeshore Flood Warning
- Flood Warning
- Excessive Heat Warning
- Flash Flood Watch
- Gale Warning
- Red Flag Warning
- Storm Surge Watch
- Hurricane Watch
- Tropical Storm Watch
- Hurricane Local Statement
- Flood Advisory
- Lakeshore Flood Advisory
- Coastal Flood Advisory
- High Surf Advisory
- Small Craft Advisory
- Rip Current Statement
- Beach Hazards Statement
- Fire Weather Watch
- Coastal Flood Statement
- Special Weather Statement
- Marine Weather Statement
- Air Quality Alert

Lots going on at this time!

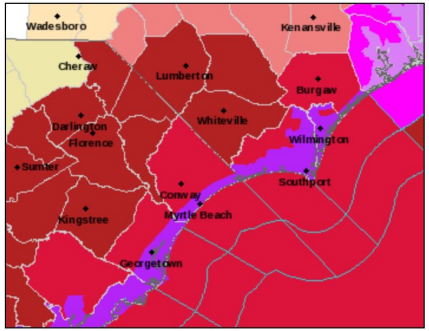
NWS Forecast Office Wilmington, NC

Weather.gov > NWS Wilmington, NC

NWS Wilmington, NC
Weather Forecast Office

Current Hazards | Current Conditions | Radar | Forecasts | Rivers and Lakes | Climate and Past Weather | Local Programs

Click a location below for detailed forecast.



Last Map Update: Tue, Sep. 3, 2019 at 6:06:36 pm EDT

Watches, Warnings & Advisories — Zoom Out

- Storm Surge Warning
- Hurricane Warning
- Tropical Storm Warning
- Flash Flood Watch
- Storm Surge Watch
- Hurricane Watch
- Tropical Storm Watch
- Hurricane Local Statement
- High Surf Advisory
- Rip Current Statement
- Beach Hazards Statement
- Hazardous Weather Outlook

A,B

Practice! - Example #1 of weather.gov Exploration

Weather Safety (3.n.) - impacts (potential and occurring) and safety information are often included in NOAA watches and warnings

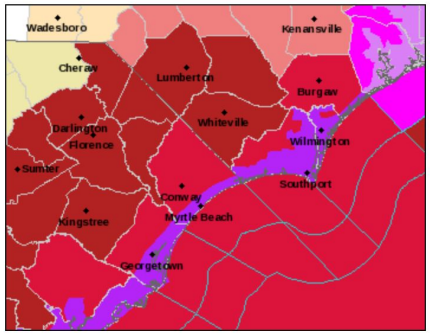
NWS Forecast Office Wilmington, NC

Weather.gov > NWS Wilmington, NC

NWS Wilmington, NC
Weather Forecast Office

Current Hazards | Current Conditions | Radar | Forecasts | Rivers and Lakes | Climate and Past Weather | Local Programs

Click a location below for detailed forecast.



Last Map Update: Tue, Sep. 3, 2019 at 6:06:36 pm EDT

Watches, Warnings & Advisories | Zoom Out

- Storm Surge Warning
- Hurricane Warning
- Tropical Storm Warning
- Flash Flood Watch
- Storm Surge Watch
- Hurricane Watch
- Tropical Storm Watch
- Hurricane Local Statement
- High Surf Advisory
- Rip Current Statement
- Beach Hazards Statement
- Hazardous Weather Outlook

Dorian Local Watch/Warning Statement/Advisory Number 42
National Weather Service Raleigh NC AL052019
511 PM EDT Tue Sep 3 2019

...

...TROPICAL STORM WATCH REMAINS IN EFFECT...

* LOCATIONS AFFECTED
  - Fayetteville
  - Fort Bragg

* WIND
  - LATEST LOCAL FORECAST: Below tropical storm force wind
    - Peak Wind Forecast: 25-35 mph with gusts to 50 mph
  - POTENTIAL THREAT TO LIFE AND PROPERTY: Potential for wind 58 73 mph
    - The wind threat has remained nearly steady from the previous assessment.
    - PLAN: Plan for dangerous wind of equivalent strong tropical storm force due to possible forecast changes in track, size, or intensity.
    - PREPARE: Efforts to protect life and property should now be underway. Prepare for significant wind damage.
    - ACT: Act now to complete preparations before the wind becomes hazardous.
  - POTENTIAL IMPACTS: Significant
    - Some damage to roofing and siding materials, along with damage to porches, awnings, carports, and sheds. A few buildings experiencing window, door, and garage door failures. Mobile homes damaged, especially if unanchored. Unsecured lightweight objects become dangerous projectiles.
    - Several large trees snapped or uprooted, but with greater numbers in places where trees are shallow rooted. Several fences and roadway signs blown over.
    - A few roads impassable from large debris, and more within urban or heavily wooded places. A few bridges, causeways, and access routes impassable.
    - Scattered power and communications outages, but more prevalent in areas with above ground lines.

* FLOODING RAIN
  - LATEST LOCAL FORECAST:
    - Peak Rainfall Amounts: Additional 2-4 inches, with locally higher amounts
  - POTENTIAL THREAT TO LIFE AND PROPERTY: Potential for localized flooding rain
    - The flooding rain threat has remained nearly steady from the previous assessment.
    - PLAN: Emergency plans should include the potential for localized flooding from heavy rain.
    - PREPARE: Consider protective actions if you are in an area vulnerable to flooding.
    - ACT: Heed any flood watches and warnings.
  - POTENTIAL IMPACTS: Limited
    - Localized rainfall flooding may prompt a few evacuations.
    - Rivers and tributaries may quickly rise with swifter currents. Small streams, creeks, and ditches may become swollen and overflow in spots.
    - Flood waters can enter a few structures, especially in usually vulnerable spots. A few places where rapid ponding of water occurs at underpasses, low-lying spots, and poor drainage areas. Several storm drains and retention ponds become near-full and begin to overflow. Some brief road and bridge closures.

Full text here:
https://mesonet.agron.iastate.edu/wx/afos/p.php?pil=TCVRAH&e=201909032111

A,B

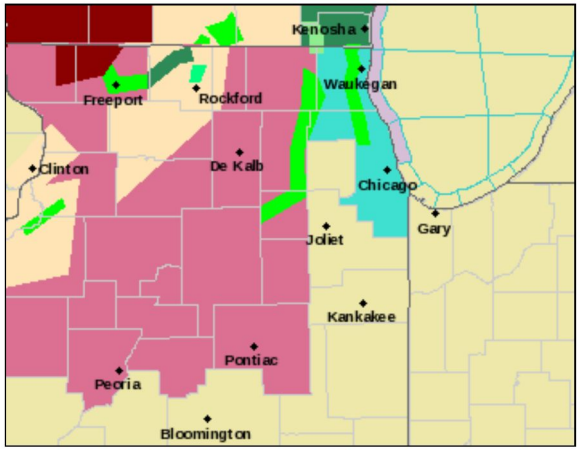
Practice! - Example #2 of weather.gov Exploration

NWS Forecast Office Chicago, IL

Weather.gov > Chicago, IL

Current Hazards | Current Conditions | Radar | Forecasts | Rivers and Lakes | Climate and Past

Click a location below for detailed forecast.



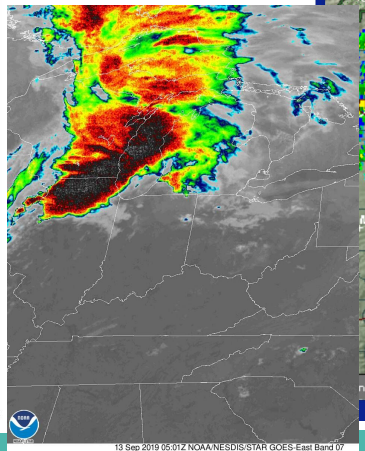
Last Map Update: Thu, Sep. 12, 2019 at 10:25:03 pm CDT

Watches, Warnings & Advisories — Zoom Out

- Flash Flood Warning
- Flood Warning
- Severe Thunderstorm Watch
- Flash Flood Watch
- Flood Advisory
- Small Craft Advisory
- Beach Hazards Statement
- Flood Watch
- Special Weather Statement
- Hazardous Weather Outlook
- Hydrologic Outlook

Lots going on here as well!

Satellite Image:
https://www.star.nesdis.noaa.gov/GOES/index.php

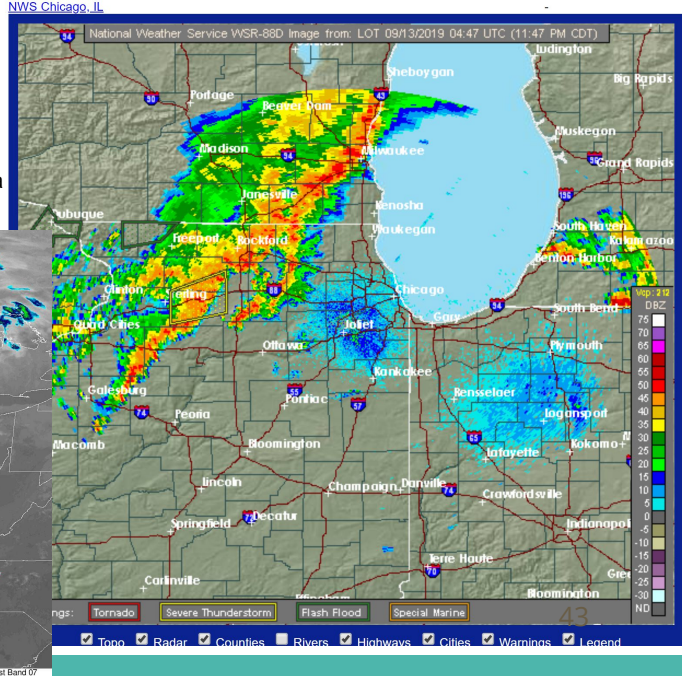


National Weather Service Enhanced Radar Image

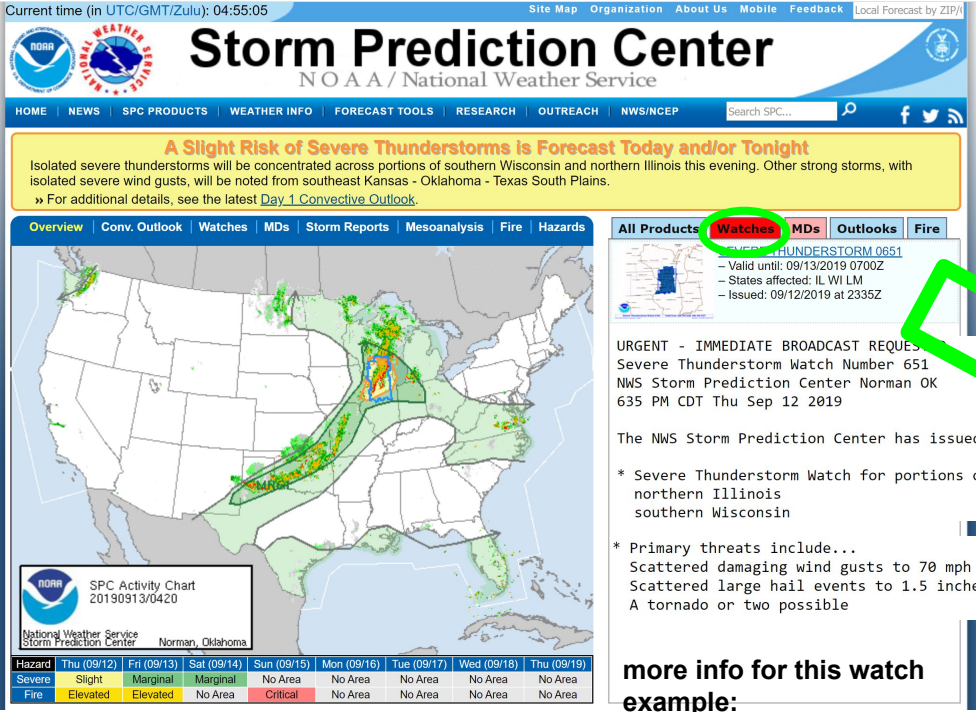
Chicago, IL Radar

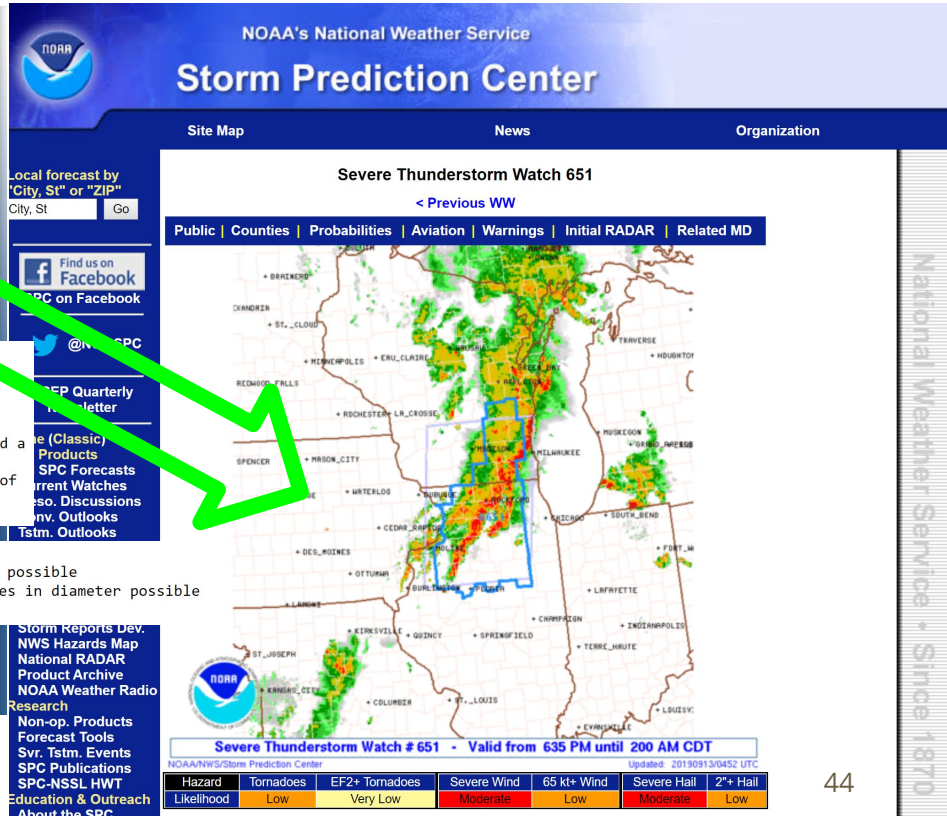
Base Reflectivity

NWS Chicago, IL



Practice! - Example #2 of weather.gov Exploration





www.spc.noaa.gov

more info for this watch example:
https://www.spc.noaa.gov/products/watch/ww0651.html

A,B

Practice! - Example #2 of weather.gov Exploration

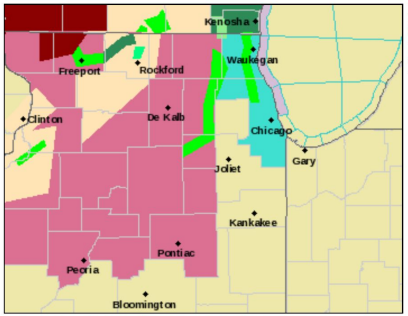
NOAA/NWS Watches and Warnings (3.n.) - look for differences in language

NWS Forecast Office Chicago, IL

Weather.gov > Chicago, IL

Current Hazards | Current Conditions | Radar | Forecasts | Rivers and Lakes | Climate and Pas

Click a location below for detailed forecast.



Last Map Update: Thu, Sep. 12, 2019 at 10:25:03 pm CDT

Watches, Warnings & Advisories — Zoom Out

- Flash Flood Warning
- Flood Warning
- Severe Thunderstorm Watch
- Flash Flood Watch
- Flood Advisory
- Small Craft Advisory
- Beach Hazards Statement
- Flood Watch
- Special Weather Statement
- Hazardous Weather Outlook
- Hydrologic Outlook

Flash Flood Watch
National Weather Service Quad Cities IA IL
747 PM CDT Thu Sep 12 2019

...Flash Flooding Possible This Evening...

.Thunderstorms produced heavy rainfall early this morning along the Highway 20 corridor in northeast Iowa and far northwest Illinois, from Buchanan county east to Stephenson county. This has saturated the soil and in addition this area has also received at least several inches of rain the past week. A strong cold front will be sweeping across the area this evening. Intense thunderstorms accompanying this front may produce rainfall rates of 2 inches per hour. This kind of rainfall can produce rapidly rising water along small creeks and streams. Flash flooding is also possible in urban areas due to high rainfall rates.

Flash Flood Warning
ILC085-177-130815-
/O.NEW.KDVN.FF.W.0053.190913T0212Z-190913T0815Z/
/00000.0.ER.000000T0000Z.000000T0000Z.000000T0000Z.OO/

BULLETIN - EAS ACTIVATION REQUESTED
Flash Flood Warning
National Weather Service Quad Cities IA/IL
912 PM CDT Thu Sep 12 2019

The National Weather Service in the Quad Cities has issued a

* Flash Flood Warning for...
  Northeastern Jo Daviess County in northwestern Illinois...
  Northwestern Stephenson County in northwestern Illinois...

* Until 315 AM CDT Friday.

* At 908 PM CDT, Doppler radar indicated heavy rain falling in the warned area where ground is extremely saturated. Expect flash flooding to occur of creeks, small streams, and low lying areas.

https://www.weather.gov/safety/

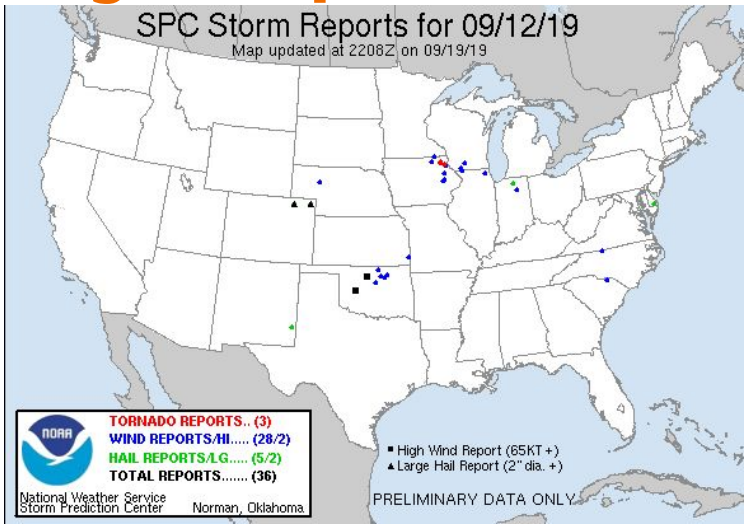
- includes info on differences between NWS warnings & watches

A,B

Practice! - Example #2 of weather.gov Exploration

Following up after a real-time event:
What impacts were reported during this event?

- SPC Storm Reports - https://www.spc.noaa.gov/climo/online/
  - scroll down to “Past Storm Reports”, enter date in YYMMDD format (190912)
  - click “Get Data”, redirected here: https://www.spc.noaa.gov/climo/reports/190912_rpts.html

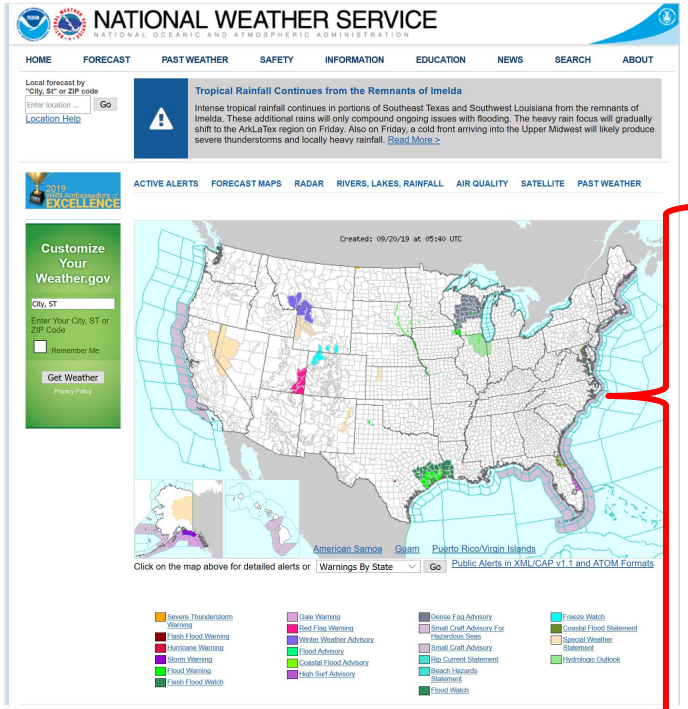


WARREN	JO DAVIESS	IL	4249 8999	SMALL BRANCHES DOWN. (DVN)
NORTH BARRINGTON	LAKE	IL	4220 8814	PHOTO SHARED VIA SOCIAL MEDIA OF LARGE TREE SNAPPED NEAR BASE IN NORTH BARRINGTON. TIME ESTIMATED BY RADAR. (LOT)

A,B

Weather of the Day - What's Up Today?

- NOAA/NWS's weather.gov
  - visit now (if internet is available), for October 4 or 5, 2019!
  - look when you get home
  - get your students in the habit of looking every day
- What weather events, watches and/or warnings are going on?



Local focus:

Several NWS Weather Forecast Offices (WFOs) serve NC counties:

- Wakefield, VA
- Blacksburg, VA
- Knoxville-Morristown, TN
- Greenville-Spartanburg, SC
- Raleigh, NC
- Newport-Morehead City, NC
- Wilmington, NC

https://www.weather.gov/jetstream/wfos

Let's try now! (if internet is available)

More Practice! Tornado Demos

Indoor tornadoes!

- Tornado tubes!
- Pet tornadoes!

Questions:

- Which way does it rotate?
- What happens when it slows down?

Tornadoes can be thin and rope-like.

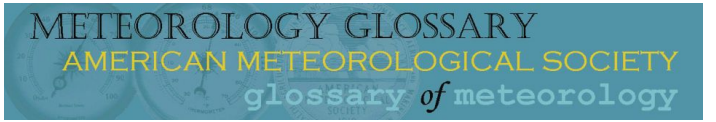
https://www.weather.gov/jetstream/tornado

Add'l Resources and Finding More Info

SCIOLY.ORG

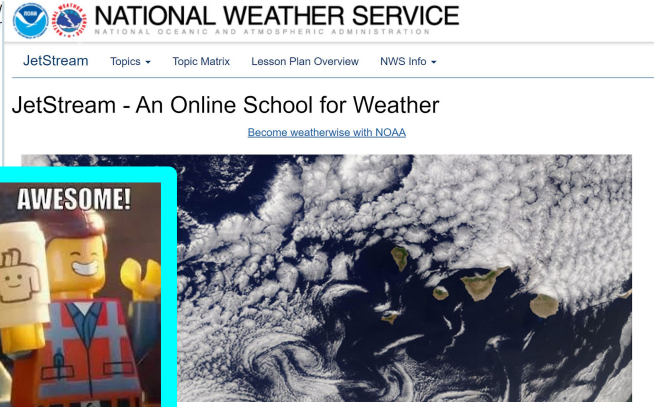
scioly.org: discussion forums focused specifically on Meteorology, test archive for practice

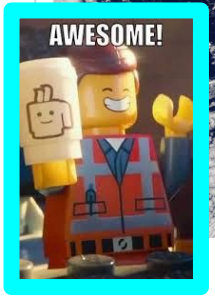
https://w1.weather.gov/glossary/



http://glossary.ametsoc.org/wiki/Main_Page

https://www.weather.gov/jetstream/





Contact local NWS WFOs to ask if they'll allow you to see a radiosonde launch!

https://www.weather.gov/jetstream/wfos

See list/handout for more!

Close

Thank you!

Grab a NOAA sticker because science is cool!

Image Credits: S. Bender