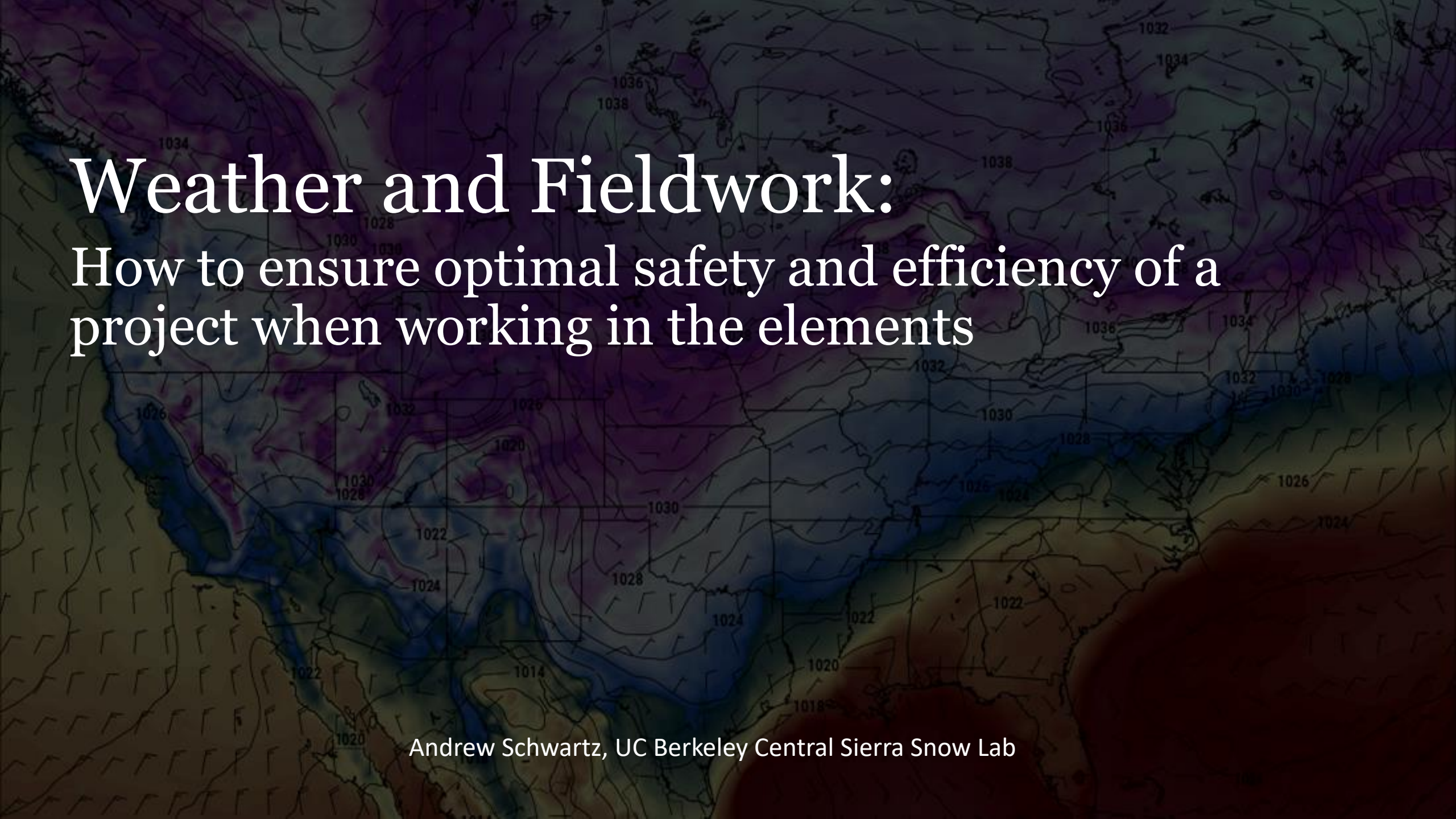
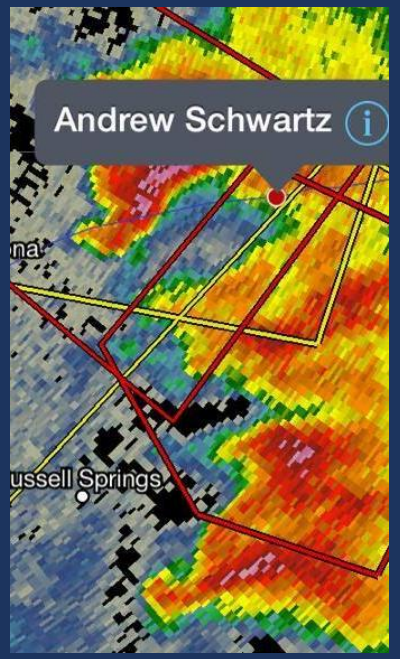


Weather and Fieldwork:

How to ensure optimal safety and efficiency of a project when working in the elements

Andrew Schwartz, UC Berkeley Central Sierra Snow Lab

My background



FOUNDATIONS FOR SUCCESS WHEN WORKING IN THE ELEMENTS

Important elements of weather preparedness during a project

1. A weather safety plan
   a. Contact info for all participants
   b. Lists potential weather hazards
   c. Identifies conditions that are/aren't favorable for work to occur
   d. Contains contingencies if unfavorable weather is encountered
   e. Lists preferred sources of weather information
   f. Suggested personal precautions (clothing, sunscreen, etc.)
2. Identified forecast monitors and weather observers
3. Effective forecast communication strategy for all participants
4. A weather emergency kit

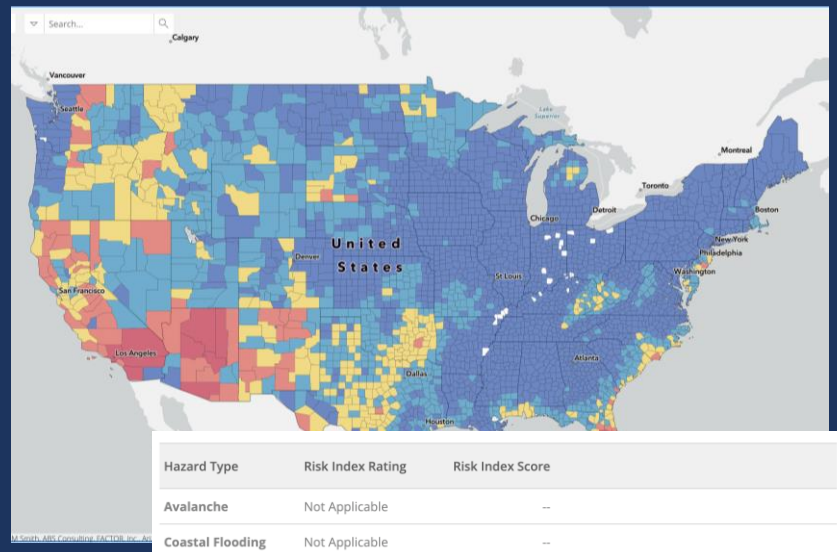
Identifying weather risks with a field site

Geographical location details determine much of the weather considerations.

- Is there shelter on site?
- Does the area have past occurrences of severe weather? What type?
- What is the level of exposure if inclement weather occurs?
- Are there any features/infrastructure that could pose risk in inclement weather (tall towers, rivers, dense forest)?
- How many potential evacuation points are there?

Information sources for identifying weather risks:

- FEMA National Risk Index
- Insurance and real estate company risk assessments



Hazard Type	Risk Index Rating	Risk Index Score		
Avalanche	Not Applicable	--		
Coastal Flooding	Not Applicable	--		
Cold Wave	No Rating	0.00	0	100
Drought	Very High	71.22	0	100
Earthquake	Relatively Moderate	20.65	0	100
Hail	Relatively Low	8.12	0	100
Heat Wave	Relatively Moderate	11.10	0	100
Hurricane	Not Applicable	--		
Ice Storm	Not Applicable	--		
Landslide	Relatively High	26.86	0	100
Lightning	Relatively Moderate	18.24	0	100
Riverine Flooding	Relatively High	25.02	0	100
Strong Wind	Very Low	7.26	0	100
Tornado	Relatively Low	12.78	0	100
Tsunami	Not Applicable	--		
Volcanic Activity	Relatively Moderate	43.12	0	100
Wildfire	Relatively High	36.30	0	100
Winter Weather	Very Low	8.38	0	100

Image credit: FEMA National Risk Index interactive map

Who should be responsible for monitoring the forecast?

PI or the project member in charge of safety is often the ideal candidate.

- They're aware of the intricacies of the project and the potential issues that may arise as a result of inclement weather.

Having more than one person monitoring the forecast and weather conditions is optimal.

- Allows for an extra perspective that may address new or different issues than a single person may have.
- Group discussions are often beneficial for determining concerns.

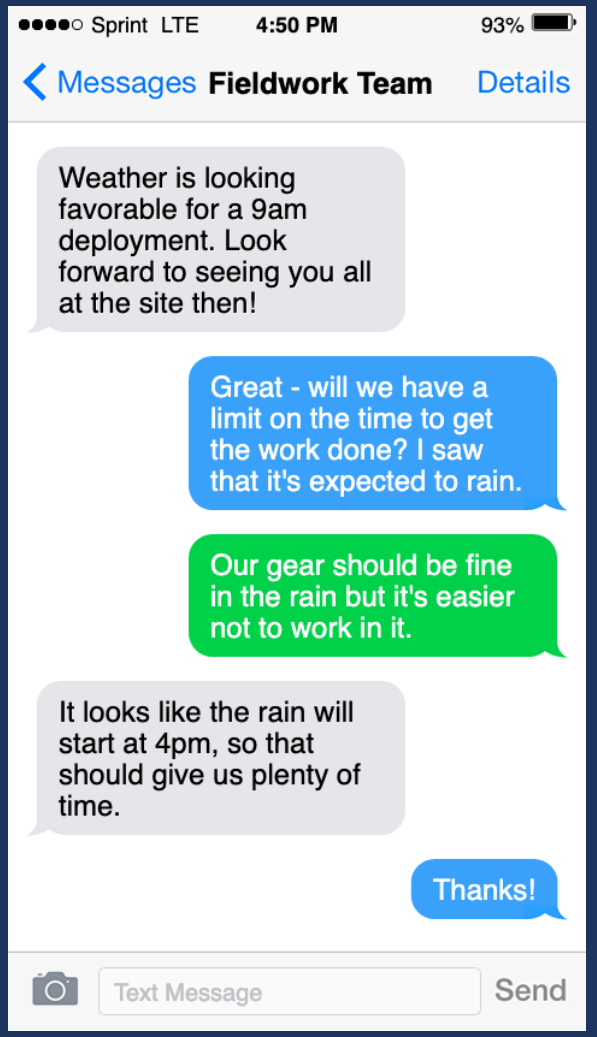
Although 1-2 people are often tasked with monitoring weather conditions, the forecast and conditions should be communicated to all project members, especially when the forecast changes.

Image credit: Apec Typhoon

How can the forecast be communicated effectively to participants?

Communication with the entire team is key!

- Make sure all participants know the criteria for continuing or cancelling fieldwork.
- Let participants know when to expect updates on the forecast and plan for fieldwork.
  - Example: Every day at 11am the forecast will be emailed/texted out.
- Use the same forecast update format each time.
  - Suggested topics:
    1. Overall forecast
    2. Fieldwork concerns
    3. Current decision/plan
- **Text messaging** is still the best form of communicating forecast and fieldwork plan updates.



When should fieldwork be cancelled due to weather conditions?

When safety of the project members or assets is jeopardized by inclement weather, fieldwork should be reconsidered or cancelled.

Each project will have different cancellation criteria, but it's crucial that all project members are aware of the defined criteria for each project.

- No room should be left for interpretation. Be specific with values and share on the weather safety plan.
- Example: *"Fire weather conditions may be high. If we have temperatures greater than 90F, winds greater than 20mph, and humidities below 40%, we are not going out."*

- If some conditions are met for cancellations and others aren't, it is a good idea to have a group discussion to determine the best course of action.

Image credit: CHP Truckee

SOURCES OF FORECASTS AND WEATHER INFORMATION

How do you find local resources of weather information?

Finding reliable sources of information in unfamiliar geographies or during international travel can be daunting.

The best ways to find locally-trusted sources of weather information are:

- Reach out to colleagues who live and work in the area and ask for their preferred sources of info.
- Simple google searches for government weather sources. Government weather services are generally more reliable than their private counterparts.

How do you find local resources of weather information?

If all else fails, find local sources on social media.

- Can often find local forecast pages on Facebook or Twitter by searching for "[Region] Weather" and that should bring up results.

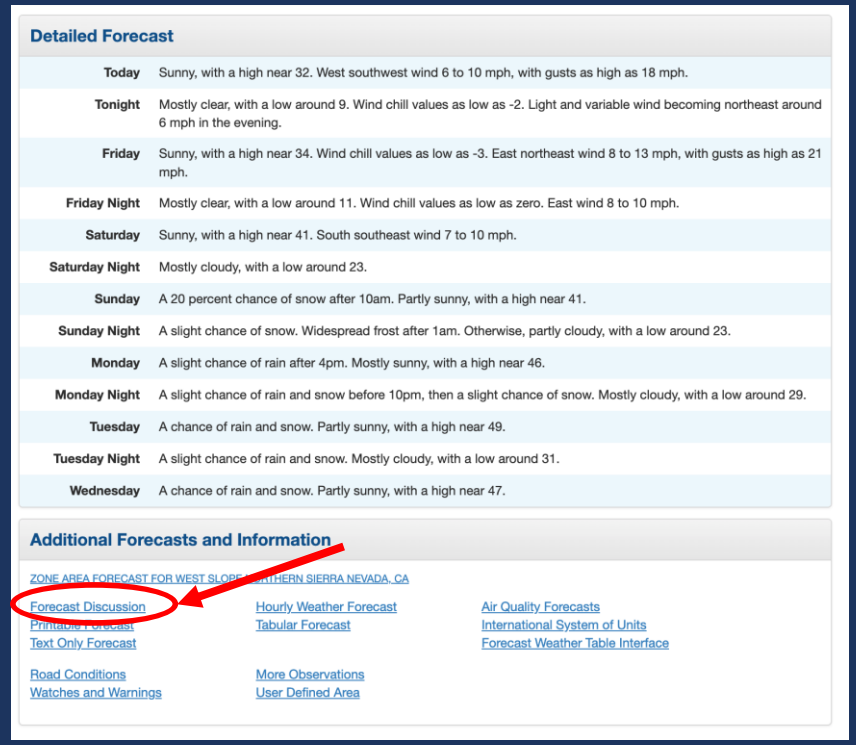
- DO NOT blindly trust "Mark's Fantastic Weather Emporium" on Facebook.
  - Do your due diligence.
  - Check for credentials of the forecasters and members.
  - If the page is run by someone without credentials, check the images/plots that they post for watermarks or logos that can often point in the direction of better sources.

Image credit: wxmankyle.wordpress.com

What resources are best for overall forecasts in the US?

National Weather Service:

- Know the office for your fieldwork location
  - Also referred to as Weather Forecasting Office (WFO)
- Forecast Discussions: Provide more information than basic location-based forecasts
- Forecast Discussion: Example from Reno NWS Office
- Can also call local NWS offices for additional details.
- Provides meteograms for detailed forecasts



Many countries have similar organizations that put out similar products and want to help.

- A few examples:
  - Bureau of Meteorology (BoM): Australia
  - Meteo-France: France
  - Japan Meteorological Agency (JMA): Japan

Specific hazard forecasts: Convective weather (hail, flooding, tornadoes)

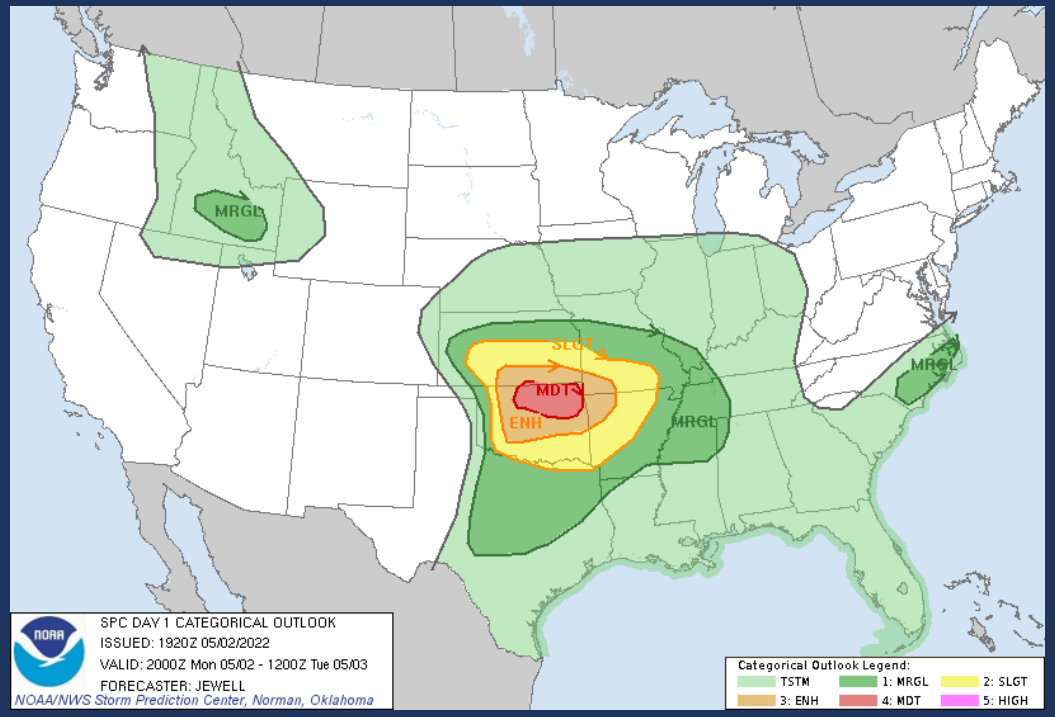
National Weather Service – Storm Prediction Center (SPC)

- Focuses primarily on hazardous weather
- Has hazardous weather outlooks
- Continual updating of information, including discussions

Important considerations:

- Lightning
- Hail size
- Flash flooding
- Tornadoes

- Road network: *What are the escape routes?*



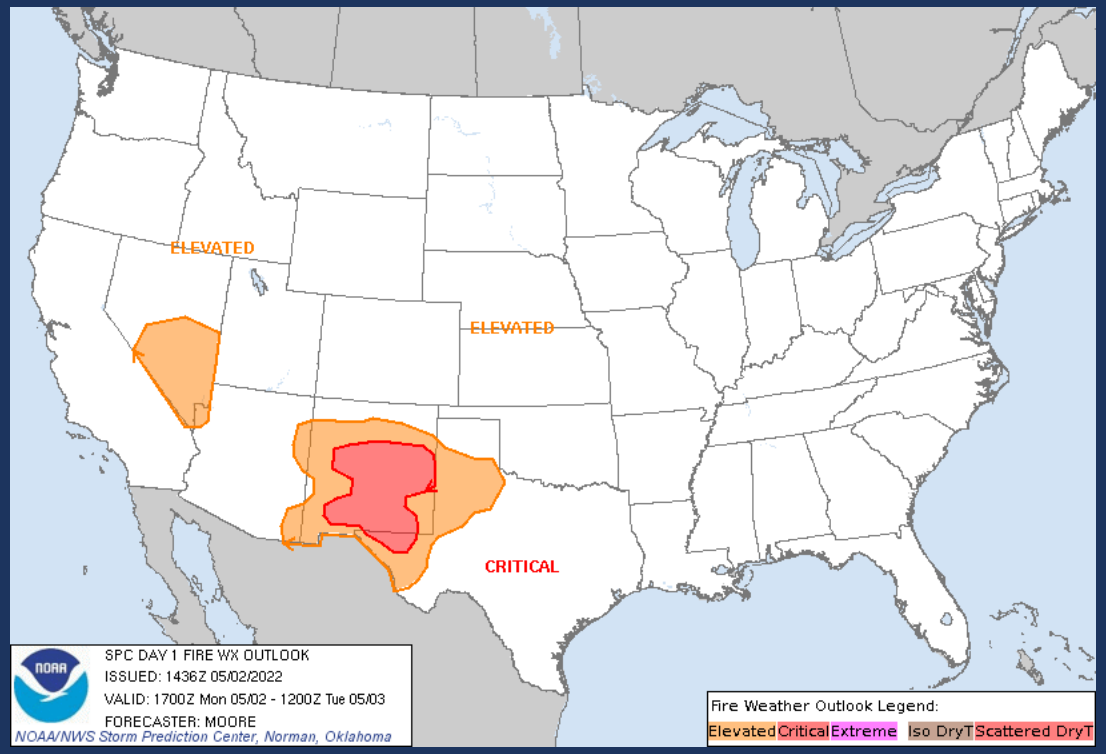
Specific hazard forecasts: Wildfires

National Weather Service: SPC
- General fire weather conditions

Calfire and other state agencies
- Monitoring of fire danger and active fires

USDA Forest Service
- Fire Danger for each forest (local info)

Important considerations:
- Red flag warnings: *issued for weather events which may result in extreme fire behavior that will occur within 24 hours.*
- Wind direction and fuel sources
- Spotting
- Road network/evacuation routes



Specific hazard forecasts: Dust/Air Quality

Forecasting:

- Airnow.gov
  - Consolidates forecasts from smaller agencies and links the agencies for more information
  - Includes resources related to wildfires and smoke
  - Has suggestions on activity based on Air Quality Index (AQI)

- Private weather companies (weather.com, Accuweather) are starting to offer air quality forecasts with their normal products – should be used with caution.

Monitoring:

- PurpleAir.com for local air quality, including wildfire smoke
- Airnow.gov

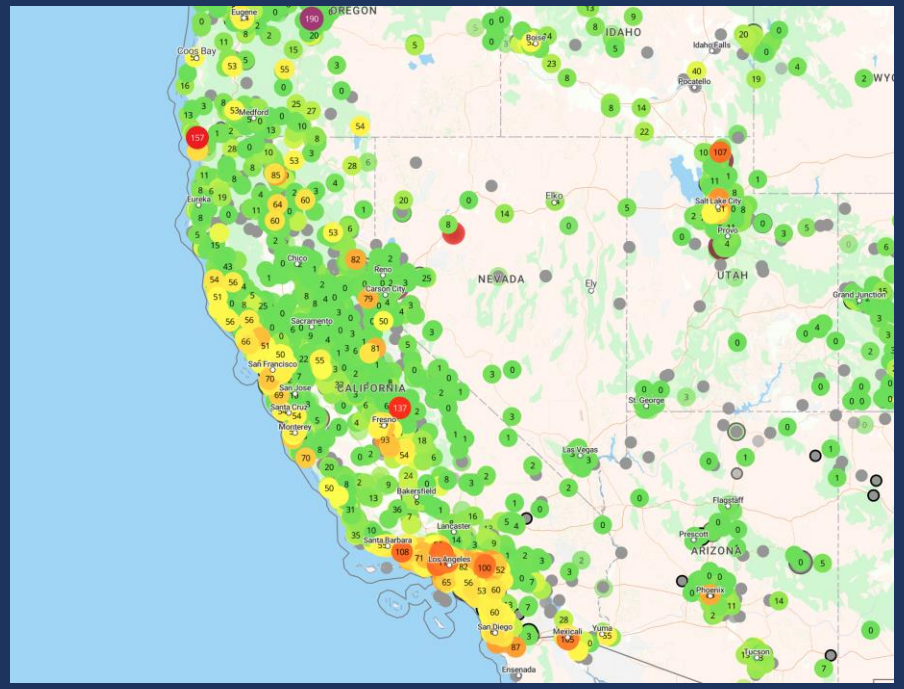


Image credit: PurpleAir.com interactive map

Specific hazard forecasts: Winter conditions and avalanches

Often state-specific:

- State department of transportation and/or highway patrol (road conditions)
- Colorado Avalanche Information Center
- Sierra Avalanche Center
- Utah Avalanche Center

Current conditions for remote travel/field sites

- USDA NRCS SNOTEL sites
  a. SNOTEL interactive charts
  b. SNOTEL recent data

- NWS National Operational Hydrologic Remote Sensing Center

Important considerations:

- Hazardous travel
- Temperatures and wind/wind-chill
- Avalanches and tree wells – always a group!

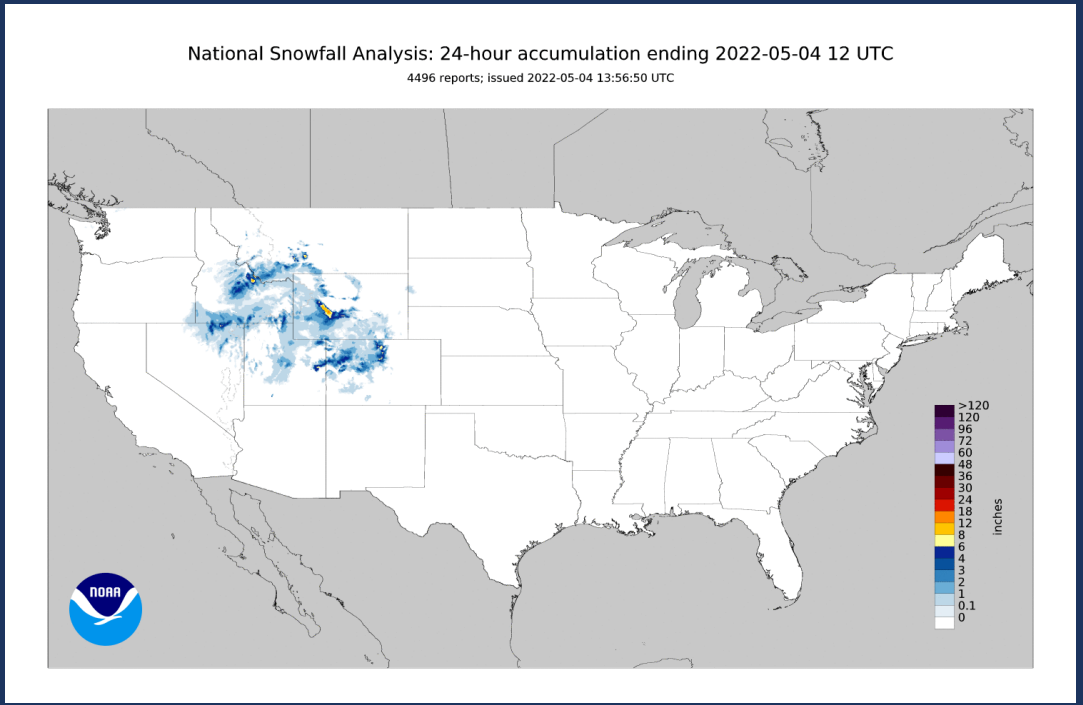


Image credit: unofficialnetworks.com

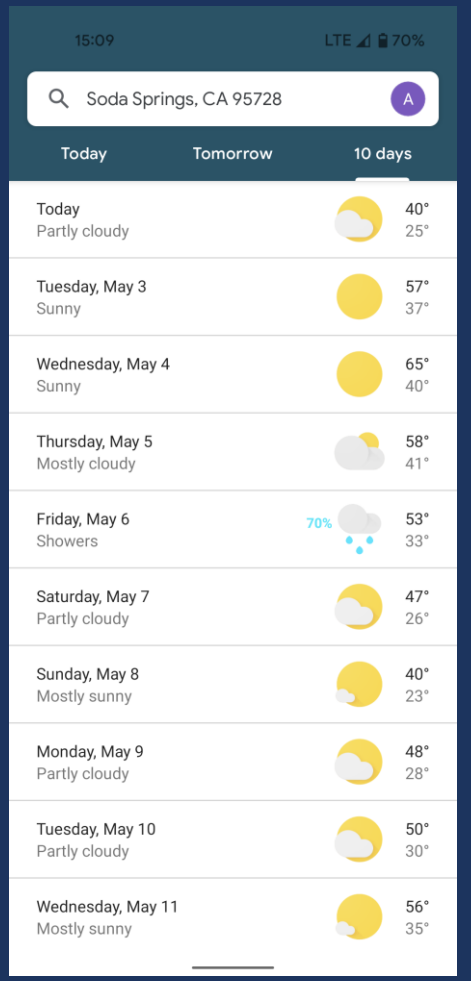
When is it ok to use basic forecasts, such as those generated by apps, rather than obtaining more in-depth forecasts?

Forecasts on apps and most websites are often algorithm-generated from raw model data.

- These forecasts often change rapidly as new model runs come out (generally 1-4 times per day).

Data from these services is generally permissible when there is no immediate danger posed to life or property by conditions.

- Fieldwork isn't in remote regions.
- Used to determine whether weather will be favorable for drone operation.
- Can be used to ensure samples are taken when temperatures aren't outside of preferred temperature range.



Safety concerns and emergency contingencies

Often, the primary safety concern is forecast variability/uncertainty (especially at fine scales). It may lead to the need for decision making in the field.

Tools when in the field:

- NOAA weather radio
- Kestrel
- Weather emergency kit
- Clothing

Image credit: kestrelinstruments.com

Image credit: safetykitsplus.com

Contingencies

- "If X weather or severe event occurs while in the field, do Y."
- Needs to be highlighted on weather safety plan and discussed with everyone participating.
- If specifics are included, a good idea to have a paper copy of contingencies in the field.

WEATHER/FORECAST PLANNING PROCESS

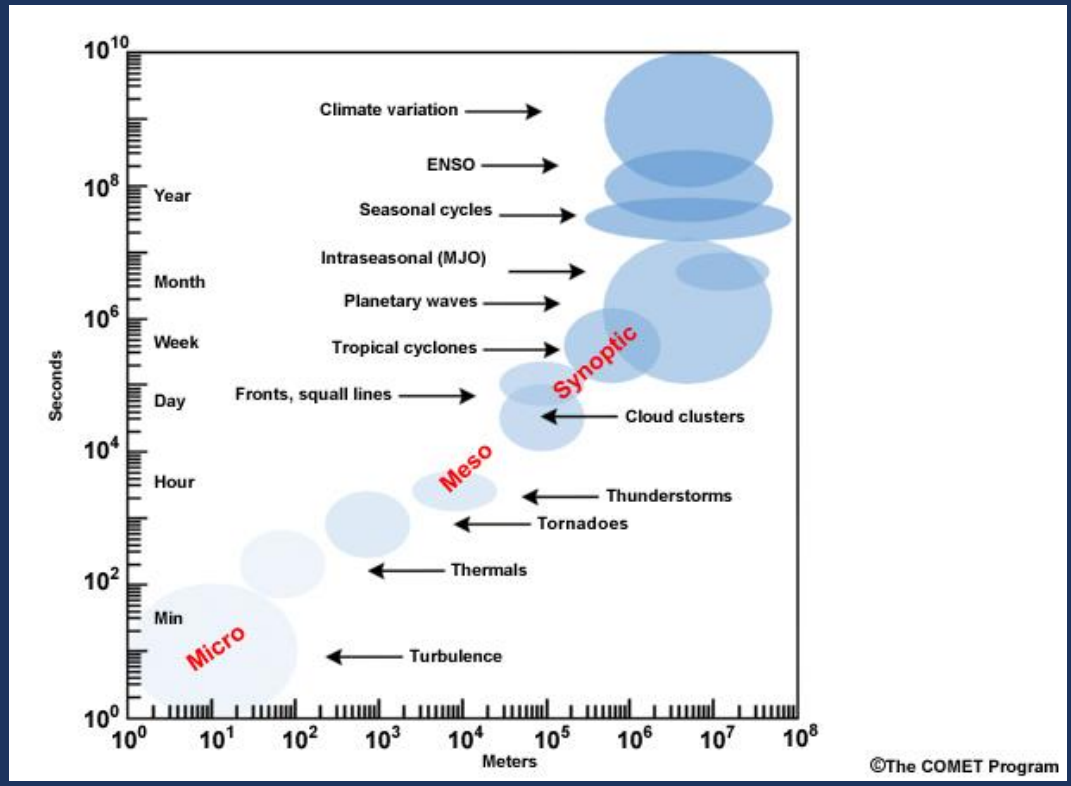
When should forecasts first be examined when planning? How often should the forecast be checked?

Atmospheric spatial and temporal scales hold the answer.

- Forecasts of smaller atmospheric phenomena (local winds, temperatures, cloud cover, precip) are more accurate as the date approaches.

- Start with a top-down or large-to-small scale approach.
  - Begin ~10-14 days before field day for indication.
  - The smaller or more detailed the atmospheric condition, the closer to the date you need to be for a good forecast.

- Forecast variability may mean tougher decisions and more frequent forecast checks



Forecasting flow chart

Days before fieldwork

10-14

- General idea of potential weather (clear or not)
- No specifics
- Should be used to determine how closely the forecast needs to be watched

7-10

- General weather pattern becoming clearer
- Start looking at temperature, wind, and precipitation quantity
- Start checking forecast at least every two days

3-7

- Weather pattern likely determined, specifics (timing, location) may still be unsettled
- Temperature, wind, and precipitation quantity forecast should be examined closely
- Checking forecast every day if unfavorable fieldwork conditions are possible

1-3

- Accuracy of forecast improves significantly - timing and location of weather better
- If forecast is still variable, checking twice a day (00Z and 12Z) may be a good idea
- Start making preliminary decisions on whether fieldwork will occur

0

- Highest accuracy forecast – often can get ‘forecast discussion’ for more details
- Examine final temperature, wind, precipitation forecasts
- Make final decision on whether to conduct fieldwork based on latest information

Resources for more weather information

University Corporation for Atmospheric Research (UCAR) MetEd

- *"MetEd is a free collection of hundreds of training resources intended for the geoscience community. Whether you're an experienced meteorologist honing existing skills or a student looking for new geoscience topics of interest, we have something for you."*
- MetEd.UCAR.edu

College of DuPage Next Generation Weather Lab

- Weather analysis tools
- Radar, satellite, and model outputs
- Text products

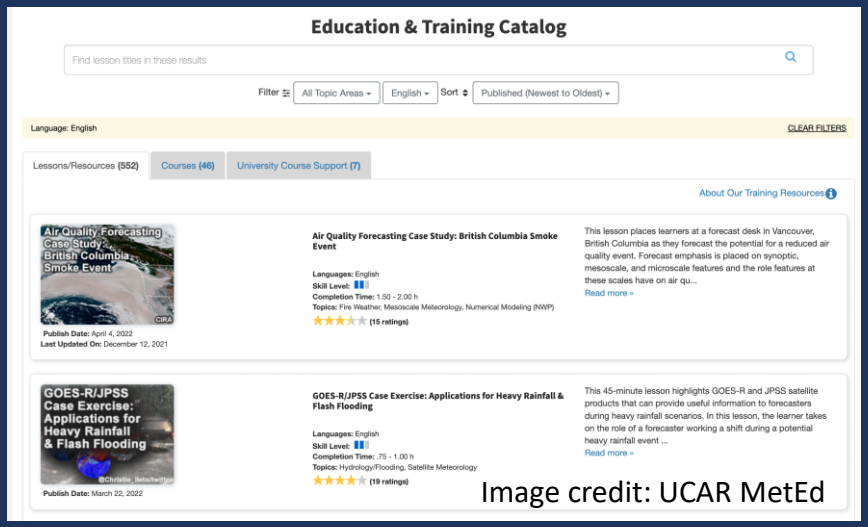


Image credit: UCAR MetEd

Image credit: CoD

Recap: Optimal weather preparedness

- Items for success:
    1. Weather safety plan including contingencies
    2. Identified weather monitors/observers
    3. Preferred data sources
    4. An agreed-upon weather monitoring process
    5. Communications plan
    6. An emergency kit

Image credit: mountainsensing.org

Questions and discussion