METEOROLOGY B - SEVERE WEATHER & STORMS

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

1. **DESCRIPTION:** Participants will use scientific process skills involving qualitative and quantitative analyses to demonstrate an understanding of the characteristics of severe weather, including the factors that contribute to, cause and influence **Severe Weather & Storms** on the Earth. The interpretation of meteorological data, graphs, maps, charts, tables and images will be emphasized.

A TEAM OF UP TO: 2 **APPROXIMATE TIME:** 50 minutes

CALCULATOR: Class II

2. **EVENT PARAMETERS:**
   a. Each team may bring writing utensils.
   b. Each team may bring two Class II calculators.
   c. Each team may bring one three-ring binder of any size containing information in any form and from any source attached using available rings. Sheet protectors, lamination, tabs and labels are permitted.
   d. If the event features rotation through a series of stations, no material may be removed from the binder during the event.
   e. Students are expected to have a U.S. map with the state names in their binder.
3. **THE COMPETITION:**
   a. The event may be either a written exam format, or teams may move from station to station with the length of time at each station predetermined and announced by the event supervisor. Participants may not return to stations but may change or add information to their original answers while at other stations.
   b. At least fifty percent (50%) of the questions shall be based upon interpretation of weather data displayed in maps, graphs, images, photographs, charts, and/or tables to analyze Severe Weather and Storms.
   c. Severe Weather & Storms Topics:
      i. Observation technologies: surface observation networks (i.e., Automated Surface Observing System (ASOS), high-resolution mesonets), radiosondes, buoys, Doppler radar (base and composite reflectivity, base velocity, correlation coefficient, storm relative motion and wind profiles), aircraft, satellite imagery (i.e., water vapor, visible, and infrared (IR))
      ii. Types of data used to forecast and monitor severe weather
         (1) Surface maps including interpretation of station models and decode METAR coded weather observations
         (2) Analysis of severe weather and storm data preferably from 2022 to 2027
         (3) Hodographs
         (4) Computer model predictions
         (5) Stüve diagrams: interpretation of cloud formation, wind shear, stability
         (6) States and National only - Skew-T diagrams, applying the same skills as used on Stüve diagrams
         (7) States and National Only - Lifting Condensation Level (LCL)
         (8) States and National Only - Convective Available Potential Energy (CAPE)
      iii. Factors and environmental conditions leading to severe weather:
         (1) Large-scale circulation patterns, jet streams, atmospheric stability, air masses, fronts, wind shear, atmospheric rivers, and drylines
         (2) Influence of oceans and large water bodies, including the effects of fetch, heat content, heat transport, and wakes caused by storms
         (3) Influence of physical landforms and topography on the formation and strengthening or weakening of severe storms
      iv. Clouds: identification and interpretation of cloud types, limited to those related to severe weather events
      v. Droughts and heat waves: definitions, causes and effects
      vi. Precipitation from severe storms: types and the relationship of intensity, duration, hail size, frequency of impacts of heavy precipitation, formation (collision-coalescence, Bergeron process, riming, aggregation, temperature layers, etc.)
         (1) Solid precipitation: snow, sleet, and hail as well as the importance of hail size
         (2) Liquid precipitation
            (a) types: freezing rain, freezing drizzle and rain
            (b) results: debris flows, mudslides, flooding (flash, stream, river, and urban)

(3) Impacts of Precipitation: (e.g., snow loads, structural damage (dams, buildings, roads, bridges, natural features) as well as the effects on air and ground travel)
(4) **States and National Only - Intensity-duration-frequency (IDF) curves and return periods for precipitation events**

vii. Lightning: process of electrification of clouds, charge differentiation, all types of lightning and lightning direction finders/systems
viii. Severe thunderstorms: definition, types (single, multicell, supercell and mesoscale convective complexes (MCCs)), characteristics, structure and life cycles
ix. Winds:
(1) Types and definitions: straight-line, downdrafts, downbursts, microbursts, macrobursts, gust fronts, squall lines, derechos, downslope winds and their impacts
(2) Detection by Doppler radar imagery: derecho, straight-line winds, gust fronts, and squall lines
x. Tornadoes and waterspouts: definition, life cycles, tracks, time of day and year, geographic preferences and atmospheric conditions for formation, as well as characteristics, structure
(1) Application of Fujita (F) [historically used before February 1, 2007] and Enhanced (EF) Fujita Scales [used after February 1, 2007] to tornado classification.
(2) Doppler radar:
(a) Images: reflectivity, velocity, and correlation coefficient
(b) Features: bow echo, tornadic vortex signature (TVS), hook echo and debris ball
xi. Hurricanes, typhoons and cyclones:
(1) Definition, life cycles (e.g., Invest, Depression, Tropical Storm, Hurricane, Major Hurricane), time of year and geographic preferences for formation
(2) Tracks, characteristics, formation, and structure
(3) Application of Saffir-Simpson Scale to hurricane classification
(4) Storm surge (causes, factors, effects of its height)
(5) Effects of topography, wind shear, El Niño-Southern Oscillation (ENSO) and pressure systems on track, intensification, or dissipation
(6) Identification of eye, eyewall, and spiral bands, using Doppler radar and satellite images
xii. Severe winter storms, characteristics and definitions: blizzards, nor'easters, lake effect snowstorms and ice storms
xiii. Hazards from each type of severe weather
xiv. Weather safety:
(1) NOAA/NWS watches/warnings
(2) Use of reliable sources for severe weather information and forecasts
(3) Severe weather preparedness
(4) Actions to take when faced with severe weather threats and/or impacts, such as tornadoes, hurricanes, flash floods, storm surge and lightning
xv. Severe Weather Events & Cases: Analysis and interpretation of data provided, and competitors will not be expected to memorize facts or data
(1) Historic severe events limited to:
(a) Hurricanes: Galveston (1900), Andrew (1992), Katrina (2005), Sandy (2012), Ida (2021), Ian (2022), Hilary (2023), Helene (2024), Erin (2025), and Melissa (2025)
(b) Blizzard of March 1888
(c) Dust Bowl of the 1930s
(d) Tornadoes: Xenia Ohio (1974) and the April 2011 Outbreaks
(e) Great Flood of 1993 in U.S.
(f) Storm of the Century (March 1993)
(2) Analysis of severe weather and storm data preferably from 2022 to 2027

4. **<u>SCORING</u>:**
a. High Score wins.
b. Points will be awarded for the accuracy of responses, the quality of supporting reasoning, and use of scientific techniques.
c. Preselected questions will be used as tiebreakers.

In partnership with the National Oceanic and Atmospheric Administration (NOAA) and the North American Association for Environmental Education (NAAEE)