PROCESS FOR FORECASTING DUST STORMS

From the "Forecasting Dust Storms" Module

Produced by The COMET® Program

Long-range Forecast Process (72 to 180 hours):

Step 1: Look for large-scale, synoptically driven dust events in the 3 to 7.5-day range in global models, such as DTA-GFS and NAAPS.

Step 2: Look for model-forecast midlatitude troughs that drive pre- and post-frontal dust storms in winter and that can amplify the large-scale wind patterns associated with summer events, such as the northerly winds that create shamals. These large-scale waves are resolved by global NWP models such as GFS and NOGAPS, while the associated dust outbreaks are modeled by the global dust models, DTA-GFS and NAAPS.

Medium-Range Forecast Process (24 to 72 hours):

Step 1: Examine the following charts from the DTA-WRF, COAMPS, NOGAPS, and/or DTA-GFS models.

- 300-mb height and wind forecast charts to track troughs and jet streaks; briefly examine upper-tropospheric winds to identify the presence of any jet streaks, especially for cool-season dust storms. Jet streaks within a pronounced upper-level trough are indicative of an intensifying low-pressure system with stronger surface fronts and associated winds
- 500-mb height and relative vorticity forecasts to identify and track troughs and vorticity maxima
- MSLP and surface wind forecast charts for fronts and potentially strong wind conditions

Step 2: Looking at the forecast soundings from WRF or COAMPS, determine the forecast stability and wind profile at your forecast time of interest.

Step 3: Check the 6-hrly precipitation and 700-mb relative humidity forecast charts to determine where increased moisture and precipitation are anticipated since they decrease the probability of dust lofting.

Step 4: Combine COAMPS forecasts of surface friction velocity, surface winds, and soil wetness from WRF and/or COAMPS with your knowledge of dust source areas to see if the criteria for a potential blowing dust event are met. Recall that friction velocity incorporates atmospheric stability and wind speed into one variable.

Step 5: Examine DTA-WRF and COAMPS forecasts of surface visibility due to dust. Compare them to WRF and COAMPS forecasts of winds through the mixed layer and dust optical depth to help assess changes in geographical extent and intensity with each successive model run.

Step 6: From the model output and your initial analysis, develop a best-guess forecast as to the onset and duration of any dust events in your area of responsibility in the 24- to 72-hr window.

Short-Range Forecast Process (0 to 24 hours):

Step 1: Analyze the present state of the atmosphere by looking at satellite imagery, upper-air charts, and surface analyses, keeping in mind the location and characteristics of relevant dust source regions.

Step 2: Examine the latest observed and/or forecast soundings from WRF and COAMPS. Note the strength of any inversions (usually during summertime) and determine if they will break due to turbulent mixing and daytime heating that would ripen the environment for a dust outbreak.

- A dry adiabatic lapse rate from the surface through a deep mixed layer allows the dust to loft to great heights, especially if winds are from the same direction and increase with height through the layer
  - Note that dust storms generally occur in this kind of environment and that the strongest wind speed aloft within the dry adiabatic layer can be brought to the surface
  - The height or top of an elevated dust layer can be approximated by determining where the lapse rate becomes less than the dry adiabatic lapse rate
- Dust storms are less likely in a stably stratified boundary layer although narrow plumes of blowing dust are still possible

Step 3: To determine the potential duration and type of dust event, pay special attention to dust lofting in your area of responsibility, local rules-of-thumb about advection, and geographic features such as the location of dust source regions, terrain, vegetation, and water sources. Also note where precipitation has fallen in the past 48 hours and whether it was convective or stratiform.

Step 4: Use satellite dust enhancement products (such as enhanced infrared imagery) and RGB and other multispectral imagery tuned for dust detection. Integrating these products with surface observations can provide information about the current extent and location of existing dust plumes and fronts.

Step 5: Make a best-guess forecast as to the onset, duration, and persistence of any dust events in your area of responsibility in the very short term, using short-range mesoscale model output from DTA-WRF and/or COAMPS as guidance. The global DTA-GFS and NAAPS models can resolve large-scale features that drive smaller-scale dust events in the short term but cannot resolve localized dust features.