AWOC Microclimate 4.3
Man-Made Snow over Northern Des Moines
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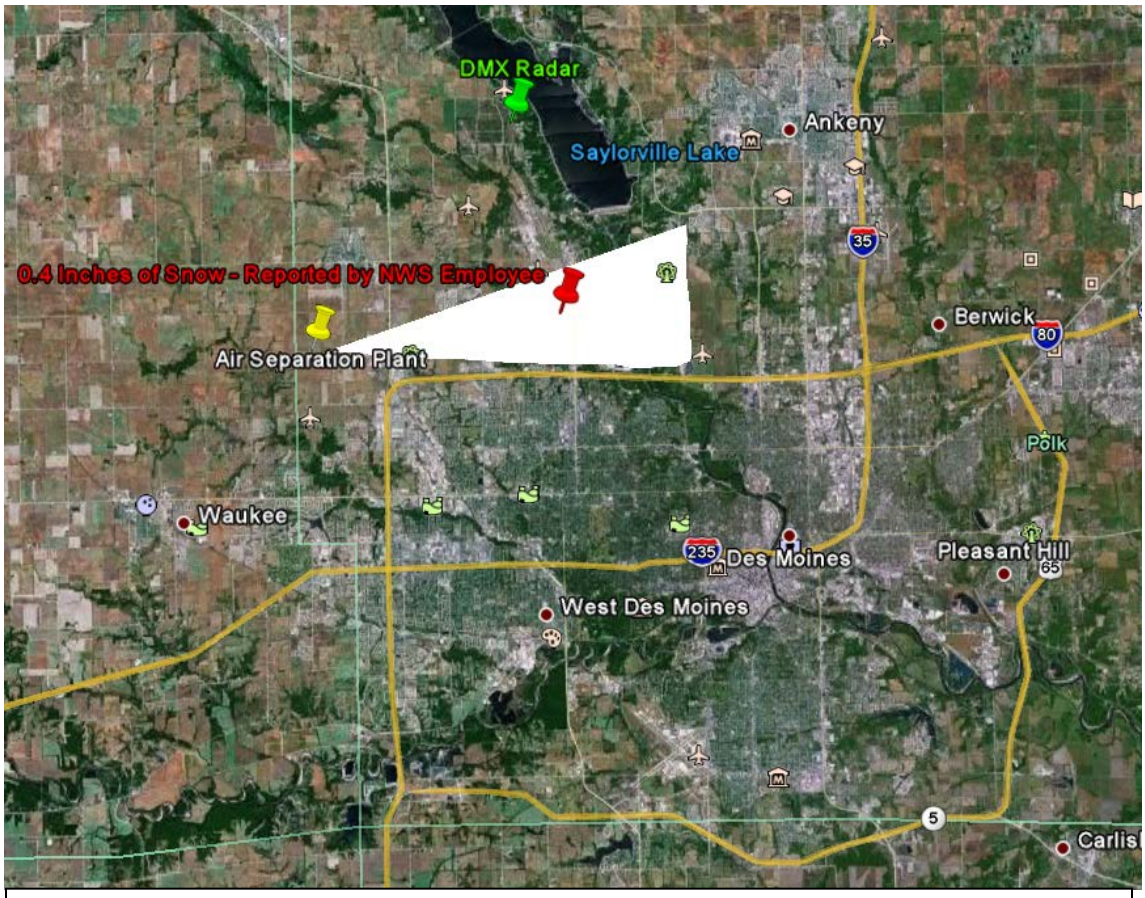
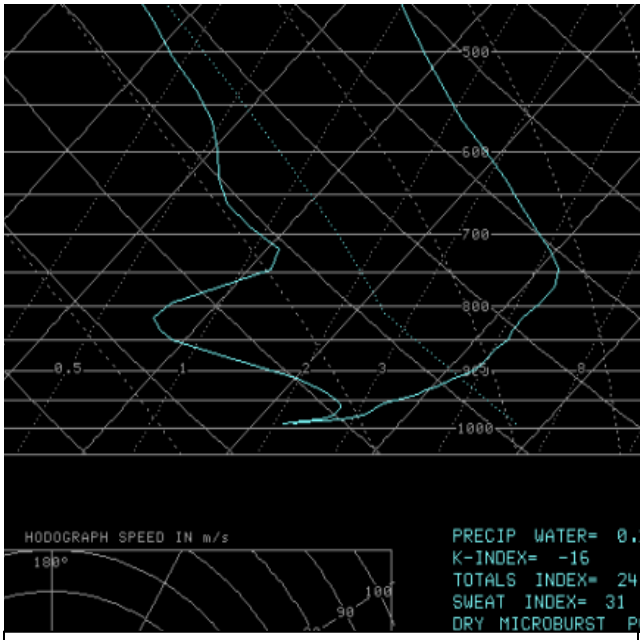
Overview: On a few occasions over the past several years, it has been noted that very small and localized snow bands form in just the right conditions near Grimes, Iowa, an area about 10 miles northwest of Des Moines. This snow has been tied to an air separation plant. Specifically, this plant is a cryogenic air separation plant, which produces purified nitrogen, oxygen, argon and other gases on an industrial scale. After calling the plant on several occasions, it has been made clear that the plant only emits water vapor into the air. It was first suspected that the plant was emitting some sort of sulfur oxide, which acts as additional CCN and has a lower ice activation temperature, therefore introducing ice into the clouds and causing this moisture to fall out as snow. However, this is not the case. The plant is simply putting additional water vapor into the air, seemingly causing an already supersaturated cloud with respect to ice to become "super supersaturated. " This process allows for the ice particles within the cloud to grow just large enough that the vertical motion within the cloud cannot suspend them any longer.

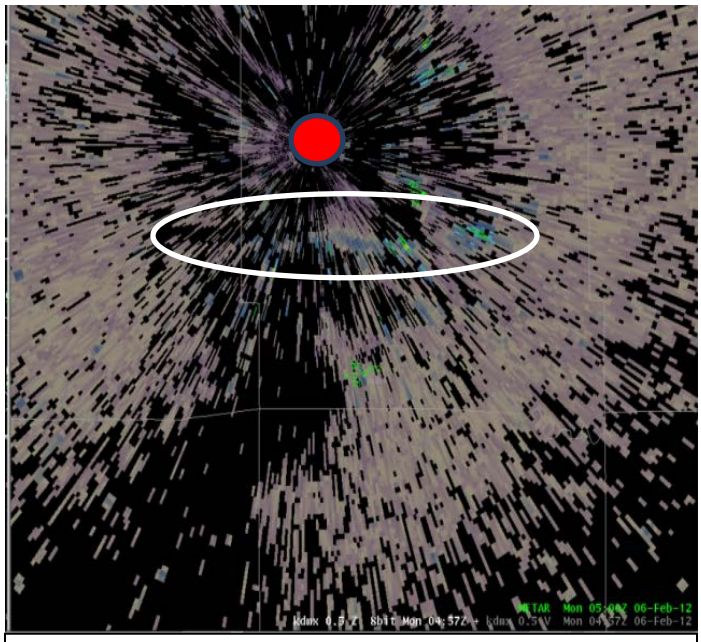


Yellow pin depicts the location of the air separation plant. The white polygon shows the area that reported snow with the plume in this case, with 0.4 inches reported near the center.

Forecasting: Obviously, this scenario is incredibly rare and hard to forecast for. However, there are some obvious necessary conditions that forecasters can key in on to diagnose the potential of these events. First, is saturation at very low levels. In the particular case below, the atmosphere was very saturated through about 1,000 feet AGL, then very dry above that. Temperatures within the saturated portion of the sounding ranged from -8 to -5C, so there was a chance ice was present in the cloud (It had to be present, assuming the factory is just emitting water vapor). Additionally, it seems that winds need to be light (ideally between 3 and 7 knots), but not calm. If winds are too strong, then the very low cloud deck tends to mix out a bit too much, placing it too high above the water vapor plume from the factory. But, if winds are too light, then vapor from the factory does not get displaced too much from its original location, thus causing much less aerial coverage of the snow and much less impact.



RUC sounding for the time the snowfall was occurring. Notice the saturation at very low-levels near -5 to -8C. This sounding also showed very light westerly winds (near 5 knots) through the saturated layer.



Although tough to spot due to close proximity and clutter, the plume is visible on the DMX radar (circled in white).

Impacts: This snow has been known to cause quite a few problems across portions of Des Moines. When this plume is able to set up for an extended period of time, it has been documented to drop in excess of an inch of snow across northern portions of the city. In the particular case below, 0.4 inches were observed just a few miles downwind from the factory. If the winds are right, this snow band can set up over Interstate 80, which has major implications on Des Moines traffic. Since these events are

not often forecasted in advance, many drivers are unaware of the potential slick spots on the roads and are more prone to accidents. More research will continue to be done as cases continue to be compiled, all in an attempt to better understand what exact factors contribute to this rare occurrence.