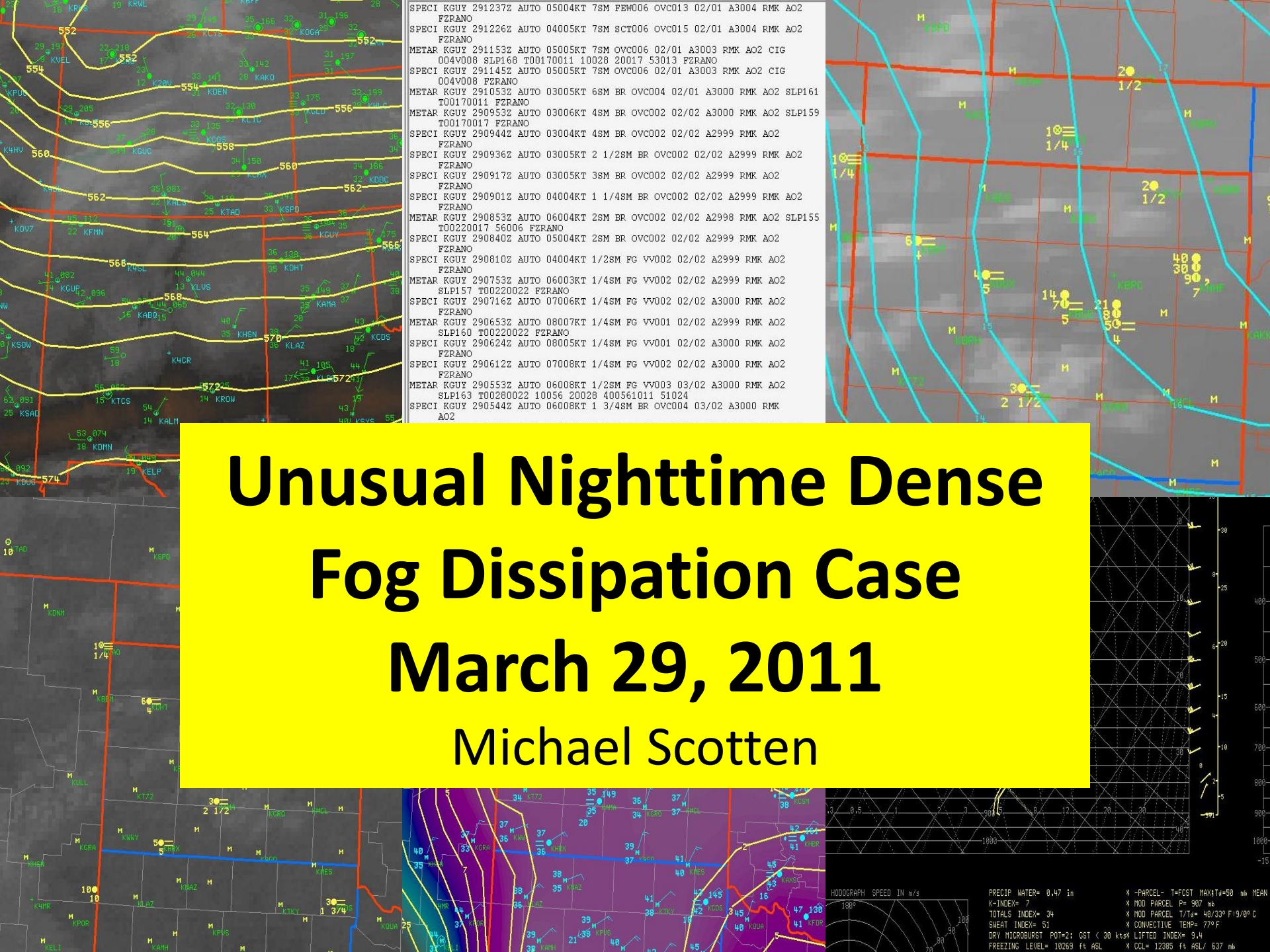


Unusual Nighttime Dense Fog Dissipation Case March 29, 2011

Michael Scotten

What happened?

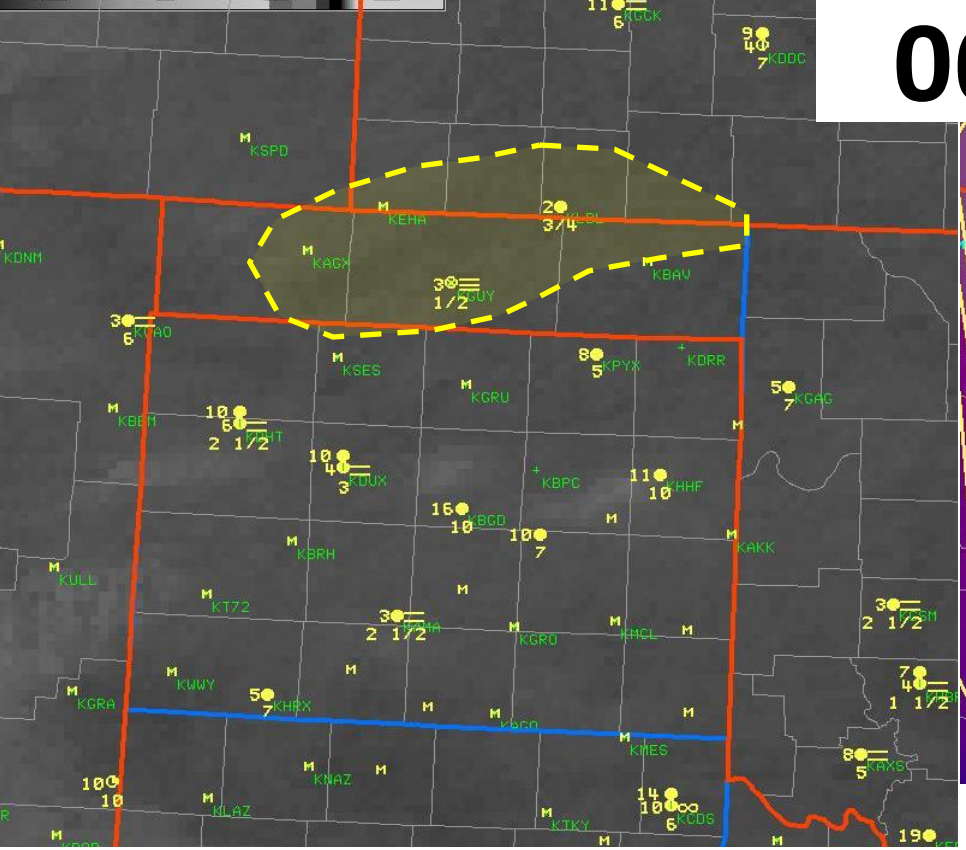
- **Areas of dense fog developed over the Oklahoma Panhandle by 07z which caused the issuance of a Dense Fog Advisory at 0731z.**

- **The dense fog quickly dissipated and lifted after 08z, causing the Dense Fog Advisory to be cancelled early at 1106z, well before sunrise.**

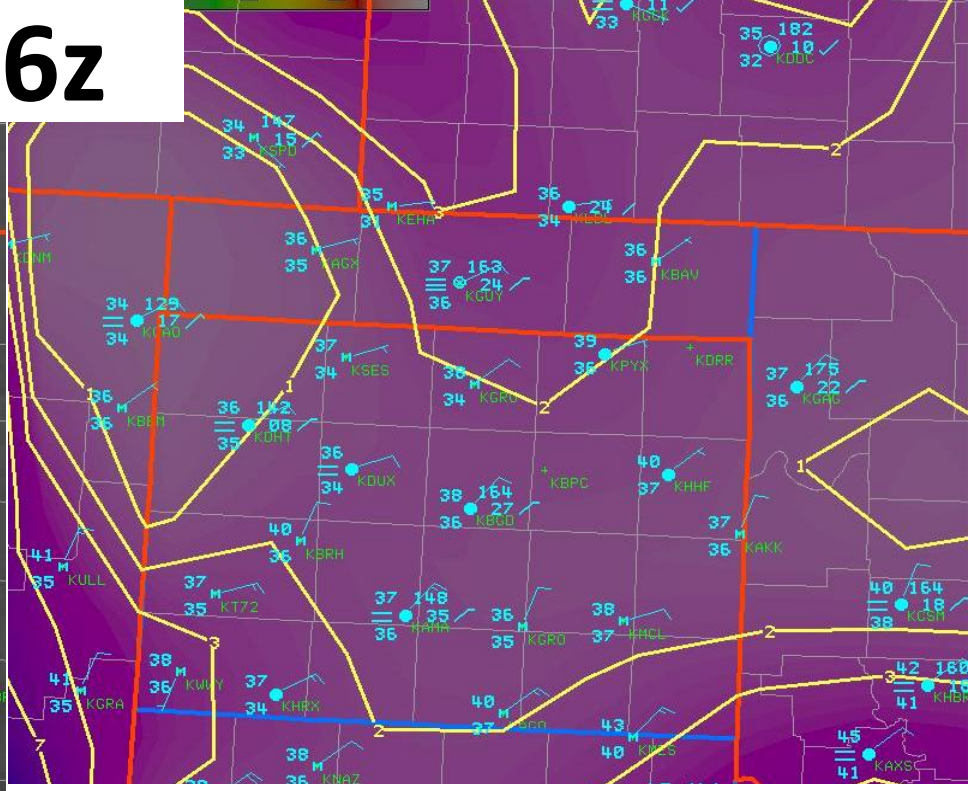
Reasons For Fog Dissipation from DLAC (Distance Learning Aviation Course) at http://www.meted.ucar.edu/dlac/lesson2a/frameset.htm

Parameter	Characteristics	What to Look For
Moisture	• Advection • Trajectories • Local Sources • Terrain Influences	• Decrease in moisture due to less advection or trajectory changes. • Will local moisture sources (lakes, moist soils, vegetation, etc.) provide adequate source to keep fog longer than models indicate? • Will mechanical lifting /blocking by local terrain features keep moisture trapped?
Stability	• Mixing • Capping Inversion • Subsidence • Dynamics	• Large-scale subsidence will help support the low-level inversion and fog. Look for decreases in subsidence or any increases in upward motions that may be associated with an approaching system. • Inversion weakening through daytime heating.
Winds	• Turbulence • Momentum Transfer	• Increased turbulence or momentum transfer from above the inversion level can contribute to dry air mixing/inversion break-up/fog layer dissipation.
Temperature	• Surface/air Differential • Advection Changes	• In warm advection cases, a cold ground will help enhance and sustain fog and its density. Look for observed or expected decreases in the air/surface temperature differential which will help thin/dissipate/or lift fog. • Switching from warm or cold advection is likely to break up a fog event rapidly and at least lift it to a stratus/stratocumulus layer.

06z

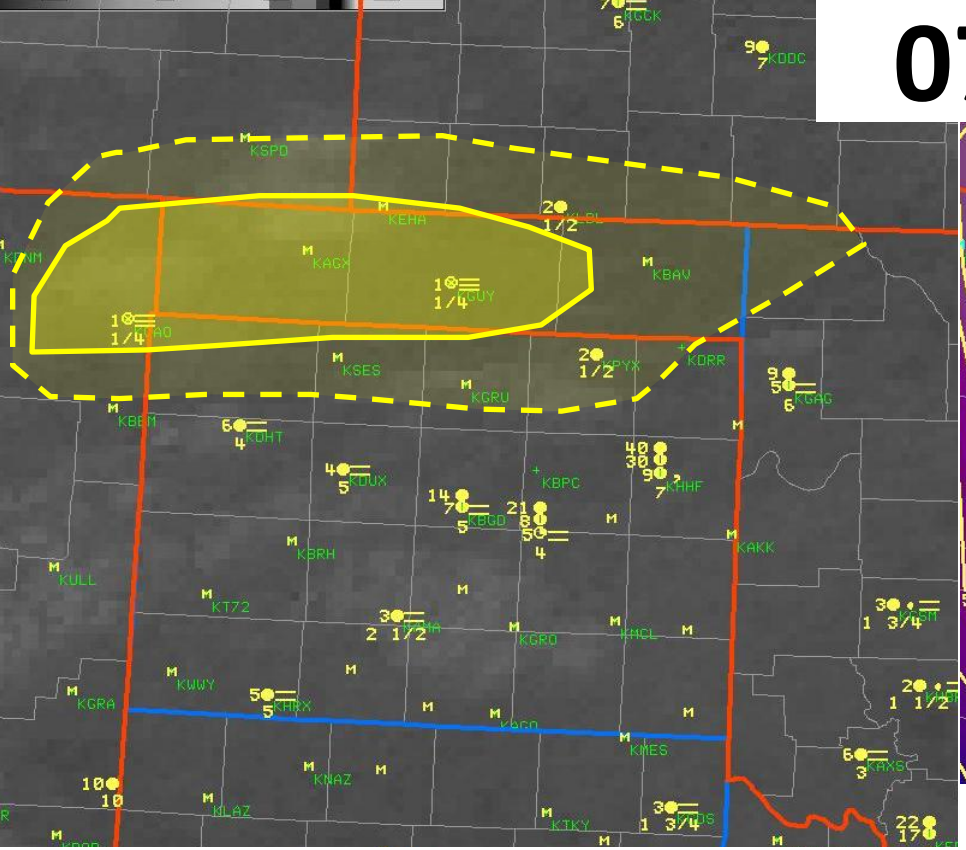


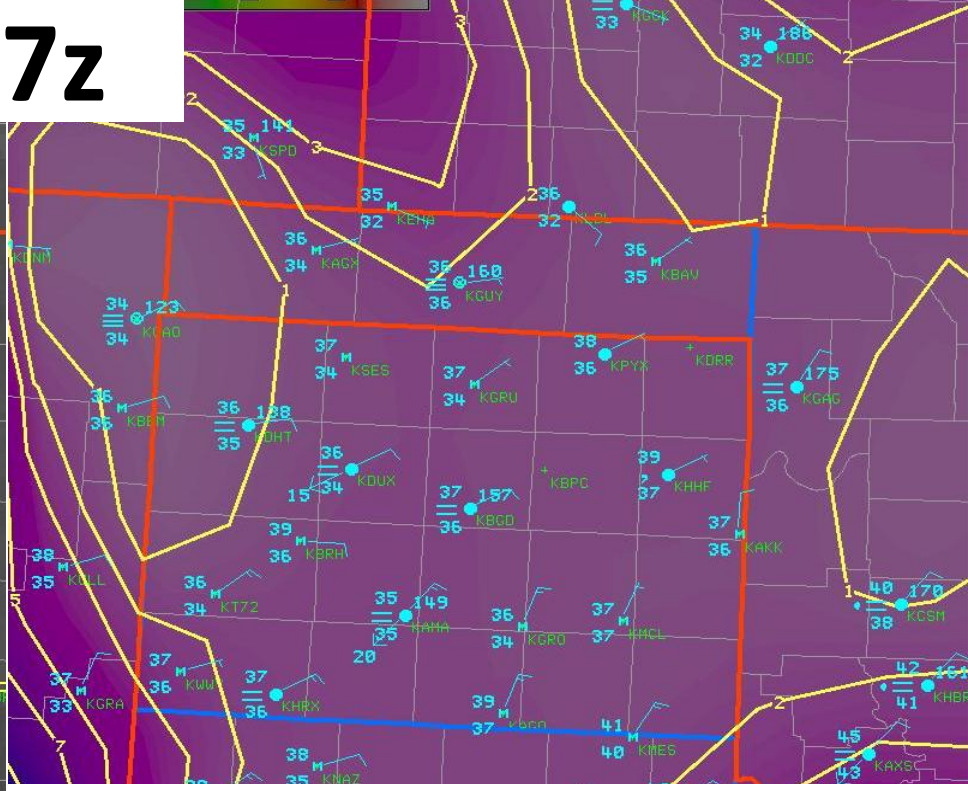
11u-3.9u Satellite/Obs



MSAS Surface Dewpoint Depressions/Obs

- Visibilities were below 1 mile across much of the Oklahoma Panhandle and far southwest Kansas, but no dense fog was occurring.
- Widespread low clouds were observed along with patchy/areas of fog.
- A very moist low level environment was occurring with surface dewpoint depressions less than 3 degrees.
- Light east to northeast surface winds mainly less than 10 mph were observed.





11u-3.9u Satellite/Obs

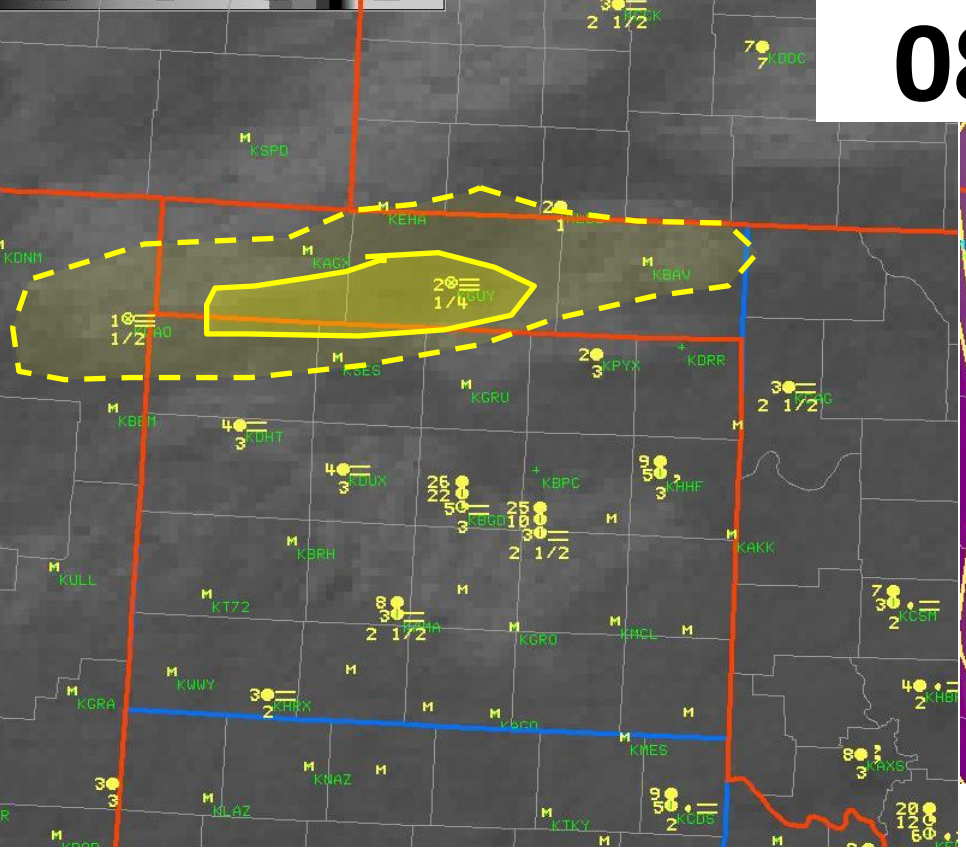
- Area of visibilities under 1 mile expanded across the Oklahoma and far North Texas Panhandles, far southwest Kansas, far southeast Colorado, and far northeast New Mexico.

- Areas of dense fog with visibilities ¼ mile or less was observed from Clayton to Guymon.

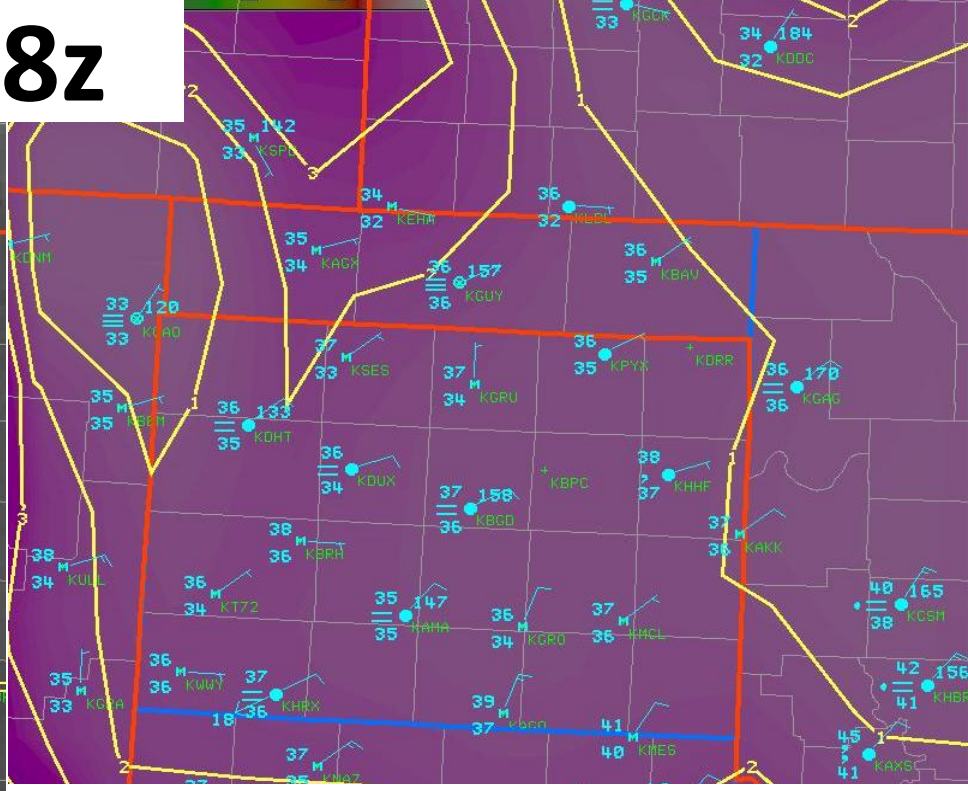
MSAS Surface Dewpoint Depressions/Obs

- A very moist low level environment continued.

- Surface winds were weakest and more easterly where lowest visibilities were occurring, whereas they were a bit stronger and more northeasterly elsewhere.



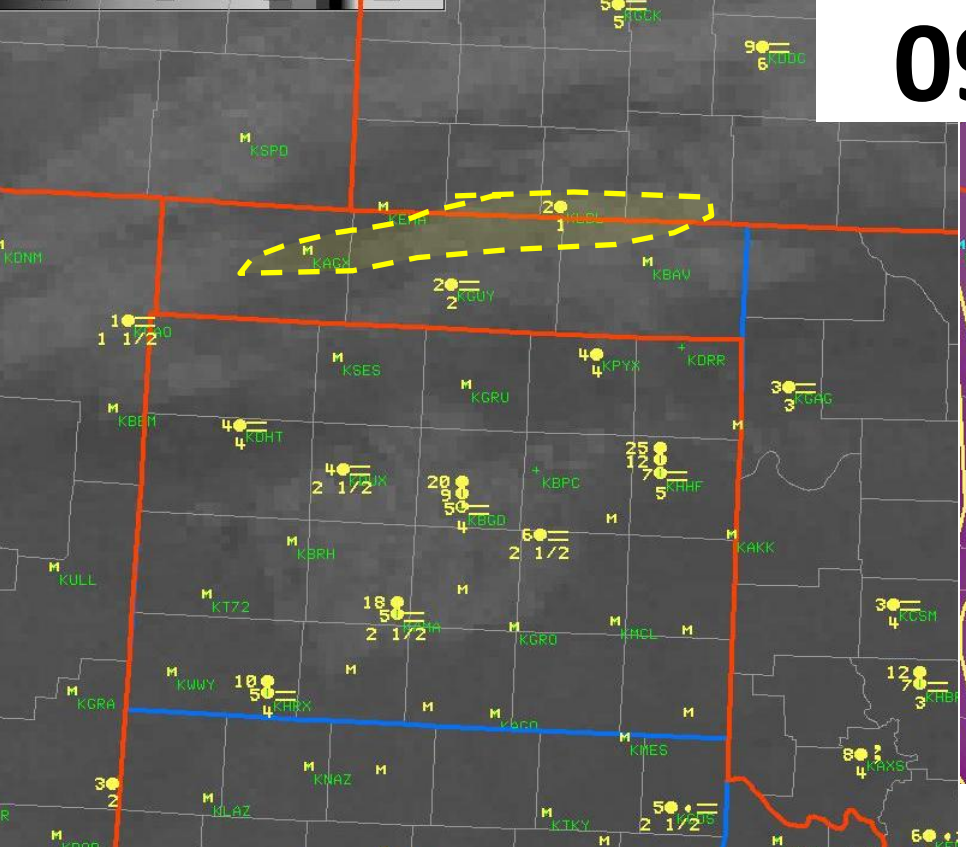
11u-3.9u Satellite/Obs



MSAS Surface Dewpoint Depressions/Obs

- Area of low visibilities decreased and shrunk with only Guymon reporting ¼ mile visibility.

- A very moist low level environment continued with a light east to northeast surface flow.



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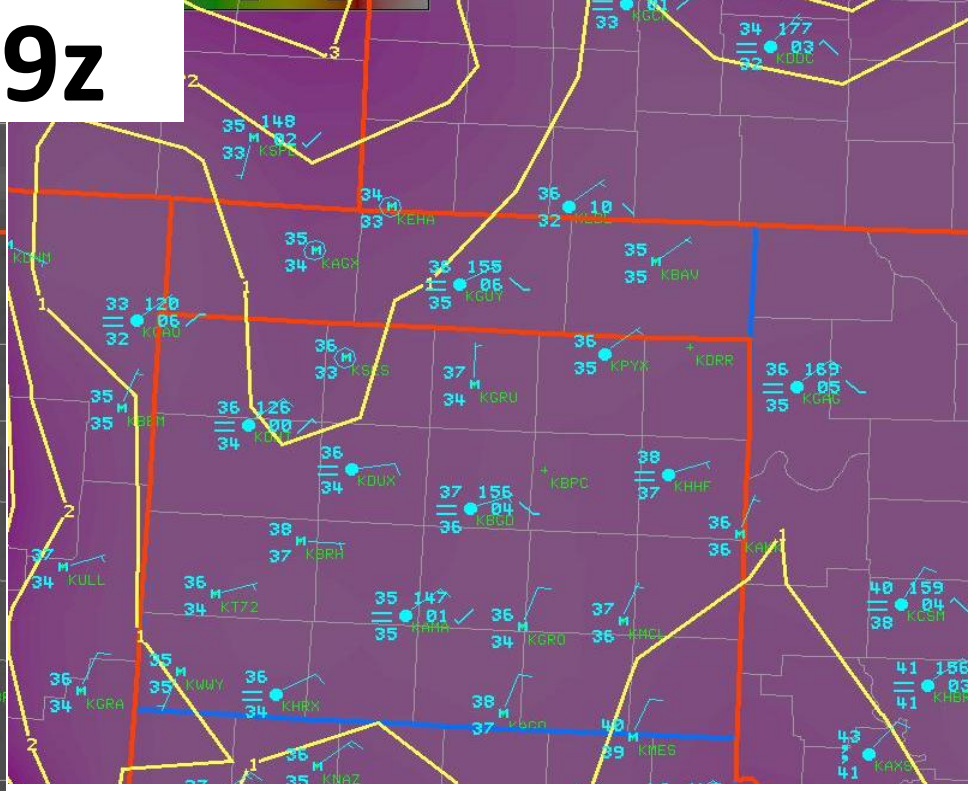
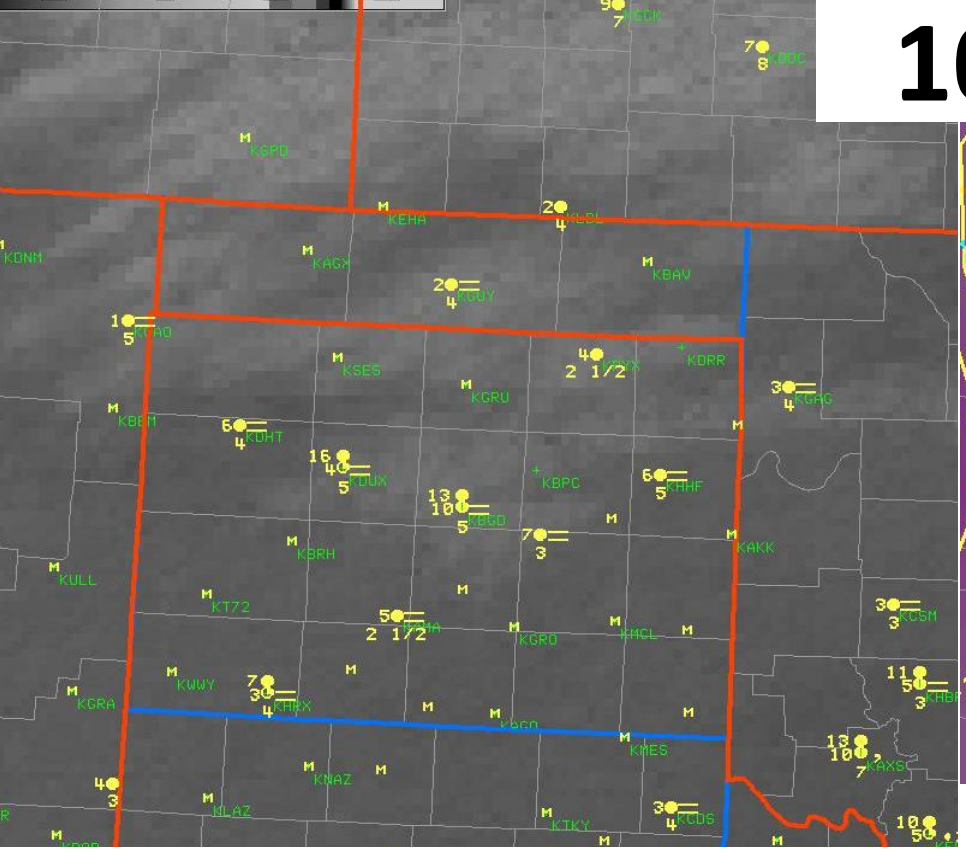


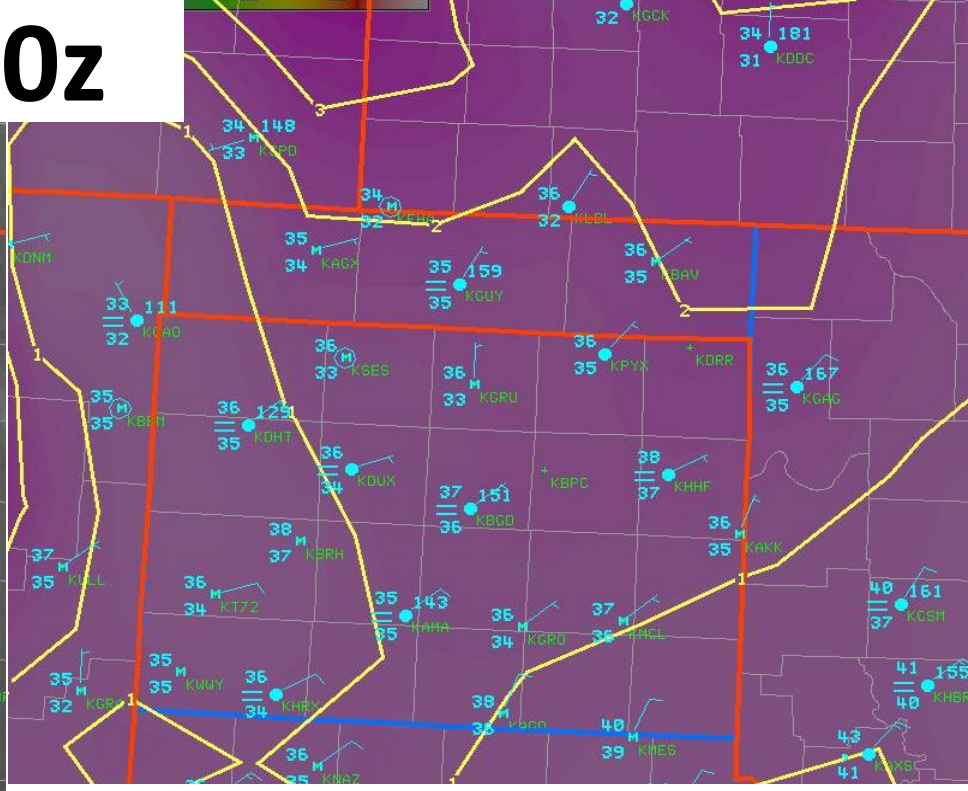
MSAS Surface Dewpoint Depressions/Obs

- Visibilities improved considerably across the Oklahoma Panhandle with visibilities generally 1 mile or greater.
- Dense fog was no longer observed or reported.
- Moist low level conditions were still occurring with very little to no advection of dry air near the surface.

10z



11u-3.9u Satellite/Obs



MSAS Surface Dewpoint Depressions/Obs

- Visibilities had improved considerably everywhere with no locations reporting visibilities 1 mile or less.

- Surface winds had shifted to more of a northerly direction over the Oklahoma Panhandle and points north.

Guymon Observations

```
SPECI KGUY 291237Z AUTO 05004KT 7SM FEW006 OVC013 02/01 A3004 RMK AO2
      FZRANO
SPECI KGUY 291226Z AUTO 04005KT 7SM SCT006 OVC015 02/01 A3004 RMK AO2
      FZRANO
METAR KGUY 291153Z AUTO 05005KT 7SM OVC006 02/01 A3003 RMK AO2 CIG
      004V008 SLP168 T00170011 10028 20017 53013 FZRANO
SPECI KGUY 291145Z AUTO 05005KT 7SM OVC006 02/01 A3003 RMK AO2 CIG
      004V008 FZRANO
METAR KGUY 291053Z AUTO 03005KT 6SM BR OVC004 02/01 A3000 RMK AO2 SLP161
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SPECI KGUY 290944Z AUTO 03004KT 4SM BR OVC002 02/02 A2999 RMK AO2
      FZRANO
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      FZRANO
SPECI KGUY 290917Z AUTO 03005KT 3SM BR OVC002 02/02 A2999 RMK AO2
      FZRANO
SPECI KGUY 290901Z AUTO 04004KT 1 1/4SM BR OVC002 02/02 A2999 RMK AO2
      FZRANO
METAR KGUY 290853Z AUTO 06004KT 2SM BR OVC002 02/02 A2998 RMK AO2 SLP155
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      AO2
SPECI KGUY 290530Z AUTO 06007KT 4SM BR OVC004 03/02 A3000 RMK AO2 CIG
      003V007
METAR KGUY 290453Z AUTO 06007KT 10SM OVC009 04/02 A3000 RMK AO2 SLP161
      T00390017
SPECI KGUY 290404Z AUTO 07006KT 10SM BKN011 OVC022 04/02 A2998 RMK
      AO2
METAR KGUY 290353Z AUTO 05006KT 10SM SCT013 OVC022 04/02 A2997 RMK AO2
```
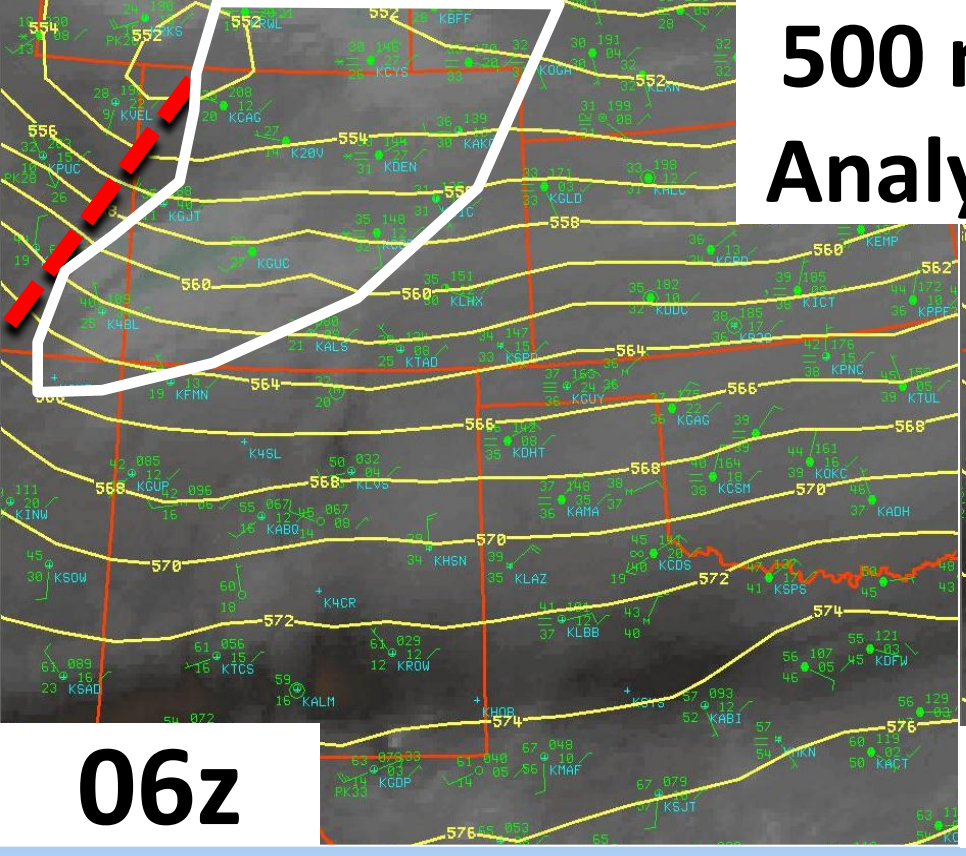
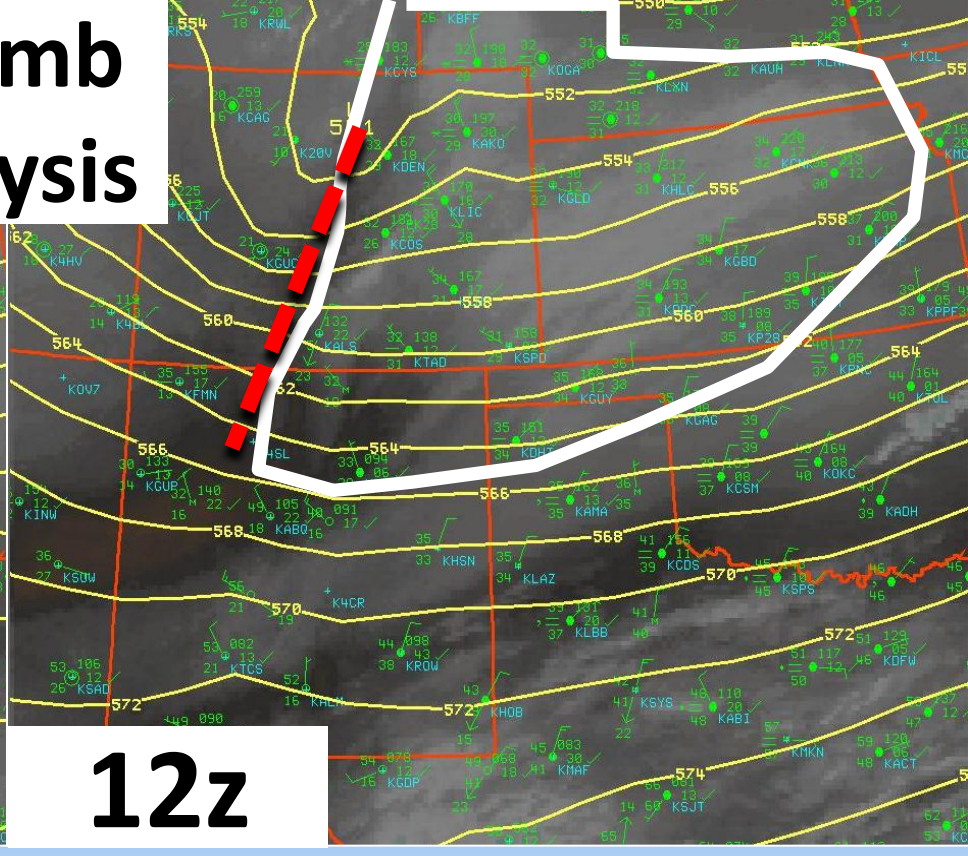

- Dense fog occurred 0612-0810z.
- Surface winds veered slightly from 060 to 080 degrees resulting in better upslope flow as dense fog formed around 06z, then backed from 080 to 040 degrees as the dense fog dissipated around 08z.
- Light surface winds prevailed along with nearly steady SLPs.

500 mb Analysis



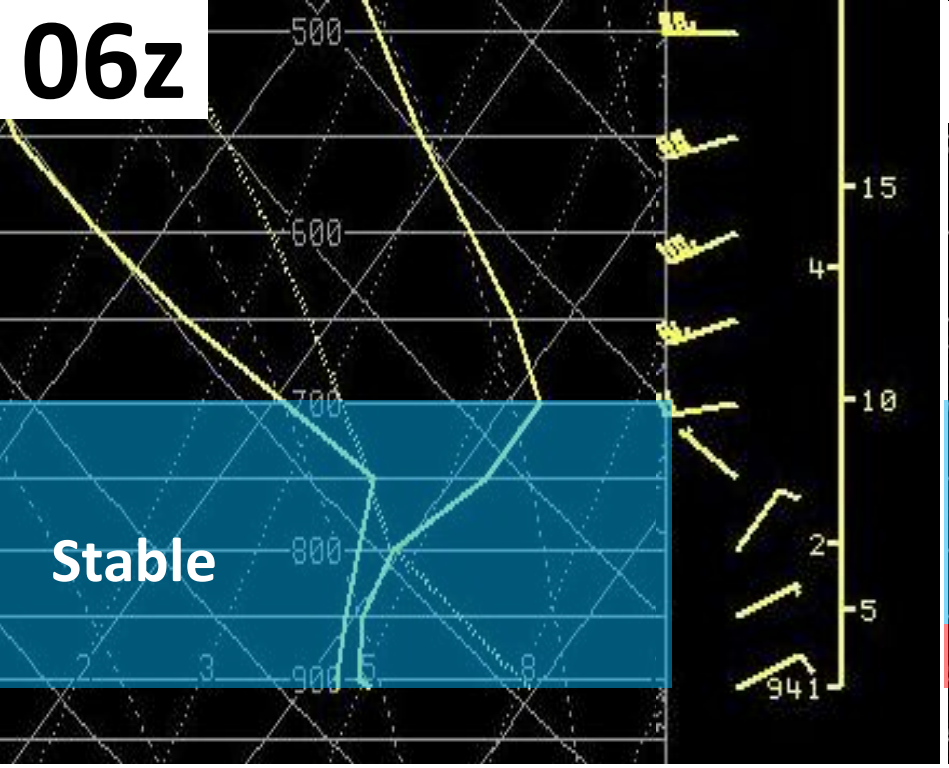
06z

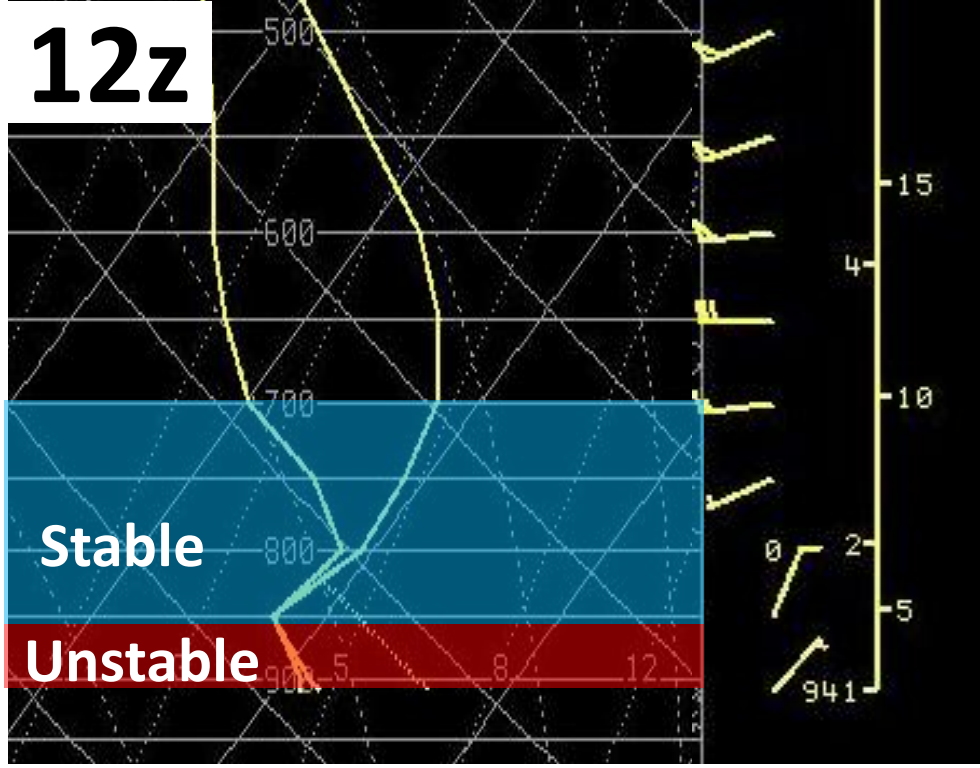


12z

- A 500 mb trough moved across the Rockies which allowed for 500 mb height falls and increased upwards motion as depicted in the white shaded areas east of the trough. An increase in mid/high level moisture was depicted by water vapor satellite imagery just east of the trough as a result of increased moisture and lift.

- The trough moved east through the night allowing for height falls, increased upwards motion, and mid/high level moisture to spread across the Oklahoma and north Texas Panhandles, northeast New Mexico, east Colorado, and much of Kansas.





LAPS Soundings at Guymon

- The 06z sounding showed moist and stable conditions below 700 mb along with weak northeast winds below 750 mb.

- The 12z sounding showed some cooling in the lowest 500 mb.

- A pronounced base of an inversion was observed at 850 mb with some slightly unstable air between the surface and 850 mb while stable air was between 850 and 700 mb.

Reasons For Fog Dissipation in This Case Study

Parameter	Characteristics	What to Look For
Moisture	• Advection • Trajectories • Local Sources • Terrain Influences	• Decrease in moisture due to less advection or trajectory changes. • Will local moisture sources (lakes, moist soils, vegetation, etc.) provide adequate source to keep fog longer than models indicate? • Will mechanical lifting /blocking by local terrain features keep moisture trapped?
Stability	• **Mixing** • **Capping inversion** • Subsidence • **Dynamics**	• Large-scale subsidence will help support the low-level inversion and fog. **Look for decreases in subsidence or any increases in upward motions that may be associated with an approaching system.** • Inversion weakening through daytime heating.
Winds	• Turbulence • Momentum transfer	• Increased turbulence or momentum transfer from above the inversion level can contribute to dry air mixing/inversion break-up/fog layer dissipation.
Temperature	• Surface/air differential • **Advection changes**	• In warm advection cases, a cold ground will help enhance and sustain fog and its density. Look for observed or expected decreases in the air/surface temperature differential which will help thin/dissipate/or lift fog. • **Switching from warm or cold advection is likely to break up a fog event rapidly and at least lift it to a stratus/stratocumulus layer.**

Overview

- **Areas of dense fog developed over the Oklahoma Panhandle by 07z which caused the issuance of a Dense Fog Advisory at 0731z. The fog quickly dissipated and lifted after 08z, causing the Dense Fog Advisory to be cancelled early at 1106z, well before sunrise.**

- **Weak low level cold air advection caused the air to destabilize near the surface which likely allowed dense fog to break up and dissipate around and after 08z.**

- **A 500 mb trough/short wave brought upward vertical motion which may have weakened a low level inversion and increased low level mixing slightly to help dissipate the dense fog.**

Lessons Learned

- **Dense fog may dissipate during the nighttime hours in rare instances.**

- **Look for:**
  1. Cold air advection in the low levels that is deep enough to cause the air near the surface to become a bit unstable

  2. A 500 mb trough/short wave that can bring increasing upward motion and lift a low level inversion to reduce stability near the surface