Dew Point Climatology

For Southeast Minnesota, Northeast Iowa, and Western Wisconsin

WFO La Crosse Climatology Series #17

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Objectives

• Become familiar with climatological hourly Td curves

• Understand how wind direction affects Td

• Become aware of the unique characteristics of KLSE and KRST
Data Methodology

- **1961-1995 Surface Hourly Observations**
  - NCDC SAMSON CDROM 1960-1990
  - NCDC HUSWO CDROM 1990-1995
  - 1965-1972 removed due to station closures: 23 total years possible.
    - LSE (17)
      - No 62, 63, 80, 81, 85, 91. Removed June 78, 82, 95.
    - RST (20)
      - No 78, 80, 90
    - ALO (18)
      - No 73, 74, 80, 81
    - EAU (19)
      - No 78-81
    - MSN: (23)
    - MCW: (17)
      - No 73, 74, 78-81
Data Methodology

- Hourly dewpoint calculated over the period of record for every day of the year at each of the six sites. Also done hourly for every month.
- Average monthly dewpoint categorized by wind direction was calculated for each site by month.
- A group average was calculated by averaging the data from each of the six sites.
- A ‘perturbation’ or anomaly (Td’) was created by subtracting the site dewpoint (Td) from the group average (Td ave). Td’ = Td ave - Td
  - This perturbation, or Td’, is used to show where the dewpoint varies from the group average.
  - Shows local or site specific differences more clearly.
Synoptic vs. Local Signals

• All months – when there is a synoptic signal, it dominates

• Winter months – synoptic scale tends to have more influence

• Summer months – local signal has more influence
  - Exchange between soil moisture and water vapor in air
  - Crop coverage vs. moisture in air
  - River as moisture source
The Big Picture (All Sites): Hourly Dew Points

- Larger variation over 24 hours during the Winter months than Summer months
Exercise - January

Average Hourly Dewpoint - January

Graph showing the average hourly dewpoint for January. The x-axis represents hours (LT) from 1 to 24, and the y-axis represents dewpoint temperature in Fahrenheit (-2.0 to 2.0). The graph compares the site dewpoint with the group dewpoint difference.
January – Td variation 6°F

Average Hourly Dewpoint - January
La Crosse, Wisconsin
July – Td variation 3° F

Average Hourly Dewpoint - July
La Crosse, Wisconsin

KLSE Td vs. Group
Exercise: Labeling

Average Hourly Dewpoint - July
La Crosse, Wisconsin

- Mixing/ET battle
- Sunset
- Stable PBL Begins
- ET still occurring
- Sunrise
- Condensation
- ET tiny

Dewpoint (F)

Hour (LT)

KLSE Td
Average Hourly Dewpoint - July
La Crosse, Wisconsin

KLSE vs. Group Dewpoint Difference (F)

KLSE Td

KLSE Td vs. Group

Condensation
ET tiny
ET
Mixing/ET battle
Stable PBL Begins
ET still occurring
Sunrise
Sunset

Dewpoint (F)

Hour (LT)

KLSE Td

KLSE Td vs. Group
Exercise – Wet and Dry

Average Hourly Dewpoint - July
La Crosse, Wisconsin

- Condensation
- ET tiny
- Mixing/ET battle
- Stable PBL Begins
- ET still occurring
- Sunrise
- Sunset

KLSE Td
KLSE Td vs. Group
Hourly Dewpoint - July - La Crosse WI

- LSE July
- LSE Wet
- 1976 - Dry
Real Life Example – July 2004

Hourly Dewpoint - July - La Crosse WI

- LSE July 26 2004 Ridge
- LSE July Average Td
- LSE July 10 2004 Ridge After Rains
ARX Forecast Trends

Daily Forecast Critique

- **Normal Diurnal cycle (condensation)**
- **Southerly Moisture Advection**
- **NW, post-frontal dry air advection**
- **Non-climo diurnal curve**
- **Wrong trend**
The Big Picture (All Sites): Hourly Dew Points

- Larger variation over 24 hours during the Winter months than Summer months
- Td rises during evening hours from April through October; 9 to 10 pm peak
  - Vegetation related
Evening Td Rises

Average Hourly Dewpoint - April
La Crosse, Wisconsin

Average Hourly Dewpoint - May
La Crosse, Wisconsin

Average Hourly Dewpoint - June
La Crosse, Wisconsin

Average Hourly Dewpoint - July
La Crosse, Wisconsin

Average Hourly Dewpoint - August
La Crosse, Wisconsin

Average Hourly Dewpoint - September
La Crosse, Wisconsin
The Big Picture (All Sites): Hourly Dew Points

- Larger variation over 24 hours during the Winter months than Summer months
- Td rises during evening hours from April through October; 9 to 10 pm peak
  - Vegetation related
- Transition from 2 Td peaks to 1 in October
  - Growing season ending
Transition from 2 peaks to 1

Average Hourly Dewpoint - September
La Crosse, Wisconsin

Average Hourly Dewpoint - October
La Crosse, Wisconsin

Average Hourly Dewpoint - November
La Crosse, Wisconsin
Unique to KLSE:

Hourly

• Td is lower than the group in winter months; higher than group in summer months
  – Especially at night
  – Important for fog development
  – Highest perturbation is in Aug/Sept
Td Lower Than Group in Winter

Average Hourly Dewpoint - February
La Crosse, Wisconsin

1.5°F lower than group
Td Higher Than Group in Summer

Average Hourly Dewpoint - August
La Crosse, Wisconsin

Hour (LT)
KLSE Td
KLSE Td vs. Group

Dewpoint (F)
KLSE vs. Group Dewpoint Difference (F)

2°F Higher than group overnight
Aug. and Sept. biggest anomaly

Average Hourly Dewpoint - September
La Crosse, Wisconsin

2°F higher than group overnight

KLSE Td vs. Group Dewpoint Difference (°F)
Unique to KLSE: Hourly

- Td is lower than the group in winter months; higher than group in summer months
  - Especially at night
  - Important for fog development
  - Highest perturbation is in Aug/Sept

- In green months, Td actually decreases during afternoon, then rises again
Td Decreases in Afternoon

Average Hourly Dewpoint - June
La Crosse, Wisconsin

- Td decrease
- Td increase

Hour (LT)

Dewpoint (F)

KLSE Td vs. Group

Dewpoint Difference (F)
Unique to KRST: Hourly

• Later impact from growing season
Growing Season

Average Hourly Dewpoint - May
La Crosse, Wisconsin

Average Hourly Dewpoint - June
La Crosse, Wisconsin

Average Hourly Dewpoint - May
Rochester, Minnesota

Average Hourly Dewpoint - June
Rochester, Minnesota

Nocturnal boundary layer forms, traps ET

Nocturnal BL forms, traps ET

Weaker BL due to mixing (elev), ET mixed

Weaker BL due to mixing (elev), ET mixed
Unique to KRST:
Hourly

- Later impact from growing season
- July and August are the only months with the evening Td higher than the daytime
  - Mixing vs. Evapotranspiration
  - Crop canopy coverage most extensive
KRST Evening Td Higher Than Afternoon

Average Hourly Dewpoint - July
Rochester, Minnesota

Average Hourly Dewpoint - August
Rochester, Minnesota
Unique to KRST:

Hourly

• Later impact from growing season

• July and August are the only months with the evening Td higher than the daytime
  - Mixing vs. Evapotranspiration
  - Crop canopy coverage most extensive

• Lower Td than group in Aug. and Sept.
  - Harder to fog at KRST
KRST Fog Season

Average Hourly Dewpoint - August
Rochester, Minnesota

Dewpoint (F)

1.5F Lower Td than group overnight

KRST Td vs. Group Dewpoint Difference (F)

1.5 to 2F Lower Td than group overnight

Average Hourly Dewpoint - September
Rochester, Minnesota

Dewpoint (F)

KRST Td vs. Group Dewpoint Difference (F)
The Big Picture (All Sites): Td vs. Wind Direction

- W to NW directions are driest Nov – Feb
- E wind yields highest Td Nov - Feb
W to NW Winds Driest; E Winds Most Moist

Average Dewpoint vs. Wind Direction - January
La Crosse, Wisconsin

Dewpoint (°F)

KLSE vs. Group Dewpoint Difference (°F)

Wind Direction

Most Moist Flow

Driest Flow
The Big Picture (All Sites): Td vs. Wind Direction

- W to NW directions are driest Nov – Feb
- E wind yields highest Td Nov - Feb
- Highest Dew points are confined to Southerly Jun – Aug
Highest Td confined to around 180°

Average Dewpoint vs. Wind Direction - June
La Crosse, Wisconsin

Dewpoint (F)

Wind Direction

KLSE vs. Group

Dewpoint Difference (F)

Td

KLSE Td vs. Group
Unique to KLSE: Td vs. Wind Direction

- Moist anomaly for NW winds compared to group in Dec. and Jan.
  - Lake Onalaska and Mississippi River influence?
KLSE NW to N moist wind anomaly

Average Dewpoint vs. Wind Direction - January
La Crosse, Wisconsin

Dewpoint (F)

KLSE vs. Group Dewpoint Difference (F)

Wind Direction
La Crosse Geography

Lake Onalaska

La Crosse River Valley

KLSE
Unique to KLSE: Td vs. Wind Direction

• Moist anomaly for NW winds compared to group in Dec. and Jan.
  – Lake Onalaska and Mississippi River influence?
• Higher Td than group with E winds in Winter
E Wind Anomaly at KLSE

Average Dewpoint vs. Wind Direction - December
La Crosse, Wisconsin

Dewpoint (F)

Wind Direction

KLSE vs. Group Dewpoint Difference (F)

Td

KLSE Td vs. Group

3F Higher than Group
Unique to KLSE: Td vs. Wind Direction

• Moist anomaly for NW winds compared to group in Dec. and Jan.
  – Lake Onalaska and Mississippi River influence?
• Higher Td than group with E winds in Winter
• Very dry anomaly at 20° and 260° (~ -5°F) in Winter
  – Bluffs?
Very dry anomaly ~ 20° and 260°

Average Dewpoint vs. Wind Direction - January
La Crosse, Wisconsin

Dewpoint (F)

0 4 8 12 16

Wind Direction

0 45 90 135 180 225 270 315 360

KLSE vs. Group

Dewpoint Difference (F)

0 2 4 6

Td

KLSE Td vs. Group

5F Dry Anomaly
Unique to KLSE:
Td vs. Wind Direction

- Moist anomaly for NW winds compared to group in Dec. and Jan.
  - Lake Onalaska and Mississippi River influence?
- Higher Td than group with E winds in Winter
- Very dry anomaly at 20° and 260° (~ -5°F) in Winter
  - Bluffs?
- SE to S and NE to E Td moist anomaly during warm months
  - La Crosse River valley influence?
Average Dewpoint vs. Wind Direction - August
La Crosse, Wisconsin

2F Higher than Group
Conclusions - Winter

- Synoptic signal typically dominates
- Larger Td variation in 24 hours than in Summer (average ~ 6-7 F, versus 2-3F)
- W to NW winds are driest; E winds correspond with higher Td
- KLSE
  - Td lower than group in dry months
  - NW to N wind: higher Td, river influence?
  - E winds even higher than rest of group
Conclusions - Summer

- More local signal is seen
- Complex diurnal behavior seen (e.g., sunrise, afternoon mixing, early evening rise, overnight condensation).
- Smaller Td swings over 24 hours
- Td decreases slightly during afternoon; rises during evening
- KLSE
  - Td higher than group in summer months
  - Biggest nighttime moist anomaly during peak fog months (Aug. and Sept.)
  - Td decrease more evident during afternoon; rises during evening
  - SE to S and NE to E Td moist anomaly during warm months