Forecasting Thunderstorms in Terminal Aerodrome Forecasts (TAFs)

WFO La Crosse Climatology Series #13

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Purpose

Identify ways to improve TAF thunderstorm forecasts to:

- Reduce false alarm (FA) hours.
- Increase efficiency of airport operations.
- Enhance aviation safety.
- Promote credibility of NWS aviation products.

NWS TAF

FM1200 18012KT P6SM SCT040

TEMPO 2024 3SM –TSRA BKN020CB

FM0000 20012KT P6SM BKN030

TEMPO 0004 VRB38G55KT 1SM +TSRAGR BKN010CB

FM0400 21010KT P6SM BKN040

PROB30 0408 3SM –TSRA BKN020CB

FM0800 24014KT 6SM HZ OVC030

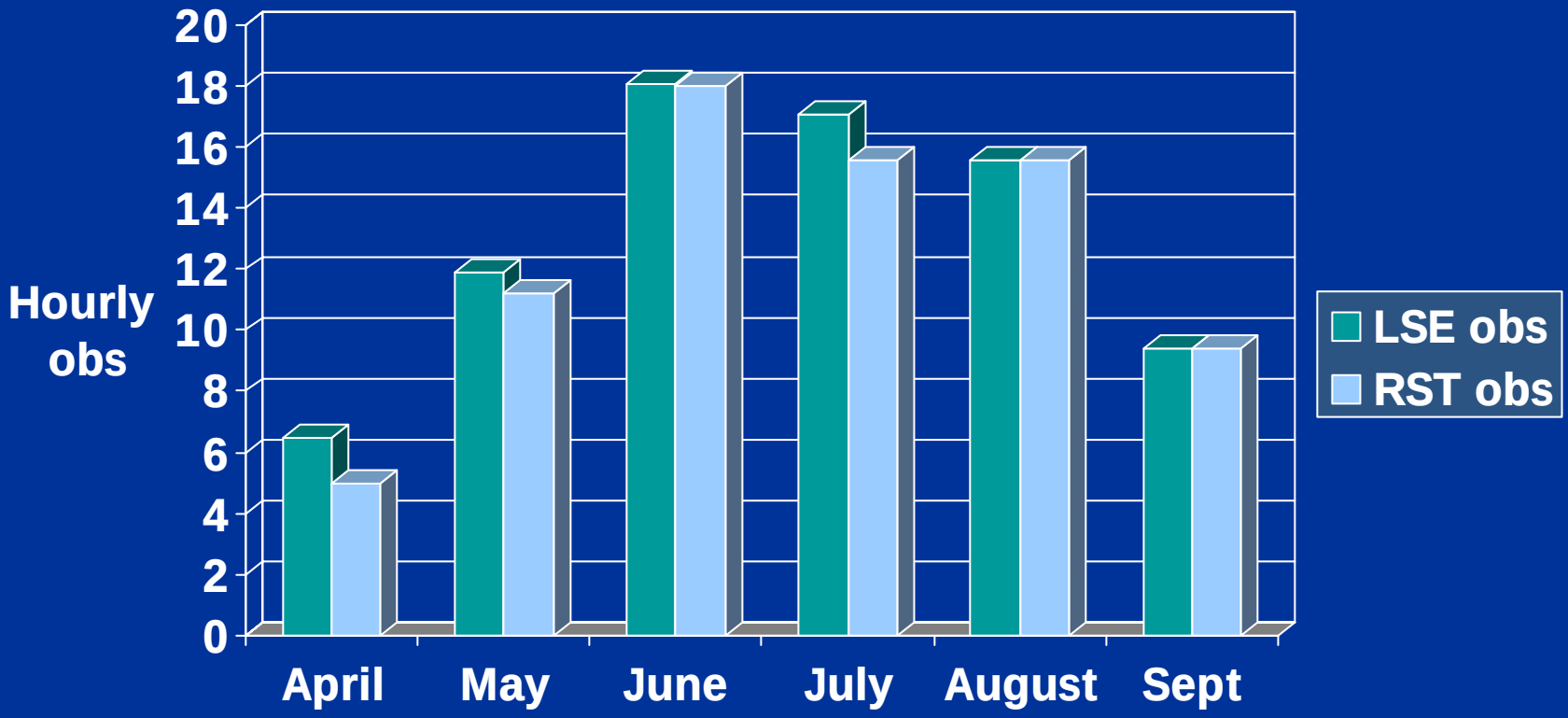
PROB30 0812 2SM TSRA BKN015CB=

Methodology

Primary data sources were:

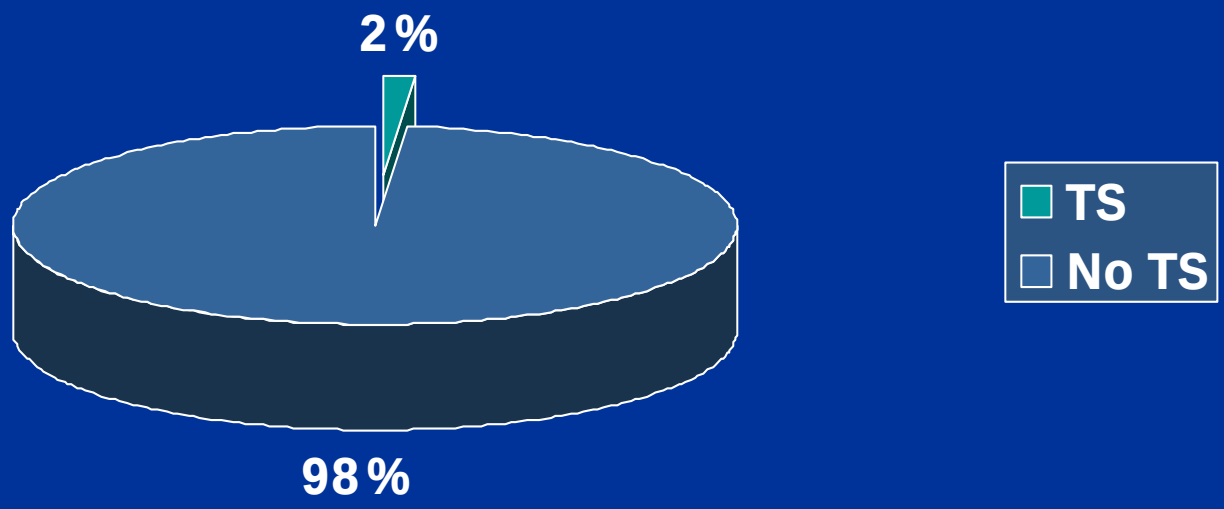
- Aviation Verify program.
- Aviation verification statistics.
- Solar and Meteorological Surface Observation Network, 1961-1990.

Thunderstorm Climatology
April-September, 1961-1990



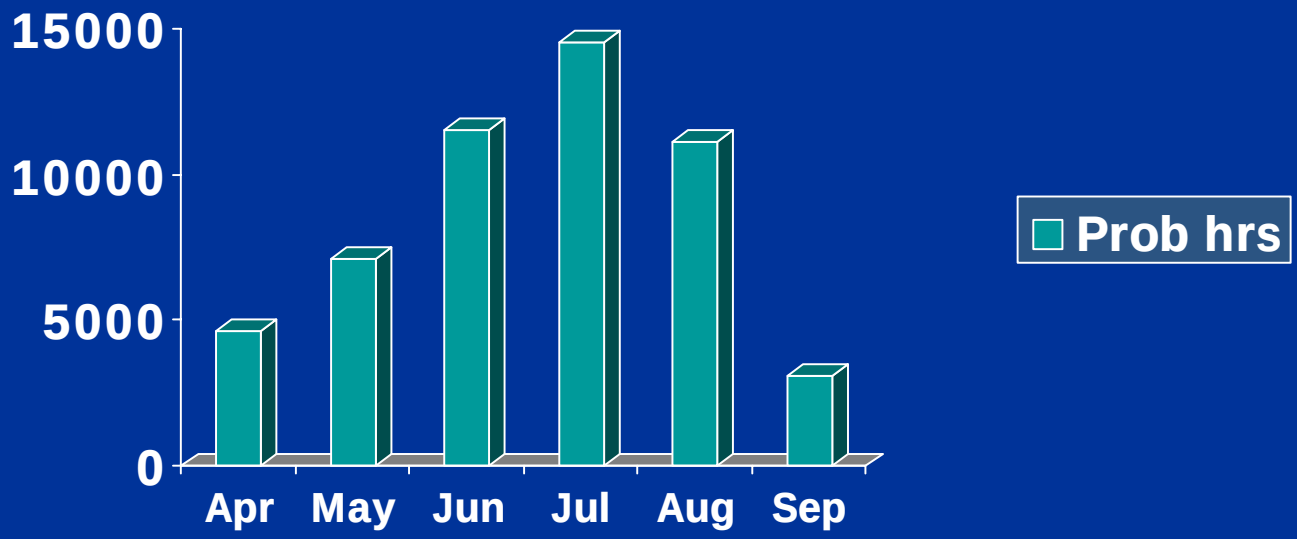
Hourly observations with a thunderstorm (TS) reported at La Crosse, WI (LSE) and Rochester, MN (RST).

Thunderstorm Climatology
April-September, 1961-1990

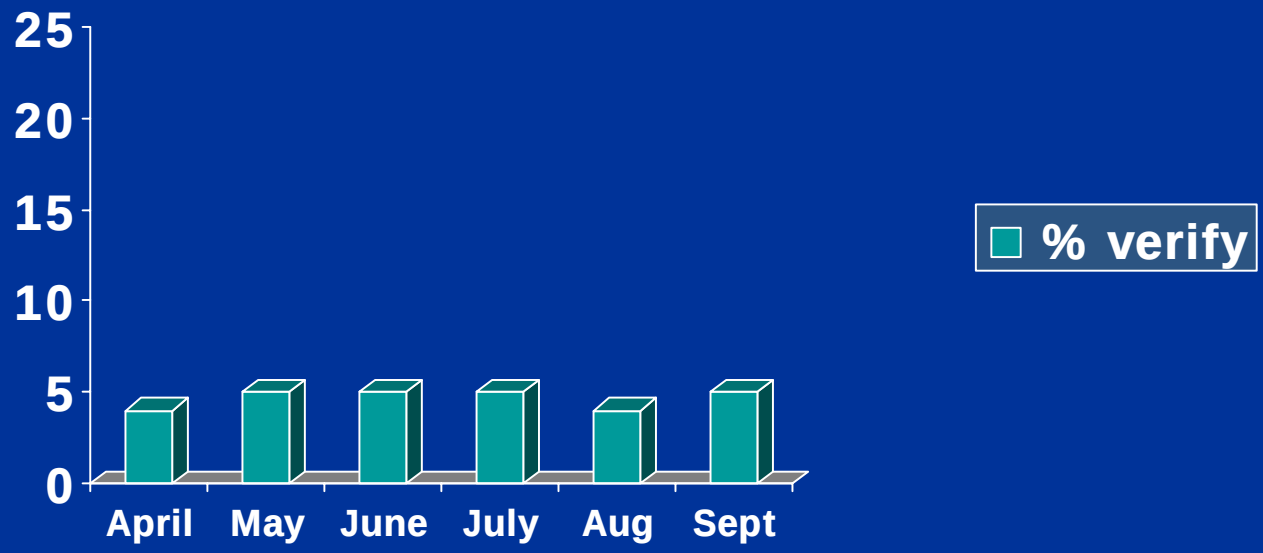


Percentage of hourly observations with and without TS at LSE and RST.

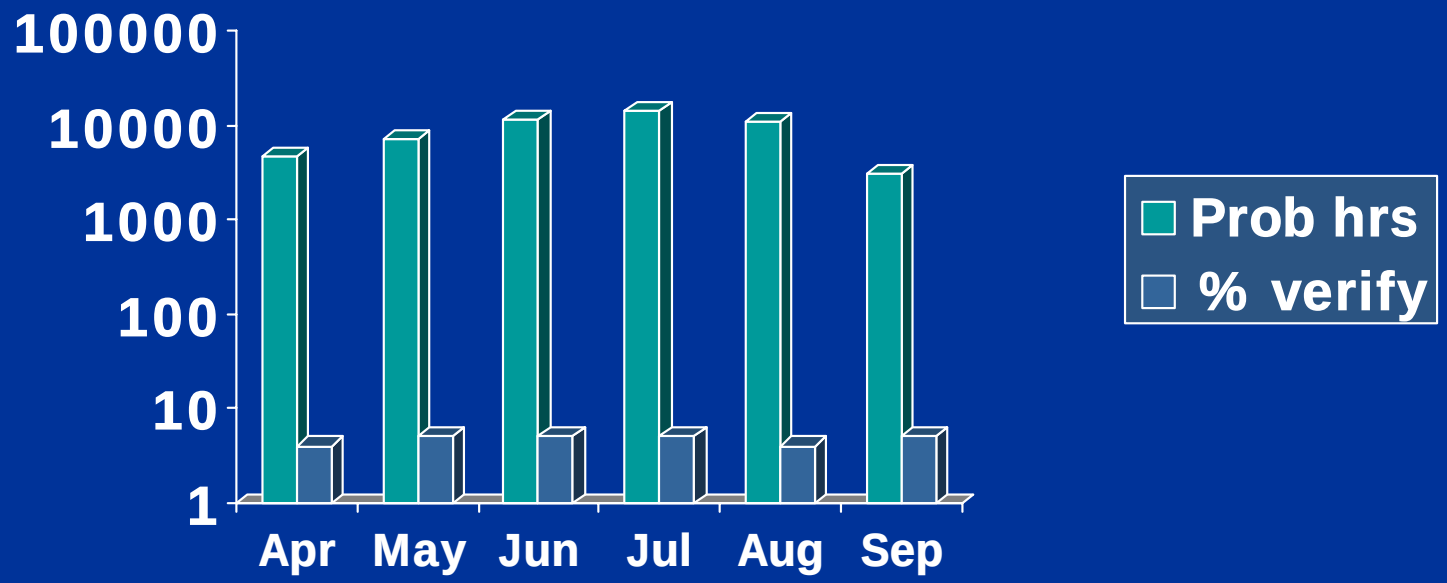
PROB TS hours
April-September 2003
NWS Central Region TAFs



PROB TS hours verified
April-September 2003
NWS Central Region TAFs



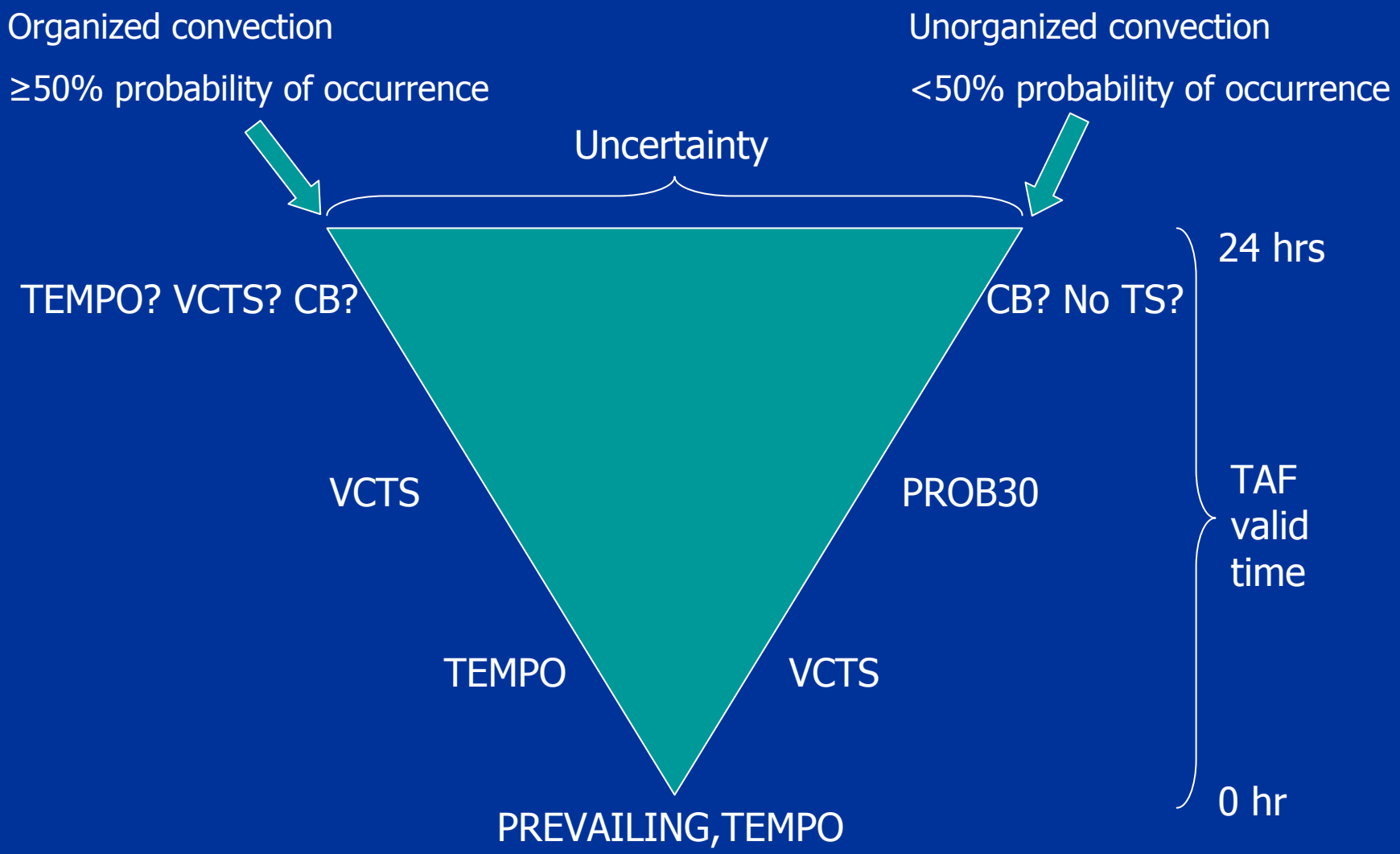
PROB TS hours vs. hours verified
April-September 2003
NWS Central Region TAFs



How can we improve TS forecasts in TAFs?
Here's what the La Crosse NWS forecasters said:

- Limit PROB and TEMPO groups beyond 8 to 12 hours.
- Limit time length of PROB and TEMPO, i.e. ≤ 2 hours.
- Eliminate forecast of thunderstorms beyond 12 hours.
- Use vicinity thunderstorm (VCTS) or cumulonimbus (CB) in lieu of TEMPO and PROB groups.
- Keep in mind climatology, i.e. time of day, month.
- Only use TEMPO for categorical events.
- Key on *organized* versus unorganized convection.

"Funnel effect" philosophy of forecasting TS in TAFs



Forecast scenarios

- Capped summer environment with a small chance of breaking the cap in the late afternoon/evening.

  The recommended TAF would be:

At 18-24hrs, *with model guidance consistently indicating a strong cap*?

FM1800 18010KT P6SM SCT040

FM0300 18010KT P6SM SCT250=

At 3-6hrs, *with nothing currently on radar*?

FM1800 18010KT P6SM SCT040

FM0300 18010KT P6SM SCT250=

Forecast scenarios

- TS possible, but will probably be scattered. There is a 30 percent chance of TS in the forecast grid database.

  The recommended TAF would be:

At 18-24hrs, *with models indicating unorganized convection*?

FM2100 18012KT P6SM BKN040CB

FM0300 18012KT P6SM SCT250=

At 3-6hrs, *with scattered thunderstorms currently on radar*?

FM2100 18012KT P6SM VCTS BKN040CB

FM0300 18012KT P6SM SCT250=

Forecast scenarios

- Cold front moving into an unstable atmosphere and there is wind shear to support *organized* convection along a squall line. The recommended TAF would be:

At 18-24hrs, *with model timing of cold front 22Z-00Z*?

FM1800 20014G22KT P6SM BKN040

FM2200 20014KT P6SM VCTS BKN040CB

TEMPO 2224 VRB20G35KT 2SM SHRA BKN020CB

FM0000 31014KT P6SM SCT250=

At 4-6hrs, *with an actual squall line approaching* ?

FM1800 20014G22KT P6SM BKN040

FM2200 20014KT P6SM VCTS BKN040CB

TEMPO 2224 VRB20G35KT 2SM TSRA BKN015CB

FM0000 31014KT P6SM SCT250=

Forecast scenarios

- Mesoscale Convective System (MCS) and moisture transport maximum support *organized* convection in your forecast area.

The recommended TAF would be:

At 20-24hrs, *with model guidance indicating potential MCS* ?

FM0600 18015G23KT P6SM BKN250

FM0800 16015G23KT 4SM –SHRA BR VCTS OVC040CB

TEMPO 0812 2SM SHRA BR BKN020CB=

At 2-6hrs, *with an actual MCS approaching*?

FM0600 18015G23KT P6SM BKN250

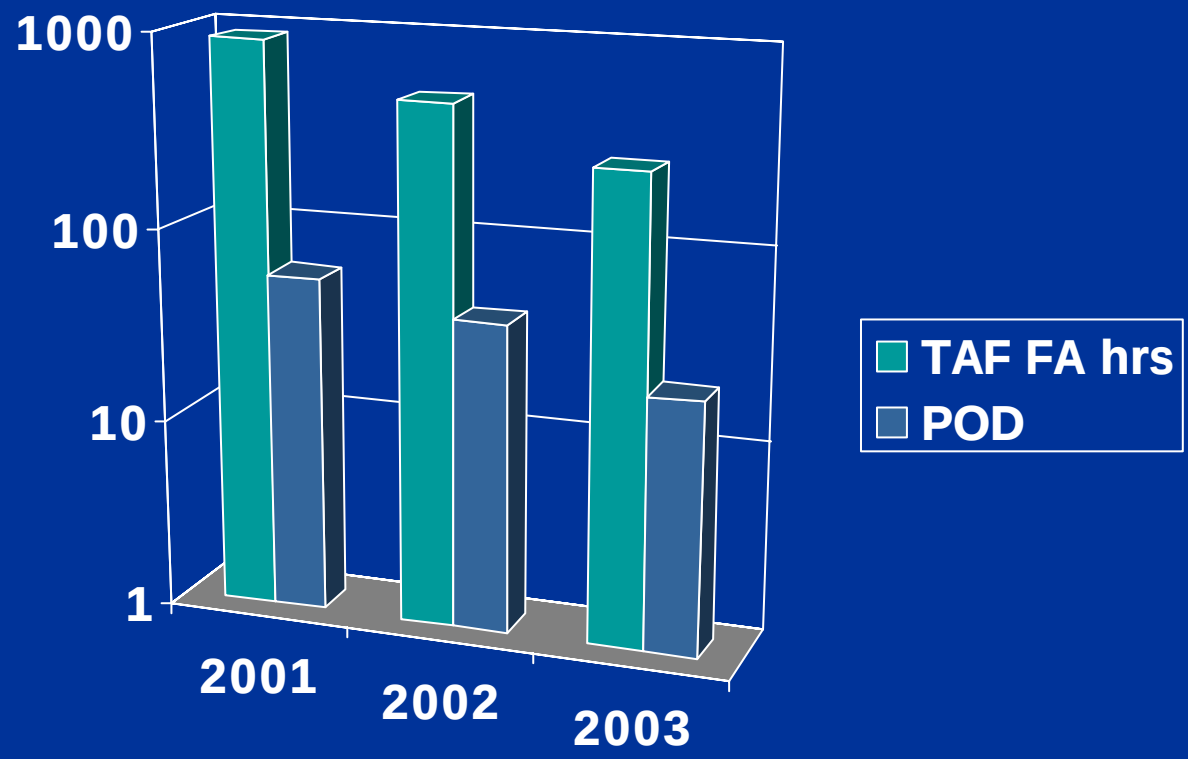
FM0800 16015G23KT 4SM –TSRA BR OVC040CB

TEMPO 0812 2SM TSRA BR BKN020CB…

CAUTION!!

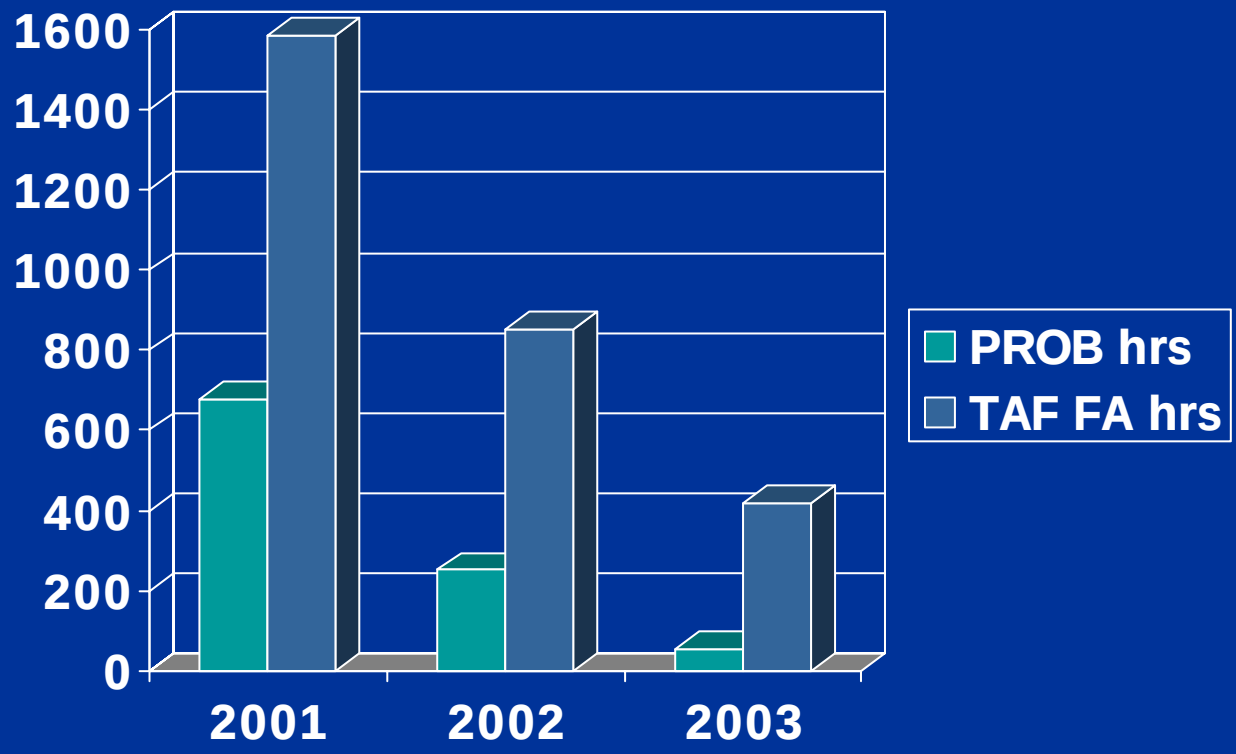
- There is no “silver bullet” when forecasting thunderstorms in TAFs.
- A higher level of TAF preparation and monitoring is required to utilize insights suggested in this presentation.
- Probability of detection (POD) may suffer at the expense of reducing false alarm hours.

TAF FA hours vs. POD
April-September
NWS La Crosse TAFs (0-12hr forecast)



TAF FA hours were reduced 71%, but POD dropped 64 %.

TAF PROB TS hours vs. TAF FA hours
April-September
NWS La Crosse TAFs (0-24hr forecast)



PROB hours were reduced 92%, with FA hours reduced 74 %.

Conclusions

How can we improve TS forecasts in TAFs?

- Limit PROB and TEMPO groups beyond 8 to 12 hours.
- Limit time length of PROB and TEMPO, i.e. ≤ 2 hours.
- Eliminate forecast of thunderstorms beyond 12 hours.
- Use VCTS or CB in lieu of TEMPO and PROB groups.
- Keep in mind climatology, i.e. time of day, month.
- Only use TEMPO during categorical events.
- Key on *organized* versus unorganized convection.

Acknowledgments

- Dan Baumgardt, Science and Operations Officer, NWS La Crosse, WI for much appreciated assistance in data assimilation and critique of this presentation.

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Some new insights

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