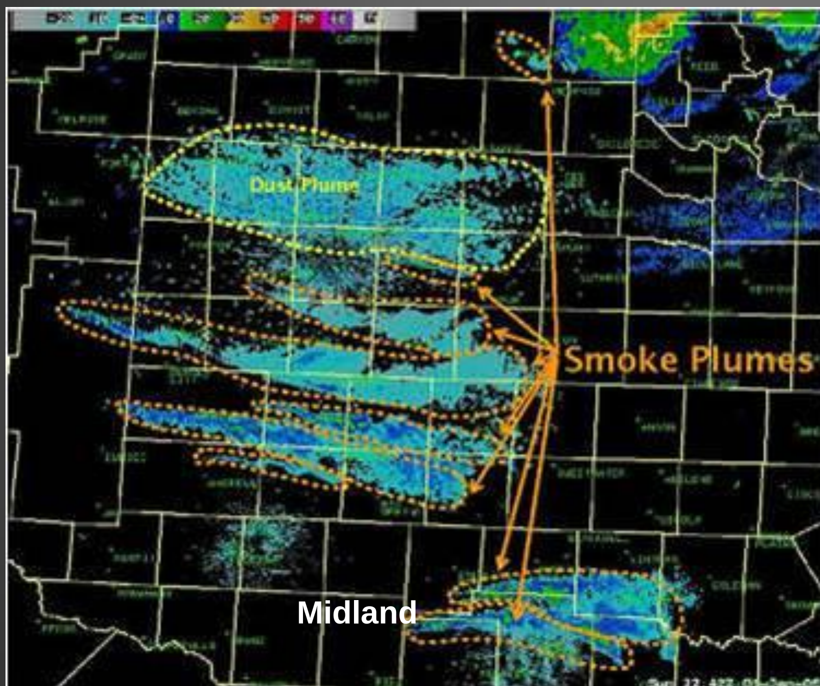
Red Flag Threat Index
A Means to Quantify/Assess



Greg Murdoch, Sr. Forecaster, IMET
Chris Gitro (BGM) and Ryan Barnes
Weather Forecast Office, Midland, TX

Red Flag Threat Index

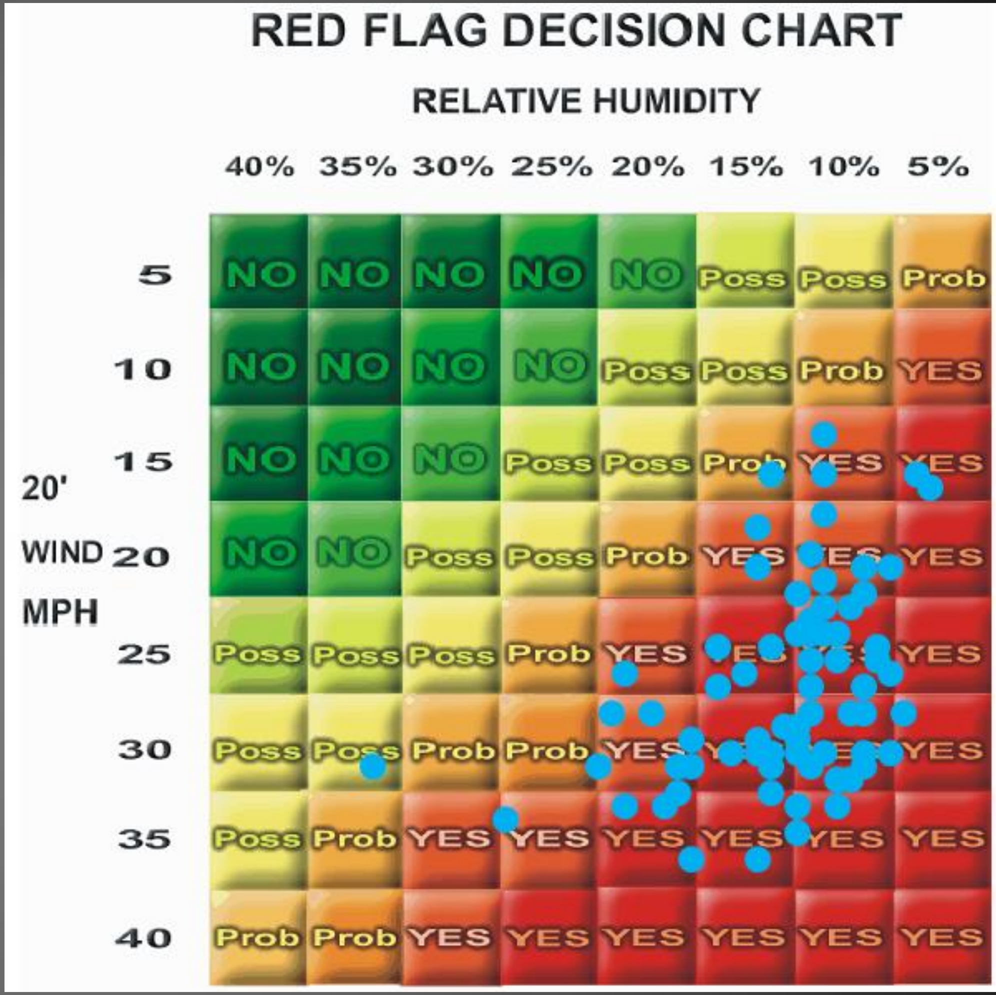
Another idea focused around a numerical relationship between wind and RH

Wind/RH =20/15=1.3

Other ratios give same result

30/23=1.3

Interesting - more applicable to a sliding RF scale

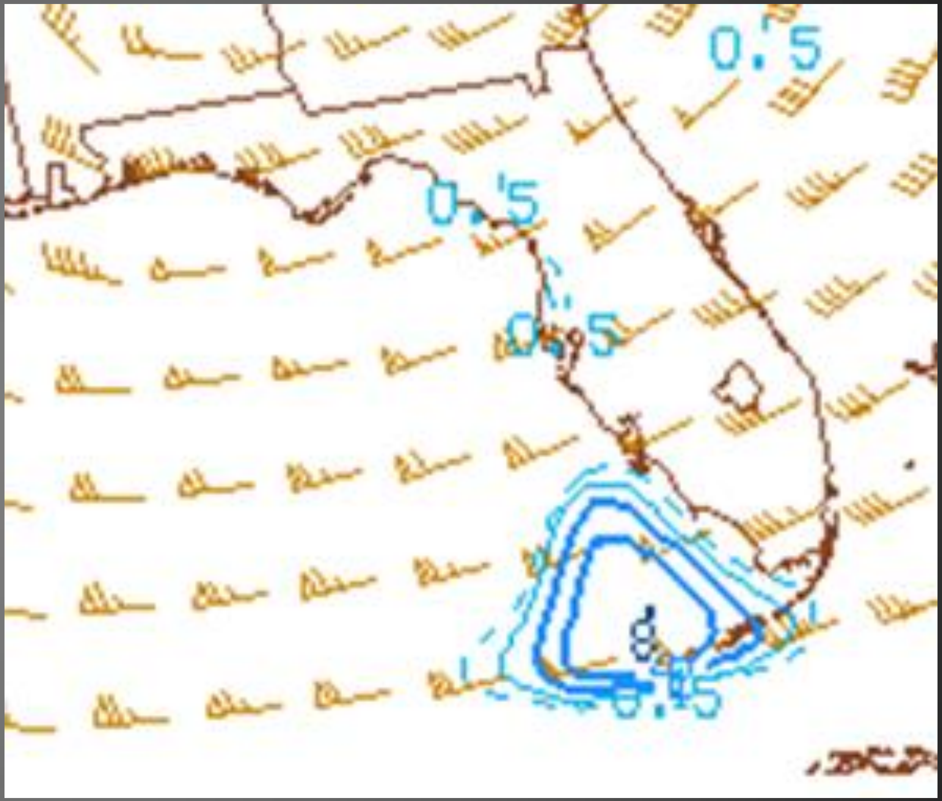


Bismark NWS

Red Flag Threat Index

Thought about how indices are used/developed in severe weather i.e., Supercell Parameters, etc

Composite indices that represent likelihood of certain traits or characteristics of storms, these are good, but too complicated



Started looking at other more easily understood indices

K-INDEX $K = (T_{850} - T_{500}) + Td_{850} - (T_{700} - Td_{700})$

SHOWALTER INDEX $SI = T_{500} - Tp_{500}$

TOTAL TOTALS INDEX $TT = T_{850} + Td_{850} - 2T_{500}$

Started to see a pattern with these indices

Reminds of how another index is calculated

Stability Moisture

$$\text{Haines Index} = (T_{p1}-T_{p2}) + (T_{p1}-T_{td1})$$
$$= \quad A \quad + \quad B$$

Red Flag Threat Index

Term A - RH
- 10-15% =1
- 5-9% =2
- <= 4% =3

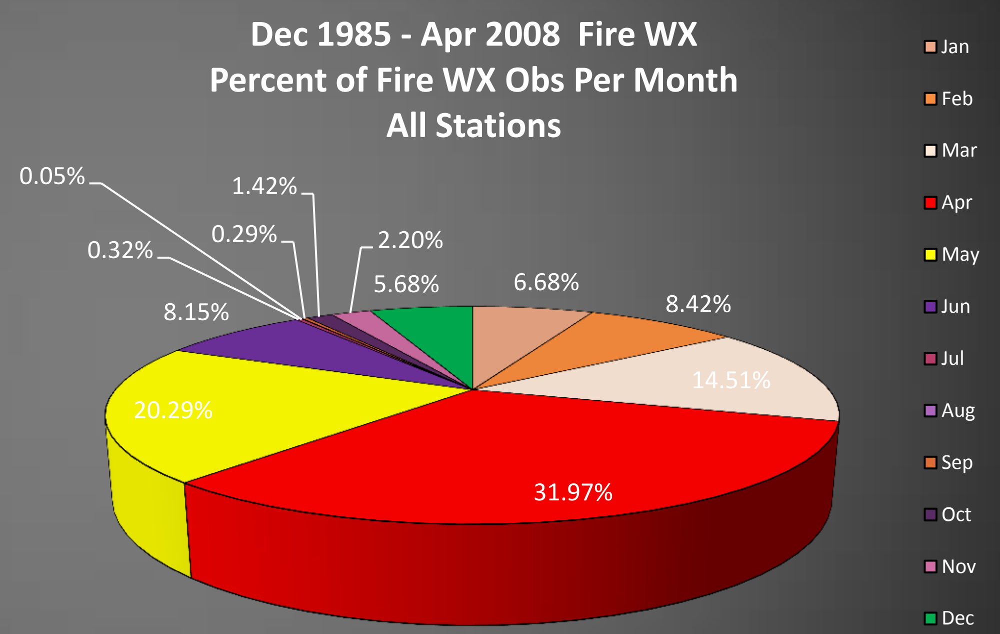
Term B - 20ft Wind Speed
- 20-22 mph=1
- 23-27 mph=2
- >=28 mph=3

RFTI = A + B

Unit-less number ranging from 2 to 6

RFTI Steeped heavily in Climatology

Ranges for terms A and B based on a set RAWS data from MAFs local RF climo (18k RF obs) from which percentile rankings where developed

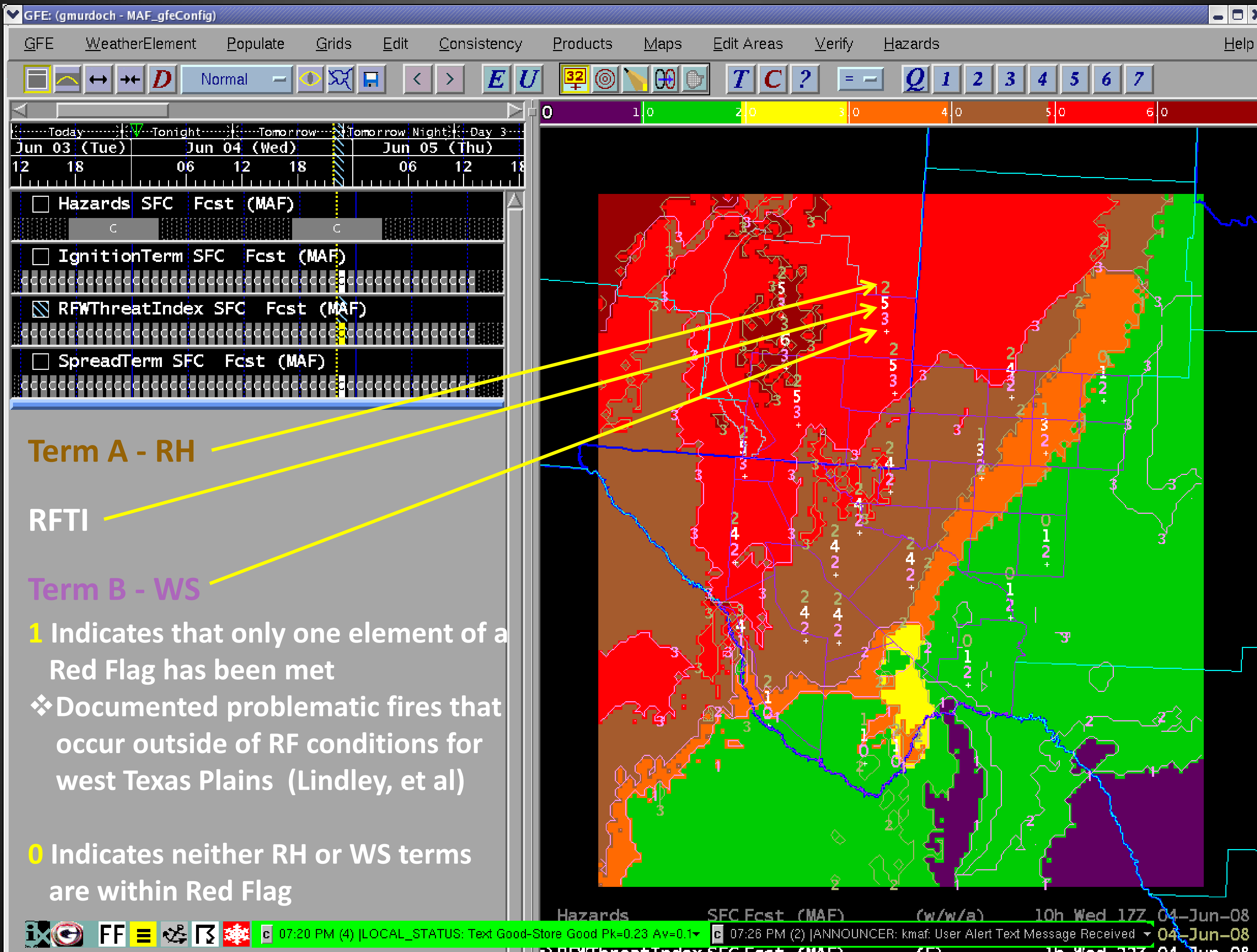


Percentile Rankings - Good fit

- Fire Management community uses percentile rankings – A means to **Quantify data**

Term A - RH	Term B - 20ft WS
10-15% =1	20-22mph=1
5-9% =2	23-27mph =2
<= 4% =3	>=28mph =3

Final Product in MAFs GFE



Other considerations

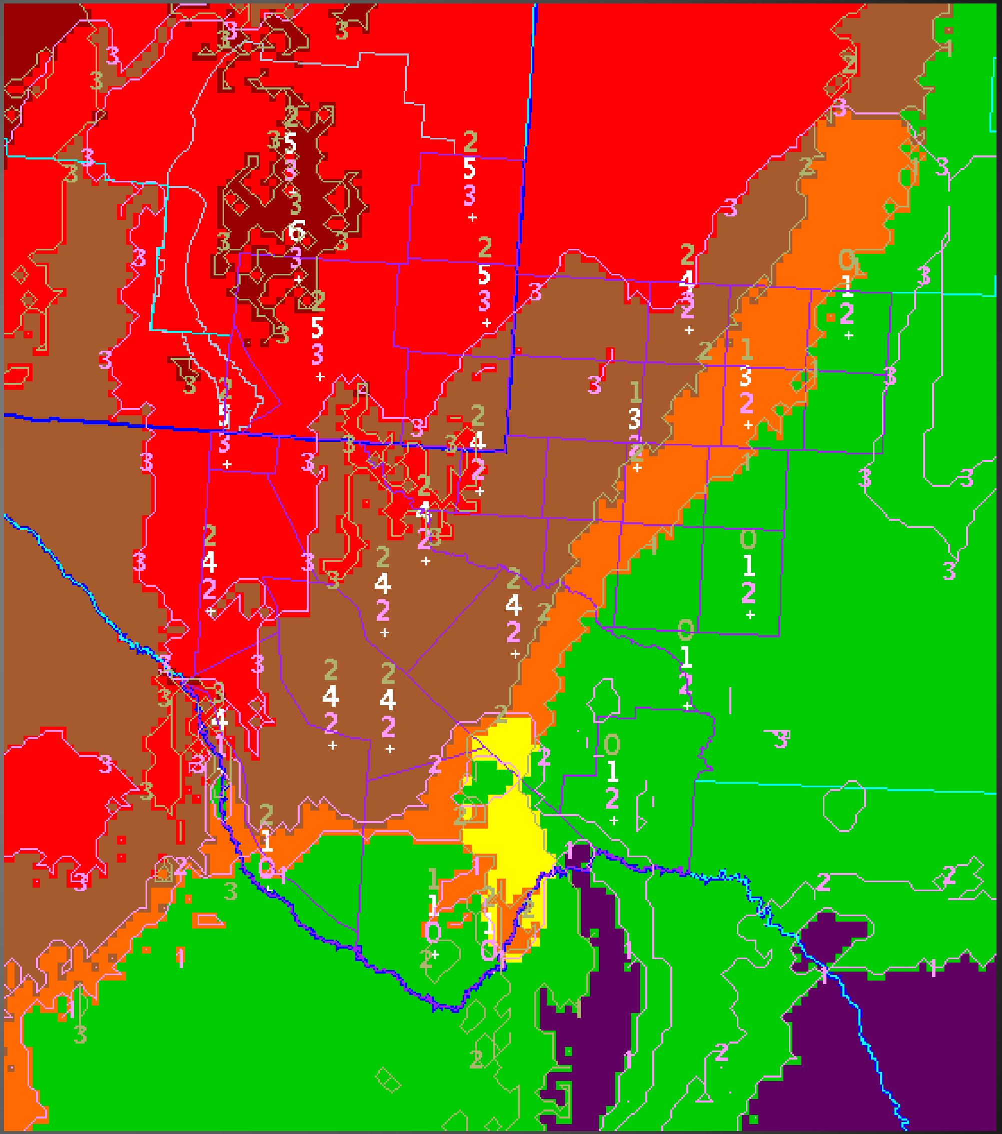
- All Red Flag days are not equal
  - Dependent on magnitude of specific weather elements
  - Antecedent fuel conditions
  - Response to RFW may be different depending on Planning Level or on local decision makers
  - During drought periods may not take "as much weather" to produce control problems (if fuels predisposed)
- RFTI quantifies severity of Red Flag conditions and increases SA
- RFTI not a predictor of fire starts, utilized in analysis, forecast, Fire Potential(?)

More considerations

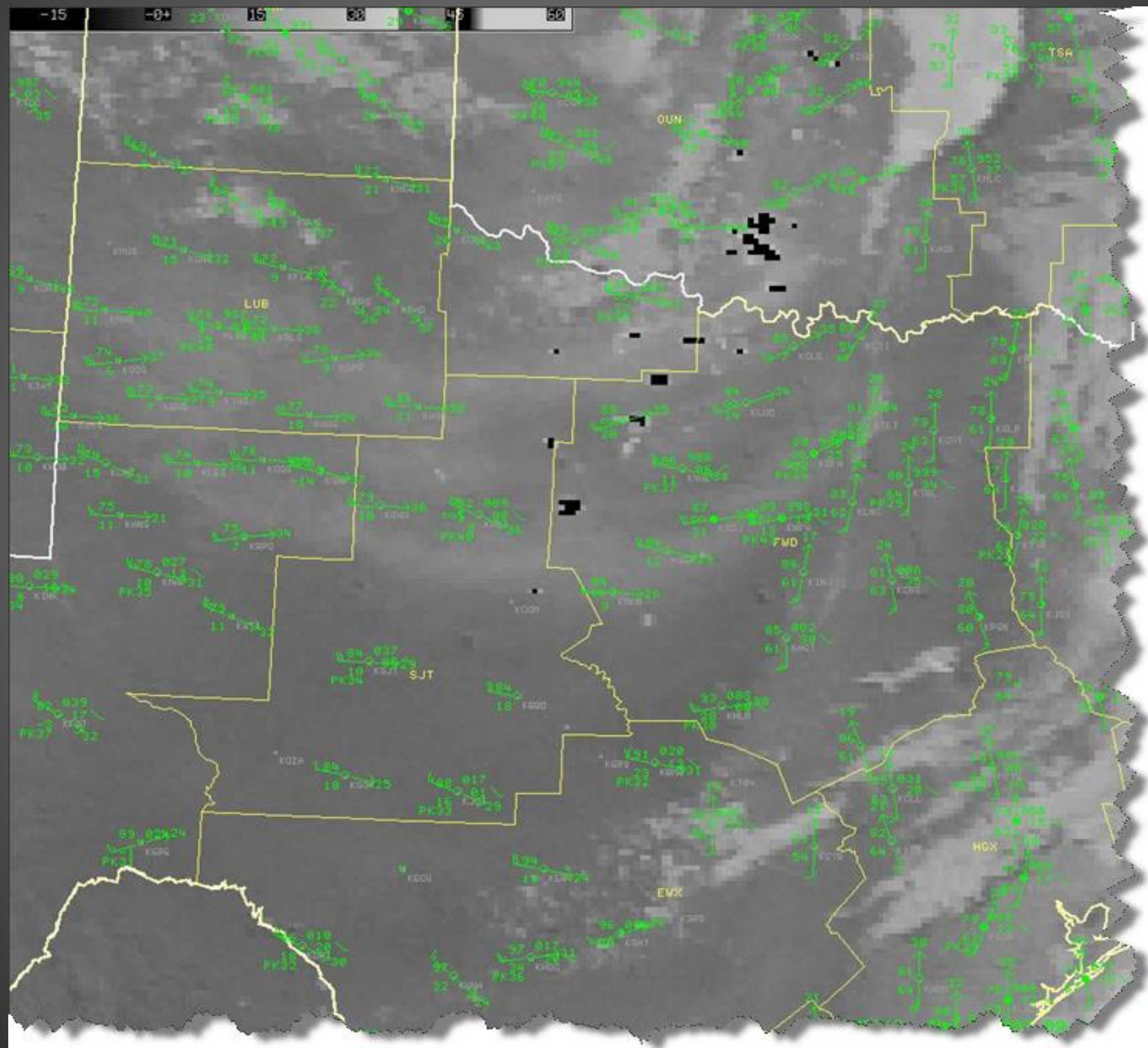
- Created in the grids for Fire Weather Zones/CWFA/PSA, falls out of grids
- Similarly to RH/Wind/Temp grids RFTI can be calculated hourly on GFE
- A max for the day
- Takes a little heavy lifting up front to get the climo data set up

Red Flag Threat Index

- Quickly see where worst conditions are
- By quantifying RF conditions forecasters can include enhanced wording in products or briefings



Severe Fire Weather Analysis - Apr 9 2009 Outbreak

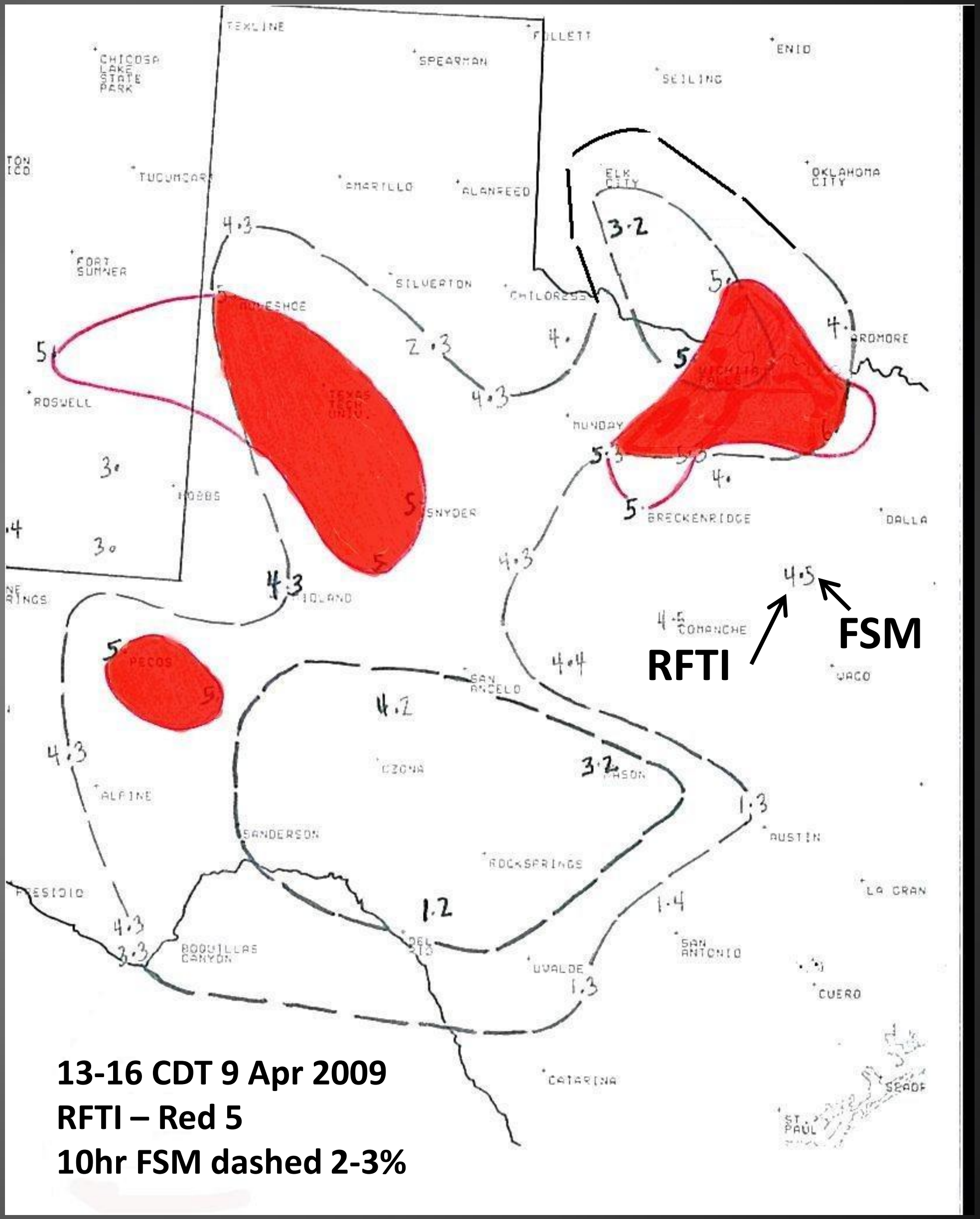


Severe Fire Weather Analysis

Went back and calculated RFTI

Plotted RFTI/10hr FSM from RAWS

3 distinct areas (solid red) where RFTI 5 or > and 2-3% 10hr FSM "Marry-Up"



When combined with other data

Conventional data…
Dry slot

Mid level speed max

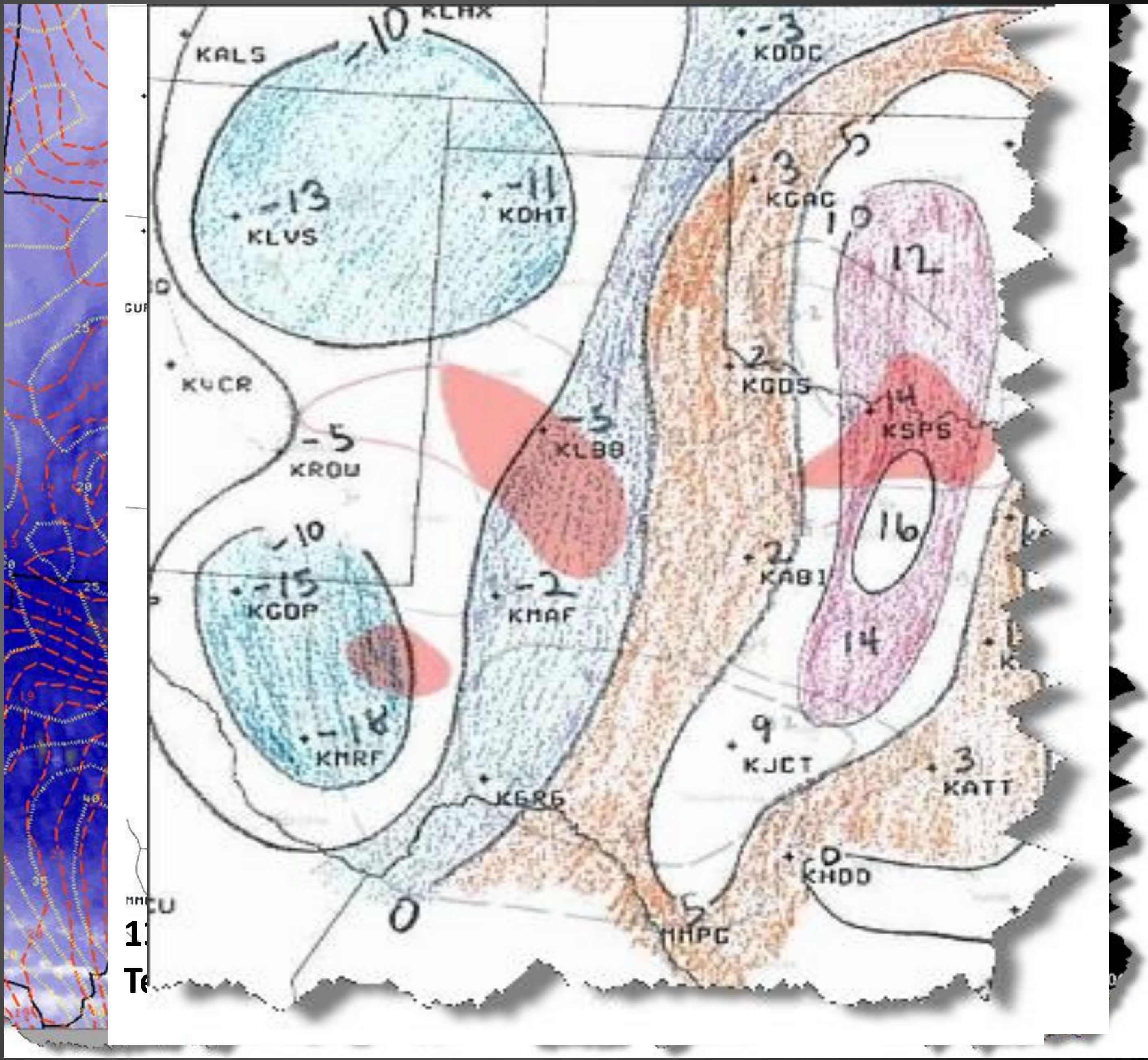
Thermal Ridge

Including:

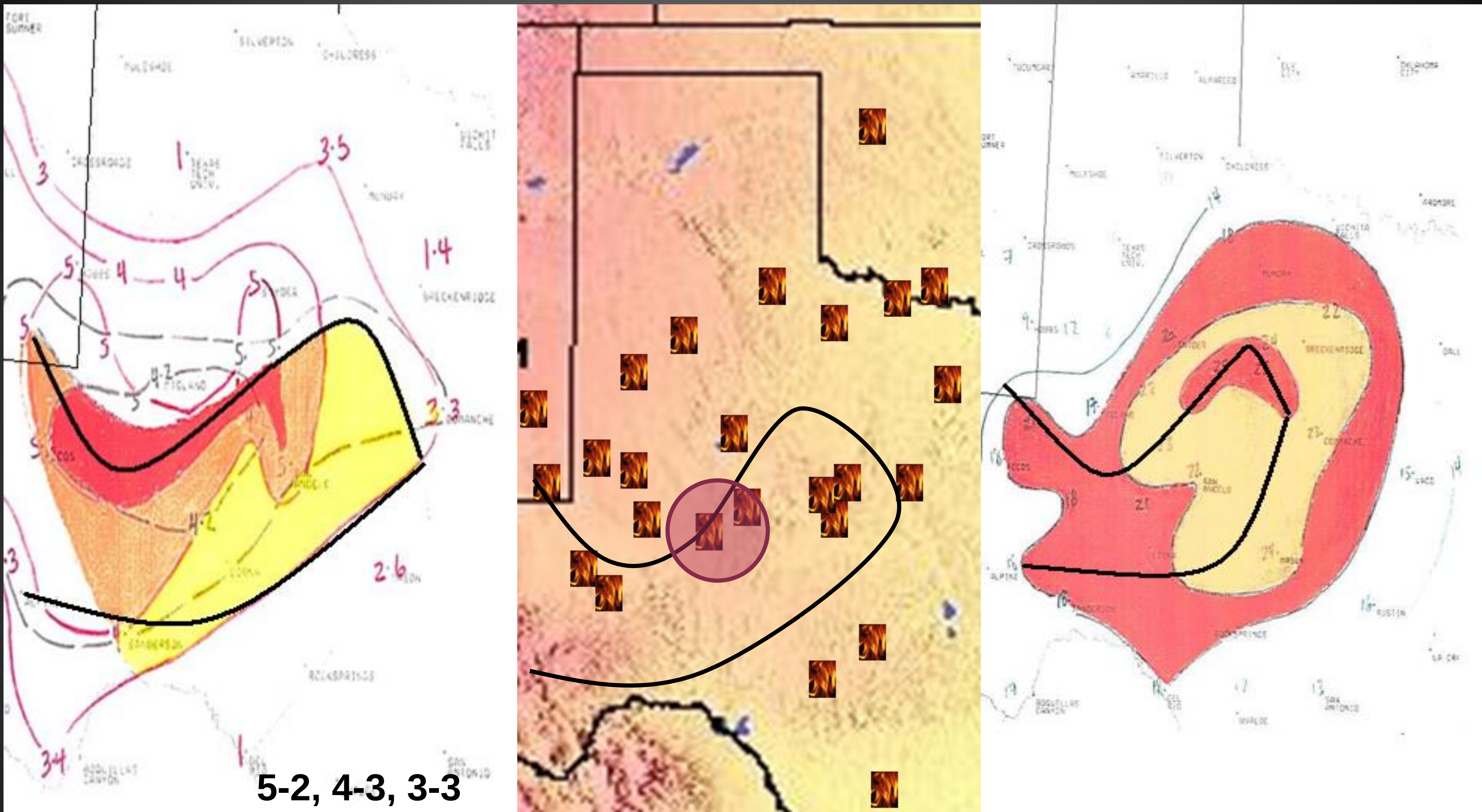
Temperature
Departure

Overlay not a surprise
to see a favored area

Null case for W TX

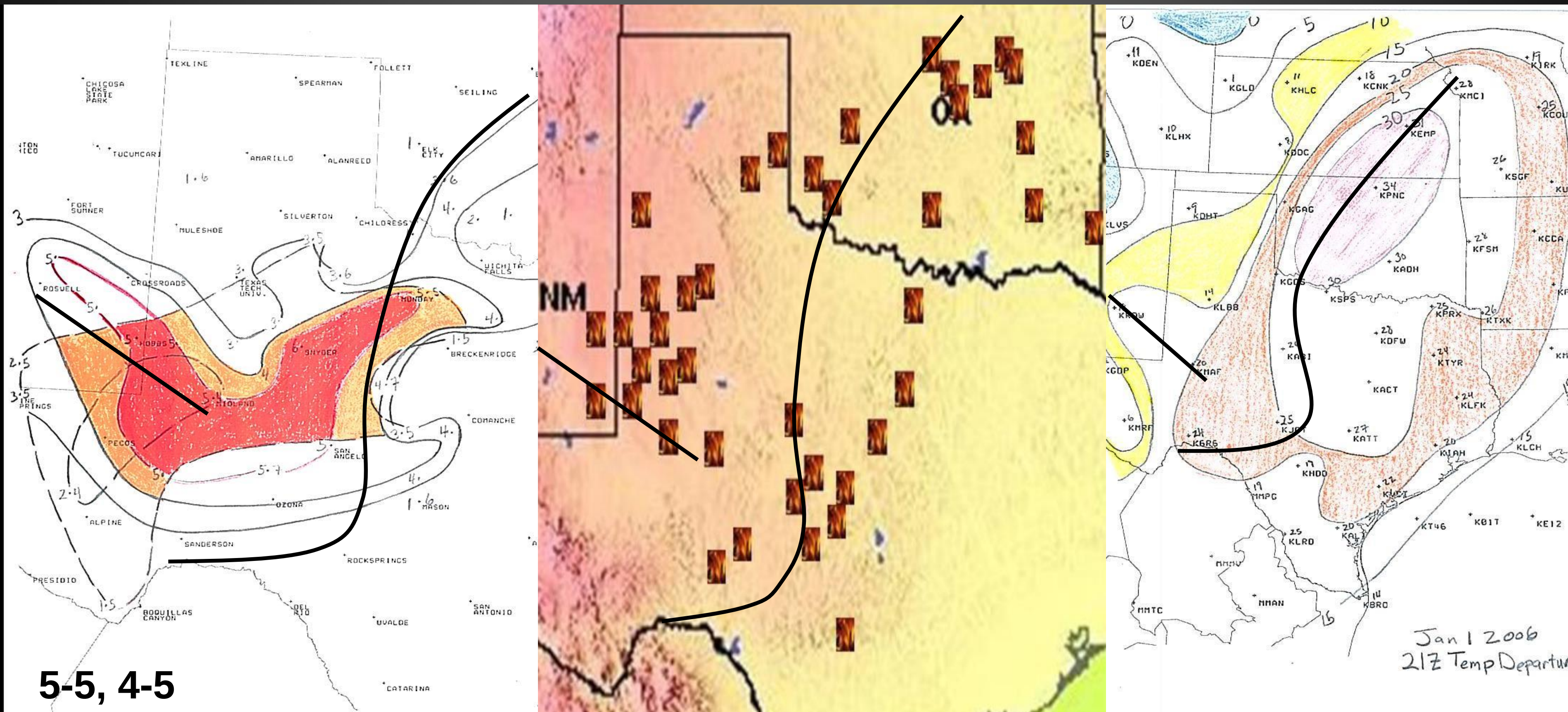


Feb 25 2008 Outbreak



Fires over a large portion of Texas, as were positive temperature departures
RFTI 3 or greater over a large part of the state, RFTI max along temperature departure
This case really started to bring to light that RFTI is a composite index - RH, wind, T
Combination of RFTI and temperature departure caught the largest fires, Glass/Silver

Jan 1 2006 Outbreak



Fire occurrence map shows that fires occurred over a large part of TX
Temperature Departure map shows large positive temperature departure over state
RFTI and 10hr FSM also depicts a large area of concern
RFTI must still be used with other data, i.e., CFWP thermal ridge

Summary

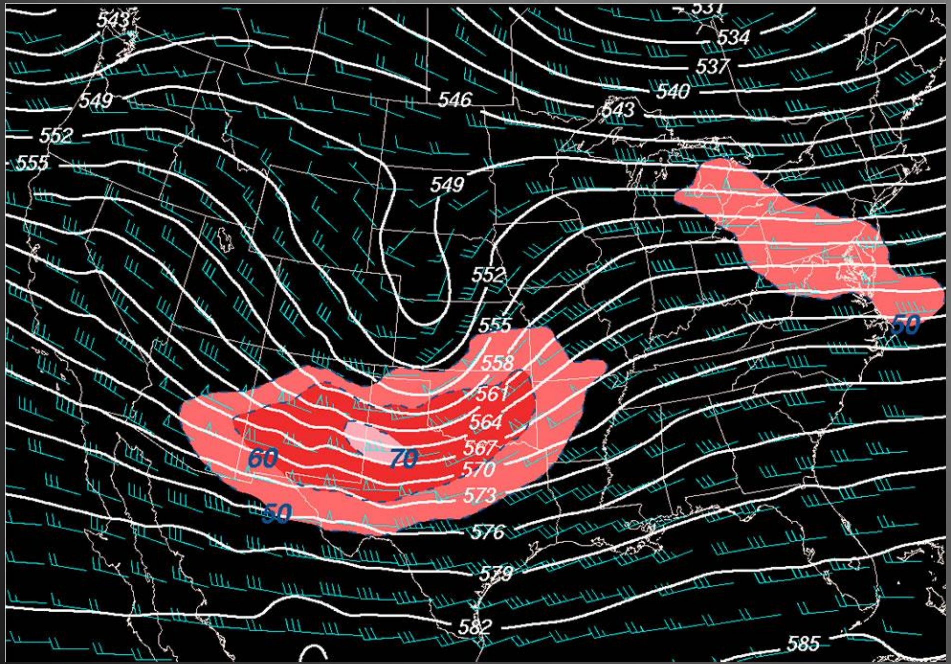
We are learning more about fire weather forecasting for the plains

Developing conceptual models of how to better forecast fire weather

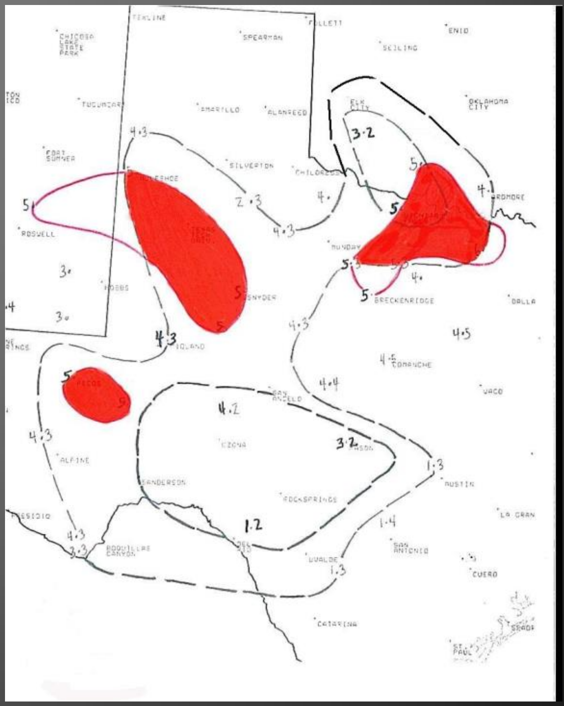
Intensity - Duration - Aerial Coverage Principles

Fire Weather Forecasting similar approach to forecasting storms

Recognize large scale patterns



Downscale and utilize Severe Fire Weather Analysis



Summary Continued

On Regional Outbreaks days multiple ingredients of Critical Fire Weather Patterns come together

Thermal Ridge	Mid level Wind Speed Maxima (Jet)	Dry slot
Positive T Departure	Chinook/Downslope Winds	Dryline

Tools like the RFTI can help quantify/assess the conditions

- Just how bad will the weather get
- Still each case is a little different, thermal ridge orientation, fuel
- Indices are empirical and need other data, temperature and fuel
- ***RFTI thought of as Composite Index***
  - RH and Wind
  - Catches thermal ridge because temperature is built into RH

Part 2 – Decision Support

Historically NWS Meteorologist issue products for specific groups, aviation and fire weather, do TX WFOs really know how the products are used?

Room to gain better understanding of user objectives, i.e., TFS Fire Management

- Assessing Fire Potential - Occurrence and Response Capability

Fire Weather Watches are of utmost importance to plan effectively

How large is TFS response area?

Gives coordination a new perspective, where are worst expected?

Be aware of concerns outside of WFO boundaries

How much time does TFS have to prepare?

Lead time is critical, time to move resources to most strategic location

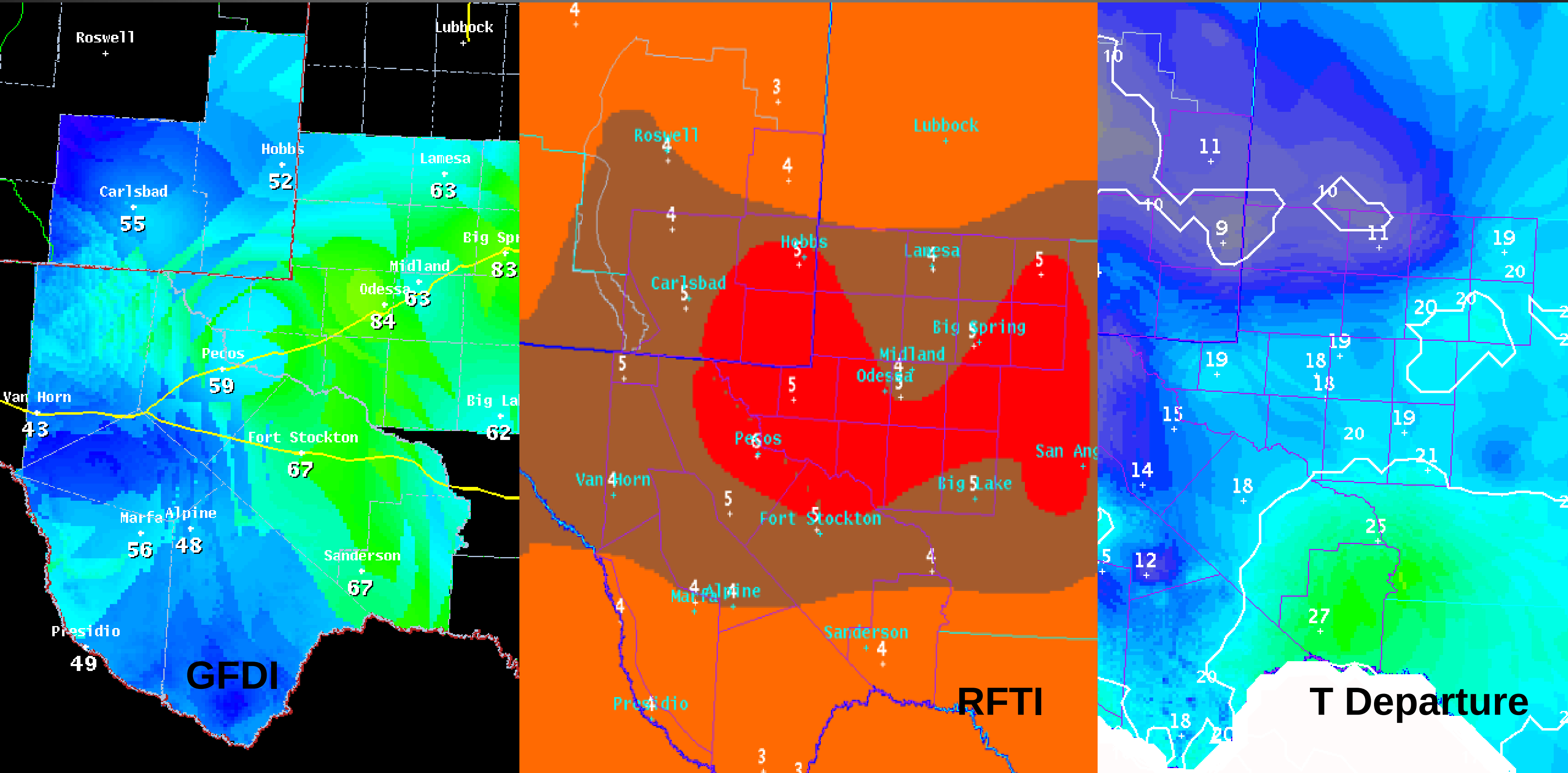
Equipment maintenance issues, how long to get it fixed

Moving forward to aid in Fire Operations Decision Support

Recent Advances

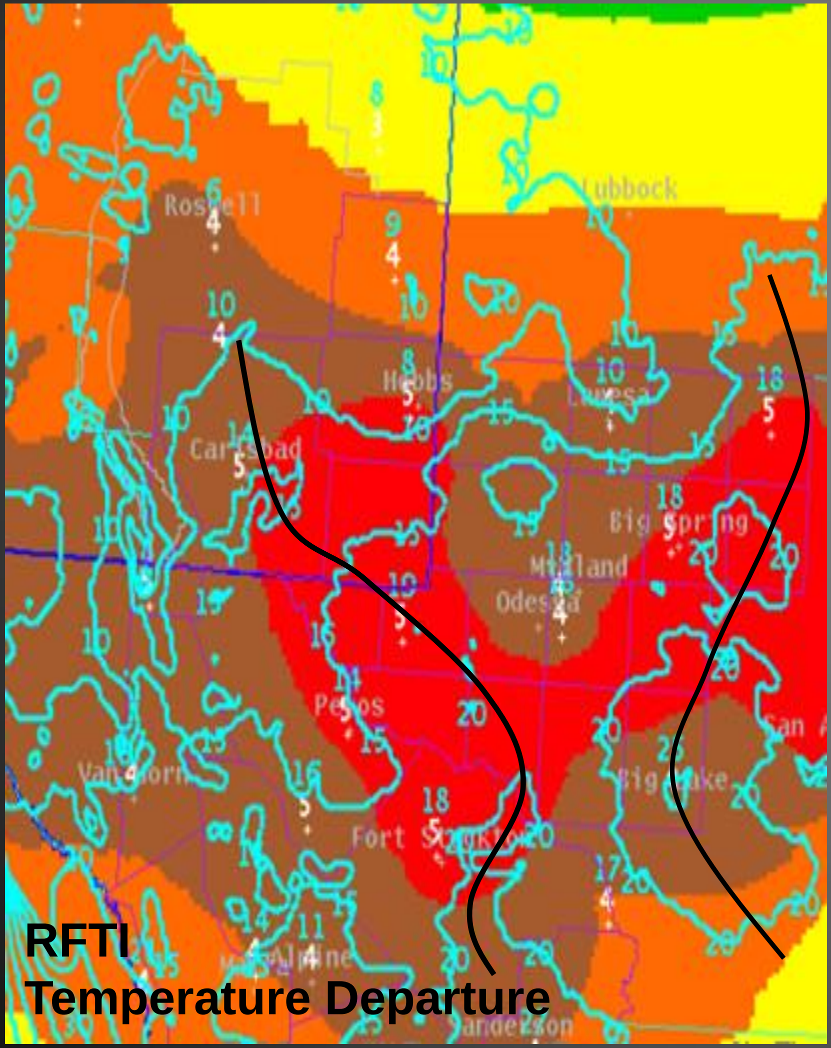
WFOs can generate GFDI, RFTI, and Temperature Departure maps

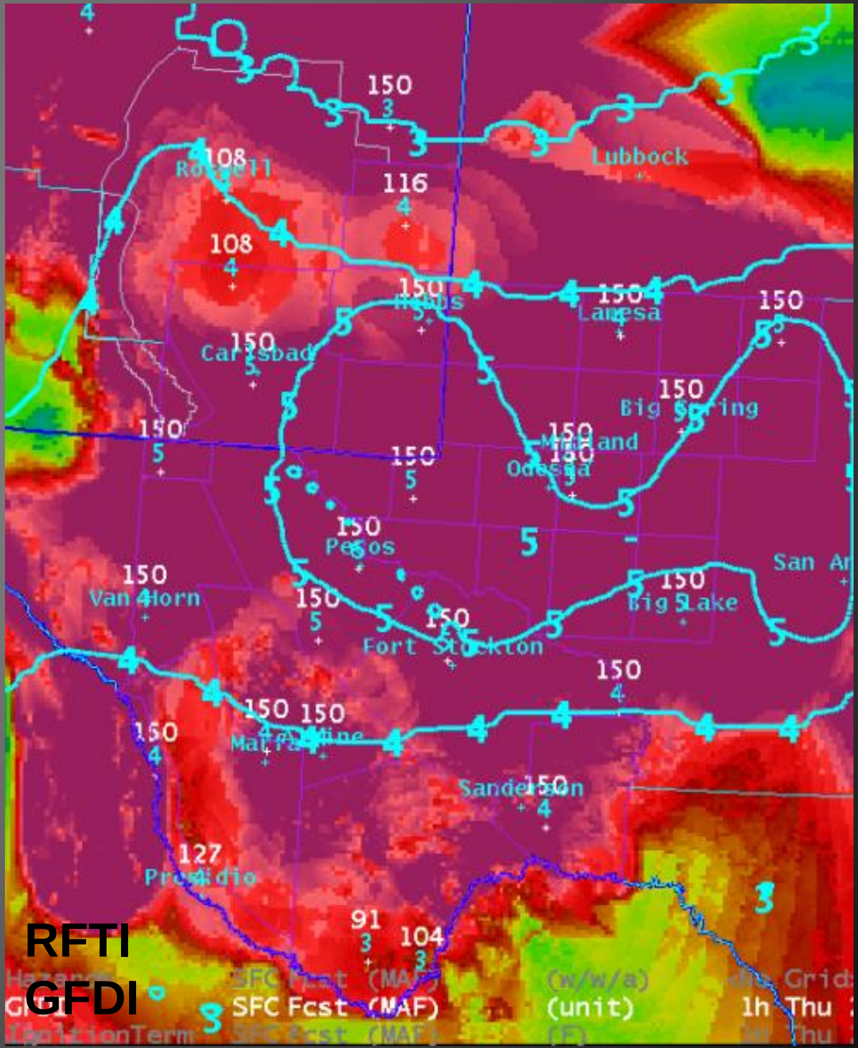
Generated at the click of a button or automatically



Overlay Era

Improving our overlay capabilities we can get better idea of where different weather features align with each other and with fuels
Availability of climate data - directly improves fire weather forecast
By use of the GFDI Midland can get fuel data into GFE, through a curing factor





The Future

- Midland believes this to be the beginning of a paradigm shift and a partial glimpse of future Fire Weather Forecasting

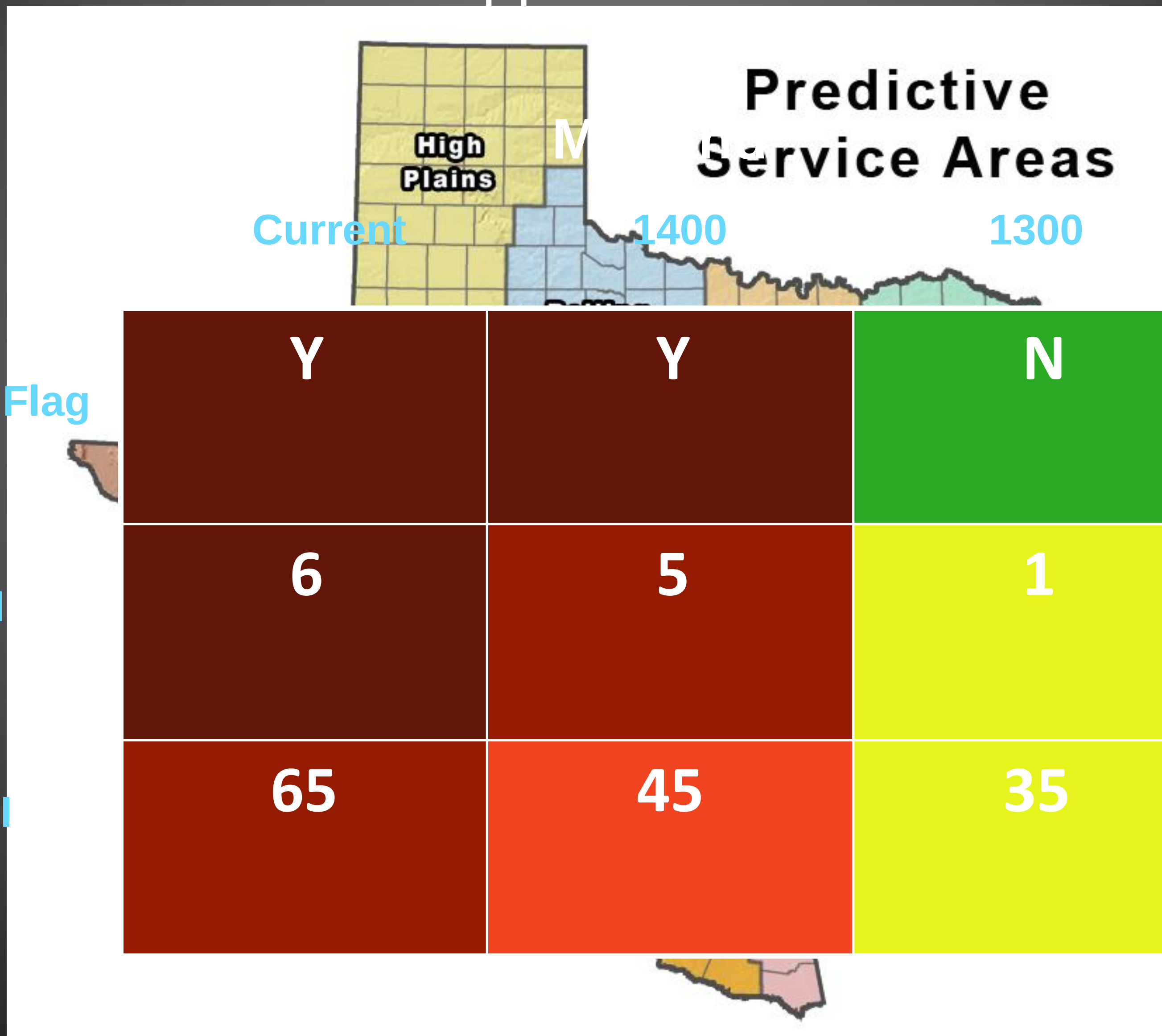
- By incorporating: Climatology through percentile ranks in RFTI
  Fuels through use of the GFDI
  Climatology in temperature departure analysis

- Get a more complete picture of fire weather and fuels, provides greater awareness and good decisions

Ultimate Goal

Tactical/Strategic Decision Support Tools for Fire Operations

Tactical Decision Support Tool – Matrix example



	Current	1400	1300
Red Flag	Y	Y	N
RFTI	6	5	1
GFDI	65	45	35

Statewide – PSA Based

Strategic Decision Support Tool

Trans Pecos Matrix

	Today	Day 2	Day 3
Red Flag	Y	Y	N
RFTI	4	2	0
GFDI	45	35	15

PSA/WFO Matrix Page

Trans Pecos

	Today	Day 2	Day 3
Red Flag	Y	Y	N
RFTI	6	5	1
GFDI	65	55	30

Rolling Plains

	Today	Day 2	Day 3
Red Flag	Y	Y	N
RFTI	3	5	0
GFDI	45	55	10

South Plains

	Today	Day 2	Day 3
Red Flag	Y	Y	N
RFTI	5	2	1
GFDI	50	40	25

North Texas

	Today	Day 2	Day 3
Red Flag	Y	Y	N
RFTI	2	5	0
GFDI	40	45	10

Assimilating this data into Decision Support we begin our move to the next level of Science and Service