

Red Flag Pattern Recognition for the Western Foothills Region of the Southern Appalachian Mountains

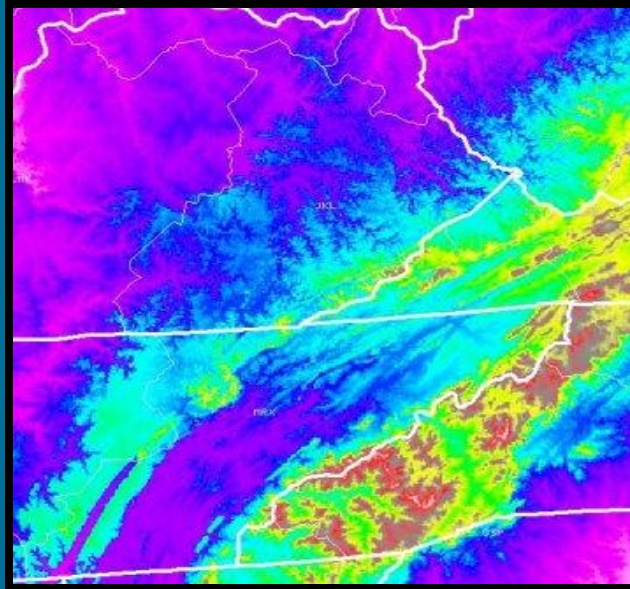
by Tony Edwards
General Forecaster & IMET

WFO Jackson, KY

Red Flag Pattern Recognition

GOALS

- Define weather patterns that frequently result in Red Flag conditions across the region encompassed by eastern Kentucky, southwestern West Virginia, southwest Virginia and eastern Tennessee.

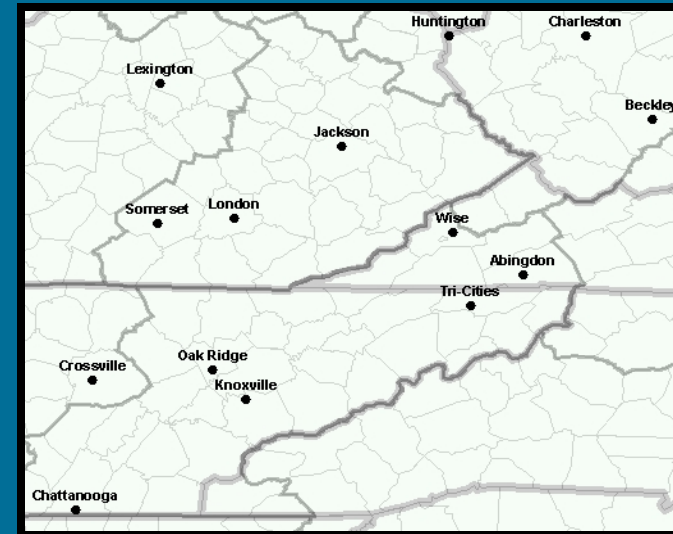


- Allow for quicker detection of Red Flag Conditions by fire weather forecasters.
- More lead time for our users...

Red Flag Pattern Recognition

Methodology

- Identify Red Flag Days
 - Red Flag Criteria –
 - 20-ft Wind \geq 15 mph
 - RH \leq 25%
 - 10-hr Fuel Moisture \leq 8% or Precip during past 2 days $<$.25 inches
 - Downloaded observations for First Order Stations from 1990 – April 2006 for Fire Season only (Feb 1st – April 30th & October 1st – December 15th)
 - Parse observations for sustained 10-m winds \geq 18 mph with RH \leq 25%
 - No accounting for Fuel Moisture!



Red Flag Pattern Recognition

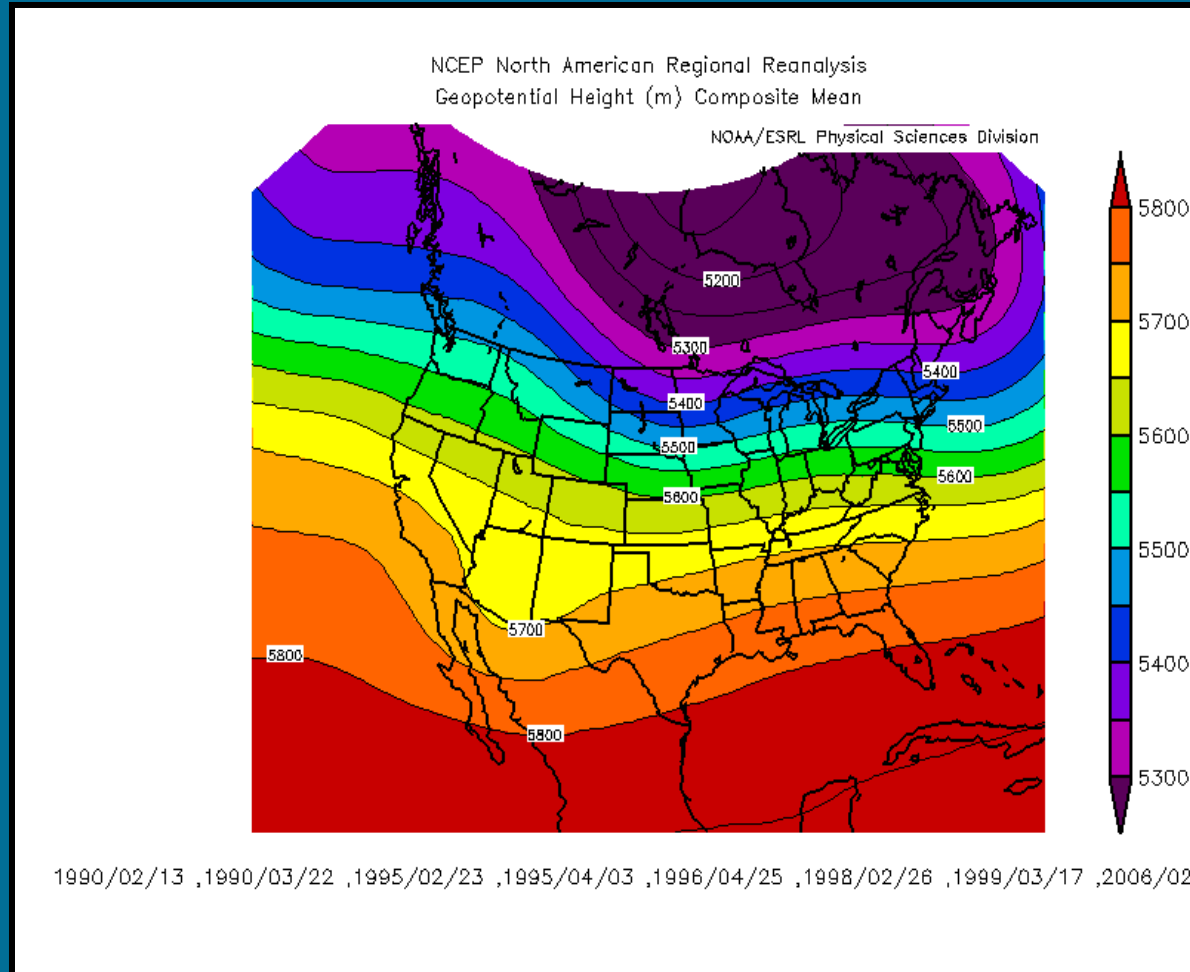
Methodology

- Sorted occurrences into regions when needed...
 - Regionwide Red Flag Days...
 - East Kentucky Only...
 - Tennessee Only...
 - Northeast Sector (northeast Tennessee, southwest Virginia, southern West Virginia...
- Analyzed surface charts to find patterns for further sorting
 - Pre-Frontal
 - Post-Frontal
- Combined all cases into either Pre-Frontal and Post-Frontal per region and analyzed CDC Reanalysis Data composite upper air charts per dates.
 - <http://www.cdc.noaa.gov/NARR/>

Red Flag Pattern Recognition

Prefrontal

- Upper level features to key in on are a digging H5 trough upstream over the Rockies/Northern Plains/Canadian Prairies.

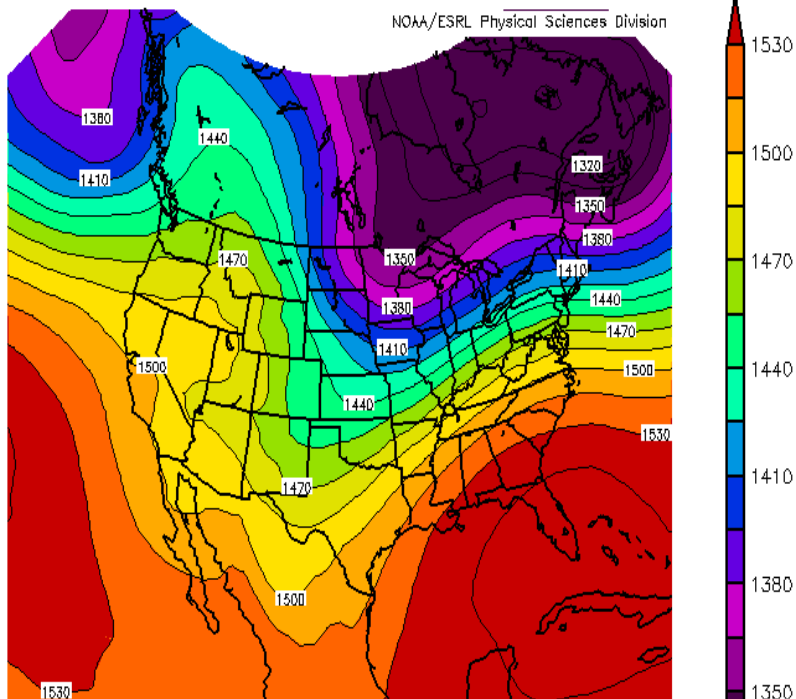


Red Flag Pattern Recognition

Prefrontal

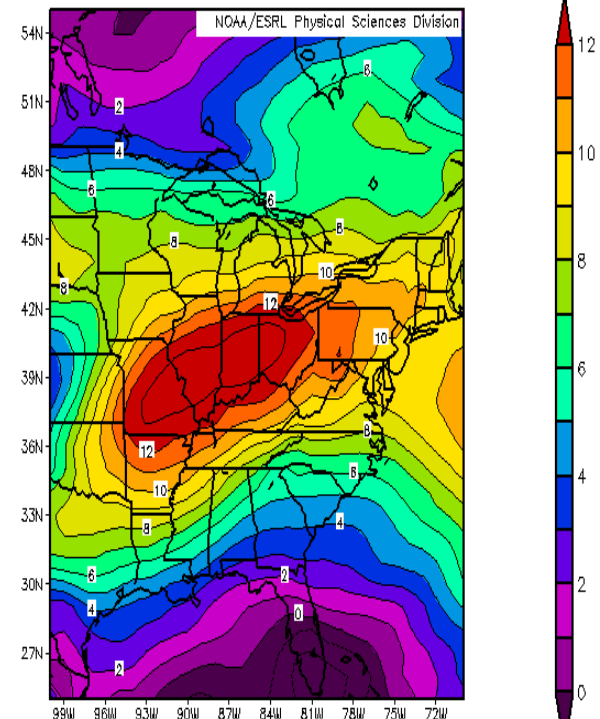
- Mid and upper levels indicate diving trough into the upper Midwest, with strong H850 jet located over the Ohio Valley.

NCEP North American Regional Reanalysis
Geopotential Height (m) Composite Mean



1990/02/13 ,1990/03/22 ,1995/02/23 ,1995/04/03 ,1996/04/25 ,1998/02/26 ,1999/03/17 ,2006/02

NCEP North American Regional Reanalysis
Zonal Wind (m/s) Composite Mean



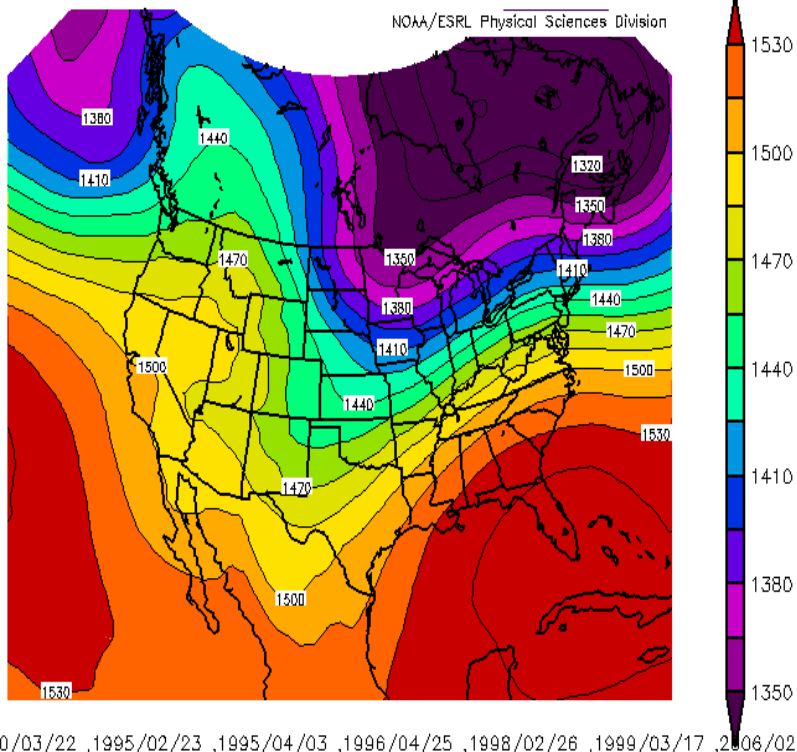
1990/02/13 ,1990/03/22 ,1995/02/23 ,1995/04/03 ,1996/04/25 ,1998/02/26 ,1999/03/17 ,2006/02

Red Flag Pattern Recognition

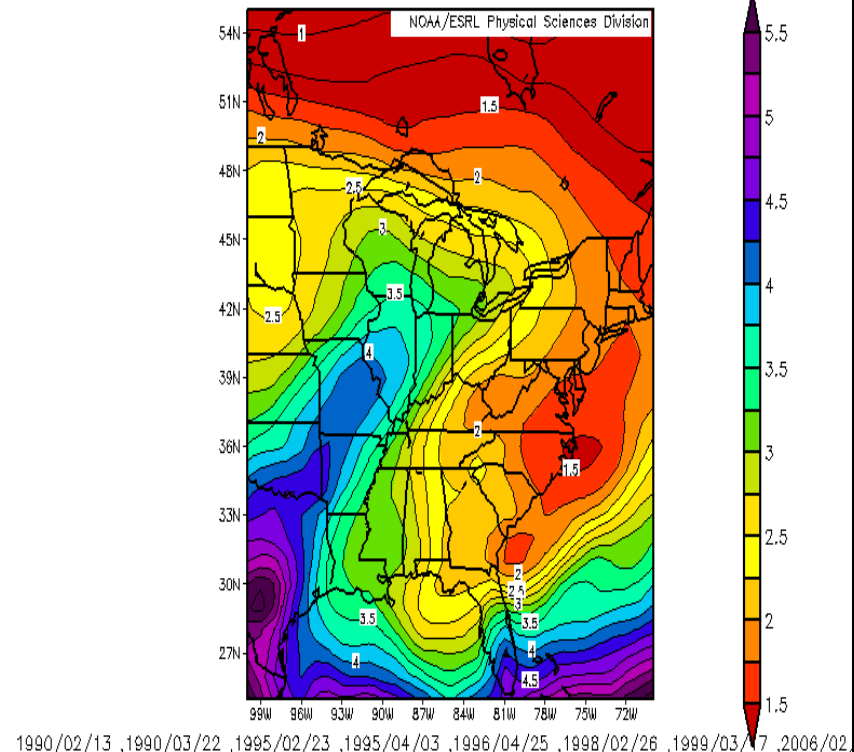
Prefrontal

- While moist tongue is located just to our west, surging northeast up the Ohio Valley, dry air is noted aloft over the southern Appalachians.

NCEP North American Regional Reanalysis
Geopotential Height (m) Composite Mean



NCEP North American Regional Reanalysis
Specific Humidity (kg/kg) Composite Mean



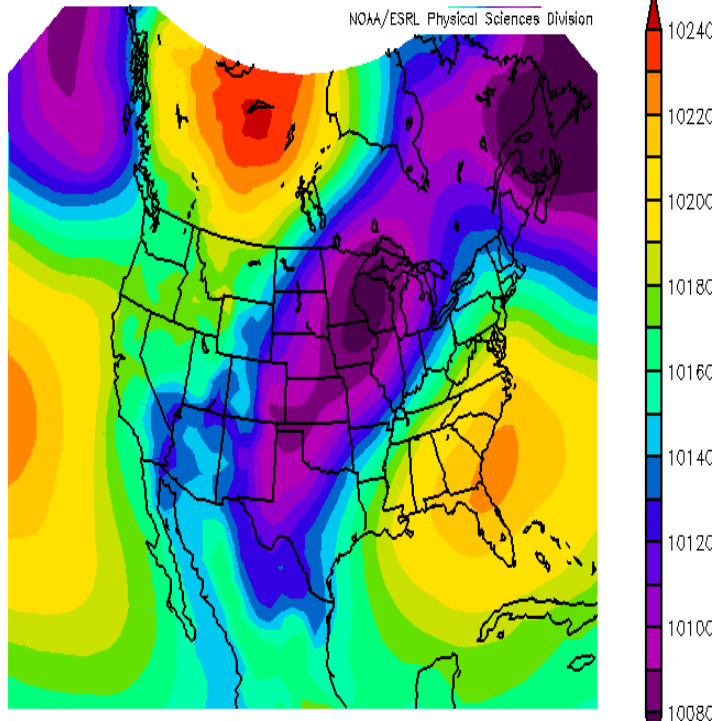
Red Flag Pattern Recognition

Prefrontal

- Classic setup involves a strong surface ridge along southeast coastline with low pressure and associated cold front diving into the upper Midwest.

Pressure at Mean Sea Level (Pa) Composite Mean

NOAA/ESRL Physical Sciences Division

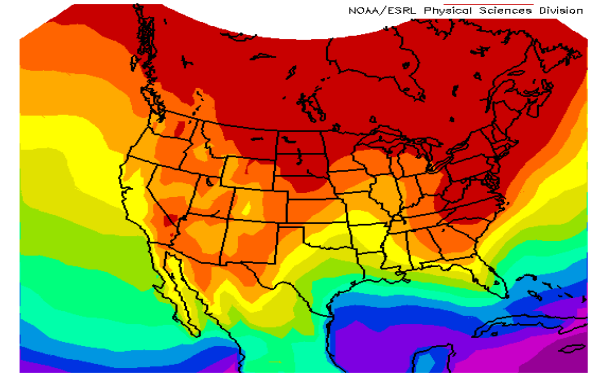


1990/02/13 ,1990/03/22 ,1995/02/23 ,1995/04/03 ,1996/04/25 ,1998/02/26 ,1999/03/17 ,2006/02/26

13 mb or greater gradient needed

NCEP North American Regional Reanalysis
Specific Humidity (kg/kg) Composite Mean

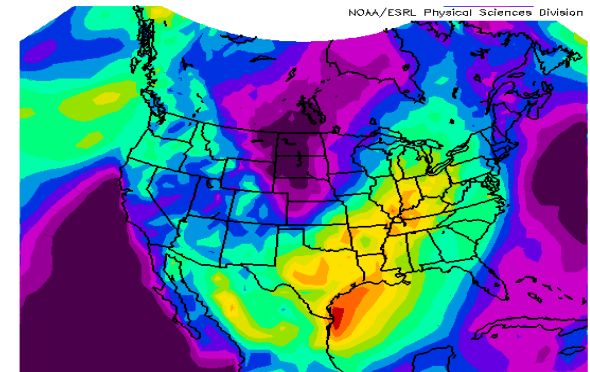
NOAA/ESRL Physical Sciences Division



1990/02/13 ,1990/03/22 ,1995/02/23 ,1995/04/03 ,1996/04/25 ,1998/02/26 ,1999/03/17 ,2006/02/26

NCEP North American Regional Reanalysis
Meridional Wind (m/s) Composite Mean

NOAA/ESRL Physical Sciences Division

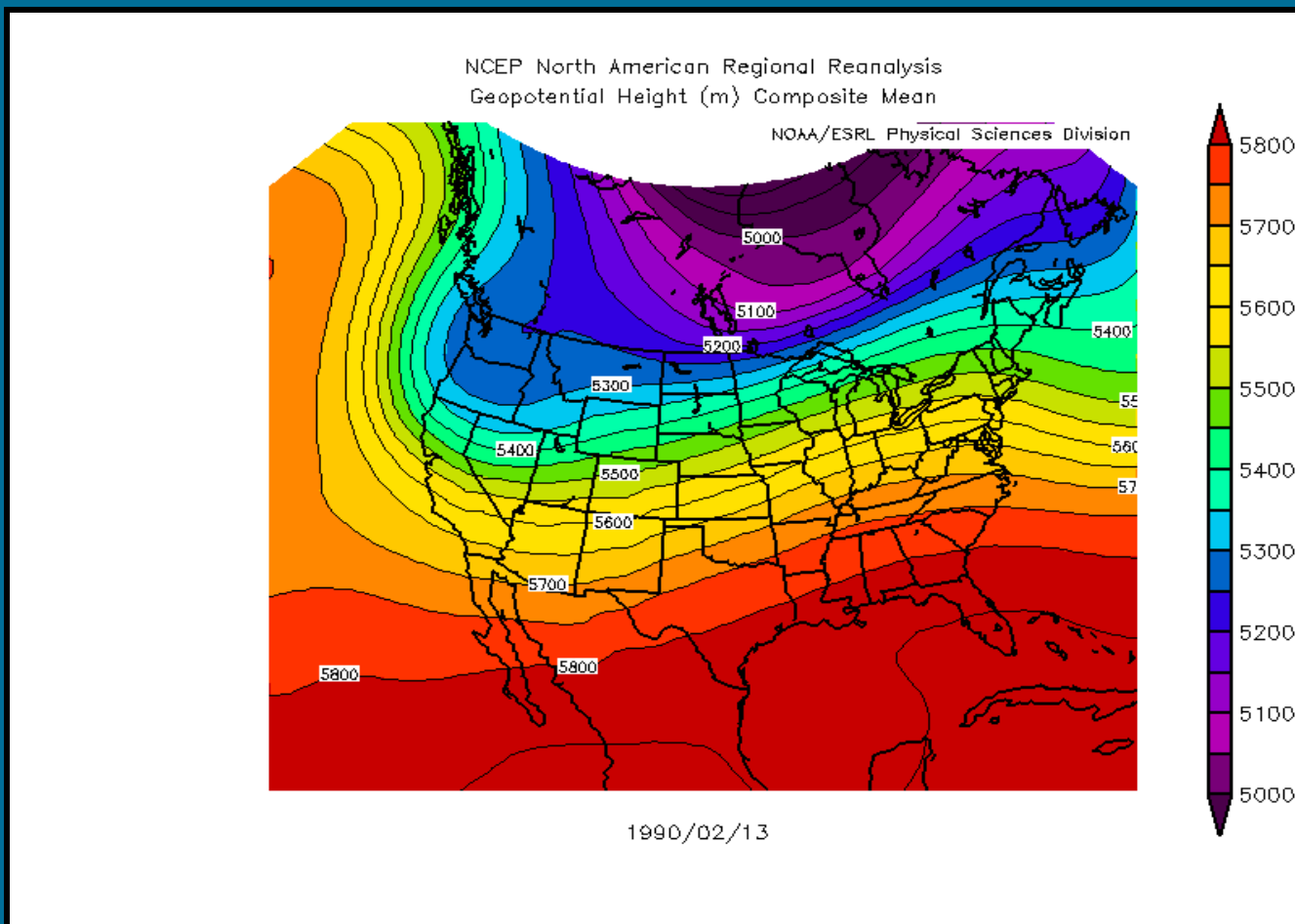


1990/02/13 ,1990/03/22 ,1995/02/23 ,1995/04/03 ,1996/04/25 ,1998/02/26 ,1999/03/17 ,2006/02/26

Red Flag Pattern Recognition

Prefrontal Event Case Study

February 13, 1990

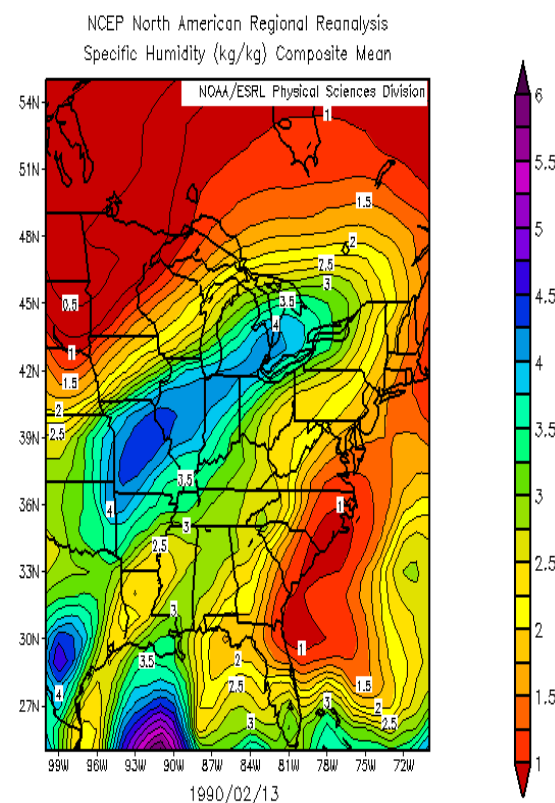
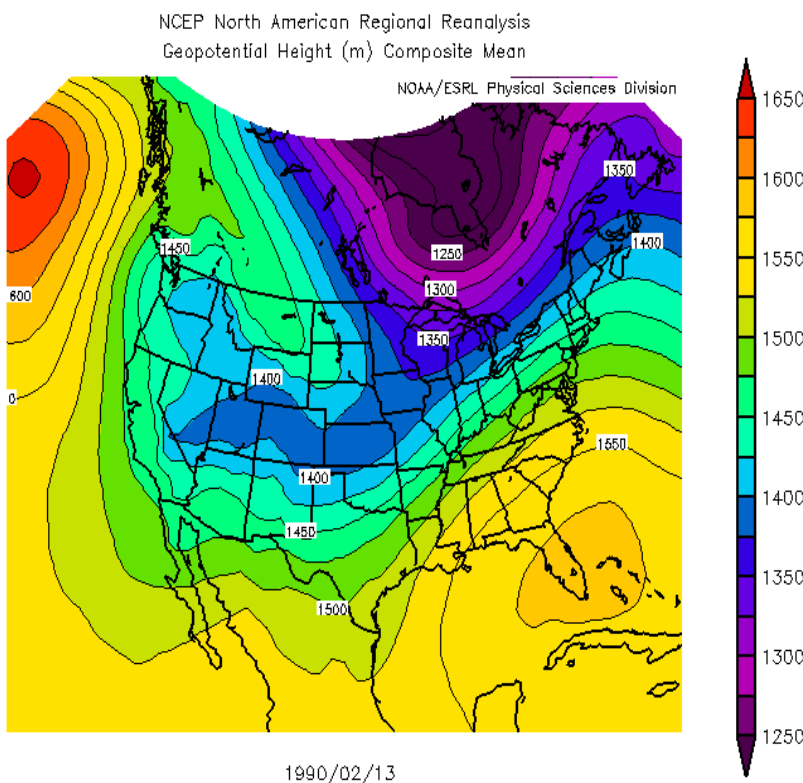


Red Flag Pattern Recognition

Prefrontal Event Case Study

February 13, 1990

- H850 Trough over the Upper Midwest with moisture return well to our west. Note dry air from the Appalachians eastward.

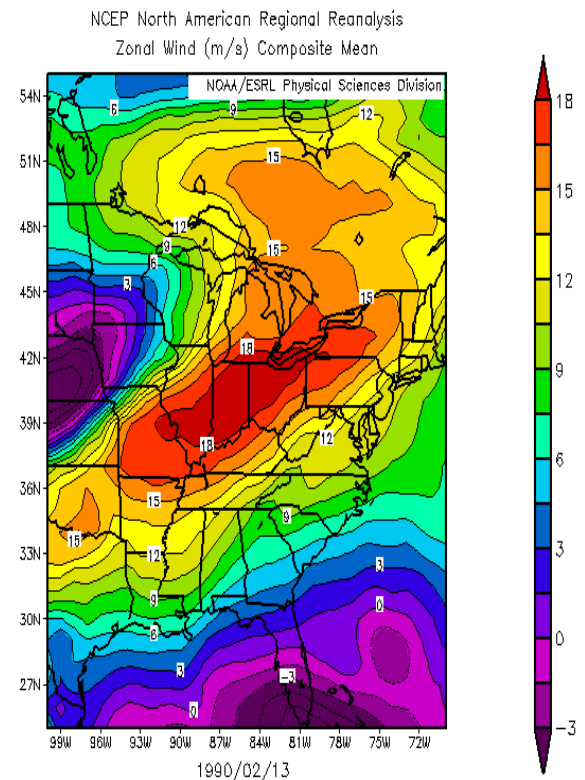
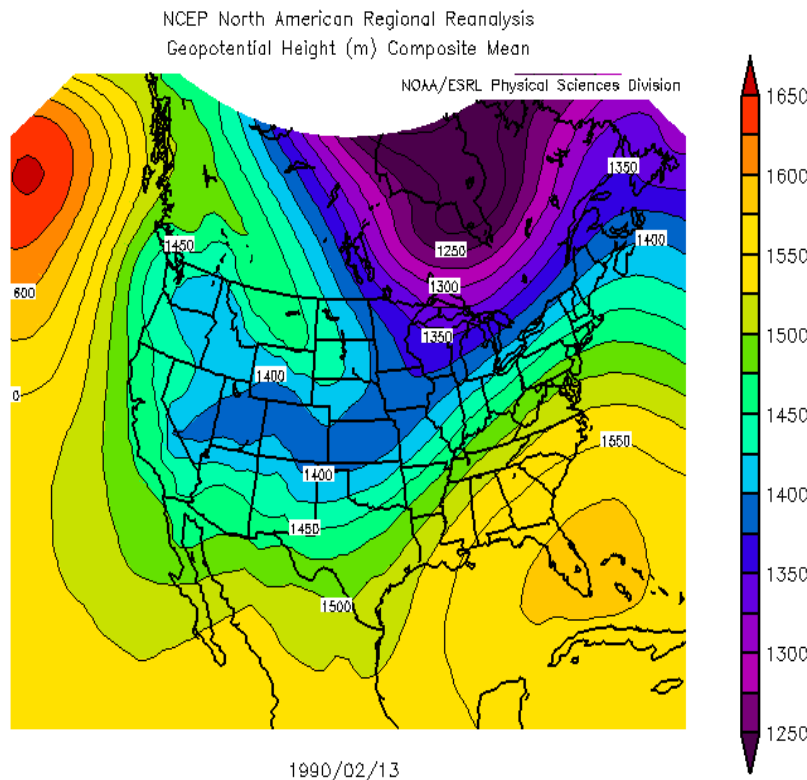


Red Flag Pattern Recognition

Prefrontal Event Case Study

February 13, 1990

- Prefrontal cases have a strong southwesterly low level jet which we mix up into creating gusty winds to go along with the low surface RH.

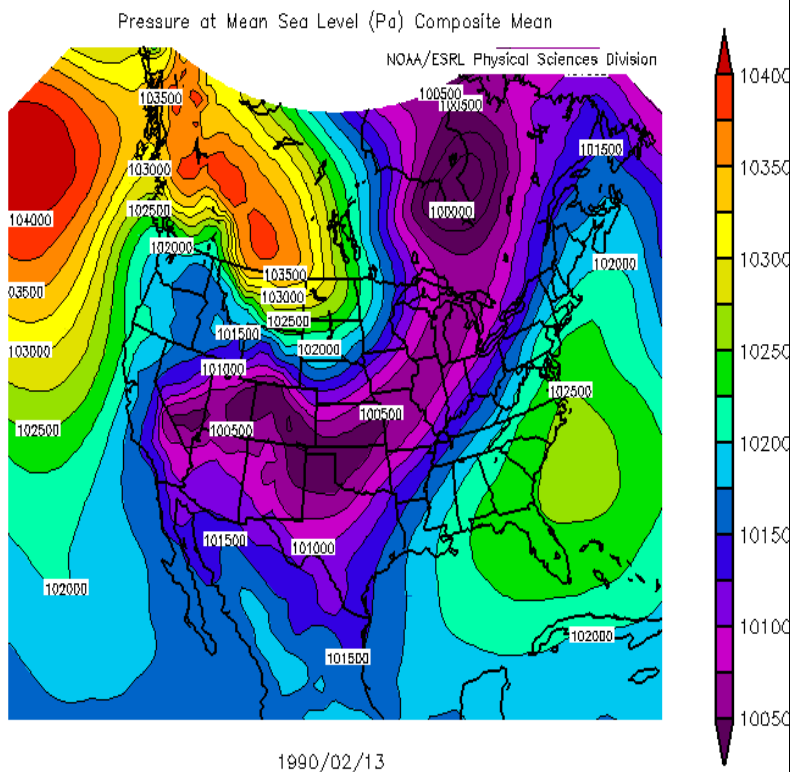


Red Flag Pattern Recognition

Prefrontal Event Case Study

February 13, 1990

- Pressure gradient is approximately 19 mb between ridge off the Carolina coast and the low over KS/OK. Note strong gusty winds in the observations.



JKL

	WIND			WIND		
HRMN	DIR	SPD	GUST	TEMP	DEW	RH
1900	190	17	26	69	32	25
2100	190	16	37	69	23	17
2200	210	18	30	67	27	22
2300	190	22	26	65	30	27

LOZ

	WIND			WIND		
HRMN	DIR	SPD	GUST	TEMP	DEW	RH
1900	220	21	29	65	28	25

LEX

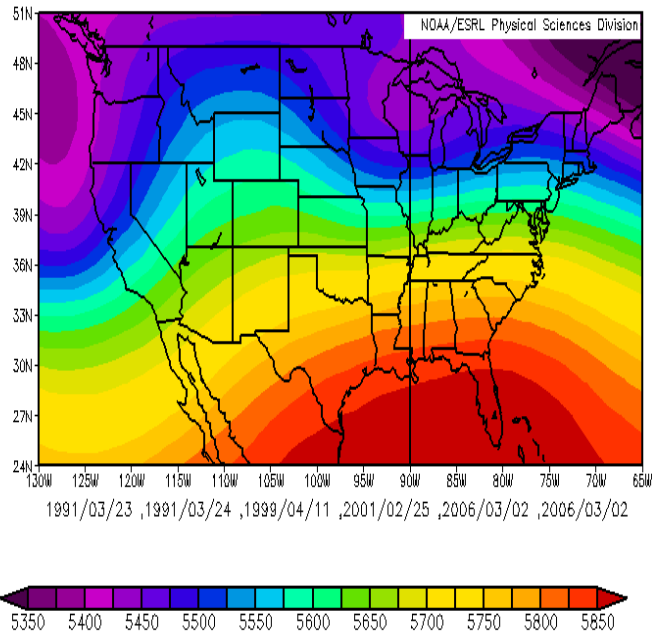
	WIND			WIND		
HRMN	DIR	SPD	GUST	TEMP	DEW	RH
1600	200	21	33	65	29	26
1700	210	25	40	65	28	25

Red Flag Pattern Recognition

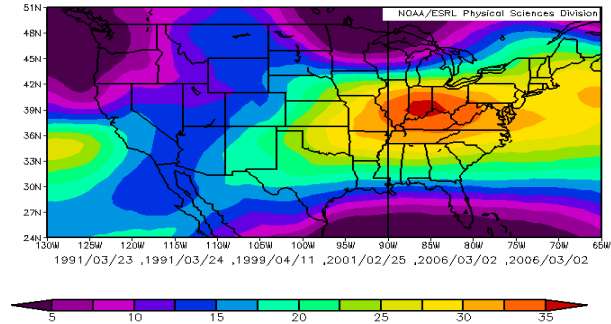
Regionwide Postfrontal

- At H500 upper level shortwave or vertically stacked occluded system is usually positioned over the Great Lakes or Upper Midwest with a strong westerly jet over the Ohio Valley.

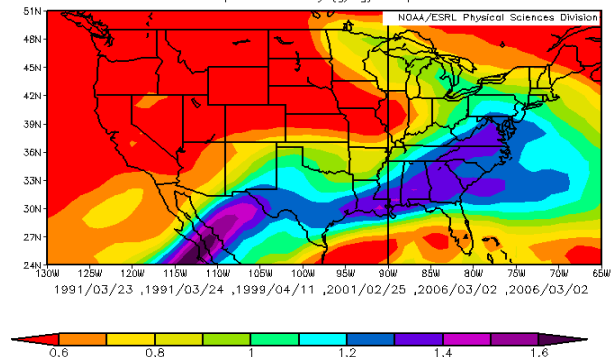
NCEP North American Regional Reanalysis
500mb Geopotential Height (m) Composite Mean



NCEP North American Regional Reanalysis
500mb Zonal Wind (m/s) Composite Mean



NCEP North American Regional Reanalysis
500mb Specific Humidity (g/kg) Composite Mean

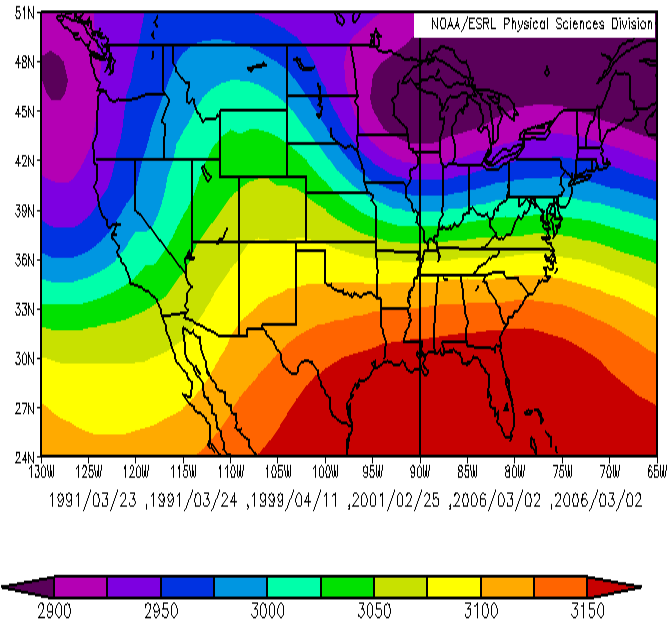


Red Flag Pattern Recognition

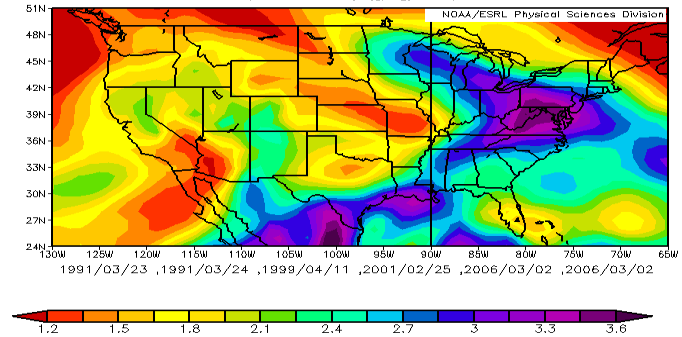
Regionwide Postfrontal

- Dry slot then punches in during the afternoon. We scatter out and mix up into this dry air aloft. RH plummets along with gusty winds. Guidance does not handle this well at all.

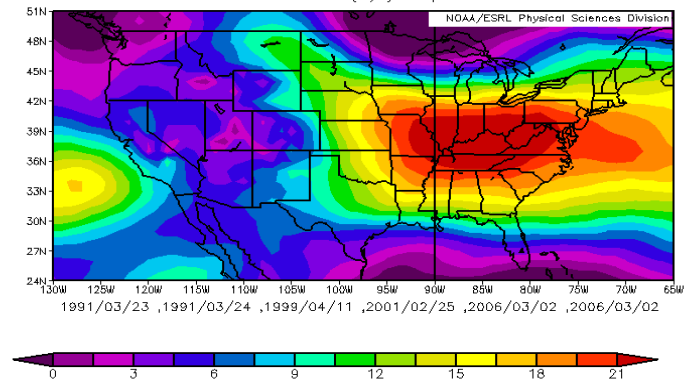
NCEP North American Regional Reanalysis
700mb Geopotential Height (m) Composite Mean



NCEP North American Regional Reanalysis
700mb Specific Humidity (g/kg) Composite Mean



NCEP North American Regional Reanalysis
700mb Zonal Wind (m/s) Composite Mean



Red Flag Pattern Recognition

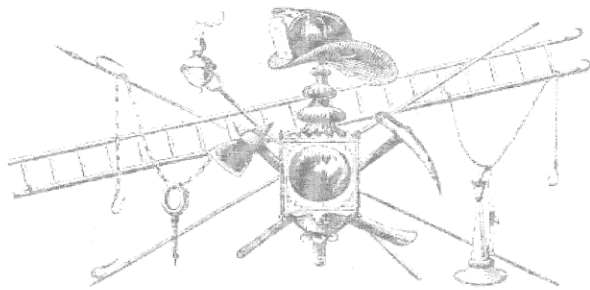
Postfrontal Event Case Study

April 6th, 1999

ISLAND FORK FIRE REPORT

In Memory of
KEVIN REX SMITH
and
KENNETH ALLEN NICKELL

Volunteer firefighters of the Route 377 Volunteer Fire Department who perished on the Island Fork Fire due to the unforeseen interaction of strong winds and complex terrain. This resulted in a rapidly spreading, high intensity fire that prevented them from using escape routes to reach the safety zone or burned-over area.



ID	TIME	T	TD	RH	DIR	SPD	GST	ALT	SLP	VIS	CIL	COV	WX	MAX	MIN
KJKL	1156	65	52	63	190	8		000	148	10		CLR		70	64
KJKL	1256	66	52	61	190	7	14	000	147	10		CLR			
KJKL	1356	68	53	59	200	10	15	002	155	10	100	BKN			
KJKL	1456	68	55	63	190	12	20	006	168	10	44	BKN			
KJKL	1556	67	57	70	230	7	24	009	177	10	28	OVC			
KJKL	1656	72	56	57	0	6		007	170	10	38	BKN			
KJKL	1756	74	54	50	180	12	19	005	162	10		CLR		75	65
KJKL	1856	76	52	43	210	10	20	005	161	10		CLR			
KJKL	1956	79	49	35	0	6	23	004	157	10		CLR			
KJKL	2056	80	39	23	250	9	26	004	157	10		CLR			
KJKL	2156	79	39	24	220	11	16	004	158	10		CLR			
KJKL	2256	77	35	22	240	8	15	005	163	10		CLR			
KJKL	2356	73	29	19	260	9	19	007	169	10		CLR		80	73
KHTS	1151	64	50	60	0	6		999	148	10		CLR		65	58
KHTS	1251	64	50	60	170	5		997	144	10	110	FEW			
KHTS	1351	67	51	57	180	10	15	997	144	10		CLR			
KHTS	1451	69	52	54	200	16	19	999	149	10		CLR			
KHTS	1551	72	54	53	230	11	17	001	155	10	46	BKN			
KHTS	1651	75	56	51	240	16	25	998	147	10	48	FEW			
KHTS	1751	79	54	42	250	12	24	997	141	10	50	FEW		79	64
KHTS	1851	79	46	31	250	19	28	996	140	10		CLR			
KHTS	1951	81	39	22	240	15	24	995	134	10		CLR			
KHTS	2051	81	37	21	260	14	24	995	135	10		CLR			
KHTS	2151	80	36	20	270	11	21	996	139	10		CLR			
KHTS	2251	77	33	20	280	12	24	998	145	10		CLR			
KHTS	2351	74	36	25	280	14	23	000	153	10		CLR		81	74

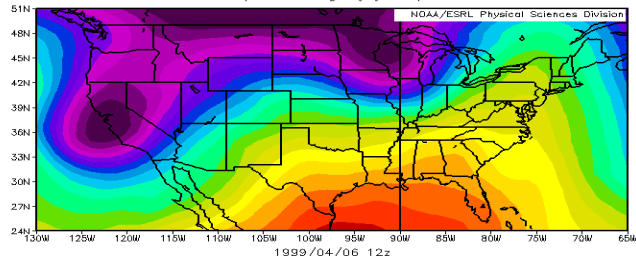
Red Flag Pattern Recognition

Postfrontal Event Case Study

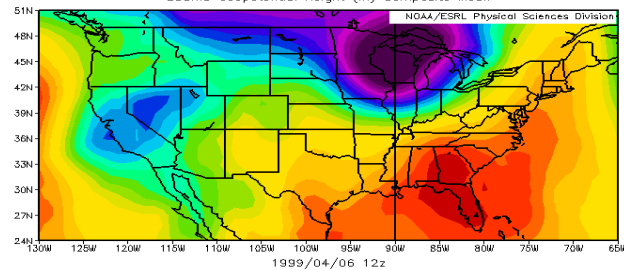
April 6th, 1999

- Mid and Upper Level Trough centered over the Upper Midwest/Great Lakes moving eastward through the day.

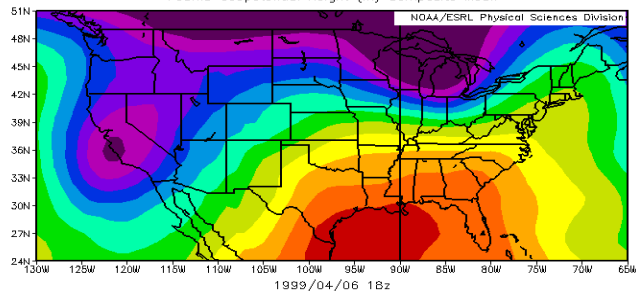
NCEP North American Regional Reanalysis
500mb Geopotential Height (m) Composite Mean



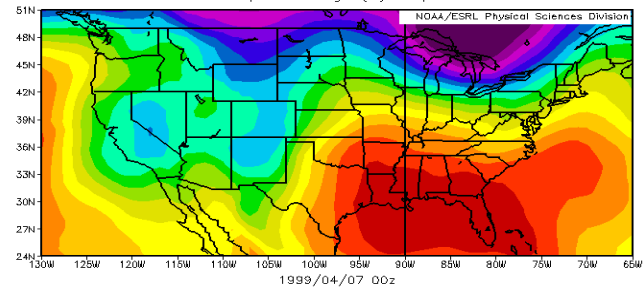
NCEP North American Regional Reanalysis
850mb Geopotential Height (m) Composite Mean



NCEP North American Regional Reanalysis
700mb Geopotential Height (m) Composite Mean



NCEP North American Regional Reanalysis
850mb Geopotential Height (m) Composite Mean

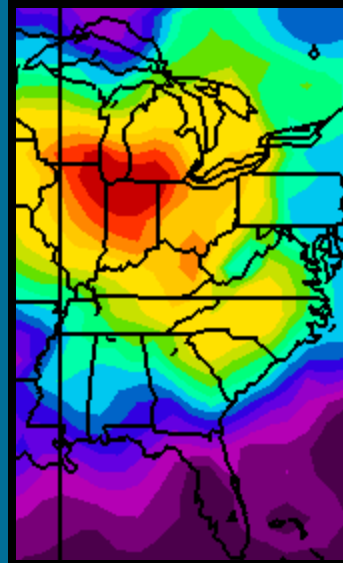
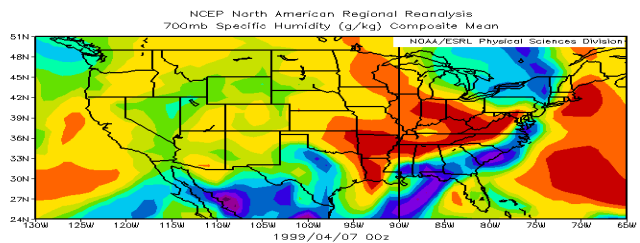
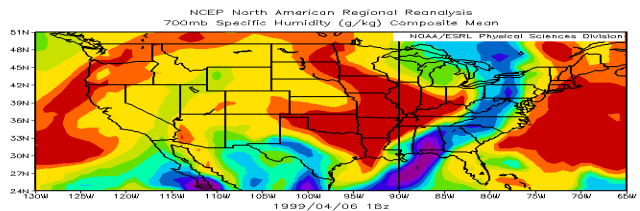
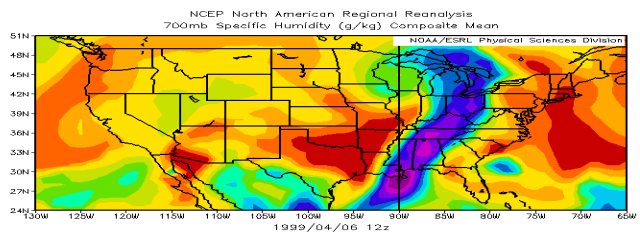


Red Flag Pattern Recognition

Postfrontal Event Case Study

April 6th, 1999

- Surface cold frontal passage around midday with lagging H850 trough and clear skies allowed strong warming and deep mixing during the afternoon.



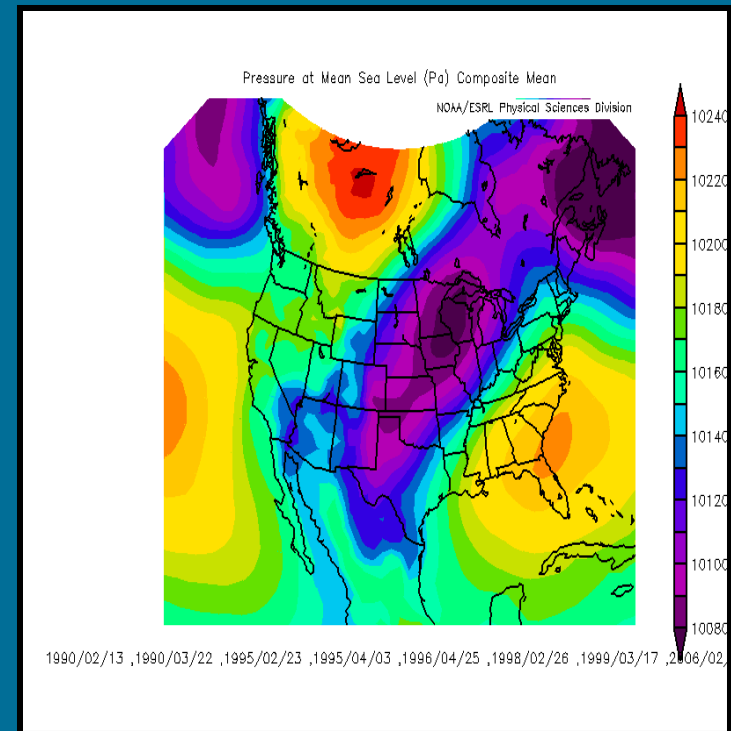
40kts
overhead
@ H850

ID	TIME	T	TD	RH	DIR	SPD	GST	ALT	SLP	VIS	CIL	COV	WX	MAX	MIN
KJKL	1156	65	52	63	190	8	000	148	10			CLR		70	64
KJKL	1256	66	52	61	190	7	14	000	147	10		CLR			
KJKL	1356	68	53	59	200	10	15	002	155	10	100	BKN			
KJKL	1456	68	55	63	190	12	20	006	168	10	44	BKN			
KJKL	1556	67	57	70	230	7	24	009	177	10	28	OVC			
KJKL	1656	72	56	57	0	6	007	170	10	38		BKN			
KJKL	1756	74	54	50	180	12	19	005	162	10		CLR		75	65
KJKL	1856	76	52	43	210	10	20	005	161	10		CLR			
KJKL	1956	79	49	35	0	6	23	004	157	10		CLR			
KJKL	2056	80	39	23	250	9	26	004	157	10		CLR			
KJKL	2156	79	39	24	220	11	16	004	158	10		CLR			
KJKL	2256	77	35	22	240	8	15	005	163	10		CLR			
KJKL	2356	73	29	19	260	9	19	007	169	10		CLR		80	73
KHTS	1151	64	50	60	0	6	999	148	10			CLR		65	58
KHTS	1251	64	50	60	170	5	997	144	10	110		FEW			
KHTS	1351	67	51	57	180	10	15	997	144	10		CLR			
KHTS	1451	69	52	54	200	16	19	999	149	10		CLR			
KHTS	1551	72	54	53	230	11	17	001	155	10	46	BKN			
KHTS	1651	75	56	51	240	16	25	998	147	10	48	FEW			
KHTS	1751	79	54	42	250	12	24	997	141	10	50	FEW		79	64
KHTS	1851	79	46	31	250	19	28	996	140	10		CLR			
KHTS	1951	81	39	22	240	15	24	995	134	10		CLR			
KHTS	2051	81	37	21	260	14	24	995	135	10		CLR			
KHTS	2151	80	36	20	270	11	21	996	139	10		CLR			
KHTS	2251	77	33	20	280	12	24	998	145	10		CLR			
KHTS	2351	74	36	25	280	14	23	000	153	10		CLR		81	74

Red Flag Pattern Recognition

Summary

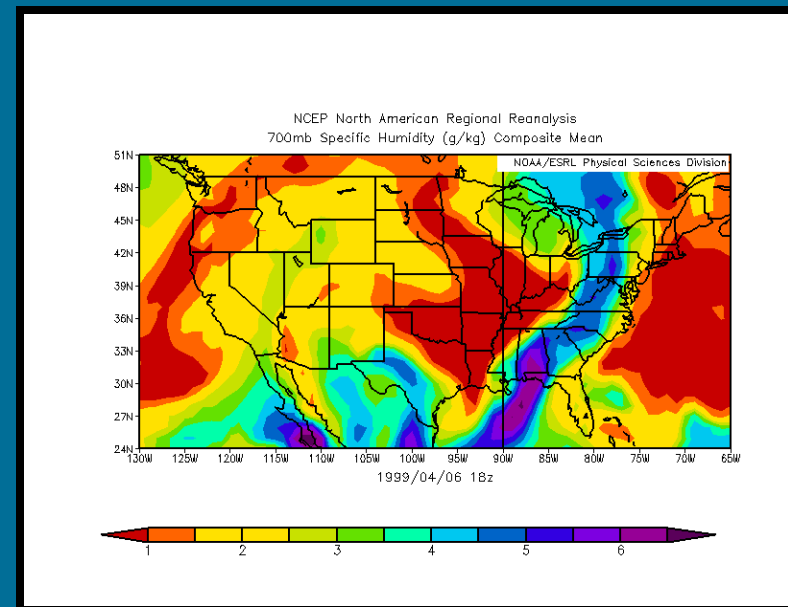
- Prefrontal
 - 500 mb – Digging trof over Nrn Plains or Rockies
 - 850 mb – Trof over Upper Midwest
 - Strong LLVL Jet over Ohio Valley
 - Moist Tongue West/Dry Air Above
- Surface –
 - Strong High over the Deep South/Florida
 - Deep Low over Upper Midwest with trailing cold front
 - Pressure gradient of 13 mb or greater



Red Flag Pattern Recognition

Summary

- Postfrontal
 - Upper Levels
 - Vertically stacked upper low over the western Great Lakes
 - Strong jet over the Ohio Valley to be mixed into
 - 850 mb trough axis lagging well behind surface frontal passage
 - Surface
 - Early morning frontal passage
 - Dry air nosing eastward across the plains can be noted on water vapor

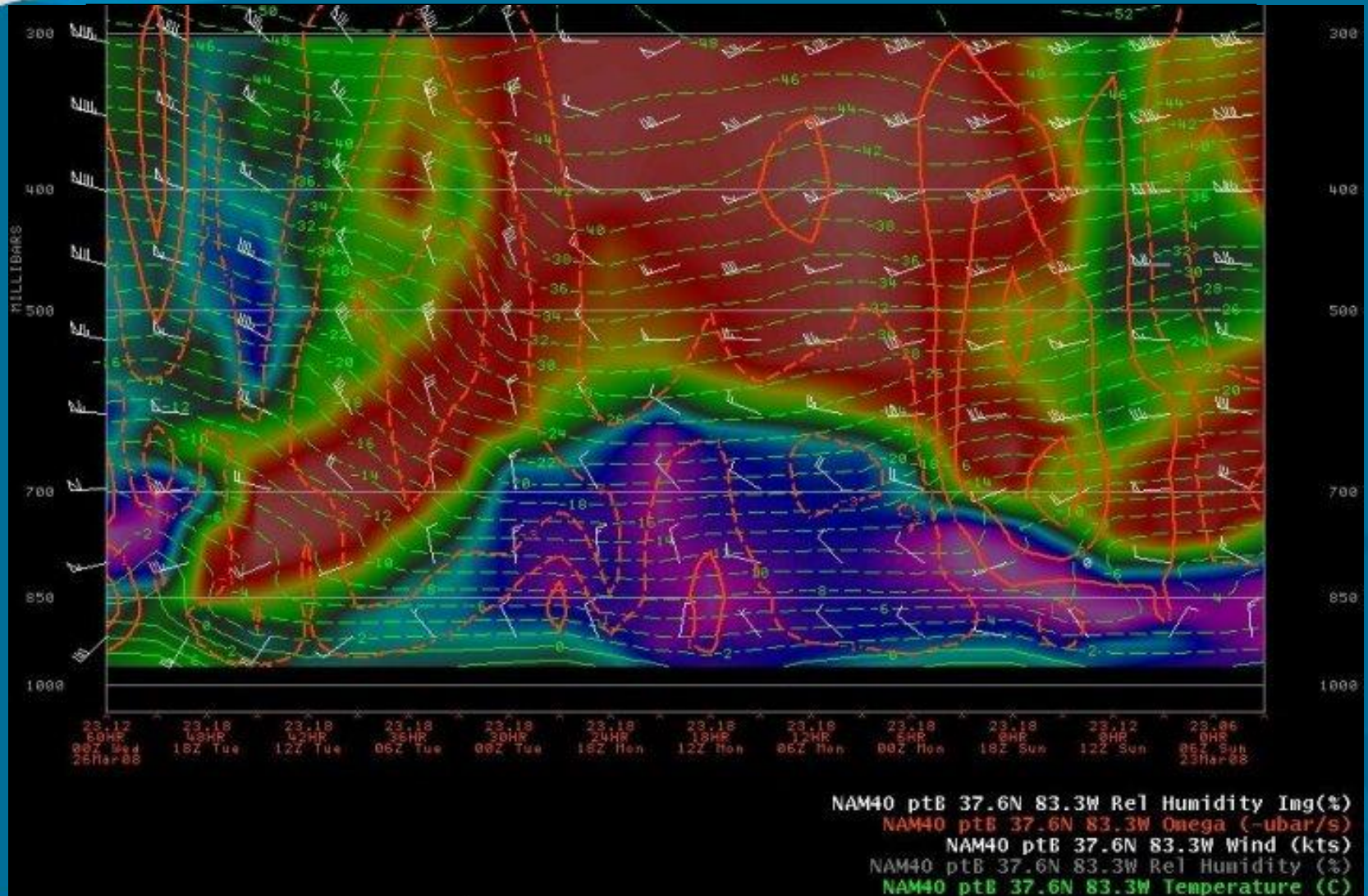


Red Flag Pattern Recognition

So, Does It Work!

Red Flag Pattern Recognition

Tuesday March 25th, 2008



Red Flag Pattern Recognition

Tuesday March 25th, 2008

AREA FORECAST DISCUSSION
NATIONAL WEATHER SERVICE JACKSON KY
330 PM EDT SUN MAR 23 2008

.FIRE WEATHER.../TONIGHT THROUGH T

NO PROBLEMS ARE EXPECTED BEFORE TUE
EXPECTED TO REMAIN OVER THE SOUTHE
PRESSURE MOVING THROUGH THE NORTHE
LOWER PRESSURE REMAINING OVER WEST
THE CLASSIC PREFRONTAL PATTERN FOR

DEWPOINTS ARE EXPECTED TO REMAIN I
20S...WITH MAX T IN THE UPPER 50S
RH NEAR 25 PERCENT AND 20 FOOT WIN
LITTLE STRONGER ACROSS THE WESTERN
BELOW IS A LITTLE MORE DOUBTFUL TH
ALSO POSSIBLE AS THE LOW LEVEL JET
CURRENTLY ARE EXPECTED TO BE MARGI
CRITERIA ON TUE IS AT LEAST 50 PER
WEATHER WATCH.

FIRE WEATHER WATCH
NATIONAL WEATHER SERVICE JACKSON KY
422 PM EDT SUN MAR 23 2008

...FIRE WEATHER WATCH IN EFFECT FROM TUESDAY AFTERNOON THROUGH
TUESDAY EVENING...

.HIGH PRESSURE WILL REMAIN ACROSS THE SOUTHEASTERN UNITED STATES ON
TUESDAY...WITH A COLD FRONT APPROACHING THE AREA FROM THE NORTHWEST.
LOW LEVEL MOISTURE WILL BE SLOW TO RETURN AND WINDS OUT OF THE
SOUTHWEST WILL INCREASE ON TUESDAY AFTERNOON...AND BECOME GUSTY.

KYZ044-050>052-058>060-068-069-079-080-083>088-104-106>120-241145-
/O.NEW.KJKL.FW.A.0002.080325T1800Z-080326T0000Z/
FLEMING-MONTGOMERY-BATH-ROWAN-ESTILL-POWELL-MENIFEE-ROCKCASTLE-
JACKSON-PULASKI-LAUREL-WAYNE-MCCREARY-WHITLEY-KNOX-BELL-HARLAN-
ELLIOTT-MORGAN-JOHNSON-WOLFE-MAGOFFIN-FLOYD-LEE-BREATHITT-KNOTT-
OWSLEY-PERRY-CLAY-LESLIE-LETCHER-MARTIN-PIKE-
422 PM EDT SUN MAR 23 2008

...FIRE WEATHER WATCH IN EFFECT FROM TUESDAY AFTERNOON THROUGH
TUESDAY EVENING...

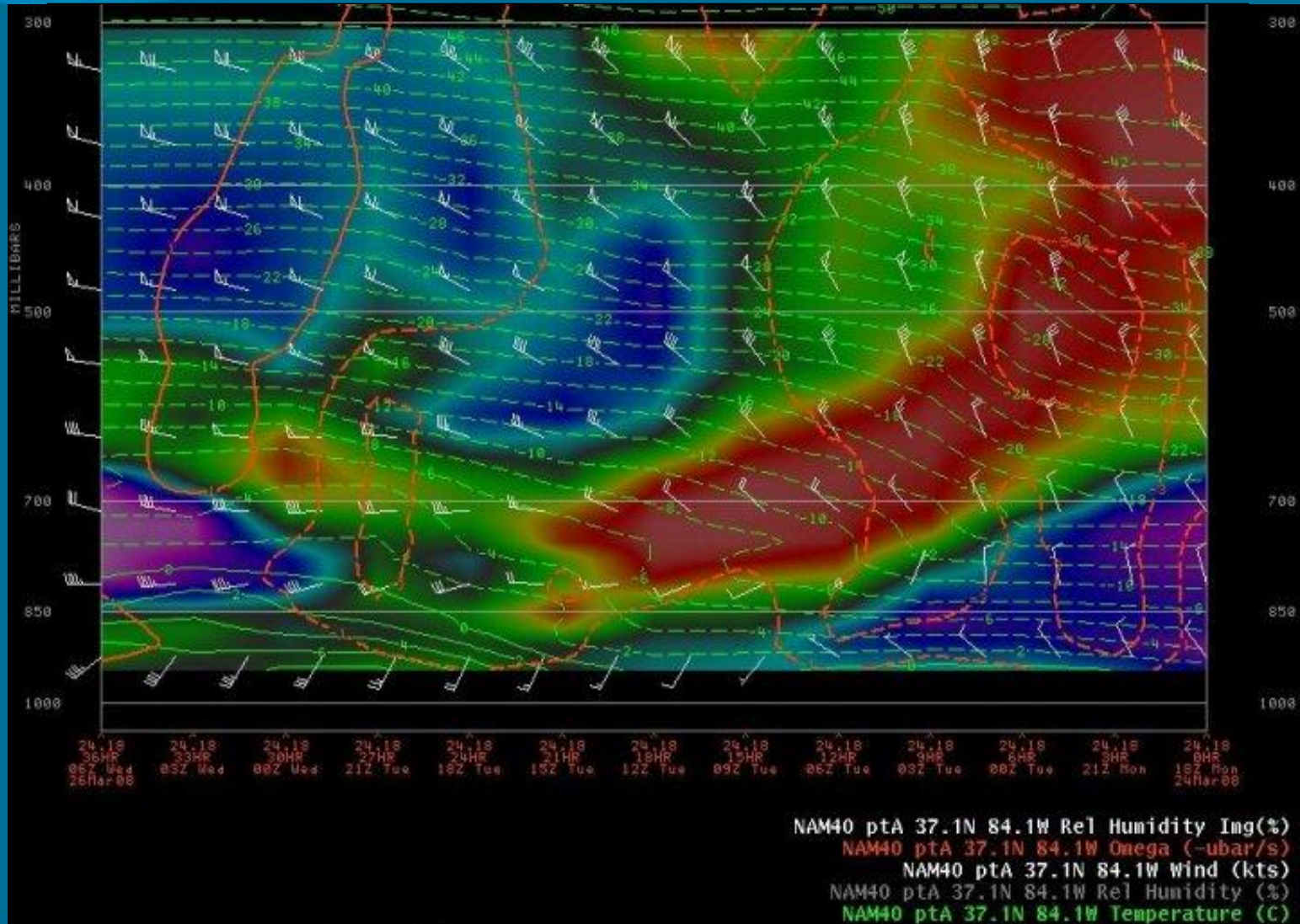
THE NATIONAL WEATHER SERVICE IN JACKSON HAS ISSUED A FIRE WEATHER
WATCH...WHICH IS IN EFFECT FROM TUESDAY AFTERNOON THROUGH TUESDAY
EVENING.

RELATIVE HUMIDITIES WILL FALL TO AROUND OR SLIGHTLY BELOW 25 PERCENT
ON TUESDAY AFTERNOON. 20 FOOT WINDS WILL INCREASE IN THE AFTERNOON TO
AROUND 15 MPH...WITH WINDS ALONG THE INTERSTATE 64 CORRIDOR REACHING
THE 15 TO 20 MPH RANGE. WIND GUSTS NEAR 30 MPH WILL ALSO BE POSSIBLE.
FUELS ARE EXPECTED TO CONTINUE TO DRY OUT AND MAY REACH CRITICAL
LEVELS ON TUESDAY AS WELL.

A FIRE WEATHER WATCH MEANS THAT CRITICAL FIRE WEATHER CONDITIONS
ARE POSSIBLE. LISTEN FOR LATER FORECASTS AND POSSIBLE FUTURE
WARNINGS.

Red Flag Pattern Recognition

Tuesday March 25th, 2008



Red Flag Pattern Recognition

Tuesday March 25th, 2008

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/O.NEW.KJKL.FW.W.0002.080325T1600Z-080325T2200Z/  
FLEMING-MONTGOMERY-BATH-ROWAN-ESTILL-POWELL-MENIFEE-ROCKCASTLE-  
JACKSON-PULASKI-LAUREL-WAYNE-MCCREARY-WHITLEY-KNOX-ELLIOTT-MORGAN-  
JOHNSON-WOLFE-MAGOFFIN-LEE-BREATHITT-OWSLEY-CLAY-  
515 AM EDT TUE MAR 25 2008
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...RED FLAG WARNING IN EFFECT FROM NOON TODAY TO 6 PM EDT THIS
AFTERNOON...

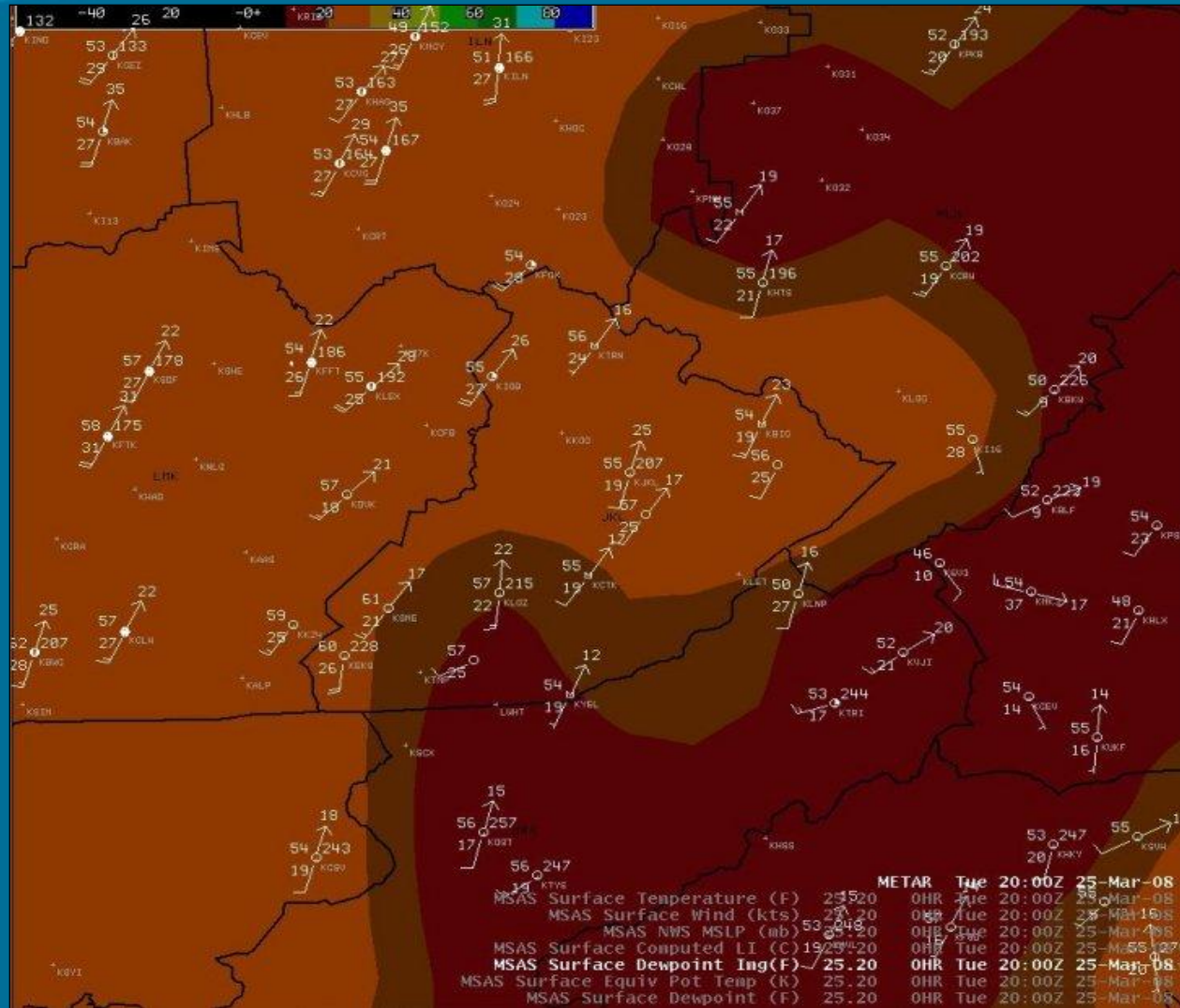
THE NATIONAL WEATHER SERVICE IN JACKSON HAS ISSUED A RED FLAG WARNING
...WHICH IS IN EFFECT FROM NOON TODAY TO 6 PM EDT THIS AFTERNOON. THE
FIRE WEATHER WATCH IS NO LONGER IN EFFECT.

LOW RELATIVE HUMIDITIES ARE EXPECTED THROUGH ALL OF EAST KENTUCKY FOR
A TIME THIS AFTERNOON. LOCATIONS GENERALLY WEST OF A LINE FROM
PAINTSVILLE TO WILLIAMSBURG ARE EXPECTED TO EXPERIENCE THE HIGHEST
WINDS TODAY WITH SEVERAL HOURS OF SUSTAINED SOUTHWEST WINDS REACHING
THE CRITICAL THRESHOLD AROUND MID AFTERNOON. IN ADDITION...FUELS ARE
EXPECTED TO CONTINUE TO DRY OUT AND MAY REACH CRITICAL LEVELS TODAY.
ACCORDINGLY...THE NATIONAL WEATHER SERVICE HAS ISSUED A RED FLAG
WARNING FROM NOON THROUGH 6 PM EDT FOR THE WESTERN TWO THIRDS OF THE
FORECAST AREA.

A RED FLAG WARNING MEANS THAT CRITICAL FIRE WEATHER CONDITIONS ARE
EITHER OCCURRING NOW...OR WILL OCCUR SHORTLY. A COMBINATION OF STRONG
WINDS...LOW RELATIVE HUMIDITY...AND DRY FUELS WILL CREATE THE
POTENTIAL FOR EXPLOSIVE FIRE GROWTH.

Red Flag Pattern Recognition

Tuesday March 25th, 2008



A photograph of a forest fire at night. The fire is intense, with bright orange and yellow flames rising from a dense line of trees in the background. The fire's light reflects on the calm water of a lake or river in the middle ground. In the foreground, a small, light-colored aluminum boat with an outboard motor is beached on a dark, rocky shore. The boat has a registration number 'KL 78 5FR' visible on its side. The overall scene is dramatic and somber due to the fire.

Questions...Comments?