Atmospheric Favorability for Flash Flooding in Warm and Cool Seasons

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PSU Student Volunteer (Summer 2017)

Background

Pittsburgh Forecast Area is very susceptible to flash flooding

SEVERE WEATHER TEAM
McKnight Road
Ross Twp., Allegheny County
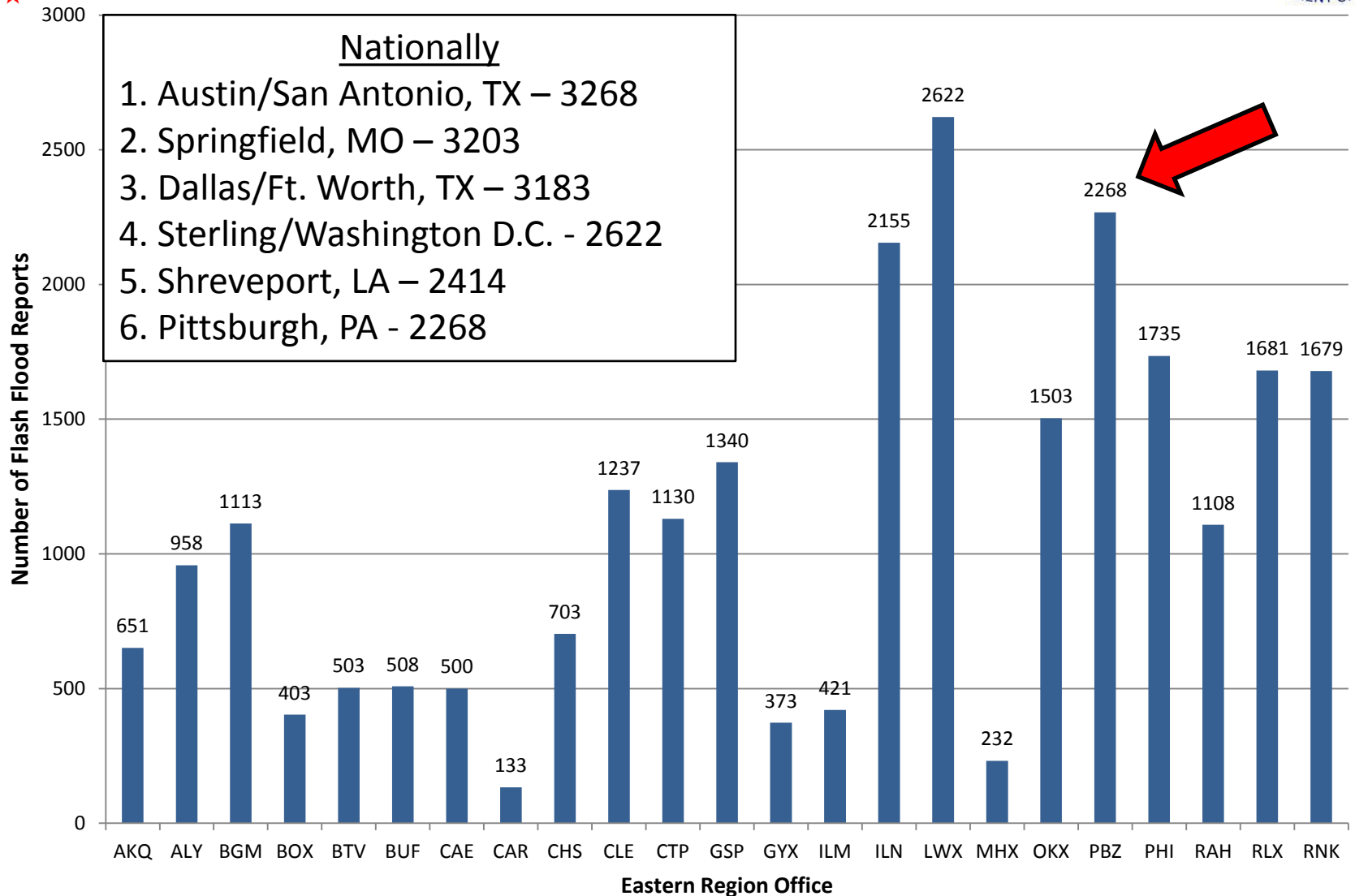
Impacts exacerbated by:

Highly Variable Terrain

Photo by Bob Davis, Pittsburgh

Interspersed urbanized areas
Older infrastructure

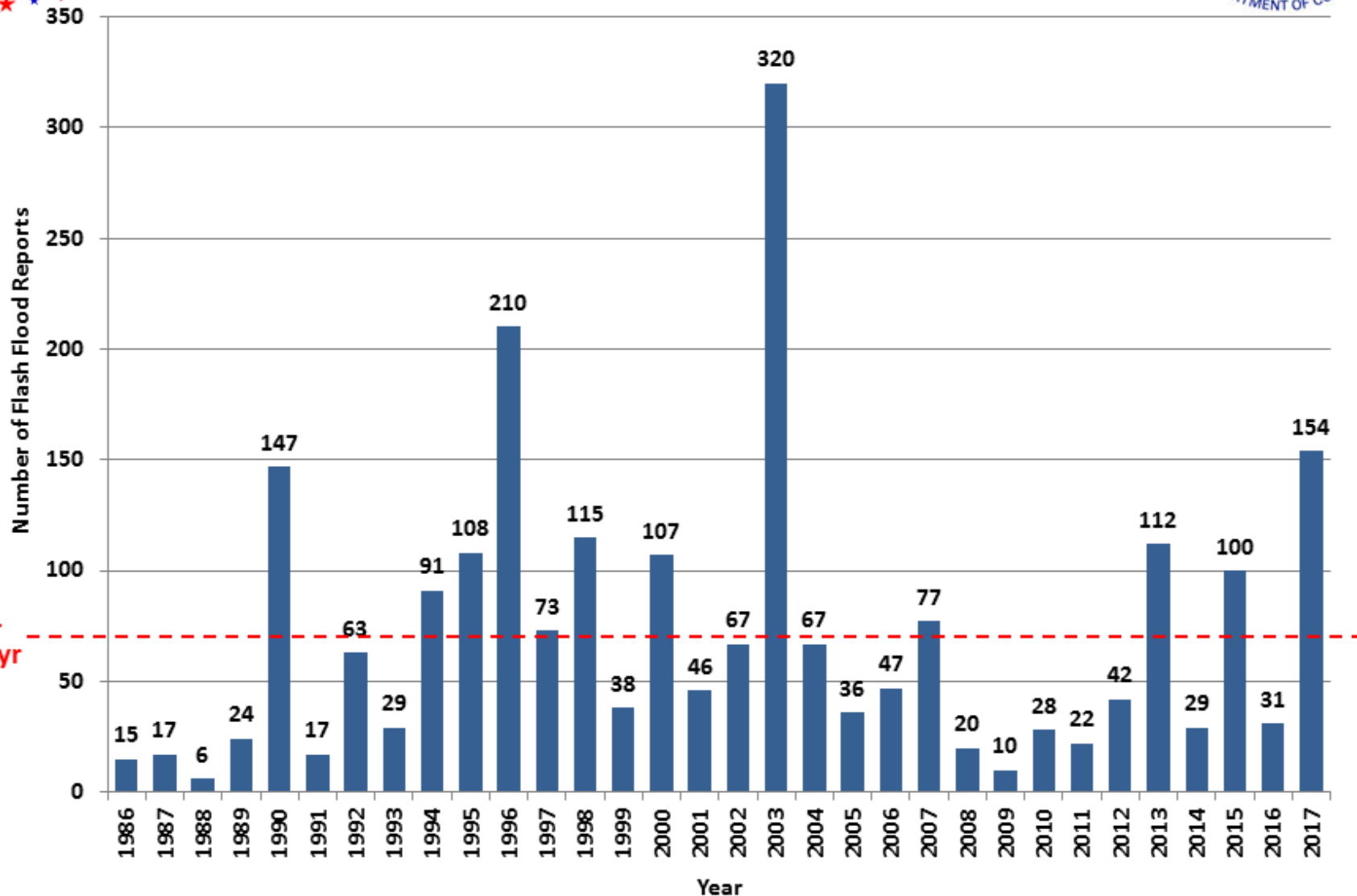**Flash Flood Events per Office (Eastern Region)**
1986 - 2017

Nationally
1. Austin/San Antonio, TX – 3268
2. Springfield, MO – 3203
3. Dallas/Ft. Worth, TX – 3183
4. Sterling/Washington D.C. - 2622
5. Shreveport, LA – 2414
6. Pittsburgh, PA - 2268

Number of Flash Flood Reports

Eastern Region Office

Office	Value
AKQ	651
ALY	958
BGM	1113
BOX	403
BTV	503
BUF	508
CAE	500
CAR	133
CHS	703
CLE	1237
CTP	1130
GSP	1340
GYX	373
ILM	421
ILN	2155
LWX	2622
MHX	232
OKX	1503
PBZ	2268
PHI	1735
RAH	1108
RLX	1681
RNK	1679

Flash Flood Report Frequency by Year
1986 - 2017

Number of Flash Flood Reports vs **Year**

Avg. ~ 71 reports/yr

Year	Reports
1986	15
1987	17
1988	6
1989	24
1990	147
1991	17
1992	63
1993	29
1994	91
1995	108
1996	210
1997	73
1998	115
1999	38
2000	107
2001	46
2002	67
2003	320
2004	67
2005	36
2006	47
2007	77
2008	20
2009	10
2010	28
2011	22
2012	42
2013	112
2014	29
2015	100
2016	31
2017	154

Flash Flood Frequency by Month
w/Precipitable Water Climatology
1986 - 2017
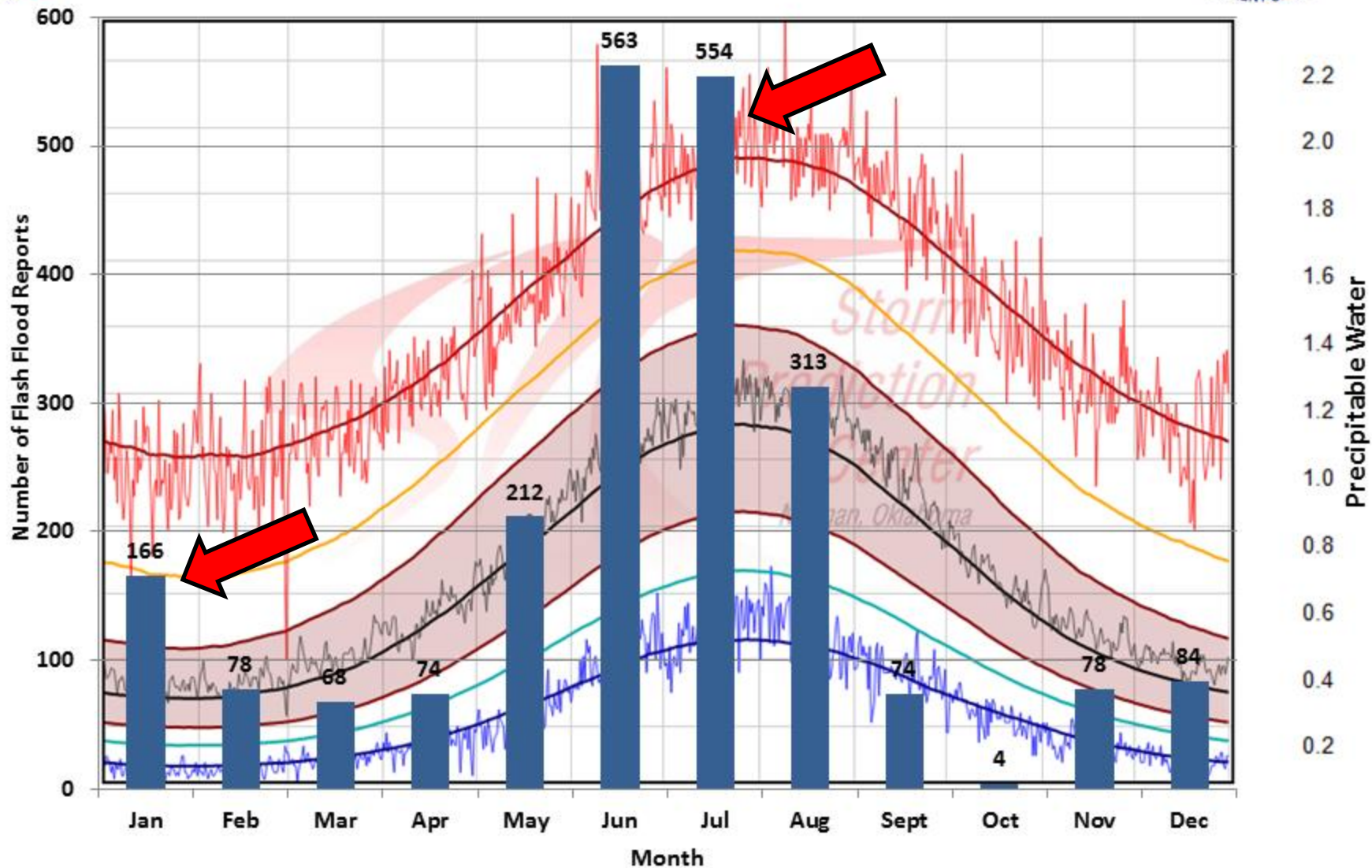
Study Background

- Anecdotally, forecasters long thought northwest flow regimes produced widespread flash flooding

- Lou Giordano:

  Thesis: "Northwest Flow Aloft and Strong Convective Events within the Mid-Atlantic States" (1987)

  W&F Journal: "Strong Tornadoes and Flash-Flood-Producing Rainstorms During the Warm Season in the Mid-Atlantic Region" (1991)

- Al Cope:

  Study: "A Climatology of Flash Flood Events in the NWS Eastern Region" (2005)

Is this the case year round or are there different regimes?

Top 20 events from 1986 - 2016
By number of counties impacted
*Impacted = at least one storm report entered into Storm Data

Warm Season (AMJJAS)

Date	Counties Impacted
06/27/98 - 07/01/98	21
7/9/13 - 7/10/13	17
7/18/96 - 7/19/96	16
08/08/03 - 08/11/03	16
08/26/03 - 08/27/03	16
07/12/90 - 07/13/90	15
05/25/97 - 05/26/97	14
05/09/03 - 05/11/03	13
06/14/90 - 06/15/90	13
05/21/04 - 05/22/04	13
06/14/04 - 06/15/04	12
6/15/15 - 6/16/15	11
09/01/03 - 09/02/03	11
07/08/03 - 07/09/03	11
08/09/07 - 08/10/07	10
07/05/07 - 07/06/07	10
06/26/95 - 06/27/95	10
7/15/1990	10
08/06/00 - 08/07/00	9
05/16/96 - 05/17/96	9

Cool Season (ONDJFM)

Date	Counties Impacted
1/18/96 - 1/20/96	36
11/19/2003	29
1/28/94 - 1/29/94	27
12/30/90 - 1/1/91	20
01/08/98 - 01/09/98	18
12/18/90 - 12/19/90	14
02/18/00 - 02/19/00	13
2/14/2000	11
03/02/97 - 03/03/97	10
2/28/1996	9
11/12/2003	7
2/23/2003	7
12/02/91 - 12/03/91	7
03/23/07 - 03/24/07	6
03/21/94 - 03/22/94	6
01/22/99 - 01/24/99	6
11/29/2005	5
2/3/2004	5
3/20/1996	5
01/30/01 - 02/01/01	5

North American Regional Reanalysis (NARR) composites were then constructed using these dates

Results:

Warm Season

Top 20 Warm Season Flash Flood Events
Geo. Heights (m) and MSLP (Pa) – Mean Values
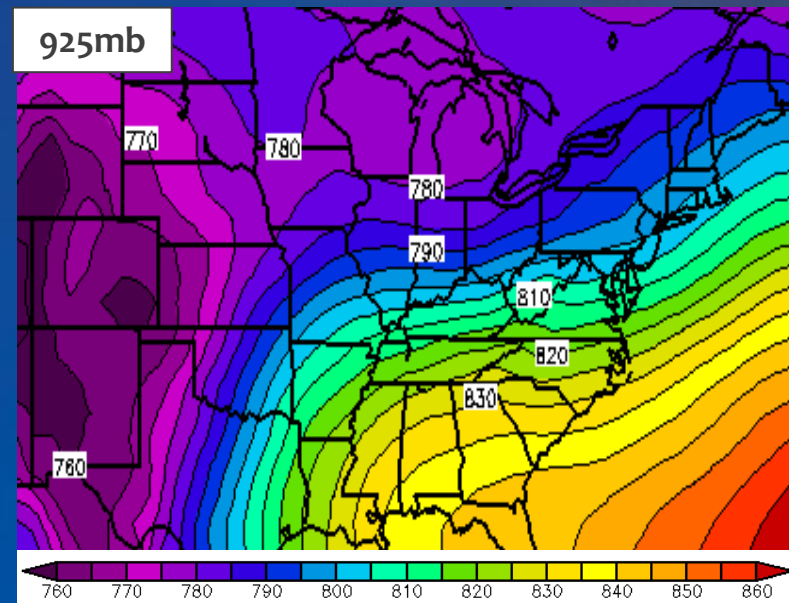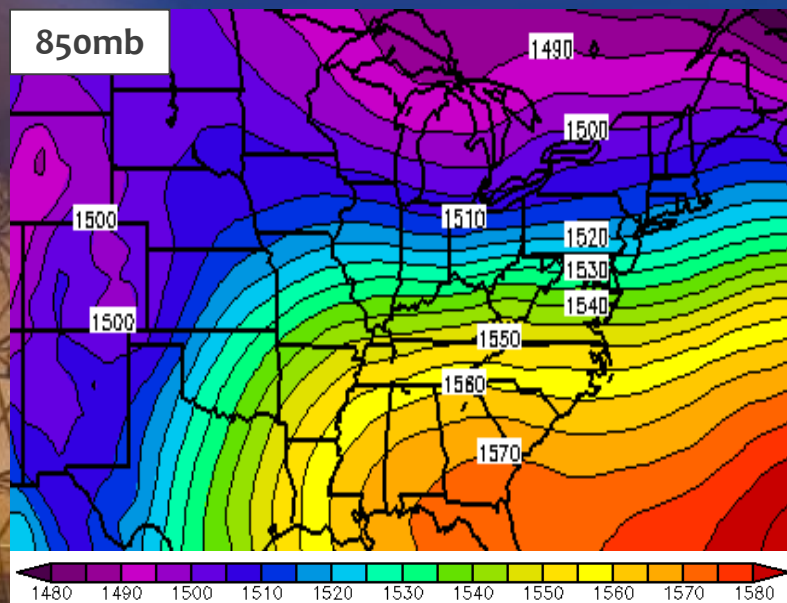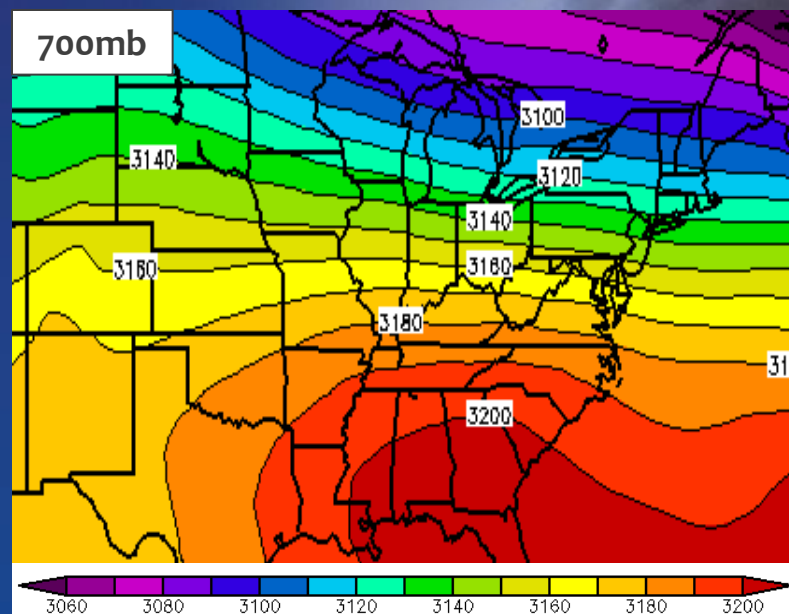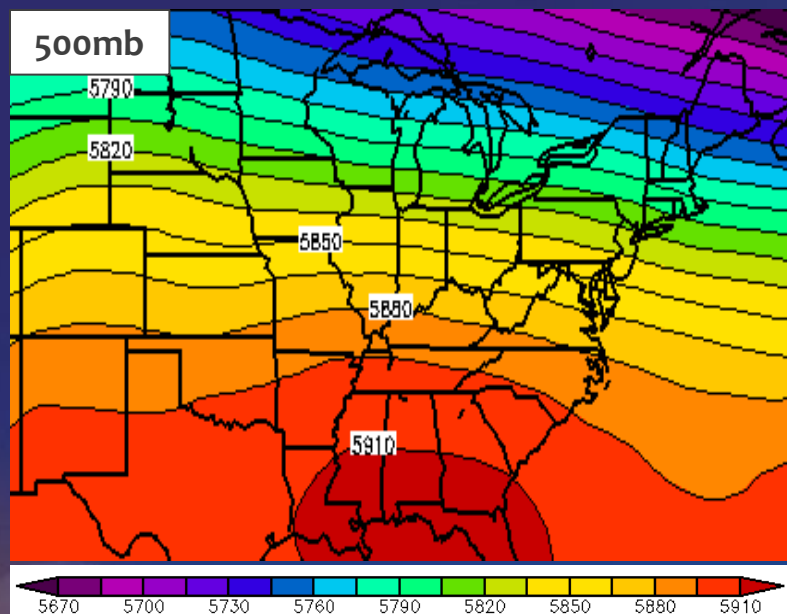
Top 20 Warm Season Flash Flood Events
Geo. Heights (m) and MSLP (Pa) - Anomalies
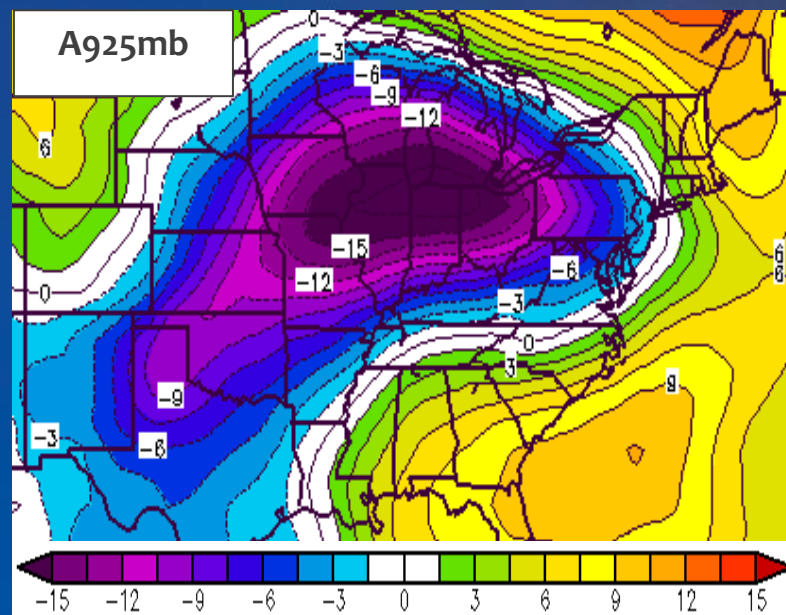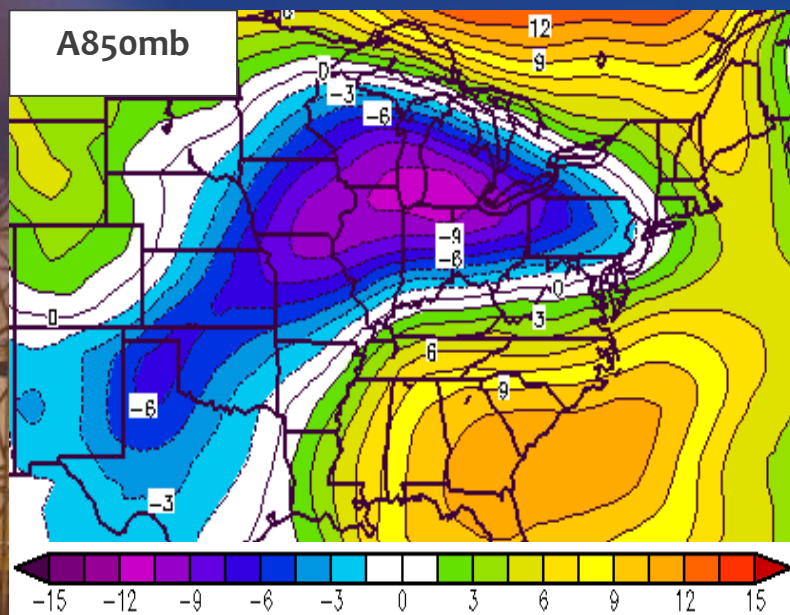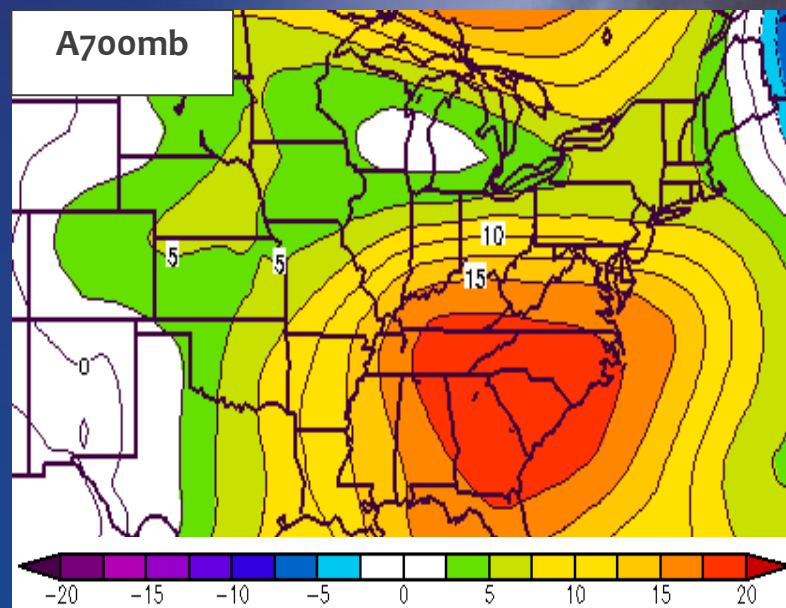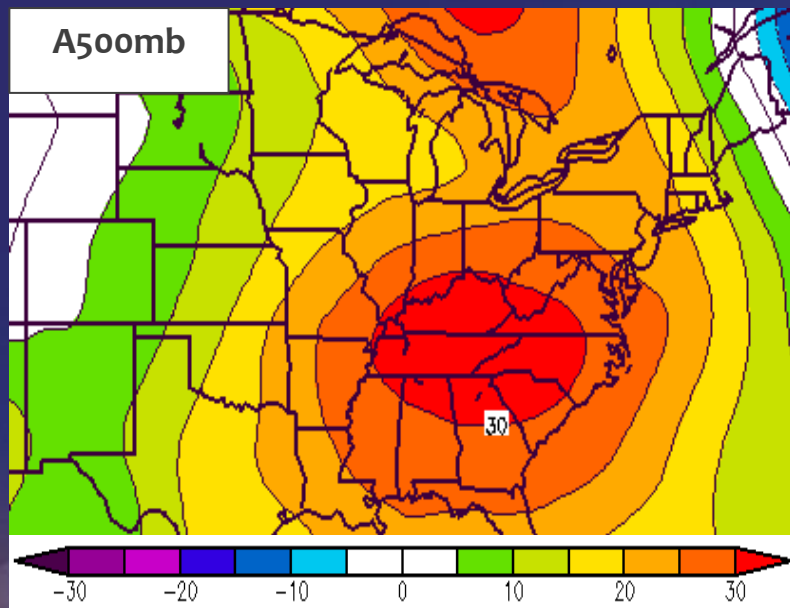
Surface Low Locations
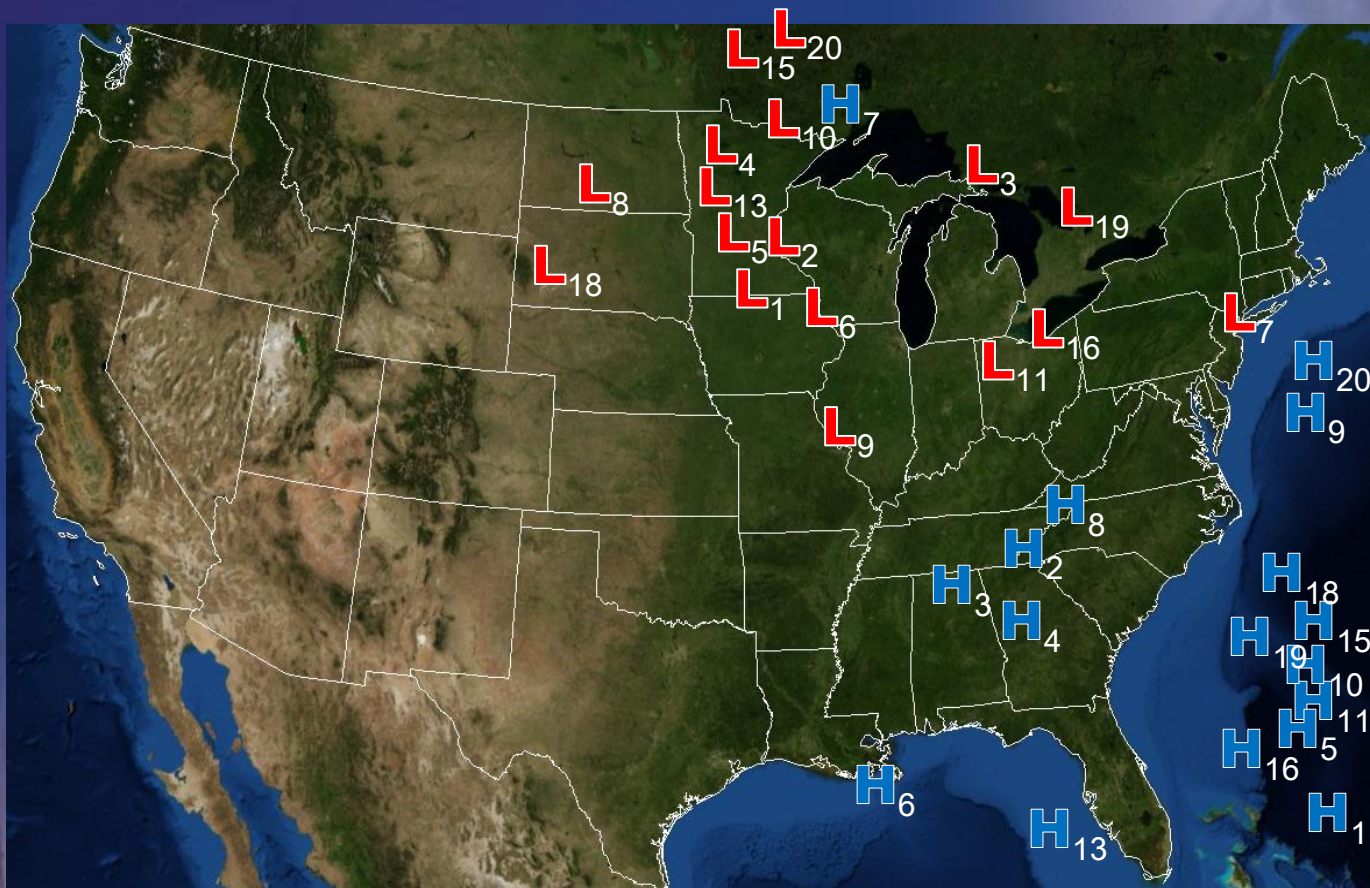
Top 20 Warm Season Flash Flood Events
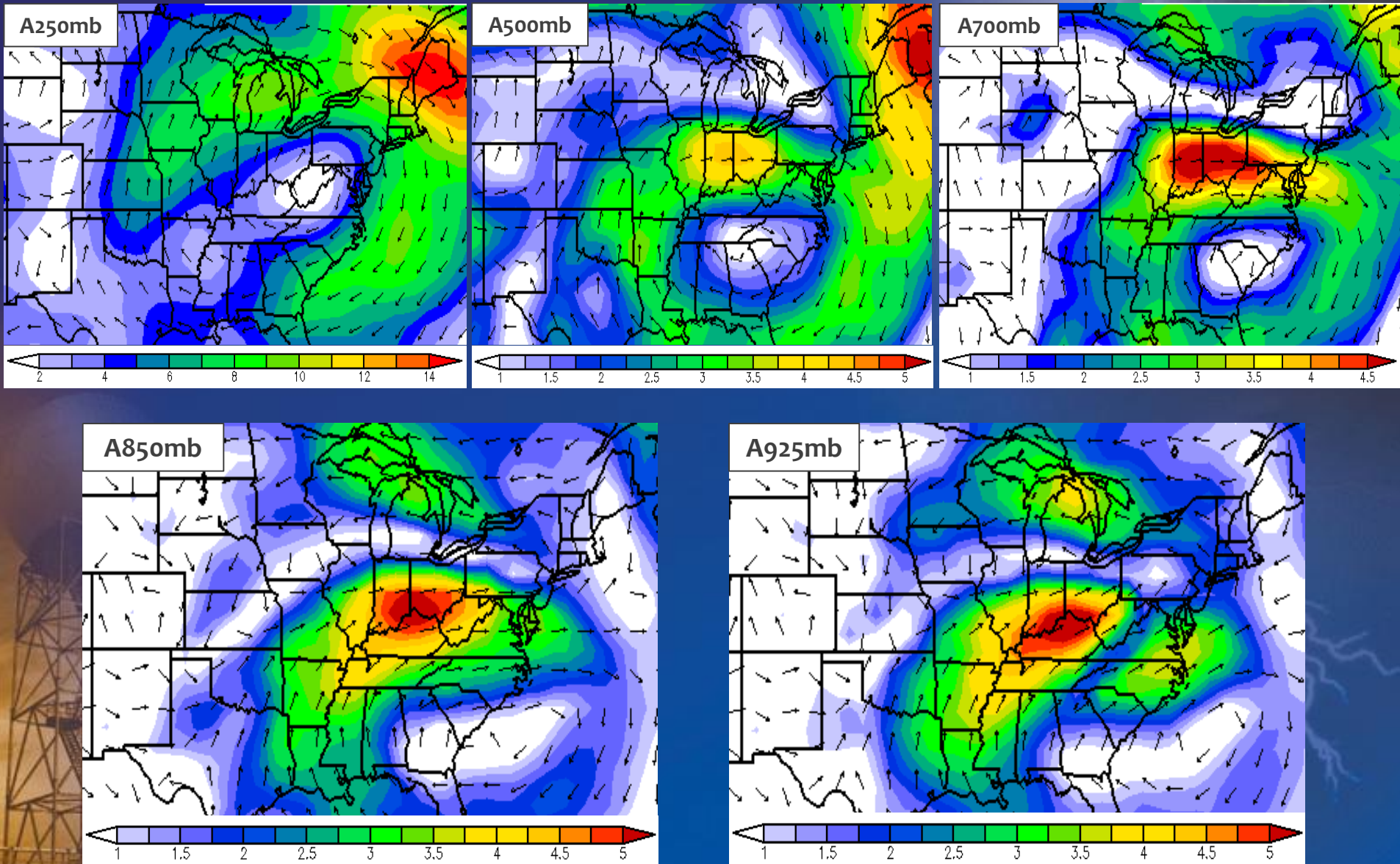## Specific Humidity (kg/kg) - Anomalies
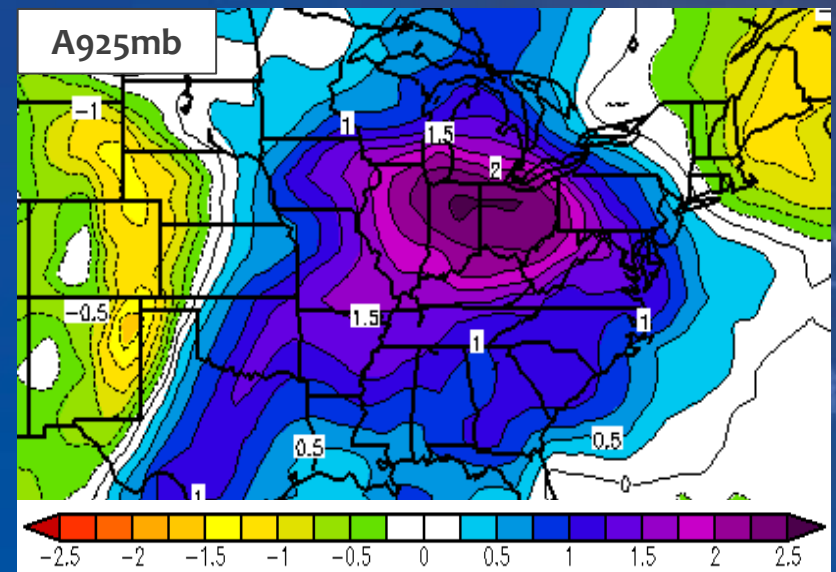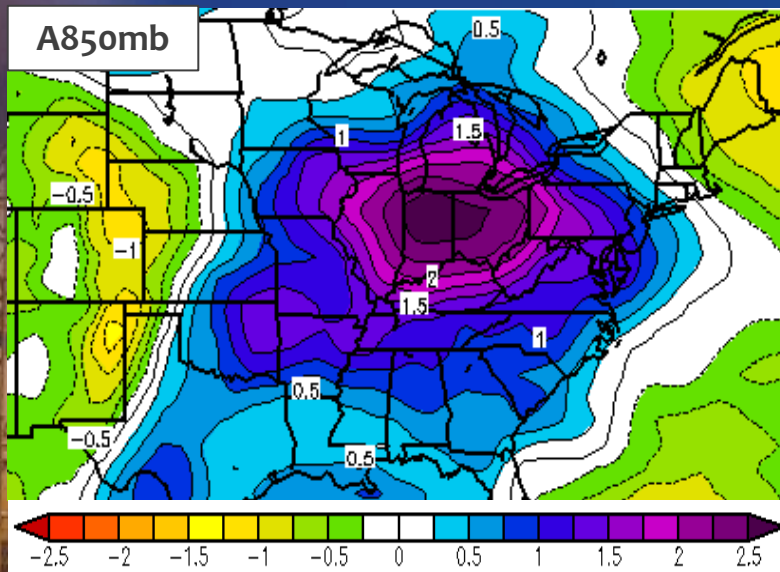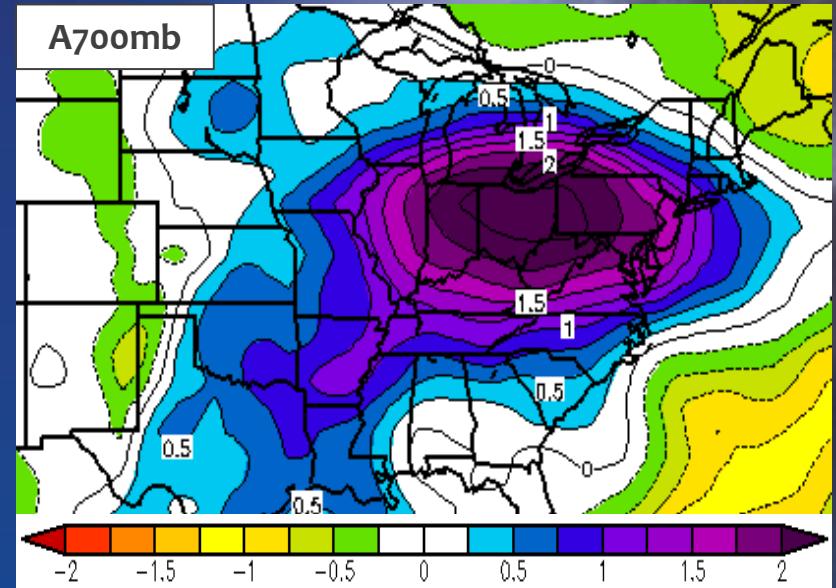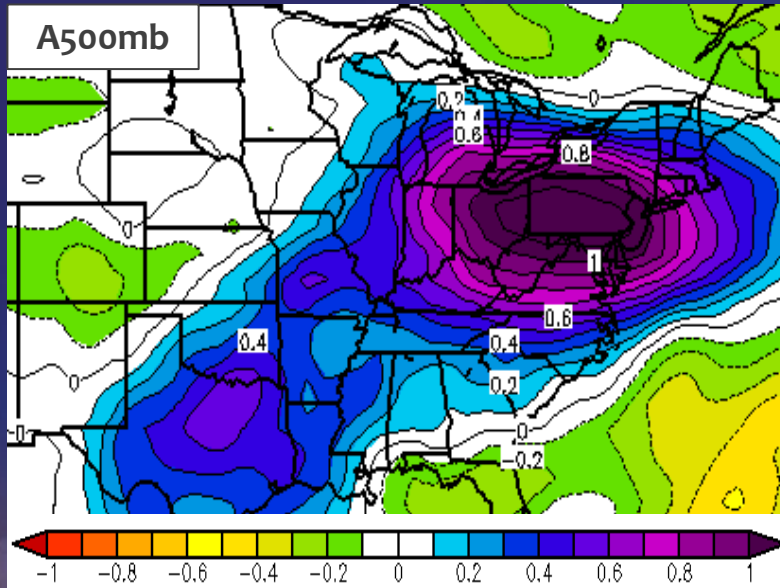
Top 20 Warm Season Flash Flood Events
Vector Wind (m/s) – Mean Values
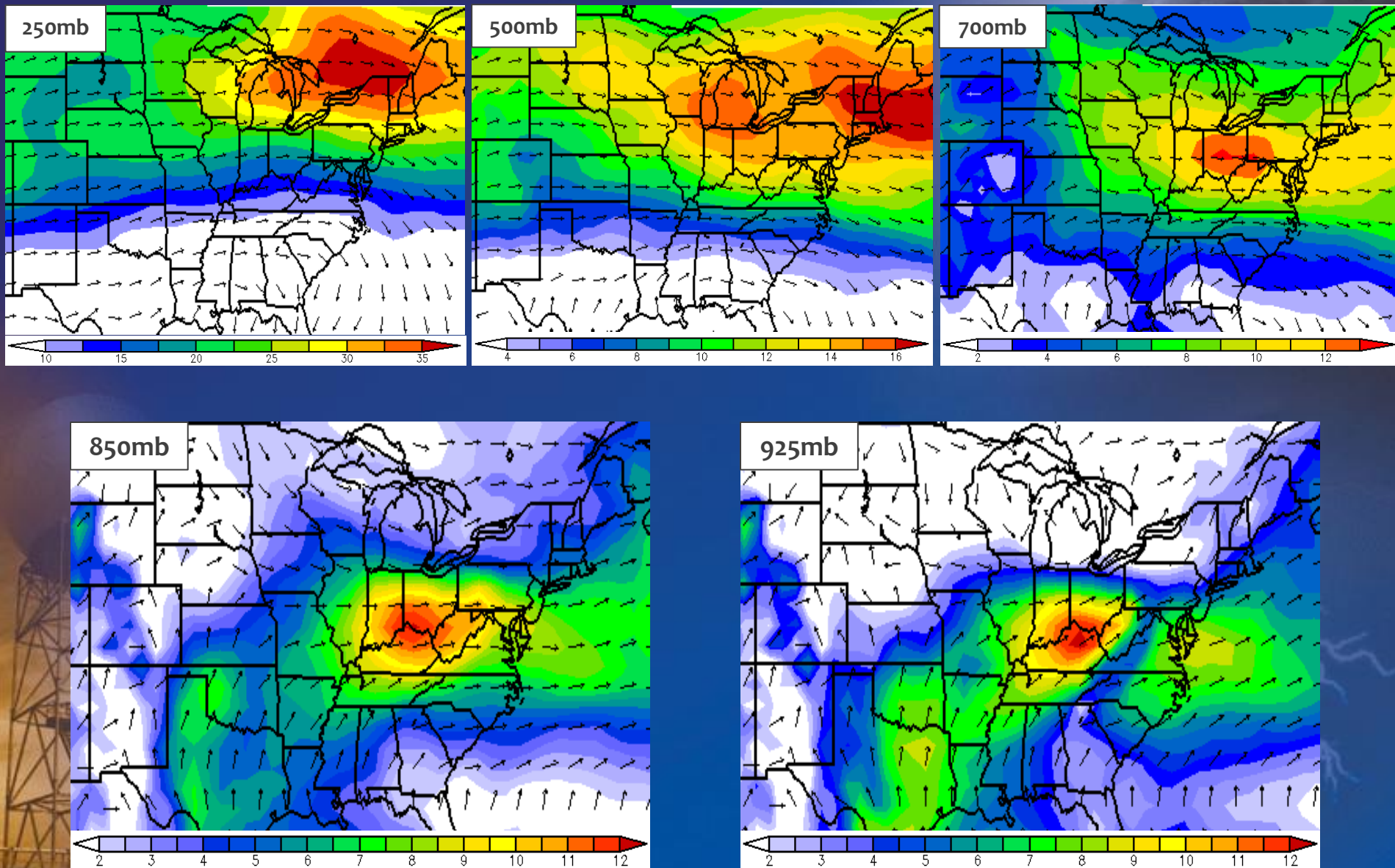
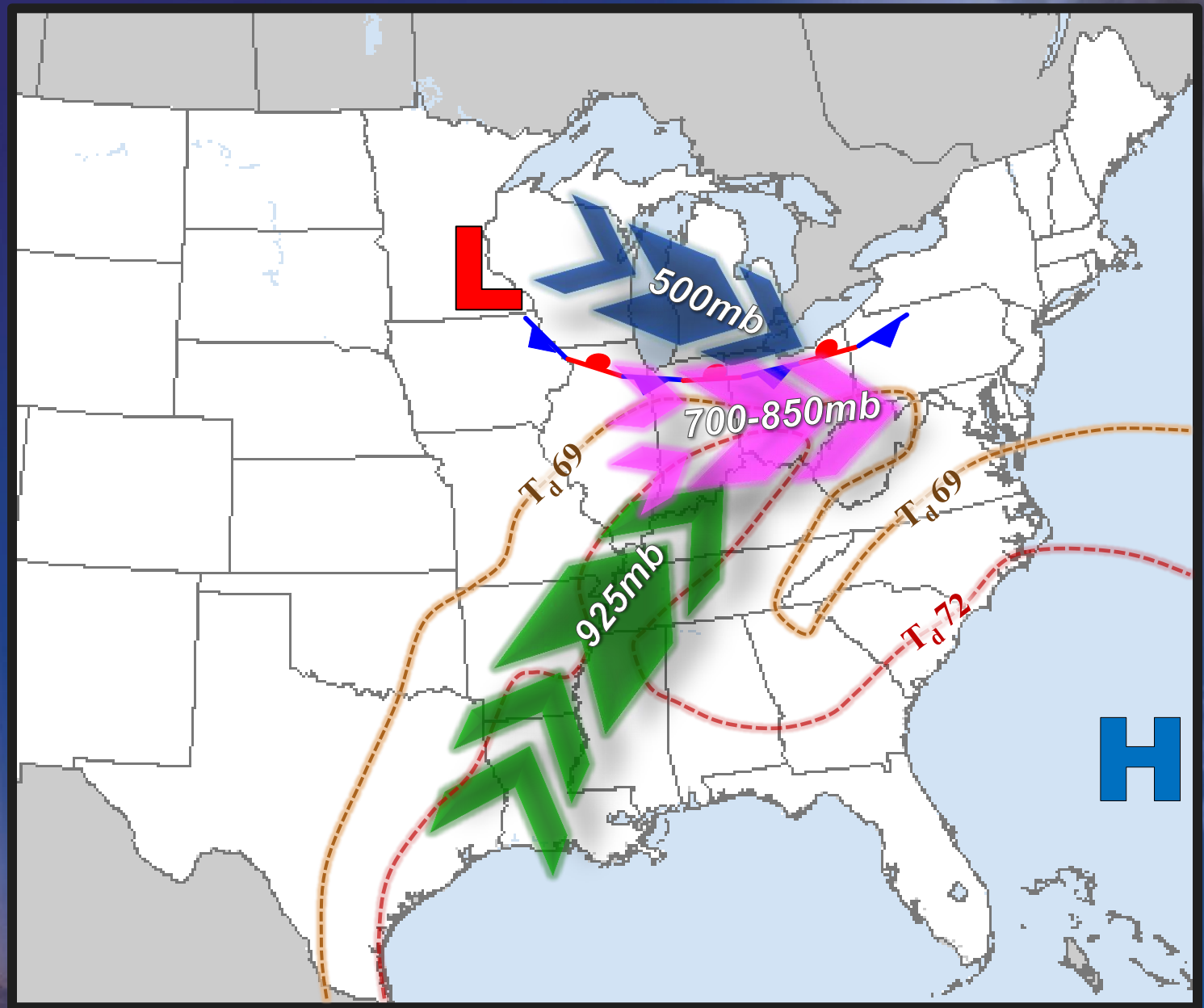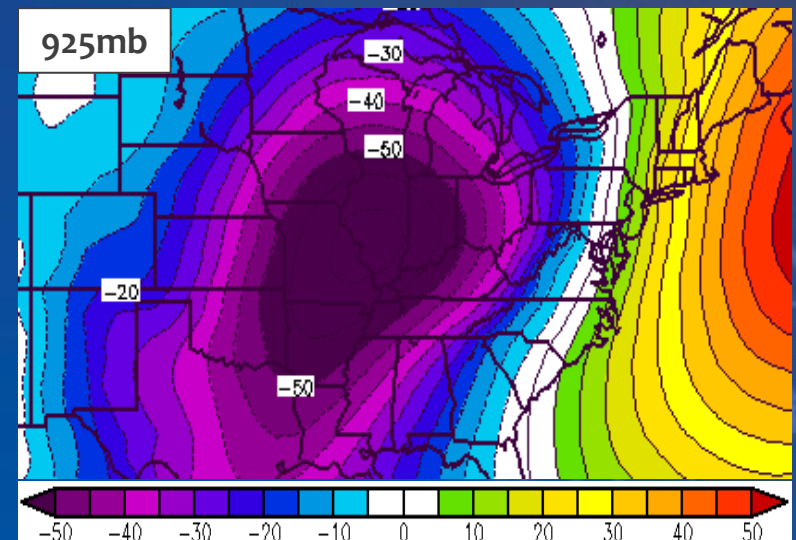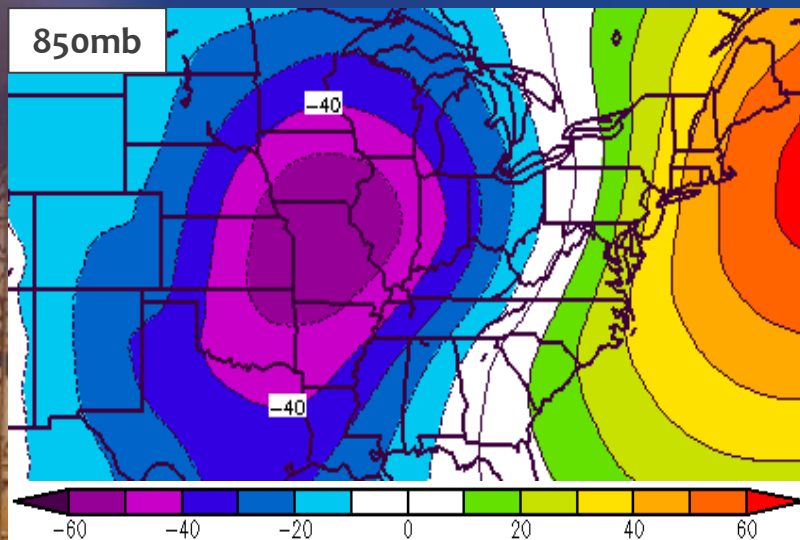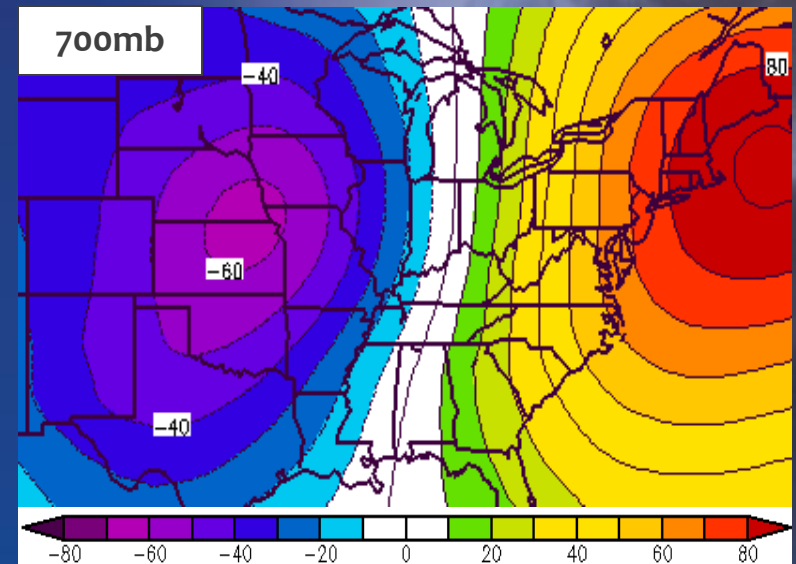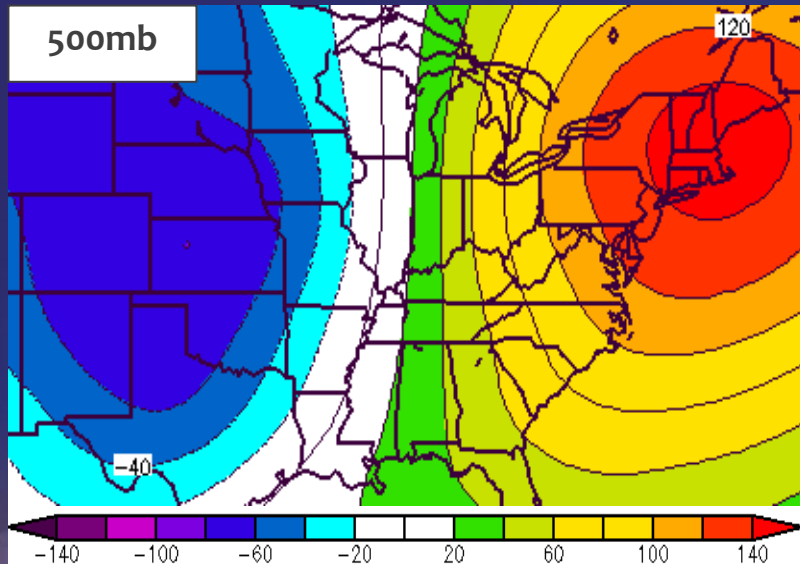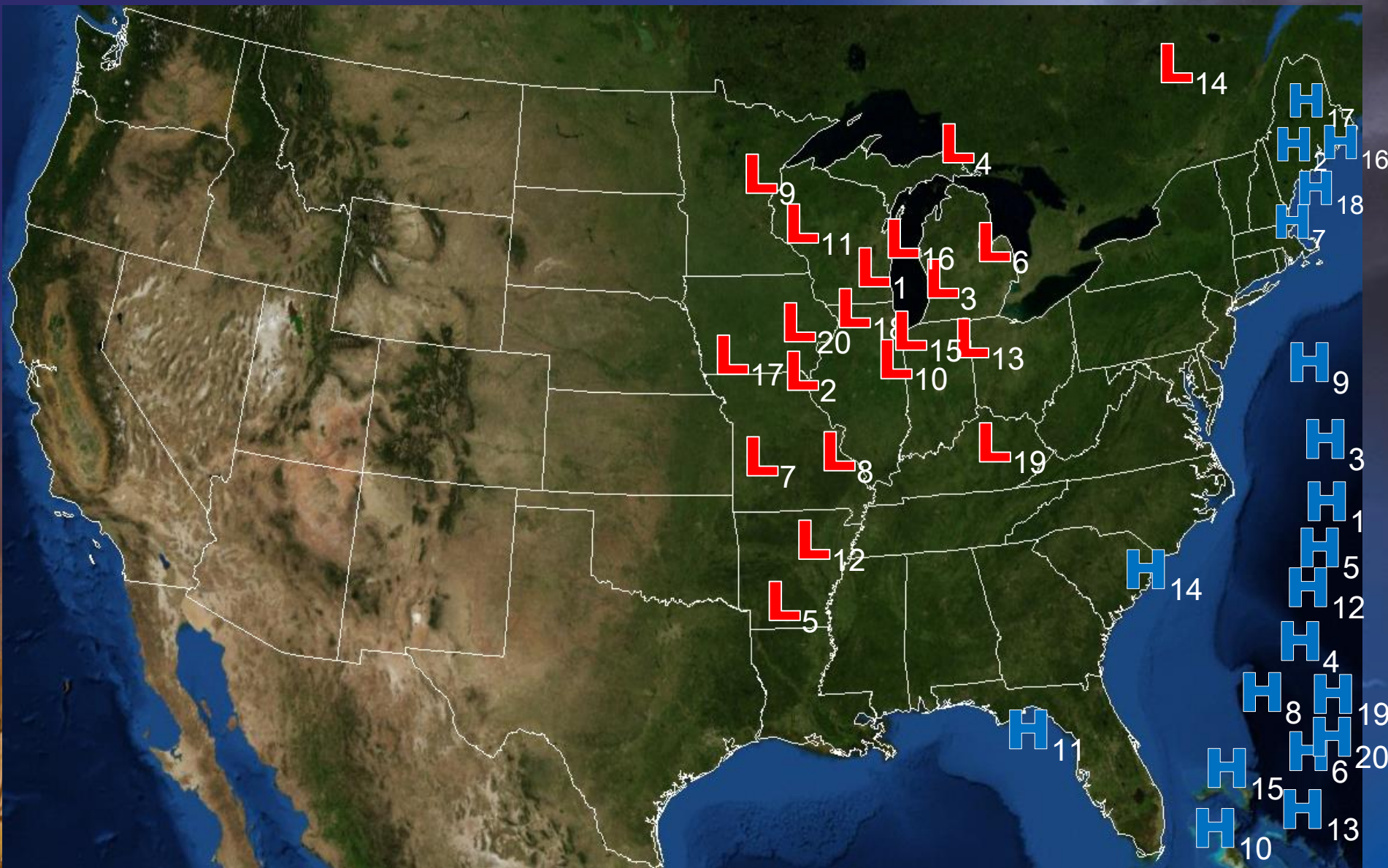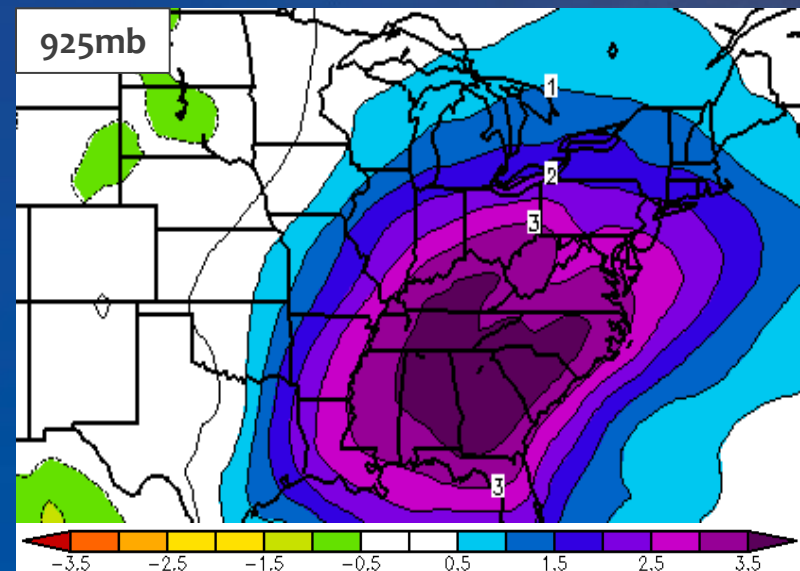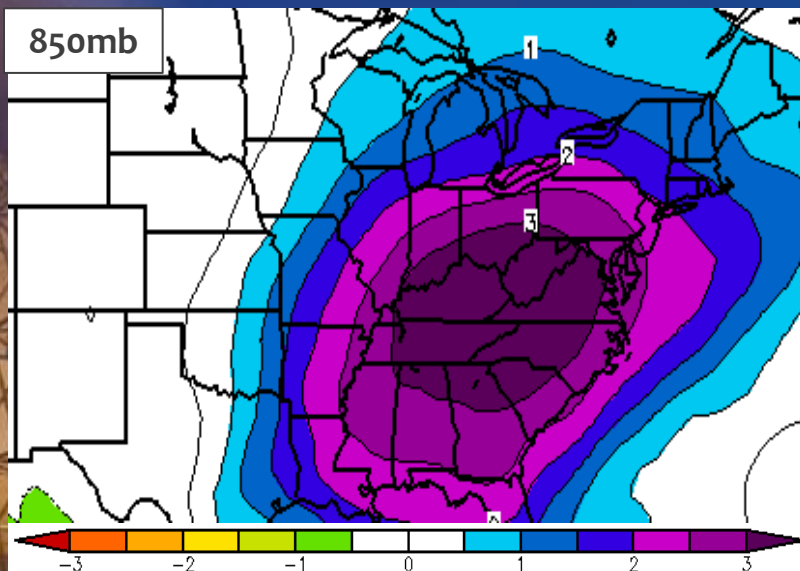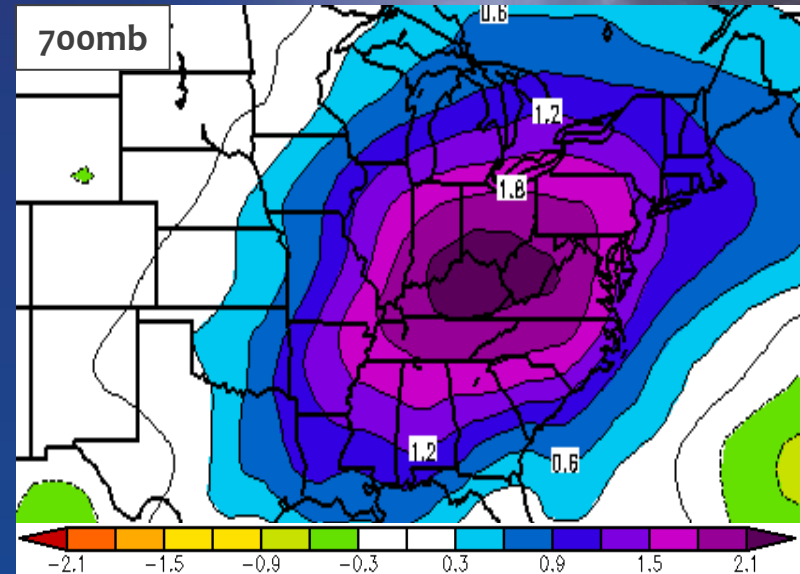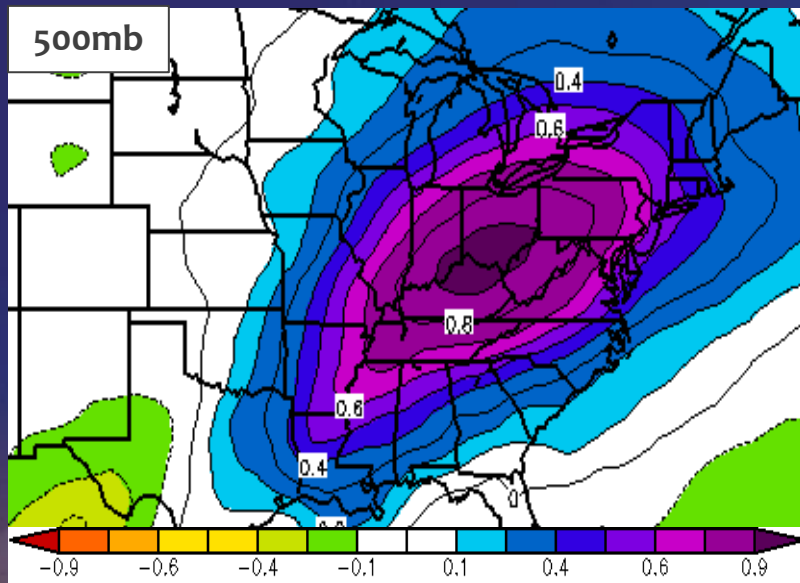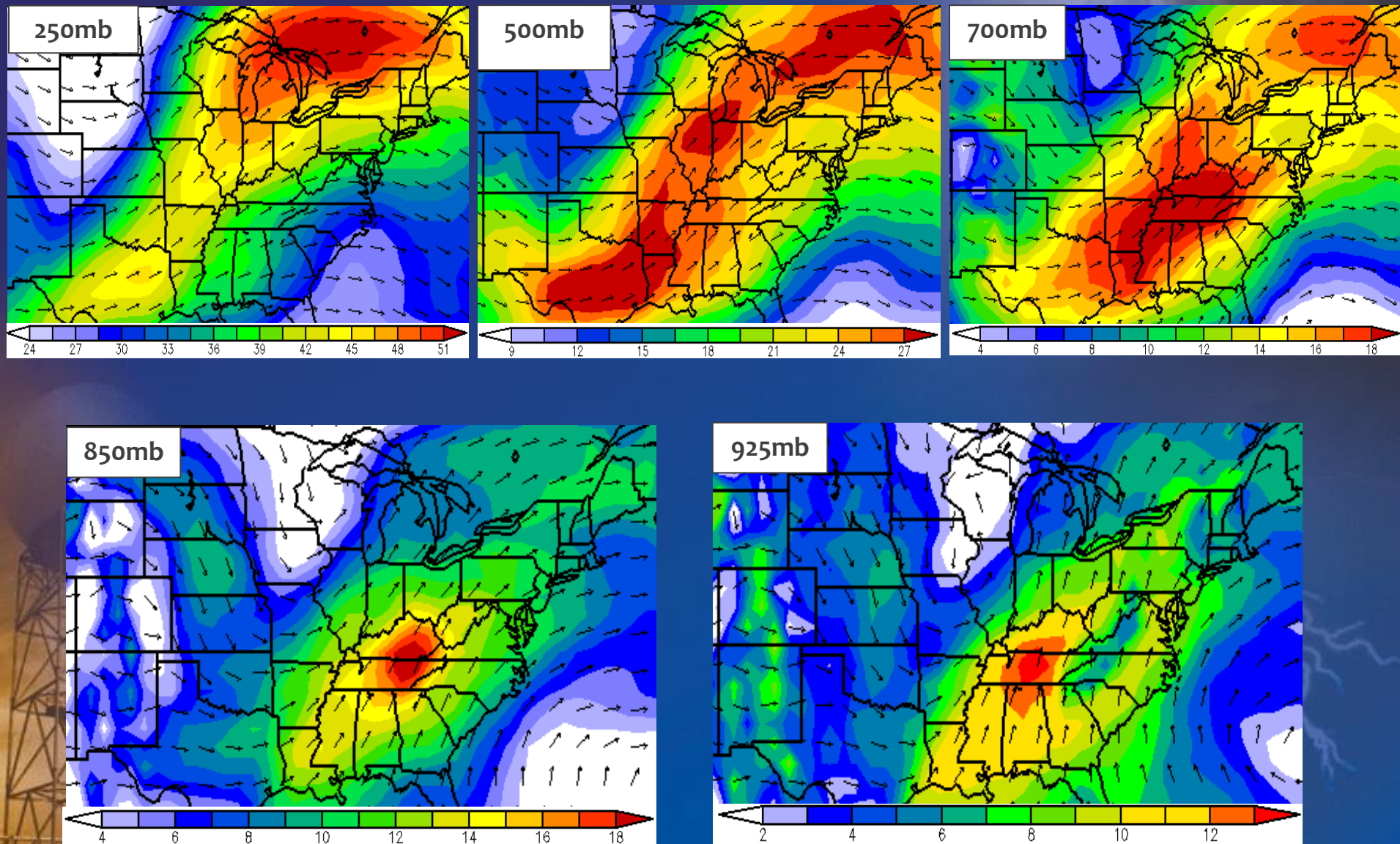Top 20 Warm Season Flash Flood Events
Vector Wind (m/s) – Anomalies

CONCEPTUAL MODEL

# Results:
Cool Season

Top 20 Cool Season Flash Flood Events
Geo. Heights (m) and MSLP (Pa) – Mean Values
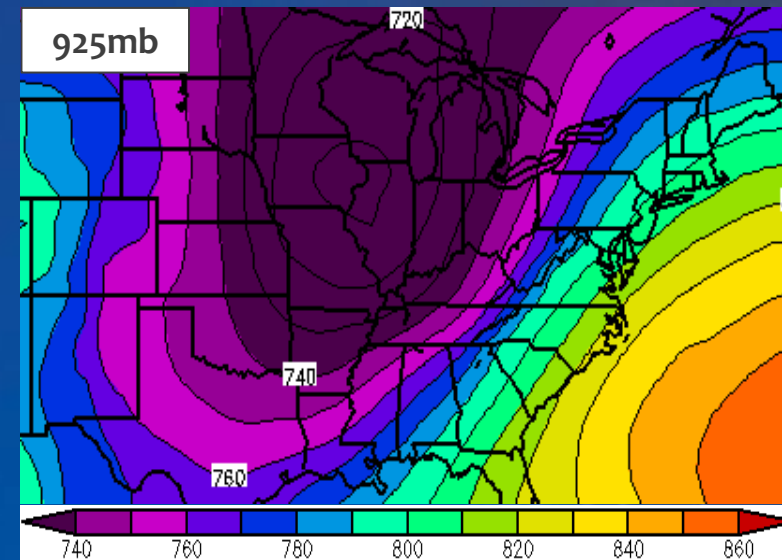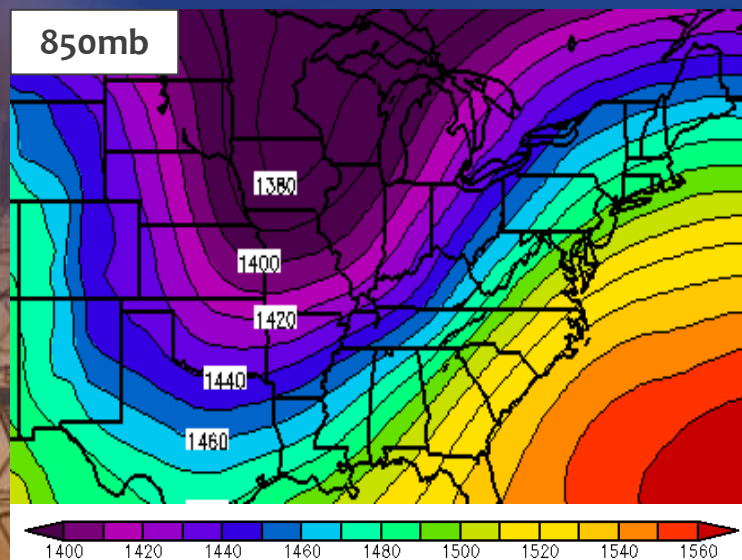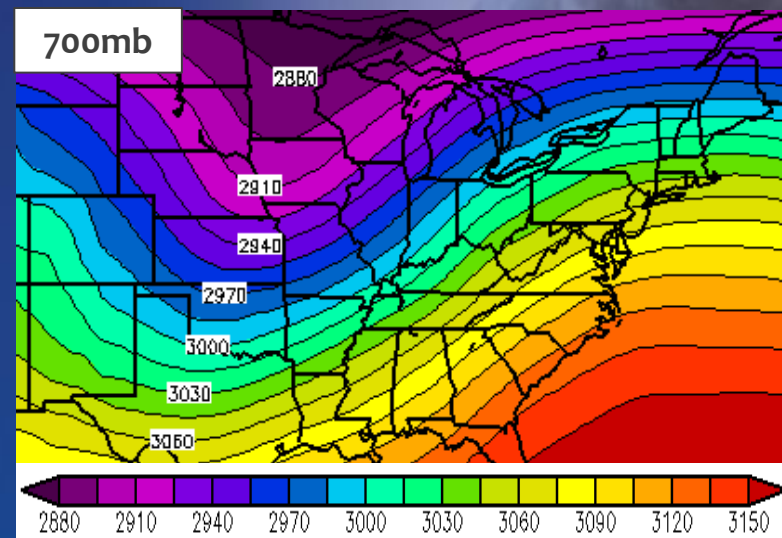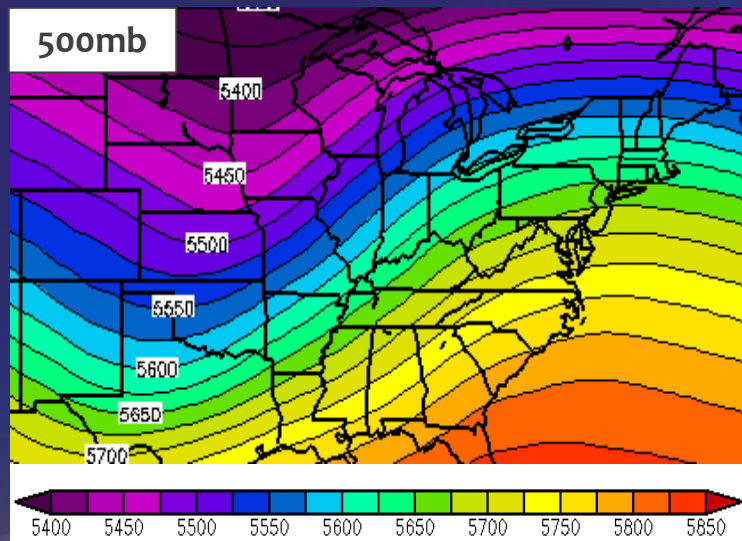
Top 20 Cool Season Flash Flood Events
Geo. Heights (m) and MSLP (Pa) – Anomalies

Surface Low Locations

Top 20 Cool Season Flash Flood Events
Specific Humidity (kg/kg)– Anomalies

Top 20 Cool Season Flash Flood Events
Vector Wind (m/s) – Mean Values

Top 20 Cool Season Flash Flood Events
Vector Wind (m/s) – Anomalies
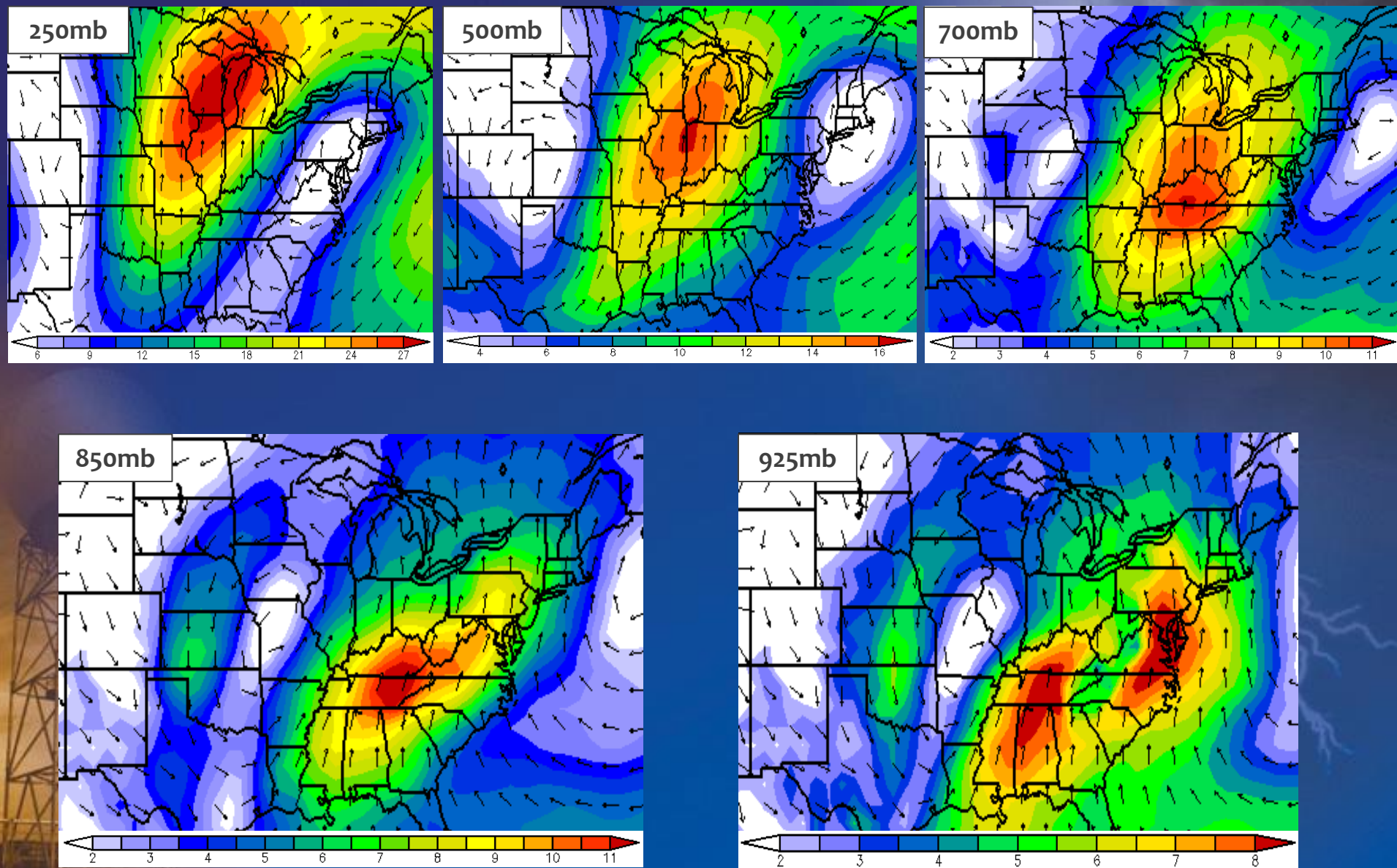
CONCEPTUAL MODEL
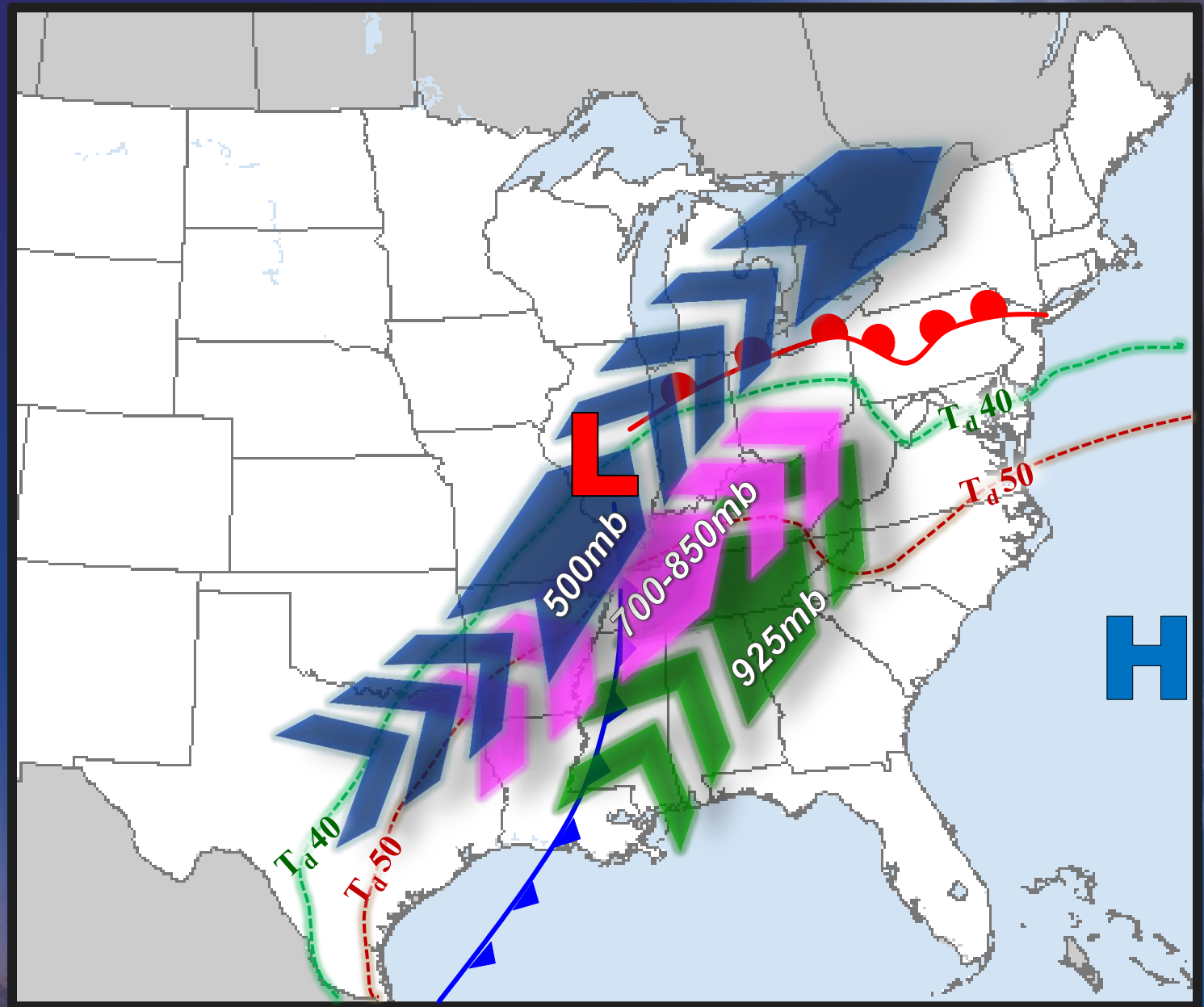
UNIQUE EVENT
July 28-29 2017

Day 3 ER Outlook

Jul 28 1200

Jul 29 1200z
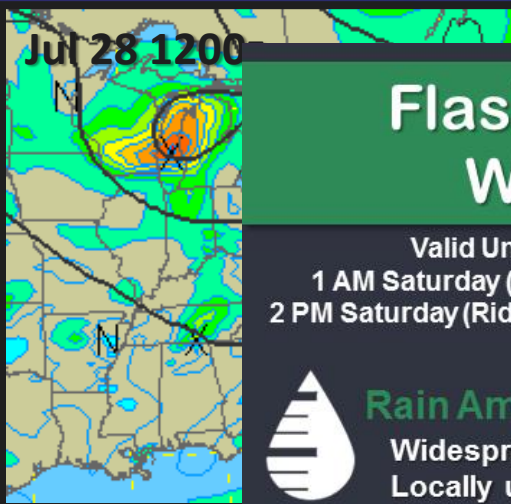
Flash Flood Watch

Valid Until
1 AM Saturday (lowlands)
2 PM Saturday (Ridge Counties)

Rain Amounts
Widespread: 1-2"
Locally up to 3"

Impacts
Possible Flooded
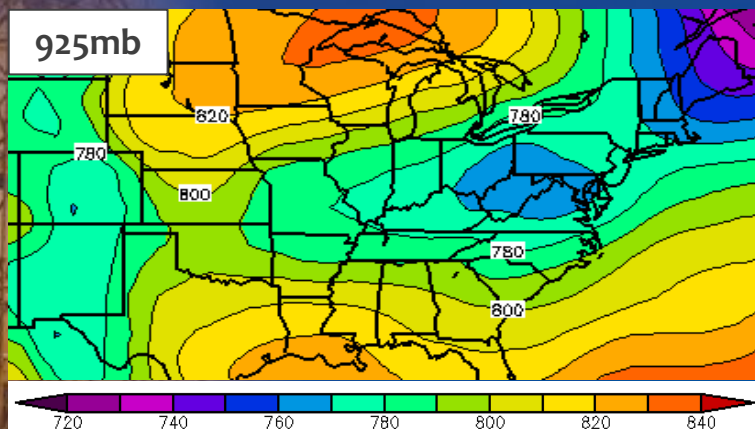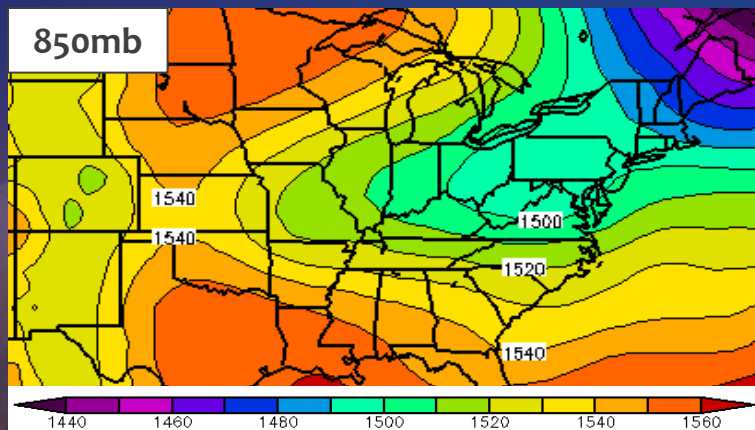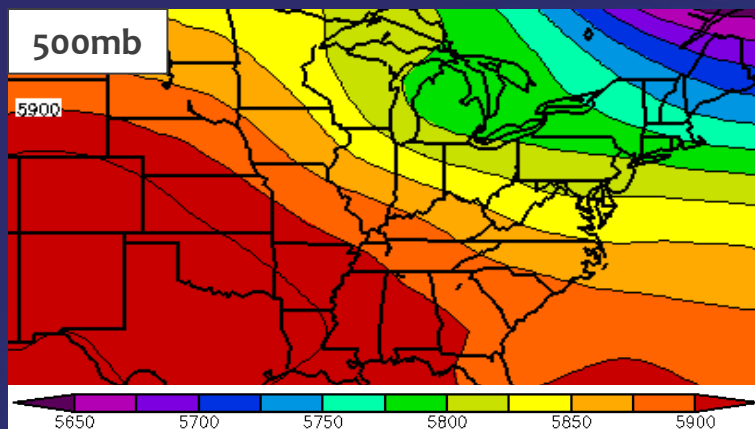Roadways

Rapid Rises on
Streams

**Turn Around
Don't Drown**

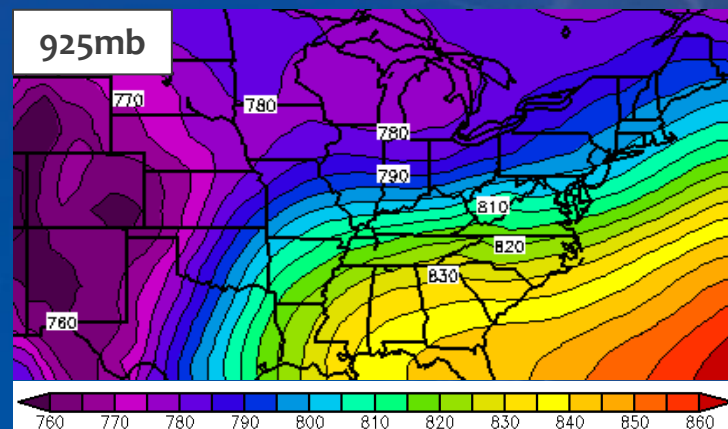National Weather Service Pittsburgh, PA
Friday, July 28, 2017 3:51 AM
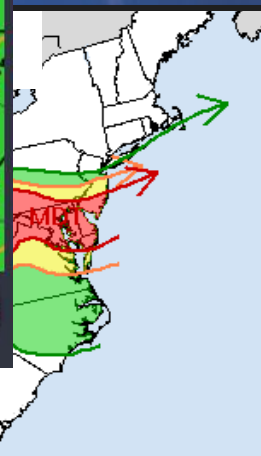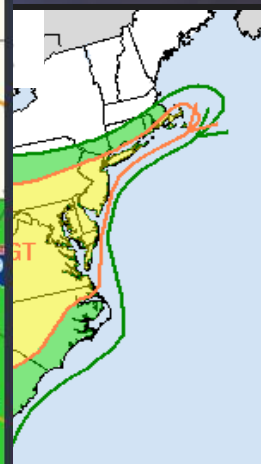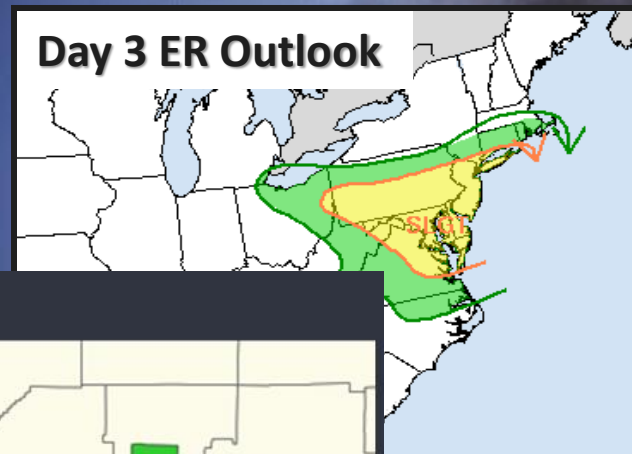
July 28-29 2017
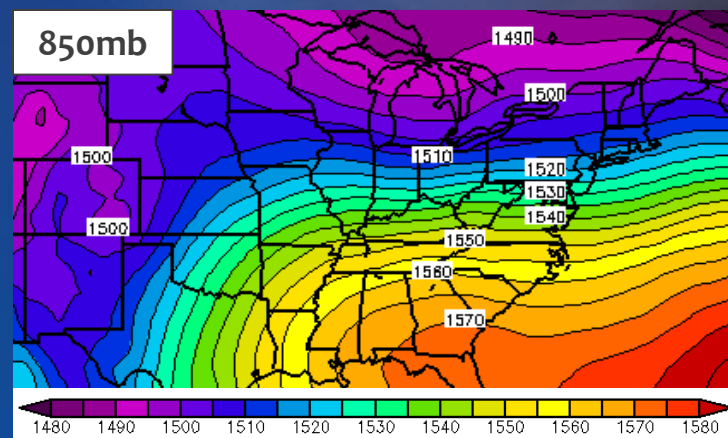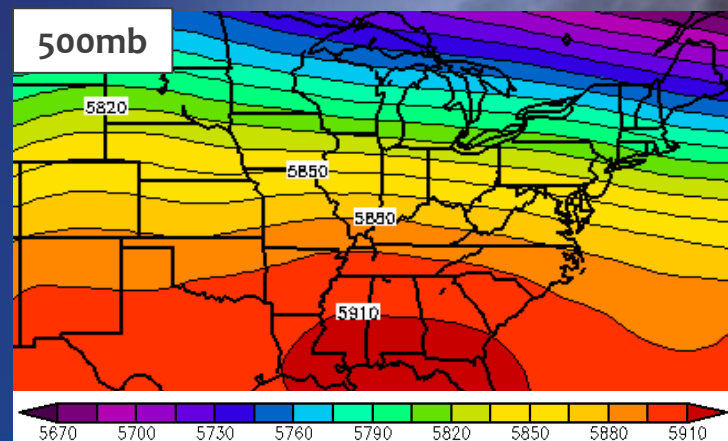
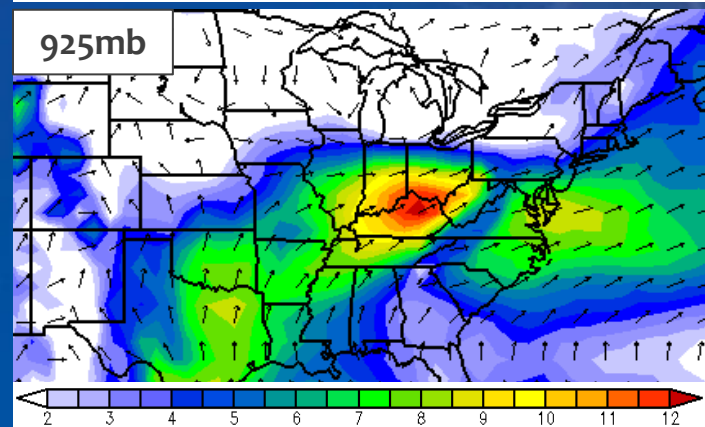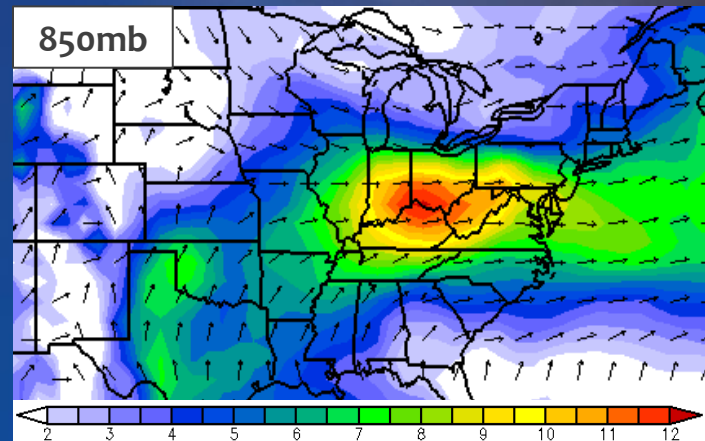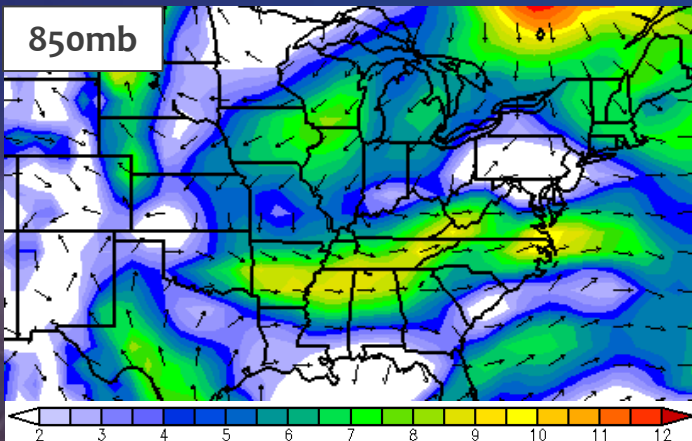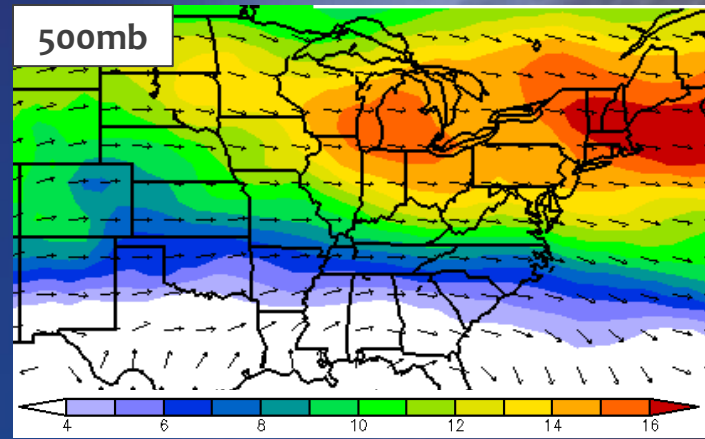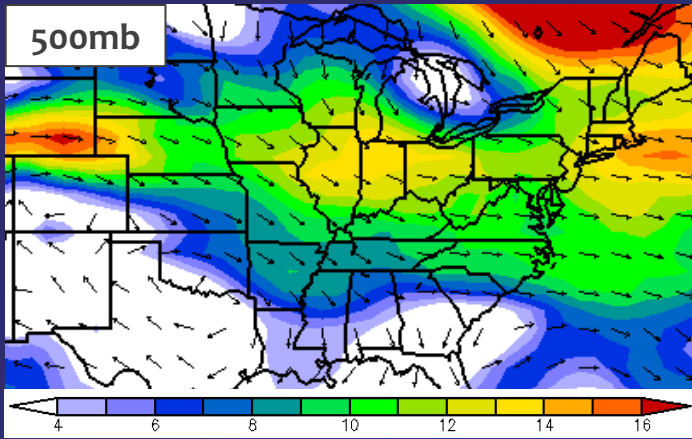# Warm Season Composite

July 28-29 2017

Warm Season Composite
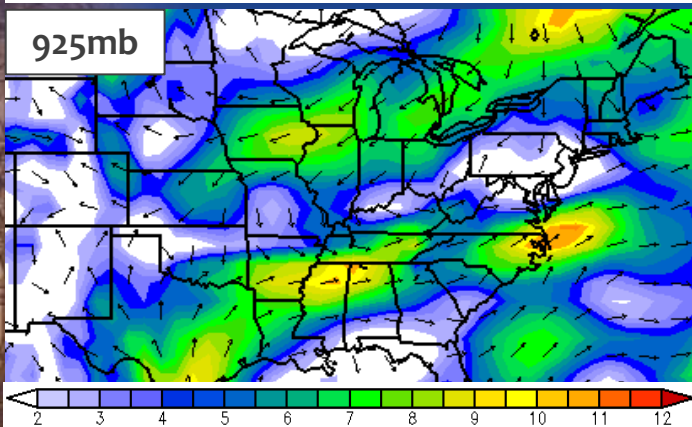
UNIQUE EVENTS DO OCCUR!

July 28-29 2017

- 16 of 18 FFW Verified
- 98 reports of flash flooding (62 entered into SD)
- Flash Flood Emergency Issued (2nd in office history)
- Multiple Evacuations
- Would've ranked 8th (if included)

CARS TRAPPED IN WATER, DRIVERS RESCUED
WASHINGTON, WASHINGTON COUNTY

Hundred, WV
Parkersburg News and Sentinel

Farmington, WV
Youtube (Jeremy White)