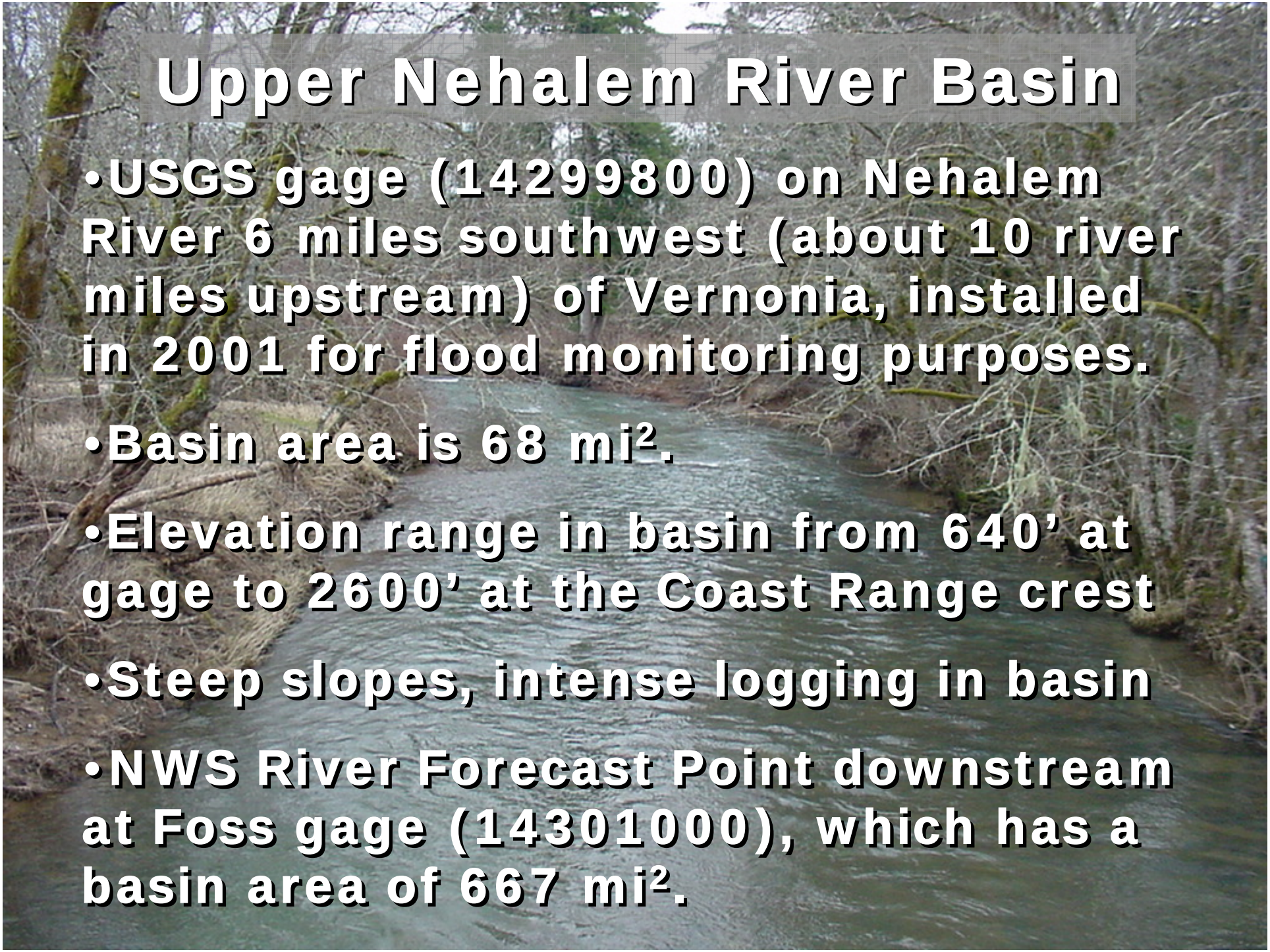
An Examination of Record Flooding on the Nehalem River at Vernonia, Oregon During December 2-4, 2007, and a Comparison with other Major Events

National Weather Service
Portland, Oregon
Andy Bryant, Service Hydrologist
William R. Schneider, Science Operations Officer

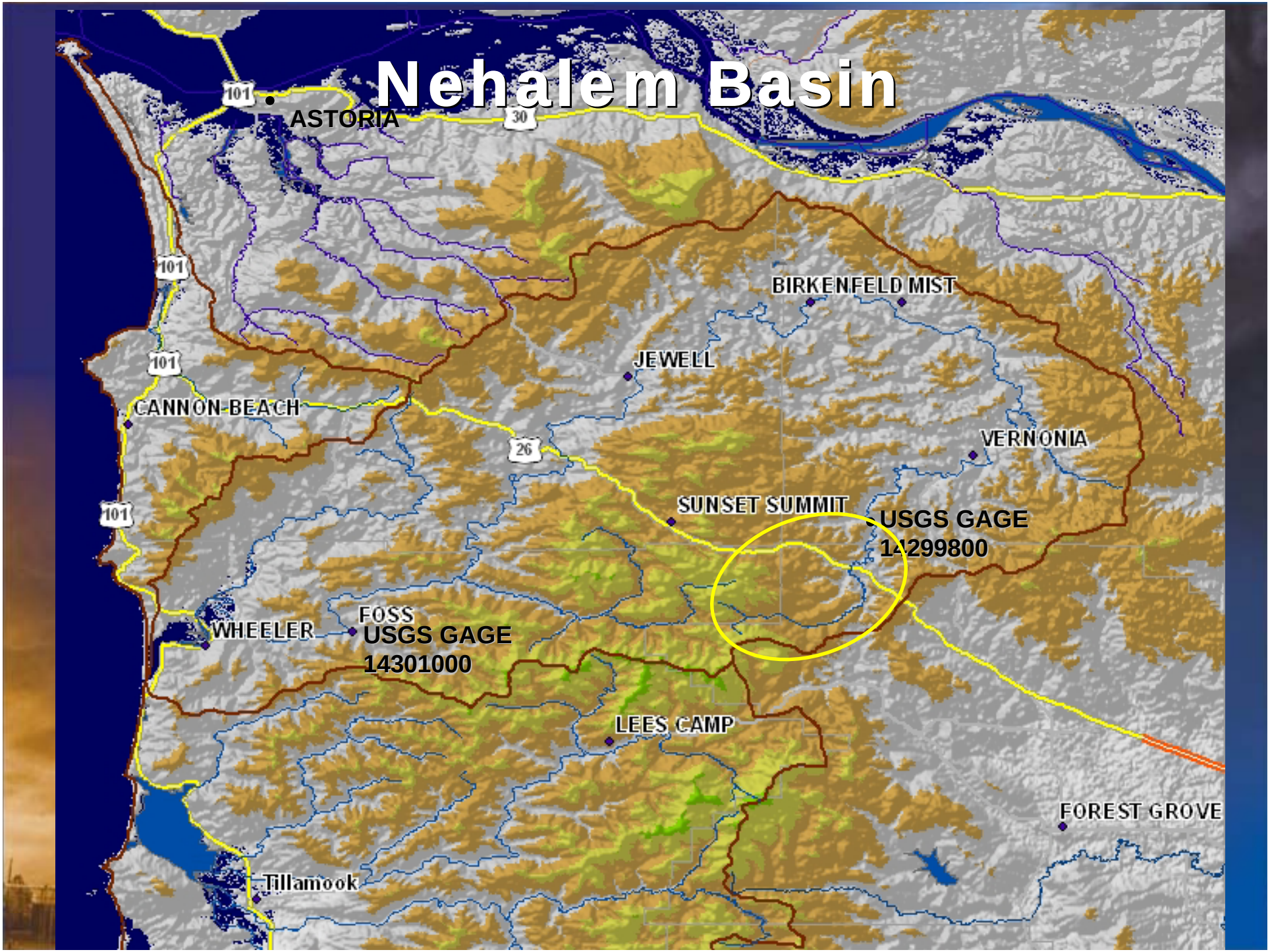
Flooding in Vernonia, Dec 2-4, 2007

Why was there such a significant difference in discharge on the Upper Nehalem River for the Nov 2006 and Dec 2007 heavy precipitation events in the NW Oregon Coast Range?



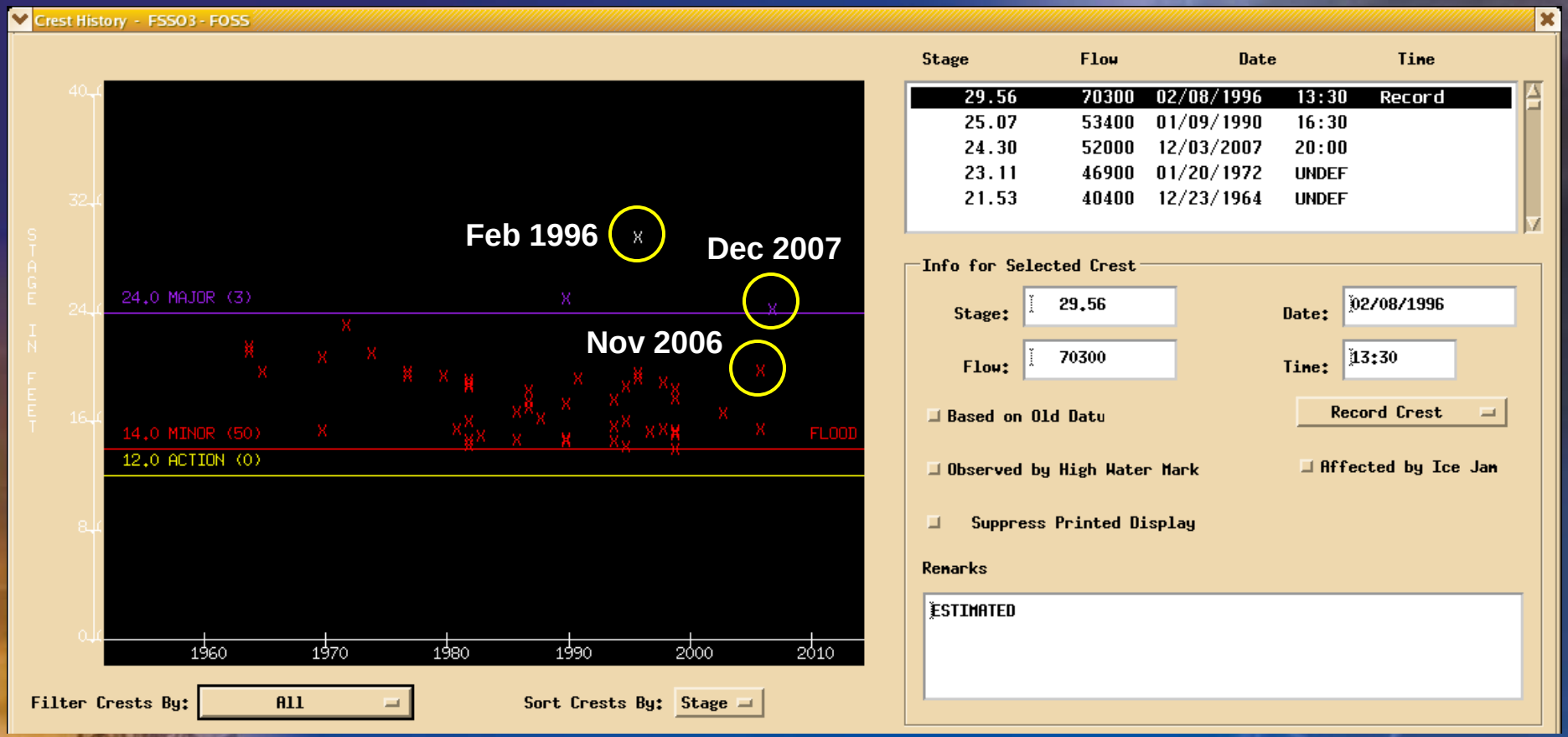
Upper Nehalem River Basin

- USGS gage (14299800) on Nehalem River 6 miles southwest (about 10 river miles upstream) of Vernonia, installed in 2001 for flood monitoring purposes.
- Basin area is 68 mi^2.
- Elevation range in basin from 640’ at gage to 2600’ at the Coast Range crest
- Steep slopes, intense logging in basin
- NWS River Forecast Point downstream at Foss gage (14301000), which has a basin area of 667 mi^2.


Nehalem Basin
ASTORIA
101
30
101
101
101
BIRKENFELD MIST
JEWELL
CANNON BEACH
26
VERNONIA
SUNSET SUMMIT
USGS GAGE
14299800
FOSS
WHEELER
USGS GAGE
14301000
LEES CAMP
FOREST GROVE
Tillamook

Flood Crests on the Nehalem

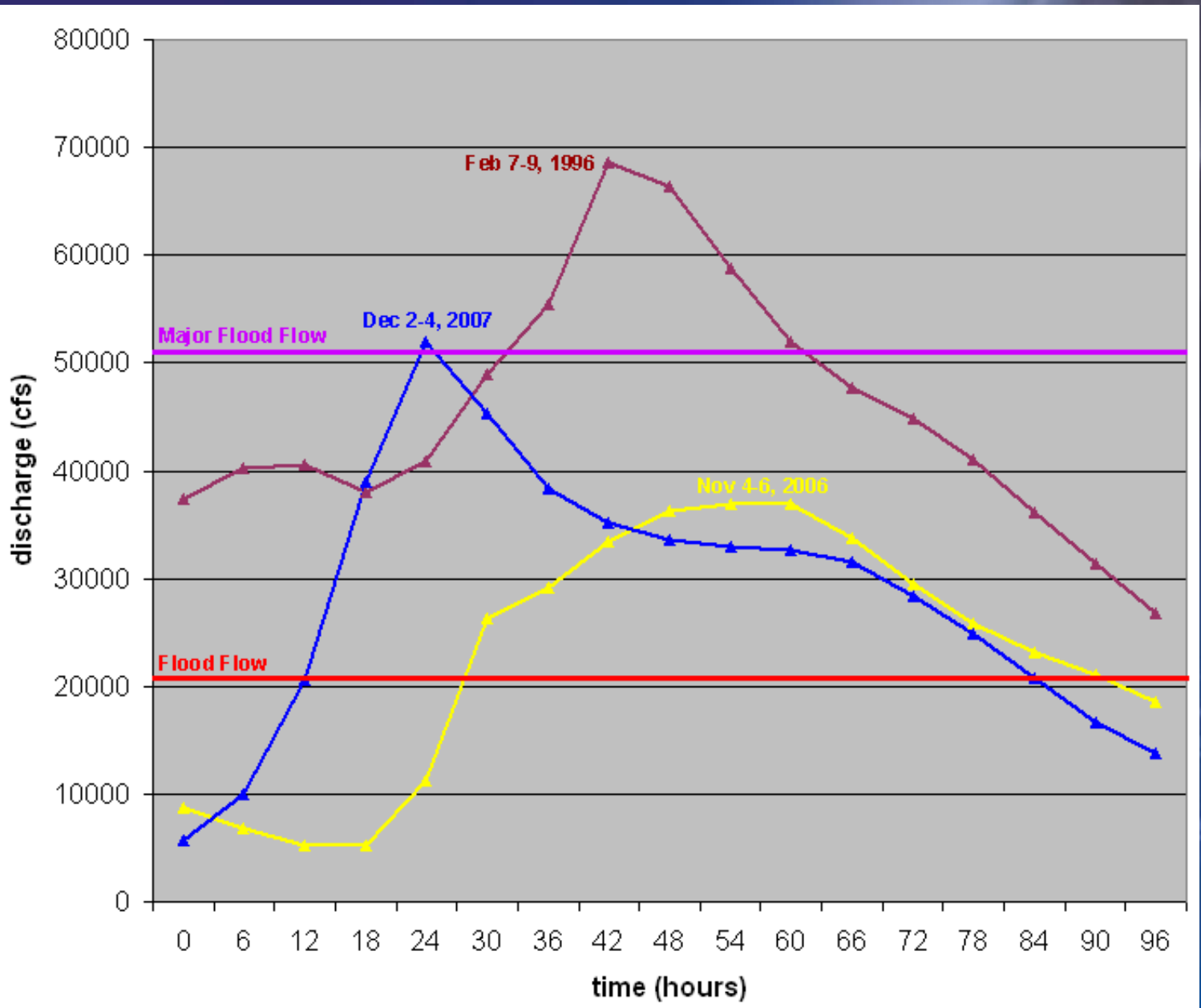
Crest History for Nehalem R near Foss



Only floods in the past 40 years on the Nehalem at Vernonia occurred in Feb 1996 and Dec 2007.

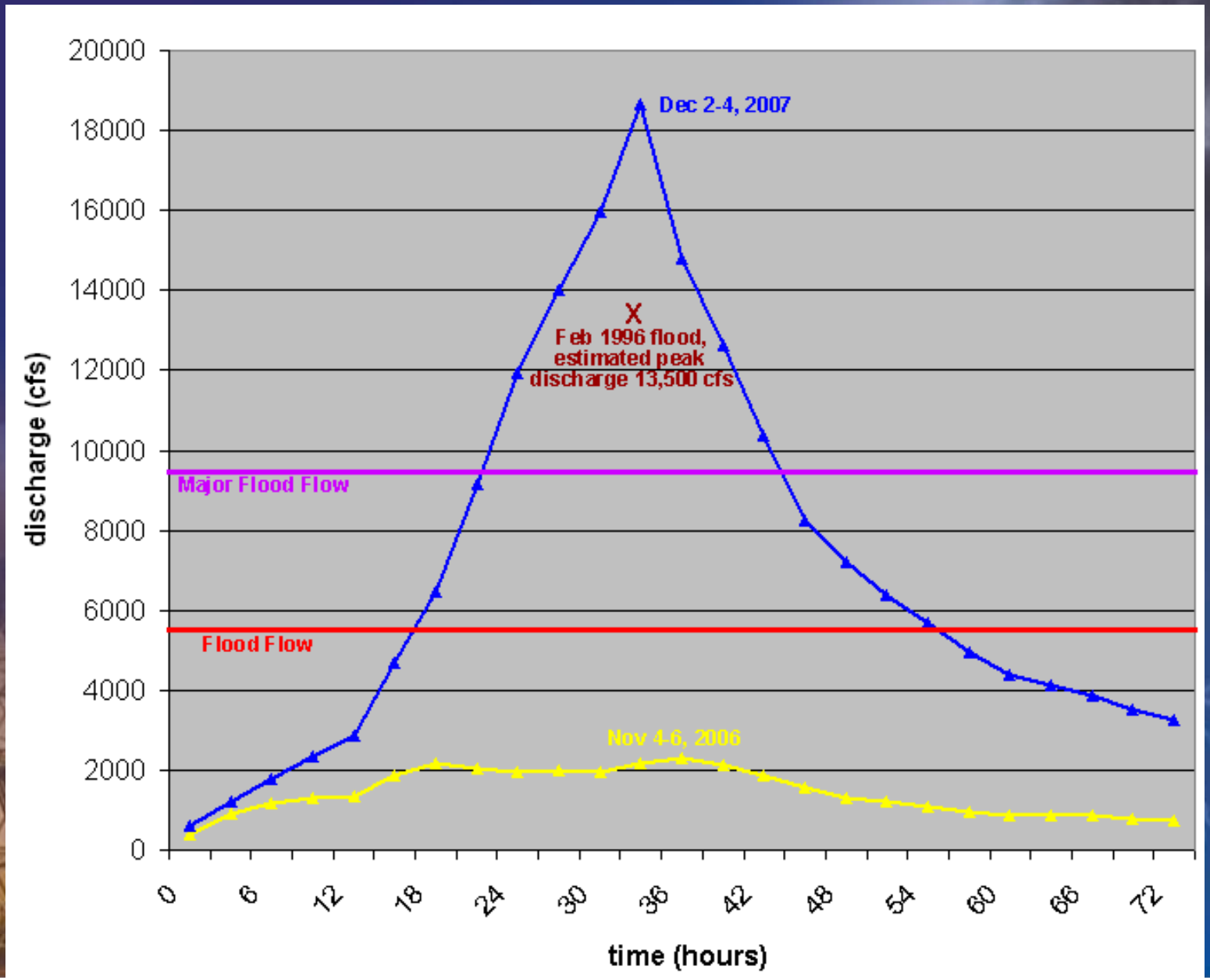
Nehalem R near Foss –

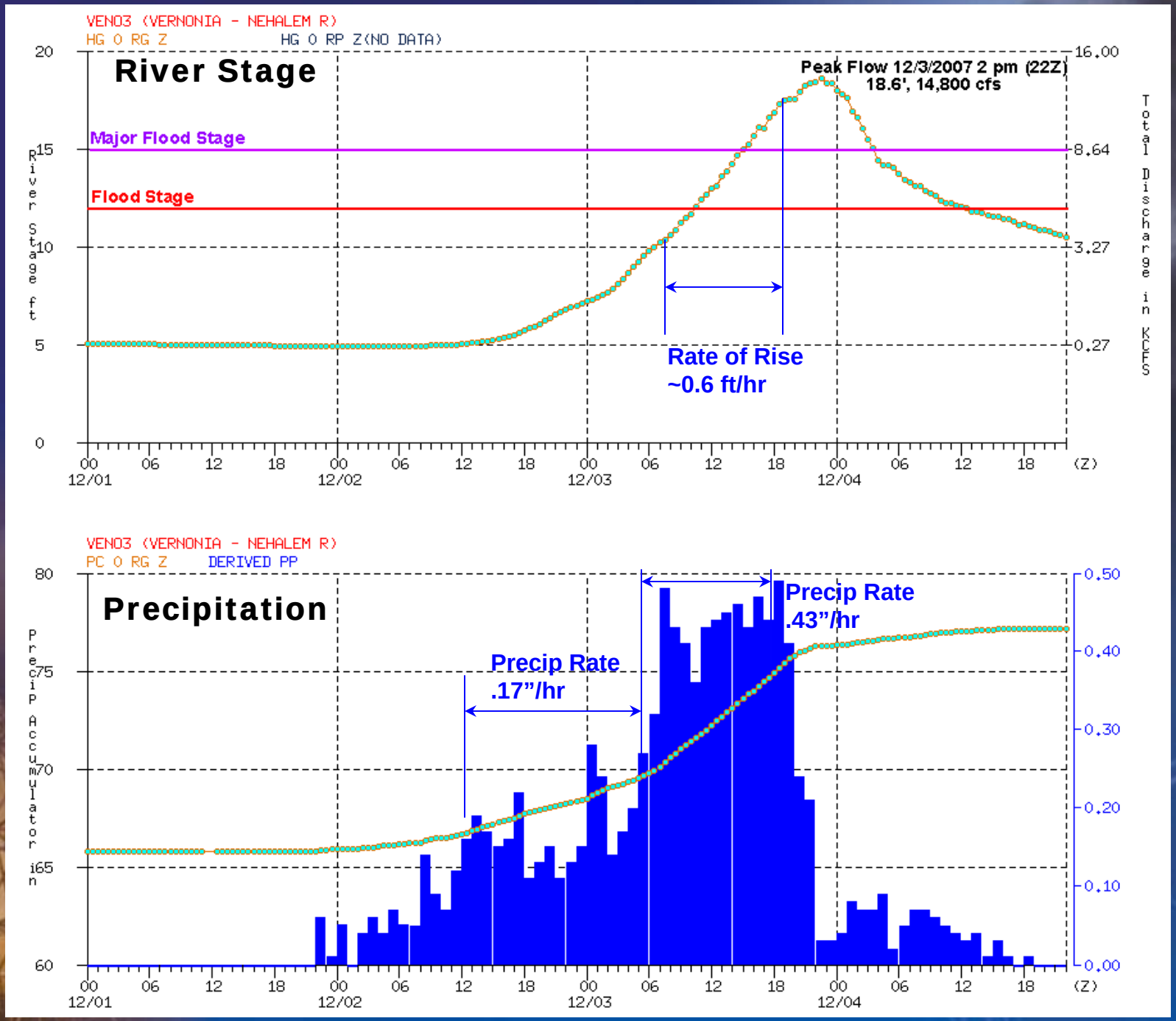
hydrographs for Feb 7-9 1996, Nov 4-6 2006, & Dec 2-4 2007



Nehalem R near Vernonia –

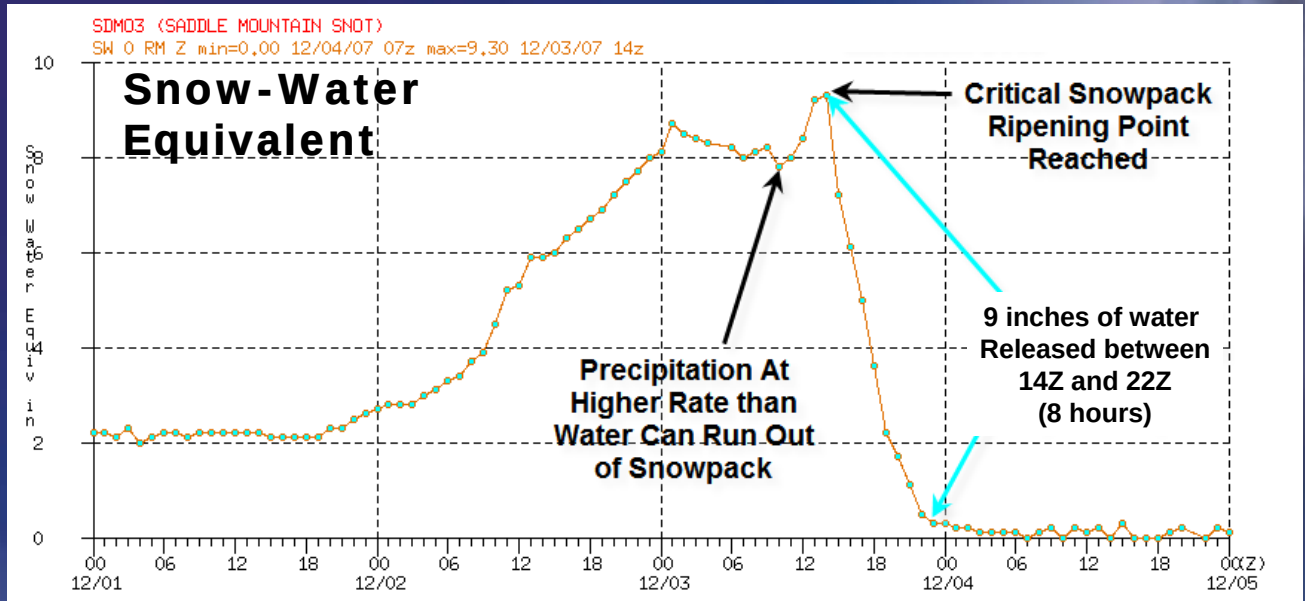
hydrographs for Feb 7-9 1996, Nov 4-6 2006, & Dec 2-4 2007

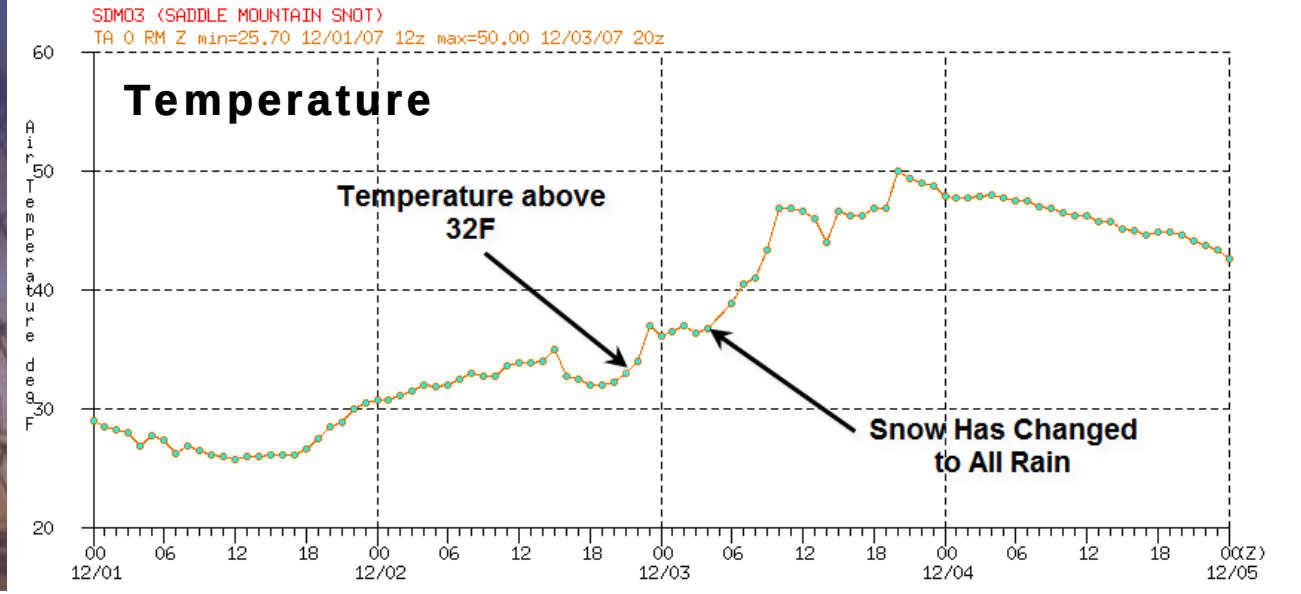



VENO3 (VERNONIA - NEHALEM R)
HG O RG Z
HG O RP Z(NO DATA)
River Stage
Peak Flow 12/3/2007 2 pm (22Z)
18.6', 14,800 cfs
Major Flood Stage
Flood Stage
Rate of Rise
~0.6 ft/hr
River Stage ft
Total Discharge in KCFS
20
15
10
5
0
16.00
8.64
3.27
0.27
00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 (Z)
12/01 12/02 12/03 12/04
VENO3 (VERNONIA - NEHALEM R)
PC O RG Z
DERIVED PP
Precipitation
Precip Rate
.17"/hr
Precip Rate
.43"/hr
Precip Accumulation in
80
75
70
65
60
0.50
0.40
0.30
0.20
0.10
0.00
00 06 12 18 00 06 12 18 00 06 12 18 00 06 12 18 (Z)
12/01 12/02 12/03 12/04

Snowmelt Component

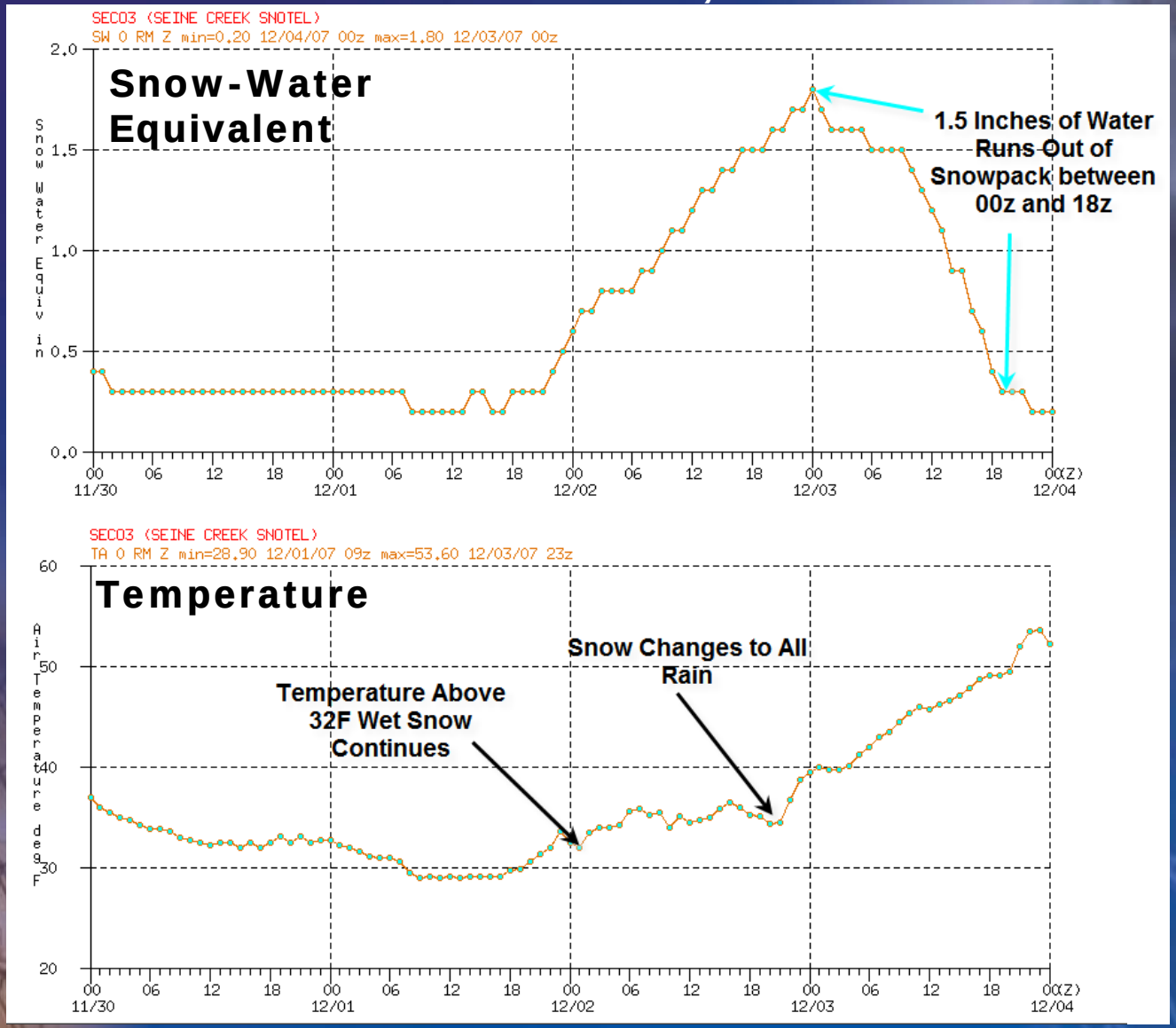
Saddle Mountain SNOTEL, Elev. 3110’

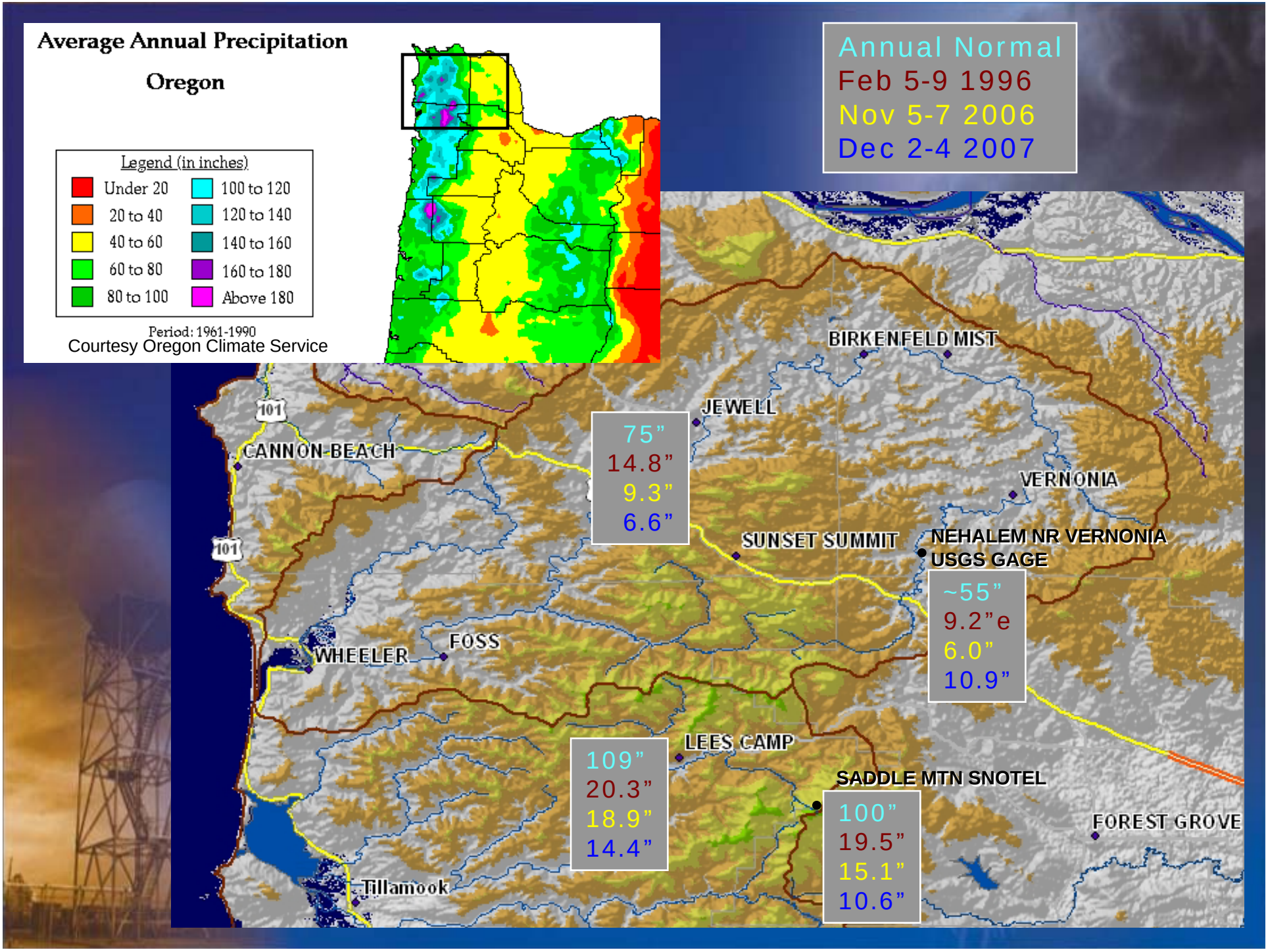




Snowmelt Component

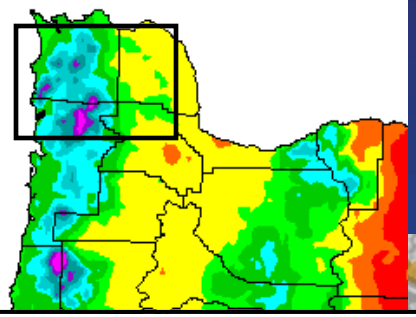
Seine Creek SNOTEL, Elev. 2060'




Average Annual Precipitation
Oregon
Legend (in inches)
Under 20
20 to 40
40 to 60
60 to 80
80 to 100
100 to 120
120 to 140
140 to 160
160 to 180
Above 180
Period: 1961-1990
Courtesy Oregon Climate Service
Annual Normal
Feb 5-9 1996
Nov 5-7 2006
Dec 2-4 2007
BIRKENFELD MIST
JEWELL
75”
14.8”
9.3”
6.6”
CANNON-BEACH
101
101
VERNONIA
SUNSET SUMMIT
NEHALEM NR VERNONIA
USGS GAGE
~55”
9.2”e
6.0”
10.9”
WHEELER
FOSS
LEES CAMP
109”
20.3”
18.9”
14.4”
SADDLE MTN SNOTEL
100”
19.5”
15.1”
10.6”
FOREST GROVE
Tillamook

Average Annual Precipitation

Oregon



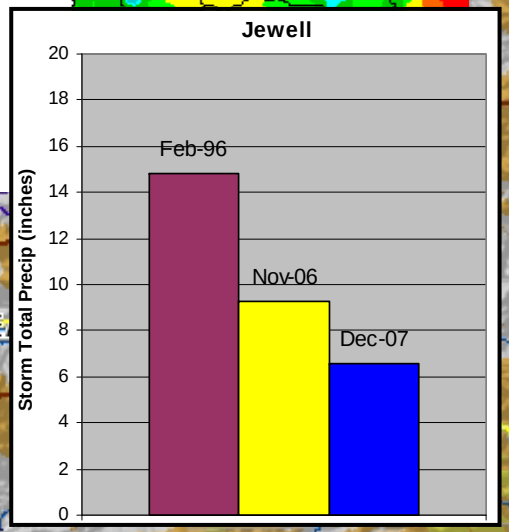
Legend (in inches)

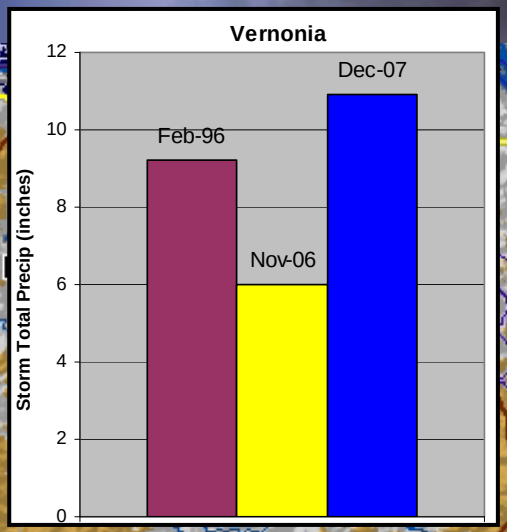
Under 20	100 to 120
20 to 40	120 to 140
40 to 60	140 to 160
60 to 80	160 to 180
80 to 100	Above 180

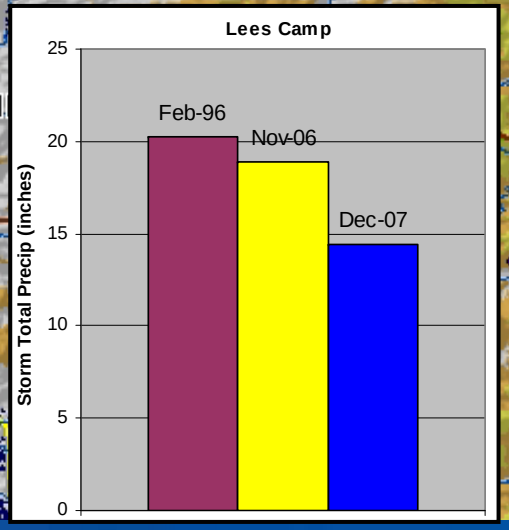
Period: 1961-1990

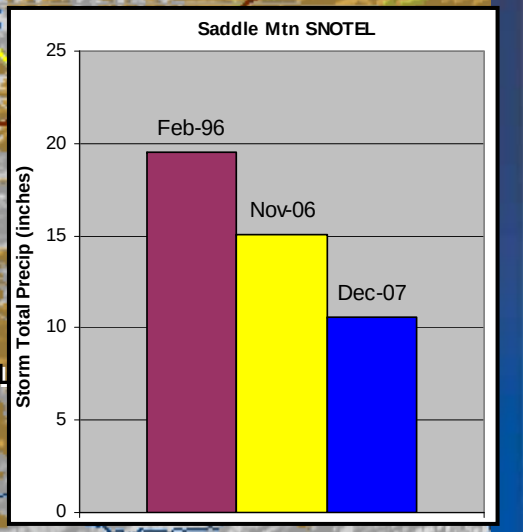
Courtesy Oregon Climate Service

Why is the precipitation anomalously high at the USGS Vernonia gage for the Dec 2-4, 2007 event?





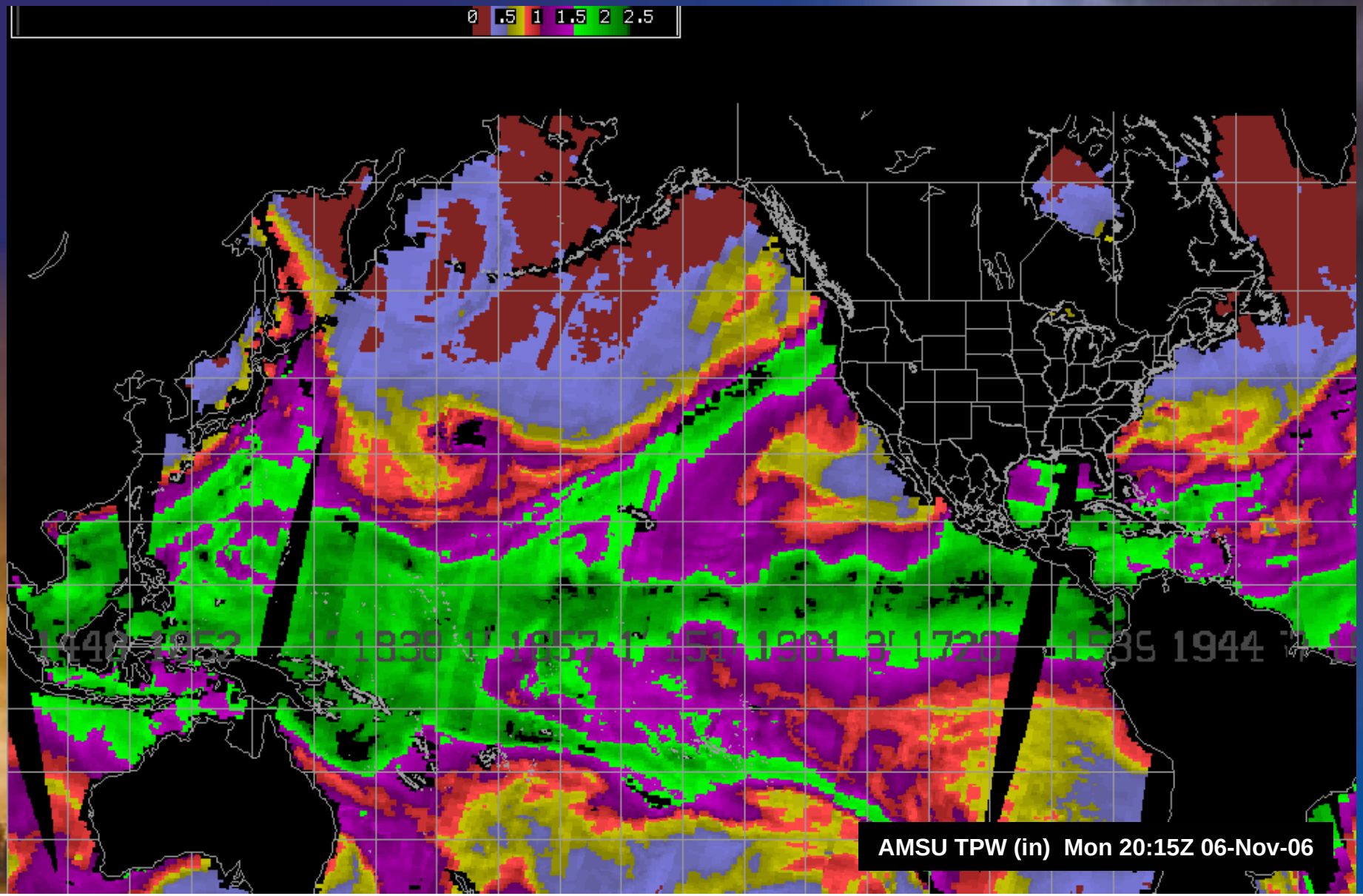




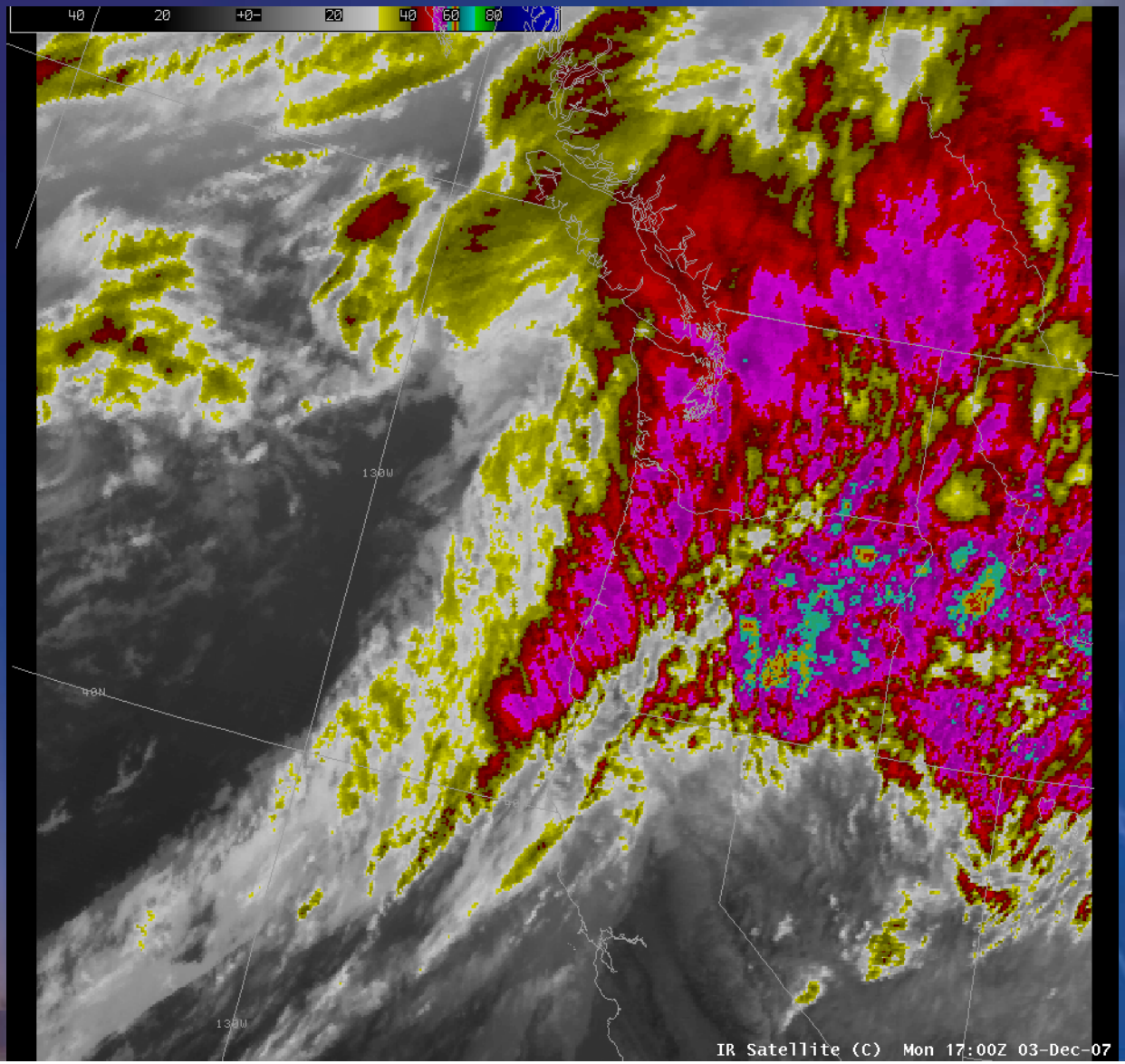
Meteorological Differences in These Major Flood Cases

- All Events – Tropical Connection with High Precipitable Water Content
- 1996 and 2007 events – Overrunning of Low Level Cold Air vs. 2006 event, Warm Air at Surface
- Westerly Flow is the Norm with Rain Shadow of Eastern Nehalem Basin (e.g. 2006)
- 1996 and 2007 – Stronger Southerly Flow, reduced Rain Shadow effect

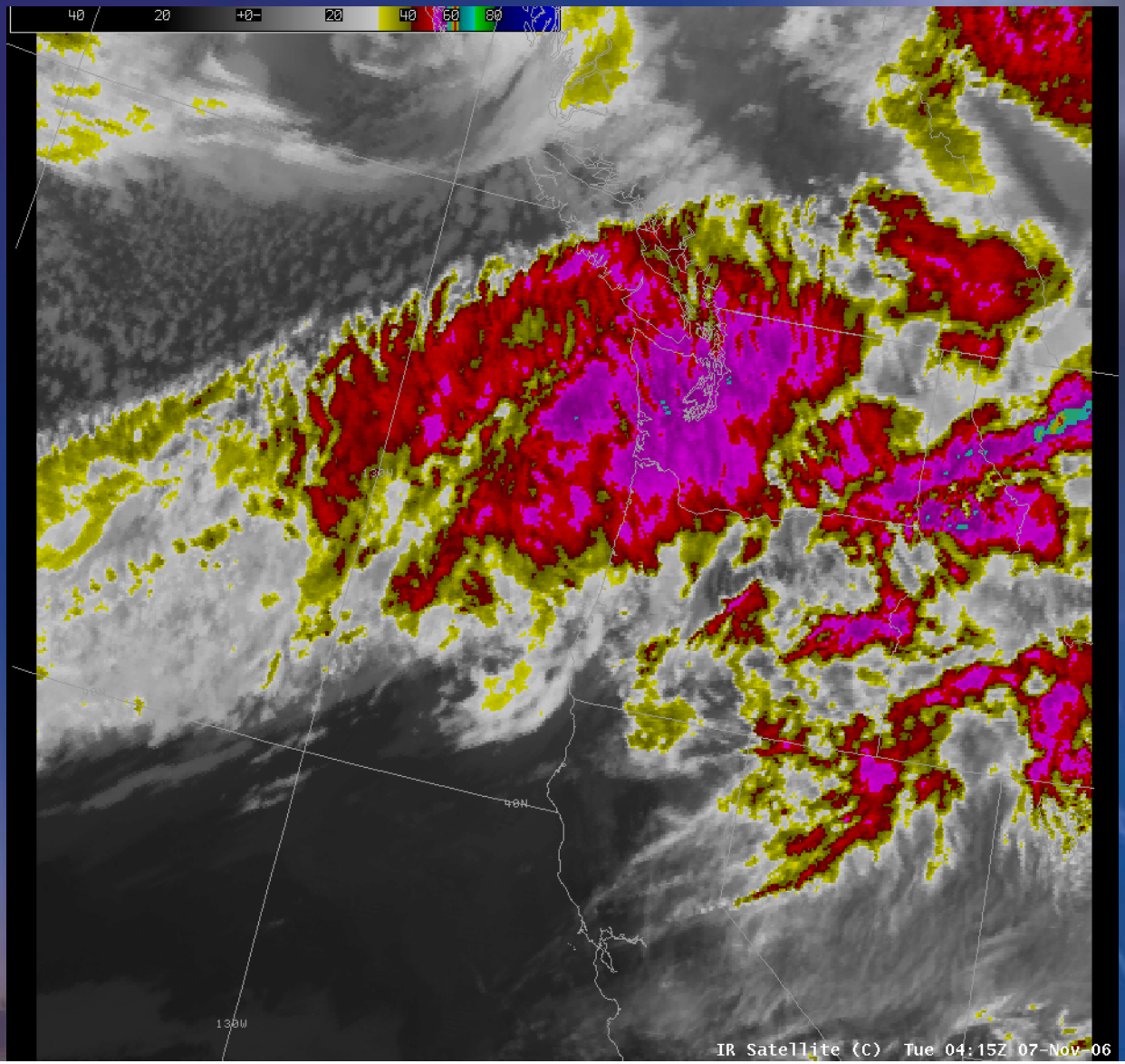
All Nehalem River Flood Cases – High Precipitable Water



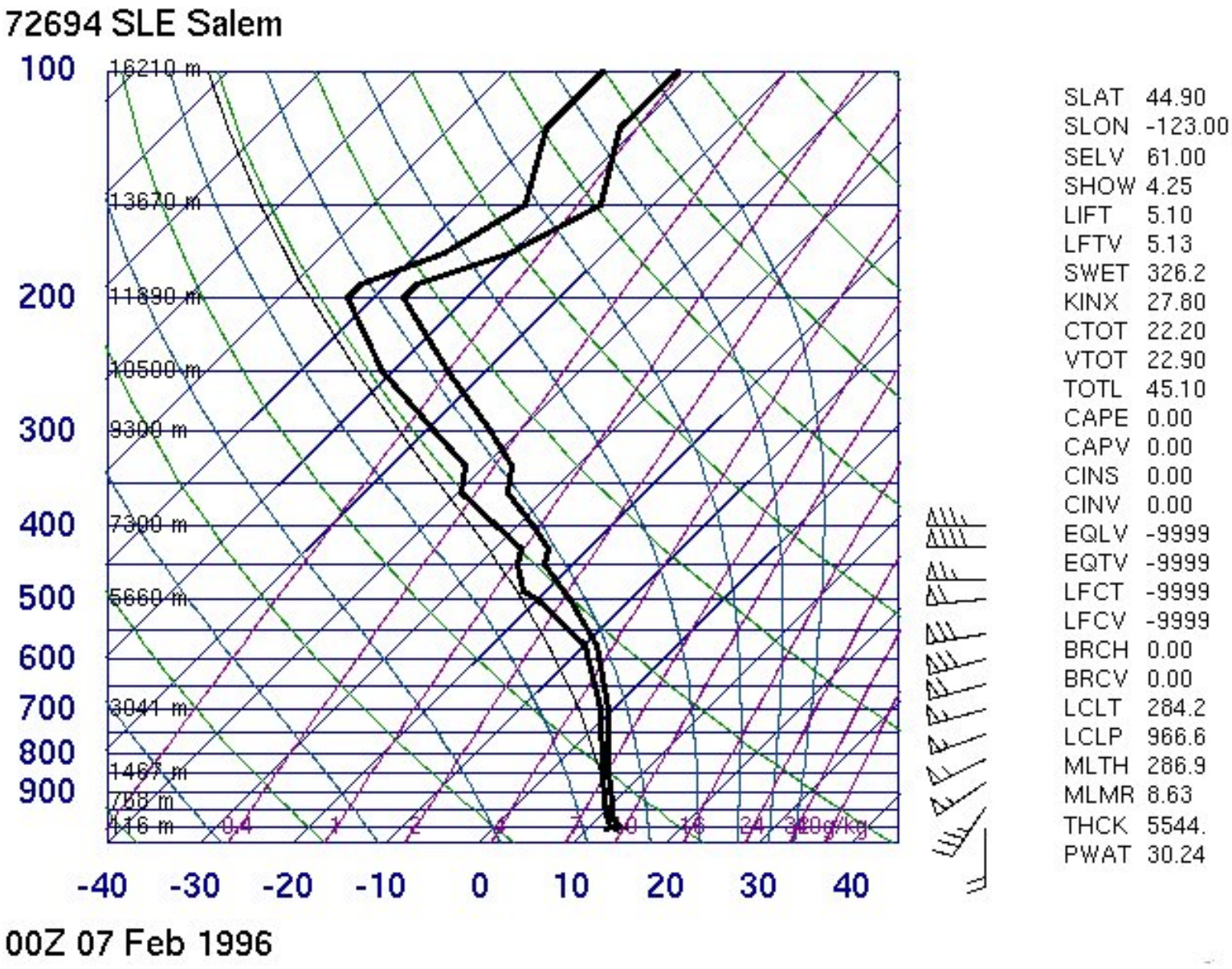
3 December 2007
Southerly Component



7 November 2006
Westerly Component

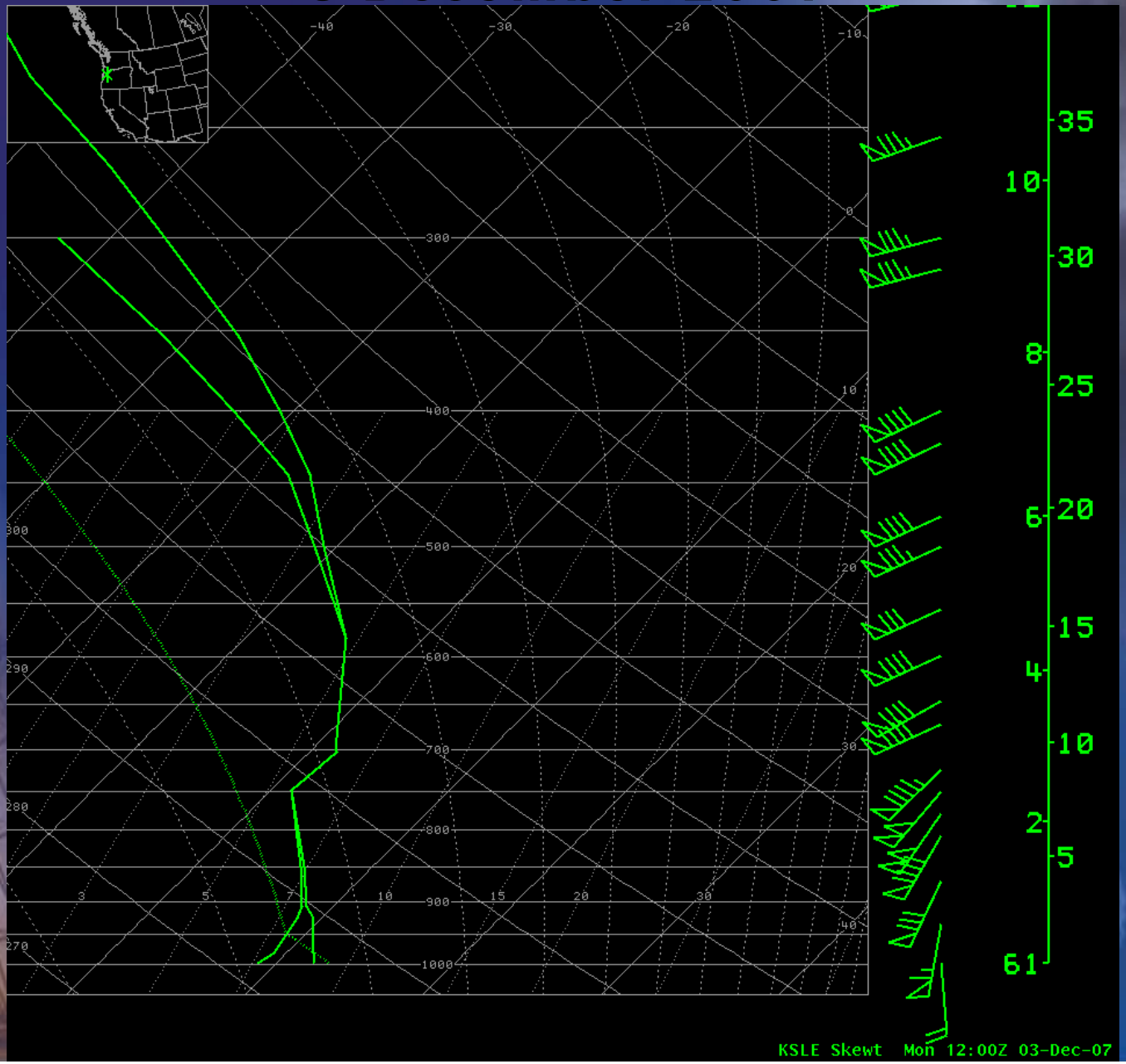


KSLE Sounding 00Z
3 December 2007

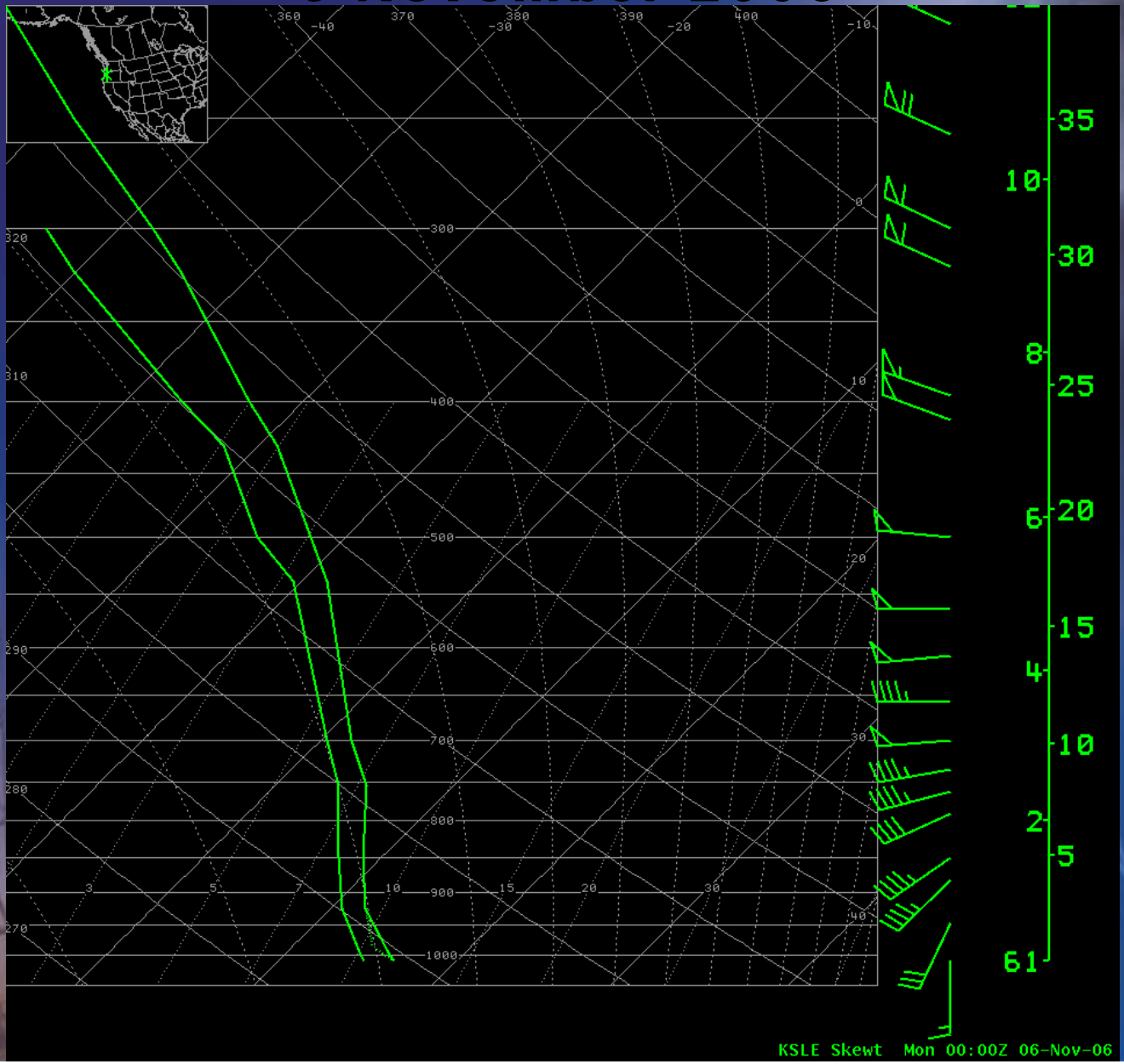


KSLE Sounding 00Z

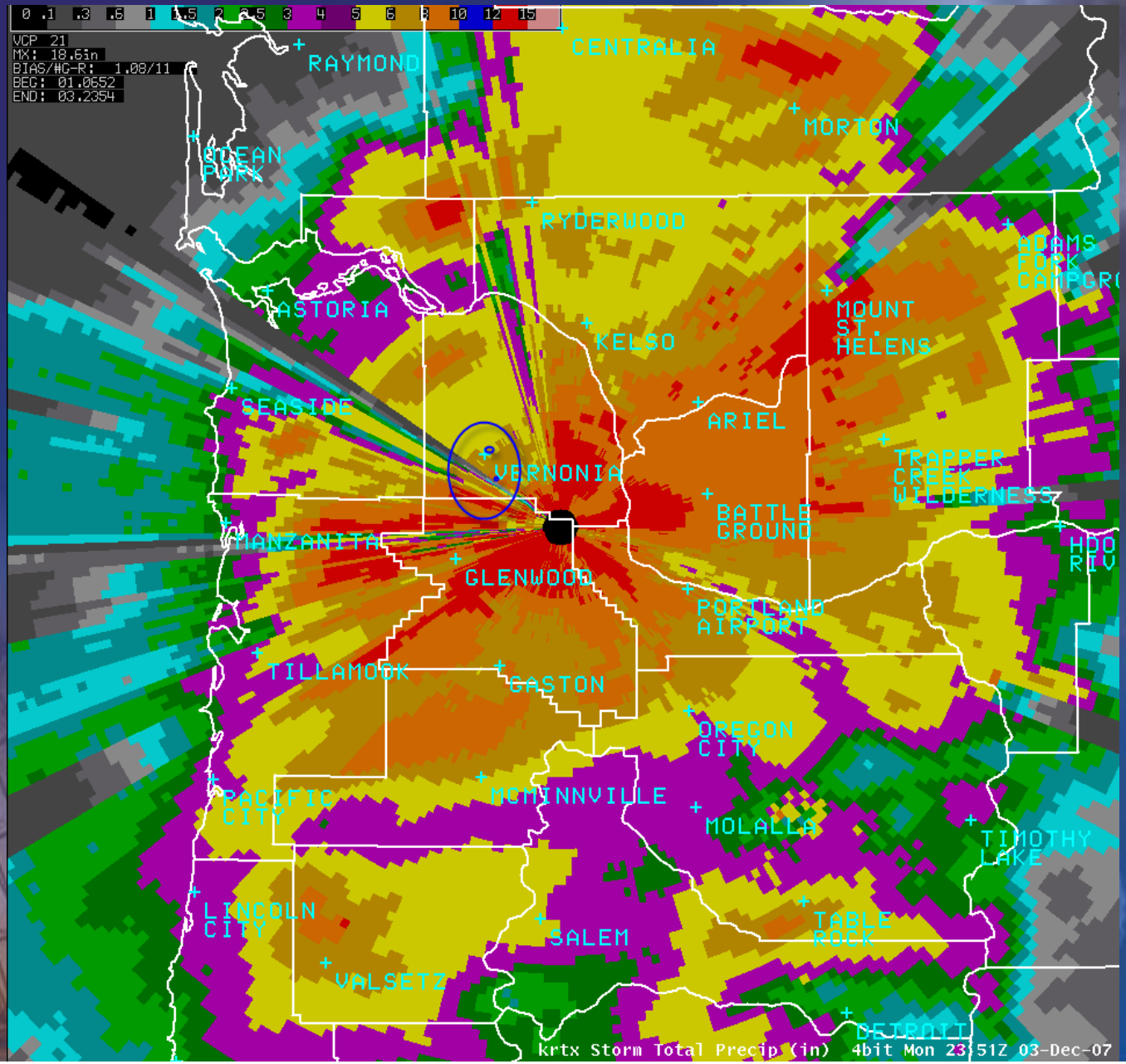
3 December 2007



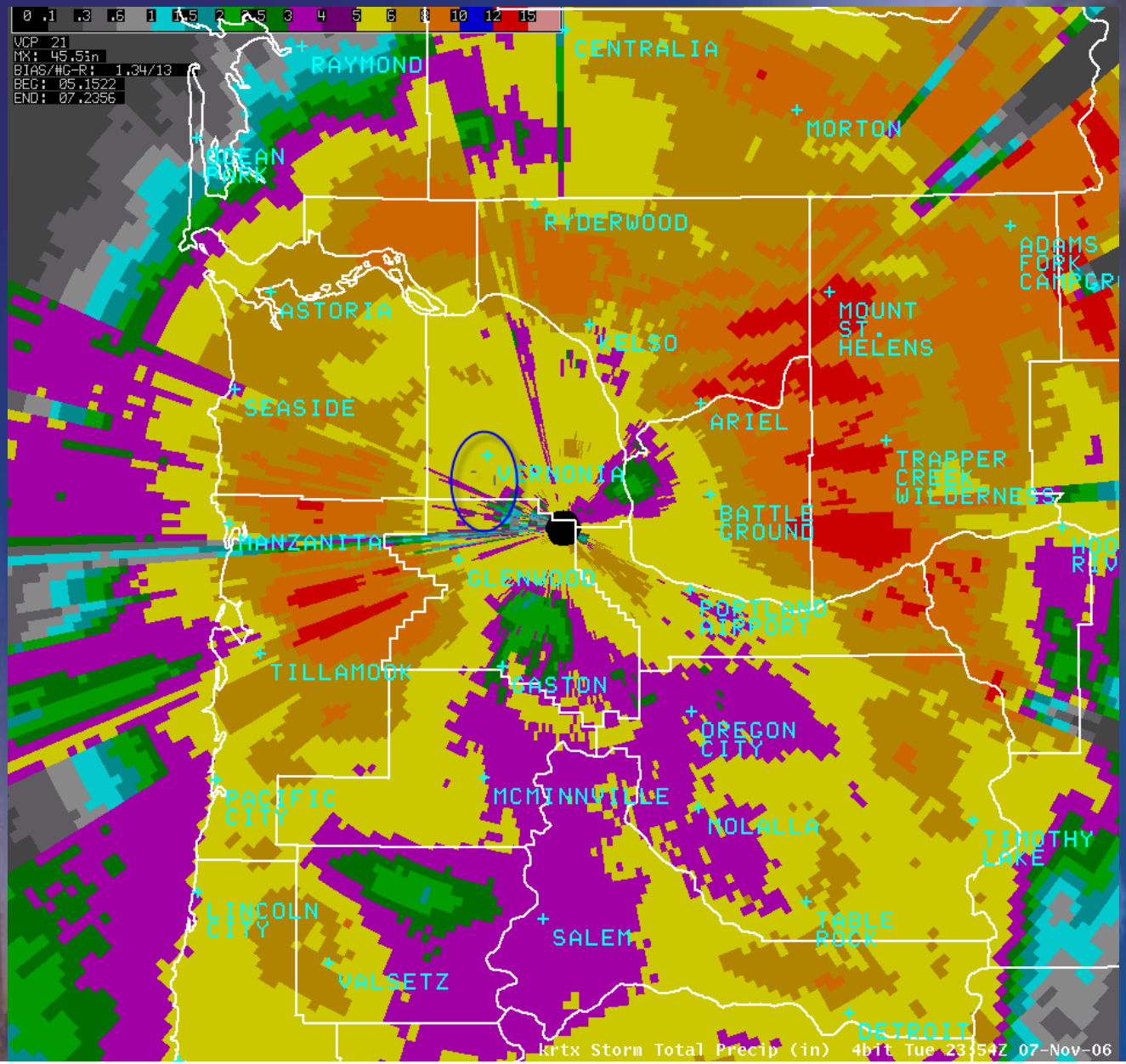
KSLE Sounding 00Z
6 November 2006



KRTX Strom Total Precipitation
3 December 2007



KRTX Storm Total Precipitation
7 November 2006



Conclusions
Causes of Flooding in Vernonia

- Snowmelt a Factor
- Tropical Connection with High Precipitable Water Values
- 12-24 Hour Period of Intense Rainfall
- Overrunning Favorable
- Strong Southerly Wind Component