A Severe Thunderstorm Event on June 10, 2003 in the Inland Northwest – A Weather Event Simulation

Ron Miller, WFO Spokane WA

Introduction

A common weather pattern in the Pacific Northwest during the spring is cold upper troughs. These troughs and their associated steep lapse rates result in considerable diurnal convection. Typically, at least one factor limits the convective development so that the thunderstorms don't become severe. These factors are often limited low-level moisture or surface temperatures that are too cool. However, there are situations where all the right ingredients are in place to generate severe thunderstorms.

Discussion

On June 10th, 2003, a cold upper trough moved into the Inland Northwest from Canada. The water vapor imagery at 1730Z on this day (Fig 1) shows good darkening associated with this trough implying a vigorous system with a good tropopause fold. Storms which move in this direction (i.e. northwesterly flow) typically produce more wind than precipitation owing to the fact that they come from a moisture deficient region. On this day, however, low-level moisture was already in place. Note the METAR and MesoWest observations at 18Z (Fig 2) with dew points in the lower and middle 50s over northeast Washington and the northern Idaho Panhandle.

The Eta model showed that resulting CAPE values (Fig 3) would be between 500-1000 J/kg in this area (CAPE values are yellow contours). However, this was offset somewhat by the lack of lower-tropospheric shear. The Eta model showed that the 0-6 km shear was moderate (around 40 kts) over the areas where the CAPE was near-zero. But over the unstable area associated with the upper trough, the shear was markedly less, below the 35 kts generally needed for mesocyclone development.

The convection that developed during the afternoon hours was fairly intense, in agreement with the forecast CAPE values. But due to the lack of shear, most of the storms failed to become organized. A few storms were able to generate some supercell characteristics. One of these storms was located near Newport, Washington.

The storm developed west of Newport and was the result of an outflow boundary from a nearby storm. The thunderstorm rapidly developed. By 2217Z a core of 60 dbZ extended more than 10,000 AGL (Fig 4), but with little or no tilt discernable. Even so, the storm did exhibit some rotation in the mid-levels (Fig 5). This rotation persisted in the mid-portion of the storm and did not show any tendency to descend to the lower levels. At this same time, the storm had excellent storm-top divergence (STD). Figure 6 shows the SRM data on the 7.5 degree tilt, which was about 34,000 AGL. The outbound velocity was greater than 50 kts with inbound velocities of 22 to 30 kts. This results in a STD of around 80 kts. In a study of hail events in the Boise, ID area, Jewell (2000) found STD of 75 kts or greater to be a good indicator of large hail. The WSR-88D Hail algorithm at this 2217Z scan estimated a hail size of 1.25". Two inch diameter hail was reported by a spotter near Newport.

Summary

The combination of a cold upper trough and surface dewpoints in the mid 50s resulted in a severe weather event on June 10, 2003. While most of the severe thunderstorms produced 0.75"-1.00" hail, one storm developed multi-cellular characteristics with some mid-level rotation and very strong updrafts. Maximum hail size from this storm was 2" which corresponded with a storm top divergence of around 80 kts.

References

Jewell, Ryan E. D., 2000: Using Storm Top Divergence Signatures as Large Hail Indicators in the Boise CWA. Western Region Technical Attachment, No. 00-14.

Figure 1

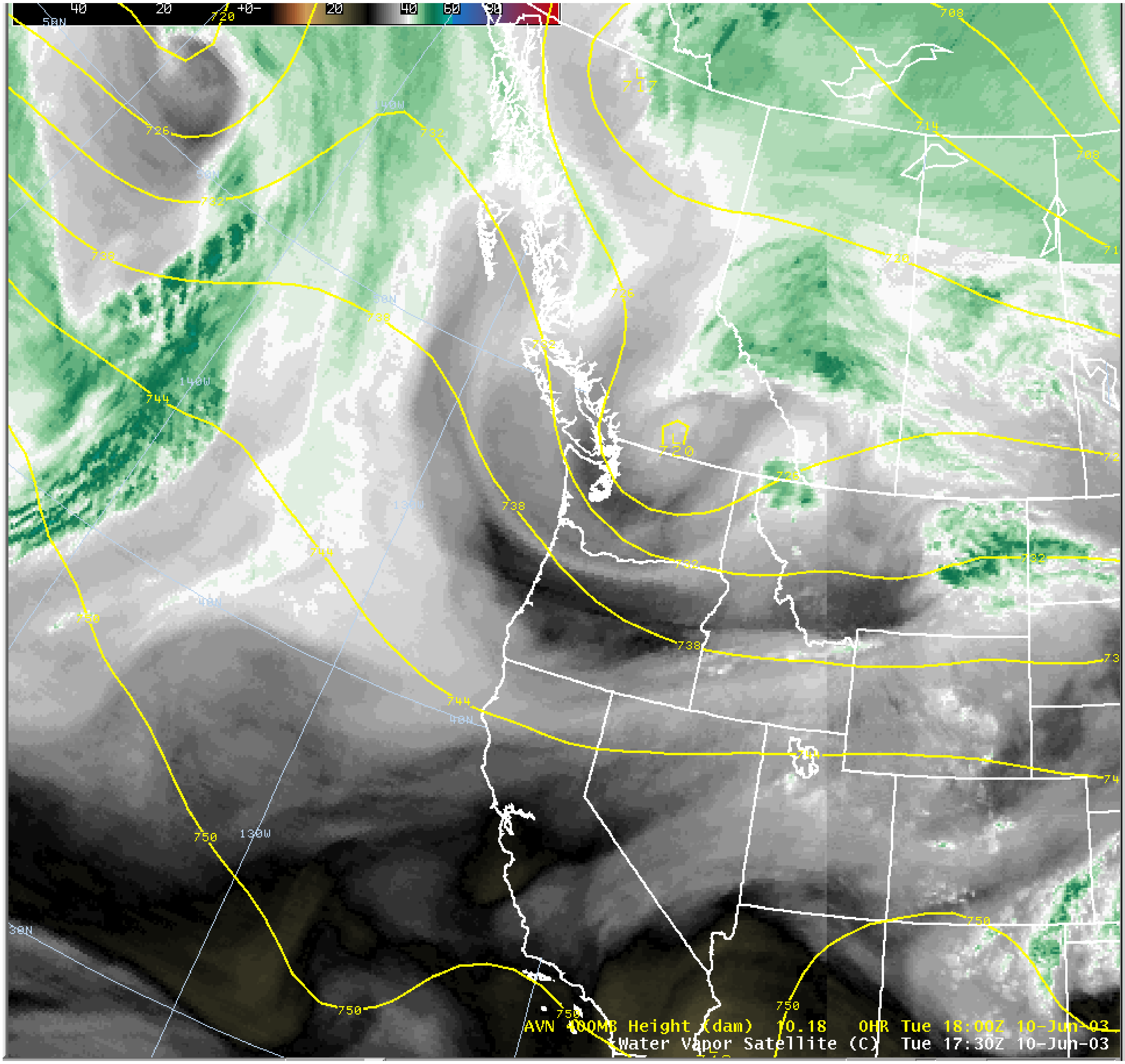

AVN 400MB Height (dam) 10.18 0HR Tue 18:00Z 10-Jun-03
Water Vapor Satellite (C) Tue 17:30Z 10-Jun-03

Figure 2

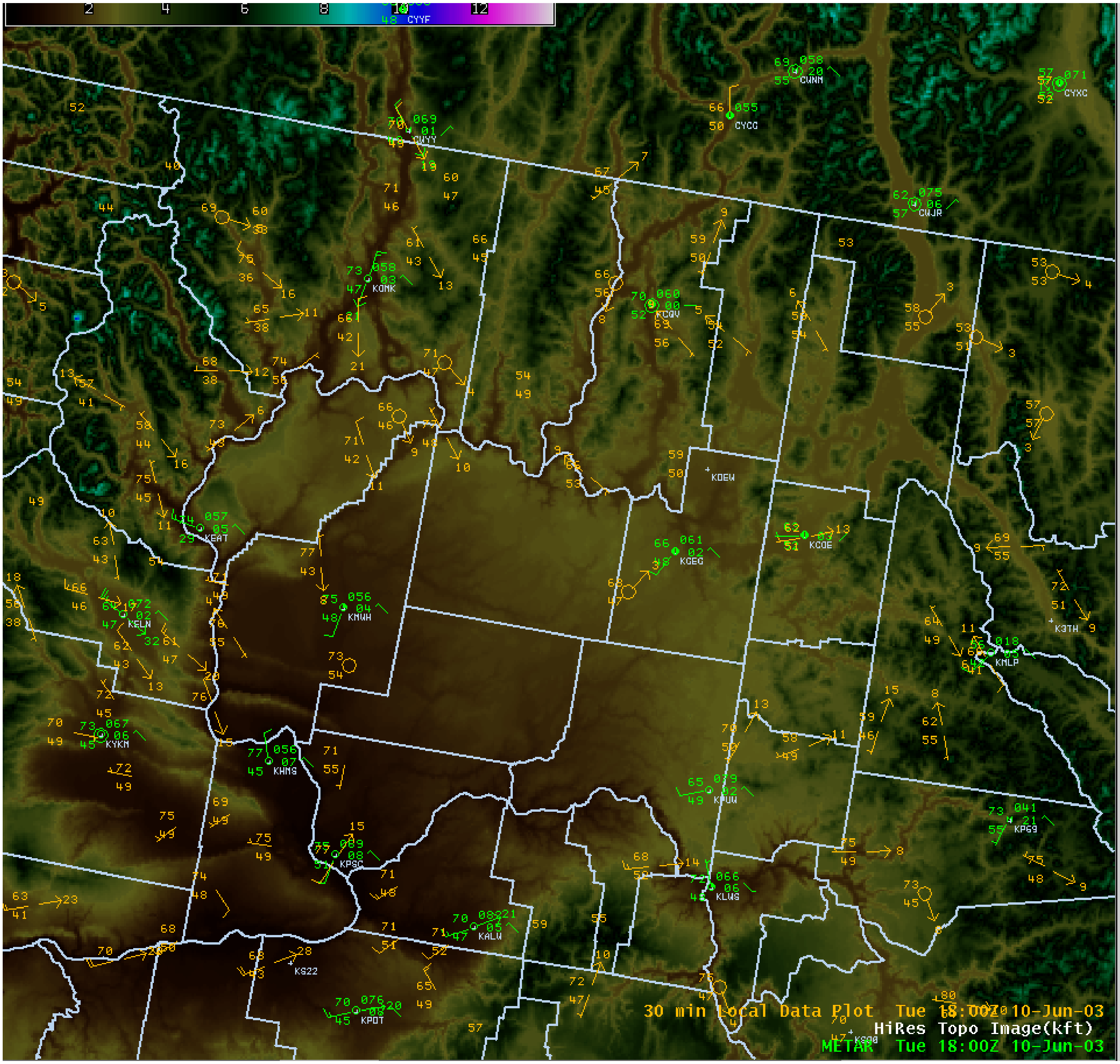

30 min Local Data Plot Tue 18:00Z 10-Jun-03
HiRes Topo Image(kft)
METAR Tue 18:00Z 10-Jun-03

Figure 3

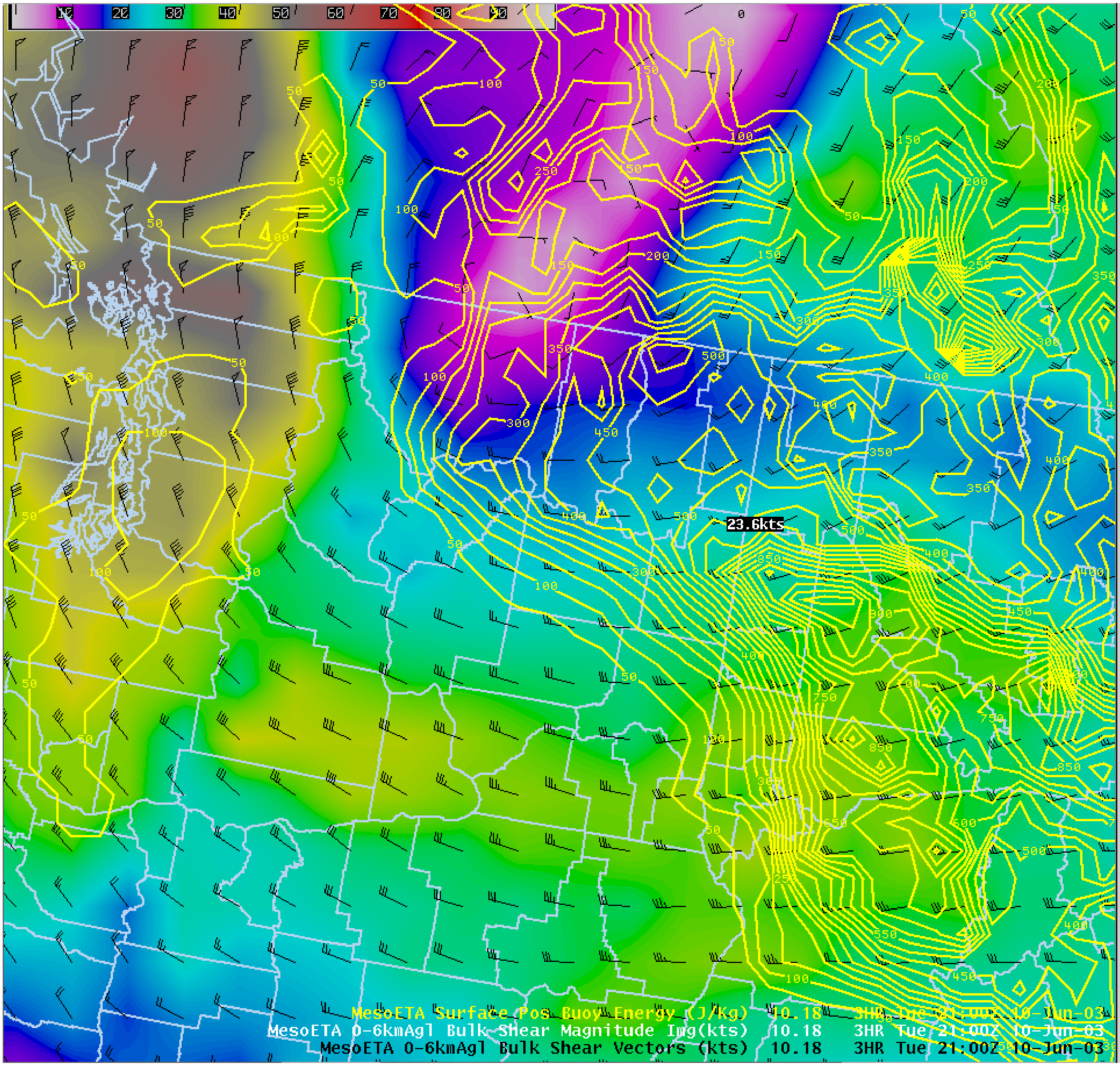
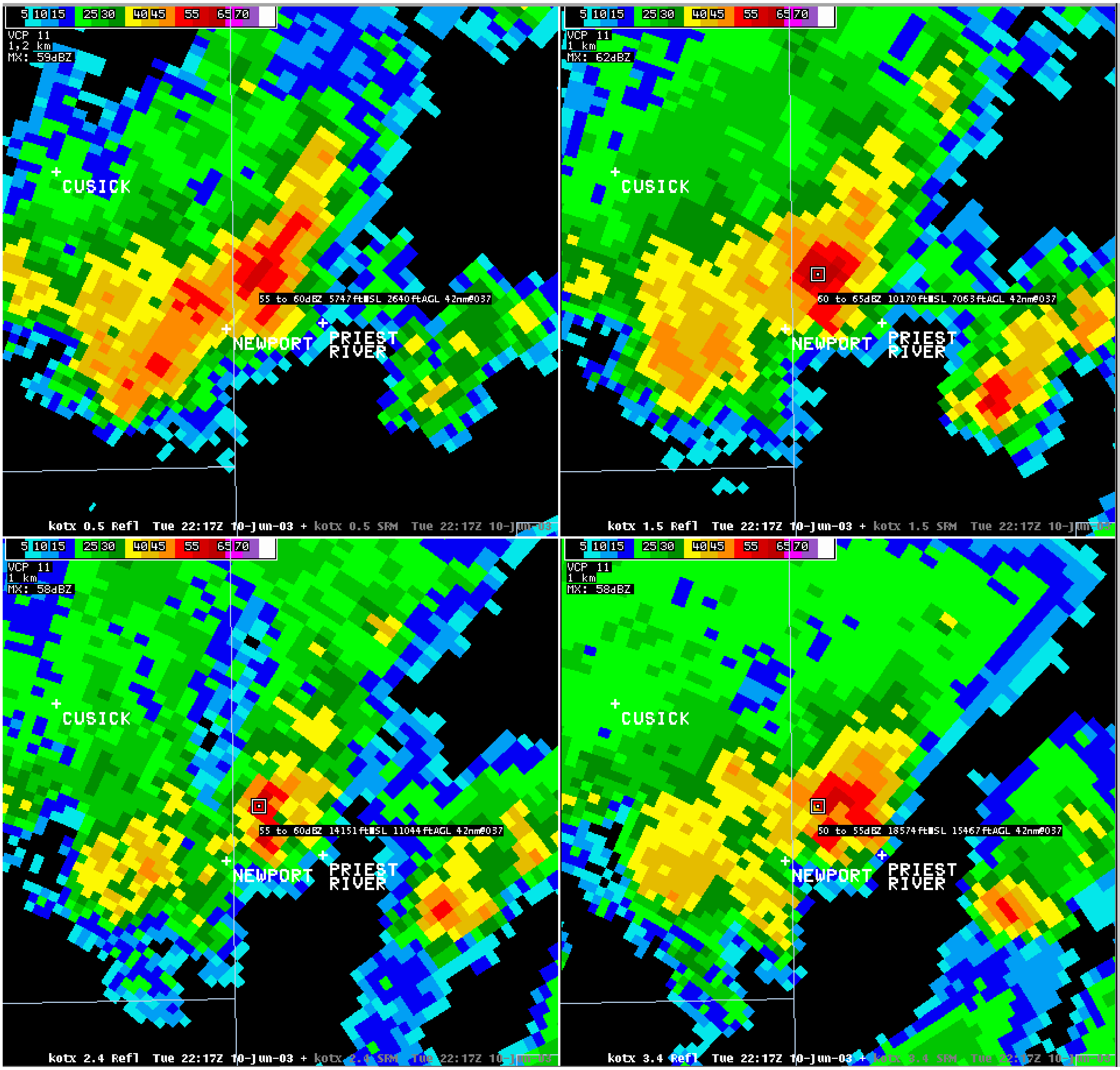

10
20
30
40
50
60
70
80
90
23.6kts
MesoETA Surface Pos Buoy Energy (J/Kg) 10.18 3HR Tue 21:00Z 10-Jun-03
MesoETA 0-6kmAgl Bulk Shear Magnitude Img(kts) 10.18 3HR Tue 21:00Z 10-Jun-03
MesoETA 0-6kmAgl Bulk Shear Vectors (kts) 10.18 3HR Tue 21:00Z 10-Jun-03

Figure 4



5 10 15 25 30 40 45 55 65 70
VCP 11
1.2 km
MX: 59dBZ
CUSICK
NEWPORT
PRIEST RIVER
55 to 60dBZ 5747ftMSL 2640ftAGL 42nm@037
kotx 0.5 Refl Tue 22:17Z 10-Jun-03 + kotx 0.5 SRM Tue 22:17Z 10-Jun-03
VCP 11
1 km
MX: 62dBZ
60 to 65dBZ 10170ftMSL 7063ftAGL 42nm@037
kotx 1.5 Refl Tue 22:17Z 10-Jun-03 + kotx 1.5 SRM Tue 22:17Z 10-Jun-03
MX: 58dBZ
55 to 60dBZ 14151ftMSL 11044ftAGL 42nm@037
kotx 2.4 Refl Tue 22:17Z 10-Jun-03
50 to 55dBZ 18574ftMSL 15467ftAGL 42nm@037
kotx 3.4 Refl Tue 22:17Z 10-Jun-03

Figure 5

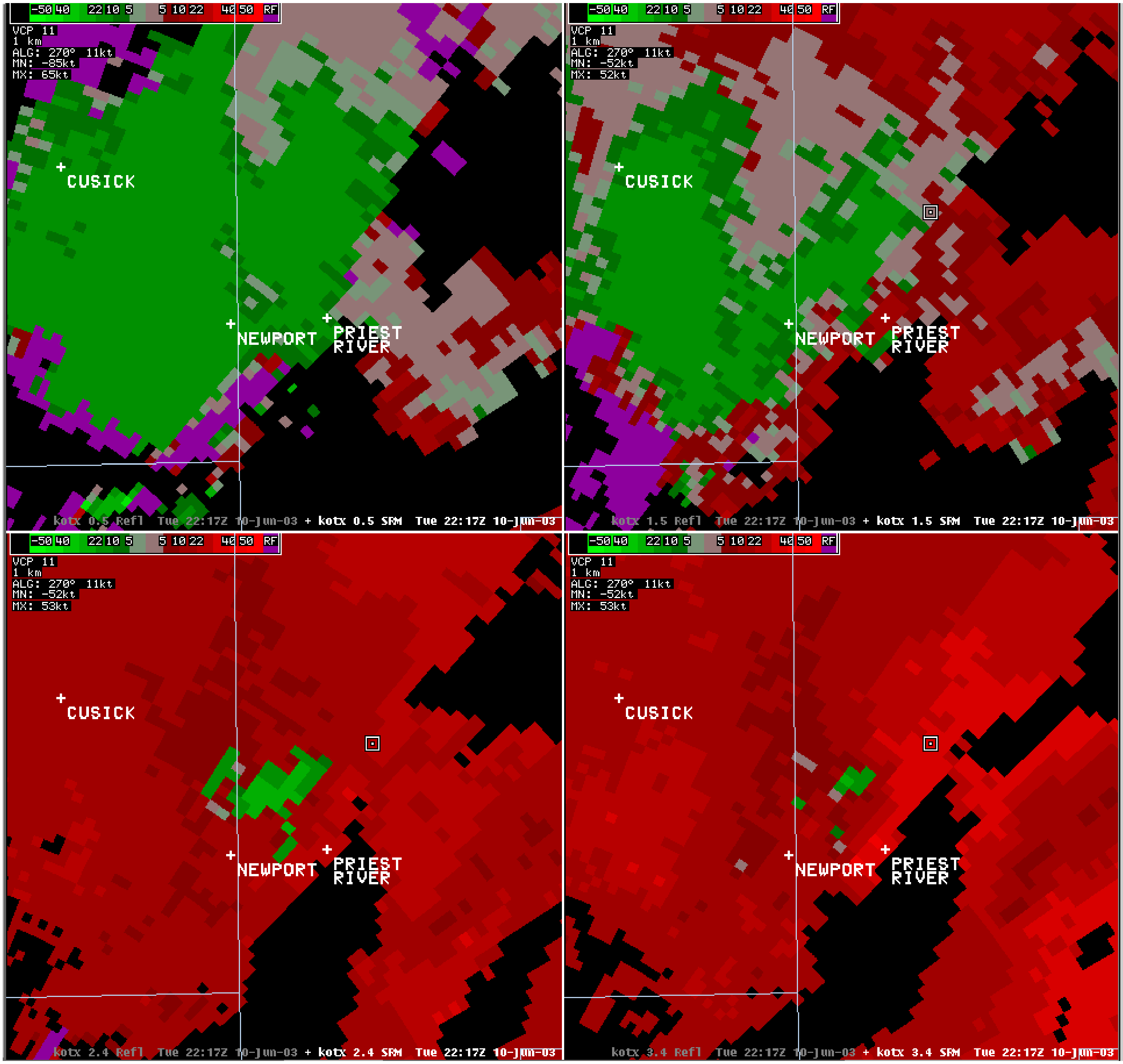
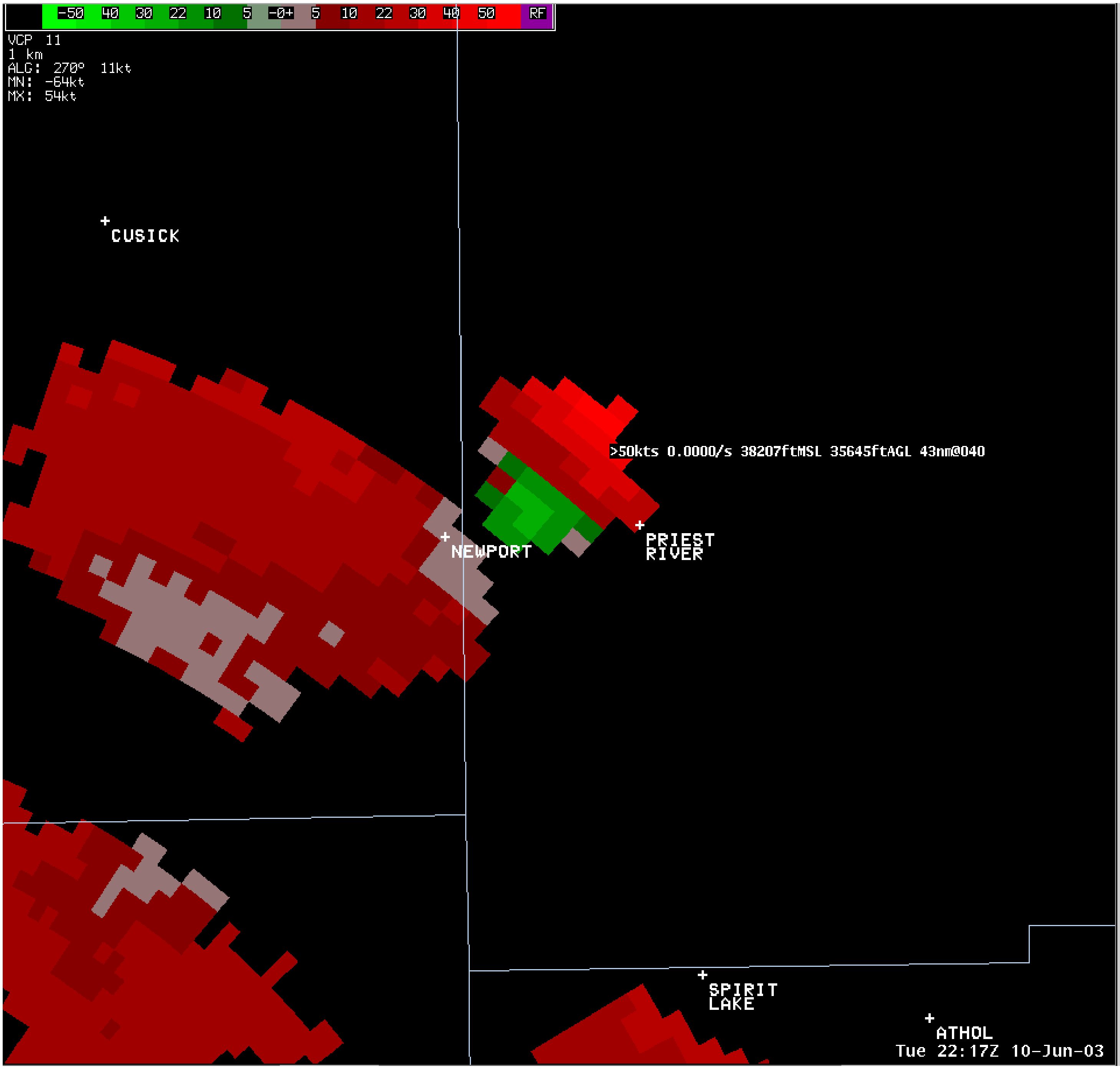

-50 40 22 10 5 5 10 22 40 50 RF
VCP 11
1 km
ALG: 270° 11kt
MN: -85kt
MX: 65kt
CUSICK
NEWPORT
PRIEST RIVER
kotx 0.5 Refl Tue 22:17Z 10-Jun-03 + kotx 0.5 SRM Tue 22:17Z 10-Jun-03
-50 40 22 10 5 5 10 22 40 50 RF
VCP 11
1 km
ALG: 270° 11kt
MN: -52kt
MX: 52kt
CUSICK
NEWPORT
PRIEST RIVER
kotx 1.5 Refl Tue 22:17Z 10-Jun-03 + kotx 1.5 SRM Tue 22:17Z 10-Jun-03
-50 40 22 10 5 5 10 22 40 50 RF
VCP 11
1 km
ALG: 270° 11kt
MN: -52kt
MX: 53kt
CUSICK
NEWPORT
PRIEST RIVER
kotx 2.4 Refl Tue 22:17Z 10-Jun-03 + kotx 2.4 SRM Tue 22:17Z 10-Jun-03
-50 40 22 10 5 5 10 22 40 50 RF
VCP 11
1 km
ALG: 270° 11kt
MN: -52kt
MX: 53kt
CUSICK
NEWPORT
PRIEST RIVER
kotx 3.4 Refl Tue 22:17Z 10-Jun-03 + kotx 3.4 SRM Tue 22:17Z 10-Jun-03

Figure 6


-50 40 30 22 10 5 -0+ 5 10 22 30 40 50 RF
VCP 11
1 km
ALG: 270° 11kt
MN: -64kt
MX: 54kt
CUSICK
>50kts 0.0000/s 38207ftMSL 35645ftAGL 43nm@040
NEWPORT
PRIEST RIVER
SPIRIT LAKE
ATHOL
Tue 22:17Z 10-Jun-03