Anomalously Heavy Summer Season Stratiform Precipitation Event in the Pacific Northwest

Mark O'Malley
National Weather Service, Portland OR

Introduction

In a six day period from August 21st through 26th, 2004, a primarily stratiform, heavy precipitation event affected the northern part of the Portland Oregon CWA. While stratiform rain events are not uncommon to this area in the summer (dry) season, the magnitude of this event caught forecasters by surprise. Two main factors appear to be significant in the evolution of this anomalous event: (1) a weak, negative, or convectively active, phase of the Madden-Julian Oscillation (MJO) in the West Pacific Ocean, and (2) the remnants of Typhoon Megi which had affected portions of Japan and South Korea days earlier. The goal of this study is to make forecasters more aware of the impacts of the convectively active MJO phase on the Pacific Northwest, and the better utilization of information, particularly satellite, to forecast these unusual situations.

Discussion

The Pacific Northwest dry season is loosely defined as a period from July 1st through August 31st. Broad upper level ridging and surface high pressure are climatologically favored during this part of the year. Occasional weak Pacific systems temporarily break through the upper level ridge to produce light amounts of stratiform precipitation. In addition, residual monsoon moisture can advect northward from the southern Rockies and across the Sierra and Cascade ranges to produce convective precipitation in Northwest Oregon. However, these precipitable processes climatologically produce less than one inch of water per month in the dry season.

The six day event in August 2004 produced 2.31 inches of precipitation at Portland International airport (PDX) and 3.42 inches at the Astoria regional airport (AST). Similar amounts were common over the entire northwest corner of Oregon. This six day event represented 250-300% of normal monthly precipitation for August over the area and lead to the 5th wettest August on record for Portland since 1871, and the 2nd wettest August in Astoria since 1953.

In the midst of this event, on the afternoon of August 24th, a convectively enhanced area of showers produced excessive rainfall over eastern Multnomah County (east the of the Portland metro area), and created localized flash flooding on and near the Sandy River. This resulted in one fatality, a debris flow across a historic highway, and numerous accounts of minor house flooding.

Synopsis

Typhoon Megi struck northern Japan and South Korea on August 18th and 19th causing dozens of fatalities and leaving thousands homeless. The remnants of Megi were quickly swept up in the Pacific westerlies off the Asian continent. IR and water vapor satellite imagery (figures 1 & 2 respectively) show the

disorganized tropical system Megi (area A) on August 21st, primarily composed of mid level moisture. Also apparent in these figures are an active tropical West Pacific Ocean (area B) already spawning two more tropical cyclones, indicative over a period of time of a negative MJO phase. A subtropical moisture plume (area C in figure 2) can be seen feeding into the midlatitude westerly flow. This plume is, in part, due to an adjustment in the jet stream pattern over the Pacific as a result of an evolving MJO. While the MJO signature was weak during this period, there appeared to be enough change in the tropical atmospheric circulation, with several strong tropical cyclones, to allow for Rossby wave dispersion into the midlatitudes.

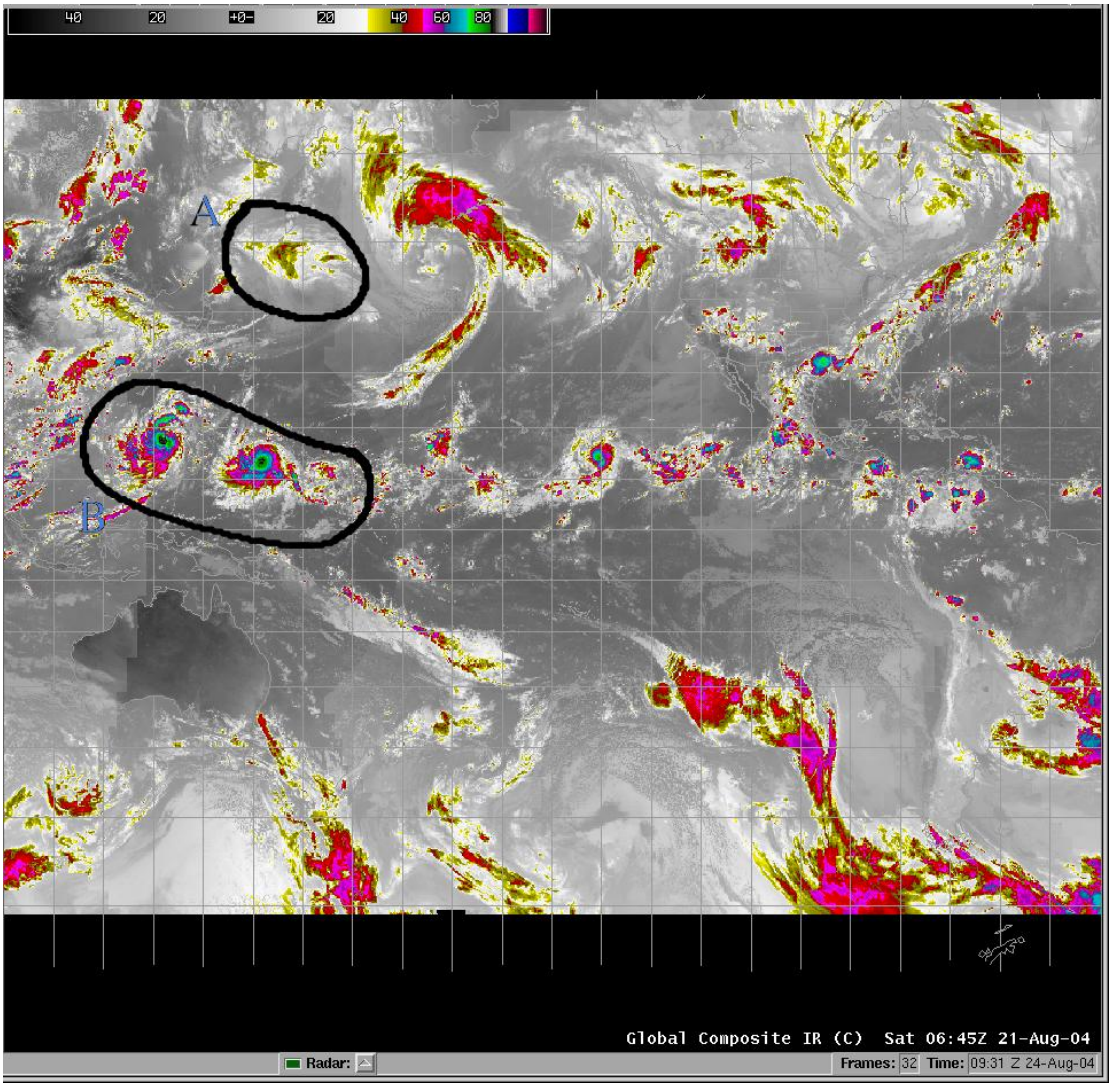

Figure 1. IR Global Composite Imagery from August 21, 2004 showing remnants of Tropical Cyclone Megi (A) and active tropical West Pacific Ocean (B).

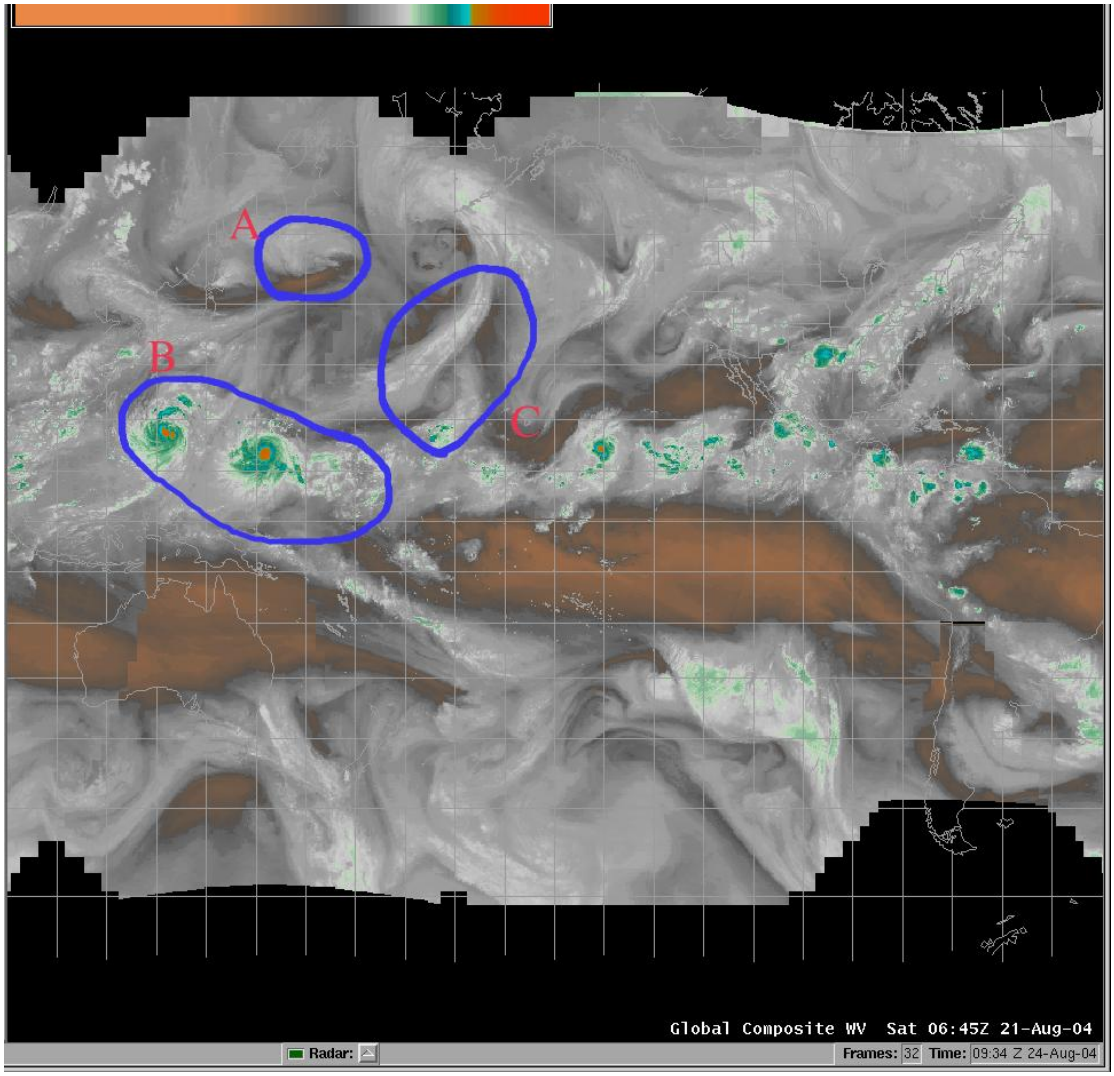

Figure 2. Water Vapor Composite Imagery from August 21, 2004 showing remnants of Tropical Cyclone Megi (A), an active tropical West Pacific Ocean (B), and a subtropical moisture plume (C).

By August 22nd, the remnants of Megi are still seen in the satellite imagery being stretched across the North Pacific in strong westerly flow (figures 3 and 4 area A). However, the true character regarding moisture content of the storm is not evident on these images. The water vapor image (figure 4) shows a more impressive subtropical moisture plume (area B), but the remnants of Megi are not clearly apparent on this image, probably due to the predominance mid and low level moisture rather than upper level moisture. It is not until investigation of total precipitable water (TPW) values, derived from the NOAA-15 AMSU product (figure 5), that a more accurate reflection of the remnants of Megi is gained. Figure 5 shows over two inches of TPW in the subtropical plume directed towards the Pacific NW. Also evident in this figure is moisture associated with Megi southeast of the Aleutian Islands in the Gulf of Alaska.

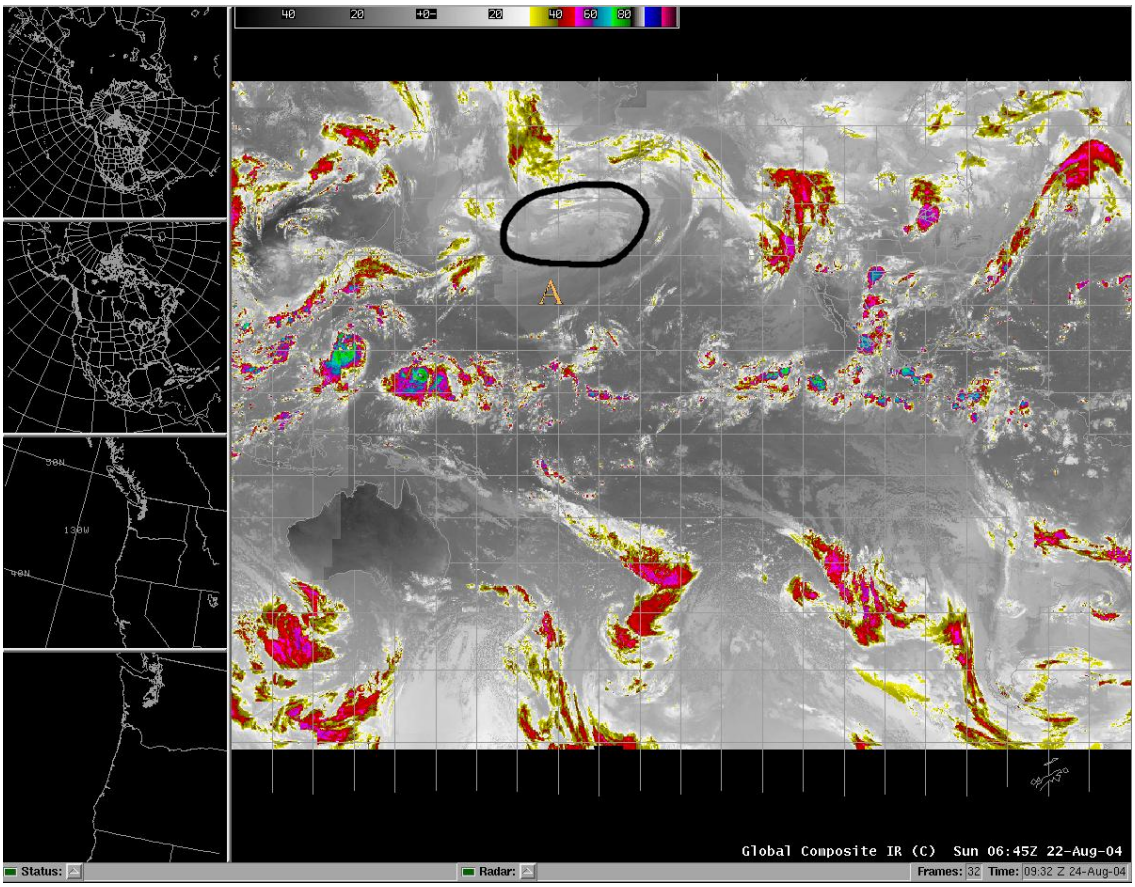

Figure 3. IR Global Composite Imagery from August 22, 2004 showing remnants of Tropical Cyclone Megi (A).

By August 24th, the rain event was well underway in the Pacific Northwest, however, by this point; the nature of the rainfall was a mix of stratiform and convective processes. Figure 6 shows a water vapor image where the mid and upper level moisture has become somewhat more apparent between 130W and 140W. Primarily stratiform precipitation passed through the northwest corner of Oregon on the morning of August 24th. By the afternoon hours, the atmosphere had destabilized sufficiently to allow for convection to develop behind the stratiform region of precipitation. Figure 7 shows a radar image taken as the urban flooding and localized flash flooding began to occur in eastern Multnomah County.

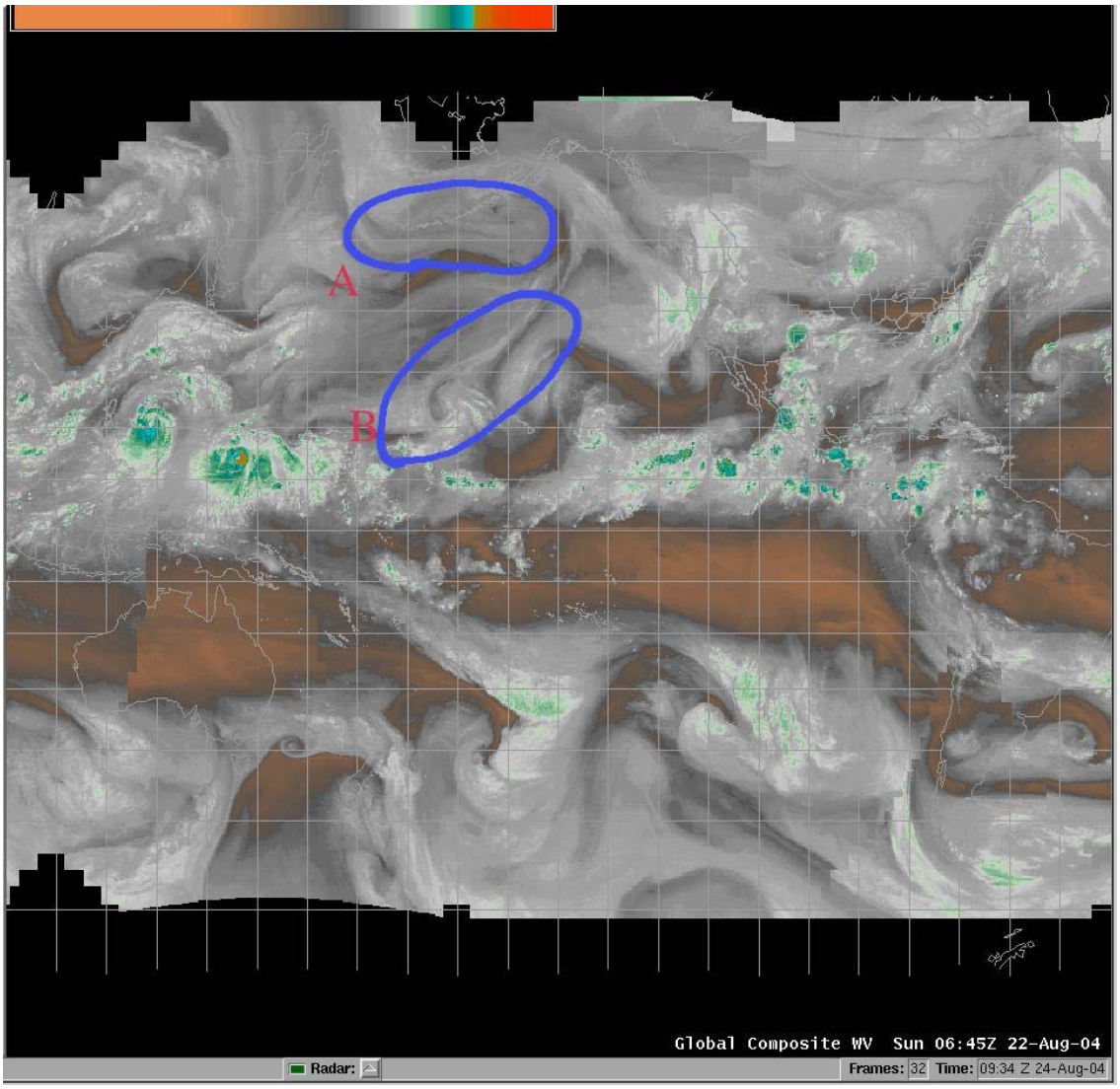

Figure 4. Water Vapor Composite Imagery from August 22, 2004 showing remnants of Tropical Cyclone Megi (A) and a subtropical moisture plume (B).

Conclusion

While the Portland Weather Service Office performed admirably in dealing with the short term forecast and warning operations associated with this event, medium range forecasts failed to recognize the magnitude of the rainfall. Days prior to the event, the days 3-5 QPF forecasts considerably underestimated eventual rainfall totals. While one would never forecast such climatologically unlikely amounts seen during these six days, a better idea of an excessive precipitation event could have been foreseen with better utilization of the products presented here.

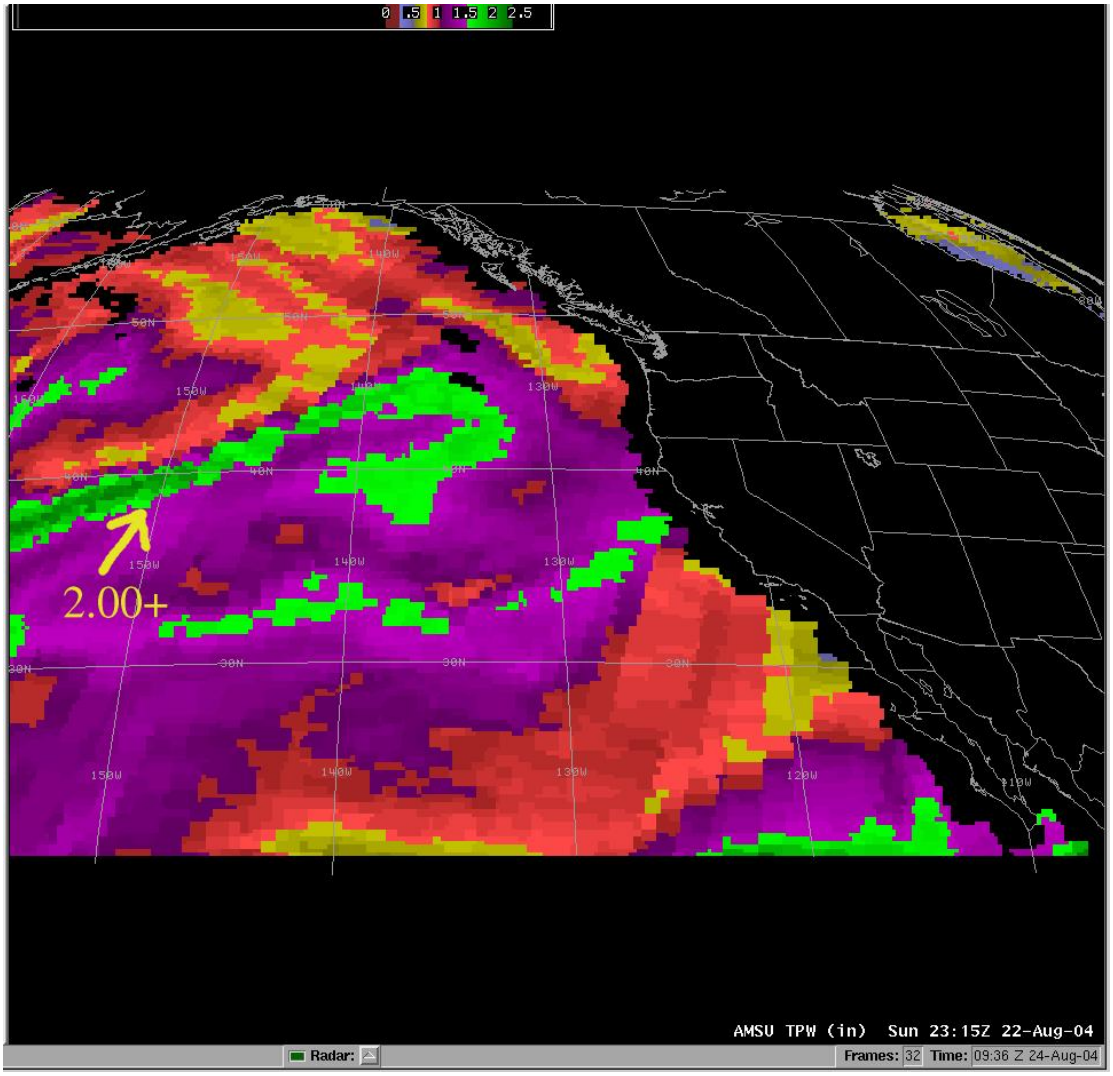

Figure 5. AMSU derived Total Precipitable Water (TPW) Imagery showing a subtropical moisture plume with over 2.00 inches of precipitable water, and remnants of Megi north of the plume in the Gulf of Alaska.

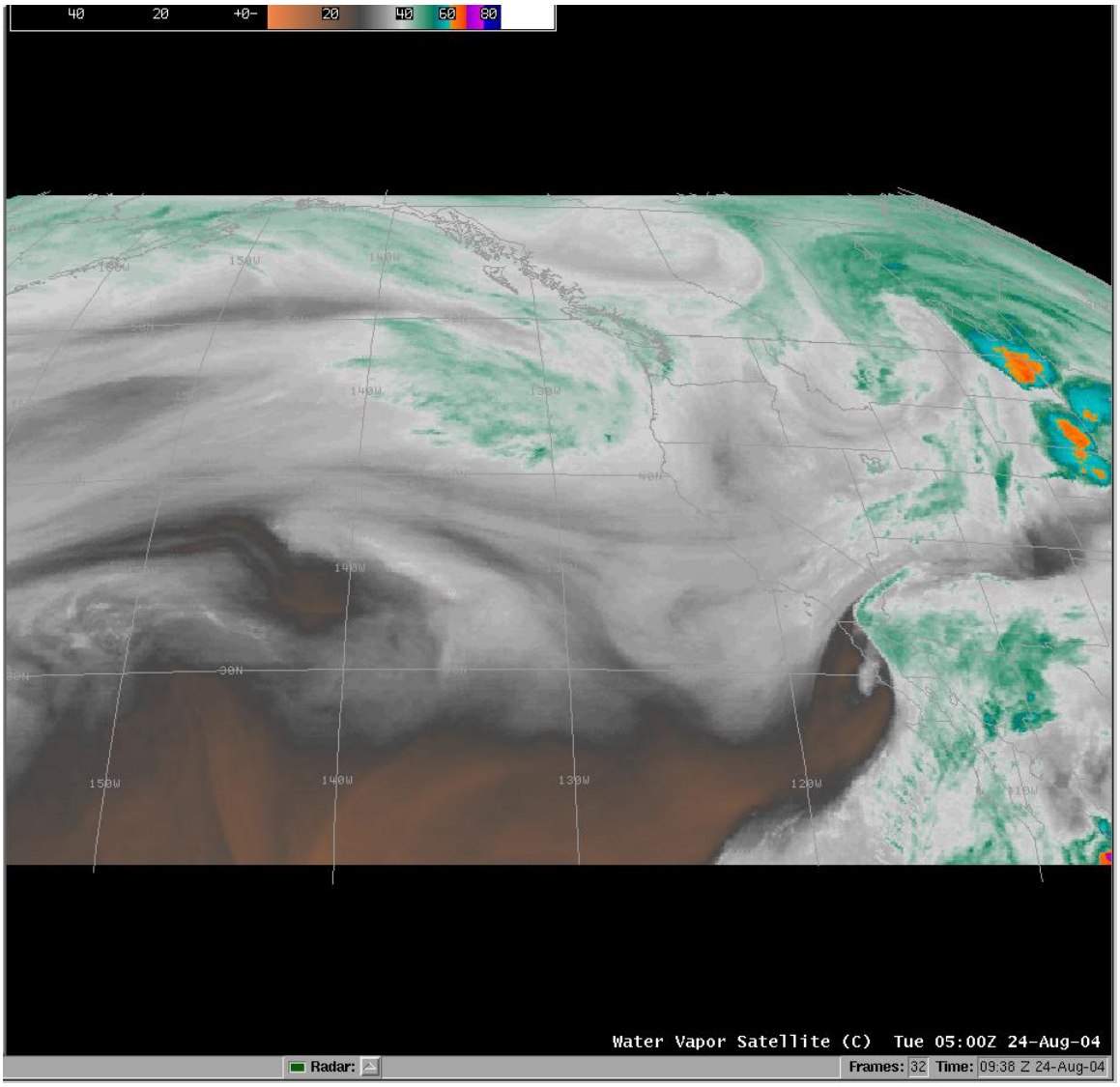

Figure 6. Water Vapor Composite Imagery from August 24, 2004 showing remnants of Tropical Cyclone Megi poised just off the Oregon coast.

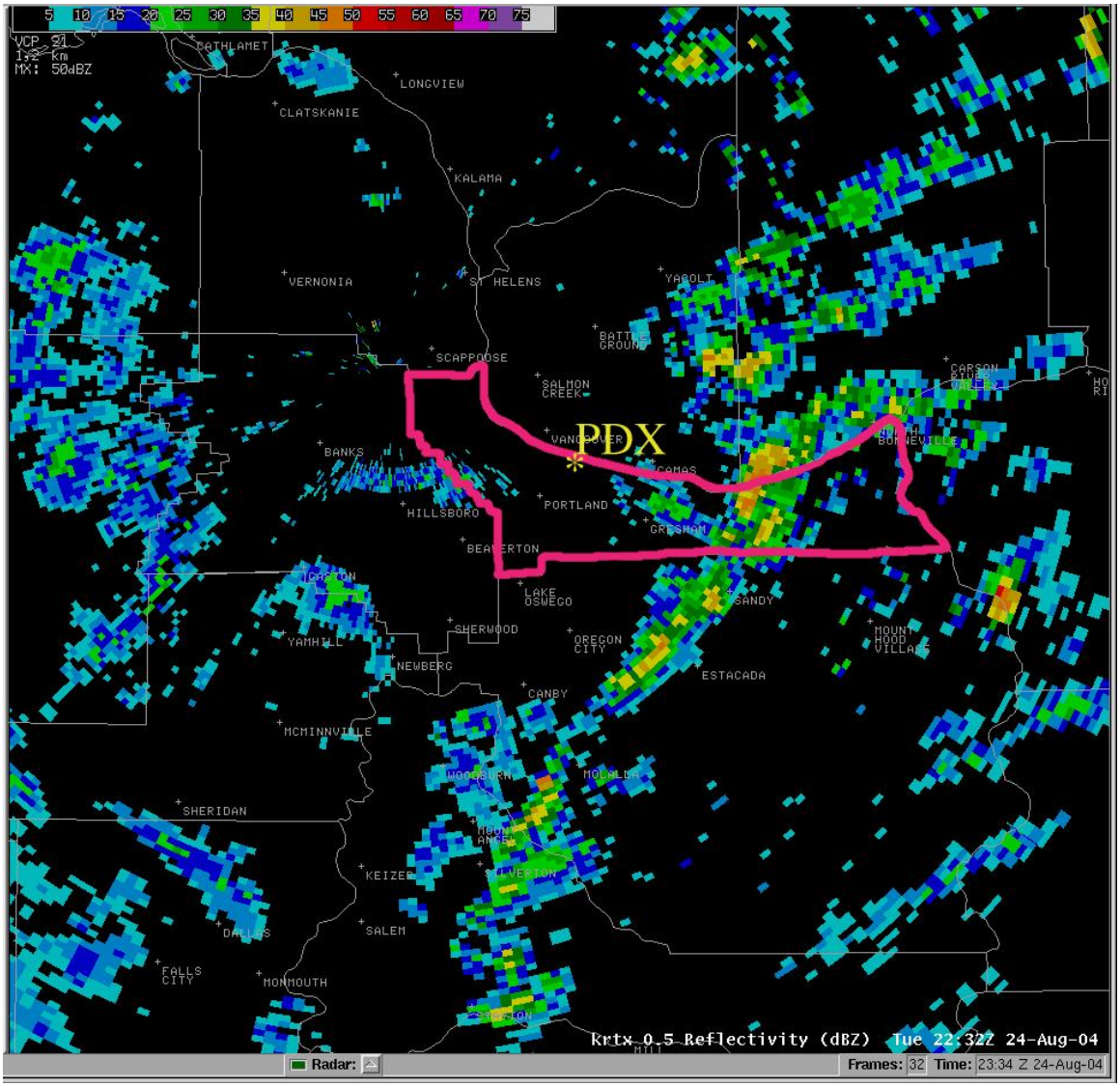

Figure 7. KRTX radar imagery of rainfall that created localized flash flooding in eastern Multnomah County.