Western Region Technical Attachment
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SPURIOUS PRECIPITATION IN THE EASTERN PACIFIC

Occasionally, the NGM QPF shows light amounts of precipitation (usually .01 inches) widely scattered near the West Coast when there is no supporting dynamics. While this is normally not a major concern for Western Region forecasters, there have been questions regarding why the model produces these apparently false precipitation amounts.

An inspection of a few of these cases, with the help of Jim Hoke, NMC Development Division, revealed that this abnormality is related to the NGM's physics and vertical structure, and the environmental conditions common in the eastern Pacific. These spurious QPFs usually occur when the mean temperature in the lowest model layer (about 35 mb thick) is warmer than the sea surface temperature (SST). The SST values used in the NGM are computed from the 15-day mean SST prior to the model run. SSTs near and along the West Coast are typically cool. Since the NGM allows sensible heat transfer between the ocean and the lowest layer, the ocean acts as a heat sink, cooling the lowest atmospheric layer to near saturation. The net result is that the model produces a low level fog or stratus layer.

Grid-scale precipitation in the NGM occurs when the relative humidity (RH) exceeds 95%. In the real world, an RH greater than 95% is common in a fog or stratus layer without the generation of precipitation. However, the model does not sustain cloud water after the RH exceeds 95%. The resulting precipitation falls to the model (ocean) surface.

The NGM has a well-mixed boundary layer whose depth is strongly dependent on atmospheric stability and especially, solar heating. Because of the cold SST, the lowest layer of the atmosphere was cooled and became saturated. Therefore, the lowest layers of the atmosphere became very stable and were not warmed by the sun because of the high RH.

The NGM run from 00Z 6 September 1988 produced light, apparently spurious, precipitation amounts along the West Coast throughout the 48-hour forecast period. Figure 1 shows the accumulative 6- and 12-hour QPF graphics through 48 hours. Note the numerous .01 inch precipitation amounts near and off the coast. During the forecast period, there was a low amplitude 500 mb ridge (not shown) near 130°W; the jet stream was well north, extending through British Columbia and dipping into northeast Montana. Generally weak flow with no significant dynamics dominated the eastern Pacific and West Coast states. Figures 2-4, provided by Jim Hoke, display model output at the 12-hour point in the NGM run (12Z 6 September) and are representative of the 48-hour period. The surface (or skin) temperature of the model run (Figure 2) shows a cool tongue extending southward along the West Coast. This represents the cool water from the upwelling near the coast. The mean sea level pressure (Figure 3) shows high pressure centered near 145°W, extending to the coast. The 700 mb vertical velocity (Figure 4) is generally negative in the areas where precipitation was recorded.

NGM initialization of low level moisture may also play a role in increasing the chances of spurious precipitation in these cases. Often, when satellite imagery shows a large area of fog or stratus in the eastern Pacific, this low level moisture is bogussed in before the model run. Although it is not certain that low level moisture was bogussed into the 00Z 6 September NGM run, the GOES visible image from 0016Z on that date (Figure 5) shows a widespread area of fog or stratus along the West Coast.

NMC is considering changes in the NGM to correct this model deficiency. One change would be to enhance the shallow mixing process at the top of the boundary layer. Another change would involve the development of a cloud water equation. With this change, when a model layer approaches saturation, moisture will be allowed to remain as cloud water, instead of precipitating out immediately in fog or stratus situations.

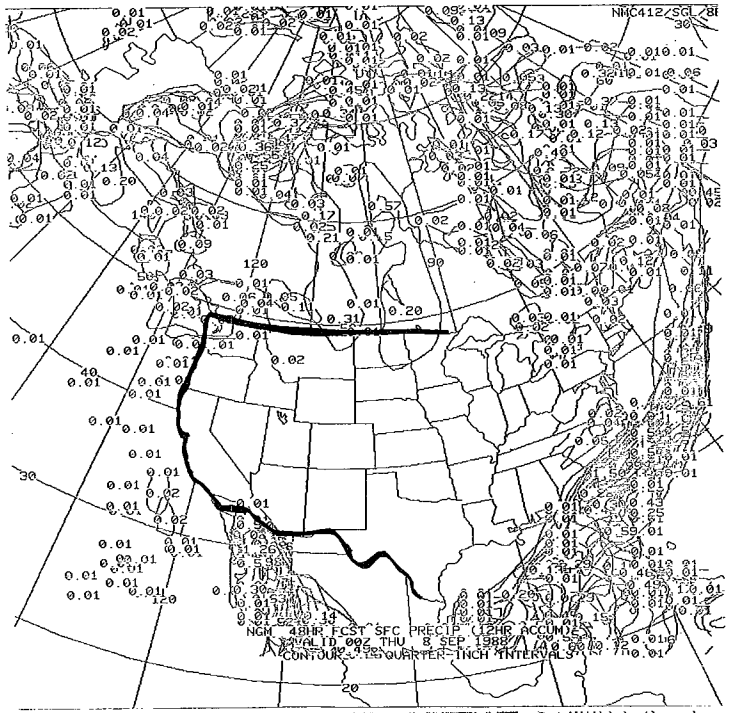


Figure 1

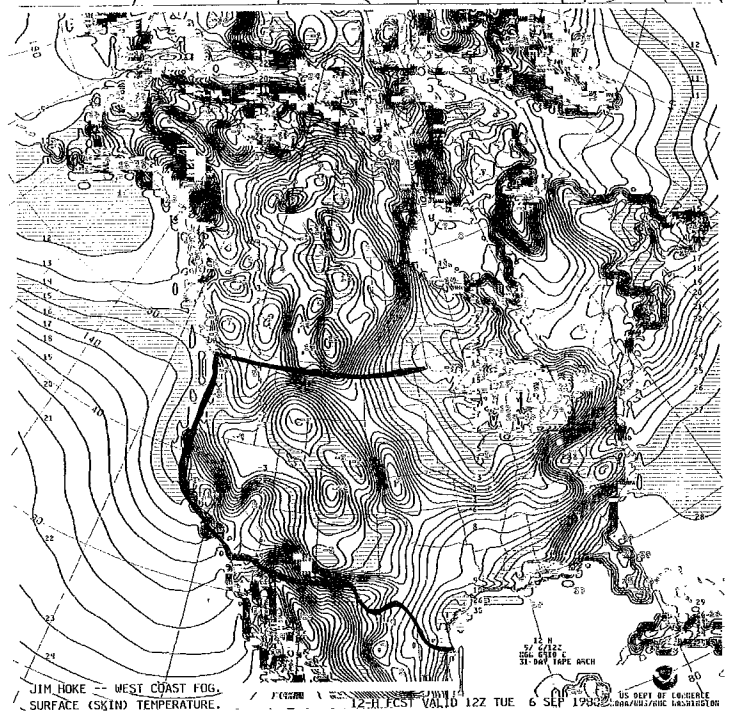


Figure 2

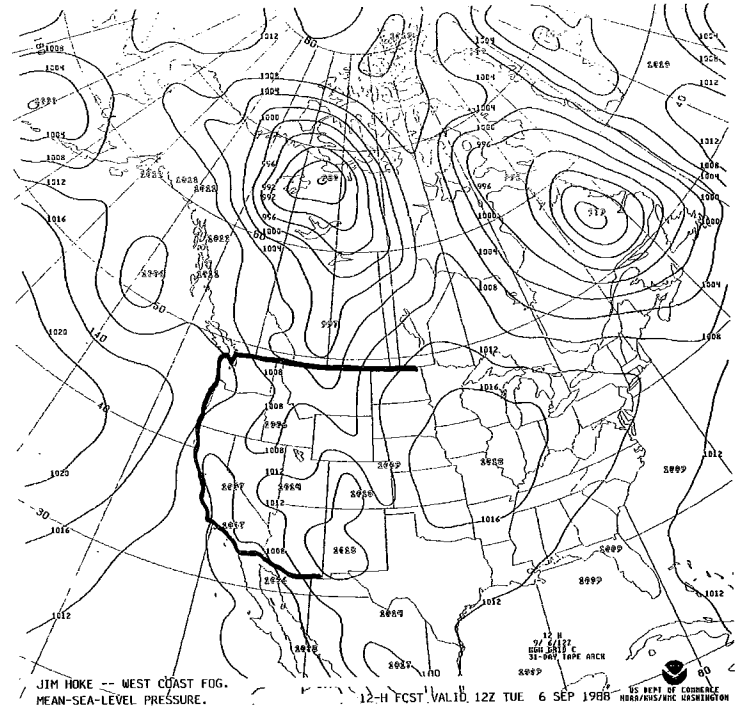


Figure 3

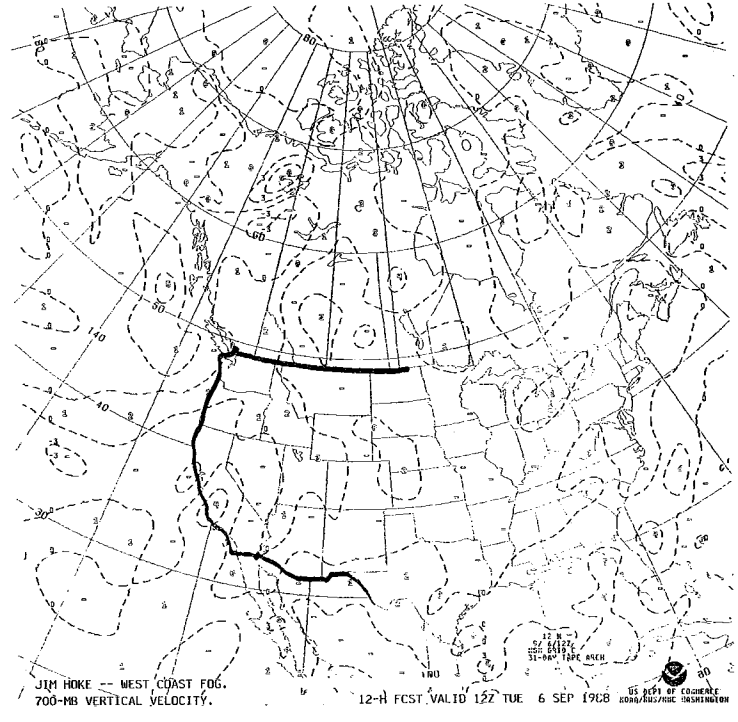
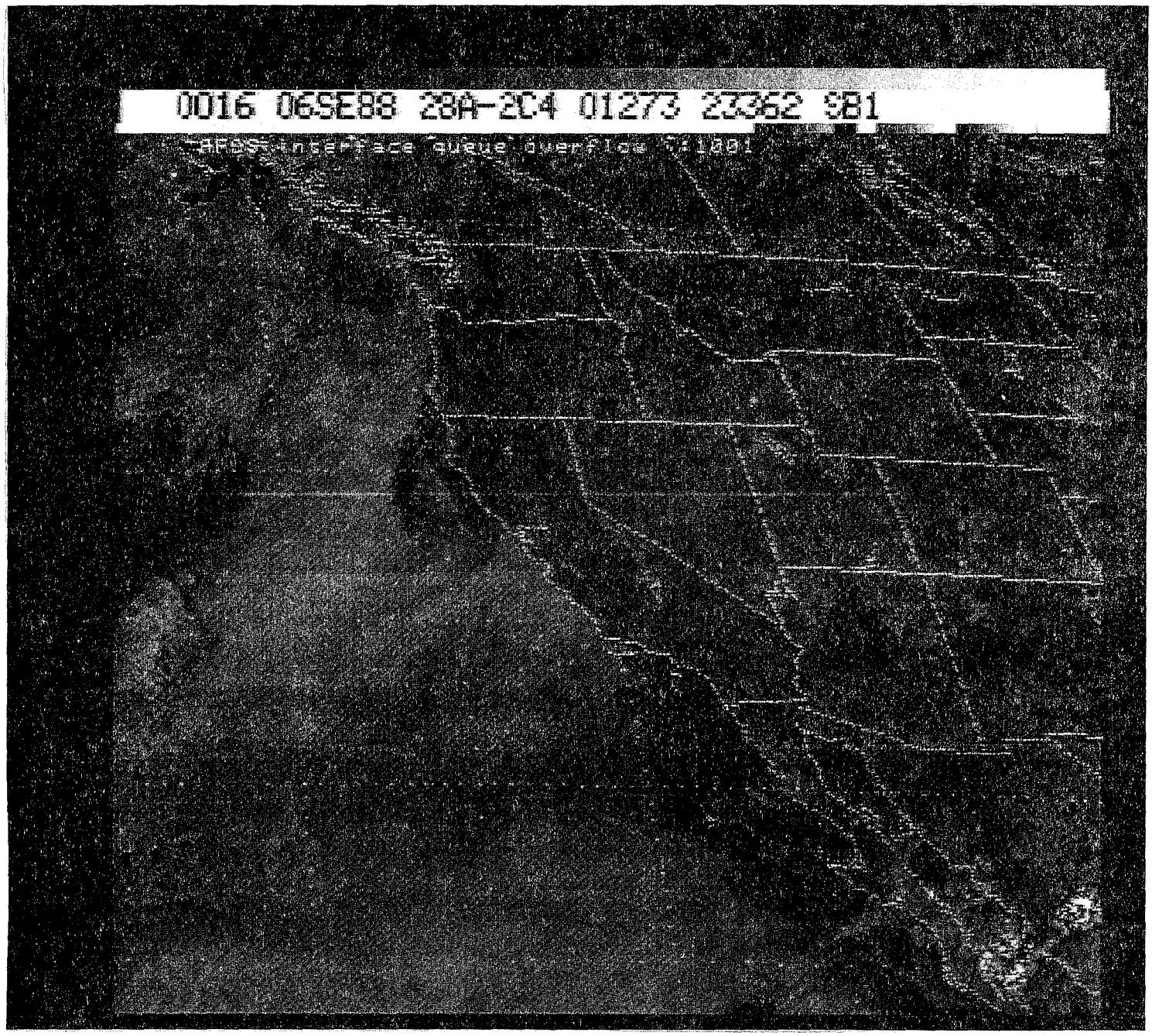


Figure 4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