Western Region Technical Attachment
No. 89-29
October 17, 1989

# HEAVY FOG PROBABILITIES AT THE SALT LAKE INTERNATIONAL AIRPORT

**Richard G. Watling - Satellite and Marine Section**
**Meteorological Operations Division - NMC**
**(Formerly at WSFO Salt Lake City)**

Analysis of weather variables over differing time or space scales can frequently reveal unexpected details of atmospheric behavior. Such is the case with heavy fog incidence at the Salt Lake International Airport (SLC).

Annual and monthly local climatological data show that heavy fog (defined as fog lowering the prevailing visibility to 1/4 mile or less) occurs almost exclusively during the months of December, January, and February. But what about variance within the fog season itself? Does the incidence of fog build gradually through December, peak in mid-January, than trail off in February, or does it occur uniformly throughout the season? A study of fog incidence on a daily basis suggests neither! Instead, a bimodal distribution is the actual pattern.

Thirty years of data from 1951 to 1980 were analyzed by tallying whether or not heavy fog occurred on each particular day of the fog season. To eliminate random daily fluctuations, a 7-day moving average of probabilities was computed for the season. A plot of these empirical fog probabilities versus time is shown in Figure 1.

The probability of heavy fog increases rapidly in mid-December, then drops off towards the end of the month. A second maximum occurs in late January and early February. This result was unexpected. The next question that comes to mind is why <u>this</u> distribution of probabilities?

A couple of possibilities exist. The first is that as the depth of the surface inversion increases (approximately from late December through mid-January), heavy fog becomes less likely because low-level moisture is trapped within a larger volume of air. The number of water droplets per unit volume of air decreases and visibility marginally increases. Also, the deeper inversion allows an above ground stratus layer to form rather than a surface-based obscuration.

Another contributing factor may be snowmelt. In mid-December, maximum daily air temperatures frequently rise above the 32°F mark; by late January and early February, temperatures again routinely exceed this value. Any snow that falls or that is already on the ground has a tendency to melt and evaporate, injecting moisture into the air. During the coldest part of the fog season, maximum temperatures frequently fail to reach 32°F, keeping snowmelt to a minimum. The lower moisture input causes fog probabilities to drop.

Whatever the mechanisms involved, there are tangible benefits in knowing that the fog season has peak periods. Of particular importance is that the strongest maximum occurs shortly before Christmas, when public air travel is very heavy. A second peak in air travel occurs just after the new year, but this peak corresponds to a minimum in the fog incidence distribution. Use of this information might allow commercial air carriers to adjust their schedules in and out of SLC, mitigating monetary losses associated with aircraft diversions and delayed departures. This information also could help FAA officials better anticipate when winter delays may occur.

Weather forecasters may make better forecasts by knowing that the "fog season" is really two seasons with a "stratus season" in between.

## Acknowledgements:

Special thanks go to Barbara Dietz, SLC WSFO, for collecting the climate data.

# EMPIRICAL FOG PROBABILITIES — Figure 1