EASTERN REGION TECHNICAL ATTACHMENT
No. 72-12-11 (A)
December 11, 1972

PRECIPITATION TYPE AS A FUNCTION OF OBSERVED THERMAL PARAMETERS AT GREENSBORO, NC

In an Eastern Region Technical Attachment (No. 72-3-13) to the Staff Notes of March 13, 1972, it was suggested that relationships between precipitation type and observed thermal parameters, such as thickness and upper air temperatures, should be used as an aid in preparing precipitation type forecasts for a period up to about six hours after the time of the observation of the thermal parameters. Because of thermal changes that take place in the atmosphere, precipitation type forecasts for any time beyond about 6 hours after a radiosonde observation should be based on the predicted thermal characteristics of the atmosphere rather than earlier observations. A case study will be presented showing how rapid the thermal structure of the atmosphere can change and how one can be mislead by not considering the possibility of these changes.

Techniques for forecasting precipitation type, using PE model predictions of thermal parameters out to 48 hours, have been described in Technical Memorandum NWS ER-45 and in Technical Procedures Bulletin No. 78. A relationship between observed thermal parameters and precipitation type at Caribou, ME, was presented in Eastern Region Technical Attachment No. 72-3-13.

The study presented here for Greensboro, NC, is based on data collected and evaluated by Johnnie M. Smith, a weather service specialist at WSO Greensboro. The thermal parameters, 1000-500 mb. thickness and mean boundary layer (lowest 50 mb.) potential temperature, observed at Greensboro, NC, are related to precipitation type observed within plus or minus three hours of the time of observation of the thermal parameters, (figure 1). This relationship is then used as an aid in forecasting precipitation type at Greensboro for cases in which the precipitation starts within a three-hour period beginning 3 hours after the time of radiosonde observation (figure 2). Figure 2 contains independent data that were not used in preparing figure 1, and is of particular interest for operational purposes. It depicts events that began soon after the time of availability of radiosonde observations.

The results presented in figures 1 and 2 are for the combined winter periods of February 1, 1971 to March 31, 1971, and November 1, 1971 to March 31, 1972. Examining figure 1, we find that when the mean boundary layer potential temperature is greater than 278°A, the precipitation type at Greensboro is predominantly rain. When the mean boundary layer potential temperature is 278°A or less, precipitation type depends on the 1000-500 mb. thickness, with freezing rain predominant above 5450 meters and snow predominant below that value. Applying these results to the independent data (figure 2), we find an excellent separation between rain and non-rain cases, but a poor separation between snow and freezing rain cases. The two freezing rain cases that occurred were with 1000-500 mb. thickness values slightly lower (colder) than the 5450 meter threshold value established from data in figure 1. A forecast "bust" of this type can occur due to changes in the thermal parameters occurring at or shortly after the time of observation. A case study will now illustrate this.

A radiosonde run taken at 0000Z March 4, 1971 showed the 1000-500 mb. thickness to be 5530 meters and the mean boundary layer potential temperature to be 282°A. Light rain began at 0005Z and continued until 0235Z when the rain changed to snow. The snow continued until 0620Z. This case appears in figure 1 as a mixed rain/snow case well within the area in which rain would be expected. The radiosonde run taken at 1200Z March 4 revealed the great cooling that was taking place. Between 0000Z and 1200Z the 1000-500 mb. thickness dropped 310 meters to 5220 meters and the mean boundary layer potential temperature dropped 12° to 270°A. Since precipitation had begun prior to 0300Z, this case was not included in figure 2. The 0000Z thermal observations would have led to an erroneos rain forecast for the period 0300Z to 0600Z, if no consideration was given to the changes taking place. It is interesting to note that the FOUS 2 message for Raleigh, NC (some 60 miles east of Greensboro), based on 1200Z March 3 initial data, did show that the PE model predicted the sharp temperature drop. The predicted 12-hour change from 0000Z to 1200Z March 4 was 12°C in the mean boundary layer potential temperature (exactly as observed at Greensboro) and 180 meters in the 1000-500 mb. thickness.

In conclusion, a relationship has been shown between observed thermal parameters and precipitation type at Greensboro, NC. This relationship is useful as an aid in preparing short range ($\leq$ 6 hours) precipitation type forecasts, after considering changes that may be taking place in the thermal structure of the atmosphere. Relationships developed with predicted values of parameters rather than observed values should be used for forecasts that extend beyond 6 hours from the time of observation.

SCIENTIFIC SERVICES DIVISION
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Attachments:
FIGURES 1 and 2

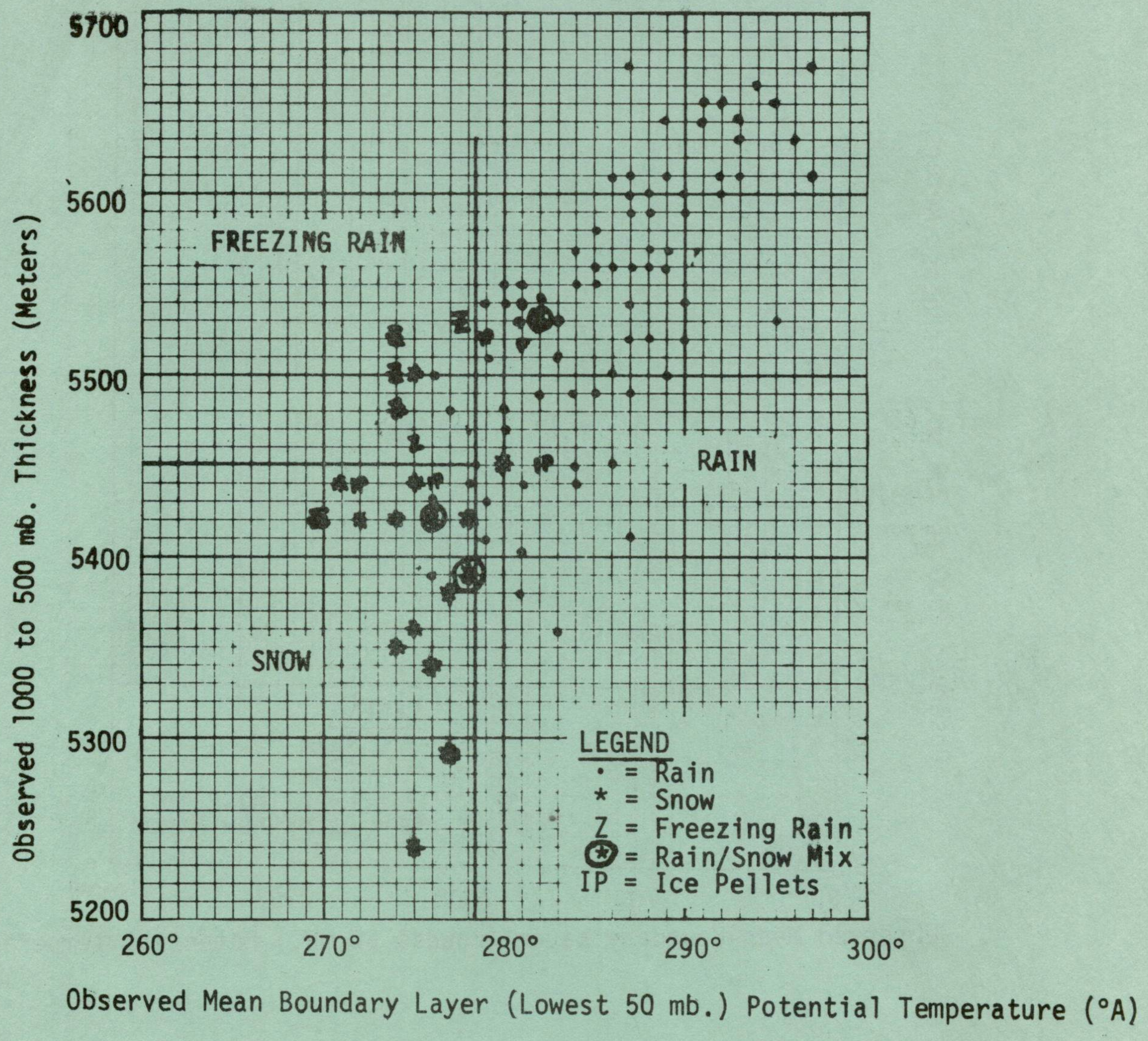

FIGURE 1. *Precipitation type observed within ± 3 hours of a radiosonde observation as a function of the observed 1000-500 mb. thickness and mean boundary layer (lowest 50 mb.) potential temperature. Data are for Greensboro, NC, February 1, 1971 to March 31, 1971, and November 1, 1971 to March 31, 1972.*

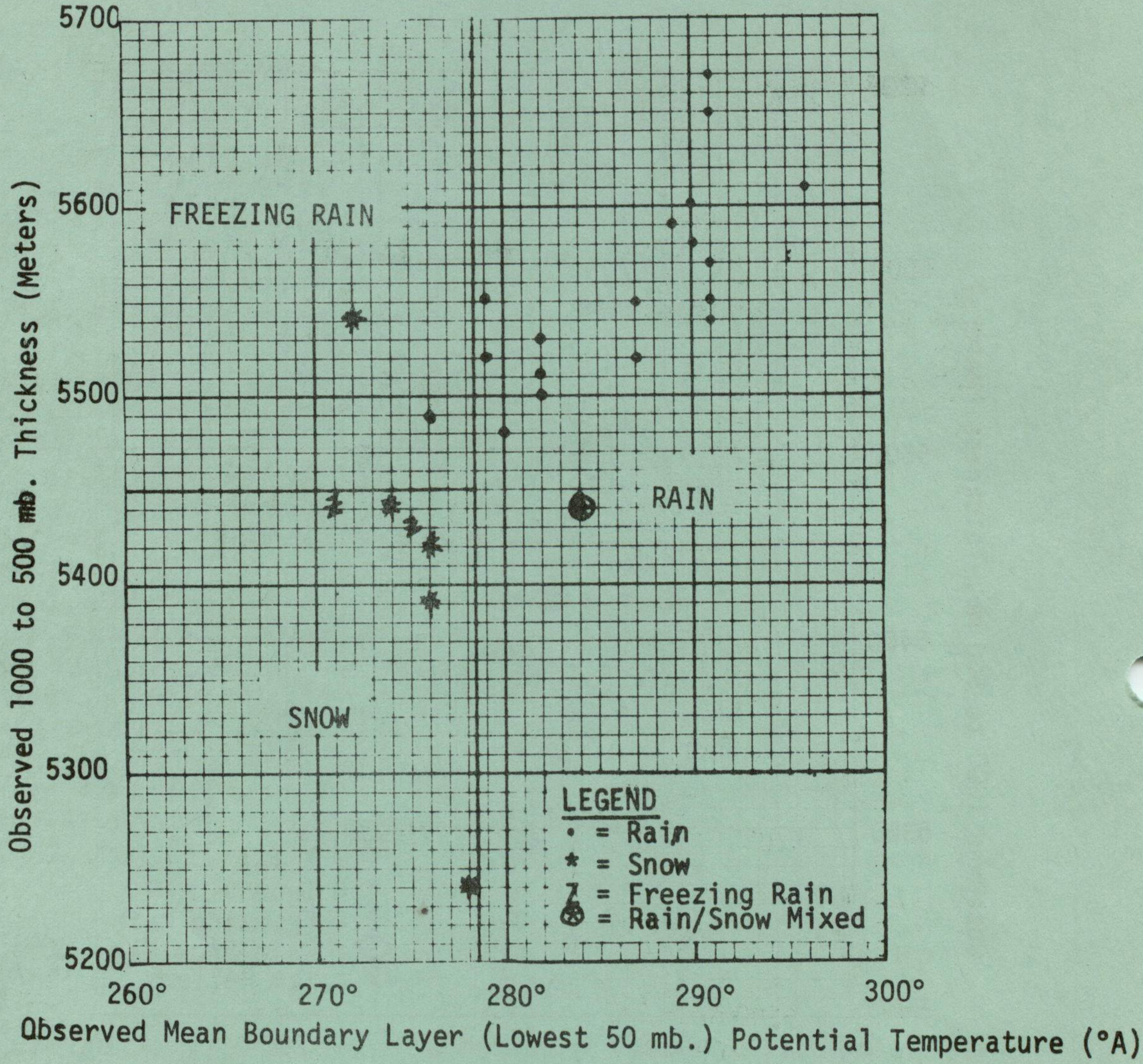

FIGURE 2. *Precipitation type for precipitation that began 3-6 hours after a radiosonde observation as a function of the earlier observed 1000-500 mb. thickness and mean boundary layer (lowest 50 mb.) potential temperature. Data are for February 1, 1971 to March 31, 1971, and November 1, 1971 to March 31, 1972.*