# PICTURES OF THE MONTH

## Early Morning River Valley Fog

JOHN A. ERNST

*Satellite Field Services Station, National Environmental Satellite Service, NOAA, Washington, D.C. 20233*

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The diagnosis and interpretation of real-time high resolution meteorological satellite imagery over data-sparse areas is one method of determining the current status and trend of certain mesoscale phenomena. Providing 1 km (½ n mi) resolution visible spectrum imagery every 30 minutes, the Synchronous Meteoro-

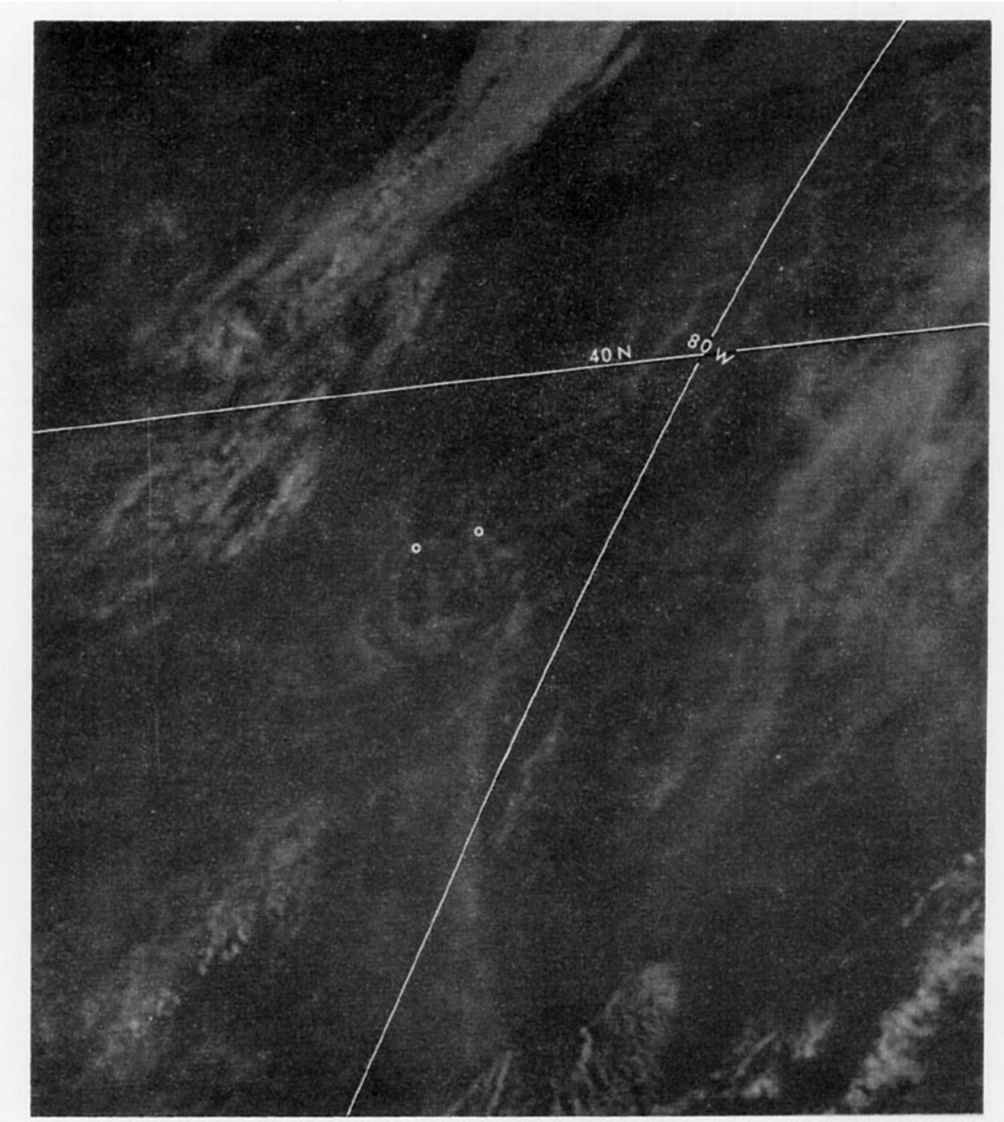


FIG. 1. SMS-1 A5 sector visible spectrum imagery, 1 km resolution, 1100 GMT 13 July 1974, subpoint 45°W. White circles represent Charleston (right) and Huntington, W. Va.

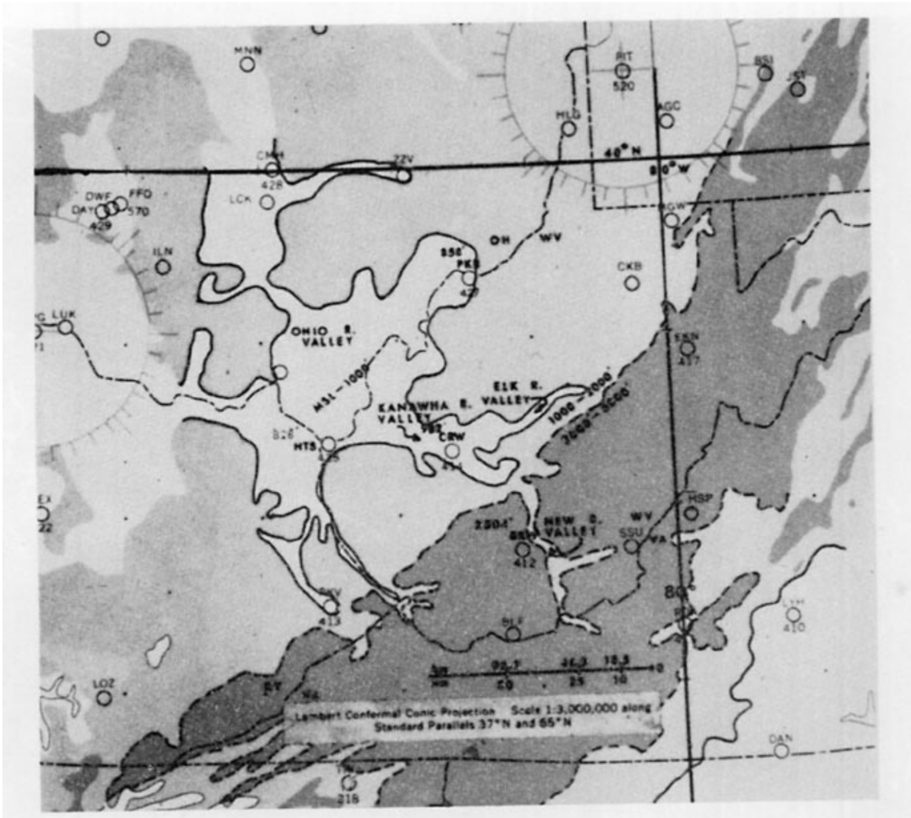


Fig. 2. General topography of area.

logical Satellite, SMS-1, can fill the gaps between conventional surface data points with respect to small scale weather events. One such application of SMS-1 imagery is the delineation of river valley fog.

Under a high pressure regime of relatively cloud-free nighttime skies and light surface winds, radiative cooling is usually the causative mechanism for river valley fog formation. Signaled by a decreasing (increasing) temperature-dew-point depression, the initial formation (eventual dissipation) is greatly influenced by topography (George, 1960). One must also take into account evapotranspiration sources, as well as the presence (or absence) of atmospheric pollutants that can increase the number of condensation nuclei.

From a study of NOAA-2 satellite infrared (IR) data, Gurka (1974) found that the heights of the tops of most fog areas are uniform. He concluded that brightness variations seen in visible imagery could be associated with either topographic features or fog droplet concentration, both of which affect fog dissipation rates. Assuming that within small areas the droplet concentration is fairly consistent, it appears that a detailed knowledge of the local area topography discernible in satellite imagery would be extremely helpful in predicting the location and time of fog dissipation.

In most cases, river valley fog has occurred prior to the receipt of usable visible imagery. However, the shape and areal extent of the fog relative to reporting stations may be initially determined from the examination of an 1100 GMT "first light" photograph (time seasonally dependent) as shown in Fig. 1. This 1 km resolution visible image, taken approximately 45 minutes after local sunrise, outlines the dendritic appearance of numerous river valleys and their tributaries. Concurrent with Fig. 1, National Weather Service (NWS) stations at Charleston (CRW) and Huntington (HTS), W. Va., marked by the station circles, reported visibilities of 100 m and zero, respectively.

Neglecting scale and projection differences, a comparison of Fig. 1 with Fig. 2, a general topographic map of the area, shows good correlation between the imaged configuration of the fog and the topography of the area. The height in feet above mean sea level (MSL) has been marked above and to the left of several NWS stations. At 300 m (982 ft) MSL, CRW is situated within the confluence of the Kanawha and Elk river valleys. On the eastern bank of the Ohio River, the elevation of HTS is 252 m (828 ft) MSL, or 48 m lower than CRW.

Used in conjunction with topographic information

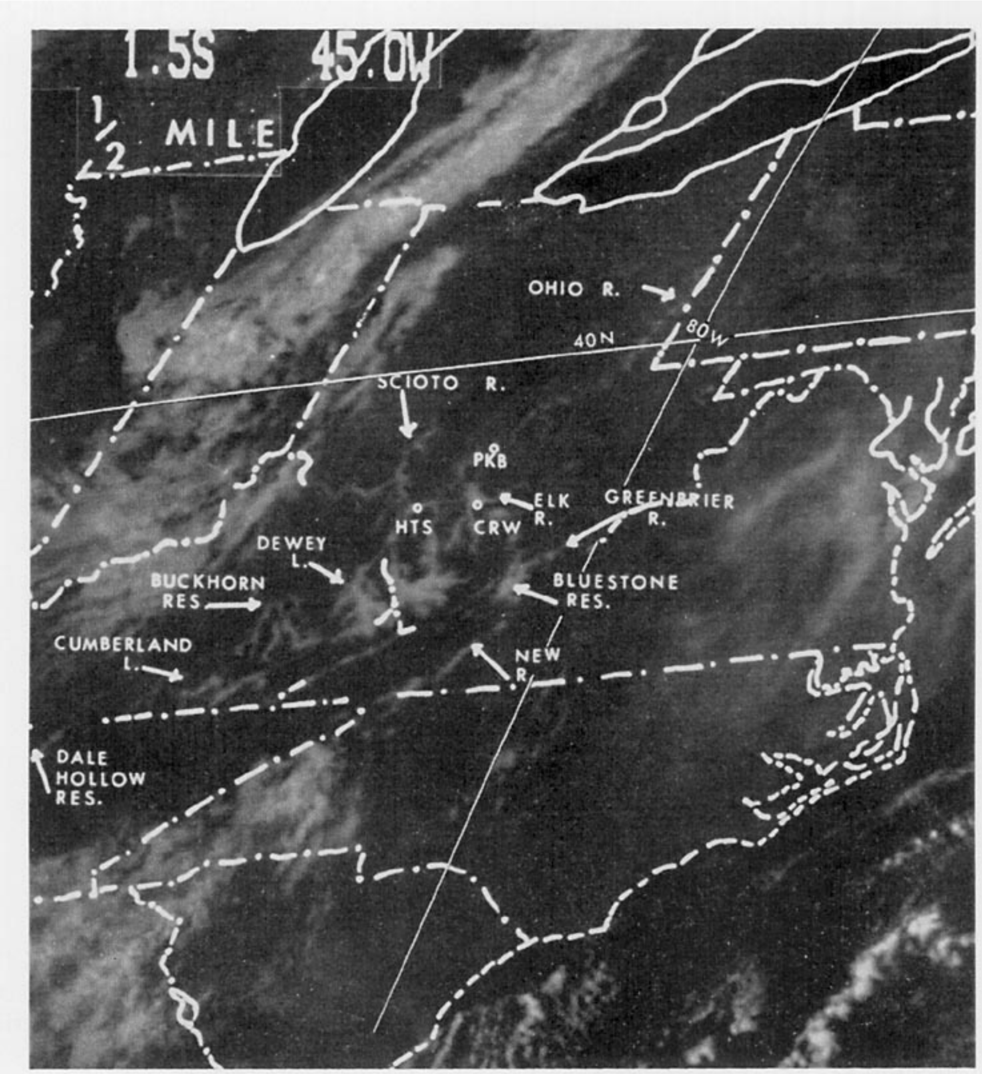


FIG. 3. Same as Fig. 1, 1230 GMT 13 July 1974.

such as between-station slope direction, half-hourly 1 km resolution visible spectrum satellite imagery can be used to pin-point those between-station areas where the fog is expected to dissipate earliest. By visual inspection, fog areas as seen in the satellite image are correlated to available hourly station reports. Between-station fog brightness is then referenced to the topographic map, where changes in fog brightness are related to differences in elevation and slope direction. With increasing solar zenith angle (greater illumination), successive photographs are then related to the topographic map for detectable changes in the fog pattern (Figs. 3 and 4).

At 1230 GMT (Fig. 3), a narrow ribbon of fog along a portion of the Mud River valley joins CRW and HTS. The eastern one-half of the fog ribbon, within which the towns of S. Charleston, St. Albans, and Dunbar are located, appears less bright than the western half. Since the solar zenith angle does not vary significantly over 83 km, visually detectable brightness variations in the visible imagery, within the constraints mentioned previously, may be attributed to variations in the fog's depth relative to the elevation of the land below. Thick (thin) fog is associated with bright (less bright) areas. At 1300 GMT, CRW reported a 400 m increase in visibility, while HTS reported only a 200 m increase since the 1100 GMT observation. These first indications of a dissipation trend are noticeable in the 1330 GMT photograph (Fig. 4). The narrow ribbon of fog has almost completely disappeared, while the fog's configuration at the reporting stations (station circles on figure) has changed appreciably. The 1400 GMT station observations of 6400 m visibility at CRW and 3200 m at HTS reflect the continuing fog dissipation.

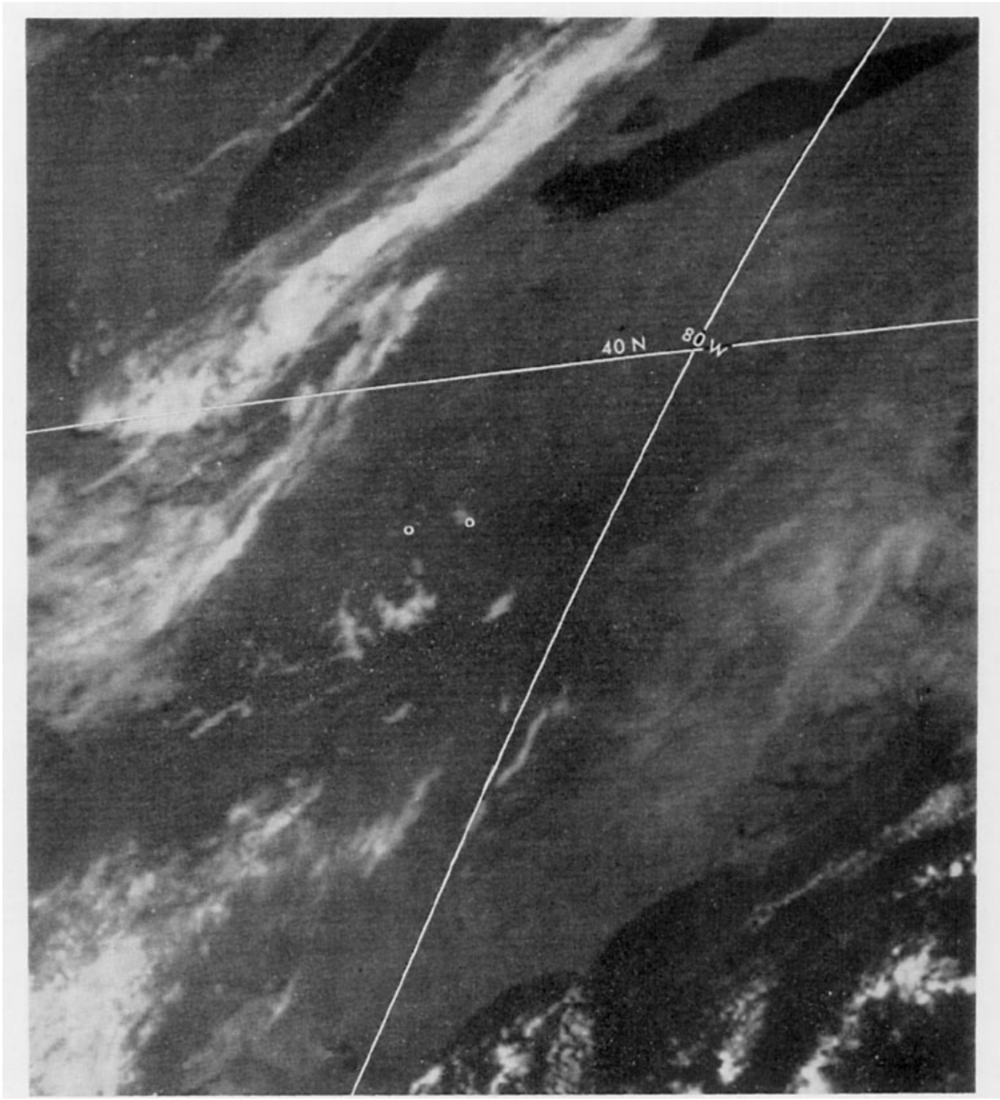


FIG. 4. Same as Fig. 1, 1330 GMT 13 July 1974.

The methodology employed is admittedly subjective. However, such an empirical determination of fog brightness correspondence to elevation differences can permit the analyst to formulate a reasonable "first approximation" for those otherwise between-station data sparse areas.

REFERENCES

George, J. J., 1960: *Weather forecasting for aeronautics*. New York, Academic Press, (See pp. 306–307).

Gurka, J. J., 1974: Using satellite data for forecasting fog and stratus dissipation. *Preprints, Fifth Conference on Weather Forecasting and Analysis*, March 4–7, 1974, St. Louis, Mo. Boston, American Meteorological Society.