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TRANSVERSE BANDS INDICATE TURBULENCE ON SATELLITE IMAGERY

Ken Labas, WSFO Salt Lake City

One of the great advantages of satellite imagery is that we are able to infer various ongoing atmospheric processes by the cloud signatures they create. We often use these tell-tale signs to determine precipitation characteristics, storm structure, and other dynamically significant features. High level turbulence (20,000 feet or higher) can be a major forecast problem to aircraft but is often an elusive feature to accurately forecast. There are certain cloud patterns, however, which indicate the likely occurrence of this event. Those observed over the western United States during the afternoon of 31 January 1986 are prime examples.

Photo 1 illustrates the synoptic situation at 14Z. A strong fetch of moist air in the upper troposphere (E) is crossing the mid-Pacific coast. The cloud plume tends to curve anticyclonically as it nears the coast and is characterized by widespread banding (noted at A) along the southern periphery of the shield. Transverse cloud bands are visible, in this enhanced imagery, near the southern extremity of the cloud plume (A). During the next 8 hours, these high level bands become much more apparent as the anticyclone along the West Coast bulges northward. By 2231Z, the phenomenon is dramatic, stretching from San Francisco to Phoenix (Photo 2)

Transverse cloud bands are irregularly spaced cirrus cloud lines that form nearly perpendicular (transverse) to the upper winds. These bands occur most often in the strongest portions of the jet stream ($\geq$80kts) and just to the right of the jet stream core. Although it is not clear what mechanism triggers such banding, it is believed that these bands are related to horizontal divergence away from the jet stream core and to strong vertical wind shear. The Winslow, Arizona sounding for January 22 ØØZ (Figure 1) illustrates strong vertical wind shear 30,000-37,000 feet. The horizontal wind speed shear associated with the jet stream distorts the bands, causing them to slope or lag farther behind as the bands spread to the right of the jet stream core.

The significance of this cloud formation is that transverse bands routinely manifest themselves in areas of moderate or greater turbulence. Compare Photo 2 with Figure 2, the 250-mb flow at 22/ØØZ. Reported moderate or greater turbulence above 25,000 feet between 22/1430Z and 22/0300Z is denoted by triangles.

The relationship between the jet, the transverse clouds, and reported turbulence is apparent. Turbulence reports were received from areas along the jet in southeast Idaho and western Utah as well as in the area of transverse banding. Note how the transverse bands have formed to the right of the jet stream core. This is consistent with cases documented in several publications [1, 2, 3] which indicate a relationship between transverse cirrus clouds and significant turbulence.

Transverse bands ~~have been observed~~ over ocean and land, and in association with the polar and subtropical jet streams, although more often with the subtropical jet. The existence of these bands should alert aviation meteorologists of the high probability of moderate or greater turbulence within the banded area.

References:

[1] Anderson, R.K. et al: "Application of Meteorological Satellite Data in Analysis and Forecasting", ESSA TR NESC S1, March 1984.

[2] Hammond, G. R.: "Metsat Imagery Interpretation Guide", USAF 1WW TN-84-001, August 1984.

[3] Weber, E.M., et al: "Satellite Interpretation", USAF 3WWTN 81-001, December 1981.

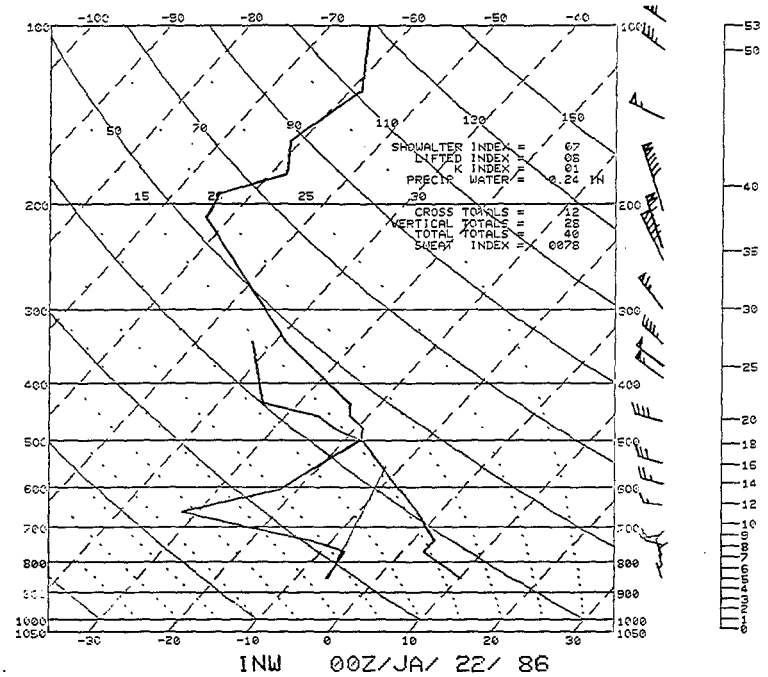

FIGURE 1.

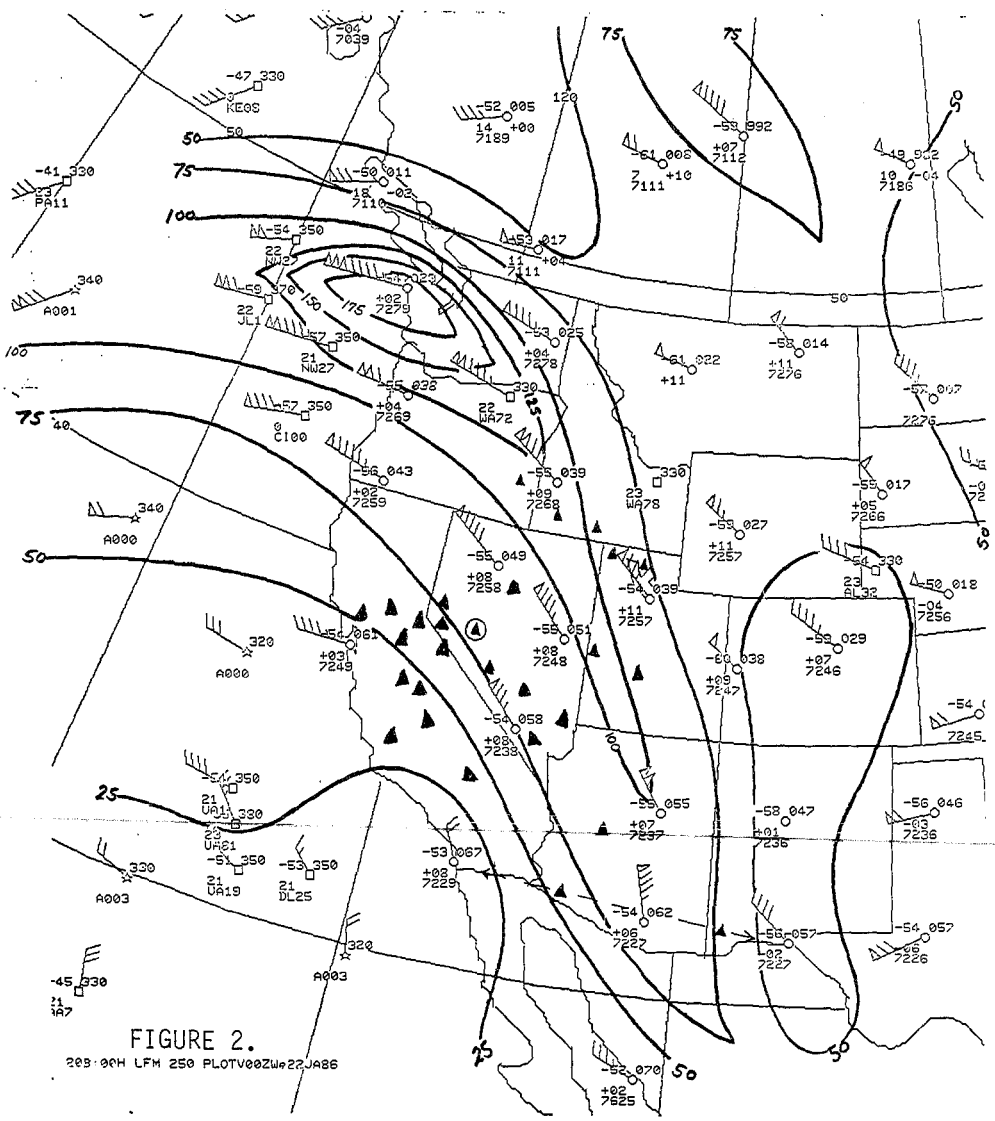

FIGURE 2.

203:00H LFM 250 PLOTV00ZW22JA86

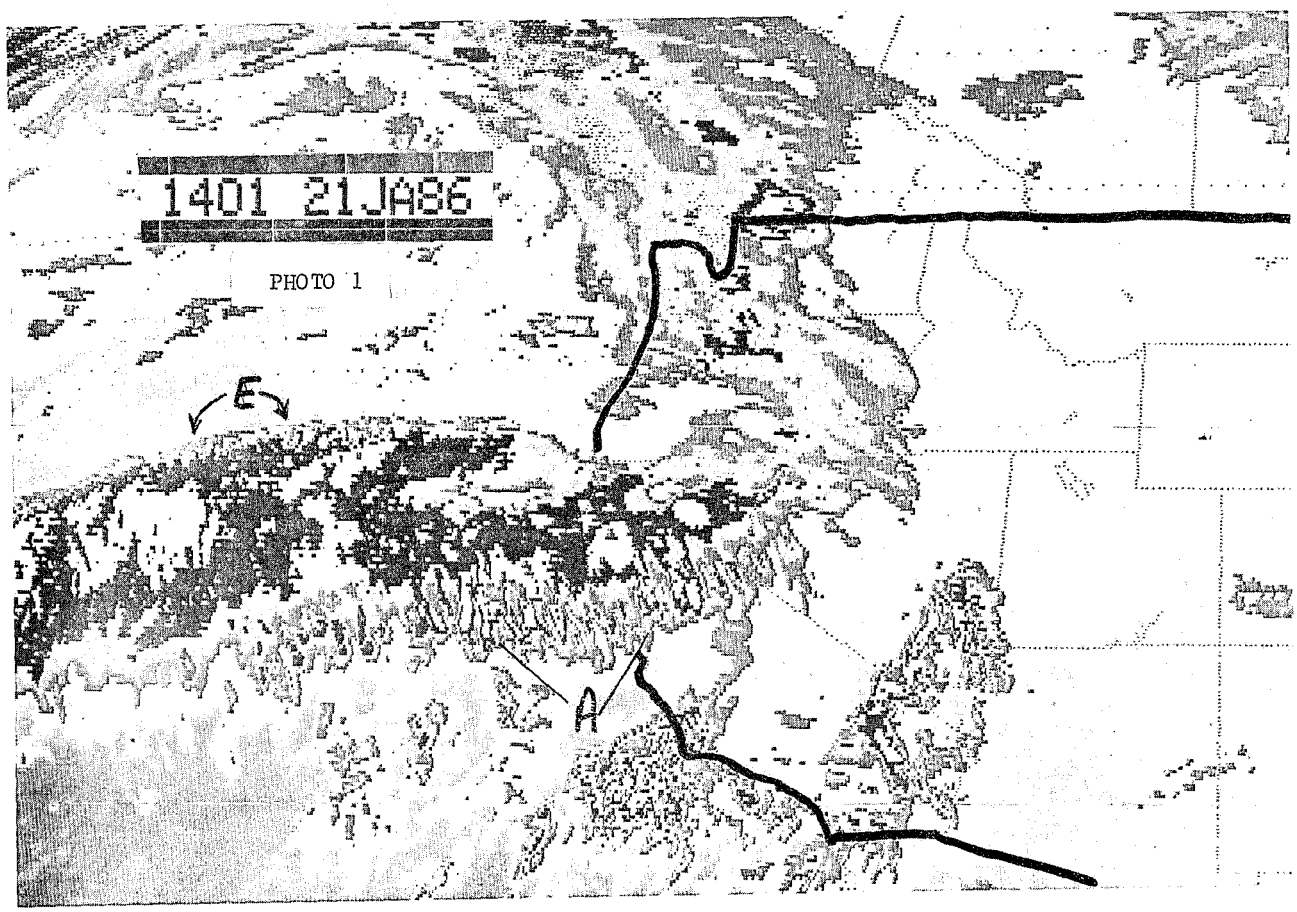

PHOTO 1

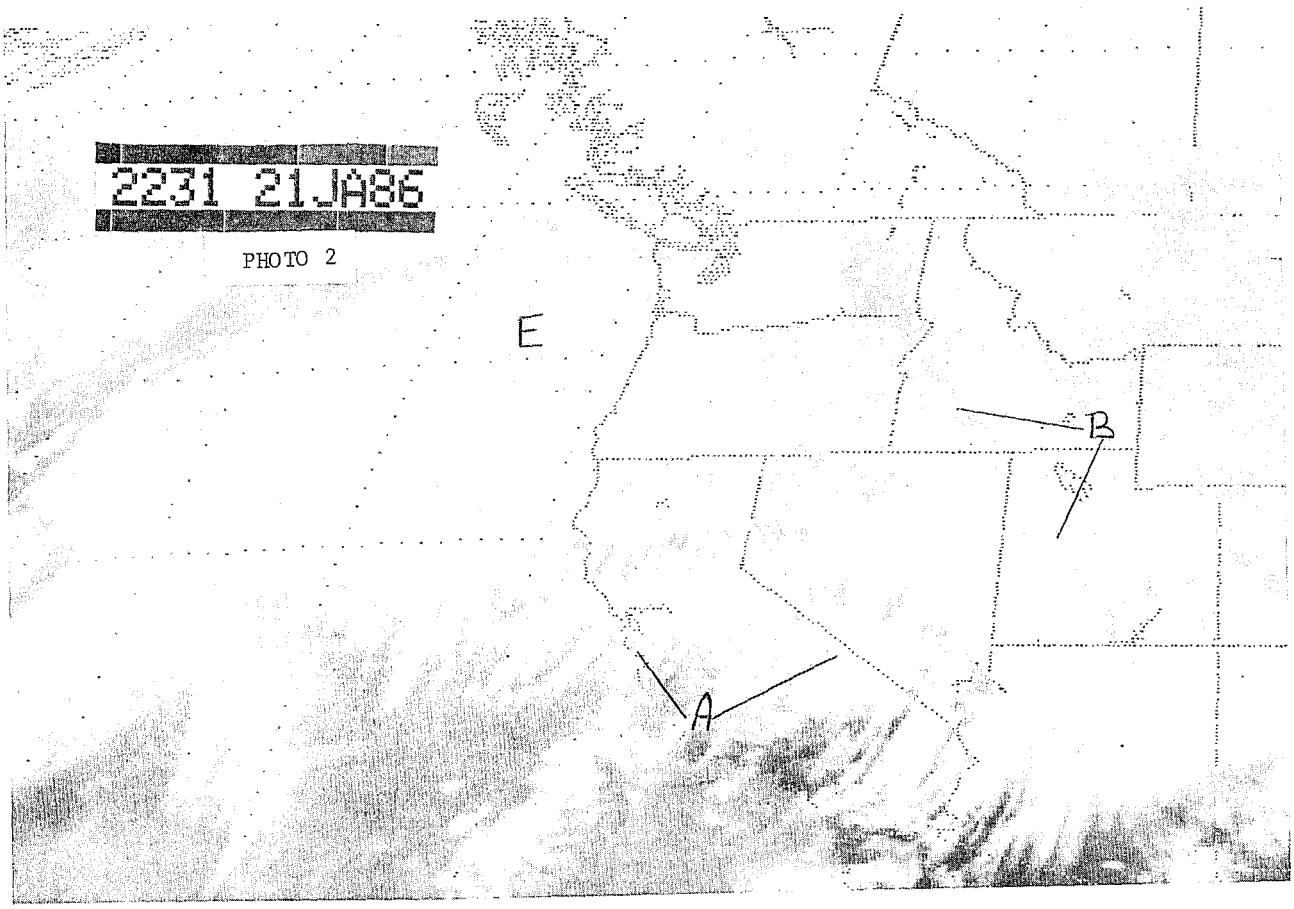

PHOTO 2