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Update on Cloud-Tracked Winds by Japanese Satellite

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Cloud-tracked winds measured by Japanese satellites have been shown to be persistently slower than winds measured by colocated aircraft or radiosondes in the winter hemisphere, particularly in regions where winds are strong (Vlcek, 1981, Statistical Surveys of Wind Sensor Colocations, NMC O.N. 238). Various causes of this phenonenon have been suggested, but the most likely cause appears to be a bias in the satellite measured altitude of the cloud tops. A spurious altitude that was consistently in a region of stronger winds than at the true altitude would readily explain the behavior of the cloud-tracked wind bias.

Figure 1 shows a history of the statistics associated with Japanese satellite winds vs. radiosonde winds in the upper troposphere (above 500 mb) from January 1979 through November 1982. Colocated pairs of sensors were within 3 latitude degrees (180 nm) and 1 hour of reporting time of each other. The radiosonde winds were linearly interpolated, with respect to height, to the cloud top altitude reported by the satellite. It is quite obvious that an abrupt change in the pattern took place during November and December 1981. A similar change took place in the aircraft vs. Japanese satellite statistics (not shown).

This paper describes the investigation into the possible causes for this change. The explanation that is best supported by the data appears to be a successful correction to the spurious cloud-top altitudes.

The other possible causes of the reduction of the mean speed difference between Japanese satellite and other sensors are: 1) a correction of the Japanese wind speed (rather than of cloud-top altitude), 2) a change in the weather pattern, 3) a change in the distribution of the Japanese satellite reports, or 4) a selective tossing out of satellite data in regions of strong winds.

Table 1 shows the history of the average Japanese satellite and radiosonde wind speed during the winter months; these speeds are markedly lower during the winter of 1981-82 than in previous winters. If the cloud-tracked wind speeds had been adjusted, the resulting speeds should have been higher. Perhaps the jet stream over mainland China (where most of the colocations occur) was significantly weaker than in previous winters. A discussion with long-range forecaster Jim Wagner (personal communication) and a glance at the charts revealed that no significant changes had occurred; the winds were actually somewhat faster than normal in December 1981 as well as December 1980.

The change in mean speed differences could easily have been caused by a change in the spatial distribution of colocations. An analysis of this distribution in previous years (not shown) had revealed that up to two-thirds of the colocations during the northern hemisphere winter occurred over mainland China. However, an analysis for the winter of 1981-82 showed that some redistribution did occur (more colocations in the tropics) but was not significantly large. Another facet of this analysis showed that mean speed differences that occurred over mainland China in previous winters were virtually eliminated in 1981-82. Obviously redistribution was not the answer.

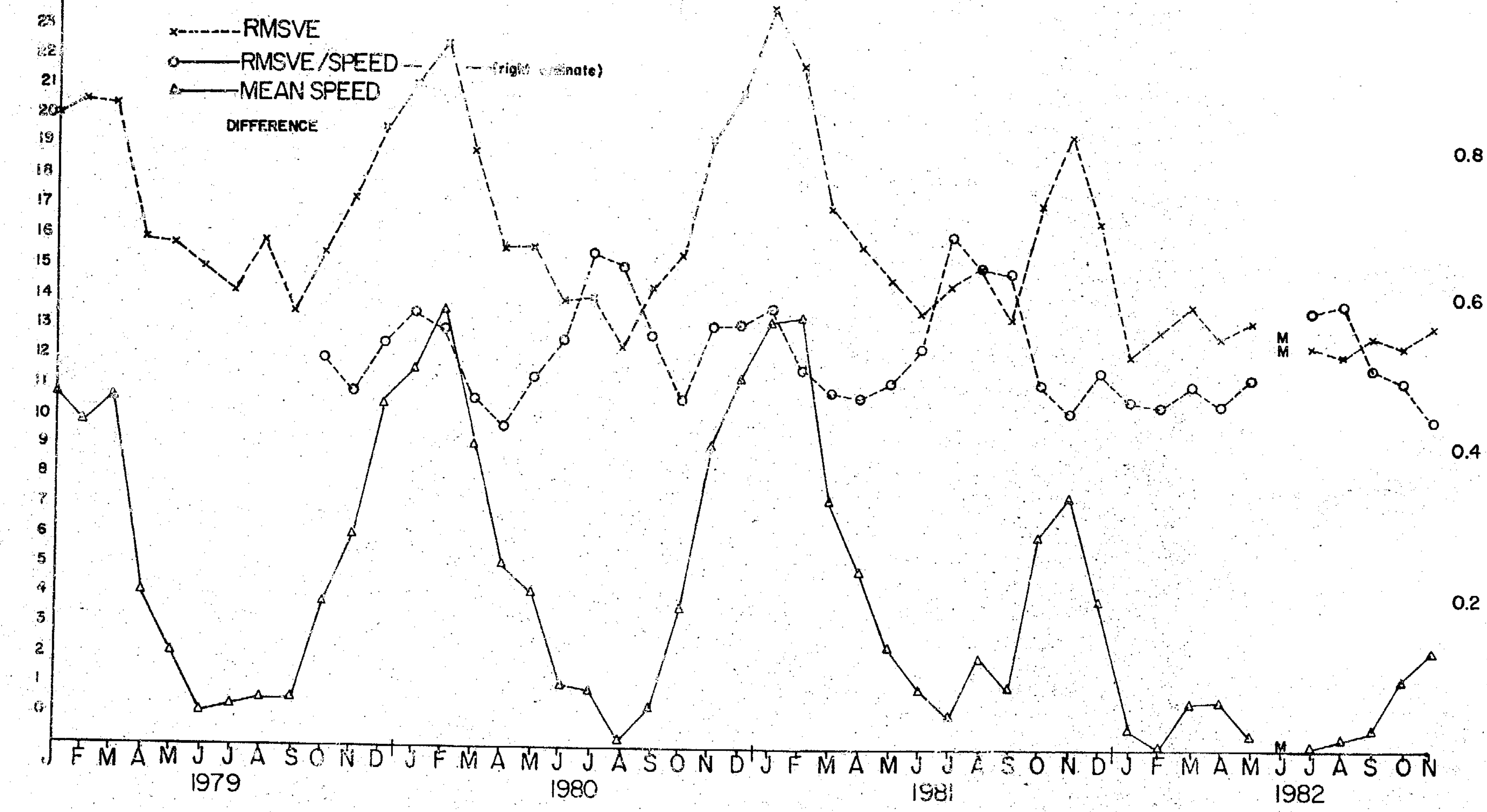
There remained a possibility that satellite observations were made in regions of lower wind speeds. To answer that question a profile of wind speed difference vs. wind speed averages was drawn up for each (northern hemisphere) winter month (Fig. 2). There were fewer reports of stronger winds but more significant was the fact that the speed differences had disappeared or changed sign for the strong wind reports that remained. Incidentally, this is a pattern typical of a northern hemisphere summer.

The only explanation remaining that fits all the data is that satellite measured cloud top altitudes have been corrected. The consequence of such a procedure would be to leave the average Japanese satellite wind unchanged, and to lower the average radiosonde wind since it is interpolated to the reported altitude of the satellite. Table 1 seems to confirm this expectation. The small decrease in Japanese cloud-tracked wind speeds during January and February 1982, as compared to speeds for these months in previous years, is probably the result of an increase of tropical reports, as previously noted.

Table 1. Monthly Average Sensor Wind Speeds (m/sec) Japanese Satellite vs. Radiosonde Colocations Above 500 mb, Within 3° and 1 Hour. (RAOBs interpolated to reported satellite wind altitude).

		'79-'80	'80-'81	'81-'82
December	RAOB	41.6	42.5	35.1
December	Satellite	31.1	31.2	31.3
January	RAOB	42.2	46.7	26.0
January	Satellite	30.8	33.5	26.3
February	RAOB	46.2	49.3	27.7
February	Satellite	33.4	35.9	28.9

FIG. 1 RAOB – JAPANESE SATELLITE ABOVE 500MB 3°,1HR LIMIT



RADIOSONDE – JAPANESE SATELLITE

FIG. 2

PLOT OF MEAN SPEED DIFFERENCE AS A FUNCTION OF MEAN SPEED AND TIME (WINTER MONTHS ONLY)