TITLE: Mesoscale Analysis of VAS 6.7μm Image Data for Several Case Studies

RESEARCH INVESTIGATOR:

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SIGNIFICANT ACCOMPLISHMENTS:

Moisture imagery from the 6.7μm water vapor channel on VAS has been available to scientists in the last few years on a somewhat regular basis. Normally this information is just one of twelve channels used in produceing temperature and moisture profiles via various inversion techniques. Recent studies have also used this moisture measurement to produce mean layer relative humidity and precipitable water values for the layer in which the radiation is emitted and also to diagnose regions of the atmosphere which are potentially unstable. Few attempts have been made, however, to verifiy the information content (moisture) of these images mainly due to the lack of appropriate ground truth data. Verification efforts documented in this report use special mesoscale rawinsonde moisture measurements from the AVE/VAS field experiment.

Several case studies have been examined in an attempt to relate VAS water vapor channel radiance data to atmospheric moisture. Since the 6.7μm channel detects radiation emitted by atmospheric water vapor from a rather thick layer, a scheme was developed which weighted rawinsonde observations of relative humidity in a similar manner. A comparison of the two fields (weighted relative humidity values from gridded rawinsonde observations and the VAS water vapor image) indicated that even when mesoscale data were used, the technique only presented a smooth representation of the radiance field. This probably occured for several reasons. First, the satellite image displays significant variability down to individual pixels (16km on a side) which is very much sub-grid-scale to the rawinsonde measurements. Second, since the level of the moisture from which the radiation is emitted is unknown, the weighting function for the VAS channel (and therefore the weighting formulation applied to the rawinsonde measurements) must be approximated. This weighting function is dependent on both the temperature and moisture distribution of the atmosphere.

In order to avoid the weighting function problem mentioned above, cross sections of relative humidity from the mesoscale rawinsondes were produced which sliced the water vapor imagery in particularly interesting regions (areas of high and low blackbody temperatures). Comparisons were then made between the cross sections and the variations in the VAS radiance data along the cross section line. This approach was more fruitful in determining

that bright regions in the water vopor imagery (cold blackbody temperatures) were often associated with thin layers of high relative humidity or thick layers of only moderately moist air. The reverse was also found to apply, i.e., dark regions (warm blackbody temperatures) in the imagery corresponded well with very dry regions in the cross sections. These relationships are not always clear-cut or easy to distinguish however, and in a few cases the bright regions did not correspond to moisture deduced from the rawinsonde cross sections. It is hypothesized, however, that in some instances the radiation field (water vapor image) can reflect the temperature along an isosteric surface on the cyclonic side of a propagating jet streak (Ramond, et al., 1981).

CURRENT AND FUTURE WORK:

One area which is currently being investigated is the extent to which low level moisture can be detected by the 6.7μm water vapor channel. It is believed that under certain conditions where the middle and upper troposphere is extremely dry, radiation emitted from water vapor below 700mb can be detected with this channel. If this is the case it adds another complexity in that this channel has an even wider range than previously thought. Further investigations will also address the effect of temperature on the variations in this water vapor channel.

PUBLICATIONS SINCE JUNE 1983:

1. Mesoscale analysis of 6.7μm image data from the VISSR Atmospheric Sounder (VAS) for several case studies. NASA TM, in press, NASA Marshall Space Flight Center, Huntsville, Alabama, 1984.

2. Mesoscale analysis of 6.7μm image data from the VISSR Atmospheric Sounder (VAS) for several case studies. Preprints Satellite Meteorology/ Remote Sensing and Applications Conference, AMS, Boston, June 1984, in press.

References

Ramond, D., Corbin, M. Desbous, G. Szejwach, and P. Waldteufel, 1981: The dynamics of polar jet streaks as depicted by the METEOSAT WV channel radiance field. Mon. Wea. Rev., 109, 2164-2176.