USE OF METEOSAT-5 DERIVED WINDS FOR OPERATIONAL WEATHER FORECASTING

R.C. Bhatia, Devendra Singh and R.K.Giri
Indian Meteorological Department,
New Delhi, India

ABSTRACT

Atmospheric Motion Vectors (AMVs) are being derived at the University of Winconsin using METEOSAT-5 data and received on a regular basis at IMD, New Delhi, through Internet. These are being used for day-today operational work of weather forecasting in IMD. In particular, the upper level winds derived from Meteosat-5 have proved to be very useful for predicting the future track position of depressions and well marked low pressure areas with deep vertical extent. On the basis of their future track predictions it is possible to give more accurate heavy rainfall warnings to the areas likely to be affected by these weather systems. It is possible to give more precise warnings to the affected area at least 48 to 72 hours in advance since these types of weather systems are steered by the upper level winds. Two such cases were examined extensively during the south west monsoon season of 2005 over the Indian subcontinent and the results are reported in the present study.

1. Introduction

Research activities in recent years have demonstrated the ability of the CMW technique when other channels are used for the tracking, that is, the visible (VIS) and water vapor (WV) bands. The former is particularly suited for tracking of low-level cumulus clouds over sea, mainly because of the good contrast in albedo between target and background. In the case of Meteosat, where the visible channel has a higher spatial resolution, the yield of CMW rises by a factor of 6 over that obtained by the infrared channel alone (Ottenbacher et al. 1997). With short time intervals (i.e., 7–15 min) between successive images, the visible channel can even depict low-level circulation in regions close to cyclone vortices (Uchida et al. 1991 ; Velden et al. 1998). In contrast, upper-level moisture patterns can be tracked in water vapor images (Laurent 1993 ; Velden et al. 1999). The resulting product or water vapor motion wind (WVMW) has an improved coverage with respect to the CMW product, the major advantage being the availability of many more targets in the image. However, there are indications of some problems in the height assignment of WV winds when extremely dry atmospheric profiles occur and the best quality is still achieved in the cloudy areas (Holmlund 1993).

2. Results and Discussions

Case study-1 : Deep Depression over Bay of Bengal (July 29-31, 2005)

The track of the land depression is shown in figure-1. A low pressure area formed over northwest Bay of Bengal on 28th July , 2005. It concentrated into a depression and lay centred at 290300 UTC near lat. 21.5 N / 87.5 E .It remained practically stationary till 30th morning when it intensified into a deep depression and lay over same place .The system crossed coast near Balasore (42895) around 30th noon and lay centred at 310300 UTC near Lat. 21.5 N/long 85.5 E . It lay centred at 311200 UTC near Champa (42783)in chhattisgarh. Afterwards, the system moved west-northwestwards and rapidly weakened into a well marked low pressure area over central Madhya Pradesh on the morning of 1st August. The Meteosat-5 derived water vapor upper level winds are shown in figure-2(a,b,c and d) for 28,29 and 30 july 2005 at 06 UTC. These winds clearly show the steering effect on weather system and likely movement of the depression over land. Under the influence of deep depression, widespread rainfall with isolated heavy to very heavy fails accurred o July 29 to 31 in Orissa and on July 31 in Chhatttisgarh. The rainfall distribution is shown in figure-3.

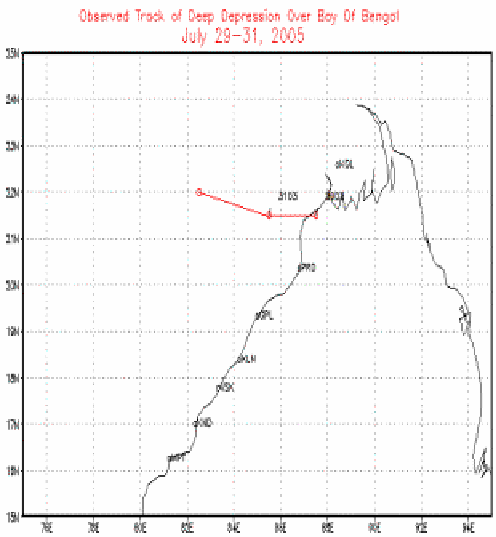

Figure-1

WV WINDS 28 July 2005 06UTC

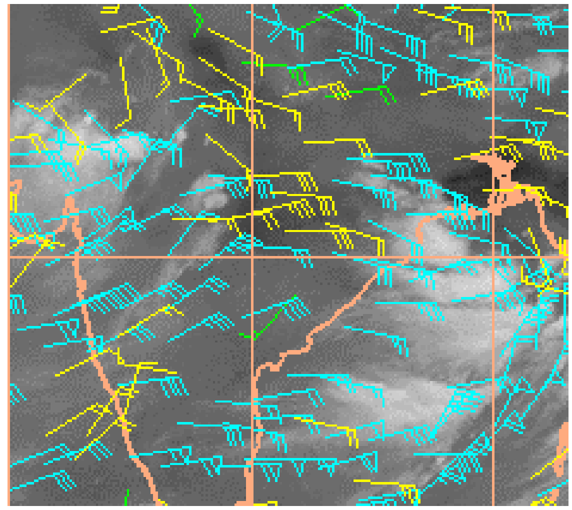

Figure-2(a)

WV WINDS 29 July 2005 06UTC

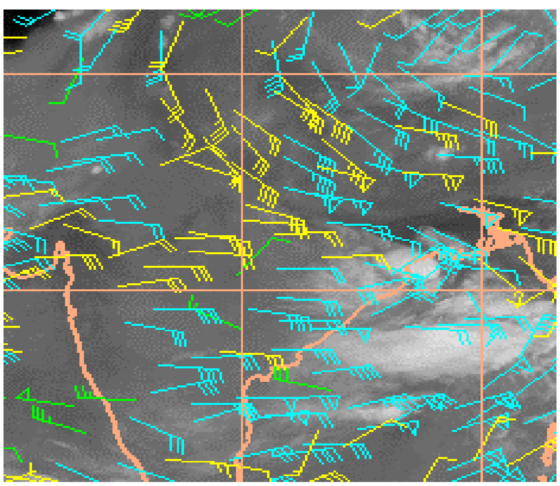

Figure-2(B)

WV WINDS 30 July 2005 00UTC

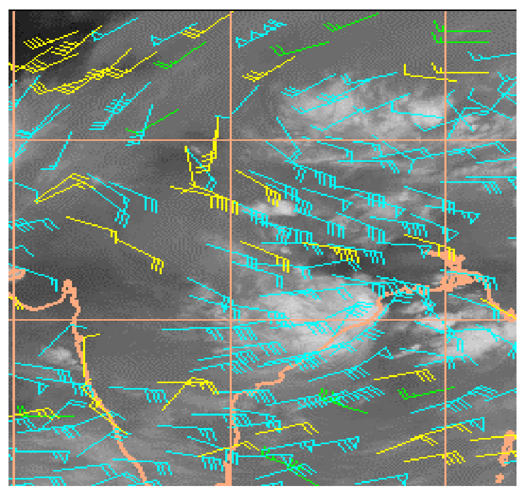

Figure-2(C)

WV WINDS 30 July 2005 06UTC

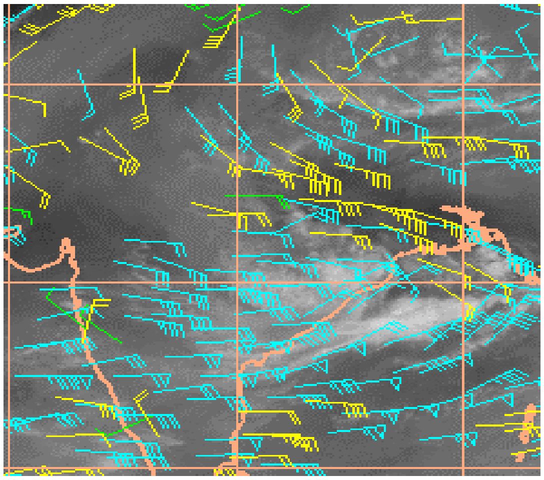

Figure-2(D)

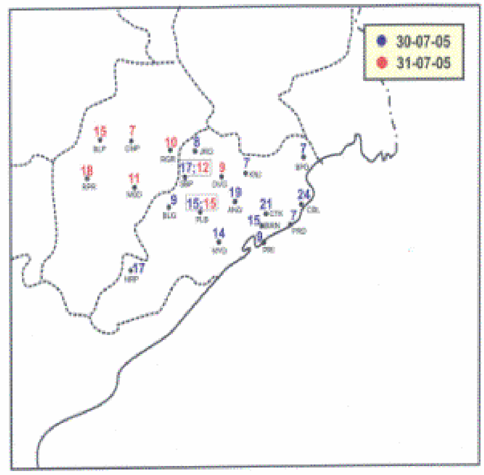

Figure-3

Case Study-2: Depression over Bay of Bengal (September 12-16 , 2006)

A low pressure area formed over west central and adjoining northwest Bay of Bengal on 10th September 2005. The track of the land depression is shown in figure-4. It moved to northwest Bay of Bengal on 11th. It concentrated into a depression into a depression over northwest Bay of Bengal and lay centred at 120300 UTC close to Paradip (42976). The system moved northwestwards and crossed Orissa coast near Paradip around 120900 UTC and lay centred at 121200 UTC near Lat. 21.0 N/ Long. 85.5 E close to Keonjhargarh. Retaining the intensity of depression the system moved initially northwestwards and then northwards till 16th . It weakened into a well marked low pressure area over west Uttar Pradesh and adjoining Uttaranchal at 170300 UTC. The Meteosat-5 derived water vapor upper level winds are shown in figure-5(a,b,c and d) for 13,14,15 and 16 september 2005 at 06 UTC. These winds clearly show the steering effect on weather system and likely movement of the depression over land.

Under the influence of depression, widespread to fairly widespread rainfall activity was realized from 12 to 15 September in Orissa (with heavy to very heavy falls at a few places). From 12 to 14 September in Chhattisgarh (with isolated heavy to very heavy falls) ; on 14 and 15 September in Madhya Pradesh (with isolated heavy to very heavy falls). It also gave fairly widespread rainfall with isolated heavy to very heavy falls in east Uttar Pradesh on 16 and 17 September and widespread rainfall activity in Uttar Pradesh and Uttaranchal on 17 and 18 September and fairly widespread with isolated heavy to very heavy falls in south Rajasthan from 14 to 16 September. The rainfall distribution is shown in figure-3.

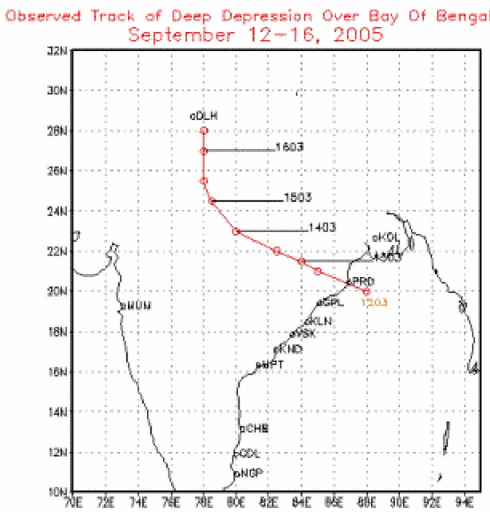

Figure-4

WV WINDS 13 Sept. 2005 06UTC

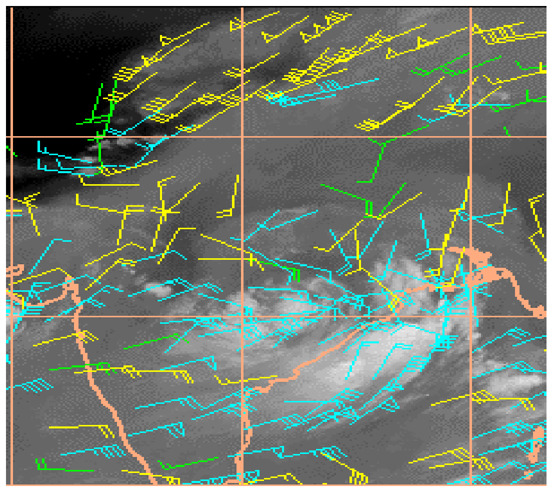

Figure-5(a)

WV WINDS 14 Sept. 2005 06UTC

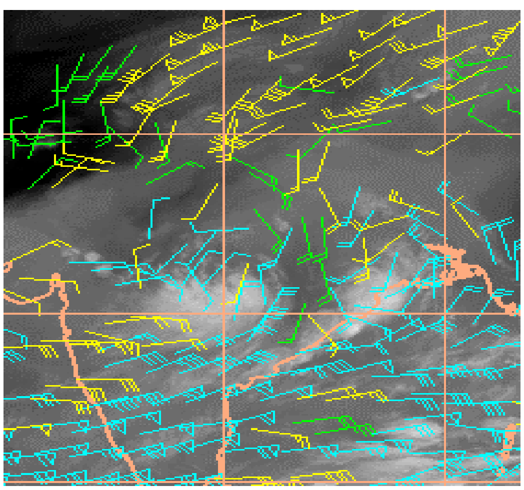

Figure-5(b)

WV WINDS 15 Sept. 2005 06UTC

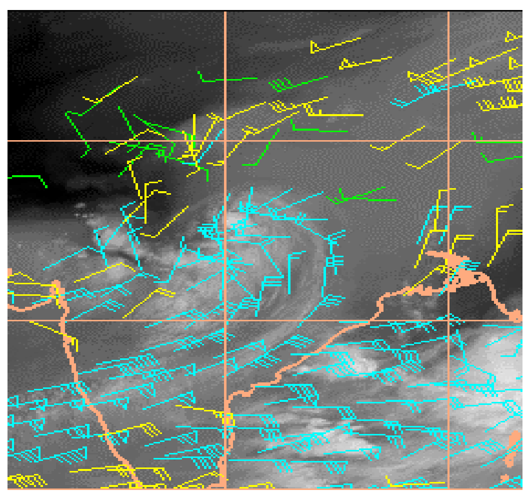

Figure-5(c)

WV WINDS 16 Sept. 2005 06UTC

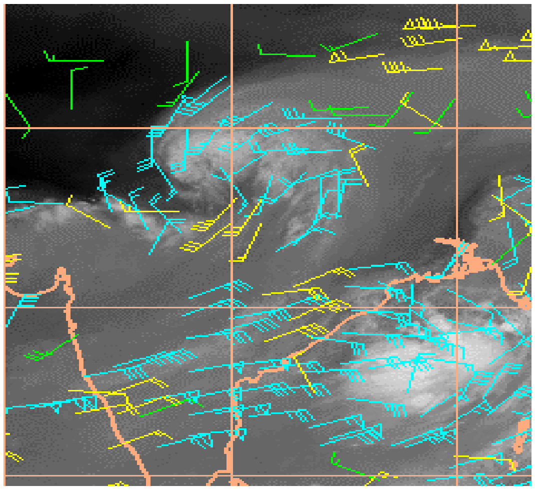

Figure-5(d)

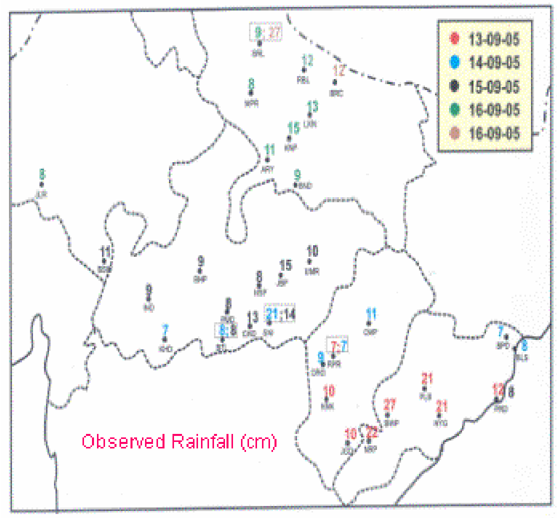

Figure-6

Conclusions

The upper level water vapor winds derived from Meteosat-5 have been found to be very useful for predicting the future track position of depressions and well marked low pressure areas with deep vertical extent in the present study. On the basis of their future track predictions it is possible to give more accurate heavy rainfall warnings to the areas likely to be affected by these weather systems. However, for the depressions of shallow extent are not so effectively predicted.

Acknowledgements

Authors are very much grateful to Director General of Meteorology, for his constant encouragement. Thanks are also due to SSEC, University of Wisconsin for providing the Meteosat-5 winds data.

References

Holmlund, K., 1993: Operational water vapour wind vectors from Meteosat imagery data. Proc. Second Wind Workshop, Tokyo, Japan, EUMETSAT, 77–86.

Laurent, H., 1993: Wind extraction from METEOSAT water vapor channel image data. J. Appl. Meteor., **32,** 1124–1133.

Ottenbacher, A., M. Tomassini, J. Schmetz, and K. Holmlund, 1997:Low-level cloud motion winds from Meteosat high-resolution visible imagery. *Wea. Forecasting,* **12,** 175–184.

Uchida, H., T. Ohshima, T. Hamada, and S. Osano, 1991: Low-level cloud motion wind field estimated from GMS short interval images in typhoon vicinity. Geophys. Mag., **44,** 37–50.

Velden, C., C. Hayden, S. Nieman, P. Menzel, and S. Wanzong, 1997:Upper-tropospheric winds derived from geostationary satellite water vapor observations. Bull. Amer. Meteor. Soc., **78,** 173–196.

Velden, C., T. Olander, and S. Wanzong, 1998: The impact of multispectral GOES-8 wind information on atlantic tropical cyclone track forecasts in 1995. Part I: Dataset methodology, description, and case analysis. Mon. Wea. Rev., **126,** 1202–1218.