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Modelling of wind profile over the Arabian Sea

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सार—दक्षिण अरब महासागर में ऊर्ध्वाधर पवन परिच्छेदिका के यू और वी एकक का निदर्श विकसित किया गया। अब तक प्राप्त संबंधों को स्तरों के लिए पवन के आकलन के लिए पूर्णतया प्रयुक्त किया गया है जो कि उपग्रह मापों से उदाहरण के लिए उपलब्ध नहीं है।

ABSTRACT. A model for vertical profiles of u and v components of wind has been developed over south Arabian Sea. The relations so obtained have potential to estimate the wind for the levels which are not available.

1. Introduction

For a variety of meteorological application knowledge of the wind profile over oceanic areas is important. As satellites provide winds for few levels in the vertical, modelling of wind profile is useful to derive wind information for various levels based on the satellite wind data available from few levels. In this communication we report for the first time a model for the wind profile over Arabian Sea. This model leads us to estimate the wind profile in terms of the wind at levels for which they are available. The month of May, being the beginning of monsoon season, the MONEX wind data for Minicoy, May 1979 has been used in this calculation.

2. Model for vertical profile of u component of wind

To develop a model based on satellite and observed wind data over Arabian Sea, the structural functions for the wind profile, *i.e.*, the mean zonal [Fig. 1(a)] and the mean meridional [Fig. 1(b)] have been deduced. A computer-fit of the u component of wind at different pressure (p) levels (*i.e.*, 1000, 900, 800, 700, 600, 500, 400, 300 and 200 mb) yields the following expression :

$$u_p = -a^{p/c} \cos(bp) \qquad (1)$$

where, $a = 2.5$, $b = 0.576$ and $c = 600$. The RMSD (root mean square deviation) in u_p is found to be 0.23. The above expression gives results in excellent agreement upto 300 mb. For upper level winds (*i.e.*, from 300 mb to 100 mb) the following expression :

$$u_p = -a'^{(b'/p)} \cos(c'p - d') \qquad (1')$$

with $a' = 1.9$, $b' = 400$, $c' = 0.818$ and $d' = 115$ gives quite satisfactory results.

To determine the wind profile for the individual days of the month, we rewrite the above Eqn. (1) in a more generalized form

$$u_p = -d(p)\,[a^{p/c} \cos(bp)] \qquad (2)$$

where a, b and c are empirical constants and $d(p)$ is a constant which depends only upon the pressure level. To determine the value of the constants a, b and c, the wind profile for the individual days (May 1979) at different pressure levels are computed in terms of u_{900}, *i.e.*, the 900 mb zonal wind. This has been attempted in two ways. In the first trial treating b as constant a and c were varied, while the next step involved the variations in a and b keeping c as fixed. The latter case, being more sensitive, has been adopted for the computation of wind profiles. This yields a set of values for the constants a and b for the individual days. The $d(p)$'s at different pressure levels starting from 900 mb upto 200 mb are found to be 1.0, —1.0, 6.0, 3.0, 3.5, —7.0, —3.5 and 3.5 respectively. The RMSD's at 800, 700 and 500 mb and calculated as 2.7, 3.2 and 0.9 respectively.

3. Model for vertical v—component profile

In the next step we have obtained the mean v component of wind and pressure (p) using a similar method as in the case of u component which is as follows :

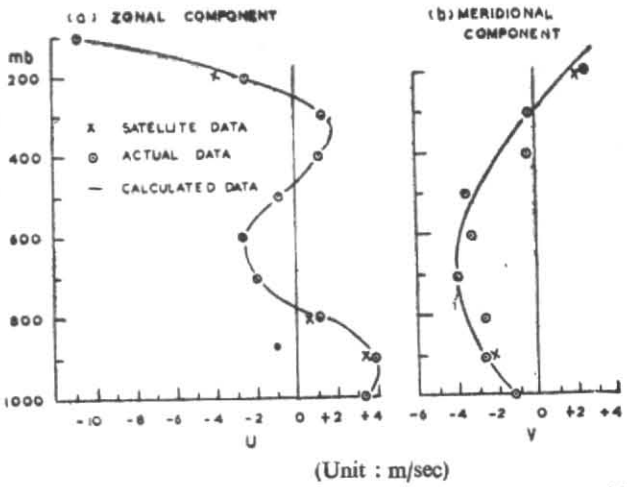
$$v_p = -e \cos(fp - g) \qquad (3)$$

where $e = 4.2$, $f = 0.24$ and $g = 160$ are empirical constants. The RMSD in v_p is found to be 0.78, it is obvious from here that this relation is much simpler as compared to Eqn. (1).

In this case also, the same procedure, as discussed for the u component, was adopted for calculating wind profile for the individual days. The RMSD's at 800, 700 and 500 mb were determined to be 3.5, 2.0 and 3.1 respectively.

4. Conclusion

The importance of the above expressions (1), (2) and (3) lie, apart from the simplicity, in the fact that knowing the satellite wind at a particular pressure level the



(Unit : m/sec)

Fig. 1(a). Mean zonal wind profile over south Arabian Sea, May 1979

Fig. 1(b). Mean meridional wind profile over south Arabian Sea, May 1979

vertical wind profile can be reasonably estimated. However, this model will be tested with sufficient data in its subsequent studies. This model can be extended for the other monsoon months and for the oceanic area as well.

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