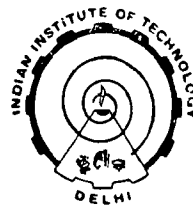


**On Certain Aspects Of Short-Range Numerical Weather
Prediction Over India With A Multi-Level Limited
Area Primitive Equation Model**

by

Wing Commander R. K. Paliwal

Thesis submitted in fulfilment of the requirements for the degree of
DOCTOR OF PHILOSOPHY



CENTRE FOR ATMOSPHERIC SCIENCES
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NEW DELHI
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TO MY WIFE AND CHILDREN

...

CERTIFICATE

This is to certify that the thesis entitled "ON CERTAIN ASPECTS OF SHORT-RANGE NUMERICAL WEATHER PREDICTION OVER INDIA WITH A MULTI-LEVEL LIMITED AREA PRIMITIVE EQUATION MODEL", being submitted by Wing Commander R.K. Paliwal for the award of the degree of DOCTOR OF PHILOSOPHY, is a record of the original bona-fide research work carried out by him. He has worked under our joint guidance and supervision and has fulfilled the requirements for the submission of this thesis. The results presented in this thesis have not been submitted in part or full to any other University or Institute for award of any degree/diploma.



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ABSTRACT

The short range prediction of tropical circulation features especially those associated with the Indian summer monsoon is a challenging problem. A limited area model is considered as an essential tool to understand and predict small scale features of such complicated flow regimes like the southwest monsoon over a short range period.

Though a tropical belt barotropic primitive equation (PE) model is found to predict the movement of pre-existing synoptic scale vortices with a reasonable degree of accuracy, a multi-level limited area PE model (LAM) is found to yield better results in simulating and predicting monsoon systems. The LAM used in this work is bounded by 30°E - 105°E and 7.5°S - 45°N with a grid resolution of 2.5° lat./long. and five sigma levels in the vertical. The space derivative terms in the model equations are approximated by a second order accurate quadratic conserving finite difference scheme over Arakawa-C grid system.

It is found that for the initialisation of a multi-level PE model in tropics, dynamic initialisation (DI) process is essential as without such an initialisation, a large forecast error is observed in the short range weather forecasts. From the numerical experiments with some of the variations of DI

method, it is found that Okamura (Nitta, 1969) scheme of DI is computationally more economic and yields better results.

Through a number of sensitivity experiments, it is found that the split-explicit time integration (as against an explicit scheme), a linear simple fourth order computational diffusion scheme, a tendency modification lateral boundary formulation (Perkin and Kreitzberg, 1976), planetary boundary layer parameterisation based on bulk aerodynamic formulations, a modified Kuo-type (Anthes, 1977) cumulus parameterisation (when tuned for monsoon) schemes provide better results with the LAM over Indian region.

The performance of the LAM in predicting different aspects of monsoon was evaluated, using FGGE level-IIb data sets of a few typical cases. The forecast verifications show a reasonably good skill in predicting meteorological fields upto a period of 48 hours.

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