

A HYBRID MESOSCALE WIND MODEL FOR AIR QUALITY MODELING

B.R.S.B. Basnayake

Centre for Climate Change Studies, Department of Meteorology

Abstract

The knowledge of the behavior of the wind flow over a particular area can have many useful applications. One of them is in air quality modeling. Due to urbanization and industrialization, air pollution is becoming a major problem. To predict pollutant concentration, wind behavior should be known, possibly through simulation of the wind flow in three-dimensional space. A hybrid mesoscale wind model for simulating the wind flow in three-dimensional space is described. The model consists of two sub models, namely: the predictive surface wind model and the diagnostic mass-consistent model. The surface wind model is a one-level primitive equation model, in terrain-following σ coordinate, that predicts the winds at the anemometer level. Physical processors such as frictional drag, horizontal diffusion, slope winds, diurnal heating and cooling and upper air forcing are incorporated and suitable parameterized in order to render the model more accurate. The predicted surface winds serve as an input data for the mass-consistent model at the anemometer level. To get the initial winds at each grid point, the anemometer level winds are vertically distributed using a profile under the constraint that the horizontal divergence along a vertical column is to be zero. After that, the wind field is adjusted in such a way that it satisfies the mass continuity equation.

The mathematical basis of the mass-consistent model is based on the variational calculus method, which is to minimize the difference between the initial wind field and final wind field such that the final wind filed obeys the continuity equation. The gauss precision moduli (σ_h and σ_v) or the weighting factors that adjust the wind filed in horizontal and vertical direction play an important role to represent the

the atmospheric stability. Hybrid model is applied to Sri Lanka under the different synoptic flows in order to check the performance of the models. The results show that the both models work well for simulating locally induced thermally driven circulations over Sri Lanka. The use of modest computer resources such as a personal computer and the fraction of time required to run the programme are the principal advantages of the hybrid model over the fully predictive three-dimensional model.