ABSTRACT

Two state-of-the-art three-dimensional non-hydrostatic mesoscale meteorological models (MM5 and RAMS) are used in this thesis to simulate local climate in two coastal areas: Swedish west coast and Spanish east coast, respectively. MM5 model is extensively evaluated and internally-compared among different planetary boundary (PBL) and land surface process (LSM) parameterization schemes in a high-latitude (57-58°N) coastal urban environment using GÖTE2001 field campaign measurement data, and is used in simulating boundary layer characteristics, low-level jet (LLJ), sea breeze (SB), and urban heat island (UHI), as well as dry deposition velocity of ozone (O_3). RAMS model is applied for sea breeze modelling, and to examine impacts of topography and land degradation on sea breeze circulation and characteristics in a low-middle latitude (38-41°N) mountainous coastal area.

The main objective of the thesis is to increase our understanding of MM5 mesoscale model's performance with different PBL and LSM parameterizations at local scale for air quality applications, and then to apply it for local climate studies such as SB circulation, UHI effect, and coastal LLJ, and in air quality modelling such as dry deposition simulations. It is found that different PBL and LSM schemes in MM5 result in very different simulated results. However, the model can simulate mesoscale futures fairly well, if the model is carefully configured. It is also suggested that the subgrid effect is evident, which is mainly caused by surface heterogeneity. Further, the impacts of topography and land degradation on the SB circulations in Spain appear to be significant. These studies can help us to build confidences when using mesoscale models for local scale meteorological or air quality applications, and thereby help us to better understand air pollution dynamics.

KEYWORDS: Dry deposition velocity, Effect of topography, Land degradation, Low-level jet (LLJ), MM5 mesoscale model, ***Model evaluation and applications***, Ozone (O_3), PBL and LSM parameterizations, Regional Atmospheric Modelling System (RAMS), Sea breeze, Spanish east coast, Subgrid effect, Swedish west coast, Urban effect