OBSERVATIONAL AND NUMERICAL STUDY ON THE INFLUENCE OF LARGE-SCALE FLOW DIRECTION AND COASTLINE SHAPE ON SEA-BREEZE EVOLUTION

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Abstract. In this study radar, surface observations and numerical simulations are used to examine the inland penetration and intensity of the sea breeze during various large-scale flow regimes along the curved coastline of the Carolinas, U.S.A. The results clearly indicate that the flow direction relative to the curved coastline has a significant effect on the sea-breeze evolution. Overall, during northerly flow regimes along the curved North Carolina coast, observations and numerical simulations show that the sea-breeze front has a tendency to remain close to the south-facing coast. During these same flow regimes the front moves further inland relative to the east-facing coast. The sea-breeze front during westerly flow cases progressed further inland relative to the south coast and less so from the east-facing coastline. South-westerly flow allows the sea breeze to move inland from both coastlines but the coastal shape influence makes the inland penetration less from the easterly facing beaches. During periods of light onshore flow (south-east), the sea breeze moves considerable distances inland but is not discernable until later in the afternoon. The simulations indicated that the sea-breeze intensity is greatest (least) when the large-scale flow direction has an offshore (onshore) component. Model results indicate the existence of a strong front well inland in the late afternoon during light onshore flow. Also noted was that the simulated sea-breeze front develops earlier in the afternoon during offshore regimes and later in the day as the large-scale flow becomes more onshore. It is concluded that the coastline shape and coast-relative flow direction are important factors in determining how the sea-breeze circulation evolves spatially.

Keywords: Complex coastline, Doppler radar, Sea breeze, Sea-breeze circulations, Sea-breeze modelling, Synoptic-flow effects.

1. Introduction

The coastal region of North and South Carolina, U.S.A. (Figure 1) is an important socio-economic area, particularly during the warm season of May through September. Sea-breeze fronts regularly trigger severe weather events with dangerous lightning (Blanchard and Lopez, 1985), which directly influences various tourism and recreational activities, and hence the regional economy. The climatology of the region is affected by regular sea breezes; evidence has included signatures in the normal (climate) precipitation distribution (Moroz, 1967). Sea-breeze circulations are also important when considering pollutant transport and

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