P1.3

NUMERICAL MODELING OF AIRFLOW IN THE VICINITY OF THE JORDAN NARROWS IN THE SALT LAKE VALLEY

Ying Chen*, R. L. Street F. and L. Ludwig
Stanford University, Stanford, California

1. INTRODUCTION

The Advanced Regional Prediction System (ARPS, developed at the Center for Analysis and Prediction of Storms, University of Oklahoma) has been used to simulate airflows like those observed during the first field campaign of the Vertical Transport and Mixing eXperiment (VTMX), carried out in the Salt Lake Valley in October 2000. The ARPS data assimilation system was used to interpolate observed data and background fields from the ETA model (developed at the National Centers for Environmental Prediction, Black, 1994) to a coarse model grid with horizontal spacing of 20 km. Outputs from model runs on that grid have served as inputs for one-way nested grid runs on finer grids with horizontal resolution of 5 km, 1 km, 250 m. Figure 1 shows the relationship of the three nested grids used to obtain the results described below. High-resolution simulations have been performed of flow in the Jordan Narrows area that separates the Utah Lake and Salt Lake Valleys.

2. DATA SIMULATIONS

The availability of VTMX field data makes it possible to compare detailed flow simulations with objective analyses of observed data for the same meteorological conditions. When the coarser model results agree with the observed data, the simulations can provide more details of the flow than can be observed. This helps us to understand the flow physics better, especially as related to vertical mixing in stable, urban atmosphere, and more importantly, in regions of complex topography.

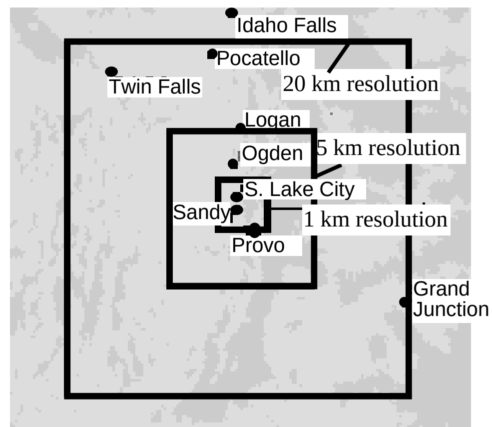

Fig 1. Relationship of ARPS grids used

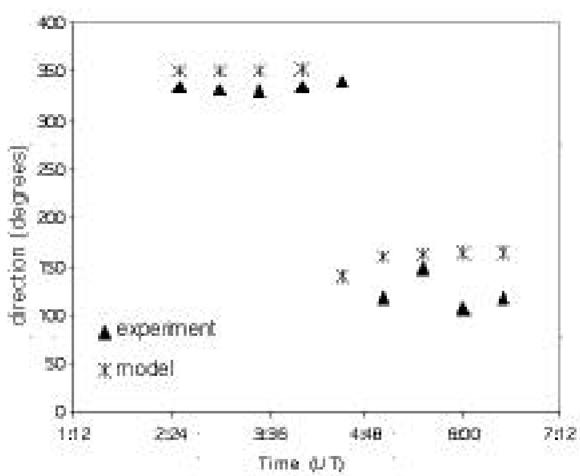

Fig.2 Observed and simulated wind directions near the Jordan Narrows during IOP 4

Corresponding author address**: Ying Chen, Stanford Univ., Environmental Fluid Mechanics Lab., Dept. Civil and Environmental Engineering, Stanford CA 94061-4020; e-mail: **yingchen@stanford.edu

During the fourth Intense Operation Period (IOP4) of the VTMX field campaign, which took place the night of October 8-9, 2000, the model output captures the evening transition period well. Figures 2 and 3 show that the simulated wind directions and speeds are consistent with those observed by National Center for Atmospheric Research (NCAR) in the Jordan Narrows.

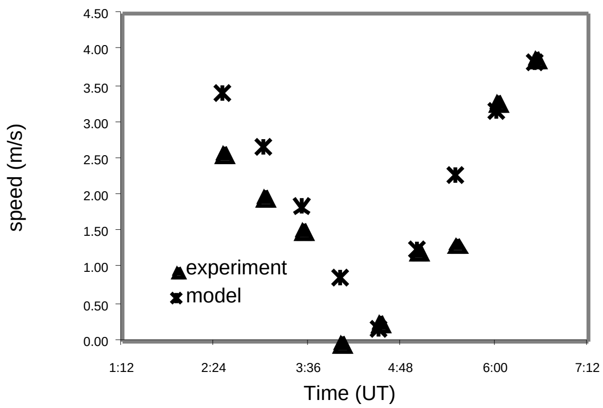

Fig.3 Observed and simulated wind speeds near the Jordan Narrows during IOP 4

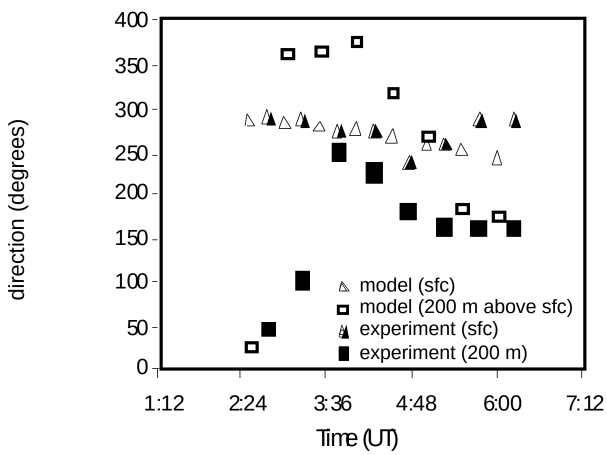

Fig.4 Observed and simulated wind directions near the Oquirrh Mountains during IOP 4

Figures 4 and 5 show that the simulated wind directions and speeds are also consistent with the tethersonde data observed by Pacific Northwest National Laboratory (PNNL) along a slope of the Oquirrh Mountains.

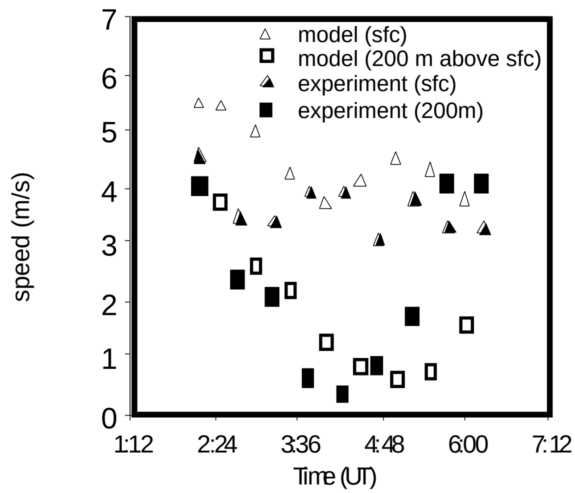

Fig.5 Observed and simulated wind speeds near the Oquirrh Mountains during IOP 4

When drainage flows developed at night, the high resolution model results revealed some interesting flow features that resembled hydraulic jumps, bores, wave initiation and Bernoulli effects. For instance, Figure 6 shows the flow in a vertical plane, oriented south-to-north, approximately following the Jordan River. The flow passes over the Traverse Mountains, just east of the Jordan Narrows The case in Figure 6 has a nighttime southerly flow through the Jordan Narrows. The simulated flow developed waves in the lee of the Traverse Mountains. In other cases, with stronger winds, flow separation and a hydraulic jump developed in this same area.

3. CONCLUSIONS

Using the ARPS model and nested grid methods has allowed us to produce realistic simulations of flows in the Jordan Narrows area. As shown in the figures, the simulated flows compare well with the field data. We expect that these simulation results can be used to guide the interpretation of measured data from the same region, and also aid in the design of future field experiments.

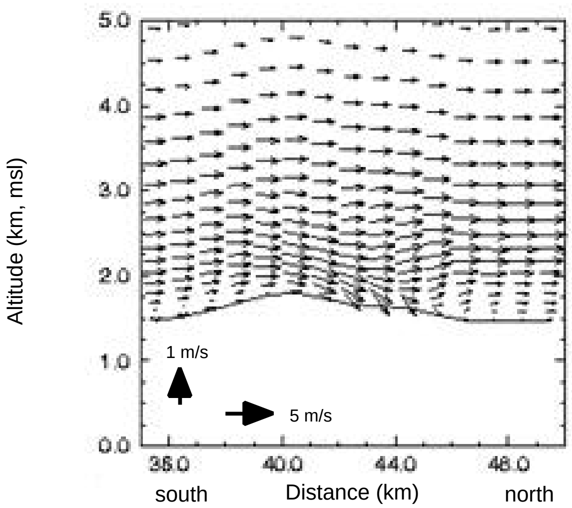

Fig.6 Flow approximately parallel to the Wasatch Mountains, 9 Oct 2000 0530 UT

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