

**The Numerical simulation of synoptically  
influenced local wind circulation  
in El Paso Airshed**

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# Objectives

- ❖ Simulating synoptically influenced local wind circulation in El Paso Airshed
- ❖ Verifying the simulation results with surface and upper atmospheric measurements for future application of air quality modeling

# Numerical model

## ❖ MIM5 (PSU/NCAR Mesoscale Model version 5)

- Non-hydrostatic equation set
- Incompressible atmosphere
- Sigma coordinate

$$\sigma = \frac{p - p_t}{p_s - p_t}$$

$p_t$  specified constant top pressure

$p_s$  surface pressure

# **Analysis**

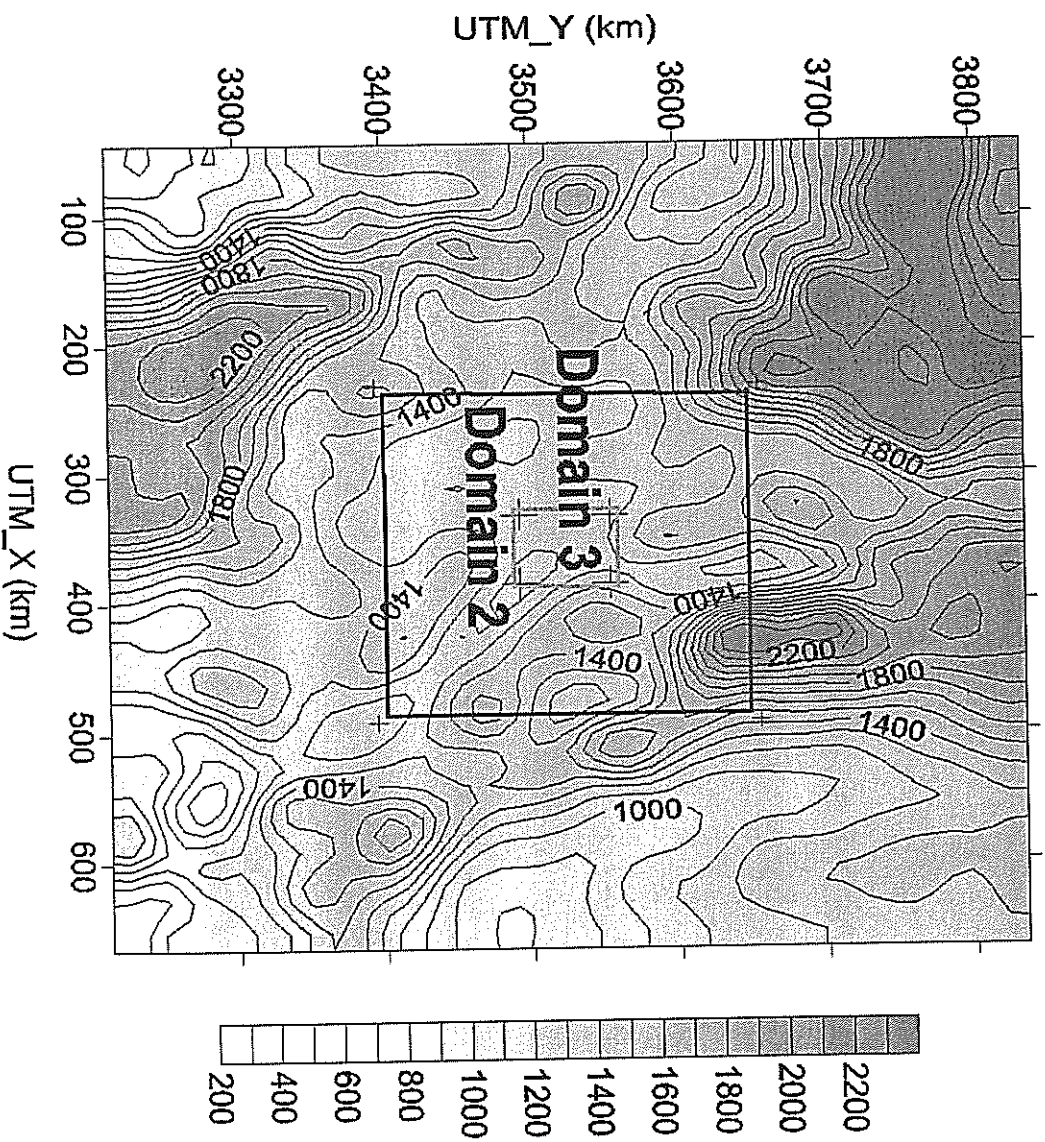
- ❖ Horizontal wind distribution
- ❖ Vertical structure of meteorological variables  
Santa Teresa NWS upper air sounding station  
(31.90N 106.70W 1257m)
- ❖ Time evolution of meteorological factors near ground  
TNRCC air monitoring site located in El Paso

## Design of the Numerical Experiment

- ❖ Case: 0000 UTC Nov 30<sup>th</sup> – 0000 UTC Dec 3<sup>rd</sup>, 1998
- ❖ Vertical layer: 28 layers
  - Min interval between layers: 10 m near ground
  - Max interval between layers: 500 m in upper atmosphere
- ❖ Domain and Grids:
  - Domain 1 (outer most domain)
    - $\Delta x = 16$  km
    - 41 X 41 in E-W and N-S direction
  - Domain 2 (middle domain)
    - $\Delta x = 4$  km
    - 65 X 65
  - Domain 3 (inner most domain)
    - $\Delta x = 1$  km
    - 53 X 61

# Topography and relative position of each domain

## Domain 1

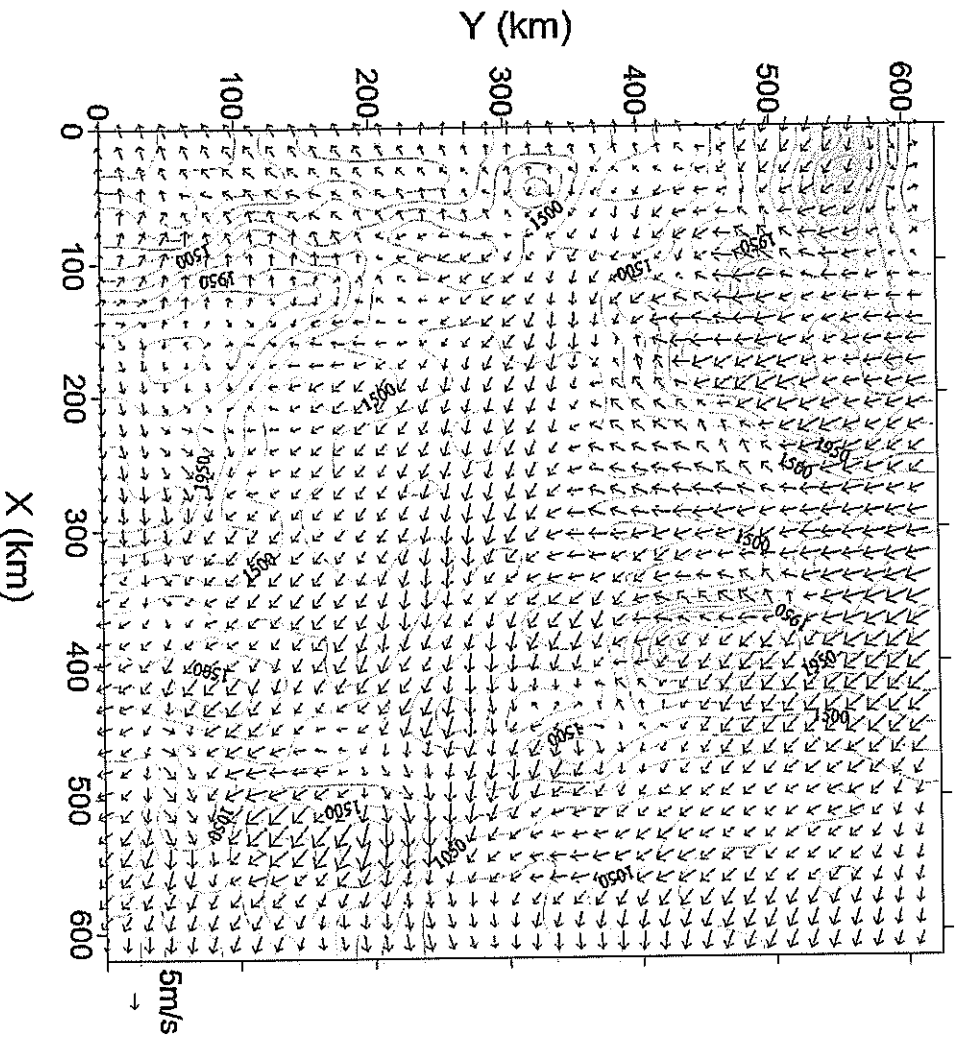


# Design of Numerical Experiment

- ❖ Initial Value:
  - NCEP Eta analysis output
  - + assimilation of local measurements
  
- ❖ Boundary Value: Externally forced B. V.
  - Domain 1 – NCEP Eta analysis output
  - Domain 2 & 3 – the output of its mother domain
  
- ❖ Model options:
  - Simple ice micro-physics
  - 5-layer soil model
  - explicit cumulus convection
  - MRF PBL

# Simulated wind of Domain 1 at Nighttime

0500 LST Nov 30

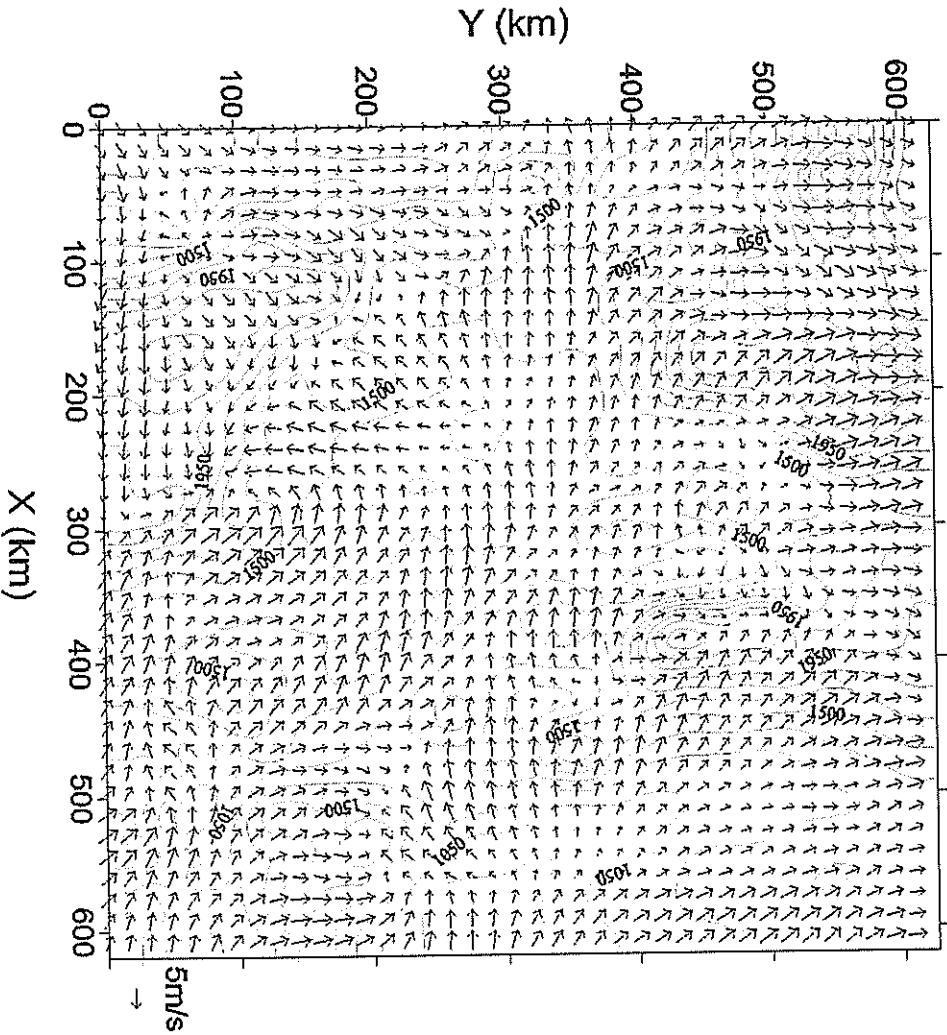


Upper level wind



# Simulated wind of Domain 1 at Daytime

1700 LST Dec 1



Upper level wind

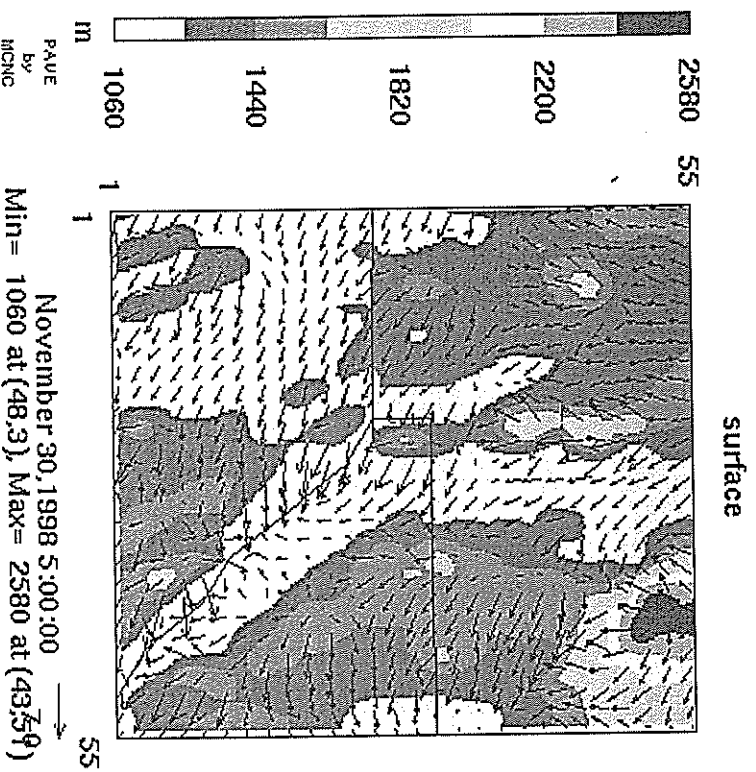


# Horizontal Wind & Topography of Domain 2:

0500 LST Nov 30 - 1700 LST Dec 2

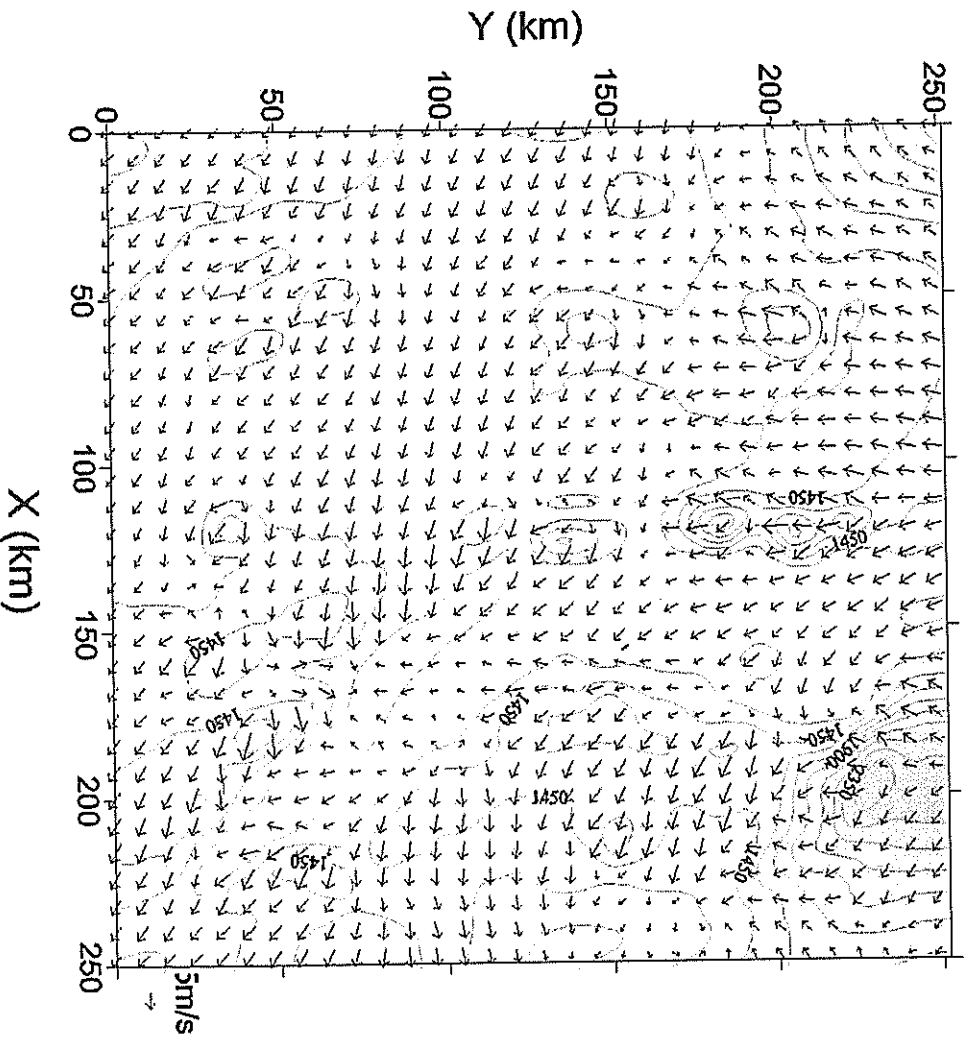
Every hour

## Horizontal Wind & Topo



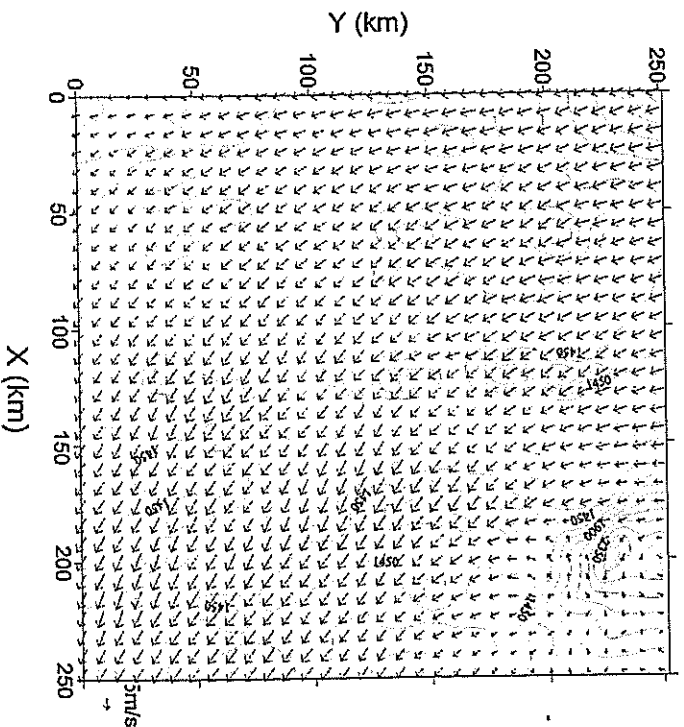
# Simulated wind of Domain 2 at Nighttime

Domain2: 0500 LST Nov 30



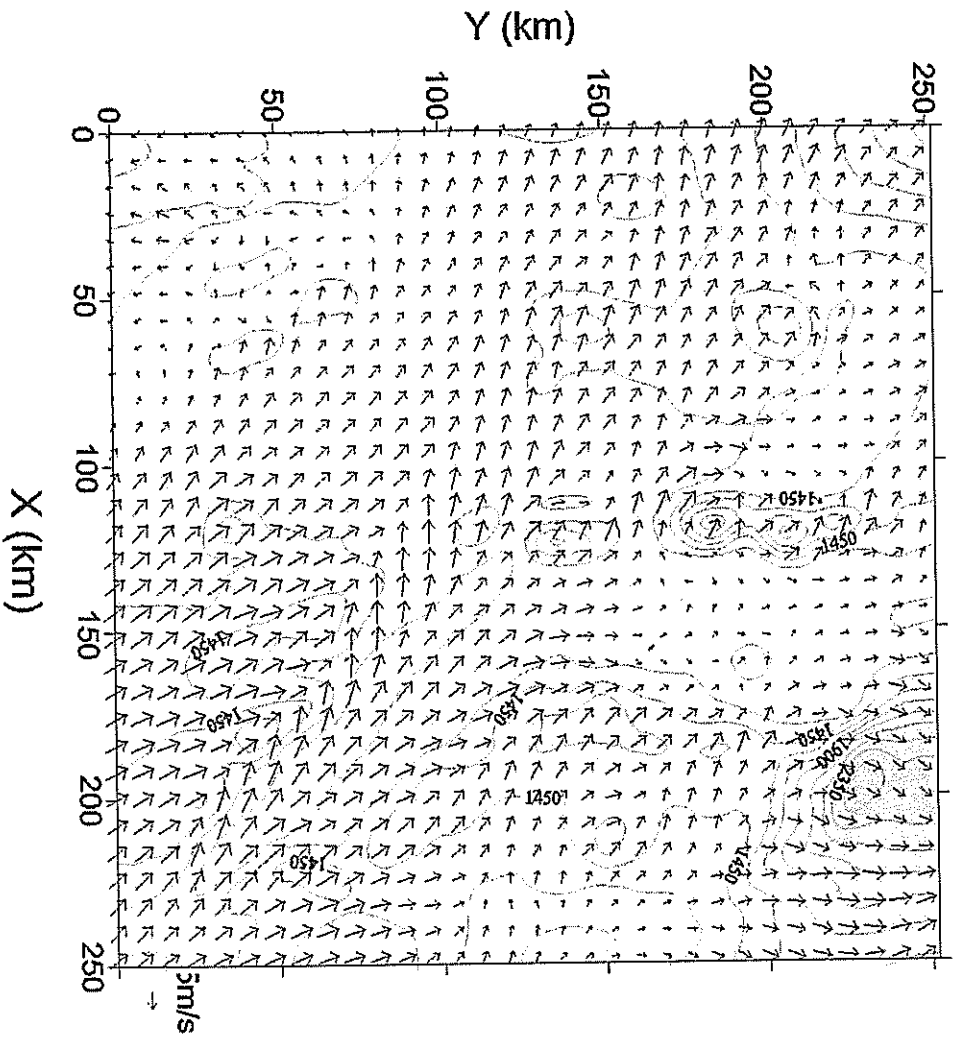
Upper wind at approx. 850hPa

Domain2: 0500 LST Nov 30



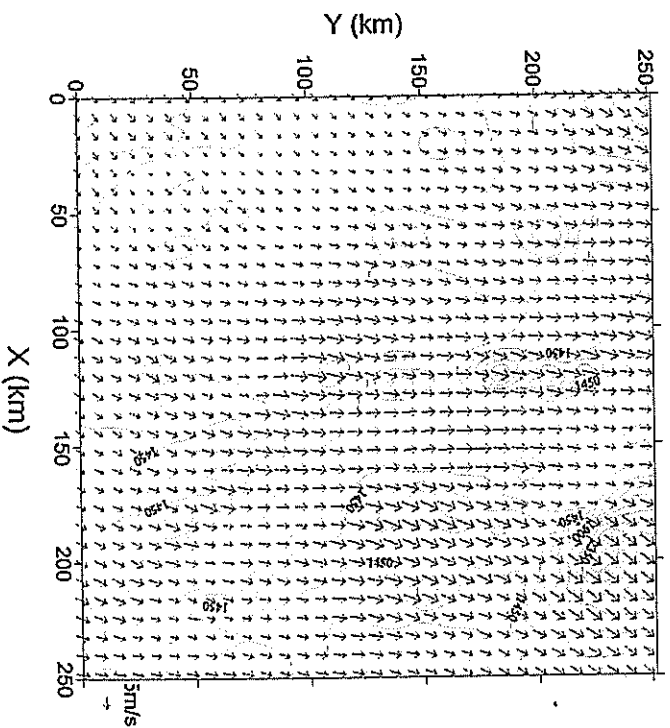
# Simulated wind of Domain 2 at Daytime

Domain2: 1400 LST Dec 1



Upper wind at approx. 850hPa

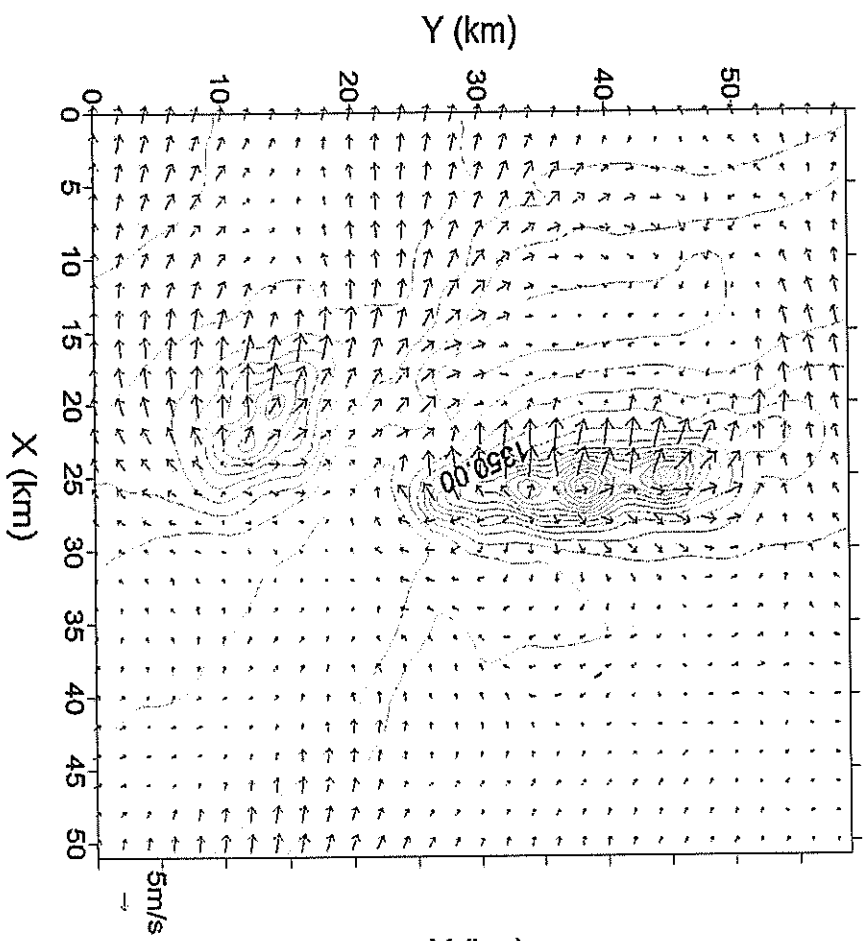
Domain2: 1400 LST Dec 1



# Simulated wind of Domain 3

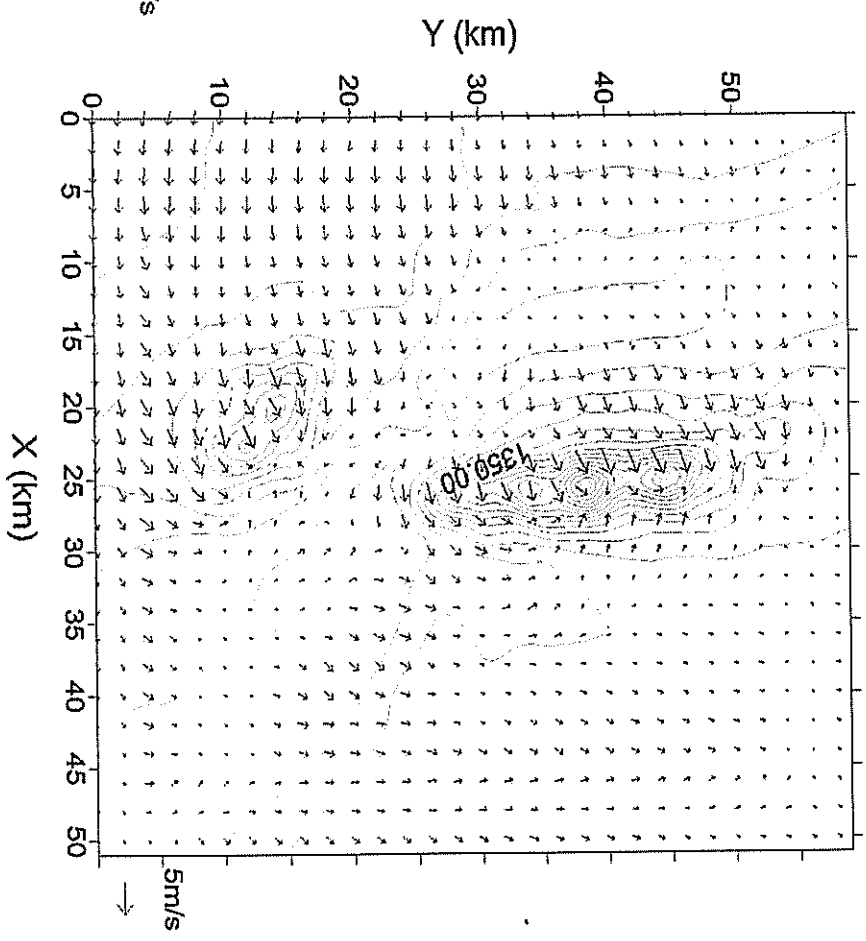
## Nighttime

Domain3: 0500 LST Dec 1

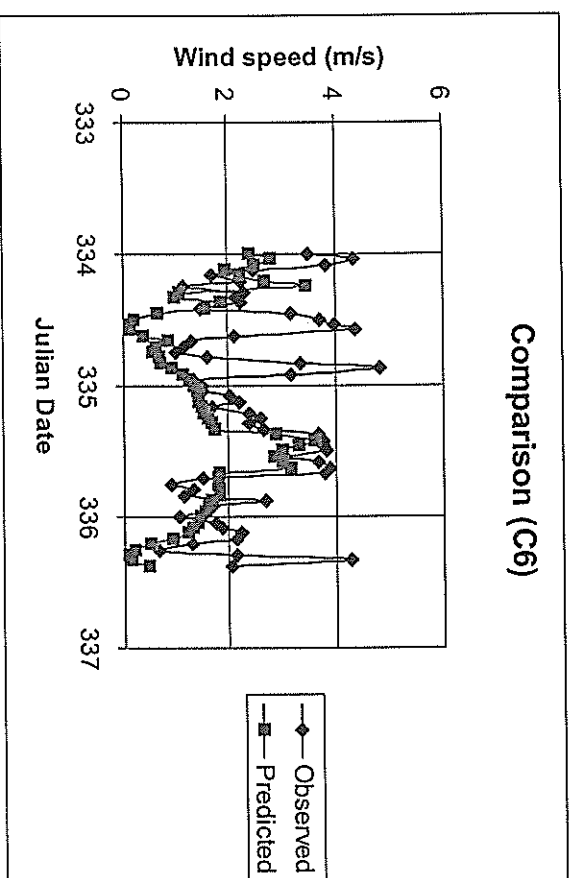
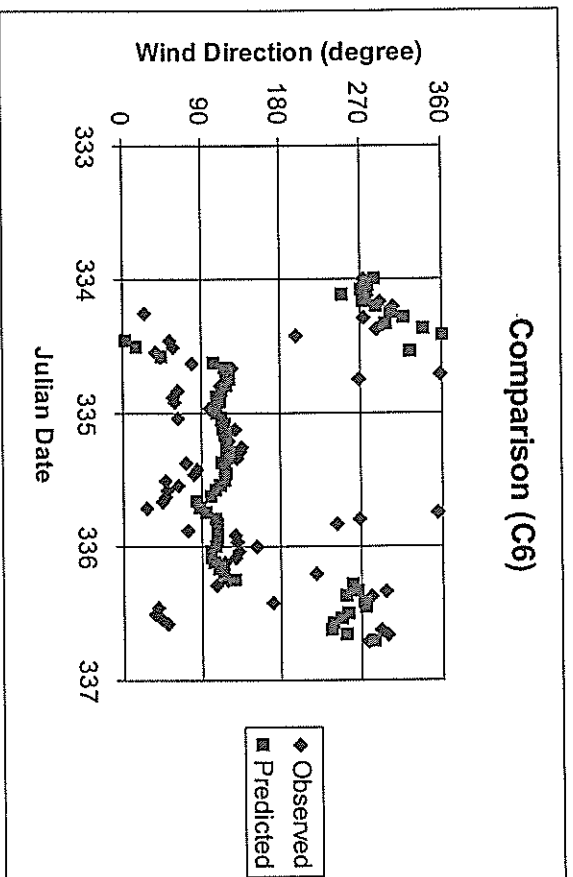
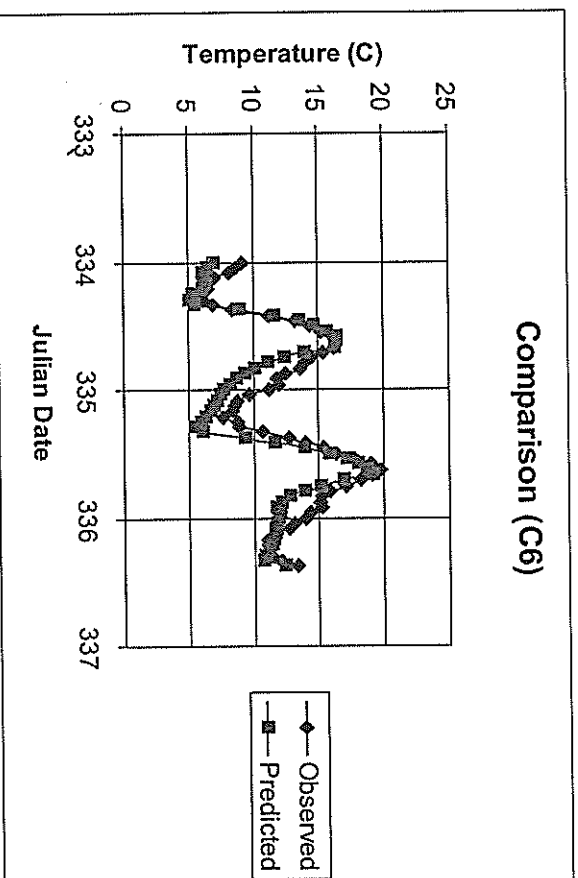


## Daytime

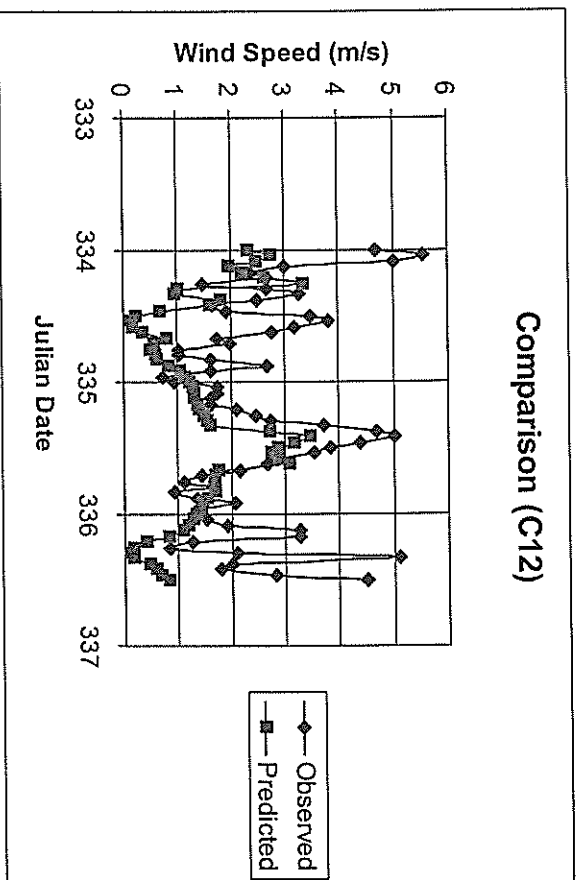
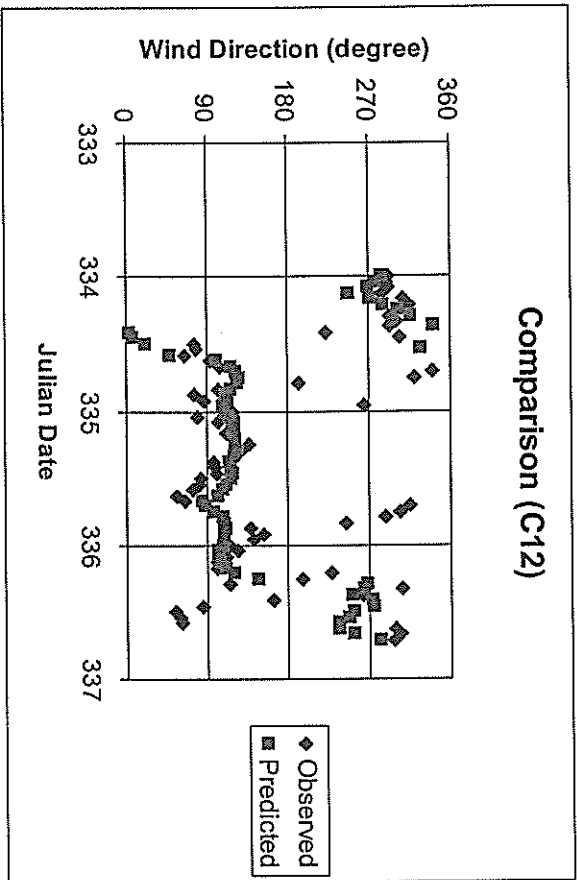
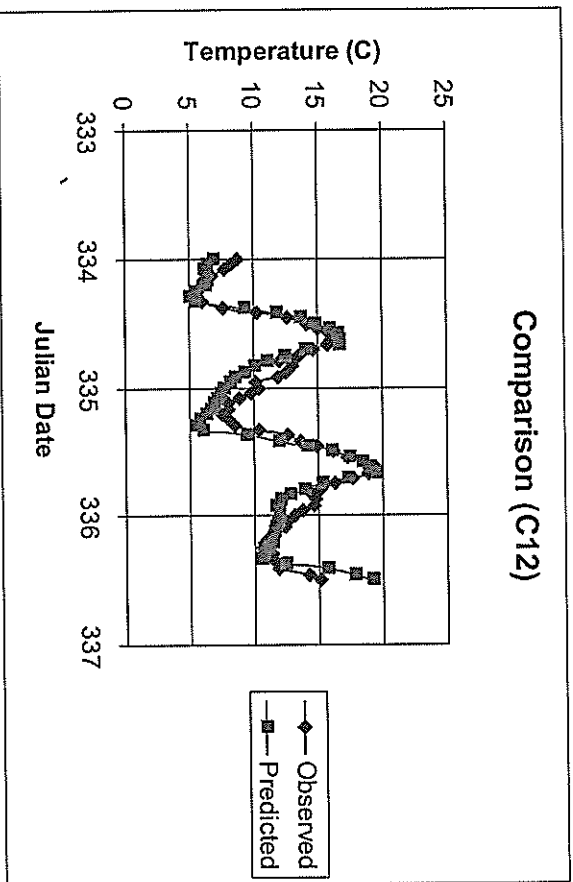
Domain3: 1100 LST Dec 2



# Time evolution of Simulated variables at C6

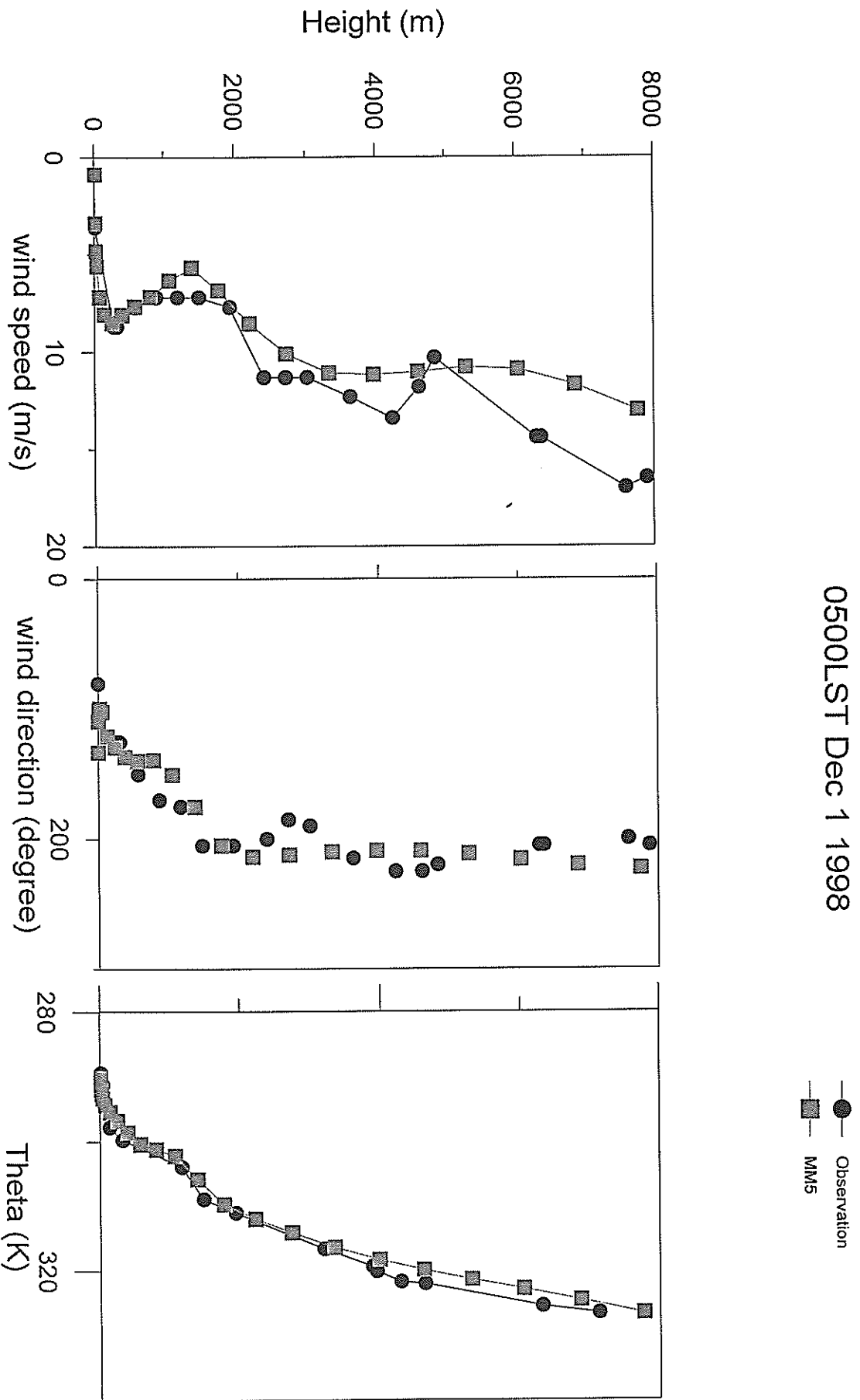


# Time evolution of Simulated variables at C12



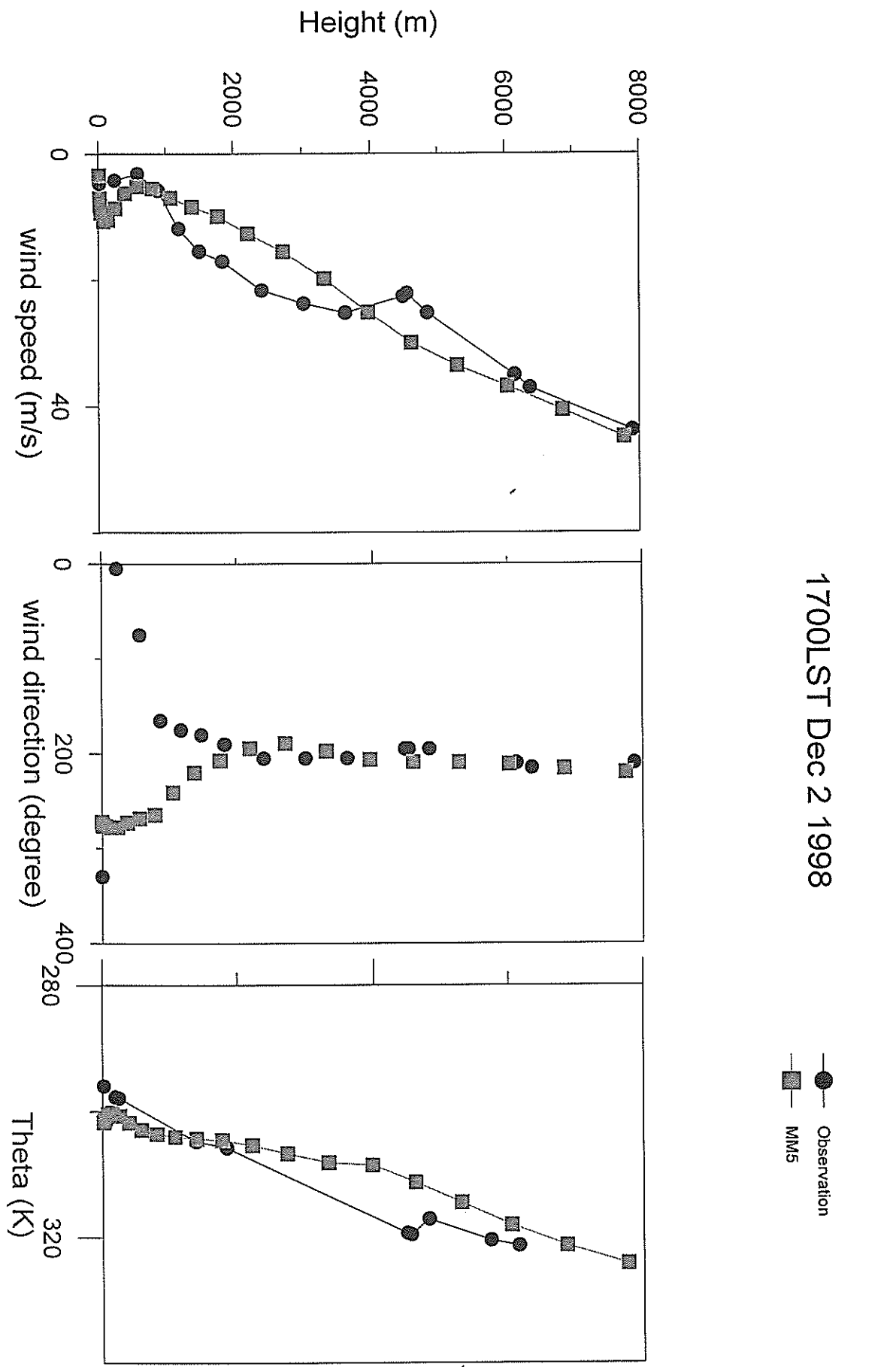
# Sounding at Santa Teresa station

0500LST Dec 1 1998



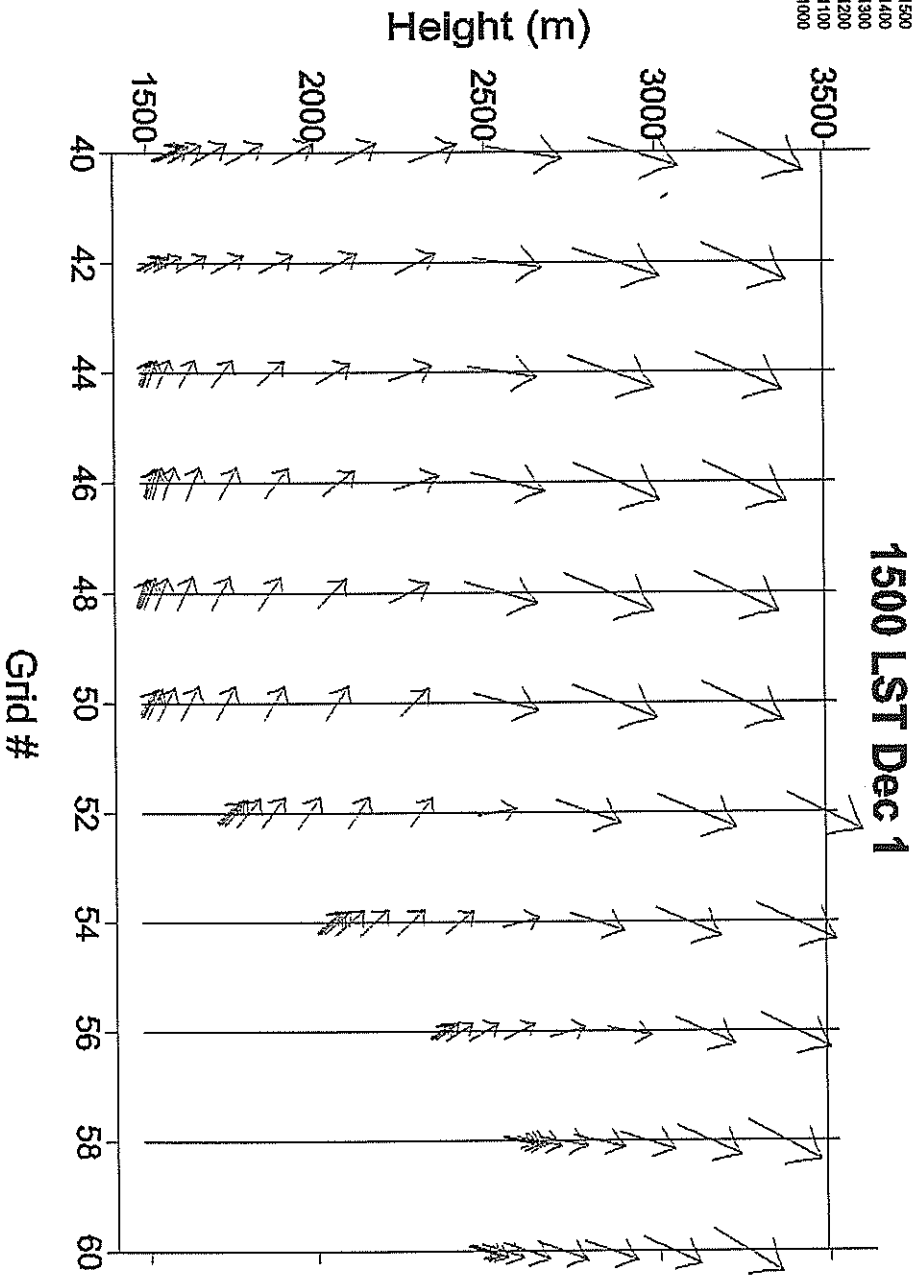
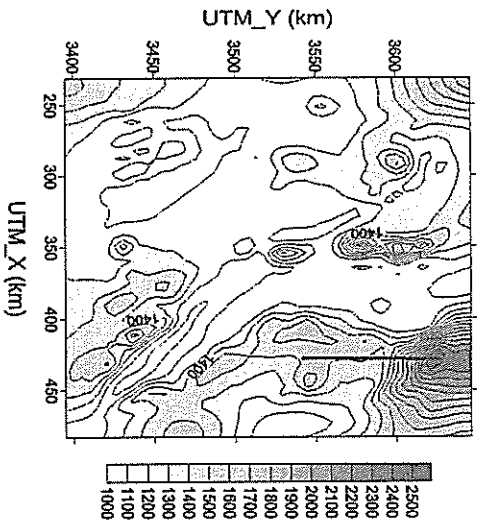
# Sounding at Santa Teresa station

1700LST Dec 2 1998

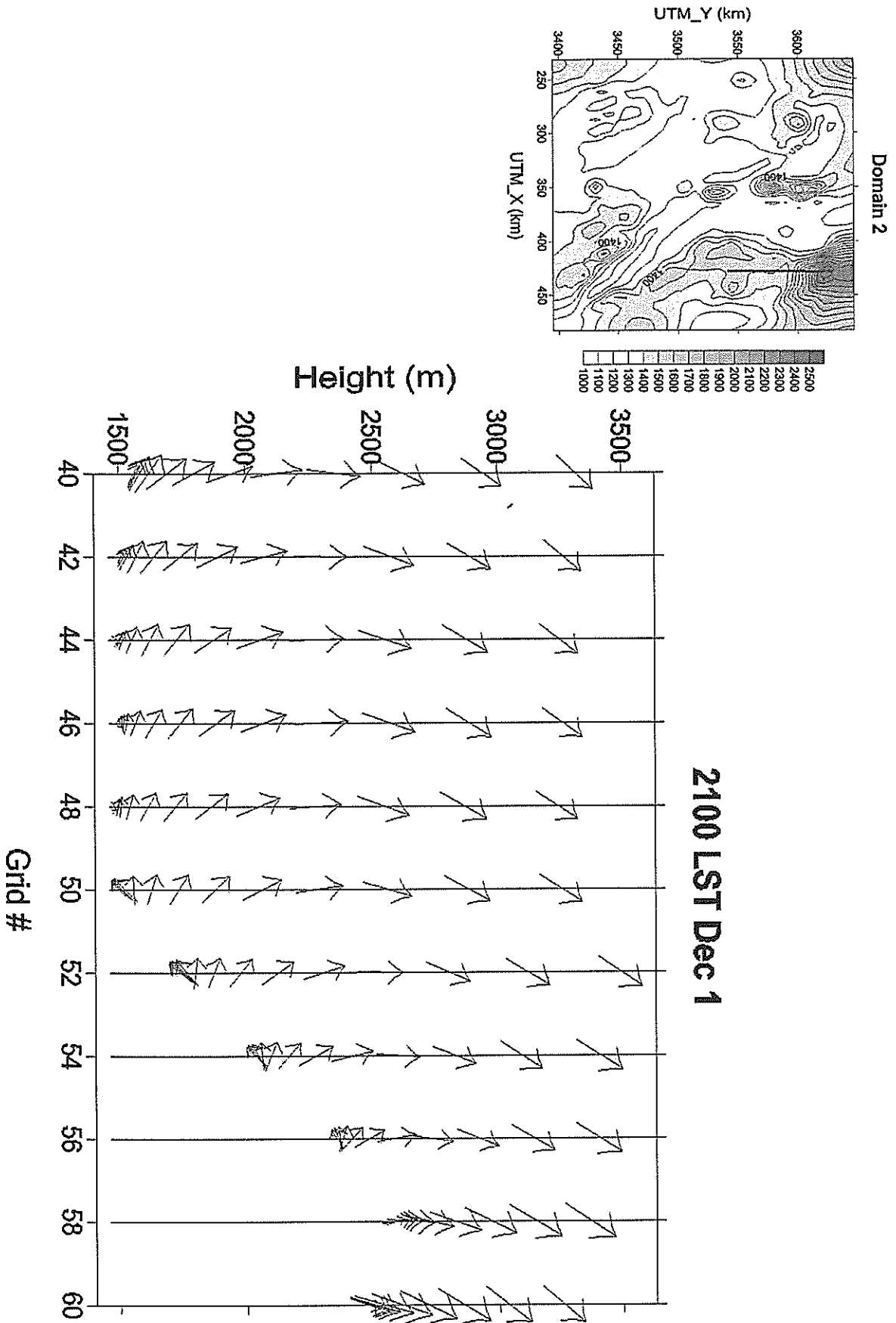


# YZ Cross section of horizontal wind : Daytime

Domain 2



# YZ Cross section of horizontal wind : Nighttime



## Conclusion

- ❖ In general, synoptically influenced thermal driven circulation pattern in El Paso airshed was well simulated by MIM5
- ❖ The vertical profiles of MIM5 was in good agreement with the NWS synoptic sounding data
- ❖ The near surface temperature of MIM5 showed good agreement with measurements. On the contrary, wind speed was underestimated although in general it followed up general time evolution of wind speed.
- ❖ In this case, thermally generated local wind was confined approximately below 500m agl height