Meso-scale Spectral Model Simulations over the San Jacinto Mountain Region

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Wildland Fire Suppression Cost

◆ The annual average expenditures on wildland fire suppression in the US from 2000 - 2004 was $1.231 billion.

◆ In California the annual average CDF expenditures for the same period 2000 – 2004 was $449 million.

◆ Better weather and climate forecasts would allow fire managers to make better decisions in reallocating fire suppression forces on the landscape to reduce fire suppression expenditures and minimizing financial and personnel losses.

10/2007 San Diego Fire Storm

Applications of Meteorological Model Prediction in Wildland Fire Research

υ **Fire spread modeling**

- **fire commander needs to know where and when the fire line will reach**
- **fire spread model (FARSITE-** A fire growth simulation model based on Rothermel (1972), using spatial information on topography and fuels along with weather and wind data (http://www.firemodels.org**)**
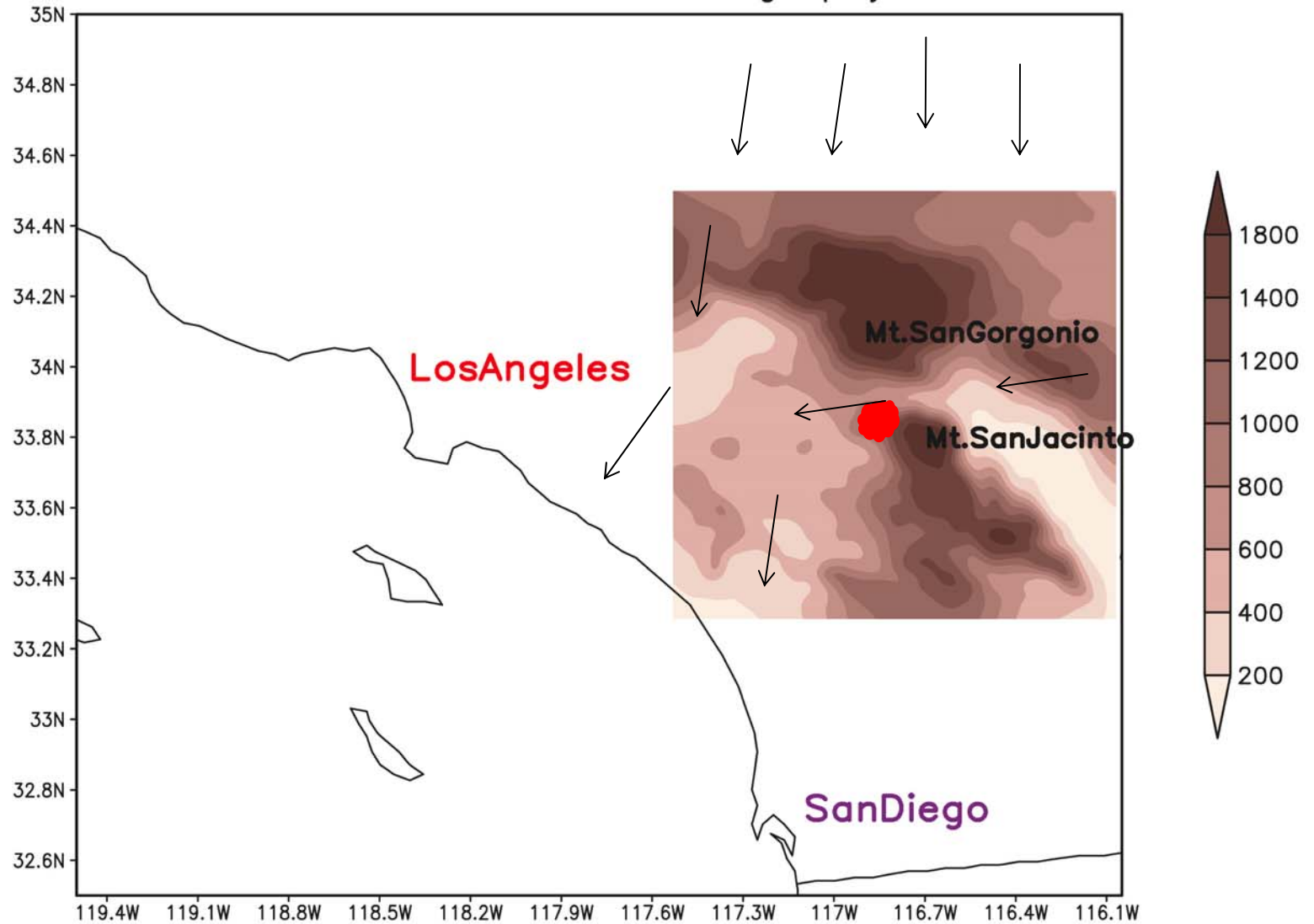- **require very high resolution (< 1km) weather model**

ignition

wind
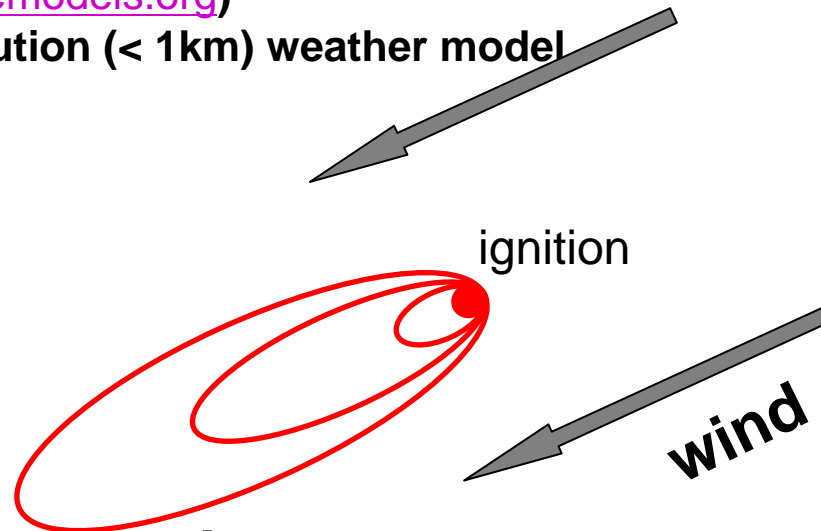
◆ **Esperanza fire case study**

- burned 16,000 ha of chaparral in Oct. 2006
- 5 Forest Service firemen perished
- Validation for simulation has been extremely difficult
- Fine-scale (5m) FireMapper thermal Imagery
- 6 RAWS deployed in the general area since Oct. 2008
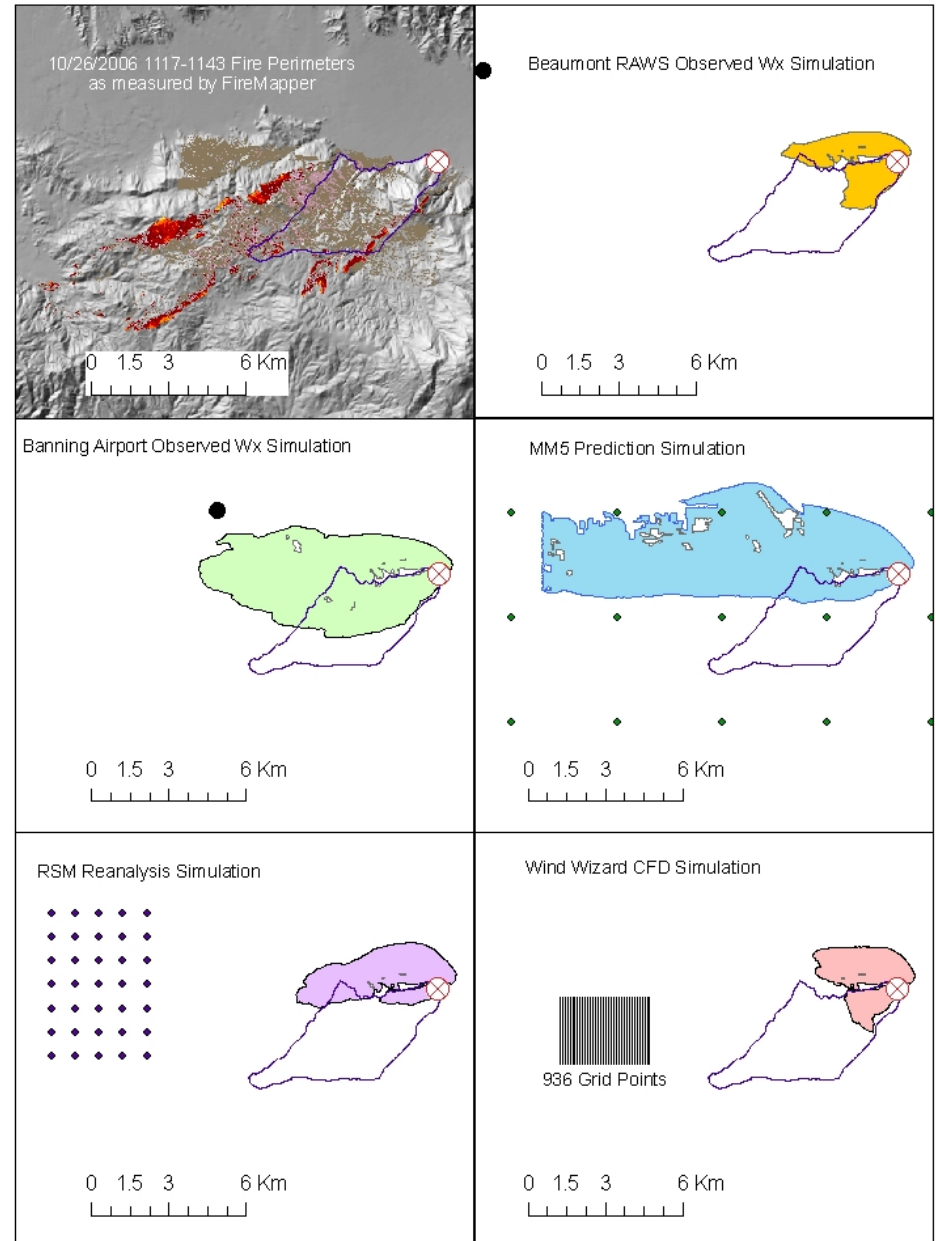
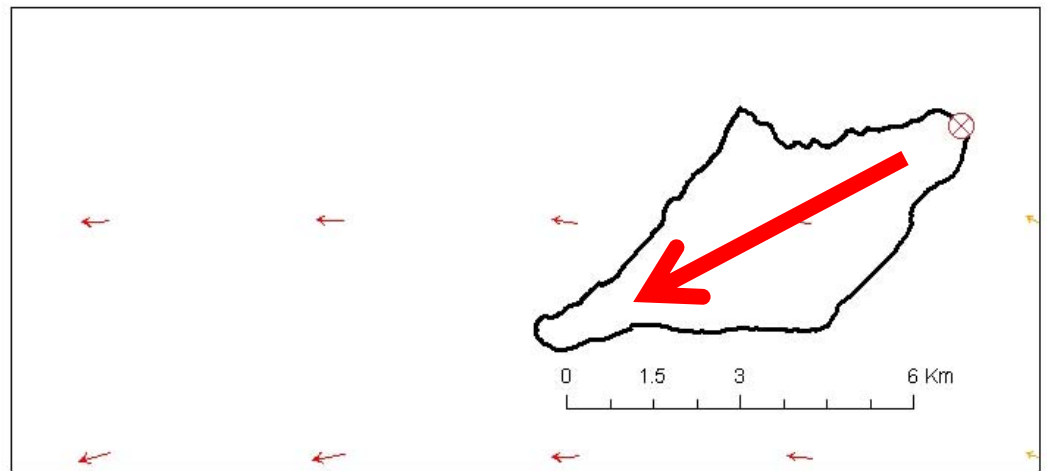# H   Santa Ana Condition

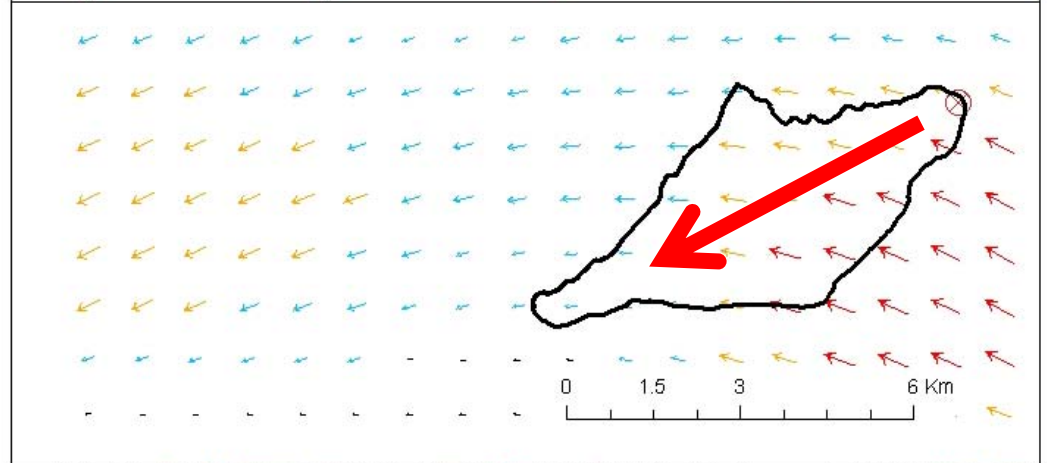## San Jacinto 1km Orography

0800 Sims

Beaumont ⦿

- υ **Upper left – fire perimeter**
- υ **Dots denote weather information density**

10/26/2006 1117-1143 Fire Perimeters as measured by FireMapper

0 1.5 3 6 Km

Beaumont RAWS Observed Wx Simulation

0 1.5 3 6 Km

Banning Airport Observed Wx Simulation

0 1.5 3 6 Km

MM5 Prediction Simulation

0 1.5 3 6 Km

RSM Reanalysis Simulation

0 1.5 3 6 Km

Wind Wizard CFD Simulation

936 Grid Points

0 1.5 3 6 Km

- MM5

- MSM

  (small domain)

- WW
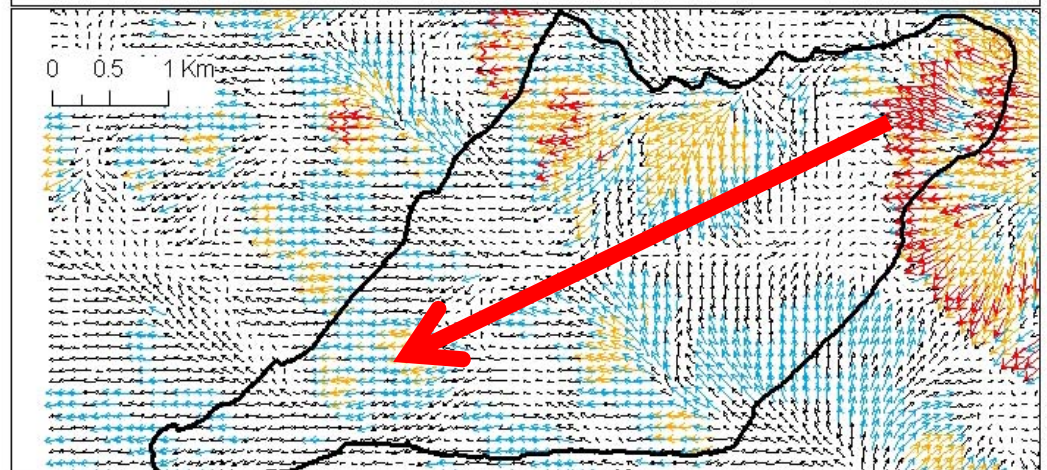
Applications Development for
Non-hydrostatic Meso-scale Spectral Model (MSM)

- ### Model aspects
  - developed at NCEP (Juang 2002) MPI parallelized
  - non-hydrostatic descendent from NCEP's GSM/RSM
  - spectral perturbation solutions and physics for small scale motions
  - capable of simulating motion at 1km grid-space scale
  - driven by current NCEP operational global forecasts T382 (~26km)
- ### Downscaling modes
  - weather forecast mode, up to 48 hours
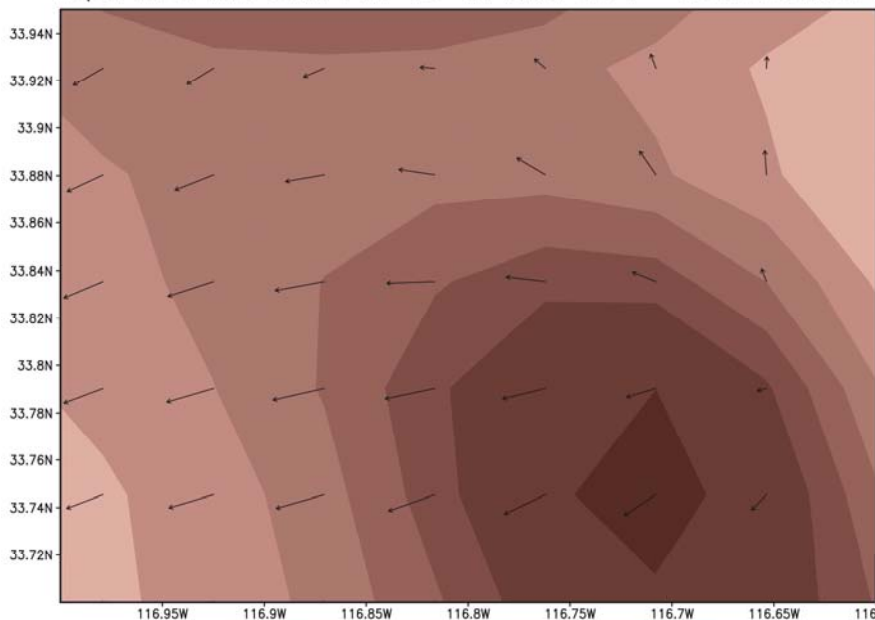 - climate simulation and seasonal forecasts
- ### Model Physics
  - Ferrier cloud scheme
  - SAS cumulus parameterization
  - no gravity-wave drag
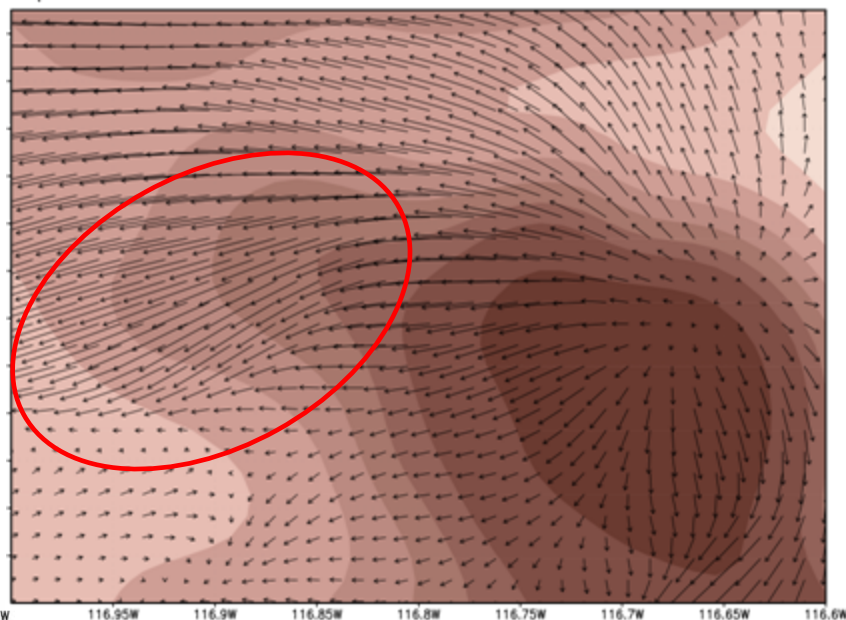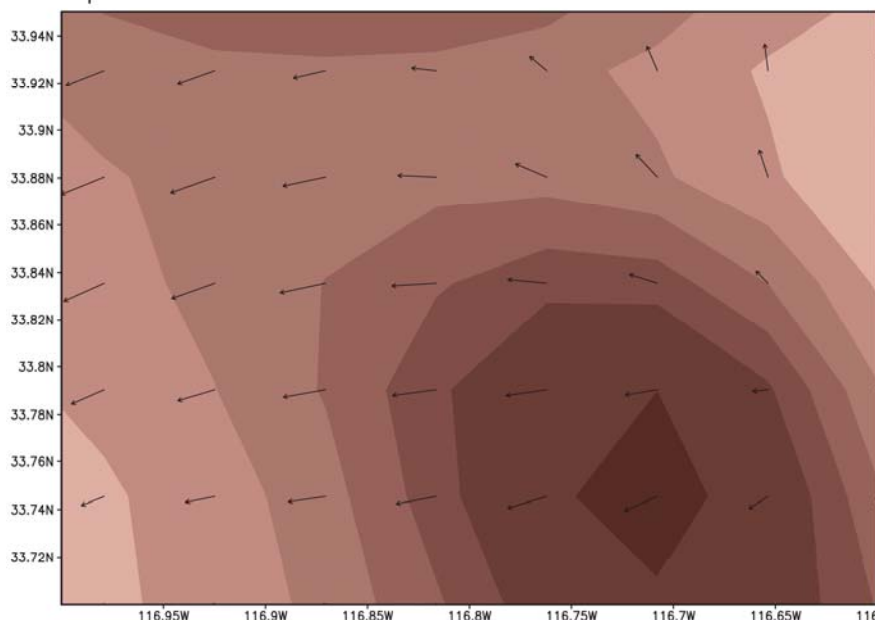 - OSU2 surface scheme
- ### Model Grids
  - 5km 136x136
  - 1km 136x136

Esperanza fire 5km run 10-m wind at T= 08Z26OCT2006   Esperanza fire 1km run 10-m wind at T= 08Z26OCT2006
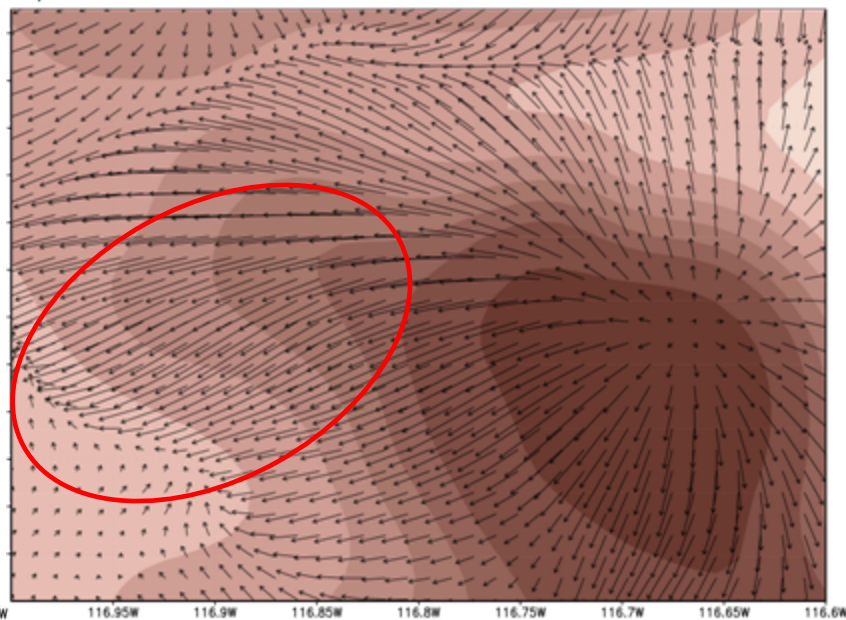
Esperanza fire 5km run 10-m wind at T= 14Z26OCT2006   Esperanza fire 1km run 10-m wind at T= 14Z26OCT2006

Local Time

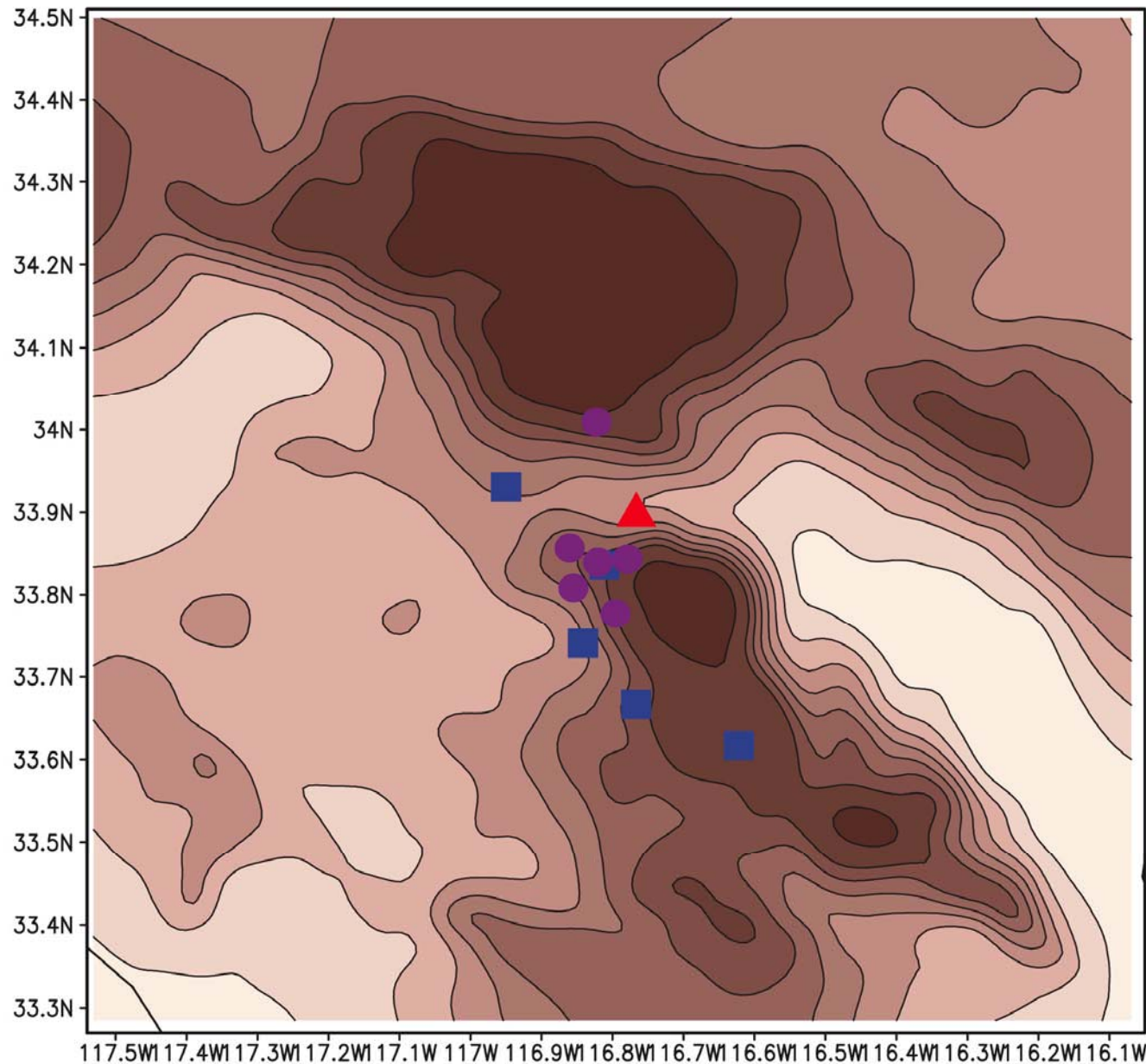**01am**

07am

5-km run   1-km run

Available SFC Validation Stations
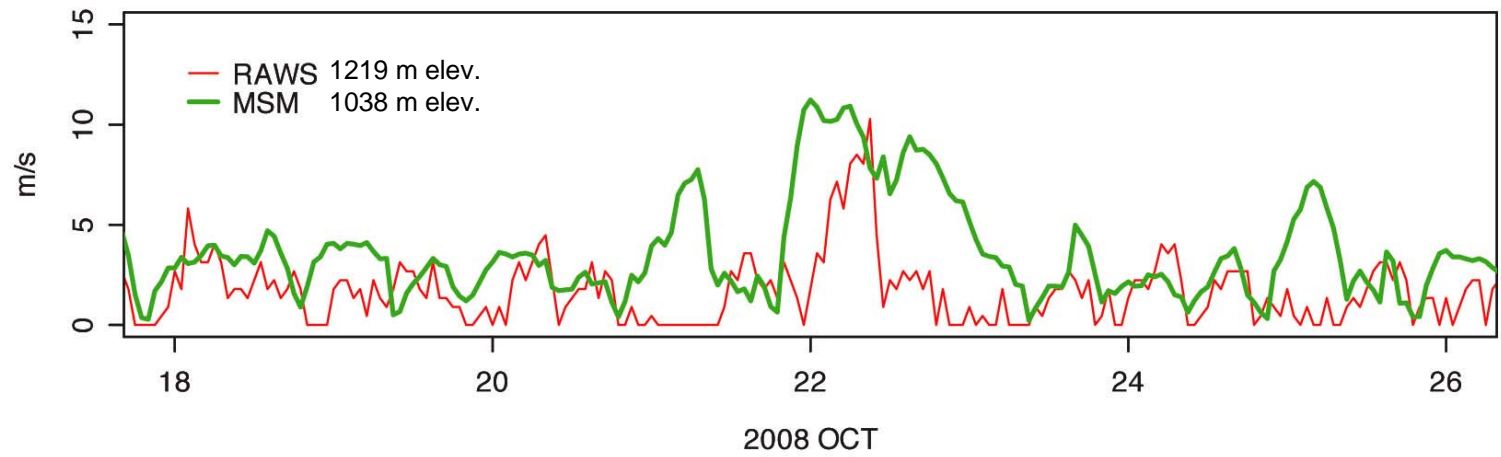
■ Existing RAWS

● Experiment RAWS

▲ Ignition point

San Jacinto 1km Orography

Beaumont Wind Speed

RAWS 805 m elev.
MSM 838 m elev.

m/s

2008 OCT
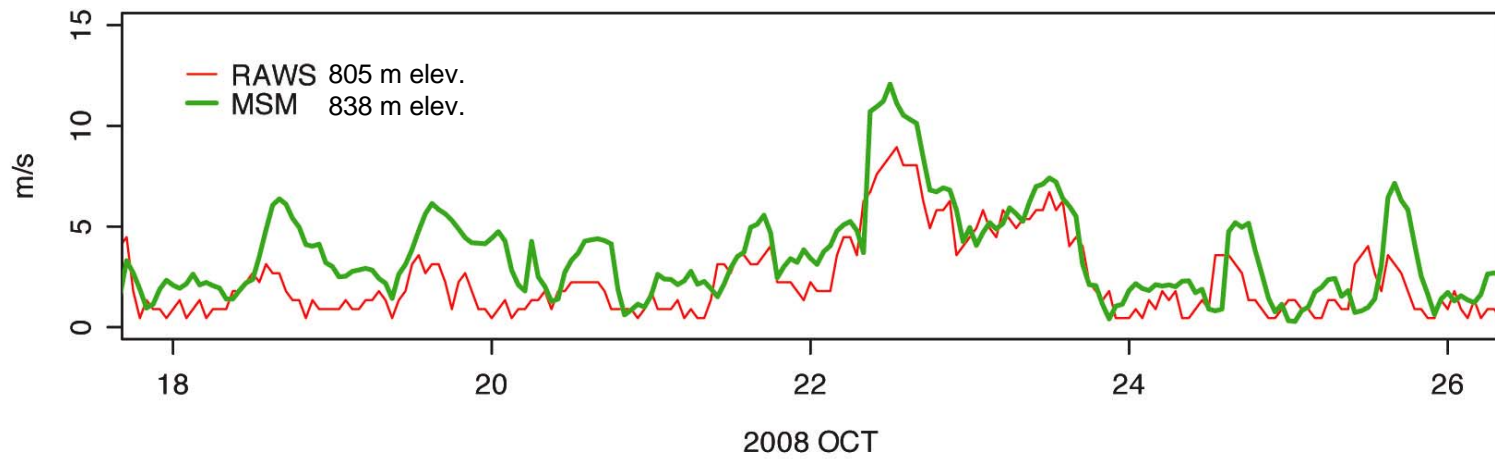
Beaumont Temperature

C

2008 OCT
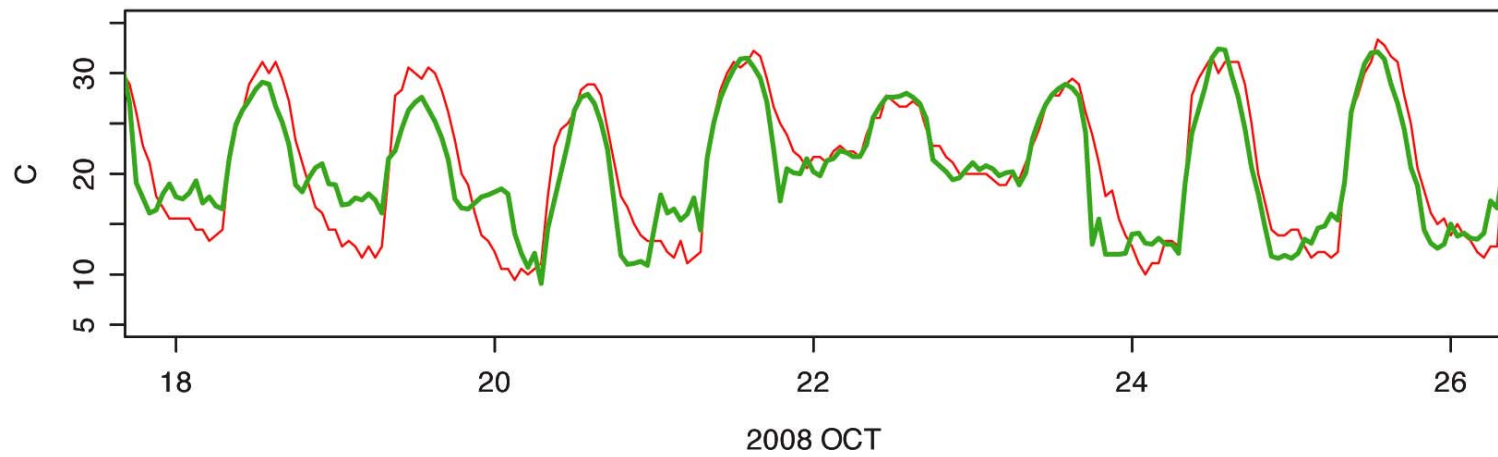
IndianMountain Wind Speed

RAWS 1219 m elev.
MSM 1038 m elev.

2008 OCT

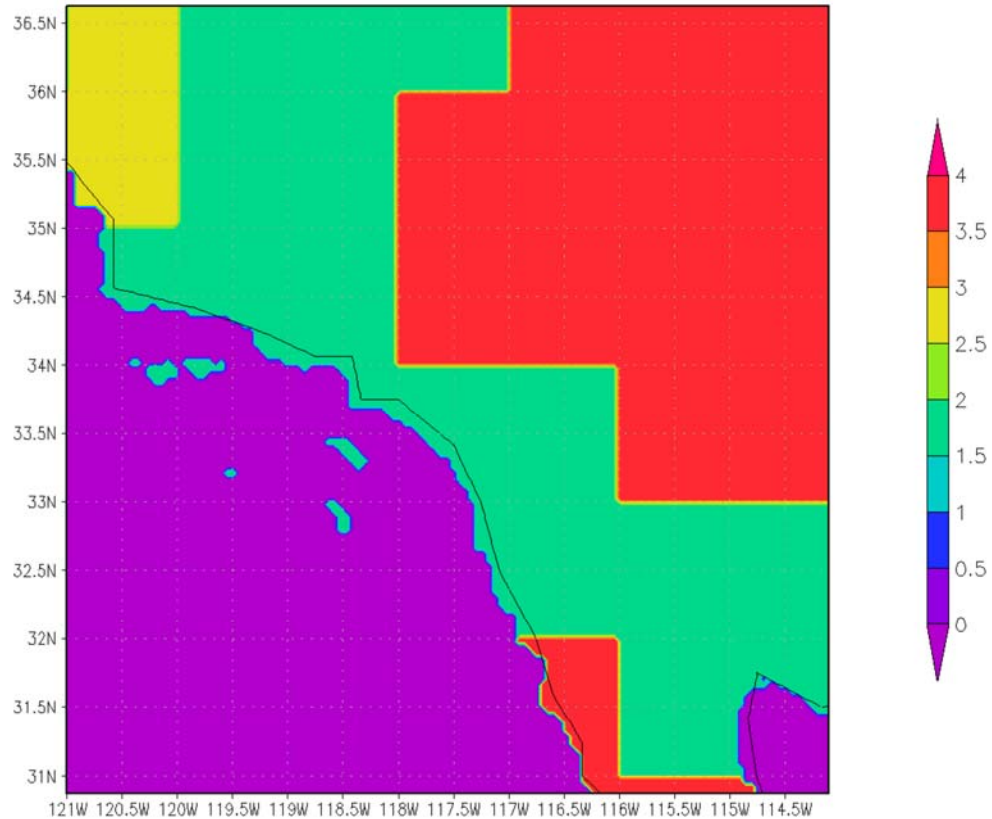**IndianMountainTemperature**
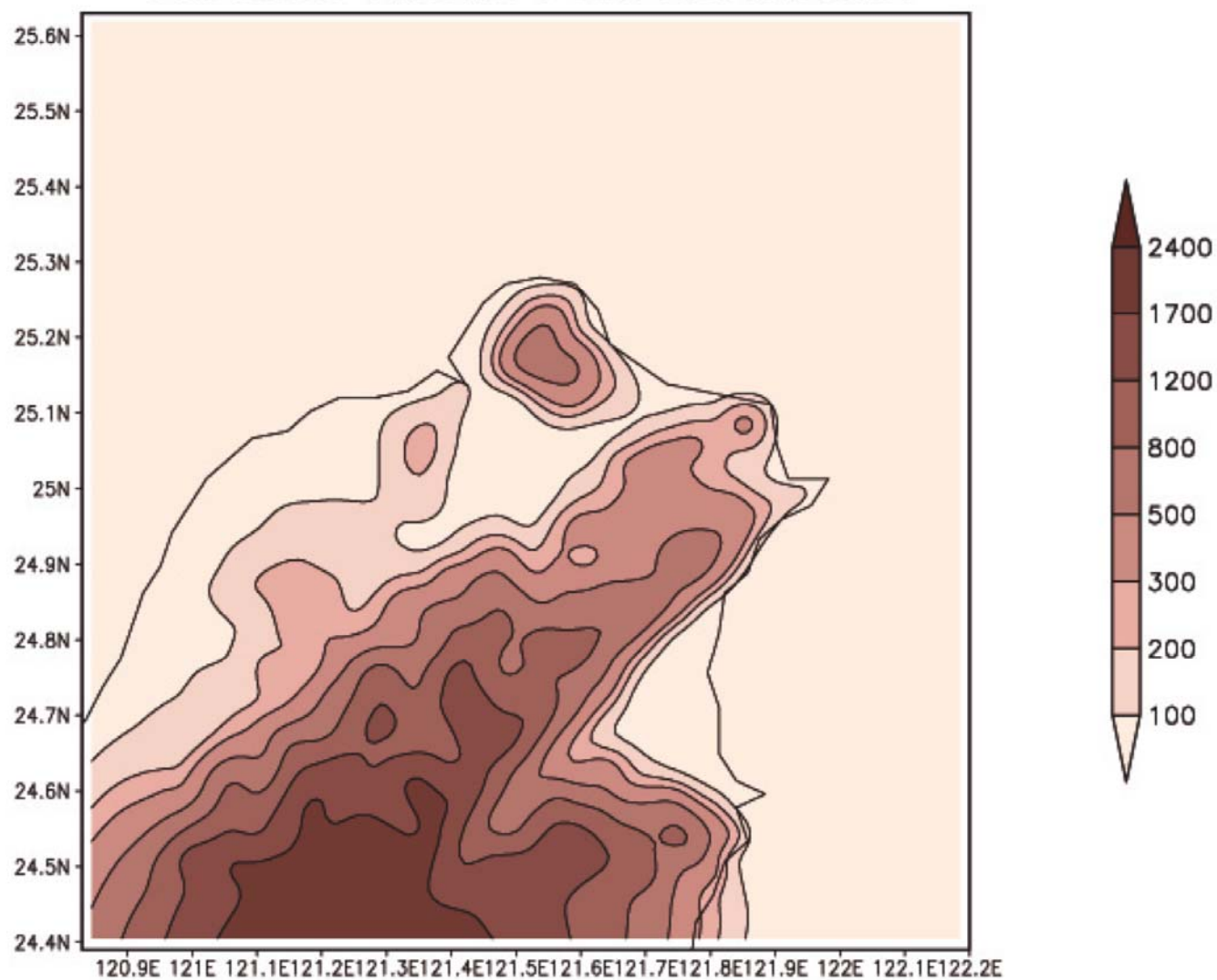
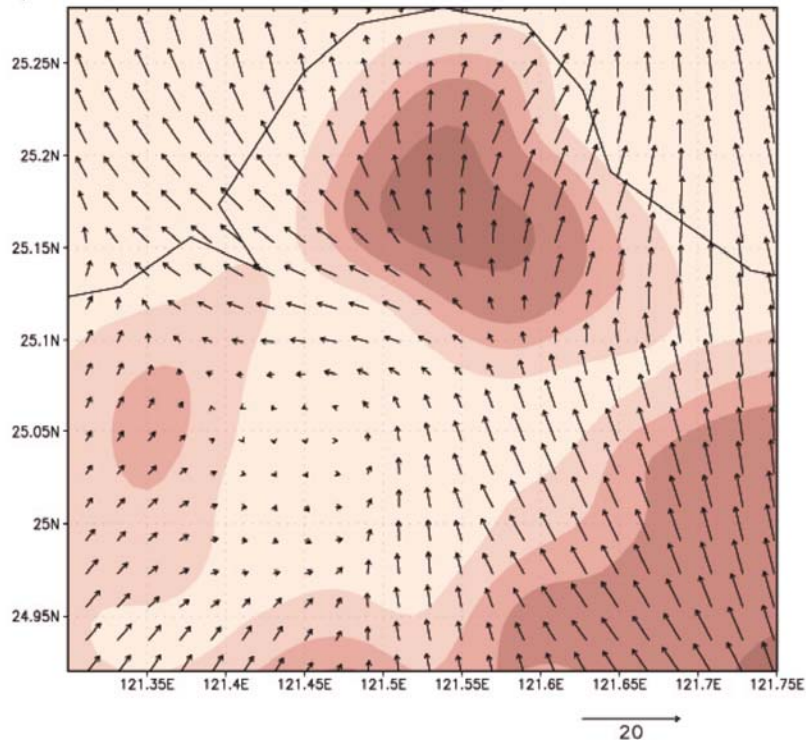2008 OCT
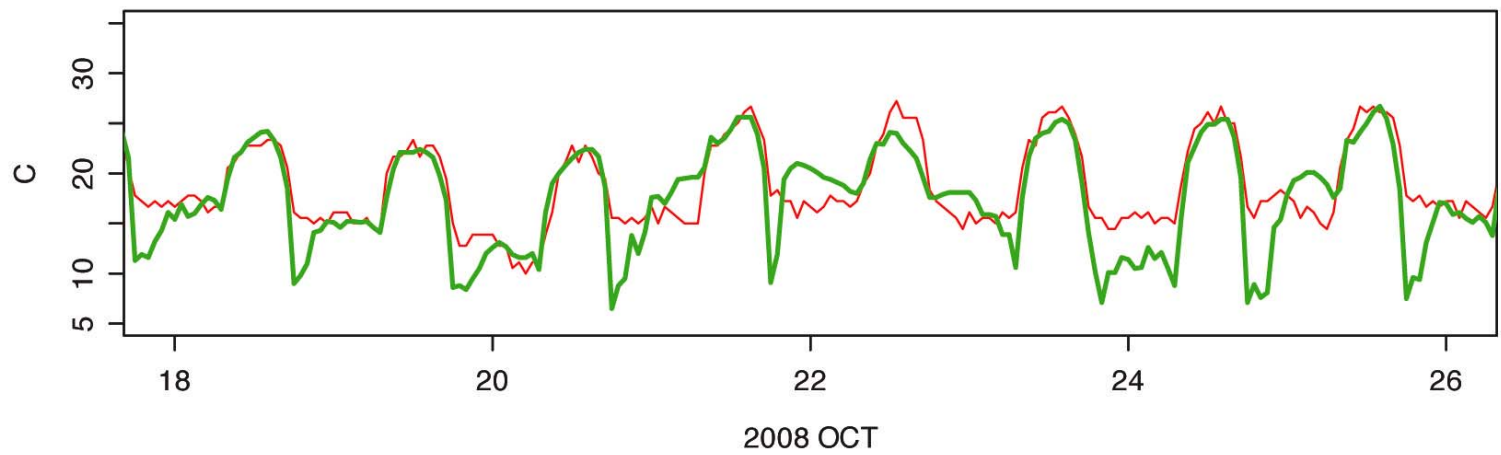
5-KM run

Night time T$_{2m}$
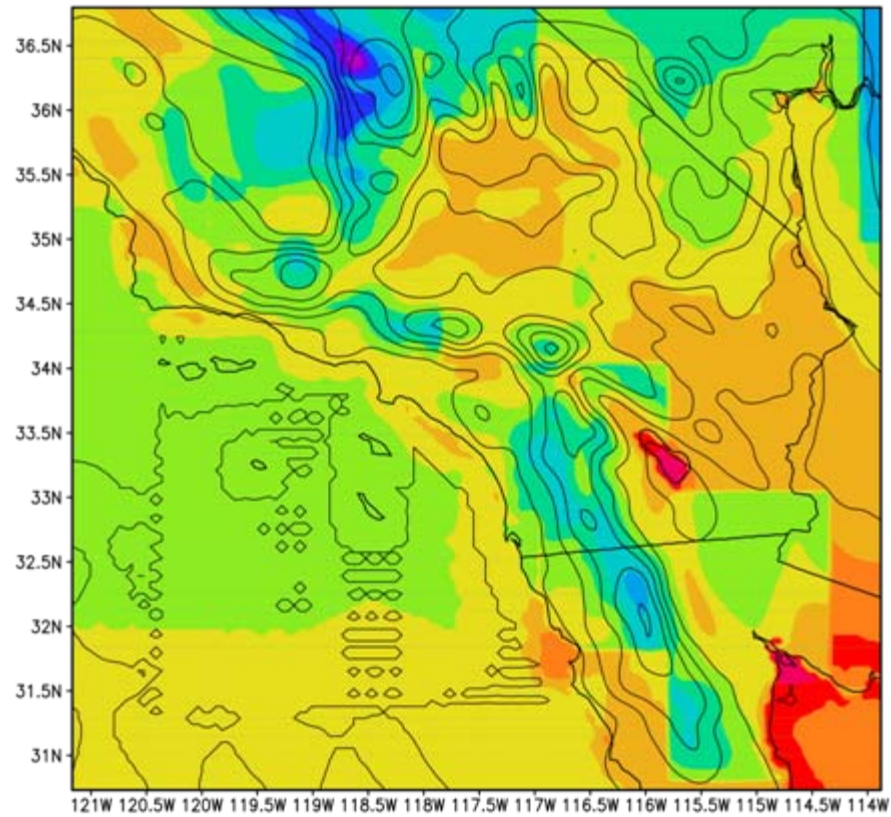
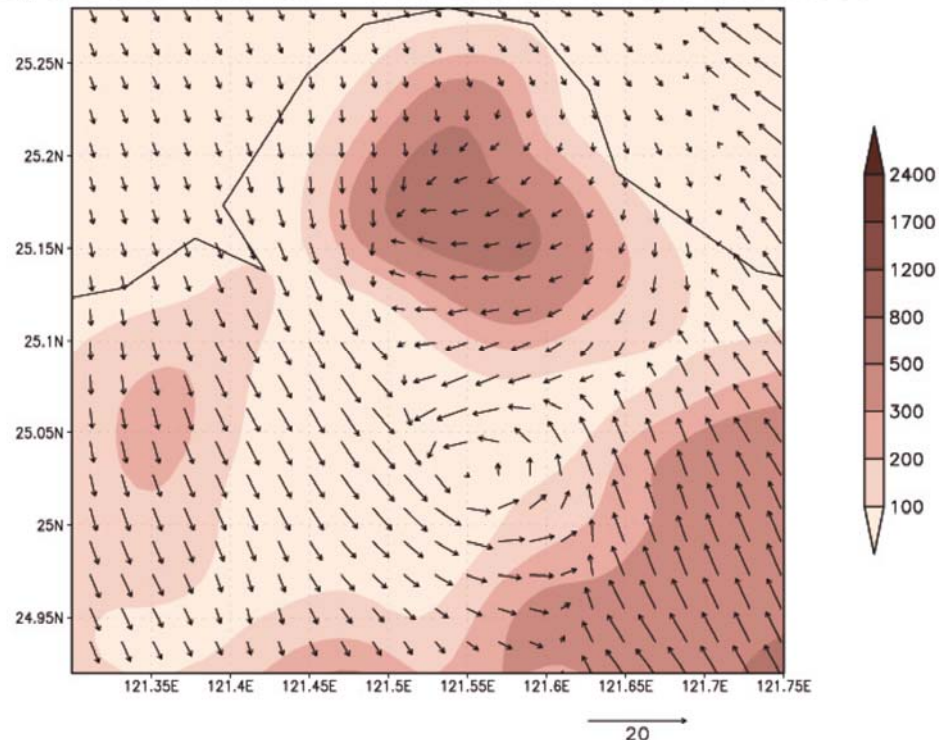Soil Type

Northern Taiwan 1-km run domain

5-KM run

4AM LST

2PM LST

Taipei Basin 1km run 10-m wind at T= 18Z15MAR2009

Taipei Basin 1km run 10-m wind at T= 08Z16MAR2009

Summary and Future Task

υ The MSM is potentially useful for fire suppression, specifically

1. the fine resolution topography improved surface wind from imposing larger scale analysis or forecasts

2. the up- and down-slope diurnal wind shift caused by radiational differential heating and cooling were reasonably simulated

3. the critical northeasterly over Esperanza fire area was simulated in a bigger domain run

4. Preliminary results show that MSM simulated wind speed and temperature compare well with observed RAWS data. However there seems to be systematic night time cold biases caused by coarse land features. The added skills by the non-hydrostatic MSM needs to be identified.

5. Even at 1-km grid spacing, the weather model resolution is far from meeting the requirement for fire spread model. Further downscaling is needed!