

MATERHORN Large Eddy Simulations

Jingyi Bao, Jason Simon and Tina Katopodes Chow

Granite Mountain application

Nesting from mesoscale model (WRF) to fine resolution(IBM-WRF)
Sophisticated lateral boundary condition from WRF
Sophisticated bottom boundary condition condition from IBM-WRF(surface similarity theory)
Achieve fine resolution down to meter scale





Granite Mountain application

The challenge is nesting from WRF to IBM-WRF
(interpolation procedure from terrain following WRF to Cartesian IBM-WRF)
Preliminary result of a semi-ideal run

WRF: terrain following coordinate system

IBM-WRF: Cartesian coordinate system





□ Real terrain

□ 60m resolution

- □ No slip
- Periodic
- Quiescent sounding initialization
- Prescribed surface cooling and heating(thermal coupling)
 (200W/m² daily cycle)
 The share termin
- □ zI: I5m above terrain







Vertical contours of u, w velocity after 2hr of heating
Neutral boundary layer allows this deep convection.



Zoom in of east slope u and w contours



Vertical contours of u, w velocity after 1/2hr of cooling

Computational cost limitation
32 processors, 200 grid points in both x and y
24 real days to run a day of simulation
Waiting for downslope drainage flow to develop
More details of the flow need to be worked out

Summary

IBM-WRF can run at least 60m resolution

Standard WRF blows up at ~300m resolution for 3D GMAST

Future setup

- Higher resolution terrain data and land use data
- Lateral boundary conditions
- Run down to 10m resolution for the slope region

Can further study

- Idealized drainage flows on slope
- Entrainment along slope
- Surface similarity theory

Future real run

□ Need input!

- Nesting from mesoscale model to microscale model
- □ Which IOP? (IOP 8 in fall campaign at Oct 18th and IOP2)
- Experiment data?
- □ Computational cost?
- □ Can further answer:
 - □ Synoptic forcing effects
 - □ soil moisture effects
 - heat budget effects

Future and Ongoing work

Ongoing work

- High resolution slope flows
- Log law 3D implementation
- Real nesting from WRF to IBM-WRF

Future work

- Methods in the "terra incognita"
- Adding TKE 1.5 closure in IBM-WRF