The Local Underlying Surface Effect on Regional Precipitation in the Three-Gorge Region in China

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Both of local underlying surface water bodies and topography have an important influence on local circulation in Three Gorges area. What impact does local land surface has on local circulation in different local precipitation cases? What do meteorological elements respond to the underlying surface changes in different regional precipitation? This study explores regional local circulation response to the underlying surface changes by using WRF-ARW model with varying local model land surface. The cases studied are 19-20 October 2001 and 14-15 March 2002 respectively.

Experimentation design

Table .1 the detail of numerical simulation experimentation scheme

Scheme	Modified parameters
Controlled experiment(CT)	——
The Yangtze River water added(ST1)	LU_INDEX
Half terrain height reduced(ST2)	HGT
The Yangtze River water added and half terrain height reduced(ST3)	LU_INDEX 、HGT

Table .2 the detail of model experimentation scheme

Experimentation Scheme	desgin
simulation domain center	107°E、30°N
Horizontal grids	116×110、163×148
Spatial resolution(D1,D2)	15 km、5km
Microphysics scheme	Purdue Lin
Longwave radiation scheme	Rrtm
Shortwave radiation scheme	Dudhia
Near surface scheme	Monin-Obukhov scheme
Land surface scheme	Themal diffusion scheme
Planetary boundary layer scheme	YSUscheme
Cumulus parameterization scheme	Grell-Devenyi

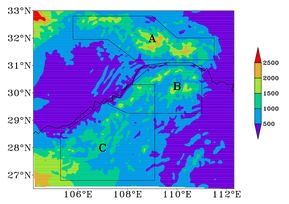

Fig.1 the modified underlying surface regions and the modified terrain height areas (A, B,C represent different terrain changed areas respectively, unit: m)

Results

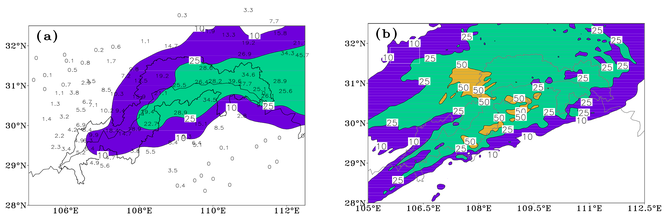

Fig.2 (a) the observed and (b) controlled experiment simulated precipitation from 12:00 UTC on19 to 12:00 UTC on 20 October (unit: mm , the intervals of contours are 10,25,50 mm, and the digital is the precipitation amount)

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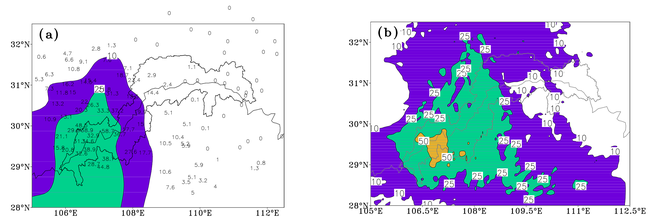

Fig.3 (a) the observed and (b) controlled experiment simulated from 12:00 UTC on 14 to 12:00 UTC on 15 March (unit: mm , the interval of contours are 10,25,50 mm, and the digital is the precipitation amount)

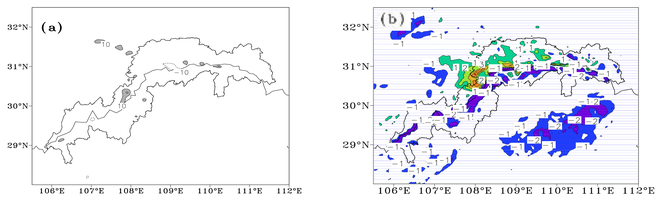

Fig.4 (a) the different precipitation between ST1 and CT from 12:00 UTC on 19 to 12:00 UTC on 20 October (the shaded areas mean the values ≥ 10 mm, unit: mm), (b) the different relative humidity between ST1 and CT (unit: %)

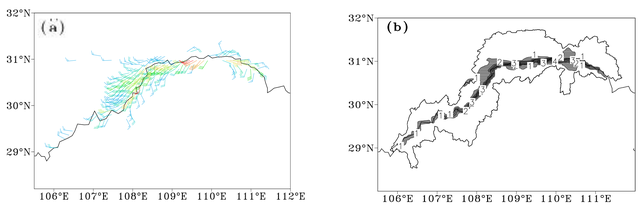

Fig.5 (a) the different wind at 10 m height between ST1 and CT (the figure shows wind ≥1 m.s^{-1} and the wind plume bar denotes 1 m.s^{-1}), (b) the different temperature at 2 m from 12:00 UTC on 19 to 12:00 UTC on 20 October (unit: K)

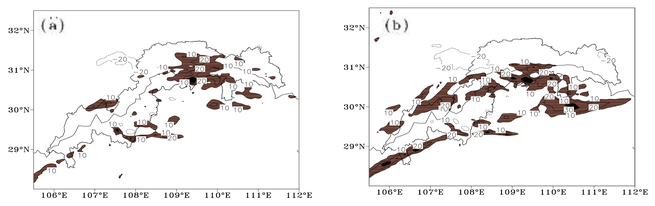

Fig.6 the different precipitation (a) between ST2 and CT , (b) between ST3 and CT from 12:00 UTC 19 to 12:00 UTC 20 October (the shaded areas mean the values ≥ 10 mm, unit: mm)

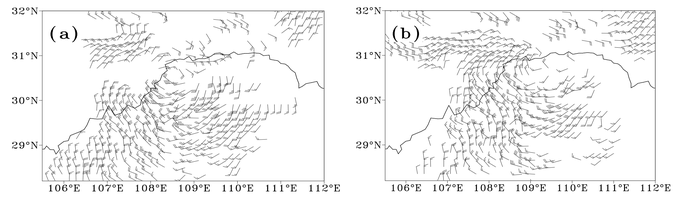

Fig.7 the different wind at 850hPa height between ST2 and CT at (a) 00:00 UTC on 20 October and (b) 06:00 UTC 20 October (the figure shows wind ≥2 m.s^{-1} and the wind plume bar denotes 2 m.s^{-1} , unit: m.s^{-1})

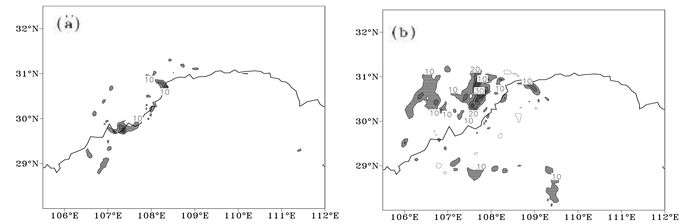

Fig.8 the different precipitation (a) between ST1 and CT, (b) between ST2 and CT from 12:00 UTC 14 to 12:00 UTC 15 March (the shaded areas mean the values ≥ 10 mm, unit: mm, unit: mm)

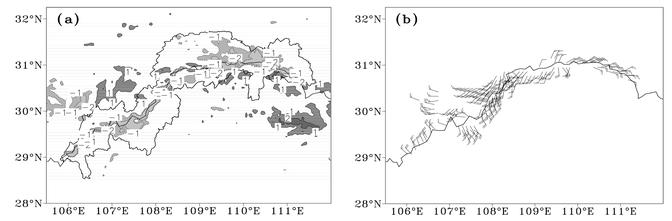

Fig.9 (a) the different relative humidity at 2 m height between ST1 and CT from 12:00 UTC 14 March to 12:00 UTC 15 March (unit: %), (b) the different wind at 10 m height (the figure shows wind ≥1 m.s^{-1} ,and the wind plume bar denotes 1 m.s^{-1}, unit: m.s^{-1})

Summary

The precipitation distribution change is not obvious with the Yangtze River Water bodies imbedding in the different regional rainfall cases and the impact on regional spatial precipitation from reducing terrain height in Three Gorges Reservoir Area is obvious, indicating the Yangtze River water bodies only weakly affects local precipitation.

With the Yangtze River underlying surface imbedded and the terrain height modified simultaneously, greater influence on the spatial rainfall variation can be observed that is the same as modifying terrain height independently, suggesting that local topography is important to the precipitation distribution.

The variation of 2 m relative humidity is different with different underlying surface water bodies and at different regional rainfall cases and the impact on local relative humidity was inconspicuous overall.

The 2 m temperature, the surface upward moisture flux and the surface upward heat flux increase mostly, which are more obvious in the Yangtze River turn under the role of local terrain “bell”.