Sensitivity analysis of Land surface schemes along with spinup time in WRF model for Precipitation

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Abstract:

This paper is divided into two sections. First section tells us about the spin up time period. A sensitivity analysis has been done by taking 0hr, 24hr and 48 hr spin up time to know the accuracy of results which depend on spin up time. This spin up analysis has been done by taking different land surface parameterization schemes available in WRF model. The second part deals with the best suited scheme validation for precipitation for 3rd and 4th September 2012. The results shows that as the spinup time period increase the accuracy of results increased. Noah Land surface parameterization scheme is giving us best result both in terms of precipitation.

Keywords: LSP, WRF, RMSE

1. Introduction:

Model initialization is very important in doing simulations. Spin-up is the time taken for a model to reach a state of statistical equilibrium under the applied forcing. It is very difficult to decide how much spinup time period we choose for initialization. So the study to decide the spinup time period becomes important. As per authors knowledge this is the first attempt to study spinup time for WRF model. To improve the accuracy of forecasts, we need to understand physical mechanisms and processes that control regional climate change(1). So LSPs study has been done to understand the physical mechanism of WRF model

II. Model Description and Data

The Weather Research and Forecasting (WRF) Model(2) version 3.2 is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting needs. For our stuty WRF 3.2 with domain resolution 30 km has been used. WSM microphysics(3), Kain Fritsch cumulus parameterization scheme, Similarity surface layer, Meller Planetary boundry layer, RRTM(4) radiation scheme has been used.

Indian Meteorological Department data is used as observational data. The simulations have been done over Indian domain for the period 3rd September 2012. The Thermal scheme is the simplest, where only soil temperature is calculated. The representations of snow, vegetation, and soil moisture processes are missed. The Noah and RUC schemes are at the intermediate level of complexity, but RUC has a relatively more complex snow scheme when compared to Noah. Sensitivity analysis of Four Land Surface schemes Noah, Thermal, RUC, Pleim has been done

Three experiments has been designed

Exp1(48h spinup) Simulation for 1st to 3rd September 2012

Exp2(24 hr spinup Simulation for 2nd to 4th September 2012

Exp3(0hr Spinup) Simulation for 3rd to 5th September 2012

III. Results and discussion:

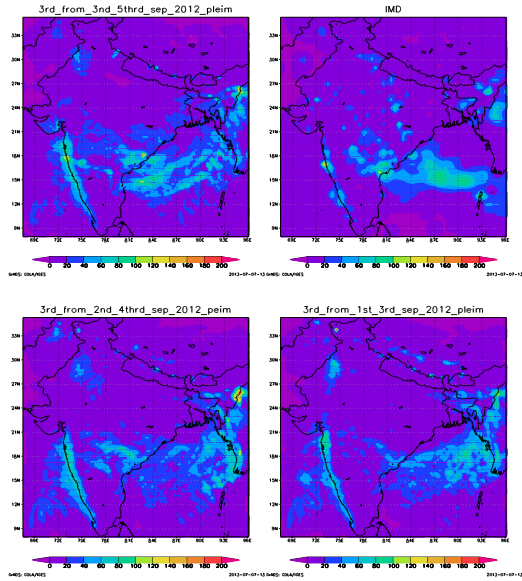After doing simulations for four LSP the results were as follows:

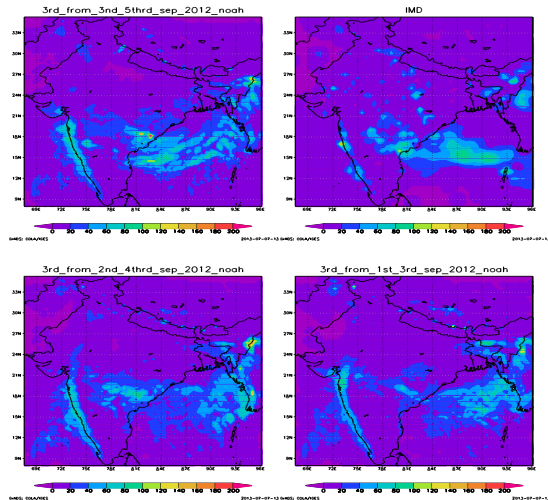Fig 1: Pleim LSP results for rainfall compared with IMD data

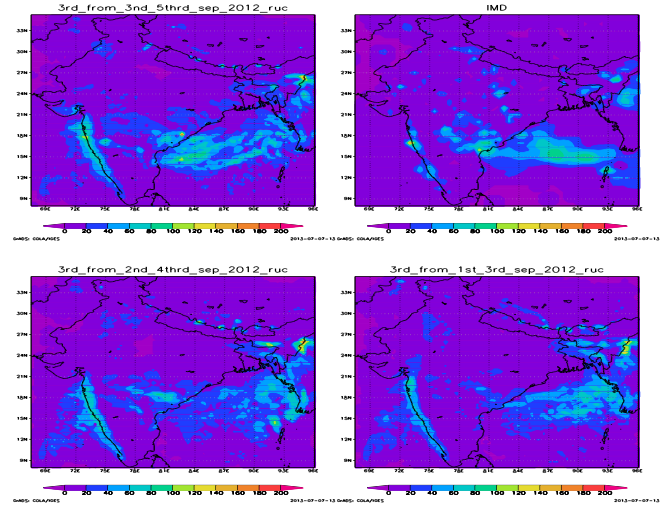Fig 2: Noah LSP results for rainfall compared with IMD data

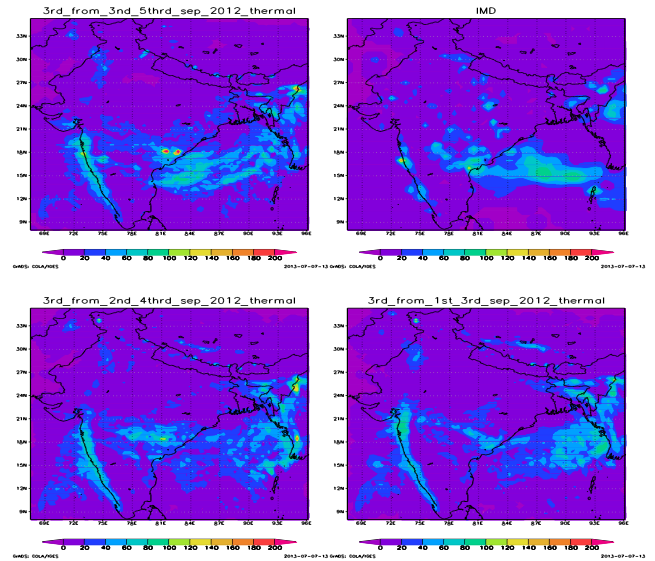Fig 3: Noah LSP results for rainfall compared with IMD data

Fig: 4 Thermal LSP results for rainfall compared with IMD data

The WRF model was able to capture the precipitation
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The Root Mean Square Error (RMSE) for the above mentioned LSPs are

Table1 : RMSE for 3rd sepetember 2012

3rd sep	1st to 3rd	2nd to 4th	3rd to 5th
Noah	12.551	13.3446	13.6155
RUC	12.76	13.45	14.01
Pleim	12.85	13.81	14.19
Thermal	13.45	13.86	14.08
IMD	10.475	10.475	10.475

Table 2: RMSE for 4th September 2012.

4th sep	2nd to 4th	3rd to 5th
Noah	12.9552	13.5488
RUC	13.17	13.68
Pleim	13.73	14.36
Thermal	14.09	14.19
IMD	12.7473	12.7473

After seeing all these results we concluded that 48 hr spin up time period gives us good results along with Noah LSP as for 3rd September the RMSE is 12.55 and IMD observed data is 10.47. Similarly for4th sepetember Noah LSP RMSE is 12.95 which is very near to 12.74.

IV Conclusion:

We concluded that as more spin up time period we take our results will be more accurate.

The evaluation of different LSPs gives Noah as the best suited scheme. So Noah scheme can be used for future studies of WRF model.

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