Improvement on precipitation forecast over complex topography: Study on physics parametrization in NWP model ALADIN

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1. Aim of the research

Within an international co-operation, the Limited Area Model (LAM) ALADIN has been developed by Meteo-France and ZAMG, together with 12 other European national weather services. Because of strong influence of mountain on weather processes ALADIN have some specific problems over complex mountainous area, especially the precipitation forecast.

The aim of the project is to improve the ALADIN precipitation forecast. Special attentions are paid to studying the physics parametrization schemes in ALADIN for improvement of the precipitation forecast.

2. Results

Up to end of Aug. 2005, several experiments with different physics parametrization schemes in the model ALADIN have been carried out. The experiments are as follows:

- ***y640***: operational version, it is with Kessler-type scheme for large scale precipitation; Geleyn's scheme of shallow convection and simple radiation; Bougeault-type scheme of deep convection; Boer-type scheme of gravity wave drag; force-restore method for soil temperature and water; vertical exchange calculation taking into account a planetary boundary layer and a surface layer based on the Louis scheme, the model integration time step is 600s.

- ***y641***: same as ***y640***, but with a shorter time step 415s for investigating the dynamics and physics interaction.

- ***y631***: A more comprehensive microphysics scheme LOPEZ is introduced into ALADIN, instead of the simple Kessler-type scheme for large scale precipitation.

- ***y634***: with microphysics scheme LOPEZ and a modified Kann-Fritsch deep convection scheme.

- ***y635***: with microphysics scheme LOPEZ, modified Kann-Fritsch deep convection scheme, and a modified Kann-Fritsch shallow convection scheme.

- ***y636***: same as ***y631***, but with the prognostic TKE (turbulent kinetic energy) parametrization.

One of the most intense rainfall episodes during the Mesoscale Alpine Programme MAP IOP2b (19-20. Sept. 1999) was used for the all the experiments. The preliminary conclusion of this case study are summarized in the following:

(1) In general, all the simulations have recognized the major features of the mesoscale structure, but many disagreements with the observation exist, especially in the region with complex topography.
(2) The statistical verification scores of the experiments show that the microphysics scheme LOPEZ together with the modified Kann-Fritsch deep convection scheme bring the most benefits on the ALADIN precipitation forecasts over complex mountainous area.
(3) Some spurious strong precipitation on the wind ward side of the mountain has been removed by the LOPEZ scheme. There are also some signs for improvement of the rainfall forecast on the lee side of the mountain.
(4) In the Valley region, like Po-Valley, it is difficult to find any improvement. In the region of steep mountain like Lago Maggiore area, all the schemes generalize the rainfall well compared with the observation.
(5) The modified Kann-Fritsch convection scheme alone doesn't improve the forecast, but it makes the convection more organized than Bougeault scheme.
(6) The prognostic TKE parametrization has little impact on the precipitation for MAP IOP2b case.

(7) Longer time step lets less interaction between dynamics and physics in the model, which makes impact on the precipitation forecast.

3. Activities in 2005 and plans for 2006

Efforts of the teams in Meteo-France and ZAMG were concentrated upon the experiments with different physics schemes in ALADIN. Wang travelled to Meteo-France for the purpose of discussing the scientific results and the plan for co-operation between Meteo-France and ZAMG in March 2005. Bazile was at ZAMG in July 2005 for investigating the MAP IOP2b case. Bazile and Wang visited the Frence embassy in Vienna in July 2005. They presented AMADEUS project to the responsible persons for science and technology of the embassy.

A one-month systematic verification of different physics scheme in ALADIN, like microphysics scheme LOPEZ, modified Kann-Fritsch convection scheme, and so on, e.g. for the August 2005 are planned in 2006. More detailed test of the physics schemes in ALADIN will be continued. Further case studies are also planed.

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