APPLICATIONS OF THE NCEP REGIONAL SPECTRAL MODEL

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I. Model Improvements

The regional spectral model (RSM) developed at the National Centers for Environmental Predictions (NCEP, formerly NMC) by Juang and Kanamitsu (1994) has been enhanced during the past two years to have more functionality. The main advantages of the model are still the higher order accuracy due to the spectral computations and the reduced computational errors due to the time-dependent perturbation method. Since the RSM has the same model physics and model structure as the global spectral model (MRF model, Sela, 1982; Kanamitsu et al, 1991), model development and management efforts are reduced. Also, the inconsistency arising at the boundary is much smaller since the same model formulation is used in the global and regional models.

Originally the RSM was nested into the global spectral model and formed one executable code. This condition has been relaxed so that the RSM can now run with lateral boundary conditions from global output files supplied externally. Furthermore, it can be nested into itself with lateral boundary conditions from the regional output files, making a multi-grid nesting from coarse to fine resolution possible. A new version of the preprocessor now makes it possible to run the same model code on either a workstation or on a Cray machine. The source codes have been fully vectorized and multi-tasking is utilized with a fast version of the Fast Fourier Transform. The GRIB format files assure that the model output is portable to any machines.

The current version of the model, just as the operational MRF, has an improved PBL physics and a simplified Alakawa-Shubert cumulus convection. In addition, a simple lateral boundary blending and local diffusion to strong wind areas have been implemented into the RSM that allowed to increase the time step by 100% (Juang, 1995). A blending of the global and regional orography (Hong and Juang, 1996) reduced the inconsistency in sea level pressure between the two models, experienced in case of small regional domains.

II. Applications at NCEP

The RSM is primarily intended to be used for daily weather forecasting. Before operational implementation, the model has to be fully tested in a quasi-operational environment for an extended period. The RSM with 80 km resolution, covering the North American region has been tested for more than one year. The averaged equatable threat score of precipitation during the past year was better than that for the MRF and was compatible with the scores for the Eta model, which is currently the operational regional model at NCEP. There are several test versions of the RMS running twice a day, out to 48 hr lead time, at 80 km and 50 km resolution. During boreal summer, a 40 km version of the RSM is run daily over a South American region, to support the South American Desk at NCEP. Recently, a 10 km resolution version of the RSM has been put into testing. The model reveals interesting mesoscale features over its domain that covers the Hawaii Islands (Juang, 1996). At the same time, the data assimilation scheme used in the global analysis is being adopted for the RSM (Wu and Juang, 1996). All these daily forecast outputs in the GRIB format were posted in nic.fb4.noaa.gov under the directory name called /pub/rsm, which can be access through ftp by anonymous.

Besides daily weather forecasting, the RSM has been used as a research tool in several experimental studies. One of the applications is in the reanalysis project. The global T62 spectral resolution analysis fields serve as lateral boundary conditions and base fields while the regional perturbations are carried over by the RSM into the next analysis cycle (instead of using real observation; Juang and Kanamitsu, 1993). The RSM was also used to create a multi-month integration from one initial condition (with sea surface temperatures updated daily, Kanamitsu and Juang, 1994) for the Indian monsoon region. The RSM is also used in the creation of an ensemble of regional forecasts at NCEP once a week (Rogers et al., 1996). To support the volcanic ash dispersion model of Air Research Laboratory, NOAA, a relocatable version of the RSM has been developed that can be run in emergency situations on the NCEP Cray computer. The multi- nesting version of the RSM has been used to support the regional model COMPARE project with a case called PYREX. The results of the simulation have some interesting observational features.

III. Applications outside NCEP

Several national and international institutes requested access to the RSM. At some places, the RSM is used to support daily weather forecasting, while at others it is used primarily in case studies for research purposes. It was the SCRIPPS Institute at the University of California at San Diego that first requested the RSM as a tool in their regional climate studies. Both the global and the regional spectral models have been running at SCRIPPS on their Dec alpha workstation for years. In the near future an emergency fire response system will be set up in collaboration with their local contractor, using a 25 km resolution RSM over California. The NCMRWF in India has been running the RSM over India at a 50 km resolution on a CRAY XMP for more than a year. The Tennessee Valley Authority (TVA) has been running the RSM over their area at a 20 km resolution to possibly support their dam operation. Universities in Taiwan, such as the National Central University, the National Taiwan University and the Chong-Cheng Institute of Technology are running the RSM in a research mode on their Dec alpha workstations.

The NWS regional office in Honolulu, Hawaii recently requested that a version of the RSM be installed on their Dec alpha server to do experimental testing for possible use in daily weather forecasting over their area with a resolution of up to 10 km or even higher. Recently a similar request was made by the Chilean Weather Service. Chile is a geographically very diverse country so we expect to see especially rich mesoscale structures when the RSM will be installed in its national weather forecast bureau.

IV. Future Plans

Although final decisions have not been made the RSM may become part of the operational aviation (AVN) forecast system. With its higher resolution, it can enhance the skill of aviation forecasts over the US. Its relocatability makes it also suitable for this application, supporting special operations.

Regarding model improvements, portability, efficiency and functionality will be enhanced. In addition, new or improved physical packages will be introduced into the RSM such as a new cloud scheme and a simple SiB scheme. A nonhydrostatic version of the RSM model (Juang, 1992) will also be made available with full model physics, for supporting weather forecasting at very high resolutions.

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