6.12 REGIONAL DATA ASSIMILATION USING A STRETCHED-GRID APPROACH AND ENSEMBLE
CALCULATIONS

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1. INTRODUCTION

The global variable resolution stretched grid (SG) version of the Goddard Earth Observing System (GEOS) Data Assimilation System (DAS) incorporating the GEOS SG-GCM (Fox-Rabinovitz 2000, Fox-Rabinovitz et al. 2001a,b), has been developed and tested as an efficient tool for producing regional analyses and diagnostics with enhanced mesoscale resolution. The major area of interest with enhanced regional resolution used in different SG-DAS experiments includes a rectangle over the U.S. with 50 or 60 km horizontal resolution. The analyses and diagnostics are produced for all mandatory levels from the surface to 0.2 hPa. The assimilated regional mesoscale products are consistent with global scale circulation characteristics due to using the SG-approach. Both the stretched grid and basic uniform grid DASs use the same amount of global grid-points and are compared in terms of regional product quality.

2. REGIONAL DATA ASSIMILATION

The efficient down-scaling to mesoscales is obtained for the stretched-grid system for both instantaneous and time-averaged regional analyses and diagnostics. The experiments are performed for different seasons. The SG-DAS is capable of reproducing regional mesoscale patterns and diagnostics that are not produced by coarser uniform resolution runs (with the same amount of global grid points). Monthly mean precipitation for two anomalous U.S. summer events, the 1988 drought and 1993 flood, as well as for the anomalous spring event of1998, is closer to gauge precipitation observations for the SG-DAS.

The SG-DAS fields and diagnostics are used for regional studies and for validation of regional climate simulation experiments produced with the GEOS SG-GCM. Also, more realistic, significantly stronger gradients and winds are produced by the SG-DAS for the super-typhoon Paka (December 1997). The impact of finer 40 km resolution is discussed in terms of subregional monsoonal precipitation and other characteristics and found positive.

The 13 months long (November 1997 to December 1998) SG-DAS experiment is performed with the stretched-grid with multiple areas of interest. The following four areas are used: the U.S.; the El Nino/Brazil area; India-China; and the eastern Indian Ocean/Australia. The efficient regional downscaling is obtained for all four areas. The assimilated products are analyzed for the following anomalous regional climate events: the April-June flooding in the Midwest and Northeast and drought in the South of the U.S.; the December-1997 - May-1998 Mexican drought; the Indian summer monsoon; the severe summer flooding in China; and anomalous precipitation over Australia.

The new series of SG-DAS experiments are conducted as ensemble calculations. Perturbations of initial conditions for the first guess (or the 6 hour forecast) are introduced. The impact of ensemble SG-DAS calculations is assessed in terms of a better representation of regional assimilated products. The perturbations of the analysis scheme parameters affecting its filtering properties is discussed.

The obtained results show that the stretched-grid data assimilation system is a viable tool/candidate for producing high resolution/mesoscale assimilated products for regional studies and applications.

References

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