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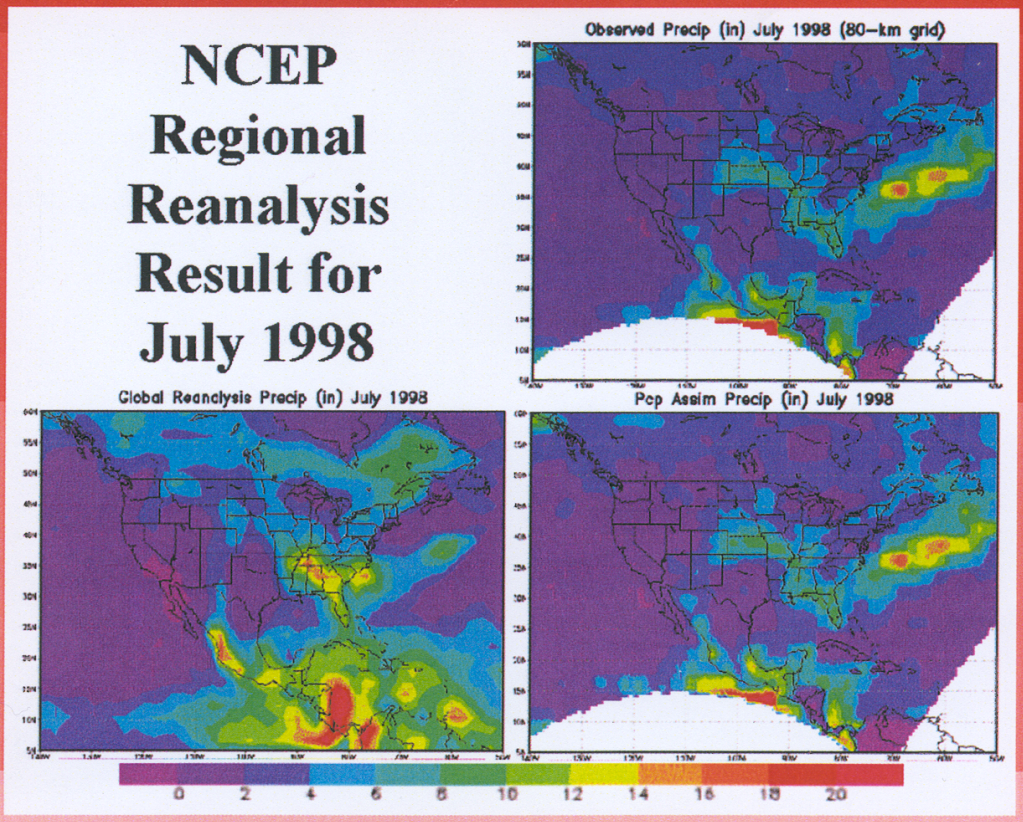

AMERICAN METEOROLOGICAL SOCIETY

J1.1 REDUCING NEAR-SURFACE COOL/MOIST BIASES OVER SNOWPACK AND EARLY SPRING WET SOILS IN NCEP ETA MODEL FORECASTS VIA LAND SURFACE MODEL UPGRADES

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1. INTRODUCTION

Since 1996, a series of NOAA GAPP/GCIP-sponsored land-surface related advances have been implemented in the NCEP mesoscale Eta model and its Eta-based data assimilation system (EDAS). This began with the introduction in January 1996 of a multi-layer soil-vegetation-snow land-surface model originally developed at Oregon State University (Mahrt and Pan, 1984), and modified for use in the Eta model (Chen et al 1996). At that time, the Eta model used initial soil moisture and temperature from the NCEP global model data assimilation system (GDAS), which employs soil moisture nudging to a fixed, annual-cycle soil moisture climatology.

Over the following 2-3 years, subsequent advances to the Eta model land-surface treatment included the use of the NESDIS, high-resolution, NDVI-based vegetation greenness fraction database, adjustments to the initial global model soil moisture, an increase from two to four soil layers, and the use of the NESDIS operational daily 23-km North American snow cover and sea ice analysis. This late 90's period of Eta land-surface improvements culminated in June 1998 with the introduction of continuous self-cycling of Eta soil moisture and soil temperature in the Eta 4-D Data Assimilation System (EDAS). The latter employs no soil moisture nudging. Since then and up to the present (over three years), the Eta model's initial soil moisture and soil temperature have been sole products of the continuous cycling of these two land states in the coupled land-atmosphere EDAS.

Between June 1998 and July 2001, no further significant changes were implemented to the operational Eta/EDAS land-surface package. Section 2 presents examples of the validation of Eta model performance during that period. Simultaneously during that period, off-line development focused on our next generation of land-surface improvements, to include frozen soil processes, plus substantial advances to the snowpack physics and ground heat flux physics. This phase of significant upgrades, in collaboration with our GAPP/GCIP and other partners, led us to coin the name "NOAH" to designate our new LSM. Section 3 describes these LSM upgrades and Section 4 presents some results from the successful testing of these upgrades in the coupled Eta/EDAS, which culminated in their operational implementation on 24 July 2001.

4. COUPLED ETA MODEL TESTING

Pre-implementation testing of the upgraded NOAH LSM in the coupled Eta model spanned 1) a summer month (12 Aug - 12 Sep 2000), 2) a winter month (01 Feb - 01 Mar 2001), and a spring month (24 Apr - 24 May 2001). Over these three periods we continuously executed the cycled EDAS and launched twice-daily 60-h Eta forecasts (one each from the 00Z and 12Z initial times) for both A) the control configuration (then operational suite) and B) the test configuration with the NOAH LSM encompassing the land-surface changes summarized in the previous section. The next two sub-sections present two examples of model bias reduction in the test case.

4.1 *Spring case*

The Eta model control case (i.e. as operational prior to the 24 Jul 2001) exhibits a near-surface cool (moist) bias in forecasts of air temperature (dewpoint) throughout the U.S. north central plains in spring, when the near-surface soil is typically moist from spring rains and the recent snowmelt season, and before substantial green vegetation has emerged. Inspection of Fig. 4 of the 60-h Eta forecast, valid at 00Z on 30 Apr 2001, of the dew point temperature in the lower boundary layer reveals that the test (right frame) is substantially less moist than the control (left frame).