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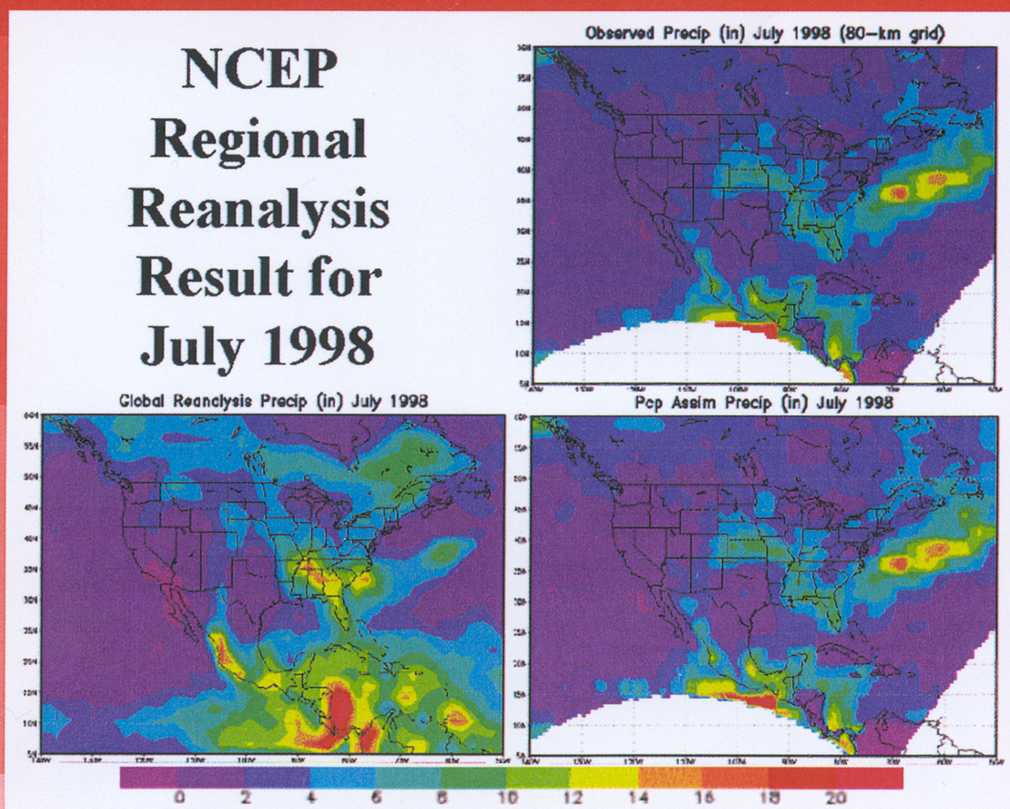


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# J4.5 THE EFFECT OF ERRORS IN SNOW ASSIMILATION ON LAND SURFACE MODELING

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## 1. INTRODUCTION

The accurate portrayal of the hydrological cycle is extremely important in land surface modeling. Central to this effort is the treatment of snow, as errors in the representation of this quantity can impact practically all other modeled quantities through alterations in the water and energy balances. Although land surface model (LSM) simulations can benefit from the assimilation of snow cover and snow depth observations, they can be negatively impacted if such observations contain errors or if a model bias exists in the simulation of surface or soil temperatures. Both cases may lead to excessive melting or growth of snow packs, and to large alterations in both the energy and water balances. Such problems in the snow assimilation process, made evident by the repeated melting and replenishing (without a snowfall event) of snow pack over significant areas of the United States, exists in the Eta Data Assimilation System (EDAS, Rogers et al., 1996) and is a product of the EDAS system's direct insertion assimilation of snow data (Figures 1a-c, 2). Occurring on a 24 hour cycle, the repeated melting infuses the soil column with a large quantity of water that upsets the hydrological cycle.

## 2. DISCUSSION

In an effort to quantify the impacts of such errors in snow assimilation on water and energy budgets, a series of Mosaic LSM (Koster and Suarez, 1996) simulations were performed over the period covering October 1998 to September 1999. A control run was conducted to provide "perfect" snow observations that were then directly assimilated, once per day, into experimental runs (Figure 3) which featured a range of warm and cold biases created by the manipulation of shortwave and surface temperature forcing data. These experimental simulations show that even a 0.5°C warm bias can interact with assimilated snow data to significantly impact the water budget. After one month of directly inserting snow data into an experimental Mosaic run characterized by this forcing bias, the total column soil moisture changed by up to 3.5%, and changed by up to 11% in a run featuring a 2°C warm bias (Figure 4). The error in the water budget is also substantial in both experimental runs, with the largest residuals of up to 250mm occurring over mountainous regions (Figure 5) in the 2°C bias run.

## 3. CONCLUSION

These preliminary results demonstrate that while it might be expected that the assimilation of error-free snow observations would lead to improved LSM results, a small LSM temperature bias leads to large-scale errors in the water balance. Even if the snow assimilation system perfectly reconciled modeled and observed snowpack states, the law of mass conservation could still be violated if biases exist in the model. Complicating the issue is the fact that in practice, snow observations are not without error. As such, more research is needed to determine how best to reconcile imperfect snow observations with LSMs that may be characterized by model biases.

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