INTEGRATION OF SNODAS DATA PRODUCTS AND THE PRMS MODEL – AN EVALUATION OF STREAMFLOW SIMULATION AND FORECASTING CAPABILITIES

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ABSTRACT

The U.S. Geological Survey (USGS) hydrologic model PRMS is being used to simulate and predict daily snowmelt runoff for a number of basins in the western United States. PRMS is a distributed-parameter model that uses the concept of polygon or gridded hydrologic response units (HRUs) to account for the spatial and temporal distribution of snow accumulations and melt. It was developed for application to a wide range of basins where available meteorological data are typically limited to daily precipitation and maximum and minimum air temperature. An energy balance and water balance are computed daily for each HRU. The sum of the water balances of each HRU, weighted on a HRU-area basis, produces the daily basin response. The Snow Data Assimilation System (SNODAS) is a modeling and data assimilation system developed by the National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) to provide estimates of snow cover, snow water equivalent, snowmelt, and associated snowpack variables at a 1-km spatial resolution to support hydrologic modeling and analysis. SNODAS includes procedures to ingest and downscale output from Numerical Weather Prediction (NWP) models; a physically based, spatially-distributed energy-and-mass-balance snow model; and procedures to assimilate satellite-derived, airborne and ground-based observations of snow covered area (SCA) and snow water equivalent. These gridded products can be used for comparing and/or updating spatially distributed state variables in PRMS. Comparison of PRMS and SNODAS SCA on selected basins show comparable results. The SNODAS snow-melt and snowpack-property data products are currently being evaluated by substituting them into PRMS for use in simulating daily streamflow. The resulting hybrid model can use the SNODAS data products to simulate current basin conditions and then use the standard PRMS model and the Ensemble Streamflow Prediction (ESP) capability in PRMS to predict future Streamflow conditions. Results of the integration of PRMS and the SNODAS data products for selected basins will be presented.

PRESENTATION EXTRACTS

Slide 3: Focus Issues:

- The distribution of point precipitation measurements for streamflow simulation and forecasting.
- Concerns:
  - Spatial and temporal availability and variability
  - Measurement error and missing data
  - Ungauged basins

Slide 4: Meteorological Variable and Appropriate Forecasting Methodology

- Historic data as analog for the future
  - Ensemble Streamflow Prediction (ESP)
- Synthetic time-series
  - Weather Generator
- Atmospheric model output
  - Dynamical Downscaling
  - Statistical Downscaling

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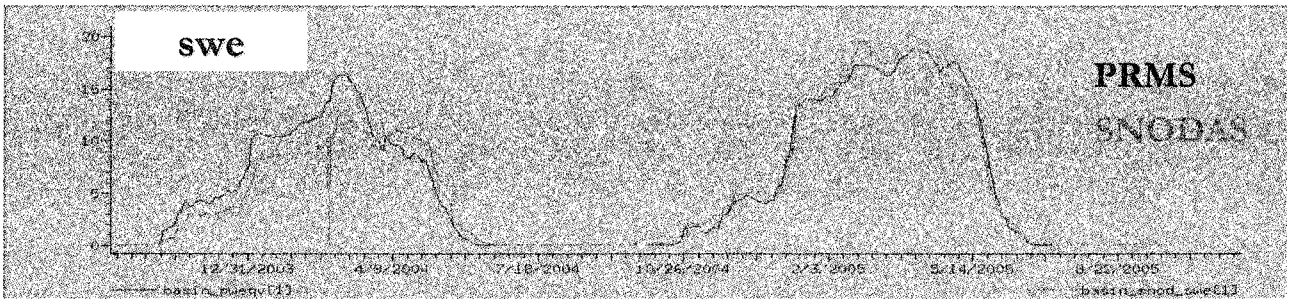
Slide 5: Precipitation Interpolation Methods:

- Inverse distance weighting
- Kriging
- Multiple linear regression
- Climatological multiple linear regression - PREFERRED
- Locally weighted polynomial
- k nearest neighbor
- others

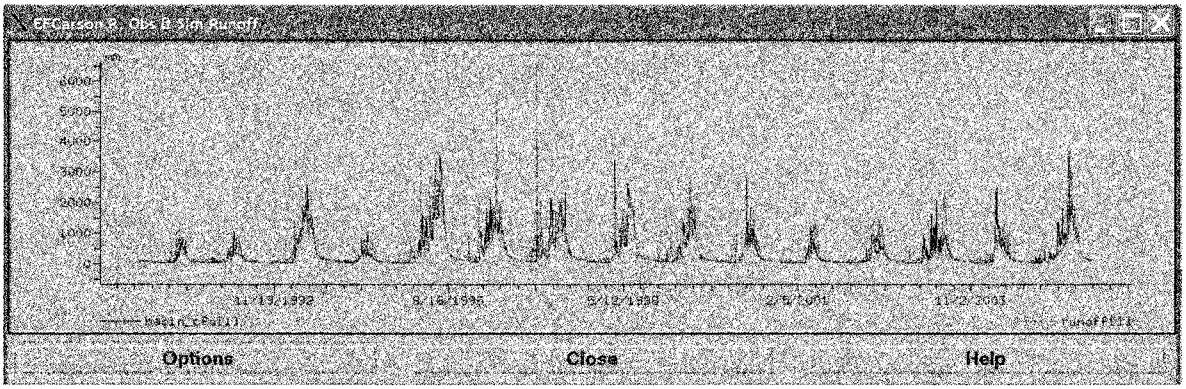
Slide 9-10: XYZ Spatial Redistribution of Precipitation and Temperature:

- 1. Develop Multiple Linear Regression (MLR) equations (in XYZ) for PRCP, TMAX, and TMIN by month using all appropriate regional observation stations.
- 2. Daily mean PRCP, TMAX, and TMIN computed for a subset of stations (3) determined by the Exhaustive Search analysis to be best stations
- 3. Daily station means from (2) used with monthly MLR xyz relations to estimate daily PRCP, TMAX, and TMIN on each HRU according to the XYZ of each HRU

Slide 11: SNODAS vs. PRMS, Animas Basin, year 2000



Slide 15: Predicted and Measured Streamflow, E. Fork Carson River, 1990-2005



Slide 39: Discussion and Conclusions

- This effort is a work in progress (Sample of 2 basins).
- Remotely sensed measures of SCA are valuable, but the combined products of SCA and SWE from SNODAS provide a needed extra dimension for modeling.
- Similar mean daily melt rates in PRMS and SNODAS can result from different spatial HRU melt rates.
- Update of PRMS SWE may be possible when distributional patterns of SNODAS SWE are similar.
- The weaknesses of a climatological multiple linear regression precipitation distribution method was demonstrated
- Work is continuing to identify the most robust precipitation distribution methods for different climatic and physiographic regions and will build on the SNODAS product.