DMIP2 Soil Moisture Results

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Experiment Design and Data

- Run uncalibrated models using *a priori* parameter grids over Oklahoma Mesonet continuously for the period 1995 – 2002.

- Select 75 river basins not affected significantly by regulation in the Arkansas River basin (areas 10 - 15,000 sq. km.)

- Simulate basin averages of runoff and soil moisture saturation ratios for 0-5 cm, 0-25 cm, and 25-75 cm soil layers at daily time interval

- Generate daily saturation index grids and basin averages using Oklahoma Mesonet measurements

- Analyze different statistics for Noah (EMC) and SAC-HT (OHD)

Oklahoma Mesonet Gauge Network and Test Catchments
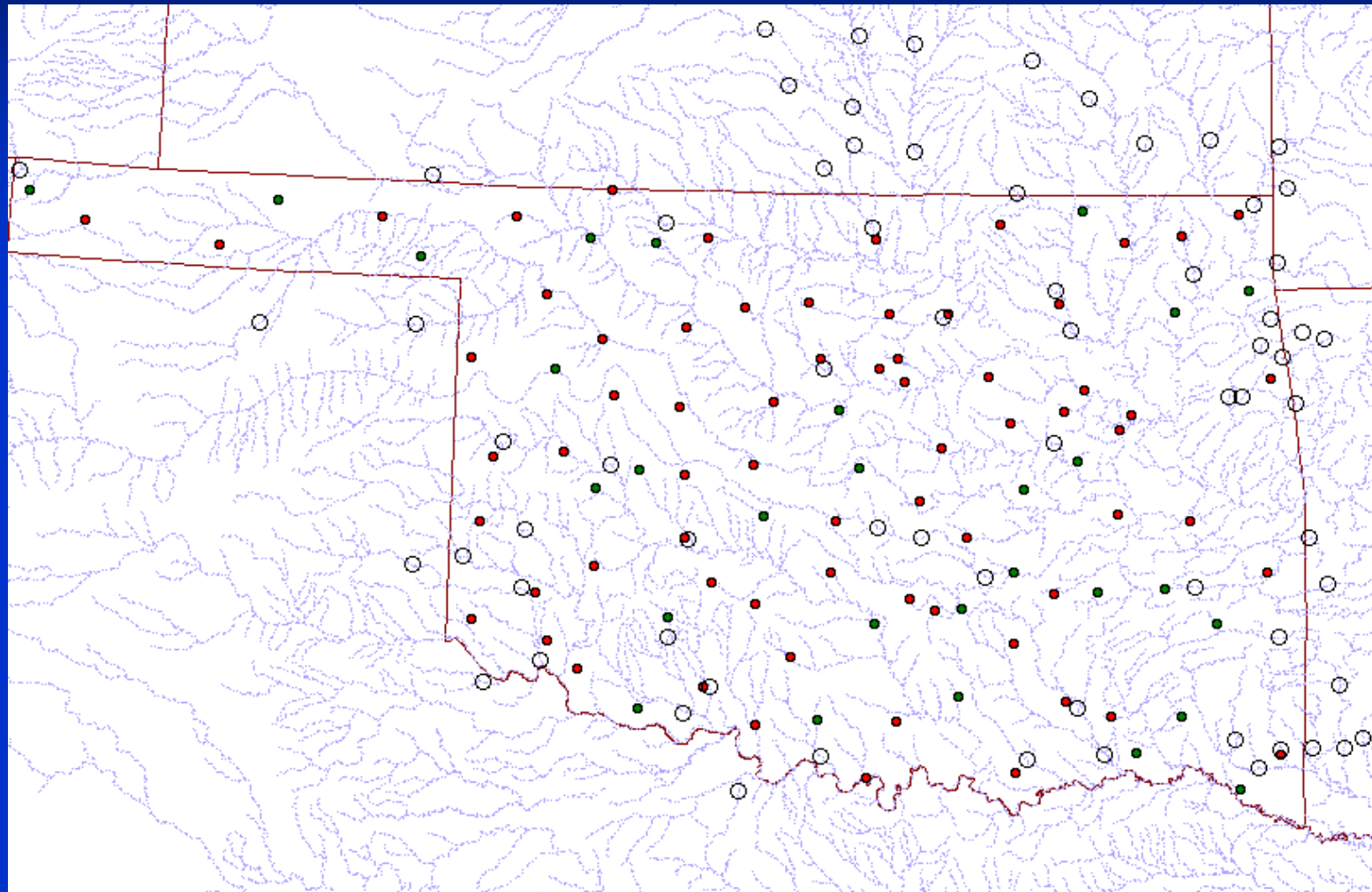
○ USGS Gauges   Mesonet Sites: ● 75 cm   ● 25 cm

Oklahoma Mesonet Measurement Problem:
From Illston et al: Representativness of Soil Moisture Conditions in Central Oklahoma During the Enhanced Drying Phase
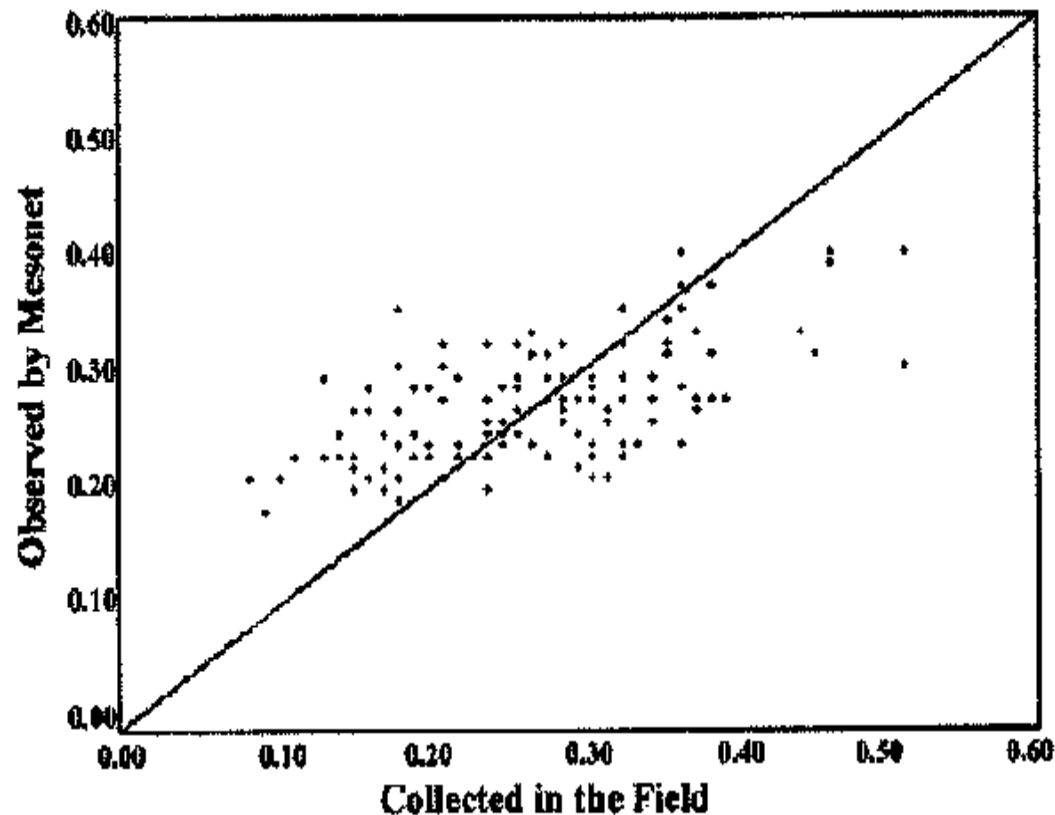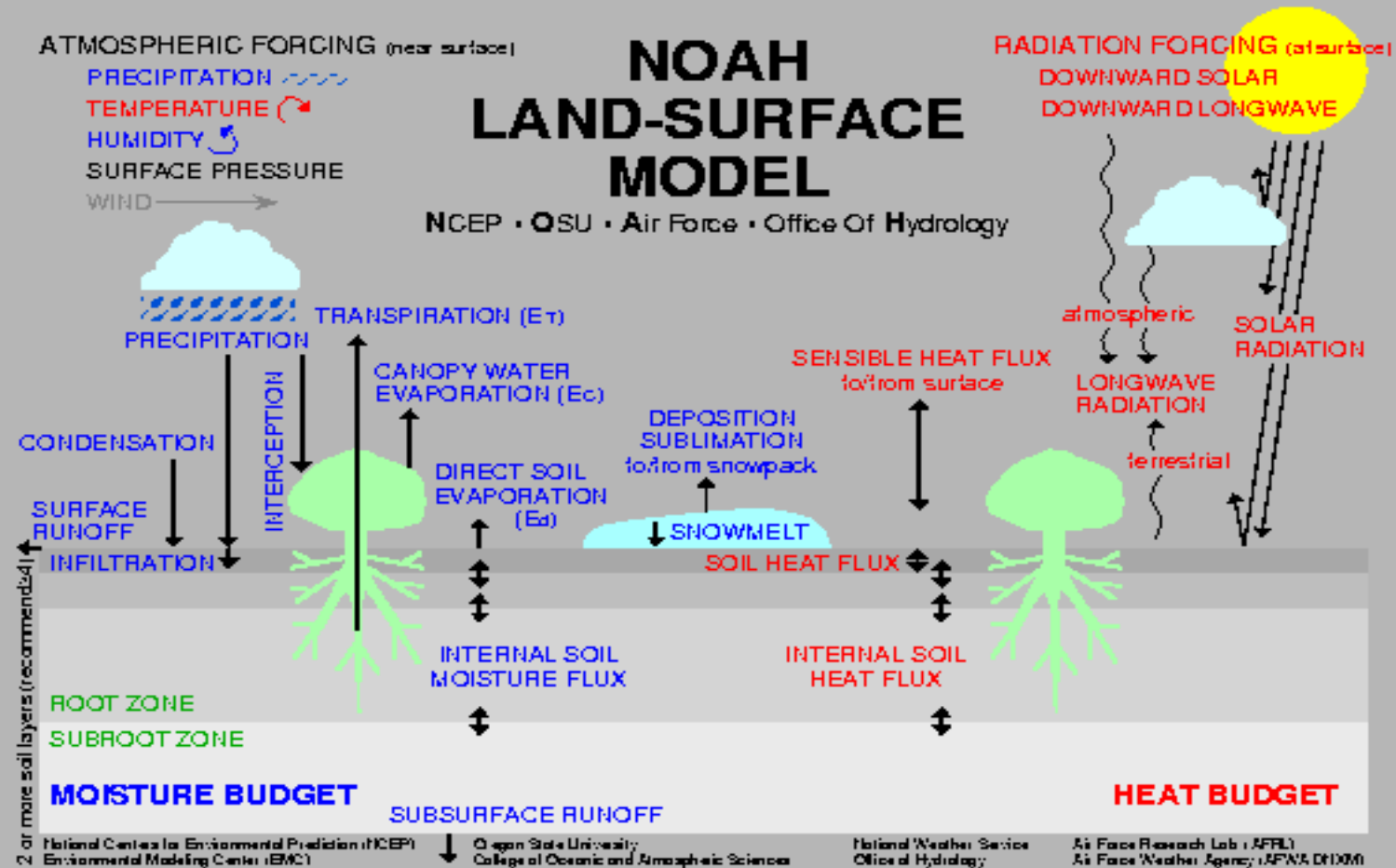

Figure 5. Collected 25cm soil water content values versus 25cm soil water content values observed by the Oklahoma Mesonet during the sampling period.

	OM	CS
MAX	0.41	0.52
MIN	0.18	0.08
AVG	0.27	0.27
STD	0.05	0.09

Models Used: Noah (EMC)

Models Used:
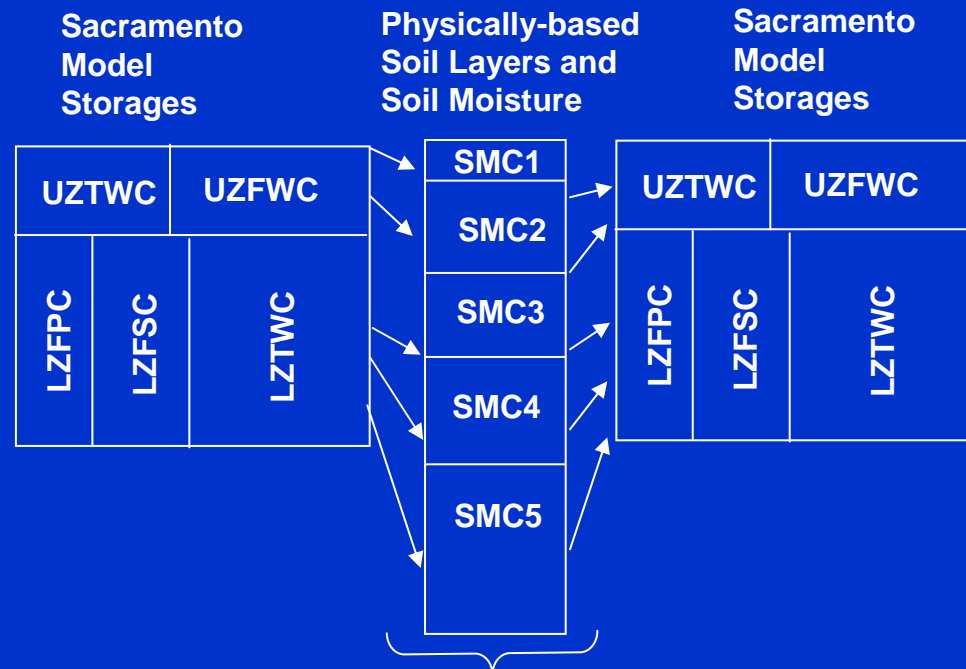## Modified Sacramento Soil Moisture Accounting Model

Gridded precipitation
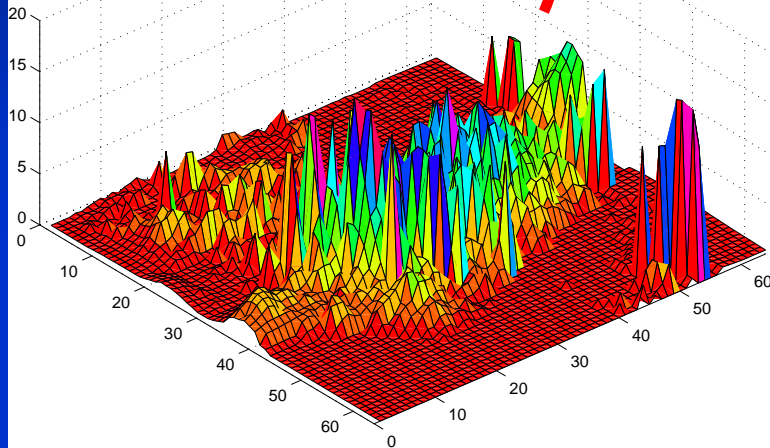
4km gridded soil moisture
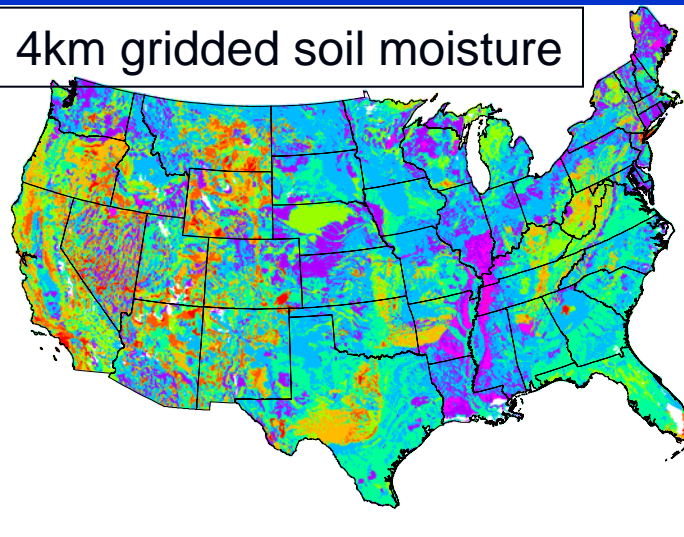
**Modified Sacramento Soil Moisture Accounting Model**

In each grid and in each time step, transform *conceptual* soil water content to *physically-based* water content

| Sacramento Model Storages	Physically-based Soil Layers and Soil Moisture	Sacramento Model Storages
UZTWC / UZFWC	SMC1	UZTWC / UZFWC
	SMC2	
LZFPC / LZFSC / LZTWC	SMC3	LZFPC / LZFSC / LZTWC
	SMC4	
	SMC5	

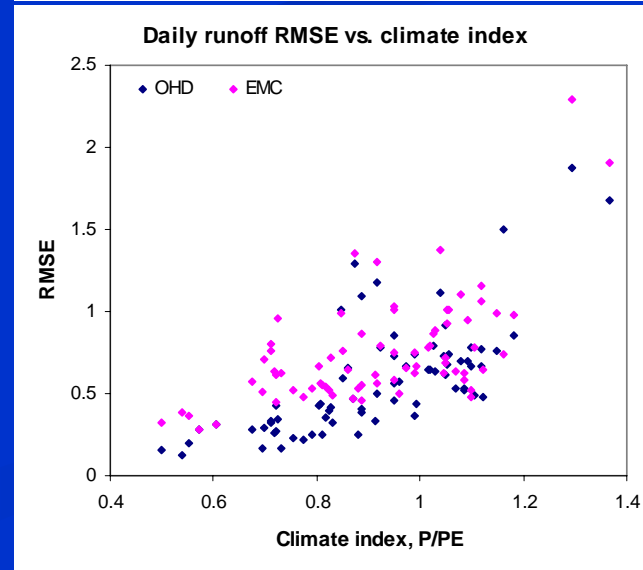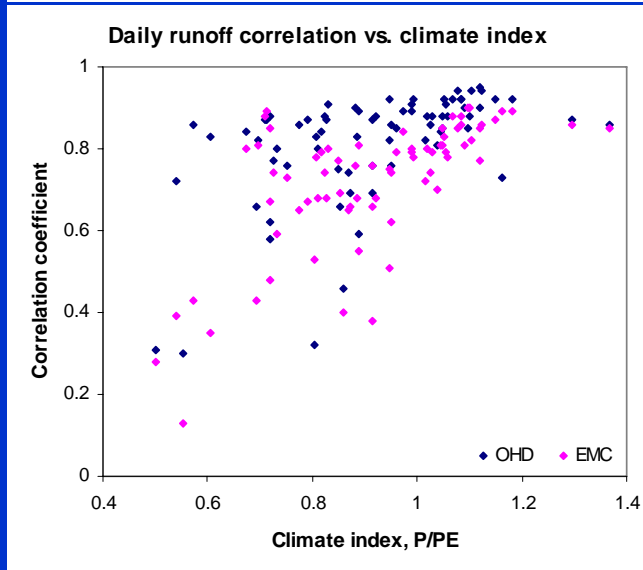**Reference**
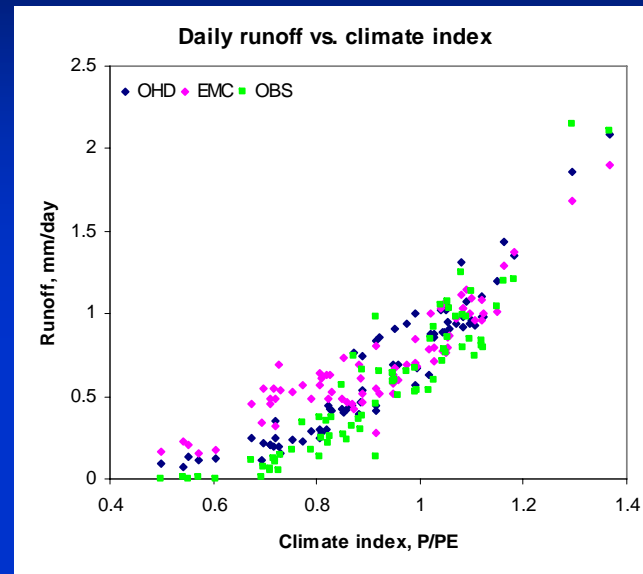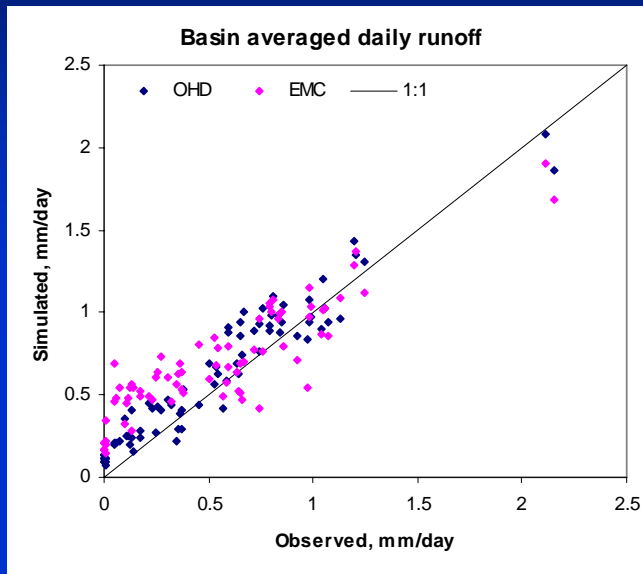
Koren et al., JGR, 104, 1999

Saturation Index over 75 Basins at Three Soil Layers: 0-5cm, 0-25cm, 25-75cm (from left to right)
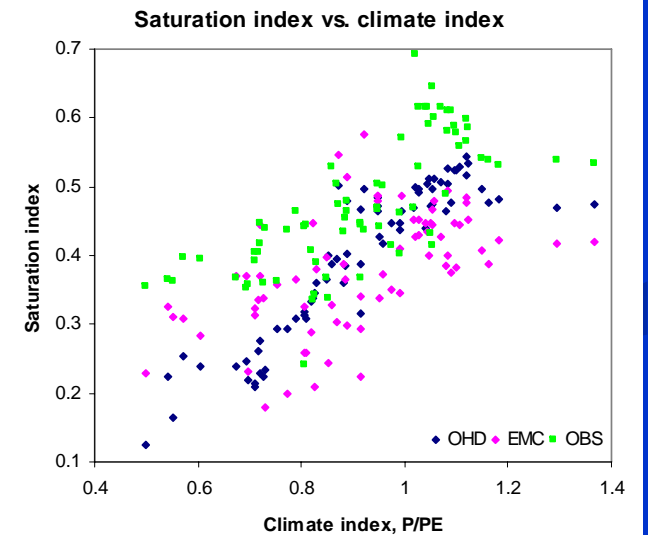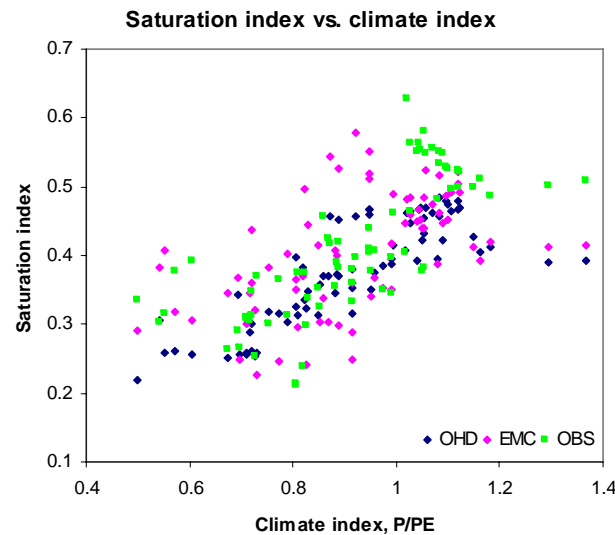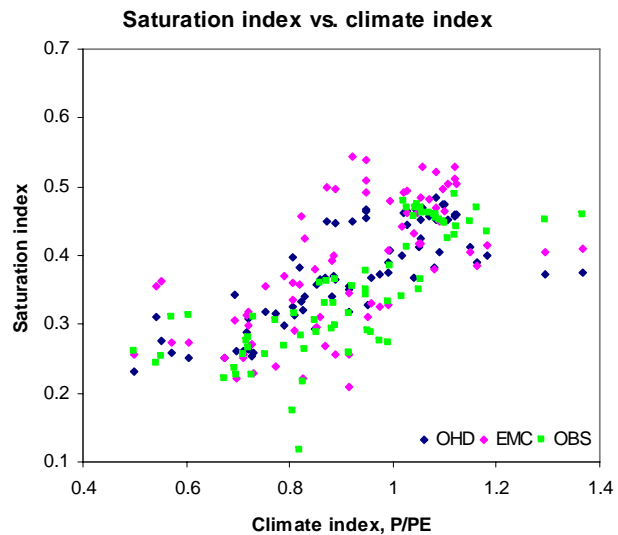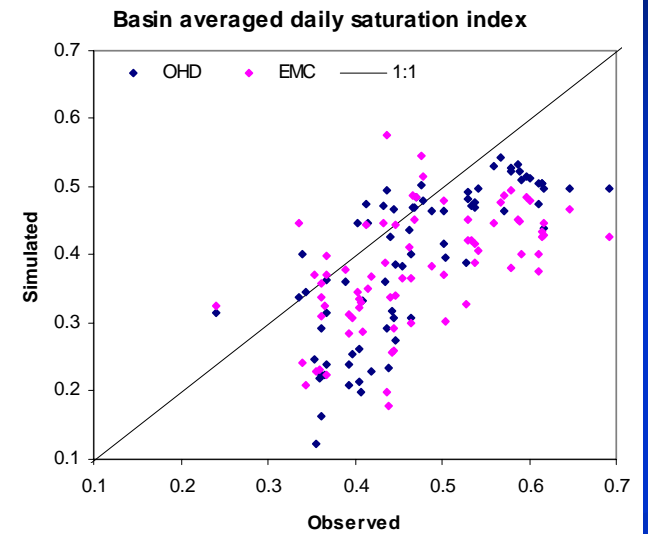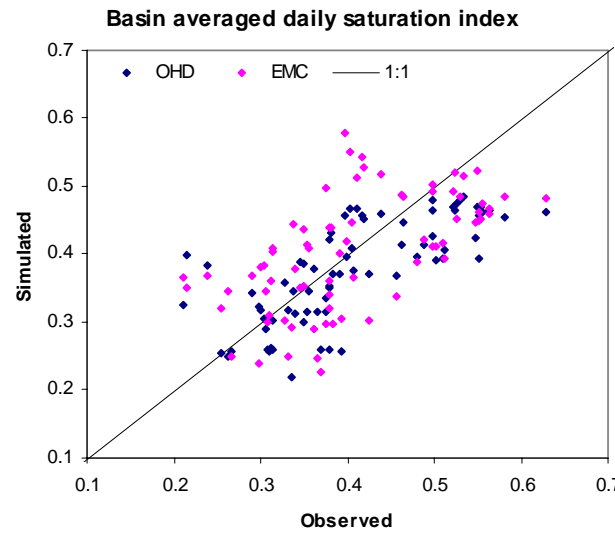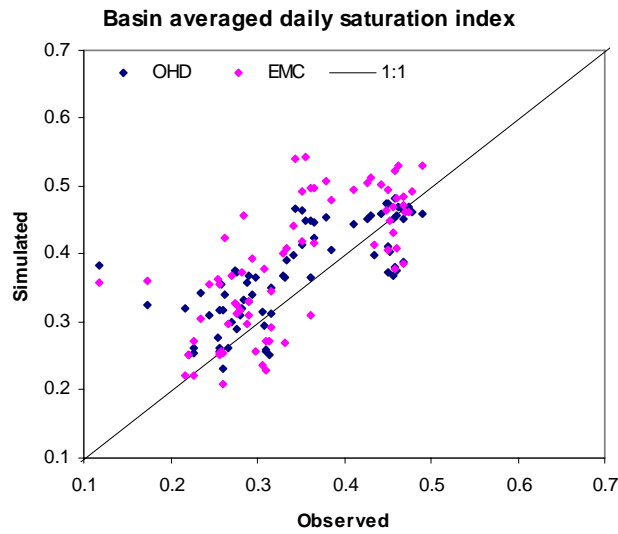
Correlation and RMSE at Three Soil Layers:
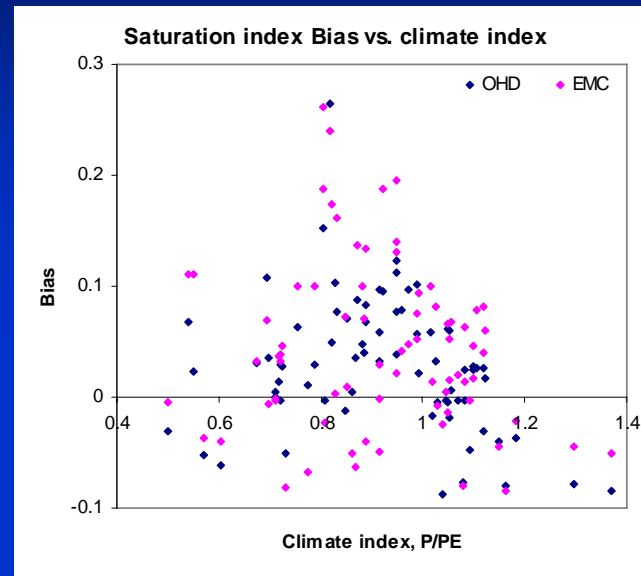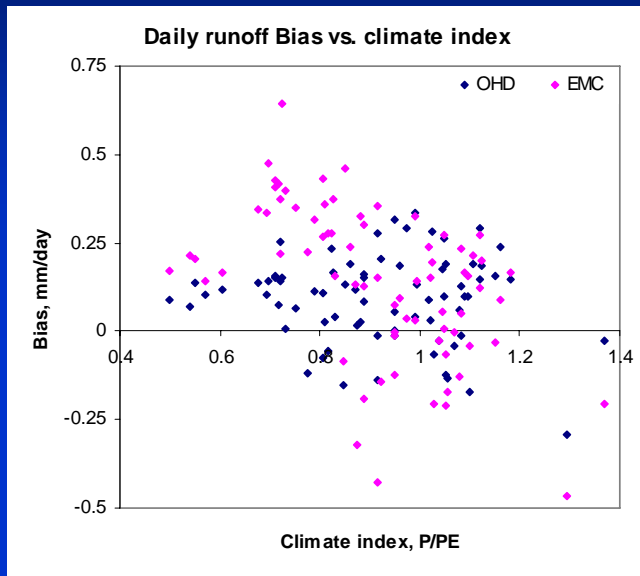## 0-5cm, 0-25cm, 25-75cm (from left to right)
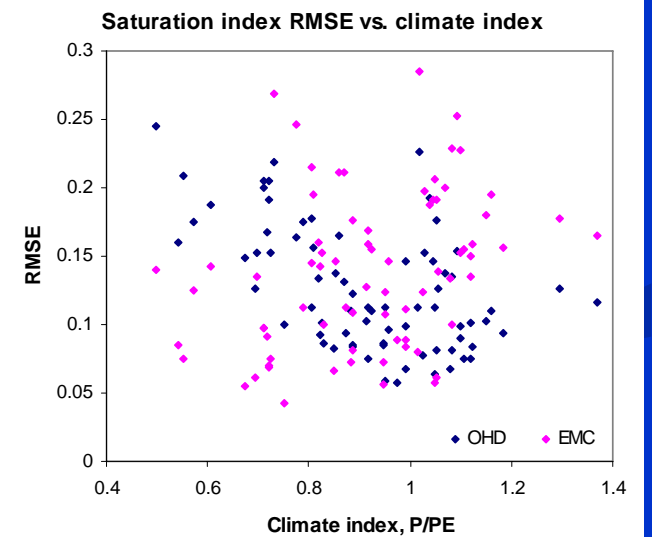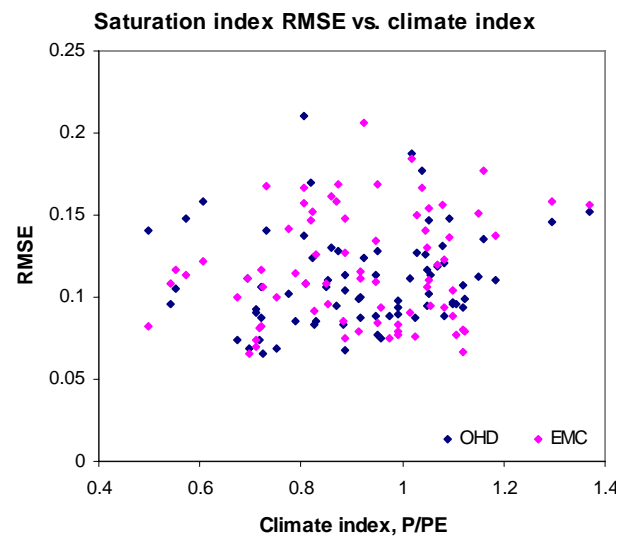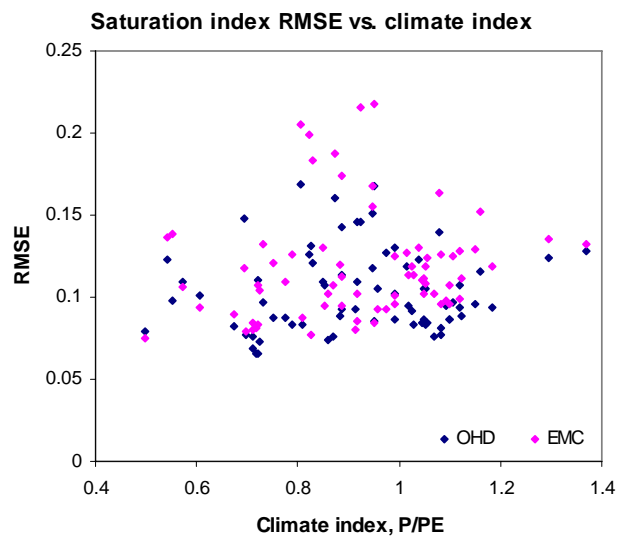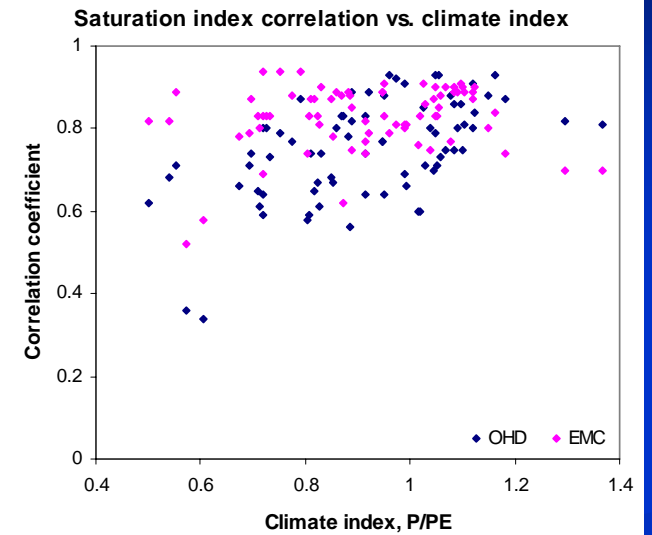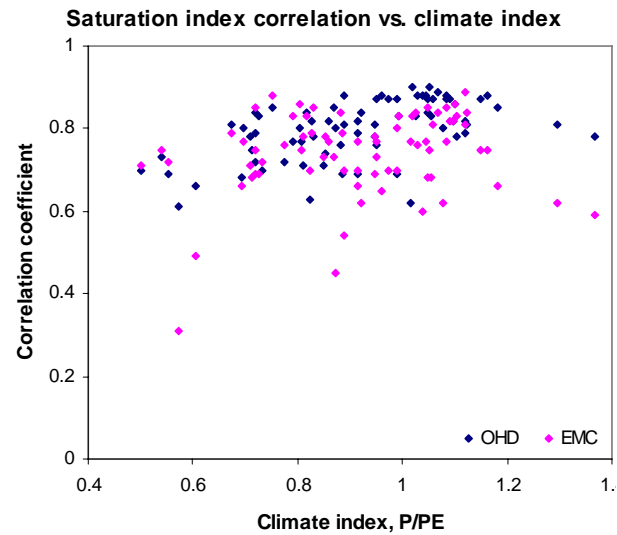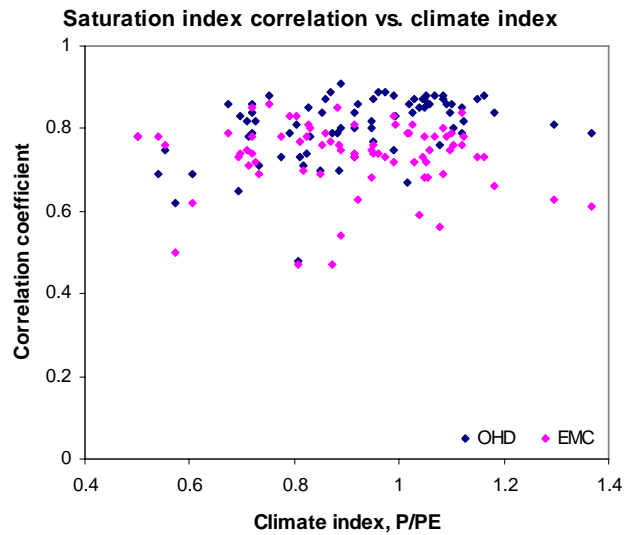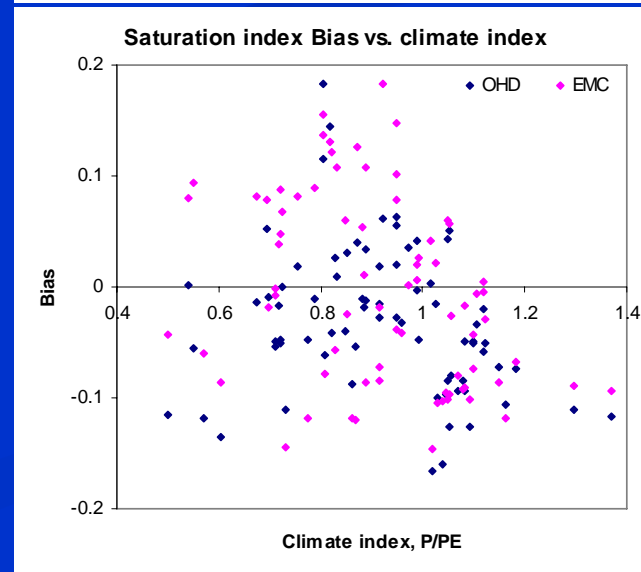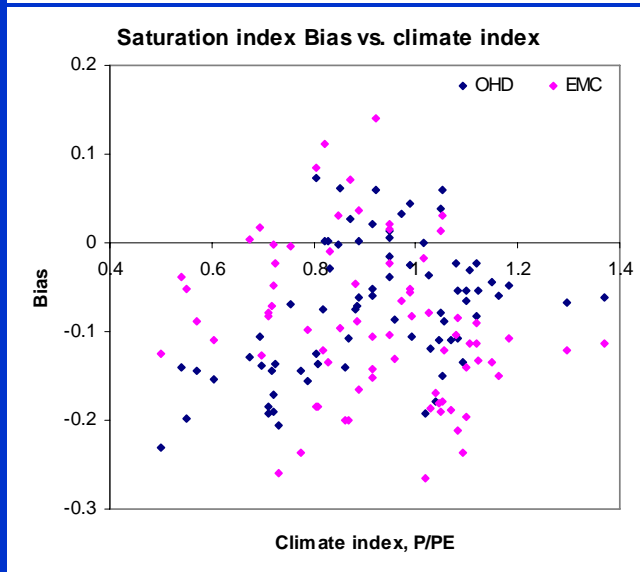
10-day Average Runoff Statistics for 75 Basins

Comparison of Runoff and Soil Moisture Biases
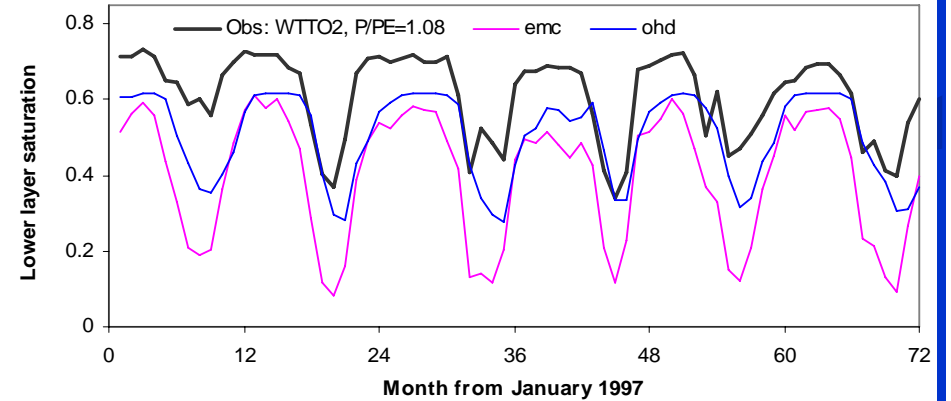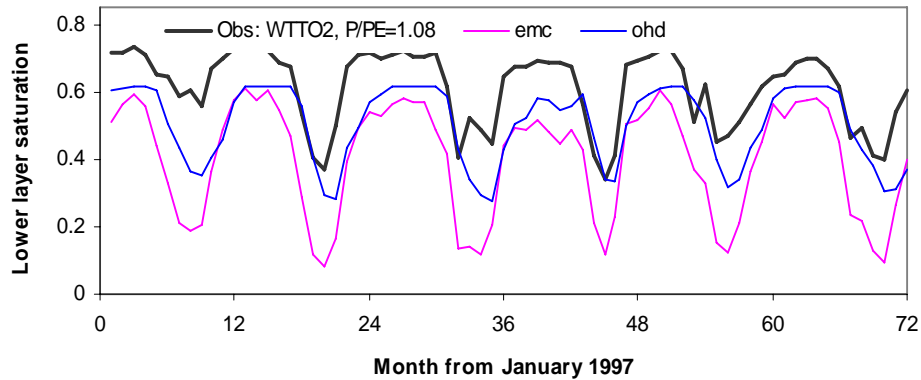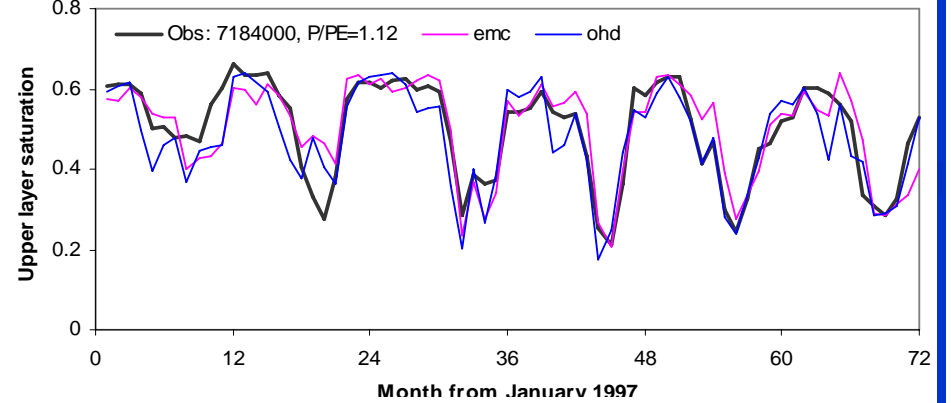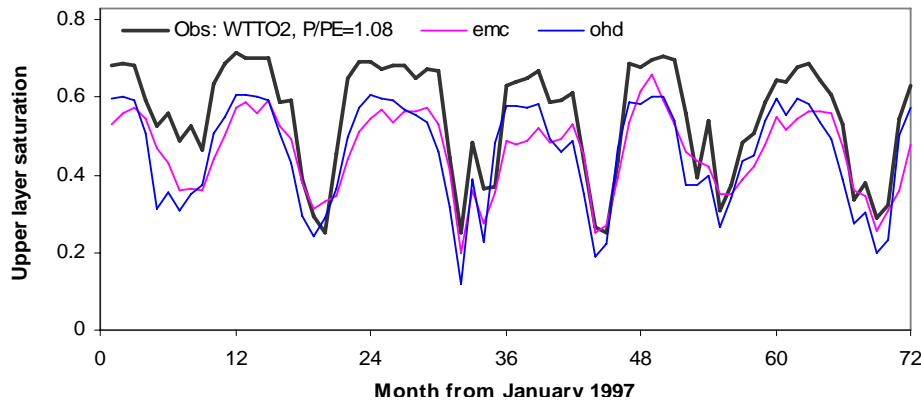
Runoff

SM 25 - 75 cm

SM 0 – 5 cm

SM 0 - 25 cm

Overall Soil Moisture and Runoff Statistics from 75 Basins

| Model	Statistics				
	RMSE	Bias	Abs. Error	R	NS
10-day averaged daily runoff (mm/day)					
EMC	0.745	0.142	0.435	0.715	0.350
OHD	0.580	0.091	0.322	0.811	0.606
Soil saturation index (00-05 cm layer)					
EMC	0.123	0.044	0.100	0.733	0.039
OHD	0.109	-0.032	0.089	0.803	0.241
Soil saturation index (00-25 cm layer)					
EMC	0.117	-0.005	0.098	0.738	0.148
OHD	0.111	-0.031	0.092	0.794	0.238
Soil saturation index (25-75 cm layer)					
EMC	0.138	-0.092	0.121	0.827	-0.421
OHD	0.128	-0.077	0.110	0.746	-0.221

Monthly Runoff and Saturation Index for 2 Wet Basins
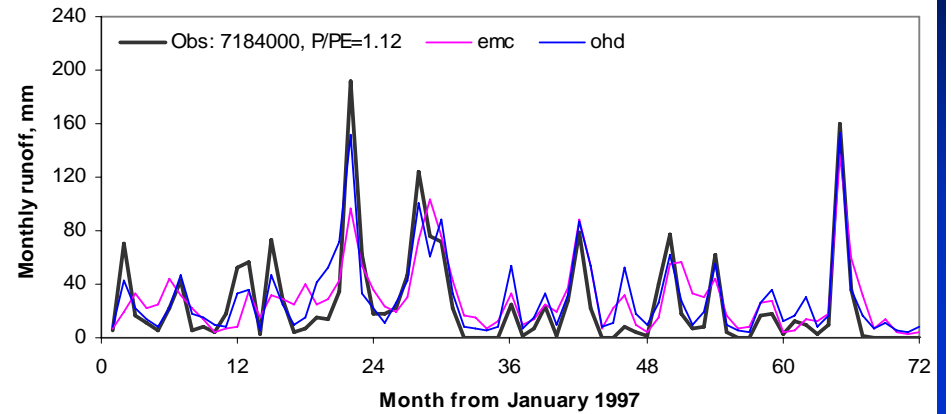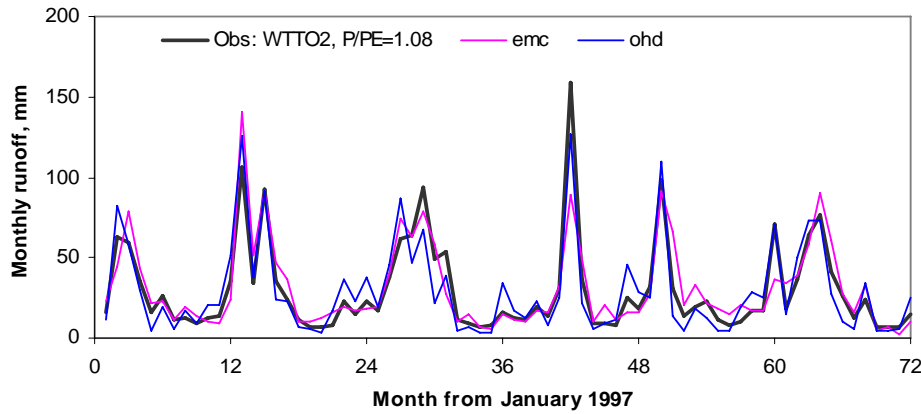
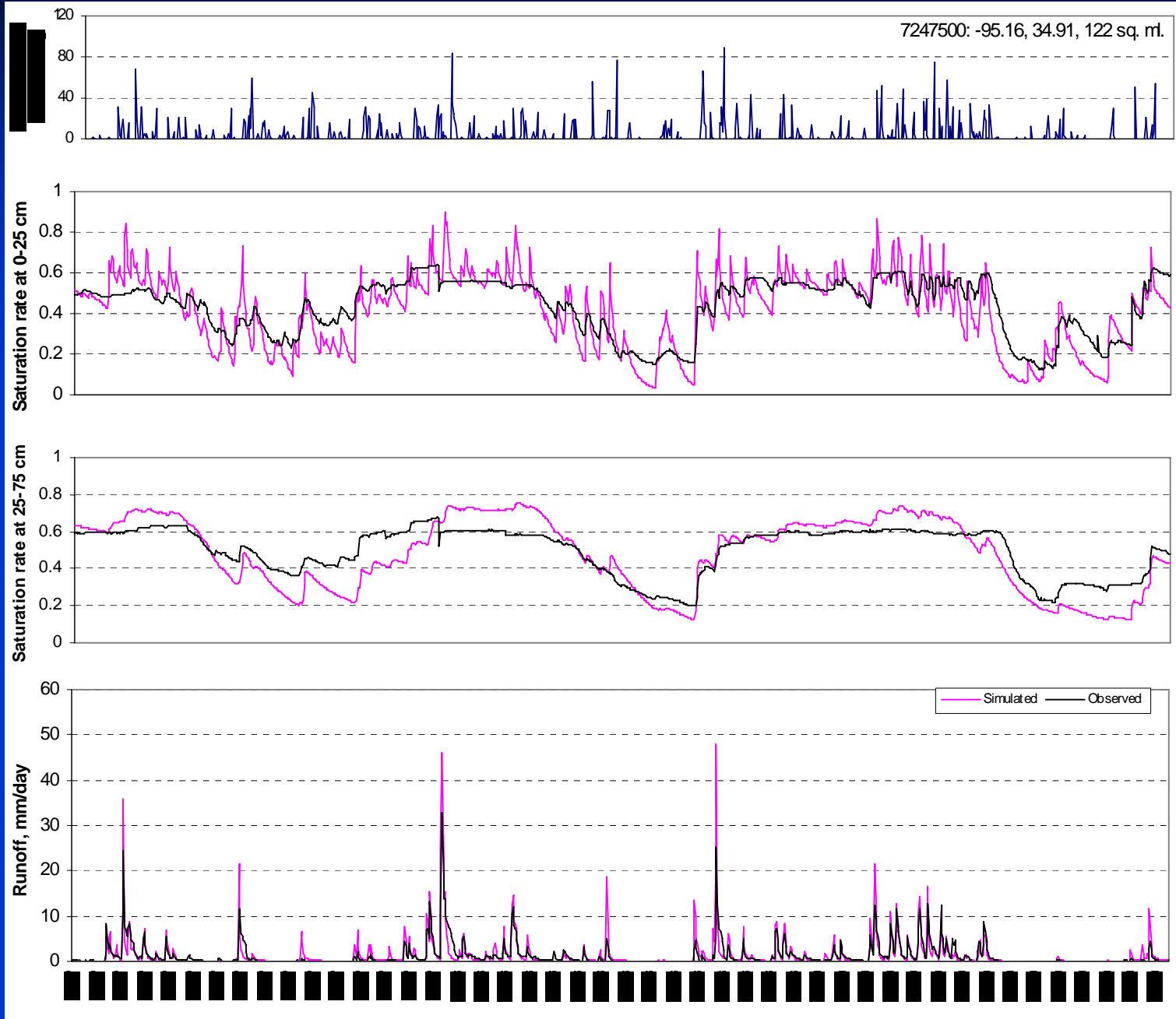# Monthly Runoff and Saturation Index for 2 Dry Basins
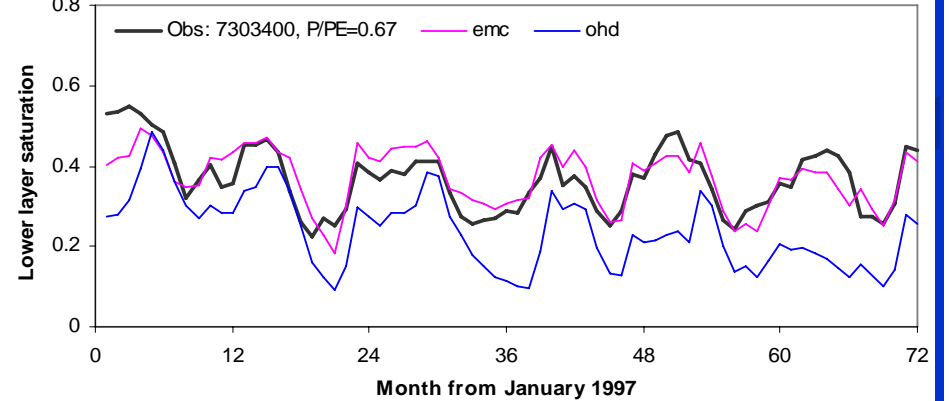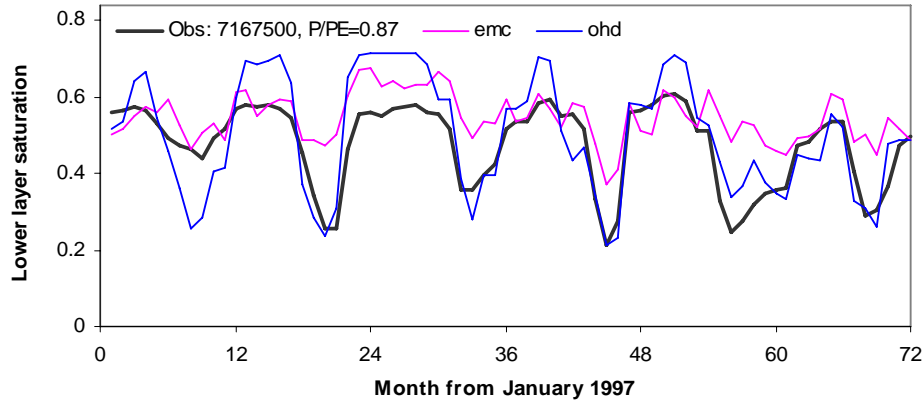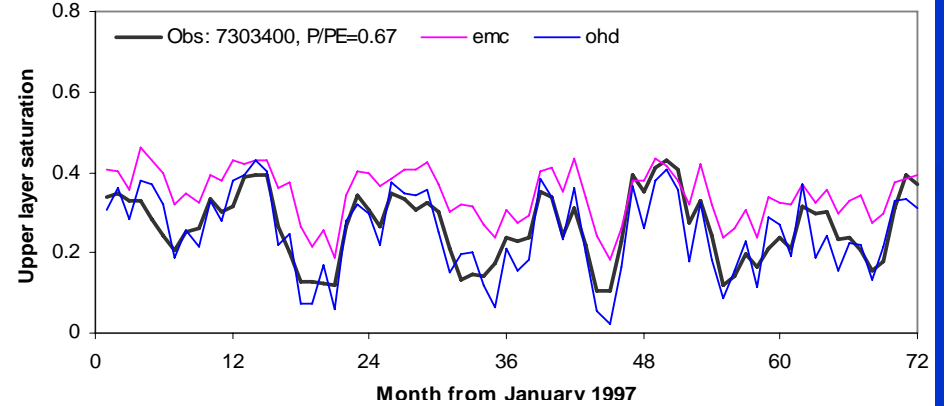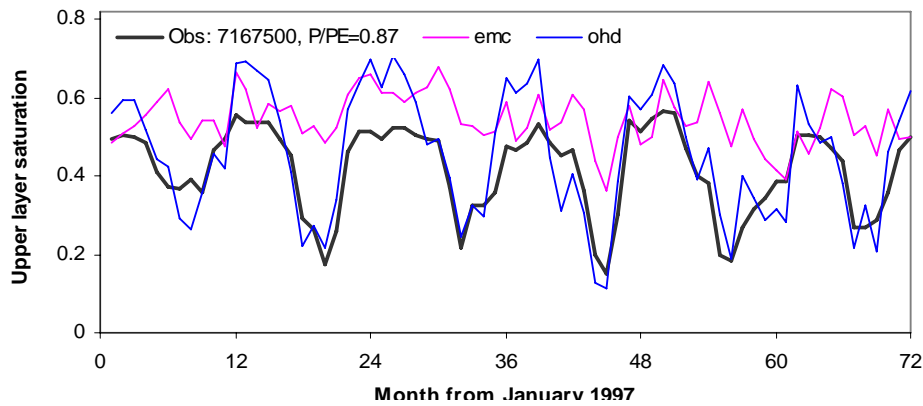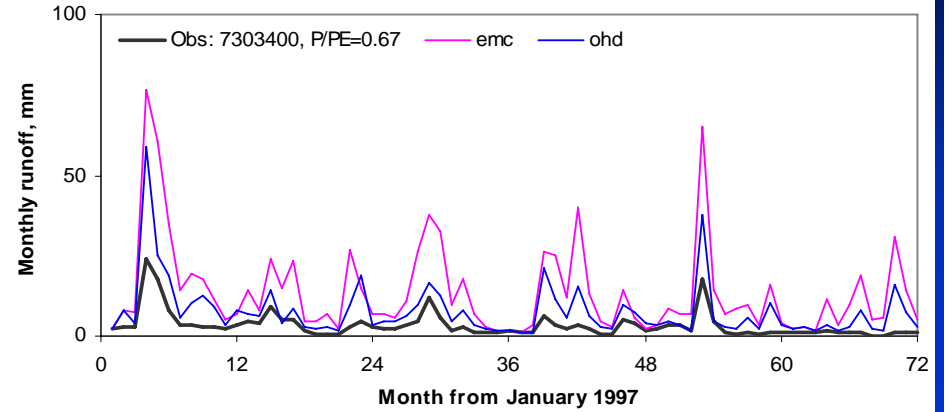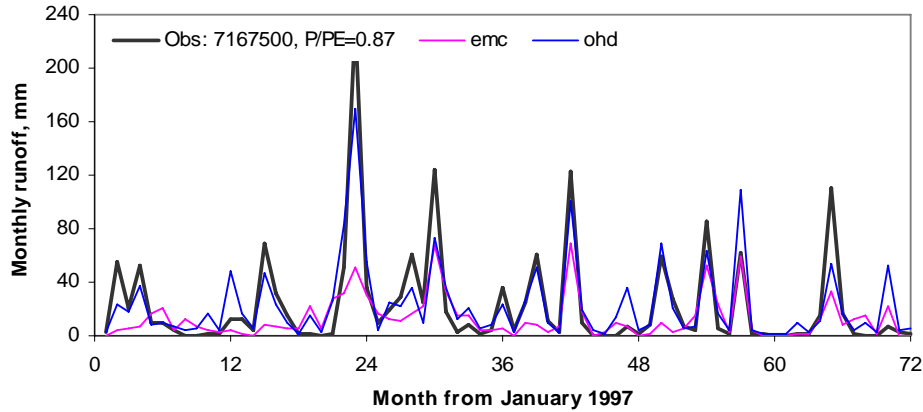
Daily Saturation Indexes

Summary

- Both models driven by a priori parameters perform reasonably well specifically in reproducing soil moisture dynamics (correlation coefficients above 0.6) at different spatial scales

- Soil moisture at deeper layer (25-75 cm) has a negative bias from both models and as a result positive bias in runoff

- The modified 'storage-type' SAC-HT model performs soil moisture simulations at the level or better than an energy-based land surface model