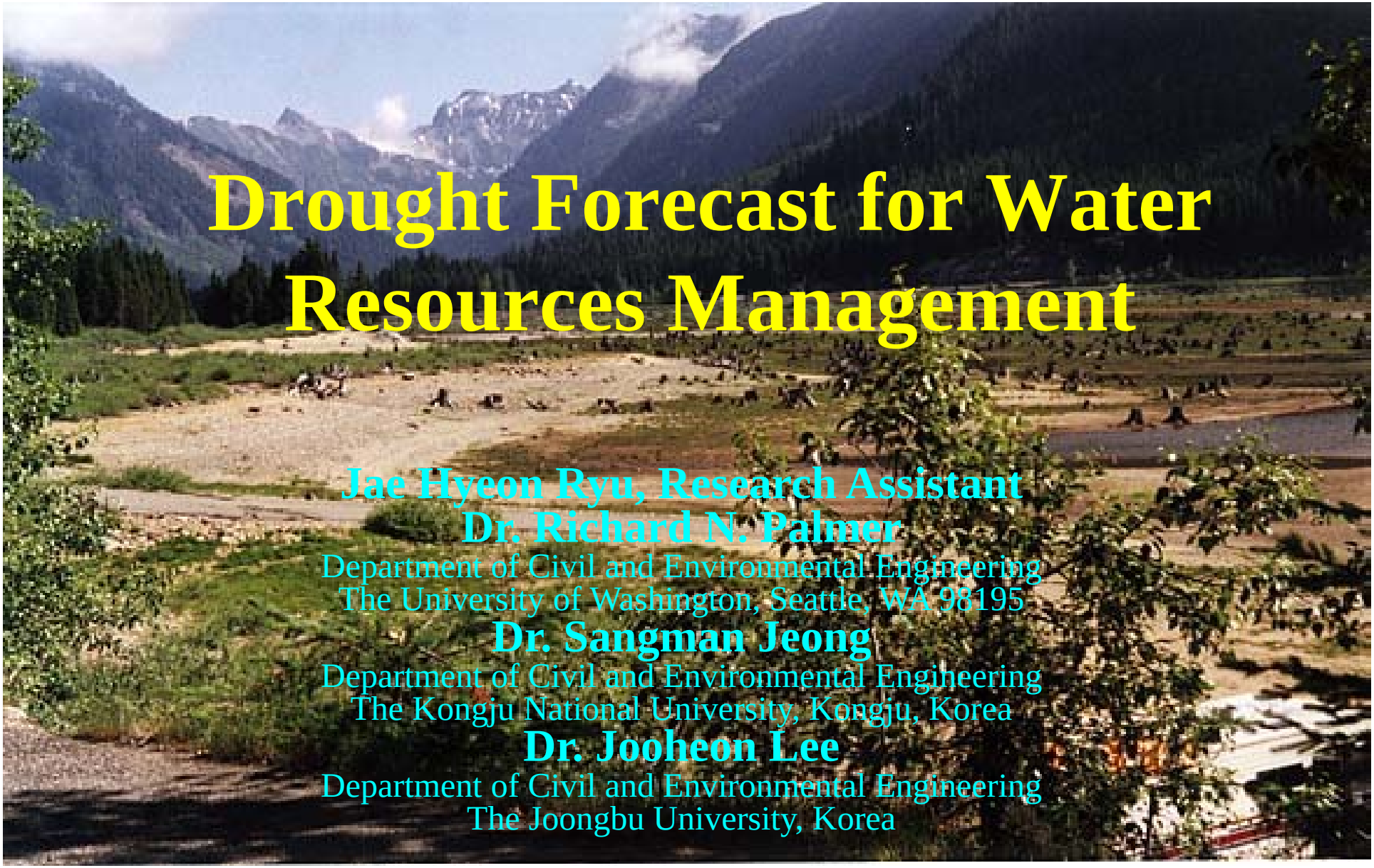

Drought Forecast for Water Resources Management

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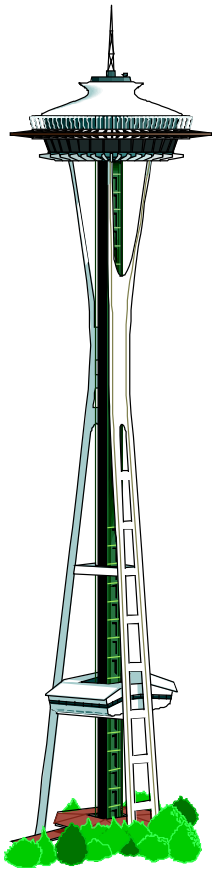
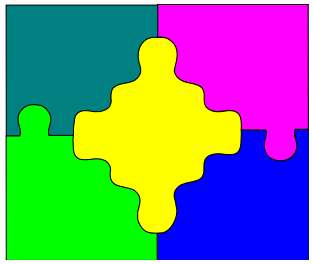
Overview

- **Research Description**
- **Drought/Drought Indicators**
- **NCEP Forecast**
- **Model Application**
- **EPA BASINS**
- **Analysis Output**
- **Conclusion**
- **Future Work**

Research Description

- Length of the project
- Funded by Korea Government (KICT)
- Participants
  - Dr. Richard N. Palmer (UW, Seattle)
  - Jae Hyeon Ryu (UW, Seattle)
  - Dr. Sangman Jeong (KNU, Kongju, Korea)
  - Dr. Jooheon Lee (Joongbu, Korea)

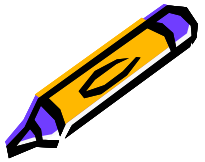




Research Goal

- Generating an operational definition of drought with perfect forecast
- NCEP forecasts as input to drought indicators
- Creating mid-term forecasts of climate variability
- Developing a decision support system for drought management that incorporates these other two features

Drought

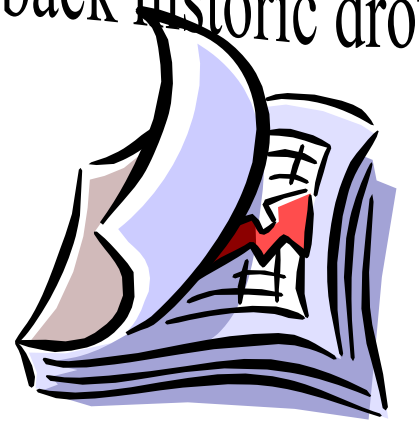


- Difficulty of analysis (slow onset, spatial variability, heterogeneous impact, and uncertain management option)
- Meteorological Drought
- Agricultural Drought
- Hydrologic Drought
  - Supply and Demand (Economics)
  - Reliability (Risk analysis)
  - Water Quality (Sociology)
  - Sustainability (Climate, long-term Water Management)

Talk Flowchart

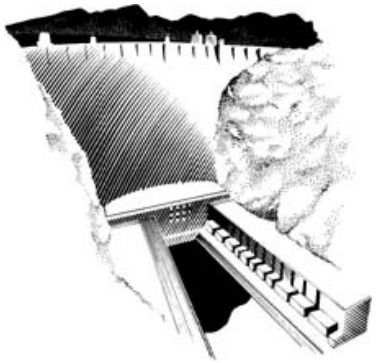
1 Define Drought

2 Look back historic drought



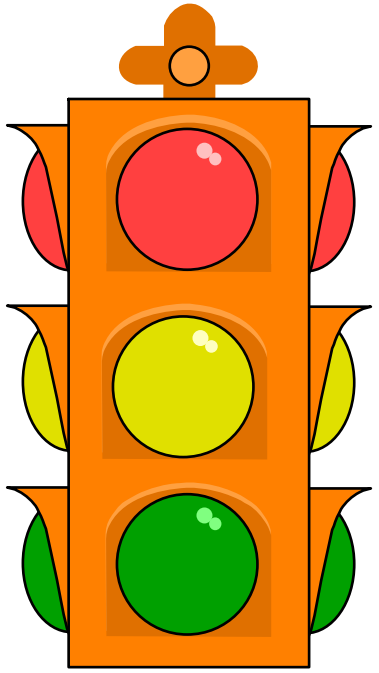
3 NCEP Forecast

4 **Decision Support System**



Drought Indicators

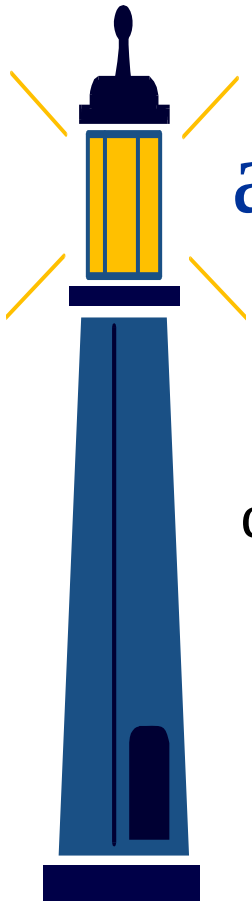
- Palmer Drought Index (PDSI,PDHI)
- Standard Precipitation Index (SPI) 3, 6, 12, 24
- Stream flow (Jan – Apr)
- Hydrologic Infrastructure
  - Reservoir capacity
  - Aquifer size
  - Water distribution system



Drought Indicators and Values

3 Month SPI (Cum. Prob. %)	**4 Month Total Inflows (Cum. Prob. %)**	**Avg. Storage in April (% of Storage)**	**Indicator Value (1-5)**
>80	>80	>80	1 – (very good)
60 – 80	60 – 80	60 – 80	2 – (Good)
40 – 59	40 – 59	40 – 59	3 – (Normal/Warning)
20 – 39	20 – 39	20 – 39	4 – (Drought)
<20	<20	<20	5 – (Severe Drought)

Standardized Drought Indicators and Values



Is there link to drought indicator and NCEP forecast?

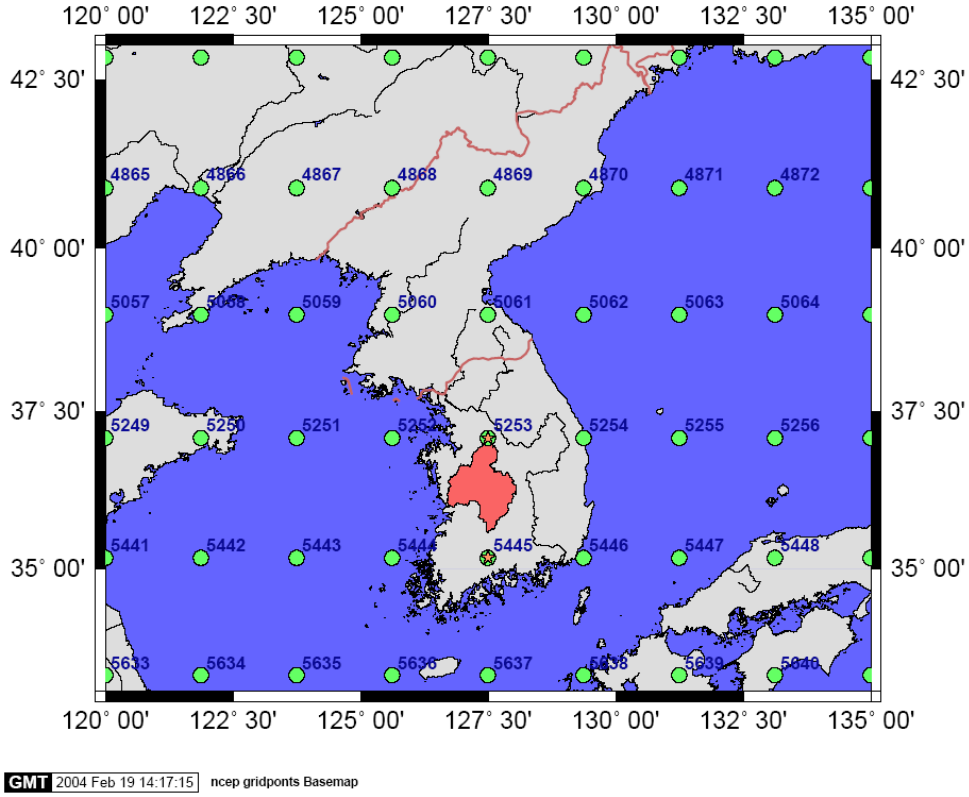
How?

Year	Drought index			Value of recalculated composite drought index	Value of recalculated drought index
	P	S	R		
1981	4	4	5	4.3	4
1982	4	5	4	4.2	4
1983	2	3	4	2.8	3
1984	3	5	2	3.2	3
1985	3	4	5	3.8	4
1986	4	4	1	3.1	3
1987	3	2	3	2.7	3
1988	3	5	4	3.8	4
1989	3	3	2	3.2	3
1990	1	2	1	1.2	1
1991	3	3	2	2.7	3
1992	3	4	4	3.5	4
1993	3	4	2	2.9	3
1994	4	5	3	3.9	4
1995	3	5	5	4.1	4
1996	3	5	3	3.5	4
1997	3	5	4	3.8	4
1998	2	2	1	1.7	2
1999	3	3	1	2.4	2
2000	4	5	2	3.6	4
2001	4	4	3	3.7	4

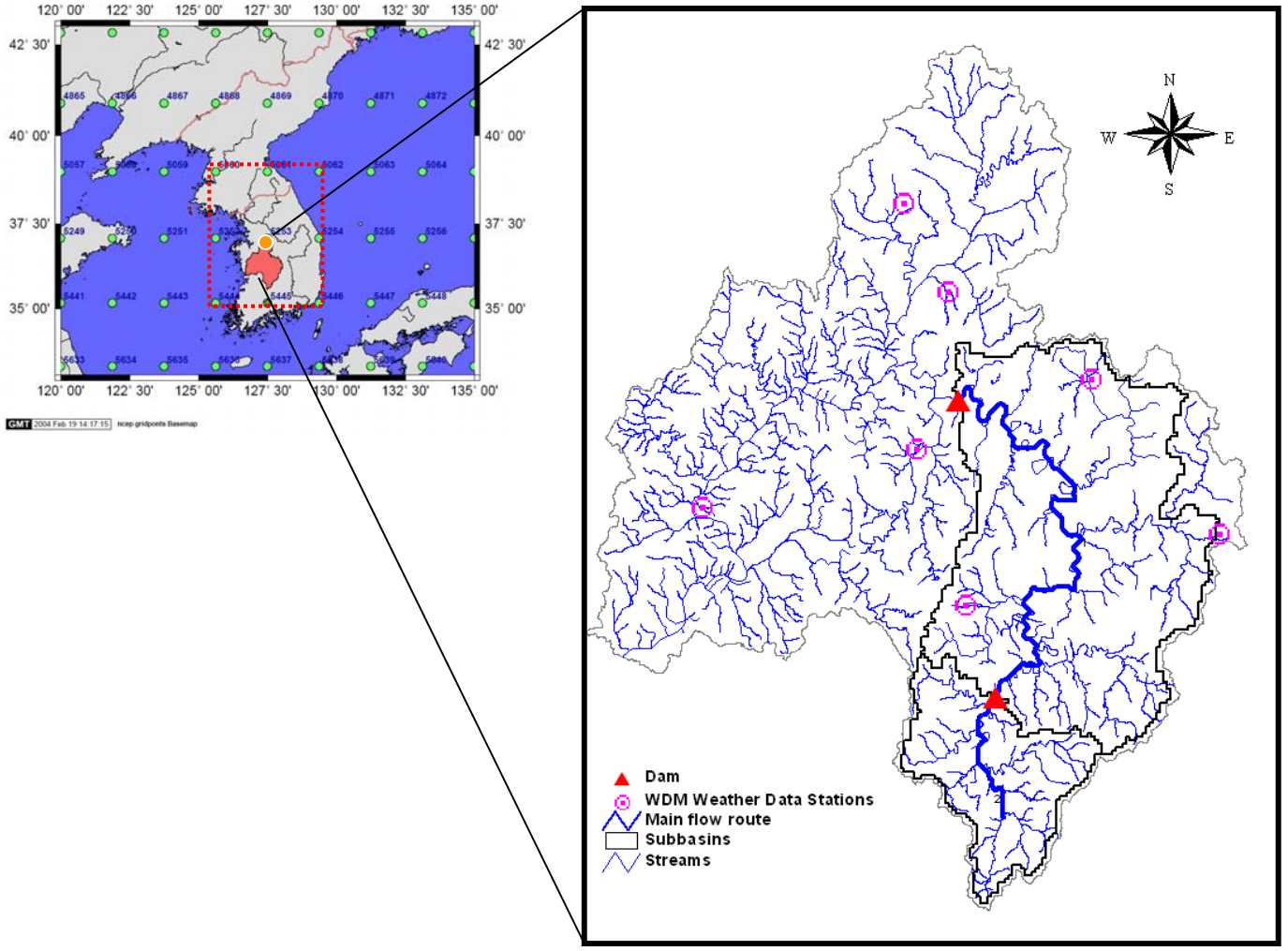
Note: P:3 month SPI,S: four month streamflow into reservoir, R: average active storage in April

NCEP Forecast

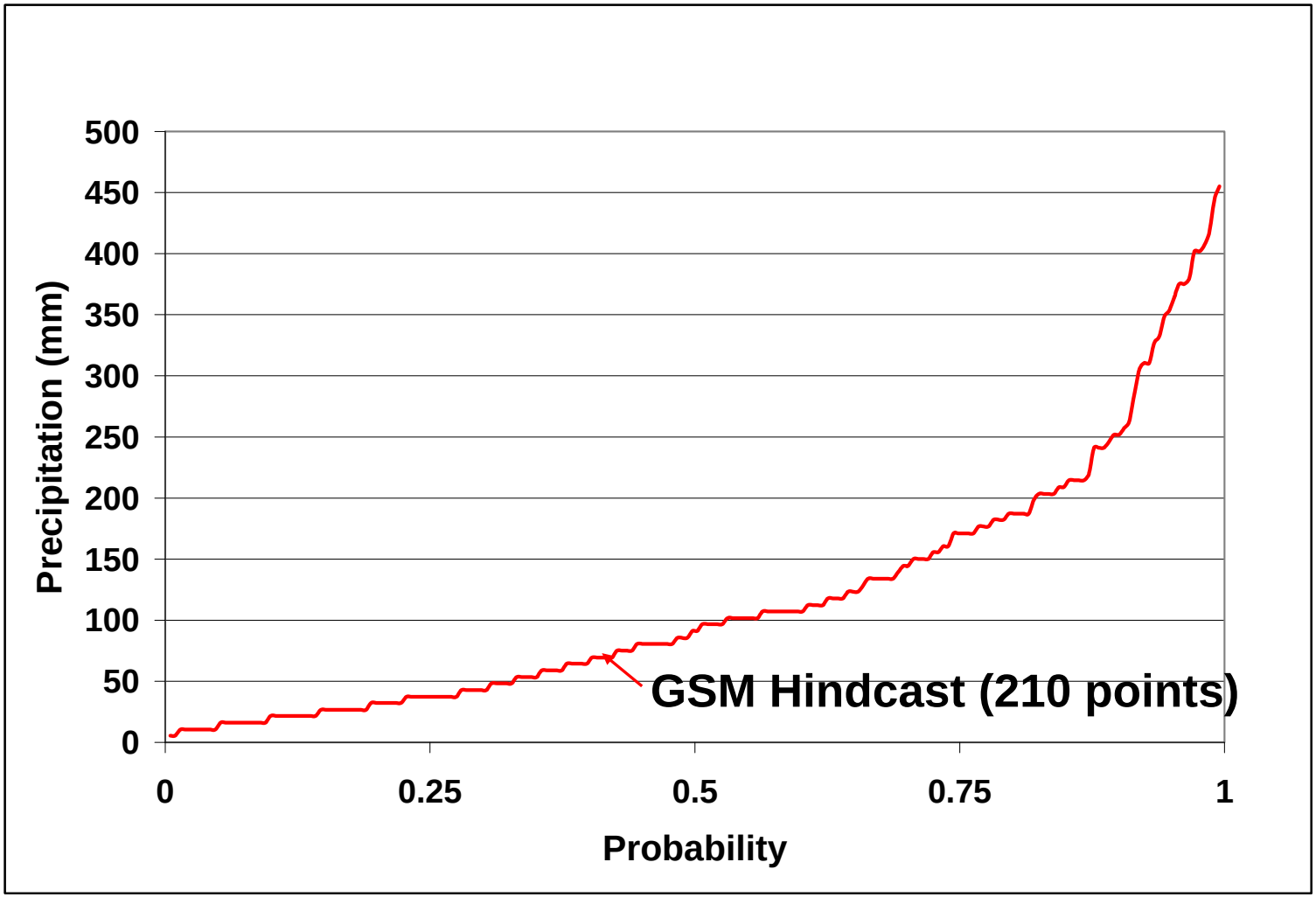
- The National Center for Environmental Prediction (NCEP), NOAA
- Six-month Prediction (Temp. & Prep)
- 1.9 degree resolution (Spatial domain)
- 5 – 15 minutes (Temporal domain)



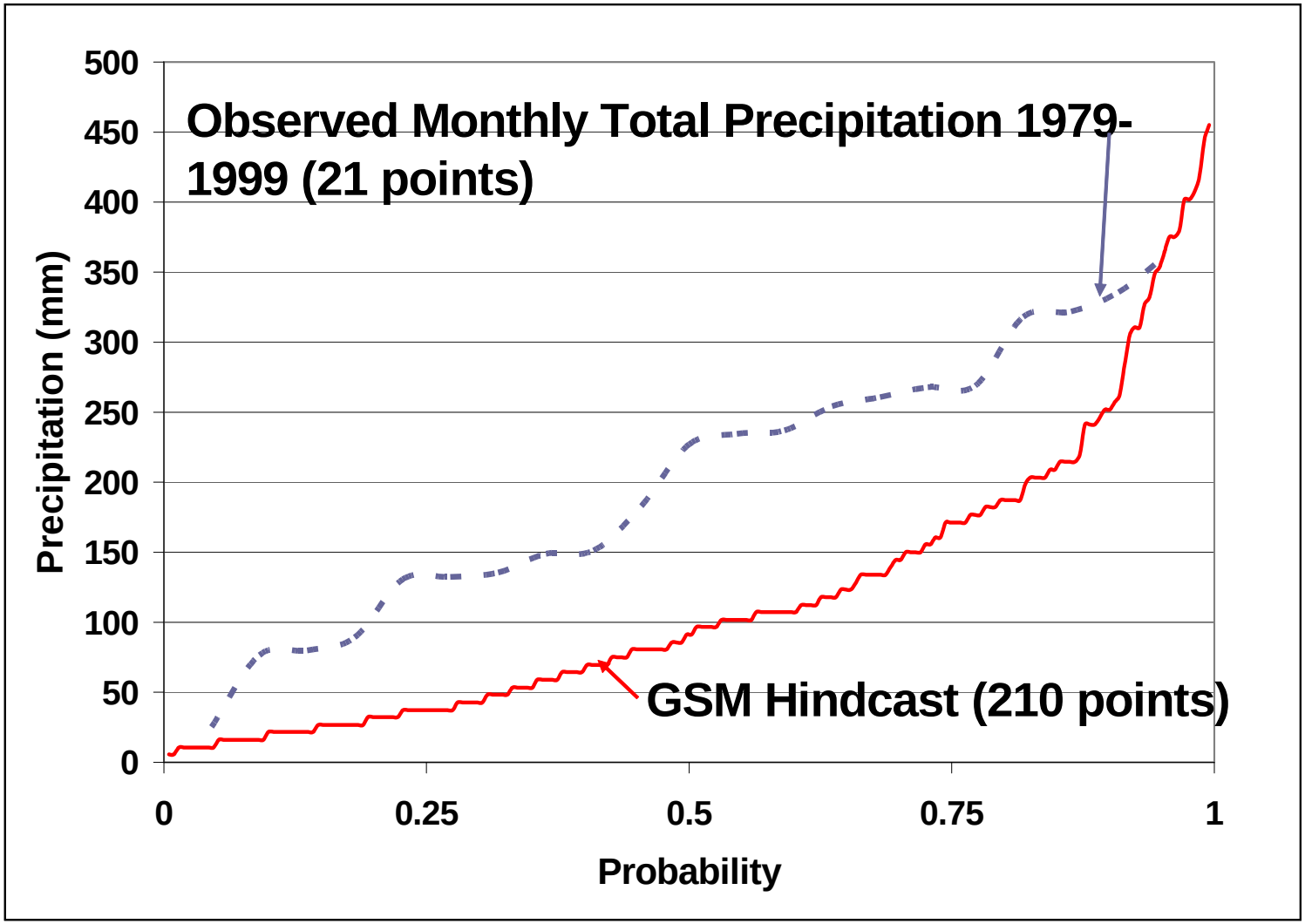
Model Application



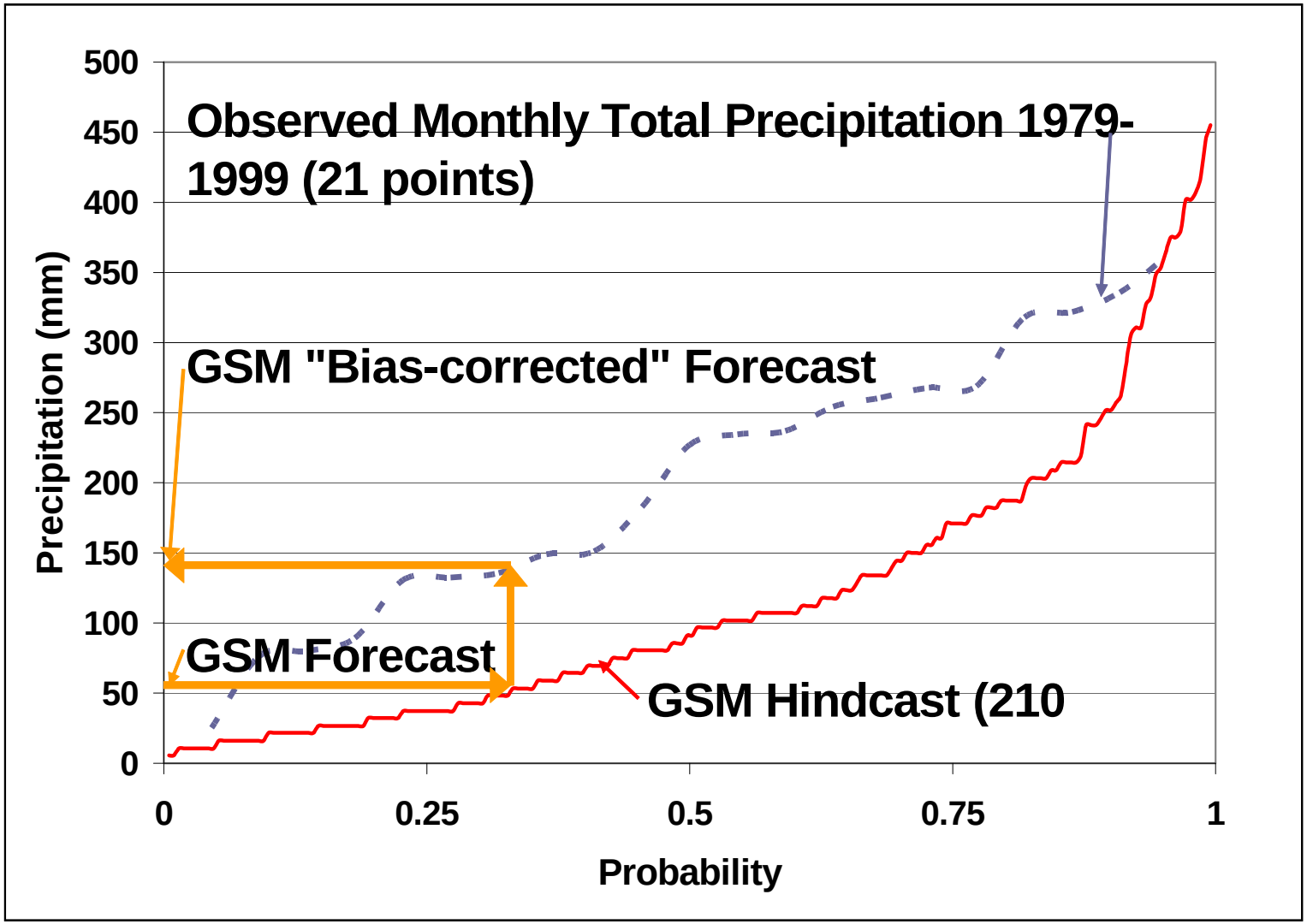
Bias Correction



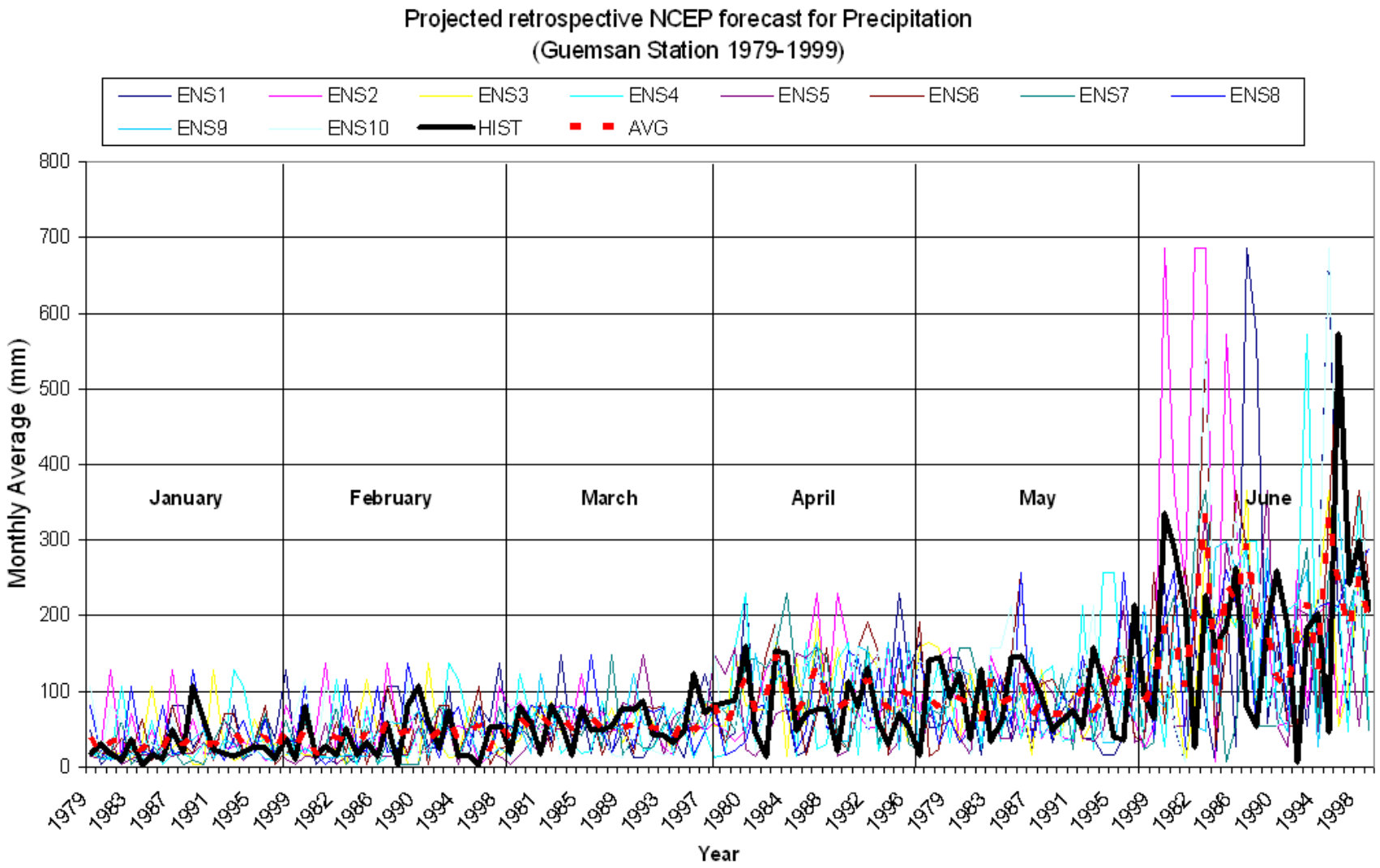
Bias Correction –Cont'd



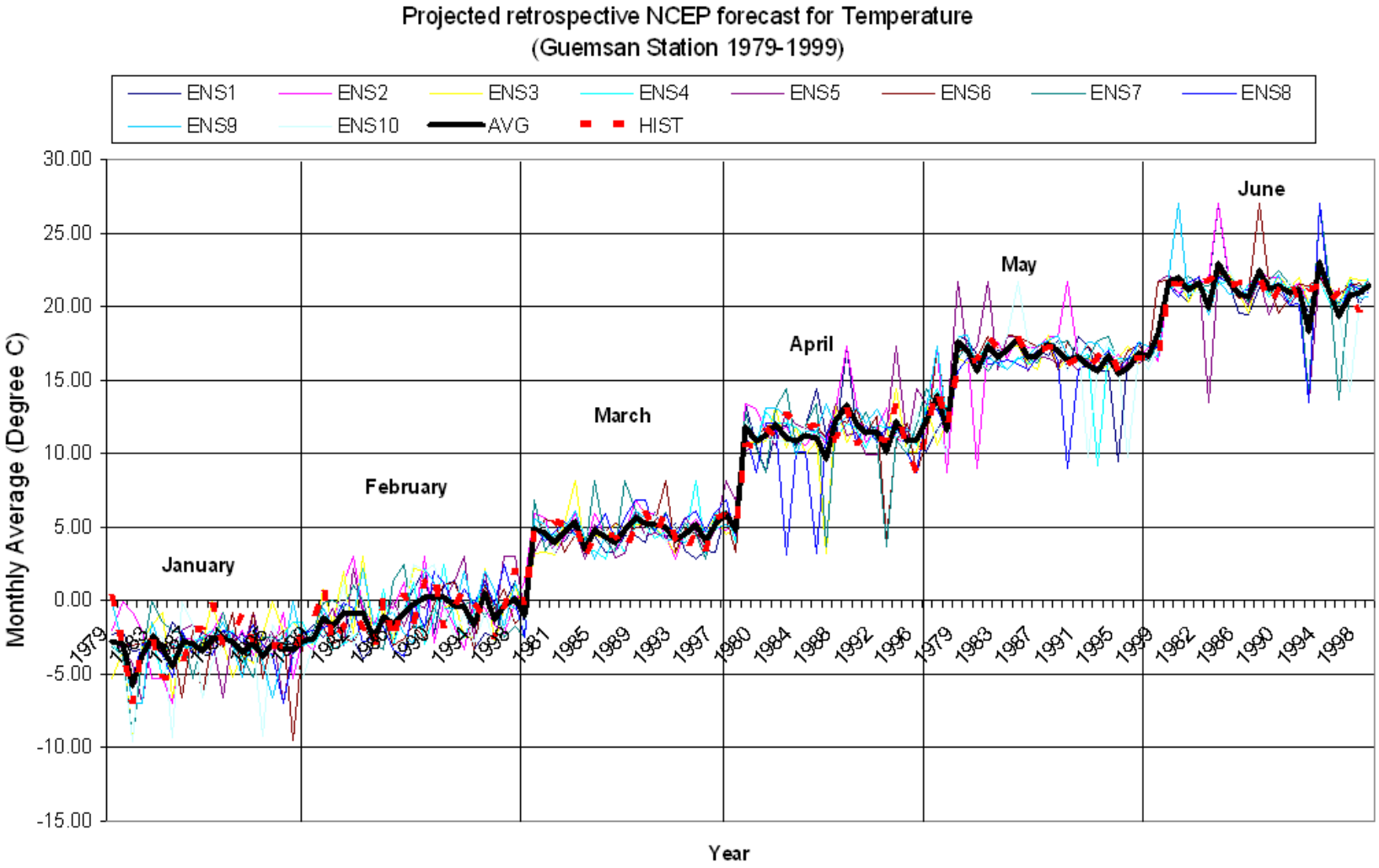
Bias Correction –Cont'd



Retrospective NCEP forecast for Precipitation



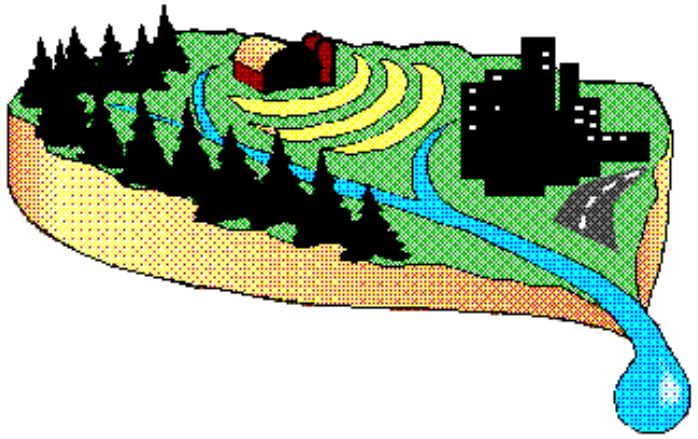
Retrospective NCEP forecast for Temperature



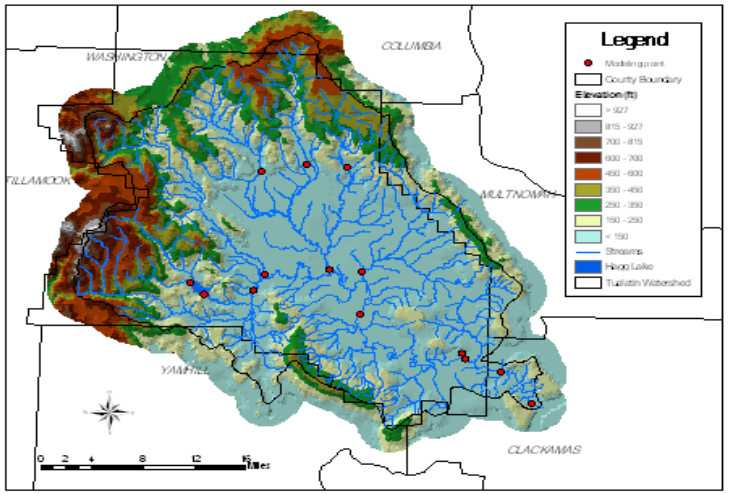
EPA BASINS

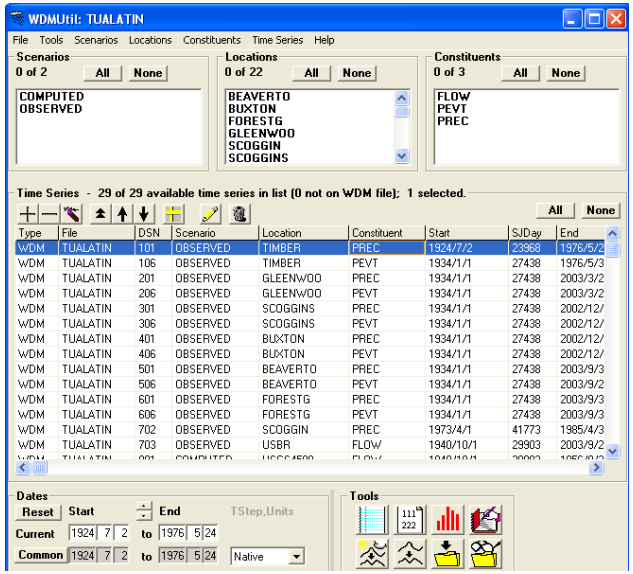
- Arcview GIS Backbone
- Data Management Tools

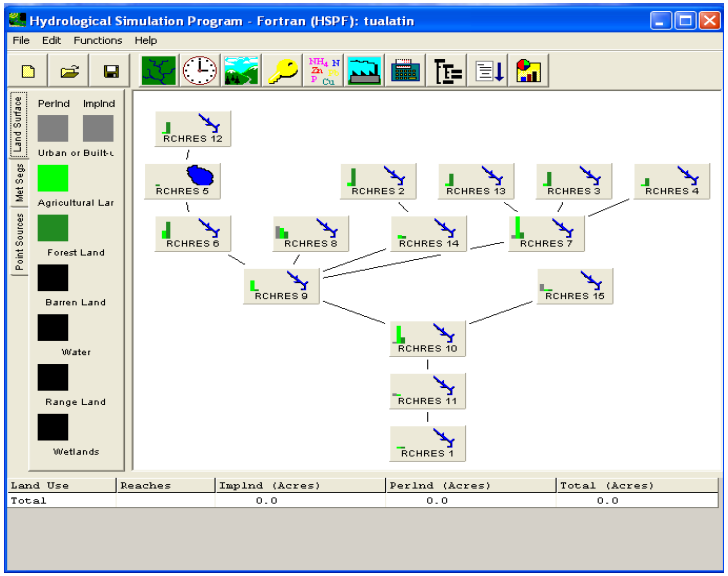
  WDMUtil, Gensen
- Simulation models
  - HSPF ✓
  - QUAL2E
  - SWAT

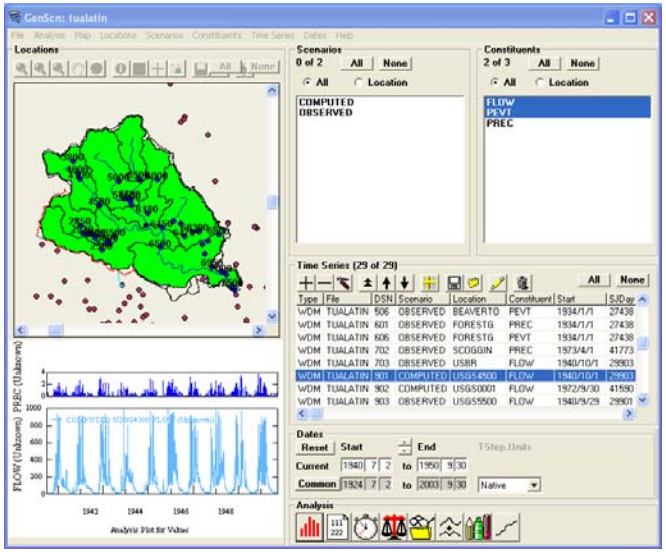


BASINS 3.0 System Overview

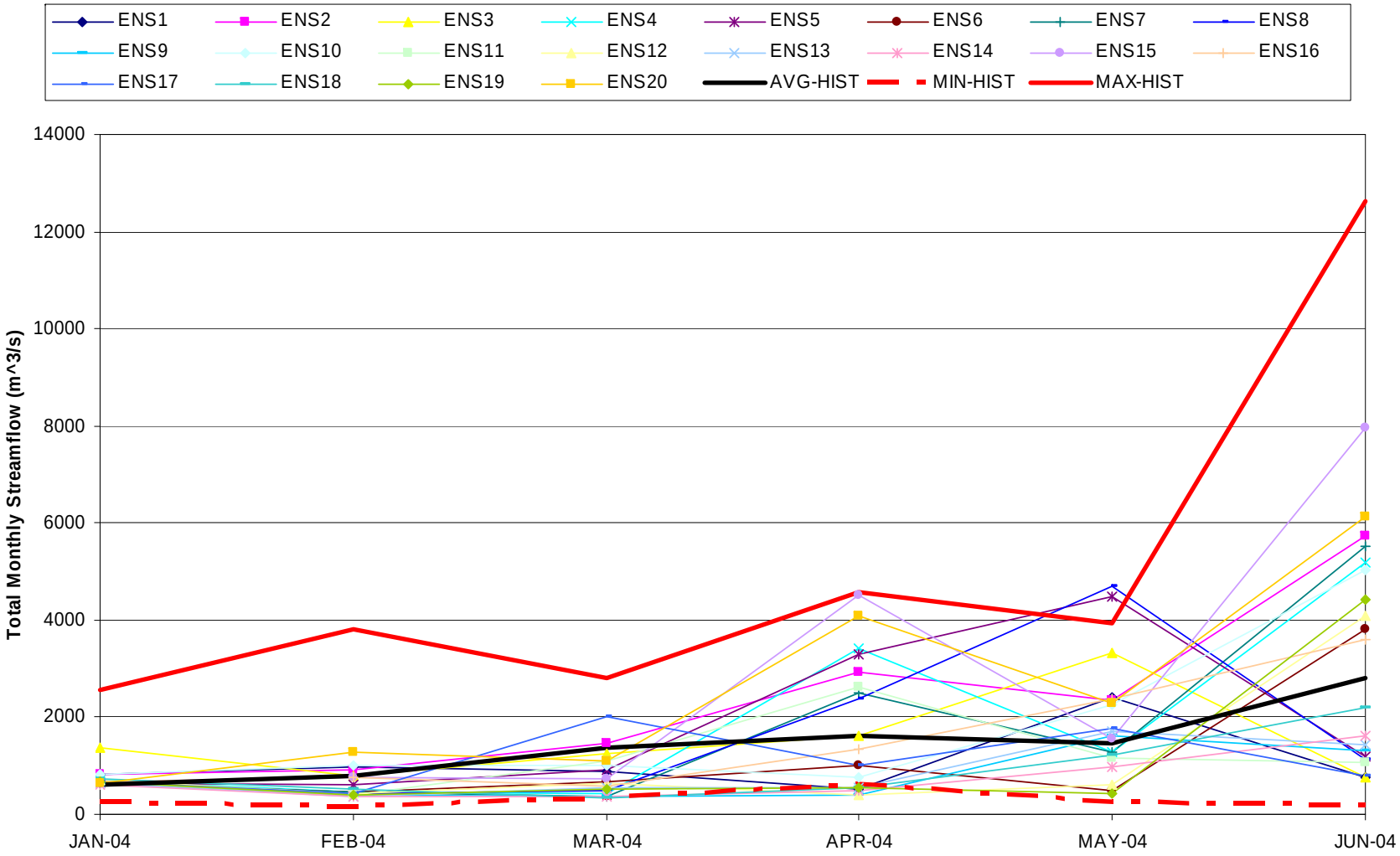




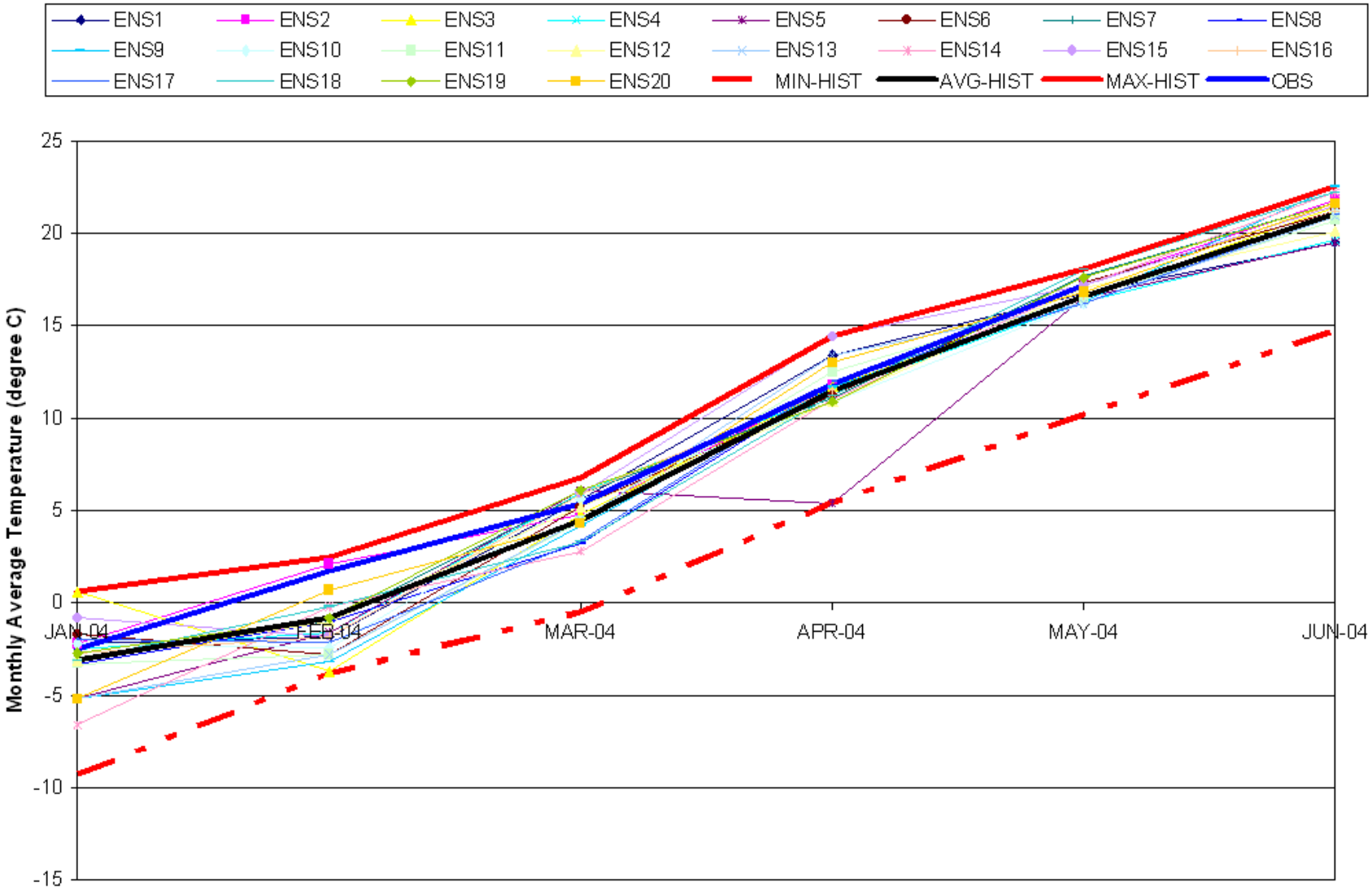




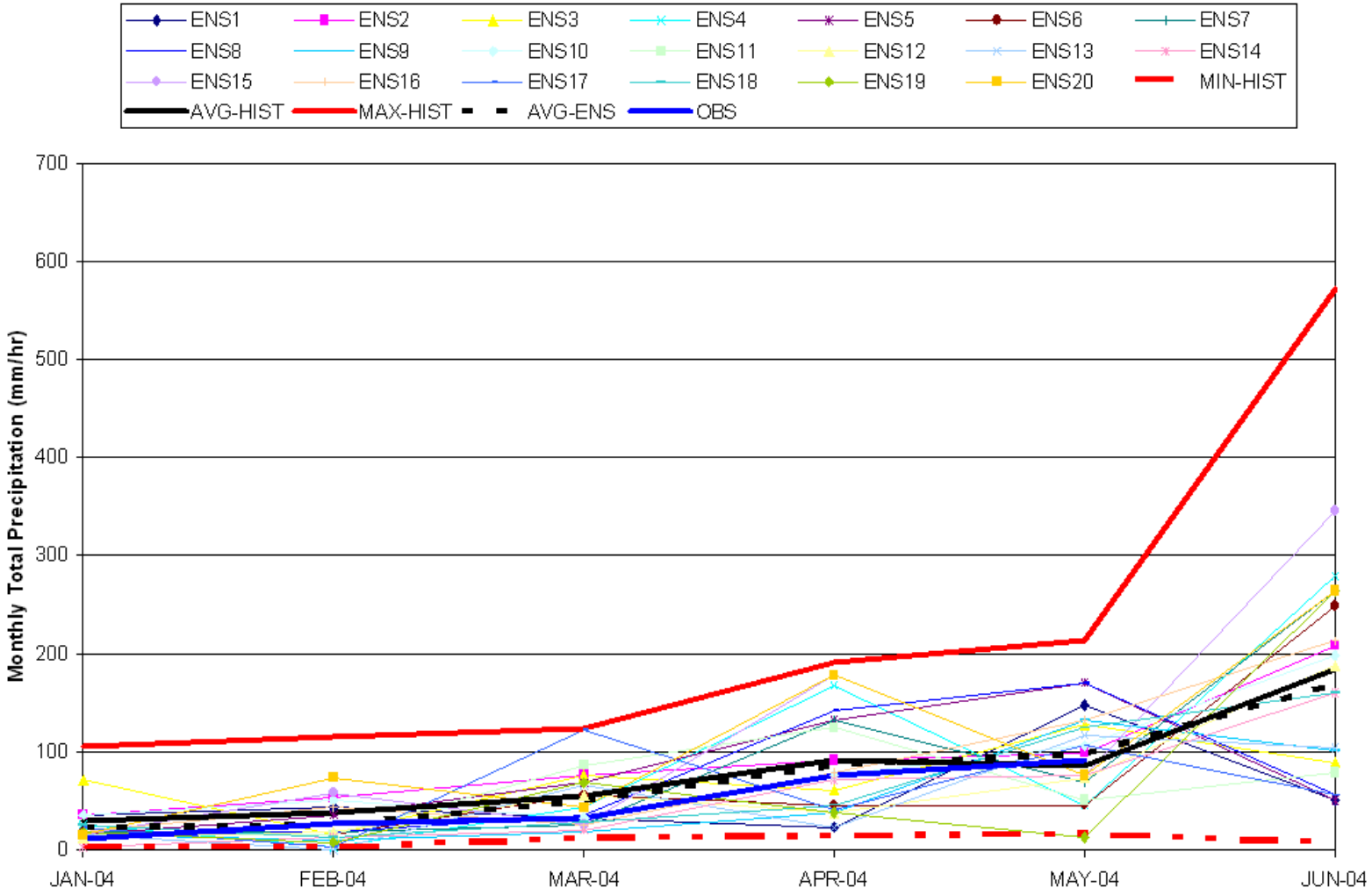
Projected Inflow into Daechong Reservoir from Jan to Jun



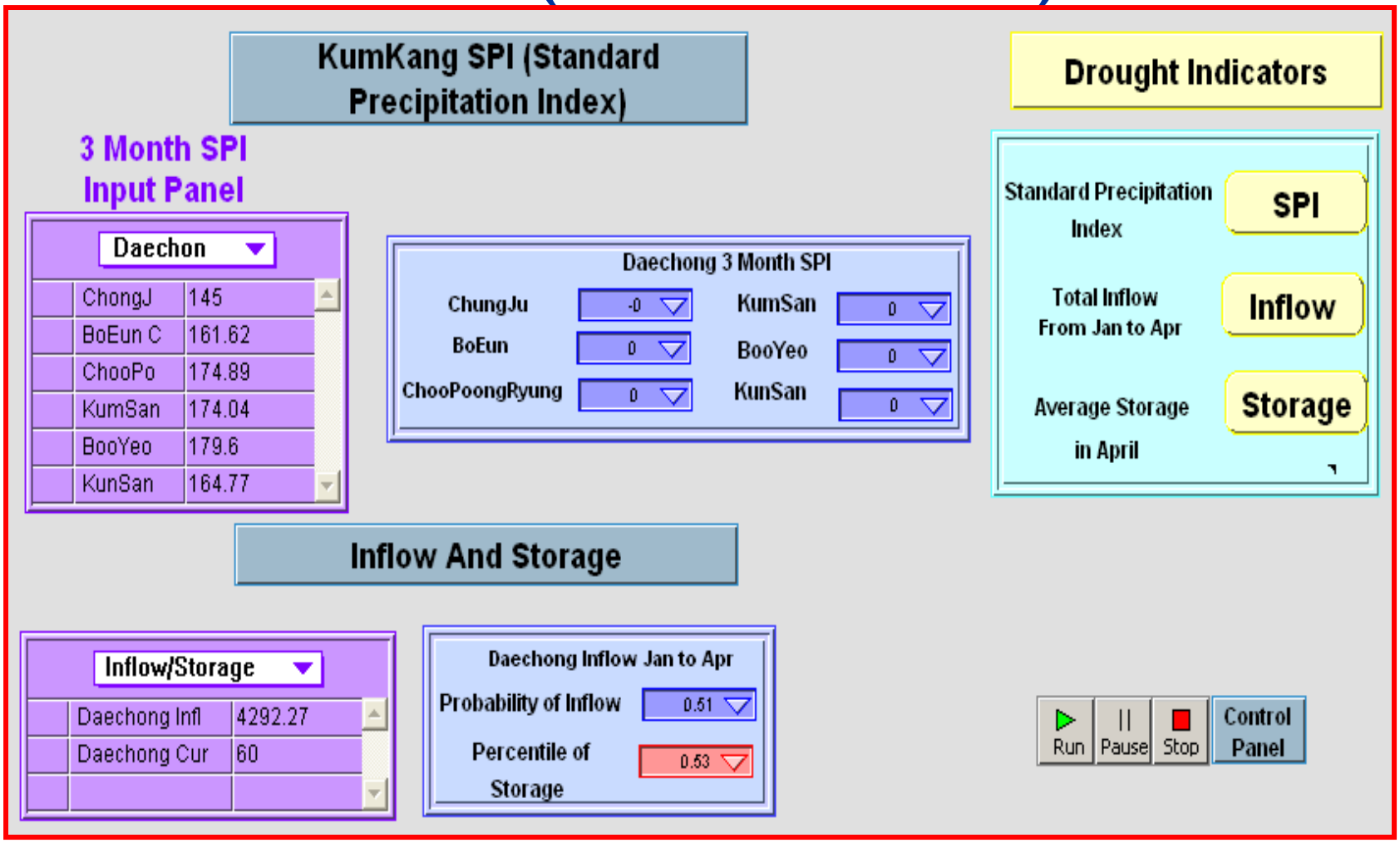
Projected average temperature at Guemsan station



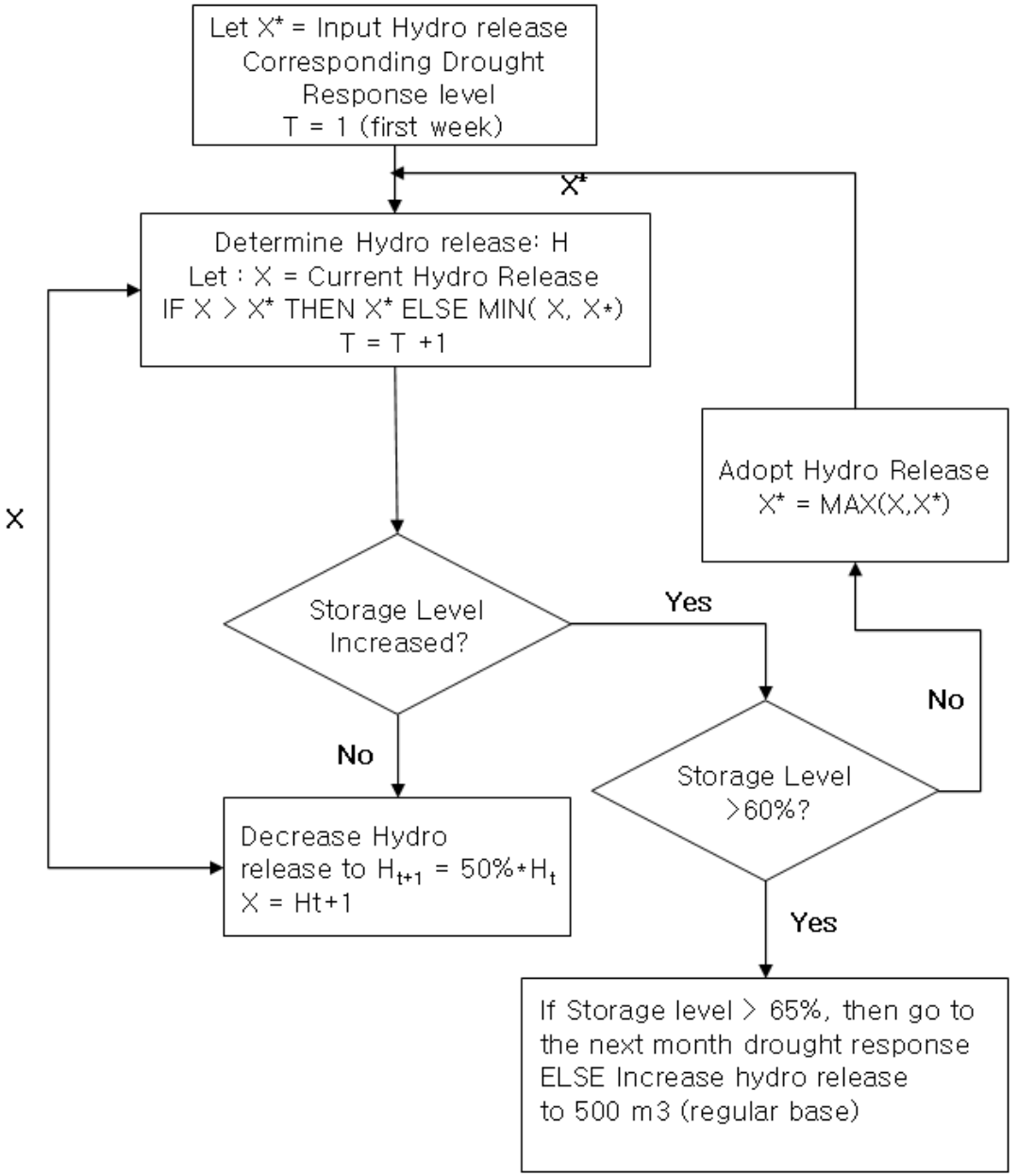
Projected Monthly Total Precipitation at Guemsan station



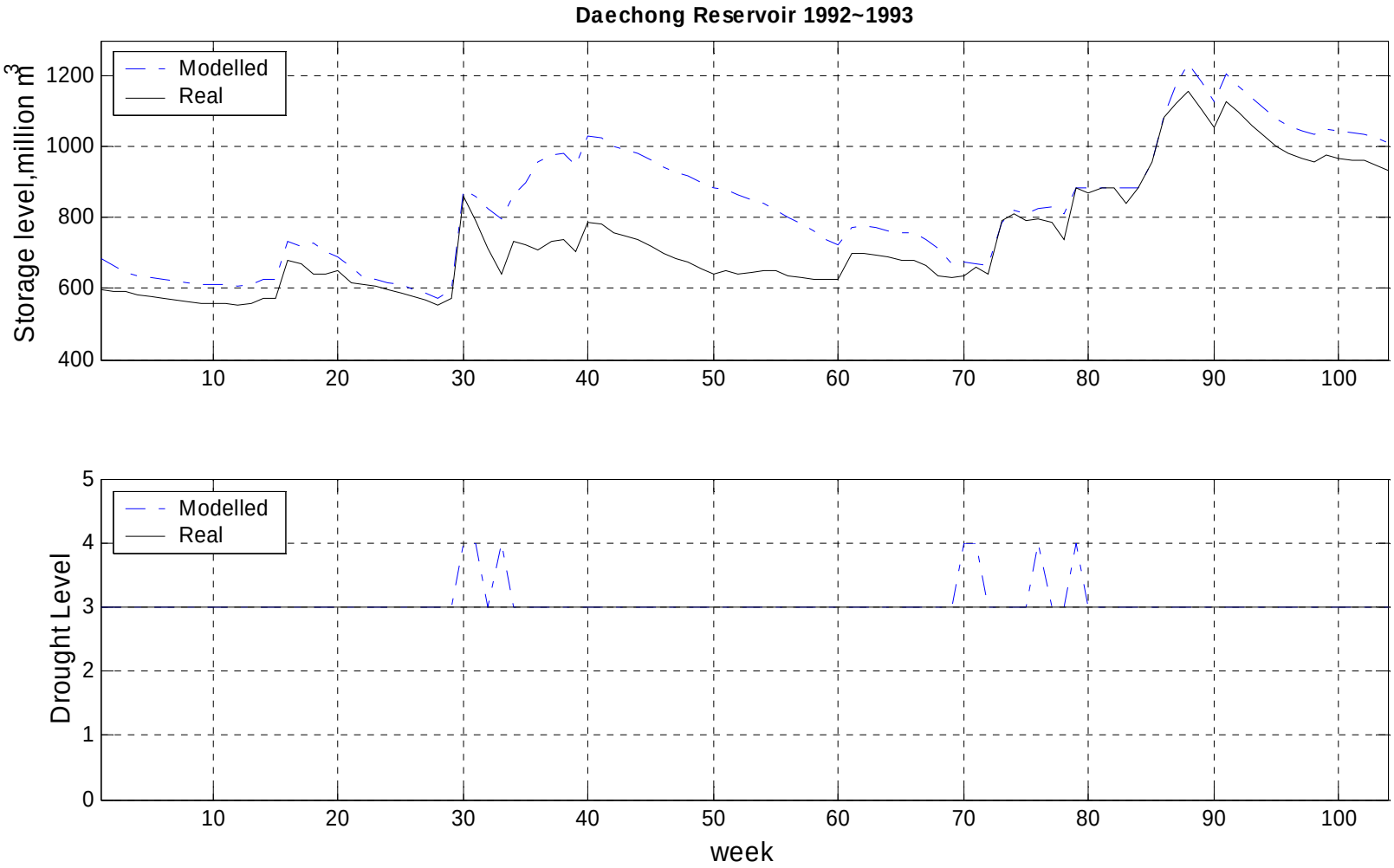
GUI for Drought Indicators and values (STELLA 7.0)



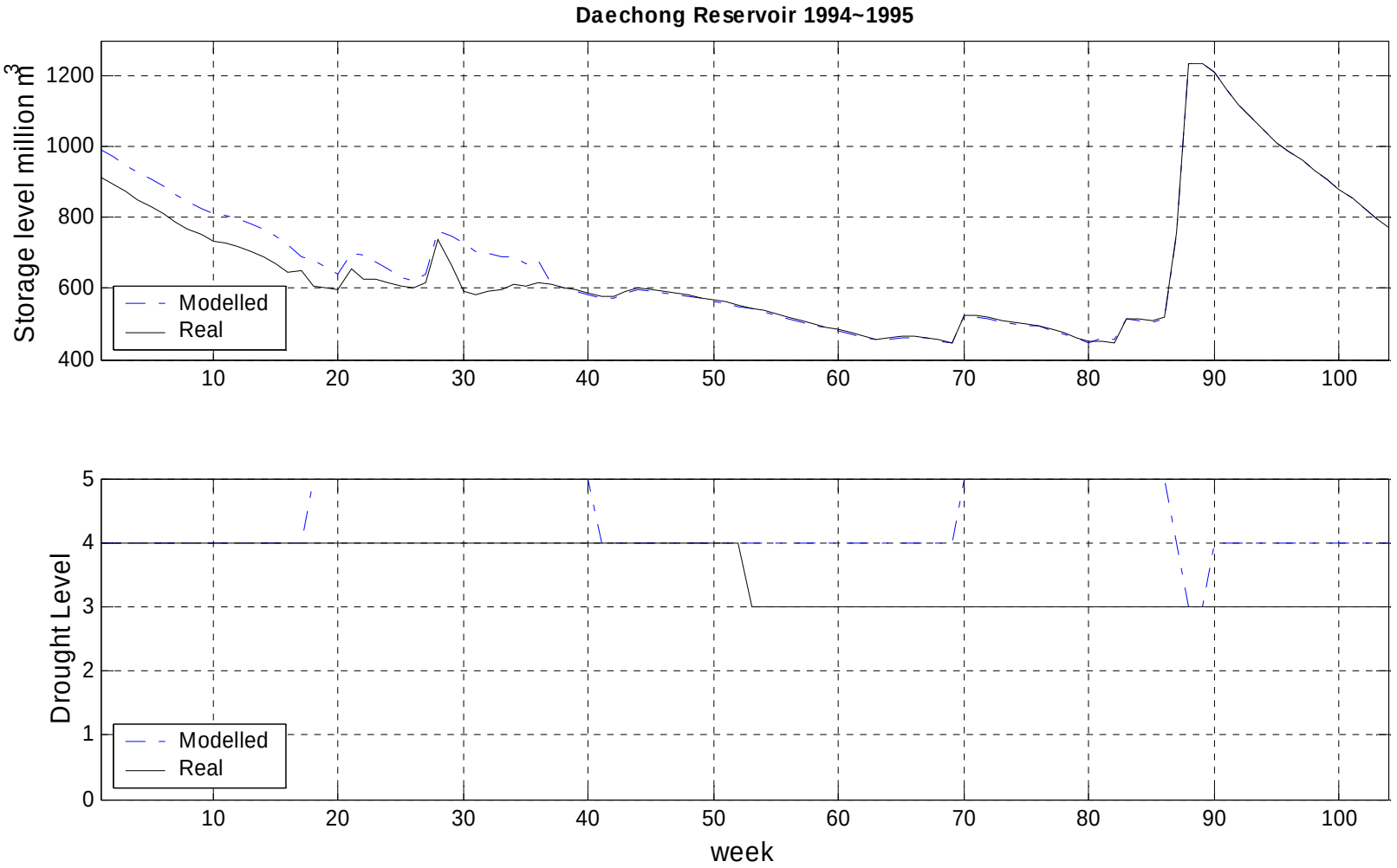
Drought Response Procedure



Drought Management Model



Drought Management Model – Cont'd

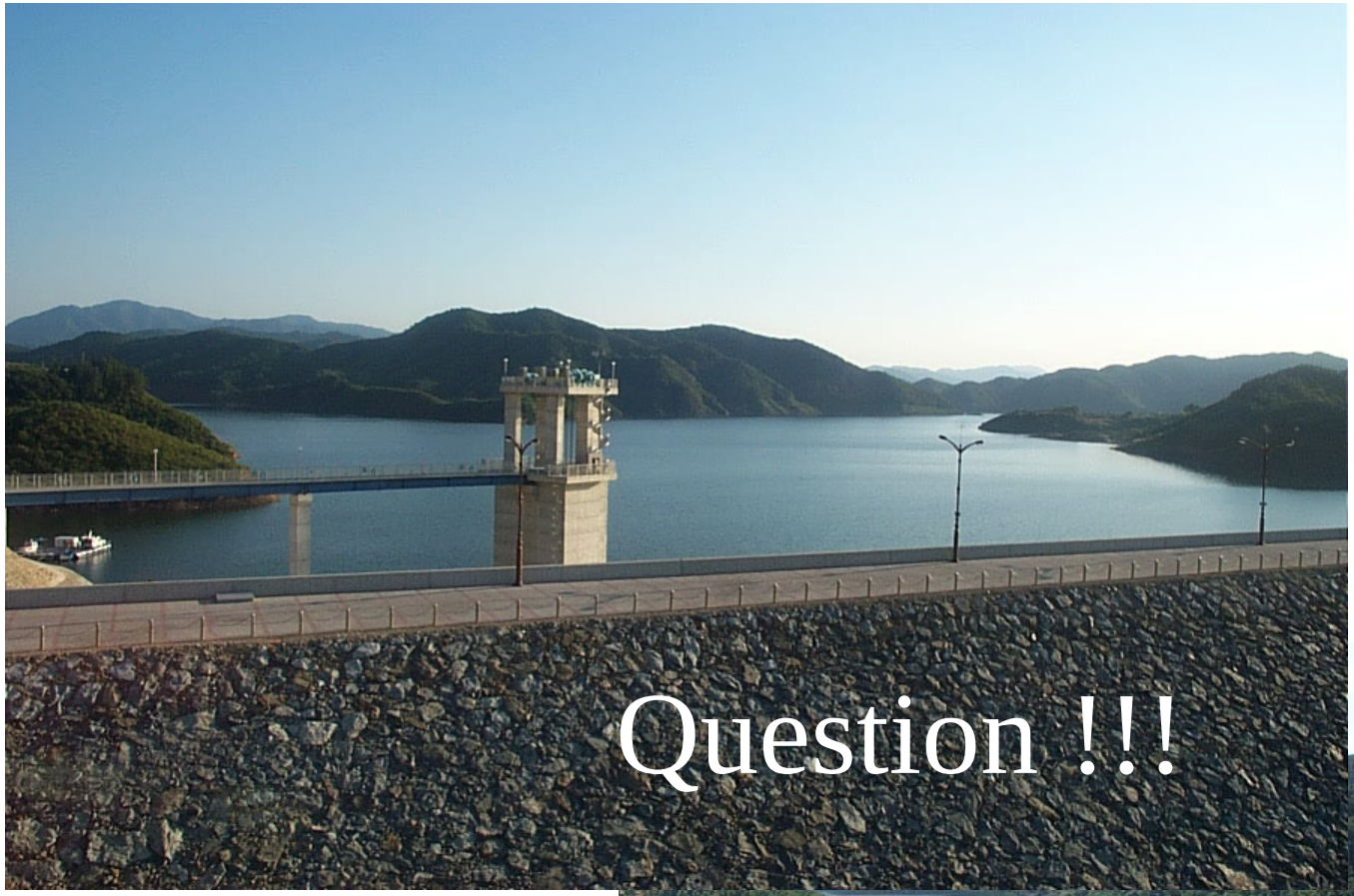
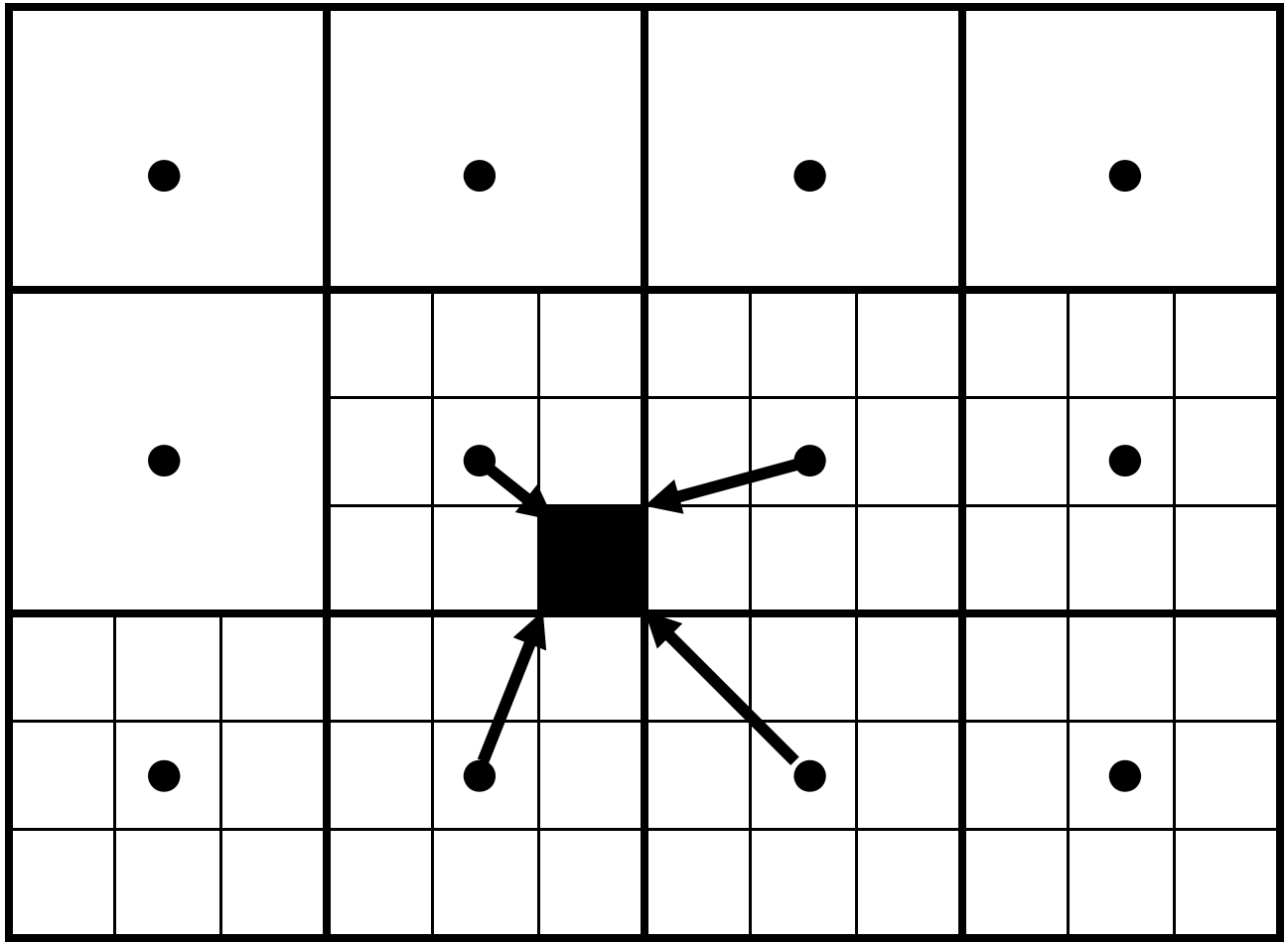


Conclusion

- Drought indicator well represented historic drought condition
- Drought management model responds normal condition as a function of storage volume
- The model should include other variable (system wide-conservation, restriction, etc) to manage drought during severe condition
- 6 month lead-time NCEP forecast represents that this year is normal condition for study area

Future Work

- Apply forecast data into drought management model
- Development of a local climate forecast model
- Compare the result between local forecast and NCEP forecast
- Forecast accuracy study



Question !!!