

Climate Forecasts and Reservoir Management : Possibilities and Challenges

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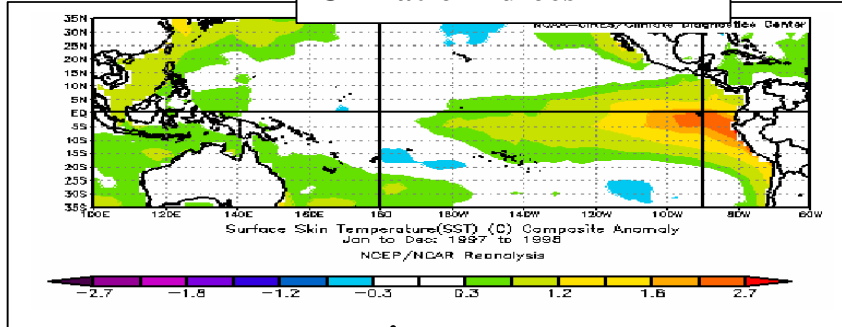
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Columbia University, Palisades**

Acknowledgements

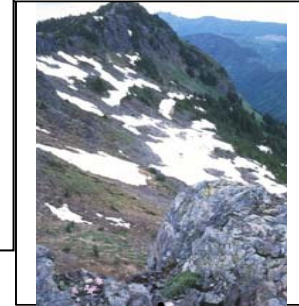
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 - Casey Brown
 - Neil Ward
- **FUNCEME, Ceara, North East Brazil**
 - Assis Filho De Souza
- **PAGASA, Manila, Philippines**
 - Susan Espinueva

Large Scale Hydroclimatology & Water Management

Climatic Indices



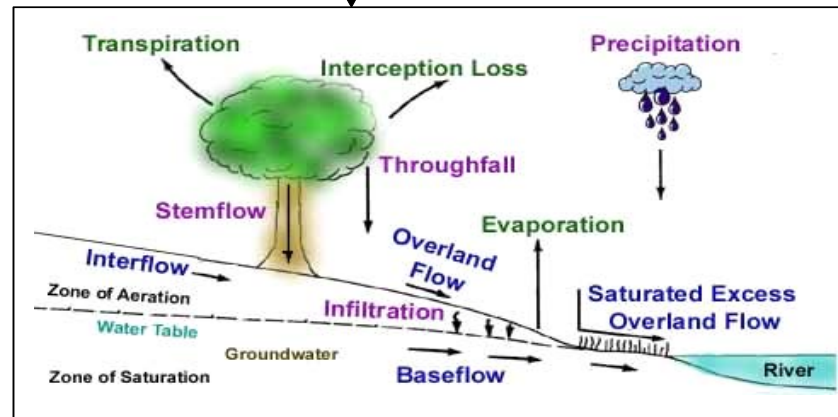
Land Surface Indices



Understanding & Monitoring of Large Scale Hydroclimatic Systems

Hydrologic Fluxes Estimation

- Modeling
- Forecasting



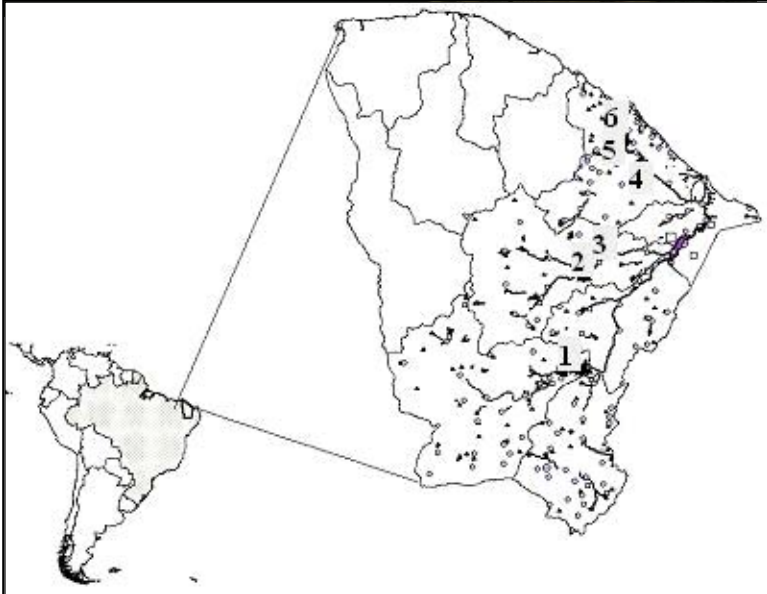
Water Management

- System Design
- Impact/Assessment
- Allocation/Operation

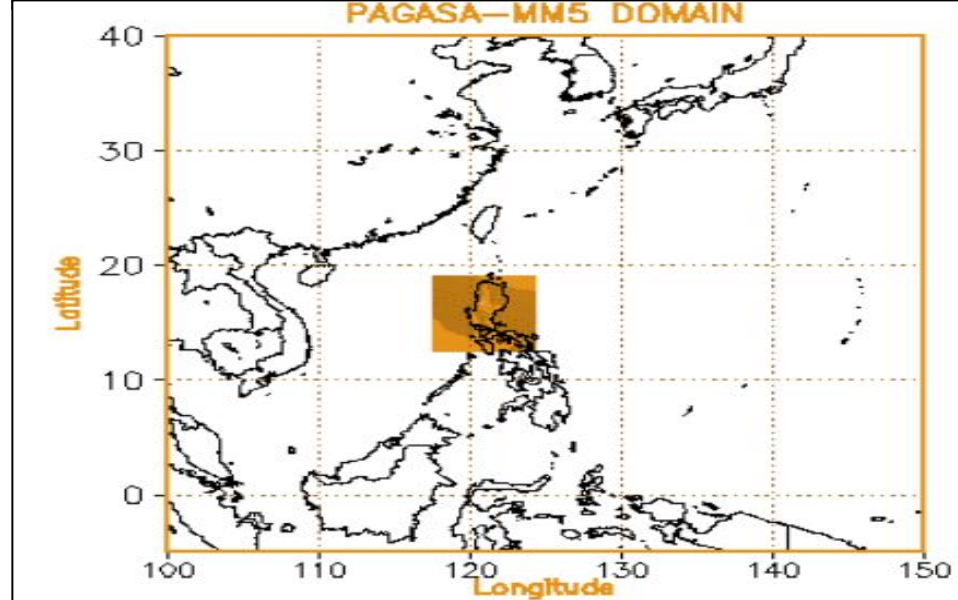


TALE OF TWO RIVER BASINS

Jaguaribe-Metropolitan HydroSystem, Ceara, Brazil



Angat Reservoir, Philippines

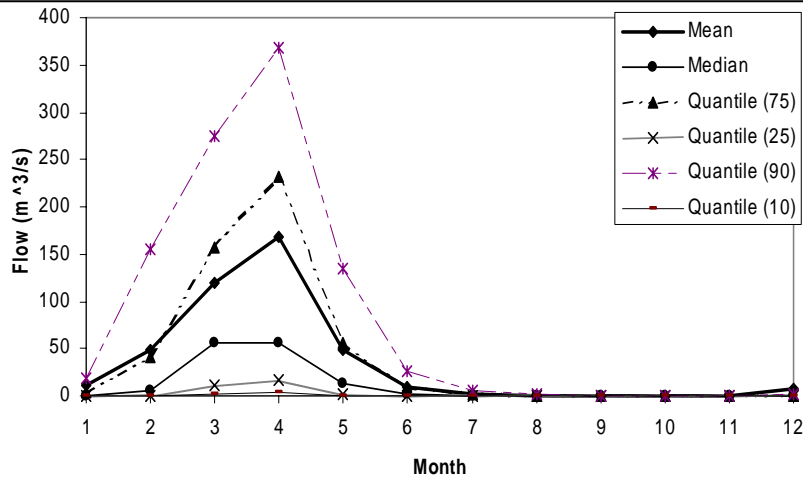


Hydroclimatology of the Basins

JMH, Ceara, NE Brazil

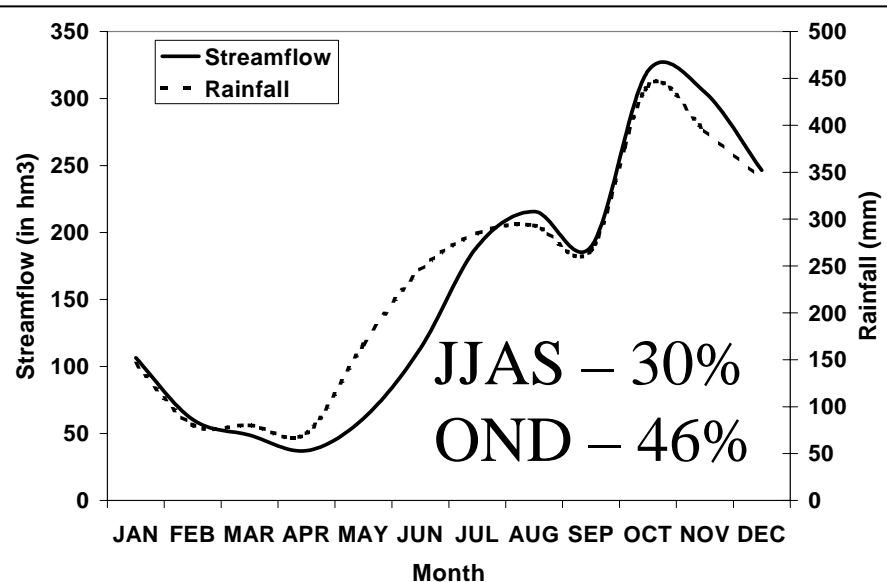
- Semi-Arid
- One Rainy season, Rest Zero flows

Seasonality of rain determined by N-S migration of the ITCZ



Angat, Philippines

- Humid
- Two Rainy Seasons (Jun-Sep) & (Oct-Dec)



Predictors

Correlation

Nino 3.4

-0.31

Dipole

-0.42

3-months lag correlation

$\rho(\text{Nino3.4}, Q_{\text{JJAS}}) = -0.20$

$\rho(\text{Nino3.4}, Q_{\text{OND}}) = -0.51$

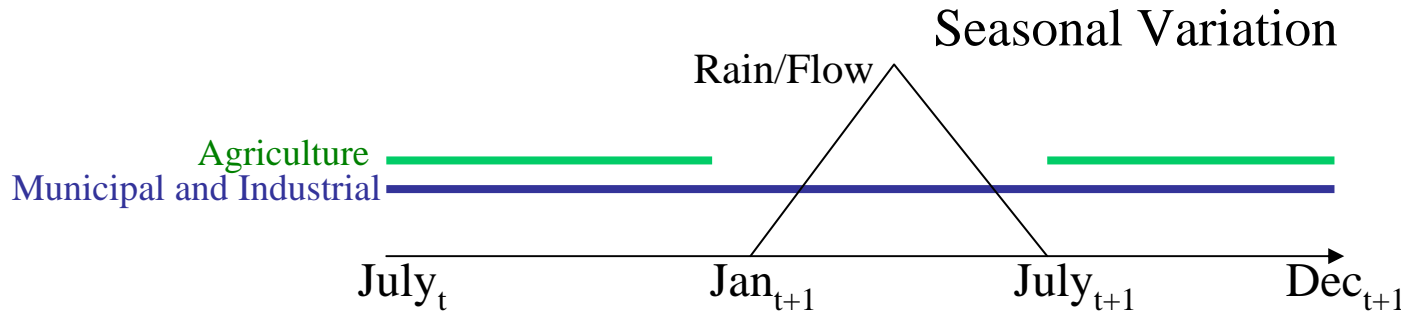
Water Management Context

JMH, Ceara, NE Brazil

Storage/Annual Demand Ratio:

Priority Uses

- Municipal
- Industrial
- Agriculture

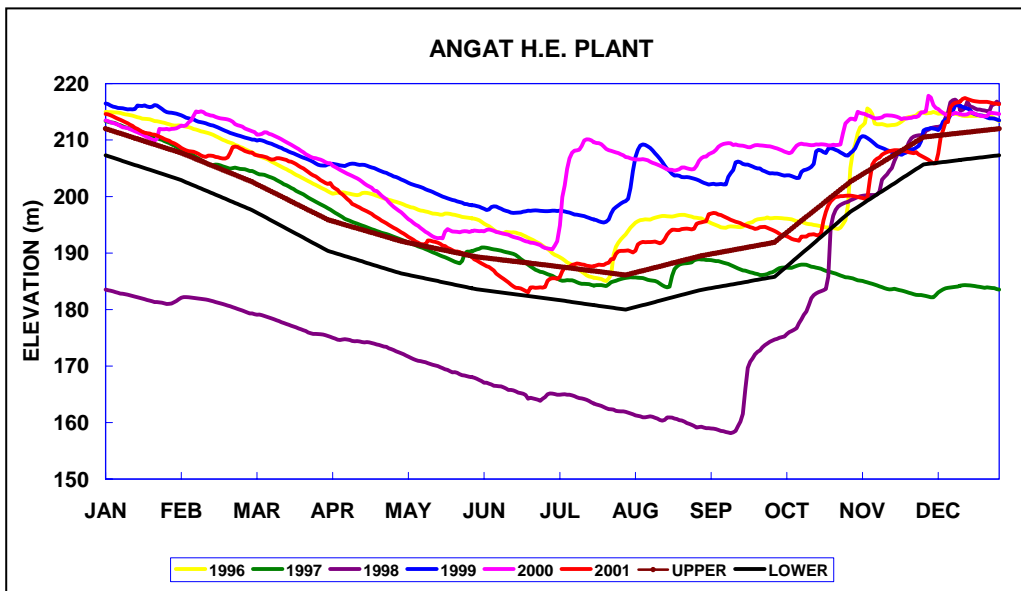


Angat, Philippines

Storage/Annual Demand Ratio:

Priority Uses

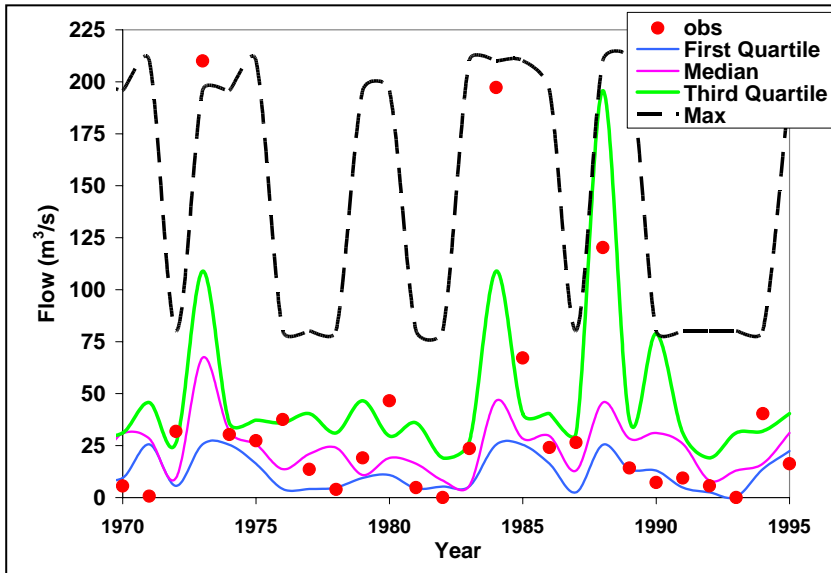
- Municipal
- Industrial
- Agriculture
- Hydropower



Climate Information based Streamflow Forecasts

JMH, Ceara, NE Brazil

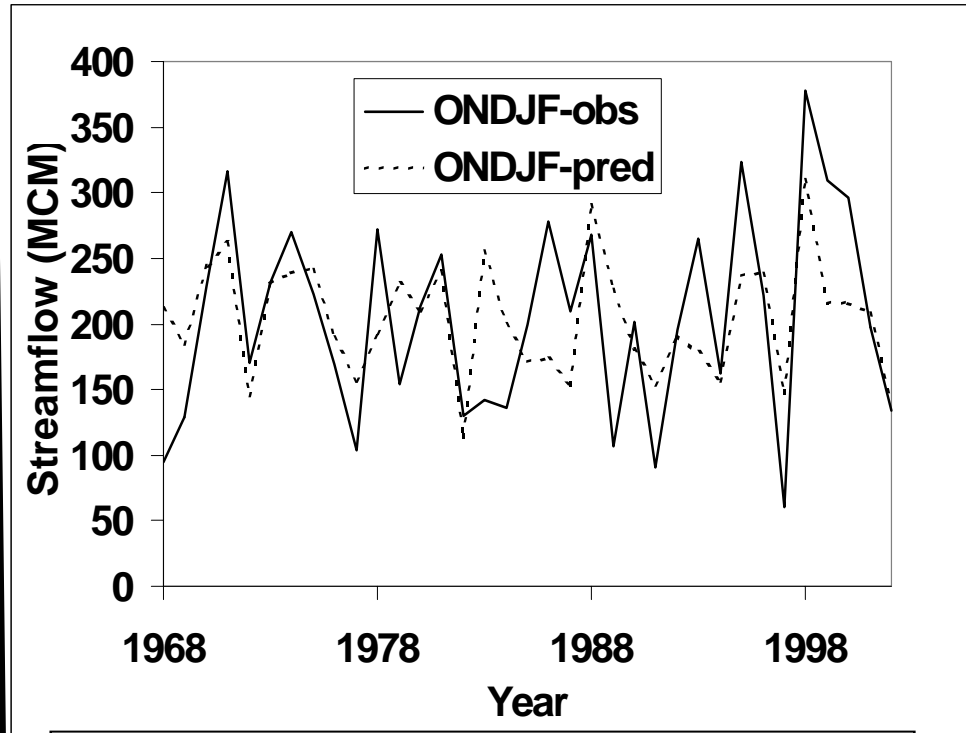
- Predictors: Nino3.4 & Atlantic Dipole
- Semi-parametric Resampling algorithm



$$\rho(Q_{\text{obs}}, Q_{\text{pred}}) = 0.75$$

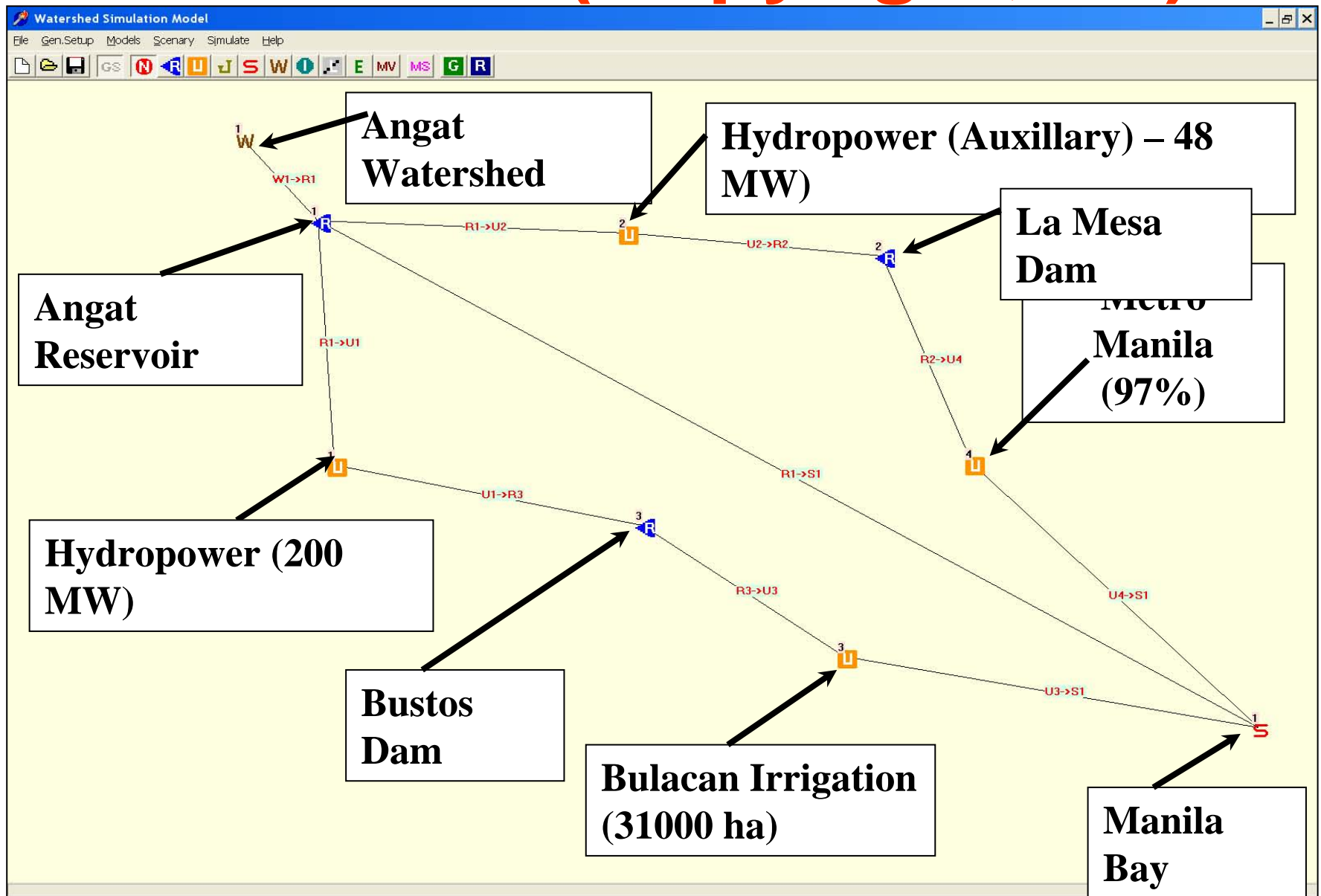
Angat, Philippines

- ECHAM 4.5 ONDJF Forecasts in persisted SST mode
- Parametric Regression



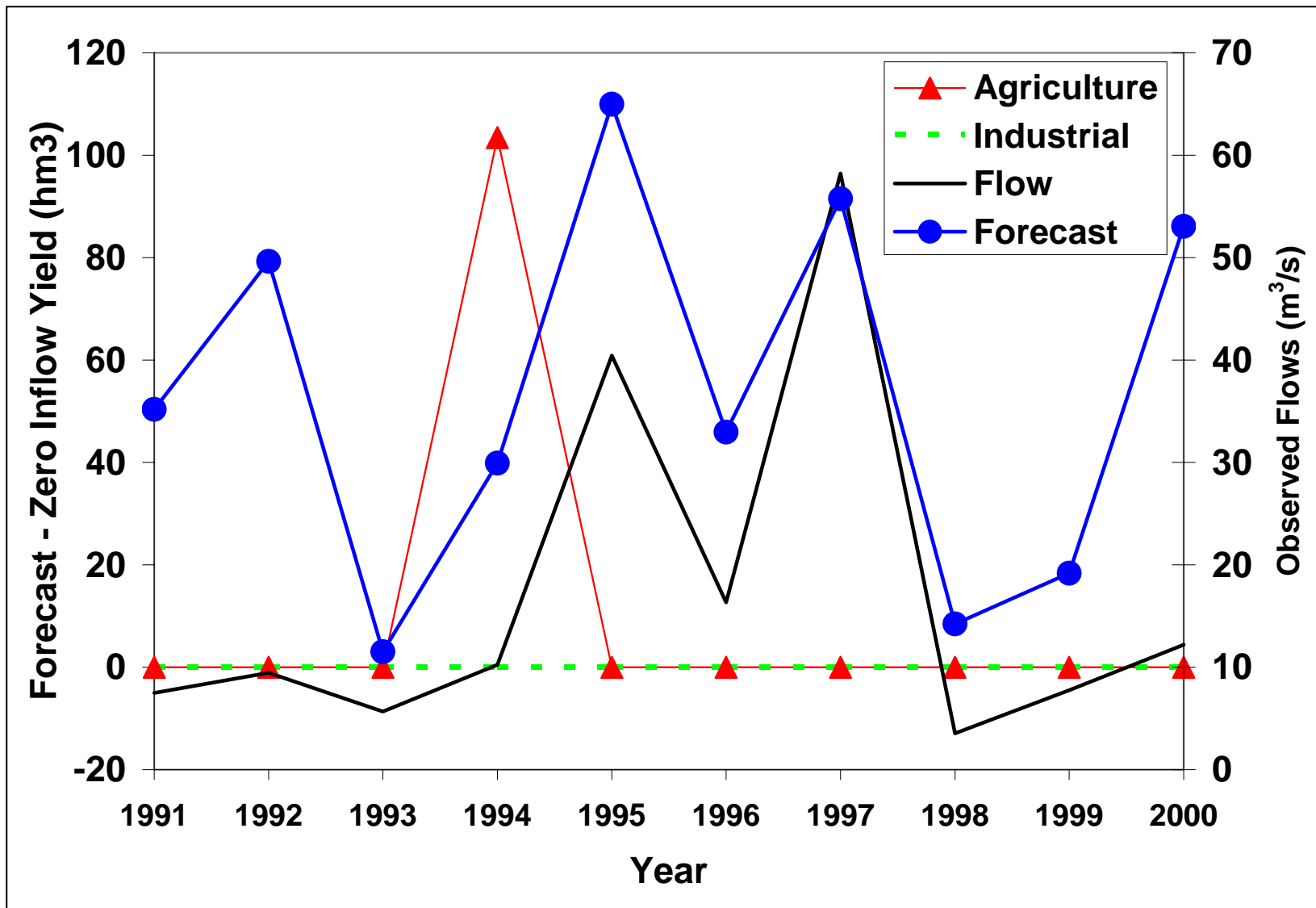
$$\rho(Q_{\text{pred}}, Q_{\text{obs}}) = 0.58$$

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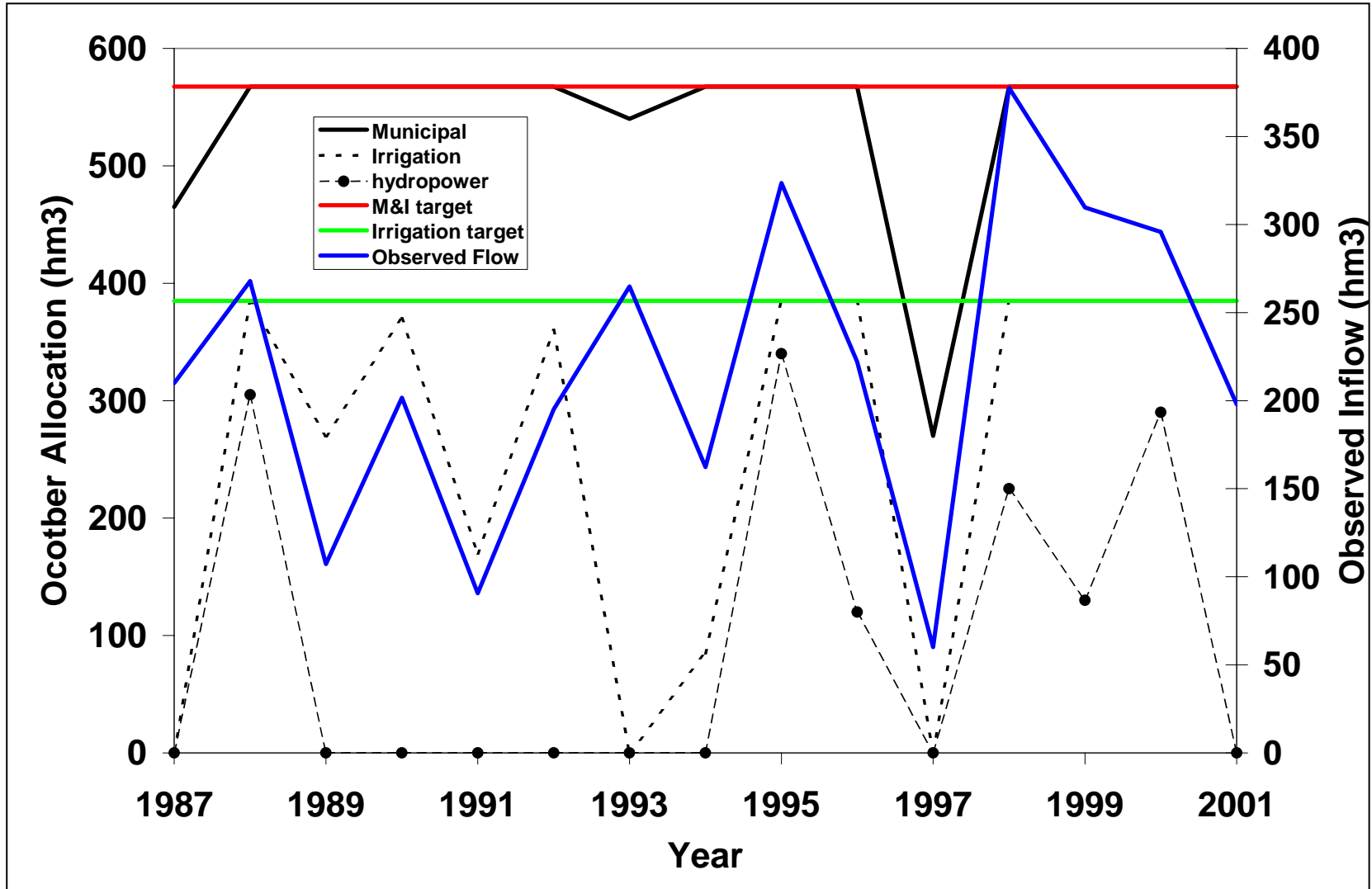
Retrospective Analyses on Water Allocation

JMH, Ceara, NE Brazil:1990 – 2000;Annual Demand

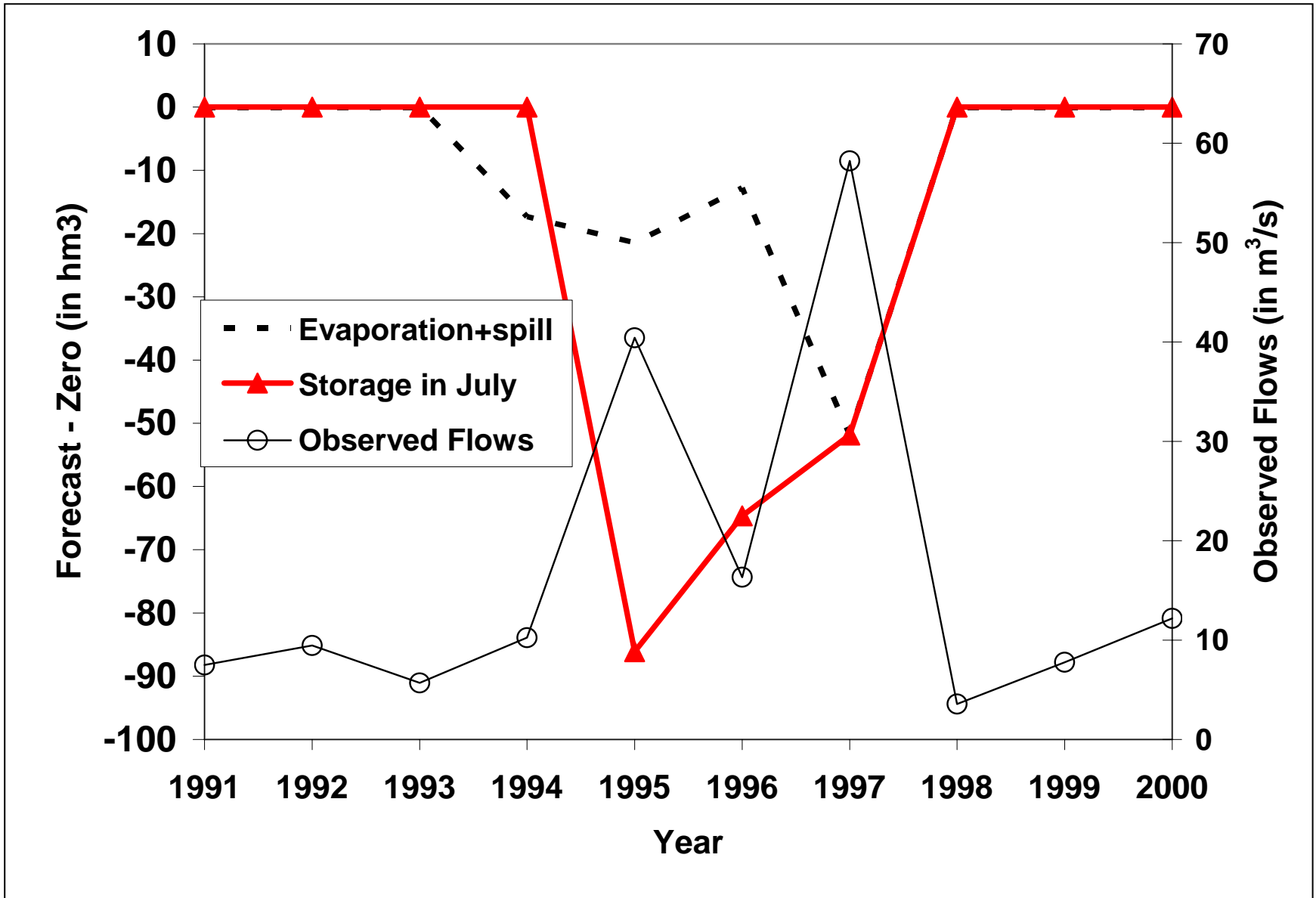


Retrospective Analyses on Water Allocation

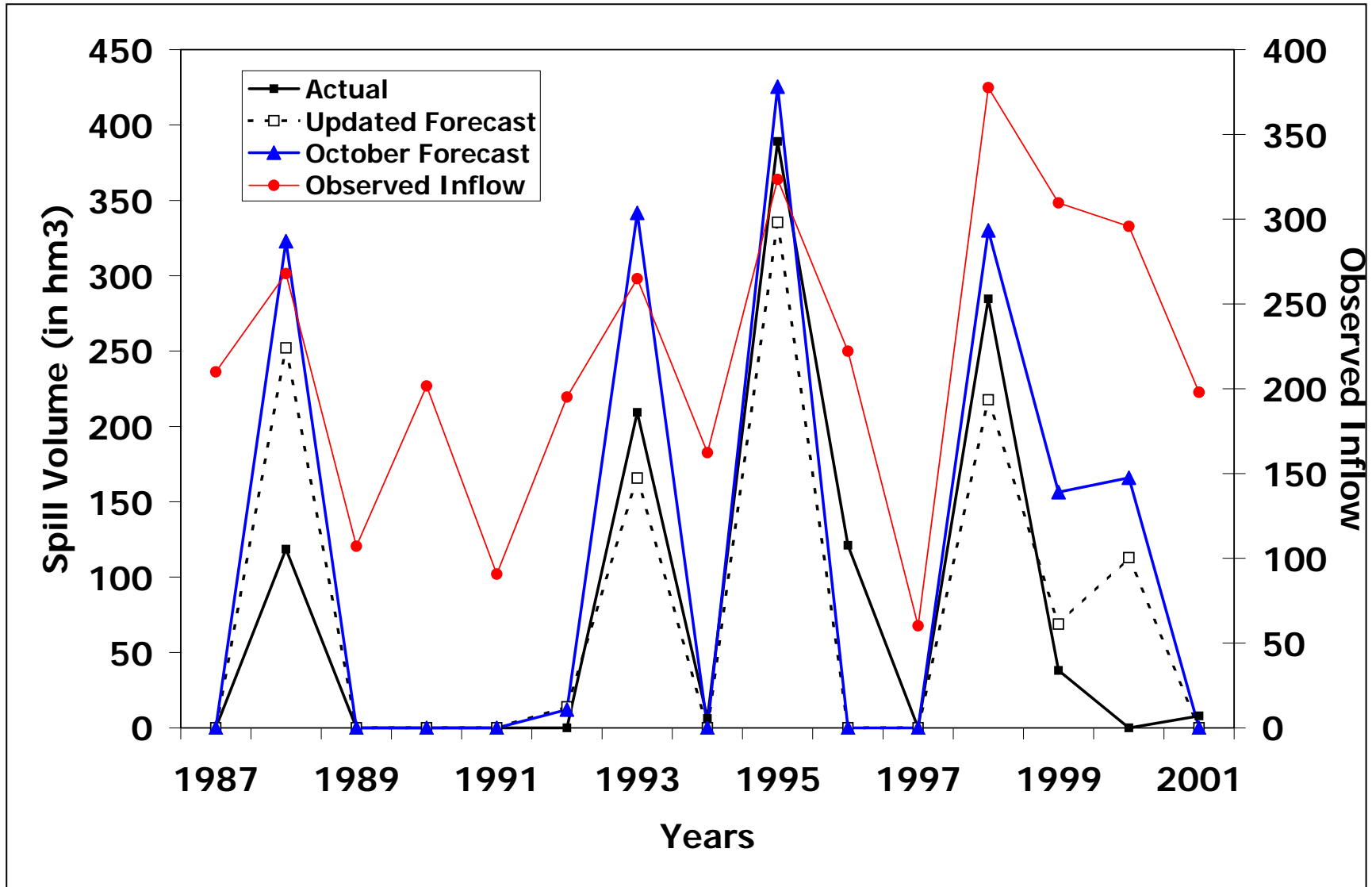
Angat, Philippines: 1987-2001 ONDJF Allocation



Oros - System Losses

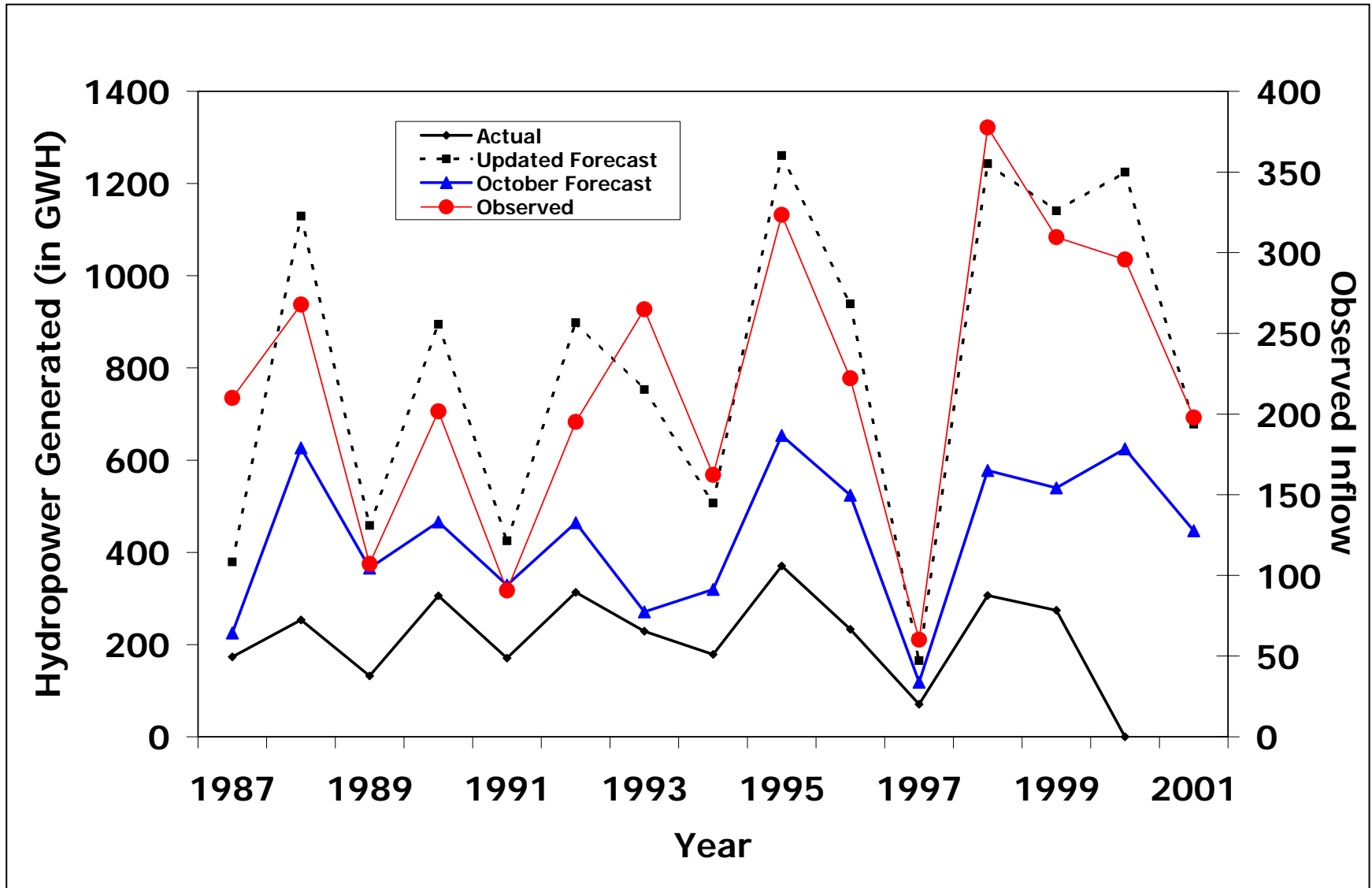


Angat- Spill Volume (Max Hydro)

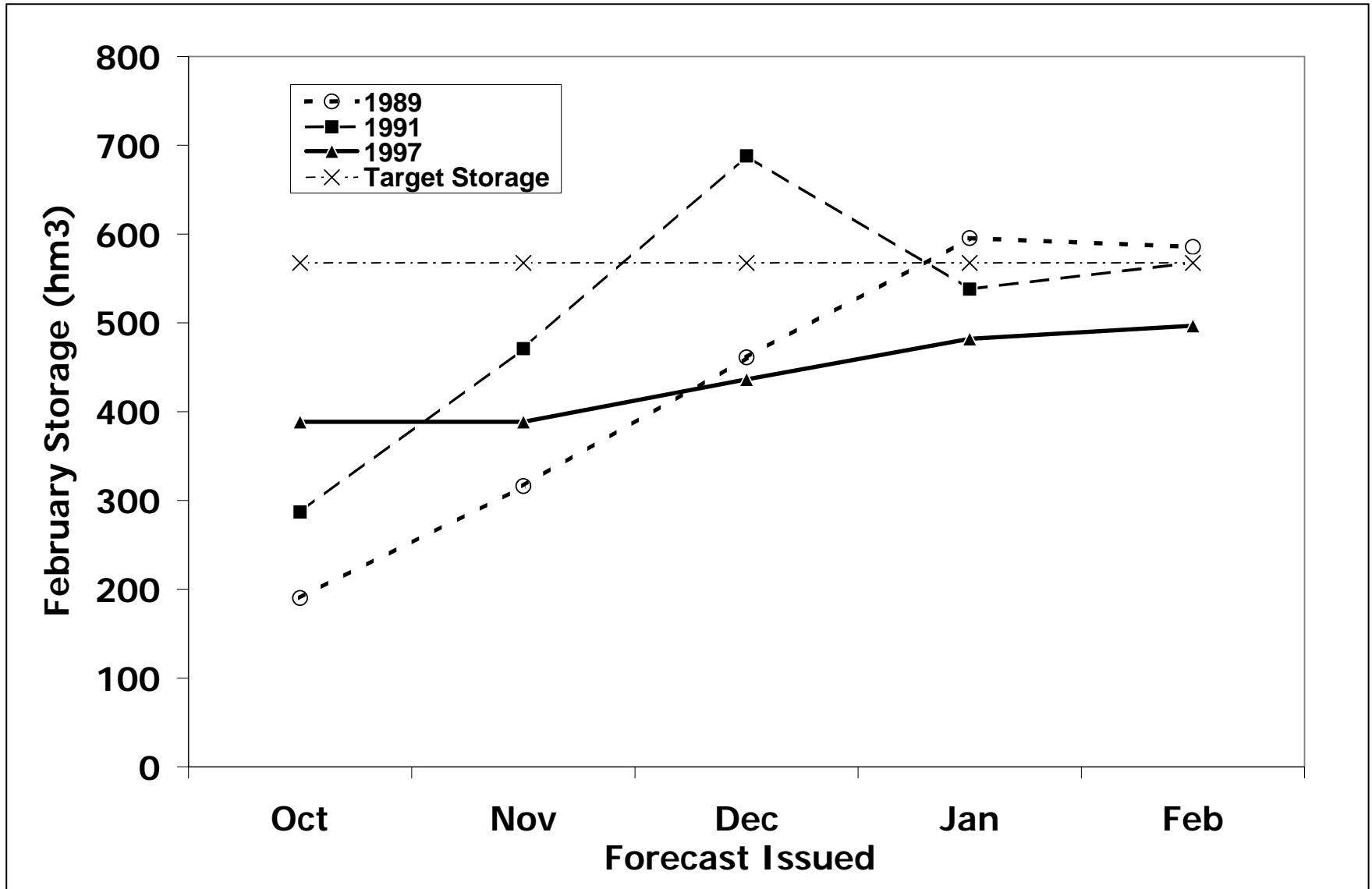


Retrospective Analyses on Water Allocation

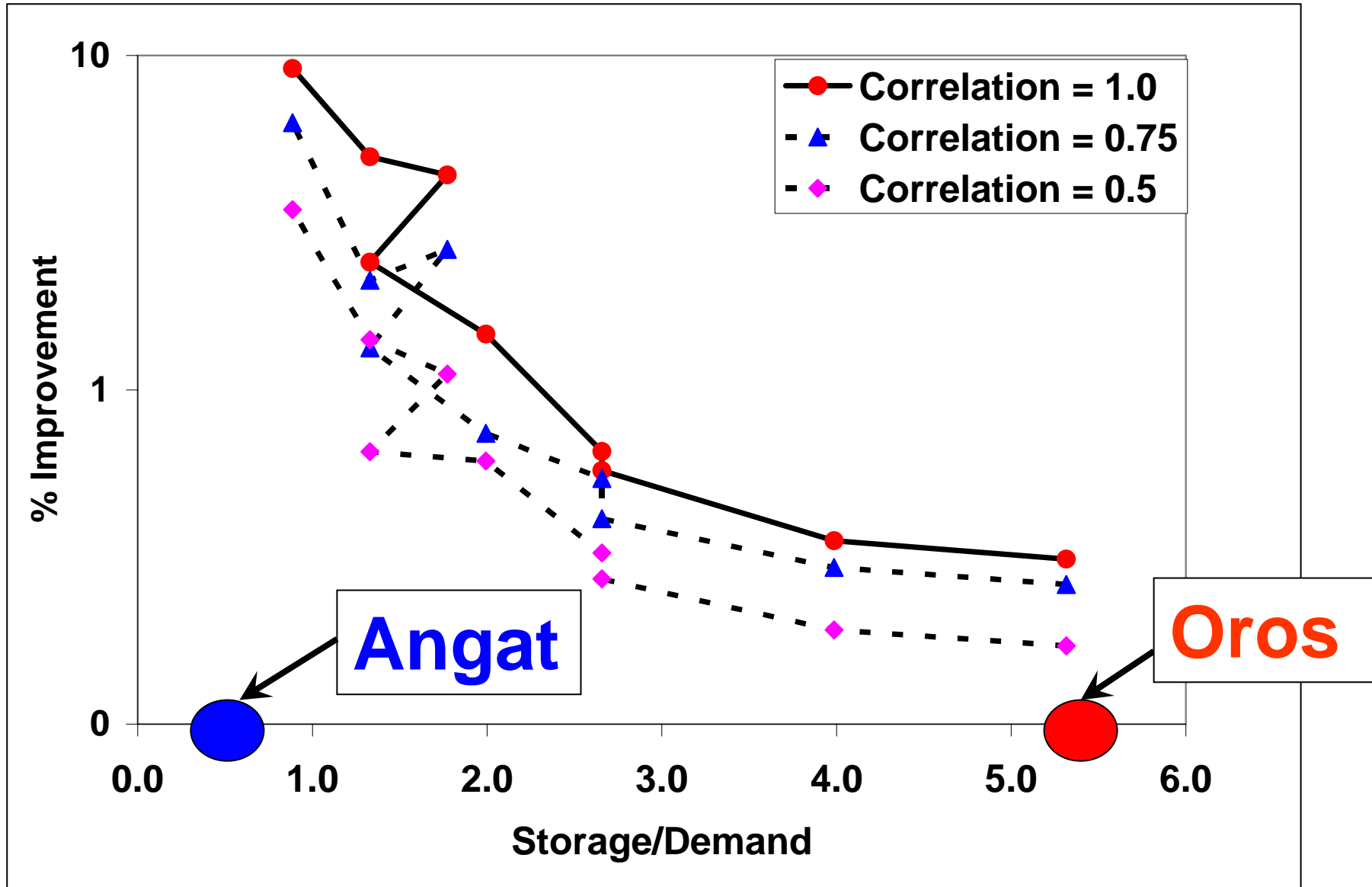
Angat, Philippines: 1987-2001 ONDJF Allocation



Meeting February Target Storage



Utility of Forecasts As Storage/Demand



Climate Forecasts – Reservoir Management

- **Forecast is more useful than climatology**

- In reducing System Losses – Spill and Evaporation
- In a system with low Storage/Demand ratio
- In a Seasonal Storage Reservoir than a Over Year System
- In Systems with multiple uses constraining the allocation process

Challenges and Way Forward

- **S-I Climate Forecasts Applications for Water Management**
 - Integrating Weather Forecasts (0-7 days outlook) with monthly and seasonal climate outlooks
 - Adaptive Management with continuous updating of forecasts
 - Community Priorities, Restriction and Compensation Mechanisms
 - Application involve Risk based management strategies and water supply reliability specification.