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Linking Atmospheric and Watershed Models

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Linking atmospheric and watershed models

Day 0

Statistical DownScaling (SDS)

Dynamical DownScaling (DDS)

Day 0-8

Statistical DownScaling (SDS)

Ensemble Streamflow Prediction (ESP)

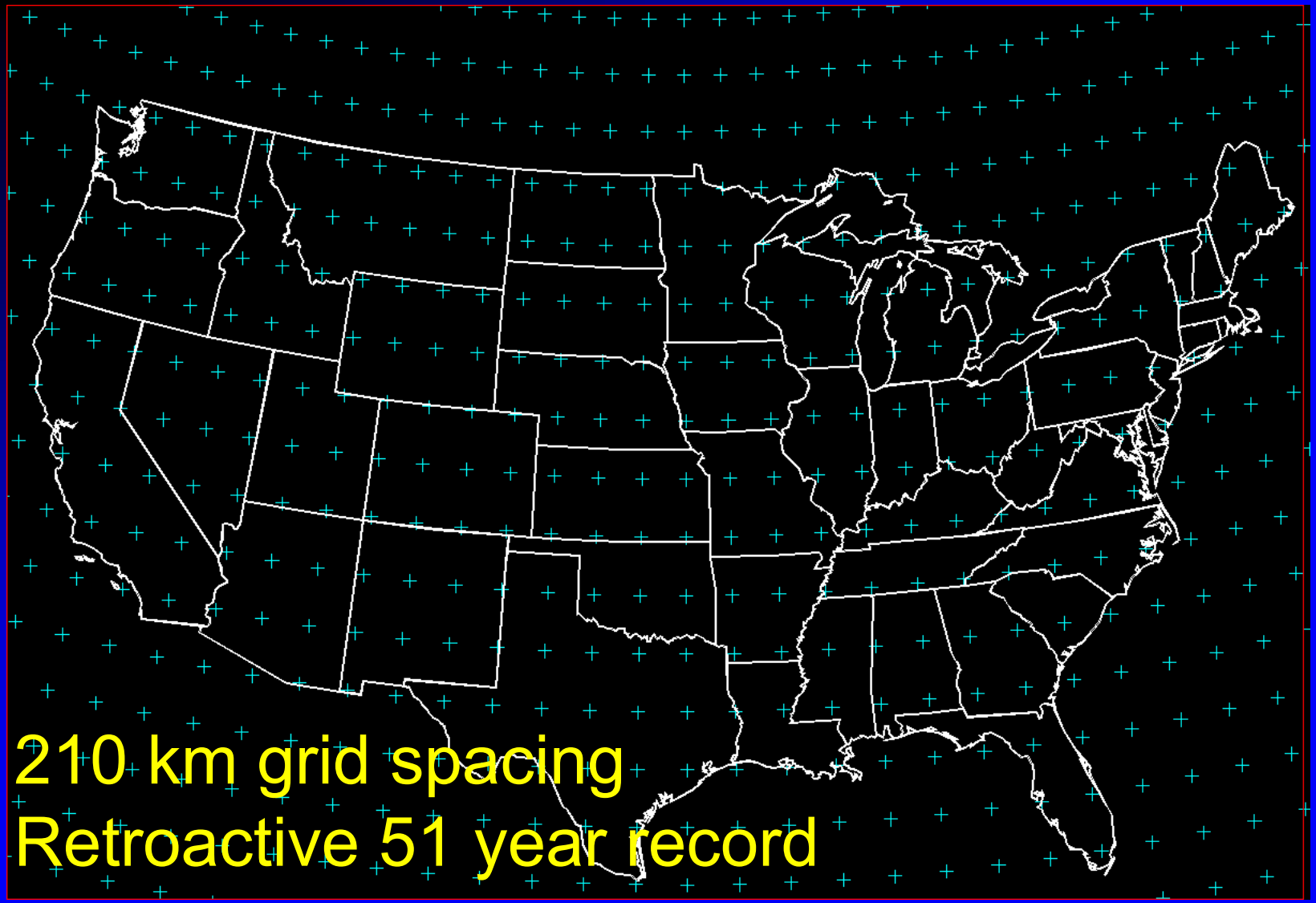
Linking atmospheric and watershed models

DAY 0

Global-scale model –

National Centers for Environmental Prediction/National Center for Atmospheric Research Reanalysis (NCEP)

NCEP



Every 5 days there is an 8-day forecast

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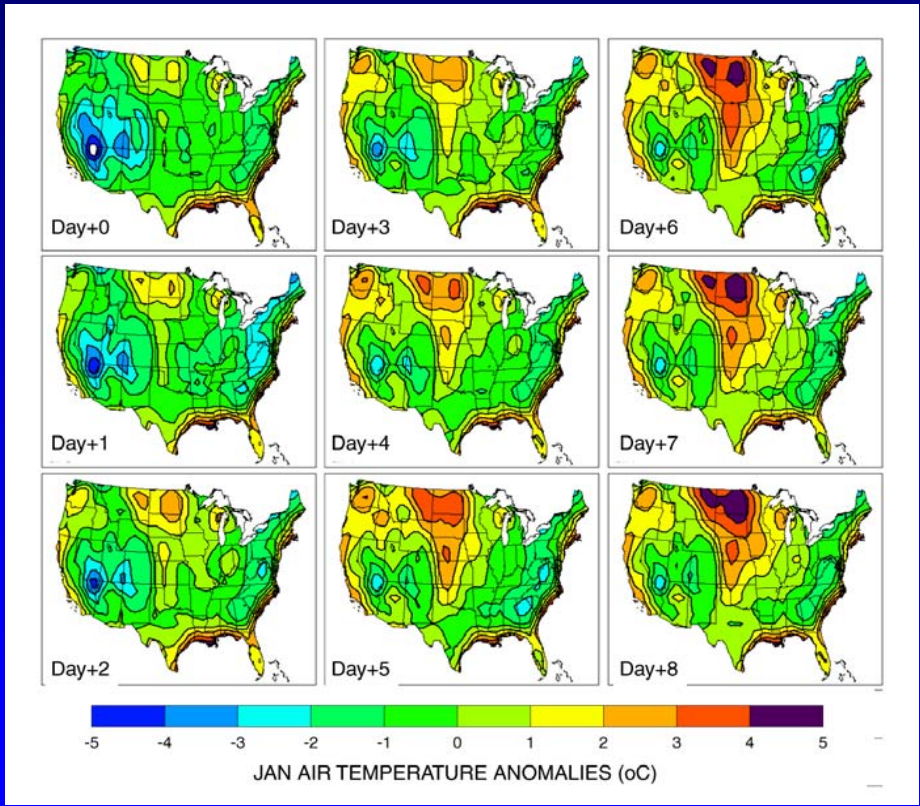
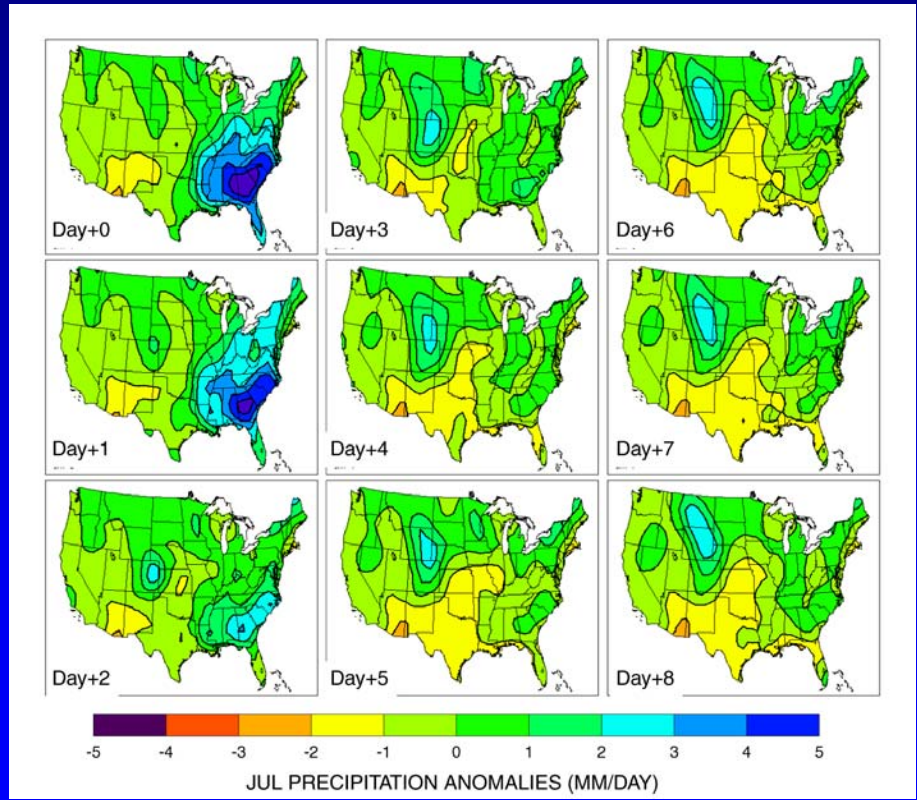
NCEP

January Air Temperature Anomalies



July Precipitation Anomalies



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Linking atmospheric and watershed models

Compare SDS and DDS output by using it to drive a distributed hydrologic model

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Hydrologic Model

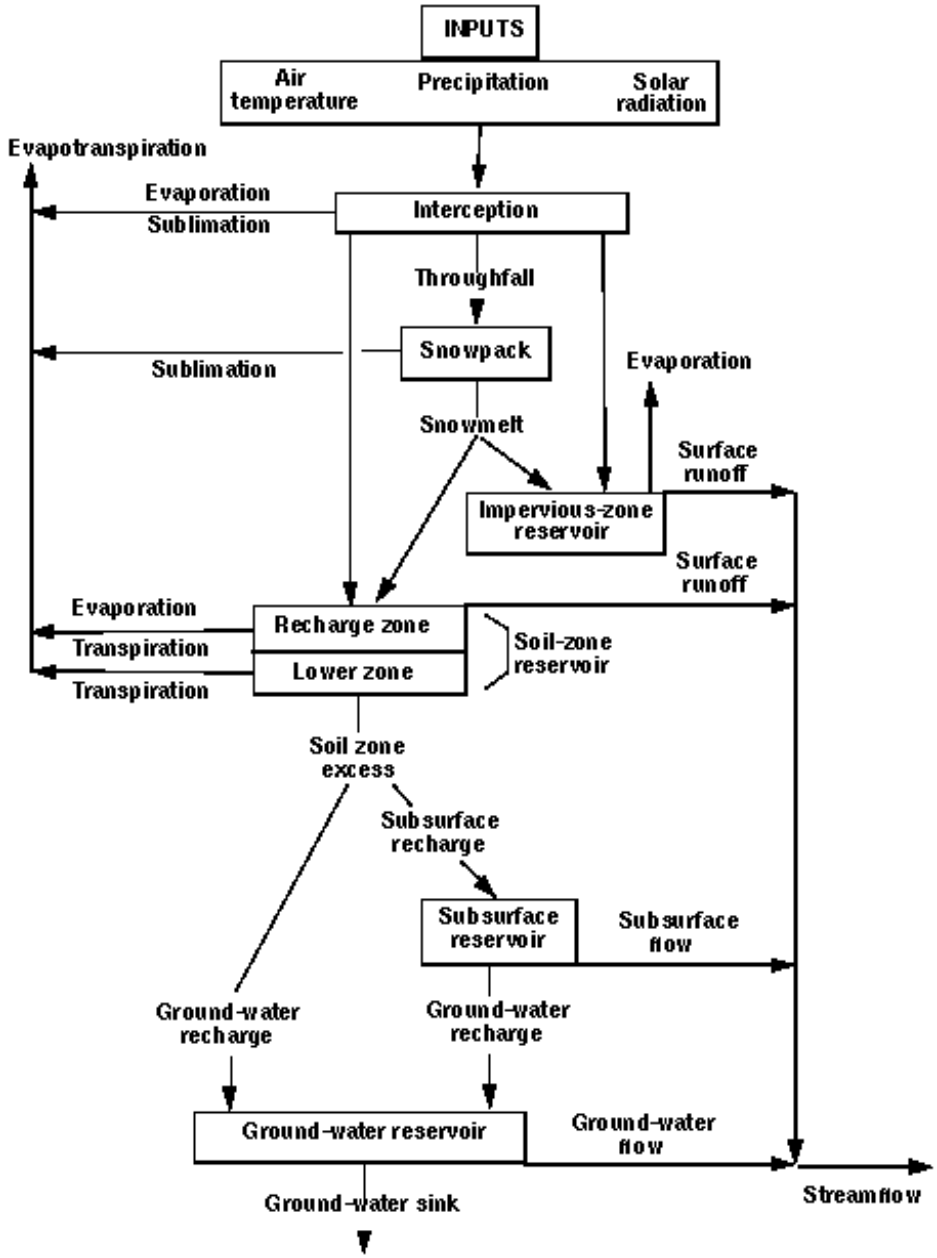
Precipitation Runoff Modeling System (PRMS)

[distributed –parameter, physically-based watershed model]

Implemented in:

The Modular Modeling System (MMS)

[A set of modeling tools to enable a user to selectively couple the most appropriate algorithms]



Hydrologic Model -- PRMS

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- Distributed capabilities provided by partitioning watershed into **M**odeling **R**esponse **U**nits

- Basin and **MRU** delineation, characterization and parameterization done using the GIS Weasel

- No parameter calibration performed on GIS weasel generated parameters

- Calibration focused on WB parameters affecting PET and precipitation distribution

- Other model parameters based on parameter sets from comparable basins

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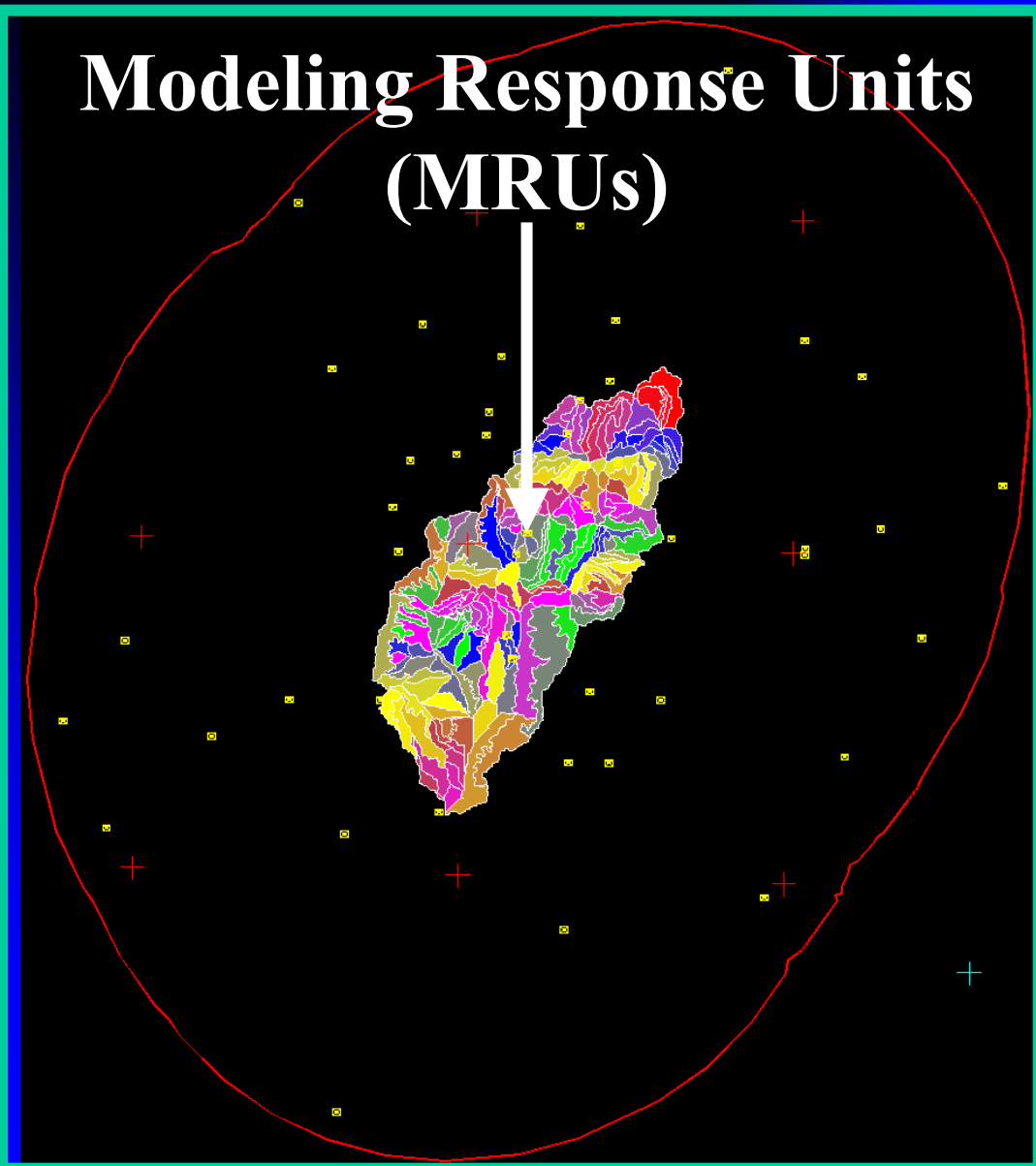
Hydrologic Model -- PRMS

Need to be able to distribute from a station or a grid point to each MRU

Input Data Sets:

1. Station Data
2. NCEP
3. SDS
4. DDS



XYZ Methodology

Distributes a single mean value from a group of stations (or a model grid node) to each modeling unit within a basin.

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XYZ Methodology

One predictor (Z) example for predicting daily PRCP

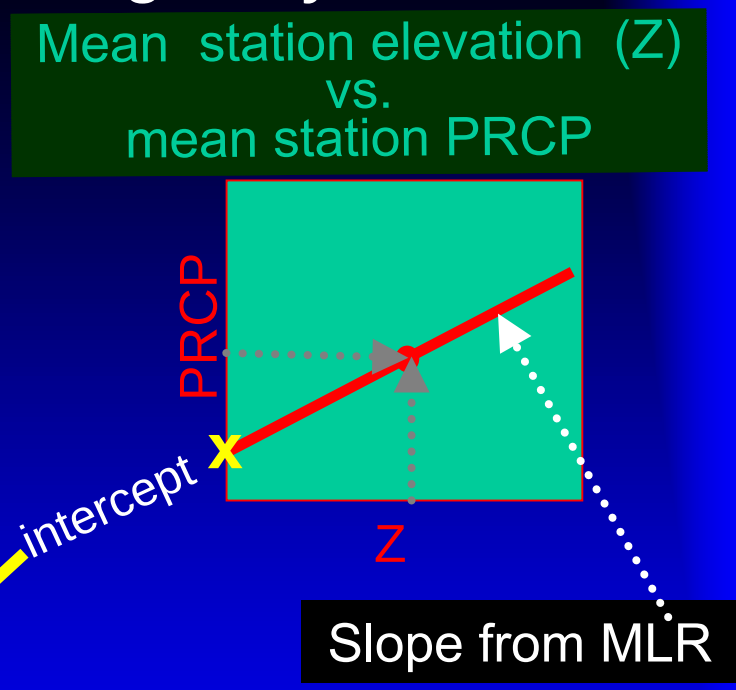
1. For each day solve for y-intercept

   intercept = $PRCP_{sta}$ - slope*Z_{sta}

   where $PRCP_{sta}$ is mean station PRCP and

   Z_{sta} is mean station elevation

   slope is monthly value from MLRs



2. $PRCP_{mru}$ = slope*Z_{mru} + intercept

   where $PRCP_{mru}$ is PRCP for your modeling response unit

   Z_{mru} is mean elevation of your modeling response unit

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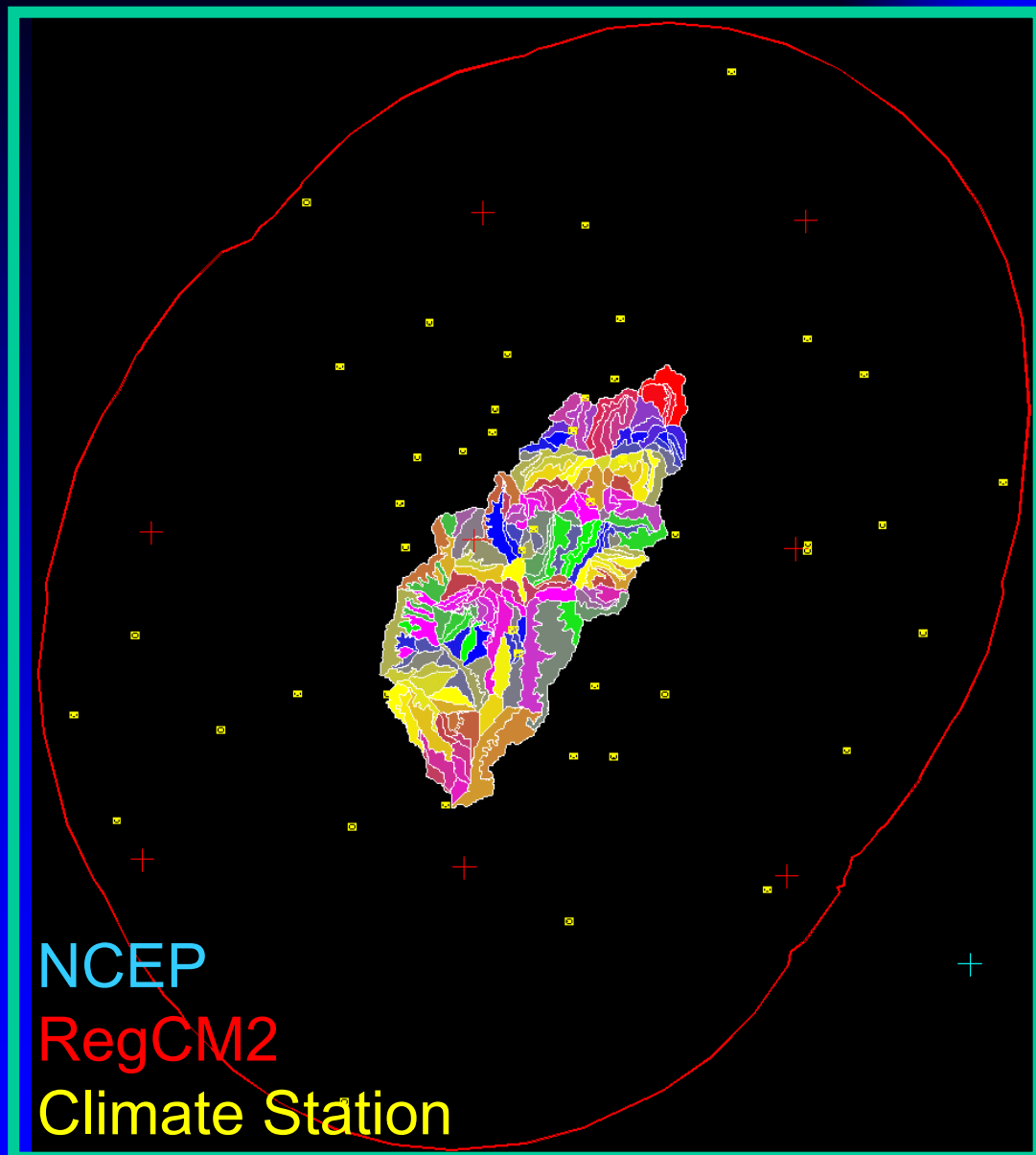
Hydrologic Model -- PRMS

Input Data Sets:

1. Station Data
2. NCEP
3. SDS
4. DDS



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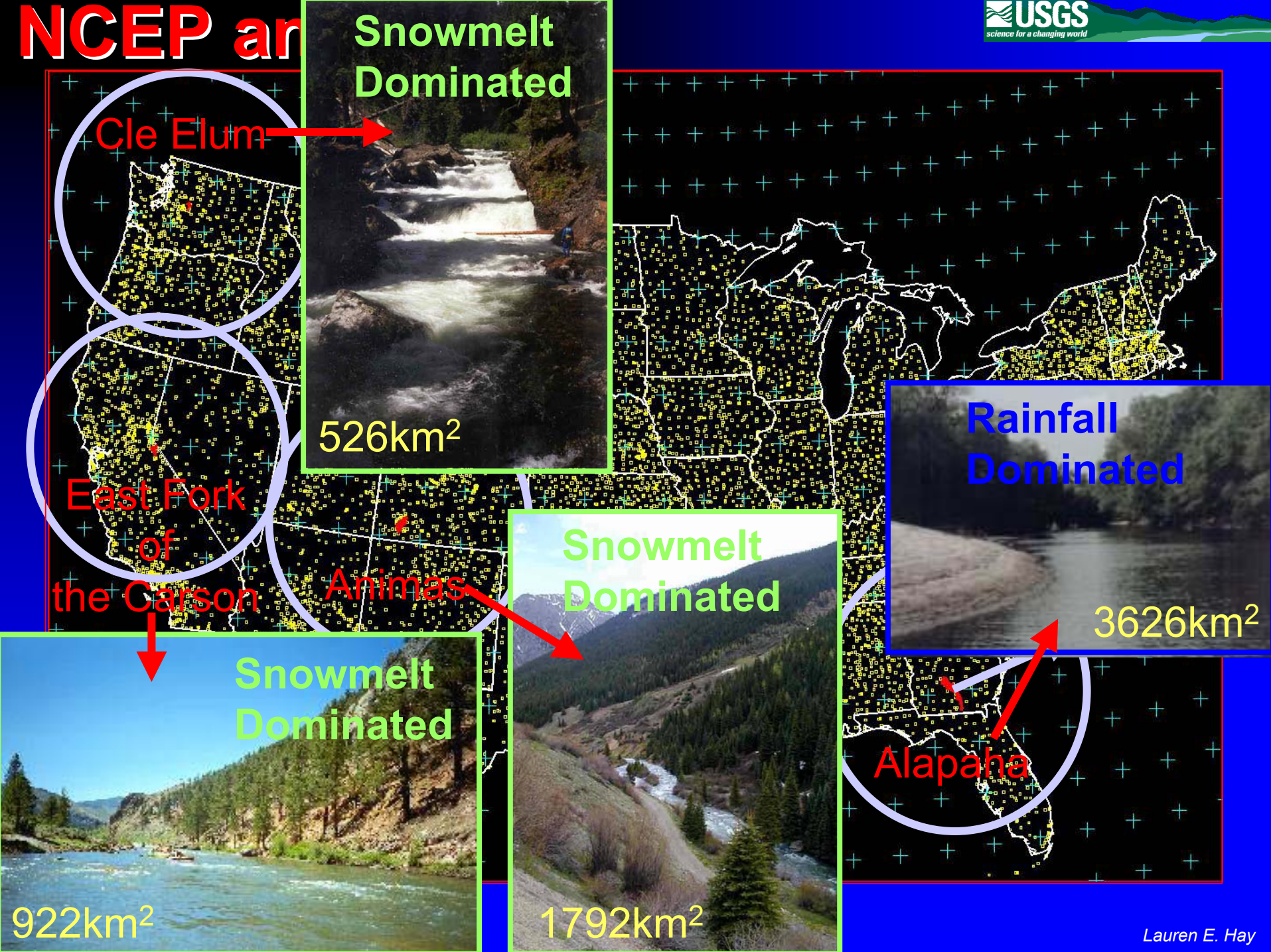
NCEP ar
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Snowmelt
Dominated
Cle Elum
526km2
East Fork
of
the Carson
Animas
Snowmelt
Dominated
Rainfall
Dominated
3626km2
Snowmelt
Dominated
922km2
1792km2
Alapaha
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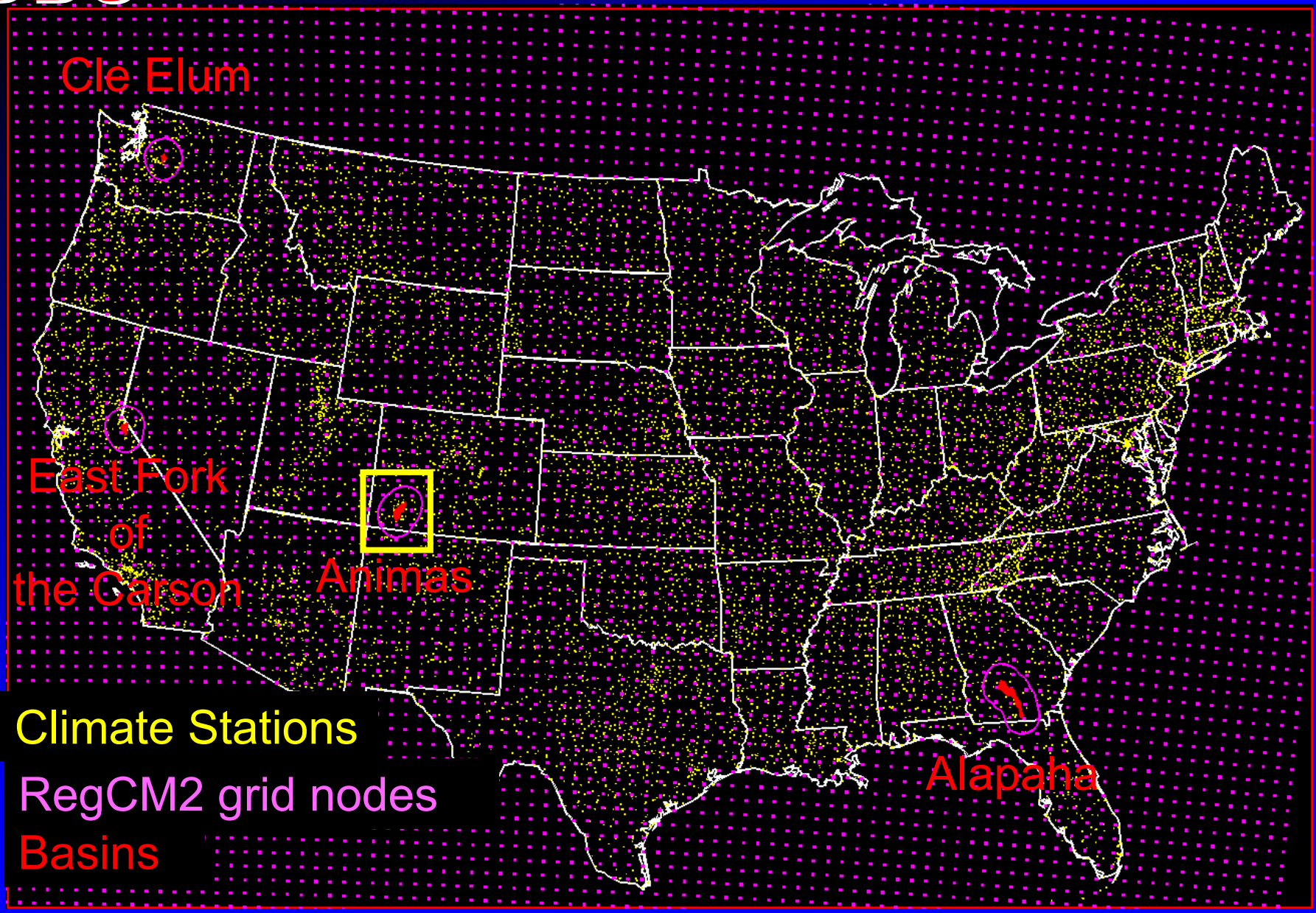
DDS

52 km grid node spacing



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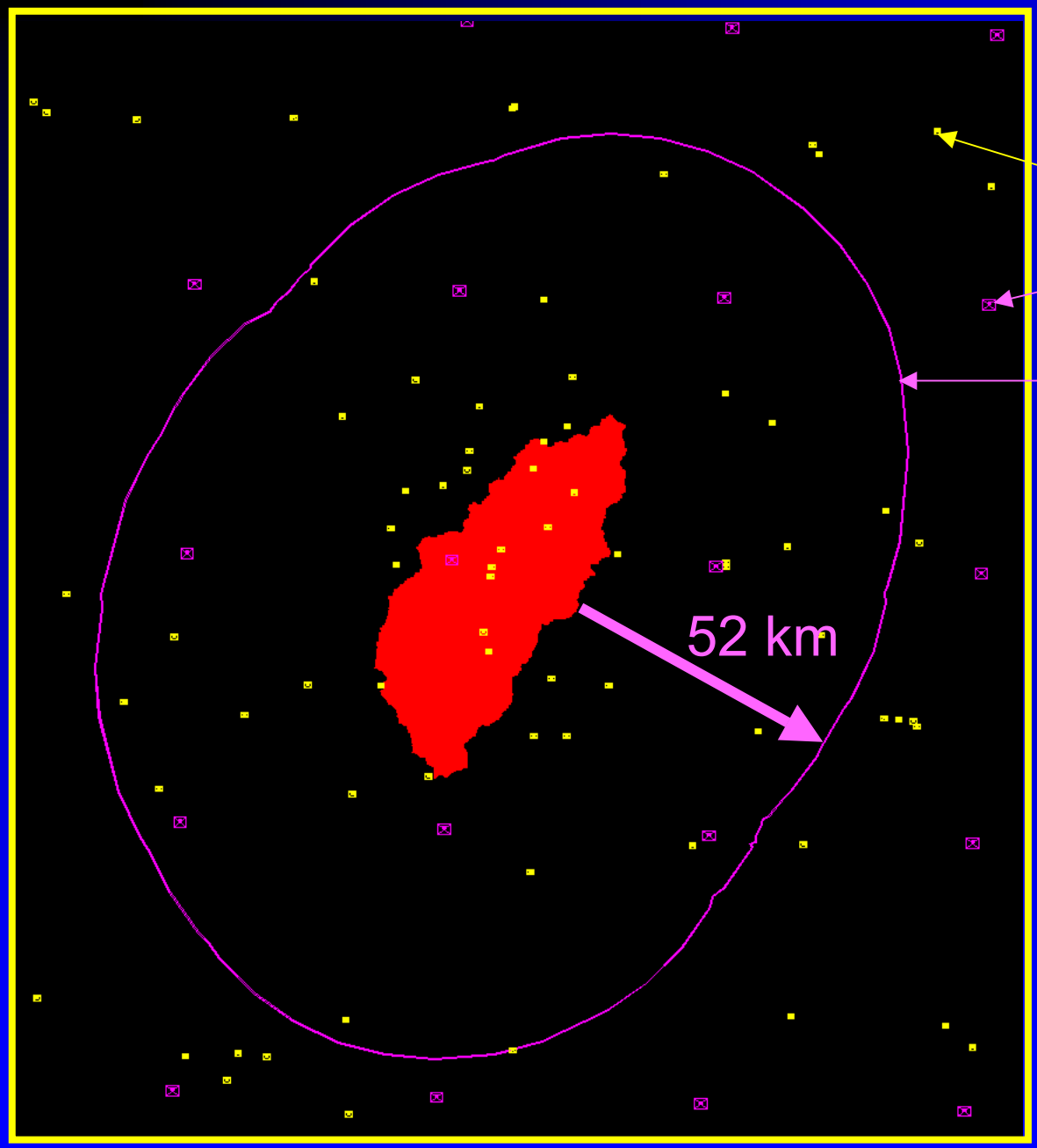
DDS



Animas

Climate Stations

RegCM2 grid nodes

Buffer

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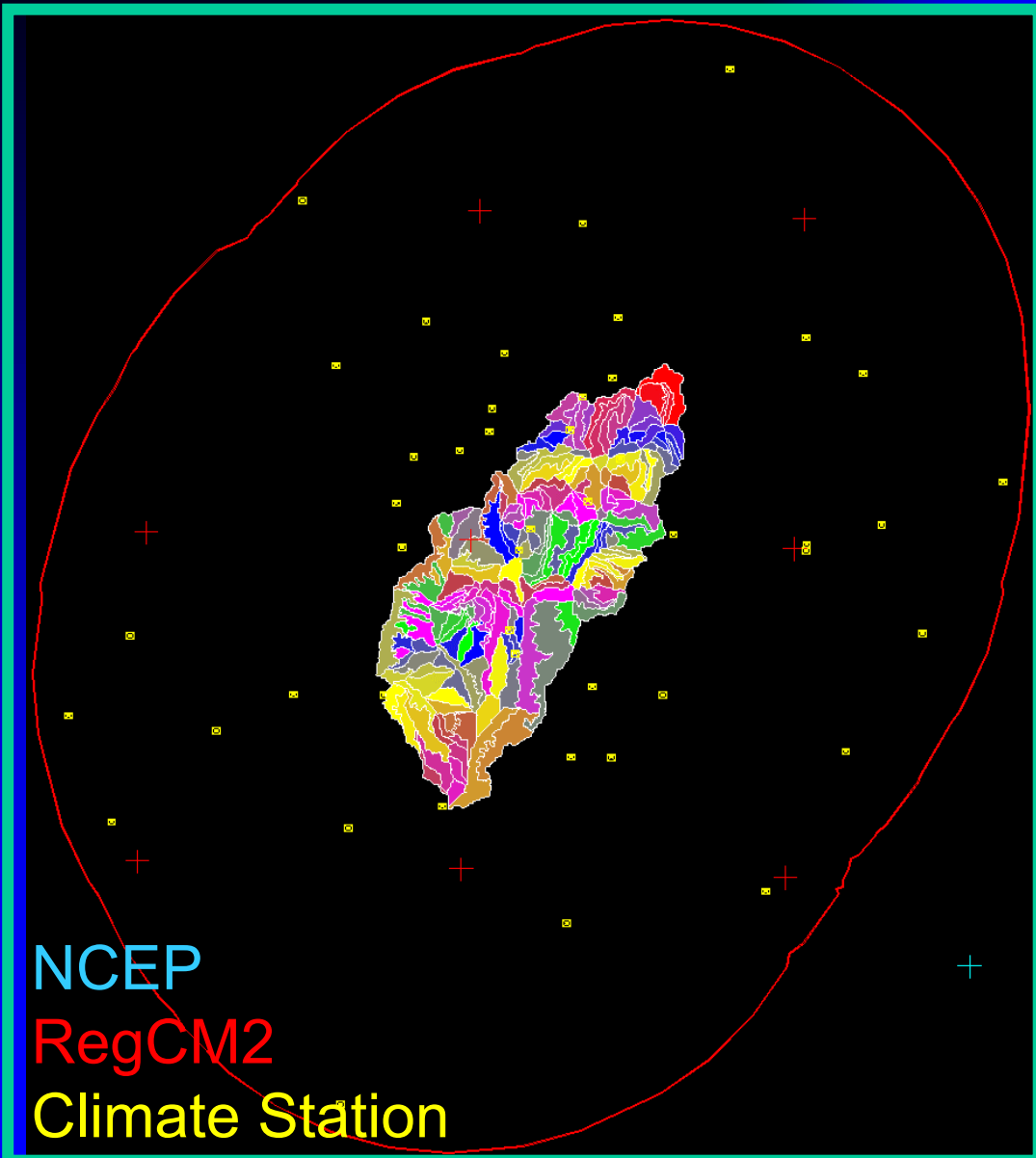
Hydrologic Model -- PRMS

Station Input Data Sets:

- Stations used to calibrate PRMS (Best-Sta)
- All Stations within RegCM2 buffered area (excluding Best-Sta)



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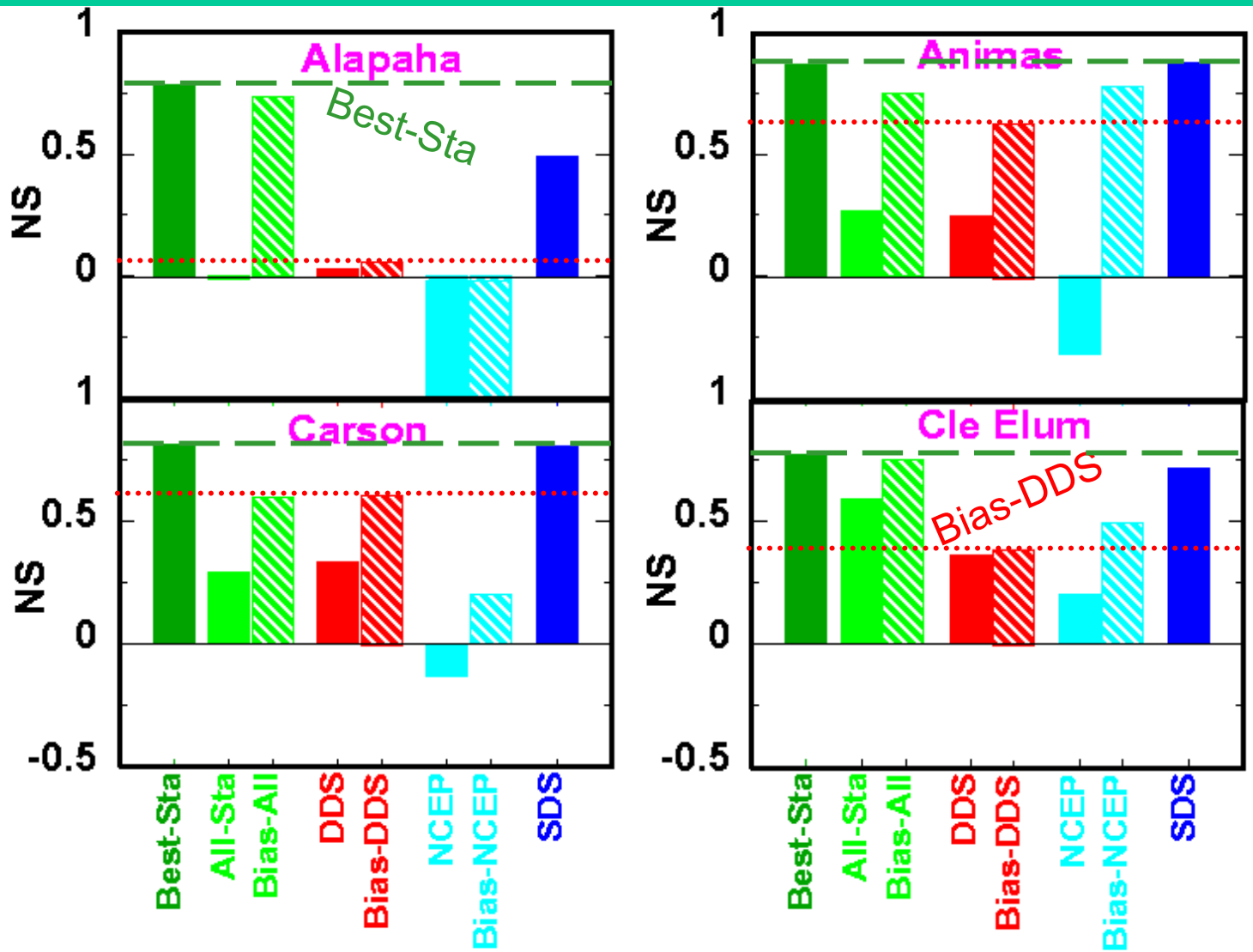
All-Sta, DDS, and NCEP need a bias correction



Linking atmospheric and watershed models

DAY 0-8

Use PRMS to produce 9-day forecasts of runoff using SDS and ESP

- 100 SDS ensembles

- 17 years tested in ESP

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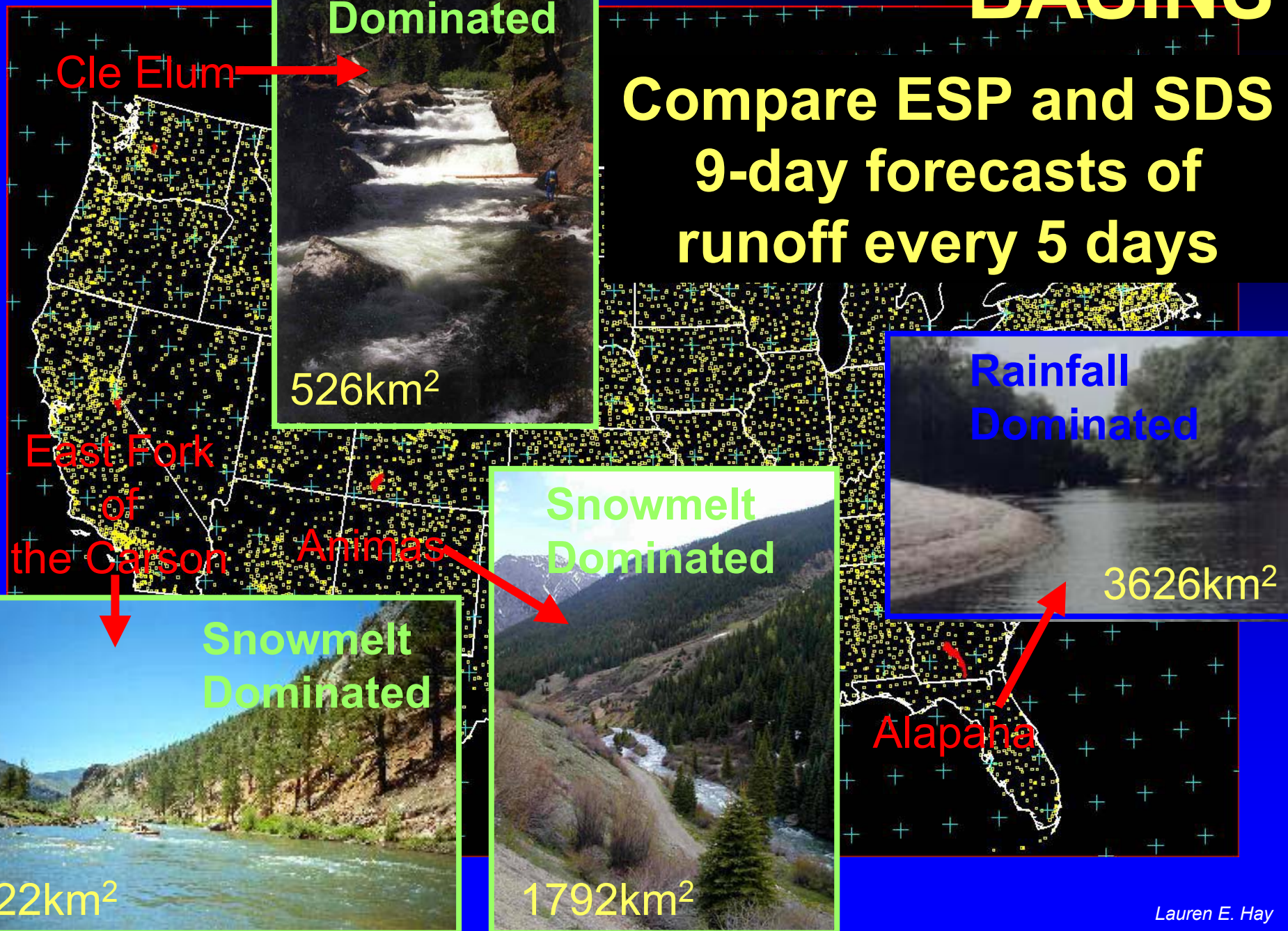
BASINS

Compare ESP and SDS 9-day forecasts of runoff every 5 days



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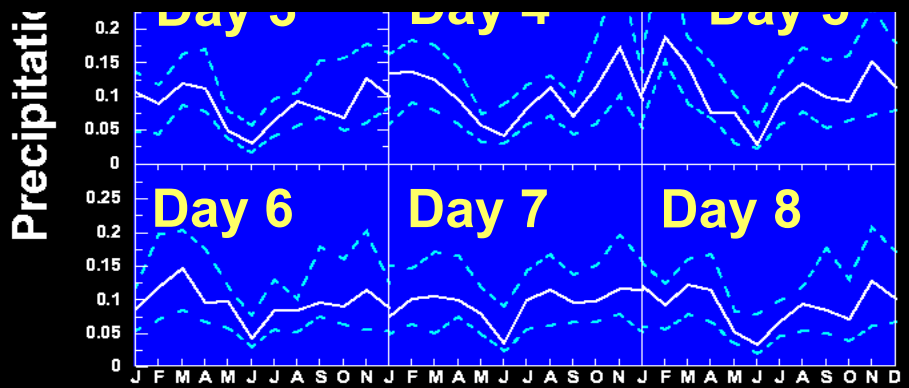
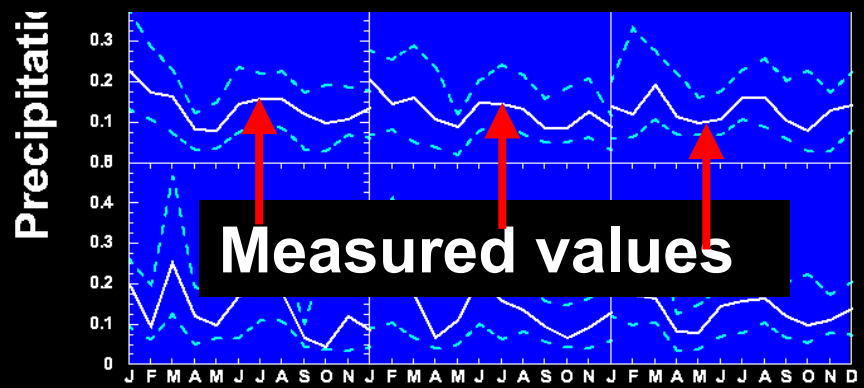
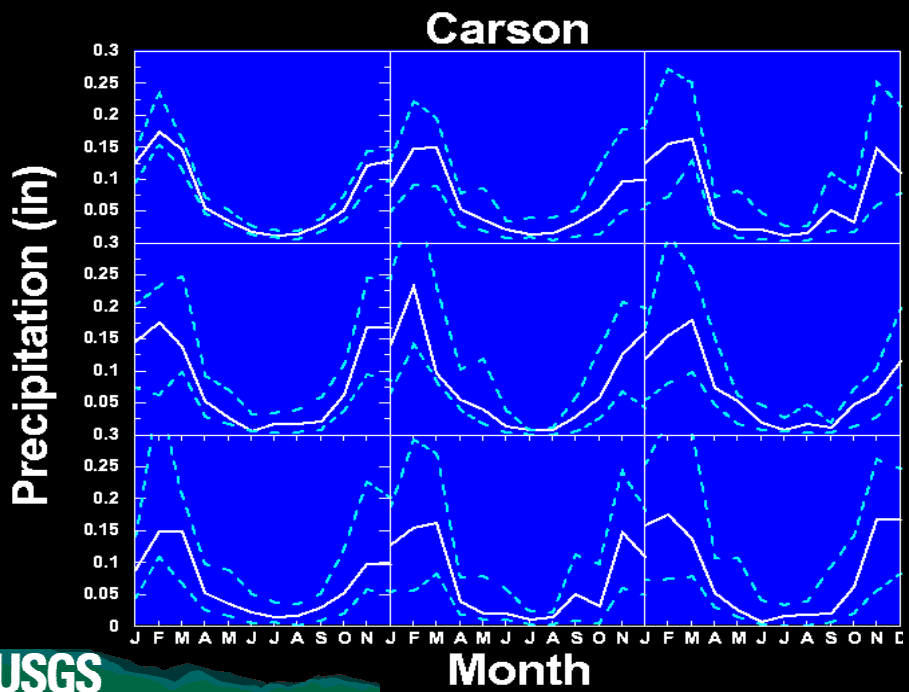
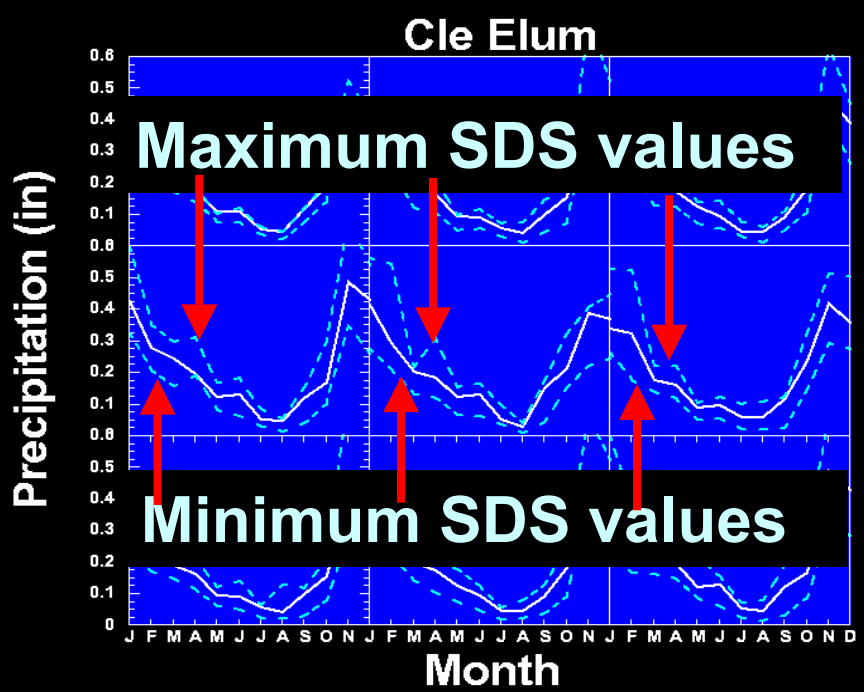
Monthly Mean Precipitation (measured and SDS)









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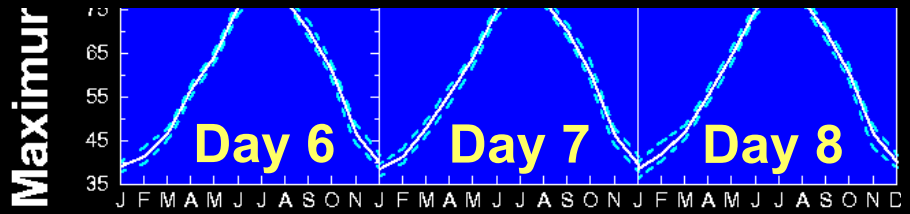
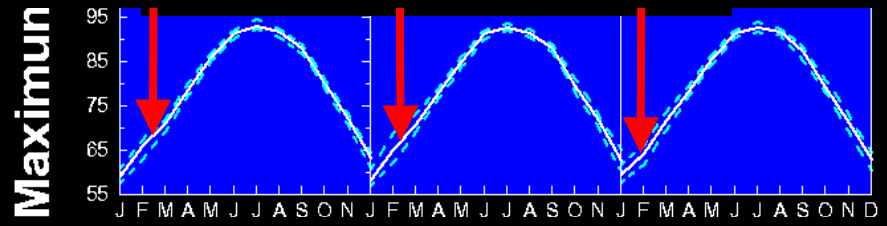
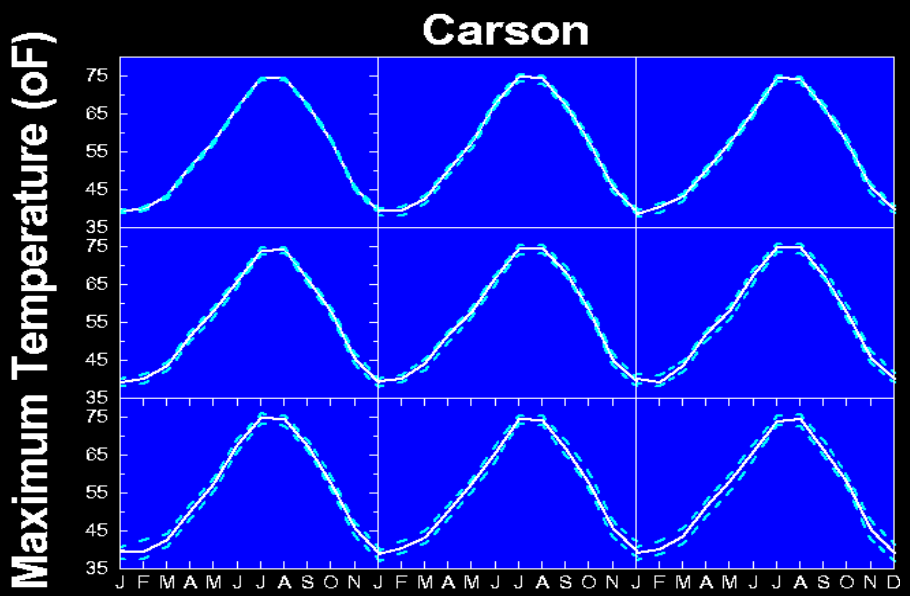
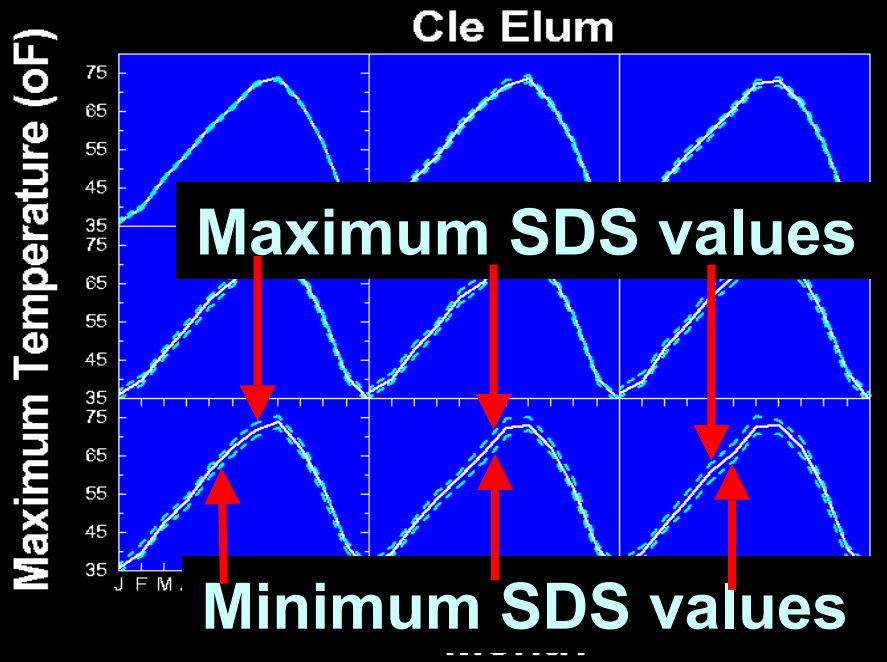
Monthly Mean Maximum Temperature (measured and SDS)









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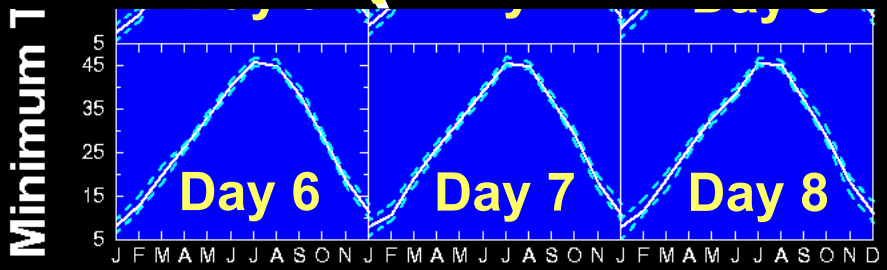
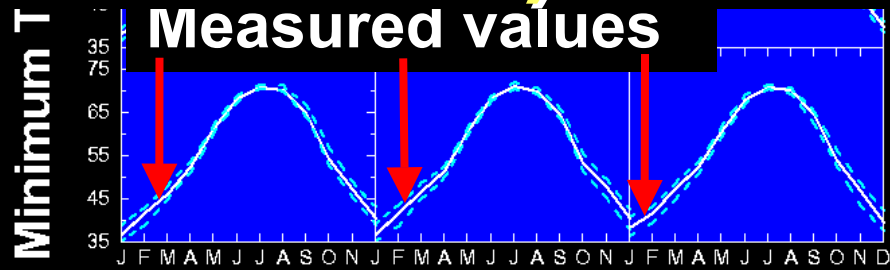
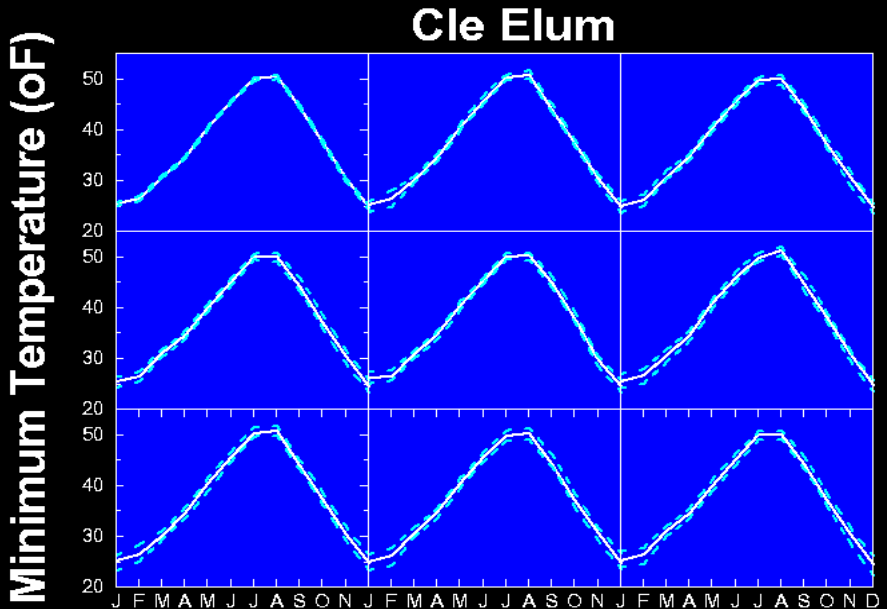
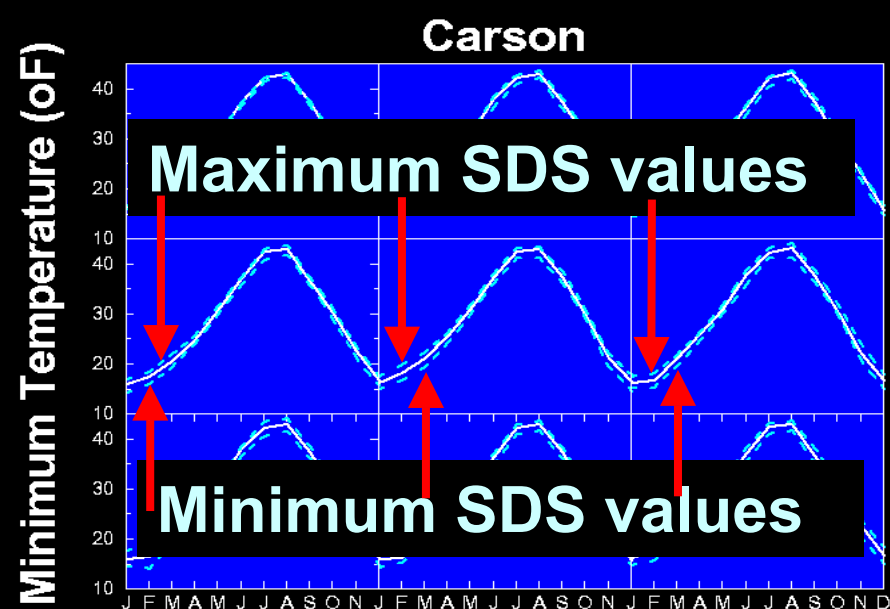
Monthly Mean Minimum Temperature (measured and SDS)









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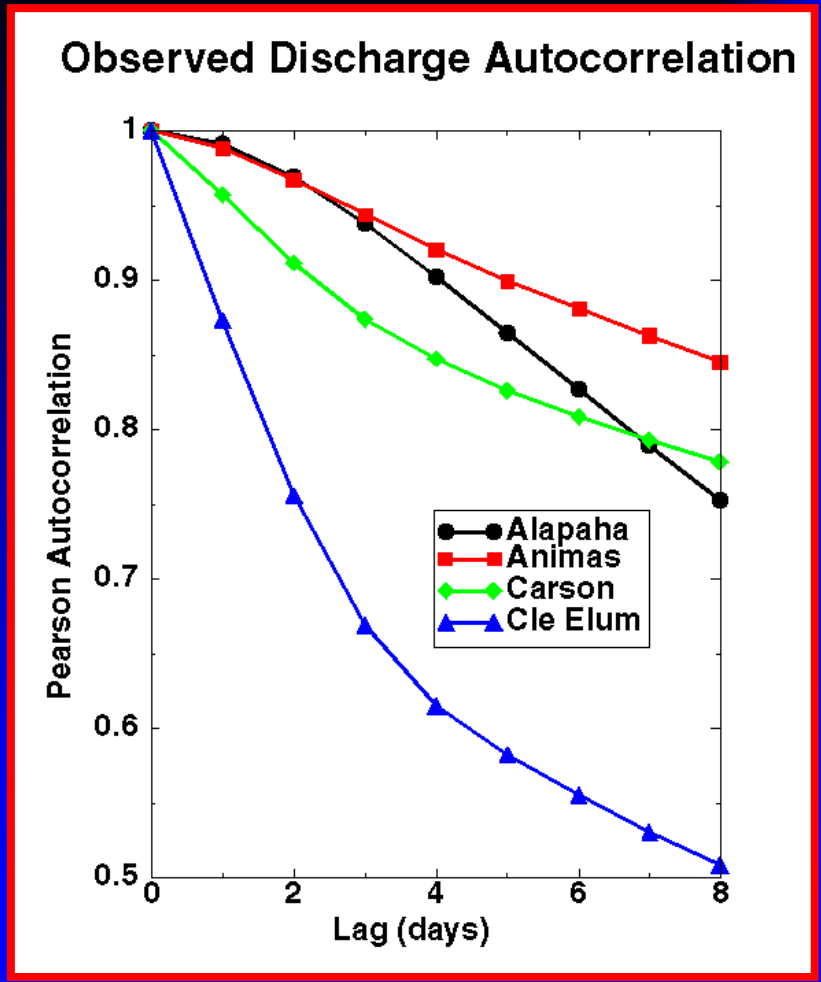
OBSERVED DISCHARGE AUTOCORRELATION

- Day+8 correlation
  - Alapaha = 0.75
  - Animas = 0.84
  - Carson = 0.78
  - Cle Elum = 0.51



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Compare SDS and ESP Forecasts

Perfect Model Scenario

-Nash Sutcliffe Goodness of Fit

- Measure of deterministic forecast skill

-Ranked Probability Score

-Measure of probabilistic forecast skill

-Forecasts are increasingly penalized as more probability is assigned to event categories further removed from the actual outcome

-Ensemble Spread

- Range in forecasts

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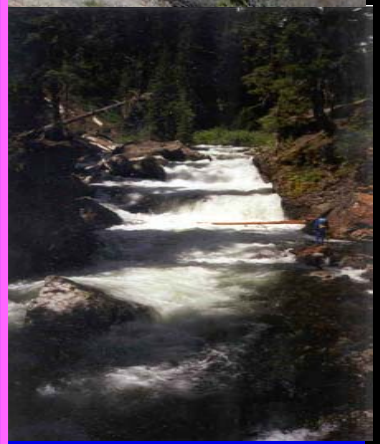
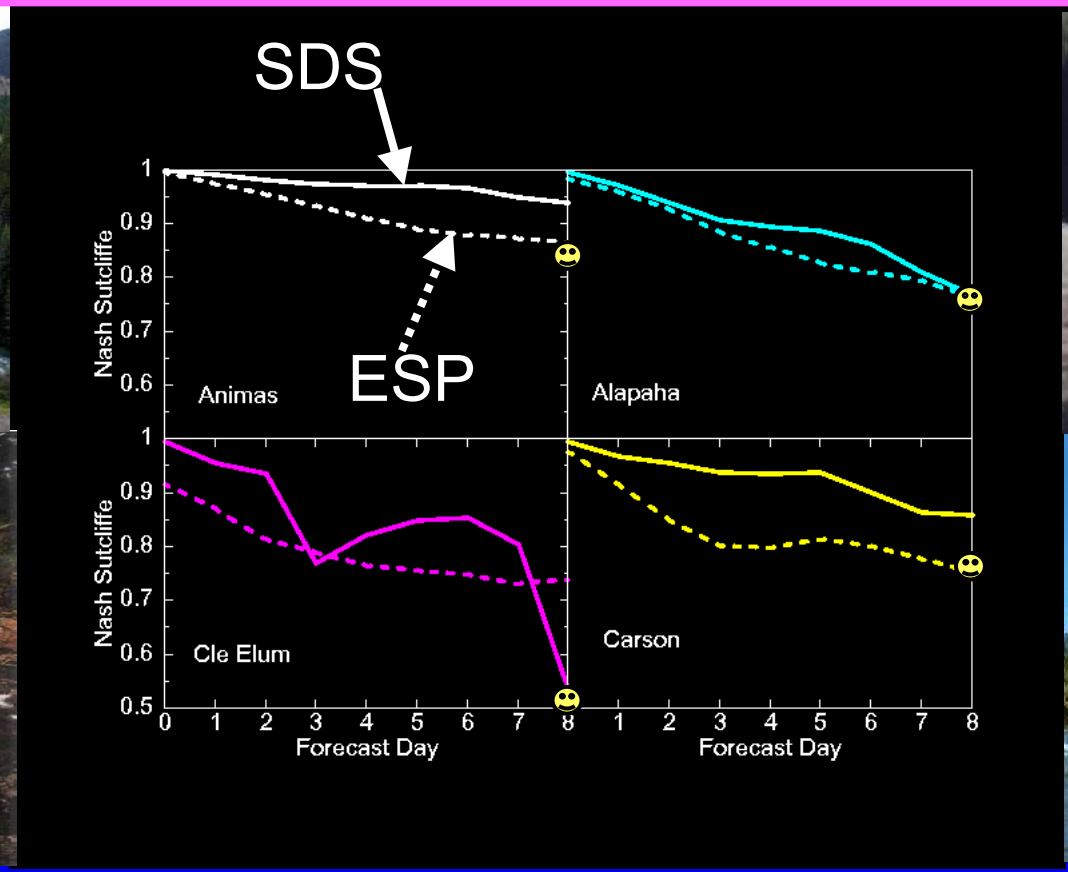
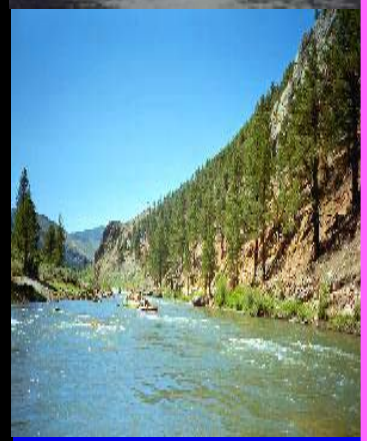
Nash Sutcliffe Goodness of Fit

Measure of deterministic forecast skill







SDS ——————

ESP ..... ☻ *Autocorrelation*

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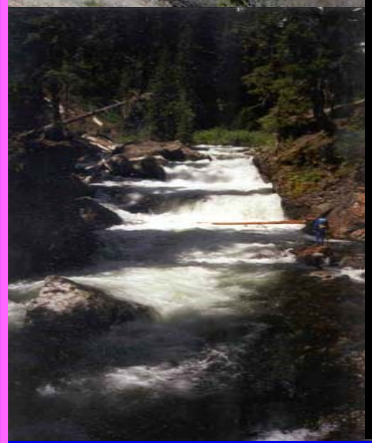
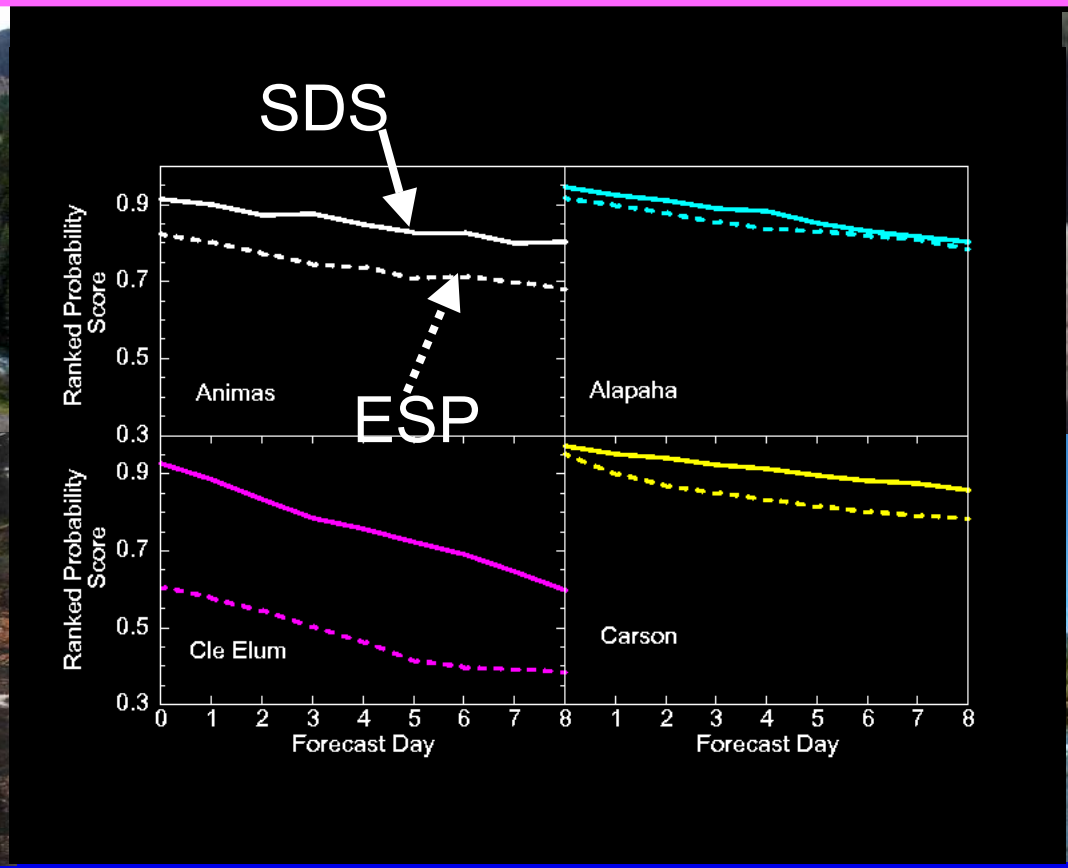
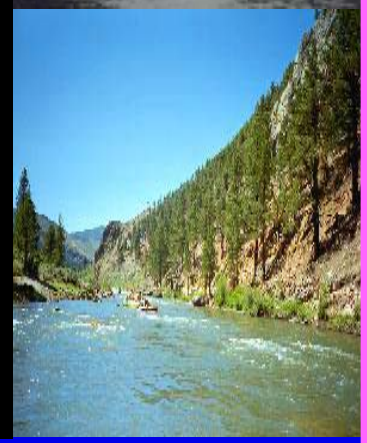
Ranked Probability Score

Measure of probabilistic forecast skill







SDS ——————

ESP ....

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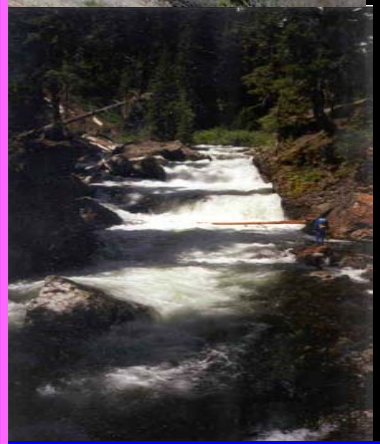
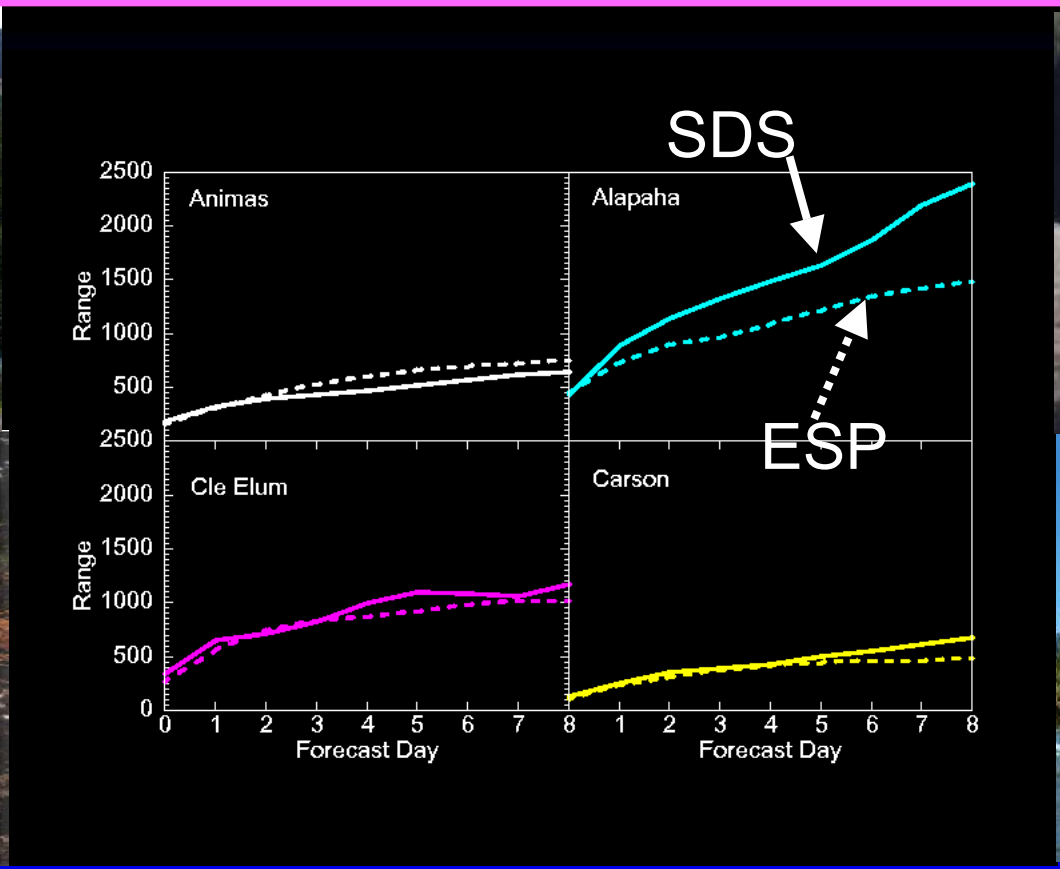
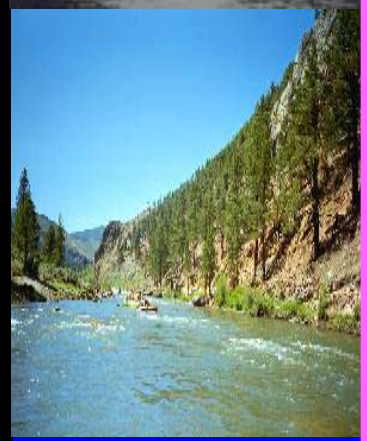
Ensemble Spread

Range in forecasts







SDS ——————

ESP ....

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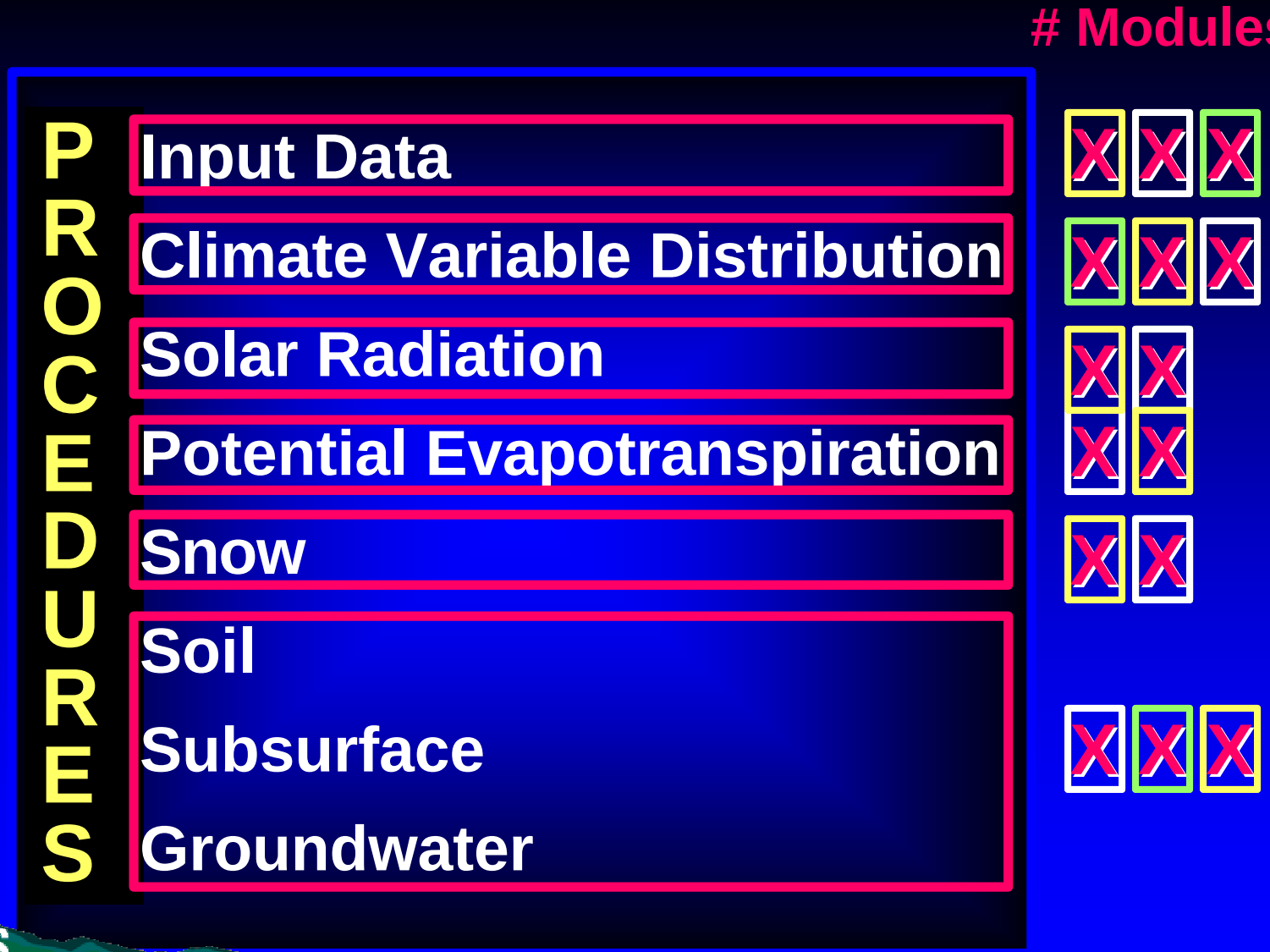
Research Efforts

- **Super-ensemble approach to watershed modeling**

Run hydrologic models in ensemble mode to provide probablistic forecasts of streamflow and estimates of forecast uncertainty

Super Ensemble Approach to Watershed Modeling



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Research Efforts

- **Super-ensemble approach to watershed modeling**

Run hydrologic models in ensemble mode to provide probablistic forecasts of streamflow and estimates of forecast uncertainty

- **Physically based watershed model that needs limited calibration**


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THE END