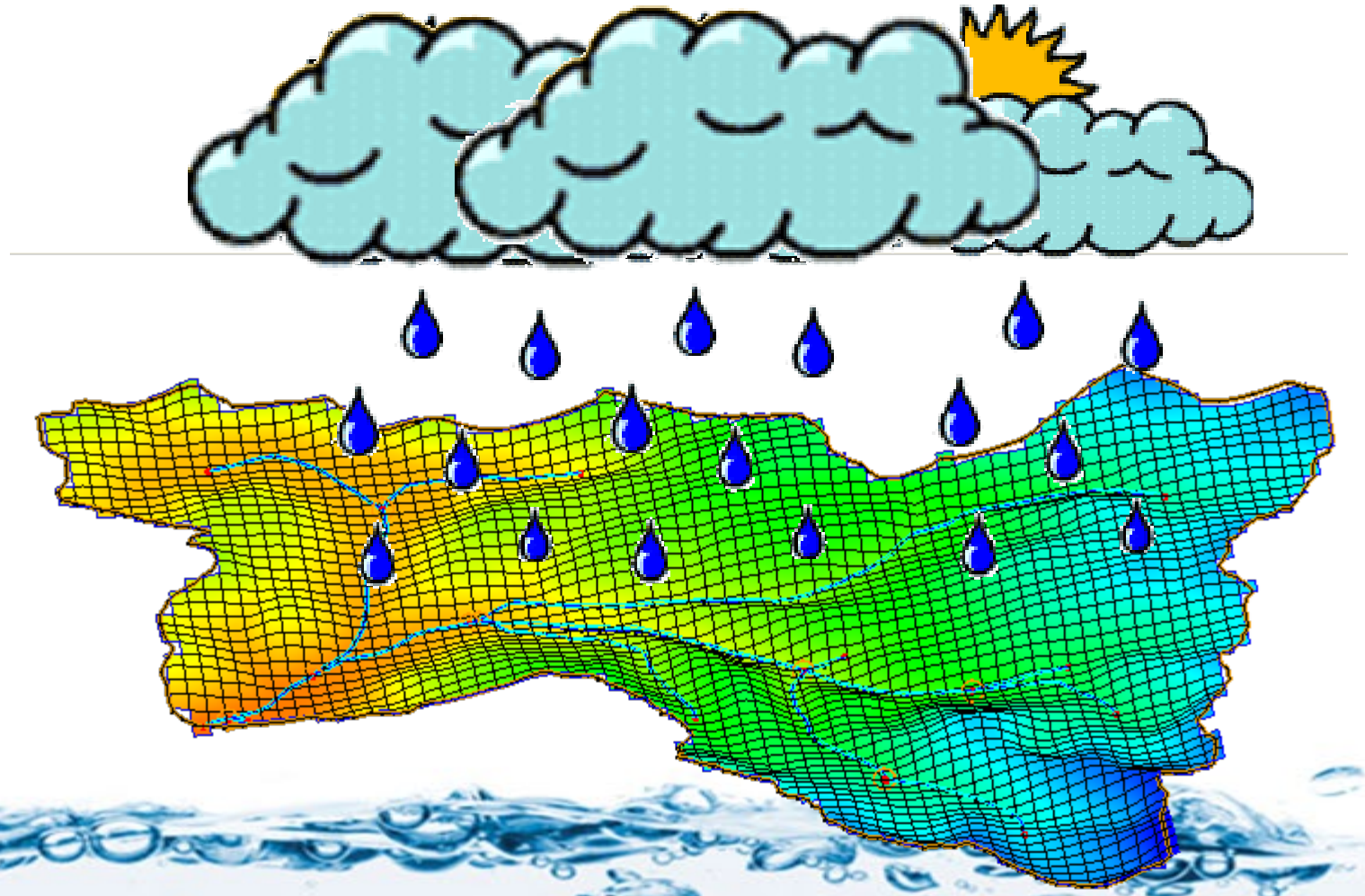
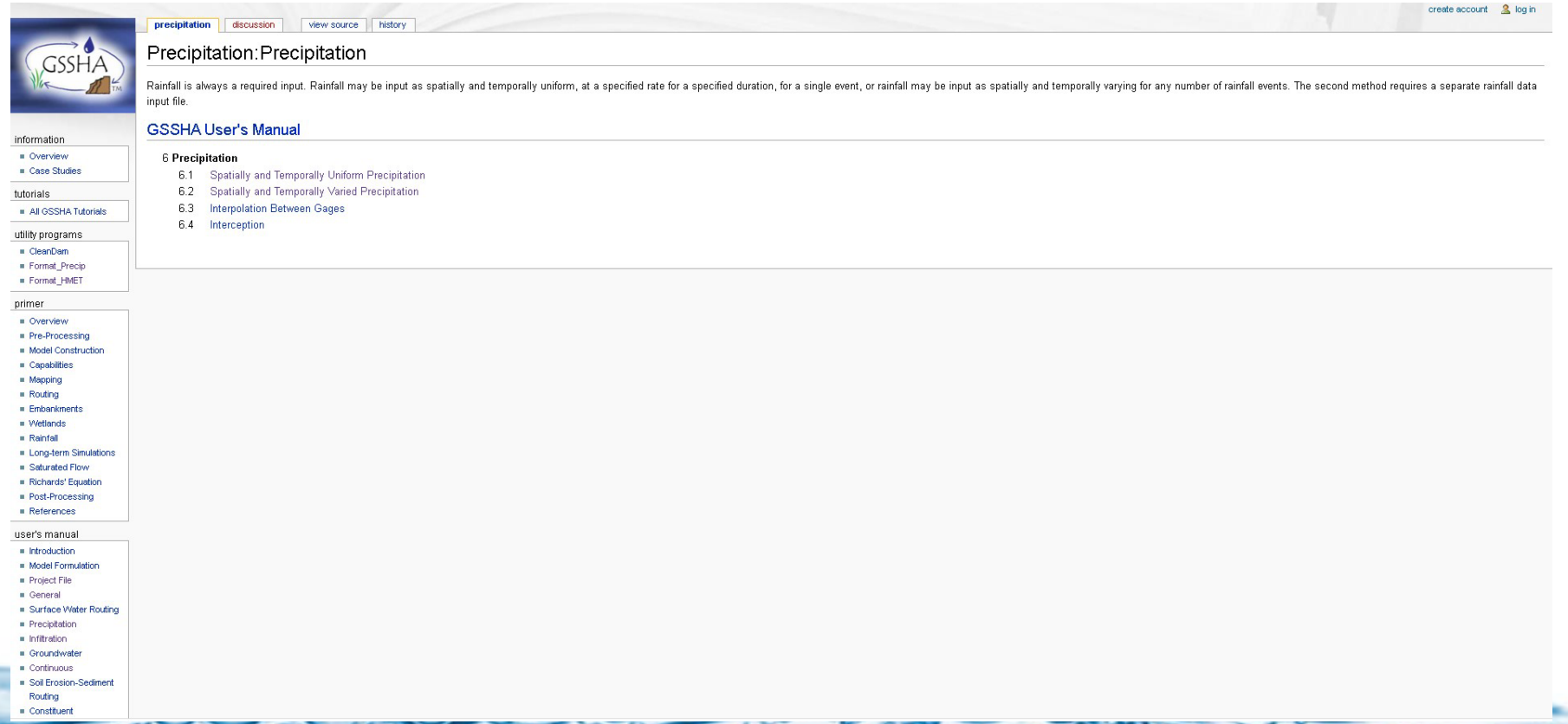
Rainfall methods in GSSHA



Precipitation Types

- Uniform rainfall
- Spatially uniform, temporally varying
- Spatially and temporally varying



Uniform Rainfall

- Specify uniform precipitation under global parameters
  - start time
    - year
    - month
    - day
    - hour
    - min
  - rate (mm/hr)
  - duration (min)

Spatially Uniform Temporally Varying Rainfall

- Specified in WMS as a single gage rainfall
- Time series data is entered as X and Y data
- Uniform time spacing is specified by the user
- Time series data can be imported or exported
- Useful for simulating "standard" storm events

Spatially and Temporally Varying Precipitation

- File built external to WMS
- Specify gage locations and rainfall rate with non-uniform time spacing
- Multiple formats for entering rainfall

Gage Data Input File

- Card based input file
  - EVENT - Storm ID
  - NRPDS - # of time distributions in the event
  - NRGAG - # of gages for event
  - COORD – rain gage coordinate
    - One for each gage (NRGAG)
  - Rainfall source card
    - GAGES – accumulation (mm) at end of period
    - RADAR – rates (mm/hr) at the end of the sampling period
    - RATES – rates (mm/hr) at the beginning of the sampling period
    - One for each time period (NRPDS)

Example Gage Input File

- EVENT "Event of 30 June 1995- rainfall stops on July 1st"
- NRPDS 5
- NRGAG 3
- COORD 205150.0 4750212.0 "center of radar pixel #1"
- COORD 205045.0 4750104.0 "center of radar pixel #2"
- COORD 205320.0 4751173.0 "center of radar pixel #3"
- RADAR 1995 06 30 22 56 0.00 0.00 0.00
- RADAR 1995 06 30 23 18 10.75 2.25 5.80
- RADAR 1995 06 30 23 39 21.16 1.80 41.50
- RADAR 1995 06 30 23 57 12.13 20.90 20.70
- RADAR 1995 07 01 00 09 11.71 16.50 2.30

Rainfall File Conversion

utility programs | discussion | view source | history

Utility Programs:Format Precip Spreadsheet

Format Precipitation Utilities

The format precipitation spreadsheet is designed to assist in converting raw precipitation data into the event-based precipitation file format that GSSHA™ needs.

Format Precip Macro Download (May 2009 version)

This python scripts accomplish the same ends, but may be more suitable for large data sets

Converts raw gage files into a formatted GSSHA precipitation event file (Feb 2018)

information
- Overview
- Case Studies

tutorials
- All GSSHA Tutorials

utility programs
- CleanDam
- Format_Precip
- Format_HMET

primer
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- Mapping
- Routing
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user's manual
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- Model Formulation
- Project File
- General
- Surface Water Routing
- Precipitation
- Infiltration
- Groundwater
- Continuous
- Soil Erosion-Sediment Routing
- Constituent

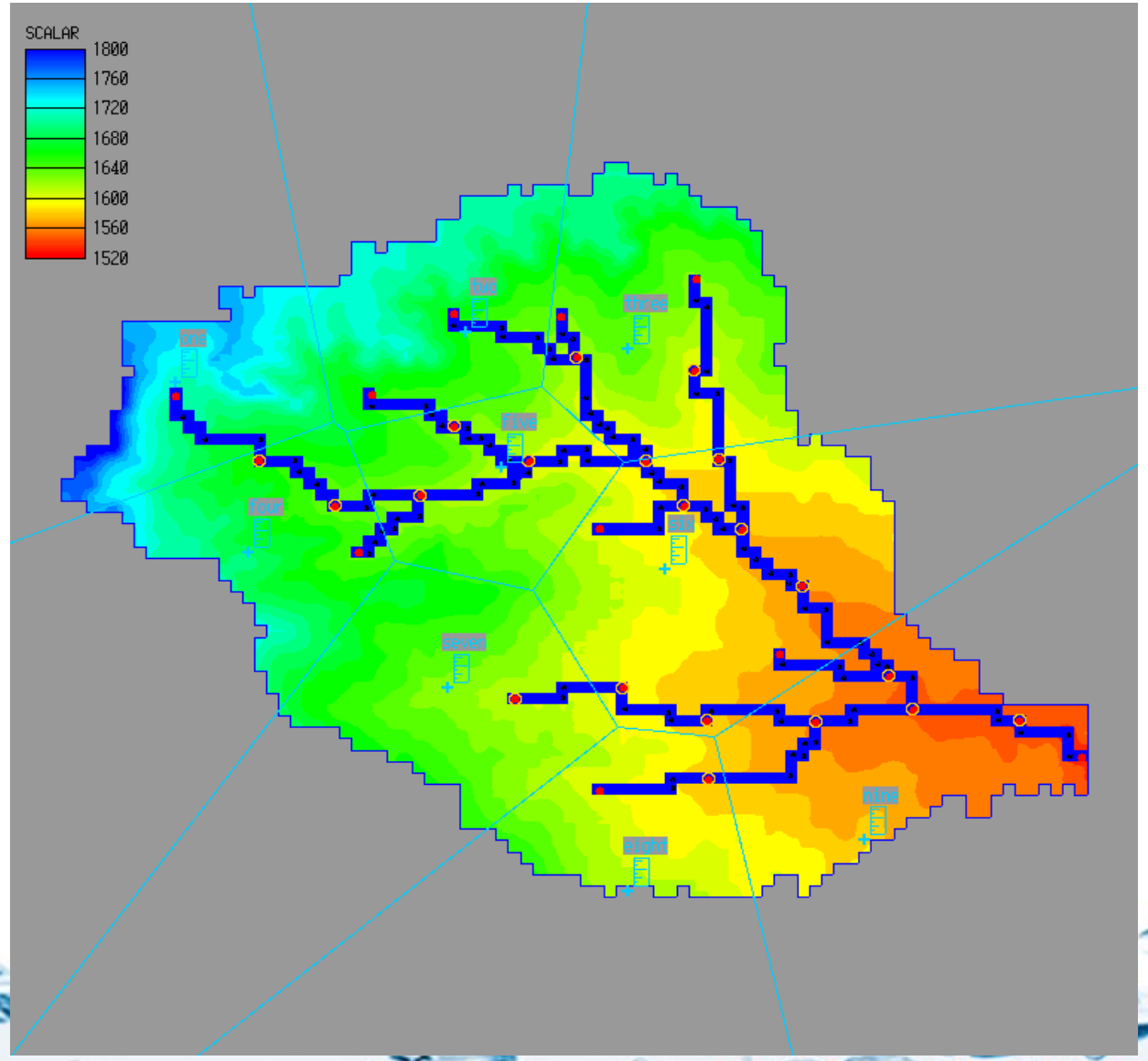
Guide for Rain Gage Selection

- GSSHA is very sensitive to rainfall input. Poor input data will result in poor model solutions.
- For best results multiple rain gages should be located inside the watershed.
- For convective storms, research indicates very poor correlation between gages more than 50 km apart.
- Include NEARBY gages outside the watershed.
- Input the finest temporal resolution possible.
  - If one gage has finer resolution than others use the data from that gage and repeat the data form the other gages.

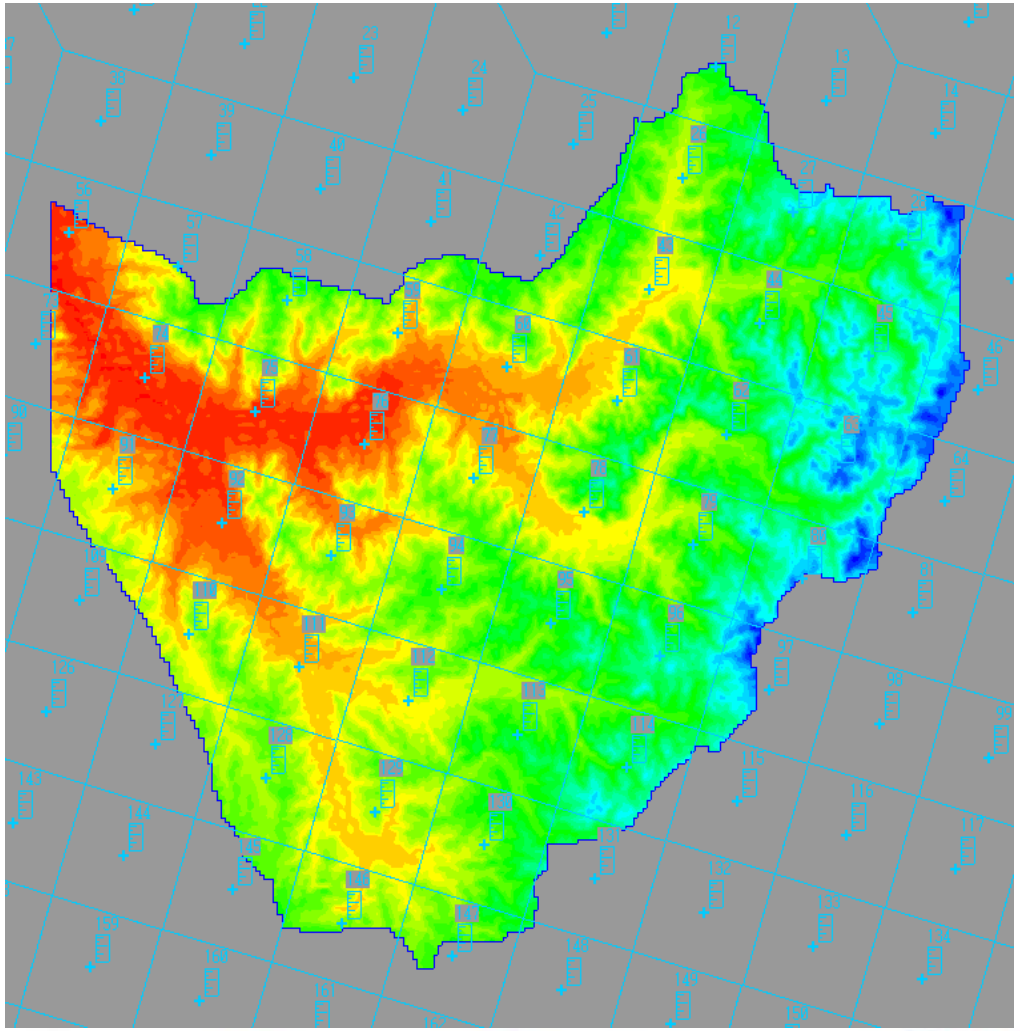
Spatial Distribution

- Thiessen polygon
- Inverse distance squared weighted
- Thiessen polygons can be used to represent radar rainfall.

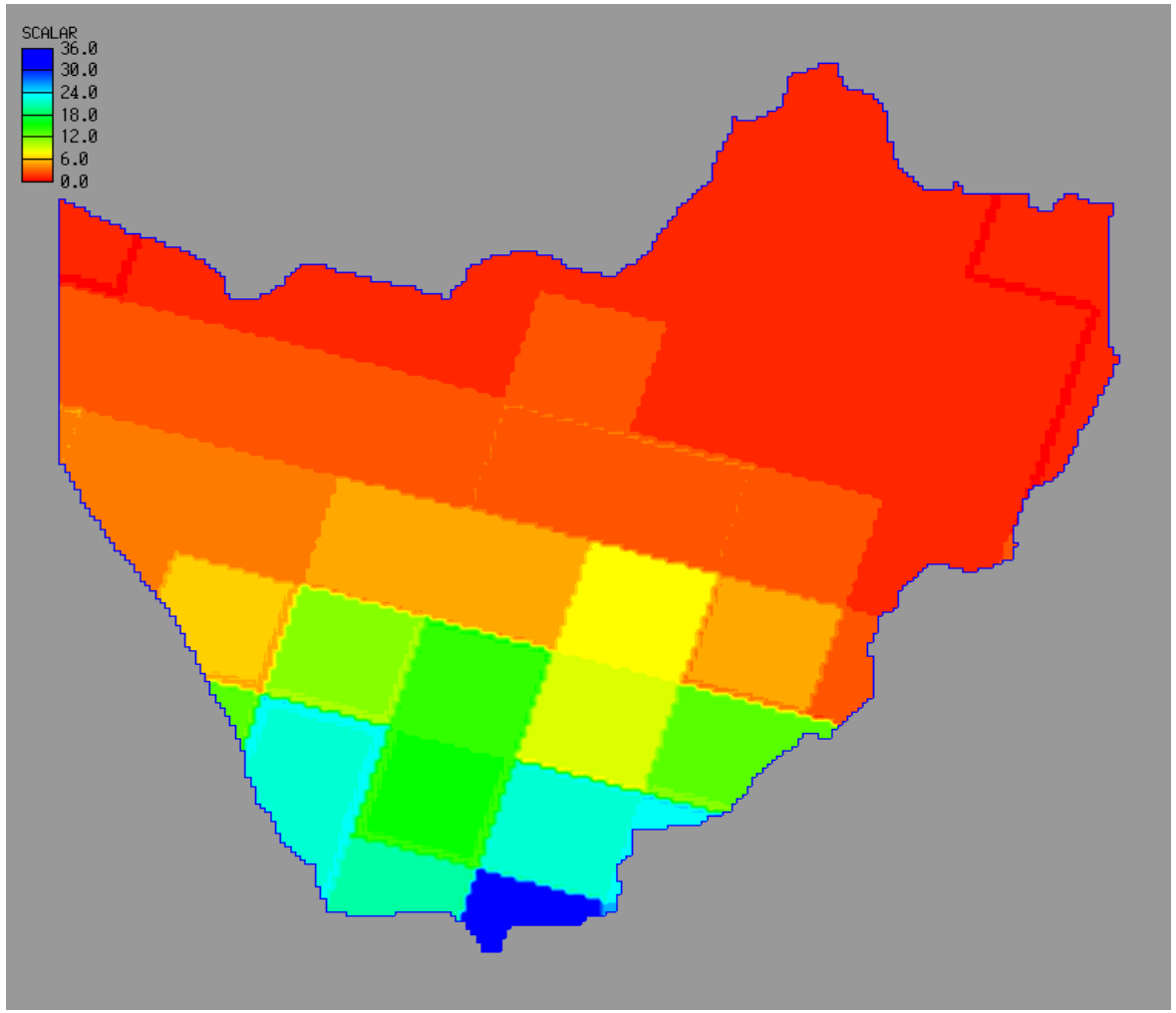
Rain Gages with Thiessen Polygons



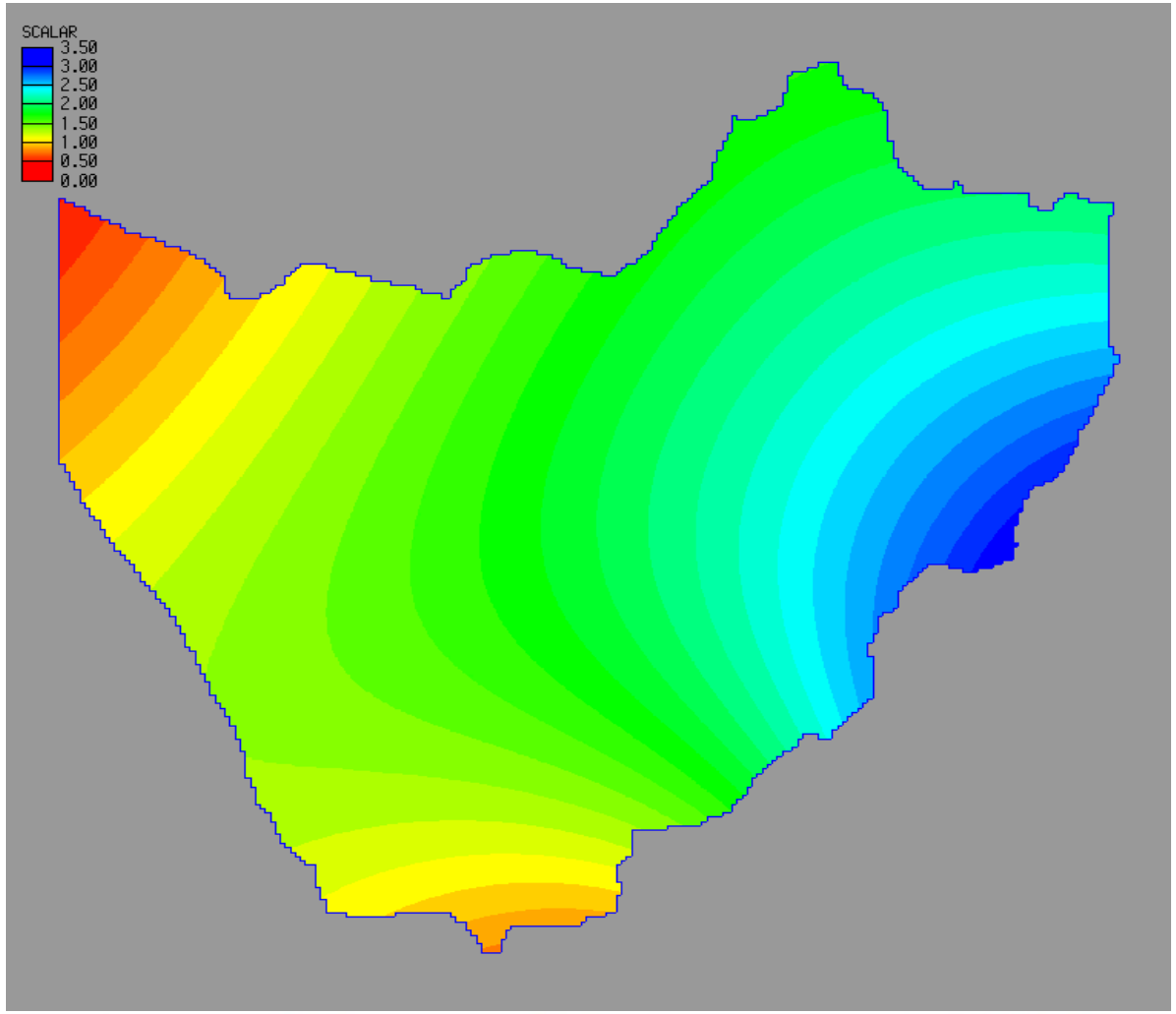
NEXRAD Radar Distributed with Thiessen Polygons



Snapshot of Rainfall Intensity



Inverse Distance Weighted Rainfall



Plant Interception

- Rainfall is intercepted by vegetation before reaching the land surface.
- Two parameter interception model
  - Initial volume of rainfall
  - Fraction retained of rainfall falling after satisfying initial storage

Inputs for Interception

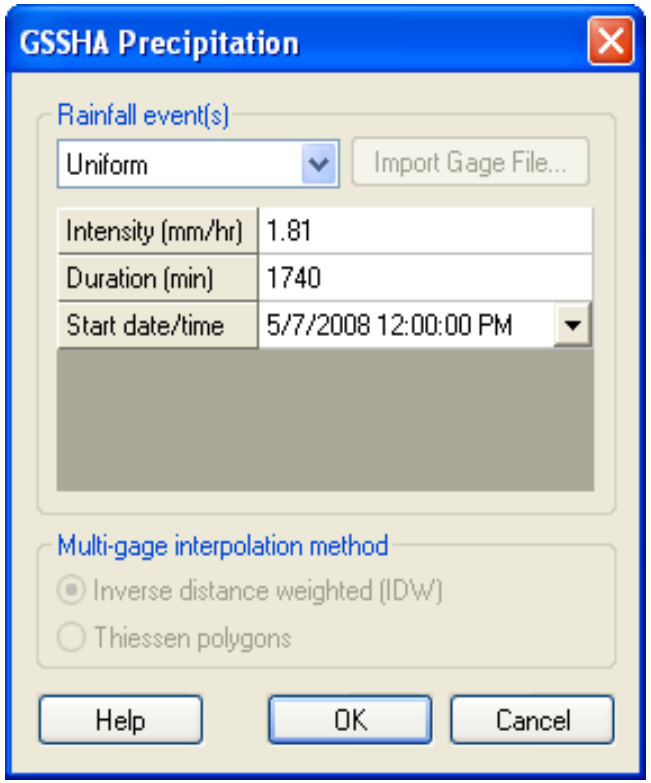
- Index map and mapping table
- Index map derived from vegetation coverage
- Mapping table contains values of
  - Initial storage volume (mm)
  - Fraction retained after satisfying initial storage

Applications

- Uniform rainfall most useful for initial model set up and trouble shooting
- Real watershed simulations are conducted with multiple gage, temporally varying rainfall
- Radar rainfall estimates can be useful when good gage data are not available
- Currently exploring the use of satellite data for remote regions

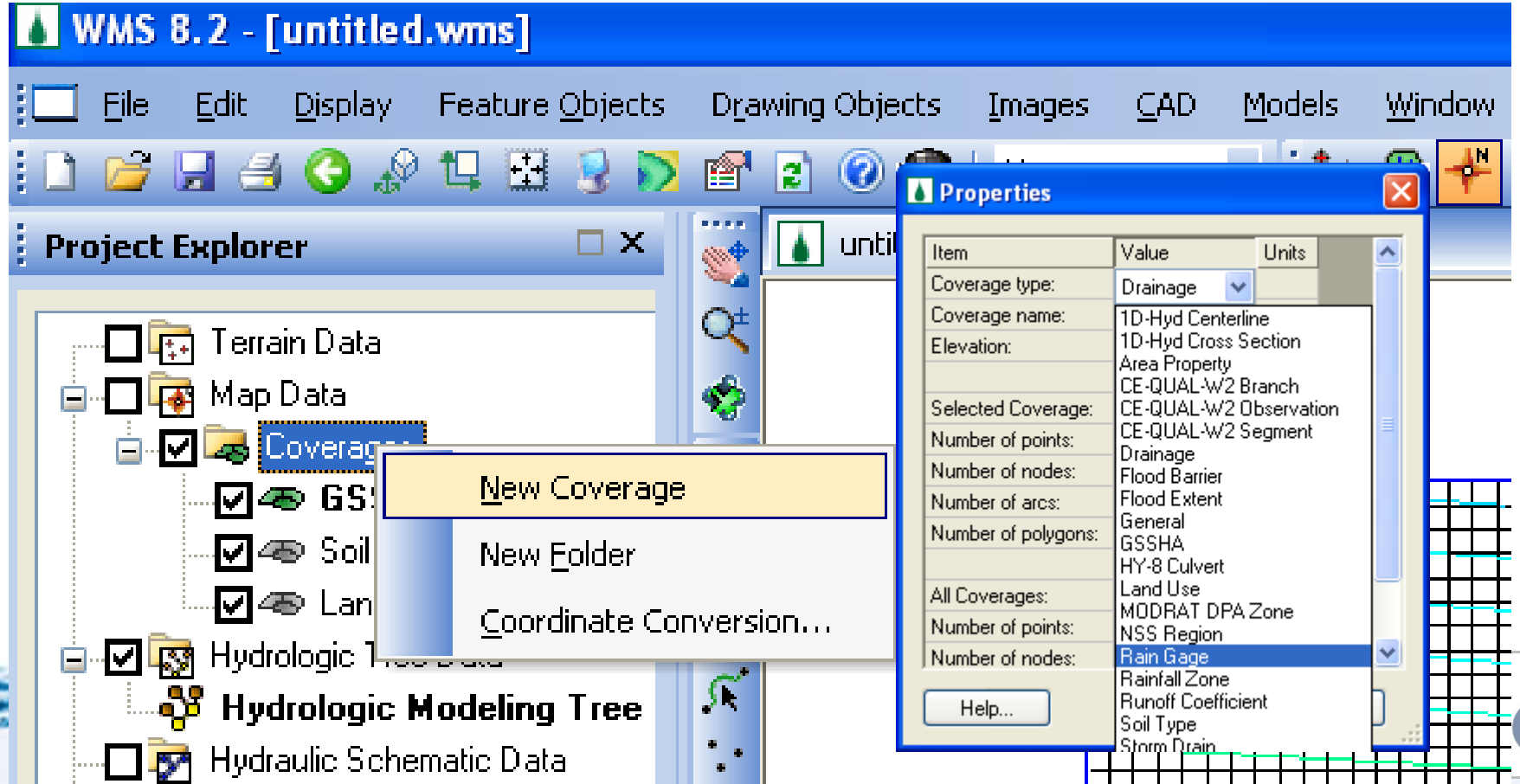
Uniform Precipitation

- The rainfall depth is uniformly distributed over time and is assumed to have same intensity all over the watershed
- Intensity: mm/hr
- Duration: min



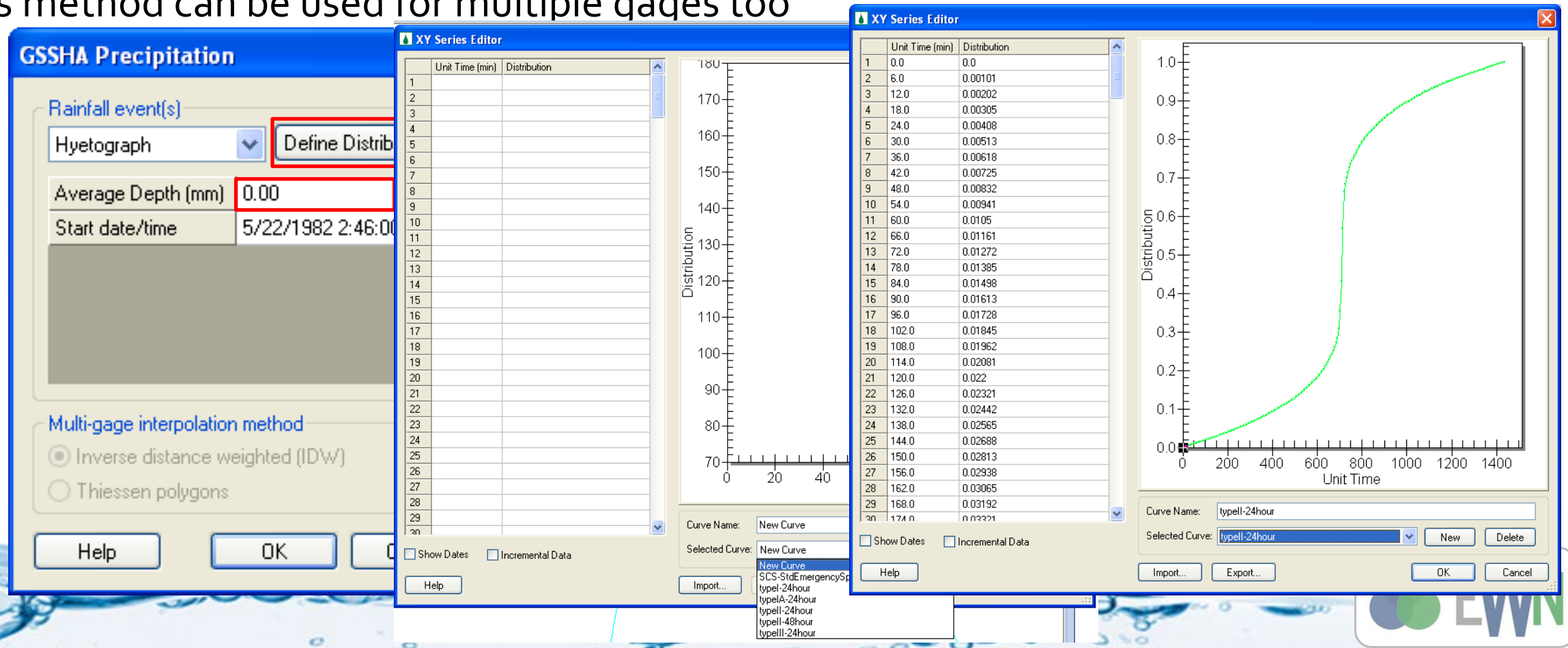
Using Gages

- Multiple gages can be used but each gage must have the same temporal distribution of rainfall
- Rain gage coverage is created



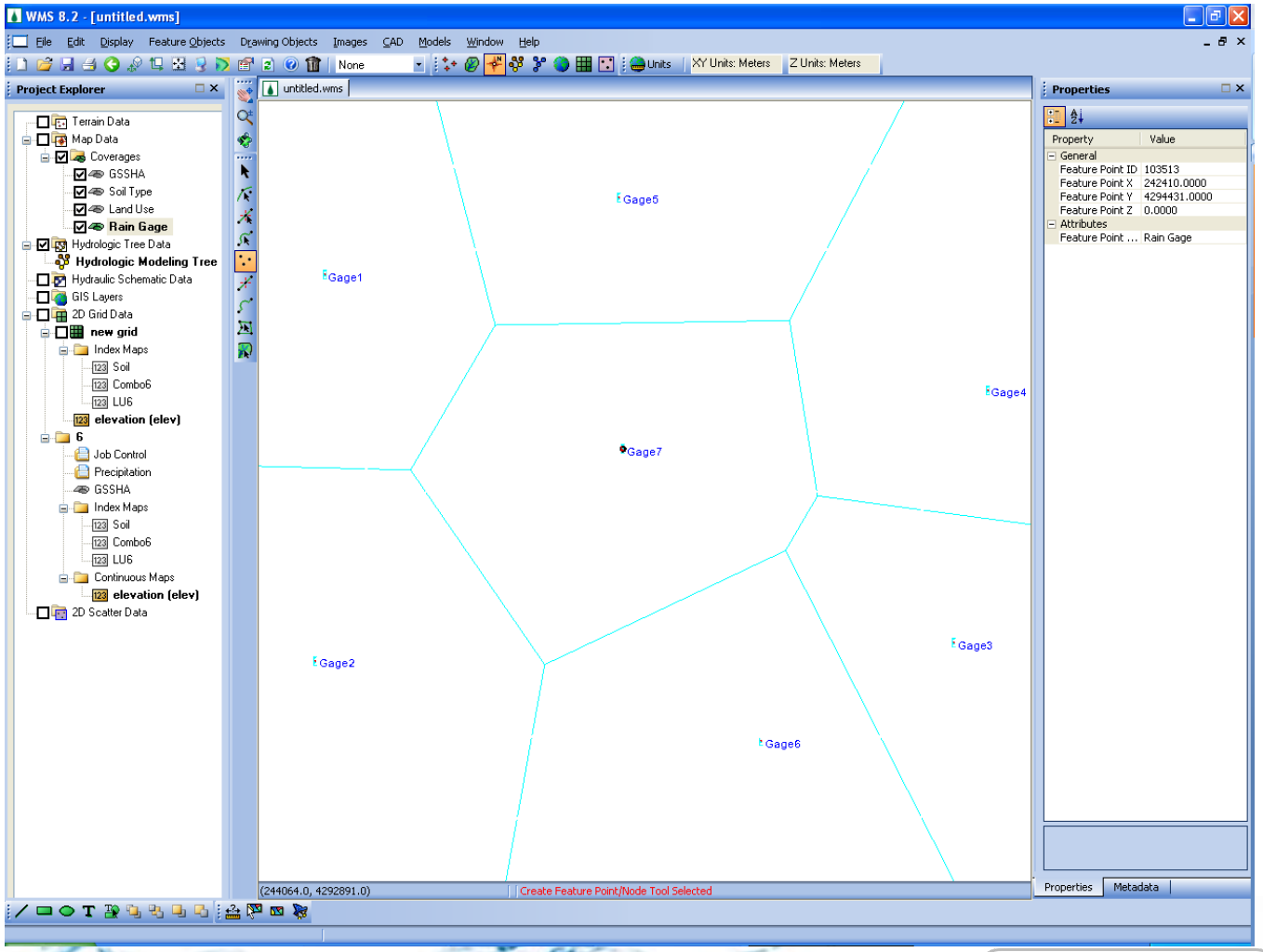
Using Hyetograph

- This option is useful if the normalized temporal distribution is available (eg NRCS storms)
- The distribution is defined in the XY series editor and total storm depth(mm) is defined.
- This method can be used for multiple gages too



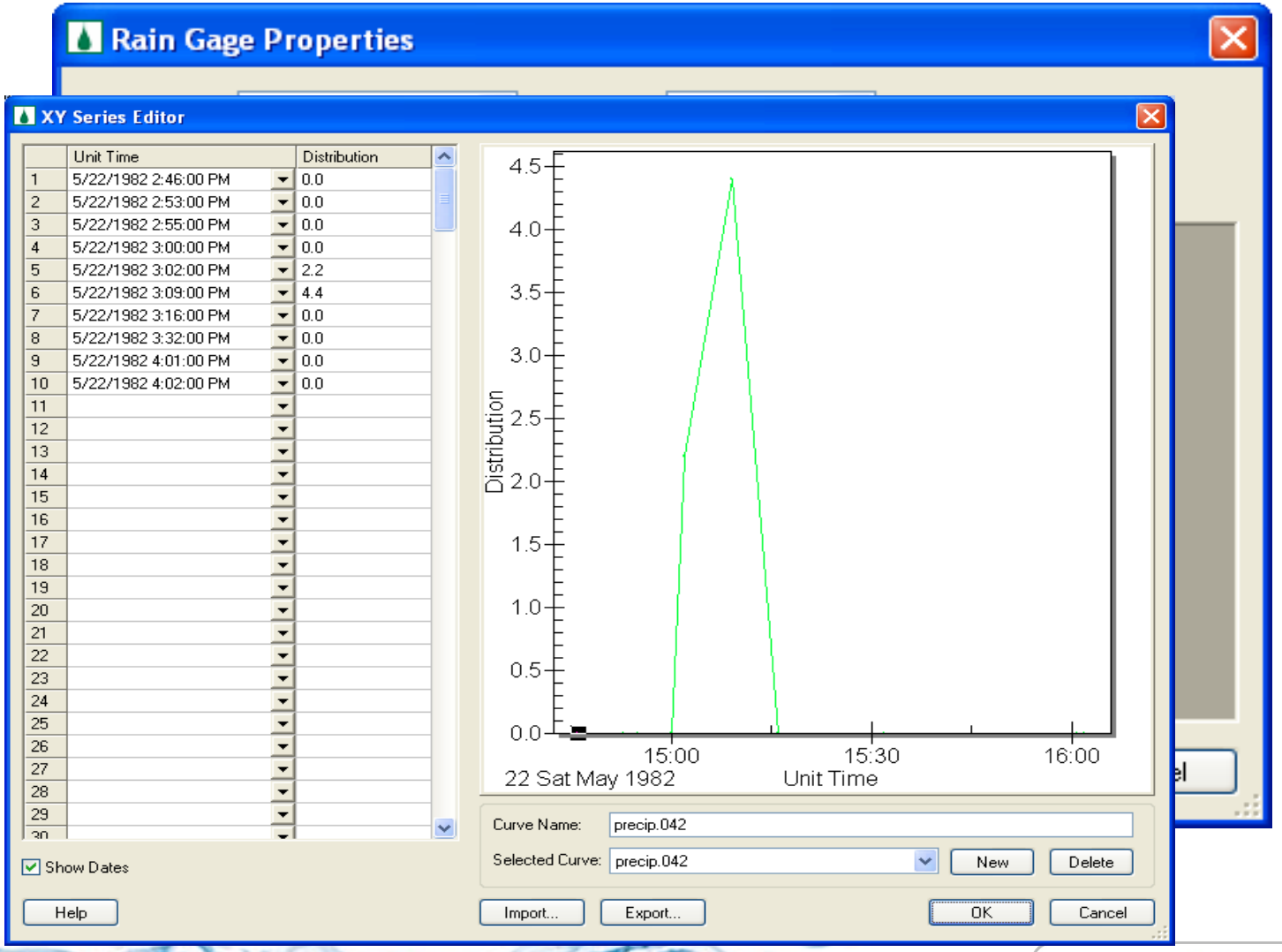
Using Gages

- The gages are created in the rain gage coverage
- WMS will automatically generate Thiessen polygons as the gages are created



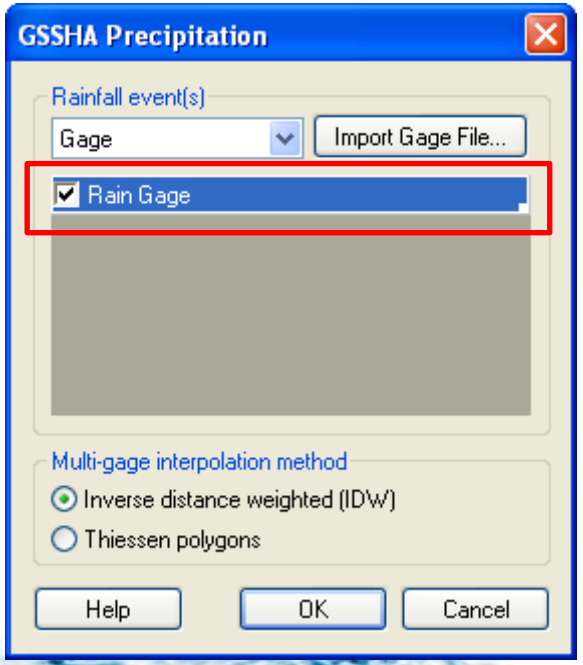
Using Gages

- The temporal distribution of the rainfall (rate/depth) in each gage is defined by double clicking each gage under rain gage coverage
- The depth should be incremental millimeters
- Cumulative millimeters can be used but the values should be normalized and multiplied by the total storm depth



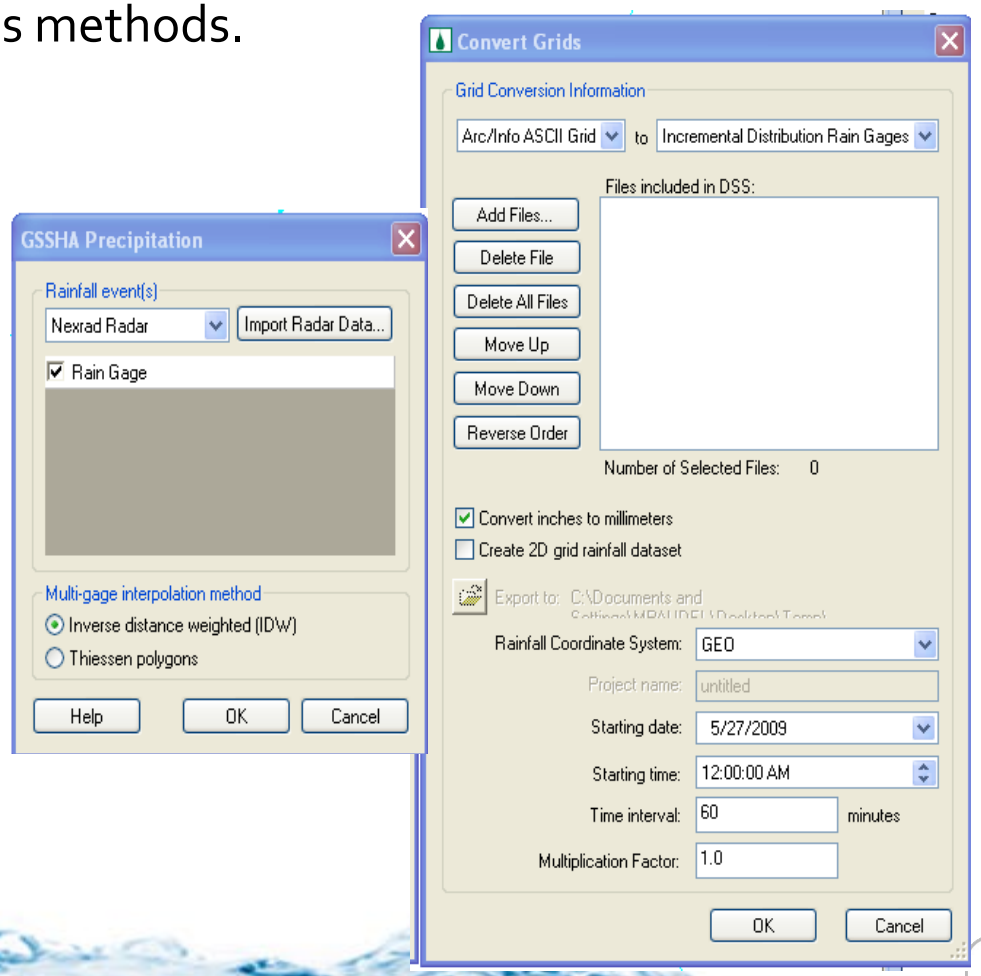
Using Gages

- Once all the gages are defined, we need to go back to GSSHA | Precipitation and select "Rain Gage" coverage to be used to get the gage information

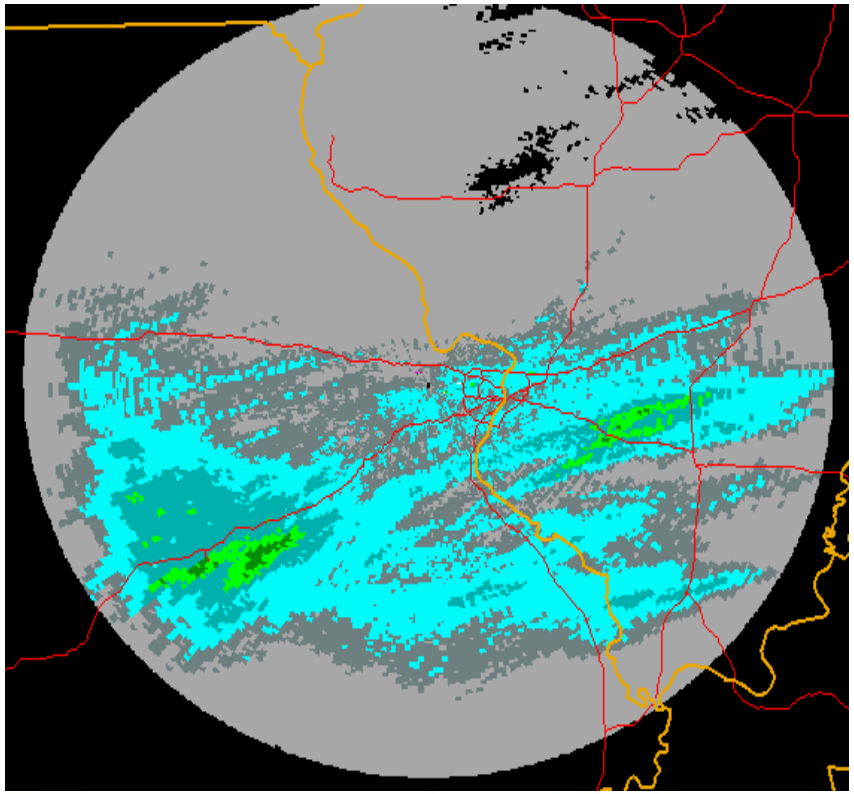


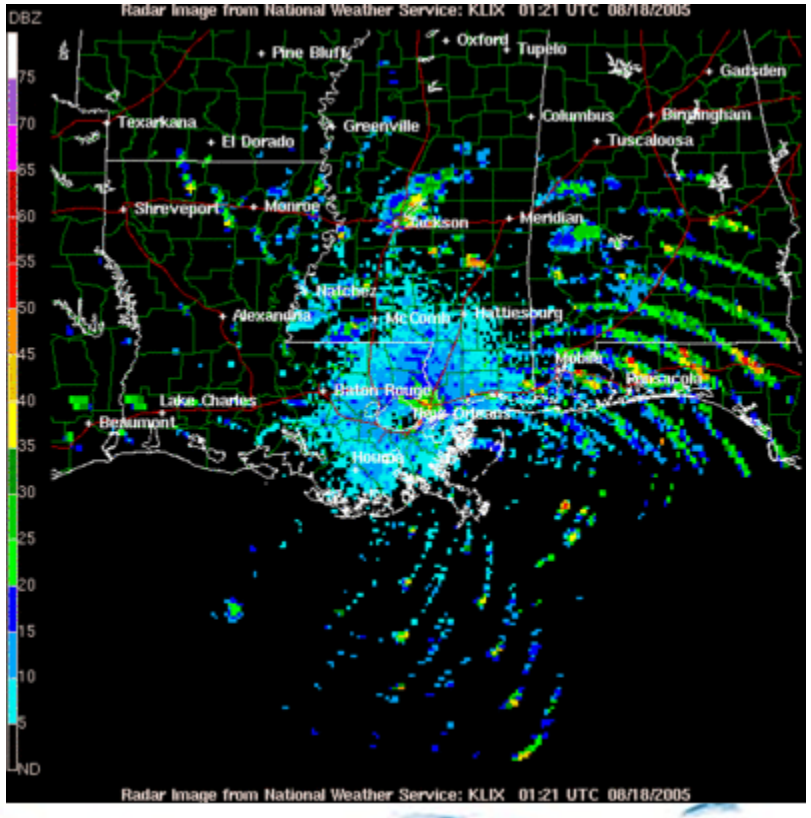
Using NEXRAD Radar data

- NEXRAD radar data is used to define the spatially and temporally varying rainfall
- It involves more computation compared to previous methods.
- This will be discussed in more detail next.



NEXRAD Radar Rainfall



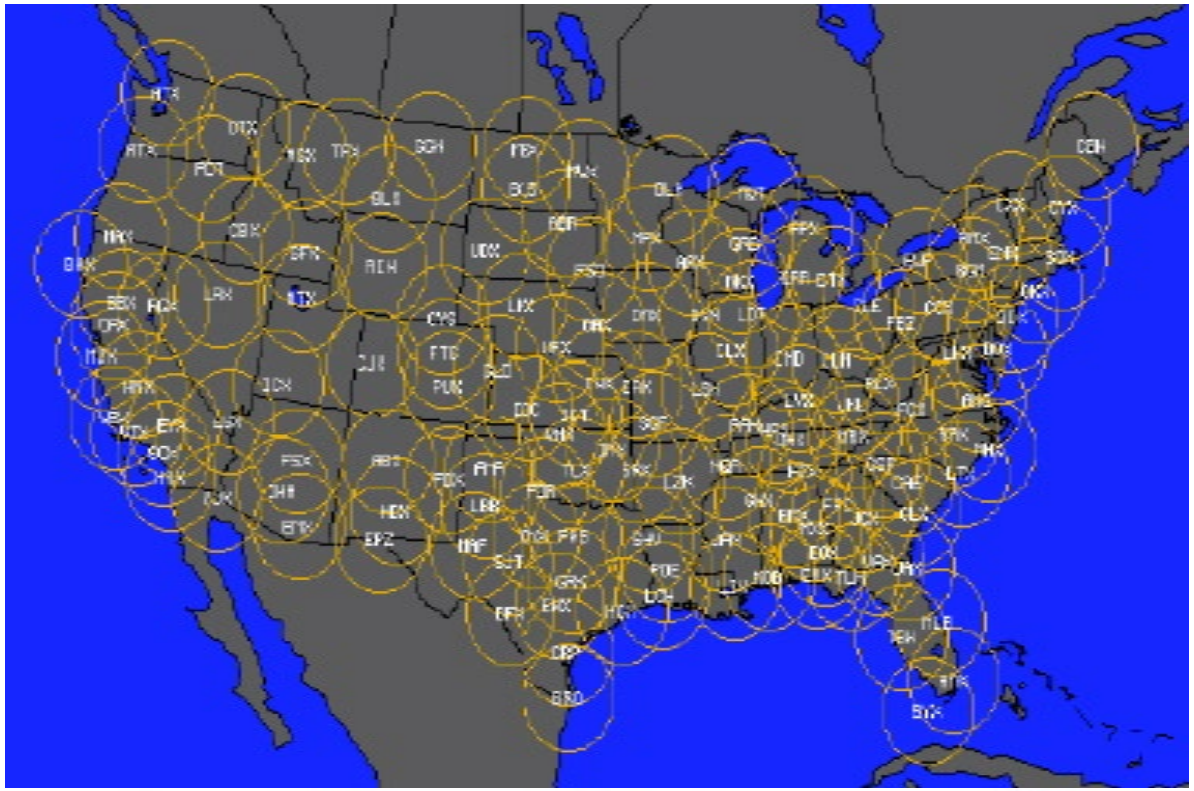


What is NEXRAD

- Developed by National Weather Service
- NEXt generation RADar (WSR-88D weather radar)
- NERAD senses the rainfall by transmitting a radio signal and measuring the reflection from falling rain drops
- Data available with 2Km*2Km grid

Coverage

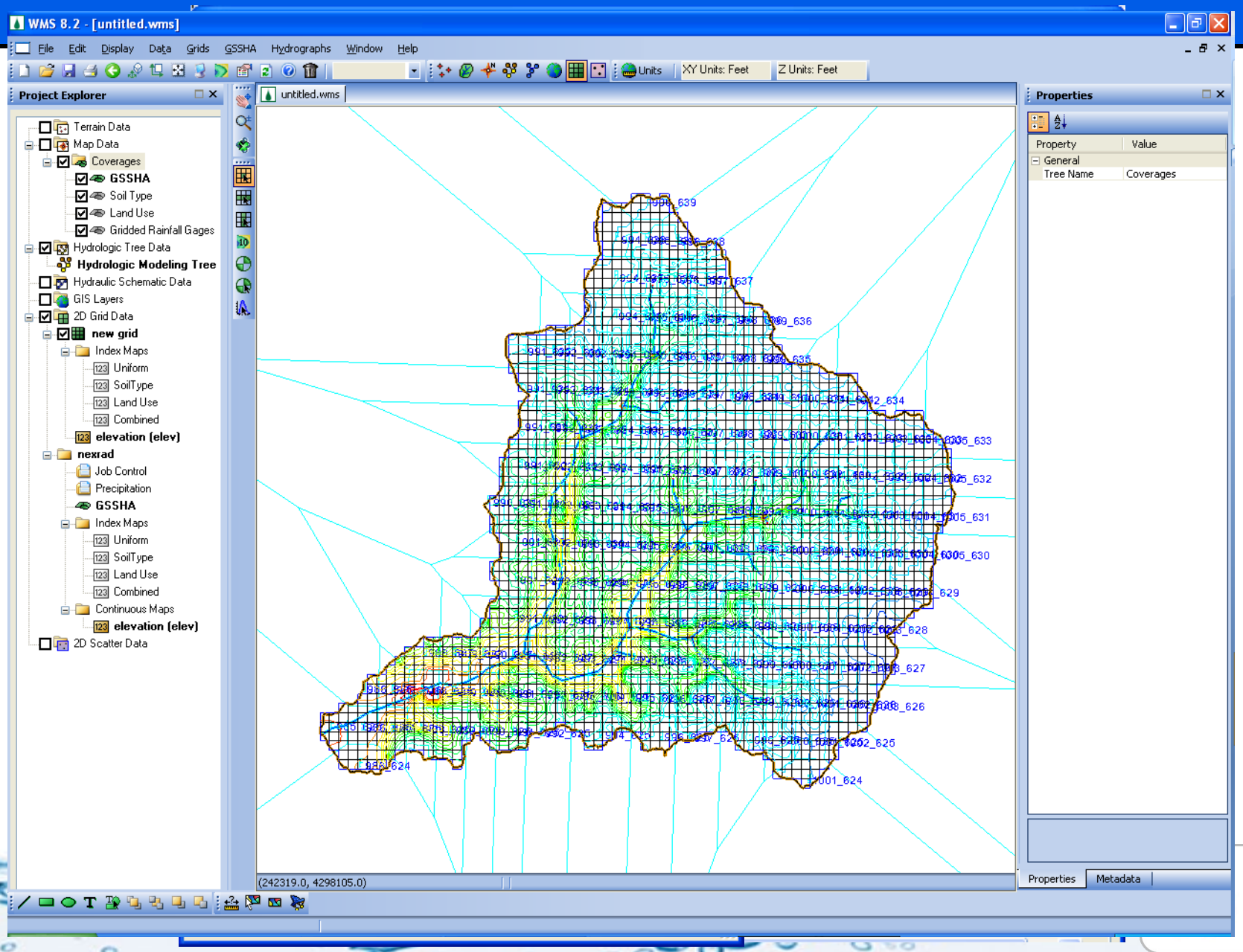
- Available for entire United States



Benefits

- When near the watershed NEXRAD data are typically of good quality and compare well with ground based gages.
- Provides superior spatial distribution of rainfall
- Can be used in GSSHA using WMS interface that processes the data and saves in the format accepted by GSSHA

Processing


WMS 8.2 - [untitled.wms]
File Edit Display Data Grids GSSHA Hydrographs Window Help
Units
XY Units: Feet
Z Units: Feet
Project Explorer
Terrain Data
Map Data
Coverages
GSSHA
Soil Type
Land Use
Gridded Rainfall Gages
Hydrologic Tree Data
Hydrologic Modeling Tree
Hydraulic Schematic Data
GIS Layers
2D Grid Data
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SoilType
Land Use
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SoilType
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Continuous Maps
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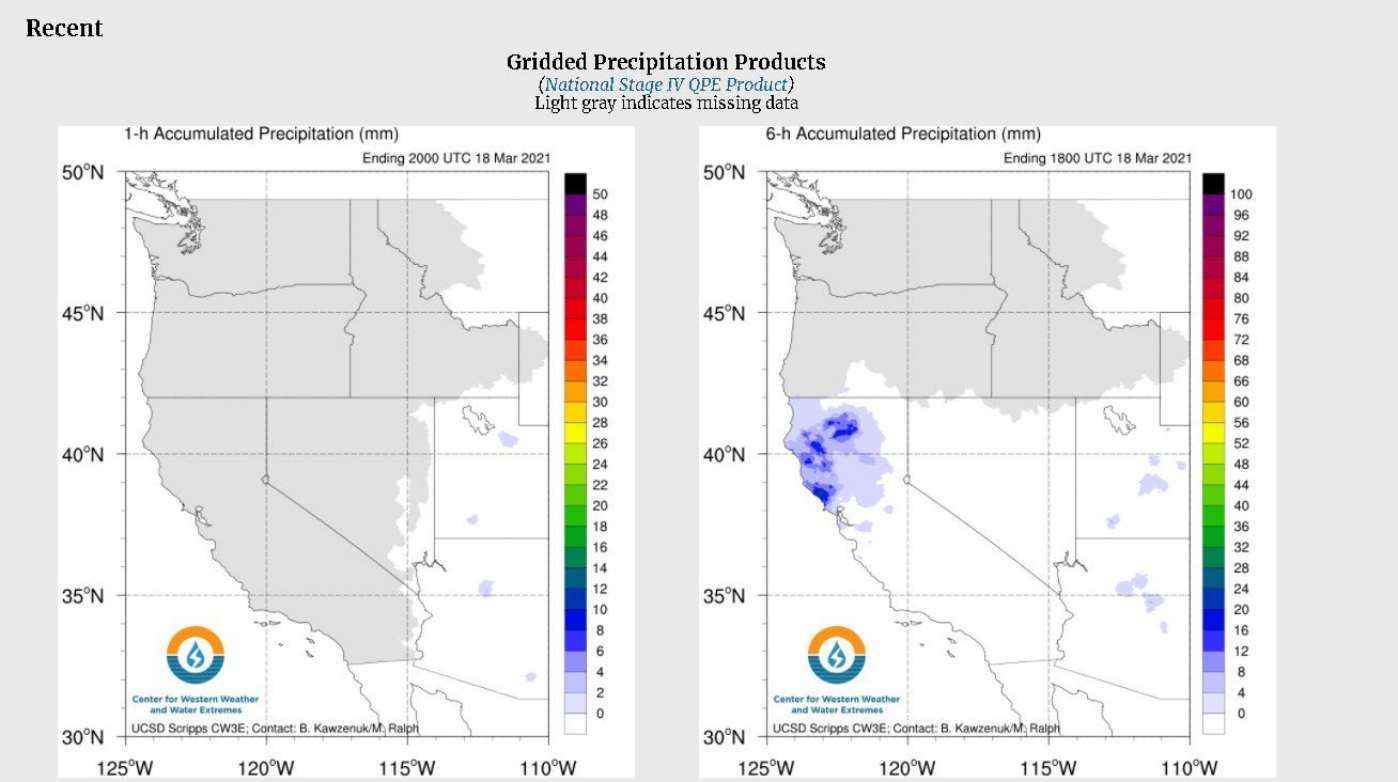
Additional Methods

- Satellite and remote sensed rainfall products
- PRISM – rainfall method from Oregon State University.
- Forecast - FIRO Project at Scripps at UC San Diego, CW3E
  - https://cw3e.ucsd.edu/