Utah State University

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LECTURE #4

WEATHER DATA AND WDMS

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WEATHER DATA

- Nonpoint source pollution is a weather-driven process
- Hydrologic processes are time varying and depend on changes in environmental conditions, i.e.,
  - Precipitation
  - Temperature
  - Wind speed

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WEATHER DATA USED IN HSPF

- Precipitation
- Potential evapotranspiration
- Air temperature
- Wind speed
- Solar radiation
- Dewpoint temperature
- Cloud cover

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HSPF WEATHER DATA REQUIREMENTS

	PERLND/IMPLND						RCHRES				
	Temp.	Snow**	Water	Sediment	Soil Temp.	Ag. Chem.*	Water	Heat	Gen. Qual.	DO	Plankton
Precipitation	●	●	●	●		● [1]	△	△			
Pot. ET			●	● [1]		● [1]	△				
Air Temperature	●	●			●	● [2]		●			
Wind Speed		●						●	● [3]	● [5]	
Solar Radiation		●						●			●
Dewpoint Temp.		●						●			
Cloud Cover								●	● [4]		

● Required

△ Optional

[1] For PWATER

[2] For PSTEMP

[3] If volatilization from lake is simulated

[4] If photolysis is simulated

[5] If RCHRES is a lake

*Ag. Chemicals include nutrients and pesticides

**Degree Day option only requires precip and air temp

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HOW PRECIPITATION IS USED IN HSPF

- Primary input for soil hydrology
- Surface runoff is directly dependent on precipitation
- Detachment of soil from soil matrix by the impact of rain and transport of detached sediment
- Pollutant transport caused by overland flow and soil erosion
- Rain falling on the water surface of a reach

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HOW EVAPOTRANSPIRATION IS USED IN HSPF

- Evapotranspiration comprises
  - evaporation directly from soil layers and vegetation surface
  - transpiration through plants.

- Evapotranspiration is used in runoff computation
  - Direct loss of water from water surface or from snow pack to atmosphere
  - Loss of water through transpiration from vegetation surface

- Evaporation from reach water surface

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HOW AIR TEMPERATURE IS USED IN HSPF

- Function of elevation
  - Temperature corrected for elevation by calculating difference between the weather station elevation and the model segment mean elevation
- Snow and snow melt
  - Determines whether precipitation is rain or snow
  - Affects density of snow
  - Affects snow melt
- Soil temperature
  - Heat transfer through soil surface
- Water temperature
  - Conductive-convective heat transport

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HOW WIND SPEED IS USED IN HSPF

- Evaporation from snow pack
  - Directly proportional to wind speed
- Heat exchange rate
  - Condensation heat flux to snowpack is directly proportional to wind speed
- Heat balance in water bodies
  - Evaporative heat loss increases with wind speed
  - Conductive-convective heat transfer between air and water is a function of wind speed
- Oxygen reaeration rate
  - Lake reaeration rate is a function of wind speed
- Chemical volatilization rate
  - Proportional to oxygen reaeration coefficient

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HOW SOLAR RADIATION IS USED IN HSPF

- Snow melt
- Heat balance in water bodies
- Plankton growth rate

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HOW DEWPOINT TEMPERATURE IS USED IN HSPF

- Snow
  - Determines when precipitation is considered as snow
- Heat balance in water bodies

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HOW CLOUD COVER IS USED IN HSPF

- Heat balance in water bodies
  - Cloud cover affects long-wave radiation balance
- Photolysis
  - Cloud cover decreases photolyzing radiation

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WATERSHED DATA MANAGEMENT (WDM) FILE

- Holds weather, input, output, calibration, and other time series data required by HSPF.
- A WDM file can contain a large number of time series data.
- HSPF can manipulate (i.e., read, replace) the data contained in a WDM file.

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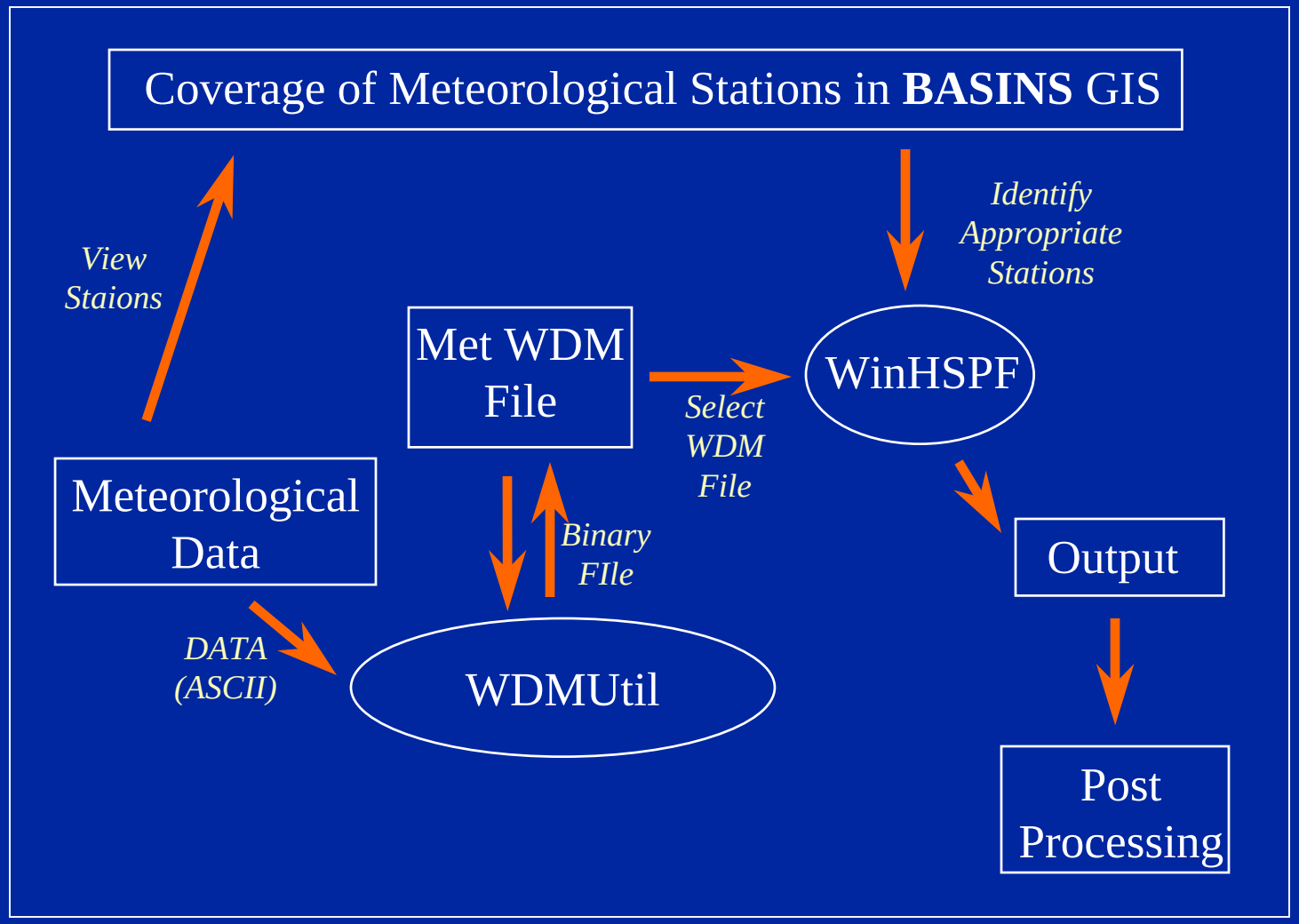
PROCESSING OF METEOROLOGICAL DATA IN BASINS-HSPF



MET WDM FILES vs. PROJECT WDM FILES IN WinHSPF

- WinHSPF uses two WDM files
  - Met WDM File
  - Project WDM File
- Met WDM File
  - Holds weather data time series required by HSPF for various locations within each state
  - Linked to the WDM Weather Data Stations shapefile
- Project WDM File
  - Holds all other time series information required or used by HSPF
    - Other required input time series including point source and atmospheric deposition information
    - Model output time series
    - Model calibration time series

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REASONS FOR MANIPULATING A WDM FILE

- Many studies require more representative weather data than is available in the BASINS weather WDM files.
- Some time series available from BASINS will need to be appended.
- Local or additional water quality or flow information may be available that will be necessary for model calibration and/or validation.

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TIME SERIES DATA MANAGEMENT TASKS

- Collect/obtain data
- Reformat data to WDM file
- Correct/fill-in missing periods; generate data from other parameters
- Aggregate or disaggregate
- Display and analyze data

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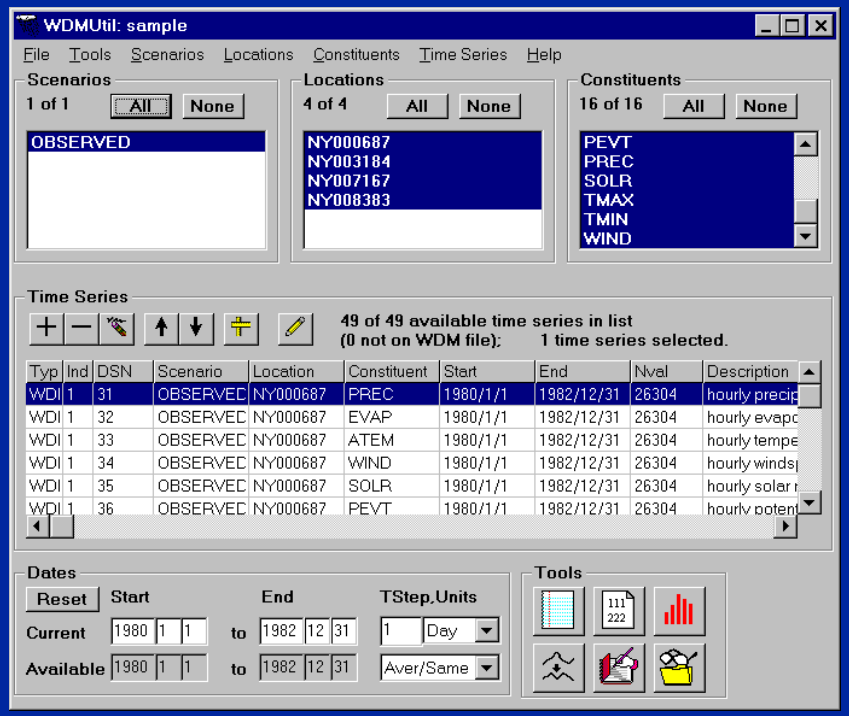
WATERSHED DATA MANAGEMENT UTILITY (WDMUtil)

Functionalities for Time Series Management Include:

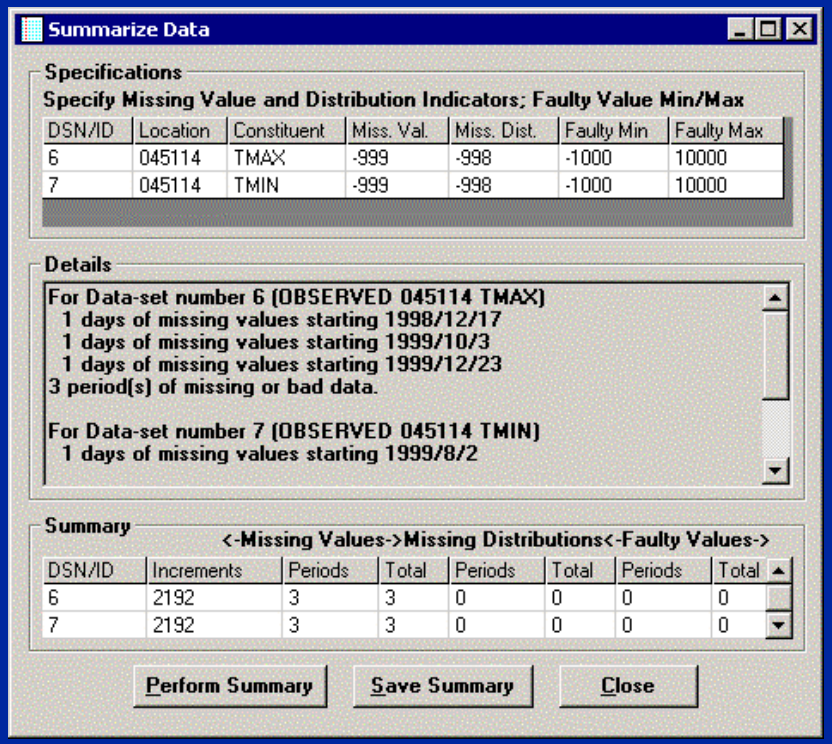
- Create/delete
- Import/export
- Update
- Fill-in
- Extend
- Generate
- Aggregate/disaggregate
- Mathematical operations



WDMUtil TOOLS

Summarize

- Missing values
- Missing distributions
- Faulty minimums and maximums
- Periods and total intervals



WDMUtil TOOLS

View/Edit

- Save to text file
- Specify date and number formats
- Edit time series attributes
- Edit specific values
- Save to new/ overwrite time series

Timeseries Data

File Edit

Scenario	OBSERVED
Location	CA000442
Constituent	ATEM
1970/01/01 00:00	36.0
1970/01/01 01:00	35.2
1970/01/01 02:00	34.7
1970/01/01 03:00	34.0
1970/01/01 04:00	33.3
1970/01/01 05:00	32.7
1970/01/01 06:00	32.0
1970/01/01 07:00	36.0
1970/01/01 08:00	40.1
1970/01/01 09:00	44.1
1970/01/01 10:00	47.1
1970/01/01 11:00	50.0
1970/01/01 12:00	53.1
1970/01/01 13:00	54.3

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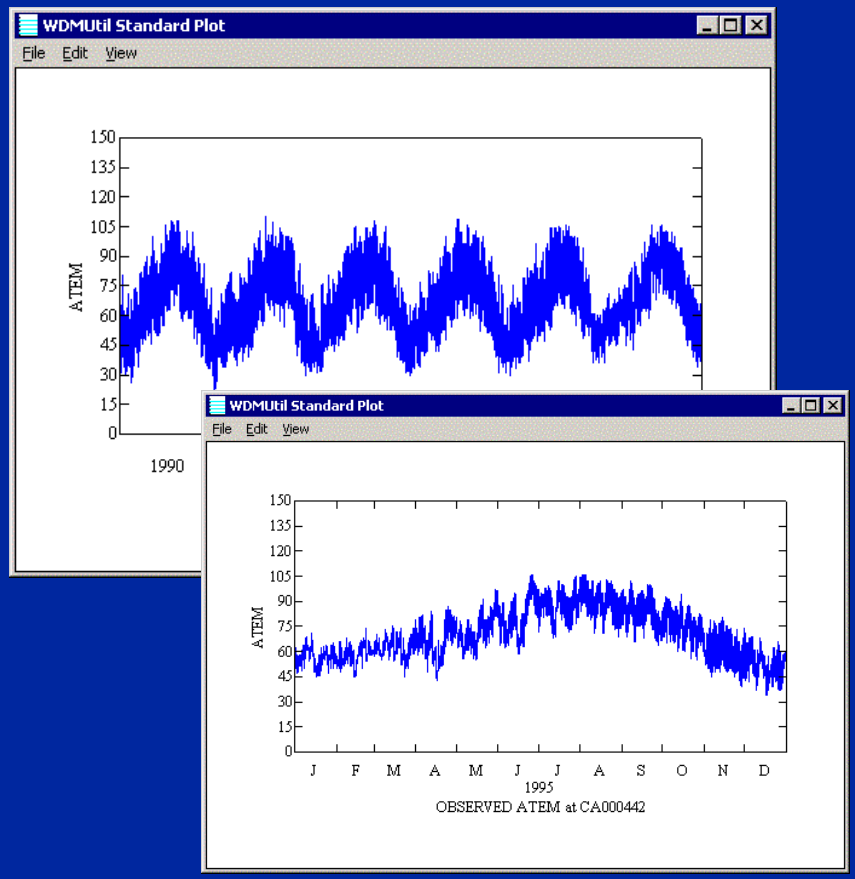
WDMUtil TOOLS

Graph

- Specify display period
- Edit title, axes, legend
- Edit curve markers, colors
- Use left, right, auxillary axes
- Arithmetic and logarithmic plots



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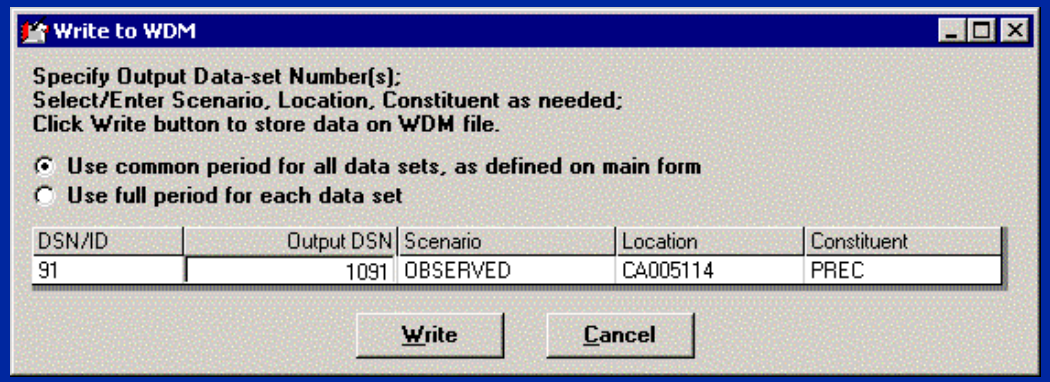
WDMUtil TOOLS



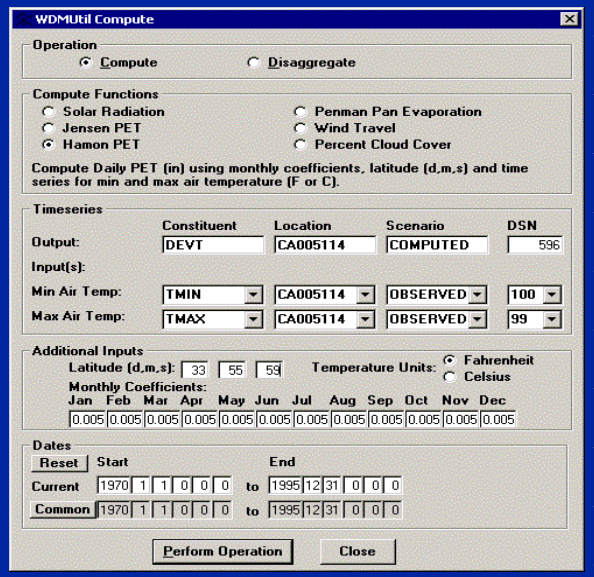
Write

- Time series are imported to *memory*
- "Write" time series from *memory* to WDM
- "Write" to copy time series
- Specify:
  - Data Set Number (DSN) – number location on WDM
  - Scenario – e.g. "OBSERVED", "COMPUTED", "Baseline"
  - Location – e.g. weather station ID
  - Constituent – e.g. PREC, EVAP, ATEM

WDMUtil TOOLS

Compute

- Solar radiation
  - From cloud cover
- Potential Evapotranspiration
  - From min/max temp and solar radiation
  - From min/max temp
- Pan Evaporation
  - From min/max temp, dewpoint temp, wind movement, and solar radiation
- Wind Travel
  - From wind speed
- Percent Cloud Cover
  - From percent sun



- Disaggregate
  - To shorter interval

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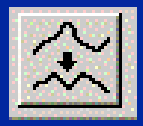
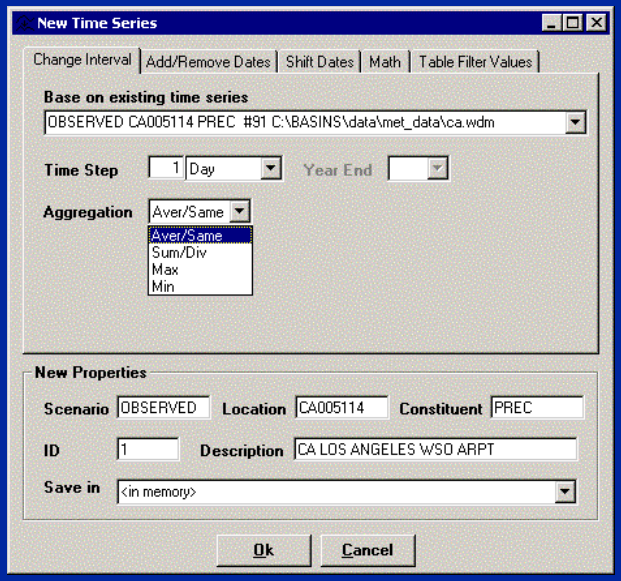
WDMUtil TOOLS



Generate New Time Series from Existing

- Specify base time series
- Change time step
  - Aggregation options
- Add/Remove dates
  - Four data fill options
- Shift dates (for all data)
- Math operations
  - *, /, +, -
  - Mean, weight
  - Logarithms, exponents
  - Running sum, min/max
- Filter values
  - Specify ranges
  - Specify “delete” or “leave unchanged”



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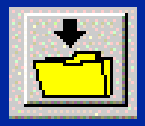
WDMUtil TOOLS



Export Time Series

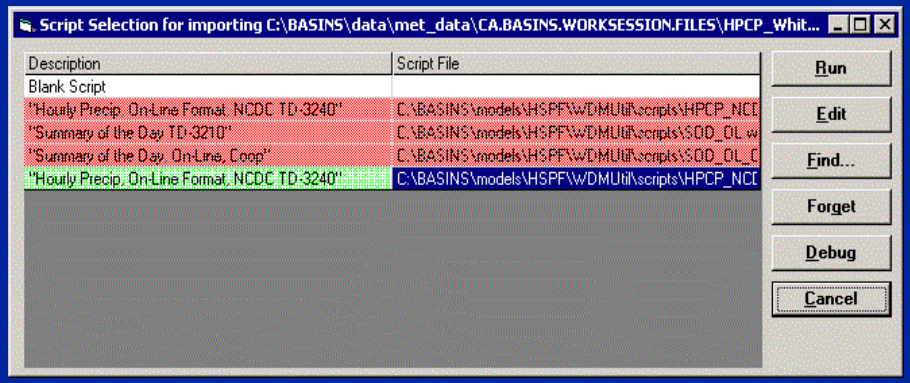
- Export file (*.exp) format
- Readily re-imported to WDM

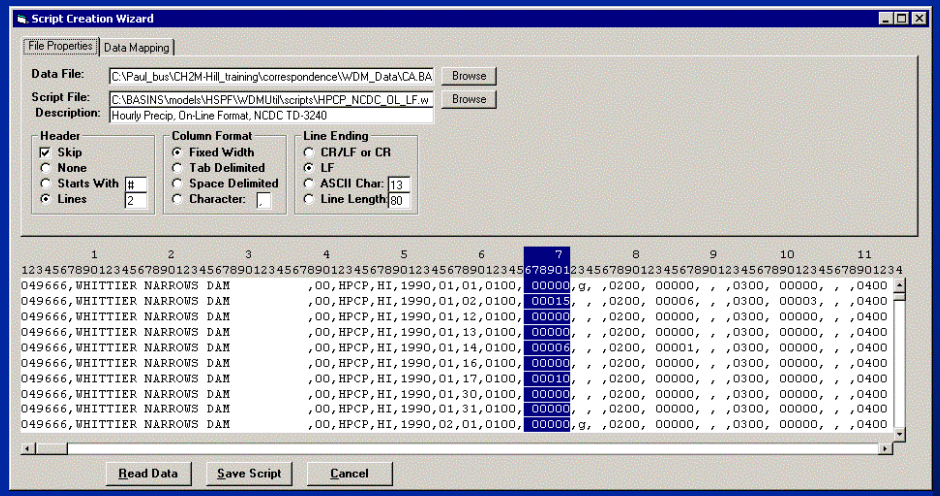
View File

- File preview

WDMUtil TOOLS

- Import
  - Browse for file
  - Select import script
  - Edit script
    - Script Creation Wizard
    - Text editor (advanced)
  - Read/import data





BASINS Meteorologic Data Update

BASINS Met WDMs have been updated to include more stations and recent data

- Over 16,000 stations are now available (many historical records included)
- From ~500 precipitation stations to over 2100 current hourly precipitation stations
- 5000 air temperature stations
- Now includes PET (SOD) stations
- Data through 2006

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BASINS Meteorologic Data Update

Availability of met constituents is indicated by icons on the map