

LECTURE #4

WEATHER DATA AND WDMS



A photograph of a waterfall cascading over dark rocks, with water splashing and creating white foam at the base. The image is positioned on the left side of the slide.

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

WEATHER DATA USED IN HSPF

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

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

A photograph of a waterfall cascading over dark rocks, with water splashing and creating white foam at the base. The image is positioned on the left side of the slide.

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

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

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

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

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

A photograph of a waterfall cascading over dark rocks, with water splashing and creating mist. The image is positioned on the left side of the slide.

HOW CLOUD COVER IS USED IN HSPF

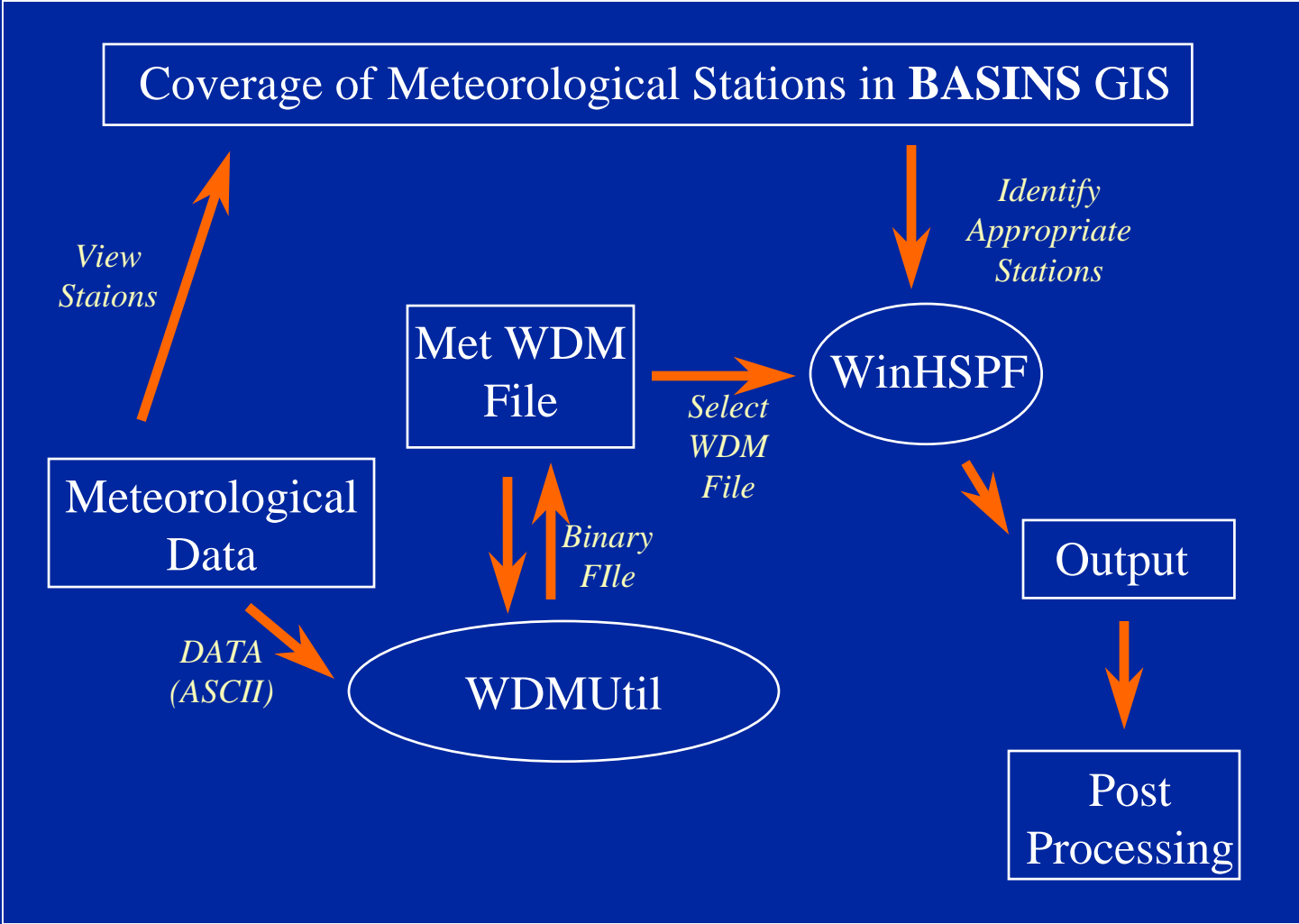
- Heat balance in water bodies
 - Cloud cover affects long-wave radiation balance
- Photolysis
 - Cloud cover decreases photolyzing radiation

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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.

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.



TIME SERIES DATA MANAGEMENT TASKS

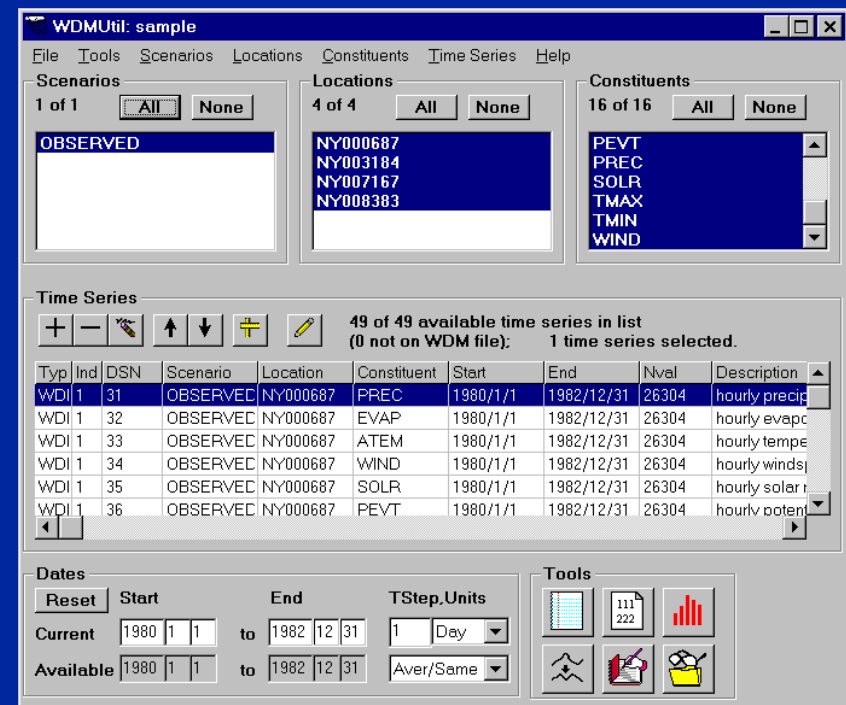
- Collect/obtain data
- Reformat data to WDM file
- Correct/fill-in missing periods; generate data from other parameters
- Aggregate or disaggregate
- Display and analyze data

WATERSHED DATA MANAGEMENT UTILITY (WDMUtil)

Functionalities for Time Series Management

Include:

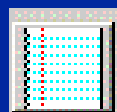
- Create/delete
- Import/export
- Update
- Fill-in
- Extend
- Generate
- Aggregate/disaggregate
- Mathematical operations



The screenshot displays the WDMUtil software interface. It features a menu bar with options: File, Tools, Scenarios, Locations, Constituents, Time Series, and Help. Below the menu bar are three panels: Scenarios (1 of 1), Locations (4 of 4), and Constituents (16 of 16). The Scenarios panel shows 'OBSERVED'. The Locations panel lists NY000687, NY003184, NY007167, and NY008383. The Constituents panel lists PEVT, PREC, SOLR, TMAX, TMIN, and WIND. The Time Series panel shows 49 of 49 available time series in list (0 not on WDM file); 1 time series selected. Below this is a table with columns: Typ, Ind, DSN, Scenario, Location, Constituent, Start, End, Nval, and Description. The table contains 6 rows of data. At the bottom, there are 'Dates' and 'Tools' sections. The 'Dates' section includes 'Reset', 'Start', 'End', 'TStep', and 'Units' fields. The 'Tools' section includes icons for a grid, a document, a bar chart, a printer, and a trash can.

Typ	Ind	DSN	Scenario	Location	Constituent	Start	End	Nval	Description
WDI	1	31	OBSERVED	NY000687	PREC	1980/1/1	1982/12/31	26304	hourly precip
WDI	1	32	OBSERVED	NY000687	EVAP	1980/1/1	1982/12/31	26304	hourly evapc
WDI	1	33	OBSERVED	NY000687	ATEM	1980/1/1	1982/12/31	26304	hourly tempe
WDI	1	34	OBSERVED	NY000687	WIND	1980/1/1	1982/12/31	26304	hourly winds
WDI	1	35	OBSERVED	NY000687	SOLR	1980/1/1	1982/12/31	26304	hourly solar t
WDI	1	36	OBSERVED	NY000687	PEVT	1980/1/1	1982/12/31	26304	hourly potent

WDMUtil TOOLS



Summarize

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

Summarize Data

Specifications
Specify Missing Value and Distribution Indicators; Faulty Value Min/Max

DSN/ID	Location	Constituent	Miss. Val.	Miss. Dist.	Faulty Min	Faulty Max
6	045114	TMAX	-999	-998	-1000	10000
7	045114	TMIN	-999	-998	-1000	10000

Details

For Data-set number 6 (OBSERVED 045114 TMAX)
1 days of missing values starting 1998/12/17
1 days of missing values starting 1999/10/3
1 days of missing values starting 1999/12/23
3 period(s) of missing or bad data.

For Data-set number 7 (OBSERVED 045114 TMIN)
1 days of missing values starting 1999/8/2

Summary

DSN/ID	<-Missing Values->			Missing Distributions		<-Faulty Values->	
	Increments	Periods	Total	Periods	Total	Periods	Total
6	2192	3	3	0	0	0	0
7	2192	3	3	0	0	0	0

Buttons: Perform Summary, Save Summary, Close

WDMUtil TOOLS

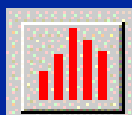


View/Edit

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

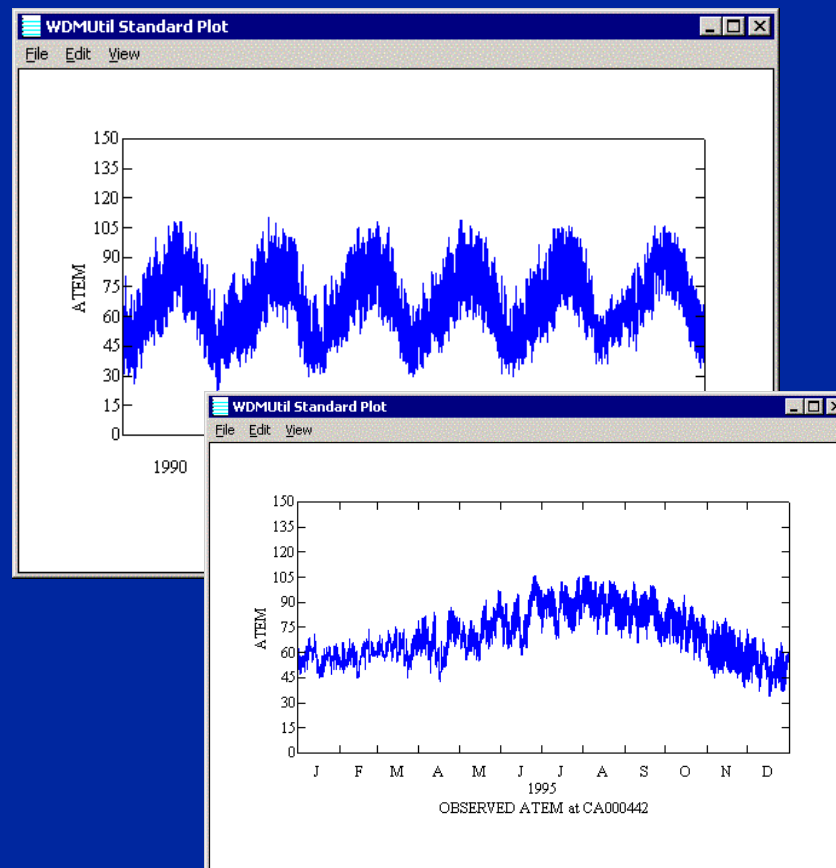
Scenario	OBSERVED
Location	CA000442
Constituent	ATEM
1970/01/01 00:00	36.0
1970/01/01 01:00	35.2
1970/01/01 02:00	34.7
1970/01/01 03:00	34.0
1970/01/01 04:00	33.3
1970/01/01 05:00	32.7
1970/01/01 06:00	32.0
1970/01/01 07:00	36.0
1970/01/01 08:00	40.1
1970/01/01 09:00	44.1
1970/01/01 10:00	47.1
1970/01/01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

WDMUtiL TOOLS



Graph

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



WDMUtil TOOLS



Write

Write to WDM

Specify Output Data-set Number(s);
Select/Enter Scenario, Location, Constituent as needed;
Click Write button to store data on WDM file.

Use common period for all data sets, as defined on main form
 Use full period for each data set

DSN/ID	Output DSN	Scenario	Location	Constituent
91	1091	OBSERVED	CA005114	PREC

Write Cancel

- 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

The screenshot shows the 'WDMUtil Compute' window with the following settings:

- Operation:** Compute, Disaggregate
- Compute Functions:**
 - Solar Radiation
 - Jensen PET
 - Hamon PET
 - Penman Pan Evaporation
 - Wind Travel
 - Percent Cloud Cover
- Compute Daily PET (in) using monthly coefficients, latitude (d.m.s) and time series for min and max air temperature (F or C).**
- Timeseries:**

Output:	Constituent	Location	Scenario	DSN
	DEVT	CA005114	COMPUTED	596

Input(s):

Min Air Temp:	Max Air Temp:	Constituent	Location	Scenario	Value
TMIN	TMAX	CA005114	CA005114	OBSERVED	100
				OBSERVED	99
- Additional Inputs:**

Latitude (d.m.s): 33 55 59 Temperature Units: Fahrenheit, Celsius

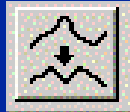
Monthly Coefficients:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
- Dates:**

Reset	Start	End
Current	1970 1 1 0 0 0	to 1995 12 31 0 0 0
Common	1970 1 1 0 0 0	to 1995 12 31 0 0 0
- Buttons:** Perform Operation, Close

- Disaggregate
 - To shorter interval

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”

New Time Series

Change Interval | Add/Remove Dates | Shift Dates | Math | Table Filter Values

Base on existing time series
OBSERVED CA005114 PREC #91 C:\BASINS\data\met_data\ca.wdm

Time Step: 1 Day Year End: []

Aggregation: Aver/Same
Sum/Div
Max
Min

New Properties
Scenario: OBSERVED Location: CA005114 Constituent: PREC
ID: 1 Description: CA LOS ANGELES WSO ARPT
Save in: <in memory>

Ok Cancel

WDMUtiL TOOLS



Export Time Series

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

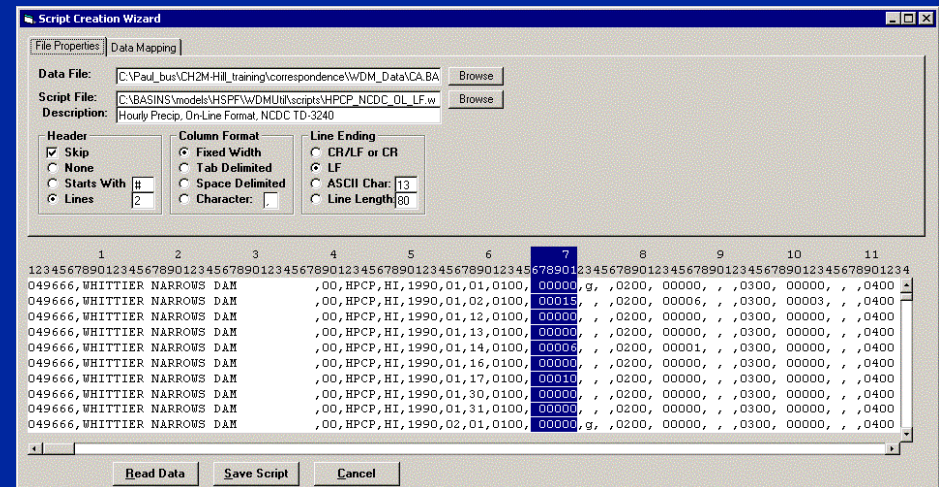
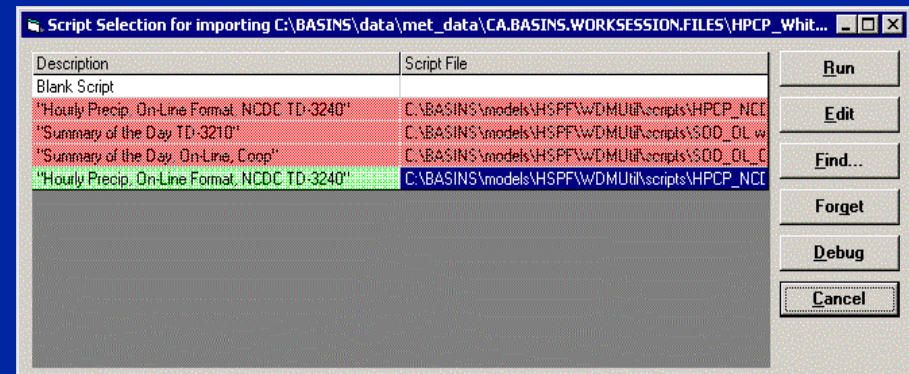


View File

- File preview

WDMUtil TOOLS

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



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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

BASINS Meteorologic Data Update

Availability of met constituents is indicated by icons on the map

