# Welcome


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## Recent SWAT Developments and Future Directions

# Presentation Overview

- Current SWAT development by “Model Developers Group”
- Modular recoding
- Status of US National Conservation (USDA) and Environmental Assessments (USEPA)

# 2013 Soil and Water Assessment Tool

## Model Developer's Workshop

**July 11-12, 2013**

**Paul Sabatier Université, Toulouse, France**

**Sabine and Jose**

## TOPICS:

(1) Landscape Processes (riparian, floodplain, overland routing and sediment)

(2) River/landscape Continuum AND In-Stream processes, Flood plains, riparian, stream aquifers (spatial, flow sediments, nutrients and biology) + emergent contaminants (antibiotics, hormones, metals, pesticides)).

(3) Plant Growth, competition, crop management

(4) New technology (web based/training, Super computers, GIS, sensitivity, autocalibration, optimization, uncertainty analysis).

# (1) Landscape Processes

Martin Volk, Nicola Fohrer, David Bosch, Hendrik Rathjens, Louis Thibodeaux, Xuesong Zhang

- Gridded landscape version at Tifton. Dynamic wetness index.
- Vertical profile transport of emerging contaminants
- Improved Lowland processes – tile and groundwater
- Century carbon validation

## (2) River Landscape Continuum and In-Stream Processes

Peter Allen, Jose Miguel Sanchez Perez, Mike White, Sabine Sauvage, Balaji

- Channel erosion, transport/deposition, pool/riffle
- Floodplain and riparian processes
- Particulate and dissolved organic carbon - biofilm
- Contaminant transfer – in-stream Kd
- Finite element groundwater model and MODFLOW link
- Rice paddy irrigation

# (3) Plant growth and crop management

Phil Gassman, Indrajeet Chaubey, Claire Baffaut, Michael Strauch, Jeff Arnold

- Updating crop parameters into single database
- Plant competition validation and development of agroforestry module
- Bioenergy crop improvements and stover removal
- Tropical conditions modifications
- Realistic planting and applications as a function of heat unit and time distribution

# (4) New Technology

**Karim Abbaspour, Jaehak Jeong, Srini**

- Objective function constraints
- Model structure uncertainty
- Sensitivity analysis routines
- Continue modularization
- Incorporate remotely sensed ET

# 2013 Soil and Water Assessment Tool

## Model Developer's Workshop

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## OUTCOMES/SUGGESTIONS:

(1) Web-Site for Developers

(2) Archive test data sets

(3) Easy access to version code

(4) Developer's manual and workshops

# *Current SWAT Development*

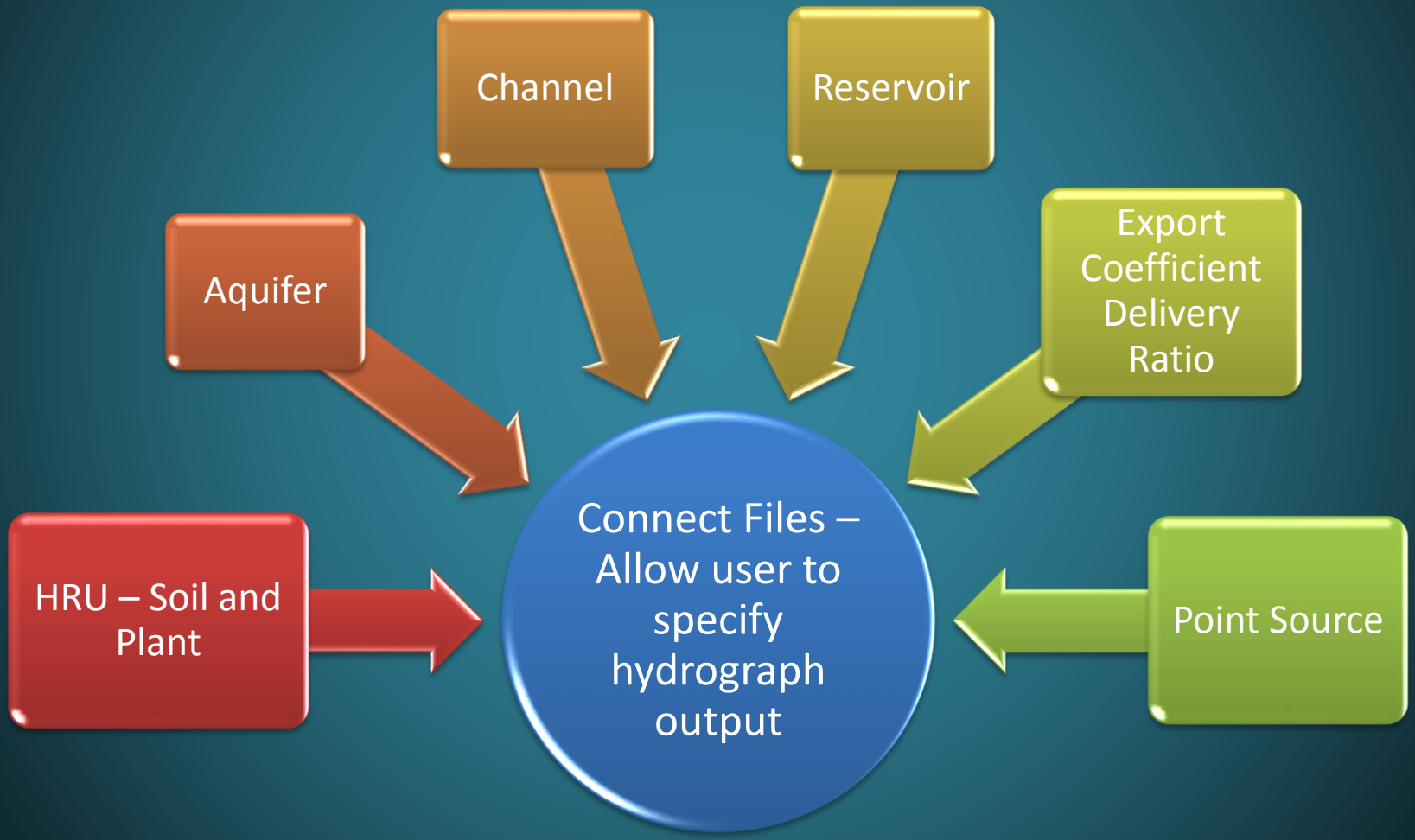
- Modular approach to enhance support and maintenance
  - JRW Libraries – Jimmy R. Williams developed many of the original hydrology, sediment, plant growth, nutrient cycling, and flood routing routines currently used in SWAT and other models. He has supported numerous models and worked for several agencies. Naming the library modules is a way to honor him as he retires.

# *Current SWAT Development*

- Modular approach to enhance support and maintenance
  - Extensive use of Fortran data structures

```
type pesticide_db
  character(len=17) :: pestnm   !!                    |pesticide name
  real :: skoc = 0.             !! (mg/kg)/(mg/L)     |soil adsorption coeff normalized for soil org carbon content
  real :: pst_wof = 0.          !! none               |frac of pesticide on foliage which is washed off by rainfall event
  real :: hlife_f = 0.          !! days               |half-life of pest on foliage
  real :: hlife_s = 0.          !! days               |half-life of pest in soil
  real :: ap_ef = 0.            !! none               |application efficiency (0-1)
  real :: pst_wsol = 0.         !! mg/L (ppm)         |solubility of chemical in water
end type pesticide_db
type (pesticide_db), dimension(:),allocatable, save :: pestdb
```

# Spatial Objects (Modules) – hydrographs and weather are passed between objects



# *JRW Data Library*

- Data files – soil, management, tillage, fertilizer, plants pesticides, bacteria, reservoirs, and channels
- Modular library of Fortran subroutines to read from data files and assemble in appropriate data structures
- Centralized archive of natural resource data that can be quality controlled, accessed and built by the international modeling community
- Operational but needs to be expanded to include required input by other models

mgtops.dat: Management schedules - Little River Experimental Watershed

6

hru.dat: HRU properties - Little River Experimental Watershed

| NUMB | NAME | WEATHER | TOPO | HYD | SOIL | LANDUSE |
|---|---|---|---|---|---|---|
| 1 | 1_1_1_AG | 1 | 1 | 1 | 7 | 2 |
| 2 | 2_1_2_AG | 1 | 2 | 1 | 23 | 2 |
| 3 | 3_1_3_AG | 1 | 3 | 1 | 7 | 1 |
| 4 | 4_1_4_AG | 1 | 4 | 1 | 23 | 1 |
| 5 | 5_1_5_FR | 1 | 5 | 2 | 1 | 3 |
| 6 | 6_1_6_FR | 1 | 6 | 2 | 20 | 1 |
| 7 | 7_1_7_FR | 2 | 7 | 2 | 23 | 2 |
| 8 | 8_2_1_AG | 2 | 8 | 1 | 23 | 2 |

4 past 4 3

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6 utrn 6 3

| MGT_OPS | STR_OPS ……. |
|---|---|
| 2 | 1 |
| 1 | 1 |
| 1 | 1 |
| 1 | 1 |
| 0 | 0 |
| 1 | 1 |
| 2 | 1 |
| 1 | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0.150 | 2 | 0 | 0.0 | PLANT AGRL |
| 11 | 0 | 0 | 0.160 | 1 | 0 | 0.0 | AUTO_FERT |
| 5 | 0 | 0 | 1.200 | 1 | 0 | 0.0 | HARVKILL |
| 20 | 0 | 0 | 0.000 | 0 | 0 | 0.0 | SKIP_YEAR |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0.150 | 2 | 0 | 0.0 | PLANT AGRL |
| 11 | 0 | 0 | 0.160 | 1 | 0 | 0.0 | AUTO_FERT |
| 5 | 0 | 0 | 1.200 | 1 | 0 | 0.0 | HARVKILL |
| 20 | 0 | 0 | 0.000 | 0 | 0 | 0.0 | SKIP_YEAR |

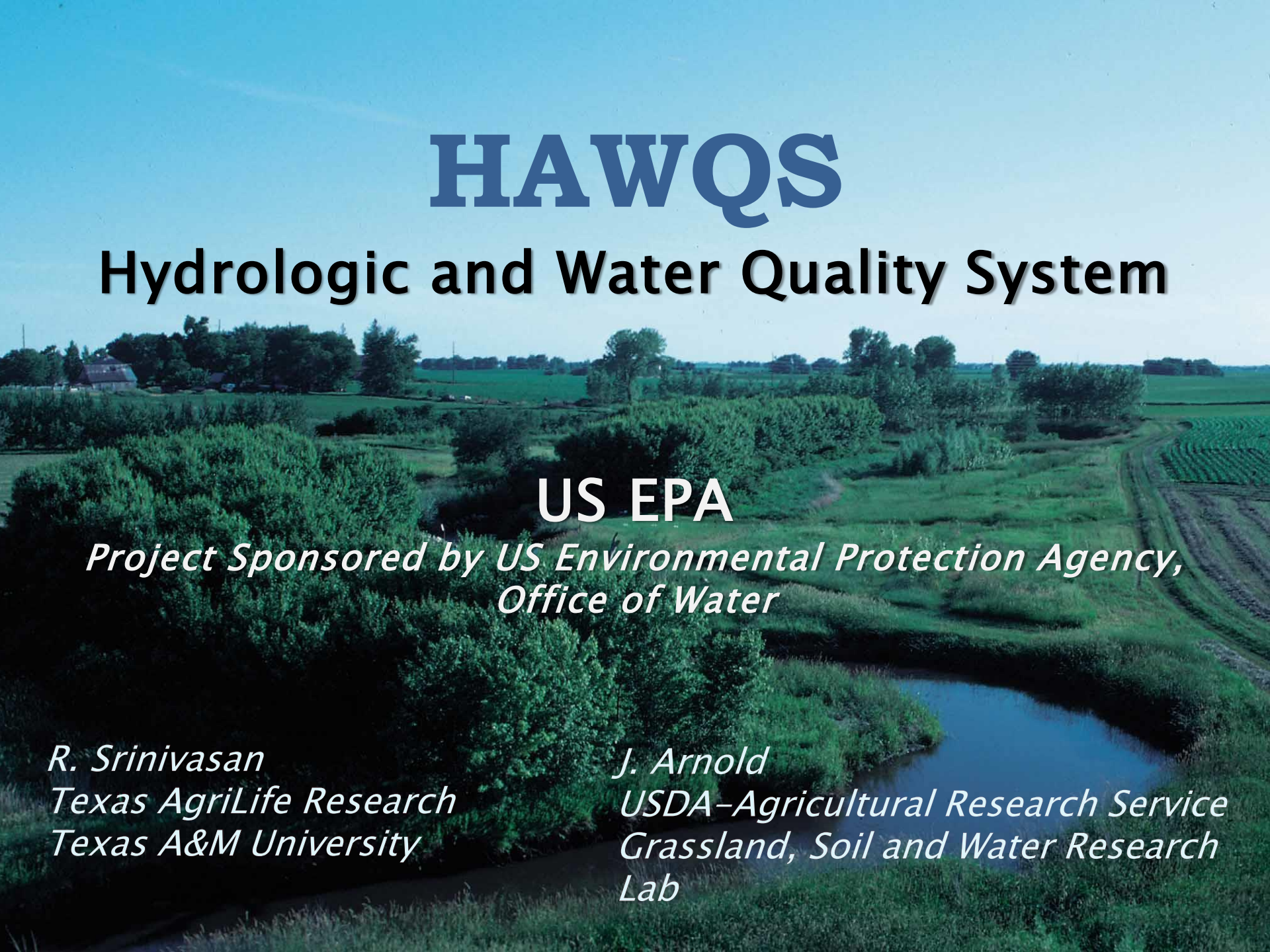
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0.150 | 4 | 0 | 0.0 | PLANT PAST |
| 5 | 0 | 0 | 1.200 | 1 | 0 | 0.0 | HARVKILL |
| 20 | 0 | 0 | 0.000 | 0 | 0 | 0.0 | SKIP_YEAR |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0.150 | 6 | 0 | 0.0 | PLANT BERM |
| 5 | 0 | 0 | 1.200 | 1 | 0 | 0.0 | HARVKILL |
| 20 | 0 | 0 | 0.000 | 0 | 0 | 0.0 | SKIP_YEAR |


# USDA

# Measuring the Environmental Benefits of Conservation

# The Conservation Effects Assessment Project (CEAP)



# HAWQS

## Hydrologic and Water Quality System

### US EPA

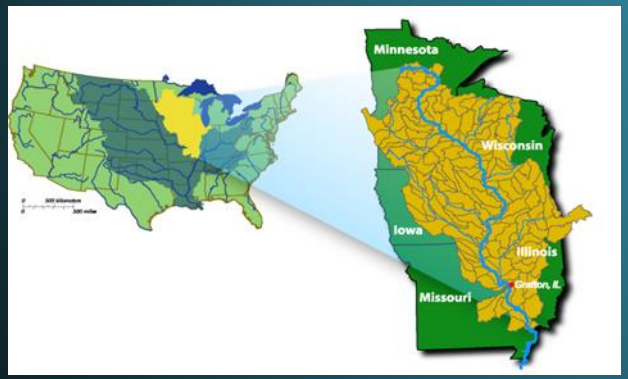
*Project Sponsored by US Environmental Protection Agency, Office of Water*

*R. Srinivasan*
*Texas AgriLife Research*
*Texas A&M University*

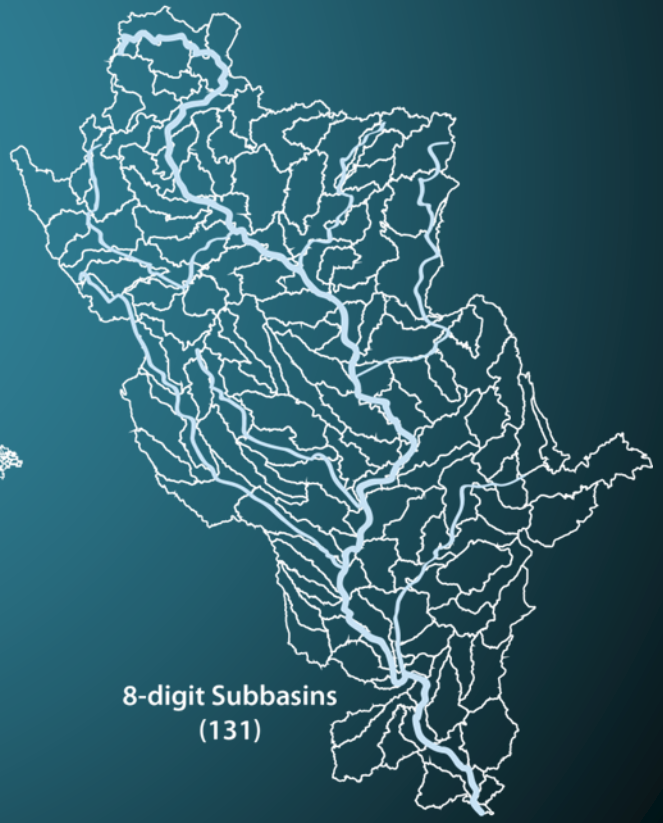
*J. Arnold*
*USDA-Agricultural Research Service*
*Grassland, Soil and Water Research Lab*

# *CEAP National Cropland Assessment*

- Downscaling from 8-digit subwatersheds (3,000 $km^2$) to 12-digits (75 $km^2$)







# *CEAP National Cropland Assessment*

- Use individual rain gages
- Model channel processes on lower order streams
- Model channel erosion and valley bottom deposition within the 12-digits

**Example: 8-digit vs. 12-digit Subwatershed Configurations for the Raccoon River Watershed in West Central Iowa**

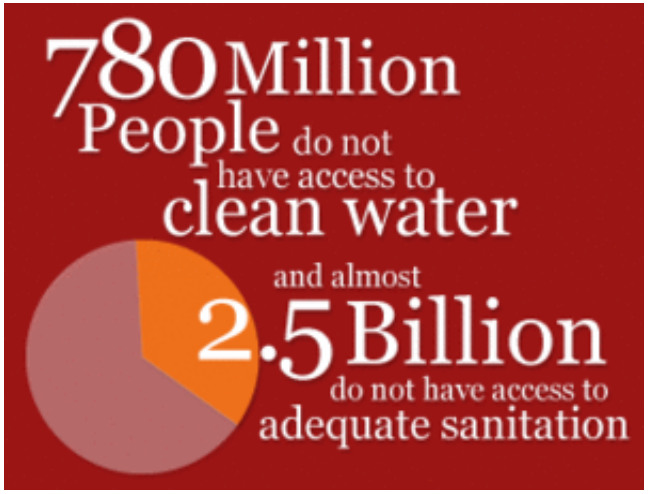
# Thank You

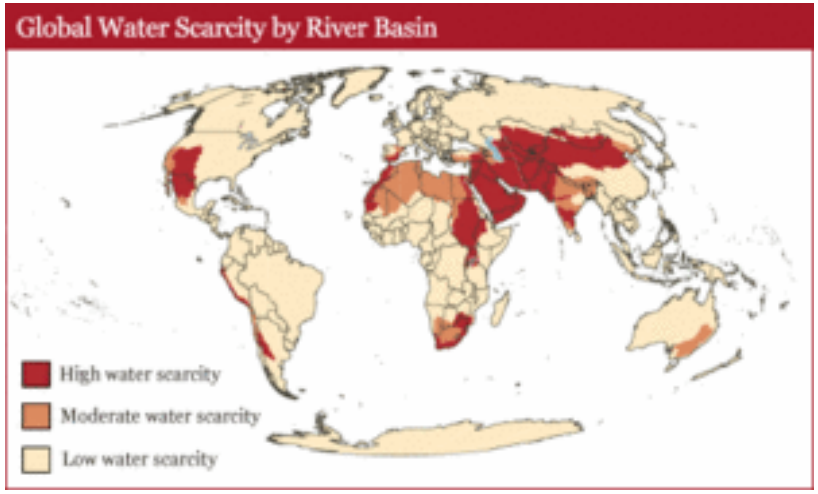
Recent SWAT Developments and Future Directions

# Why are we here?

2013 - UN International Year of Water Cooperation

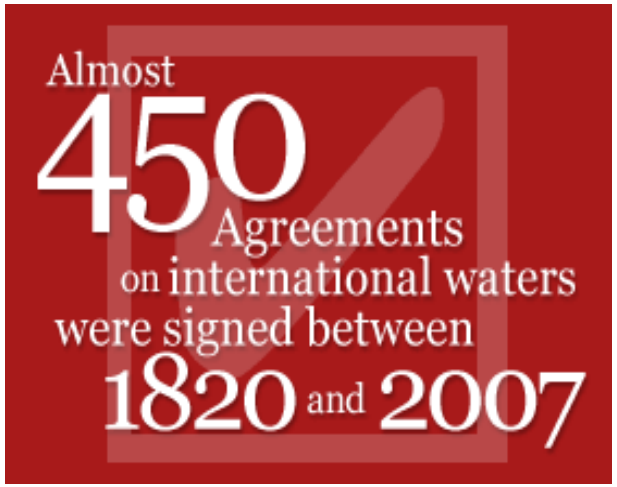
- Increasing Demand for Water – decreasing availability
- 6-8 Million People Die Annually from water related disasters and diseases
- 3.5 planets Earth would be needed to sustain a global population with the current European/N. American lifestyle
- Next 40 years – population growth of 2-3 billion and increase in food demand of 70%
- Agriculture accounts for 70% of freshwater withdrawals

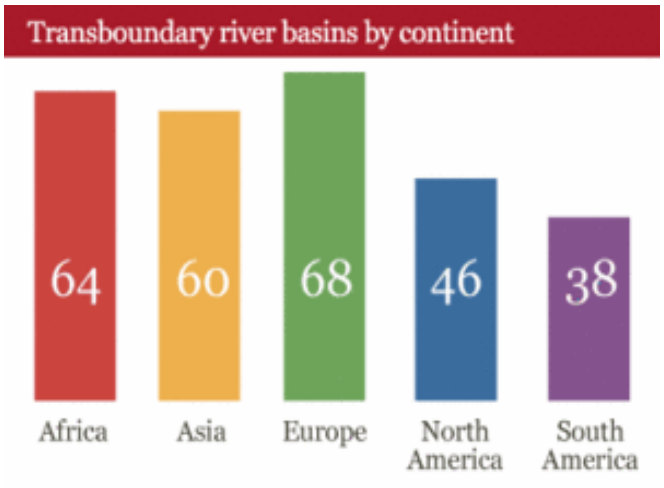


# Why are we here?

- 148 countries have international basins within their territory
- 276 transboundary river basins in the world (46% of world)
- 90% of wastewater in developing countries flows untreated
- 80% of water worldwide is not collected or treated



# *JRW Component Library*

- Well documented and validated library of model components (subroutines or modules) that are developed, maintained and used by model developers.
- Central archive of components that will be verified and validated by an international team of scientists
- Still conceptualizing