Designating Hydrologic Response Units Using a Custom ArcMap Add-in

Lesley Bross and Geoffrey Duh
Geography, Portland State University
October 7, 2011

Portland State UNIVERSITY

The mission

- USDA-NRCS National Weather and Climate Center
  - Provides seasonal water forecasts across the Western US
  - Sample factors affecting the forecasts
    - Snowpack
    - Soil moisture
    - Ground water
    - Precipitation patterns / air temperature
    - Vegetation
    - Frequency of storm events

http://www.wcc.nrcs.usda.gov/

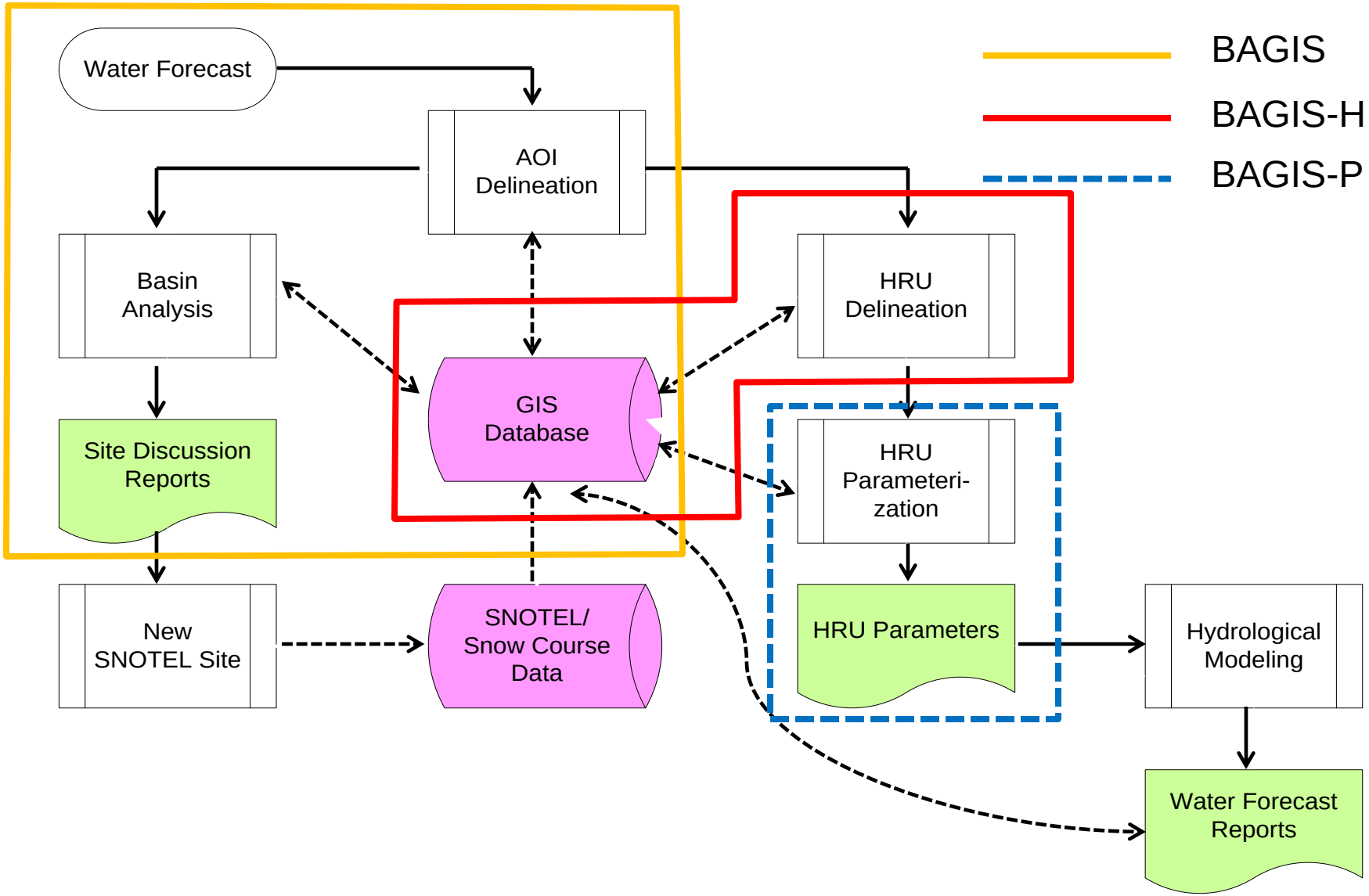
Introducing a new SDSS…

- CSAR engaged in a multi-year agreement with the USDA-NRCS, NWCC to develop a spatial decision support system (SDSS)
- The new SDSS is intended to replace the GIS Weasel to improve water forecast accuracy (GIS Weasel's last release was in 2003)

NRCS Natural Resources Conservation Service

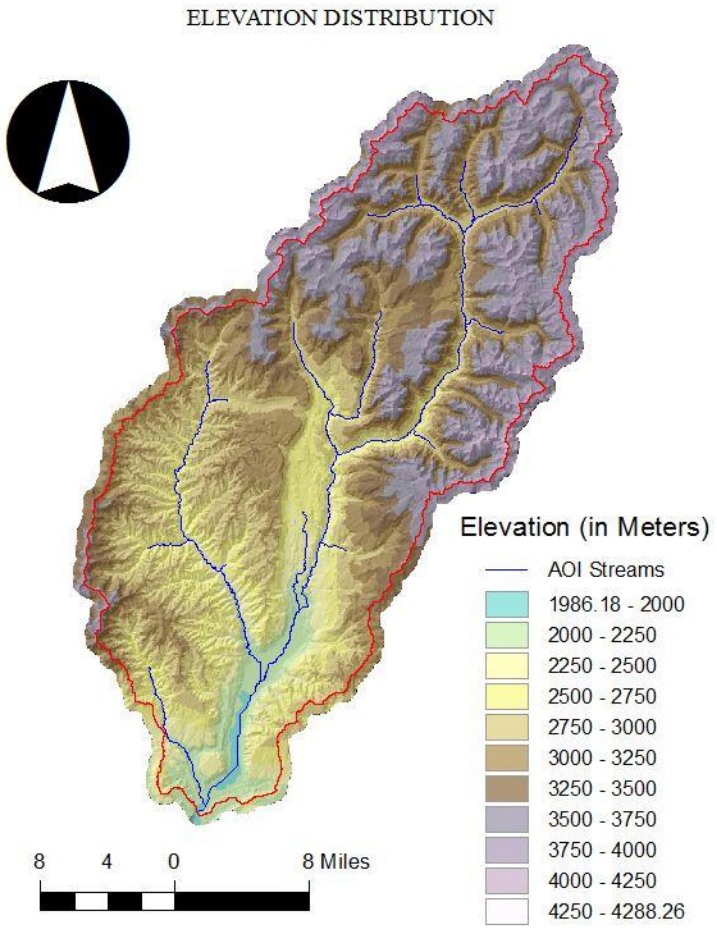
The BAGIS-H project was funded by USDA-NRCS National Water and Climate Center (CESU Agreement #: 68-7482-10-514)

The forecasting process



BAGIS

- Basin Area GIS (BAGIS) released as an ArcMap VBA application in 2010
  - Manages/organizes basin analysis data
  - Prepares terrain datasets for Area of Interest (AOI) delineation
  - Performs spatial computations
  - Generates beautiful maps and Excel reports.



What is an HRU?

- Hydrologic Response Unit
- The smallest “hydrologically” homogeneous area in PRMS
- Each HRU is assumed to be homogeneous for each attribute such as soil type or vegetation density
- Your HRUs should represent a spatially unique area such as a headwater basin

http://wwwbrr.cr.usgs.gov/projects/SW_MoWS/faqs/faqs.shtml#PRMSQuestions

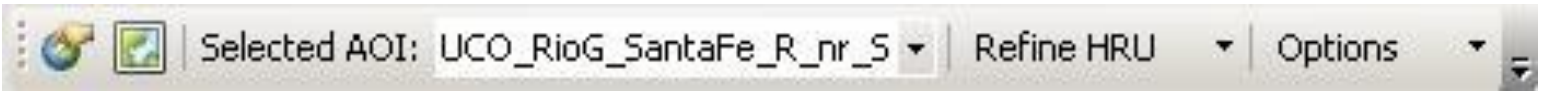
Potential HRU delineation factors

- Terrain features (e.g., flow contributing area)
- Slope grades
- Precipitation distribution
- Aspect classes
- Landuse / land-cover classes
- Soil drainage properties
- Others

HRU zones (sample)

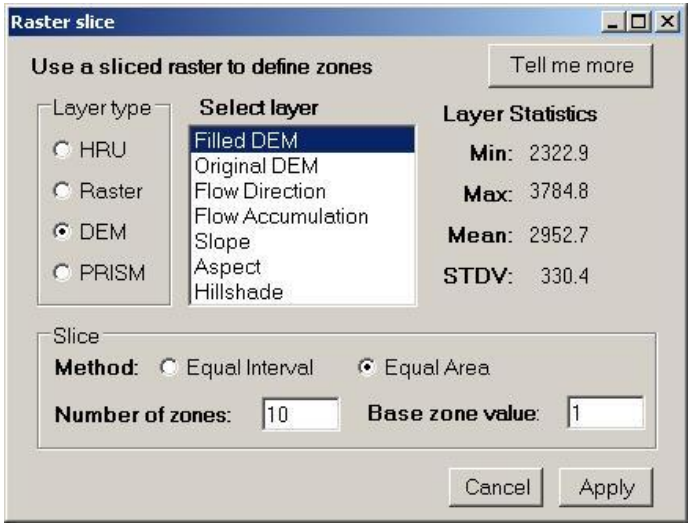
Precipitation distribution and slope grade factors

BAGIS-H key features



- Define HRUs (HRU Delineation)
- Refine HRUs (HRU Post-processing)
- Process logging module
- Data management module

HRU Delineation (rules)

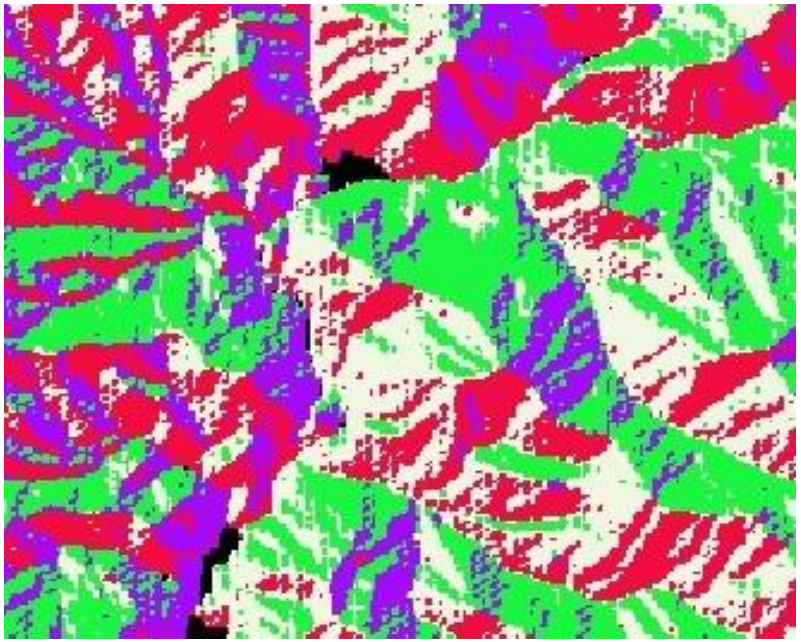


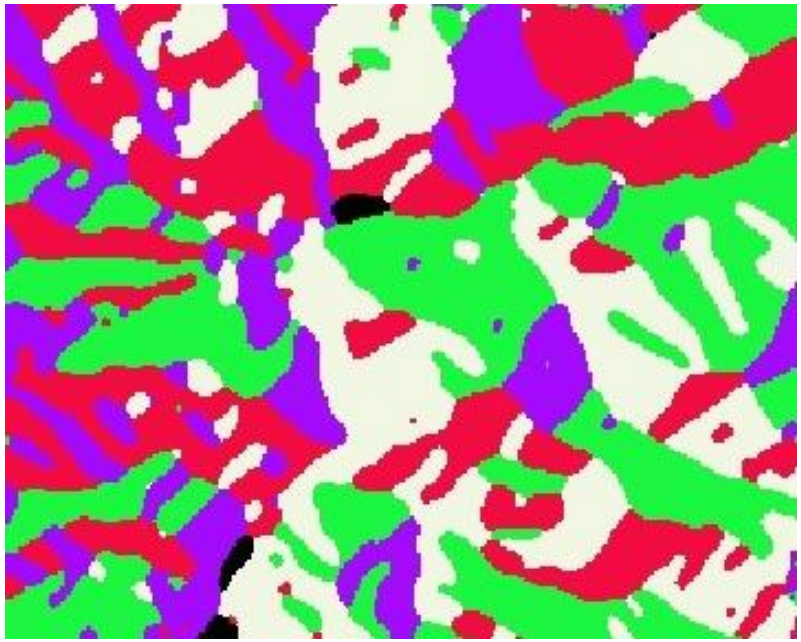
Rule Types	Input Layer	BAGIS*	Actions
Contributing Area	Flow accum	Y	Contributing area
Raster Reclass	User specified	Maybe	Reclassify discrete or continuous data
Raster Slice	User specified	Maybe	Slice – equal area/equal interval
DAFlow-Type Zones	Parameters	Y	Generate grid system
PRISM Precipitation	PRISM	Y	Customized precip slice

* Indicates whether the input layers are generated in BAGIS.

HRU Delineation (templates)

- Templates combine 2 or more processes
- Default templates provided but can be edited
- Aspect example (aspect reclass tool + majority filter)





HRU Delineation (templates)

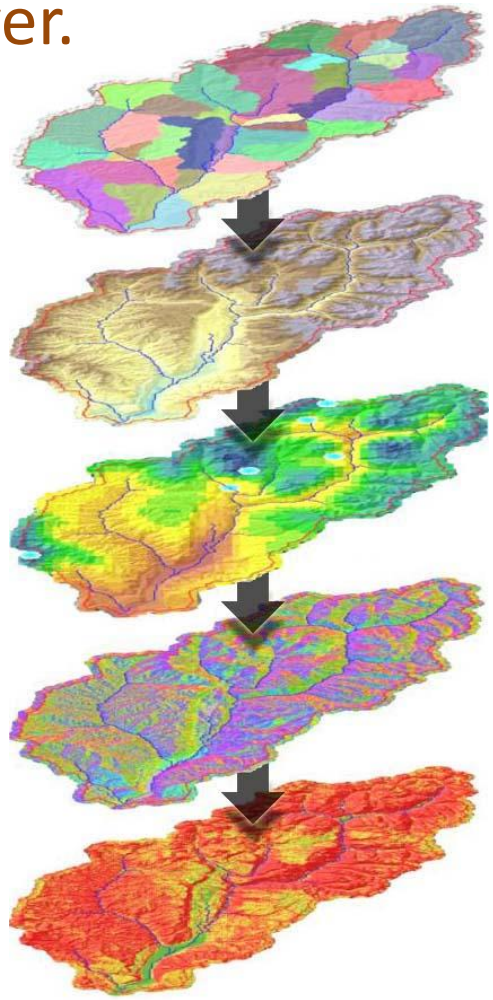
Template	Input Layer	BAGIS*	Actions
Aspect	DEM	Y	Aspect tool; Filter
Slope	Slope	Y	Filter; Reclassify slope; Filter
Canopy	cov_den	N	Filter; Reclassify canopy; Filter
Land Use/Land Cover	west_cotype	N	Reclass cov type; Filter

* Indicates whether the input layers are generated in BAGIS.

HRU Delineation (adding it up)

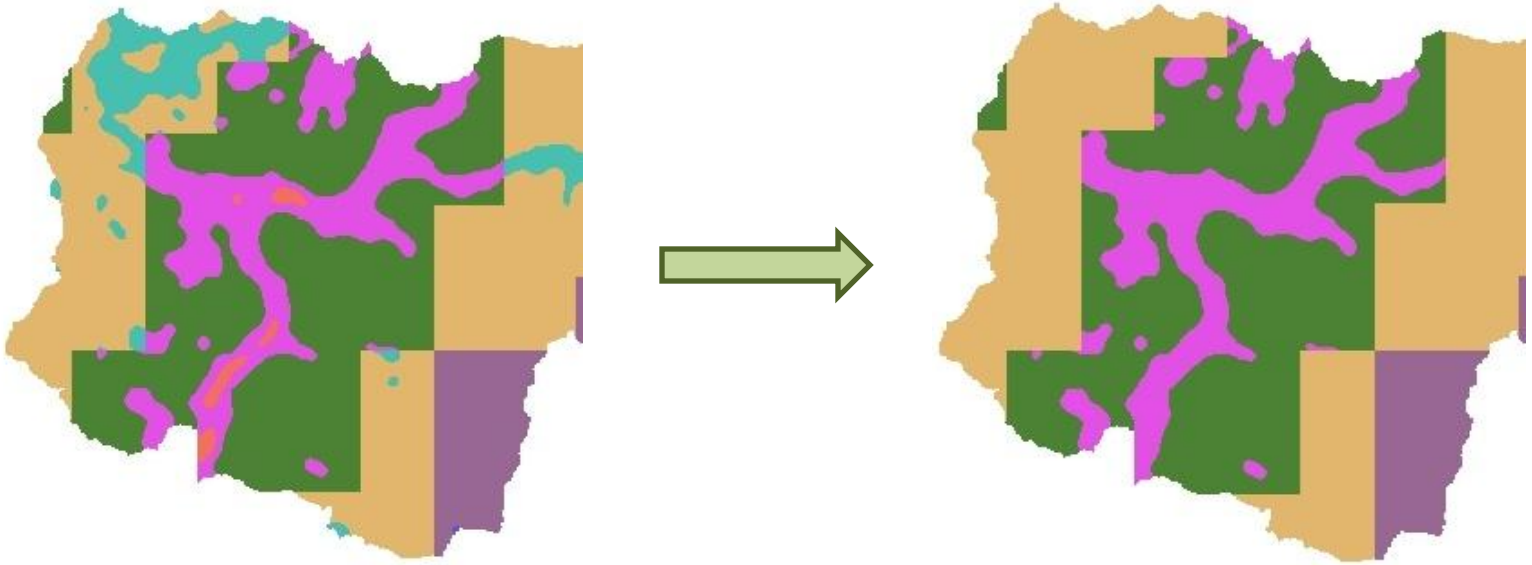
Each rule or template creates a layer. These layers are “combined” to create an HRU zone layer.

slope	aspect	prism	combined value
1	1	2	1
1	2	3	2
2	3	3	3
1	4	1	4
1	4	1	4
1	4	1	4
1	1	2	1
3	3	3	5
1	1	2	1
1	1	2	1

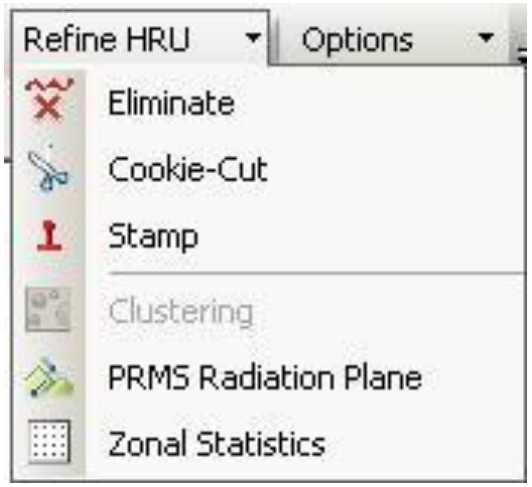


HRU Post-processing

- Refine HRU zones by:
  - Removing zones that are too small
  - Merging zones based on similarity of the zones
  - Subsetting zones to form a new output layer
  - Integrating HRU zones from multiple HRU layers
- Generate additional attributes for each HRU zones



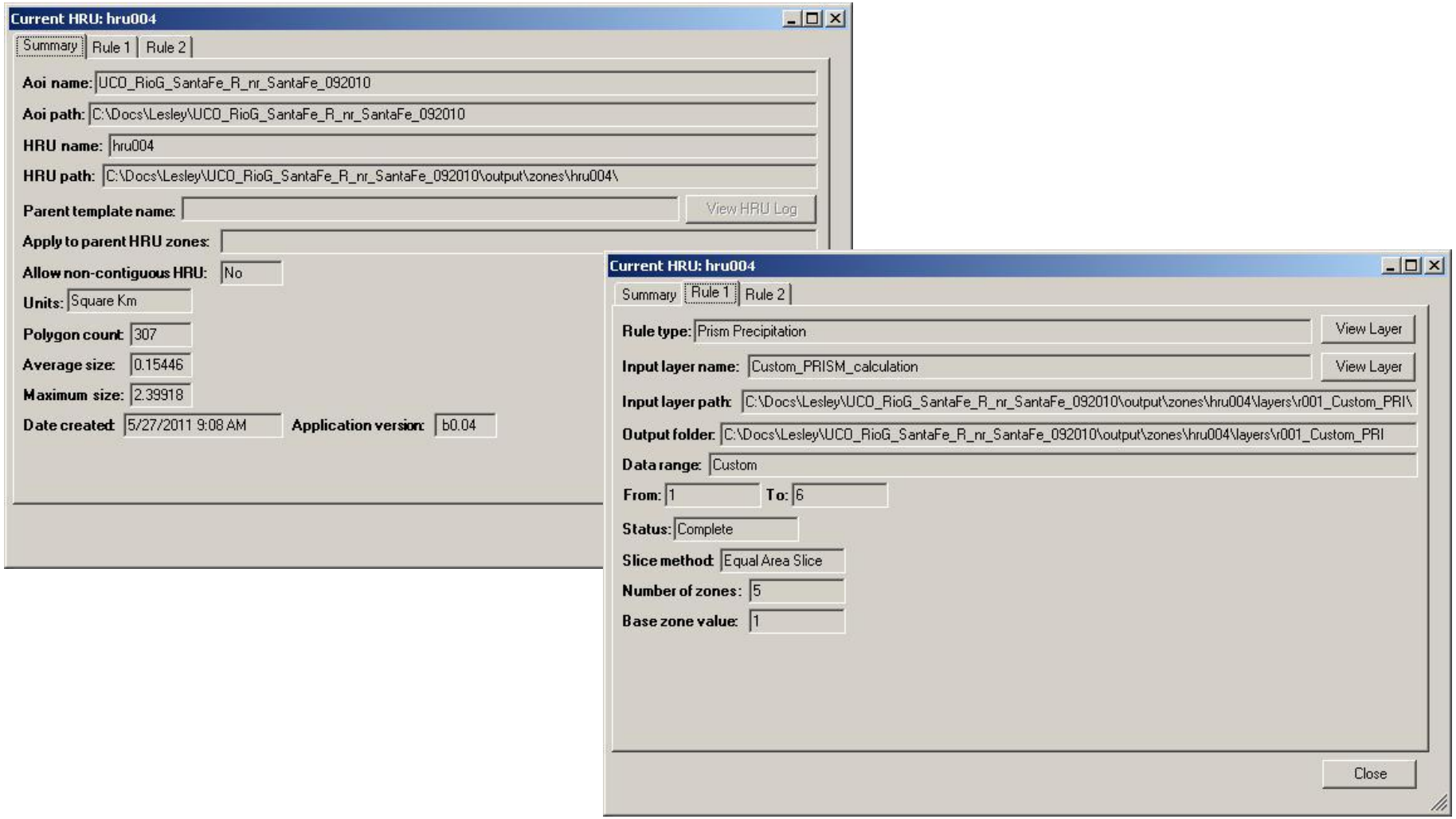
Post-processing tools



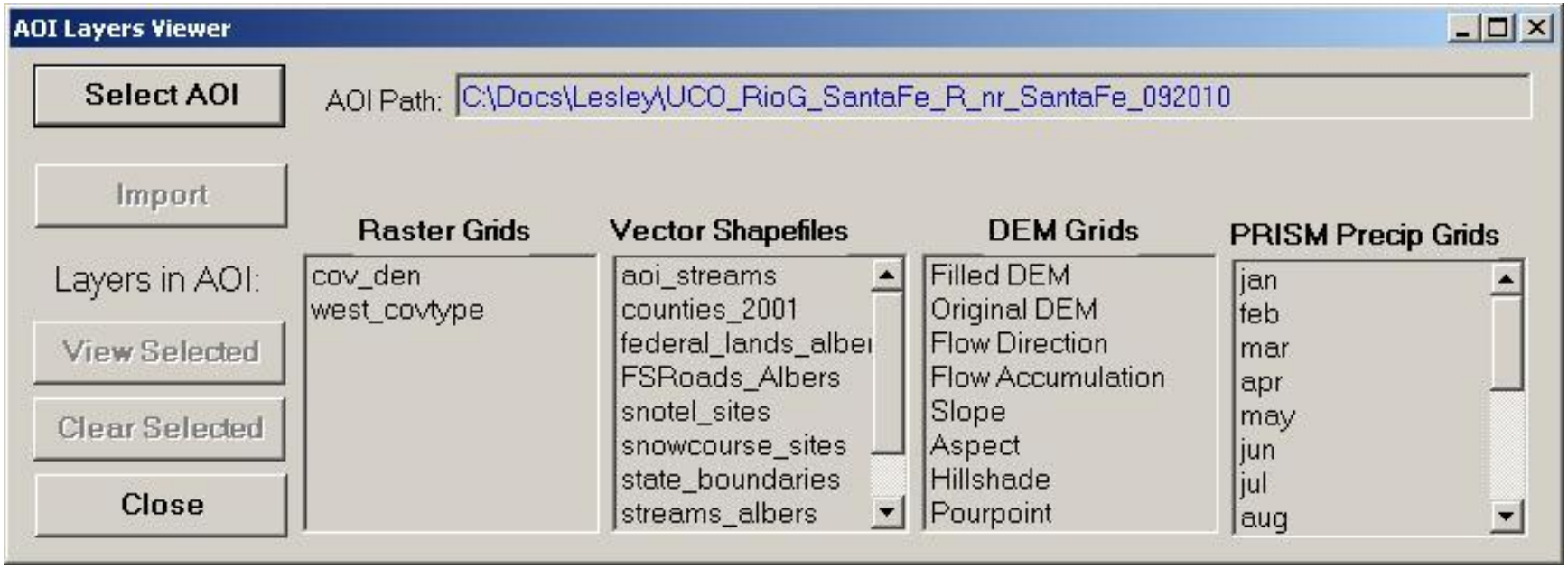
- Eliminate: Remove small HRU's by area or percent
- Cookie-Cut: Extract portions of an HRU dataset
- Stamp: Overlay zones from one HRU to another
- Clustering: Group HRU zones
- PRMS Radiation Plane: Add slope and aspect
- Zonal Statistics: Calculate and add selected statistics

Process logging

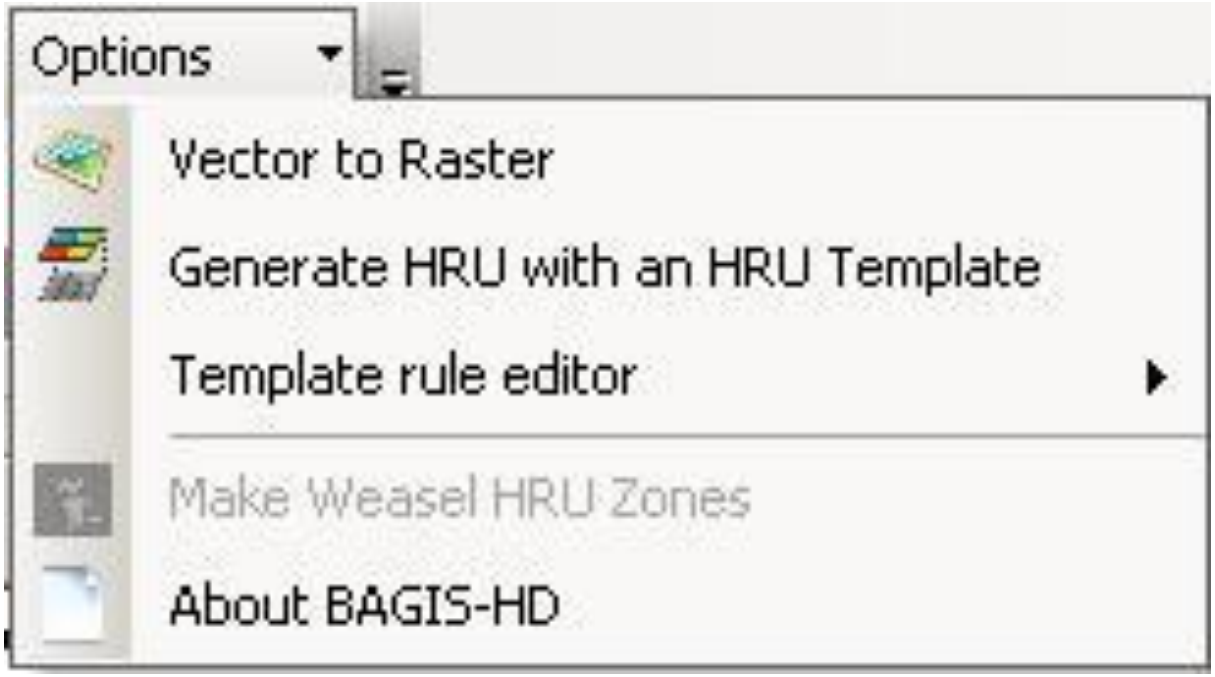
All actions are recorded in an xml file



Data management

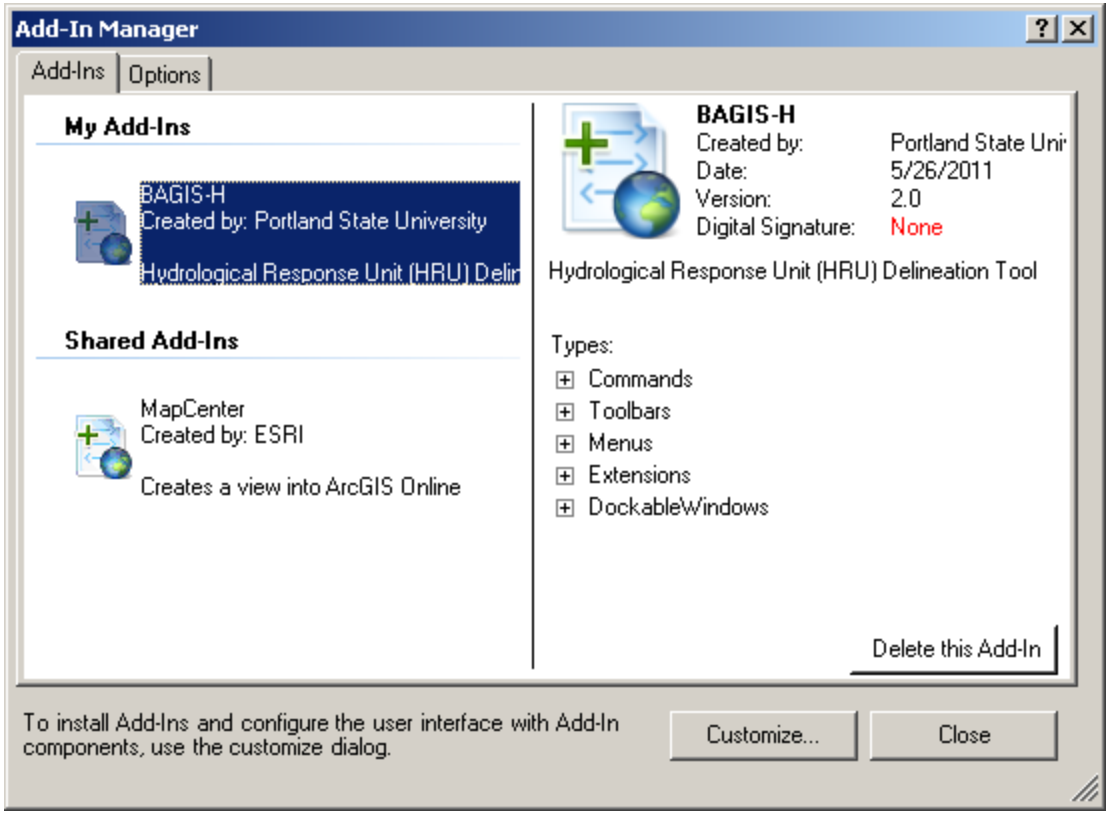


Miscellaneous functions



Implementation

- Distributed as an ArcMap Add-in
- Requires ArcGIS 10.0 SP2 with Spatial Analyst
- Beta release October 2011



Coming soon!

- BAGIS-P: Generates physical parameters from BAGIS-H zones to source PRMS
- Converting BAGIS to ArcMap add-in technology
- Model calibration: best practices for creating HRU's

License restrictions

- USDA has a nonexclusive license to copy, display, and perform BAGIS.
- USDA has the right to distribute BAGIS to any commercial, nonprofit, or government entity partnered with USDA through grant, contract, or collaboration agreement for the ongoing research and projects performed for or in conjunction with USDA.

For more information

- BAGIS website: http://www.geog.pdx.edu/CSAR/BAGIS/
- E-mail: lbross@pdx.edu or jduh@pdx.edu