Hydrology – Related Research
ERDC - CRREL

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Overview of Some Examples from Civil Works R&D

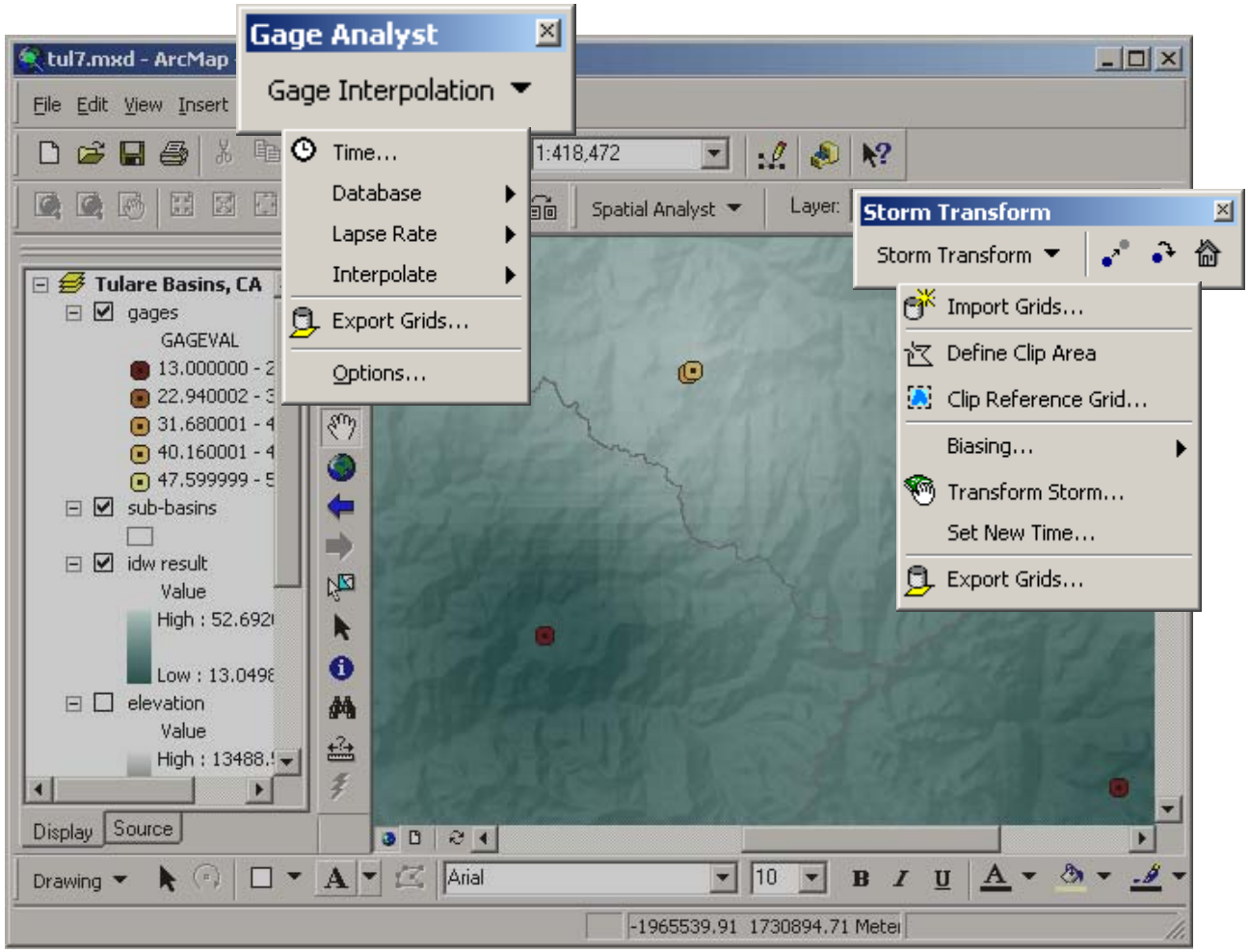
- **CW - Object-Oriented Tools for Interpolation of Meteorological Parameters for Hydrologic Modeling**
- **CW - Distributed Snow Modeling**
- **CW - Retrospective Spatial Analysis of Snow**
- **ERDC Military Program – Terrestrial Sciences**

Object-Oriented Tools for Interpolation of Meteorological Parameters for Hydrologic Modeling

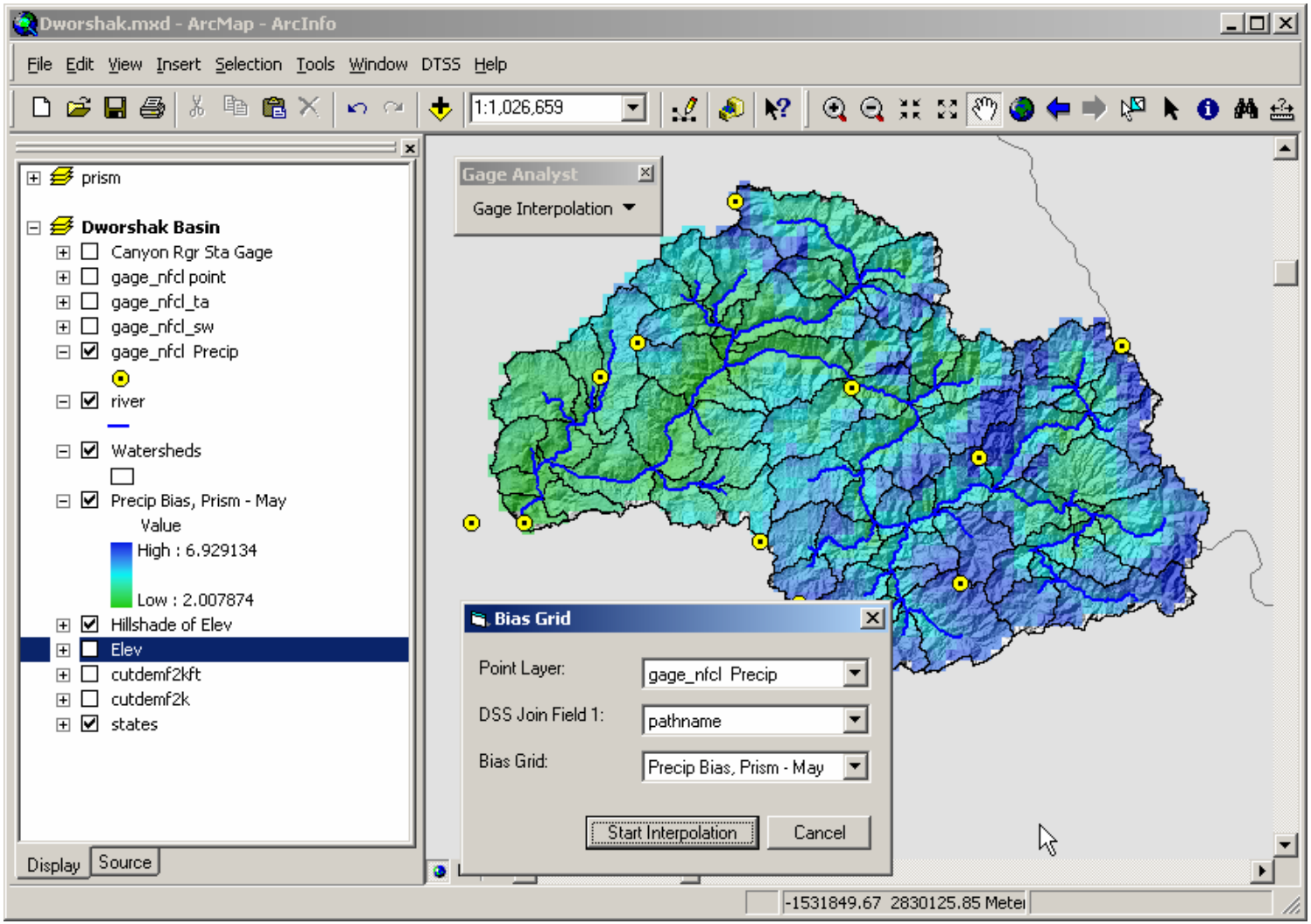
Objectives

- To produce gridded precipitation from of historic storm events with the storm track translated in space and time and for hypothetical design storms
- To produce gridded interpolation based on point measurements of air temperature and other relevant parameters
- To include orographic, elevation, and other terrain- and case-related trends in the development of the gridded interpolations

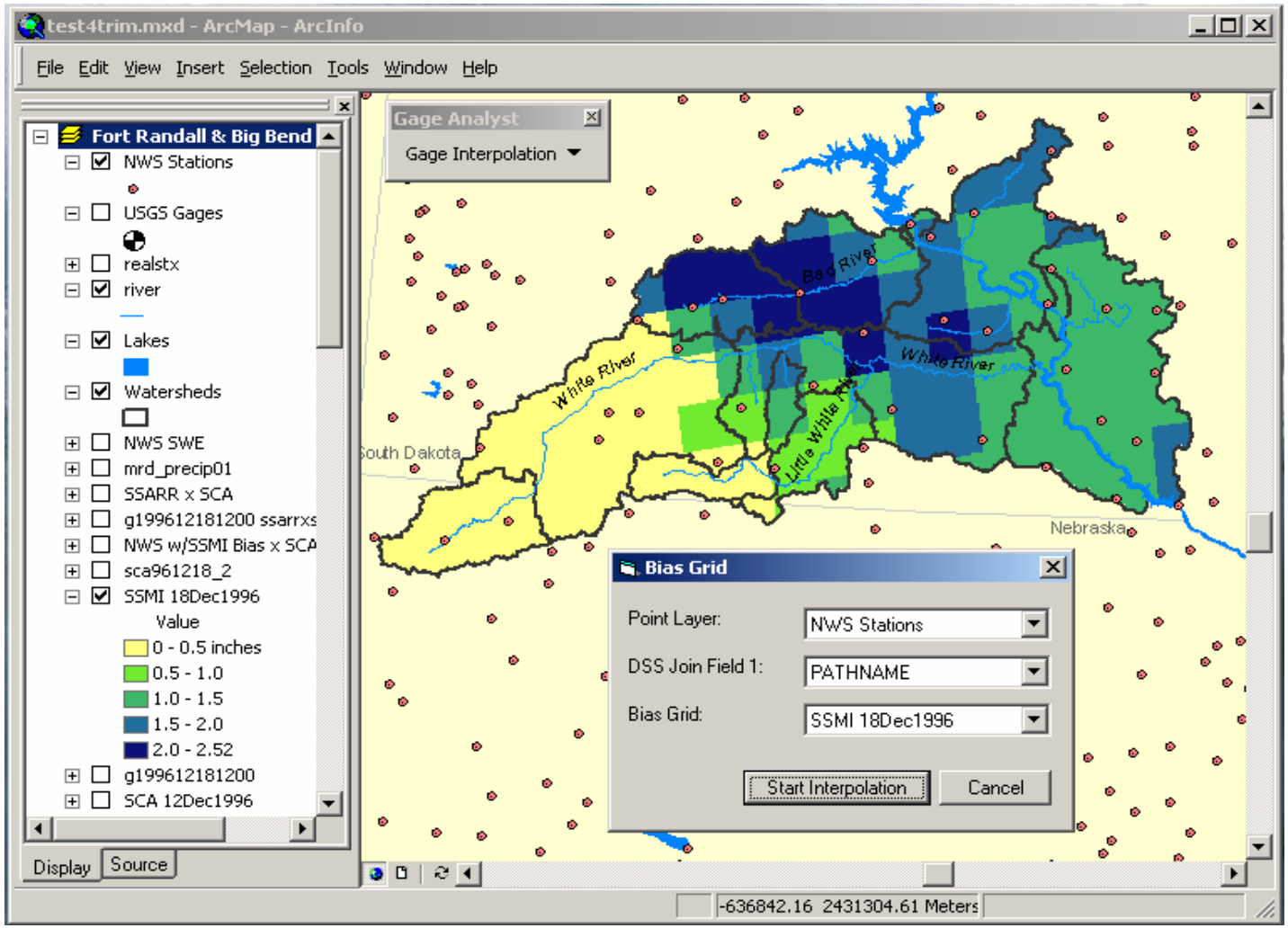
Tool Sets


Gage Analyst
Gage Interpolation
Time...
Database
Lapse Rate
Interpolate
Export Grids...
Options...
tul7.mxd - ArcMap
File Edit View Insert
1:418,472
Spatial Analyst
Layer:
Storm Transform
Storm Transform
Import Grids...
Define Clip Area
Clip Reference Grid...
Biasing...
Transform Storm...
Set New Time...
Export Grids...
Tulare Basins, CA
gages
GAGEVAL
13.000000 - 2
22.940002 - 3
31.680001 - 4
40.160001 - 4
47.599999 - 5
sub-basins
idw result
Value
High : 52.692
Low : 13.049
elevation
Value
High : 13488.
Display
Source
Drawing
Arial
10
-1965539.91 1730894.71 Meter

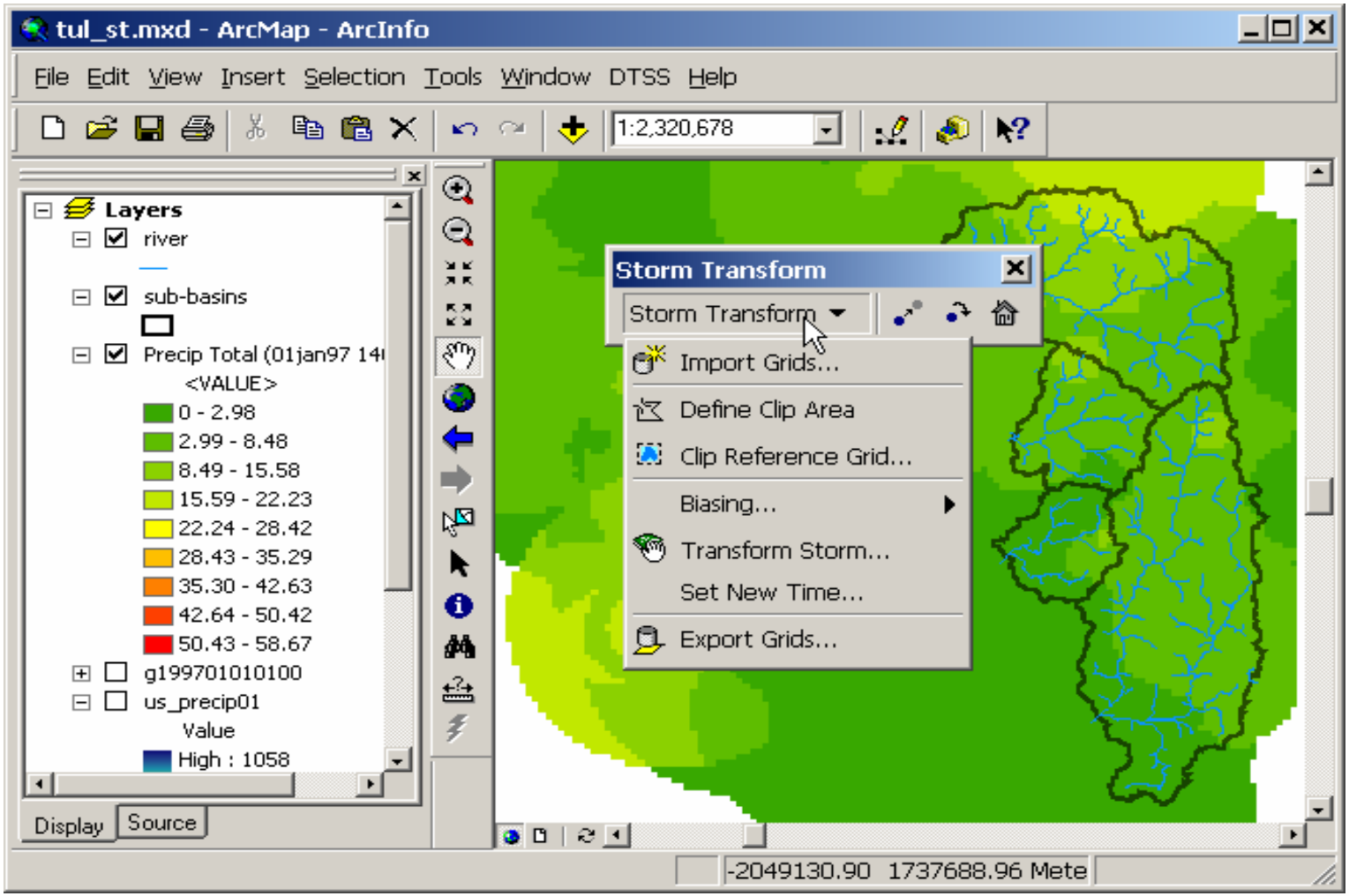
Using PRISM as a Weighting Surface



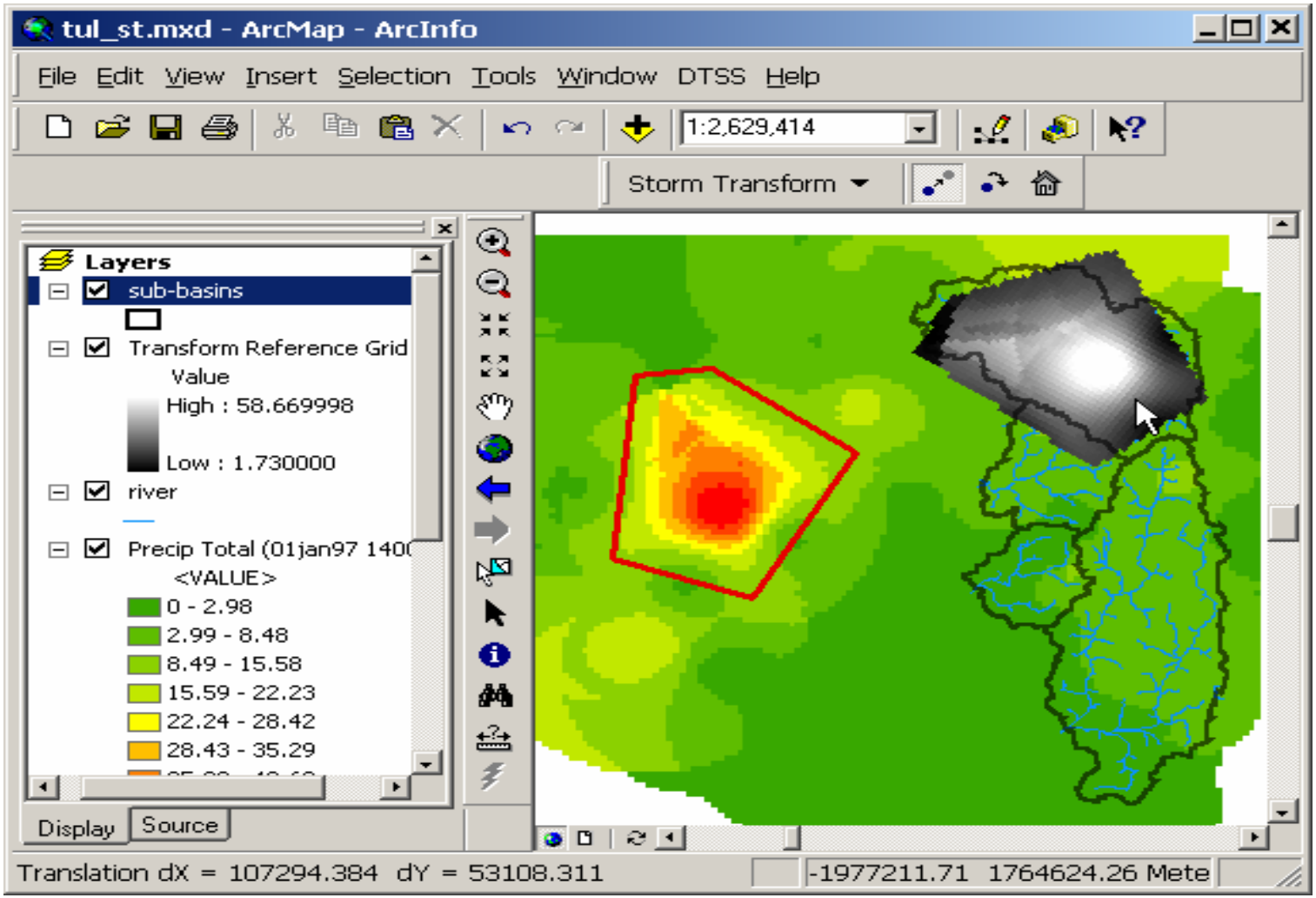
Using SSM/I as a Weighting Surface



“Moving” Storms



“Moving” Storms



Benefits

- Ability to produce distributed data for retrospective hydrologic models in a rational, consistent manner
  - Uses inverse distance weighting (IDW), with orographic, elevation and other known, or observed, trends in interpolations
  - Based on ESRI ArcGIS 8.2
- Interacts with HEC-DSS database, ASCII output, and ORACLE

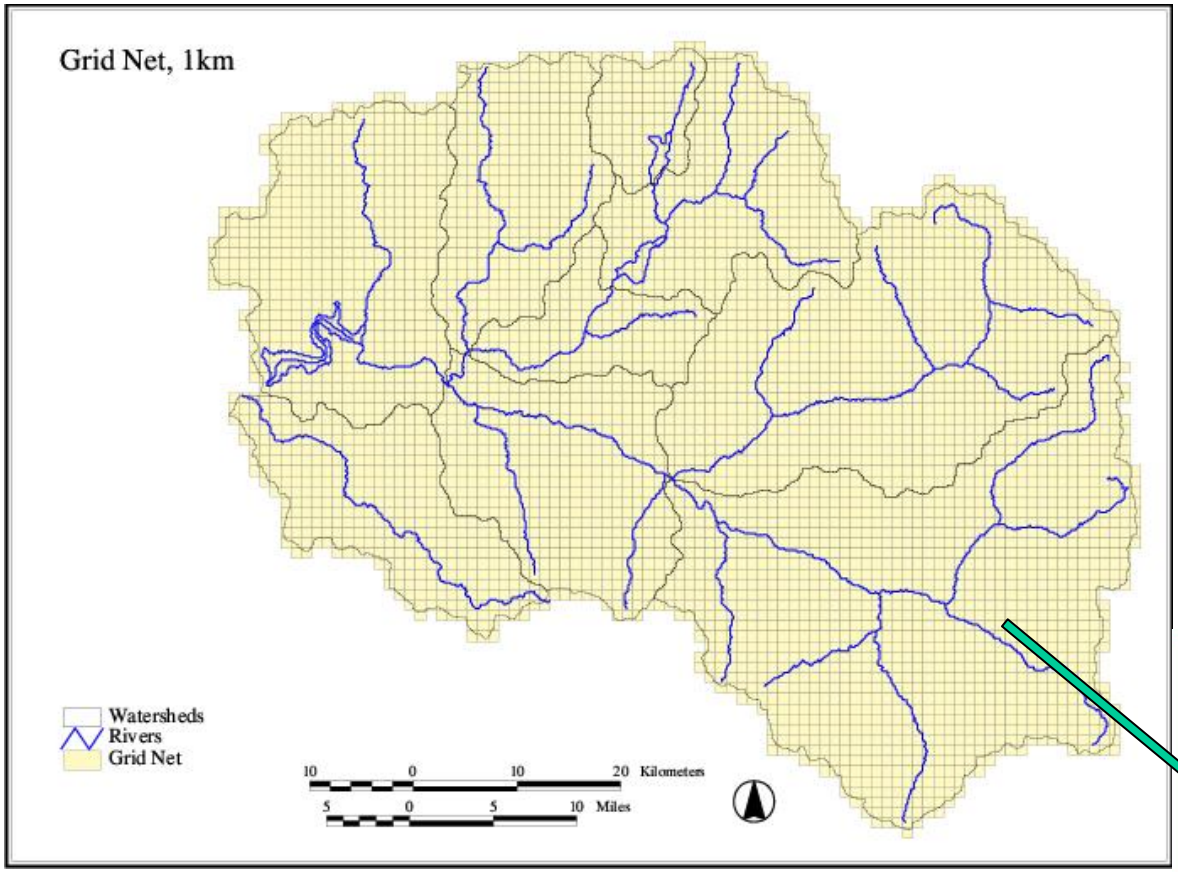
Distributed Snow Modeling

Objectives

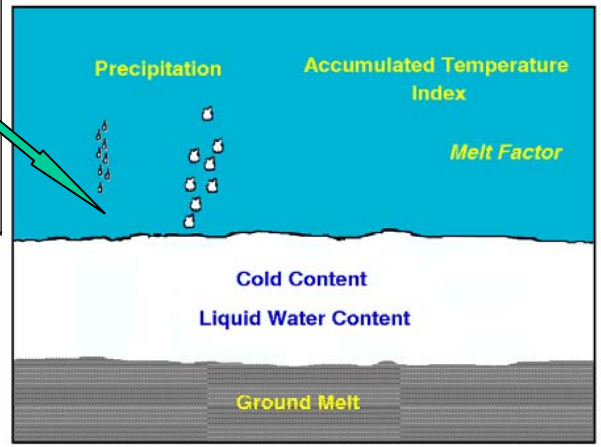
- To produce gridded snow processes, including accumulation and ablation from simple, historical data.
- To interface with HEC's gridded routing system
- To upate based on snow maps derived from remote sensing

Distributed Snow Modeling

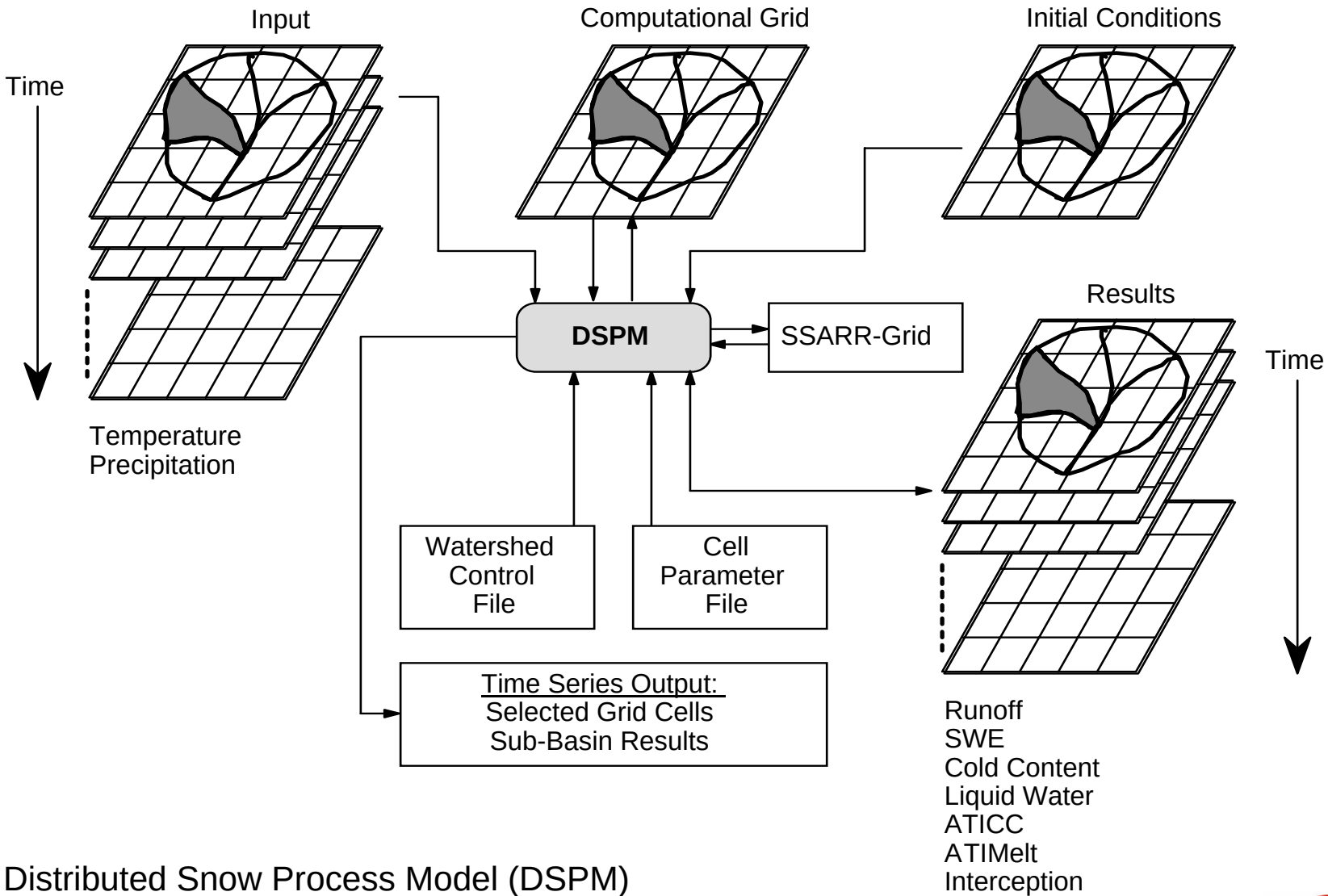
- DSPM
  - Distributed Snow Process Model
  - The gridded snow modeling platform for HEC-HMS
- SSARR_grid
  - The current snow model used by DSPM
- DSPM and HEC-HMS



DSPM



Using HEC-DSS database, DSPM
runs every cell every time step ,
saves data for restart and runoff for routing.



Distributed Snow Process Model (DSPM)

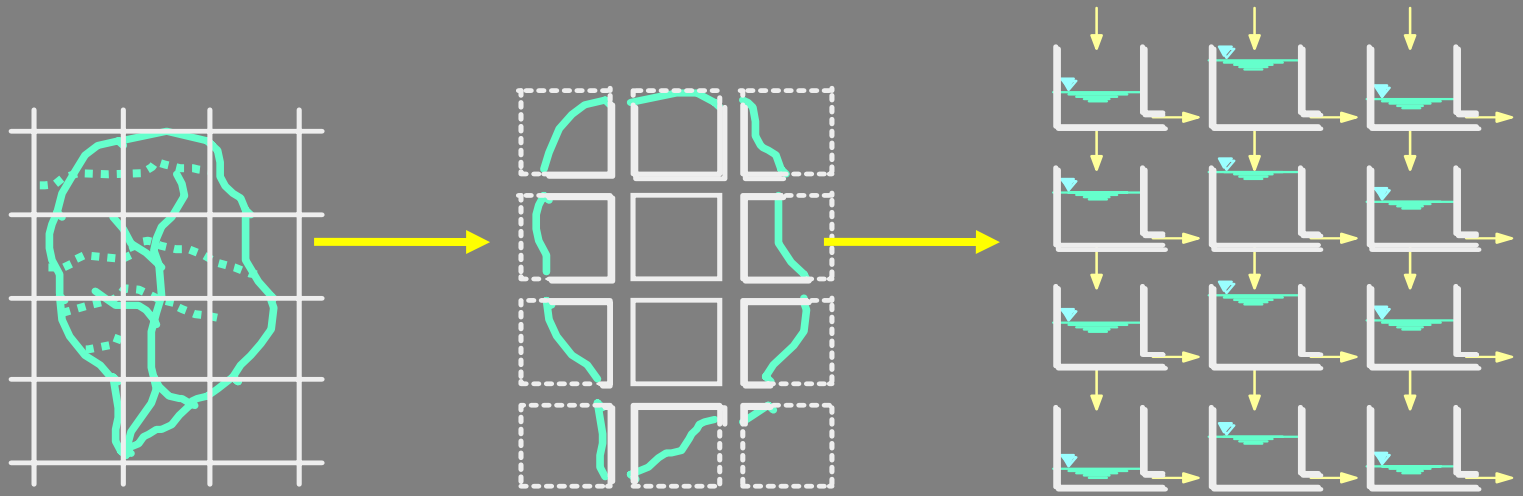
HEC-HMS

- Single/continuous event model designed to estimate maximum discharge and flow volumes
- Gridded snowmelt
- Mod-Clark synthetic hydrograph

FEATURES

Stream network development, precipitation excess, time varying losses, runoff hydrograph, addition of baseflow, routing of stream flow, reservoir operation, combination of hydrographs, GIS

Mod-Clark Conceptual Model



Grid Superimposed on Basin

Cell Discharges: Function of a Cell Area, Snowmelt/Rainfall, Infiltration, and Travel Time

Attenuation by Linear Reservoir

Basin Direct Runoff Hydrograph

Cell Outflow Hydrographs Lagged by Travel Time

ERDC Engineer Research and Development Center

U.S. Army Engineer Research and Development Center

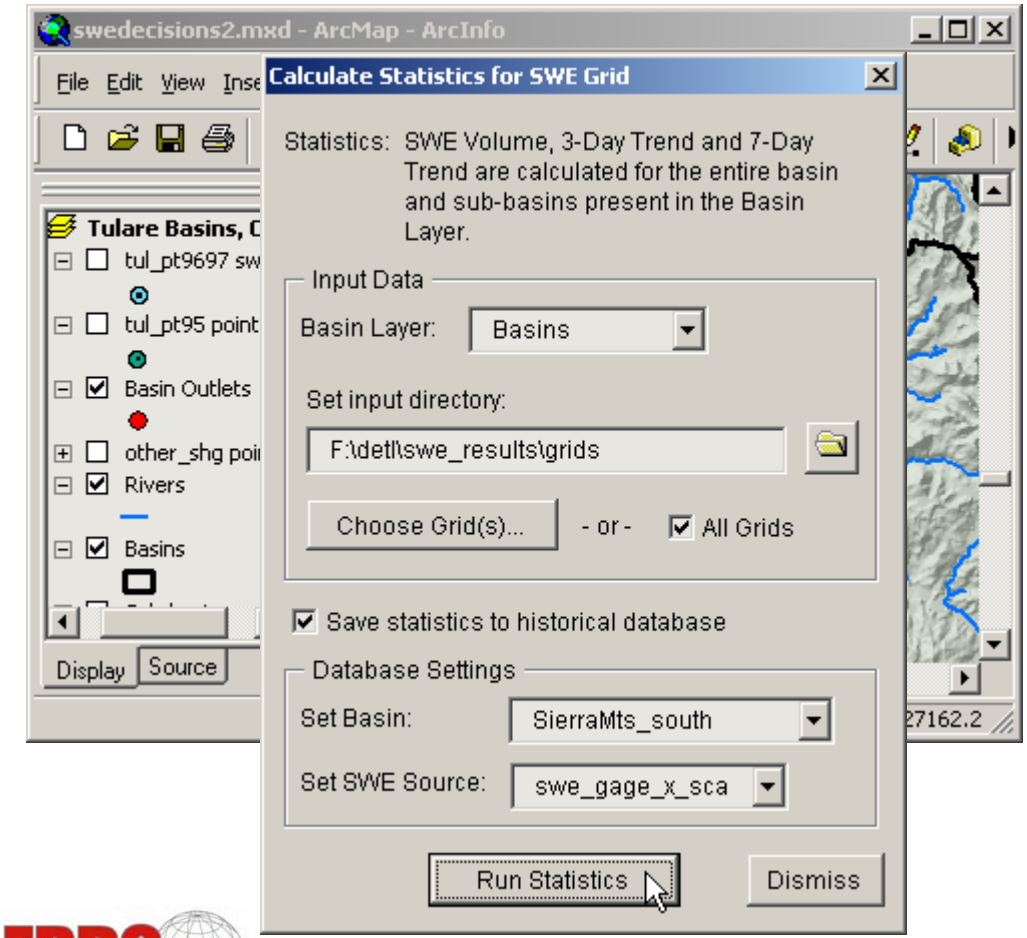
Retrospective Spatial Analysis of Snow

- Calculate basin and sub-basin statistics for a grid of snow water equivalent
  - total water volume (above a gage)
  - 3 and 7 day trends
- Compare statistics with historical data, generate list of closest matching dates
- Evaluate historical matches by calculating differences and/or viewing hydrograph

Start-up Requirements

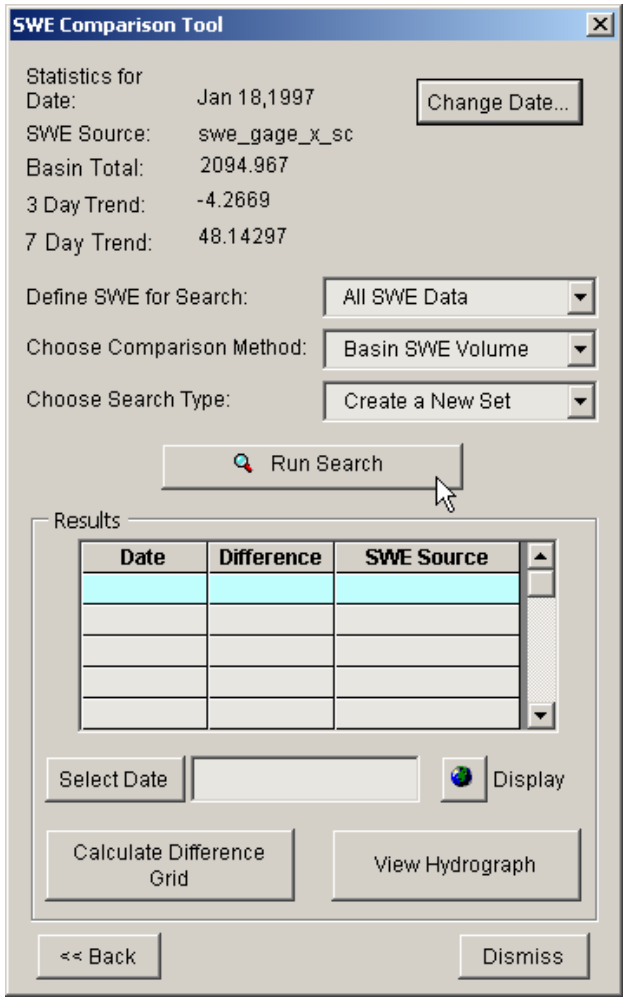
- Database of historical snow water equivalent (SWE) - grids and tabular statistics. Database organized by basin and snow data source.
- Grid of current SWE, used to compare with historical data

Calculate Statistics



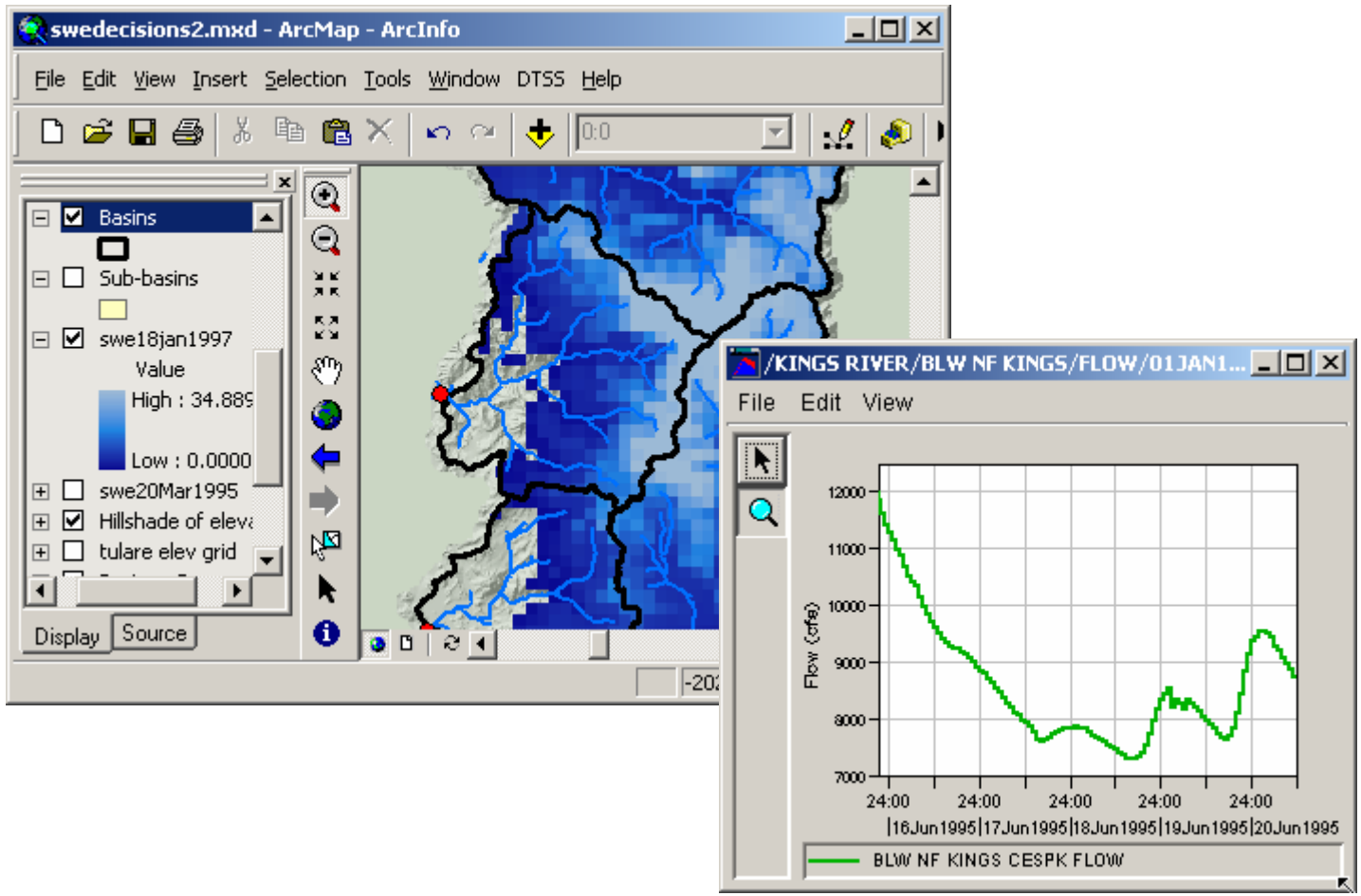
- Define Basin GIS Layer
- Define input snow grids
- Choose whether saving to database
- Calculate volume and trend statistics
- Move on to comparison step…

Comparison of SWE Volume



- Comparison Methods
  - Basin:
    - Volume
    - 3 Day Trend
    - 7 Day Trend
  - Sub Basin: same options as Basin
- Search Types
  - Create New Set
  - Select from Results

View Hydrograph



ERDC Military R&D in Terrestrial Sciences

- Focus on scales of 10s to 100s of meters
- Develop novel approaches to predicting atmospheric effects on terrain (energy and mass transfer)
- Spatially distributed approach, usually implementing 1-dimensional models
- Span from basic research, through applied science to applied technology demonstrations

ERDC Military R&D in Terrestrial Sciences

- Examples of past and continuing R&D
  - SNTHERM – physics-based snow model
  - SOILTHERM – SNTHERM coupled to physics-based soil
  - Snow mapping – spectral unmixing
  - Soil moisture and strength modeling, FASST-C

ERDC Military R&D in Terrestrial Sciences Process

- Basic research:
  - Annual process competes 1/3 of program as 2-3 year projects
  - Outsourcing up to ~40% based on partner and learning potential
- Applied research:
  - Annual program formulation of 1-5 year projects
  - Extra-mural funding usually through BAA