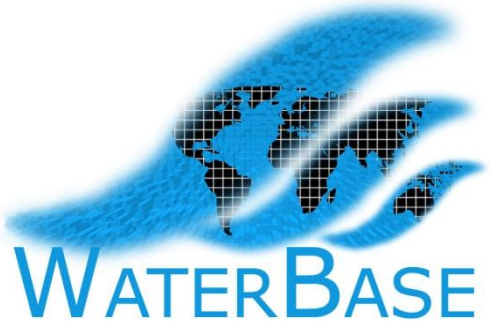


MapWindow and TauDEM V5

Chris George

WaterBase

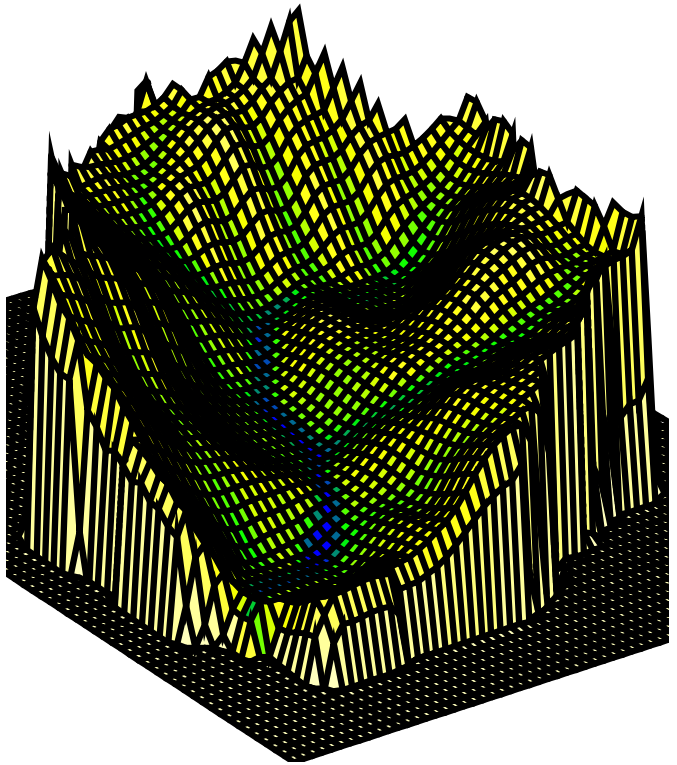
Terrain Analysis Using Digital Elevation Models (TauDEM)

David Tarboton[1], Dan Watson[2], Rob Wallace,[3] Kim Schreuders[1], Jeremy Neff[1]

[1]Utah Water Research Laboratory, Utah State University, Logan, Utah

[2]Computer Science, Utah State University, Logan, Utah

[3]US Army Engineer Research and Development Center, Information Technology Lab, Vicksburg, Mississippi



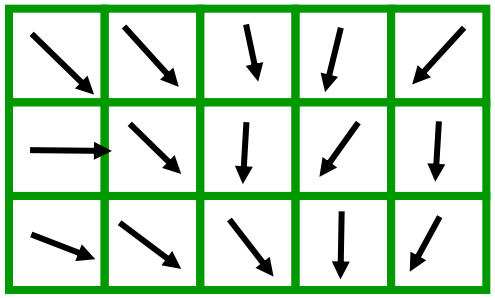
his research was funded by the US Army Research and evelopment Center under contract number W9124Z-08-P-0420

Deriving hydrologically useful information from Digital Elevation Models

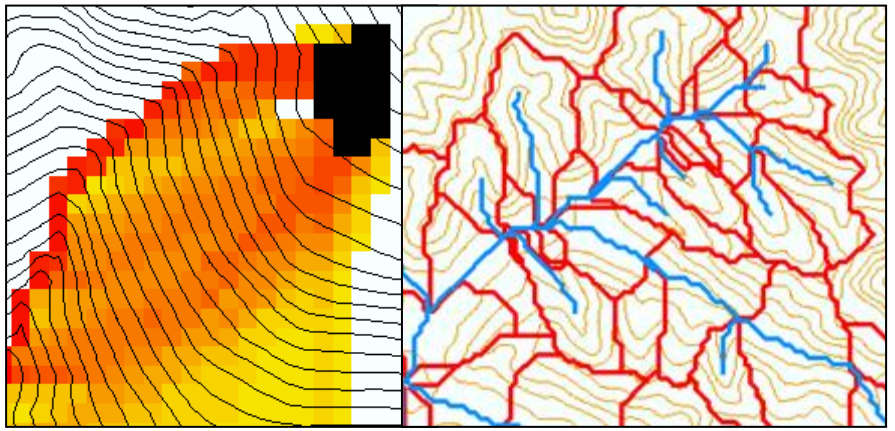
Raw DEM

Pit Removal (Filling)

Flow Field



Flow Related Terrain Information



The challenge of increasing Digital Elevation Model (DEM) resolution

1980's DMA 90 m

10^2 cells/km^2

1990's USGS DEM 30 m

10^3 cells/km^2

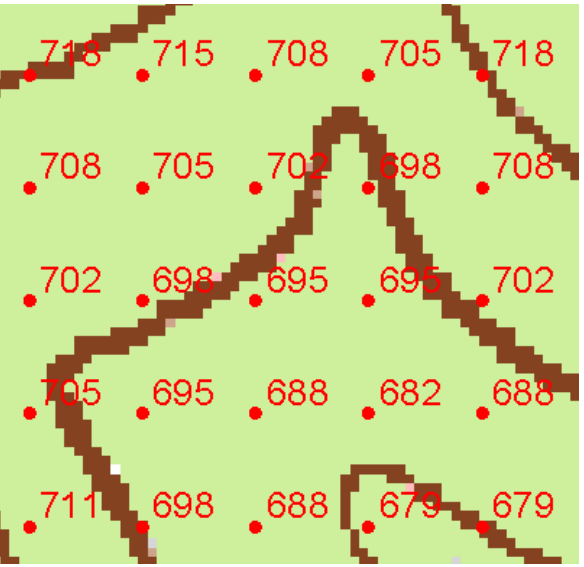
2000's NED 10-30 m

10^4 cells/km^2

2010's LIDAR ~1 m

10^6 cells/km^2

Grid Data Format Assumptions



- Input and output grids are uncompressed GeoTIFF
- Maximum size 4 GB
- GDAL Nodata tag preferred (if not present, a missing value is assumed)
- Grids are square ($\Delta x = \Delta y$)
- Grids are identical in extent, cell size and spatial reference
- Spatial reference information is not used (no projection on the fly)

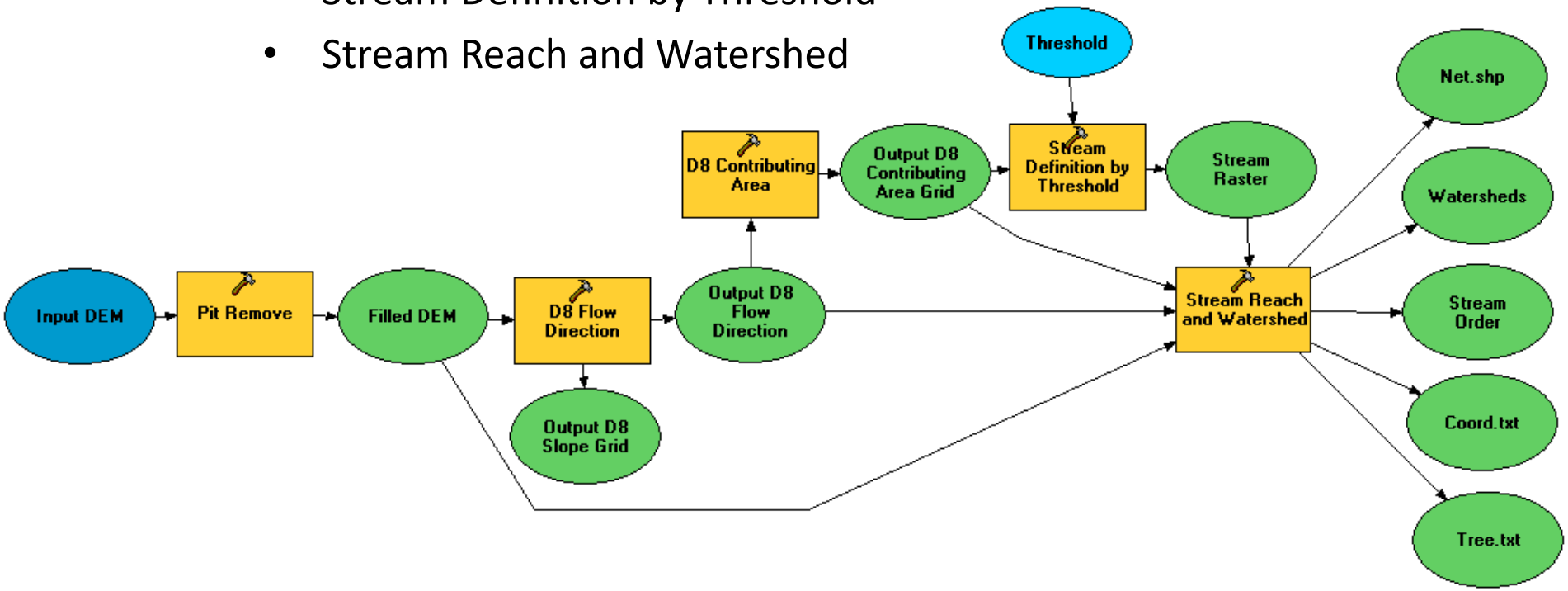
MapWindow port:

- Initial conversion to GeoTIFF if necessary
- Projection information is preserved

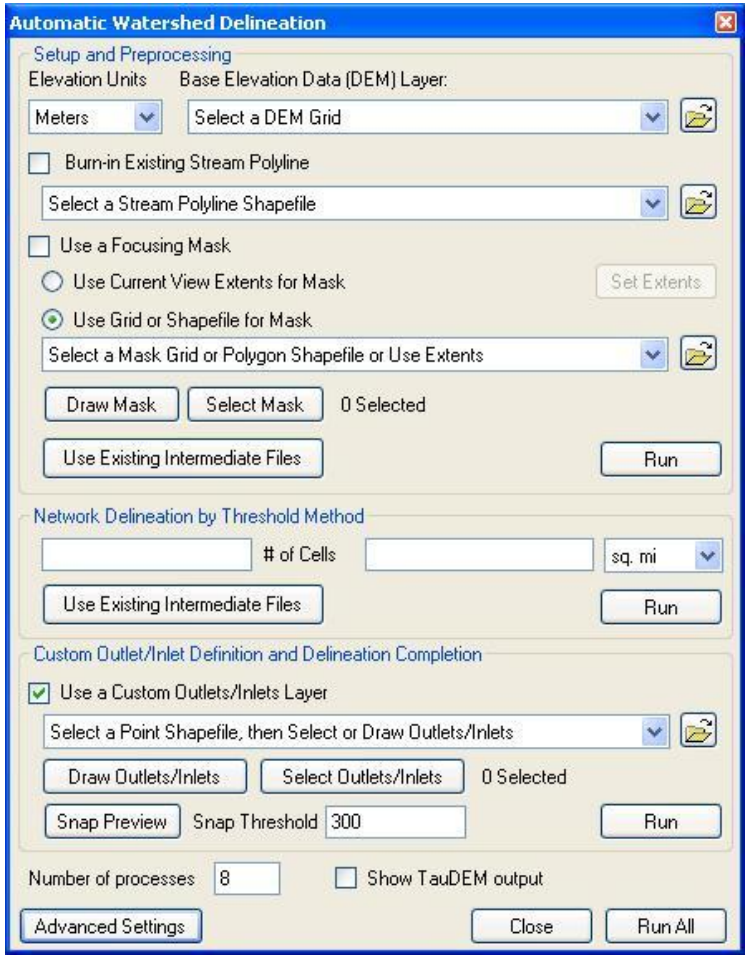
Illustrative Use Case: Delineation of channels and watersheds using a constant support area threshold

Steps

- Pit Remove
- D8 Flow Directions
- D8 Contributing Area
- Stream Definition by Threshold
- Stream Reach and Watershed

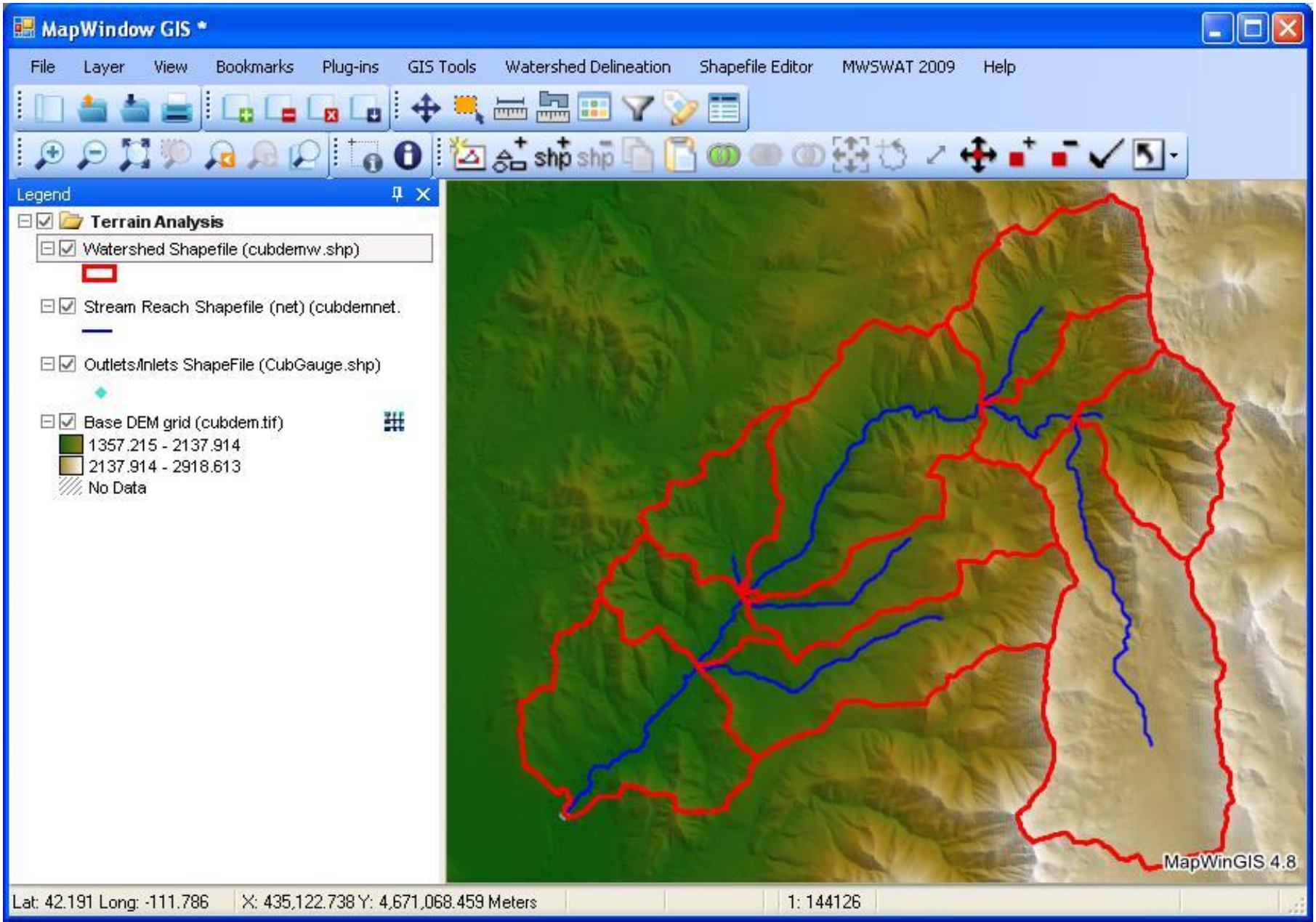


MapWindow AWD



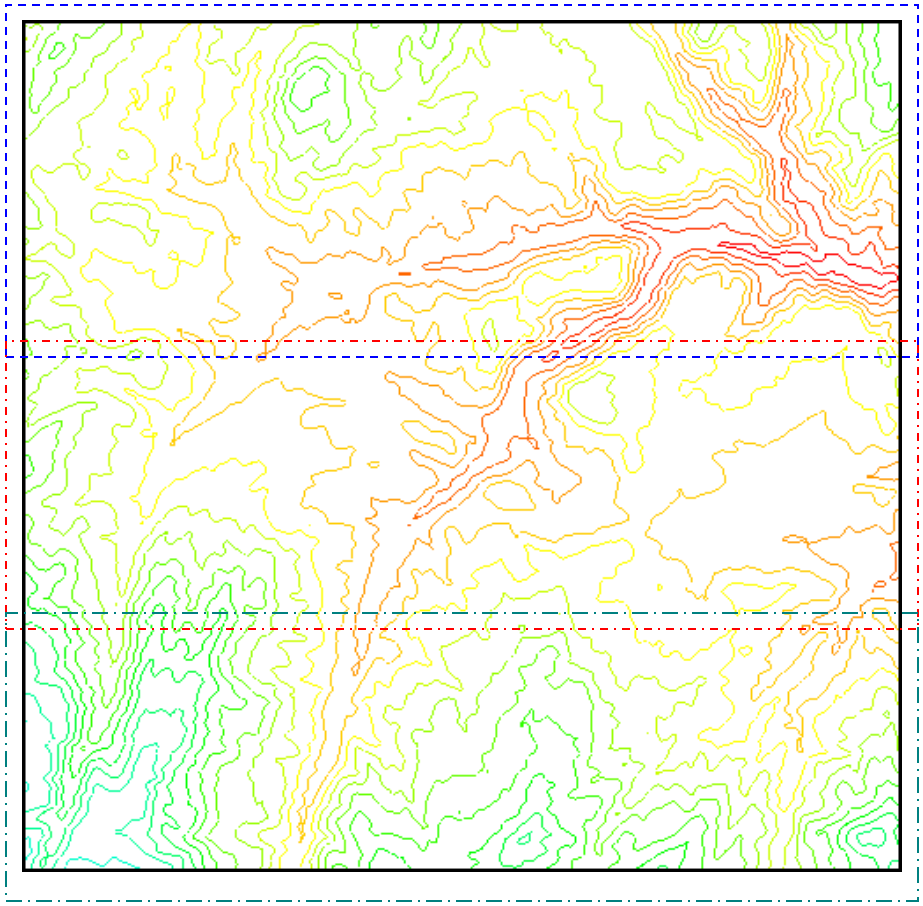
- Burn-in option
- Mask option
- Manual threshold (with suggestion based on DEM
- Outlets option
- Plus inlets, point sources, reservoirs
- As previous foil, but also makes subbasin shapefile

AWD Result


MapWindow GIS *
File
Layer
View
Bookmarks
Plug-ins
GIS Tools
Watershed Delineation
Shapefile Editor
MWSWAT 2009
Help
Legend
Terrain Analysis
Watershed Shapefile (cubdemw.shp)
Stream Reach Shapefile (net) (cubdemnet.
Outlets/Inlets ShapeFile (CubGauge.shp)
Base DEM grid (cubdem.tif)
1357.215 - 2137.914
2137.914 - 2918.613
No Data
MapWinGIS 4.8
Lat: 42.191 Long: -111.786
X: 435,122.738 Y: 4,671,068.459 Meters
1: 144126

Parallel Approach

- MPI, distributed memory paradigm
- Row oriented slices
- Each process includes one buffer row on either side
- Algorithm essentially compute, exchange buffer data, compute, until no change

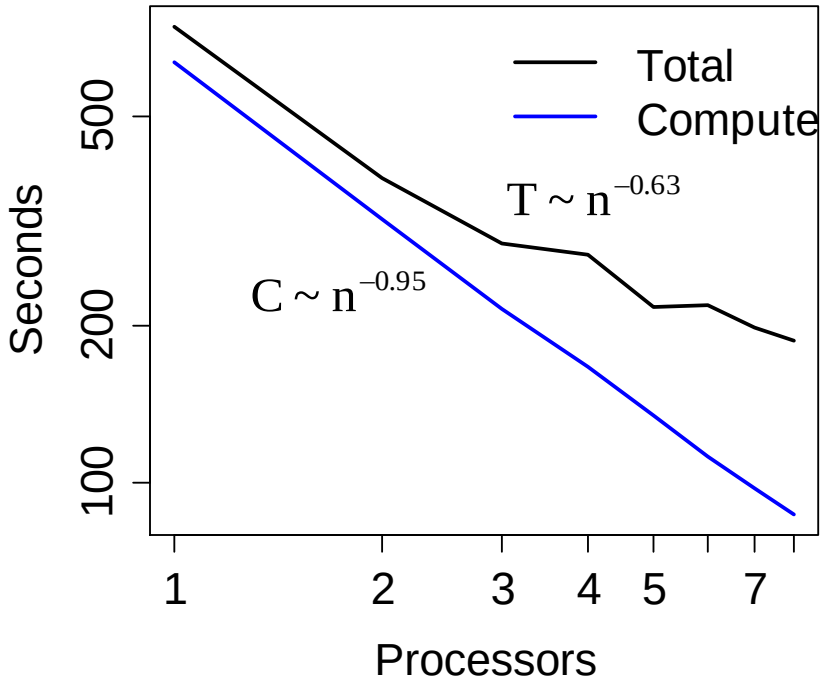


MPI implementation

- MPICH2 from Argonne National Laboratory
- Supports MPI-1 and MPI-2 standards
- Open source
- High performance, widely portable

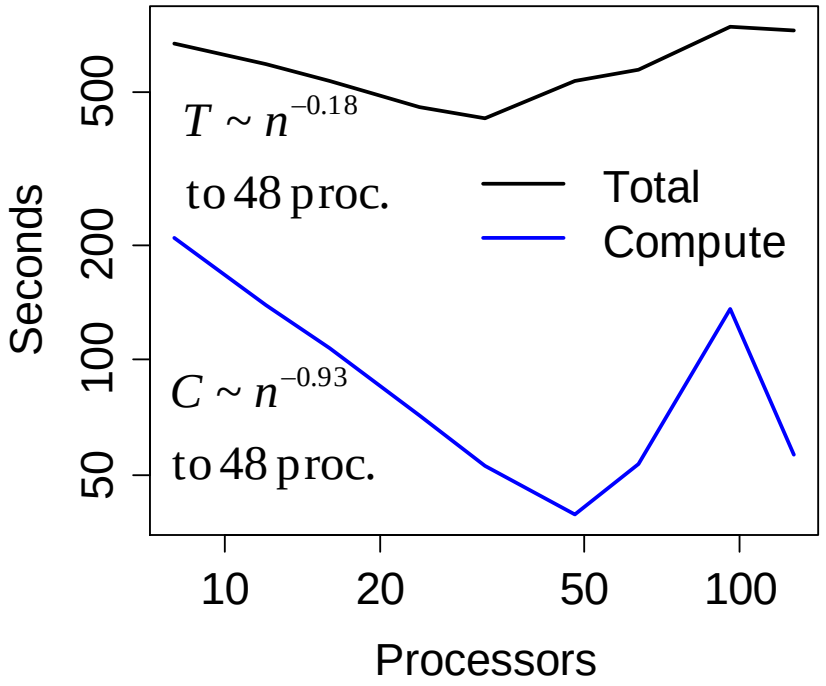
Improved runtime efficiency: Tarboton's results

Parallel D-Infinity Contributing Area Timing for Boise River dataset (24856 x 24000 cells ~ 2.4 GB)



8 processor PC

Dual quad-core Xeon E5405 2.0GHz PC with 16GB RAM

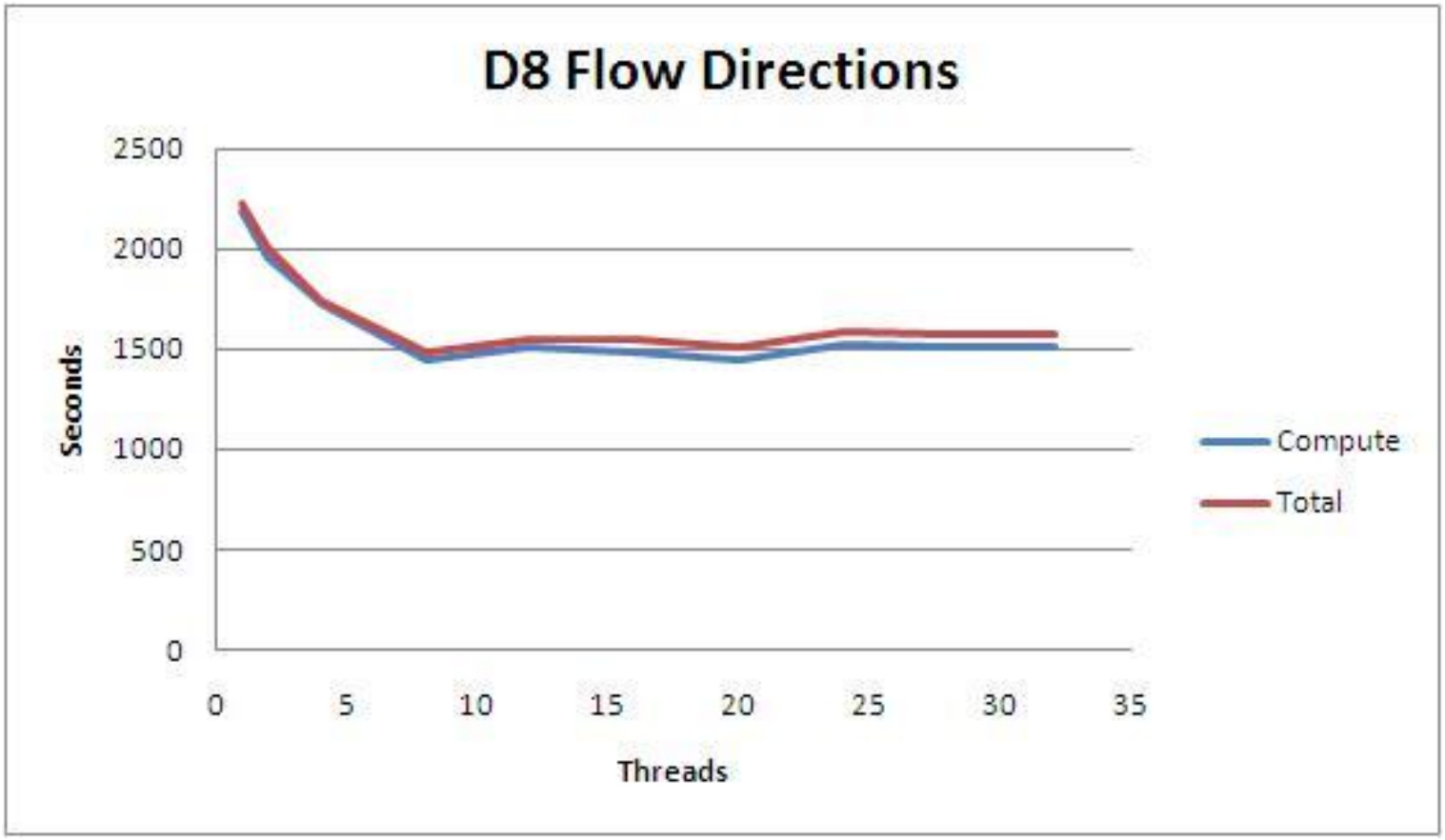


128 processor cluster

16 diskless Dell SC1435 compute nodes, each with 2.0GHz dual quad-core AMD Opteron 2350 processors with 8GB RAM

On a More Typical Machine?

2 core CPU, 2.53 GHz, 2 GB Ram
6000 x 6000 SRTM 90m DEM



TauDEM Upgrade Objectives

- Same interface
- Easy installation
- Minimal maintenance

BUT

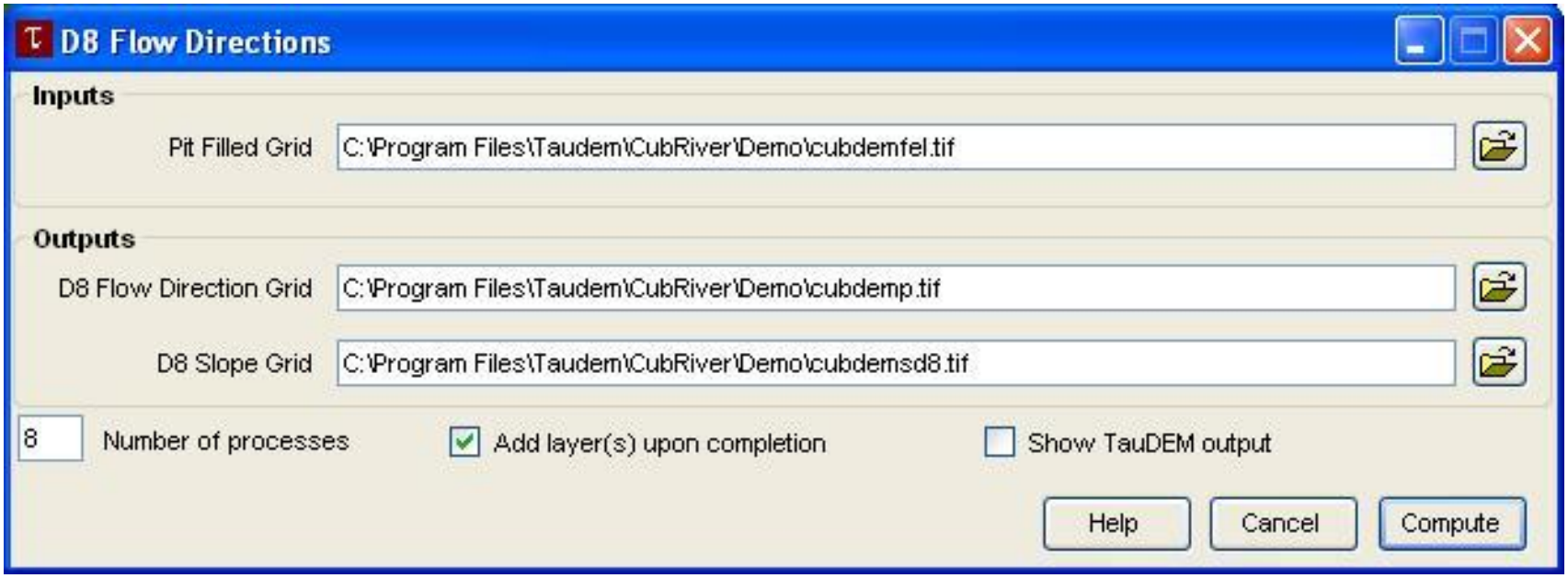
- TauDEM V5 comes as 25 separate executables
- MPICH2 needs administrator privileges
- Needs
  - Path to be set
  - User name and password to be set

although only local install needed

Approach used

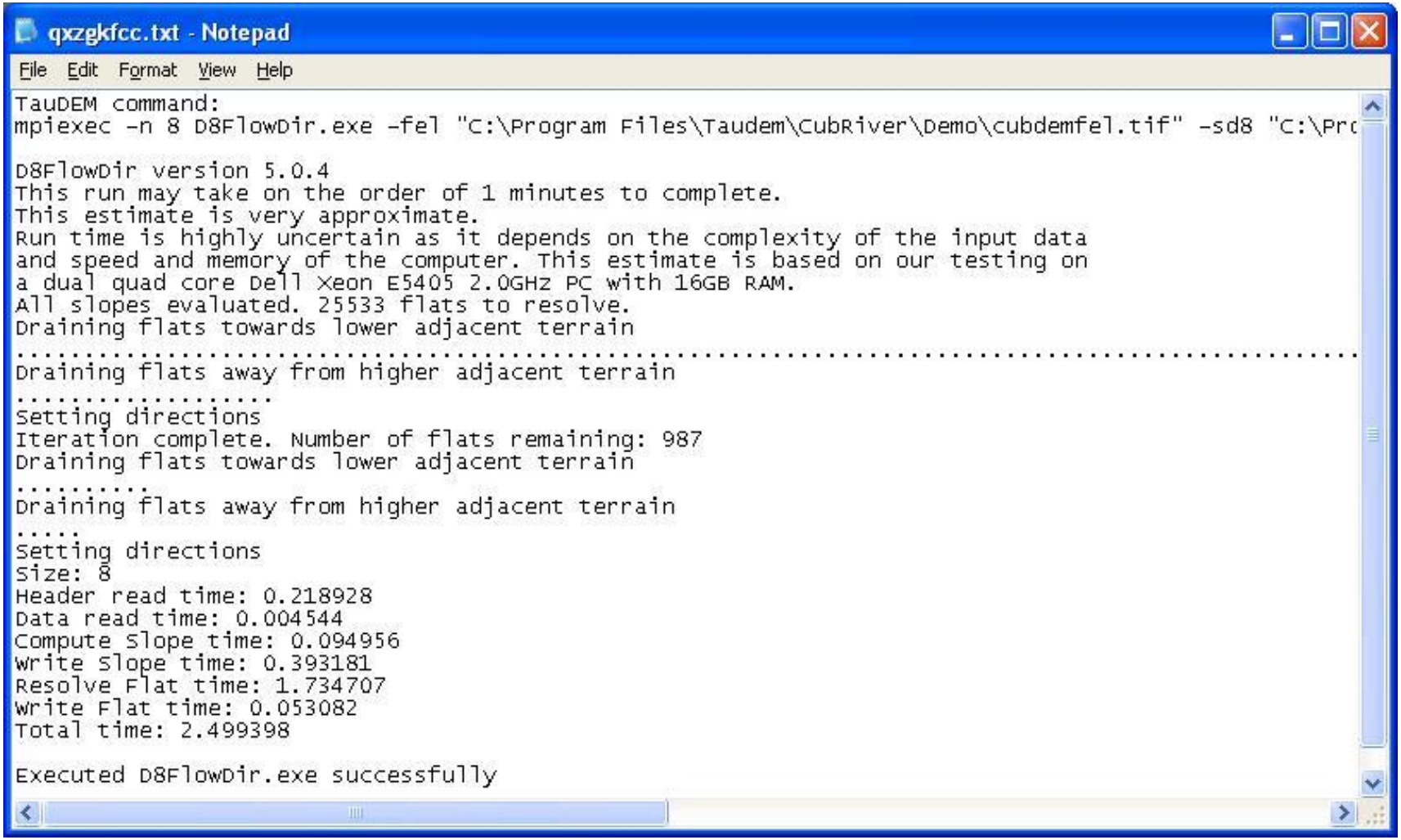
- Basic install gives single processor use: MPICH2 used if program manager running
- MPICH2 can be installed (and upgraded) separately
- TauDEM executables run in minimised command window
- Output shown if requested or if error
- Requested output can be used to tune number of threads

Typical TauDEM Form



This is the default initial view: most file names preselected as defaults

TauDEM Output



Where else should MapWindow be using multiple threads?