Practical Approaches to Large Model Management

Tricks and Tools of the Trade

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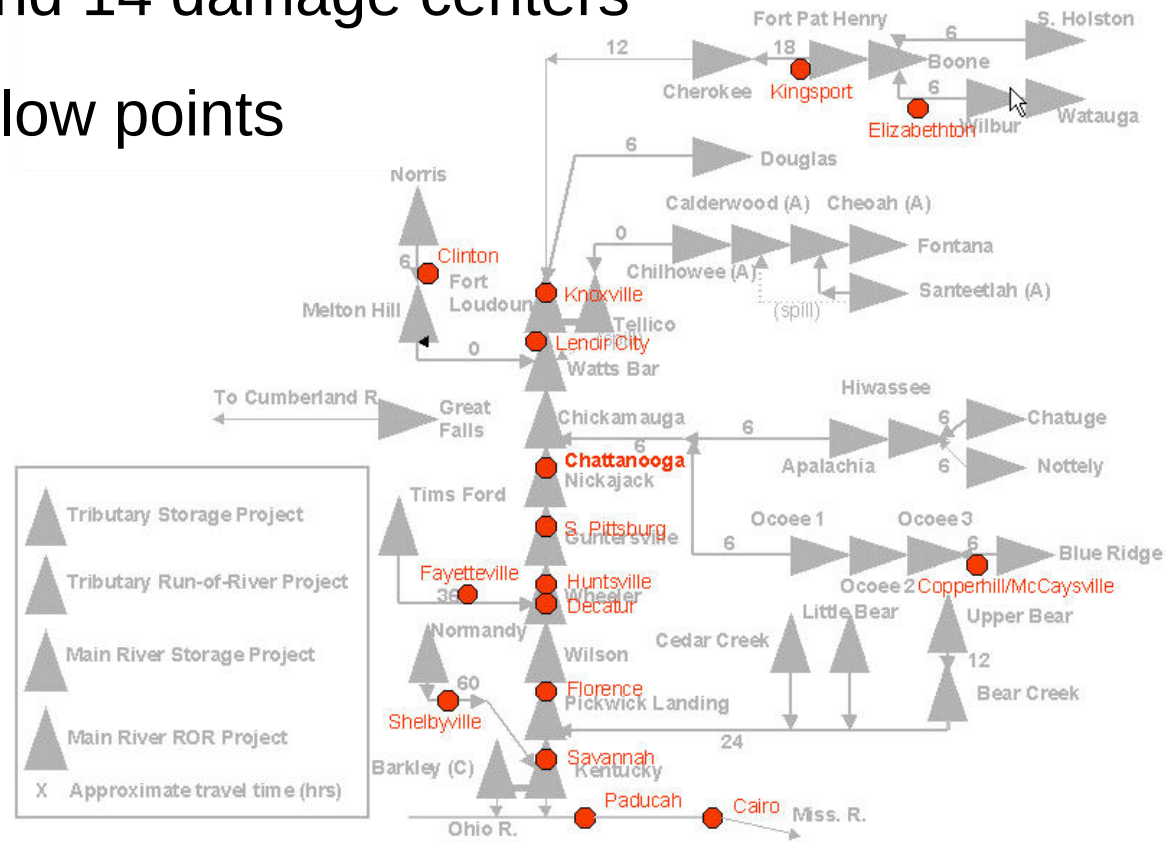
A LARGE, COMPLEX MODEL

- 37 dams and 14 damage centers
- 55 local inflow points



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- 37 dams and 14 damage centers
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- 99 years at 6 hour timestep: ~144k timesteps
- 69 historic storms scaled 1.5x, 2.0x and 2.5x

A LARGE, COMPLEX MODEL

Major Concerns

- Run-time
- Model size
- Accuracy of policy representation
- Decision tracking: debugging, calibration, reproduction
- Extensibility to alternatives

Trick 1: Careful Rule Design

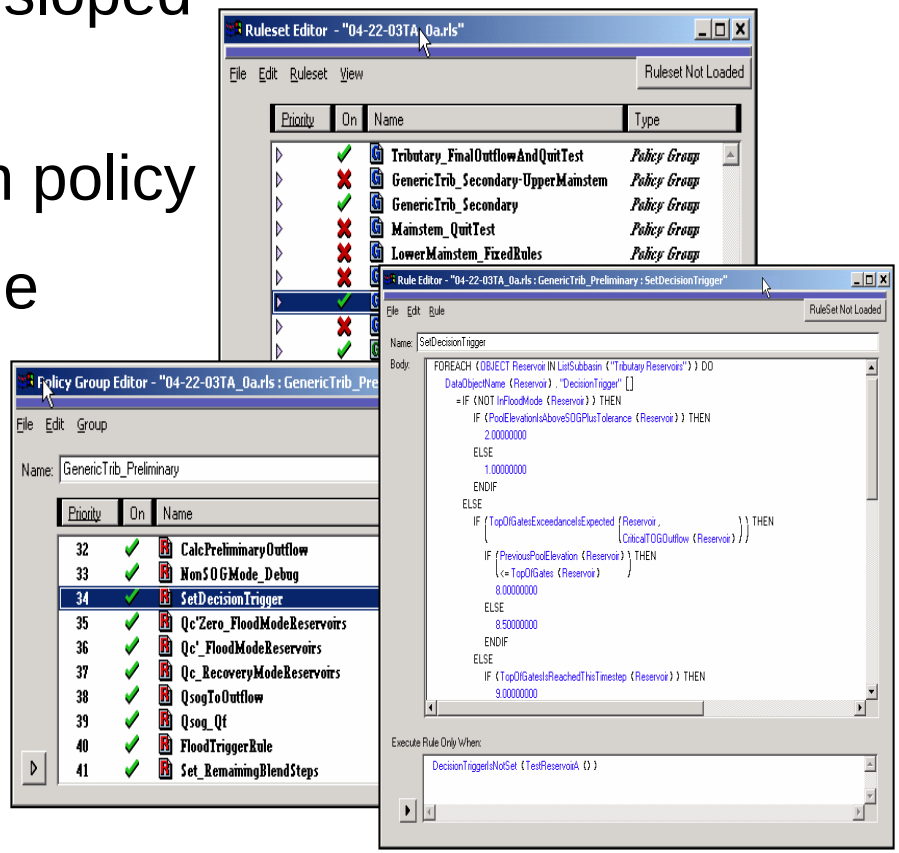
Generic Algorithms

Generic Tributary Algorithms

- Applied to virtually all non-sloped power reservoirs
- Foundation of all operation policy
- Quarantined deviating code

Mainstem Fixed Rule (sloped-power reservoir)

- Acceptable discharge vs. pool elevation operational points



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Trick 1: Careful Rule Design

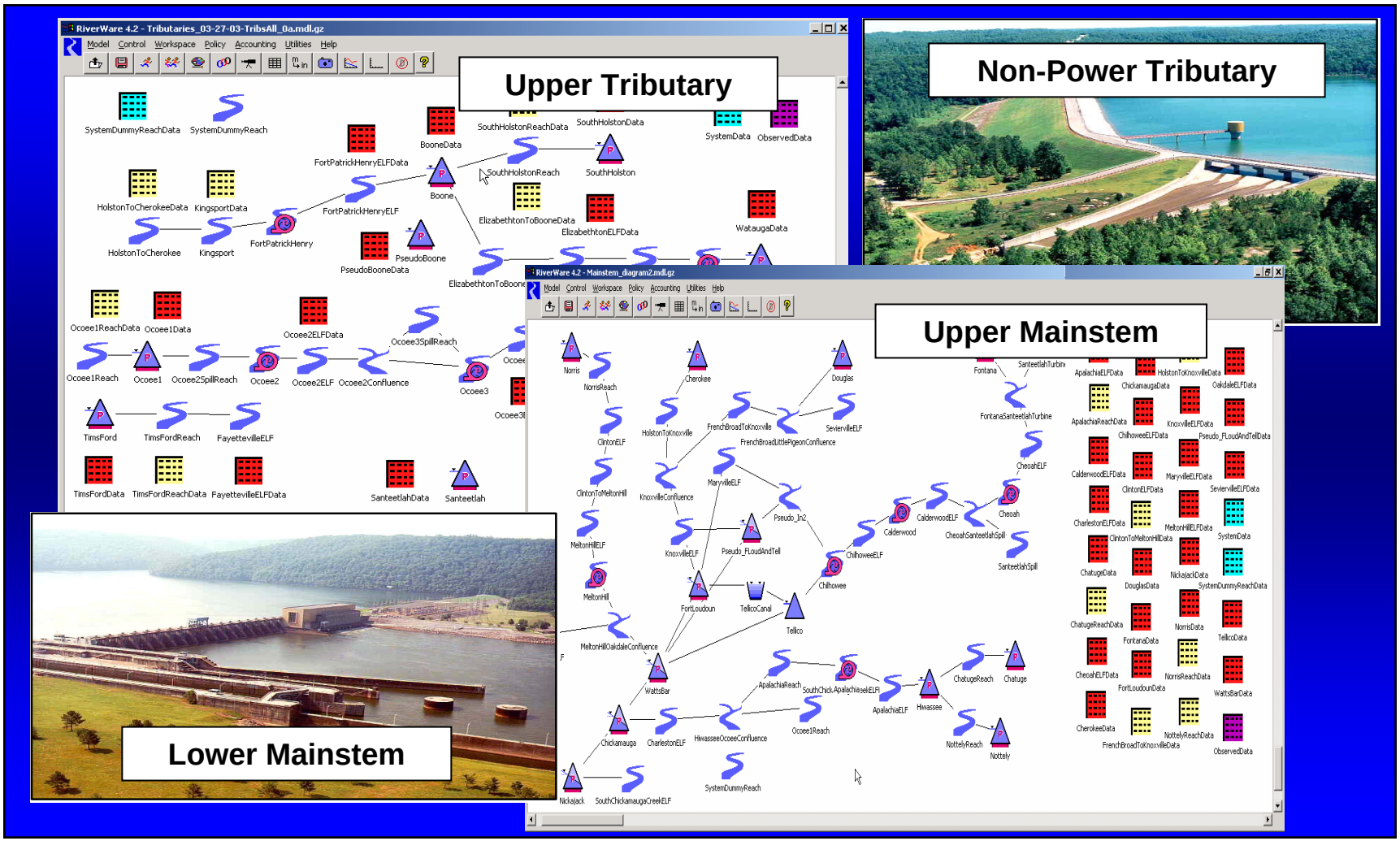
Generic Algorithms

Results of rule set design

- Carefully tested, compact, reused code base
- Eliminated re-firing of rules
- Decision variables stored
- Limited re-solution of objects
- Individual policy relegated to parameters, not logic

Trick 2: System Segmentation

Space



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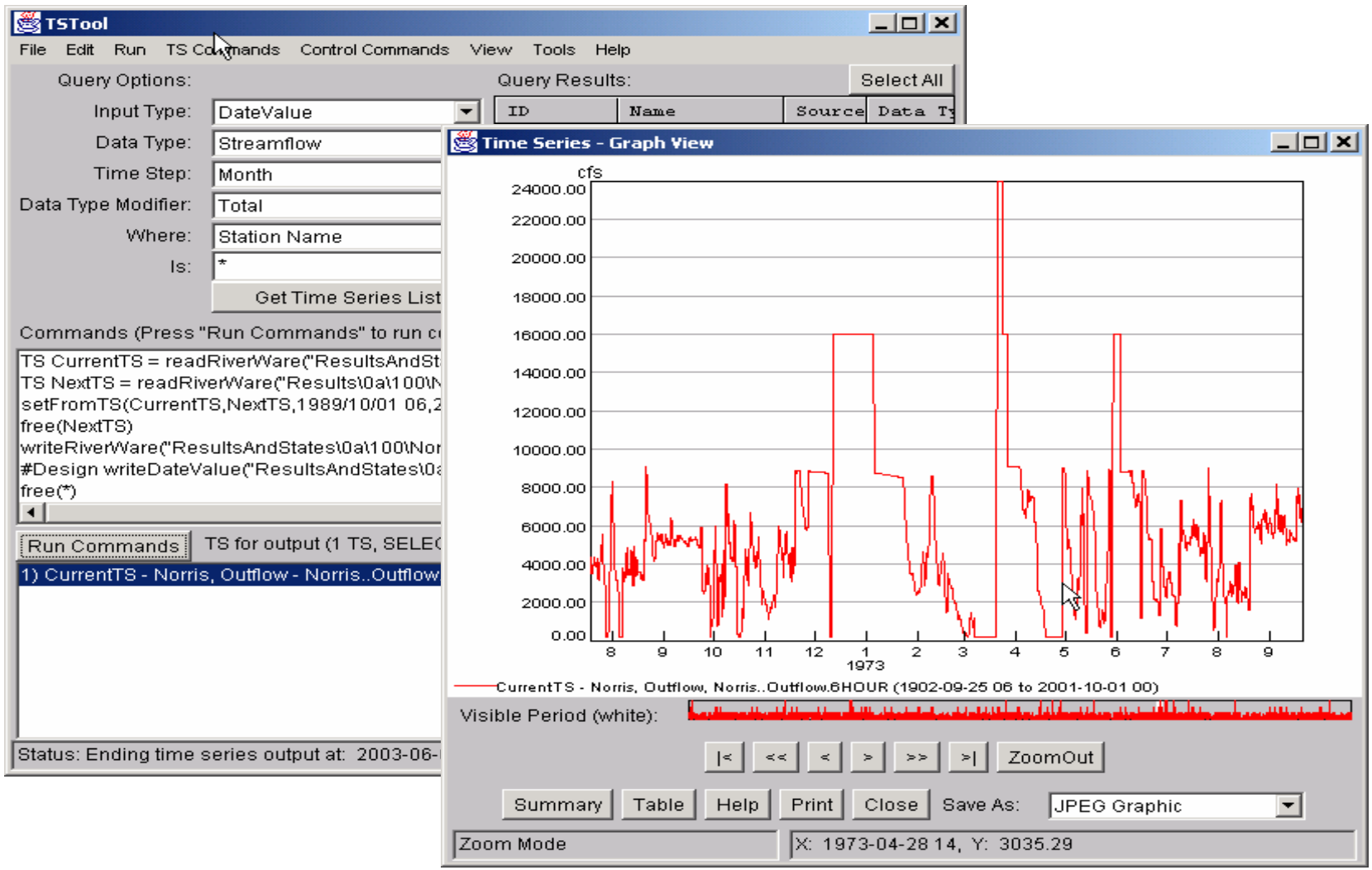
Trick 2: System Segmentation

Time

- Initial conditions
- Archival and access to state variables
- Control of sub-periods

Tool 1: TSTool

Data Management



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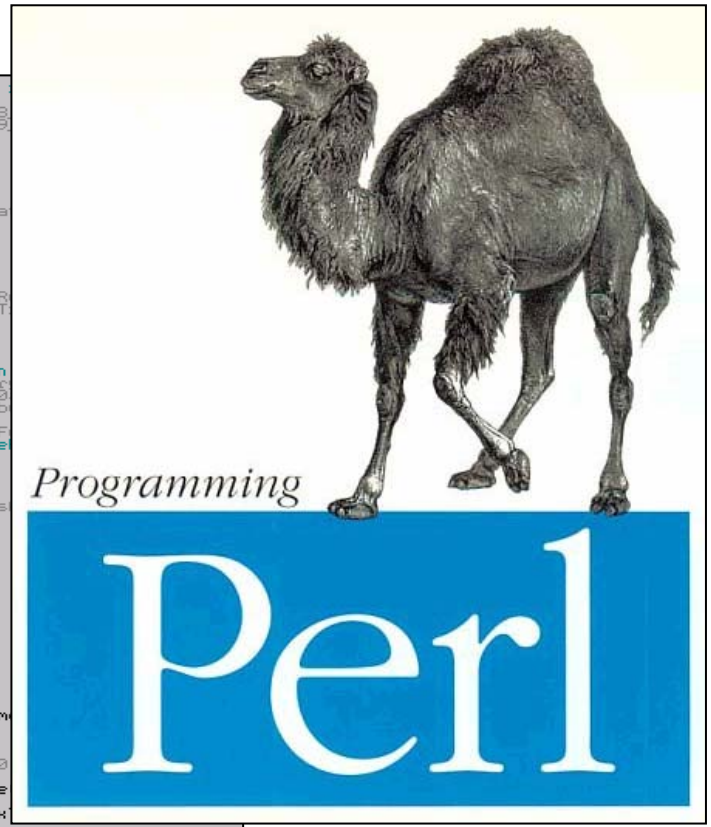
Tool 2: Perl Scripting

Control and Data Management

```
# The following array contains paired values X_Y where X will be used to
# time series handling scripts and model periods.
@dateSwaps = (   "1902_1903", "1903_1913", "1913_1923", "1923_1933", "1933
                 "1953_1963", "1963_1973", "1973_1983", "1983_1989", "1989
#@dateSwaps = ("1947_2001");

$DesignRun = "100";    #<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
$AltNum = "0a";
$RunNumber = 0;

$Initialize = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\TSTool_TribsAllInitializa
$NewInitialize = join("",$Initialize,"X",$AltNum, "_",$DesignRun);

# The following is not needed for Tributaries
#$Dval = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\TSTool_MainstemTB_DVal';
#$NewDval = join("",$Dval,"X",$AltNum,"_",$DesignRun);

$KnownInflows= 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\TSTool_KnownInflows_forR
$NewKnownInflows = join("",$KnownInflows,"X",$AltNum, "_",$DesignRun, "_T

$RCL = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\BATCH\TribsAll.rcl';
#$RCL = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\BATCH\TribsAll.rclPOST';
$NewRCL = join("",$RCL,"X",$AltNum, "_",$DesignRun);
        # Note the backslashes are required to produce two backslashes in
$BaseModel = 'K:\\\\PROJECTS\\\\A636_TVA\\\\Phase_3\\\\Models\\\\Tributar
$Rules = 'K:\\\\PROJECTS\\\\A636_TVA\\\\Phase_3\\\\Models\\\\04-22-03TA_0
$BaseSaveModel = 'C:\\\\PROJECTS\\\\A636_TVA\\\\PHASE_3\\\\MODELS\\\\Trib

$UpdateResults = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\TSTool_TribsAllUpdateF
#$UpdateResults = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\TSTool_TribsAllUpdate
$NewUpdateResults = join("",$UpdateResults,"X",$AltNum, "_",$DesignRun);

$TSTool = 'W:\PROGRA~1\RTI\RIVERT~1\BIN\TSTOOL.BAT';
$RiverWare = 'C:\PROGRA~1\CADSWES\RIVERW~1.2\RIVERW~1.EXE';
$RiverWareOutput = join("","TribsAll\",$AltNum, "_",$DesignRun, '_xTribs

$ftpComm = 'k:\PROJECTS\A636_TVA\PHASE_3\DMI\BATCH\ftpcomm';
$NewFTP = join("","ftpCommX",$AltNum, "_",$DesignRun, "_TribsAll");

$stillGO = 1;
if( 1 ) {
        foreach $year (@dateSwaps) {
          if( $stillGO) {
                print "$year\n";
                @Fld = split( '_', $year );
                $RunNumber++;

                # Set up the dates
                @xxTime[0] = "@Fld[0]/10/01 06";
                $xxTimePrexx = '1901/12/31 24';
                for( $i = 1; $i <= 17; $i++ ) {
                        print @xxTime[$i] = SubtractHoursFromDate( @xxTim
                        print "\n";
                }
                if( @Fld[1] < 2001 ) {
                        print    $xxTimeEndAnalysisWindow = "@Fld[1]/09/30
                        print "\n";
                        print    $xxTimeEndModelRunPeriod = AddHoursToDate
                        print "\n";
                        print    $xxTimeEndModelELFs = AddHoursToDate( $xx
                        print "\n";
                }
                else {
                        print    $xxTimeEndModelRunPeriod = "@Fld[1]/09/22 18";
                        print "\n";
                        # Note the next line gets ready for a SubtractHoursFromDate of the sam
                        print    $xxTimeEndAnalysisWindow = AddHoursToDate( $xxTimeEndModelRunP
                        print "\n";
                        print    $xxTimeEndModelELFs = AddHoursToDate( $xxTimeEndModelRunPeriod
                        print "\n";
                }

                # Update TSTool Initialization command file
```



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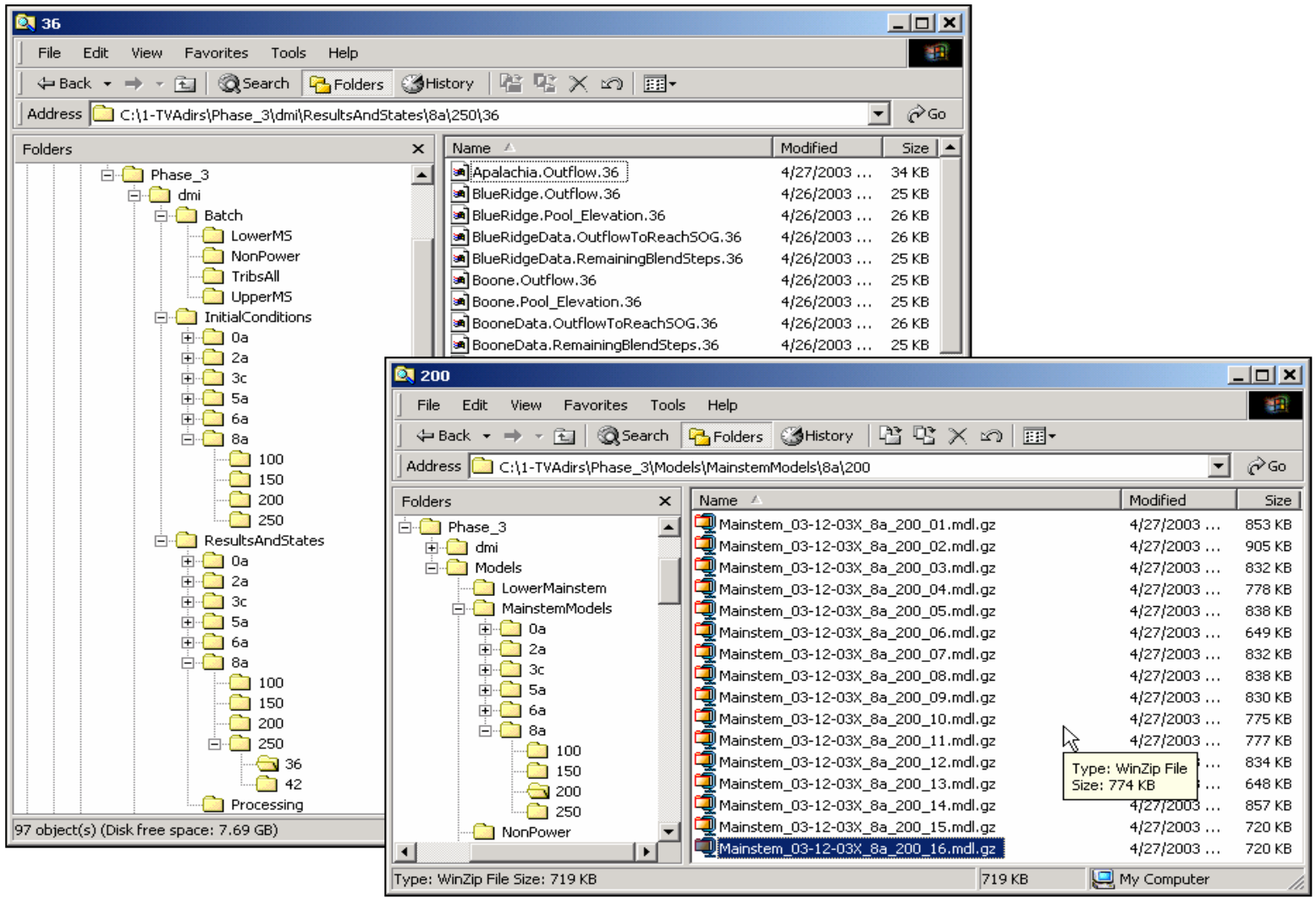
Tool 3: Directory Structure

Data Management



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Trick 3: Integration of Tools

Control and Data Management

Control Algorithm: For each successive run period--

- Modify TSTool and RiverWare batch control files
- Run TSTool initialization commands
  - Access archived data
  - Locate RiverWare input in expected directory
- Run RiverWare using its control file
  - Import data
  - Simulation
  - Export data
  - Save model with new name
- Run TSTool archival commands
  - Store results in archive time series files

Results of Approach

- Flexibility
  - Debugging
  - Event isolation
- Run-time
- Consistency throughout alternatives
- Built-in archival of runs / models / decisions
- Elimination of model size concerns

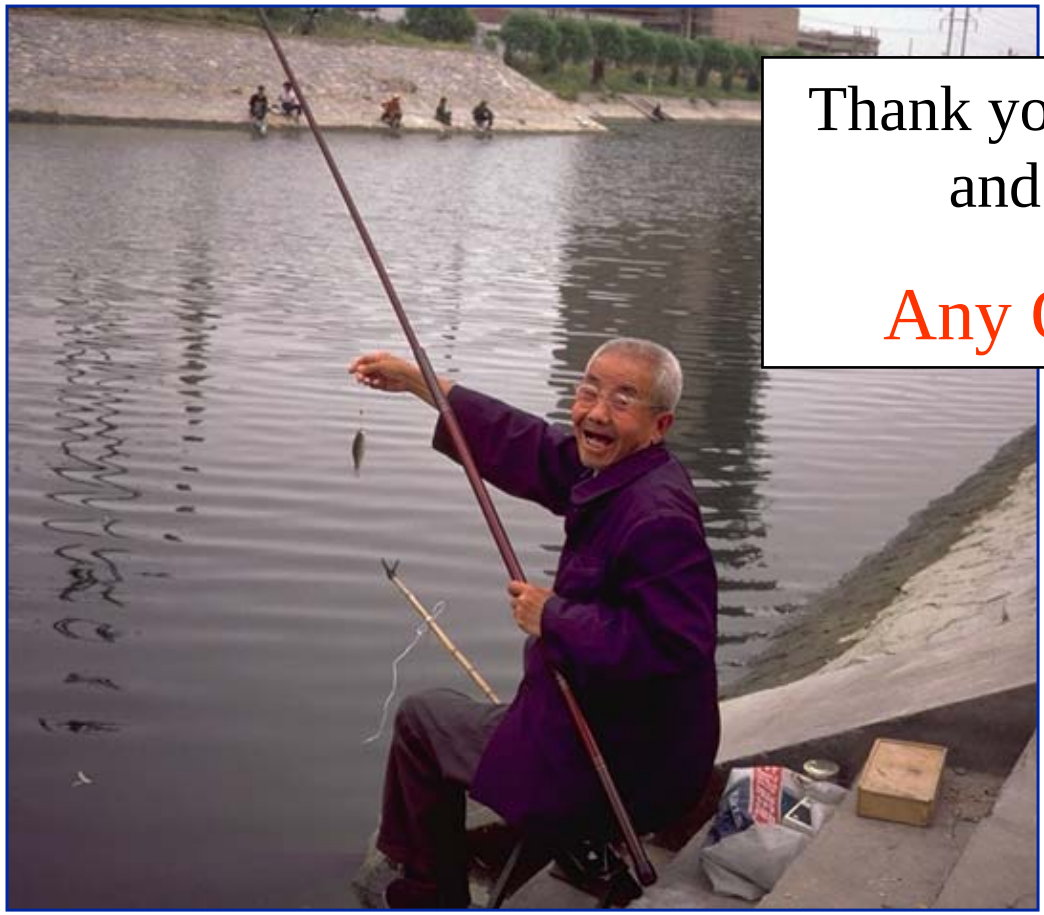
Looking to the Future

- More large models
- Water Accounting
- Optimization

- Real-time operation
- Probabilistic forecasting

- Post-processing Product Generation

Conclusion



Thank you for your time and attention.

Any Questions?

IDIQ Contractor for A&E Services (2003)

NOAA Partner for Advanced Hydrologic Prediction Services (AHPS 2003)

GSA Schedule (2004)

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