Quality Assurance of Emission Inventory Data using the EMF and EmisView

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Goals for Quality Assurance in EMF

- Formalize list of QA Steps to be performed on each type dataset
- Track information about progress of steps: status, who, when, etc.
- Integrate with EMF data management
- Support tracking of QA steps for multiple versions of datasets
- Speed (automate) the QA process

Typical QA Process for Emission Model Inputs

- *Level of formalization of QA processes varies between modeling studies and organizations*
- Typically, there is a list of steps to perform that vary for each type of data
- Some part of each step may be automated and other parts are manual
- If a step does not pass, it may need to be repeated if data values were changed
- Ideally, once steps are completed successfully, data is then used for modeling

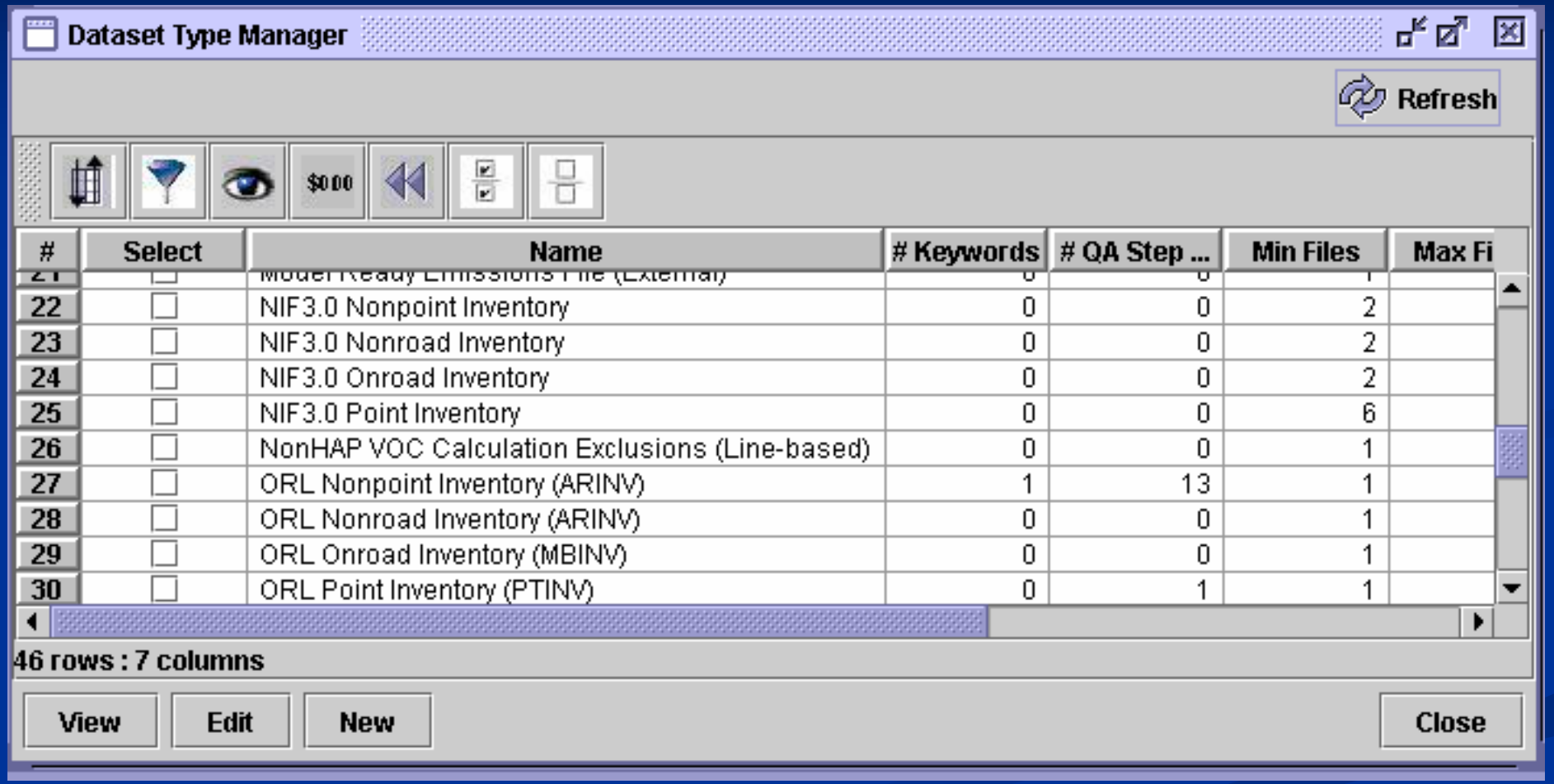
Example Inventory QA Steps

- Validate data format
- Compare high level summaries to previous summaries (by state, SCC)
- Verify that the expected regions, codes, and pollutants exist in the data
- Check for duplicate records
- Verify that the time period is correct
- Validate outliers for emissions records
- Check for within-record consistency (e.g., validate coords., stack params.)
- Check consistency across records

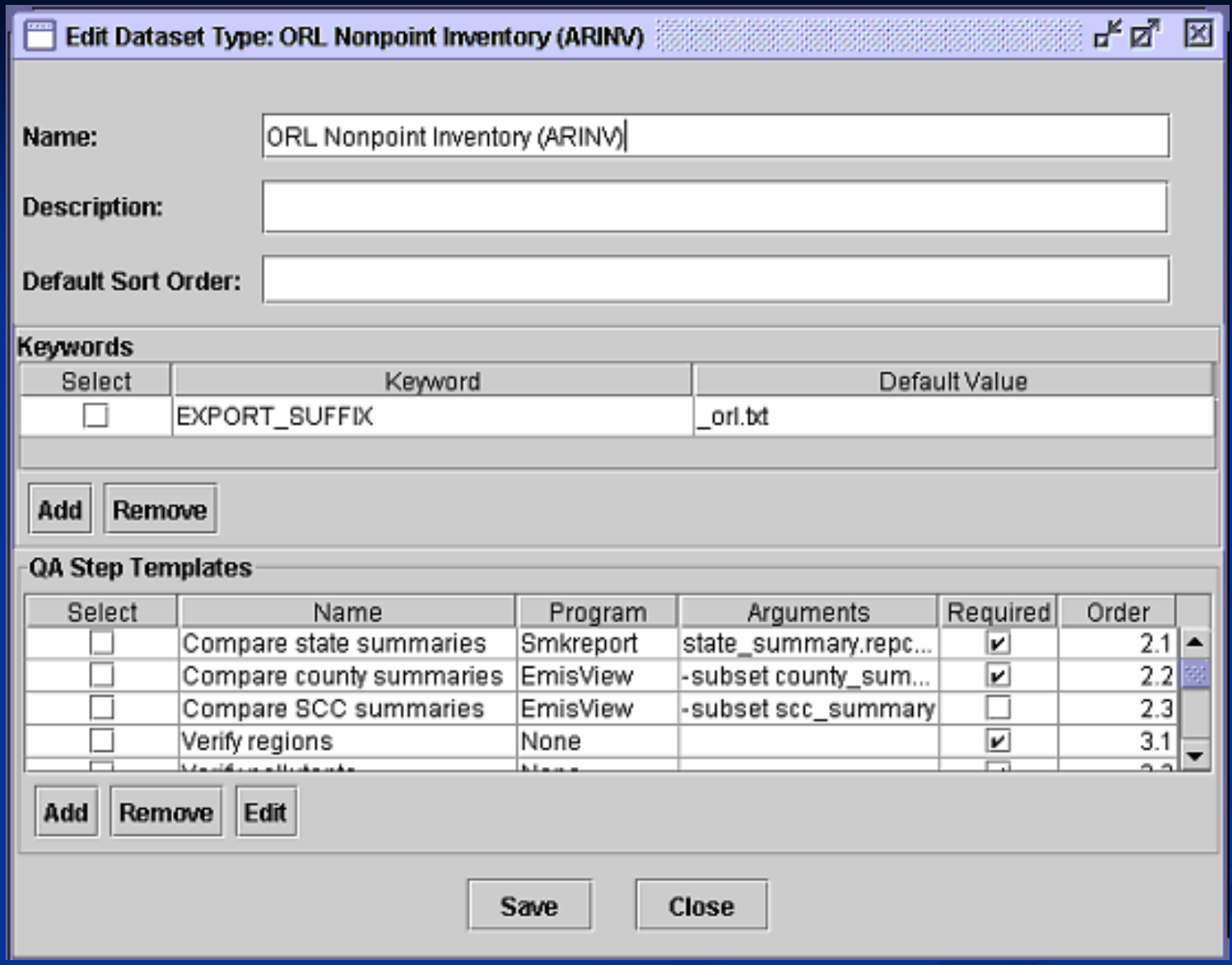
Tracking QA Steps in EMF

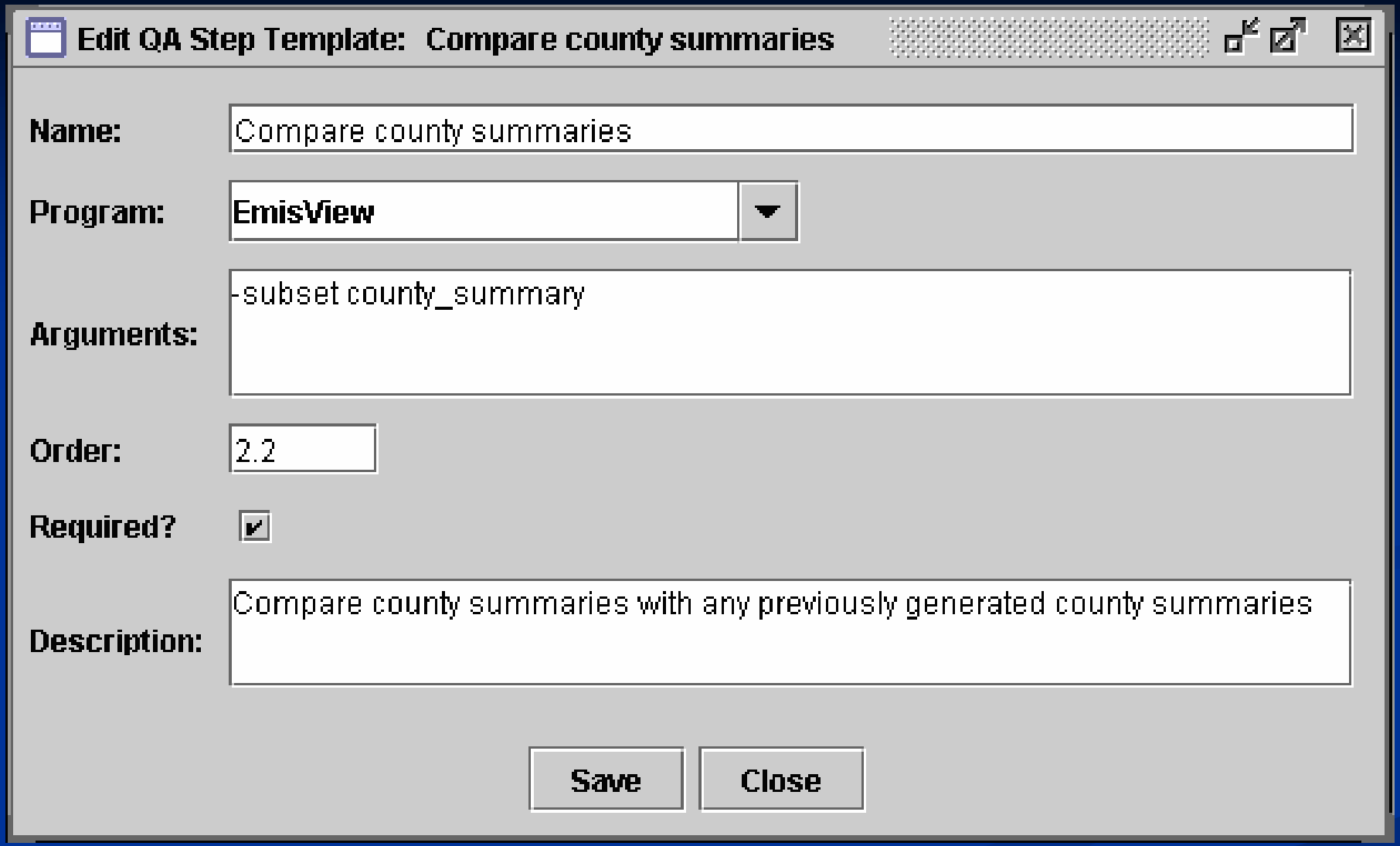
- First, set up Step Templates for Dataset Types
- Copy Steps to Dataset metadata from Templates
- Add any ad-hoc steps (not from templates) to Dataset metadata
- Record results of the steps for each version of a Dataset

Dataset Type Manager

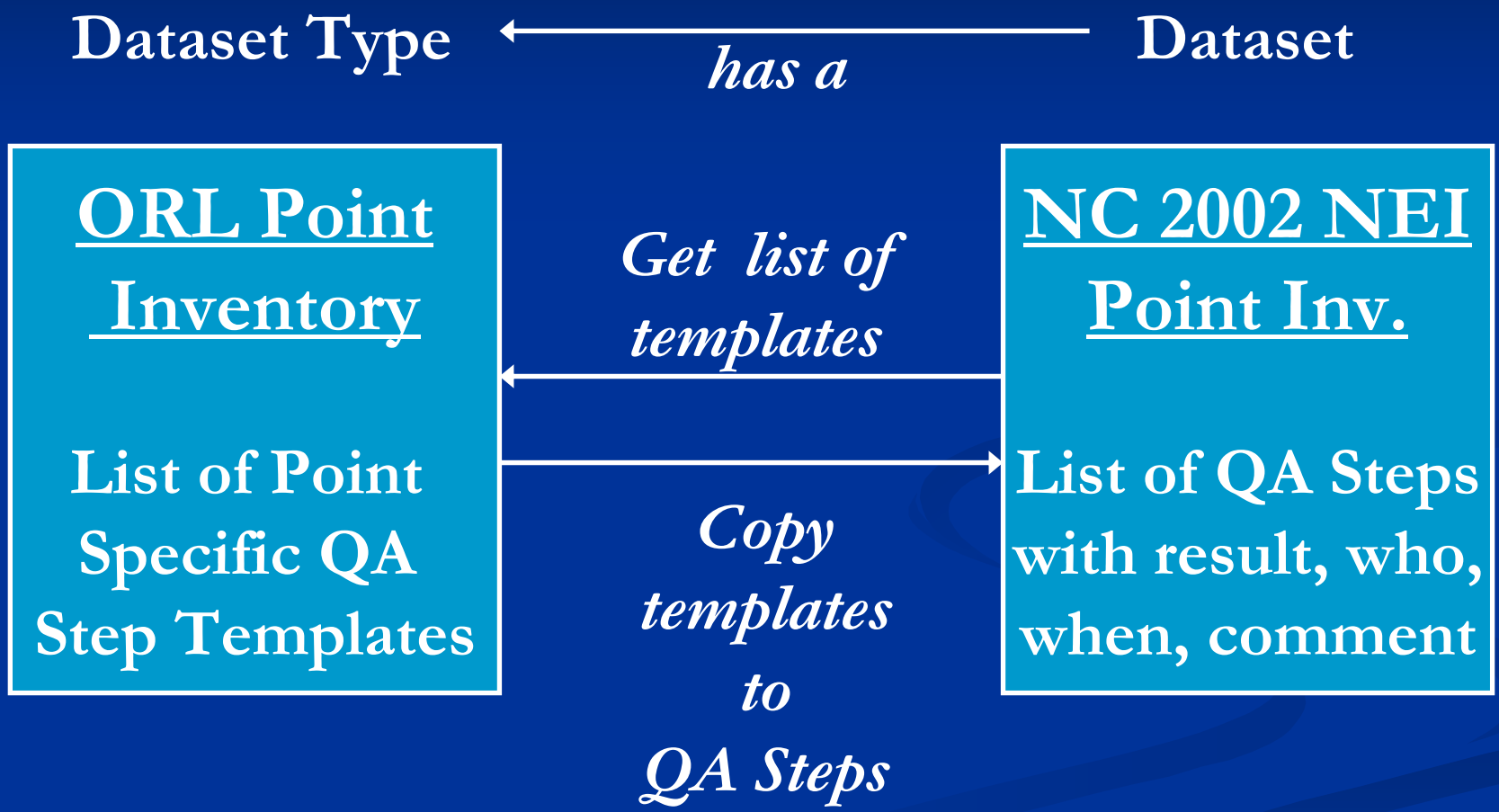


#	Select	Name	# Keywords	# QA Step ...	Min Files	Max Fi
22	☐	NIF3.0 Nonpoint Inventory	0	0	2	
23	☐	NIF3.0 Nonroad Inventory	0	0	2	
24	☐	NIF3.0 Onroad Inventory	0	0	2	
25	☐	NIF3.0 Point Inventory	0	0	6	
26	☐	NonHAP VOC Calculation Exclusions (Line-based)	0	0	1	
27	☐	ORL Nonpoint Inventory (ARINV)	1	13	1	
28	☐	ORL Nonroad Inventory (ARINV)	0	0	1	
29	☐	ORL Onroad Inventory (MBINV)	0	0	1	
30	☐	ORL Point Inventory (PTINV)	0	1	1	

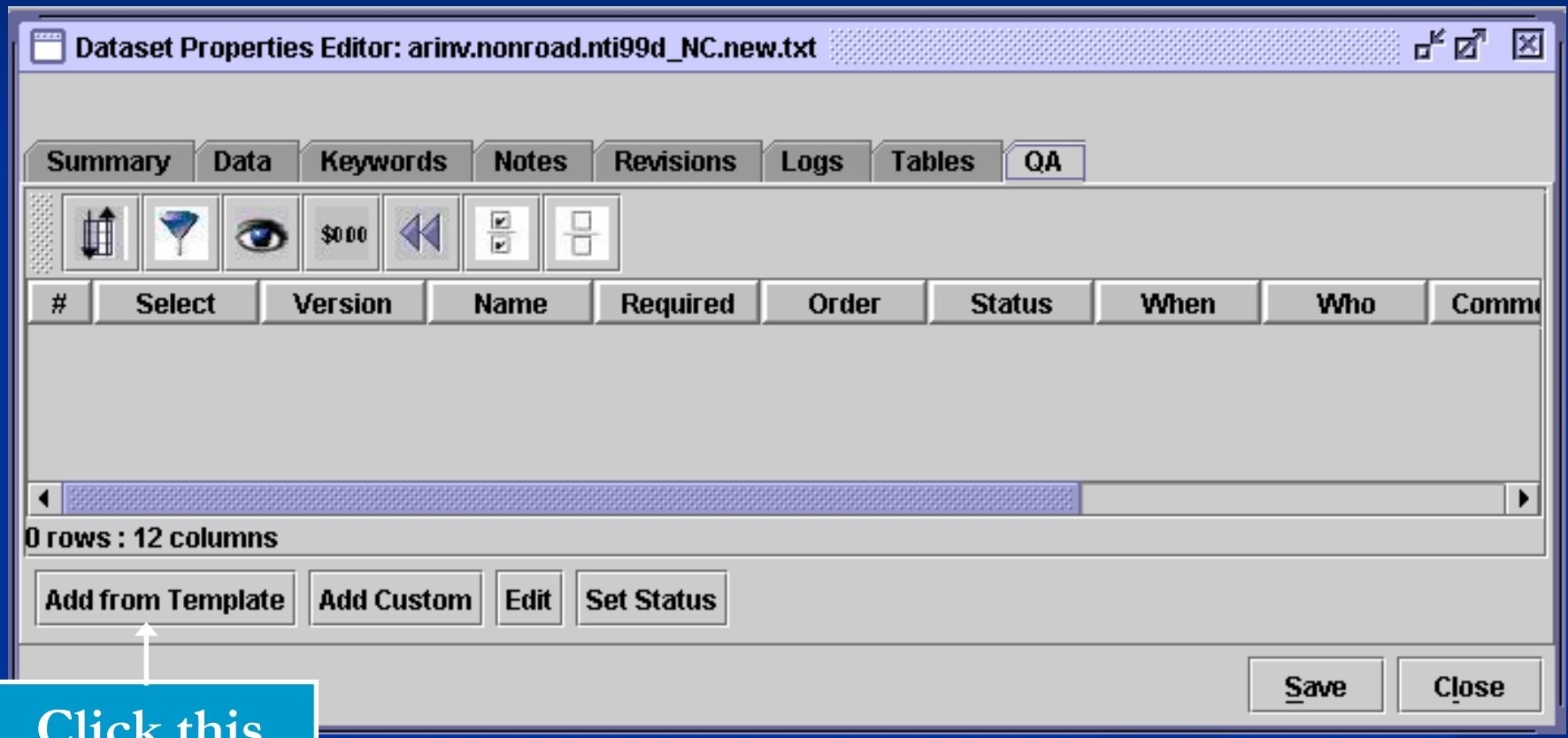

Edit Dataset Type: ORL Nonpoint Inventory (ARINV)
Name:
ORL Nonpoint Inventory (ARINV)
Description:
Default Sort Order:
Keywords
Select
Keyword
Default Value
EXPORT_SUFFIX
_orl.txt
Add
Remove
QA Step Templates
Select
Name
Program
Arguments
Required
Order
Compare state summaries
Smkreport
state_summary.repc...
2.1
Compare county summaries
EmisView
-subset county_sum...
2.2
Compare SCC summaries
EmisView
-subset scc_summary
2.3
Verify regions
None
3.1
Add
Remove
Edit
Save
Close


Edit QA Step Template: Compare county summaries
Name:
Compare county summaries
Program:
EmisView
Arguments:
-subset county_summary
Order:
2.2
Required?
Description:
Compare county summaries with any previously generated county summaries
Save
Close

QA Step Templates vs. QA Steps

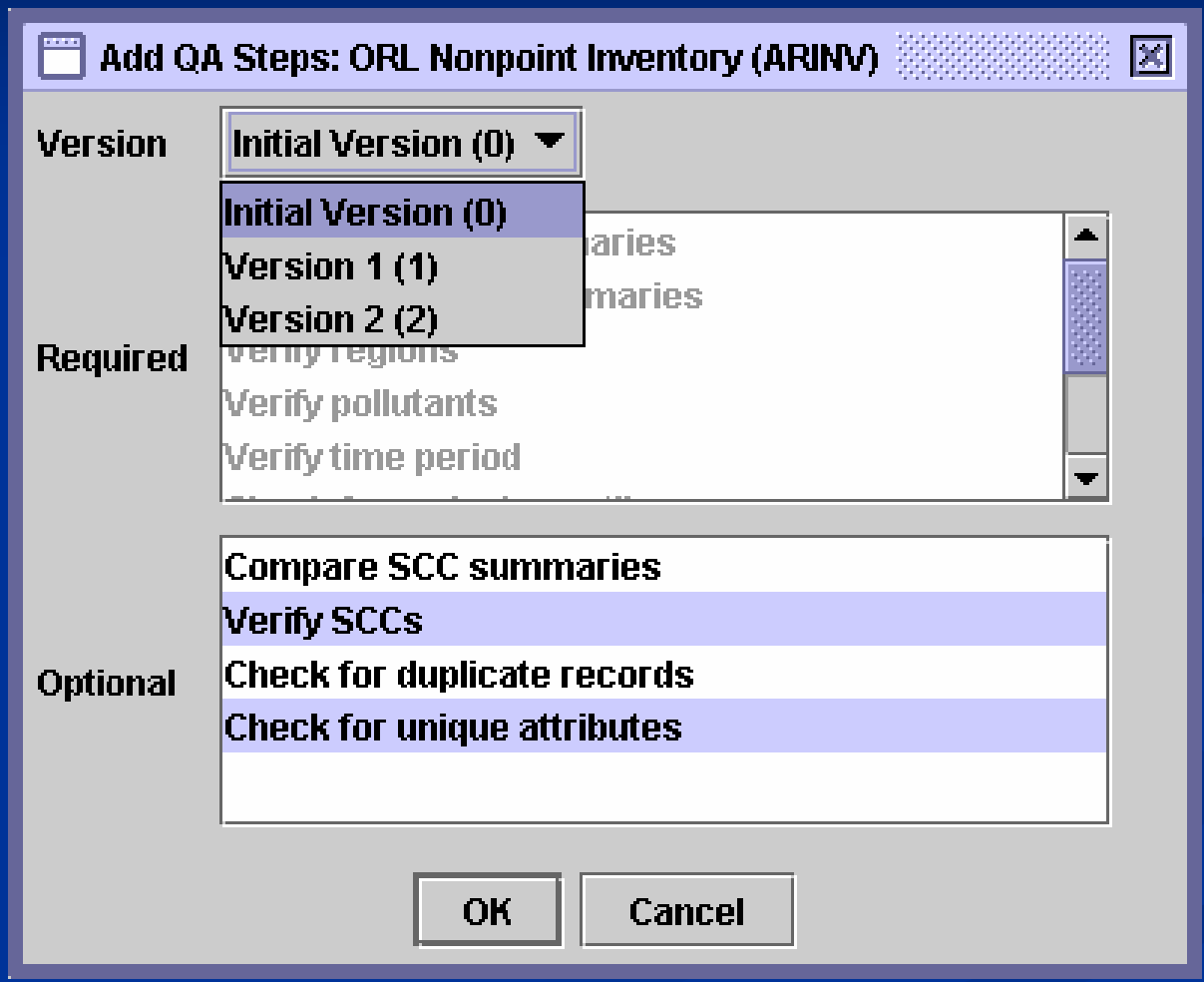


Adding QA Steps to a Dataset

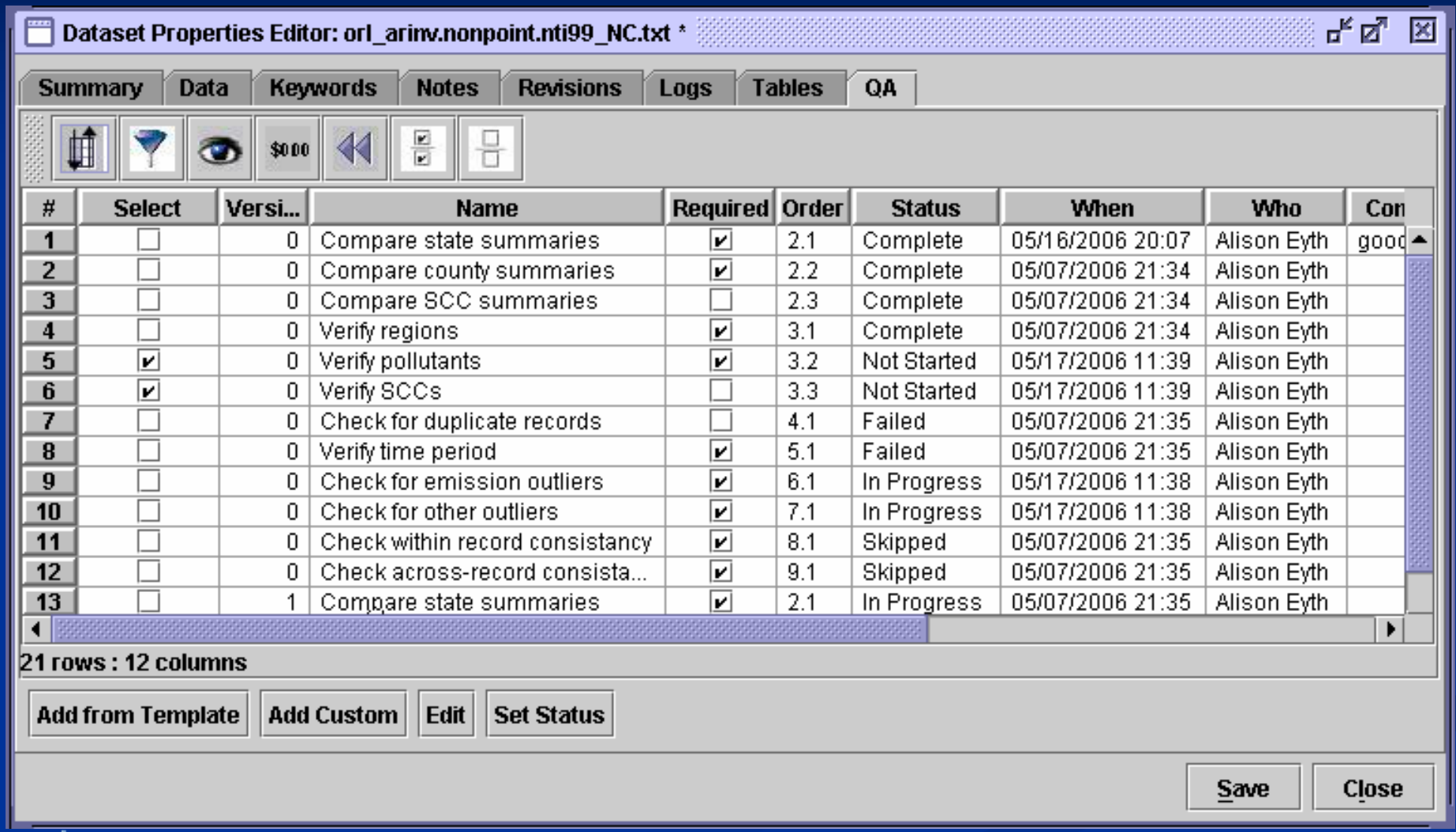


Click this button

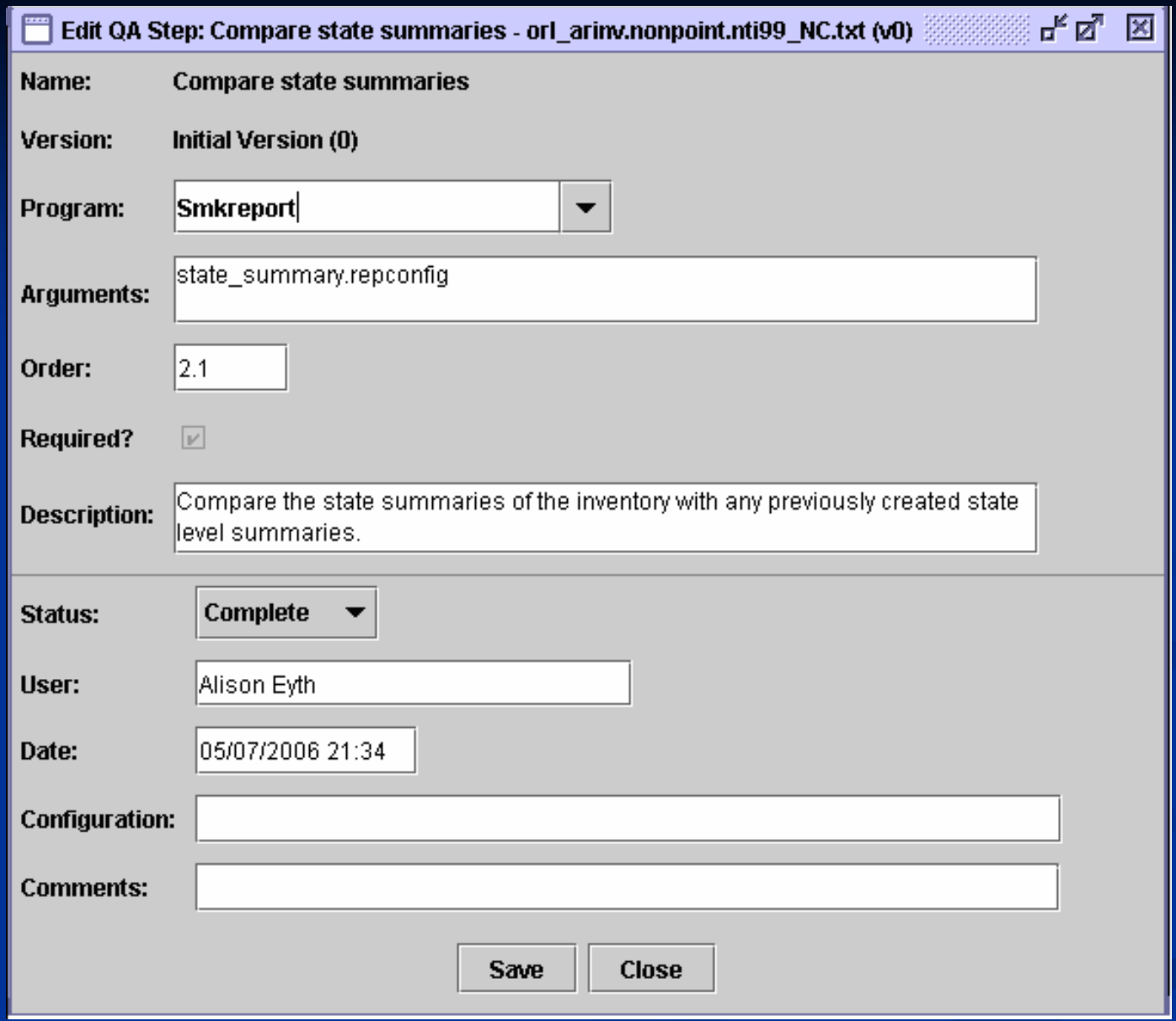
Adding Steps to Dataset from Templates



Summary of QA Steps for all Versions of a Dataset



#	Select	Versi...	Name	Required	Order	Status	When	Who	Con
1	☐	0	Compare state summaries	☑	2.1	Complete	05/16/2006 20:07	Alison Eyth	good
2	☐	0	Compare county summaries	☑	2.2	Complete	05/07/2006 21:34	Alison Eyth	
3	☐	0	Compare SCC summaries	☐	2.3	Complete	05/07/2006 21:34	Alison Eyth	
4	☐	0	Verify regions	☑	3.1	Complete	05/07/2006 21:34	Alison Eyth	
5	☑	0	Verify pollutants	☑	3.2	Not Started	05/17/2006 11:39	Alison Eyth	
6	☑	0	Verify SCCs	☐	3.3	Not Started	05/17/2006 11:39	Alison Eyth	
7	☐	0	Check for duplicate records	☐	4.1	Failed	05/07/2006 21:35	Alison Eyth	
8	☐	0	Verify time period	☑	5.1	Failed	05/07/2006 21:35	Alison Eyth	
9	☐	0	Check for emission outliers	☑	6.1	In Progress	05/17/2006 11:38	Alison Eyth	
10	☐	0	Check for other outliers	☑	7.1	In Progress	05/17/2006 11:38	Alison Eyth	
11	☐	0	Check within record consistancy	☑	8.1	Skipped	05/07/2006 21:35	Alison Eyth	
12	☐	0	Check across-record consista...	☑	9.1	Skipped	05/07/2006 21:35	Alison Eyth	
13	☐	1	Compare state summaries	☑	2.1	In Progress	05/07/2006 21:35	Alison Eyth	


Edit QA Step: Compare state summaries - orl_arinv.nonpoint.nti99_NC.txt (v0)
Name:
Compare state summaries
Version:
Initial Version (0)
Program:
Smkreport
Arguments:
state_summary.repconfig
Order:
2.1
Required?
Description:
Compare the state summaries of the inventory with any previously created state level summaries.
Status:
Complete
User:
Alison Eyth
Date:
05/07/2006 21:34
Configuration:
Comments:
Save
Close

Generating QA Reports

- Not currently automated, but…
- EmisView, Smkreport, Smkinven, and other utilities can generate information needed for inventory QA
- Commonly needed reports:
  - Summaries by state, county, SCC, …
  - Outlier [threshold] reports for emissions values and stack parameters
  - Top N reports [by state] (needs sorting)
  - Reports of particular slices of inventory

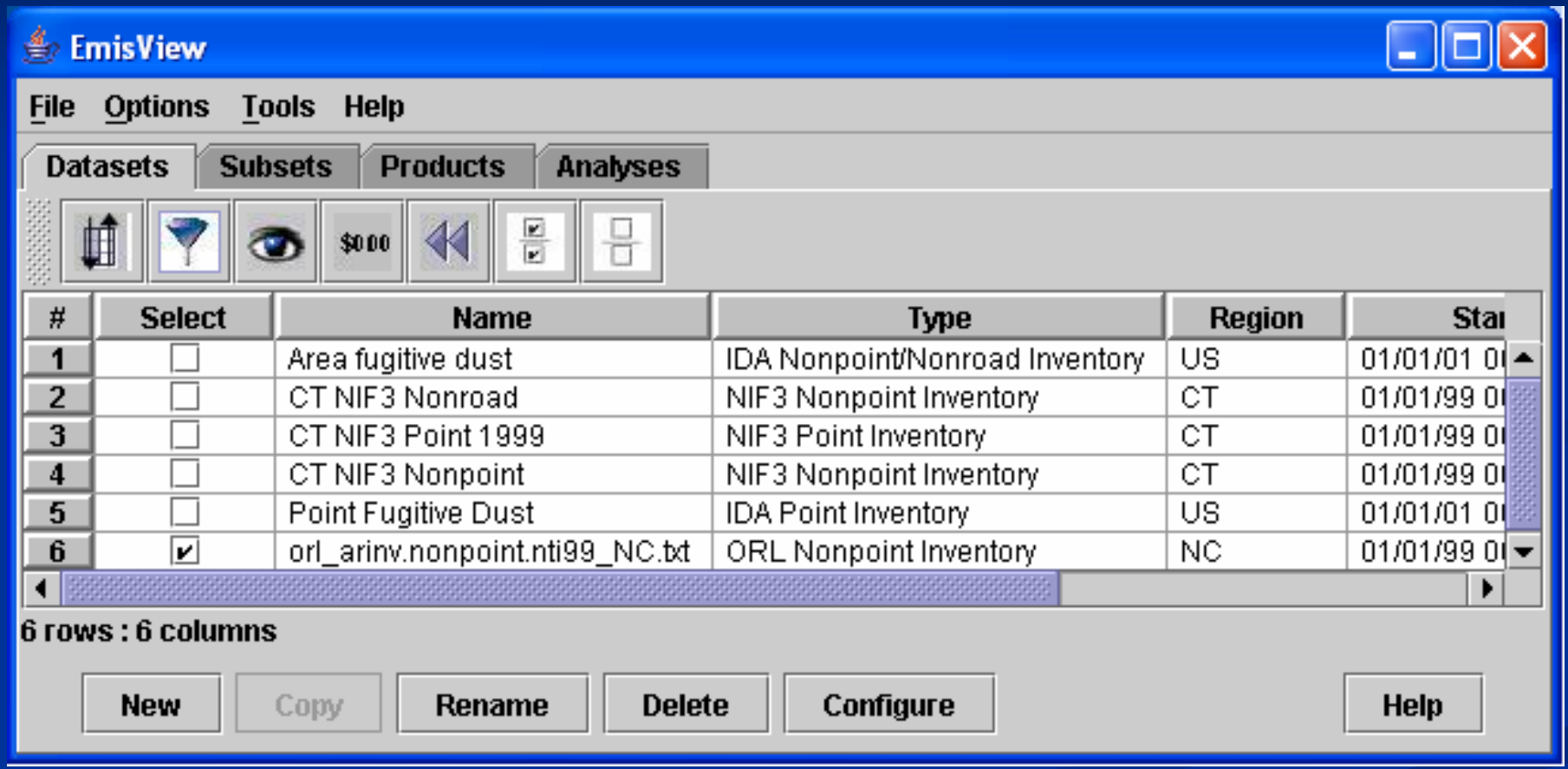
Goals for EmisView

- Preserve (and reproduce) analyses that have already been performed
- Subselect and summarize inventories for each of the major inventory formats
- Present same subset of data in multiple ways (e.g., tables, plots, maps)
- Automatically generate consistent set of tables and plots for similar datasets
- Integrate with EMF, but developed before EMF Data Management was mature

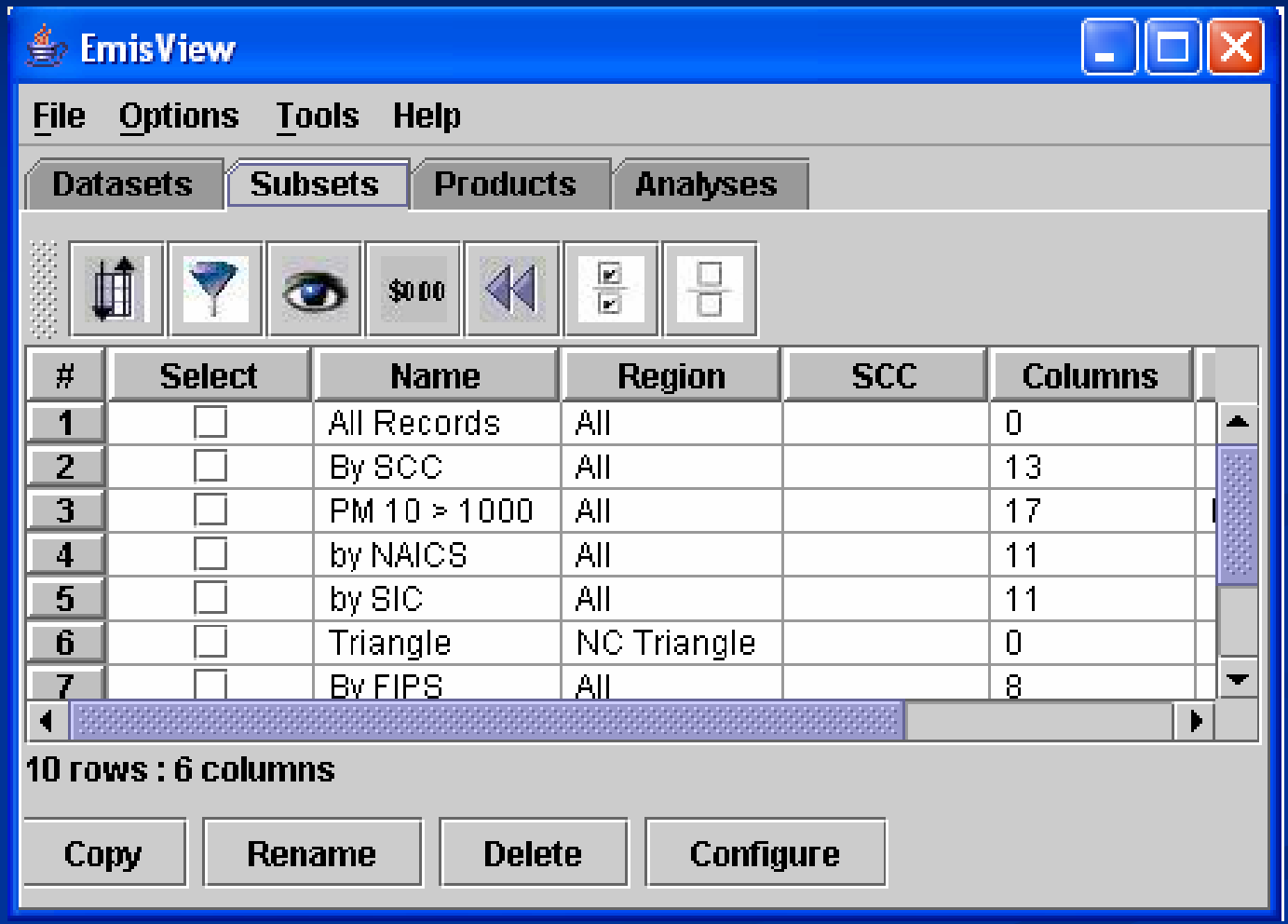
Mix and Match Components

- Between sessions, EmisView stores:
  - Datasets - inventories to analyze
  - Subsets - ways to slice & summarize data
  - Products - ways to present data
  - Analyses
- Each Analysis uses one Dataset, Subset, and Product – you can mix & match the components

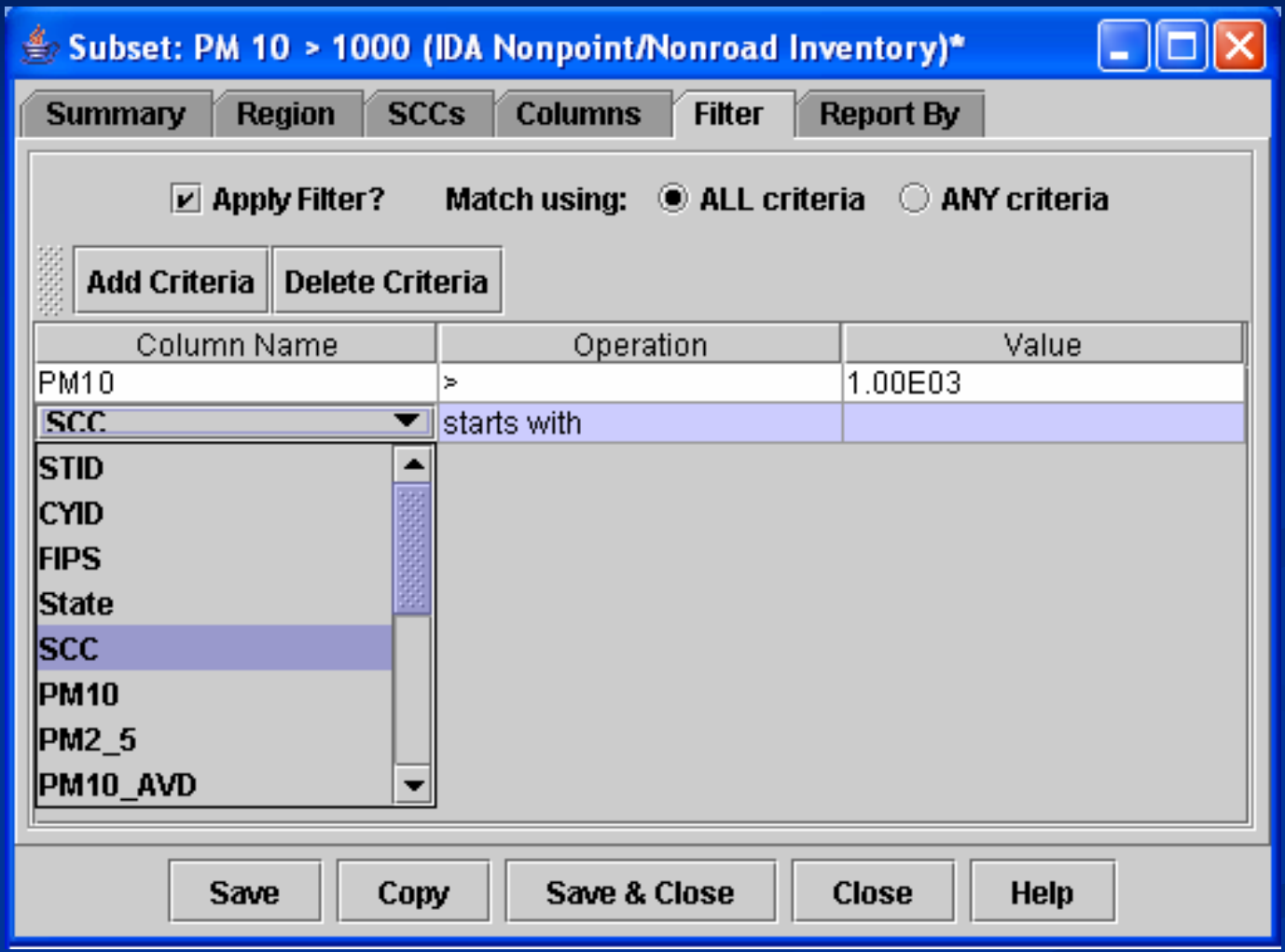
Main EmisView GUI - Datasets



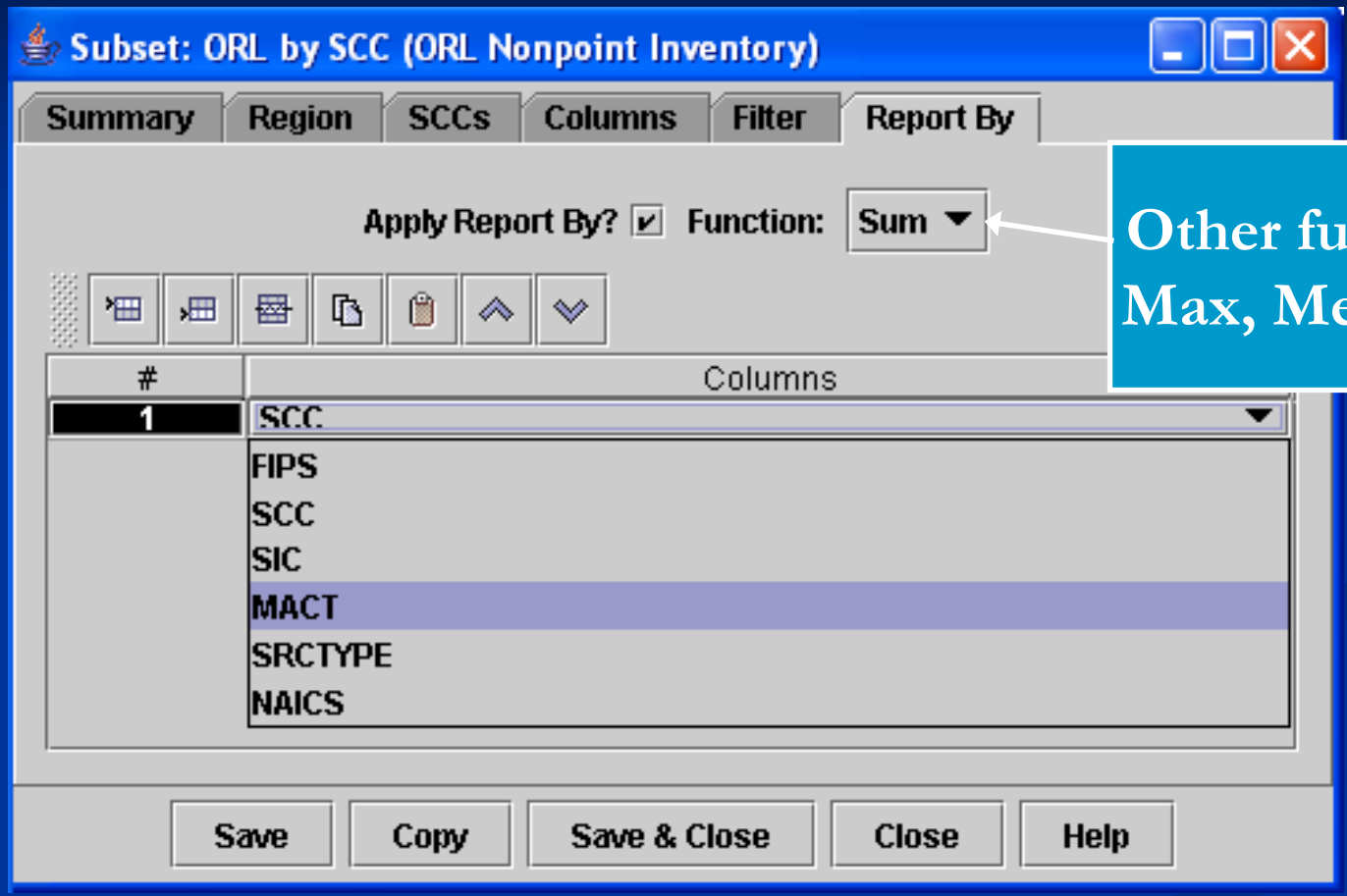
Main EmisView GUI - Subsets



A Threshold Subset



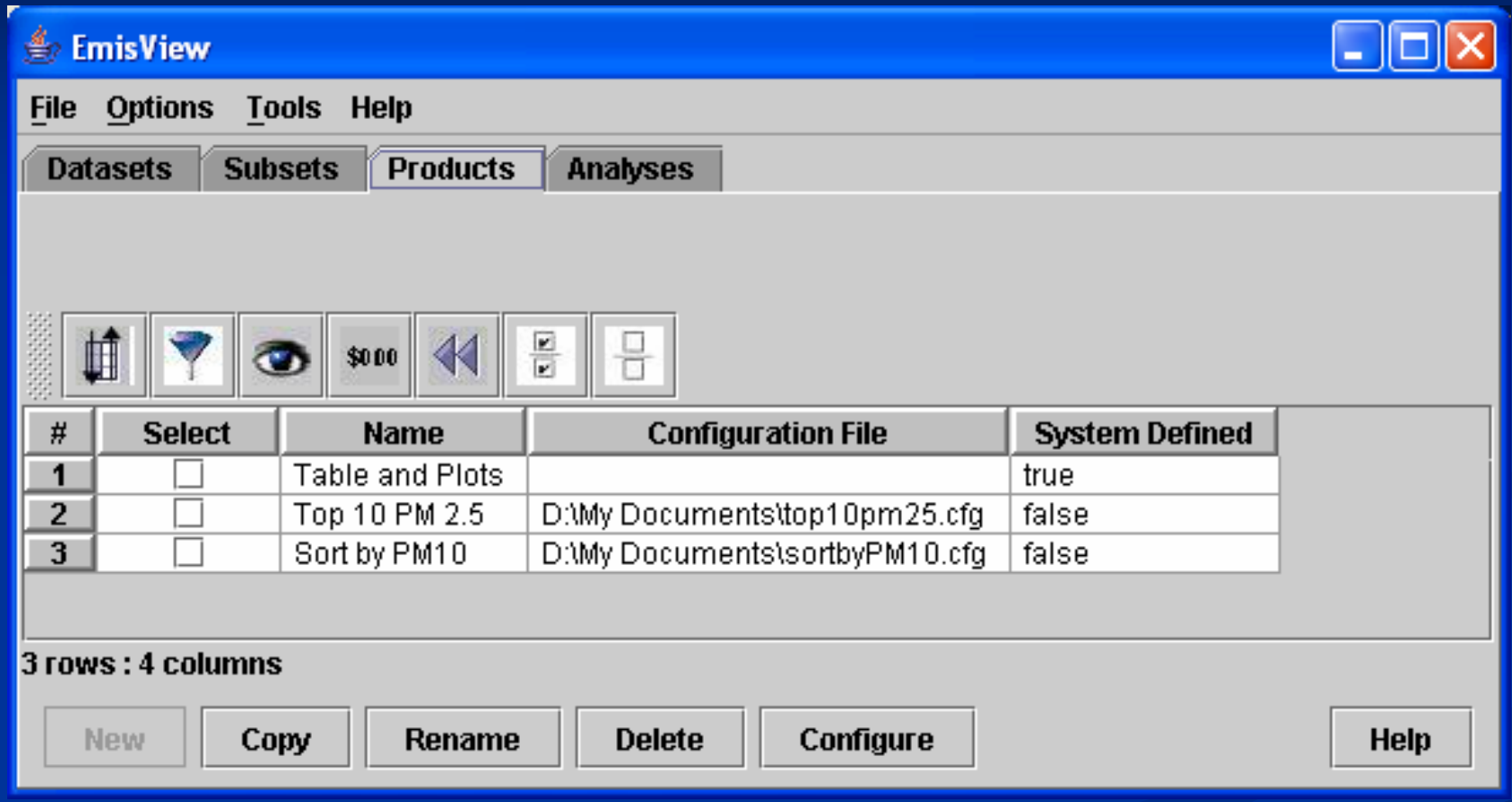
A Summarizing Subset



Other functions: Max, Mean, Min

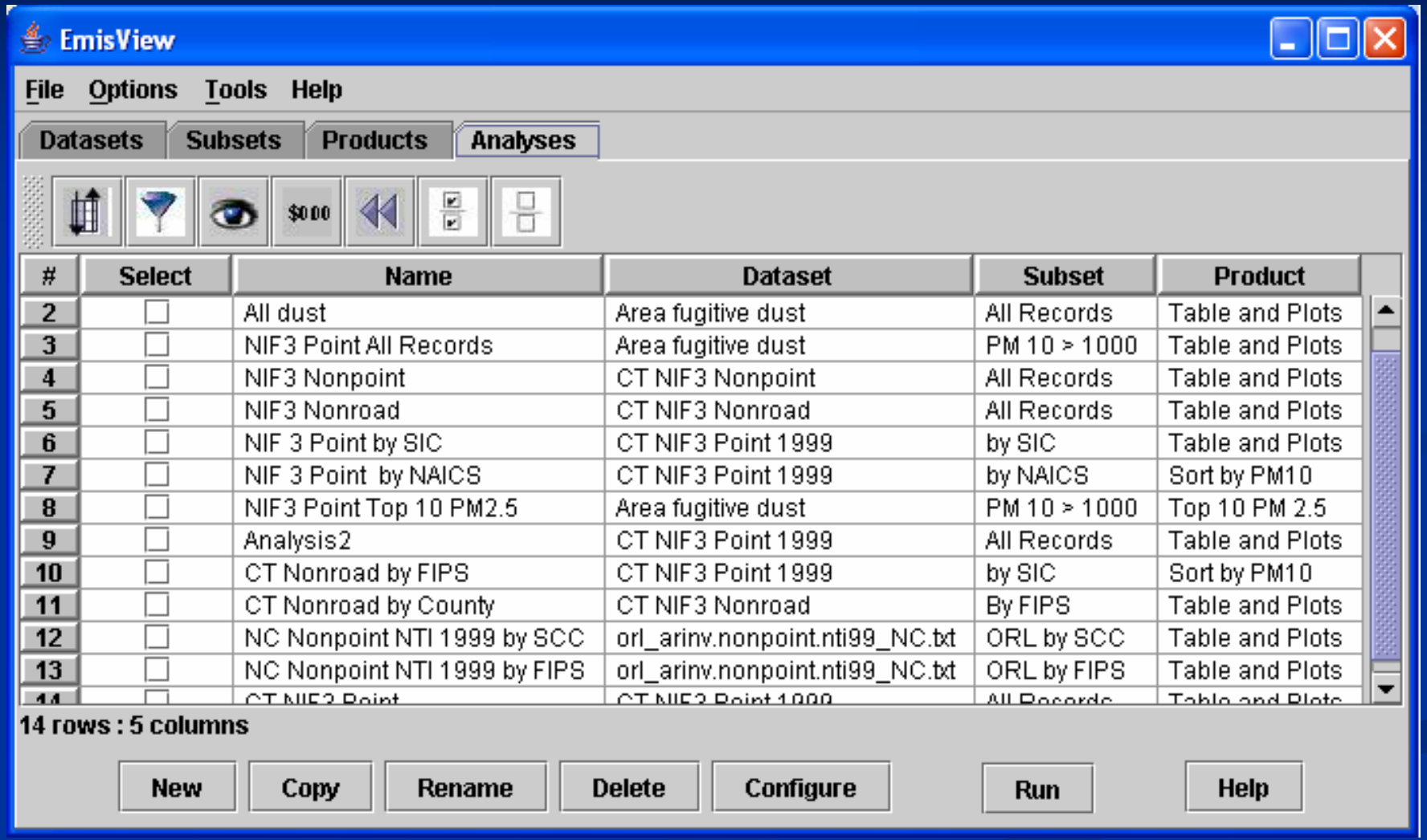
Other features of subsets: Set of states or counties, list of SCCs, choose columns – features are cumulative

EmisView Main GUI - Products

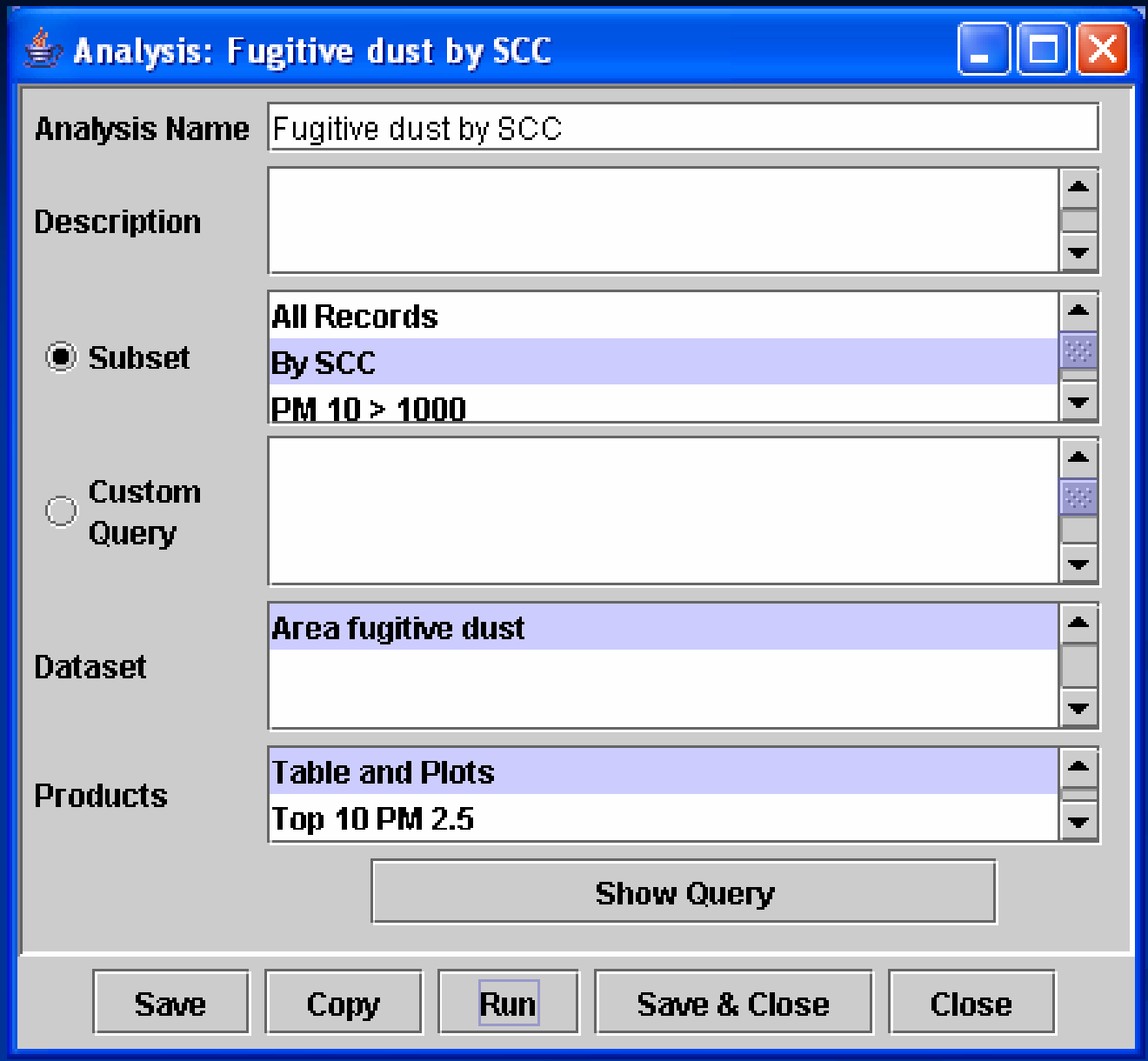


Currently, products are differentiated based on their Configuration file (saved from Table to be shown later)

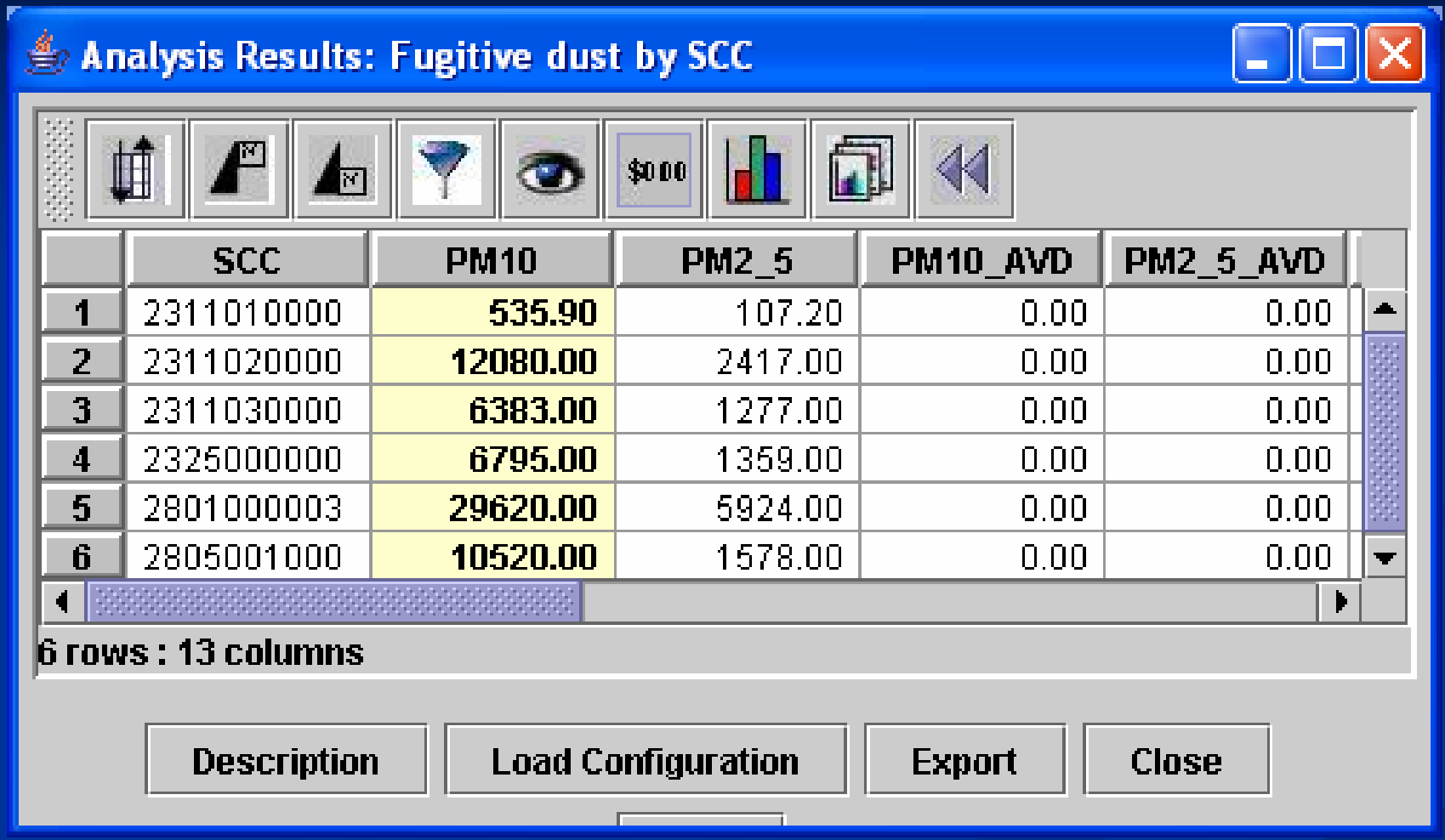
EmisView Main GUI - Analyses



#	Select	Name	Dataset	Subset	Product
2	☐	All dust	Area fugitive dust	All Records	Table and Plots
3	☐	NIF3 Point All Records	Area fugitive dust	PM 10 > 1000	Table and Plots
4	☐	NIF3 Nonpoint	CT NIF3 Nonpoint	All Records	Table and Plots
5	☐	NIF3 Nonroad	CT NIF3 Nonroad	All Records	Table and Plots
6	☐	NIF 3 Point by SIC	CT NIF3 Point 1999	by SIC	Table and Plots
7	☐	NIF 3 Point by NAICS	CT NIF3 Point 1999	by NAICS	Sort by PM10
8	☐	NIF3 Point Top 10 PM2.5	Area fugitive dust	PM 10 > 1000	Top 10 PM 2.5
9	☐	Analysis2	CT NIF3 Point 1999	All Records	Table and Plots
10	☐	CT Nonroad by FIPS	CT NIF3 Point 1999	by SIC	Sort by PM10
11	☐	CT Nonroad by County	CT NIF3 Nonroad	By FIPS	Table and Plots
12	☐	NC Nonpoint NTI 1999 by SCC	orl_arinv.nonpoint.nti99_NC.txt	ORL by SCC	Table and Plots
13	☐	NC Nonpoint NTI 1999 by FIPS	orl_arinv.nonpoint.nti99_NC.txt	ORL by FIPS	Table and Plots
14	☐	CT NIF3 Point	CT NIF3 Point 1999	All Records	Table and Plots

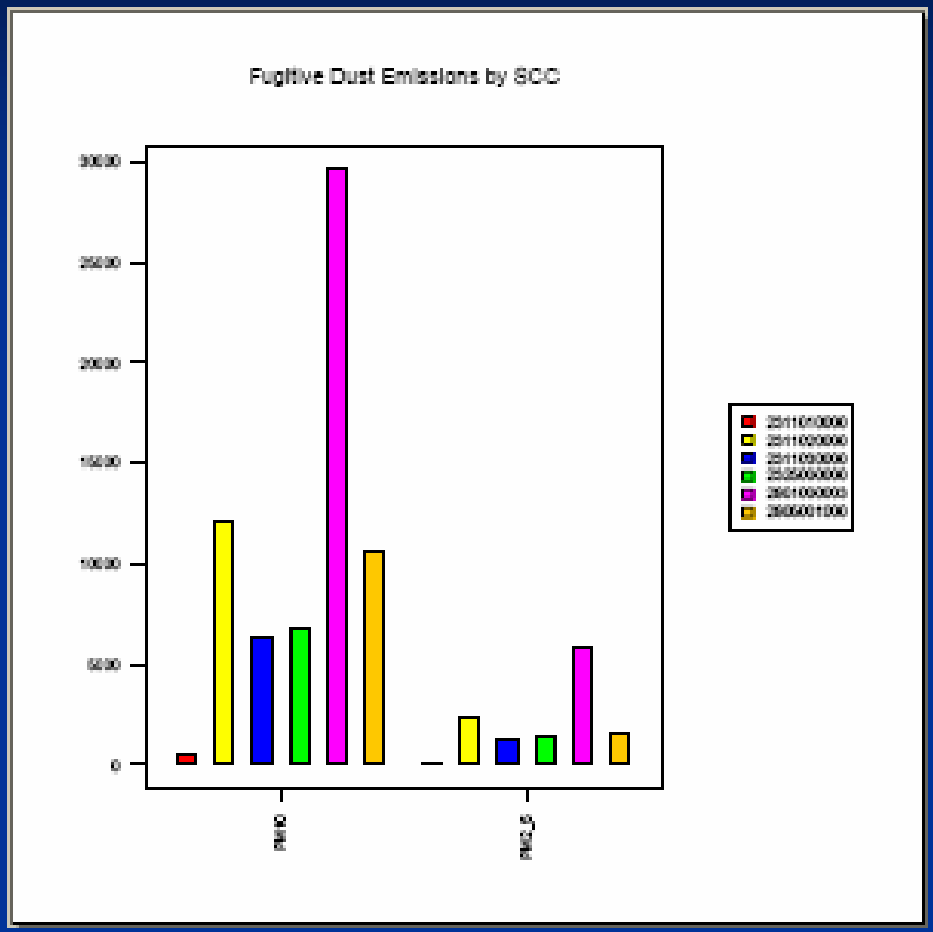

Analysis: Fugitive dust by SCC
Analysis Name
Fugitive dust by SCC
Description
Subset
All Records
By SCC
PM 10 > 1000
Custom Query
Dataset
Area fugitive dust
Products
Table and Plots
Top 10 PM 2.5
Show Query
Save
Copy
Run
Save & Close
Close

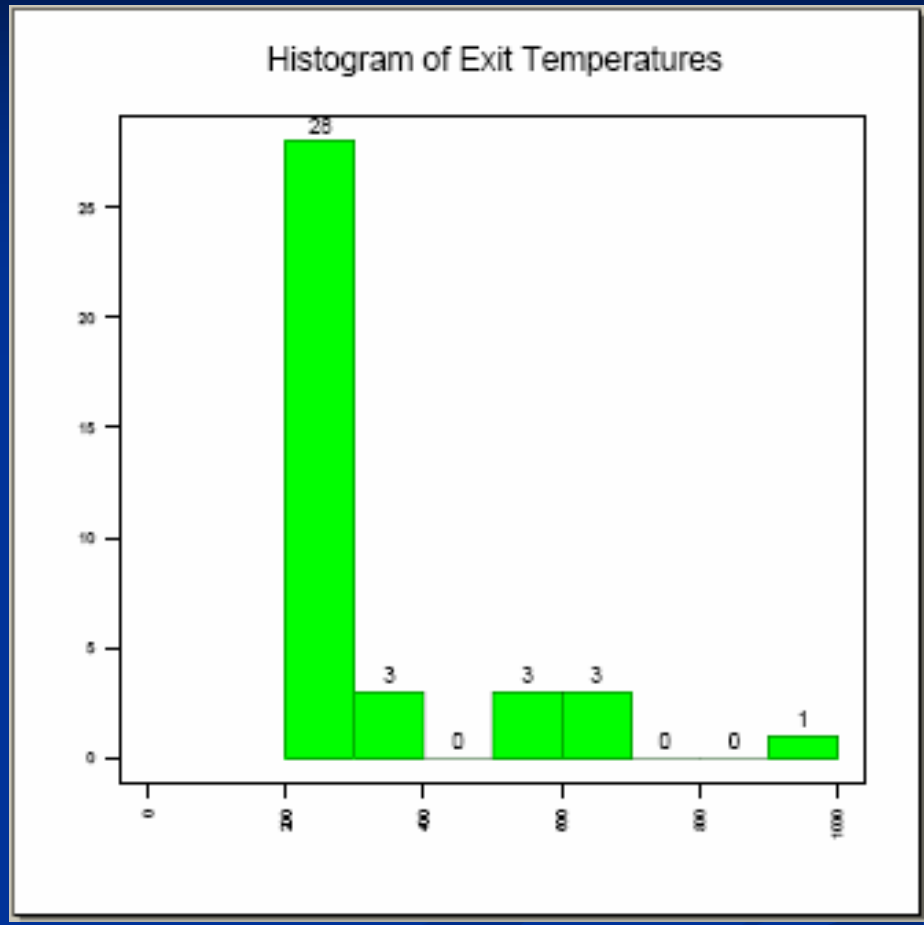
Analysis Results



Toolbar: multi-column sort, top N, bottom N, filter, hide cols, format, plot, save configuration, reset, [statistics]

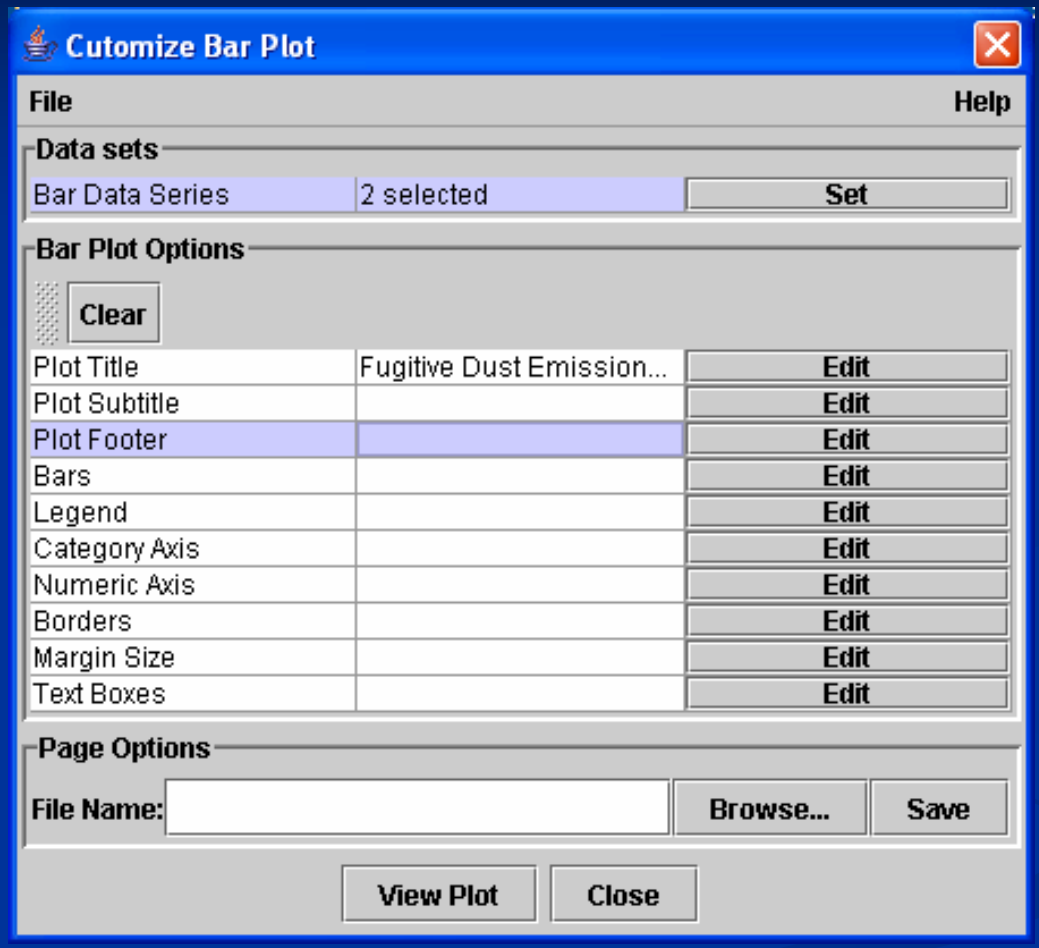
Examples of Plots





Other plots: CDF, box-whisker, rank order, XY, line, time series, discrete category, tornado

Plot Configuration Options



Plots can be saved as PDF, PNG, JPG, PS, and PTX

Software Requirements

- Open source software
- Runs on Linux, Unix, and Windows
- Requires Java 1.4 or 1.5 and R
- EmisView accesses local or remote DB server
  - Fall 2005 version supports MySQL or PostgreSQL
  - Later versions PostgreSQL only
- EMF is client-server PostgreSQL only

EmisView FY0? Enhancements

- Integrate with latest EMF importers
- Support more types of datasets
- New summaries: State (ORL), Overall
- Save Top-N as a configuration
- Simple script-based interface / API
- Integrate with EMF client
- Select and access Datasets and Versions directly from EMF DB
- Export Shapefiles for GIS analysis
- Access to existing statistical analyses

Availability of EmisView & EMF

- EmisView October 11, 2005 version is available from http://emisview.sourceforge.net
- Please report any issues
- Enhanced FY06 EmisView will be released by September 2006
- Public EMF release not yet funded, but direct arrangements could be made and code is on SourceForge

EmisView Summary

- EmisView should be able to produce the commonly desired reports for EI QA (summary, outlier, top N)
  - Needs testing on national scale
- EmisView will be able to produce standardized sets of tables and plots for similar types of inventories
- Addition of new data types should increase usefulness beyond inventories

Summary of EMF QA Features

- EMF supports definition of required and optional steps for each type of dataset (codifies the QA process)
- For a particular dataset, steps can be quickly copied from templates, or can be added as custom steps
- Tracking is performed for each step: who did it, when, status, comment
- Information is available to support future automation of steps

Analysis Results: CT Point 1999 All Records

	State	FIPS	Facility	Unit	Process	Point	SCC	SIC	NAICS
1	CT	9001	0019	P0010	01	001	10200603	873	1
2	CT	9001	0019	P0012	01	002	20300101	873	1
3	CT	9001	0167	E0001	01	003	40301019	517	1
4	CT	9001	0167	E0002	01	004	40400101	517	1
5	CT	9001	0167	E0004	01	006	40400101	517	1
6	CT	9001	0167	E0005	01	007	40400101	517	1
7	CT	9001	0167	E0006	01	008	40301019	517	1

1113 rows : 27 columns

Description