Forecasting Tools of the FUTURE

NEW
Forecasting
Tools
Are Coming
SOON

Overview of Talk

- Overview of what we forecast
- List the goals of the project
- Show how we will accomplish the individual goals.

Terminology

- Model = generic term that describes a process of simulating the real physical world
  - Statistical Models
    - Regression
    - Spatial
  - Physical Models

What are these Forecasting Tools?

- Use statistical relationships to estimate future runoff from:
  - Long range historical averages and percentiles
  - Along with current conditions

- Used in creating reports that describe the current water year:
  - Bulletin 120 and unofficial weekly updates
  - Water Supply Index

What we have now:

- A series of Excel spreadsheets stored on a single shared server
- Data is ingested with Microsoft Query and from other spreadsheets
- Statistical data is calculated and stored in Excel spreadsheets and accessed by other spreadsheets

Forecaster Complaints about Current Tools

- The tools are not multi-user friendly
- Making changes to the spreadsheets can be hazardous
- The manual archiving method is too manual
- There is too much separation between the forecasters and some of the spreadsheets
- Updating the models in the tools takes too much time

Simple Calculation

Goals = (-1) Complaints

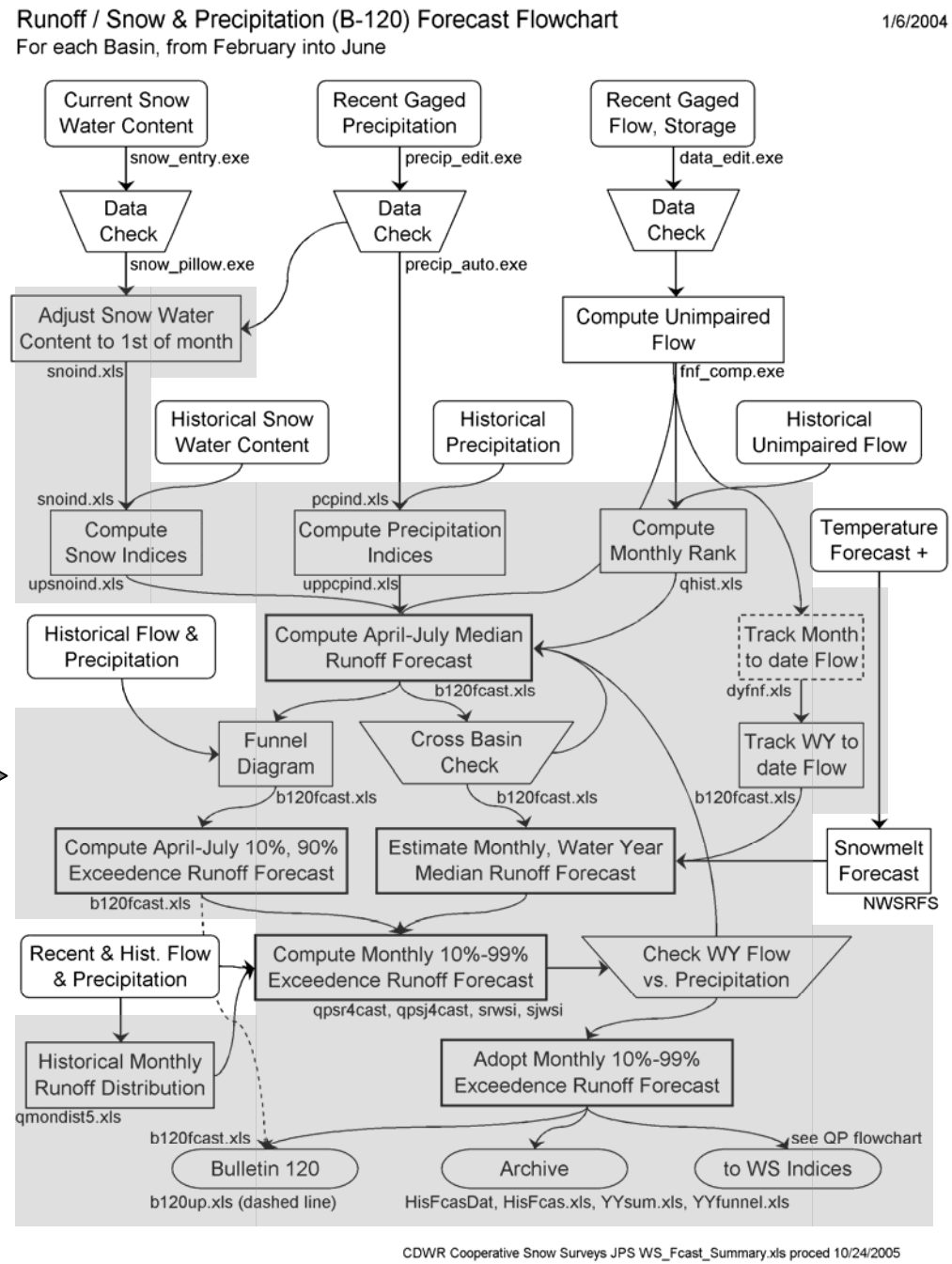
Goals of Future Tools

- Make multi-user friendly
- Making changes should not be hazardous
- The manual archiving should be automatic
- Reduce the separation between the forecasters and their responsible basins
- Updating the models in the tools should be easy
- Keep much of the logic, and flexibility of the current tools

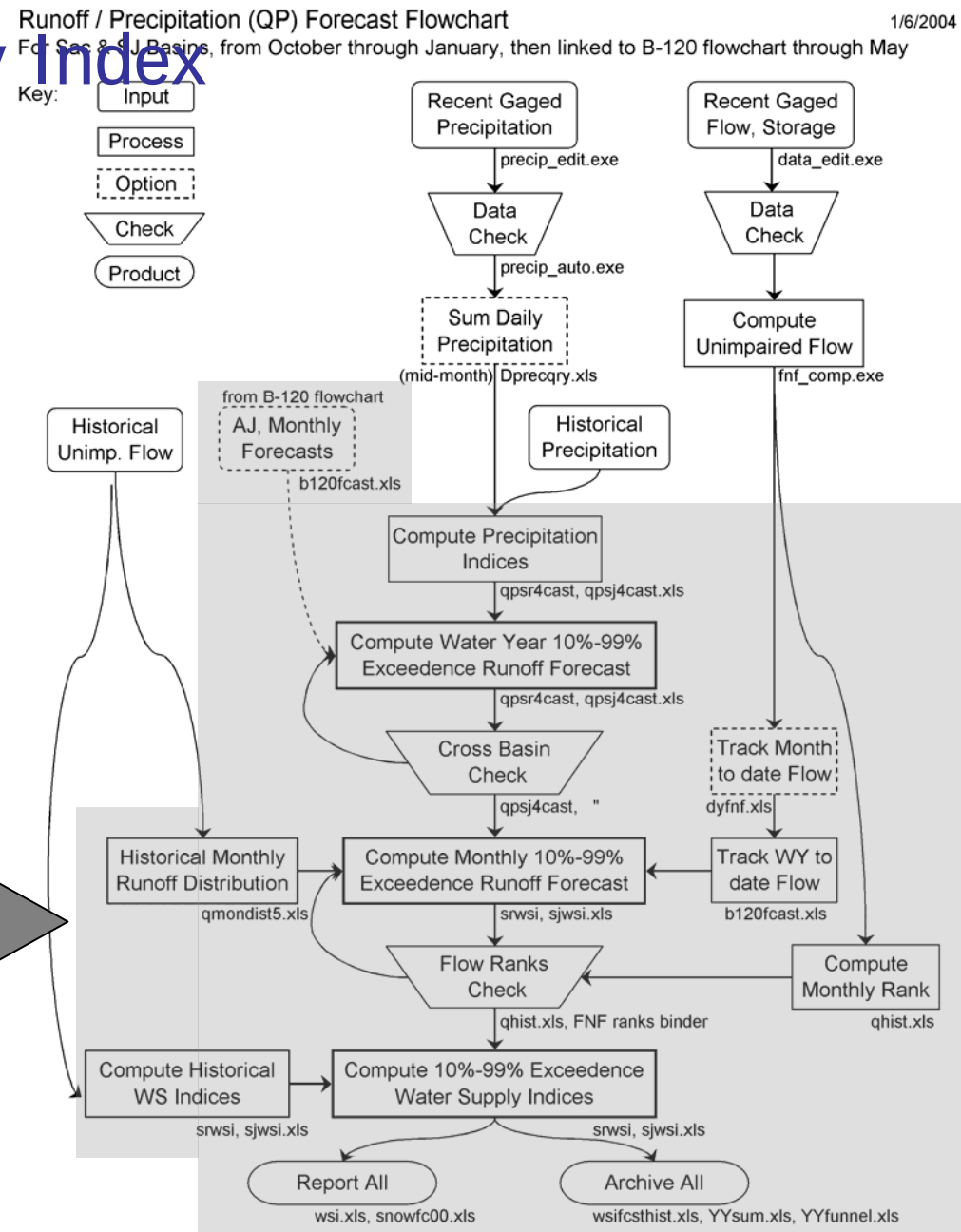
The Model Logic and Equations

Bulletin 120

All of this logic will be incorporated into the new tool



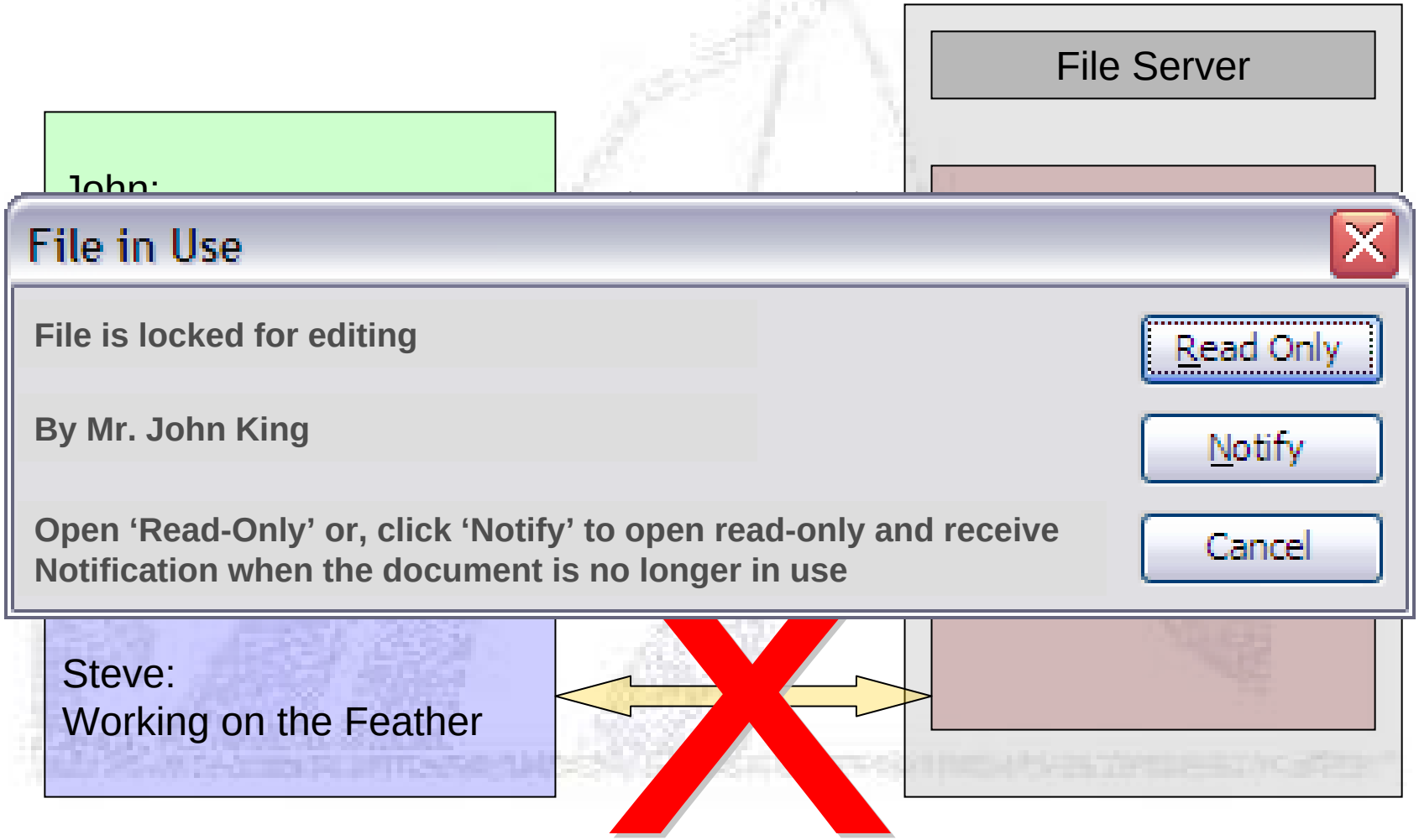
Water Supply Index



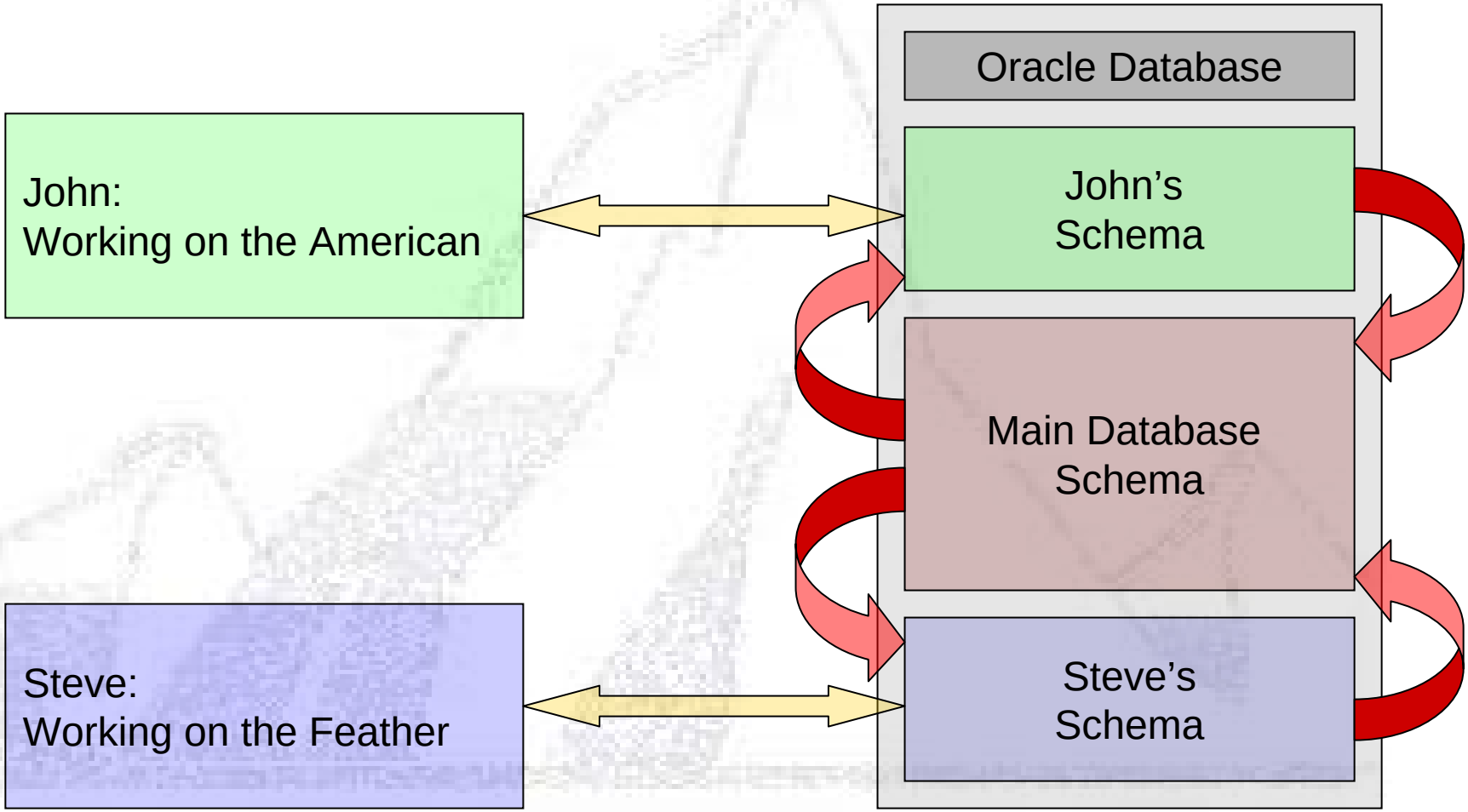
All of this logic will be incorporated into the new tool

Make Multi-User Friendly

Current Interaction



Database Interaction



Making Changes to the Model

Making Changes in Excel

Microsoft Excel - b120fcast.xls

File Edit View Insert Format Tools Data S-PLUS Window Help Adobe PDF

D6 =4.96*B6

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	**April-July Runoff Forecast Regression Equations**									**Archive (copy values from column J to columns K through ...)**														
2	Runoff in [taf]					Date:	6/28/2005			6/28	2/1	2/15	3/1	3/15	4/1	4/12	4/19	4/26	5/1	5/10	5/17	5/24	5/31	6/7
4	**Trinity River inflow to Lewiston Lake**				Avg =	660																		
5		Index	Eq. 1 (10/88)	Runoff	Eq. 2 (11/82)	Runoff																		
6	Snow	113	4.96 S	560	4.897 S	553				113	107	0	94	0	113	113	113	113	113	113	113	113	113	113
7	O-M precip	94	.0072 P²	63	1.077 P	101				94	101	89	87	82	96	96	96	96	94	94	94	94	94	94
8	A-J precip	188	.0076 P²	269	1.322 P +.0028 P²	348				188	91	91	91	91	91	111	99	101	100	158	157	196	190	188
9	Constant	-	-8.7	-9	-101	-101																		
10	Sum			**884**		**901**				884	660	112	575	102	683	714	695	698	691	805	802	906	888	885
11	% of average			134%		137%				901	677	139	597	130	701	739	716	721	713	832	829	919	905	902
12																								
13	**Sacramento River inflow to Lake Shasta**				Avg =	299																		
14		Index	Eq. 1 (10/88)	Runoff	Eq. 2 (3/82)	Runoff																		
15	pre A-J runoff	240	-		.0533 R	13				240	240	240	240	240	240	240	240	240	240	240	240	240	240	240
16	Snow	115	1.065 S +.0046 S²	183	1.24 S +.0036 S²	190				115	114	105	110	101	115	115	115	115	115	115	115	115	115	115
17	O-M precip	99	.2424 P	24	.262 P	26				99	104	93	92	87	101	101	101	101	99	99	99	99	99	99
18	A-J precip	176	1.003 P +.0011 P²	211	1.07 P +.0009 P²	217				176	84	84	84	84	84	103	92	94	95	148	151	179	173	177
19	Constant	-	-4.7	-5	-31	-31																		
20	Sum			**414**		**415**				414	293	273	282	262	295	318	305	307	308	375	380	418	410	415
21	% of average			139%		139%				415	293	273	282	262	295	318	305	307	308	376	380	419	410	416
22																								
23	**McCloud River inflow to Lake Shasta**				Avg =	400																		
24		Index	Eq. 1 (10/88)	Runoff	Eq. 2 (3/82)	Runoff																		
25	pre A-J runoff	352	.135 R	48	.155 R	55				352	352	352	352	352	352	352	352	352	352	352	352	352	352	352
26	Snow	112	.0058 S²	73	.0064 S²	80				112	111	103	110	106	112	112	112	112	112	112	112	112	112	112
27	O-M precip	95	1.12 P	106	1.22 P	115				95	100	90	89	83	96	96	96	96	95	95	95	95	95	95
28	A-J precip	188	.74 P +.0013 P²	207	1.04 P +.0007 P²	221				188	85	85	85	85	85	106	95	98	102	158	165	191	185	189
29	Constant	-	79.7	80	44	44																		
30	Sum			**513**		**515**				513	387	366	374	362	385	408	396	399	401	470	480	516	508	514
31	% of average			128%		129%				515	393	370	378	366	390	415	402	405	407	476	485	518	510	516
32																								
33	**Pit River inflow to Lake Shasta**				Avg =	1090																		
34		Index	Eq. 1 (2/93)	Runoff	Eq. 2 (3/82)	Runoff																		

note / distnote / index / eqn / AJadj / wydist / pub / trib / web / map / 10yr / chk / 2004E(

Draw AutoShapes

Ready NUM

XML Data File

C:\My Documents\exampleInput.xml - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address C:\My Documents\exampleInput.xml

```
<?xml version="1.0" encoding="UTF-8" ?>
<!--
maybe we can set some data parameters up here
like setting of SQL statements for use in the code
  -->
- <Project name="Test XML">
    <SQL_Statement id="select1" value="SELECT object_value FROM test_object WHERE object_id=?" />
    <SQL_Statement id="insert1" value="INSERT INTO test_object_usr (object_id, object_value) VALUES (?, ?)" />
  - <System name="California">
    - <Region name="Sacramento River">
      - <DrainageArea name="UpperSac" description="Upper Sacramento River">
        - <WaterShed name="Sac@Delta" description="Sacramento River at Delta above Shasta Lake">
            <GeoInfo filename="something.shp" />
          - <ModelGroup name="precipIndex">
              <Model name="precipIndex" class="dwr.dfm.wasp.model.PrecipIndex" description="Estimates runoff index from precip" />
            </ModelGroup>
          - <ModelGroup name="snowIndex">
              <Model name="snowIndex" class="dwr.dfm.wasp.model.SnowIndex" description="Estimates runoff index from snow" />
            </ModelGroup>
          - <ModelGroup name="UpperSac.Sac@Delta.B120">
            - <Model name="B120_B" class="dwr.dfm.wasp.model.RegressionModel" description="Does better in dry years">
              - <Formula>
                  <!-- input tags are specific to each model  -->
                  <!-- use the jep library to parse equations  -->
                - <Param var="x">
                    <SQL_select name="2" sql_id="select1" />
                  </Param>
                - <Param var="y">
                    <SQL_select name="5" sql_id="select1" />
                  </Param>
                  <Evaluate var="AJ" equation="2 * x^4 + 2*x - 34" />
                  <Evaluate var="OM" equation="12.3 * y^1.2 + 2*x - y" />
                  <Evaluate var="AJOM" equation="AJ + OM" />
                - <Output>
                    <SQL_insert name="2" var="AJOM" sql_id="insert1" />
                  </Output>
                </Formula>
              </Model>
            - <Model name="B120_A" class="dwr.dfm.wasp.model.RegressionModel" description="Does better in wet years">
              - <Formula>
                  <!-- input tags are specific to each model  -->
                  <!-- use the jep library to parse equations  -->
                - <Param var="x">
                    <SQL_select name="2" sql_id="select1" />
                  </Param>
                - <Param var="y">
                    <SQL_select name="5" sql_id="select1" />
```

Done

My Computer

Stored SQL

WAter Supply Program

File Edit

- Test XML
  - California
    - Sacramento River
      - UpperSac
        - Sac@Delta
          - precipIndex
          - snowIndex
          - UpperSac.Sac@Delta.B120
        - McCloud
          - precipIndex
          - snowIndex
          - UpperSac.McCloud.B120
        - Pit
          - precipIndex
          - snowIndex
          - UpperSac.Pit.B120

Time Parameters | Database Connection | SQL Statements

Name	Value
insert1	INSERT INTO test_object_usr (object_id, object_value) VALUES (?, ?)
select1	SELECT object_value FROM test_object WHERE object_id=?

Add SQL Statement

Name

Value

OK Test

Delete Save

Database Interface

WAter Supply Program

File Edit

- Test XML
  - California
    - Sacramento River
      - UpperSac
        - Sac@Delta
          - precipIndex
          - snowIndex
          - UpperSac.Sac@Delta.B120
        - McCloud
          - precipIndex
          - snowIndex
          - UpperSac.McCloud.B120
        - Pit
          - precipIndex
          - snowIndex
          - UpperSac.Pit.B120

Time Parameters | Database Connection | SQL Statements

UserID: miller

Password: ******

Connection URL: jdbc:oracle:thin:@monsoon.water.ca.gov:1521:cdecdb01

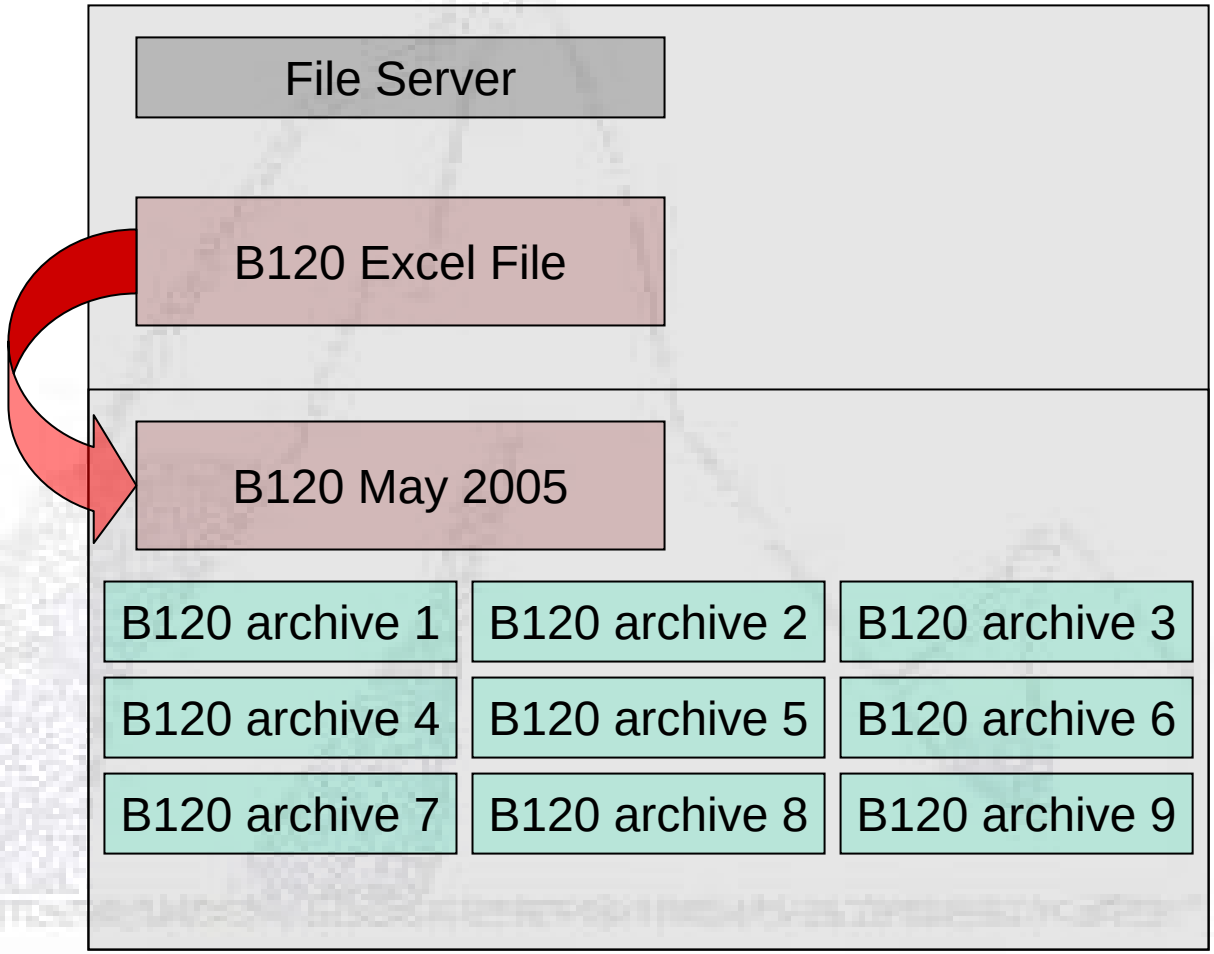
JDBC Driver: oracle.jdbc.driver.OracleDriver

Query DB | Apply | Save as Default

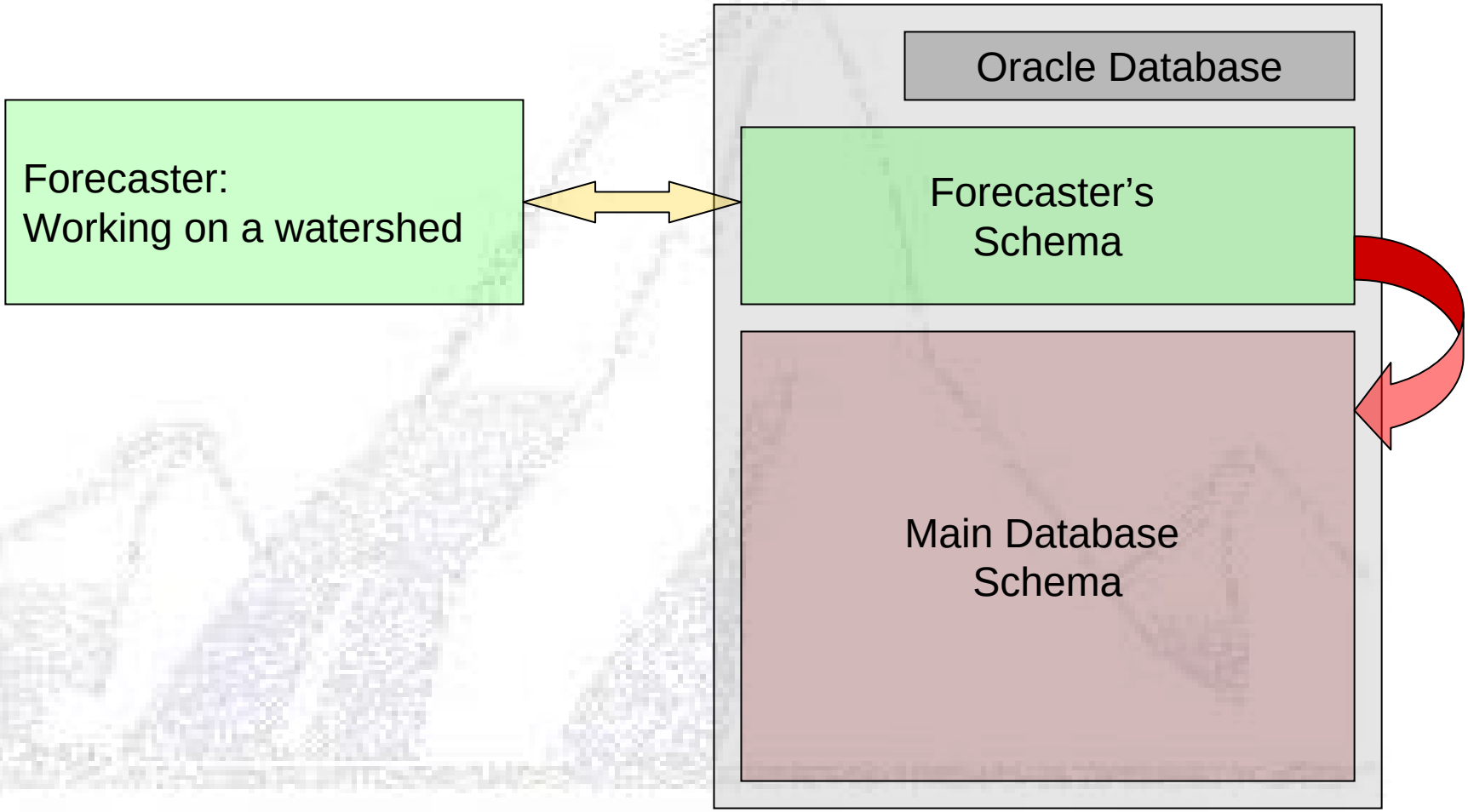
```
Database: Oracle

Version: Oracle8i Enterprise Edition Release 8.1.7.0.0 - 64bit Production
With the Partitioning option
JServer Release 8.1.7.0.0 - 64bit Production

URL: jdbc:oracle:thin:@monsoon.water.ca.gov:1521:cdecdb01

User: MILLER
```

Archiving results

Current Archive Procedure

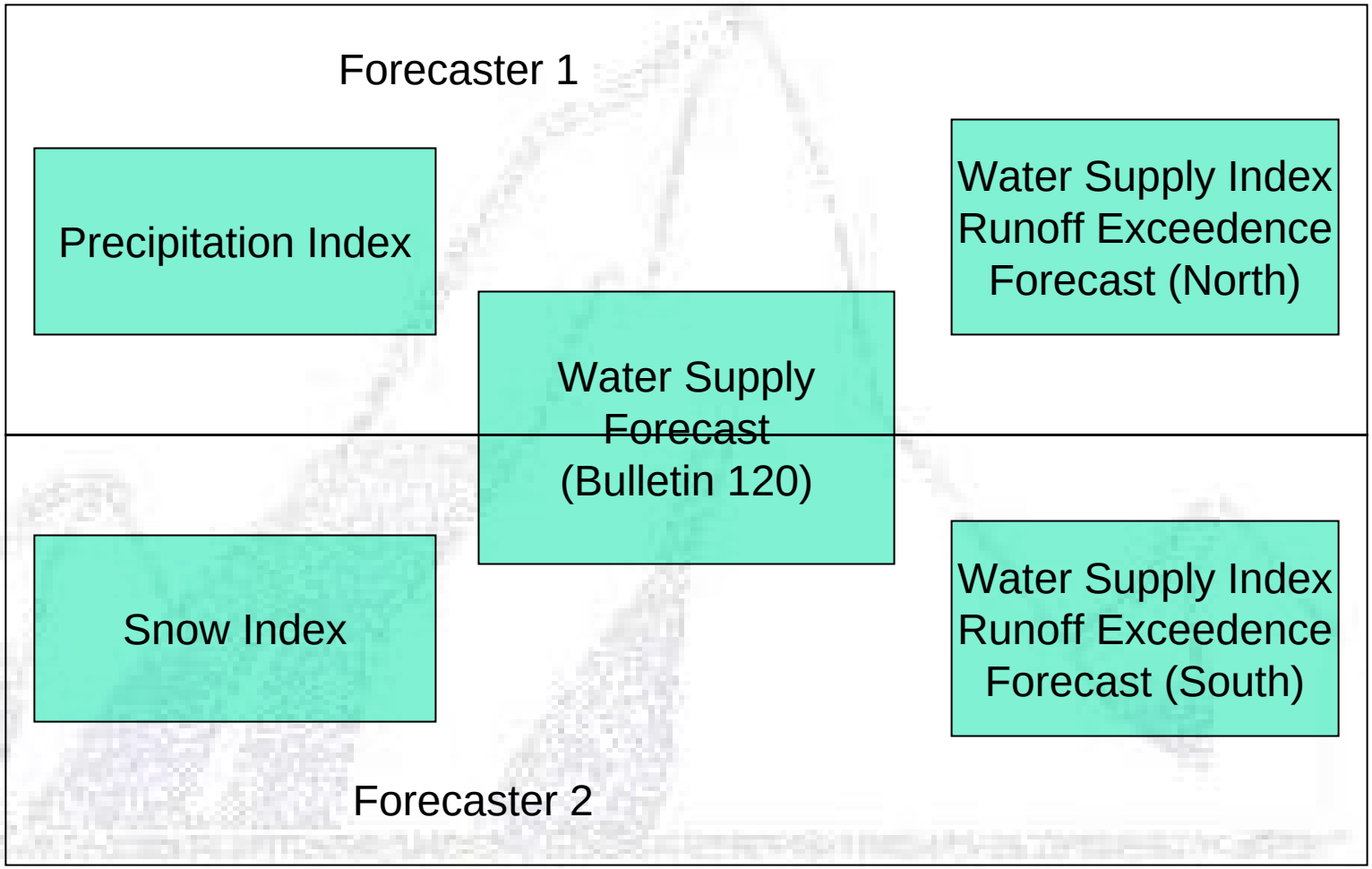


Database Interaction



Reduce Separation

Distribution of Work



New Distribution

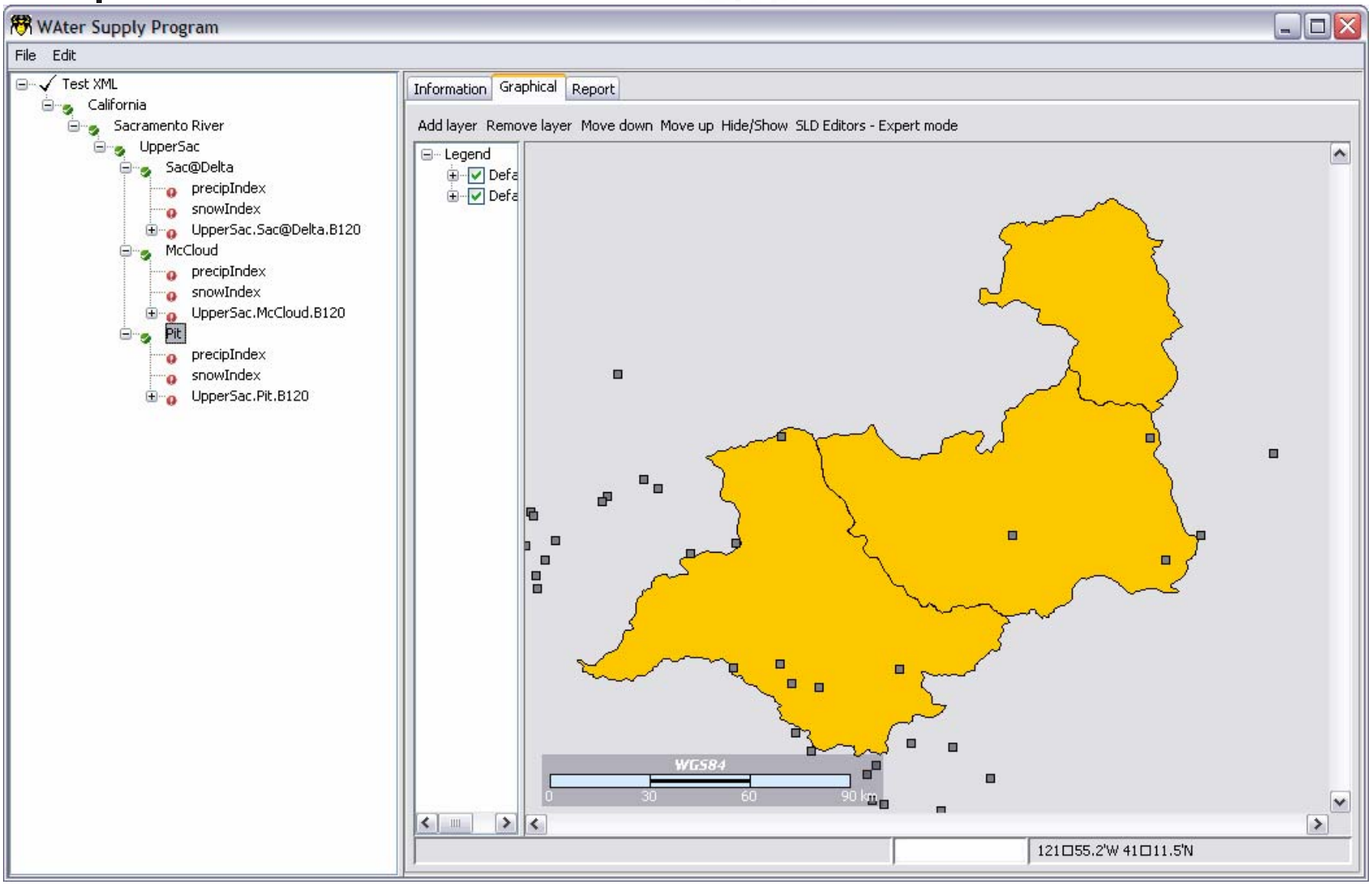
Upper Sacramento Water Supply

- Precipitation Index
- Water Supply Forecast
- Snow Index
- Water Supply Exceedence

Kern Water Supply

- Precipitation Index
- Water Supply Forecast
- Snow Index
- Water Supply Exceedence

GIS Interface



Updating / Adding Models

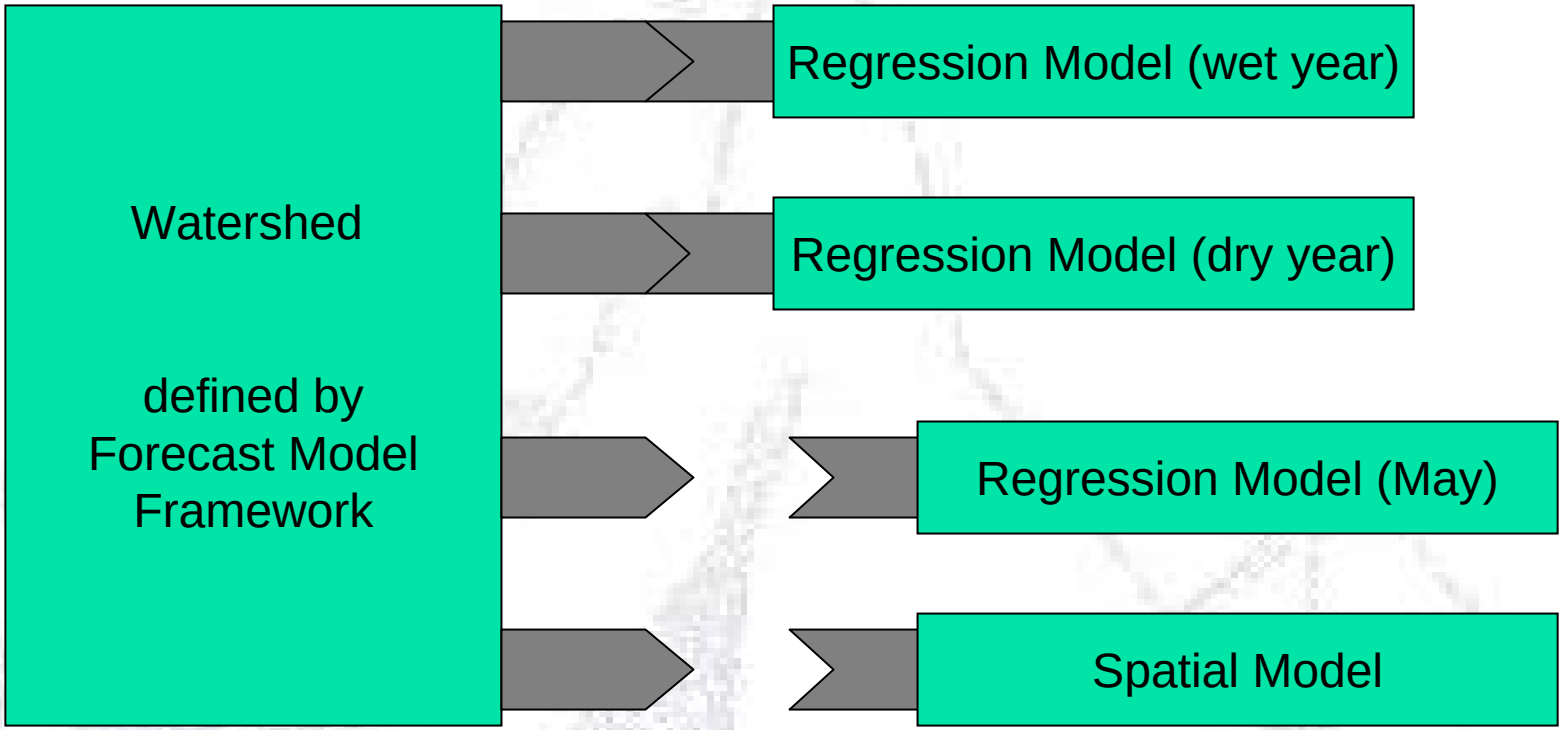
Current Procedure

- Updating Equations in Models (not too hard)
  - Do statistical analysis to estimate parameters
  - Incorporate new equations into spreadsheets
- Adding additional Regression Models would require some spreadsheet reworking
- Adding new types of models would require additional spreadsheets

Future Procedure

- Updating Equations in Models (not too hard)
  - Do statistical analysis to estimate parameters
  - Incorporate new equations into each watershed
- Adding models (not too hard)
  - Do statistical analysis to estimate parameters
  - Create new model in watershed
  - Incorporate new equations into watershed
- Adding new types of models (not too hard)
  - Define model and write it in Java
  - Plug the model into the model frame work
  - The tool incorporates the new model easily

Illustration of Model Plug-In



Forecast Regions

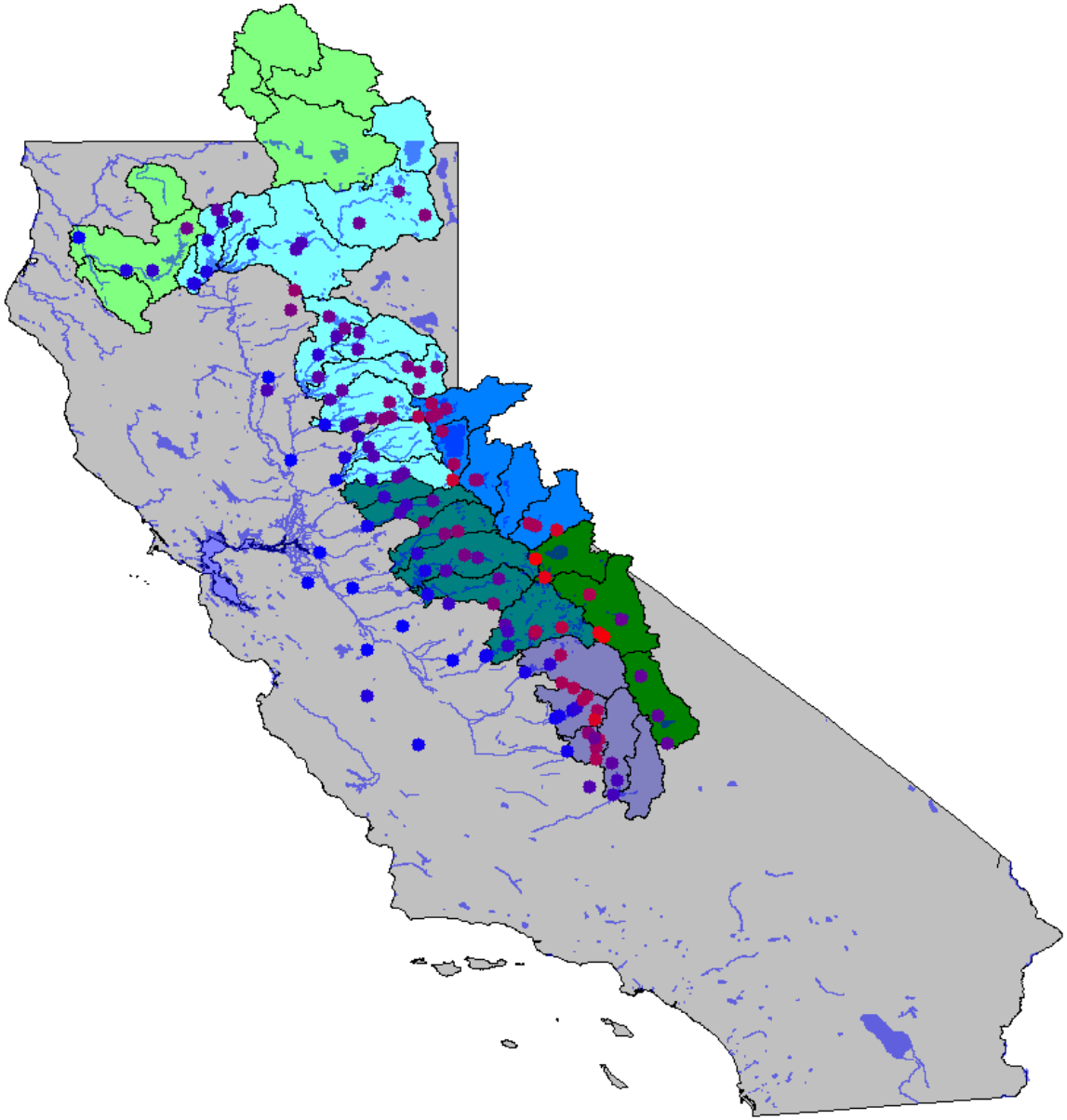
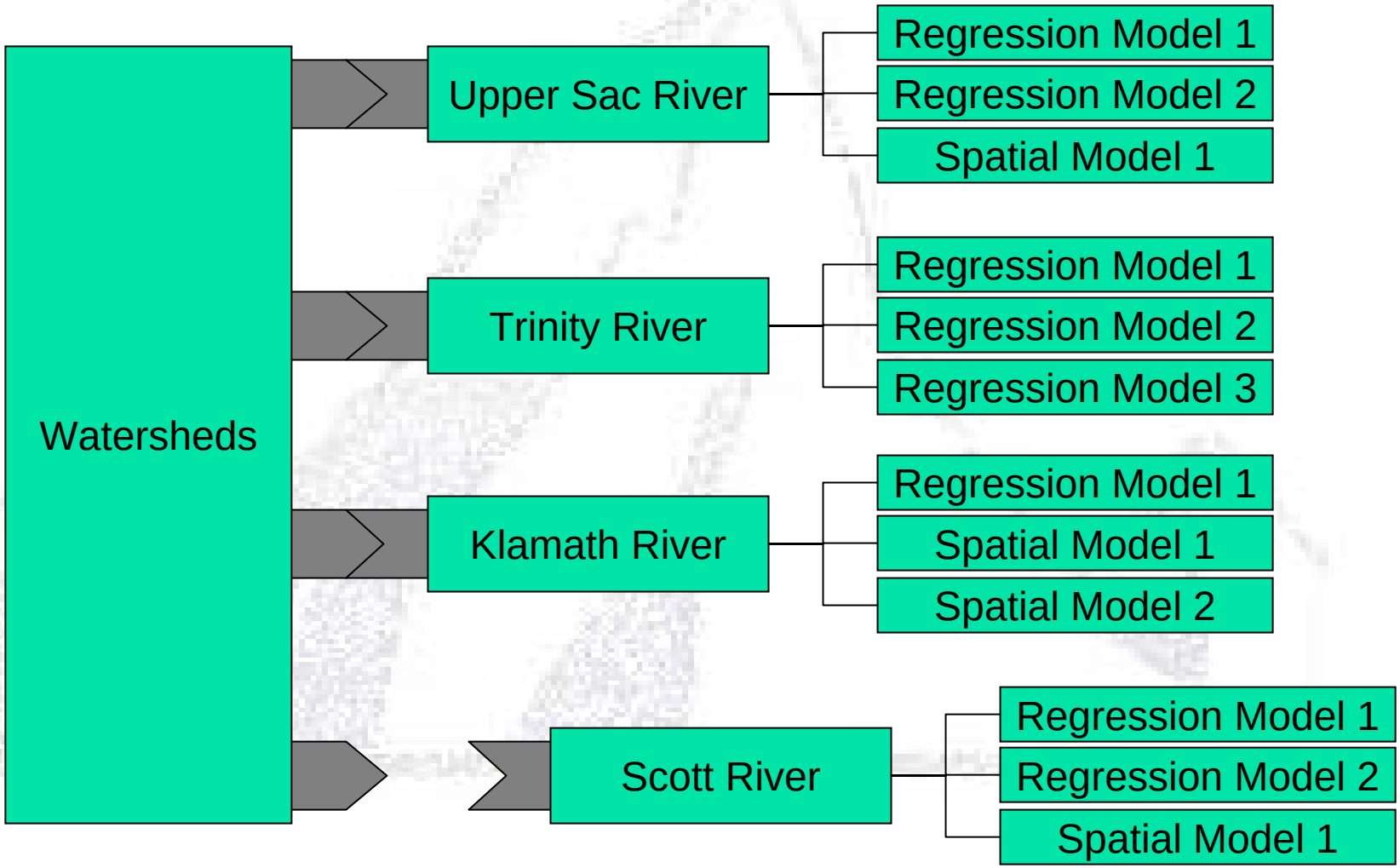


Illustration of Watershed Plug-In



Timeline

- We have already begun developing a new tool
- We should begin testing a regression model in January for one or more watersheds
- Continue to make modifications until next forecast season
- Operate in parallel with current tools and make needed adjustments
- Use as a production tool Water Year 2008

Summary

- The tools that we have for forecasting are sufficient
- Updating the tools will allow forecasters to spend their time forecasting not trying to get the tools to work... hopefully...

Questions ?