The use of the Simple Model for informing environmental science and management:

Is this the right tool for your needs?

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Fact: Field data collection cost heaps!

What is a model?

- Models are simulations of the real environment that allow us to:
    1) Interpolate between temporal sampling points.
    2) Extrapolate spatially to other areas that are not sampled.

- When suitably parameterized, calibrated, and verified, models can predict (with accuracy and precision) concentrations and loads in space and time where and when empirical sampling data are not adequate for locally determined needs.

- In reality, at watershed scales, no model can simulate perfectly, the complex hydrological and biogeochemical processes that occur in watersheds with heterogeneous physical properties and heterogeneous rainfall patterns.

Fact: Models cost heaps of money also!

Types of models

1) Conceptual or "planning level" models
   - low data inputs (land use, pollutant generation rates)
   - Minimum time step: 1 year

2) Assessment models
   - moderate data inputs such as rainfall, soils, land use, topography
   - Use empirical equations such as MUSLE and SCS curve numbers
   - Minimum time step: 1 day and event.

3) Complex conceptual models
   - high data inputs
   - Account for hydrological variability and in-stream processes through calibrated and field verified, concentrations, processes, and discharge data
   - No minimum time step.

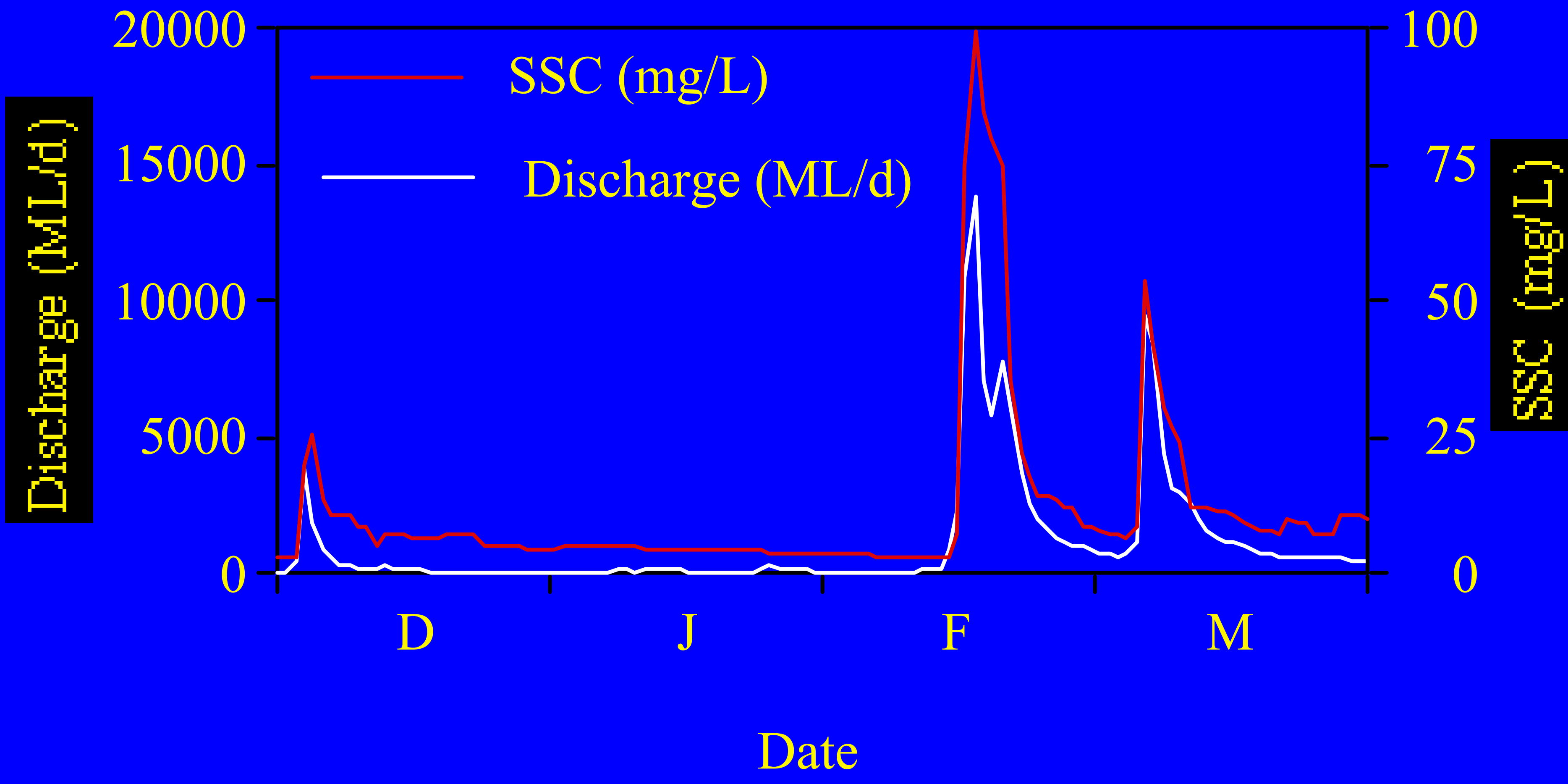
4) Process models have extreme data requirements

Choosing the right combination of model and empirical observation

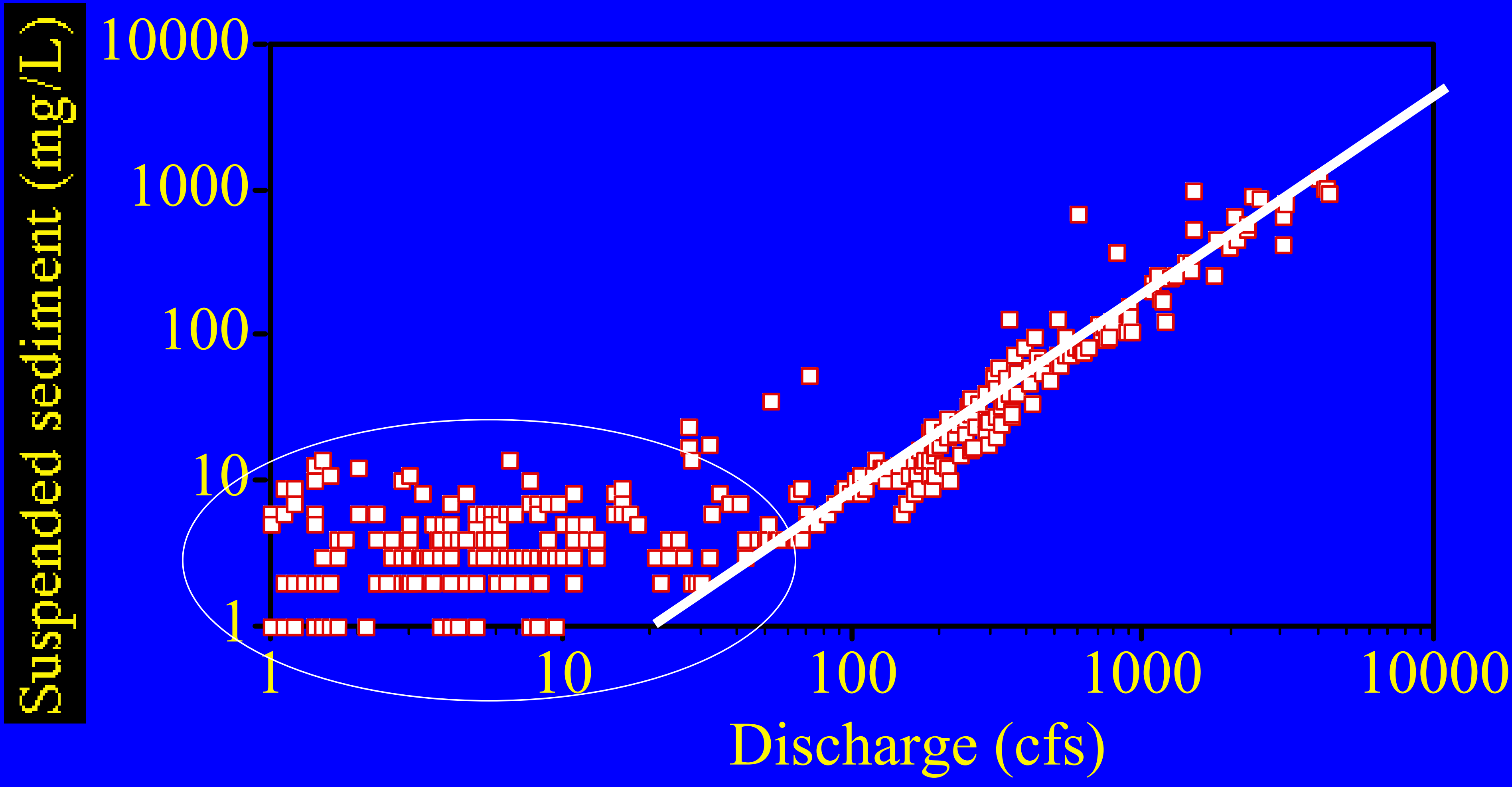
Fact: Even though models can not simulate the environment perfectly, the right combination of a model and observations will reduce long term costs and provide input into local and regional level needs

- Accuracy
- Time step
- Compliance monitoring
- Cost
- Technical expertise
- Logistical issues
- Computer hardware requirements
- Field equipment and personal requirements
- Management questions

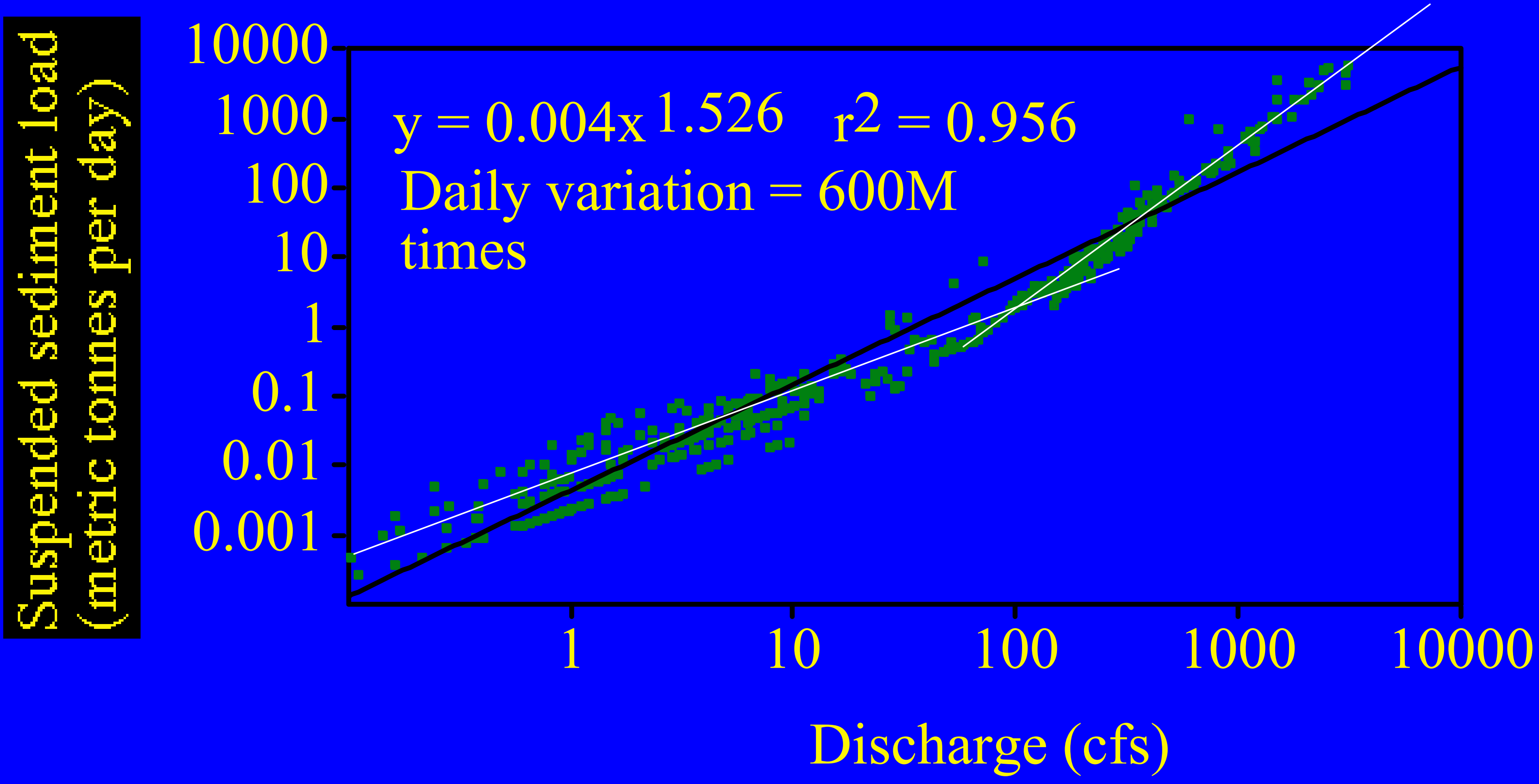
So what are we trying to model?



Is there a relationship between discharge and concentration?



What do empirically derived loads look like?



The Simple Model

So what are the best uses of the simple model?

A planning tool:

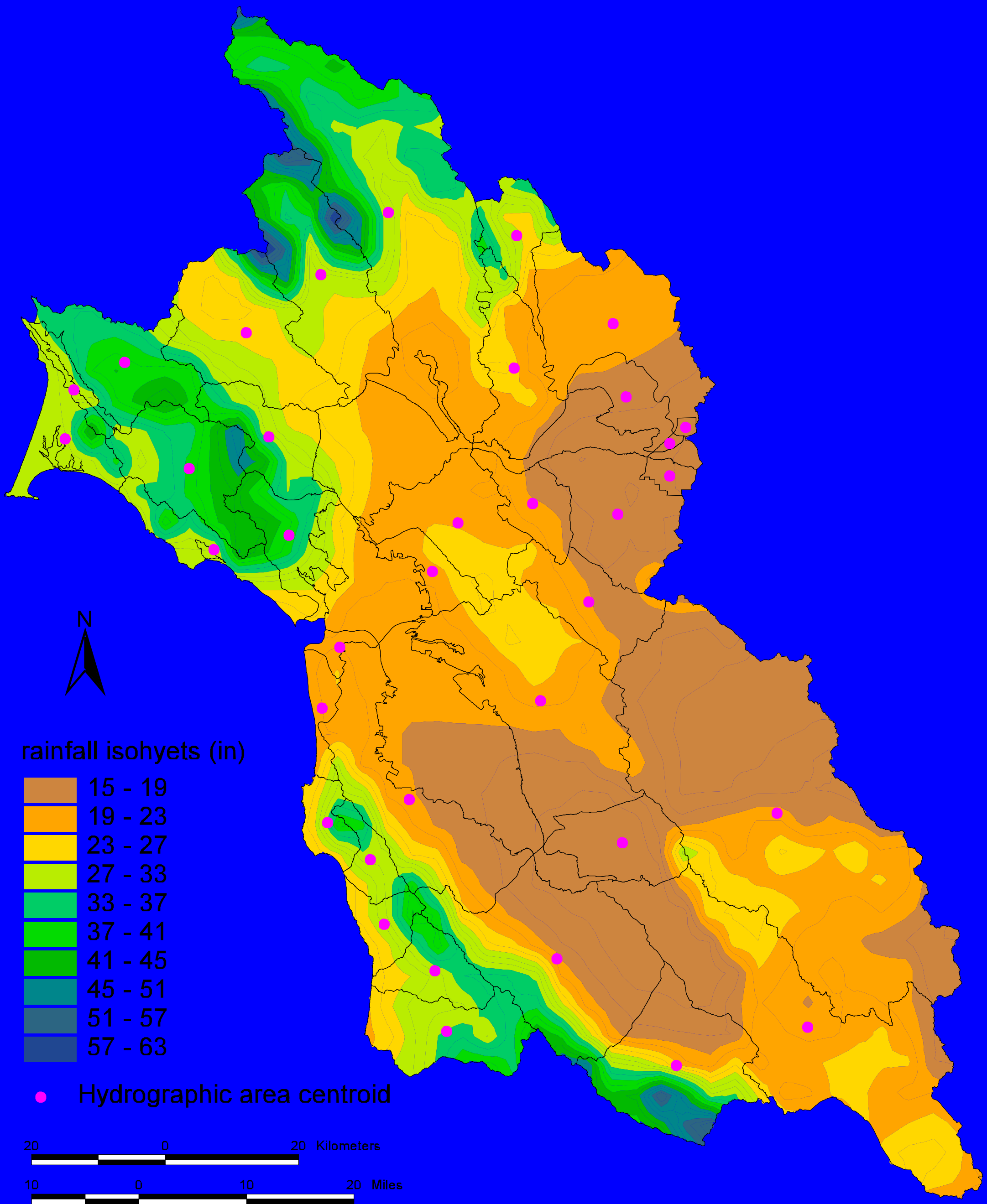
- As an impetus for collating all the data that exists and building an inventory.
- For determining the data gaps and prioritizing future data collection.
- For building hypotheses of loads.
- For educating people about human (relative to natural) effects on pollutant loads

- Making predictions of **RELATIVE** change in impact GIVEN FUTURE LAND USE OR MANAGEMENT CHANGES

How does the simple model work?

To calculate a load for a given land area it combines:

- Rainfall for a chosen land area.



- A runoff coefficient for a given land use.

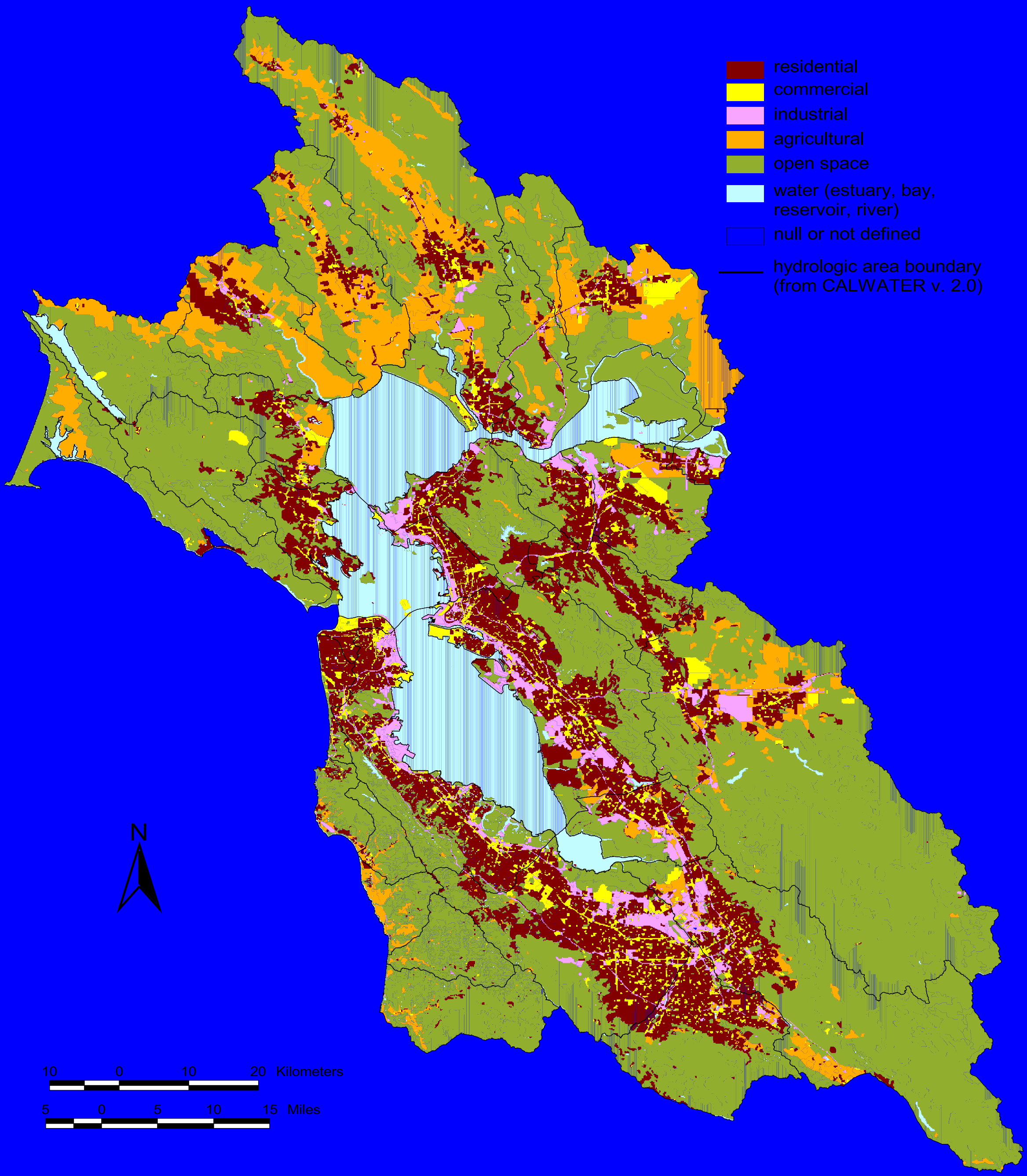
Residential	0.35
Commercial	0.90
Industrial	0.90
Agricultural	0.10
Open	0.25

- A concentration (µg/L) for a given land use.

e.g. lead.

Residential	52
Commercial	151
Industrial	97
Agricultural	60
Open	7

- An area of a given land use.



Example: Napa

Drainage area	420 square miles
Residential	10%
Commercial	3%
Industrial	1%
Agricultural	24%
Open space	62%

How do we calculate loads with the Simple Model?

Load for a given land use = A x R x RC x C

Where A = area of a given land use

R = rainfall

RC = runoff coefficient for a given land use

C = concentration for a given land use

Load for a given area = the sum of the loads for all of the land uses in that area

What major assumptions are made?

- That the runoff response to rainfall is linear.
- That the delivery ratio of pollutant load to the bay is 100% (i.e. no in-stream processes or losses).
- That concentration is a function of land use and that that function is constant over the annual cycle (there are no hysteresis patterns).

http://www.sfei.org/rmp/reports/AB1429/ab14.html

Answers to the BASMAA modeling meeting questions

Objectiveness, Scope and Effectiveness

- The model type is a planning level model for decision support

- The objective of the model is to:
  - provide an impetus for collating all the data that exists
  - determine data gaps and prioritizing future data collection
  - determine approximate loads.
  - educate
  - make predictions of **RELATIVE** change over time

- The modeling method is spreadsheet with input from GIS for land use and land areas
- Model components are rainfall, ABAG land use, runoff coefficients for each land use, and concentrations for each land use
- The model is not normally calibrated. Verification can occur if the output is compared to empirically derived loads in a local watershed
- The outputs from the model are annual average loads of each pollutant for which there is input concentration data
- The model has been used effectively as a planning tool for determining next steps at the SF Bay area level and the state level (AB1429)

- The model gives loads of pollutants as its output however the accuracy and precision are hard to determine
- The pollutants that this model can be used for are any that can be related to land use. For the bay area there are adequate data for: **TSS, Cd, Cr, Cu**, **Pb**, **Ni**, **Zn**, **BOD**, **Nitrate**, **Phosphate**
- The model has been validated for use as a planning tool for decision support. No scientist in their right mind would attempt to validate it as a true representation of hydro-geo-chemical processes

Needed resources

- The model can use rainfall for any year or average rainfall depending on the desire of the user
- The model has low data needs, low computing power needs, low technical understanding requirements. The GIS input is simple land use and area
- The land use resolution can be any resolution that is available but ABAG land use is appropriate

Ease of use

- The model has no user interface. All its data requirements are entered into Excel spreadsheets including outputs from GIS
- The model is therefore compatible with any GIS output
- The models processing time scale (time step for output) is usually 1 year but it could be used at shorter time scales of 1 month or 1 day if the data are available (this seems unlikely)

- The model can be used to predict improvements associated with BMPs but only within the bounds of the model parameters. For example, sediment catch basins, reductions in runoff, and changes in land use

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