

# Progress to December 2002

## Clarity Model, Stream Particles, In-lake Particles

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# Project Components

## ➤ Tahoe Clarity Model

- Continued Model Development
- Data compilation
- Model Validation
- Synthetic data set
- Long term management scenarios
- TMDL

## ➤ Related Research

CARB	Air Sample ICP-MS
USGS	Groundwater PSD and ICP-MS
	Other lakes PSD and ICP-MS
NASA	Remote sensing
UCD	Real-time meteorological network
DRI	Near-shore turbidity

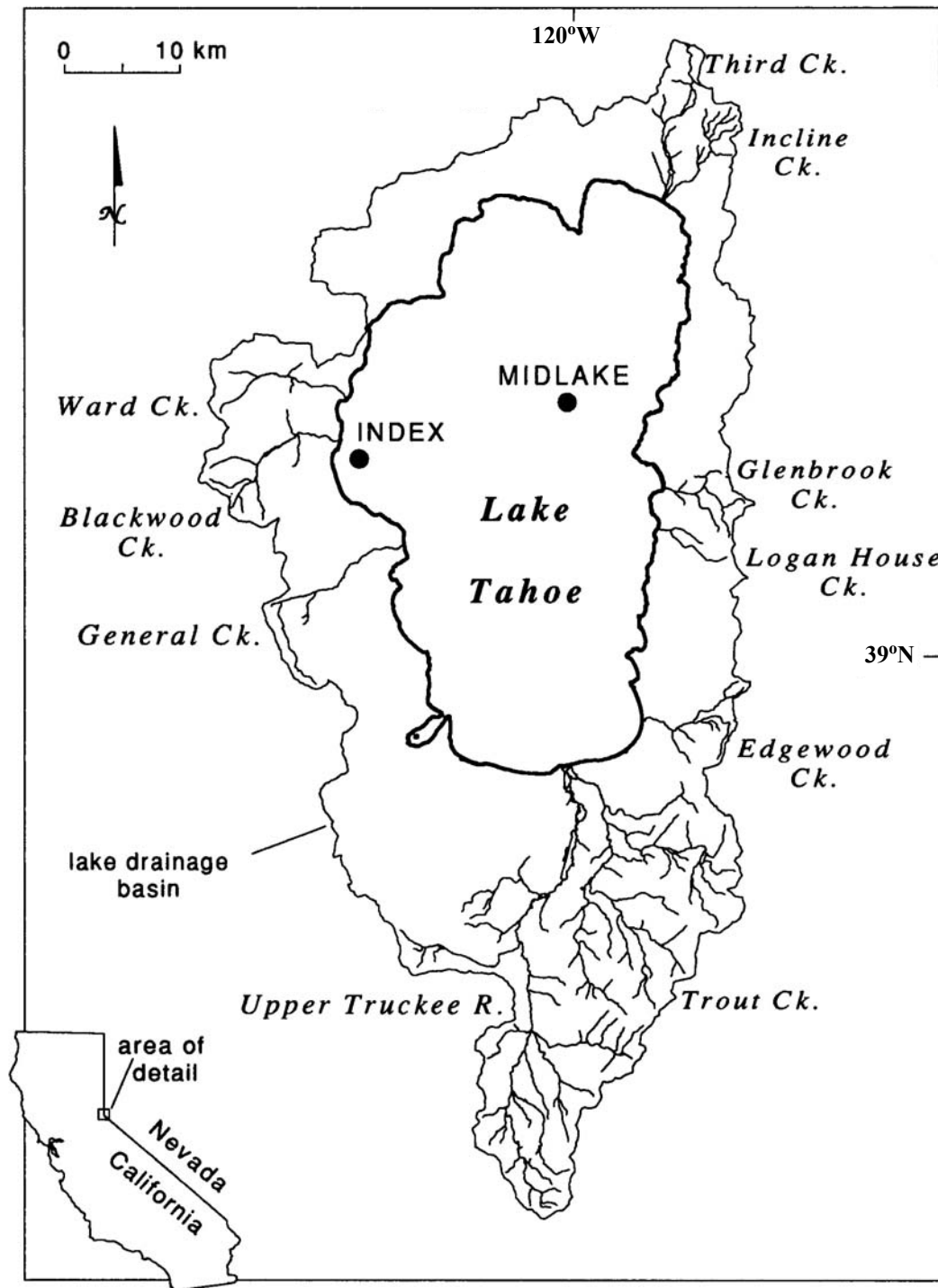
## ➤ Aggregation (in lake)

- Characterization of lake constituents
  - Epifluorescence microscopy
  - Confocal laser scanning microscopy
  - Flow cytometry
  - PSD
  - ICP-MS
  - Sediment traps and biofilm plates

## ➤ Streams

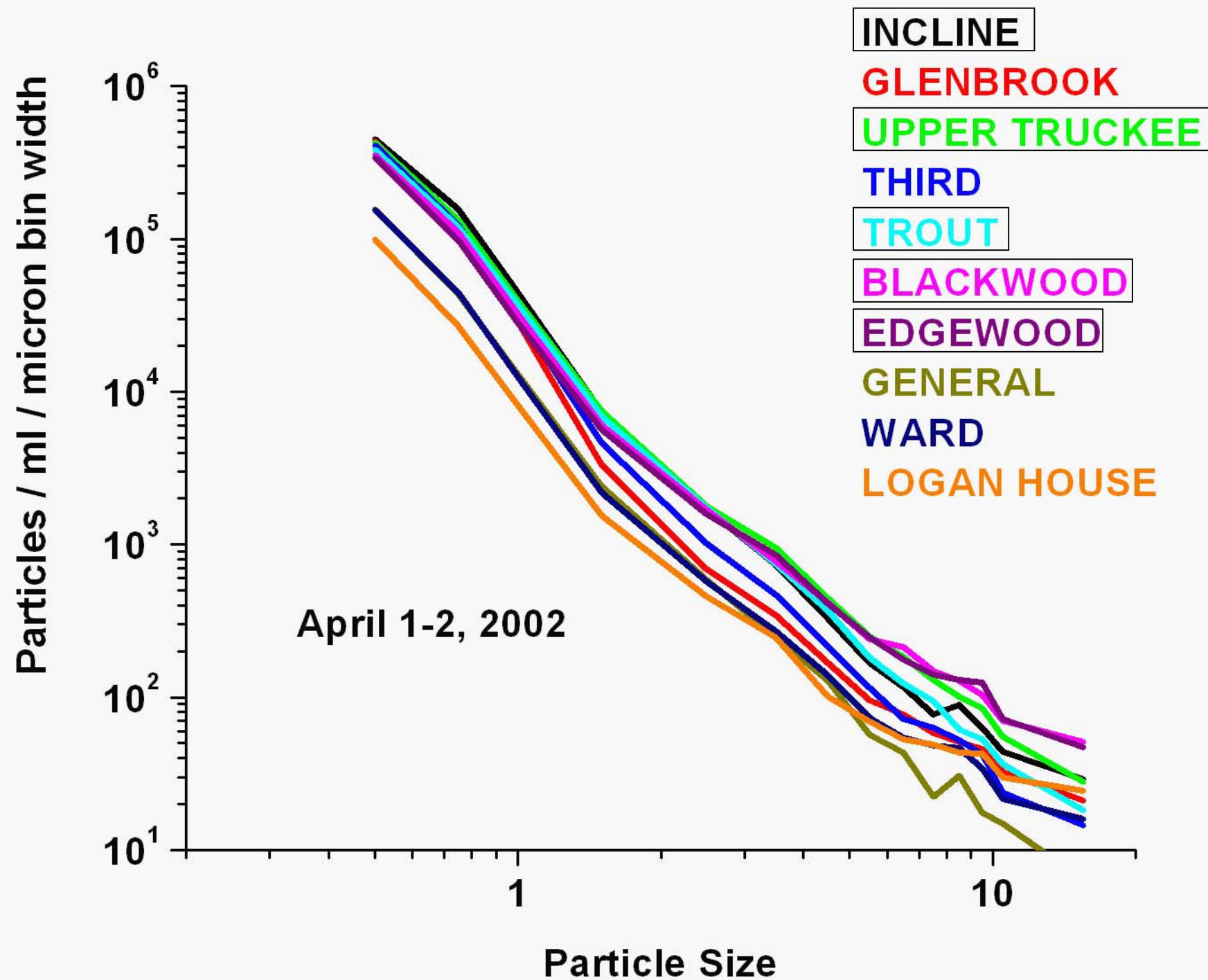
- Characterization of stream constituents
  - PSD
  - ICP-MS



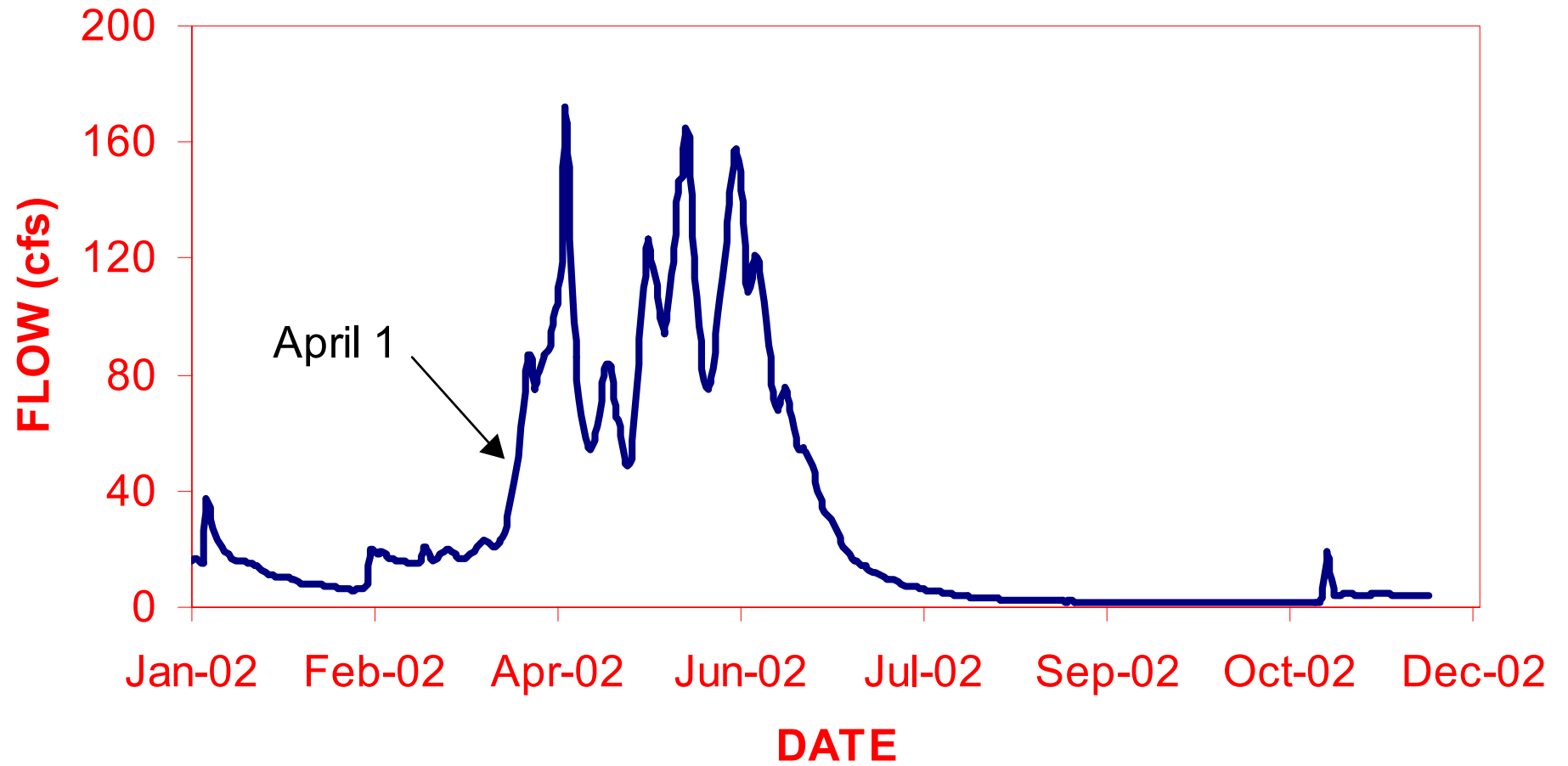


# 10 LTIMP STREAMS



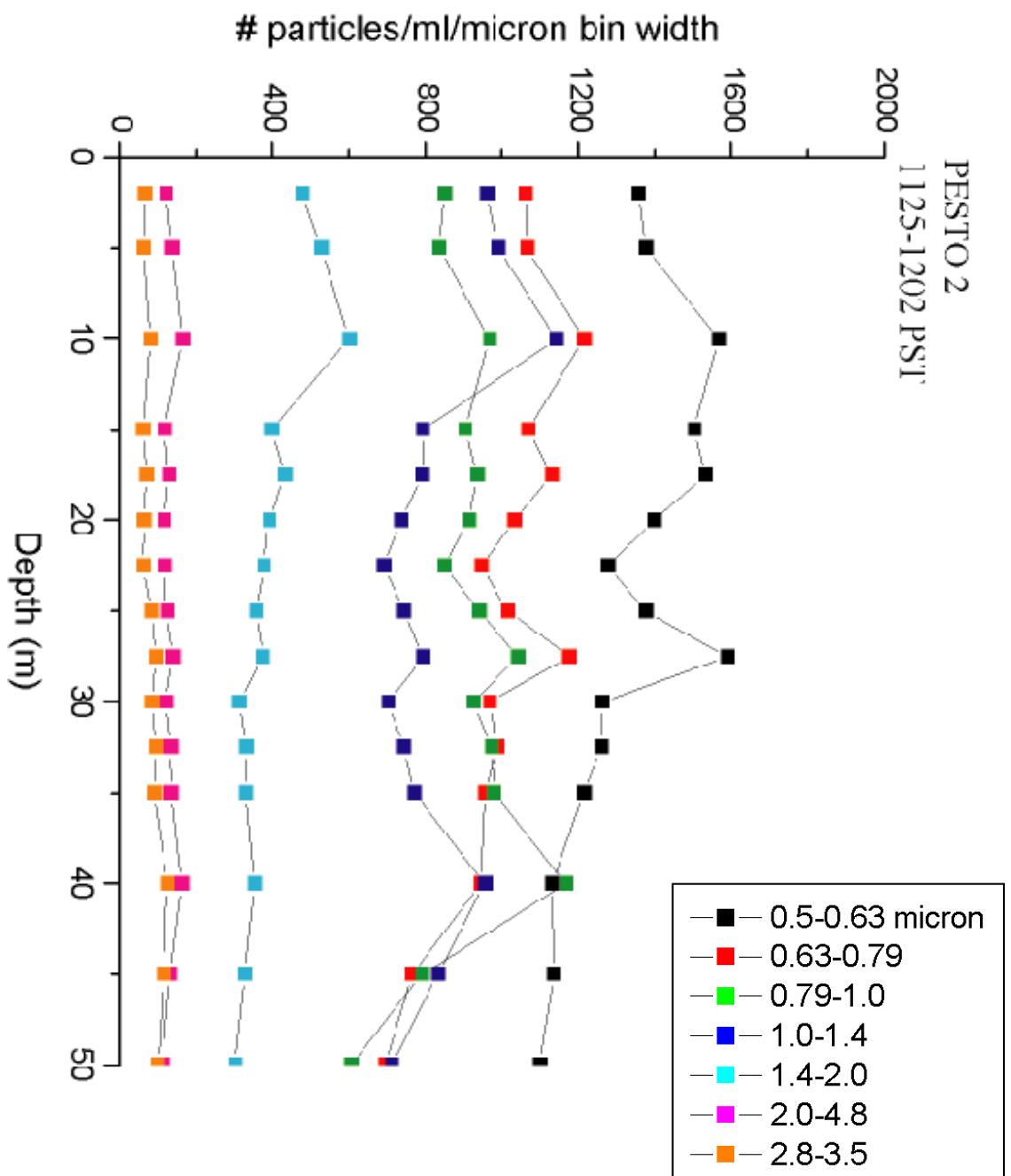


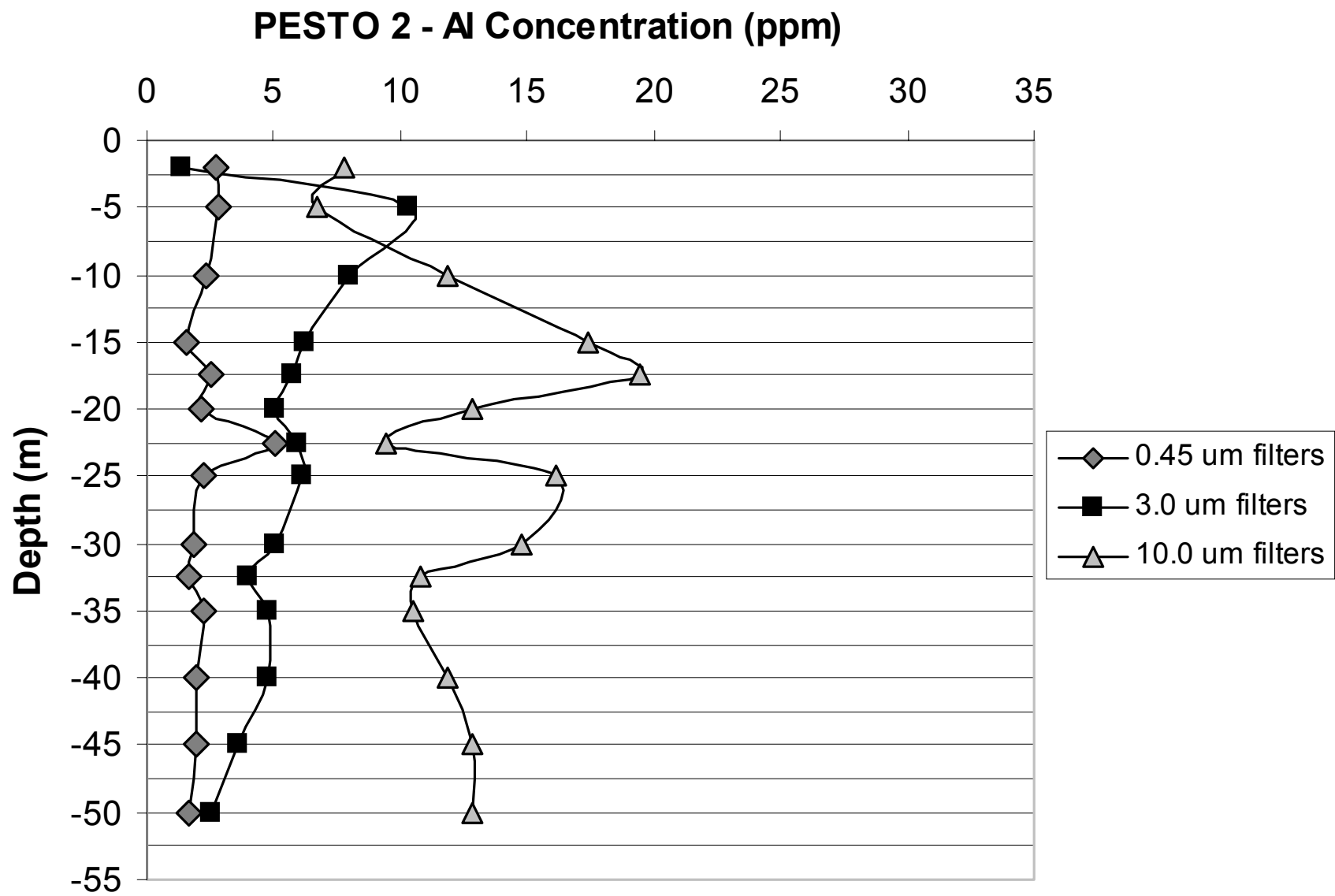
# BLACKWOOD CREEK



# Questions

- Nature of particles – organic vs inorganic?
  - Particle sizing and enumeration, serial filtration, ICPMS, flow cytometry
- Source of particles?
  - Streams, near shore turbid zones, air deposition
- Removal mechanisms – role of bacteria in aggregation?
  - Analyze biological material in suspended lake aggregates  
Grow biofilms in the lake and check their composition  
Collect aggregates in sediment traps and study them noninvasively
- Transparency dynamics in water column?
  - In-lake observation

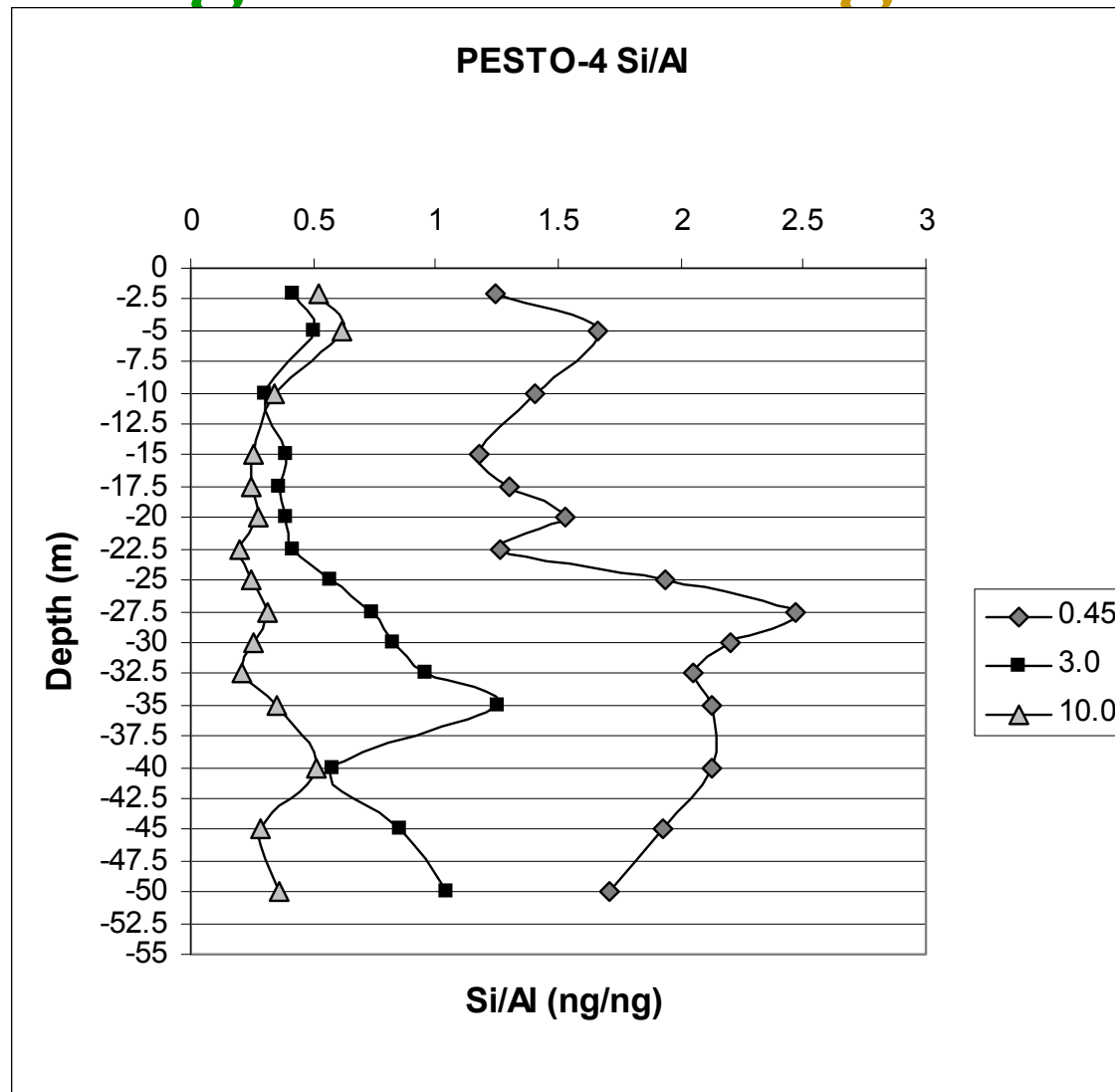






# Nature of Particles

## Organic vs Inorganic



# Lake Tahoe Clarity Model

## DLM-WQ Components

### Physical Sub-Model:

- Thermodynamics.
- Mixing Layer Dynamics.
- Hypolimnetic Processes.
- Inflows & Outflows.
- Ground Water.

### Water Quality Sub-Model:

- Phytoplankton.
- Nutrients.
- Inorganic Particles.
- Oxygen.
- Atmospheric Deposition.
- Zooplankton & Mysis.

### Optical Sub-Model:

- Absorption.
- Scattering.
- Link to Secchi Depth.

### Input Data (WQ & Physical):

- Meteorological.
- Inflow (Rate & WQ).
- Initial Conditions.
- Physical Parameters.

### Model Assumptions:

- Forcing Parameters.
- 1-D Assumption.

## DLM-WQ Linkages

### PHYSICAL FORCING INPUTS

**MET** [U, SW, LW, RH, T, PRECIP]  
**STREAMS** [Q, T]  
**GROUNDWATER** [Q]

### WATER QUALITY INPUTS

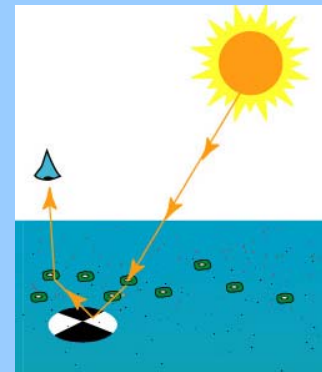
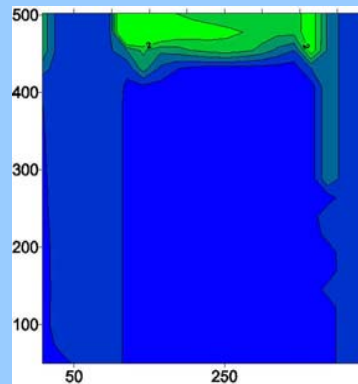
**STREAMS** [DO, BOD, CHL<sub>a</sub>, **P** (PP, THP, POP, RP),  
**N** (NO<sub>3</sub>, NH<sub>4</sub>, DON, PN, PON), # PART]  
**G/WATER** [**P** (THP, RP), **N** (NO<sub>3</sub>, NH<sub>4</sub>, DON), # PART]  
**ATMOS** [**P** (THP, POP, RP), **N** (NO<sub>3</sub>, NH<sub>4</sub>, DON)]

### LAKE CLARITY MODEL

**BIOLOGY**

**PHYSICS**

Vertical  
distribution of  
the State  
Variables as a  
function of time



# Optical Sub-Model Definition

Scattering by organic particles

Scattering by inorganic particles

Scattering by pure water

Scattering

Absorption by pure water

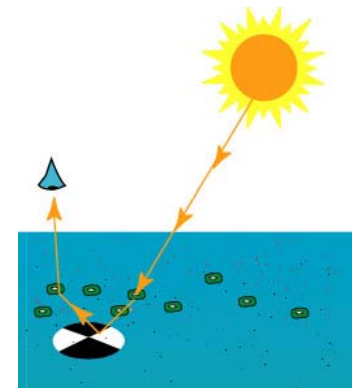
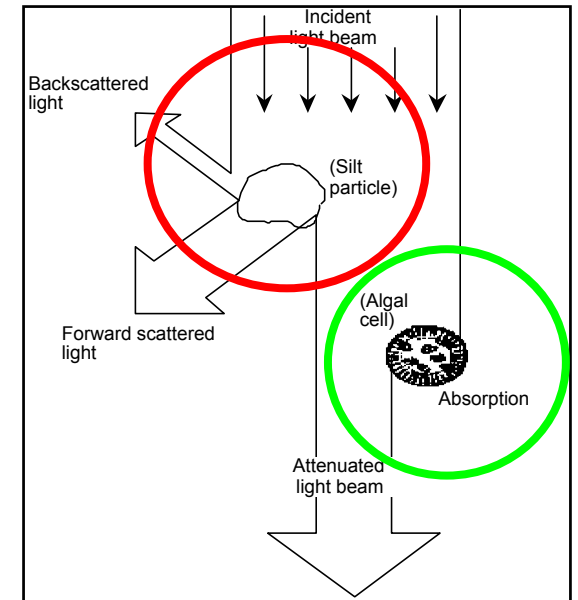
Absorption by CDOM

Absorption by organic particles

Absorption

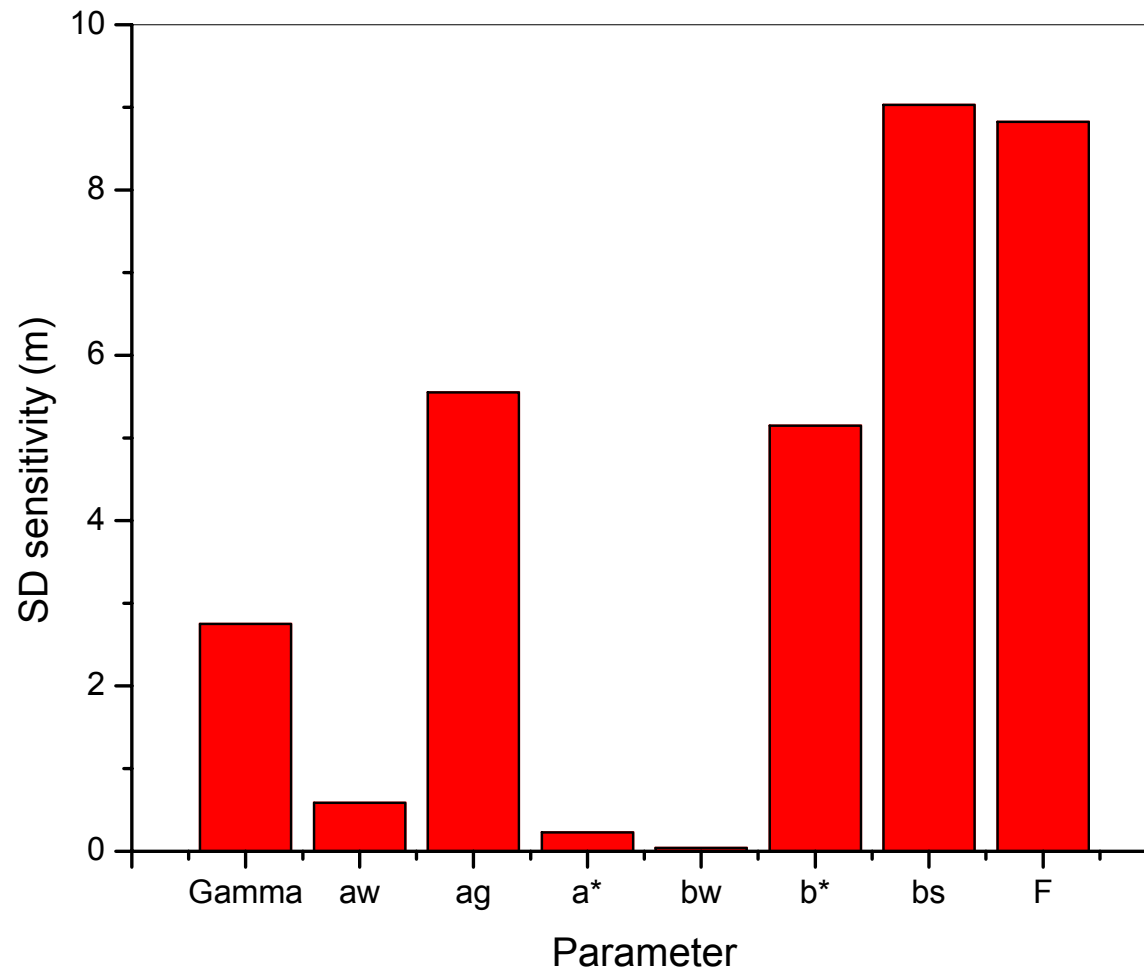
Photopic Response

$$SecchiDepth = \frac{\gamma}{(c + K_d)}$$



# Parameter Sensitivity

1999 - 2001



$$SecchiDepth = \frac{\gamma}{(c + K_d)}$$

$$c = a + b$$

$$a = a_{water} + a_{gelb} + a_{Chla}^* \cdot [Chla]$$

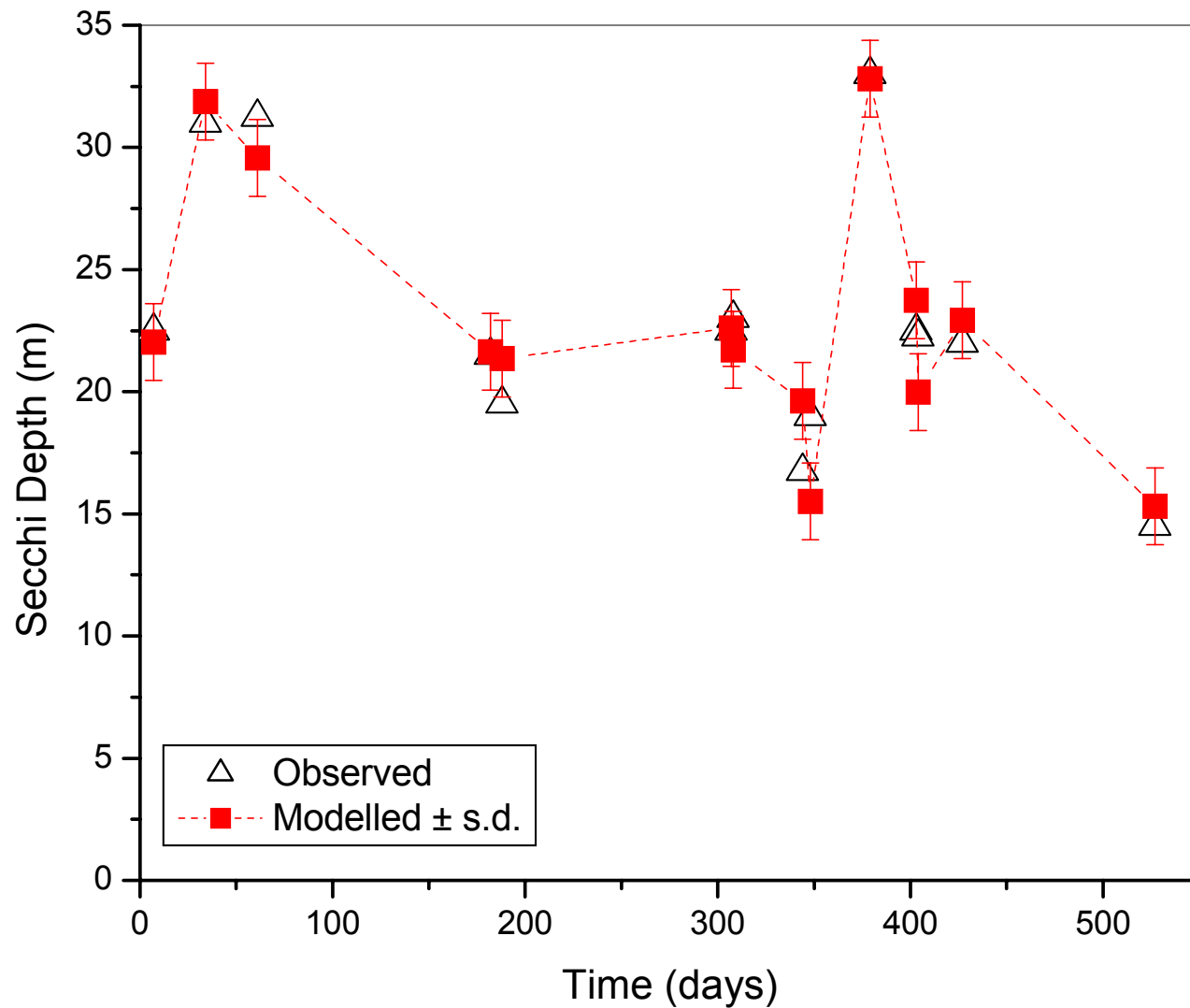
$$b = b_{water} + b_{sed} + b_{Chla}^* \cdot [Chla]$$

## Optical Sub-Model Parameters

1. Constant (gamma)
2. Water absorption (aw)
3. Gelbstoffe absorption (ag)
4. Chl-a specific absorption (a\*)
5. Water scattering (bw)
6. Chl-a specific scattering (b\*)
7. Sediment scattering (bs)
8. Inorganic fraction (F)

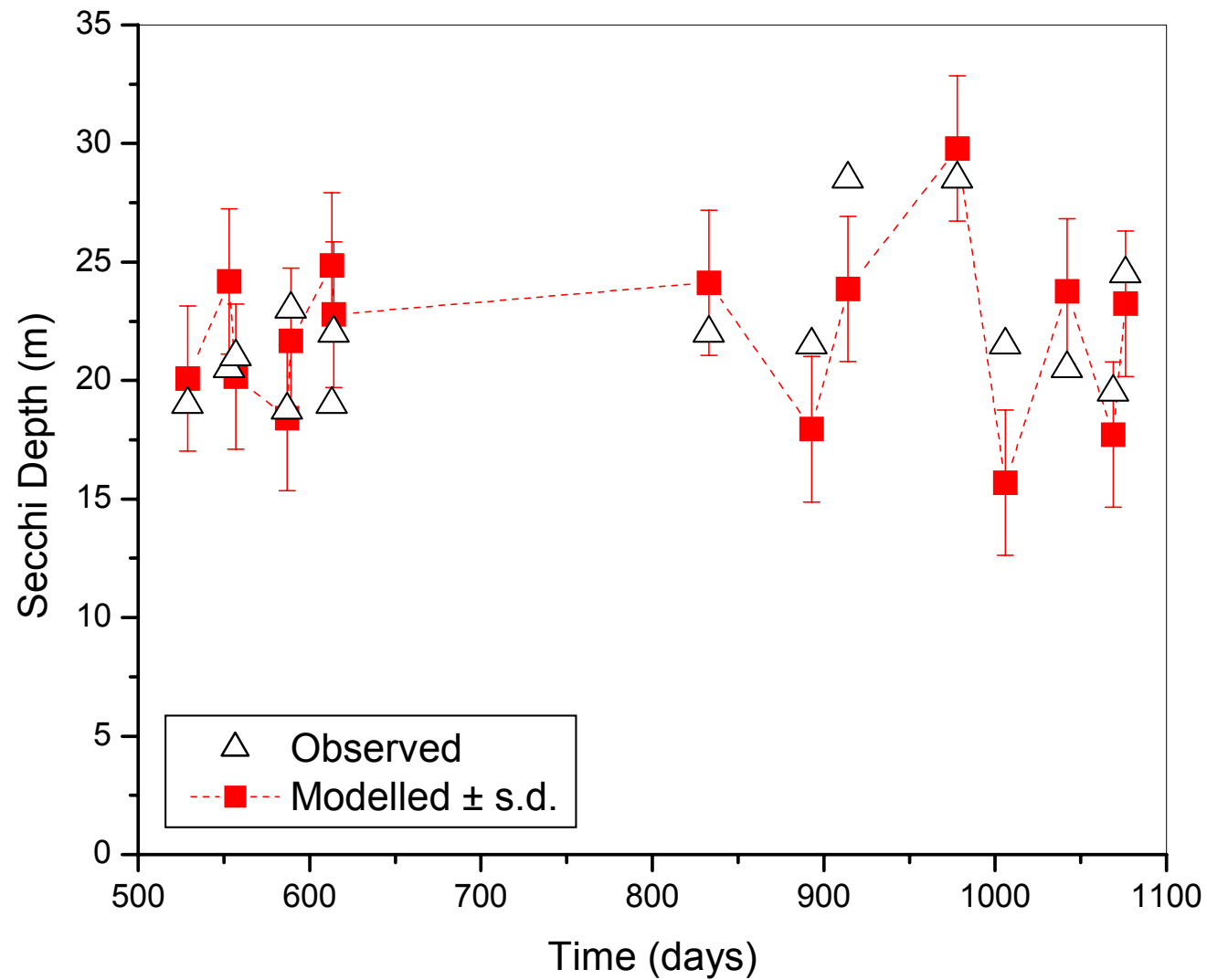
# Calibration of Optical Sub-Model

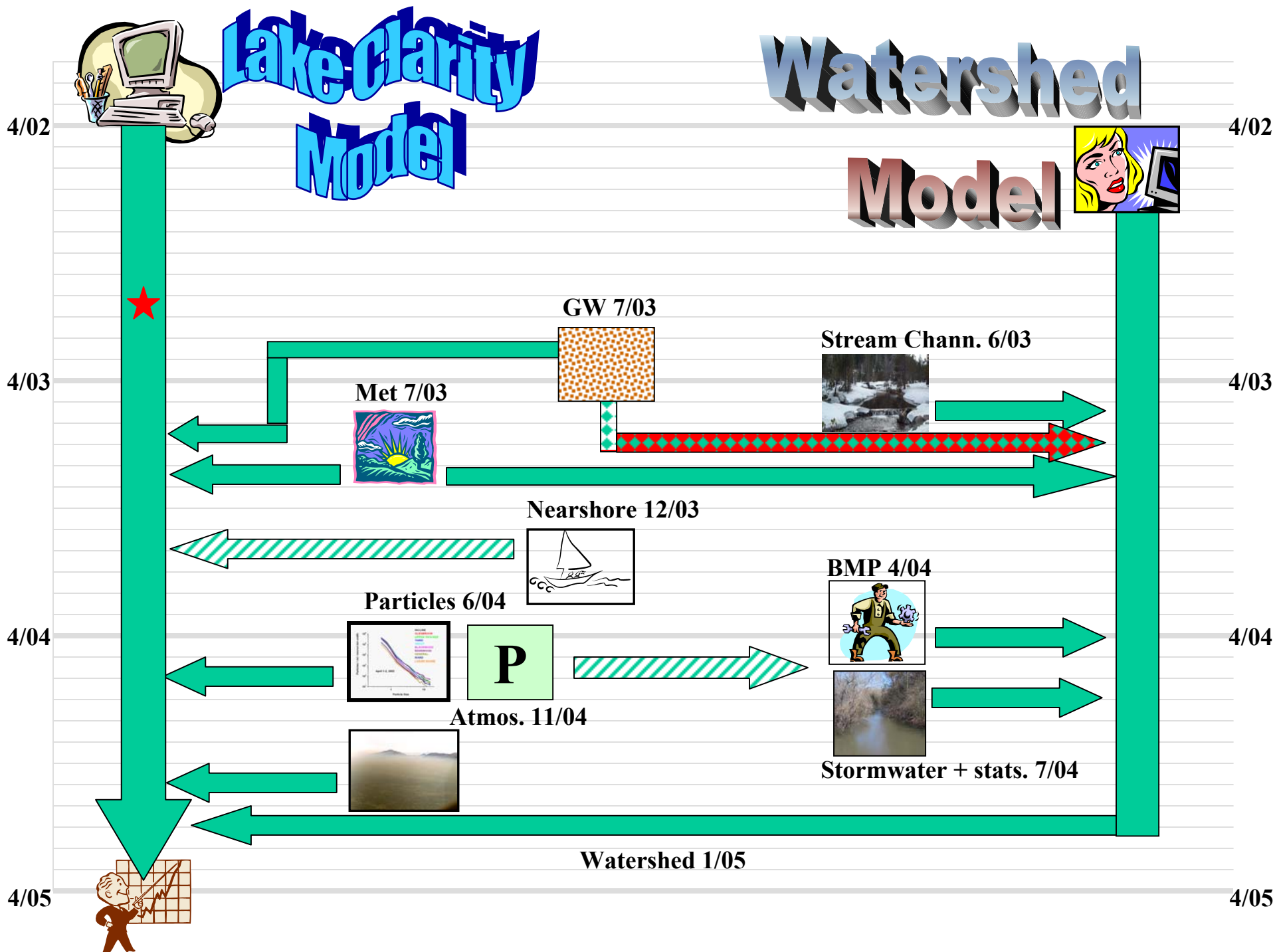
1999 - 2000



# Validation of Optical Sub-Model

2000 - 2001







# Things we need to help make Dave happy

- “Preliminary inputs” long before final reports
- Met data
  - Validation:reconstructed + hydrology to match lake level
  - Future scenarios – next 50 years may not be like the last 50 years?
- Groundwater – demarcation between direct lake input and stream input. Intervening zones?
- Nearshore Turbidity Zone – are these stagnant hot spots? If not, what is flux?
- Stream particles, nutrients – if important, plunge depth of streams?
- Aggregation
- Nutrients – linkages between BAP and SRP/TP. Particle/BAP? – maybe atmospheric particles too?
- Atmospheric – particle loads, P-loads. Do controlled burns have an effect? Effect of a hot burn?
- Channel erosion
  - PSD and ICP-MS of erodable material
  - Linkage between Q, TSS, PSD
  - How factored in hydrology output
- Stormwater runoff
  - ICP-MS analysis
  - Intervening zones? Or hydrological model output
  - Bob Coates methodology for P, N and particles (for calibration, validation)
- BMP effectiveness early