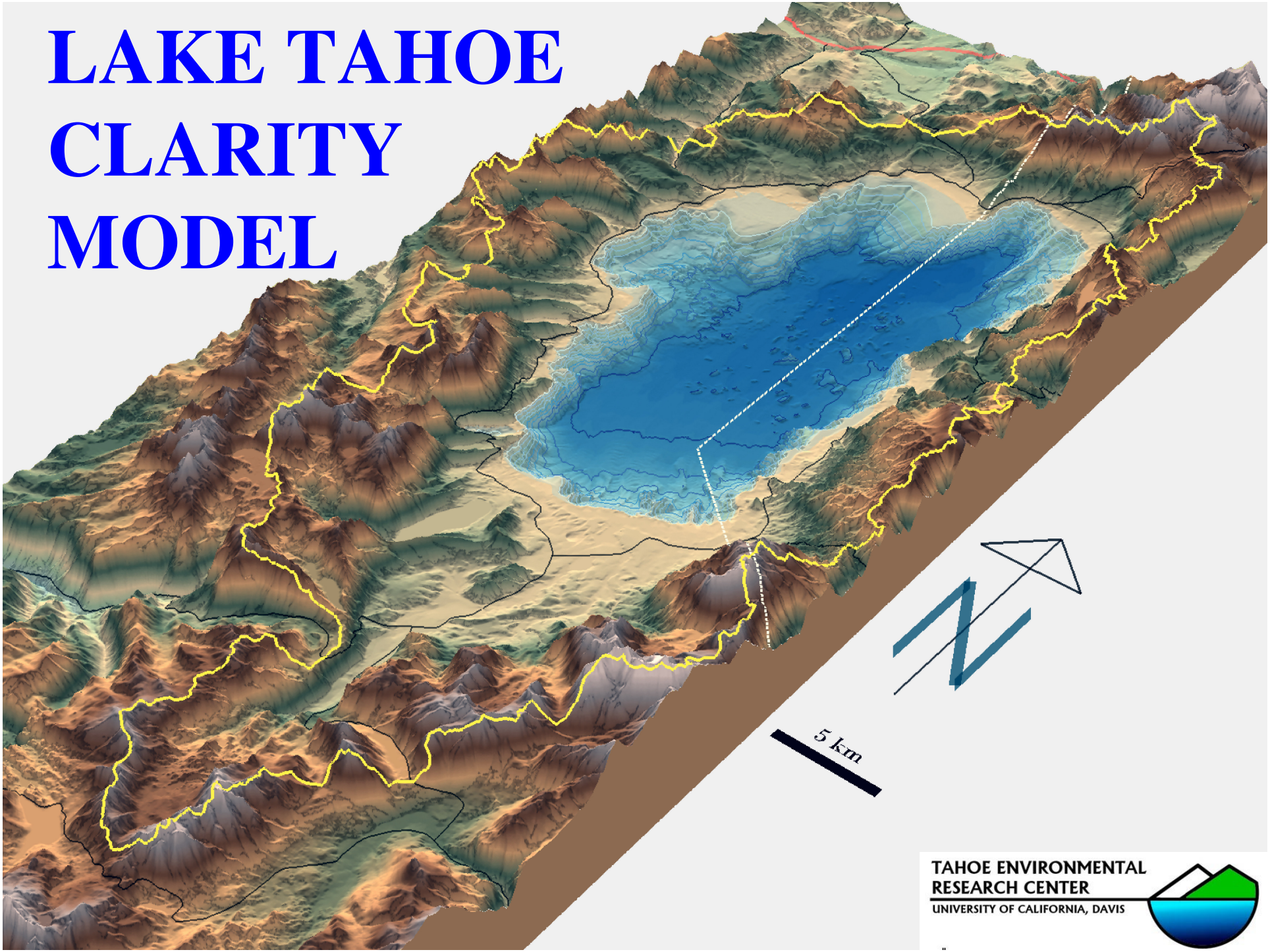
LAKE TAHOE CLARITY MODEL



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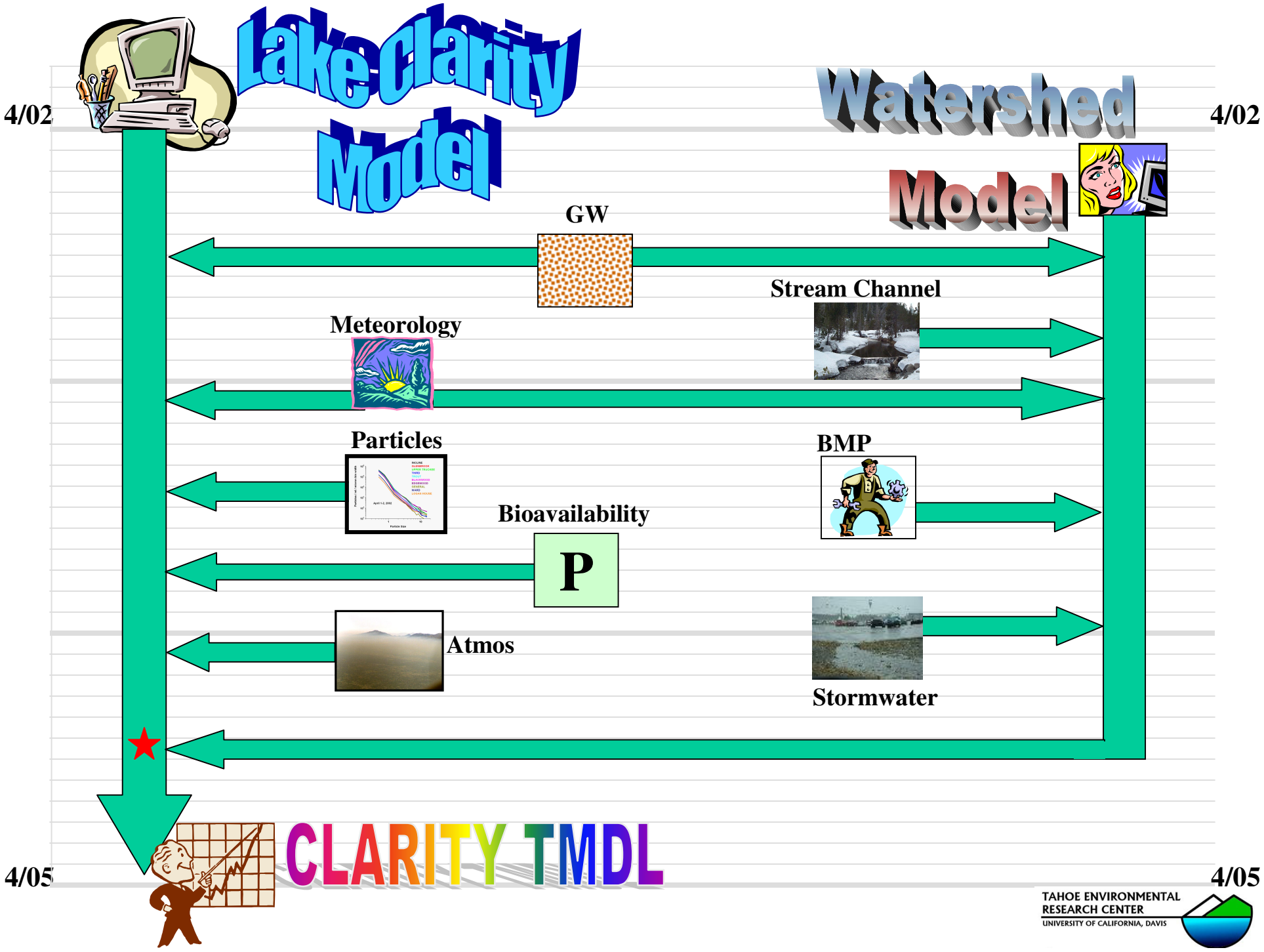
OUTLINE

- The Tahoe Clarity Model and the TMDL Process
- Model Description – modular basis
- Model inputs
- Some recent model results – improved performance
- Example of research changing model – fine particles


4/02
Lake Clarity Model
Watershed Model
4/02
GW
Stream Channel
Meteorology
Particles
BMP
Bioavailability
P
Atmos
Stormwater
CLARITY TMDL
4/05
4/05
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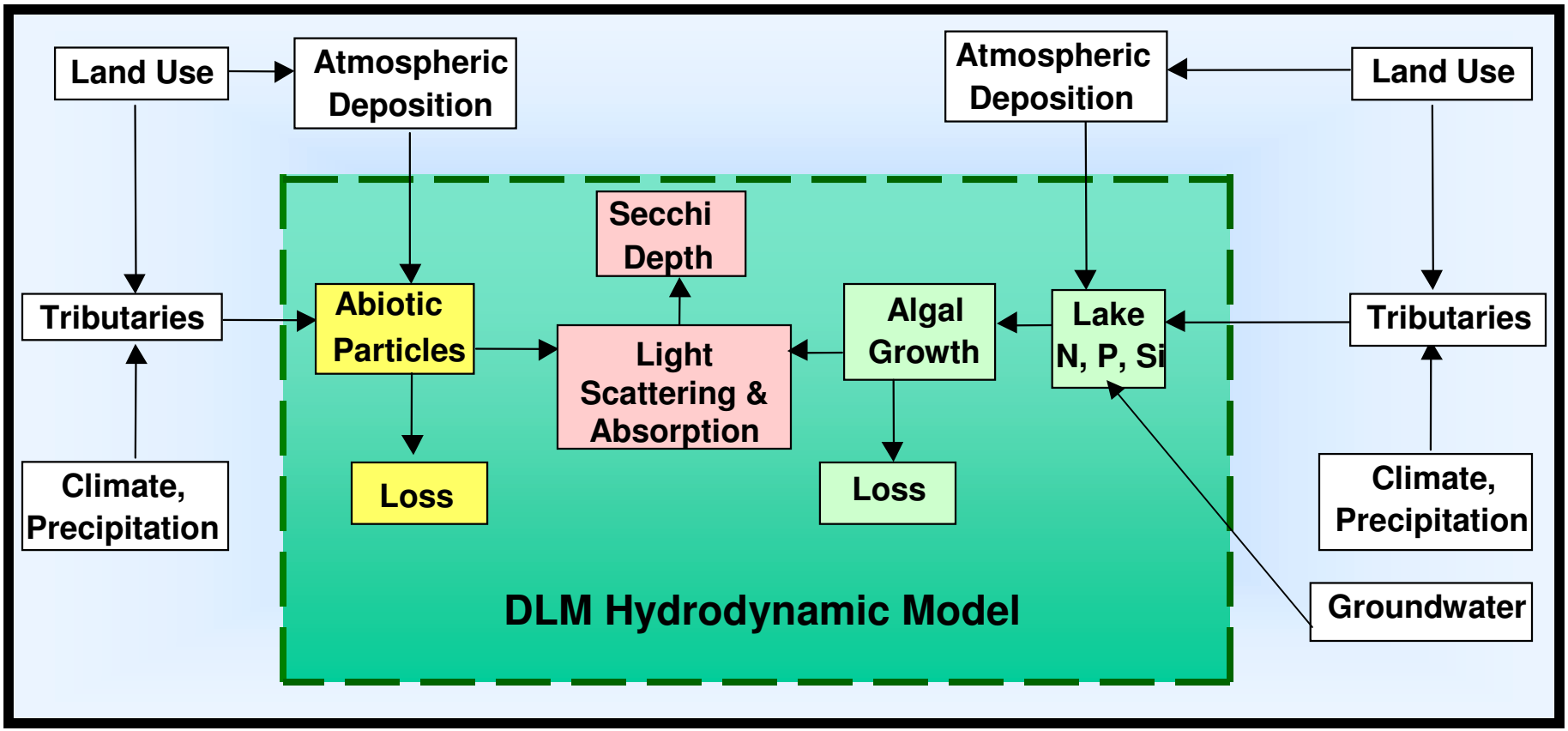
Lake Tahoe Clarity Model



MODEL INPUTS - METEOROLOGY

DAILY VALUES OF:

- SOLAR RADIATION
- LONGWAVE RADIATION
- WIND SPEED
- AIR TEMPERATURE
- VAPOR PRESSURE
- PRECIPITATION

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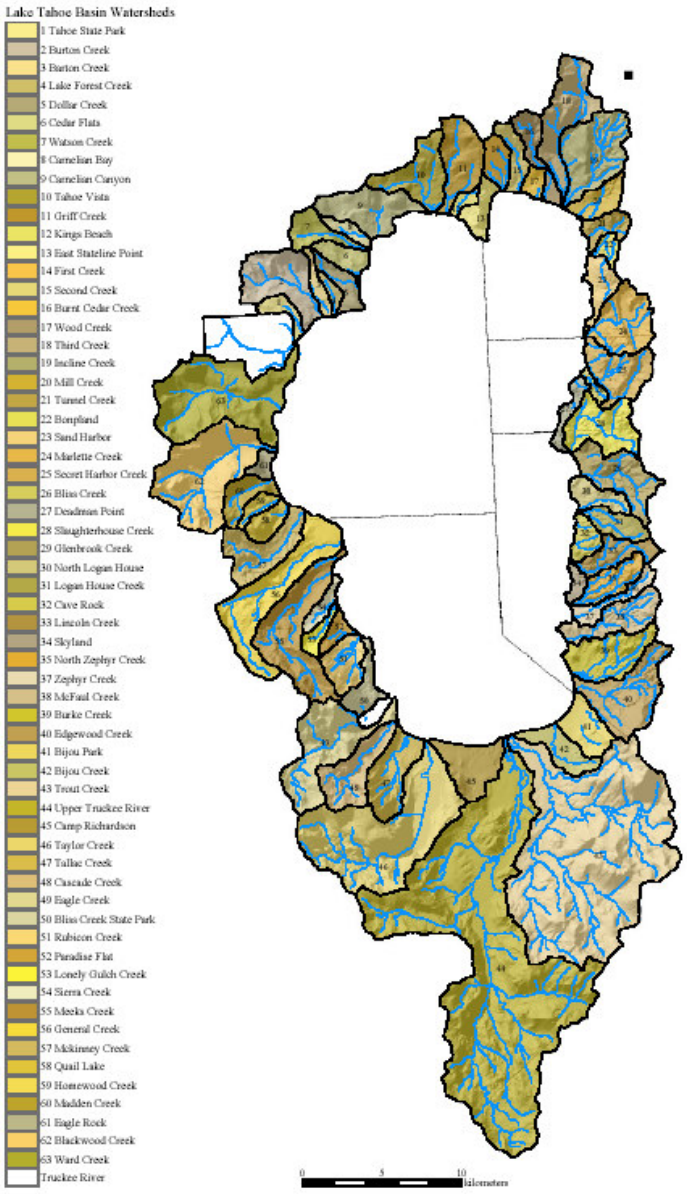
MODEL INPUTS – 63 STREAM INFLOWS



DAILY VALUES OF:

- STREAM FLOW
- STREAM TEMPERATURE
- STREAM PARTICLE SIZE DISTRIBUTION
- STREAM NITROGEN
- STREAM PHOSPHORUS

STREAM GEOMETRY

- WIDTH
- SLOPE
- SHAPE

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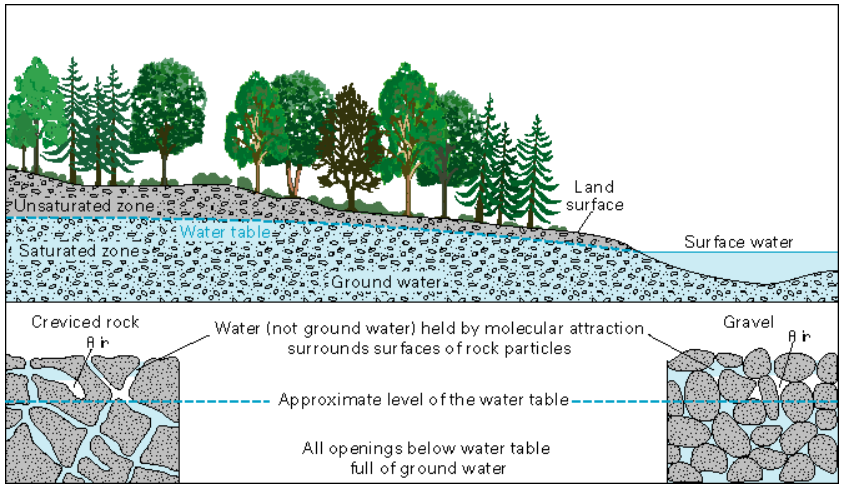
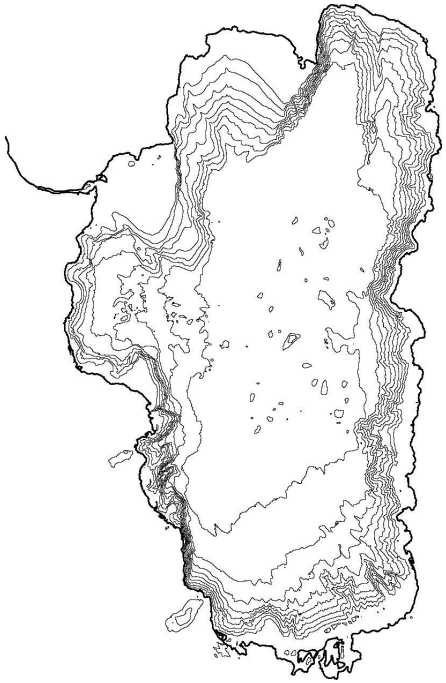
LOWER TRUCKEE OUTFLOW

GROUNDWATER INFLOWS



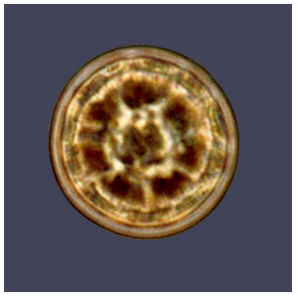
LAKE BATHYMETRY

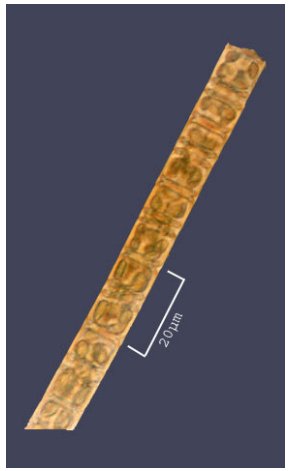


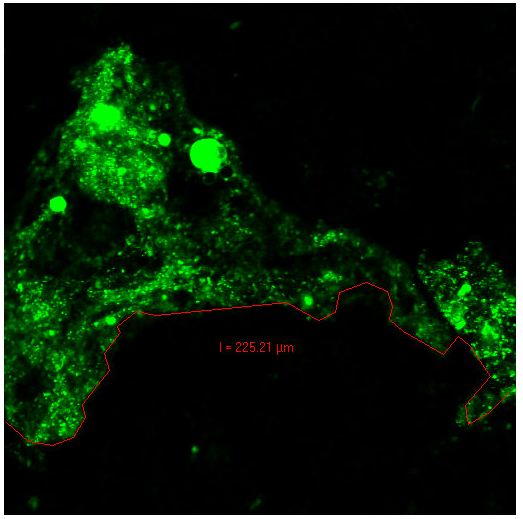
ATMOSPHERIC DEPOSITION

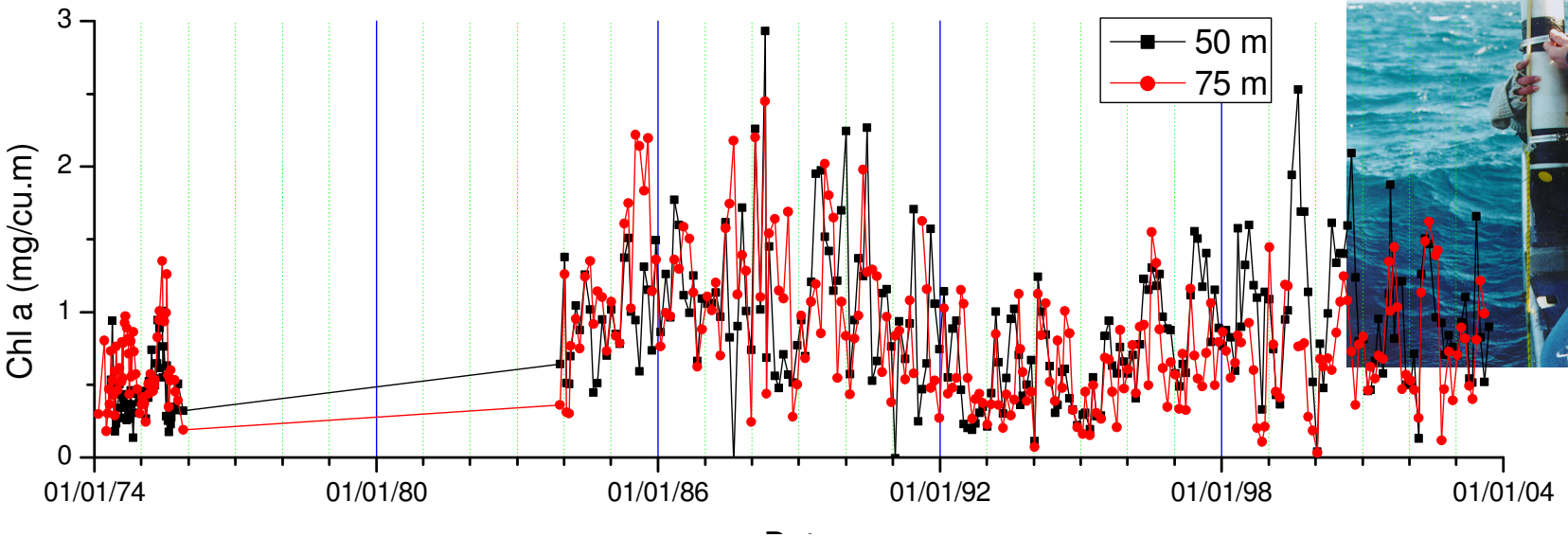
LAKE DATA


28.3.2000

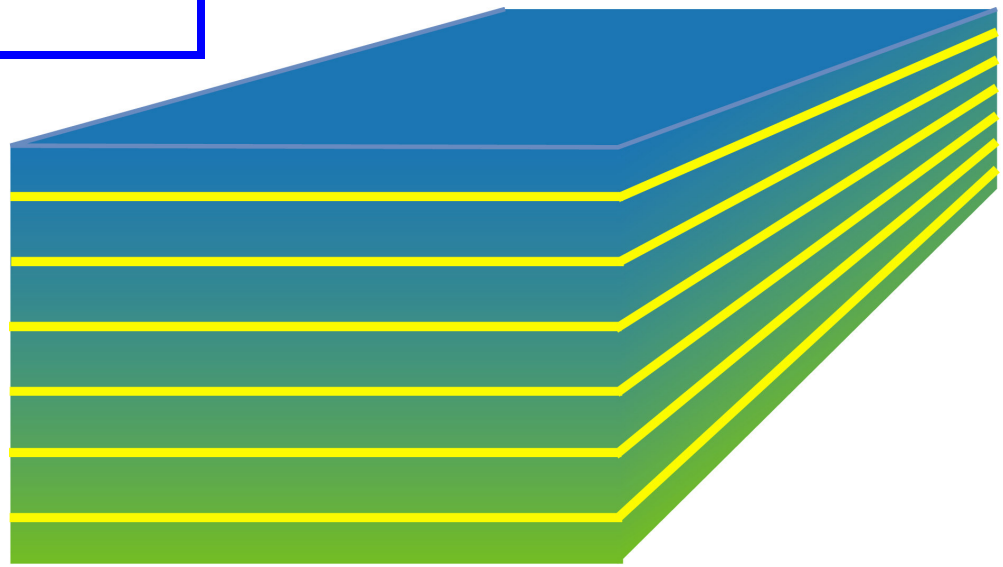



2.0 µm


l = 225.21 µm


Chl a (mg/cu.m)
3
2
1
0
01/01/74
01/01/80
01/01/86
01/01/92
01/01/98
01/01/04
50 m
75 m

ONE-DIMENSIONAL (1-D) MODEL



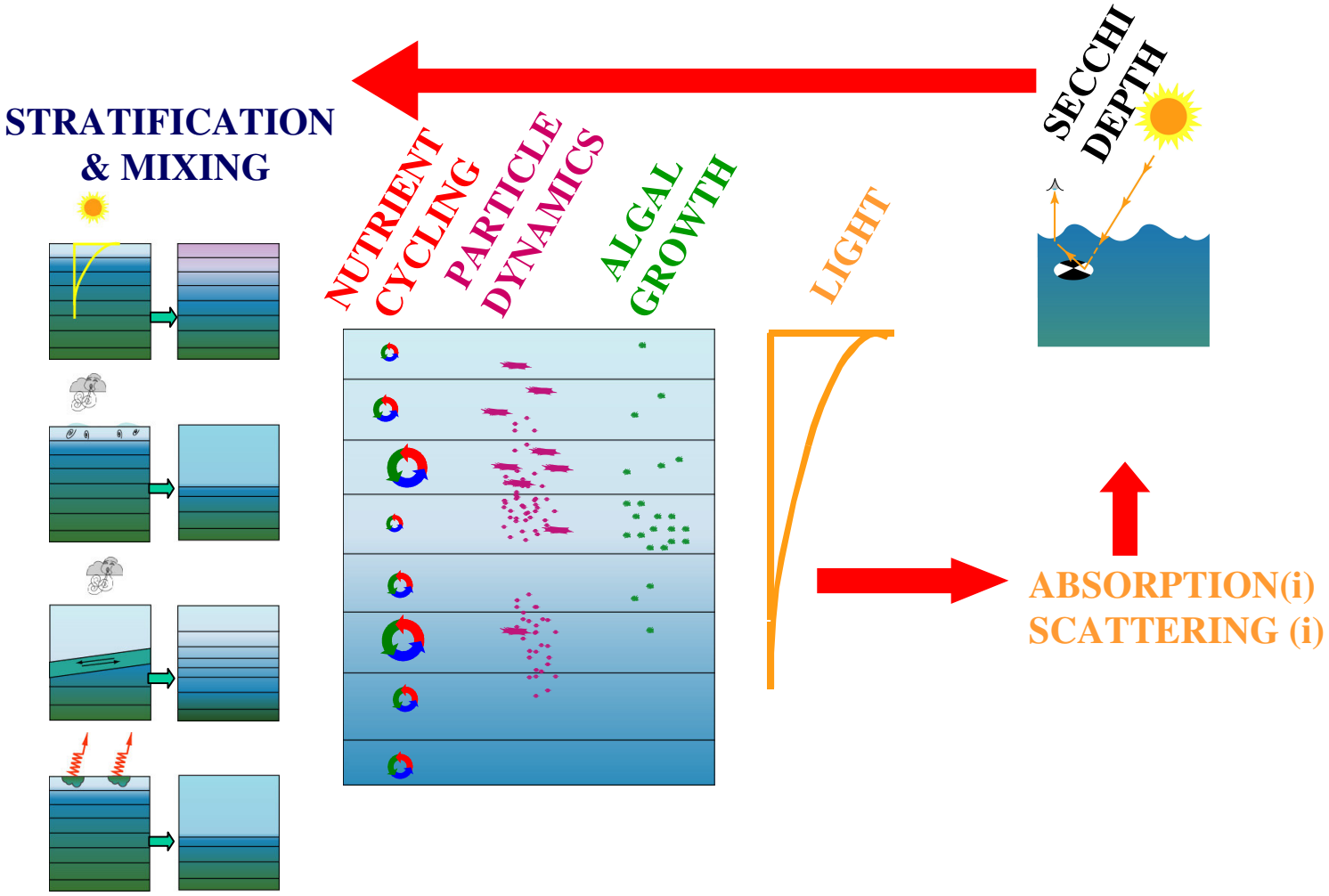
PROCESS BASED

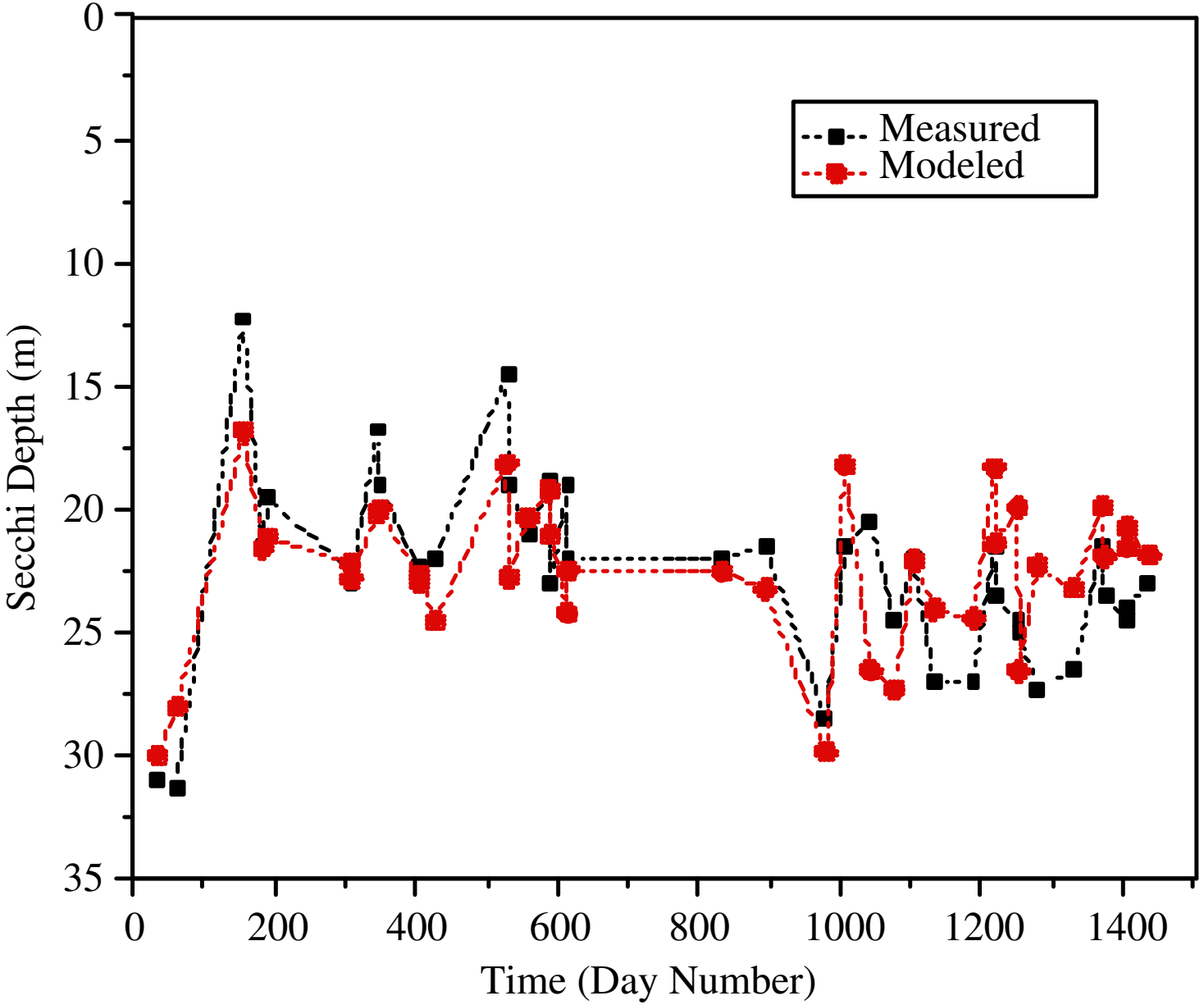
- Hydrodynamic and Thermodynamic Model - Physical mixing
- Biological growth – Phytoplankton growth, Zooplankton and mysis grazing
- Chemical transformations – nitrogen, phosphorus and oxygen cycles
- Particle fate – settling and aggregation
- Light scattering & absorption – optical sub-model

DETERMINISTIC

- External forcing and loading

AT EACH TIMESTEP





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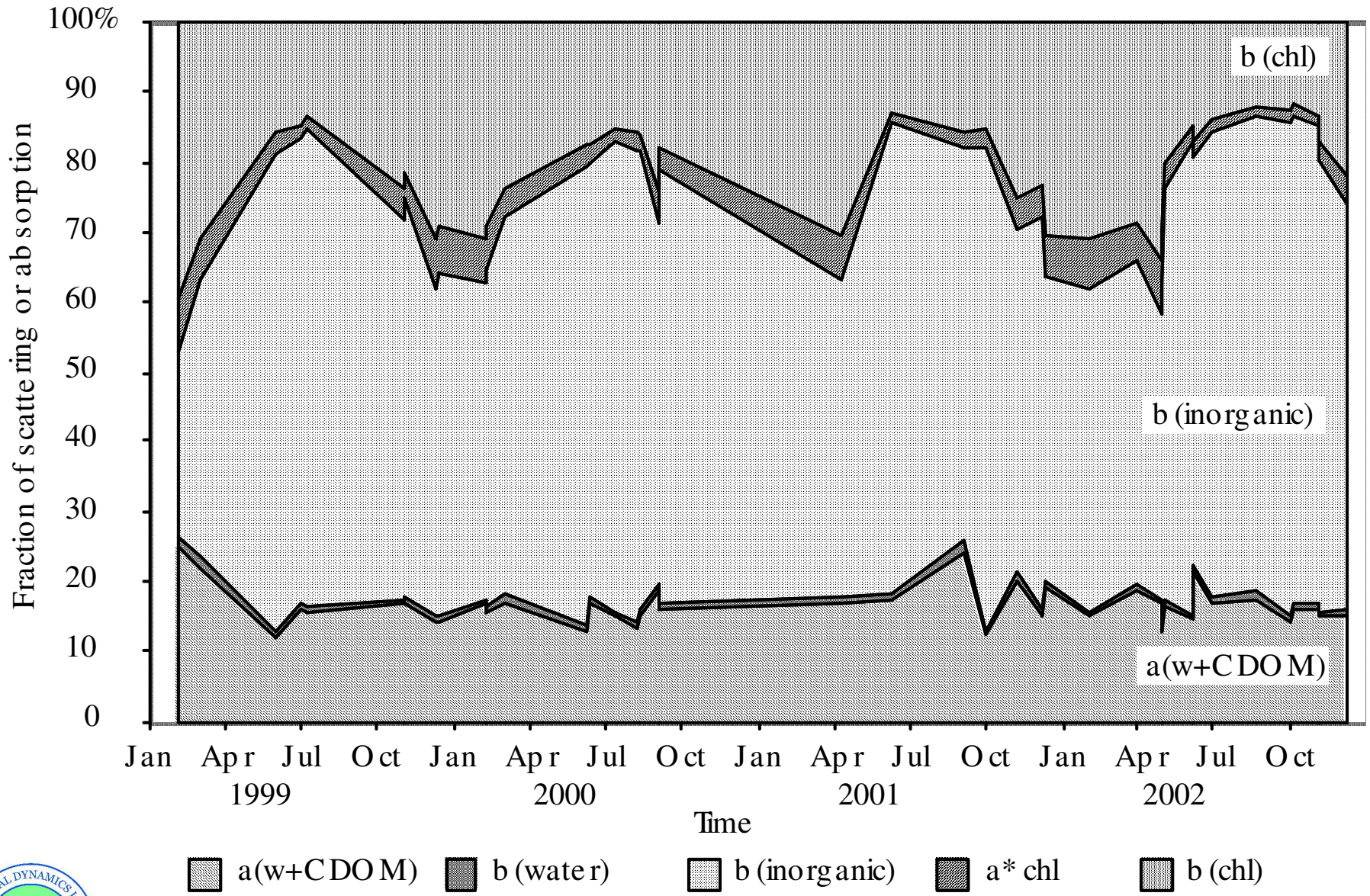

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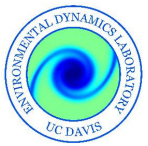
CURRENT STATUS OF TAHOE CLARITY MODEL

"The Death Star is fully operational" (Vader, D. 1977)

- Model has had preliminary calibration and validation
- Optical model has been submitted for peer review publication
- Model input structure has been modified to accept inflow from 63 streams and intervening zones
- Methodology for extrapolation of stream particle data is being finalized
- An improved particle aggregation model is the focus of present research



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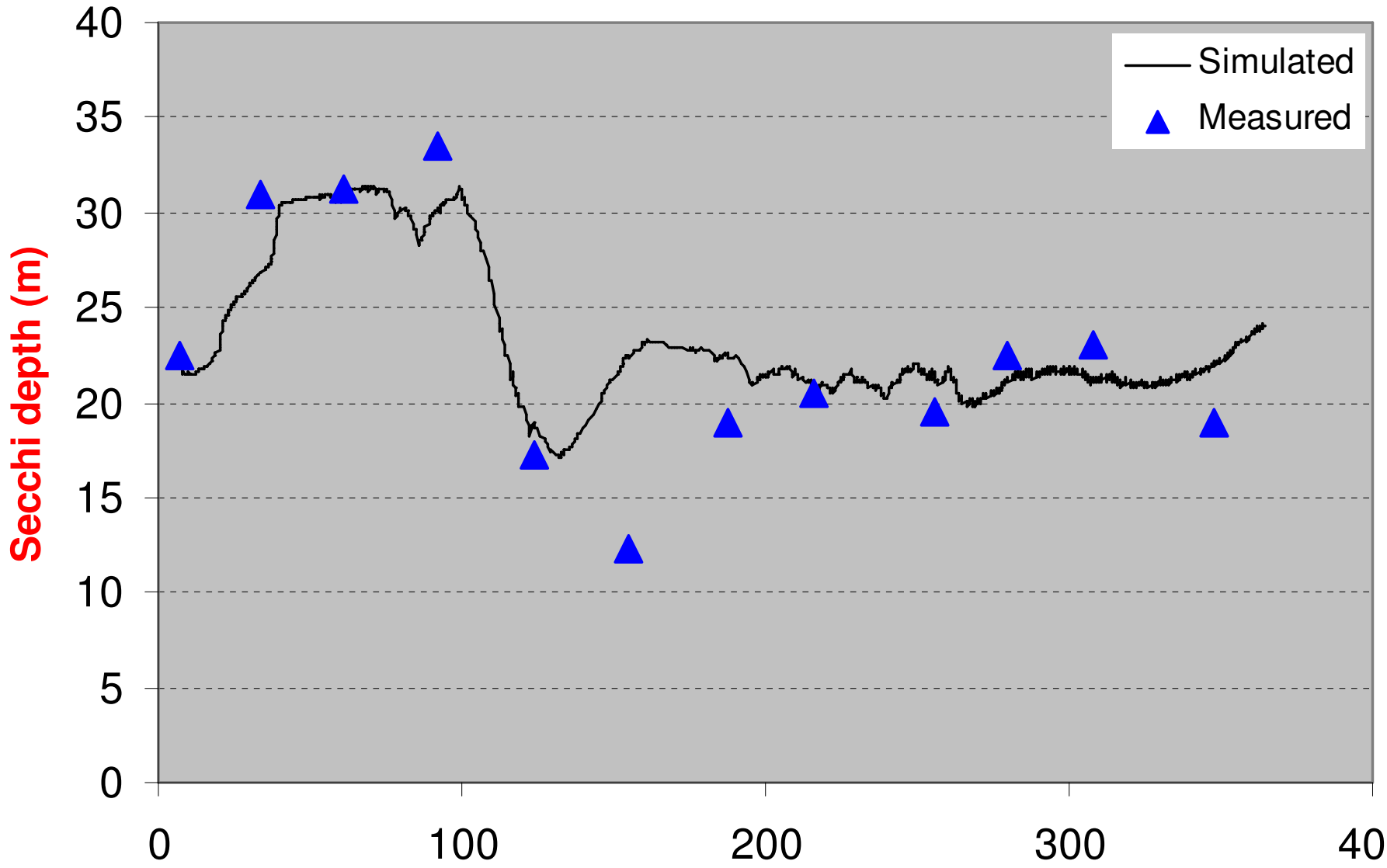
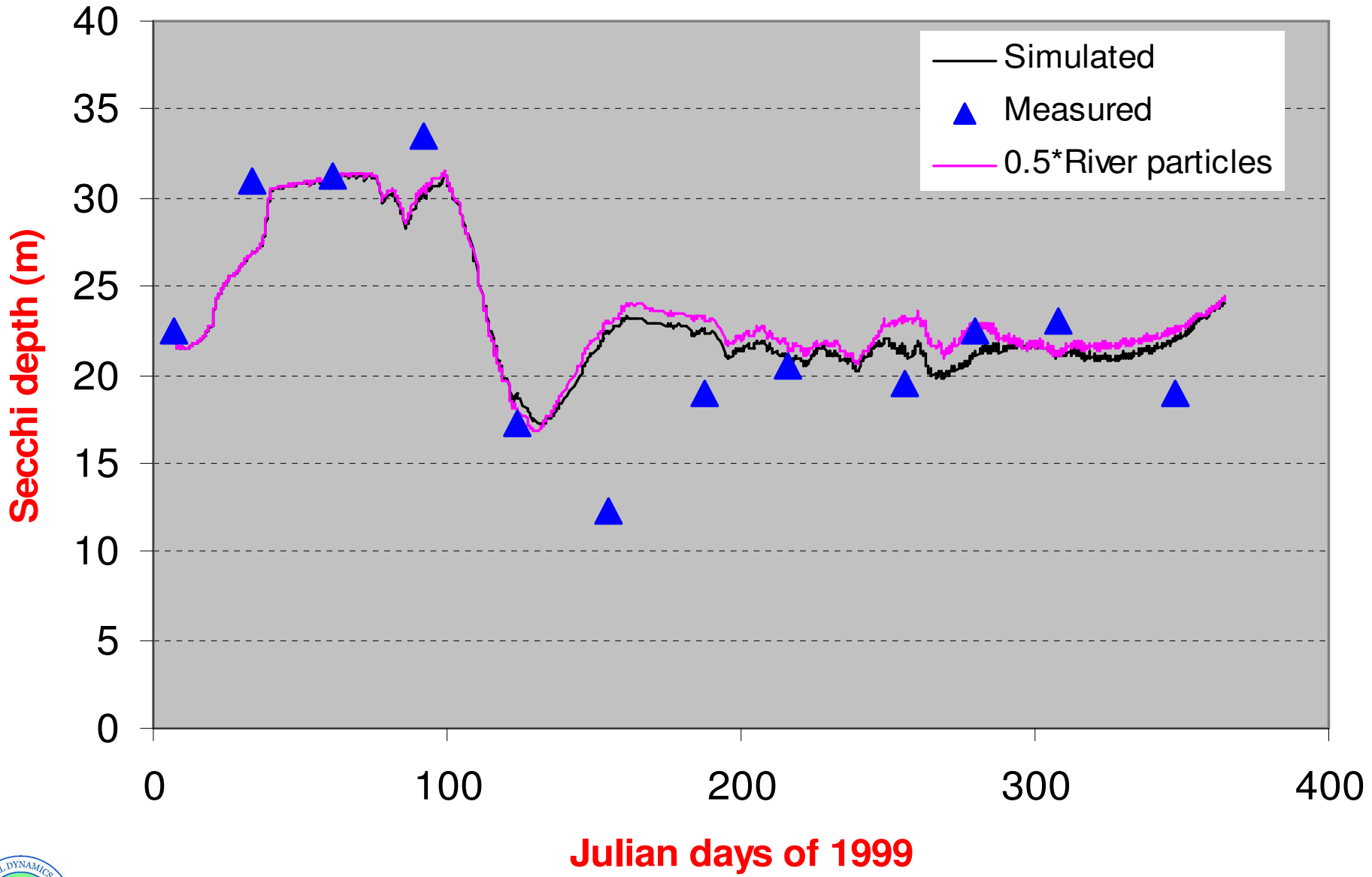

Simulated
Measured
Secchi depth (m)
0
5
10
15
20
25
30
35
40
0
100
200
300
400
Julian days of 1999



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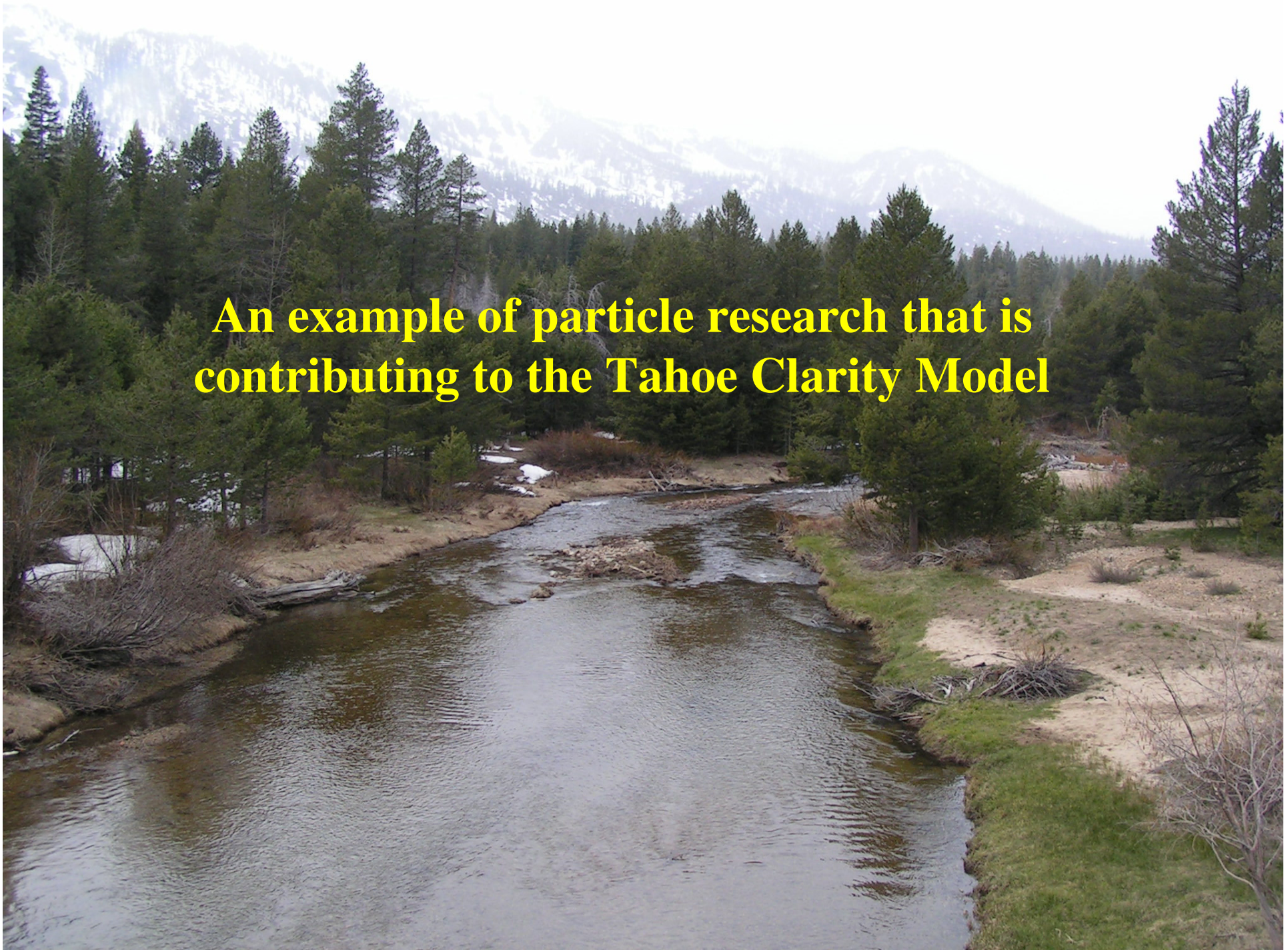
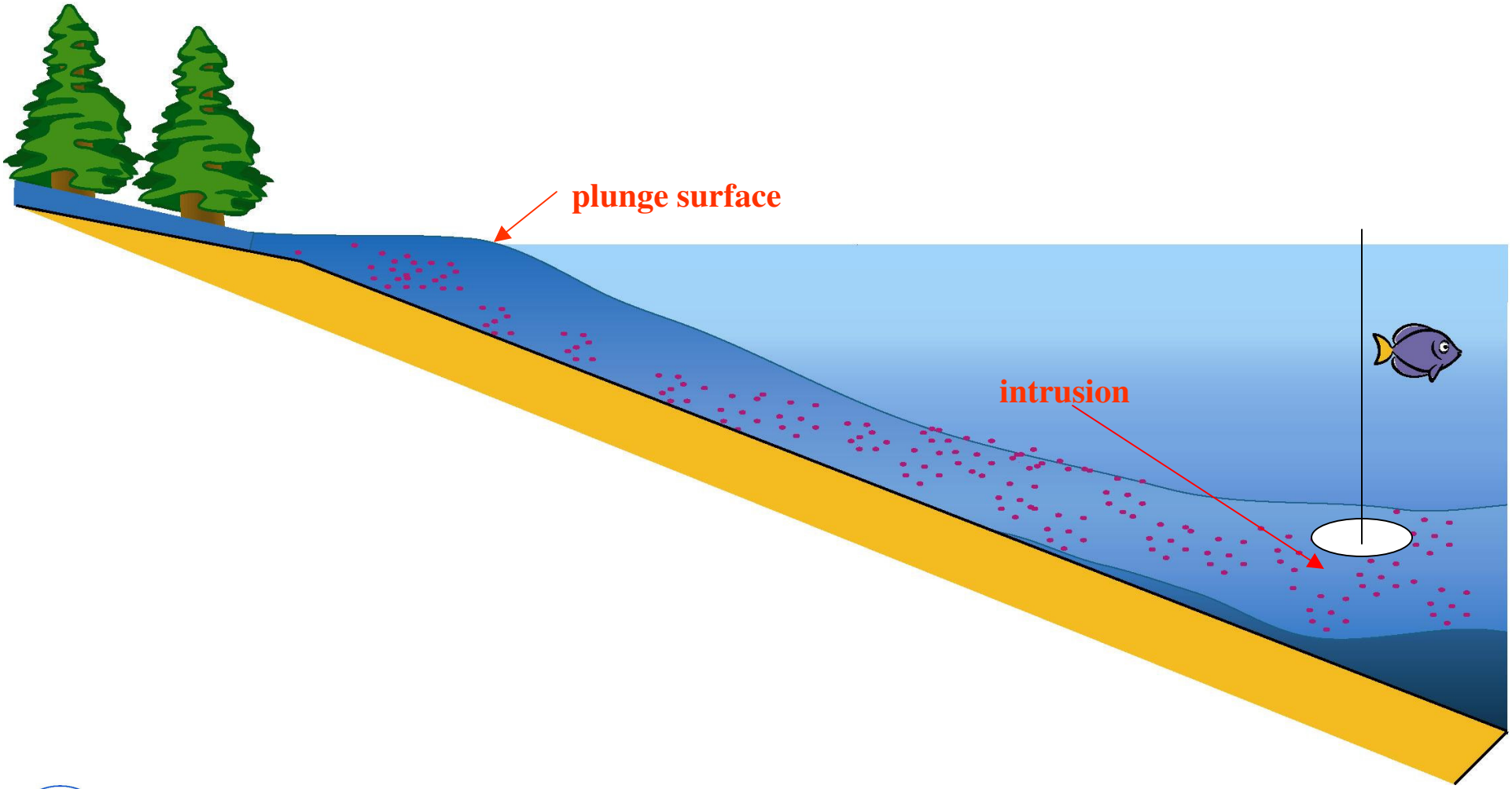
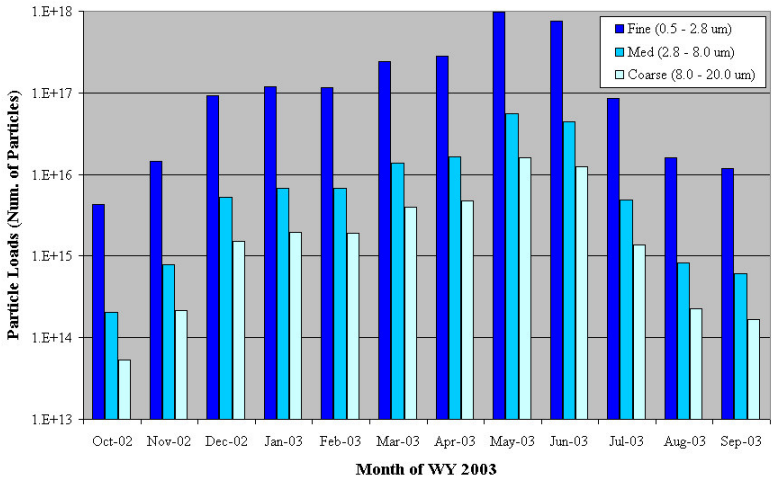

An example of particle research that is
contributing to the Tahoe Clarity Model

STREAM INFLOWS AND PARTICLES

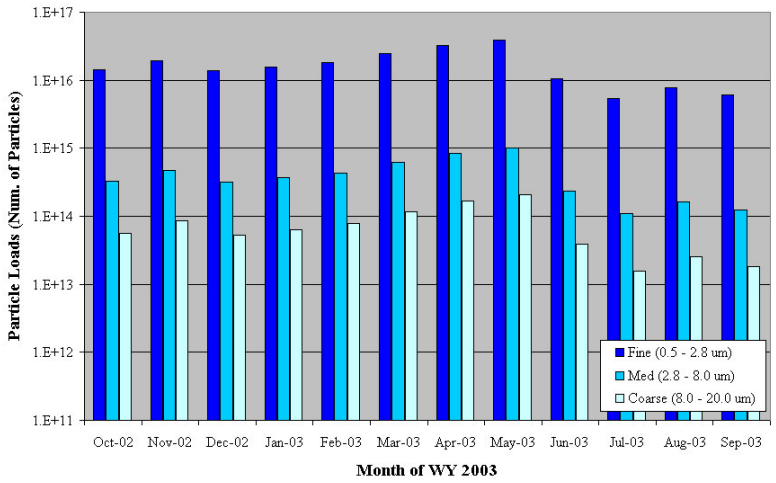


Monthly Particle Loadings - LTIMP Streams

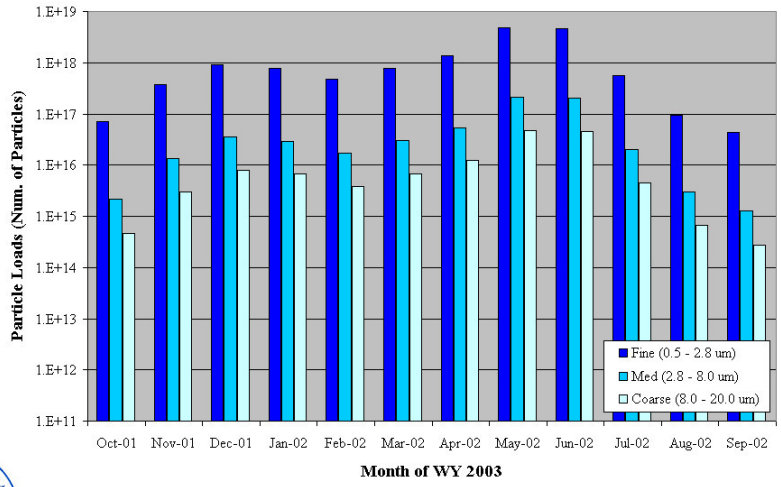
(A) Monthly Particle Loads for Blackwood Creek, WY 2003



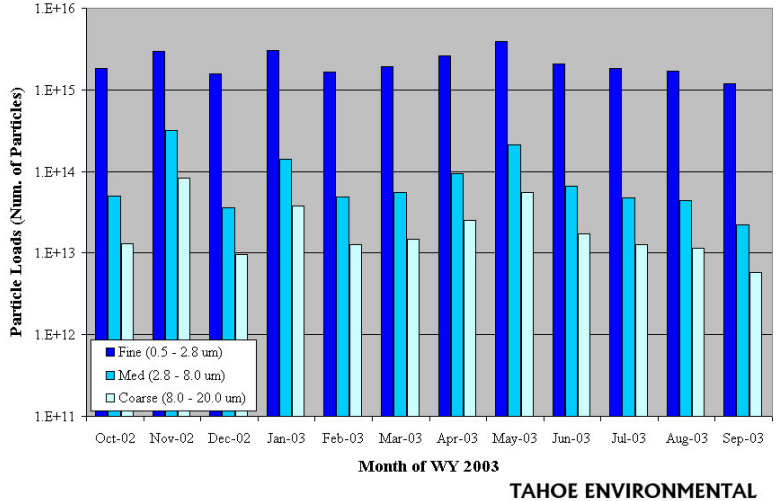
(C) Monthly Particle Loads for Edgewood Creek, WY 2003



(B) Monthly Particle Loads for Upper Truckee River, WY 2003



(D) Monthly Particle Loads for Eagle Rock Creek, WY 2003



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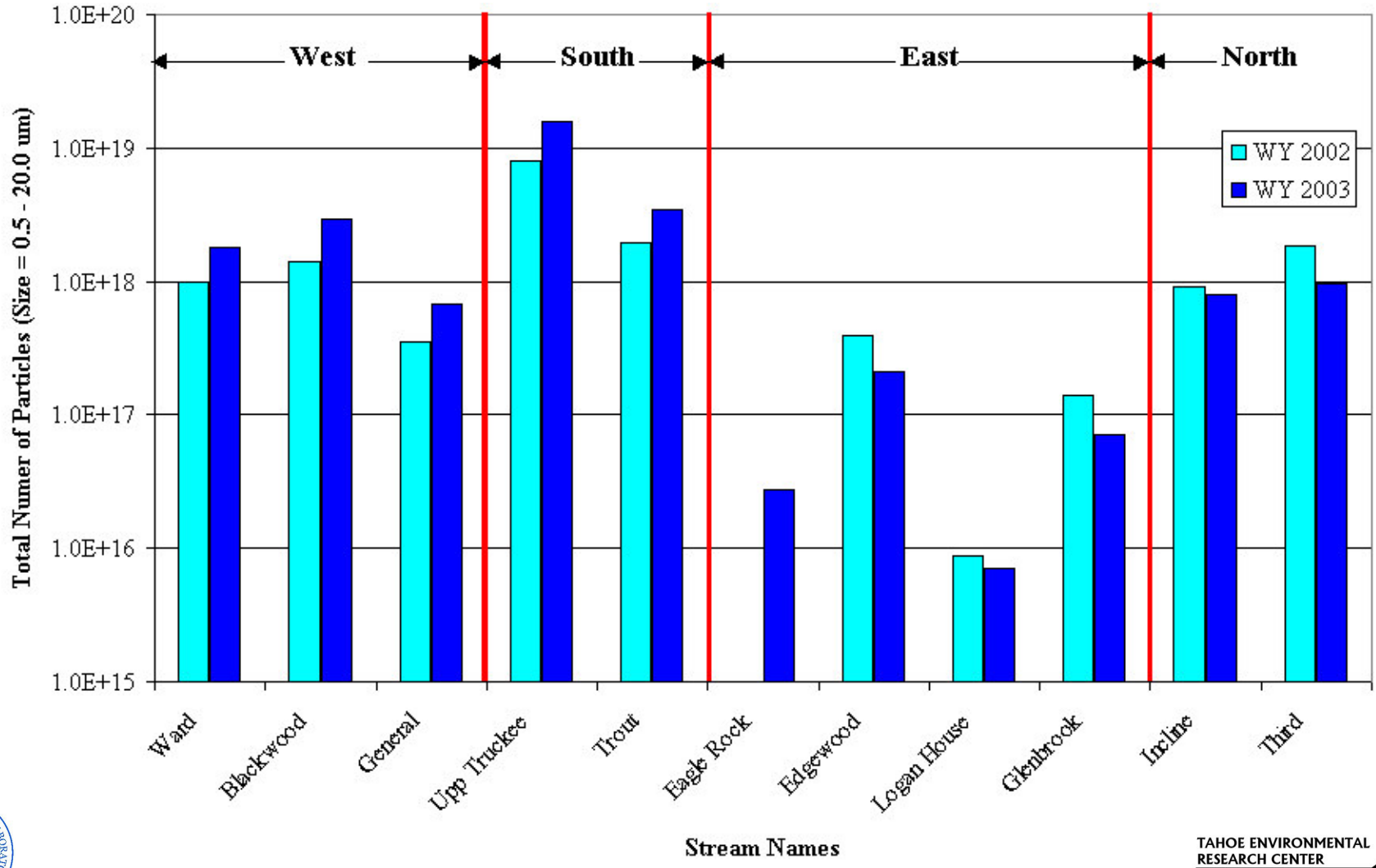
Yearly Particle Loadings - LTIMP Streams



Stream Contributions to Yearly Load

Percent of Yearly Load (Particle Size 0.5 - 20.0 um)

Stream	WY 2002	WY 2003	Area (ha)
Upp Truckee	49.7%	58.9%	14670
Trout	12.3%	13.0%	10611
Blackwood	8.8%	11.0%	2896
Ward	6.2%	6.7%	2523
Third	11.6%	3.6%	1570
Incline	5.7%	3.0%	1751
General	2.2%	2.5%	1958
Edgewood	2.5%	0.8%	
Glenbrook	0.9%	0.3%	1059
Eagle Rock	0.0%	0.1%	
Logan House	0.1%	0.0%	565

Percent of Yearly Suspended Sediment Load

Stream	WY 2002	WY 2003
Upp Truckee	48.0%	47.7%
Blackwood	20.8%	22.5%
Ward	9.3%	8.8%
Trout	5.6%	8.0%
Third	7.4%	6.6%
General	2.6%	3.1%
Incline	3.7%	2.6%
Edgewood	1.9%	0.2%
Eagle Rock	0.0%	0.2%
Glenbrook	0.5%	0.2%
Logan House	0.2%	0.1%

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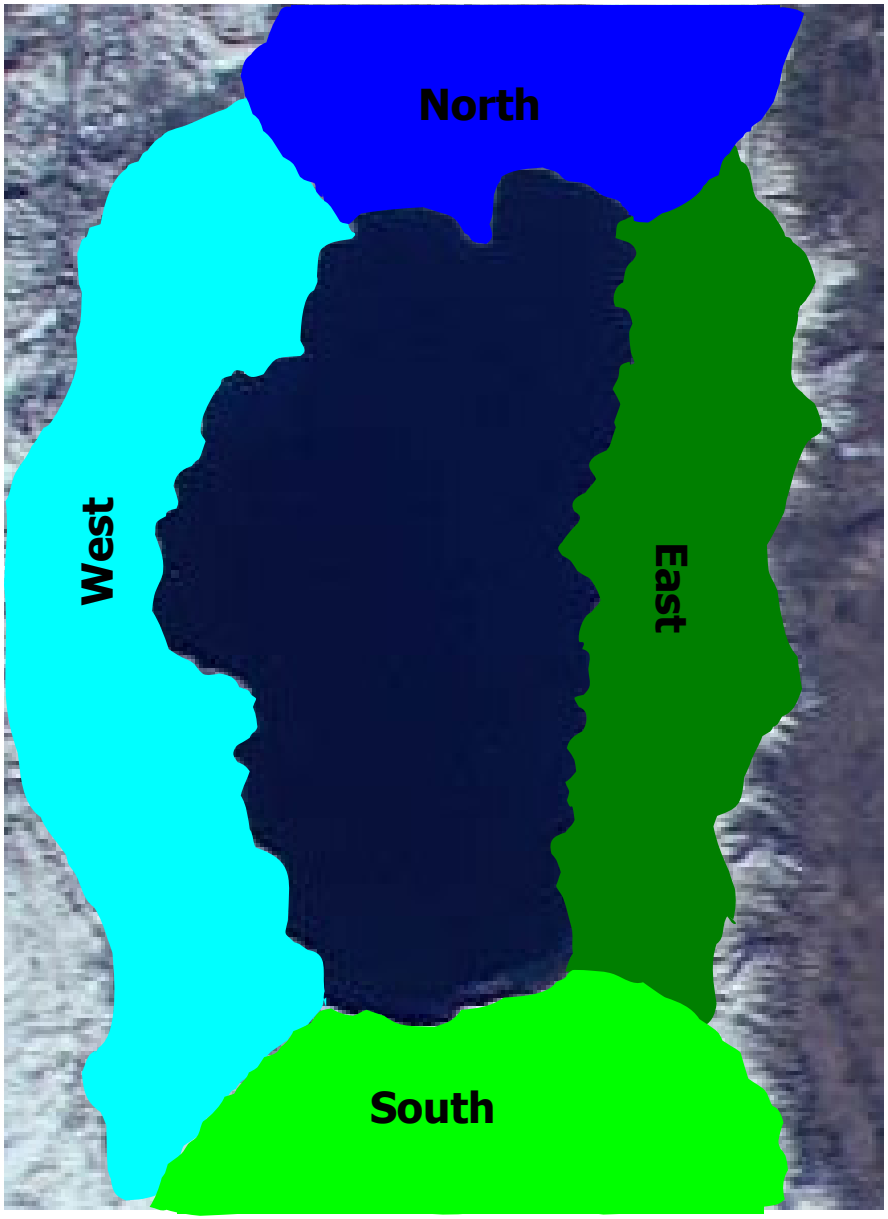

Snapshot Day Data

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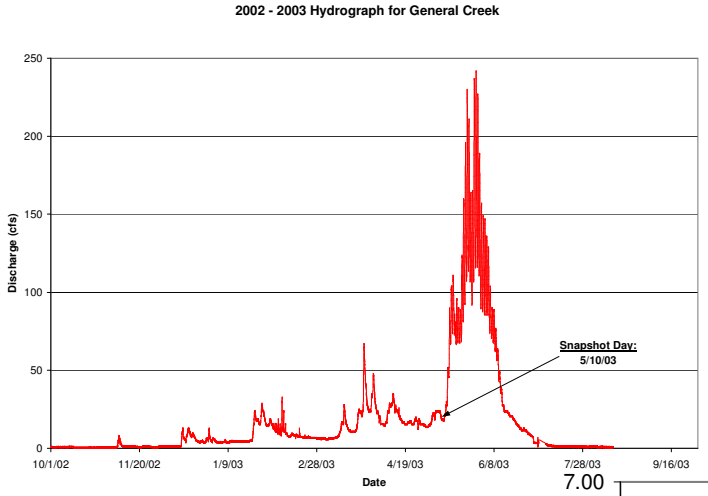
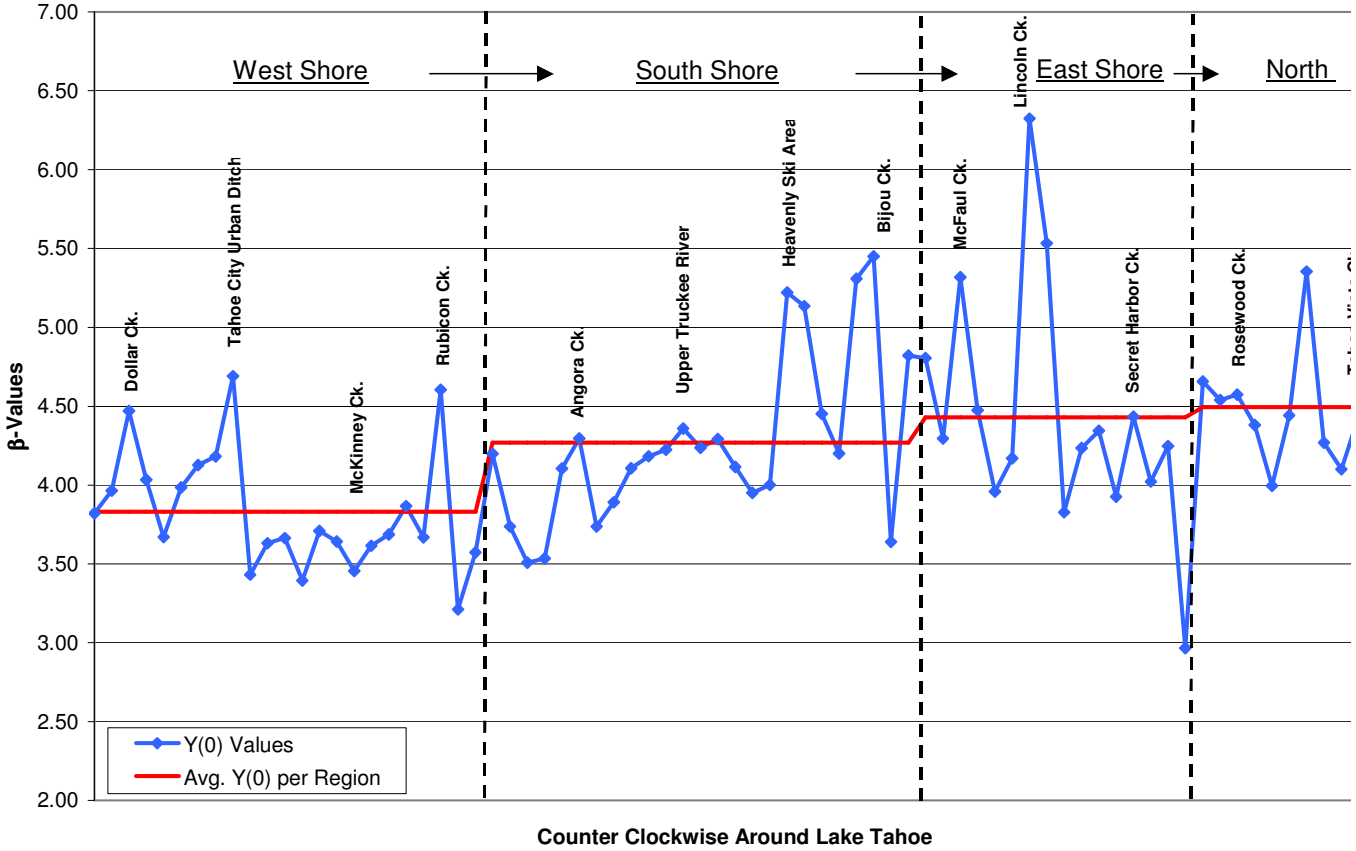


SNAPSHOT DAY 2003

Snapshot Day: Plot of Intercept Values for Four Regions around Lake Tahoe



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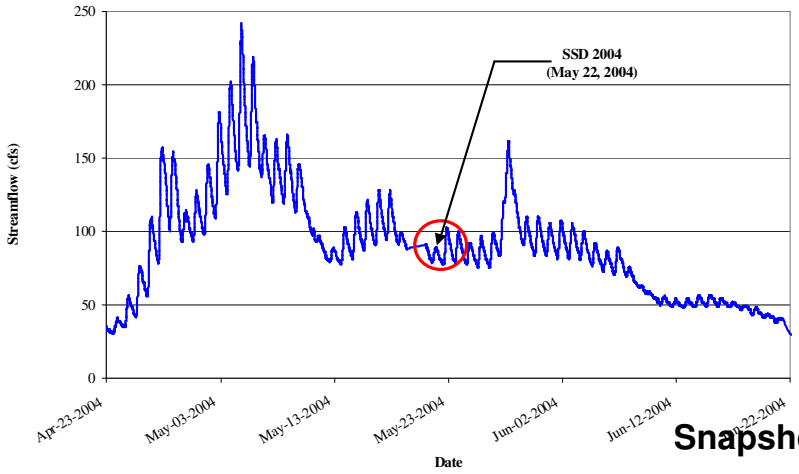
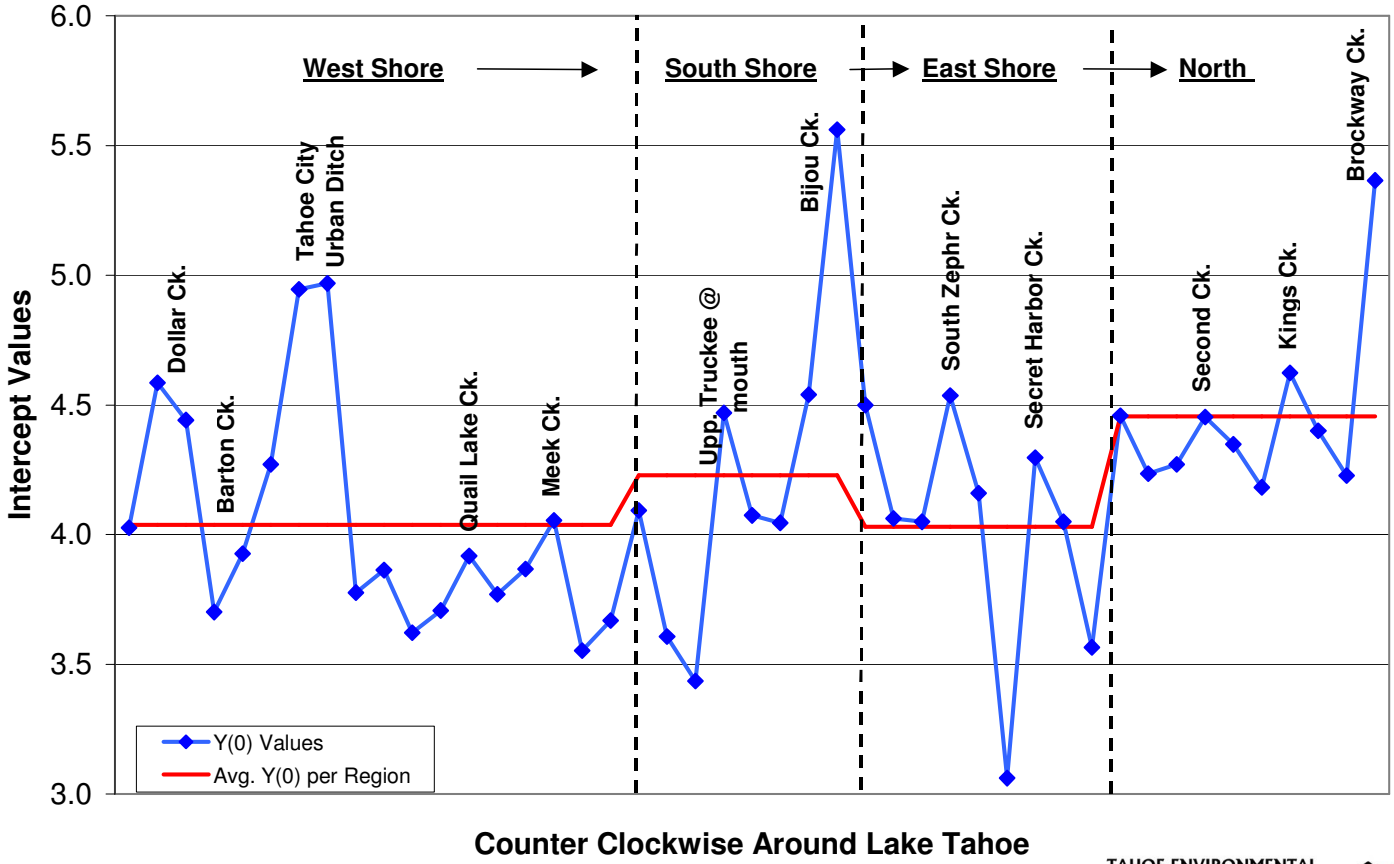


SNAPSHOT DAY 2004

Snapshot Day 2004: Plot of Intercept Values around Lake Tahoe



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SUMMARY

- The Lake Clarity Model is ready for input from the hydrology model
- LTIMP stream particle flux varies considerably from stream-to-stream, region-to-region, and year-to-year. Particle flux is distinct from total suspended sediment flux. Linking particle flux to watershed characteristics is in progress
- Two "snapshots" are helping to extend the LTIMP results to the rest of the basin's watersheds
- Particle aggregation is important – an improved sub-model is currently under development
- The clarity model is a work in progress – past and present research has been incorporated into the model. Ongoing and future research must also be incorporated, particularly on aspects that are not yet covered in the model


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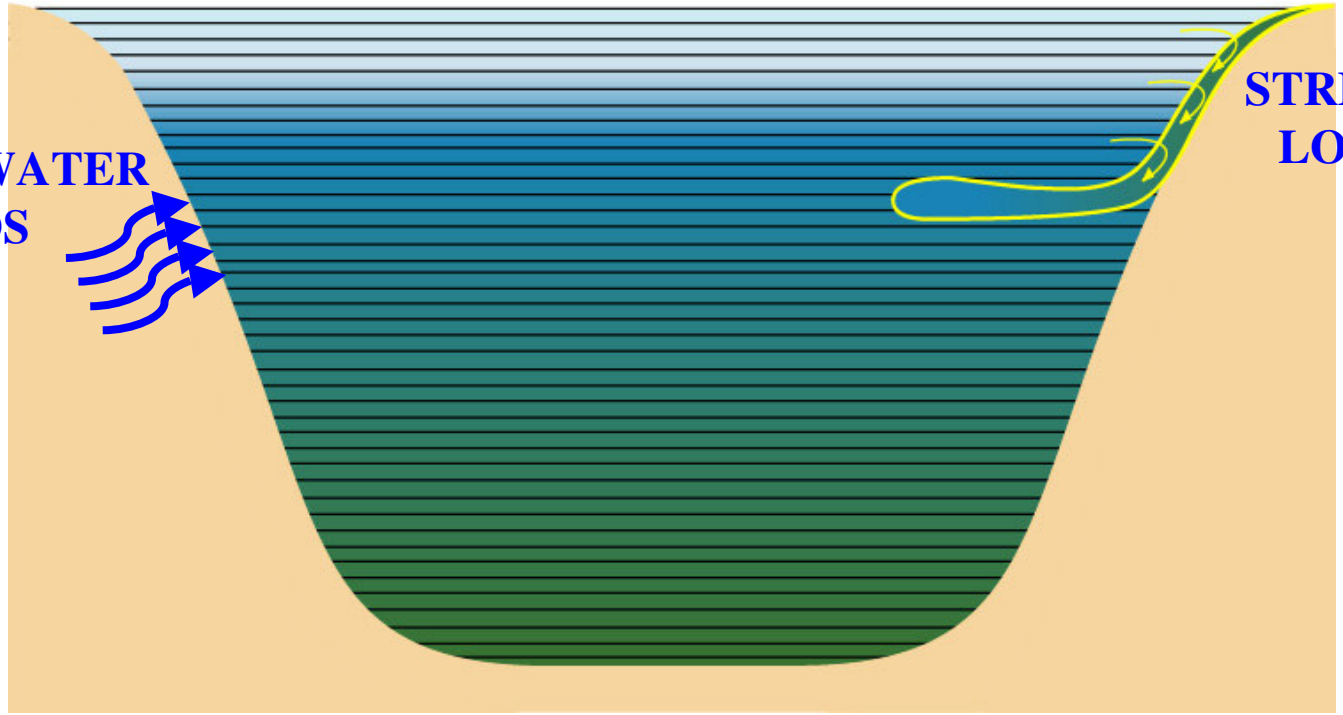
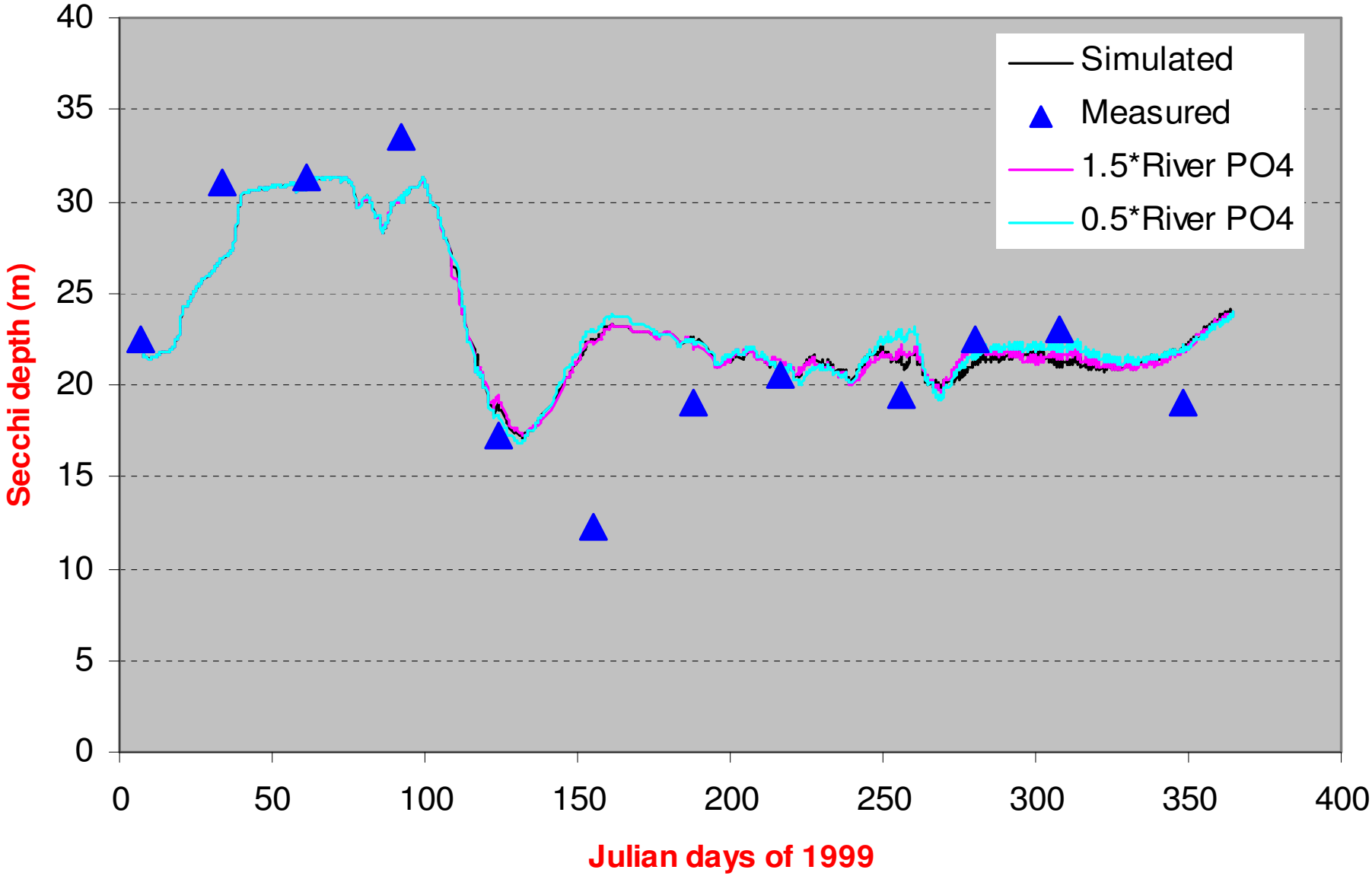
METEOROLOGY

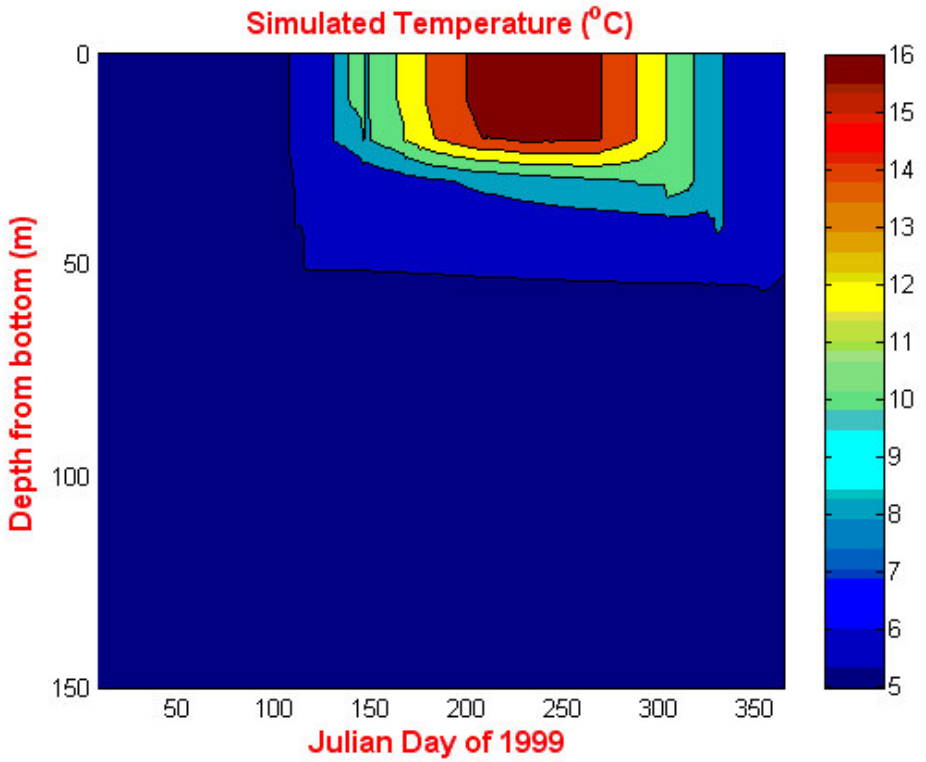
ATMOSPHERIC LOADS

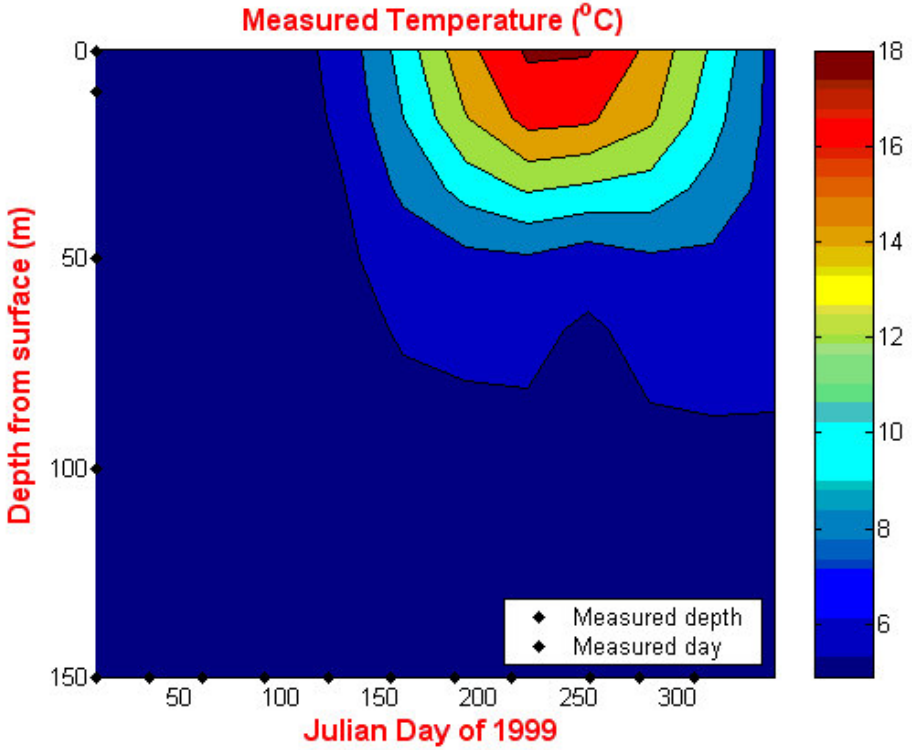
GROUNDWATER LOADS



STREAMS LOADS


Simulated
Measured
1.5*River PO4
0.5*River PO4
Secchi depth (m)
Julian days of 1999
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350
400


Simulated Temperature (°C)
Depth from bottom (m)
0
50
100
150
50
100
150
200
250
300
350
Julian Day of 1999
16
15
14
13
12
11
10
9
8
7
6
5


Measured Temperature (°C)
Depth from surface (m)
0
50
100
150
50
100
150
200
250
300
Julian Day of 1999
Measured depth
Measured day
18
16
14
12
10
8
6