Use of FlowCAM in the Sacramento-San Joaquin Delta: An Innovative Technology to Rapidly and Reliably Preform Particle Analysis

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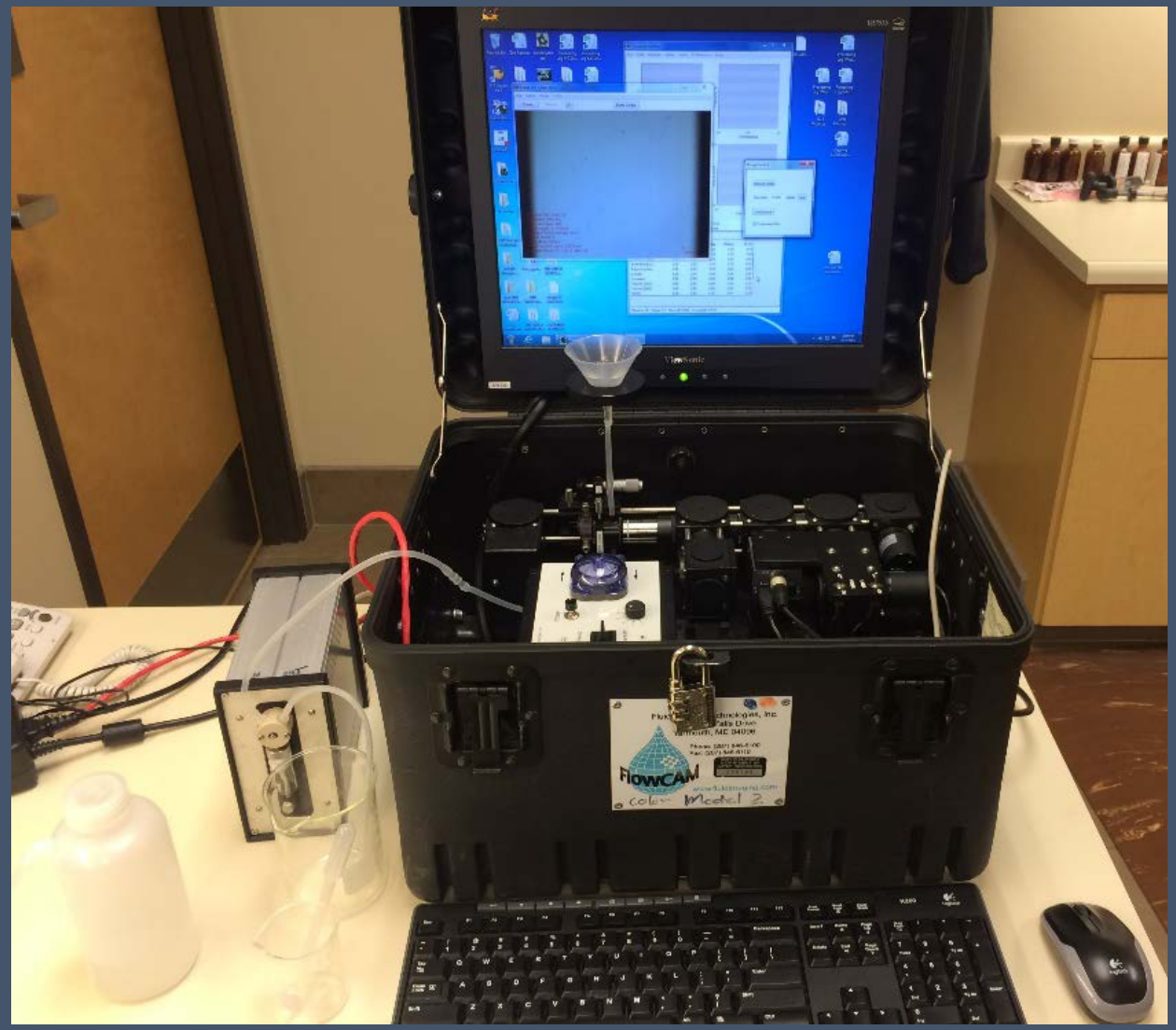
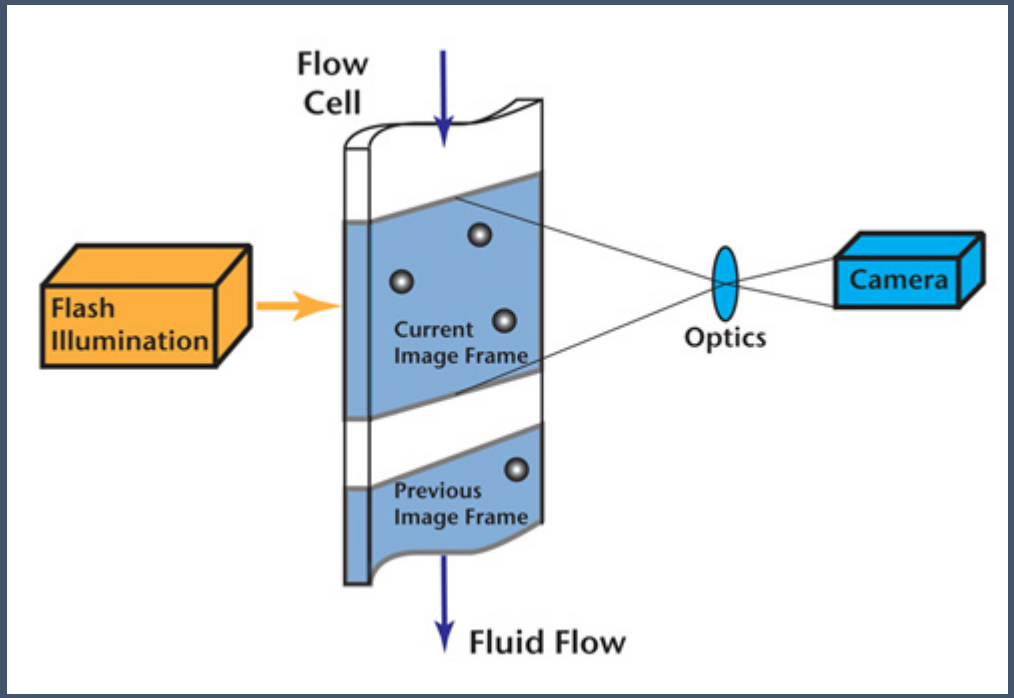
Outline

- What is FlowCAM?
- Benefits
- Challenges
- Use in SFE
- Example



What is the FlowCAM?

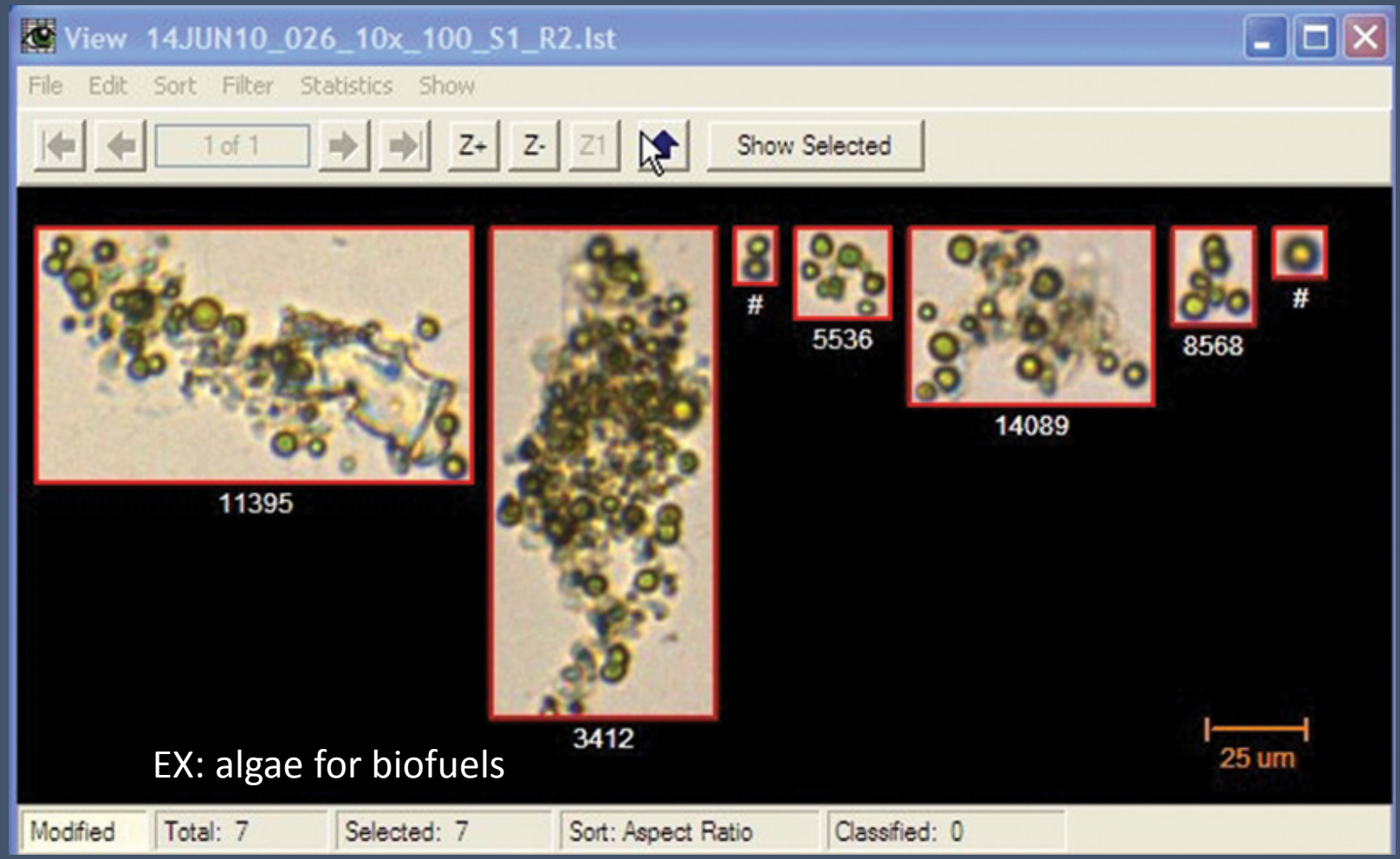
- Particle Analysis
- Combines flow cytometer with a digital imaging microscope
- Flow Cytometer And Microscope



Images: fluidimaging.com

FlowCAM Applications

- Aquatic Research
  - Characterizing phyto/zooplankton
  - HAB monitoring
- Algae technology
  - biofuels
- Water management
  - Taste and order algae
- Biopharmaceuticals
- Oil and Gas
- Other Industries worldwide

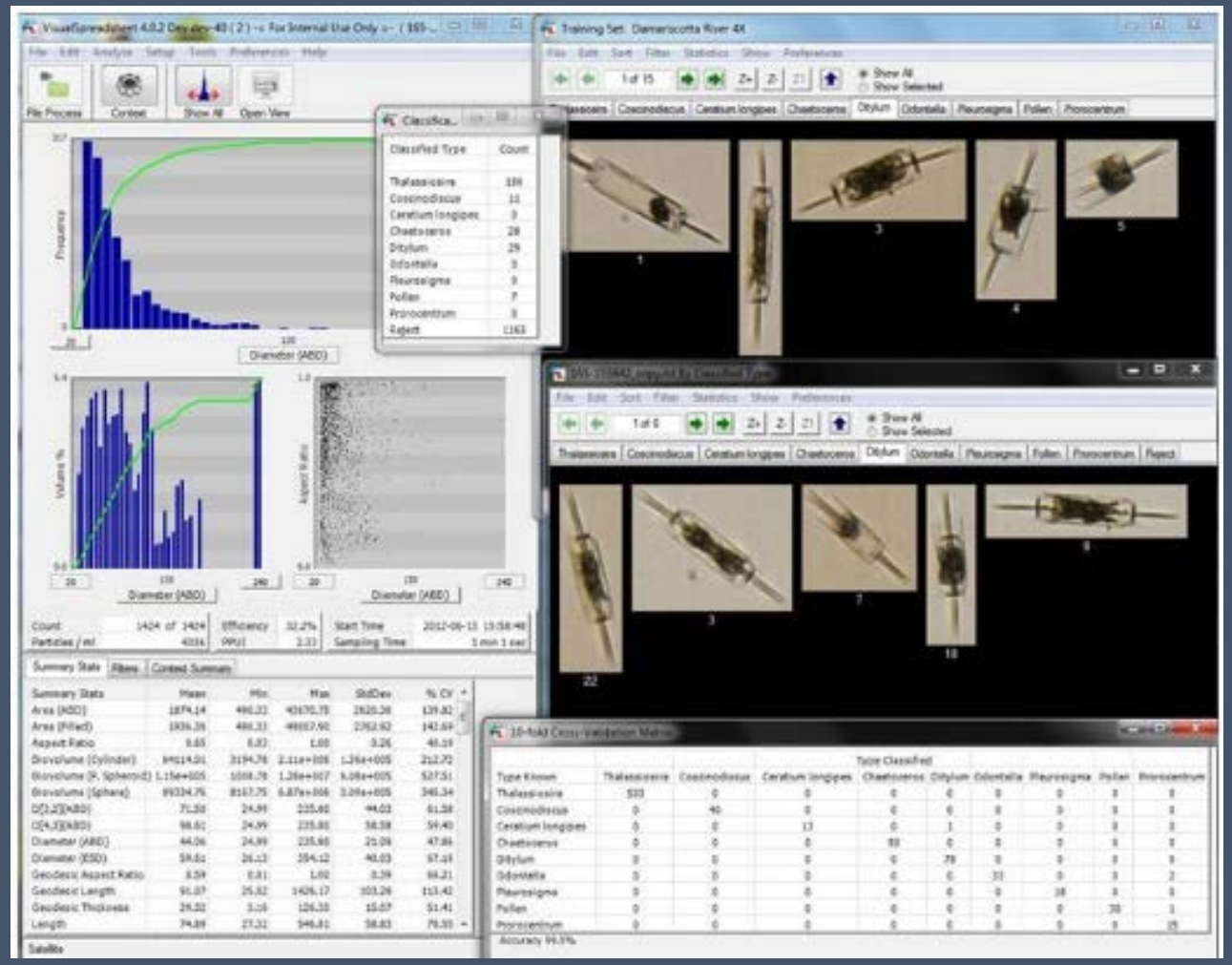


EX: algae for biofuels

Images: fluidimaging.com

FlowCAM Data

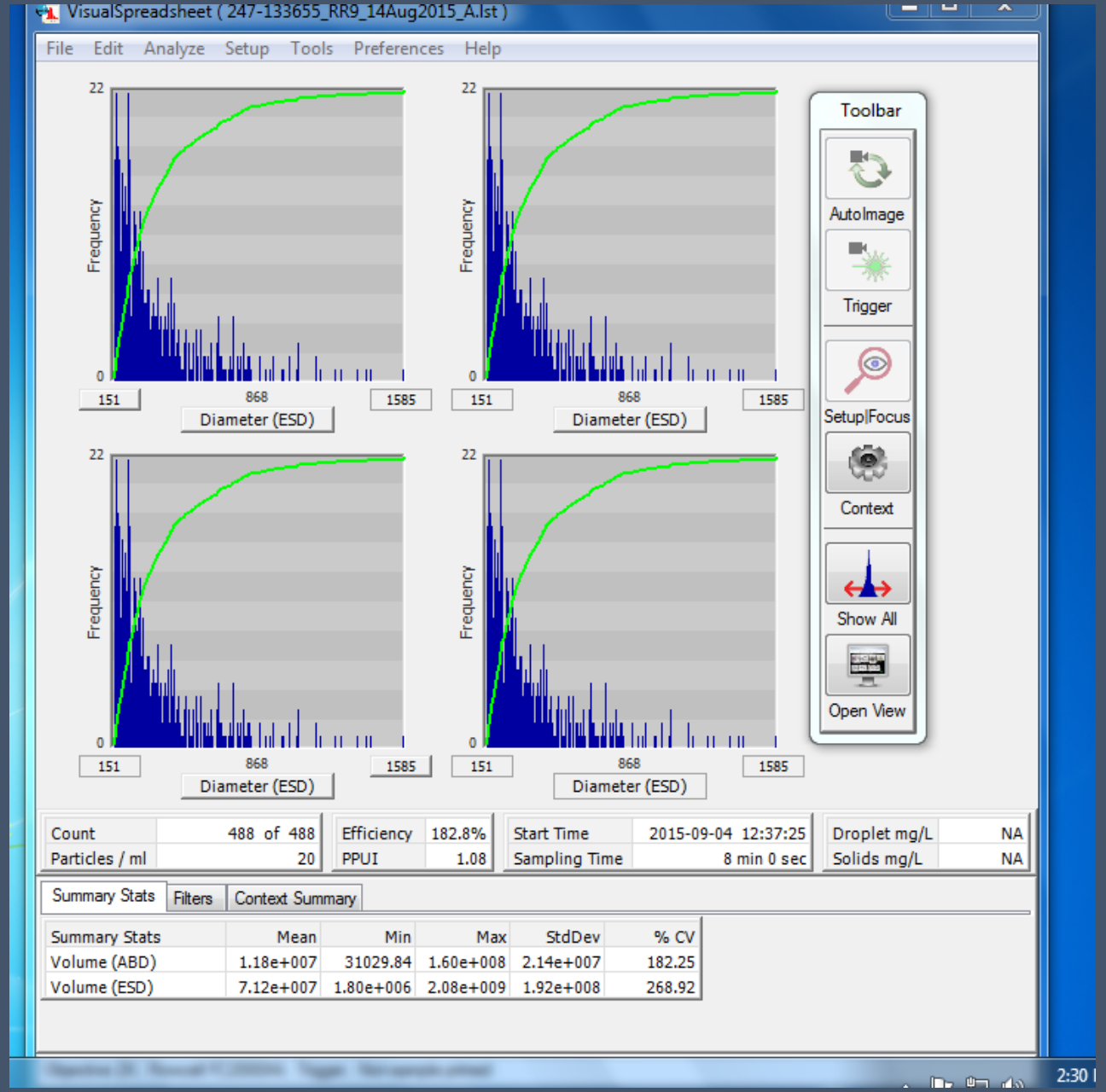
- Up to 40 different parameters (per particle)
- Morphological
  - Diameter, length, width
- Gray scale
  - Transparency, intensity, color formation
- Visual Spreadsheet Software

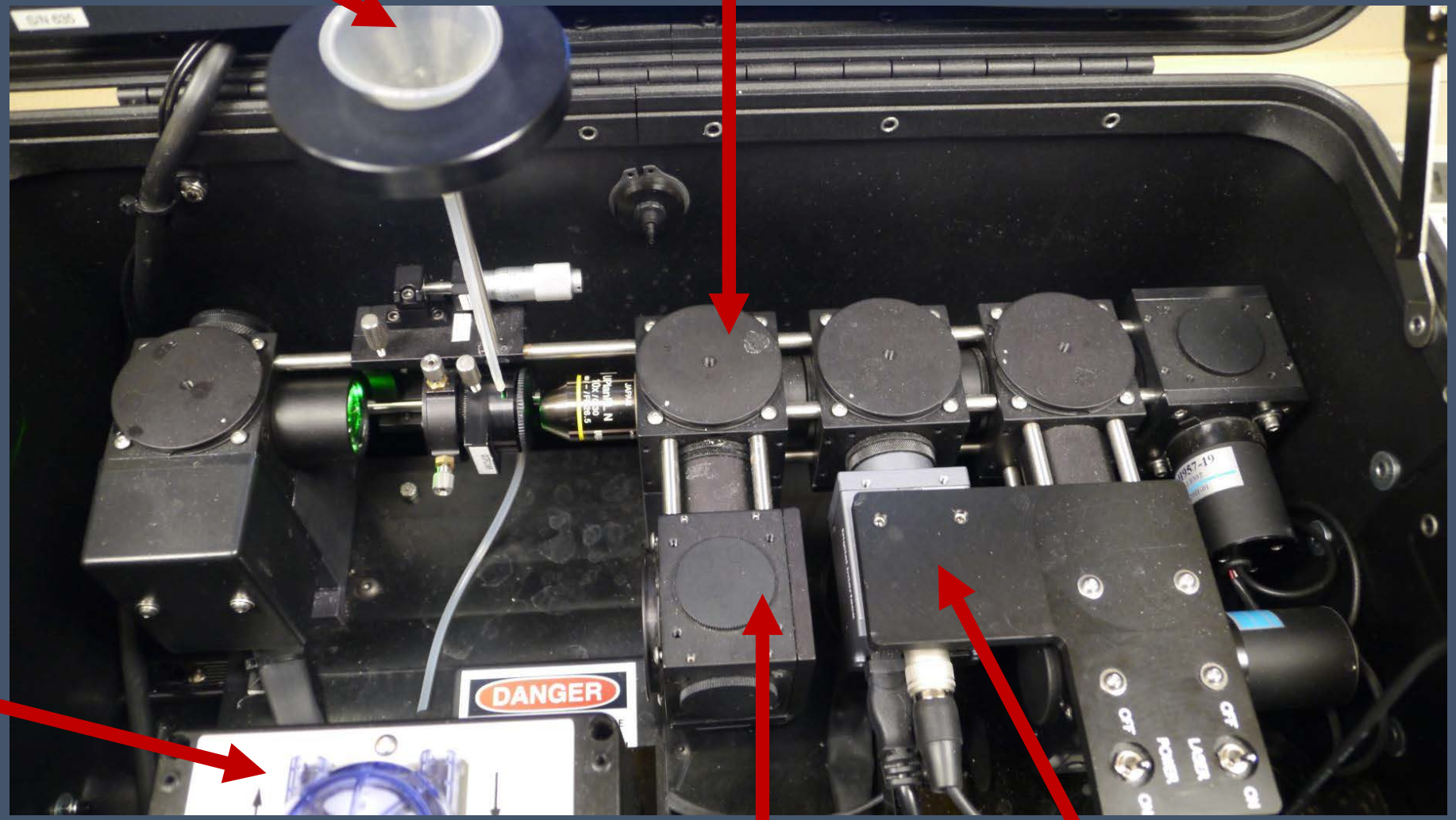


Images: fluidimaging.com

Machine

Software



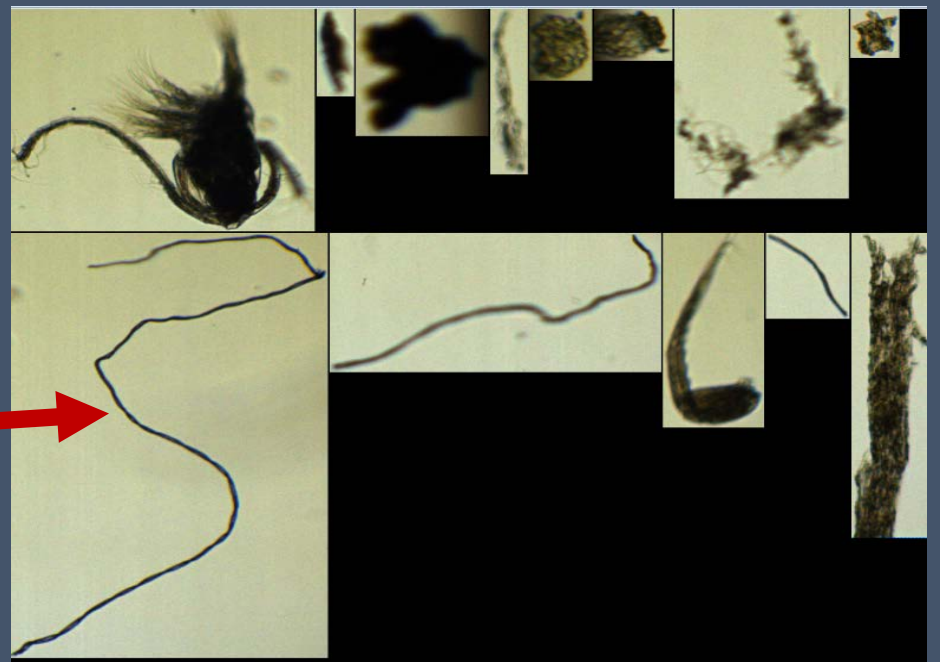

sample port
microscope
pump
laser
camera
DANGER

Benefits

- Rapid
- Transportable
- Data for every single image
- Libraries
  - Pattern recognition software based on up to 40 different parameters
  - Create once and apply to future samples

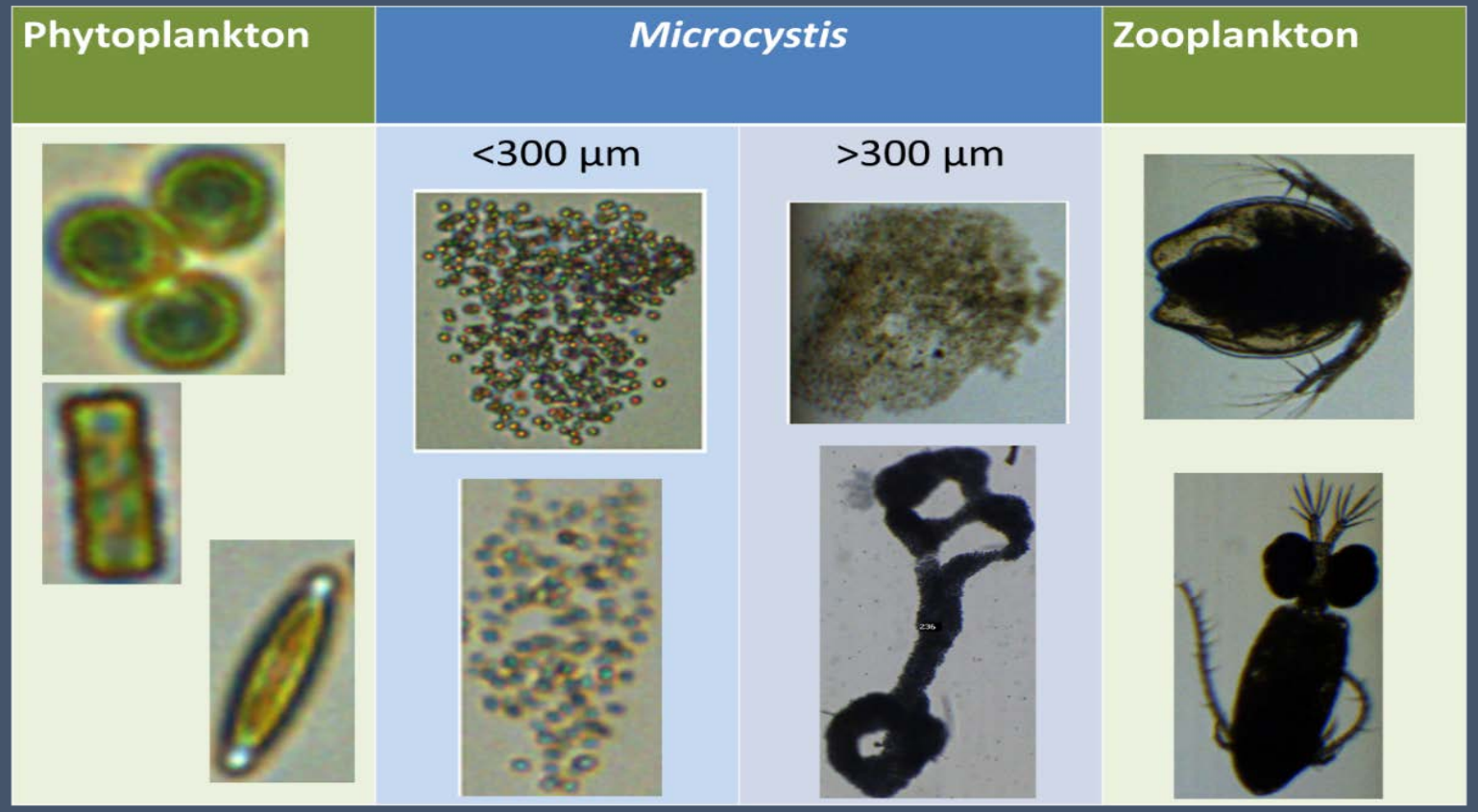
Challenges

- High detritus in samples
  - Able to detect live samples
- Particle sizes (<5µm)
  - New technology developing
- Lots of data/ storage
  - 40 data measurements for each particle



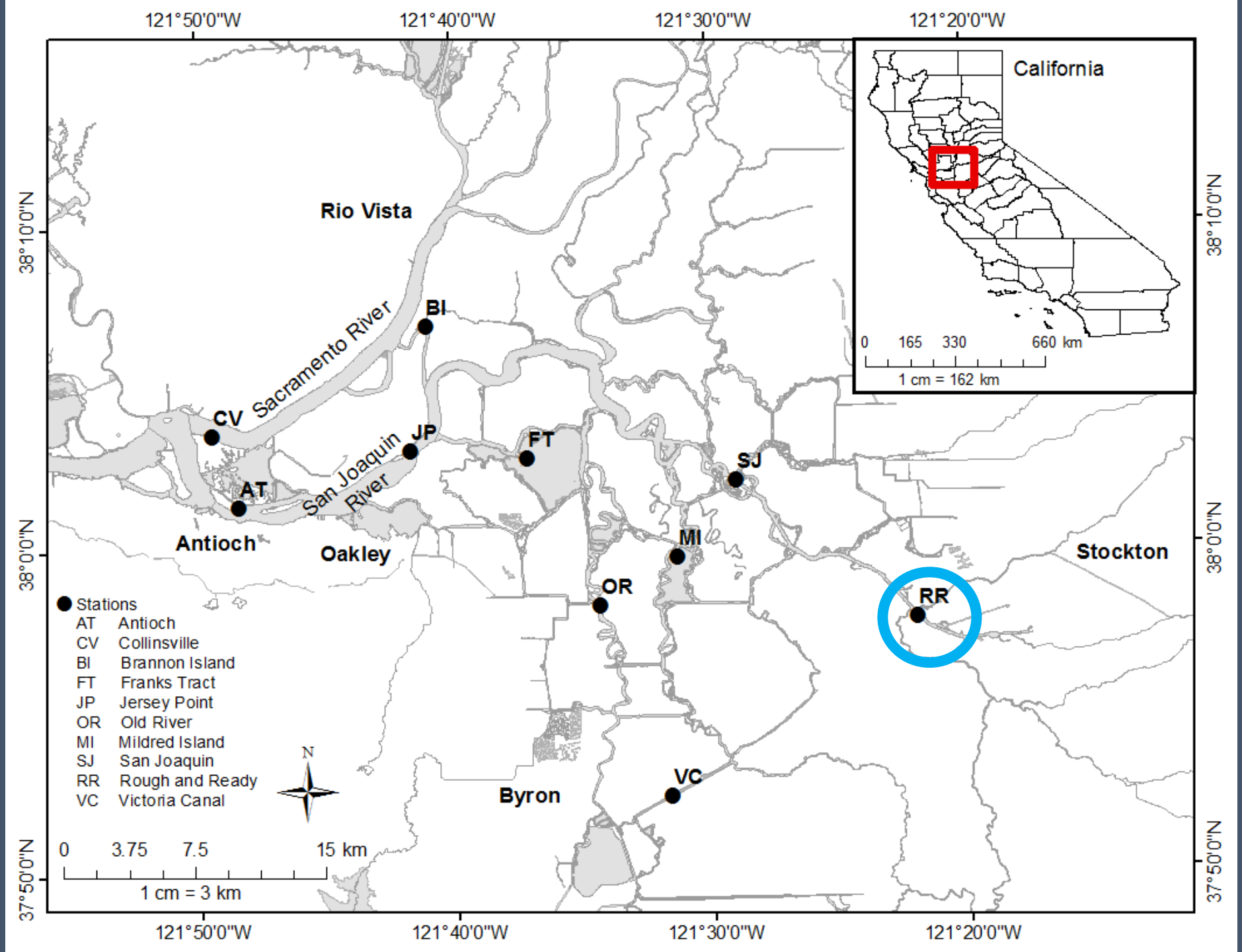
FlowCAM Use in the San Francisco Estuary

- Phytoplankton
- *Microcystis*
  - Up to 50,000 µm
- Zooplankton
  - Broad groupings
- Counts
- Biovolume

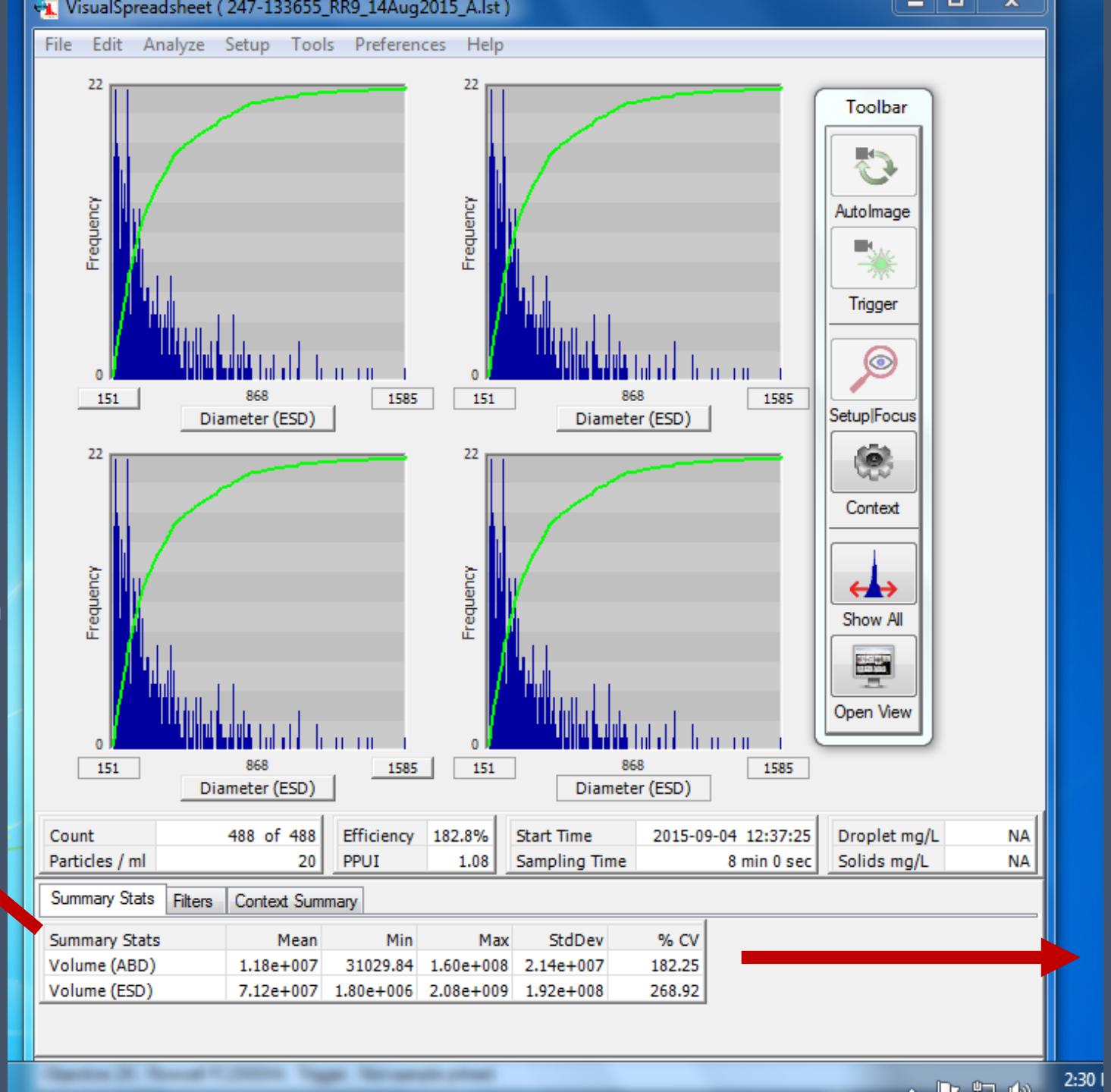


Case Study

- 2014/2015 Drought Special study
- Water quality/nutrients
- Cyanotoxins
- Primary Productivity
- *Microcystis* count/biovolume
- Zooplankton count/biovolume
- And more…

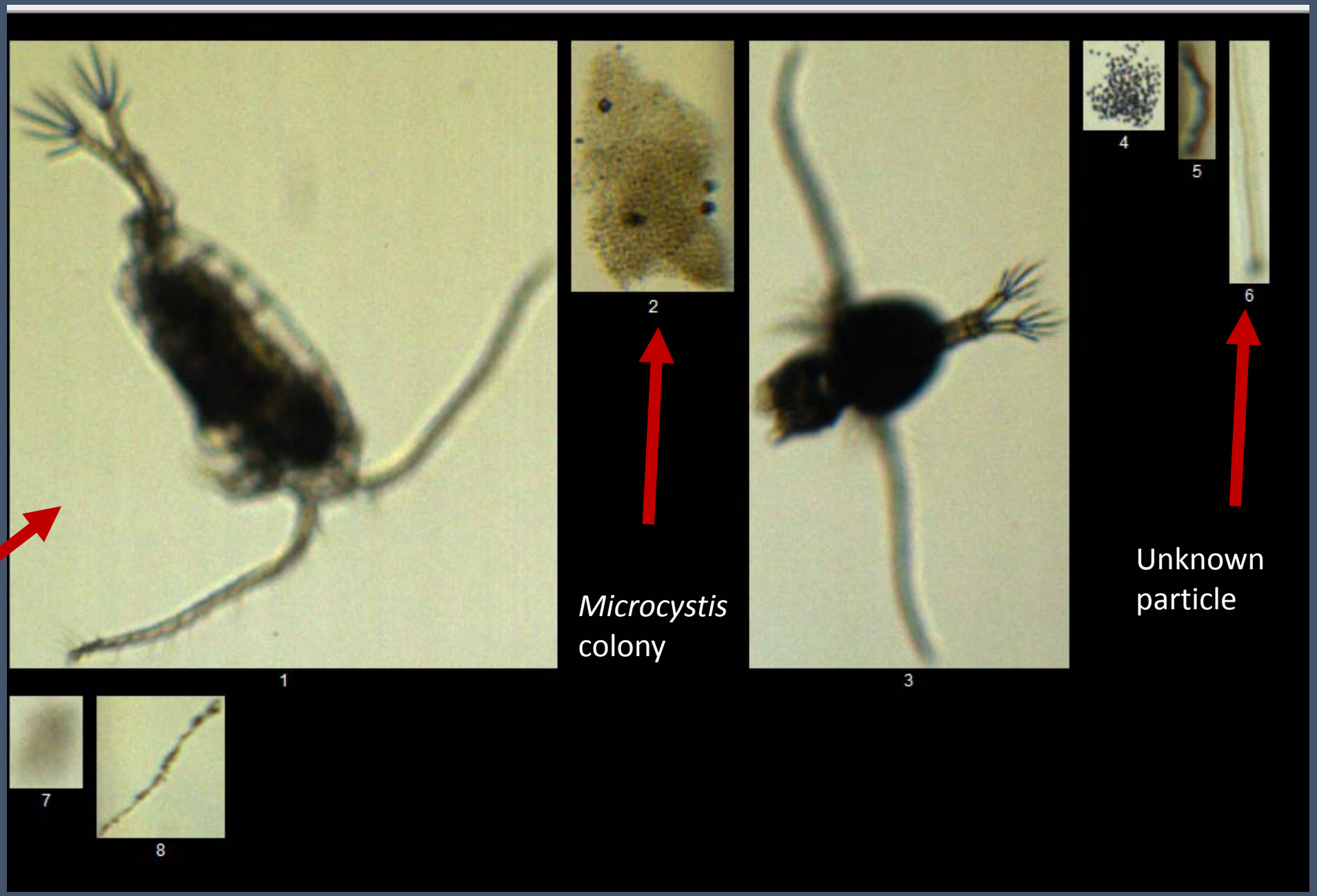

121°50'0"W
121°40'0"W
121°30'0"W
121°20'0"W
38°10'0"N
38°0'0"N
37°50'0"N
Rio Vista
Sacramento River
San Joaquin River
BI
CV
JP
FT
SJ
AT
MI
OR
RR
VC
Antioch
Oakley
Byron
Stockton
Stations
AT Antioch
CV Collinsville
BI Brannon Island
FT Franks Tract
JP Jersey Point
OR Old River
MI Mildred Island
SJ San Joaquin
RR Rough and Ready
VC Victoria Canal
N
0 3.75 7.5 15 km
1 cm = 3 km
California
0 165 330 660 km
1 cm = 162 km

Summary of all particles in sample including zoo, phyto and detritus



User can select what parameters are visible in summary box

Lets follow this organism/ particle (particle ID #1)

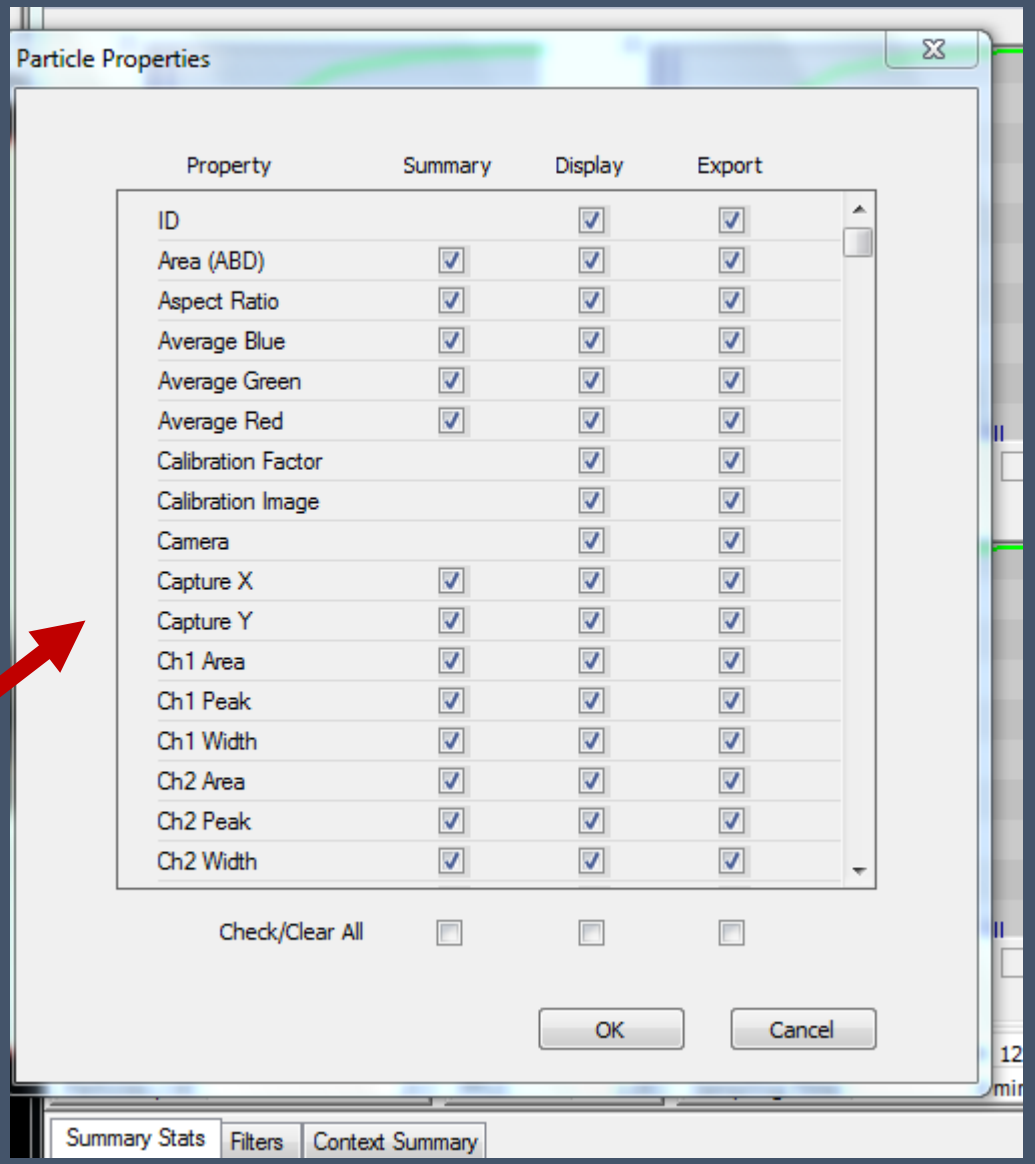


Different categories with numerous pages of each category

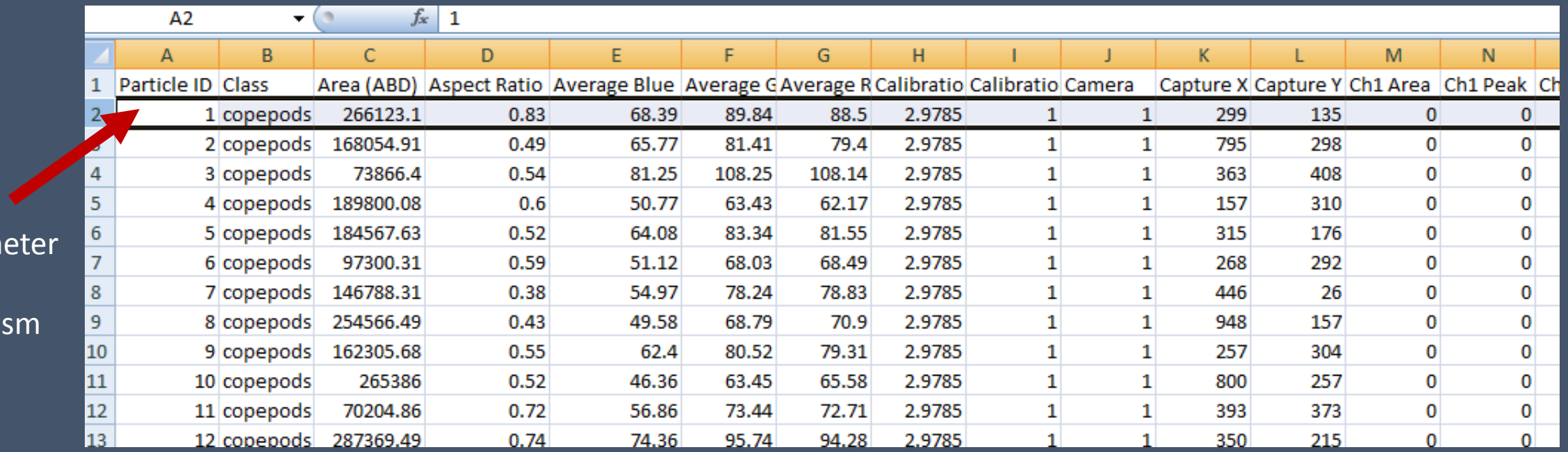
Particle ID #1
Classified into “copepods”

Other particles
Classified into “copepods”

The user can select what parameters they want exported



Over 40 parameter
For each
particle/organism

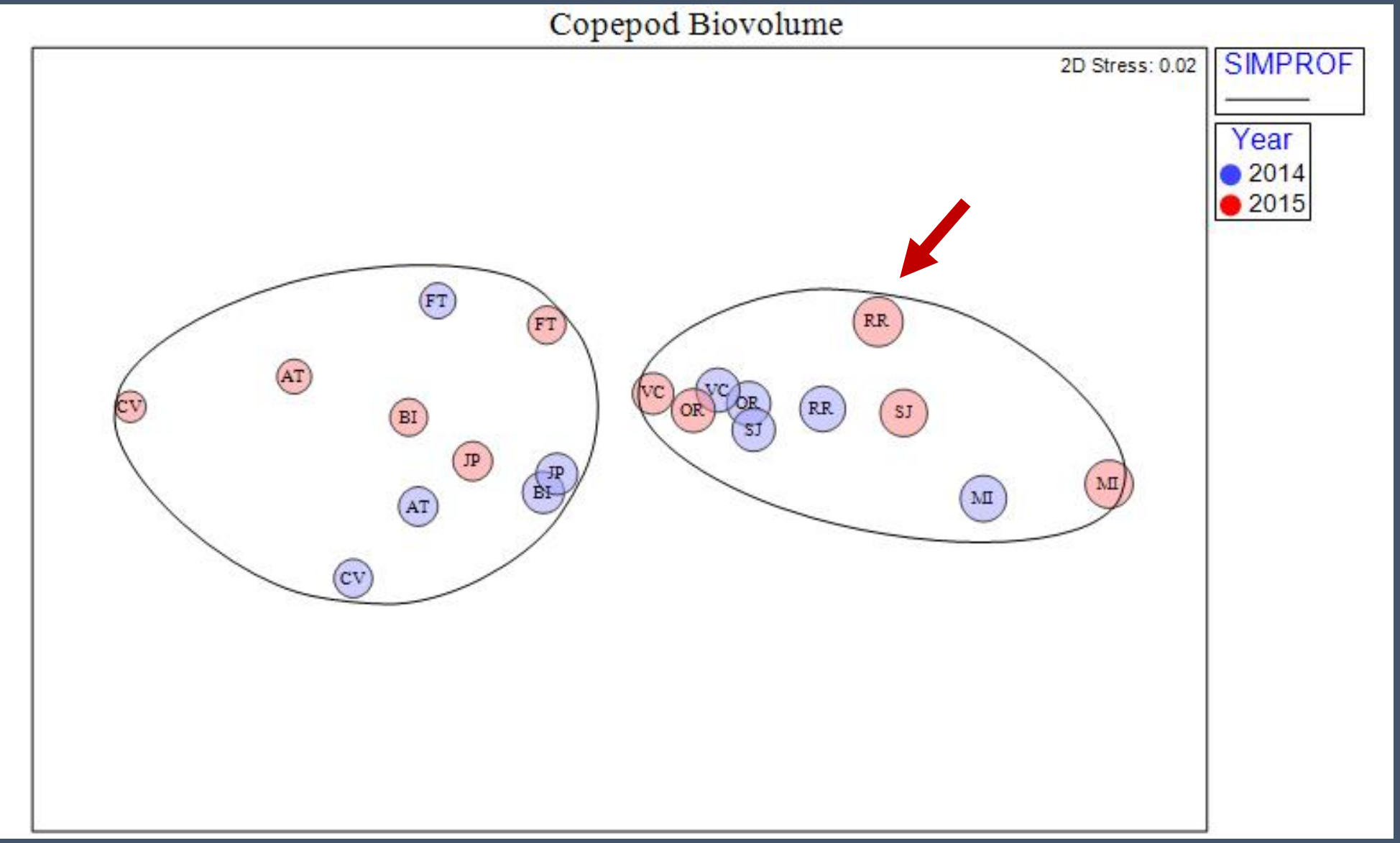


A2 | 1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	Particle ID	Class	Area (ABD)	Aspect Ratio	Average Blue	Average G	Average R	Calibratio	Calibratio	Camera	Capture X	Capture Y	Ch1 Area	Ch1 Peak	Ch
2	1	copepods	266123.1	0.83	68.39	89.84	88.5	2.9785	1	1	299	135	0	0	
3	2	copepods	168054.91	0.49	65.77	81.41	79.4	2.9785	1	1	795	298	0	0	
4	3	copepods	73866.4	0.54	81.25	108.25	108.14	2.9785	1	1	363	408	0	0	
5	4	copepods	189800.08	0.6	50.77	63.43	62.17	2.9785	1	1	157	310	0	0	
6	5	copepods	184567.63	0.52	64.08	83.34	81.55	2.9785	1	1	315	176	0	0	
7	6	copepods	97300.31	0.59	51.12	68.03	68.49	2.9785	1	1	268	292	0	0	
8	7	copepods	146788.31	0.38	54.97	78.24	78.83	2.9785	1	1	446	26	0	0	
9	8	copepods	254566.49	0.43	49.58	68.79	70.9	2.9785	1	1	948	157	0	0	
10	9	copepods	162305.68	0.55	62.4	80.52	79.31	2.9785	1	1	257	304	0	0	
11	10	copepods	265386	0.52	46.36	63.45	65.58	2.9785	1	1	800	257	0	0	
12	11	copepods	70204.86	0.72	56.86	73.44	72.71	2.9785	1	1	393	373	0	0	
13	12	copepods	287369.49	0.74	74.36	95.74	94.28	2.9785	1	1	350	215	0	0	

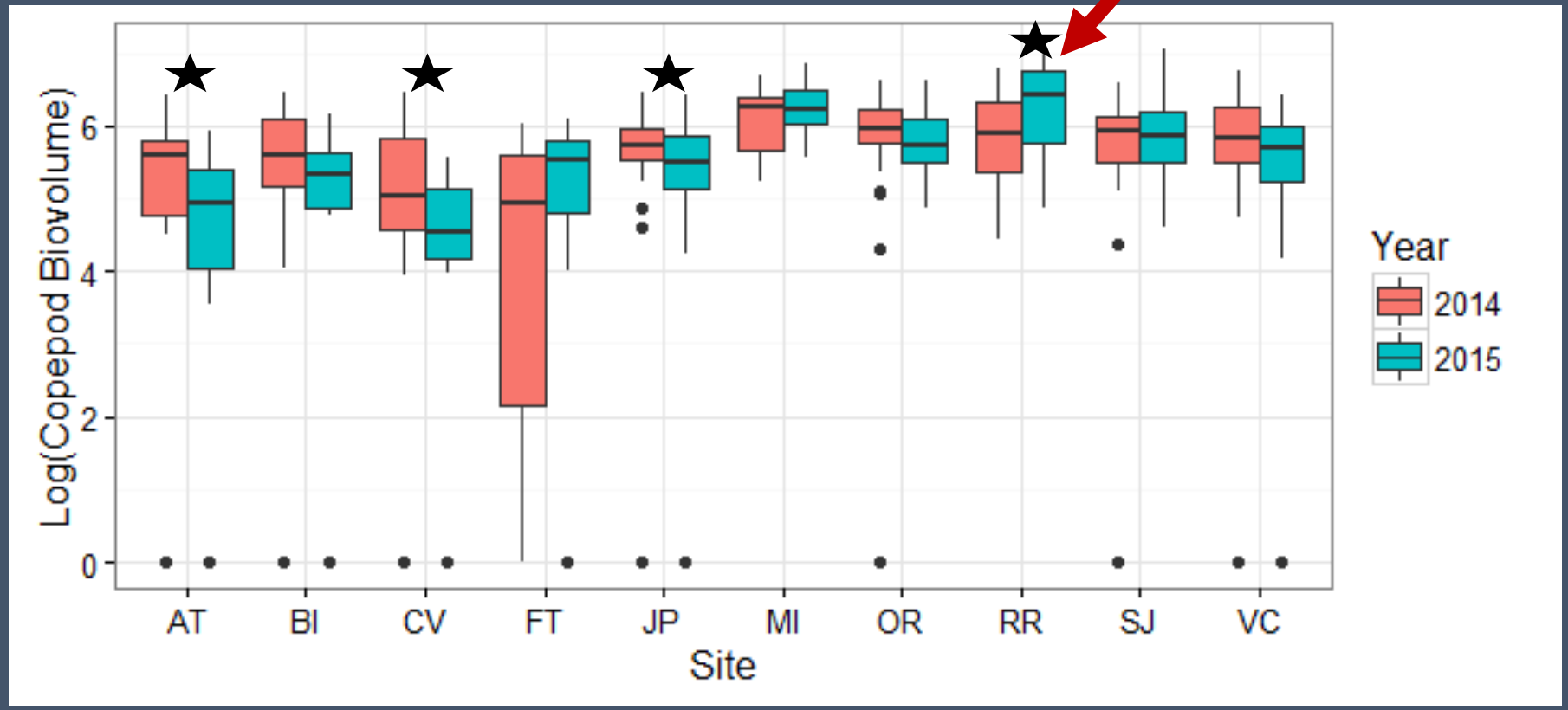
How is the FlowCAM data applied?

- Compare zooplankton biovolume between years
- Compare zooplankton biovolume between sites and regions.



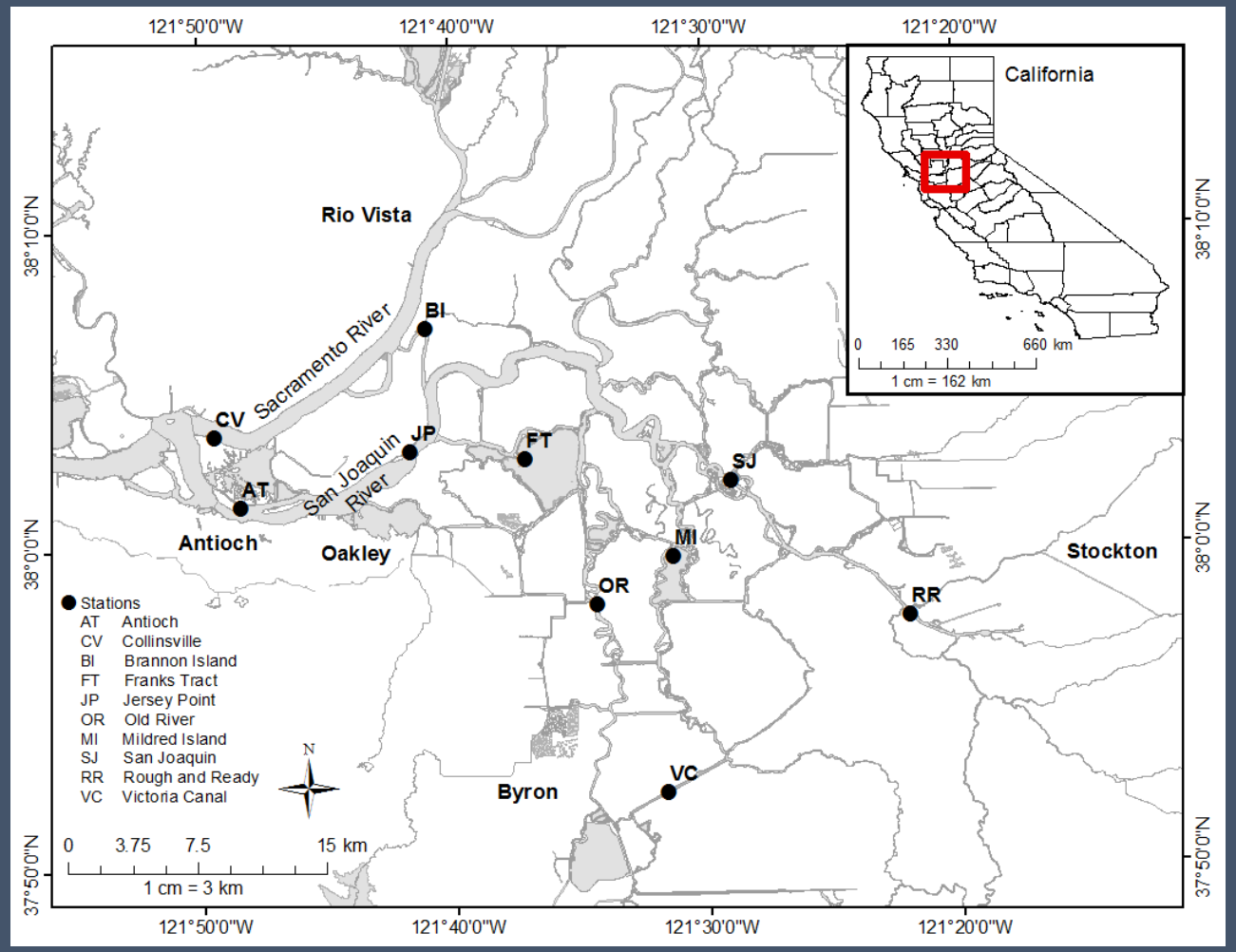
Significant station groupings between freshwater and brackish sites

Significantly more copepod biovolume at RR in 2015



Average Biovolume per Individual

	Copepoda	Cladocera
AT	47,611	34,314
BI	52,100	22,642
CV	30,415	25,792
FT	71,607	28,021
JP	69,639	35,484
MI	85,716	50,266
OR	106,570	33,389
RR	52,210	21,034
SJ	85,038	32,839
VC	114,059	32,840



Copepod biovolume varied by up to 375% between sites

Cladoceran biovolume varied up to 238%

Future studies

- Monitoring efforts
  - Rapid assessment of plankton biovolume
- Plastics
  - Prior observations in samples
- Special Studies
  - Mesocosoms
  - Contaminant effects

Thank You!

Questions?