Overview of satellite research for chlorophyll *a* and phycocyanin on large salt lakes

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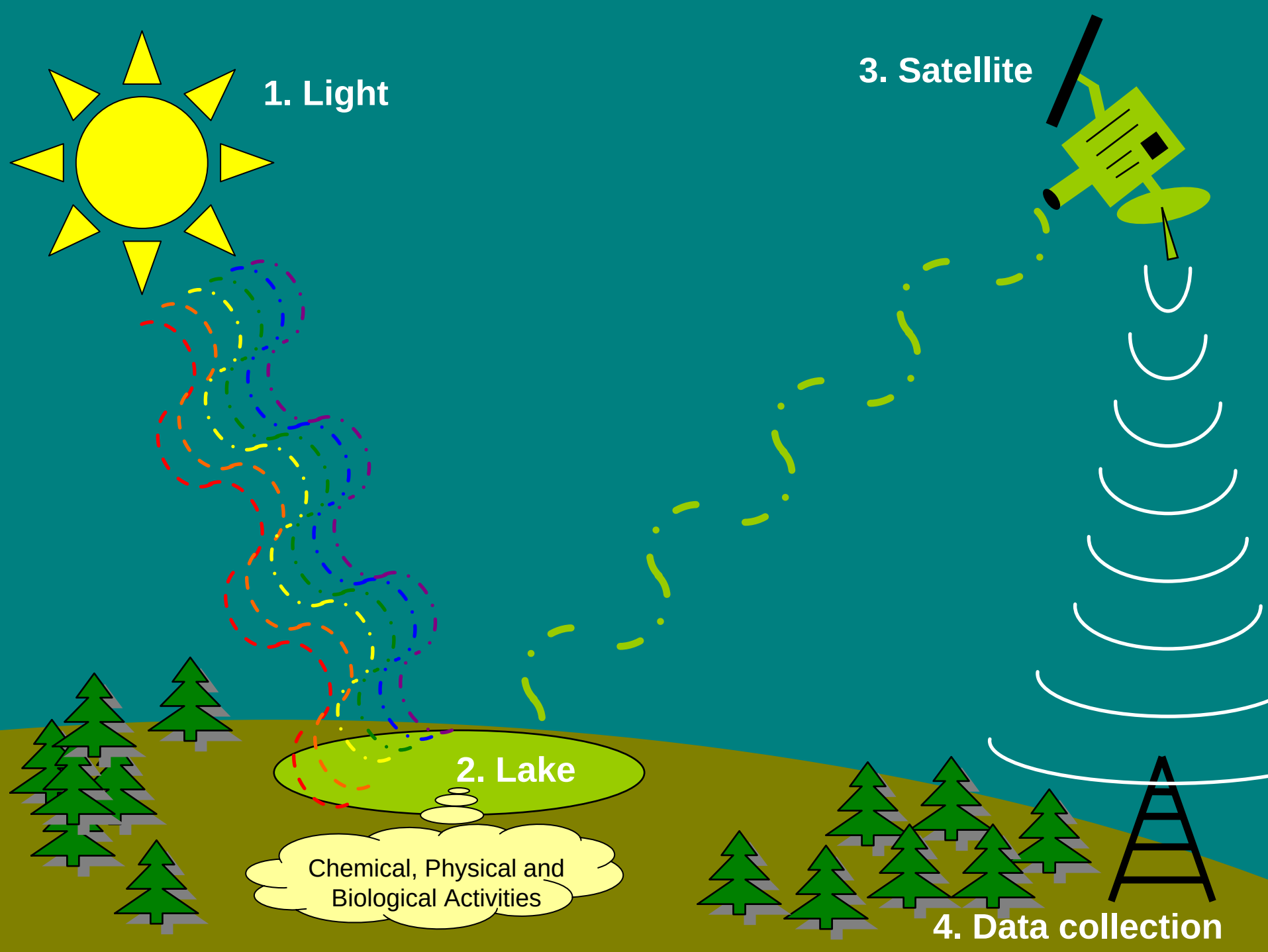
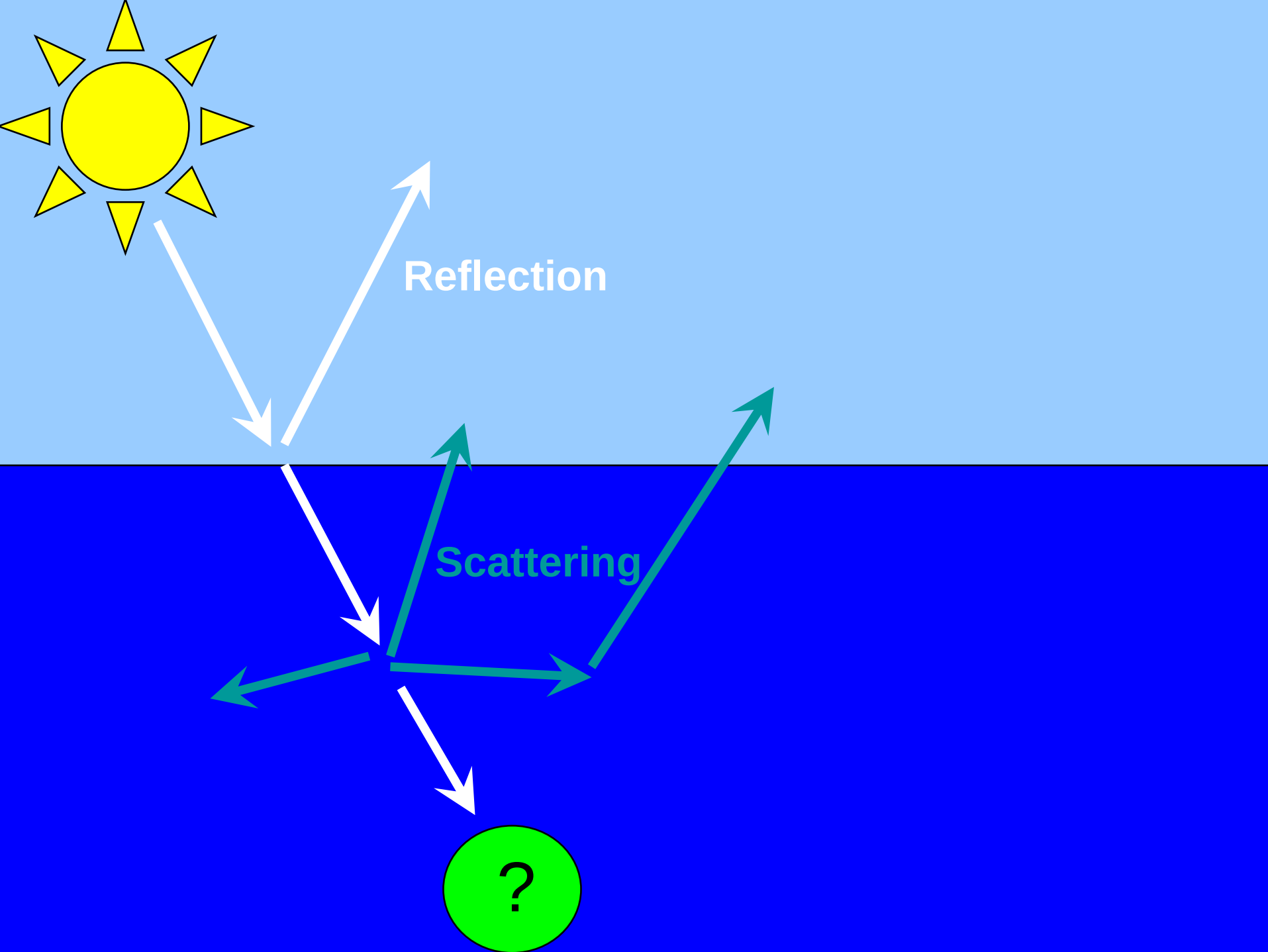
1. Light in water
2. Types of satellites
3. The Great Salt Lake
4. The Aral Sea

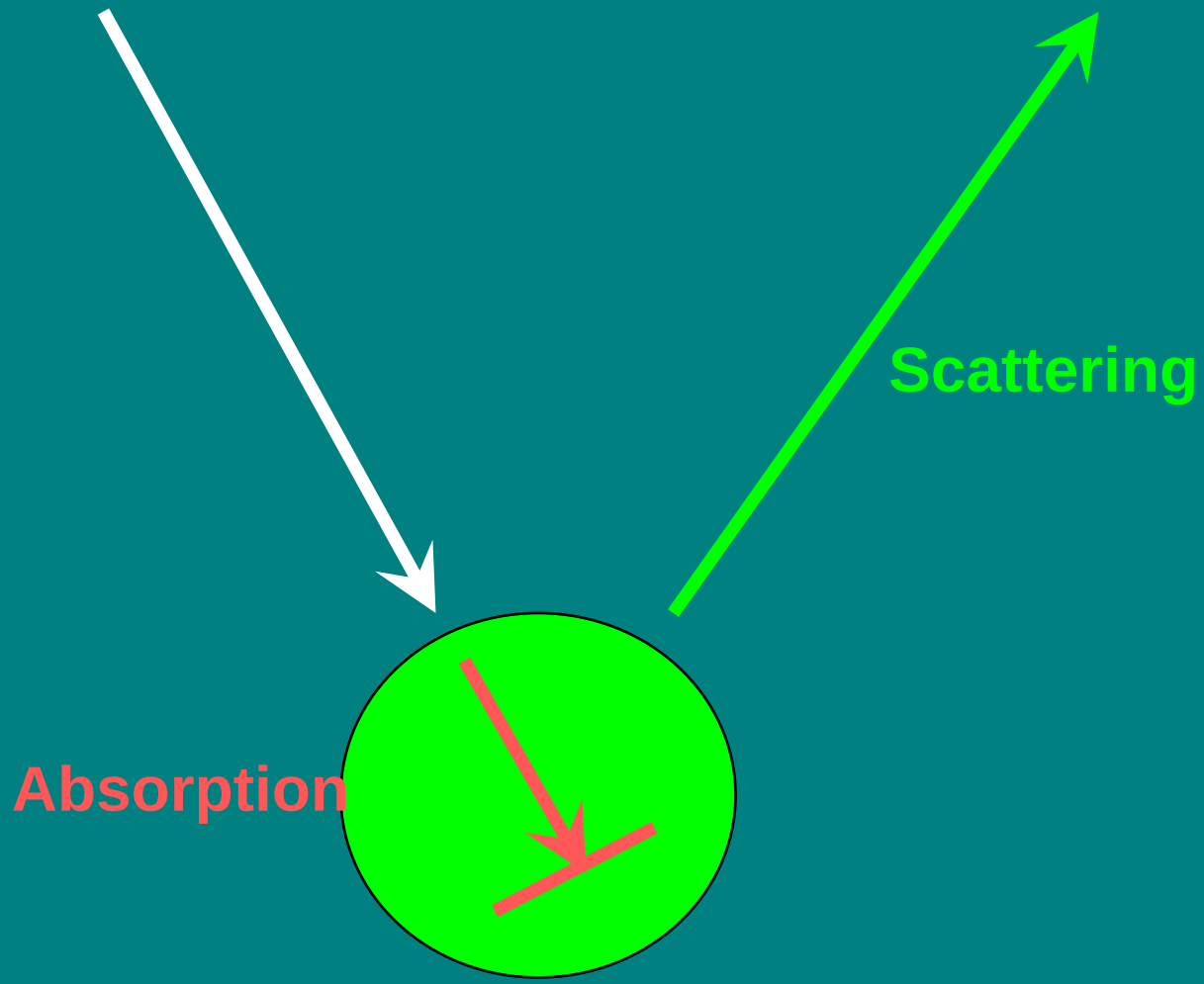
What is your impression of this lake?

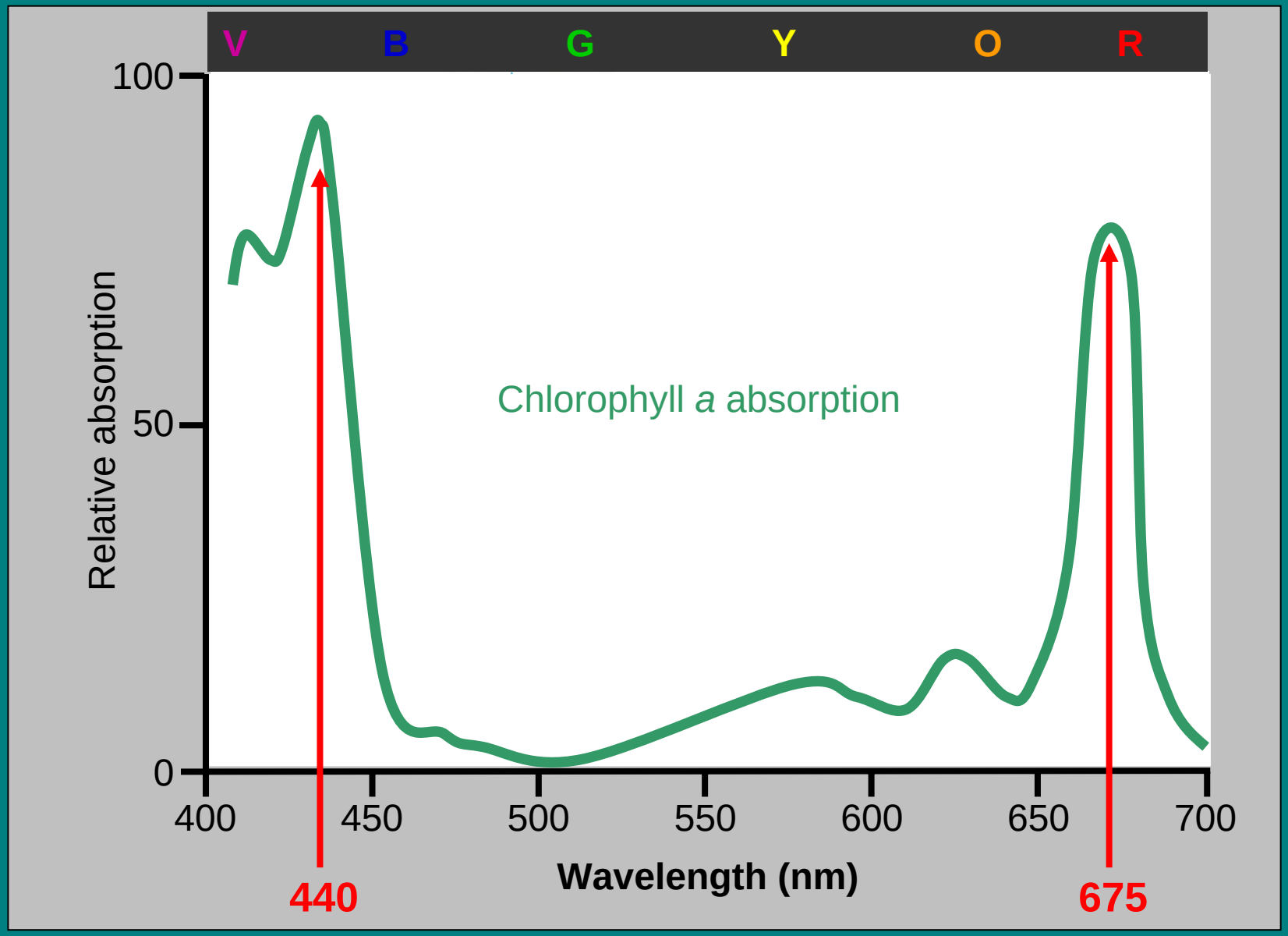

What is your impression of this lake?

Water color tells you what is going on in the water

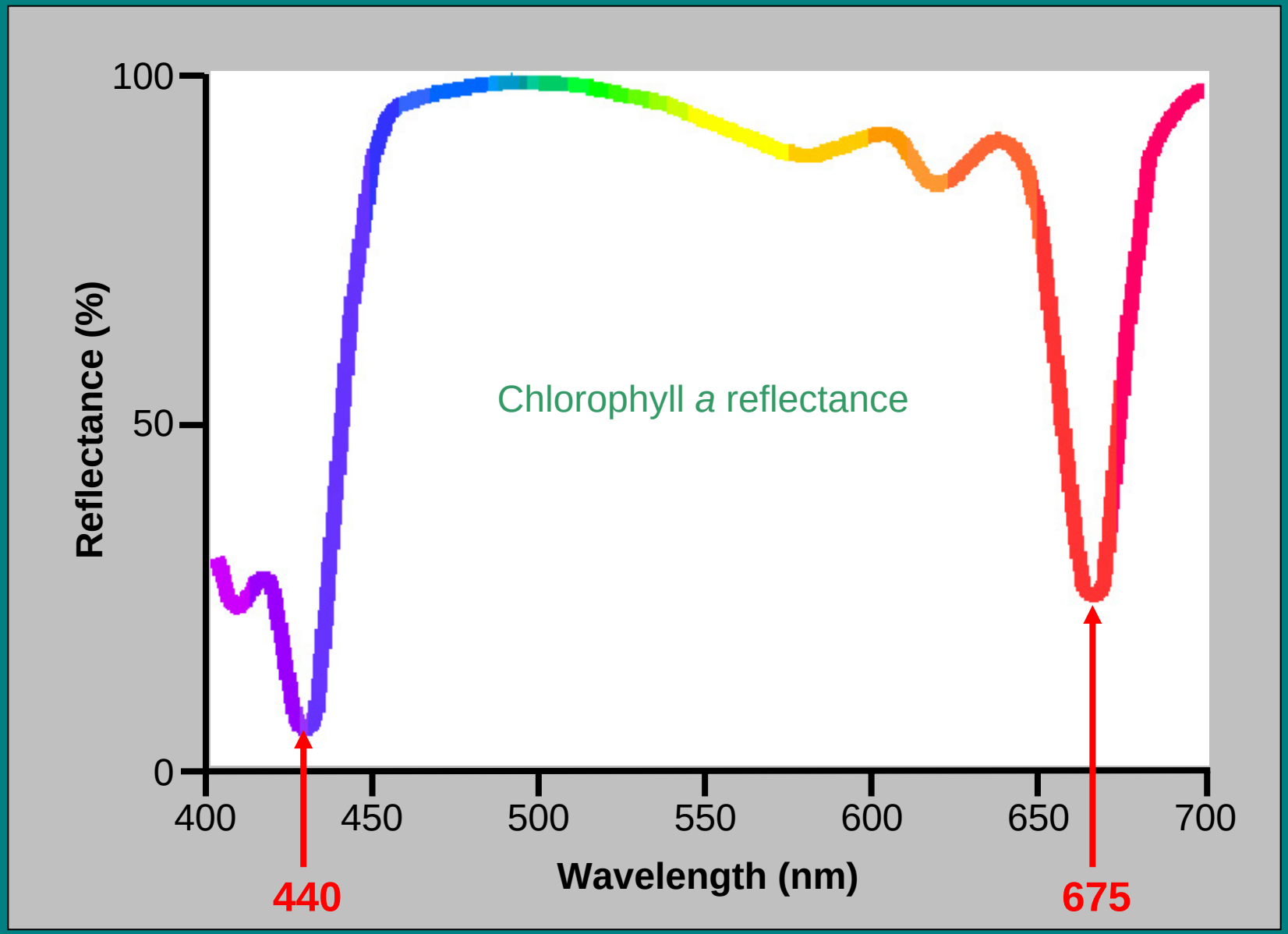

1. Light
3. Satellite
2. Lake
Chemical, Physical and
Biological Activities
4. Data collection


Reflection
Scattering
?

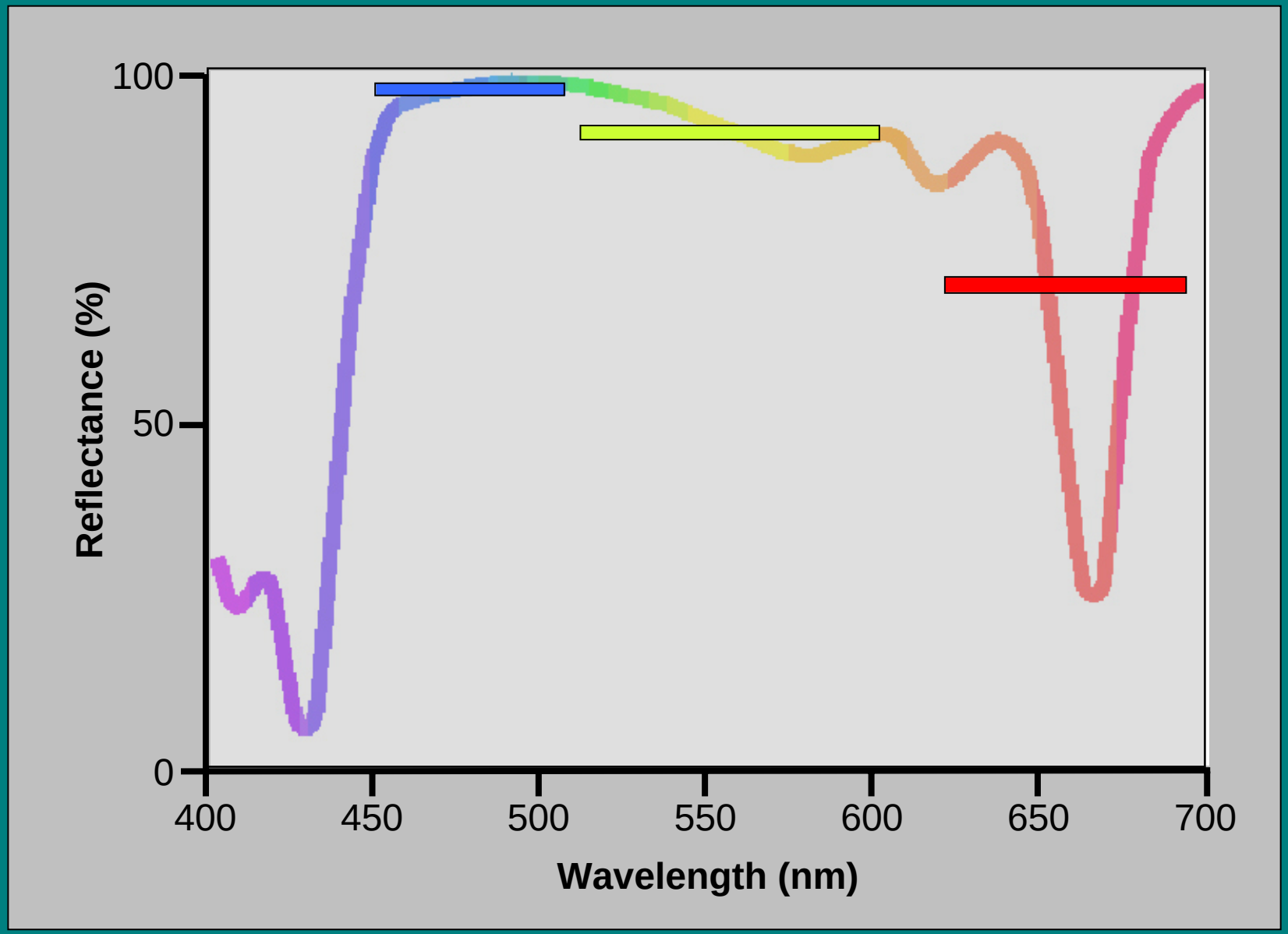

Scattering
Absorption


V
B
G
Y
O
R
100
50
0
Relative absorption
Chlorophyll a absorption
400
450
500
550
600
650
700
Wavelength (nm)
440
675

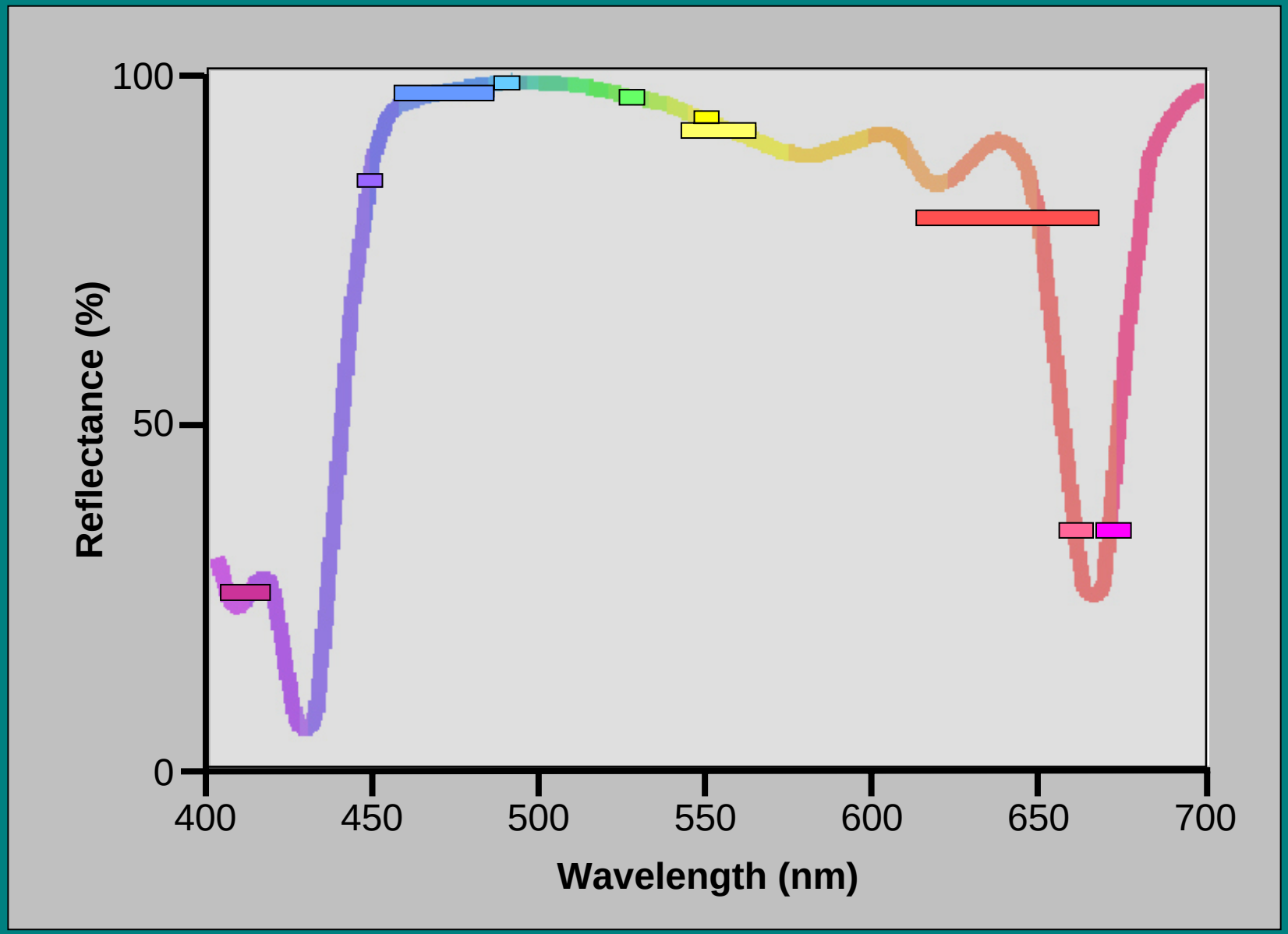
Idealized satellite



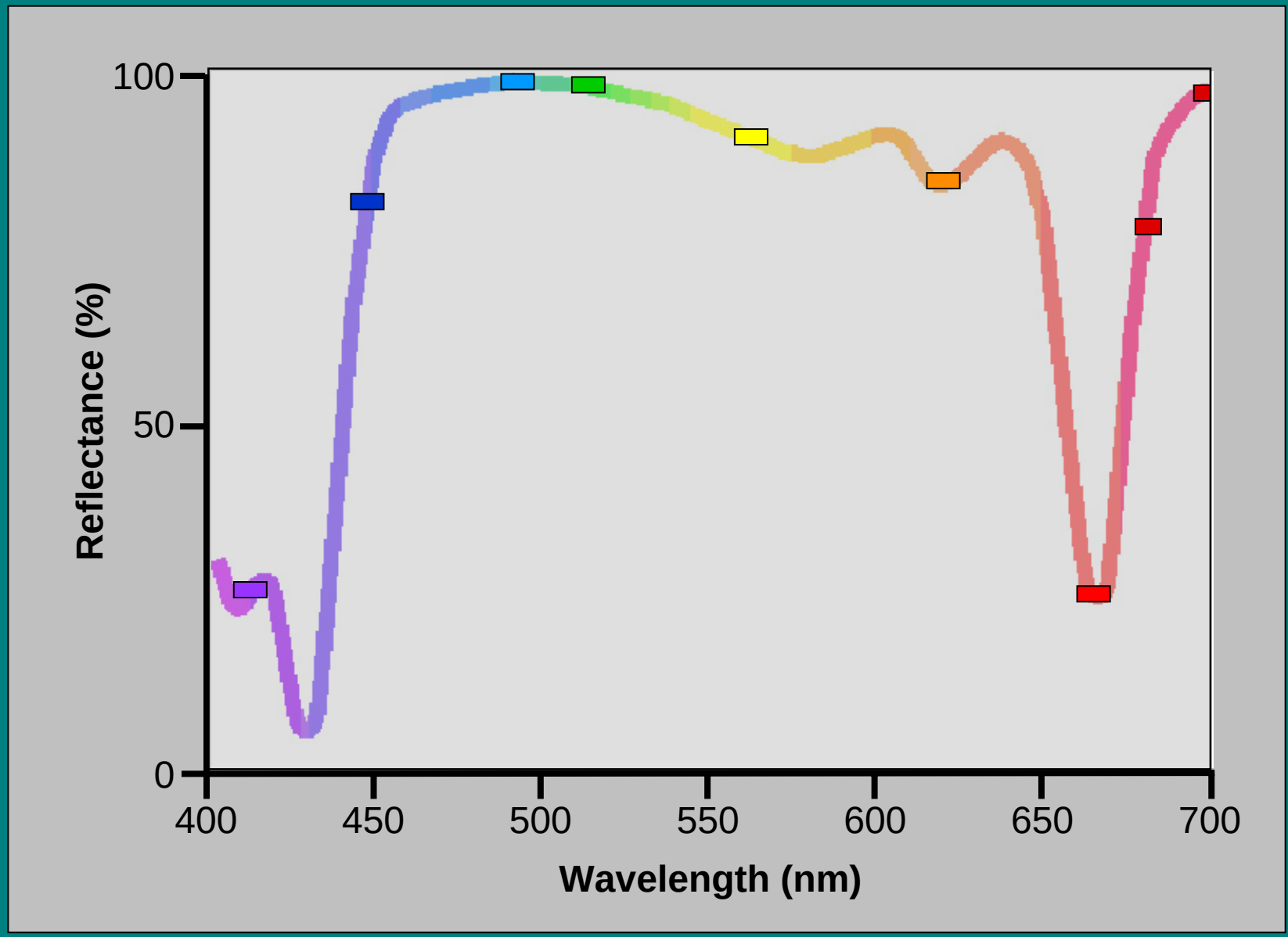
Landsat ETM+

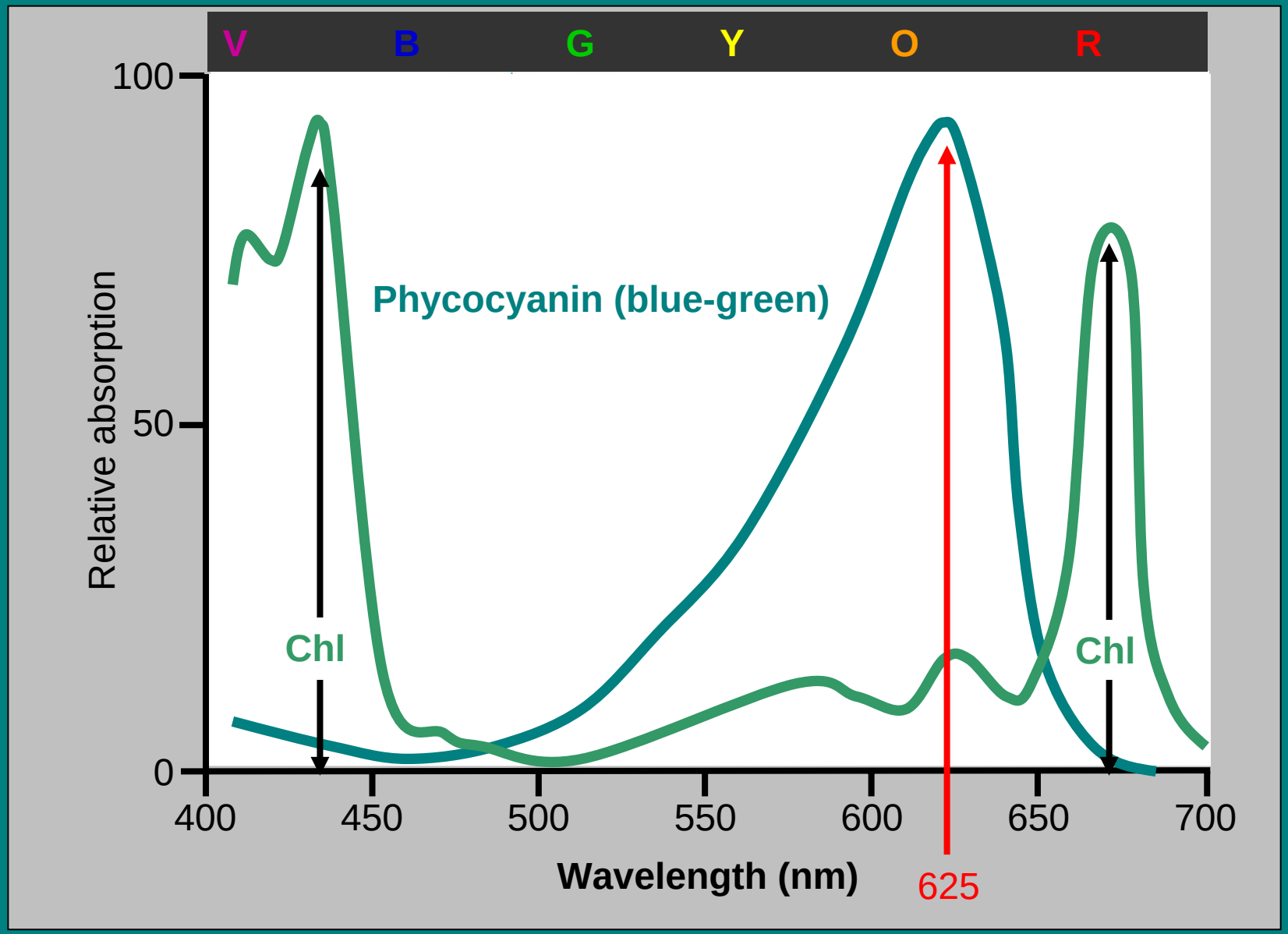

100
50
0
Reflectance (%)
400
450
500
550
600
650
700
Wavelength (nm)

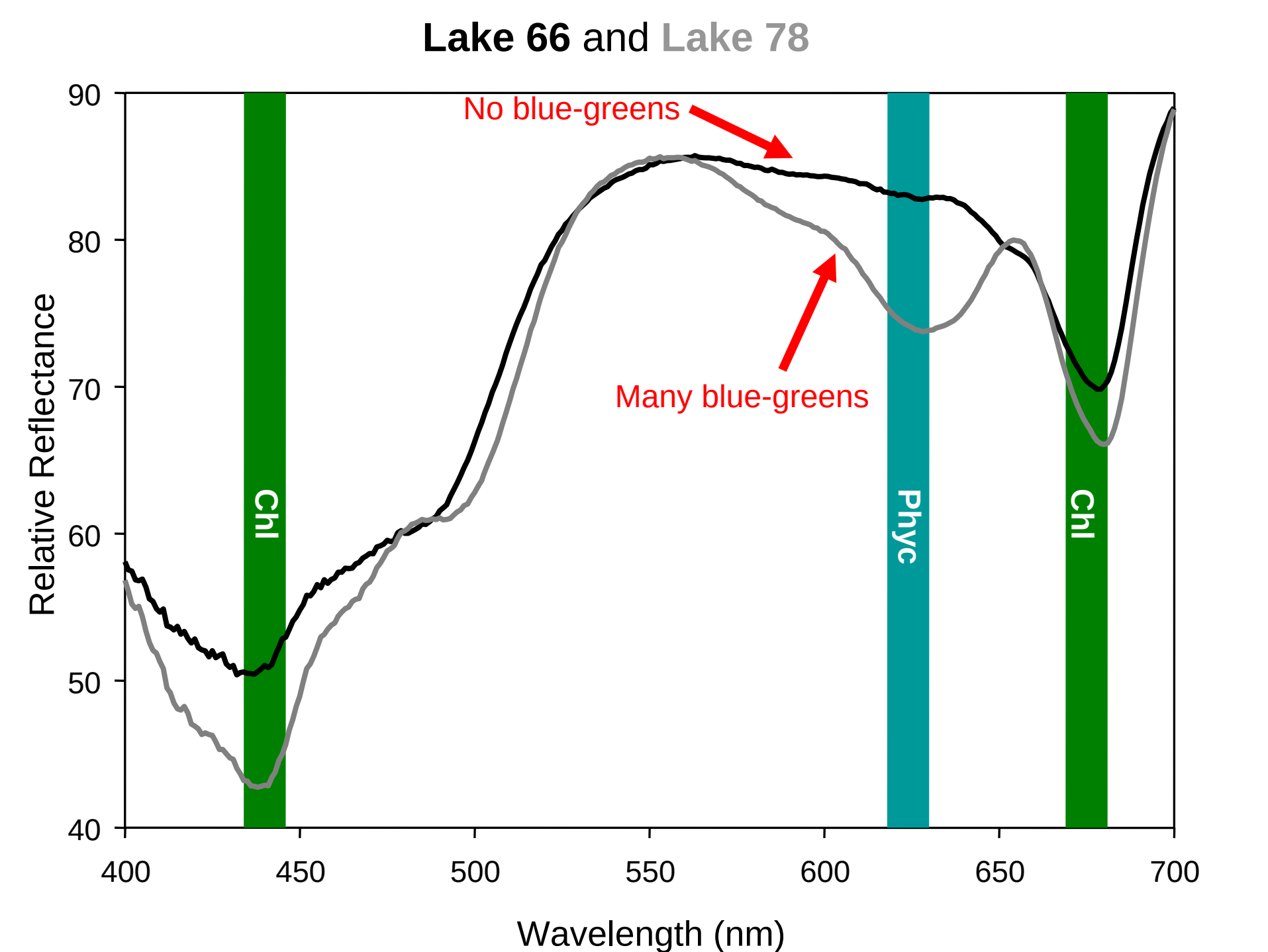
MODIS

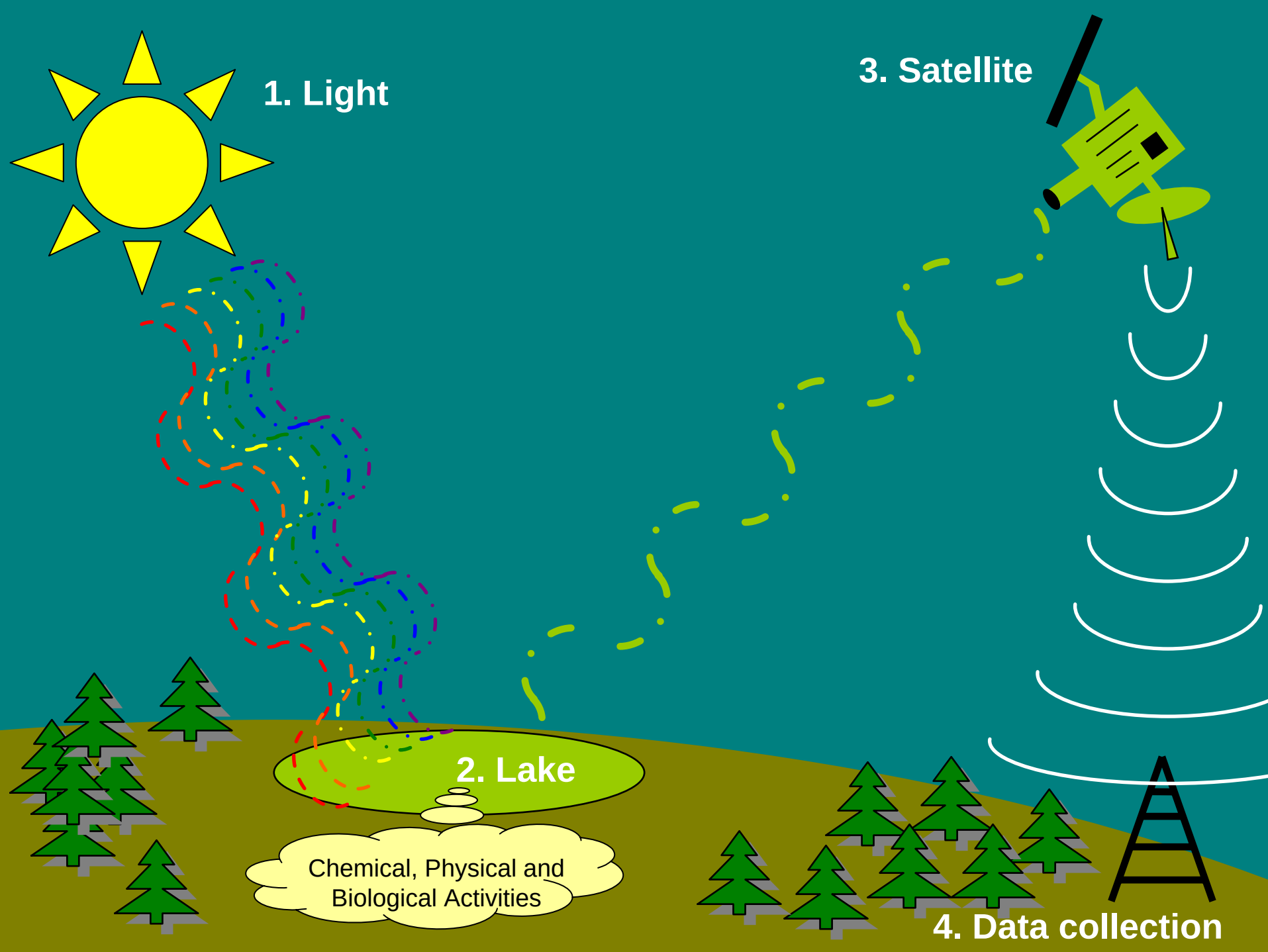

100
50
0
Reflectance (%)
400
450
500
550
600
650
700
Wavelength (nm)

MERIS


100
50
0
Reflectance (%)
400
450
500
550
600
650
700
Wavelength (nm)


V
B
G
Y
O
R
100
50
0
Relative absorption
Phycocyanin (blue-green)
Chl
Chl
400
450
500
550
600
650
700
Wavelength (nm)
625


Lake 66 and Lake 78
No blue-greens
Many blue-greens
Chl
Phyc
Chl
Relative Reflectance
90
80
70
60
50
40
400
450
500
550
600
650
700
Wavelength (nm)


1. Light
3. Satellite
2. Lake
Chemical, Physical and
Biological Activities
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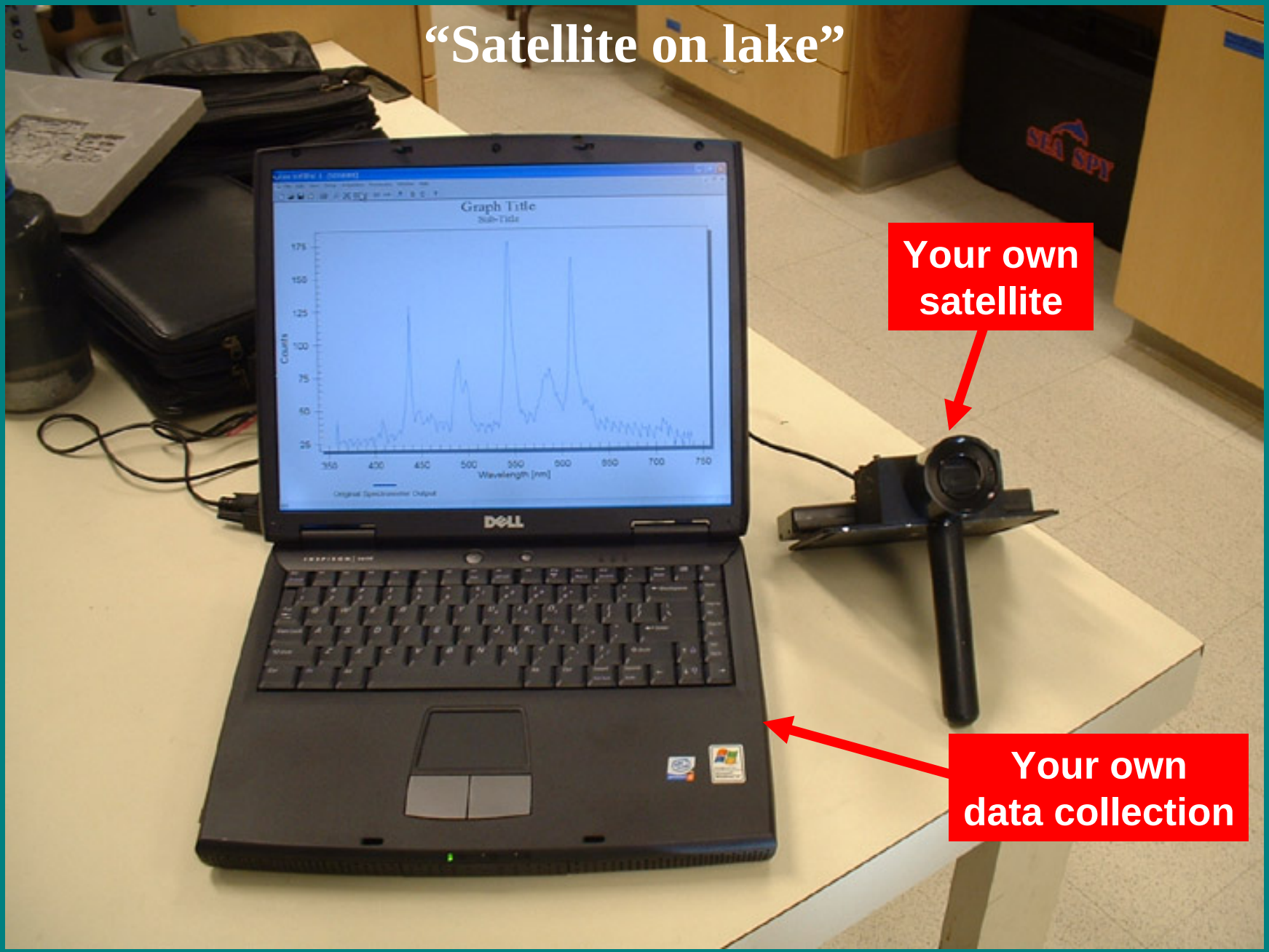
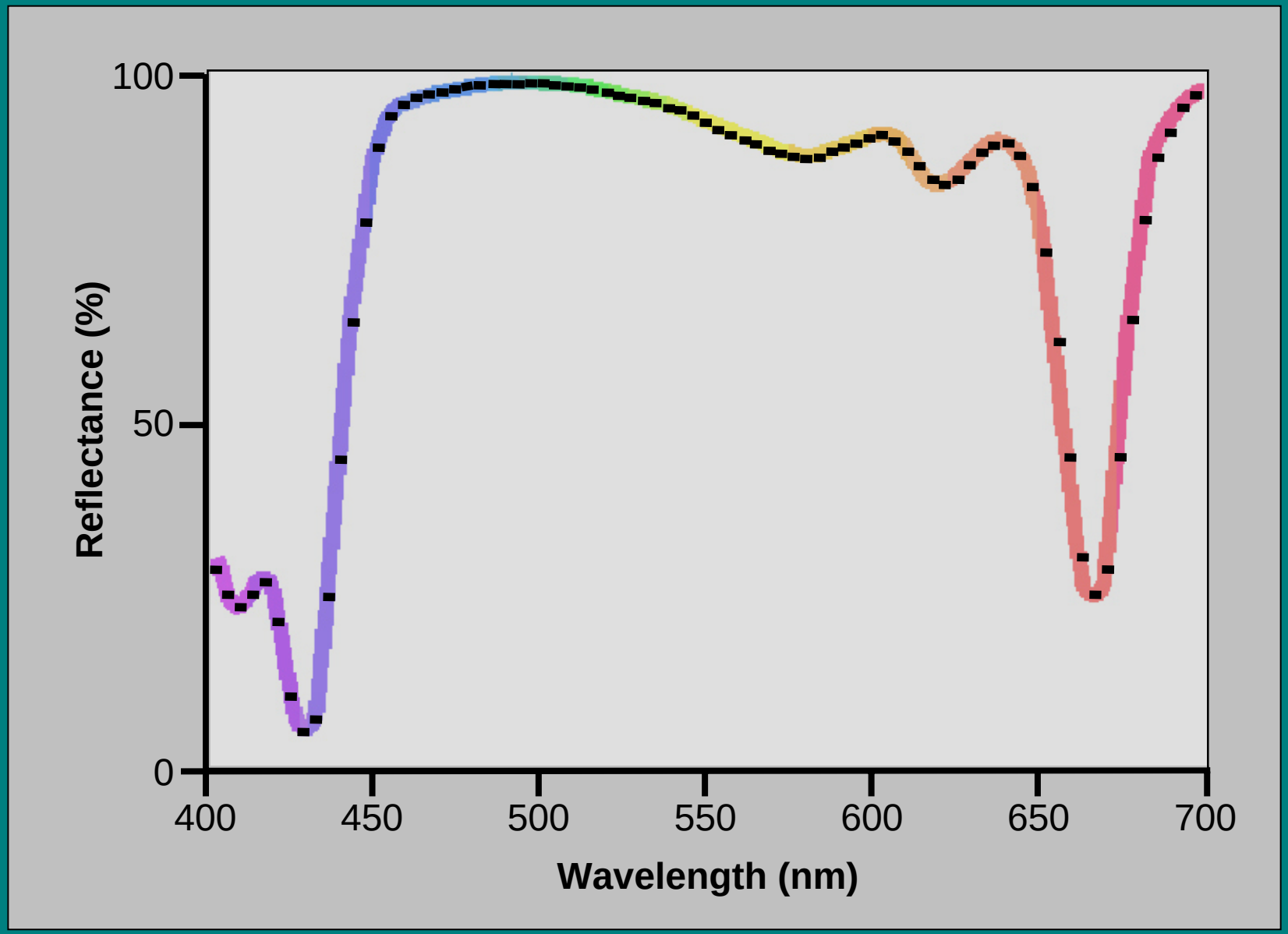
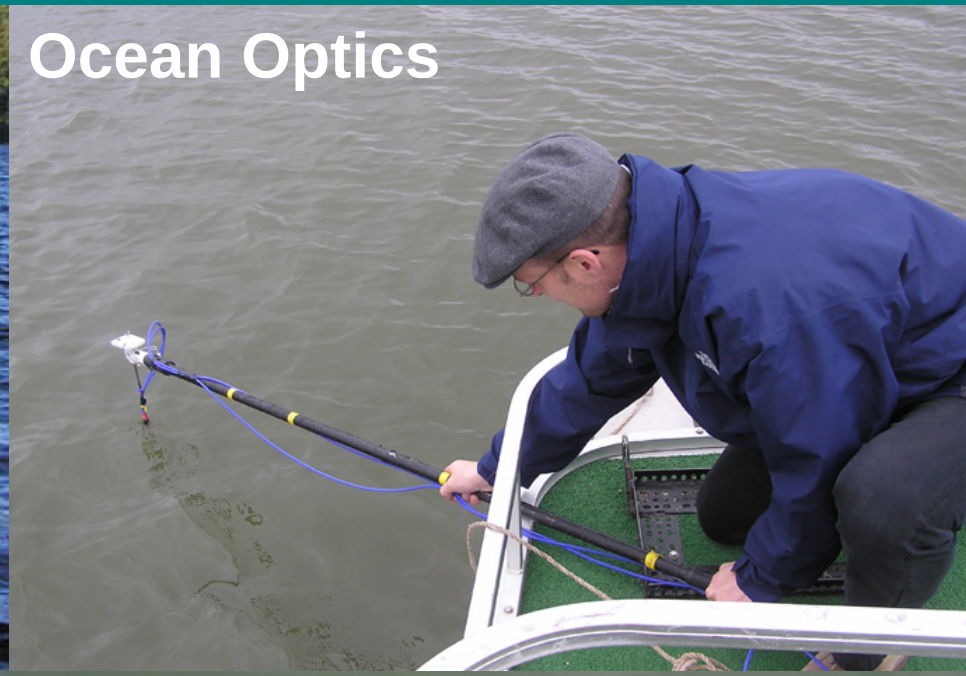
“Satellite on lake”

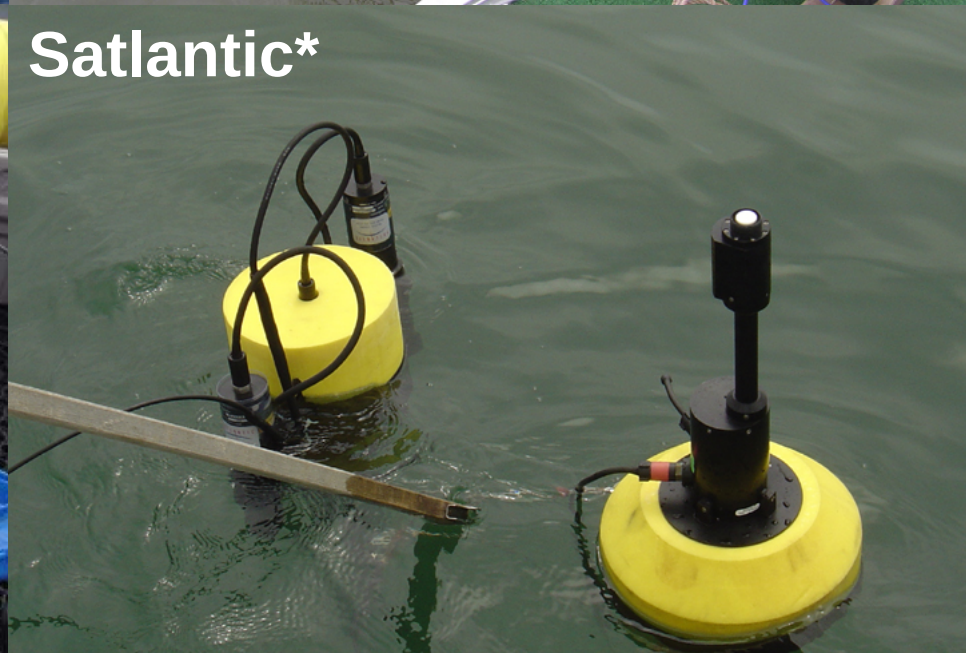


“Satellite on lake”



“Satellites” on the lake

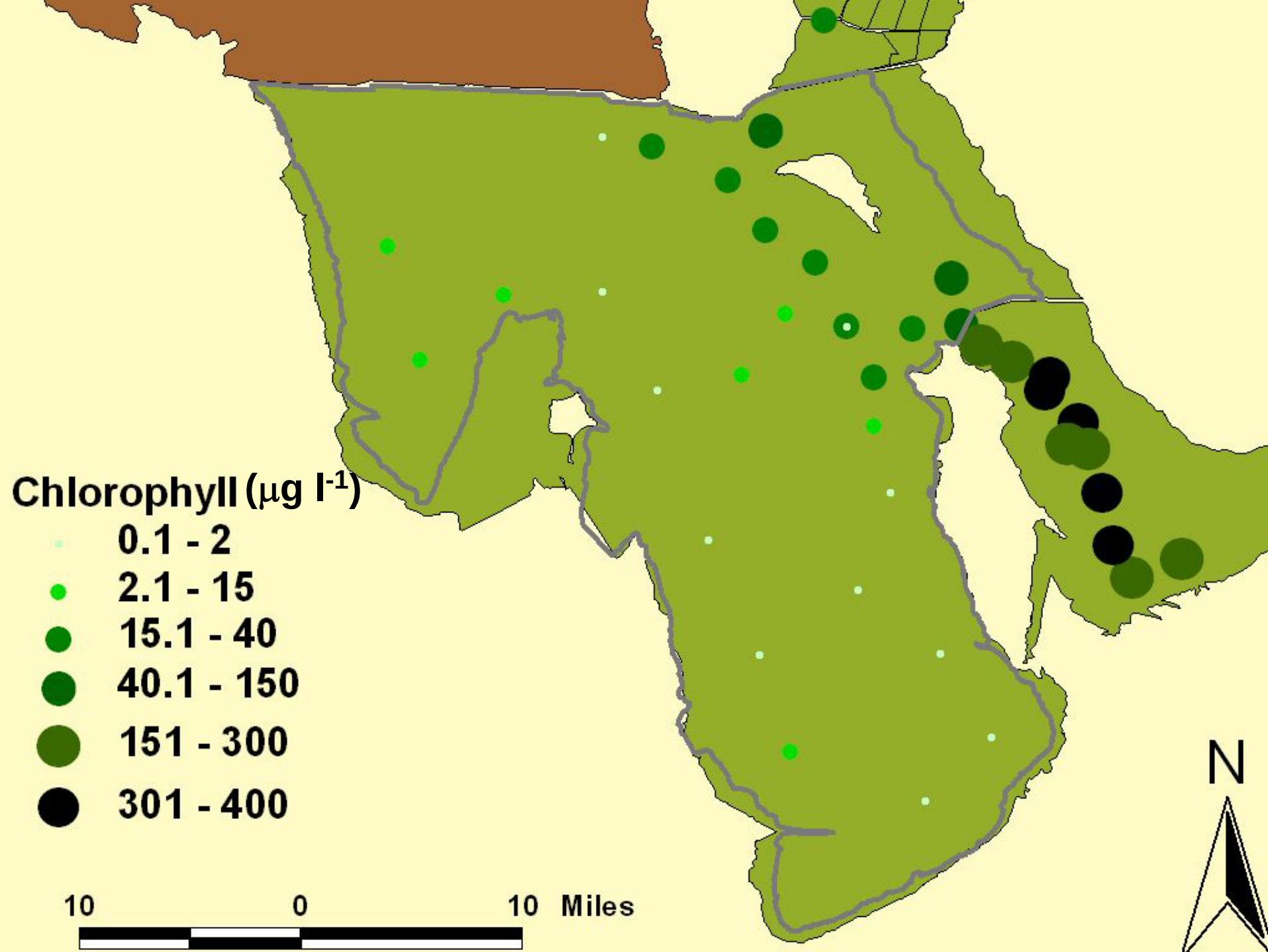


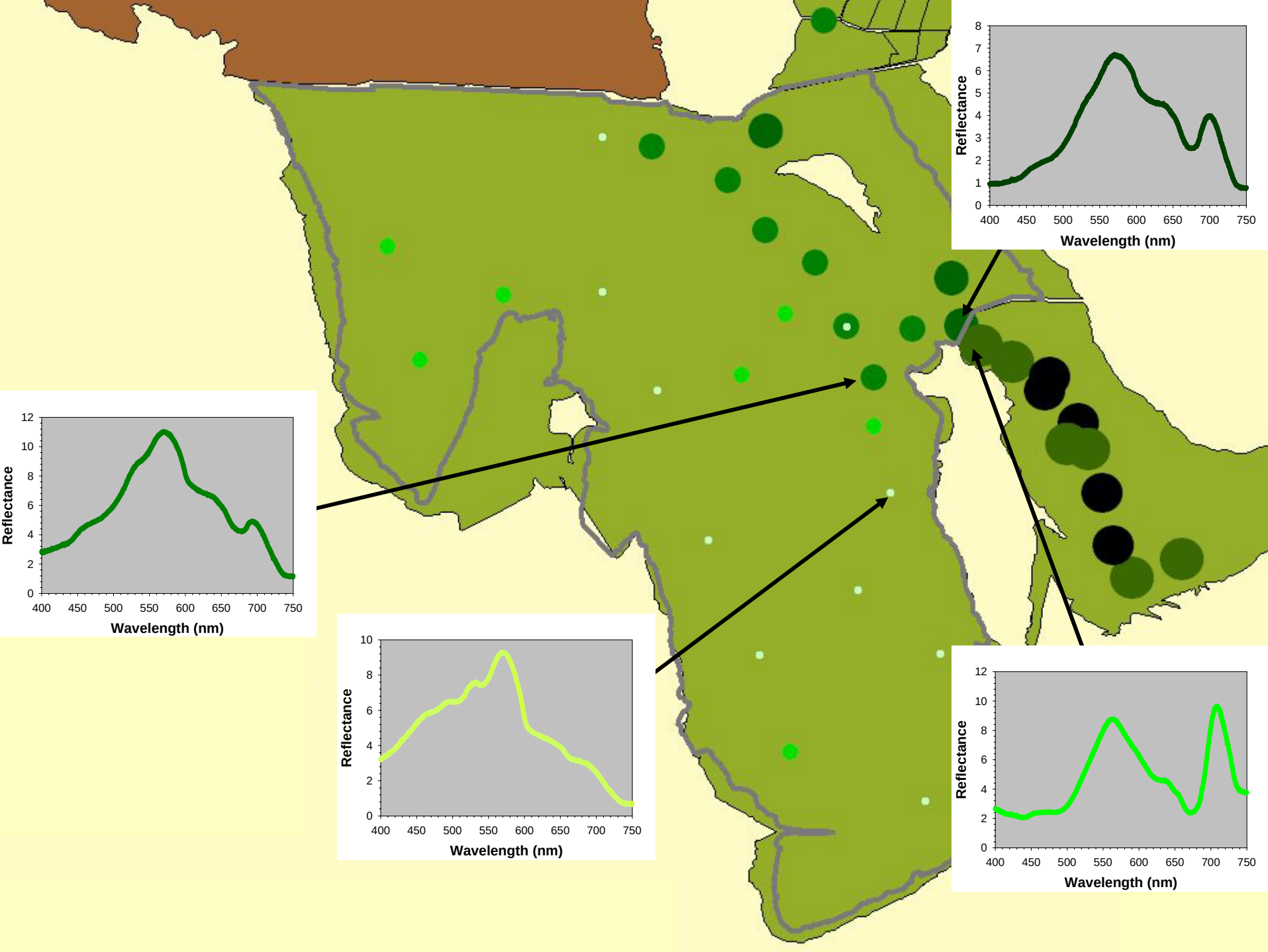



13 May 05
Dam
Bear River
Farmington
Bay
Salt
Lake
City
15 km

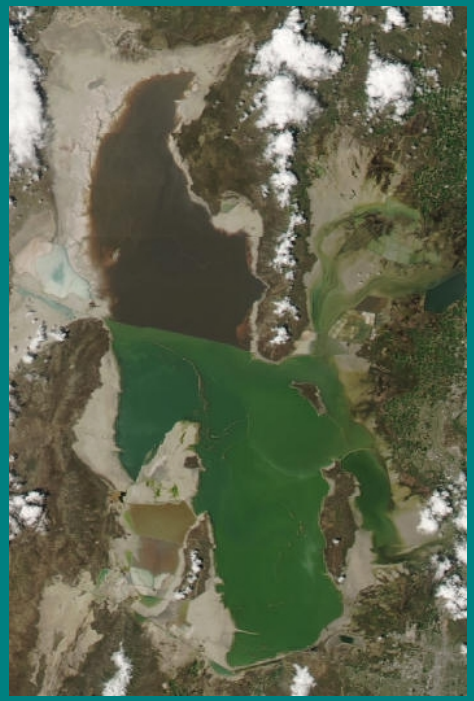

Eutrophication
-Anoxia
-Artemia
-Blue-green algae toxins

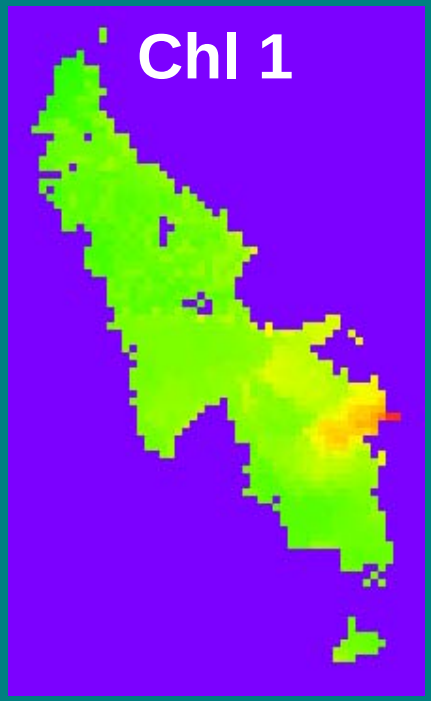
Brine shrimp (*Artemia franciscana*)

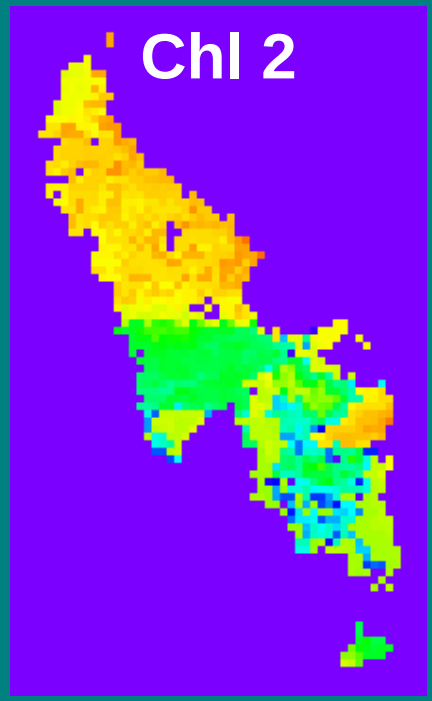

Chlorophyll (μg l-1)
0.1 - 2
2.1 - 15
15.1 - 40
40.1 - 150
151 - 300
301 - 400
10
0
10 Miles
N

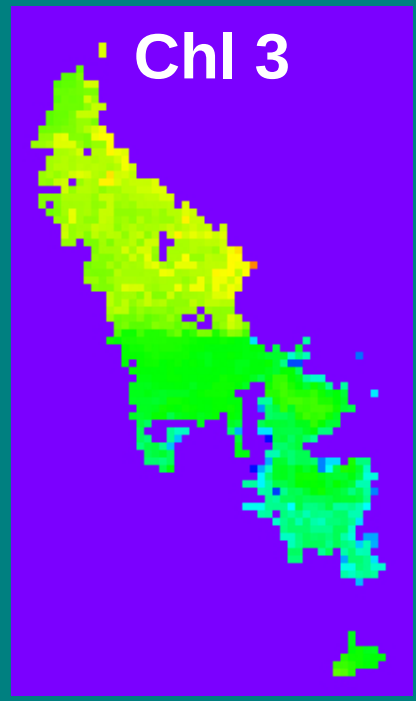

Reflectance
Wavelength (nm)
0
1
2
3
4
5
6
7
8
400
450
500
550
600
650
700
750
Reflectance
Wavelength (nm)
0
2
4
6
8
10
12
400
450
500
550
600
650
700
750
Reflectance
Wavelength (nm)
0
2
4
6
8
10
400
450
500
550
600
650
700
750
Reflectance
Wavelength (nm)
0
2
4
6
8
10
12
400
450
500
550
600
650
700
750

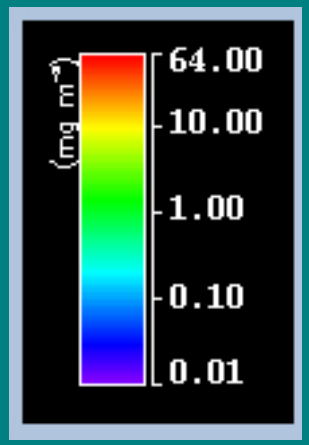
NASA Satellite (MODIS)

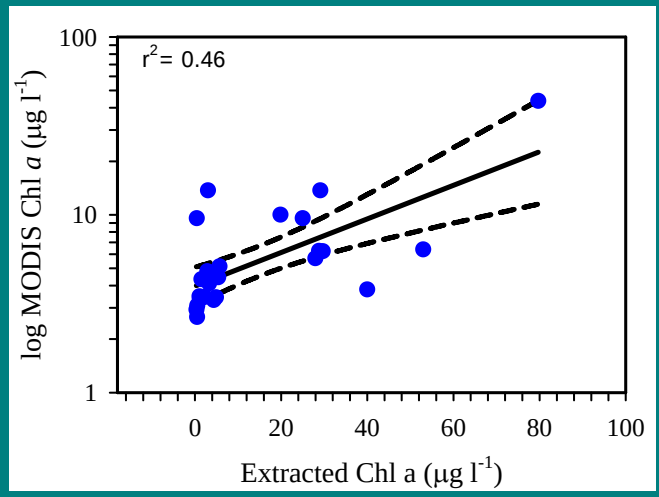


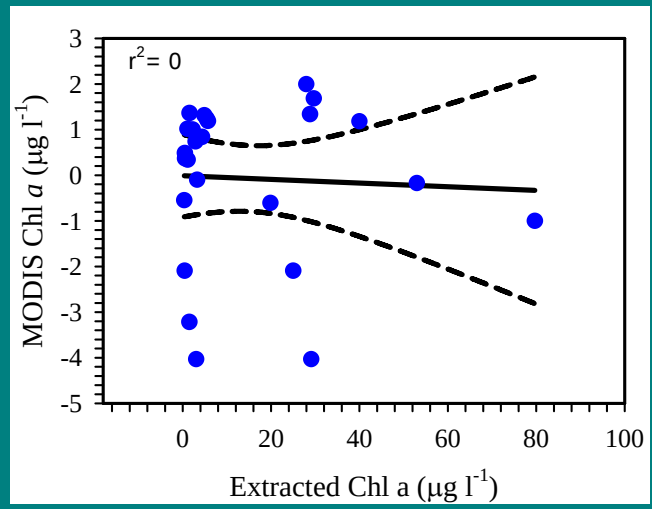


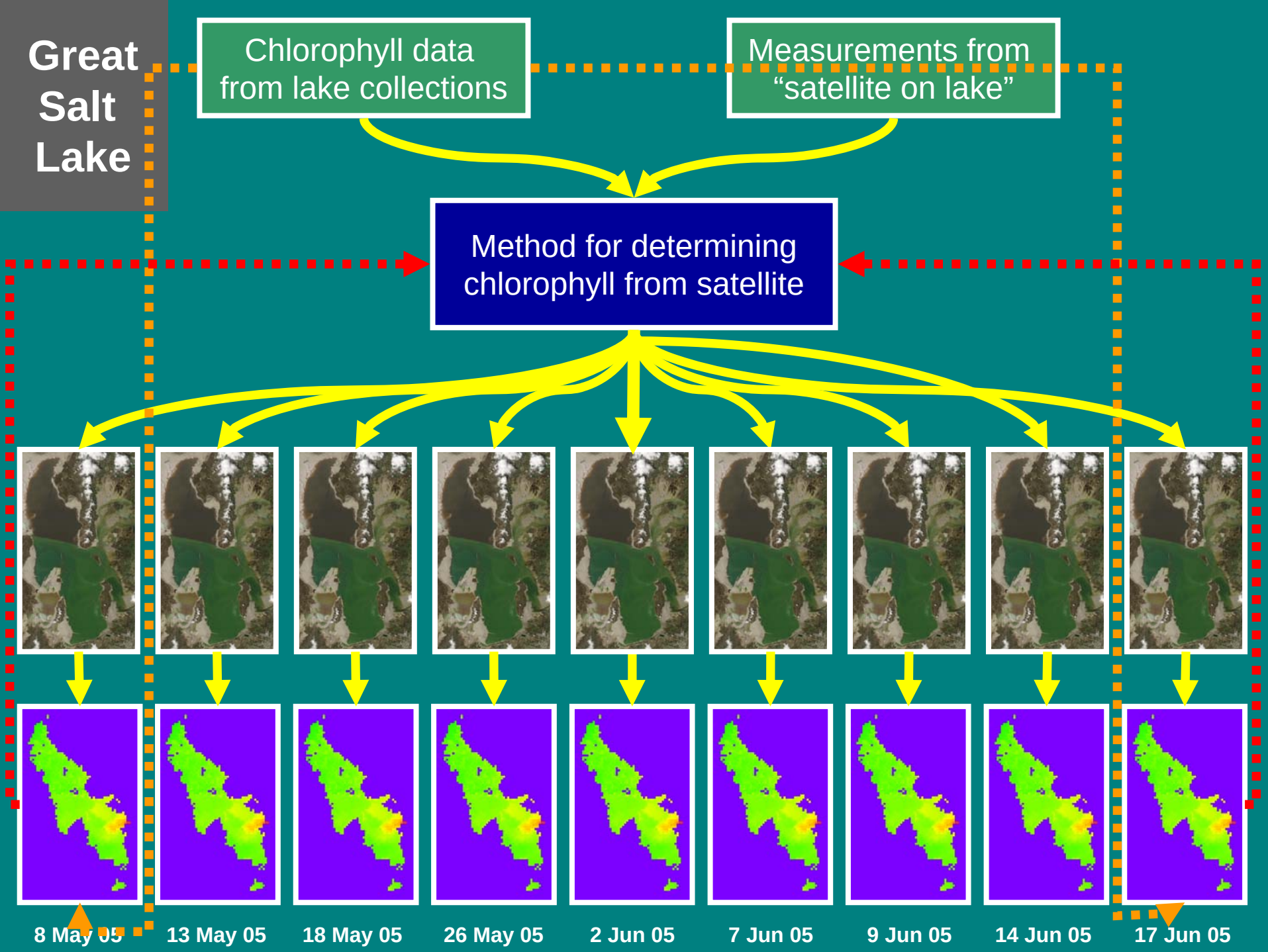


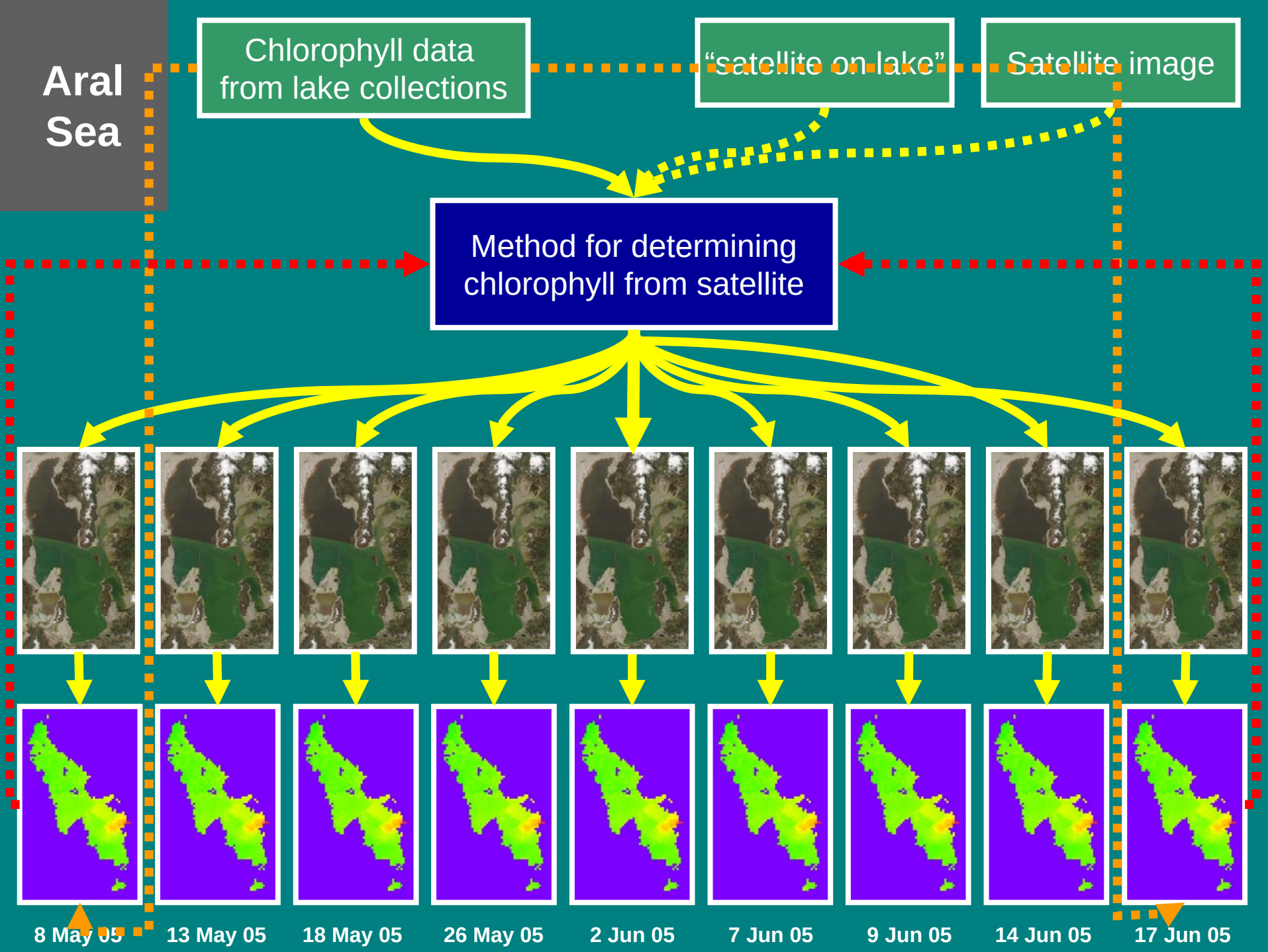









Great Salt Lake
Chlorophyll data from lake collections
Measurements from "satellite on lake"
Method for determining chlorophyll from satellite
8 May 05
13 May 05
18 May 05
26 May 05
2 Jun 05
7 Jun 05
9 Jun 05
14 Jun 05
17 Jun 05


Aral Sea
Chlorophyll data from lake collections
“satellite on lake”
Satellite image
Method for determining chlorophyll from satellite
8 May 05
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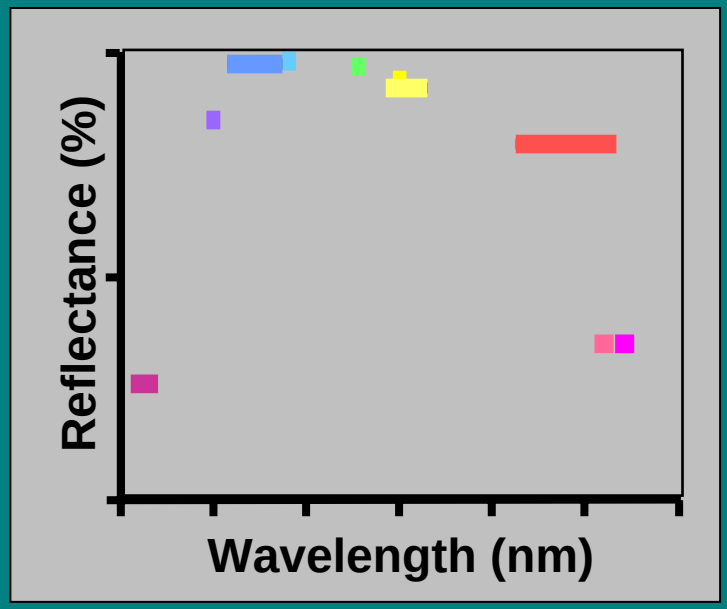
18 May 05
26 May 05
2 Jun 05
7 Jun 05
9 Jun 05
14 Jun 05
17 Jun 05

Satellites sensors for monitoring the Aral Sea

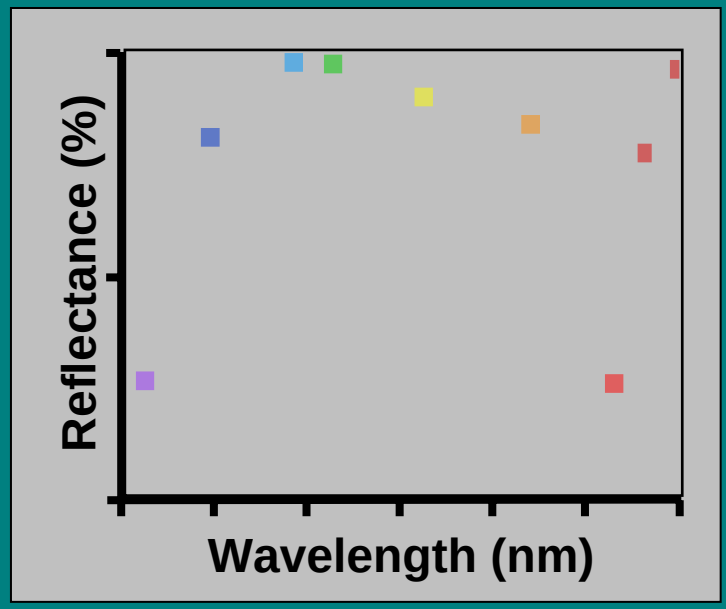
MODIS (NASA)

- 1 flyover per day
- 1 km pixels (some 250m, 500m)
- Current images freely available online
- Past images freely available online
- Additional processing necessary
- 2002 – present



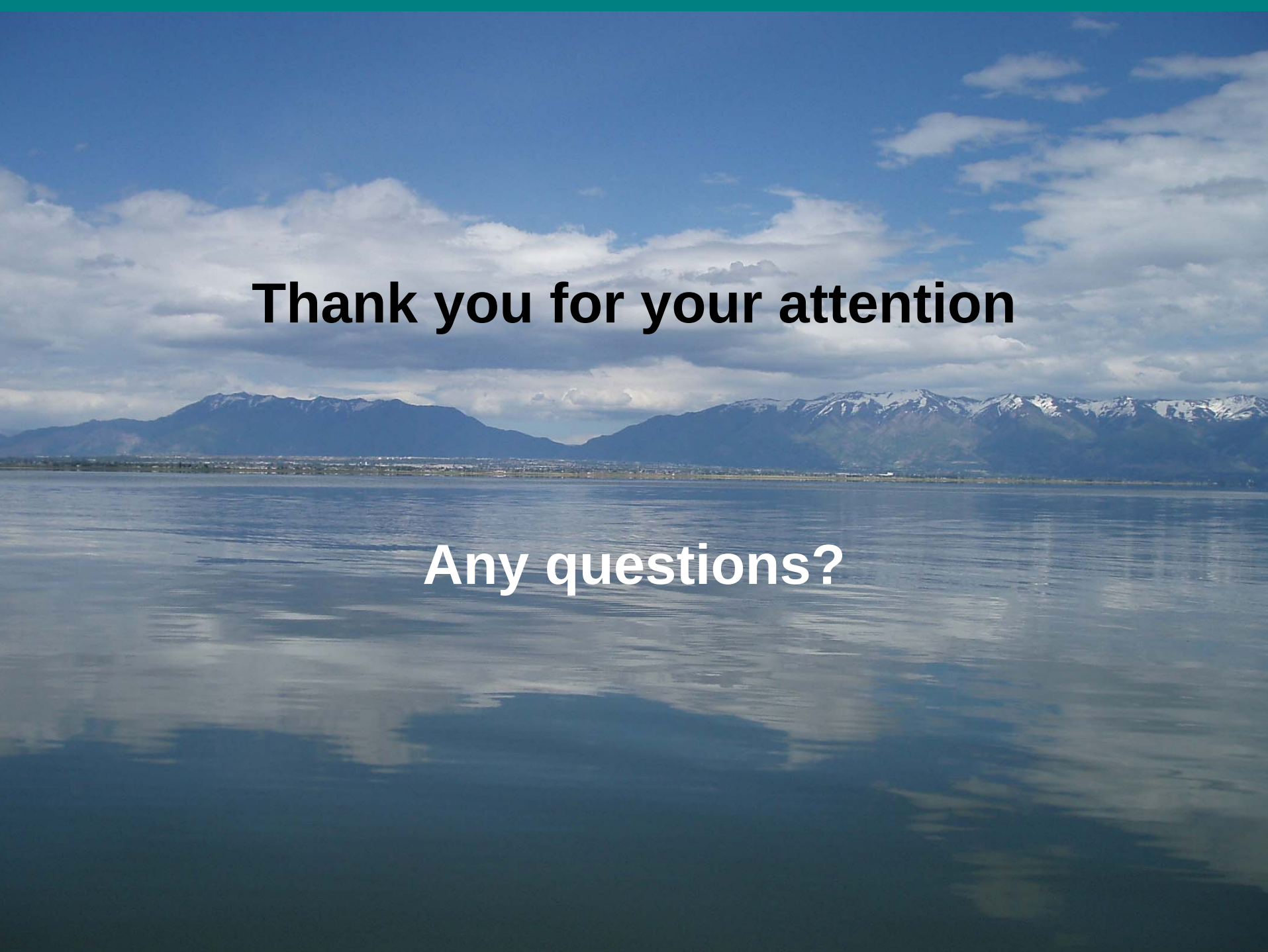
MERIS (ESA)

- 1 flyover every three days
- 300m pixels
- Current images freely available online
- Past images freely available by order
- Additional processing necessary
- 2004 - present



Conclusions

- Satellites exist for monitoring chlorophyll and phycocyanin in large salt lakes
- Current satellite methods for chlorophyll were developed for oceans and do not work for lakes
- Collection of chlorophyll data from the lake is very important to develop a good method
- Once perfected, methods can be applied to past, present and future satellite images


Thank you for your attention
Any questions?