Understanding the biogeochemical functioning and Hg cycling of High Altitude Andean lakes

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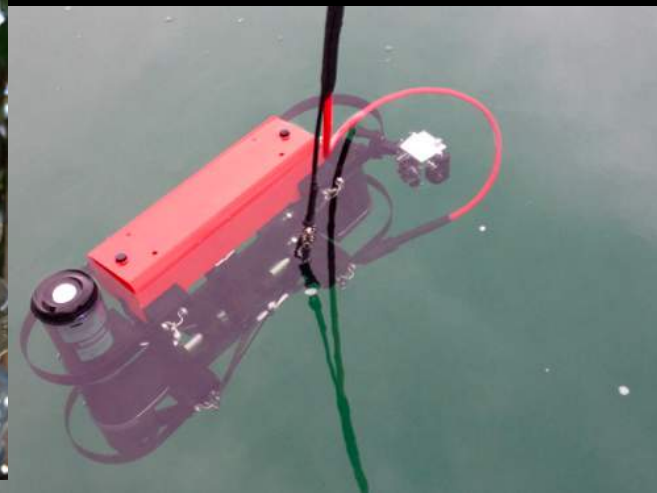
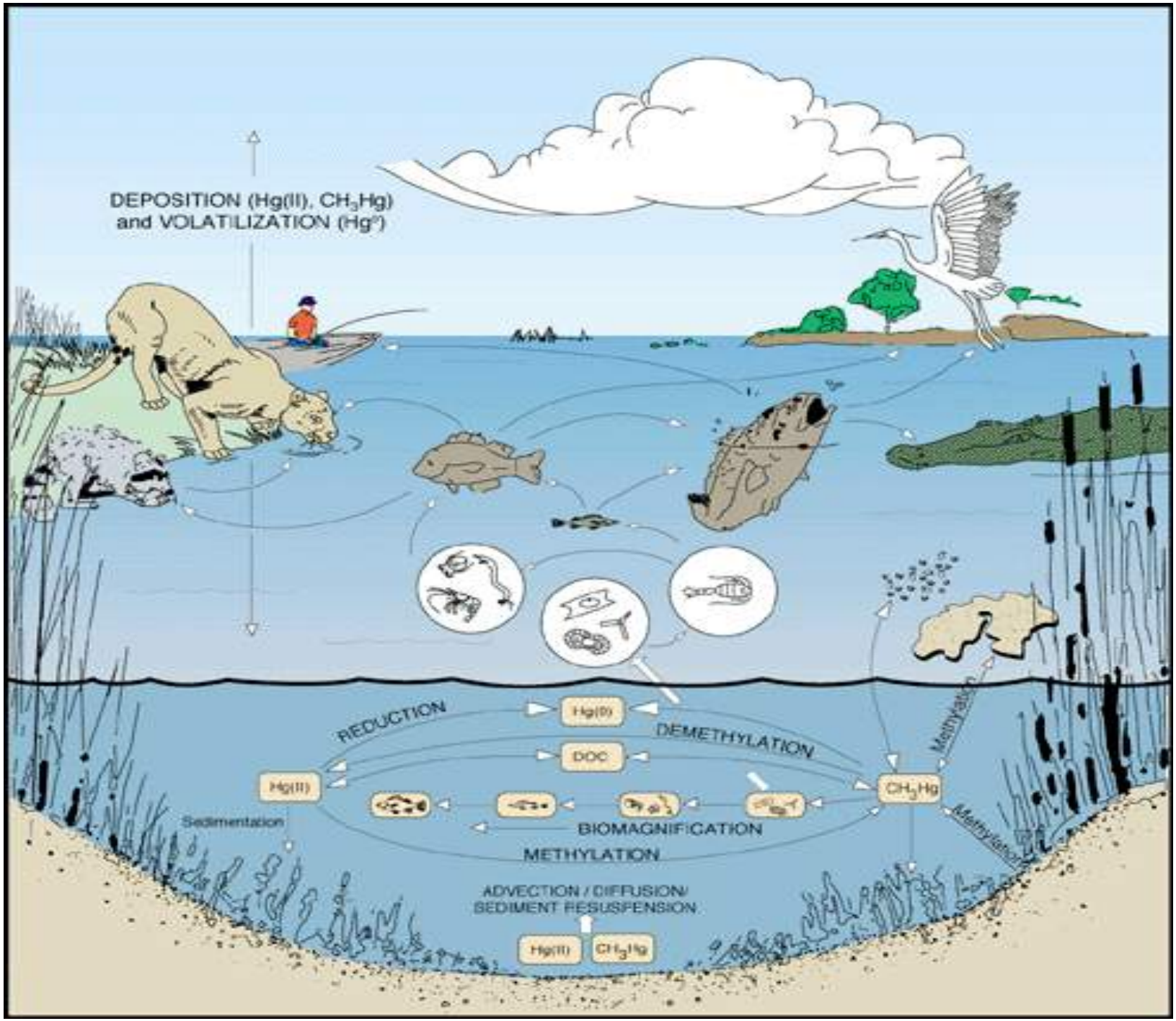
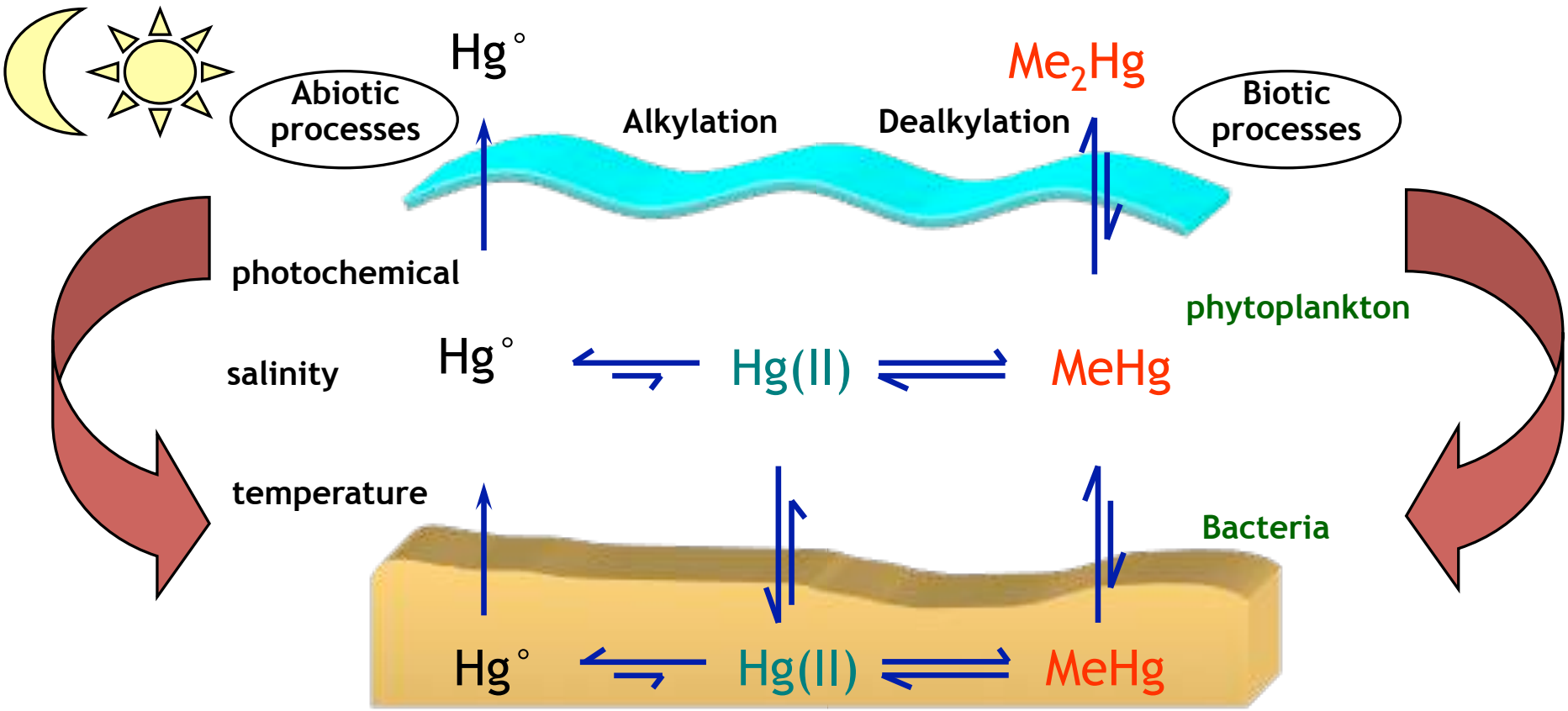
Importance of using combined in situ approaches




DEPOSITION (Hg(II), CH_3Hg)
and VOLATILIZATION (Hg^0)
Hg(0)
REDUCTION
DEMETHYLATION
DOC
Hg(II)
CH_3Hg
Methylation
Sedimentation
BIOMAGNIFICATION
METHYLATION
Methylation
ADVECTION / DIFFUSION/
SEDIMENT RESUSPENSION
Hg(II)
CH_3Hg

Natural (trans)formation of organometallic compounds

Hg Geochemical Cycle



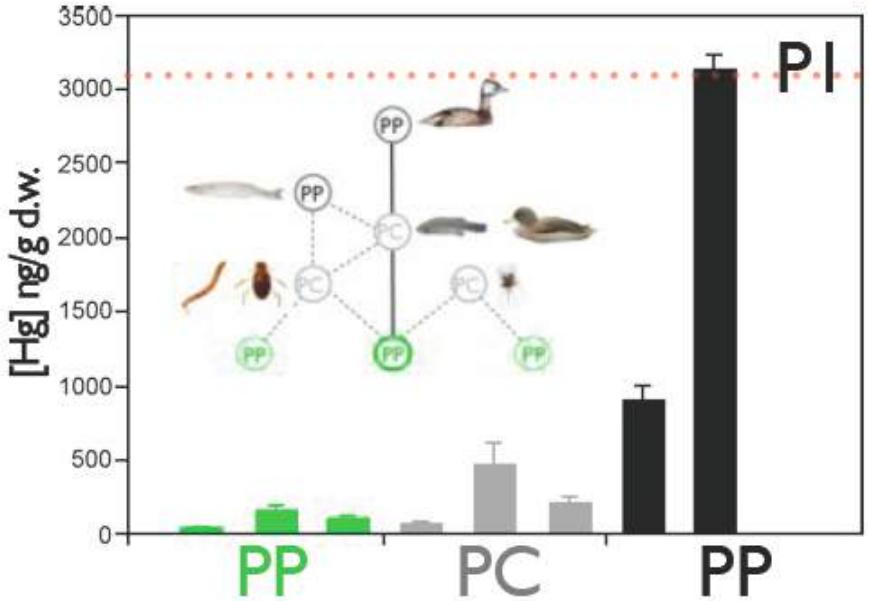
High Altitude lakes of the Altiplano region: = Extreme Environments

High daily gradient, High productivity, High UV, low O2

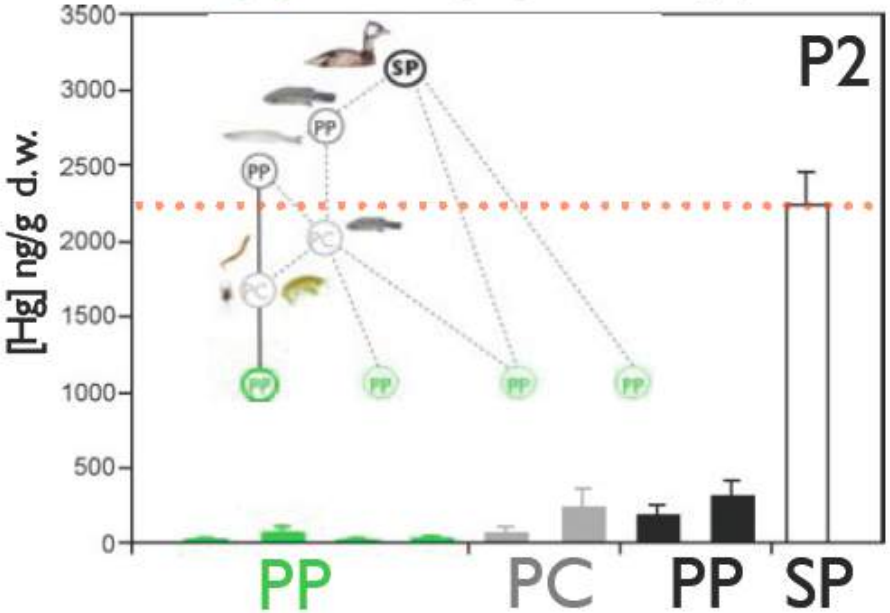
Endoreic basin, Salinity Gradient

Uru Uru lake

Hg transfer in both food chains

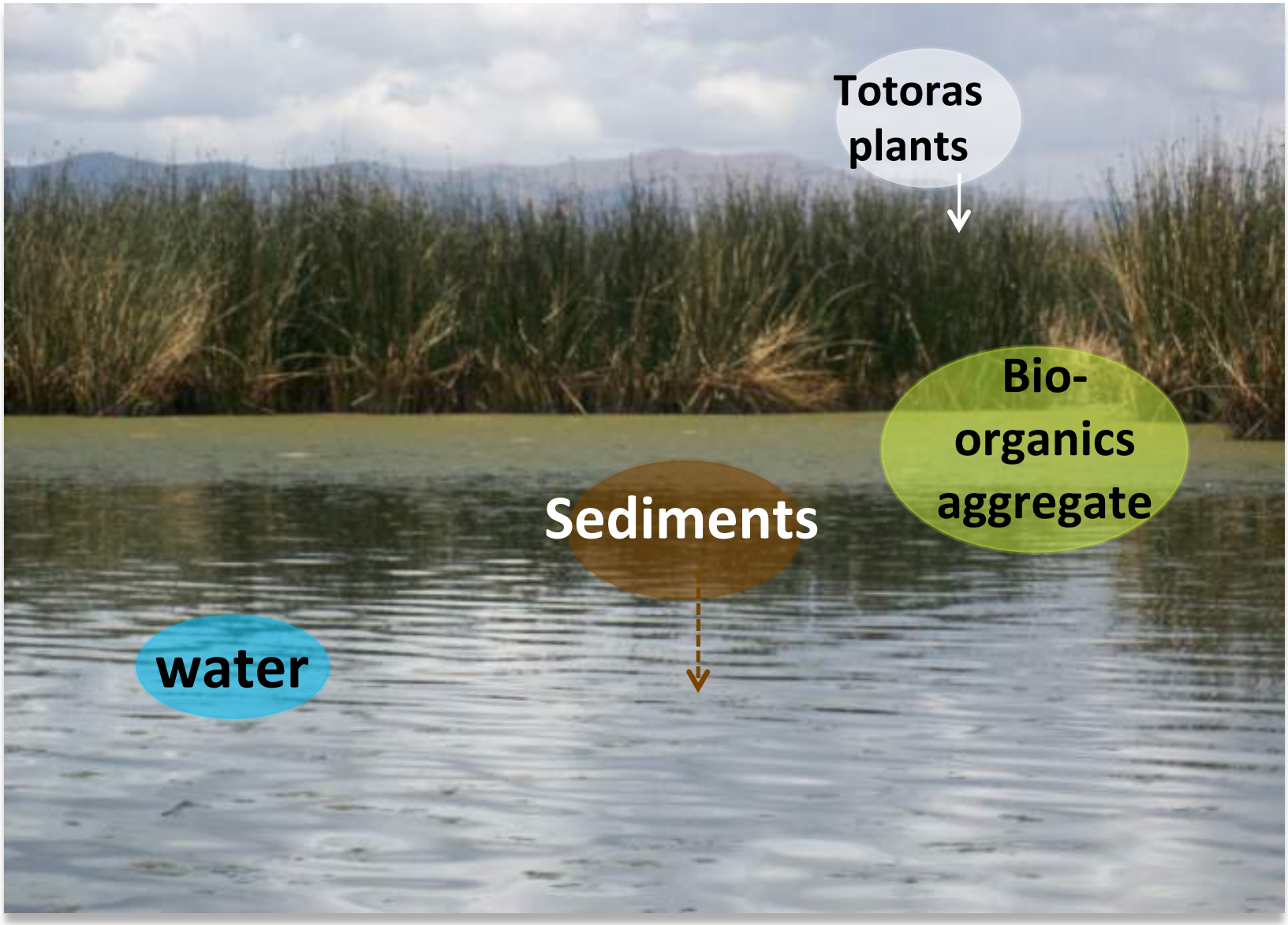


Mercury transfer in both food chains showed the highest accumulation in higher trophic position, as is the case of grebe bird



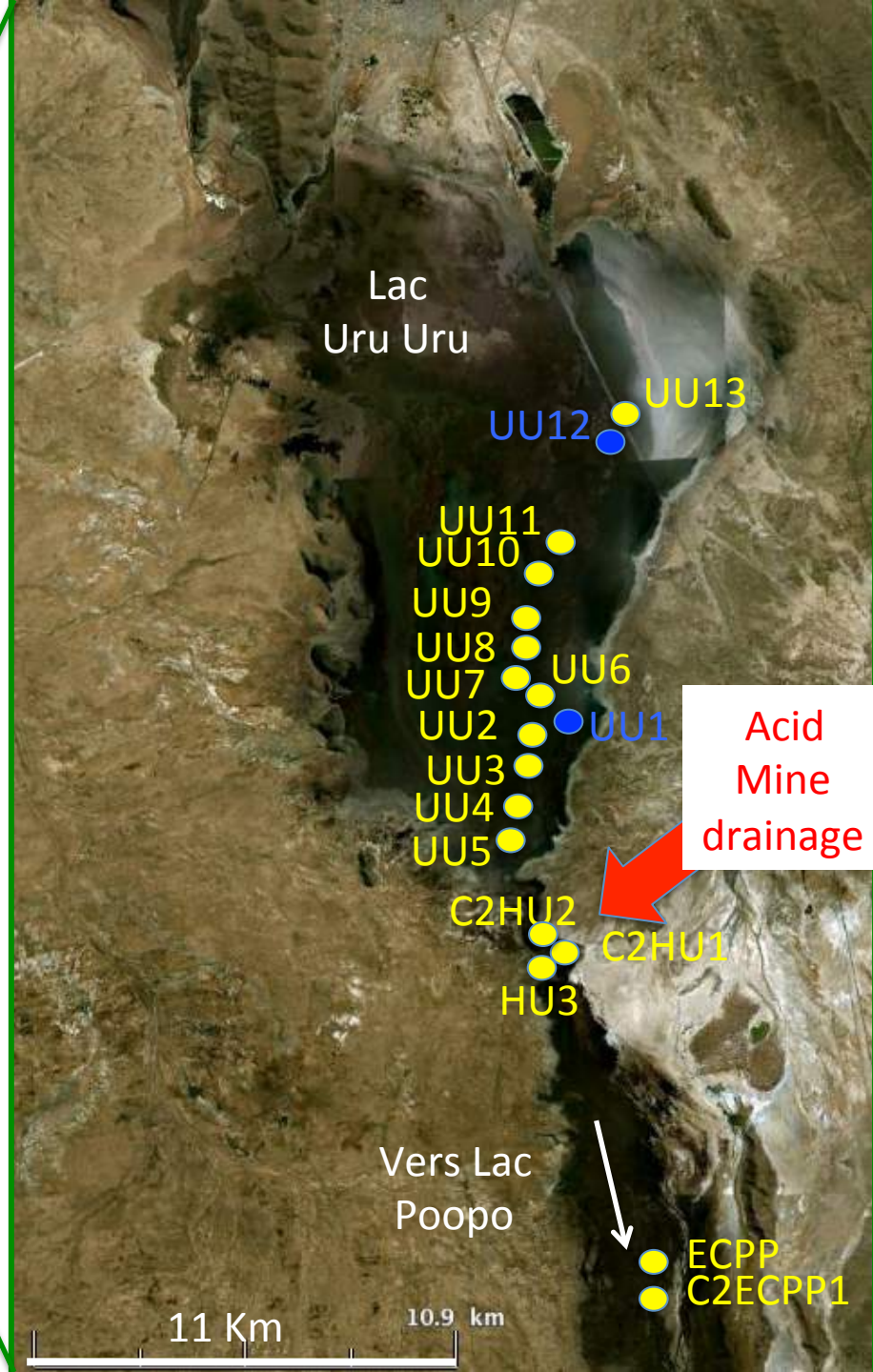
Hg concentrations are above the limit. A monitoring process should be established for this highly toxic metal

Where, When Hg methylates and demethylates ?

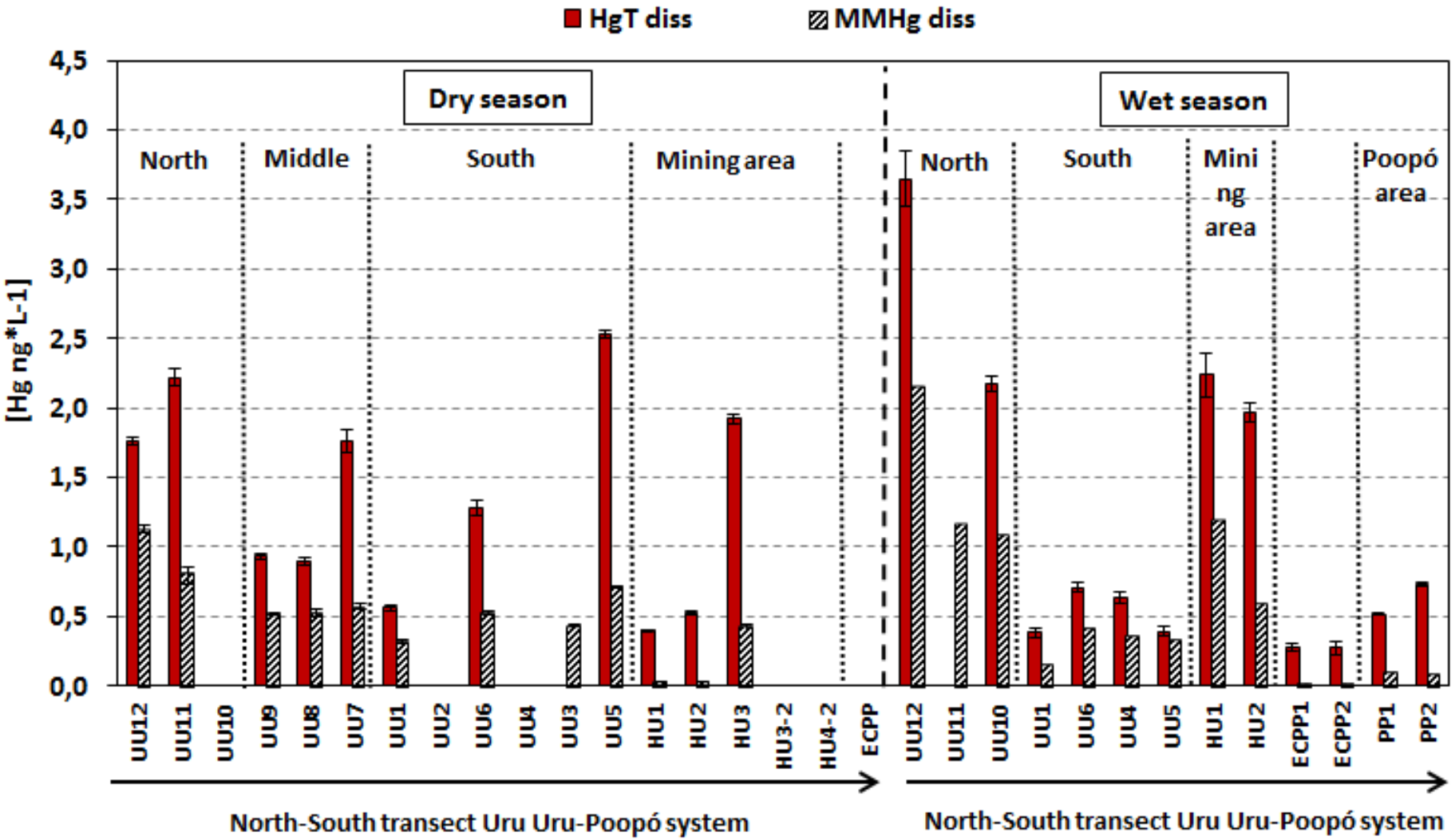


Sampling:Dry & wet seasons *(Oct. 2010, May 2011)*

EC2CO CYTRIX 2010-2012 « COMIBOL »



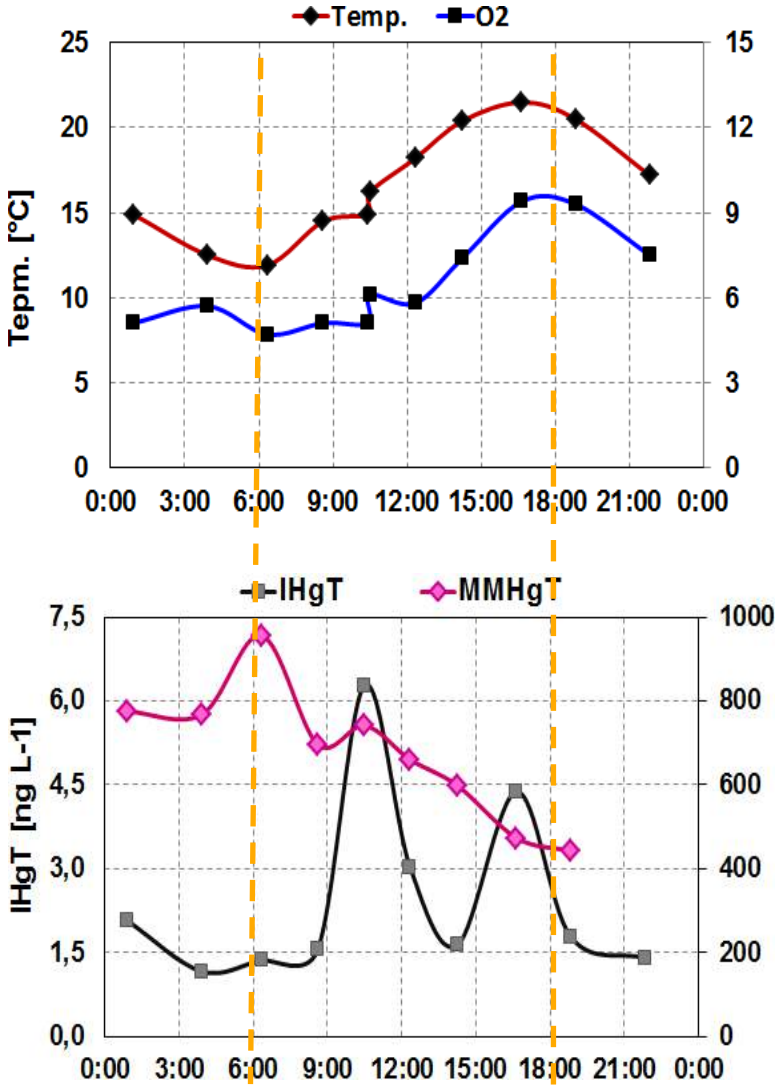
Geographical Trend



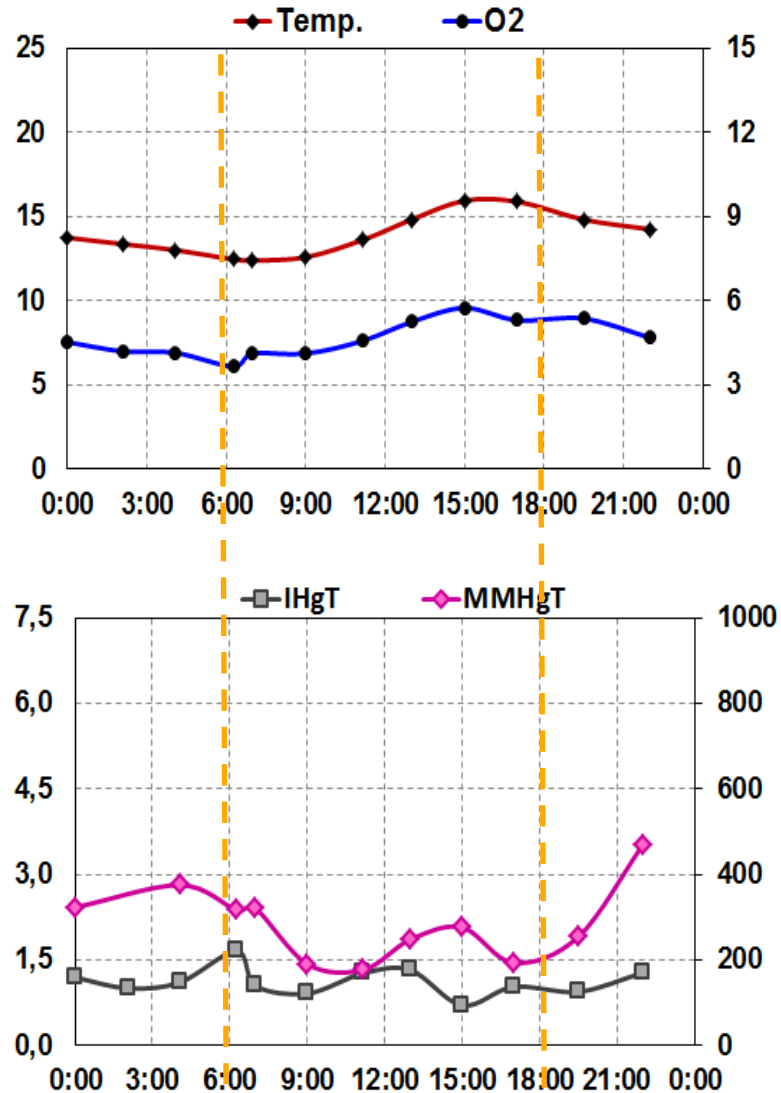
30-60% MeHg!

Diurnal temporal variations of Mercury

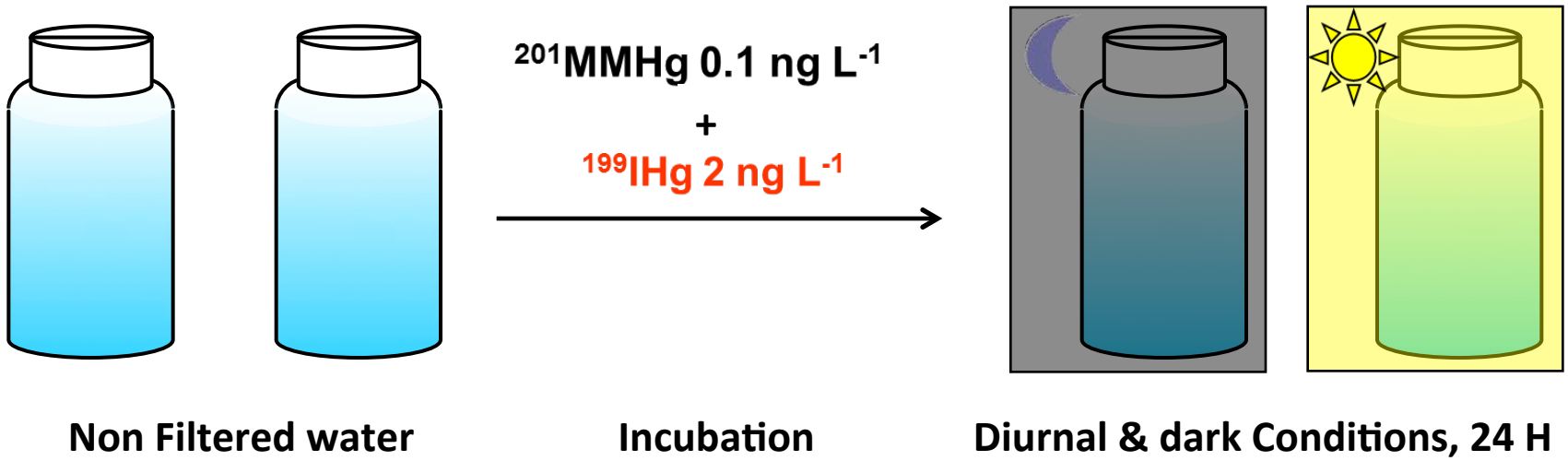
UU1 (South), dry season



UU1 (South), wet season



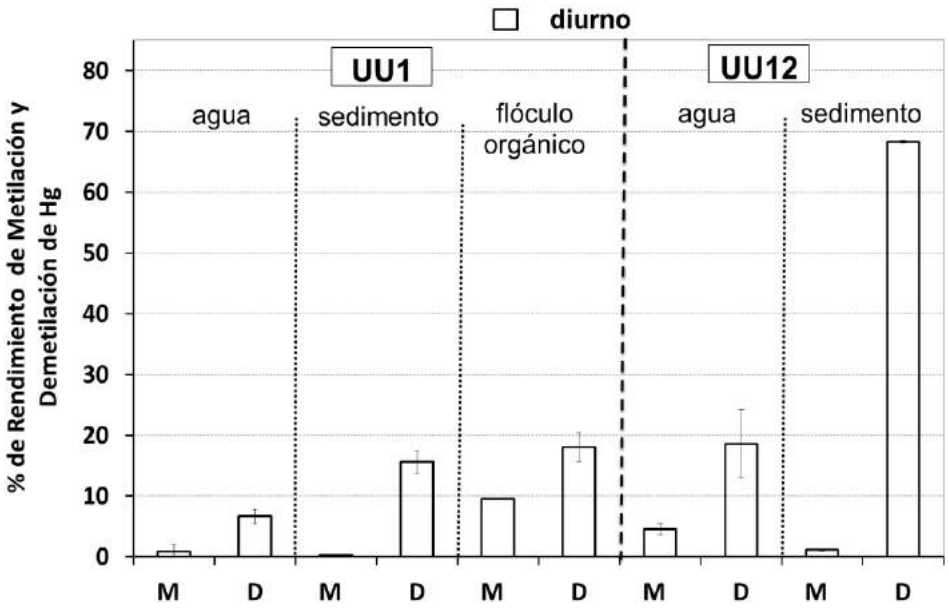
Mercury species transformation experiments

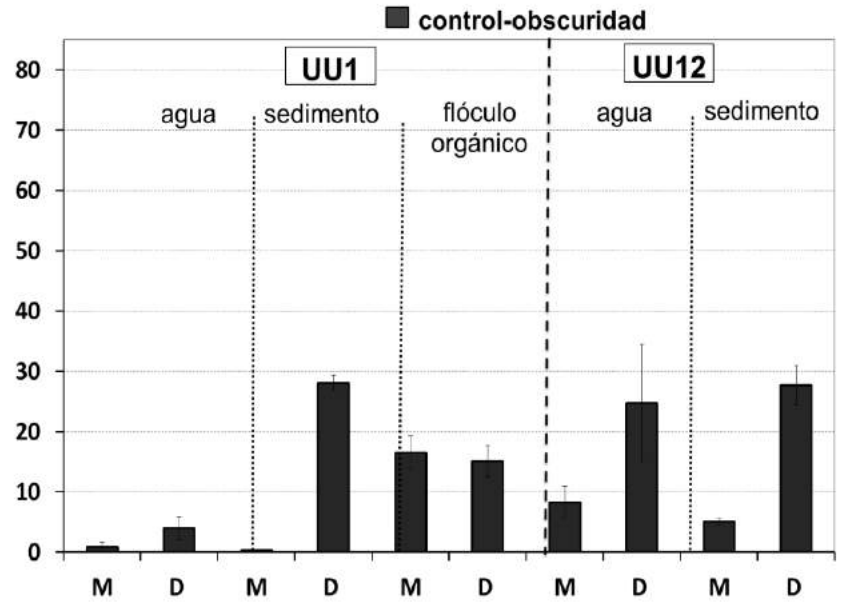


In situ incubations were conducted by adding enriched isotopes (**MM^{201}Hg** and **^{199} IHg**) to different sample **sediments, substrates biorganic and water samples** for determining Hg methylation (M) and MMHg demethylation (D) rates.

Main Results

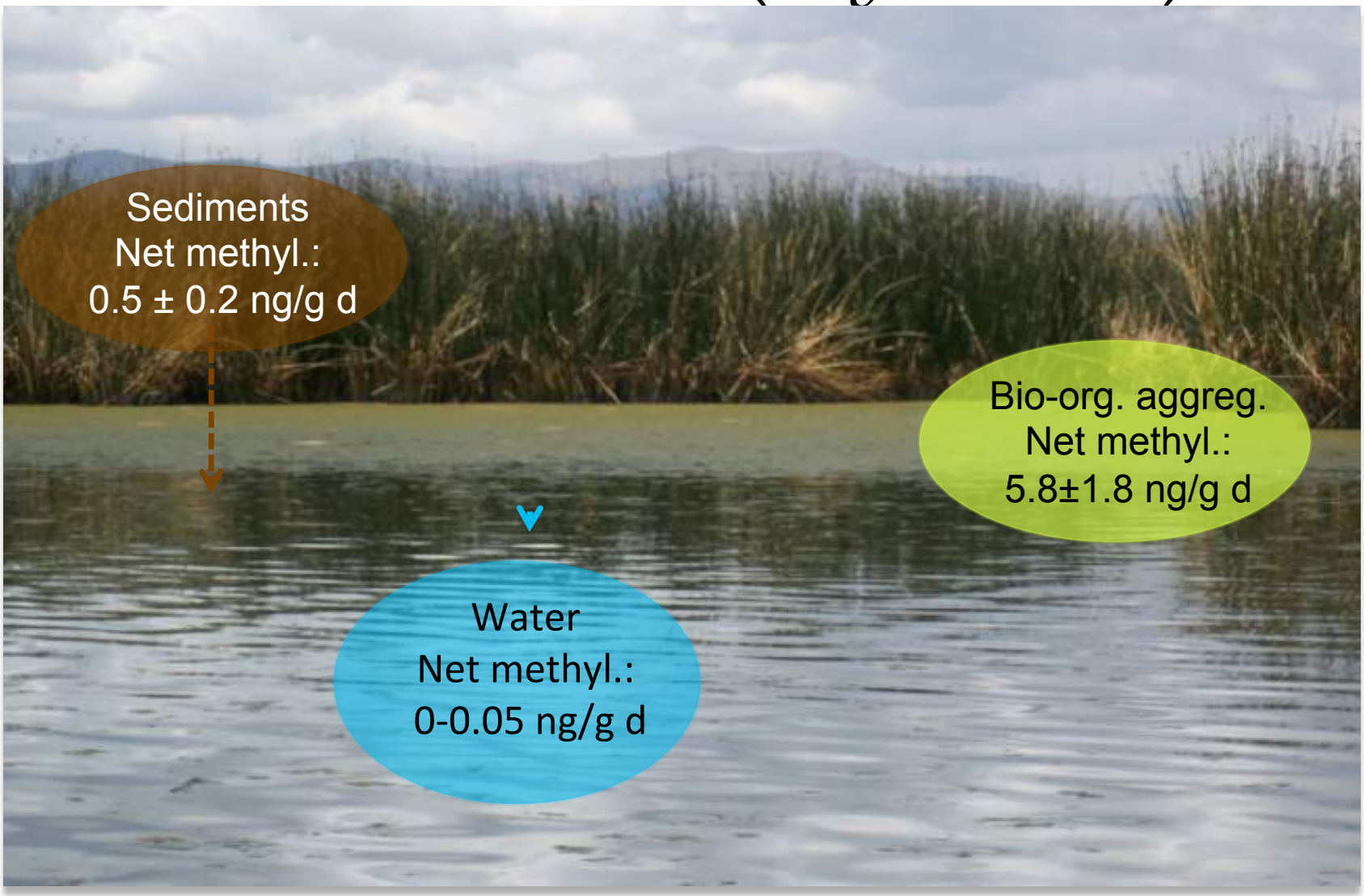
- Methylation (M) & Demethylation (D) rates (Dry season)

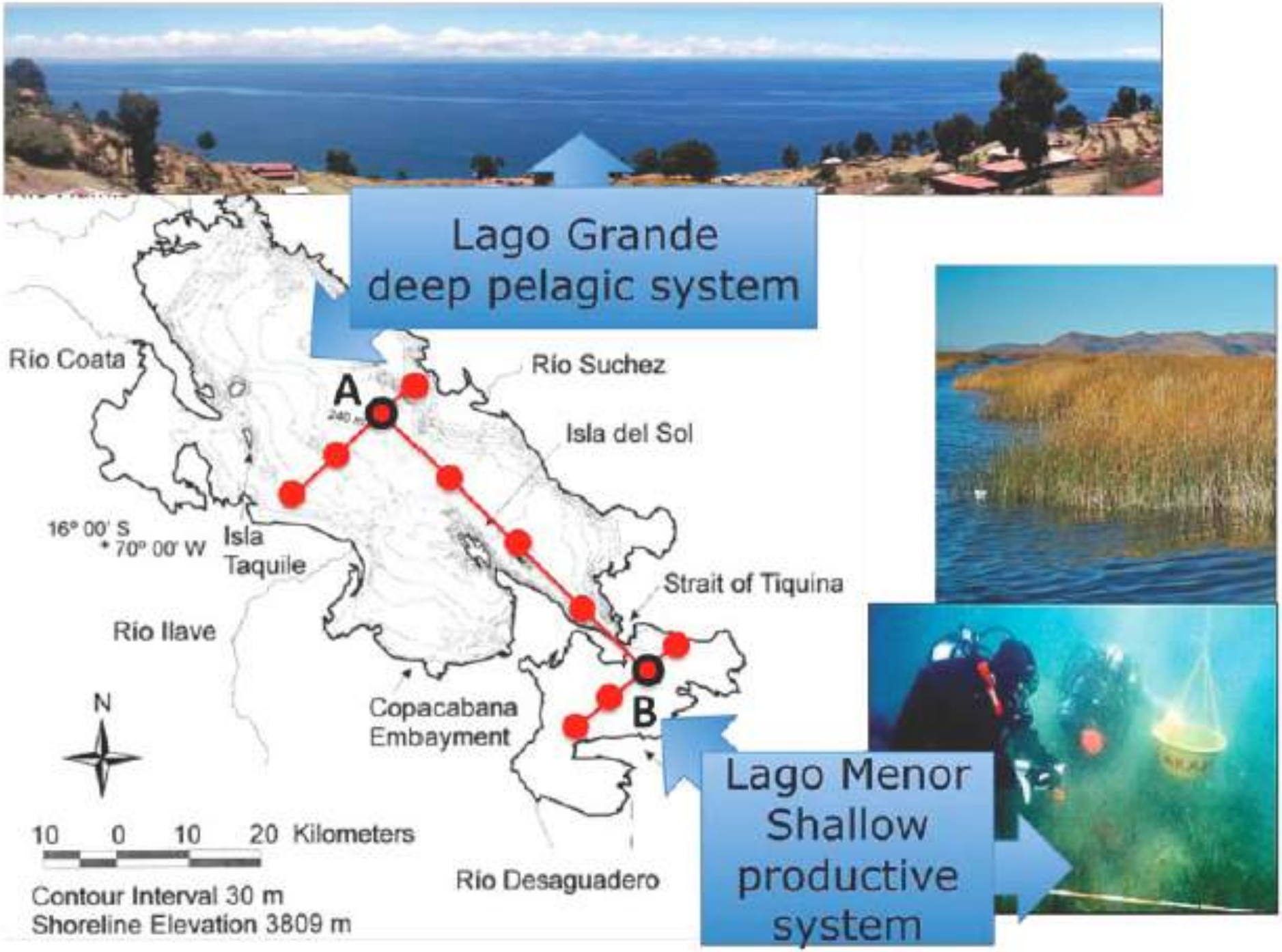




Methylation rates
UU12 (North): waters 4,6% ; sediments: 1,1%
UU1 (South): waters: 0,9%; sediments: 0,25%; floating aggregates: 9,57 %

Net methylation/demethylation Uru Uru Lake (*dry season*)



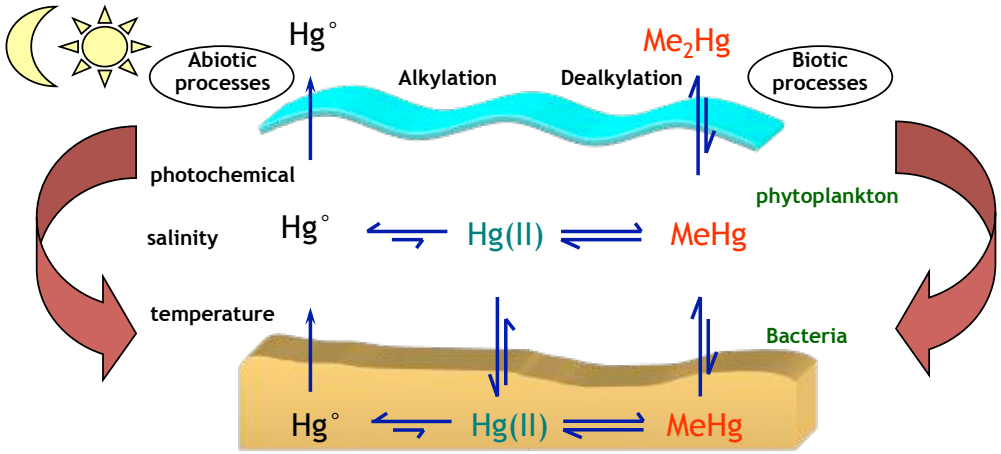

Lago Grande
deep pelagic system
Río Coata
Río Suchez
A
Isla del Sol
16° 00' S
70° 00' W
Isla
Taquile
Strait of Tiquina
Río Ilave
B
Copacabana
Embayment
N
10 0 10 20 Kilometers
Río Desaguadero
Contour Interval 30 m
Shoreline Elevation 3809 m
Lago Menor
Shallow
productive
system

ANR CESA 2013-2016 LA PACHAMAMA

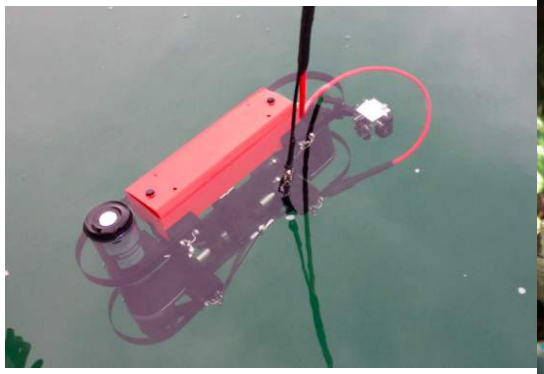
Lakes of the Altiplano : in situ exploration of the (a)biotic Processes controlling the Aquatic biogeoCHemistry of Mercury At the Molecular and Isotopic scAle.

IRD GET/BOREA/LEMAR/ISTERRE - CNRS IPREM/IPGP

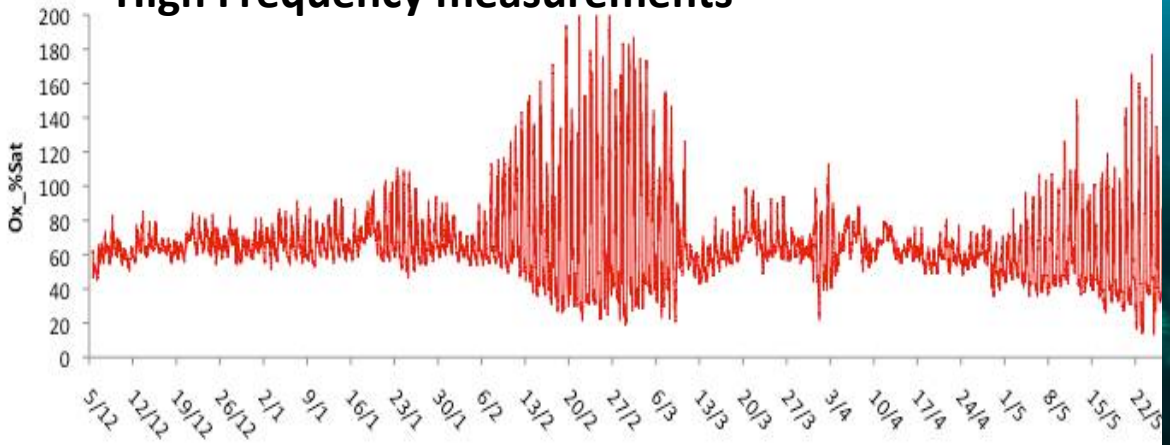
Hg Geochemical Cycle



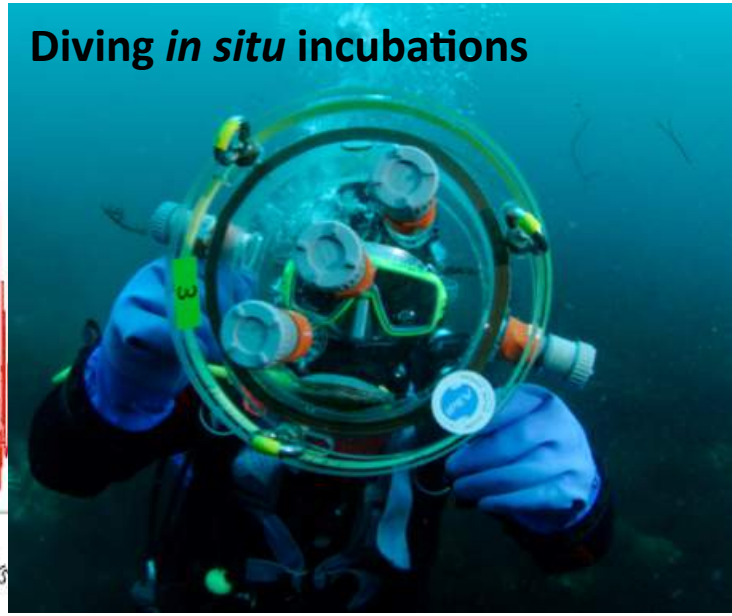
in situ Sensors



High Frequency measurements



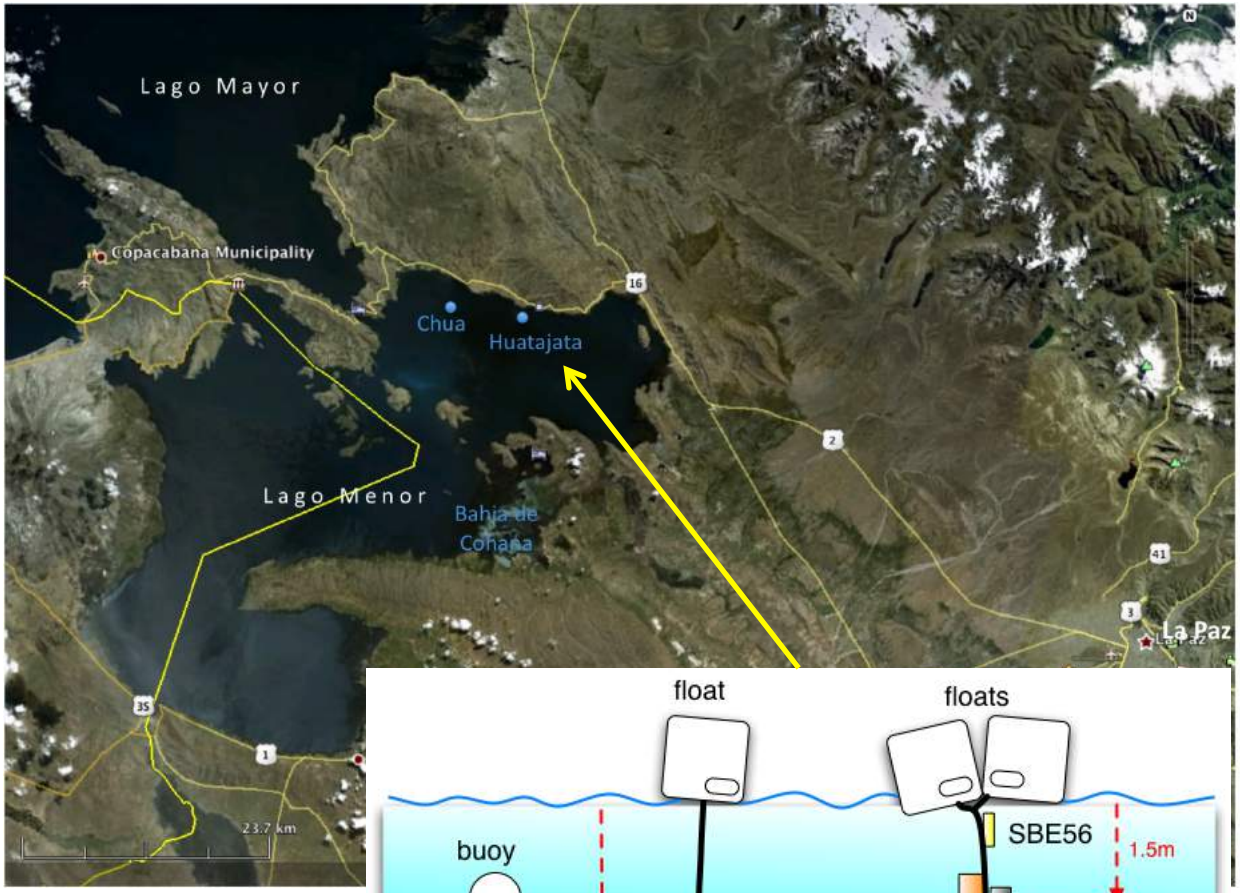
Diving *in situ* incubations

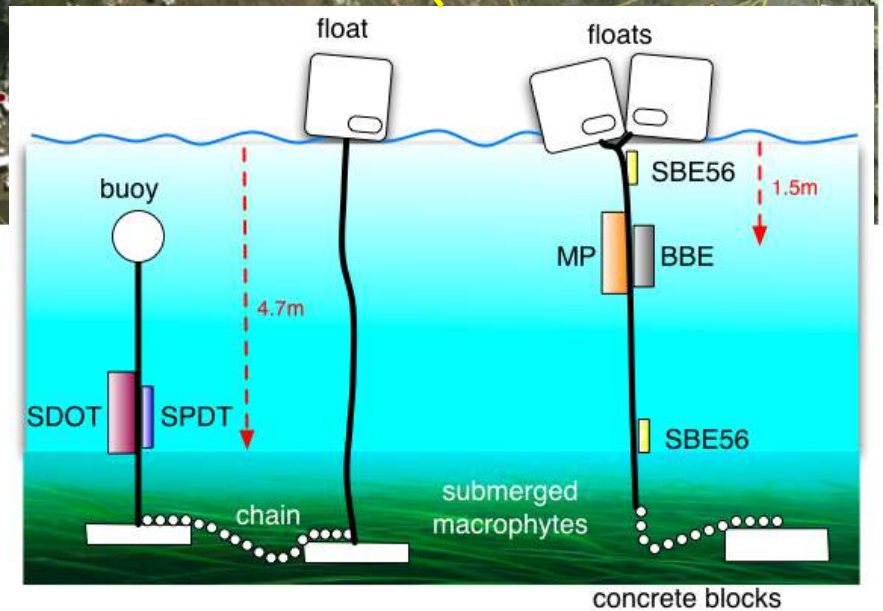


Why continuous measuring of biogeochemistry in aquatic ecosystems?

1. Because it's became possible: from the origin to new generations of sensors
2. Because it's the right time scale of physical and biogeochemical processes
3. Forecasting models wait for these dataset

TITICACA SENSORS

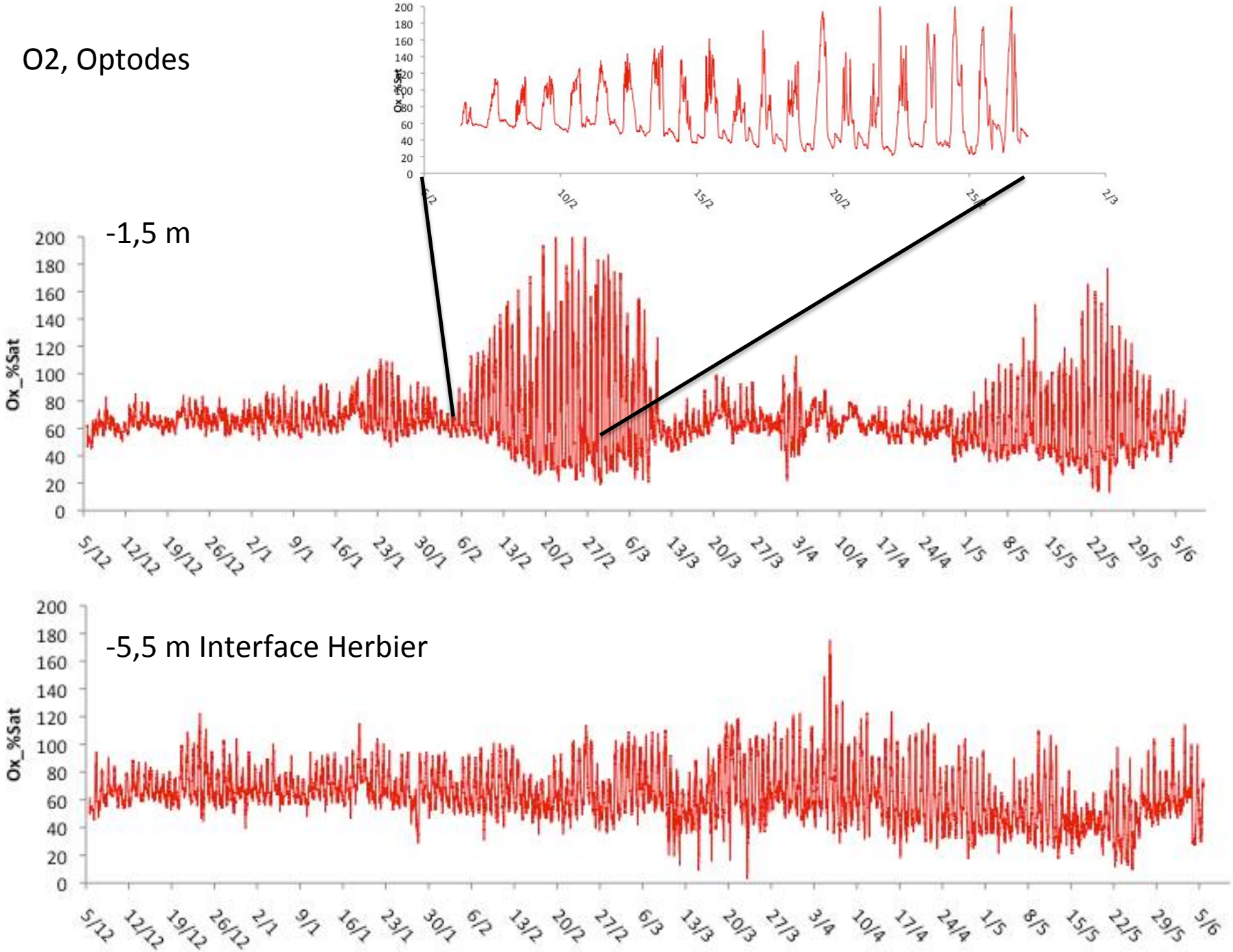




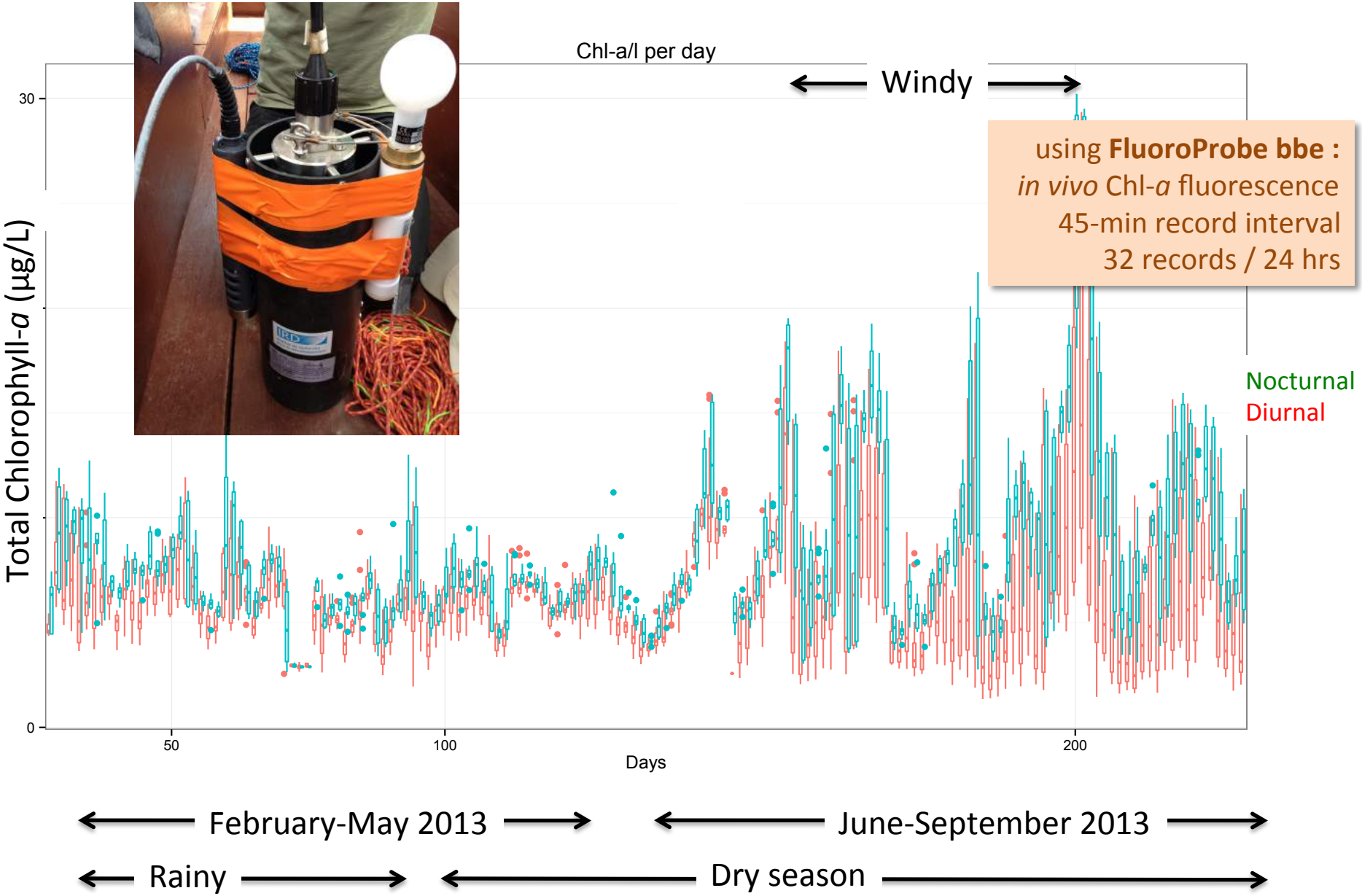
6 Water quality param. online for each station.
C_{25}, T°, Press., O_2, , pH, chlorophylle (4 algae classes),
5 meteor. param.
Air T, RH, Wind speed and dir. , pluviometry, solar irradiance

O2, Optodes Sensors

O2, Optodes


-1,5 m
-5,5 m Interface Herbier
Ox_%Sat
200
180
160
140
120
100
80
60
40
20
0
5/12
12/12
19/12
26/12
2/1
9/1
16/1
23/1
30/1
6/2
13/2
20/2
27/2
6/3
13/3
20/3
27/3
3/4
10/4
17/4
24/4
1/5
8/5
15/5
22/5
29/5
5/6

Total Chlorophyll-*a* dynamics at Huatajata (1.5-m depth)



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