

Mission report of November, 2015 field work at Lakes Nyos and Monoun

Djomou Serges, Fantong Wilson, Issa, Bassogog Zachée, Yutaka Yoshida, Minoru Kusakabe, and Kazuhiro Nishio

Within the framework of SATREPS-NyMo project, whose activities include regular monitoring of Lakes Nyos and Monoun, a monitoring campaign was conducted by the Cameroonian and Japanese scientists from the 6th to the 15th of November, 2015.

The objective of the fieldwork was that Cameroonian scientists should demonstrate that they could effectively do the following:

- i. Measure conductivity and temperature profiles of the lakes,
- ii. Sample lake water for chemical analysis,
- iii. Measure CO₂ concentration by using the YY and MK methods,
- iv. Check deep water removal system at Lake Monoun, and also,
- v. To check/control the availability and state of field equipment for lake monitoring at both lakes.

1. Methodology of field work

During the field work, the measurement of conductivity, temperature and depth profiles at both lakes was carried out with the use of a CTD. Before the measurement, the calibration of pH sensor using standard solution of pH showed strange results. Therefore, pH data were not reliable.

The lake water was collected at various depths by use of a Niskin sampler and MK syringes. With the use of the Niskin device, water samples were collected in duplicates in a clean 100 ml plastic bottle (for cation and anion analyses), after filtration through a 0.45µm membrane filter. One of the duplicate samples (collected for cation and trace elements analyses) was acidified with 1 ml of 7N HNO₃ solution to prevent deposition of ferric oxide compounds.

The in-situ CO₂ (gas) concentration at pre-determined depths of lakes was measured using the YY method.

2. Results

2.1 Depth profiles of conductivity and temperature

The profiles of temperature and conductivity at Lake Monoun are shown in Fig 1 and 2, respectively.

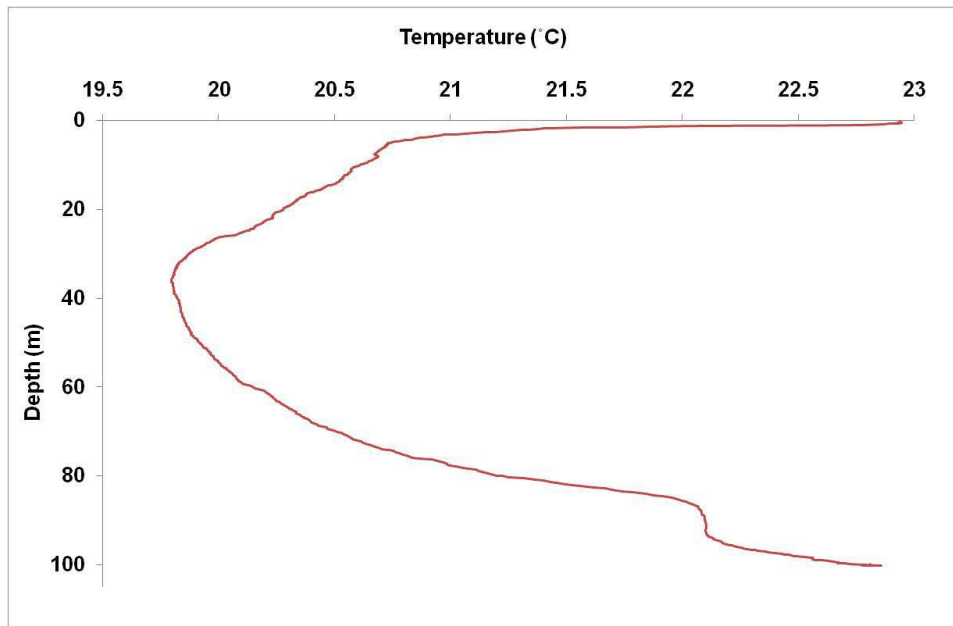


Figure 1: Temperature profile at Lake Monoun in November 2015

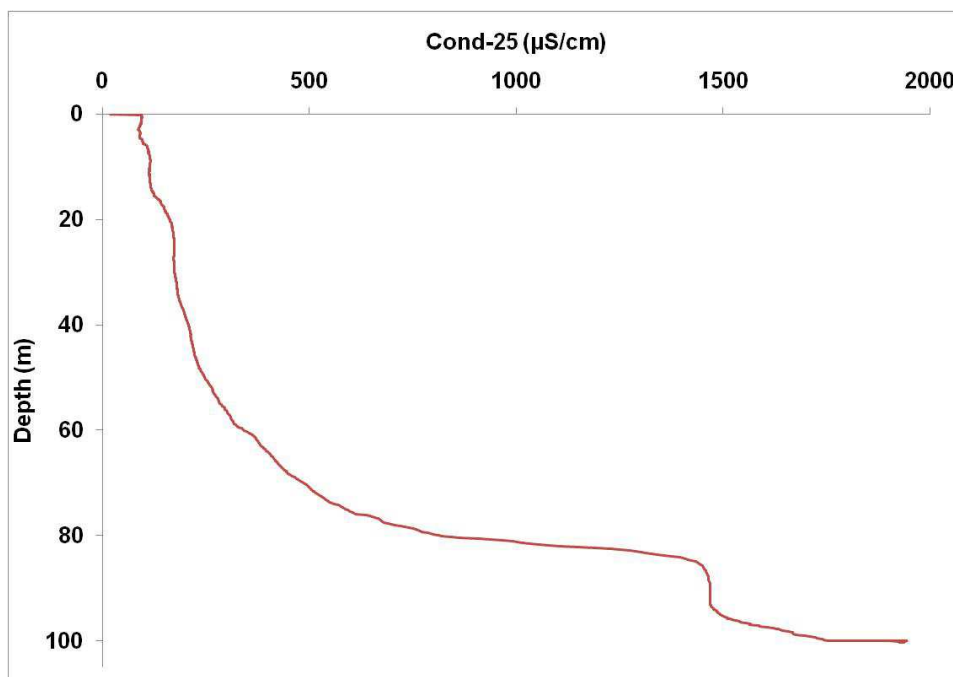


Figure 2: Conductivity profile at Lake Monoun in November 2015

The profiles of temperature and conductivity at Lake Nyos are shown in Fig 3 and 4, respectively.

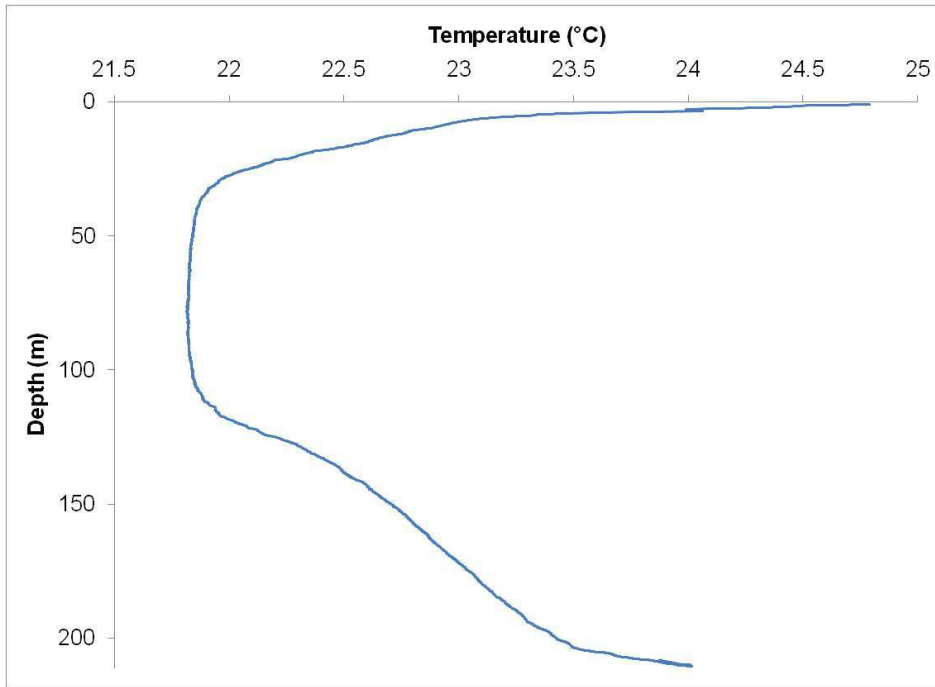


Figure 3: Temperature profile at Lake Nyos in November 2015

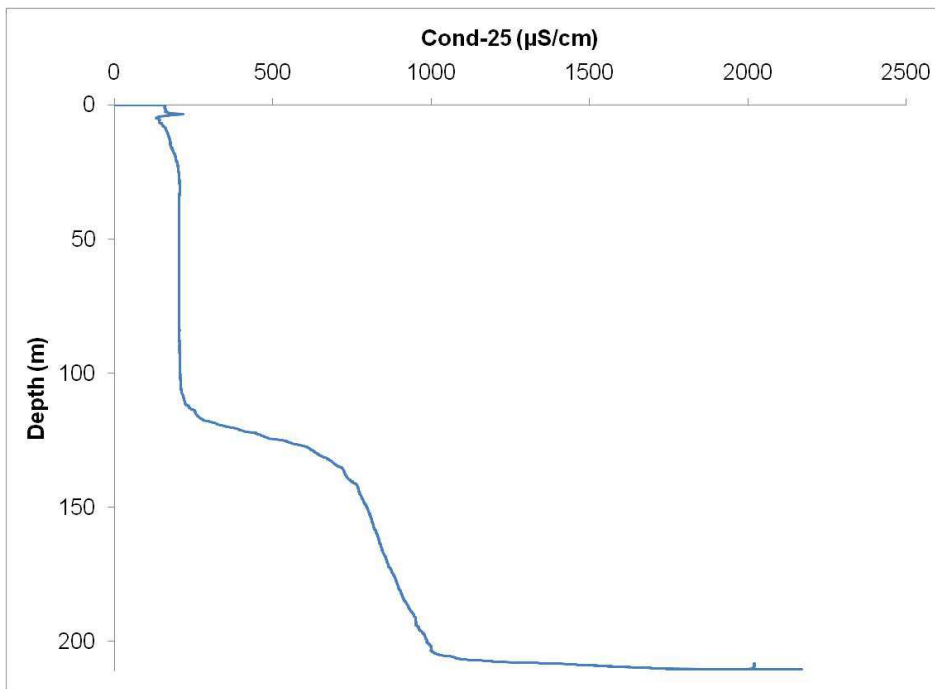


Figure 4: Conductivity profile at Lake Monoun in November 2015

The conductivity profiles were used to select target depths for sampling water in the lakes for chemical analysis.

2.2 Sampling lake water for chemical analysis

Water samples for chemical analyses were collected at Monoun at 9 depths (-99.5 m, -97 m, -95 m, -91 m, -85 m, -80 m, -70 m, -40 m and -10 m) by the Niskin sampler and YY-

system (for deep four samples) in November 8th, 2015. At Nyos, water samples for CO₂ determination were collected at 9 depths respectively with MK syringes (-210 m, -208.5 m, -206.5 m, -204.5 m, -201.5 m, -175.5 m, -150.5 m, -130.5 m and -100.5 m) on November 10th, 2015 and for chemical analysis using the Niskin sampler and YY-system (-210 m, -207 m, -201 m, -178m, -150 m, -130 m, -100 m, -50 m and -10 m) in November 11th, 2015.

For the intra-comparison of analytical results, Tokai University will start to analyse the samples and will send the same samples to IRGM for another laboratory analyses that will enable comparison of inter-laboratory analyses.

2.3 Measurement of in-situ CO₂ (gas) concentration

The YY-method was applied to measure CO₂ concentration at Lake Monoun on November 7th and 8th, 2015 and at Lake Nyos on November 11th, 2015. The depths of the lake bottom were 99.5 m at Monoun and 210 m at Nyos. At Nyos, the measurement started at the depth 210 m (where the YY method was primed) and ended at 175 m where the gas self-lifting ceased. At Lake Monoun, the measurement started at depth of 99.5 m and stopped at depth of 91 m where the gas self-lifting ceased. The results are shown in Fig. 5 for Monoun and Fig. 6 for Nyos.

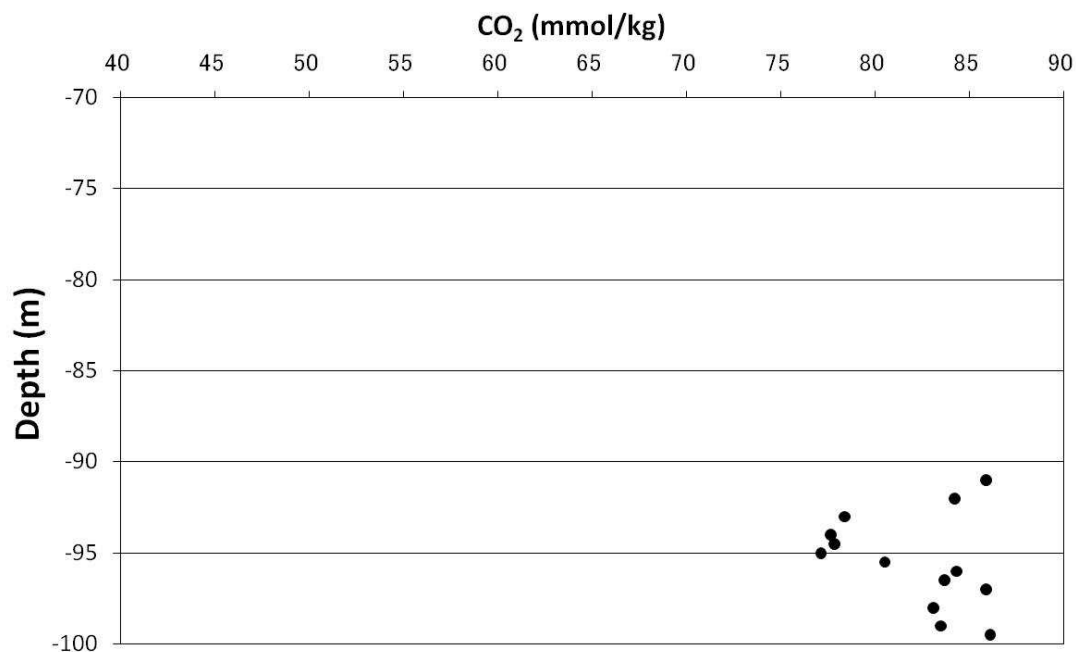


Figure 5: Depth distribution of dissolved CO₂ concentrations at Lake Monoun, November 7th and 8th, 2015

Two points at the shallowest depths at Monoun plotted as outliers (away from the common profile). The outliers may reflect an artifact caused by the fact that the YY method was not

run continuously in a single day. With such a skip in continuity of the measurement, the flow rate that was so small probably resulted in gas/liquid separation to take place in the hose. If the data at the shallowest depths are neglected, the results showed a general decreasing trend which is consistent with the results obtained previously. However, this hypothesis will be checked during the next expedition to Monoun where the YY measurement shall be finished within a day.

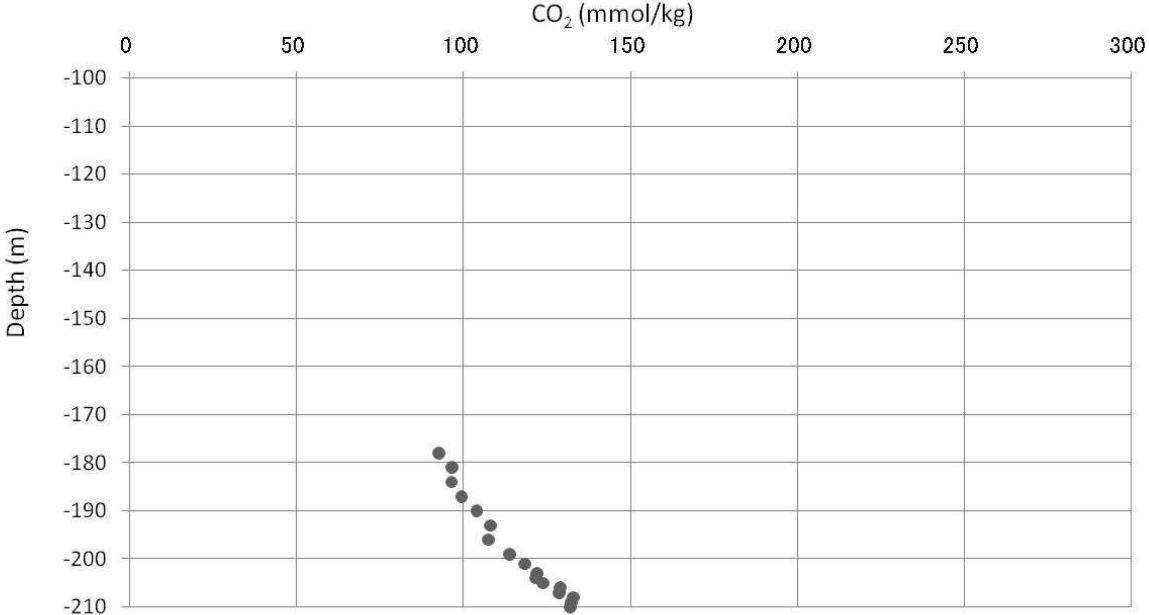


Figure 6: Depth distribution of dissolved CO₂ concentrations at Lake Nyos, November 11th, 2015

The distribution of dissolved CO₂ at both lakes measured in March 2014, December 2014 and November 2015 was compared as shown in Fig. 7 for Monoun and Fig. 8 for Nyos. Figure 7 shows that the Nov. 2015 data are in general agreement with the Dec. 2014 data, and implies that the effect of degassing by the deep water removal system balances with natural recharge of CO₂ these days. Figure 8 shows steady decrease of CO₂ concentration with time, reflecting continuous degassing by 3 pipes.

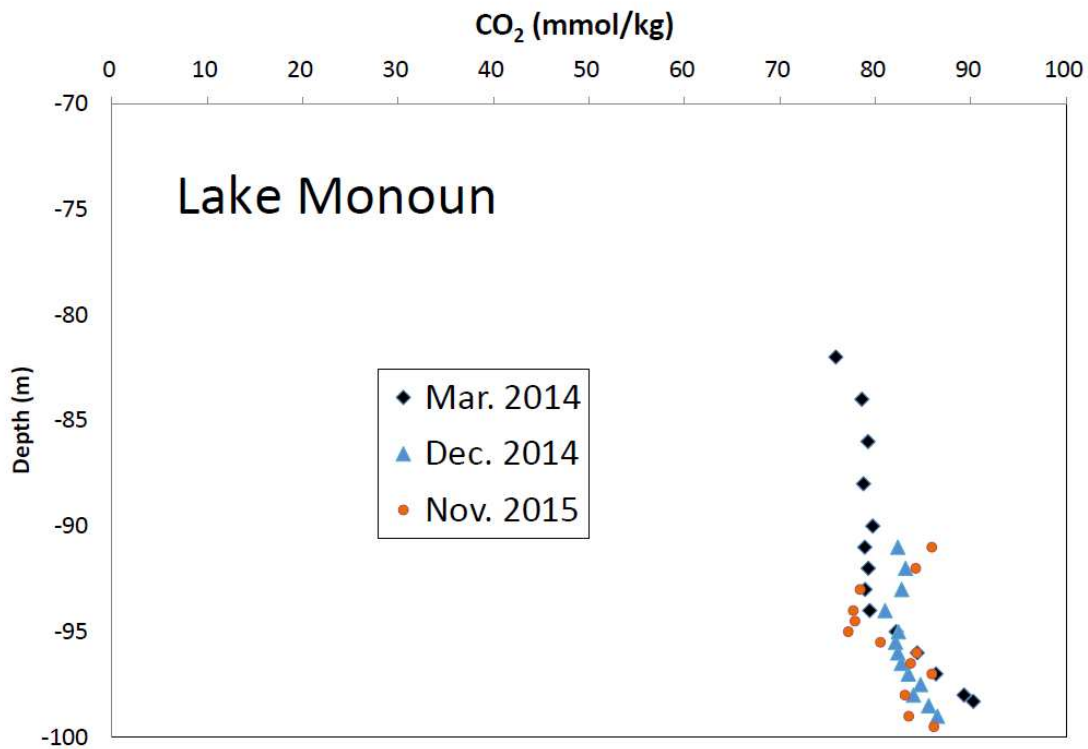


Figure 7: Depth distribution of CO₂ in March 2014, December 2014 and November 2015 at Lake Monoun measured with the YY-method

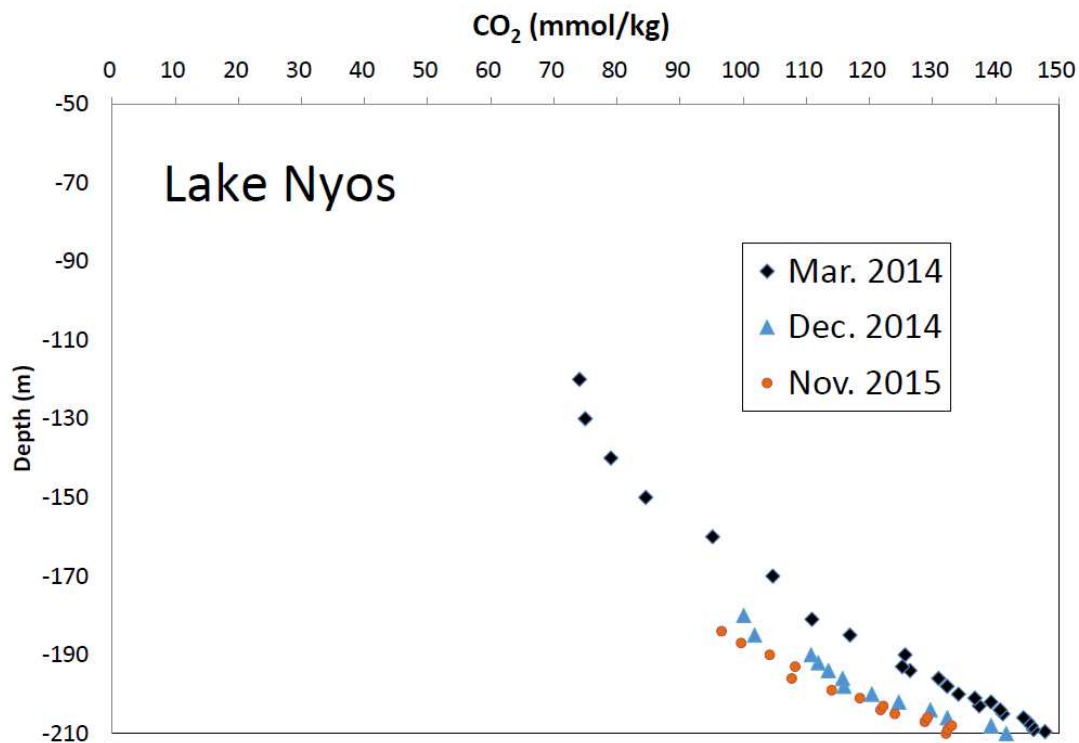


Figure 8: Depth distribution of CO₂ in March 2014, December 2014 and November 2015 at Lake Nyos measured with the YY-method

2.4 Checking of the solar power-driven deep water removal system at Lake Monoun

The solar power-driven deep water removal system was functioning properly (photo 1). It was observed that lake water continues to flow through the pipe mouth. After all checks, the solar panels that were partially covered by bird dropping were cleaned. Everything (solar panels, controller, pump, rafts and joint fittings) is all right.



Photo 1: The solar power-driven deep water removal system (November 7th, 2015)

3. Conclusion

In conclusion, the specific objectives of the field work were met, indicating that the Cameroonian scientists who actually lead and did the operations are capable of independently carrying out the routine lake monitoring.