Mission report of the field work at Lakes Nyos and Monoun (December, 2014)

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Within the framework of regular monitoring of Lakes Nyos and Monoun of SATREPS Ny-Mo project, a nippo Cameroonian team visited, from 03th to 12th December, lakes Nyos and Monoun for the regular annual monitoring. The overall objectives of the mission was to ensure the transfer of knowhow to IRGM team by the Japanese were:

  i. Specifically, the goals were: Measurement of conductivity, temperature and depth profile;
  ii. Sampling lake water for chemical and analysis;
  iii. Measurement of CO_2 concentration by MK- and YY methods;
  iv. Maintain the boats and Engines and transfer the maintenance techniques to local workers.

1. Methodology of field work

To fulfill one of the major recommendation of JCC, which is to ensure the Cameroonian scientists independently monitor the lakes, the IRGM team played a first role during this fieldwork under the supervision of Japanese team.

The various works were carried out on the working rafts. At Nyos, the work started by anchoring the working rafts at the center of the lake; At Monoun the working raft is already anchored at the center of the lake.

The conductivity, temperature and depth profile are measured using CTD. Water for chemical analysis was collected using Niskin sampler and the FDP during gas measurement. Immediately after collection, water was filtered through a 0.45μm membrane filter in duplicate in 100 ml of polyethylene bottle (for cation and anion analyses). One of the sample was acidified by 5ml of H_2SO_4 solution (4N) for cation analysis. This was done to prevent precipitation.

Two methods were used to obtain the CO_2 concentration: the MK sampling and YY-method. MK-sampling is a method used to determine the total CO_2 ($CO_2aq + HCO_3^-$) concentration in the lake water. In that method, the lake water was fixed *in situ* in a plastic syringe containing 10ml of 5M KOH and fixed the total dissolved carbonate. The Fixed CO_2 will be subsequently determined using the micro-cell diffusion analysis at the Nkolbisson laboratory.

The YY-method is a physical based method used to obtain the CO_2 (gas) concentration by measuring the several parameters on which depend the concentration. Once the parameters are measured, the concentration can be calculated by an excel-sheet. MK sampler, Niskin sampler and YY system were deployed at the specific depths by using the winch powered by gasoline engine to reduce human power.

2. Measurement of conductivity, temperature and depth profile

During the field work, it was not possible to do CTD because of a problem of communication with the Thoughbook. Two other laptops were then requested. However, it was not possible to use them because of the lack of the USB adaptor.

Figure 1: Testing of switching on of the CTD by the Cameroonians team

3. *Sampling lake water for chemical analysis*

Water samples for chemical analysis were collected at 16 depths at Nyos (in December 5th, 2014) and 15 depths at Monoun (from 9 to 10 December 2014). The various depths (m) were the following. At Nyos: -210, -208, -206, -204, -202, -200, -196, -190, -180, -170, -160, -140, -120, -100, -80, -50, 0; at Monoun: -99, -98, -97, -96, -95, -93, -90, -87, -85, -82, -70, -60, -50, -30, 0. All these samples will be analyzed in the LAGE at Nkolbisson.

4. *Measurement of CO_2 concentration*

The works on the measurement of CO_2 concentrations started in the field by the MK-Method at the both lakes. The depths of water collection were the same as those chosen to collected water samples for chemical analysis, except for the surface water samples. Fifteen samples were collected at Nyos in December 5th, 2014 while fourteen were collected at Monoun in December 9th, 2014.
Using the YY-method, we measured the parameters at Lake Nyos on December 6th, 2014 and Lake Monoun on December 10th, 2014. The depths of the lake bottoms were 210 m at Nyos and 99 m at Monoun. At Nyos, the measurement started at the depth 210 m and ended at 180 m where the gas self-lifting ceased. At Monoun, we started at depth 99 m and ended at depth 91 m. The results are shown in Fig.2 and Fig.3.
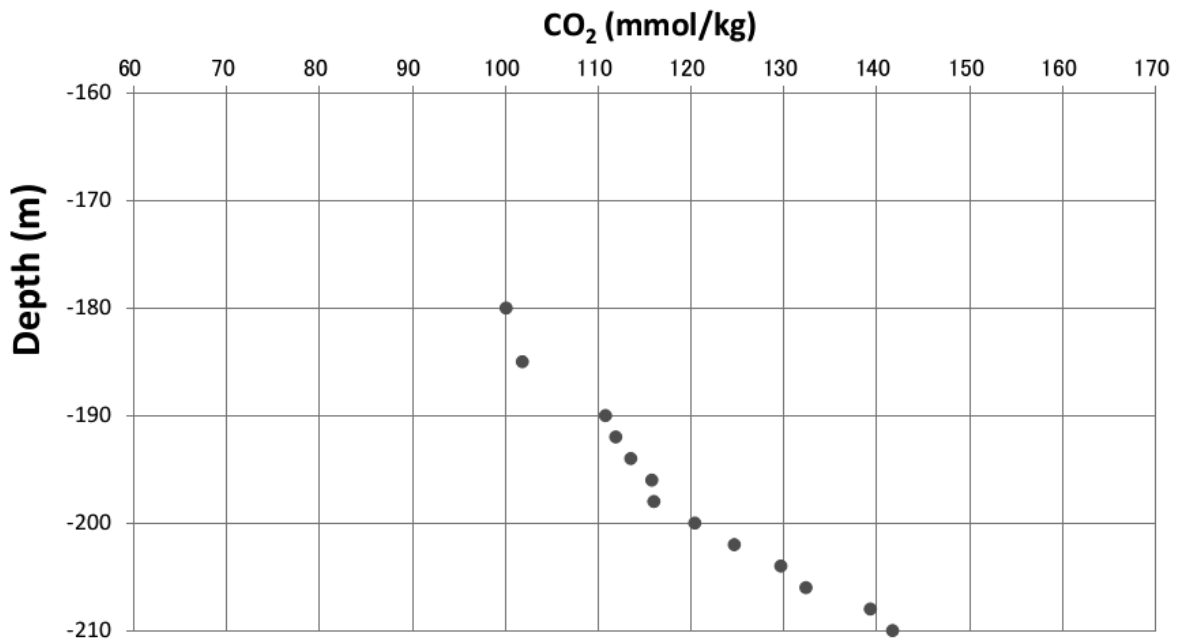
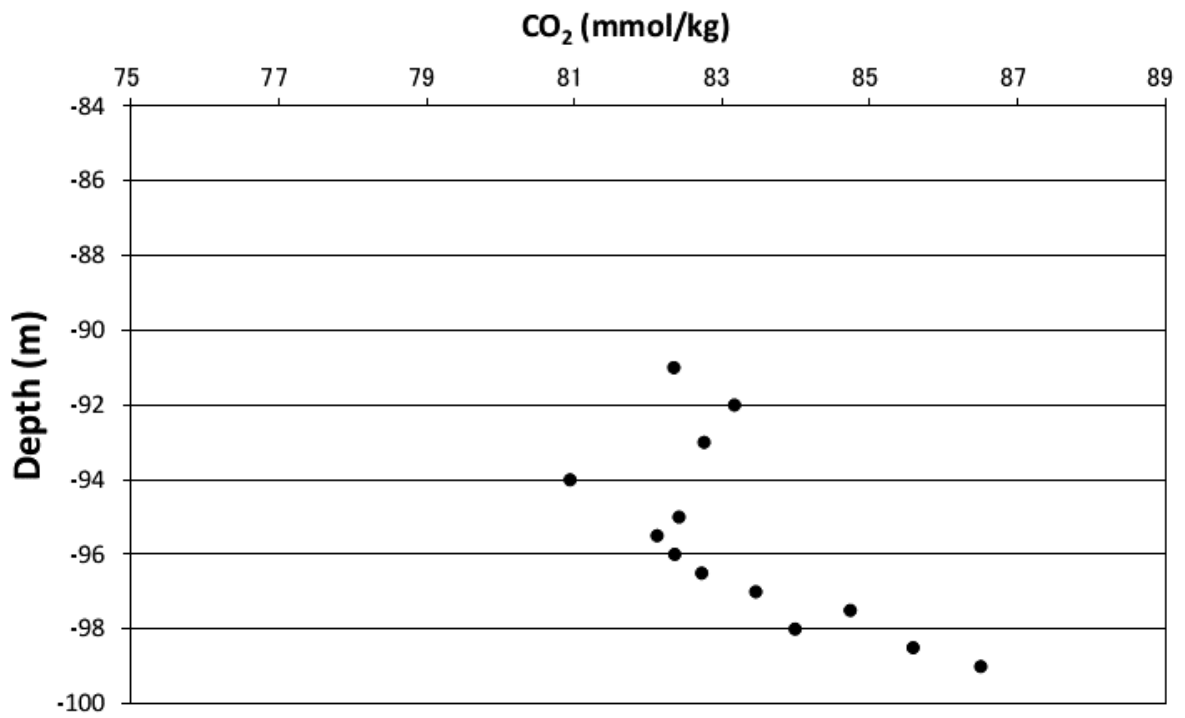Figure 2: Distribution of dissolved CO_2 concentrations at Lake Nyos,

Figure 3: Distribution of dissolved CO_2 concentrations at Lake Monoun

Figure 4 and 5 show the distribution of dissolved CO_2 at the both lakes in time.
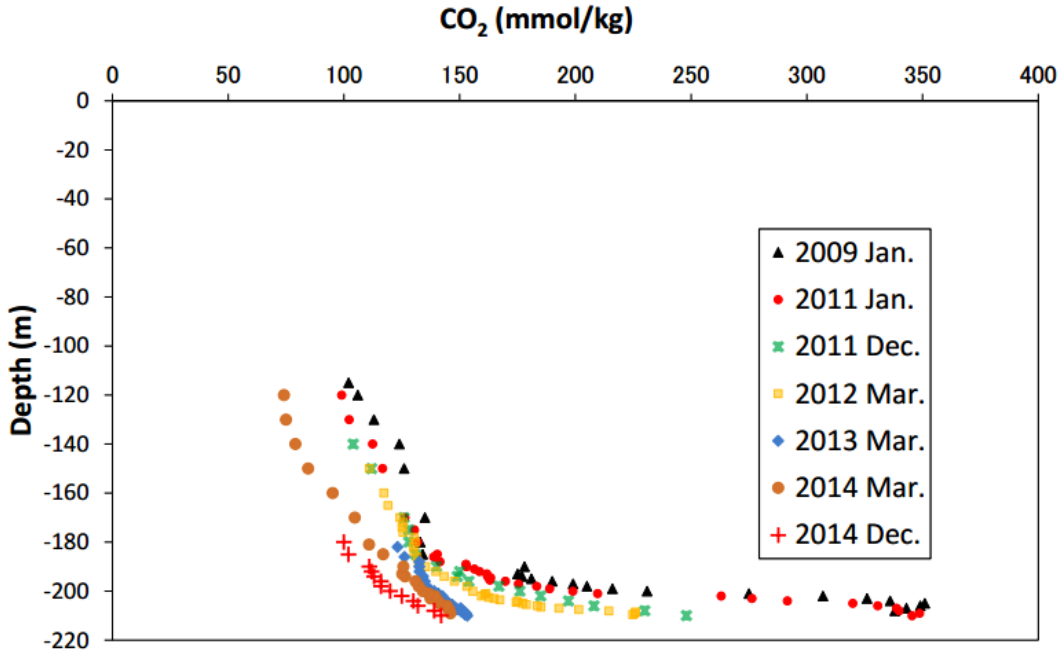
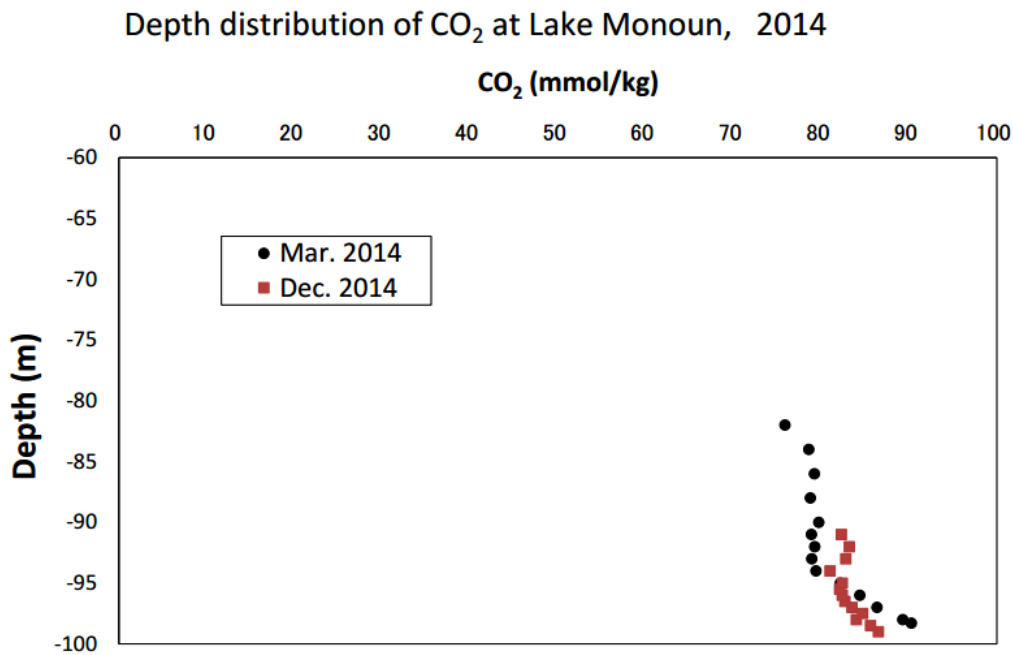Figure 4: Comparison between 2009, 2011, 2012, 2013 and 2014 CO2 profiles at Lake Nyos.

Figure 5: Distribution of CO_2 in March and December 2014 at Lake Monoun

5. *Capacity building of local workers and maintenance of the boats and the engines*

The damaged RPF boat at Lake Nyos was thoroughly fixed by Mr Nishio. He also maintained some engines. Subsequently, he trained the local workers of lakes Nyos and Monoun and maintenance of the boats and the engines continued during this mission.
The maintenance techniques of the two damaged boats (Lake Nyos, Fig.6), the engine and the engine powered winch were transferred to local workers by Mr Nishio. They have also benefited advises on how to sustainably use and maintain donated and used equipment
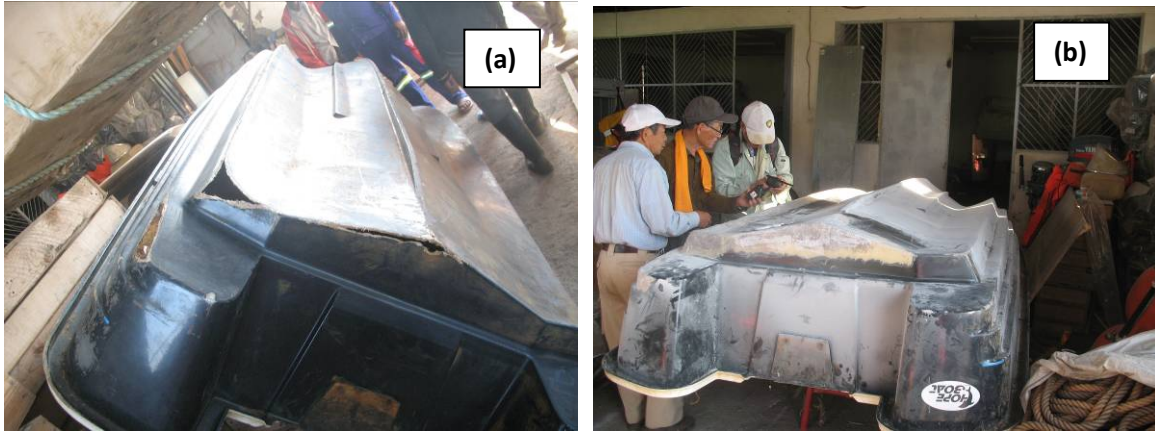
Figure 6: Damaged boat at Lake Nyos before (a) and after (b) repair by Mr Nishio

6. *Checking of a solar power-driven deep water removal system at Lake Monoun*

The solar power-driven deep water removal system is working well. The flow rate of water measured and the output of solar modules are from 2.9 to 3.2 m3/h and 0.23 kW, respectively. Estimated total flow rate of deep water through a pump and an annulus was more than 100 m3/day (about equal to that of this March). After all checks, the solar panels were cleaned (Fig.7).

Figure 7: Cleaning of the solar panels