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ADVANCED ESTIMATION OF TROPICAL PEATLAND/WETLAND ECOSYSTEMS USING INNOVATIVE TECHNOLOGIES

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SUMMARY

High Carbon Reservoir (HCR) Ecosystems is most important Ecosystem for Carbon Flux affecting strongly Climate Change and Human Impact, where are as Peatland/Wetland (by CO_2 and CH_4), Costal Ecosystem including Mangrove and Coral Reef (by CO_2), and Permafrost (by CH_4). The HCR Ecosystems is very important not only for storage and conservation of carbon, but also the conservation of water stock and biodiversity. To establish the HCR Ecosystems, a MRV system that is coupled with two components – satellite sensing and grand truth data - is urgently required. For this purpose, several satellite data were integrated with ground truth data in our JST-JICA (SATREPS) Project on "Wild Fire and Carbon Management in Peat-Forest in Indonesia", then it is successes to make carbon content mapping and water table mapping in peatland, using model and remote sensing data, which were first success in the world. These mappings are excellent innovated technology, however as these mapping must integrate many data of satellite sensing and grand truth, resolution of mapping is low and it is not real time. As Hyper-sensor of HISUI as next generation sensor have high performance of Ecological Sensing on The HCR Ecosystems including Plant Phenology Changing, which make a possibility to take under ground information, such as nutrients condition, water table in Peatland/Wetlands, carbon accumulation in Peatland/Wetland, Permafrost melting level, so on. Thus, Hyper-sensor function in UAV and Airborne is introduced and discussed on innovation of ecological research, not only The HCR Ecosystems.

Keywords: *MRV, SESAME, Hypersensor, Carbon emission, Groundwater level*

INTRODUCTION

Recent anthropogenic disturbances have had significant impacts to tropical peatland ecosystem. Particularly drainage system constructed in Pearland makes ground water level lower drastically. As a result, huge amount of carbon dioxide (CO_2) is released due to decomposition of soil carbon and peatland fire. It is thought that CO_2 emission will keep on increasing if no appropriate monitoring system is introduced into peatland monitoring.
Thus, the introduction of a carbon credit mechanism such as REDD (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries) and JCM (Joint Credit Mechanism) to protect and rehabilitate tropical peatlands is an urgent issue. COP15 in Copenhagen, **MRV** (Measurement, Reporting and Verification) focused on establishing reference emission levels, national monitoring systems, use of IPCC guidelines, and parameters to be MRV-ed. Therefore, the most reliable methodologies for the “Reference Emission Level (REL)” and “Measuring, Reporting and Verification (MRV) “should be developed based on a precise carbon estimation system using advanced sensors. An effective MRV system must include new integration of data truly necessary, data analysis, modeling and simulation.

MATERIALS AND METHODS

(1) Research field of tropical peatland

Hokkaido University has been studying on Various Topics in tropical peatland; GHG Flux (CO_2, CH_4, N_2O) measuring, Fire Detection and Protection, Water Table Monitoring and Management, Peatland Ecology, Soluble Carbon Monitoring, Peatland Subsidence Monitoring, which is almost 20 years in Central Kalimantan, Indoneshia after Mega Rice Project (Fig. 1). Hokkaido University has been studying on Various Topics in tropical peatland; GHG Flux (CO_2, CH_4, N_2O) measuring, Fire Detection and Protection, Water Table Monitoring and Management, Peatland Ecology, Soluble Carbon Monitoring, Peatland Subsidence Monitoring, which is almost 20 years in Central Kalimantan, Indonesia after Mega Rice Project.

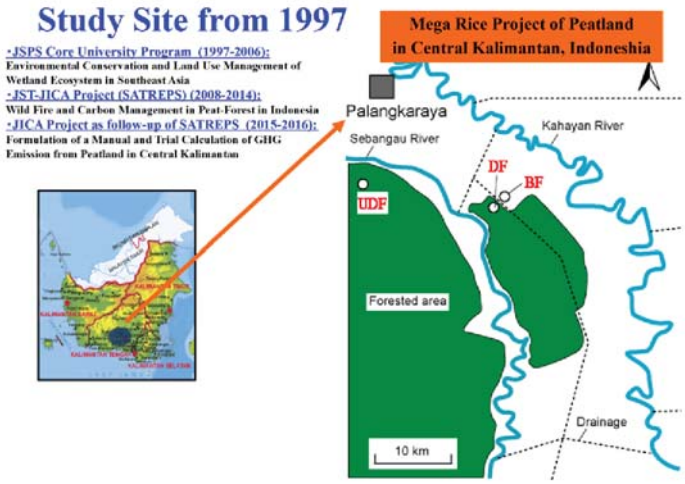


Fig. 1 Map of study site in Central Kalimantan, Indonesia

(2) Estimation of carbon stock and emission from peatland

Peatland monitoring can be conducted at three levels of altitude: from ground, airborne, and space borne. Hokkaido University and collaborative research group with Indonesian experts concluded that eight key elements are essential for reliable and comprehensive monitoring based on over ten-year long-term ground observation data in the peatland of Central Kalimantan, Indonesia. Proposed monitoring system is shown in Figure 2 and the eight key elements are as follows; 1) CO_2 flux and concentration, 2) Hotspots detection, 3) Forest degradation and species mapping, 4) Deforestation, forest biomass changes, 5) Water level and soil moisture, 6) Peat dome detection and peat thickness, 7) Peat-subsidence, and 8)Water soluble organic carbon.

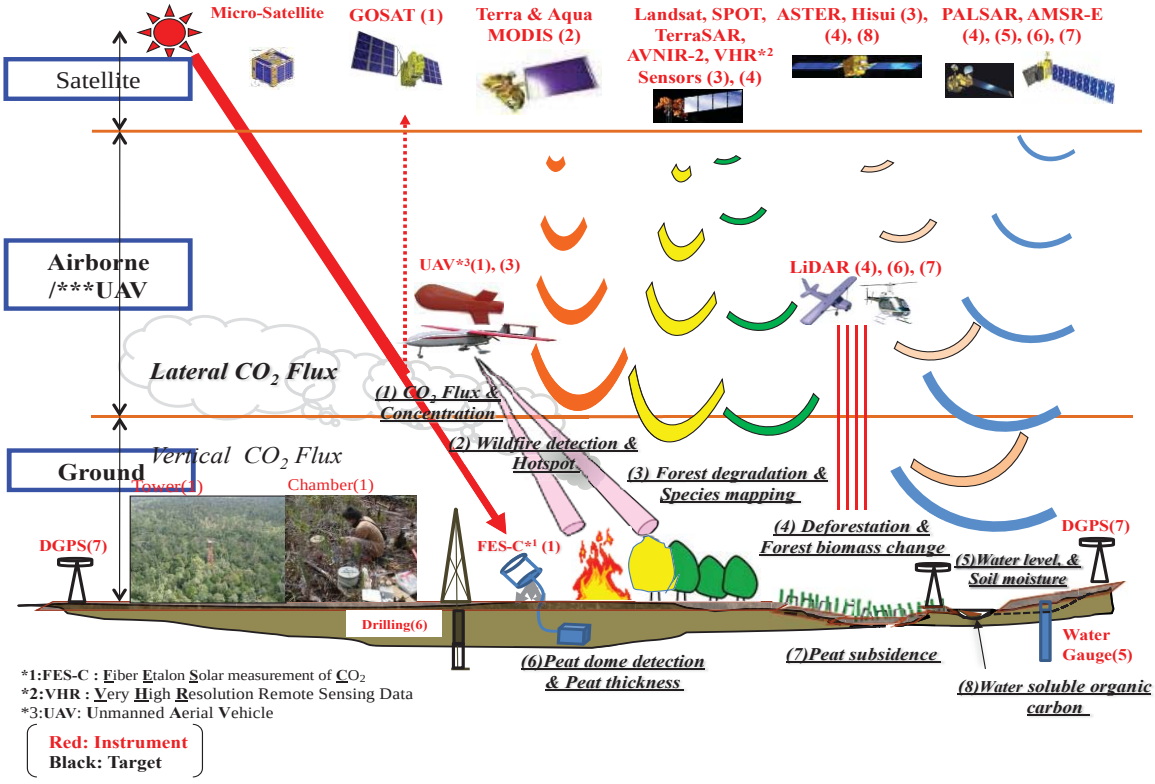


Fig. 2 Element of Carbon Stock and Carbon Flux estimating by ground truth and remote sensing

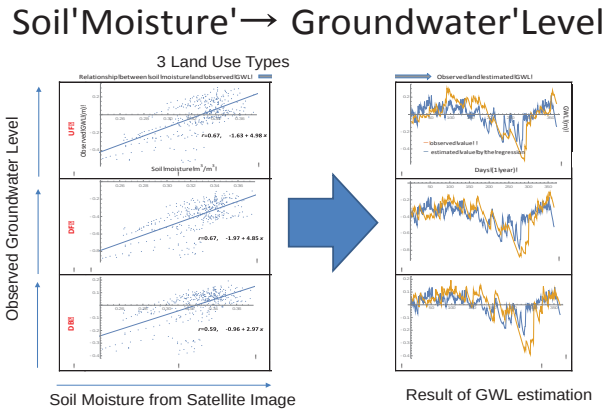


Fig. 3 Groundwater level estimation

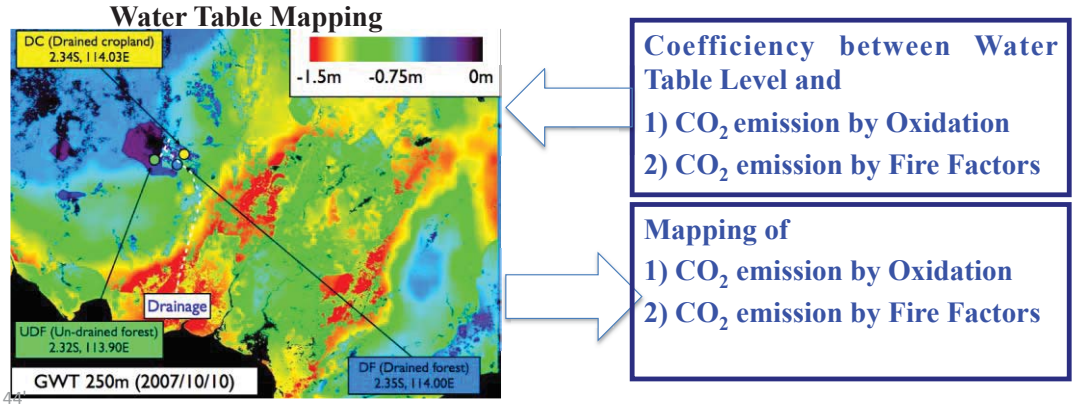
RESULTS AND DISCUSSION

(1) Groundwater level mapping

Water level data obtained under different land types were coupled with soil moisture grid data served by the European Centre for Medium-Range Weather Forecasts in order to estimate water level distribution in Central Kalimantan peatland (Fig. 3). Annual CO_2 emission from ecosystem respiration was then estimated by applying the relationship between the water level and net ecosystem CO_2 exchange, which was obtained by eddy covariance in previous studies (Fig. 4). Annual carbon emission from peat fire was estimated based on the relationship between water level observed at a monitoring well and annual peat carbon loss by fire, also established in a previous study.

(2) Guidebook on MRV on Carbon Budget

"GUIDEBOOK FOR ESTIMATING CARBON EMISSIONS FROM TROPICAL PEATLANDS IN INDONESIA" (2016) was published for estimation on annual carbon emission by fire and microorganisms activity in peatland degradation. What is this guidebook about? This guidebook provides step-by-step procedures to: 1) Collect spatial information from remote sensing data sources, 2) Collect field sampling data of GWL and other parameters, 3) Estimate GWL distribution based on the field samples and remote sensing data , 4) Establish a linear relationship (model) between carbon emissions and GWLs, and 5)Predict GWLs several days into the future based on field sampling data.



By Wataru Takeuchi, University of Tokyo, Japan

Fig. 4 Water table Mapping and Mapping on CO_2 emission by Fire and Oxidation

CONCLUSION

In non-forest (peat land and agriculture land) REDD+, peat carbon (storage and flux) MRV is one of most important missions. If the MRV system for non-forest REDD+ is established, it will be easier to apply this MRV system to forest REDD/REDD+. To achieve a non-forest REDD+, *"Integrated Monitoring/Sensing System (IMSS)"* on Carbon Flux and Biodiversity in Tropical Peat and Forest is proposed here, which is composed of an "MRV Unit" and a "Capacity Building Unit". As an institution for maintaining the *"Integrated Monitoring/Sensing System (IMSS) with the* "MRV Unit" and the "Capacity Building Unit", we propose a Peat Carbon Initiative. The Peat Carbon Initiative has two functions: 1) the sensing monitoring and capacity building for REDD+ in Indonesia, which is the most advanced country for REDD+ activity, and 2) the establishing of an international network to develop collaboration research for the MRV, especially Verification.

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REFERENCES

1. Gibbs, K. H., Brown, B., Niles, O. J. and Foley, A. J. (2007) Monitoring and estimating tropical forest carbon stocks: making REDD a reality. Environ. Res. Lett: 2 045023: 13.
2. Jaenicke, J., Rieley, J.O., Mott, C., Kimman, P. and F. Siegert (2008) Determination of the amount of carbon stored in Indonesian peatlands. Geoderma: 147: 151–158.
3. Maria Strack ed.(2008) Peatland and Climate Change, International Peat Society, 223.
4. Rieley, J.O., Wüst, R.A.J., Jauhiainen, J., Page, S.E., Wösten, H., Hooijer, A., Siegert, F., Limin, S. H., Vasander H. and Stahlhut, M. (2008) Chapter 6: Tropical peatlands: carbon stress, carbon gas emissions and contribution to climate change process, Maria Strack ed. "Peatlands and climate change" International Peat Society, Finland :148-181
5. Page, S. E., Rieley, J.O. and Banks C.J., 2011, Global and regional importance of the tropical peatland carbon pool, Global Change Biology 17: 798 – 818.
6. Yohei Hamada・Nobuyuki Tsuji・Yasuhito Kojima・Muhammad Abdul Qirom ・Albertus Sulaiman Firmanto ・Yusurum Jagau・Dedy Irawan ・Rumi Naito・Eli Nur Nirmala Sari : GUIDEBOOK FOR ESTIMATING CARBON EMISSIONS FROM TROPICAL PEATLANDS IN INDONESIA (2016), Indonesia-Japan Project for Development of REDD+ Implementation Mechanism, Technical cooperation project between Ministry of Environment and Forestry Indonesia and Japan International Cooperation Agency, Manggala Wanabakti Building, Block VII 6th Floor, Jl. Jenderal Gatot Subroto, Jakarta 10270, Indonesia, March 15, 2016