LARGE-SCALE PROJECTS

Collaborative Research in ASEAN Region

Kyoto University has been actively involved in research activities in the ASEAN region for many years, and the collaborative activities with ASEAN universities and research institutions are expanding these days.

THAILAND

Strengthening Japan–Thailand Relations

Developing cleaner fuels through a new five-year program.


Kick-off meeting in Bangkok, 14 January 2014

Kyoto University has launched a Japan-Thailand collaborative research project titled "Development of clean and efficient utilization of low rank coals and biomass by solvent treatment," supported by the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA) through the Science and Technology Research Partnership for Sustainable Development (SATREPS) program. More than 15 Japanese researchers from Kyoto University, Akita University, the Central Research Institute for Electric Power Industry (CRIEPI), and Kobe Steel Co. Ltd and 12 Thai researchers from the Joint Graduate School of Energy and Environment at King Mongkut's University of Technology Thonburi and PTT Public Company Limited will be involved in the project.

The five-year program will involve developing several technologies to convert biomass waste as well as low-rank coals into valuable products such as carbon fiber, biofuel, and high quality solid fuel based on a novel degradative solvent extraction technology developed at Kyoto University. The outcomes from this project are expected to make a global impact in every respect. Clean and efficient utilization of low-rank coals as well as increased use of biomass will help to reduce CO_2 emission. The project may therefore help to address the increasing demand for biomass energy, as well as the need to create local employment opportunities and generate income for farmers in developing countries.


Carbon fibers (left) derived from biomass (right)


Kouichi Miura, PhD (left) *Specially Appointed Professor, Institute of Advanced Energy*
Hideaki Ohgaki, PhD (right) *Professor, Institute of Advanced Energy*
WEB www.iae.kyoto-u.ac.jp/quantum/member.html

Indonesia

Volcanic Hazard Mitigation in Indonesia

Mitigation of Hazards from Volcanic Eruptions and Induced Sedimentary Hazards.

Volcanic disasters are highly complicated, because eruptions are the only type of natural phenomenon ejecting large amounts of material from underground to the earth's surface. Many types of disasters are also induced by volcanic eruptions, such as lahars, debris flows, earthquakes, and tsunami.

Indonesia has 127 active volcanoes along the archipelago from Sumatra to Nusa Tenggara, Sulawesi and the Maluku Islands, and has suffered from numerous volcanic eruptions. Similarities between Indonesia and Japan include the existence of a large number of active volcanoes and large residential populations in areas surrounding these volcanoes. Consequently there is great demand in both countries for evaluation of volcanic activity for evacuation and hazard mitigation during eruptions.

In 1993, I began a collaboration study with the then Volcanological Survey of Indonesia (presently named the Center for Volcanology and Geological Hazard Mitigation, Geological Agency, Ministry of Energy and Mineral Resources), which was responsible for monitoring volcanic activity and the issuing of alerts.

The 2010 eruption at Merapi volcano, Central Java, influenced me greatly, beginning with a vulcanian eruption that destroyed the lava dome at the summit. After a week of lessened activity, the volcano forcefully ejected a plume up to 10 km high and a pyroclastic flow reaching 17 km from the summit. More than 300 people were killed by this flow, and pyroclastic and ash-fall deposits induced frequent lahars along many rivers on the flanks of Mount Merapi.

This eruption brought into sharp focus the difficulties of forecasting transient activity and intensities, and the necessity of implementing countermeasures in a wider area and in cooperation with the study on secondary hazards such as lahars.

I am currently managing the SATREPS project "Integrated study on mitigation of multimodal disasters caused by ejection of volcanic products". This project aims to forecast sedimentary hazards along rivers and the dispersion of volcanic ash in the atmosphere affecting aviation safety, based on discharge rates of volcanic ash from the crater. This discharge rate is estimated in real-time using monitoring apparatus, delivering a preliminary forecast based on the eruption history of the volcanoes and probable eruption scenarios. Eventually I hope to see volcanic ash-fall forecasting on television alongside regular weather forecasts.

Masato Iguchi, PhD *Professor, Disaster Prevention Research Institute*

WEB www.svo.dpri.kyoto-u.ac.jp/indonesia-vs/

PHILIPPINES

Why not an engineering for non-engineered systems?

An approach to mitigating natural disasters worldwide.

Figure 1 House along the coastline of Leyte Island

Much effort and funding have been used to expand the frontiers of engineering such as in the fields of architecture and civil engineering, as realized in the construction of high-rise buildings, long-span bridges, large-space structures, and wide-spread lifelines. Being vehicles of economic growth and also playing a role as iconic symbols of technological development, these stand out in society. And thanks to their careful design and construction they seldom fail in the event of a natural hazard — at least in developed countries.

Turing our eyes to natural disaster statistics worldwide, however, we see another picture. Many disasters occur on the opposite side of the "engineering frontier". Indeed, these disasters are often associated with failures of buildings and infrastructure systems that are empirically designed and constructed without relying on engineering knowledge (Figures 1). In some cases, it is even fair to say that there is no such engineering knowledge available (Figure 2). This leads to the question: Why not an engineering for non-engineered systems? This is the starting point of my research.

Funded by Kyoto University as part of the SPIRITS (Supporting Program for Interaction-based Initiative Team Studies) program, my team has been developing an international research network with the ultimate goal of extending our engineering body of knowledge to include non-engineered systems, thereby providing engineering solutions to mitigate failures of such non-engineered systems. So far, the network consists of members from more than 11 organizations — research institutes, engineering societies, and non-governmental organizations — in nine countries. Aside from this SPIRITS project, I am also leading a project within the J-RAPID program funded by the Japan Science and Technology Agency for the reconstruction of areas of the Philippines struck by Typhoon Yolanda in 2013 (Figure 3). A case study of this J-RAPID project has, among other purposes, also addressed the need to develop engineering knowledge for non-engineered structures.

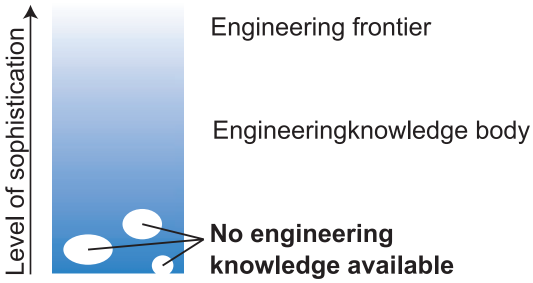

Figure 2 Our engineering body of knowledge.

Figure 3 House under reconstruction by residentsafter Typhoon Yolanda

To improve implementation, I think it is important not to lose traditional, cultural, and societal continuity in improving the performance of these non-engineered systems, and moreover I would personally feel bored if these non-engineered systems lost their unique, local characteristics and were simply replaced by technologies we can see anywhere in cities like Tokyo or New York. Instead, why don't we dream of high-performance bamboo houses on the coastline of Leyte Island or high-rise timber buildings in the city of Yangon?

Kazuyoshi Nishijima, PhD

Associate Professor, Disaster Prevention Research Institute

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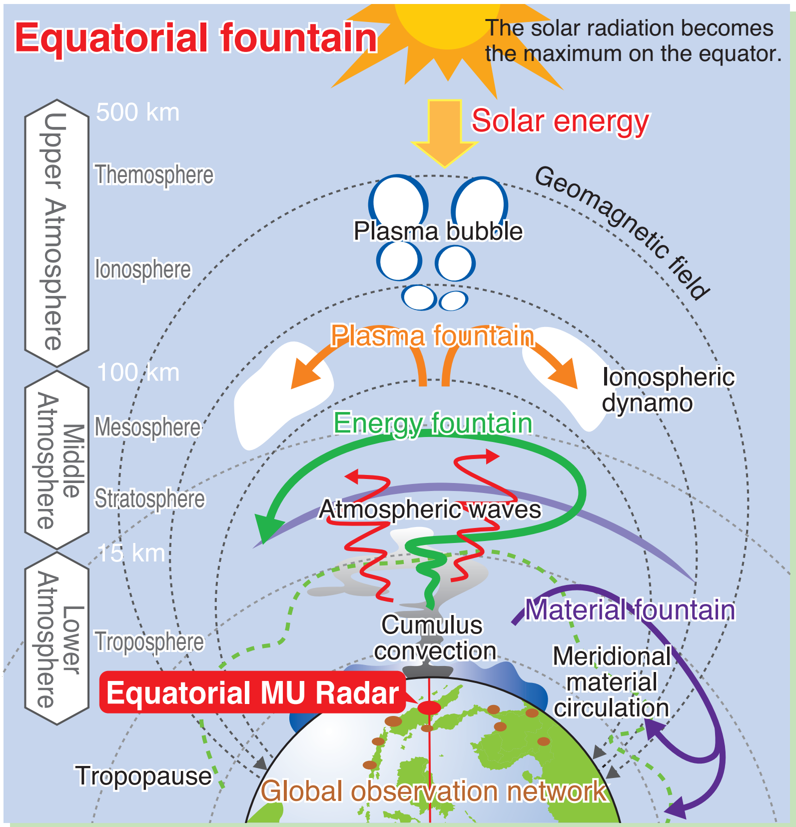
Indonesia

Equatorial MU Radar (EMU)

Equatorial fountain in the middle and upper atmosphere over Indonesia.



We are studying coupling processes in the solar-terrestrial system, focusing on solar energy inputs to Earth, and the response of the atmosphere to energy input. Solar energy can be divided into two parts: solar radiation involving infrared, visible, ultraviolet and X-ray, and solar wind, consisting of a high-speed flow of plasma particles. Electromagnetic energy due to solar wind converges into the polar region, while solar radiation reaches a maximum at the equator, and atmospheric disturbances are actively generated near the Earth's surface. In particular, cumulonimbus convection over Indonesia is the most active in the world, resulting in various atmospheric waves that propagate upward to transport energy and momentum into the upper atmosphere. Different kinds of materials (atmospheric minor constituents) originating at low- and mid-latitude regions converge in the equatorial region, and are blown upward through the tropopause at about 15 km into the middle atmosphere (10-100 km), and spread across the whole globe. In the upper atmosphere, plasma disturbances and equatorial ionization anomalies are generated around the equator.

A number of international collaborative programs on the coupling processes in the solar-terrestrial system have been coordinated under the aegis of the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) of the International Council for Science (ICSU). We have contributed a great deal to such programs through observations particularly using a state-of-the-art large atmospheric radar that enables us to study the behavior of the troposphere (altitude up to 10-15 km), middle atmosphere (10-100 km), and upper atmosphere (above 100 km). We have developed the middle and upper atmosphere radar (MU radar) in Shigaraki, Japan, in 1984, and the Equatorial Atmosphere Radar (EAR) right over the equator in West Sumatra, Indonesia, in 2001. We are now promoting the construction of the Equatorial MU Radar (EMU), which will be 10 times more sensitive than EAR. Using EMU, we aim to study and capture the energy and material flow occurring in all height ranges of the equatorial atmosphere — a phenomenon known as the equatorial fountain.

Toshitaka Tsuda, PhD

Professor, Research Institute for Sustainable Humanosphere / President of the Japan Geoscience Union

WEB www.rish.kyoto-u.ac.jp/emu/index-e.html