# Summary of Research Activities in ERI

I visited ERI from Oct. 9, 2017 to Nov. 30, 2017. The original plan was to collaborate with Dr. Hisayoshi Shimizu in ERI on short-timescale geomagnetic variability and core dynamics. By the end of my visit, we have met the original research objectives, and have carried out additional research activities. Following are the details of the research activities and achievements from this visit.

1. Short-timescale geomagnetic variability and core dynamics

This collaborative effort aims at enabling ERI's ability to predict geomagnetic secular variation (SV) via data assimilation approach, thus requiring a complete geomagnetic data assimilation system installed in ERI computing system (eic.eri.u-tokyo.ac.jp). I have installed a version of GEMS (**G**eomagnetic **E**nsemble **M**odeling **S**ystem) that we developed in NASA GSFC. It is successfully installed and benchmarked on eic.eri.u-tokyo.ac.jp by both of us. In addition, Dr. Shimizu is using this system to collaborate with our group in NASA GSFC to validate and improve GEMS system.

This research requires further development in future, including addition of Japanese dynamo models to GEMS. We discussed and agreed to develop GEMS further to become an open-source framework for both ERI and GSFC (and other collaborative researchers and institutions around the world) for geomagnetic forecast and for studies of the deep Earth structure and dynamics via geomagnetic observations and geodynamo modeling. I wish that ERI can actively support this new research development in future.

2. Habitability of the Earth

This is the project beyond our original plan. Both Dr. Shimizu and I worked together to investigate the life-span of the Earth's habitability in future (on geological time scales). We have collaborated on studying future growth of the inner core, and geodynamo in future. We have found from our study that the Earth could become inhabitable (from magnetic perspective) in as quickly as 300 million years. We are currently preparing a manuscript on our findings. In particular, this collaborative research could be utilized for studies of exoplanets and habitable worlds.

3. Scientific Presentations

During my visit, I gave two separate seminars, one on planetary magnetic fields at Kyoto University, and one on polar motion and electromagnetic core-mantle interactions in ERI. I enjoyed very much my visit and benefited from scientific discussions with colleagues from ERI, JAMESTEC, Tokyo Institute of technology and Kyoto University. I would certainly love to visit ERI again in future.