

## 【Grant-in-Aid for Transformative Research Areas (A)】

### Section IV



#### Title of Project : Digital Biosphere: Integrated Biospheric Science for Mitigating Global Environment Change

ITO Akihiko  
(National Institute for Environmental Studies, Earth System Division, Head)

Number of Research Area : 21A403 Researcher Number : 70344273

#### 【Purpose of the Research Project】

Mitigation of devastating global environment change is critical for achieving the sustainable society. The biosphere plays unique roles in the energy and biogeochemical cycles and shows remarkable adaptability and resilience against climate changes. The goal of the research project is to develop a set of mitigation options of global environmental change by utilizing the biospheric functions.

The biosphere encapsulates a wide range of hierarchical scales from genome, cell, organ, individual, community, ecosystem, and biome, and therefore investigated by difference scientific fields such as molecular biology and ecology. On the other hand, recent advancements such as genome analysis and Earth observation provide an increasing amount of information at micro to macro scales, allowing us, in conjunction with data science, to elucidate the biospheric functions in an innovative manner.

The Research Area aims at developing a new scientific field, called the integrated biospheric science, through interdisciplinary collaborations in relation to biospheric functions. It develops a novel global model, called the digital biosphere, to integrate diverse findings. Focusing on overarching issues on global change mitigation, i.e., CO<sub>2</sub> sequestration, biomass production, and land use, this Research Area intends to give quantitative answers to support establishment of the sustainable society.

#### 【Content of the Research Project】

The Research Area contains three research categories in terms of the biospheric function: A) investigation about underlying mechanisms, B) broad-scale observational monitoring, and C) global model development (Fig. 1).

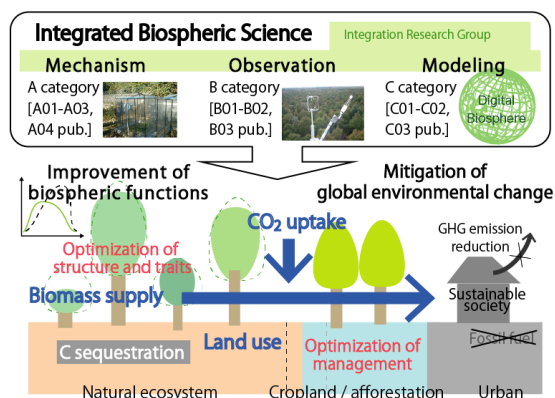


Fig.1: Research groups and their collaboration

Research category A (Research Groups A01–A04) conducts studies about the mechanisms of determinant

factors and environmental responses of plant CO<sub>2</sub> assimilation and on functional optimization of structure and traits, using experimental data and data-driven models. This category explores also soil carbon budget focusing on microbial and organic matter dynamics. Research category B (B01–B03) performs observations of biospheric functions using field and remote sensing approaches. This category observes atmosphere–ecosystem CO<sub>2</sub> exchange and biomass production at field sites in Japan and Asia to clarify the spatial and temporal patterns. Also, this category uses high-resolution and hyperspectral remote sensing data to detect the impacts of climate change and human activities. Research category C (C01–C03) conducts advanced modeling studies on the biosphere to develop a global biosphere model with a high resolution. The model allows us mapping the key functions taking account of environmental and land use factors. Also, this category uses the Earth system model, which includes interactions with the atmospheric and ocean components of the climate system, to evaluate the climatic feedback on the basis of future socioeconomic scenarios.

#### 【Expected Research Achievements and Scientific Significance】

Establishment of the integrated biospheric science by the Research Area is expected to enhance interdisciplinary collaborations and capacity building. Deepening insights into the biosphere provides useful outcomes to mitigation, adaptation, and nature-based solutions. The new model, the digital biosphere, is anticipated to allow us performing high-resolution simulations of the biospheric functions (CO<sub>2</sub> uptake and biomass supply), which are useful to prevent the global environmental change.

#### 【Key Words】

Biospheric function: Function indigenous to the biosphere to form and maintain the environmental condition on the Earth by regulating energy and biogeochemical cycles. It also brings profits to the human society by providing various biomass-derived goods (e.g., fuel and timber).

【Term of Project】 FY2021-2025

【Budget Allocation】 1,124,200 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<http://digital-biosphere.jp>  
itoh@nies.go.jp