

July 2009

*Nagoya University Global COE Program*

***“From Earth System Science to Basic and Clinical Environmental Studies”***

**(FY2009-2013)**

**Organizations and related programs**

Graduate School of Environmental Studies (GSES)

<http://www.env.nagoya-u.ac.jp/en/index.html>

Graduate School of Bioagricultural Sciences (GSBS)

<http://www.agr.nagoya-u.ac.jp/index-e.html>

Hydrospheric Atmospheric Research Center (HyARC)

[http://www.hyarc.nagoya-u.ac.jp/English/site\\_english.html](http://www.hyarc.nagoya-u.ac.jp/English/site_english.html)

Solar-Terrestrial Environment Laboratory (STEL)

<http://www.stelab.nagoya-u.ac.jp/ste-www1/index.html>

Graduate School of Engineering (GSE)

<http://www.engg.nagoya-u.ac.jp/en/index.html>

Study Consortium for Earth-Life Interactive System (SELIS)

<http://www.selis.hyarc.nagoya-u.ac.jp/en/>

Global Environmental Leaders Program (NUGELP)

<http://www.envleaders.env.nagoya-u.ac.jp/>

Academic Consortium 21 (AC21)

<http://www.ac21.org/>

Nagoya University

<http://www.nagoya-u.ac.jp/en/>

**The website of this program will be uploaded soon.**

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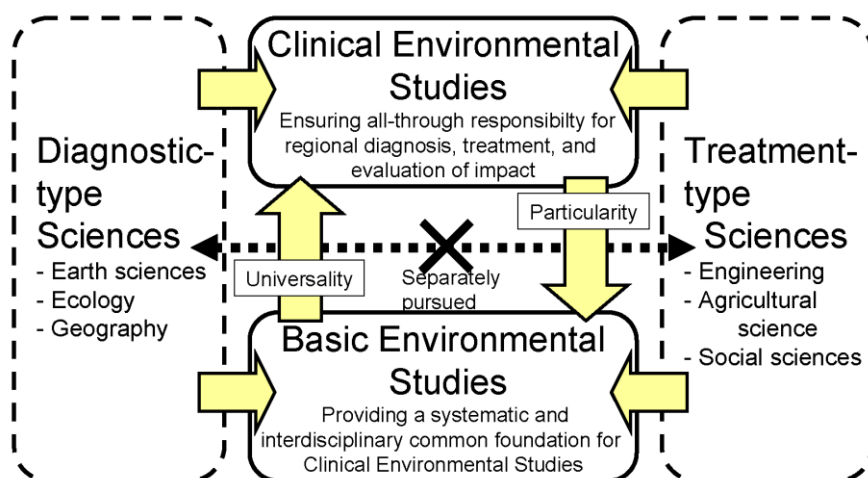
3 Hydrospheric Atmospheric Research Center

4 Solar-Terrestrial Environment Laboratory

5 Graduate School of Engineering

## Outline

【Rationale for establishing COE】



### **Current Status of Environmental Science**

Global environmental problems are caused by changes in the way human activity interacts with nature. Tackling these complex multifaceted interactions presents new challenges to conventional research requiring coordination of different knowledge-bases and approaches. The changes in the Earth-Life interactive system brought about by human activity can be compared to pathological changes in the human body. In the same way, one of the **essential roles of environmental studies can be compared to the role of medical science in confronting disease**. However, environmental studies have conventionally been conducted with fields such as earth sciences, ecology and geography concerned with understanding how the Earth-Life system interacts with human society—the **diagnostic-aspect**—and fields such as engineering, agricultural science and the social sciences concerned with technological or regulatory solutions for environmental problems—the **treatment-aspect**—in nearly complete isolation from each other. As a result, there has been a lack of systematic progress towards an environmental analogue to clinical medicine, in which there is synthesis of the two branches of diagnosis and treatment to provide care at the point where the problem occurs.

### **The Proposed Program**

This COE program aims to develop new practical approaches that incorporate both diagnosis of “sicknesses” that threaten the sustainability of human relations with nature and appropriate treatments including anticipation and avoidance of harmful side effects. To achieve this goal requires a new look at conventional approaches to environmental studies. We propose to develop a field of “Clinical Environmental Studies” to provide diagnosis and treatment of problems as and where they occur. At the same time, we will remold existing programs in Basic Environmental Studies to complement our proposed Clinical Studies and foster understanding of global-scale universal issues. This is essential for the future development of the new Clinical Studies. Our Basic Studies will focus on two broad themes: a general assessment of first-order environmental problems that undermine the sustainability of

human society and identifying and evaluating strengths and weaknesses of technological and regulatory approaches to their remedy. Clinical and Basic Environmental Studies thus represent the two “driving wheels” for our new proposed vehicle to tackle a wide range of fundamental environment issues; this vehicle will provide the framework for a synthesis of previously independent areas of environmental studies.

### **Relationship with our Past Achievements**

The Graduate School of Environmental Studies has a proven track record of successfully setting up and managing multidisciplinary programs. The proposed new program in **Clinical Environmental Studies** will be closely linked to the established self-funded **Sustainability Project**, the **Nagoya University Global Environmental Leaders Program**, and its **Initiative for Attractive Education in Graduate Schools**—both funded by competitive grants from the central government. The success of these existing programs has shown the importance of using **On-site Research Training (ORT)** to develop effective ways of collaborating with local populations, government administrations and NPOs. This experience and understanding of how to interleave education, research and collaboration to identify local problems, frame their solutions, and predict the solution impacts will be invaluable to the success of our new more ambitious Clinical Environmental Studies program. The aim will be to train personnel able to assume responsibilities not only in academia but also in local administration, international organizations and regional businesses.

The goal of the **Basic Environmental Studies** program will be to nurture a broad understanding of the Earth-Life system. This will expand on the highly successful **21<sup>st</sup> Century COE program “Dynamics of the Sun-Earth-Life Interactive System” (SELIS COE)** hosted by earth scientists of the Graduate School of Environmental Studies (FY2003-2007) and which earned a ‘superlative’ end-of-project evaluation. In addition to earth sciences, the program in **Basic Environmental Studies** will incorporate knowledge from the fields of engineering, agriculture and the social sciences with the aim of promoting a systematic understanding of interrelations between human activity and the natural world. Graduates of this program will be trained as researchers of the future capable of acting as project leaders to tackle environmental problems.

### **【Outline of plan for establishing COE】**

- 1) An ***Integrated Environmental Studies Course*** will be established by the two Graduate Schools of Environmental Studies and Bioagricultural Sciences. This course will consist of a training program in Clinical Environmental Studies as well as classes and research instruction in Basic Environmental Studies; participation in both will be compulsory. The aim is to provide a systematic education that trains students both in practical skills needed to operate in a particular area of environmental studies and the ability to think globally.
- 2) A ***Training Program in Clinical Environment Studies*** will be structured with teams of research students led by faculty members from diverse fields. These teams will conduct **On-site Research Training (ORT)** in various geographical regions to evaluate environmental threats to the sustainability of the local natural and social systems. To seek truly effective measures and assess possible negative impacts of their implementation, we will include collaboration with the local

population and government. Students will be encouraged to select research topics of close personal interest that are also intimately connected with a particular region. Through discussions with team leaders and students from other disciplines, the team members will experience the importance of cross-disciplinary knowledge and gain a wider perspective on the significance of their own individual research.

- 3) ***Classes and Research Instruction in Basic Environmental Studies*** will also be based around teams of students and faculty members from different disciplines. These teams will review and analyze universal topics of global significance (e.g. global warming or water resources). The results of this work will be made public on the COE website in the form of jointly composed and edited reports. These reports will form the basis of a new Japanese-English bilingual textbook.
- 4) ***Interdisciplinary Research*** with potential to expand the base of Basic and Clinical Environmental Studies will be actively promoted through competitively awarded research funds. A large part of these funds will be earmarked for proposals from young researchers including students, postdoctoral researchers, and junior research staff.
- 5) ***Construction and Consolidation of an International Collaboration Platform*** will be a cornerstone of our program. Firstly, we plan to develop the **Nagoya University Center for Global Environmental Leaders**, created in 2008. With this development we aim to consolidate existing networks with universities and research organizations; to promote the international development of ORTs; to bring structure to the present *ad hoc* region-based approaches to issues such as climate change or urban planning and global warming; and to assist in international dissemination of research results. Secondly, the **Study Consortium for Earth-Life Interactive System (SELIS)**—established in 2008 as an outcome of the SELIS COE program—will become the centre for coordinating the new COE research activities including collaboration with other international research programs and the invitation of leading overseas academics.
- 6) ***Career Path Support*** is an important part of our vision for the COE. We will promote a wide range of career paths leading not only to jobs in academia but also in NPO's, local government etc. The opportunities for networking presented by the ORT program will be the key in this endeavor. Support will also be given to graduates who wish to set up independent consulting firms.

### **Objectives, significance and prospective impacts**

Environmental studies can be divided into **diagnostic-type sciences** that study mechanisms of the Earth-Life system and their relations with human society—broadly covered by traditional fields of earth sciences, ecology, and geography, etc. —and **treatment-type sciences** that consider technological or regulatory measures to tackle environment problems—covered by traditional fields of engineering, agricultural science, the social sciences, etc. Until now, there has been little systematic effort to synthesize these two approaches. We intend to meet this need by establishing a field of **Clinical Environmental Studies**. This new field will incorporate the outcome of diagnosis of environmental

problems into the treatments of individual cases. An important aspect of this synthesis will be to ensure that new problems arising from the treatments are reflected back into higher-level diagnosis. To maintain a set of core-competencies to support this new field, there is also need to develop a complementary systematic approach to **Basic Environmental Studies**, which will allow the diagnosis of individual cases to be placed in the context of more global issues and universal concepts.

**Multidisciplinary collaboration and integration** lie at the heart of our proposed COE program. We propose not only a new synthesis but also a restructuring of research and education in subjects that are at present the remit of natural sciences, the humanities, engineering, agriculture, and economics. This program, therefore, meets the three criteria of “interdisciplinary,” “combined fields” and “new disciplines.”

#### **【Concept of how COE program will be formed】**

There can be few who doubt the central importance of environmental issues to the wellbeing and future prosperity of human society. Examples of such problems are global warming, expanding demands for fresh water and problems related to biodiversity, urbanization and population concentration—these are all areas where Nagoya University has already made significant contributions in both education and research. Tackling these problems requires ‘diagnosis’—careful analysis of causes—and ‘treatment’—identification of solutions and action on these solutions. Until now, the effectiveness of scientific responses to environmental problems has been limited by the lack of integration of these **diagnostic** and **treatment** aspects. For example, the Intergovernmental Panel on Climate Change has set up three working groups to study the problem of Global Warming. Important steps have been taken to marshal a global response, but these remain limited due to limited joint action and collaboration between the groups. For most other first-rank environmental problems, progress is even more restricted. We believe our proposed field of **Clinical Environmental Studies** will provide a framework to overcome such limitations. At the same time, we recognize a need to develop a complementary program in **Basic Environmental Studies**. This program should be concerned with universal issues that transcend regional differences. The foundations for this program have already been laid in the **21<sup>st</sup> Century COE ‘SELIS’**.

#### **【COE as an International Hub】**

The COE research activities related to Basic Environmental Studies will be intermeshed with the existing **Study Consortium for Earth-Life Interactive System (SELIS)** organization, which is an active forum for promoting collaboration with international research programs such as ESSP (Earth System Science Partnership) including Asian regional research project “Monsoon Asia Integrated Regional Studies” (MAIRS). Many of the study areas that have been selected for **Clinical Environmental Studies** lie in Asia and basing the COE in Nagoya University will allow us to take full advantage of a range of well-established academic networks to promote the On-site Research Training (ORT). In education, we aim to create a doctoral program that has a clear developmental link with the Master’s course curriculum; the **Global Environmental Leaders Program** of Nagoya University is a successful blueprint for this type of graduate education. After completing the doctoral program, our goal is that all students should have a good understanding of both basic research and practical applications. They

should also have competence not only in basic and clinical approaches but also in diagnosis and treatment. With these tools, graduates of our program should be equipped to assess the stability of human interactions with the Earth-Life system on a wide range of temporal and spatial scales. They should also have the knowledge to respond to and alleviate or solve environmental problems.

It will be important for our COE to attract students from Asian and other nations where a worsening of problems related to the environment is foreseen, and to train them as future leaders responsible for their countries' environmental research and policy making. Nagoya University hosts Academic Consortium 21 (AC21), the only Japanese led international academic consortium, which includes links with research institutes important to this proposal in Laos, Indonesia, Thailand and China. In addition, the international science profile of Nagoya University has been raised recently by the awarding of Nobel Prizes in 2008 to three graduates of our University. This will assist greatly in attracting foreign students of the highest caliber.

#### 【Necessity of establishing the COE program】

Since its establishment in 2001, a central role of the **Graduate School of Environmental Studies** has been to foster interdisciplinary collaboration among its faculty members who are drawn from a wide range of diverse specialties. Our proposed COE takes this collaboration a major step further by including the Biosphere Resources Department of the **Graduate School of Bioagricultural Sciences**. This expansion allows us to benefit from the input of many additional researchers with expertise in the fields of ecology and agriculture. These fields are indispensable for our proposed development of environmental studies, and their inclusion will be key in forming a vibrant and productive hub of education and research. Throughout the world there are numerous organizations actively engaged in environmental studies, but **none that incorporates a broad enough range of expertise to conduct education in both diagnosis and treatment and nowhere that offers integration of Basic and Clinical Environmental Studies**. There is a clear but as yet unfulfilled need for this integrated approach. We believe, therefore, that our proposed COE is of the highest global significance. Hosting this COE at the **Graduate School of Environmental Studies** of Nagoya University is key to its success, because we can take full advantage of an already existent environmental studies research network, which is Asia-centered but global in scope.

#### 【Importance and development potential of COE】

One of the most compelling reasons for establishing this COE at Nagoya University is that the researchers with the skills needed to make this proposal a success are already at hand and, despite their diverse backgrounds in science, engineering and humanities, nearly all are already engaged in interdisciplinary work under the umbrella of a single faculty, that is, Nagoya University Graduate School of Environmental Studies (NUGSES). Two concrete examples of interdisciplinary projects hosted by NUGSES are “Sustainability”, and “Safety and Security”. The broad-based interdisciplinary nature of NUGSES and its established programs are, we believe, unique in the world and make NUGSES ideally suited to hosting the proposed COE. NUGSES already provides an outstanding platform for cooperation between science-based **Earth and Environmental Studies**, engineering-based **Environmental Engineering and Architecture**, and humanities-based **Social and**

**Human Environment.** In this COE we propose to expand this range of fields to encompass the agriculture-based **Biosphere Resources Department of the Graduate School of Bioagricultural Sciences**. This expansion is vital to achieve our goal of forging a new path for education and research leading to a new combined field of Basic and Clinical Environmental Studies. A vital role of our COE is to act as a counterbalance to the tendency in existing environmental studies programs, throughout the world, to emphasize either the diagnostic or the treatment approach but not their interactions. The foundations for success in our endeavor have already been laid by the achievements of the 21<sup>st</sup> Century COE program “**Dynamics of the Sun-Earth-Life Interactive System**” (SELIS COE) and the **Initiative for Low Carbon Cities**, both based at NUGSES.

### **Research activities**

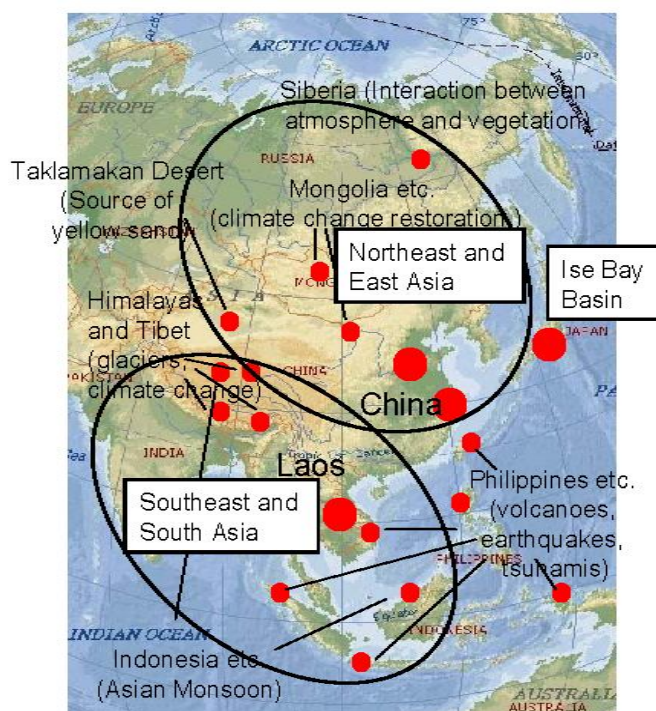
The process of tackling environmental problems has strong analogies with the ways in which medical science tackles disease. However, development of environmental studies lags behind the field of medicine. In this COE program we aim to develop a new field of **Clinical Environmental Studies**; this is needed to integrate the traditionally separate diagnostic and treatment aspects of environmental studies. The second related objective is to recast the field of **Basic Environmental Studies** as a complementary partner to the Clinical Studies. This is needed to ensure members have a good understanding of a common set of universal scientific and environmental concepts not limited to a particular geographic region.

We believe that appropriate diagnosis and treatment of environmental problems is most effectively achieved through area-specific **On-site Research Training (ORT)**. We have selected three key regions for detailed study. These regions are in different stages of economic and social development and each faces its own set of linked environmental problems. The originality of this program is not only in the research themes, but also in the approach that we take to tackle them. Below, examples are given of research plans that are suitable for carrying out in these regions.

- 1) **Ise Bay Basin Zone:** The declining ability of the rapidly aging society in rural parts of this region to manage the surrounding environment has resulted in the demise of farming villages and deterioration of biodiversity in forested mountainous areas. These changes strongly influence the living environment in the lower-lying cities and natural conditions of the Ise Bay area. To understand how these problems can be alleviated, students and researchers will collaborate with local administrators and NPOs to study how to forge new relations between cities and villages, the creation of a theory to coordinate design of manmade structures with the burden of environmental maintenance and policy measures, and measures to minimize waste of natural energy sources including woody biomass.



2) **Northeast and East Asia:** Extremely rapid urbanization in China has led to a severe shortage of water resources and an increase in air and water pollution. As a result, China has initiated the North-South Water Transfer Project. To understand the full environmental implications of this gargantuan construction project requires interweaving the diagnosis and treatment aspects. As a first step, we have established annual research forums with Shanghai Jiao Tong University. Another aspect of the urbanization is rapidly increasing energy use. The resulting problems are being researched in collaboration with Tsinghua and Tongji Universities.



3) **Southeast and South Asia:** Recent development in Laos has led to a situation in which a market economy coexists with a self-sufficient subsistence one. The implications of these recent changes are as yet unclear. The focus of research in this region will be farming villages on the periphery of the capital Vientiane with the objective of investigating the effects of the ongoing clearance of forests and introduction of modern agriculture on the social system in the region. Topics for study are loss of traditional ways of life and changes in forest biodiversity, water and particulate matter cycles. Collaborative research has already been initiated with the National University of Laos and the National Research Institute for Agriculture and Forestry. An important and related research theme is regional climate change associated with collapse of glacier lakes in the Himalayan region.

**【Method of realizing the international COE program】**

**On-site Research Training (ORT)** lies at the core of our plans for developing **Clinical Environmental Studies**. Three study regions have been selected with significant environmental problems that match the goals of our COE and the expertise of our research teams: the Ise Bay Basin Zone, Northeast and East Asia, and Southeast and South Asia. Details of research plans for each region will be decided by competitive selection of proposals. Our extensive use of **ORT** will include numerous opportunities for international travel. And collaboration with foreign counterparts including academic institutions, local government and NPOs will provide ample opportunities for networking and gaining understanding of local experiences.

The ORT programs will also enrich **Basic Environmental Studies**, where importance will be placed not only on knowledge of conventional disciplines, but also on innovative field-developing research concerned with the systems of mutual interaction between human beings and nature and their sustainability. To clarify the key processes and phenomena with potential to shed new light on unresolved environmental problems, we also plan research that includes broader cross-disciplinary research. Examples of the research include the impact of change in aerosols on change in Asian monsoon climate through the

interaction between the atmosphere and land use. In addition, SELIS will act as an intermediary to promote international collaboration with international environmental research programs or with institutions with which Nagoya University already has academic agreements.

To tackle global environmental problems requires a global perspective. Internationalization is key. We use this expression to signify having an international aspect to all our activities. We have begun the process through use of the NUGSES guest professor scheme to invite eminent researchers in environmental studies from around the world. We also consider it important to attract talented young researchers. Nagoya University is very well provided with a wide range of different types of accommodation for foreign guests. We also plan to take full advantage of existing multilateral and bilateral exchange agreements with other academic institutions. One example is AC21 whose members include many institutions in the regions selected for ORT. Shanghai Jiao Tong University will be an important partner in our COE both for the high level of related research and its location. NUGSES has strong bilateral links with this institution including an annual joint research forum.

#### 【Participation system for researchers】

Through our proposed ORT program, members will have more opportunity for free and full cooperation than in conventional joint education programs and these will have a central role to play in ensuring effective collaboration. In the three field regions listed above, the following faculty members already have numerous research achievements: Region 1) M. Takano, K. Fukushima; Region 2) H. Imura, Y. Hayashi; Region 3) C. Takenaka, K. Okamoto, K. Fujita. These researchers will take responsibility to ensure integration of other staff responsible for promoting the program, while at the same time participating as specialists in the work of the various research teams and assisting with the work of setting up new fields. To provide coordination for the education and research in the regions for Clinical Environmental Studies and to ensure their smooth running, special teaching staff will be employed from the research or administrative institution, NPO, or other local bodies partnering the program.

For training in **Basic Environmental Studies**, the central roles will be played by S. Watanabe and Y. Yamaguchi. These workers will have the task of overseeing the interdisciplinary research centered on the Basic Environmental Studies classes and research instruction. They will work in cooperation with the staff responsible for leading the program activities in the various specialty areas.

The top page of this document shows how the COE team will be divided into the four divisions: 1) Diagnosis of Earth-Life Interactive System —ELIS, 2) Diagnosis of ELIS and Human Society, 3) Treatment of ELIS and Human Society, 4) Treatment of Human Society. As is clear from their titles, divisions 2 and 3 have a central role to play in helping to mesh the two aspects of diagnosis and treatment linking ELIS with Human Society.