SCIENTIFIC AGENDA FOR THE INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH-IAI FOCUS ON TROPICAL ECOSYSTEMS AND BIOGEOCHEMICAL CYCLES

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Following the series of thematic IAI workshops, the IAI Workshop on Tropical Ecosystems and Biogeochemical Cycles convened by IAI and the Ministry of Science and Technology of Brazil through the Brazilian National Institute for Space Research (INPE) was held in São José dos Campos, São Paulo, Brazil, on April 4-7, 1994.

The workshop was developed to promote an interdisciplinary approach for establishing general guidelines and recommendations for the scientific agenda of the priority theme Tropical Ecosystems and Biogeochemical Cycles of IAI. The agenda was organized to benefit from a broad representation of the scientific expertise and of the regional interest related to this topic. The Workshop was attended by more than 70 scientists from nine countries of the region. The first day and a half consisted of plenary sessions to review the state of the scientific knowledge on key issues related to the topic and also to guide the working groups discussions that followed on the next two days of the workshop.

After an overview of the IAI approach to global change research, the objectives of the workshop were discussed and the plenaries covered aspects of the functions of the tropical ecosystems and biogeochemistry of wetlands terrestrial, and aquatic ecosystems. The presentations also included land use
change and its interactions with the carbon-water-energy cycles, exchange of trace gases between ecosystems and the atmosphere, greenhouse gases emissions, global change implications of land use and atmospheric chemistry, ocean-atmosphere-land interactions, paleo-climates of the tropics and the human dimensions implications of changes. Social-economics aspects and the role of field research and community involvement in global change research relevant to the Americas were also covered. After reviewing the major scientific questions the international related projects were presented. Following the plenaries the participants were divided into three active working groups: (1) Land Use Change, (2) Ecosystems Processes and (3) Biogeochemistry, and Water and Energy Cycles. The working groups acted independently with summaries and conclusions presented and discussed in plenary sessions.

Major findings from the working groups:

(1) Land Use Change

The over-arching/organizing theme: What are the effects of land use and cover change (LUCC) on biogeochemistry (BGC), water and energy cycles, and in turn their effect on LUCC?

Special research efforts should be placed to define the driving forces, the models and the scales of this theme. To develop this, the following scientific/action issues are needed: (a) current land use change distribution of the tropical region; (b) rate and pattern distribution of land cover conversion; (c) knowledge on the effects of LUCC on sustainable development; (d) criteria for measurement of sustainability; (e) models for LUCC processes, and (f) dissemination of information to decision makers. This working group discussed appropriate scales in spatial and temporal domains, the linkage of IAI action with on-going international programs by examining the data provision efforts, analysis modeling efforts. The UNEP GRID node in South America was identified as one possible outreach.
The group also outlined a framework designed to integrate regional scale analysis with local case studies through modeling, comparative synthesis and links with BGC, water and energy cycles, based on input data from remote sensing, physical/natural resource surveys, census statistics and field work/surveys.

Important issues such as the need to separate the concept of land cover from land use change were also identified by this working group. Land cover change is a function of land use change which in turn is a function of land cover characteristics, incorporating all the human dimensions aspects; therefore, LUCC is global change and even though it is a major cross cutting theme for BGC, water and energy cycles studies, it was concluded that it has its own right in the IAI agenda.

(2) Ecosystems Processes and Biogeochemistry

This group discussed a broad range of issues including: (a) land-atmosphere interactions (C and nutrient cycles); (b) land-water interactions (rivers and lakes, wetland processes, coastal and estuarine processes, and ground water); (c) water-atmosphere interactions (coastal, estuarine, and oceans); (d) agricultural landscapes (biogeochemical successes, consequences of intensification); (e) functional significance of biodiversity (conservation of function, functions of species); (f) biogeochemistry of restoration (methodology, evaluation, and consequences); and (g) pollution and contamination.

Three sets of priorities were identified:

1. Baseline Studies - Consequences of Land Use Change. Important issues are: (a) links of C and H2O; (b) links of N, P, S (bio-elements); (c) physiologically mediated processes (fast processes); (d) decomposition, soil, and ground water (slow processes); (e) trace gas release (CH4, N2O, reactive gases); (f) links to atmospheric properties (e.g. radiative balance); and (g)
sensitivities to climate (baseline models and experiments). For these studies, systematic data sets are needed and IAI should make inventory of existing data, facilitate access, and identify further needs of data gathering.

II. Biogeochemical Aspects of Restoration. This should include: methodology development, regional applicability, monitoring of consequences, and evaluation of outcomes. As a new scientific area for the tropical ecosystems, there is a need for an additional workshop to further evaluate this priority item. Another priority is the Biogeochemical Aspects of Urbanization which should include: economic and social aspects, impacts on systems, and needs for resources. Again, there is a need for another workshop to develop this item further.

III. Future Issues. As IAI is developing the initial priorities on BGC of the tropics, the following issues should be considered: industrialization, history of land use, biodiversity, human health impacts, water rights and management (quantity and quality), and biotechnology.

This group proposed a strategy to cover the above priorities: transect-based studies across spectrum of land use types, including comparisons of "pristine" and transformed ecosystems in terms of functioning through: (1) long-term research studies in selected sites with intensive process studies in small network and extensive studies in larger network; (2) process model development; and (3) case studies, securing regional applicability.

(3) Water and Energy Cycles

This working group identified the following scientific-relevant questions: (1) What are the relative roles of regional evapotranspiration and horizontal transport of water vapor in determining precipitation over Amazonia? How are the energy and water balances affected by changes in the vegetation cover of the basin? (2) What is the impact of biomass burning on: (a) the
redistribution of nutrients; (b) modification of regional and global surface temperatures; and (c) regional and global geochemical changes. (3) How do the distributions of soil moisture, climate variability, and other climatic factors control the distribution of biomes in the tropical Americas? (4) What micrometeorological measurements/processes must be made (understood) to adequately specify the soil-vegetation/atmosphere exchange processes? (5) What is required to predict the surface and subsurface hydrologic flows of the Amazon basin?

The group also identified the following policy-relevant questions: (1) Variations in the moisture transport out of the Amazon basin can have major impacts on hydro-electric power generation outside of the basin (e.g. Itaipu) and present energy policy does not take into account changes in the hydrologic cycle; (2) Quantification of the water and energy cycles in the basin may eventually help to develop sustainable agriculture in the humid tropics; (3) Variations in moisture transport out of the Amazon basin, will have major impacts on agricultural practices in the extra tropics (e.g. "cerrado"); (4) Biomass burning in Amazonia has both regional and global policy implications (e.g., human health, agriculture, transportation, global climate) and (5) Transport of industrial contamination (e.g. mining activities) can impact human and agricultural development.

Overall conclusions

In terms of data collection and management needs, IAI should develop regional and disciplinary data bases using a centralized management for archival, continuity, integration, and quality control. Priority should be given to initiate a compilation of information on national and regional activities, with standardization of information across countries and followed by accessibility to data sets through installation of appropriate hardware and software, a major lacuna in the tropical region as a whole.
The assessment of the community readiness indicated that there is a basic personnel infrastructure that could be employed to address several issues; however, great regional discrepancies were identified. There is a need for IAI to convene a series of specific workshops (e.g. biomass measurements, biogeochemical aspects of ecosystem restoration or of urbanization) to better address the community readiness issue. Training and education for researchers, technicians and decision makers were found to be important. Also, there is a need to guarantee access to Internet not only to improve communication but also to serve as an education tool. Short-term fellowships (1-4 months) for training courses (e.g. INPE) and Doctoral/Post-doctoral fellowships (1-4 years) involving multinational, multicultural research within IAI priorities were identified to be important. Outreach for society should include education seminars, elucidative material and training for solutions - link of global change to local change.

Another major finding of this workshop was that IAI should benefit from the already existing specific science planning such as the existing proposal of the Large-Scale Biosphere-Atmosphere Experiment in the Amazon Basin - LBA Experiment, planned for the 1996-1998 time frame. This proposal covers the scientific priorities identified by the three working groups and IAI could complement this experiment not only by coordinating the regional activities but also by stressing the human dimension aspects.