What is iLEAPS?

iLEAPS is the land-atmosphere interface research project of the International Geosphere - Biosphere Programme (IGBP).

The objective is to study how interacting physical, chemical and biological processes transport and transform energy and matter through the land-atmosphere interface.
iLEAPS vision

iLEAPS is a **multidisciplinary** international research program aimed at improved understanding of processes, linkages and **feedbacks** in the **land-atmosphere interface** affecting the Earth System.

iLEAPS facilitates scientific collaboration as well as synthesis and distribution of results to scientific, politic and public audiences.
iLEAPS questions

• How do interacting physical, chemical, and biological processes transport and transform energy, momentum and materials through the land-atmosphere system?

• What are the implications for the dynamics of the Earth System?

• How did the terrestrial-ecosystem/ atmosphere system function under pre-industrial conditions, and how are human activities influencing it?

• To what extent does the terrestrial biosphere determine its physical and chemical environment on various temporal and spatial scales?
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Science Foci

Focus 1  Land-atmosphere exchange of reactive and conservative compounds: Key feedbacks in the Earth System

Focus 2  Interactions and feedbacks between biogenic/anthropogenic aerosol production, cloud processes, climate and the water cycle

Surface-atmosphere exchanges and the self-cleansing mechanism of the atmosphere

Focus 3  Feedbacks and teleconnections in the land surface-vegetation-water-atmosphere system

Focus 4  Transfer of materials and energy in the soil/canopy/boundary-layer system: Measurements and Modelling
THE GREAT TROPICAL REACTOR
as operated by the biosphere

CHEMISTRY

\[ \text{H}_2\text{O} + \text{O}_3 \rightarrow 2\text{OH} + \text{O}_2 \]

\[ \text{O}_3 \text{ Sink at low NO}_x \]

\[ \text{CH}_4 \rightarrow \text{CO} \rightarrow \text{CO}_2 \]

PHYSICS

Lower level release of heat and trace gases

“A warm” cloud rain

AEROSOL CCN

soil

NO

NO\text{X}

VOC

NO\text{X}

CH\text{4}

CO

CO\text{2}

UV

H\text{2}O

H\text{2}O

N\text{O}\text{X}

N\text{O}_2

N\text{O}
iLEAPS research guidelines

• Multiple scalars, interactions and feedbacks
• Process-based understanding
• Broad variety of temporal and spatial scales
• Measurements integrated with modelling
• Regional as well as global scientific consequence
• Across traditional scientific and organizational boundaries
• International, open to participants from all countries and organizations
• Participants selected based on scientific contribution
• Public data access
• Capacity building component
iLEAPS recognized activities

- **Inter-American Network for Atmospheric/Biospheric Studies (IANABIS)**
- **AMMA** - African Monsoon Multidisciplinary Analyses
- **FLARES** - Fire-Land-Atmosphere Regional Ecosystem Studies
- **LEARN** - Land Ecosystem-Atmosphere Reactive Nitrogen
- **VOCBAS** - Volatile Organic Compounds in the Biosphere-Atmosphere System
iLEAPS recognized activities

Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate, Chemistry, Aerosols, and Transport

iLEAPS/GEIA INITIATIVE
vegetation dynamics-BVOC interactions, GDVM

Northern Eurasia Earth Science Partnership Initiative

Isotopes in the Project for Intercomparison of Land-surface Parameterization Schemes
Links and collaboration

IGBP

DIVERSITAS

ESSP

IHDP

iLEAPS

GTOS

PAGES

GLP

GLOBEC

LOICZ

IMBER

SOLAS

IGAC

AIMES

GEIA

GCP

GABLS

CiC

GLASS

ISLSCP

GEWEX

WGCM

WCRP

BACC

CBACC

NECC
iLEAPS ↔ NEESPI

Switch and Choke Elements in Planetary Machinery
iLEAPS ↔ NEESPI

Both projects focus on the interactions between the biogeochemical cycles, water and energy cycle, as well as human influence.

Ecosystem and climate interactions

Carbon (CO$_2$, CH$_4$), water and energy cycles

Aerosols: anthropogenic, biogenic, biomass burning, weathering, desert dust

Mixed aerosols? Radiative forcing?

Dust aerosols and the hydrological cycle?

Land surface dynamics, hydrological processes in land surface models in dry areas?

Study of C cycle in connection with the N cycle?

Chemical environment?
FLUXNET

International Network Measuring Terrestrial Carbon, Water and Energy Fluxes Across Daily to Inter-Annual Time Scales

379 Sites, circa 2006
Land cover change experiment

LUCID – Land-Use and Climate, IDentification of robust impacts

Led by de Noblet, Bonan and Pitman

Scenarios of land-cover change important because humans have profoundly modified the landscape and will continue to do so

• Global, coupled, fixed SSTs, multiple realizations
• Links to AIMES and C4MIP and C20C
• At least four groups: NCAR, IPSL, CSIRO, CNRM
• Use a statistical rigorous experimental design
• How much of the (a) global and (b) regionally observed changes can be robustly explained by land cover?

Global distribution of crops (Ramankutty & Foley 1999) at resolution of 1° x 1°
Aerosol-cloud-precipitation-climate

Land surface properties and atmospheric aerosol particles $\rightarrow$ precipitation processes $\rightarrow$ thermodynamic and radiative energy budgets of the Earth

SMOCC, Smoke Aerosols, Clouds, Rainfall and Climate: Aerosols from Biomass Burning Perturb Regional and Global Climate

The aerosol-cloud-precipitation-climate issue cuts across many projects $\rightarrow$ a cross-cutting activity for IGBP-WCRP

Initiating group
Danny Rosenfeld, Andi Andreae, Pavel Kabat, Ulrike Lohmann, Christian Jacob, Sandro Fuzzi, Phil Rasch, Roni Avissar, Markku Kulmala, Sarah Doherty, Anni Reissell, Kevin Noone
Aerosol-cloud-precipitation-climate

White papers from communities → science questions for workshop → workshop in 2007 → IGBP-WCRP project

• White papers
  iLEAPS&IGAC (Danny Rosenfeld), GEWEX (Christian Jacob and Ulrike Lohmann)

• Science questions for workshop
  5-7 big questions to use as the focus of the ws

• iLEAPS, IGAC, SOLAS, AIMES from IGBP

• iLEAPS IPO, IGAC IPO and GEWEX IGPO to prepare program for ws
Aerosol-cloud-precipitation-climate (ACPC)

Which datasets are presently available that can be used to corroborate model calculations?

What work needs to be done to make these datasets comparable?

What processes in global models need the most work (e.g., convection schemes, aerosol/cloud interactions, …)?

What additional data must be acquired, and what are the most promising strategies to obtain them?
Aerosol-cloud-precipitation-climate (ACPC)

WORKSHOP AIMS
• Provide new information
• Identify the science questions, tools, gaps
• Get communities together for an overview what is being done
• Get dialogue between modellers and experimentalists
• Plan what to do with the existing datasets
• Design a large long-term IGBP-WCRP project to begin within one year
• Important to get to know each other in order to work together to design a joint project

WORKSHOP OUTCOME
1) Identification of areas of collaborative research for the cross-cutting project
2) Short, medium, long-term work together
3) Agreements, disagreements
4) Document to summarize the results
5) List of testable hypothesis
iLEAPS products

Synthesis papers
✓ Journal special issues
✓ Science Plan
✓ Website
✓ Email bulletin, quarterly
✓ Email alert
✓ Newsletter, biannual
✓ Flyers
✓ Posters
✓ PowerPoint presentations
✓ Press releases
✓ Media interviews
✓ Workshops
✓ Summer school
✓ Science Conference, biennial
✓ People database
✓ Synthesis book

www.atm.helsinki.fi/ileaps
iLEAPS Newsletter Issue 3 (Nov)

NEESPI Introduction

Eurasian Forest Cover and Climate Feedbacks
H.H. Shugart, J.K. Shuman, Yan Xiaodong and Zhang Ningning

SIBERIA-II project
C. Schmullius, R. Gerlach and S. Hese
Thank you!