XII College on Soil Physics – 30th Anniversary (1983-2013)

Directors: D. Gabriels (Belgium), D. Nielsen (USA), I. Pla (Spain), E. Skydmore (USA)
Local organizer: G. Ghirardi

ACHIEVMENTS AND DEVELOPMENTS IN SOIL PHYSICS SINCE 30 YEARS OF ICTP COLLEGES ON SOIL PHYSICS

Ildefonso Pla Sentís
Universitat de Lleida
Lleida (Spain)
ipla@macs.udl.es

COLLEGE ON SOIL PHYSICS (1983-2013) ICTP (Trieste, Italy)

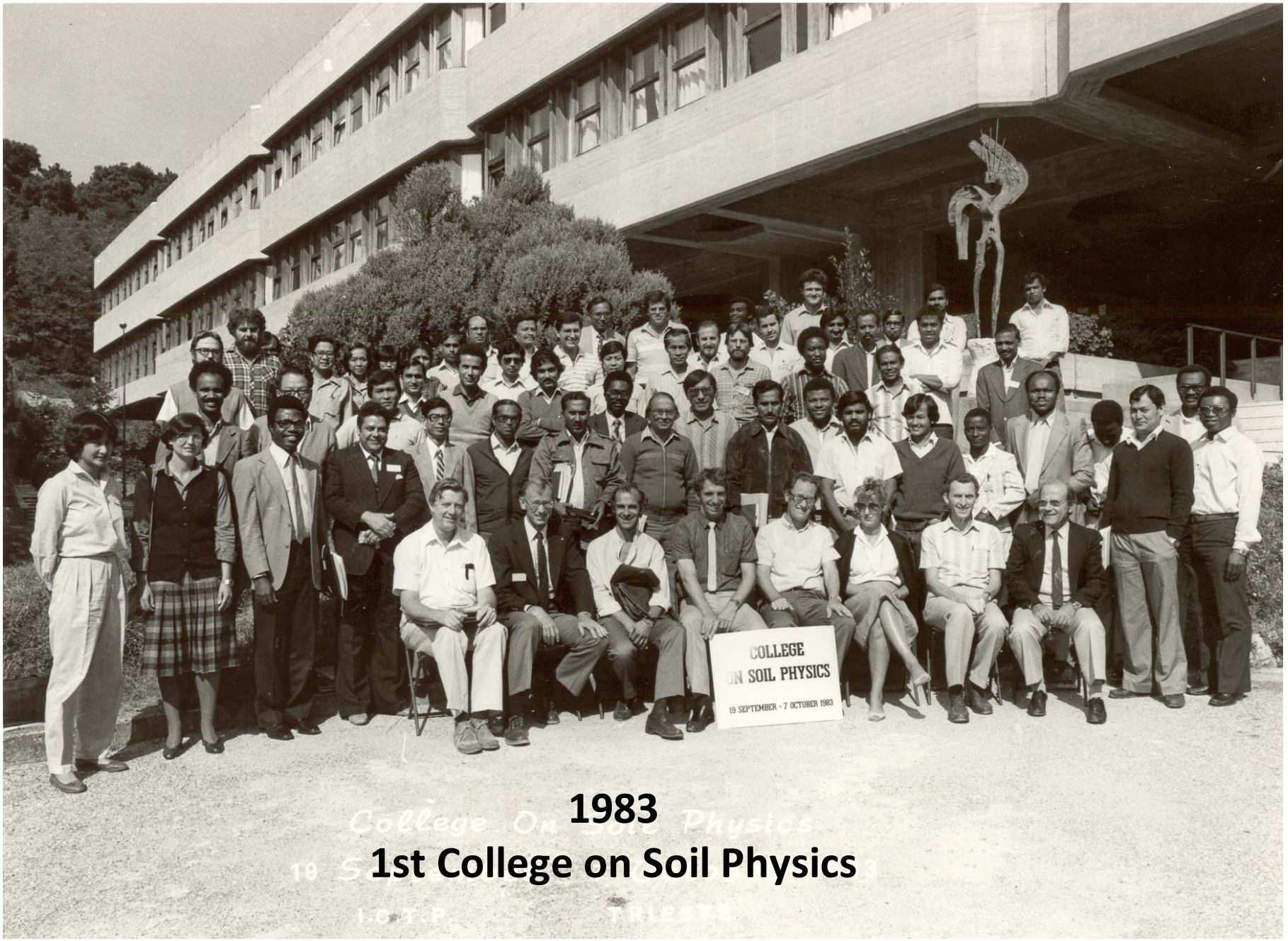
The main objectives of the Colleges on Soil Physics have been:

-**To increase the knowledge of the participants on the soil physical properties and processes, as a basis for better understanding and focusing of agronomic, engineering and environmental problems related with runoff, erosion, drainage, irrigation, and contamination of soils and water.**

-**To contribute to the training of participants to apply gained knowledge and skills to solving world problems as "climate change", "loss of biodiversity", and "land degradation".**

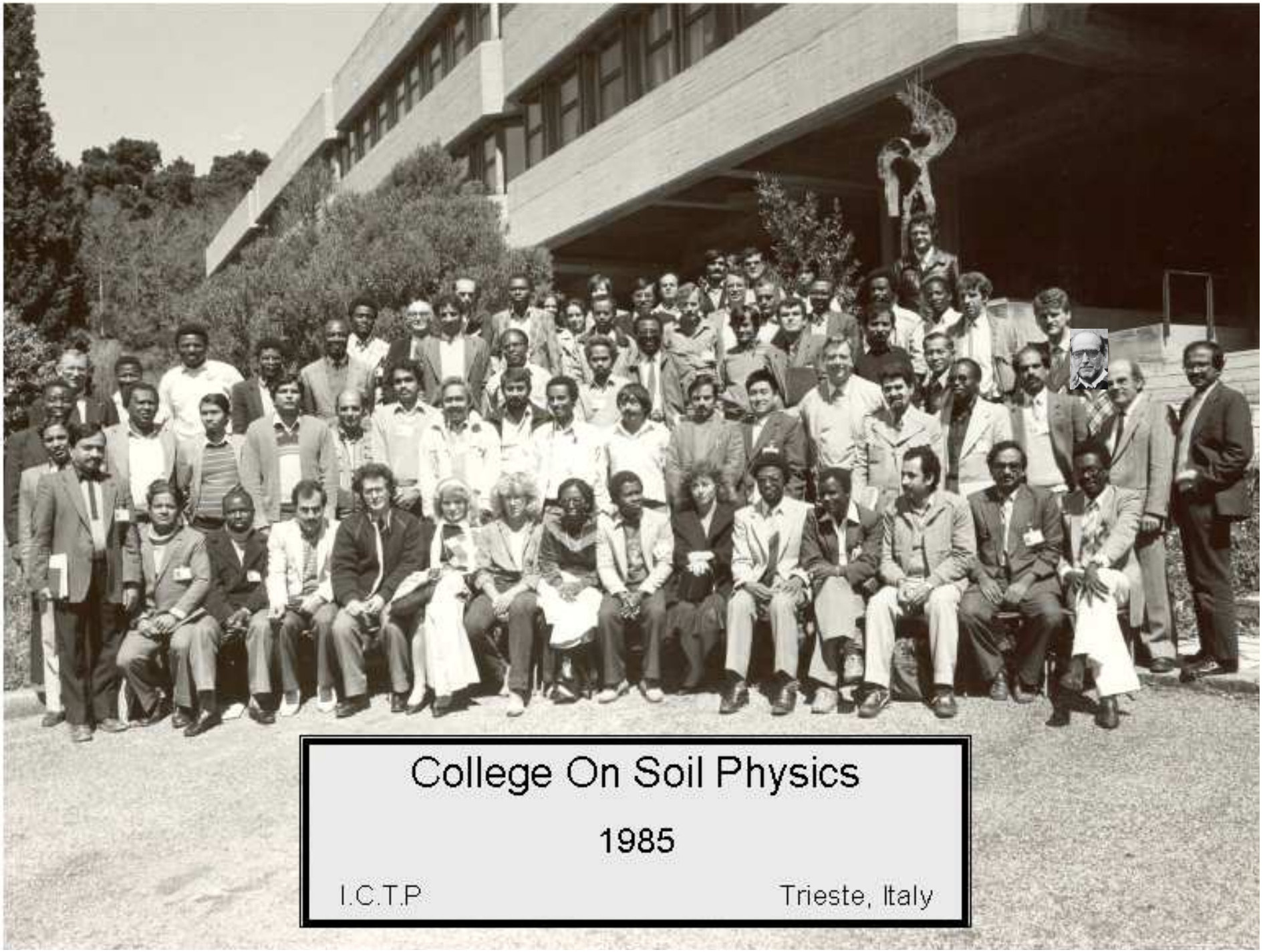
The Colleges have been partially descriptive and theoretical, but they have also covered practical applications, measurement and evaluation techniques, and modeling of the soil physical and hydrological processes, in relation to soil use, management and degradation.

One important objective has been to promote the interaction among participants, through the presentation and critical discussion of their own experiences.



1983

1st College on Soil Physics



College On Soil Physics

1985

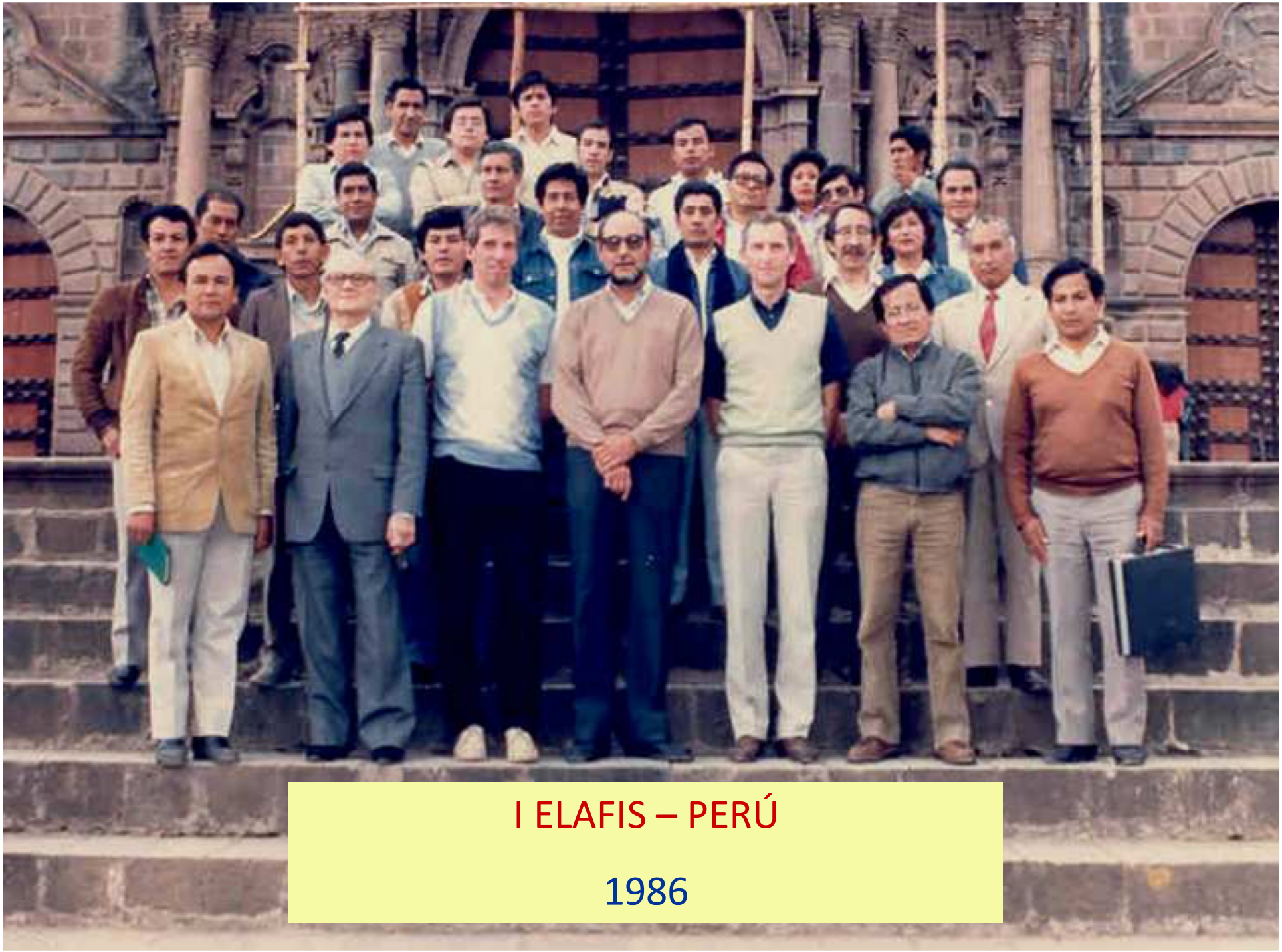
I.C.T.P Trieste, Italy

1985

ESCUELA LATINOAMERICANA DE FÍSICA DE SUELOS (1986-2012)

Parallel to the Colleges on Soil Physics there have been organized "Escuelas Latinoamericanas de Física de Suelos (ELAFIS)", partially sponsored by ICTP, in different Latin-American countries, with the same objectives as the Colleges in Trieste.

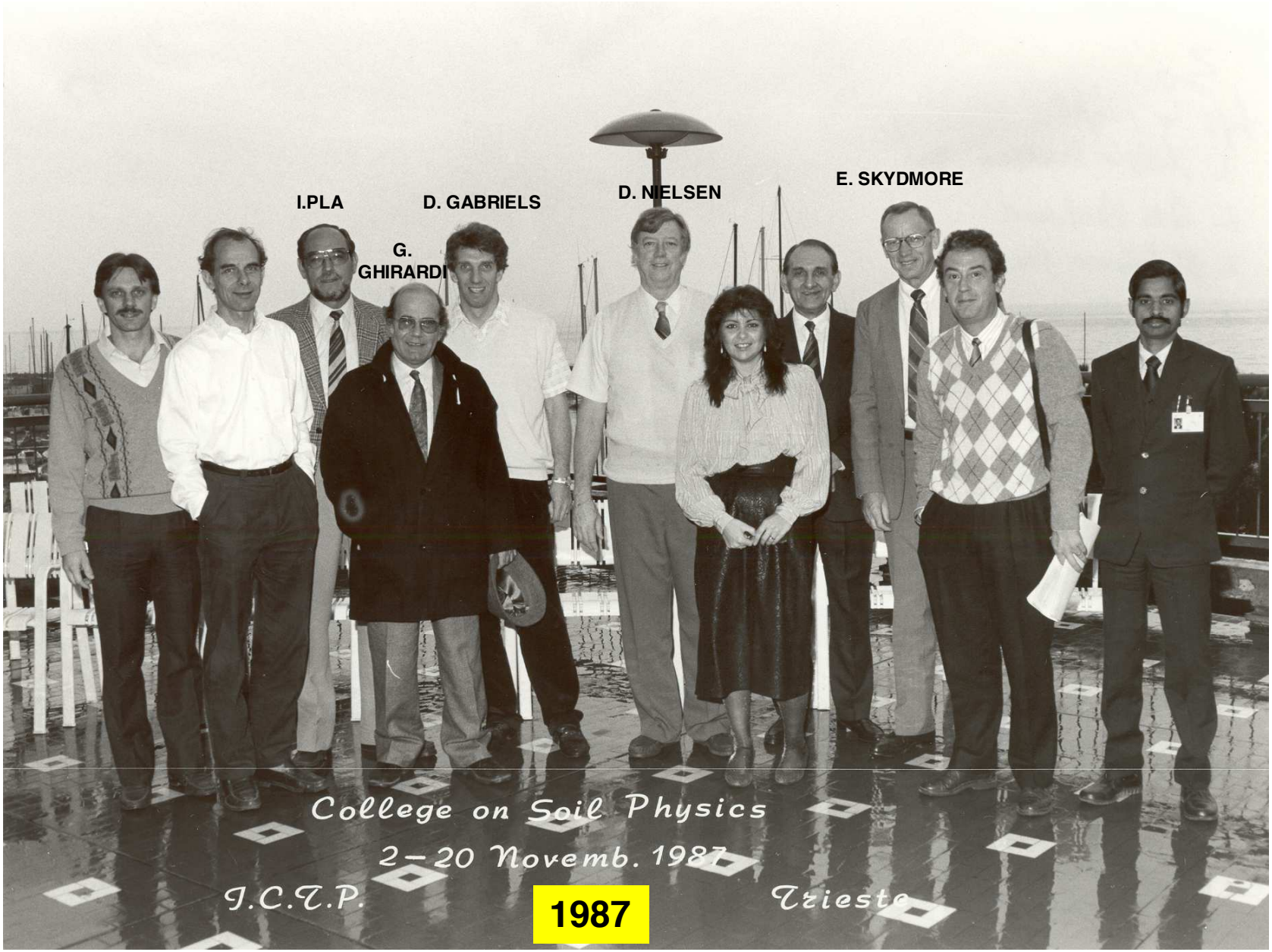
Together with the Colleges on Soil Physics, they have contributed to the formation of most of the people presently doing research on Soil Physics and its applications to agricultural production and environmental protection in the developing countries of the whole World.



I ELAFIS – PERÚ

1986

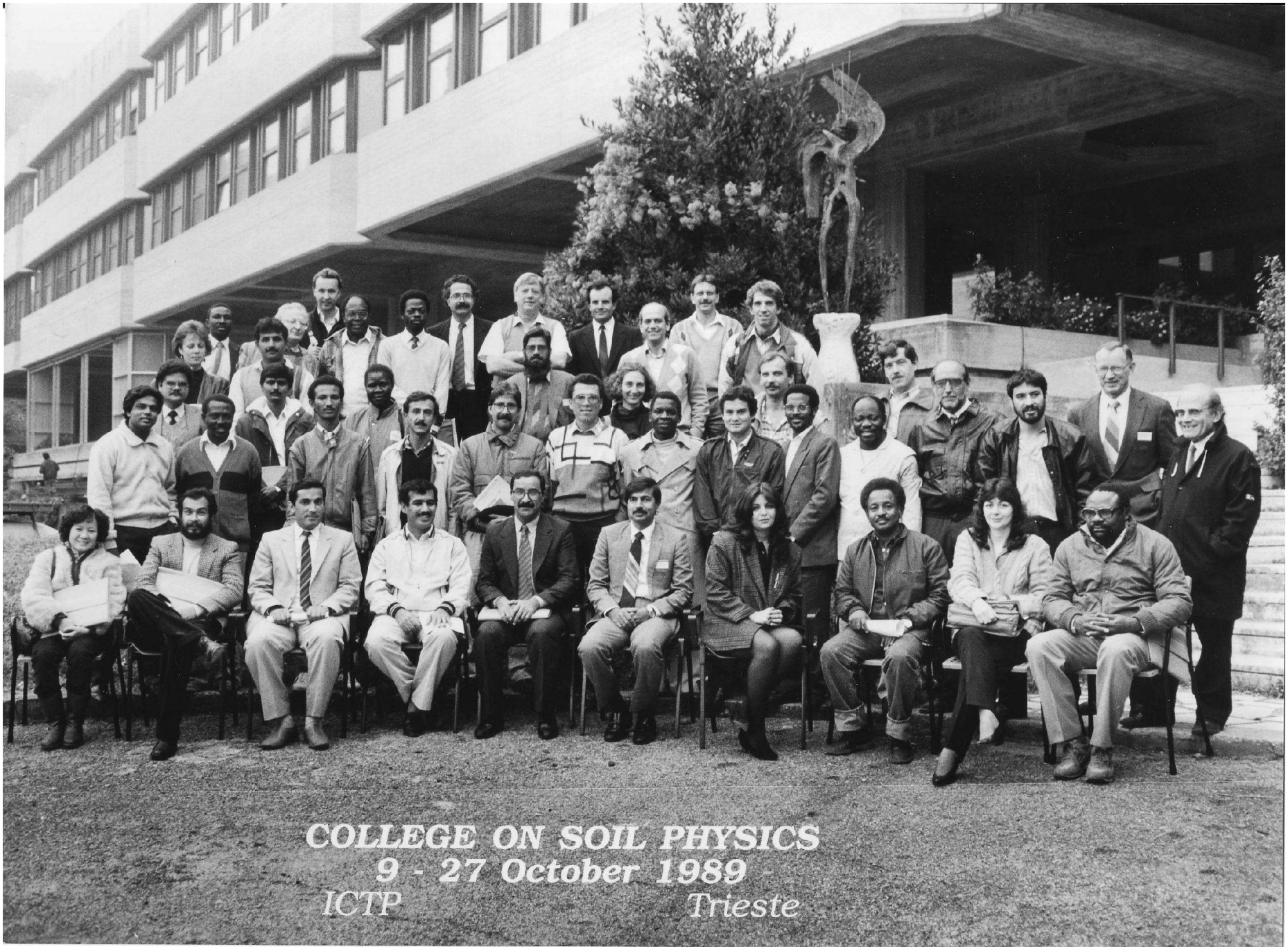

College on Soil Physics
2 – 20 Novemb. 1987
I.C.T.P.
Trieste


I.PLA
G. GHIRARDI
D. GABRIELS
D. NIELSEN
E. SKYDMORE
College on Soil Physics
2-20 Novemb. 1987
I.C.T.P.
Trieste
1987

II ELAFIS – BRASIL

1988


COLLEGE ON SOIL PHYSICS
9 - 27 October 1989
ICTP
Trieste


COLLEGE ON SOIL PHYSICS
9 - 27 October 1989
ICTP
Trieste


1989


College on Soil Physics
6 - 24 September 1993
ICTP, Miramare - Trieste, Italy


I.PLA
G. GHIRARDI
D. GABRIELS
E. SKYDMORE
College on Soil Physics
6 - 24 September 1993
ICTP, Miramare - Trieste, Italy
1993

1995


1995


1998

V ELAFIS – VENEZUELA

2000

V ELAFIS – VENEZUELA

2000

College On Soil Physics

2001

I.C.T.P Trieste, Italy

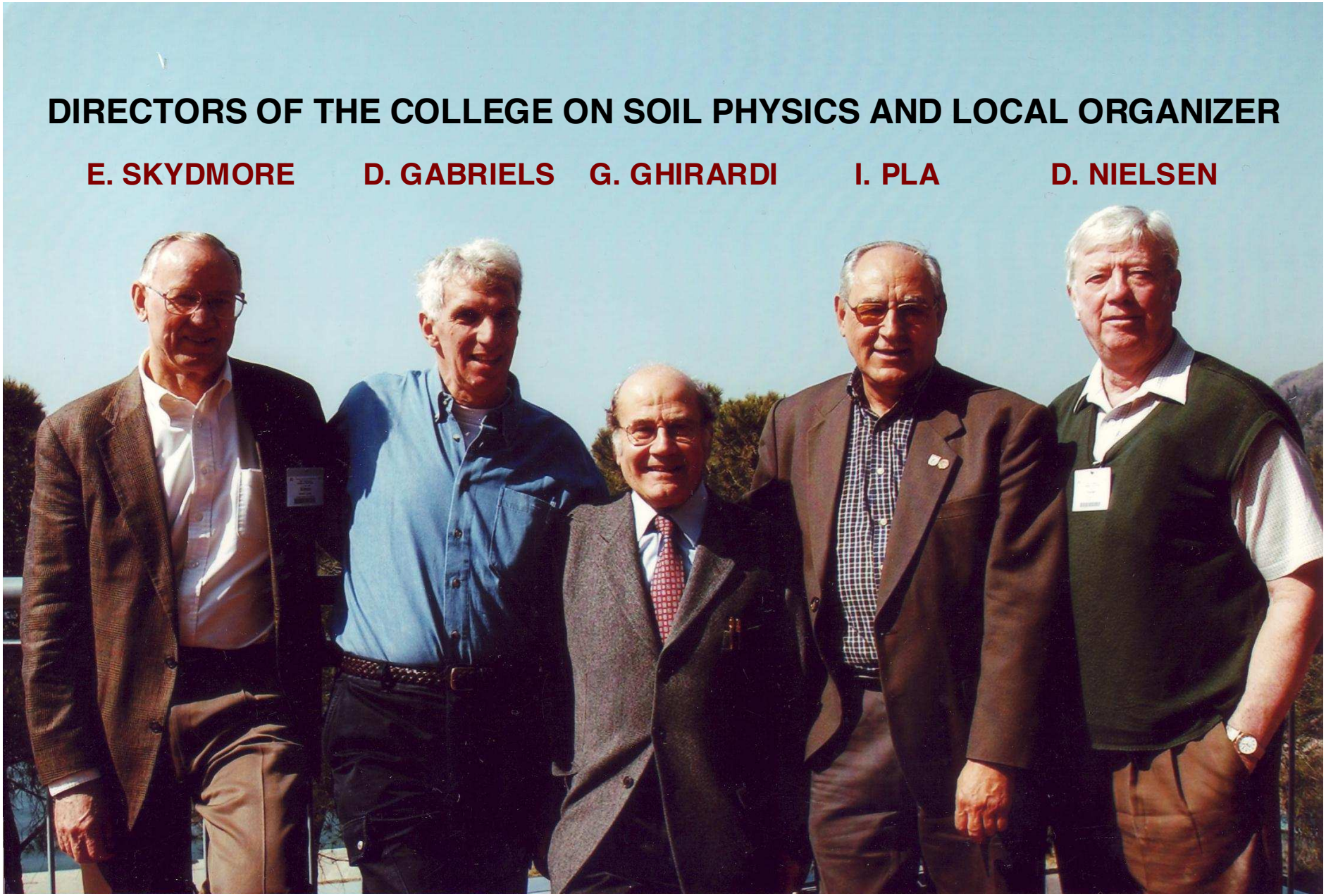
Pictured are: Luis Fernando Chavez, Rehab Eltayb Hassan, Ivan Chirinos, Venelina Koleva, Deyanira Lobo, Domnica Breban, Lourdes Ruiz Guiterrez, Vladia Correchel, Svetla Rousseva, Marcello Pagliai, Kamal Jeet Singh, Elena Bojilova, Jose' Ronaldo de Machedo, Salona Senoussi, Usha Singh, Shayra Shahira, Xiomara Abreu, Hema Achyuthan, Luis Carlos Timm, Ishwar Paul Sharma, Daniel Okae-Anti, Jozsef Urban, Ildefonso Pla Sentis, Flavia Bartoly Rosa, Moacir Souza Dias Junior, Maria Elena Ruiz Peraz, Lalla Laaziza Ichir, Joao Eduardo Pilotto, Donald Gabriels, Maroslav Kutilek, Jorge Diaz, Kouman Koumanov, Mahmut Basi Halitigil, Anisur Rahman Khan, Milena Kercheva, Gariella De Meo, Mariela Rivera, Giancarlo Ghirardi, Muhammad Latif, Donald Nielson, Charles Asadu, Wang Yu, Sanjay Kumar Sharma, Marco Gani, Pragnesh Gajjar, Alberto Jorge Sfeir, Rajesh Shah and Daniel Kwasi Asare.

20th Anniversary College on Soil Physics

ICTP March 2003 Trieste, Italy

DIRECTORS OF THE COLLEGE ON SOIL PHYSICS AND LOCAL ORGANIZER

E. SKYDMORE D. GABRIELS G. GHIRARDI I. PLA D. NIELSEN



2003

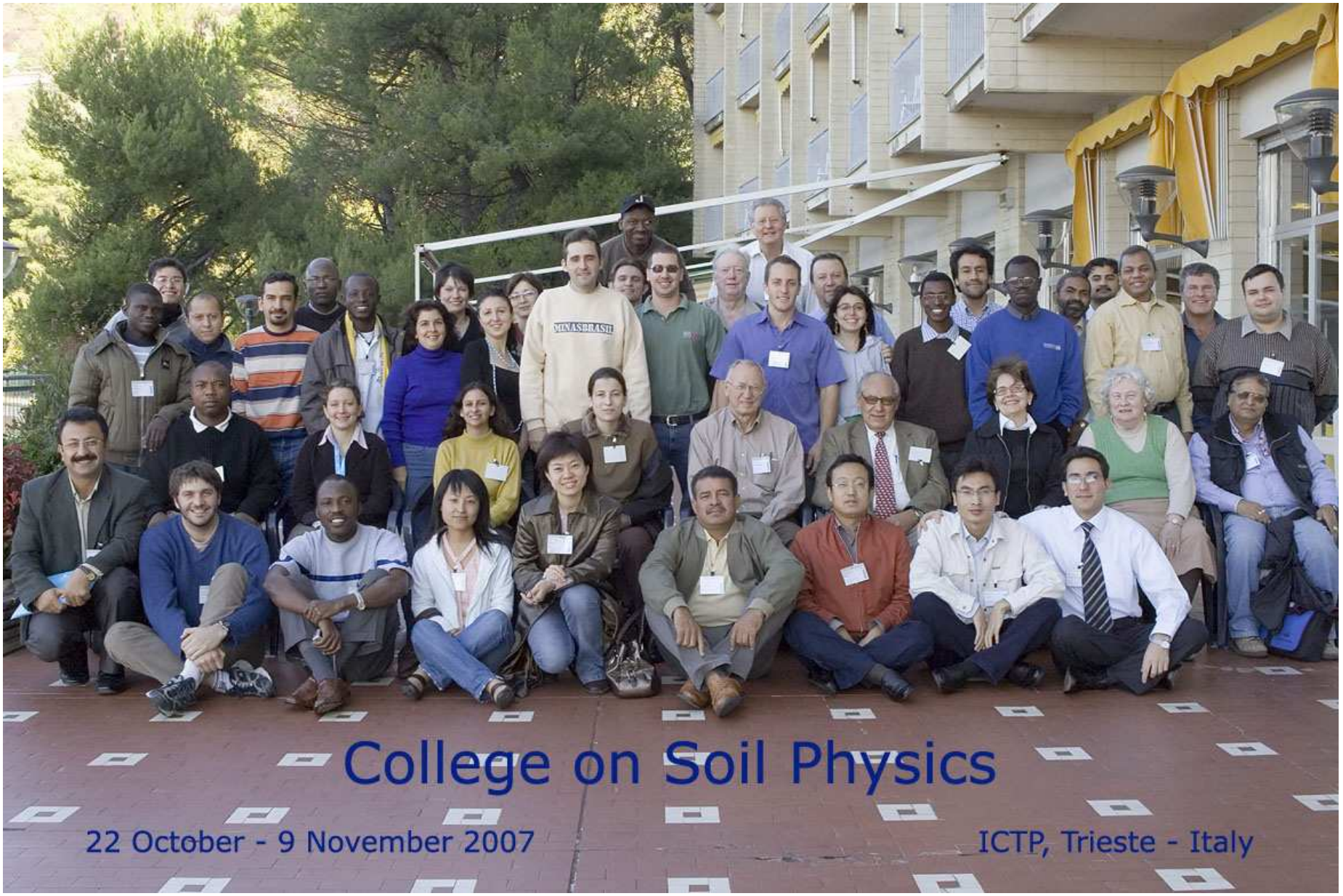

2003

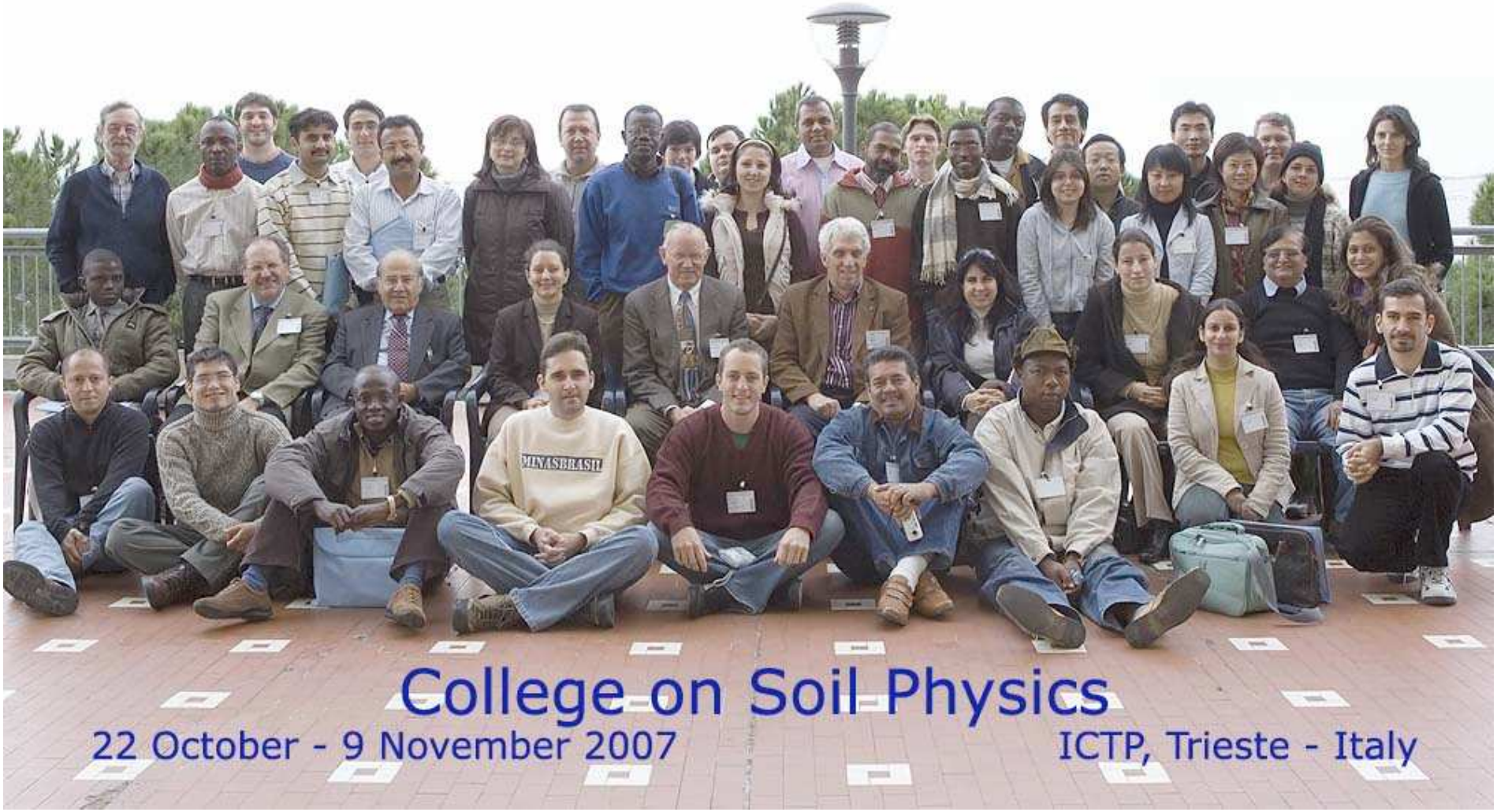
20th Anniversary College on Soil Physics ICTP March 2003 Trieste, Italy

Front row (seated & kneeling) left to right: Joanne Nielsen, (USA), Maria Teresa Alonso (Cuba), Selina Camacaro (Venezuela), Yezena Huaypar Vasquez (Peru), Teresa Lopez Seijas (Cuba), Daniel Okae-Anti (Ghana), Cretu Mirela-Simona (Romania), Maria Elena Ruiz (Cuba), Olteanu Mirela Carmen (Romania), Ildefonso Pla Sentis (Spain), Adriana Lucia da Silva (Brazil), Ligmar Carolina Lopez Plaz (Venezuela).
Standing left to right: Leonardo Lugo Salinas (Venezuela), Durval Dourado Neto (Brazil), Miguel A. Taboada (Argentina), Radka Kodesova (Czech Republic), Huijun Wu (China), Donald Nielsen (USA), Jesus H. Galvis (Columbia), Sampson Agodzo (Ghana), Roger Hartmann (Belgium), Carlos Espinosa Jimenez (Venezuela), Hanoi Medina (Cuba), Bucur Maria Crina (Romania), Giancarlo Ghirardi (Italy), Donald Gabriels (Belgium), Ravindrababu B.T. (India), Mensah Bonsu (Ghana), Luis Guarracino (Argentina), Jose Miguel de Paz (Spain), Luiz Fernando Pires (Brazil), Svetla Rousseva (Bulgaria), Plamen Ivanov (Bulgaria), Martin Nenov (Bulgaria), Mauro Giudici (Italy), Moacir Dias Junior (Brazil).

2003


College On Soil Physics
12 - 30 september 2005
I.C.T.P - Trieste, Italy


College on Soil Physics
22 October - 9 November 2007
ICTP, Trieste - Italy

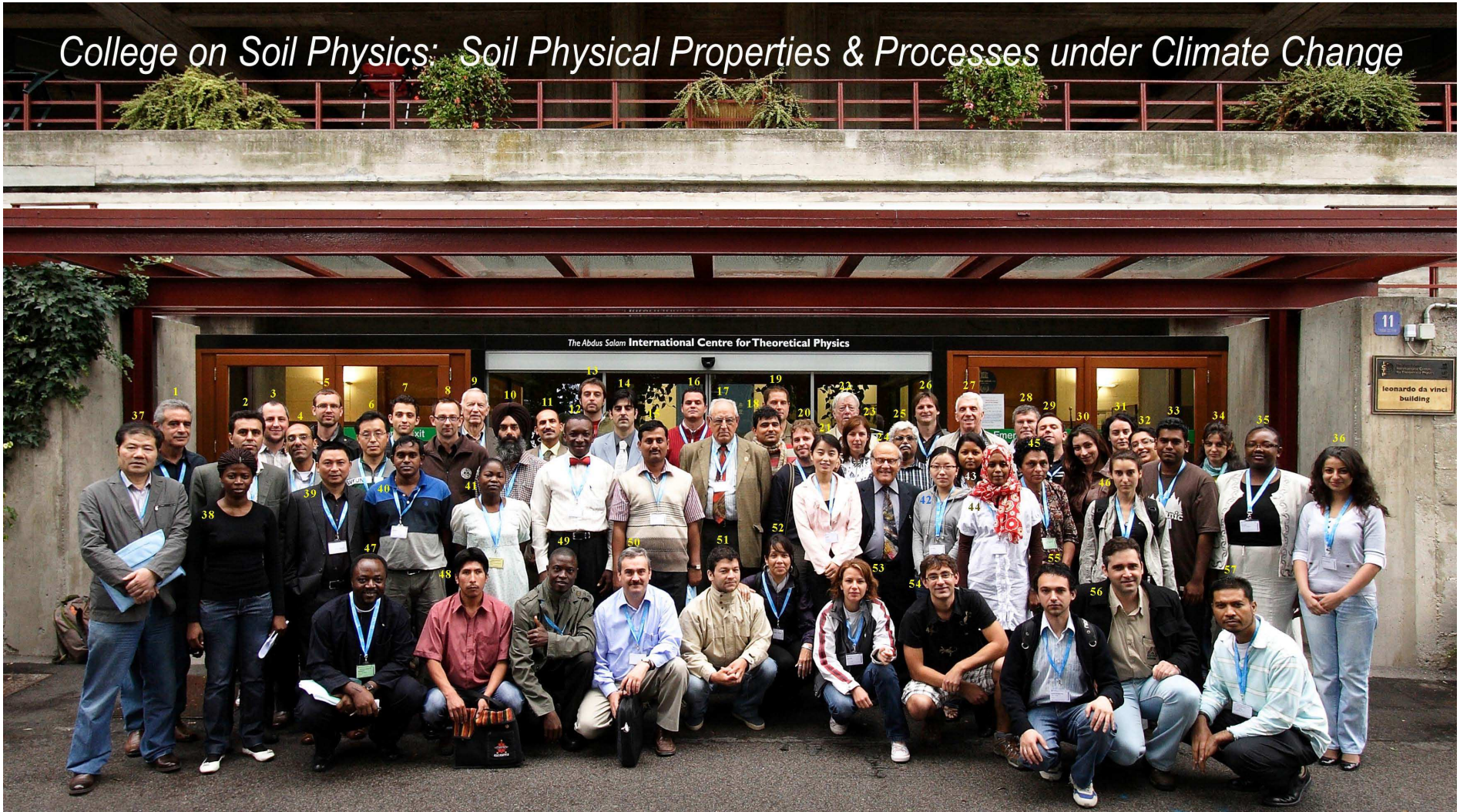

College on Soil Physics
22 October - 9 November 2007
ICTP, Trieste - Italy


2007


2007


MINASBRASIL
2007

College on Soil Physics: Soil Physical Properties & Processes under Climate Change



ICTP, Trieste, Italy

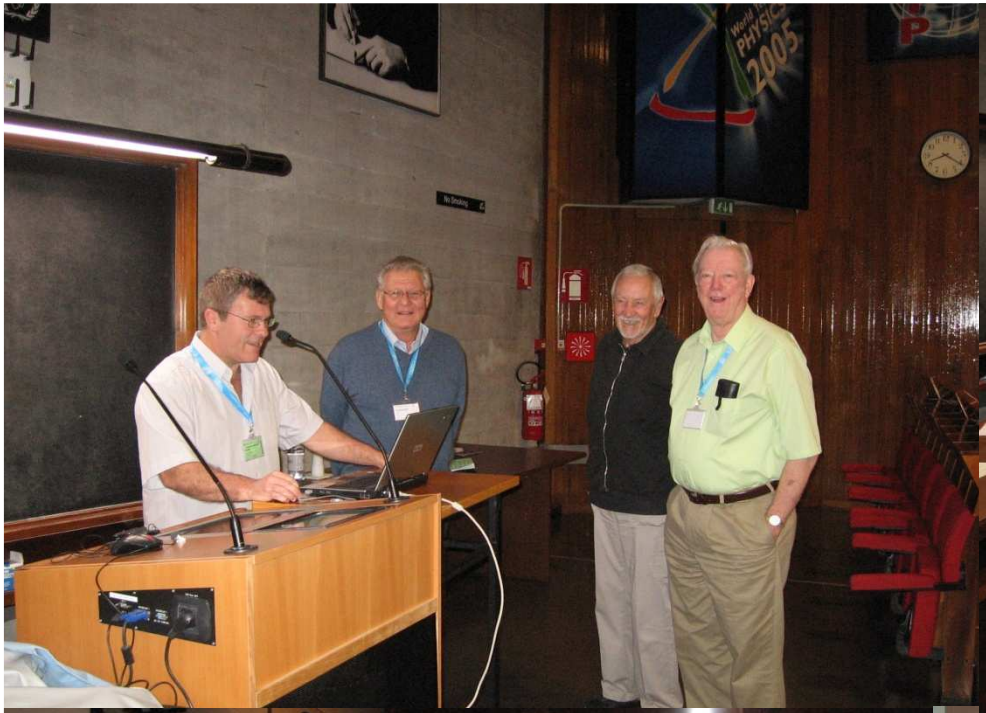
30 August - 10 September 2010

45 - ACHYUTHAN Hema
41 - ADENIYI Mojisola O.
38 - AHIABU Ivy Belinda
16 - ALONSO BRITO Gustavo
29 - AQUINO Leandro Sanzi
56 - ARAUJO JUNIOR Cezar F.
51 - ARISTIZABAL BOTERO Jorge A.
2 - ASADI Hossein
53 - BALOG Irena
43 - BARDHAN Gopali
20 - BODNER Gernot
55 - BORTOLOTTO Rafael Pivotto
13 - BRESSAN Emiliano Miguel
30 - CARUANA Paula
26 - CEDDIA Marcos Bacis
4 - DARWISH MOSTAFA Khaled M.
32 - DEVIREN SAYGIN Selen
1 - DIAS JUNIOR Moacir de Souza
46 - DONEVA Katerina
44 - ELSHEIKH Eman Rahamtalla Ahmed
50 - ERSAHIN Sabit
47 - EZEAKU Peter I.
54 - FER Miroslav
27 - GABRIELS Donald
31 - GALVEZ PEREZ Antonia
36 - GEVORGYAN Lusine
24 - GHIRARDI GianCarlo
25 - HAKEEM Shaik Hiremutt
11 - IBRAIHI Mohammed Ahmed
33 - JEGAJEEVAGAN Kanagaratnam
14 - KHAN Aftab Ahmad
23 - KOGELBAUER Ilse
18 - LOAIZA USUGA Juan Carlos
3 - LOZANO Luis Alberto
34 - MAYMO HERNANDO Ana Cristina
39 - NGUYEN Manh Ha
22 - NIELSEN Donald
12 - OKON Paul Bassey
49 - OLADIPO Isaac Olaposi
35 - OUKO Caroline Achieng
8 - PIEPRZKA Roman
52 - PINEDA SOCORRO Maria Carina
7 - PINTO Victor Meriguetti
17 - PLA SENTIS Ildefonso
48 - QUISPE MAMANI Juan Carlos
15 - SANTRA Priyabrata
19 - SCHOLL Peter
5 - SCHWEN Andreas
10 - SINGH Manmohan Jit
9 - SKIDMORE Edward
28 - TIMM Luis Carlos
40 - UDAYAKUMARA Eramuddeniye P.N.
6 - WANG Li
57 - YAHYA Abd Karim
42 - ZHANG Xiao
37 - ZHAO Jun
21 - ZHOU Peipei


E. SKYDMORE
I. PLA
D. GABRIELS
D. NIELSEN
The Abdus Salam
International Centre
for Theoretical Physics
2010


The Abdus Salam International Centre for Theoretical Physics

2010


PHYSICS
2005


PHYSICS
2005

2010


PHYSICS
2005
ICTP


PHYSICS
2005
ICTP


College on Soil Physics
30th Anniversary
(1983-2013)
25 February - 1 March 2013
Energy and mass balances at the
Land-Water-Atmosphere continuum
ICTP
2013


D. GABRIELS G. GHIRARDI I. PLA
2013


2013

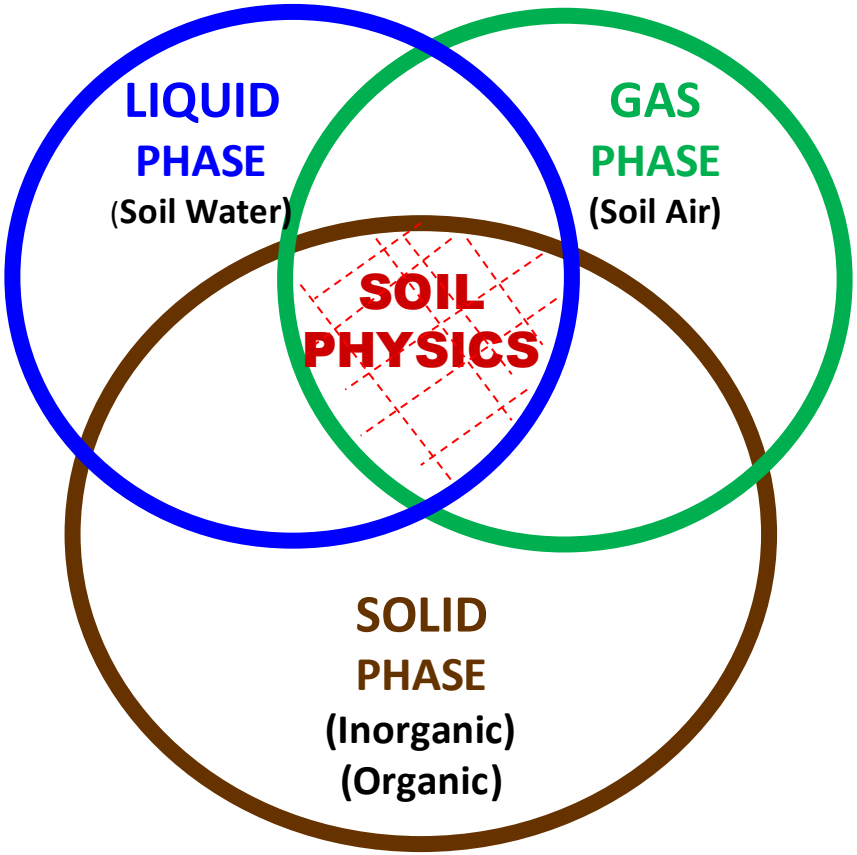
SOIL PHYSICS is the application of the PHYSICS principles to the characterization of the soil properties and to the study of the soil processes responsible of the transport of matter and energy.

Therefore, SOIL PHYSICS is both a sub-discipline of PHYSICS and SOIL SCIENCE

Up to now the studies and research on SOIL PHISICS have included topics related with:

- **the physical condition of the soil (soil structure)**
- **the water retention and movement in the soil**
- **soil mechanics**
- **soil salinity**

most of them referred to the *soil physical properties affecting plant growth, mainly those with effects on the root growth and on the use of soil water by plants*


LIQUID
PHASE
(Soil Water)
GAS
PHASE
(Soil Air)
SOIL
PHYSICS
SOLID
PHASE
(Inorganic)
(Organic)

The research on SOIL PHYSICS has been changing in emphasis, from the initial studies, mainly theoretical, on movement of water, heat and solutes in idealized soil systems, to laboratory experiments in homogeneous soil systems or disturbed soil samples, and lastly to field tests of theories and models about flux and transport of water and solutes

Practical application of soil physics knowledge has been hampered, and still is to an extent, by the publication of unsubstantiated theory based on simple well defined systems unlike field soils.

Research at the field scale into soil hydrology and soil-plant water systems is increasing, taking advantage of the benefits of recent developments in equipment for *in situ* and regular monitoring of soil water potential and water content in particular.

SOIL PHYSICS must continue having as one of the main objectives in research the study of the physical soil environment in relation to plant growth, because the agricultural production will continue being a critical issue in relation to the food production for and increasing population in a world with decreasing soil and water resources.

But the conservation of those resources vs. problems of degradation and contamination related both to agricultural and non agricultural activities, at local, regional and global levels, has become one of the main present and future responsibilities of SOIL PHYSICS.

The focus of soil physics research, has gradually broadened the last 30 years from mostly agricultural production issues to more comprehensive studies of environmental issues.

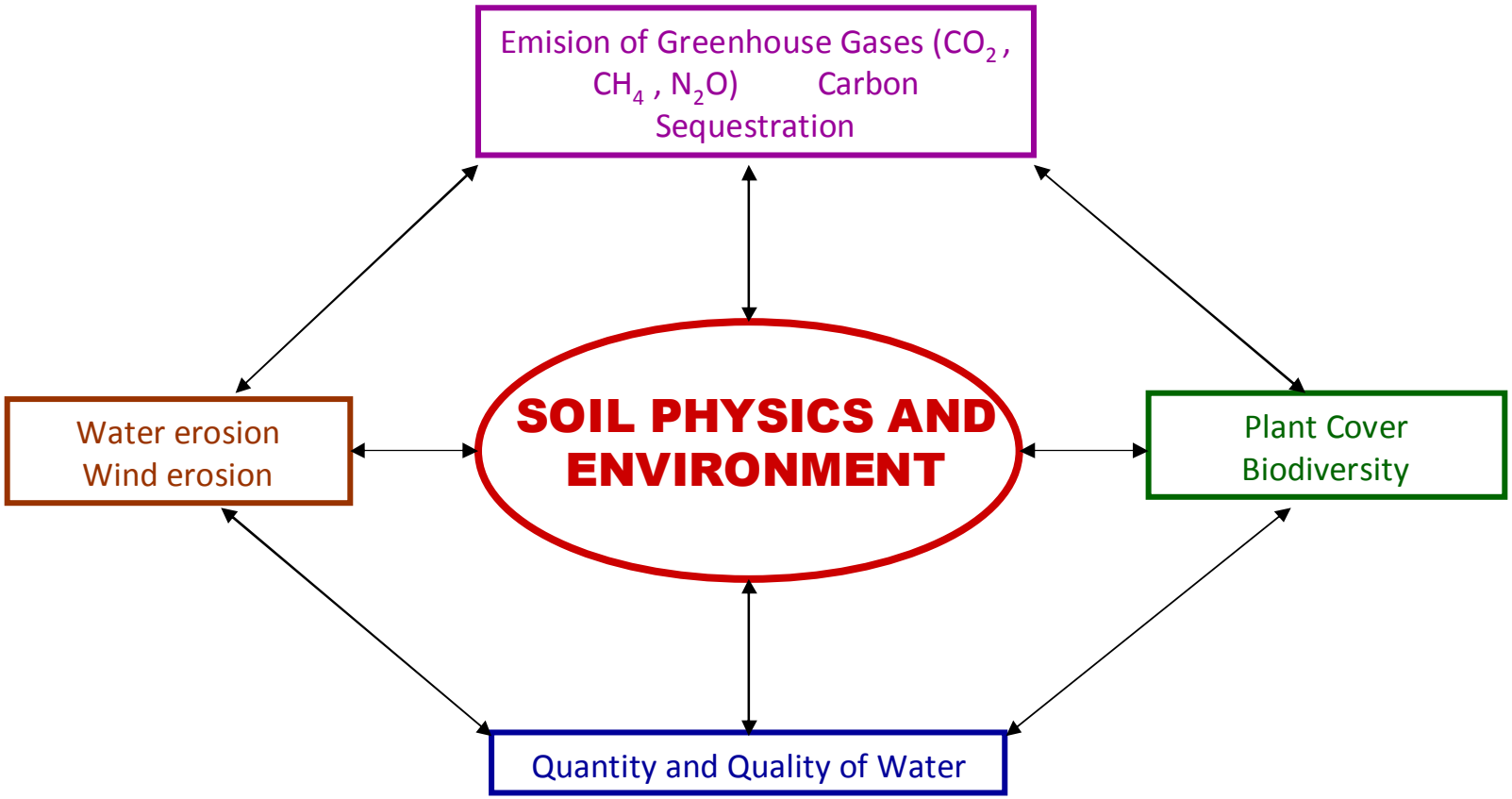
In the last 30 years it has been made more evident that Soil Physics provides the main foundation for environmental science. With this the applications of Soil Physics have been extended to:

-the study and control of pollution of groundwater and surface water

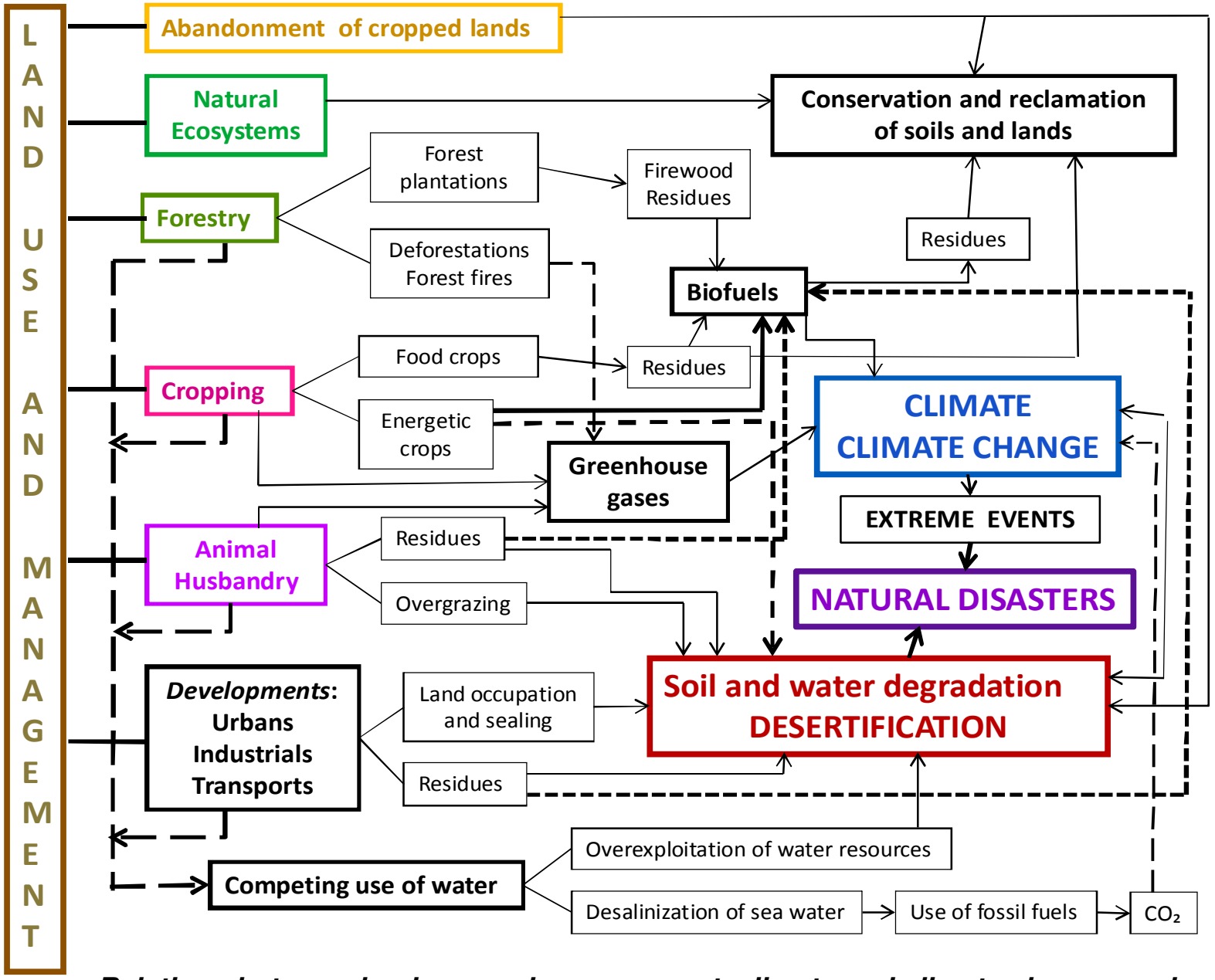
-the prediction and control of the displacement and loss of sediment, nutrients, and organic matter through surface runoff, erosion, and leaching, all of them depending on soil physical processes and properties

-the prediction of how the production, storage, and movement of greenhouse gases (CO_2, N_2O and CH_4) in the soil atmosphere, will affect global climate.

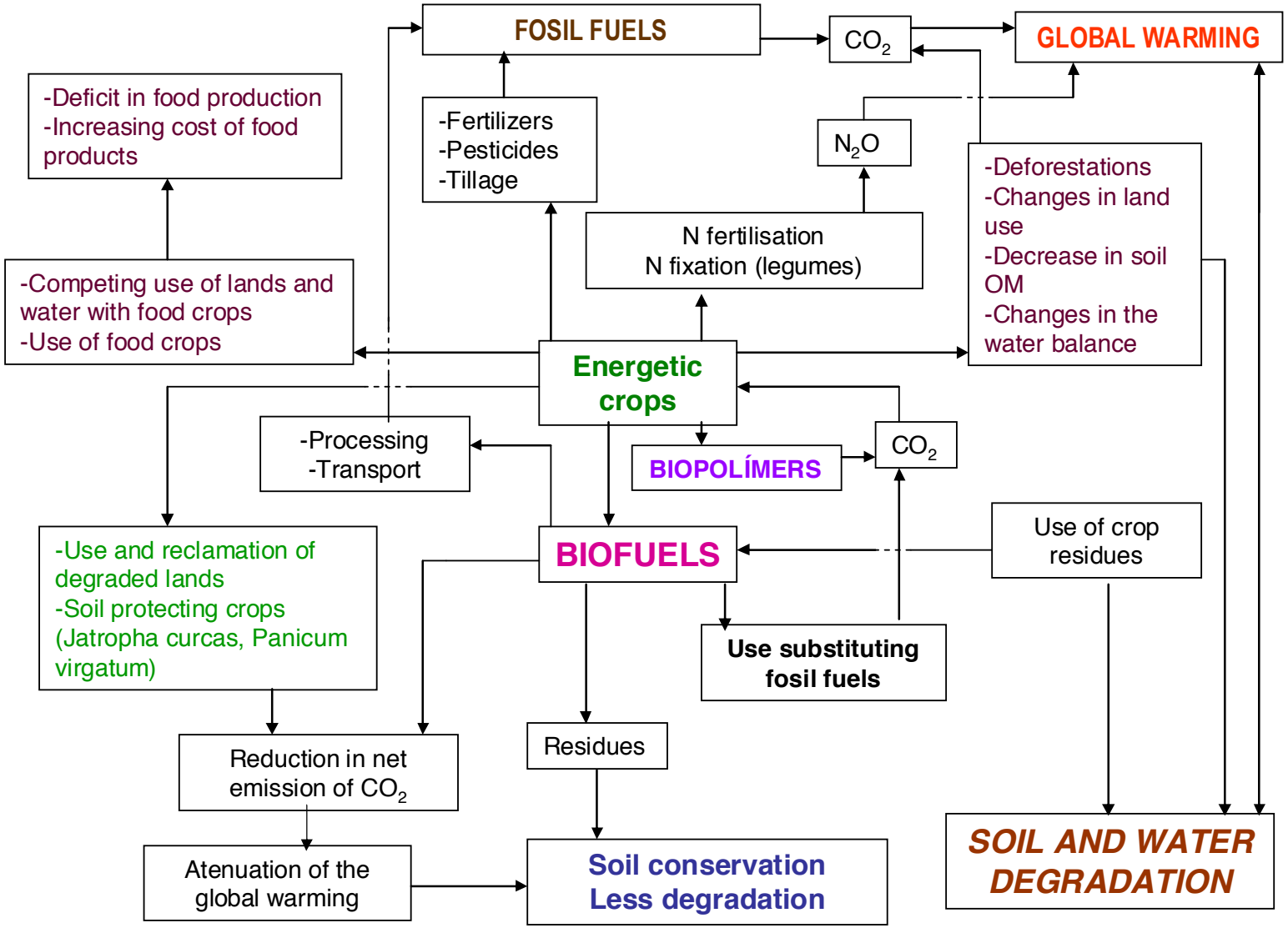
But none of these issues can be addressed by soil physics alone, because chemical and biological aspects must be considered simultaneously. Therefore most of the present environmental problems must be approached in a multi-disciplinary way, incorporating soil physics. This requires more research on soil physics, that can be applied to real-life problems.



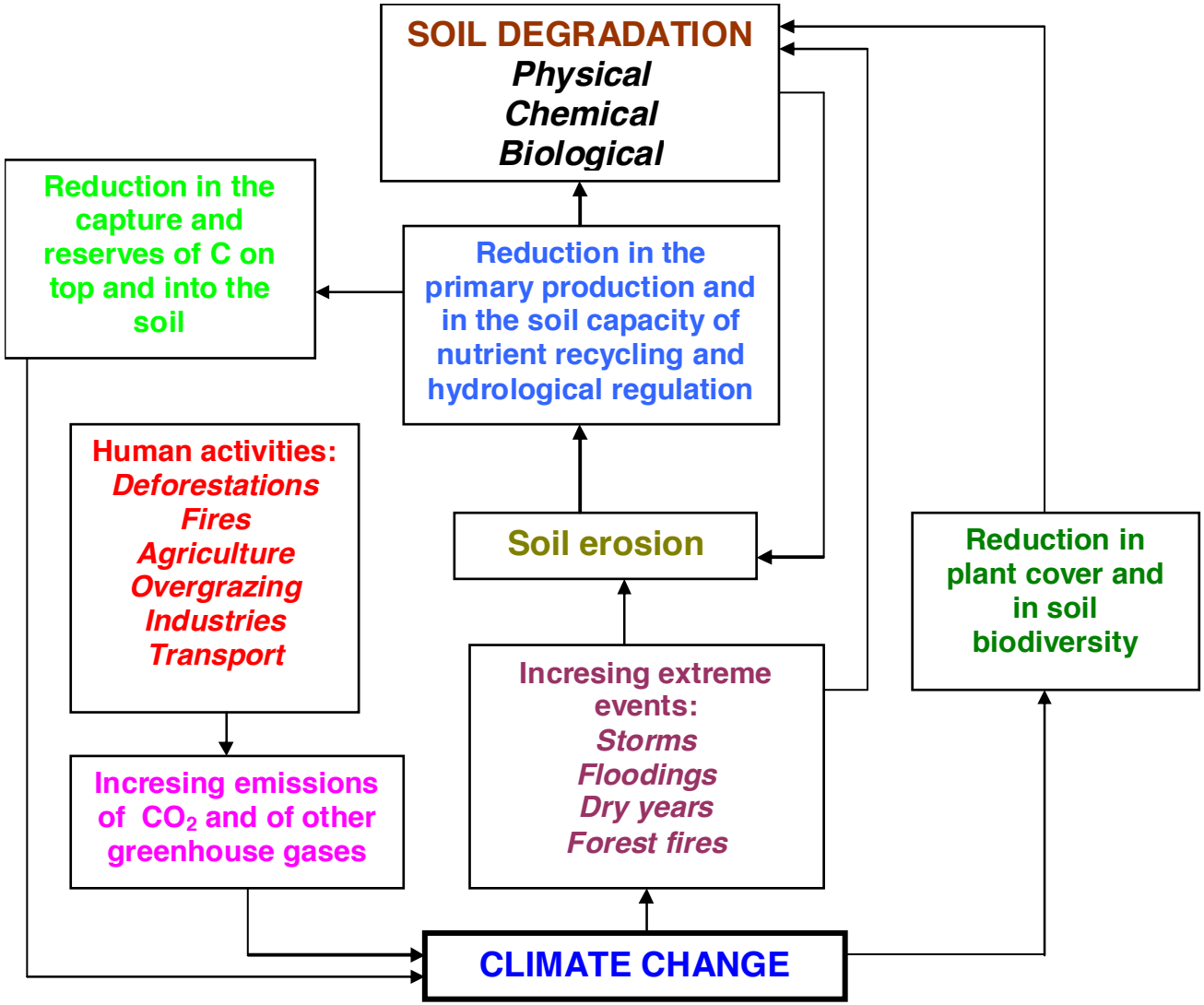
Relations between Soil Physics and Environment



Relations between land use and management, climate and climate change, and soil and water degradation **(Pla, 2005)**



Potential effects of biofuel production on soil and water degradation and global warming



Relations between soil degradation and climate change.

In the last 30 years there have been significant advances in modeling soil physical and hydrological processes and measurement technologies that have allowed soil physicists to tackle more complex problems .

There has been an increasing use of complex highly parameterized models to understand and describe coupled physical and hydrological processes to support management and policy decissions.

But the use of increasingly complex models has also increased the requirements of appropriate parameters and more efficient methods for parameter evaluation.

The advances in the availability of more and better measurement techniques and equipments and the continued increase in computational power, have still not been able to solve most of the difficulties associated with those model requirements

Obtaining hydrological parameters remains one of the largest problems in modeling soil physical and hydrological processes.

Trying to solve this, the last 30 years there has been a considerable effort to develop conceptual approaches, techniques, and methodologies for estimating soil hydraulic and related parameters from readily available soil data.

To do this there have been developed the so called pedotransfer functions (PTF), which supposedly provide such estimates, translating data we have into data we need. In any case the prediction of soil hydrologic properties and processes and related phenomena through pedotransfer functions should meet the issues of simplicity, reliability, accuracy, and utility.

The PTF have increasingly been used during the last 30 years , many times without any real valitation at field level, by scientists and engineers across a range of soil-related disciplines.

They have ben mainly used to estimate hydrological parameters and processes, related to soil water retention, soil water movement and soil erosion processes, using information on soil texture, soil structure, organic matter content, and other soil chemical, mineralogical, and mechanical properties, as well as topographical information and remote sensing data.

In the last decades there have been also developed some empirical approaches to soil physical evaluation, without any scientific basis.

They are based on qualitative data and concepts based on expert judgments, called indices of soil quality.

These have very limited accuracy and are insufficient for developing adequate policies for land use and management.

Among them are the so called visual soil assessments (VSA), based on the visual assessment, presented in a scoreboard (relative score of poor, moderate, good) of the soil condition, sometimes rating them with a subjective weighting factor.

The irrational and increasing use of pedotransfer functions and visual soil assessments, mostly without an acceptable scientific basis, have been the main cause of a quasi-stagnation in soil physics research in the last decades, and the source of many failures in the identification and evaluation of soil physical and hydrological processes involved in the World increasing environmental problems, and in the application of measures to control them.

SOME CONCLUSIONS

Modeling has been extensively and increasingly used the last 30 years as a tool to integrate information, and to avoid measurements and field experiments for every soil and conditions. But modeling is not a substitute for experimentation and models need input parameters of good quality, not only from laboratory but from field conditions

These studies are not common because are time consuming, costly and difficult to finish in a publication fulfilling the requirements of soil science journals.

They are substituted in many cases by empirical approaches, or the use of data that are already available or easier to obtain, empirically deducing them by the use of the so called pedo-transfer functions of properties and processes required for modeling.

Besides, much of the accepted and used methodology and instruments for evaluating physical and hydrological parameters of soils under field conditions are not adequate.

Progress in developing models and processing systems of information have been much faster than the development and use of methodologies and equipment to get the adequate field information to feed them.

To correct this, there will be required continued advances in measurement technologies together with improved methods to identify those measurements that are most likely to provide the information that is most valuable for physical process understanding and hydrologic predictions. In any case, the selection of the methodology must consider both practicality and cost

The future developments in soil physics research must be directed to:

- A better understanding of the processes and reactions in soils related with crop production, chemical recycling and water balance, over a range of spatial and temporal scales. Of particular importance will be the improved identification and description of important dynamic processes in soils critical for the supply of water and nutrients for plant growth and for soil degradation as affected by external temporal factors like climate.

- The development of simplified simulation models to find the best combination of use and management practices (combining selected critical parameters of soils, climate and crops) for a more efficient and economical use of soil water and energy addressed to increased crop production, overcoming depletion and minimizing risks of soil, water and environmental degradation, including risks of natural disasters like flooding and landslides.

In general, in the future research on Soil Physics, there will be required:

-A more holistic approach, including soil physical processes and reactions in soils related with crop production, chemical recycling and water balance, over a range of spatial and temporal scales.

-Improvement and reorientation of training in Soil Physics, according to the other requirements

-An interdisciplinary approach, with increased cooperation with other scientists of related disciplines

SOIL PHYSICS (CHANGE GENERATIONS)