

**E R C A 2006**

**C**ours de **R**echerche **E**uropéen sur les  
**A**tmosphères  
***E**uropean **R**esearch **C**ourse on **A**tmospheres*

**Grenoble - FRANCE**  
**9 January – 11 February 2006**

***FINAL CIRCULAR***

# ERCA 2006

**(9 January – 11 February 2006)**

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University Joseph Fourier of Grenoble/Institut  
Universitaire de France/CNRS***

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ERCA 2006 is supported by the University Joseph Fourier of Grenoble, the Centre National de la Recherche Scientifique, the Ministère de l'Education Nationale, de l'Enseignement Supérieur et de la Recherche, the Integrated Project ENSEMBLES of the European Commission's Sixth Framework Programme, GREENCYCLES (a Marie Curie Research Training Network of the European Commission's Sixth Framework Programme), the European Network of Excellence ACCENT of the European Commission's Sixth Framework Programme, the Abdus Salam International Centre for Theoretical Physics (ICTP), the City of Grenoble, the Conseil Général de l'Isère and Grenoble Alpes Métropole.

# ERCA 2006

**(9 Janvier - 11 Février 2006)**

**DIRECTEUR:** *Claude BOUTRON, Professeur,  
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# **FINAL PROGRAMME**

*(subject to changes)*



# PROGRAMME OF ERCA 2006

*The first 4 weeks of ERCA will take place at POLYTECH' GRENOBLE, close to the main campus of the University of Grenoble, in the city of Saint Martin d'Hères, in the suburbs of Grenoble. Information on how to reach POLYTECH' GRENOBLE from the hotels is given in the "PRACTICAL INFORMATION" at the end of the circular.*

*Lectures, seminars and panels will take place in lecture hall 146. The only exceptions are the Official Opening and the 2 lectures by Paul Crutzen on Monday 9 January morning and the second lecture by Mark Thiemens on Tuesday 17 January at the end of the morning, which will take place in lecture hall 101.*

## FIRST WEEK (9-13 JANUARY)

### MONDAY 9 JANUARY

- 9.00 - 9.45 a.m. Official Opening at POLYTECH' GRENOBLE ( lecture hall 101) with **Yannick VALLEE**, *President of the University Joseph Fourier of Grenoble*, **Paul CRUTZEN** (*Max Planck Institute, Mainz, Germany, 1995 Nobel Laureate for Chemistry*), **André BERGER** (*Catholic University of Louvain la Neuve*), **Christian ELICHEGARAY** (*french Environmental Agency (ADEME)*), **Daniel CORDARY** (*Director of Polytech' Grenoble*), **Michel FILY** (*Director of the Laboratory of Glaciology and Geophysics of the Environment*) and **Claude BOUTRON** (*Director of ERCA*).
- 9.45 - 10.30 a.m. Introductory lecture by **Paul CRUTZEN** : "Introduction to atmospheric sciences" (lecture hall 101)
- 10.45 - 12.15 a.m. **Paul CRUTZEN** : "Atmospheric chemistry and climate in the Anthropocene"
- 12.15 - 2.00 p.m. **Buffet** at "POLYTECH' GRENOBLE (Room 105)
- 3.00 - 3.30 p.m. **Paul SHEPSON** (Purdue University, West Lafayette, USA) : "Atmospheric radiation and photochemistry"
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.30 p.m. **André BERGER** : "The greenhouse effect"
- 5.45 - 7.00 p.m. **Oral presentation of the posters of the first week**

## TUESDAY 10 JANUARY

- 9.00 - 10.30 a.m. **Paul CRUTZEN** : *"Background tropospheric chemistry, Part I"*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **André BERGER** : *"Man's impact on climate"*
- 2.00 - 3.30 p.m. **Paul CRUTZEN** : *"Background tropospheric chemistry, Part II"*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.30 p.m. **Paul SHEPSON** : *"Chemical kinetics, sources and sinks of atmospheric chemical species and atmospheric lifetimes"*
- 5.30 - 6.30 p.m. **Panel** : **"Climate Change"**. Moderators : Bernard Barnier (CNRS Grenoble), André Berger, Paul Crutzen, Dominique Raynaud (CNRS Grenoble) and Paul Shepson.

## WEDNESDAY 11 JANUARY

- 9.00 - 10.30 a.m. **André BERGER** : *"The astronomical theory of paleoclimate, a tool for predicting the future of our climate over the next millennia"*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **Graeme STEPHENS** (Colorado State University, Fort Collins, USA) : *"The forward problem : basics of radiative transfer"*
- 2.00 - 3.30 p.m. **Graeme STEPHENS** : *"The inverse problem : estimation methods"*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.30 p.m. **Jochem MAROTZKE** (Max Planck Institute for Meteorology, Hamburg, Germany) : *"Key ocean processes in climate"*
- 5.45 - 6.45 p.m. Seminar by **Philippe CARDIN** (CNRS Grenoble) : *"The Earth's magnetic field : its origin, its history and its geography"*

## THURSDAY 12 JANUARY

- 9.00 - 10.30 a.m. **Jochem MAROTZKE** : *"Ocean thermohaline circulation and abrupt climate change"*
- 10.30 - 11.00 a.m. **Coffee interval**

- 11.00 - 12.30 a.m. **Graeme STEPHENS** : *“Atmospheric remote sensing : general principles”*
- 2.00 - 3.30 p.m. **Tony COX** (University of Cambridge, United Kingdom) : *“Stratospheric chemistry and the ozone layer : theory and observations”*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.30 p.m. **Jochem MAROTZKE** : *“Monitoring the Atlantic thermohaline circulation at 26°N”*
- 5.45 - 6.45 p.m. **Poster session**

## FRIDAY 13 JANUARY

- 9.00 - 10.30 a.m. **Tony COX** : *“Impact of pollutants on the ozone layer – heterogeneous chemistry in the lower stratosphere”*
- 10.30 – 11.00 a.m. **Coffee interval**
- 11.00 – 12.30 a.m. **Nicholas HALL** (CNRS Grenoble) : *“The atmospheric general circulation”*
- 2.00 - 3.30 p.m. **Hugh COE** (University of Manchester, United Kingdom) : *“Atmospheric research using airborne platforms”*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.00 p.m. **Nicholas HALL** : *“Modelling the atmosphere, atmospheric variability and predictability”*

## SECOND WEEK (16-20 JANUARY)

### MONDAY 16 JANUARY

- 9.00 - 10.30 a.m. **Martin WERNER** (Max Planck Institute for Biogeochemistry, Jena, Germany) : *“Global climate modeling : basic ideas and concepts of GCMs”*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **Alain SALIOT** (University Pierre et Marie Curie/Institut Pierre-Simon Laplace) : *“The ocean, an active chemical and biological reactor and its role in climate change”*



- 2.00 - 3.30 p.m.      **Alain SALIOT** : *“Biogeochemical processes at the air-ocean interface”*
- 3.30 - 4.00 p.m.      **Coffee interval**
- 4.00 - 5.30 p.m.      **Mark THIEMENS** (University of California San Diego, La Jolla, USA) : *“Isotope effects : classical and mass independent”*
- 5.45 - 7.00 p.m.      **Oral presentation of the posters of the second week**

## TUESDAY 17 JANUARY

- 9.00 - 10.30 a.m.      **Martin WERNER** : *“Global climate modeling : advantages and limitations”*
- 10.30 -11.00 a.m.      **Coffee interval**
- 11.00 - 12.30 a.m.      **Mark THIEMENS** : *“Mass independent isotope effects and their observation in nature : from Mars to Earth, from the past to present”*
- This lecture will also be part of the series of conferences of the Graduate School “Earth, Universe, Environment” of University Joseph Fourier. It will take place in Lecture Hall 101 of Polytech’***
- 2.00 - 3.30 p.m.      **Frank RAES** (EC Joint Research Center, Ispra, Italy) : *“Introduction to atmospheric aerosols : properties, processes, impacts”*
- 3.30 - 4.00 p.m.      **Coffee interval**
- 4.00 - 5.30 p.m.      **Markus QUANTE** (GKSS Geesthacht, Germany): *“Introduction to cloud physics”*
- 5.45 – 6.45 p.m.      Seminar by **Jean-Marc JANCOVICI** (Manicore Company, Orsay, France) : *“Climate and material consumption : how far can we go ?”*

## WEDNESDAY 18 JANUARY

- 9.00 - 10.30 a.m.      **Frank RAES** : *“Linkages between air pollution and climate change : research and policy”*
- 10.30 - 11.00 a.m.      **Coffee interval**
- 11.00 - 12.30 a.m.      **Franck SELSIS** (Ecole Normale Supérieure, Lyon France) : *“The nature of the Martian environment today”*
- 2.00 - 3.30 p.m.      **Markus QUANTE** : *“The role of clouds in the climate system”*

- 3.30 - 4.00 p.m.      **Coffee interval**
- 4.00 - 5.30 p.m.      **Franck SELSIS** : *“The evolution of Mars to the present day”*
- 5.30 - 6.30 p.m.      Seminar by **Wolfgang LUCHT** (Potsdam Institute for Climate Impact Research, Germany) : *“The future of the biosphere : where are we heading ?”*

#### THURSDAY 19 JANUARY

- 9.00 - 10.30 a.m.      **Joachim CURTIUS** (University of Mainz, Germany) : *“Nucleation of atmospheric aerosol particles”*
- 10.30 - 11.00 a.m.      **Coffee interval**
- 11.00 - 12.30 a.m.      **John PLANE** (University of East Anglia, United Kingdom) : *“Spectroscopic techniques for making atmospheric measurements”*
- 2.00 – 3.30 p.m.      **Andrew WATSON** (University of East Anglia, United Kingdom) : *“Atmospheric oxygen and the major transitions of Earth history”*
- 3.30 – 4.00 p.m.      **Coffee interval**
- 4.00 – 5.30 p.m.      **Timothy OSBORN** (University of East Anglia, United Kingdom) : *“The North Atlantic oscillation : observed variability and response to climate change forcing”*
- 5.45 – 6.45 p.m.      Seminar by **Julian HUNT** (University College London, United Kingdom) : *“Scientific, technical and political developments in climate change policy”*

#### FRIDAY 20 JANUARY

- 9.00 - 10.30 a.m.      **Andrew WATSON** : *“What controls atmospheric carbon dioxide concentrations over glacial-interglacial cycles ?”*
- 10.30 - 11.00 a.m.      **Coffee interval**
- 11.00 - 12.30 a.m.      **Timothy OSBORN** : *“Simulation and reconstruction of climate during the last 1000 years”*
- 2.00 - 3.30 p.m.      **Martin FULLEKRUG** (University of Bath, United Kingdom) : *“Atmospheric electromagnetics and climate change”*
- 3.30 - 4.00 p.m.      **Coffee interval**
- 4.00 - 5.30 p.m.      **John PLANE** : *“The mesosphere and thermosphere”*

5.45 – 6.45 p.m.            **Poster session**

## **THIRD WEEK (23-27 JANUARY)**

### **MONDAY 23 JANUARY**

- 9.00 - 10.30 a.m.        **Michiel VAN DEN BROEKE** (University of Utrecht, The Netherlands) : *“Climate of the polar regions”*
- 10.30 - 11.00 a.m.        **Coffee interval**
- 11.00 - 12.30 a.m.        **Carlo BARBANTE** (University Ca' Foscari, Venice, Italy) : *“Natural biogeochemical cycles of trace elements”*
- 2.00 - 3.30 p.m.         **Michiel VAN DEN BROEKE** : *“Mass balance of the large ice sheets”*
- 3.30 - 4.00 p.m.         **Coffee interval**
- 4.00 - 5.30 p.m.         **Eric WOLFF** (British Antarctic Survey, Cambridge, United Kingdom) : *“Past climate and atmospheric chemistry from ice cores : principles and methods”*
- 5.45 - 7.00 p.m.         **Oral presentation of the posters of the third week**

### **TUESDAY 24 JANUARY**

- 9.00 - 10.30 a.m.        **Carlo BARBANTE** : *“The role and fate of heavy metals emitted by human activities”*
- 10.30 - 11.00 a.m.        **Coffee interval**
- 11.00 - 12.30 a.m.        **Eric WOLFF** : *“The records of climate and atmospheric chemistry as deduced from ice cores”*
- 2.00 – 3.30 p.m.         **Henrik LUNDSTEDT** (Swedish Institute of Space Physics, Lund, Sweden) : *“The weather and climate of the Sun”*
- 3.30 – 4.00 p.m.         **Coffee interval**
- 4.00 - 5.30 p.m.         **Hans VON STORCH** (GKSS Geesthacht, Germany) : *“Regional storm climate and related marine hazards in the last decades“*
- 5.45 – 6.45 p.m.         Seminar by **Carl BRENNINKMEIJER** (Max Planck Institute for Chemistry, Mainz, Germany) : *“The potential of civil aircraft for atmospheric composition research”*

## WEDNESDAY 25 JANUARY

- 9.00 - 10.30 a.m.      **Hans VON STORCH** : *“Regional pollution – the case of gasoline lead”*
- 10.30 - 11.00 a.m.      **Coffee interval**
- 11.00 – 12.30 a.m.      **Henrik LUNDSTEDT** : *“Living with the space (solar) weather”*
- 2.00 - 3.30 p.m.      **Richard BETTS** (Hadley Centre for Climate Prediction and Research, Exeter, United Kingdom) : *“Forcing of climate change by large-scale vegetation changes”*
- 3.30 – 4.00 p.m.      **Coffee interval**
- 4.00 – 5.30 p.m.      **Marcello CORADINI** (European Space Agency Science Directorate, Paris, France) : *“New trends in the exploration of the Solar System”*
- 5.45 - 6.45 p.m.      **Panel : “Space exploration : can the dream continue ?”**  
Moderators : Richard Betts, Marcello Coradini, Wlodek Kofman (CNRS Grenoble) and Henrik Lundstedt.

## THURSDAY 26 JANUARY

- 9.00 - 10.30 a.m.      **Richard BETTS** : *“Feedbacks on climate change by large-scale vegetation changes”*
- 10.30 - 11.00 a.m.      **Coffee interval**
- 11.00 - 12.30 a.m.      **Kevin NOONE** (International Geosphere/Biosphere Programme, Stockholm, Sweden) : *“Earth system science”*
- 2.00 – 6.00 p.m.      **Visit of the European Synchrotron Radiation Facility (ESRF)**

**Important** : access to the European Synchrotron Radiation Facility is subject to prior authorization due to the sensitive nature of some of the research carried out at ESRF. Authorization to certain participants may thus be refused. Moreover the visit might be cancelled in case of exceptional situations.

**The ESRF is a Research Institute funded by fifteen European countries. Its main task is to produce hard X-rays with high brilliance using synchrotron radiation emitted by very high energy electrons. The electrons are accelerated first in a linac and then in a booster synchrotron, before being injected into a 844 m storage ring where they circulate for hours at constant energy (6 GeV). The synchrotron radiation beams emitted by the electrons are directed towards the 40 beamlines which are distributed all around the ring in the experimental hall. Each beamline is dedicated to a field of research or a particular**

**technique. The fields of research include materials science, surfaces, biology, medicine, high pressures, chemistry, magnetism and industrial applications. Some of these fields are of relevance for ERCA such as the analysis of atmospheric particulate matter using X-ray microfluorescence. Other techniques used on the beamlines are diffraction, absorption spectroscopy, imaging, small-angle scattering or microscopy, generally in the range of hard X-rays. Each year, 3000 researchers worldwide come to Grenoble to carry out experiments at the ESRF.**

The programme of the visit will be as follows :

- 2.00-2.30 p.m. : transfer from the University Cafeteria Barnave to ESRF by tramway (line B from stop "Les Taillées", close University Cafeteria Barnave), to the terminus "Cité Internationale") and then bus (line 34 from "Cité Internationale" to "Polygone Scientifique ESRF")

- 2.30 p.m. : arrival to the entrance of ESRF for official formalities (don't forget to bring your passport)

- 2.45 - 3.45 p.m. : presentation by **Dominique CORNUEJOLS** (Information Officer at ESRF) : "*The European Synchrotron Radiation Facility*"

- 3.45 - 5.00 p.m. : presentation by **Freddy ADAMS** (University of Antwerpen, Belgium) : "*Synchrotron radiation in environmental sciences*"

- 5.00 - 6.00 p.m. : visit to the experimental hall around the storage ring and a few beamlines

- 6.00 p.m. : end of the visit and return to the hotels by bus (line 34) then tramway (line B)

## FRIDAY 27 JANUARY

- |                    |   |
|--------------------|---|
| 9.00 - 10.30 a.m.  | <b>Kevin NOONE</b> : " <i>Biogeochemical cycles and global change, Part I</i> "   |
| 10.30 - 11.00 a.m. | <b>Coffee interval</b>  |
| 11.00 - 12.30 a.m. | <b>Jorgen OLESEN</b> (Danish Institute of Agricultural Sciences, Tjele, Denmark) : " <i>Responses of crops and cropping systems to climate and climatic variation</i> " |
| 2.00 - 3.30 p.m.   | <b>Kevin NOONE</b> : " <i>Biogeochemical cycles and global change, Part II</i> "  |
| 3.30 - 4.00 p.m.   | <b>Coffee interval</b>  |
| 4.00 - 5.30 p.m.   | <b>Jorgen OLESEN</b> : " <i>Vulnerability, adaptation and mitigation to climate change in agriculture</i> "   |

5.45 – 6.45 p.m. **Poster session**

## **FOURTH WEEK (30 JANUARY-3 FEBRUARY)**

### **MONDAY 30 JANUARY**

- 9.00 - 10.30 a.m. **Richard FLAGAN** (California Institute of Technology, Pasadena, USA) : *“Methods for measurement and characterization of aerosols : physical properties ”*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 – 12.30 a.m. **Colin PRENTICE** (University of Bristol, United Kingdom) : *“Terrestrial biosphere processes and their significance for climate”*
- 2.00 - 3.30 p.m. **Martin BENISTON** (University of Fribourg, Switzerland) : *“Climate change and extreme events”*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.30 p.m. **Colin PRENTICE** : *“Overview of the global carbon cycle – past, present and future”*
- 5.45 - 7.00 p.m. **Oral presentation of the posters of the fourth week**

### **TUESDAY 31 JANUARY**

- 9.00 - 10.30 a.m. **Richard FLAGAN** : *“Methods for measurement and characterization of aerosols:chemical composition”*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **Martin BENISTON** : *“Impacts of climatic change on hydrology and water resources”*
- 2.00 - 3.30 p.m. **Filippo GIORGI** (Abdus Salam International Centre for Theoretical Physics, Trieste, Italy) : *“Regional climate modeling : status and perspectives”*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00- 5.30 p.m. **Bruno MALAIZE** (University of Bordeaux, France) : *“Different proxies in paleoceanography”*
- 5.45 – 6.45 p.m. **Poster session**

## WEDNESDAY 1 FEBRUARY

- 9.00 - 10.30 a.m. **Filippo GIORGI** : *“Regional climate change over the Mediterranean regions”*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **Ralf EBINGHAUS** (GKSS Geesthacht, Germany) : *“Emission sources, regional and global distribution of atmospheric mercury”*
- 2.00 – 3.30 p.m. **Bruno MALAIZE** : *“Major Quaternary climatic events seen through the ocean, from orbital to millennial time scales”*
- 3.30 – 4.00 p.m. **Coffee interval**
- 4.15 – 6.15 p.m. Half of the participants will visit the **Laboratory of Glaciology and Geophysics of the Environment** (CNRS/University Joseph Fourier of Grenoble). The other half will visit the **Coriolis Experimental Facility** (CNRS/National Polytechnical Institute of Grenoble/University Joseph Fourier of Grenoble).

*The **Laboratory of Glaciology and Geophysics of the Environment (LGGE)** is a laboratory of the French National Center for Scientific Research (CNRS) and the University Joseph Fourier of Grenoble (UMR CNRS/UJF 5183). Its scientific reputation is mainly based on outstanding research achievements on the reconstruction of past changes of climate and atmospheric composition during the last climatic cycles from polar ice cores. These studies are based on the well preserved frozen atmospheric archives which can be obtained by ice drilling in the central plateau areas of Antarctica and Greenland. The time periods under investigation now include the last seven climatic cycles as well as the Holocene and the last few centuries. Current investigations also include the study of the physical and mechanical properties of the ice, modelling of ice caps, chemical exchanges between the low atmosphere and snow and ice fields, remote sensing of snow and ice covered areas in polar and temperate regions, mass balance of Alpine and Andean glaciers as well as high latitude climate modelling and atmospheric chemistry modelling. Research carried out at LGGE combines technological and analytical approaches. Of particular importance are polar field campaigns organized in the frame of international programmes such as the ongoing European Programme for Ice Coring in Antarctica (EPICA), as well as field parties in the Alps, in the Arctic and in the Andes. Research conducted at LGGE contributes to a better understanding of important scientific issues which are fundamental for our society as a whole, such as the greenhouse effect, climate and environmental changes, atmospheric pollution at global and regional scales, as well as risks associated with glaciers. The participants will be guided by **Michel FILY, Director of LGGE**, and several other researchers.*

**Coriolis** is a European large scale experimental facility which is part of the Industrial and Geophysical Flows Laboratory (LEGI). It is a 13 m diameter rotating turntable with a rotation period ranging between 18 and 1000 s. The tank can be filled with homogeneous, two-layer or continuously stratified fluid. It is used for experimental modeling of geophysical flows, taking the effects of the earth rotation into account with or without stratification or topography. It was built in

1960 for modelling tidal currents in the English Channel. It has been later renovated and instrumented to study the dynamics of rotating fluids. Modeling of oceanic (or atmospheric) dynamics at mesoscale is performed, involving internal waves, convection, gravity currents, boundary layers, topographic effects, geostrophic turbulence and the emergence of organized vortices. Thanks to the large size, inertial regimes can be approached, with low effects of viscosity and centrifugal force. Laboratory experiments allow then to test models of ocean dynamics, and to develop their physical parametrisations. The participants will be guided by **Joël SOMMERIA** and **Henri DIDELLE**.

## THURSDAY 2 FEBRUARY

- 9.00 - 10.30 a.m. **Pim MARTENS** (University of Maastricht/Open University Netherlands/Zuyd University, The Netherlands) : *“Climate change and human health”*
- 10.30 - 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **Peter BRIMBLECOMBE** (University of East Anglia, United Kingdom) : *“Health and policy”*
- 2.00 - 3.30 p.m. **Ralf EBINGHAUS** : *“Emission sources, regional and global distribution of classical and new Persistent Organic Pollutants (POPs)”*
- 3.30 - 4.00 p.m. **Coffee interval**
- 4.00 - 5.30 p.m. **Peter BRIMBLECOMBE** : *“Material damage and air pollution”*
- 5.45 – 6.45 p.m. **Panel : “Environmental pollution and trends in human health”**.  
Moderators : Peter Brimblecombe, Ralf Ebinghaus, Christophe Ferrari, Marc Kuchner and Pim Martens.

## FRIDAY 3 FEBRUARY

- 9.00 - 10.30 a.m. **Marc KUCHNER** (NASA Goddard Space Flight Center, Greenbelt/Princeton University, USA) : *“Water planets, carbon planets and the origin of the Earth’s oceans”*
- 10.30 – 11.00 a.m. **Coffee interval**
- 11.00 - 12.30 a.m. **Pim MARTENS** : *“Global changes, sustainable development and human health : scenarios for the 21<sup>st</sup> century”*
- 2.00 - 3.30 p.m. **Ellen STOFAN** (Proxemy Research, Rectortown, USA) : *“On the nature of Venus and its divergence from Earth”*
- 3.30 - 4.00 p.m. **Coffee interval**



4.00 - 5.30 p.m.

**Marc KUCHNER** : *"The detection of extrasolar planets today and tomorrow"*

## **FIFTH WEEK (5-11 FEBRUARY)**

The participants will visit the "**Observatoire de Haute-Provence**" (OHP), near the small city of Forcalquier (about 170 km South of Grenoble).

### ***General presentation of the stay at OHP***

OHP is one of the main French astronomical Observatories, with several large optical telescopes (diameter : 1.93 m ; 1.52 m ; 1.20 m and 0.80 m) and various other instruments. It is located at a place which is renowned for clear sky conditions.

It is also the place where the Aeronomy Laboratory ("Service d'Aéronomie") of Paris (CNRS/University Pierre et Marie Curie/University of Versailles-St Quentin/Institut Pierre Simon Laplace) has extensive experimental facilities for the study of the middle and upper atmosphere. The instruments which are operated at OHP by the Service d'Aéronomie include especially :

- 1) **Temperature Lidar** (measurement of temperature in the middle atmosphere),
- 2) **Wind Lidar** (measurement of wind in the middle atmosphere)
- 3) **Ozone Lidar** (determination of the vertical profile of ozone from ground level to 50 km)
- 4) **SAOZ Spectrometer** (SAOZ means in french : "Système d'Analyse par Observation Zénithale" i.e. : Analysis System for Zenith Observation) and **Dobson Spectrometer** (measurement of stratospheric constituents)

### ***Transportation and accommodation***

The participants will arrive at OHP by special bus from Grenoble at the end of the morning of **Sunday 5 February**. They will leave OHP at the end of the morning of **Saturday 11 February** (arrival in Grenoble in front of the railway station is scheduled around 5 p.m.).

During the stay at OHP, some of the participants will be accommodated at the Observatory itself ("**Maison Jean Perrin**" ; rooms with single, double or triple occupancy, with or without private bathroom facilities). The others will be accommodated at "**Grand-Hotel**" in Forcalquier (about 15 km from the Observatory ; rooms with single or double occupancy, with or without private bathroom facilities) and at "**Hotel de l'Observatoire**" in St Michel l'Observatoire (a few km from the Observatory ; rooms with single, double or triple occupancy, without private bathroom facilities). Breakfast will be either at "Maison Jean-Perrin" or at the hotels. Lunch and dinner will be at "Maison Jean Perrin" for all the participants. Transportation

between the hotels and the Observatory will be by bus.

## **Programme**

### **SUNDAY 5 FEBRUARY**

- 8.00 a.m. Departure from Grenoble by bus. Arrival around 12.00 a.m. at O.H.P.
- 12.30 a.m. Lunch at "Maison Jean Perrin"
- 2.00-4.00 p.m. Settling of the participants in their rooms at "Maison Jean Perrin" or at the hotels
- 4.00-5.30 p.m. **Jonathan LUNINE** (University of Arizona, Tucson, USA) : *"Earth : evolution of a habitable world"*
- 6.00 p.m. Dinner at "Maison Jean Perrin"

### **MONDAY 6 FEBRUARY**

- 8.45 – 10.15 a.m. **Jonathan LUNINE** : *"Titan : a model for the pre-biotic Earth"*
- 10.15 – 10.30a.m. Coffee interval
- 10.30 – 12.00 a.m. **Julie PATRIS** (University of Aix-Marseille, France) : *"Purpose of ground based astronomical observations"*
- 12.00 a.m. Lunch at "Maison Jean Perrin"
- 1.30 p.m. Departure from OHP by bus. Arrival around 2.15 p.m. at the Cadarache Research Center of the French Atomic Energy Commission in St Paul les Durance, about 40 km from Forcalquier
- 2.30 - 6.00 p.m. Visit of the **Cadarache Research Center of the French Atomic Energy Commission (CEA)**

Special emphasis will be given to current international research on fusion energy, especially to the International Thermonuclear Experimental Reactor (ITER), which will be built at Cadarache by the European Union, the United States, Russia, China, Japan and South

Korea. The participants might also see the Tore Supra Tokamak.

**Important** : access to the Cadarache Research Center of the French Atomic Energy Commission is subject to prior authorization due to the sensitive nature of some of the research carried out at the Center. Authorization to certain participants may thus be refused. These participants will have to stay at OHP or Forcalquier during the visit of the Cadarache Research Center.

7.00 p.m. Dinner at "Maison Jean Perrin"

## TUESDAY 7 FEBRUARY

9.00 - 10.30 a.m. **Thérèse ENCRENAZ** (Observatory of Paris-Meudon/CNRS) : "*The outer solar system*"

10.30 - 10.45 a.m. Coffee interval

10.45 - 11.00 a.m. **Alain SARKISSIAN** (CNRS/University Pierre et Marie Curie/University Versailles-St Quentin/Institut Pierre Simon Laplace) : "*OHP as a primary station of the NDSC (Network for Detection of Stratospheric Change)*"

11.00 -12.15 a.m. **Julie PATRIS** : "*Imaging and spectroscopy techniques in optical astronomy*"

12.30 a.m. Lunch at "Maison Jean Perrin"

2.15 - 3.45 p.m. **Andrea PAZMINO** ((CNRS/University Pierre et Marie Curie/University Versailles-St Quentin/Institut Pierre Simon Laplace) : "*The lidar technique for atmospheric ground-based sounding*"

3.45 – 4.15 p.m. Coffee interval

4.15 –5.45 p.m. **Philippe KECKHUT** (CNRS/University Pierre et Marie Curie/University Versailles-St Quentin/Institut Pierre Simon Laplace): "*Lidar studies of atmospheric dynamics*"

6.00 p.m. Dinner at "Maison Jean Perrin"

**7.30 - 10.30 p.m.**

**Visits to the lidars, the 1.2 m and 0.8 m optical telescopes (see the enclosed map 1 of Observatoire de Haute-Provence). The participants will be splitted into 4 groups for the visits (according to alphabetical order).**

Here is a brief description of the instruments you will see (for more detailed descriptions, please read the chapters by A. Hauchecorne, P. Keckhut and A. Sarkissian in the ERCA books).

### **Mie-Rayleigh Lidar**

*The lidar is an active system including a laser and a telescope receiver. In this case the emitted laser beam is a visible wavelength that permits stratospheric aerosol to be measured by backscattering below 30 km, by assuming molecular scattering, and temperature above (30-80 km) by using the perfect gas law. Temperature time series obtained at OHP since 1978 are the longest ever obtained with this technique. This system is also able to measure water vapour and temperature in the presence of aerosols.*

### **Total ozone**

*Total ozone is measured using the differential technique with two different instruments. The well-known Dobson spectrometer observes directly the sun at a couple of wavelengths: one absorbed and the other non-absorbed by ozone. The total ozone quantity can be derived from the data if the absorption cross section is known. The SAOZ spectrometer is based on the same principle except that the full spectrum is observed. In that case there are less interferences with other absorbents and the total column of other chemical constituents such as NO<sub>2</sub> can be derived. The SAOZ spectrometer points towards the zenith direction. During sunset and sunrise, the optical path is increased and the sensitivity maximised. The SAOZ spectrometer is well adapted for polar regions during winter when sun elevation is always small.*

### **Ozone lidar**

*Ozone profiles can be derived using the DIAL techniques. Two lasers are required : one emitting in the ozone absorption band and the other at a non absorbed wavelength. The differential absorption profile can be inverted into ozone density profiles. The two lidars are dedicated for two different altitude ranges : the troposphere and the stratosphere. The two systems use two different pairs of wavelengths because the range (and hence required laser power) and the ozone density (larger in the stratosphere) are different. The laser used for the stratosphere is more powerful, with a wavelength not too strongly absorbed by ozone in order to reach the stratosphere.*

### **Wind lidar**

*It is a spectral lidar. The method is based on the measurement of the Doppler shift of the backscattered beam. This is achieved by using two narrow bandwidth Fabry-Perot filters on each wing of the Gaussian envelope. The ratio of the two signals provides a direct measurement of the wind. Two directions and the zenith (for calibration) are sounded*

successively every two minutes to obtain the meridional and zonal winds.

### 1.20 m optical telescope

The 1.20 m telescope, third in size on the OHP site, is entirely dedicated to astronomical imagery and multiple band photometry, with a 1024 x 1024 camera.

7.15 – 7.30 p.m. : Walking from Maison Jean-Perrin to the telescopes (Groups I and II) or the lidar station (Groups III and IV)

7.30 - 9.00 p.m. :  
Group I : 1.20 m optical telescope (**Julie Patris**)  
Group II : 0.80 m optical telescope (**Alain Sarkissian**)  
Group III : ozone lidars and polar ozone campaigns (**Andrea Pazmino**)  
Group IV : temperature and wind lidars (**Philippe Keckhut**)

9.00 - 10.30 p.m. :  
Group I : 0.80 m optical telescope (**Alain Sarkissian**)  
Group II : 1.20 m optical telescope (**Julie Patris**)  
Group III : temperature and wind lidars (**Philippe Keckhut**)  
Group IV : ozone lidars and polar ozone campaigns (**Andrea Pazmino**)

### WEDNESDAY 8 FEBRUARY

9.30 - 10.30 a.m     **Alain SARKISSIAN** : " Ozone sounding ; stratospheric ozone"

10.30 – 10.45 a.m.     Walking to the lidar station

10.45-12.15 a.m.     Ozone balloon sounding from the lidar station (if meteorological conditions are acceptable)

12.30 a.m.             Lunch at "Maison Jean Perrin"

2.00 – 4.30 p.m.       Visit of the 1.93 m and 1.52 m optical telescopes

4.30 – 5.30 p.m.       Coffee interval and sale of OHP postcards, posters and sky maps

6.00 p.m.              Dinner at "Maison Jean Perrin"

**- 7.30 – 10.30 p.m. Visits to the lidars, the 1.2 m and 0.8 m optical telescopes**

7.15 – 7.30 p.m. : *Walking from Maison Jean-Perrin to the telescopes (Groups III and IV) or the lidar station (Groups I and II)*

7.30 - 9.00 p.m. : *Group I: ozone lidars and polar ozone campaigns (Andrea Pazmino)*

*Group II: temperature and wind lidars (Philippe Keckhut)*

*Group III: 1.20 m optical telescope (Julie Patris)*

*Group IV: 0.80 m optical telescope (Alain Sarkissian)*

9.00 - 10.30 p.m. : *Group I: temperature and wind lidars (Philippe Keckhut)*

*Group II: ozone lidars and polar ozone campaigns (Andrea Pazmino)*

*Group III: 0.80 m optical telescope (Alain Sarkissian)*

*Group IV : 1.20 m optical telescope (Julie Patris)*

#### **THURSDAY 9 FEBRUARY**

9.00 – 10.30 a.m. **Jonathan LUNINE** : *“How did the Earth acquire its water and organics? Putting together the meteorite evidence with computer simulations”*

10.30 – 10.45 a.m. Coffee interval

10.45 – 12.15 a.m. **Alain SARKISSIAN** : *“Spectroscopic measurements of stratospheric constituents”*

12.30 a.m. Lunch at “Maison Jean Perrin”

**2.00 – 4.45 p.m. Visit to instruments and data analysis**

2.00 – 2.15 p.m. *Walking from the Maison Jean Perrin to the lidar station*

2.15 – 2.45 p.m. *Group I: Dobson and SAOZ spectrometers (Alain Sarkissian)*

*Group II* : astronomical image processing (**Julie Patris**)

*Group III* : lidars (**Philippe Keckhut**)

*Group IV* : ozone maps (**Andrea Pazmino**)

2.55 – 3.25 p.m.

*Group I* : ozone maps (**Andrea Pazmino**)

*Group II* : Dobson and SAOZ spectrometers (**Alain Sarkissian**)

*Group III* : astronomical image processing (**Julie Patris**)

*Group IV* : lidars (**Philippe Keckhut**)

3.35 – 4.05 p.m.

*Group I* : lidars (**Philippe Keckhut**)

*Group II* : ozone maps (**Andrea Pazmino**)

*Group III* : Dobson and SAOZ spectrometers (**Alain Sarkissian**)

*Group IV* : astronomical image processing (**Julie Patris**)

4.15 – 4.45 p.m.

*Group I* : astronomical image processing (**Julie Patris**)

*Group II* : lidars (**Philippe Keckhut**)

*Group III* : ozone maps (**Andrea Pazmino**)

*Group IV* : Dobson and SAOZ spectrometers (**Alain Sarkissian**)

7.30 p.m. – 1.00 a.m. **Diner de gala at Chateau de Sauvan**

## **FRIDAY 10 FEBRUARY**

10.00 a.m. – 6.00 p.m. **Sightseeing tour**

6.00 p.m. Dinner at “Maison Jean Perrin”

## **SATURDAY 11 FEBRUARY**

**Return from Observatoire de Haute Provence to Grenoble by special bus – arrival in front of the Grenoble railway station around 5 p.m.**

***END OF ERCA 2006***







