ERCA
European Research Course on Atmospheres
Organized by Université Joseph Fourier of Grenoble & CNRS

Université Grenoble-Alpes (UGA)
Centre National de la Recherche Scientifique (CNRS)

European Research Course on Atmospheres – ERCA 2017

Scientific report

ERCA 2017
January 11 – February 9, 2017
Grenoble, OHP

ERCA - Maison des Magistères 25 avenue des Martyrs BP166- 38042 Grenoble Cedex 09 FRANCE
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Scientific report for the 25th session of ERCA 2017

Contents

1. Organisation of the session

This 25th session of the European Research Course on Atmospheres (ERCA) has been the third session directed by Pr. **Didier VOISIN** of the Grenoble-Alpes University in Grenoble. These sessions followed the first 20 sessions directed by Pr. Claude BOUTRON, and two other sessions directed by Dr. Paolo LAJ, both at the Grenoble-Alpes University.

The Director was assisted by the Office of the Grenoble European schools, a management committee and a scientific committee.

The Office of the Grenoble European schools is located at the 'Maison des magistères', a belonging of the Grenoble Alpes University located on the 'Scientific Polygon', in West Grenoble.

The Office of the European schools comprises:

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Dr. Stéphane LA BRANCHE (EDDEN, Grenoble Alpes University)

Dr. Jean LILENSTEN, CNRS / University of Grenoble, France

Dr. Samuel MORIN (CEN Grenoble, Météo France)

Dr. Luc FAVRE (Université Aix-Marseille)

Dr. Alain SARKISSIAN (LATMOS, CNRS Verrières)

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Pr. Peter BRIMBLECOMBE, University of East Anglia, Norwich, UK

Dr. Nathalie POISSON, French Environment and Energy Management Agency (ADEME), Paris, France

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1. Financial supports

The Grenoble-Alpes University and the local CNRS representative ('Delegation Alpes') are our main supports, without which ERCA could not exist. In addition to them, several other institutions trust ERCA and are important funders. These funds are either directly given to ERCA, or specifically attributed to students (to cover registration and travel/housing costs).

Supports from international agencies

- **The Abdus Salam International Centre for Theoretical Physics (ICTP)**: Founded in 1964 by the late Nobel Laureate Abdus Salam, ICTP has been a driving force behind global efforts to advance scientific expertise in the developing world, under the auspices of the Italian government, UNESCO and IAEA
- **Max-Planck Institute for Chemistry (MPIC)**. The leading German agency for funding and managing research, training and knowledge exchange in chemistry. It carries out investigations of the earth system and chemical processes in the atmosphere as well as the interactions between air, water, earth and mankind.
- **Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research (HZG)**: As a member of the Helmholtz Association of German Research Centres, the largest scientific organization in Germany, the Helmholtz-Zentrum Geesthacht is engaged in long-term activities in the fields of materials and coastal research that are making a major contribution to resolving the large and pressing issues facing society and the scientific and business worlds.

Supports from national agencies

- **Institut de Recherche pour le Développement (IRD)** has focused its research for over 65 years on the relationship between man and its environment, in Africa, Mediterranean, Latin America, Asia and the French tropical overseas territories. Its research, training and innovation activities are intended to contribute to the social, economic and cultural development of southern countries.

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- **L'Institut National des Sciences de l'Univers (INSU)** has a national responsability of definition and coordination of research activities in astronomy, Earth sciences, ocean and space sciences. **It** supports participants from developing countries.

- **Meteo-France** is the national agency for meteorology and climatology, especially responsible of meteorological vigileance. **Centre d'Etudes de la Neige (CEN)** in Grenoble is MeteoFrance centre dedicated to snow and avalanche forecast and study.

- **Observatoire de Haute-Provence (OHP)** is a premier observatory site for astronomy, environment, and the study of atmosphere. As a national facility for astronomy it welcomes visiting astronomers. The first exoplanet was discovered at OHP in 1995.

- **IRSTEA** is a research organization which, since more than 30 years, boasts a dual culture of researchers and engineers who tackle environmental matters from three angles: research, innovation and expertise. By studying ecosystems on a countrywide basis, they provide indispensable theoretic knowledge to help understand ecosystems, and work to create solutions to reduce the impacts of human activity on the environment whilst providing expertise on public policies at the request of decision-makers.

- **Aix-Marseille Universite (AMU)** is the largest university in France with 74,000 students; it is located in the French second city along the Mediterranean sea, Marseille, as well as in Aix-en-Provence.

- **Pytheas Institute** is an Earth observatory of Aix-Marseille Universite. It runs the Observatoire de Haute-Provence which hosts ERCA, as well as the Oak observatory at OHP (O3HP), which studies the Mediterranean forest.

- **L'École doctorale des sciences de l'environnement d'Île-de-France (EDSEIF – ED 129)** trains PhD students of the Paris area to become specialists in the pluridisciplinary sciences of the environment, atmosphere, ocean, and continental surfaces. It supports the ERCA program at OHP.

- **L'Observatoire de Versailles Saint-Quentin-en-Yvelines (OVSQ)** is a national Earth observatory. It is run by the University of Versailles Saint-Quentin-en-Yvelines (UVSQ). OVSQ runs the instrumented plateform 'Gérard-Mégie' at the Observatoire de Haute-Provence (OHP). The staff of OVSQ provides a great support to ERCA by organising and managing the ERCA session at OHP.

Supports from local agencies

- **Observatoire des sciences de l'univers de Grenoble (OSUG)** is a geosciences observatory within the University of Grenoble, grouping six laboratories. It supports ERCA with the Labex2020 program.

- **The Physics, engineering, mechanics, and geosciences department (PhITEM)** of the University of Grenoble-Alpes

- **The Collège doctoral (Doctoral school) of the Communauté Université Grenoble-Alpes** manages about 3700 PhD students (of them, 45% foreigners) and is especially responsible for their training. ERCA is part of this training.

- **GIANT partnership** in Grenoble is building links between research and industry to foster breakthroughs in challenges at the forefront of Grenoble research: communicaton technologies, renewable energies, and health/medical science.

- The **Auvergne-Rhône-Alpes** political area is the second in France, and one of the European leaders. It contributes in training 300,000 students, and invests in research and academic activities.

- **Grenoble Alpes Métropole** operates the metropolitan area around Grenoble. It supports its economy, scientific activities, and the universities.

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These supports have been acknowledged regularly, to the participants as well as in our communication means (web site http://erca-school.eu, posters and programs).

3. Course of events

This 25th ERCA session took place from January 11th to February 9th, 2017. The first 4 weeks (11thJanuary to 5th February) took place in Grenoble, in the Maison des Magistères on the CNRS site. The last week (5th to 9th February) took place at the Observatoire de Haute-Provence, close to Forcalquier, in South of France.

Keynote lecture

The key-note lecture of this session was given by Dr. Patrick CRIQUI, director of the EDDEN group specialised on the economy of sustainable development and energy. His lecture, entitled "Governance levels, scientific paradigms and policy instruments for Deep Decarbonization Pathways", focused on decarbonization scenarios and energy transition.

Training programme

The training program of the first 4 weeks in Grenoble comprised a very consistent package of lectures (about 80 hours), proposal building, debates, and poster session during which participants presented their research work.

The session comprised six main thematics:

Atmospheric chemistry & atmospheric composition changes
Earth climate system & the science of climate change
Earth Science system - Impact & society
Experimental techniques & research methodologies for the atmospheric sciences
Hydrology & precipitation: Water cycle in climate change
Planetary atmosphere, solar activity & space weather

The participants have been confronted to very diverse thematic and lecturers, providing them both a global picture of the climatic system, as well as advanced views through specific seminars and tutorials. Currently, no other school than ERCA provides a similar training, which explains the success of ERCA, especially with first year PhD students, as well as with young researchers willing to get to the field of environment. About 50 lectures have been provided by 34 lecturers (Annexe 1). The presentations were available to participants on the ERCA web site. Lectures covered not only scientific problems, but also communication tools for young researchers: how to write a scientific paper and a proposal.

Group project

Since last year, students are asked to collaborate within groups to collectively write a project, that is, a document with detailed propositions in response to a given scientific proposal ('call'). Last year, three calls related to environmental questions were proposed to them.

For the 25th anniversary of ERCA, a special call was proposed, dedicated to the scientific future of students: "Atmospheric and climate sciences in 2040". As a collective work, the students had to collaborate within 6 groups to define scientific domains and problematics of interest, and write a 'white paper' on future directions and expected achievements of research in these domains. The full proposal is in Annexe 3. In total, 9 slots (27 hours) were allocated to this work, supervised by the ERCA staff. These projects were then reviewed by the other groups, in order to get improved. An oral presentation was given by each group at OHP. Six groups emerged with the following proposals:

- **Data acquisition**: *In this paper we explore the position and characteristics of data acquisition in the next 25 years. We introduce and describe the potential development and improvement of the current*

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measurement methods and instruments, and their impact on the current unanswered scientific questions and problems.

- **Geoengineering**: *Our aim is to explore and evaluate the cleaning of earth through three broad principles: the capture and cleaning of aerosols and rain which can yield potential products for reuse; the removal of carbon dioxide (CO_2) from air and oceans to reduce its atmospheric concentration; the storage of CO_2 and the storage of sea-water to counteract sea level rise under the earth's surface. This paper is focused on different cleaning techniques that could be implemented in the near future.*
- **Education and awareness** (of global warming): *Education is an essential element of the global response to climate change. It helps young and adult people understand and address the impact of global warming, encourages changes in their attitudes and behavior, and helps them adapt to climate change related problems.*
- **Data access and uses - The super portal: one stop shop for measurements***: to create a user friendly super web portal containing database which cover the Earth system data observations in general, which includes in situ observations from ground-based stations, buoys, aircraft, radiosondes as well as remote sensing measurements such as those from open path spectrometers and satellite observations.*
- **Translating Science into Policy**: *we discuss scientists roles in informing policy, identify why there are gaps between scientific knowledge and policies, and we suggest how those communication gaps can be overcome in order to reach fact-/evidence-based climate policy in our 2040 vision.*
- **Basic Science**: Which fondamental science domains do we need to support over the next decades, for which achievements in 2040? How these scientific fields will interact; how to promote interactions?

Other trainings

A '**real game**' on climate negociations was organised by Dr. Stéphane La Branche, a specialist of political negociations at IEP Grenoble. The aim for our students was to get some grasp on the way climate negociations really happen, and on political motivations and arguments used within these negociations. Such a negociation typically corresponds to the COP summits organised by UNEP (and more specifically to the COP21 in 2015 which lead to the Paris Agreement on climate).

Three more **informal debates** have been organized at night at Café des Arts, downtown Grenoble, dealing with philosophy of science, political negociations, and the benefit of networking in scientific research.

A **poster session** has been organized during which students presented their research work to the other students and to researchers of the Institut de geosciences de l'environnement (IGE). and discussed with the other students. Three hours were devoted to exchanges in front of posters. The posters were hung up at Maison des Magistères for the rest of the session.

Visit of laboratories / infra-structure

During the session the participants visited the former LGGE and the Coriolis platform.

- The former **Laboratoire de glaciologie et géophysique de l'environnement** (LGGE) is now part of the Institut des géosciences de l'environment (IGE), an Institute of the French National Center for Scientific Research (CNRS) and the Grenoble Alpes-University. The scientific reputation of LGGE is based largely on outstanding research achievements related to the reconstruction of past changes of climate and atmospheric composition during the last climatic cycles from polar ice cores.
- The **Coriolis platform** (see below in tutorials)

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Tutorials

Four tutorials were organized for the participants during the ERCA 2017 session, during a half day. A tutorial was designed as a very special occasion to exchange with specialists around an experimental setup. Each participant had to choose one of the following 4 tutorials:

Planeterrella, proposed by Jean Lilensten (IPAG)

The Planeterrella is an experiment inspired from the Terrella developped by Kristian Birkeland from 1896 to 1917, and is basically an aurora demonstrator for the Earth. Yet, its exceptional flexibility enables us now to simulate all kinds of planetary systems (Uranus and Neptune with their inclined rotation axis, Ganymeda - Jupiter interactions).

Corolis platform, proposed by Joël Sommeria (LEGI)

The Coriolis platform, 13 m in diameter, is the largest rotating platform in the world dedicated to fluid dynamics. Its main activity is the experimental modeling of geophysical flows, taking into account the rotation of the Earth, in the presence or not of density stratification or topography. The large size provides access to the inertial regimes that characterize ocean dynamics, with little influence of viscosity and centrifugal force. Laboratory experiments can thus provide support to model ocean dynamics and develop their physical parameterizations. The platform is run by the LEGI laboratory. It belongs to the European HYDRALAB and EuHIT infrastructures.

Snow monitoring at the Col-de-Porte station, proposed by Samuel Morin (CEN/Météo-France)

A wide range of automated and manual snow and meteorological observations are co-located at the Col-de-Porte station (1325m elevation, ~ 30km away from Grenoble) and serve as: testbed for new instrumentation, establishment of driving/evaluation data for snowpack model development and build-up of climatologically relevant dataset. The practical at Col-de-Porte consisted of an illustration of key snow-related processes (surface energy and mass balance) together with existing and novel instrumentation to probe them (challenges for radiation, precipitation, wind measurements).

Eddy correlation for flux measurements, proposed by Jean-Emmanuel Sicard (IGE)

Exchange fluxes between surface and atmosphere are key processes for meteorology (sensible and latent heat fluxes), but also for biogeochemistry and air quality (CO_2 and other trace gases, aerosol). Measuring those exchange fluxes is thus crucial for many applications and is now mostly done through Eddy Covariance techniques. These use fast collocated measurements of 3D wind speeds and of the variable of interest to evaluate the local flux from the covariance between their fluctuations. In this practical, a sonic mast will be installed with the participants on a lawn, to measure latent and sensible heat fluxes, thus discussing the observational constraints on those measurements. Then the acquired signal will be used to discuss data treatment methods and how these methods need to be adjusted to enable the measurement of chemical fluxes (CO_2 and other trace gases).

Last week of the session at the Observatoire de Haute-Provence

The last week dealt with the study of instruments installed on the site of the Observatoire de Haute-Provence (OHP), directed by Dr Auguste LE VAN SUU. This observatory is a service unit attached to the Observatoire des sciences de l'univers Pythéas (INSU/Aix-Marseille University/IRD/Collège de France), directed by Pr. Bruno HAMELIN. OHP is a premium site for observing:

- atmosphere, with lidars and spectrometers run by the Laboratoire Atmosphères, Milieux et Observations Spatiales (LATMOS) of the University of Versailles-Saint-Quentin-en-Yveline (UVSQ), and with greenhouse measurements by the ICOS network;

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- space, with the historical telescopes of the Observatory (0.8 to 2m), especially the one with which the first exoplanet was discovered in 1995;
- the Mediterranean forest, with the help of an instrumented platform run by the Pythéas OSU and by the research federation ECCOREV (directed by Joël GUIOT);

The principle of the various instruments, operating procedures and applications, has been first presented to the participants by specialists, especially by a group of scientists from LATMOS. Then, the participants have been divided into several groups in order to study the running instruments and to work on measurements.

4. Lecturers

There were 34 lecturers (5 women of them), from 10 countries: France (19), Germany (3), Hong Kong/China (2), Italy (2), USA (2), Israel (2), Finland (1), Croatia (1), United Kingdom (1), and Switzerland (1).

The detailed list of the lecturers with their affiliation is given in Annexe 1.

Lecturers have been proposed by the scientific and management committees. They were selected for their renowned scientific expertise, as well as for their educational abilities.

5. Participants

Thirty three (33) participants have been selected from the 70 applications posted on the ERCA web site. Such elevated number of applications proves the great interest and the reputation of ERCA at an international level. Many researchers who participated to ERCA in the past now send their students train with ERCA. Among these 33 selected participants, 1 eventually arrived late by few days because of problem with a visa.

ERCA 2017 had 19 females and 14 males (i.e. 58% of women), with 20 different nationalities:

Australia (1), Belarus (1), Brazil (1), Canada (1), Chile (1), China (1), Finland (1) France (2), Germany (4), Hungary (2), India (4), Iran (1), Lebanon (1), Lithuania (1), Malaysia (1), Nigeria (2), Romania (1), Russia (5), Sweden (1), UK (1).

They are working in 15 different countries:

Australia (3), Belarus (1), Brazil (1), Chili (1), France (4), Germany (5), Hungary (1), India (4), Iran (1), Lithuania (1), Nigeria (2), Rumania (1), Russia (4), Sweden (2), UK (2).

The list of participants can be found in Annexe 2, which includes their position and research thematic.

The age of the participants ranges from 23 to 44 years, with a median value of 28,6 years.

32 participants are undergrad or PhD students,1 is researcher.

The selection of participants was multi-criteria: the research thematic, the laboratory, the country and the possibility to get a visa; the possibility to get funded, the advisor support.

Grants have been allowed to 14 participants, to cover the whole or partial registration cost. The origins of these grants are the following:

LabEx OSUG@2020: 5 grants

Abdus Salam International Center for Theoretical Physics: 2 grants

INSU: 3 grants

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IRD: 3 grants

Fostering sciences / GIANT/CEA : 1 grant

6. Detailed Program

The daily program is given in Annexe 4.

7. ERCA Community

One of the ERCA strengths is to facilitate exchanges between lecturers and participants, and between participants themselves, in order to create a multidisciplinary scientific community dealing with the ERCA thematics. Selection of candidates has been made to have a very representative panel of participants from both well-established research institutions and fast-developing research institutions from emerging countries. Half of participants originate from countries with emerging economies as defined by UNO representing all different continents. In addition, invitation to lecturers from developing countries completes the clear ERCA strategy to offer students a course that responds to actual needs in countries outside the OECD, in particular the very strong problem of air pollution.

It is important to note that many students from emerging economies are involved into ERCA through their advisors, often themselves former ERCA participants. ERCA intends to continue being at the forefront of post-graduate education provided at international level and opened to all different countries. The organization of ERCA has been pro-active to create the conditions for exchange amongst participants, by ensuring participants of balanced origin and gender and providing special opportunities to meet throughout the session.

In addition to the regular coffee breaks, the Monday scientific debates were followed by dinners which were opportunities to exchange with lecturers. One day trip was also organized: a snowshoe trip took place on the first Saturday –although based on volunteering all participants were there.

8. Evaluation

Evaluating the lectures and the whole session organization is our major concern. For three years now, such an evaluation is done by the participants through the ERCA web site, which allows us to get digital results and to compute them quickly. Satisfaction of participants is one of the parameters accounted for when selecting lecturers and when modifying the program of ERCA. A survey is proposed both on lectures and on the general organization of ERCA.

Concerning the quality of the lectures, participants have been asked to grade each of them using one of the following grades: « *Very good* », « *good* », « *average* » or « *bad* ». The results for this session show a very high level of satisfaction (cf. Figure below)

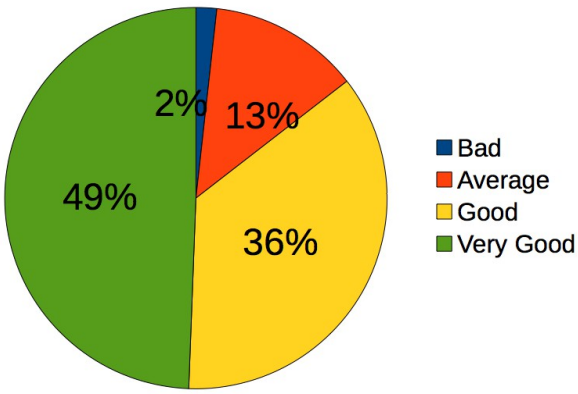

Figure: The results of evaluation of the ERCA lectures (based on 915 answers).

ERCA benefits from a long term process of selecting lecturers, which allows us to provide top quality lectures. A special feature of ERCA is also to keep, year after year, a core of highly motivated and active lecturers. The satisfaction level is consistently very high. In addition to evaluating ERCA, participants also gave comments and

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propositions for improvement, which will be of course accounted for when organizing the next session.

9. Impacts and fallouts

The overall objectives for the 2017 sessions of ERCA have been reached: to offer high-quality training, both theoretical and practical, to offer access to state-of-the-art equipment, to favor multidisciplinarity, and finally create and stimulate scientific exchange between lecturers and students of different geographic and scientific origins. This can be measured by the satisfaction survey organized anonymously for participants, expressing a high degree of satisfaction with the scientific level of lectures, and the overall organization.

ERCA international visibility probably contributes to the very high international ranking of the University Grenoble Alpes (UGA) in the Earth and environmental sciences. For instance, the 2016 QS World University Rankings places UGA at the 51-100 level for Earth sciences and environmental studies.

ERCA is a recurrent yearly event. Next year session will be held in January/February 2018. Some modifications will be implemented in the 2018 program, based on the evaluation of the 2017 session. The main part of the program will be defined by the end of May 2017 and announced via electronic mailing lists in June 2017. The internet site of the school (http://erca-school.eu) will be used for announcements and for registration.

ERCA is one of the reference training in the atmospheric science and climate fields for the international scientific community. We hope that ERCA contributes to gather and train young scientists from all over the world.

Acknowledgements

We have to acknowledge all the personal contributions which made ERCA 2017 another great session. We are especially grateful to the very kind staff of Café des Arts and of OHP.

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Annexe 1: ERCA 2017 Lecturers

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Annexe 2: The ERCA 2017 participants

Family name	First name	Nationality	Age	Thesis/research	Affiliation
ACHARYA	Asutosh	India	27	Aerosol-precipitation interaction over Indian regions	School of Earth, Ocean and Climate Sciences, Indian Institute of Technology, Satyanagar, INDIA
BESSARDON	Geoffrey	France	27	Boundary layer activity in West Africa	School of Earth and Environment, University of Leeds, UK
BUKOSA	Beata	Hungary	28	Modelling of greenhouse gases in Australia and the Globe on multiple scales	School of Chemistry, University of Wollongong, Australia
DOREENA ANAK	Dominick	Malaysia	34	Particle Number Size Distribution in a Urban-Marine Environment	School of Chemistry, University of Wollongong, Australia
EKELUND	Robin Nils	Sweden	28	Single Scattering Properties of Ice Particles (cloud and precipitation)	Department of Earth and Space Science, Chalmers University of Technology, Gothenburg, Sweden
GHOMASHI	Fatemeh	Iran	34	Study of atmospheric aerosols over northwest area of Iran by space-borne LIDAR measurements, Satellite Data and Meteorological Data	Institute for Advanced Studies in Basic Sciences, Zanjan, Iran
GREENSLADE	Jesse	Australia	30	Modelling isoprene emissions through a top down inversion of formaldehyde over Australia	School of Chemistry, University of Wollongong, Australia
GUBENKO	Inna	Russia	27	A study of physical processes in convective clouds during thunderstorms based on numerical simulation	Hydrometeorological Research Centre of Russian Federation, Moscow, Russia
HADAD	Dani	Lebanon	30	Analysis of atmospheric water vapor, cyrus and associated dynamic processes	LaMP, Aubière, France
JOERSS	Hanna	Germany	30	Per- and Polyfluorinated Substances in the Aquatic Environment	Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research, Geesthacht, Germany
MOTTUNGAN	Kavitha	India	29	Studies on organic components in ambient air over Indian region	Space Physics Laboratory, Vikram Sarabhai Space Center, Kerala, India
KIVIRANTA	Joonas	Finland	26	Mesospheric Nitric Oxide	Department of Earth and Space Science, Chalmers University of Technology, Gothenburg, Sweden
KOSHELEV	Dmitry	Russia	25	Ground based FITR monitoring of CO2	LERMA, UPMC, Paris, France
KRIVENOK	Liudmila	Russia	25	Methane and carbon dioxide fluxes from different ecosystems: examples of spatial generalizations	A.M.Obukhov Institute of Atmospheric Physics Russian Academy of Sciences, Russia

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Family name	First name	Nationality	Age	Thesis/research	Affiliation
LI	Jing	China	29	Modeling/Investigation of long-range atmospheric transport and air/sea exchange of emerging persistent organic pollutants in the marine environment	Helmholtz-Zentrum Geesthacht Centre for Materials and Coastal Research, Geesthacht, Germany
MENDONÇA MACEDO	Fernanda De	Brasil	44	Bioaerosol Laser Remote Sensing in Cubatão Region	Centro de Laser e Aplicações, Cidade Universitária, São Paulo
OGHAGHARE	Ese Freeman	Nigeria	32	Levels of indoor air pollutants and the perception of its associated health problems among rural women in Ibadan	Dpt of Environmental Health Sciences, Faculty of Public Health, College of Medicine, University of Ibadan, Nigeria.
PAPP	Enikö	Hungary	26	Characterization of urban aerosol pollution using ion beam analytical and complementary techniques	University of Debrecen, Hungary
PAURAITE	Julija	Lithuania	26	Application of the aerosol mass spectroscopy for the assessment of biomarkers	Center for Physical Sciences and Technology, Vilnius, Lithuania
PFANNERSTILL	Eva	Germany	28	Using OH reactivity and VOC measurements to understand atmospheric chemistry in pristine and polluted environments	Max-Planck-Institute for Chemistry, Mainz, Germany
RETTINGER	Ricarda	Germany	29	Weighting climate model projections considering model performance and model interdependence	German Aerospace Center, Institute of Atmospheric Physics, Wessling, Germany
SHAH	Adil	UK	23	Measurement of greenhouse gases using unmanned aerial vehicles	Centre for Atmospheric Science, University of Manchester, UK
SILIUK	Volha	Belarus	24	Cross-calibration of multispectral images of Belarussian satellite and others aerospace system with atmospheric correction	A.N. Sevchecnko Research Institute of Applied Physical Problems, Minsk, Belarus
SKAKUN	Aleksandra	Russia	24	Insolation and its role in global climate changes as revealed by the nonlinear chaotic dynamics method	Central Astronomical Observatory of the Russian Academy of Sciences, St-Petersburg, Russia
TETZNER	Dieter	Chili	27	Stable water isotopes as climate tracers	Center for Climate and Resilience Research, Santiago, Chile
THUPSTAN	Angchuk	India	30	Glacio-meteorological and hydrological study of Patsio glacier: A field based measurements in Himachal Pradesh Western Himalaya	School of Environmental Sciences, Jawaharlal Nehru University, New Delhi, India

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Family name	First name	Nationality	Age	Thesis/research	Affiliation
TIGNAT-PERRIER	Romie	France	27	Microorganisms in the atmosphere	IGE, Université de Grenoble, France
TOMSCHE	Laura	Germany	30	Trace gas transport out of the Indian summer monsoon	Max-Planck-Institute for Chemistry, Mainz, Germany
TRIPATHI	Nidhi	India	26	Emission sources of Volatile Organic Compounds in Earth Atmosphere	Space and Atmospheric Sciences Division, Ahmedabad, India
UGBOMA	Emeka	Nigeria	32	An Investigation of Greenhouse gas Inventory in Tropical Africa	Imo State University, Owerri, Nigeria
VAIDEANU	Petru Cosmin	Rumania	32	Investigating natural and anthropogenic variability through climate modes	Faculty of Physics, Atmosphere and Earth Science, Bucharest University, Ilfov, Romania
VAZAEVA	Natalia	Russia	27	The forecasting of the atmospheric boundary layer characteristics by sodars and temperature profiler data assimilation	Laboratory of geophysical hydrodynamics, Moscow, Russia
WING	Robin	Canada	30	Rayleigh Lidar retrievals	LATMOS, Guyancourt, France

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Annexe 3: The proposal for the collective project of the 25th ERCA session

ERCA 2017 collective project: atmospheric and climate sciences in 2040

ERCA requires you to work on a collective science-writing project, to foster teamwork and literature review on diverse subjects. For the 25th anniversary of ERCA, the project is dedicated to your future. As experience shows, YOU will be managing the atmospheric sciences in 25 years from now. So this year's group project will be for you to build up your vision of atmospheric and climate sciences in 25 years from now, their place in society and relation with other sciences; and to describe possible paths that could lead to that vision, and how these paths are visible in today's science.

Scientific bodies and agencies regularly produce documents meant to plan for the future. These are typically called strategic plans or implementation plans[1]. They are written by senior scientists in charge of managing those bodies or agencies, with input from a larger community. They mostly deal with near future projections (5 – 7 years). They analyze the present and project it in the near future, taking into account the missions given to the agency. Agencies managers typically use them as a guide for financial priority making.

Other planning documents written by scientists include white papers[2]. These are typically written by a research community to set goals for itself, and organize its activity. Like agencies strategic plans, they are written with a large community input, and aim at a time horizon depending on the typical time scale of big projects in the community. It might be ~ 5-10 years for field communities, and up to 20+ years for space science related projects (including satellites). They are normally quite focused on one scientific issue.

Scientists also contribute to drawing perspectives for their field through regular publications in scientific journals. Some of them actually feature special sections for that (e.g. Atmospheric Environment's "Correspondence", Science's "Perspectives" or Nature's "Comments"[3]). These contributions are very focused, pointing to a nagging or emerging issue in a given. Finally, journals themselves, such as Nature contribute through some more journalistic articles analyzing and commenting on some emerging trends[4].

1 Some strategic plans: NCAR, ncar.ucar.edu/directorate/documents/ncar-strategic-plan-2014-2019; NASA, science.nasa.gov/about-us/science-strategy ; NOAA, nrc.noaa.gov/CouncilProducts/ResearchPlans.aspx; ESA, doi:10.1016/j.spacepol.2014.07.009

2 Some example of white papers: Ocean – Atmosphere – Sea Ice – Snowpack initiative : oasishome.net/WP/white-paper/; Surface Ocean – Lower Atmosphere Study (SOLAS, one of « Future Earth » global projects) : www.solas-int.org/about/future_solas.html

3 Ex. : Rinne et al, 2016, doi:10.1016/j.atmosenv.2016.02.005: *Simple, stable, and affordable*. Saiz-Lopez, A. and Blaszczak-Boxe, C. S., 2016, doi:10.1016/j.atmosenv.2016.09.019: *The polar iodine paradox*. Stott, P., 2016, doi:10.1126/science.aaf7271: *How climate change affects extreme weather events*. Watson, A. J., 2016, doi:10.1126/science.aaj2321: *Oceans on the edge of anoxia*. El-Chichakli et al, Nature 2016, doi:10.1038/535221a: *Five cornerstones of a global bioeconomy*.

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Although very diverse, most of these documents often share a common philosophy: they extend the present state of science in identified directions. More rarely, these kind of documents describe a long term vision (several deacades), and a path leading to that vision from existing trends. This might happen more frequently in e.g. white papers for some very novel satellite missions, as these typically span over more than a decade from concept to launch to scientific results to wide spread applications.

As ERCA turns 25, we know from experience that some of you will be managing, leading atmospheric and climate sciences in 25 years from now. The generation that started ERCA in 1992 is the generation that saw atmospheric chemistry established as a modern science having deep implications in everyone's lives and in state's policymaking: the Convention on Long-range Transboundary Air Pollution was signed in 1979, and the Montreal Protocol in 1987 (with the related Nobel Prize in 1995); the first IPCC report was delivered in 1990. Those who attended the first sessions of ERCA have contributed to populate the sky with earth observing satellites, to develop earth system models and ever more sophisticated observation networks; and we have seen the Kyoto Protocol and the Paris Agreement being signed. We continued the work of our predecessors, while taking it in directions that made sense to us.

Today, our question to you, is: where do you imagine YOU will take atmospheric and climate sciences in 25 years from now? What is **your collective vision** of what YOU want your field to be in 25 years from now? What are the directions for this field that make sense to YOU?

More specific questions that might help you develop the precise vision needed for this project include:

- Which problematic(s) would you like your scientific field to face in 25 years from now? These can be theoretical, technical, related to social needs and expectations, …
- What are the problems you would like to have solved in the meantime? How do you propose to solve these problems? Again, these are not necessarily limited to technological problems and solutions, and may include external conditions for realization.
- How do you imagine atmospheric and climate sciences to relate to other sciences (biology and ecology, mathematics and data sciences, sociology and economical sciences, …) and to society? What are its tools (technical but also methodological)? What do you imagine atmospheric and climate sciences will be used for? How?
- What would you like the role of atmospheric and climate scientists to be in 25 years from now? More generally, what do you think would be possible jobs for students of atmospheric and climate sciences in 2040? What skills will be necessary to work in the field by that time?

You will certainly have varying opinions and ideas on those questions. But we want you to build a consensus on a vision more or less common to the whole group, and deliver it as a collection of short

4 Jones, N.: *Mini satellites prove their scientific power*, Nature, doi:10.1038/508300a, 2014. Landhuis: *Scientific literature*, Nature, doi:10.1038/nj7612-457a, 2016.

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papers exploring each a given aspect of that vision and the path(s) that could lead to it, starting from today's emerging picture.

This collective project will thus be led in 3 phases:

- Phase 1 (sessions 1 and 2): generate a detailed description of a desired future end point (the vision) in as much detail as possible.
  This will first be done through discussing your individual aspirations in small groups (brainstorming, session 1), then share those with the entire group to let emerge 4 to 6 principal themes making consensus (session 2). These themes will be the themes developed in the final individual papers.
  This phase is important, as it will structure phase 2. Think hard, be bold, don't censor yourself!!! The better (more comprehensive) the initial structure, the smaller the risk to have to modify it during phase 2
  As some of you might be unfamiliar with actual group work, do not forget the following general principles for it to be effective: Be benevolent! Listen, don't judge! Be cooperative! Distribute Roles! Keep track of time!
- Phase 2 (sessions 2 to 7): after working groups are adjusted to fit the number of themes that emerged from phase 1, each group will work on his own paper developing the chosen theme.
  Some small cues:
  - Use the Suggested Task List to structure the work in the group, and the session planning suggested below to stay in the general timing.
  - Do not forget to organize your group. Set Roles! Exercise leadership (not all at once)! Accept responsibility! Keep track of time!
  - Beware that the ensemble of papers should reflect some general vision from the entire ERCA student group, so you will probably need some "inter-group" discussions as well. This is where you'll keep an eye on the general structure.

  Initial drafts of each paper should be ready by end of session 7 for internal cross-review (session 8).
- Phase 3 (sessions 8 to the end): review groups will be set up and each review group will have session 8 to review one of the other groups' papers, and suggest improvements. Such improvements will be implemented during sessions 9-10, at the end of which a final version will be due (before departure to OHP). A final oral presentation of your work will occur at OHP on the last day.

Suggested Task List:

- Research on emerging and predicted climate and atmospheric sciences developments, disruptive technologies in neighboring fields, changes in educational methods, and similar areas that might interact with climate and atmospheric sciences.

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- Review the current long-term goals of important agencies for our field (e.g. NOAA, NCAR, NERC, CNRS, ESA, Copernicus[5], …). Compare them with their counterparts in your own countries, if such documents are available.
- Identify current and potential future atmospheric and climate sciences stakeholders in the public and private sectors (think along the lines of environmental services).
- Create a list of key challenges facing atmospheric and climate sciences, climate and environmental services, and associated endeavors.
- Envision the skills, knowledge, infrastructures and methods necessary to address the challenges.
- Explain how atmospheric and climate scientists could provide these specific skills and knowledge, developing its unique culture and partnerships with other sciences.
- Recommend new approaches (educational, technological, management, …) to keep atmospheric and climate sciences at the forefront of the rapidly changing environment.
- Define a full 25 year path leading to your vision, considering the potential results of intermediate short-term strategies, together with a set of parameters that could track the development of this path

Project planning:

1. Thursday 12/01	13:45 – 17:00	3 hrs	Presentation of the project. Individual aspiration in small groups, brainstorming.
2. Monday 16/01	13:45 – 17:00	3 hrs	Consensus building on general scope; definition of the working themes
3. Wednesday 18/01	13:45 – 17:00	3 hrs	Research on each theme
4. Thursday 19/01	10:45 – 17:00	4.5 hrs	Don't forget to coordinate between groups
5. Monday 23/01	13:45 – 17:00	3 hrs	Initial drafts should circulate in each group
6. Wednesday 25/01	13:45 – 17:00	3 hrs	Research/work
7. Thursday 26/01	10:45 – 12:15	1.5 hrs	First draft completed
8. Friday 27/01	10:45 – 12:15	1.5 hrs	Drafts reviewed from group to group
9. Tuesday 31/01	10:45 – 15:15	3 hrs	Final draft > reviews by the other groups
10. Thursday 02/02	15:15 – 17:00	1.5 hrs	Oral presentation preparation should start
11. OHP	At night	1 hour	Final details on oral presentations
12. OHP			Final public presentation (20 min per paper)

5 Copernicus Services: www.copernicus.eu; www.earthobservations.org/vision.php; www.ecmwf.int/en/about/what-we-do/environmental-services;

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Role of ERCA lecturers and organizing committee:

- Phase 1:
  - Introduce students to group work (be benevolent; listen, don't judge; be cooperative; distribute roles; keep track of time; exercise leadership; accept responsibility…)
  - Help the group brainstorm to develop the required vision to be shared on session 2
    - What do you want? What do you not want?
    - Foster the reflexion of the group in
- Phase 2:
  - Provide feedback to the groups as needed, eventually putting them in contact with the right persons (specially when they exist in Grenoble)
  - Probe for divergences amongst the groups to promote interactions and deeper thinking in the groups

- Phase 3:
  - Chair the review groups
  - Give an independent evaluation of the final version of the papers

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NB: the programme is always subject to change
in case of cancellation or strong weather perturbations.

> First 4 weeks: Wednesday 11th January to Friday 3rd of February 2017 - Grenoble

Lectures are at the Maison des Magistères (cf. 'Practical Information') with very few exceptions.

WEEK 1: GRENOBLE

Tuesday 10 January 2017	
17.00-21.00	**Welcome of ERCA2017 Participants** at the hall of Residence Marie-Curie
19.00-21.00	**Buffet for ERCA2017 Participants** at the Residence Marie-Curie

Wednesday 11 January 2017 IMAG / auditorium	
10.00-10.30	**Welcome Coffee** IMAG building, 700 rue Centrale, University campus, 38400 Saint Martin d'Hères
10.30-11.15	**Official opening - Amphitheatre at IMAG building** By **ERCA director** and representatives of ERCA main supports
11.15-12.15	**Keynote lecture Gaël GIRAUD**, economist, Director of Agence Française de Développement: Climate change and development aid
12.15-14.00	**Buffet** IMAG
14.00-15:30	**Francis Codron** Fondamentals on atmospheric dynamics
15.30-16.00	**Coffee break**
16.00-17.30	**Eugene Clothiaux,** Atmospheric radiation: basic physics and concepts
18.30	**Ice-breaking party** Café des Arts, downtown, 36 Rue Saint Laurent, Grenoble (the plan is on page 20)

→ Official Opening

	Thursday 12/01/2017 Maison des Magistères	Friday 13/01/2017 Maison des Magistères
9.00-10.30	**Francis Codron** *Fondamentals on atmospheric dynamics*	**Eugene Clothiaux** *Radiation through clear and cloudy atmospheres*
10.30-10.45	Coffee break	Coffee break
10.45-12:15	**Ralf Ebinghaus** *Emission sources, regional and global distribution of atmospheric mercury*	**Ralf Ebinghaus** *Emission sources, regional and global distribution of persistant organic pollutants (POPs)*
12.15-13.45	Lunch at H2 cafeteria	Lunch at H2 cafeteria
13.45-15.15	**Introduction of the project** **Didier Voisin & Jean Lilensten**	**Eugene Clothiaux** *Radiation and Remote Sensing: A Few Current Applications*
15.15-15.30	*Break*	*Break*
15.30-17.00	**Introduction of the project** **Didier Voisin & Jean Lilensten**	**Francis Codron** *Fondamentals on atmospheric dynamics*

→ Saturday 14th January 2017: snowshoes day trip organized by ERCA

ERCA will organize a snowshoe day trip.

Do not forget to bring:

- → Warm and waterproof clothes (gloves are very important)
- → Waterproof shoes/boots (if possible, sturdy ankle boots)
- → Sun glasses and cream (if the weather is sunny…)
- → A backpack
- → A bottle of water and your own picnic

Participants will be transported to Belledonne mountains by a special bus. Departure at 8 am from your hotel. Arrival by 17 pm at your hotel. The trip will be accompanied by professional mountain guides. Snowshoes and walking poles will be provided.

WEEK 2: GRENOBLE

	Monday 16/01	Tuesday 17/01	Wednesday 18/01	Thursday 19/01	Friday 20/01
9.00-10.30	**Peter Brimblecombe** Air pollutants and their health impact	**Peter Brimblecombe** Indoor air pollution	**Anne Monod** Secondary organic aerosol in the troposphere: formation, fate and impacts (part 2)	**Tao Wang** Photochemical ozone and smog in China: insights learned from several large research projects	**Poster session IGE/LGGE**
10.30-10.45	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
10.45-12.15	**Anne Monod** Atmospheric chemistry and photochemistry	**Caroline Brimblecombe** Developing focus and productivity in academic and technical writing	**Tao Wang** Air pollution in China: a review of control efforts, their effectiveness, and challenges	**Project work**	**Poster session IGE/LGGE**
12.15-13.45	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch Buffet at IGE/LGGE
13.45-15.15	**Project work**	**Peter Brimblecombe** Climate change and cultural heritage	**Project work**	**Project work**	**Coriolis / IGE-LGGE visits**
15.15-15.30	Break	Break	Break	Break	Break
15.30-17.00	**Project work**	**Anne Monod** Secondary organic aerosol in the troposphere: formation, fate and impacts (part 1)	**Project work**	**Project work**	**Coriolis / IGE-LGGE visits**
18.30	Debate: *Café des arts* **Jean LILENSTEN** "Philosophy of science"				Participants take their posters with them in order to expose them on Monday 23rd in Maison des Magistères

WEEK 3: GRENOBLE

	Monday 23/01	Tuesday 24/01	Wednesday 25/01	Thursday 26/01	Friday 27/01
9.00-10.30	**Markus Quante** The role of clouds in climate and environment	**Jed Kaplan** The co-evolution of the Earth System and human civilizations over the preindustrial Holocene TBC	**Stéphane La Branche** Climate game Introduction	**Yoav Yair** From ions to thunderstorms: a review of atmospheric electricity	**Carlo Barbante** Ice-core records of climate and atmospheric chemistry
10.30-10.45	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
10.45-12:15	**Benoît Hingray** Climate variability, renewable energy production and decision scaling	**Markus Quante** Clouds and precipitation physics	**Irène Xueref-Rémy** The carbon cycle	**Give back project**	**Yoav Yair** Lightning in the solar system and beyond
12.15-13.45	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria
13.45-15.15	**Project work**	**Jed Kaplan** The role of land surface processes in the climate system: Global modeling of biogeophysical and biogeochemi-cal feedbacks	**Project work**	**Give back project**	**Stephane La Branche** Climate game
15.15-15.30	Break	Break	Break	Break	Break
15.30-17.00	**Project work**	**Barbara Nozière** Aerosols and warm cloud formation	**Project work**	**Carlo Barbante** Ice core records as archives of past climate and atmospheric composition	**Stephane La Branche** Climate game
18.30	Debate: *Café des arts* **Julien le Sommer** Emails revolutionized scientific research; what about social media?				

WEEK 4: GRENOBLE

	Monday 30/01	Tuesday 31/01	Wednesday 01/02	Thursday 02/02	Friday 03/02
9.00-10.30	**Mark Flanner** Snow and Climate	**Jasa Calogovic** Composite analysis and Monte Carlo methods, an example with Forbush decreases and cloud cover	**Yinon Rudich:** From deserts to reefs: global processes of mineral dust	**Andreas Richter** Nitrogen oxides in the troposphere-sources, distributions, impacts and trends	**Filippo Giorgi** Climate change and the hydrologic cycle
10.30-10.45	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
10.45-12.15	**Ilya Usoskin** The variable Sun (solar magnetic activity and cycles)	**Evaluation panels**	**Andreas Richter** Satellite measurements of troposphere composition: principles, results, and future developments	**Ilya Usoskin** The Heliosphere and solar wind	**Julien le Sommer** Role of the oceans in the climate system: processes and time-scales
12.15-13.45	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria	Lunch at H2 cafeteria
13.45-15.15	**Jasa Calogovic** A cosmic ray–cloud link and cloud observations	**Evaluation panels**	**Yinon Rudich:** Optical properties of aerosols : theory and new measurement methods	**Filippo Giorgi** Regional climate modeling; update and CORDEX developments	
15.15-15.30	Break	Break	Break	Break	**Tutorials**
15.30-17.00	**Thierry Pellarin** Hydrology as a boundary condition for the atmosphere (TBC)	**Yinon Rudich:** Primary Biological Aerosol Particles: Climate, ice and health	**Mark Flanner** Snow and Climate	**Project rework**	
18.30	Debate: *Café des arts* **Stéphane La Branche** Debriefing of the climate game				

DAY 1 OHP

Sunday 5/02/2017	
8.00	Departure from Grenoble, residence Marie-Curie to OHP
12.00	Arrival at OHP "Maison Jean Perrin"
12.30-14.00	Lunch at Maison Jean Perrin (buffet)
14.00-15.00	Settling the participants in their rooms at Maison Jean Perrin
15.00-15.45	**Alain Sarkissian: Presentation of the "Observatoire de Haute-Provence"** (movie theatre)
15.45-16.00	Coffee break
16.00-17.00	**Julien Jumelet : Lidar technique for Atmosphere observations** (movie theatre)
17.00-18.00	**Luc Favre: Astronomical observations at OHP and elsewhere**
18.00-20.00	Diner at Maison Jean Perrin
20.00-21.00	Group 1: Astronomy on open sky (Luc Favre) Group 2: 80 cm telescope (Alain Sarkissian) Group 3: Visit of Observatory (Julien Jumelet) Group 4: Work on Practicals
21.00-22.00	Group 4: Astronomy on open sky (Luc Favre) Group 1: 80 cm telescope (Alain Sarkissian) Group 2: Visit of Observatory (Julien Jumelet) Group 3: Work on Practicals
22.00-23.00	Group 3: Astronomy on open sky (Luc Favre) Group 4: 80 cm telescope (Alain Sarkissian) Group 1: Visit of Observatory (Julien Jumelet) Group 2: Work on Practicals
23.00-00.00	Group 2: Astronomy on open sky (Luc Favre) Group 3: 80 cm telescope (Alain Sarkissian) Group 4: Visit of Observatory (Julien Jumelet) Group 1: Work on Practicals

DAY 2

Monday 6/02/2017	
9.00-10.30	**Irène Xueref-Rémy: "Observing atmospheric gases"** (movie theatre)
10.30-10.40	Coffee break
10.40-11.20	Group 1: Practical on CO2 measurements (Irène Xueref-Rémy) Group 2: Atmospheric spectroscopy from scratch (Didier Voisin) Group 3: Practical on Lidar inversion (Julien Jumelet) Group 4: Visit of Oak Observatory (Jean-Philippe Orts)
11.20-12.00	Group 4: Practical on CO2 measurements (Irène Xueref-Rémy) Group 1: Atmospheric spectroscopy from scratch (Didier Voisin) Group 2: Practical on Lidar inversion (Julien Jumelet) Group 3: Visit of Oak Observatory (Jean-Philippe Orts)
12.00-13.45	Lunch at Maison Jean Perrin
13.45-14.30	Visit of the 193 cm telescope (Luc Favre)
14.30-15.10	Group 3: Practical on CO2 measurements (Irène Xueref-Rémy) Group 4: Atmospheric spectroscopy from scratch (Didier Voisin) Group 1: Practical on Lidar inversion (Julien Jumelet) Group 2: Visit of oak Observatory (Jean-Philippe Orts)
15.10-15.50	Group 2: Practical on CO2 measurements (Irène Xueref-Rémy) Group 3: Atmospheric spectroscopy from scratch (Didier Voisin) Group 4: Practical on Lidar inversion (Julien Jumelet) Group 1: Visit of oak Observatory (Jean-Philippe Orts)
15.50-16.10	Coffee-Break
16.10-17.40	**Philippe Keckhut: Observation of climate changes with NDACC instruments** (movie theatre)
18.00-20.00	Dinner at Maison Jean Perrin
20.00-00.00	**Lidars and Telescopes**
20.00-22.00	Group 1: 0.80 m optical telescope (Luc Favre) Group 2: Mimosa (Alain Sarkissian) Group 3: Ozon Lidars (Andrea Pazmino) Group 4: Temperature and wind lidars (Philippe Keckhut)
22.00-00.00	Group 2: 0.80 m optical telescope (Luc Favre) Group 1: Mimosa (Alain Sarkissian) Group 4: Ozone lidars (Andrea Pazmino) Group 3: Temperature and wind lidars (Philippe Keckhut)

DAY 3

Tuesday 7/02/2017	
10.00-11.00	**Jean-Marc Ané: "Is nuclear energy sustainable"** (movie theatre)
11.00-11.15	Coffee break
11.15-12.15	**Jean-Marc Ané: "Is nuclear energy sustainable" continued** (movie theatre)
12.30-14.00	Lunch at Maison Jean Perrin (buffet)
14.00-15.30	**Andrea Pazmino: Spectroscopic measurements of stratospheric constituents** (movie theatre)
15.30-15.50	Coffee break
15.50-16.30	Group 1: Dobson and SAOZ spectrometers (Andrea Pazmino) Group 2: Lidars (Julien Jumelet) Group 3: Visit of the 152 cm telescope (Luc Favre) Group 4: Preparation of Ozone sondes (Alain Sarkissian)
16.30-17.10	Group 2: Dobson and SAOZ spectrometers (Andrea Pazmino) Group 3: Lidars (Julien Jumelet) Group 4: Visit of the 152 cm telescope (Luc Favre) Group 1: Preparation of Ozone sondes (Alain Sarkissian)
16.30-17-30	**Alain Sarkissian : Open discussion**
18.00-20.00	Dinner at "Maison Jean Perrin"
20.00-00.00	**Visit to the lidars and observation with 0.80 m optical telescope**
20.00-22.00	Group 3: 0.80 m optical telescope (Luc Favre) Group 4: Mimosa (Alain Sarkissian) Group 1: Ozone lidars (Andrea Pazmino) Group 2: Temperature and wind lidars (Philippe Keckhut)
22.00-00.00	Group 4: 0.80 m optical telescope (Luc Favre) Group 3: Mimosa (Alain Sarkissian) Group 2: Ozone lidars (Andrea Pazmino) Group 1: Temperature and wind lidars (Philippe Keckhut)

DAY 4

Wednesday 8/02/2017	
	Visit to instruments and data analysis
10.00-10.40	Ozone balloon launch + Coffee break
10.40-11.20	Group 3: Dobson and SAOZ spectrometers (Andrea Pazmino) Group 4: Lidars (Philippe Keckhut) Group 1: Visit of the 152 cm telescope (Luc Favre) Group 2: Preparation of Ozone sondes (Alain Sarkissian)
11.20-12.00	Group 4: Dobson and SAOZ spectrometers (Andrea Pazmino) Group 1: Lidars (Philippe Keckhut) Group 2: Visit of the 152 cm telescope (Luc Favre) Group 3: Preparation of Ozone sondes (Alain Sarkissian)
12.00-14.00	**Lunch at Maison Jean Perrin**
14.00-15.30	Projects: Final presentations
15.30-16.00	Coffee break
16.00-17.00	Projects: Final presentations
18.00	Departure by bus to the Gala-dinner at Château Sauvan
18.30-00.00	**Diner-Gala at Château Sauvan**
00.00	Departure for OHP from Château Sauvan by bus

DAY 5

Thursday 9/02/2017	
9.00	Departure from Maison Jean Perrin for Grenoble
14.00	Arrival to Grenoble, Railway station