AIR² Access to INFRASTRUCTURES for Radiation protection Research

Issue 19
July 2017

CONCERT CORNER

Editorial

The end of the OPERRA project marks another step in the integration process. OPERRA has mainly been the brainstorming forum to prepare for the future. CONCERT WP6 "Access to Infrastructures" will benefit from much of the ground work performed during OPPERA. OPERRA has widened our knowledge of radiation protection research infrastructures in new EU Member States, and has highlighted the process of national and EU road mapping including ESFRI projects versus landmarks. This is described in the final report, in the survey of infrastructures inside and outside of the radiobiology/radioprotection fields and their applicability to the radioprotection community. A chapter of the survey is dedicated to proposals to establish a common basis for the first supporting documents (Charter, Guidelines) to facilitate access to infrastructures.
Our thanks to Jean-René and his colleagues for their commitment to a such challenging coordination - the first of its kind to attempt to integrate the different scientific communities on low dose research, radioecology, dosimetry, emergency preparedness and medical exposure of healthy tissue.
Dr Laure Sabatier, CEA

The floor to...

Easy open access to data and material from legacy, current and future studies in radiation science

A key criterion for progress in research and development is the efficient sharing of data and bioresources. In task 6.2 strategies and tools are being developed to facilitate and sustain access to data and material from legacy, current and future studies in radiation science. The principle aim of subtask 6.2.1 is to develop and maintain the STORE data platform and to work with the community to meet its needs for data sharing, plus the dissemination of information about other data sources and biomaterials[1]. The range of domains covered by STORE is very wide and encompasses radioecology, with data and archives created within the STAR and COMET projects, such as FREDERICA, experimental science, and epidemiology.

Maintaining STORE
Strategies for a better exploitation of databases for archived data and biological material

The imperative for data sharing is simply summarised:

- Data produced with public money should be made public to benefit society,
- Restrictions on the use of public data impede scientific progress,
- Open data is the best way to combat misconduct and errors in the literature, and to improve public trust in the scientific enterprise.

Radiobiological science forms the basis for radiological protection guidelines, and this community in particular has an obligation to be as transparent and open as possible, to retain the trust of legislators and the public.
The requirement for open access to scientific publications and to research data has been formally signalled by the European Commission, as shown in the Horizon 2020 Guidelines from March 2017[2]. However, resistance to data sharing is not being addressed adequately by journals and there is also a lack of significant investment in data repositories, a problem pointed out in a recent Nature Editorial[3]. The radiation science community, in contrast, has taken legacy and prospective data issues seriously, and the STORE database is one of very few research area dedicated databases open to all data types. To date STORE has more than 80 studies including large datasets.
Within CONCERT-EJP, it is indicated that post-publication research data, should be made available as far as possible via open access in STORE or in another open, searchable database. The work in Subtask 6.2.1. will help to implement and facilitate this approach for researchers and our wider stakeholders.

Dr Ulrike Kulka
BfS
CONCERT WP6.2.1

Photo: BfS/SG1

(1) http://www.storedb.org)
(2) http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf
(3) Nature Editorial, Vol. 546, 12 June 2017, 327

This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 662287

Future events:

Second Funding Decision meeting:

July 27th 2017, Munich, Germany

WP 6 News:

Second Technical Periodic Report session is open

Next WP6 meeting:

October 10th, Paris, France
During the ICRP-ERPW

AIR²D²:
- Please complete the online form(s) to register your infra-structure(s) in the database.
- A new option to feature your infrastructure is now

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MICADO'LAB Experimental Platform

Effects on ecosystems of chronic exposure to gamma radiation

On 22 May 2017, the French Institute for Radiological Protection and Nuclear Safety (IRSN) inaugurated its new irradiation platform. MICADO'Lab (Moyen d'Irradiation Chronique pour l'Acquisition de relations DOse effet en Laboratoire) is an external gamma irradiation platform designed to study the effects on ecosystems of chronic exposure to ionising radiation.

MICADO'Lab is designed to cover the reference values for the ecosystem's protection and the band of dose rates (see graph) that could potentially result in deleterious effects in individuals from the different types of Reference Animals and Plants (Derived Consideration Reference Levels, DCRLs). The MICADO'Lab platform, set up on the Cadarache site (Bouches du Rhône, France), consists of an air-conditioned irradiation hall measuring 4 m in width, 35 m in length and 5 m in height, which is able to accommodate experimental equipment for the exposure of different biological models (cell cultures, plants and animals). Four ^{137}Cs sources are used to irradiate the organisms at dose rates ranging from 5 µGy/h to 100 mGy/h. The irradiation period of between a few hours and several weeks means that chronic exposure of one or more generations can be carried out.

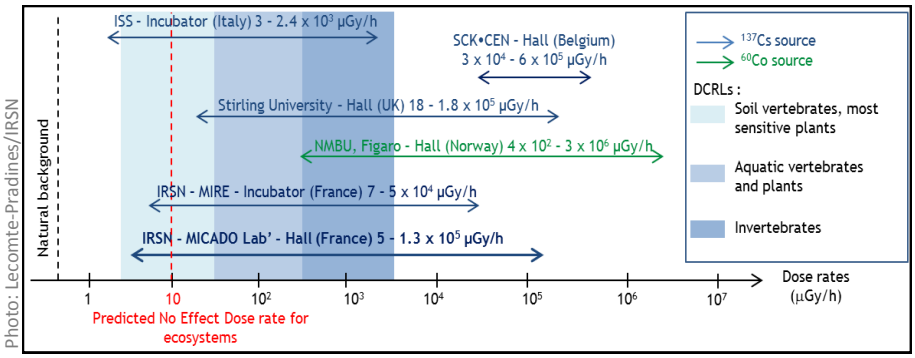


Photo: Lecomte-Pradines/IRSN

Comparison of MICADO'Lab and other European facilities
(reference value for ecosystem protection and DCRLs are indicated)

MICADO'Lab is open for scientific collaboration, especially on research conducted within the framework of European projects. This irradiation platform offers unique exposure conditions that complement the conditions offered by other European facilities, particularly in terms of the radiation energy and the range of dose rates that can be applied.

The research for which the facility is being used aims to:

- understand the mechanistic links between the effects observed at different biological levels (from molecules to individuals), in particular to identify early markers of toxicity (biomarkers),
- characterise and compare the radiosensitivity of species,
- evaluate the transgenerational effects (heritability, reversibility, adaptation),
- characterise the effects on the structure and function of ecosystems.

These studies are conducted on model organisms that are widely used in ecotoxicology (e.g. the zebrafish *Danio rerio*, the nematode *Caenorhabditis elegans* and the daphnid *Daphnia magna*) distinguished by their life cycle and radiosensitivity (see additional graph 1). Breeding facilities are available for such vertebrate and invertebrate species. Growth-chambers are also available for the research on plants and experiments with contaminated soils.

Photo: C. Adam-Guillermin/IRSN

Dr Christelle Adam

MICADO'Lab is part of a wider IRSN platform dedicated to the ECOtoxicology of Ionising Radiation & Trace Metals (ECORITME), allowed to host experiments using a wide spectrum of radionuclides. The effects of ionising radiations are measured experimentally from molecular level to individual level. Establishing the links between the different biological levels relies on the use of modelling tools (see analytical platform ECORITME page 4). The platform offers:

- analytical support consisting of physiology, cellular and molecular biology, biochemistry, microscopy and dosimetry laboratories, which are essential for characterizing radiation-induced effects at different biological levels;
- modeling support for performing and improving predictive ecological risk assessments for chronic exposure to low doses of ionising radiation and/or metals, in isolation or in mixtures (speciation-bioavailability relationships, dose-effects relationships, mixture exposure and effects models, PBPK models, individual to population extrapolation, ecological risk).

MICADO'Lab control room and view of the irradiation hall

Photo: Francesco Acerbis/IRSN

Gagnaire B et al. (2015) External gamma irradiation-induced effects in early-life stages of Danio rerio. Aquat Toxicol 169:69
Parisot F et al (2015) DNA alterations and effects on growth and reproduction in Daphnia magna during chronic exposure to gamma radiation over three successive generations. Aquat Toxicol 163: 27-36

IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

ID Card:

Exposure type: External

Source: ^{137}Cs (4x111 GBq)

Dose rate: 5 µGy/h to 100 mGy/h

Irradiation type: gamma

Irradiated organism type: model organisms in ecotoxicology (nematode, daphnid, zebrafish, plants…)

Address:
IRSN/PRP-ENV/SERIS
Bât. 159 – Cadarache, B.P. 3
13115 Saint Paul Lez Durance
France

Access: Joint research collaborations only

Supporting lab: cellular biology laboratory, breeding facilities, analysis platform (physiology, cellular and molecular biology, biochemistry, microscopy), dosimetry

Internet link:
http://www.irsn.fr/FR/Larecherche/outils-scientifiques/installations-moyens-experimentaux/Micado-Lab/

Contact: micado-lab@irsn.fr

Related to: ALLIANCE, MELODI

ESTCHERN COHORT

Cohort Study of Chernobyl clean-up workers from Estonia

The Estonian cohort study of Chernobyl clean-up workers was set up in 1992 at the Institute of Experimental and Clinical Medicine (now the National Institute for Health Development), in collaboration with US and Finnish colleagues and with major funding from the National Cancer Institute (USA). The aim of the study was to contribute to the knowledge on the long-term health effects of the Chernobyl accident. The cohort consists of 4,831 men from Estonia who worked in the Chernobyl area between 1986 and 1991. Initial information gathered for each individual includes name, date of birth, place of residence, date of arrival in and departure from Chernobyl, and documented whole-body radiation dose. Follow-up of the cohort members through the national population registry, to get unique personal identification numbers and update their vital status, is almost complete (0.4% of subjects untraced). By 31 December 2014, 108,331 person-years at risk (mean 22.5) had accumulated. Two-thirds of the men were sent to the contaminated area in 1986; their mean age was 31 years, mean duration of the service 102 days, and documented mean radiation dose 99 mGy.

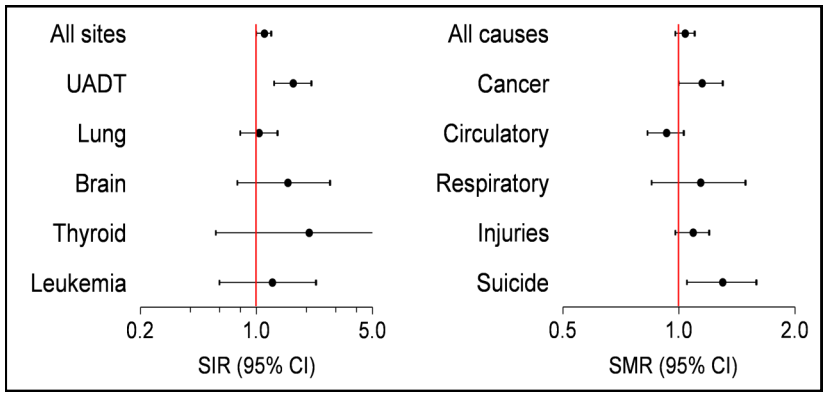
Several sub-studies were carried out: 1) A self-administered questionnaire (1992–1995, 3,888 responses) was a major source of information on service in Chernobyl, health behaviour and socio-demographic characteristics, 2) Biodosimetry (1992–1996, blood samples from 3,197 men) which incorporated the GPA locus mutation assay and FISH chromosomal translocation analyses confirmed the low mean dose of 100–110 mGy, 3) Thyroid screening (1995, 1,984 screenees) did not reveal higher prevalence of thyroid nodules or thyroid cancers in the cohort, 4) Minisatellite mutation frequency among post-Chernobyl offspring (1999, 147 families) was slightly (not significantly) increased compared to their pre-Chernobyl siblings, 5) Follow-up for cancer incidence through the cancer registry (1986–2012, 369 cases) showed borderline overall cancer risk; there were 10 leukaemias *vs* 8.03 expected, and 4 thyroid cancers *vs* 1.93 expected; significant excess was evident for UADT* cancer, 6) Mortality in the cohort (1986–2014, 1,176 deaths) was similar to that expected; the risk of suicide among clean-up workers has been persistently 30 % higher than in the male population (94 suicides *vs* 72.15 expected), 7) Non-cancer morbidity analysis (2004–2012, 3,680 clean-up workers *vs* 7,631 unexposed men) revealed an elevated risk for diseases of the thyroid gland (not related to year of arrival) and ischaemic heart disease; clean-up workers experienced an excess of alcohol-induced conditions and external causes of morbidity, and 8) A mental health questionnaire (2010, 614 clean-up workers *vs* 706 unexposed men) demonstrated the increased risk of suicide ideation, depressive disorders and alcohol dependence in the cohort.

No clear evidence of adverse health effects of radiation exposure among clean-up workers has been observed, however small risks may have been undetectable.

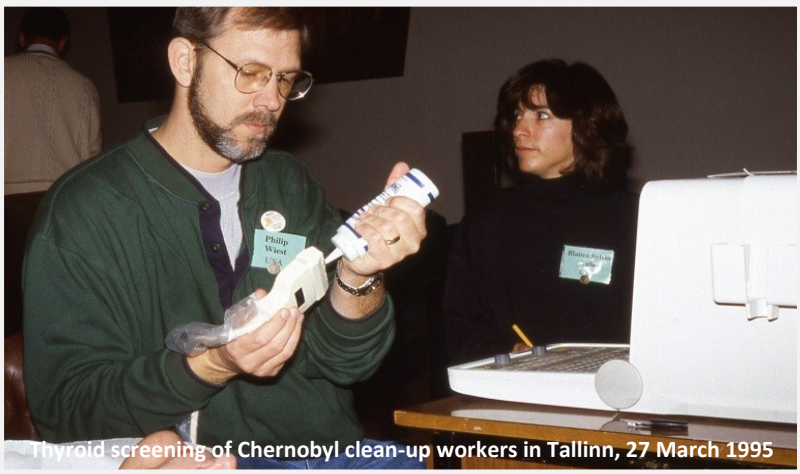
*Upper AeroDigestive Tract

Photo: K.Rahu (selfie)

Dr Kaja Rahu



Cancer incidence and mortality in the cohort of Chernobyl clean-up workers in comparison with the Estonian male population



Thyroid screening of Chernobyl clean-up workers in Tallinn, 27 March 1995

Photo: M.Rahu/NIHD

ID Card:

Cohort type:
Chernobyl clean-up workers from Estonia; individual records of 4,831 men exposed to low-dose ionising radiation after the Chernobyl accident

Age/follow-up:
Age at exposure: 18–68 years; follow-up for site-specific cancer incidence and cause-specific mortality

Biobank available: Yes

Sample type:
Primary lymphocytes (from 3,197 clean-up workers)

Sample storage conditions:
-80°C, liquid nitrogen

Conditions of use:
External use possible

Access:
Subject to permission from the Scientific Resource Committee

Internet link:
http://www.tai.ee

Contact:
Kaja Rahu
Department of Epidemiology and Biostatistics
National Institute for Health Development Tallinn, Estonia
kaja.rahu@tai.ee
Tel. +372 659 3943

Related to: MELODI

Rahu K, Rahu M, Tekkel M, Veidebaum T, Hakulinen T, Auvinen A et al. (2015) Chernobyl cleanup workers from Estonia: cohort description and related epidemiological research. J Radiol Prot;35:R35–R45.

Rahu K, Auvinen A, Hakulinen T, Tekkel M, Inskip PD, Bromet EJ et al. (2013) Chernobyl cleanup workers from Estonia: follow-up for cancer incidence and mortality. J Radiol Prot 2013;33:395–411.

ECORITME

ECOtoxicology of Ionising Radiation and Trace Metals

The **ECORITME** platform is specialized in the field of "**ECO**toxicology of **M**etals and **I**onising **R**adiation". It combines analytical tools, modeling developments and advanced statistics. **ECORITME** offers all the required skills for performing and improving predictive ecological risk assessment for chronic exposure to low doses of ionising radiation. It is also designed for studying complex toxicant exposure (from the external media to the molecular targets including dynamic transformations, biokinetics, and interactions in mixtures) through the development of advanced and innovative in vitro models and analytical methods.

Photo: C. Adam-Guillermin/IRSN

Dr Christelle Adam

ECORITME allows the controlled exposure of experimental units from micro- to large-scales, to external gamma irradiation and/or internal contamination with alpha- or beta-radionuclides alone or in combination with metals or organic compounds. It offers the possibility to use various biological models such as unicellular algae, plants, invertebrates (e.g. the waterflea *Daphnia magna*, the nematode Caenorhabditis elegans) or fish (e.g. the zebrafish *Danio rerio*, including fish cells such as ZF4). A phytotron and growth-chambers complement the platform for the research on plants and experiments with contaminated soils. **ECORITME** includes 1200 m^2 of laboratory space (plus 1600 m^2 of associated technical zones and radioactive waste/effluent treatment areas). The laboratories are authorized to host experiments using a wide spectrum of radionuclides (82 radioisotopes including ^{3}H, ^{14}C, ^{137}Cs, isotopes of Pu, Am, U…) in compliance with the current regulations.

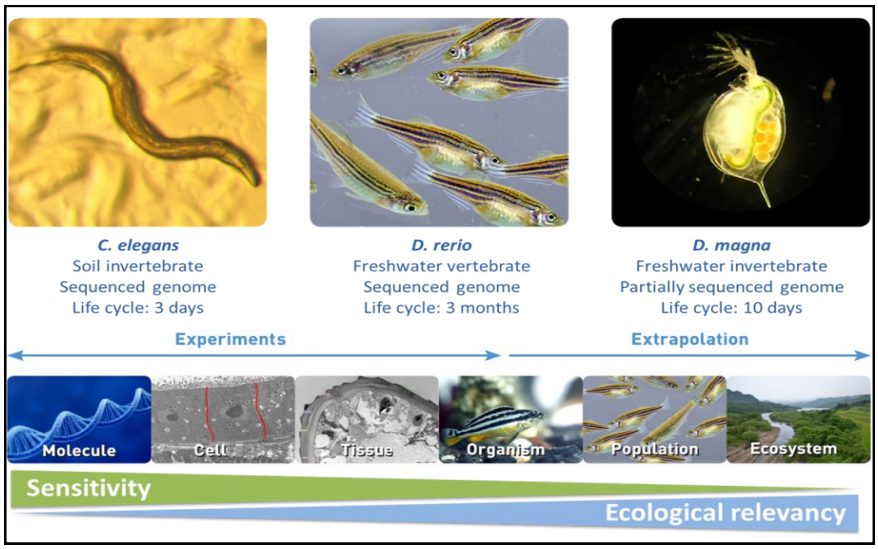


Photo: IRSN

Main biological models used in the ECORITME platform and various levels of biological organisation at which effects are measured, combining sensitive and ecologically relevant responses

ECORITME offers supports as follows: (i) Modeling skills and tools for : speciation and bioavailability (Biotic Ligand Model), dosimetry (**EDEN** model), dose-effects, mixture exposure and effects, individual to population effect extrapolation, biostatistics for field data, bioinformatics and system biology, ecological risk; (ii) An integrated technical platform (analytical equipment, organism husbandry, and exposure laboratories). This platform allows experiments to be performed under controlled conditions for various biological models with or without the use of radioactive tracers and/or ionising radiation, and/or any chemical elements such as metals; (iii) A unique tool with **MICADO'Lab** equipment (see Exposure platform page 2). An innovative field of application of this equipment is to that is allows perfect control of the delivered energy. Thus enabling manipulation of the red-ox status of any biological object.

Photo: IRSN

Devices used to detect low concentrations of metals and their chemical forms (top), and Transmission Electronic Microscope used for histological and microlocalisation analyses (bottom)

ID Card:

Analytical platform type:

Use of biochemistry, immunochemistry, microscopy, transcriptomics, proteomics to characterize biological responses:

- DNA damages
- Oxidizing stress,
- Neurotoxicity,
- Immunotoxicity…

Quantification of trace and major elements, radionuclides and their speciation in environmental and biological matrices

Main techniques proposed:

- Coulter-Counters,
- Flow cytometer,
- Epifluorescence microscope,
- Apotome,
- Transmission Electronic Microscope with EDAX probe for elementary analysis,
- Confocal microscope (ZOOM plateau),
- Ultramicrotome,
- Cryomicrotome,
- PCR, Rt-qPCR,
- 2D-electrophoresis,
- Incubators for cell culture or organisms maintenance,
- ICP-MS, ICP-OES,
- HPLC,
- Gamma spectrometry,
- Liquid scintillation,
- SLRT…

Access:

Analytical tools available for joint research collaborations only

Internet link:

http://www.irsn.fr/EN/Research/Research-organisation/Research-units/environment-unit/LECO/

Contact:

christelle.adam-guillermin@irsn.fr

Related to: ALLIANCE, MELODI

Alonzo F., Hertel-Aas T., Réal A., Lance E., Garcia-Sanchez L., Bradshaw C., Vives i Batlle J., Oughton D. H., Garnier-Laplace J. (2016). Population modelling to compare chronic external gamma radiotoxicity between individual and population endpoints in four taxonomic groups. Journal of Environmental Radioactivity 152: 46-59

Armant O., Kewin Gombeau, Sophia Murat El Houdigui, Magali Floriani, Virginie Camilleri, Isabelle Cavalie, and Christelle Adam-Guillermin (2017). Zebrafish exposure to environmentally relevant concentration of depleted uranium impairs progeny development at the molecular and histological levels. PLoS One 12(5): e0177932.

AIR²

Access to INFRASTRUCTURES for Radiation protection Research

Issue	Exposure platforms	Databases, Sample banks, Cohorts	Analytical platforms, Models & Tools
Published to date:			
Oct 2015, #1	FIGARO	FREDERICA	RENEB
Nov 2015, #2	B3, Animal Contamination Facility	The Wismut Cohort and Biobank	The Hungarian Genomics Research Network
Dec 2015, #3	Pulex Cosmic Silence	STORE	METABOHUB
Feb 2016, #4	SNAKE	French Haemangioma Cohort and Biobank	Dose Estimate, CABAS, NETA
Mar 2016, #5	Radon exposure chamber	3-Generations exposure study	PROFI
Apr 2016, #6	Biological Irradiation Facility	Wildlife TransferDatabase	Radiobiology and immunology platform (CTU-FBME)
May2016, #7	CIRIL	Portuguese Tinea Capitis Cohort	LDRadStatsNet
Jun 2016, #8	Mixed alpha and X-ray exposure facility	Elfe Cohort	ERICA Tool
Jul 2016, #9	SCRS-GIG	RES^{3}T	CROM-8
Sep 2016, #10	Facility radionuclides availability, transfer and migration	INWORKS cohort	France Génomique
Oct 2016 #11	LIBIS gamma low dose rate facility ISS	JANUS	Transcriptomics platform SCKCEN
Nov 2016, #12	Microtron laboratory	EPI-CT Scan cohort	CATI
Dec 2016, #13	Nanoparticle Inhalation Facility	UEF Biobanking	The Analytical Platform of the PRE-PARE project
Feb 2017, #14	Infrastructure for retrospective radon & thoron dosimetry	Chernobyl Tissue Bank	HZDR Radioanalytical Laboratories
Mar 2017, #15	Alpha Particles Irradiator Calibration Laboratory at KIT		SYMBIOSE
Apr 2017, #16	Changing Dose rate (SU) Low dose rate (SU)		Advanced Technologies Network Center
May 2017, #17	Chernobyl Exclusion Zone	Chernobyl clean-up workers from Latvia	BfS whole and partial body Counting
Jun 2017, #18	MELAF	Belgian Soil Collection	INFRAFONTIER
Jul 2017, #19	MICADO'LAB	Estchern Cohort	ECORITME
Coming soon:			
Sep 2017, #20	To Be Announced	To Be Announced	To Be Announced

Future events:

CONCERT Short Courses

3-7 July 2017

Uncertainty analysis in low dose radiation epidemiology
ISGLOBAL, Barcelona, Spain
Contact:
elisabeth.cardis@isglobal.org

Other Training Courses

25 October 2017

From Nuclear data to a relaible estimate of spent fuel decay heat
SCK•CEN, Mol,Belgium
Jointly organized by:
JRC, Geel & SCK•CEN Academy for Nuclear Science and Technology
Contact:
SCK•CEN Academy website

Other Events

3-8 September 2017

ICRER 2017, 4th International conference on Radioecology and Environmental Radioactivity,
Berlin, Germany

10-12 October 2017

Joint ICRP-RPW 2017
Paris, France

5-11 November 2017

MICROS 2017, 17th International Symposium on Microdosimetry,
Venice, Italy
See also on CONCERT website

Editorial Committee: Jean-Michel Dolo, Elisabeth May, Laure Sabatier

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