304011/00

COLLABORATIVE RESEARCH AGREEMENT "MONOIL"

BETWEEN:

The Institute of Research For Development, a public institution of a scientific and technological nature, n° SIRET 180006025 00159, code APE 7219Z, the head office of which is located at 44, boulevard de Dunkerque, "Le Sextant", CS 90009, 13572 Marseille Cedex 02, France,
Represented by its President, Mr Michel Laurent, who has delegated its signing authority to Mr Bernard DREYFUS, General Director of Science

Hereinafter referred to as "**IRD**"

AND

The CENTRE NATIONAL de la RECHERCHE SCIENTIFIQUE,
public establishment for scientific and technological research, whose registered office is at 3 rue Michel Ange 75794 Paris Cedex 16, France, SIREN no. 180 089 013, APE/NAF code 7219Z,
Represented by its Director General, Mr Alain FUCHS,
Who has delegated the *Délégué Régional* for "délégation Midi-Pyrénées et Aquitaine", Mr Patrick Mounaud, to act on his behalf for the purposes of this Agreement (decision of 21 January 2010 giving delegation of signing a regional delegate for the coordination of partnership agreements)

Hereinafter referred to as "**CNRS**"

AND

The UNIVERSITY Toulouse Paul Sabatier
public establishment of scientific, cultural and professional nature whose registered office is at 118 Route de Narbonne - 31062 Toulouse Cedex 9, France,
Represented by its President, Mr. Bertrand MONTHUBERT.

Hereinafter referred to as "**UT3**"

AND

The UNIVERSITY Toulouse Le Mirail,
public establishment of scientific, cultural and professional nature whose registered office is at 5 allées Antonio Machado, 31058 TOULOUSE Cedex 9 France,

Represented by its president, Mr. Jean-Michel MINOVEZ.

Hereinafter referred to as "**UT2**"

AND

The UNIVERSITY Toulouse Capitole,
public establishment of scientific, cultural and professional nature whose registered office is at 2 Rue du Doyen-Gabriel-Marty, 31042 Toulouse France, represented by its president, Mr. Bruno SIRE;

Hereinafter referred to as "**UT1**"

AND

The UNIVERSITY of Bordeaux,
public establishment of scientific, cultural and professional nature whose registered office is at 35 place Pey Berland, 33000 BORDEAUX, France,
Represented by its President, Manuel Tunon de Lara;

Hereinafter referred to as "**UB**"

AND

The UNIVERSITY of Montpellier 1,
public establishment of scientific, cultural and professional nature whose registered office is at 5 bd Henri IV - CS 19044, 34967 Montpellier Cedex 2 France,
Represented by its President, Mr. Philippe AUGÉ;

Hereinafter referred to as "**UM1**"

AND

The UNIVERSITY of Montpellier 2,
public establishment of scientific, cultural and professional nature whose registered office is at 2 Sciences et Techniques - Place Eugène Bataillon - 34095 Montpellier Cedex 5 France,
Represented by its President, Mr. Michel ROBERT.

Hereinafter referred to as "**UM2**"

AND

National polytechnic institute of Toulouse
public establishment of scientific, cultural and professional nature whose registered office is

Represented by its president Dr. Olivier Simonin

Hereinafter referred to as "**INPT**"

IRD, UT3 and CNRS acting in the name and on behalf of Unit GET « Geosciences Environnement Toulouse », directed by Dr. Michel Grégoire;

IRD, acting in the name and on behalf of Unit LTHE «Laboratoire d'etude des Transferts en Hydrologie et Environnement", directed by Dr. Thierry LEBEL;

UB and CNRS acting in the name and on behalf of Unit EPOC « Environnements et Paléoenvironnements Océaniques et Côtiers », directed by Dr. Antoine Grémare;

UT1 and CNRS acting in the name and on behalf of the Unit LEREPS Study Laboratory and Research on Economy, Politics and Social systems (UMR MA 119; équipe d'accueil 4212 UT1 capitole) directed by Dr Charilaos Kephaliacos;

UT2 and CNRS acting in the name and on behalf of the Unit GEODE Laboratory Of Environmental Geography (UMR 5602) directed by Dr Didier Galop;

UT3 and CNRS acting in the name and on behalf of the Unit IMRCP Laboratory of molecular Interactions and chemical and photochemical reactivity (UMR 5623) directed by Dr Monique MAUZAC;

UM1, UM2, IRD and CNRS acting in the name and on behalf of Unit HSM "Hydrosciences Montpellier" , directed by Dr. Eric Servat;

UT2 and CNRS acting in the name and on behalf of the Unit CERTOP directed by Dr. Vincent Simoulin,

CNRS, UT3 and INPT acting in the name and on behalf of the Unit ECOLAB, Laboratory of functional ecology and environment, directed by Dr. Jean-Luc Probst,

AND

National Polytechnic School,
public establishment of academic and scientific nature whose registered office is at Ladron de Guevera E11-253, Quito, Ecuador,
Represented by Ing. Jaime CALDERÓN;

Hereinafter referred to as "**EPN**"

AND

The UNIVERSITY of Guayaquil
public establishment of academic and scientific nature whose registered office is at Ciudadela universitaria, Salvador Allende, en la Avenida Kennedy s/n y Avenida Delta. Guayaquil, Ecuador, Represented by Dr. Carlos CEDEÑO NAVARRETE;

Hereinafter referred to as "**UG**"

AND

The UNIVERSITY San Francisco de Quito
private establishment of academic and scientific nature whose registered office is at Cumbayá, Diego de Robles y Vía Interoceánica, Quito, Ecuador,
Represented by Dr. Santiago GANGOTENA GONZÁLEZ;

Hereinafter referred to as "**USFQ**"

AND

The UNIVERSITY Simon Bolivar of Quito, based in Ecuador
public establishment of academic and scientific nature, institution of public international law whose registered office is at Avenida Toledo N22-80, Quito, Ecuador,
Represented by Dr. Enrique AYALA MORA;

Hereinafter referred to as "**UASB**"

AND

The Ministry of Environment, through the management team of the Programa de Reparación Ambiental y Social, PRAS,
public establishment of governmental nature whose registered office is at Av. la Coruña E25-58 y San Ignacio, Edificio Altana Plaza, Tercer piso, oficina 302, Quito-Ecuador,
Represented by its director, Ing. José Ignacio MARTÍNEZ VEGA;

Hereinafter referred to as "**PRAS**"

AND

The Bureau of health, safety and environment management of the Ecuadorian national PETROECUADOR Company,
public establishment of scientific nature whose registered office is at Calle Alpallana E8-86 y Av. 6 de Diciembre, Quito, Ecuador,

Represented by its Gerente General, Ingeniero Marco CALVOPIÑA V;

Hereinafter referred to as "**EP PEC**"

IRD, CNRS, UB, UT1, UT2, UT3, UM1, UM2, INPT, EPN, UG, USFQ, UASB, PRAS and EP PEC are hereinafter referred to as "the Parties".

WHEREAS

ANR "Partners":

The GET has expertise in the field of geology, geochemistry, environmental and social sciences at the crossroad with human health and vulnerability.

The EPOC has expertise in the field of environment and paleo-oceanic and continental aquatic environment study. It has a long experience in the study of sources, fluxes and fate of organic pollutants and trace metals in aquatic environments

The LEREPS has expertise in economics and sociology. It is a multidisciplinary research centre (economics, management, sociology and regional and urban studies) organised around two main topics: 1) Space and Territories; 2) Organisational Dynamics.

The GEODE has expertise in the Environmental Geography (biodiversity, water quality, natural reserves, environmental and landscape history), using methods and tools as diverse as remote sensing, geographic information systems, social investigations, archive research and paleo-environmental sciences.

The IMRCP has expertise in molecular chemistry. It develops organised molecular systems and studies processes of therapeutic or environmental interest. The originality of the «Systèmes Moléculaires Organisés et Développement Durable » research group lies in its innovative synthetic engineering of Organised Molecular Systems (OMS) with the research of concepts for a new chemistry for a sustainable development.

The HSM has expertise in water studies and on the impact of environmental disturbance. Axe 1 entitled "Biogeochemistry, Contaminants and Health" deals specifically with the impact of contaminants on environment and human health.

The National Polytechnic School of Ecuador, EPN, has expertise in the field of food and environmental chemistry and in aquatic biology.

The MAE-PRAS (Environmental and Social Reparation Program from the Environment Ministry) has expertise in the management of the information, valuation and formulation of norms and methodologies, in the development of environmental and social tools of management at national level, contributing and articulating the construction and application of the public policy.

The public company EP Petroecuador has expertise in oil exploitation, transport and refinery.

Additional participants who won't receive ANR funds:

In Ecuador:
The University of Guayaquil, UG, has expertise in the field of complex system modelling and informatics.
The University San Francisco of Quito, USFQ, has expertise in the field of environmental geochemistry.
The University Andina Simón Bolivar has expertise in social and health studies.

In France:
The LTHE has expertise in the field of atmospheric contamination studies due to human activities.
The ECOLAB has expertise in the field of ecotoxicity monitoring in aquatic and terrestrial ecosystems.
The CERTOP has expertise in sociology of organizations and public action applied to environmental problems.

Given their complementarities, the Parties proposed the Research Project « **MONOIL: Monitoring of Oil activities in Ecuador: a cross-disciplinary approach between Environment, Health and People** », and applied to the **ANR** (Agence Nationale de la Recherche) **SOCENV** (Society and Environment) Call, in May **2013**.

The ANR approved the Project and notified, the 4th of July, 2013, the total funding to the French participants. The exact amount funded by the ANR is 861 000 Euros. The teams began to work on the Project from the **January 15th, 2014 for 42 months** (till July 14th, 2017).

It should be noted that a non-funded partner, the Central University of Ecuador (UCE), withdrew from the project after the funding notification of ANR. Tasks 3 and 6 of the program, in which the UCE had to get involved, are taken over by other partners.

Regarding the Ecuadorian participation, the partners are submitting a parallel project to the SENESCYT (National Science and Technology Secretary of Ecuador), called MONOIL-SENESCYT. The total support asked to the SENESCYT for the project is 3,8 millions of US$ (2,8 millions Euros on December, 19th 2013).Rights and obligation of Ecuadorian Partners implied on this project are conditioned to its approval by SENESCYT.

Both projects have been articulated jointly by their participants depending on their expertises and interests, with coordinated tasks.

The PARTIES wishes, by this Agreement, specify the practical details for the realization of the Project and agree on their corresponding rights and obligations.

NOW THEREFORE THE PARTIES AGREE AND STATE AS FOLLOWS:

SECTION 1 – PURPOSE OF THIS AGREEMENT

The Parties decide to conduct a joint study. The study supported with ANR funding, hereinafter referred to as "the Study" or "the Project" entitled:
« MONOIL: Monitoring of Oil activities in Ecuador: a cross-disciplinary approach between Environment, Health and People » A detailed programme of the Study appears in APPENDIX 1 enclosed herewith.

SECTION 2 – DEFINITIONS

Words beginning with a capital letter in this Agreement shall have the meaning defined herein:

Agreement: means this Agreement plus its Annexes and its potential amendments.

Confidential Information: means any and all information and/or data, in any form and of any nature whatsoever, that is disclosed by a Party to one or several other Parties under this Agreement, subject to the disclosing Party having clearly and unambiguously stated its confidential nature or, in the event of oral disclosure, that the disclosing Party states its confidential nature orally when it is disclosed and confirms such nature in writing within fifteen (15) days. The Parties agree that Foreground is Confidential Information.

Know-How: body of knowledge or information of a technical, trade or business nature, substantial, secret or not immediately accessible to the public and transmittable.

Previous Know-How: Know-How acquired prior to, or independently of, this Agreement and which have been necessary at any time whatsoever to carry out the Study and potential improvements of the Previous Know-How achieved in this Agreement.

New Know-How: Know-How developed achieved in this Agreement but which is not considered as improvements of the Previous Know-How.

Results deriving from the Study or Foreground: results, including New Know-How, arising out of the cooperation, that is to say anything that will result, at any time whatsoever, of this Agreement, whether or not protectable or protected by intellectual property rights.

Knowledge not arising from the Study or Background : Knowledge not arising from the Study means any information and scientific and/or technical knowledge i.e. know-how, secret processes, trade secrets, data, software in its source code version or in its object code version, files, plans, diagrams and figures, designs, formulae and/or any other type of information, whatever its form, whether it is patentable or not and/or whether it is patented or not, which is needed for carrying out the Study and belongs to or is held by each Party prior to the entry into force of this Agreement, or is acquired or developed by a Party

independently from the Study, as well as copy rights and other intellectual property rights pertaining to such information.

Co-ordinators: the scientific managers in charge of the coordination of the Study MONOIL (ANR funds), Mrs Sylvia Becerra from CNRS and Mrs Laurence Maurice from IRD. The project submitted to SENESCYT funding will have its own Ecuadorian Co-ordinators.

Work: means the activities/tasks undertaken by the Parties within the framework provided by the Project and under this Agreement, as specified in Annex 1 of this Agreement.

Field of Application: biomarkers, genetics, molecular biology, geochemistry (isotope fractionation, speciation), biochemical and transcriptomic approaches, governance, current energy policy guidelines, environmental safety, decontamination of domestic water.

SECTION 3 – CONDUCT AND MONITORING OF THE STUDY

3.1 Scientific managers

In France:
Mrs Sylvia Becerra and Laurence Maurice from the Laboratory GET are the scientific managers of the Study for the CNRS and IRD respectively as well as the project Coordinators in charge of the coordination of the Study.
The scientific manager of the Study for EPOC is Mrs Hélène Budzinski, CNRS Researcher;
The scientific manager of the Study for LEREPS is Mr. Charilaos Kephaliacos, UT3 Professor;
The scientific manager of the Study for GEODE is Mr. Mehdi Saqalli, CNRS Researcher;
The scientific manager of the Study for IRMCP is Mrs. Alexandra Ter Halle, CNRS Researcher;
The scientific manager of the Study for HSM is Mrs. Emmanuelle Cadot, IRD Researcher;
The scientific manager of the Study for LTHE is Mrs. Gaëlle Uzu, IRD researcher;
The scientific manager of the Study for CERTOP is Mr. Vincent Simoulin, UT2 professor;
The scientific manager of the Study for ECOLAB is Mrs. Severine Jean, INPT professor.

In Ecuador:
Mrs Jenny Ruales is the scientific manager of the Study for the EPN, as well as the Ecuadorian Coordinator in charge of the coordination of the MONOIL Project in case of they receive funds from the SENESCYT.
The scientific manager of the Study for MAE-PRAS is Mr. José Ignacio Martínez Vega, responsible for the "dirección de generación de indicadores de respuesta ministerio del ambiente" of the PRAS Program;
The scientific manager of the Study for EP PEC is Mrs. Maria Isabel Perez, Engineer in Environmental Sciences, the main duty is to perform the access of all the teams to sampling sites and data in Ecuador with the aim to establish a system of socio-environmental management of petroleum activities: environmental monitoring and remediation, social management in concert with communities and socio-environmental conflict management;
The scientific manager of the Study for UG is Mrs. Estelita Benavidez, UG professor;

The scientific manager of the Study for USFQ is Mrs. Valeria Ochoa, USFQ professor;
The scientific manager of the Study for UASB is Mr. Carlos Larrea and Mr. Jaime Breilh, UASB professors.

3.2 Co-ordinators for the Study

3.2.1 Appointment of the Co-ordinators

The Parties agree that CNRS (represented by Mrs Sylvia Becerra) and IRD (represented by Mrs Laurence Maurice) shall be the project Co-ordinators, hereinafter referred to as "Co-ordinators" and shall therefore be the intermediary between the Parties and ANR to report Work progress and ensure dissemination of the documents. Mediation with Ecuadorian Parties will be achieved via Ecuadorian Co-ordinators.

3.2.2 Roles and missions of the Co-ordinators

The Co-ordinators shall be responsible for:
a) disseminating any information of interest from ANR to the Parties, within a reasonable time limit so as to allow smooth Study development;
b) compiling and communicating at ANR scientific progress reports when required, as well as a final activity report by the end of the Study;
c) establishing, disseminating and updating the schedule of the Study as well as monitoring its implementation;
d) collecting solution proposals from the Parties in case a difficulty arises, disseminating them among the Parties, synthetizing them and implementing the proposal that has been selected by the Committee;
e) informing ANR in case a difficulty arises from the implementation of the Study, modification of the Project, and in particular in case a Party decides to leave the consortium or in the event of an irreversible default by a Party or in case the Parties wish another Party to join the consortium. ANR shall be informed following agreement upon the most appropriate solution proposal between the non-defaulting Parties within the Committee.

3.3 Liability of the Parties

3.3.1 Towards the Co-ordinators of the Study

Each Party shall perform and fulfil, promptly and on time, the following obligations:
a) providing the Co-ordinators with all information necessary to respond to potential inquiries from ANR;
b) reporting progress of its part of the Work to the Co-ordinators, according to the reporting periodicity that shall be agreed upon by Committee members;
c) notifying the Co-ordinators promptly of any difficulty that might be detrimental to the execution of the Study;
d) communicating to the Co-ordinators, at its request, the elements necessary to establish the technical interim reports and the final activity report to be submitted to ANR.

Activities with Ecuadorian Parties will be co-ordinated with Ecuadorian Co-ordinators.

3.3.2 Towards each other

The Parties acknowledge having an obligation on each other to use best endeavours under this Agreement. Each Party shall therefore undertake to execute its part of the Work with due care and to provide the other Parties with the Confidential Information that the former deems necessary to implement the Study, without prejudice to its interests.

3.4 Committee

3.4.1 The Committee shall seek to foster Study development. It shall be chaired by the Co-ordinators of the Study and Ecuadorian Co-coordinators and shall consist of one (1) duly authorised representative of each laboratory involved in the Work to be performed, listed in section 3.1 above "Scientific managers".
If needed, those representatives might be assisted by any relevant specialist, following notification to the Committee members and after signature by the aforesaid specialist of a confidentiality agreement mentioning the provisions set in Art. 6 of this Agreement. The above-mentioned specialists shall only contribute on a consultative basis during Committee meetings.
Each laboratory representative can be represented at Committee meetings by one (1) duly authorised colleague from his/her laboratory, who shall dispose of the same representation capacity, provided that she/he notifies the other members beforehand.

3.4.2 Missions
3.4.2.1 The Committee shall monitor the execution of the Agreement and especially Work progress. It shall ensure that all deadlines set in Annex 1 of this Agreement are met and, if needed, shall implement solutions at the suggestion of the Co-ordinators or of a Party in case execution difficulties arise. The Committee shall potentially validate any modification that it would deem useful, together with the corresponding financial estimate, subject to the ANR's authorisation when such is required and Parties' authorisation.
3.4.2.2 The Committee gives an opinion to the Parties which decide, if relevant, on the termination of a Party's participation in the consortium and measures relating thereto or on the entry of a new Party into the consortium, subject to prior approval by ANR.
3.4.2.3 The Committee shall provide the Parties with the opportunity for them to exchange any information, whether of a technical, industrial, commercial or any other nature.
3.4.2.4 The Committee shall act as a "concertation body" in case a difficulty/dispute arises.

3.4.3 The Committee shall not deliberate and decide validly unless three-fourths (3/4) of its members are present or duly represented (quorum). Where quorum is not reached, the Committee shall meet again within one (1) month. The Committee shall be held at least every six (6) months over the duration of this Agreement. The Parties shall be notified to attend either by the Co-ordinators or at another Party's request. Minutes of each Committee meeting shall be drafted by the Co-ordinators to formalise in writing all decisions taken and shall be sent to all Committee members within fifteen (15) calendar days of the meeting. The minutes shall be considered accepted by the Committee attendees if, within fifteen (15) calendar days from receipt thereof, no attendee has objected in writing to the chairperson with respect to the accuracy of the draft of the minutes.

3.4.4 All Committee decisions shall be taken unanimously by Party representatives present or represented at Committee meetings. Each laboratory representative shall have one vote.

This principle notwithstanding and on the assumption foreseen in section 3.4.2.2 and Art. 11 of this Agreement, defaulting laboratory representatives shall not vote and the decisions shall therefore be taken unanimously by the non-defaulting members of the Committee.
Any time unanimity is not reached, the Committee shall re-examine the disagreement point(s) within one (1) month.
In this case, Committee decisions are adopted by a majority of two thirds (3/4) of present or represented members. Each Party nevertheless has a right of veto in the event that the decision would increase its financial contribution to the Project.

SECTION 4 – MUTUAL STAFF HOSTING

The staff whose list is annexed to the present Agreement (Appendix 2) is assigned to the implementation of the Study.

In case of accident involving an employee of one Party hosted in the premises of the other Party, the latter will warn the Party employer as soon as possible.

A Party shall never be regarded as the employer for any contract of employment or part-time work concluded by the other Party for the implementation of this Agreement.

SECTION 5 – FUNDING AND FINANCIAL TERMS

An estimation of the total budget of the Study is given in Appendix 3. The Parties shall participate in the financing of the Study according to the modalities described in this financial appendix.

The ANR grant shall be distributed by ANR to each French Party according to the part of the Work that each Party shall perform in compliance with the provisions of its convention - or "Décision attributive d'aide" –, which shall be notified and signed by ANR.

EPN, USFQ, UASB and UG shall receive from the SENESCY their own funding.

As strategic collaborators, EP PEC and MAE-PRAS will not receive funding.

ECOLAB shall receive from the IRD-EP Petroecuador agreement the necessary funding to achieve their objectives; the associated team can also receive external funding.

Each Party manages the appropriations allocated to carry out the Study according to its own budgetary and accounting procedures.

Each Party shall individually provide the additional funding required to carry-out its share of the Study.

In case of obtaining external financing, each Party shall be responsible for the budget

allocated thereto for performance of the tasks assigned by the third party payer.

SECTION 6 – SECRET, PUBLICATIONS

Any Confidential Information and its reproductions that are transferred by a Party to another Party shall remain the disclosing Party's property, subject to third party's rights, and shall be returned to the latter at its request.

6.1 Secret

6.1.1 - The Parties undertake to keep secret the Work and the Foreground of the Study.

However, this obligation of secrecy cannot prevent from filing a patent application, or making any commercial use of Know-How, nor any scientific communication.
Assuming that the Foreground is unlikely to lead to filing a patent application, but can either be usable Know-How in nature or be the subject of a scientific publication, the Parties shall have a period of three (3) months to determine:

- which Foreground is considered as Know-How that must be kept secret,
- which information may be published or disclosed to third parties.

6.1.2 - In addition to the reciprocal commitments of secrecy taken by the Parties in accordance with the provisions above, each Party undertakes not to publish nor disclose in any manner whatsoever, without the owning Party's written consent, any Confidential Information, owned by another Party and which the Party may have been aware on occasion of the performance of this Agreement.

Any exceptions to this obligation of confidentiality shall be mutually agreed upon and subject to the approval of the Parties involved.

6.1.3 - The commitments of this article shall remain in effect throughout the term of this Agreement and five (5) years following its early termination or its expiry.

6.1.4 - This obligation of confidentiality shall not be an obstacle to personal information of people who individually contributed to the collection of data on their farms or in nearby areas for their water supply, food or natural resources, in consistency with the Ecuadorian constitution, *Art. 18.- Todas las personas, en forma individual o colectiva, tienen derecho a (...) 2- Acceder libremente a la información generada en entidades públicas, o en las privadas que manejen fondos del Estado o realicen funciones públicas. No existirá reserva de información excepto en los casos expresamente establecidos en la ley. En caso de violación a los derechos humanos, ninguna entidad pública negará la información";*
And the principle of information and public participation established by the Ministerial Agreement 161 of the August 2011 amends title 31 V and VI of Book VI of Text unified secondary environmental legislation of the Ministry of Environment in particular Art.151.
Part refund information to individuals who have contributed to the collection of data will be coordinated by the competent authorities in their respective fields, eg the Ministry of Environment through the Social and Environmental Remediation Program (PRAS).

6.2 - Shall not be considered as confidential, the information for which the Party involved can prove:

- that it had already knowledge of said information on the date of communication by the other Party;
- that this information has been already published, disseminated or that it has come into the public domain, without any breach of this Agreement;
- that the information has been subsequently received from a third party having a right to dispose of.

6.3 Publications - Communications

Any planned publication or communication by either Party of information about the Foreground of the Study shall receive, during the term of this Agreement and one (1) year after its expiry, the written approval of the other Parties, which will announce their decision within a maximum period of one (1) month from the date of request. Should a Party fail to reply within this time limit, it shall be deemed to have given its agreement.

The other Parties may delete or change some information whose disclosure would be likely to prejudice the commercial and industrial use, under proper conditions, of the Foreground of the Study. Such deletions or changes shall not affect the scientific value of the publication.

In addition, the other Parties may delay the publication or communication for a maximum period of eighteen (18) months from the request, especially whether information contained in the publication or communication must be subject to protection under intellectual property law.

These publications and communications shall mention the contribution made by each Party in carrying out the Study, as well as the financial support provided by ANR. Furthermore, the name of the Parties, as well as the name of the researchers involved, shall be inserted in a clear and visible way.

6.4 - The provisions of this Article 6 shall not preclude:

- neither the obligation binding upon each of the participants in the Study to produce a periodic activity report to the organisation where he belongs, insofar as this communication is not regarded as a disclosure within the meaning of intellectual property laws. If need be, in case of highly confidential information, this report shall be kept confidential;

- nor the thesis defense by researchers whose scientific activity is connected with the object of this Agreement; this defense must be held whenever necessary in a manner to ensure, in compliance with the applicable Establishment regulations, the confidentiality of some Foreground.

SECTION 7 – OWNERSHIP PRINCIPLES

7.1 - Results not arising from the Study (Background)

Each Party retains full and total ownership of its Background.
The other Parties do not receive any right on corresponding patents and know-how under this Agreement.

7.2 – Results deriving from the Study (Foreground)

7.2.1 Ownership of Foreground

Foreground shall be the property of the Party generating such Foreground. Potential new patents resulting from such Foreground shall be taken out only for the account and at the expenses of the above-mentioned Party, and on its own initiative.
In case Foreground is created by a laboratory which is a joint research unit e.g. UMR, FRE, URA, etc. - and is therefore not a legal entity - consisting in several Parties, the latter shall be considered as the co-owners of Foreground, and the ownership shall be shared out in accordance with the agreements that they have concluded.

7.2.2 Joint Foreground

7.2.2.1 Ownership principle

Where two or several Parties, hereinafter referred to as the "Co-owning Parties" or "Co-owners", have jointly carried out Work generating Foreground and where their respective share of the Work cannot be ascertained, they shall have joint ownership of such Foreground, hereinafter referred to as "joint Foreground", according to the proportion of their intellectual, human, material and financial contributions unless otherwise agreed between them in a specific written agreement.

In case joint Foreground is generated by two researchers from two (2) different laboratories constituting joint research units, e.g. UMR, FRE, URA, etc., made up of different Parties, ownership of joint Foreground shall be distributed to the Parties according to the proportion of their respective intellectual, human, material and financial contributions, it being understood that the Parties belonging to a joint research unit shall deal with Foreground in accordance with the agreements that they have concluded.

Joint Foreground consisting in a new patent, software or knowledge covered by intellectual property rights, shall be subject to the establishment of a joint ownership agreement as soon as necessary, and in any case prior to any industrial/commercial application or use.

It's already specified between the Parties, that process of fast analysis of toxicity of environmental samples is a joint Foreground between UB, CNRS and IRD.

7.2.2.2 Patentable Joint Foreground

The Parties co-owning patentable joint Foreground shall decide whether such Foreground shall be subject to a joint patent application and shall appoint the Party in charge of patent filing and patent maintenance procedures.

Joint new patent filing, obtaining and maintenance fees shall be borne by the co-owning Parties according to their share of ownership, in compliance with the provisions set out in Art. 7.2.2 of this Agreement.

Where one of several co-owning Parties, hereinafter referred to as the "withdrawing Party", does not wish to file nor maintain one or several new patents, either in France or abroad, it shall notify the other co-owning Party (ies) in due time for it/them to apply for and maintain those new patents for its/their own account, at its/their own expenses or for its/their own benefit. The withdrawing Party shall commit to signing or having signed all necessary documents to allow the other co-owning Party (ies) to become the sole co-owner (s) of the new patent (s) concerned for the country (ies) concerned.

A co-owning Party shall be considered withdrawing sixty (60) days after reception of a recorded delivery letter with acknowledgement of receipt that shall be addressed by the other co-owning Party (ies) asking the withdrawing Party to make its decision known in this regard. Moreover, it is understood that the withdrawing Party shall not benefit from any financial counterpart resulting from the exploitation of the new patent (s) concerned in the country (ies) concerned.

Each co-owning Party individually shall deal with the potential remuneration conditions of its inventors.

SECTION 8 – USE AND EXPLOITATION PRINCIPLES

8.1 Use and exploitation of Background

8.1.1 Each Party is free to dispose of its Background.

8.1.2 Use rights for implementation of the Study

For the sole purpose of implementing the Study, the right to use a Party's Background shall be granted to the other Parties, hereinafter referred to as the "recipient Parties", if it is needed to enable those Parties to carry out their own part of the Study. Such use rights shall not be assignable or exclusive. They shall not be subject to sub-licensing and shall be granted on a royalty-free basis.
Such Background shall be communicated by the owning Party to the recipient Party at the latter's request and shall be considered as Confidential Information, as specified in Art. 6.1 of this Agreement.

8.1.3 Use rights for commercial purposes

Each Party commits to granting the right to use or exploit its Background to the other Parties, at their request, subject to third Parties' rights, if it is necessary to the development or exploitation of Foreground, under the current market conditions for the field concerned. Those conditions shall be negotiated prior to any industrial and/or commercial exploitation and shall be subject to a licensing agreement concluded between the Parties concerned. Such use rights shall not be assignable or exclusive and shall not be subject to sub-licensing, unless otherwise agreed between the Parties involved.

8.2 Use and exploitation of Foreground

8.2.1 General Principle

Each Party shall be free to use and/or exploit the Foreground of which it is the sole owner under Art. 7 of this Agreement.

The Parties commit to taking any appropriate measure, especially towards their employees and/or their potential sub-contractors, which shall allow them to grant the other Parties the right to use and exploit Foreground or joint Foreground under the terms and conditions of this Agreement.

8.2.2 Use for executing the Study

Use rights to a Party's Foreground shall be granted to the other Parties, if it is needed to enable those Parties to carry out their part of the Study. Such use rights shall not be assignable or exclusive and shall not be subject to sub-licensing. They shall be granted on a royalty-free basis. Conditions for exercising those use rights shall be the same as those foreseen in Section 8.1.2 regarding the use of Background.

8.2.3 Use for scientific purposes

Each Party shall be free to use, at its request, other Parties' Foreground for the sole purpose of scientific research, excluding any use for commercial purposes, either direct or indirect.

8.2.4 Exploitation of joint Foreground

Prior to any industrial and commercial exploitation of joint Foreground, the Parties co-owning joint Foreground shall specify the terms and conditions for that exploitation within the scope of a specific development agreement or, regarding Foreground that is joint patents, in the framework of the joint ownership agreement mentioned in Art. 7.2.2.1.

The Parties agree that any direct and/or indirect industrial and/or commercial exploitation by one co-owning Party of joint Foreground shall result in a financial compensation for the other co-owning Parties' benefit, under the conditions subsequently defined in the above-mentioned development agreement.

SECTION 9 – AGREEMENT TERM

This agreement shall enter into force on the date of beginning of the MONOIL Project validated by the ANR SOCENV, *i.e.* 15th of January, 2014, for a period of forty two (42) months.
It may be altered and extended by means of amendment.

Notwithstanding the expiration or early termination of the Agreement under the conditions provided for under the Section entitled "TERMINATION":

- the provisions provided for under the Section 11 entitled "SECRET - PUBLICATIONS" shall remain in effect for the terms provided for under said Section;

- the provisions of Sections 7 (OWNERSHIP PRINCIPLES) and 8 (USE AND EXPLOITATION PRINCIPLES) shall remain in effect.

SECTION 10 - LIABILITY

10.1
As and when required, each Party assures (depending on statute of the Party) that it has subscribed the insurance policies covering its liability in the context of performing this Agreement.

The rule under which "*l'Etat est son propre assureur*" (the State acts as its own insurance company) applies to some public organisations. Consequently, the latter may provide cover for the damage/loss which their activity may cause to third parties from their own budgets.

10.2
Materials and equipment made available by one of the Parties to the other Party or financed by such Party under a specific agreement shall remain the property of the Party which has made the materials and equipment available.
Each Party is responsible for the damage (physical, material or immaterial) and loss, in accordance with common law, caused by it to another Party's moveable property, or to a person owing to, or during performance of, the Agreement.

10.3
In conducting the Study, agents acting for and paid by one of the Parties may be required to work on the premises of the other Party. Such staff is therefore bound by and shall comply with the regulations of the establishment in which they are working. Appropriate instructions will be given to such staff at the time of assignment.

In the case a Party hosts third parties (especially students, visiting scholars) on the initiative of another Party; the latter shall ensure that the aforementioned third parties have subscribed all appropriate insurances, covering in particular their civil liability

10.4
Each of the Parties shall continue however to assume any and all employer-related social and fiscal responsibilities for its paid staff and shall continue to exercise any and all management prerogatives over such staff (rating, promotion, discipline, etc.). Any pertinent information, and more specifically information with respect to vital assessments, will be submitted by the establishment which effectively makes use of the services of such staff.

Each Party shall provide coverage for their respective agents for occupation accidents and illnesses without prejudice to any claims which may be made against responsible third parties.

10.5
By agreement amongst the Parties, this Agreement constitutes an obligation of means for ETABLISHMENTS and not an obligation of result under the jurisprudence and French laws.

SECTION 11 – TERMINATION

Each Party is fully and exclusively responsible for the completion of its part of the Project.

In case of default by either Party in its obligations and/or in the execution of all or part of its part of the Project, and on the supposition that the defaulting Party would not remedy the breach in the period of one (1) month after a notice sent by the Co-ordinators by registered letter with recorded delivery, the Co-ordinators will call the Committee for a special meeting which given the arguments, declare the Party defaulting or not. The decision to terminate the participation of the defaulting party shall be taken unanimously by the non-defaulting Parties.

The non-defaulting Parties may, subject to the prior approval of the ANR, elect either to share the tasks of the defaulting Party between themselves or to entrust a third party with all or part of the tasks to be carried-out.

The Co-ordinators will inform ANR of the solution proposed by the non-defaulting Parties and will request its approval. In the event that approval is given, the Co-ordinators will ask the ANR to change the allocation of funds according to the new sharing of the tasks.

Such a termination shall not discharge the defaulting Party from complying with its contractual obligations until the effective termination date, without prejudice to the right of the complaining Party to claim damages for any loss or injury that may be suffered owing to the early termination of this Agreement.

The defaulting Party can't interfere in any way with the execution of the Project, nor stopping it, for any reason.

The defaulting Party undertakes to restore to the other Parties all Confidential Information, results, documents and other material transmitted by the other Parties, without keeping any copy of them. Similarly, the non-defaulting Parties will restore to the defaulting Party all Confidential Information, results, documents and other material transmitted by the defaulting Party.

SECTION 12 – FORCE MAJEURE

Force Majeure shall mean any unforeseeable and exceptional event affecting the fulfilment of any obligation under this Agreement by the Parties, which is beyond their control and cannot be overcome despite their reasonable endeavours.

No Party shall be considered to be in breach of this Agreement if such breach is caused by Force Majeure. Each Party will notify the Co-ordinators of any Force Majeure without undue delay. If the consequences of Force Majeure for the Project are not overcome within seven (7) days after such notification, the transfer of tasks - if any - shall be decided by the Co-ordinators in accordance with the other Parties in the Committee and the ANR.

SECTION 13 – ASSIGNMENT OF THE AGREEMENT AND SUBCONTRACTING

This Agreement is concluded *intuitu personae*. None of the Parties may assign in any way whatsoever the rights and obligations arising from this Agreement without the prior consent of the other Parties.

Pursuant to Articles 2 and 10 of the Decree No. 2014-1038 of September 11th, 2014 on the establishment of the University of Montpellier, University of Montpellier 1 and 2 will cease to exist as a legal entity as of January 1st, 2015. As of that date, the University of Montpellier will replace the universities of Montpellier 1 and 2, which will be merged into this new institution. The rights and obligations of the former institutions will then automatically be transferred to the University of Montpellier. The Parties take note of these dispositions and shall refrain from claiming a transfer amendment to this Agreement after January 1st, 2015.

Neither of the Parties may, without the written authorisation of the other Parties, subcontract part of the services that it has been commissioned to provide in the performance of this Agreement. Each of the Parties shall remain solely liable towards the other Parties and towards third parties for due performance by its (their) subcontractor(s) of the services which any subcontractor may have been commissioned to provide.
Subcontractors shall be solely deemed to be natural persons or corporate bodies having a binding relationship with the contracting Party by means of a contract for services under which the subcontractor is commissioned to carry out part of the research services covered under this Agreement and/or to provide supplies complying with the specifications required for the research.

The sub-contracting Party contractually must impose on the third party subcontractor the obligations required to comply with the provisions of the Agreement.
With the written authorisation of the other Parties, IRD, UT3 and CNRS (for GET) and UB and CNRS (for EPOC) have subcontracted to a private company or a public institution, a part of the services that they have been commissioned to provide in the performance of this Agreement:

-UB and CNRS (for EPOC) subcontract the cell test to develop LUCS tests for measuring the alteration of DNA for 450 samples;
-IRD UT3 and CNRS (for GET) subcontract the NRRT Test (lysosomal neutral red retention time) for 450 inorganic and biological samples and micronuclei Test for 50 human samples;

With the written authorisation of the other Parties, IRD, UT3 and CNRS (for GET) have subcontracted to another private company, a part of the services that they have been commissioned to provide in the performance of this Agreement:

- Photographic and audivisual works for pedagogical aim and large public diffusion via internet interface: photographies (with texts), video ; photo book realisation ; photography exposure.

If the subcontractor is not capable of filling his obligations, then this agreement could be partially terminated by IRD, UT3 and CNRS (for GET) and by UB and CNRS (for EPOC) without being responsible towards other Parties. In this case, IRD, UT3, UB and CNRS won't be considered as defaulting Party.

SECTION 14 – COMPREHENSIVENESS AND LIMITS OF THIS AGREEMENT

This Agreement and the schedules thereto, include all of the obligations of the Parties. No clause appearing in any document sent or submitted by the Parties may be incorporated to the Agreement.

SECTION 15 – NULLIFICATION OF A CLAUSE

If any provision of this Agreement should be held invalid or declared as such by application of a treaty, law or regulation or as a result of a final ruling given by an authority having jurisdiction over such matters, the other provisions shall be remain in full force and effect. The Parties shall then act in all due diligence to make any modifications necessary while maintaining, as far as possible, the intent of the Parties at the time of signing this Agreement.

SECTION 16 – DISPUTES

SECTION 16 – DISPUTES

In case of any dispute relating to validity, interpretation or the performance or breach of this Agreement, the parties undertake to make every effort to settle their differences by amicable agreement through the Committee and subsequently through their respective direction.

In the event that the Parties are unable to come to an amicable solution, within two (2) months after the meeting of the Committee, the dispute shall be submitted to the competent court of the defendant Party, and the agreement shall be interpreted in accordance to the laws of the country of the defendant.

SECTION 17 – CONTRACTUAL DOCUMENTS

This Agreement is comprised of the present agreement and its appendices, namely:

Appendix 1: Scientific and Technical Program
Appendix 2: List of the participants
Appendix 3: Financial Appendix

which the Parties hereto initial and declare knowing the contents thereof.

Done in 16 originals in English ant 16 originals on Spanish, **IN WITNESS WHEREOF**, the parties hereto affix their signatures;

For IRD,

The General Director of Science
Mr. Bernard DREYFUS,

I. R. D.
INSTITUT DE RECHERCHE POUR LE DÉVELOPPEMENT

DATE: 13 NOV. 2014

For CNRS

Délégué regional
Patrick Mounaud

Pour le Délégué Régional Empêché

Jean-Paul EWERTS

CENTRE NATIONAL de la RECHERCHE SCIENTIFIQUE

DATE: 14 NOV. 2014

For UT3,

The President
Bertrand MONTHUBERT

Le Président de l'Université Paul Sabatier
Par Délégation
La Directrice Adj. D.S.L.
Carole MATTHIA

DATE: 03-04-2014

Visa by Dr. Michel Grégoire Director of GET

Visa Dr. Monique MAUZAC director of IMRCP

For UT2

President
Mr. Jean-Michel MINOVEZ,

Pour le Président,
Le Vice-Président de la Commission Recherche

Daniel LACROIX

DATE: .....

Visa by Dr. Didier Galop director of GEODE

Didier GALOP
Directeur
GEODE UMR 5602 CNRS

Visa by Dr. Vincent Simoulin director of CERTOP

CERTOP
Le Directeur
Vincent SIMOULIN

For UT1

President
Mr. Bruno SIRE

DATE: 26/04/2014

Visa by Dr Charilaos Kephaliacos director of LEREPS

For University of Bordeaux,

President
Mr. Manuel TUNON DE LARA

30 AVR. 2014

DATE: .....

Aquitaine Science Transfert
Accélérateur des innovations d'avenir
2014-008
VISA

Visa by Dr. Antoine Grémare Director of EPOC

Le Directeur de l'OASU
et par délégation :
Antoine GREMARE
Directeur de l'UMR EPOC

For UM1

President,
Mr. Philippe AUGÉ

P. Le Président et par délégation
Le Vice-Président chargé de la recherche

Jacques MERCIER

UNIVERSITÉ MONTPELLIER 1
Droit
Sciences Économiques
Gestion - A.E.S.
Médecine - Pharmacie
Odontologie
S.T.A.P.S.

DATE: 27/11/15

For UM2

President,
Mr. Michel ROBERT

UNIVERSITE MONTPELLIER 2 SCIENCES ET TECHNIQUES

Pour le Président
et par délégation
le Vice-Président
délégué aux relations internationales

François HENN

DATE: ...12/11/2014.....

For INPT

President,
Dr. Olivier SIMONIN

DATE: 07 JAN. 2015 .....

For PRAS

Director,
Ing. José Ignacio Martínez Vega

DATE: April 2, 2014 .

For EPN

Rector
Ing. Jaime Calderón Segovia

DATE: 08 OCT. 2014

For EP PETROECUADOR

Gerente General
Ingeniero Marco Calvopiña V.

DATE: .....

For university of Guayaquil (UG)

Rector,
Doctor Héctor Roberto Cassis Martínez

UNIVERSIDAD DE GUAYAQUIL
RECTORADO

DATE: 17 NOV. 2014

For university San Francisco of Quito (USFQ)

Rector,
Doctor Santiago Gangotena González

DATE: October 16th, 2014...

For Universidad Andina Simón Bolívar, Sede Ecuador (UASB-SE)
Rector,
Doctor Enrique Ayala Mora;

UNIVERSIDAD ANDINA SIMÓN BOLÍVAR Ecuador

DATE: .....

Appendix 1
Scientific and Technical Detailed programme of the Study

The cross-disciplinary project MONOIL takes part in the scientific description of the human vulnerability to environmental change caused by oil industry activity in Ecuador. Its principal objective is the improvement of understanding, monitoring, reduction and prevention of oil contamination and its impact on environment and society. This involves either the co-construction of strategies to reduce this vulnerability, or the construction of ecologically sustainable, economically viable, sociologically appropriate and politically pertinent adaptation strategies.

The main objectives of MONOIL are:

1. to identify and map oil-rich areas according to the vulnerability/population's capacity to deal with environmental contamination;
2. to measure the impact of chemical cocktails consisting of polycyclic aromatic hydrocarbons (PAHs) and heavy metals associated with water-based petroleum activities in waters (rainfall, surface water and groundwater), soils and in the food chain (fish, molluscs, agricultural products);
3. to understand the constraints and levers that affect the implementation of environmental rules and regulations that are supposed to regulate petroleum activities;
4. to study links between environmental contamination and health from a human scale (epidemiology) to the cellular level (molecular biology, cytotoxicity)
5. to test an innovative system for depolluting water intended for human consumption.

The cross-disciplinary and ecosystem-focused approaches bring together researchers from sociology, economics, geography, epidemiology, hydrology, geochemistry, toxicology, biology as well as the operational actors involved in Ecuador. This methodology will enable the attainment of the scientific objectives of the project and will also ensure an operational transfer. It is thanks to this transfer that the project will contribute most significantly to the implementation of a public policy inclusive of concerns for public health, environment and sustainable development.

1. Scientific and technical programme project management

1.1. Scientific programme, specific aims of the proposal

MONOIL was inspired by the conceptual framework of the Integrated Environmental Assessment (IEA), formed from the GEO approach devised by the United Nations for Environment and Development (UNEP, 2007), inspired itself from the model Driving Forces - Pressure - State-impact - Response (for Driving Forces - Pressure-State-Impact-Response) developed by the European Environment Agency (Smeets and Weterings, 1999). In MONOIL, oil-drilling activities are the driving forces that cause environmental pressure, hereby contamination (water, air and soil). This pressure causes environmental degradation, in other words, its quality; these changes to the environment have an impact

on the associated society, especially in terms of health (public and animal, etc.) that increase correspondingly with initial social vulnerability (before impact) as well as economic development. Finally, the response reflects the social capacity to cope with these impacts: it is the political, industrial or social measures, whether individual or collective, at local, regional or national levels that aim to regulate, prevent and reduce contamination and/or exposure to contaminants and thus reduce the intensity of impacts. MONOIL will focus on the core of the model (state-impact-response) whereby exploratory work and existing data provided by the partners will enable the study of driving forces and pressures. The specificity of the project lies in its focus on the processes that define the transition from one element to another: for example, to understand the impact of petroleum activities and contamination on societies, we will work on both social dispositions (e.g., action strategies) that enable the reduction of exposure to contamination but also, at another level, we will focus on the "dose-response" (via the use of biomarkers) that enable an understanding of the scale of the impact that environmental contaminants have on living organisms and human cells (which in turn provides data regarding both their capacity for defense and level of damage). We will question effectiveness and efficiency of certain social responses at different levels: public authorities (hydrocarbon reform bill; PRAS) and civil society (the capacity for political representation, resources for action).

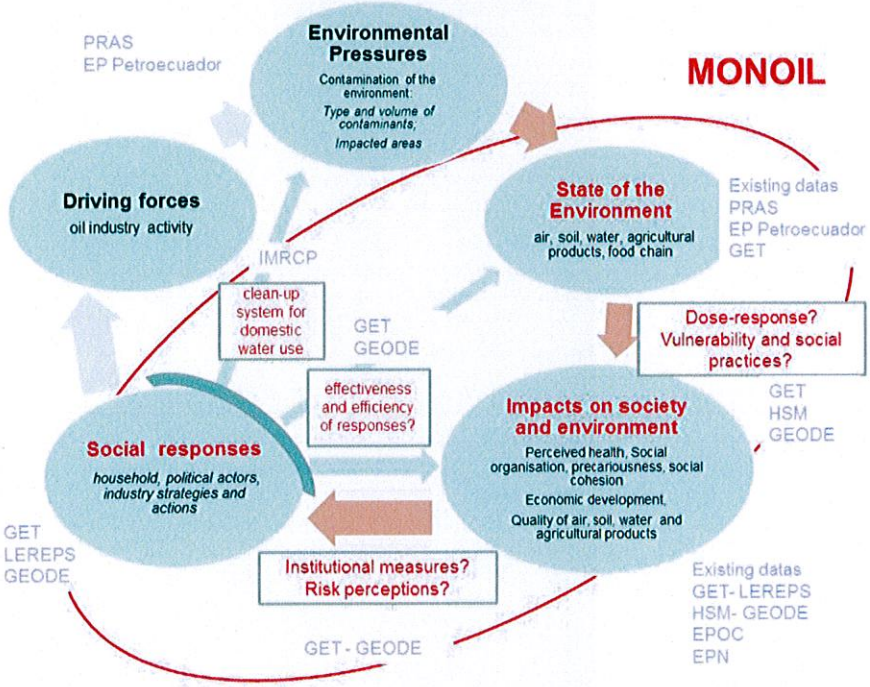

Figure 1: Conceptual framework of the MONOIL Project

Study sites

Research will first be conducted on an enlarged territory based on two "parishes" (equivalent to "communes" in France), Dayuma and Pakayacu, which were identified by the Ecuadorian Ministry of Environment as having the highest index of socio-environmental vulnerability for the period 1967 - 2009 in the area under considerable pressure from the oil industry (SIPAS, 2011).

(1) Amazonia

Dayuma: in this parish, the PRAS accounts for an average of 16,840 leaks per thousand inhabitants between 1967 to 2009, with nearly 19 pools and 20 oil spills per 1000 people in poverty between 1967 and 2009 and an average rate of formation waters in the environment of 67,141 barrels per dwelling without access to drinking water in the same period (14,033 barrels per capita). The territory is considered particularly sensitive: 90.8% has been deforested in favour of oil production plants, which render water resources and soil particularly vulnerable to contamination.
Pakayaku: the authorities that manage the PRAS estimate that an average of 43 092 barrels of formation waters were released into the environment per household, for those with no access to drinking water. It accounts for 9736 barrels of formation waters per capita between 1967 and 2009, some 19 pools and 21 oil leaks for 1000 inhabitants living in poverty during the same period. The social vulnerability index is thus very high. In addition, in June 2009, the site was subject to an important leak of formation waters which lasted for fifteen days; site remediation was undertaken at a late stage, rendering environmental consequences still visible. Today, the site is the subject of an action plan for the remediation of environmental and social liabilities.

(2) At the request of EP Petroecuador, the site of Esmeraldas national refinery on the **Pacific coast** will also be studied. The refinery, originally constructed in an unpopulated area of the Esmeraldas city, was commissioned in 1967 with the aim of producing petroleum products to meet domestic demand. After its construction, legal and illegal settlements have gradually emerged in the zone of its greatest influence, often with the complicity of the municipal authorities. In addition, even if the refinery does have an environmental management plan (revised in 2009), the city is not prepared for emergencies, despite past experience (including a fire of great scope in 1998). The zone of influence is thus characterised by a conjunction of problems of an environmental, sanitation and safety nature, based on the operation of the refinery.

(3-4) **Control areas** will also be chosen: In Amazonia, the area will be located in the province of Morona-Santiago, along the Río Wichimi (3), near San Jose de Morona, in the southeast of the country: devoid of anthropogenic source of hydrocarbons, heavy metals, or pesticides, its geographical, geomorphological, ecological and hydrological characteristics are similar to those of the study areas. It is part of a sub-watershed that originates in the Amazonian plain. It does not transport sediment and is devoid of chemical elements from the erosion of Andean basins upstream. For the Pacific coast, the control area will be located in the province of Manabí, in the "Galera San Franciso" a protected area (4).

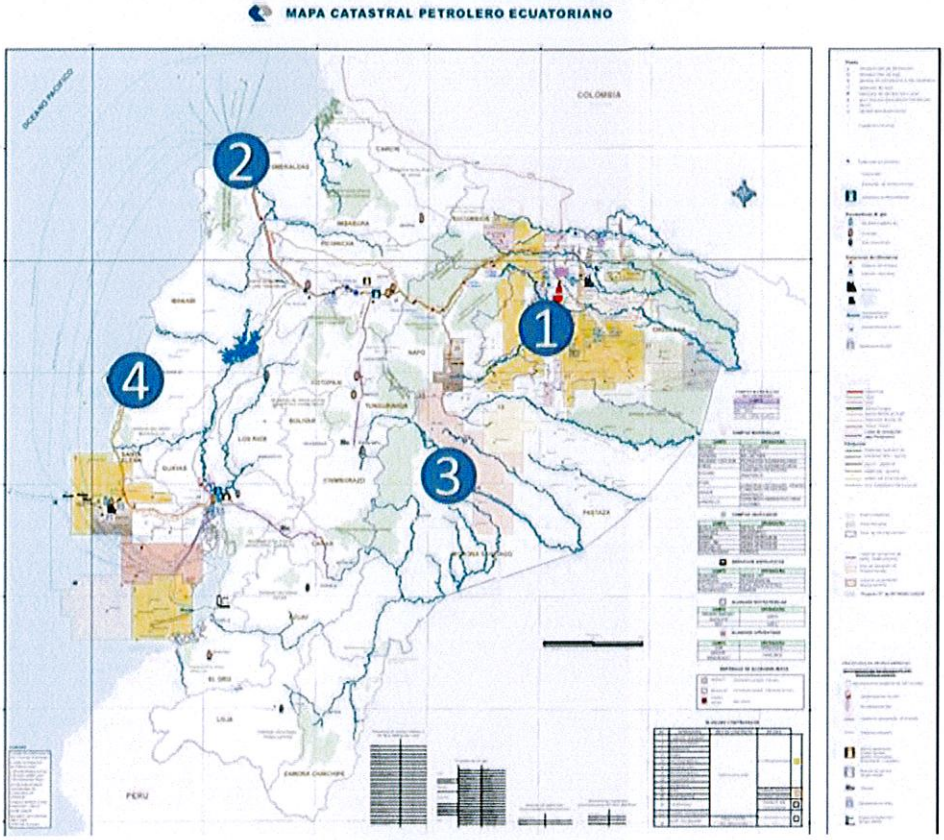

Figure 2: geographical location of study sites

1.2. Detailed description of the work by tasks

TASK 1 – COORDINATION, PROMOTION AND RETURN BENEFIT TO CONCERNED POPULATIONS

Managers: Sylvia Becerra (GET) and Laurence Maurice (GET)

Coordination of the project will be conducted by Sylvia Becerra (CR CNRS), aided by Laurence Maurice (DR IRD) and a scientific committee composed of one P.I from French and Ecuadorian scientific partners: LEREPS, GEODE, HSM, EPOC, IMRCP, ECOLAB, EPN, EP Petroecuador, PRAS, USFQ, UASB, UG and LED. Coordination will also ensure collaboration with social actors and liaison with local institutions. Two scientific coordination meetings will be held each year, one in France, the other in Ecuador.

The project will also be carried out in a collaborative approach with Ecuadorian partners, associations and local communities. The transfer of scientific results to operational use will be provided in real time. Our previous field experience shows that our straight collaboration with national and local stakeholders also contributes to the transfer of both reflective and organizational capacities and technical knowledge and know-how.

Three deliverables are proposed for this task:

(1) the in situ restitution of scientific results to populations and other stakeholders in the studied areas; (2) a closing symposium of the project will enable all partners to review the scientific results, to exchange views and knowledge with researchers from

other countries and to develop perspectives for future action; (3) the communication of scientific results for the general public will use various media: photography, video and book.

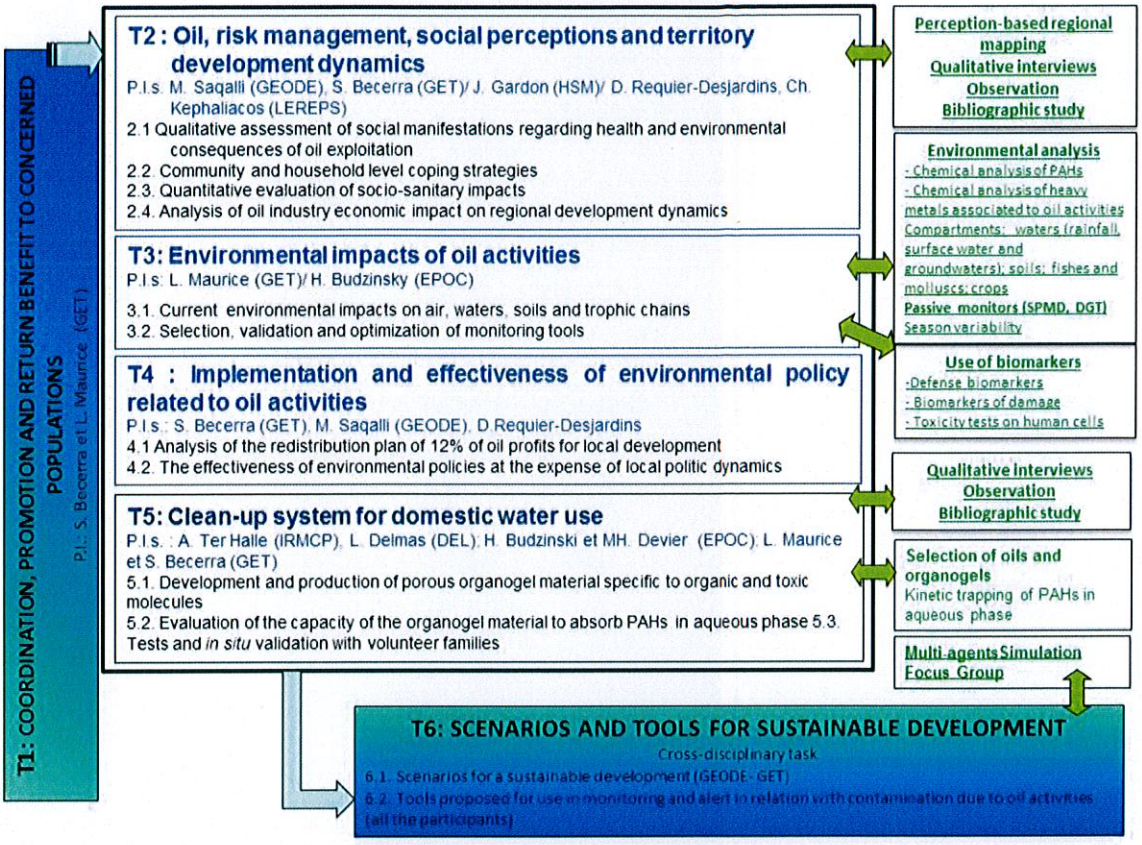

Figure 1: Task diagram of the MONOIL Project

TASK 2: OIL, RISK MANAGEMENT, SOCIAL PERCEPTIONS AND TERRITORY DEVELOPMENT DYNAMICS

Managers: M. Saqalli (GEODE) & S.Becerra (GET) J. Gardon, D. Requier-Desjardins
Participants: E. Cadot (HSM), Ch. Kephaliacos, , L.Orozco Noguera, J.P Delcorso (LEREPS), D. Laffly (GEODE) ; C.Larrea, N.Greene (UASB)
Objectives: Evaluating and spatialising social manifestations of health & environmental hazards and related household strategies to cope with petroleum contamination;
Deliverables: Production of A-level articles; assessment report with recommendations; production of maps and statistical analyses of the oil-related socio-sanitary impacts;
Methods: Perception-based regional mappings, questionnaires, interviews, literature analysis
Risks: Access to communities not living close to road networks: Cooperation with local associations and health centers of the two studied parishes will facilitate access to families and will support the distribution of the questionnaires. The simultaneous presence on the field of project sociologists, economists, geographers and physicians and the co-elaboration of guidelines for the interviews and questionnaires will ensure the coherence and feasibility of the data collections.

The overall assumption is that, on each territory, the related populations are not uniformly vulnerable to contamination and there exists a differential in their capacity to mitigate or adapt themselves to its impact (Becerra 2012).

T2.1. Qualitative assessment of social perceptions regarding health and environmental consequences of oil exploitation (GET, GEODE, UASB)

A first hypothesis is that, in the social manifestation of the territory, the importance of short-term economic risk is higher than the health risks associated with environmental contamination. Another hypothesis is that the particular nature of the impact of contamination on the environment and health modulate the social responses, i.e. collective action and individual strategies. Our first task implies understanding the perceptions and social representations of the risk of contamination and distinguishing it from other risks, including the social and economic. The second point deals with the analysis of the ways in which these risks affect the incentive for self-protection, securitization policies and relationships among the different identified stakeholders. The third task consists in identifying and spatializing social practices and economic activities that contribute to a reduction or an increase in direct and indirect exposure to contaminations: practices regarding use and management of natural resources, mobility, hygiene, health and diet. Such information will provide insight on risk perception and the related bedrock of social issues.

Methods: We first adopt a socio-spatial zoning approach using a tool called perception-based regional mapping (ZADA in French) (Saqalli et al, 2009): it is a diagnostic tool designed for socio-spatial analysis of stakeholders' perceptions through interviews via a local map on which will be placed a transparent sheet. Interviewees can then locate territorial specificities related to the chosen theme. This zoning allows: 1/ the prioritization of social, economic, environmental variables that best describe the study area from the stakeholders' point of view, including the dynamics that affect these variables; 2/ a description of the demarcated areas based on the previously indicated variables, 3/ the collection of factual data on each area. Zoning can here address different themes: sources of contamination, vulnerable natural resources, health risks, basic infrastructure offering protection, and vulnerable communities. We then proceed to a qualitative study based on semi-structured interviews with people from the areas previously identified as the most vulnerable thanks to the ZADA tool in order to investigate more specific issues. In parallel, the results from ZADA and the interviews will then be commensurately analyzed along with economic activities (subtask 2.4) and land use (Task 3) for all the study sites.

T2.2. Community and household level coping strategies (LEREPS, GET, UASB)

Populations are not passive objects at the receiving end of contamination, but actors on a contaminated territory, with practices and strategies dedicated to survival and adaptation. This adaptation is not only about the impact of oil contamination but also the economic risks and opportunities generated by the trajectories of territorial development, including petrol activities. The goal here is to better understand the local capacity for mobilization (resources and limits), through identifying curative and/or preventative actions and strategies assessed at the household level but also at the broader community level.

Method: First, a qualitative approach will be adopted for in-depth interviews with households located in areas previously identified as the most vulnerable by use of the ZADA tool. These interviews should allow: 1/ the identification of the livelihood systems of the concerned

households, in order to identify the differing socio-economic strategies for households; 2/ the identification of the diversification of activities and sources of income among households in the concerned territories and their importance as alternatives to direct or indirect petrol-related activities. The objective here is to identify the various types of strategy that address the impact of petroleum activities. This approach will be supplemented by literature analysis and direct observation of local practices. Finally, a common questionnaire will be set up for tasks T2.2. and T2.3, not to solicit the people interviewed several times. UASB would contribute in both surveys.

T2.3. Quantitative evaluation of socio-sanitary impacts (HSM, UASB)

We hypothesize that environmental pollution – easily observed in these communities since the 1970s - has changed the perception of health status as well as attitudes and beliefs related to health. We will conduct quantitative surveys of the adult population of three parishes (the two selected parishes exposed to contamination and one unexposed control parish). A total of 900 individuals (300 per parish) will be required in order to demonstrate any significant differences between exposed and unexposed individuals. A face-to-face questionnaire will be administered by trained and skilled interviewers; it will include scales and measuring instruments validated by literature to estimate various behavioural, social, demographic and health indicators. In this study, the researched variables include three aspects of health and health-related attitudes that may have been modified by the social and environmental context. Firstly, perceived stress will be estimated by a scaled tool with ten items (Cohen, 1983). Perceived health will be estimated by use of the standard WHO question "How is your general health?" which features five response levels (very good, good, average, bad, very bad). Finally, beliefs and attitudes towards health will be particularly evaluated with regard to water and its management, the main source of contamination in the two exposed parishes. The Health Belief Model (HBM) is a psychosocial model that attempts to predict the behaviour of individuals based on their beliefs and attitudes. Developed in the 1950s to explain participation differences in public health programs, it is widely used today to assess risk behaviours in HIV/AIDS issues. The main dimensions explored by this instrument (Rosenstock et al. 1974) relate to the perceived threat (severity of and susceptibility to illness), the perceived benefits of adopting a preventative behaviour, barriers (potentially negative), self-efficacy (belief in their own ability to adopt behavioural strategies and to reap the benefits). This instrument will be specifically adapted to behaviours related to water and chemical contamination issues, which will also be questioned as explanatory variables. Independent explanatory variables will refer not only to the exposure of individuals by estimated water use (drinking, domestic, etc.) but also by distance to the main source of pollution or residence duration. The perception of petrochemical risk on health will be estimated by a scale of four items validated by literature (Cutchin et al., 2008). The relation to environment will be estimated by questions on the subjective judgment of individuals vis-à-vis their place of residence. Finally, we include various social and economic individual determinants classically understood as potential confounders: marital status, family composition, age, gender, education level, tobacco consumption, ethnicity, income and social remittances (scale of Sherbourne & Stewart, 1991). Data processing will in particular assess and compare the association strengths in different subpopulations of individuals (exposed/unexposed). We will assess descriptive and then multivariate analyses by testing the effect of each variable. For each researched variable, we will select dimension-independent variables (socio-economic status, family status, risk perception, etc.) and we will then estimate the final models by analyzing interactions and performance models.

This time-limited study will not fully address the controversy arisen around San Sebastian observations (see § 2.2). It will, however, facilitate the formulation of hypotheses on the relationship between oil contamination and morbidity, thereby enabling further epidemiological studies, such as control-case or prospective cohort studies. Ultimately, our Ecuadorian partners want to establish an observatory on health, including cancer registries and malformations. We believe that the study we propose in MONOIL will provide strong argument for an increased interest in health studies and will encourage the participation of the concerned populations as well as Ecuadorian authorities.

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T2.4. Analysis of oil industry economic impact on regional development dynamics (LEREPS)

The purpose of this task is to place the oil industry along the development path of the concerned areas, through the characterization of its integration with the local production system and its impact on the economic vulnerability of concerned groups of people. This integration will be evaluated not only by economic indices such as the creation of local wealth, sector diversity and productive complementarities between sectors, job creation potential (permanent or temporary), but also by the existence and variable strength of oil-related environmental externalities. Our approach will be territorial, as we define territory as a geographical space deeply linked to a population, i.e. lived, produced and thought (Di Meo, 1998) by this population. However available data should probably refer to administrative districts (parroquias or provinces) which will frame the chosen geographic scale.

We shall successively utilize two analytical tools for an economic approach to place or territory:

(1) At the productive system level of concerned territories (local productive systems)

1/ Identification of the offer of goods and services, the structure of economic activities (other than oil industry) and characterization of the role of oil industry in the (de) stabilization of this productive system (opportunities for some sectors or competition for resources or labour, etc.)

2/ A specific analysis will be dedicated to agriculture, a sector with generally greater dependence on environmental resources.

(2) At the level local economic circuit structure.

1/ Identification of the territory's economic base according to the approach of "base theory" (Archer, 1976 ; Andrews, 1953, Davezies, 2008). We assume that two main components of the productive base exist: the oil industry and agricultural production, be it smallholder agriculture or entrepreneurial agriculture (palm oil). We shall also consider the potential existence of a "residential base" fed by private and public transfers and perhaps also by tourism (notably ecotourism).

2/ Characterization of the local income generation capacity of the oil industry and the impact of its multiplier effect on the development of "domestic activities" (in the base theory terminology); Evaluation of local "Dutch Disease" effect, through local relative price change hampering the development of other basic activities; characterization of the role of local organizations (professional or human rights) and their achievements (goals and means) in local development processes and resource conservation and valorization.

Methodology: collection of available data on these elements at the territory level; qualitative and semi-structured interviews with key-persons.

TASK 3: ENVIRONMENTAL IMPACTS OF OIL ACTIVITIES

Principal Investigators: Laurence Maurice (GET) and Hélène Budzinski (EPOC)
Participants: Eva Schreck (GET), Karyn Le Menarch, Marie-Hélène Devier, Patrick Pardon (EPOC), Gaëlle Uzu (LTHE) and ECOLAB laboratories in France ; EPN, USFQ and EP Petroecuador in Ecuador
Private start-up collaboration : LED Engineering Development
Objectives: Evaluation of environmental contamination levels and validation of monitoring tools
Deliverables: Assessment of the environmental quality (PAHs and toxic heavy metals) in the studied areas; Reports, rank A Articles; specific biomarkers of the oil activities impact in the study area
Methods: Sampling (instantaneous and passive), elementary chemical analysis, comparison with the natural biogeochemical background, use of biomarkers (of defense and damage), development of tests to measure the toxicity of natural tissues
Risks: Sampling limitation caused by field access and the number of analyses (financial or climatic limitations)

T3.1. Current state of oil activities environmental impact (GET, EPOC, LTHE, EPN, USFQ) by active and passive samplings

The main objective of MONOIL program Task 3 is to study the environmental impact of oil activities by analyzing and implementing passive samplers to measure polycyclic aromatic hydrocarbons or PAHs, their metabolites and trace metals associated with these activities (Ni, V, Cd, As, Pb and Hg in particular), in various compartments: air, water (rain, surface and groundwater), sediments, soils, aquatic food chains and agricultural products. This current state of oil activities environmental impact will be performed in these various matrices and interrelations will be established to better understand: i) the transfer of PAHs, their metabolites and trace metals in environment and ii) the potential risks involved for aquatic and terrestrial ecosystems and human health.
We propose to analyze PAHs/ heavy metals cocktails directly linked to anthropogenic activities and whose risks on ecosystems and human health are proven. On one hand, these compounds have never been analyzed with accuracy in this region and, on the other hand, these cocktails have hitherto never been analyzed in studies of oil related contamination.

Air sampling will be performed using inertial impactors in strategic points, windward pollution emissions and inside villages. Aerosol particles will be size-segregated thanks to particulate matters (PM) inlet filters so as to characterize their chemistry according to their granulometry. PM emitted by flares will be characterized by their size (PM_{10}, particles with a diameter <10 microns, $PM_{2.5}$, PM_1). For these three size classes, ambient particles levels will be carried out by a continuous gravimetric analyzer (Dustrack, TSI). Metals and PAHs concentrations of the different fractions will be analyzed on quartz membranes after a 24 or 48 hours inertial impaction, depending on the levels of PM.

Epiphytes plants such as angiosperms, lichens or mosses will be used too as bioindicators of air contamination by metal(loid)s. Time-depending experiments would be performed to better follow the metal(loid) transfers and accumulation process depending on the plant species, climatic factors and pollution contexts.
Several samples (aerosols, soils and organisms) will be kept for further experimentations on ecological and health impacts using biomarkers and *in vitro* tests.

For the terrestrial compartments: soils, plants and living organisms samplings will be performed to determine HAPs and metal(loid) concentrations in the different matrices. Topsoils (0-30 cm) will be collected at strategic points, near cultivation areas. Moreover, vegetables (roots, shoots and edible parts) will be harvested to determine the concentration in metal(loid)s in their tissues. Some terrestrial organisms (for example invertebrates such as earthworms that are known to highly accumulated heavy metals (Dai et al., 2004) and metabolize organic compounds (Schreck et al., 2008)) will be collected in impacted soils in view of monitoring the soil contamination and understanding bioaccumulation processes in the food chain. Metal concentrations will be determined in their tissues and bioaccumulation and enrichment factors will be calculated.
As detailed above for terrestrial environments, the ecosystem functional integrity (or alteration) will be assessed using ecotoxicity indicators based on leaf litter breakdown. For this purpose, leaves from riparian woody species will be used and exposed at the various sites in immerged litter bags.
Depending on the possibilities to get other funding sources and/or to involve PhD students, these indicators based on leaf litter breakdown may be complemented with indicators based on aquatic primary production, such as periphyton colonisation of artificial substrates (Biggs et al. 1988, MacDonald et al. 2012).

For the aquatic compartments: rain, surface and ground waters, as well as aquatic organisms, will be collected in the impacted areas. Biological aquatic species selected for the sampling must be representative of their environment. For example bivalves, accumulate PAHs without biomagnification between trophic levels, however, in fish, they are not accumulated but are enzymatically degraded (P450) and then excreted in bile as polar metabolites. To assess organism PAHs exposure and contamination in the natural environment in a context of oil pollution, PAH metabolites will also be analyzed, especially in fish species consumed by humans. We also plan to combine these samplings with the installation of **passive samplers** integrating a flux of dissolved PAHs (SPMD: Semi-Permeable Membrane Device) and heavy metals (DGT: Diffusive Gradient Thin Film) on a selected period of time. These samplers are used to measure bioavailable dissolved fractions of these toxic molecules in key areas (places of living, fishing, drinking water, etc.). Passive membranes will be placed in water and also in the air, close to residential and emissions areas.

PAHs and metal(loid) concentrations determination will be performed in the different matrices. PAHs will be extracted using microwave process and solvents (acetone / hexane 1: 1) before being analyzed by Gas Chromatography Mass Spectrometry (GC-MS) according to the protocol developed by Piñeiro-Iglesias et al. (2003). Metals will be analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) after acid digestion (HNO_3/HF) and microwave according to the protocol developed by Rimetz-Planchon (2007).

For the experimental design, about twenty sampling points are planned for each site exposed to oil activities (~ 40 samplings per compartment: water, soil, sediment, fish/shellfish, agricultural products (roots, shoots and edible parts) + 54 air samples). A control of water quality will be done in the downstream areas of the oil exploitation zones: in the Amazon floodplain, along the Rio Napo and Aguarico rivers that borders Peru (~ 5 samples per compartment: water, sediment, soils and fish). Samples of water, sediment and fish will also be done in an area of bituminous sandstone natural outcrops (~ 10 samples per compartment: water, sediment, soil, fish/shellfish, soil organisms and plants if available) and also done in a control zone (~ 20 samples per compartment: water, air, soils, sediments, fish/shellfish, soil organisms and plants).To cope with the seasonal variability of contaminants flows into the environment, at least two sampling campaigns will be carried out, one during the low water period and the other one during floods, and if fund raise allows it, a third validation campaign during critical low flow.
The results of the sub-task will be useful for understanding the data collected in Tasks 1 and 5. We can underline that the choice of sentinel species make it possible to integrate the role of diet in the human populations studied. Moreover, the knowledge of pollutant concentrations in agricultural products consumed by humans is necessary to perform bioaccessibility tests to assess human exposition and the involved risks.
Finally, a global assessment of the contamination levels and localization will be proposed with mapping and GIS tools in order to better understand the impact for the environment and the risks involved for human health.

T3.2. Selection, validation and optimization of monitoring tools (GET, EcoLab, LED Engineering)

The second objective of Task 3 is to study of the potential impacts of oil activities for ecosystems and humans and to validate various **ecotoxicity tests and biomarkers** in the Ecuadorian Amazon for a transfer to competent authorities and universities. This work intends to focus on various biomarkers and the use of bioaccessibility tests for humans (for ingestion process and oxidation tests for inhalation assessment).
For ecosystems, additionally to ecotoxicity tests, biomarkers will also be developed in parallel with the elementary measures of chemical contamination *in situ*. A **biomarker** is a biological response to a chemical substance presents in the environment that can be connected to an exposure or a toxic effect (Peakall, 1994).

In soils, **pollutant phytoavailability** will be determined with soil extractions using different salts and/or chelatants. Metal(loid)s extractions from soil by $CaCl_2$ or EDTA will be performed as described by Chaignon et al., 2003; Feng et al., 2005; Schreck et al., 2012.
Seed germination and growth assays will be performed on selected plants widely cultivated in Ecuador in the different impacted areas (*Theobroma cacao*, *Viscia faba*, *Manihot esculenta*).
Some biomarkers related to photosynthetic activities will also be developed to asses toxic impacts of PAH and metals on terrestrial plants. For this purpose, photosynthetic pigment contents will be determined using spectrophotometric and/or HPLC methods. A possible alteration of photochemical conversion in plant leaves will be assessed using Pulse-Modulated Chlorophyll Fluorescence methods (Maxwell & Johnson 2000). These methods allow the estimation of photosynthetic rates from light-stimulated changes of photosystem II, and can be used to estimate the capture of photons by light-harvesting pigments, the light

reactions, the thylakoid electron transport rate (ETR), and some associated regulatory feedbacks. They can be used both to provide generic plant stress markers, and to understand mechanisms of photosynthesis inhibition.

Finally, micronuclei will be used as biomarkers of nuclear DNA anomalies and chromosomal instability. Indeed, Micronucleus (MN) standardized assays are widely used to assess the genotoxicity of contaminants in various cell types and to assess the extent of chromosome loss (aneugenic effect)or breakage (clastogenic effet) (Shahid *et al.* 2011).

Following exposure to metal(loid)s, the fatty acid composition of plant leaves is modified after exposure to soils polluted by metals (Le Guédard et al., 2008). A standardized foliar fatty acid ratio (C18:3/(C18:2+ C18:1 + C18:0)) is nowadays available to diagnose soil contamination by metals *ex situ* (AFNOR, 2012) and it was also successfully used in field (Le Guédard et al., 2012 a,b). Both foliar and root pathways significantly impact plant leaf fatty acid composition and do not interact. Recently, a new dimensionless quantity in the form of is the weighted product of fatty acid concentration ratios: Z=(C16:1/C16:0)(C18:3/C18:0)0.57(C18:1/C18:2)0.23,has been built up from statistical analyses. This index provides new insights on the mechanisms involved in metal uptake (air or soil pathways) and phytotoxicity (Schreck et al., 2012). Plant leaf fatty acid composition is thus robust and fruitful approach to detect and understand the effects of metal contamination on plants. A decrease in the amount of tri-unsaturated fatty acids in higher plants was also observed for tomato seedlings grown in culture solution containing copper or cadmium (Ouariti et al., 1997; Djebali et al., 2005), as well as for pepper and rape seedlings grown in nutrient solution supplemented with Cd (Jemal et al., 2000; Ben Youssef et al., 2005). Then, foliar fatty acid ratio will be determined on various plant species exposed *in situ* to pollutants. Experiments and measures will be performed in collaboration with LBM and LEB laboratories in Bordeaux.

Concerning pollution impact on microorganisms, the solid-phase Microtox® test will be used to evaluate the toxicity of contaminated soils or sediments (Doshi et al., 2008; Barrena et al., 2009; Schreck et al., 2011). The Microtox® test measures the decrease in light emitted by the bioluminescent bacteria *Vibrio fischeri* when bacteria are exposed to pollutants. Toxicity is reported as the effective concentration EC50, which is the concentration of a contaminant that produces a 50% reduction in light emission.

To have an insight into environmental-wide impacts of PAH and associated metals, some ecotoxicity markers will be used as well, with a particular focus on leaf litter breakdown as an indicator of functional ecosystem integrity (Gessner & Chauvet 2002, Cornut *et al.* 2012*)*. This ecosystem process depends both on leaf litter characteristics, on abiotic external parameters, and on the presence, abundance and activity of both microorganisms and macroinvertebrates. This has been well documented for woody and herbaceous plant species, under different climates including tropical ones, both in aquatic (*e.g.* Costantini *et al.* 2004, Konig *et al.* 2014) and terrestrial habitats (*e.g.* Walter *et al.* 2013, Meyer *et al.* 2013). Leaf litter breakdown rate has notably been shown to be a sensitive indicator of metal contamination (Kohler *et al.* 1995, Roussel *et al.* 2008; Lecerf & Chauvet 2008). Some litter bags will be deployed at the study sites (using litters from common native woody and/or herbaceous plants species), and breakdown rates will be compared between contaminated and reference locations. If necessary, temperature correction will be performed to allow such comparisons. These data will be related to the biomass of macroinvertabrates and fungi within litter bags. Depending on the possibility to get some extra-funding, an assessment of the biomass of different microbial groups (including both bacteria and fungi) may be performed by qPCR.

Biomarkers such as **metallothioneins** in terrestrial organisms will also be developed in parallel with the elementary measures of metal contamination *in situ*. Actually, metallothioneins belong to a group of intracellular, high molecular and cysteine-rich proteins whose content in an organism increase with increasing concentration of heavy metals. Then, their use could be helpful to determine the global impact on soil ecosystems (Huska et al., 2008; Schreck et al., 2008).

Cholinesterase (ChE) activity is studied as a biomarker for pollutant exposure (Denoyelle et al., 2007, Reinecke and Reinecke, 2007a and Reinecke and Reinecke, 2007b). Acetylcholinesterase enables hydrolysis of the neurotransmitter acetylcholine at the synapses. Toxic molecules inhibit this enzyme and are responsible for an over-accumulation of acetylcholine causing tetanus and death (Day and Scott, 1990, Stenersen et al., 1992, Jemec et al., 2007, Reinecke and Reinecke, 2007a and Reinecke and Reinecke, 2007b).

Moreover, it is generally thought that exposure to organic compounds such as PAHs initiates a metabolisation process (Saint-Denis et al., 1998). In eukaryotes, this usually occurs in two phases of which the second involves conjugation enzymes such as **glutathione-S-transferase (GST)** which attach a polar compound to the toxic molecules, promoting elimination by excretion. Thus, the increase of GST activity will be evaluated to quantify the metabolisation process induced by pollutant exposure. Finally, the metabolisation phase can imply the production of reactive oxygen species (ROS), whose effects are countered in organisms by antioxidant enzymes (Saint-Denis et al., 1998). One of them is **catalase (CAT)**. The latter is responsible for breaking down the hydrogen peroxide free radical (H_2O_2) into water and molecular oxygen, especially in the case of PAH exposure (Brown et al., 2004). So, an increase in its activity should indirectly indicate the metabolisation of pollutants leading to soil detoxification.

In the atmosphere, both flare emission factors (CO/CO_2, Black Carbon/Organic Carbon, metals, PAHs) will be characterized. Redox property of PM has been suggested to be a unifying factor to explain the biological activity of ambient air pollutants thus, the overall **pro-oxidant potential** of these aerosols will be characterized. It will be evaluated by measuring the intrinsic ability of an aerosol to oxidize the environment and could be used as a pollution-health indicator predictive of their aggression on the lungs (Cho et al., 2005; Uzu et al., 2011). The evaluation of the pro-oxydant potential of aerosols will be done by the **DTT a-cellular test** that is directly correlated with biological inflammatory responses, as reported by Cho et al. 2005; Li et al. 2003; Uzu et al., 2011 working in high polluted urban areas. This diagnosis will be made at the study area scale, Dayuma and Pakayaku corresponding to the sub-watersheds of the Tiputini and Aguarico rivers and then compared with the control area; enrichment factors will be estimated according to the geochemical background measured in a pristine watershed.

For aquatic compartments, two non-cellular biomarkers will be studied: (1) The metabolites of PAHs are involved in **DNA damage and carcinogenic effects** associated with PAHs. They are produced in fish bile and measured thanks to their fluorescent properties. These biomarkers also give information on the bioavailability of PAHs in the fish species studied, (2) **hepatic neoplasms**: a histopathological examination of the sampled fish liver will be conducted in order to reveal the presence of micro-and macroscopic tumors. These analyses and markers will be performed in different types of matrices.

(1) Passive samplers capable of accumulating contaminants in water for PAHs (SPMD) and trace metals (DGT). In water, passive samplers such as SPMD (semipermeable membrane) or DGT (diffusive gradient thin film) will simulate the bioconcentration of dissolved PAHs and heavy metals in animal species. The SPMD simulates the aquatic organisms' bioconcentration of organic contaminants in tissues (fatty acids) and concentrate dissolved forms, of PAHs, aliphatic hydrocarbons, PCBs, dioxins, furans and chlorinated pesticides. The DGT technique is dynamic and concentrates the available fraction (labile) of heavy metals (Hg –total and methylmercury-, Pb, As, Cd, etc.) dissolved in water. These samplers are commonly used to measure the presence of contaminants in fresh and marine waters.
(2) Sentinel animals species: These species will be selected according to standard criteria associated with sentinel species: sedentary lifestyle, easy identification and capture, population size, wide and referenced area of distribution (affected and unaffected area), a several years longevity, the bibliographic data availability for classic biomarkers. Different organs will be collected according to their level of accumulation or metabolism: hepatopancreas and hepatocytes in molluscs, bile, liver, blood, brain and muscles of fish.
As mentioned for terrestrial plants, molecular biomarkers such as micronucleus assay (MN) will also be studied on fish erythrocytes. An increase in MN frequency has been demonstrated to result from exposure to various compounds found in the aquatic environment such as PAH (Al-Sabti and Metcalfe, 1995; Pacheco and Santos, 1997), heavy metals (Al-Sabti and Metcalfe, 1995) and pesticides (Polard et al 2011). MN induction indicates non-repairable mutagenicity and thus this early biomarker is widely used in fish to investigate the genotoxic effects of chemicals, isolated or in mixtures, present in the aquatic environment.
Once taken up by an organism, xenobiotic compounds including PAHs undergo a series of biotransformation processes, before being excreted through the bile as hydroxylated and/or conjugated metabolites. Thus, as presented above, biliary metabolites of these contaminants will be used in this study as exposure markers in fish. Furthermore, the activation of enzymatic biotransformation systems (cytochrome P450 system measured through 7-ethoxyresorufin-O-deethylase EROD activity) can serve as ecotoxicological tools to assess the response of the organism to these pollutants.
In this project, it would be interested to study the relationships between the EROD activity in the liver, the level of micronuclei in blood cells and the concentration of PAH metabolites in the bile of the sentinel fish organisms.
The activation of detoxification mechanisms leads to significant energetic challenges to the intoxicated fish. Evidence for such energetic costs is demonstrated as decreased growth rates, reduced activity and impaired reproductive success of exposed fish (Smolders et al, 2003; Nault et al. 2013). To assess such impact of contaminants on the energy budget of exposed organisms the biochemical cellular energy allocation (CEA; De Coen and Janssen, 2003) will be developed on liver, muscle and gonads of fish sentinel.

Biomarkers of effect will be studied too to evaluate the impact of contamination human health. These biomarkers of effect measure the deterioration of vital cell functions such as the fragility of the membrane lisosomes (NRRT) and DNA damages (LUCS). LUCS test (Fernandez Cruz et al. 2002) is a simple, robust and informative approach measuring from living human cells, the effects of contaminants on the integrity of the DNA structure. It can be implemented for the evaluation of generic toxicity and/or oxidative stress generated by the contaminant (Fernández-Cruz et al., 2012). This test was chosen as reference toxicity test in

various research programs (ANR Sécuriviande and RIMNES) and by the AFNOR (validation in progress). The micronucleus test will also be implemented on human blood samples.

Contaminant bioaccessibility by ingestion or inhalation is nowadays investigated in terms of risk assessment in various matrices. A lot of ***ex vivo* tests** have been developed in the last years in order to determine by laboratory experiments the bioavailable fraction of metals for organisms.

Uptaken by plants via root or shoot pathways, metals may enter the food chain in significant amounts (Alexander et al., 2006; Polichetti et al., 2009; Perrone et al., 2010) and could be responsible for contamination risks and human toxicity via food consumption. Then, in order to assess the risk of **human contamination by ingestion** of polluted products, bioaccessibility assays will be performed on vegetable samples. The *ex vivo* test (BARGE) allows studying human bioaccessibility of priority contaminants in soils and vegetables such as arsenic, lead and cadmium by simulating the physiochemical conditions of the human gastrointestinal tract (Caboche et al., 2009).

Finally, the interrelations between (1) the contamination level in PAHs, PAH metabolites, and trace metals of the environmental media (air, soil, water), (2) the contamination level of the biological media (plants, soil fauna, aquatic organisms), and (3) the stress level on the biological media measured *via* biomarkers will be highlighted with appropriate statistical analyses. Statistical results will bring additional materials in order to evaluate the strength of the interrelations between contamination level of the environmental media, contamination level of the biological media, and biological stress. Statistical results will also help in comparing the efficiency of all biomarkers and provide a selection of the most relevant, non-redundant biomarkers. In more details, the interrelations between contamination and stress levels of the biological media will be highlighted by studying the correlations between both sets of variables with PCoA (Principal Coordinate Analysis) and RDA (Redundancy Analysis). Both sets of variables would be measured on the same sets of samples, one sample being one organism. The interrelations between the contamination level of the environmental media and biological stress will also be highlighted by studying the correlations between both sets of variables with PCA and RDA. This time, analysis would be performed at a higher level, one sample being one locality, both sets of variables would be measured at the same localities. Highlighted significant interrelations for both series of statistical analyses will help in better understand the transfer of contaminants from the environment to the biological matrices and ii) the potential risks involved for aquatic and terrestrial ecosystems.

Terrestrial compartments	Laboratories involved
Soils, plants and soil organisms sampling	GET
Air sampling and air monitoring	LTHE
Soil to plants transfer and monitoring	GET
Air to plants transfer and monitoring	LTHE
Gastric bio accessibility gastrique in consumed plants	GET
Phyto-availability (chemical extractions)	GET
Lipid Index	GET + partenariat Bordeaux LEB
Biomarkers on plants photosynthesis	EcoLab
Litter degradation (experience with litter bags),	EcoLab
Biomarkers on terrestrial organisms	GET + EcoLab

Micronucleus assays, on plants	EcoLab et LED
microcosms assays / germination/elongation	EcoLab
DTT I pro-oxidative potentia	LTHE
Statistical analysis	GET + EcoLab

Aquatic compartments	**Réalisations ECOLAB/LED**
Water, sediments and organisms sampling	GET, EPOC et EPHA
Litter degradation / associated microorganisms	EcoLab
Micronucleus assays on fish red blood cells,	EcoLab
LUCS (environmental and human samples)	LED (LED Engineering Development)
Micronucleus assays (human samples) and NRRT assays (env. samples)	LED
EROD and other biomarkers on fishes and shells	EcoLab
Réserves glucidiques, lipidiques et protéiques	EcoLab
SPMD passive sampling and chemical analysis	EPOC
DGT passive sampling and chemical analysis	GET

TASK 4: IMPLEMENTATION AND EFFICIENCY OF AN ENVIRONMENTAL POLICY FOR PETROLEUM ACTIVITIES

Principal Investigators: Sylvia Becerra (GET) ; Guilhem Juteau (doctorant)
Participants : Ch. Kephaliacos (LEREPS) ; V. Simoulin (CERTOP); C.Larrea, N.Greene (UASB)
Objectives : to analyze the efficiency of political responses to environmental contamination by identifying vulnerabilities and political-institutional capacity
Methods : interviews, analysis of legal and administrative documentation, observation
Deliverables : Report on the effectiveness of environmental policies by coupling sociological surveys & simulation results to highlight political indicators of vulnerability/capacity; scientifc publication; PhD thesis
Risks : Access to communities; we will call up the institutional partners network and key-persons reached during exploratory surveys to facilitate field access to actors.

The regulation of industrial activities has become a central issue of public policies in Ecuador; Rafaël Correa's coming into power in 2006 and recent re-election has lead to reforming the state's implication in risk management and impacts generated by petroleum activity. For many years, the Ecuadorian government has taken on board the regulatory aspect of serious environmental, health and socio-cultural impacts linked to oil-drilling activities in the region of North-Amazonia.

The study of policy instruments implementation for two concerned parishes will enable gauging the efficacy of their social and institutional conditions. The objective is to highlight existing similarities and inequalities between neighboring territories considering their own characteristics (social organization, petroleum projects, political management, geographical and environmental conditions) and the manner in which these instruments are put into action. The aim of this task is to identify vulnerability factors and politico-institutional capacities (to

cope with oil-related environmental issues) in order to form efficiency indicators of political responses. One hypothesis, outlined by Bustamante's (2007) work, is that the Amazonian region has special characteristics in terms of political management (patronage, in particular) which render it particularly vulnerable to pressures generated by petroleum activities, and which also directly affect the population's quality of life. This hypothesis can be overturned by: practices of patronage that can originate in the manner in which oil companies interact thus leading to a political type of management specific to RAE. Another hypothesis could be, based on local government (parish), that initiative and political capacity are fundamental strengths of resilience when faced with environmental and socioeconomic risks, insofar as these strengths enable taking advantage of opportunities offered by recent policies of compensation of socio-environmental impacts to oil extraction.

T4.1. Analysis of system of redistribution of 12% of Oil Company profits for local development (GET, LEREPS)

The aim is to first identify different scenarios for implementing the system for social redistribution of oil profits (12%), put into place by the 2010 reform bill of the hydrocarbons Act. How many parishes in the oil provinces have filed a development project application with the relevant organizations in the light of this redistribution system? What exactly do the elected parties expect? What is their capacity for responding to this financial manna (creation of development projects)? How will the civil society participate in the definition of this new development model put forward by the reform bill? How will its represented interests be assured in the design and implementation of territorial development plans?

Methodology: The methodology for this subtask is of a qualitative nature: documentary analysis and semi-structured interviews. This subtask is closely related to task no. 6 concerning the building of "governance and sustainable development" scenarios; it will give information on logistics and action strategies of agents of the multi-agent simulation model.

T4.2. Efficiency of environmental policies at the cost of local political dynamics (GET)

Presently, two state-implemented policies are at the centre of environmental regulations concerning petroleum activities: the 1999 Environmental Management Law (LGE) and the 2011 Environmental regulations for activities concerning hydrocarbons (known as RAHOE or "12-15"). A variety of stakeholders of heterogeneous rationalities (public authorities, industry, residents, associations) are concerned, at the centre of which the Ministry of Environment is in charge of applying monitoring procedures, sanctions and remediation policies, and the Public enterprises, Petroecuador and Petroamazonas, are responsible for present-day and past contamination, its monitoring and reduction. The implementation of these regulations implies a minimum of coordination between these concerned stakeholders, of differing rationalities, which leads to three main questions:

1. Can the evolution of legislation and regulations in the 2008 Constitution framework enable monitoring, even the reduction of externalities of the in situ oil activity?
2. What is the position of present-day politico-administrative organization and territorial political dynamics in the efficacy of policies of environmental regulations for petroleum activities; how do these policies influence the coordination necessary for these regulations?
3. Is the implementation of environmental standards adapted to the socio-cultural context on a local level? How and Why?

To realize these objectives, a scholarship in sociology has been requested in order to recruit a PhD student for three years. This student in question can be supported by both the GET in Toulouse and the CERTOP laboratory (sociology, section 40), at the same time associated by the MONOIL project.

Methods: The methodology for this subtask is of a qualitative nature: firstly, a summary and an analysis of legal documentation and relevant public policies will be undertaken; secondly, data collections on different strategies on how regulations are put into practice, both nationally and locally, utilising an array of tools (focus groups, semi-structured interviews, observations):

(1) implementation of Agenda and standards and regulations, (2) their appropriation by the varied stakeholders – advantages, disadvantages, adaptation, expectations, (3) development of companies' internal standards (a companies' social responsibility).

TASK 5: CLEAN-UP SYSTEM FOR DOMESTIC WATER USE

Principal Investigators: A. Ter Hal (IRMCP), L. Delmas (DEL)
Persons involved: L. Maurice, S. Becerra (GET), H. Budzinski, M.H. Devier (EPOC)
Objectives: Development and production of a system to purify water for domestic use
Methods: development of an organogel material that specifically traps PAHs dissolved in water. The organogel material will be prepared using local resources
Deliverables: a prototype (this project is in correlation with the GELUCS project submitted at the AO ANR ECO-TS in February 2013 by the team IMRCP (PI), EPOC and GET)
Risks: although a new material that is easy to prepare and to use with reduced fabrication costs, this material must first be tested and validated under laboratory conditions before being evaluated under real conditions.

« Hydrosafe » is the name given to the organogel material. The purpose of this material is to remove polycyclic aromatic derivatives from water for domestic use. The word « Hydro » for *hydrocarbon* and *water* and the word « safe » are used because after purification, the water will be safer for human use. So far, no systems have been described with the same characteristics. The future applications of this material are numerous (from potable water to decontamination of water bodies).

T5.1. Development and production of porous organogel material specific to organic and toxic molecules (IRMCP- DEL)

The criteria for selection of the constituents of the organogel materials are the following: they should be made from local and edible vegetable oils, the organogelator should also be edible (like carnauba wax, for example) and preferably from local resources. The porosity in the materials will be introduced by the leaching method made possible through the use of sugar or salt crystals. During the step of elaboration of the material, it will be important to adjust the mechanical strength of the organogel (development of the mould from sugar or salt: grain size, mould size). The organogel materials are characterised by sol-gel and gel-sol phase diagrams, by elastic modules and by Scanning Electron Microscopy.

T5.2. Evaluation of the capacity of the organogel material to trap PAHs in aqueous phase (DEL-EPOC)

Four molecules will be selected among the list of the sixteen priority PAHs established by the US-EPA: naphthalene, anthracene, phenanthrene, benzo(a)pyrene. Each molecule will be first studied independently. Aqueous solution of the model compounds at sub-micromolar concentrations will be prepared for absorption by the porous organogel materials. The model compound decay will be monitored by HPLC and fluorescence detection or by GC-MS. The uptake kinetics will be then established. The equilibrium constant will be calculated for each molecule, together with the time necessary to attain equilibrium. The first tests will be undertaken with deionised water, and the second round of testing will use water with the same characteristics as that used by the population (pH, conductivity, natural organic matter content, etc.). The laboratory tests will be undertaken under conditions similar to the storage conditions of water in the everyday life of the population (size of the container, temperature, time of storage). There will be an investigation of the compounds that could eventually leach from the material. There will also be an investigation of possible bacterial development on the materials. After use, the material must be eliminated or destroyed. Calcination or composting is under consideration.

T5.3. Tests and *in situ* validation with volunteer families (GET- IRMCP-EPOC)

Like every innovation, Hydrosafe must induce change. Under the present circumstances, the goal is to bring a significant improvement in the daily life conditions of the families involved and to reduce risk by exposure to hydrocarbon derivatives. In order to conceive, produce and validate Hydrosafe, efforts will be made to take into consideration the sociological conditions leading to a technological innovation from the earliest stage of the invention to the everyday life uses of the object, as evidenced by Rogers (1995). The advantages of the use of Hydrosafe must be clearly perceptible and it must be compatible with the existing values, past experiences and social habits of its users. The product must be easy to use and to understand. Furthermore, the people that will tests the system will also help to develop confidence in the new product. Finally, considering Hydrosafe rapidity in trapping organic pollutants and the easy handling of the product, it is anticipated that volunteers' families will easily and clearly see the results and willingly adopt its everyday use.

TASK 6: SCENARIOS AND TOOLS FOR SUSTAINABLE DEVELOPMENT

Cross-disciplinary task managed by M. Saqalli, L.Maurice and S. Becerra
Aims: To develop scenarios and tools for sustainable development and to favour the transfer and scientific valorization of results
Methods: Multi-agent simulation validated in focus group; focus group of discussion about scenarios
Deliveries: SMA, report forming the basis of a definition for the creation of an agency for alert and assessment of socio-environmental liabilities in relation to oil activities
Risks: The synchronization of the results of Task-2 and Task-4 will enable realization of Task-6. The risk, however, is limited as reported by the exploratory data that allows realization of the simulation platform.

T6.1. Scenarios for a sustainable development (all the partners)

The totality of social, economic, geographic and environmental data collected by the project will enable the development of various scenarios of development for the attention of public actors.

Method: Development of a multi-agent system. The aim of the system will be the formalization and integration of action in view of the elaboration and implementation of projects and development policies enabled by legislation regarding hydrocarbons. Simulations will allow the use of SMA:
- as an exploration tool for sustainable development scenarios : what happens when an element or an actor is added or changed in the model?
- as a synthesis tool : the formalization will allow the production of synthetic indicators of vulnerability on one or several study cases, enabling comparisons to be made.
- as an assistant support for negotiation between politics and industry: the modeling support will facilitate exchange between actors and proposed solutions.
Scenarios will be presented to institutional actors in focus groups with a view to instigating further discussion.
Risks: the realization of the platform and model depends on the social analysis conducted and its expertise in scenario development. In view of team coordination and implication in the construction of the model, a meta-model or formalized model will be developed using UML (Unified Modeling Language) to enhance its legibility to different scientific specialisms and to avoid all ambiguity in model conception. This meta-model or formalized model will facilitate communication between modelers and specialists in its development and in the development of the scenarios. Meta-model conception will begin at the outset of the project and will be adjusted throughout until it is finalized. It will provide a solid base for the project as well as relevant results from the scientific methodology conducted in MONOIL.

T6.2. Tools proposed for use in monitoring and alert in relation with contamination due to oil activities (all the partners)

Environmental monitoring tools will be transferred to universities, industrial and public actors at the end of the project: educational training will be planned before project end.
On a political and institutional level, results transfer will enable the achievement of an integrated system for prevention, alert and risk assessment for environmental contamination, health and social risk.
Team work begun and strengthened during the project and in the long-term will be succeeded by the creation of a national Observatory for results valorization with the aim of fostering sustainable development in oil countries. For the MONOIL project, only the organisational basis for the observatory will be developed.

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3. Planning of tasks, deliverables and milestones

Planning of tasks

Schedule of tasks & deliverables	**Year 1**				**Year 2**				**Year 3**			
Tasks	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1 **Coordination**	x		x				x		x		x	x
2 **Risk culture & area development**												
2.1. Representations	x	x	x	x	x	x	x				x	
2.2. Social strategies	x	x	x	x	x	x	x				x	
2.3. Socio-sanitary impacts			x	x	x	x	x	x	x	x	x	x
2.4. Regional development								x	x	x	x	
3 **Current state of the environmental impacts**												
3.1. Environmental Impacts			x	x	x	x	x	x	x			
3.2. Control tools						x	x	x	x	x	x	
4 **Responses in terms of policy**												
4.1. Implementation of redistribution procedure concerning 12% of oil revenues	x	x	x	x					x	x	x	
4.2. Effectiveness of environmental policy	x	x	x	x	x	x	x	x	x	x	x	x
5. Clean-up system for domestic water use												
5.1. Development & manufacturing	x	x	x	x								
5.2. Assessment of sequestration capacity					x	x	x	x	x	x		
5.3. Testing & validation with local populations											x	x
6. Scenarios & tools												
6.1.a .UML, Agent-based model &	x				x	x	x	x		x	x	

simulations 6.1.b. Scenarios 6.2. Defining the survey & warning platform										x	x x	x x
Deliverables/Milestones Reports			1	★			2,3, 4 ⌐	5,6, 7	8 à 11		12, 13	14 à 20 ✪

★*12 month-progress report* _ : *Mid-project report* ✪ : *Final report and expenses summary*

Deliverables

Code	Description	Partner	Month
L1	Project website	1, 3	6
L2	Perception-based regional mapping (PBRM): Report on perceptions & practices facing contaminants from PBRM (1st site)	1, 3	18
L3	Report on the economic strategies of local populations	2	18
L4	Report on the implementation of oil law reform	1	18
L5	PBRM: Report on perceptions & practices regarding contaminants from PBRM (2nd site)	1, 3	24
L6	Scientific publications in peer-reviewed international journals	all	24, 36
L7	HD photo & video reportage	1	24
L8	Report on findings from the socio-sanitary survey	4	30
L9	Report on specific biomarkers (French and Spanish)	1, 9	30
L10	Agent-based model	3	30
L11	Extension ok book aimed at the general public	1	30
L12	Evaluation of contamination levels of hydrocarbons and heavy metals	1, 5	30
L13	Report on area development from the study sites	2	33
L14	Report on results from the socio-sanitary survey	4	33
L15	Report on sustainable development scenarios	3	36
L16	Report on the effectiveness of environmental policies by coupling sociological surveys & simulation results	1, 3	36
L17	Photographic exhibition in Quito and in France	1	36
L18	Return results to local populations in situ	all	36
L19	International Symposium on Contaminants, Environment, Health & Society	all	36
L20	Delivery & Technology Transfer of the drinking water pollution control and clean-up prototype	1, 5	36

Appendix 2
PARTICIPANTS

Institutions involved in the realization of the MONOIL project, with ANR funding (List of the personnel assigned to the achievement of the Study > 25% in research time : partners 1-6)

Laboratory	Last name	First name	Current position	Field of research	Involvement in the project	Contribution to the project
GET (partner 1)	BECERRA	Sylvia	CR1, CNRS	Environmental sociology	18	**MONOIL Coordination** Master supervisor (T4) Participation to T2, T4, T5 and T6 Risk perceptions and public policies
GET	MAURICE	Laurence	DR2, IRD	Environmental Hydro-geochemistry	15	**MONOIL Coordination** For Partner n°1, in charge of T3 and T5 coordination Hydrogeochemistry of metallic contaminants
LTHE	UZU	Gaëlle	CR2, IRD	Atmospheric Chemistry	9	T3 : aerosols chemistry In charge of atmospheric samples and associated chemical analysis
GET	SCHRECK	Eva	MC, UPS	Geochemistry	7	T3 : soil contamination and soil-plant transfer
LEREPS (partner 2)	REQUIER DESJARDINS	Denis	Pr Émérite IEP	Economy for the Development	6	Coordination and participation to T2.2. et 2.4 : coordination of household and territory surveys Participation to T6 (sustainable development scenarios)
LEREPS	KEPHALIACOS	Charilaos	PR1, ENFA	Economy/ agriculture and environment	6	In charge of (partner n°2) ; Participation to T2 et 4 : territorial survey ; economic impact of public policies
LEREPS	OROZCO NOGUERA	Luis	MCF UTM	Economy/ agriculture and territory	4.5	Participation to T 2.4 : territorial survey / oil industry economic impact on agriculture
LEREPS	DEL CORSO	Jean-Pierre	MCF ENFA	Economy/ agriculture and territory	4.5	Participation to T 2.4 : territorial survey / oil industry economic impact on agriculture
GEODE (partner 3)	SAQALLI	Mehdi	CR1, CNRS	Geography-agronomy (model ; risk)	10	For Partner n°3, in charge of Co-coordination T2 : public policies ; Participation to T6 (link PBRM-MAS)
HSM (partner 4)	CADOT	Emmanuelle	CR2, IRD	Environmental and social epidemiology	9	Scientific and technical coordinator (partner n°4) Task 2 : in charge of the social and sanitary survey (realization, analysis, writing)
HSM	GARDON	Jacques	DR2, IRD	Epidemiology (MD)	9	Task 2 : social and sanitary survey (realization, analysis, writing)
EPOC (partner 5)	BUDZINSKI	Hélène	DR CNRS	Environmental chemistry	6	T3 : geochemistry of organic contaminants (HAPs) T3 : development of passive monitor T5 : validation of remediation

EPOC	DEVIER	Marie-Hélène	MC U Bx1	Analytic chemistry	6	T3 : HAP analysis of environmental matrix
EPOC	PARDON	Patrick	IR Univ.	Analytic chemistry	9	T3 : LC/MS/MS
EPOC	LEMENACH	Karyn	IE CNRS	Analytic chemistry	9	T3 : GC/MS et GC/MS/MS
IMRCP (partner 6)	TER HALLE	Alexandra	CR1 CNRS	Chemistry	10	Coordination of T5; Design of organogel material
IMRCP	GARRIGUES	Jean-Ch.	IE	Analytic chemistry	8	HPLC-UV, HPLC-FI, HPLC/MS
IMRCP	NOIROT	Arielle	AI	Analytic chemistry	7	HPLC-UV, HPLC-FI

Institutions involved in the realization of the MONOIL project, without ANR funding (partners 7-10 ANR)

EPN (partner 7)	RUALES	Jenny	Pr.	Chemistry/ nutrition	6	For Partner n°7, in charge of: T3 : analysis of metallic contaminants
EPN	DIAZ	Ximena	Pr.	Geochemistry/ mines	6	T3 : coordination of chemical analysis
EPN	BARRIGA	Ramiro	Pr.	Biology/ichthyology	6	T3 : monitoring of sentinel species contamination
EPN	MUNOZ	Florinella	Pr.	Organic chemistry	6	T3 : HAPs analysis
EP PETRO ECUADOR (partner 8)	PEREZ	Maria Isabel	Ing.	Environmental sciences	6	For Partner n°8, in charge of participation to T1, T3 and T6
PETRO ECUADOR	SAENZ	Melio	Dr.	Mathematics (model)	9	T6 : development of multi-agents system T1 : coordination with EP Petroecuador
MAE-PRAS (partner 9)	MARTINEZ	J.I	ING.		6	co-coordination of T6 + contribution to T1 et T2

Institutions involved in the realization of the MONOIL project, with other funding

UG (Quito-Ecuador): web site
UASB (Quito-Ecuador): task 2 ; 4 and 6
USFQ (Quito-Ecuador): tasks 3 and 6
ECOLAB (Toulouse-Ecuador): task 3

Additional Institution involved in the coordination of PhD or Master students work

CERTOP (Toulouse-France): task 4
ECOLAB (Toulouse- France): task 3

Services

LED Engineering Development (Toulouse)
Sabine Desprats Bologna, photographer (Toulouse)

Appendix 3
Financial Appendix

1/

	Programme SOCENV	Acronyme du projet :	MONOIL
ANR	Document de financement	Edition 2013	

RECAPITULATIFS : Partenariat, Budgets et Main d'œuvre

	Aide Demandée (€)	Coût Complet(€)	Aide allouée maxi hors pôle (€)	Personnel permanent (pers.mois)	Personnel non permanent (pers.mois)	Complément du pôle	Partenaire étranger	Partenaire sans financement ANR
GET - IRD (coord)	313567,7	1229183	306425	76	57	0	non	non
LEREPS / U-Tlse1	105430,08	331139	105510	21	14	0	non	non
GEODE - DR14 CNRS	75179,52	292025	73506	19	20	0	non	non
HSM - IRD	126790,98	358819	126791	18	9	0	non	non
EPOC - U-Bdx1	185120	585060	180960	46	18	0	non	non
IMRCP - DR14 CNRS	67808	333463	67808	29	12	0	non	non
EPN	0	0	0	0	0	0	oui	non
EP	0	0	0	0	0	0	oui	non
PETROEC UADOR								
PRAS	0	0	0	0	0	0	oui	non
UCE	0	0	0	0	0	0	oui	non
Total	873896,28	3130589	861000	209	130	0		

Dates et durée du projet

Date de début :	15 /01/2014
Durée :	42
Date de fin :	14 /07/2017