

## Environmental Toxicology and Chemistry

Programme code: MSENVITOX

Anthropogenic pollution is one of the most significant threats to the environment. Organic and inorganic environmental toxicants originating from human activities are distributed throughout the world via e.g. oceanic currents and atmospheric transport processes. This issue is of global importance. Consequently there is a high demand from both society and industry for scientists with competence within the interdisciplinary scientific area of environmental toxicology and chemistry.

### Learning outcomes

The master programme in Environmental Toxicology and Chemistry provides students with knowledge, analytical skills and general knowledge at an advanced level, with the aim of working in research, manufacturing, consulting, education and public administration, or for the purpose of further education in a doctoral program.

The master programme aims to enable students to combine biological and chemical knowledge to solve problems related to environmental pollution.

The master programme is interdisciplinary and will provide students with specialization in issues related to natural and anthropogenic pollution in the natural environment with an either chemical or biological main approach, but with a solid basis in both chemistry and biology. The programme will provide a thorough insight into the processes and mechanisms related to how environmental toxicants are absorbed by organisms, dispersal mechanisms locally and globally, how they are distributed and transported in ecosystems, how they can be monitored, and the effects that environmental toxicants have on cells, organs, organisms, populations and ecosystems. Depending on the main approach, the programme will also provide insight and practical experience in methodology and analytical techniques of relevance for working with issues within environmental chemistry and environmental toxicology. The study also focuses on the dissemination of research results to a wide audience.

### Knowledge

After finishing the study programme, the candidate should have acquired

- wide academic and applied knowledge in biology and/or chemistry with specialization in the field of Environmental Toxicology and/or Environmental Chemistry.
- knowledge of chemical properties of different groups of compounds and biological effects and important cycles, as basis for a comprehensive understanding of climate/environment, pollution and toxicology.
- knowledge of the physicochemical and/or biophysical processes of importance to the natural environment.
- research experience in a speciality that requires advanced knowledge of biology and/or chemistry through a supervised master's project that extends over several semesters.
- knowledge of relevant methods and hypothesis testing, including experimental analysis (chemical and/or biological), statistical techniques and other tools used to analyze and solve biological and/or chemical issues in research, manufacturing, management and/or teaching.
- knowledge of international research in her/his speciality, knowledge of international research groups in the field, and the breadth of research being done in the fields of

"Environmental Toxicology" and "Environmental Chemistry".

### **Skills**

After finishing the study programme, the candidate should

- have professional knowledge of and be able to utilize a variety of advanced quantitative and qualitative analysis methods, methodology in the field and the application of these to independently analyze and solve (modelling) toxicological and/or chemical problems.
- be able to collect and analyze environmental samples, perform statistical analysis of data and interpretation and presentation of research results.
- combine insights from several scientific disciplines.
- make critical and independent assessments of methods and results.
- continuously develop his/her professional competence.
- be able to communicate subject matter and scientific results both to specialists and to a wider audience and be able to formulate scientific reasoning/argumentation.
- have expertise in handling chemical substances and/or biological material and understand environmental issues, including EHS.

### **General competence**

After finishing the study programme, the candidate should

- know important aspects in environmental pollution, understand this discipline's role in society and be able to assess ethical issues within this field.
- be able to acquire, evaluate and adopt relevant and reliable new information.
- have the background to carry out/solve advanced tasks and projects, both independently and in teams, and have the ability to assess her/his own efforts in projects.
- have an international perspective on her/his scientific field.

### **Career prospects**

Graduates of the Masters programme will be internationally qualified for a wide range of positions in public and government institutions, administrative environmental agencies, consultancy companies and industry (e.g. oil and energy companies and the chemical industry) both as researcher or adviser. Some examples are Statoil and other oil companies, Det Norske Veritas, SINTEF or other research institutes/consulting firms, and national environmental authorities. Furthermore, there is an increasing need for competence within the area of risk assessment (REACH).

Through this programme you will be part of a large international scientific and industrial network. The candidates in environmental toxicology can after five years of work experience apply to become a "European Registered Toxicologist".

### Admission requirements

One of the following requirements has to be fulfilled to qualify for admission to the programme:

- To qualify for the specialisation in Environmental Toxicology: BSc in Biology (minimum of 80 ECTS credits biology courses) including pollution biology. In addition, applicants must have basic knowledge in chemistry.
- To qualify for the specialisation in Environmental Chemistry: BSc in Chemistry (minimum of 80 ECTS credits chemistry courses) including environmental and/or analytical chemistry. In addition, applicants must have basic knowledge in mathematics.
- Bachelor degrees within other related areas may be considered on an individual basis. The candidate's background should provide a biological and/or chemical relevant basis for the master study in Environmental Toxicology and Chemistry (e.g. courses listed below in the bachelor degrees at NTNU forming the basis for this master study).

In the following tables you will find the admission requirements for NTNU BSc students. Compulsory courses are written in bold.

### BSc in Chemistry:

3	6. Spring	KJ2072 Environmental Chemistry	KJ2073 Analytical Environmental Chemistry	<b>TKJ4150 Organic Synthesis I</b>	<b>KJ20XX Bachelor project</b>
	5. Autumn	<b>KJ1041 Chemical Bonds, Spectroscopy and Kinetics</b>	TBT4102 Biochemistry	GEOL1003 Geology and the Environment	BI2050 Biological resources
2	4. Spring	<b>KJ1042 Basic Thermodynamics with Laboratory</b>	<b>KJ2022 Spectroscopic Methods in Organic Chemistry</b>	<b>KJ2053 Chromatography</b>	<b>FY0001 Service Course in Physics</b>
	3. Autumn	<b>Perspective Course</b>	<b>KJ2050 Analytical Chemistry, Basic Course</b>	<b>ST0103 Statistics with Applications</b>	<b>KJ2031 Inorganic Chemistry, Advanced Course</b>
1	2. Spring	<b>TMT4130 Inorganic Chemistry</b>	<b>MA0002 Mathematical Methods B</b>	<b>KJ1020 Organic Chemistry</b>	
	1. Autumn	<b>EXPH0001 Philosophy and Theory of Science</b>	<b>MA0001 Mathematical Methods A</b>	<b>KJ1000 General Chemistry</b>	
ECTS Credits:		7,5	7,5	7,5	7,5

*Students admitted to BSc in Chemistry, NTNU, before 2013 follows the relevant study plans*

from the year they were accepted (plan for 2010-2011, 2011-2012 or 2012-2013). Hence, this table applies for the classes from 2013 onwards. NTNU-students completing their BSc in Chemistry, specialization in environmental- and analytical chemistry according to the study plans from 2010-2011 or 2011-2012 are therefore qualified for admission autumn 2014.

**BSc in Biology, Cell and Molecular Biology:**

Year	Semester				
3	6 Spring	<b>BI2071 Pollution Biology</b>		<b>ST2304 Statistical modelling for biologists/biot echnologists</b>	<b>KJ2072 Environmental Chemistry</b>
	5 Autumn	<b>BI2014 Molecular Biology</b>	<b>BI2015 Molecular Biology, Laboratory Course</b>	<b>ST0103 Statistics with Applications</b>	KJ2050 Analytical Chemistry, Basic Course/Elective course
2	4 Spring	<b>Perspective course</b>	<b>BI2012 Cell Biology</b>	<b>KJ1020 Organic Chemistry</b>	
	3 Autumn	<b>BI1004 Physiology</b>		<b>MA0001 Mathematical Methods A</b>	<b>EXPH0004 Philosophy and Theory of Science</b>
1	2 Spring	<b>BI1001 Cell and Molecular Biology</b>		<b>BI1002 Faunistics and Floristics in Norwegian Ecosystems</b>	
	1 Autumn	<b>BI1003 Evolutionary Biology, Ecology and Ethology</b>		<b>KJ1000 General Chemistry</b>	
ECTS Credits:		7,5	7,5	7,5	7,5

**BSc in Biology, Physiology:**

Year	Semester				
3	6 Spring	<b>BI2071 Pollution Biology</b>		<b>ST2304 Statistical modelling for biologists/biot echnologists</b>	<b>KJ2072 Environmental Chemistry,</b>
	5 Autumn	<b>BI2020 Zoo-Physiology or BI2021 Plant Ecophysiology or BI2022 Plant Growth and Development</b>		<b>ST0103 Statistics with Applications</b>	BI2014 Molecular Biology/KJ2050 Analytical Chemistry, Basic Course
2	4 Spring	<b>Perspective course</b>	<b>BI2012 Cell Biology</b>	<b>KJ1020 Organic Chemistry</b>	
	3 Autumn	<b>BI1004 Physiology</b>		<b>MA0001 Mathematical Methods A</b>	<b>EXPH0004 Philosophy and Theory of Science</b>
1	2 Spring	<b>BI1001 Cell and Molecular Biology</b>		<b>BI1002 Faunistics and Floristics in Norwegian Ecosystems</b>	
	1 Autumn	<b>BI1003 Evolutionary Biology, Ecology and Ethology</b>		<b>KJ1000 General Chemistry</b>	
ECTS Credits:		7,5	7,5	7,5	7,5

**Information about the Master's Study****Workload and structure**

The programme requires two years of full-time study, beginning with the autumn term (medio August). The normal work load for a full-time student for one academic year is 60 ECTS credits.

The Master's study consists of two parts:

1. A written thesis of the project (Master thesis). The extent of the assignment should correspond to a work load of 60 credits. The work on the thesis is time limited. The thesis has to be submitted within May 15<sup>th</sup> of the 2nd year.
2. An approved selection of courses, a minimum of total 60 credits, from what (at least) 30 credits must be courses at 3000-level (master level) (UTF§14.1).

**Master's agreement**

Every master student has to make a Master's agreement. This agreement comprises your syllabus and master project together with regulations for the counseling given during the master's study. The subjects, compulsory or elective, stated as syllabus in your Master's

agreement cannot be changed. If there for serious reason develops a need for change, the Master's agreement must be revised. The supervisor, the responsible Department and the student must agree upon the revision and the new agreement filed.

### **The Master thesis**

The Master thesis should be developed as your own original work (with some support from your adviser). Any quotation, use of data, information etc from other sources (including the scientifically literature and your fellow students) should therefore be carefully listed and included in the reference list of your thesis, according to best practice within your field of study.

### **Submission and Examination**

The student has to:

- Register for the final master's degree exam (through STUDWEB) within February the 15<sup>th</sup> of the 2<sup>nd</sup> academic year
- Apply for approval of your [individual special syllabus](#) (KJ3091 or KJ3093 for students in Environmental Chemistry/BI3091 or BI3093 for students in Environmental Toxicology). It is important that this is done well in advance of the examination. A study committee will evaluate the syllabus, and if it is not accepted, you must change it. Your supervisor must approve and sign the form. Hand in the thesis (within the deadline given, see below) for print through [DAIM](#). The Department will give you 5 copies of the thesis. At the Department of Biology, the special syllabus exam (and similar special curriculum courses) can be arranged at the same day as the final master exam or at an earlier stage in the master programme. At the Department of Chemistry, the special syllabus exam (and similar special curriculum courses) can be arranged at the same day as the final master exam or within two weeks before the final master exam.

In addition to the judgment of thesis, the candidate will have an oral exam consisting of:

- A conversation on/presentation ("defence") of the research assignment (the master thesis)
- Examination on the special syllabus of the advanced courses which has previously not been evaluated during the study (at least 7,5 credits, preferentially individual special syllabus). All exams, except the special syllabus (if any) have to be passed before the date of the final Master's Degree exam, unless otherwise stated in your Master's agreement.

A grade is given for every course/special syllabus that constitutes a part of the exam.

### **Important deadlines**

- **15<sup>th</sup> of October (1<sup>st</sup> year):** Decide on a Master's project in cooperation with the supervisor.
- **15<sup>th</sup> of October (1<sup>st</sup> year)** Register your Master's agreement in DAIM and hand in the signed agreement, a project description and risk assessment of the project.

- **15<sup>th</sup> of February (2<sup>nd</sup> year):** Deadline for registration for the final Master's Degree exam (through STUDWEB)
- **15<sup>th</sup> of May (2<sup>nd</sup> year).** Deadline for the submission of the master thesis. If the thesis is not submitted within this date the grade "not passed" will be awarded, unless there is handed in an application for extension of the deadline in reasonable time before the deadline. The reasons given in the application must be in accordance with Supplementary Regulations for the Natural Sciences (UTF) § 20.3 and the Examination Regulations at NTNU, § 20. Alternatively such an application may be dealt with, taken into consideration The Supplementary Regulations for the Natural Sciences (UTF) § 7 and the Examination Regulations at NTNU, § 7. See below for further information regarding §7 and §23.3.
- **15<sup>th</sup> of June (approximately, 2<sup>nd</sup> year):** is the date for the final Master's Degree exam. (Individual agreement with the respective Department, approximately four weeks after the thesis is submitted).

**Leave of absence from the Master Study (UTF § 7) (extract):**

- a) Leave of absence from the master studies of two years of duration and from the two last year of master studies of five years of duration is normally not granted.
- b) Leaves of absence may nevertheless be granted when applied for and compelling circumstances are present. Such circumstances might be illness (yourself or among close family member) etc.

**Prolongation of the study (UTF § 20.3) (extract):**

The master thesis is time limited. In case of illness, the deadline for handing in the thesis can be postponed equivalent to the time of absence due to illness. The illness must be documented by medical certificate.

If there is a valid reason for not handing in the thesis in time, one can apply for up to three months prolongation of the deadline. If the thesis is not handed in within the extended deadline, a new extension must be applied for, or else the candidate is regarded failed. Delay of deadline can only be applied for twice.

Valid reasons for postponement (in addition to illness) is teaching, organized student activity, social work and unmerited problems concerning the thesis. Written documentation or statement is required, in addition to a new plan of completion. The Faculty, or Department when given the assignment by the Faculty, determines the application. When the reason for delay is teaching, organized student activity or social work, the extended time given is according to the time spent on these activities.

The agreed delay has no influence on the evaluation of the thesis.

### **Programme Structure and Specialisations**

A diverse team of scientists is ready to offer you a two year international, interdisciplinary Master's programme in close collaboration with SINTEF and Statoil. You will work in a group incorporating both Norwegian and international students. All teaching is in English. The programme also offers you the opportunity to experience one semester in the University Centre in Svalbard (UNIS). Svalbard is an island archipelago situated in the heart of the Arctic.

There are two areas of scientific specialisation in this Masters programme:

Environmental Chemistry

Environmental Toxicology

Below you will find tables and lists of courses that describe the programme structure for each of these specialisations. The final structure of the course will be individually selected by each student allowing you to create the study programme most suited to your interests and skills. Advice will be given by the course administrators if required, and all study plans must be approved by the respective department.

You will find the course descriptions at the following web sites:

**NTNU courses:** <http://www.ntnu.no/studies/courses>

**UNIS courses:** [http://www.unis.no/10\\_STUDIES/1020\\_Courses/](http://www.unis.no/10_STUDIES/1020_Courses/)



**Environmental Chemistry:****1) For students spending all semesters at NTNU:**

Year	Semester				
2	4 Spring NTNU:	<b>KJ3091 (7,5 ECTS) Special syllabus for Master's degree</b>	Master thesis		
	3 Autumn NTNU:	KJ3051 (7,5 ECTS) Ocean Space: Marine Biogeochemic al Processes	Master thesis		
1	2 Spring NTNU:	<b>Experts in Team Work (7,5 ECTS)</b>	Elective course (7,5 ECTS)	Master thesis	
	1 Autumn NTNU:	<b>KJ3050<sup>1)</sup> (7,5 ECTS) Organic Marine Environment al Chemistry</b>	KJ3072 (7,5 ECTS) Advanced Aquatic Chemistry	Elective course	<b>RFEL3070<sup>2)</sup> (7,5 ECTS) Scientific Seminars in Pollution</b>
ECTS Credits		7,5	7,5	7,5	7,5

<sup>1)</sup> KJ3050 requires previous knowledge in general chemistry corresponding to KJ1000 and a basic course in analytical chemistry (e.g. KJ2050).

<sup>2)</sup> The students have to follow the RFEL3070 course in all semesters at NTNU.

*Compulsory courses (written in bold in the table):*

KJ3050<sup>1)</sup> Organic marine environmental chemistry (7,5) (Autumn)

REFEL3070 Scientific Seminars in Pollution (7,5) (All semesters)

Experts in team work (7,5) (Spring)

KJ3091 Special syllabus for Master's degree (7,5) (Last semester)

*Elective courses:*

KJ2050<sup>1)</sup> Analytical Chemistry, Basic Course (7,5) (Autumn)

KJ3051 Ocean Space: Marine Biogeochemical Processes (7,5) (Autumn)

KJ3053 Analytical methods for industrial- and environmental monitoring (7,5) (Autumn)

KJ3059 Advanced Chromatography (7,5) (Autumn)

KJ3072 Advanced Aquatic Chemistry (7,5) (Autumn)

BI3071 Advanced Ecotoxicology (7,5) (Autumn)

BI3072 Environmental Toxicology (7,5) (Autumn)

(TKJ4175 Chemometrics (7,5) (Spring) is recommended previous knowledge for KJ3053).

**2) For students spending the second semester at UNIS:**

Year	Semester					
2	4 Spring NTNU:	<b>KJ3091/KJ3093 (7,5/10 ECTS) Special syllabus for Master's degree</b>	Master thesis			
	3 Autumn NTNU:	Elective course/ Master thesis	Master thesis			
1	2 Spring UNIS:	<b>AT-324 (10 ECTS) Techniques for the Detection of Organo- Chemical Pollutants in the Arctic Environment<sup>3)</sup></b> and/or <b>AT-330 (10 ECTS) Arctic Environmental Toxicology<sup>3)</sup></b> and/or <b>AT-331 (10 ECTS) Arctic Environmental Pollution: Atmospheric Distribution and Processes<sup>3)</sup></b>			Elective course/ Master thesis	
	1 Autumn NTNU:	<b>KJ3050<sup>1)</sup> (7,5 ECTS) Organic Marine Environmental Chemistry</b>	KJ3072 (7,5 ECTS) Advanced Aquatic Chemistry	Elective course/ Master thesis	<b>RFEL3070<sup>2)</sup> (7,5 ECTS) Scientific Seminars in Pollution</b>	
ECTS Credits		7,5	7,5	7,5	7,5	

<sup>1)</sup> KJ3050 requires previous knowledge in general chemistry corresponding to KJ1000 and a basic course in analytical chemistry (e.g. KJ2050).

<sup>2)</sup> The students have to follow the RFEL3070 course in all semesters at NTNU.

<sup>3)</sup> Students spending the second semester at UNIS must take at least two of the three courses offered (AT-324, AT-330 and AT-331) and not be able to follow the intensive EiT to get exempted from Experts in Team Work at NTNU. For students also doing corresponding field work at Svalbard, special agreements can be made according to the rules for exception from EiT.

*Compulsory courses (written in bold in the table):*

KJ3050<sup>1)</sup> Organic marine environmental chemistry (7,5) (Autumn)

REFEL3070 Scientific Seminars in Pollution (7,5) (All semesters)

*Two of the three following courses offered at UNIS (total of 20 ECTS):*

AT-324 Techniques for detection of organo-chemical pollutants in the arctic environment (10) (Spring)

AT-330 Arctic Environmental Toxicology (10) (Spring)

AT-331 Arctic Environmental Pollution: Atmospheric Distribution and Processes (10) (Spring)

KJ3091 Special syllabus for Master's degree (7,5) (last semester)

or

KJ3093 Special syllabus for Master's degree (10) (last semester) only for those who follow 2 of the 3 courses at UNIS

KJ3091 Special syllabus exam (or KJ3093) can be held together with the final master exam or within two weeks of the master exam.

*Elective courses:*

KJ2050<sup>1)</sup> Analytical Chemistry, Basic Course (7,5) (Autumn)

KJ3051 Ocean Space: Marine Biogeochemical Processes (7,5) (Autumn)

KJ3053 Analytical methods for industrial- and environmental monitoring (7,5) (Autumn)

(TKJ4175 Chemometrics (7,5) (Spring) is recommended previous knowledge for KJ3053).

KJ3059 Advanced Chromatography (7,5) (Autumn)

KJ3072 Advanced Aquatic Chemistry (7,5) (Autumn)

BI3071 Advanced Ecotoxicology (7,5) (Autumn)

BI3072 Environmental Toxicology (7,5) (Autumn)

**Environmental toxicology:**

**1) For students spending all semesters at NTNU:**

Year	Semester				
2	4 Spring NTNU:	<b>BI3091 (7,5 ECTS) Special syllabus for Master's degree</b>	Master thesis		
	3 Autumn NTNU:	<b>BI3075 (7,5 ECTS) Experimental Ecotoxicology</b>	Elective course (7,5 ECTS)	Master thesis	
	2 Spring NTNU:	<b>Experts in Team Work (7,5 ECTS)</b>	BI3073 (7,5 ECTS) Genetic Toxicology	Master thesis	
	1 Autumn NTNU:	<b>BI3071 (7,5 ECTS) Advanced Ecotoxicology</b>	<b>BI3072 (7,5 ECTS) Environmental Toxicology</b>	<b>RFEL3070<sup>1)</sup> (7,5 ECTS) Scientific Seminars in Pollution</b>	Master thesis
ECTS Credits		7,5	7,5	7,5	7,5

<sup>1)</sup> The students have to follow the RFEL3070 course in all semesters at NTNU.

*Compulsory courses:*

RFEL3070 Scientific Seminars in Pollution (7,5) (All semesters)

BI3071 Advanced Ecotoxicology (7,5) (Autumn)

BI3072 Environmental Toxicology (7,5) (Autumn)

Experts in Team Work (7,5) (Spring)

BI3075 Experimental Ecotoxicology (7,5) (Autumn)

BI3091 Special syllabus for Master's degree (7,5) (last semester)

*Elective courses:*

BI3073 Genetic Toxicology (7,5) (Spring)

KJ2050 Analytical Chemistry, Basic Course (7,5) (Autumn)

KJ3050 Organic marine environmental chemistry (7,5) (Autumn)

*(KJ3050 requires previous knowledge in general chemistry corresponding to KJ1000 and a basic course in analytical chemistry (e.g. KJ2050))*

**2) For students spending the second semester at UNIS:**

Year	Semester					
2	4 Spring NTNU:	<b>BI3091/BI3093 (7,5/10 ECTS) Special syllabus for Master's degree</b>		Master thesis		
	3 Autumn NTNU:	<b>BI3075 (7,5 ECTS) Experimental Ecotoxicology</b>		Master thesis		
1	2 Spring UNIS:	<b>AT-324 (10 ECTS) Techniques for the Detection of Organo-Chemical Pollutants in the Arctic Environment<sup>2)</sup></b> and/or <b>AT-330 (10 ECTS) Arctic Environmental Toxicology<sup>2)</sup></b> and/or <b>AT-331 (10 ECTS) Arctic Environmental Pollution: Atmospheric Distribution and Processes<sup>2)</sup></b>			Master thesis	
	1 Autumn NTNU:	<b>BI3071 (7,5 ECTS) Advanced Ecotoxicology</b>	<b>BI3072 (7,5 ECTS) Environmental Toxicology</b>	<b>RFEL3070<sup>1)</sup> (7,5 ECTS) Scientific Seminars in Pollution</b>	Master thesis	
ECTS Credits		7,5	7,5	7,5	7,5	

<sup>1)</sup> The students have to follow the RFEL3070 course in all semesters at NTNU.

<sup>2)</sup> Students spending the second semester at UNIS must take at least two of the three courses offered (AT-324, AT-330 and AT-331) and not be able to follow the intensive EiT to get exempted from Experts in Team Work at NTNU. For students also doing corresponding field work at Svalbard, special agreements can be made according to the rules for exception from EiT.

**Compulsory courses:**

RFEL3070 Scientific Seminars in Pollution (All semesters)

BI3071 Advanced Ecotoxicology (Autumn)

BI3072 Environmental Toxicology (Autumn)

BI3075 Experimental Ecotoxicology (Autumn)

**Two of these courses offered at UNIS (total of at least 20 ECTS):**

AB-203 Arctic Environmental Management (15) (Spring)

AB-323 Light, Climate and Primary Production in the Arctic (10) (Spring)

AT-324 Techniques for Detection of Organo-chemical Pollutants in the Arctic Environment (10) (Spring)

AT-330 Arctic Environmental Toxicology (10) (Spring)

AT-331 Arctic Environmental Pollution: Atmospheric Distribution and Processes (10) (Spring)

BI3091 Special syllabus for Master's degree (7,5)

or

BI3093 Special syllabus for Master's degree (10) only for those who follow 2 of the 3 courses at UNIS

BI3091 Special syllabus exam (and similar special curriculum courses) can be held together with the final master exam or at an earlier stage in the master programme.

**Examples of Master Theses**

- Developing and establishing analytical methods and tools for use in environmental monitoring of marine and coastal areas, including quality assurance of these methods.
- Impacts of oil and gas activities on the marine environment, including biomonitoring and studies of harmful effects on invertebrates and fish.
- Distribution of brominated flame retardants in nature, including their bioaccumulation and toxicological effects in different organisms.
- Long-range atmospheric transport, deposition and effects of trace metals (e.g. lead, mercury, cadmium) in air, snow, soil, water, and ecosystems. An example of this is the chemistry of mercury in the Arctic after polar sunrise.
- Occurrence of environmental pollutants in complex mixtures. To increase the understanding of their interaction, in vitro studies are carried out, in which cells are exposed to individual toxicants and mixtures of known environmental pollutants (e.g. PAHs, PCBs, trace metals)
- Fate and effects of crude oil in the marine environment following accidental and chronic releases. The behavior of spilled oil in the environment and the use of analytical chemical methods for oil spill identification and monitoring.

**Contact information and counselling**

Address: NTNU, Faculty for Natural Sciences and Technology, 7491 Trondheim, Norway

Telephone: 73 59 41 97

E-mail: [studier-nt@nt.ntnu.no](mailto:studier-nt@nt.ntnu.no)

URL: <http://www.ntnu.no/nt/english>

<http://www.ntnu.edu/studies/msenvitox>

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