

# Department of Space, Earth and Environment (SEE)

## Strategy document 2019 -2029

### The Department's vision

SEE is an international, outward-looking department in which research is driven by curiosity and challenges. We contribute to realising Chalmers' vision *of a sustainable future* by building long-term sustainable solutions based on knowledge and technology in our fields.

SEE has a unique mix of expertise that permits collaboration between our various research fields. Our vision is to have a leading position when it comes to identifying and meeting big, relevant challenges in sustainability, energy, Earth sciences and space science by providing society with the foremost experts, state-of-the-art knowledge and innovative solutions. This vision permeates all of the department's research, education and utilisation, which are characterised by excellence and based on a solid scientific foundation.

### Research strategy

Our research objectives are to understand where we come from and where we are going by observing space and our planet. We develop technology for the conversion of energy processes and we study the local and global sustainability issues facing society. Our aim is to remain the world leader in our fields and strive for excellence and fair scientific methods at all times. Our priorities:

- To seek challenges that move and drive developments in our scientific fields.
- To collaborate with the best research groups in Sweden and abroad.
- To develop our local research infrastructure (Kraftcentralen (Chalmers' own combined heat and power plant (CHP)) and Onsala space observatory) and participate actively in relevant international equivalents.
- To obtain external grants from important funding bodies (for example VR, ERC, KAW, VINNOVA...) and collaborate with strategically important companies.
- To publish our results in leading journals and at leading conferences.

SEE has five research divisions:

#### **Astronomy and plasma physics (AoP):**

We want to understand how stars and planets are formed and die, how cosmic dust is formed and grows, and how exoplanetary systems can be characterised. On a wider scale, we strive to understand how galaxies, galaxy clusters and black holes develop. To this end, we develop new observation technologies for all relevant scales and physical processes, and design interdisciplinary methods (including, for example, chemistry, magnetohydrodynamic (MHD) simulations and radiative transfer) using the latest advances in computation and data science. We also provide theoretical support for global efforts to realise thermal fusion energy as a clean, safe and sustainable energy source. In this connection, we study plasma turbulence and plasma transfer, the energy-rich particle physics of burning fusion plasma and magnetohydrodynamic (MHD) stability.

#### **Energy technology (EnT):**

We develop and demonstrate new thermochemical energy transformation processes in which all materials are utilised in product flows and the integration of all energy flows is optimised to

minimise environmental impact. Another main research field involves enhancing knowledge about and identifying obstacles to the transition to an energy system with 100% renewable energy sources, which includes intermittent primary energy sources and emissions control.

**Microwave and optical remote analysis (MOF):**

We develop and improve observation technologies from various platforms to supply data for climate and environmental research with the emphasis on social use. We work actively to develop and promote innovative measuring systems with broad areas of application. We study the fundamental principles of the technologies, generate and supply top quality data and then use the results in models of varying complexity to understand processes and changes in the Earth's systems.

**Physical resource theory (FRT):**

We develop knowledge about the transition to a sustainable future in areas such as land use, transport and energy systems, complex systems and sustainable consumption. We base this knowledge on studies of the interaction between technology, society and nature in relation to sustainability.

**Onsala space observatory (OSO):**

We provide the best possible instrumentation for observations at wavelengths from metres down to sub-mm to astronomers in Sweden, and operate the fundamental station for geodetic measurements at international level within the framework of the national OSO infrastructure. We strive to enhance OSO's position as a Swedish national hub in relation to large international infrastructures such as Square Kilometre Array (SKA) and Atacama Large Millimeter Array (ALMA), and provide advanced scientific equipment, data analysis and scientific support. This also includes the scientific task of developing innovative new receiver technology, which also benefits environmental science. In Earth sciences, we aim to drive and support research in geodesics and global geodynamics, including theoretical work and the development of new measurement technologies, such as Onsala's new twin telescope, for geodesics, geophysics, metrology and meteorology.

**Collaboration**

Collaboration between the department's divisions and external partners, both within and outside Chalmers, is dynamic over time. Our collaborations aim to maintain and develop the quality of research within the department. Our priorities:

- To raise awareness of SEE's research fields in society and research policy, for example by building national and international networks with academia, the business community and other actors in society.
- To gain access to experimental infrastructures that enhance the quality of research.
- To gain access to top-level expertise in research fields that supplement our own knowledge. This also involves internal collaboration at Chalmers and via areas of advance and excellence initiatives.

At SEE, we strive to enhance research collaboration between divisions according to the principles outlined above. A few of the topics that the divisions share are:

- Astronomy (OSO, AoP)
- Environmental assessment (FRT, MOF, OSO, EnT)
- Measurement technology (EnT, MOF, AoP, OSO, FRT)
- System analysis (FRT, EnT)
- Earth observation, the Chalmers in Space initiative (MOF, AoP, OSO)

## **Strategy for undergraduate and Master's studies**

SEE contributes to enhancing the quality of undergraduate and Master's studies at Chalmers, and helps meet the needs of society by ensuring that our specific subject skills are visible and applied well when we recruit students and in teaching. Our introductory courses contribute to the recruitment of talented students to higher education and research in our core areas. The key factors are top quality and attractive courses.

### **Top quality**

Our courses are based on relevant, topical subject content. They are designed with a clear focus on the study programmes and are an important part of the development of the study programmes. The courses lead to students achieving very high results and finding their studies very meaningful. This is achieved by:

- Building up and successfully running a new interdisciplinary Bachelor's programme, Global systems, which is largely based on expertise from several of our own research fields.
- Ensuring that teachers are experts in both their subjects and educational methods.
- Retaining an environment that promotes teachers' development, provides inspiration and encourages innovative educational methods.
- Systematically assuring quality. The courses are the department's shared responsibility, and support must be given to teachers, as required.

### **Attractive courses**

Our courses are popular among students on account of their:

- High relevance to study programmes and the needs of future employers.
- Unique first-hand knowledge of ongoing research, primarily in connection with Master's studies.
- Contributions to Chalmers' goals for broad-based recruitment, digitisation and internationalisation.
- Contributions to Chalmers' vision and society's goals for sustainable development.

## **Strategy for doctoral studies**

Doctoral studies at SEE aim to educate future researchers for industry, academia, public research institutions and other areas in society with the following focus areas:

### **World leader**

SEE's graduate schools ensure excellent education by giving doctoral students:

- A central role in research activities that generate high-impact knowledge
- Supervisors with expertise in their subjects and top-level supervision skills
- A wide range of relevant, high-quality doctoral courses

### **Personal development**

During their doctoral studies, our doctoral students develop basic research skills by:

- Enhancing the independence of their research.
- Identifying new research challenges, evaluating their societal and scientific relevance, charting their main knowledge gaps and designing efficient investigation paths.
- Acquiring and developing knowledge of educational methods, supervision and communication.
- Developing their ability to work with others.

### **Internationalisation and networks**

Doctoral studies are characterised by the global perspective of research and the build-up of relevant professional networks. This is made possible thanks to:

- An international working environment at Chalmers
- International collaboration, in which extended visits abroad are encouraged
- International dissemination of research
- Access to professional networks, including international research partners, both academic and non-academic (for example industry, stakeholders)

### **First-class graduates**

SEE's graduate schools should attract and recruit the best possible doctoral students thanks to a recruitment process characterised by:

- Clear information about the department's graduate schools
- International advertising and proactive searches for international graduates
- Professional evaluation of applicants' technical and soft skills

## **Utilisation**

All utilisation is solidly based on the department's research and education and is seen as a natural part of operations. The breadth of utilisation activities also reflects the subject breadth at SEE.

Utilisation also promotes individual personal development. The objective is therefore an inclusive culture in which our employees are motivated and encouraged to take responsibility for utilising their knowledge in appropriate contexts. The department promotes utilisation by:

- Implementing selected activities with the focus on further enhancing knowledge of tools and relevant mechanisms for utilisation.
- Facilitating exchange of experience between research groups and individuals.
- Including utilisation in career planning and performance assessments.

Our utilisation activities can be divided into two main tracks:

#### **Communication:**

- Disseminating knowledge openly and freely to the general public by various means such as education, utilisation and other external activities, and involvement in committees, etc. SEE is now one of Chalmers' most visible departments in the media and must remain so.
- Being available for and active in advisory roles for the general public, and for national and international authorities and other actors.
- Ensuring that employees at SEE receive support to perform utilisation activities, partly through development of personal communication skills and partly through opportunities to participate in networks and be contacts for people such as decision makers.

#### **Collaboration:**

- Applying and directing our knowledge to selected stakeholders via research collaborations, our infrastructures, commissioned research and education, etc.
- Packaging our knowledge about products, services and research companies.
- Participating in large collaboration projects and networks, and disseminating our work under open source code licences.

## **Strategy for operational support**

The department's operational support is attentive to research divisions' needs and supports their academic staff with accounting, administration and communication, in accordance with Chalmers' rules. Our objective is to find shared working methods, and methods and processes that support the most important academic activities, with the aim of achieving simple, efficient solutions and a reasonable workload.

## **Code of conduct**

We strive to maintain an attractive working environment that is characterised by equal rights and treatment for all employees. The department will focus on recruitment in order to improve the gender balance in all our divisions. Another objective is that temporary employment at SEE will ensure the opportunity for a career outside the division.

Everyone at SEE is expected to treat each other with respect. We rely on each other, communicate openly, are inclusive in our way of working and support each other when necessary.