Earth System Science M.S.

Admission Requirements

Complete the following admission requirements:

University Admission criteria apply to Earth System Science, notably, that incoming students must have an undergraduate degree in a suitable field of study. Admission to Earth System Science (without concentration) is determined by an admissions committee. Admission to Earth System Science with concentration is determined by an admissions committee established within each concentration. Furthermore, the following concentrations have specific admission requirements:

- Hydrology: 1 year calculus, 1 year physics, and 1 year of either geology, chemistry, biology, or engineering
- Atmospheric and Climate Sciences: 1 year calculus, differential equations, chemistry
- Cryosphere and Solid Earth Geophysics: 1 year calculus, differential equations, and linear algebra (recommended: partial differential equations, computational physics)

Program Requirements

Minimum Requirements for Earth System Science M.S.: 30 credits

CONCENTRATIONS: SUSTAINABILITY (P. 2), ECOSYSTEMS (P. 2), HYDROLOGY (P. 3), ATMOSPHERIC AND CLIMATE SCIENCES (P. 3), CRYOSPHERE (P. 4), SOLID EARTH GEOPHYSICS (P. 4), GEOSCIENCE (P. 4), GEOSPATIAL SCIENCE (P. 4)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>General University Requirements</td>
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<tr>
<td></td>
<td>Complete the graduate general university requirements. (<a href="https://catalog.uaf.edu/masters/#gurmastersdegreeextext">https://catalog.uaf.edu/masters/#gurmastersdegreeextext</a>)</td>
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<td>Master's Degree Requirements</td>
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<tr>
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<tr>
<td></td>
<td>ESS F601 Introduction to Earth System Science</td>
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<tr>
<td></td>
<td>ESS F602 Best Practices for Research in Alaska</td>
<td>1</td>
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<td></td>
<td>ESS F692P Seminar</td>
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<tr>
<td>Concentration</td>
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<td></td>
<td>Complete one of the following:</td>
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<tr>
<td></td>
<td>Sustainability Concentration</td>
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<tr>
<td></td>
<td>Ecosystems Concentration</td>
<td></td>
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<tr>
<td>Hydrology Concentration</td>
<td></td>
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</tr>
<tr>
<td>Atmospheric and Climate Sciences Concentration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryosphere Concentration</td>
<td></td>
<td></td>
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<tr>
<td>Solid Earth Geophysics Concentration</td>
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<tr>
<td>Geoscience Concentration</td>
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<tr>
<td>Geospatial Science Concentration</td>
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<tr>
<td></td>
<td>30</td>
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</table>

1. Requires 12 thesis credits.
2. Master's degree with project (6 project credits) can be completed with the following concentrations: sustainability, atmospheric and climate sciences, or geospatial science.
3. Recommended courses from any of the concentrations or the methods and cross-cutting list.

METHODS AND CROSS-CUTTING COURSE LIST

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACNS F629</td>
<td>Geography of the Arctic and Circumpolar North</td>
<td>3</td>
</tr>
<tr>
<td>ATM F601</td>
<td>Introduction to Atmospheric Sciences</td>
<td>3</td>
</tr>
<tr>
<td>ATM F610</td>
<td>Analysis Methods in Meteorology and Climate</td>
<td>3</td>
</tr>
<tr>
<td>ATM F625</td>
<td>Physical Hydrometeorology</td>
<td>3</td>
</tr>
<tr>
<td>ATM F680</td>
<td>Climate Change Processes: Past, Present, Future</td>
<td>4</td>
</tr>
<tr>
<td>BIOL F602</td>
<td>Research Design</td>
<td>3</td>
</tr>
<tr>
<td>BIOL F604</td>
<td>Scientific Writing, Editing and Revising in the Biological Sciences</td>
<td>3</td>
</tr>
<tr>
<td>BIOL F680</td>
<td>Data Analysis in Biology</td>
<td>3</td>
</tr>
<tr>
<td>CCS F612</td>
<td>Traditional Ecological Knowledge</td>
<td>3</td>
</tr>
<tr>
<td>FISH F646</td>
<td>Freshwater Habitat Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F422</td>
<td>Geoscience Applications of Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F605</td>
<td>Geochronology</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F606</td>
<td>Volcanology</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F618</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F622</td>
<td>Digital Image Processing in the Geosciences</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F627</td>
<td>Inverse Problems and Parameter Estimation</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F631</td>
<td>Foundations of Geophysics</td>
<td>4</td>
</tr>
<tr>
<td>GEOS F633</td>
<td>Aqueous and Environmental Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F636</td>
<td>Programming and Automation for Geoscientists</td>
<td>2</td>
</tr>
<tr>
<td>GEOS F639</td>
<td>InSar and Its Applications</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F653</td>
<td>Palynology and Paleopalynology</td>
<td>4</td>
</tr>
<tr>
<td>GEOS F654</td>
<td>Visible and Infrared Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F657</td>
<td>Microwave Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F658</td>
<td>Big Geospatial Data</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F660</td>
<td>The Dynamic Alaska Coastline</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F670</td>
<td>Selected Topics in Volcanology</td>
<td>2</td>
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</table>
Concentrations

SUSTAINABILITY

This concentration encompasses scholarly and practical aspects of sustainability and society in Earth System Science with a specific emphasis on Alaska and the Arctic. The vision is to provide graduate training in interdisciplinary research to solve real-world problems, especially in building mutually respectful research partnerships with groups, organizations, and communities outside the University.

Sustainability Concentration with Thesis

Complete the following:

- CCS F612 Traditional Ecological Knowledge
- NRM F613 Resilience Internship
- NRM F647 Sustainability in the Changing North

Complete 6 credits from the following disciplinary courses:

- ACNS F600 Perspectives on the North
- ACNS F601 Research Methods and Sources in the North
- ACNS F608 Indigenous Knowledge Systems
- ACNS F629 Geography of the Arctic and Circumpolar North
- ACNS F652 International Relations of the North
- ACNS F657 Comparative Indigenous Rights and Policies
- ACNS F669 Arctic Politics and Governance
- ACNS F683 20th-century Circumpolar History
- CCS F602 Cultural and Intellectual Property Rights
- CCS F608 Indigenous Knowledge Systems
- FISH F611 Human Dimensions of Environmental Systems
- FISH F613 Human-environment Research Methods
- FISH F675 Political Ecology
- NRM F630 Resource Management Planning
- NRM/CCS F656 Sustainable Livelihoods and Community Well-being
- NRM F692 Graduate Seminar
- STO F601 Communicating Science

Complete 12 thesis credit hours of the following:

- CCS F699 Thesis
- or NRM F699 Thesis

Total Credits: 14

Sustainability Concentration with Project

Complete the following:

- CCS F612 Traditional Ecological Knowledge
- NRM F613 Resilience Internship
- NRM F647 Sustainability in the Changing North

Complete 6 credits from the following disciplinary courses:

- ACNS F600 Perspectives on the North
- ACNS F601 Research Methods and Sources in the North
- ACNS F608 Indigenous Knowledge Systems
- ACNS F629 Geography of the Arctic and Circumpolar North
- ACNS F652 International Relations of the North
- ACNS F657 Comparative Indigenous Rights and Policies
- ACNS F669 Arctic Politics and Governance
- ACNS F683 20th-century Circumpolar History
- CCS F602 Cultural and Intellectual Property Rights
- CCS F608 Indigenous Knowledge Systems
- FISH F611 Human Dimensions of Environmental Systems
- FISH F613 Human-environment Research Methods
- FISH F675 Political Ecology
- NRM F630 Resource Management Planning
- NRM/CCS F656 Sustainable Livelihoods and Community Well-being
- NRM F692 Graduate Seminar
- STO F601 Communicating Science

Complete 5 credits of advisory committee-approved electives

Complete 6 project credits of the following:

- CCS F698 Non-thesis Research/Project
- or NRM F698 Non-thesis Research/Project

Total Credits: 19

ECOSYSTEMS

The Ecosystems concentration in Earth System Science addresses the interactions of organisms with the transformation and flux of energy and matter. Ecosystem science is inherently interdisciplinary, including ecology, natural history, statistics, chemistry, geology, geography, and hydrology. Students will therefore benefit from shared courses and seminars with other concentrations. Students enrolling in the Ecosystems concentration will pursue research and training in observing, modeling, and predicting processes including fluxes of water, energy, carbon, and nutrients, and many will focus on high-latitude ecosystems...
Earth System Science M.S.

**Ecosystems Concentration Requirements**

Complete 13 credits from the following courses or the Methods and Cross-cutting course List

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL F618</td>
<td>Biogeography</td>
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</tr>
<tr>
<td>BIOL F646</td>
<td>Freshwater Habitat Dynamics</td>
<td>1</td>
</tr>
<tr>
<td>BIOL F669</td>
<td>Landscape Ecology and Wildlife Habitat</td>
<td>1</td>
</tr>
<tr>
<td>BIOL F673</td>
<td>Ecosystem Ecology (Ecosystem Ecology (course in progress))</td>
<td>1</td>
</tr>
<tr>
<td>BIOL F686</td>
<td>Vertebrate Paleontology</td>
<td>1</td>
</tr>
<tr>
<td>BIOL F688</td>
<td>Arctic Vegetation Ecology: Geobotany</td>
<td>1</td>
</tr>
<tr>
<td>BIOL F689</td>
<td>Vegetation Description and Analysis</td>
<td>1</td>
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</table>

**Thesis**

Complete 12 thesis credit hours of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>BIOL F699</td>
<td>Thesis</td>
<td>1</td>
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</table>

**Total Credits**

13

**HYDROLOGY**

Understanding how water cycles through the Earth's many systems fundamentally links hydrology to a broad range of scientific disciplines and societal needs. Focusing on water movement and storage in the Arctic brings particular intrigue and challenge in terms of interactions with frozen ground, glacier runoff, freeze-thaw cycles, snowmelt, and river and lake ice dynamics. Career opportunities for graduates of the Hydrology Concentration in Earth System Science include river flood forecasting, field and remote sensing hydrologist, water quality specialist, water resources management and policy, water supply treatment and distribution, stream and fish habitat restoration, and the opportunity to work as a cold-regions hydrologist with interdisciplinary science and resource management teams in Alaska and other northern regions. Graduates are prepared to hold positions in government, industry, consulting or academia.

**Hydrology Concentration Requirements**

Complete the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CE F665</td>
<td>Watershed Hydrology</td>
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Complete 10 credits from the following:

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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>CE F663</td>
<td>Groundwater Hydrology</td>
<td>1</td>
</tr>
<tr>
<td>CE F662</td>
<td>Open Channel and River Engineering</td>
<td>1</td>
</tr>
</tbody>
</table>

Methods and Cross-cutting course list

One graduate-level course approved by the student’s advisory committee

**Thesis**

Complete 12 thesis credit hours of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE F699</td>
<td>Thesis</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Credits**

13

**Atmospheric and Climate Sciences Concentration with Thesis**

Complete three of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ATM F601</td>
<td>Introduction to Atmospheric Sciences</td>
<td>1</td>
</tr>
<tr>
<td>ATM F613</td>
<td>Atmospheric Radiation</td>
<td>1</td>
</tr>
<tr>
<td>ATM F615</td>
<td>Cloud Physics</td>
<td>1</td>
</tr>
<tr>
<td>ATM F645</td>
<td>Atmospheric Dynamics</td>
<td>1</td>
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<tr>
<td>ATM F646</td>
<td>Atmospheric Dynamics II: Climate Dynamics</td>
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Complete one of the following:

<table>
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<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ATM F644</td>
<td>Weather Analysis and Forecasting</td>
<td>1</td>
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<tr>
<td>ATM F658</td>
<td>Air-sea Interactions</td>
<td>1</td>
</tr>
<tr>
<td>ATM F673</td>
<td>Micrometeorology with Focus on Subarctic and Arctic Ecosystems</td>
<td>1</td>
</tr>
</tbody>
</table>

One graduate-level course approved by the student’s advisory committee

**Thesis**

Complete any 1-credit seminar.

**Total Credits**

13

**Atmospheric and Climate Sciences Concentration with Project**

Complete the following:

<table>
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<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ATM F601</td>
<td>Introduction to Atmospheric Sciences</td>
<td>1</td>
</tr>
<tr>
<td>ATM F613</td>
<td>Atmospheric Radiation</td>
<td>1</td>
</tr>
<tr>
<td>ATM F645</td>
<td>Atmospheric Dynamics</td>
<td>1</td>
</tr>
<tr>
<td>ATM F646</td>
<td>Atmospheric Dynamics II: Climate Dynamics</td>
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Seminar course

Complete 6 credits from the following disciplinary courses:

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<td>ACNS F600</td>
<td>Perspectives on the North</td>
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<td>ACNS F601</td>
<td>Research Methods and Sources in the North</td>
<td>1</td>
</tr>
<tr>
<td>ACNS F610</td>
<td>Northern Indigenous Peoples and Contemporary Issues</td>
<td>1</td>
</tr>
<tr>
<td>ACNS F629</td>
<td>Geography of the Arctic and Circumpolar North</td>
<td>1</td>
</tr>
<tr>
<td>ACNS F652</td>
<td>International Relations of the North</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total Credits**

13

**ATMOSPHERIC AND CLIMATE SCIENCES**

The field of atmospheric and climate science covers a wide variety of disciplines involving the physical and chemical properties and processes of the atmosphere. Current research in atmospheric sciences focuses on atmospheric dynamics, chemistry and biogeochemistry, air-sea-ice interactions, climate modeling, cloud and aerosol physics, radiative processes, mesoscale modeling, numerical weather prediction, aviation weather, and the upper atmosphere (stratosphere and mesosphere). The faculty are well-positioned to be a vibrant part of cross-cutting education and research in the Earth System Science Program.

Graduate students are an essential component of a research university and an integral component of the research activities across the campus at UAF, both in the experiments in the laboratory and the field as well as in data sciences, which includes modeling and analysis of weather and climate data. Research institutes and the CNSM provide excellent environments for research in atmospheric and climate sciences as well as multidisciplinary research with researchers spanning diverse expertise.

**Atmospheric and Climate Sciences Concentration with Thesis**

Complete three of the following:

<table>
<thead>
<tr>
<th>Code</th>
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<th>Credits</th>
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<tr>
<td>ATM F601</td>
<td>Introduction to Atmospheric Sciences</td>
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</tr>
<tr>
<td>ATM F613</td>
<td>Atmospheric Radiation</td>
<td>1</td>
</tr>
<tr>
<td>ATM F615</td>
<td>Cloud Physics</td>
<td>1</td>
</tr>
<tr>
<td>ATM F645</td>
<td>Atmospheric Dynamics</td>
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</tr>
<tr>
<td>ATM F646</td>
<td>Atmospheric Dynamics II: Climate Dynamics</td>
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Complete one of the following:

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<tr>
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<th>Title</th>
<th>Credits</th>
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</thead>
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<tr>
<td>ATM F644</td>
<td>Weather Analysis and Forecasting</td>
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</tr>
<tr>
<td>ATM F658</td>
<td>Air-sea Interactions</td>
<td>1</td>
</tr>
<tr>
<td>ATM F673</td>
<td>Micrometeorology with Focus on Subarctic and Arctic Ecosystems</td>
<td>1</td>
</tr>
</tbody>
</table>

One graduate-level course approved by the student’s advisory committee

**Thesis**

Complete any 1-credit seminar.

**Total Credits**

13
**CRYOSPHERE**

The Cryosphere Concentration is located within the geosphere cohort of ESS tracks. This concentration focuses on snow, sea-ice, glaciers, and permafrost. Research within the Cryosphere Concentration is grounded in physics, mathematics, numerical modeling and data science. Methods and applications in the Cryosphere seek to understand earth surface processes at high latitudes and how they are responding to ongoing climate change as well as associated impacts on both the built and natural environment. The courses and research associated with snow, sea-ice, glaciers, and permafrost connect with the full spectrum of topics in the Earth System Science curriculum, including geospatial sciences, geosciences, climate science, hydrology, ecology, and sustainability. The Cryosphere Concentration at UAF is strengthened by the expansive natural laboratory and faculty expertise. Ph.D. and MS coursework and graduate research will be conducted closely with the Geophysical Institute.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>GEOS F631</td>
<td>Foundations of Geophysics</td>
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<tr>
<td>Complete 1 course from the Methods and Cross-cutting course list</td>
<td>3-4</td>
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<tr>
<td>Complete two of the following:</td>
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<tr>
<td>GEOS F615</td>
<td>Sea Ice</td>
<td></td>
</tr>
<tr>
<td>GEOS F616</td>
<td>Permafrost</td>
<td></td>
</tr>
<tr>
<td>GEOS F617</td>
<td>Glaciers</td>
<td></td>
</tr>
<tr>
<td>GEOS F681</td>
<td>Snow in the Environment</td>
<td></td>
</tr>
<tr>
<td>PHYS F614</td>
<td>Ice Physics</td>
<td></td>
</tr>
<tr>
<td>One graduate-level course approved by the student's advisory committee</td>
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**Thesis**

Complete 12 thesis credit hours of the following:

<table>
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<tbody>
<tr>
<td>GEOS F699</td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits** 19

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**SOLID EARTH GEOPHYSICS**

The Solid Earth Geophysics concentration of Earth System Science includes the disciplines of seismology, geodesy, volcanology, and infrasound, and it is grounded in physics, mathematics, computing, and data science. Methods and applications in Solid Earth Geophysics seek to characterize dynamic Earth processes and associated natural hazards relevant to Alaska and surrounding regions, including earthquakes, tsunamis, volcanoes, and landslides. Continuously recording instruments used in Solid Earth Geophysics, such as seismometers and GPS, capture a wide range of environmental activities and phenomena relevant to Earth System Science, in addition to human-caused events such as nuclear explosions.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>GEOS F631</td>
<td>Foundations of Geophysics</td>
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<td>Complete 9 credits from the following:</td>
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<tr>
<td>GEOS F604</td>
<td>Seismology</td>
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</tr>
<tr>
<td>GEOS F606</td>
<td>Volcanology</td>
<td></td>
</tr>
<tr>
<td>GEOS F626</td>
<td>Applied Seismology</td>
<td></td>
</tr>
<tr>
<td>GEOS F669</td>
<td>Geodetic Methods and Modeling</td>
<td></td>
</tr>
<tr>
<td>GEOS F670</td>
<td>Selected Topics in Volcanology</td>
<td></td>
</tr>
<tr>
<td>GEOS F692</td>
<td>Geol/Geophys Seminar</td>
<td></td>
</tr>
<tr>
<td>Methods and Cross-cutting course list</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One graduate-level course approved by the student's advisory committee</td>
<td></td>
<td></td>
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</table>

**Thesis**

Complete 12 thesis credit hours of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS F699</td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits** 13

---

**GEOSCIENCE**

The Geoscience concentration falls within the geosphere cohort of ESS tracks with a focus on tectonics, paleontology, and petrology of sedimentary, igneous, and metamorphic rocks. Methods and applications include reconstruction of past climates, ecosystems, and plate configurations, dating of geologic specimens, and locating economically valuable mineral deposits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS F615</td>
<td>Sea Ice</td>
<td></td>
</tr>
<tr>
<td>GEOS F616</td>
<td>Permafrost</td>
<td></td>
</tr>
<tr>
<td>GEOS F617</td>
<td>Glaciers</td>
<td></td>
</tr>
<tr>
<td>GEOS F681</td>
<td>Snow in the Environment</td>
<td></td>
</tr>
<tr>
<td>PHYS F614</td>
<td>Ice Physics</td>
<td></td>
</tr>
<tr>
<td>One graduate-level course approved by the student's advisory committee</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Thesis**

Complete 12 thesis credit hours of the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS F699</td>
<td>Thesis</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits** 13

---

**GEOSPATIAL SCIENCE**

The Geospatial Science concentration of Earth System Science includes the disciplines of visible to infrared and microwave (SAR and
InSAR) remote sensing, Geographic Information Systems, and their applications in the area of geosciences, natural resource management, and environmental monitoring. It is grounded in geographic science, mathematics, computer science, and data science. Methods and applications in the Geospatial Science concentration seek to characterize our changing environment, inventory and management of natural resources, and mitigate risks from geo-hazards relevant to Alaska and surrounding regions. Continuous geospatial observations of our ever-changing environment and geo-hazards from space and air are essential components of Earth System Science, as they allow for detailed studies of processes and events across scales relevant to the associated disciplines.

**Geospatial Science Concentration with Thesis**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS F622</td>
<td>Digital Image Processing in the Geosciences</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F629</td>
<td>Geologic Hazards and Natural Disasters</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F639</td>
<td>InSar and Its Applications</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F654</td>
<td>Visible and Infrared Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F657</td>
<td>Microwave Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F658</td>
<td>Big Geospatial Data</td>
<td>3</td>
</tr>
<tr>
<td>NRM F435</td>
<td>GIS Analysis</td>
<td>3</td>
</tr>
<tr>
<td>NRM F638</td>
<td>GIS Programming</td>
<td>3</td>
</tr>
<tr>
<td>NRM F641</td>
<td>Natural Resource Applications of Remote Sensing</td>
<td>3</td>
</tr>
</tbody>
</table>

**Thesis**

Complete 12 thesis credit hours of the following:

- GEOS F699  | Thesis                                        | 3       |
- NRM F699  | Thesis                                        | 3       |

**Total Credits**

13

**Geospatial Science Concentration with Project**

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACNS F600</td>
<td>Perspectives on the North</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F601</td>
<td>Research Methods and Sources in the North</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F610</td>
<td>Northern Indigenous Peoples and Contemporary Issues</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F629</td>
<td>Geography of the Arctic and Circumpolar North</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F652</td>
<td>International Relations of the North</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F657</td>
<td>Comparative Indigenous Rights and Policies</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F669</td>
<td>Arctic Politics and Governance</td>
<td>3</td>
</tr>
<tr>
<td>ACNS F683</td>
<td>20th-century Circumpolar History</td>
<td>3</td>
</tr>
<tr>
<td>CCS F602</td>
<td>Cultural and Intellectual Property Rights</td>
<td>3</td>
</tr>
<tr>
<td>CCS F608</td>
<td>Indigenous Knowledge Systems</td>
<td>3</td>
</tr>
<tr>
<td>FISH F611</td>
<td>Human Dimensions of Environmental Systems</td>
<td>3</td>
</tr>
<tr>
<td>FISH F613</td>
<td>Human-environment Research Methods</td>
<td>3</td>
</tr>
<tr>
<td>FISH F675</td>
<td>Political Ecology</td>
<td>3</td>
</tr>
<tr>
<td>NRM F630</td>
<td>Resource Management Planning</td>
<td>3</td>
</tr>
<tr>
<td>NRM/CCS F656</td>
<td>Sustainable Livelihoods and Community Well-being</td>
<td>3</td>
</tr>
<tr>
<td>NRM F692</td>
<td>Graduate Seminar</td>
<td>3</td>
</tr>
<tr>
<td>STO F601</td>
<td>Communicating Science</td>
<td>3</td>
</tr>
</tbody>
</table>

Complete 6 credits from other courses approved by the student’s advisory committee.

**Project**

Complete 6 project credits of the following:

- GEOS F698  | Non-thesis Research/Project                   | 3       |
- NRM F698  | Non-thesis Research/Project                   | 3       |

**Total Credits**

13

**Road Maps**

< Back to Department (https://catalog.uaf.edu/academic-departments/earth-system-science/)

Road Maps are recommended semester-by-semester plans of study for programs and assume full-time enrollment unless otherwise noted.

Some courses and milestones must be completed in the semester listed to ensure timely graduation. Transfer credit may change the road map.

This road map should be used in conjunction with regular academic advising appointments. All students are encouraged to meet with their advisor or mentor each semester. Requirements, course availability and sequencing are subject to change.

**EARTH SYSTEM SCIENCE M.S. - SUSTAINABILITY CONCENTRATION**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>NRM F647</td>
<td>Sustainability in the Changing North</td>
<td>3</td>
</tr>
<tr>
<td>FISH F613</td>
<td>Human-environment Research Methods</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total Credits**

6

**Spring**

- CCS F612  | Traditional Ecological Knowledge                                 | 3       |
- ACNS F662  | Alaska Government and Politics                                   | 3       |

**Total Credits**

6

**Second Year**

**Fall**

- NRM/CCS F613 | Resilience Internship                                           | 2       |
- FISH F611   | Human Dimensions of Environmental Systems                       | 3       |

**Total Credits**

5

**Spring**

- ACNS F662  | Alaska Government and Politics                                   | 3       |

**Total Credits**

3

**Third Year**

**Fall**

- CCS/NRM F656 | Sustainable Livelihoods and Community Well-being                | 3       |

**Total Credits**

3
### Earth System Science M.S.

#### EARTH SYSTEM SCIENCE M.S. - SOLID EARTH GEOPHYSICS CONCENTRATION

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOS F631</td>
<td>Foundations of Geophysics</td>
<td>4</td>
</tr>
<tr>
<td>GEOS F636</td>
<td>Programming and Automation for Geoscientists</td>
<td>2</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td><strong>Spring</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOS F627</td>
<td>Inverse Problems and Parameter Estimation</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F692</td>
<td>Geol/Geophys Seminar</td>
<td>1-6</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td><strong>4-9</strong></td>
</tr>
<tr>
<td><strong>Second Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fall</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOS F669</td>
<td>Geodetic Methods and Modeling</td>
<td>3</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td><strong>Spring</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOS F626</td>
<td>Applied Seismology</td>
<td>4</td>
</tr>
<tr>
<td>GEOS F657</td>
<td>Microwave Remote Sensing</td>
<td>3</td>
</tr>
<tr>
<td>GEOS F692</td>
<td>Geol/Geophys Seminar</td>
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<td><strong>8-13</strong></td>
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<tr>
<td><strong>Fall</strong></td>
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</tr>
<tr>
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<td>4</td>
</tr>
<tr>
<td>GEOS F636</td>
<td>Programming and Automation for Geoscientists</td>
<td>2</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td></td>
<td><strong>6</strong></td>
</tr>
<tr>
<td><strong>Spring</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>Credits</strong></td>
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<td><strong>4-9</strong></td>
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<tr>
<td><strong>Total Credits</strong></td>
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<td><strong>31-46</strong></td>
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