Earth System Science

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Note: The Earth System Science degree programs are administered by the Atmospheric Science department.

The Atmospheric Science department offers the following undergraduate degrees:

- Earth System Science, BS - Atmospheric Science/Meteorology Concentration (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-system-sciences-bs-atmospheric-science-meteorology-concentration)
- Earth System Science, BS - Geographic Information Systems (GIS) & Remote Sensing Concentration (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-system-sciences-bs-geographic-information-systems-gis-remote-sensing-concentration)
- Earth System Science, BS - Human Dimensions - Societal Impacts Concentration (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-system-sciences-bs-human-dimensions-societal-impacts-concentration)

Program Objectives

The two primary objectives of the ESS program are to meet important national, regional and statewide needs for highly technically-educated professionals who understand the Earth as a system, and to produce graduates who will be able to perform a variety of functions in research centers and industry centered in our impact on the Earth system.

Learning Outcomes

Earth System Science BS Graduates will:

- Demonstrate the ability to deal quantitatively with real-world problems
- Integrate knowledge from multiple disciplines to scientifically address Earth system issues quantitatively
- Work collaboratively in interdisciplinary teams
- Successfully carry out research projects to completion

Majors in Earth System Science

- Earth System Science, BS - Atmospheric Science/Meteorology Concentration (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-system-sciences-bs-atmospheric-science-meteorology-concentration)
- Earth System Science, BS - Geographic Information Systems (GIS) & Remote Sensing Concentration (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-system-sciences-bs-geographic-information-systems-gis-remote-sensing-concentration)
- Earth System Science, BS - Human Dimensions - Societal Impacts Concentration (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-system-sciences-bs-human-dimensions-societal-impacts-concentration)

Minors in Earth System Science:

- Atmospheric Science
- Earth Ecosystems (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/earth-ecosystems-minor)
- Geographic Information Systems/Remote Sensing (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/gis-minor)
- Natural Disaster Impacts and Policy (http://catalog.uah.edu/undergrad/colleges-departments/science/earth-system-sciences/natural-disasters-minor)

UAH's Joint Undergraduate Master's Program (JUMP) allows undergraduate students to study at the graduate level. By taking graduate courses in your senior year you could reduce the time taken to get a graduate (MS) degree. Please visit JUMP (http://catalog.uah.edu/undergrad/academic-information/jump) page for general information.

GIS Track * JUMPs to MS in Earth System Science

Requirements For Admissions

1. Cumulative Overall 3.5 GPA
2. Major GPA of 3.5
3. ESS 301, PH 112/ PH 115, MA 172, and CS 102 must be taken in Sophomore and Junior years

Additional Information

1. Maximum of 12 credit hours count toward both degrees
2. JUMP students may take ESS 507, ESS 508, ESS 509, ESS 514, ESS 515 in place of the undergraduate versions of these courses (ESS 407, ESS 408, ESS 409, ESS 414, ESS 415)

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* HDSI Track can JUMP into MS in Earth System Science if Physics with Calculus courses through PH 112 are taken as an option and an extra calculus course, MA 172 is added.

ATS Track JUMPs to MS in Atmospheric Science

Requirements For Admissions

1. Cumulative Overall 3.5 GPA
2. Major GPA of 3.5
3. ESS 301, PH 112/PH 115, MA 172, and CS 102 must be taken in Sophomore and Junior years

Additional Information

1. Maximum of 12 credit hours count toward both degrees
2. JUMP students may take ATS 509, ATS 510, ATS 520, ATS 541, ATS 551, ATS 554, ATS 561, ATS 571 in place of the undergraduate versions of these courses (ESS 409, ESS 410, ESS 420, ESS 441, ESS 451, ESS 454, ESS 461, ESS 471)

Designated Faculty Contact/Advisor

Dr. Lawrence Carey lawrence.carey@uah.edu 256.961.7909
ESS 100 - INTRODUCTION TO SPACE SCIENCE
Semester Hour: 1

Covers physiology in space, computer systems, materials, in space, robotics, thermodynamics, astrophysics, and solar physics. Laboratory experiments and simulated missions. Offered in cooperation with the Alabama Space and Rocket Center. Open only to students enrolled in Space Academy II.

ESS 101 - EXPLORING SPACE SC & ENGR
Semester Hour: 1

Exploring Space Science and Engineering courses 1-9. Each course examines an aspect of space exploration including but not limited to space science, human factors, medicine and engineering. Each course focuses on a single aspect. No more than three of the courses in the ESS 101 group may be taken for credit. The courses are offered through distance learning.

ESS 103 - ENVIRONMENTAL EARTH SCIENCE
Semester Hours: 4

Principles and foundations of Earth and environmental science with lectures and labs on concepts in Earth system science. Applied science labs use applications and real-world examples from ecosystems, geology, soil science, water, pollution, agriculutre, population, natural disasters and energy.

ESS 103L - LABORATORY
Semester Hours: 0

ESS 111 - WEATHER, CLIMATE & GLOBAL CHNG
Semester Hours: 4

Intro to the atmosphere and climate system, including weather systems, climate extremes, and natural / human-induced changes in the atmosphere - climate system. Major topics discussed include greenhouse effect, solar impacts on climate, El-Nino, climate change, atmospheric and ocean circulations, cyclones, hurricanes, thunderstorms, and tornadoes.

ESS 111L - LABORATORY
Semester Hours: 0

ESS 210 - COLLAPSE OF CIVILIZATIONS
Semester Hours: 3

This course will investigate why some cultures succeed and others fail. From archeological and historical records of past civilizations we will examine the factors which lead to collapse in an attempt to determine the future of current societies.

ESS 212 - SEVERE WEATHER ANALYSIS
Semester Hours: 4

Meteorological analysis and beginning forecasting of weather systems, severe weather, snowstorms, hurricanes, and tornadoes through the interpretation of surface, upper air, satellite, and radar weather observations. Strong emphasis placed on unique observations of severe weather from UAH radar and profiling systems. Prerequisite: ESS 111.

ESS 212L - LABORATORY
Semester Hours: 0

Laboratory. Prerequisite: ESS 111.

ESS 301 - INTRO TO EARTH & ATMOSPHC PHYS
Semester Hours: 3

This course will provide a survey of earth and atmospheric science for undergraduate students. Topics that will be covered will focus on how the earth-atmosphere system works in an integrated fashion. Prerequisites: ESS 103, ESS 111, (PH 101 or PH 111), and (MA 120 or MA 171).

ESS 302 - PEOPLE, PLANTS, & ENVIRONMENT
Semester Hours: 3

This course is designed to introduce students from multiple departments to the vital roles that plants have in our ecosystems through the study of basic plan and soil science. Special attention is placed on the impact plants have on our technology-based society. Sophomore standing or above.

ESS 303 - CLASSI & PHYSICAL CAUSES CLIM
Semester Hours: 3

Basic atmospheric structure and physical processes, surface processes, climate history and climate change, land use and land change, microclimates, topoclimates, Ecoclimatology. Prerequisites: ESS 103, ESS 111, MA 120 or MA 171, and PH 101 or PH 111.

ESS 305 - HYDROLOGY
Semester Hours: 3

Introduction to hydrologic cycles and concepts of how water interacts with the environment. Covers water properties, precipitation, groundwater and runoff, currents, waves, sediment processes, and conservation strategies. Prerequisites: ESS 103, ESS 111, MA 120 or MA 171, and PH 101 or PH 111.

ESS 307 - ENVIRONMENTAL ARCHEOLOGY
Semester Hours: 3

Archeologists today need a wide range of scientific approaches in order to delineate and interpret the ecology of their sites. This approach is revolutionizing archeology making it relevant to the modern-day world. Investigated in this course includes climate modeling, remote sensing, and GIS. Prerequisite: ESS 103.

ESS 312 - PRINCIPLES OF ECOLOGY
Semester Hours: 4

Lecture/Lab One 3 hour lab a week. Ecological principles controlling plant and animal populations. Development of ecosystems, communities and habitats. Field trips required. Strongly recommend CH 101 or 121. Prerequisite: BYS 120.

ESS 313 - GEOGRAPHIC INFORMATION SYSTEMS
Semester Hours: 3

Introduction to scientific spatial analysis concepts and spatial data processing with focus on ESRI ArcGIS software. Basic concepts in GIS data management and creation, with topics including raster and vector data, projections, data query, data acquisition, and cartography. Prerequisites: ESS 103 and either CS 102 or CS 103.

ESS 321 - POLLUTION PROBLEMS
Semester Hours: 3

Quantitative study of environmental conditions, processes, and problem-solving techniques related to specific pollution problems in air, water, and land. Prerequisites: ESS 111, ESS 103 and (MA 120 or MA 171) and (CH 101 or CH 121) and (PH 101 or PH 111).

ESS 351 - DYNAMIC METEOROLOGY
Semester Hours: 3

Dynamics and kinematics of atmospheric flow. Meteorological coordinate systems. Fundamental governing equations of atmospheric motion, circulation, and vorticity. Prerequisites: PH 111, ESS 301, CS 102 or CS 103, and MA 201 (with concurrency).

ESS 352 - SYNOPTIC METEOROLOGY
Semester Hours: 3

Analysis, interpretation and forecasting synoptic-scale and mesoscale phenomena, including air masses, frontal systems, cyclones, anti-cyclones, tropical cyclones, and associated mesoscale phenomena. Emphasis is placed on the use of remote sensing data from satellites, radars, and profilers using state-of-the-art workstations. Prerequisite: ESS 212 and ESS 351.

ESS 370 - INTRODUCTION TO REMOTE SENSING
Semester Hours: 3

This course introduces the fundamental physics of remote sensing systems and incorporates hands-on exercises of image processing, information extraction and interpretation, and basic applications of airborne and satellite data in Earth System Science and Atmospheric Science. Prerequisites: ESS 103, ESS 111, (MA 120 or MA 171), (PH 101 or PH 111), and CS 102.

ESS 402 - SCI & SOC ASPTS NATRL DISASTER
Semester Hours: 3

Students will understand causes of major natural events and evaluate effects of disasters on populations and possible mitigation measures. GIS software will be used to show progression of events and/or their impacts, with course case studies. Prerequisites: ESS 103 and ESS 111.

ESS 407 - ENV THRTS, PUB POLY, & DEC MKG
Semester Hours: 3

Researchers, policymakers and environmental campaigners have identified 25 potential future threats to the global environment. This course examines the nature and consequences of these threats and their potential impacts for the survival of the human race. Prerequisite: ESS 103.

ESS 408 - PYTHON FOR GIS
Semester Hours: 3

Introduction to GIS model building, Python programming, and automation of scripts for ArcGIS. Techniques in Model Builder, Python, and the methods for automation will be taught using data from numerous available data sources across the internet with heavy emphasis on the Earth Sciences. Prerequisites: ESS 313.

ESS 409 - SCI PROGRMNG FOR EARTH & ATMOS
Semester Hours: 3

Survey of data types and languages commonly used in the meteorological community along with practical applications to meteorology. Course is designed to prepare students for graduate work and research in atmospheric science. Prerequisite: CS 102 or 103; ESS 301; MA 172; PH 112 and PH 115. Or consent of instructor.

ESS 410 - OPERATIONAL WEATHER FORECAST'G
Semester Hours: 3

Subjective and objective methods of atmospheric prognosis. Techniques for forecasting critical weather elements. Interpretation, use and systematic errors of computer-generated products, human factors with forecasting, and application of meteorological theory in an operational setting. Prerequisites: ESS 111, ESS 212, ESS 352, MA 172, PH 112 and PH 115.

ESS 414 - GEOSPATIAL APPLICATIONS
Semester Hours: 3

An introductory look at the ways in which GIS can be put to use in different fields of study, drawing examples from Demography, Sociology, Archaeology, History, and Ecology. Focus on cartography and map creation principles and public geospatial data acquisition. Prerequisite: ESS 313.

ESS 415 - ADVANCED TOPICS IN GIS
Semester Hours: 3

Advanced continuation of concepts applied in Geospatial Applications. Students will learn through modules of real world scientific research how to use further tools in ArcGIS including: 3D Analyst, Spatial Analyst, Network Analyst. Topics include web data dissemination, spatiotemporal analysis and some basic spatial statistics measures. Prerequisite: ESS 414.

ESS 420 - INTRO ATMOSP CHEM & AIR POLLU
Semester Hours: 3

This self-contained introductory course in atmospheric chemistry and air pollution is designed to provide students the basics of atmospheric chemistry and air pollution concepts. Topics include air pollutants, air-pollution meteorology, atmospheric gases and aerosols, and atmospheric processes. Prerequisites: PH 112, PH 115, CH 121, ESS 301 and ESS 321.

ESS 441 - ATMOSP THERMODY & CLOUD PHYSIC
Semester Hours: 3

General aspects of thermodynamics and cloud physical processes occurring within the atmosphere; atmospheric statics and stability, saturation point analysis, aerosols, nucleation, and the behavior/growth of cloud particles and hydrometeors. Prerequisites: ESS 301, MA 238, PH 112 and PH 115.

ESS 451 - ATMOSPHERIC FLUID DYNAMICS I
Semester Hours: 3

Fluid dynamics in the atmosphere. Coriolis acceleration, scale analysis and appropriate approximations of the complete governing equations. Numerical analysis and interpretation of weather phenomena. Same as ATS 451. Prerequisites: ESS 351, MA 238, PH 112 and PH 115.

ESS 454 - FORECASTING MESOSCALE PROC
Semester Hours: 3

Detection and forecasting of atmospheric mesoscale phenomena including the structure and evolution of clouds, precipitation (including floods) thunderstorms and severe weather. Includes basics of instruments used to detect mesoscale phenomena, most notably satellite and radar. Prerequisite: ESS 352.

ESS 461 - ATMOSPHERIC RADIATION I
Semester Hours: 3

Fundamentals of terrestrial atmospheric radiation. Topics include: basic concepts, radiative transfer equation, gaseous absorption, scattering by molecules and particles, band models, transmittance along an inhomogeneous path. Prerequisite: ESS 301, MA 238, PH 112 and PH 115.

ESS 471 - INTRO TO RADAR METEOROLOGY
Semester Hours: 3

Introduction to principles of radar meteorology, including radar operations, hardware, interpretation and analysis. Doppler, dual-polarization and dual-wavelength radar theory, methods and applications are covered. Prerequisite: ESS 301 and ESS 441.

ESS 490 - SELECTED TOPICS IN ENVIRON SCI
Semester Hours: 1-3

Special offerings to students in areas of interest not covered in the present curriculum. Prerequisite: permission of instructor.

ESS 495 - DIRECTED STUDY
Semester Hours: 2-4

Specialized research for undergraduates often is offered to undergraduates who have senior standing.

ESS 498 - RESEARCH & PROF DEV CAPSTONE
Semester Hour: 1

Applied concepts for professional and research development. Includes evaluation and discussion of published literature and department seminars, with focus on research synthesis and critique. Also includes development of professional and career skills focused on the Earth and Atmospheric Sciences. Senior Standing required.

ESS 499 - UNDERGRADUATE RESEARCH
Semester Hours: 2-4

For advanced Earth System Science students. Individual investigations into Earth systems science problems under direct supervision of a research mentor. Research is conducted and thesis-style paper is written and orally presented. Students identify and obtain consent from a faculty research mentor.