EAS 3610

Introduction to Geophysics

Instructor: Dr. Winnie Chu, Dr. Andy Newman

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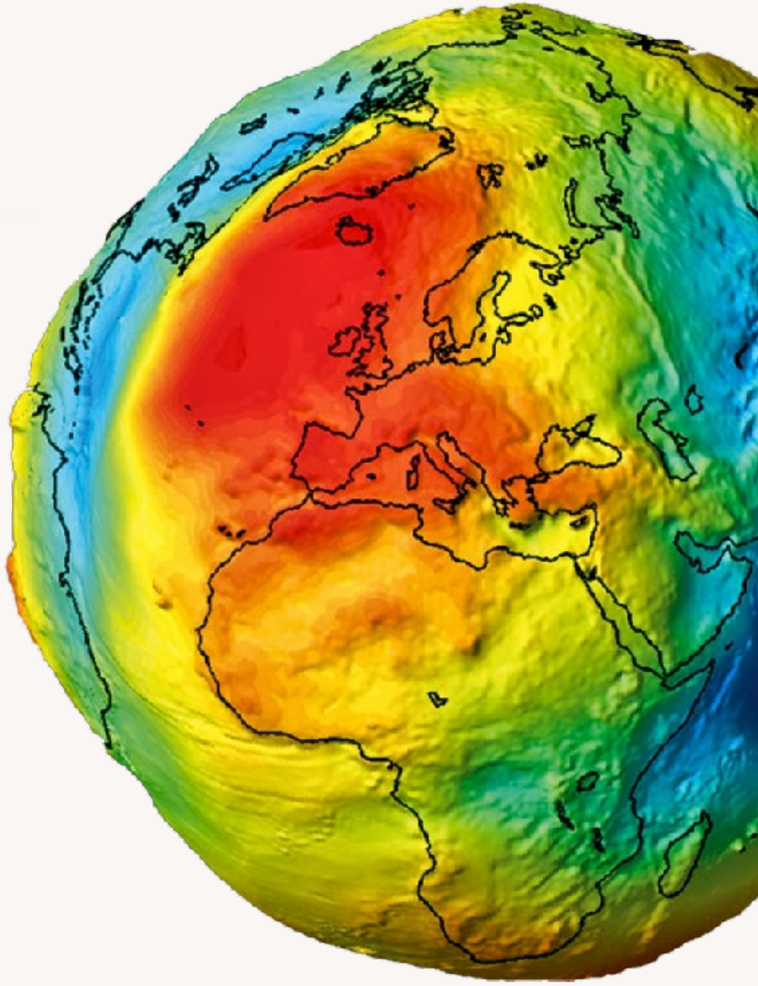
anewman@gatech.edu

Grader: Donglai Yang (dyang379@gatech.edu)



Today's Objectives

1. Introduction
2. Syllabus
3. What's Geophysics?

Let's Introduce Ourselves

Dr. Winnie Chu

- **PI** for PGSL
- **Background:** Ph.D. Earth Sciences (Columbia University) | Postdoc (Stanford Geophysics)
- **Research Interest:** Ice-sheet dynamics, Subsurface processes, Radar echo sounding, Model Synthesis

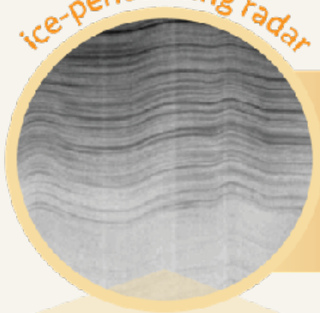
PGSL

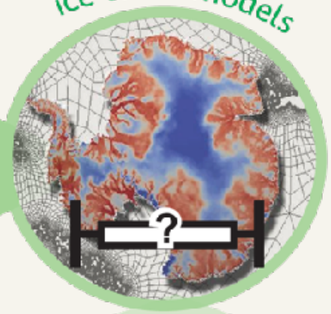
Polar Geophysical Simulation Lab

PGSL

Combines Geophysics, AI & Modeling

investigate ice sheets interaction with climate & glacier dynamics





Radioglaciologists

Advancing radio sounding technology

Computer modelers & Data scientist

Develop data assimilation workflow in models

Introduce Yourself

1. Your background
2. Year & program
3. Hobbies
4. Why Geophysics?

Course Canvas

EAS 3610: Introduction to Geophysics

Lecture: Monday and Wednesday 9:30 -10:45 am

Location: Ford Environmental Sci & Tech L1116

Course Summary: Introduction to how the Earth functions as an integrated system through exploration of the atmosphere, hydrosphere, lithosphere, and the biosphere. Laboratory exercises will supplement the lecture material.

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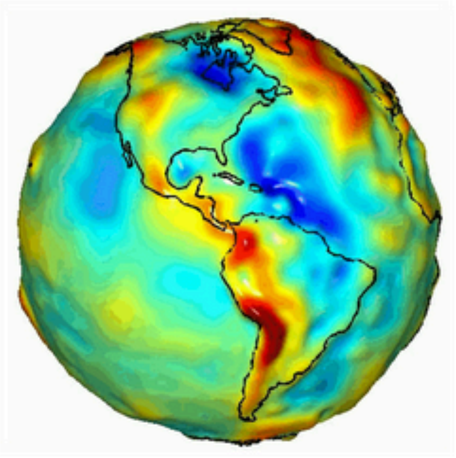
Grader: Donglai Yang (dyang379@gatech.edu)

Office hours: Directly after classes or by email appointments



Canvas Link:

https://gatech.instructure.com/courses/392946

Structure & Grading

In each module:

- 3 - 4 lectures
- Lab or Homework

Due 1 week after

Homework	40%
Lab	40%

7 total modules

Aiming to finish at ~ Nov 25th

Final Exam (20%)

Dec 11th
8:00 - 10:50 a.m.

Final Exam Structure

3 sections:

1. Multiple choice

Section 1. Multiple choice section (answer ALL questions) **[12 points]**

1. The radius of Earth's core (both the inner and outer) is approximately:
   - (A) The radius of the Moon
   - (B) Half the size of the Earth
   - (C) 6,000 km
   - (D) 1,000 km
   - (E) None of the above

2. The S-wave shadow zone is evidence that:
   - (A) The outer core is liquid
   - (B) The outer core is composed of iron and nickel oxides
   - (C) The inner core is solid
   - (D) It is very hot near the core

2. Short questions

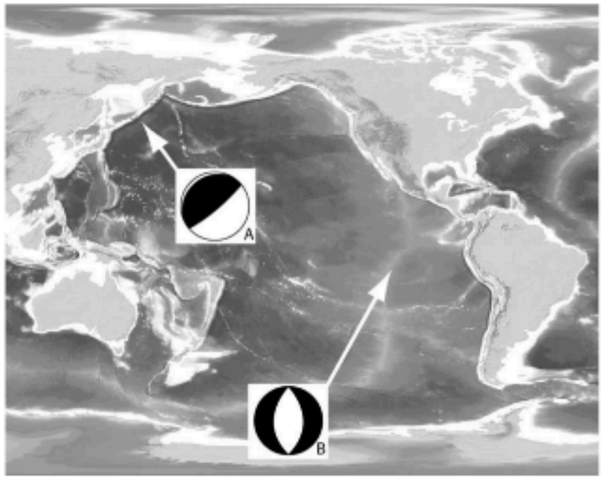
Section 2. Short Questions (Answer ALL questions)

Question 1. **[17 points]**

(a) Describe the two types of surface wave. Sketch the particle motion for each wave. **[5 points]**

(b) For each, name the type of fault that caused the earthquake. Explain how is each earthquake is related to its location and local stress distribution (i.e. extension, shearing, compression). **[6 points]**

Two earthquake focal mechanisms are shown below: (**A** and **B**)



Final Exam Structure

3. Calculations (answer 1 of 2)

C. Calculations (Answer 1 of 2 questions)

Question 1. [15 points]

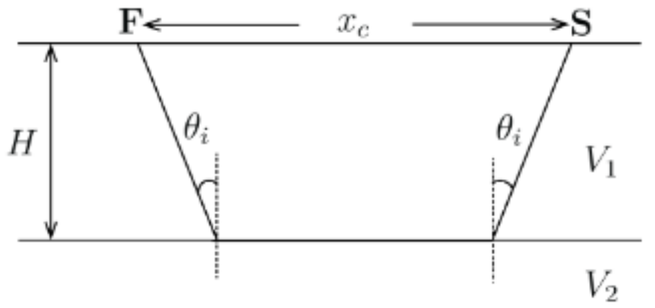
The table below gives the densities and seismic P- and S-wave velocities at various depths in the Earth.

(a) From these quantities calculate the rigidity modulus (μ) and bulk modulus (κ) at each depth. **[6 points]**

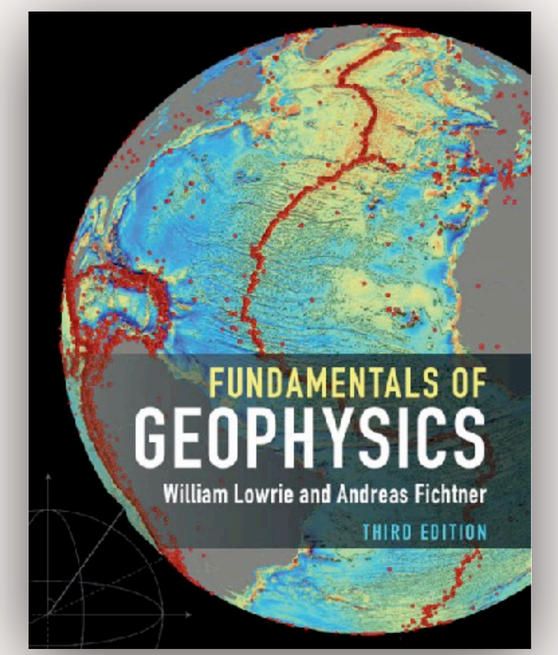
Depth (km)	ρ (1000 $kg\ m^{-3}$)	V_p ($km\ s^{-1}$)	V_s ($km\ s^{-1}$)
100	3.38	8.05	4.45
500	3.85	9.65	5.22
1000	4.58	11.46	6.38
2900	9.90	8.07	0
5500	12.92	11.14	3.58
6470	13.09	11.26	3.67

(b) Discuss in your own words the information that these data give about the deep interior of the Earth. **[3 points]**

(c) Assume that the Earth's crust consists of a single layer of thickness H and a constant speed of propagation of seismic waves of v_1 on top of a mantle of velocity of propagation 20% greater than the crust. Given that a focus on the surface produces a reflected wave that takes 17.2 s to reach a distance of 99 km, and that this is the critical distance, calculate the values of H, v_1, and v_2. **[6 points]**

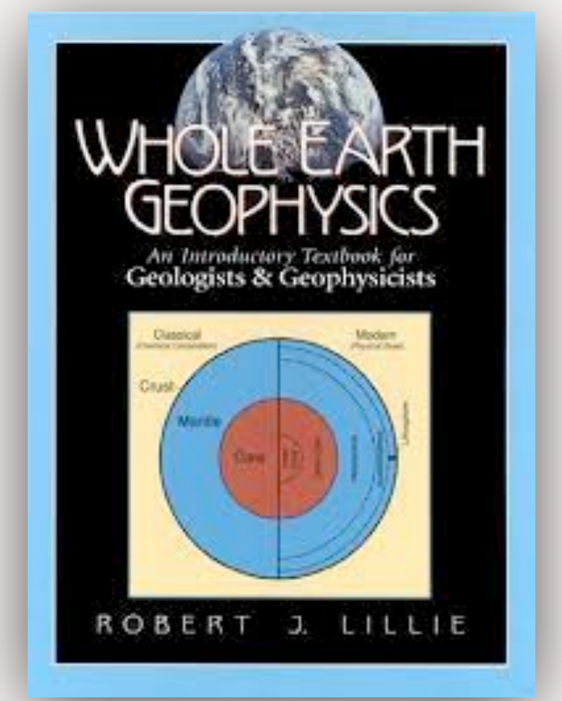


Syllabus: Textbook

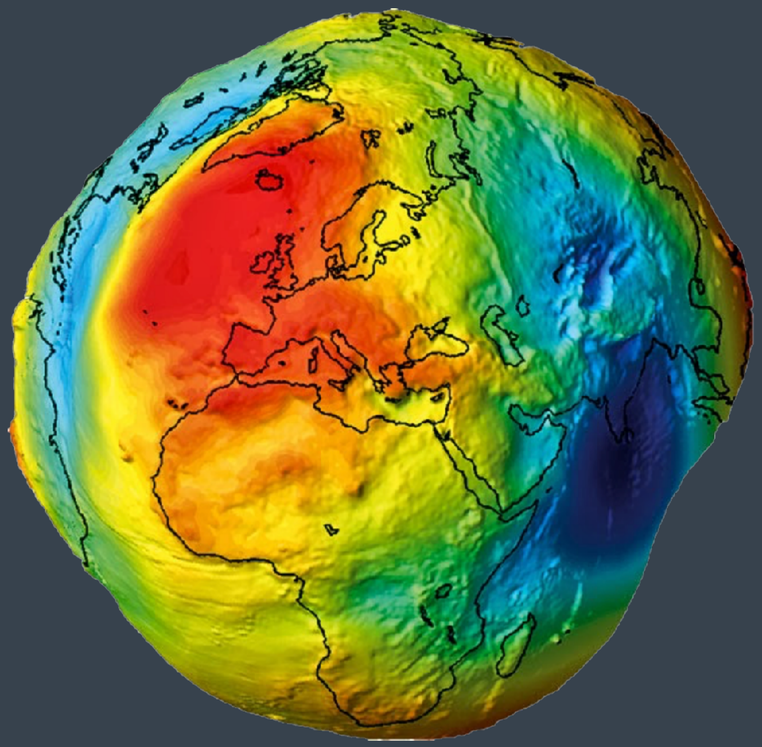


Lowrie. **Fundamentals of Geophysics** (3rd Ed)

Lillie. **Whole Earth Geophysics** (1st Ed.)



What's Geophysics

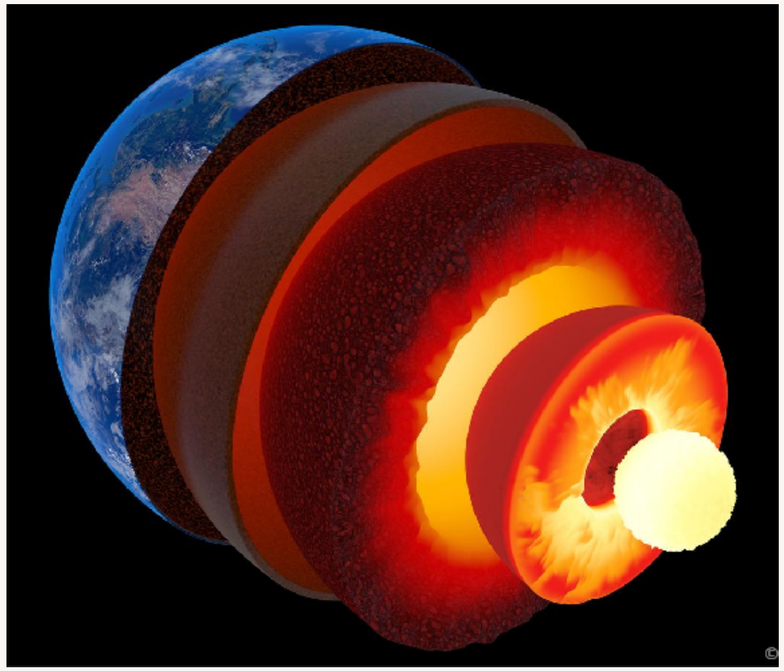


Geophysics

Study of the physics of the Earth and its environment in space

1

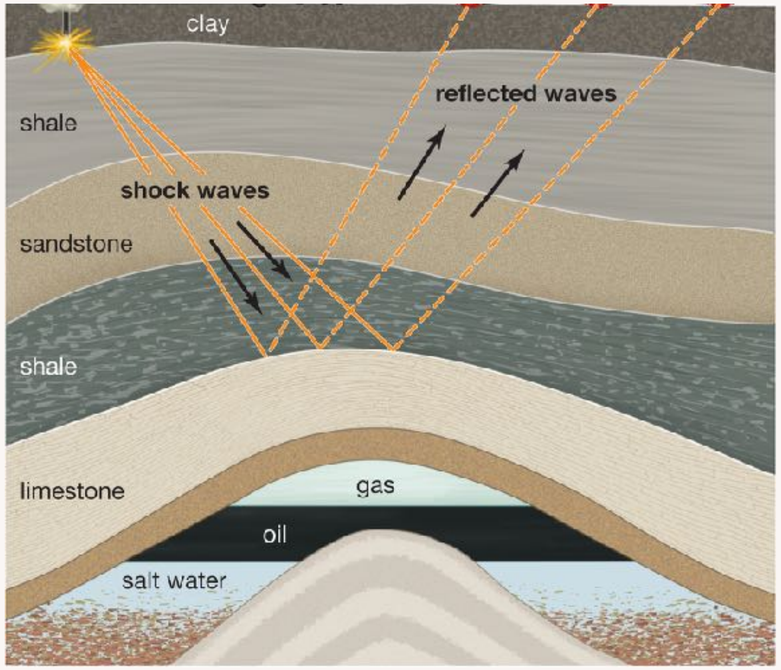
Solid Earth Geophysics



Geodynamics

2

Exploration Geophysics



Oil & Gas Exploration

3

Environmental Geophysics

Groundwater Exploration

Geophysicists at Georgia Tech

1 Solid Earth Geophysics: Geodynamics & Tectonics

Samer Narif

- Marine Geodynamics
- Electromagnetic methods

Andy Newman

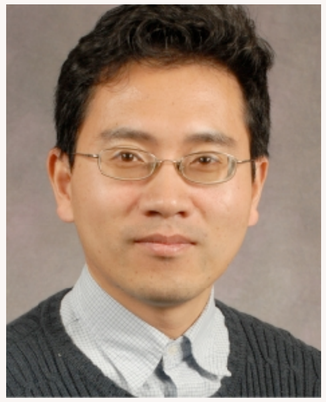
- Seismology
- Ground deformation and failure

Karl Lang

- Surface tectonics process
- Thermochronology , sediment provenance

Joyce Sim

- Thermodynamic modeling
- Melt transport at plate boundaries



Zhigang Peng

- Seismology
- Earthquake source properties

Geophysicists at Georgia Tech

2 Exploration Geophysics

Felix Herrmann

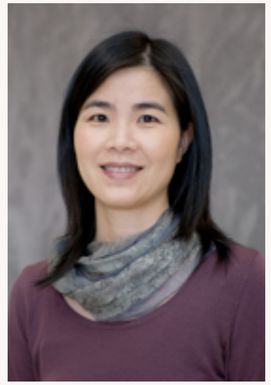
- Computational seismic imaging
- Inverse problems, machine learning

EAS

Chloé Arson

- Rock and fracture mechanics
- Computational mechanics

CEE



Haiying Huang

- Geomechanics
- Rock drilling, cutting, reservoir stimulation

CEE

... and more in CEE Geosystem engineering

Geophysicists at Georgia Tech

3 Environmental Geophysics

EAS

Alex Robel

- Ice-sheet modeling
- Glacial dynamics, ice-climate interaction

CEE

Chris Lai

- Experimental fluid mechanics
- Turbulence theory and modeling

... and more in CEE Water Resource & Environmental engineering

Student Internships & Opportunities

Sandia National Laboratories

https://www.sandia.gov/

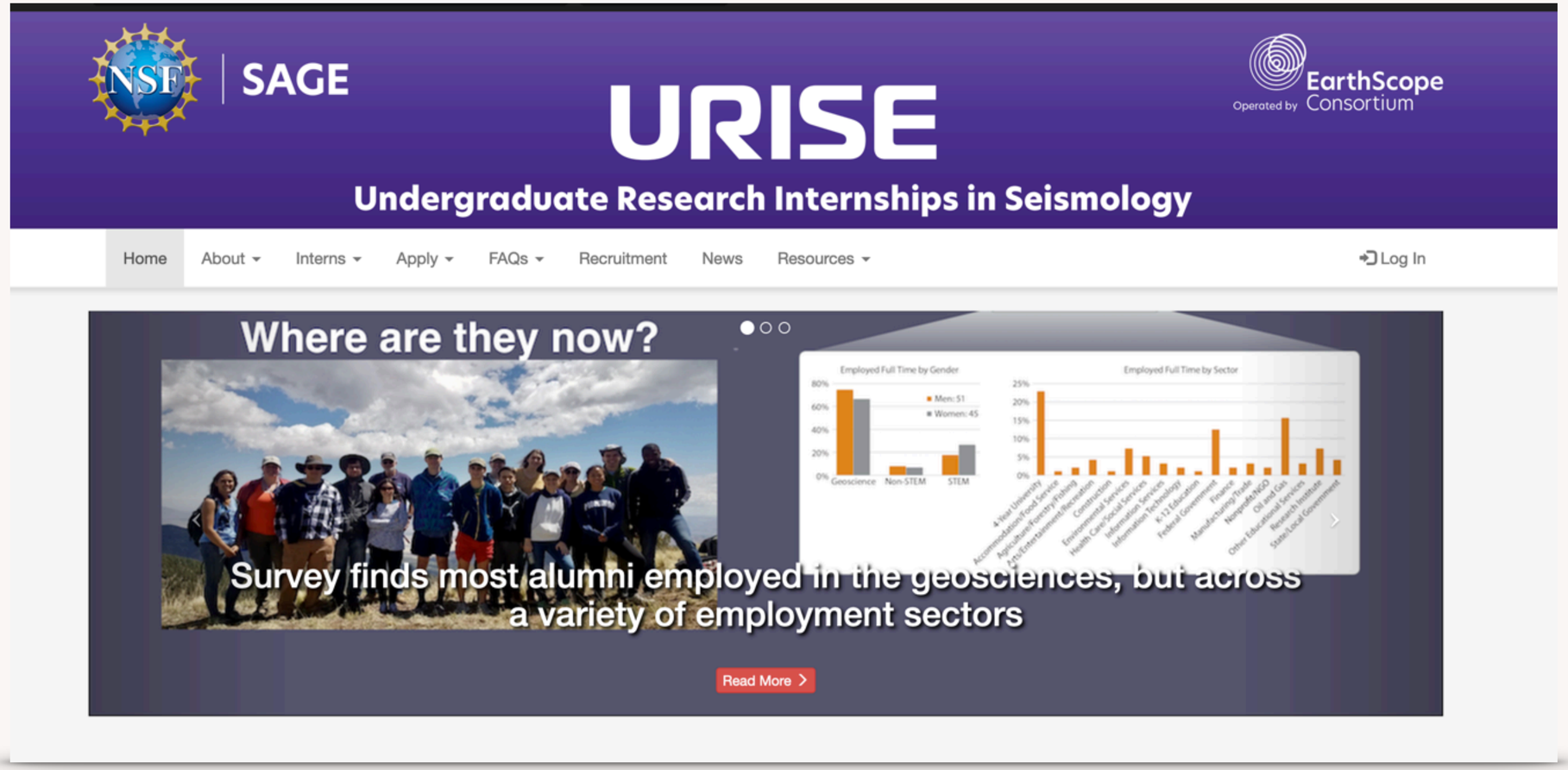
CONTACT:

Scottie-Beth Fleming
eflemin@sandia.gov

Programs

- Arctic Science & Security
- Climate Security
- Electric Grid
- Energy Efficiency
- Energy & Water
- Energy Storage
- Fossil Energy
- Nuclear Energy
- Nuclear Waste Management
- Renewable Energy
- Sustainable Transportation
- Tribal Energy Security

Student Internships & Opportunities



https://www.iris.edu/hq/internship/

Student Internships & Opportunities

Jet Propulsion Laboratory
California Institute of Technology

https://www.jpl.nasa.gov/edu/intern/apply/summer-internship-program/