A Journey to Look at Accelerating Change for the Geosciences

A look at how externalities are driving the reality of geoscience work now and into the future

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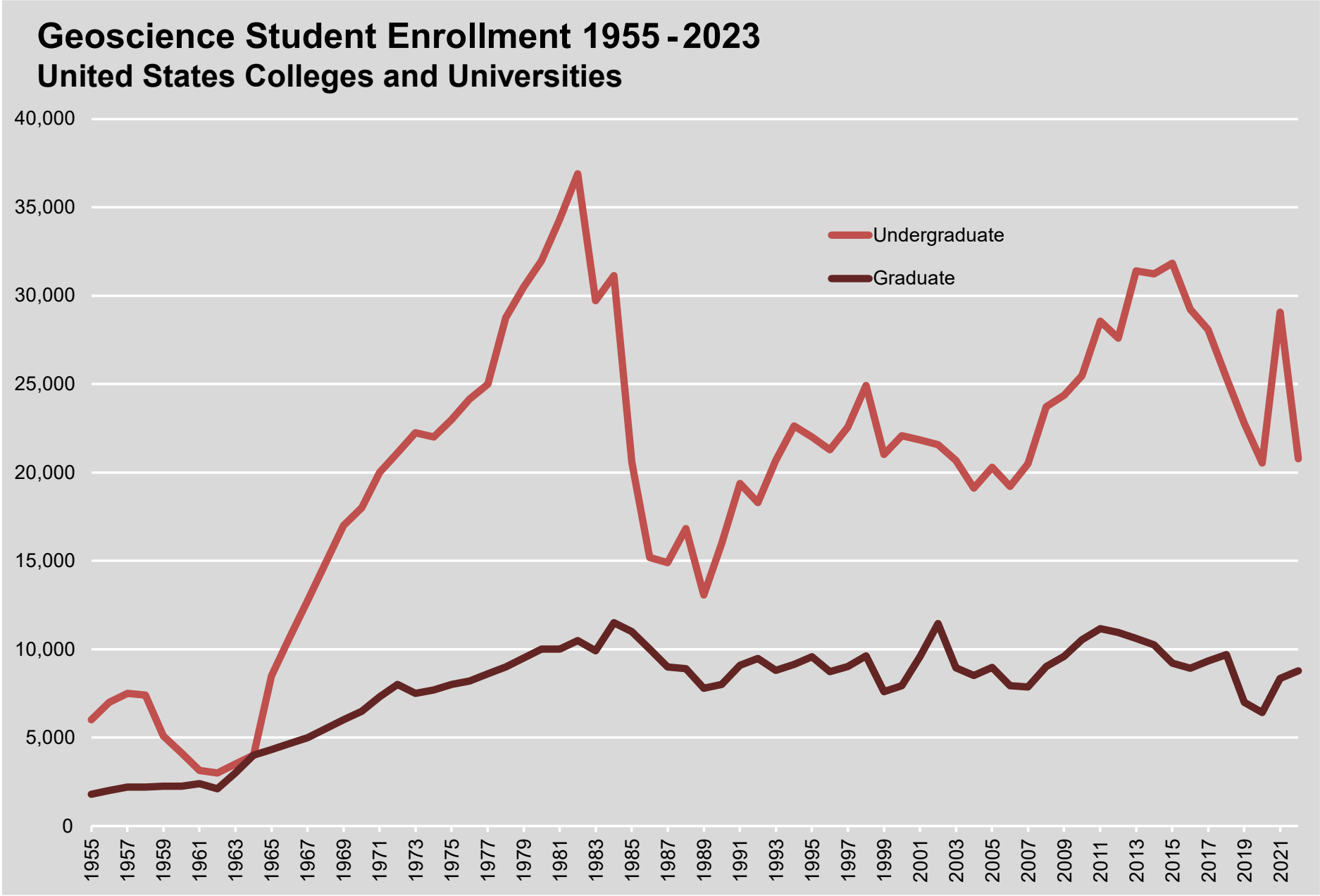
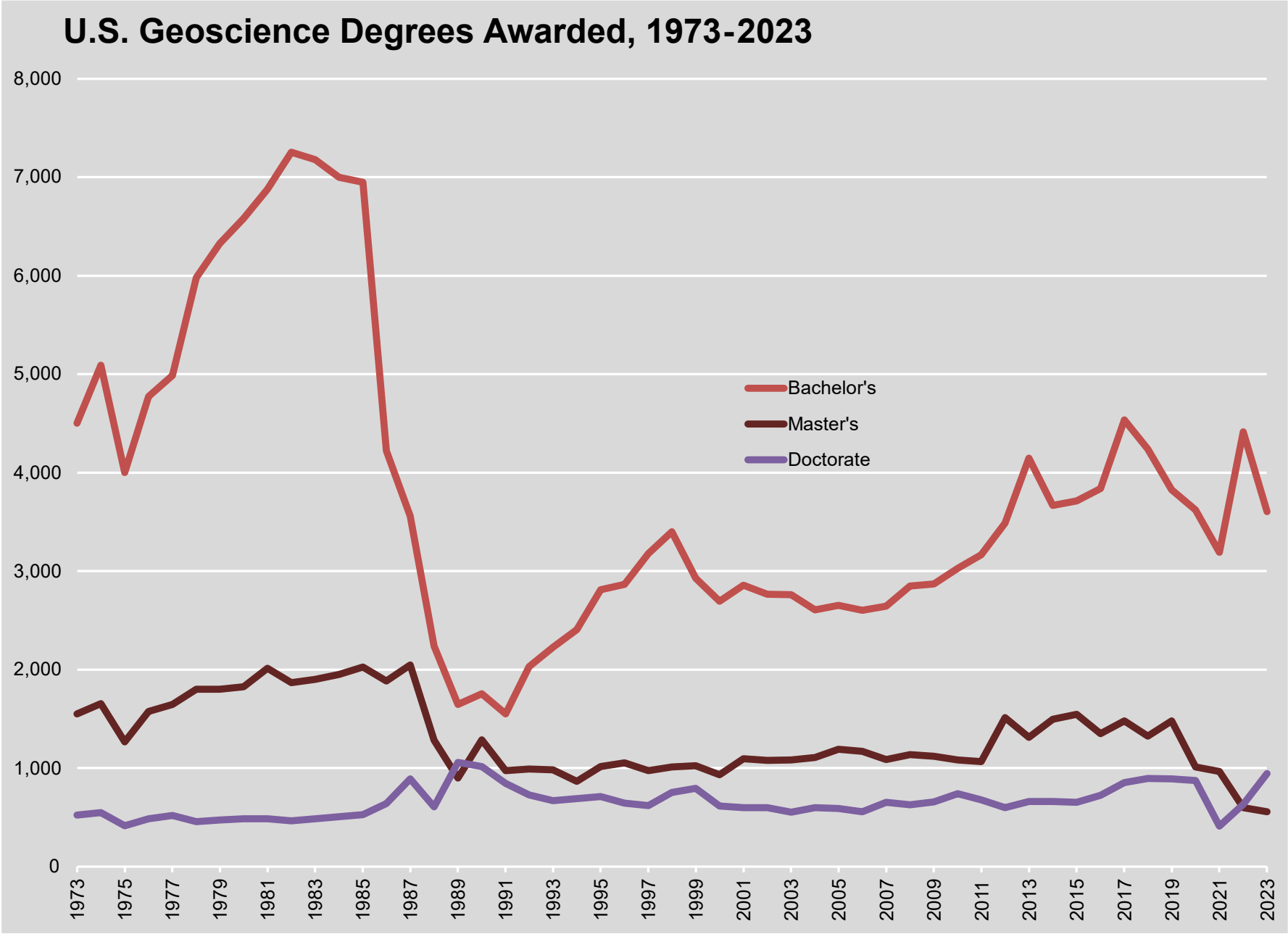
A Fresh Look at Enrollments & Degrees

- As expected, 2022 saw a dead-cat bounce in enrollment from students returning post-pandemic to finish degrees
- Graduate enrollments are beginning to recover



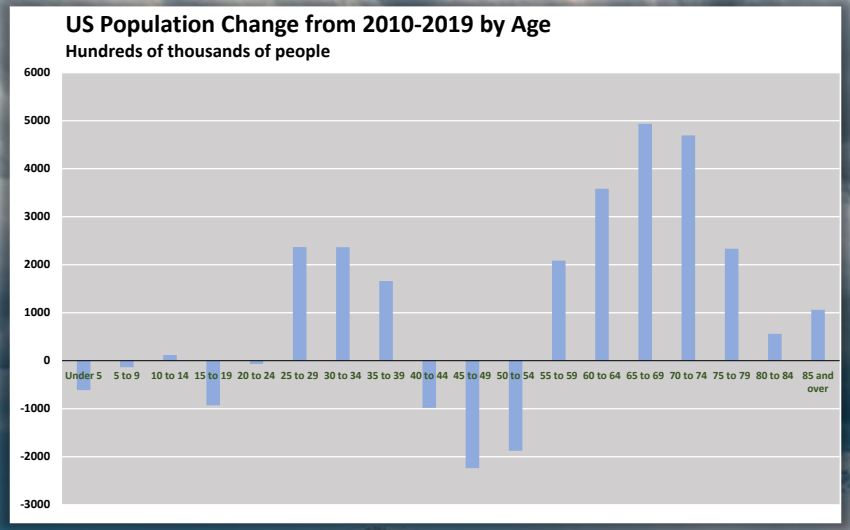
- The drop in bachelor degrees supports the dead-cat theory
- The cross-over of MS and PhD degrees granted is a critical signal of structural change in the system



Global Observations

- **In general, globally:**
  - Enrollments are down in geoscience (disfavor; demographics)
  - Aggregate employment demand is up (critical skill matching)
  - Employment is shifting to the professional services sector
- **Curious Observations**
  - China has seen >30% decline in geoscience enrollments
  - China has mass unemployment of new geoscientists
  - Chinese departments are surviving on foreign graduate student revenue
  - Overall, the US is looking healthy
  - Emerging creative approaches

Facing the Storms



Demographic Challenges

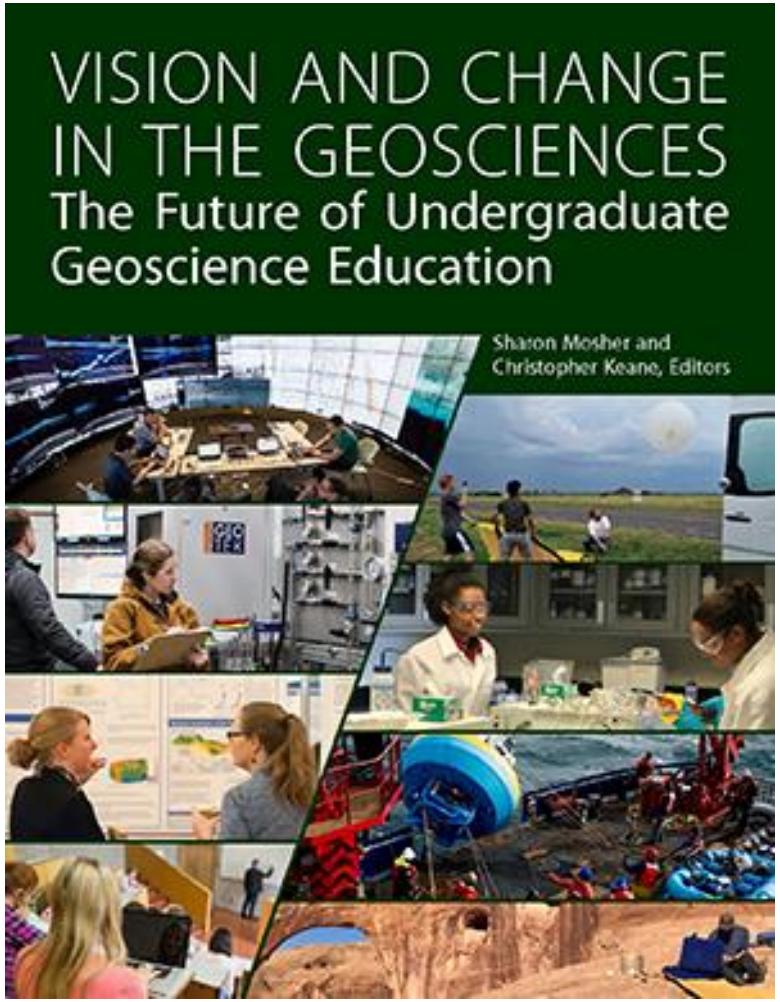
Public View of Higher Education

Industry-Driven Apprenticeship Pathways

Alternative Pathways

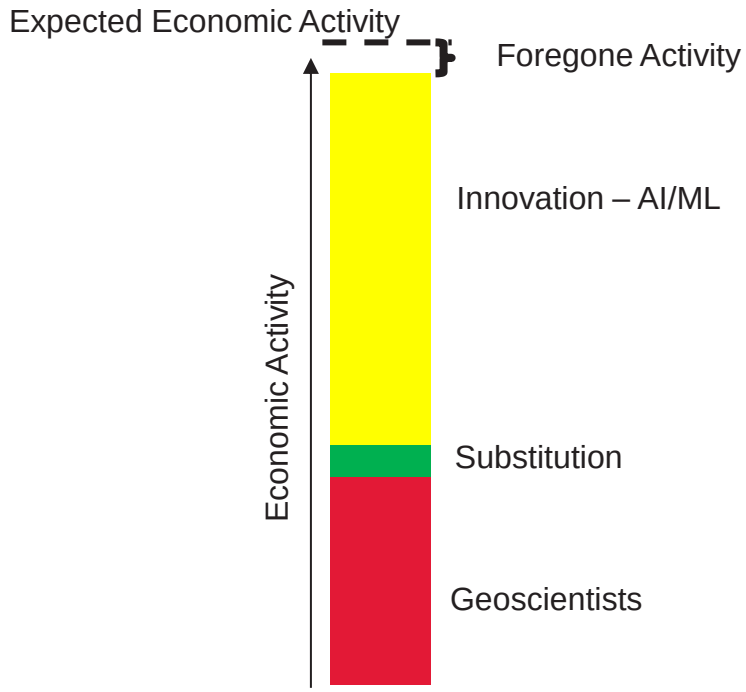
Roadmaps to Agility Exist

- Confident geoscience programs can adapt, the social engineering is the challenge
- Vision and Change does not itemize narrow actions, it fosters the big picture and agility



Rapid Changes to the Nature of Geoscience Work

- AI/ML is impacting geoscience employment
- Failure to meet FTE demand is leading to AI/ML replacement of FTEs
- Fastest in organizations that are growing
- Decline in middle-skills
- Concerns on graduate ability to DO anything
- 92% of geoscience positions are in APPLICATION
- Jobs are not siloed
  - Educate for the “Big G” Geosciences



Two Emerging Workforce Entry Models

HS to Industry Apprenticeships

- Focus on work ethic; energy; potential
- Train as Geotech; JIT geoscience knowledge introduction
- With demonstrated potential, support for college degree

Brazilian Residency Model

- Universities are very poor at skill/application development
- Employ graduates for 2 years in Geological Survey
- Move around the org to learn many different areas
- Exit with strong skill portfolio and an awarded Master's Degree

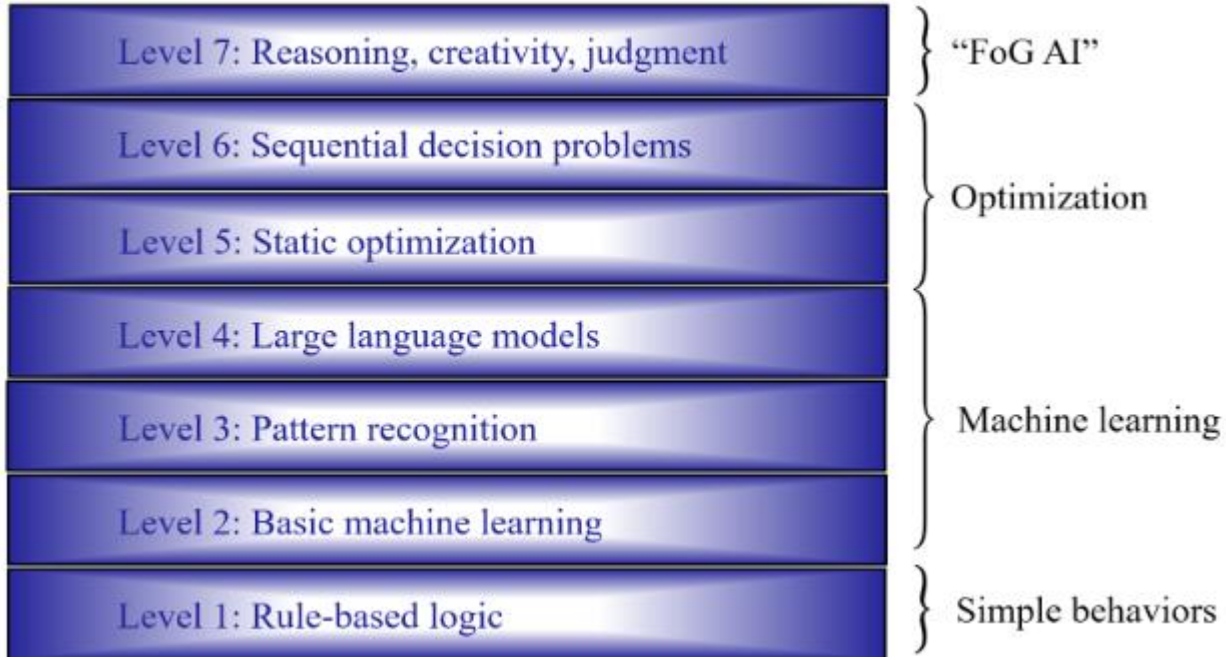
What About AI?

- It is replacing FTEs
- “Dirty” and “Dangerous” and “Repetitive” are being automated
  - Remote Mine Operations
  - Nearly fully remote mineral exploration
  - Automation of core, log, seismic interpretation
- Focus is on **empowering geoscientists to do geoscience**

The 7 levels of AI

Understand AI Beyond the Hype

- AI/ML is everywhere – from your coffee maker to the military
- AI is a tool-base. Technically we are at Level 4.
- Coupled applications moves us up the functional level (emerging practice of applications at level 6)

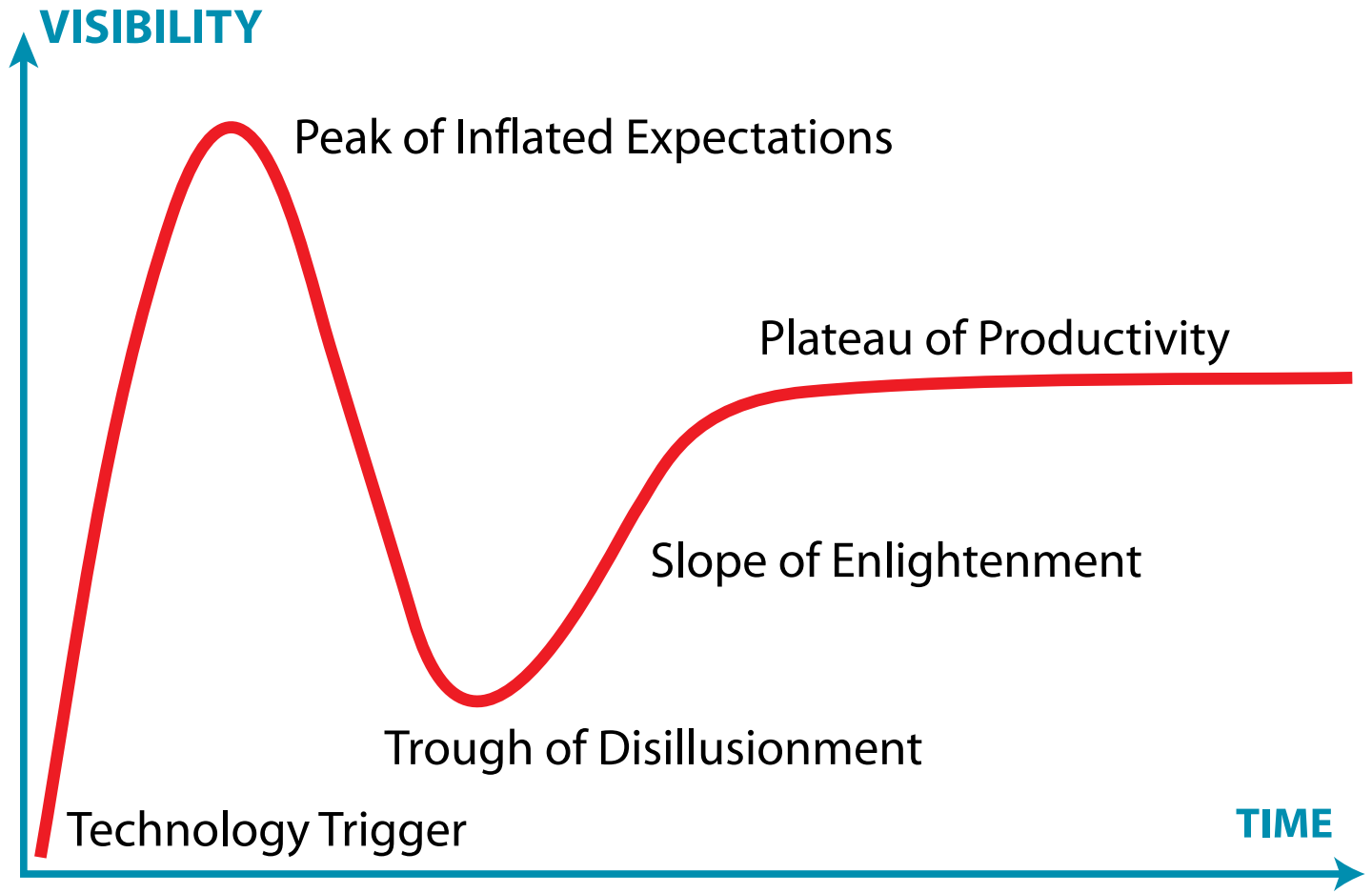


Source: The 7 Levels of AI, Warren Powell

Gartner Curve of Tech Lifecycle Phases

Understand AI Beyond the Hype

- Most people seem to be between Peak and Trough.
  - “I used ChatGPT a couple times and it wasn’t very good”
- The cutting edge (and industry) is already into the Plateau of Productivity
  - It is a tool that gives the 80% solution FAST
  - RAG, Knowledge Graph, and Agents are accelerating productivity.
- In Geo, seeing a lot of fudged use of AI for sexiness



Source: https://en.wikipedia.org/wiki/Gartner_hype_cycle

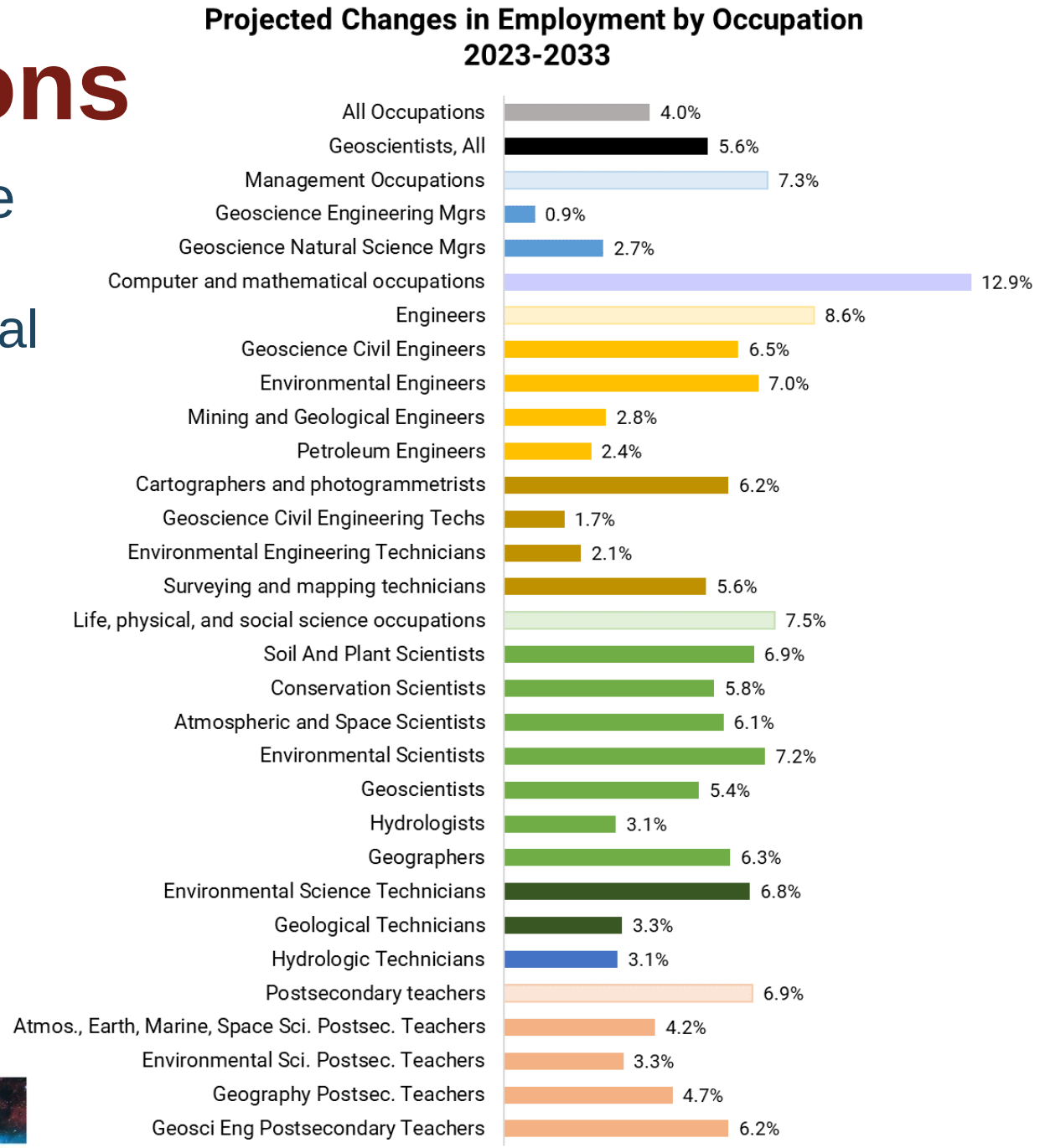
AI and Culture Change are Now Evident

Geoscience jobscape has evolved

- AI is underlying driver for what is driving change for skills in demand
  - This is doubling down on science for application
- Climate Change is no longer a policy/societal debate
  - Policy, investment, and innovation are about implementing solutions to address climate change impacts
  - NCSL discourse demonstrated this fundamental shift; Insurance disruption is the driver.
- Departments are being forced thru the crucible
  - Ongoing transformation is exhausting – disruption is a hard space
  - Lots of opportunities but also risk

Employment projections

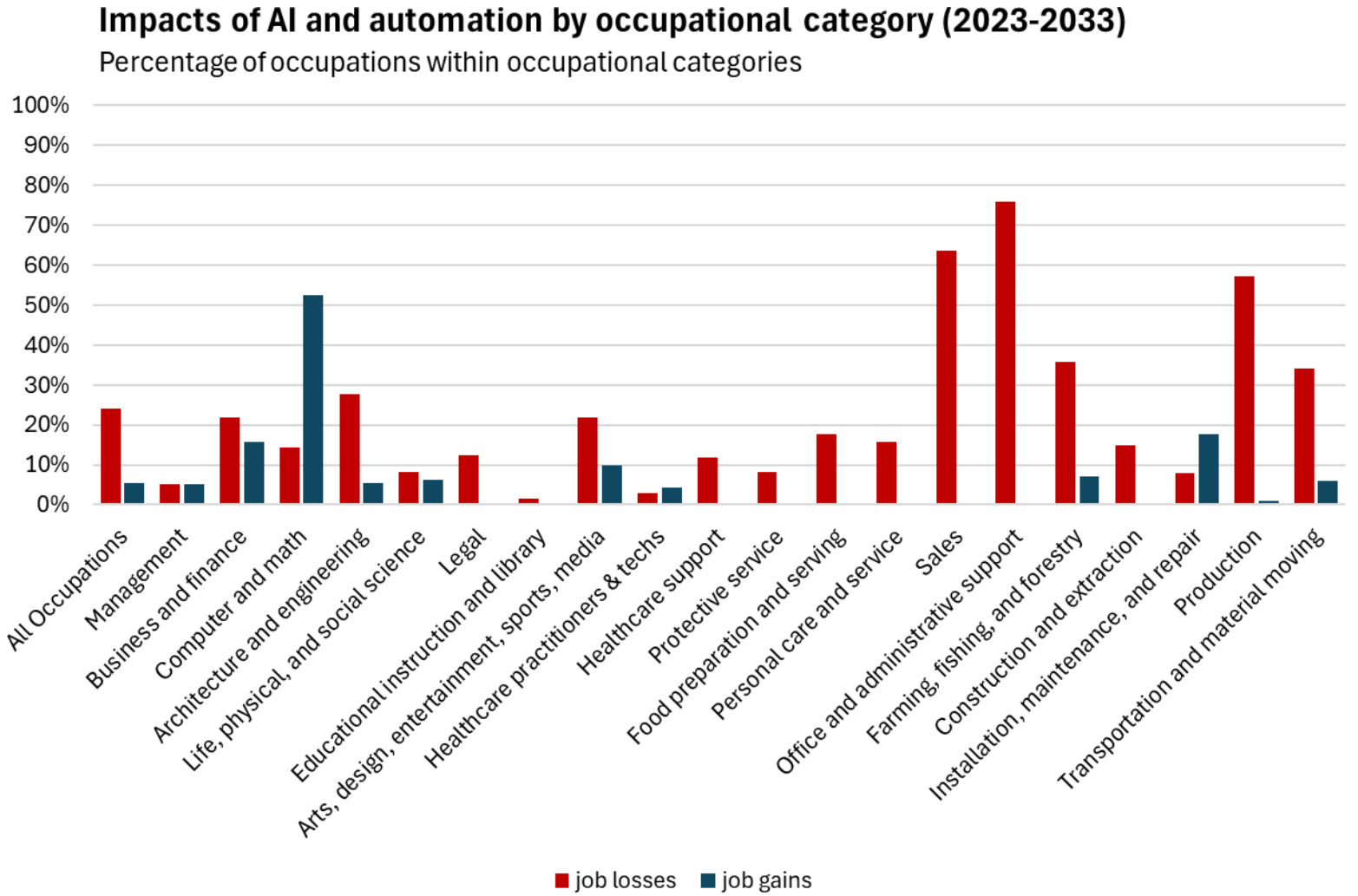
- AI/automation impacts on geoscience
  - Technician jobs: civil engineering, geological, hydrological, environmental engineering
  - Hydrologists
- Societal response to climate change
  - Conservation scientists
  - Environmental scientists
- Other occupations
  - Computer science & math (AI)
  - Engineering (AI, climate)
  - Life, physical, social science (AI, climate)



Source: US BLS Employment Projections

AI & automation revolution

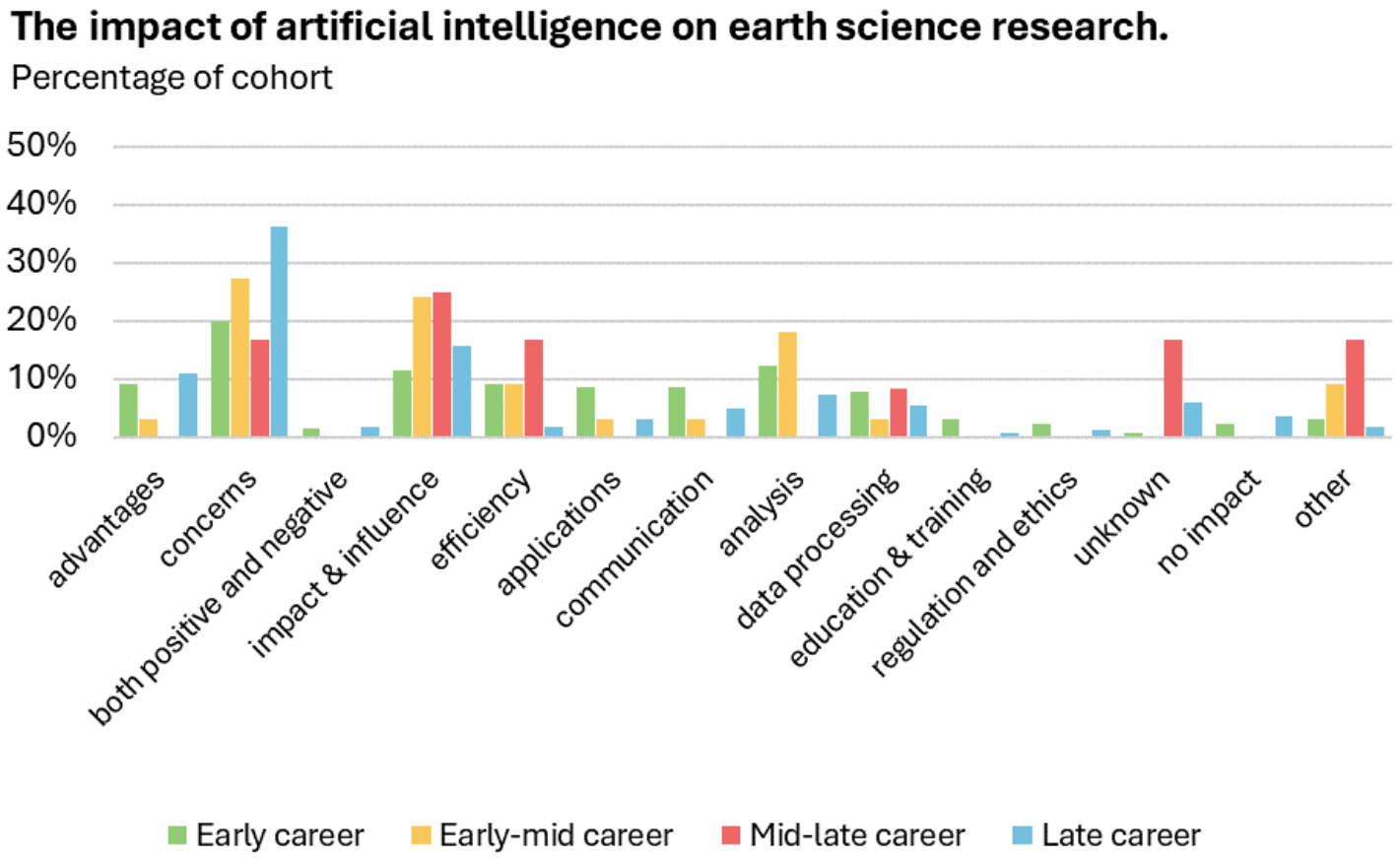
- Majority of occupational categories affected by job losses / slowed hiring due to replacement and increased efficiencies.
- Middle and low skill jobs being replaced.
- AI / automation job gains in computer, math and technology-related areas.



Source: US BLS Employment Projections

AI Impacts on Geoscience Research

- **Concerns**
  Bias, black box, flawed, fraudulent, invasive,
  mistrust, not accurate, overblown, risky, scary
- **Impacts & Influence**
  Emerging, expands impact, high potential, promising
- **Efficiency**
  Automation, saves time, discovery, faster progress
- **Analysis**
  Forecasting, modeling, anomalies, patterns, problem solving, visualizing



Source: AGI GRANDE project
Funded by NSF under Grant No. (2223004).

Research topics important for today

- **Climate**

  Adaptation, resiliency, drought, ocean acidification, sea level rise

- **Hazards**

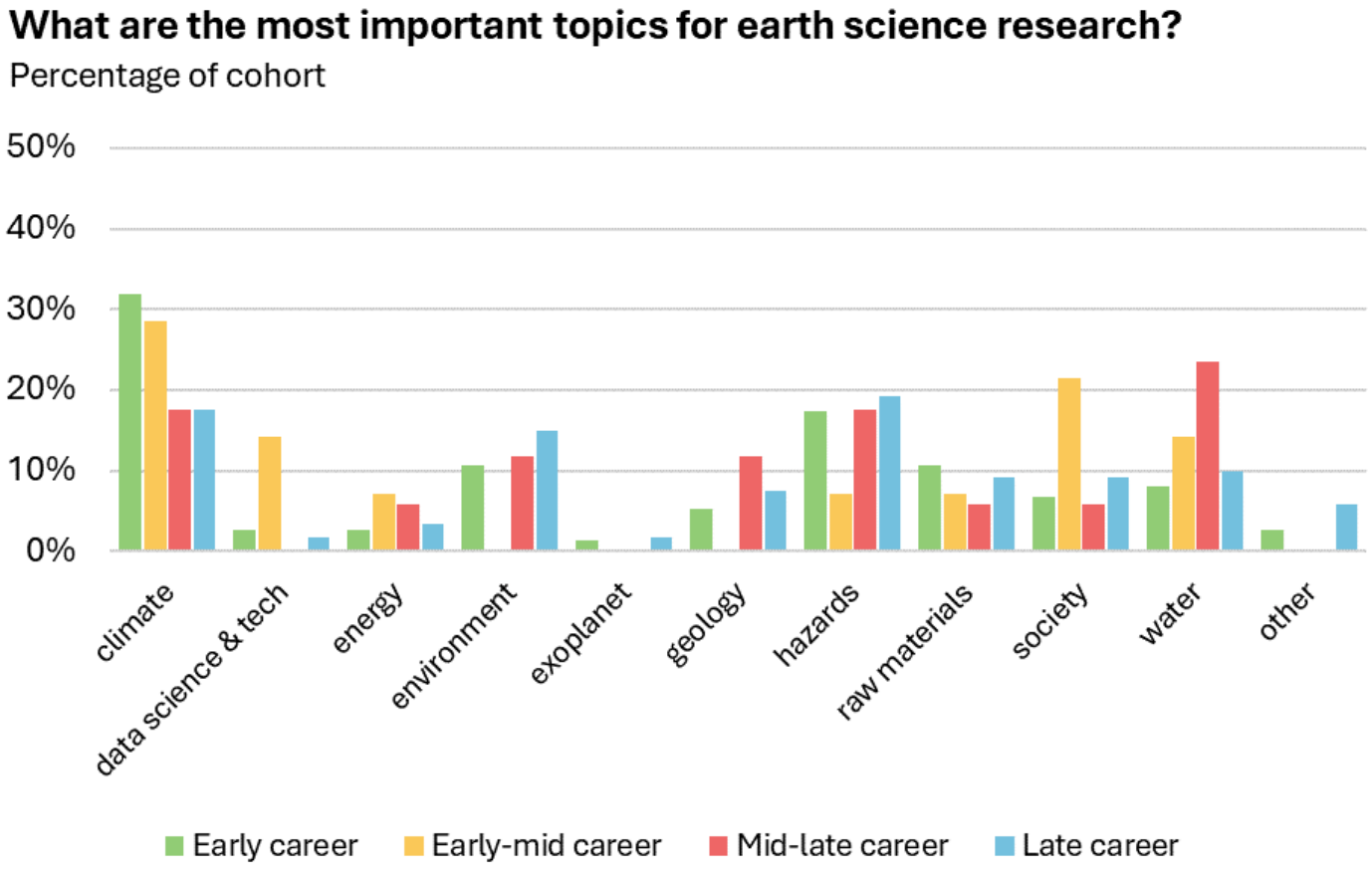
  Coasts, floods, earthquakes, landslides, volcanoes

- **Society**

  Community trust, co-production, resource allocation, sustainability

- **Water**

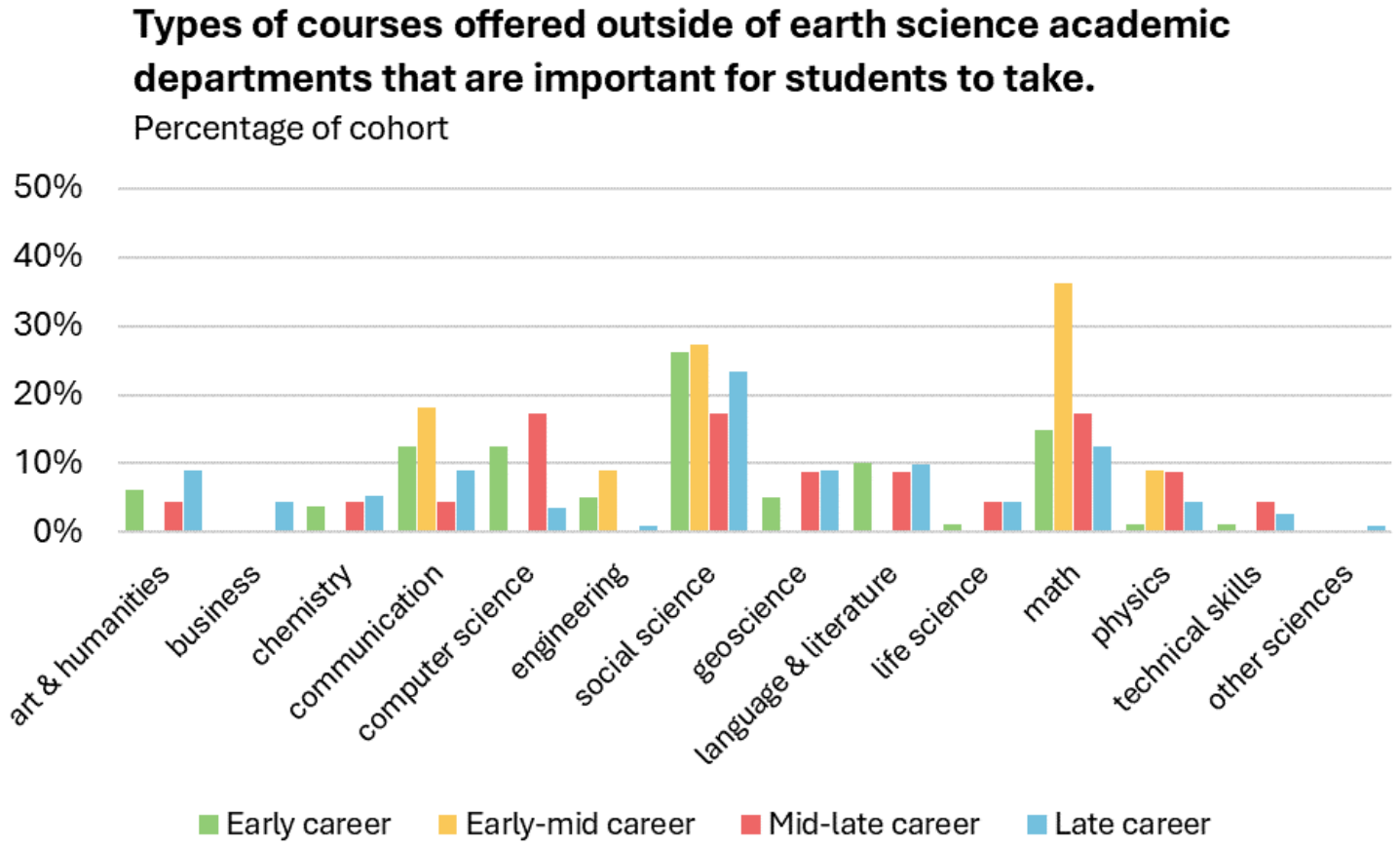
  Groundwater, aquifer sustainability, water security



Source: AGI GRANDE project
Funded by NSF under Grant No. (2223004).

Skills needed in addition to geoscience

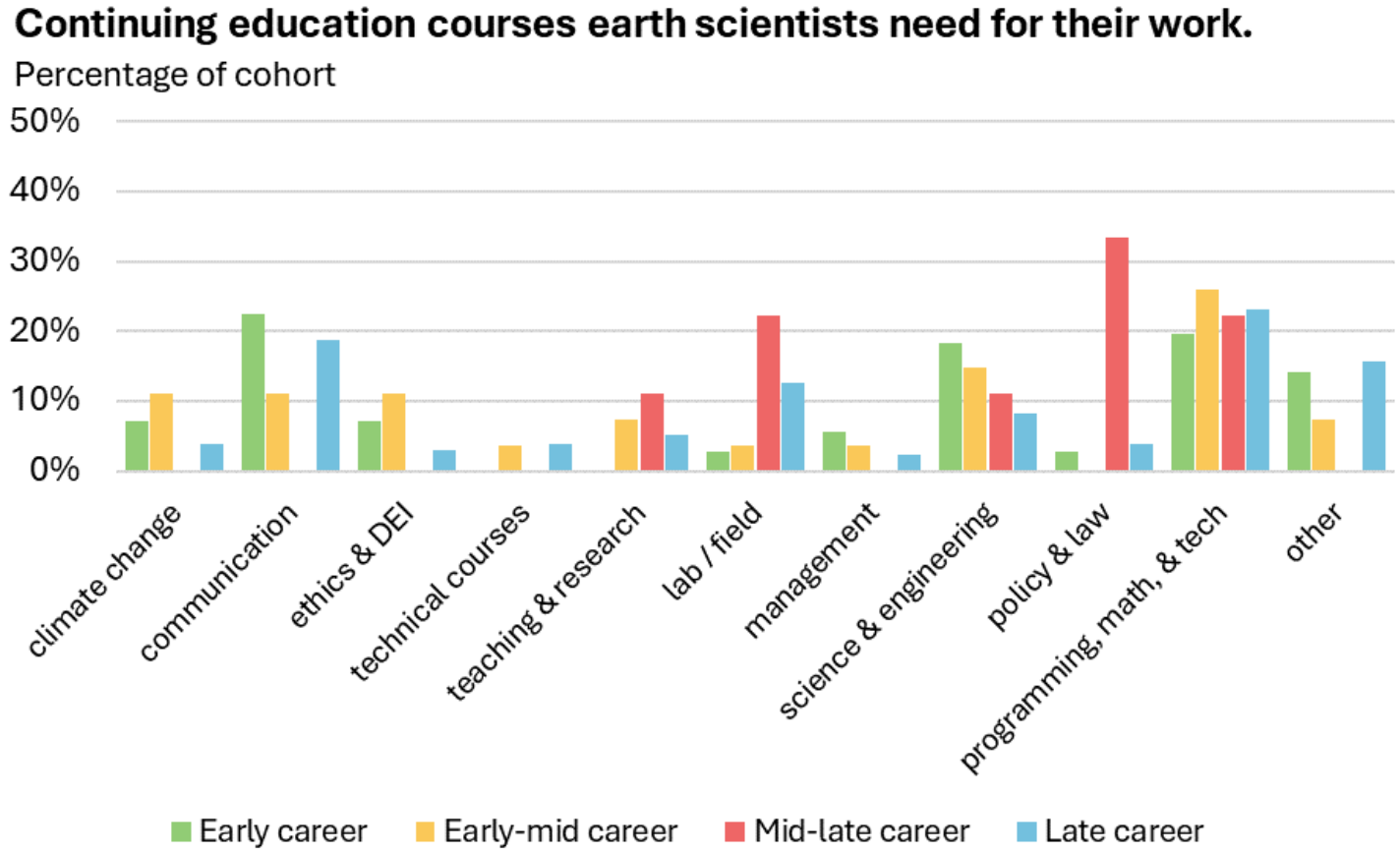
- **Math**
  - Calculus
  - Statistics
- **Social science**
  - GIS
  - Ethics and logic
  - Economics
  - Policy and political science



Source: AGI GRANDE project
Funded by NSF under Grant No. (2223004).

Continuing education important today

- **Programming, math & tech**
  - AI / ML
  - Programming
  - Data analysis
  - Statistics
- **Science & Engineering**
  - Chemistry
  - GIS / Remote sensing
  - Hazards
  - Risk management



Source: AGI GRANDE project
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Factors for successful careers

- **Personal attributes**

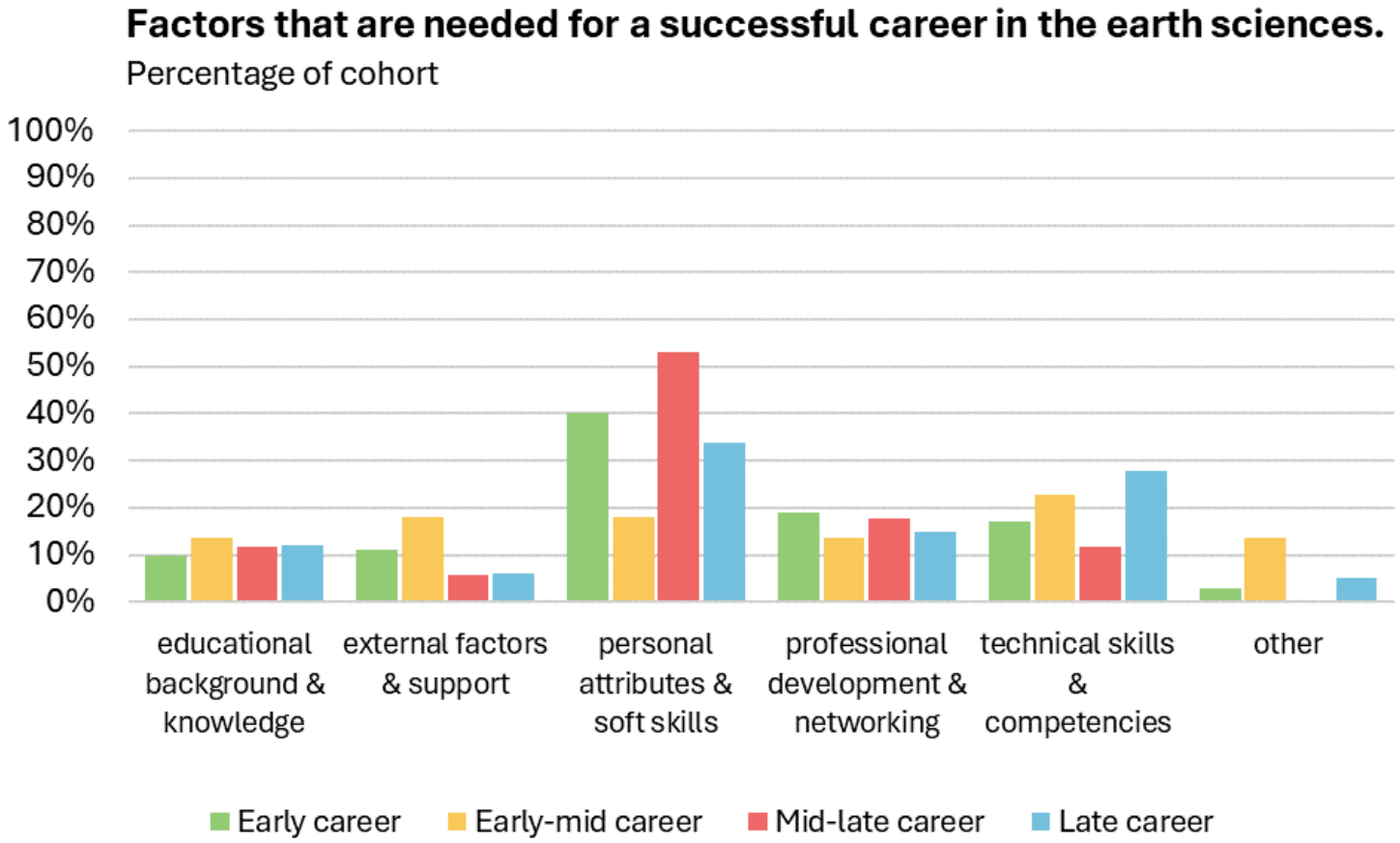
  Adaptability, flexibility, attention, focus, curiosity, creativity, dedication, gumption, self-motivated, thinking outside the box

- **Professional development**

  Communication, collaboration, teamwork

- **Technical skills**

  Analysis, critical thinking, math, programming, writing, spatial thinking



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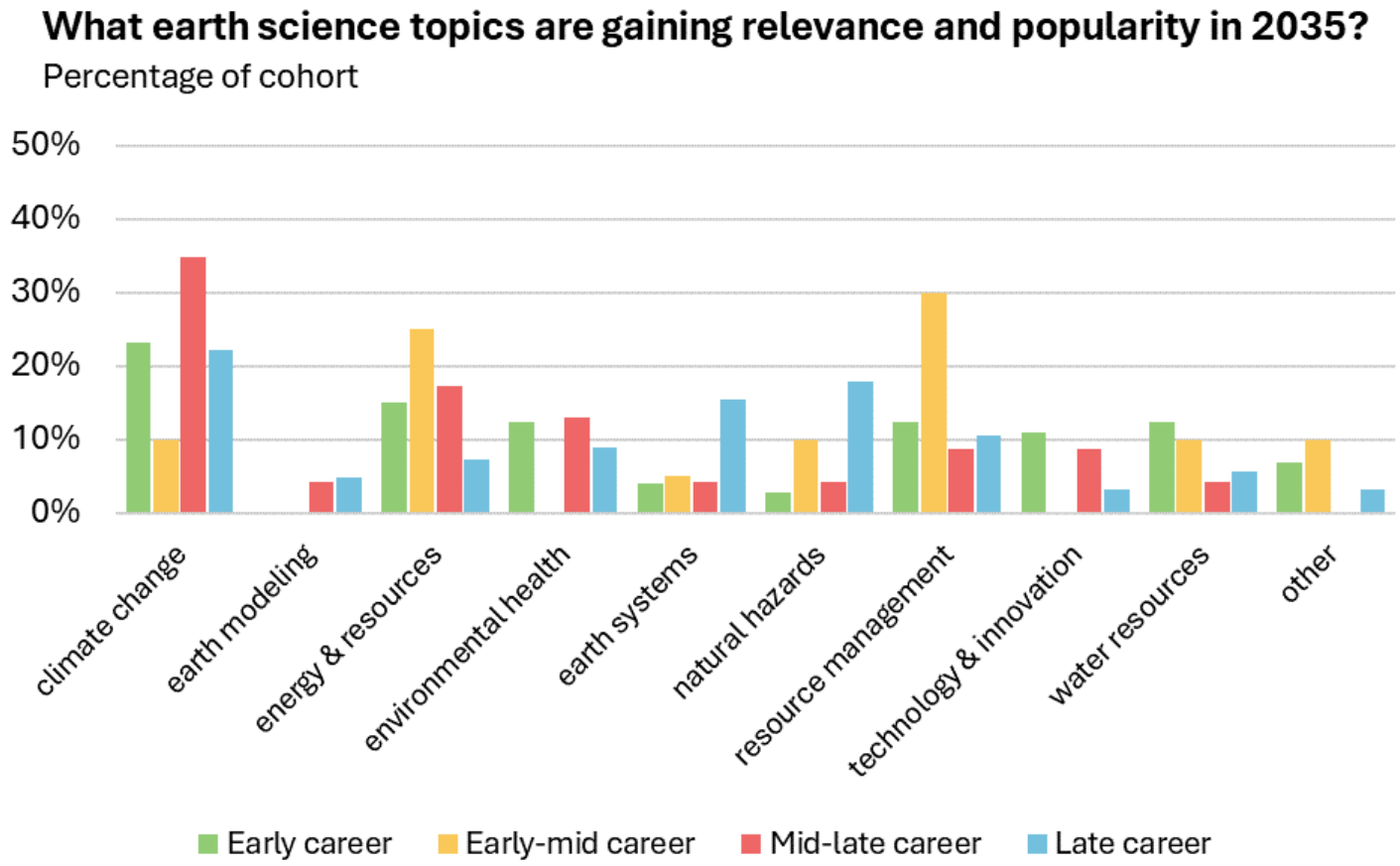
Geoscience in 2035

- **Climate change**
  - Mitigation
  - Sea level rise
  - Sustainability
- **Energy & resources**
  - Carbon capture
  - Renewable energy
- **Resource management**
  - REEs / Critical minerals



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Future sectors for earth science skills

- **Energy & resources**

  Mining, critical minerals, renewable energy, resource extraction

- **Government**

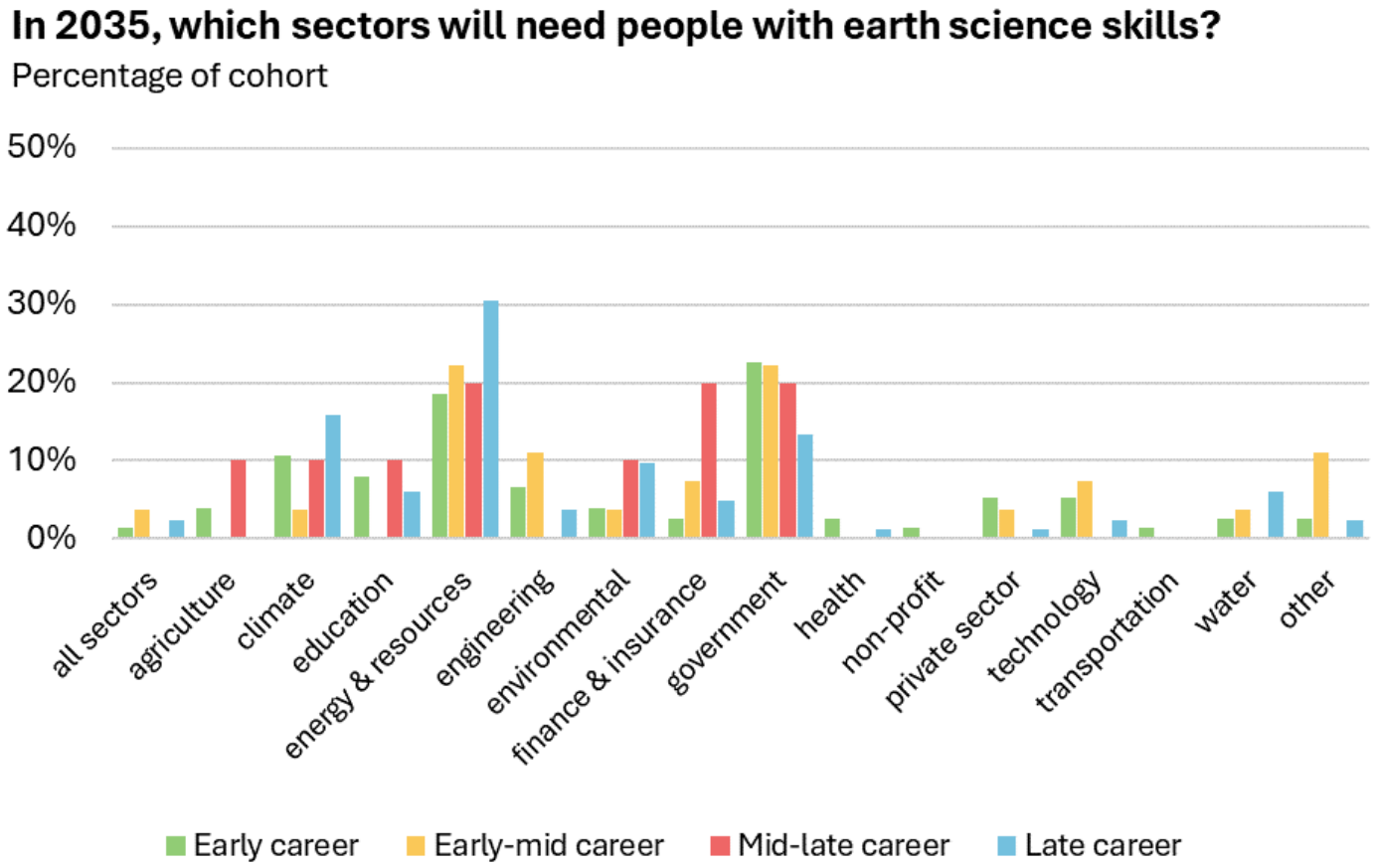
  Planning, policy, regulation

- **Finance & insurance**

  Economics, insurance

- **Climate**

  Mitigation, resilience, hazards



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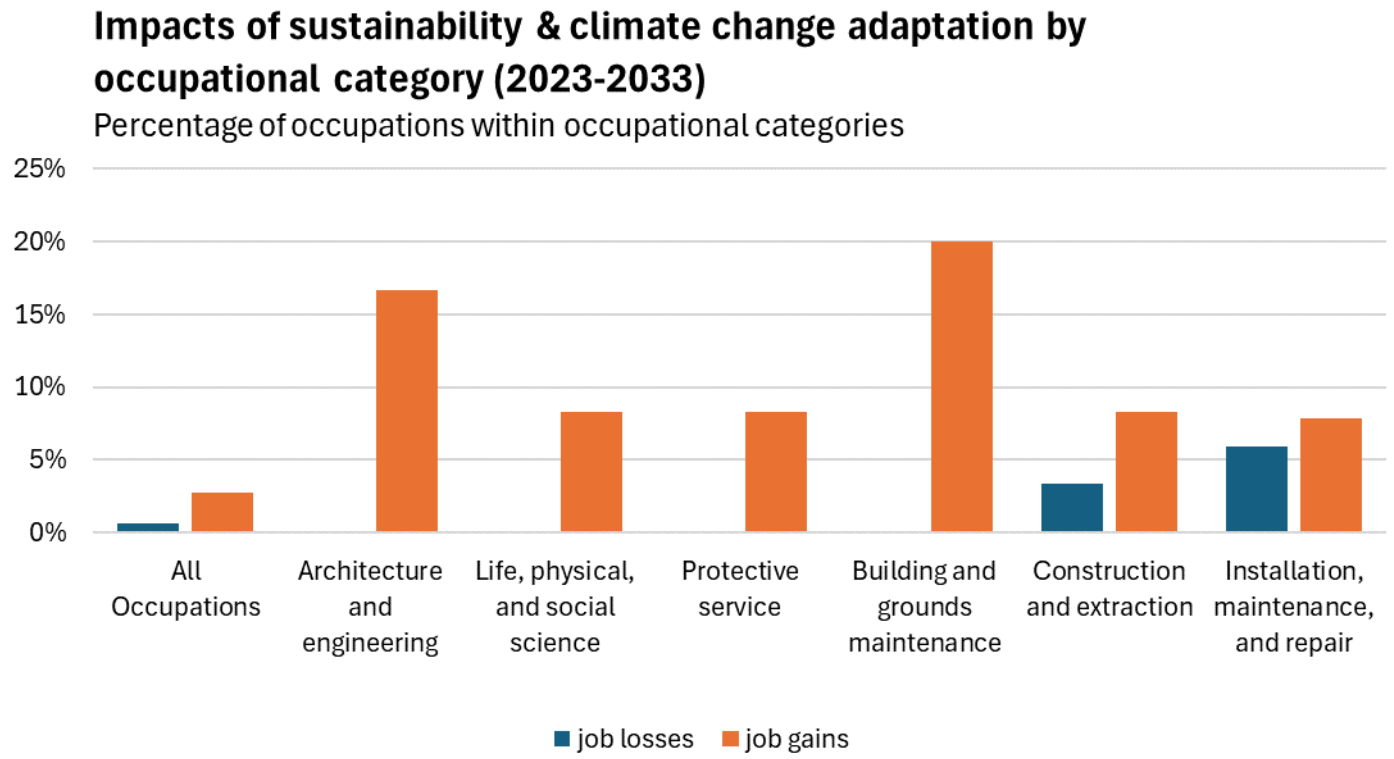
Sustainability & climate change adaptation

- Small number of occupational categories affected, primarily through job growth.
- Job growth focused on transition to renewable and electrified sources, sustainability-related regulations, and climate-related hazard mitigation and preparedness.



Source: US BLS Employment Projections

Considerations

- AI implementations – applications and problem spaces
  - Technological advances promote solutions for multi-faceted problems like climate-related impacts
  - Skills are building blocks that should advance learners towards application and problem spaces
  - AI should be introduced during degree programs not as continuing education
- How are we preparing future geoscientists?
  - Skills, transferability, agility
  - Personal attributes & soft skills
  - Opportunity spaces to allow for growth during academic programs

Chart data

Charts related to employment projections

www.americangeosciences.org/profession

Charts related to AGI's GRANDE project

https://grande.americangeosciences.org

Does Hazard Risk Influence Your Career Choice?

Natural Hazards Impact on Job Choice game

https://hazardgame.americangeosciences.org