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Defining Critical Issues Survey

Final Survey Results

January 2014

Critical Issues Program

Center for Geoscience Education & Public Understanding

A service of the American Geosciences Institute

**Defining Critical Issues Survey, Final Results
January 2014**

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Table of Contents

Introduction.....	1
Key Highlights	1
Demographics of Survey Participants.....	2
Critical Issues Facing Society by Cohort	4
Critical Issues Facing Society by Priority and Cohort.....	10
Re-defining the Term “Critical Issues”.....	14
Conclusions	15
Appendix A: Survey Questions	A-1
Appendix B: Survey Response Open Coding	B-1
Appendix C: Critical Issues Definitions by Cohort.....	C-1

Table of Figures

Figure 1: Cohort Classification of Survey Participants	2
Figure 2: Survey Participants by Industry and Cohort.....	3
Figure 3: Age Ranges of Survey Participants	3
Figure 4: Age Ranges of Survey Participants by Cohort	4
Figure 5: Critical Issues Facing Society by Cohort	6
Figure 6: Critical Issues Facing Society: Geoscience Community.....	7
Figure 7: Critical Issues Facing Society: Geoscience Community (18–44 years old).....	8
Figure 8: Critical Issues Facing Society: Geoscience Community (45–65+ years old).....	8
Figure 9: Critical Issues Facing Society: Decision-making Community	9
Figure 10: Critical Issues Facing Society: Public.....	9
Figure 11: Critical Issues Facing Society: Other	10
Figure 12: Critical Issues Facing Society by Priority: Geoscience Community	11
Figure 13: Critical Issues Facing Society by Priority: Geoscience Community (18–44 years old)	11
Figure 14: Critical Issues Facing Society by Priority: Geoscience Community (45–65+ years old)	12
Figure 15: Critical Issues Facing Society by Priority: Decision-making Community.....	12
Figure 17: Critical Issues Facing Society by Priority: Public	13
Figure 18: Critical Issues Facing Society by Priority: Other	13

Table of Tables

Table 1: Most Cited Critical Issues by Cohort	5
Table 2: Highest Priority Critical Issues by Cohort.....	5

Introduction

The Critical Issues Program launched its “Defining Critical Issues” survey on November 5, 2013 (see Appendix A for the survey questions). Emails were sent to 11,400 geoscientists and 83 decision makers at national, state and local level decision making organizations and think tanks. The survey was also disseminated via social media channels. Preliminary results were released at the end of November 2013, and efforts were made to garner more input from the decision-making community and general public, the non-academic sectors of the geoscience community, and individuals in the age groups between 18 and 44 years of age. A total of 890 usable responses were received.

The aim of the web-based survey was to understand how the decision-making community, geoscience community, and the public define the term “critical issue,” as well as which critical issues were of top concern to each community. The survey was deliberately short, broad, and unstructured in order to capture a wide range of responses. This report provides the final analysis of the survey responses received through December 31, 2013, the closing date of the survey.

About the Critical Issues Program

The Critical Issues program (<http://geocnr.org/critical-issues/>) is part of the Center for Geoscience Education and Public Understanding, a service of the American Geosciences Institute. The program's mission is to support well-informed public and individual decision making by providing relevant geoscience information to decision makers at all levels, from federal to regional, state, local, and individual. The program aims to serve as a hub that facilitates the exchange of ideas, inquiries, and relevant geoscience information between decision makers and the geoscience community.

Key Highlights

The Defining Critical Issues survey received 890 usable responses in the period November 5th to December 31st 2013. Responses from the geoscience community overwhelmed the much smaller number of responses from the public and the decision-making community. Across all cohorts, survey participants were predominantly from the post-secondary academic sector. Over two-thirds of the survey participants were 45 years of age or older and nearly one-quarter of participants were between 18 and 44 years old.

Most frequently mentioned critical issues by cohort:

1. Climate change (all cohorts)
2. Water and environment (geoscientists, decision makers, “other”)
3. Economics and human population growth & health (decision makers, public)
4. Energy (geoscientists, “other”)
5. “Other” issues (public, “other”)
6. Natural hazards (geoscientists)
7. Agriculture, food, and soils (public)

The top three highest priority issues by cohort:

1. Climate change (all cohorts)
2. Water (geoscientists, “other”); human population growth & health (public); energy (decision makers)
3. Human population growth (geoscientists, decision makers, “other”); water (public)

Revised definition for the term “critical issues”: Critical issues are natural and human-influenced Earth processes that require immediate attention in order to mitigate significant, adverse, wide-ranging impacts in both the short and long term on people and their way of life, living organisms, and/or Earth’s resources and ecosystems.

Demographics of Survey Participants

Survey participants were asked if they represented the geoscience community, the public, the decision-making community, or other. An overwhelming majority of survey participants were from the geoscience community (Fig. 1), which was to be expected given the large number of emails that were sent to individual geoscientists. Decision makers comprised just one percent (a total of 10 survey participants) of the survey respondents. Future surveys will target the decision-making community because one of the main goals of the Critical Issues program is to understand the range of issues where additional relevant geoscience information would be beneficial to decision makers.

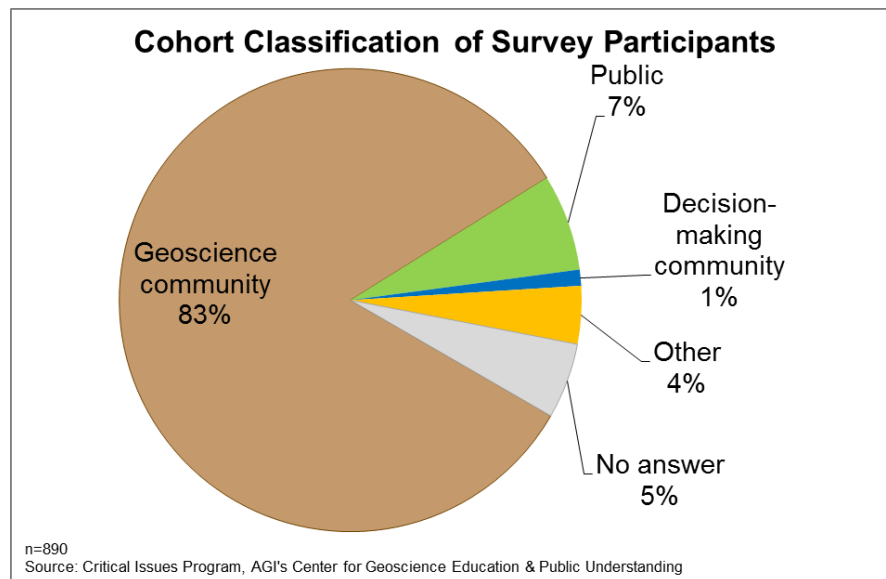


Figure 1: Cohort Classification of Survey Participants

Public citizens comprised seven percent (a total of 60 survey participants) of the survey respondents, while participants identifying themselves in the “Other” category comprised four percent (a total of 36 survey participants) of the survey respondents. Upon examination of the comments, nearly half of the respondents in the “Other” category could have been grouped with the geoscience community or with the public cohort. However, we did not reclassify these individual records because they would not have changed the overall results substantially, and we also wanted to preserve the self-classification of the survey participants.

In addition to choosing the primary cohort classification, survey participants were also asked to identify the industry they represented. In each cohort, survey participants were predominantly from the academic (post-secondary education) sector (Fig. 2). Within the geoscience community, 70% of survey participants were in academia, compared to 39% in the “other” cohort, 23% in the public cohort, and 20% in the decision-making community. Note that the number of survey participants in the decision-making community cohort was small (a total of 10 survey participants).

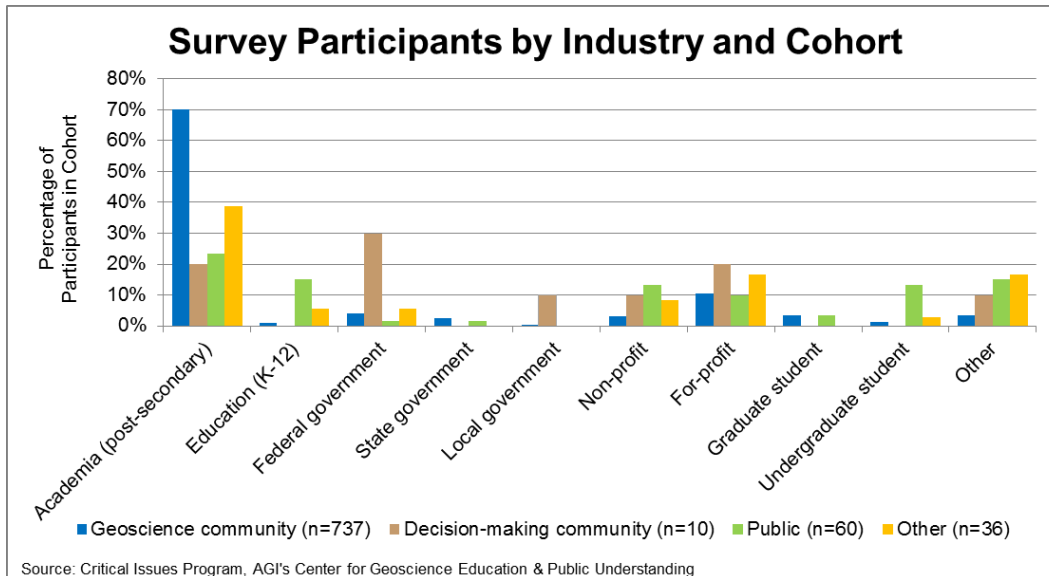


Figure 2: Survey Participants by Industry and Cohort

Over two-thirds of the survey participants were 45 years of age or older, while nearly one-quarter of participants were between 18 and 44 years old (Fig. 3). Just over three-quarters of survey participants in the geoscience community were 45 years of age or older, while 75% of survey participants in the “other” cohort, 70% of participants in the decision-making community cohort, and 52% of survey participants in the public cohort were 45 years of age or older (Fig. 4).

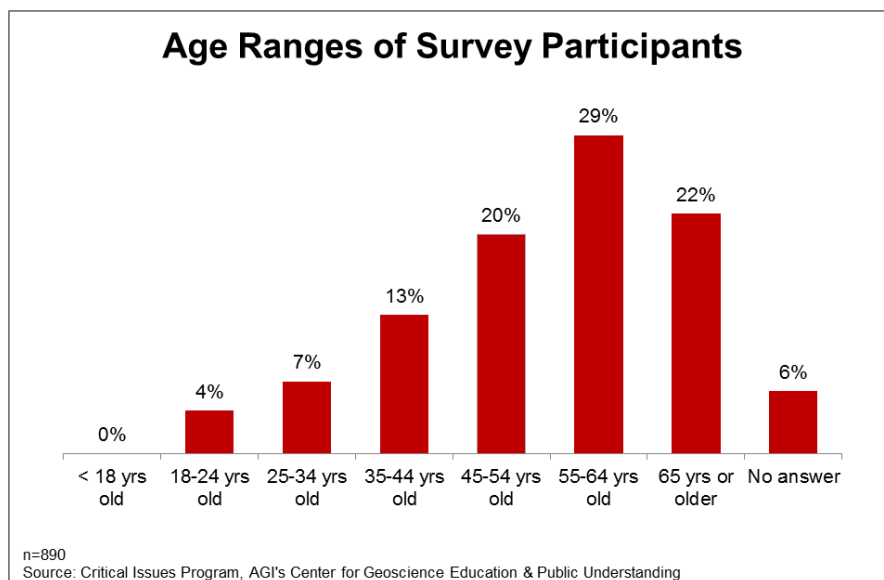


Figure 3: Age Ranges of Survey Participants

Additionally, survey participants in the 35 to 44 year old age range were more represented in the decision-making community (20%) than in the “other”, geoscience community, and public cohorts (14%, 13% and 12%, respectively). Survey participants between the ages of 18 and 34 years old comprised 35% of the public cohort, while representation of this age group was much smaller in the other cohorts (decision-making community: 10%, geoscience community: 9%, “other”: 8%).

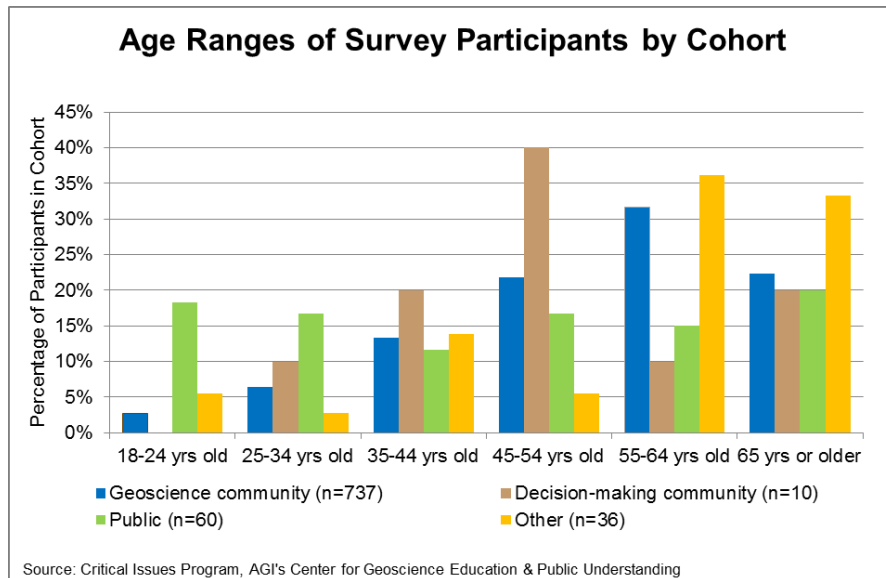


Figure 4: Age Ranges of Survey Participants by Cohort

Critical Issues Facing Society by Cohort

Survey participants were asked to list up to five critical issues facing society today. Responses were categorized into 22 categories (see Appendix B for open coding schema), and then were analyzed by the total number of mentions of the issue by cohort (Figs. 5–11) as well as by the priority given to the issue by each cohort (Figs. 12–18). Tables 1 and 2 summarize the most cited critical issues and highest priority critical issues by cohort.

	Geoscientists	Decision makers	Public	Other
Climate change	X	X	X	X
Water	X	X		X
Energy	X			X
Environment	X	X		X
Natural hazards	X			
Economics		X	X	
Human population growth and health		X	X	
Agriculture, food, and soils			X	
Other			X	X

Table 1: Most Cited Critical Issues by Cohort

	Geoscientists	Decision makers	Public	Other
Climate change	1	1	1	1
Water	2		3	2
Human population growth and health	3	3	2	3
Energy		2		

Note: 1: Highest priority issue; 2: Second highest priority issue; 3: Third highest priority issue

Table 2: Highest Priority Critical Issues by Cohort

Overall, climate change was the most frequently mentioned issue by participants across all cohorts (Fig. 5). Water was the second most frequently mentioned issue for geoscientists, followed by natural hazards, energy, and the environment. For decision makers, environment was the second most frequently mentioned issue tied with economics and human population growth & health, followed by water. For participants in the public cohort, agriculture, food and soils was the second most frequently mentioned issue, tied with human population growth & health, followed by “other”, and economics. Water and energy were tied for the sixth most cited critical issue. For those participants in the “other” cohort, environment was the second most frequently mentioned issue, followed by “other” issues, water, and energy.

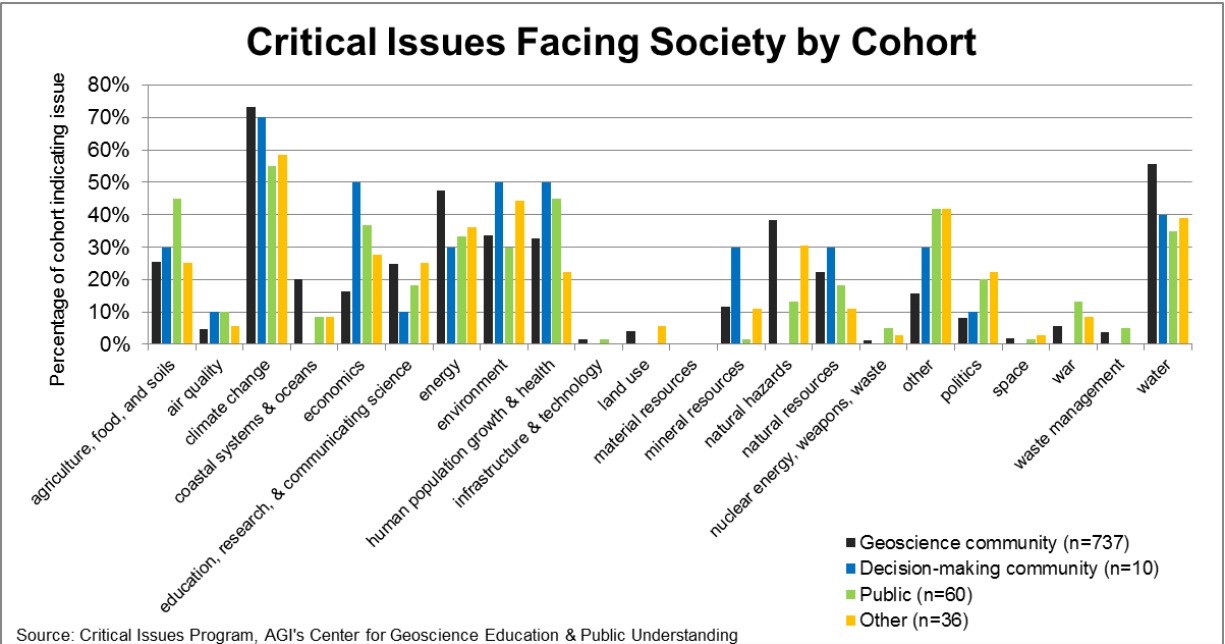


Figure 5: Critical Issues Facing Society by Cohort

Due to the large difference in the number of survey participants per cohort, we also examined the raw number of responses by cohort in order to discover any similar patterns in the most frequently mentioned issues by participants in the different cohorts (Figs. 6–11). We examined the similarities and differences in the five most frequently mentioned issues of each cohort. Climate change ranked in the five most frequently mentioned issues by all cohorts. Water and environment were ranked in the top five most frequently mentioned critical issues by participants in the geoscience community, and “other” cohort, but not by the public. Energy was mentioned by participants in the geoscience community and “other” cohorts among their top five most frequently mentioned concerns, but not by the decision-making community and public cohort. Economics was ranked in the top five most frequently mentioned critical issues by the decision-making community and public, but not by the geoscience community and “other” cohort. Natural hazards was ranked in the top five most frequently mentioned critical issues by participants in the geoscience community, while human population growth & health were highlighted as part of the top five most frequently mentioned issues by participants in the decision-making community and public cohorts. “Other” issues were cited in the top five most frequently mentioned issues by the public and “other” cohorts, but not by the geoscience community or decision-making community. Agriculture, food, and soils was in the top five most frequently mentioned issues by participants in the public, but not by geoscientists, decision makers and those in the “other” cohort.

Education, research & science communication was the eighth most frequently mentioned issue for participants in the geoscience community and was tied in eighth place with agriculture, food and soils for those in the “other” cohort. This issue was the fifth most frequently mentioned issue in the decision making community, tied with politics and air quality, and was the ninth most frequently mentioned issue for participants in the public cohort, tied with natural resources. Additionally, education, research & science communication was the ninth most

frequently mentioned issue for geoscientists between the ages of 18 and 44 (tied with natural resources), and was the seventh most commonly mentioned issue for geoscientists between the ages of 45 and 65+.

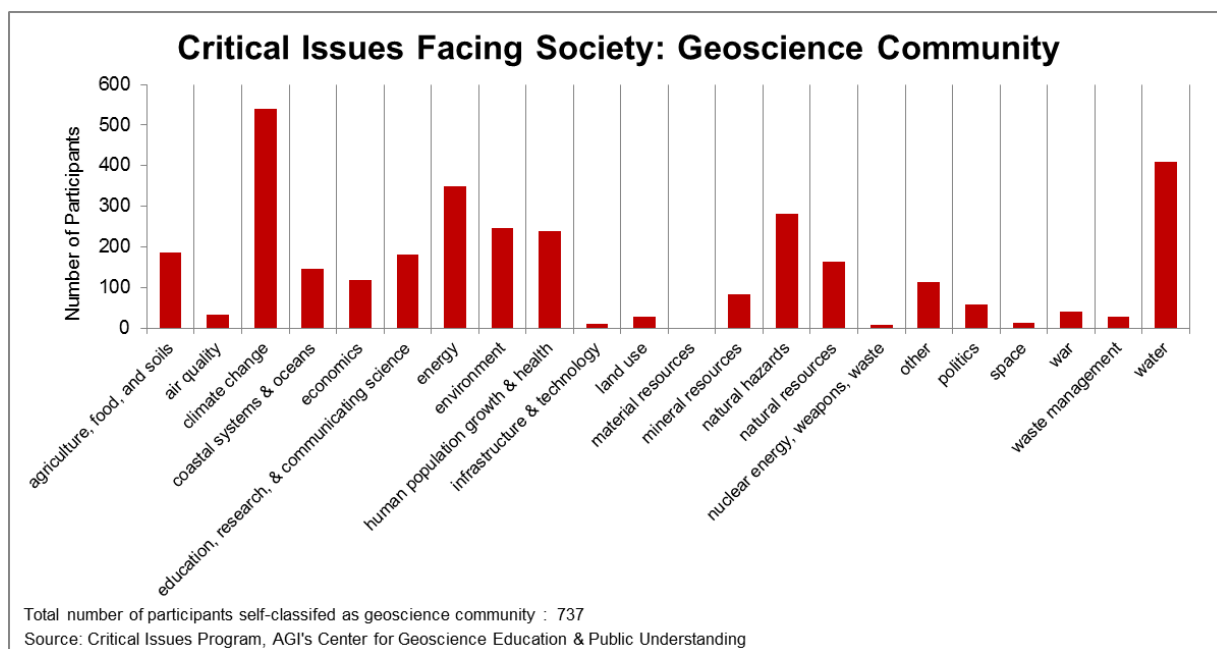


Figure 6: Critical Issues Facing Society: Geoscience Community

We also analyzed the top critical issues by age group for the geoscience community cohort to examine differences between those in the 18–44-year-old age group and those in the 45–65+-year-old age group. Although climate change and water were ranked as the first two frequently mentioned issues for both age groups, there were some differences regarding other critical issues. Natural hazards was the most commonly mentioned issue for those in the 18–44-year-old age group and was the fifth most commonly mentioned issue for those in the 45–65+-year-old age group. This issue was the tenth most commonly mentioned issue for participants in the public cohort (tied with war) and was the sixth most commonly mentioned issue for those participants in the “other” cohort. Energy was the fourth most frequently mentioned issue for geoscientists between the ages of 18 and 44, and was the third most commonly mentioned issue for geoscientists between the ages of 45 and 65+, while environment was the fifth most frequently mentioned issue for geoscientists between the ages of 18 and 44, and was the sixth most commonly mentioned issue for geoscientists between the ages of 45 and 65+.

Human population growth & health was the sixth most frequently mentioned issue for geoscientists between the ages of 18 and 44, and was the fourth most commonly mentioned issue for geoscientists between the ages of 45 and 65+. This issue was the second most frequently mentioned issue for decision makers (tied with environment and economics) and for the public cohort (tied with agriculture, food, and soils), while it was the eighth most commonly mentioned issue (tied with politics) for those in the “other” cohort.

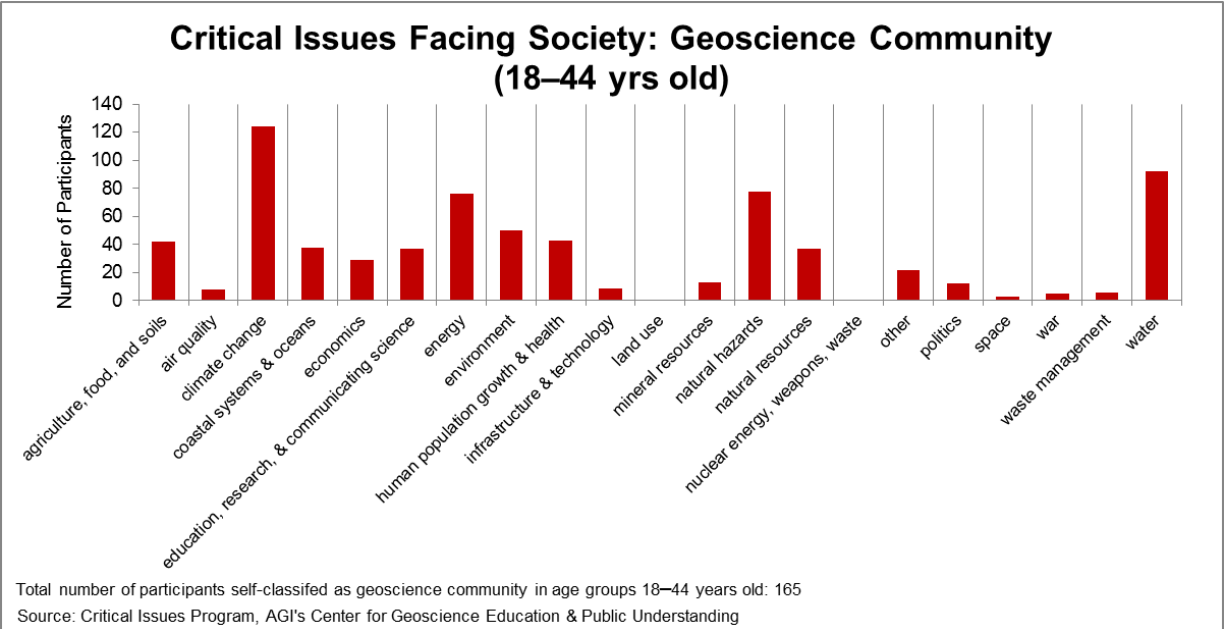


Figure 7: Critical Issues Facing Society: Geoscience Community (18–44 years old)

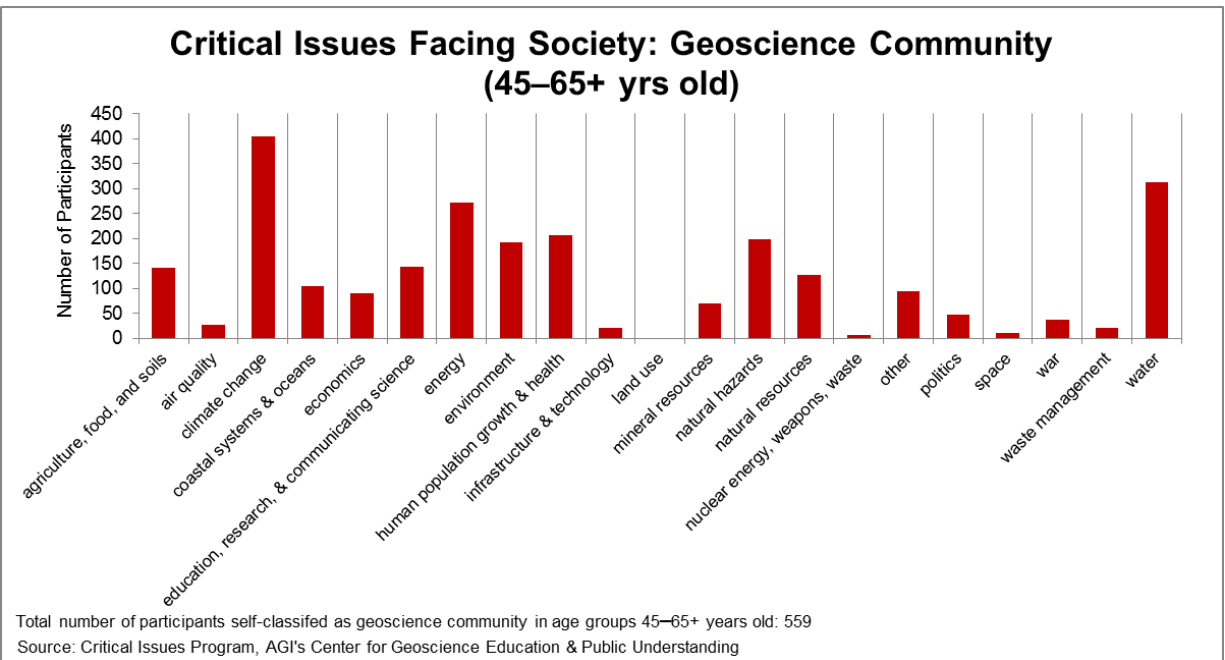


Figure 8: Critical Issues Facing Society: Geoscience Community (45–65+ years old)

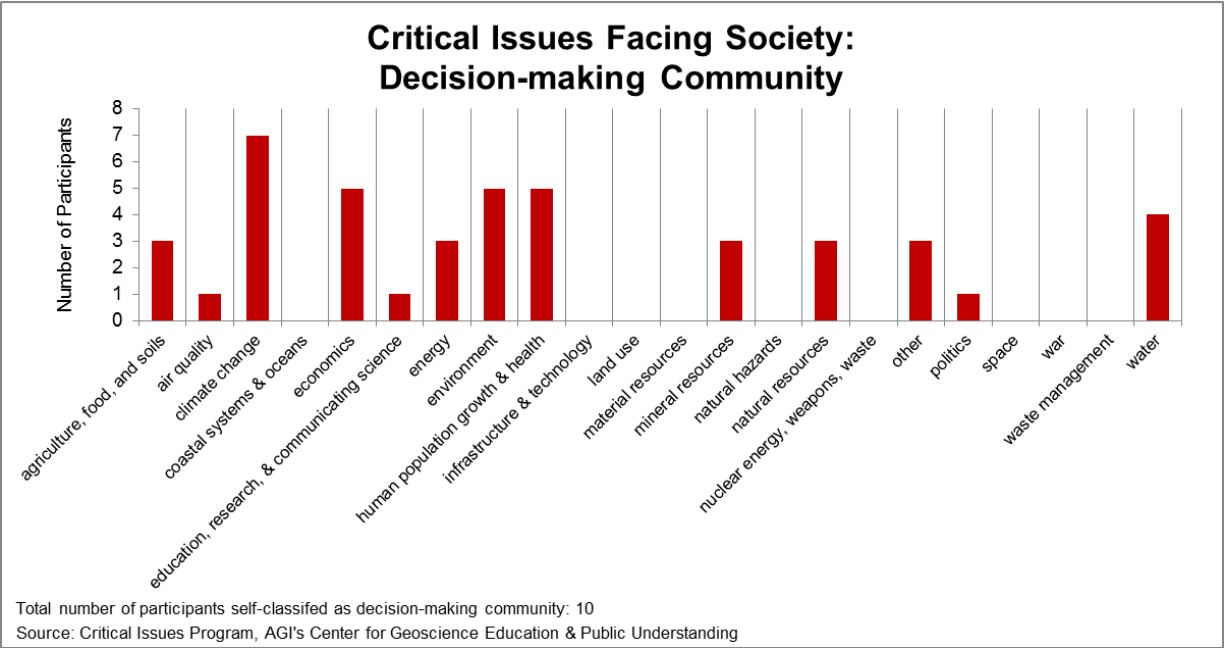


Figure 9: Critical Issues Facing Society: Decision-making Community

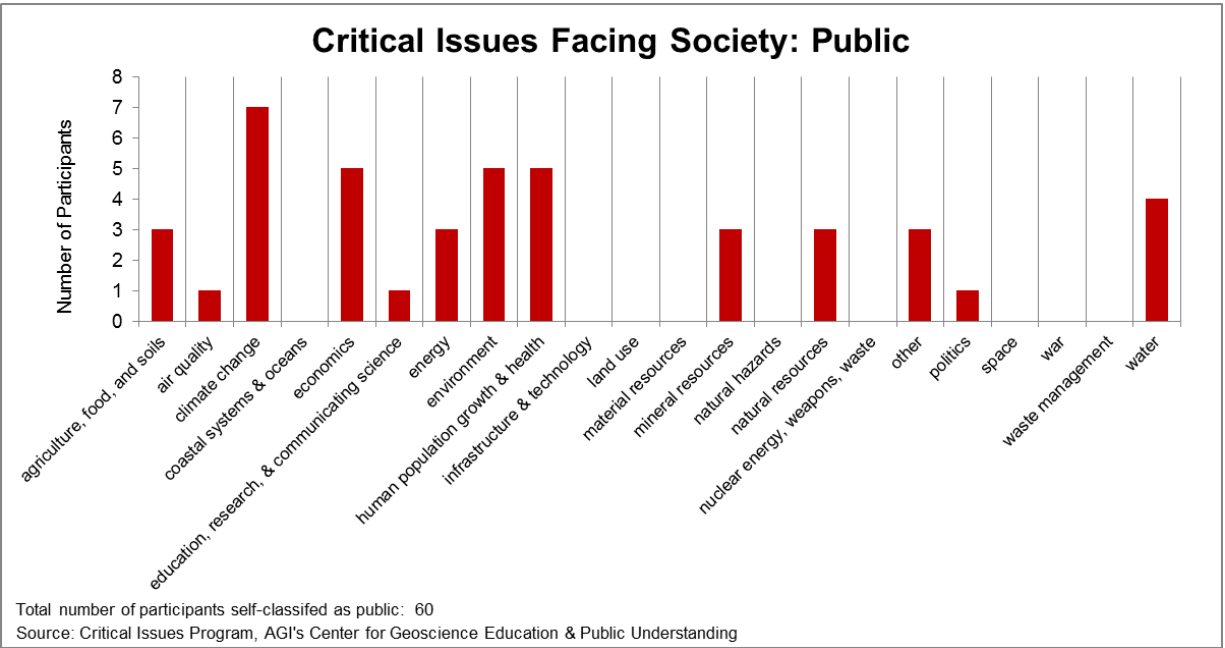


Figure 10: Critical Issues Facing Society: Public

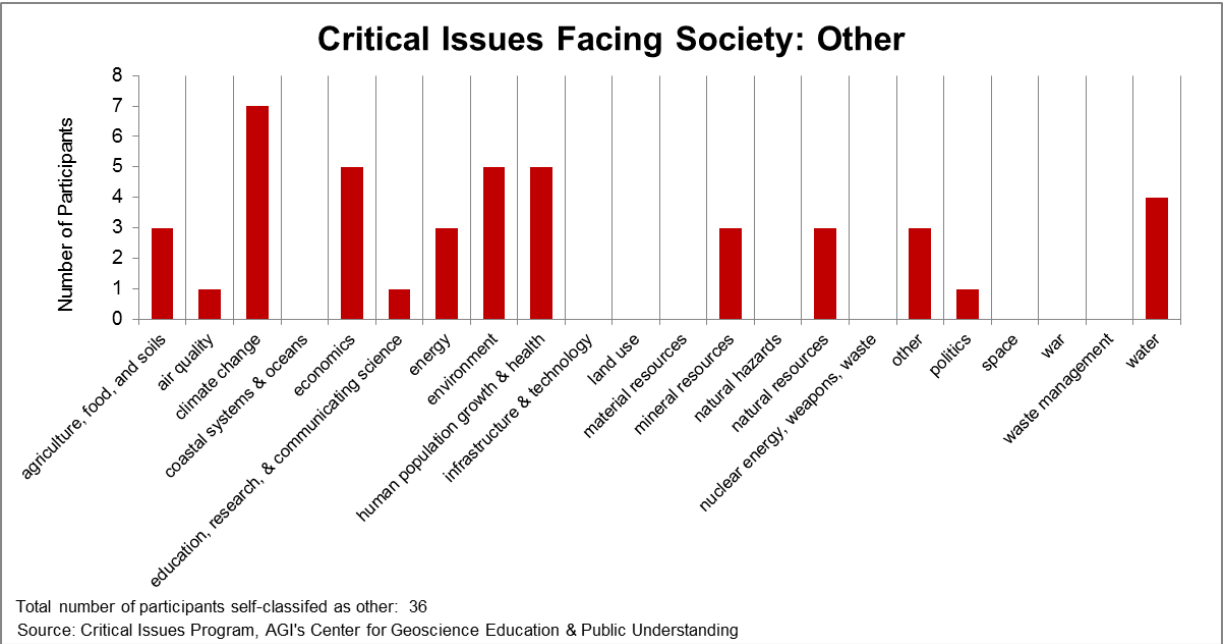


Figure 11: Critical Issues Facing Society: Other

Critical Issues Facing Society by Priority and Cohort

In addition to analyzing the frequency that each critical issue was mentioned by participants in each cohort, we also analyzed how participants from each cohort prioritized the critical issues they mentioned (Figs. 12–18). The most frequently mentioned highest priority issue was climate change across all cohorts. The second most frequently mentioned highest priority issues were water (geoscientists, geoscientists ages 18–44, “other”), human population growth & health (geoscientists ages 45–65+, public), and energy (decision makers). Human population growth was the third most frequently mentioned highest priority issue by participants in the geoscience community, decision-making community, and “other” cohort. Water was the third most frequently mentioned highest priority issue for geoscientists ages 45–65+ and those in the public cohort.

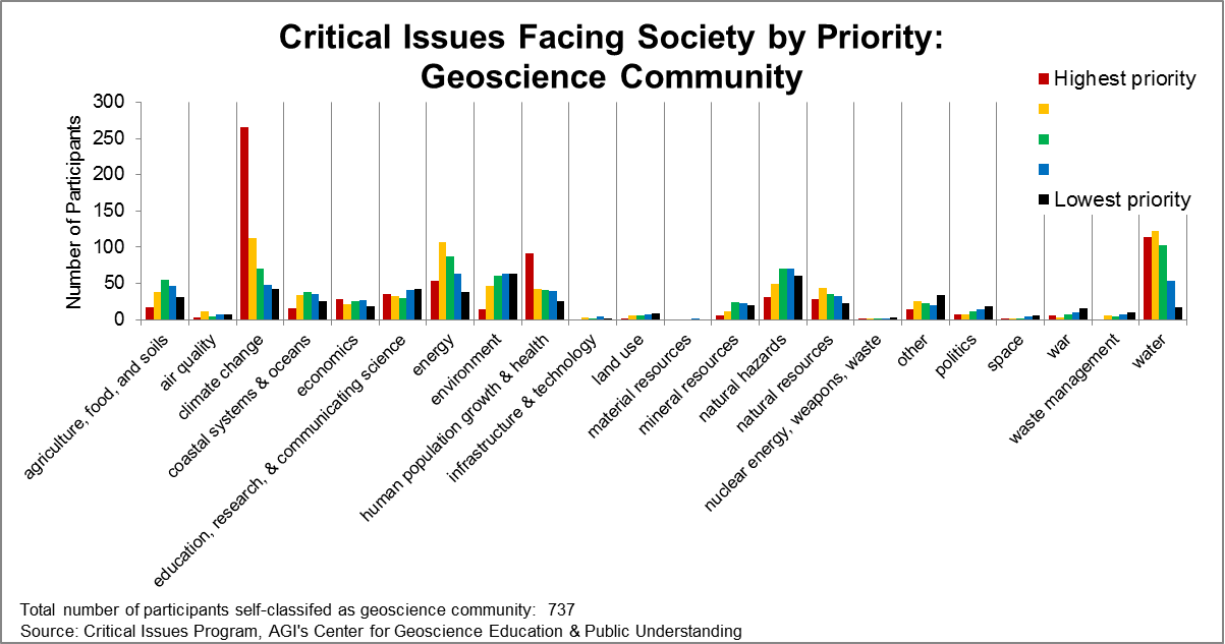


Figure 12: Critical Issues Facing Society by Priority: Geoscience Community

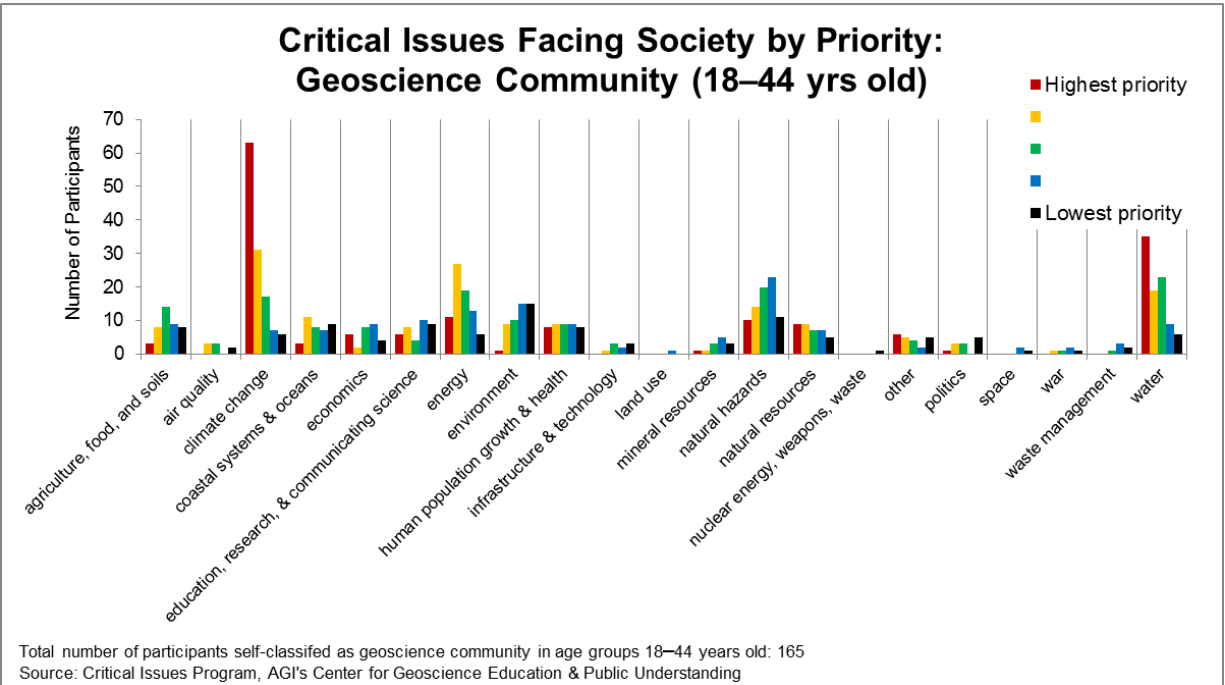


Figure 13: Critical Issues Facing Society by Priority: Geoscience Community (18–44 years old)

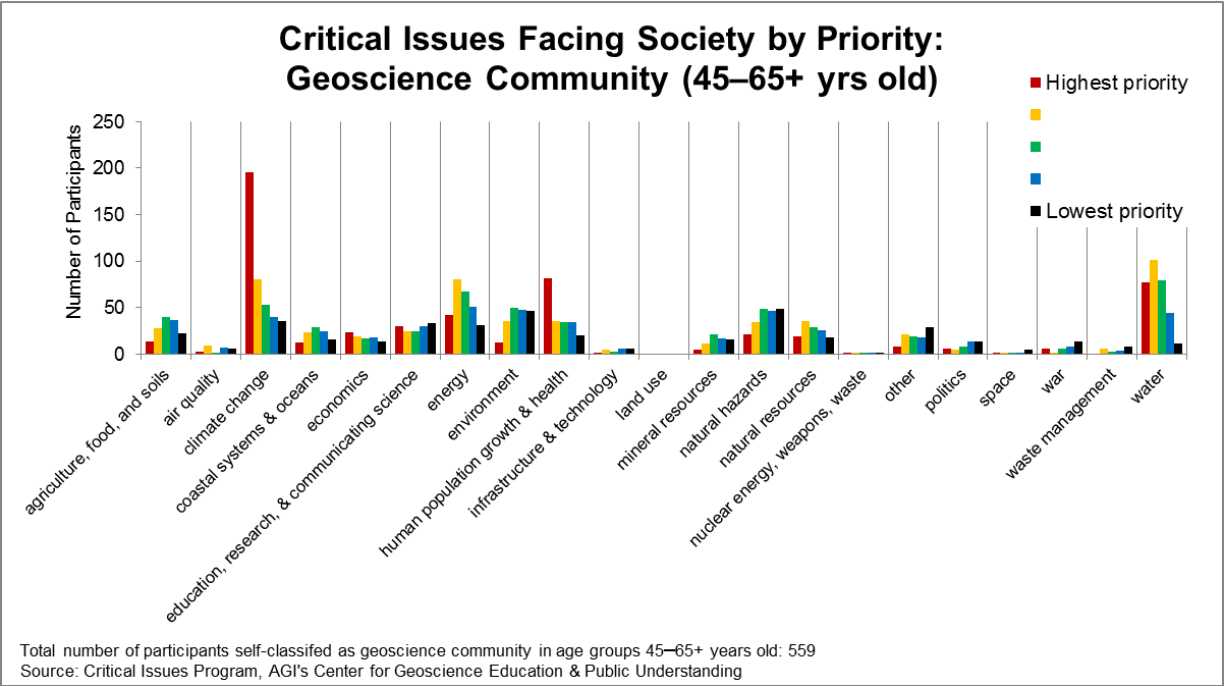


Figure 14: Critical Issues Facing Society by Priority: Geoscience Community (45–65+ years old)

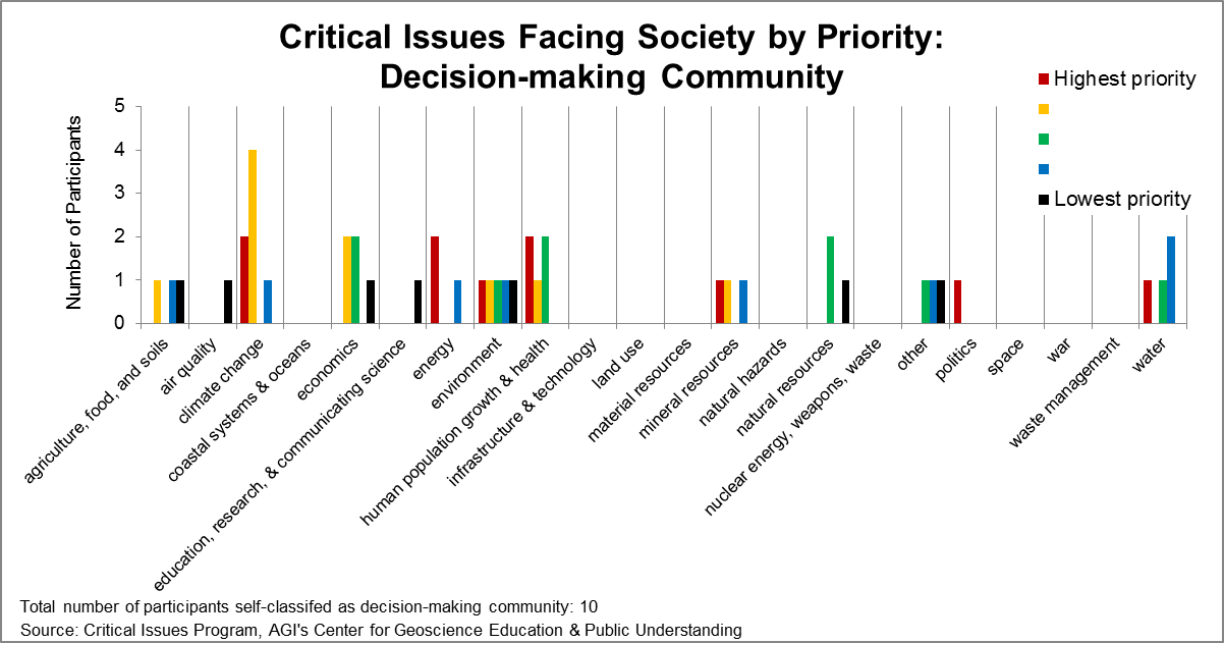


Figure 15: Critical Issues Facing Society by Priority: Decision-making Community

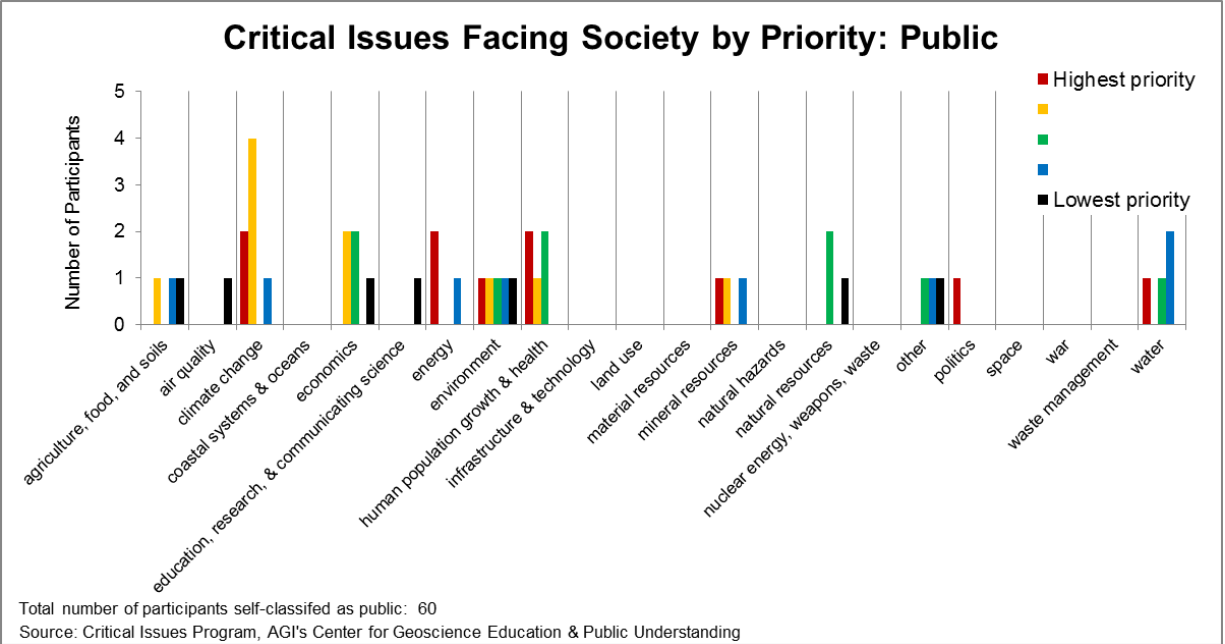


Figure 17: Critical Issues Facing Society by Priority: Public

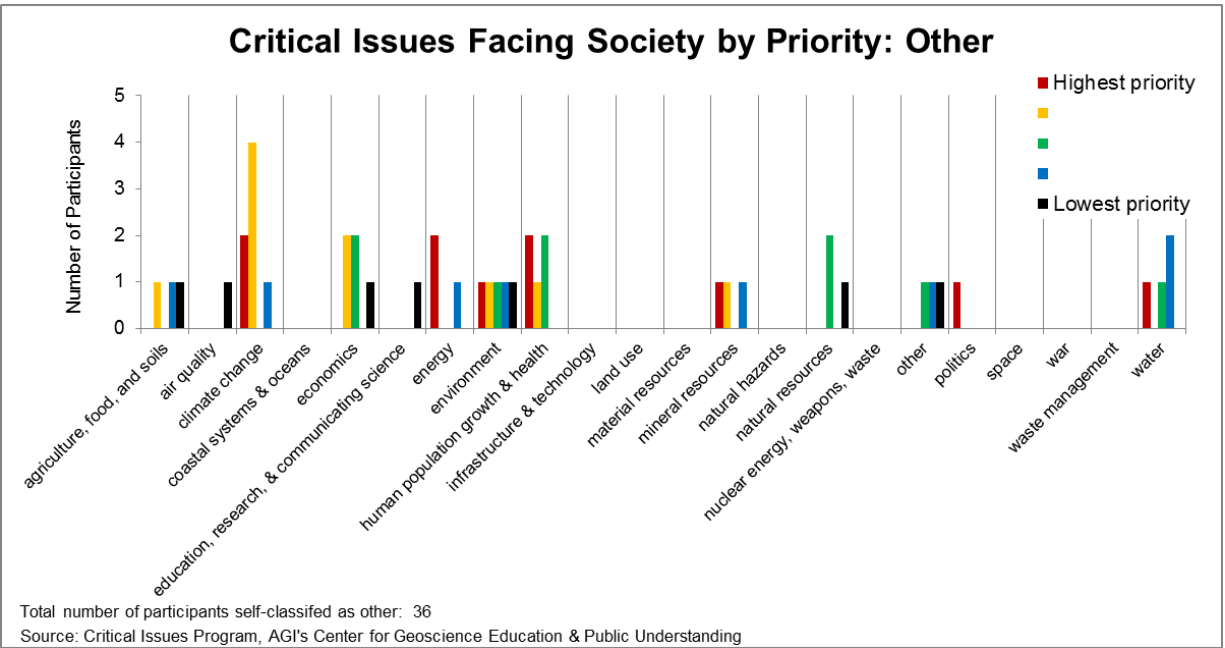


Figure 18: Critical Issues Facing Society by Priority: Other

Re-defining the Term “Critical Issues”

Survey participants were given a very broad and vague definition of the term “critical issues” (“Critical issues are things about the Earth that can affect people”) and were asked to modify it. Common themes in the way the term critical issues was defined by survey participants included critical issues being Earth processes and/or features/aspects of the Earth system that could be influenced by humans as well as mitigated by humans. Other common elements in the definition of the term included the impacts of critical issues to people and their way of life, including their health, survival, quality of life, economic status, as well as the Earth and its resources, and living organisms. Additionally, critical issues were frequently defined as having wide-ranging negative impacts that had the potential to persist for a long period of time. Highlights of how survey participants in each cohort defined the term “critical issues” are covered below, and a summary of the phrases used by participants in each cohort can be found in Appendix C.

Common themes in how survey participants in the geoscience community cohort defined critical issues included Earth processes, challenges, conditions, events, aspects, phenomena, materials, and resources that often had an element of change or development associated with them. Additionally, survey participants in this cohort included interactions between humans and Earth systems as the basis for critical issues. Critical issues were seen to affect people and their way of life, including their safety, health, economic security, governments, income, employment, everyday life, recreational enjoyment of the natural landscape, resources needed for living, and even influence wars. Critical issues were also seen to impact living organisms, including both plants and higher forms of life, as well as Earth’s processes, resources and ecosystems. Critical issues were also defined as having immediate and long-term impacts that were overwhelmingly negative, and required action by humans in order to mitigate their effects. Unlike participants in other cohorts, survey participants in the geoscience community cohort defined how critical issues should be addressed, including through education, policy making, applied studies, and through geoscientists providing information to empower people to make appropriate decisions at both the personal and society-wide levels.

Survey participants in the decision-making community cohort defined critical issues as both “issues” and geosphere features that affected people and their property. Critical issues also had a time-sensitive nature in terms of needing attention in the near-term and also having short- and long-term impacts. Furthermore, survey participants in this cohort mentioned that humans had control over critical issues, both by influencing the occurrence of these issues and by mitigating these issues.

Survey participants in the public cohort defined critical issues to include Earth processes, materials, events, and problems that had a dynamic component of change and development. Survey participants in this cohort also often mentioned that critical issues were caused by both natural processes and by humans. Critical issues affected people, Earth and its natural resources, the environment, living creatures, and the interactions between people and the planet. In terms of their effects on people, critical issues were deemed to impact the communities, quality of life, health, industry, economies, future generations, and even the existence of humanity. Critical issues were also defined as having predominantly negative and substantial impacts in both the short and long term, and required immediate attention. Additionally, survey participants in this cohort mentioned that critical issues could be managed by humans.

Survey participants in the “other” cohort defined critical issues as changes or processes in the earth system were both natural and human-induced. Critical issues affected people (including their health, security, well-being, current and future generations, economic well-being, and quality of life), Earth, the environment, and living things. Similar to the other cohorts, survey participants in this cohort described critical issues as having negative effects that had long-term impacts. Unlike other cohorts, participants in this cohort did not mention the ability of humans to control or mitigate the impacts of critical issues.

Based on the suggestions by all survey participants, we refined the Critical Issues program’s definition of the term “critical issues” to read as follows:

Critical issues are natural and human-influenced Earth processes that require immediate attention in order to mitigate significant, adverse, wide-ranging impacts in both the short and long term on people and their way of life, living organisms, and/or Earth’s resources and ecosystems.

Conclusions

The “Defining Critical Issues” survey received 890 usable responses. The survey was advertised widely in the geoscience community with more limited distribution in the decision-making community and general public. As a result, the geoscience community was the cohort with the highest percentage of survey participants (83%), while the public and decision-making community had a much smaller representation (7% and 1%, respectively). Across cohorts, survey participants were predominantly from the post-secondary academic sector. Additionally, over two-thirds of the survey participants were 45 years of age or older and nearly one-quarter of participants were between 18 and 44 years old. The preliminary results of the survey were released at the end of November 2013 with the goal to garner additional input from the decision-making community and general public, the non-academic sectors of the geoscience community, and individuals in the age groups between 18 and 44 years of age. However, only an additional 130 useable responses were received in December, primarily from geoscientists in the post-secondary academic sector. Thus, we were unable to substantially gain more in-depth insights into the decision-making community and public cohorts.

Climate change ranked in the five most frequently mentioned issues by all cohorts. The other most frequently mentioned critical issues by cohort were water and environment (geoscientists, decision makers, “other”), economics and human population growth & health (decision makers, public), energy (geoscientists, “other”), “other” issues (public, “other”), natural hazards (geoscientists), and agriculture, food, and soils (public). The highest priority issue for all cohorts was climate change, followed water (geoscientists, “other”), human population growth & health (public), energy (decision makers); and then human population growth (geoscientists, decision makers, “other”) and water (public).

Based on the suggestions by all survey participants, we refined the Critical Issues program’s definition of the term “critical issues” to read as follows: *Critical issues are natural and human-influenced Earth processes that require immediate attention in order to mitigate significant, adverse, wide-ranging impacts in both the short and long term on people and their way of life, living organisms, and/or Earth’s resources and ecosystems.*

Appendix A: Survey Questions

1. How would you modify the following definition of "critical issues"?

"Critical issues are things about the Earth that can affect people."

2. What are the most critical issues facing society today? Please name up to five issues.

1 (Highest priority): _____

2: _____

3: _____

4: _____

5 (Lowest priority): _____

3. Please select the community you represent. Choose one of the following answers:

Geoscience community

Public

Decision-making community

Other

No answer

4. Please identify your industry sector. Choose one of the following answers:

Non-profit

Academia (post-secondary)

Education (K-12)

State government

Local government

Federal government

For-profit

Graduate student

Undergraduate student

Other

No answer

5. Please select your age group. Choose one of the following answers.

< 18 years old

18-24 years old

25-34 years old

35-44 years old

45-54 years old

55-64 years old

65 year or older

No answer

6. If you would like to leave any additional comments, please do so below.

Appendix B: Survey Response Open Coding

Open Coding of Critical Issues

agriculture, food, and soils

agriculture

agricultural production, collapse, issues, land degradation, over-fertilization, practices, production, sustainability, runoff, soils, water, food supply, arable land, BMPs, cropland, decreasing grain production with increasing population, industrial agriculture and need to return to healthy soil & food, factory animal husbandry, GMO foods, intensive agriculture/animal husbandry, land use, loss of arable/agricultural/farm lands, monoculture, poor farming practices, preservation, surface erosion, weather in agricultural areas, productivity of crop land, third world agricultural technologies

food

adequate supplies, famine, access, availability, food and water supply, harvest yield, sustainability, production, distribution, allocation, quality, resources, safety, security, shortages, supplies, feeding and housing people, organic food, poverty & hunger, sustainable food chain, nutritious food & fiber, overuse of antibiotics and hormones in food supply/farm animals

soils

alteration of nutrient cycles, availability, land use, erosion, runoff, loss, pollution, productivity, soil “health” management, nutrients, nitrogen cycle, phosphorous, exhaustion, conservation, degradation, food supply, agriculture, fertility loss, industrial scale farming, food production, topsoil loss

air quality

contamination, pollution, climate, hydrocarbon burning effects, quality, alteration of atmospheric gases, particulates, ozone layer depletion, CF₄ (methane) emission, clean air

climate change

mitigation, adaptation, effects of climate change, climate issues, climate alteration, links to CO₂, vs. adequate energy, sea acidity, sea level rise, habitat loss, increasing storms, loss of icecaps, changing hydrology, disruption, extremes, floods, droughts, global warming/cooling, variability, preparation and lack thereof, environment, severe weather, methane release, agriculture, habitat, impacts, prediction, management, temperature increase, public debate, understanding the nature of climate change, warming atmosphere and ocean.

CO₂ levels

Atmospheric CO₂ level rise, carbon cycle alterations, pollution, emissions, greenhouse gases

coastal systems & oceans

coastal systems

change, destruction, erosion, eutrophication, land loss, flooding, pollution, deoxygenation, land use, limit building on floodplains & coasts, land subsidence

oceans

health of oceans, acidification, change in ocean currents, dead zones, depletion of marine life, overfishing, pollution, glacial and arctic ice-melting, sea level rise, increased sea surface temperatures, lack of understanding about oceans, marine protected areas, ecosystems, research, coastal flooding, coastal hazards, integrity of the oceans, oceanic food supply

economics

income inequality/disparity, poverty, inequitable distribution of power and opportunity, international business, unethical banking processes, jobs and lack thereof, stratification of society, over-consumption, over-development, social inequality, stagnant economies, sustainable development, sustainable economic growth, job security and lack thereof, unemployment, unsustainable economic models based upon faulty assumptions of resource availability, worldwide economic parity, instability, bottom line, capital inequity, consumption/growth, economic prosperity, lack of free enterprise

education, research & science communication**education**

access, breakdown of the educational system, critical thinking, deviation from face-to-face education, diminishing quality of science and geoscience in K-12 education, earth science education and illiteracy, of females, of public, science/logic based reasoning, educator have low knowledge of math, physics, chemistry, online geology courses and no lab, intelligent design, lack of education, low quality, math literacy, poorly-educated populace, inability to make rational decisions, privatization of education, STEM education, support, understanding evolution, creationism, lack of general knowledge concerning geoscience and geoscience education of the general public, appreciation of the scientific method, lack of scientific literacy, integrity in education

research

science ethics, forecast models, science funding, research

communicating science

to the public, to policy makers, to lawmakers, to congress, educate the public, congress, workforce, effective communication, poor media coverage and false information, lack of understanding and support of STEM by the general public, loss of respect for scientific issues, lack of science involvement by public, misunderstanding what science can and cannot do, attacks on science as a process, credibility of science, impact of disinformation, lack of earth science input into government, lack of truth in media, loss of the public's belief in science and engineering-based concepts

energy

clean energy sources, sustainable resources, accessibility, energy crisis, affordability, alternative sources, availability, carbon-free sources, carbon sequestration, conservation, efficiency, usage, fossil fuel dependence, renewable sources, declining fuel resources, detecting and stopping destabilization of methane hydrate, distribution of resources, geopolitical problems, exploitation of hydrocarbons, and material resources, and mineral resources, demand, literacy, energy needs of developing world, options and economics, policy, production, resource depletion, resource distribution, security, use and extraction, and climate, environmental degradation, shortages, climate, CO₂, water use, hydraulic fracturing, fracking and environmental consequences, green energy; hydrocarbon depletion, consumption, and pollution; interaction of energy sources with local environments,

mountain top removal, non-natural disasters (oil spills, etc.), effects on climate, pollution, power supply, realistic energy policies, regulation of fracking, clean transportation modes, consumption per capita, safe shale gas development, tar sands, transformation of the global energy system, unconventional resources, unequal use, delays in permitting, lack of secure access to public lands for extractive industries, social license to operate, third world energy development

environment

environmental degradation, abuse and disregard, air and water pollution, quality, contamination, anthropogenic modifications of Earth System, biodiversity loss, collapse, endangerment, extinction, homogenization, conservation of geologically educational sites, deforestation, desertification, destruction of habitats and soils, disruption of Earth's systems, degradation of the natural environment, ecological change and impacts, ecosystem services destruction, ecosystem stability, viability, element cycling and its impact on the biosphere, impacts of extractive industries, environmental health, protection, services, sustainability, exploitation of rain forests, invasive species, land degradation caused by human overpopulation, outsourcing of environmental catastrophes, chemical pollution, radioactive pollution, preservation and restoration, ecosystem disruption, toxic metals, vegetation die-off, effective environmental regulations

human population & health

health

antibiotic resistant bacteria, global epidemics, development of old/new medical resources, disease, public health needs, effects of chemicals on people and Earth, health care access and affordability, impacts of fracking on health, and diet, effects of air and water pollution on health, delivery, medicine, obesity, need for increased research on diseases, public health and basic needs, wider latitude ranges of disease carrying insects, pandemic disease, sanitation

human population growth

overpopulation, unsustainable population growth with limited resources, exceeding Earth's carry capacity, population control, overpopulation and pollution, population density, displacement, aging demographics

infrastructure & technology

infrastructure

failing infrastructure, inappropriate building, resilience, transportation by-products, lack of mass transportation

technology

applications, challenges, resources (metals)

land use

appropriate land use, landscape development, land management, preservation, conservation, increased wetland susceptibility, availability, open space protection, reclamation of abandoned land, urban planning, urban sprawl, land use restrictions, public lands access

mineral resources

non-energy earth resources, responsible mine development as China and BRICS attain peak metal, secure supply of rare earth minerals, availability, strategic mineral resources, coal mining, depletion

of resources, elemental distribution, scarcity, industrial minerals, metallogenic epochs and provinces, metals, availability, access, development, minerals critical to the building of emerging economies, policy, recycling, pollution, prospecting, extraction, environmentally sound mining, supply, sustainable mining

natural hazards

earthquakes, floods, volcanoes, geo-hazards, geologic hazards, hydro-hazards, atmospheric, preparedness, awareness, response, relief, including climate change, people living in unsafe geohazard areas (shore zones, flood zones, landslide zones), lack of proper knowledge and education on the possibility of hazards, prediction of hazards, extreme weather, protection, risk mitigation, tsunami, storminess increase, storms, unstable landscapes, wildfire, hurricanes, drought, mass wasting hazards, sinkholes, slope stability, landslides

natural resources

access, conservation, preservation, depletion, extraction, finite amount of natural resources, management, maximizing efficient usage, availability, food, water, hydrocarbons, metals, energy, fossil fuels, agriculture, minerals, soil, overuse, sustainability, uneven distribution, materials resources, diminishing natural resources, supply, resource pollution, responsible resource acquisition

resource availability

unequal access to resources (particularly healthy environments and education), lack of critical resources, lack of long-term planning, demand, non-sustainable use, overconsumption, availability, renewable resources, depletion, environmental destruction, exploration, extraction, development, management, conservation, water, energy, materials, soil, helium shortage, unequal distribution

sustainability

sustainability (air, water, soil, land, other resources), resource use, sustainable practices

nuclear energy, weapons, waste

atomic weapons, nuclear proliferation, terrorism, pollution, waste, waste disposal, storage

other

independence, infiltration rates, international space exploration cooperation, justice, liberty, equality, lack of diversity in the geosciences, lack of human harmony with nature, lack of sustainability, lack of understanding among people, litter, local issues, misunderstanding of Nature, moral decay, polarization of media, preservation of middle class, press freedom, privacy/security, profit driven entities, racism, nationalism, radicalism, respect for others, righteous finger-pointing blaming, safe living conditions, short-sighted "solutions" leading to long-term damage, slavery, slopes, social justice, social stability, social unrest among global underemployed/unemployed youth, status of women and human rights, substance abuse, taking action on critical environmental issues rather than just talking about them and spending large sums of NSF money to study them, this survey, uncertainties, understanding global issues, universal peace, unregulated chemicals, widespread denial of reality, women's rights, greed, ignorance, personal freedom, global peace, human rights

philosophy

extreme religious fervor, fundamentalism, feeling humans are separate from laws of nature, general disregard for the environment, religious beliefs, religious intolerance, religious wars, religious strife, dogmatism, religion, theocracies/autocracies

politics

imperial wars, congress, international cooperation, big business influencing governmental decision-making related to environmental issues, broken political system, politicians, excessive government regulation, geopolitical instability, government stalemates, lack of good governance, lack of data to support policy-making, corruption, intolerance, oppression, polarization, unrest, lack of long-term view to address issues, lobbying, public policy, political discourse, political power and money, accountability of regulators, polarization along too many axes, energy and natural resource policies

space

asteroids, meteorites, solar flares, electromagnetic storms, space-related events, space weather, space exploration, Sun-Earth interactions

war

avoidance of, conflict, genocide, violence, resulting from competition for resources, international and domestic conflict, terrorism, ideology, religion, political systems, economic development, militarism, peace and lack thereof, strife, tribalism, crime, weapons of mass destruction, civil war, race war

waste management

contaminant clean-up, contamination, industrial pollution, recycling, waste management, waste, disposal, waste products, pollution, sanitation, trash, remediation

water

demand exceeding supply, access to clean water, aging water infrastructure, availability, quality, contamination, water wells, development in floodplains, disposal of waste into water, distribution, dwindling supply, inadequate supplies, eutrophication, floodplain protection, management, resources, protection, security, Great Lakes protection, groundwater, sustainability, hydrologic manipulation, increase in nutrient and chemical levels, sanitation, mining of water in arid climates, mismanagement, pollution, river flooding, supply and quality, shortages, water and food security, water and food, regulation, infrastructure, rights, wetlands loss/wildlife habitat loss

Appendix C: Critical Issues Definitions by Cohort

Decision makers

Critical issues are:

issues; geosphere features

Critical issues affect:

people; property

Descriptive aspects of critical issues:

time-sensitive; controlled by and sensitive to anthropogenic activities; can be mitigated using existing technologies; significant impacts in both short and long term; wide ranging impacts; people's interactions with the earth; dependent upon human interaction with the earth

Public

Critical issues are:

a natural system which is developing or changing; aspects of everyday life; changes on Earth; conditions involving the Earth and its relationship to the universe; crucial topics about the world; developments; Earth processes; earth processes and materials, including shortages; earth related events; environmental impacts; events; events and trends of Earth; events occurring on Earth; issues; natural and man-triggered events; processes/events; programs and policies; qualities or events regarding the earth; solvable problems; things; things about people; things about the Earth; things caused by people; things in our world; things that affect people; time-sensitive issues; topics; urgent situations all around the world

Critical issues affect:

a group's way of life; all living creatures; all living things; animals; balance in nature; biosphere; Earth; Earth and all of its inhabitants; economy of a community; ecosystems; environment; global population; groupings of people; health; human health; human life; human welfare; humanity; industry; interaction between people and the Earth; life Earth supports; natural resources; organisms; people; people and their surrounding environment; people, the natural environment, and industry; people's lives; planet and humanity; quality of life, the environment and the planet; society; the natural environment; the planet; us and our children; us and/or life on earth; very large numbers of human beings; well-being of people and the biosphere

Descriptive aspects of critical issues:

affect in countless ways; can adversely affect; can be studied and enhanced; or mitigated by science; can impact; concern the relationships and/or existence of the planet and humanity; consistent daily effects; deleterious effects; detrimental impacts that lessen the quality of life and health; disastrous effects in short and long-term; drastically affect; exceedingly negative impacts; have consequences; have the potential to negatively affect; if left unresolved, will affect; impact and influence; need special attention due to the importance of the way they affect people; need to be understood and addressed; profoundly affect; require immediate and long-term action to remediate; require extensive time, resources or funding to resolve; result from geological activities; seriously affecting; severely affect; significantly affect the near-

term survival and well-being; significantly impact; threaten lives; will result in catastrophic consequences

Other

Critical issues are:

changes in the Earth; Earth processes; geological processes; impacts on natural processes; issues; interactions with the earth; natural and human-induced events and processes; natural phenomena that occur on Earth; things; things about people; things about the Earth

Critical issues affect:

Earth; ecological balance of the planet; environment; health, security, and well-being of current and future generations; human life; health or economic well-being; humans; living things; people; quality of life; societies

Descriptive aspects of critical issues:

can affect; suffer; adverse impact; may have a long-term impact; negative impact; adversely affects; have serious impacts or consequences; dramatic impact

Geoscientists

Critical issues are:

a level of seriousness; a result of the ways that humans have used earth's resources; about the relationship between the Earth and the biosphere that it supports; active challenges; anthropogenic and natural things about the Earth; anything related to the fragile balance between humans and the earth we live on; area of geologic focus or study; areas; aspects; aspects of earth materials and processes; aspects of Earth processes and resources; aspects of earth science; aspects of economic resources and environmental change; aspects of human interactions with Earth; aspects of our natural environment; aspects of the Earth; aspects of the Earth System; aspects of the natural environment; aspects of the physical Earth; aspects of the relationship between humans and their environment; bending policies or regulations; biotic and/or abiotic issues; broad thematic subjects; challenges; changes in the earth systems; characteristics of the Earth; characteristics of the Earth and environment; concerns; conditions of the Earth; conditions or events in Earth systems; consequences of Earth processes; current topics in earth science; dynamically developing processes and issues; Earth events and circumstances; Earth materials and processes; Earth changes; Earth events; earth processes; hazards; Earth products; use of earth resources; changes in the earth's environment; Earth resources; Earth science elements; Earth sciences topics; Earth situations; Earth system perturbations; Earth system phenomena or mechanism; earth systems based problems; elements of human-environmental interactions; essential problems; events or actions; events or changes about the Earth; events or processes of the Earth; events, features, and resources on Earth; factors about the Earth; geological processes; geoscience problems; global trends and processes; human and social concerns; humanly changeable things; imperatives for action; information-related things about the Earth; instances of Earth/human intersections; interaction of humans and natural processes; interactions between and within the four "spheres" of the Earth; interactions between earth, earth processes, societies and individuals; interplay of Earth and humans; inter-relationship between Earth Systems processes and human activity; intersection of earth processes and human society; issues; items dealing with the Earth; manifestations of Earth processes; man-made processes;

matters; most important Earth-related problems; natural and anthropogenic matters about the Earth; natural and anthropomorphically-caused Earth processes; natural and human-induced Earth processes and concepts; natural and induced events; natural and man-made hazards on the earth; natural and man-made phenomena; natural and/or man influenced processes; natural Earth processes; natural forces; natural or man-made changes on Earth; natural processes; natural processes, hazards and resources; natural processes properties; and resources; natural processes; events; and materials; natural processes; hazards and resources; natural variations; negative outcomes; organic and non-organic (biologic vs. non-biologic) processes; parts of Earth Science; phenomena; physical and biological issues; physical aspects of the Earth; potentially harmful things about the Earth; problems and processes in our global environment on land; in the oceans; and in the atmosphere; problems in the environment; problems or concerns; problems that arise at the intersection between human actions and the natural world; processes active on the Earth; processes and resources; processes or events that occur on Earth; processes or phenomena (natural or man-made); processes; paradigms; and problems; products; processes; outcomes; regional to global human-Earth interaction issues; relate to portions of the Earth system; related to Earth processes; resources and geologic disasters; science-based global action items; scientific issues related to the geosciences; significant concerns in the geosciences; situations about the Earth; situations involving humans and their livelihoods; environments and health; a subset of larger critical issues; systems; term; the physical characteristics of the Earth; the way in which planet Earth changes; things about Earth's resources and natural systems; things about the lithosphere, hydrosphere, atmosphere, and resources; things about people; things about the earth and human behavior; things about the solar system; things that people do; topics about systems in nature; topics and problems; topics in earth sciences; unbiased information about the Earth; uncontrollable phenomena; urgent matters; urgent things

Critical issues affect:

ability of people to live on the planet; all life on the planet; animals; balance of life; biodiversity; biosphere; civilizations; communities; conditions on Earth; cultures; Earth; Earth as a system; Earth processes; Earth Science; Earth's biota; Earth's capacity to support diverse forms of life; earth's climate; ecology of the earth; economic security; economic well-being; economies; ecosystem health; ecosystem services; ecosystems; environment; environmental systems; established practices; finances; future cultural evolution; future generations; future sustainability of the planet; future use of the Earth by mankind; geocosystem; geosciences community; global economy; global environment; global security; governments; habitability of our planet; habitats; health; health, economic well-being, and security of humanity; health of a community; health of the planet; how society operates; human activities; human communities; human existence; human health; human lifestyles; human misery; human societies; human survival and societies' ways of living; human welfare; human well-being; humanity; humans; human's living environment; income; individuals; inhabitants; large numbers of people; large populations; large segments of society; life; life on earth; livelihood; lives of the largest number of people; living organisms; local-to-global citizens; majority of people; mankind; many people; millions of people; most people; nature; other ecological communities; other higher forms of life; other life on earth; other living things; other organisms; our lives; our natural environment; our sustainability on this planet; our use or understanding of the Earth; overall health of the environment; people; people on Earth; people's ability to live; people's ability to survive and thrive in their ecosystem; people's ability to sustainably use Earth's resources; people's employment; people's everyday life; people's health; people, life on earth, and the Earth's climate,

environment, and habitats; people's lives; people's lives, health and prosperity; people's safety; people's survival; people's well-being; physical, socio-economic, geo-political health of the global human condition.; people, the economy, and the environment; places; planet's population; plants; political, social, and economic decisions; processes on Earth; population, ecosystem services, and the environment; property; prosperity; prosperity of humankind; quality of life; quality of life for Earth's inhabitants; quality of life in human societies; quality of life of people; quality of life on Earth; recreational enjoyment in the natural landscape; resources; resources on Earth; resources people need to live healthful lives; safety, security, well-being and prosperity of humankind; safety; security; security of humanity; security of people; societies; society and our natural environment; structure of society; substantial proportion of the ecosystem; survival of humanity; survival of humankind; sustainability; sustainability of the planet for humans and all other forms of life; the decisions we make; the Earth systems on which we depend; the future of humanity; the human species; vast numbers of people locally or around the world; viability of life on the planet; viability of the Earth to sustain a diversity of ecosystems; especially those critical to human success; viability of the planet and society; wars; way we live today; welfare of humans from individuals to societies to all humanity; well-being; well-being of all people; well-being of Earth's physical environments; well-being of ecosystems; well-being of humans; wellbeing of individual humans; well-being of the Earth's human environments

Descriptive aspects of critical issues:

adversely; to a significant extent; long-term; affected by human activities; affected by decision-making; affected by people; can be modified or ameliorated by human action; that people need to be aware of; which may not directly involve the earth; predictable or non-predictable; critical importance; are not well understood by the public; arise from changes in the Earth system that destabilize life sustaining systems; avoided by society because of political; economic and budgetary realities; biggest impact; positive or negative effects; alter; impact; can be addressed by Earth science; can be affected by human use and or mismanagement and consumption; can be fixed if there is the will; can cause physical or economic harm; capable of being improved; carry the potential for present or future harm; cause significant changes in ecosystems; caused by human activity and overpopulation; compromises the integrity of the earth system; concern the existence of life on Earth; critical; constrain; degrade; long and short-term perturbations to the Earth's biosphere; climate; oceans; and other systems; demonstrable potential to affect negatively; in the next 100 years; determine our understanding of basic physical and chemical processes; determine the future; greatly determined by geological and other earth processes; determined by our interactions with Earth; detrimental manner; different durations of time; directly affect; can interact with other natural systems to trigger unexpected change; directly or indirectly affect; directly related to Earth's natural systems and cycles and their functioning; need immediate attention; dramatically affect; dynamically evolving inter-relationships between human beings or human societies and the physical environment of planet Earth; encompass the relationship between humans and nature and how they affect each other; evaluated results have the potential to adversely impact; far-reaching effects if left unresolved; for which scientific understanding remains incomplete; great consequences; greatly affect; will continue to have detrimental effects for generations; greatly alter; harm or displace; harmful or degrading qualities; have consequences which people can affect; have the ability to change people's lives; have the potential to significantly influence; humans can exacerbate by their actions; immediate and negative impacts; immediate effect; immediate future; impact is critically important; requiring understanding and possibly action; impacting the natural ecosystem;

impacts are either unknown or negative to one or the other; important relevance; in response to the Earth's ever-changing conditions; in severe and widespread or catastrophic ways; in the immediate future; influence; inherent value to the geosphere; interaction of people and the Earth; negatively affect; largest effect; limit the sustainability of resources and environmental quality; magnitudes affecting; major impact; major or irreversible changes; material impact; may adversely affect; may be caused by humans; may be affected most directly by the Earth; may be used for the benefit of; might affect; now or in the future; most likely to affect in the coming century; must be addressed to avoid seriously and irreversibly impacting; must be dealt with immediately; must be understood to make wise choices; natural or anthropogenically influenced; significant potential to positively or negatively impact; near future; need to be addressed before they negatively affect; need to be addressed through education; policy making; and applied studies; need to be addressed to allow society to continue to prosper in a reasonable fashion; negative effects; negative manner; over which humanity has some control or ability to better provide warnings or to ameliorate geologic; atmospheric or climatic hazards; negative way; leading to a lower quality of life; negatively affect; need an unbiased analysis of the pros/cons of how they affect the components; notable impact; now or in the future; on a daily basis; on timescales that matter to civilization; over the short- and long-term; directly affect; people do to the Earth; poorly understood things about the earth and solar system; pose key challenges; positive or negative effects in the present and future; potential for negative impacts ; long time period; potential to change or be changed; potential to negatively affect; potential to negatively affect; can be mitigated or eliminated through prompt action; potential to result in detrimental changes; potentially life-altering; most important; present serious challenges to and opportunities to sustain or enhance; profound and often long-term; profound impact; profound impact; poorly understood by the general public; profoundly affects; reducing sustainability; related to Earth's environment; relating to human interaction with the Earth about which the public and governments need more understanding in order to develop personal and public action plans; relationship between the Earth and human populations; require a human response; require immediate action for solutions; require immediate attention; are expected to require fundamental changes; require the participation of geoscientists to provide an informed debate; require continuity of basic research in order to help mitigate disasters; scales bigger than can be handled by local governments/agencies; serious consequences; seriously affect; seriously impact; serve to illustrate the relevance of Earth Science; severely impact the function; shape the earth; short and long-term; significant impacts over timescales that people care about; significant loss; significant ways; significantly affect; significantly impact; significantly negatively impact; strongly affect; substantially or catastrophically affect; that people do; threaten; threaten to have significant detrimental impact; in the immediate to short-term; which can only be overcome by coordinated international effort; threatens; through Earth processes or human activity; very likely potential to have significant negative impacts over short time scales; ways that people understand or misunderstand the Earth and how it works; we can do something about or at least mitigate the effects of; where knowledge about the Earth informs possible actions that can be taken to improve; where knowledge of earth science can empower people to make appropriate decisions; widely publicly discussed or have significant implications; will affect; require public awareness (or earth science literacy) to promote informed decision making; will require personal and society-wide decisions related to sustainability

AGI Critical Issues Program
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