Questions & Answers Part 1

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Alex Ruane (alexander.c.ruane@nasa.gov) or Nick Pelaccio (njp2142@columbia.edu)

Question 1: On slide 27, are all of these farming inputs included in the assessment, or do you include the input that connects more to the identified question?

Answer 1: In our AgMIP project we are developing models along different scales and systems within the broader farming system. That means we have detailed farm models that include weather, soils, genetics, and management information and unique models for each crop species. We also have household models that look at net returns for a farm household that may have multiple fields, livestock, equipment, and costs for supplies and labor. We also connect many farm responses into regional and global models of production that can link into economic models that track broader land use, trade and prices as affected by policies and socioeconomic demand. As we resolve more components and interactions within the broader food system we learn more about current and future risk.

Question 2: Concerning the step of development, "agree on the process," it will not be possible to manage this cooperation between stakeholders and scientists using a different approach or model, such as the quadruple helix model. This approach also allows for the inclusion of citizens, a group that is typically excluded from the decision-making process and the creation of solutions, often only being involved in the consultation phase.

Answer 2: It is important to develop a group of representative stakeholders who can participate in both early and iterative phases and final assessment phases of the project when it comes to decision making. It is true that citizens are often left out of this mix, but we have had success reaching farmers and avoiding the trap of only speaking to administrators, policymakers, and powerful private sector interests. This is a challenge, yes, but it is worth it.

Question 3: What drivers are important and need to be considered while working in inland cities?
Answer 3: Inland cities do not have the coastal or open ocean risks, but are still potentially vulnerable to extreme temperatures, shifts in the water cycle, storms and ice. Stakeholders in many of these cities are keenly aware of their most prominent vulnerabilities, but it is important to ask questions about all of the climatic impact-drivers to cover the potential of smaller, but still influential, risks, as well as the chance that a new CID will emerge as a hazard in the future.

Question 4: Would context-specific hazard metrics be equivalent to damage functions?
Answer 4: Damage functions are often built upon context-specific hazard indices, but imply a direct relationship from that hazard to the impact given information on vulnerability. In some cases this is a simple relationship and in other cases we might employ a detailed sectoral model to understand the implications of future change.

Question 5: The humanitarian approach these days with the help of technology is shifting its focus from response to preparedness, and anticipatory actions are saving lives and properties. Can you please share your thoughts on how technology can contribute to this? How about incorporating anticipatory action in the risk triangle too so as to minimize it?
Answer 5: Anticipatory action is a major part of the proactive interventions that we emphasize here. In New York City, Mayor Bloomberg raised the elevation of water treatment plant pumps in anticipation of future sea level rise and coastal flooding, and for agriculture we know that there is a research and development cycle needed to push the limits on heat or flood or drought tolerant crops that we would like to have available for future hazards. These efforts can take decades or more. Proactive action can also move beyond technology to include policies, subsidies, and market development that will build resilience to future hazards and create more good options for future stakeholders.

Question 6: I am searching for real-time temperature data from satellites. Where can I find such data?
Answer 6: Moderate Resolution Imaging Spectroradiometer (MODIS) data are available

through NASA's Land, Atmosphere Near real-time Capability for EOS (LANCE) generally within 60 to 125 minutes after a satellite observation. **Near real-time (NRT)** MODIS data products available through LANCE include **land surface temperature**, land surface reflectance, radiances, clouds/aerosols, water vapor, active fire, snow cover, and sea ice.
https://www.earthdata.nasa.gov/learn/find-data/near-real-time/modis

Question 7: Around when can we see the SWOT mission data in the NASA worldview?
Answer 7: We are unaware of the timeline for SWOT data to be visualized in NASA Worldview.

Question 8: How are vulnerability and exposure maps created, and what are the data used?
Answer 8: Lots of examples for exposure, including GIS datasets that map out infrastructure, residences, farms, ecosystems, and other assets. These are available through a variety of public, private and academic databases (e.g., SEDAC, city or county governments). Vulnerability information is much more difficult to map out, particularly as there are likely multiple types of vulnerability to explore. We have used our impact models to 'stress test' crop systems to identify response to heat and drought and CO2 impacts, which reveal strong regional and system-dependent vulnerability patterns that may inform this process.

Question 9: When will NASA SEDAC be currently updated?
Answer 9: NASA SEDAC is constantly updating datasets as information becomes available.

Question 10: Are there data on locations/density of concentrated animal feeding operations?
Answer 10: I don't have any resources to point you toward off the top of my head, but these data are likely available through USDA in the United States.

Question 11: I have always understood vulnerability as defined by exposure, sensitivity, and response/adaptive capacity. Why is vulnerability, exposure, and response being treated separately in this case?

Answer 11: This is a common approach adopted by the Intergovernmental Panel on Climate Change (see https://www.ipcc.ch/event/guidance-note-concept-of-risk-in-the-6ar-cross-wg-discussions/). Our approach treats vulnerability more like 'sensitivity' in your list. Adaptive capacity has a time scale that is important to recognize, but this is often generalized (rather than hazard-specific) and relates to the ability to modify vulnerability.

Question 12: How do you assess the risk without adaptation? Isn't it extremely complicated to set up a counterfactual as adaptation efforts are overly location specific?
Answer 12: Need to understand no-adaptation risk as a counterfactual scenario with adaptation future.

Question 13: A quick question on the section and WWF Myanmar example: this was done in 2017. How frequently would we expect to 'go back' and see if our forecasted hazards (and impacts) have occurred? 5 years later or 10 or more?
Answer 13: This question is context specific (i.e., different climate impacts have different time scales). However, ideally climate adaptation is a circular process, where we are continuously monitoring climate impacts (including previous climate analysis based on models) and update accordingly.

Question 14: How accurate are the GCMs when it comes to a city-level assessment? As per my understanding, the coarser resolution makes it difficult to perform the analysis at a granular level. What could be the possible work-arounds to help the stakeholders interested in taking actions at a higher spatial scale? Any references would be great.
Answer 14: We will get more into this in Part 2, but for the CASI project we use a statistically downscaled model called NEX GDDP. There are many caveats and nuances, but in general it is considered more valuable to use downscaled climate model data for city-level climate adaptation planning. However, there is still valuable information to be gained from GCM's granular resolution for city-level assessment. Temperature extremes are a good example of this. Please see the 2022 ARSET training:

Question 15: Can any country apply for a mitigation package or evaluation?

Answer 15: NASA is not performing these as a service, but the approach being developed should be able to be applied to assets in other regions. We aim for this training to show examples that can be replicated in your locale.

Question 16: To what extent is this methodology appropriate to use in combination with intersectional vulnerability analyses, and how would we integrate the two?
Answer 16: Climatic impact-drivers, we know there are many changes (social, cultural, etc), but we are looking at the climate drivers. These will have to be connected to other pressures stakeholders are experiencing.

Question 17: How do you explain the difference between adaptation, adaptation capacity, and response?
Answer 17: Adaptation would be a particular strategy that could be implemented. Adaptation capacity is a reflection of capabilities to respond (but not yet realized) including scientific, economic, sociocultural, and political resources. A response is an action actually implemented in an effort to adapt to and/or mitigate climate risk.

Question 18: Please talk about the multidisciplinary characteristics of the adaptation team developing the AP.
Answer 18: Adaptation packages often start with a biophysical and/or engineering modification that is meant to alleviate risk, but its success also needs to recognize the socioeconomic and geopolitical context as well as the potential reverberations of implementation across linked systems. This requires collaboration of experts across multiple disciplines.

Question 19: Are qualitative types of data or assessments considered for the assessment, or is quantitative data the main type of data considered?
Answer 19: Qualitative assessments can be very important! We often start with qualitative discussion before translating storylines and general responses into elements that we can model quantitatively. In many cases the data or models do not support detailed quantitative assessment, but key elements must be represented to support quantitative assessments in other parts of the system. We also find that some stakeholders prefer qualitative messages built from a more complex quantitative analysis when making their decisions.

Question 20: Can we get source code to make similar visualizations (intensity/frequency/shift of season)? Are all these datasets available on Google Earth Engine?
Answer 20: This figure (12.3) is a part of the IPCC AR6 WG1 FAQ's, and is not based on 'real' data, rather showing examples of how climate change can affect climate hazards. You can find out more here: https://www.ipcc.ch/report/ar6/wg1/downloads/faqs/IPCC_AR6_WGI_FAQs_Compiled.pdf.
Many of these plots are made with open-source software like Python.

Question 21: Do you have a sponsored PhD available?
Answer 21: Not at present, sorry! We recommend looking into the NASA Postdoctoral Program, where we have NASA GISS Climate Impacts Group opportunities listed on a competitive basis.

Question 22: These climate risk analyses are evidently conducted impressively on a higher and lower resolution. In conducting these assessments throughout the world, what have you encountered as the resolution boundary for the assessments? When is the scale too large or too small to make predictions that are operational, and how may we overcome these?
Answer 22: This is very context-specific; in general, we would like higher resolution (down to the scale of the asset itself, for example a farmer's field), but this is not practical given climate model capabilities and observational coverage. Chasing the highest possible resolution can therefore introduce errors that reduce the value of this costly information. See more on selecting a climate projection set in last year's ARSET training (link).

Question 23: Cyclone hazard and its projection are quite intricate. Does NASA have any data?
Answer 23: NASA and other federal agencies have data. For more information, please refer to the previous ARSET training, *Monitoring Tropical Storms for Emergency Preparedness*.

Question 24: In addition to biophysical and geo-spatial information, how can we make use of socio-economic information (such as history of household shocks) in the assessment of climate risks?

Answer 24: Socio-economic information is critical to the exposure and vulnerability components of risk, and is often a major motivation for selecting among potential adaptation or mitigation actions. This is part of theoretical process phases where we identify interests and develop metrics of success.

Question 25: Do you have a Crop Yield Monitoring and prediction system at the global scale for different major crops?
Answer 25: NASA has the GEOGLAM Crop Monitor (link) that observes many crops' status from space during the growing seasons. Our AgMIP team is developing some process-based crop forecasting models, but not operational or published yet. We have published long-term crop model projections for maize, wheat, rice, and soybean under climate change (Jonas Jagermeyr et al., 2021). Learn more at www.agmip.org.

Question 26: Climate change increases social-political and geopolitical risks in the medium- to long- term. What do you think about this based on your experience with DRM?
Answer 26: There are many factors affecting long-term sociopolitical and geopolitical risks, but the IPCC assessed that climate change was acting as a net accelerator of risk. This is an important message delivered to the national governments within the UN Framework Convention on Climate Change. In the GISS Climate Impacts Group, we are trying to zoom in on particular regions and systems to provide risk assessments more in line with the scale of most adaptation and mitigation implementations.

Question 27: The challenge that we have had recently in our organization is accessing the newer CMIP6 climate change datasets downscaled to the smaller scales needed for local risk assessments. In previous CMIPs (i.e., 3, 5) portals were made available to access downscaled datasets that didn't require the ability to script or program or require terabytes of storage to download. I wondered if you know of plans to provide multiple GCM & downscaled CMIP6 datasets for the US. Or is the trend with this latest CMIP to require working with researchers/universities just to get the data? (By the way, I am aware of the globus site, but it does require some ability with scripting downloads and terabytes for storage).

Answer 27: CMIP6 output portals are catching up to the quality and best features of CMIP5 portals – this takes time to set up more user-friendly interfaces. I think the interfaces will be better in the long run, but we are still publishing dynamically-downscaled projections (e.g., CMIP6 outputs from CORDEX) and there remain unfortunate barriers to access as described by the question. Check out the IPCC WGI Interactive Atlas for quick glimpses of climate change hazard shifts (link).

Question 28: Risk is Expected Loss = E[L]. What comes first, vulnerability or risk? A wetland is vulnerable to periodic flooding, but nobody lives there [no loss?]. If you develop it and people flood you have a loss and can calculate risk.
Answer 28: There is no risk if nothing that is vulnerable is exposed, but 'nothing' may be different for one stakeholder than the next. For example, a calculation on real estate value may not consider losses to ecosystems. The potential development of a wetland is a great example of why we have to model future risks including changing hazards but also changing vulnerability and exposure (e.g., in the future there are new assets in former wetland). If all three change, the risk calculation can be very different than in the past.

Question 29: What type of evaluation is considered for the climate assessment? I read online there are two types: formative and summative.
Answer 29: We did not use an approach broken into formative/summative types.

Question 30: To respond to climate change and climate variability, would you use the same variables and vulnerability assessment methodologies?
Answer 30: Yes. On shorter time horizons there is less change in vulnerability and exposure, some climatic impact-drivers (like mean temperature) are less dramatic in their changes, and you may be looking at the one-time response to an extreme event rather than the net impact of a changing distribution (and return periods) of extreme events, but otherwise the approach can be adopted consistently.

Question 31: Does NASA SEDAC hold data from all around the world?
Answer 31: Yes.

Question 32: How would CID/hazard data from satellites/regional climate models be useful for assessing risk at the village/gram panchayat level?
Answer 32: CID data can help distinguish different geographical patterns of hazards or boons across small regions. We recommend looking at last year's ARSET training on selecting climate projection sets to understand the types of choices that might be made in determining climate products to be used, with finer resolution not always being better.

Question 33: From slide 36: I'm trying to differentiate risk and danger. Could you please help me identify the difference?
Answer 33: This is largely a semantic question so we would not want to indicate there is only one answer. To us, 'danger' indicates a more distinct term related to physical risk (e.g., of bodily injury), while 'risk' includes additional concerns related to economic, social, political, ecosystem, or other costs.

Question 34: Can you please clarify how you delineate between the Climate Phenomena and Climate Impact Drivers?
Answer 34: Climate phenomena are a large category including many variables, scales, and levels of the atmosphere, ocean, cryosphere, and biosphere components of the climate system. The climatic impact-driver approach encourages us to focus on the specific subset of climate conditions that drive impacts; for example, for agriculture we are more concerned with surface rainfall than stratospheric vorticity. Of course the larger dynamics of the climate system can affect surface rainfall, but impacted sectors effectively see these larger dynamics in the way they influence their immediate environment. Further, we use climatic impact-driver indices to zoom in on the specific thresholds and operational range limits that are associated with biophysical or engineering vulnerabilities. This helps us better target our climate information and adaptation responses.

Question 35: With the example of the projected frequency of occurrence - the predictions are using expected average change. Is it possible to predict the extreme limits? In Australia, as elsewhere, we have experienced extreme events beyond previous records.

Answer 35: Different techniques can be used to assess changes in tail probabilities beyond simply applying an average change. When we assess projections (not just as a mean response, but tracing back to the physical conditions), extreme heat events are warming faster than the temperature. Changes in extreme event duration, frequency, or geographic locations need to be considered as well.

Question 36: To mitigate means to eliminate the risk, while to adapt means to find a way around the risk, correct?
Answer 36: Mitigate means to reduce the hazard (e.g., through reductions in greenhouse gasses. Climate-scale mitigations involve a reduction of GhG. Mitigation reduces the hazards while adaptation reduces the vulnerability and exposure.

Question 37: Could you please provide an example/link of an adaptation package that addresses multiple hazards?
Answer 37: Within AgMiP, there were multiple elements that address the system.

Question 38: I am from eastern Libya and live in the areas where Hurricane Daniel passed, which caused us great destruction and floods. Climate change transformed the depression into a subtropical cyclone. Will the upcoming lectures provide us with some solutions, preventative measures, and methods to evaluate?
Answer 38: First, condolences to Eastern Libya. This type of event has been seen in our models. We will not focus on that in this training. Much literature exists within IPCC reports that addresses this.

Question 39: How would you generally define the limits of mitigation and adaptation?
Answer 39: Limits that come from different parts of a system. Engineering limitations, for example. Maximum flow through a drain pipe. Heat resistant seeds will have an upper threshold. This is one of the most important areas of research in the next IPCC report (limitations).

Question 40: When considering the Climatic Impact Drivers, how do we evaluate the likelihood of the impacts (rather than frequency/intensity etc)?
Answer 40: A system or tool to replicate or estimate the type of response under those conditions.

Question 41: Hi, we live in Ecuador at 3,000 meters and we have just one meteorological station. Can we do climatic analysis with one station?
Answer 41: Data-sparse regions present problems. Models using the observations we do have, and assimilate retroactively into these regions. But when there is not a way to validate, bias needs to be recognized. I suggest connecting with those who work in these regions to help decide how to do the analysis.

Question 42: Are the adaptation packages created or proposed by experts, or are they based on solutions proposed by stakeholders?
Answer 42: If there are adaptation packages with no stakeholder input, be wary. Both inputs from experts and stakeholders are needed.

Question 43: Institutional arrangements tend to have remote sensing capabilities separate from climate services. How would you approach integration of EO capabilities in the risk assessment?
Answer 43 Earth observations (EO) can be validated (ground truthed) and can be used to constrain the models. Model projections. RS can directly feed into impact models.

Question 44: Both mitigation and adaptation sound like a public domain effort. Such a top-down structure could be disadvantageous at a specific asset level. Is there room for the private sector to be actively involved in the practice? In the end, most infrastructures are designed, built, and maintained by private sector entities. Can you share some insights?
Answer 44: IPCC synthesis report figure (SPM6) has an icon that shows how the private and public sectors need to come together to succeed in climate actions. Private sector entities may likely have shorter time horizons.