Questions & Answers Part 2

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 Augusto Getirana (augusto.getirana@nasa.gov) or Amita Mehta (amita.v.mehta@nasa.gov).

Question 1: If there is a lack of data available (for instance, if all the small tributaries in a region are not mapped or we do not have information of those that are not available in our model), how can we account for that and perform flood modeling?
Answer 1: In terms of model inputs, it comes from datasets that should be accounted for. If you do not have those observations, then accuracy can be affected.

Question 2: What inputs are required in HEC-RAS software for flood modeling?
Answer 2: Meteorological forcing data, terrain data and channel geometry and hydraulic information, and flow data are required. An example can be see here: https://files.carlsonsw.com/mirror/manuals/Carlson_2017/source/Hydrology/Watershed/Prepare_HECRAS_Input_File/Prepare_HECRAS_Input_File.htm

Question 3: Is sea level rise measured by anomalies in the coastline during a measurement period? How can we measure it through observations with satellite instruments?
Answer 3: They are measured as absolute elevation using vertical datum as a reference. We will provide a website that is used for this: https://podaac-tools.jpl.nasa.gov/drive/files/allData/merged_alt/L2/TP_J1_OSTM

Question 4: Can machine learning be used to answer some of these questions? (e.g. drivers of flood risk). If so, could you give some examples?
Answer 4: Machine learning has been used for these applications, but this is beyond the scope of this training series.

Question 5: Could you explain more about climate-induced hydrological change (CHC) and sea level rise (SLR) factors, and how you implemented them in your model?
Answer 5: In some locations, you will find hydrologic change, but not in others. SLR does play a role in the models as observed SLR can change over time.

Question 6: Is it possible to share your model, to replicate in our study area?
Answer 6: The model is available on GitHub (https://github.com/NASA-LIS/LISF). Also feel free to contact Augusto for more information.

Question 7: Can HyMAP modeling provide solutions that can support flood water harvesting for irrigation of farmlands?
Answer 7: You need a more comprehensive model framework for farmland. The user comes up with the solution based on what HyMAP provides.

Question 8: How is the existing infrastructure like underground/constructed storm water drains handled in HyMAP? Urban flood modeling requires high resolution DEM like LIDAR (reformed urban elevation) and (time scale: like 15 min rainfall) - how does HyMap handle data issues?
Answer 8: We have LiDAR data from the municipality and that product is divided into two. For urban flood monitoring, you need LiDAR DEM. The city also has a real time precipitation monitoring system as well. Infrastructure such as this helps to aid in the accuracy of the model.

Question 9: Could public reporting during flooding events assist in model validation at city scales - given that imagery data is limited during weather events? Are there examples?
Answer 10: Using the example of Rio de Janeiro, crowdsourcing data does help play a role in collecting local level observations. GDACS also has a system in place that helps organizations after a disaster takes place to aid in post-disaster efforts.

Question 10: What parameters are needed to use Hymap for urban flood forecasting?
Answer 10: Only monitoring was showcased in this presentation, as forecasting is predicting future events and not monitoring present events. For forecasting purposes, in addition to all data mentioned in Question 8, you would need meteorological forecasts to force the model.

Question 11: How can we perform flood monitoring in glacial areas such as in the Himalayas, Andes or Alps?
Answer 11: HyMAP is being used in a project covering the Himalayas domain (High Mountain Asia), but as long as the data is present, you can run the model anywhere in the world.

Question 12: Is it possible to install LIS or HyMAP to install on Windows system or conda environment?
Answer 12: You would need a Linux virtual machine (i.e. Ubuntu) to use a conda environment.

Question 13: What is the maximum spatial extent of the region of interest that HyMap can be used reliably (i.e. urban 5x5 km or watershed 30x30)?
Answer 13: HyMAP is a global dataset so there is no fixed maximum, but expect the model simulation to take longer.

Question 14: Has this method been used for real-time flood forecasting purposes? Where?
Answer 14: NASA SERVIR had a project in West Africa to help develop a flood forecasting system by using GRACE data.

Question 15: What is the difference between a Deterministic and Probabilistic model? For insurance and reinsurance which model is required?
Answer 15: For deterministic models, it is based on physical processes. For insurance and reinsurance purposes, statistical models are used, but this is not covered in detail in the presentation.

Question 16: In the usage of Hymap and the supply of satellites of height for Q estimation, what do you suggest for small rivers where altimetry is not possible?
Answer 16: If there are no observations, then it is not possible. SWOT is helping to provide extent and will launch Q4 2022.

Question 17: Riparian flooding has a slope, unlike "rising water" flooding in lakes and coastal areas. How can this slope be captured between cross-sections, like the ones employed in HEC modeling? These models don't assume the water level between these points are flat, right?
Answer 17: We will look into this further. Slope is determined by the DEM. If there is a slope in the river you are looking at, then it will be represented in the model.

Question 18: Which satellite tool can show almost real time flooding? Will ARSET provide capacity building using HECRAS and SWAT? How can HyMap be applied by integrating local information?

Answer 18: If there is interest, we can build a webinar series based on that. There is always latency between observation and data collection and processing. For local modeling SWAT/HEC-RAS may be used, particularly for including management practices.

Question 19: Does HyMap give room for embellishment flood vulnerability maps?
Answer 19: Once HyMAP provides flooding information, you can then create flood vulnerability maps.

Question 20: For the HyMap model and data resources for Pakistan, users are usually restricted with satellite data access. Is HyMap capable of predicting floods before time so that the devastation can be minimized?
Last but not the least, how can we start using the model? Is there any tutorial available with any example run file?
Answer 20: You can run HyMAP for forecasting, but you need the appropriate data to support it. Tutorials on HyMAP can be found on the GitHub website.

Question 21: Can one make maps of vulnerable areas in Nigeria that are susceptible to flooding?
Answer 21: After the implementation of the model, you can create maps based on flood vulnerability.

Question 22: "Small" watersheds respond more directly to individual rain events. Large basins, like the Mississippi River, are much more complicated and difficult to model, using these approaches. At what scales do these models work best?
Answer 22: I haven't seen any limitations based on scale in the model, but data availability is the main constraint.

Question 23: Does the database cover the Middle East and North Africa region?
Answer 23: The flood monitoring tools covered in the presentation cover this region. HyMAP is also a global dataset.

Question 24: How can we monitor outburst lakes in glaciers with HyMAP for urban flood forecasting?
Answer 24: There is no lake monitoring in HyMAP, but it is a work in progress to implement it.

Question 25: Which factors are you considering in HYMAP for urban flood forecasting?
Answer 25: You would be looking at near real time data in conjunction with HyMAP. The model outputs can then be converted into a flood risk map.

Question 26: Without LIDAR data is it possible to forecast urban flood? Any experience of implementing the model in West Africa to share with us?
Answer 26: You can use a global DEM, but spatial resolution will be compromised. We will also provide a link to a paper that covers West Africa specifically.
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019WR026259

Question 27: Since floods are an extreme event, the pixels representing flood on land are usually small compared to non-flood pixels. I was wondering how this imbalanced classification dealt with flood modeling at NASA? I believe some used SMOTE, Borderline SMOTE, etc. Could you please shed some more light onto it?
Answer 27: We are not sure if this has been done operationally, but it has been done statistically.

Question 28: From a modeling perspective, can I give a relative weight to the risk factors of flood based on their actual contribution to flood risk? (Since not all factors are not equal contributors to risk, certain factors may be more important than others.)
Answer 28: In general, that is true since not all factors carry the same level of risk. IT is all dependent on the situation and the type of data you are working with.

Question 29: In a large watershed that would not respond to individual rainfall events, isn't Baseflow a more important component of total flow? How do these models perform with respect to Baseflow prediction?
Answer 29: In some locations, Baseflow is more important, but not a major factor in a flooding event. Surface runoff is seen as more important.

Question 30: So do they use the input from the wastewater treatment plant outflows as well? Because it can be a huge amount in certain basin areas.
Answer 30: The kind of water used is not accounted for in our observation system, as this is more of a local data type. This is something that has to be provided in the model.

Question 31: Is HyMap software free to download and use? If so, I look forward to downloading it for flood modeling in my flood stricken country South Sudan.
Answer 31: HyMAP is free to use and is available through GitHub.

Question 32: You provided a slide with median event and annual event and looked at cropland flood risk and population flood risk. How are you defining median events?
Answer 32: Median events are flood extent events that occur more than fifty percent of the time.

Question 33: What kind of computational resources are required to run HyMAP simulation? Is it cloud based? Can we mask areas outside the area of interest while running at global scale to optimize computation?
Answer 33: You can run it on any computer, but depending on the capabilities of your machine, the processing can take some time. You can mask areas outside of our AOI.

Question 34: Is the HyMap working like SWAT?
Answer 34: HyMAP has features that SWAT does not such as the possibility to run the model with different land surface models.

Question 35: Can we run this model on Google Earth Engine (GEE)?
Answer 35: Not yet, but HYDRAFloods is available, which was covered last session.

Question 36: Few years ago I saw flood mapping using SNAP. Now I am seeing HyMAP. What is the difference between the two? Is SNAP also applicable?
Answer 36: SNAP is a tool that uses Sentinel-1 SAR data. HyMAP is a model that works with land surface models.

Question 37: Is HyMAP relevant in countries such as Uganda where the only floods in Uganda are from the seasonal rains?
Answer 37: HyMAP can be used anywhere, but if you do not have good data to inform the model, then it will not be as useful.

Question 38: Is there any method to determine flooded areas that are not based on the detection of water, but on the deposit left by the flood?
Answer 38: Deposit left behind by flooding is also classified as water. HyMAP simulates rivers and floodplains and any water detected will be classified as such. Standing water such as ponds, are not detected.

Question 39: Given the scale, I would like to know if any sort of normalizations were applied to the data presented?
Answer 39: The area within the cell divided by the grid area can be seen as a normalization. All data are given as absolute values.

Question 40: What is your recommendation for tracking flash floods given the limitations which you mentioned? (For creating a flash flood inventory)
Answer 40: For flash floods, you need to find the temporal resolution for precipitation. You need the appropriate forcing for detecting floods and then the model will do the rest.

Question 41: Is HyMAP currently using altimetry data to determine flooded areas?
Answer 41: You can use altimetry data for flood mapping. If you are improving the simulation, you should improve the determination of the area.

Question 42: Can you please explain what dt and dS represent in slide 34?
Answer 42: dt is the timestamp and dS is the water storage change.

Question 43: Can these models perform well for areas such as floodplains that are fairly flat and have virtually no dominant landforms?
Answer 43: Flat areas can prove to be a challenge since HyMAP uses a global DEM. There are limitations in which physical processes are presenting the model. It is dependent on your research area. In a more flat area with a two-way coupling, the model may produce a larger flooded area.

Question 44: Is HyMAP able to simulate flooding under vegetation, for example in wetlands or tropical forests?
Answer 44: HyMAP will give you the flooded area as a function of the DEM. The DEM will need to be corrected for vegetation.

Question 45: How would you validate flood models derived from HyMap, especially if there are missing data, such as drainage or precipitation? What advantage does it have over HecRAS?
Answer 45: HyMAP is a global model and HecRAS applies for smaller domains.

Question 46: Are there any regions that HyMap has not covered yet?

Answer 46: HyMAP is a global model and covers most of the world and uses datasets from GDACS, HecRAS, etc.

Question 47: The models were compared with real flood events, what is the estimated error? Could you mention an example?
Answer 47: There is a comparison for flooded extent for Lake Victoria, showcased in the presentation.

Question 48: Can non-Newtonian flows be simulated?
Answer 48: No, they cannot.

Question 49: There is a new DEM that has been generated by removing buildings and vegetation, FABDEM I think. Do you think this can be used instead of the classic DEM (SRTM)?
Answer 49: More information about FABDEM can be found here (https://www.fathom.global/product/fabdem/). Currently we are using SRTM DEM.kljcbvhx