



Questions & Answers Part 3

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 Amber McCullum (amberjean.mccullum@nasa.gov) or Juan Torres-Peréz (juan.l.torresperez@nasa.gov).

Question 1: FHI can we do for tanks or pond or reservoir? Having an area of 250 ha (hectares) or more? In arid or semi-arid regions can do FHI of water reservoir?

Answer 1: Yes, in a sense that some of the indicators will be applicable to these bodies directly. Ideally, for an FHI assessment to be helpful, we would expand to the areas contributing runoff to the surface water body (like the pond or reservoir). Also, the FHI can be developed for water bodies located in different climates. The framework itself should be robust enough to apply in different regions.

Question 2: Where can you get the pass-ability scores of each individual dam for the calculation?

Answer 2: Passability is a relative value (0-1) and is based on expert judgment. The study by Noonan et al (2012) on the efficiency of fish passage structure and functioning should be a useful resource.

Question 3: From which year can we assess the FHI of large water bodies in the case of South Asia? What is the range actually?

Answer 3: The baseline depends on available input data. We recommend using the most recently available datasets, to match with the assessment of current social indicators which are based on stakeholders' input. But several indicators benefit from having time series data (e.g., a 5 year range).

Question 4: Is there any scope of a geologist to work for FHI assessment in the future?

Answer 4: Yes. One of the key indicators is groundwater depletion, therefore geologists are very useful particularly to calculate this indicator. But also geologists are usually present as technical representatives in watershed commissions and committees, so can help there as well. Currently groundwater is represented by a simple indicator but we hope to expand that.



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Question 5: Just wondering how this FHI assessment compares to either environmental flows models like the ELOHA model or adaptive management.

Answer 5: FHI as an assessment is more focused on an entire basin and is more comprehensive than environmental flow (EF) estimation methods like ELOHA. FHI incorporates environmental flows as a factor (a source of 'demand') when calculating water supply reliability whereas ELOHA and similar approaches may be crucial to actually estimate the EF. Therefore, is better to see them as complementary tools.

Question 6: Would you have any suggestion for river habitat mapping where geomorphology is important? Would drone or very detail aerial photography the only way to go?

Answer 6: We usually don't assess in-river habitat directly per se. Rather, it can be gleaned from a combination of Flow Connectivity (essentially lateral flow), Bank Modification (a proxy for longitudinal flow), and Water Quality. Aerial surveys can be useful to refine the Bank Modification in particular.

Question 7: Can I extract Water quality Parameters from a pan sharpened Satellite image..?

Answer 7: Certain quality parameters (with optical qualities, e.g. turbidity and chlorophyll) are available now for lakes around the world. But rivers and streams require either modeled or in-situ monitored data. And all assessments usually require additional parameters which, at present, do not have suitable proxies from satellite data. The issue is spatial resolution. Ground truthing will be necessary here as well. Pan sharpening just increases the spatial resolution as a black/white image, it does not assist in interpreting the water quality parameters, so this does not improve estimates of water quality parameters.

Question 8: In your view, what's the best DEM for the morphometric analysis for a watershed basin?

Answer 8: For hydrology, SRTM data typically work well enough: It is global and most standard.

Question 9: Hi, what happens when local data (i.e. on water quality) is not available? How does FHI deal with unavailable data for an indicator?

Answer 9: Ideally, for WQ indeed in-situ data is required. But in the absence of WQ data, modeling might be an option, but still some calibration of the model will be



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important, therefore a minimum availability of data is important. There are some global model results available now, which may be a starting point. Example: Stokal et al (2019) uses multi-pollutant modelling with global databases to track hotspots of river pollution with microplastics, nutrients, triclosan and *Cryptosporidium* in many sub-basins of Europe, North America and South Asia.

Question 10: The FHI seems to be driven by a number of datasets which is not available in all cases. Does FHI tool work on limited data availability cases?

Answer 10: We try to adapt that FHI methods for the kind of data that is available when data is absolutely not available based on the suggested methods. Also, based on data used, level of confidence in the indicator score should be assigned and communicated through the assessment.

Question 11: Is NASA planning any collaborative studies with fish/freshwater biologists and scientists for riverscape-level climate modelling studies?

Answer 11: NASA's Applied Sciences Program support research through solicitations. NASA has funded these studies. We do not have an internal directive to do so outside of the solicitation guidelines themselves.

Question 12: Where do we get the drainage network? Is it necessary to develop our one drainage network map for the purpose to FHI?

Answer 12: HYDROBASIN is a good source of drainage network, and we usually recommend to use this dataset because the shapefiles are clean and don't have problems. HYDROBASIN is derived from SRTM so very physically accurate.

URL: <https://hydrosheds.org/page/hydrobasins>

Question 13: Are there any provisions for research collaboration between NASA and other agencies?

Answer 13: NASA ROSES solicitations, these come out every 2-3 years for Applied Sciences---Ecological Forecasting. Check the NSPIRES website for opportunities: <https://nspires.nasaprs.com/external/>

You can also go to the NASA Applied Sciences Eco website here to learn about the current work and portfolio: <https://appliedsciences.nasa.gov/programs/ecological-forecasting-program>



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Question 14: You mentioned total nitrogen. Are there any remote sensing data related to nitrogen?

Answer 14: Not at the moment, as remote sensing typically relies on optical properties and so cannot capture nutrients directly. There are proxies, however. ChlA and turbidity can be. See GEOAquawatch.org for WQ community and remote sensing

Question 15: Is FHI Mac compatible? Or just Windows?

Answer 15: Right now the tool is only Windows compatible. If we see sufficient demand from Mac users, we will consider developing that.

References:

- Manuel et al. 2003:
<https://www.sciencedirect.com/science/article/abs/pii/S0169534703000089>
- Jaisuk and Senanan 2018:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5845392/>
- Brook Charr example: <https://www.canadiangeographic.ca/article/la-mauricie-national-park-paddles-and-pines>
- Florida Python example:
<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0121655>
- A presentation about a few NASA MBON projects:
https://cce.nasa.gov/biodiversity/pdf/meetings/mbon2018/0900_Muller-Karger_Sanctuaries_MBON_FMK_Short.pdf
- Hand et al 2015: <https://onlinelibrary.wiley.com/doi/full/10.1111/mec.13517>
- A few references for freeze/thaw from brightness temperature:
 - <https://www.sciencedirect.com/science/article/pii/S0034425717300172>
 - <https://www.sciencedirect.com/science/article/pii/S003442570900248X>
- Noonan, Michael J., James WA Grant, and Christopher D. Jackson. "A quantitative assessment of fish passage efficiency." *Fish and Fisheries* 13, no. 4 (2012): 450-464.
- Strokal, Maryna, J. Emiel Spanier, Carolien Kroeze, Albert A. Koelmans, Martina Flörke, Wietse Franssen, Nynke Hofstra et al. "Global multi-pollutant modelling of water quality: scientific challenges and future directions." *Current opinion in environmental sustainability* 36 (2019): 116-125.
- StreamNet (a reference provided from a participant), that is a tool similar to RAP:
 - <http://www.psmfc.org/program/streamnet>