Tech Paper Checklist

The Tech Paper provides the technical details for partners and future DEVELOP teams to replicate and understand your project analyses. It fully explains the problem, provides a scientific basis for your methodology, and thoroughly explains your results and what they mean for your project partners. It can even act as a foundation for a future publication.

Feel free to use this checklist as a resource while you work to complete your Tech Paper; however, this should not be used as a stand in for the template. Deliverable templates serve as the primary source for all formatting and content requirements. Therefore, it is your responsibility to ensure that your team is following all DEVELOP guidelines for deliverables.

General Writing & Formatting

- [ ] The entire tech paper (everything before the references & appendices) should be no longer than 12 pages. Also, please pay attention to word count where applicable
- [ ] Write in past tense and use active voice as much as possible. Here are examples in the past passive and past active voice:
    - o Past passive: Three 2-L samples were taken by the Park Service Biologist at a depth of between 0.1 and 0.5 m at the down-wind end of each wetland.
    - o Past active: The Park Service Biologist took 2-L samples at a depth of between 0.1 and 0.5 m at the down-wind end of each wetland.
- [ ] *Each paragraph should have at least three sentences.*
- [ ] *Data are plural*.
- [ ] The tech paper should be written in either first person or third person and should not switch between the two (i.e., switching between "We" and "The team")
- [ ] Spell out acronyms the first time they are used.
- [ ] All references should have a corresponding in-text citation and vice versa. Additionally. whenever a formula is used, a reference needs to be provided.
- [ ] The formatting for each section should match the template. Examples below:
    - o All body text is Garamond, 11pt font, single spaced, 0pt above and below each line
    - o Text is left justified throughout the document, paragraphs should not be indented, one space between each paragraph but not after a section title.
    - o Heading levels are consistent.

Figures & Images

- [ ] Reference all figures and charts within the text. However, sentences like "A temperature time series can be found in Figure 5" should *never* be said. Do this instead:
    - o We found that temperature increased throughout the study period (Figure 5).
    - o We acquired Landsat 8 OLI and Landsat 9 OLI-2 satellite imagery spanning from June – September of 2023 from Google Earth Engine (Table 1).
- [ ] Figures can be grouped. Text and map elements do not have to be separate and editable. However, text must be large enough and clearly legible (no blurry text).
- [ ] Consider image gallery or other way to share additional images/figures with partners – *you don't have to include everything in the tech paper.*
- [ ] Including a lot of high-resolution images exported from ArcGIS could make your tech paper file size very large. Consider compressing images in your tech paper by clicking on the image -> Picture Tools -> Compress Pictures. (Only go as low as "Print" when compressing)

- <mark>Copyright / image credits are **required** for any private data imagery</mark> used to create your visuals i.e., DigitalGlobe/Maxar imagery, etc.
  - Credits no less than 8-point font.

Equations & Software

- Number equations and reference them within the text.
  - The equation number should be right aligned and the equation itself should be middle aligned.
  - Garamond font – find Normal Text on the left side of the Equation Tools tab
- Include the version number for the first mention of all software that was used (ArcGIS Pro, R/RStudio, Python, etc.).

Header & Title Page

- Text in the cover page Header needs to be updated.
  - If you're using the Microsoft Word Online version the Header text may not be visible to you. Select "Header" in the upper right-hand corner and edit "Insert DEVELOP Node Name (Ex. Virginia – Langley)" appropriately.
- Fill in all information on the title page to match the template. Delete "Previous Contributors" if necessary. If only one advisor, delete the plural "s". If multiple, delete the parenthesis around the plural "s"

Abstract

- Key Terms should be the same as the Project Summary; only 2-8 words

Introduction

- Be concise; this section should be between 500 and 800 words as one to two pages should suffice
- A minimum of 5 journal article references is required for the introduction section (e.g., information about your focal species, habitat, or problem, scientific basis for your remote sensing methods, etc.).
- Include a study area map (with north arrow & scale bar)
- Include the following content (in whatever order flows best, do not simply create a subsection for each):
  - **Background Information** – Relevant information to inform the reader of the current environmental issue, what decision is being made, etc.
  - **Scientific Basis** – previous studies, the general scientific basis, and use of <u>**remote sensing methods**</u> in this context. Remember that at least 5 peer-reviewed journal articles must be referenced.
  - **Project Partners** – Explain who your partners are and the work that they do. What environmental decision are they trying to make? What do they currently do to address this environmental problem/decision? How does your project attempt to address their needs and how will your partner benefit from your end products/results?
  - **Project Objectives** – These should be short and specific action items that your project completed in paragraph form, not a bulleted list.
  - **Study Area** – Describe the geographic location of the study and include a study area map that contains required map elements (i.e., inset map, scalebar, north arrow, and legend if applicable).

- **Study Period** – Explain the reasoning behind the time period you are looking at (years and dates of data). Why are these years/dates important?
- **For II & III term projects** – Include a paragraph discussing what was done and/or found in the previous term (with partners and objectives).
- **Feasibility** – While this doesn't have to be a specific paragraph or section of your introduction, it should be clear to reader how the concept of assessing feasibility of using remote sensing methods for this application is central to the goals of this project alongside creating end products to inform your partner's environmental decision-making.

Methodology

- This should be the focus of the paper – concise, yet explanatory. Be specific in explaining why you employed your methodologies – remember your partner is your audience! Highlight the NASA Earth observations utilized and their capabilities. Include a paragraph or more for each of the following sections. There is no word cap, but be thoughtful and keep it in the 2- to 6-page range.
- Use past tense and active voice whenever possible.
- Don't forget to cite your data in the references and include citations for all indices or formulas used.
- **Data Acquisition**
  - What data did you get, what level products are they, for what dates did you get images, where did you get the images from, etc.? Consider adding a table to display this information if you are using multiple platforms/sensors.
  - Each paragraph should have at least three sentences.
    - You don't need a separate paragraph for each data source under the Data Acquisition section. Group content together so you have substantive content.
- **Data Processing**
  - What did you do to the data to make it 'readble'? Were there conversions needed to be able to analyze them? Did you have to mosaic images? Did you have to normalize anything to fit other datasets? Did you run an NDVI calculation, change detection, etc.?
- **Data Analysis**
  - How did you analyze the data – statistical analysis, validation, etc.? What methods did you use? Explain what you did and why you did it.

Results & Discussion

- Insert images, graphs, maps, charts, etc. in this section. Choose the most important results to highlight here. No word cap, but 2 to 6 pages is a good range. (See template for a more detailed description).
- **Analysis of Results**
  - What can you tell from your graphs, images, etc.? What is the outcome of the analysis that you conducted?
  - Be careful that conclusions are not stated in this section.
- **Errors & Uncertainties**
  - Errors were quantified whenever possible.
  - What factors, parameters, etc. were not considered or could be accounted for? What are the potential holes, problems, and limitations with your methodology?
- **Feasibility & Partner Implementation**
  - Answer the question of feasibility in this section.

- This section is partner-centric and should speak to the feasibility of applying your methods or end products into your partner's decision-making practices related to the environmental problem at hand.
- What steps can your partner take to further your methodology if needed?
- If you found that utilizing remote sensing methods for this application was not feasible, explain why not.
- For multi-term projects only: how should the next team proceed?

Conclusions

- Word count: 200 to 600, about a page.
- Synthesize the main findings based on the Results section – what are the main takeaways from your results and feasibility analysis?
- How do the main takeaways relate to the environmental decision/issue that you introduced at the beginning of the tech paper and how will your partners benefit from the project?
- Conclusions should summarize the main findings and major implications of the study. Things like "We made a map" are not proper conclusions. What does the map show and what does that mean to your question and your partners?

Acknowledgments

- Keep to a concise paragraph or bullets of names. End with the following sentences:
  - This material contains modified Copernicus Sentinel data (insert year), processed by ESA.
    - (Only if you used European Space Agency data from a Sentinel satellite)
  - This work utilized data made available through the NASA Commercial Smallsat Data Acquisition (CSDA) program.
    - (Only if you displayed commercial imagery in your Tech Paper)
  - Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration.
    - Required for all Tech Papers
  - This material is based upon work supported by NASA through contract 80LARC23FA024.
    - Required for all Tech Papers

Glossary

- Define field-specific terms and acronyms. The goal of this section is to help the reader better understand the work presented in the paper. Include vocabulary that the reader may not be familiar with, in addition to defining the acronyms in your paper.
- Be consistent with how you write each entry (i.e., sentences vs. fragments).
- This section should be in alphabetical order.

References

- The references section is formatted consistently using APA 7 formatting (See the template for more information).
- References should be in alphabetical order.
- There should be a reference for all data that is used.

- o References should include Digital Object Identifiers (DOIs) for NASA and other satellite data products.
- □ Only include articles & data cited within the body of the text. It's great if you read many other articles, but they should not all be listed here unless they are being cited in this report.
  - o Similarly, if there is an in-text citation in the body of the Tech Paper, there should be a corresponding reference in this section.
  - o Please check every in-text citation **and** every full citation to ensure that it has its counterpart!

Appendices

- □ If there are no appendices, the heading is deleted.
- □ Use appendices to include detailed information that would be distracting in the main body of the paper (e.g. supplementary information, equations, maps, etc.).
  - o However, the appendix is not the place to stick every map/graph/figure that you want to send your partners!
- □ Restart numbers labels for tables and/or figures at each appendix (i.e., A1, A2, etc. for Appendix A, B1, B2, etc. for Appendix B), if necessary.
- □ Don't forget to refer to **all** appendices in the body of the Tech Paper.
- □ See the template for examples and formatting.