Short Title (Location + Main App Area)

Longer subtitle (Example: Synthetic Aperture Radar Data Decision Support for Atlantic Blue Fin Tuna Population Assessment and Management in the Gulf of Mexico)

 **Technical Report**

Rough Draft – October 13th, 2022

Author 1 (Project Lead)

Author 2

Author 3

Author 4

***Advisors:***

Advisor 1, Affiliation (Science Advisor)

Advisor 2, Affiliation (Science Advisor)

***Previous Contributors:***

Contributor 1

Contributor 2

***Fellow:***  
Node Fellow (Node Name)

# 1. Abstract

Insert here (150 to 250 words, one paragraph). Best Practices:

1. The abstract should be fully contained and give the reader a good grasp of the project. It should describe the purpose of your project, the reason for your project, how you go about your project, and what you ultimately discovered over the course of your project (e.g., objectives, community concerns, methods, and conclusions).
2. While there is a maximum word limit, if you can say it with fewer words, do so.
3. State the most important information first.
4. Write in past tense.
5. Write in active voice and avoid passive words like “might” or “could” – use powerful language.
6. Spell out all acronyms except NASA.
7. Don’t include citations.
8. Don’t define terms.
9. Read other projects’ abstracts for inspiration.
10. Any major restrictions or limitations on results (if results are included) should be stated.
11. Reread the abstract. Did it answer: who, what, where, when, and why? If it didn’t, then revise it!
12. Don’t forget to add results!

**Key Terms**

Insert 2 to 8 keywords here that relate to your project. Example: remote sensing, MODIS, Floating Algal Index, biodiversity hotspot, MaxEnt

# 2. Introduction

Be concise; this section should be between 500 and 800 words as one to two pages should suffice.

***2.1 Background Information***

Things to include (in whatever order you think flows best): **Background Information** – Relevant information to inform the reader of the current status, environmental issues, decision making, etc. **Scientific Basis** –previous studies, the scientific basis of your methods and how they have been used in previous research, etc. **Study Area** – Describe the geographic location of the study. **Study Period** – Explain the time period of data you are looking at (years and dates of data). **For II & III term projects** – Include a paragraph discussing what was done and/or found in the previous term.

***2.2 Project Partners & Objectives***

Things to include: **Project Partners** – Explain who the project partners are, why they are interested in this project, how they will use it, what decision making they have to do and is being addressed with this research and methodologies, etc. How will they benefit from this project and methodology? **Project Objectives** – These should be short decisive action items in paragraph form, not a bulleted list.

# 3. Methodology

This should be the focus of the paper – concise, yet explanatory. Highlight the NASA Earth observations utilized and their capabilities. Include a paragraph or more for each of the following items. There is no word cap, but be thoughtful and keep it in the 2- to 6-page range. **Use past tense, active voice whenever possible!**

***3.1 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. You do not need a separate paragraph for each data source under the Data Acquisition section.

***3.2 Data Processing***

What did you do to the data to get it ‘readable’? Were there conversions needed to be able to analyze it? Did you have to mosaic images or cloud filter? Did you have to normalize anything to fit other datasets? Did you run an NDVI calculation, change detection, etc.?



[copyright statement placeholder for visualizations using private imagery like DigitalGlobe/Maxar products:

e.g., WorldView-2. (Source: DigitalGlobe). © 2021 DigitalGlobe NextView License]

Figure 1*.* This is a composited and cloud-masked NDMI image clipped to the 4 km study boundary of Glacier National Park (from Landsat 5 TM, 2005).

(1)

***3.3 Data Analysis***

How did you analyze the data – statistical analysis, validation, etc.? What methods did you use?

# 4. 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.

***4.1 Analysis of Results***

What can you tell from your graphs, images, etc.? What does the data tell you? What does this mean for your project?

What factors could you not account for? What are potential holes or problems with your methodology. Include an error analysis. What things didn’t work out like you expected they would, etc.?

Table 3

*Interannual periods used to create persistence maps*

|  |  |
| --- | --- |
| **Persistence Year Range** | **Interannual Periods Aggregated for Persistence** |
| 2000-2005 | 2000-2001, 2001-2002, 2002-2003, 2003-2004, 2004-2005 |
| 2005-2011\* | 2005-2006, 2006-2007, 2007-2009, 2009-2010, 2010-2011 |
| 2010-2016\* | 2010-2011, 2011-2013, 2013-2014, 2014-2015, 2015-2016 |

The “\*” indicates ranges with gaps due to missing interannual periods from Landsat for 2008 and 2012.

***4.2 Future Work***

If your team had more time to work on this project, what additional analyses would you pursue? If this project were to be selected for another term, what would be the focus? What additional research questions and topics would your partners wish to investigate themselves or have DEVELOP pursue in the future?

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# 5. Conclusions

Word count: 200 to 600, about a page.

**Synthesize your results here** – how do they relate to your community concerns, how will your partners benefit from the project results, etc.? What is the ultimate result of your research?

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# 6. Acknowledgments

Keep to a concise paragraph or bullets of names. If relevant, you may also include a land acknowledgement statement here. Include acknowledgments for your Node and PC Fellows. End with the following sentences:

This material contains modified Copernicus Sentinel data (insert year), processed by ESA.

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.

This material is based upon work supported by NASA through contract NNL16AA05C.

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# 7. 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.

**Earth observations** – Satellites and sensors that collect information about the Earth’s physical, chemical, and biological systems over space and time

**MODIS** – Moderate Resolution Imaging Spectroradiometer

# 8. References

Start your alphabetized list of references on a new page and use APA 7 formatting. Please review the separate References template document to learn more! You should be able to copy-paste the example citations into this document with formatting intact. Then, just replace with your source’s information!

# 9. Appendices

Begin each appendix on a **new page** with the word appendix in the top center. Use an identifying capital letter (e.g., Appendix A, Appendix B, etc.) if you have more than one appendix.

Label tables and figures in the appendix as you would in the text of your manuscript, using the letter A before the number to clarify that the table or figure is found in the appendix (e.g., Figure A1, Table B2, etc.)

**Don’t forget to refer to all appendix figures in the body text of the paper.** If an appendix consists entirely of a single table or figure, the title of the table or figure should serve as the title of the appendix.

**The appendix is not the place to stick every map/graph/figure that you want to send to your partners!** The purpose of the appendix is to supplement your tech paper, not add copious amount of new information; therefore, the appendices have a page limit of 10. If you want to put 10 or more pages of appendices or supplementary information, it should be submitted as an extra, optional deliverable. This deliverable can mimic how the appendices are set up in the tech paper.

**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.

###### ***General Writing & Formatting***

* The entire tech paper (everything before the references & appendices) should be no longer than 12 pages.
* Write in past tense. Use active voice as much as possible. Here are examples in the past passive and past active voice:
  + 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.
  + 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.*
* Spell out acronyms the first time they are used. No need to define an acronym in the text if it is already defined in the abstract.
* The formatting for each section should match the template:
  + All text is Garamond, 11pt font
  + The subtitle is not italicized
  + Text is left justified throughout the document.
  + Heading levels are consistent.

###### ***Figures & Images***

* Reference all figures and charts within the text.
* Figures can be grouped. Text and map elements do not have to be separate. 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.
* Copyright / image creditsare **required** for any private data imagery used to create your visuals i.e., DigitalGlobe/Maxar imagery, etc.
  + Credits no less than 8-point font.

###### ***Equations***

* 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

## Header

* 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.

## 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 references is required for the introduction section (e.g., information about your focal species, habitat, or problem, scientific basis for your methods, etc.).
* Include a study area map (with north arrow & scale bar)
* **Background Information**: Things to include (in whatever order you think flows best):
  + Background Information – Relevant information to inform the reader of the current status, environmental issues, decision making, etc.
  + Scientific Basis – previous studies, the scientific basis of your methods and how they have been used in previous research, etc.
  + Study Area – Describe the geographic location of the study.
  + Study Period – Explain the time period of data you are looking at (years and dates of data). For II & III term projects – Include a paragraph discussing what was done and/or found in the previous term
* **Project Partner & Objectives:** 
  + Project Partners – Explain who the project partners are, why they are interested in this project, how they will use it, what decision making they have to do and is being addressed with this research and methodologies, etc. How will they benefit from this project and methodology?
  + Project Objectives – These should be short decisive action items in paragraph form, not a bulleted list.

## Methodology

* This should be the focus of the paper – concise, yet explanatory. Highlight the NASA Earth observations utilized and their capabilities. Include a paragraph or more for each of the following items. There is no word cap, but be thoughtful and keep it in the 2- to 6-page range.
* Be specific in why you did particular methods – don’t leave the readers hanging. Are you answering “The Five Ws” (who, what, when, where, & why)?
* **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? Were there conversions needed to be able to analyze it? 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?

## 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.
* **Analysis of Results**
  + What can you tell from your graphs, images, etc.? What does this mean for your project?
  + What factors could you not account for? Include an error analysis. What things didn’t work out like you expected they would, etc.?
* Future Work
  + If your team had more time to work on this project, what additional analyses would you pursue? If this project were to be selected for another term, what would be the focus? What additional research questions and topics would your partners wish to investigate themselves or have DEVELOP pursue in the future?

## Conclusions

* Word count: 200 to 600, about a page.
* Synthesize your results here – how do they relate to your community concerns, how will your partners benefit from the project results, etc.?
* 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)
  + 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.
  + This material is based upon work supported by NASA through contract NNL16AA05C.
* Include Maxar or other 3rd party imagery data acknowledgements, if used.

## 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).

## References

* The references section is formatted consistently using APA formatting.
* Includes Digital Object Identifiers (DOIs) for NASA and other satellite data products.
* Your RD needs to include citations for all data that your team is considering using.
* 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.

## 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.).
* Each distinct item should have its own appendix. Separate content into multiple appendices if necessary.
* 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 your appendices in text.

## Checklist

* Delete checklist before FD submission.