Working Paper 2

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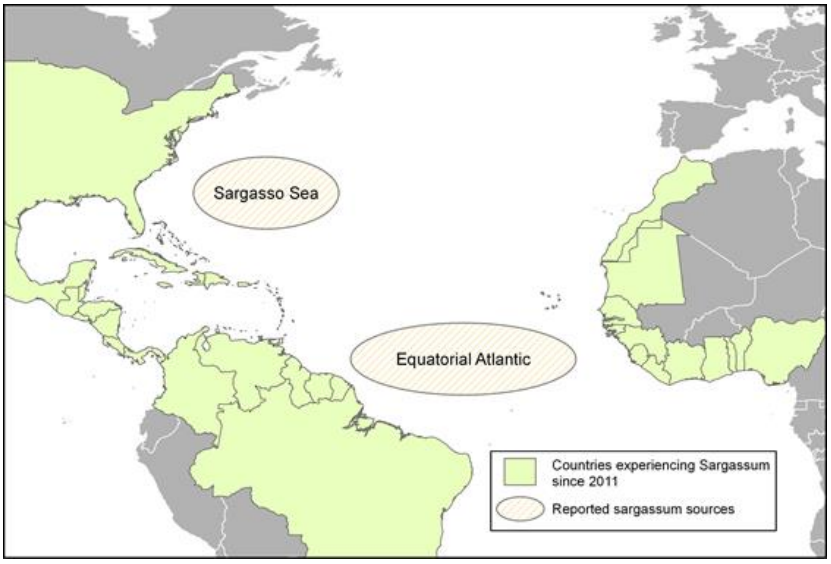
Comparison of IDL and Python programming languages for analysing satellite imagery of *Sargassum*



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About SARTRAC Working Papers

This series is based on the work of the project 'Teleconnected Sargassum risks across the Atlantic: building capacity for TRansformational Adaptation in the Caribbean and West Africa' (SARTRAC), funded by the UK's Economic and Social Research Council (ESRC) through the Global Challenges Research Fund (GCRF) call on Equitable Resilience. The ESRC GCRF 'Equitable Resilience' programme supports collaborative interdisciplinary research to inform resilience and adaptation policy and practice. Titles in this series are intended to share initial findings and lessons from research studies commissioned by the programme. Papers are intended to foster exchange and dialogue within science and policy circles concerned with climate change adaptation in vulnerability hotspots. As an interim output of the SARTRAC project, they have not undergone an external review process. Opinions stated are those of the author(s) and do not necessarily reflect the policies or opinions of ESRC, GCRF, or partners. Feedback is welcomed as a means to strengthen these works: some may later be revised for peer-reviewed publication. Contact Prof. Emma L. Tompkins email: E.L.Tompkins@soton.ac.uk

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The views expressed in this work are those of the creators and do not represent those of ESRC and GCRF or its Boards of Governors. SARTRAC focuses on three case study countries in the Caribbean and West Africa: (i) Jamaica, (ii) Ghana (iii) St Lucia, working with various project teams from each country that are part of the consortium. Hence, the Working Paper has greatly benefited from a number of discussions with and feedbacks from various members of the country teams during different consortium meetings and communications.

Contents

1. Introduction

The aim of this working paper is to provide guidance to new remote sensing researchers who are investigating *Sargassum* by offering a comparison of two commonly used programming languages for interpreting satellite imagery – Interactive Data Language (IDL) and Python.

IDL is a programming language which is popular in image processing and in space science. ENVI image processing package is written in IDL which allows the user to exploit libraries associated with ENVI. However, it is not freely available. Python is a popular general-purpose programming language with a wide range of applications and is open source. Both are suitable options for detecting ocean surface *Sargassum* blooms in satellite imagery. This paper provides a comparative overview of the pros and cons of using each of these languages.

The following figure was compiled using evidence and experience of using both Python and IDL to detect ocean surface *Sargassum* blooms in the tropical Atlantic and the Gulf of Guinea using Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data. The comparison is based on experiences using Python version 3.8 through Jetbrains Pycharm Integrated Development Environment (IDE) and the IDL 8.7 platform in a windows operating system.

The programming languages IDL and Python were considered because they are both commonly used in image processing and offer distinct contrasts (e.g. open source/closed source, wide application/specific) which provides an opportunity to compare disparate languages. Other languages which are not as popular in the field were not included for comparison, for example JavaScript was not considered because it is primarily used for web development and outside of platforms such as Google Earth Engine (GEE) it lacks necessary scope and libraries for use in image processing. It was not appropriate to use GEE at this time as the cloud-based platform has limited memory which is not ideal for processing large amounts of data.

The analysis comprised four areas: user programming skills; accessing and setting up the IDE; applying and using the language; and file output options.
The results are presented in Figure 1.

2. Results

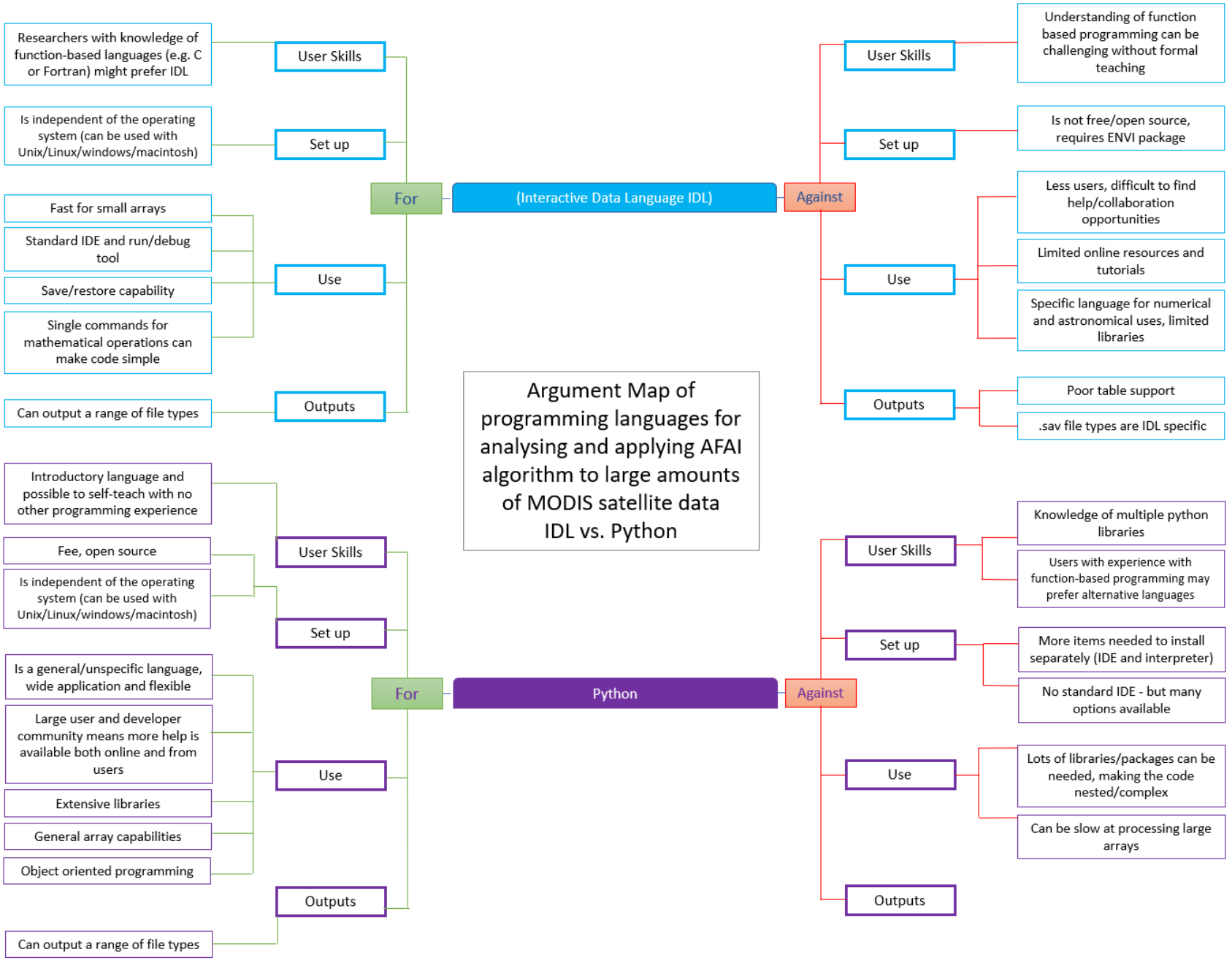

Figure 1 Argument Map illustrating the pros and cons of IDL and Python programming languages.

Figure 1 shows that Python has more advantages compared to IDL, particularly in the 'Use' category. Although Python is a more suitable solution for researchers with less coding experience, users with experience using other languages that are function-based may prefer IDL. Set-up of IDL is straight-forward and requires installing and licensing from L3Harris Geospatial. Comparatively, Python requires research to identify a suitable IDE, and also requires downloading a Python interpreter. As Python executes using an interpreter instead of a compiler it can become slow, especially when dealing with multiple large arrays.

A further consideration is that IDL has limited libraries which are specific for numerical and astronomical methods, conversely, Python has many libraries and packages making it dynamic and facilitating methods beyond numerical applications. However, lack of knowledge on these can hinder researcher's success at using python; though, this can be largely overcome by using freely available online resources and community forums.

Whilst there are no factors against using Python in the 'output' category in Figure 1, it's worth noting that Python has reduced 3D plotting capability, but as this is not needed for *Sargassum* detection it was not included in the figure.

3. Conclusion

In summary, Python is advantageous for use in *Sargassum* detection as it is open source and there are significant resources available online, which is particularly valuable for the inexperienced programmer. However, beyond these advantages the choice of using IDL or Python is dependent on the user and their skills and preferences, as well as the quantity of data and aims. New versions of both Python and IDL are released regularly, and in the future, these may offer additional features which may overcome current limitations.