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Standardizing Algorithm Documentation for Improved Scientific Communication and Data Understanding

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Current Data Infrastructure

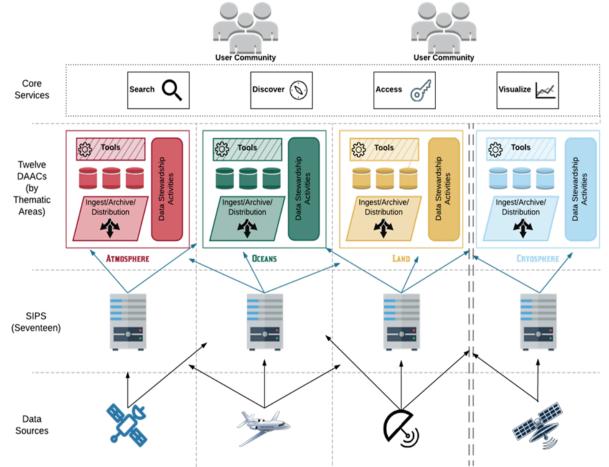
Collect data by Earth observing remote sensing instruments

Process at Science Investigator-led Processing Systems (SIPS)

Archive at Distributed Active Archive Centers (DAACs)

Distribute to user community through key services

Detailed data documentation and curation is a service that aids in distribution of data by enhancing search and discovery while promoting transparency and scientific reproducibility



Current NASA EOSDIS Architecture

Algorithm Theoretical Basis Documents

Algorithm Theoretical Basis Documents, or ATBDs, provide data users the physical theory, mathematical procedures and assumptions made for developing algorithms which convert radiances received by remote sensing instruments into geophysical quantities

ATBDs are *required* for every NASA Earth Observing System (EOS) instrument product



The Documentation Problem

No standard template or content requirements

- Creates confusion and uncertainty for scientists writing ATBDs
- Large volume of instruments, products and associated science teams
- An ATBD may address multiple products or a product may be addressed by multiple ATBDs

No central repository for search and discovery

- Documents are delivered to archival centers for preservation and distribution
- Important for data distribution velocity and science reproducibility that discovery is consistent and efficient

Difficult to update or maintain

- Data and associated algorithms may change rapidly
- Documents must be readily updated for advancements in data processing or when corrections are identified

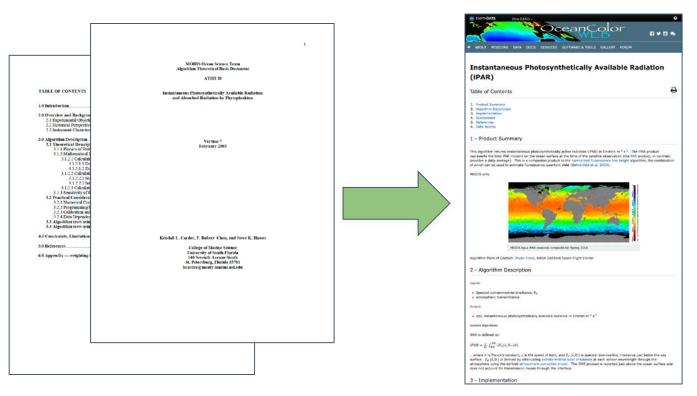
Limited ability to efficiently parse content

• Often available as PDFs; not search engine optimized

What is APT?

The Algorithm Publication Tool (APT) is a cloud-based publication tool for standardizing ATBDs and streamlining the authoring process

APT has the goal of moving from a static to dynamic model of documentation with intelligent connections to software, data and other supporting resources to improve transparency and promote scientific reproducibility

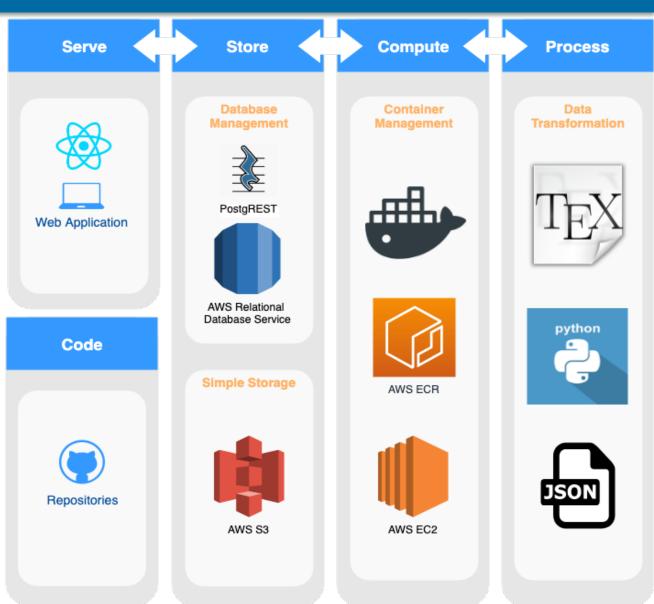


High Level Architecture

Web application front-end which serves, and is served by, a content model schema implemented as a database

Latex backend supports rich content required for scientific writing

All components implemented using AWS cloud resources



Algorithm Metadata Model

Basis of the tool are rich models for storing ATBD content

- Traditional metadata information about the document
- ATBD content as metadata standardize and simplify content

ATBD information model is based on review of Earth observations community algorithm documentation

1	Element Name	Element Description	Туре	Constraints	Required	Cardinality	Element Used to Build/Create Document?
38	Algorithm Description						
39	AlgorithmDescription/AlgorithmInputIntrod uction	Provides a brief contextual, introduction for the InputVariables table	String	For prototype: 1024 maximum characters	Yes	1	Yes
40	AlgorithmDescription/AlgorithmInputVariabl eName ***[Variable/Name in UMM-Var] See	The name(s) of the variables that are inputs into the algorithm as they are named in the data. A variable is a named set of data that contains the recorded values of a measurement. A variable can also be the	For prototype: String Longer term: Build from	For prototype: 1024			
	comment column.	output of a model.	UMM-Var	maximum characters	Yes	1n	Yes

ATBD Publication

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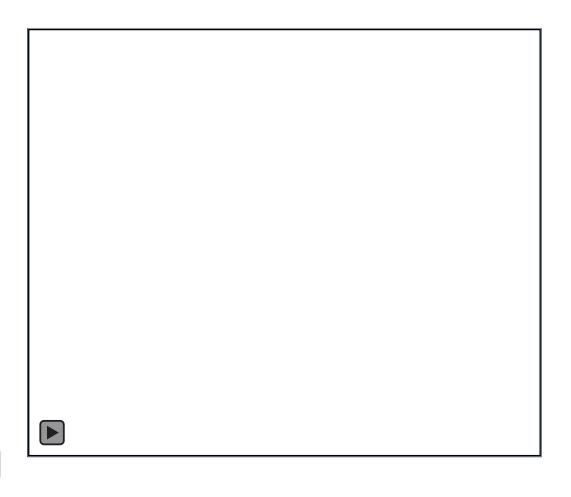
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APT initial development focused on the publication web interface

- Ease document publication burden Simplify embedding and generation of rich content
- Equation building with in-line validation
- UI for table construction; inserting figures
- Automatic formatting of tables, figures and equations within the document

 Database implementation promotes content reuse and

consistency

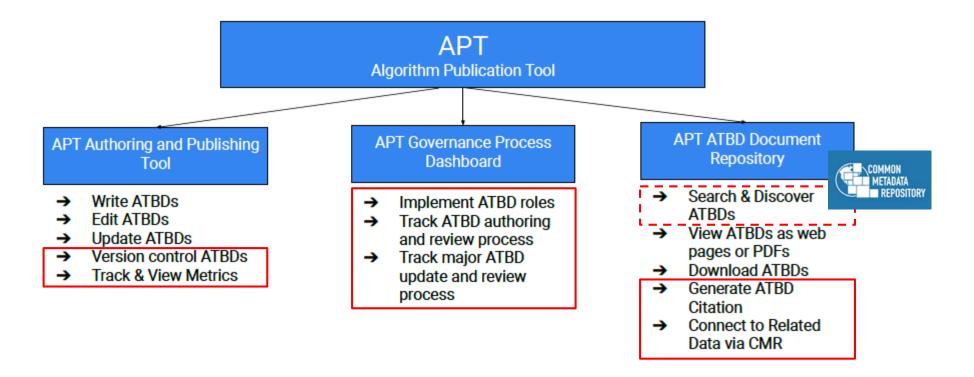


Long-term Vision

Integrate into NASA EOSDIS data curation and preservation system

- Interconnected with *input* and *output data* through CMR metadata
- Leverage future metadata schemas including that for *variables* and *software*

Adoption of APT for future mission documentation requirements



Long-term Vision: Centralized Repository

Implement interface and capabilities for search and discovery of documents by

- Identifying metadata, such as citation information and keywords and
- Document content, such as equations or scientific concepts

Integration of existing NASA ATBDs into the document repository

			NASA APT		Documents About	
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References	Contacts Revery	6	STATUS	TITLE	AUTHORS	
	References	4	Draft	[<mark>Demo</mark> Only] MOD20: Instantaneous Photosynthetically Available Radiation and Absorbed Radiation by Phytoplankton	Aaron Kaulfus	PDF HTML 👁 Preview :

Long-term Vision: Governance

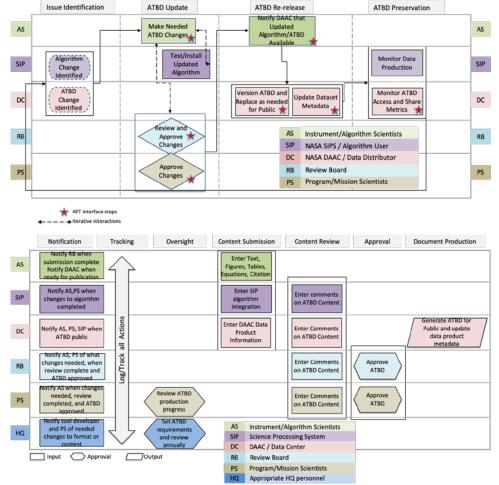
APT will reinforce NASA EOSDIS and data provider responsibilities throughout the data lifecycle

Provides independent workflows for

- 1) Initial creation and publication of an ATBD (formulation phase)
- 2) Updates to a ATBD (operations phase)

Dashboard for tracking/managing workflows

 APT serves as a centralized location for interactions between all parties involved in the data stewardship process



Sample governance workflow and required interactions

Discussion

Versioning for dynamic documents is difficult

- Must decide what changes constitutes a new version of an ATBD
- How are persistent identifiers (document DOI) impacted?
- All versions must be archived and made available for transparency

For repository completeness, existing archived ATBDs should be incorporated

- Significant effort to rewrite all of these documents
- Can all ATBDs and their versions be accounted for?

Community support is required for success

- The tool should minimize resistance to adoption of a single typesetting service
- The tool must accommodate all scientific writing needs
- A standard governance plan should not overly/unnecessarily burdensome

Maximum value is achieved when integrated into EOSDIS existing metadata resources

 Need a flexible, future-proof tool to fit an evolving documentation vision and supporting suite of tools



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