Best Practices & Tips: Tech Paper

October 25, 2017

Elements of a Scientific Research Paper

How is a technical report different from a typical paper?

Experimental Process	Section of Paper
What did I do in a nutshell?	Abstract
What is the problem?	Introduction
How did I solve the problem?	Materials & Methods
What did I find out?	Results
What does it mean?	Discussion & Conclusion
Who helped me out?	Acknowledgments
Whose work did I refer to?	Literature Cited
What extra information could be beneficial to include?	Appendices

Introduction

Things to keep in mind

Introduction

Every sentence* should have a citation.

Avoid "common knowledge" within the discipline. Instead, **cite articles that reported specific results relevant to your study**.

Be specific. Don't just say "Increased commercial development and urbanization is altering the natural makeup of the landscape..", but rather something with quantitative data to back it up: "Since 2000, 456,000 acres of forest, barren land, and grassland have been urbanized...."

Introduction

Explain your rationale and approach. *Why* did you choose this approach? *What* are the scientific merits of this project? *What* advantages would your results have in answering the questions and the issue at hand?

Include:

- ➔ Project Partners
- ➔ National Application Area
- ➔ Study Area (Map)
- ➔ Study Period

Methodology

Not a step-by-step protocol

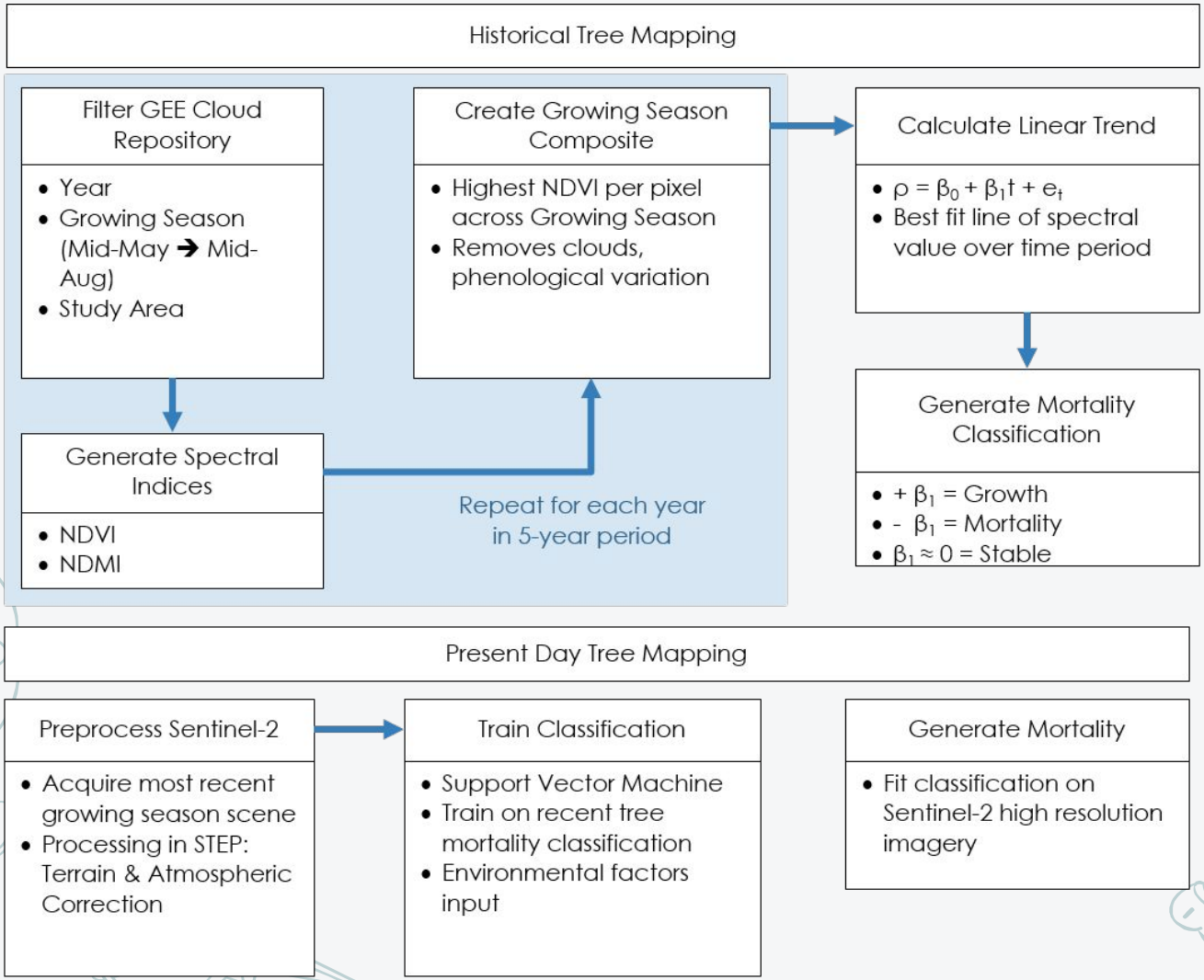
Methodology

Remember: **use past tense & an active voice throughout!**

Specificity is better than vagueness.
Make sure the "why" and "how" behind data acquisition, processing, and analysis is clearly understood by the reader.

Use proper dataset names

Methods & workflow figures



Credit: Josh Verkerke, Anna McGarrigle, John Dilger of the Lassen Volcanic National Park Disasters Summer 2017 Team

Results

Report findings ***without*** interpreting them (yet)

Results

When reporting results, use Figures & Tables to help report your findings

A picture is worth a thousand words (*and helps you meet the page count!*)

Make sure your figures **add to the content** of your paper, not detract from what you are reporting

When to use an **appendix vs. in-line** figures

Turn on **Ruler**, **Grid Lines**, **Navigation Pane** in the **View** section of MS Word

Caption and Label figures in a **separate text box**

Results

When reporting differences, directionality, and magnitude: provide useful details.

"Groups A and B were significantly different"

vs.

"Group A individuals were 23% larger in volume than those in Group B"
"Group B pups gained weight at twice the rate of Group A pups"

Results

When reporting significance one common mistake is the overuse of the word “significant”.

Your results will read much more clean and professional when you avoid overuse of the word significant in any of its forms.

The same goes for using forms of any word repetitively.

Avoid devoting whole sentences to report a statistical outcome alone.

Don’t leave out negative results too - they are also important!

Example:

"Males (180.5 ± 5.1 cm; n=34) averaged 12.5 cm taller than females (168 ± 7.6 cm; n=34) in the AY 1995 pool of Biology majors (two-sample t-test, $t = 5.78$, 33 d.f., $p < 0.001$)"

Discussion & Conclusion

Interpreting Results

Discussion & Conclusions

Fundamental questions to answer in this section include:

Did you answer the hypothesis or questions posed (i.e., what is the solution?)

How does your study compare to past studies?

Did you describe any new understandings of the problem?

What future work could come from this project?

How can your end-users use your products for decision-making?

Results → Conclusion

Order Matters! Discuss each section (and topic) in the same sequence as presented in Results.

Methods	Results & Discussion	Conclusion
A) NDVI time series 1) NDVI Formula 2) …	A) NDVI time series 1) Image of NDVI 2) X% of veg lost	A) NDVI time series 1) More area lost than expected 2) Possible cause…
B) Land Surface Temperature 1) Locate hotter/cooler regions	B) Land Surface Temperature 1) Cooler at higher elevations	B) Land Surface Temperature 1) MODIS LST differs from weather stations by X amount
C) Artichoke suitability map 1) Factors and weights 2) …	C) Artichoke suitability map 1) X region more suitable 2) Show map	C) Artichoke suitability map 1) Farmers will have to move by XX year

Glossary

Glossaries are great!

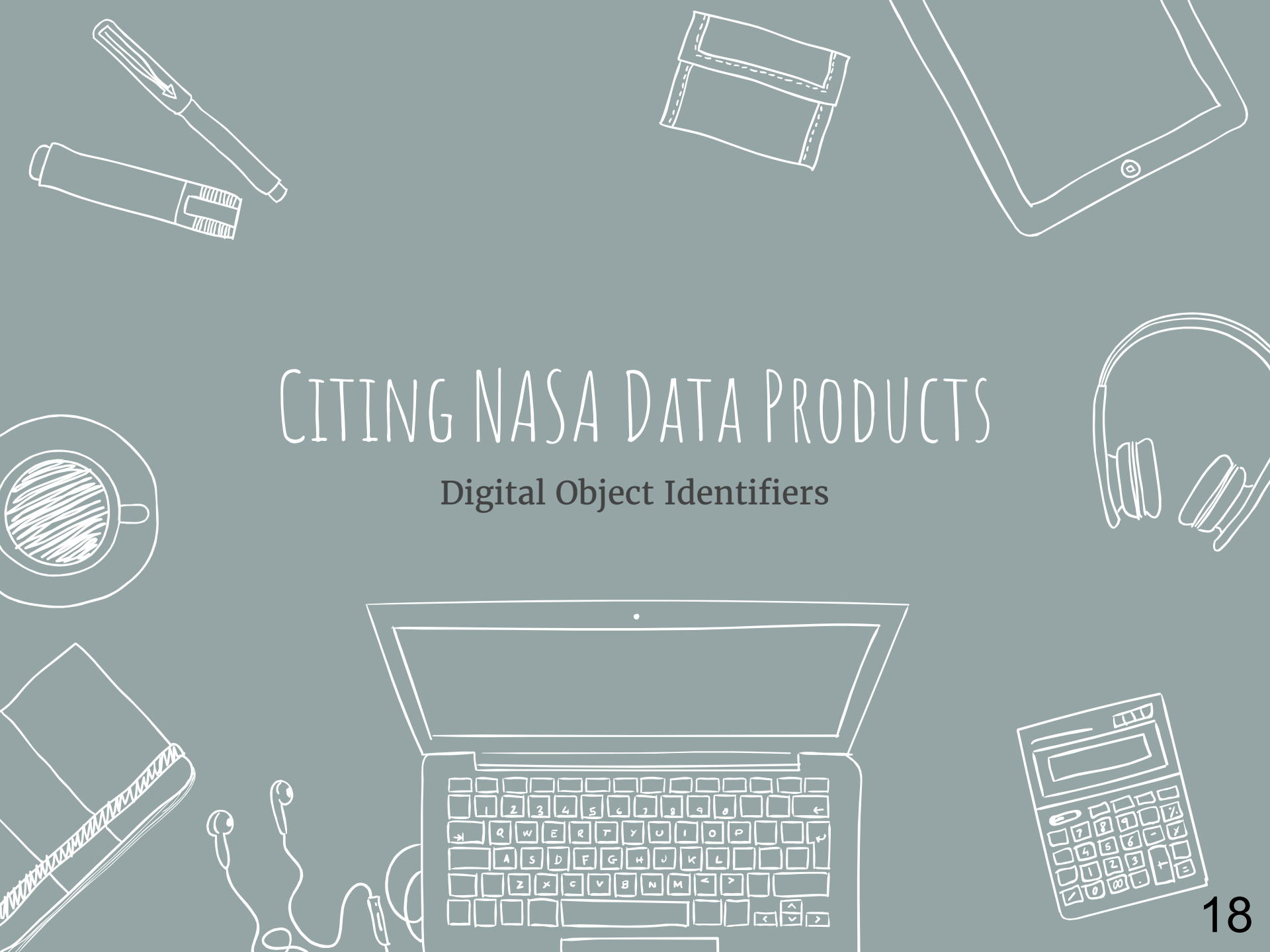
Spell out abbreviations and acronyms

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
AVHRR	Advanced Very High Resolution Radiometer
DMSP	Defence Meteorological Satellite Program
IRT	Infared Thermometer
IFOV	Instantaneous Field of View
MSS	Multispectral Scanner
NDVI	Normalized Difference Vegetation Index
SUHI	Surface Urban Heat Island.
TIMS	Thermal Infrared Multispectral Scanner.
TIrS	Thermal Infrared Scanner.
UHI	Urban Heat Island
UCL	Urban Canopy Layer
UBL	Urban Boundary Layer

and

Define discipline specific terms

Aerosol optical depth (AOD) or thickness	The integral of the atmospheric extinction coefficient from the surface to space (unitless)
Air mass (sunphotometry)	The inverse of the cosine of the solar zenith angle (i.e., an air mass of 1 is vertical and air mass of 5 is a solar angle zenith angle of 78°).
Albedo	From the Greek meaning "reflectance," albedo is the ratio of the scattered to scattered plus absorbed radiation. For the surface, the albedo is the percentage of the intercepted radiation that is scattered back to space. The Earth's average albedo is ~30% in the visible.
Anomaly	In a satellite orbit, the angle between the satellite and its position at the perigee.
Blackbody	An object that is in thermal equilibrium with its environment and radiates as much energy as it receives.
Emissivity	The fraction of emitted infrared radiation to that which would be expected from a perfect blackbody at temperature *T*.
Extinction	The sum of scattering and absorption; the extinction coefficient is a measure of light loss per meter of path (units m^{-1}).
Extrinsic (intrinsic) properties	Aerosol microphysical properties that depend (do not depend) on the number density of the aerosol.
Irradiance	The measurement of the flux of energy across a plane area (units $W \cdot m^{-2}$) or spectral irradiance, the flux within a limited range of wavelengths (units $W \cdot m^{-2} \cdot nm^{-1}$, visible, or $mW \cdot m^{-2} \cdot cm$, infrared).
LEO, MEO, GEO	Low, medium, and geostationary Earth orbit. Note GEO is also used for Geostationary Earth Observations and Global Earth Observations in other contexts.
Perigee, periapsis	The point in the path of an orbiting body that is closest to the surface.
Precess	Change in the orbital plane of an orbit with respect to the Earth's pole.
Product	The result of a satellite retrieval algorithm that describes a dataset from an instrument designed to represent a geophysical parameter.
Specific extinction coefficient	The mass weighted extinction or the extinction per unit concentration of an aerosol (units $m^2 \cdot g^{-1}$).
Spectral radiance	The physical measurement of radiation intensity within a defined solid angle and at a given wavelength (units $W \cdot m^{-2} \cdot nm^{-1} \cdot sr^{-1}$ in visible or $mW \cdot m^{-2} \cdot cm \cdot sr^{-1}$ in infrared). This is what a satellite uses as a signal.
Terminator	The line on the Earth between the illuminated and dark hemispheres



Citing NASA Data Products

Digital Object Identifiers

DOIs

What?

A unique alphanumeric string used to ID a digital object and provide a permanent link online

Why?

- Provide persistent identification for easier access to research data
- Find definitive documentation & creation of the data
- Increases verification and validation of scientific results

doi:[prefix]/[suffix]

prefix	**suffix**
10.[number]	IDs data item

5067 – NASA
5066 - USGS

NASA Earthdata DOIs

EARTHDATA Data Discovery DAACs Community Science Disciplines

Earthdata Wiki Spaces Forums Support Log

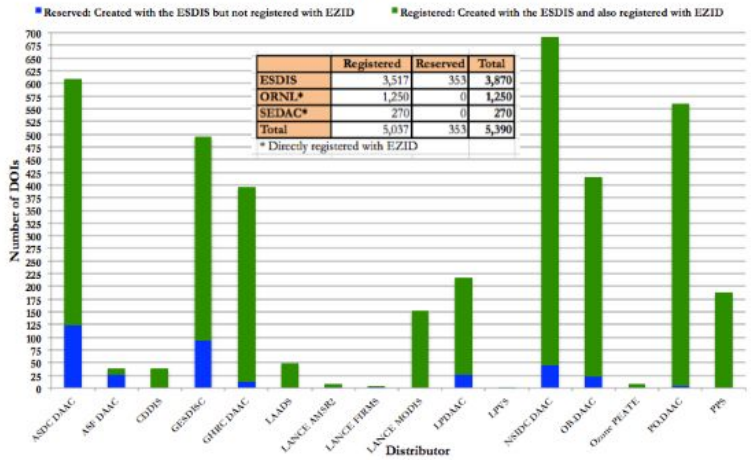
EOSDIS DOIs Status and Listing

Created by Beth Stolte, last modified on Feb 08, 2017

Many EOSDIS components have created DOIs and registered or reserved them using our help. The following missions and projects have begun the process of creating and registering DOIs. The chart below shows the registered/reserved DOIs by Data Provider. The table below gives a status of each mission's DOIs. The links go to the mission page where there is information about the DOIs they have begun to create.

- DOI Background Information
- ESDIS DOI Process
- DOI Submission Process
- DOI Landing Page
- Contact Information
- EOSDIS DOIs Status and Listing
- DOI Documents
- ESDSWG Recommendations
- FAQs
- References and Links

Status of Digital Object Identifiers (DOI) Created with the ESDIS by the Data Providers as of 6 March 2017



	Registered	Reserved	Total
ESDIS	3,517	353	3,870
ORNL*	1,250	0	1,250
SEDAC*	270	0	270
Total	5,037	353	5,390

* Directly registered with EZID

Data Distributor	DOI Provider	Registered	Reserved	Total DOIs
ASDC DAAC	ASDC DAAC	486	123	609
ASF DAAC	ASF DAAC	12	26	38
CDDIS	CDDIS	39	0	39
GES DISC	GES DISC	401	94	495
GHRC DAAC	GHRC DAAC	383	12	395
LAADS	LAADS	48	0	48
LANCE AMSR2	LANCE AMSR2	6	1	7
LANCE FIRMS	LANCE FIRMS	2	1	3
LANCE MODIS	LANCE MODIS	152	0	152
LP DAAC	LP DAAC	191	27	218
LPVS	LPVS	1	0	1
NSIDC DAAC	ICESat SIPS	21	0	692
	NSIDC DAAC	627	44	
OB.DAAC	OB.DAAC	394	22	416
Ozone PEATE	Ozone PEATE	7	0	7

DOI	Product Title	Shortname	Creator	Distributor	P Y
10.5067/CALIOP/CALIPSO/CAL_LID_L1-ValStage1-V3-40	CALIPSO LID L1 ValStage1 HDF File - Version 3.40	CAL_LID_L1-ValStage1-V3-40	Winker, David	NASA Langley Atmospheric Science Data Center DAAC	20
10.5067/CALIOP/CALIPSO/CAL_LID_L2_PSCMask-Prov-V1-10	CALIPSO LID L2 PSCMask Prov HDF File - Version 1.10	CAL_LID_L2_PSCMask-Prov-V1-10	Winker, David	NASA Langley Atmospheric Science Data Center DAAC	20
10.5067/CALIOP/CALIPSO/CAL_LID_L3_APro_AllSky-Standard-V3-10	CALIPSO LID L3 Apro AllSky - Standard HDF File - Version 3.10	CAL_LID_L3_APro_AllSky-Standard-V3-10	Winker, David	NASA Langley Atmospheric Science Data Center DAAC	20
10.5067/CALIOP/CALIPSO/CAL_LID_L3_APro_CloudFree-Standard-V3-10	CALIPSO LID L3 Apro Cloud Free - Standard HDF File - Version 3.10	CAL_LID_L3_APro_CloudFree-Standard-V3-10	Winker, David	NASA Langley Atmospheric Science Data Center DAAC	20
10.5067/CALIOP/CALIPSO/CAL_LID_L3_APro_CloudySkyOpaque-Standard-V3-10	CALIPSO LID L3 Apro Cloudy Sky Opaque - Standard HDF File- Version 3.10	CAL_LID_L3_APro_CloudySkyOpaque-Standard-V3-10	Winker, David	NASA Langley Atmospheric Science Data Center DAAC	20
10.5067/CALIOP/CALIPSO/CAL_LID_L3_APro_CloudySkyTransparent-Standard-V3-10	CALIPSO LID L3 Apro Cloudy Sky Transparent - Standard HDF File - Version 3.10	CAL_LID_L3_APro_CloudySkyTransparent-Standard-V3-10	Winker, David	NASA Langley Atmospheric	20

http://citation.crosscite.org/

DOI: 10.5067/CALIOP/CALIPSO/CAL_LID_L1-ValStage1-V3-40

Product Title: CALIPSO LID L1 ValStage1 HDF File - Version 3.40

Shortname: CAL_LID_L1-ValStage1-V3-40

Creator: Winker, David

Distributor: NASA Langley Atmospheric Science Data Center DAAC

Publication Year: 2016

URL:

https://eosweb.larc.nasa.gov/project/calipso/CAL_LID_L1-ValStage1-V3-40_table

CAL_LID_L1-ValStage1-V3-40

Version 3.40, Validated Stage 1

Expedited Data Set

Project Title:	CALIPSO
Discipline:	Clouds Aerosols
Version:	V3
Platform:	CALIPSO
Instrument:	Cloud-Aerosol LIdar with Orthogonal Polarization (CALIOP)
Spatial Coverage:	(-90, 90)(-180,180)
Spatial Resolution:	333 m
Temporal Coverage:	12/15/2016 - present
Temporal Resolution:	0.05 seconds

ASDC Order Tool: **Order Data**

Subset/Visualization Tool: CALIPSO Subsetting Tool

Quality Summary: Version 3

User's Guide

DOI:
10.5067/CALIOP/CALIPSO/LID_L1-ValStage1-V3-40_L1B-003.40

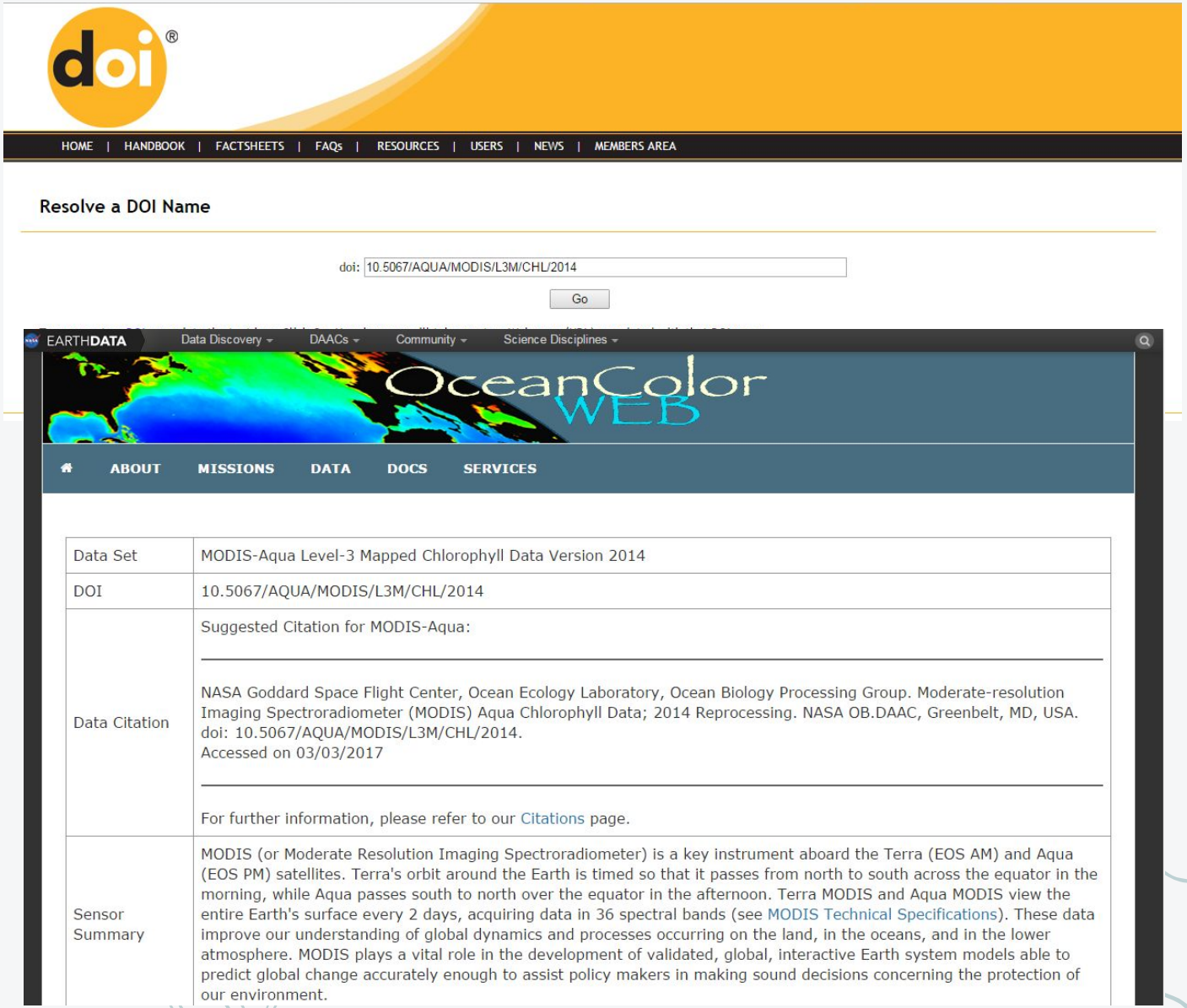
Browse Images | **Parameters** | **Order Data** | **Documentation** | **Data Citation**

To cite the data in publications:

CALIPSO Science Team (2015), CALIPSO/CALIOP Level 1B, Lidar Profile Data, version 3.40, Hampton, VA, USA: NASA Atmospheric Science Data Center (ASDC), Accessed <**author citing data inserts date here**> at doi: 10.5067/CALIOP/CALIPSO/LID_L1-ValStage1-V3-40_L1B-003.40

For more general information, please see our Data Product Citation page

DX.DOI.ORG


doi
HOME | HANDBOOK | FACTSHEETS | FAQs | RESOURCES | USERS | NEWS | MEMBERS AREA
Resolve a DOI Name
doi: 10.5067/AQUA/MODIS/L3M/CHL/2014
Go
EARTHDATA
Data Discovery
DAACs
Community
Science Disciplines
OceanColor WEB
ABOUT
MISSIONS
DATA
DOCS
SERVICES
Data Set
MODIS-Aqua Level-3 Mapped Chlorophyll Data Version 2014
DOI
10.5067/AQUA/MODIS/L3M/CHL/2014
Data Citation
Suggested Citation for MODIS-Aqua:
NASA Goddard Space Flight Center, Ocean Ecology Laboratory, Ocean Biology Processing Group. Moderate-resolution Imaging Spectroradiometer (MODIS) Aqua Chlorophyll Data; 2014 Reprocessing. NASA OB.DAAC, Greenbelt, MD, USA. doi: 10.5067/AQUA/MODIS/L3M/CHL/2014.
Accessed on 03/03/2017
For further information, please refer to our Citations page.
Sensor Summary
MODIS (or Moderate Resolution Imaging Spectroradiometer) is a key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS view the entire Earth's surface every 2 days, acquiring data in 36 spectral bands (see MODIS Technical Specifications). These data improve our understanding of global dynamics and processes occurring on the land, in the oceans, and in the lower atmosphere. MODIS plays a vital role in the development of validated, global, interactive Earth system models able to predict global change accurately enough to assist policy makers in making sound decisions concerning the protection of our environment.

Mandatory ESA Sentinel Citation

“This material conatins modified Copernicus Sentinel data (yyyy i.e. 2017), processed ESA” (If more than ESA then we are normally obliged to give right credits as well to the other entities)

Example:

“Copyright contains modified Copernicus Sentinel and Landsat data (2015–16), processed and analysed by Humboldt University Berlin/P. Griffiths (ESA Living Planet Research Fellow). Data preprocessing: NASA and Harmonized Landsat–Sentinel initiative.”

See **Tech Paper page** on DEVELOPedia for more info!

Common Mistakes

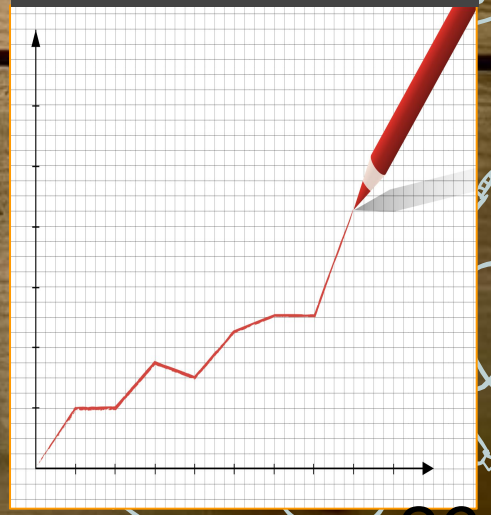
Keep a sharp eye out

DATA = PLURAL

"The data are" NOT "the data is"

DATA SINGULAR

DATA PLURAL



Incorrectly using APA Style

In-text citations:

Number of authors	First text citation	Subsequent text citations
One or two	Grice & Walton, 2017	Grice & Walton, 2017
Three to five	**Ohta, Mitchekk, & McMahon, 2006**	**Ohta et al., 2006**
Six or more	Falchi et al., 2016	Falchi et al., 2016

Use the word **"and" within the text** and use the **ampersand (&) in parentheses**

- Research by Wegener and Petty (1994) supports...
- (Wegener & Petty, 1994)

Purdue Online Writing Lab - APA Style

Incorrectly using APA Style

References:

When referring to books, chapters, articles or Web pages, **capitalize only** the first letter of **the first word of a title/subtitle**, the first word after a colon/dash, and proper nouns

✓ Gregalis, K. C., Powers, S., & Heck Jr., K (2008). Restoration of oyster reefs along a bio-physical gradient in Mobile Bay, Alabama. *Journal of Shellfish Research, 27(5)*, 1163-1169.

✗ Gregalis, K. C., Powers, S., & Heck Jr., K (2008). Restoration of Oyster Reefs Along a Bio-physical Gradient in Mobile Bay, Alabama. *Journal of Shellfish Research, 27(5)*, 1163-1169.

Common Mistakes

Validate
Be careful how you use the word “validate”. You only validate with *in situ* data, nothing else. A different word to use could be “compare”.

Acronyms
Please define an acronym in the beginning of the tech paper. From there on, use acronym or spell out - whichever works best!

URLs
Please DO NOT include URLs in the body of the tech paper. Instead, include an in-text citation, and put the URL in the references section.

Consistency
‘We’ vs. ‘the team’ vs. ‘the project’

Figures & Tables
All text on figures should be legible & garamond font (including axis titles, legends, labels, etc.); reference them in text

Word Choice
Avoid conversational language and vague sentences. Look at your sources for examples of professional language.

(More) Common Mistakes

Weak Verbs
"To be or not to be?" The answer is "not to be!" Try to use descriptive verbs that indicate action. Your writing will improve vs.

Your writing will be better.

Nouniness
Noun chains impede sentence flow. That is, noun chains cause

noun chain sentence flow impediment problems.

The Active Voice
The team clipped 32 Landsat scenes.

32 Landsat scenes were clipped by the team.

Equation numbering
Start equations on a new line and number consecutively, using numbers in parentheses near the right margin.

For example:

Pythagoras said he could write on the moon and also really loved triangles (see Equation 1).

$$A^2 + B^2 = C^2 \qquad (1)$$

Citations
Don't cite sources in the text body that are not in the References section and vice versa. Use APA formatting and don't rely on Google Scholar for formatting!

Sentence Structure
To keep the reader engaged, vary the sentence structure while maintaining appropriate length and complexity. Don't drown your reader in clauses, conjunctions, or commas!

Things to Remember

You are making an argument – **support it**!

When in doubt, refer back to your **objectives**.

Use the power of **topic sentences**!

Use **past tense** throughout!

Tech Paper is in **Garamond** not Century Gothic

We're here to help

☺

Online Resources

- **How to Write a Paper in Scientific Journal Style and Format**
  http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWsections.html
- **Reporting Statistical Results in Your Paper**
  http://abacus.bates.edu/~ganderso/biology/resources/writing/HTWstats.html
- **Interpreting P value** https://www.youtube.com/watch?v=03bw0ByJrkE
- **Issues in Reading Statistical Tables** https://www.youtube.com/watch?v=b-N7vPlYBDo
- **Reporting Statistics in APA Style** http://my.ilstu.edu/~jhkahn/apastats.html
- **Reporting Results of Common Statistical Tests in APA Format**
  http://www.psych.uw.edu/writingcenter/writingguides/pdf/stats.pdf
- **Writing Tips and Lessons**
  http://www.quickanddirtytips.com/education/grammar/active-voice-versus-passive-voice?page=2

  https://owl.english.purdue.edu/owl/resource/539/02/

  http://writingcenter.unc.edu/handouts/passive-voice

  http://legalsolutions.thomsonreuters.com/law-products/promotions/dat/effective-legal-writing

Questions?

Full Speed Ahead!