

Transición de MODIS a VIIRS para Aplicaciones de la Calidad del Aire

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22 de octubre de 2020, Capacitación Online



Estructura y Material del Curso

- Las grabaciones de los webinars, las presentaciones PowerPoint y la tarea asignada se podrán encontrar después de cada sesión en la siguiente página:
 - <https://appliedsciences.nasa.gov/join-mission/training/english/modis-viirs-transition-air-quality-applications>
 - Preguntas y Respuestas después de cada sesión y/o por correo electrónico a:
 - pawan.gupta@nasa.gov o
 - melanie.cook@nasa.gov



Objetivos de Aprendizaje

Al final de esta capacitación, los/las participantes podrán:

- Acceder a productos de aerosoles de NASA VIIRS a través de Earthdata
- Describir las diferencias entre los instrumentos de MODIS y VIIRS y productos de la profundidad óptica de aerosoles (aerosol optical depth o AOD)
- Entender cómo las observaciones de la profundidad óptica de aerosoles se pueden utilizar para aplicaciones de la calidad del aire



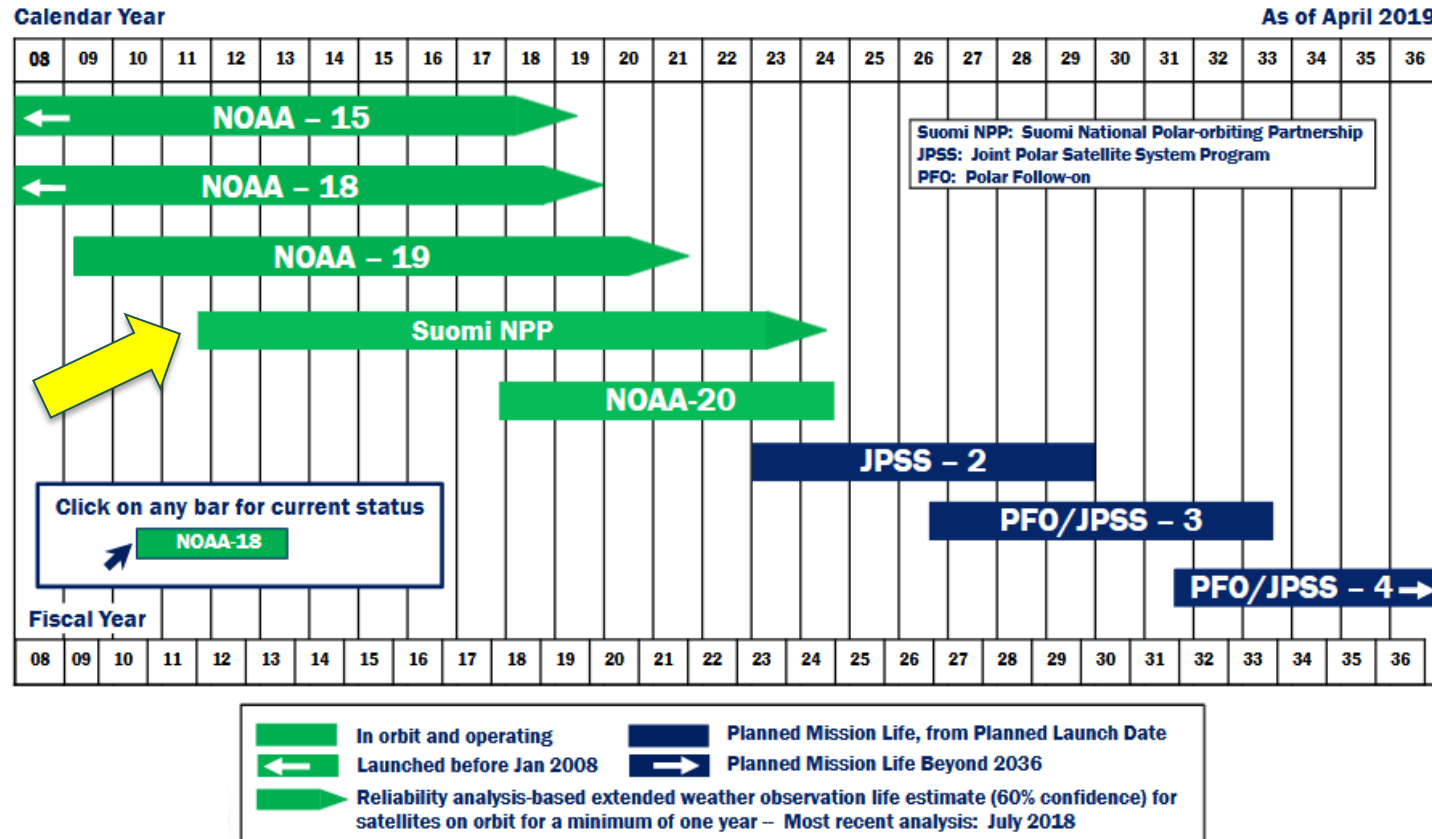


Satélites y Sensores

Serie de Satélites de la NOAA – Perspectiva Histórica



NOAA Polar Satellite Programs Continuity of Weather Observations

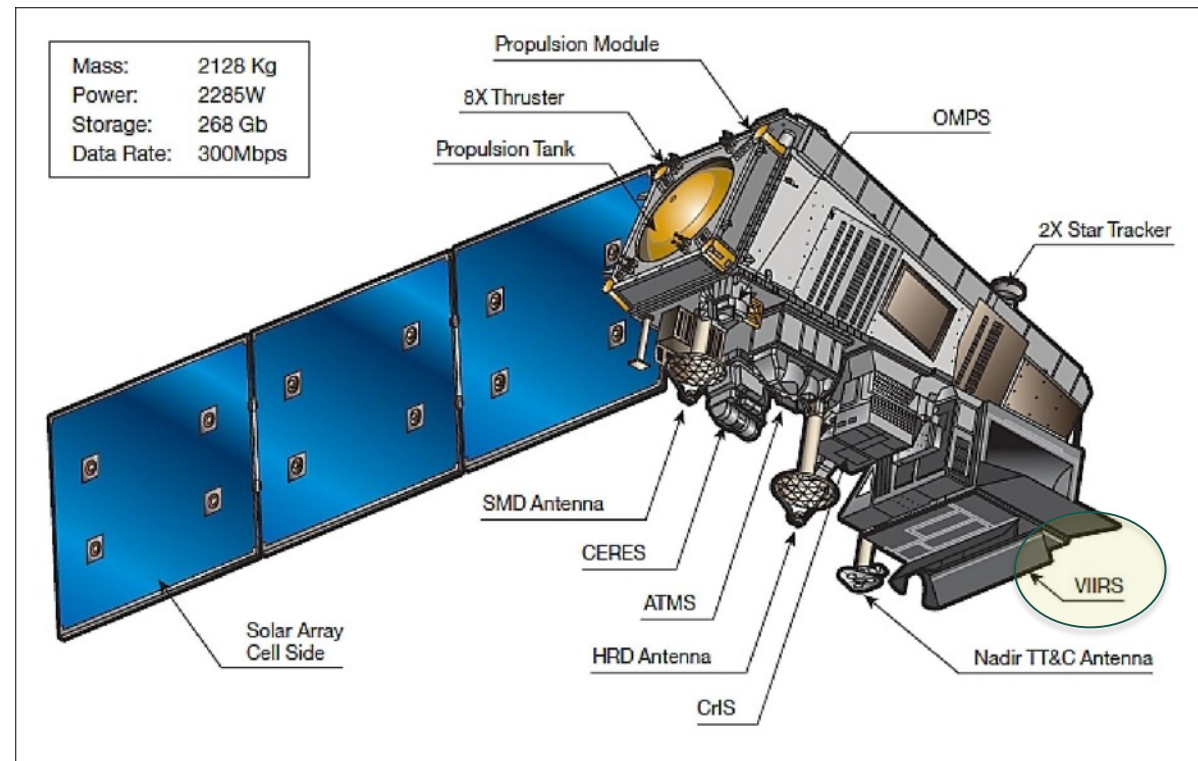


https://www.nesdis.noaa.gov/sites/default/files/asset/document/POES_Flyout_April_2019_Signature.pdf



El Satélite S-NPP

- Nombrado en honor a Verner E. Suomi, un meteorólogo en la Universidad de Wisconsin, reconocido como “el padre de la meteorología satelital.”
- **Sensores**
 - **VIIRS** (Visible/Infrared Imager and Radiometer Suite) – Tierra, Atmósfera, Océano
 - **CrIS** (Cross-Track Infrared Sounder)- Vapor de Agua, Presión
 - **OMPS** (Ozone Mapping and Profiler Suite) - Ozono
 - **ATMS** (Advanced Technology Microwave Sounder) – Humedad y Temperatura
 - **CERES** (Clouds and the Earth's Radiant Energy System) – Balance Energético

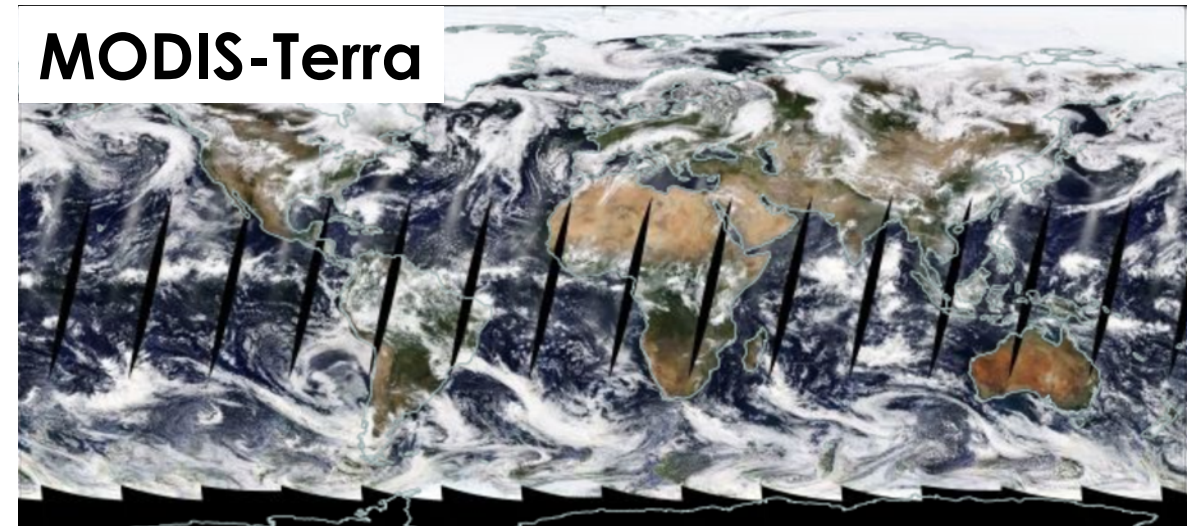
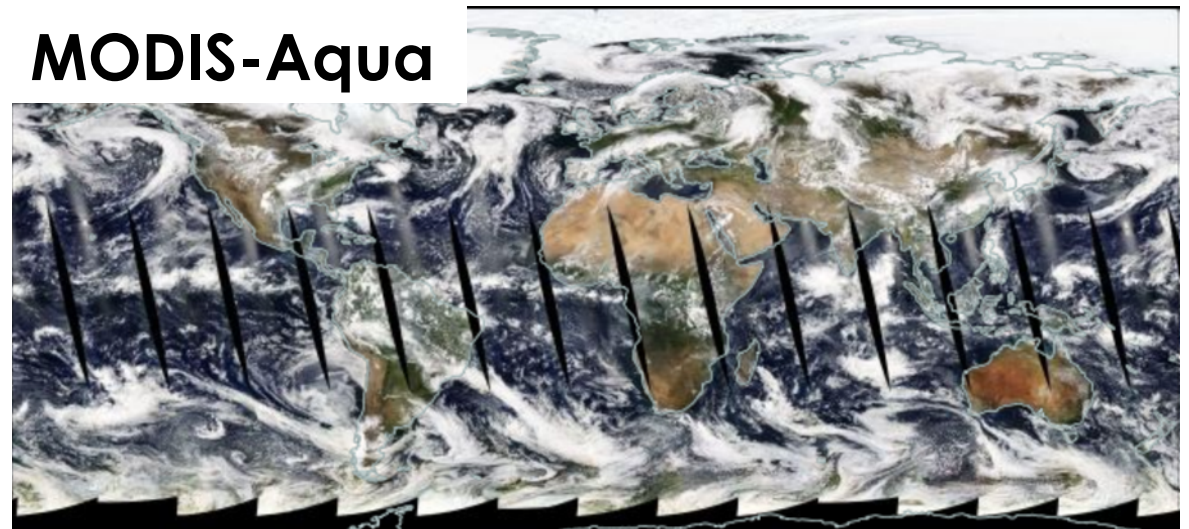


<https://directory.eoportal.org/web/eoportal/satellite-missions/s/suomi-npp>



Moderate Resolution Imaging Spectroradiometer (MODIS)

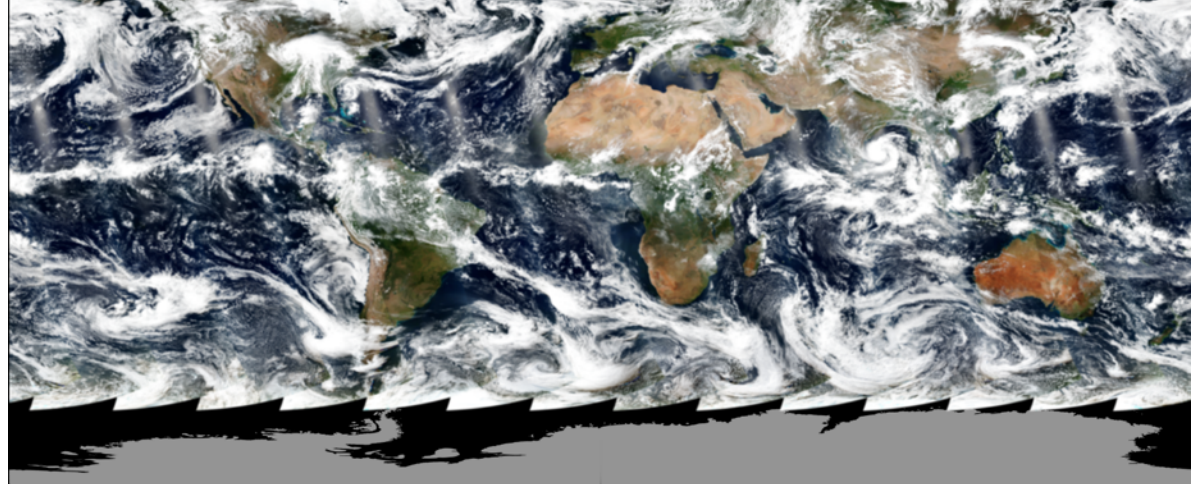
- 2000 – Hoy
- Resolución Espacial:
 - 250 m, 500 m, 1 km
- Plataformas:
 - Terra (paso superior matutino)
 - Aqua (paso superior vespertino)
- Resolución Temporal:
 - Diaria, 8 días, 16 días, mensual, anual
- Cobertura Espectral:
 - 36 Bandas (bandas principales incluyen roja, azul, infrarroja, infrarroja cercana e infrarroja media)
- Brinda mediciones de la tierra, el agua y la atmósfera



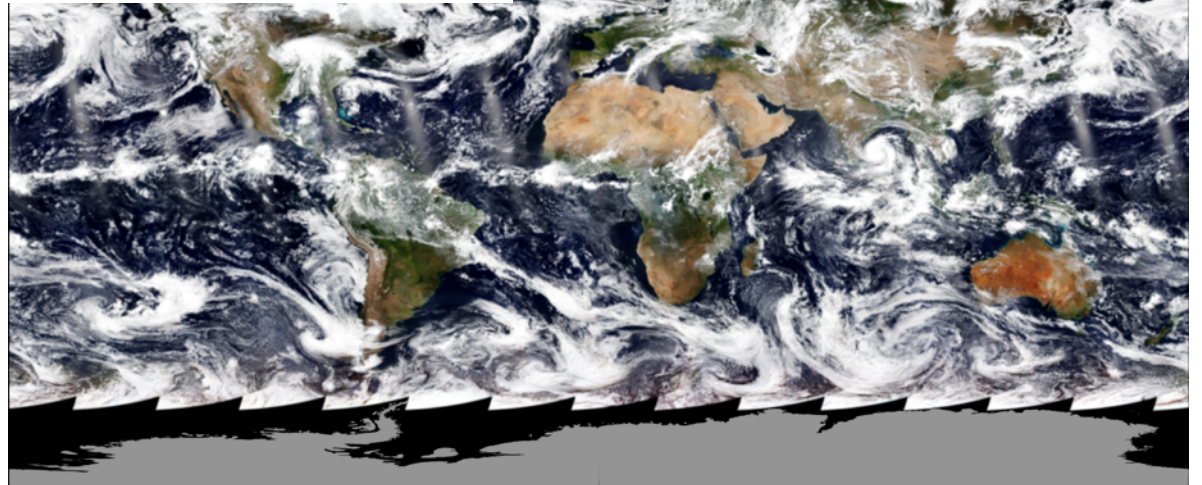
Visible Infrared Imaging Radiometer Suite (VIIRS)

- 2011 – Hoy
- Resolución Espacial:
 - 375 m, 750 m
- Plataformas:
 - SNPP, NOAA20 (JPSS1) - Actual
 - JPSS2, JPSS3 - Futura
- Resolución Temporal:
 - Diaria, 8 días, 16 días, mensual, anual
- Cobertura Espectral:
 - 22 bandas (bandas principales incluyen roja, azul, infrarroja, infrarroja cercana, infrarroja media)
- Brinda mediciones de la tierra, el agua y la atmósfera

VIIRS-SNPP



VIIRS-NOAA 20





MODIS vs. VIIRS

MODIS vs. VIIRS – Perspectiva Histórica

- S-NPP sirve como puente entre los satélites NASA EOS y JPSS.
- JPSS anteriormente se llamaba NPOESS
- JPSS fue desarrollado por la NASA para la NOAA

MODIS - Moderate Resolution Imaging Spectroradiometer

VIIRS – Visible Infrared Imaging Radiometer Suite

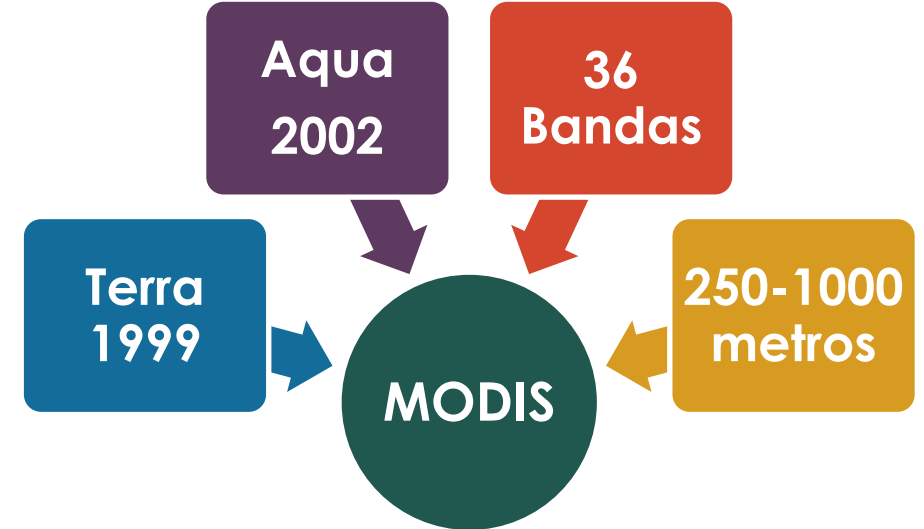
NPOESS - National Polar-orbiting Operational Environmental Satellite System

S-NPP - Suomi National Polar-orbiting Partnership

JPSS - Joint Polar Satellite System (NOAA 20)

EOS - Earth Observing System

Misiones NASA EOS

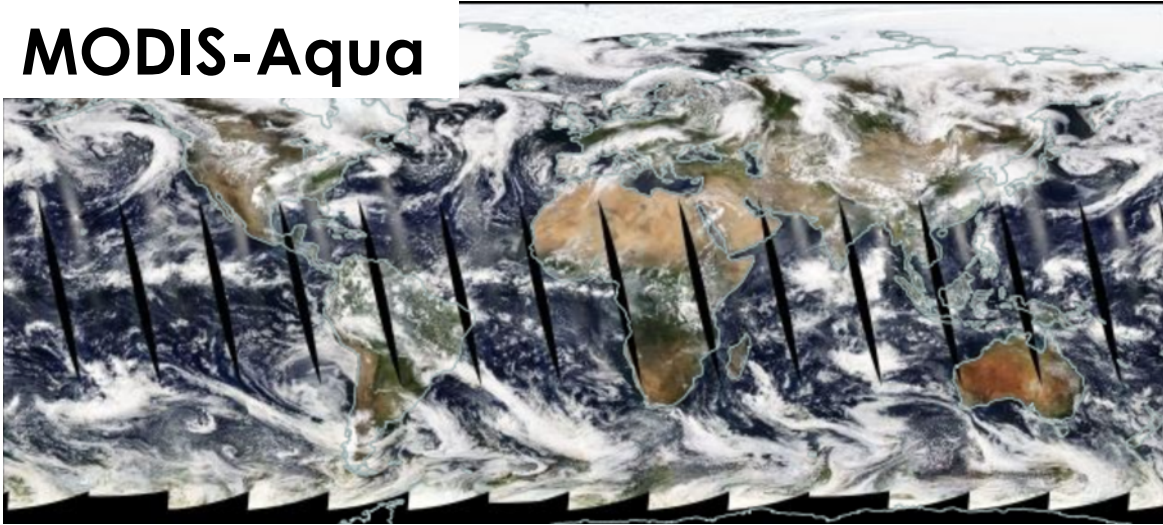


Misión Colaborativa NASA-NOAA

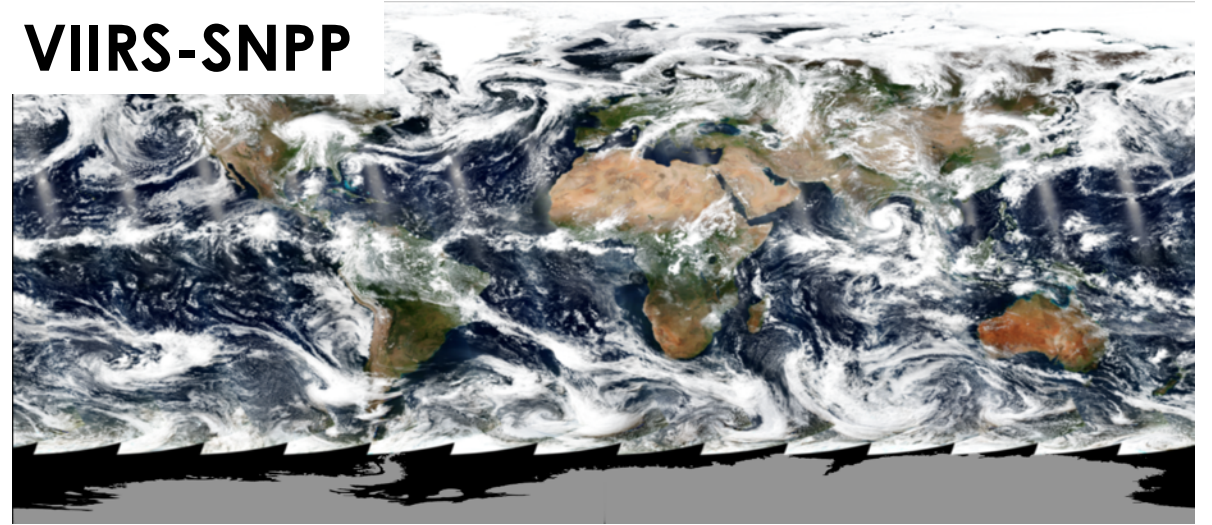


MODIS vs. VIIRS - Cobertura

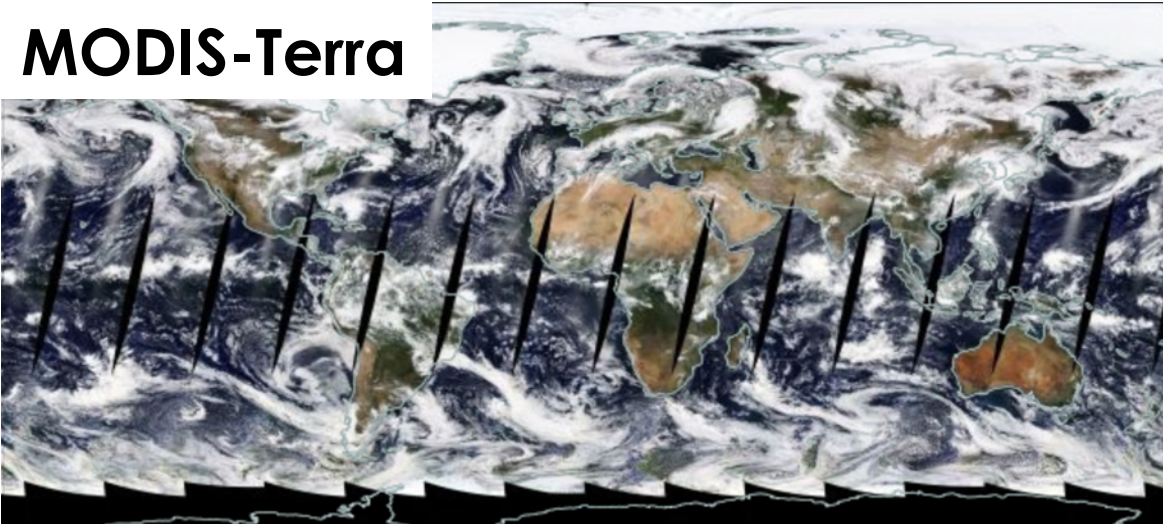
MODIS-Aqua



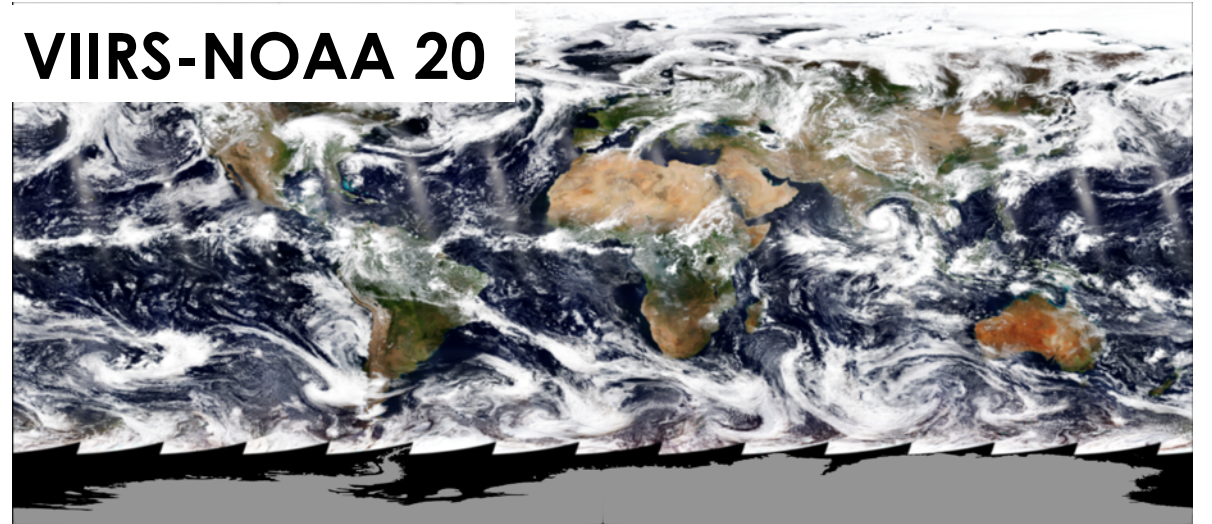
VIIRS-SNPP



MODIS-Terra



VIIRS-NOAA 20



Visible Infrared Imaging Radiometer (VIIRS)

Un captador de imágenes de múltiples longitudes de onda como MODIS con bandas de longitudes de onda similares

| | MODIS | VIIRS-SNPP | VIIRS-N20 |
|--------------------------|------------------------------|----------------------------|----------------------------|
| Altura Orbital | 690 km | 824 km | 824 |
| Hora de Cruce Ecuatorial | 13h30 hora local | 13h30 hora local | 12h40 hora local |
| Franja | 2,330 km | 3,060 km | 3,060 km |
| Pixel en el Nadir | 0.5 km | 0.75 km | 0.75 km |
| Pixel en el Borde | 2 km | 1.5 km | 1.5 km |
| Cobertura Espectral | 0.405 a 14.385 μm | 0.412 a 12.1 μm | 0.412 a 12.1 μm |
| Bandas Espectrales | 36 | 22 | 22 |

*Radiómetro de Imágenes Visibles e Infrarrojas





Imágenes de Color Real

Imagen de Color Real (o RGB)

Una “imagen de color real” de MODIS usa las bandas de longitudes de onda visibles 1, 4, 3.

R = 0.66 μm

G = 0.55 μm

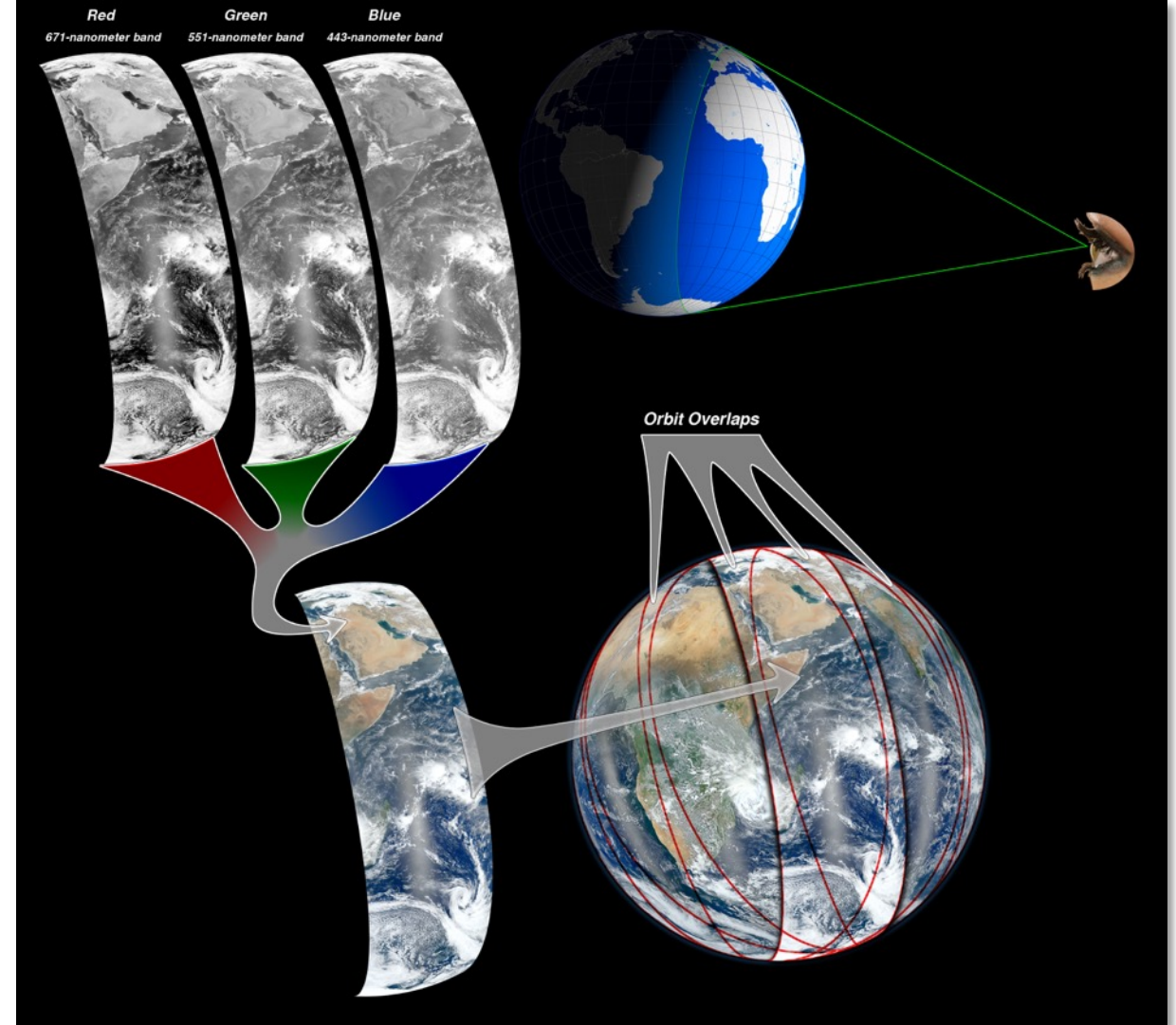
B = 0.47 μm

Una “imagen de color real” de VIIRS usa las bandas de longitudes de onda visibles I1, M4, M3.

R = 0.640 μm

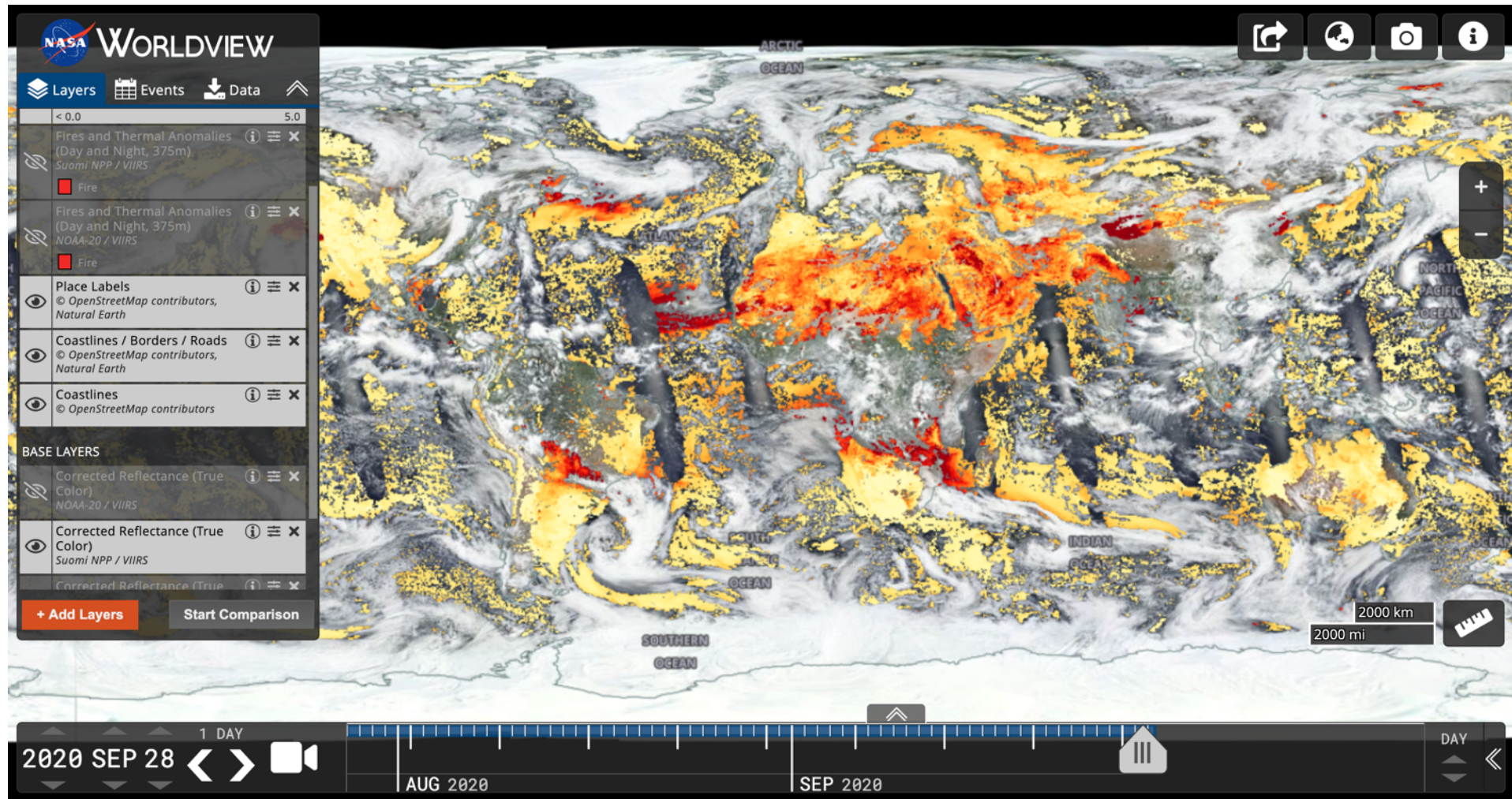
G = 0.555 μm

B = 0.488 μm



Visualización de Datos de la NASA– Nivel 1 y 2 – Tiempo Casi Real

<https://worldview.earthdata.nasa.gov/>



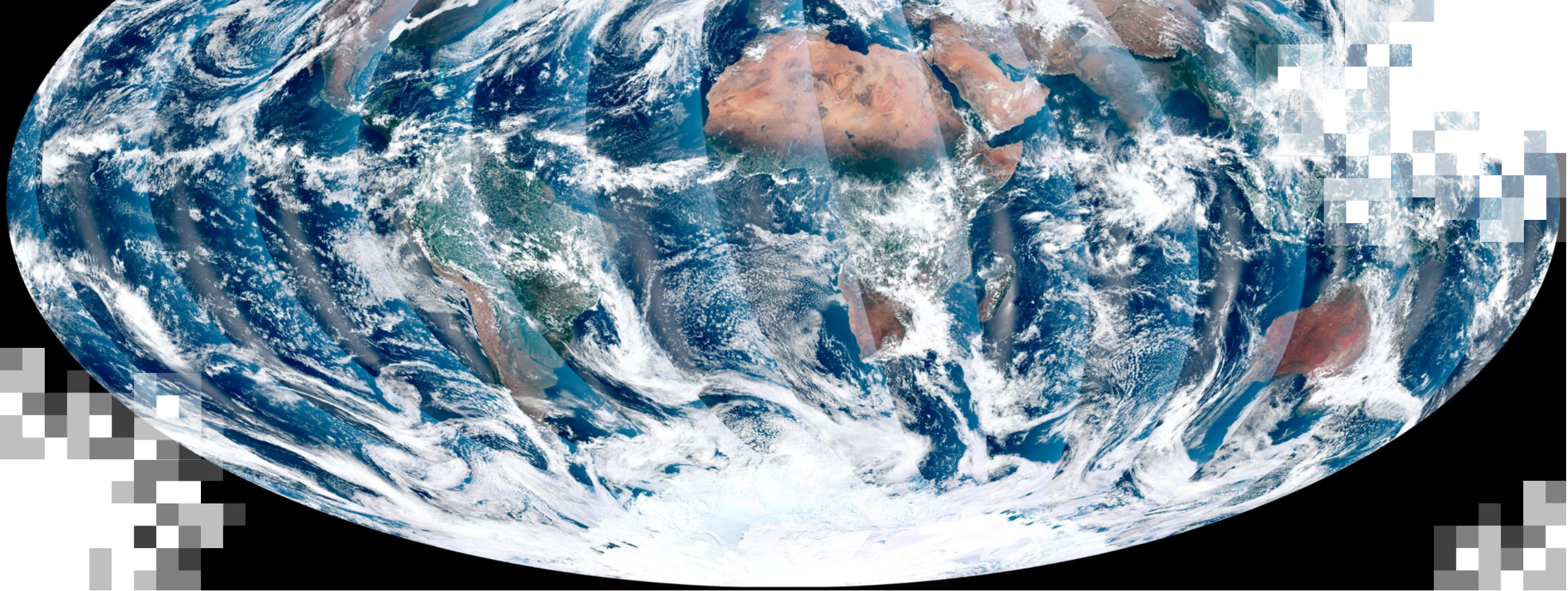


Observaciones Relevantes a la Calidad del Aire

Productos de Datos Relevantes a la Calidad del Aire

| | MODIS (T y A) | VIIRS-SNPP | VIIRS-N20 |
|---------------------------------|---------------|------------|-----------|
| Profundidad Óptica de Aerosoles | ✓ | ✓ | ✓ |
| Detección de Humo | ✗ | ✓ | ✓ |
| Detección de Polvo | ✗ | ✓ | ✓ |
| Detección de Incendios | ✓ | ✓ | ✓ |
| Imágenes de Color Real | ✓ | ✓ | ✓ |





Datos de Aerosoles de la NASA

Datos de Aerosoles – Productos de la NASA

| | MODIS (T y A) | VIIRS-SNPP | VIIRS-NOAA20 |
|-------------------------|-------------------|------------|--------------|
| Datos | AOD | AOD | X |
| Resolución Espacial | 1, 3, 10 km | 6 km | X |
| Cobertura Global | 1-2 días | Diaria | Diaria |
| Algoritmo | DT, DB, MAIAC | DB, DT | X |
| Disponibilidad de Datos | 2000 (2003) – hoy | 2012- hoy | 2017- hoy |
| Formato de Datos | HDF | NetCDF | X |

DT = Dark Target

DB = Deep Blue

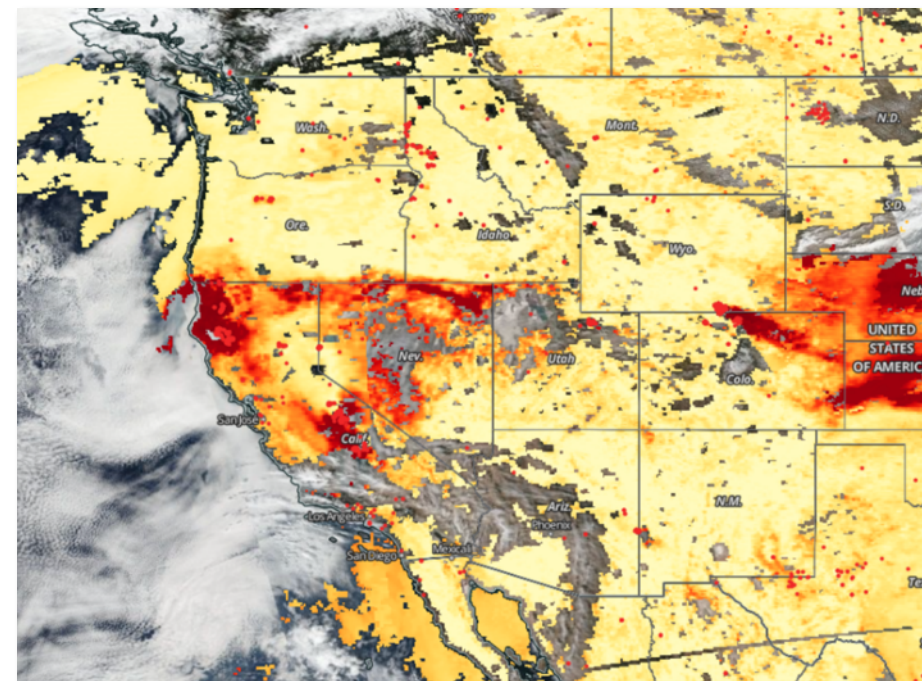
MAIAC = Multi-Angle Implementation of Atmospheric Correction



Productos SNPP VIIRS – NASA

- Deep Blue (DB)
 - Resoluciones espaciales: 6 km (Nivel 2), 1 grado (Nivel 3)
 - Productos: AOD, Angstrom Exponent, Aerosol Type
 - Nombre abreviado: AERDB_L2
 - <https://deepblue.gsfc.nasa.gov/>
- Dark Target (DT)
 - Resoluciones espaciales: 6 km (Nivel 2), 1 grado (Nivel 3)
 - Productos: AOD
 - Nombre abreviado: AERDT_L2_VIIRS_SNPP
 - https://ladsweb.modaps.eosdis.nasa.gov/missions-and-measurements/products/AERDT_L2_VIIRS_SNPP/

5 de octubre de 2020



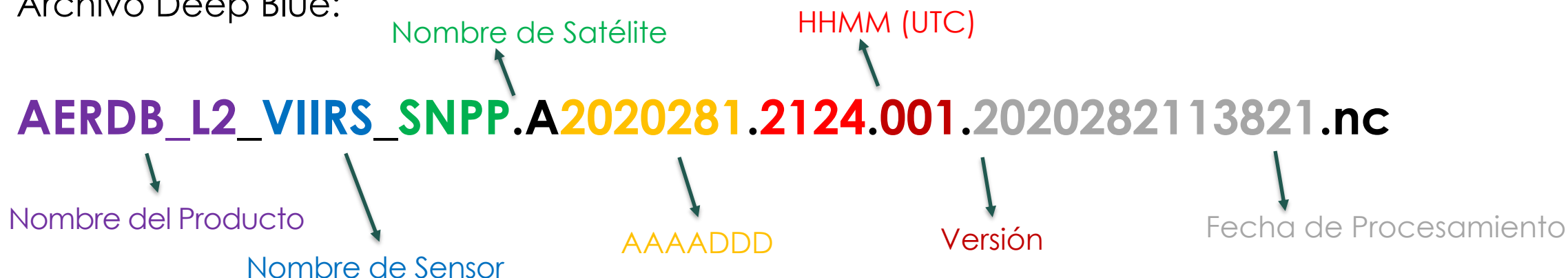
<https://go.nasa.gov/2GzTOye>



Nombres de Archivos

- Los conjuntos de datos Deep Blue y Dark Target vienen en dos archivos diferentes.

Archivo Deep Blue:



AERDB_D3_VIIRS_SNPP.A2020251.001.2020255000324.nc
AERDB_M3_VIIRS_SNPP.A2020214.001.2020252000719.nc

- Archivo Dark Target
 - AERDT_L2_VIIRS_SNPP.A2020251.2042.001.2020252071112.nc



Aerosoles Deep Blue VIIRS

<https://deepblue.gsfc.nasa.gov/data#data-viirs>

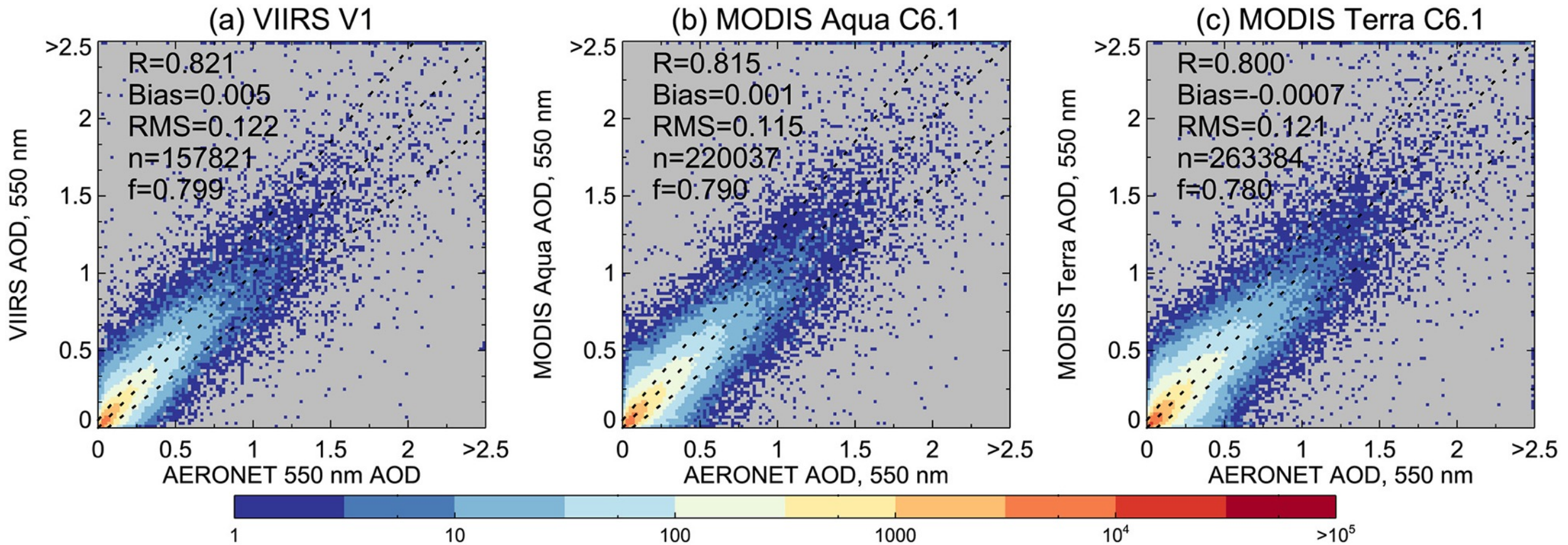
- Nivel 2
 - Archivo de 6 minutos
 - Resolución de 6x6 km en el nadir
- Nivel 3
 - Diario
 - Mensual
 - 1x1 grado
- NetCDF4

| SDS name | Description |
|--|--|
| L2 files (AERDB_L2) | |
| Latitude | Central latitude of the retrieval pixel, degrees North. |
| Longitude | Central longitude of the retrieval pixel, degrees East. |
| Aerosol_Optical_Thickness_550_Land | The AOD at 550 nm over land. |
| Aerosol_Optical_Thickness_550_Land_Best_Estimate | As above, except only populated for those retrieval pixels passing quality assurance tests. This is the SDS that is it anticipated the majority of data users will use. |
| Aerosol_Optical_Thickness_550_Ocean | The AOD at 550 nm over ocean |
| Aerosol_Optical_Thickness_550_Ocean_Best_Estimate | As above, except only populated for those retrieval pixels passing quality assurance tests. This is the SDS that is it anticipated the majority of data users will use. |
| Aerosol_Optical_Thickness_550_Land_Ocean | The combined AOD at 550 nm, from the Deep Blue algorithm over land, and the SOAR algorithm over water. |
| Aerosol_Optical_Thickness_550_Land_Ocean_Best_Estimate | As above, except only populated for those retrieval pixels passing quality assurance tests. This is the SDS that is it anticipated the majority of data users will use. |



Validación

<https://doi.org/10.1029/2018JD029688>

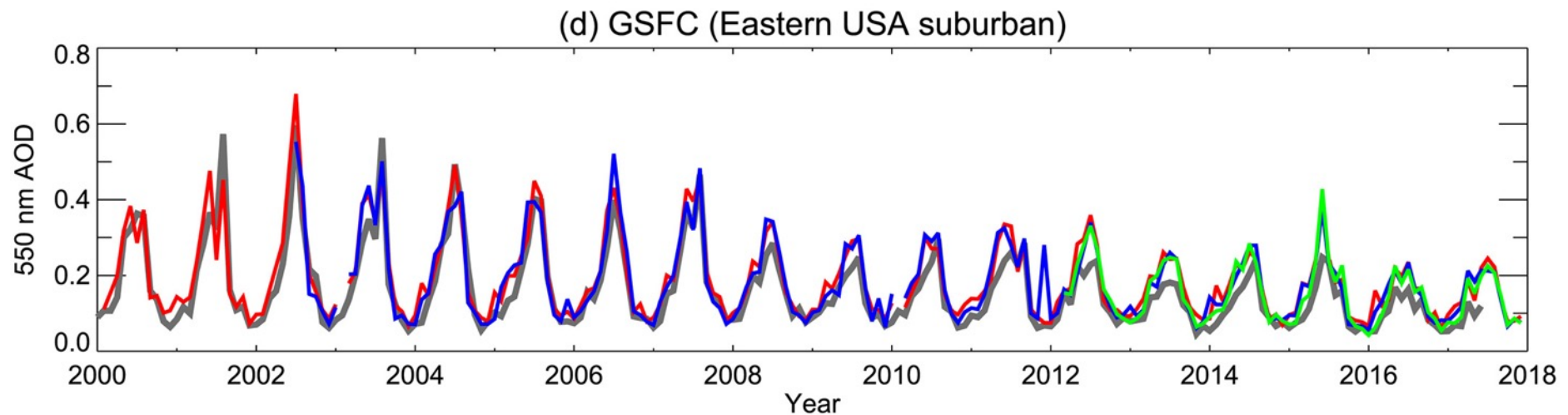
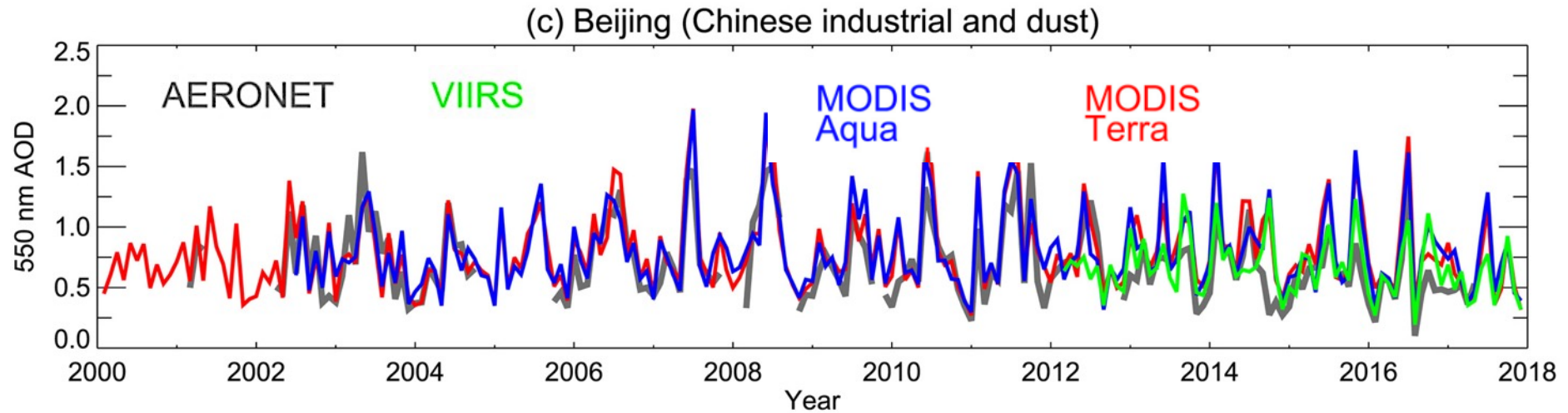


Hsu et al., 2019



Validación – Consistencia Temporal

<https://doi.org/10.1029/2018JD029688>

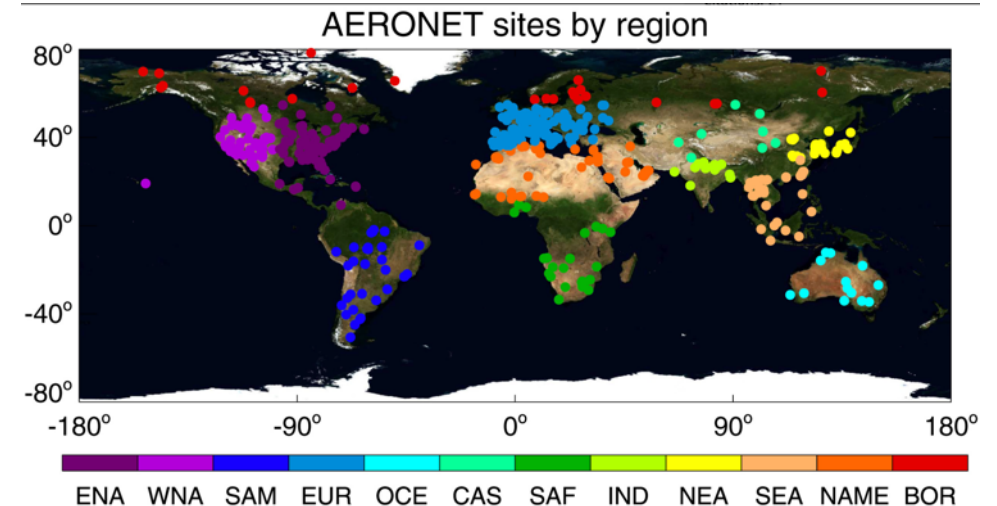
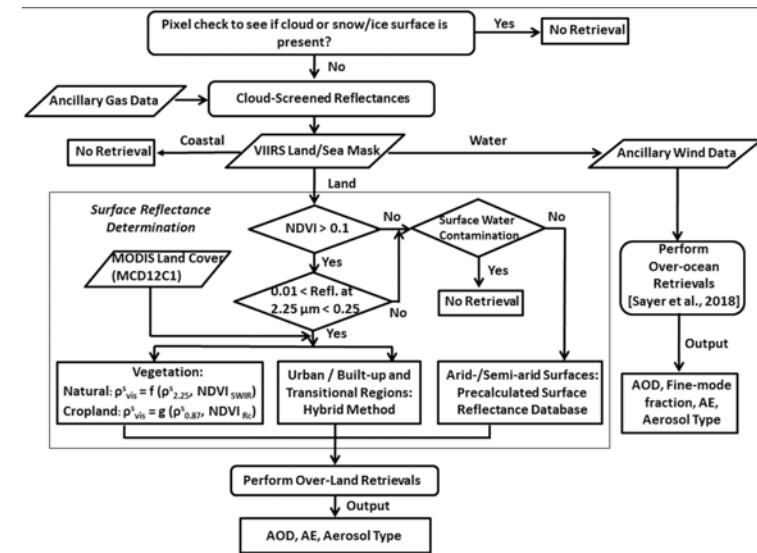


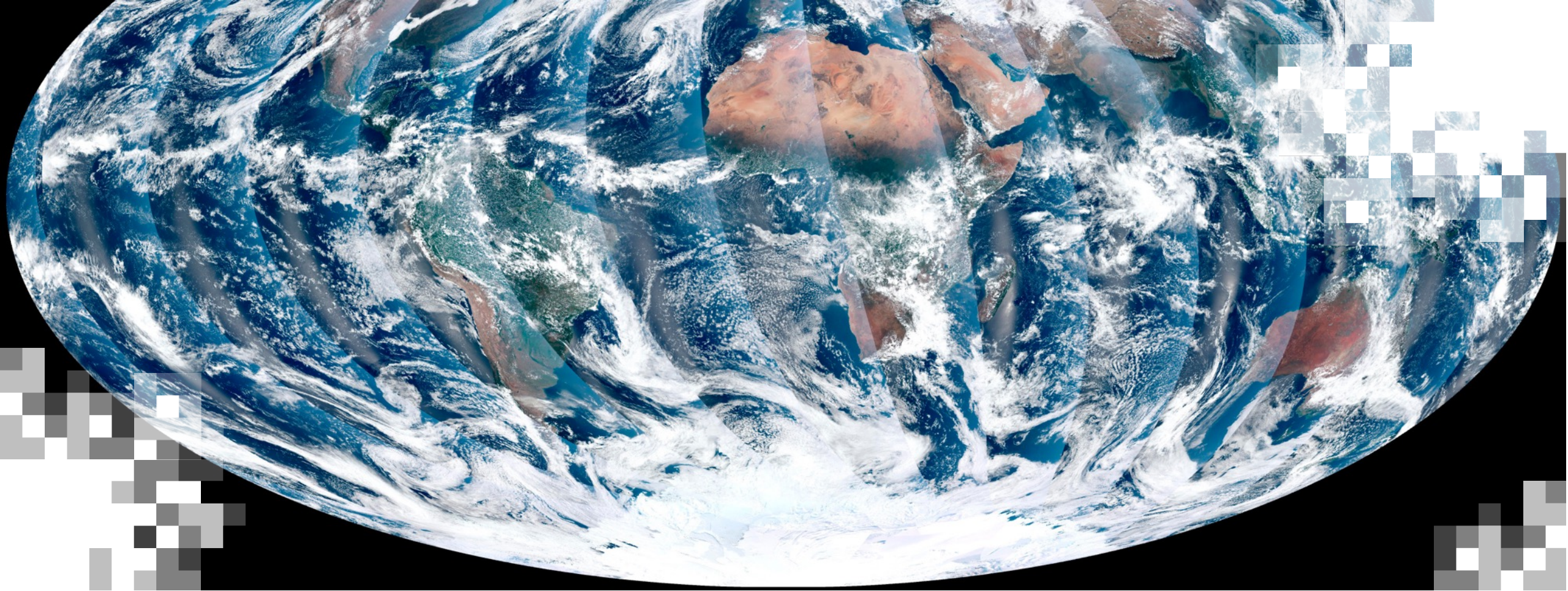
Hsu et al., 2019



Referencias de Aerosoles de VIIRS Deep Blue

- [Hsu, N. C., J. Lee, A. M. Sayer, et al. 2019.](#) "VIIRS Deep Blue Aerosol Products Over Land: Extending the EOS Long-Term Aerosol Data Records." *Journal of Geophysical Research: Atmospheres* **124** (7): 4026-4053 [[10.1029/2018jd029688](#)]
- [Sayer, A. M., N. C. Hsu, J. Lee, W. V. Kim,](#) and S. T. Dutcher. 2019. "Validation, Stability, and Consistency of MODIS Collection 6.1 and VIIRS Version 1 Deep Blue Aerosol Data Over Land." *Journal of Geophysical Research: Atmospheres* **124** (8): 4658-4688 [[10.1029/2018jd029598](#)]





Cómo Acceder a Los Datos

Descarga de Datos de Aerosoles de la NASA– Nivel 1, 2, 3 - Históricos

<https://ladsweb.modaps.eosdis.nasa.gov/>

The screenshot displays the LAADS DAAC website interface. At the top, there is a navigation bar with the NASA EarthData logo, 'Other DAACs', and utility icons for feedback and help. Below this is a search bar and a large satellite image of Earth. A secondary navigation bar contains icons for 'About LAADS', 'Find Data', 'Data Discovery', 'Quality', 'Help', and 'Profile'. Below the search bar, there are five main category buttons: 'Missions', 'Level-0 / Level-1', 'Atmosphere', 'Airborne', and 'Land'. At the bottom, four data visualization thumbnails are shown, each with a caption: 'Aqua MODIS' (a color-coded aerosol map), 'Terra MODIS' (a green-toned aerosol map), 'SNPP | JPSS-1 VIIRS' (a satellite view of Earth with aerosol data), and 'Envisat MERIS' (a satellite view of Earth with aerosol data).



Descarga de Datos de Aerosoles de la NASA

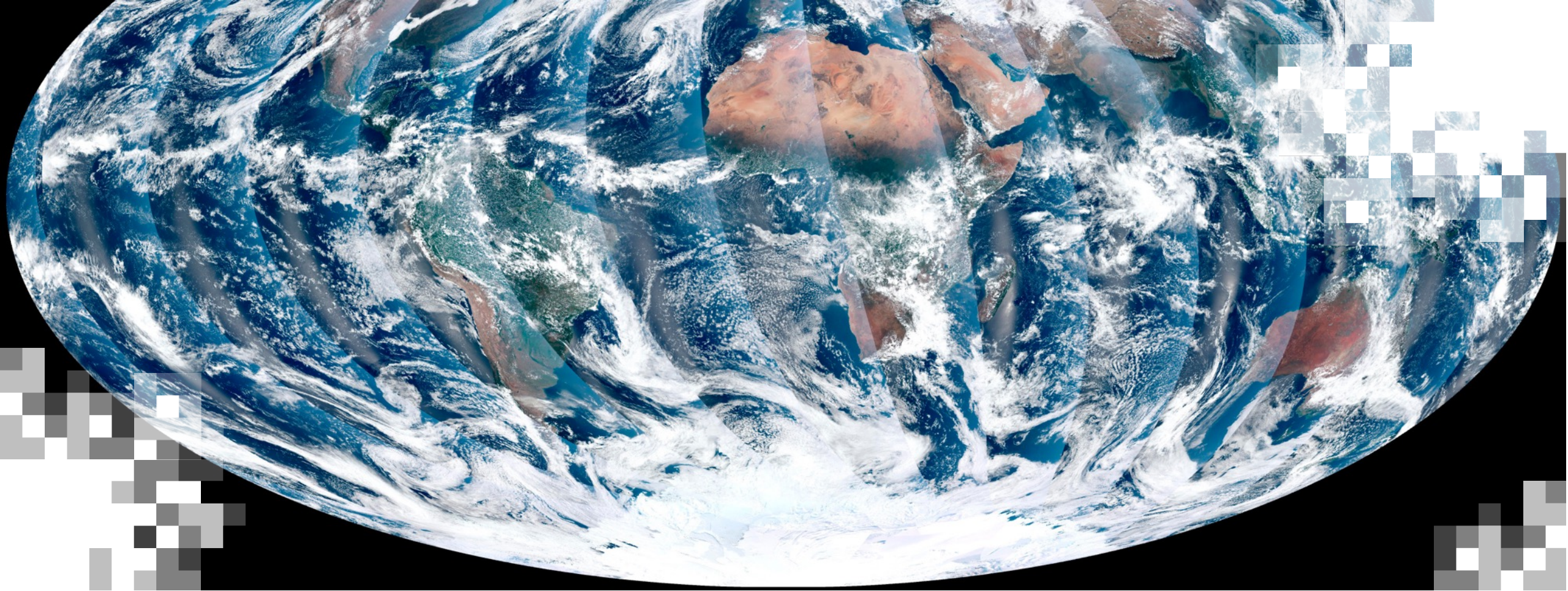
<https://ladsweb.modaps.eosdis.nasa.gov/>

The screenshot displays the LAADS DAAC (Level-1 and Atmosphere Archive & Distribution System) interface. The top navigation bar includes the NASA logo, the text "LAADS DAAC", and links for "About LAADS", "Find Data", "Data Discovery", "Quality", "Help", and "Profile". Below the navigation bar is a progress indicator with five steps: 1. PRODUCTS, 2. TIME, 3. LOCATION, 4. FILES, and 5. REVIEW & ORDER. A search bar is located below the progress indicator, with a "reset" button. The main content area shows a list of products under the heading "All Sensors". A dropdown menu is open, showing "Products (Collection)" with an "Add product" button and two selected items: "AERDB_L2_VIIRS_SNPP (5110)" and "AERDT_L2_VIIRS_SNPP (5110)". The list of products includes:

- AERDB_D3_VIIRS_SNPP: VIIRS/SNPP Deep Blue Level 3 daily aerosol data, 1x1 degree grid
- AERDB_L2_VIIRS_SNPP**: VIIRS/SNPP Deep Blue Aerosol L2 6-Min Swath 6 km
- AERDB_M3_VIIRS_SNPP: VIIRS Deep Blue Level 3 monthly aerosol data, 1x1 degree grid
- AERDT_L2_VIIRS_SNPP**: VIIRS/SNPP Dark Target Aerosol L2 6-Min Swath 6 km
- CLDSK_L2_MODIS_Aqua: MODIS/Aqua Cloud Mask 5-Min Swath 1000 m
- CLDSK_L2_VIIRS_SNPP: VIIRS/Suomi-NPP Cloud Mask 6-Min Swath 750 m
- CLDPROP_D3_MODIS_Aqua: MODIS/Aqua Cloud Properties Level 3 daily, 1x1 degree grid
- CLDPROP_D3_VIIRS_SNPP: VIIRS/SNPP Cloud Properties Level 3 daily, 1x1 degree grid
- CLDPROP_M3_MODIS_Aqua: MODIS/Aqua Cloud Properties Level 3 monthly, 1x1 degree grid

The footer of the page includes the NASA logo, the text "Goddard SPACE FLIGHT CENTER", "Level-1 and Atmosphere Archive & Distribution System", and a link to "Privacy Policy and Important Notices".

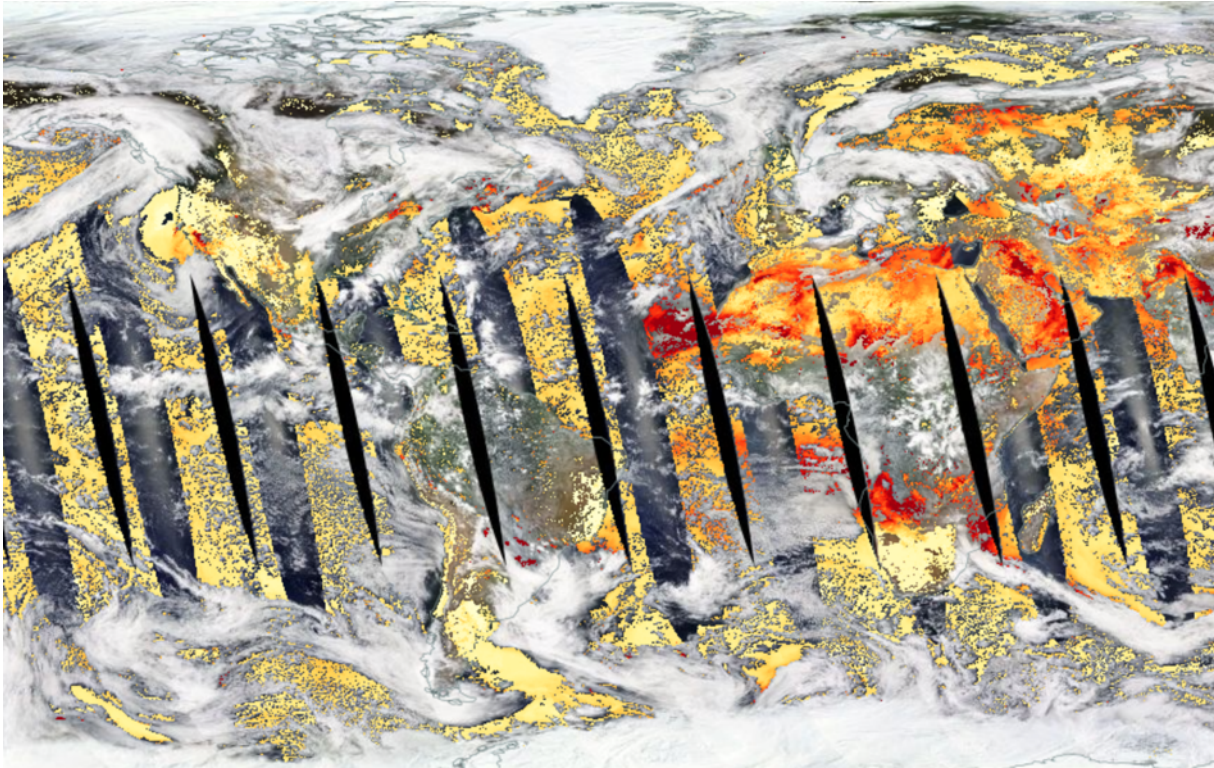




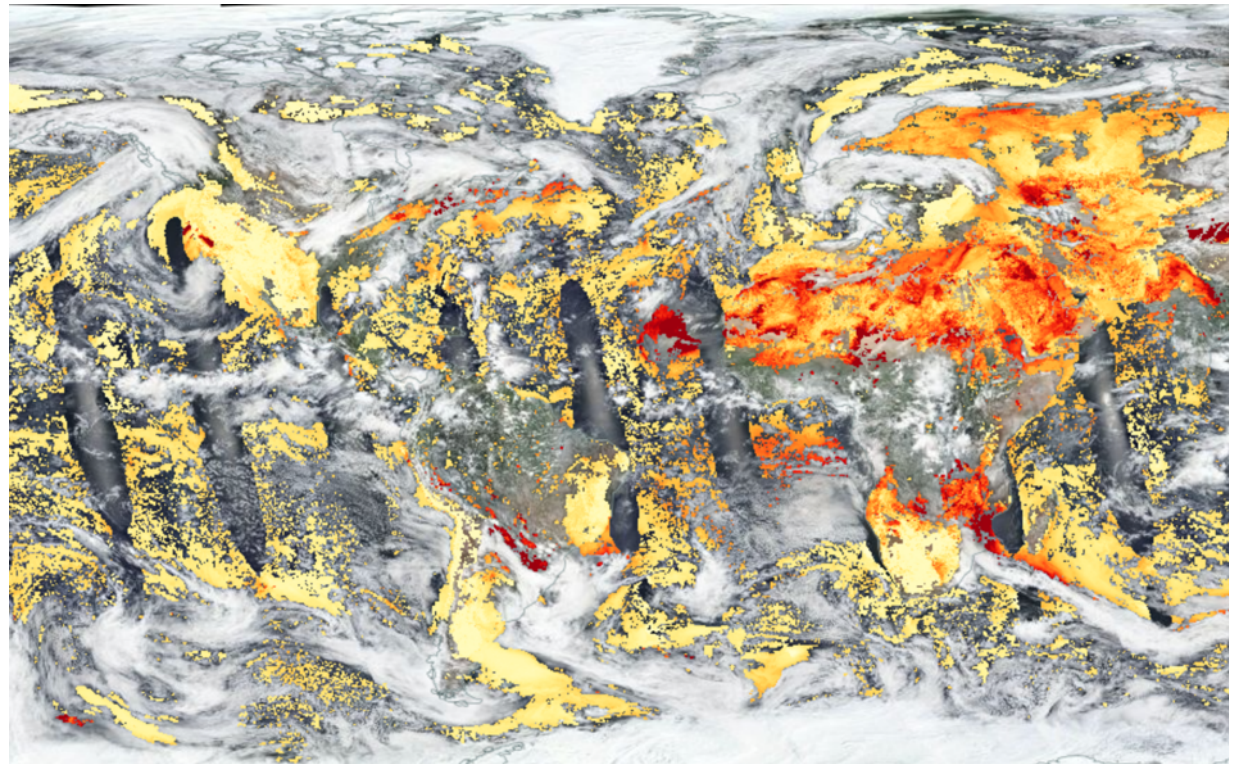
Ejemplo del AOD

MODIS vs. VIIRS – 27 de septiembre de 2020

<https://go.nasa.gov/3nrOyz>



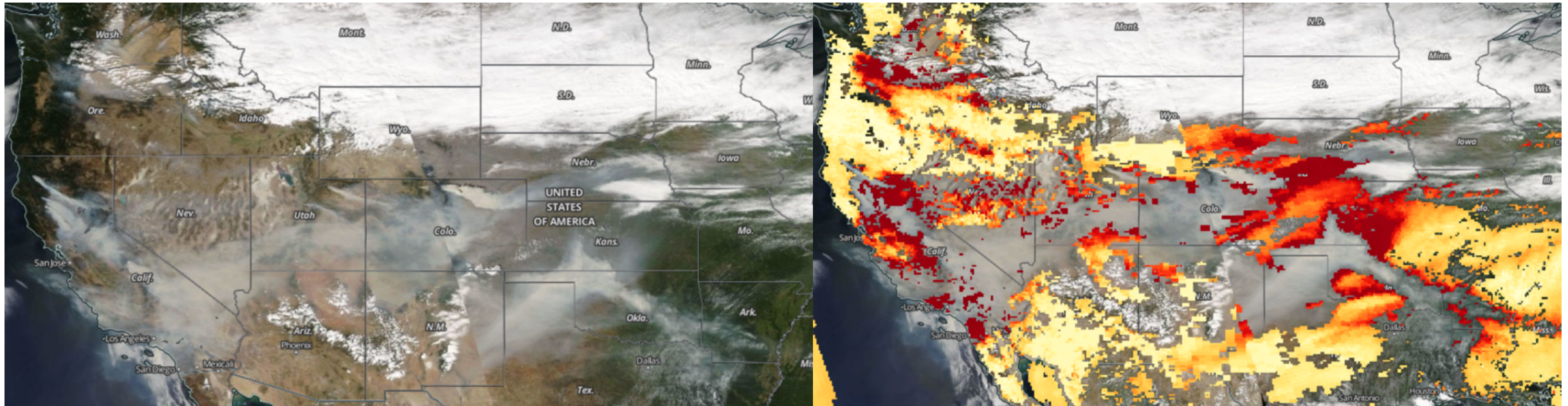
MODIS-Aqua (DB)



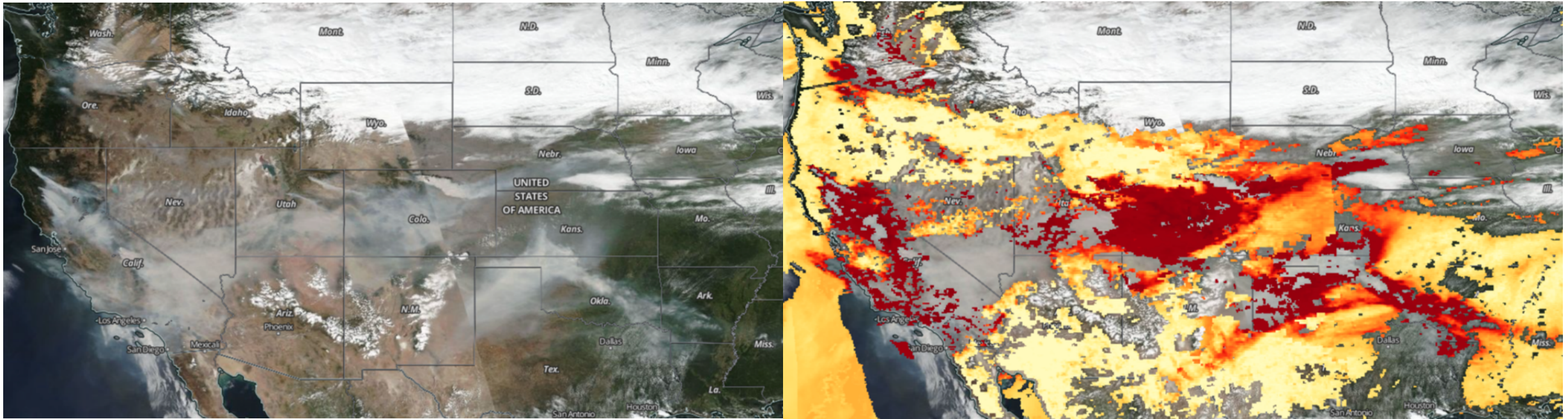
VIIRS-SNPP (DB)

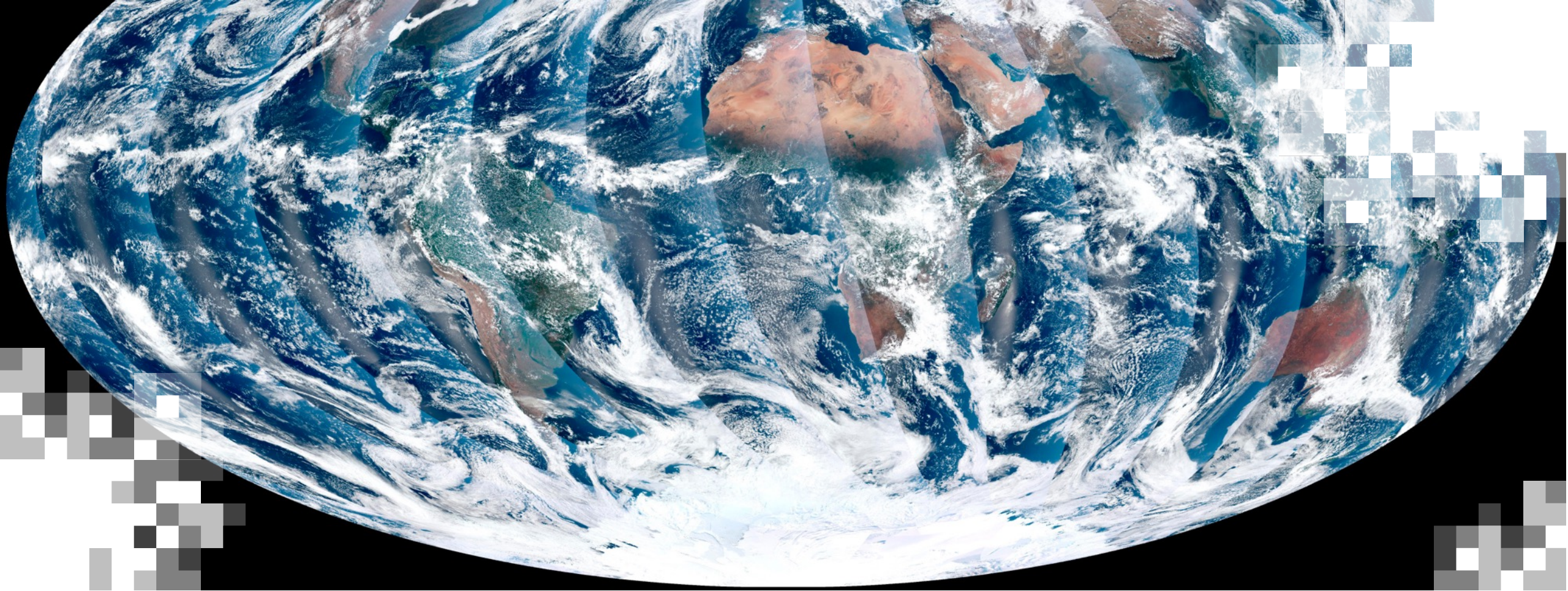


Aplicación – MODIS- Aqua (7 sep. 2020)



Aplicación – VIIRS-SNPP (7 sep. 2020)





Datos de Aerosoles de la NOAA

Datos de Aerosoles – Productos de la NOAA

| | MODIS (T & A) | VIIRS-SNPP | VIIRS-N20 |
|----------------------------|---------------|----------------------------------|----------------------------------|
| Datos | X | AOD Humo, Máscara de Polvo | AOD Humo, Máscara de Polvo |
| Resolución Espacial | X | 750m, 6 km | 750m, 6 km |
| Cobertura Global | X | Diaria | Diaria |
| Algoritmo | X | NOAA | NOAA |
| Disponibilidad de Datos | X | 2012- hoy | 2017- hoy |



Datos de Aerosoles – Productos de la NOAA

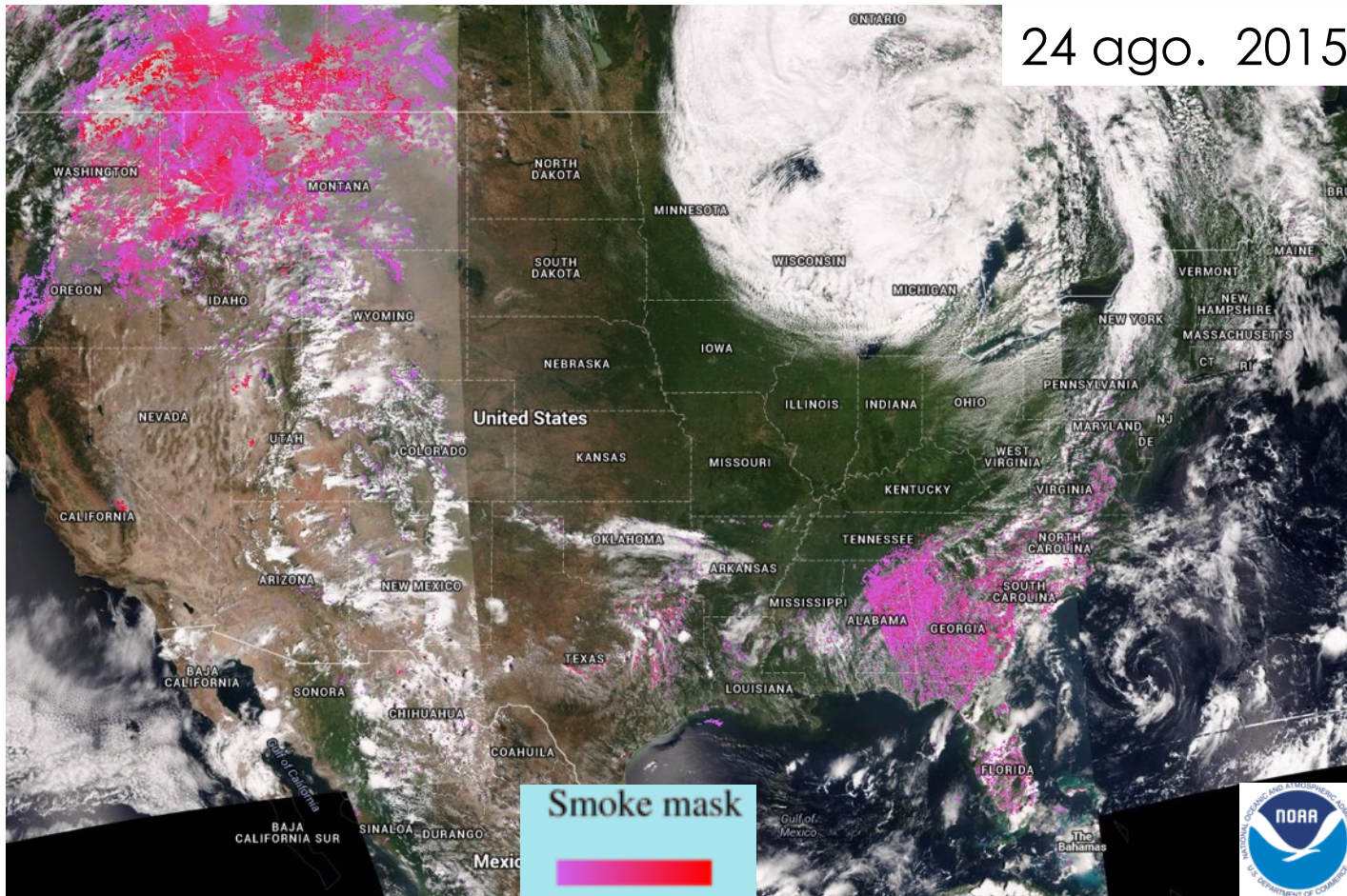
Nombres de Archivos

La NOAA tiene dos productos de aerosoles (conjuntos de datos):

- Profundidad Óptica de Aerosoles
 - JRR-AOD_v2r3_ **j01**_s202009280811382_e202009280813027_c202009280832280.nc
 - JRR-AOD_v2r3_ **npp**_s202009280709032_e202009280710274_c202009280749220.nc
- Producto de Detección de Aerosoles (Aerosol Detection Product o ADP)
 - JRR-ADP_v2r1_npp_s201911010742162_e201911010743404_c201911010834210.nc
 - 6 Tipos de Etiquetas: (1-presence; 0-absence) 1. *Volcanic ash flag* 2. *Dust flag* 3. *Smoke flag* 4. *Nuc (none/unknown/clear)* 5. *Cloud flag* 6. *Snow/ice flag*
 - Valores de Índices de Aerosoles de Polvo/Humo
 - Etiquetas de Calidad (confianza baja, media y alta para cada tipo)



Producto VIIRS “Smoke Mask” - NOAA



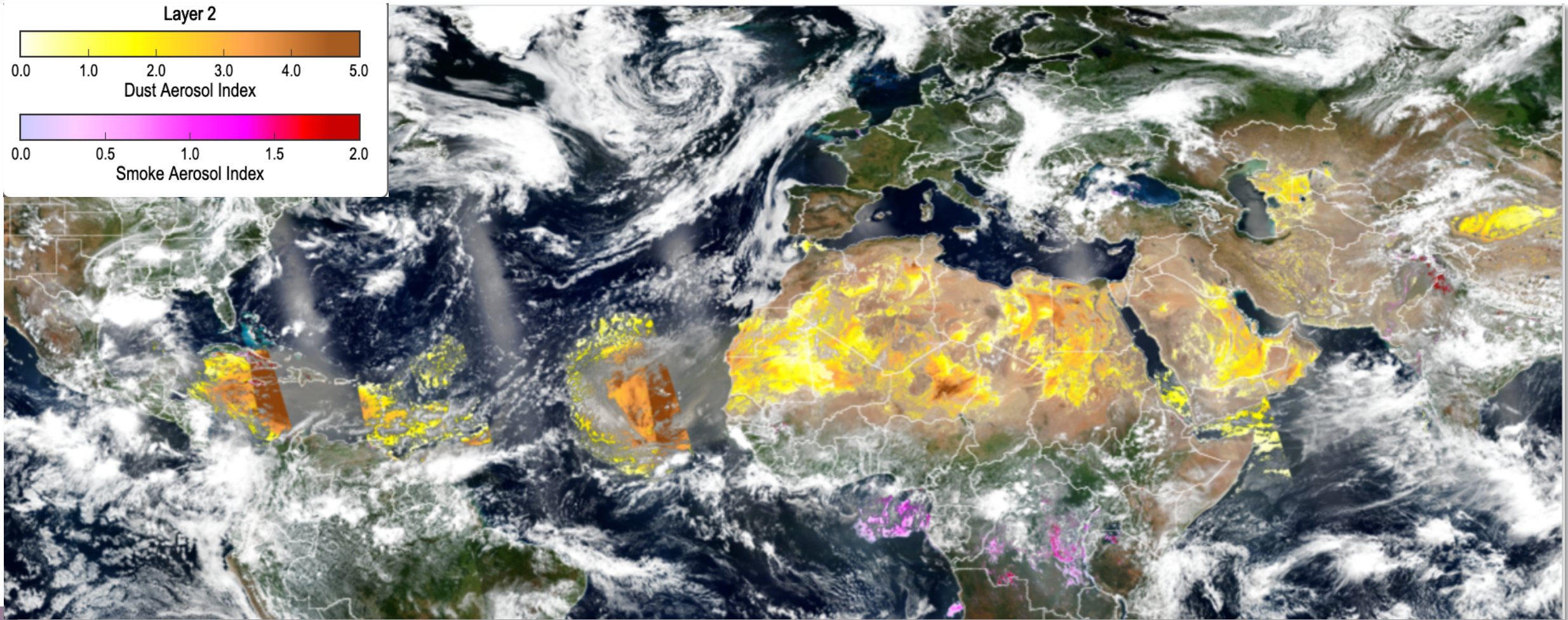
- Smoke Mask: Indicador cualitativo de humo
- Es derivado usando pruebas de umbral espectrales y espaciales en base a mediciones de VIIRS en el visible e IR
- **Es útil para identificar plumas de humo local y transportado**
- Usa tonos de rosado
- Rosado claro: Humo ligero
- Rosado brillante/Magenta: Humo Denso

Side Courtesy of Shobha Kondragunta



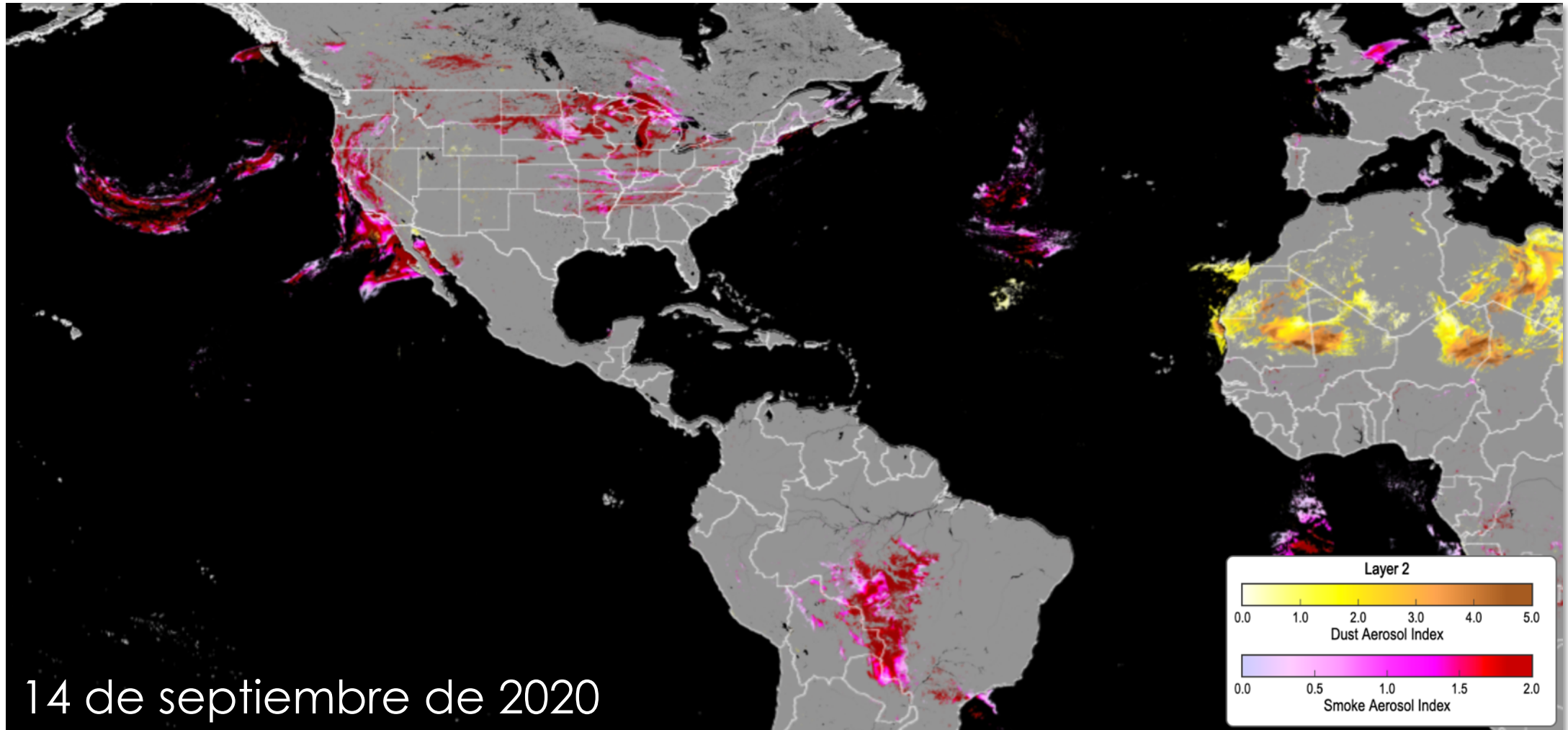
Máscara de Polvo – Transporte de Polvo en el Sahara en el Verano de 2020

<https://www.star.nesdis.noaa.gov/jpss/mapper>



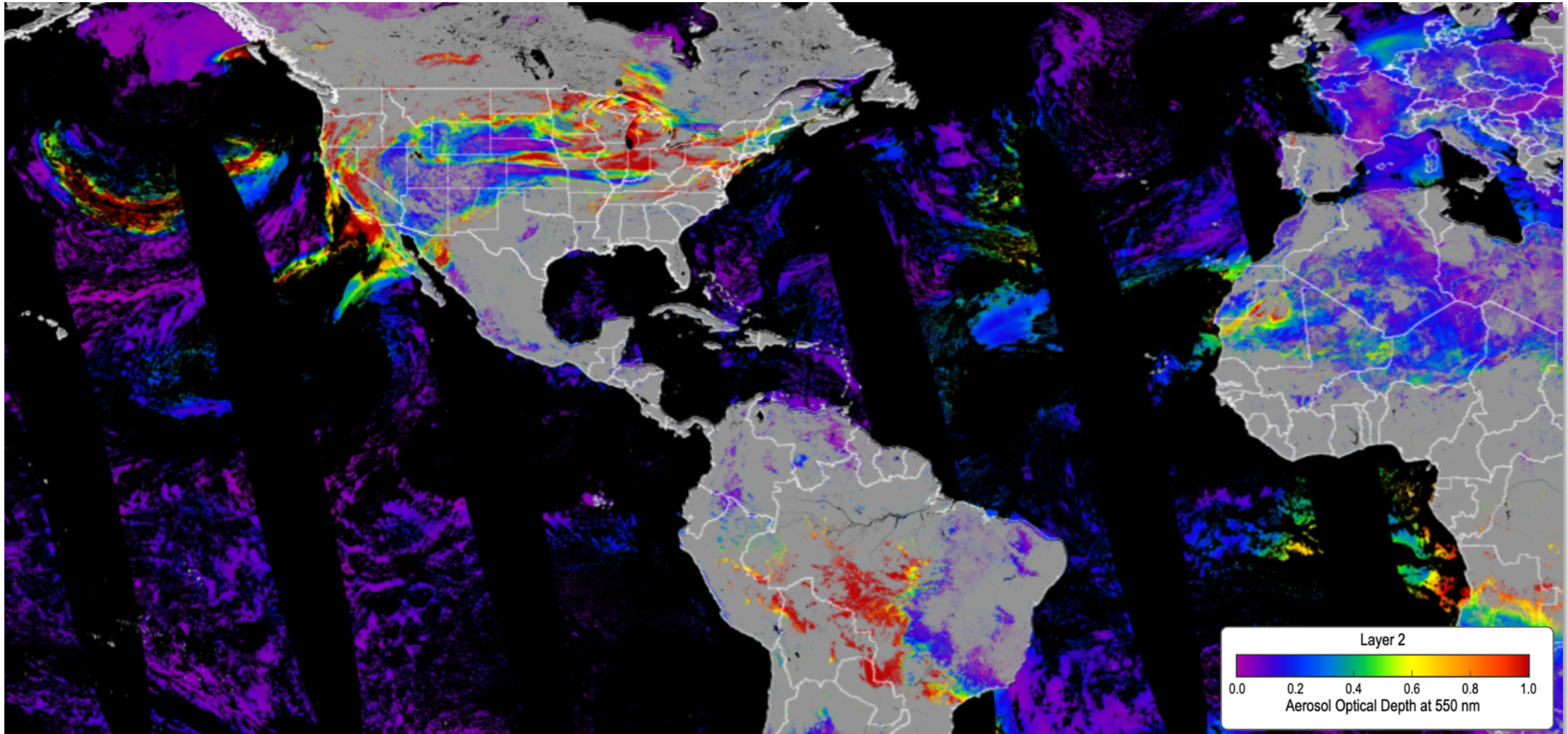
Humo de los Incendios en el Oeste de EE.UU.– Máscara de Humo

<https://www.star.nesdis.noaa.gov/jpss/mapper>

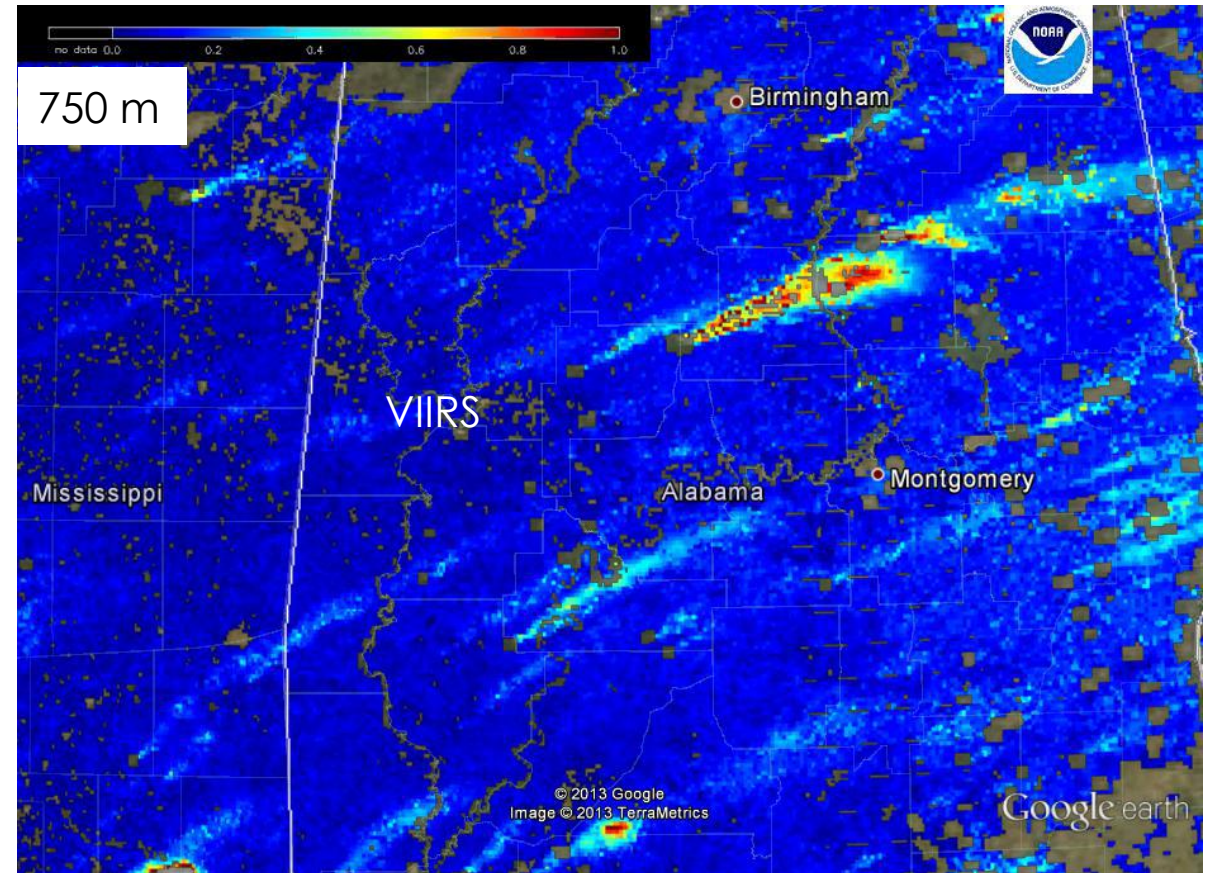
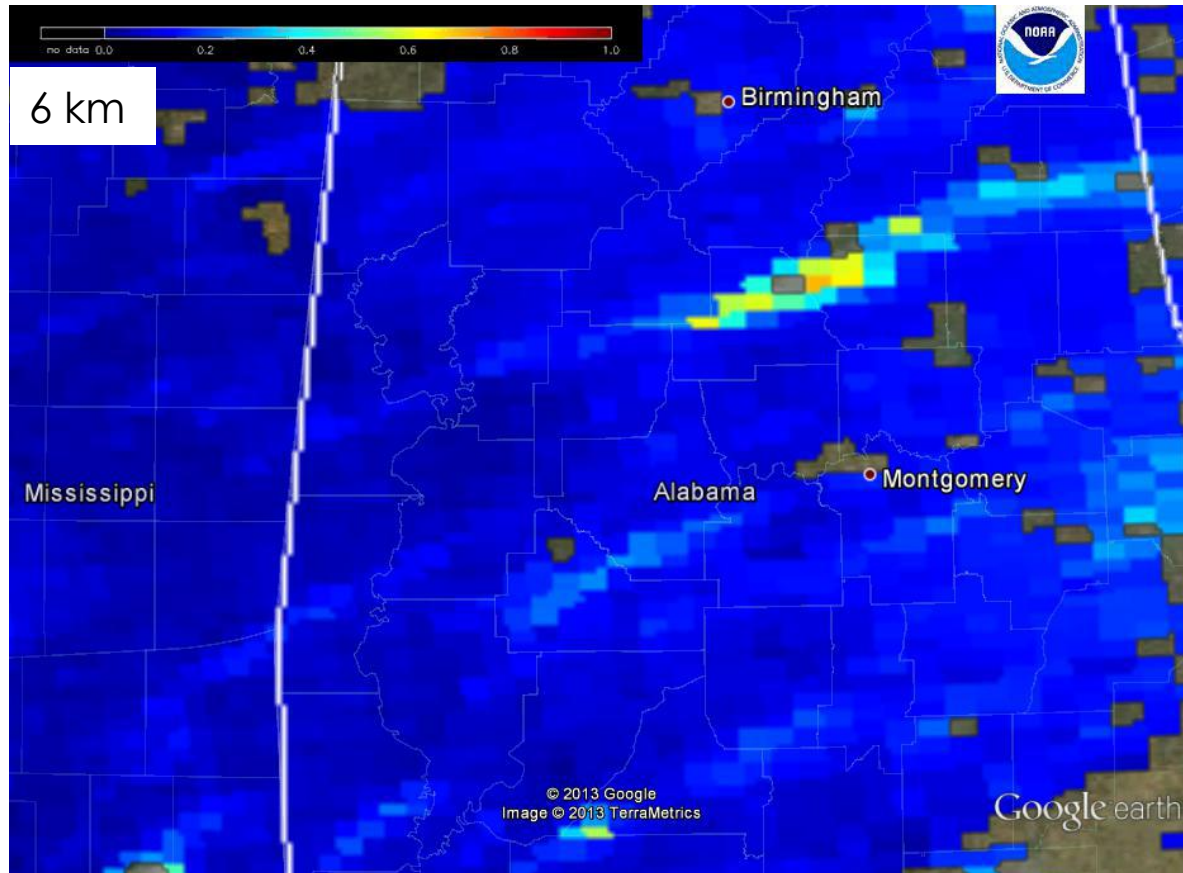


Humo de los Incendios en el Oeste de EE.UU. – profundidad Óptico de Aerosoles

<https://www.star.nesdis.noaa.gov/jpss/mapper>



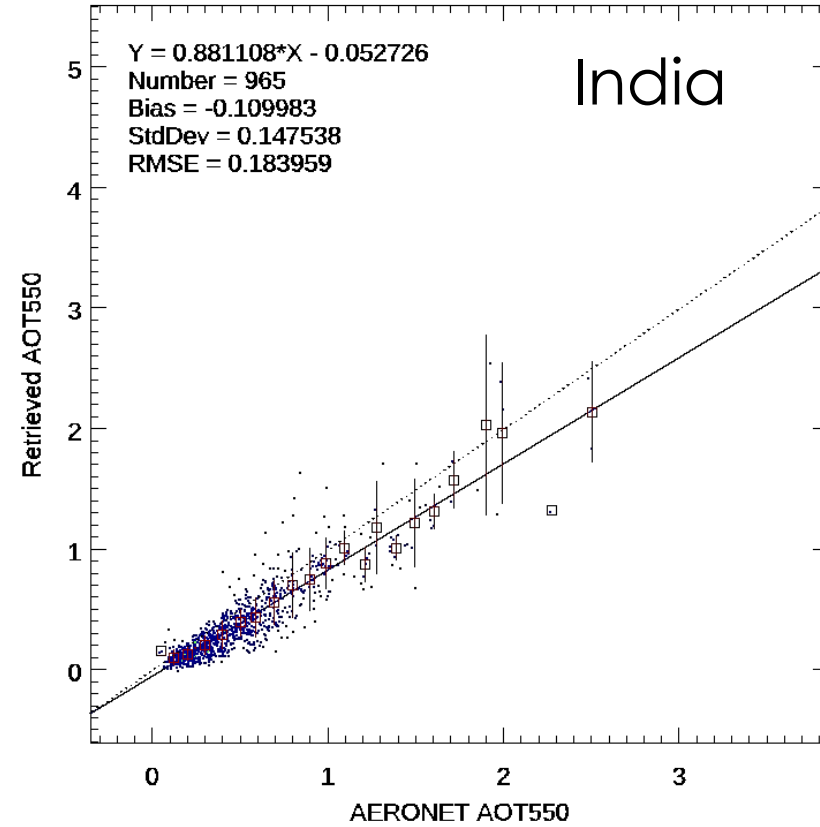
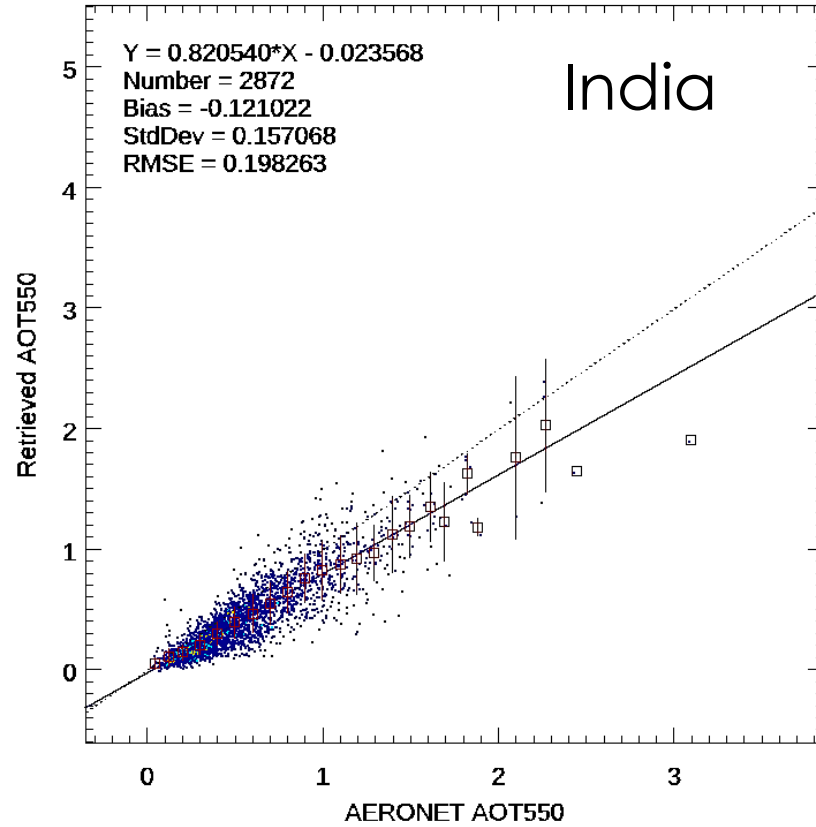
Datos del AOD de Resolución Alta vs. Baja



Diapositiva Cortesía de Shobha Kondragunta



Validación

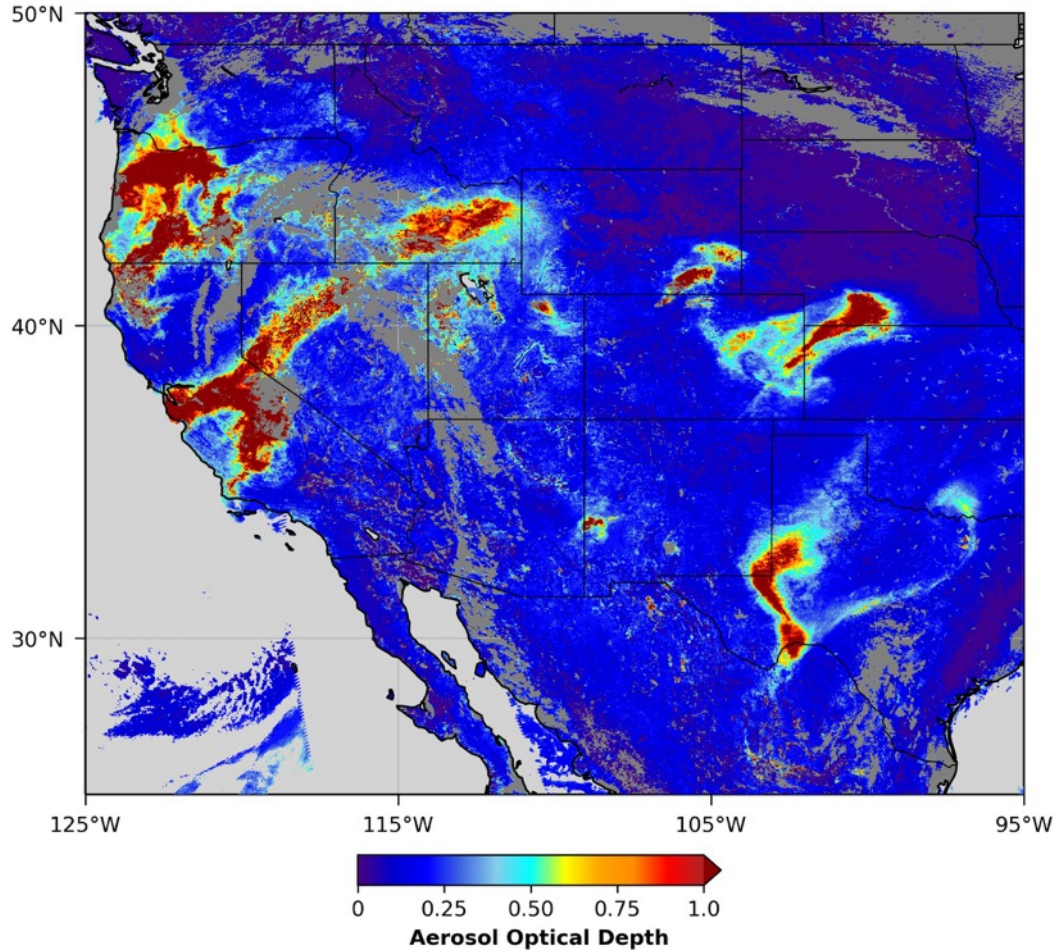


Diapositiva de Hongqing Liu (NOAA)

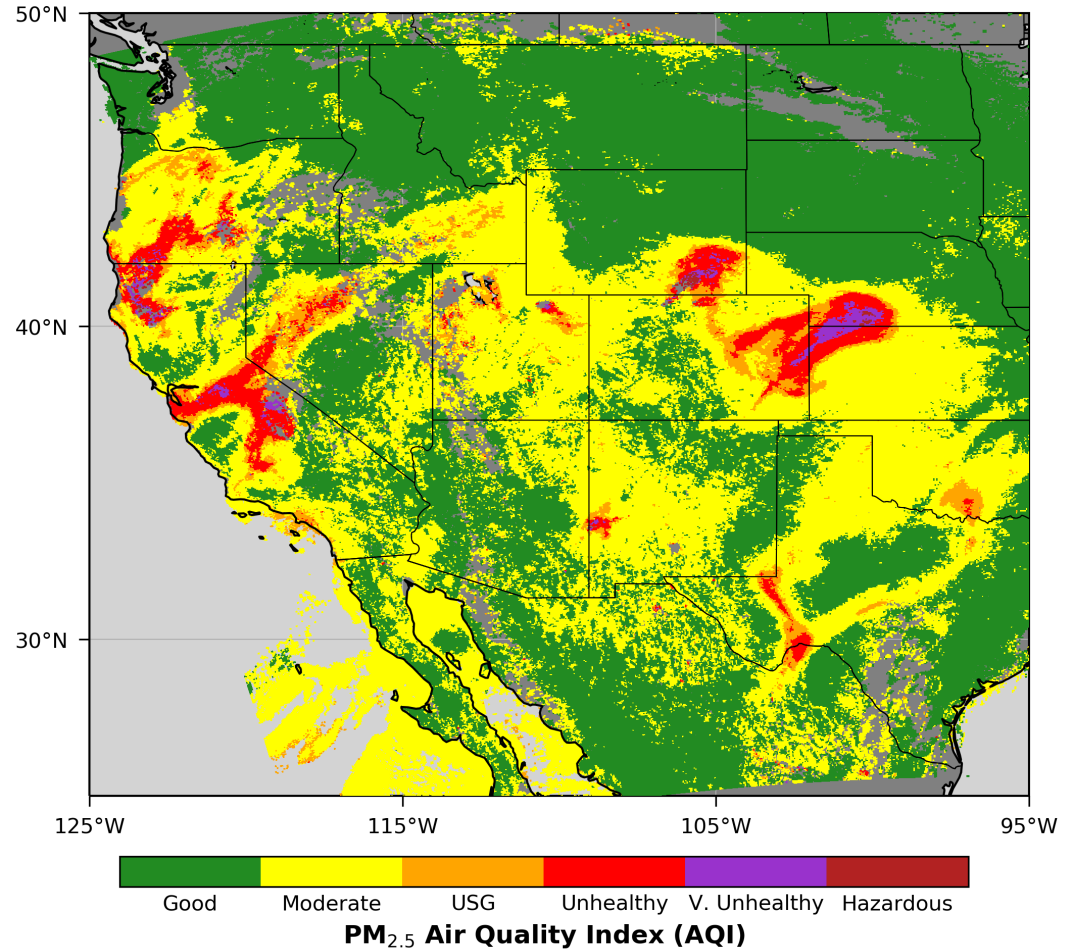


Profundidad Óptica de Aerosoles – Aplicación

NOAA-20/VIIRS
Aerosol Optical Depth
07 Oct 2020



Daily (24-Hour Average) Fine Particles
Estimated from VIIRS Aerosol Optical Depth
07 Oct 2020

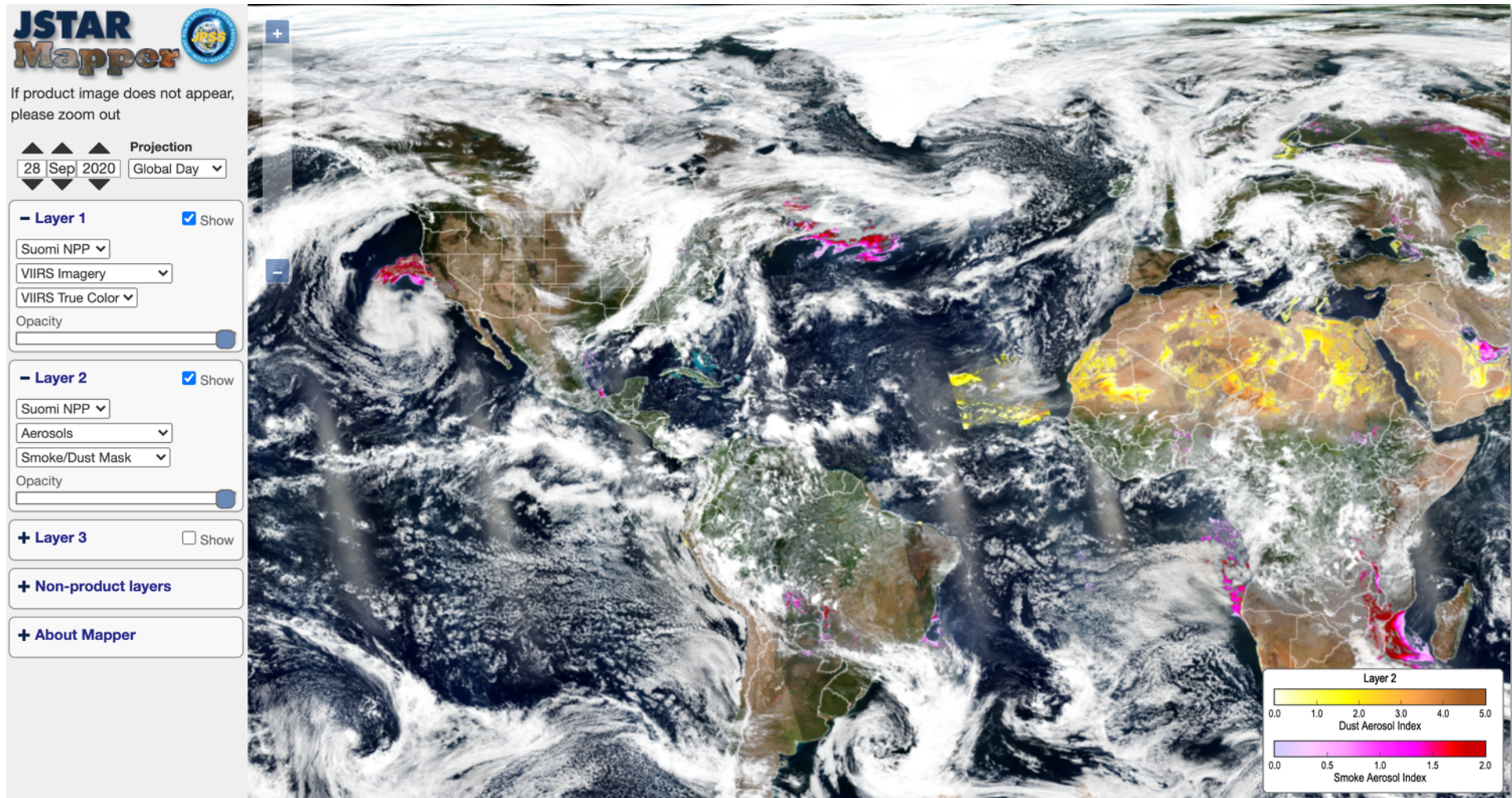


<https://twitter.com/AerosolWatch/status/1314208278222569472>



Visualización de Datos de la NOAA

<https://www.star.nesdis.noaa.gov/jpss/mapper/>



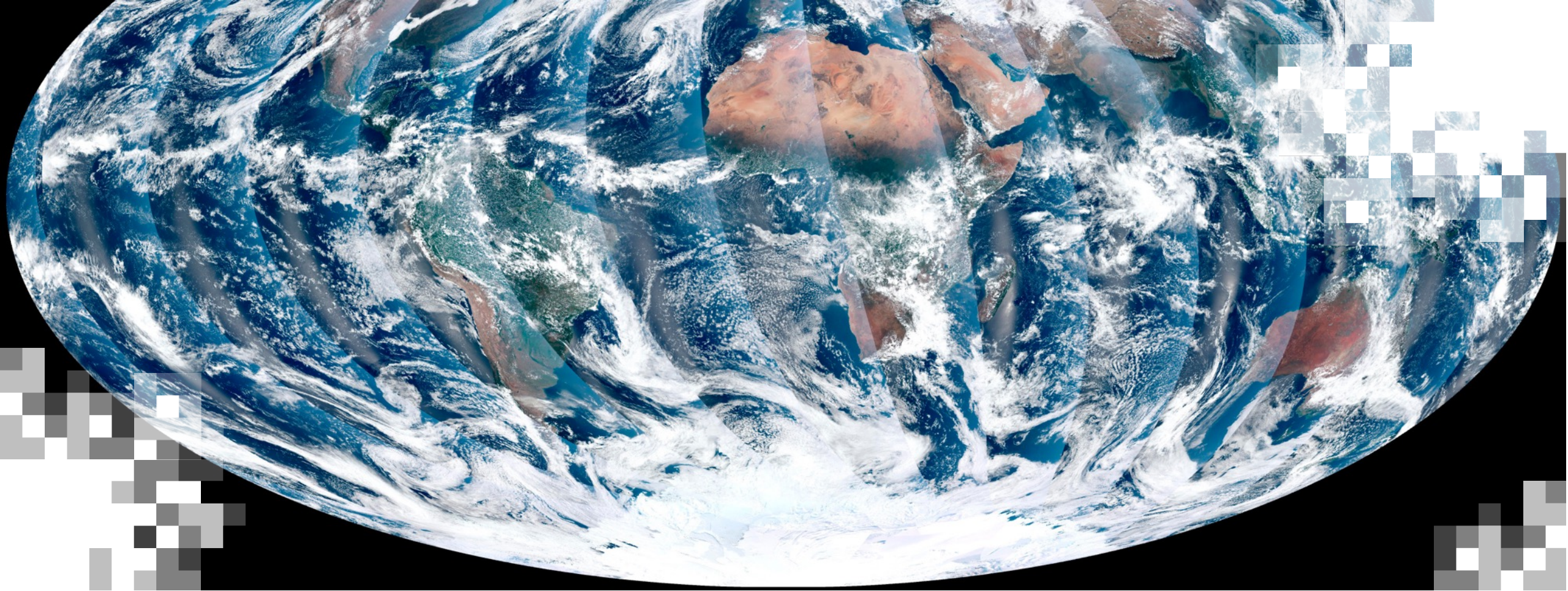
Descarga de Datos de la NOAA

- NOAA CLASS
 - <https://www.avl.class.noaa.gov/saa/products/welcome>
- Register; Login; User Preference
- Seleccione “JPSS VIIRS Products (Granule)(JPSS_GRAN)” de la lista desplegable en la parte superior de la página de CLASS y haga clic en GO

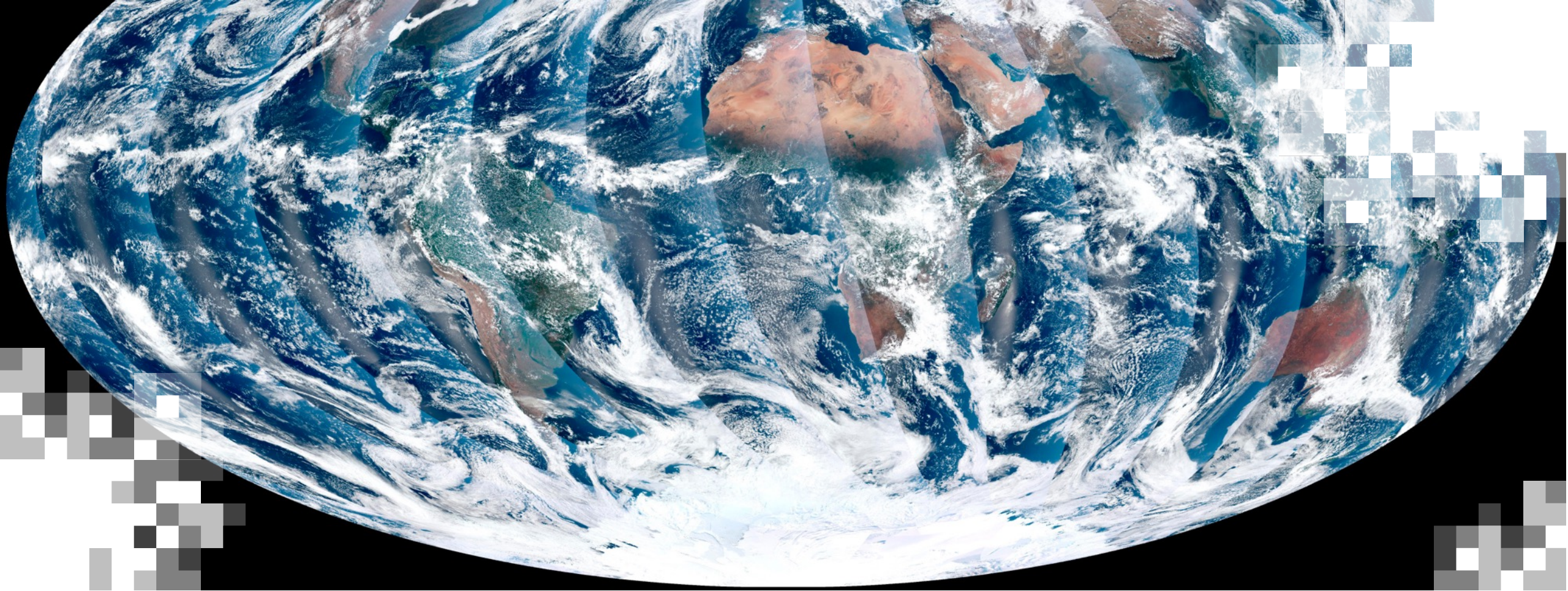
The screenshot shows the NOAA CLASS website interface. The top navigation bar includes links for HOME, WEATHER, OCEANS, FISHERIES, CHARTING, SATELLITES, CLIMATE, RESEARCH, COASTS, and CAREERS. The main header features the NOAA logo and the text "COMPREHENSIVE LARGE ARRAY-DATA STEWARDSHIP SYSTEM (CLASS)". Below the header, there is a search bar and a navigation menu with options like "CLASS Home", "Login", "Register", "Help", "About CLASS", and "RSS". The left sidebar contains a "User Account" section with links for "User Profile", "User Preferences", and "Advanced Options". The main content area displays a list of products, with "JPSS VIIRS Products (Granule)(JPSS_GRAN)" highlighted. A "GO" button is located at the bottom right of the product list.

Más Detalles – [Haga clic aquí](#)





Lectura, Mapeo y Extracción de Datos – Demostración de Jupyter Notebook



Descargar Jupyter Notebooks y Guardar en
Su Computadora

Descargar Jupyter Notebooks y Guardar en Su Computadora

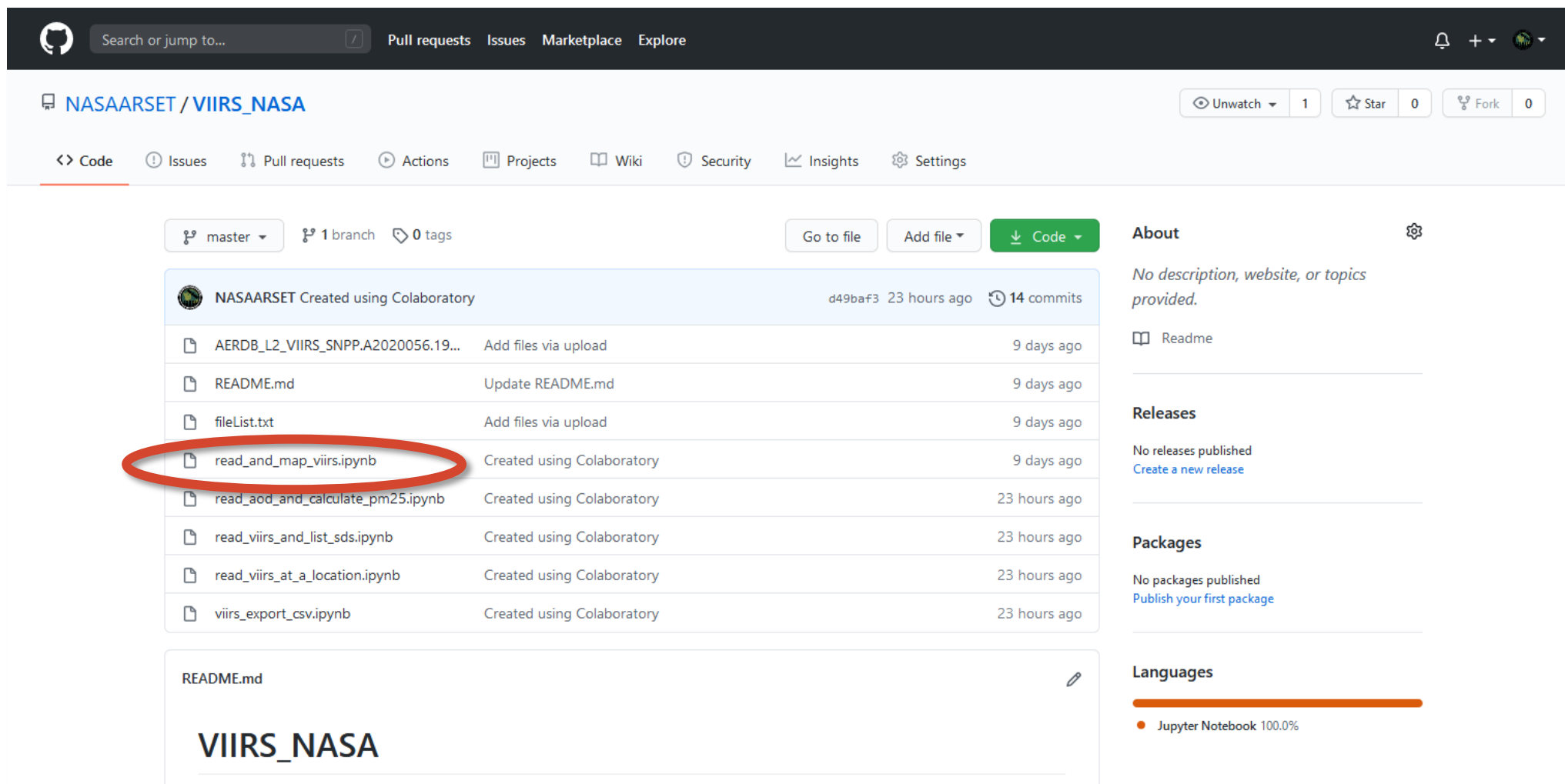
Paso 1: Vaya a <https://github.com/NASAARSET/>, haga clic en VIIRS_NASA

The screenshot shows the GitHub profile page for NASAARSET. The profile name is NASAARSET, and the profile picture is a circular logo with a globe and the text "APPLIED REMOTE SENSING TRAINING PROGRAM" and "TRAIN - EMPOWER - ADVANCE". The "Popular repositories" section shows two repositories: "VIIRS_NASA" (circled in red) and "VIIRS_NOAA". The "VIIRS_NASA" repository is a Jupyter Notebook. Below the repositories is a contribution calendar for the last year, showing 18 contributions. The page also includes navigation links like "Overview", "Repositories", "Projects", and "Packages".



Descargar Jupyter Notebooks y Guardar en Su Computadora

Paso 2: Haga clic en read_and_map_viirs.ipynb



The screenshot shows the GitHub interface for the repository NASAARSET/VIIRS_NASA. The repository is on the master branch and has 14 commits. The file list includes:

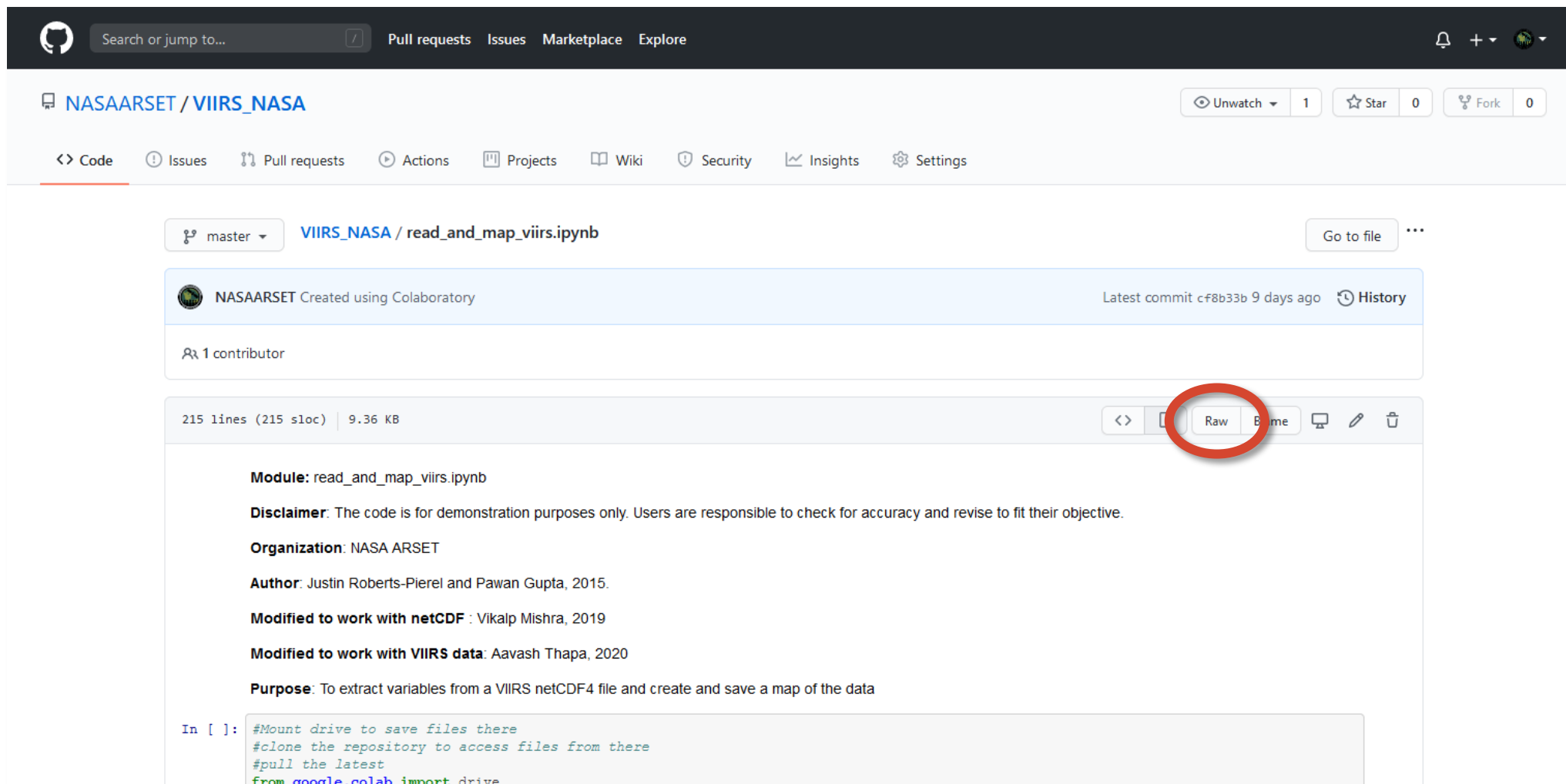
| File Name | Action | Time |
|------------------------------------|----------------------------|--------------|
| AERDB_L2_VIIRS_SNPP.A2020056.19... | Add files via upload | 9 days ago |
| README.md | Update README.md | 9 days ago |
| fileList.txt | Add files via upload | 9 days ago |
| read_and_map_viirs.ipynb | Created using Colaboratory | 9 days ago |
| read_aod_and_calculate_pm25.ipynb | Created using Colaboratory | 23 hours ago |
| read_viirs_and_list_sds.ipynb | Created using Colaboratory | 23 hours ago |
| read_viirs_at_a_location.ipynb | Created using Colaboratory | 23 hours ago |
| viirs_export_csv.ipynb | Created using Colaboratory | 23 hours ago |

The file **read_and_map_viirs.ipynb** is circled in red. The README.md file is visible below the list, showing the repository name VIIRS_NASA. The right sidebar shows repository statistics: 1 Unwatch, 0 Stars, and 0 Forks. The 'About' section states 'No description, website, or topics provided.' The 'Releases' section shows 'No releases published' and the 'Packages' section shows 'No packages published'. The 'Languages' section shows 'Jupyter Notebook 100.0%'.



Descargar Jupyter Notebooks y Guardar en Su Computadora

Paso 3: Encima del código, haga clic en 'Raw'. Esto visualizará el código en bruto.



The screenshot shows the GitHub interface for the repository NASAARSET/VIIRS_NASA. The file 'read_and_map_viirs.ipynb' is selected, showing its metadata (215 lines, 9.36 KB) and a toolbar with buttons for 'Raw', 'Blame', 'Download', 'Edit', and 'Delete'. The 'Raw' button is circled in red. Below the toolbar, the file content is displayed, including a disclaimer, organization information, author details, and a code block for mounting a drive.

215 lines (215 sloc) | 9.36 KB

Module: read_and_map_viirs.ipynb

Disclaimer: The code is for demonstration purposes only. Users are responsible to check for accuracy and revise to fit their objective.

Organization: NASA ARSET

Author: Justin Roberts-Pierel and Pawan Gupta, 2015.

Modified to work with netCDF : Vikalp Mishra, 2019

Modified to work with VIIRS data: Aavash Thapa, 2020

Purpose: To extract variables from a VIIRS netCDF4 file and create and save a map of the data

```
In [ ]: #Mount drive to save files there
#clone the repository to access files from there
#pull the latest
from google.colab import drive
```



Descargar Jupyter Notebooks y Guardar en Su Computadora

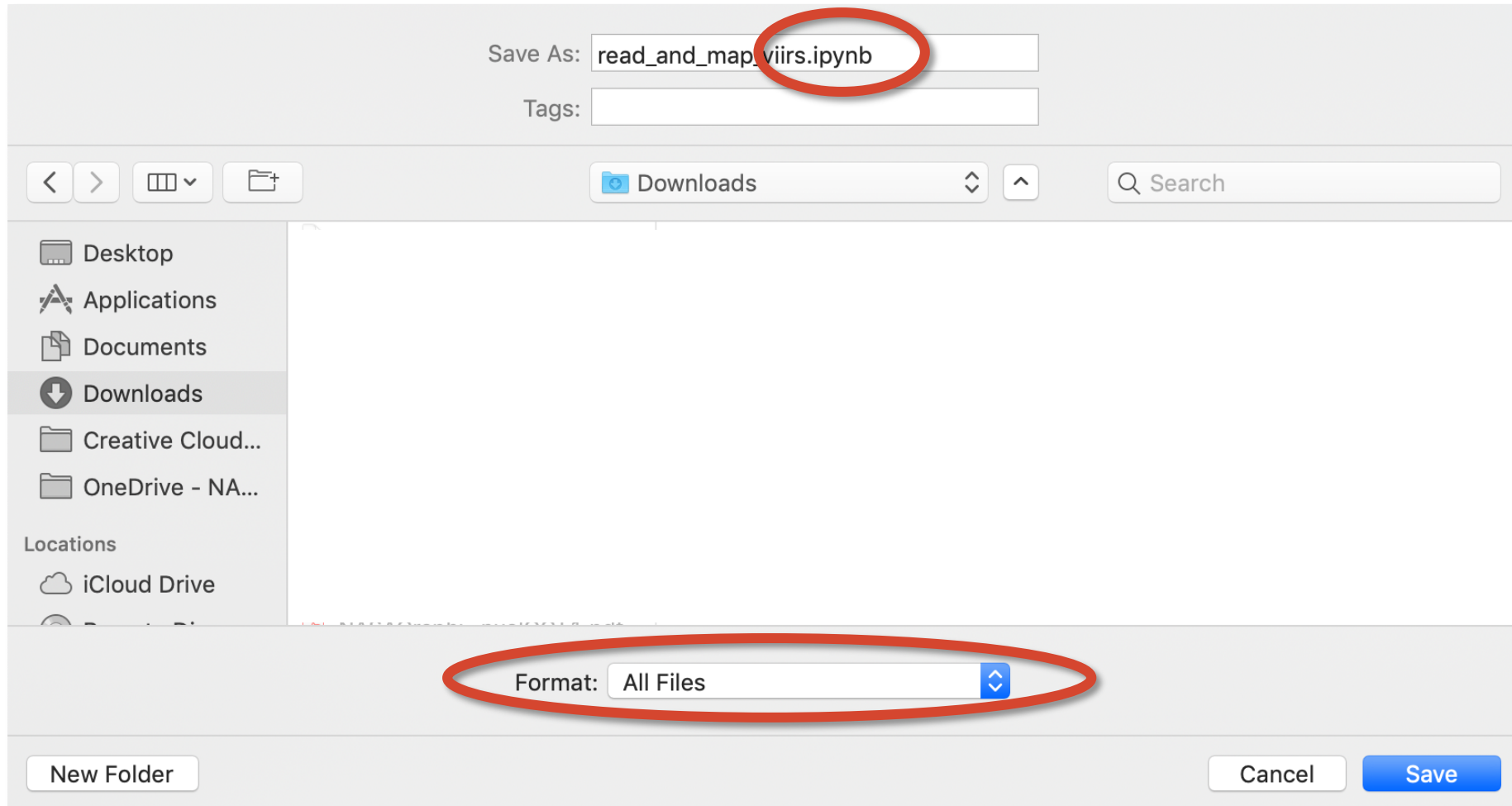
Paso 4: Haga clic en Ctrl+S para guardar en su computadora como archivo .ipynb.

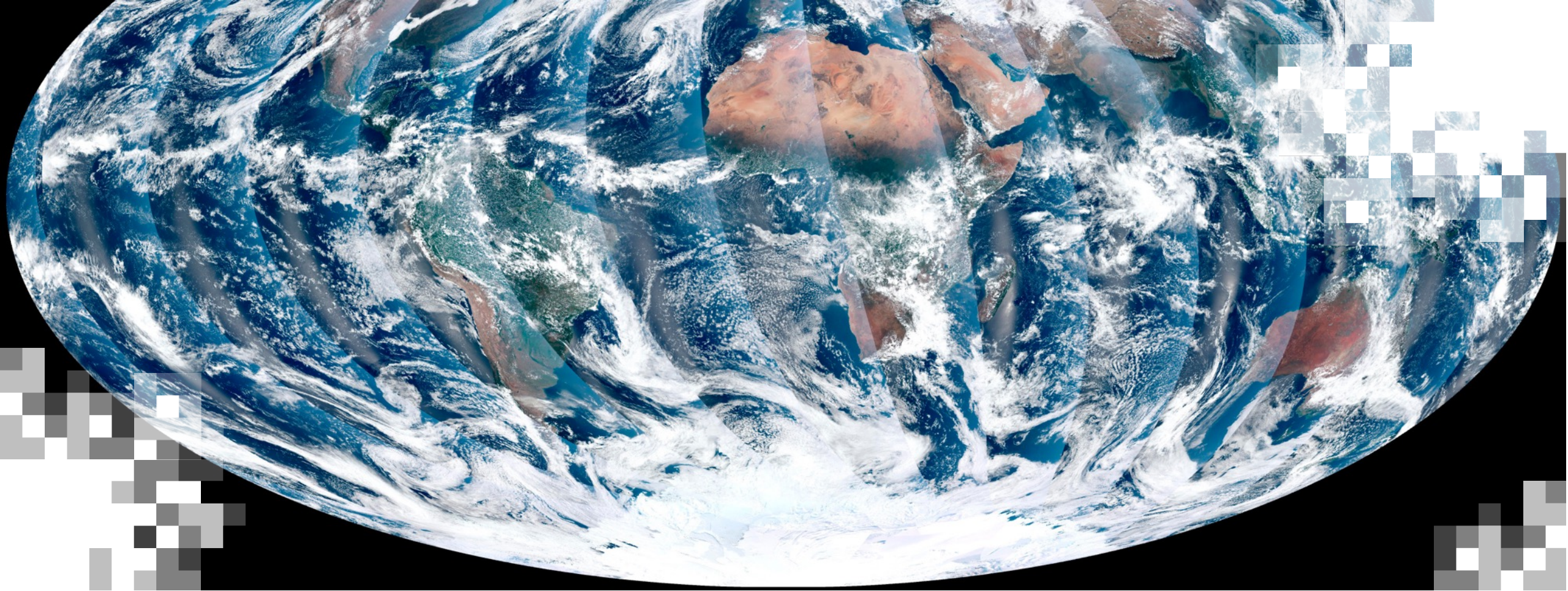
```
{
  "nbformat": 4,
  "nbformat_minor": 0,
  "metadata": {
    "colab": {
      "name": "read_and_map_viirs.ipynb",
      "provenance": [],
      "collapsed_sections": []
    },
    "kernelspec": {
      "name": "python3",
      "display_name": "Python 3"
    }
  },
  "cells": [
    {
      "cell_type": "markdown",
      "metadata": {
        "id": "im8zRbMsiQLL"
      },
      "source": [
        "***Module** read_and_map_viirs.ipynb\n",
        "\n",
        "***Disclaimer**": The code is for demonstration purposes only. Users are responsible to check for accuracy and revise to fit their objective.\n",
        "\n",
        "***Organization**": NASA ARSET\n",
        "\n",
        "***Author**": Justin Roberts-Pierel and Pawan Gupta, 2015.\n",
        "\n",
        "***Modified to work with netCDF** : Vikalp Mishra, 2019 \n",
        "\n",
        "***Modified to work with VIIRS data**": Aavash Thapa, 2020\n",
        "\n",
        "***Purpose**": To extract variables from a VIIRS netCDF4 file and create and save a map of the data"
      ]
    },
    {
      "cell_type": "code",
      "metadata": {
        "id": "Y7U02gkECz6c"
      },
      "source": [
        "#Mount drive to save files there\n",
        "#clone the repository to access files from there\n",
        "#pull the latest\n",
        "from google.colab import drive\n",
        "drive.mount('/content/drive', force_remount=True)\n",
        "! git clone https://github.com/NASAARSET/VIIRS_NASA.git\n",
        "! git -C VIIRS_NASA/ pull"
      ]
    }
  ]
}
```



Descargar Jupyter Notebooks y Guardar en Su Computadora

¡Asegúrese de guardar el archivo con la extensión “.ipynb”!

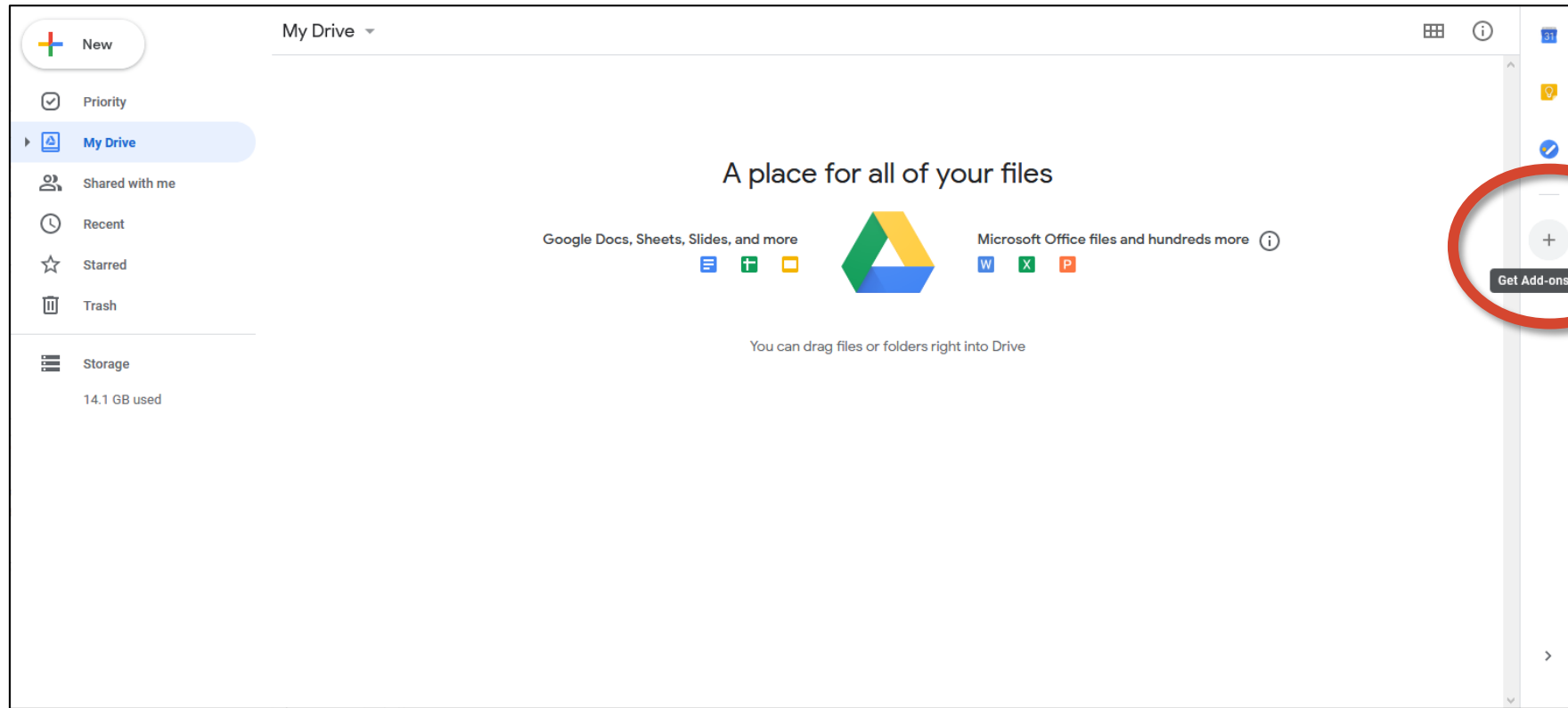




Instalar el Complemento Google Colaboratory y
Agregar Notebooks a la Carpeta 'Colab Notebooks' en
Google Drive

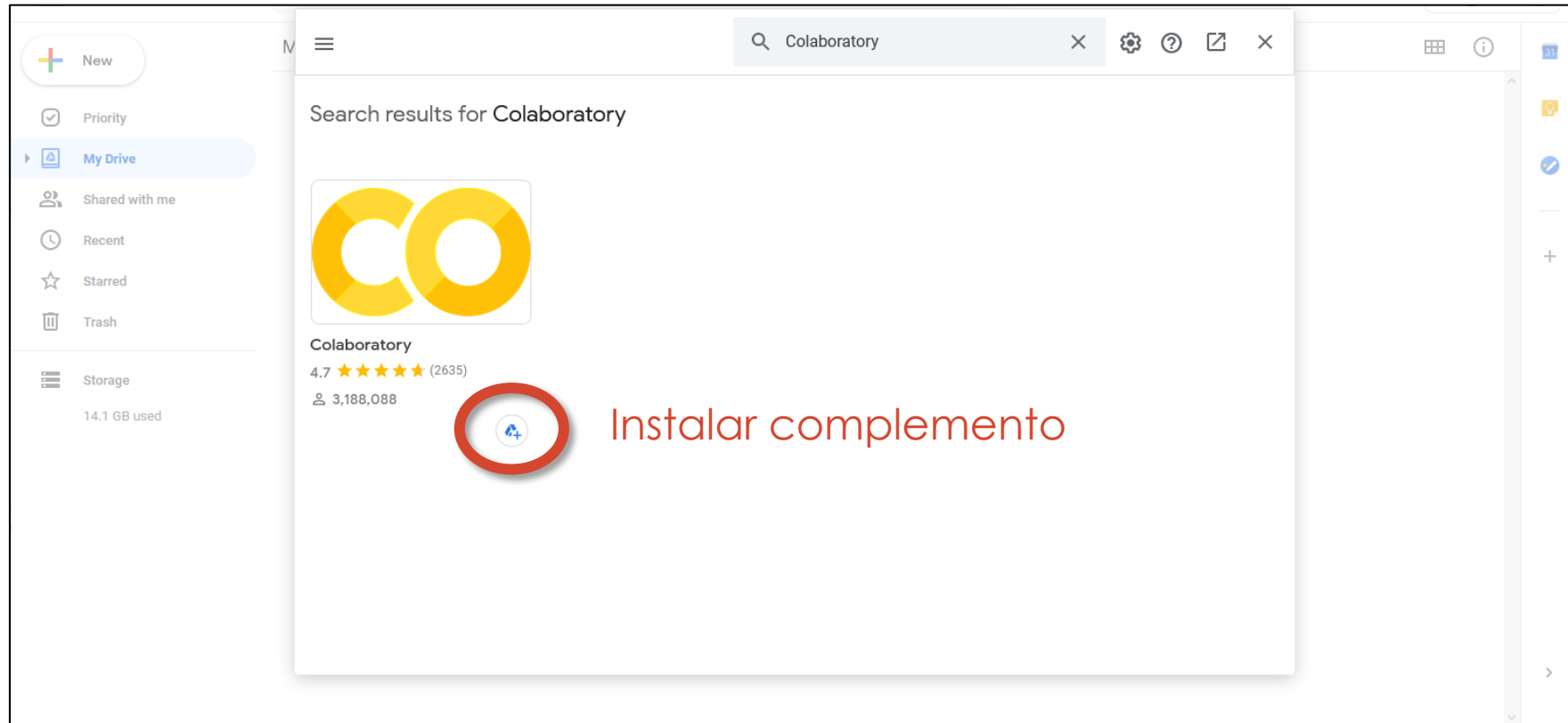
Agregar Sus Cuadernos (Notebooks) a Google Drive

Paso 1: Vaya a drive.google.com and haga clic en el + a la derecha para agregar complementos.



Agregar Sus Cuadernos (Notebooks) a Google Drive

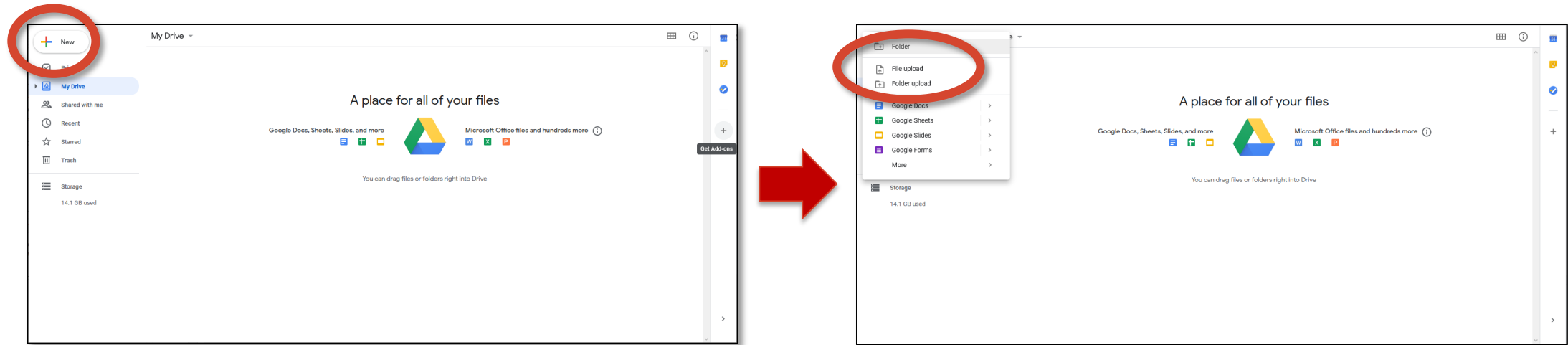
Paso 2: Busque "Colaboratory" e instale.



Agregar Sus Cuadernos (Notebooks) a Google Drive

Paso 3: Agregar Notebook a Google Drive arrastrando archivos o haciendo clic en New → File Upload.

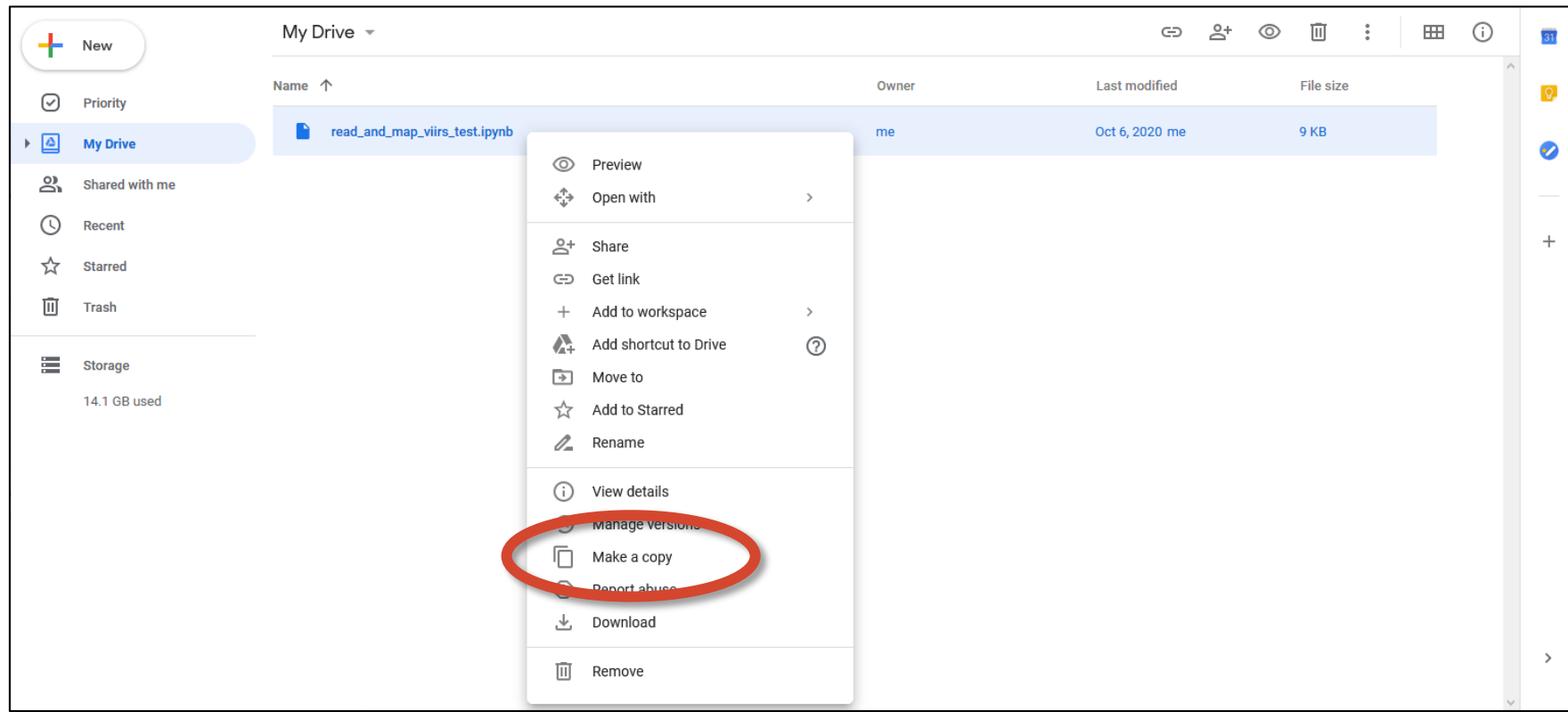
* Si ya tenía Colaboratory instalado, agregue el archivo a su carpeta Colab Notebooks. *

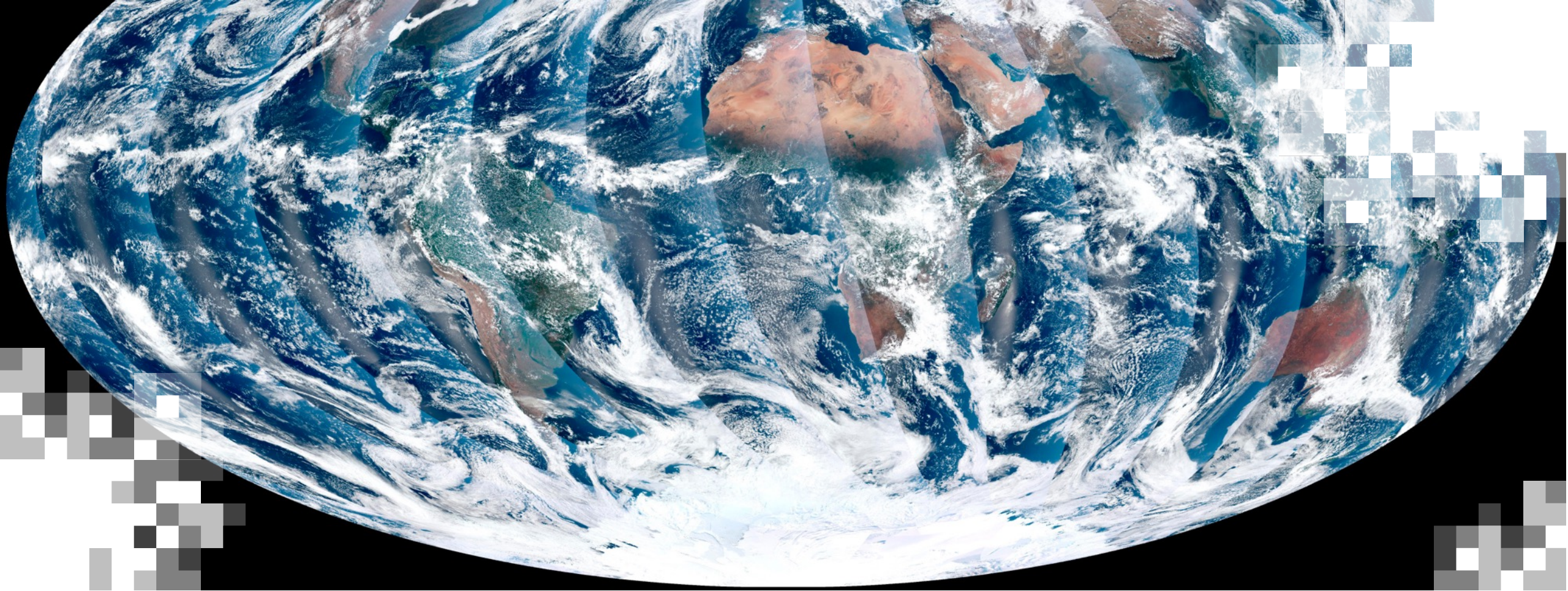


Agregar Sus Cuadernos (Notebooks) a Google Drive

Paso 3a: Haga clic con el botón derecho en su archivo y haga clic en “Make a copy” (hacer copia). Esto creará la carpeta Colab Notebooks en su Google Drive. La copia del archivo estará dentro de esta carpeta.

* Este paso es necesario si tuvo que instalar Colaboratory. *

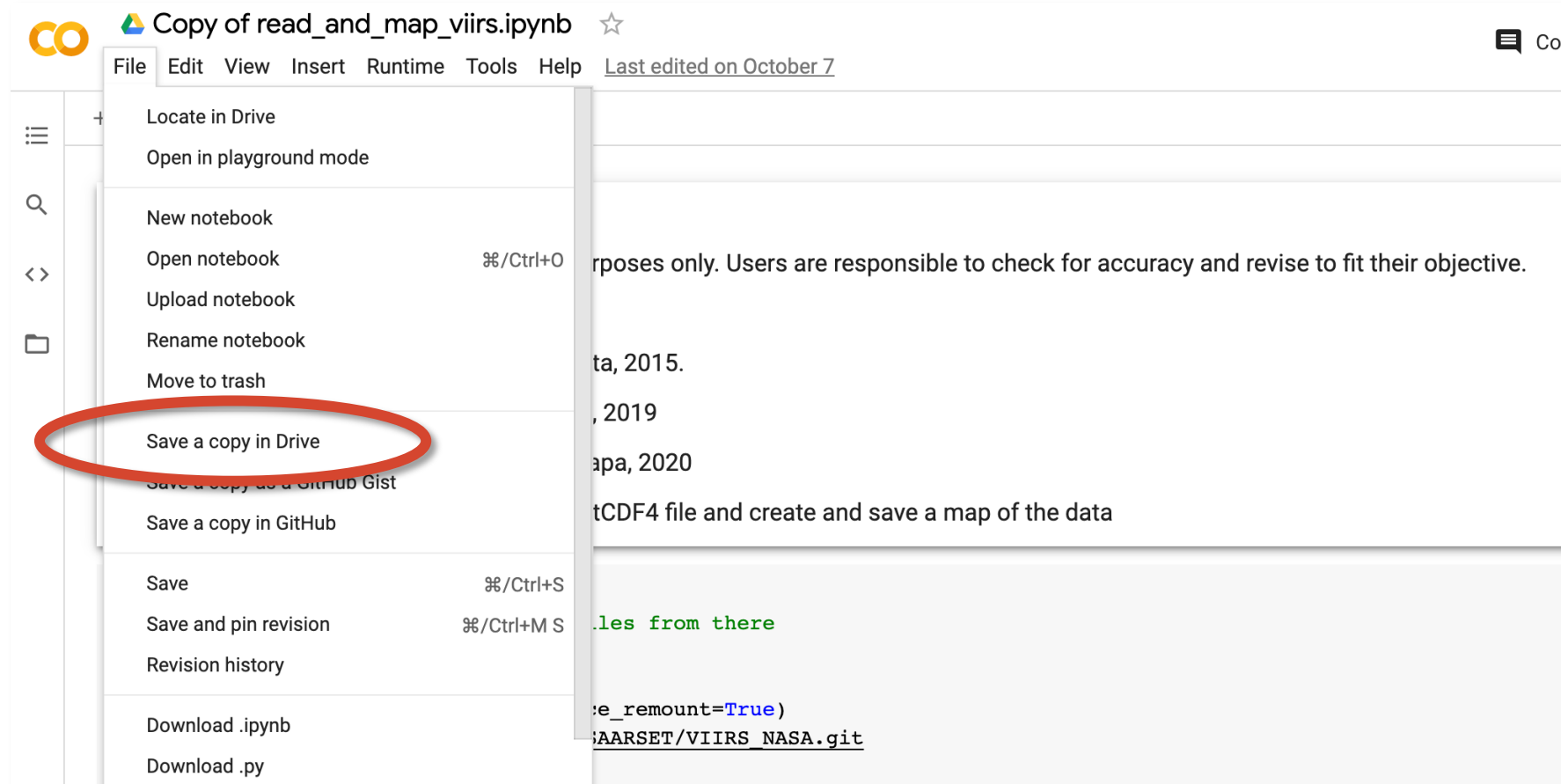




Ejecutar Jupyter Notebooks Usando Google Colaboratory

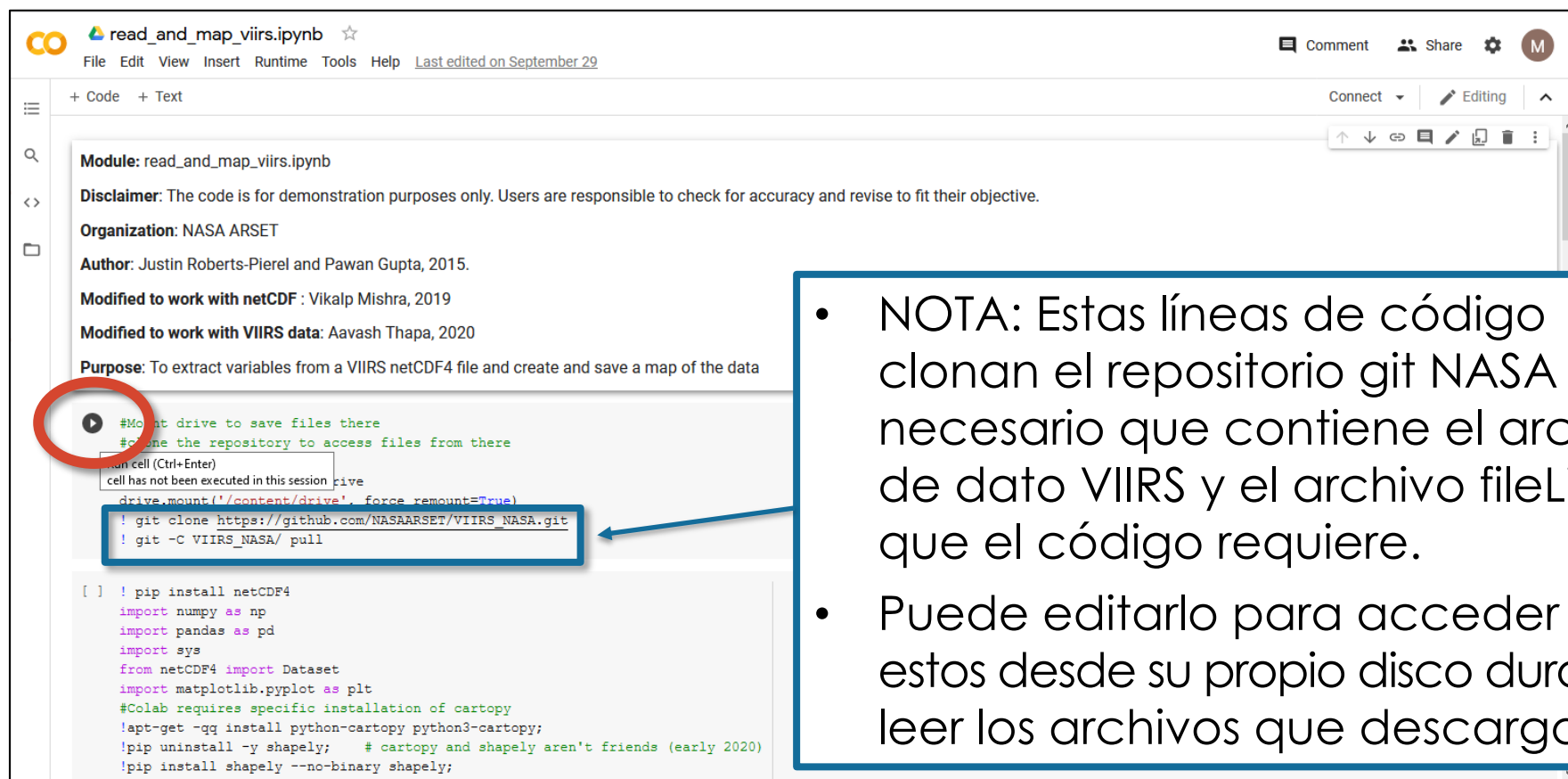
Ejecutar su Jupyter Notebook

Paso 1b: Una vez abierto, haga clic en File > Save a copy in Drive. Esto automáticamente creará una copia en una carpeta llamada “Colab Notebooks”.



Ejecutar su Jupyter Notebook

Paso 2: Ejecute cada celda de su cuaderno en orden.



Module: read_and_map_viirs.ipynb

Disclaimer: The code is for demonstration purposes only. Users are responsible to check for accuracy and revise to fit their objective.

Organization: NASA ARSET

Author: Justin Roberts-Pierel and Pawan Gupta, 2015.

Modified to work with netCDF4: Vikalp Mishra, 2019

Modified to work with VIIRS data: Aavash Thapa, 2020

Purpose: To extract variables from a VIIRS netCDF4 file and create and save a map of the data

```
! git clone https://github.com/NASAARSET/VIIRS_NASA.git
! git -C VIIRS_NASA/ pull
```

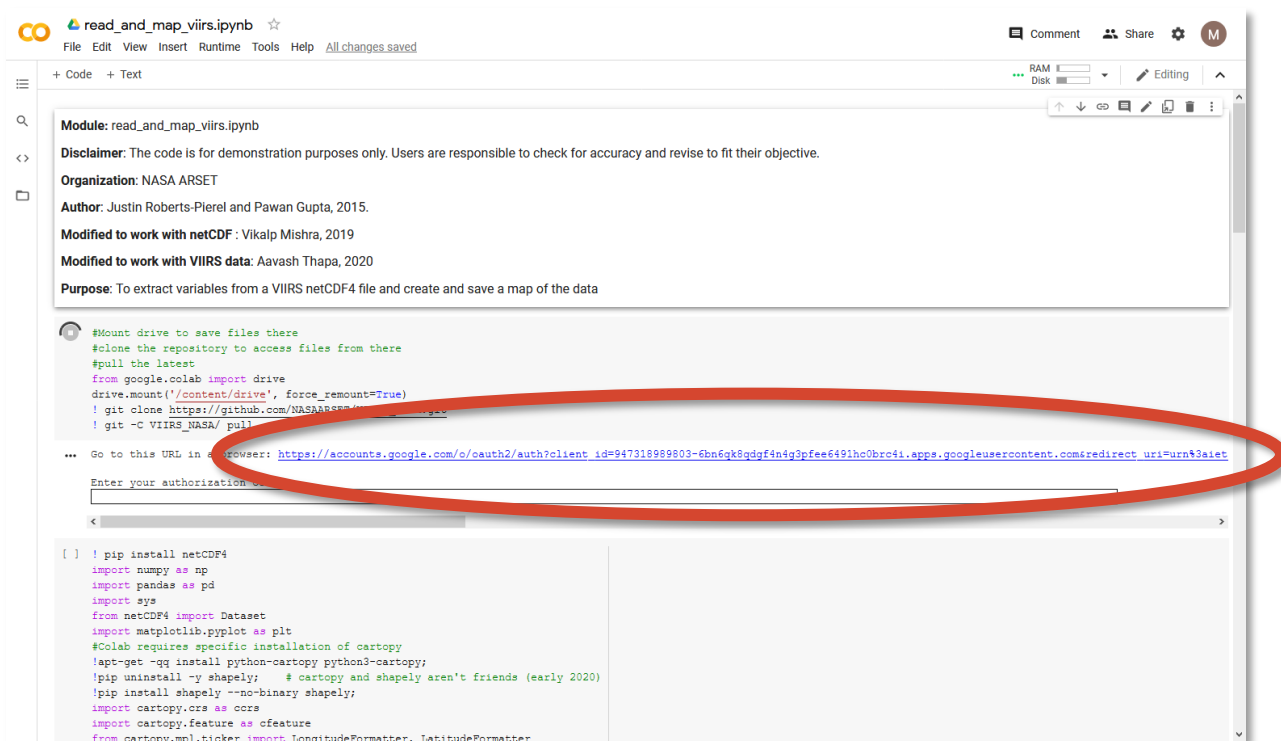
```
[ ] ! pip install netCDF4
import numpy as np
import pandas as pd
import sys
from netCDF4 import Dataset
import matplotlib.pyplot as plt
#Colab requires specific installation of cartopy
!apt-get -qq install python-cartopy python3-cartopy;
!pip uninstall -y shapely; # cartopy and shapely aren't friends (early 2020)
!pip install shapely --no-binary shapely;
```

- NOTA: Estas líneas de código clonan el repositorio git NASA ARSET necesario que contiene el archivo de dato VIIRS y el archivo fileList.txt que el código requiere.
- Puede editarlo para acceder a estos desde su propio disco duro para leer los archivos que descarga.



Ejecutar su Jupyter Notebook

Paso 2a: La primera vez que ejecute cada código deberá obtener un código de autorización de Google File Stream. Haga clic en el enlace y elija su cuenta de Google Drive.



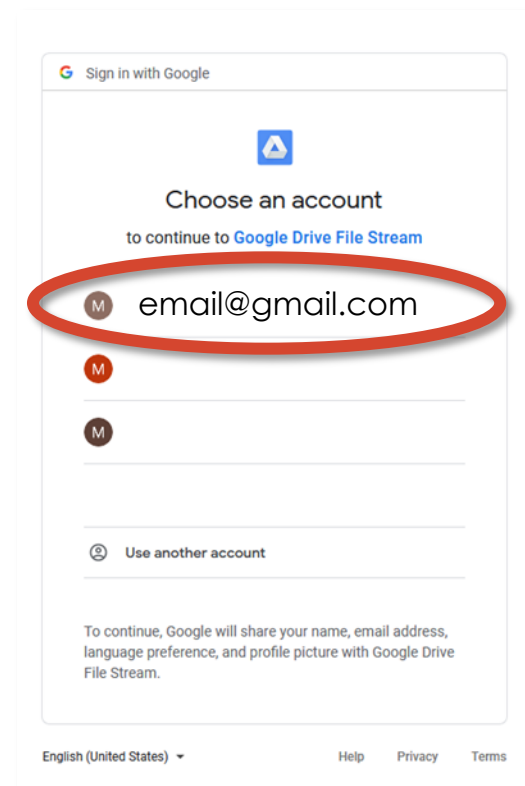
```
Module: read_and_map_viirs.ipynb
Disclaimer: The code is for demonstration purposes only. Users are responsible to check for accuracy and revise to fit their objective.
Organization: NASA ARSET
Author: Justin Roberts-Pierel and Pawan Gupta, 2015.
Modified to work with netCDF: Vikalp Mishra, 2019
Modified to work with VIIRS data: Aavash Thapa, 2020
Purpose: To extract variables from a VIIRS netCDF4 file and create and save a map of the data

#Mount drive to save files there
#clone the repository to access files from there
#pull the latest
from google.colab import drive
drive.mount('/content/drive', force_remount=True)
! git clone https://github.com/NASAARSET/VIIRS-netCDF4
! git -C VIIRS_NASA/ pull

... Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6gk8qdgf4nig3pfee6491hc0brc4i.apps.googleusercontent.com&redirect_uri=urn%3Aietf:

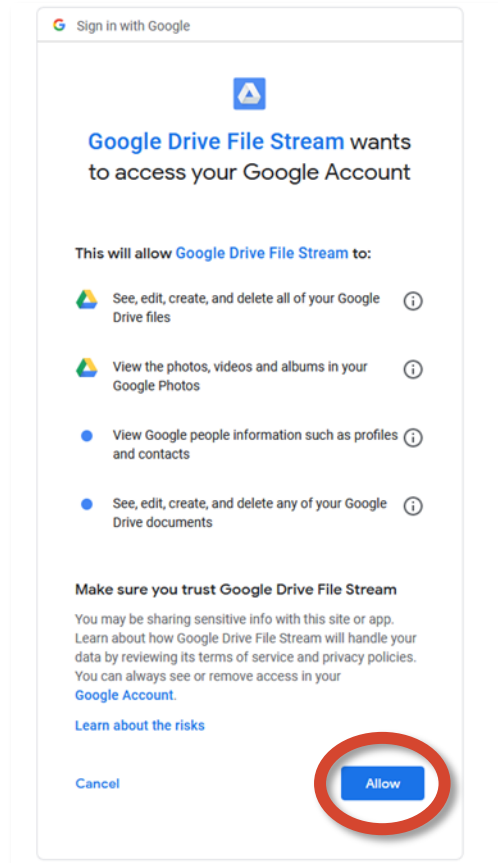
Enter your authorization code

[ ] ! pip install netCDF4
import numpy as np
import pandas as pd
import sys
from netCDF4 import Dataset
import matplotlib.pyplot as plt
#Colab requires specific installation of cartopy
!apt-get -qq install python-cartopy python3-cartopy;
!pip uninstall -y shapely; # cartopy and shapely aren't friends (early 2020)
!pip install shapely --no-binary shapely;
import cartopy.crs as ccrs
import cartopy.feature as cfeature
from cartopy.mpl.ticker import LongitudeFormatter, LatitudeFormatter
```



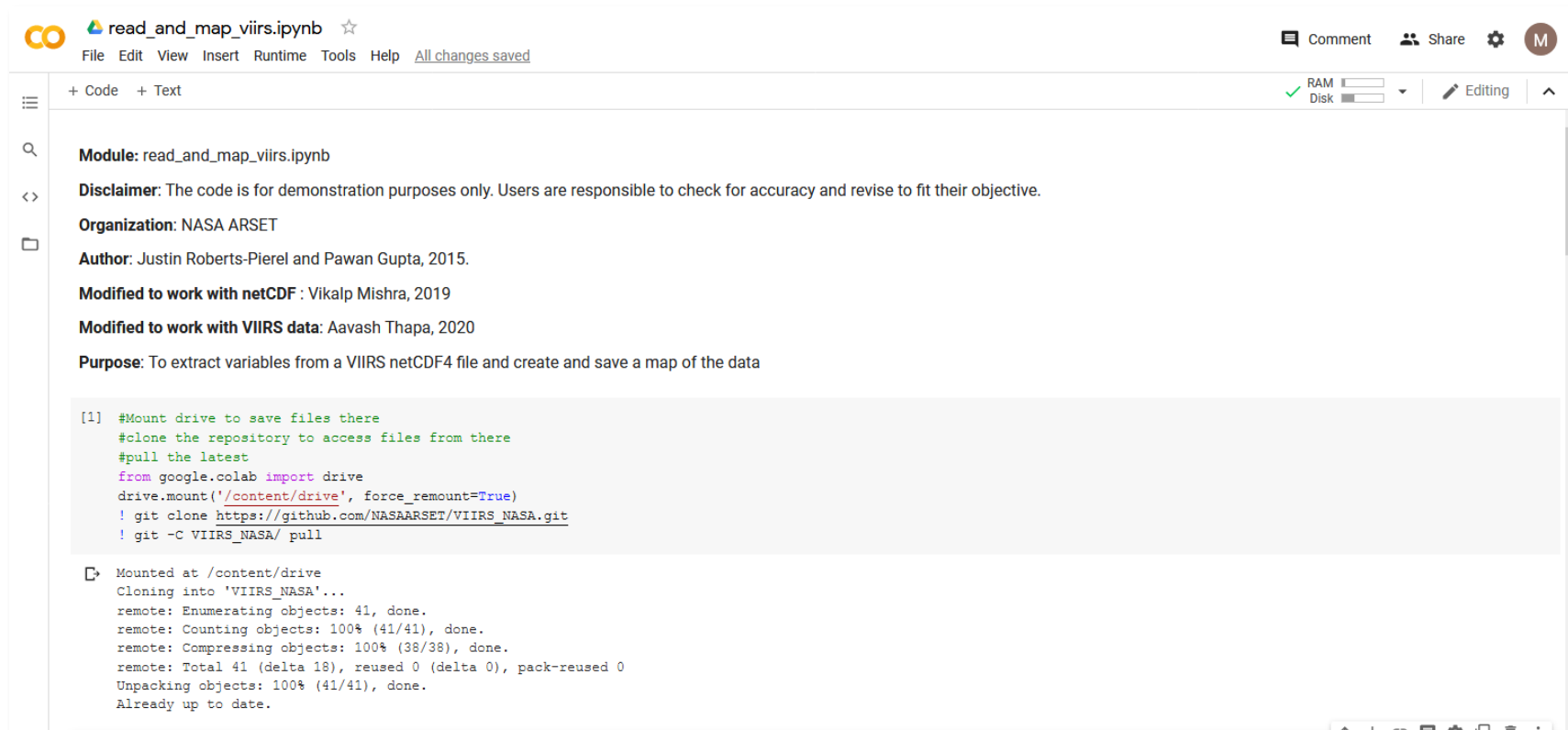
Ejecutar su Jupyter Notebook

Paso 2b: Haga clic en Allow y copie el código.



Ejecutar su Jupyter Notebook

Paso 2c: Pegue el código en el cuaderno y presione Enter.



The screenshot shows a Jupyter Notebook window titled "read_and_map_viirs.ipynb". The interface includes a top menu bar with options like File, Edit, View, Insert, Runtime, Tools, and Help. Below the menu, there are tabs for "+ Code" and "+ Text". On the right side, there are icons for Comment, Share, and a user profile icon labeled "M". A status bar at the top right shows RAM and Disk usage, and a "Editing" mode indicator.

The notebook content includes a disclaimer, organization information, author details, and a purpose statement. The code cell [1] contains the following Python and shell commands:

```
[1] #Mount drive to save files there
#clone the repository to access files from there
#pull the latest
from google.colab import drive
drive.mount('/content/drive', force_remount=True)
! git clone https://github.com/NASAARSET/VIIRS_NASA.git
! git -C VIIRS_NASA/ pull
```

The output of the code execution shows the drive mounting process and the cloning of the repository:

```
Mounted at /content/drive
Cloning into 'VIIRS_NASA'...
remote: Enumerating objects: 41, done.
remote: Counting objects: 100% (41/41), done.
remote: Compressing objects: 100% (38/38), done.
remote: Total 41 (delta 18), reused 0 (delta 0), pack-reused 0
Unpacking objects: 100% (41/41), done.
Already up to date.
```



Ejecutar su Jupyter Notebook

Paso 4: Ejecutar la última celda para ejecutar el código.

The screenshot shows a Jupyter Notebook titled 'read_and_map_viirs.ipynb'. The code in the cell is as follows:

```
[ ] #!/usr/bin/python
try:
    fileList = open('VIIRS_NASA/fileList.txt', 'r')
except:
    print('Did not find a text file containing file names (perhaps name does not match)')
    sys.exit()

#loops through all files listed in the text file
for FILE_NAME in fileList:
    FILE_NAME=FILE_NAME.strip()
    #change 'raw_input' to 'input' if an error is shown about the input
    user_input=input('\nWould you like to process\n' + FILE_NAME + '\n\n(Y/N)')
    if(user_input == 'N' or user_input == 'n'):
        print('Skipping...')
        continue
    else:
        file = Dataset('VIIRS_NASA/'+ FILE_NAME, 'r')
# read the data
ds=file
#grp='PRODUCT'
lat= ds.variables['Latitude'][:][:]
lon= ds.variables['Longitude'][:][:]
if 'AERDB' in FILE_NAME:

#The user has a choice of 5 sds variable and has to input a number to choose.
#The loop keeps repeating until the user inputs a value between 1-5 inclusive.
while True:
    choice = input("""Pick the number with the corresponding sds variable of your choice:
1) Aerosol_Optical_Thickness_550_Land
2) Aerosol_Optical_Thickness_550_Land_Ocean_Best_Estimate
3) Aerosol_Optical_Thickness_QA_Flag_Land
4) Aerosol_Type_Land_Ocean
5) Angstrom_Exponent_Land_Ocean_Best_Estimate """)

    if choice in ['1', '2', '3', '4', '5']:
        break
    else:
        print("Please input a valid response!")

if choice == '1':
```

Two callout boxes with blue borders and arrows point to specific lines of code:

- The first callout box points to the line `fileList = open('VIIRS_NASA/fileList.txt', 'r')` and contains the text: "Esto lee el fileList.txt del repositorio NASA ARSET git."
- The second callout box points to the line `file = Dataset('VIIRS_NASA/'+ FILE_NAME, 'r')` and contains the text: "Esto lee el archivo de datos listados en fileList.txt del git."



Ejecutar su Jupyter Notebook

Paso 4: Ingrese Y para procesar el archivo.



The screenshot shows a Jupyter Notebook interface with a code cell containing the following Python code:

```
cb = plt.colorbar(shrink = 0.7)
cb.set_label(map_label, fontsize =9, wrap=True)
"""
    grd = m.gridlines(crs=ccrs.PlateCarree(), draw_labels=True, linewidth=2, color='gray', alpha=0.5, linestyle='--')
    grd.xlabel_top = None
    grd.ylabel_right = None
    grd.xformatter = LONGITUDE_FORMATTER
    grd.yformatter = LATITUDE_FORMATTER
    """
# Show the plot window.
plt.show()
#once you close the map it asks if you'd like to save it
#change 'raw_input' to 'input' if an error is shown about the input
is_save=str(input('\nWould you like to save this map? Please enter Y or N \n'))
if is_save == 'Y' or is_save == 'y':
    #saves as a png if the user would like
    pngfile = '{0}.png'.format(FILE_NAME[:-3])
    fig.savefig('/content/drive/My Drive/Colab Notebooks/' + pngfile, dpi = 300, bbox_inches='tight')
#close the hdf5 file
file.close()
```

Below the code cell, the notebook displays the prompt: "Would you like to process" followed by a file path. Below this, there is an input field with the text "(Y/N)" and a red circle around it, indicating where the user should enter 'Y'.

A blue box with a blue arrow points to the `fig.savefig` line in the code, containing the text: "Es aquí donde su mapa se guardará".



Ejecutar su Jupyter Notebook

Paso 5: Ingrese 2 (Aerosol_Optical_Thickness_550_Land_Ocean_Best_Estimate) y luego ingrese Y para crear un mapa. Ahora ingrese Y para guardarlo en su Google Drive/Colab Notebooks/ carpeta

```
read_and_map_viirs.ipynb
File Edit View Insert Runtime Tools Help All changes saved
+ Code + Text
#close the hdf5 file
file.close()

Would you like to process
AERDB_L2_VIIRS_SNPP.A2020056.1954.001.2020057113600.nc

(Y/N) Y
Pick the number with the appropriate description of your choice:
1) Aerosol_Optical_Thickness_550_Land
2) Aerosol_Optical_Thickness_550_Land_Ocean_Best_Estimate
3) Aerosol_Optical_Thickness QA Flag Land
4) Aerosol_Type_Land_Ocean
5) Angstrom_Exponent_Land_Ocean_Best_Estimate 2

The average of this data is: 0.075
The standard deviation is: 0.073
The median is: 0.059
The range of latitude in this file is: 11.471696 to 36.39784 degrees
The range of longitude in this file is: -120.826866 to -85.44587 degrees

Would you like to create a map of this data? Please enter Y or N
Y
/usr/lib/python3/dist-packages/cartopy/io/_init_.py:264: DownloadWarning: Downloading: http://naciscdn.org/naturalearth/110m/physical/ne\_110m\_coastline.zip
warnings.warn("Downloading: {}".format(url), DownloadWarning)

AERDB_L2_VIIRS_SNPP.A2020056.1954.001.2020057113600.nc
Deep Blue/SOAR aerosol optical thickness at 550 nm over land and ocean, QA-filtered



Would you like to save this map? Please enter Y or N
Y
```



Preguntas

- Por favor escriba su pregunta en el cuadro para preguntas.
- Publicaremos las preguntas y las respuestas en la página web de la capacitación después de la conclusión del curso.



Contactos

- Contactos
 - Pawan Gupta: pawan.gupta@nasa.gov
 - Melanie Follette-Cook: melanie.cook@nasa.gov
- Preguntas Generales sobre ARSET
 - Ana Prados: aprados@umbc.edu
- Página web de ARSET:
 - appliedsciences.nasa.gov/arset





Thank You!

