



National Aeronautics and
Space Administration



ARSET

Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

Panorama de los productos de nieve de la NASA

Objetivo

Poder acceder a los datos del manto de nieve y del equivalente en agua de la nieve (snow water equivalence o SWE) de la NASA útiles para el monitoreo climático y la gestión de recursos hídricos, e.g. gestión de ríos alimentados por deshielos.

Esquema

- La percepción remota de la nieve
- Productos de nieve de la NASA de satélites y modelos de sistemas terrestres
- Productos de datos de la nieve del MODIS y acceso a ellos

Definiciones

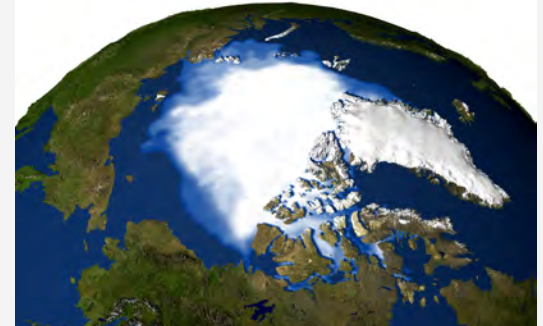
¿Qué es el hielo?

- Cuando una masa, capa, o superficie de agua se congela convirtiéndose en un sólido a bajas temperaturas

¿Qué es la nieve?

- Deposición: cuando el vapor de agua se congela convirtiéndose directamente en cristales de hielo
- Los copos de nieve son la agregación de muchos cristales de hielo
- Una Nevada es cuando copos de nieve precipitan de la nubes

Hielo marino



Nieve en las montañas



La necesidad de mediciones de la nieve

Mediciones importantes para saber acerca de áreas cubiertas de nieve:

- Cobertura de nieve inicial y restante
- Reducción en el manto de nieve
- Tasa de deshielo

Regiones del mundo dominadas por la nieve

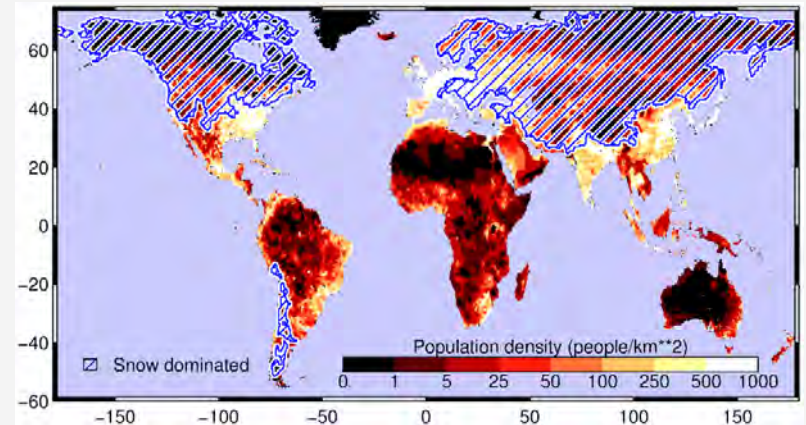
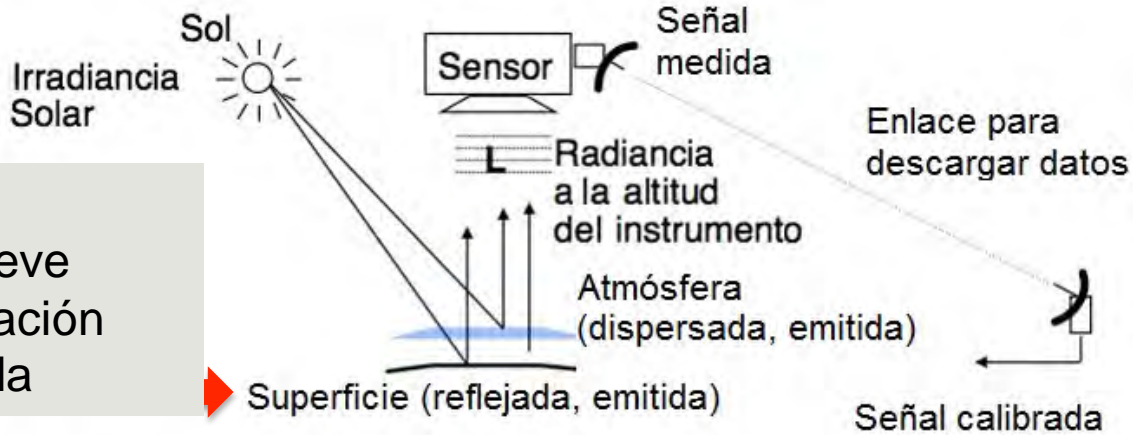


Figura cortesía: Tim Barnett (Scripps Inst. Ocean)

Técnica de la percepción remota

Las superficies cubiertas de nieve influyen la radiación reflejada/emitada



El sol y las fuentes planetarias emiten energía

La energía es transmitida y dispersada por la atmósfera y reflejada de la superficie.

El sensor de imágenes responde a la energía (L) dentro de un campo visual y gama espectral

La señal del sensor es digitalizado y transmitido a la superficie y grabado

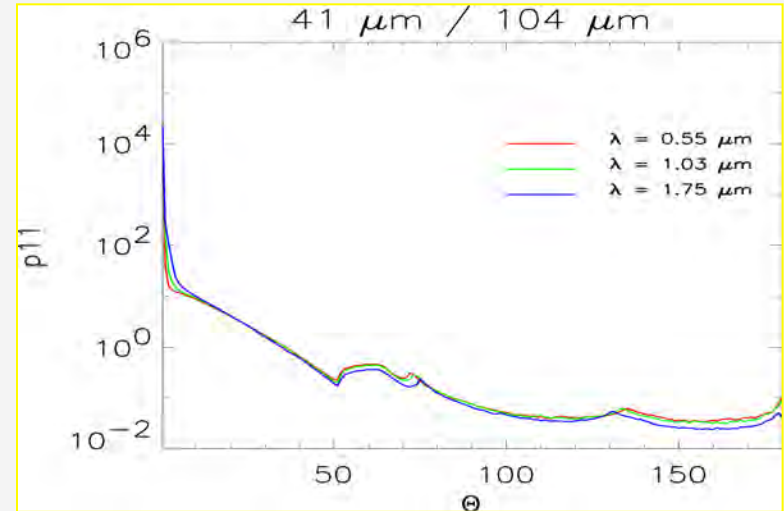
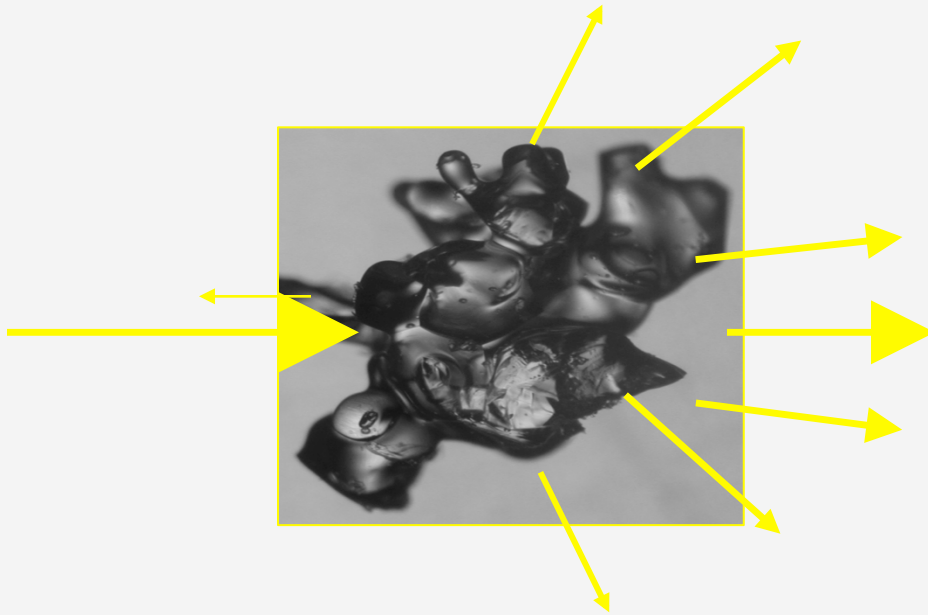
La señal es calibrada, procesada y analizada para responder a las preguntas de interés

Propiedades de la nieve

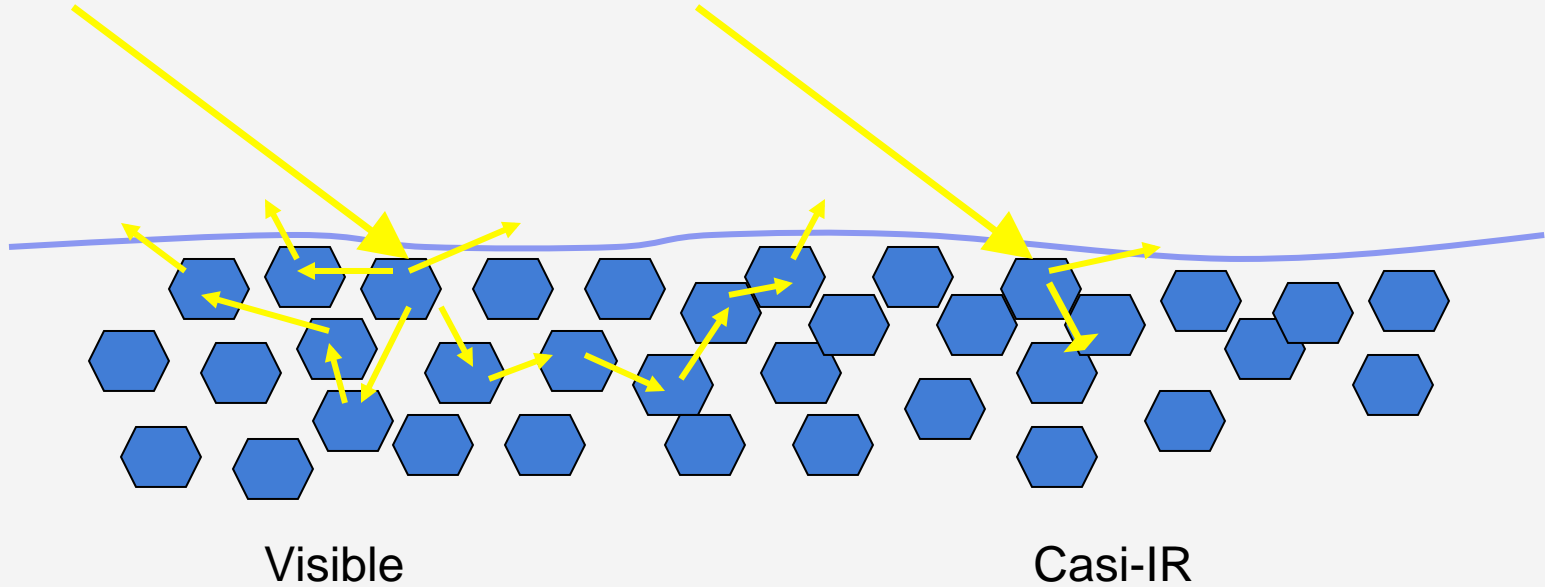
- Las superficies cubiertas de nieve afectan el **albedo** – fracción de la radiación solar reflejada de vuelta al espacio
- El tamaño de las partículas de la nieve afecta el albedo
- El manto de nieve puede variar de manera significativa en el espacio/ tiempo



Dispersión singular por partículas de nieve

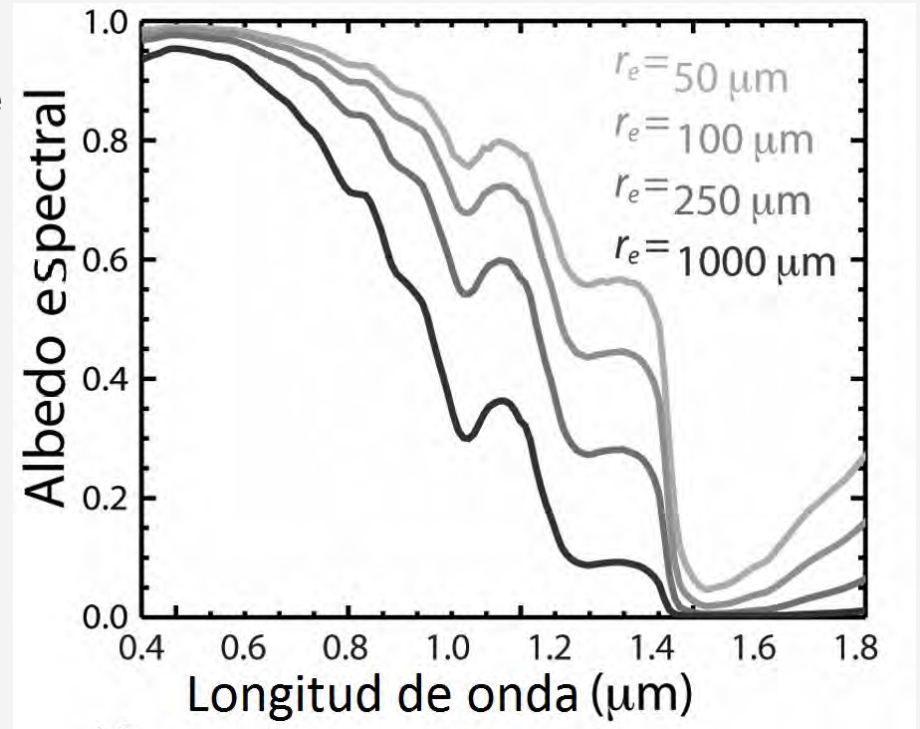


Dispersión múltiple por partículas de nieve



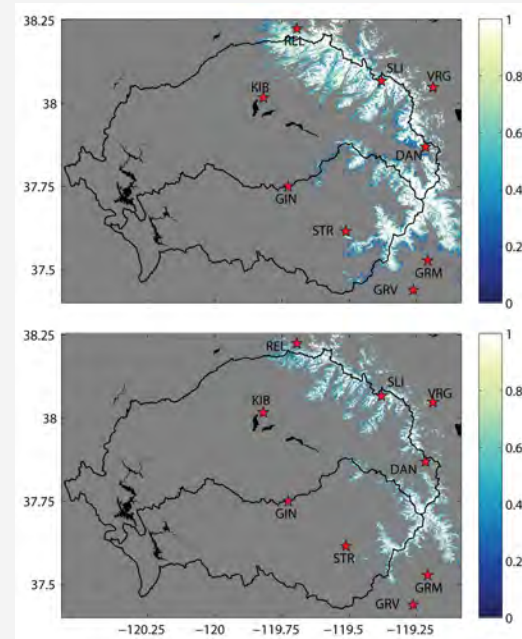
Reflectancia de la nieve

Los sensores satelitales miden la radiación solar dispersada por la nieve



Beneficios de la percepción remota del manto de nieve

- Los sensores de nieve en la superficie recopilan mediciones puntuales y no logran informar la distribución espacial exacta de la nieve
- Los sensores de nieve no cubren las elevaciones más altas de las montañas
- La percepción remota ofrece cobertura espacial continua y proporciona observaciones en áreas difíciles de llegar



Manto de nieve fraccional de Landsat TM el 2 y el 18 de julio de 2011

NASA Snow Products Available from Satellites

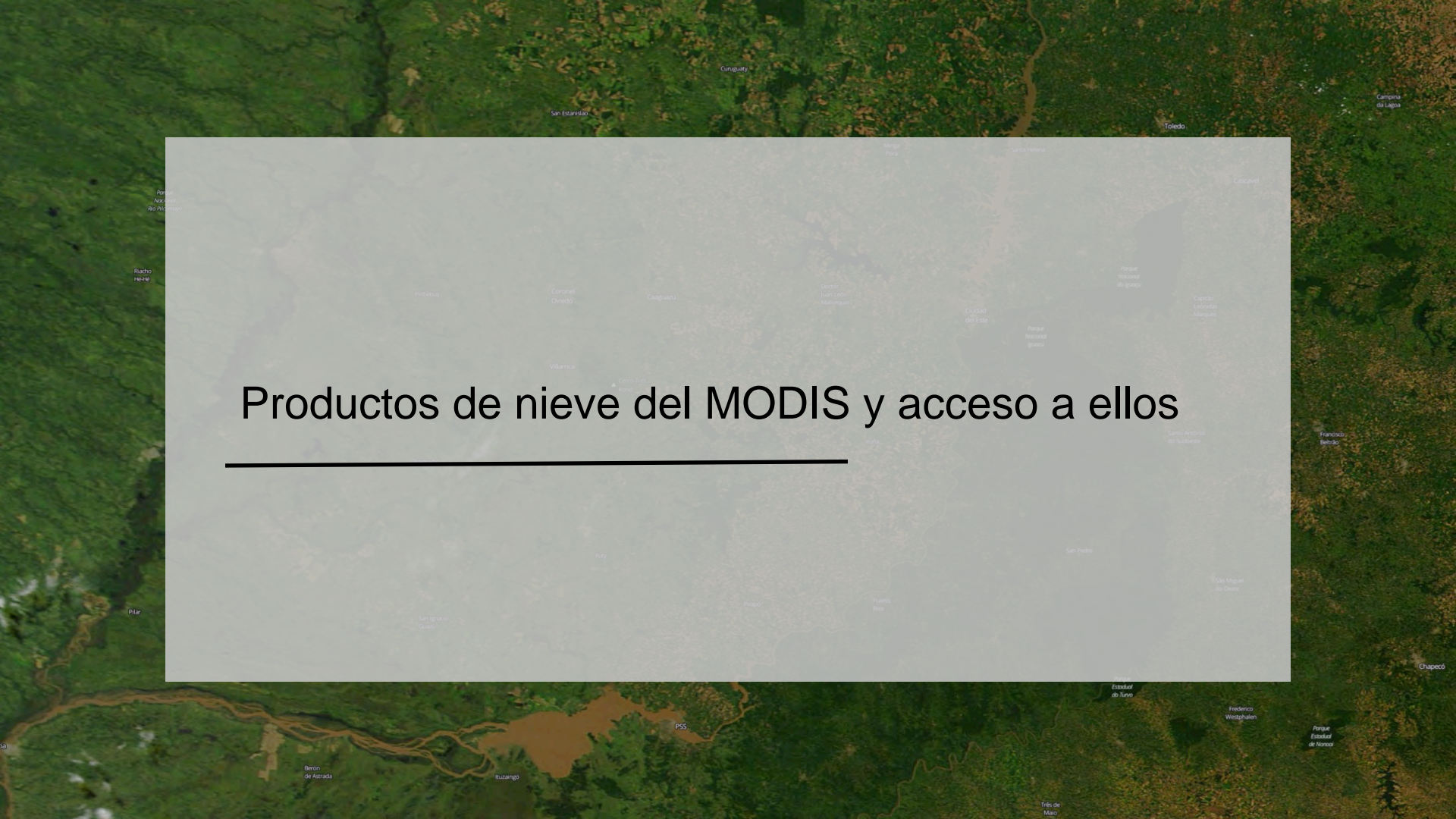
| Satélite | Sensores | Cantidades |
|--|---|--|
| Terra | <ul style="list-style-type: none"> • MODerate Resolution Imaging Spectroradiometer (MODIS) • 500m de resolución espacial • Resolución temporal ~diaria | <ul style="list-style-type: none"> • Área cubierta de nieve • Albedo de la nieve • Tamaño de gránulo de nieve • Forzado radiativo de polvo/carbono negro |
| Aqua | | |
| NPOESS Preparatory Project (NPP) - Sumoi | <ul style="list-style-type: none"> • Visible Infrared Imaging Radiometer Suite (VIIRS) • 750m de resolución espacial • Resolución temporal ~diaria | |
| Landsat Data Continuity Mission (LDCM) (launch Feb 2013) | <ul style="list-style-type: none"> • Operational Land Imager (OLI) • 30m de resolución espacial • Resolución temporal- 16 días | |

Productos de nieve de la NASA: Modelos

| Producto de nieve | Fuente | Espacial temporal |
|---|--------------------------|---|
| Tasa de nieve (kg/m ² /segundo) Profundidad de la nieve Masa de la nieve | MERRA* GLDAS-NOAH | <ul style="list-style-type: none">• 0.5°x0.625°, mensual (1980-02/2016)• 0.125°x0.125° y 1°x1°, 3 horas (1948-05/2016) |
| Equivalente en agua de la nieve* (kg/m ² o m) | GLDAS-NOAH | <ul style="list-style-type: none">• 0.125°x0.125° y 1°x1°, 3 horas (1948-05/2016) |

*MERRA: Modern-era Retrospective Analysis for Research and Applications
(Análisis moderno para la investigación y aplicaciones)

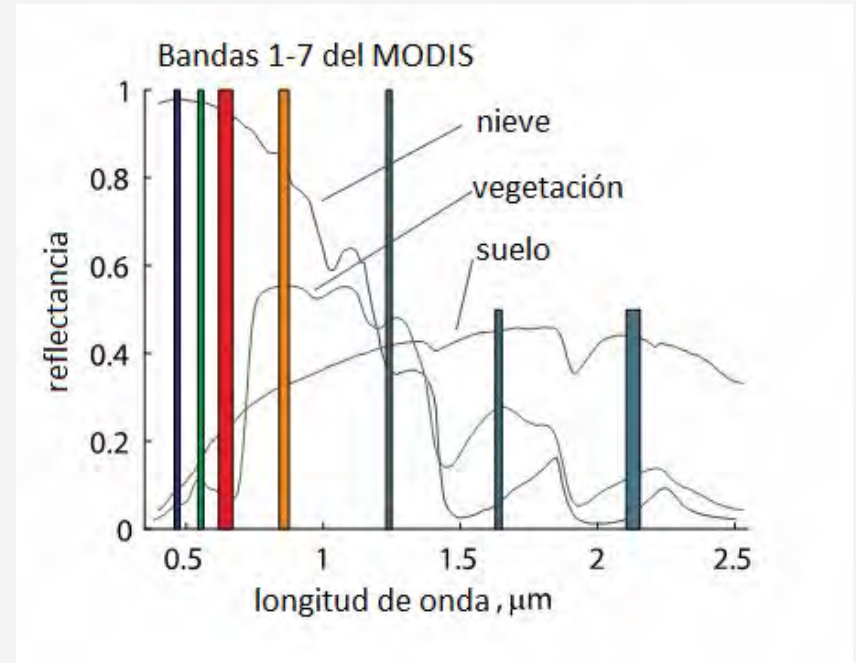
*El equivalente en agua de la nieve es la profundidad del agua en la que un manto de nieve se convierte cuando se derrite



Productos de nieve del MODIS y acceso a ellos

MODIS- Productos de datos del manto de nieve

- Alta resolución, cobertura diaria
- 1999 – presente
- Disponible a 500m y 0.05°
- Hay dos productos del manto de nieve basados en la reflectancia espectral del MODIS:
 - Producto estándar de manto de nieve fraccional del MODIS
 - Producto MODSCAG (MODIS Snow Covered Area and Grain-size)
 - Manto de nieve fraccional, tamaño de gránulo, equivalente en agua de la nieve (SWE por sus siglas en inglés)



MODIS- Productos estándar

http://nsidc.org/data/modis/data_summaries#snow

Los productos
MOD son de Terra
y los MYD son de
Aqua

Snow Cover

Version 6 Version 5

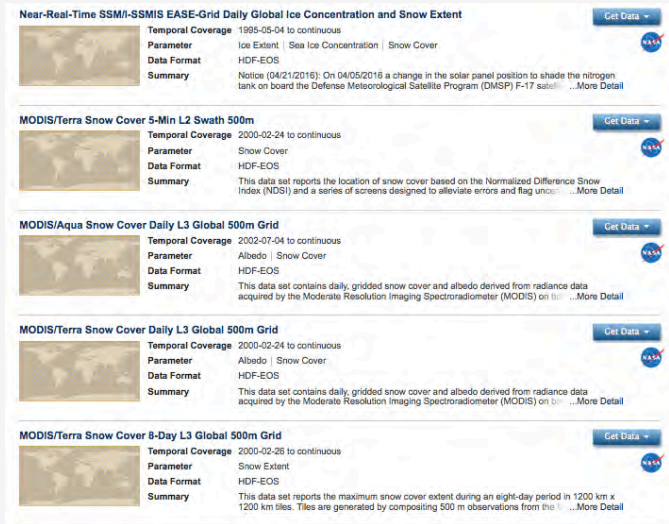
The following Version 6 snow cover data sets are currently available at NSIDC. This table will be updated as new data sets are released. NSIDC will continue to distribute Version 5 until Version 6 reprocessing is complete.

| ID | Version | Title | Spatial Resolution | Temporal Resolution | Parameters |
|----------|---------|---|--------------------|---------------------|--------------------|
| MYD10_L2 | 6 | MODIS/Aqua Snow Cover 5-Min L2 Swath 500m, Version 6 | 500 m | 5 minute | Snow Cover |
| MOD10_L2 | 6 | MODIS/Terra Snow Cover 5-Min L2 Swath 500m, Version 6 | 500 m | 5 minute | Snow Cover |
| MYD10A1 | 6 | MODIS/Aqua Snow Cover Daily L3 Global 500m Grid, Version 6 | 500 m | 1 day | Albedo, Snow Cover |
| MOD10A1 | 6 | MODIS/Terra Snow Cover Daily L3 Global 500m Grid, Version 6 | 500 m | 1 day | Albedo, Snow Cover |
| MYD10C1 | 6 | MODIS/Aqua Snow Cover Daily L3 Global 0.05Deg CMG, Version 6 | 0.05 Deg | 1 day | Snow Cover |
| MOD10C1 | 6 | MODIS/Terra Snow Cover Daily L3 Global 0.05Deg CMG, Version 6 | 0.05 Deg | 1 day | Snow Cover |
| MYD10A2 | 6 | MODIS/Aqua Snow Cover 8-Day L3 Global 500m Grid, Version 6 | 500 m | 8 day | Snow Extent |
| MOD10A2 | 6 | MODIS/Terra Snow Cover 8-Day L3 Global 500m Grid, Version 6 | 500 m | 8 day | Snow Extent |

MODIS- Acceso a productos estándar

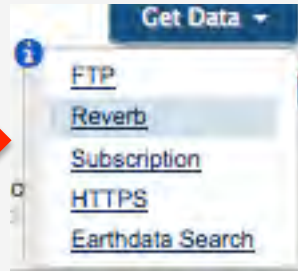
Available to Download from National Snow and Ice Data Center

<http://nsidc.org/>



The screenshot displays a list of MODIS snow cover products with the following details:

- Near-Real-Time SSM/I-SSM/IS EASE-Grid Daily Global Ice Concentration and Snow Extent**
 - Temporal Coverage: 1995-05-04 to continuous
 - Parameter: Ice Extent | Sea Ice Concentration | Snow Cover
 - Data Format: HDF-EOS
 - Summary: Notice (04/21/2016): On 04/05/2016 a change in the solar panel position to shade the nitrogen tank on board the Defense Meteorological Satellite Program (DMSP) F-17 satellite. ...More Detail
- MODIS/Terra Snow Cover 5-Min L2 Swath 500m**
 - Temporal Coverage: 2000-02-24 to continuous
 - Parameter: Snow Cover
 - Data Format: HDF-EOS
 - Summary: This data set reports the location of snow cover based on the Normalized Difference Snow Index (NDSI) and a series of screens designed to alleviate errors and flag unusable data. ...More Detail
- MODIS/Aqua Snow Cover Daily L3 Global 500m Grid**
 - Temporal Coverage: 2002-07-04 to continuous
 - Parameter: Albedo | Snow Cover
 - Data Format: HDF-EOS
 - Summary: This data set contains daily, gridded snow cover and albedo derived from radiance data acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on board the Aqua satellite. ...More Detail
- MODIS/Terra Snow Cover Daily L3 Global 500m Grid**
 - Temporal Coverage: 2000-02-24 to continuous
 - Parameter: Albedo | Snow Cover
 - Data Format: HDF-EOS
 - Summary: This data set contains daily, gridded snow cover and albedo derived from radiance data acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on board the Terra satellite. ...More Detail
- MODIS/Terra Snow Cover 8-Day L3 Global 500m Grid**
 - Temporal Coverage: 2000-02-25 to continuous
 - Parameter: Snow Extent
 - Data Format: HDF-EOS
 - Summary: This data set reports the maximum snow cover extent during an eight-day period in 1200 km x 1200 km tiles. Tiles are generated by compositing 500 m observations from the Terra satellite. ...More Detail



The 'Get Data' dropdown menu includes the following options:

- FTP
- Reverb
- Subscription
- HTTPS
- Earthdata Search

- Datos están en formato HDF
- Imágenes FTP jpg de manto de nieve de Nivel-2 y Nivel-3
- Descargue usando Reverb o Earth Data Search (requiere registración de usuario)

MODIS- Acceso a productos estándar desde Reverb

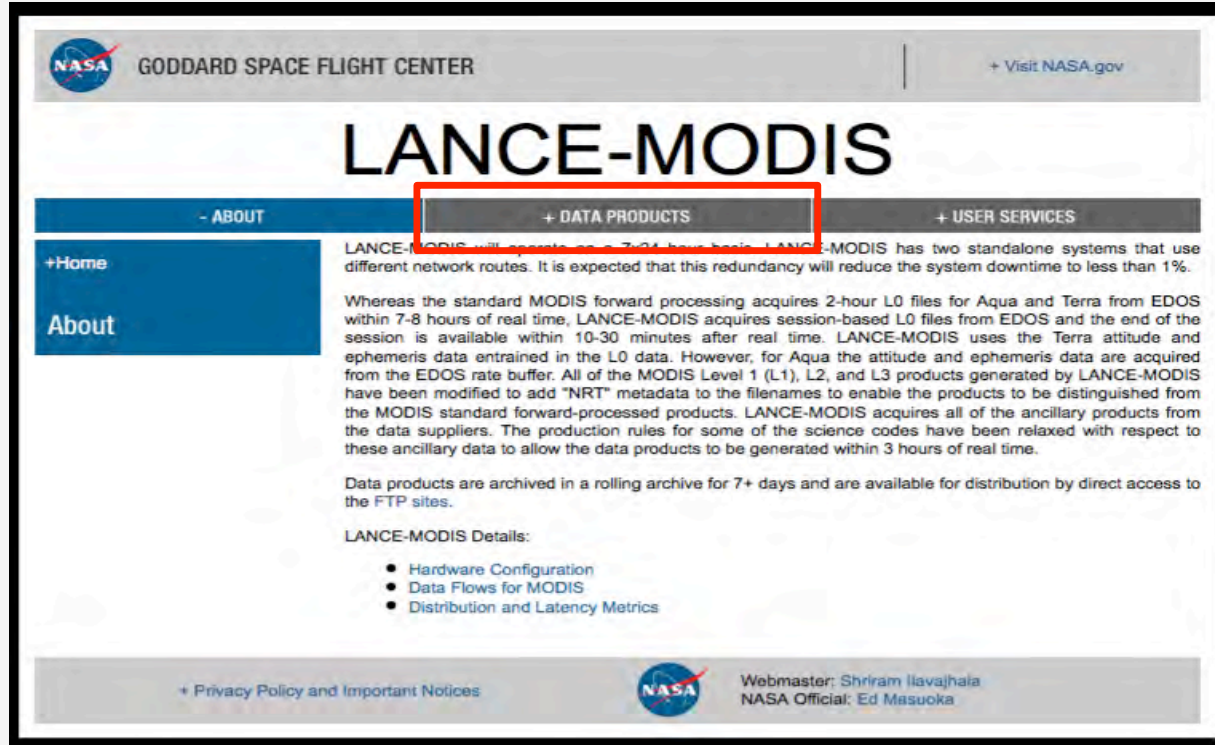
<http://reverb.echo.nasa.gov/reverb/>

Productos de barrido,
diarios y mensuales
disponibles

The screenshot displays the NASA Reverb ECHO interface. At the top, the NASA logo and 'National Aeronautics and Space Administration' are visible, along with 'EOSDIS NASA's Earth Observing System Data and Information System'. The page title is 'Reverb | ECHO The Next Generation Earth Science Discovery Tool'. The navigation bar includes 'EOSDIS Home', 'Reverb Home', 'About', 'Tutorial', 'Shopping Cart (0)', 'Order Status', 'Service Request Status', and 'Sign In'. The main content area is divided into two steps: 'Step 1: Select Search Criteria' and 'Step 2: Select Datasets'. In Step 1, the 'Spatial Search' section shows a bounding box of '-50.736, 163.477, -11.144, 105.680 (S,E,N,W)' and a satellite selection dropdown. The 'Search Terms' section contains the query 'MODIS Fire AST_L1A'. The 'Temporal Search' section has 'START' and 'END' date fields. In Step 2, a list of datasets is shown, with the first entry 'MODIS/Aqua Snow Cover Monthly L3 Global 0.05Deg CMG V005' circled in red. The bottom right corner indicates 'Found 7 dataset. Total Query Time: 0.156s'.

Manto de nieve del MODIS en tiempo casi real

<http://lance-modis.eosdis.nasa.gov/>



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LANCE-MODIS will operate on a 7x24 hour basis. LANCE-MODIS has two standalone systems that use different network routes. It is expected that this redundancy will reduce the system downtime to less than 1%.

Whereas the standard MODIS forward processing acquires 2-hour L0 files for Aqua and Terra from EDOS within 7-8 hours of real time, LANCE-MODIS acquires session-based L0 files from EDOS and the end of the session is available within 10-30 minutes after real time. LANCE-MODIS uses the Terra attitude and ephemeris data entrained in the L0 data. However, for Aqua the attitude and ephemeris data are acquired from the EDOS rate buffer. All of the MODIS Level 1 (L1), L2, and L3 products generated by LANCE-MODIS have been modified to add "NRT" metadata to the filenames to enable the products to be distinguished from the MODIS standard forward-processed products. LANCE-MODIS acquires all of the ancillary products from the data suppliers. The production rules for some of the science codes have been relaxed with respect to these ancillary data to allow the data products to be generated within 3 hours of real time.

Data products are archived in a rolling archive for 7+ days and are available for distribution by direct access to the FTP sites.

LANCE-MODIS Details:

- Hardware Configuration
- Data Flows for MODIS
- Distribution and Latency Metrics

[+ Privacy Policy and Important Notices](#)  Webmaster: Shriram Ilavajjala
NASA Official: Ed Masuoka

Manto de nieve del MODIS en tiempo casi real

<http://lance-modis.eosdis.nasa.gov/>

Datos de barrido de manto de nieve de Nivel-2 en 500m y 5km de resolución

Terra

| | | | | | | | | |
|---------------------------------------|--------------------------|------|----------------------|-----|----|------|----------|------|
| L2 Snow Cover, 5-Min Swath 500m | MOD10_L2 | 0.26 | L2 Snow Cover Browse | N/A | 07 | 0:46 | 1:32 (8) | 3:14 |
| L2 Coarse Snow Cover, 5-Min Swath 5km | MOD10L2C | 0.17 | | | | 0:46 | 1:32 (8) | 3:14 |

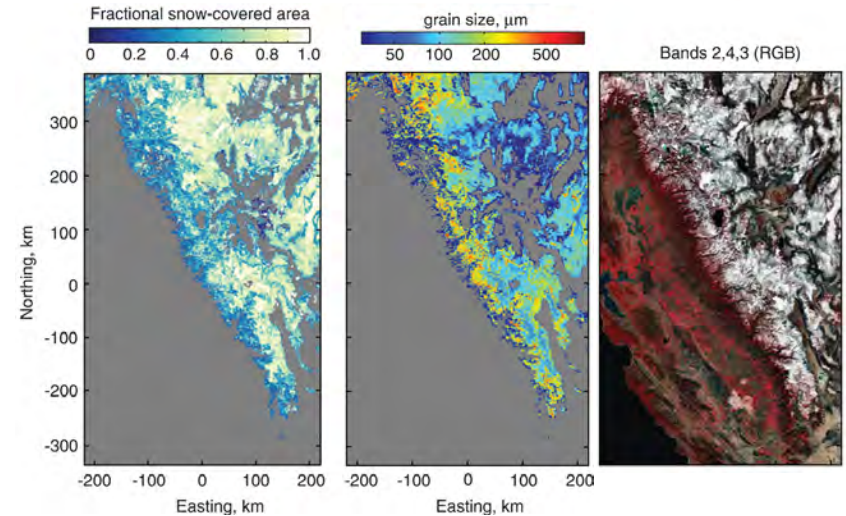
Aqua

| | | | | | | | | |
|---------------------------------------|--------------------------|------|----------------------|-----|----|------|-----------|------|
| L2 Snow Cover, 5-Min Swath 500m | MYD10_L2 | 0.26 | L2 Snow Cover Browse | N/A | 07 | 1:00 | 1:47 (25) | 3:30 |
| L2 Coarse Snow Cover, 5-Min Swath 5km | MYD10L2C | 0.17 | | | | 1:00 | 1:47 (25) | 3:30 |

Productos de nieve de MODSCAG

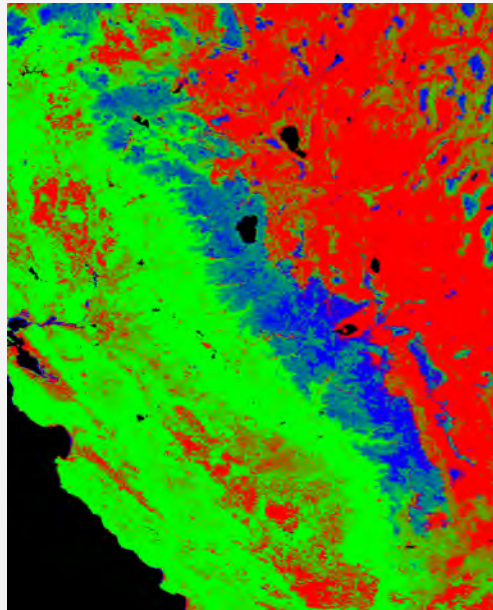
- Usa las bandas de reflectancia superficial de MODIS
- Inversión de matriz para recuperar la fracción de manto de nieve en cada pixel
- También determina el tamaño de gránulo y el albedo de ese manto de nieve fraccional (brindando lo que los modeladores quieren, no el compuesto)
- Más exacto que el manto de nieve estándar del MODIS




Productos de MODSCAG



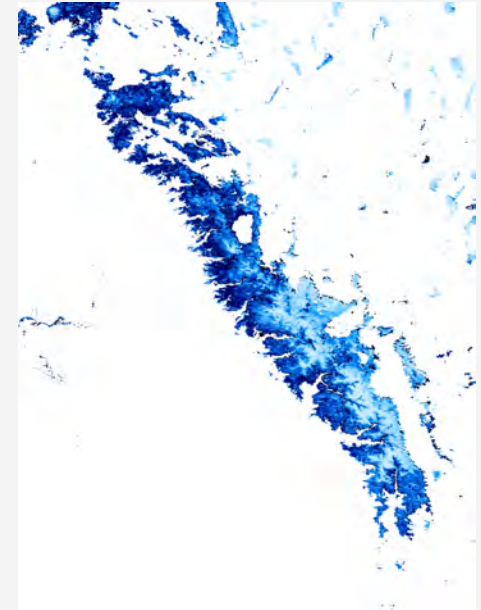
MODSCAG- Ejemplos de productos de datos de la nieve

Recuperaciones de MODSCAG, Sierra Nevada, 1^{ro} de abril de 2015



-  100% Manto de nieve
-  100% Cobertura de vegetación
-  100% Cobertura rocosa

Tamaño granular de la nieve



MODSCAG- Acceso a datos

<http://snow.jpl.nasa.gov/portal/>

Disponibles del servidor de datos de nieve del JPL

Home **Data** Publications Media People Links

SNOW DATA SYSTEM

Welcome to the Snow Data System

About This Site....

Welcome to the JPL Snow Data System. The Snow Data System serves cutting edge snow-related satellite and airborne remote sensing data, energy balance data for the Western US, and snow services targeting the snow, ice, climate, and water management communities.

For information about the project or comments, please contact

Thomas Painter (thomas.painter@jpl.nasa.gov)
Chris Mattmann (chris.a.mattmann@nasa.gov)

Latest News

28 November 2012 JPL Snow Products Training for SERVIR-Himalaya/ICMOD in Kathmandu, Nepal
<https://servirglobal.net/Globar/Articles/tabid/98/Article/1184/servir-himalaya-hosts-training-on-assessing-water-availability-and-flooding-pot.aspx>

24 Sept 2012
[Avalanche on Manaslu, Nepal](#)

15 Feb 2012

Latest Images

WATER RESOURCES RESEARCH

Volume 48 | Number 7 | July 2012
Articles published online 1 July - 31 July 2012

NASA Jet Propulsion Laboratory
California Institute of Technology

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Data

This page contains information about how to access snow data products and how to use them.

Data Access

Thank you for your interest in data dissemination from the JPL Snow Server. We have several forms of data access, the most reliable of which is WebDAV-based dissemination, in which you download our products in GeoTIFF format.

To gain WebDAV-based access, please email snowds-dev@jpl.nasa.gov with the subject line "DATA ACCESS REQUEST" and a brief description of your area of work and the products you would like to access. We will process a new account for you in a timely fashion. Thank you!

Documentation

Please see the [MODSCAG](#) and [MODRRFS](#) help pages for detailed information about these products.

Snow Map (Experimental)

This experimental map overlays data from multiple remote sensing and in situ sources to provide a comprehensive picture of snow and ice properties.

Western Energy Balance of Snow (WEBS) Data

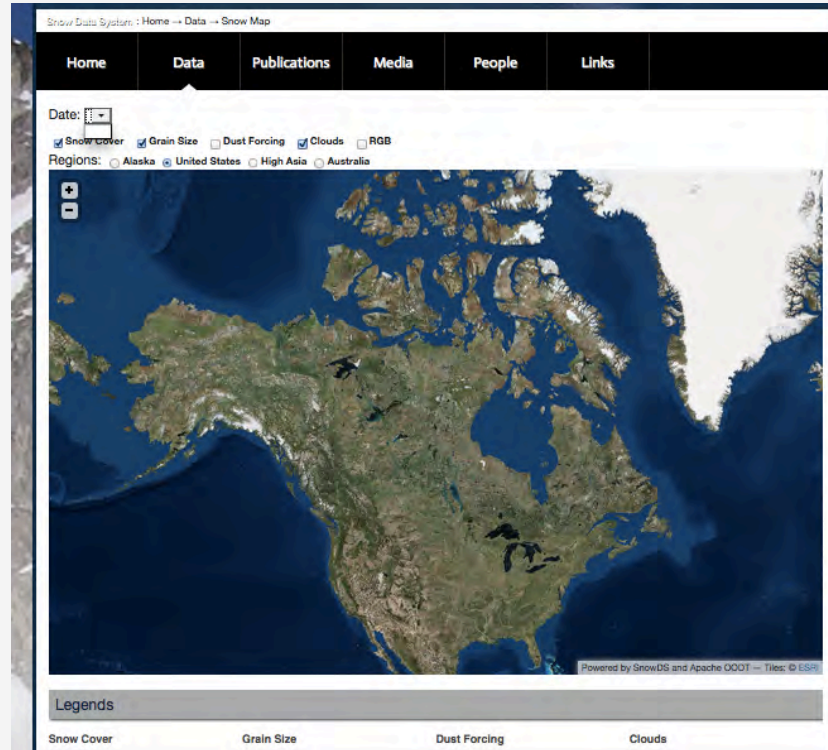
View Western Energy Balance of Snow data plotted by station and parameter.

Snow Data System Portal
NASA Jet Propulsion Laboratory
Built On Apache OODT
[Privacy Usage Policy](#)

NASA Site Contact: Dr. Chris Mattmann & Dr. Tom Painter

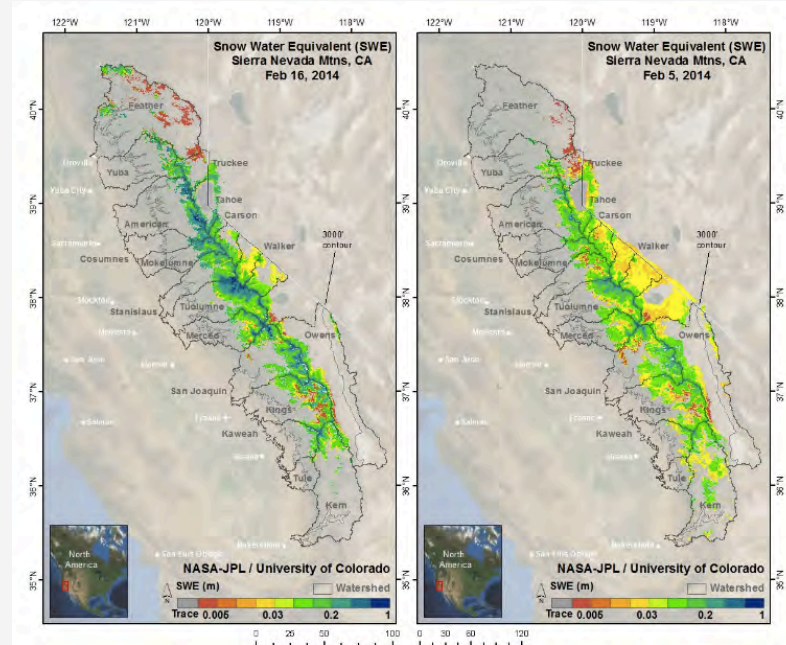
MODSCAG- Acceso a datos

<http://snow.jpl.nasa.gov/portal/data/map/>



MODSCAG- Equivalente en agua de la nieve derivado


- Derivado del manto, tamaño granular y albedo de la nieve



https://instaar.colorado.edu/uploads/research/labs-groups/mountain-hydrology-group/20140216_real_time_swe_report.pdf

MODSCAG- Aplicación

Water Resources



Integration of Precision NASA Snow Products with the Operations of the Colorado Basin River Forecast Center (CBRFC) to Improve Decision Making Under Drought Conditions

Principle Investigator: Thomas Painter, Jet Propulsion Laboratory

Abstract
The Colorado Basin River Forecast Center (CBRFC) is responsible for the entire Colorado Basin (CRB) and the eastern Great Basin (GB). From a water management perspective, the commitment of water to various users most often occurs in the spring, and is almost entirely based on estimates of the western USA snowpack. Improving seasonal drought predictions requires use of models that provide physically realistic simulations of fundamental hydrologic processes. Among these, for the western USA, representation of snow is perhaps most critical.

As drought frequency increases in the CRB and GB, it is critical that the CBRFC and the dependent water managers have more comprehensive real-time knowledge of the snow cover and its properties for more precise runoff forecasting and stakeholder decision support. The primary objective of this proposal is to integrate real-time high precision MODIS Snow Covered Area and Grain size (MODSCAG) fractional snow covered area (SCA) into CBRFC modeling and analysis systems and into stakeholder oriented data products, drastically reducing SCA uncertainties that have hampered forecasting operations for decades. A secondary objective is to ingest and study MODIS Dual Radiative Forcing in Snow (MODDRFS) radiative forcing imagery, to better understand its value as an input to modeling and forecasting approaches.

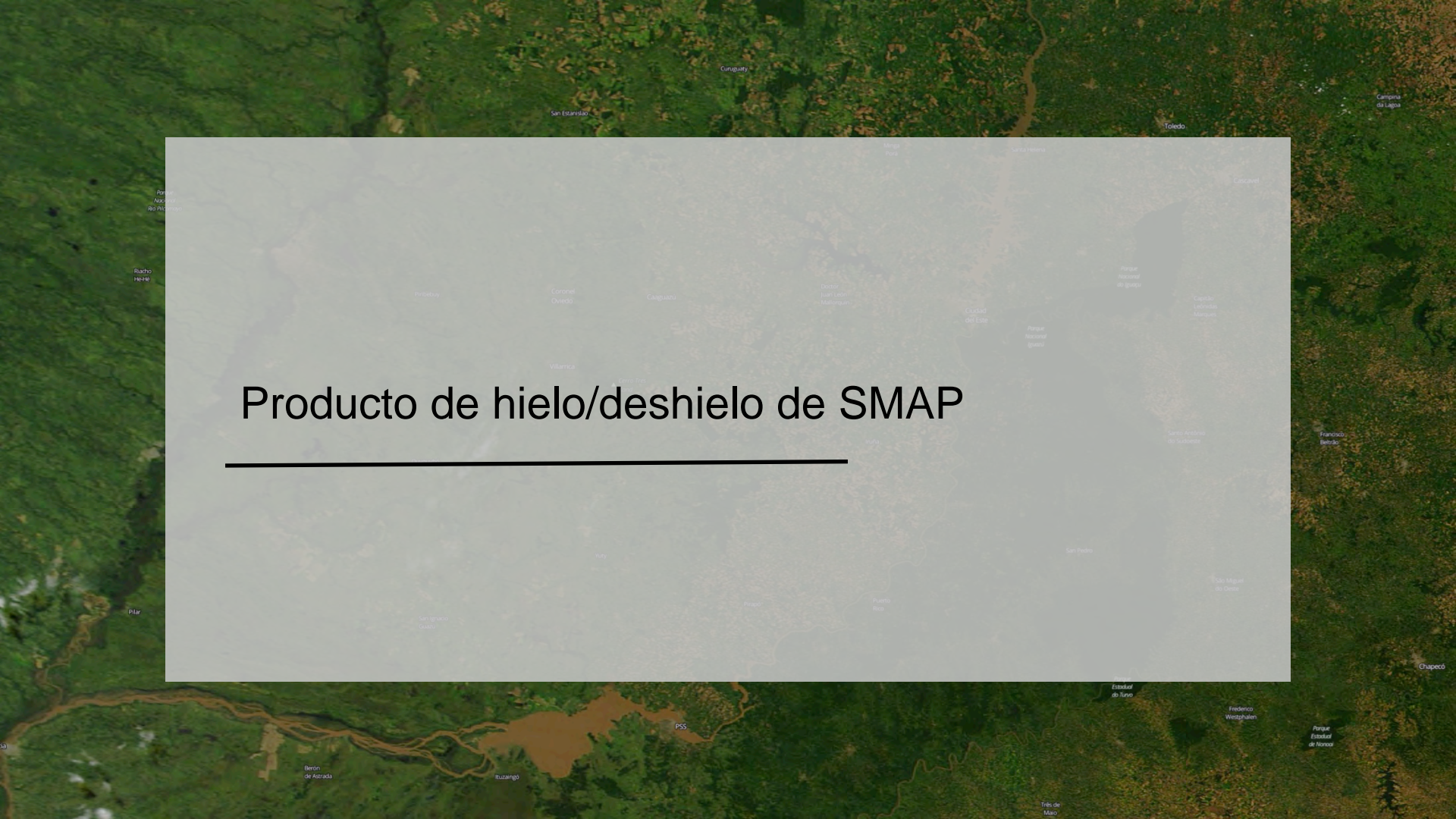
This collaboration directly addresses drought prediction, assessment, adaptation, and mitigation in support of energy security/efficiency; natural resource conservation; and household, municipal, industrial, and in-stream demands for water. It will also improve access and availability of actionable water monitoring, hence drought information. The Snow Cover and Dust Forcing products will be generated and distributed in near real-time by the JPL Snow Server for access by CBRFC. CBRFC will offer a direct connection to stakeholders (End Users) and together with other linked NWS operational centers provides an institutional home to maintain the advances of this effort beyond the project's end.

[top](#)

- Toma de decisiones para la gestión de cuencas fluviales
 - MODSCAG
 - Información de forzado radiativo de la nieve y del polvo
 - Colorado Basin River Forecast Center (CBRFC) Centro de pronósticos de la cuenca del río Colorado

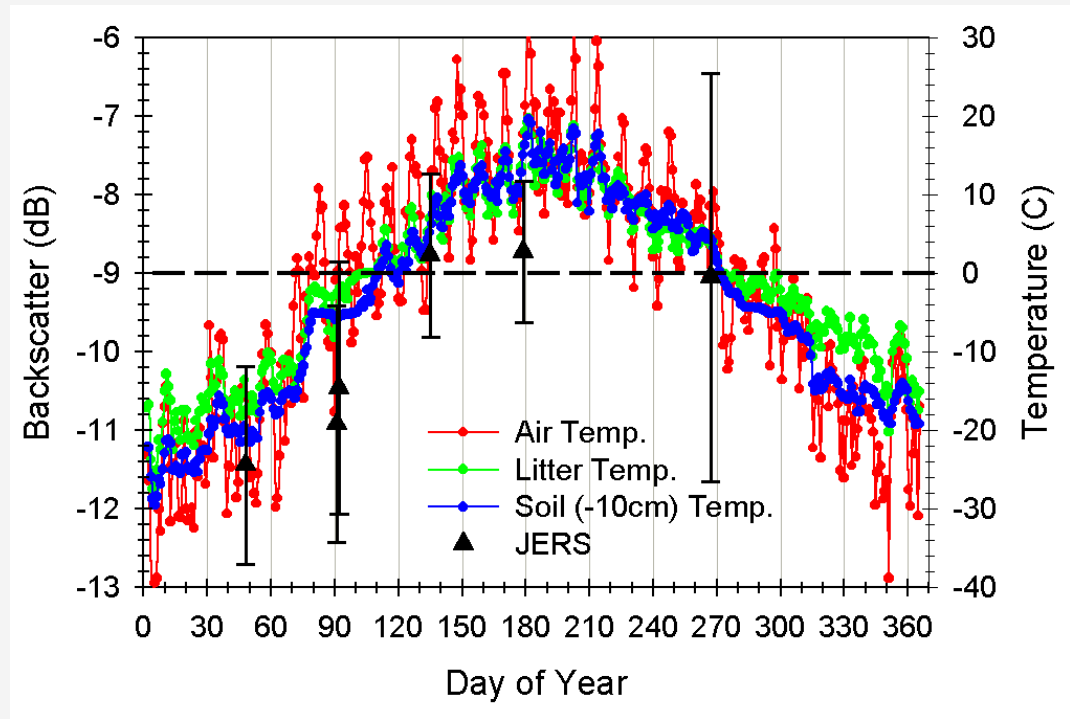
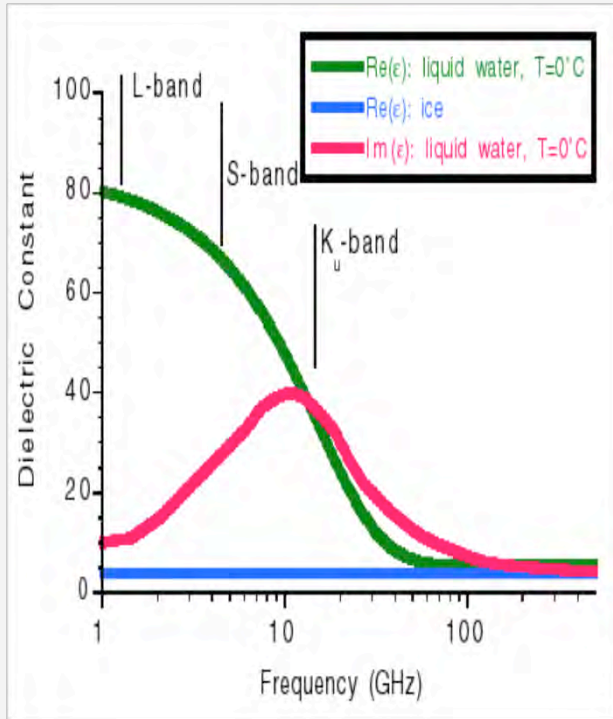
Limitaciones de datos de nieve del MODIS

- No mapea bajo nubes
- Consideraciones geométricas
- Consideraciones de ruido

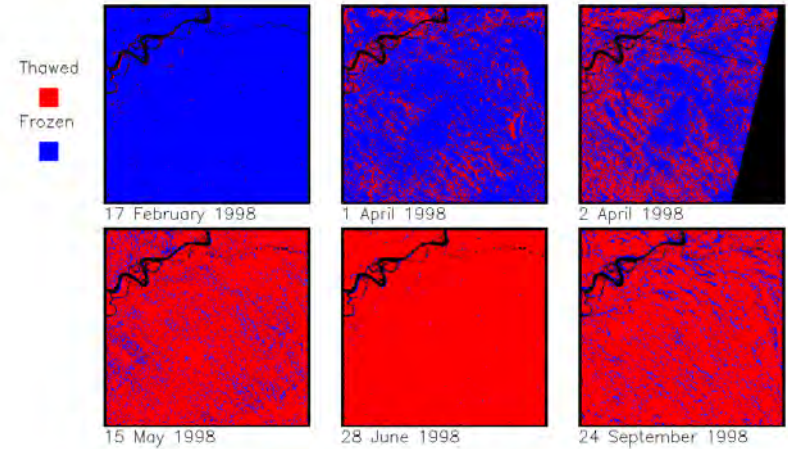
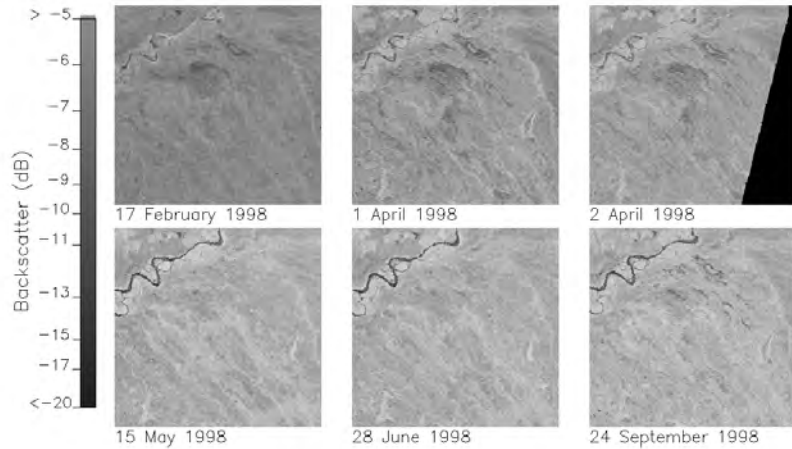


Producto de hielo/deshielo de SMAP

La detección del estado de hielo/deshielo con la percepción remota de microondas

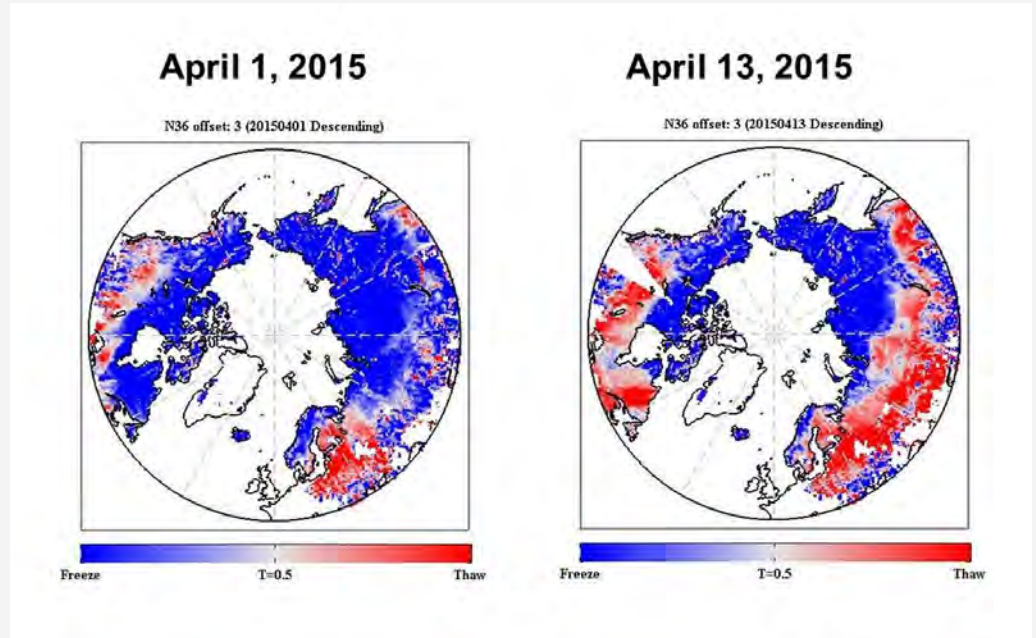


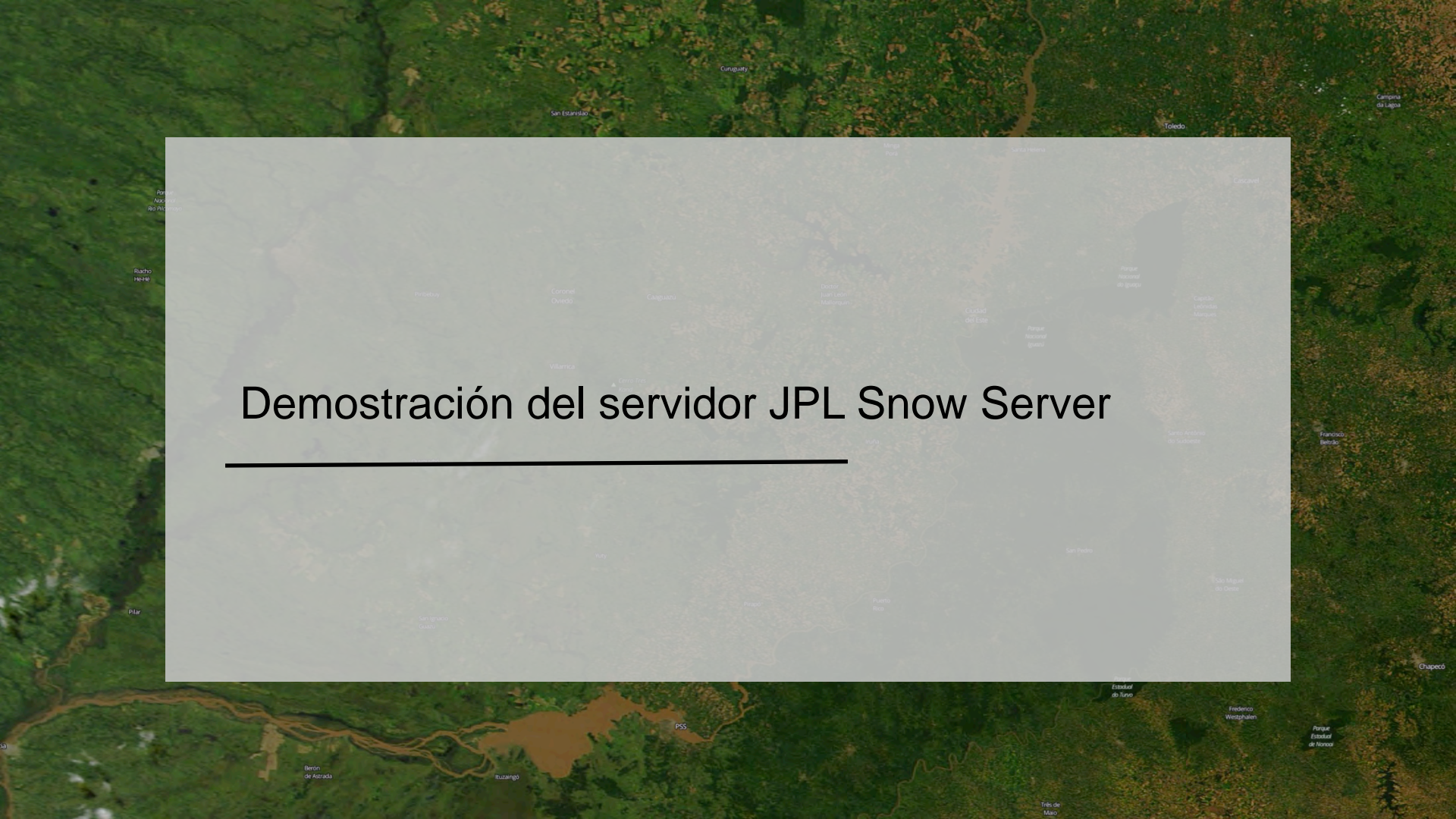
La detección del estado de hielo/deshielo con la percepción remota de microondas



Hielo/deshielo de SMAP

- Indica si es que la superficie de la tierra está helada o deshelada (incluye deshielo de la nieve)
- Características
 - 36km de resolución
 - Repetición espacial cada 3 días
 - Medición binaria indicando helada o deshelada





Demostración del servidor JPL Snow Server
