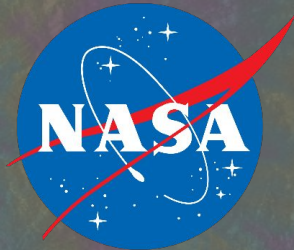
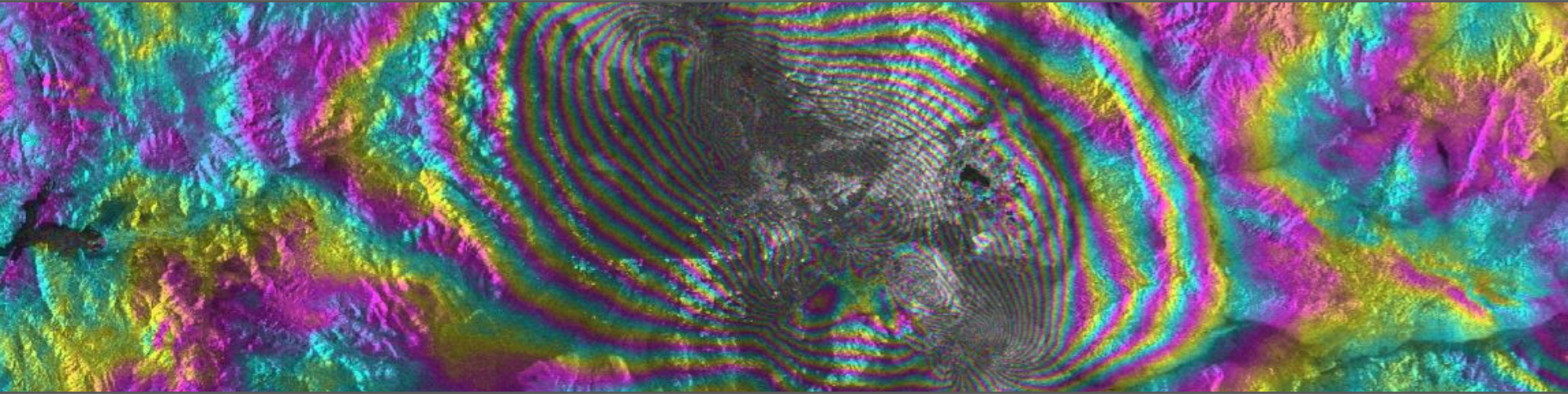


ASF OpenSARlab

A Cloud-Hosted JupyterHub Platform to Streamline
Teaching, Development, and Collaboration in EO



Alex Lewandowski, Kirk Hogenson, Rui Kawahara, Tom
A Logan, Eric Lundell, Franz J Meyer, Rebecca Miller,
Tim Stern

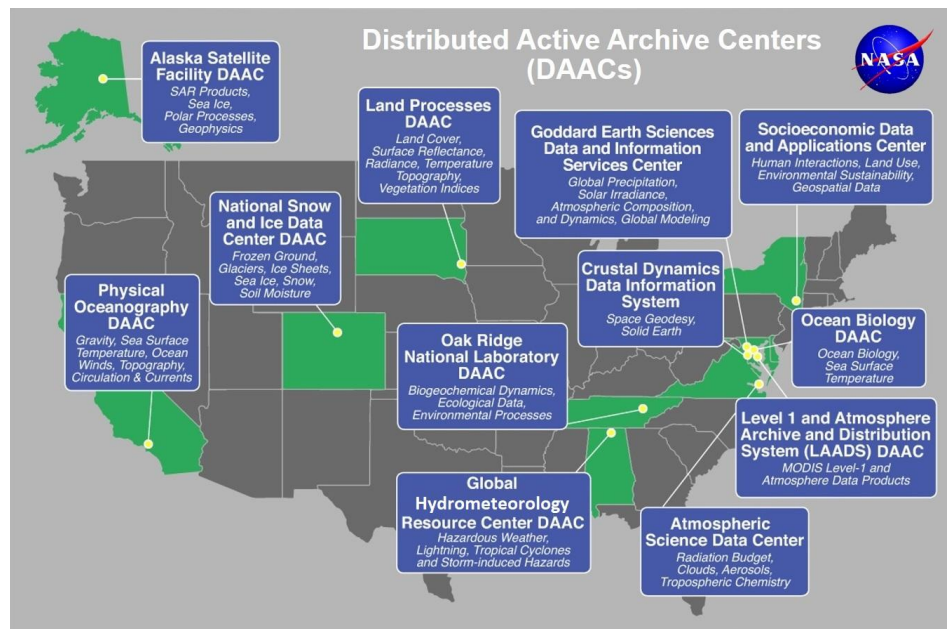
Presented by: Joseph H. Kennedy



The Alaska Satellite Facility

Making remote-sensing data accessible

- Acquire, process, archive, and distribute **Synthetic Aperture Radar (SAR) data** from polar orbiting satellites and airborne sensors
 - Data from NASA, ESA, JAXA, CSA
 - Easy to access and free to use
- Additional capabilities
 - Satellite tracking and ground station
 - SAR and Remote Sensing training and education
 - Science support



Sentinel-1

European Space Agency mission

<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/overview>

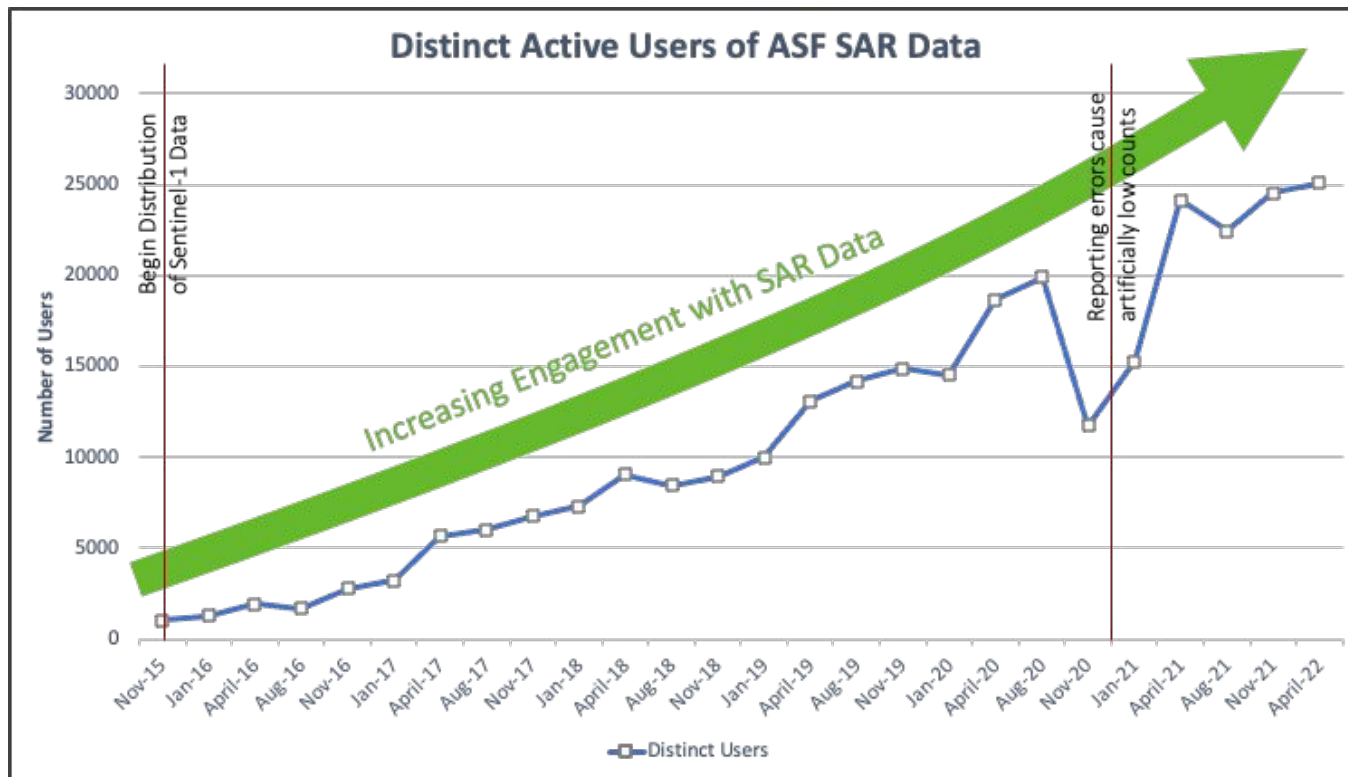
- Two polar orbiting satellites (A and B)
 - 12 day repeat cycle
 - 180° orbital offset (same orbital plane)
 - Potential for 6-day repeat acquisitions
 - **Global coverage**
 - Active C-band imaging
 - Suitable for interferometry
- Free and easy to download from ASF in multiple formats
- On Demand processing to Analysis Ready Data available from ASF



Some SAR data applications

- Solid Earth Geophysics
 - Seismology
 - Volcanology
- Natural Hazards and Ecosystem Disturbances
 - Logging
 - Wildfire
 - Flood
- Cryospheric Sciences
 - Glacier monitoring
 - Ice-sheet monitoring
- Infrastructure Monitoring
 - Shipping
 - Surface mining

Increasing demand for SAR data



SAR can be hard to use

- Complex data and processing
- Specialized software
- Resource-intensive
 - disk, compute, and memory
- Sheer volume of data available
 - Sentinel-1 has produced ~ 14 PB of data
 - Small area of interest may still result in thousands of scenes
- Impedes users *and* reproducibility

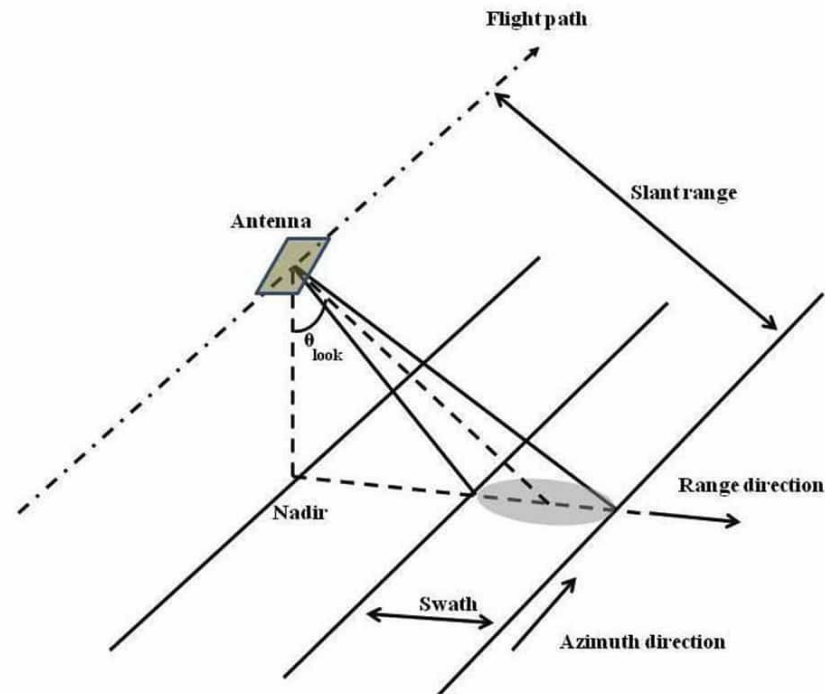
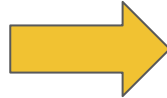
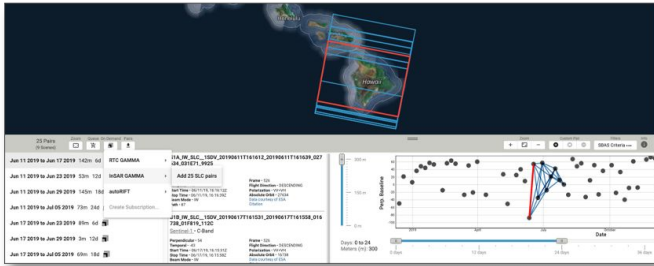


Image credit: NASA

ASF services facilitate SAR usage

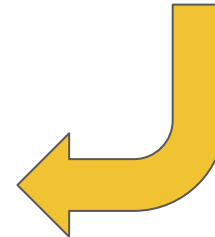
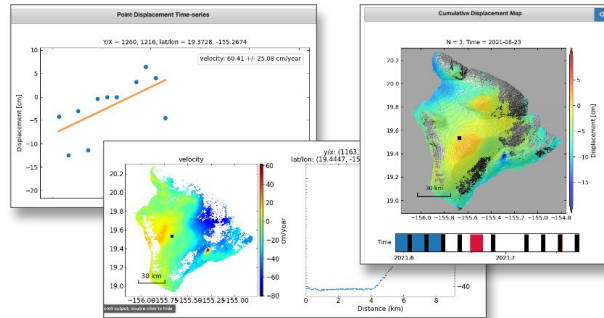


```
In [*]: if hyp3_data:
        print(f"\nProject: {jobs.jobs[0].name}")
        project_zips = jobs.download_files(analysis_directory)
        for z in project_zips:
            asfn.asf_unzip(str(analysis_directory), str(z))
            z.unlink()

Project: La_Palma_2021
8% [Progress bar] 1/13 [00:04<00:53, 4.46B/s]
SIAB_20210910T071102_20210916T071020_VVP006_INT80_G_wef_9616.zip: [Progress bar] 134M/134M [00:04<00:00, 41.5MB/s]
STAA_20211004T071102_20211016T071102_VVP012_INT80_G_wef_1554.zip: [Progress bar] 80.0M/134M [00:02<00:01, 36.1MB/s]
```

Order On Demand ARD products from
HyP3 with Data Search - Vertex

Download HyP3 Products into **OpenSARlab**



Analyze Data and **develop** new algorithms in Jupyter Notebooks

- Kubernetes backed JupyterHub deployment in AWS
 - “Your computer in the cloud”
 - Accessible from a web browser
- Sits alongside ASF's data archives in AWS
 - Fast (and free!) in-region data transfer
- Persistent user storage
- Flexible compute environments
 - “laptop” to HPC



- Curated conda environments
 - RTC analysis
 - InSAR analysis
 - Machine learning
 - Create and share your own custom environments
- Curated training materials
 - Change detection
 - Geodetic source modeling from InSAR
 - InSAR time series analysis
 - much, much more!
- Easily reproduce workflows
- Collaborative development
- Digital classroom

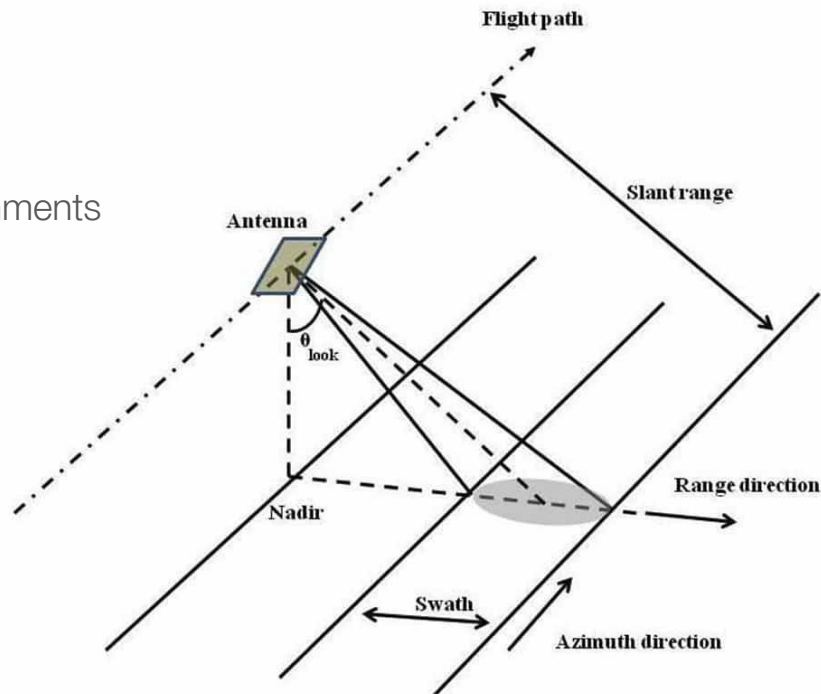


Image credit: NASA

Examples: Change detection

The screenshot shows a JupyterLab notebook titled "Change_Detection_From_Prepared_Data_Stack.ipynb". The notebook content includes the following code:

```
8 # cbar_ax = fig.add_axes([0.85, 0.15, 0.05, 0.7])
9 # fig.colorbar(p,cax=cbar_ax)
10
11 ax.set_title('Dates of Change')
12 # cbar = fig.colorbar(cax,ticks=ticks)
13 cbar = fig.colorbar(cax, ticks=ticks, orientation='horizontal')
14 _ = cbar.ax.set_xticklabels(ticklabels, size=10, rotation=45, ha='right')
15 plt.savefig(f'{output_path}/change_dates.png', dpi=300, transparent='true')
```

The plot, titled "Dates of Change", is a 2D map showing change detection results. The x-axis ranges from 0 to 3000, and the y-axis ranges from 0 to 2000. The map is color-coded according to the legend below it, which shows dates from 2011-09-21 to 2011-09-30. The legend is a horizontal bar with 10 colored segments, each labeled with a date: 2011-09-21 (dark blue), 2011-09-01 (light blue), 2011-08-14 (orange), 2011-08-28 (green), 2011-09-08 (red), 2011-09-20 (purple), 2011-09-01 (brown), 2011-08-13 (pink), 2011-09-25 (grey), 2011-09-06 (yellow-green), 2011-09-18 (cyan), and 2011-09-30 (light blue).

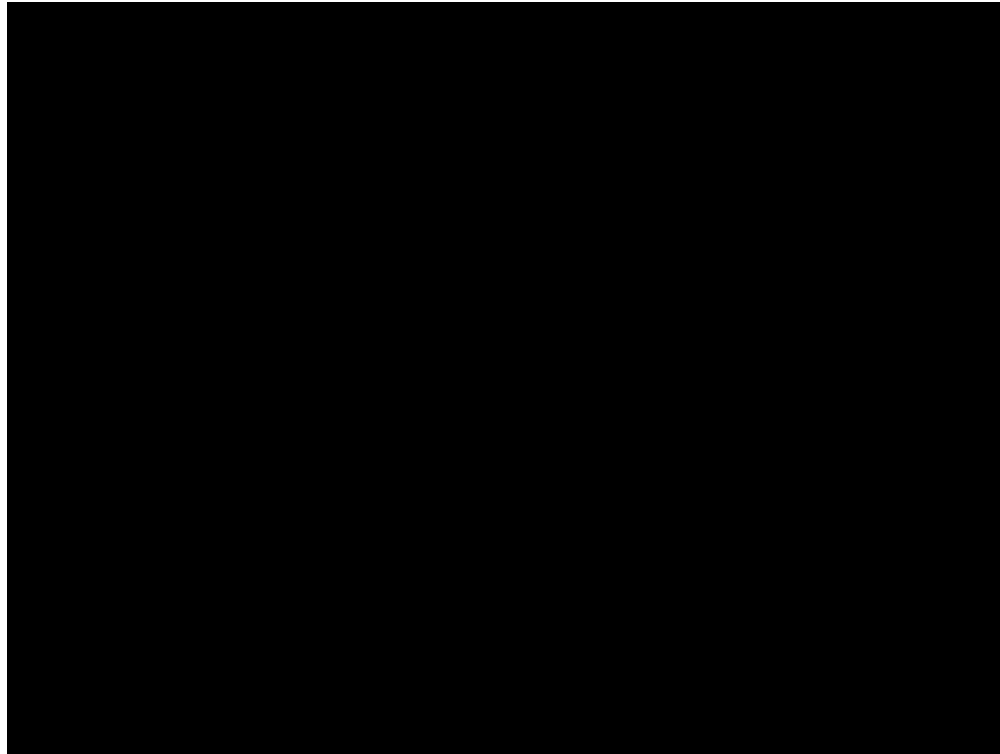
Below the legend, the notebook provides instructions to save the change dates as a GeoTIFF:

Save the change dates as a GeoTIFF (change_dates.tiff):

```
[89]: 1 %capture
      2 geotiff_from_plot(change_point_index, f'{output_path}/change_dates', coords, utm, cmap=cmap, interpolation='nearest', dpi=600)
```

The notebook footer indicates the version: "GEOS 657 Microwave Remote Sensing - Version 1.4.1 - November 2021".

Examples: InSAR Time Series with MintPy



Custom OpenSARlab deployments

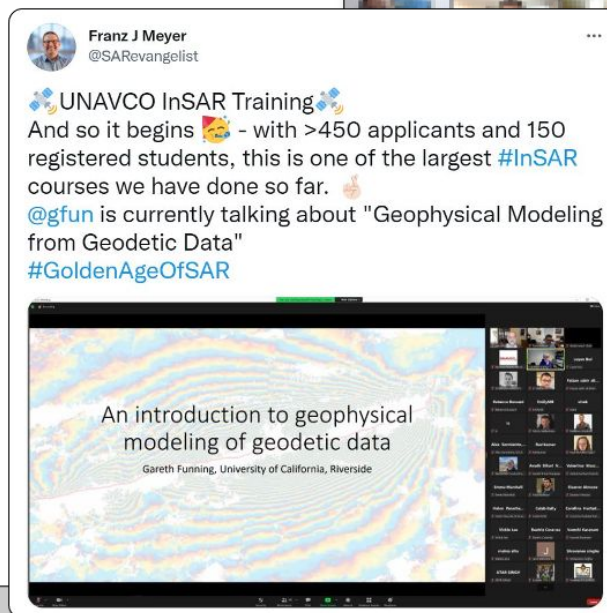
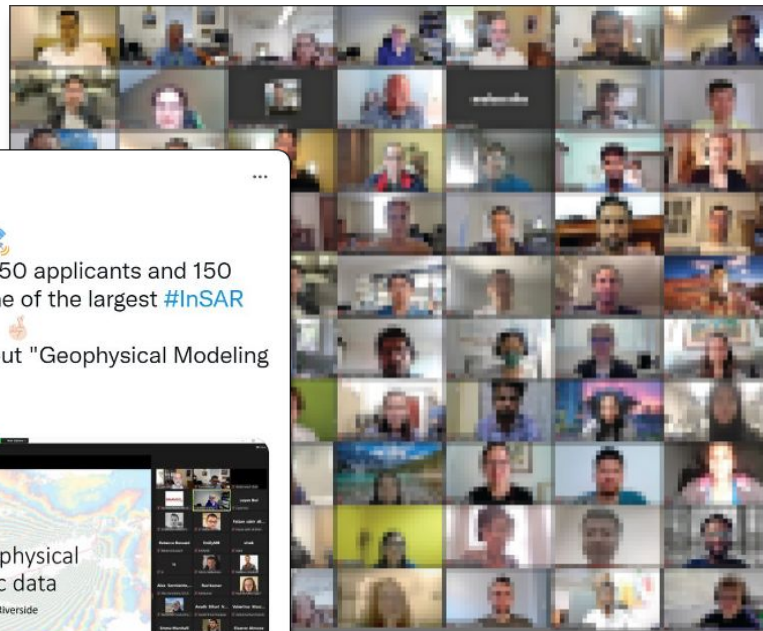
Custom OpenSARlab deployments

- In an ASF hosted AWS account or your own
- Control resources
 - CPU cores
 - RAM
 - user volume sizes
- Curate your own environments and materials
 - Automatically clone your GitHub repositories upon server startup
 - Pre-bake conda environments onto user volumes

Custom OpenSARlab deployments

UNAVCO InSAR Training

- Annual training
- 150+ students
- MintPy workflows



Custom OpenSARlab deployments

- Alaska Volcano Observatory
 - Small, ongoing deployment (with HyP3 too!)
 - Monitoring volcanic activity
- GEOS626 Applied Seismology
- GEOS627 Inverse Problems and Parameter Estimation
- GEOS657 Microwave Remote Sensing
- GEOS639 InSAR and its Applications
- ROSES
 - Summer 2021
 - 75 students



**Remote
Online
Sessions for
Emerging
Seismologists**



Making remote-sensing data accessible
Building open-source, cloud-native tools
Enabeling rapid discovery and analysis

Questions?



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