

SEEING THROUGH THE CLOUDS

SAR Monitoring of Reykjanes Volcano

Team: **Surface Sleuths**

Member: **Yasaswini Chebolu**

Challenge: **Through the Radar Looking Glass: Revealing Earth Processes with SAR**

WHY TRADITIONAL MONITORING FAILS IN ICELAND

THE CHALLENGE:

- Iceland: 200+ cloudy days annually
- Winter darkness (64°N latitude)
- Volcanic ash obscures optical satellites
- Reykjanes Peninsula: 6 eruptions in 2024
- Traditional sensors blind 60% of the time

OPTICAL SATELLITES FAIL WHEN:

- Clouds block the view
- Night prevents imaging
- Ash plumes obscure surfaces
- Snow cover masks changes

THE CRITICAL QUESTION:

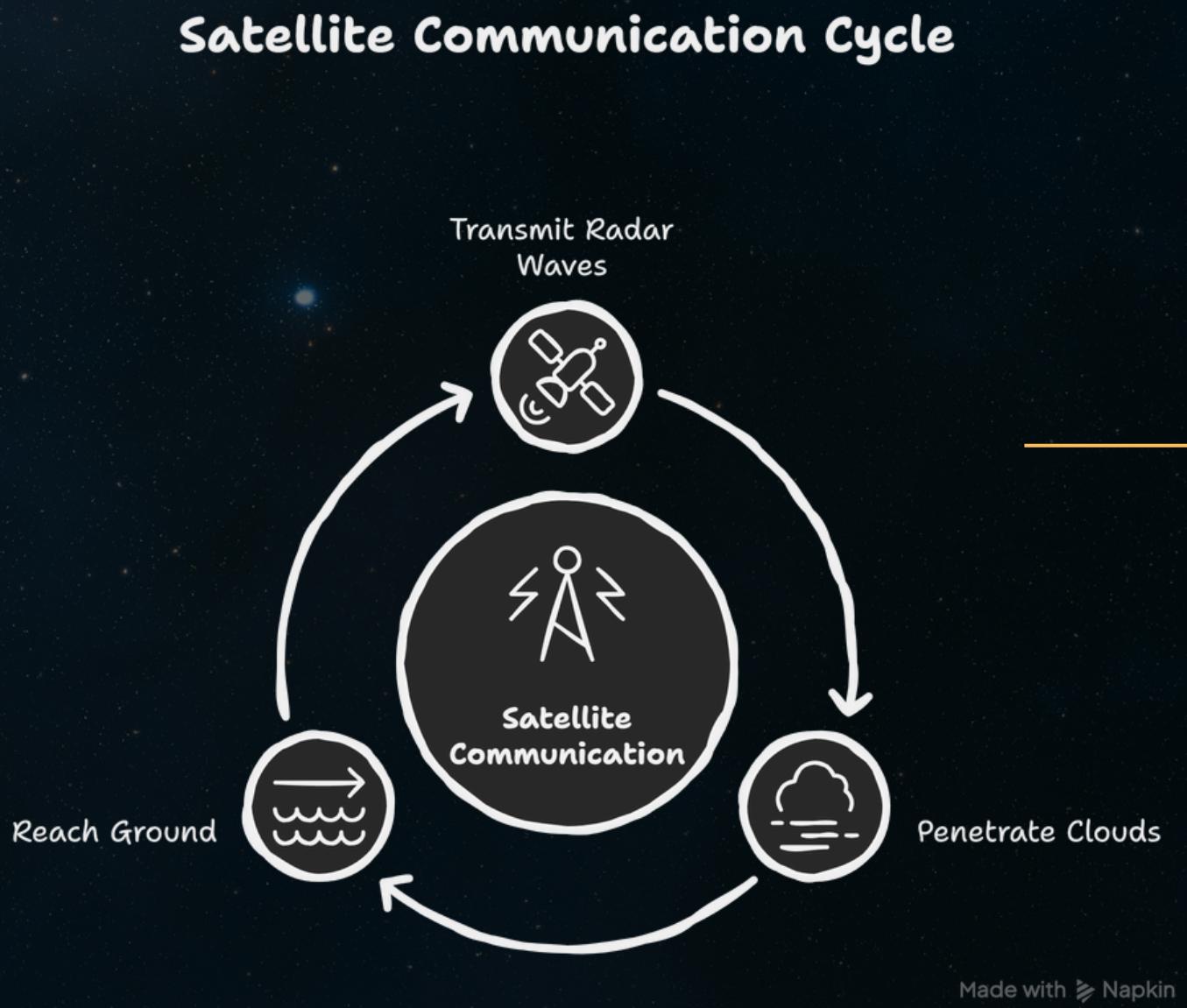
How do we monitor one of Earth's most active volcanic systems when we can't see it?

SYNTHETIC APERTURE RADAR (SAR)

All-Weather Eyes from Space

HOW IT WORKS:

- Active sensor - sends its own microwave signals
- Penetrates clouds, darkness, and volcanic ash
- Measures surface texture and roughness
- Sentinel-1 revisits every 6 days
- Works 24/7 regardless of conditions



OUR SOLUTION: SAR TO THE RESCUE

OUR KEY METRIC: VH/VV RATIO

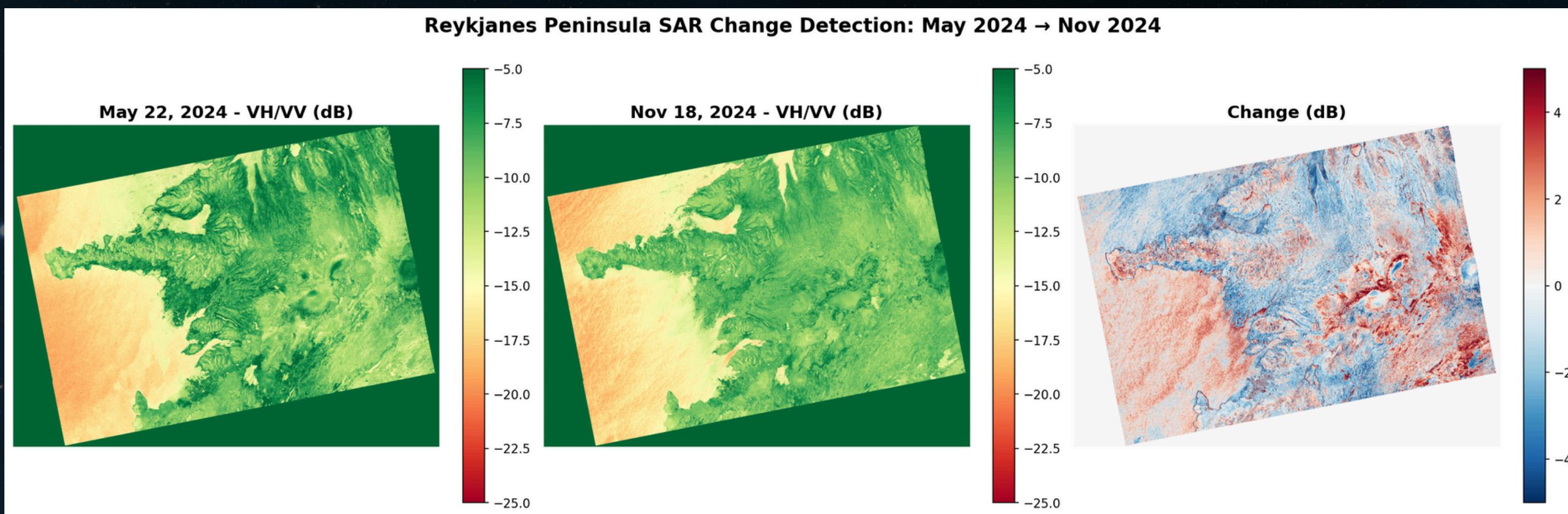
What the data tells us:

- Low ratio = Smooth surfaces (ocean, fresh lava flows)

- High ratio = Rough terrain (vegetation, weathered lava)

- Red zones = Increased roughness
- Blue zones = Decreased roughness

MAY TO NOVEMBER 2024: DETECTING CHANGE THROUGH ERUPTIONS



TIME PERIOD: May 22, 2024 → November 18, 2024

KEY FINDINGS:

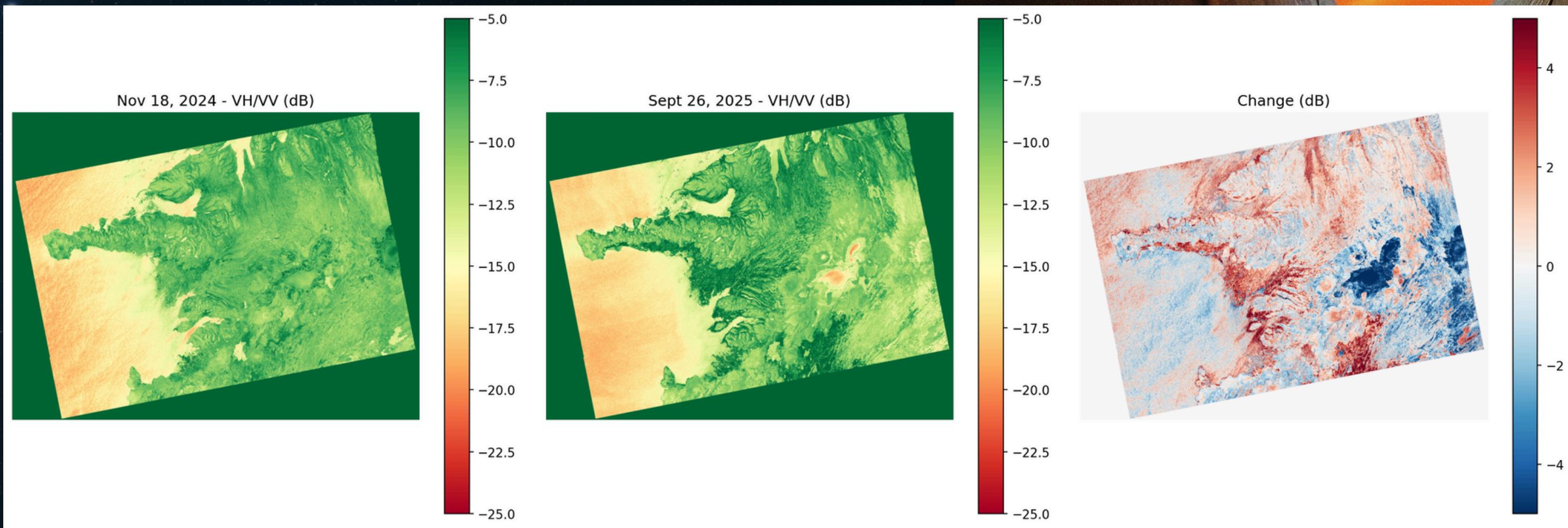
- Red zones: Increased surface roughness (new lava weathering)
- Blue zones: Decreased roughness (vegetation loss, ash deposits)
- Changes localized to known fissure systems
- Captured 6 months spanning multiple volcanic events

NOVEMBER 2024 TO SEPTEMBER 2025: POST-ERUPTION EVOLUTION

TIME PERIOD: November 18, 2024 → September 26, 2025

WHAT WE OBSERVED:

- Captured August 2025 eruption aftermath (1-2 months post-event)
- Fresh lava weathering process visible
- Red zones show surface roughening as lava cools and cracks
- Continued surface evolution across peninsula



OUR TECHNICAL PIPELINE:

1. DATA DISCOVERY
ASF Search API - Find Sentinel-1 scenes
2. CLOUD PROCESSING
HyP3 - RTC correction (no local software needed)
3. ANALYSIS
Python - VH/VV ratios & change detection
4. VISUALIZATION
Interactive NASA-themed maps with eruption timeline

POWERED BY OPEN DATA:

- ESA Sentinel-1 (free SAR imagery)
- NASA ASF HyP3 (cloud processing)
- Copernicus Programme (data access)

No expensive software required just open data and Python

WHY THIS MATTERS:

- ✓ Free, open data (ESA Copernicus)
- ✓ Cloud-based processing accessible to anyone
- ✓ Reproducible workflow
- ✓ Democratizes volcanic monitoring

INTERACTIVE TOOLS & METHODOLOGY



IMPACT & FUTURE APPLICATIONS

01

WHAT WE PROVED

- ✓ SAR detects volcanic changes through clouds
- ✓ Cloud processing accessible to anyone
- ✓ Multi-temporal analysis reveals subtle patterns
- ✓ Open data enables rapid response

02

BEYOND ICELAND

- This methodology applies to:
- Flood monitoring
 - Earthquake damage
 - Deforestation tracking
 - Agricultural health
 - Any cloud-covered region

03

THE FUTURE

Open Data + Cloud Computing =
Democratized Earth Observation Anyone can
become a planetary monitor

GitHub: github.com/Yasaswini-ch/reykjanes-sar-analysis