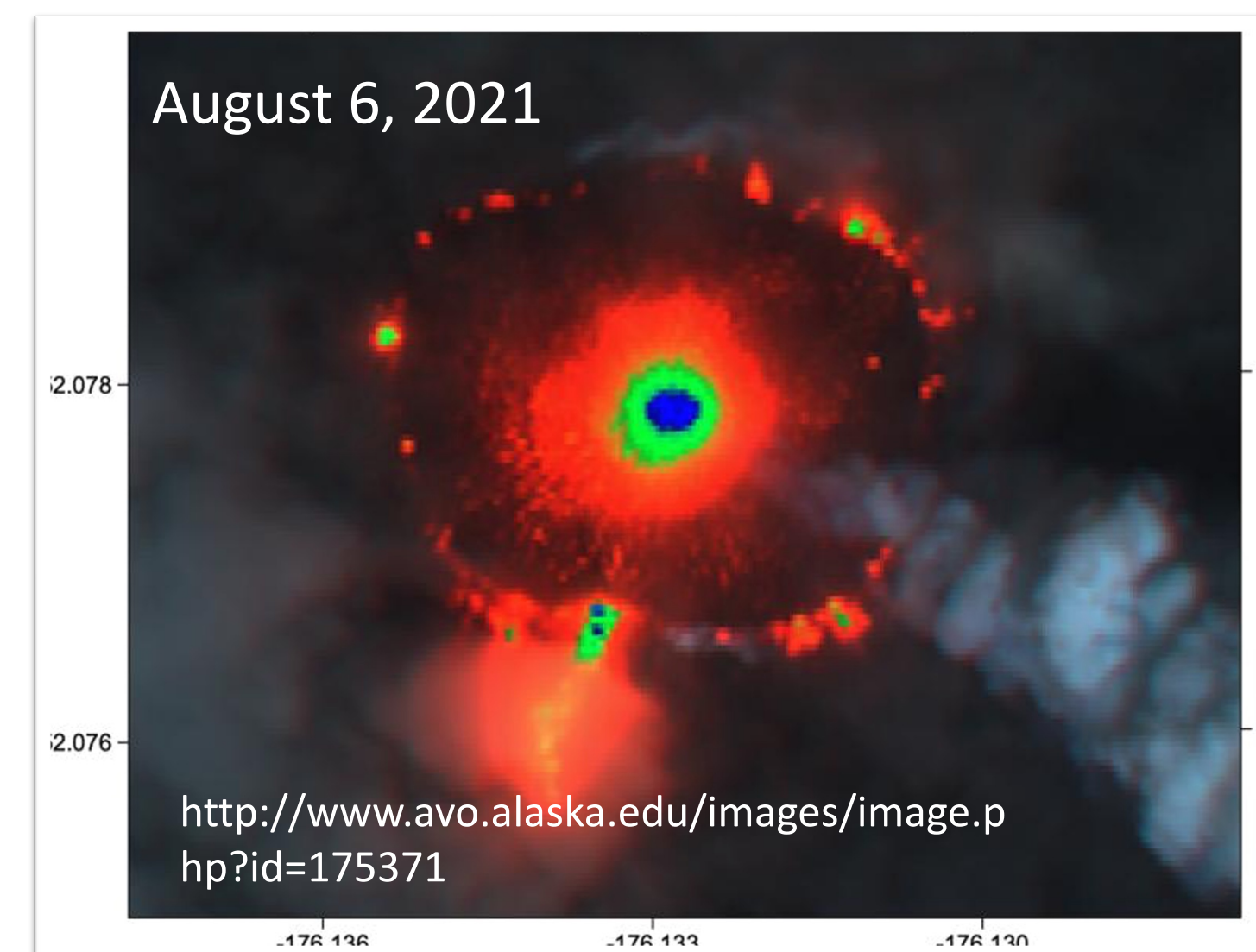


## 1. Motivation and Research Question

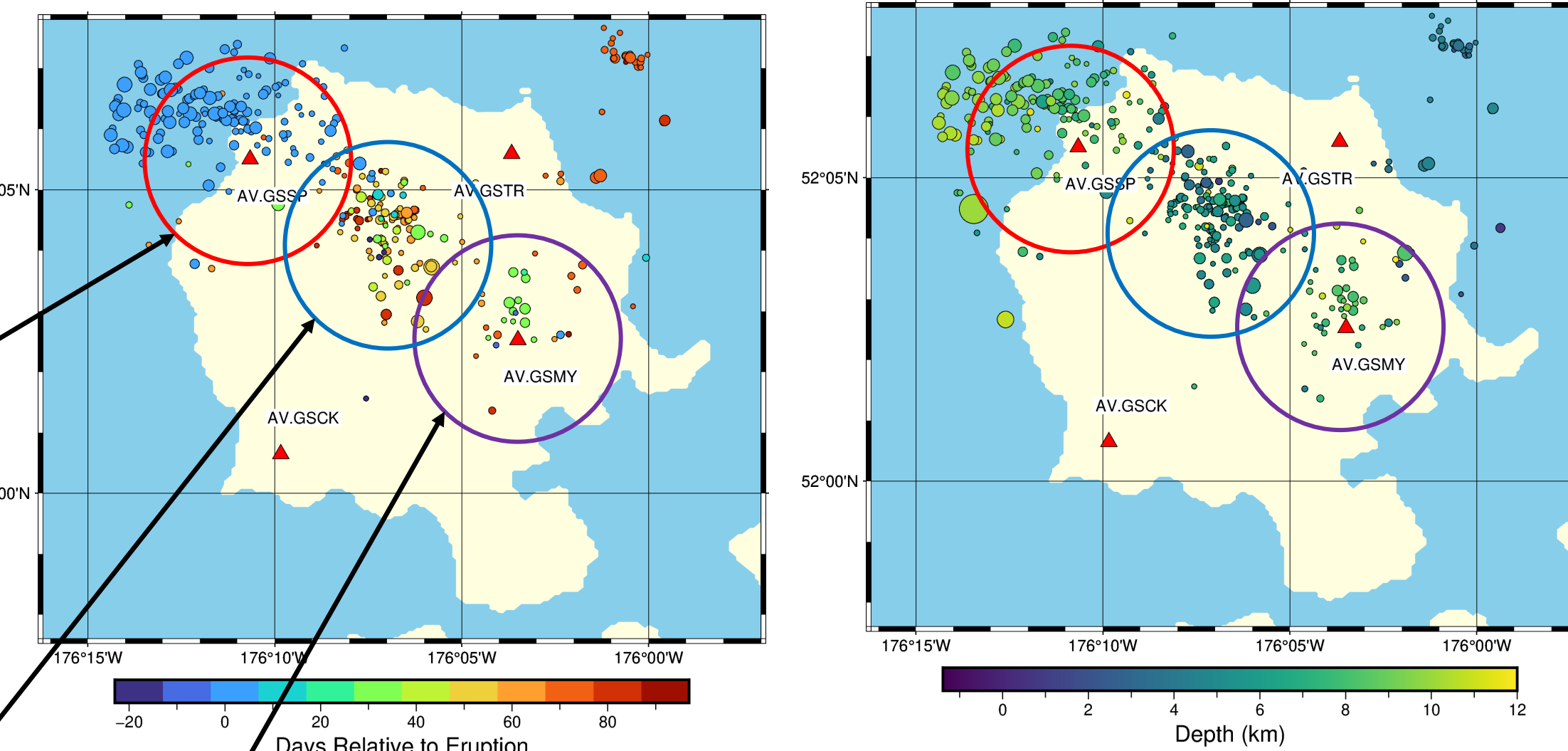
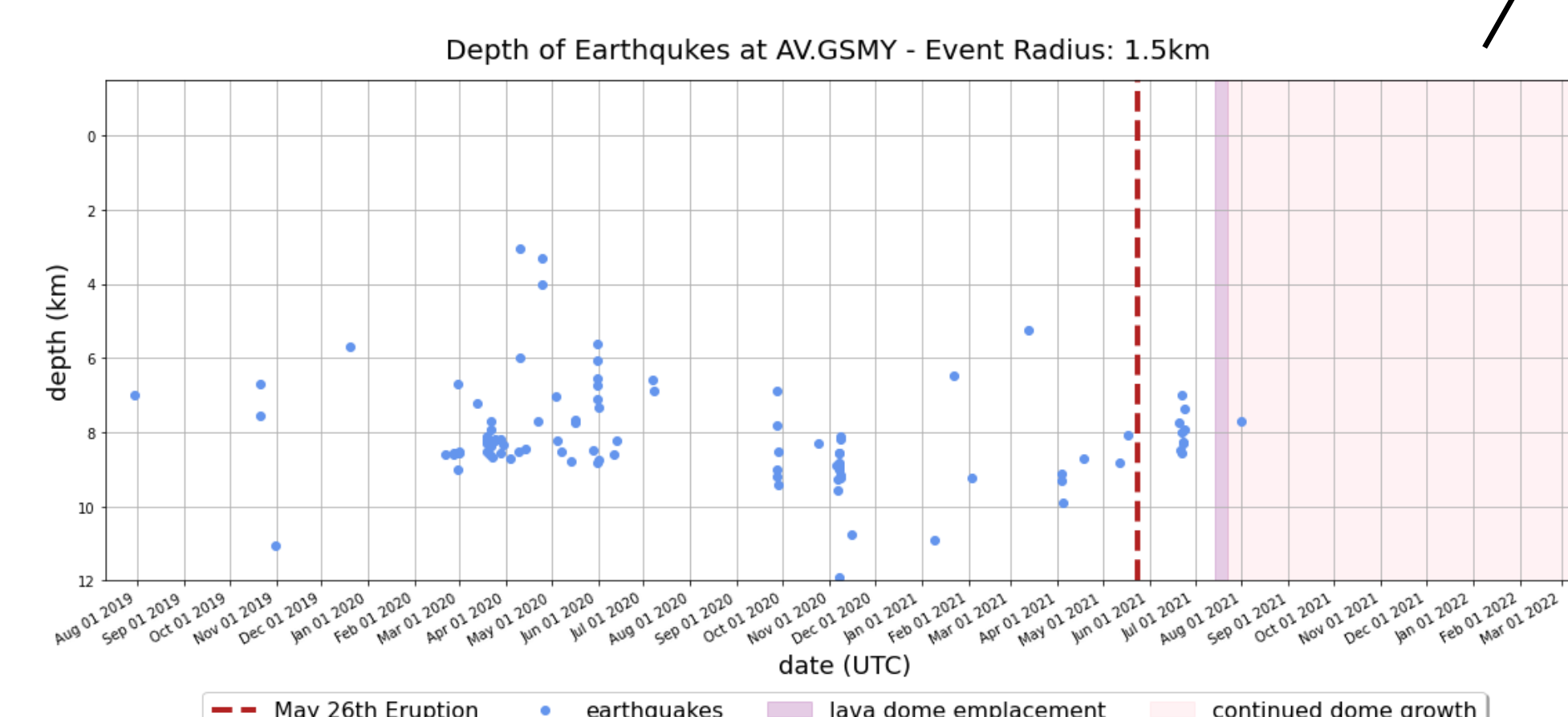
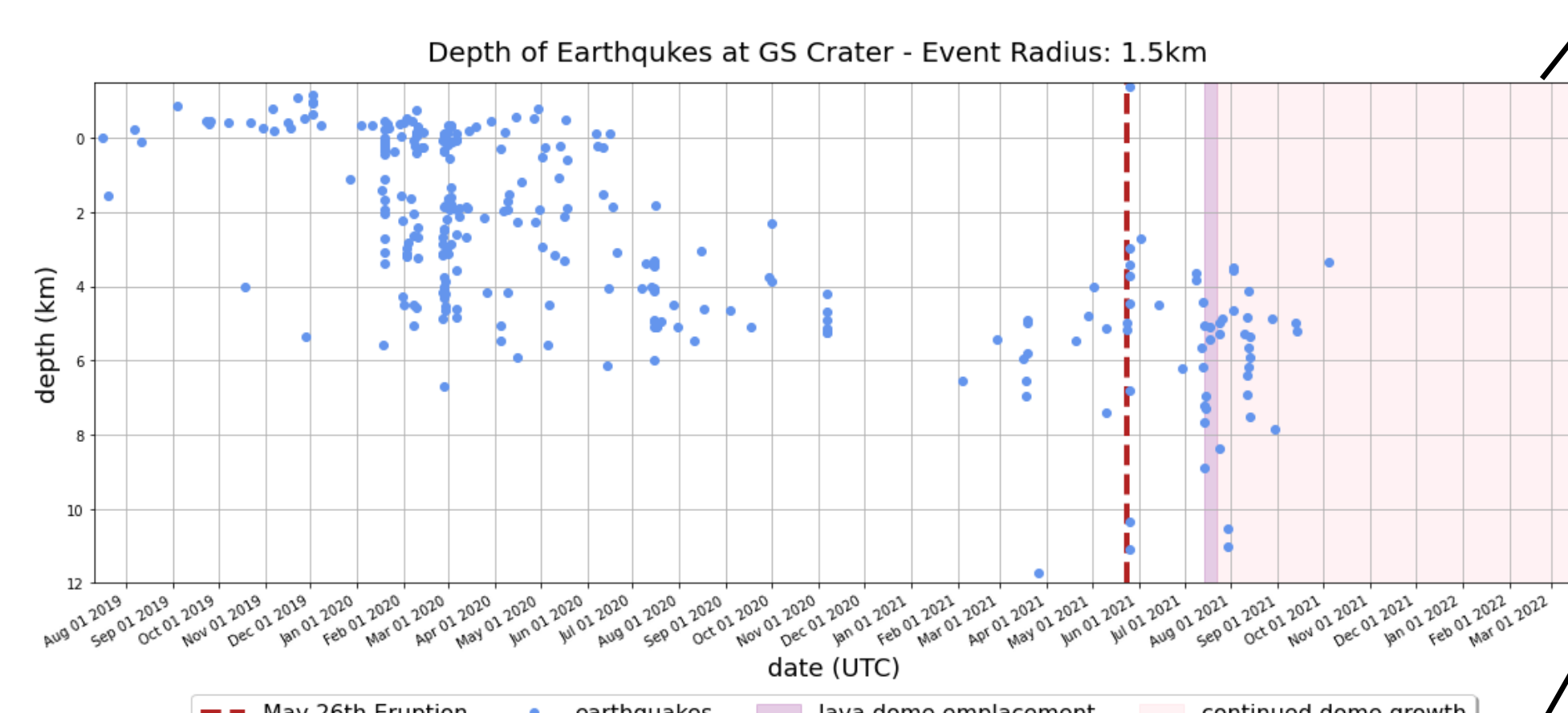
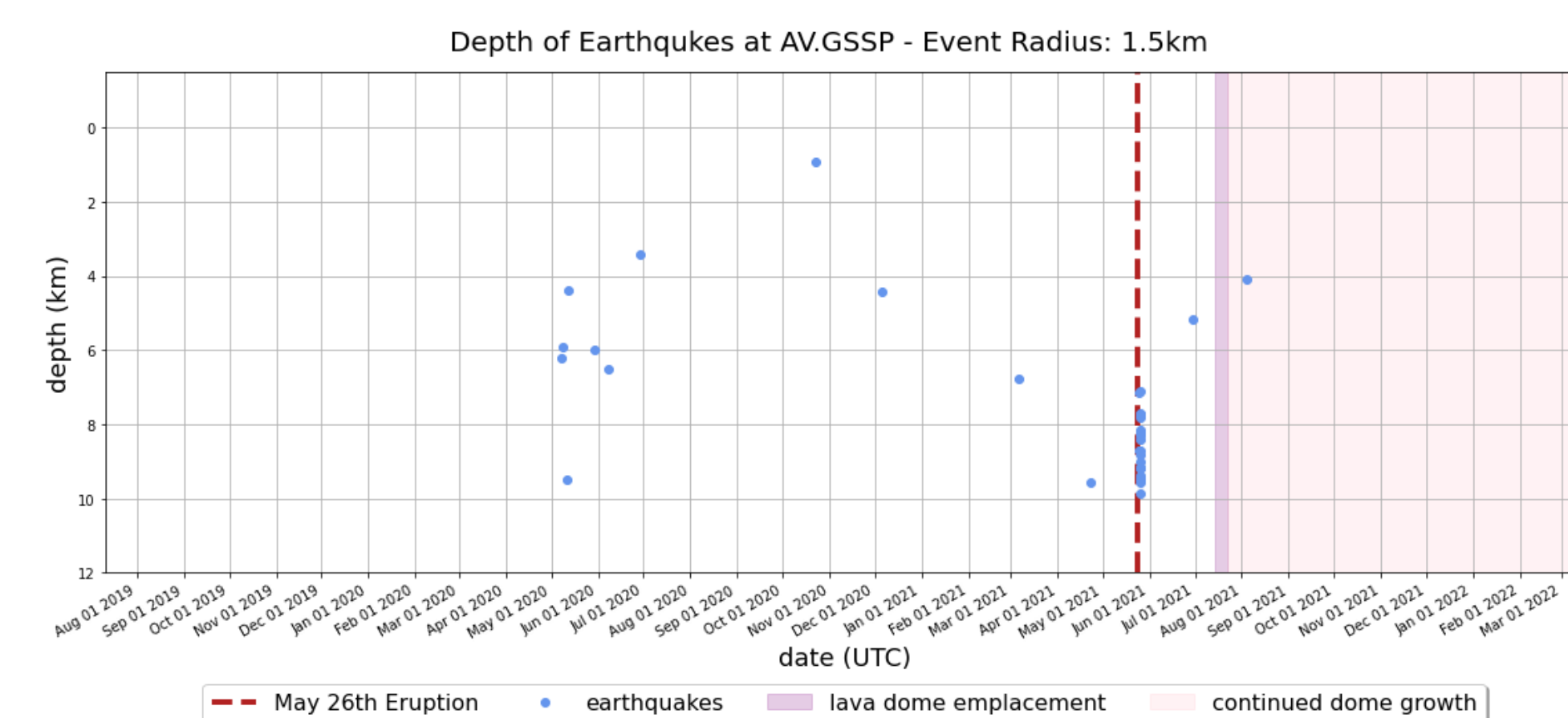
The Great Sitkin volcano erupted on May 25, 2021, followed by the formation of a new lava dome in July and August of 2021. Activities continue till the present day. Observations from multiple datasets indicate a complicated eruption behavior. **We seek to address this question: how did the eruptive cycle start and develop?**



May 25, 2021



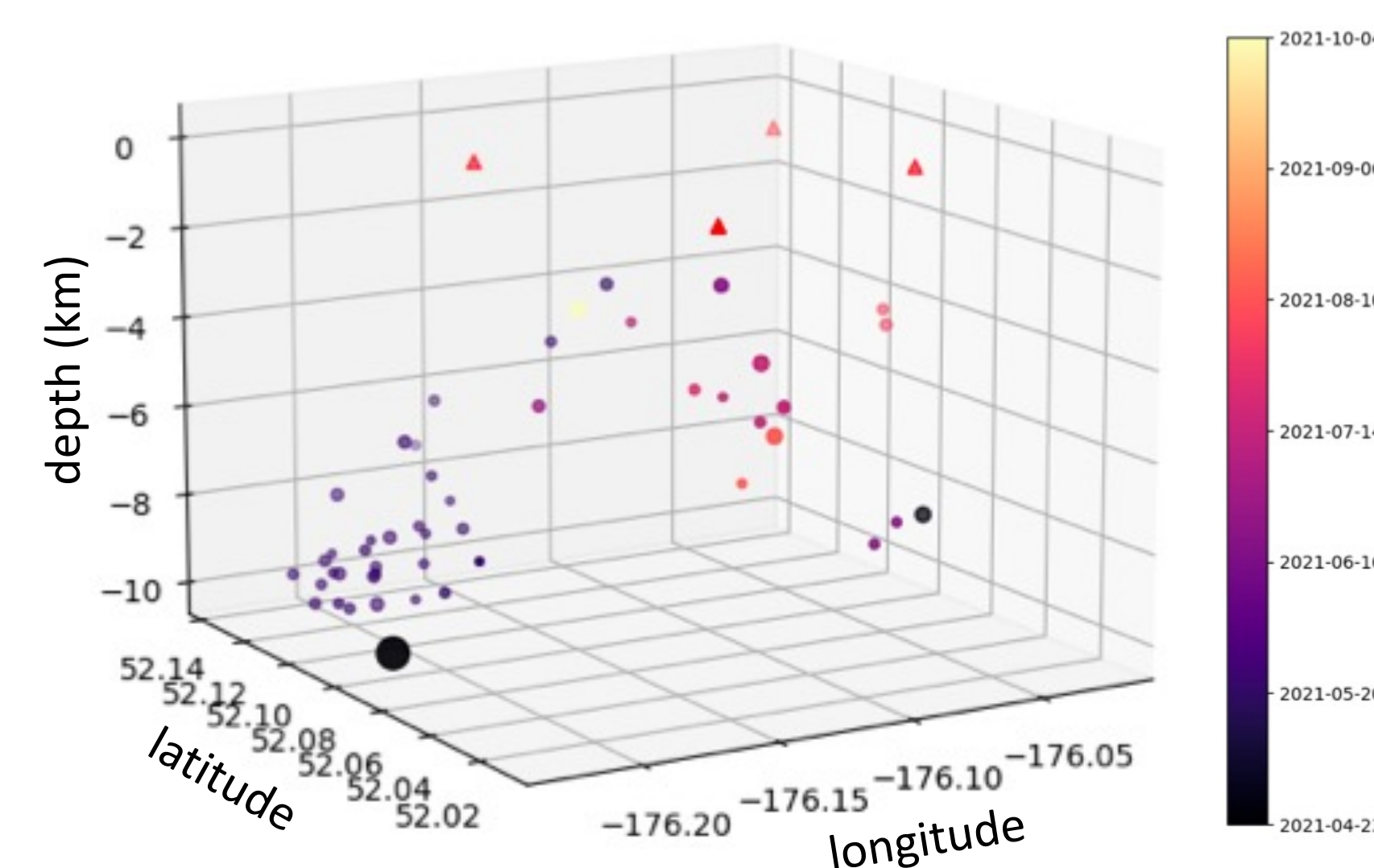
## 2. Seismicity



The volcano was seismically active in early 2020 without eruption. A swarm of earthquakes occurred when it erupted on May 25, 2021.

### Key observations:

- Earthquakes are primarily concentrated within a NW-SE trending zone across the caldera
- The inverse-V shaped seismicity may outline the top of the magma reservoir
- The May 25 swarm was primarily NW of the caldera



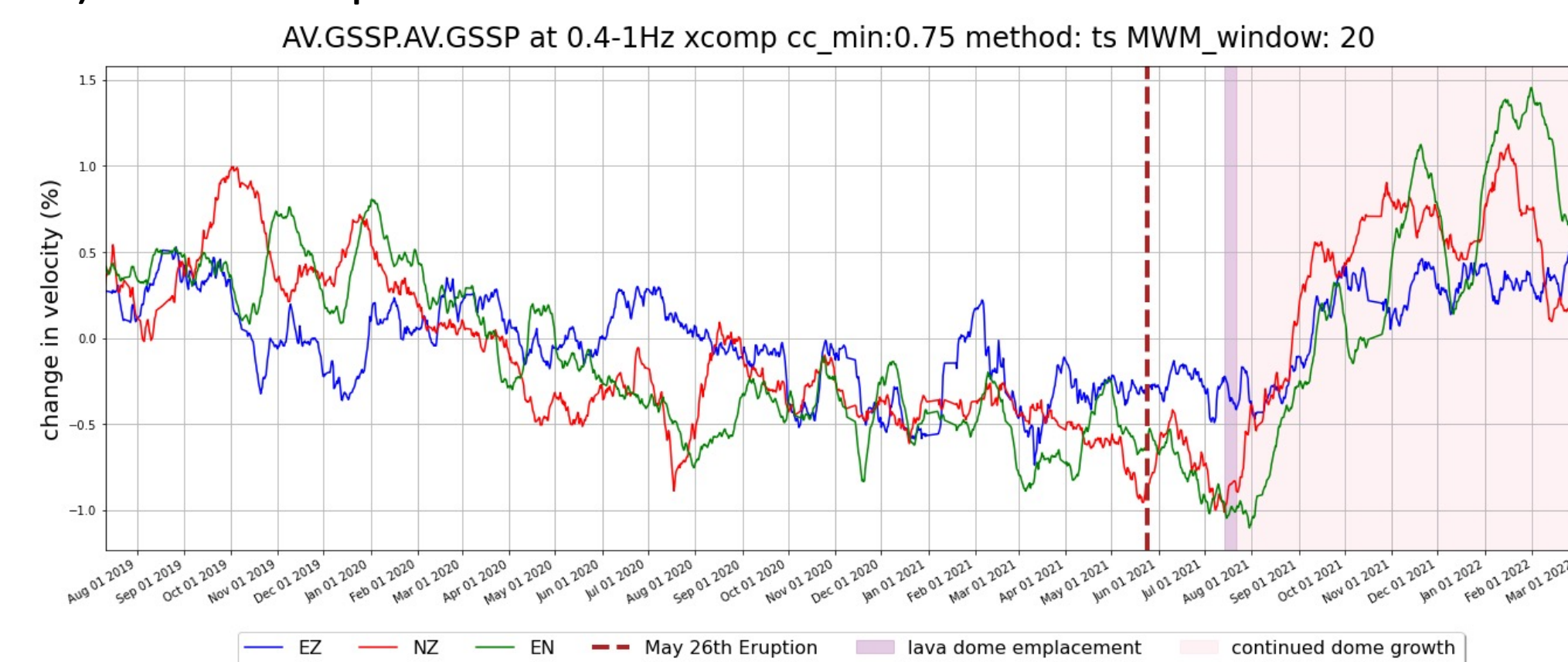
## 3. Temporal velocity changes

We estimated the velocity changes from multiple station-component combinations with trace stretching. The  $dv/v$  was measured with 12-hour stacks, with a moving averaging over 20-day windows for visualization.

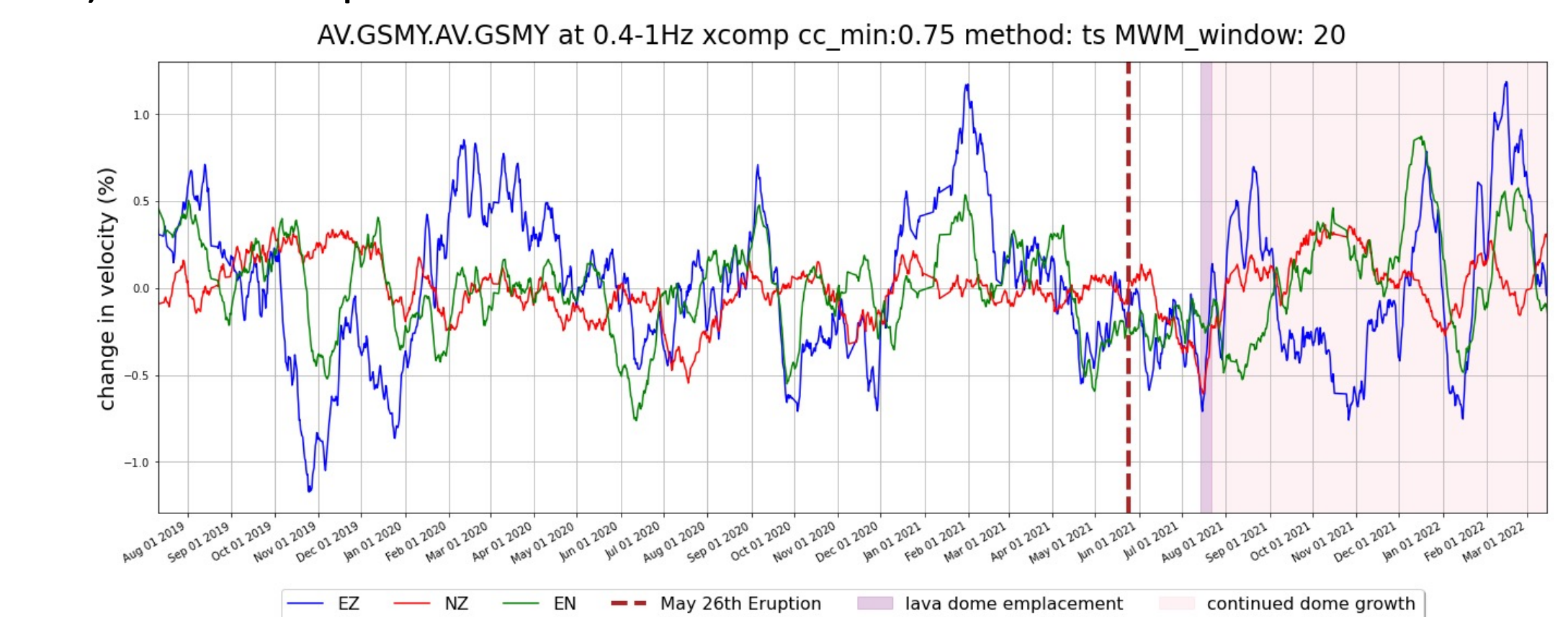
### Key observations:

- Long-term ( $> 1.5$  years) velocity decrease before eruption only at AV.GSSP (NW of the caldera), followed by increasing velocity starting August 2021 --> single-station cross-component  $dv/v$  (panels a-b)
- All stations show a drastic velocity decrease (up to 2.5%) in August 2021, followed by an increase in September 2021 --> single station same-component  $dv/v$  (panels c-d)

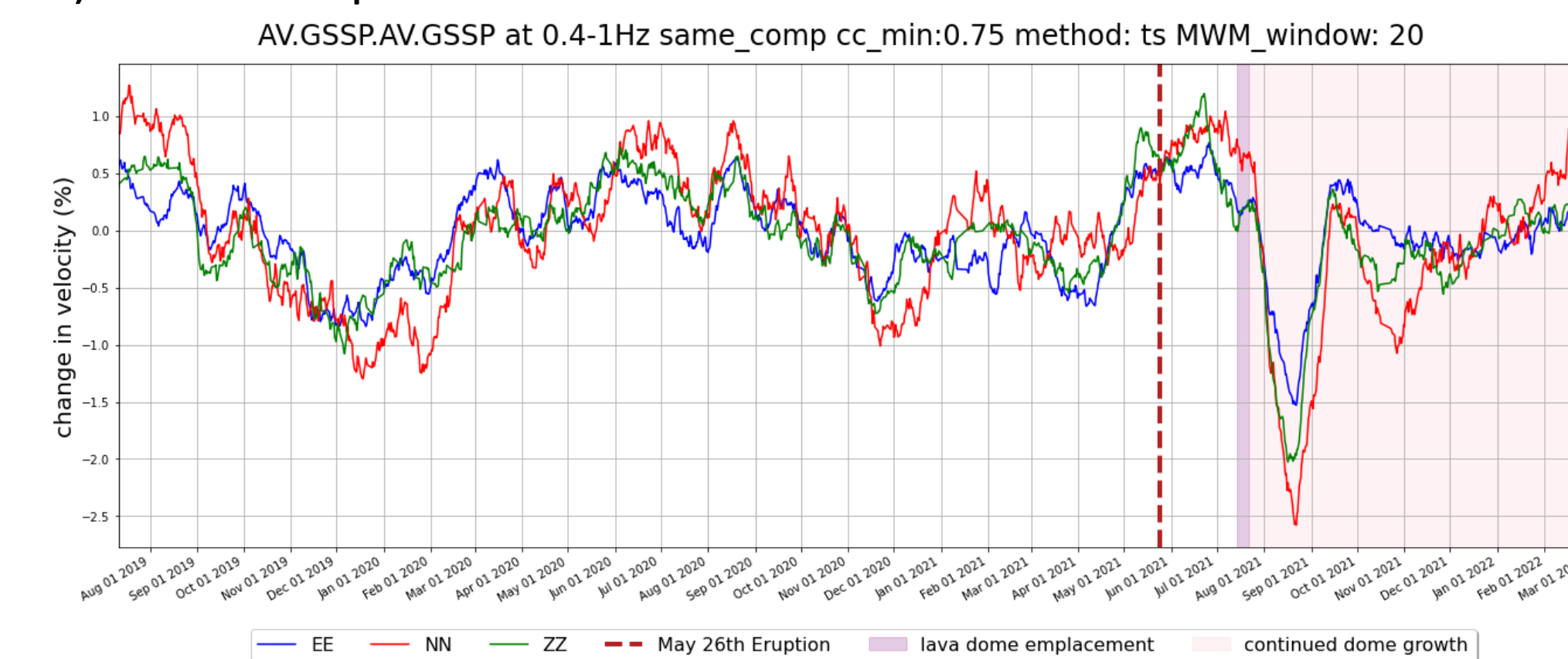
### a) Cross-component correlation at AV.GSSP



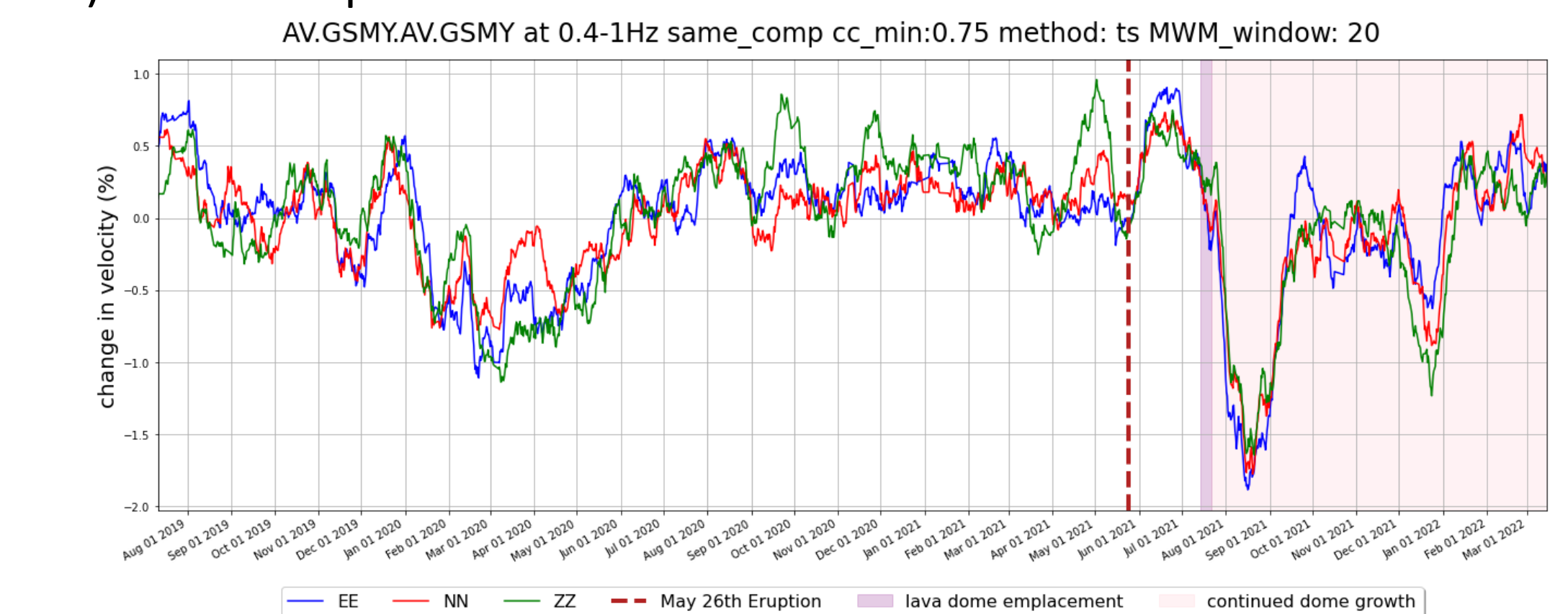
### b) Cross-component correlation at AV.GSMY



### c) Same-component autocorrelation at AV.GSSP



### d) Same-component autocorrelation at AV.GSMY

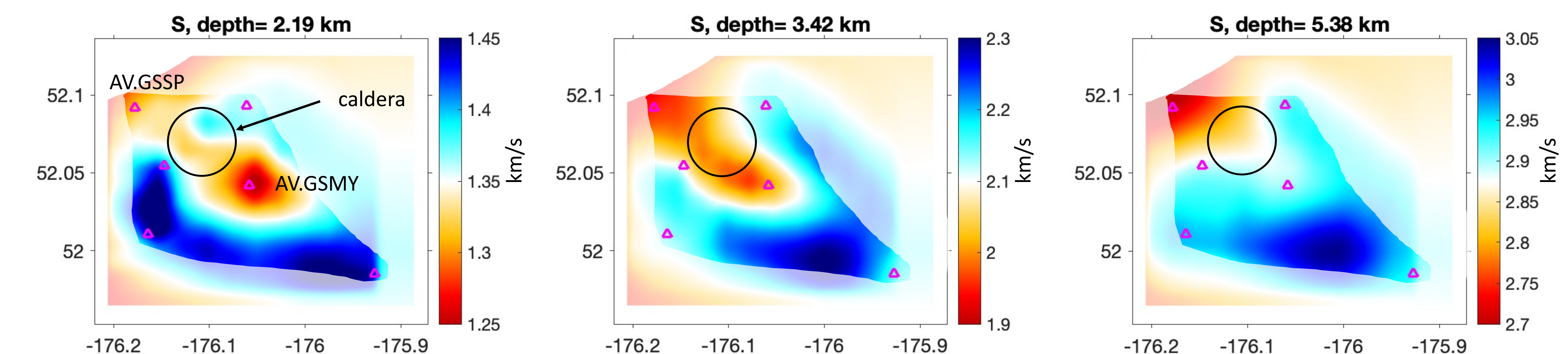


## 4. Upper crustal shear-wave velocity model from ambient noise tomography

We extracted the empirical Green's functions from the vertical component of 5 stations from July 2019 to July 2020, with a sampling rate of 20 Hz. We conducted the full-wave ambient noise tomography with 8 overlapping frequency bands ranging from 0.3 Hz to 1 Hz. The results shown here are after 4 iterations.

### Key observations:

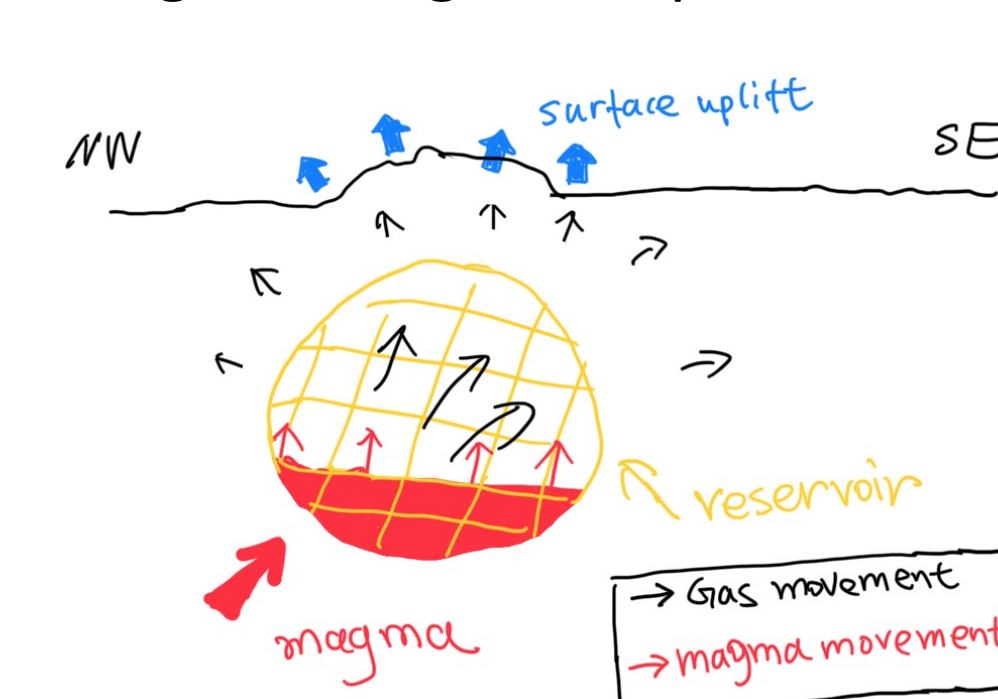
- A NW-SE trending low-velocity zone is observed at the depth of about 2-5 km, consistent with the overall distribution of earthquakes



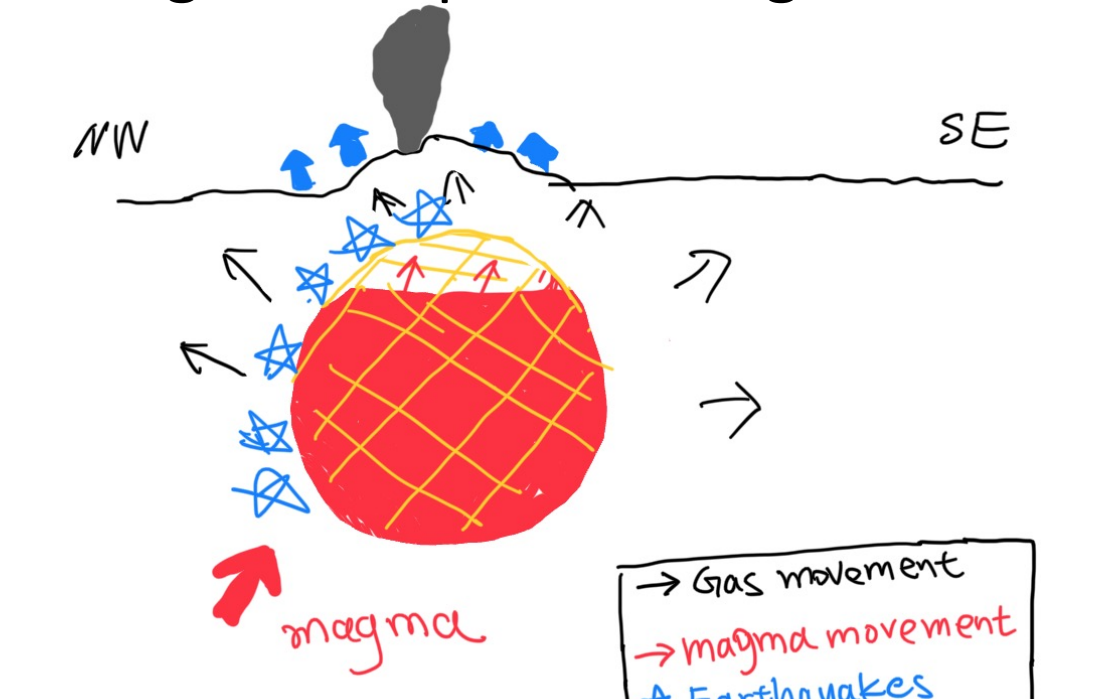
## 5. Hypothesis

The observations from seismicity,  $dv/v$ , and shear-wave velocity model suggest a four-stage eruption cycle.

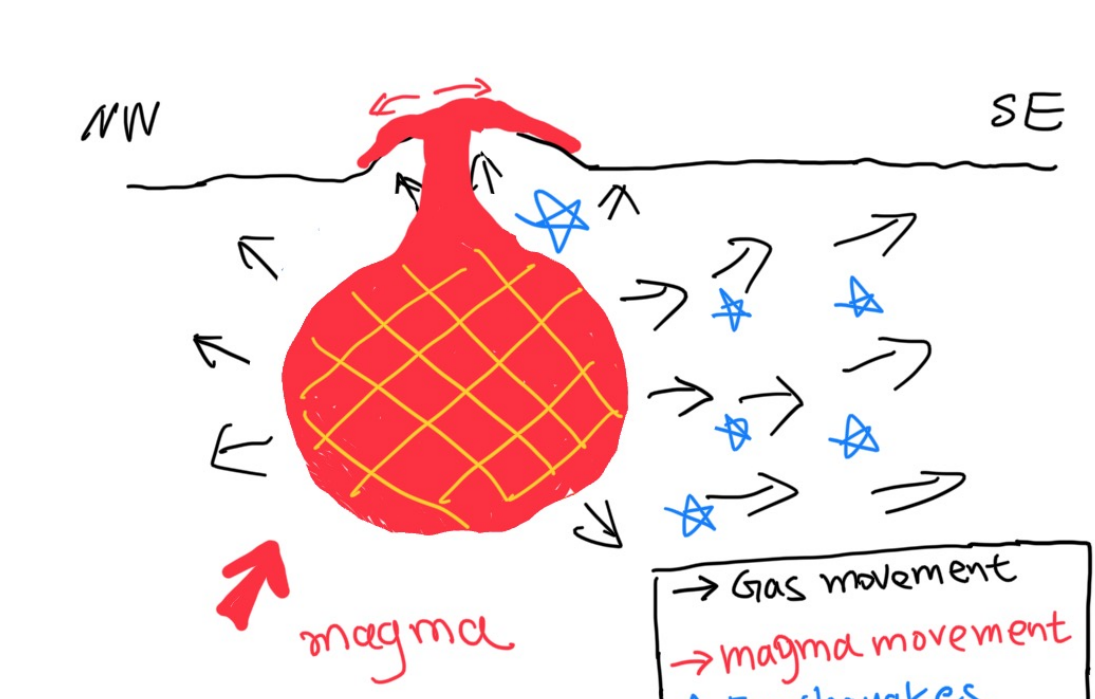
Stage-1: Magma emplacement



Stage-2: Eruption with gas release



Stage-3: Formation of lava dome



Stage-4: Slow dike extrusion

