Using ambient noise tomography to image tectonic and magmatic features of the Irazú-Turrialba volcanic complex at regional and local scales

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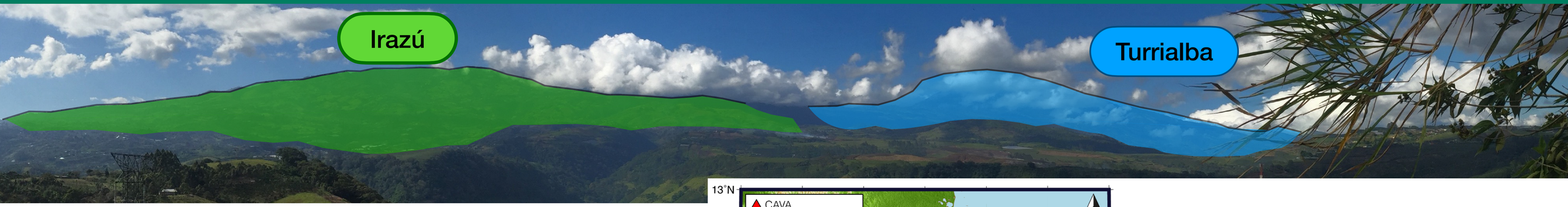
Objectives



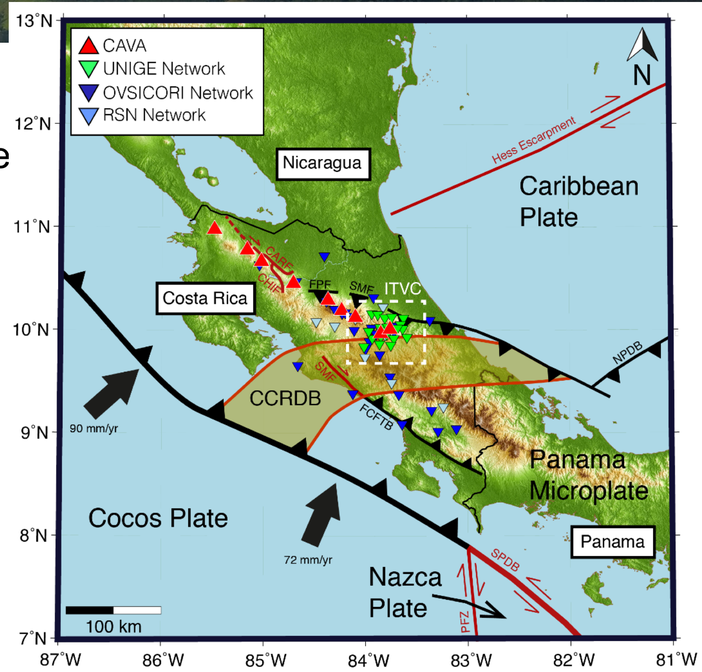
Perform an **A**mbient **N**oise **T**omography (**ANT**) to the **C**entral **A**merican **V**olcanic **A**rc (**CAVA**) and **I**razú-**T**urrialba **V**olcanic **C**omple (**ITVC**)

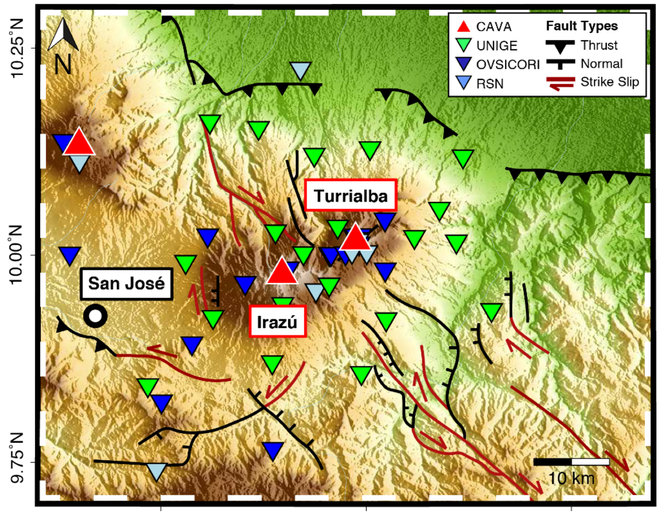
(1) **Image** the volcanic subsurface by producing a 3D Shear Wave velocity model

- Locate distinct features e.g.
  - **Reservoirs**
  - **Conduit** plumbing
  - **Magmatic** and **plutonic** bodies

(2) Explore the **tectonic control** on magmatic system

- **Regional** and **Local** scales
  - **Alignment** of the ITVC compared to the whole CAVA





[1] Alvarado, G.E., et al. (2017), *Tectonophysics*, *721*, pp.462-476.
[2] Montero, P. W., er al. (2013), *125*(5-6), 857-876.

Figure 1. Regional scale simplified tectonic map of the Costa Rican portion of the Central American Volcanic Arc, adapted from [1] & [2] and local scale tectonic map of the Irazú-Turrialba Volcanic Complex, adapted from [2]. Included is the joint seismic networks of OVSICORI, RSN & UNIGE

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ANT - 2D V_g Model

Regional scale:

- At T = 2 & 4s, there are low velocity anomalies possibly associated with the the complex faulting system around the ITVC, and also an unknown anomaly, running just south of but parallel to the CAVA between Irazú volcano and the NW succession
- At T = 6 & 4s, there is the increased emergence of high velocity anomalies that correspond with the high-altitude Talamanca Range, a juvenile continental subduction driven arc. Here could mark the tectonic feature that is responsible for the cessation of the volcanic arc. There are also emerging low-velocity anomalies beneath all the volcanoes within the well-resolved region of coverage

Local Scale

- At T = 2 & 4s, there is the emergence of a low velocity anomaly possibly corresponding with the observed and recorded strike-slip & normal faults that start NW of both summits and propagate around and between the two volcanoes
- At T = 6 & 8s, there is the emergence of a small low velocity anomaly beneath Irazú and a larger anomaly approximately 3km NE of the Turrialba summit. There is also the gradual emergence of a large high velocity anomaly, potentially attributed to the Talamanca Range

(NB. Each period represents approximately 1km of depth penetration)

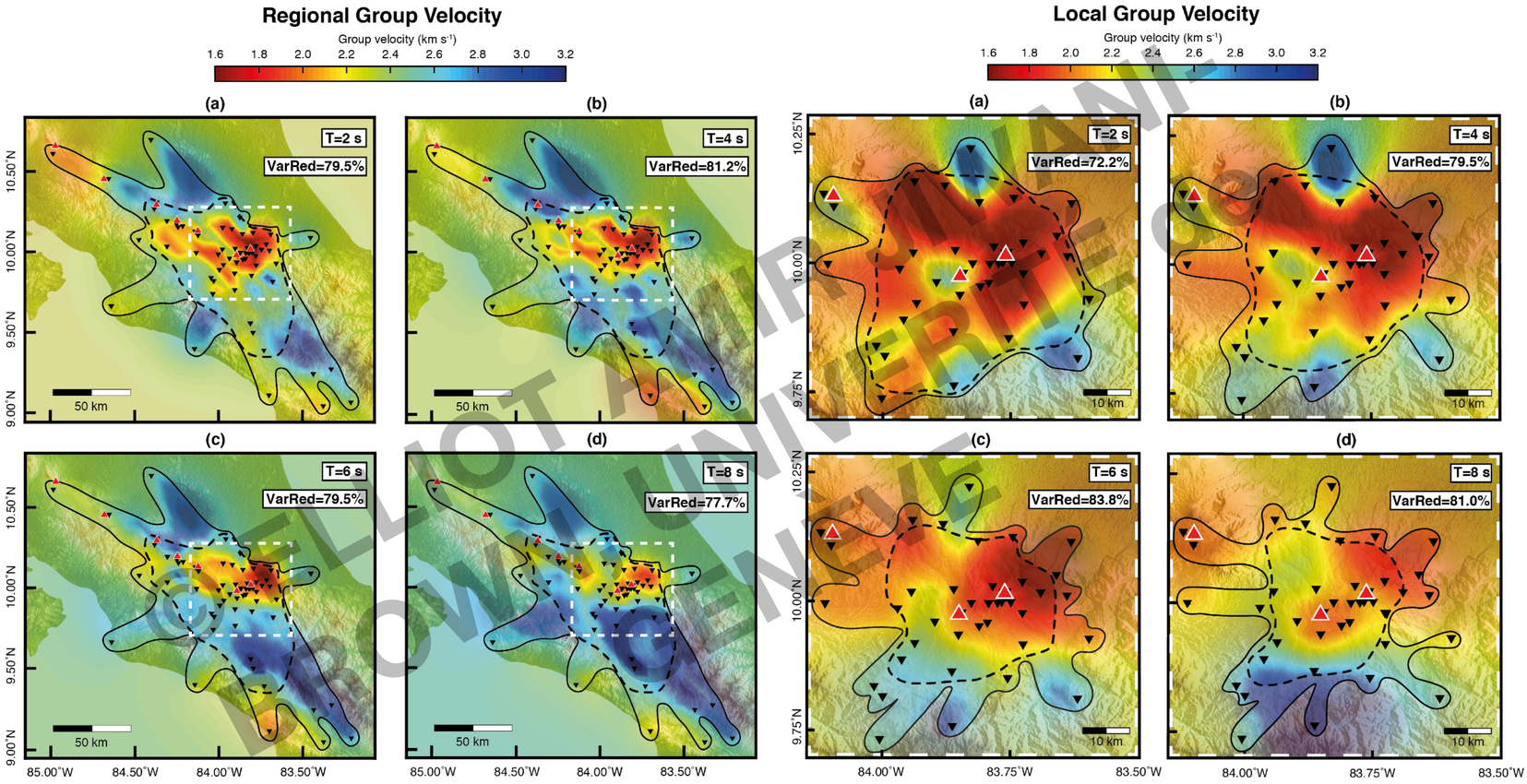

Figure 2. Inverted 2D group velocity maps at periods of T = 2 (a), 4 (b), 6 (c) & 8s (d) of the regional scale of the Central American Volcanic Arc (CAVA) and local scale of the Irazú-Turrialba Volcanic Complex (ITVC). The solid black contour is the computed area of good ray coverage and the dotted contour is the qualitatively interpreted, preferred area of good ray coverage that is expected to be well resolved. The regional maps have a grid spacing of 9km and the local maps have a grid spacing of 3km

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ANT - 3D V_s Model

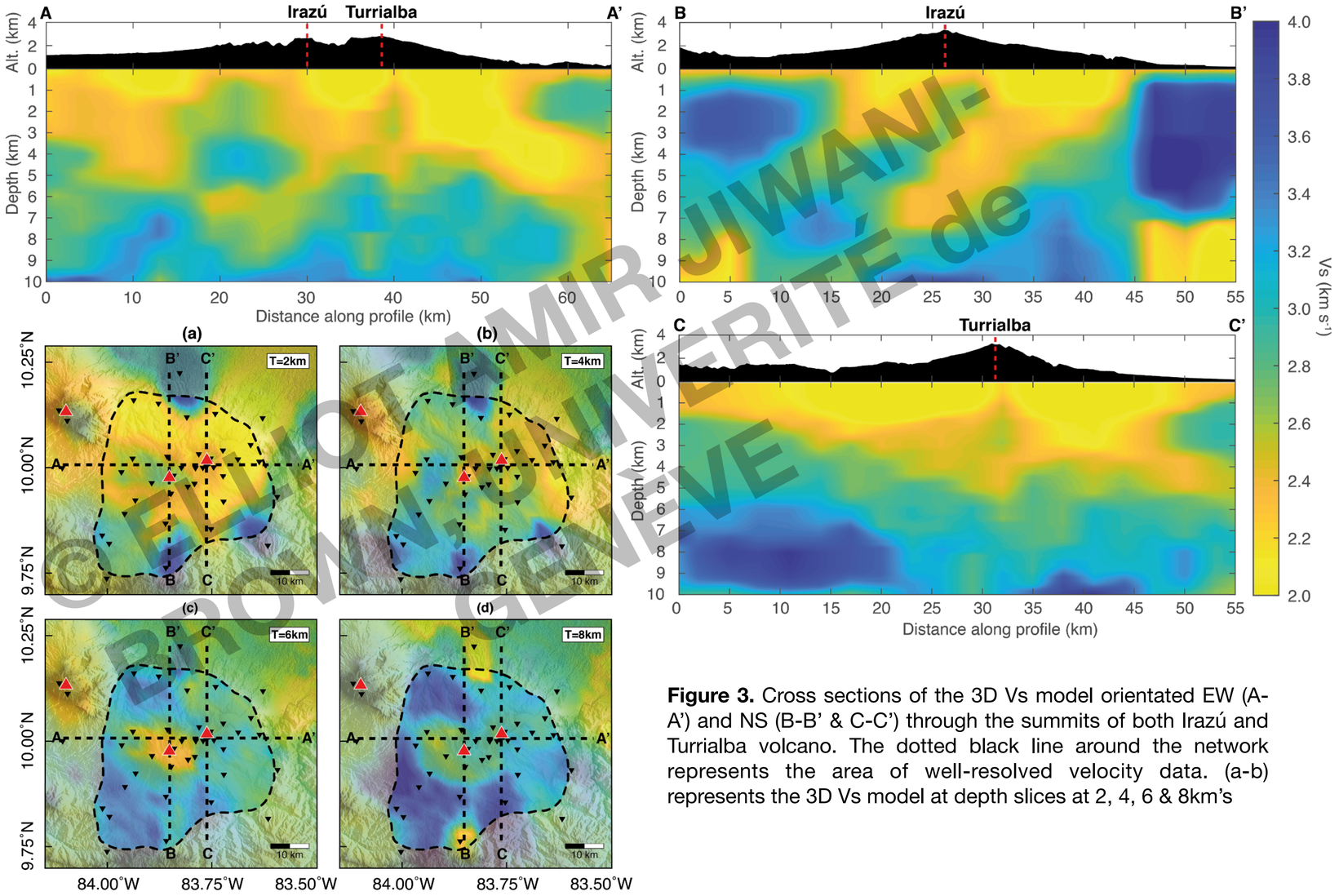

Figure 3. Cross sections of the 3D Vs model orientated EW (A-A') and NS (B-B' & C-C') through the summits of both Irazú and Turrialba volcano. The dotted black line around the network represents the area of well-resolved velocity data. (a-b) represents the 3D Vs model at depth slices at 2, 4, 6 & 8km's

Vs Cross sections

- The EW cross-section (A-A') reveals two partially distinct low-velocity anomalies emerging from beneath both Irazú & Turrialba, at 35 & 45km respectively, however they seem to penetrate in different directions. The low-Vs anomaly stops at approximately 6km however there are some faint details that these individual anomalies could reconnect at around 9km. There is also a low velocity anomaly at 10km along the profile however this is outside the resolution of the model.
- The NS cross-section (B-B') shows a substantial low-velocity anomaly with an approximate 35° southerly dipping shape beneath that of Irazú, ceasing at approximately 6km in depth. Turrialba has a wide high-velocity anomaly (C-C'), possibly attributed to the shallower localised faulting and does extend until ≈3/4km. Beneath this there appears to be no presence of the magmatic system. The low-velocity anomaly beneath that of Irazú could be the interlinking conduit system from depth, with the shallower anomaly of Turrialba connected to a shallower separate reservoir.

Vs Maps

- At 2km, there is a low-velocity anomaly similar to that of the group velocity (Figure 1) and could be attributed to the complex faulting surrounding the summits of there ITVC (see local map Figure 1).
- At 4km, there exists low-Vs anomalies beneath both Irazú and Turrialba, however they do not appear to be linked.
- At 6km, there exists only a lower anomaly directly beneath the summit of Irazú and by 8km it appears less prominent but wider (≈15km width) and could be the top of the deeper, larger reservoir

Further modelling and comparison to the large-scale 3D Vs inversion will better constrain the lateral extent of these anomalies and how they link to a wider or deeper system

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