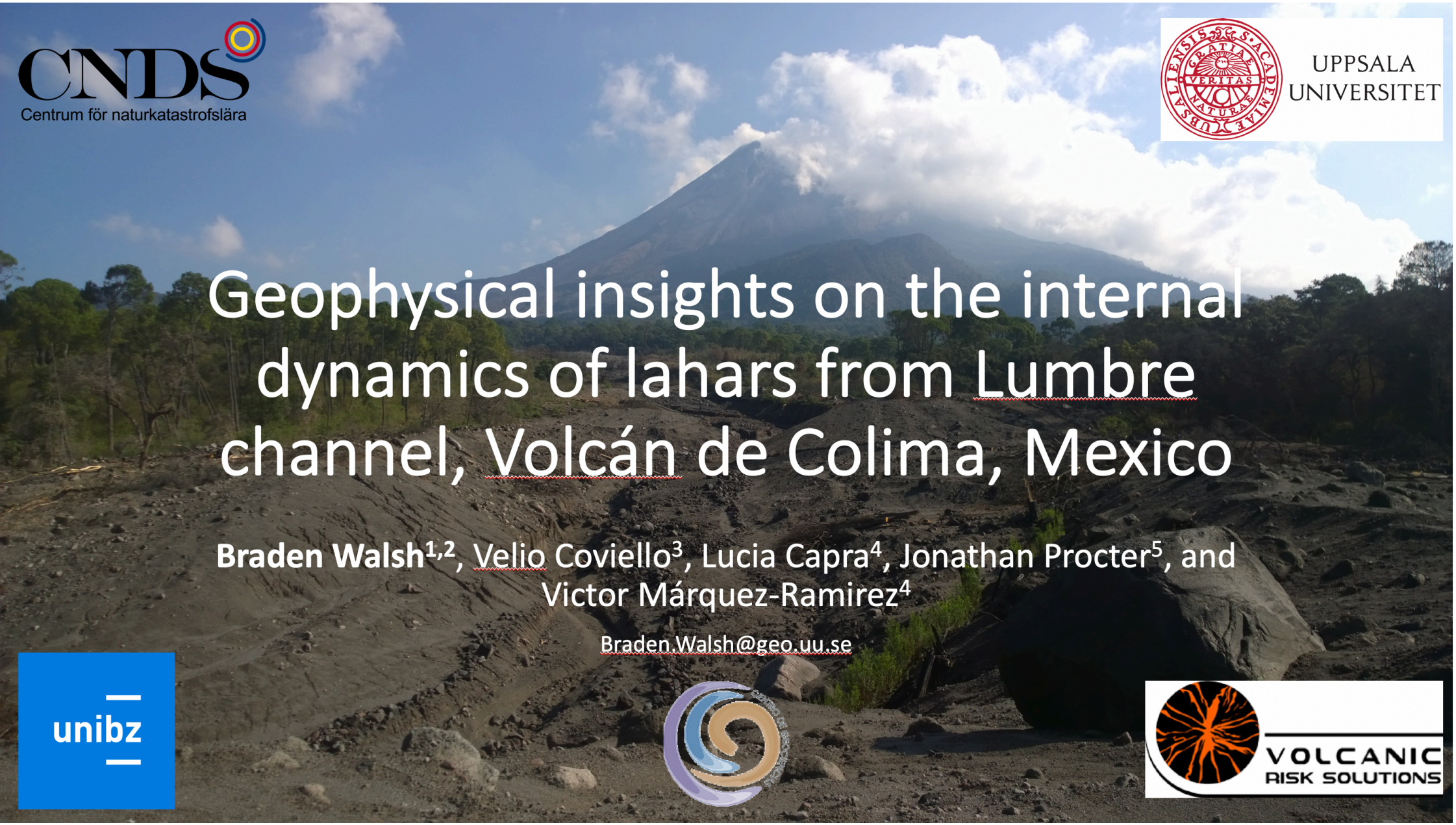

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Geophysical insights on the internal dynamics of lahars from Lumbre channel, Volcán de Colima, Mexico

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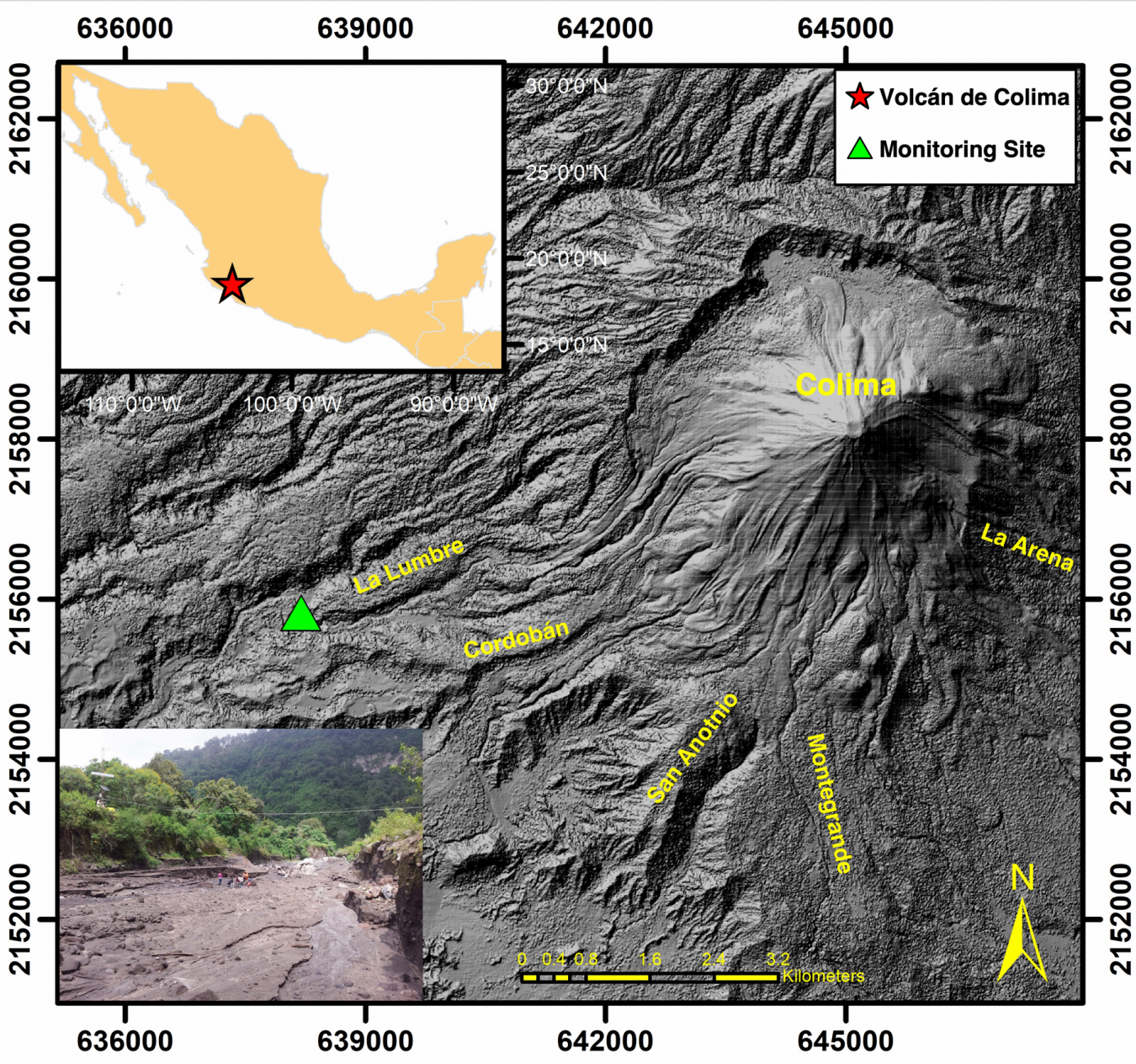
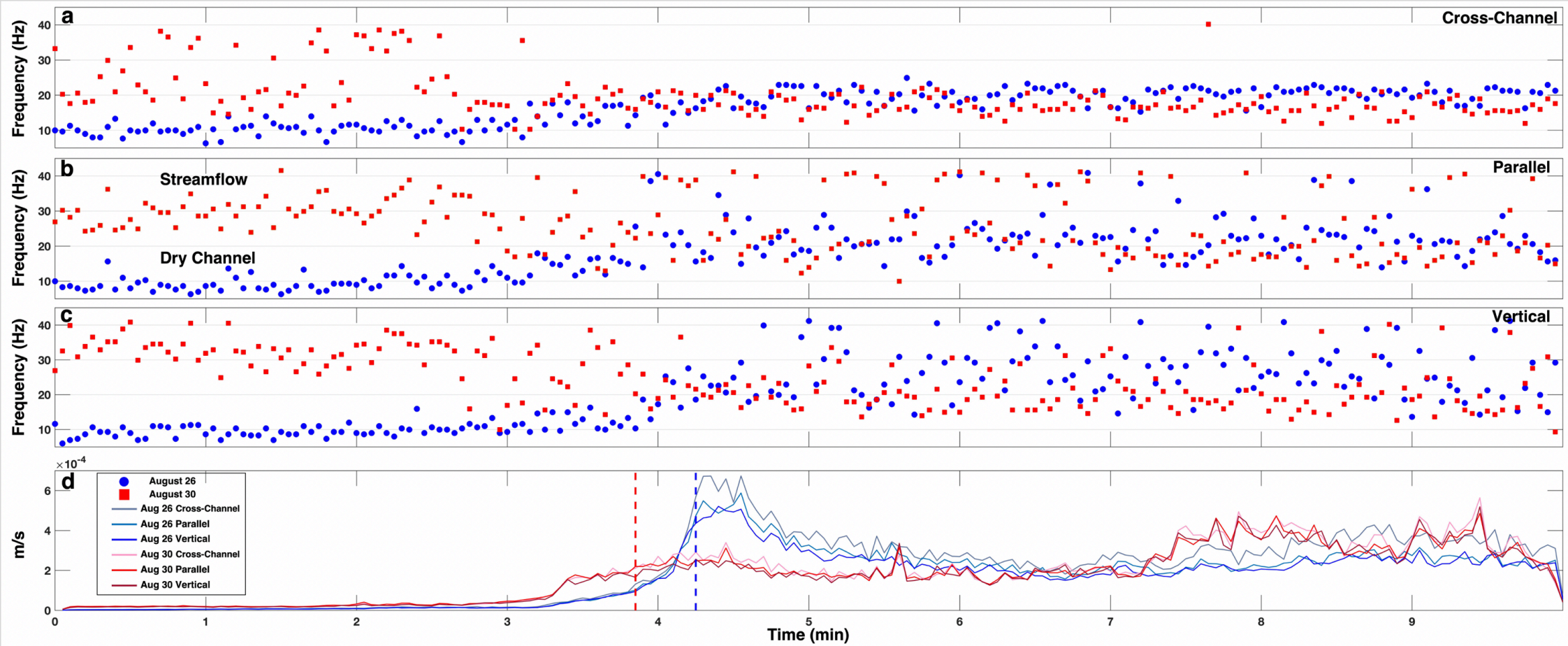
VOLCANIC RISK SOLUTIONS



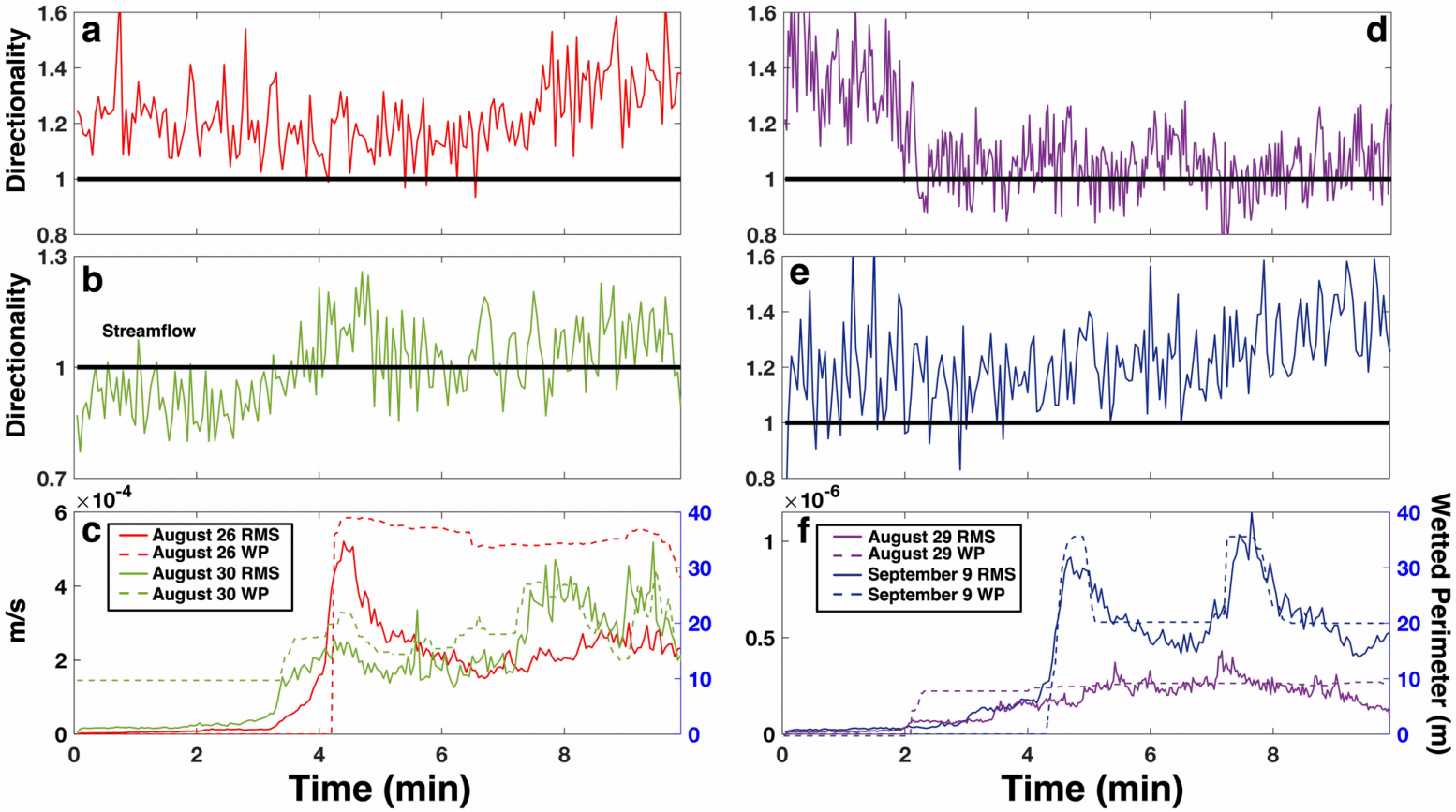
- Volcán de Colima
  - Many lahar events each rainy season
  - Lahar events flow down five main channels
    - Cordobán, Arena, Lumbre, Montegrande, San Antonio
  - Monitoring site at Lumbre
    - 1580m asl
    - 3m from channel
    - 6º slope, 30m wide channel
    - Walls on left bank 7m high
    - Camera, seismometer, geophone, accelerometer

Movie, see powerpoint

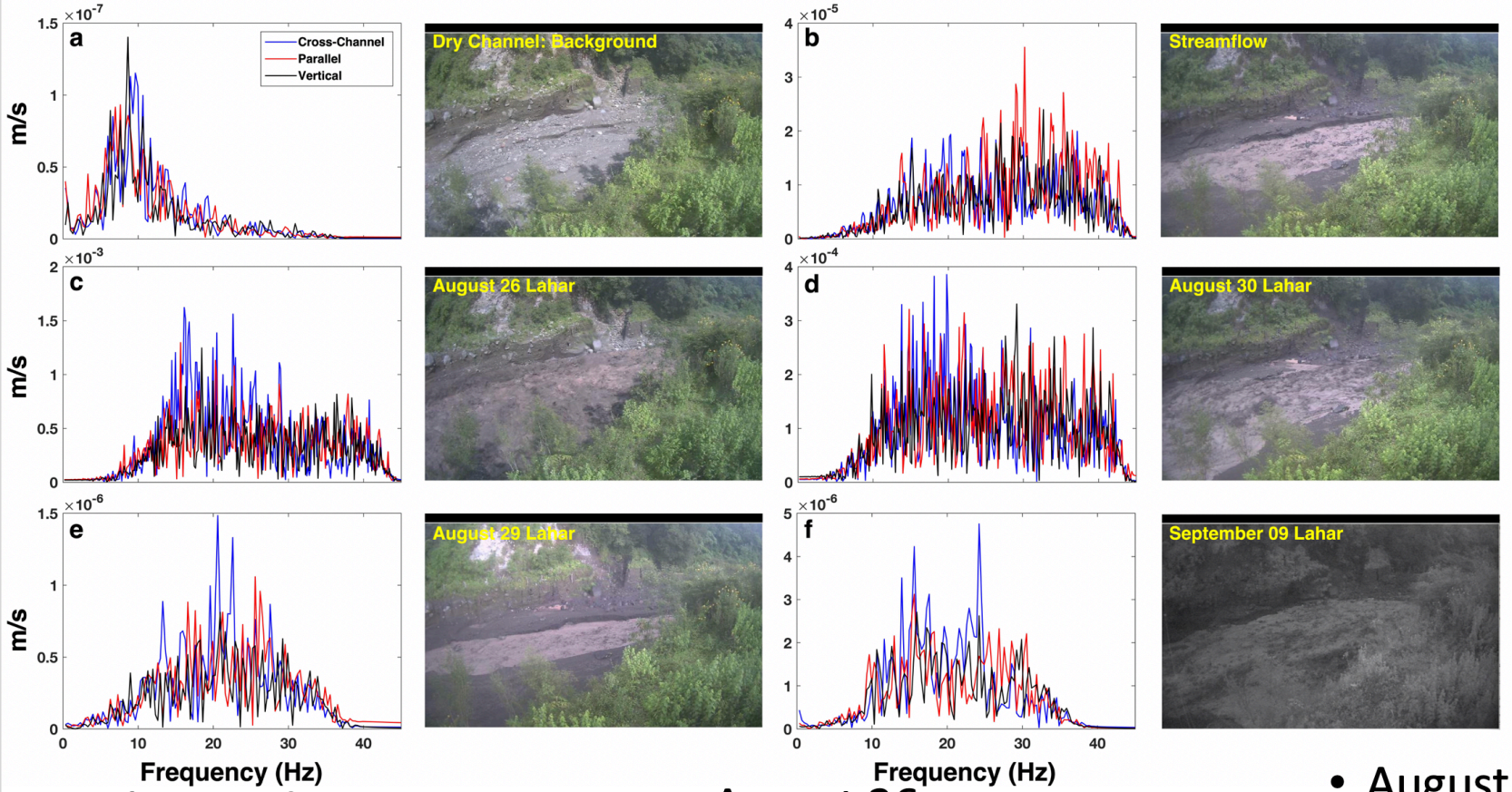
- 2016 flow events
  - 4 lahars recorded by both camera and seismometer
  - August 26, 29, 30, Sep 9
  - Largest were August 26, 30
  - 26th sunny conditions, dry channel large bulky front
  - 30th long precursory streamflow front
  - 29th small, contained within incised channel formed by Aug 26 event
  - 9th dry channel, flowed over fine grained deposits emplaced by Aug 30



- Max peak spectral frequency of August 26, 30 events
  - 10 min surrounding the front of the lahar
    - 3 second time window to match camera
- Frequency increase when flow arrives from background noise
- Parallel/Vertical have wide frequency range, cross-channel narrow
  - Opposite for streamflow (red squares before lahar front)



- Directionality ratios (DR)
  - Cross-channel divided by parallel signals
  - Linked to wetted perimeter, # of particle collisions and concentrations (Doyle et al., 2010)
  - Aug 26 DR>1, background noise also >1
  - Switch in directionality when lahar arrives for Aug 30 event (streamflow precursor to lahar)
  - Aug 29 DR~1 smaller and higher water content
  - Sep 9 large DR, smaller amplitude, but bigger wetted perimeter than 30th

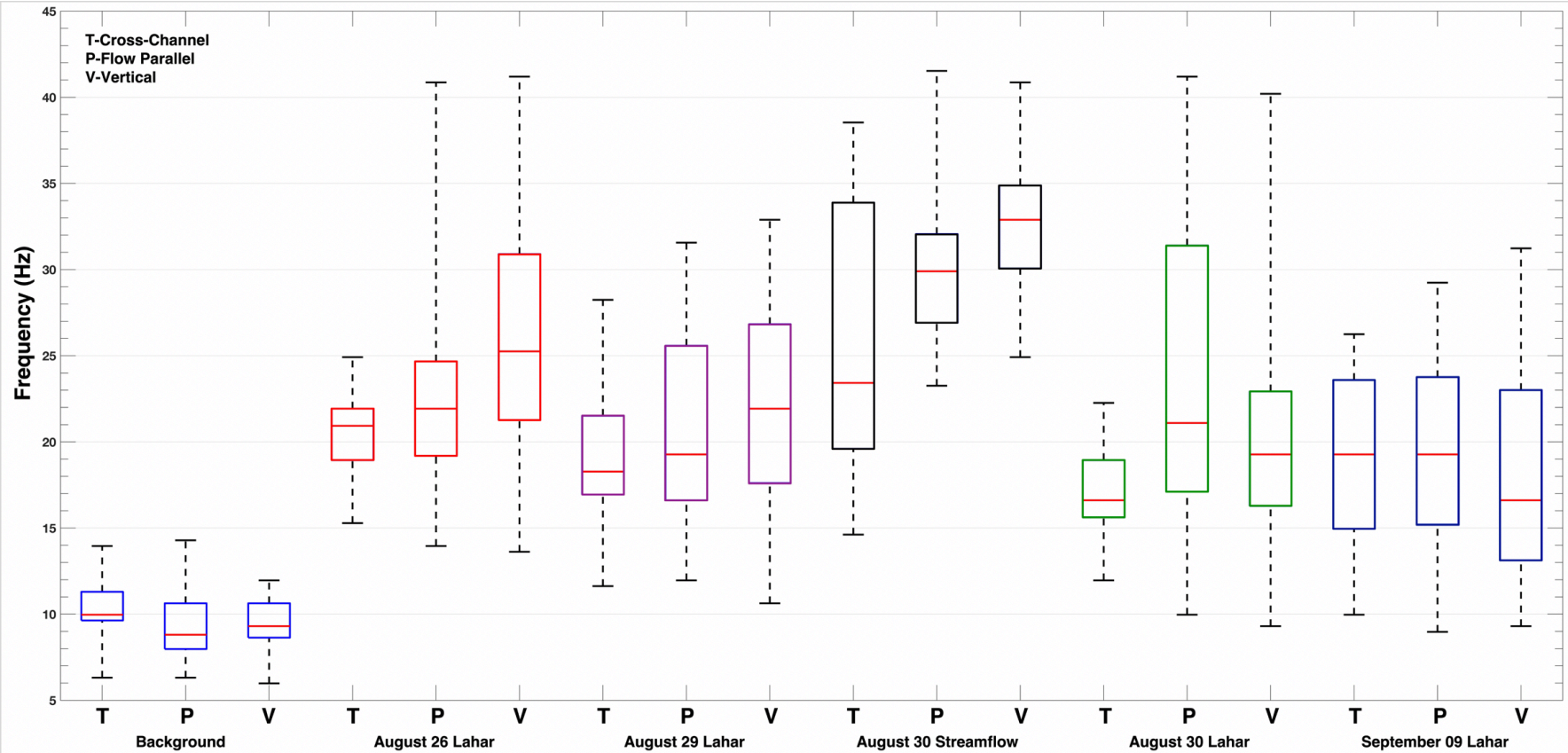


- Full spectra of the front of each flow event with image

- Background noise
  - Low frequency
- Streamflow
  - High frequency dominates
    - Bedload sensitive

- August 26
  - Lower frequency dominate
    - 15-25 Hz (frictional effects?)
- August 30
  - Broad frequency range
    - Combination of both frictional and collisional processes?

- August 29
  - Similar to Aug 26, with higher peak frequency
    - Smaller grain size distribution/lower concentration?
- September 9
  - Bimodal peaks at 16 and 22 Hz
    - Turbulence and bedload processes?



- Boxplots for each event and seismic component
  - Depicts evolution of the frequency over time
- IQR (interquartile range)

- Cross-channel
  - Narrow IQR for august events
    - Wider for September
  - Channelization/freedom of movement?
- Flow parallel
  - Aug 26 narrow IQR
    - Aug 30 wide IQR
  - Erosiveness?
    - 26th incised the channel, 30th deposited fine grained material
- Vertical
  - Decrease in median peak frequency with time
    - Channel composition?
    - Little fine grains (26th, 29th) to deposition (30th) to flowing over (Sep 9th)

Conclusions

- For the vertical and flow parallel directions the transition from streamflow to a lahar coincides with a widening of the peak frequency distribution
- The cross-channel frequency content is opposite with streamflow generating a wide frequency distribution which transitions to a narrow distribution with the lahars
  - There is also a drop in overall peak frequency when transitioning from streamflow to lahar
- Channelization or freedom of movement in the cross-channel direction, bedload transport in the flow parallel direction, and channel bed composition in the vertical direction are possibly the main drivers in the peak frequency output of lahars
- Questions, comments, concerns, explanations, want to work with me?
  - Contact me at this email braden.walsh@geo.uu.se