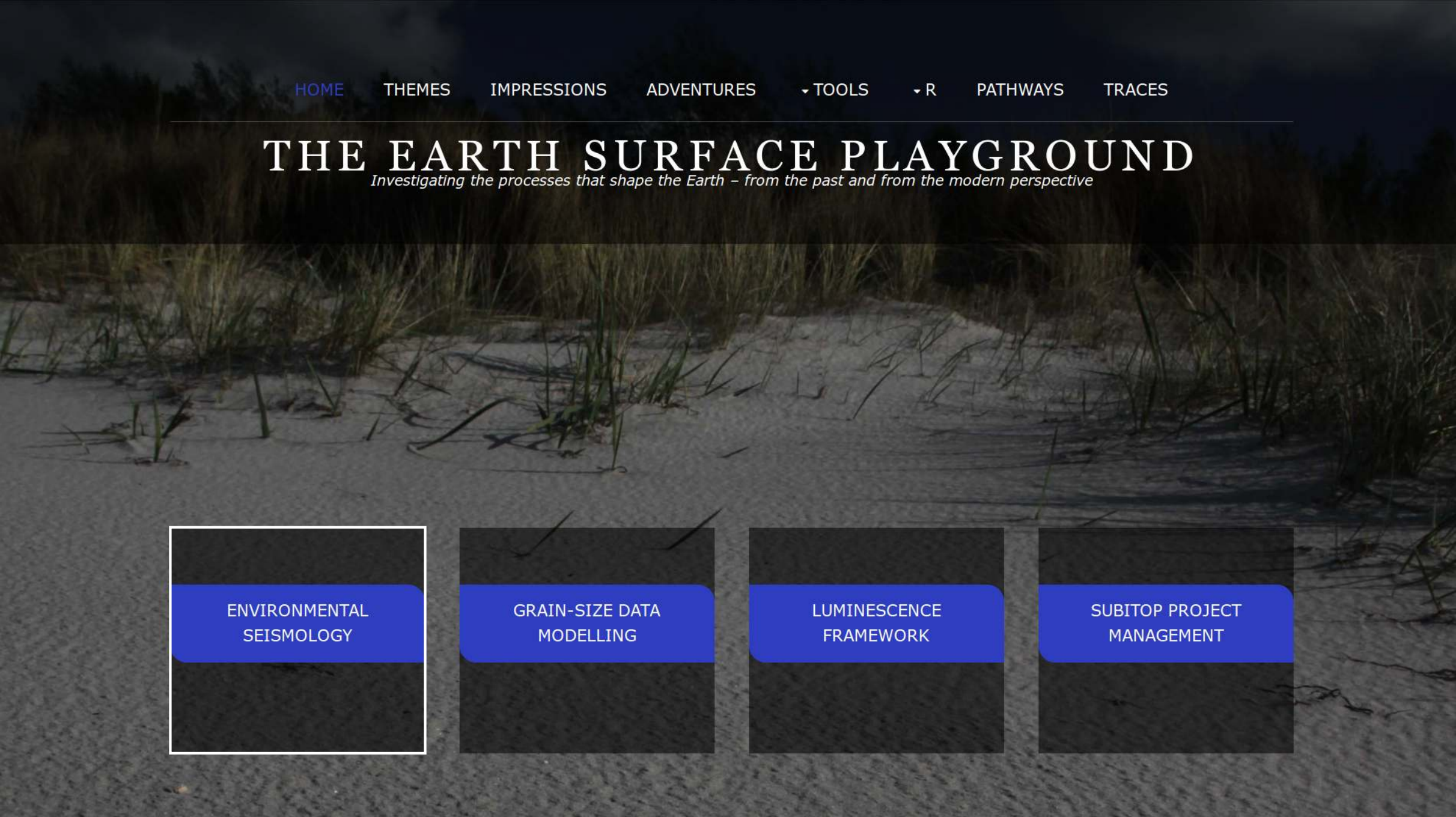




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THE EARTH SURFACE PLAYGROUND

Investigating the processes that shape the Earth – from the past and from the modern perspective

ENVIRONMENTAL
SEISMOLOGY

GRAIN-SIZE DATA
MODELLING

LUMINESCENCE
FRAMEWORK

SUBITOP PROJECT
MANAGEMENT

The trembling of a disrupting Alpine peak

NEAR REAL TIME SEISMIC SENSING OF ROCK FAILURE INITIATION AT THE HOCHVOGEL

Michael Dietze¹, Michael Krautblatter²



1 - GFZ German Research Centre for Geosciences, Section 4.6 Geomorphology

2 - TU München, Monitoring, Analysis and Early Warning of Landslides

slides at www.micha-dietze.de

The Hochvogel: a peak falling apart



The Hochvogel: a peak falling apart



The Hochvogel: a peak falling apart



The Hochvogel: a peak falling apart

(less in)stable northern part

Instable southern part

Conceptual approach – What is being done to the rock mass



Progressive evolution of

Joint coalescence

Shear plane development

Crack opening, deepening

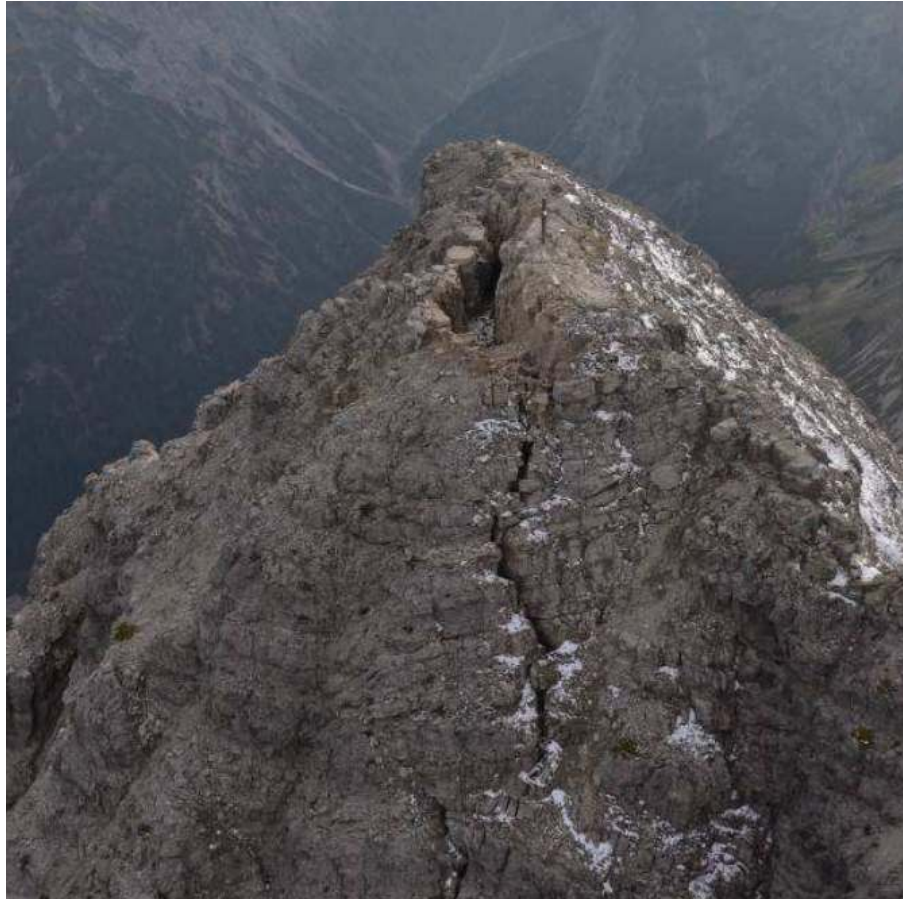
Filling of main crack

Subsidence of failing mass

Sculpting of isolated towers



So what? – Questions to be addressed.



What are proper survey techniques and proxies?

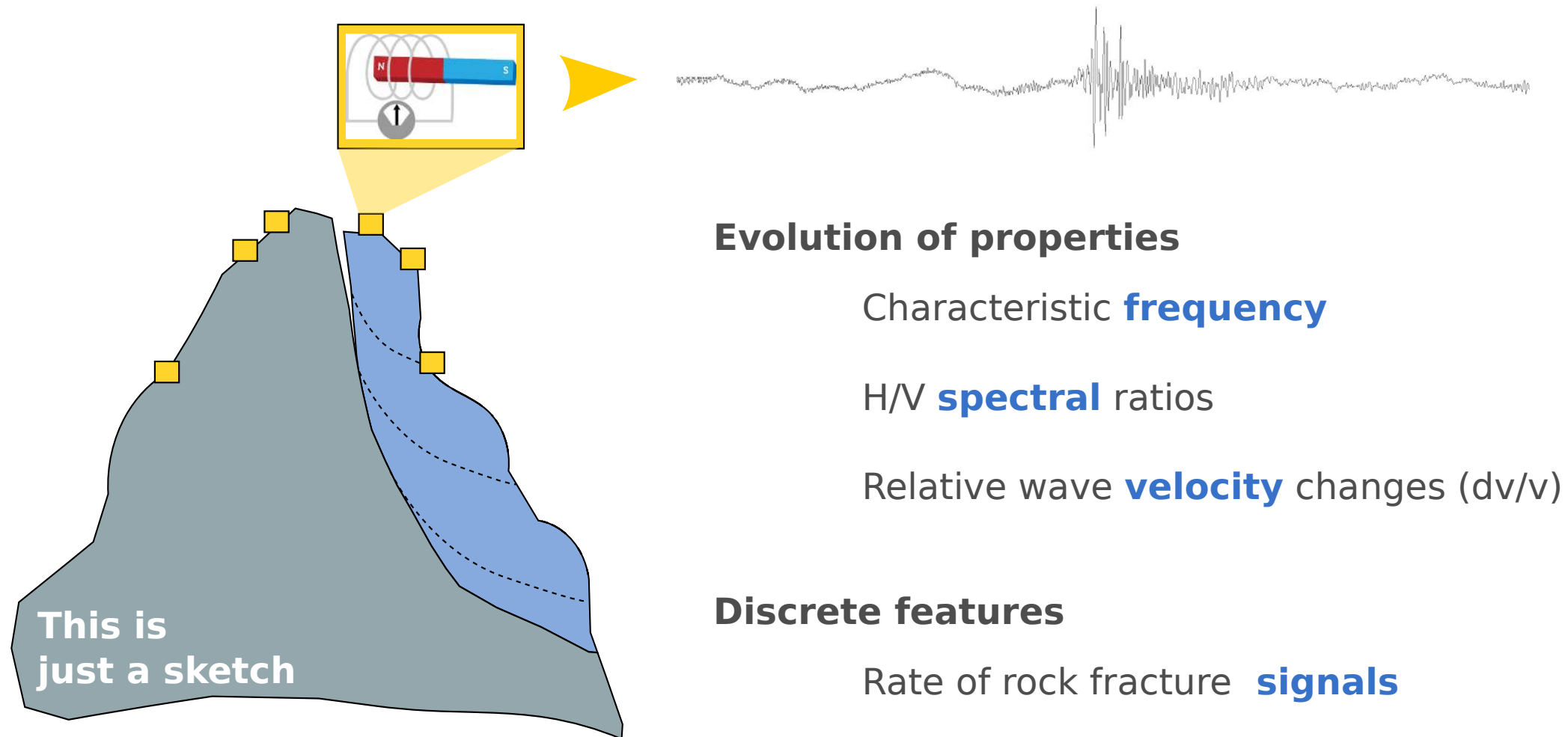
Near real-time, quasi-continuous, spatially extensive and spatially resolving (at best 3D), high explanatory power, robust/rugged, ...

When, by which activity type, and under which boundary conditions is the peak moving?

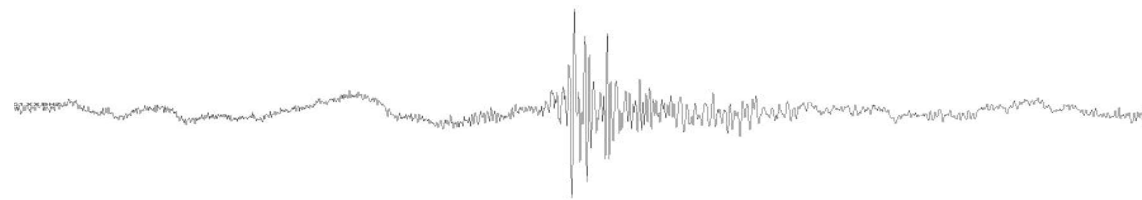
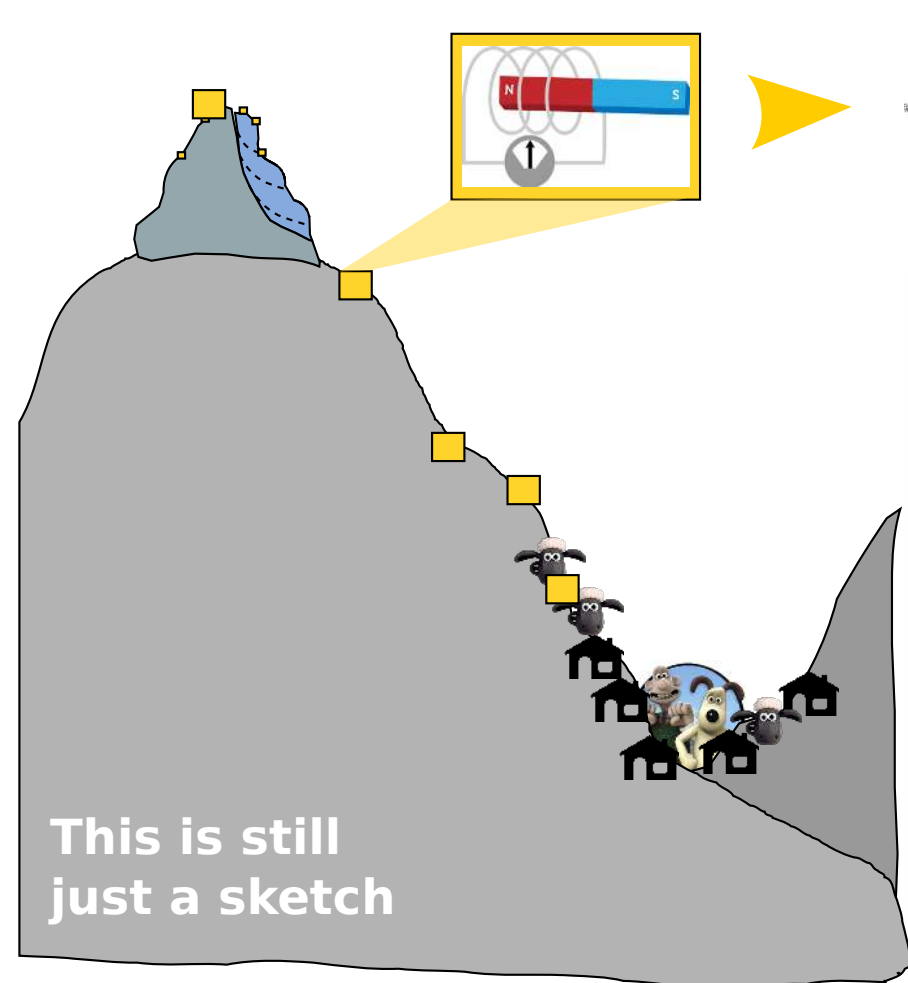
What are the precursor signals of peak activity?

What are the long term trends in peak activity?

Conceptual approach – How can we tackle these mechanisms (seismically)



Conceptual approach – How can we tackle these mechanisms (seismically)



The down slope consequences

Detect rock avalanches

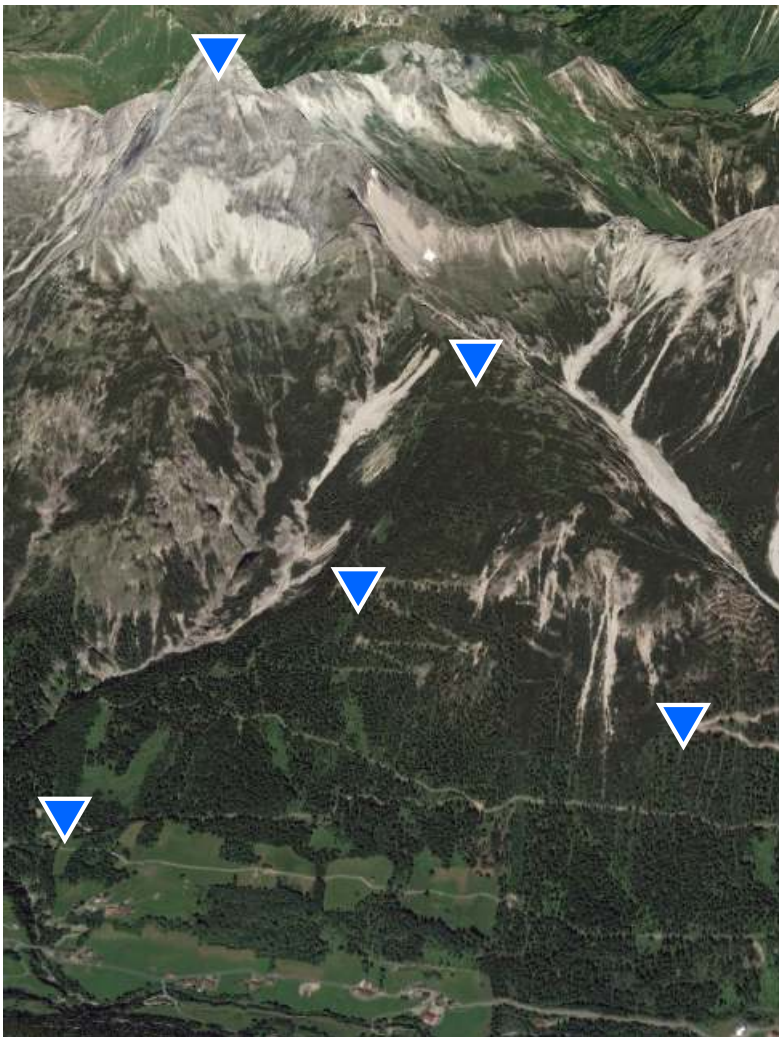
Locate & track mass movements

Constrain boundary conditions

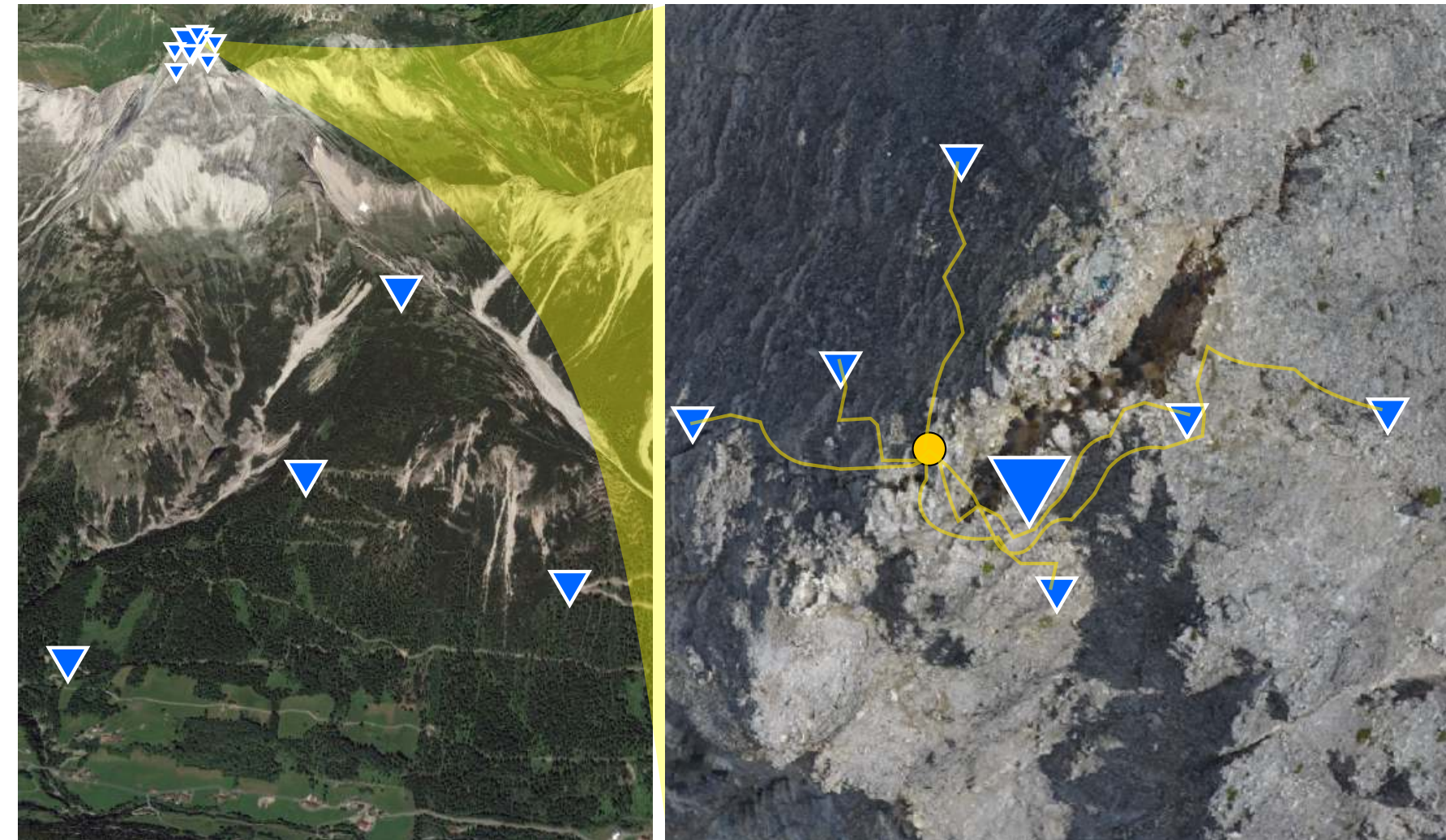
And finally....

Convert knowledge to perspectives & budgets

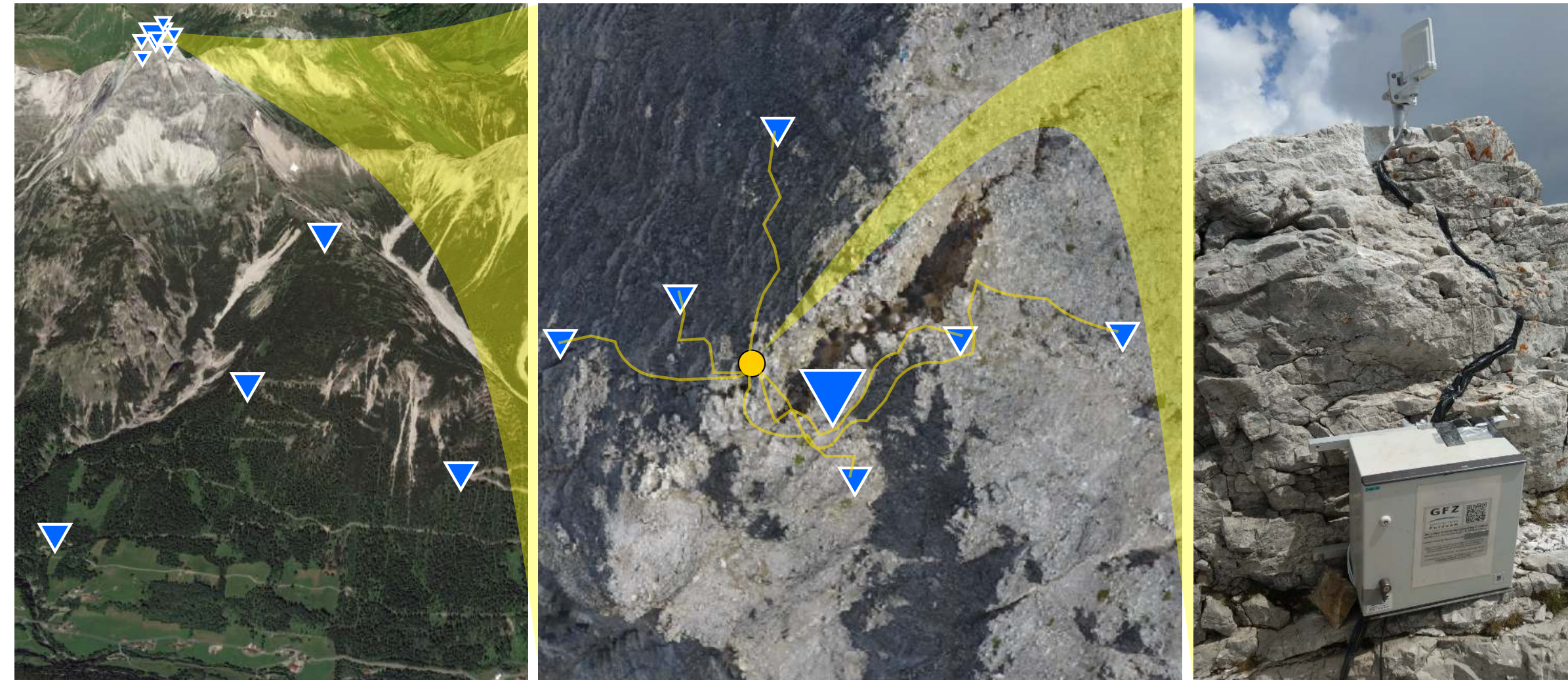
Intrumental approach



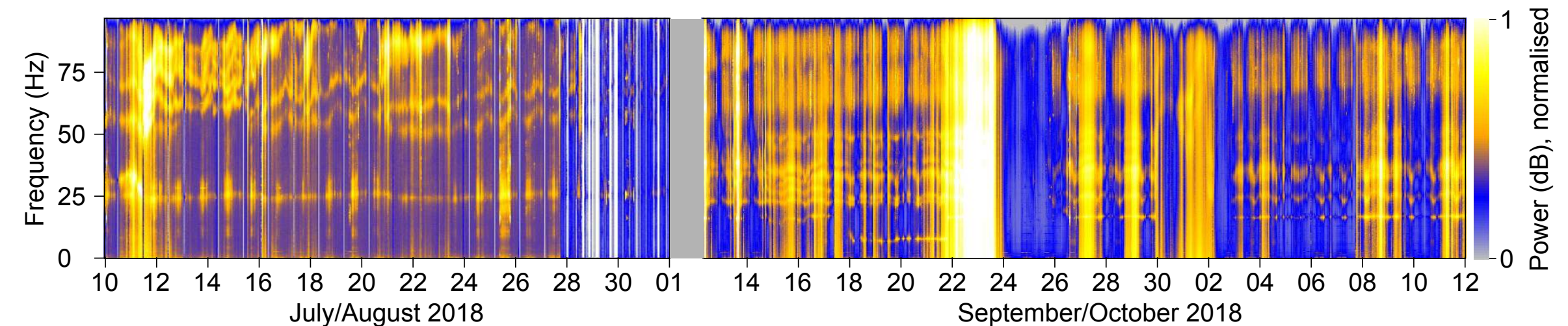
Intrumental approach



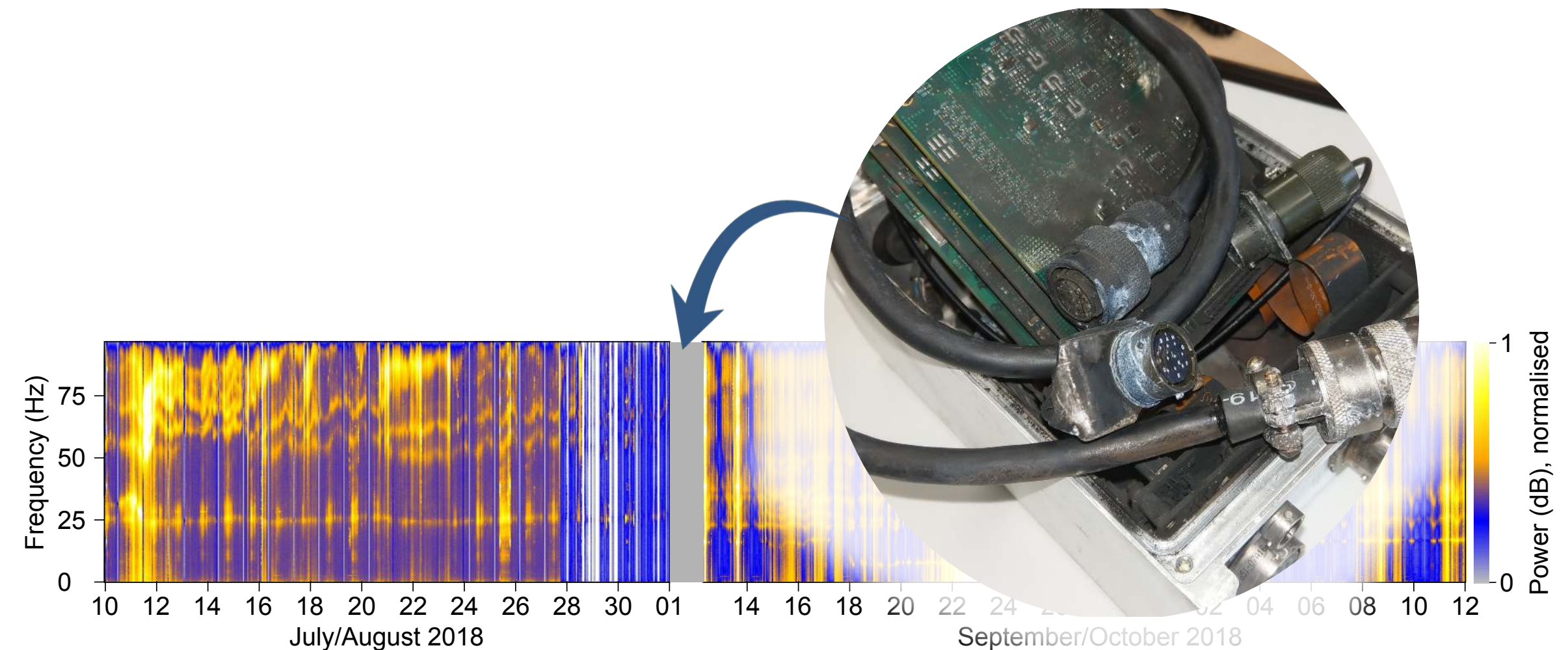
Intrumental approach



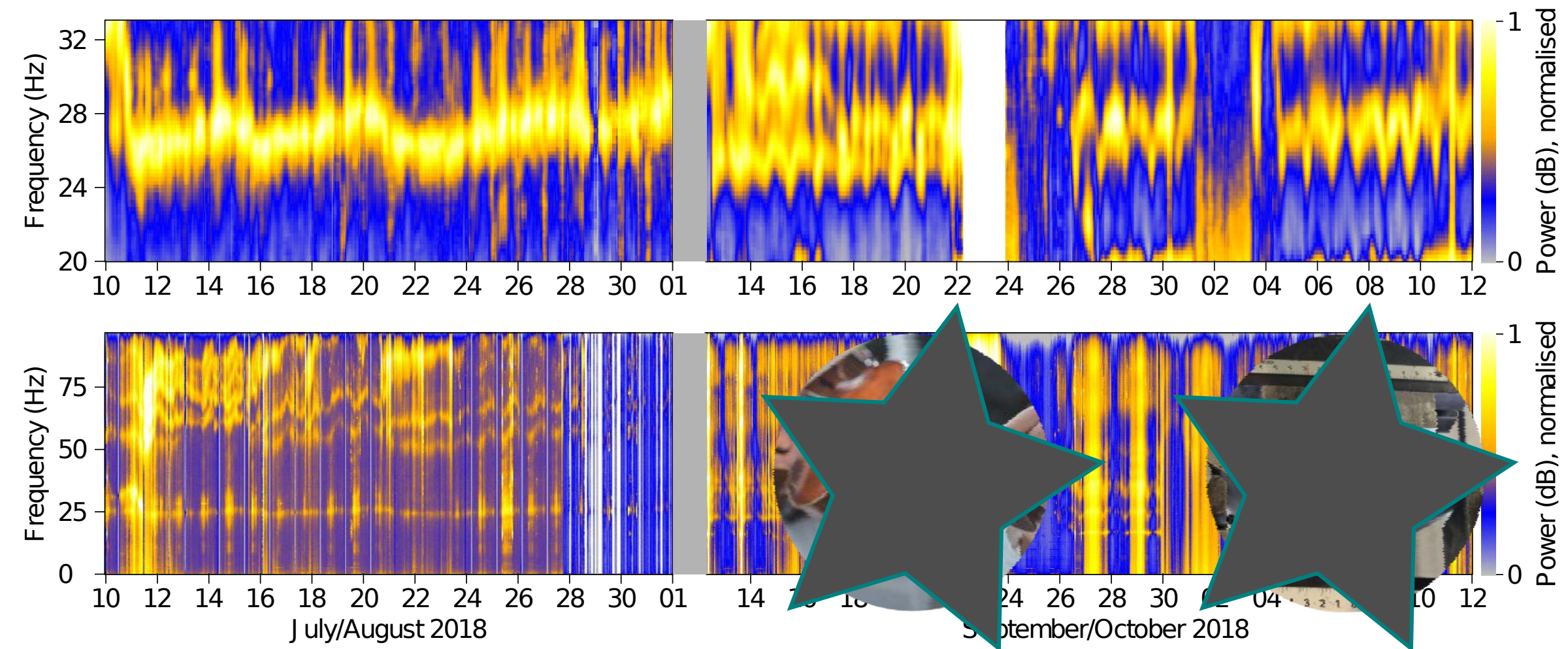
Processing approach I – Surveying the fundamental frequency of the peak



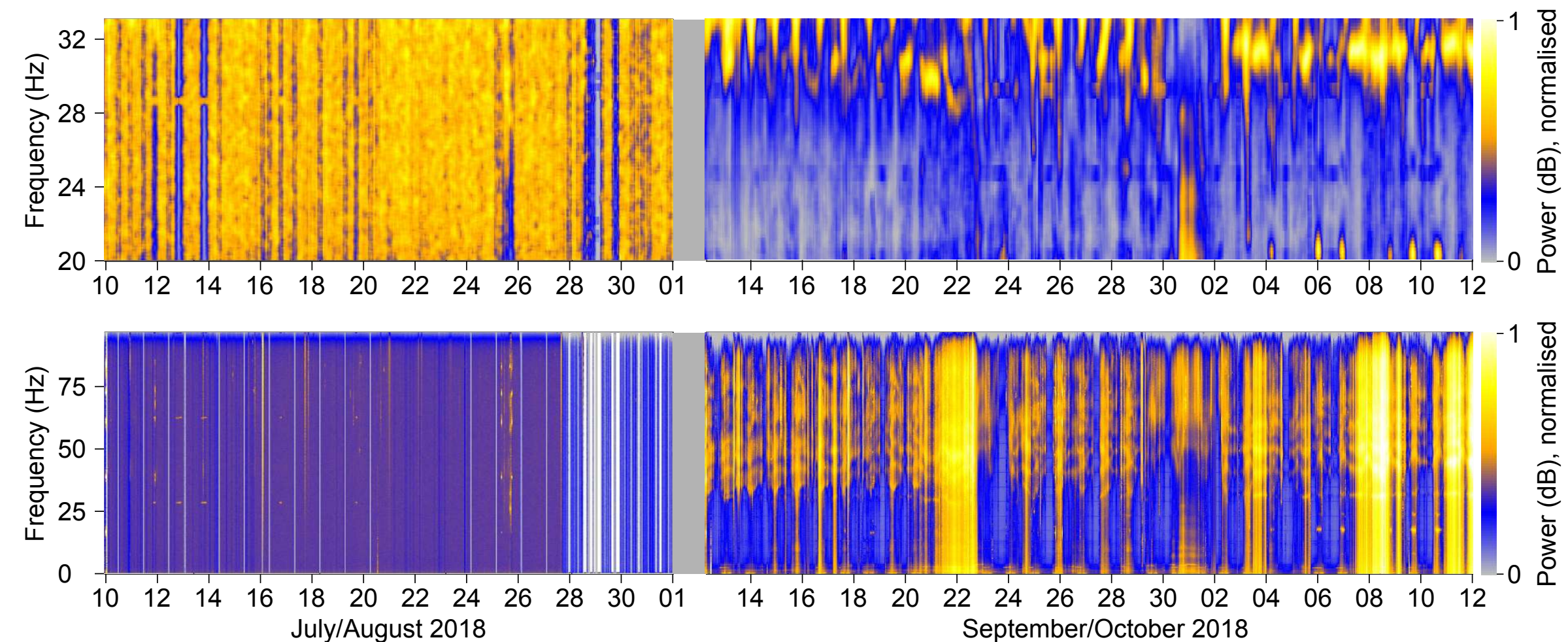
Processing approach I – Surveying the fundamental frequency of the peak



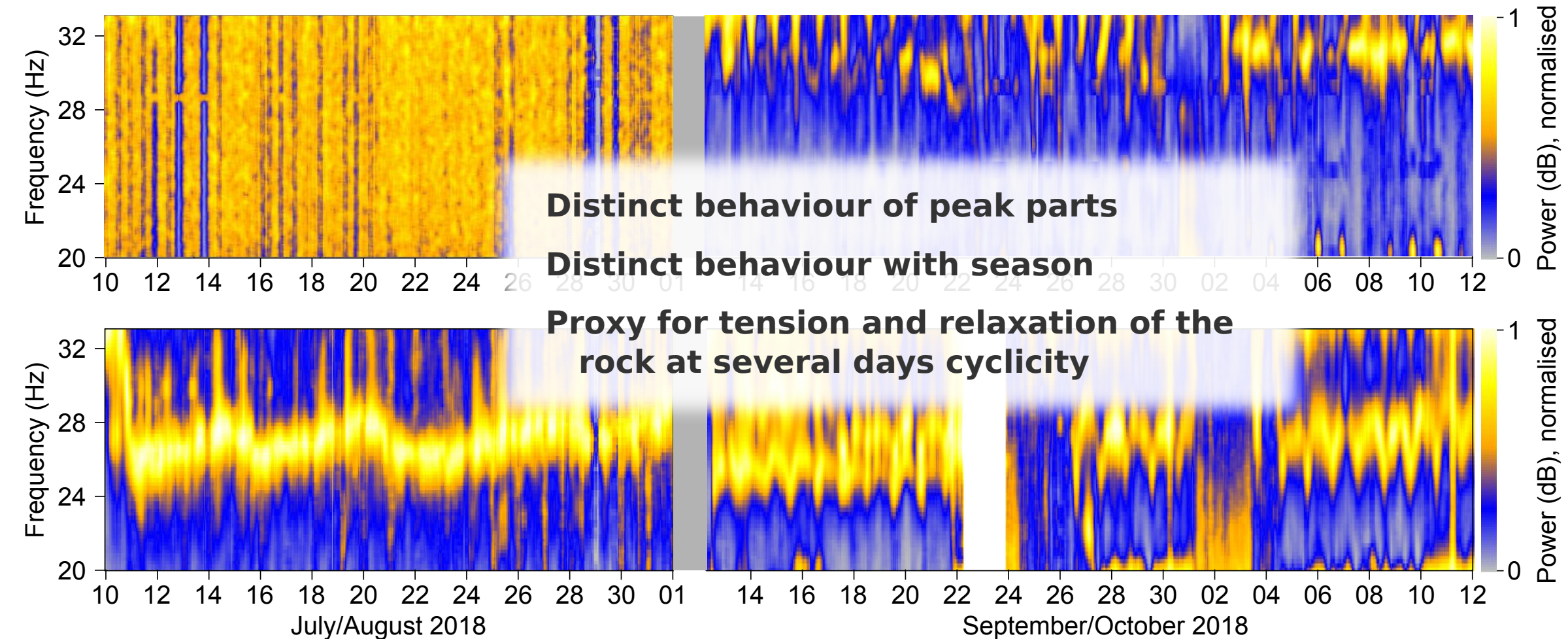
Processing approach I – Surveying the fundamental frequency of the peak



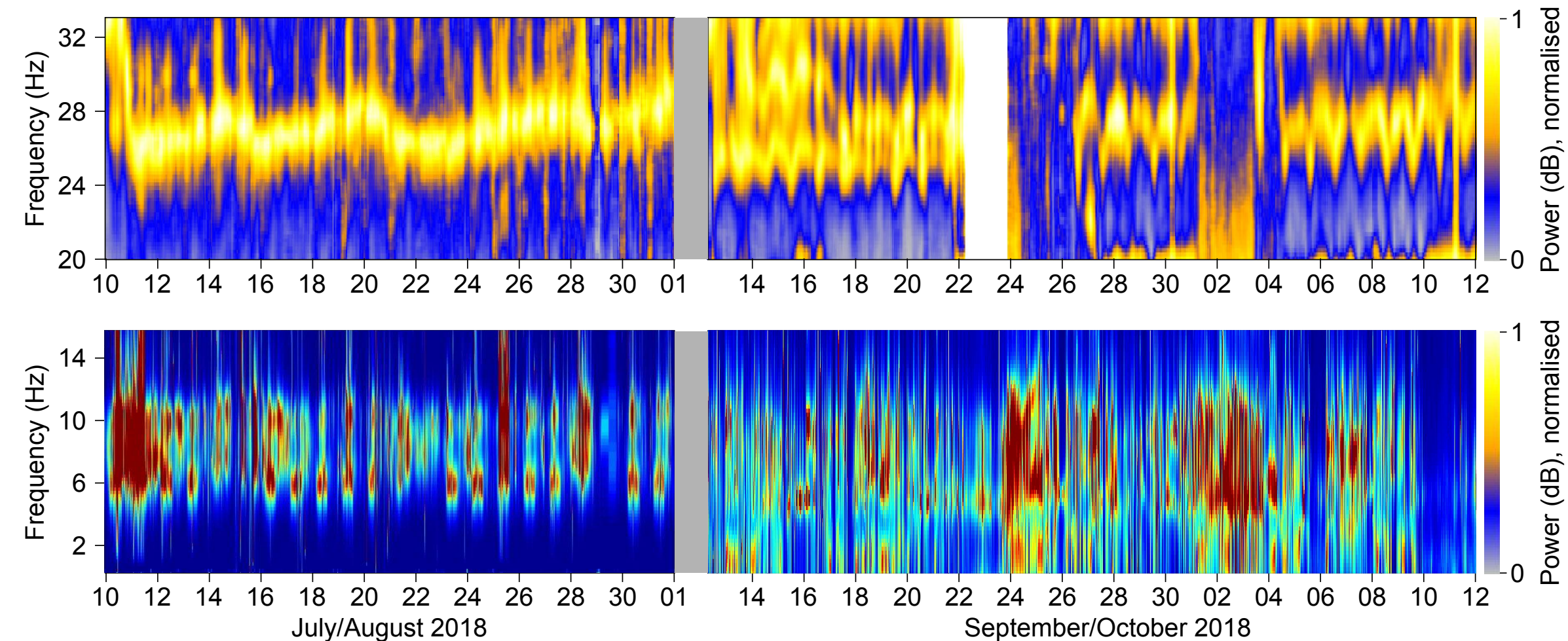
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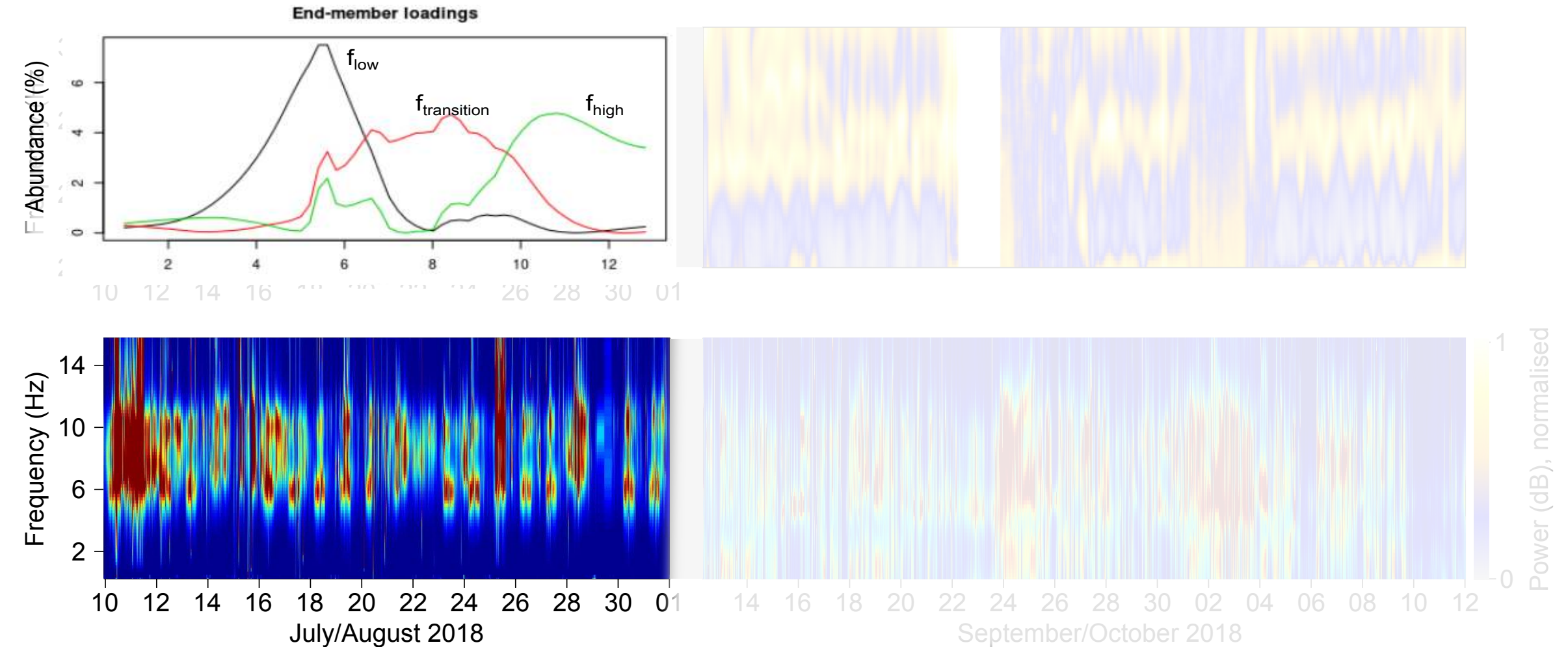
Processing approach I – Surveying the fundamental frequency of the peak



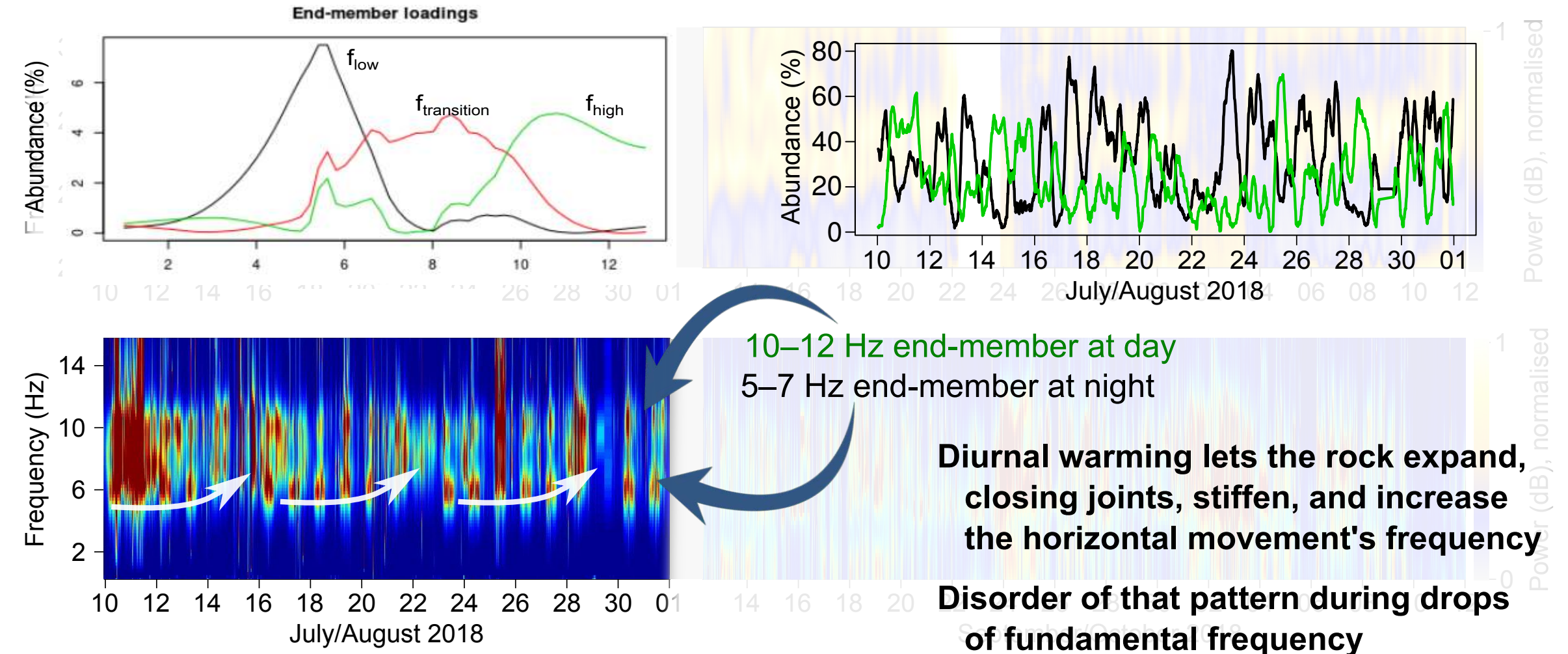
Processing approach II – Surveying the H/V spectral ratio

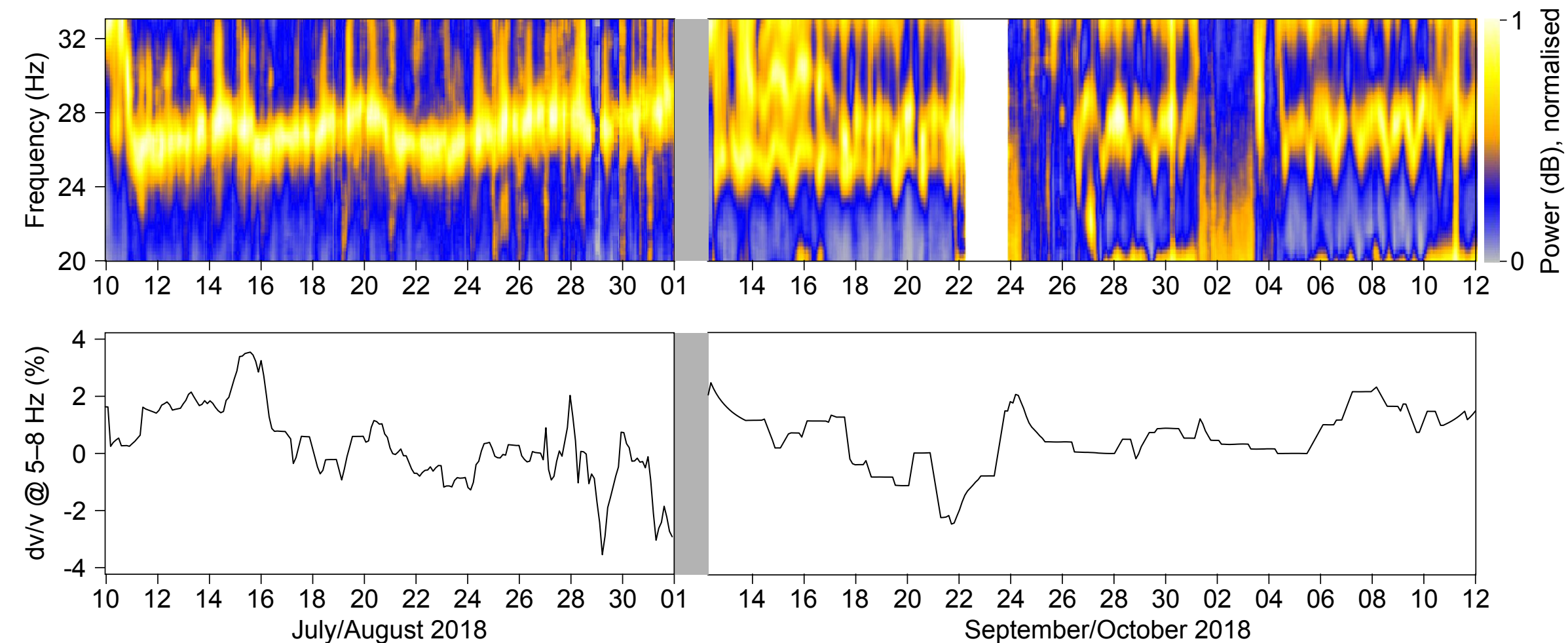


Processing approach II – Surveying the H/V spectral ratio

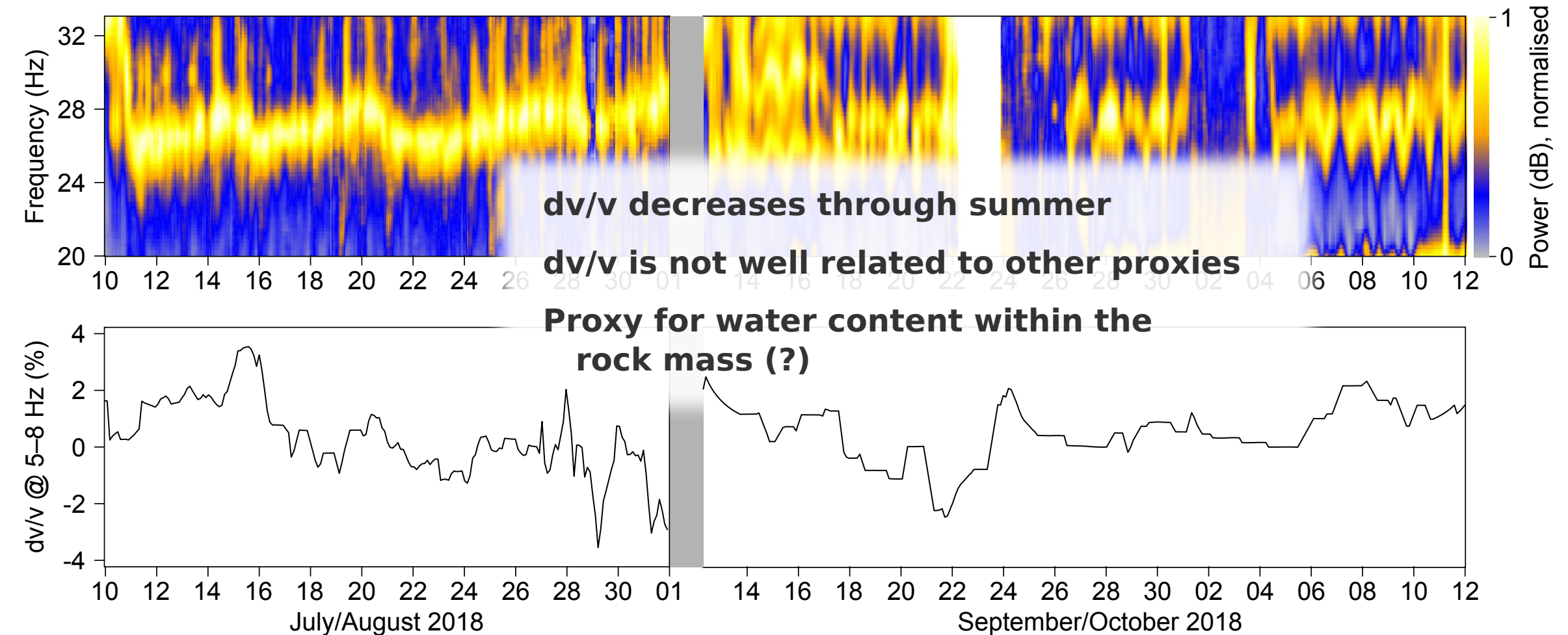


Processing approach II – Surveying the H/V spectral ratio

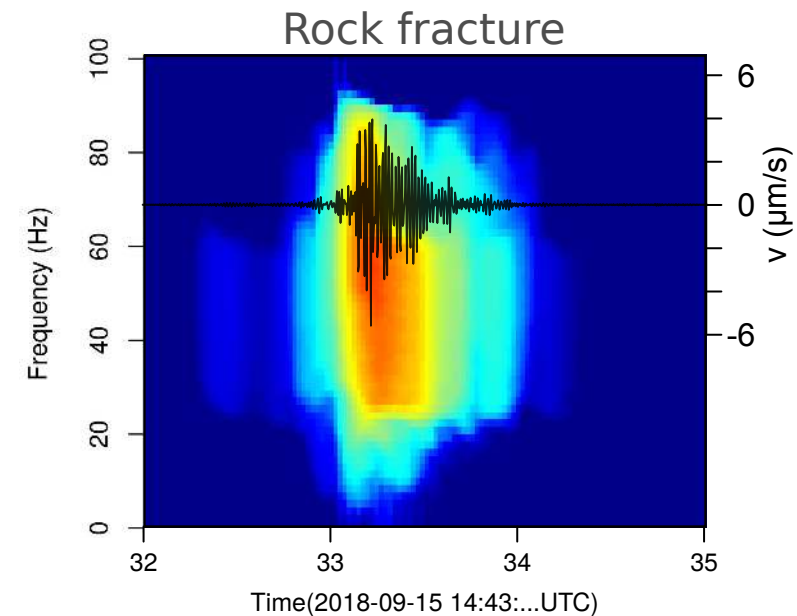
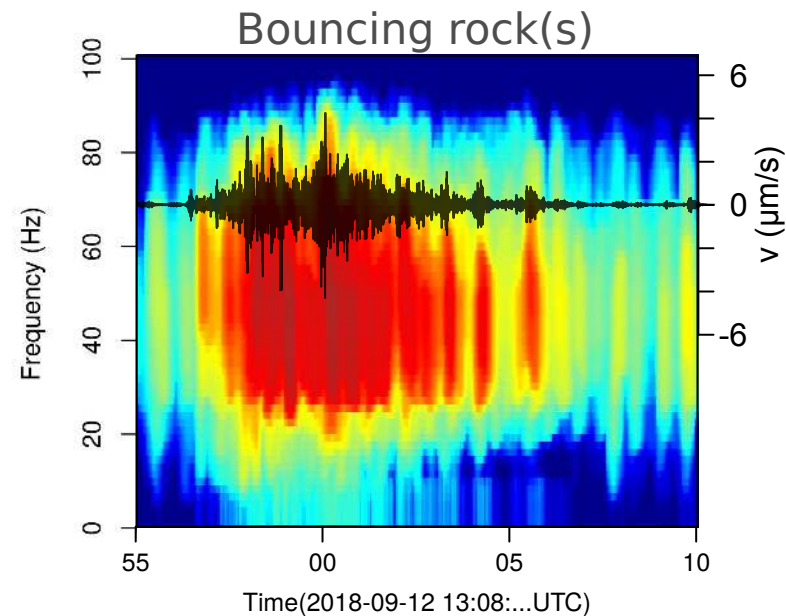
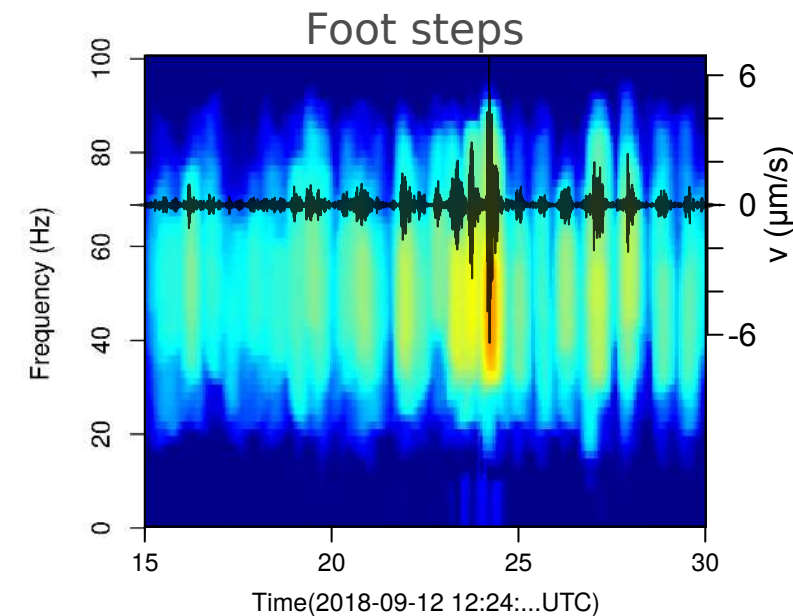
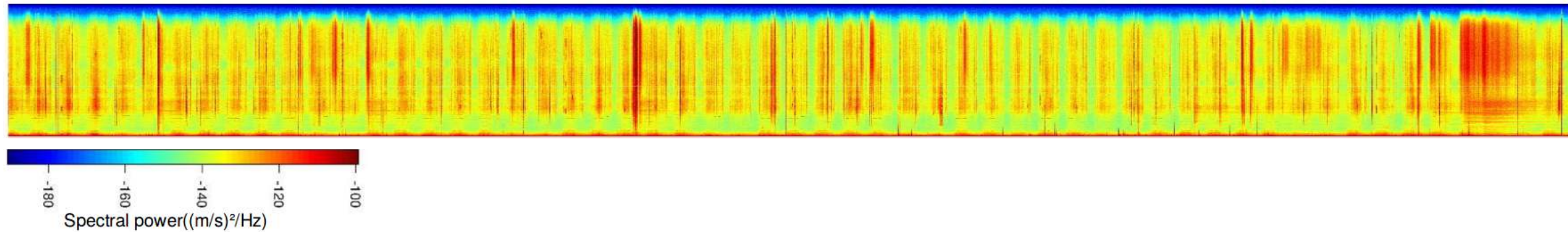


Processing approach III – Surveying the coda wave patterns: dV/V evolution

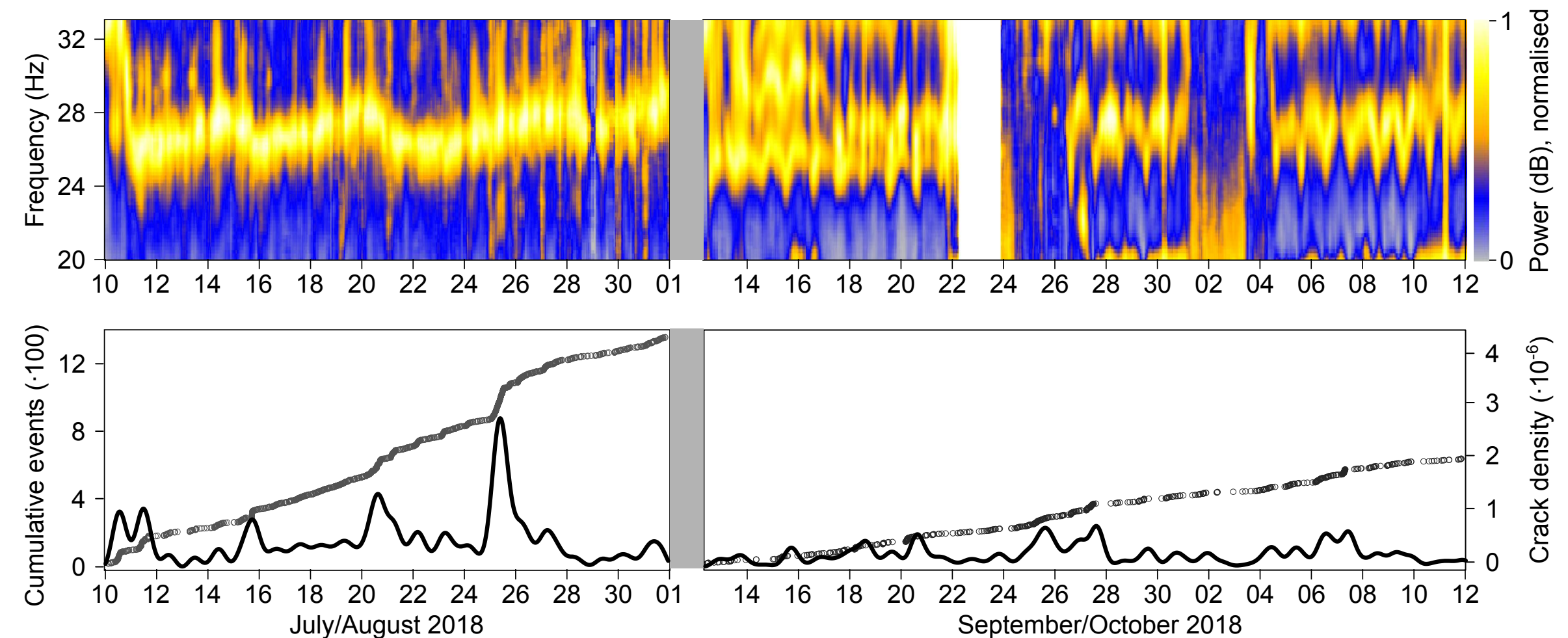
Processing approach III – Surveying the coda wave patterns: dV/V evolution



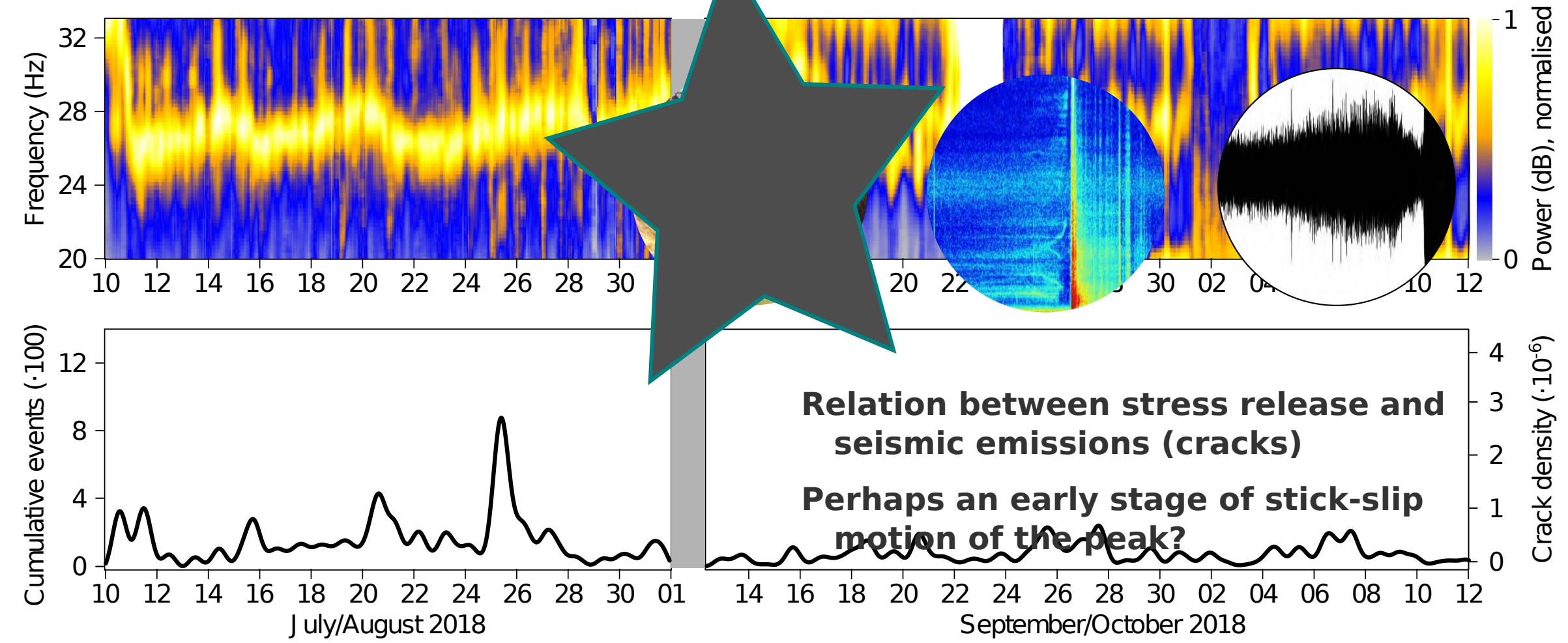
Processing approach IV – Explore discrete activity periods of the peak



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Wrapping up and warming a discussion

Seismic monitoring: one layout, a series of proxy data

Fundamental frequency – a proxy for rock stress evolution

H/V spectral ratio – a proxy for temperature driven crack opening/closure

Coda wave interferometry – a proxy for water content or temperature balance

Crack signal detection – a proxy for rock mass movements

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The Hochvogel, what is going on?

Periodic release of continuously accumulating stress through stick-slip movement

Diurnally oscillating frequency (6 <-> 10 Hz) of horizontal hum (irreversible or not?)

A system that stops moving when it runs out of water as lubricant

Thanks!

A lot of skilled and helpful friends/colleagues:

Torsten Queißer, Hannah Derkum, Benjamin Huxol,
Johannes Leinauer, Benedikt Friedrich,
AlpSenseBench team,
Jens Turowski & Niels Hovius

Slides available at
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