



## Locating aftershocks using sparse PSM networks

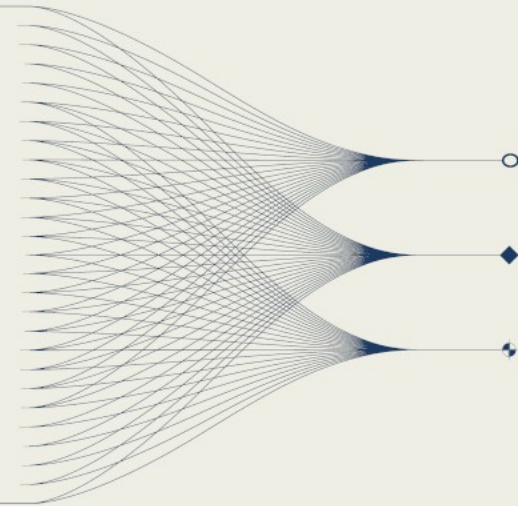
Rolf Häfner, Manfred Joswig and Marco Walter

Sonicona GbR, Germany – [www.sonicona.com](http://www.sonicona.com)

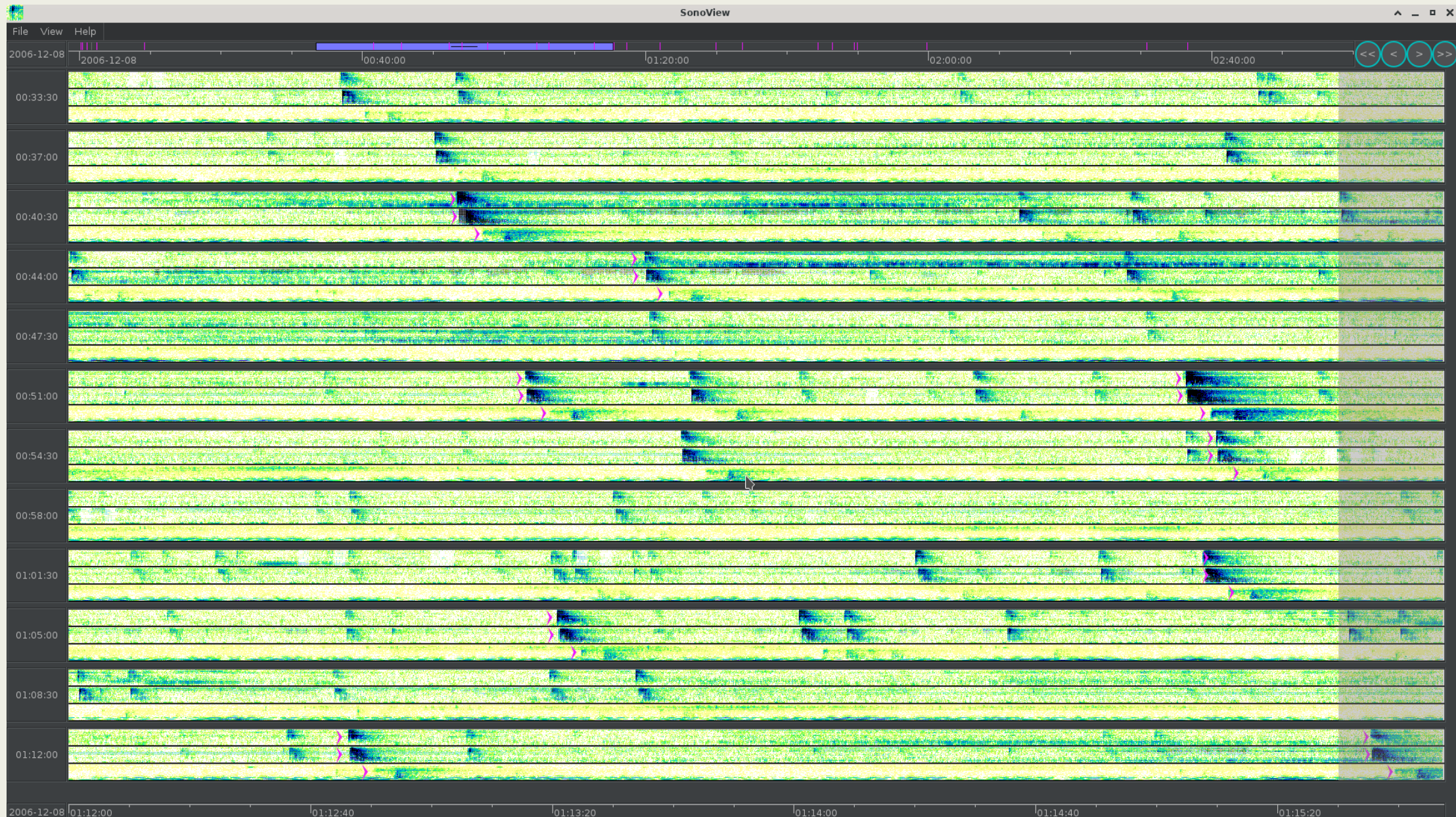
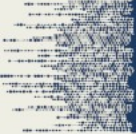
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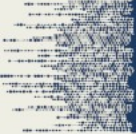
Presentation Date: 11 September 2025, 17:15





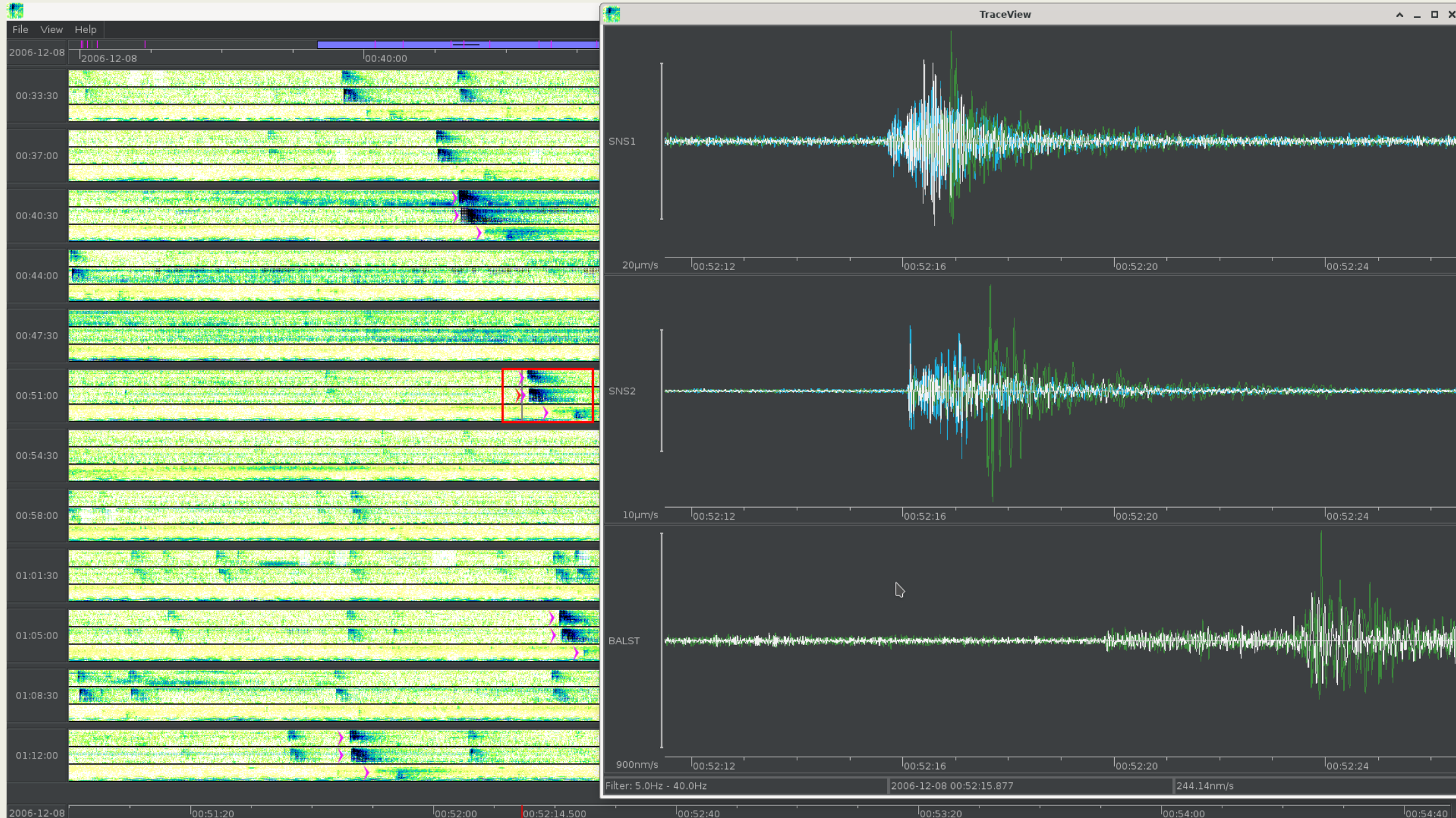


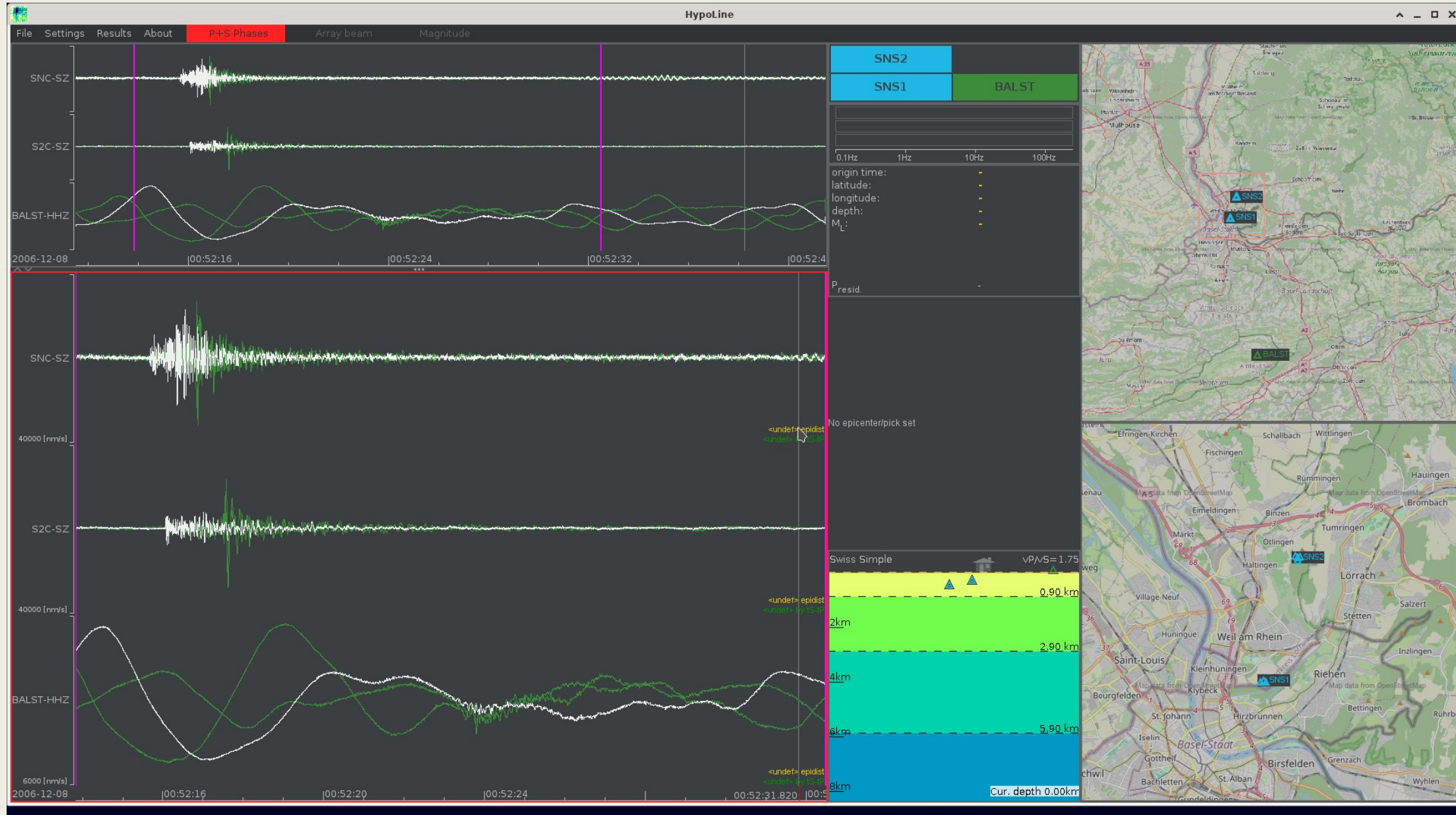
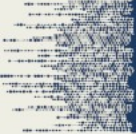




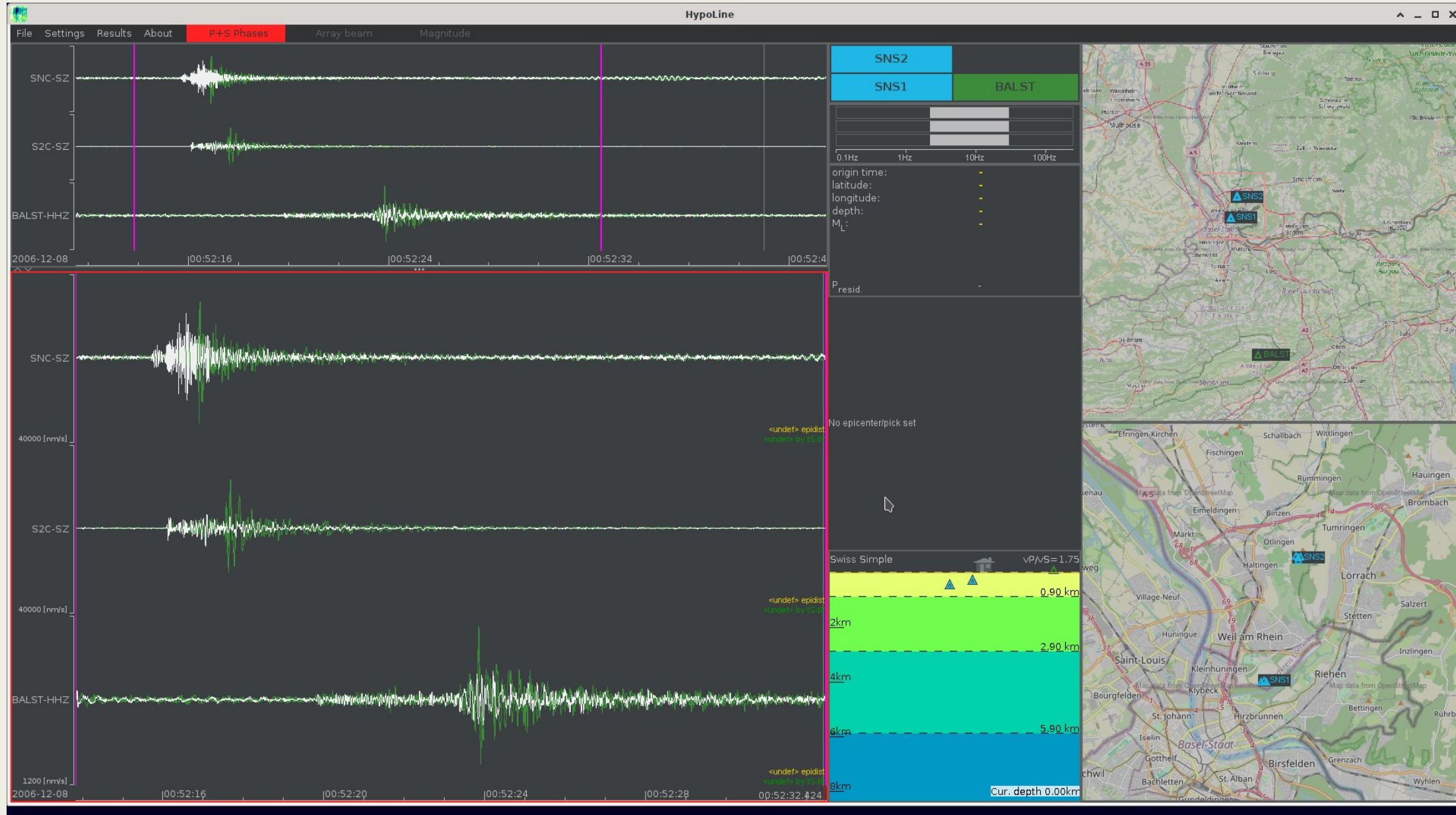
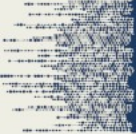
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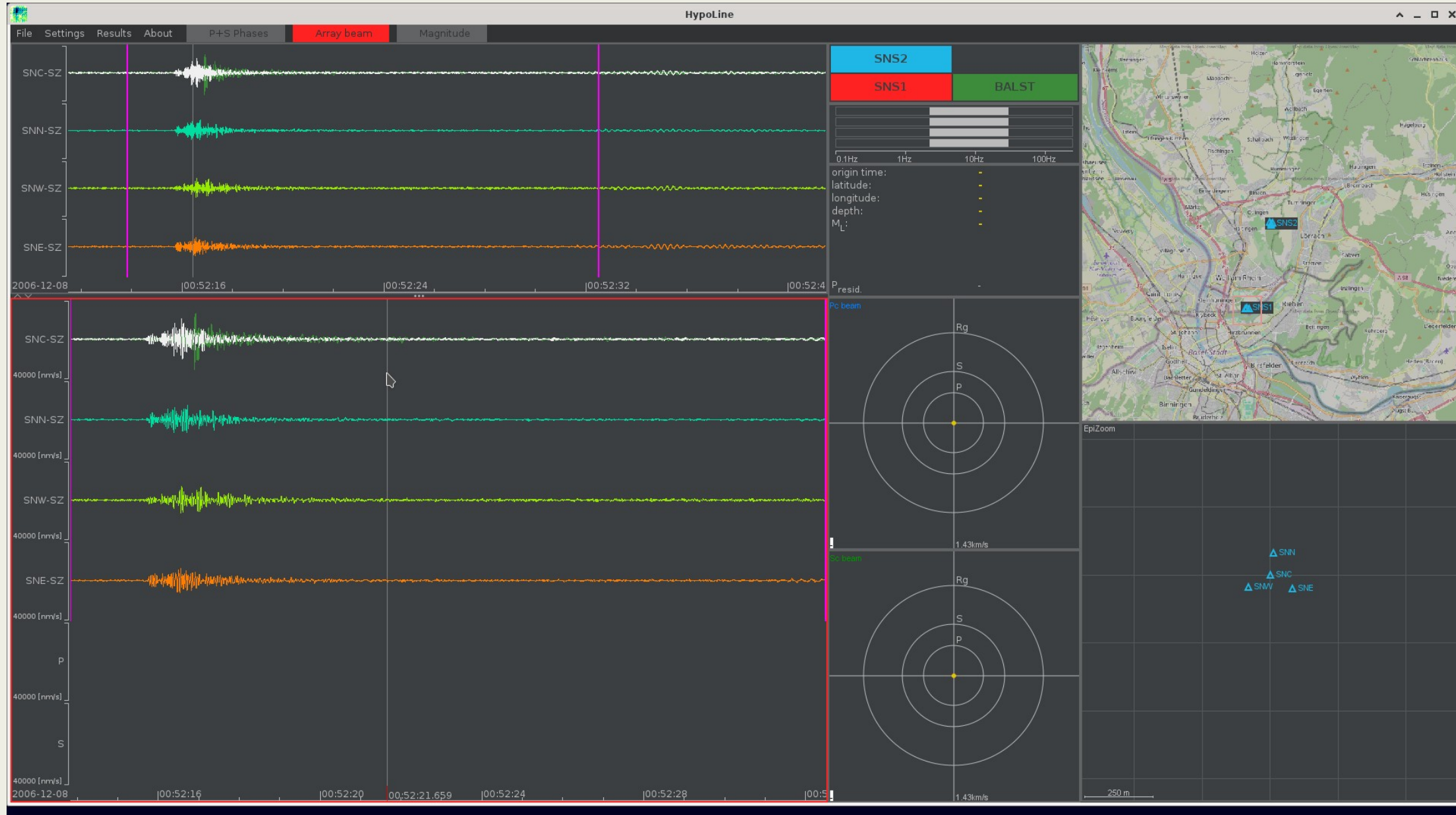
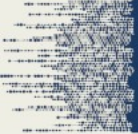
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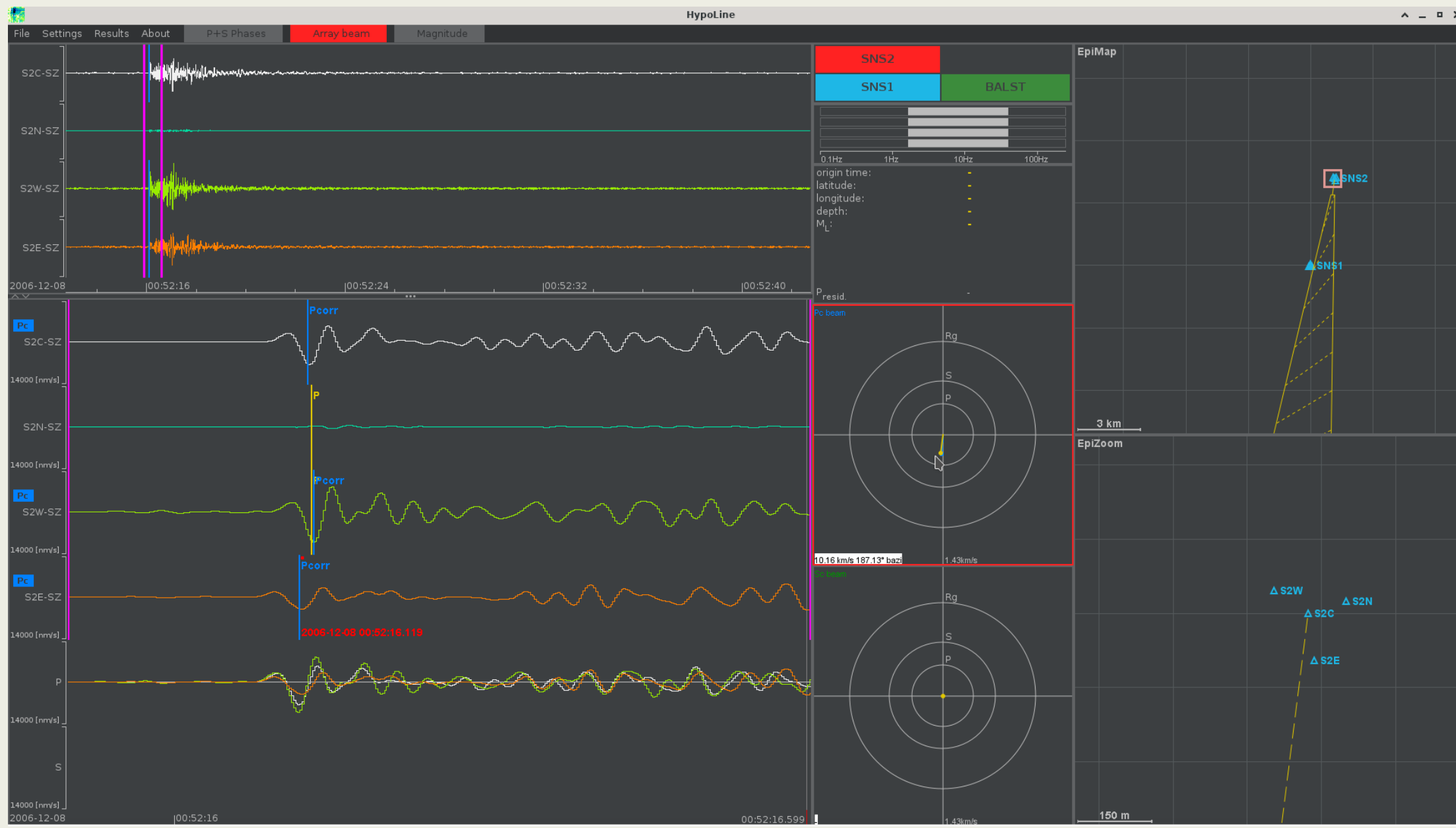




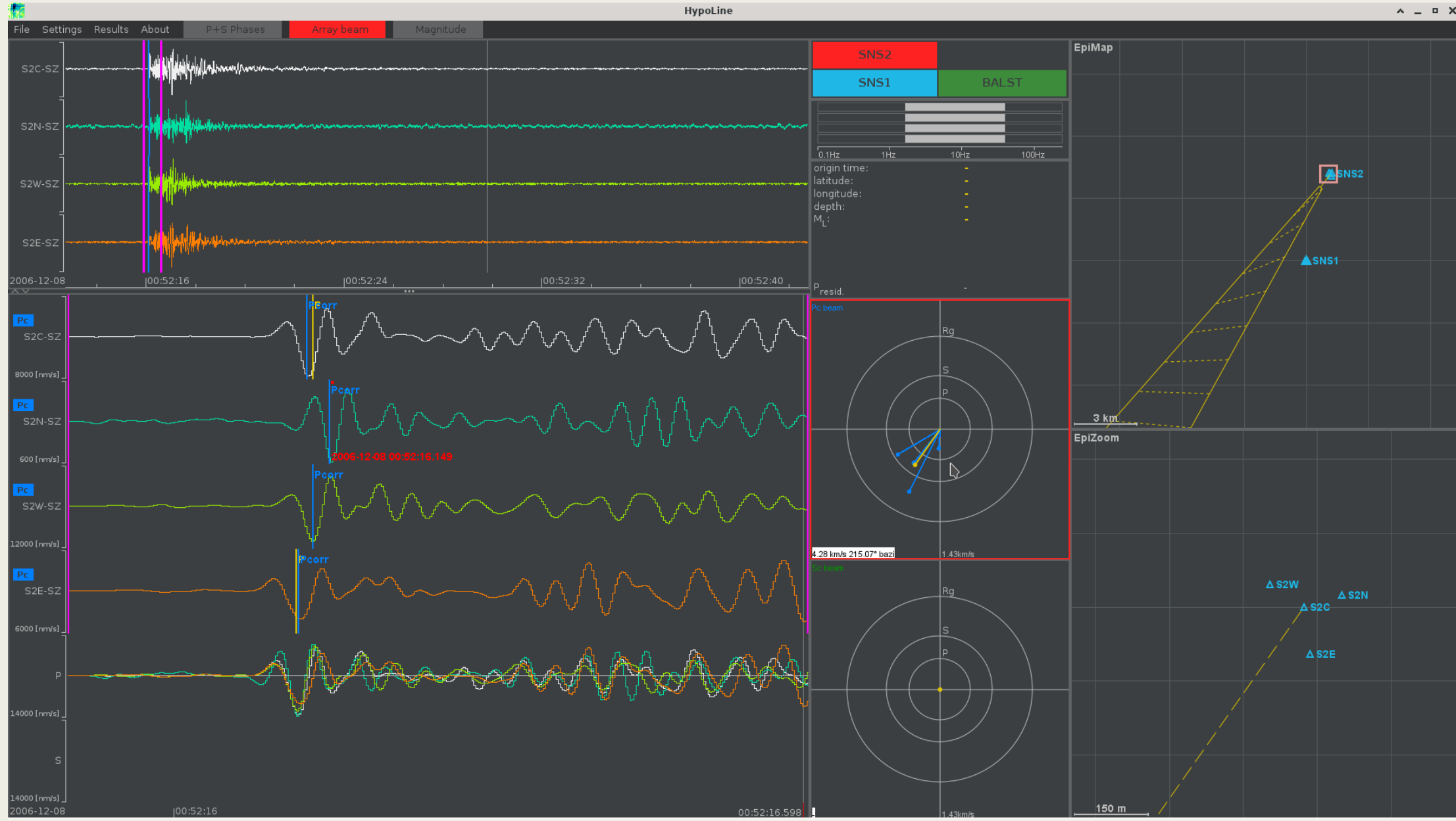
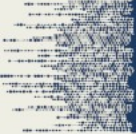




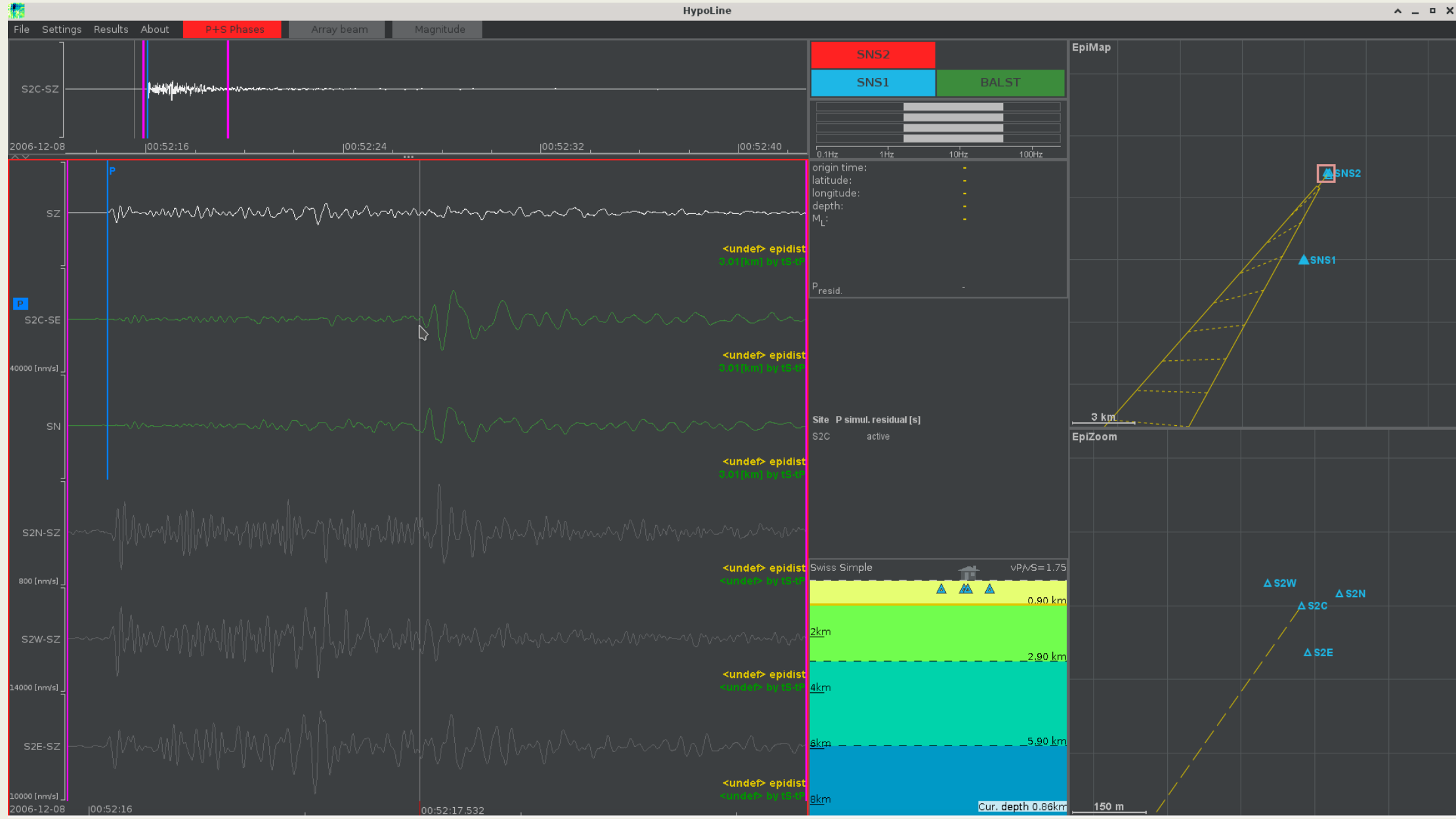
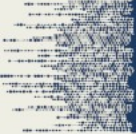


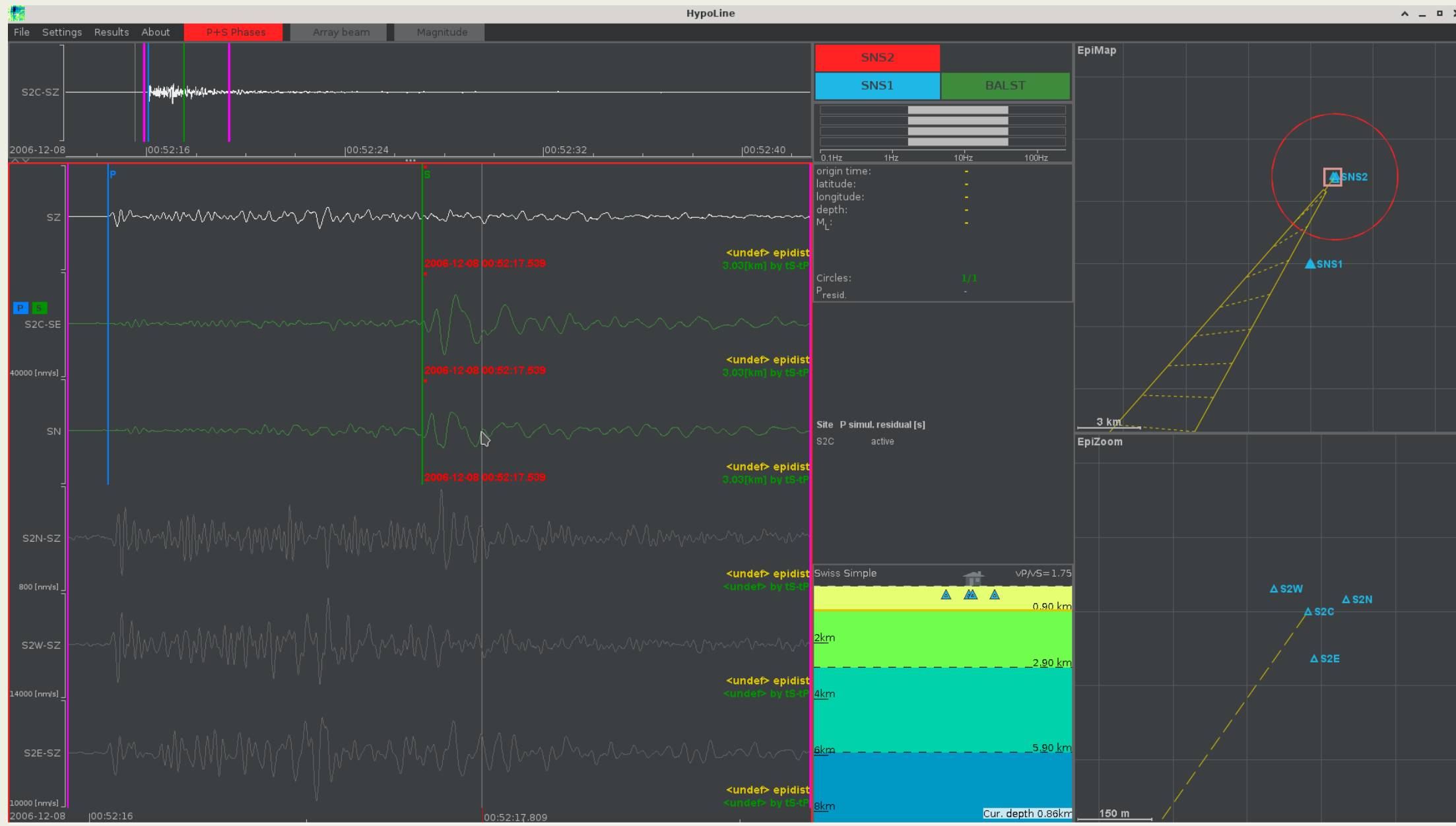




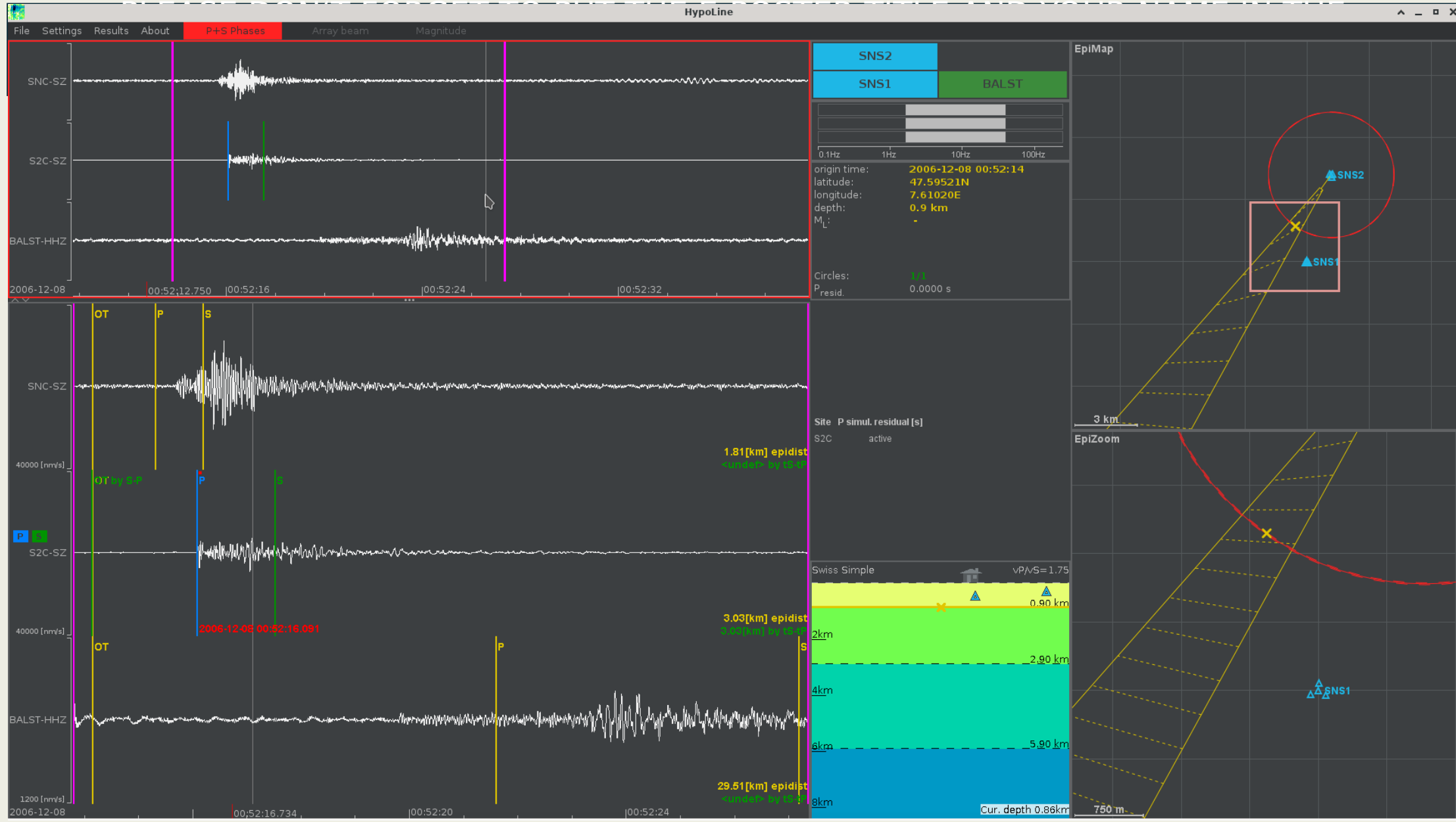


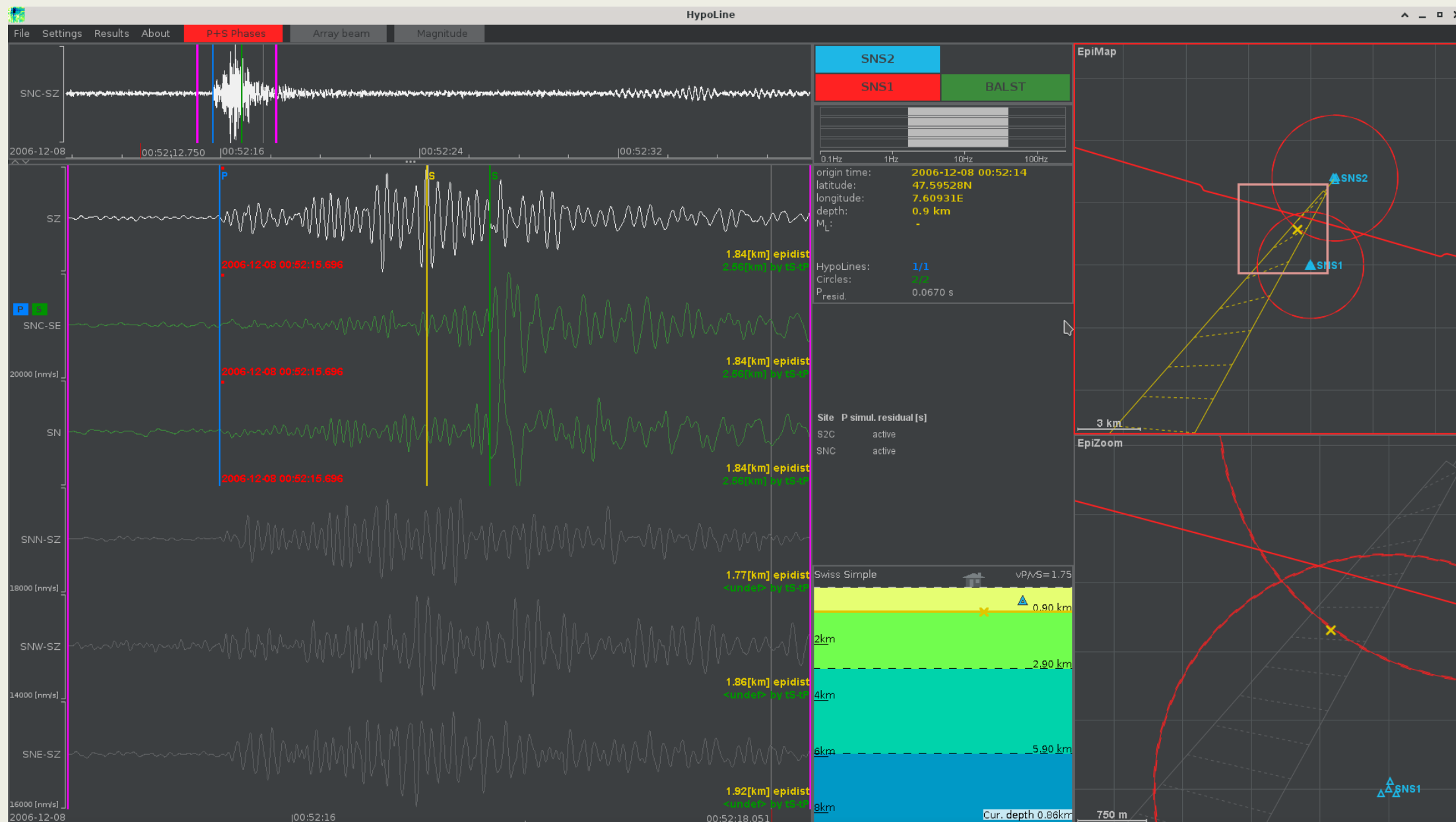
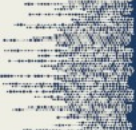




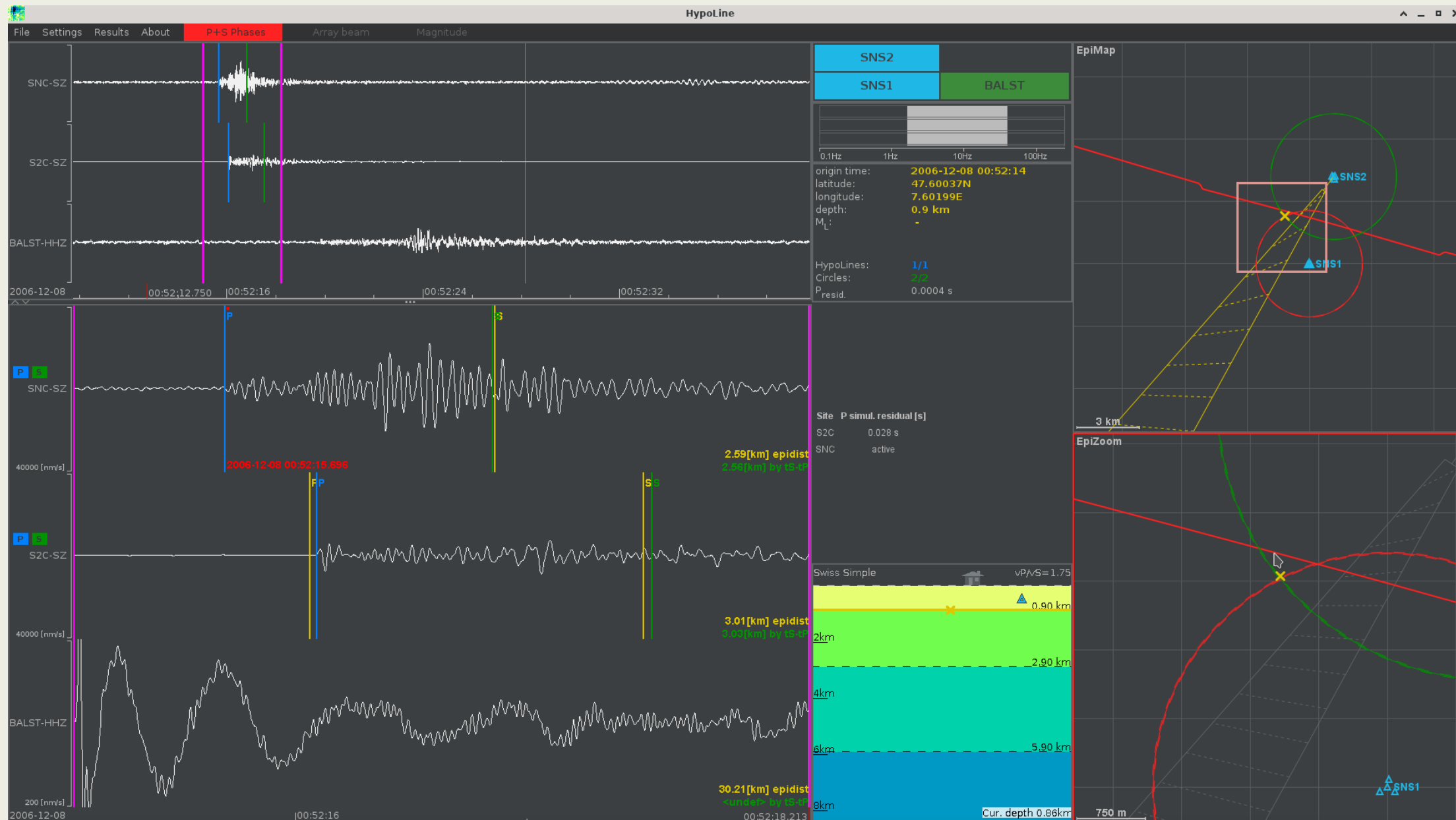
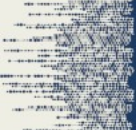


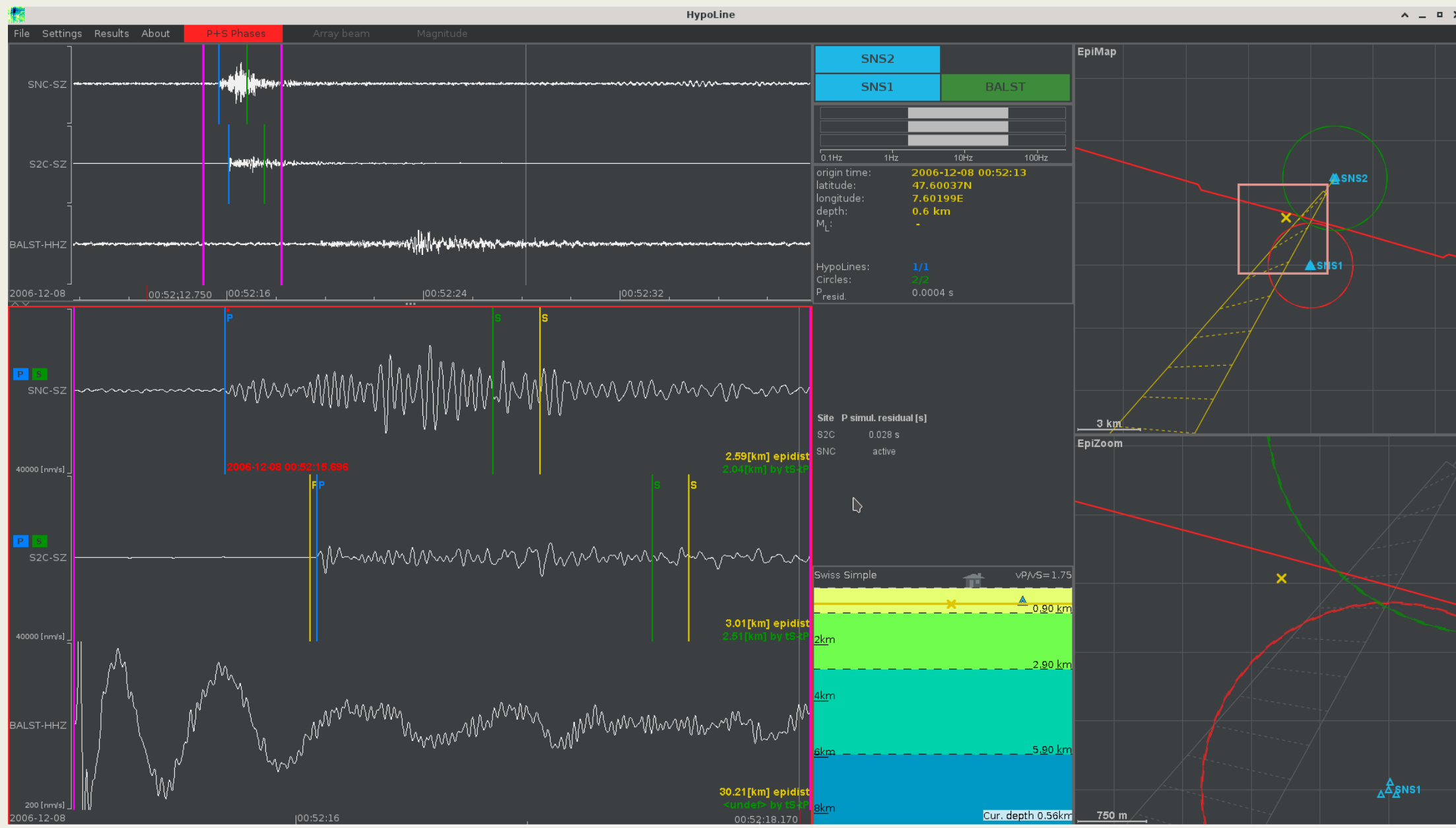
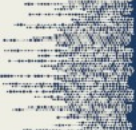


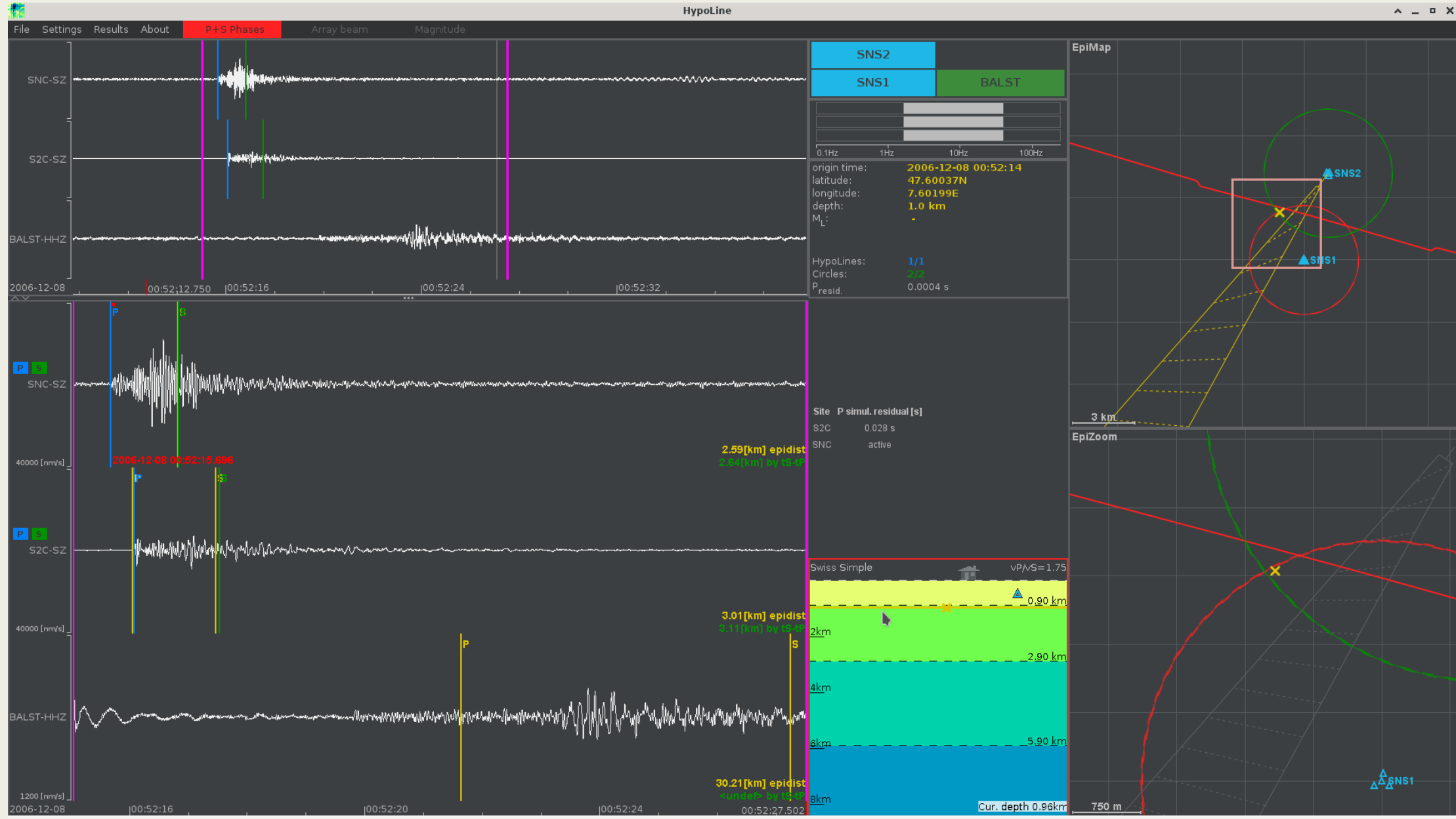
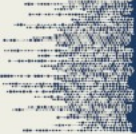




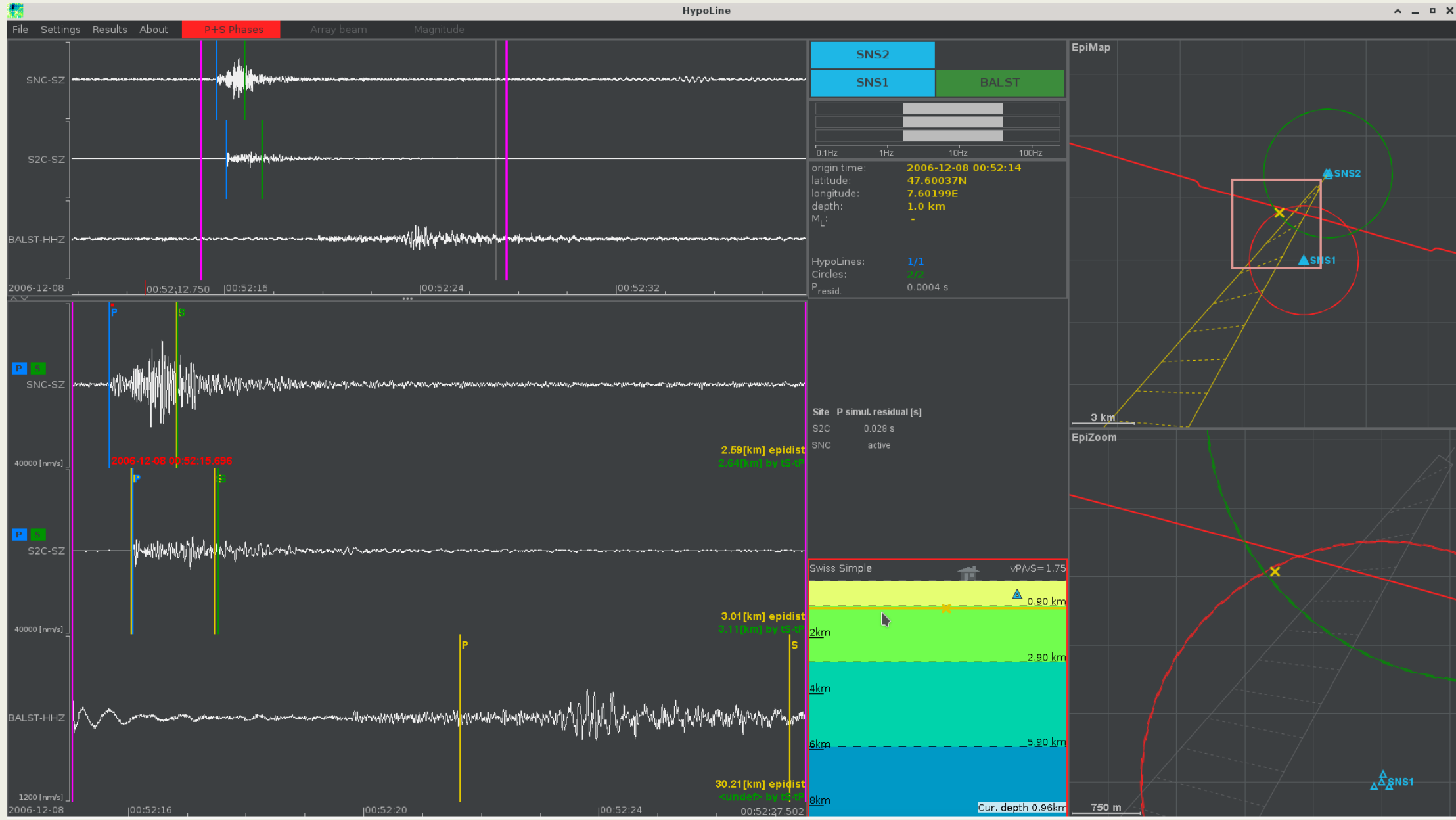
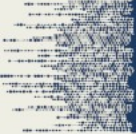


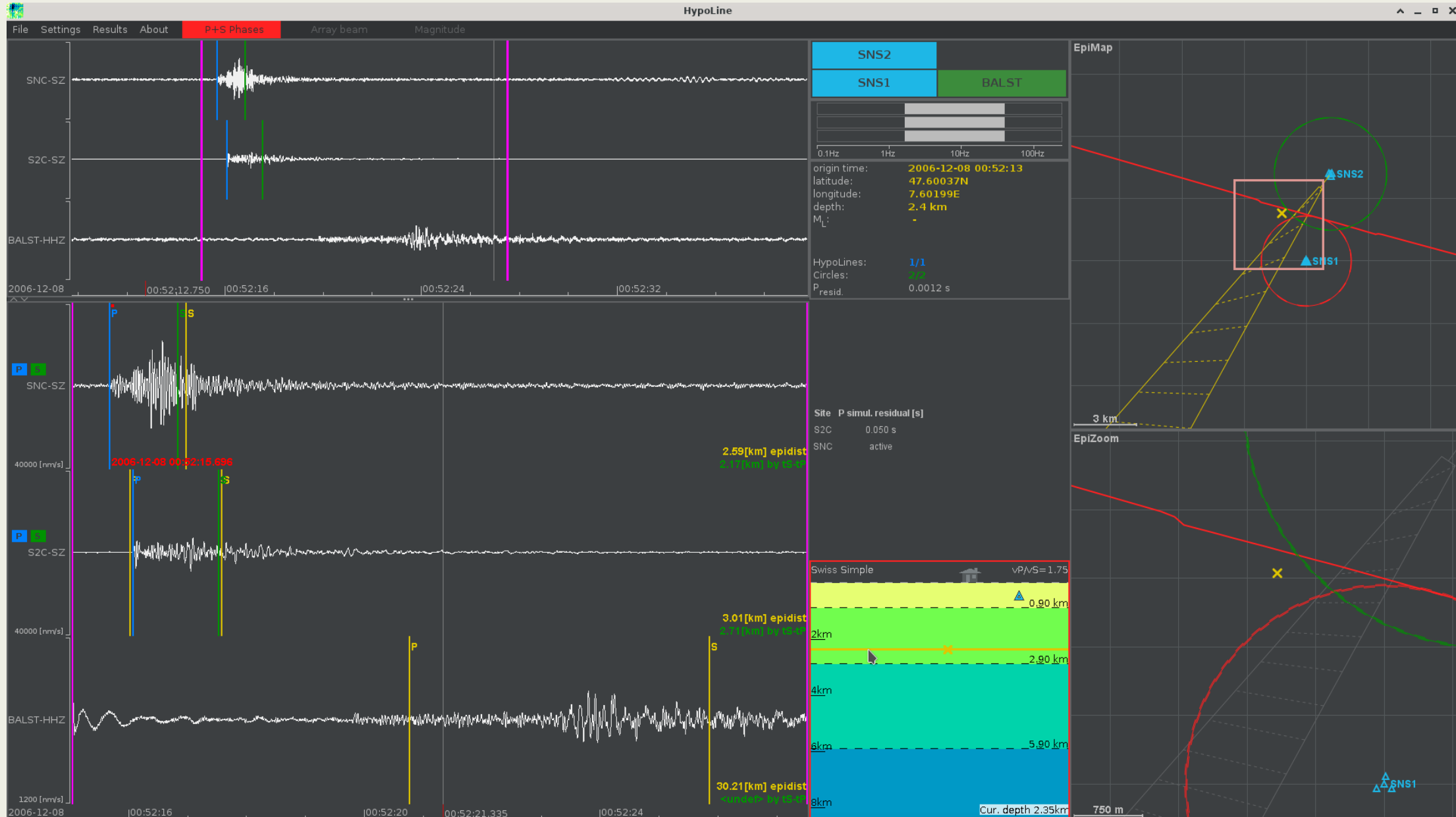
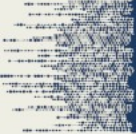


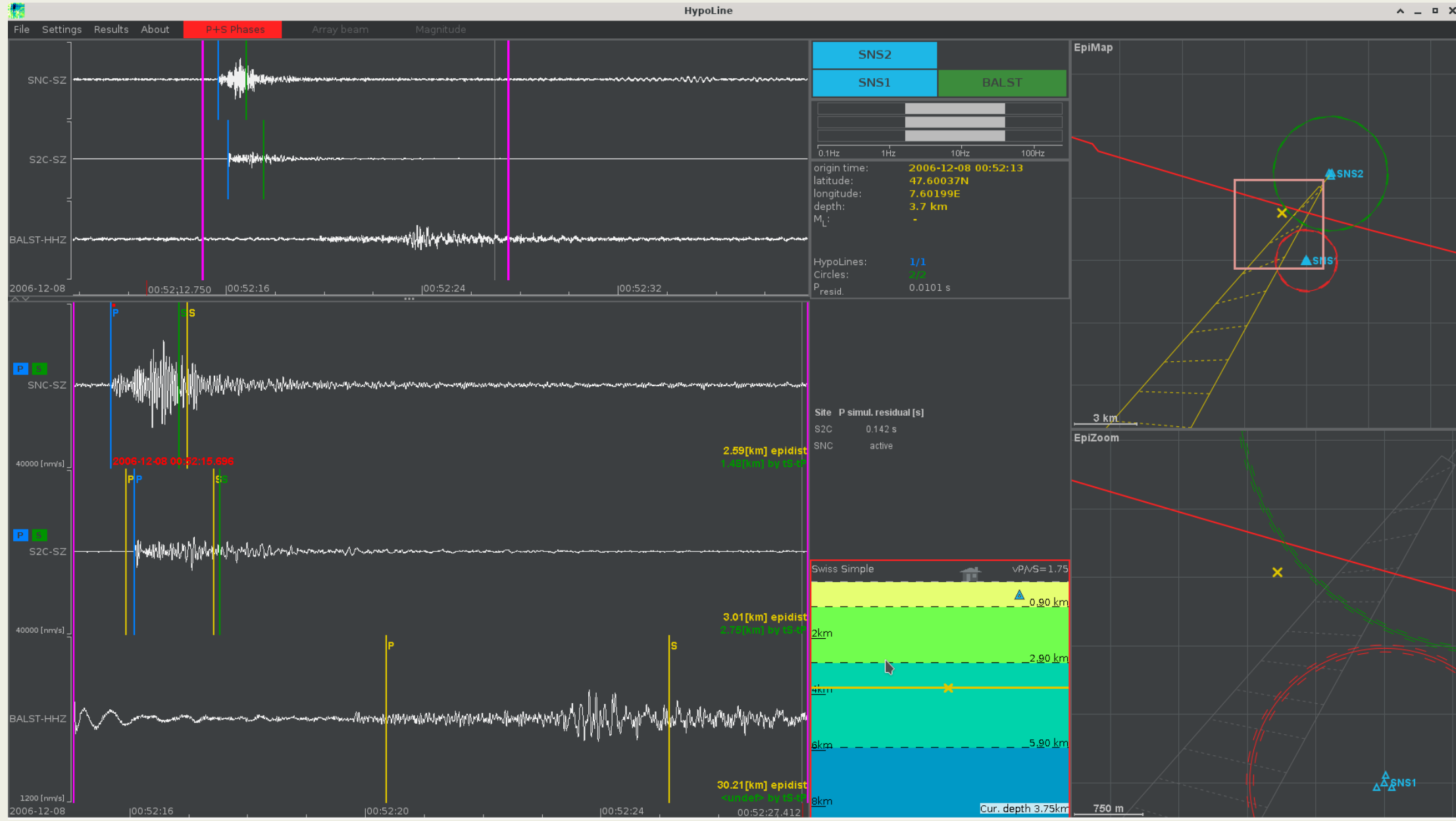
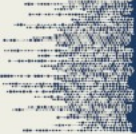




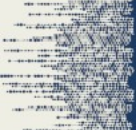




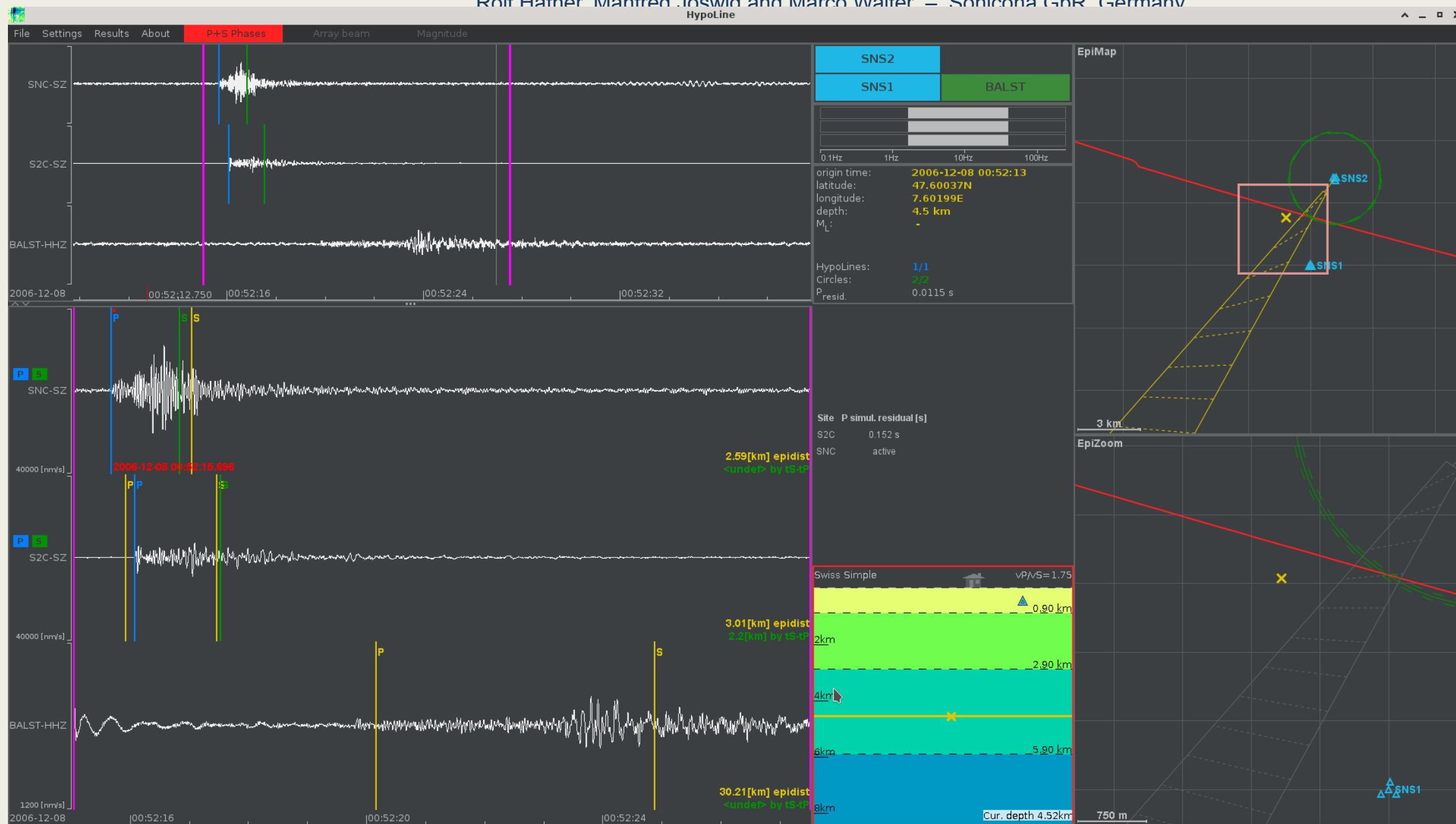


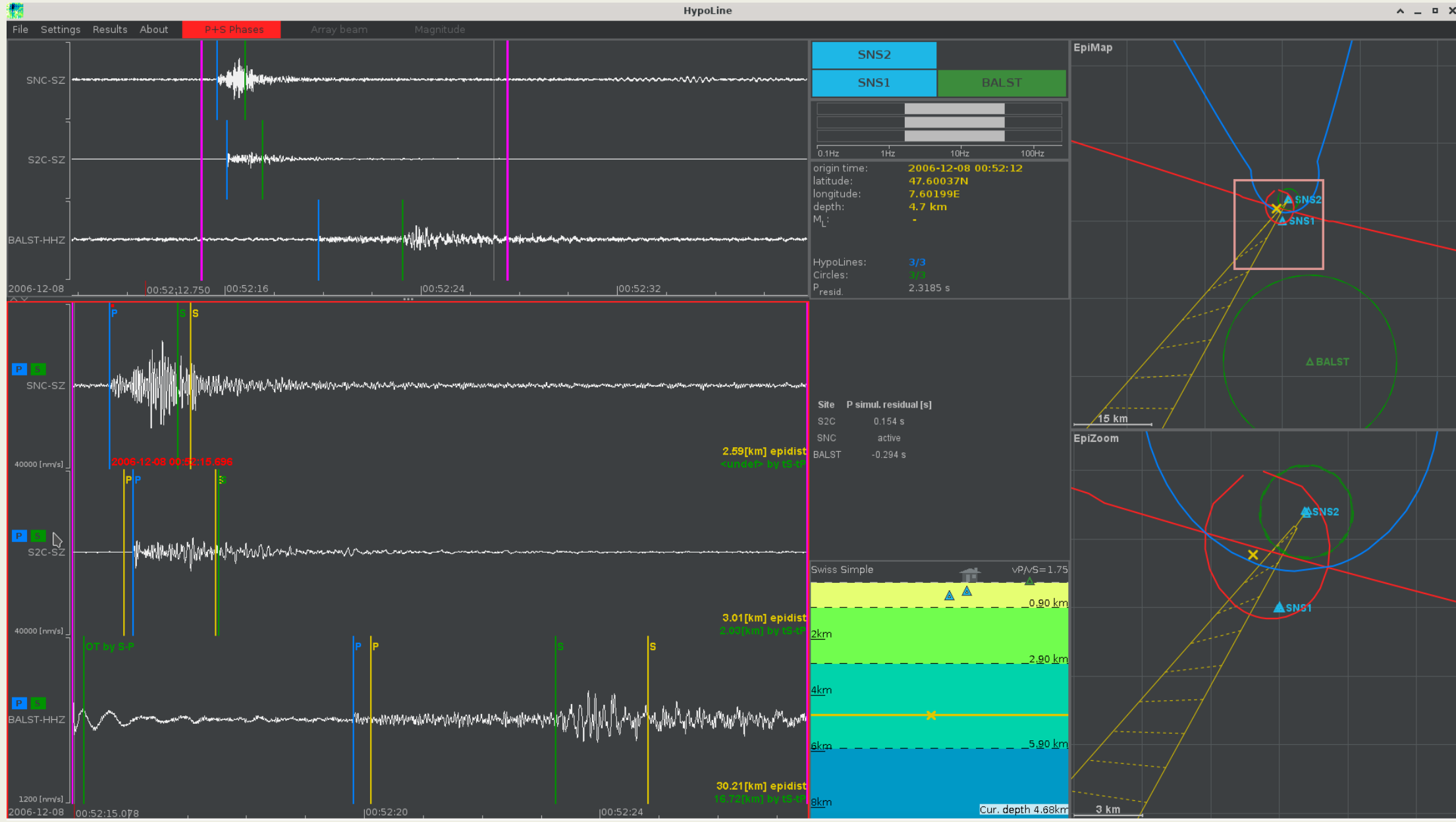
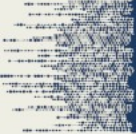


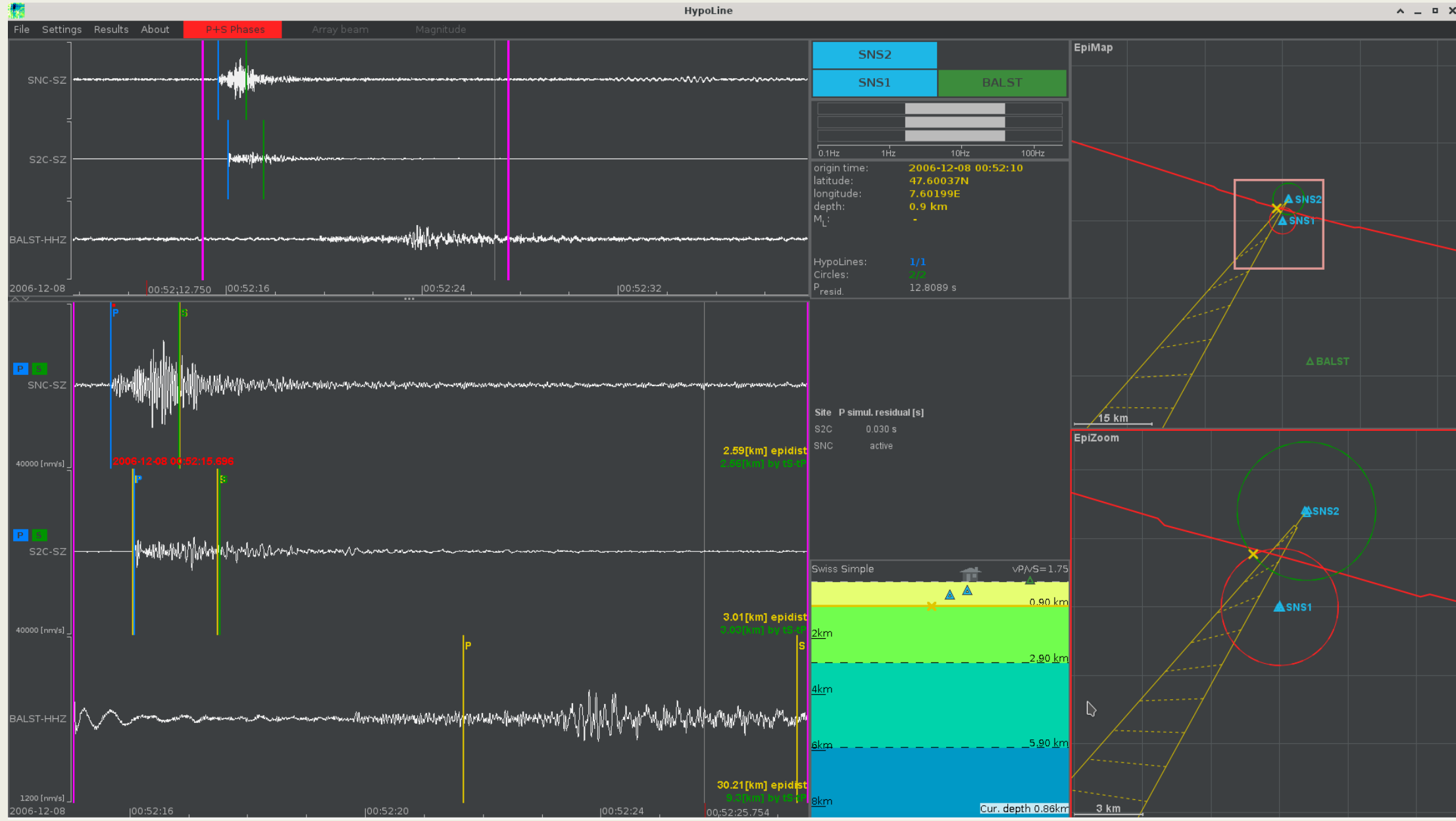
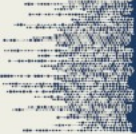


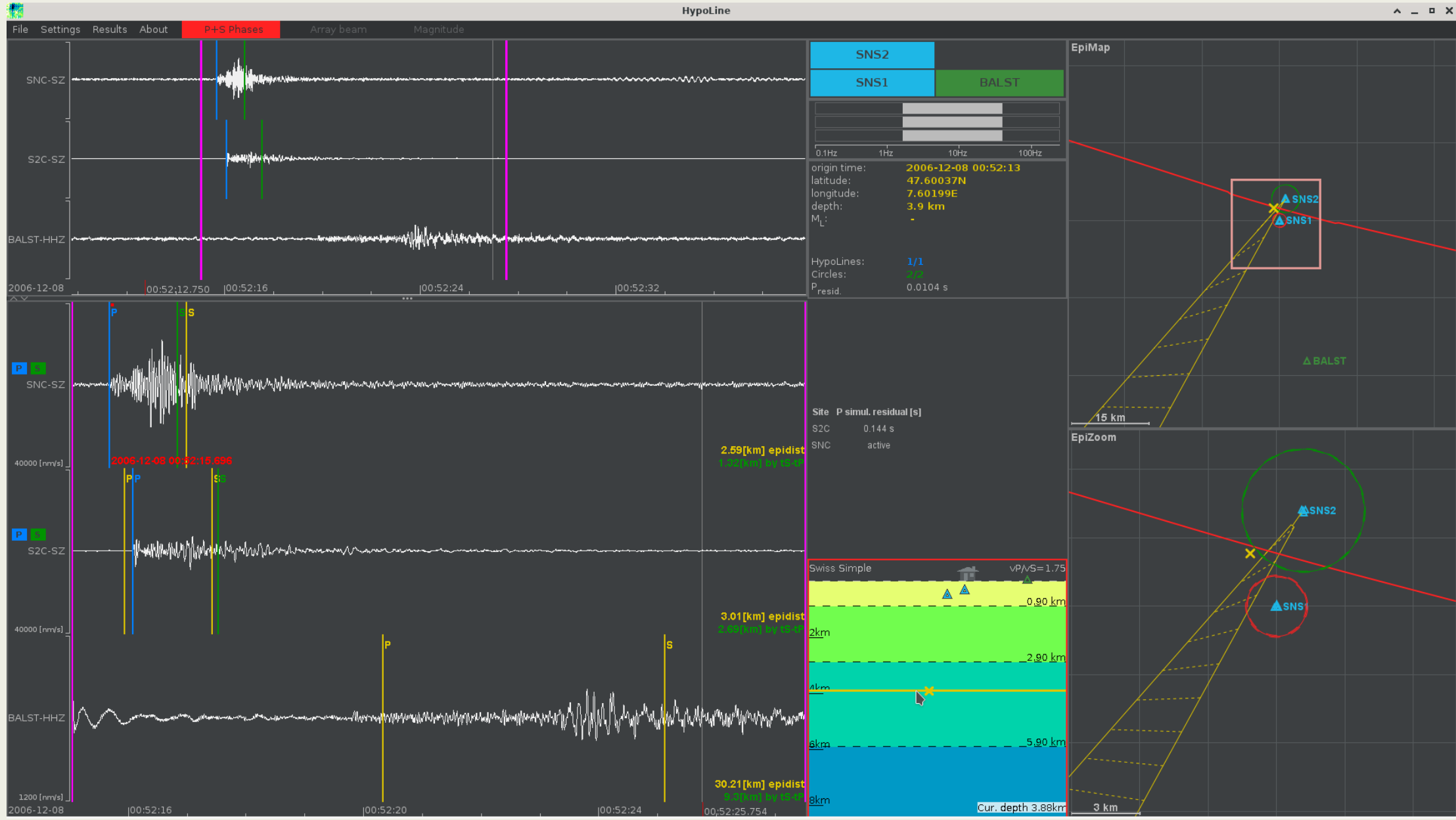
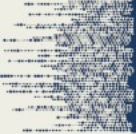


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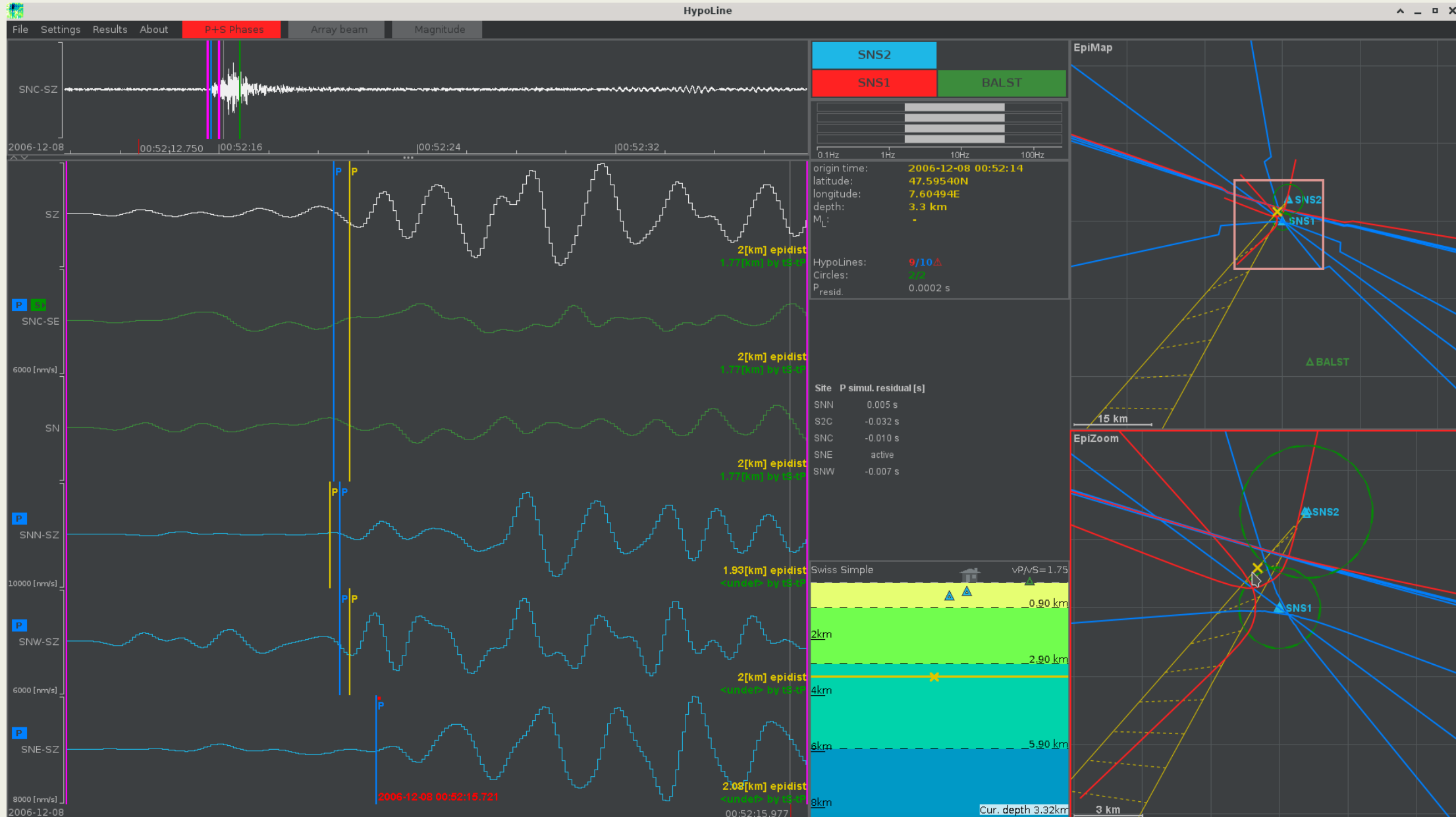
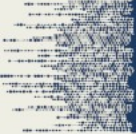


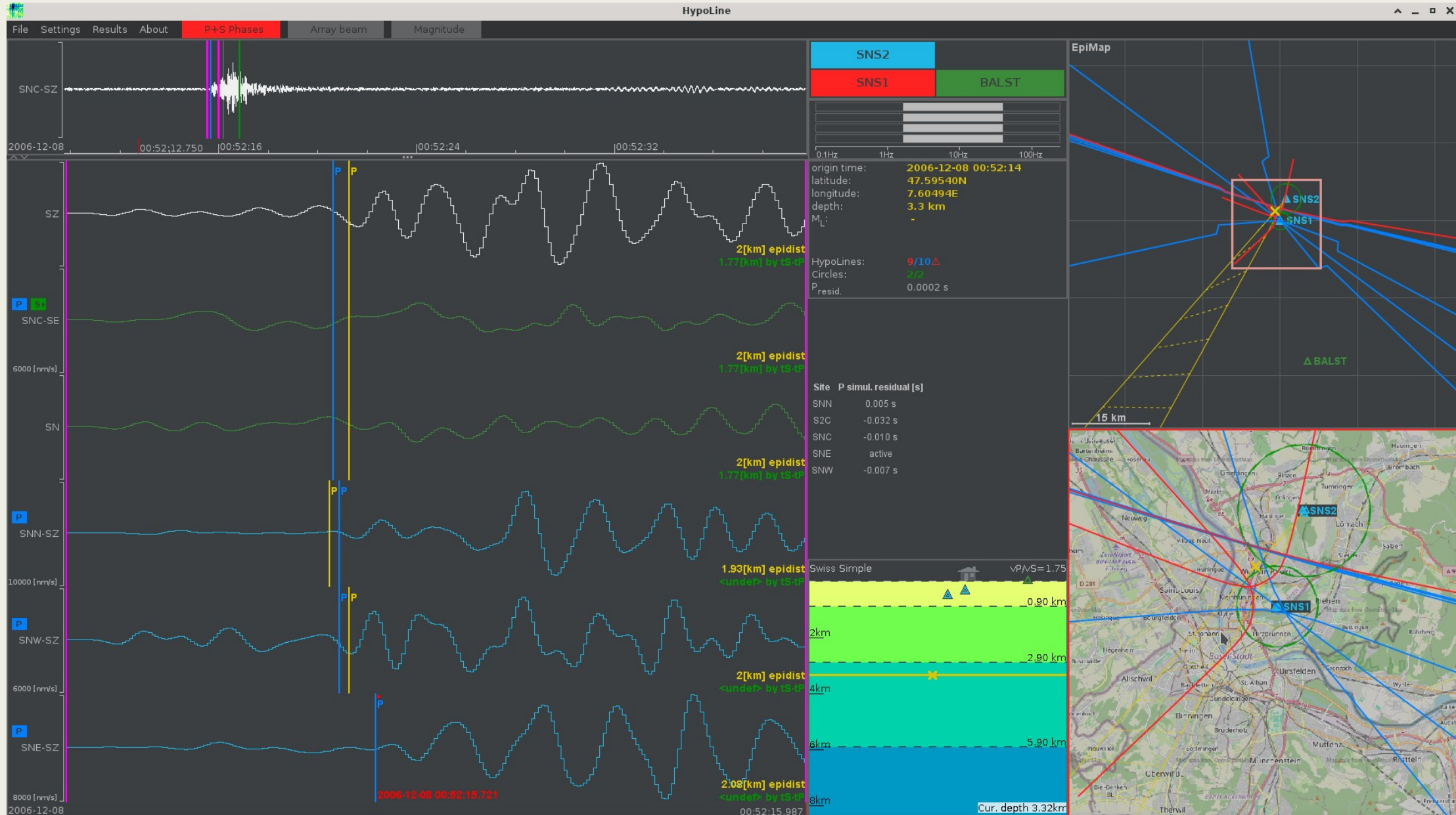
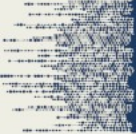


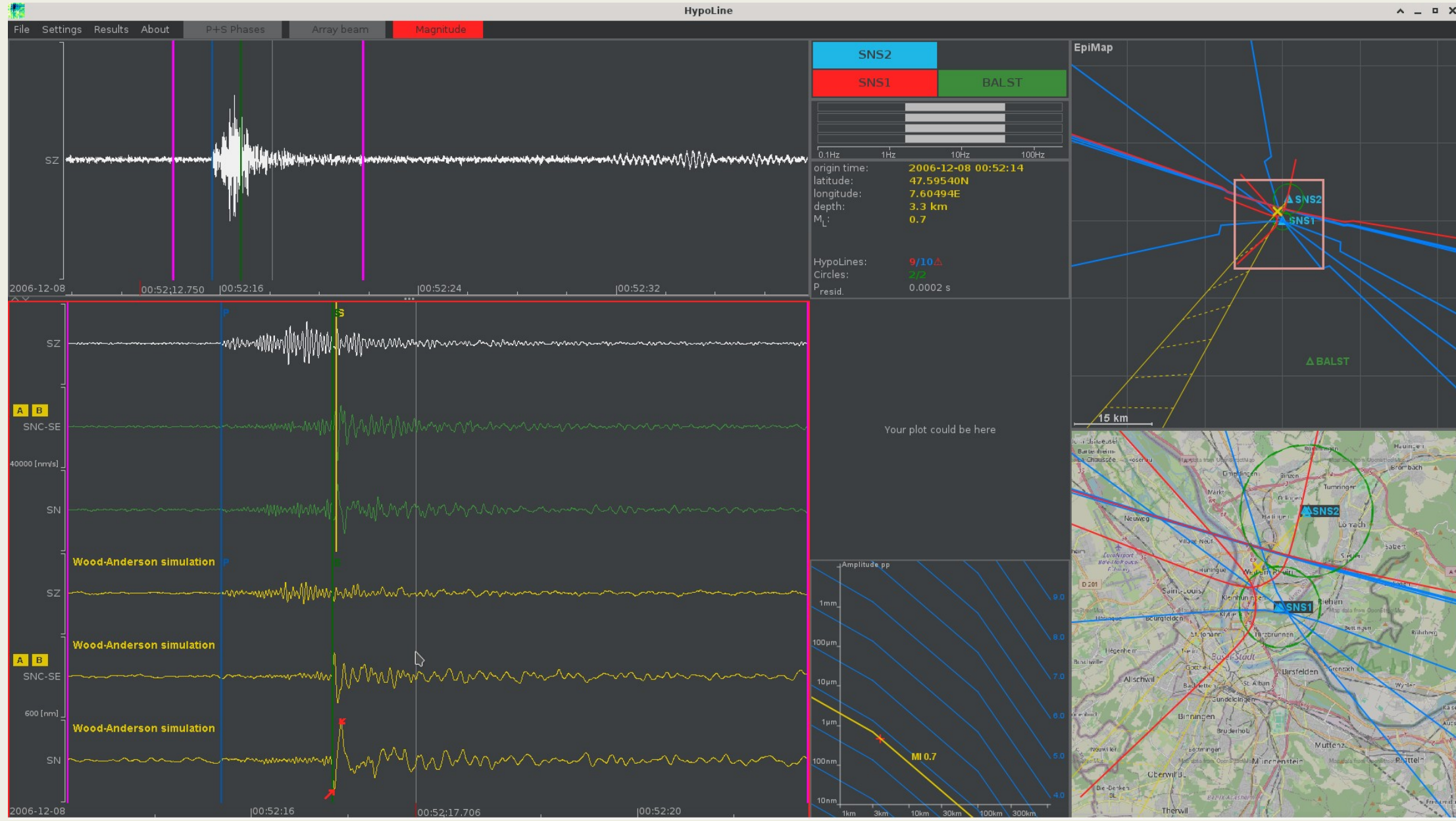
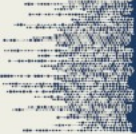




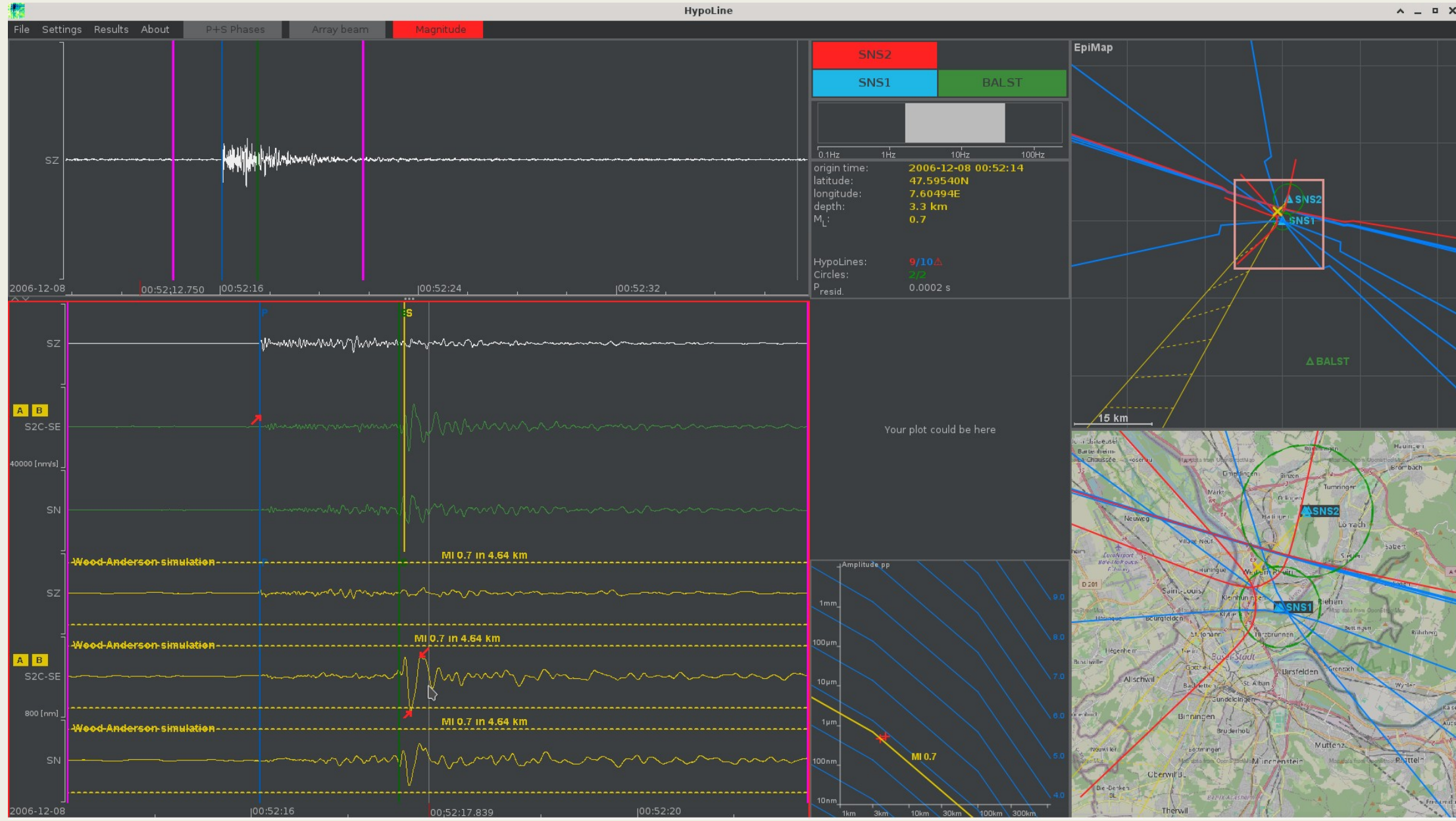
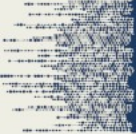




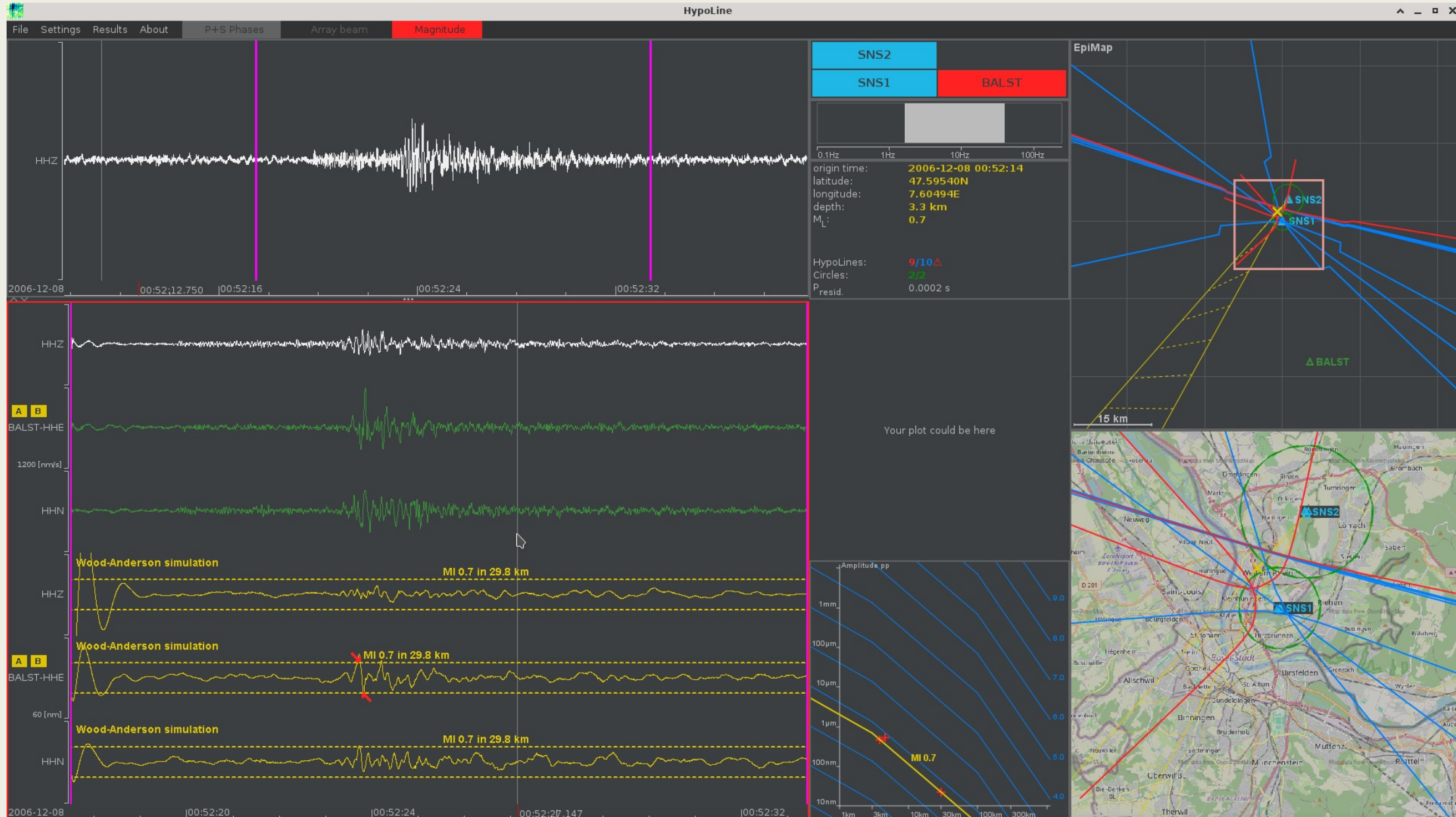
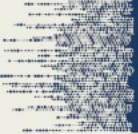






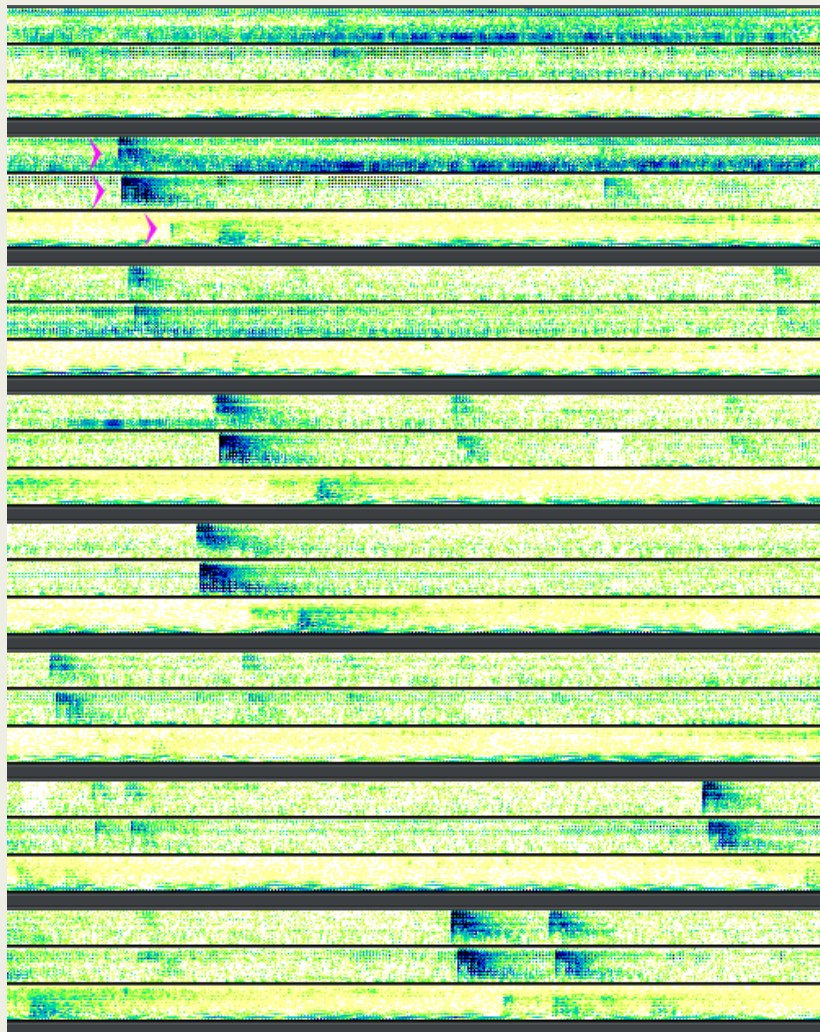




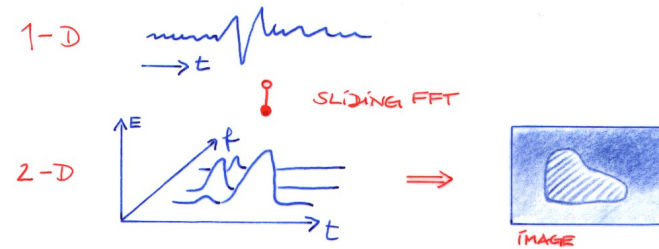




## How can we automate event detection with no training data and limited time for detector calibration?



### DISMENSIONALITY CONVERSION



### IMAGE ENHANCEMENT

#### STATISTICS OF NOISE

$$M(f) = M_{50}(f) = \text{median}(E(f, t))$$

$$S(f) = M_{75}(f) - M_{50}(f)$$

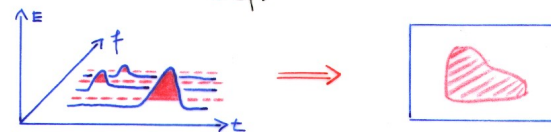
#### DECISION

$$E(f, t) - (M(f) + S(f)) \begin{cases} \geq 0 & E(f, t) \\ < 0 & 0 \end{cases}$$

ENERGY  
DETECTOR  
PER  
FREQ. BAND

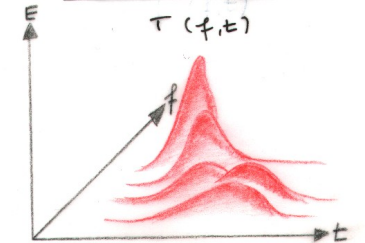
#### OFFSET REMOVAL AND PREWHITENING

$$D(f, t) = \frac{E(f, t) - M(f)}{S(f)}$$



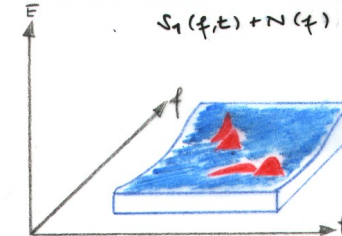
### SONOGRAM CALCULATION

### ORIGINAL TEMPLATE



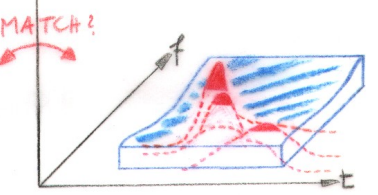
### WEAK SIGNAL IN NOISE

$$S_1(f, t) + N(f)$$



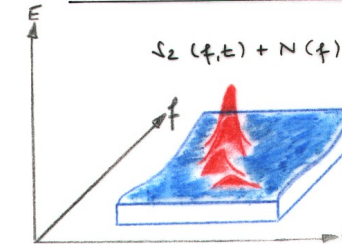
$$T(f, t) - \text{shift}_1$$

MATCH?



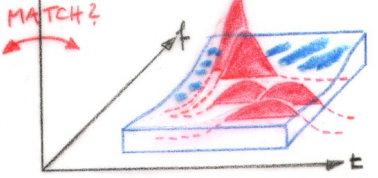
### STRONG SIGNAL IN NOISE

$$S_2(f, t) + N(f)$$



$$T(f, t) - \text{shift}_2$$

MATCH?



### ADAPTATION OF TEMPLATES



## Conclusion

When using the PSM Toolkit, each user input is directly visualized.

Each new constraint or alteration of an constraint is visualized.

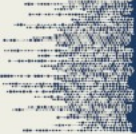
Each simulated onset, amplitude, etc is backprojected on the data after defining a source.

There are no black boxes!

## You want to try?

Download the free demo of the Nanoseismic Suite, including three example datasets  
[www.sonicona.com](http://www.sonicona.com)





## Conclusion

