The 2011 Sendai Tsunami Observations off Chile by HF Radar

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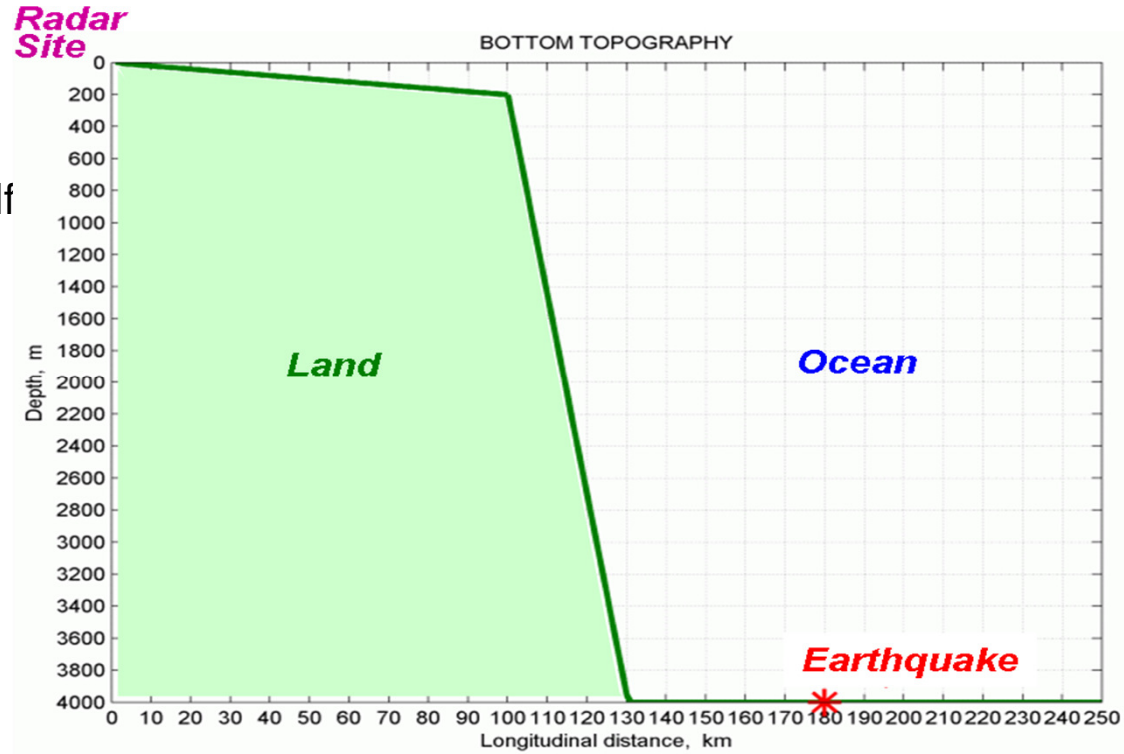
How can HF Radar detect Tsunamis?

- HF radar can not detect the ocean surface elevation due to a Tsunami.
- When the Tsunami reaches the shelf edge and travels into shallower water, a strong current signal is induced all along the water column.
- This current signal can be detected by an HF radar.



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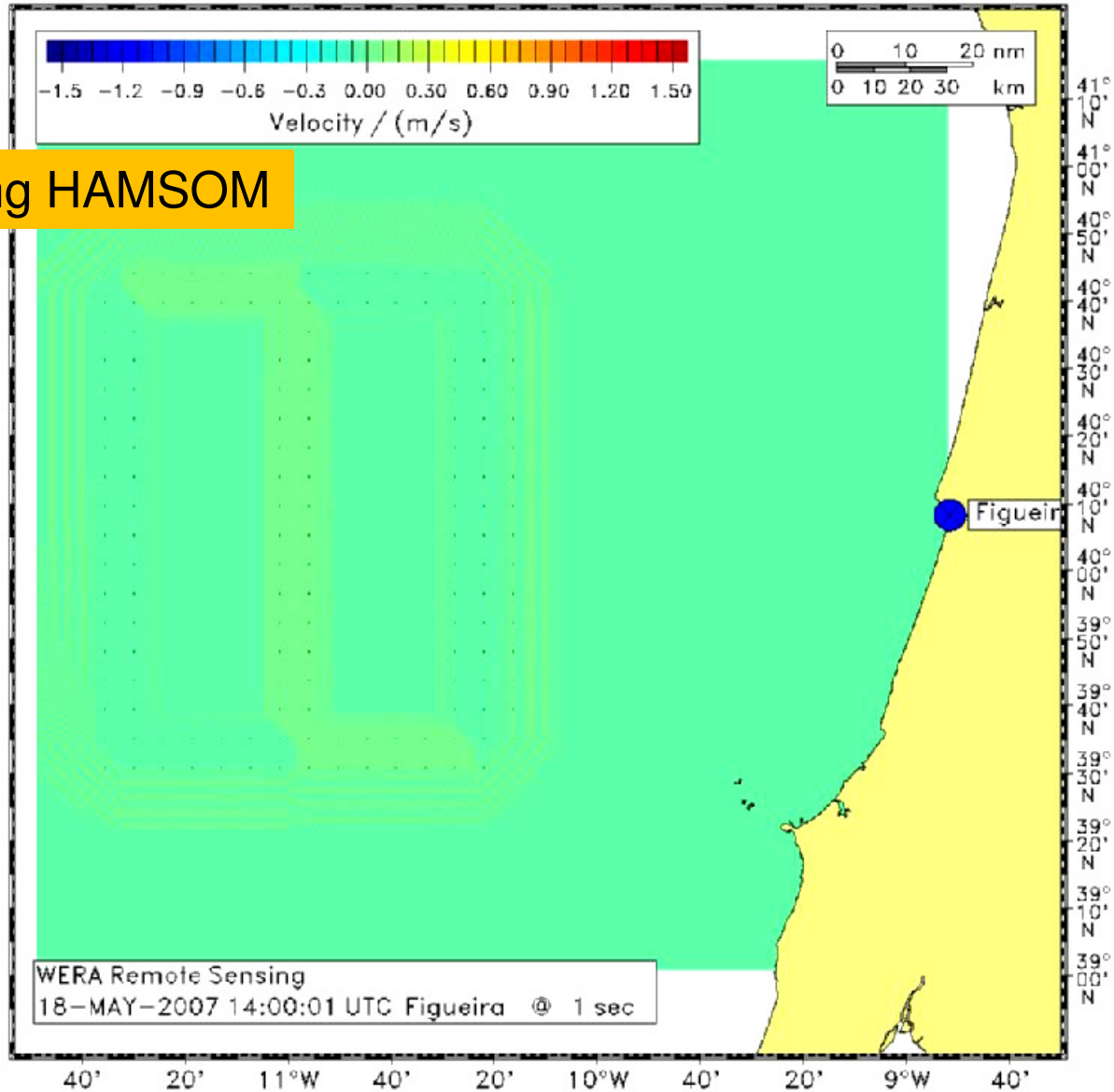
Simulation using HAMSOM



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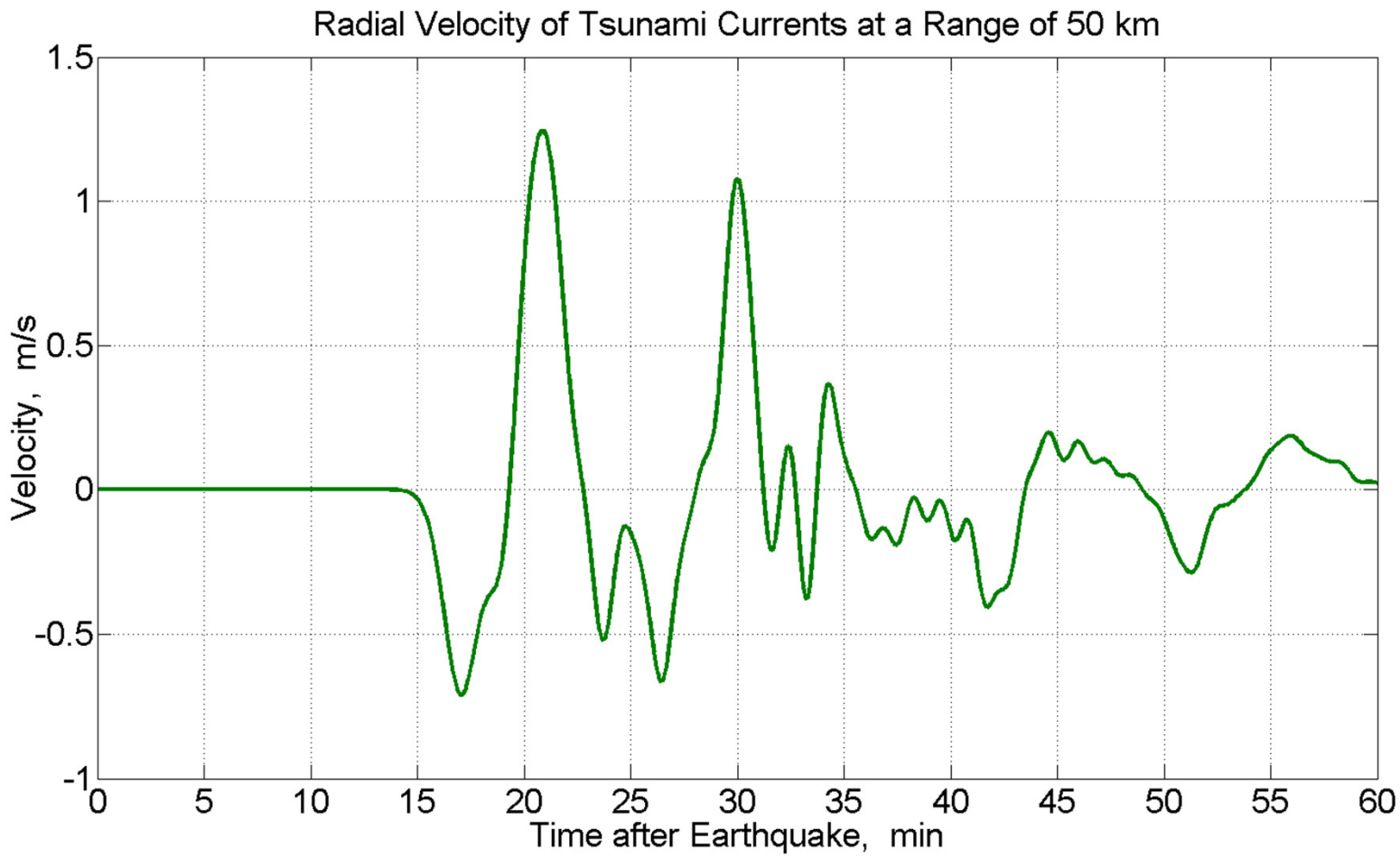

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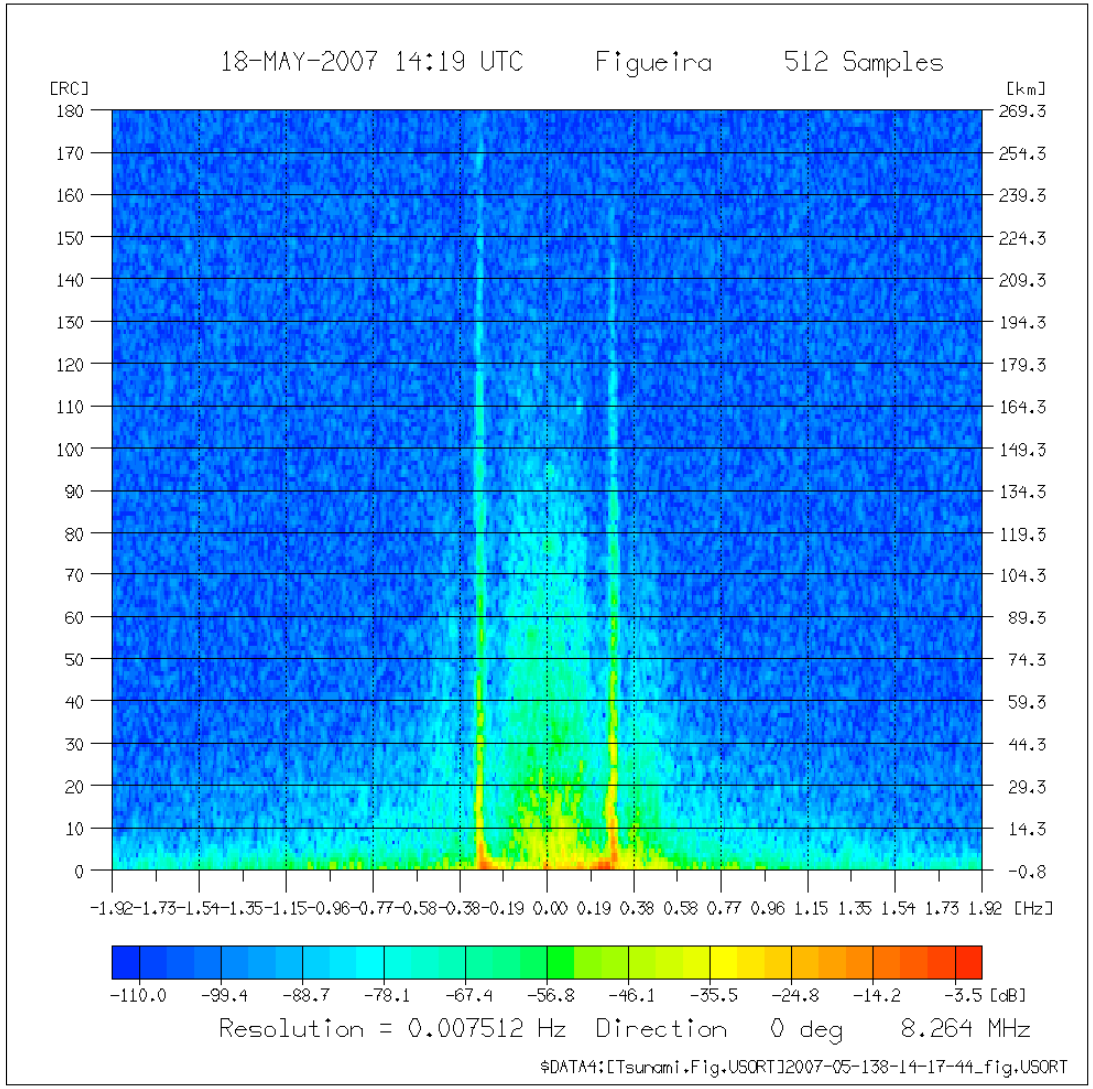
- An example of radar backscatter data.
- Integration time is about 2 minutes (512 x 0.26 s).
- Radar frequency is 8.264 MHz.
- Data have been collected at Figueira.



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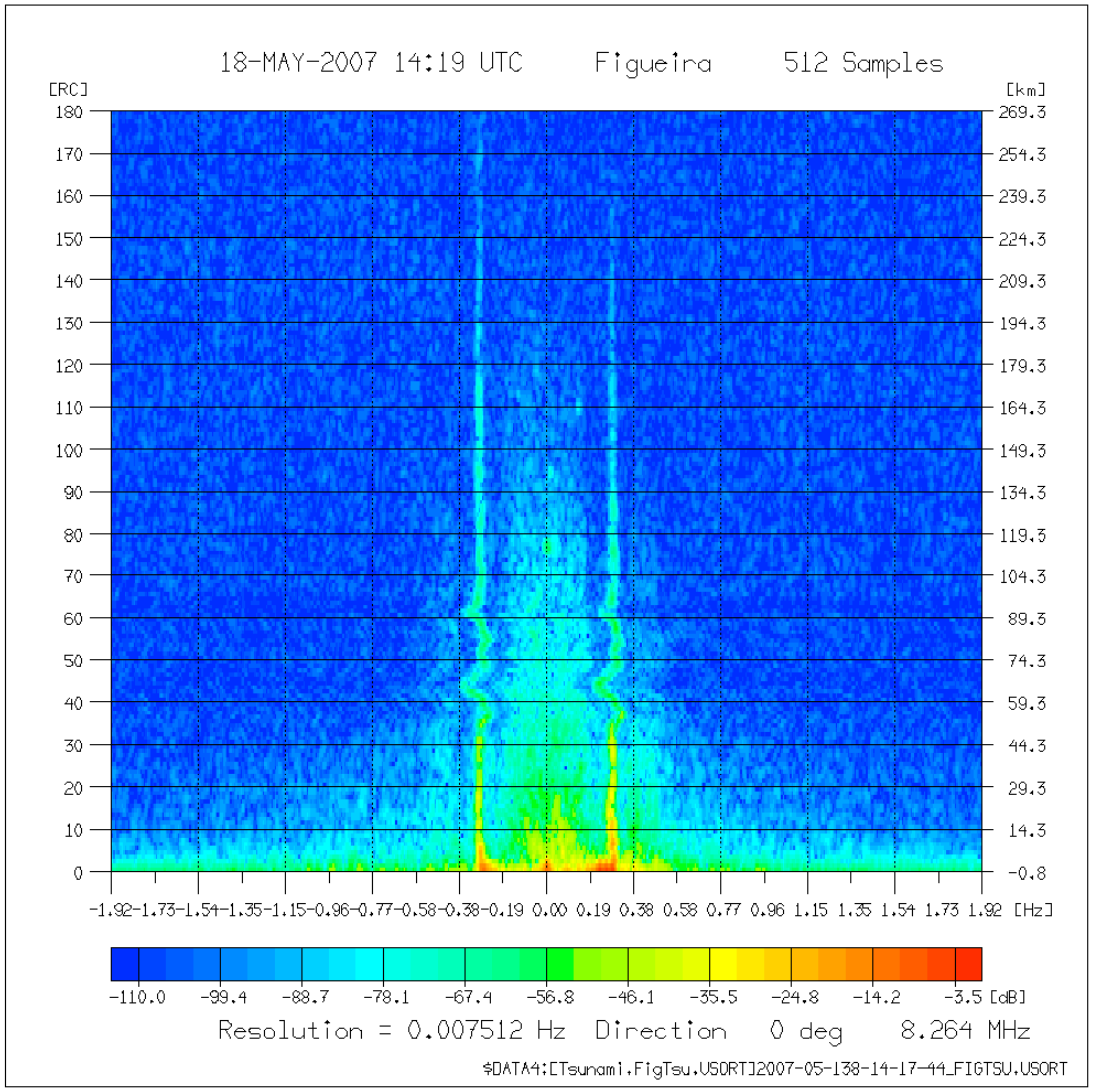
- An example of radar backscatter data.
- Integration time is about 2 minutes (512 x 0.26 s).
- Radar frequency is 8.264 MHz.
- Data have been collected at Figueira.
- The tsunami currents are applied by the modulation technique.



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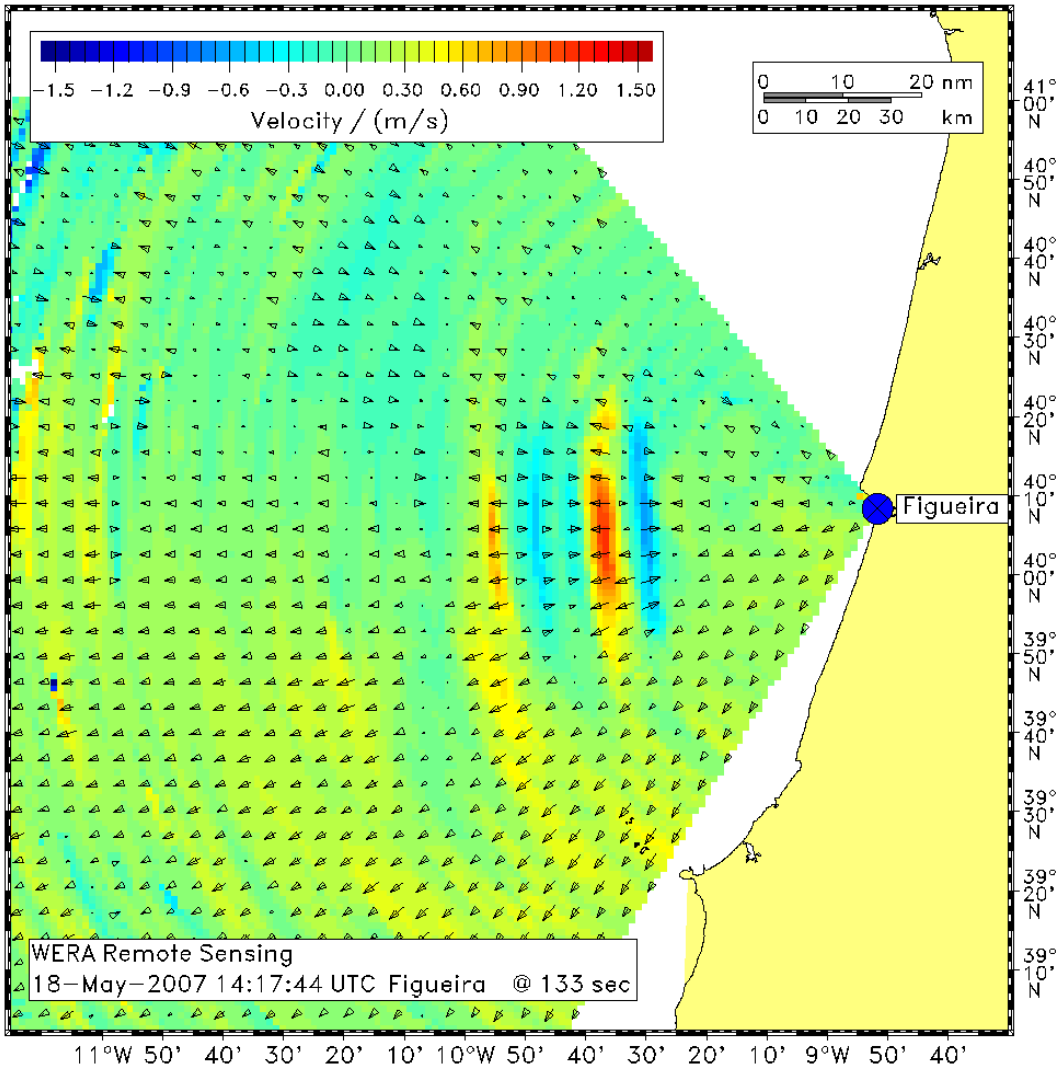
- A radial currents measured at Figueira **with the tsunami signature superposed** to the time series of backscatter data.
- The integration time is about **2 minutes (512 x 0.26 s).**
- This is the standard processing of WERA data.



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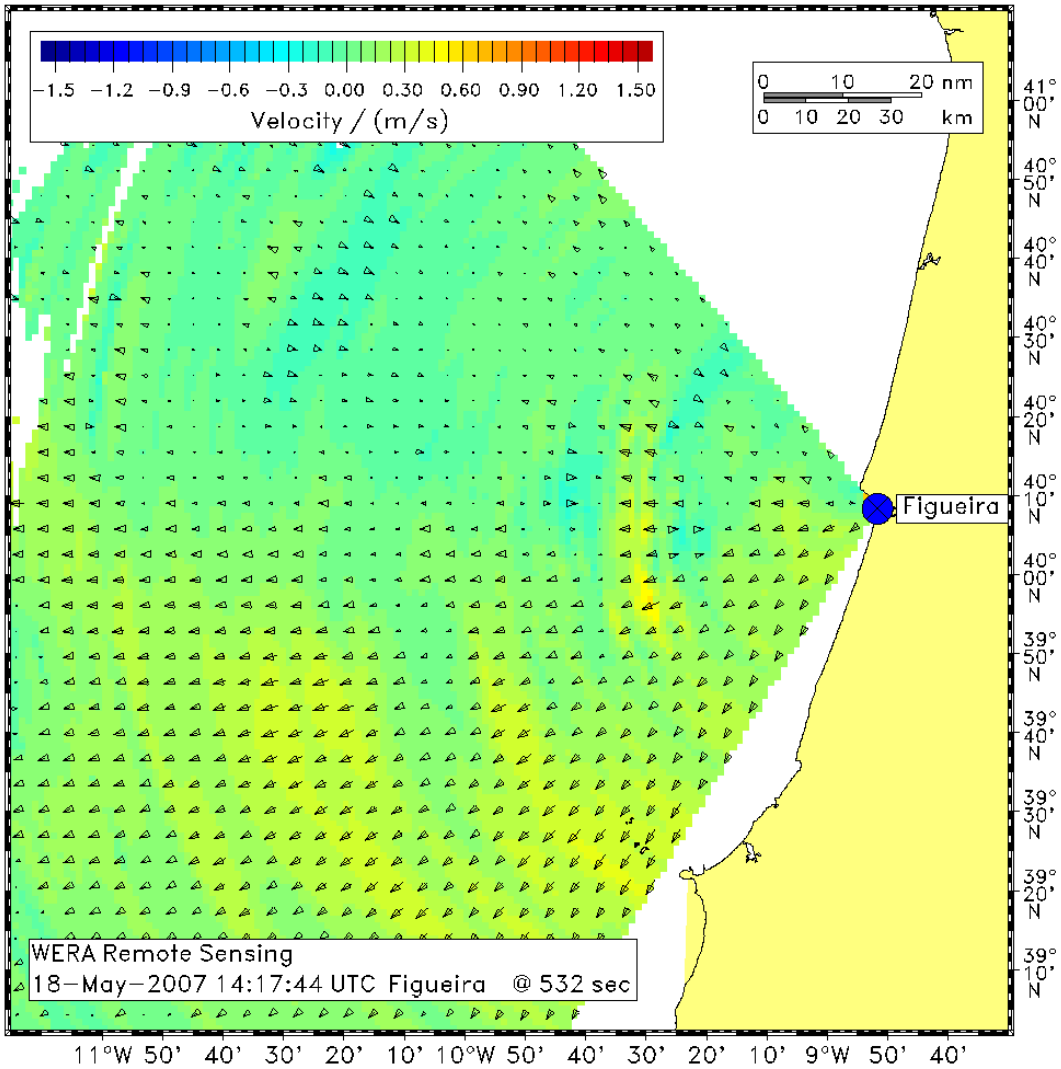
- A radial currents measured at Figueira **with the tsunami signature superposed** to the time series of backscatter data.
- The integration time is about 9 minutes (2048 x 0.26 s).
- **The tsunami induced current is hidden by the long integration time.**



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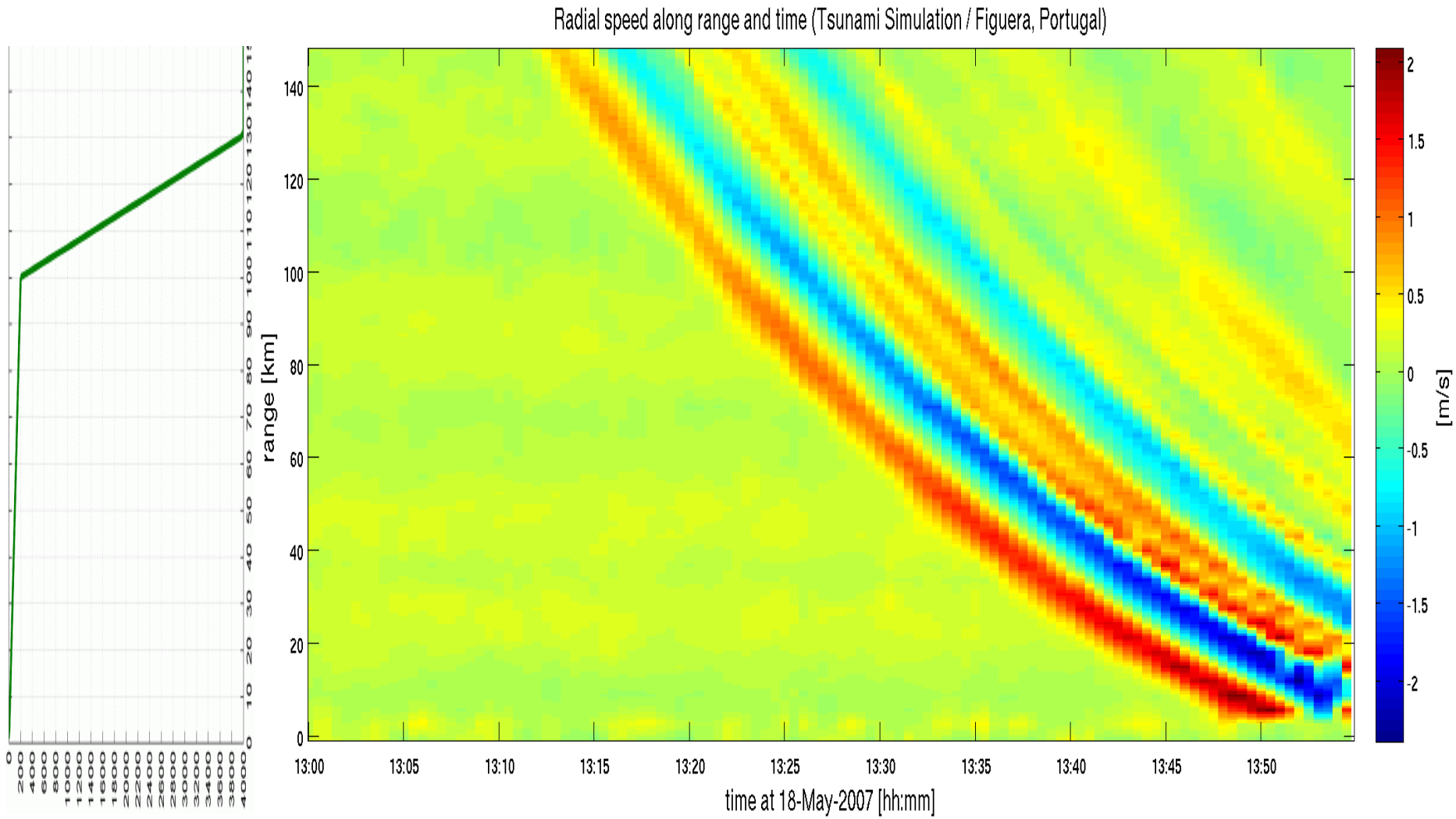

NOAA Animation

http://nctr.pmel.noaa.gov/animate.html

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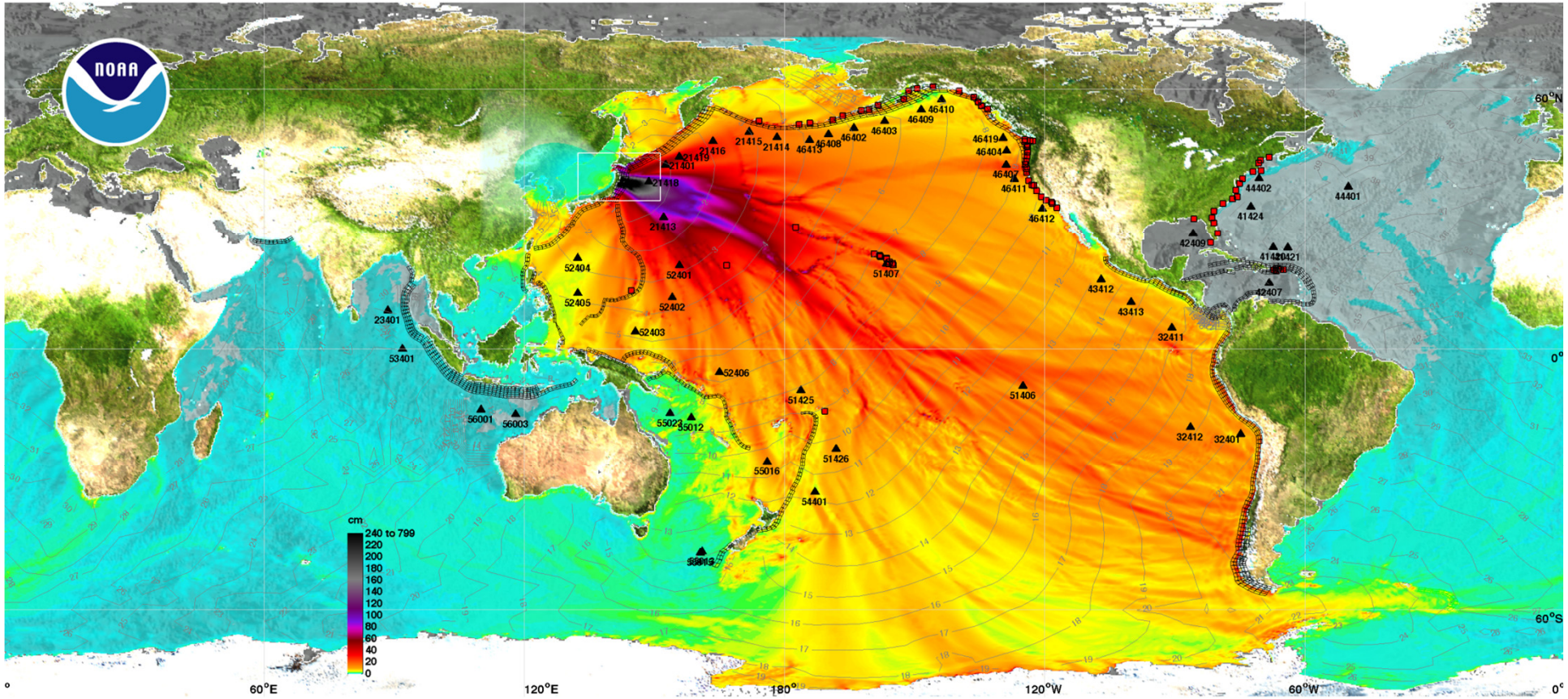
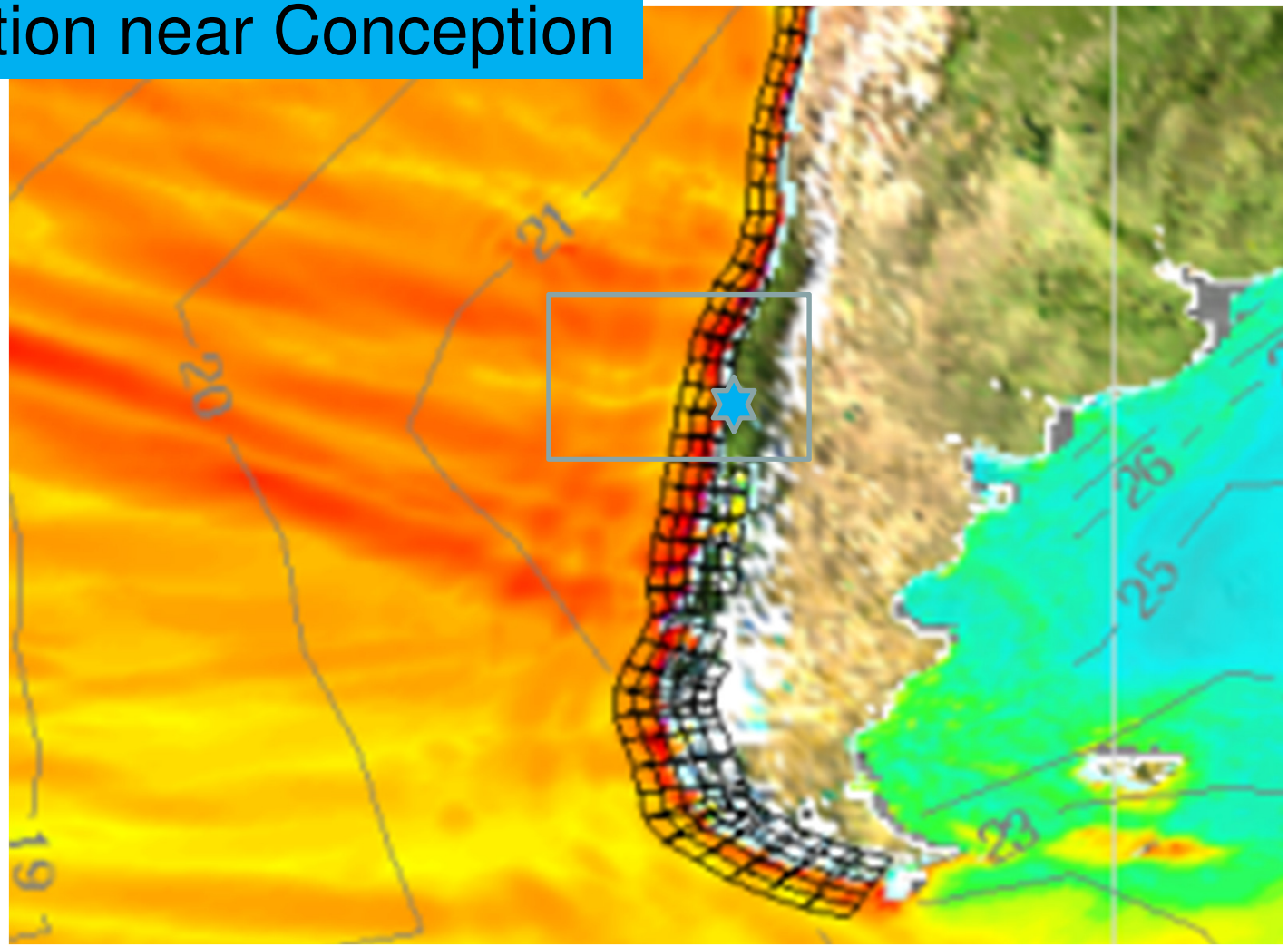


Figure from

NOAA Center for Tsunami Research

Developing methods and tools to reduce tsunami hazard and protect life

WERA location near Conception



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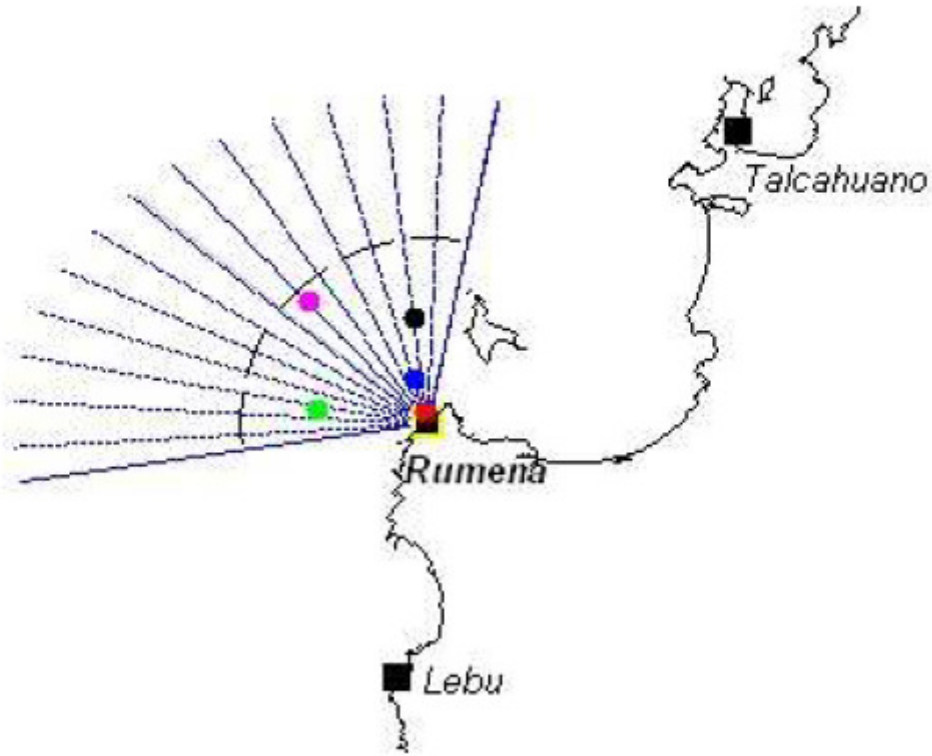

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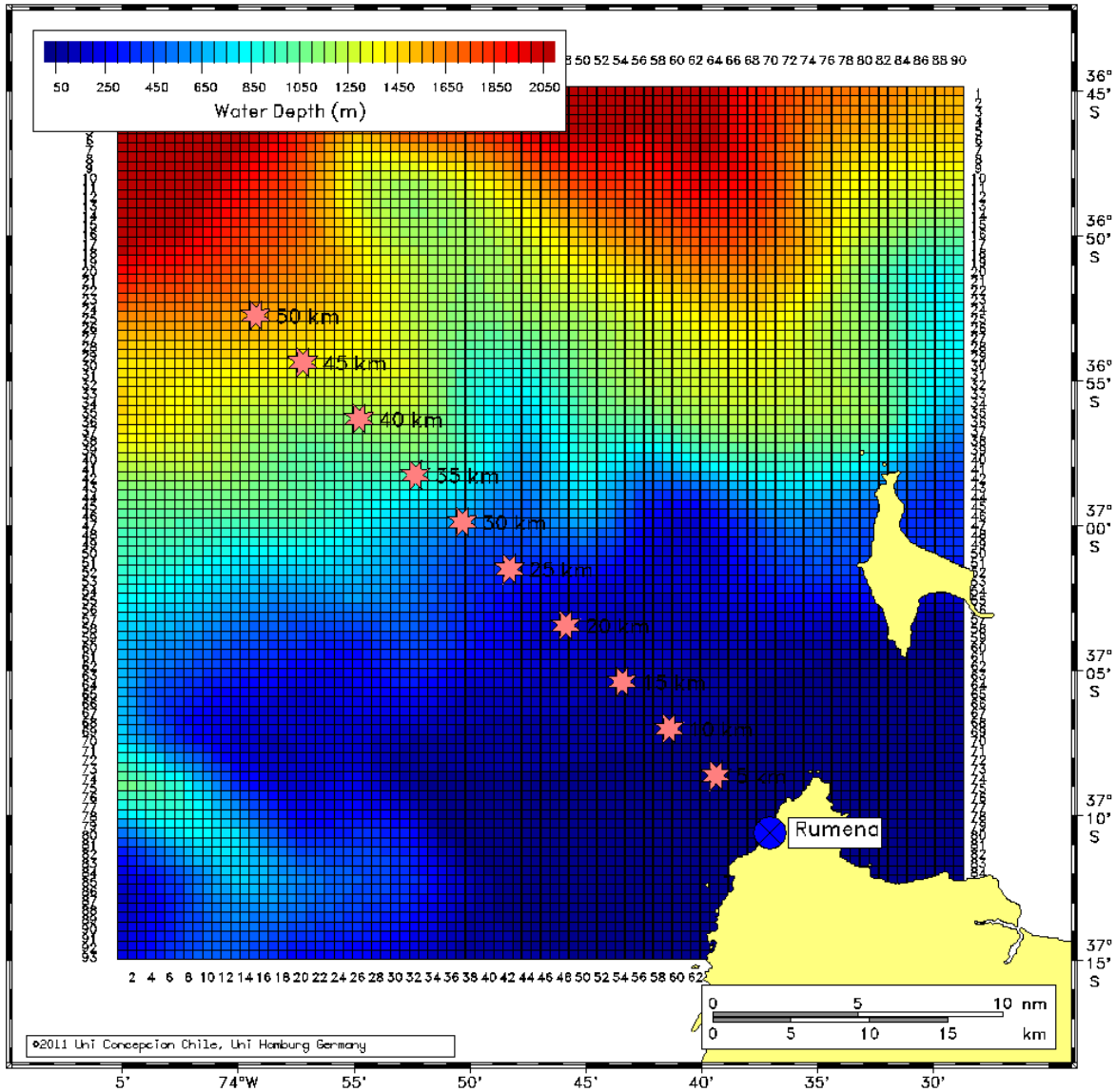

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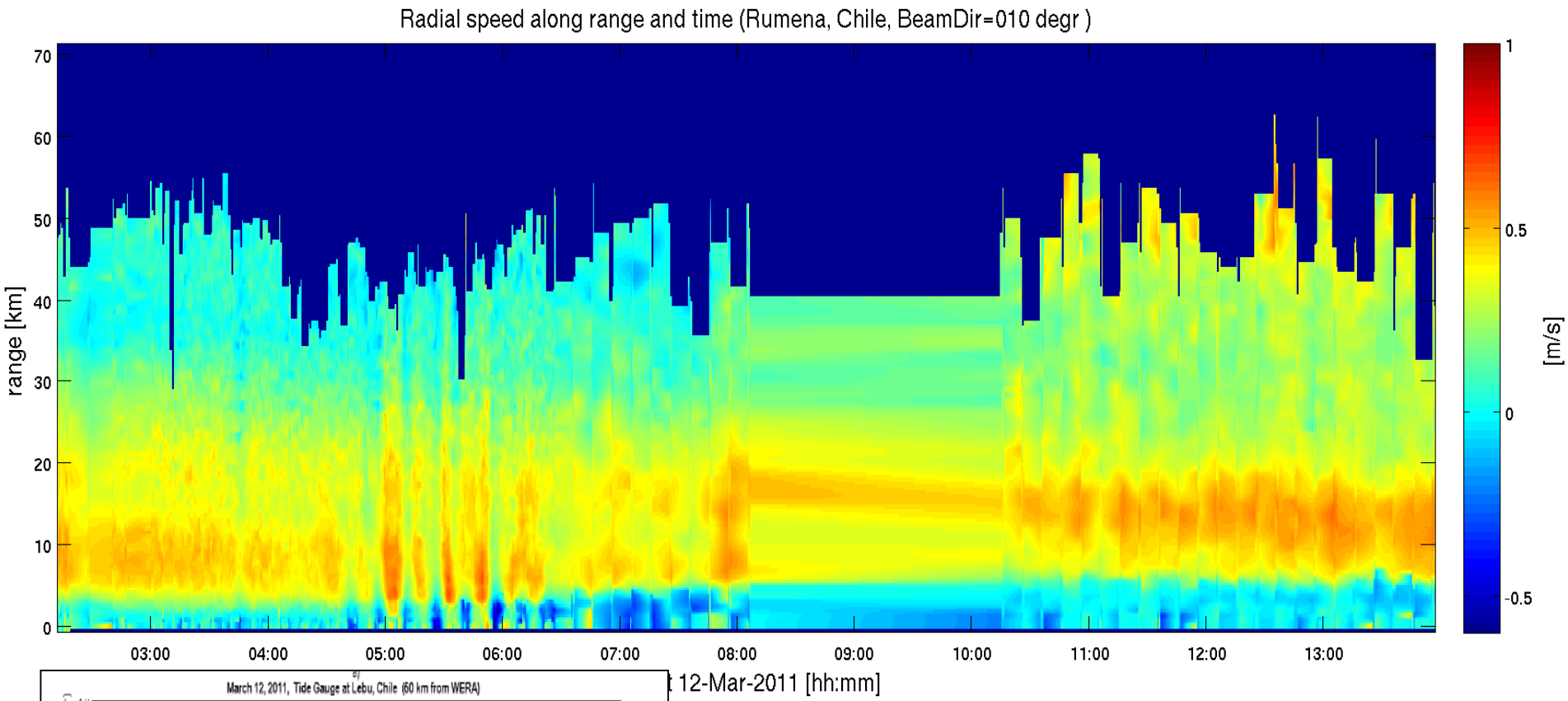

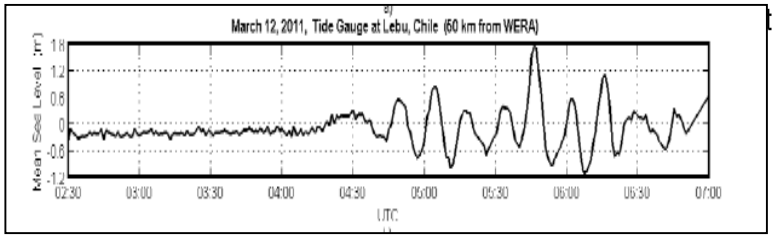

Sea level at Lebu

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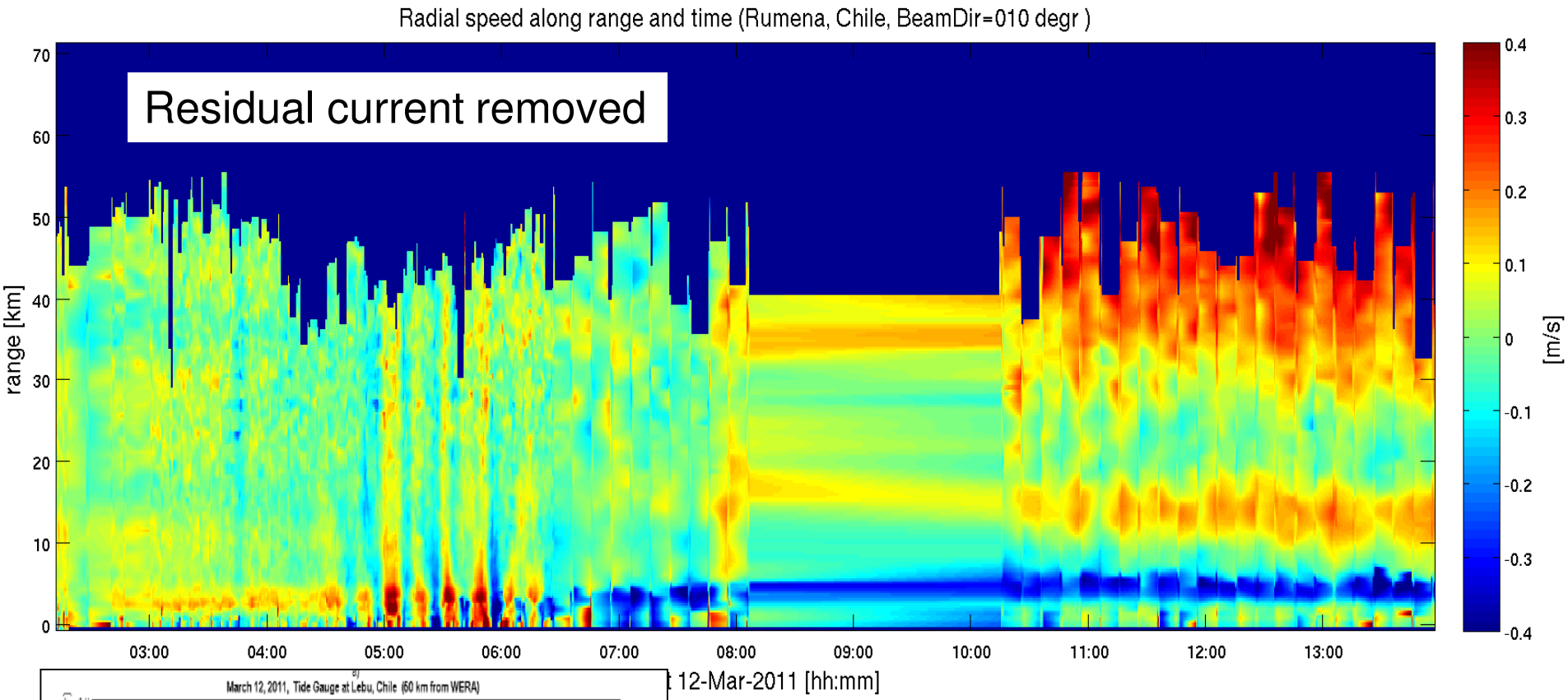
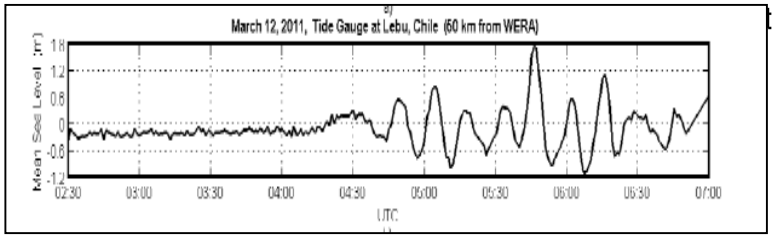
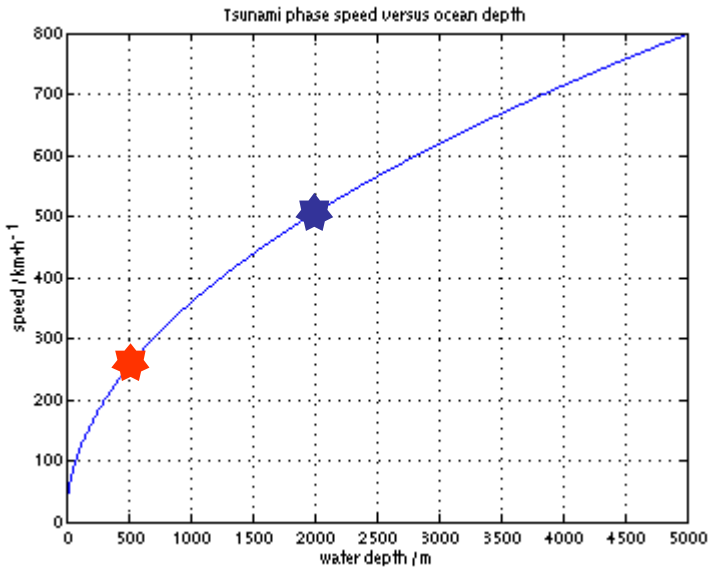


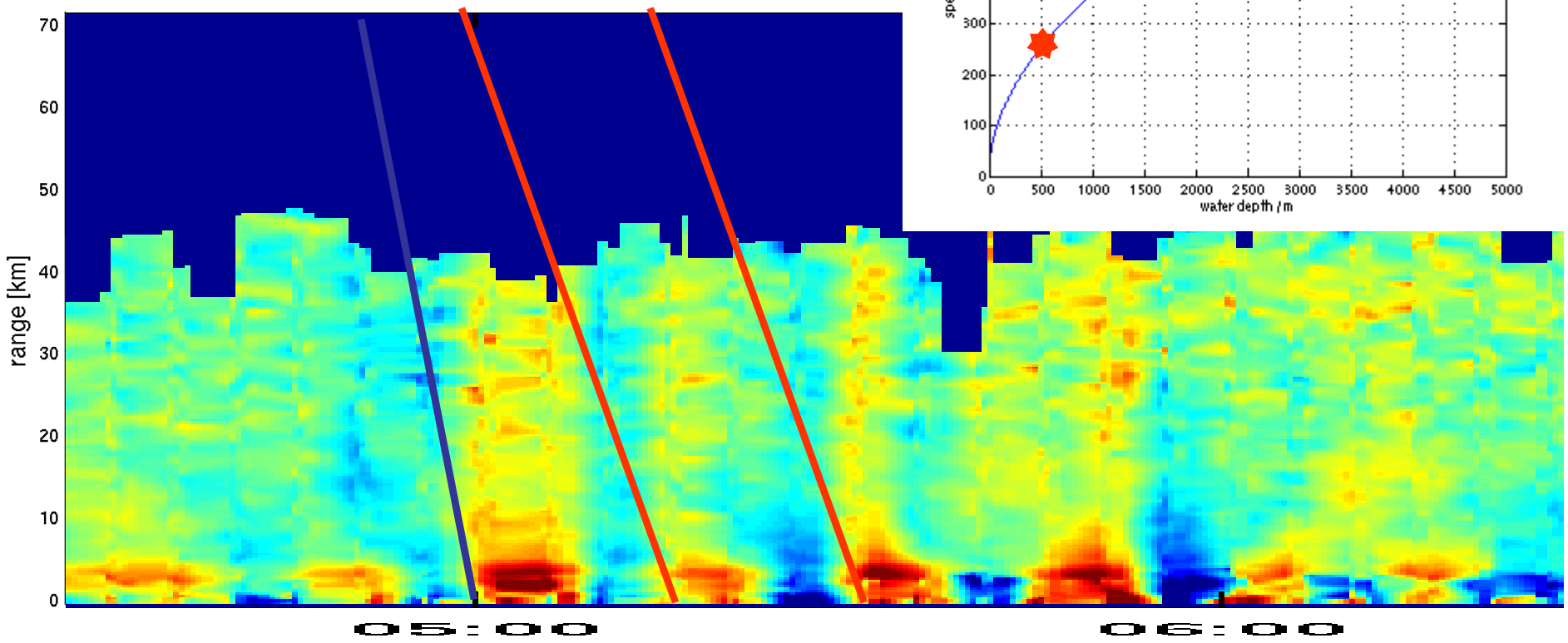


Sea level at Lebu

Tsunami speed

500 km/h 250 km/h





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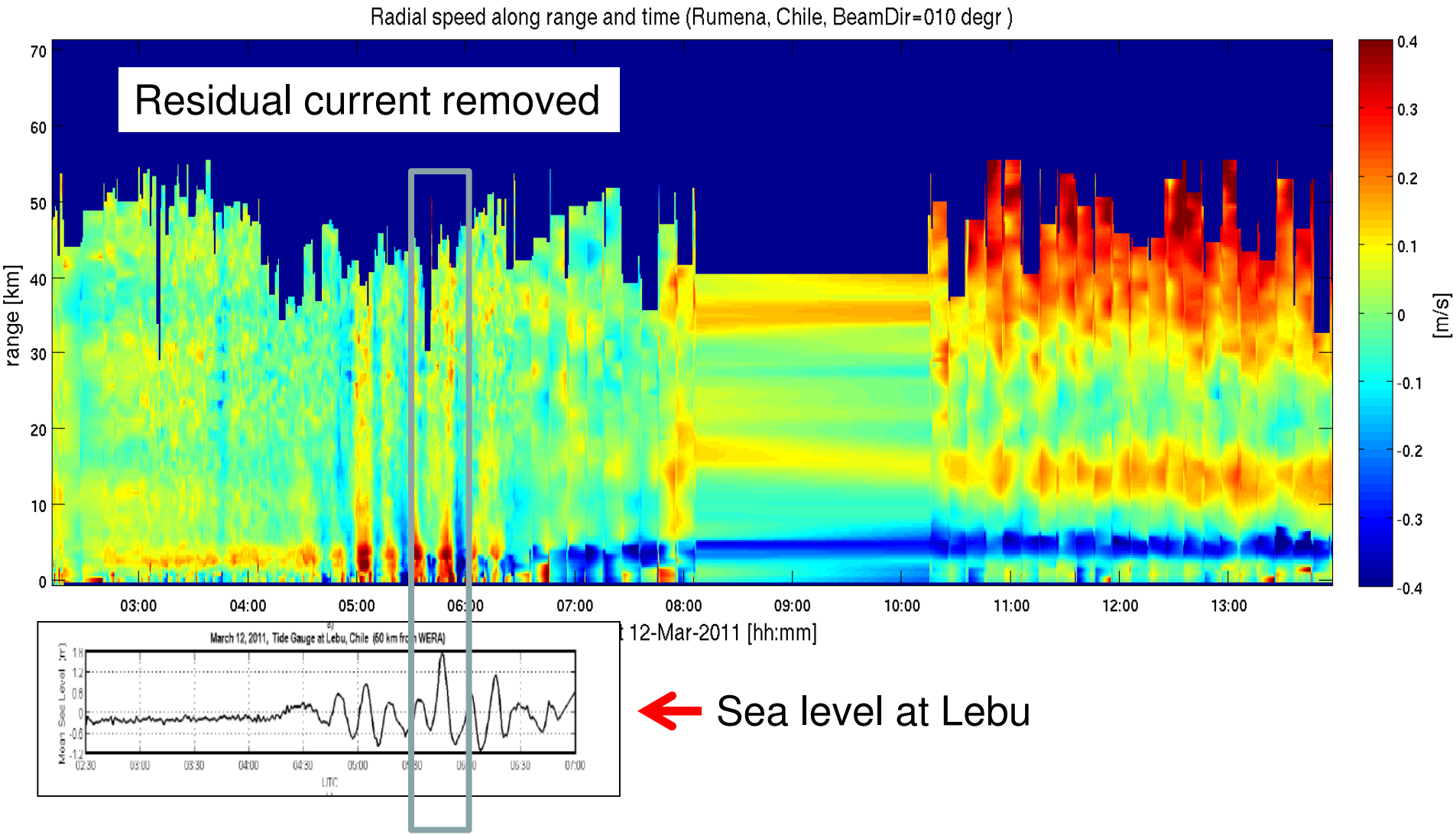

Conclusions

- The 2011 Sendai tsunami was observed at the coast of Chile.
- Because the shelf in this area is quite narrow (200 m @ 10 km, 1000 m @ 35 km), the tsunami's phase speed is staying at high levels (250 – 500 km/h).
- When the residual ocean currents are subtracted, the tsunami waves can clearly be seen in the currents measured by WERA out to ranges of 40 km.
- Comparisons to sea level measurements at the coast 50 km south of the radar show a high correlation with the observed ocean current signatures, which confirms earlier theoretical investigations.