

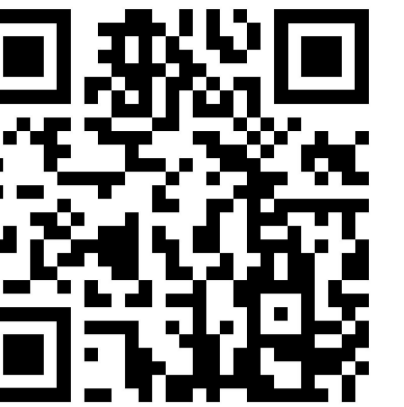


Espresso

multibeam water-column
visualization & processing

<https://github.com/alexschimel/Espresso>

Espresso: An Open-Source Software for Visualizing and Analysing Multibeam Water-Column Data



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Introduction

Espresso is a free and open-source app (MIT license) to visualize and process water-column data acquired by multibeam echosounders. The main feature of this tool is the possibility to vertically echo-integrate water-column data so as to visualize and examine acoustic anomalies.

Espresso uses the CoFFee multibeam data processing toolbox (hence the name). It is coded in MATLAB, but is available as a standalone application that does not require a MATLAB licence.

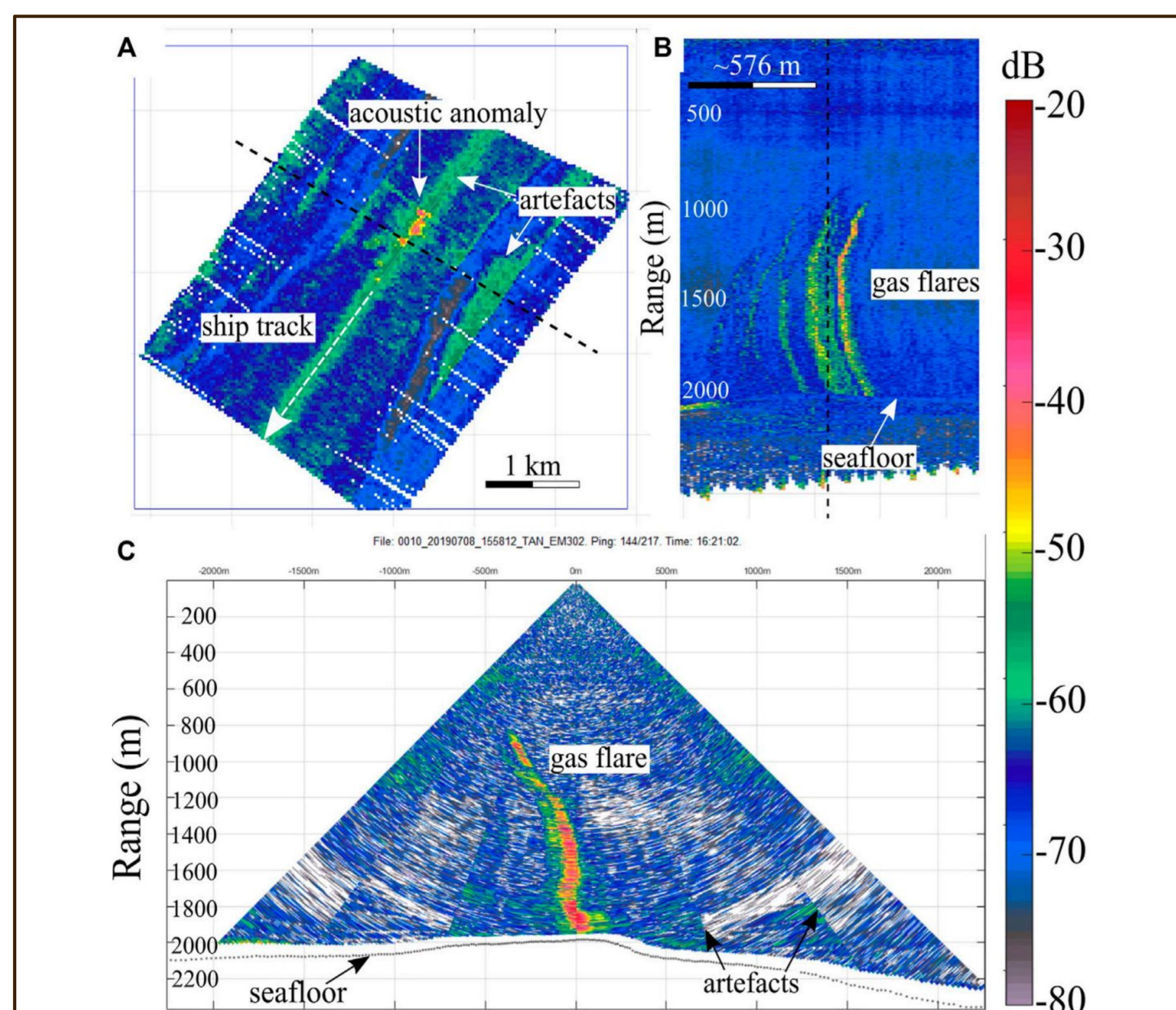
Convert and load raw data files (.all.wcd, .kmall/.kmwcd, .s7k)

Select lines to display

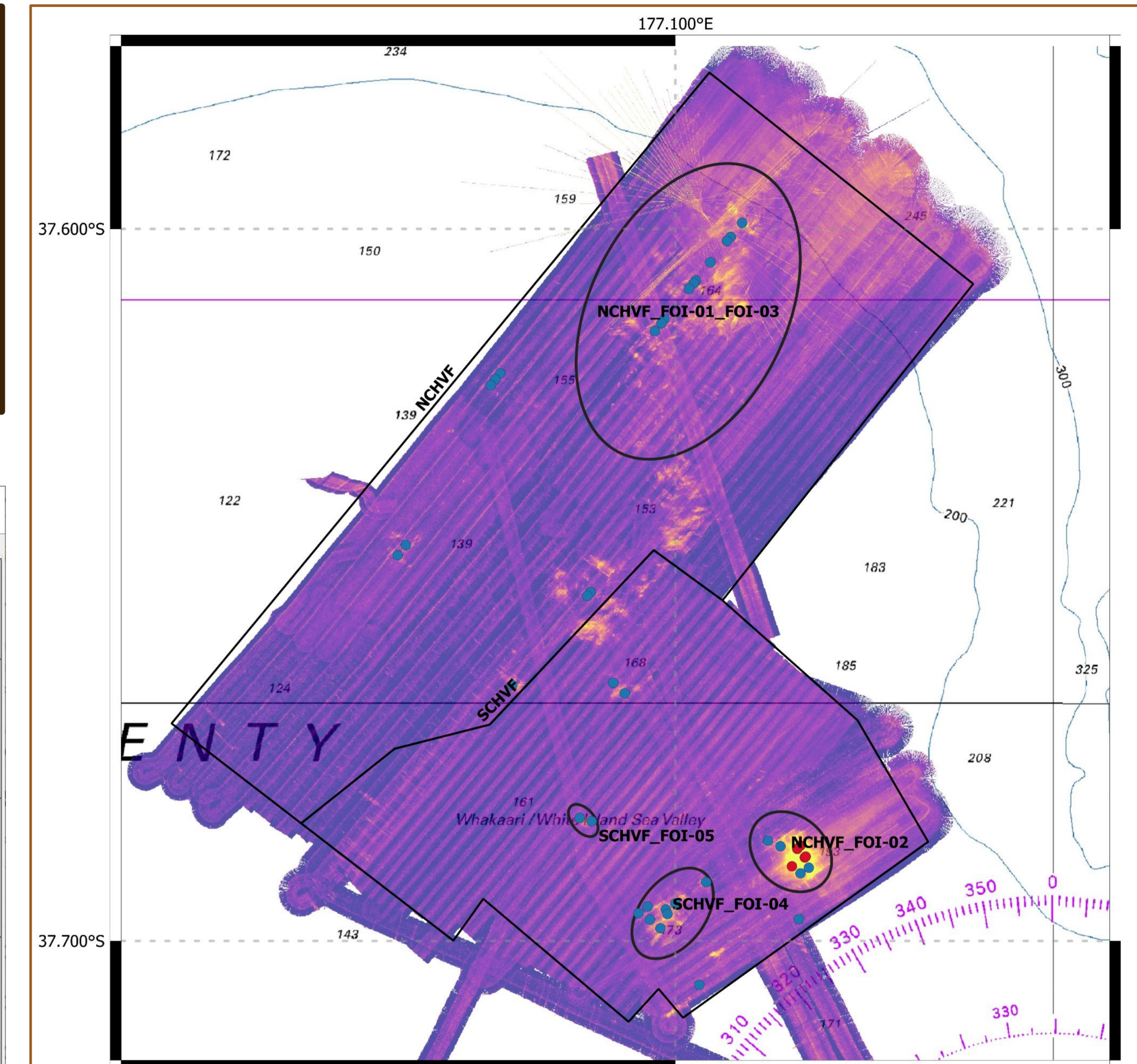
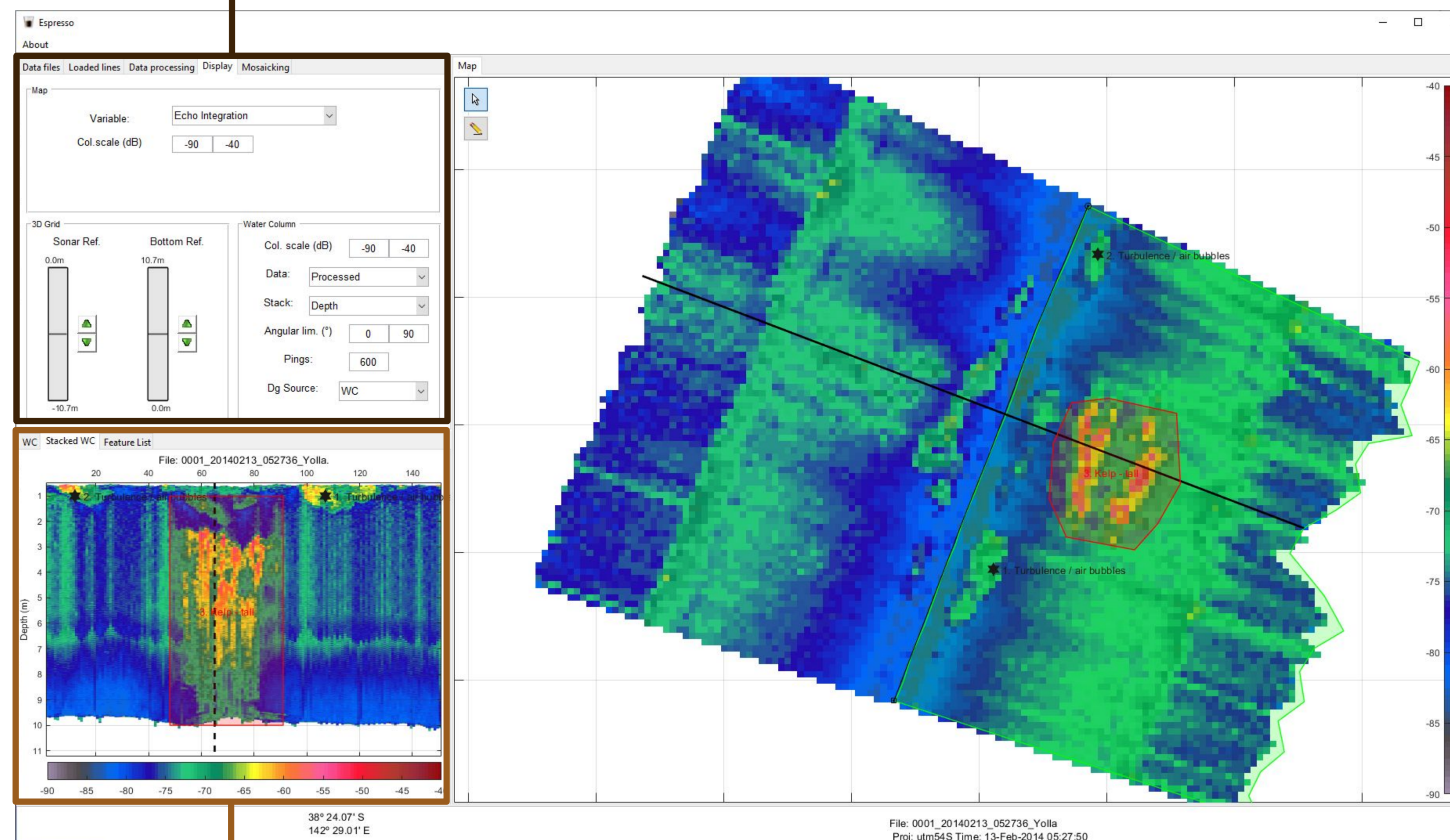
Process and echo-integrate lines in one or several slices

Adjust display parameters

Blend echo-integrated slices in mosaics and export to geotiff



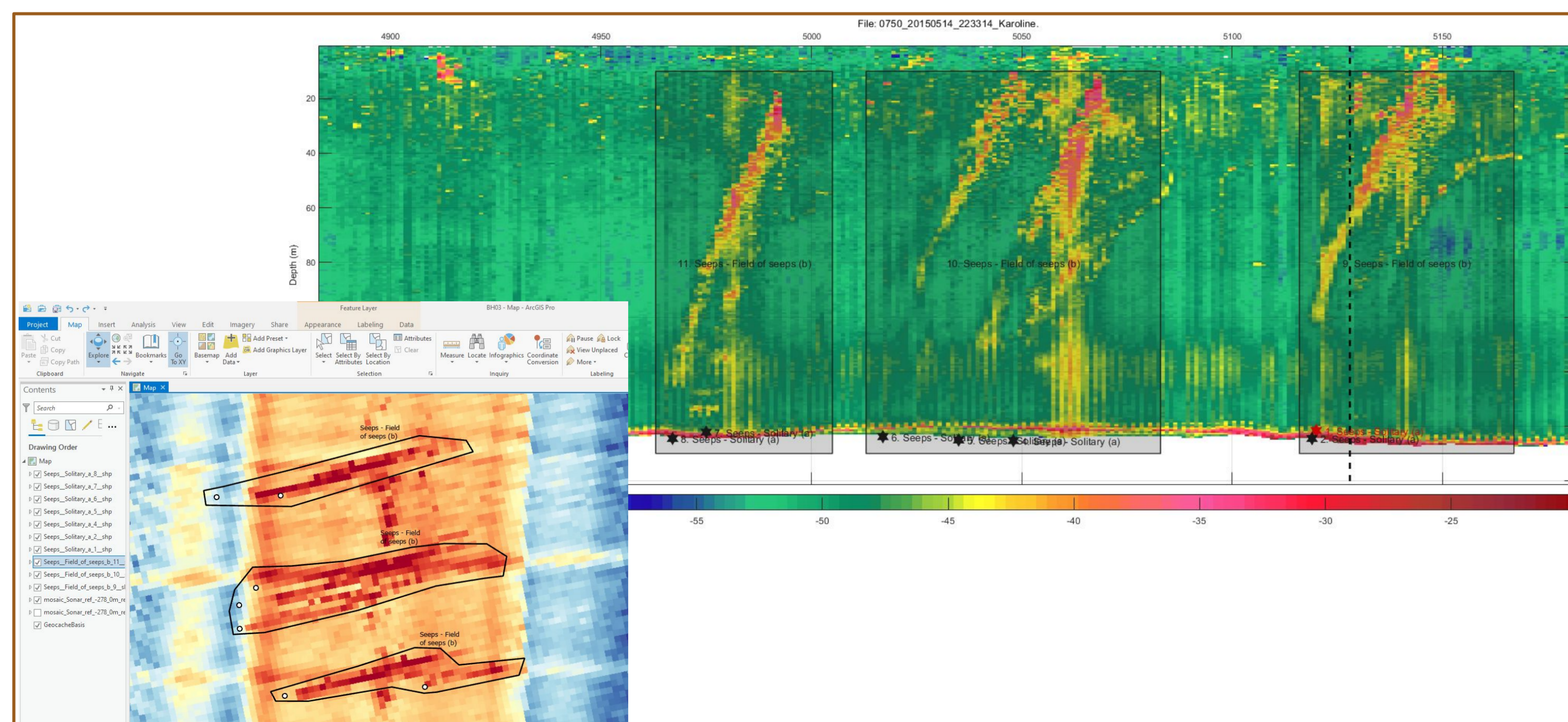
Example of water-column data highlighting gas flares visualized in **Espresso**. Data processing included masking the seafloor echo and all data below it, and sidelobe artefact filtering. (A) Vertically echo-integrated data; (B) Range-stack view; (C) Single-ping view. Data: EM 302. Reproduced with permission from Turco et al. 2022 (DOI 10.3389/feart.2022.834047)



Example of mosaic (vertically echo-integrated data) exported to GIS, highlighting volcanic vent fields. Data: EM 302. NIWA Whakaari / White Island Sea Valley survey (TAN2007)

Relevant features

- Support Kongsberg .all.wcd, Kongsberg .kmall/.kmwcd, and Reson-Teledyne .s7k formats.
- Flexibility in masking unwanted data (seafloor echo and below, angles, inner-range, outer-range, pings with too many bad detections, data beyond minimum slant range).
- Sidelobe artefact filtering (*Slant-range signal normalisation* algorithm, see method in Schimel et al. 2020 – <https://doi.org/10.3390/rs12091371>).
- Visualize water-column data stacked in range or depth.
- Vertical echo-integration over the whole water column, or in any number of slices of any desired thickness defined relative to the water surface (i.e. depth slice) or to the bottom (i.e. height-above-bottom slice).
- Mosaic the echo-integrated slices across all lines, and export mosaic as a geotiff file.
- Geo-picking tools to annotate features as polygons or points. To export as .csv and shapefiles.



Example of water-column data filtered and stacked in depth in **Espresso**, with gas flares annotated (base and extents) with geo-picking tools, and exported to ArcGIS Pro. Data: EM 710. MAREANO dataset FOSAE-2015-BH03 from NGU records.

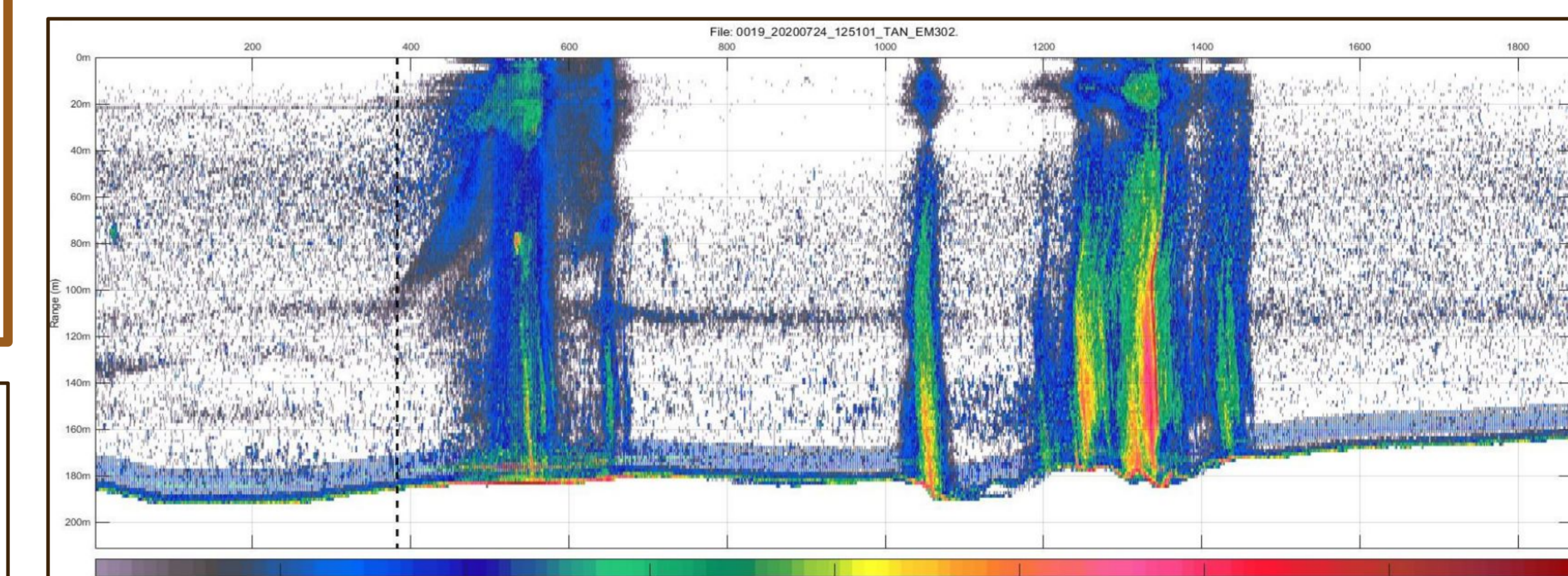
Display original or processed water-column data for a single ping

Display data from several pings, stacked in range or depth

Geo-pick points and polygons, exportable to csv and shapefile

Strategies & Limitations

Espresso implements strategies to manage the high-volume of water-column data including memory-mapping the converted data, and parallel processing on machines disposing of a GPU. However, as a research software, it still has limitations, such as the need for data conversion into its internal format, lengthy conversion and processing time, and limited data capacity (depending on the available RAM). It is best seen as a complement – rather than a replacement – to commercial software for the analysis of water-column data.



Example of water-column data limited in angle ($\pm 30^\circ$), filtered, and stacked in range, showing volcanic gas seeps. Data: EM 302. NIWA Whakaari / White Island Sea Valley survey (TAN2007)