

# Open-source software to estimate the submerged landscapes of Western Australia

## An emerging field

- In 2019 two Aboriginal archaeological sites were discovered underwater in Murujuga, northwest Australia (Benjamin 2020).
- These sites have brought submerged cultural landscapes into scientific focus.
- Traditional Owners, scientists, industry and government are all interested in better understanding this submerged 'Sea Country'.
- The first step towards understanding is to map the extent of former landscape.

## Complex datasets...

- There are many type of sea level curve - from eustatic (volume of ice near the poles), to local relative curves (eustatic + neotectonics and glacio-hydro-isostasy).
- New seabed data is rapidly becoming available, with a push to map the entire shelf by 2030.

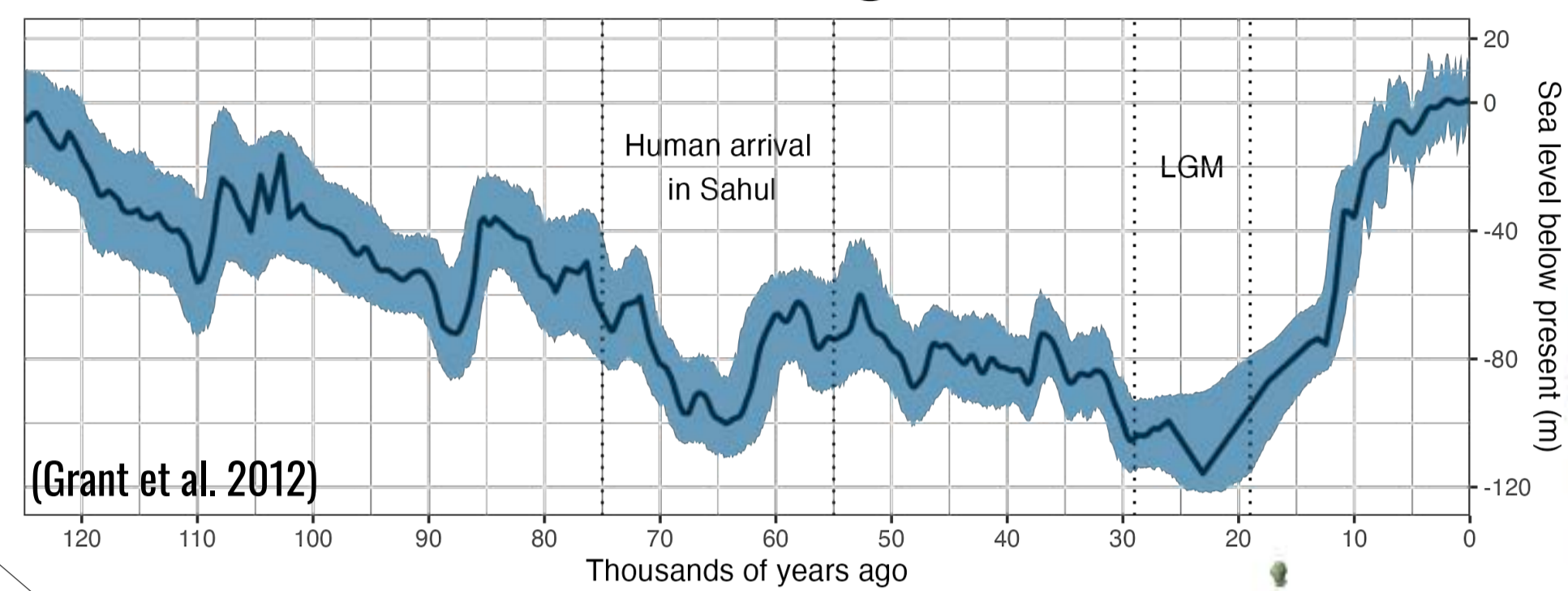
## ...making many maps

- Our software allows researchers to combine many datasets by extending the industry standard QGIS software.
- Sea level curves can be interpolated and compared.
- Users can rapidly adjust bathymetric data.
- Specialised indices can be computed - showing time subaerial (not underwater), age last exposed, and time in the coastal zone.

## Seeing change

- SeaLevelTool is an extension of the usual sea level contour maps used for decades.
- The key advantage is the interactive exploration of sea level change - which highlights ancient coastal features and builds intuition.

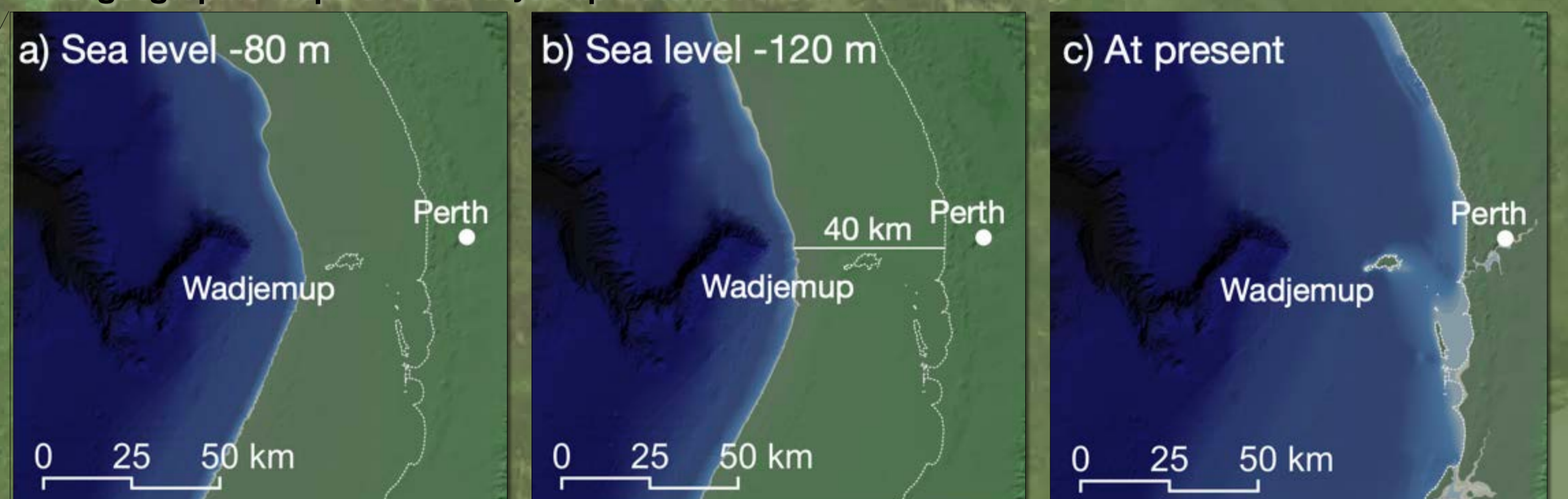
Sea levels since the last interglacial



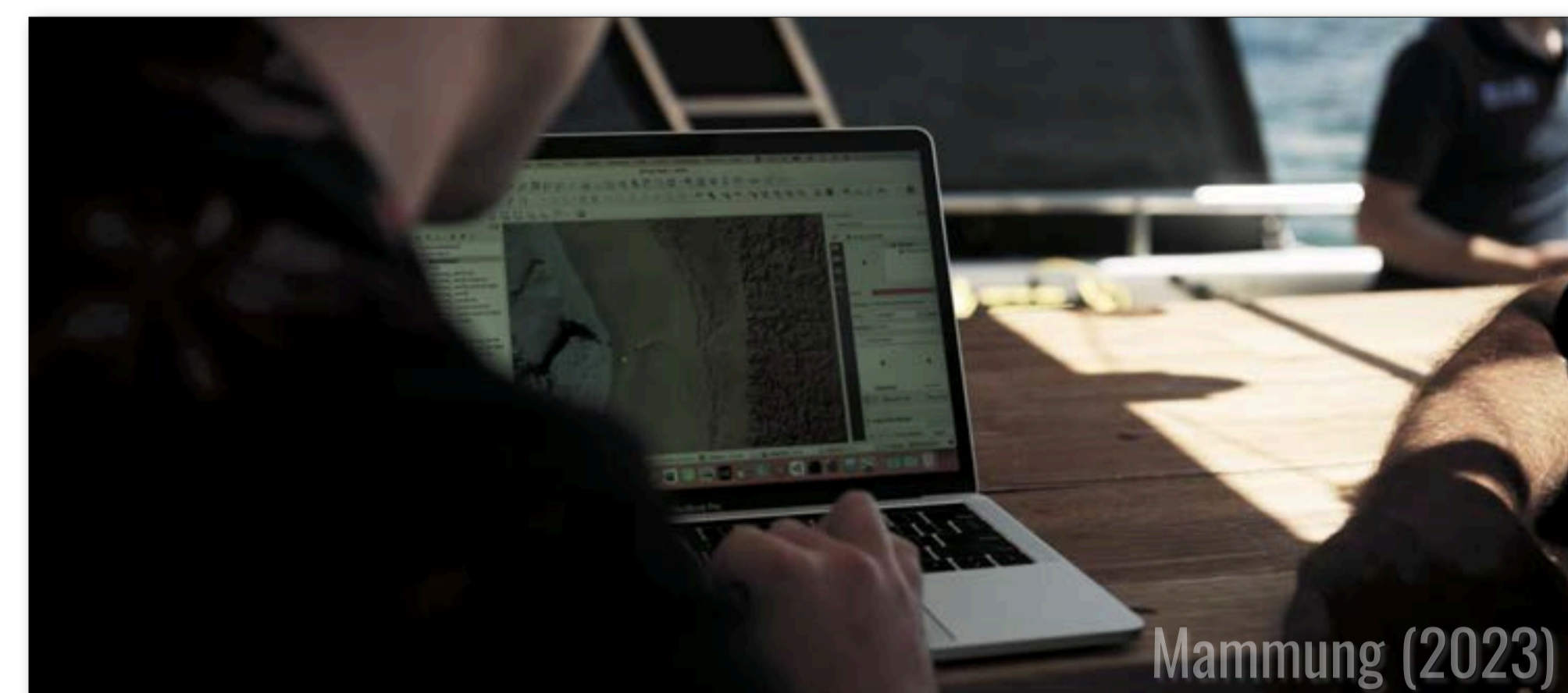
## Changing sea levels

- Sea level was much lower for most of Australia's human past.
- When Aboriginal people first arrived more than 65,000 years ago, sea levels were up to 100 m lower than present.
- During the Last Glacial Maximum (~22 thousand years ago), sea levels were up to 130 m below present.
- Over this time sea level fluctuated, until it stabilised around present levels 8,000 years ago.

Paleogeographic maps of the Wadjemup Rottneest shelf



I acknowledge the Traditional Owners - the Noongar people, and pay my respects to Elders past and present.



Mammung (2023)

## Mapping Noongar Country

- SeaLevelTool was originally developed to map underwater Noongar country for the documentary film 'Mammung'.
- During filming, we mapped the ice-age shoreline in the company of Noongar Elder Dr Noel Nannup, 40 km out to sea on the Wadjemup Rottneest Shelf.
- We have run workshops within UWA, and at a national conference. This is being used to inform the assessment of submerged landscapes by researchers and local communities.

## Use this in your work:

- Available in the QGIS Plugins Repository
- Open source code - available on Github

[bit.ly/sea\\_level\\_tool](https://bit.ly/sea_level_tool)



## References

- Benjamin, J., O'Leary, M., McDonald, J., Wiseman, C., McCarthy, J., Beckett, E., Morrison, P., Stankiewicz, F., Leach, J., Hacker, J., Baggaley, P., Jerbić, K., Fowler, M., Fairweather, J., Jeffries, P., Ulm, S., Bailey, G., 2020. Aboriginal artefacts on the continental shelf reveal ancient drowned cultural landscapes in northwest Australia. Plos One 15, e0233912. <https://doi.org/10.1371/journal.pone.0233912>
- Grant, K.M., Rohling, E.J., Bar-Matthews, M., Ayalon, A., Medina-Elizalde, M., Ramsey, C.B., Satow, C., Roberts, A.P., 2012. Rapid coupling between ice volume and polar temperature over the past 150,000 years. Nature 491, 744-747. <https://doi.org/10.1038/nature11593>

Base map adapted from the Australian Topography and Bathymetry Grid 2009, Bing Virtual Earth (© Microsoft 2023) and the SahulArch Radiocarbon Collection.

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