

Detection of local mixing in time-series data using permutation entropy

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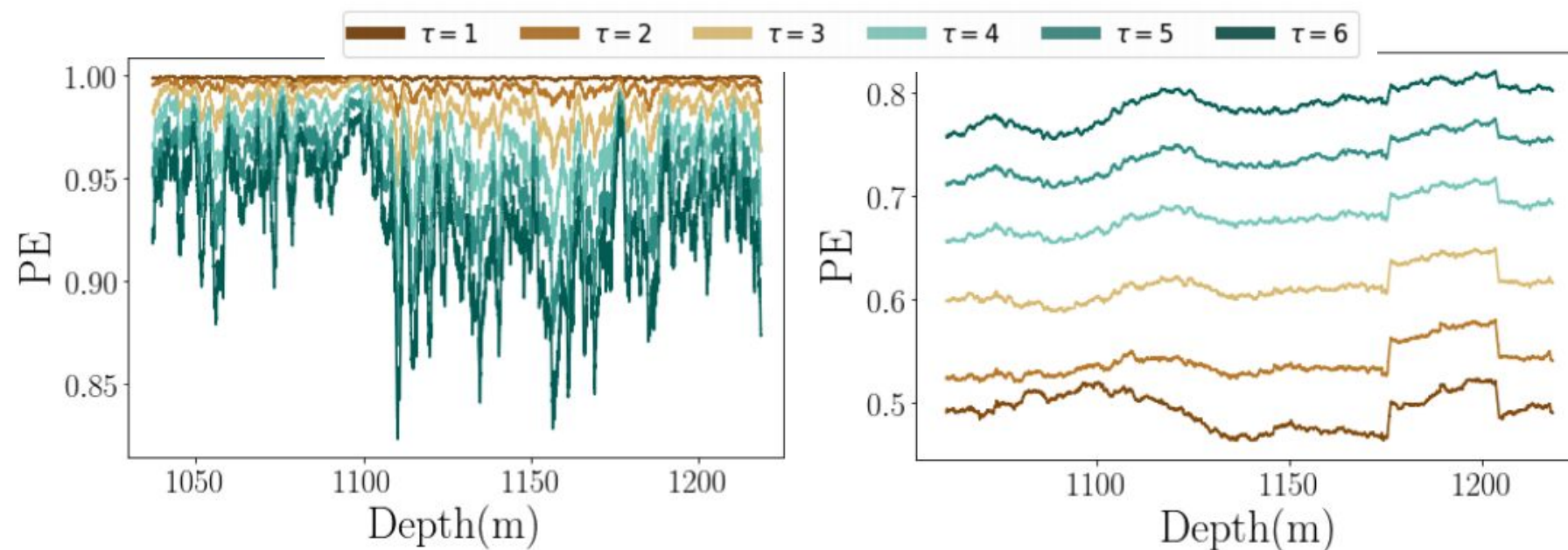
²National Oceanic and Oceanographic Administration

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PE techniques flag mixing in data sequences (and even let you estimate the mixing *scales*)

- By varying the “stride” of the calculation and observing the effects on the PE, one can flag the presence of local mixing in the data.
- Combined with a careful bin-averaging procedure, this allows one to estimate the scales of the mixing effects.
- In the case of water-isotope data from the West Antarctic Ice Sheet Divide core, this suggested a 4.5mm mixing scale.
- The lab scientists estimated a mixing scale of 5mm based on instrument and domain knowledge, which is very close to what we estimate.

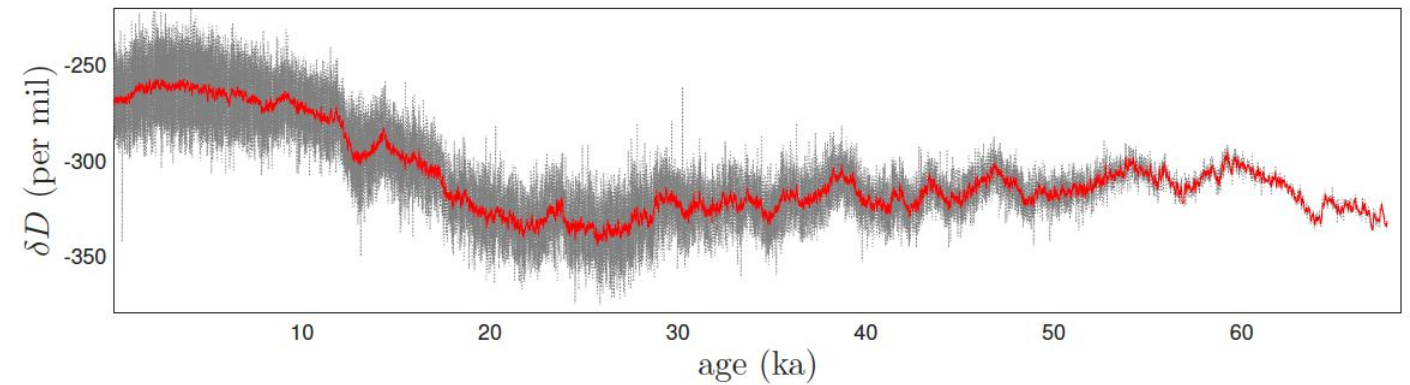
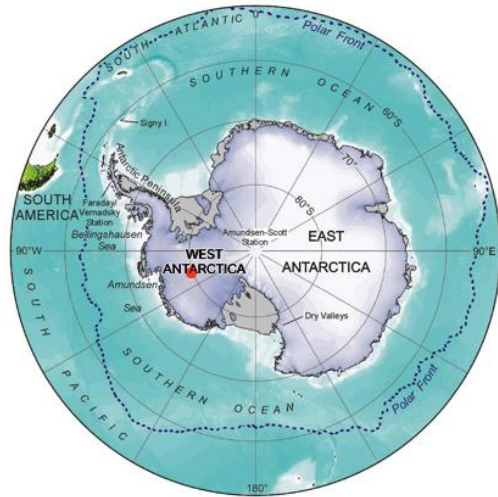


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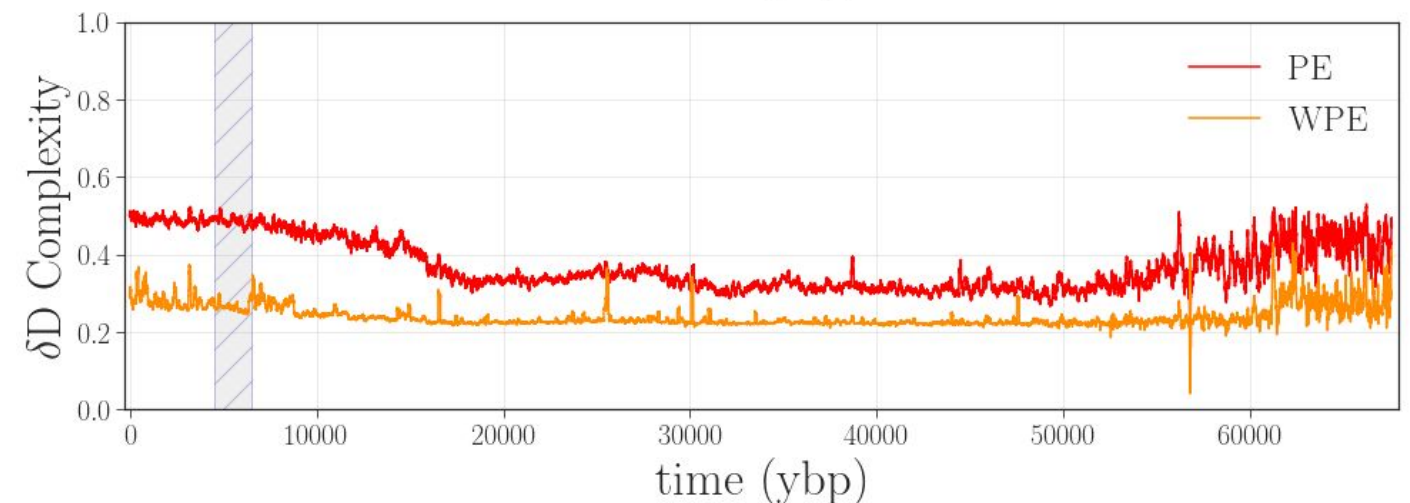
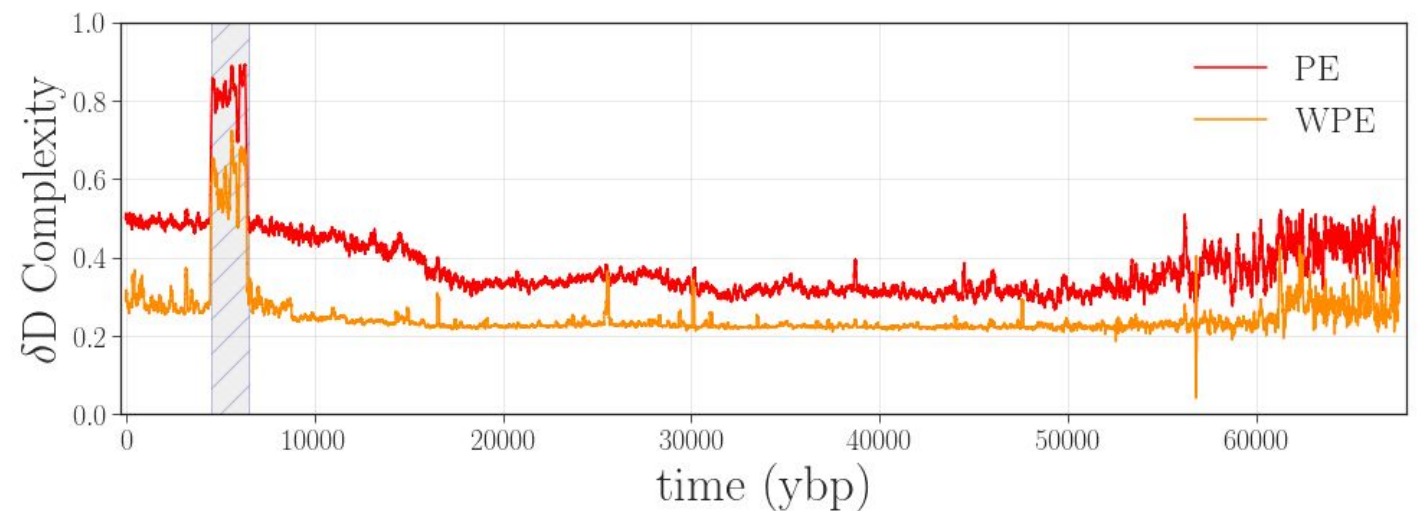
Michael Neuder, Elizabeth Bradley, Edward Dlugokencky, James W. C. White, and Joshua Garland
Phys. Rev. E **103**, 022217 – Published 26 February 2021

PE techniques flag noise and other anomalies in data

Water isotope data from the
West Antarctic Ice Sheet Divide
(WAIS) core

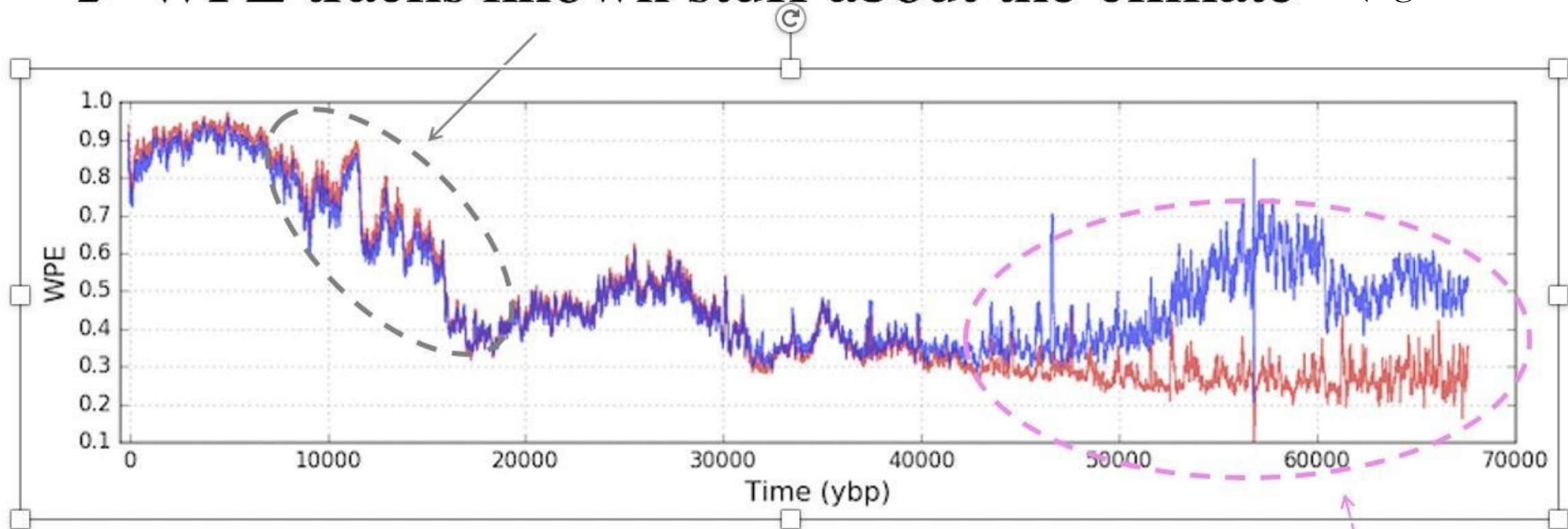


One segment of this core was analyzed with an older instrument. The effects of that, which were all but invisible in the raw data, were brought out clearly by PE-based calculations



Doing *science* with permutation entropy

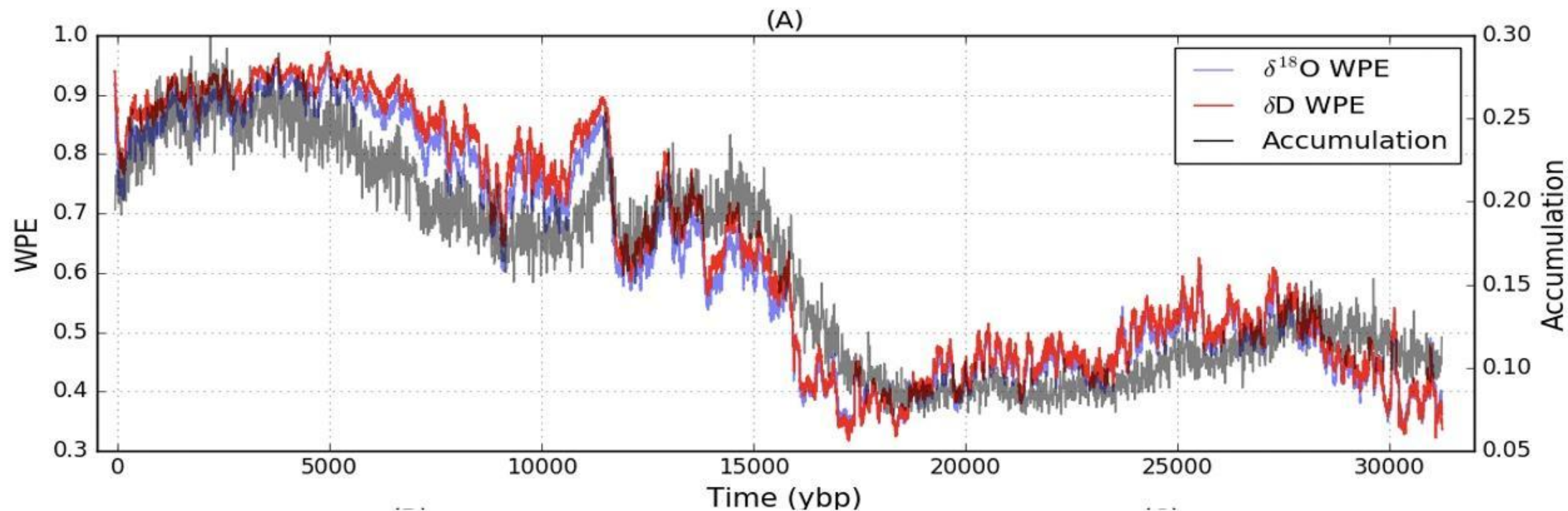
→ WPE tracks known stuff about the climate (e.g. YD/BO)



but WPE of dD and $d^{18}O$ diverge near the base of the ice sheet...possible signature of heating at the base of the core? (*Note: not visible in raw data*)

Doing *science* with permutation entropy

➔ WPE tracks accumulation



This is cool because the grey curve is real work for a person while the red one is seconds on a CPU

➔ And maybe the deviations from perfect tracking are encodings of climate signals???



An information-theoretic approach to extracting climate signals from deep polar ice cores

The main take-away:

PE-based techniques can pull out information that is lurking in your data...

- Anomalies
- Noise
- Science!

For more:

SIAM NEWS OCTOBER 2018



Research | October 01, 2018

Information Theory in Earth and Space Science

By Joshua Garland and Elizabeth Bradley



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<https://home.cs.colorado.edu/~lizb/paleoWPE.html>

