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A statistical look at turbulence from high-resolution temperature measurements above a deep-ocean sloping seafloor.

Andrea Cimatoribus and Hans van Haren
Royal NIOZ, Physical Oceanography, 't Horntje (Texel), Netherlands (andrea.cimatoribus@nioz.nl)

A detailed analysis of the statistics of temperature in an oceanographic observational dataset is presented. The data is collected using a moored array of 144 thermistors, $100\,\mathrm{m}$ tall, deployed above the slopes of a seamount in the North Eastern Atlantic Ocean from April to August 2013. The thermistors are built in-house at the Royal Netherlands Institute for Sea Research, and provide a precision better than $10^{-3}\,\mathrm{K}$ and very low noise levels. The thermistors measure temperature every second, synchronised throughout the moored array. The thermistor array ends $5\,\mathrm{m}$ above the bottom, and no bottom mixed layer is visible in the data, indicating that restratification is constantly occurring and that a mixed layer is either absent or very thin. Intense turbulence is observed, and a strong dependence of turbulence parameters on the phase of the semidiurnal tidal wave (the dominant frequency in the power spectrum) is also evident.

We present an overview of the results obtained form this dataset, exploiting the unprecedent detail of the observations. We compute the statistical moments (generalised structure functions) of order up to 10 of the distributions of temperature increments. Strong intermittency is observed, in particular, during the downslope phase of the tide, and farther from the seafloor. In the lower half of the mooring during the upslope phase, the temperature statistics are consistent with those of a passive scalar. In the upper half of the mooring, the temperature statistics deviate from those of a passive scalar, and evidence of turbulent convective activity is found. The downslope phase is generally thought to be more shear-dominated, but our results suggest on the other hand that convective activity is present. High-order moments also show that the turbulence scaling behaviour breaks at a well-defined scale (of the order of the buoyancy length scale), which is however dependent on the flow state (tidal phase, height above the bottom). At larger scales, wave motions are dominant.