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What is spiciness and is it really passive?

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Variations of temperature and salinity along a given isopycnal surface are generally referred to as spice, given that the waters can either be relatively warm and salty (spicy) or cold and fresh. While many studies of density-compensating temperature and salinity anomalies are done by studying either temperature or salinity anomalies on isopycnal surfaces, there has been several attempts in the past to define a dedicated variable, called spiciness, to measure T/S variations on isopycnals, most notably by Jackett and McDougall (1985) and Flament (2002). The use of a dedicated single variable to measure spice has the obvious advantage that it can facilitate in principle the study of spiciness anomalies without necessarily having to restrict oneself to isopycnal surfaces. An understanding of the evolution equation for spiciness, and in particular of its source and sink terms can also facilitite linking its variations to surface fluxes. In this paper, we outline the desirable properties that any spiciness variable should possess to be useful, and in so doing we have to revisit the classical definition of Jackett and McDougall (1985) and Flament (2002). Several possible alternative definitions of spiciness are proposed, and we compare their relative advantages and weaknesses. We also discuss the important issue of the extent to which spiciness can be regarded as a passive tracer. While spiciness is often regarded as a passive tracer, we show that spiciness actually affects the density field in a number of obvious and more subtle ways which means that it cannot be truly be passive. These effects will be discussed and quantified.