Minimal Lattice Model with Water-Like Anomalies

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The notion that water behaves as an intimate mixture of two competing states has a long history, and is able to account for many anomalous properties such as water's density maximum or compressibility and heat capacity increase upon cooling. Based on molecular dynamics simulations, phase separation of water in two distinct liquids (polyamorphism) has been predicted, but at temperatures that are too low for obtaining a clear experimental proof. This leaves open the possibility of explaining water's anomalies with other scenarios which do not involve a liquid-liquid phase separation. Here we present a minimal lattice model of a mixture of two interconverting species. By varying its few parameters, the model is able to generate water-like anomalies and to capture all proposed scenarios for water. Interestingly, even in the symmetric case where the two pure fluids made of one of the species have the same thermodynamics, the interconverting fluid can exhibit water-like anomalies.