



## **On the use of composite analyses to form physical hypotheses: An example from heat wave – SST associations**

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This study highlights some caveats in using composite analyses to form physical hypotheses on the associations between environmental variables. This is illustrated using a specific example, namely the apparent links between heat waves (HWs) and sea surface temperatures (SSTs). In this case study, a composite analysis is performed to show the global and regional SST conditions observed during summer HWs in southwest Australia. Results initially point to the importance of the subtropical South Indian Ocean, where physically coherent SST dipole anomalies may form a necessary preconditioning for HWs to develop across southwest Australia. However, sensitivity experiments based on pattern correlation analyses, and using both observations and coupled climate model simulations, indicate that the vast majority of days when the identified SST pattern appears are actually not associated with HWs, which suggests that this is definitely not a sufficient condition for HW development. The results presented here have interesting implications and applications for other climate case studies, and highlight the importance of applying comprehensive statistical approaches before making physical inferences on apparent climate associations.