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# On the Role of North Atlantic Sea Surface Temperatures for European Heat Events

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## **Dissertation**

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by

**Julian Krüger**

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Main Supervisor and  
First Examiner:

**Prof Dr. Joakim Kjellsson**

GEOMAR - Helmholtz Centre for Ocean Re-  
search Kiel

Research Division: Ocean Circulation and  
Climate Dynamics

Research Unit: Marine Meteorology

Second Examiner:

**PD Dr. Joke Lübbecke**

GEOMAR - Helmholtz Centre for Ocean Re-  
search Kiel

Research Division: Ocean Circulation and  
Climate Dynamics

Research Unit: Physical Oceanography

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## Abstract

The European continent experienced a considerably increased number of heat events within the last two decades, most likely driven by a surface warming due to anthropogenic greenhouse gas emissions. The investigation of heat events and associated drivers is essential due to numerous impacts, e.g., on human health. The European heat event in 2015 was accompanied by unusually cold sea surface temperatures (SSTs) south of Greenland, which led to the influence of North Atlantic SSTs being considered along with other potential drivers. This thesis incorporates three different research chapters, all contributing to disentangle the role of North Atlantic SSTs for European heat events.

The first chapter is based on a composite study with reanalysis data and highlights that events of unusually cold North Atlantic SSTs with a negative tendency precede a surface temperature maximum over central Europe a few days later, increasing the probability for European heat events.

The second chapter utilises seven coupled climate models with different horizontal resolutions in the atmosphere and ocean model component. The model simulations generally confirm the identified relationship between cold North Atlantic SSTs with a negative tendency and European heat events. The relationship is better reproduced with an increased horizontal resolution, particularly of the ocean model component.

The third research chapter demonstrates the importance of SSTs and warm conveyor belt activity in the North Atlantic sector for the development of the 2015 European heat event. Additionally, sub seasonal-to-seasonal reforecasts are used to estimate the forecast skill of North Atlantic warm conveyor belt activity and the 2015 European heat event.

All three research chapters emphasise to account for North Atlantic SSTs in future assessments of the European summer climate and the development of European heat events.