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# The role of heat-flux–temperature covariance in the evolution of weather systems

**Andrea Marcheggiani** and Maarten Ambaum
Department of Meteorology, University of Reading, Reading, UK (a.marcheggiani@pgr.reading.ac.uk)

Local diabatic heating and temperature anomaly fields need to be positively correlated for the diabatic heating to maintain a circulation against dissipation. Here we quantify the thermodynamic contribution of local air–sea heat exchange on the evolution of weather systems using an index of the spatial covariance between heat flux at the air–sea interface and air temperature at 850 hPa upstream of the North Atlantic storm track, corresponding with the Gulf Stream extension region. The index is found to be almost exclusively negative, indicating that the air–sea heat fluxes act locally as a sink on potential energy. It features bursts of high activity alternating with longer periods of lower activity. The characteristics of these high-index bursts are elucidated through composite analysis and the mechanisms are investigated in a phase space spanned by two different index components. It is found that the negative peaks in the index correspond with thermodynamic activity triggered by the passage of a weather system over a spatially variable sea-surface temperature field; our results indicate that most of this thermodynamically active heat exchange is realised within the cold sector of the weather systems. Finally, we will discuss the implications of our findings, including a link with meridional heat flux pulses and a novel way of understanding whether such pulses are due to enhanced correlations or enhanced variances.