Current measurements signify a cooling of the tropical lower stratosphere (TLS) and most chemistry-climate models (CCMs) demonstrate a link to an intensifying tropical upwelling, caused by the anthropogenic increase in well-mixed greenhouse gas (GHG) concentrations. In particular, the associated rise in tropical sea surface temperatures (SSTs) appears to stimulate the dissipation of resolved waves in the TLS, and hence the local upwelling. Yet, the relevant studies are ambiguous about the mechanisms behind the dissipation enhancement. We present findings from our studies with the CCMs E39C and E39C-A.

For E39C, we compare two transient scenarios that share the same boundary conditions, but differ via prescribed SSTs and GHG concentrations. In the summer hemisphere tropics, the higher SSTs amplify the deep-convective excitation of quasi-stationary waves. These waves propagate upward, intensifying the wave dissipation in the TLS. Our findings for E39C-A are based both on a multi-decadal transient simulation and on a set of sensitivity simulations in time slice mode. The former includes a steady increase in GHG concentrations and SSTs. The latter serve to isolate the sensitivity to differences in SSTs and GHG concentrations. Again, the dissipation of resolved waves intensifies in the TLS mainly in response to higher tropical SSTs. The intensification, however, occurs year-round and is associated with quasi-stationary and transient waves which propagate into the TLS more efficiently due to altered zonal winds.

Resolving the discrepancy is an important task and, given the entanglement of zonal winds and waves, should not only involve CCMs, but also simpler mechanistic models.