Diabatic heating is an important driver of the atmospheric circulations. The horizontal distribution and vertical structure of diabatic heating in the tropics influences (and is influenced by) the thermodynamic structure and clouds and precipitation. Differences in the diabatic heating distribution provide insights on representation of moist physics, including convective processes, and can thus help to identify problems in recent atmospheric reanalyses and general circulation model based climate simulations. In this study, residually diagnosed El Niño-Southern Oscillation (ENSO)-related diabatic heating is intercompared in three recent reanalyses – ERA-interim, MERRA2 and the CFSR – in order to assess the robust and uncertain aspects of the ENSO heating anomaly structure. The latent heating from the Tropical Rainfall Measuring Mission (TRMM) estimates of the convective and stratiform components of precipitation serve as the reference for the diabatic heating distribution in the reanalyses and model simulations. The diabatic heating of the Coupled Model Intercomparison Project Phase 5 (CMIP5) models, which were separated into two groups based on their performances in precipitation climatology and ENSO-related precipitation, are also compared with the reanalyses heating. We also show the 3D diabatic heating structure along with the tropical Hadley and Walker circulations in both climatology and ENSO conditions. The preliminary results suggest that the both diabatic heating climatology and ENSO-related diabatic heating profiles of ERA-interim, MERRA2 and the CFSR are very similar, with the CFSR ones being weaker over the equatorial Pacific. Both CMIP5 groups exhibit more westward located heating anomaly centers in the tropical Pacific than in the reanalyses during ENSO. The better performing group exhibits strong resemblance to the reanalyses in most of the heating and circulation features. The underperforming group has much weaker heating and circulations over the tropical Pacific than in the other datasets in climatology and during ENSO.