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If you work with phenology, you work with bud cold hardiness dynamics

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Budbreak is one of the most observed and studied phenological phases in perennial plants. Historically, two effects of temperature are used to model budbreak: the accumulation of heat units (forcing); and the accumulation of time spent at low temperatures (chilling). These two effects have a well-established negative correlation: the more chilling, the less forcing is required to reach budbreak. However, prediction of budbreak remains a challenge, as even artificial warming experiments do not match changes in observed budbreak timing during the past few decades of climate warming. The cold hardiness of buds is, however, largely ignored in estimations of timing to budbreak. Cold hardiness level fluctuates throughout the winter as temperatures change, constantly altering the initiation point of deacclimation. During budbreak assays, cold hardiness loss is extremely slow (low deacclimation rate) at low chill accumulation, and increases to a maximum at high chill accumulation. By standardizing deacclimation rates for each species based on the maximum observed, a deacclimation potential describes dormancy fulfillment. Our studies show that deacclimation rates vary at different temperatures demonstrating the effect of forcing is non-linear. We show that the concept of variable chilling requirements for satisfying dormancy (high chill vs. low chill) is largely erroneous and instead these phenotypes reflect previously unmeasured differences between species or genotypes regarding the interaction between cold hardiness state and deacclimation potential. Our studies show that forcing responses (maximum rates of deacclimation) are normally distributed within a species, and are a heritable trait. Three effects of temperature are thus necessary to describe contemporary phenology patterns as well as predict future impacts of climate change: the accumulation of chill, the forcing temperature response, and the cold hardiness of buds.