Abstract: Rational modulations of molecular interactions are of significant importance in compound properties optimization. We have previously shown that fluorination of conformationally rigid cyclohexanols leads to attenuation of their hydrogen-bond (H-bond) donating capacity (designated by pK\textsubscript{AHY}) when OH···F intramolecular hydrogen-bond (IMHB) interactions occur, as opposed to an increase in pK\textsubscript{AHY} due to the fluorine electronegativity. This work has now been extended to a wider range of aliphatic b-fluorohydrins with increasing degrees of conformational flexibility. We show that the observed differences in pK\textsubscript{AHY} between closely related diastereomers can be fully rationalized by subtle variations in populations of conformers able to engage in OH···F IMHB, as well as by the strength of these IMHBs. We also show that the Kenny theoretical Va(r) descriptor of H-bond acidity accurately reflects the observed variations and a calibration equation extended to fluorohydrins is proposed. This work clearly underlines the importance of the weak OH···F IMHB in the modulation of alcohol H-bond donating capacity.