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There are two inequivalent notions of relative nearby cycles for a complex analytic function; while the two collections of cohomology modules are isomorphic, the monodromy acts very differently on them. The two corresponding notions of relative vanishing cycles have non-isomorphic cohomology modules, and yet are related in a way that is easy to visualize via polar curves and discriminant loci. This relationship, when combined with properties of distinguished bases for vanishing cycles, leads to nontrivial bounds on the Betti numbers of Milnor fibers, and to restrictions on the types of perverse sheaves that can be vanishing cycles of intersection cohomology complexes. (Received August 31, 2010)