

Boundedness properties of some classical operators of harmonic analysis (namely the Hilbert and Riesz transforms, the Riesz potentials and (fractional and nonfractional) maximal operators) as well as certain Sobolev-type embeddings on the entire space are studied. The compactness of Sobolev trace embeddings is also investigated. The focus is on the optimality of the results within the class of rearrangement-invariant function spaces. The aforementioned questions are reduced to equivalent problems concerning appropriate Hardy-type operators acting on functions of a single variable. The behavior of the Hardy-type operators on rearrangement-invariant function spaces is investigated first. The results concerning the Hardy-type operators are used as the building blocks from which together with known results from the literature the other results are obtained. To illustrate possible applications, general results are accompanied by particular examples. The results presented in this thesis are based on some of the papers authored or coauthored by the author.