Differential interferometry based on satellite-based remote sensing sensors using synthetic aperture radar (DInSAR) has widely proven expedient for detecting deformations of the earth's surface. It enables measuring accuracies in the range of millimetres. Beside many questions in earth sciences, it also became interesting for geodetic measurements, for example height changes induced by mining activities. To achieve high measuring accuracies, error sources in the data have to be known, and furthermore should be avoided as possible. This doctoral thesis mainly treats the influence of the earth's atmosphere on differential radar interferometric results.

The earth's atmosphere possesses considerable influence on the propagation of electromagnetic waves emitted by satellite-based radar sensors. In particular, small-sized inhomogeneities of the troposphere originating from weather, as well as differing electron densities in the ionosphere, play an important role. In interferograms, atmosphere appears as an additional phase component in superposition with other components indicating deformation or topography. Furthermore interferograms always contain the difference between the two atmospheric conditions of the acquisition dates used for building the interferogram.

In this thesis, a new type of method is presented allowing to determine the atmospheric phase shift of a single acquisition date. Calculations are based on a time-series of radar acquisitions. All interferogram combinations relating to one date also contain the atmospheric phase shift of this date, which allows its statistical determination. As a special feature of the proposed method, there is no need for phase unwrapping beforehand. In addition the approach enables to detect borders of deformation areas and the identification of single pixels with stable phase over time.

Results will be shown based on a total of six time series originating from radar sensors of three remote sensing satellites: TerraSAR-X, ENVISAT, and ALOS. These sensors possess different radar wavelengths in the X-, C- und L-band of the spectrum, enabling the examination of frequency-dependent influences.

The information derived from radar data using the new method is compared with weather data. In particular optical remote sensing data originating from METEOSAT MSG and ENVISAT MERIS show good analogy. Also imaginable is the prospective usage of the derived results in order to gain meteorological characteristics of the atmosphere with high spatial resolution.

Furthermore, several parameters have been developed, allowing the characterisation and comparison of atmospheric conditions to different dates. Using these parameters seasonal and monthly differences in the occurrence of the atmosphere can be observed, showing greater atmospheric effects during summer, while lower in winter times. Also comparison of the atmospheric magnitudes between radar sensors are performed and discussed, due to differing solar radiation depending on the acquisition time. Moreover the ionosphere causes a different seasonal behaviour at long radar wavelengths (for instance using ALOS) compared to the shorter wavelengths of ENVISAT and TerraSAR-X.

Finally considerations concerning the theoretical detectability of height changes using differential radar interferometry are done. Taking into account the occurrence of atmospheric signals in the data, consequences upon diverse interferometric techniques like raster-based interferogram stacking or point-based persistent scatterer interferometry (PSI) are discussed.