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Title of the dissertation: Large-scale flood mapping using SAR remote sensing data

Abstract

Floods are among the most damaging and costly natural disasters worldwide. Spaceborne synthetic aperture radar (SAR) sensors provide a valuable opportunity for monitoring flood-affected areas globally regardless of solar illumination and weather conditions. However, due to the complexity of relevant backscattering mechanisms and the diversity of land cover classes affected by floods, fully automated flood mapping algorithms at large-scale are still missing. Moreover, this technology offering for operational emergency response is limited by a current lack of information about land areas where observations of radar backscatter do not allow detecting the presence of water. In this general framework, the work of the thesis has targeted the development of two automatic large-scale flood mapping algorithms, i.e. the first one focussing on rural areas that takes advantage of historic time series of SAR intensity data and a second one focussing on urban areas using multi-temporal SAR intensity and interferometric SAR coherence. Additionally, a new method based on Sentinel-1 time-series has been developed and evaluated for automatically identifying regions where SAR data are not sensitive to the appearance of floodwater. The development of these three algorithms has allowed increasing our understanding of floodwater mapping using SAR data, in terms of selecting adequate reference images, handling the effects of incidence angles and wind, dealing with the issue of water-lookalike surfaces and problematic land use classes such as vegetation and built-up areas. Meanwhile, the thesis explored the potential of innovative machine learning algorithms by developing an urban-aware module for efficiently fusing heterogeneous sources of information.