EGU23-10088, updated on 23 Apr 2024
https://doi.org/10.5194/egusphere-egu23-10088
EGU General Assembly 2023

Removing Atmospheric Noise from Interferograms in Mountainous Regions with a Deep Convolutional Neural Network

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Atmospheric errors in interferometric synthetic aperture radar (InSAR)-derived estimates of surface deformation often obscure real signals, especially in mountainous terrain. By taking advantage of the differing spatial characteristics of periglacial landforms and atmospheric noise, we trained a deep convolutional neural network (CNN) to remove atmospheric noise from individual interferograms. Unlike existing corrections, which rely on coarse climate reanalysis or radiometer data, this computer vision correction is applied at the spatial and temporal resolution of the interferogram. We processed Sentinel 1 interferograms of the Colorado Rocky Mountains using the Alaska Satellite Facility's Hybrid Pluggable Processing Pipeline (ASF HyP3) and used the Miami INsar Time-series software in PYthon (MintPy) package to generate low-noise line-of-sight (LOS) velocity maps containing primarily rock glacier and hillslope motion. These maps were combined with noisy short temporal-baseline interferograms to contrive a training dataset. Model performance was assessed using the structural similarity index measure (SSIM) and compared to that of other widely used corrections. We find that our CNN significantly outperforms standard corrections and that previously hidden intraseasonal kinematic behavior is revealed in Colorado rock glaciers. We suggest that insights from external validation against GNSS data and sensitivity analysis could be used to further improve model performance and assess model scalability and transferability.