Urban Footprint Mapping with Sentinel-1 Data

By

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Objective:
The goal of this process is to map urban footprints by analyzing Sentinel-1 synthetic aperture radar (SAR) data. By using backscatter and coherence values from the SAR data, urban areas can be distinguished from other land cover types like agricultural fields or forests, providing insights into stable and developed areas.

Why Urban Footprint Mapping?
Urban footprint mapping helps identify stable, developed regions (such as urban areas) by analyzing the consistency of radar signals between different time points. This process supports urban planning, disaster management, and environmental monitoring by distinguishing urban areas from rural, agricultural, or natural zones based on how radar waves scatter off the surfaces.

Procedure Overview:

1. **Data Preparation**: Sentinel-1 SLC datasets from two different dates are imported. After visualizing the SAR bands, a subset of the area of interest is selected.
2. **Orbit Application & Calibration**: Precise orbits are applied to ensure accurate satellite positioning, followed by radiometric calibration to adjust the radar signal values.
3. **Debursting and Multi-Looking**: Debursting removes image gaps, and multi-looking enhances the signal by averaging pixel values, which improves visual quality.
4. **Backscatter to dB Conversion and Terrain Correction**: The radar backscatter is converted to dB for better interpretability, and geocoding (terrain correction) is applied to adjust the image based on the Earth's curvature.
5. **Coherence Estimation**: By comparing the radar signal phases between two dates, coherence is calculated to determine areas of stability (high coherence) or change (low coherence).
6. **Creating the Urban Mask**: Using backscatter and coherence values, urban areas are masked based on set thresholds (e.g., backscatter > -10 dB, coherence > 0.6), with another threshold applied for further refinement.