Comparing DInSAR time series software and their compatibility with RMACC resources: MintPy and MSBASv3

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Abstract

The recent growth in access to C-band Synthetic Aperture Radar (SAR) data through the European Space Agency (ESA) Sentinel-1A/B satellites and the upcoming NASA-ISRO Synthetic Aperture Radar (NISAR) mission provides increased opportunities for differential interferometric synthetic aperture radar (DInSAR) monitoring. In 2020 we developed a container which allowed use of dockerized InSAR scientific computing environment (ISCE) (Rosen, 2012) software from 2019, allowing us to rapidly generate DInSAR pairs from Sentinel-1 imagery using the ISCE processing software at ~10 meter resolution in the Rocky Mountain Advanced Computing Cluster (RMACC). Here we compare results from an updated ISCE workflow with a stack processor (Fattahi 2017), from a newly generated container running on RMACC against the previous version of ISCE. The new workflow is compatible with the MintPy (Yunjun 2019) DInSAR time series software, which I compare with the previous time series processed with Multidimensional Small Baseline Subset (MSBAS) (Samsonov 2013). Results from both workflows are used to create a time series of subsidence for Lagos, Nigeria, where rapid urban growth has led to accelerated subsidence throughout the city in recent years. The new results also incorporate European Center for Medium-Range Weather Forecasts (ECMWF) atmospheric corrections and a newly available Ionospheric correction.

Future Steps:

- Write up paper with subsidence related findings
- Provide clearer examples showing the additional capabilities of the Ionospheric Correction

References:

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MSBASv3 Methodology

- Built from Alaska Satellite Facility Docker from 2019
- Provided parallelizable method for processing Interferograms

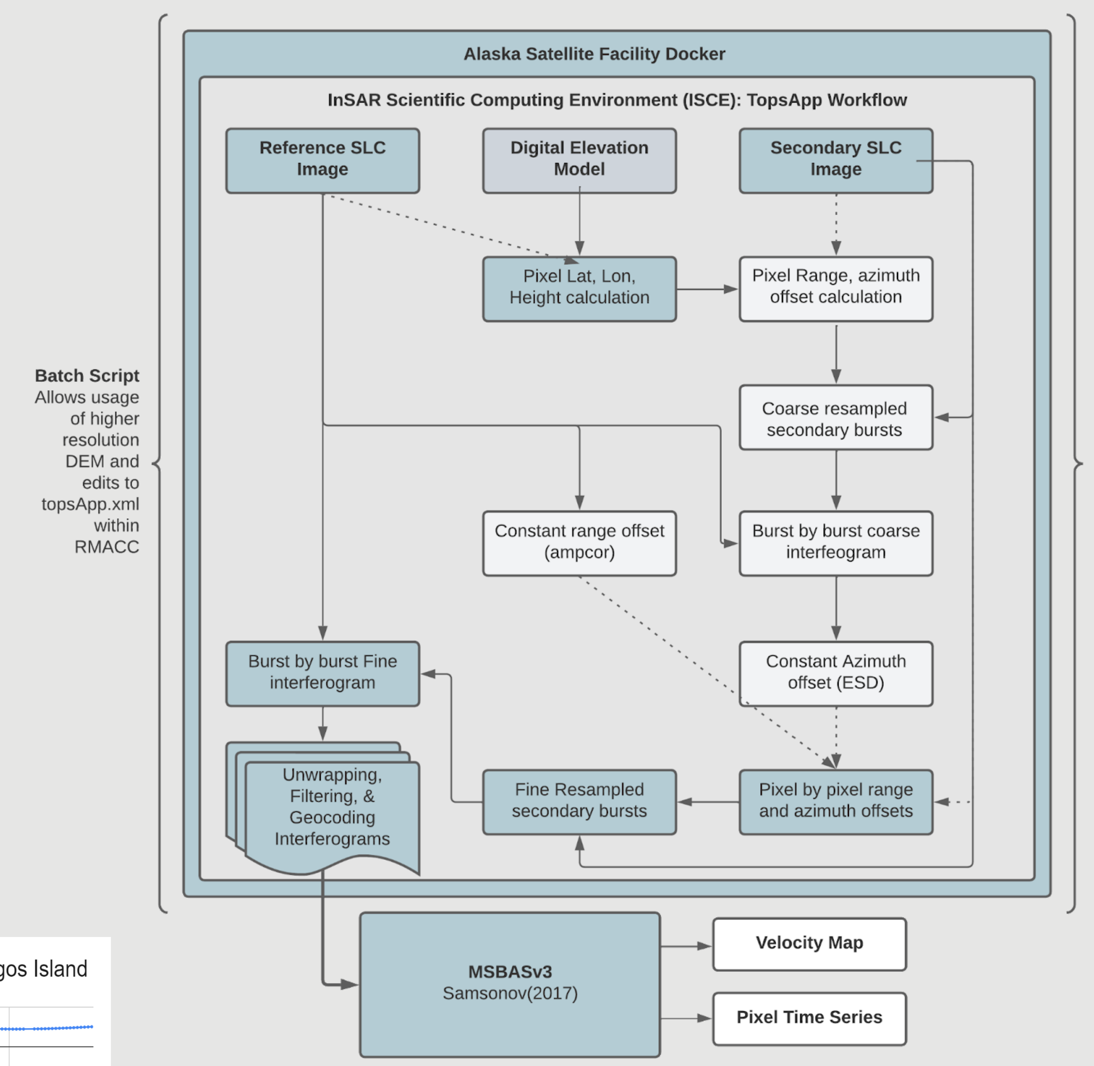

Figure 1. TopsApp workflow with the ASF docker and software wrapper.

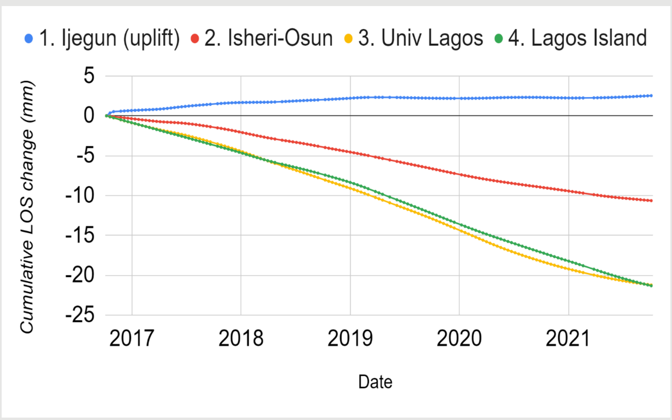

Figure 2. Pixel time series showing motion for locations marked by Diamonds in Figure 3

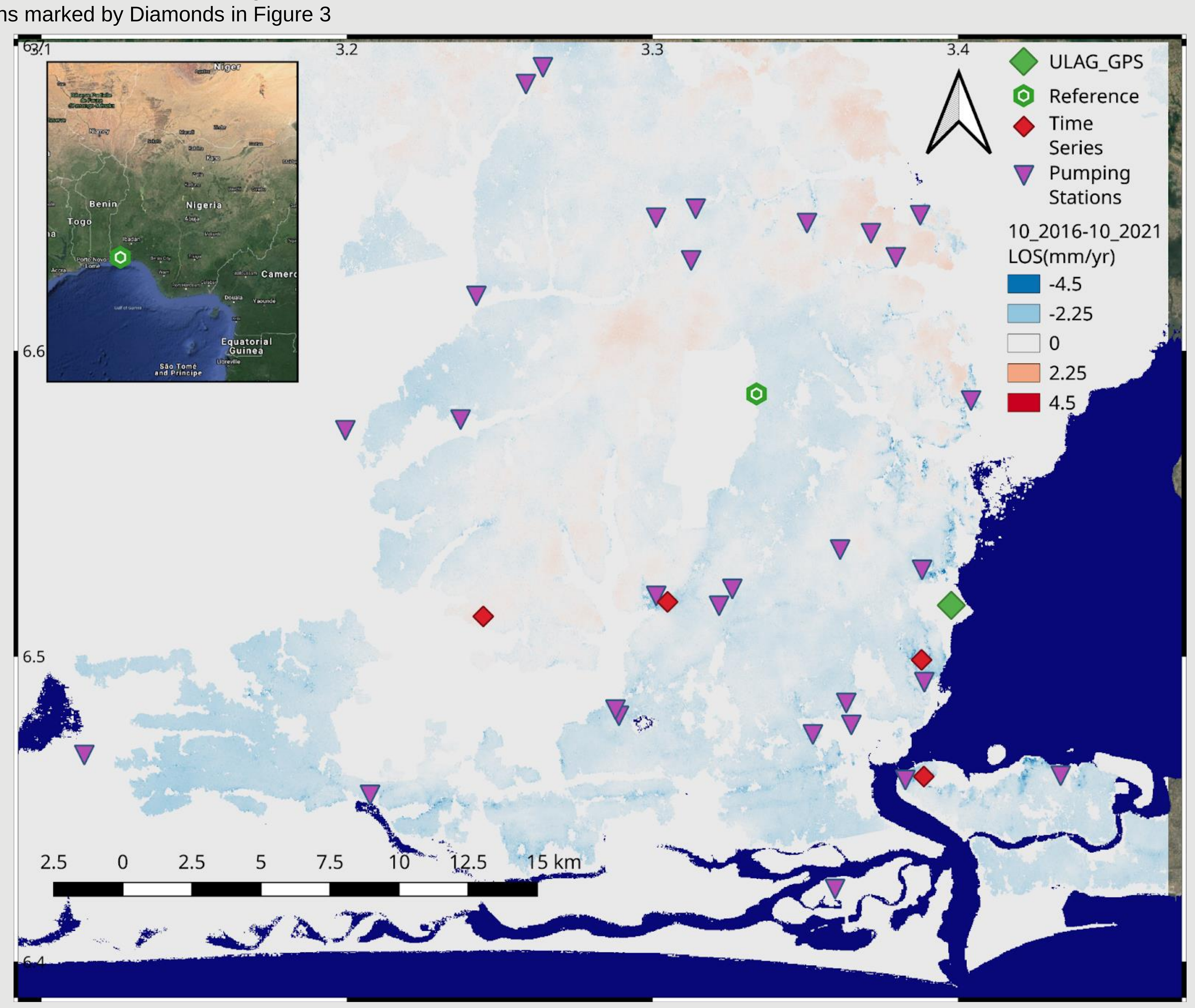

Figure 3. Line of Sight (LOS) map on left from October 2016 – October 2021 displaying yearly LOS motion for Lagos Nigeria. The map's reference point is directly East of the Lagos Airport, displayed by green hexagon. Pumping station locations are from Balogun et al. 2016, displayed in purple triangles. Four points were selected to show individual time series, which are numbered and displayed above.

MintPy Methodology

- Contains up to date version of ISCE with ionospheric correction
- Stack processors are more computationally efficient.
- Has more compatibility with time series generators.

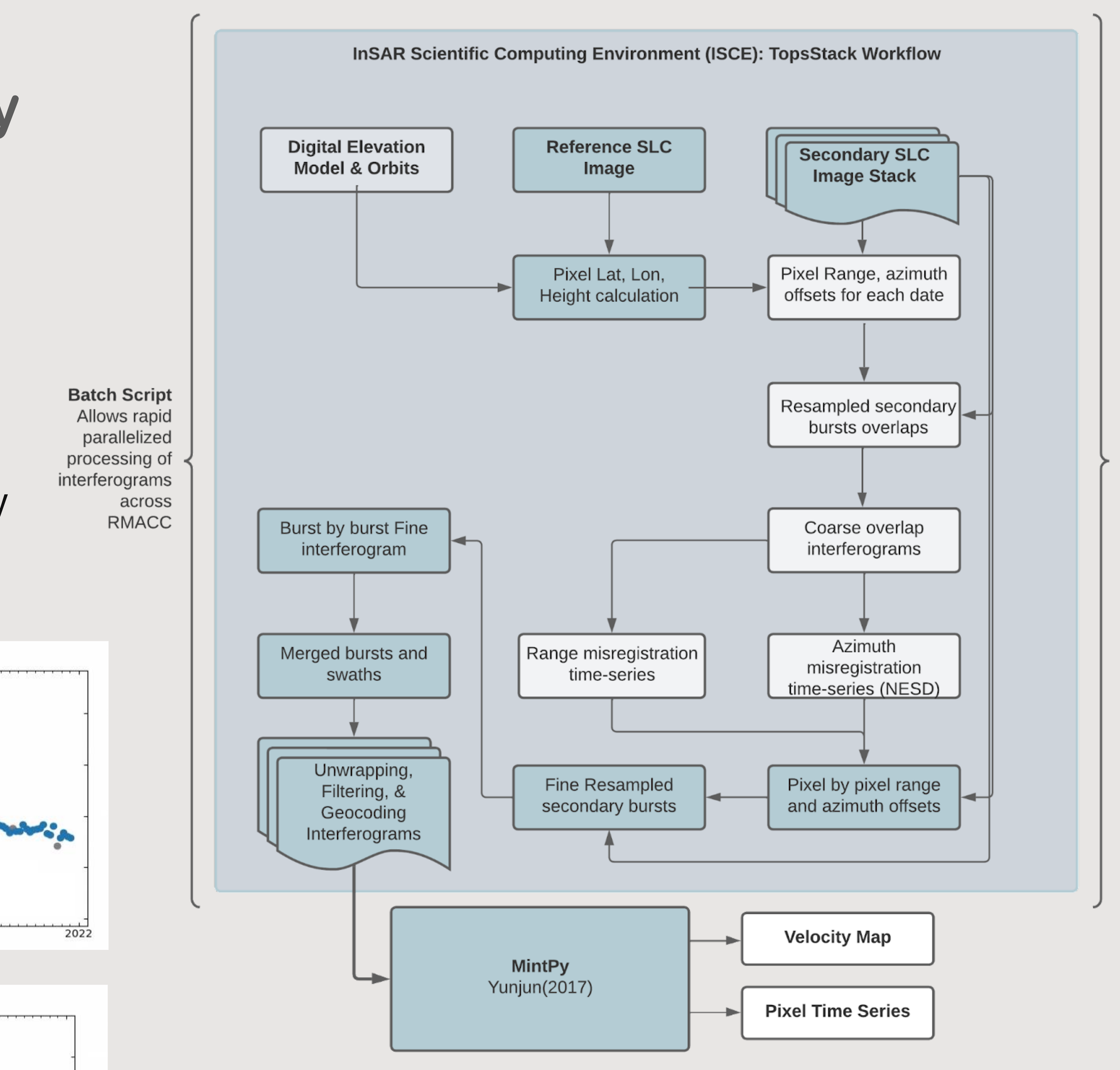

Figure 4. TopsStack workflow running on RMACC resources for parallelized processing

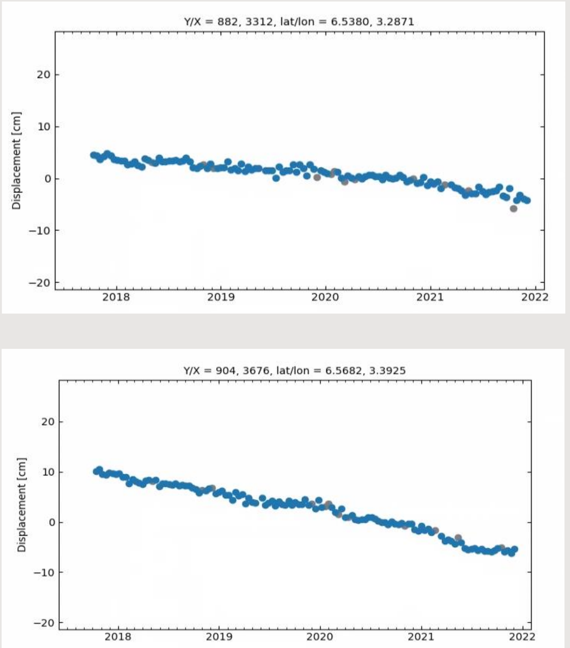

Figure 5. Pixel time series showing motion for locations marked by Diamonds in Figure 6

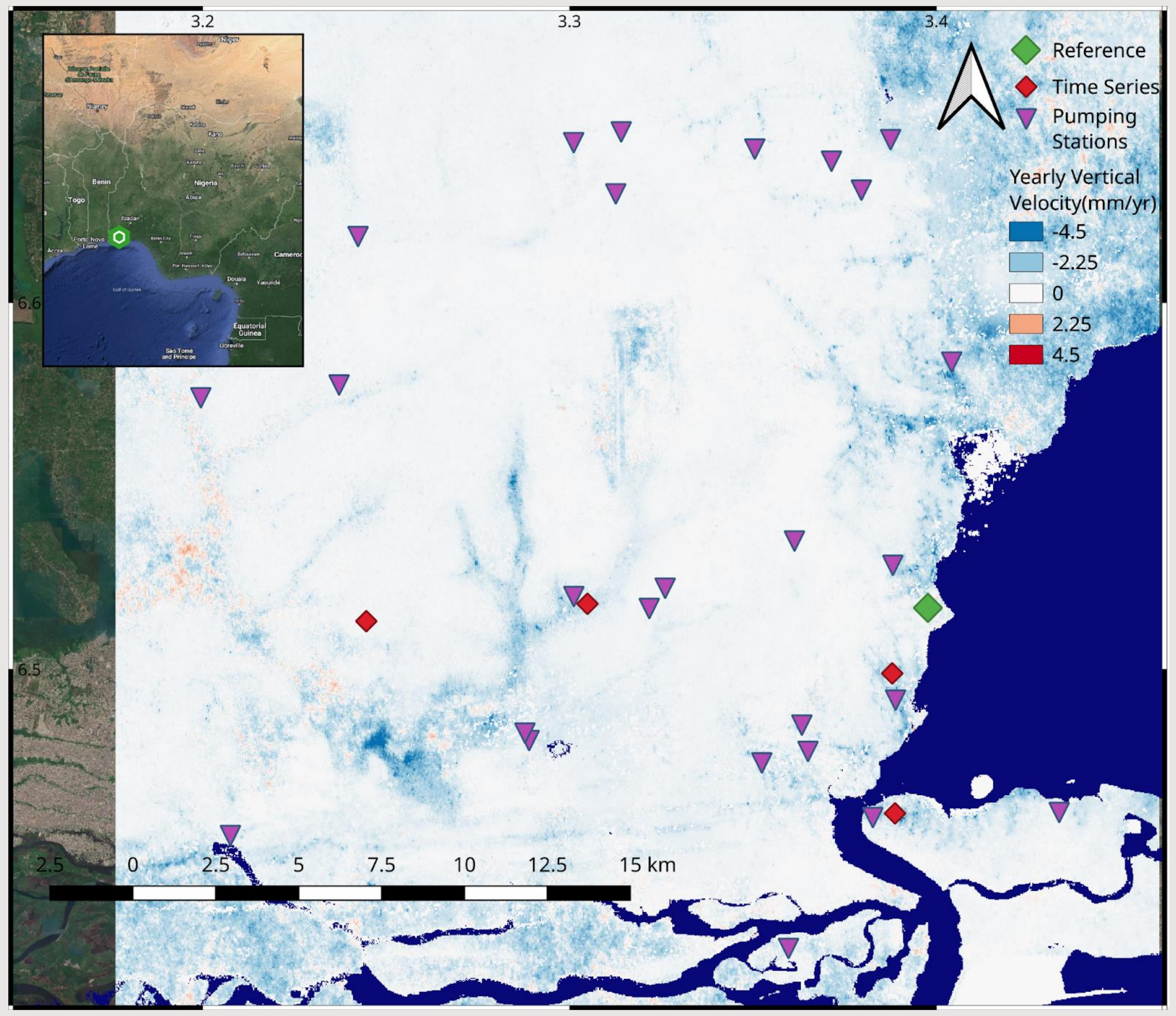

Figure 6. Map of vertical motion from October 2017 – December 2021 in Lagos, Nigeria. The map's reference point is displayed by the green diamond. Pumping station locations are from Balogun et al. 2016, displayed in purple triangles. Two points were selected to show individual time series, which are numbered and displayed above.