Engineering Applications of Radar Remote Sensing: Monitoring of Critical Infrastructure, and of Open and Underground Mining

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Sentinel-1 Ascending

Sentinel-1 Descending







ascending time-series







 close monitoring of surrounding area important to detect deformation related e.g. to groundwater lowering

Mining deformation in Inner Mongolia, China



Shangwan underground coal mine

- a main pit of Shendong Coal branch
- coal mine area of 61.8 square kilometers
- geological reserves of 1.23 billion tons (recoverable reserves of 830 million tons)
- established in 2000, produced 13.3 million tons of coal in 2008





Mining deformation in Inner Mongolia, China



Sentinel-1A Ascending

- 30 images (Path 11 Frame 126)
- 14 Oct 2017- 21 Oct 2018
- 98 interferograms

interferogram example



(b)

(C)







Mining deformation in Inner Mongolia, China



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better stabilization of underground mine needed?

Anthropogenic induced ground motion in Berlin



- Salt pillows used for gas storage
- ~10 × 10 km² area
- Maximum ~5 mm/yr uplift (Kampes 2005, Kuehn et al. 2009)

- Sentinel-1 dataset
 - > 2014 2017
 - ➢ 68 ascending images
 - 63 descending images

Haghighi and Motagh 2017, ZFV



Anthropogenic induced ground motion in Berlin



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Anthropogenic induced ground motion in Berlin





for precise geolocation increase in spatial baseline needed!

Subsidence in Teheran



Subsidence in Teheran



Subsidence in Teheran







Construction period: 1995-2000 Watershed area: 60,000 km² Dam type: earth-fill dam with a vertical clay core Crest length 500 m & Crest width: 15 m Potency: 2000 MW Spillway capacity: 21700 m³/sec





















descending interferograms





ascending interferograms





usefulness of only one orbit prevents decomposition to 3D deformation! HELMHOLTZ





Emadali L., Motagh M., and Haghshenas Haghighi M., 2017, ENGSTRUCT







one orbit data can provide information where a denser GPS network is needed

Bridge over Lake Urmia, NW Iran

SCIENCE | Seeking the Source of the Vanishing Great Salt Lake





Iran's shrinking Lake Urmia, shown in 1998, left, and 2011 NASA Earth Observatory



Lake Urmia is one of the world's largest salt lakes, but it is shrinking in recent years





Embankments: 1979-1995 Bridge: 2002-2009

Bridge over Lake Urmia, NW Iran



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Bridge over Lake Urmia, NW Iran





Shamshiri, Motagh, et al., JG, 2014



Questions?





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