ALOS-2 (Japan) & Sentinel-1 (global) Layover-shadow Map

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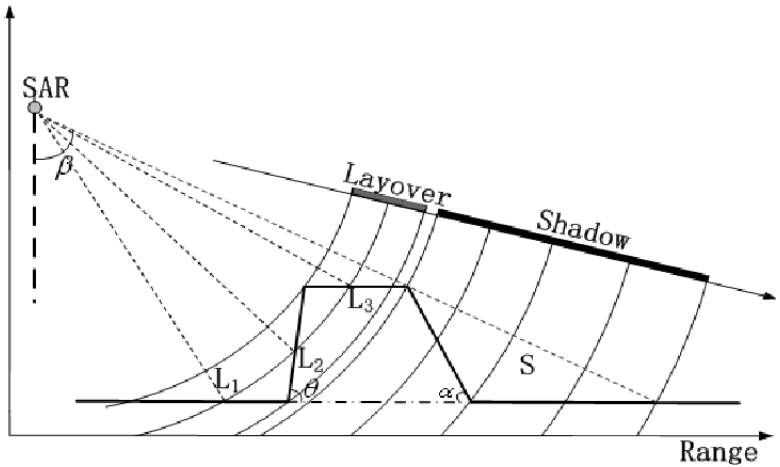
What is layover & shadow?

- Layover and shadow areas caused by the relationship between the SAR observation geometry and the surface topography cannot be normally observed by SAR (i.e., invisible area)
- The layover-shadow map enables to identify the invisible area beforehand (determine the effective SAR data/geometry)



Ren Yun et al 2014 IOP Conf. Ser.: Earth Environ. Sci. 17 012235
https://doi.org/10.1088/1755-1315/17/1/012235

Contents of the product

	ALOS-2	Sentinel-1[*2]
Area	Japan only	Global (partially missing)
Type	Layover-shadow Local incidence angle	Layover-shadow
Resolution	1 arcsec (~30 m)	3 arcsec (~100 m)
DEM	ASTER GDEM ver3	Copernics DEM
Format	Numerical data COG[*1] Image COG[*1] XYZ tiles (ZL5-14)	XYZ tiles (ZL2-12)[*2]
Software	GAMMA (v20211208)	GAMMA (v20201216)[*2]

[*1] Cloud Optimized GeoTIFF

[*2] Numerical data were created by Kellndorfer et al. (2022) and here we created XYZ tiles from them

Data description

Layover-shadow

Numerical value	Image Color	Description
0		Outside of data
1		Neither layover nor shadow
5		Layover
17		Shadow
21		Layover and shadow

Local incidence angle

Numerical value	Image Color
0-90°	

ALOS-2 product

- Target area: Ultrafine (3m) mode, incidence angle 30-44°, right-looking (U2R, basic observation mode)
- Files are split into even/odd path numbers to avoid overlapping
- In areas where the topography has changed significantly since the date of ASTER data acquisition (2000~), the current status may not be reflected (e.g., Miyakejima Island).
- ALOS-4 is also on the same track, so this product can be used without modification
- Naming convention : **U2[AD]R_[oe]_[type][format]**
  - **AD**: Ascending (**A**) or Descending (**D**)
  - **oe**: **odd** or **even** path number
  - **type**: Layover-shadow map (**lsmap**)
    or local incidence angle (**inc**)
  - **format**: Numerical data COG (**_data.tif**), Image COG (**.tif**),
    or XYZ tiles (**/{z}/{x}/{y}.png**)

ALOS-2 product list

Numerical data COG:
https://s3.abci.ai/lsmap-alos-2/U2AR_even_lsmap_data.tif
https://s3.abci.ai/lsmap-alos-2/U2AR_odd_lsmap_data.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_even_lsmap_data.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_odd_lsmap_data.tif
https://s3.abci.ai/lsmap-alos-2/U2AR_even_inc_data.tif
https://s3.abci.ai/lsmap-alos-2/U2AR_odd_inc_data.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_even_inc_data.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_odd_inc_data.tif

Image COG:
https://s3.abci.ai/lsmap-alos-2/U2AR_even_lsmap.tif
https://s3.abci.ai/lsmap-alos-2/U2AR_odd_lsmap.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_even_lsmap.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_odd_lsmap.tif
https://s3.abci.ai/lsmap-alos-2/U2AR_even_inc.tif
https://s3.abci.ai/lsmap-alos-2/U2AR_odd_inc.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_even_inc.tif
https://s3.abci.ai/lsmap-alos-2/U2DR_odd_inc.tif

XYZ tiles:
https://s3.abci.ai/lsmap-alos-2/U2AR_even_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2AR_odd_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2DR_even_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2DR_odd_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2AR_even_inc/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2AR_odd_inc/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2DR_even_inc/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-alos-2/U2DR_odd_inc/{z}/{x}/{y}.png

KMZ to display XYZ tiles (including path number information):
https://s3.abci.ai/lsmap-alos-2/lsmap-alos-2.kmz

Sentinel-1 product

- XYZ tiles derived from numerical data of layover-shadow map created by Kellndorfer et al. (2022, CC by 4.0)
- Files are split into northern/southern and eastern/western hemispheres
- Files are also split by the remainder (0-4) of the path number divided by 5 to avoid overlapping
- Naming convention:
  [NS][EW][AD][mod]_lsmap/{z}/{x}/{y}.png
  - **NS**: Northern (**N**) or southern (**S**) hemisphere
  - **EW**: Eastern (**E**) or western (**W**) hemisphere
  - **AD**: Ascending (**A**) or Descending (**D**)
  - **mod**: remainder (**0-4**) of the path number divided by 5

Sentinel-1 product list

Northern & eastern hemisphere:
https://s3.abci.ai/lsmap-sentinel-1/NEA0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NEA1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NEA2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NEA3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NEA4_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NED0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NED1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NED2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NED3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NED4_lsmap/{z}/{x}/{y}.png

Northern & western hemisphere:
https://s3.abci.ai/lsmap-sentinel-1/NWA0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWA1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWA2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWA3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWA4_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWD0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWD1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWD2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWD3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/NWD4_lsmap/{z}/{x}/{y}.png

KMZ to display XYZ tiles (including path number information):
https://s3.abci.ai/lsmap-sentinel-1/lsmap-sentinel-1.kmz

Southern & eastern hemisphere:
https://s3.abci.ai/lsmap-sentinel-1/SEA0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SEA1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SEA2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SEA3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SEA4_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SED0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SED1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SED2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SED3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SED4_lsmap/{z}/{x}/{y}.png

Southern & western hemisphere:
https://s3.abci.ai/lsmap-sentinel-1/SWA0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWA1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWA2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWA3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWA4_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWD0_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWD1_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWD2_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWD3_lsmap/{z}/{x}/{y}.png
https://s3.abci.ai/lsmap-sentinel-1/SWD4_lsmap/{z}/{x}/{y}.png

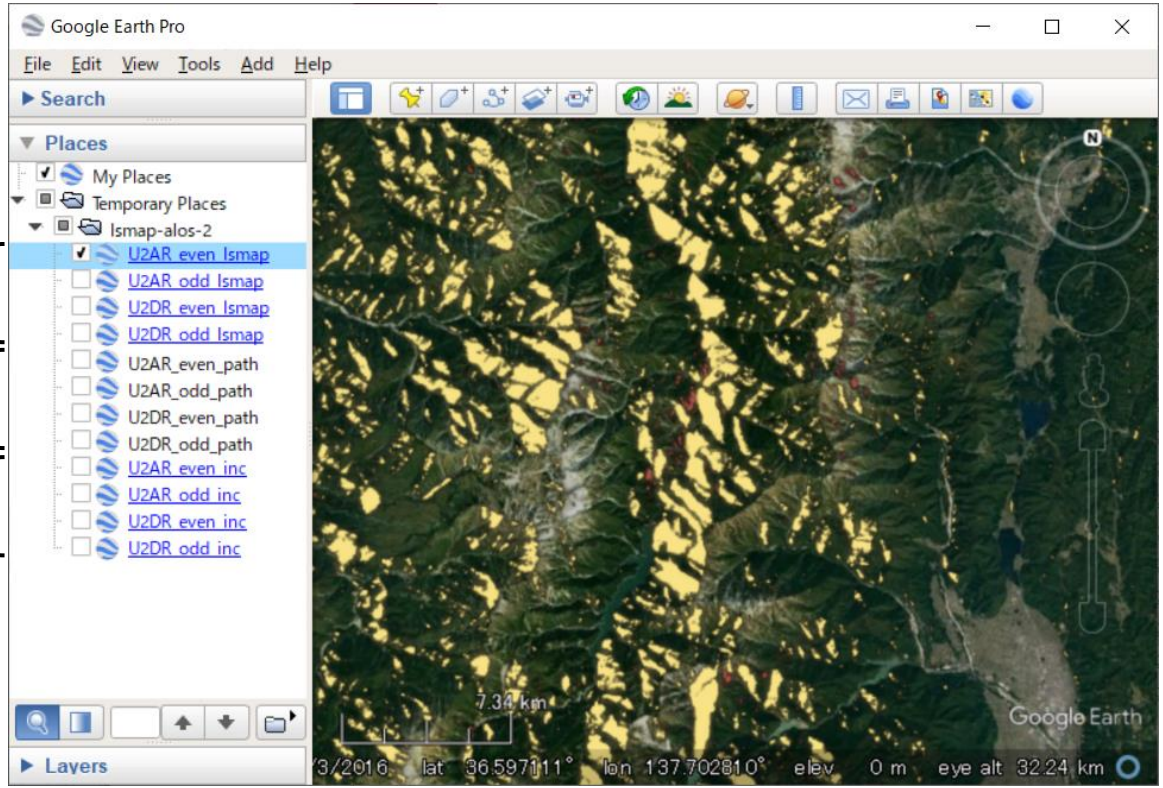
How to use XYZ tiles in Google Earth Pro

Download the KMZ file (lsmap-alos-2.kmz, lsmap-sentinel-1.kmz) and open in Google Earth Pro

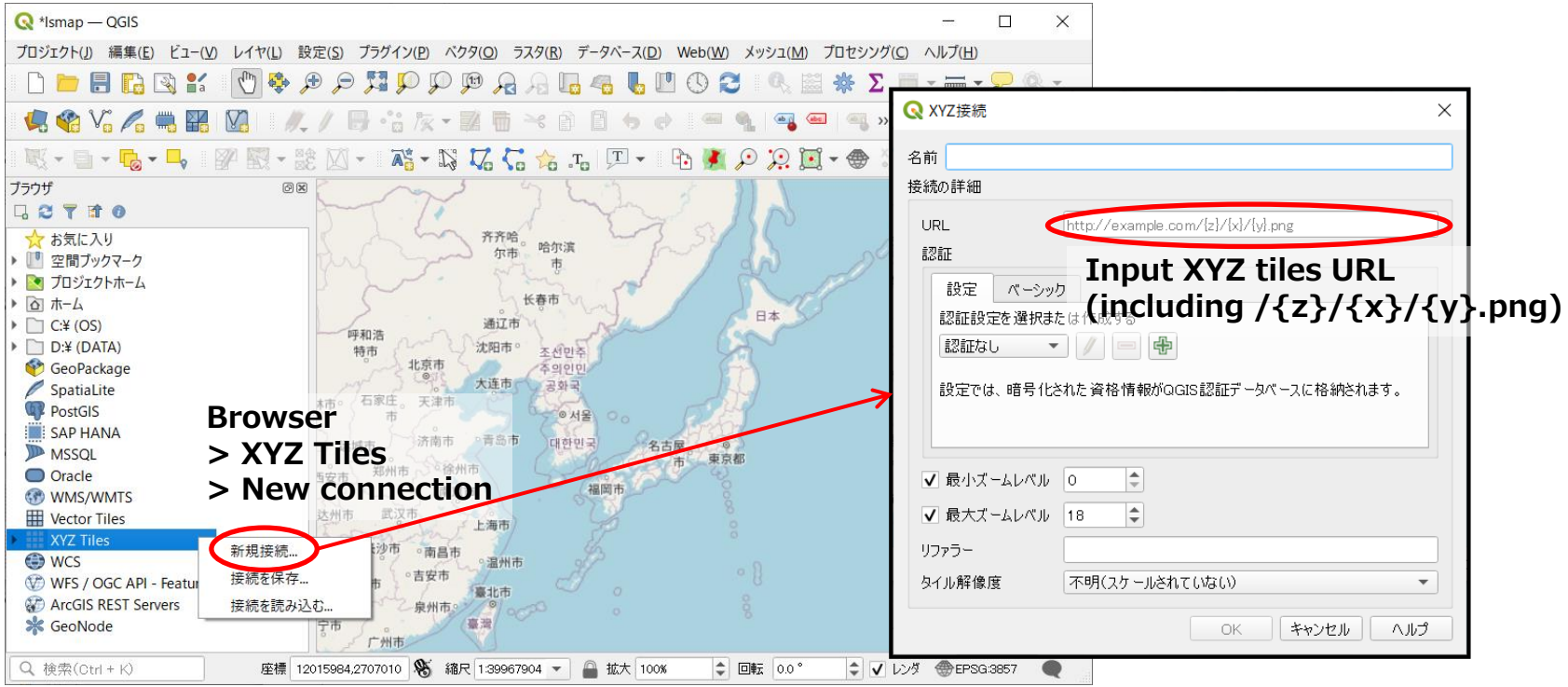
Layover-shadow

Path number information

Local incidence angle



How to use XYZ tiles in QGIS



*Confirmed in QGIS 3.22.6

Acknowledgments

ALOS-2 data were provided by JAXA under the partnership agreement between AIST and JAXA. JAXA holds full ownership of the ALOS-2 raw data.

Computational resource of AI Bridging Cloud Infrastructure (ABCI) provided by AIST was used.

Global Seasonal Sentinel-1 Interferometric Coherence and Backscatter Data Set was accessed on June 21, 2022 from https://registry.opendata.aws/ebd-sentinel-1-global-coherence-backscatter.

Kellndorfer, J., Cartus, O., Lavalle, M. et al. Global seasonal Sentinel-1 interferometric coherence and backscatter data set. Sci Data 9, 73 (2022). https://doi.org/10.1038/s41597-022-01189-6