



1. Introduction

In this study, to constitute a machine learning (ML) model, a big dataset is needed. To obtain sufficient amount of data, mainly concerning the amount of sampled copper geochemical data, we set our region of interest (ROI) as wide as possible. The ROI include Arizona and its outskirts, which includes the boundary areas of California, Nevada, Utah, and New Mexico. The whole ROI is in a rectangle range from (W115.9040, N37.6758) to (W107.888, N30.9958), (not including the territory of Mexico) and finally a total of approximately 16,000 samples are obtained. To cover the whole area, a total 637 ASTER images and 160 DEM images from the data pool and created a composite of all the images in accordance with their longitude and latitude to create a wide range map. In this supplementary materials we use tables and figures to show some extra information including detail information of the study areas, the detail and sources of the data which are not listed in the main text.

2. Extra information

2.1. Detailed introduction of the study areas

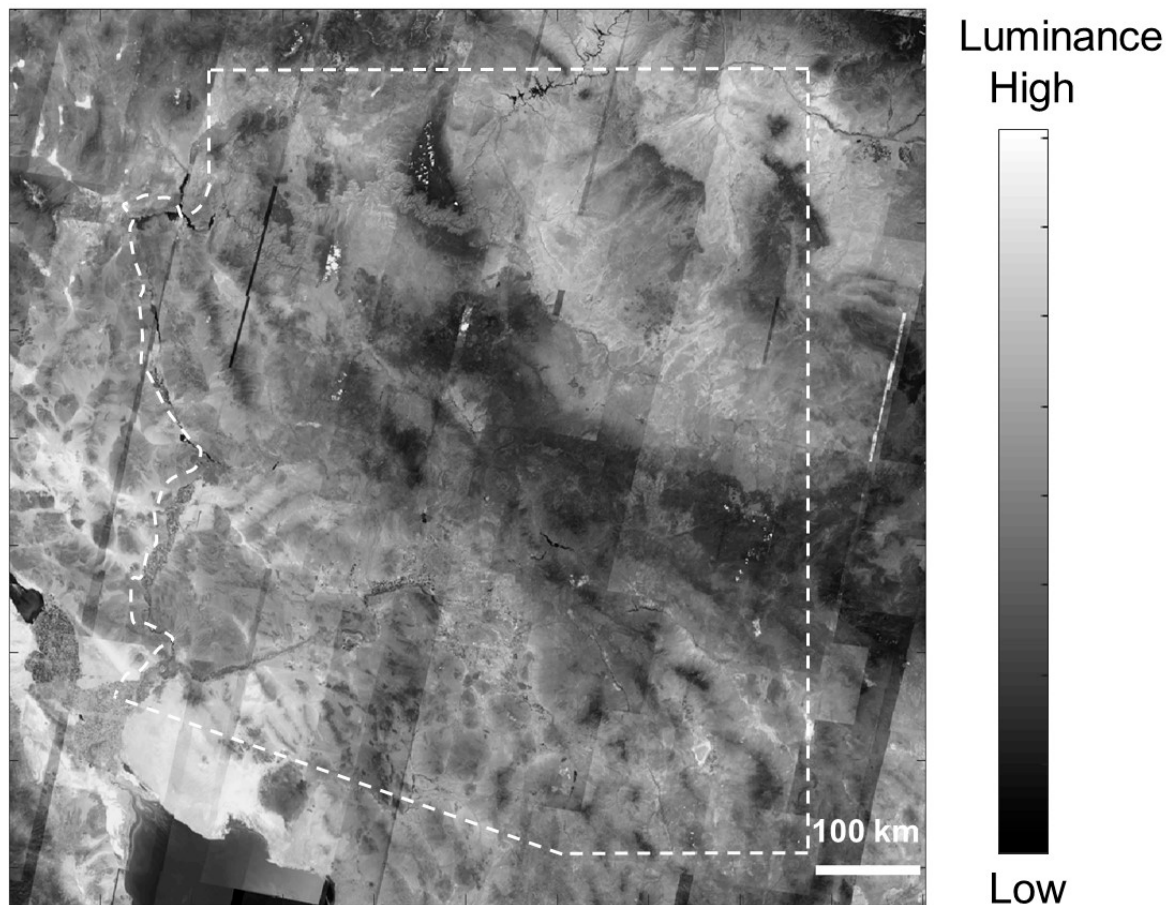
Table S1 shows the detailed introduction of study areas: T_a, T_b, T_c, P_a, P_b, P_c. These areas are all selected from mining restricts which contain adequate geochemical information.

Table S1. Detailed introduction of the study areas.

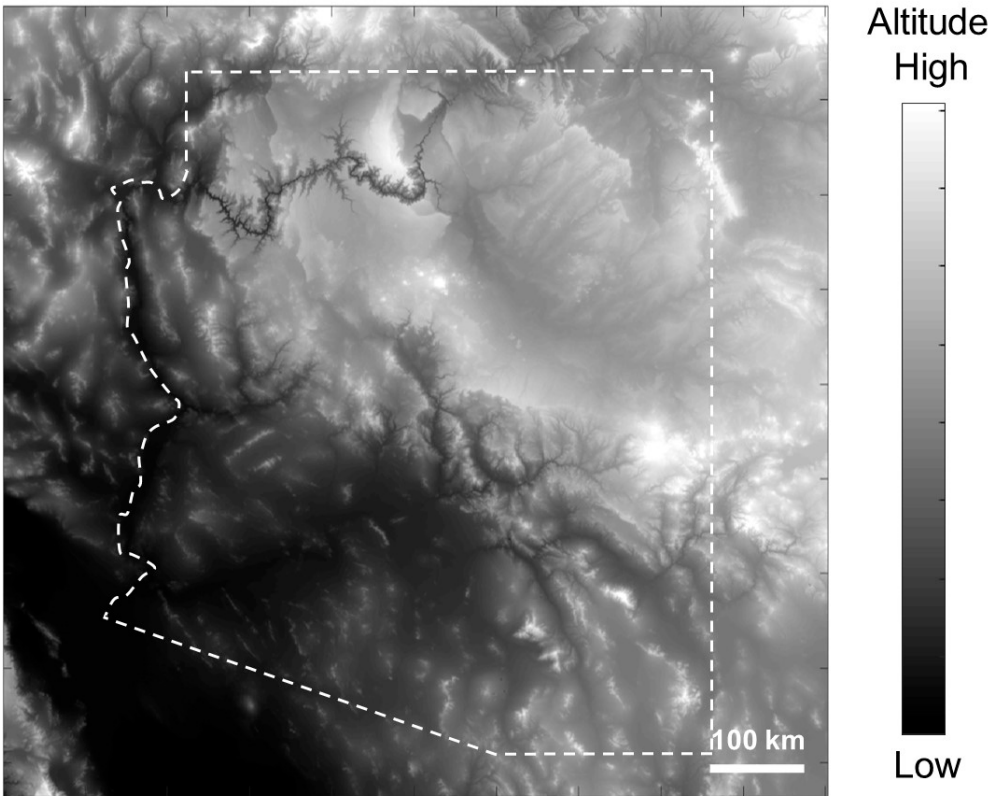
Area	Range	Area description
T _a	(W111.7200, N33.5638)–(W110.9440, N32.7958)	The center of this area is located at approximate 80 km of the southeast of Phoenix, Arizona. It includes a part of Superstition mountains area, which has abundant copper deposit and plenty of copper mines historically [1]. Surrounding Superior, the content of copper is higher than other region due to its high density of copper mine.
T _b	(W111.7840, N32.5558) to (W110.9120, N31.6838)	The center of this area is locate at approximate 30 km of the west of Tucson, Arizona. This area is famous as a mining industrial area of copper and silver. Sierrita Mountains are included in this area, where a large copper mine, Sierrita Mine is located here and The Sierrita-Esperanza porphyry copper complex is central to a large fossil hydrothermal system located in the southeastern part of the Sierrita Mountains [2]. High copper content areas are seen in the upper part and right part of the map.
T _c	(W110.7840, N32.7158)–(W109.9920, N31.9238)	The center of this area is locate at approximate 30 km of the west of Tucson, Arizona. It covers San Manuel district which has large reserves of low-grade "porphyry copper" ore and a small outcrop [3]. It is observed that high copper contents points crowd together near Oracle-San Manuel region and the east of Benson.
P _a	(W114.3840, N35.4758)–(W113.9840, N35.0758)	This area covers part of Mineral Park and Wallapi Mining District. Mineral Park mine is located in this selected area. Porphyry-style copper-molybdenum mineralization occurs within and near Laramide granitoid stocks at the center of an elongate zone of polymetallic quartz veins in this district [4]. Turquoise yields from this district.
P _b	(W109.6240, N33.2758)–(W109.2240, N32.8758)	This area covers part of Clifton-Morenci mining district and Morenci mine is included in this selected area. This mine is also porphyry copper mine, which was formed as a result of the coupled processes of erosion and chemical weathering that accompanied five stages of landscape evolution in the Cenozoic Era [5]. Azurite yields from this district.
P _c	(W112.2640, N34.5558)–(W111.8640, N34.1558)	This area covers part of Agua Fria Mining District. It is a historically famous copper mining district. Copper Queen mine is included in this selected area. [6].

2.2. The Detail of Remote Sensing Data

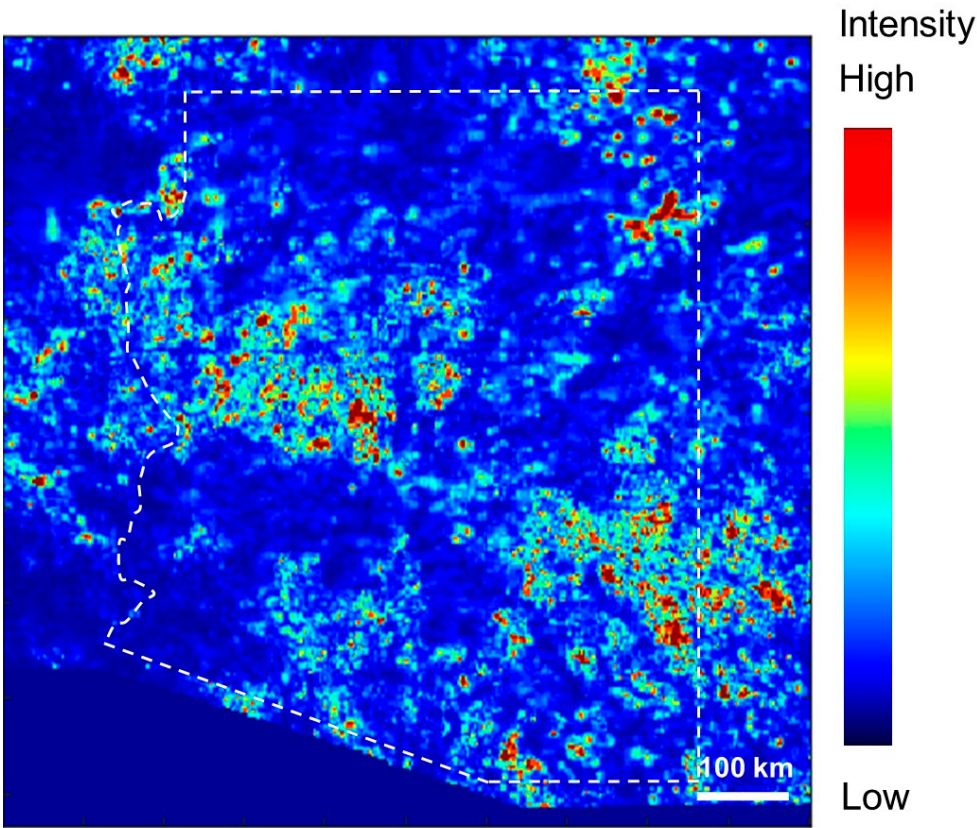
Figure S1a shows the image of detail ASTER data (Band 1) as the example of ASTER data series. 637 images are joint together like a “montage image” to make sure all the area is covered, and the luminance of the image are used as predictor variable. Figure S1b shows the image of detail DEM data (altitude) as the example of DEM data series. 160 DEM images are joint together according their latitude and longitude. Figure S1b shows the image of geomagnetic data (Analytic signal processed data) as the example of geomagnetic data series. The data in ROI is cropped from the geomagnetic distribution map of all US.



(a)



(b).



(c).

Figure S1. The detail of remote sensing data: (a) ASTER band 1 data; (b) DEM altitude data; (c) Analytic signal processed geomagnetic data.

All the ASTER data was extracted from “ASTER Level 1T” and DEM data was extracted from “ASTER Global Digital Elevation Model” in the USGS’s EarthExplorer search engine, respectively. The default filename of source files of ASTER data, DEM altitude data and DEM elevation data are listed in Table S2, S3 and S4, respectively. The files in Table S2 are used for prediction model construction, cross-validation of measured data, and blind test in T areas. The ASTER data files of P_a, P_b and P_c used in temporal stability test are listed in Table S5.

Table S2. The default filename of source files of ASTER data.

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Table S3. The default filename of source files of DEM altitude data.

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'ASTGTM2_N30W114_dem.tif'
'ASTGTM2_N30W115_dem.tif'
'ASTGTM2_N30W116_dem.tif'
'ASTGTM2_N30W117_dem.tif'
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'ASTGTM2_N31W109_dem.tif'
'ASTGTM2_N31W110_dem.tif'
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 'ASTGTM2_N37W114_dem.tif'
 'ASTGTM2_N37W115_dem.tif'
 'ASTGTM2_N37W116_dem.tif'
 'ASTGTM2_N37W117_dem.tif'

Table S4. The default filename of source files of DEM elevation data.

Filename
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'ASTGTM2_N30W114_num.tif'
'ASTGTM2_N30W115_num.tif'
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'ASTGTM2_N31W116_num.tif'
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'ASTGTM2_N32W116_num.tif'
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'ASTGTM2_N33W110_num.tif'
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'ASTGTM2_N37W114_num.tif'
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'ASTGTM2_N37W117_num.tif'

Table S5. The default filename of source files of ASTER data used in temporal stability test.

Area	Filename
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	'AST_L1T_00306172007182705_20150519230858_32869.hdf'
P _b	'AST_L1T_00311022001181344_20150423131911_107539.hdf'
	'AST_L1T_00308282006180847_20150515224745_21548.hdf'
	'AST_L1T_00307142007180919_20150520065540_112871.hdf'
P _c	'AST_L1T_00304202006182029_20150514013600_63974.hdf'
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	'AST_L1T_00305062006182027_20150514065329_72681.hdf'
	'AST_L1T_00305062006182035_20150514065332_81458.hdf'
	'AST_L1T_00309272006182026_20150516091642_110650.hdf'
	'AST_L1T_00309272006182035_20150516091642_110652.hdf'

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