

Disaster Risk Monitoring Using Satellite Imagery

04 - UNOSAT Flood Impact Analysis Case Study

In this notebook, we will learn how UNOSAT, the United Nations Satellite Centre, uses satellite imagery and deep learning-based flood detection models to support emergency response efforts.

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Background

Nepal is a hazard-prone country. Recurring disasters have been monitored throughout the years, including severe floods in 2008, 2014, and 2017. In 2015, following the 7.8-magnitude earthquake, UNOSAT's Emergency Mapping service was activated to provide satellite-derived damage assessment in support of the humanitarian response efforts on the ground. Acting as coordinator for mapping products, UNOSAT integrated the results from various sources in a publicly available web map. Very innovative at the time, this online viewing tool gathered all the analysis results. It also showed images collected from the ground through the newly developed UN ASIGN app. With the crowdsourcing app, individuals are able to send geotagged content, including photos of damages, to validate the satellite imagery-based assessment. Over the years, UNOSAT has worked with different partners in Nepal, providing technical support and implementing different activities to strengthen capacities in using Geospatial Information Technology (GIT) and data for Disaster Risk Management (DRM).

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Nepal June 2021 Flood Event Case Study

In a more recent incident that occurred during June 2021, Nepal was hit by heavy rainfall. Flooding and landslides were reported in many parts of the country and affected thousands of families^[1]. Later in August of the same year, rainfall intensified again for several consecutive days, resulting in rivers overflowing, landslides triggered across the hills, and widespread inundation in the southern plains. In the affected areas, many houses, informal settlements, and other buildings were destroyed, forcing people to seek refuge with relatives or in temporary shelters. Health and sanitation concerns arose as access to running water became limited, increasing the risk of water-borne disease transmission, and limiting the ability to adhere to preventive measures against COVID-19.

[1] https://reliefweb.int/disaster/fl-2021-000134-npl

To rapidly respond, UNOSAT Rapid Mapping Service deployed the AI flood detection dashboard (shown below). Flood impact statistics such as sqkm of flood and flood affected population by admin units were automatically generated and displayed on the dashboard. UNOSAT FloodAl was able to process all the available Sentinel-1 overlapping with the area of interested shared by the Information Management Unit of the United Nation Resident Coordination Office in Nepal during the 29 days of activation. We will demonstrate the use of the flood segmentation model on Sentinel-1 images captured around July 2nd, 2021, to analyze the impact of the flood.

Sentinel-1 Data

Sentinel-1 images can be viewed freely from the Alaska Satellite Facility (ASF) Data Search Vertex. Below are the instructions:

- 1. Open the ASF Data Search Vertex
- 2. Input the image name:

S1A_IW_GRDH_1SDV_20210702T001952_20210702T002017_038591_048DBF_C0E0 under "List of Scene Name". You can also use this link.

- No description has been provided for this image
- 3. Find the image name in the bottom left corner
- 4. Click "Zoom to scene" No description has been provided for this image

Note: no ASF login required.

Load Data

The Sentinel-1 images have been downloaded and pre-processed using the ESA SNAP toolbox. Below, we will load the two polarizations of Sentinel-1, namely VV and VH, and combine them into an RGB image.

First, we need to unzip the UNOSAT_case_study.zip file, which includes all of the data.

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inflating: UNOSAT case study/tiles VH/tile 8 8.png
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inflating: UNOSAT case study/tiles VH/tile 16 9.png
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inflating: UNOSAT case study/tiles VH/tile 19 15.png
inflating: UNOSAT case study/tiles VH/tile 36 25.png
inflating: UNOSAT case study/tiles VH/tile 18 43.png
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inflating: UNOSAT case study/tiles VH/tile 9 16.png
inflating: UNOSAT case study/tiles VH/tile 18 7.png
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inflating: UNOSAT case study/tiles VH/tile 23 38.png
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inflating: UNOSAT case study/tiles VH/tile 41 38.png
inflating: UNOSAT case study/tiles VH/tile 38 23.png
 creating: UNOSAT case study/tiles VV/
extracting: UNOSAT case study/tiles VV/tile 36 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_9.png
inflating: UNOSAT case study/tiles VV/tile 27 53.png
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inflating: UNOSAT case study/tiles VV/tile 37 16.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_27.png
inflating: UNOSAT case study/tiles VV/tile 38 60.png
inflating: UNOSAT case study/tiles VV/tile 25 37.png
extracting: UNOSAT case study/tiles VV/tile 17 18.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_28.png
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inflating: UNOSAT_case_study/tiles_VV/tile_38_6.png
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extracting: UNOSAT case study/tiles VV/tile 23 57.png
```

```
extracting: UNOSAT case study/tiles VV/tile 15 38.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_48.png
inflating: UNOSAT case study/tiles VV/tile 29 33.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_29.png
inflating: UNOSAT case study/tiles VV/tile 37 52.png
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inflating: UNOSAT_case_study/tiles_VV/tile_27_17.png
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inflating: UNOSAT_case_study/tiles_VV/tile_23_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_43.png
inflating: UNOSAT case study/tiles VV/tile 31 58.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_48.png
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inflating: UNOSAT_case_study/tiles_VV/tile_18_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_5.png
inflating: UNOSAT case study/tiles VV/tile 25 55.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_36.png
extracting: UNOSAT_case_study/tiles_VV/tile_34_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_27.png
extracting: UNOSAT_case_study/tiles_VV/tile_39_50.png
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inflating: UNOSAT case study/tiles VV/tile 25 19.png
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inflating: UNOSAT_case_study/tiles_VV/tile_33_38.png
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inflating: UNOSAT case study/tiles VV/tile 16 28.png
inflating: UNOSAT case study/tiles VV/tile 29 51.png
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inflating: UNOSAT case study/tiles VV/tile 21 59.png
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inflating: UNOSAT case study/tiles VV/tile 28 34.png
inflating: UNOSAT case study/tiles VV/tile 36 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_58.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_43.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_39.png
inflating: UNOSAT case study/tiles VV/tile 37 25.png
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extracting: UNOSAT case study/tiles VV/tile 17 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_37.png
extracting: UNOSAT case study/tiles VV/tile 16 55.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_47.png
inflating: UNOSAT case study/tiles VV/tile 33 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_7.png
inflating: UNOSAT case study/tiles VV/tile 7 28.png
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inflating: UNOSAT_case_study/tiles_VV/tile_18_17.png
inflating: UNOSAT case study/tiles VV/tile 34 55.png
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inflating: UNOSAT case study/tiles VV/tile 38 51.png
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inflating: UNOSAT case study/tiles VV/tile 36 35.png
inflating: UNOSAT case study/tiles VV/tile 9 0.png
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inflating: UNOSAT_case_study/tiles_VV/tile_26_1.png
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inflating: UNOSAT case study/tiles VV/tile 32 13.png
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inflating: UNOSAT_case_study/tiles_VV/tile_22_5.png
inflating: UNOSAT case study/tiles VV/tile 5 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_10.png
inflating: UNOSAT case study/tiles VV/tile 33 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_20.png
inflating: UNOSAT case study/tiles VV/tile 24 30.png
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inflating: UNOSAT_case_study/tiles_VV/tile_30_33.png
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inflating: UNOSAT case study/tiles VV/tile 40 5.png
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inflating: UNOSAT case study/tiles VV/tile 21 24.png
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inflating: UNOSAT case study/tiles VV/tile 21 6.png
inflating: UNOSAT case study/tiles VV/tile 20 16.png
inflating: UNOSAT case study/tiles VV/tile 25 20.png
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inflating: UNOSAT_case_study/tiles_VV/tile_13_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_8.png
inflating: UNOSAT case study/tiles VV/tile 41 13.png
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inflating: UNOSAT_case_study/tiles_VV/tile_15_12.png
inflating: UNOSAT case study/tiles VV/tile 32 22.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_41.png
inflating: UNOSAT case study/tiles VV/tile 18 0.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_40.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_43.png
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inflating: UNOSAT case study/tiles VV/tile 12 24.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_15.png
extracting: UNOSAT_case_study/tiles_VV/tile_39_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_30.png
inflating: UNOSAT case study/tiles VV/tile 12 6.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_16.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_42.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_51.png
inflating: UNOSAT case study/tiles VV/tile 41 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_12.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_40.png
inflating: UNOSAT case study/tiles VV/tile 24 21.png
inflating: UNOSAT case study/tiles VV/tile 36 0.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_11.png
inflating: UNOSAT case study/tiles VV/tile 32 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_42.png
inflating: UNOSAT case study/tiles VV/tile 30 24.png
inflating: UNOSAT case study/tiles VV/tile 15 3.png
inflating: UNOSAT case study/tiles VV/tile 4 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_15.png
inflating: UNOSAT case study/tiles VV/tile 38 59.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_25.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_10.png
inflating: UNOSAT case study/tiles VV/tile 30 6.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_34.png
inflating: UNOSAT case study/tiles VV/tile 13 5.png
inflating: UNOSAT case study/tiles VV/tile 34 20.png
inflating: UNOSAT case study/tiles VV/tile 40 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_60.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_13.png
inflating: UNOSAT case study/tiles VV/tile 31 32.png
```

```
inflating: UNOSAT case study/tiles VV/tile 17 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_29.png
extracting: UNOSAT_case_study/tiles_VV/tile_36_48.png
inflating: UNOSAT case study/tiles VV/tile 22 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_0.png
inflating: UNOSAT case study/tiles VV/tile 39 36.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_56.png
inflating: UNOSAT case study/tiles VV/tile 29 37.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_10.png
inflating: UNOSAT case study/tiles VV/tile 17 58.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_38.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_0.png
inflating: UNOSAT case study/tiles VV/tile 30 11.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_59.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_55.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_18.png
inflating: UNOSAT case study/tiles W/tile 4 1.png
inflating: UNOSAT case study/tiles VV/tile 21 2.png
extracting: UNOSAT_case_study/tiles_VV/tile_38_46.png
inflating: UNOSAT case study/tiles VV/tile 20 12.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_48.png
inflating: UNOSAT case study/tiles VV/tile 35 58.png
inflating: UNOSAT case study/tiles VV/tile 27 39.png
inflating: UNOSAT case study/tiles VV/tile 40 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_29.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_57.png
inflating: UNOSAT case study/tiles VV/tile 28 38.png
inflating: UNOSAT case study/tiles VV/tile 10 4.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_59.png
inflating: UNOSAT case study/tiles VV/tile 31 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_45.png
inflating: UNOSAT case study/tiles VV/tile 21 11.png
inflating: UNOSAT case study/tiles VV/tile 12 20.png
inflating: UNOSAT case study/tiles VV/tile 14 0.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_10.png
extracting: UNOSAT case study/tiles VV/tile 18 39.png
```

```
inflating: UNOSAT case study/tiles W/tile 26 58.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_28.png
extracting: UNOSAT_case_study/tiles_VV/tile_37_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_3.png
inflating: UNOSAT case study/tiles VV/tile 10 22.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_56.png
inflating: UNOSAT case study/tiles VV/tile 38 19.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_59.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_20.png
extracting: UNOSAT case study/tiles VV/tile 17 49.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_0.png
extracting: UNOSAT_case_study/tiles_VV/tile_11_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_55.png
inflating: UNOSAT case study/tiles VV/tile 20 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_39.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_29.png
extracting: UNOSAT_case_study/tiles_VV/tile_22_54.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_36.png
inflating: UNOSAT case study/tiles VV/tile 9 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_5.png
inflating: UNOSAT case study/tiles VV/tile 34 33.png
inflating: UNOSAT case study/tiles VV/tile 26 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_9.png
extracting: UNOSAT case study/tiles VV/tile 16 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_8.png
inflating: UNOSAT case study/tiles VV/tile 25 42.png
extracting: UNOSAT case study/tiles VV/tile 12 19.png
inflating: UNOSAT case study/tiles VV/tile 20 38.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_23.png
extracting: UNOSAT_case_study/tiles_VV/tile_8_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_24.png
inflating: UNOSAT case study/tiles VV/tile 16 15.png
inflating: UNOSAT case study/tiles VV/tile 32 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_34.png
inflating: UNOSAT case study/tiles VV/tile 28 3.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_44.png
inflating: UNOSAT case study/tiles VV/tile 33 25.png
extracting: UNOSAT case study/tiles VV/tile 15 43.png
inflating: UNOSAT case study/tiles VV/tile 10 39.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_6.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_50.png
inflating: UNOSAT case study/tiles VV/tile 13 27.png
```

```
inflating: UNOSAT case study/tiles W/tile 36 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_18.png
inflating: UNOSAT case study/tiles VV/tile 41 8.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_4.png
inflating: UNOSAT case study/tiles VV/tile 32 35.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_16.png
inflating: UNOSAT case study/tiles VV/tile 41 26.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_13.png
inflating: UNOSAT case study/tiles VV/tile 21 28.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_9.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_56.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_41.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_7.png
inflating: UNOSAT case study/tiles VV/tile 35 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_2.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_52.png
extracting: UNOSAT_case_study/tiles_W/tile_11_29.png
inflating: UNOSAT case study/tiles VV/tile 25 24.png
inflating: UNOSAT case study/tiles VV/tile 33 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_14.png
inflating: UNOSAT case study/tiles VV/tile 4 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_45.png
extracting: UNOSAT case study/tiles VV/tile 36 31.png
extracting: UNOSAT case study/tiles VV/tile 31 27.png
inflating: UNOSAT case study/tiles VV/tile 28 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_18.png
inflating: UNOSAT case study/tiles VV/tile 5 26.png
inflating: UNOSAT case study/tiles VV/tile 27 40.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_17.png
inflating: UNOSAT case study/tiles VV/tile 30 55.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_36.png
inflating: UNOSAT case study/tiles VV/tile 19 21.png
inflating: UNOSAT case study/tiles VV/tile 14 44.png
inflating: UNOSAT case study/tiles VV/tile 18 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_5.png
inflating: UNOSAT case study/tiles VV/tile 41 17.png
```

```
inflating: UNOSAT case study/tiles VV/tile 6 25.png
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inflating: UNOSAT_case_study/tiles_VV/tile_31_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_9.png
inflating: UNOSAT case study/tiles VV/tile 26 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_42.png
inflating: UNOSAT case study/tiles VV/tile 21 19.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_1.png
extracting: UNOSAT case study/tiles VV/tile 20 47.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_51.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_10.png
inflating: UNOSAT case study/tiles VV/tile 24 43.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_52.png
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extracting: UNOSAT_case_study/tiles_VV/tile_18_40.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_36.png
inflating: UNOSAT case study/tiles VV/tile 33 7.png
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inflating: UNOSAT_case_study/tiles_VV/tile_36_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_27.png
extracting: UNOSAT_case_study/tiles_VV/tile_35_50.png
inflating: UNOSAT case study/tiles VV/tile 27 31.png
inflating: UNOSAT case study/tiles VV/tile 30 46.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_17.png
inflating: UNOSAT case study/tiles VV/tile 16 6.png
extracting: UNOSAT_case_study/tiles_VV/tile_24_25.png
inflating: UNOSAT case study/tiles VV/tile 32 44.png
inflating: UNOSAT case study/tiles VV/tile 7 15.png
inflating: UNOSAT case study/tiles VV/tile 36 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_35.png
inflating: UNOSAT case study/tiles VV/tile 19 3.png
extracting: UNOSAT case study/tiles VV/tile 15 34.png
extracting: UNOSAT_case_study/tiles_VV/tile_23_53.png
inflating: UNOSAT case study/tiles VV/tile 26 41.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_18.png
inflating: UNOSAT case study/tiles VV/tile 34 60.png
inflating: UNOSAT case study/tiles VV/tile 21 37.png
inflating: UNOSAT case study/tiles VV/tile 18 22.png
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inflating: UNOSAT_case_study/tiles_VV/tile_15_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_8.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_32.png
inflating: UNOSAT case study/tiles VV/tile 30 28.png
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inflating: UNOSAT case study/tiles W/tile 27 13.png
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inflating: UNOSAT_case_study/tiles_VV/tile_34_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_13 9.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_42.png
inflating: UNOSAT case study/tiles VV/tile 11 38.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_23.png
inflating: UNOSAT case study/tiles VV/tile 17 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_52.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_33.png
inflating: UNOSAT case study/tiles VV/tile 17 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_12.png
inflating: UNOSAT case study/tiles VV/tile 22 45.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_26.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_58.png
extracting: UNOSAT_case_study/tiles_VV/tile_8_29.png
extracting: UNOSAT_case_study/tiles_VV/tile_36_46.png
inflating: UNOSAT case study/tiles VV/tile 28 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_55.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_47.png
inflating: UNOSAT case study/tiles VV/tile 27 19.png
inflating: UNOSAT case study/tiles VV/tile 35 38.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_56.png
inflating: UNOSAT case study/tiles VV/tile 19 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_59.png
inflating: UNOSAT case study/tiles VV/tile 38 26.png
inflating: UNOSAT case study/tiles VV/tile 20 1.png
inflating: UNOSAT case study/tiles VV/tile 29 35.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_48.png
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inflating: UNOSAT case study/tiles VV/tile 26 29.png
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inflating: UNOSAT case study/tiles VV/tile 25 57.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_7.png
inflating: UNOSAT case study/tiles VV/tile 10 11.png
inflating: UNOSAT case study/tiles VV/tile 28 45.png
extracting: UNOSAT case study/tiles VV/tile 19 54.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_37.png
inflating: UNOSAT case study/tiles VV/tile 19 18.png
```

```
inflating: UNOSAT case study/tiles W/tile 35 56.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_0.png
extracting: UNOSAT_case_study/tiles_VV/tile_38_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_59.png
inflating: UNOSAT case study/tiles W/tile 20 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_16.png
inflating: UNOSAT case study/tiles VV/tile 29 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_49.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_43.png
inflating: UNOSAT case study/tiles VV/tile 34 39.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_55.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_2.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_45.png
inflating: UNOSAT case study/tiles VV/tile 37 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_19.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_28.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_10.png
inflating: UNOSAT case study/tiles VV/tile 29 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_59.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_28.png
inflating: UNOSAT case study/tiles VV/tile 35 29.png
extracting: UNOSAT case study/tiles VV/tile 17 47.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_20.png
inflating: UNOSAT case study/tiles VV/tile 28 54.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_17.png
inflating: UNOSAT case study/tiles VV/tile 11 1.png
extracting: UNOSAT case study/tiles VV/tile 37 45.png
inflating: UNOSAT case study/tiles VV/tile 29 26.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_37.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_55.png
extracting: UNOSAT case study/tiles VV/tile 19 27.png
inflating: UNOSAT case study/tiles VV/tile 27 46.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_0.png
inflating: UNOSAT case study/tiles VV/tile 33 49.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_53.png
inflating: UNOSAT case study/tiles VV/tile 39 25.png
extracting: UNOSAT case study/tiles VV/tile 16 39.png
inflating: UNOSAT case study/tiles VV/tile 24 58.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_7.png
extracting: UNOSAT case study/tiles VV/tile 8 30.png
```

```
inflating: UNOSAT case study/tiles W/tile 12 17.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_3.png
inflating: UNOSAT case study/tiles VV/tile 6 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_24.png
inflating: UNOSAT case study/tiles VV/tile 31 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_15.png
inflating: UNOSAT case study/tiles VV/tile 14 33.png
extracting: UNOSAT_case_study/tiles_VV/tile_22_52.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_11.png
inflating: UNOSAT case study/tiles VV/tile 30 35.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_42.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_37.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_13.png
inflating: UNOSAT case study/tiles VV/tile 32 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_9.png
inflating: UNOSAT_case_study/tiles_W/tile_3_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_11.png
inflating: UNOSAT case study/tiles VV/tile 21 26.png
inflating: UNOSAT case study/tiles VV/tile 26 30.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_16.png
inflating: UNOSAT case study/tiles VV/tile 9 20.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_7.png
extracting: UNOSAT case study/tiles VV/tile 12 35.png
extracting: UNOSAT case study/tiles VV/tile 20 54.png
inflating: UNOSAT case study/tiles VV/tile 6 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_6.png
inflating: UNOSAT case study/tiles VV/tile 41 24.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_19.png
inflating: UNOSAT case study/tiles VV/tile 23 42.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_23.png
inflating: UNOSAT case study/tiles VV/tile 32 33.png
extracting: UNOSAT case study/tiles VV/tile 40 52.png
inflating: UNOSAT case study/tiles VV/tile 24 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_16.png
inflating: UNOSAT case study/tiles VV/tile 25 4.png
```

```
inflating: UNOSAT case study/tiles VV/tile 8 3.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_24.png
inflating: UNOSAT case study/tiles VV/tile 4 7.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_12.png
inflating: UNOSAT case study/tiles VV/tile 41 60.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_41.png
inflating: UNOSAT case study/tiles VV/tile 21 8.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_11.png
inflating: UNOSAT case study/tiles VV/tile 26 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_7.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_30.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_3.png
inflating: UNOSAT case study/tiles VV/tile 15 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_52.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_24.png
inflating: UNOSAT case study/tiles VV/tile 40 43.png
extracting: UNOSAT case study/tiles VV/tile 14 42.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_34.png
extracting: UNOSAT case study/tiles VV/tile 21 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_20.png
inflating: UNOSAT case study/tiles VV/tile 31 16.png
inflating: UNOSAT case study/tiles VV/tile 33 5.png
inflating: UNOSAT case study/tiles VV/tile 16 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_25.png
inflating: UNOSAT case study/tiles VV/tile 30 44.png
inflating: UNOSAT case study/tiles VV/tile 33 32.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_51.png
inflating: UNOSAT case study/tiles VV/tile 25 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_1.png
extracting: UNOSAT case study/tiles VV/tile 15 50.png
inflating: UNOSAT case study/tiles VV/tile 12 8.png
inflating: UNOSAT case study/tiles VV/tile 7 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_60.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_16.png
inflating: UNOSAT case study/tiles VV/tile 21 35.png
```

```
inflating: UNOSAT_case_study/tiles_VV/tile_15_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_26.png
inflating: UNOSAT case study/tiles VV/tile 27 11.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_30.png
inflating: UNOSAT case study/tiles VV/tile 41 33.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_14.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_28.png
inflating: UNOSAT case study/tiles VV/tile 23 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_23.png
extracting: UNOSAT_case_study/tiles_VV/tile_32_42.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_9.png
inflating: UNOSAT case study/tiles VV/tile 17 3.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_27.png
inflating: UNOSAT case study/tiles VV/tile 25 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_36.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_0.png
inflating: UNOSAT case study/tiles VV/tile 34 22.png
inflating: UNOSAT case study/tiles VV/tile 13 7.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_32.png
inflating: UNOSAT case study/tiles VV/tile 12 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_41.png
inflating: UNOSAT case study/tiles VV/tile 5 2.png
inflating: UNOSAT case study/tiles VV/tile 22 3.png
inflating: UNOSAT case study/tiles VV/tile 39 38.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_59.png
inflating: UNOSAT case study/tiles VV/tile 6 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_12.png
inflating: UNOSAT case study/tiles VV/tile 30 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_2.png
inflating: UNOSAT case study/tiles W/tile 7 0.png
extracting: UNOSAT case study/tiles VV/tile 13 21.png
inflating: UNOSAT case study/tiles VV/tile 24 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_33.png
extracting: UNOSAT case study/tiles VV/tile 20 50.png
```

inflating: UNOSAT case study/tiles W/tile 18 20.png

```
extracting: UNOSAT case study/tiles VV/tile 12 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_3.png
inflating: UNOSAT case study/tiles VV/tile 4 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_56.png
inflating: UNOSAT case study/tiles VV/tile 21 22.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_49.png
inflating: UNOSAT case study/tiles VV/tile 10 15.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_20.png
inflating: UNOSAT case study/tiles VV/tile 31 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_14.png
extracting: UNOSAT_case_study/tiles_VV/tile_38_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_4.png
inflating: UNOSAT_case_study/tiles_W/tile_4_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_2.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_13.png
extracting: UNOSAT case study/tiles VV/tile 39 47.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_20.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_59.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_10.png
inflating: UNOSAT case study/tiles VV/tile 10 6.png
inflating: UNOSAT case study/tiles VV/tile 41 11.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_11.png
inflating: UNOSAT case study/tiles VV/tile 16 0.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_40.png
inflating: UNOSAT case study/tiles VV/tile 22 21.png
inflating: UNOSAT case study/tiles VV/tile 31 12.png
inflating: UNOSAT case study/tiles VV/tile 33 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_14.png
inflating: UNOSAT case study/tiles VV/tile 12 4.png
inflating: UNOSAT case study/tiles VV/tile 38 39.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_40.png
inflating: UNOSAT case study/tiles VV/tile 32 2.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_22.png
inflating: UNOSAT case study/tiles VV/tile 15 1.png
inflating: UNOSAT case study/tiles VV/tile 21 31.png
inflating: UNOSAT case study/tiles VV/tile 13 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_21.png
extracting: UNOSAT_case_study/tiles_VV/tile_37_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_58.png
inflating: UNOSAT case study/tiles VV/tile 33 10.png
```

```
inflating: UNOSAT case study/tiles W/tile 40 21.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_30.png
inflating: UNOSAT case study/tiles VV/tile 18 59.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_32.png
inflating: UNOSAT case study/tiles VV/tile 39 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_13.png
inflating: UNOSAT case study/tiles VV/tile 38 57.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_34.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_16.png
inflating: UNOSAT case study/tiles VV/tile 16 53.png
extracting: UNOSAT_case_study/tiles_VV/tile_22_56.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_6.png
inflating: UNOSAT case study/tiles VV/tile 36 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_24.png
inflating: UNOSAT case study/tiles VV/tile 35 43.png
inflating: UNOSAT case study/tiles VV/tile 26 52.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_29.png
extracting: UNOSAT case study/tiles VV/tile 21 48.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_9.png
inflating: UNOSAT case study/tiles VV/tile 18 33.png
inflating: UNOSAT case study/tiles W/tile 7 8.png
inflating: UNOSAT case study/tiles VV/tile 36 15.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_40.png
inflating: UNOSAT case study/tiles VV/tile 32 55.png
extracting: UNOSAT case study/tiles VV/tile 7 26.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_31.png
inflating: UNOSAT case study/tiles VV/tile 41 46.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_27.png
inflating: UNOSAT case study/tiles VV/tile 28 5.png
inflating: UNOSAT case study/tiles VV/tile 15 45.png
inflating: UNOSAT case study/tiles VV/tile 35 25.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_9.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_58.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_34.png
inflating: UNOSAT case study/tiles VV/tile 18 15.png
```

```
inflating: UNOSAT case study/tiles W/tile 34 53.png
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inflating: UNOSAT_case_study/tiles_VV/tile_27_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_22.png
inflating: UNOSAT case study/tiles VV/tile 40 56.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_18.png
extracting: UNOSAT case study/tiles VV/tile 37 41.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_50.png
inflating: UNOSAT case study/tiles VV/tile 15 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_38.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_42.png
inflating: UNOSAT case study/tiles VV/tile 30 57.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_47.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_14.png
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inflating: UNOSAT_case_study/tiles_VV/tile_39_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_54.png
extracting: UNOSAT case study/tiles VV/tile 16 35.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_26.png
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inflating: UNOSAT_case_study/tiles_VV/tile_35_16.png
inflating: UNOSAT case study/tiles VV/tile 25 53.png
inflating: UNOSAT case study/tiles VV/tile 20 49.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_34.png
inflating: UNOSAT case study/tiles VV/tile 39 3.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_15.png
inflating: UNOSAT case study/tiles VV/tile 26 25.png
inflating: UNOSAT case study/tiles VV/tile 34 44.png
inflating: UNOSAT case study/tiles VV/tile 14 46.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_47.png
inflating: UNOSAT case study/tiles VV/tile 32 28.png
inflating: UNOSAT case study/tiles VV/tile 29 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_6.png
inflating: UNOSAT case study/tiles VV/tile 35 7.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_19.png
inflating: UNOSAT case study/tiles VV/tile 23 37.png
inflating: UNOSAT case study/tiles VV/tile 36 60.png
inflating: UNOSAT case study/tiles VV/tile 15 18.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_33.png
inflating: UNOSAT case study/tiles VV/tile 19 14.png
```

```
inflating: UNOSAT case study/tiles W/tile 35 52.png
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inflating: UNOSAT_case_study/tiles_VV/tile_16 8.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_57.png
extracting: UNOSAT case study/tiles VV/tile 18 42.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_38.png
inflating: UNOSAT case study/tiles VV/tile 36 24.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_12.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_26.png
inflating: UNOSAT case study/tiles VV/tile 24 45.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_55.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_54.png
inflating: UNOSAT case study/tiles VV/tile 35 34.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_15.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_52.png
extracting: UNOSAT_case_study/tiles_VV/tile_9_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_6.png
extracting: UNOSAT_case_study/tiles_VV/tile_37_50.png
inflating: UNOSAT case study/tiles VV/tile 24 27.png
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inflating: UNOSAT_case_study/tiles_VV/tile_32_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_37.png
inflating: UNOSAT case study/tiles VV/tile 23 55.png
extracting: UNOSAT case study/tiles VV/tile 15 36.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_5.png
inflating: UNOSAT case study/tiles VV/tile 27 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_28.png
inflating: UNOSAT case study/tiles VV/tile 22 47.png
inflating: UNOSAT case study/tiles VV/tile 34 8.png
inflating: UNOSAT case study/tiles VV/tile 19 32.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_7.png
inflating: UNOSAT case study/tiles VV/tile 18 60.png
inflating: UNOSAT case study/tiles VV/tile 31 38.png
extracting: UNOSAT_case_study/tiles_VV/tile_28_23.png
inflating: UNOSAT case study/tiles VV/tile 23 19.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_42.png
inflating: UNOSAT case study/tiles VV/tile 39 30.png
inflating: UNOSAT case study/tiles VV/tile 34 26.png
inflating: UNOSAT case study/tiles VV/tile 38 4.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_25.png
inflating: UNOSAT case study/tiles VV/tile 18 27.png
```

```
inflating: UNOSAT case study/tiles W/tile 26 46.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_36.png
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inflating: UNOSAT_case_study/tiles_VV/tile_27_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_37.png
inflating: UNOSAT case study/tiles VV/tile 38 25.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_8.png
inflating: UNOSAT case study/tiles VV/tile 23 58.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_49.png
inflating: UNOSAT case study/tiles VV/tile 37 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_0.png
extracting: UNOSAT_case_study/tiles_VV/tile_36_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_54.png
inflating: UNOSAT case study/tiles VV/tile 19 35.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_19.png
extracting: UNOSAT_case_study/tiles_W/tile_16_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_7.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_27.png
inflating: UNOSAT case study/tiles VV/tile 27 36.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_55.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_39.png
inflating: UNOSAT case study/tiles VV/tile 37 8.png
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inflating: UNOSAT_case_study/tiles_VV/tile_29_52.png
inflating: UNOSAT case study/tiles VV/tile 24 48.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_15.png
inflating: UNOSAT case study/tiles VV/tile 10 10.png
inflating: UNOSAT case study/tiles VV/tile 31 59.png
inflating: UNOSAT case study/tiles VV/tile 28 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_35.png
extracting: UNOSAT case study/tiles VV/tile 19 53.png
inflating: UNOSAT case study/tiles VV/tile 14 49.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_6.png
inflating: UNOSAT case study/tiles VV/tile 25 56.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_37.png
inflating: UNOSAT case study/tiles VV/tile 35 19.png
inflating: UNOSAT case study/tiles VV/tile 9 18.png
extracting: UNOSAT case study/tiles VV/tile 34 47.png
extracting: UNOSAT_case_study/tiles_VV/tile_39_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_55.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_18.png
inflating: UNOSAT case study/tiles VV/tile 35 46.png
```

```
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inflating: UNOSAT_case_study/tiles_VV/tile_38_34.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_48.png
inflating: UNOSAT case study/tiles VV/tile 7 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_39.png
inflating: UNOSAT case study/tiles VV/tile 32 58.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_1.png
extracting: UNOSAT_case_study/tiles_VV/tile_9_9.png
inflating: UNOSAT case study/tiles VV/tile 28 35.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_26.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_59.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_47.png
inflating: UNOSAT case study/tiles W/tile 16 56.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_42.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_38.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_54.png
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inflating: UNOSAT_case_study/tiles_VV/tile_36_36.png
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inflating: UNOSAT_case_study/tiles_VV/tile_33_48.png
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inflating: UNOSAT case study/tiles VV/tile 25 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_19.png
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extracting: UNOSAT_case_study/tiles_VV/tile_24_57.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_24.png
inflating: UNOSAT case study/tiles VV/tile 38 16.png
inflating: UNOSAT case study/tiles VV/tile 28 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_49.png
inflating: UNOSAT case study/tiles VV/tile 40 59.png
extracting: UNOSAT_case_study/tiles_VV/tile_37_44.png
inflating: UNOSAT case study/tiles VV/tile 29 25.png
inflating: UNOSAT case study/tiles VV/tile 11 0.png
inflating: UNOSAT case study/tiles VV/tile 27 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_37.png
inflating: UNOSAT case study/tiles VV/tile 39 60.png
inflating: UNOSAT case study/tiles VV/tile 34 56.png
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inflating: UNOSAT case study/tiles VV/tile 9 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_10.png
inflating: UNOSAT case study/tiles VV/tile 24 4.png
inflating: UNOSAT case study/tiles VV/tile 21 43.png
inflating: UNOSAT case study/tiles VV/tile 13 24.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_36.png
extracting: UNOSAT case study/tiles VV/tile 15 40.png
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inflating: UNOSAT_case_study/tiles_VV/tile_20_8.png
inflating: UNOSAT case study/tiles VV/tile 32 50.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_12.png
inflating: UNOSAT case study/tiles VV/tile 24 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_23.png
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inflating: UNOSAT_case_study/tiles_VV/tile_22_51.png
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inflating: UNOSAT_case_study/tiles_VV/tile_32_14.png
inflating: UNOSAT case study/tiles VV/tile 12 16.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_35.png
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inflating: UNOSAT_case_study/tiles_VV/tile_5_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_6.png
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inflating: UNOSAT_case_study/tiles_VV/tile_13_42.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_52.png
inflating: UNOSAT case study/tiles VV/tile 14 14.png
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inflating: UNOSAT_case_study/tiles_VV/tile_40_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_6.png
inflating: UNOSAT case study/tiles VV/tile 8 11.png
inflating: UNOSAT case study/tiles VV/tile 21 7.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_17.png
inflating: UNOSAT case study/tiles VV/tile 33 40.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_21.png
inflating: UNOSAT case study/tiles VV/tile 34 12.png
extracting: UNOSAT case study/tiles VV/tile 16 30.png
inflating: UNOSAT case study/tiles VV/tile 11 26.png
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extracting: UNOSAT_case_study/tiles_VV/tile_15_22.png
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inflating: UNOSAT_case_study/tiles_VV/tile_41_23.png
inflating: UNOSAT case study/tiles VV/tile 27 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_50.png
inflating: UNOSAT case study/tiles VV/tile 24 13.png
extracting: UNOSAT case study/tiles VV/tile 40 51.png
inflating: UNOSAT case study/tiles VV/tile 32 32.png
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inflating: UNOSAT_case_study/tiles_VV/tile_6_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_16.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_34.png
inflating: UNOSAT case study/tiles VV/tile 20 53.png
```

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inflating: UNOSAT case study/tiles W/tile 21 25.png
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inflating: UNOSAT_case_study/tiles_VV/tile_4_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_6.png
inflating: UNOSAT case study/tiles VV/tile 33 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_15.png
extracting: UNOSAT case study/tiles VV/tile 13 33.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_52.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_43.png
inflating: UNOSAT case study/tiles VV/tile 5 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_31.png
extracting: UNOSAT case study/tiles VV/tile 7 30.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_17.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_9.png
inflating: UNOSAT case study/tiles VV/tile 22 60.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_42.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_11.png
inflating: UNOSAT case study/tiles VV/tile 14 5.png
extracting: UNOSAT case study/tiles VV/tile 20 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_25.png
inflating: UNOSAT case study/tiles VV/tile 9 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_6.png
inflating: UNOSAT case study/tiles VV/tile 21 16.png
inflating: UNOSAT case study/tiles VV/tile 26 20.png
inflating: UNOSAT case study/tiles VV/tile 23 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_3.png
inflating: UNOSAT case study/tiles VV/tile 22 42.png
extracting: UNOSAT case study/tiles VV/tile 14 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_24.png
inflating: UNOSAT case study/tiles VV/tile 30 7.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_26.png
extracting: UNOSAT case study/tiles VV/tile 17 11.png
inflating: UNOSAT case study/tiles VV/tile 25 30.png
inflating: UNOSAT case study/tiles VV/tile 8 20.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_0.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_31.png
inflating: UNOSAT case study/tiles VV/tile 10 27.png
```

```
inflating: UNOSAT case study/tiles W/tile 23 50.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_1.png
inflating: UNOSAT case study/tiles VV/tile 11 8.png
extracting: UNOSAT_case_study/tiles_VV/tile_32_41.png
inflating: UNOSAT case study/tiles VV/tile 40 60.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_25.png
inflating: UNOSAT case study/tiles W/tile 12 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_30.png
inflating: UNOSAT case study/tiles VV/tile 41 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_59.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_32.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_58.png
inflating: UNOSAT case study/tiles VV/tile 32 10.png
extracting: UNOSAT_case_study/tiles_VV/tile_36_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_37.png
inflating: UNOSAT_case_study/tiles_W/tile_5_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_2.png
inflating: UNOSAT case study/tiles VV/tile 20 31.png
inflating: UNOSAT case study/tiles VV/tile 12 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_59.png
inflating: UNOSAT case study/tiles VV/tile 14 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_11.png
extracting: UNOSAT case study/tiles VV/tile 18 49.png
inflating: UNOSAT case study/tiles VV/tile 31 20.png
inflating: UNOSAT case study/tiles VV/tile 39 19.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_2.png
inflating: UNOSAT case study/tiles VV/tile 20 13.png
extracting: UNOSAT case study/tiles VV/tile 38 47.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_3.png
extracting: UNOSAT case study/tiles VV/tile 19 57.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_39.png
inflating: UNOSAT case study/tiles VV/tile 28 48.png
inflating: UNOSAT case study/tiles VV/tile 10 14.png
inflating: UNOSAT case study/tiles VV/tile 39 55.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_2.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_12.png
inflating: UNOSAT case study/tiles VV/tile 6 0.png
```

```
inflating: UNOSAT case study/tiles VV/tile 23 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_59.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_11.png
inflating: UNOSAT case study/tiles VV/tile 33 0.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_47.png
inflating: UNOSAT case study/tiles VV/tile 11 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_3.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_48.png
inflating: UNOSAT case study/tiles VV/tile 41 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_12.png
extracting: UNOSAT_case_study/tiles_VV/tile_39_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_2.png
inflating: UNOSAT case study/tiles VV/tile 12 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_56.png
inflating: UNOSAT case study/tiles VV/tile 20 22.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_29.png
extracting: UNOSAT_case_study/tiles_VV/tile_37_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_4.png
inflating: UNOSAT case study/tiles VV/tile 10 23.png
inflating: UNOSAT case study/tiles VV/tile 28 57.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_20.png
inflating: UNOSAT case study/tiles VV/tile 21 30.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_11.png
inflating: UNOSAT case study/tiles VV/tile 15 0.png
inflating: UNOSAT case study/tiles VV/tile 32 1.png
inflating: UNOSAT case study/tiles VV/tile 30 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_23.png
inflating: UNOSAT case study/tiles VV/tile 30 38.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_42.png
inflating: UNOSAT case study/tiles VV/tile 36 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_28.png
inflating: UNOSAT case study/tiles VV/tile 26 51.png
inflating: UNOSAT case study/tiles VV/tile 24 8.png
inflating: UNOSAT case study/tiles VV/tile 18 32.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_16.png
inflating: UNOSAT case study/tiles VV/tile 24 35.png
```

```
inflating: UNOSAT case study/tiles W/tile 15 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_26.png
inflating: UNOSAT case study/tiles VV/tile 32 18.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_37.png
inflating: UNOSAT case study/tiles VV/tile 37 22.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_40.png
extracting: UNOSAT_case_study/tiles_VV/tile_22_55.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_36.png
inflating: UNOSAT case study/tiles VV/tile 9 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_17.png
inflating: UNOSAT case study/tiles VV/tile 5 9.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_52.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_43.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_6.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_7.png
inflating: UNOSAT case study/tiles VV/tile 5 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_60.png
inflating: UNOSAT case study/tiles VV/tile 22 37.png
inflating: UNOSAT case study/tiles VV/tile 36 32.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_13.png
inflating: UNOSAT case study/tiles VV/tile 31 28.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_46.png
extracting: UNOSAT case study/tiles VV/tile 18 50.png
inflating: UNOSAT case study/tiles VV/tile 29 3.png
inflating: UNOSAT case study/tiles VV/tile 24 53.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_20.png
inflating: UNOSAT case study/tiles VV/tile 8 15.png
inflating: UNOSAT case study/tiles VV/tile 25 25.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_44.png
inflating: UNOSAT case study/tiles VV/tile 29 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_36.png
inflating: UNOSAT case study/tiles VV/tile 24 17.png
inflating: UNOSAT case study/tiles VV/tile 37 40.png
inflating: UNOSAT case study/tiles VV/tile 40 55.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_27.png
inflating: UNOSAT case study/tiles VV/tile 34 52.png
```

```
inflating: UNOSAT case study/tiles W/tile 21 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_19.png
inflating: UNOSAT case study/tiles VV/tile 23 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_24.png
inflating: UNOSAT case study/tiles VV/tile 6 8.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_42.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_38.png
inflating: UNOSAT case study/tiles VV/tile 35 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_18.png
inflating: UNOSAT case study/tiles VV/tile 33 8.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_23.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_41.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_56.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_60.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_37.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_11.png
inflating: UNOSAT case study/tiles VV/tile 15 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_46.png
extracting: UNOSAT case study/tiles VV/tile 37 31.png
inflating: UNOSAT case study/tiles VV/tile 29 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_27.png
inflating: UNOSAT case study/tiles VV/tile 18 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_45.png
inflating: UNOSAT case study/tiles VV/tile 6 26.png
inflating: UNOSAT case study/tiles VV/tile 31 55.png
inflating: UNOSAT case study/tiles VV/tile 28 40.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_18.png
inflating: UNOSAT case study/tiles VV/tile 35 6.png
inflating: UNOSAT case study/tiles VV/tile 9 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_24.png
inflating: UNOSAT case study/tiles VV/tile 34 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_15.png
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extracting: UNOSAT case study/tiles VV/tile 25 52.png
inflating: UNOSAT case study/tiles VV/tile 14 9.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_33.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_28.png
inflating: UNOSAT case study/tiles VV/tile 14 27.png
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```
inflating: UNOSAT case study/tiles W/tile 27 50.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_22.png
inflating: UNOSAT case study/tiles VV/tile 31 37.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_18.png
inflating: UNOSAT case study/tiles VV/tile 36 41.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_6.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_43.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_39.png
inflating: UNOSAT case study/tiles VV/tile 38 3.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_26.png
inflating: UNOSAT case study/tiles VV/tile 32 45.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_4.png
extracting: UNOSAT_case_study/tiles_VV/tile_23_54.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_8.png
inflating: UNOSAT case study/tiles VV/tile 9 32.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_42.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_33.png
inflating: UNOSAT case study/tiles VV/tile 27 14.png
inflating: UNOSAT case study/tiles VV/tile 30 29.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_51.png
inflating: UNOSAT case study/tiles VV/tile 32 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_2.png
inflating: UNOSAT case study/tiles VV/tile 29 36.png
inflating: UNOSAT case study/tiles VV/tile 37 55.png
inflating: UNOSAT case study/tiles VV/tile 38 27.png
extracting: UNOSAT_case_study/tiles_VV/tile_10_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_29.png
inflating: UNOSAT case study/tiles VV/tile 17 57.png
inflating: UNOSAT case study/tiles VV/tile 35 39.png
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inflating: UNOSAT case study/tiles VV/tile 38 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_0.png
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inflating: UNOSAT case study/tiles VV/tile 33 59.png
inflating: UNOSAT case study/tiles VV/tile 12 10.png
extracting: UNOSAT_case_study/tiles_VV/tile_36_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_56.png
inflating: UNOSAT case study/tiles VV/tile 39 17.png
```

```
inflating: UNOSAT case study/tiles W/tile 11 20.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_1.png
extracting: UNOSAT_case_study/tiles_VV/tile_38_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_11.png
inflating: UNOSAT case study/tiles VV/tile 4 0.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_47.png
inflating: UNOSAT case study/tiles VV/tile 36 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_19.png
inflating: UNOSAT case study/tiles VV/tile 34 49.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_0.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_10.png
inflating: UNOSAT case study/tiles VV/tile 28 46.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_37.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_55.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_1.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_57.png
inflating: UNOSAT case study/tiles VV/tile 35 48.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_58.png
inflating: UNOSAT case study/tiles VV/tile 25 49.png
inflating: UNOSAT case study/tiles VV/tile 10 3.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_37.png
inflating: UNOSAT case study/tiles VV/tile 36 56.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_28.png
inflating: UNOSAT case study/tiles VV/tile 19 46.png
inflating: UNOSAT case study/tiles VV/tile 39 26.png
inflating: UNOSAT case study/tiles VV/tile 13 0.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_59.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_10.png
inflating: UNOSAT case study/tiles VV/tile 20 20.png
inflating: UNOSAT case study/tiles VV/tile 38 54.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_1.png
extracting: UNOSAT case study/tiles VV/tile 18 56.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_19.png
inflating: UNOSAT case study/tiles VV/tile 36 38.png
inflating: UNOSAT case study/tiles VV/tile 27 47.png
extracting: UNOSAT case study/tiles VV/tile 19 28.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_39.png
extracting: UNOSAT_case_study/tiles_VV/tile_9_29.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_18.png
extracting: UNOSAT case study/tiles VV/tile 10 21.png
```

```
inflating: UNOSAT case study/tiles W/tile 28 55.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_2.png
extracting: UNOSAT_case_study/tiles_VV/tile_37_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_52.png
inflating: UNOSAT case study/tiles VV/tile 16 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_33.png
inflating: UNOSAT case study/tiles VV/tile 7 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_38.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_42.png
inflating: UNOSAT case study/tiles VV/tile 41 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_6.png
inflating: UNOSAT case study/tiles VV/tile 21 45.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_7.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_32.png
inflating: UNOSAT case study/tiles VV/tile 26 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_60.png
extracting: UNOSAT case study/tiles VV/tile 8 31.png
inflating: UNOSAT case study/tiles VV/tile 6 15.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_4.png
inflating: UNOSAT case study/tiles VV/tile 23 25.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_44.png
inflating: UNOSAT case study/tiles VV/tile 9 3.png
inflating: UNOSAT case study/tiles VV/tile 14 34.png
extracting: UNOSAT case study/tiles VV/tile 22 53.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_16.png
extracting: UNOSAT case study/tiles VV/tile 16 32.png
inflating: UNOSAT case study/tiles VV/tile 24 51.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_28.png
inflating: UNOSAT case study/tiles VV/tile 29 1.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_14.png
inflating: UNOSAT case study/tiles VV/tile 25 23.png
extracting: UNOSAT case study/tiles VV/tile 33 42.png
inflating: UNOSAT case study/tiles VV/tile 20 19.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_11.png
inflating: UNOSAT case study/tiles VV/tile 31 26.png
```

```
inflating: UNOSAT case study/tiles W/tile 13 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_54.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_35.png
inflating: UNOSAT case study/tiles VV/tile 5 25.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_4.png
inflating: UNOSAT case study/tiles VV/tile 40 17.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_21.png
inflating: UNOSAT case study/tiles VV/tile 4 17.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_22.png
inflating: UNOSAT case study/tiles VV/tile 6 6.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_7.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_36.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_55.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_43.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_34.png
inflating: UNOSAT case study/tiles VV/tile 24 15.png
extracting: UNOSAT_case_study/tiles_VV/tile_40_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_19.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_42.png
extracting: UNOSAT_case_study/tiles_W/tile_16_23.png
extracting: UNOSAT case study/tiles VV/tile 15 51.png
inflating: UNOSAT case study/tiles VV/tile 37 2.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_9.png
inflating: UNOSAT case study/tiles VV/tile 33 33.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_14.png
inflating: UNOSAT case study/tiles VV/tile 41 52.png
inflating: UNOSAT case study/tiles VV/tile 31 17.png
inflating: UNOSAT case study/tiles VV/tile 36 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_6.png
extracting: UNOSAT_case_study/tiles_VV/tile_13_35.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_54.png
inflating: UNOSAT case study/tiles VV/tile 5 16.png
inflating: UNOSAT case study/tiles VV/tile 16 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_26.png
inflating: UNOSAT case study/tiles VV/tile 19 11.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_45.png
inflating: UNOSAT case study/tiles VV/tile 27 30.png
inflating: UNOSAT case study/tiles VV/tile 26 22.png
inflating: UNOSAT case study/tiles VV/tile 34 41.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_0.png
extracting: UNOSAT case study/tiles VV/tile 17 31.png
```

```
inflating: UNOSAT case study/tiles VV/tile 14 7.png
extracting: UNOSAT_case_study/tiles_VV/tile_20_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_50.png
extracting: UNOSAT_case_study/tiles_VV/tile_12_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_53.png
inflating: UNOSAT case study/tiles VV/tile 15 15.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_34.png
inflating: UNOSAT case study/tiles VV/tile 6 24.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_4.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_43.png
inflating: UNOSAT case study/tiles VV/tile 40 44.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_60.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_41.png
inflating: UNOSAT case study/tiles VV/tile 34 23.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_35.png
inflating: UNOSAT case study/tiles VV/tile 23 16.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_26.png
inflating: UNOSAT case study/tiles VV/tile 37 11.png
inflating: UNOSAT case study/tiles VV/tile 15 6.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_17.png
inflating: UNOSAT case study/tiles VV/tile 26 40.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_21.png
inflating: UNOSAT case study/tiles VV/tile 21 36.png
extracting: UNOSAT case study/tiles VV/tile 9 30.png
inflating: UNOSAT case study/tiles VV/tile 35 31.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_7.png
extracting: UNOSAT case study/tiles VV/tile 15 33.png
extracting: UNOSAT_case_study/tiles_VV/tile_23_52.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_29.png
inflating: UNOSAT case study/tiles VV/tile 19 2.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_34.png
inflating: UNOSAT case study/tiles VV/tile 33 15.png
inflating: UNOSAT case study/tiles VV/tile 24 24.png
inflating: UNOSAT case study/tiles VV/tile 32 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_6.png
inflating: UNOSAT case study/tiles VV/tile 37 59.png
```

```
inflating: UNOSAT case study/tiles W/tile 16 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_32.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_1.png
inflating: UNOSAT case study/tiles VV/tile 13 22.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_41.png
inflating: UNOSAT case study/tiles VV/tile 24 2.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_33.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_39.png
inflating: UNOSAT case study/tiles VV/tile 22 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_42.png
inflating: UNOSAT_case_study/tiles_W/tile_5_3.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_12.png
extracting: UNOSAT_case_study/tiles_VV/tile_31_40.png
inflating: UNOSAT case study/tiles VV/tile 23 21.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_15.png
extracting: UNOSAT_case_study/tiles_W/tile_38_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_10.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_31.png
inflating: UNOSAT case study/tiles VV/tile 14 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_13.png
extracting: UNOSAT case study/tiles VV/tile 13 40.png
inflating: UNOSAT case study/tiles VV/tile 31 22.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_2.png
inflating: UNOSAT case study/tiles VV/tile 30 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_3.png
extracting: UNOSAT case study/tiles VV/tile 12 32.png
extracting: UNOSAT case study/tiles VV/tile 20 51.png
inflating: UNOSAT case study/tiles VV/tile 4 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_57.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_4.png
inflating: UNOSAT case study/tiles VV/tile 19 59.png
inflating: UNOSAT case study/tiles VV/tile 24 11.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_30.png
inflating: UNOSAT case study/tiles VV/tile 41 21.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_20.png
inflating: UNOSAT case study/tiles VV/tile 10 16.png
inflating: UNOSAT case study/tiles VV/tile 12 5.png
inflating: UNOSAT case study/tiles VV/tile 25 10.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_5_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_41.png
inflating: UNOSAT case study/tiles VV/tile 22 22.png
```

```
inflating: UNOSAT case study/tiles W/tile 13 31.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_2.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_23.png
inflating: UNOSAT case study/tiles VV/tile 20 42.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_3.png
inflating: UNOSAT case study/tiles VV/tile 31 4.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_14.png
extracting: UNOSAT_case_study/tiles_VV/tile_39_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_21.png
inflating: UNOSAT case study/tiles VV/tile 40 40.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_0.png
inflating: UNOSAT_case_study/tiles_VV/tile_41_12.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_20.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_30.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_11.png
inflating: UNOSAT case study/tiles VV/tile 30 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_3_14.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_58.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_13_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_33.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_21.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_1.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_0.png
inflating: UNOSAT case study/tiles VV/tile 23 12.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_31.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_23.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_3.png
inflating: UNOSAT_case_study/tiles_VV/tile_20_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_12_41.png
inflating: UNOSAT case study/tiles VV/tile 21 32.png
inflating: UNOSAT case study/tiles VV/tile 13 13.png
inflating: UNOSAT_case_study/tiles_VV/tile_4_22.png
inflating: UNOSAT case study/tiles VV/tile 15 2.png
inflating: UNOSAT_case_study/tiles_VV/tile_11_6.png
inflating: UNOSAT case study/tiles VV/tile 24 20.png
inflating: UNOSAT case study/tiles VV/tile 7 10.png
inflating: UNOSAT case study/tiles VV/tile 41 30.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_11.png
inflating: UNOSAT_case_study/tiles_VV/tile_10_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_59.png
inflating: UNOSAT case study/tiles VV/tile 28 6.png
inflating: UNOSAT case study/tiles VV/tile 41 47.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_32.png
inflating: UNOSAT case study/tiles VV/tile 33 28.png
extracting: UNOSAT_case_study/tiles_VV/tile_15_46.png
inflating: UNOSAT case study/tiles VV/tile 37 60.png
inflating: UNOSAT case study/tiles VV/tile 24 37.png
inflating: UNOSAT case study/tiles VV/tile 32 56.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_7_27.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_44.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_25.png
inflating: UNOSAT case study/tiles VV/tile 36 16.png
```

```
inflating: UNOSAT case study/tiles VV/tile 7 9.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_53.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_34.png
inflating: UNOSAT_case_study/tiles_VV/tile_21_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_35.png
extracting: UNOSAT case study/tiles VV/tile 17 26.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_45.png
inflating: UNOSAT case study/tiles VV/tile 16 54.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_36.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_40.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_17.png
inflating: UNOSAT case study/tiles VV/tile 40 39.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_24.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_42.png
extracting: UNOSAT_case_study/tiles_VV/tile_22_57.png
extracting: UNOSAT_case_study/tiles_VV/tile_14_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_19.png
inflating: UNOSAT case study/tiles VV/tile 28 33.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_52.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_27.png
extracting: UNOSAT_case_study/tiles_VV/tile_38_50.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_55.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_36.png
inflating: UNOSAT case study/tiles VV/tile 29 5.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_22.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_9.png
inflating: UNOSAT_case_study/tiles_VV/tile_8_8.png
inflating: UNOSAT_case_study/tiles_VV/tile_22_39.png
inflating: UNOSAT case study/tiles VV/tile 19 24.png
inflating: UNOSAT case study/tiles VV/tile 30 58.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_43.png
inflating: UNOSAT case study/tiles VV/tile 36 34.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_15.png
extracting: UNOSAT case study/tiles VV/tile 18 52.png
extracting: UNOSAT case study/tiles VV/tile 17 44.png
inflating: UNOSAT case study/tiles VV/tile 20 59.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_25.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_35.png
inflating: UNOSAT case study/tiles VV/tile 34 54.png
inflating: UNOSAT case study/tiles VV/tile 18 16.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_57.png
inflating: UNOSAT case study/tiles VV/tile 37 42.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_19.png
inflating: UNOSAT case study/tiles VV/tile 29 23.png
inflating: UNOSAT case study/tiles VV/tile 32 38.png
inflating: UNOSAT case study/tiles VV/tile 27 7.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_60.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_15_28.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_47.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_14.png
inflating: UNOSAT case study/tiles VV/tile 41 29.png
```

```
inflating: UNOSAT case study/tiles W/tile 41 56.png
extracting: UNOSAT_case_study/tiles_VV/tile_38_41.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_18.png
inflating: UNOSAT_case_study/tiles_VV/tile_33_37.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_6.png
inflating: UNOSAT case study/tiles VV/tile 15 55.png
inflating: UNOSAT_case_study/tiles_VV/tile_29_50.png
inflating: UNOSAT case study/tiles VV/tile 16 27.png
inflating: UNOSAT_case_study/tiles_VV/tile_24_46.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_13.png
inflating: UNOSAT_case_study/tiles_VV/tile_16_9.png
inflating: UNOSAT case study/tiles VV/tile 27 34.png
inflating: UNOSAT_case_study/tiles_VV/tile_30_49.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_15.png
inflating: UNOSAT_case_study/tiles_VV/tile_36_25.png
extracting: UNOSAT_case_study/tiles_VV/tile_18_43.png
extracting: UNOSAT_case_study/tiles_VV/tile_21_58.png
extracting: UNOSAT case study/tiles VV/tile 13 39.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_54.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_35.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_4.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_17.png
inflating: UNOSAT_case_study/tiles_VV/tile_34_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_26_26.png
inflating: UNOSAT_case_study/tiles_VV/tile_9_16.png
inflating: UNOSAT_case_study/tiles_VV/tile_18_7.png
inflating: UNOSAT_case_study/tiles_VV/tile_40_48.png
inflating: UNOSAT_case_study/tiles_VV/tile_37_33.png
inflating: UNOSAT case study/tiles VV/tile 29 14.png
inflating: UNOSAT_case_study/tiles_VV/tile_32_29.png
inflating: UNOSAT_case_study/tiles_VV/tile_14_47.png
extracting: UNOSAT_case_study/tiles_VV/tile_19_51.png
inflating: UNOSAT_case_study/tiles_VV/tile_23_38.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_57.png
extracting: UNOSAT case study/tiles VV/tile 15 19.png
inflating: UNOSAT case study/tiles VV/tile 28 42.png
inflating: UNOSAT_case_study/tiles_VV/tile_6_28.png
inflating: UNOSAT case study/tiles VV/tile 35 8.png
inflating: UNOSAT_case_study/tiles_VV/tile_25_36.png
inflating: UNOSAT case study/tiles VV/tile 33 55.png
inflating: UNOSAT case study/tiles VV/tile 17 17.png
inflating: UNOSAT case study/tiles VV/tile 8 26.png
extracting: UNOSAT_case_study/tiles_VV/tile_16_45.png
inflating: UNOSAT_case_study/tiles_VV/tile_38_5.png
inflating: UNOSAT_case_study/tiles_VV/tile_39_31.png
inflating: UNOSAT case study/tiles VV/tile 34 27.png
inflating: UNOSAT case study/tiles VV/tile 37 15.png
inflating: UNOSAT_case_study/tiles_VV/tile_27_52.png
inflating: UNOSAT case study/tiles VV/tile 14 29.png
inflating: UNOSAT_case_study/tiles_VV/tile_19_33.png
inflating: UNOSAT case study/tiles VV/tile 34 9.png
inflating: UNOSAT case study/tiles VV/tile 22 48.png
inflating: UNOSAT case study/tiles VV/tile 36 43.png
inflating: UNOSAT_case_study/tiles_VV/tile_28_24.png
inflating: UNOSAT_case_study/tiles_VV/tile_31_39.png
inflating: UNOSAT_case_study/tiles_VV/tile_17_8.png
extracting: UNOSAT_case_study/tiles_VV/tile_17_53.png
inflating: UNOSAT_case_study/tiles_VV/tile_35_35.png
inflating: UNOSAT case study/tiles VV/tile 27 16.png
```

```
inflating: UNOSAT_case_study/tiles_VV/tile_18_25.png
         inflating: UNOSAT_case_study/tiles_W/tile_26_44.png
         inflating: UNOSAT_case_study/tiles_VV/tile_9_34.png
         inflating: UNOSAT_case_study/tiles_VV/tile_36_7.png
         inflating: UNOSAT_case_study/tiles_VV/tile_7_18.png
         inflating: UNOSAT case study/tiles VV/tile 29 32.png
         inflating: UNOSAT_case_study/tiles_VV/tile_32_47.png
         inflating: UNOSAT case study/tiles VV/tile 24 28.png
         inflating: UNOSAT_case_study/tiles_VV/tile_37_51.png
        extracting: UNOSAT_case_study/tiles_VV/tile_23_56.png
        extracting: UNOSAT_case_study/tiles_VV/tile_15_37.png
         inflating: UNOSAT_case_study/tiles_VV/tile_28_60.png
         inflating: UNOSAT_case_study/tiles_VV/tile_19_6.png
         inflating: UNOSAT_case_study/tiles_VV/tile_33_19.png
         inflating: UNOSAT_case_study/tiles_VV/tile_41_38.png
         inflating: UNOSAT_case_study/tiles_VV/tile_38_23.png
In [3]: # DO NOT CHANGE THIS CELL
        # set environment variables
        os.environ['NEPAL_VV_PATH']='/dli/task/UNOSAT_case_study/tiles_VV'
        os.environ['NEPAL_VH_PATH']='/dli/task/UNOSAT_case_study/tiles_VH'
        # list all VV tiles
        !ls $NEPAL_VV_PATH
```

```
tile_10_0.png
                tile_18_18.png
                                tile_24_8.png
                                                 tile_31_51.png
                                                                  tile_38_40.png
                                                 tile_31_52.png
                                                                  tile_38_41.png
tile_10_1.png
                tile_18_19.png
                                 tile_24_9.png
tile_10_10.png
                tile_18_2.png
                                 tile_25_0.png
                                                 tile_31_53.png
                                                                  tile_38_42.png
tile_10_11.png
                tile_18_20.png
                                 tile_25_1.png
                                                 tile_31_54.png
                                                                  tile_38_43.png
tile_10_12.png
                tile_18_21.png
                                 tile_25_10.png
                                                 tile_31_55.png
                                                                  tile_38_44.png
                                                                  tile 38 45.png
tile 10 13.png
                tile 18 22.png
                                 tile 25 11.png
                                                 tile_31_56.png
tile_10_14.png
                tile_18_23.png
                                 tile_25_12.png
                                                 tile_31_57.png
                                                                  tile_38_46.png
tile_10_15.png
                tile_18_24.png
                                 tile_25_13.png
                                                 tile_31_58.png
                                                                  tile_38_47.png
tile_10_16.png
                                 tile_25_14.png
                tile_18_25.png
                                                 tile_31_59.png
                                                                  tile_38_48.png
tile_10_17.png
                tile_18_26.png
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                                                                  tile_38_49.png
                tile_18_27.png
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tile_10_18.png
                                 tile_25_16.png
                                                 tile_31_60.png
                tile 18 28.png
                                                                  tile 38 50.png
tile_10_19.png
                                 tile 25 17.png
                                                 tile 31 7.png
                tile_18_29.png
                                 tile_25_18.png
                                                                  tile_38_51.png
tile_10_2.png
                                                 tile_31_8.png
tile_10_20.png
                tile_18_3.png
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tile_10_22.png
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                tile_18_32.png
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                                                 tile 32 12.png
                                                                  tile 38 57.png
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                                 tile_25_24.png
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tile_10_27.png
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tile_10_28.png
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                                 tile_25_28.png
                                                 tile_32_17.png
                                                                  tile_38_7.png
tile_10_3.png
tile_10_30.png
                tile_18_4.png
                                 tile_25_29.png
                                                 tile_32_18.png
                                                                  tile_38_8.png
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                                 tile_25_3.png
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tile_10_31.png
tile_10_32.png
                tile_18_41.png
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                                                                  tile_39_1.png
tile_10_33.png
                tile_18_42.png
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tile_10_38.png
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                tile_18_48.png
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tile_10_4.png
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tile 10 5.png
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tile 11 0.png
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                                 tile 25 51.png
                                                                  tile 39 3.png
tile 11 17.png
                tile 18 8.png
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tile_11_18.png
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tile 11 19.png
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tile 11 2.png
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                tile 19 10.png
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tile_11_23.png
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tile_11_24.png
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tile 11 26.png
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tile_11_27.png
                tile_19_17.png
                                tile_25_7.png
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                                                                 tile_39_4.png
                                                 tile_32_51.png
                                                                  tile_39_40.png
tile_11_28.png
                tile_19_18.png
                                 tile_25_8.png
tile_11_29.png
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tile_11_3.png
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tile_11_30.png
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tile 11 31.png
                                tile 26 10.png
                                                 tile_32_55.png
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tile_11_32.png
                tile_19_22.png
                                 tile_26_11.png
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tile_11_33.png
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tile_11_36.png
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                tile_19_28.png
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tile_11_38.png
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tile_11_39.png
                tile_19_29.png
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                                                 tile_32_8.png
                                                                  tile_39_51.png
tile_11_4.png
                tile_19_3.png
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tile_11_40.png
                tile_19_30.png
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The Sentinel-1 mission provides data from a dual-polarization C-band Synthetic Aperture Radar (SAR) instrument. The data we've collected are from the 2 primary bands:

- VV (vertical transmit/vertical receive)
 - Better at detecting vertical structures and rough surfaces
 - Useful for urban area mapping, infrastructure monitoring, and ocean applications
 - More sensitive to surface roughness and soil moisture
- VH (vertical transmit/horizontal receive)
 - More sensitive to volume scattering, making it valuable for vegetation analysis
 - Particularly useful for forest monitoring, biomass estimation, and crop classification
 - Better at distinguishing different types of vegetation cover

The Sentinel-1 images are divided into tiles of size 512 x 512 so that they are easier to manipulate (as opposed to one large file). While Sentinel-1 data is already preprocessed to some extent, additional preprocessing steps are typically needed to prepare the data for analysis. These preprocessing steps help to improve the quality and usability of Sentinel-1 data for various applications, ensuring that the information derived from both VV and VH bands is as accurate and meaningful as possible.

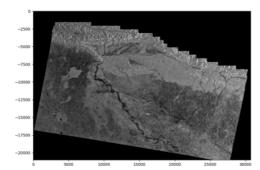
```
In [4]: # DO NOT CHANGE THIS CELL
    # Load the images
    vv_img=mpimg.imread('full_vv_image.png')
    vh_img=mpimg.imread('full_vh_image.png')

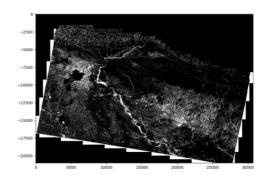
# create a figure with two subplots
# fig=plt.figure(figsize=(5, 10))
fig, ax=plt.subplots(1, 2, figsize=(10, 5))

# display the images
ax[0].imshow(vv_img)
ax[0].set_title('VV')
ax[0].axis('off')
ax[1].imshow(vh_img)
ax[1].imshow(vh_img)
ax[1].set_title('VH')
ax[1].axis('off')

plt.tight_layout()
```

VV VH





DO NOT CHANGE THIS CELL # plot composite for all tiles band='VH' # or 'VV' fig=plt.figure(figsize=(10, 10)) ax=plt.subplot(111) max_x, max_y=0, 0 for each_tile in os.listdir(os.environ[fNEPAL_{band}_PATH']): if (each_tile.split('.') [-1]=='png'): tile_name=each_tile.replace('.png', ")_, y, x=tile_name.split('_') y=int(y) x=int(x) if y>max_y: max_y=y if x>max_x: max_x=x image=mpimg.imread(os.path.join(os.environ[fNEPAL_{band}_PATH'], each_tile)) plt.imshow(image, extent=(512*x, 512*(x+1), -512*(y+1), -512*y), cmap='gray') ax.set_xlim([0, max_x*512]) ax.set_ylim([-max_y*512, 0]) ax.set_facecolor("black") plt.show()

Click ... to show the **script** to generate these full images.

Processing large image files is memory intensive. To ensure we have sufficient memory for the rest of the notebook, we free up some memory with del() and gc.collect().

```
In [5]: # DO NOT CHANGE THIS CELL
del(fig)
del(ax)

gc.collect()
!free
```

total used free shared buff/cache available Mem: 28726056 3019668 422528 309512 25283860 24946536 Swap: 0 0 0

```
In [6]: # DO NOT CHANGE THIS CELL
# define function to create RGB composite from VV and VH bands
def RGB_composite(tile_name):
    vv=mpimg.imread(os.path.join(os.getenv('NEPAL_VV_PATH'), tile_name))
    red=np.clip(vv, 0, 1)

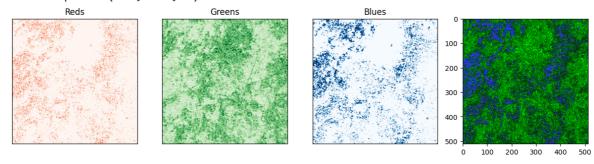
# remove noise from speckle, scattering, and bounce
red[red>0.7]=0

vh=mpimg.imread(os.path.join(os.getenv('NEPAL_VH_PATH'), tile_name))
green=np.clip(vh, 0, 1)

blue=np.clip(vv/vh, 0, 1)
    stacked=np.dstack((red, green, blue))
    return stacked
```

```
In [7]: # DO NOT CHANGE THIS CELL
        # display the RGB composite of one tile
        tile_name=random.choice(os.listdir(os.getenv('NEPAL_VV_PATH')))
        print(f'Displaying {tile_name}.')
        # create RGB composite
        RGB_tile=RGB_composite(tile_name)
        cmaps=['Reds', 'Greens', 'Blues']
        # plot RGB bands
        fig, ax=plt.subplots(1, 4, figsize=(15, 5))
        for idx in range(3):
            ax[idx].imshow(RGB_tile[:, :, idx], cmap=cmaps[idx])
            ax[idx].get_yaxis().set_visible(False)
            ax[idx].get_xaxis().set_visible(False)
            ax[idx].set_title(cmaps[idx])
        ax[3].imshow(RGB_tile)
        print(f'The shape is {RGB_tile.shape}.')
        plt.show()
```

Displaying tile_27_54.png. The shape is (512, 512, 3).



You can compare the composite with one that is generated on ASF.

No description has been provided for this image

Segmentation Model Inference

For inference, we will send requests to the Triton Inference Server to ensure the best performance. We will use the previously trained sample_resnet18.engine TensorRT engine, which has been optimized for inference performance.

```
In [8]: # DO NOT CHANGE THIS CELL
!curl -v triton:8000/v2/health/ready
```

```
* Connected to triton (172.18.0.3) port 8000 (#0)
        > GET /v2/health/ready HTTP/1.1
        > Host: triton:8000
        > User-Agent: curl/7.81.0
        > Accept: */*
        * Mark bundle as not supporting multiuse
        < HTTP/1.1 200 OK
        < Content-Length: 0
        < Content-Type: text/plain
        * Connection #0 to host triton left intact
 In [9]: # DO NOT CHANGE THIS CELL
         import tritonclient.http as tritonhttpclient
         # set parameters
         VERBOSE=False
         input name='input 1:0'
         input_shape=(1, 3, 512, 512)
         input_dtype='FP32'
         output_name='argmax_1'
         model_name='flood_segmentation_model'
         url='triton:8000'
         model_version='1'
In [10]: # DO NOT CHANGE THIS CELL
         # configure Triton client
         triton_client=tritonhttpclient.InferenceServerClient(url=url, verbose=VERBOSE)
         model_metadata=triton_client.get_model_metadata(model_name=model_name, model_ver
         model_config=triton_client.get_model_config(model_name=model_name, model_version
         We will performance inference on the image tiles. Since we are only interested in a
         specific area, we limit this to a subset of the total tiles.
In [11]: # DO NOT CHANGE THIS CELL
         # define function to pre-process images for Triton consumption
         def get image ary(tile name):
             image=RGB composite(tile name)
             image_ary=((image*255)-127.5)*0.00784313725490196
             BGR=np.empty_like(image_ary)
             BGR[:, :, 0]=image_ary[:, :, 2]
             BGR[:, :, 1]=image_ary[:, :, 1]
             BGR[:, :, 2]=image_ary[:, :, 0]
             image_ary=BGR
             image_ary=np.transpose(image_ary, [2, 0, 1])
             image_ary=np.expand_dims(image_ary, axis=0)
             return image ary
In [12]: # DO NOT CHANGE THIS CELL
         # configure input and output
         inference input=tritonhttpclient.InferInput(input name, input shape, input dtype
         output=tritonhttpclient.InferRequestedOutput(output name)
         # create one large array by concatenating inference results on individual tiles
```

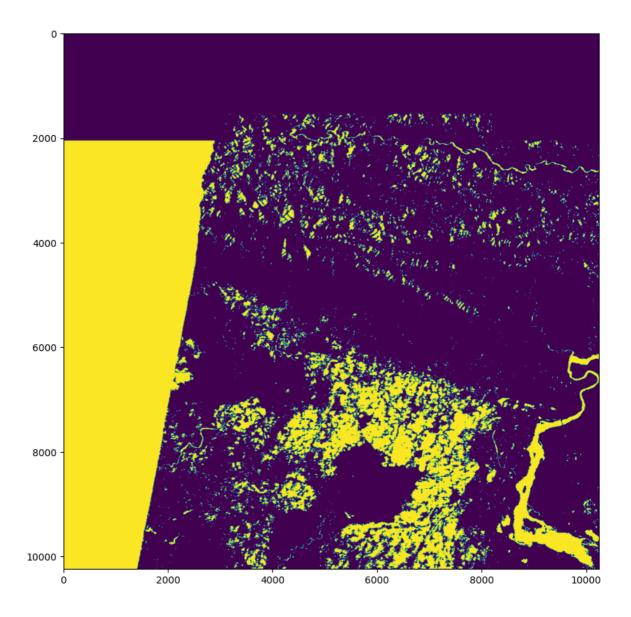
Trying 172.18.0.3:8000...

```
prediction_y=[]
for each_y in range(0, 20):
   prediction_x=[]
   for each_x in range(20):
        each_file=f'tile_{each_y}_{each_x}.png'
        if each_file in os.listdir(os.getenv('NEPAL_VV_PATH')):
            # preprocess input tiles
            image_ary=get_image_ary(each_file)
            # genreate inference with Triton
            inference_input.set_data_from_numpy(image_ary)
            response=triton_client.infer(model_name,
                                         model_version=model_version,
                                         inputs=[inference_input],
                                         outputs=[output])
            logits=response.as_numpy(output_name)
            logits=np.asarray(logits, dtype=np.int32)
            mask=logits[0]
            prediction_x.append(mask)
        else:
            prediction_x.append(np.zeros((512, 512, 1)))
    prediction_y.append(np.concatenate(prediction_x, axis=1))
prediction=np.concatenate(prediction_y, axis=0)
print(f'The result predictions has a shape of {prediction.shape}.')
```

The result predictions has a shape of (10240, 10240, 1).

```
In [13]: # DO NOT CHANGE THIS CELL
fig=plt.figure(figsize=(10, 10))
plt.imshow(prediction)
```

Out[13]: <matplotlib.image.AxesImage at 0x7f4276a3be50>



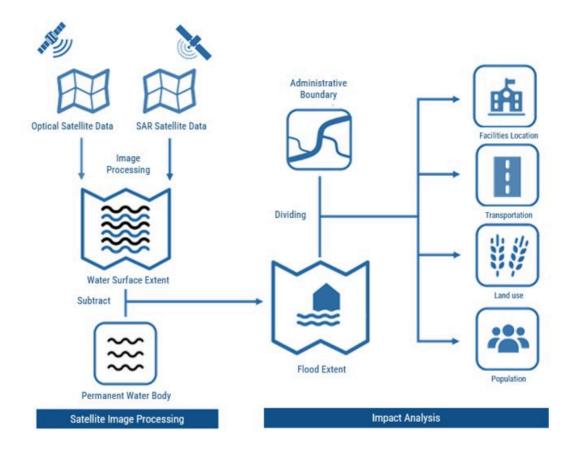
Impact Analysis

When performing an impact analysis, we are concerned with:

- What is the extent of the flood?
- How many people are likely affected or located within flood affected areas?
- What is the estimated number of critical facilities located within the flood affected areas?

We will use baseline data, which refers to information that provides humanitarian actors with a pre-disaster picture of the potentially affected populations, critical infrastructure, basic geography, and other issues that will become crucial when disaster strikes. Baseline data are obtained from several different sources, each responsible for ensuring accuracy and integrity. Some examples of commonly used baseline data are:

- Humanitarian Data Exchange
- Common Operational Datasets
- WorldPop
- OpenStreetMap
- Esri 2020 Land Cover Map



To estimate the population potentially affected by the flood, we will subtract the permanent water from the Al-based water extent. This will be the flood extent that didn't have water pre-disaster. We then intersect the flood extent with the open-source spatial demographic dataset WorldPop. It is important to notice that there is a discrepancy between Sentinel-1 10-meter resolution and the 100-meter resolution of WorldPop. Resampling the population layer is required to align it with the flood extend before computing any impact analysis. The area of interest for the impact analysis includes the Nawalparasi West, Rupandehi and Kapilbastu districts, and Lumbini province. We curated the permanent water layer and the WorldPop dataset to easily compute the impact analysis.

No description has been provided for this image

```
ax[idx].get_xaxis().set_visible(False)
ax[idx].set_title(map['name'])
```







```
In [15]: # DO NOT CHANGE THIS CELL
    # make a copy of the water extent
    flood_extent=prediction[:, :, 0].copy()

# focus on the region inside the analyis extent only
    flood_extent[analysis_extent==0]=0

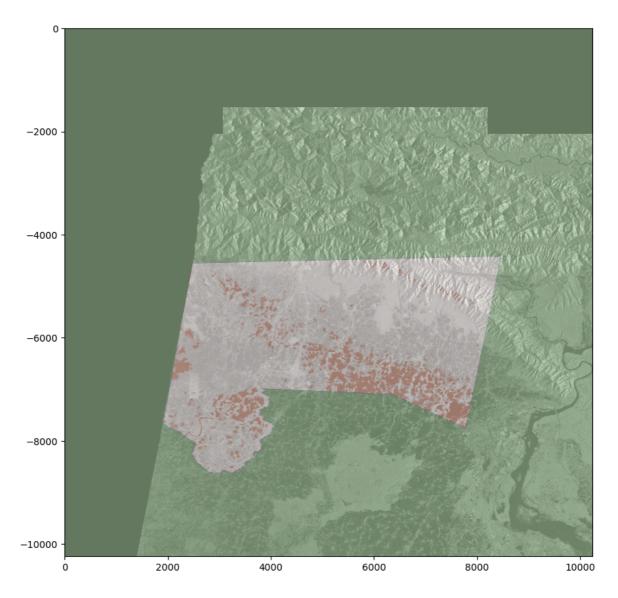
# subtract permanent water
    flood_extent[permanent_water!=0]=0

# calculate the potentially affected population resempling the WorldPop resoluti
    affected_population=np.sum(world_pop*255*np.float32(flood_extent)/98.50665986164

print(f"Population potentially affected: {affected_population}.")
```

Population potentially affected: 199719.171875.

```
In [16]: # DO NOT CHANGE THIS CELL
         # plot layers of the impact analysis
         fig=plt.figure(figsize=(10, 10))
         ax=plt.subplot(111)
         # plot map (by tiles)
         for each_y in range(20):
             for each_x in range(20):
                 each_file=f'tile_{each_y}_{each_x}.png'
                 if each file in os.listdir(os.environ['NEPAL VV PATH']):
                     image=RGB_composite(each_file)
                     plt.imshow(image[:, :, 1], extent=(512*each_x, 512*(each_x+1), -512*
         # plot predicted flood extent
         plt.imshow(flood_extent, extent=(0, 10240, -10240, 0), cmap='Reds', alpha=0.5, v
         # plot area of interest
         plt.imshow(analysis_extent, extent=(0, 10240, -10240, 0), cmap='ocean', alpha=0.
         ax.set_xlim([0, 10240])
         ax.set_ylim([-10240, 0])
         ax.set_facecolor("black")
         plt.show()
```



The United Nations Satellite Centre (UNOSAT) map, displayed below, indicated a potential exposed population of 195'000 on June 2nd. Is it in line with the number you just obtained?

No description has been provided for this image

Near-Real-Time FloodAl Dashboard

To run flood detection at scale and respond to a growing need for daily updates, it is crucial to develop end-to-end pipelines where satellite images are automatically downloaded and processed by machine learning algorithms to output flood extent. Tools that provide access and disseminate this information could play a key role, such as the operational dashboards that UNOSAT developed for the UN Regional Coordination Office in Nepal.

To ensure timely and accurate updates, the Al-generated flood extents are reviewed and corrected as necessary by the UNOSAT Rapid Mapping team, before feeding the dashboard for end user consumption. Another tailor-made feature was the integration of UN ASIGN, an application that was shared with field officers across the country to upload

geotagged information and photos in real time. The UN ASIGN application provided a way to collect and centralize ground data, which was extremely useful during the national lockdown. The visualization of all the data on the same platform provides a comprehensive overview of the area of interest despite movement restrictions.

No description has been provided for this image

Summary

Thank you for completing the NVIDIA DLI Disaster Risk Monitoring Using Satellite Imagery lab. In this lab, you learned how to build and deploy a flood detection segmentation model using data collected from Sentinel-1 satellites. You also learned how flood detection is used to support disaster response. While this lab focuses primarily on detecting flood events, it should be noted that similar applications can be created for other natural disasters.

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