

Disaster Risk Analysis Methods

iMAP provides several disaster risk assessments based on geospatial analysis across Afghanistan. Most of the analysis is or will be made available on the [Humanitarian Spatial Data Center](#) where registered members can view and download the data. Following is an overview of the data sources and methodologies used.

Flood Risk

Flood risk is analyzed at two levels – long term (based on hydrological models and 100-year precipitation events) and short term (based on weather forecasts).

Long term risk is analyzed using the *NATO Afghanistan Flood Hazard Map* which provides a spatial extent of the expected inundation (disaggregated to three different levels) at a 100-year event. Additionally, the flood model is being used in combination with WorldPop population data and Microsoft building footprints to generate estimates of number of people, buildings and total areas exposed to flood risk (at the three different inundation levels) within provinces and districts. Technically, this is done using zonal statistics in a semi-automated Python based workflow.

The aggregated flood risk data is available on the [flood risk dashboard](#) on HSDC.

The inundation levels of the NATO Afghanistan Flood Hazard map can be interpreted as the modelled water depth expected for a given area, likely to occur once per 100 years. On the Humanitarian Spatial Data Center, iMAP has converted these inundation levels to risk estimates as follows:

- 29 cm inundation → low risk
- 121 cm inundation → medium risk
- 271 cm inundation → high risk



Figure 1. Example of NATO Flood Model Map and Risk Categories

Short term risk is currently not analyzed at iMAP, however we expect to reactivate the analysis, which will be available on HSDC, by the end of the year. The short-term risk analysis will be based on the Global Flood Awareness System (GloFAS), which provides flood forecast maps 15 days in advance. GloFAS is based on both a meteorological forecast and a hydrological model. iMAP will overlay these flood forecasts with population data and building footprints to generate estimates of the number of people, buildings and areas exposed to flood risk, their geographic location, and aggregated information at district and province level. Technically, this will be done using zonal statistics in a fully automated workflow, with the data output made available daily on the HSDC.

Data Sources

Afghanistan Flood Hazard Map v.2. 1:100 000, Emlyn Hagen, NATO C3 Agency NC3A (2008).
Global ML Building Footprints, Microsoft (2022)
Afghanistan Population 2020 (United Nations Adjusted, unconstrained), WorldPop (2020)
 Global Flood Awareness System (GloFAS), <https://www.globalfloods.eu/>

Disclaimer

The NATO flood map is based on a hydrological model with a high degree of uncertainty. The population count is based on the 'unconstrained' WorldPop dataset which is likely to overrepresent population figures in rural areas. Building counts might be underrepresented in some areas, in particular in the North Eastern districts where the Microsoft building footprint dataset has poor coverage.

Landslide Risk

iMAP analyses landslide risk using a combination of the WorldBank landslide susceptibility dataset, WorldPop population data and the Microsoft building footprint dataset. Through a zonal statistics analysis, the number of people, buildings and total area per landslide susceptibility category is calculated and aggregated to district and province level.

The WorldBank has calculated several landslide datasets. iMAP uses the version called 'material landslides in rapid evolution (s3), which includes debris and mud flows, and is most relevant for rapid landslide events (as opposed to slow bedrock movement). The data has 9 susceptibility categories that are converted by iMAP to 4 risk categories as follows:

0	=	Null
1-3	=	Low
4-5	=	Moderate
6	=	High
7-9	=	Very High

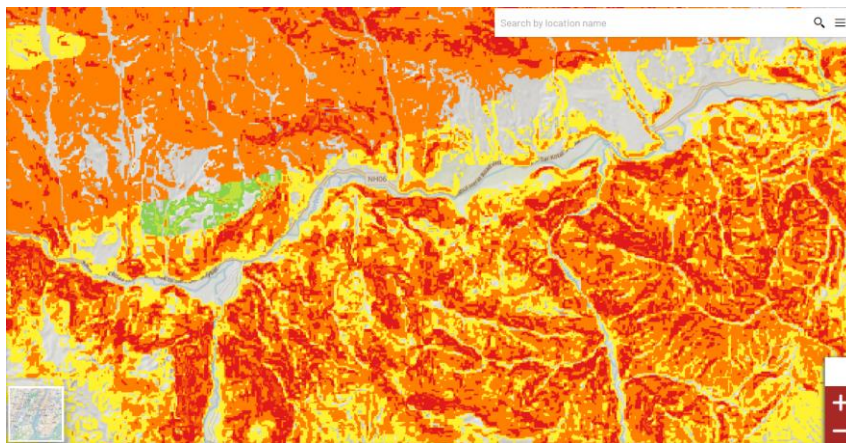


Figure 2. WorldBank Landslide susceptibility dataset available on HSDC.

Data Sources

Landslide susceptibility - cover material in rapid evolution (S3), WorldBank (2016)

Global ML Building Footprints, Microsoft (2022)

Afghanistan Population 2020 (United Nations Adjusted, unconstrained), WorldPop (2020)

Disclaimer

The accuracy of the WorldBank landslide susceptibility dataset is unknown. The population count is based on the 'unconstrained' WorldPop dataset which is likely to overrepresent population figures in rural areas. Building counts might be underrepresented in some areas, in particular in the North Eastern districts where the Microsoft building footprint dataset has poor coverage.

Avalanche Risk

Avalanche risk is mapped statically across Afghanistan using a combination of iMAP produced risk maps, WorldPop population and Microsoft Building Footprint data. iMAP produced a landslide risk dataset that includes both trigger and runout areas across the country. The areas were modelled using the 30 m ASTER digital elevation model following established methods. Only areas with observed snow cover over a 10-year period prior to analysis were included.



Figure 3. Example of avalanche risk areas calculated by iMAP.

The specific methods are described in detail in "Marek, B. and Ivan, B., 2010. Spatial modelling of snow avalanche run outs using GIS. In *Proceedings from Symposium GIS, Ostrava*".

Similar to the other disaster risk, the avalanche risk areas have been overlayed with population and building data using zonal statistics to calculate number of people, buildings and total areas at risk at district and province level.

Disclaimer

The population count is based on the 'unconstrained' WorldPop dataset which is likely to overrepresent population figures in rural areas. Building counts might be underrepresented in some areas, in particular in the North Eastern districts where the Microsoft building footprint dataset has poor coverage.

Data Sources

iMMAP Avalanche Risk Exposure, 2016

Global ML Building Footprints, Microsoft (2022)

Afghanistan Population 2020 (United Nations Adjusted, unconstrained), WorldPop (2020)

Earthquake Risk

iMMAP calculates both general earthquake risk and post-event impact. The general seismic intensity is calculated by USGS and made available on the HSDC as the Earthquake map. This dataset is then overlaid with WorldPop population and Microsoft Building Footprints to generate the number of people and buildings within each seismic risk zone.

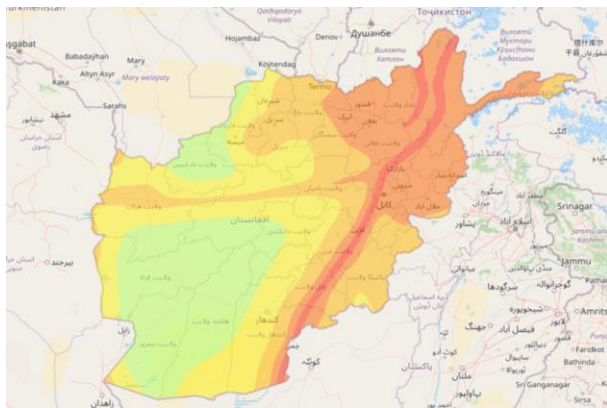


Figure 4. USGS Seismic Intensity Map.

The seismic zones in the USGS Earthquake Hazard Map for Afghanistan (2007) represent the Peak Horizontal Acceleration with 2 Percent Probability of Exceedance in 50 years.

The post-event impact assessments are calculated by overlaying the earthquake epicenter with population and infrastructure data and calculating the number of people and buildings within different proximity zones to the epicenter.

Disclaimer

The population count is based on the 'unconstrained' WorldPop dataset which is likely to overrepresent population figures in rural areas. Building counts might be underrepresented in some areas, in particular in the North Eastern districts where the Microsoft building footprint dataset has poor coverage.

Data Sources

USGS Earthquake Hazard Map for Afghanistan (2007)

Global ML Building Footprints, Microsoft (2022)

Afghanistan Population 2020 (United Nations Adjusted, unconstrained), WorldPop (2020)

Mapping of Climate Outlook Using Geoprocessing Tools

iMAP offers a range of climate-related outlooks, utilizing the latest climate raster datasets accessible online, encompassing Afghanistan's geographical scope. The maps and accompanying tabular data, available at both provincial and district levels, are produced through diverse geoprocessing tools within the ESRI ArcGIS software.

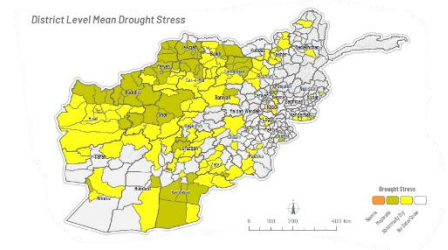
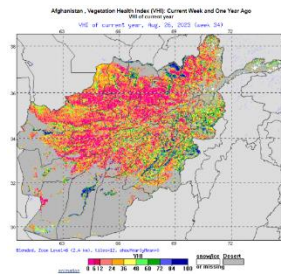
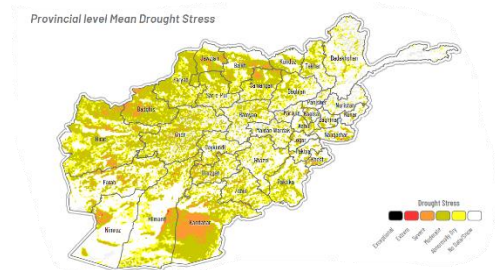
To harness these online resources tailored to specific timeframes, we first isolate Afghanistan's geographical boundaries from the globally downloaded raster data. Subsequently, we execute additional calculations, symbology adjustments, and geographic disaggregation processes to derive the ultimate tabular dataset.

Drought Stress Mapping

Drought stress risk is based on the vegetation index in Afghanistan. The data is a 4 km resolution, and a 7-day composite of the Vegetation Health Index (**VHI**), Vegetation Condition Index (**VCI**), and Temperature Condition Index (**TCI**) adjusted for the drought stress level (if their Values are below 40). These indices in raster format are accessible through **NOAA STAR Center for Satellite Applications and Research** in this [link](#).

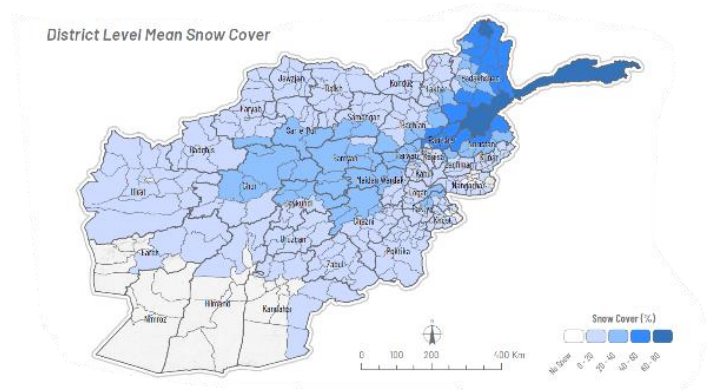
Using different geo-processing tools available at ArcGIS software, the VHI, VCI and TCI rasters are combined, performed further calculations, and extracted at the Afghanistan extent for geographical disaggregation.

Drought stress is categorized as "**Exceptional**" if the indices are between 0 and 5; "**Extreme**" if they are 6-15, "**Severe**" 16-25; "**Moderate**" 26-35; "**Abnormally dry condition**" 35-40 and "**No Data or Snow Cover**" > 40.



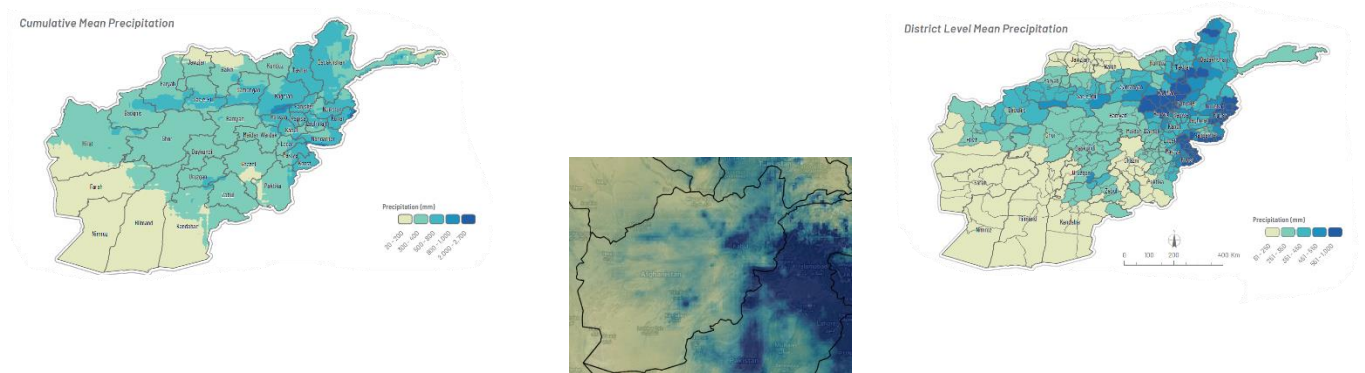
Snow Cover Mapping

Mapping of the snow cover in Afghanistan is depicted as a percentage (%) cover for a specific targeted period. The percentage figures indicate the number of days an area has experienced snow cover. As an example, in January of one year, 81-100% snow cover would be equivalent to 25 - 31 days of snow, and 1 - 20% to 1 - 6 days of snow. The dataset is a result of a daily aggregation of rasters at 1 km resolution observations grouped on specified period. The source data originates from the **U.S. National Ice Center's Interactive Multi-Sensor Snow and Ice Mapping System (IMS)**. It is derived from a variety of data products including satellite imagery and in-situ data.



Cumulative Precipitation Mapping

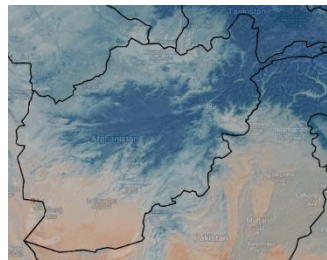
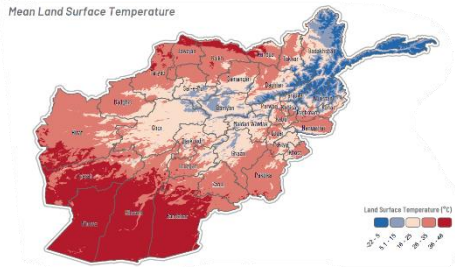
The Hydrological and remote sensing data were used to depict cumulative precipitation for Afghanistan in (mm), data sourced from the **Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)** - Daily Precipitation dataset with 4800 m (1/20-deg) computation resolution (scale). As described on their website, “the CHIRPS is a 35+ year quasi-global rainfall data set. Spanning 50°S-50°N (and all longitudes) and ranging from 1981 to near-present, CHIRPS incorporates an in-house climatology, CHPclim, 0.05° resolution satellite imagery, and in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring. CHIRPS is produced by the Climate Hazards Center at the University of California Santa Barbara.”



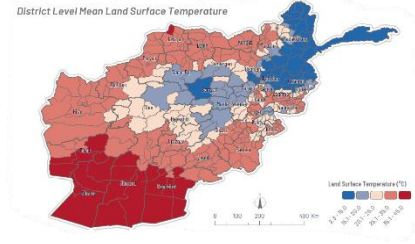
Land Surface Temperature Mapping

LST temperature shows land surface temperature as degree Celsius (°C). The dataset is the result of daily aggregations at 1 km resolution observations grouped by month. The source data originates from **Moderate Resolution Imaging Spectroradiometer (MODIS)** product that provides daily Land Surface Temperature (LST), we always mention the difference between Land surface temperature and Air temperature on our maps otherwise most of the partners raised those figures are not correct.

Mean Land Surface Temperature



District Level Mean Land Surface Temperature

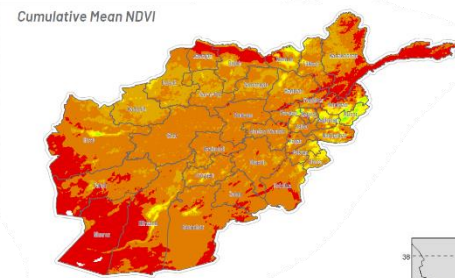


Normalized Difference Vegetation Index Mapping

Normalized Difference Vegetation Index (NDVI) is statically mapped across Afghanistan using **NOAA STAR data** with a 4 km spatial and a 7-day temporal resolution for the different time periods.

NDVI is a standardized way to measure healthy vegetation, positive NDVI values indicate healthier vegetation, and negative NDVI values indicate less or no vegetation (NDVI always ranges from -1 to +1).

Cumulative Mean NDVI



District Level Mean NDVI

