Lebanon - Preliminary Debris Quantification

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Damage Assessment Analysis: 5th December 2024

UN environment programme

This initial quantification of conflict debris in Lebanon is derived from a Compreensive Damage Assessment using radar imagery from 5 December 2024, in conjunction with building footprints from Microsoft Bing and conflict data from ACLED and the Washington Institute.

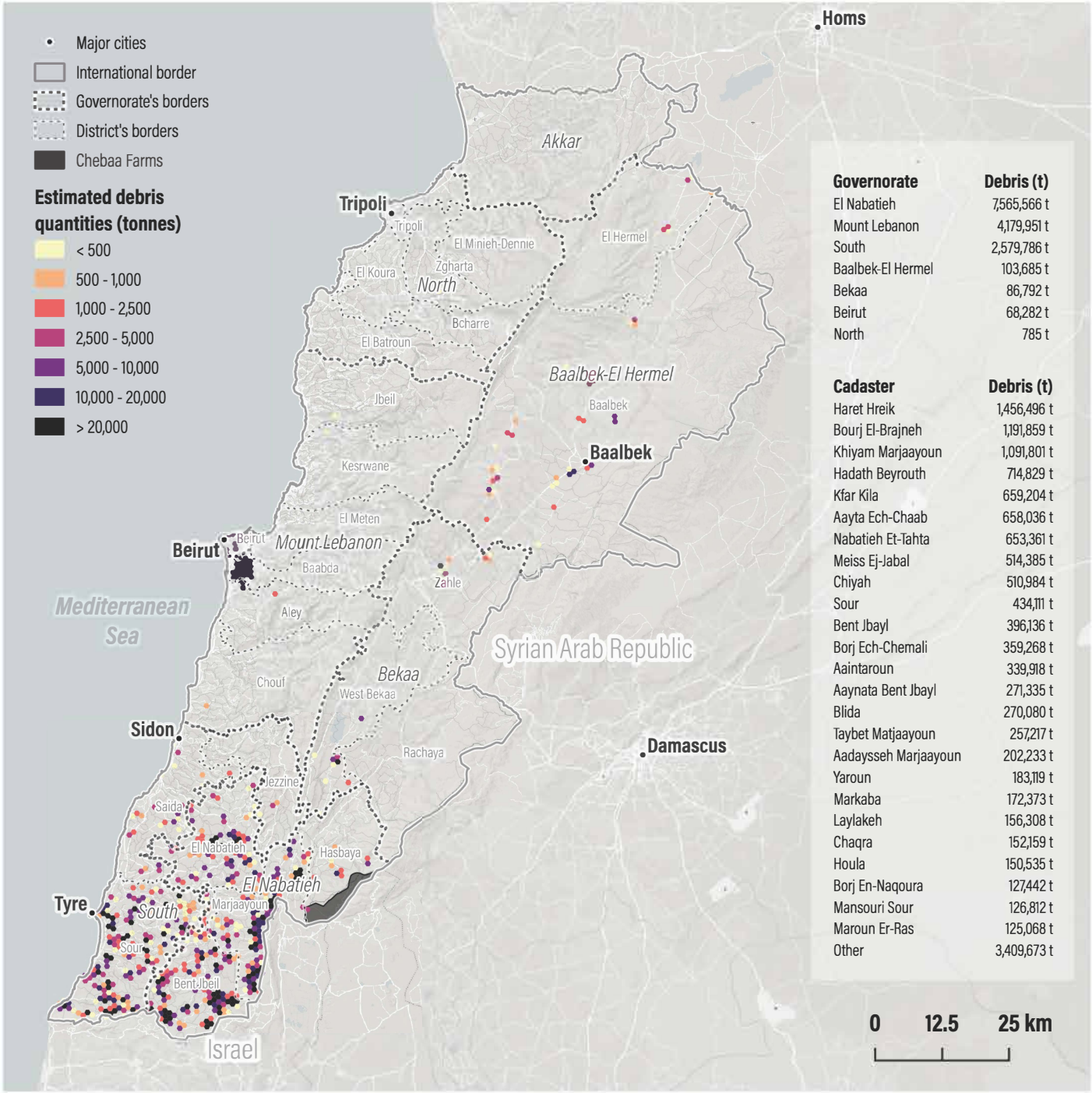
Damaged building footprints were enriched through zonal statistics with an above surface height model, derived from the difference between a Digital Terrain Model (SRTM) and a Digital Surface Model (ALOS World 3D) as provided by the European Commission in the GHS-Built H product.

For modelling purposes, minimum building height and average story height were considered to be 3m. Each built sq. meter is considered to have generated 1 tonne of debris.

For visualization and modelling purposes, results were aggregated into an H3 hexagonal grid where each cell is 250m wide.

District	Debris (t)
Baabda	4,119,335 t
Marjaayoun	3,626,403 t
Bent Jbeil	2,751,023 t
Sour	2,523,261 t
El Nabatieh	1,148,801 t
Baalbek	90,992 t
Beirut	68,282 t
Aley	59,470 t
West Bekaa	55,901 t
Saida	52,123 t
Hasbaya	39,336 t
Zahle	30,891 t
El Hermel	12,693 t
Jezzine	4,401 t
Chouf	799 t
Zgharta	785 t
Jbeil	305 t
Other	41 t
Total	**14,584,851 t**

Datum: WGS 1984
Coordinate System: Universal Transverse Mercator 36N



Governorate	Debris (t)
El Nabatieh	7,565,566 t
Mount Lebanon	4,179,951 t
South	2,579,786 t
Baalbek-El Hermel	103,685 t
Bekaa	86,792 t
Beirut	68,282 t
North	785 t

Cadaster	Debris (t)
Haret Hreik	1,456,496 t
Bourj El-Brajneh	1,191,859 t
Khiyam Marjaayoun	1,091,801 t
Hadath Beyrouth	714,829 t
Kfar Kila	659,204 t
Aayta Ech-Chaab	658,036 t
Nabatieh Et-Tahta	653,361 t
Meiss Ej-Jabal	514,385 t
Chiyah	510,984 t
Sour	434,111 t
Bent Jbayl	396,136 t
Borj Ech-Chemali	359,268 t
Aaintaroun	339,918 t
Aaynata Bent Jbayl	271,335 t
Blida	270,080 t
Taybet Matjaayoun	257,217 t
Aadaysseh Marjaayoun	202,233 t
Yaroun	183,119 t
Markaba	172,373 t
Laylakeh	156,308 t
Chaqra	152,159 t
Houla	150,535 t
Borj En-Naqoura	127,442 t
Mansouri Sour	126,812 t
Maroun Er-Ras	125,068 t
Other	3,409,673 t

Debris management Preliminary outputs

Total debris quantity (metric tonnes)	**14,584,851**

According to this damage assessment, a total of 17,321 structures were damaged in Lebanon as of 5th December 2024, which constitutes 1.7% of all (1,013,619) buildings in Lebanon.

The underlying data represents likely damage across Lebanon. Given the assumed presence of small-scale damage that cannot be detected using Sentinel-1 data with 10-meter resolution pixels, the damage maps likely offer a conservative estimate for areas affected by building damage. This approach is not designed to be sensitive to potential damage in agricultural or other vegetated ("natural") regions.

The damage maps are based on multi-date analyses of Copernicus Sentinel-1 acquisitions from April 2024 to the present, by comparing images acquired during the conflict to hundreds of images acquired before the conflict, classifying damage using information on changes in the complex radar signal, and aggregating damage signals across Microsoft building footprints to label buildings with the timing of damage. This general logic is applied in two separate complementary approaches - coherence change detection (CCD) and pixel-wise T-test (PWTT) - that are later combined. Significant changes in the built environment are then filtered by proximity to reported airstrikes, as provided by ACLED and the Washington Institute.

This preliminary analysis has not yet been validated in the field and is appropriate for general planning of debris operational responses and related humanitarian action in Lebanon.

Source for CCD data: Damage analysis of Copernicus Sentinel1 satellite data by Corey Scher of CUNY Graduate Center and Jamon Van Den Hoek of Oregon State University. (05/12/2024)

Source for PWTT data: Building damage assessment in Lebanon through Pixel-wise T-test applied to S1 data (as proposed in Ballinger, 2024) by UNEP (05/12/2024)