

Harvesting Heat: Agricultural Cycles as Hidden Drivers of Heat Risk



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Abstract

Agricultural harvesting replaces evapotranspiring crop canopies with bare soil, yet this transition is absent from heat risk frameworks. Using 7 years (2020–2026) of Landsat 8/9 and Sentinel-2 open data over Lleida, Catalunya, we show post-harvest city-level LST exceeded **40°C** every year. Pixel-wise correlation confirms **vegetation and moisture loss** coupled with the **seasonal warming** drives the heating. The open-source methodology is globally transferable and directly applicable to disaster risk management under the Sendai Framework 2015–2030.

Background

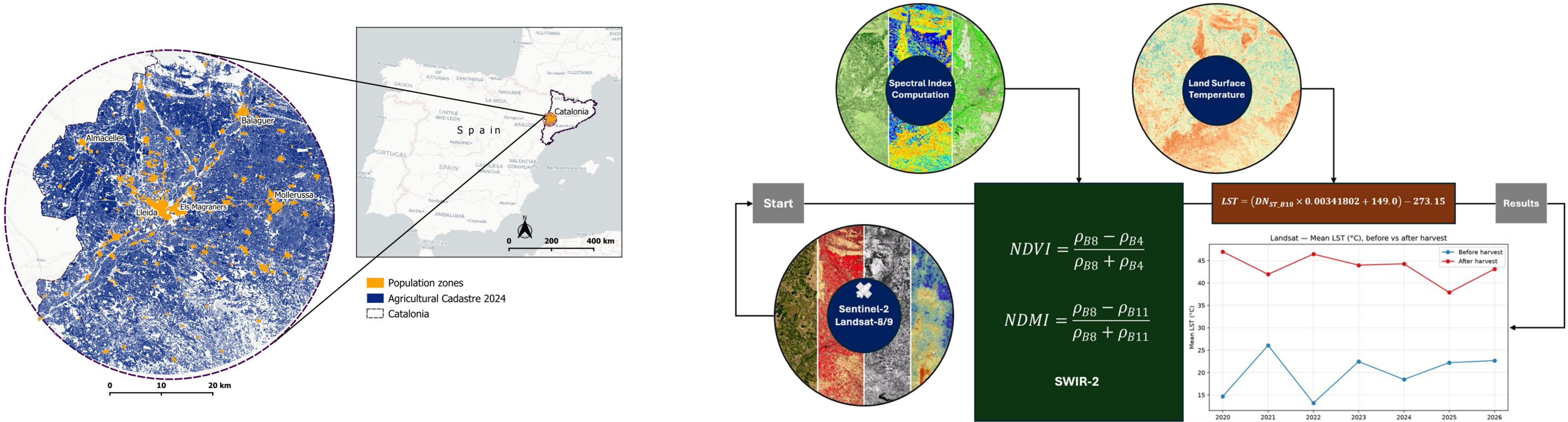
Extreme heat is the deadliest weather-related hazard globally, yet harvest-driven surface heating at the urban fringe remains **unmeasured** and **unmanaged**. Each summer, cereal harvest replaces cooling green canopies with bare soil that radiates heat toward nearby cities. Unlike most hazards, this thermal surge is calendrically predictable since the harvest window is known weeks in advance. Yet harvest phenology is absent from heat emergency plans and disaster risk registers worldwide.

Our question is:

Can it be quantified, monitored, and acted upon using freely available open data?

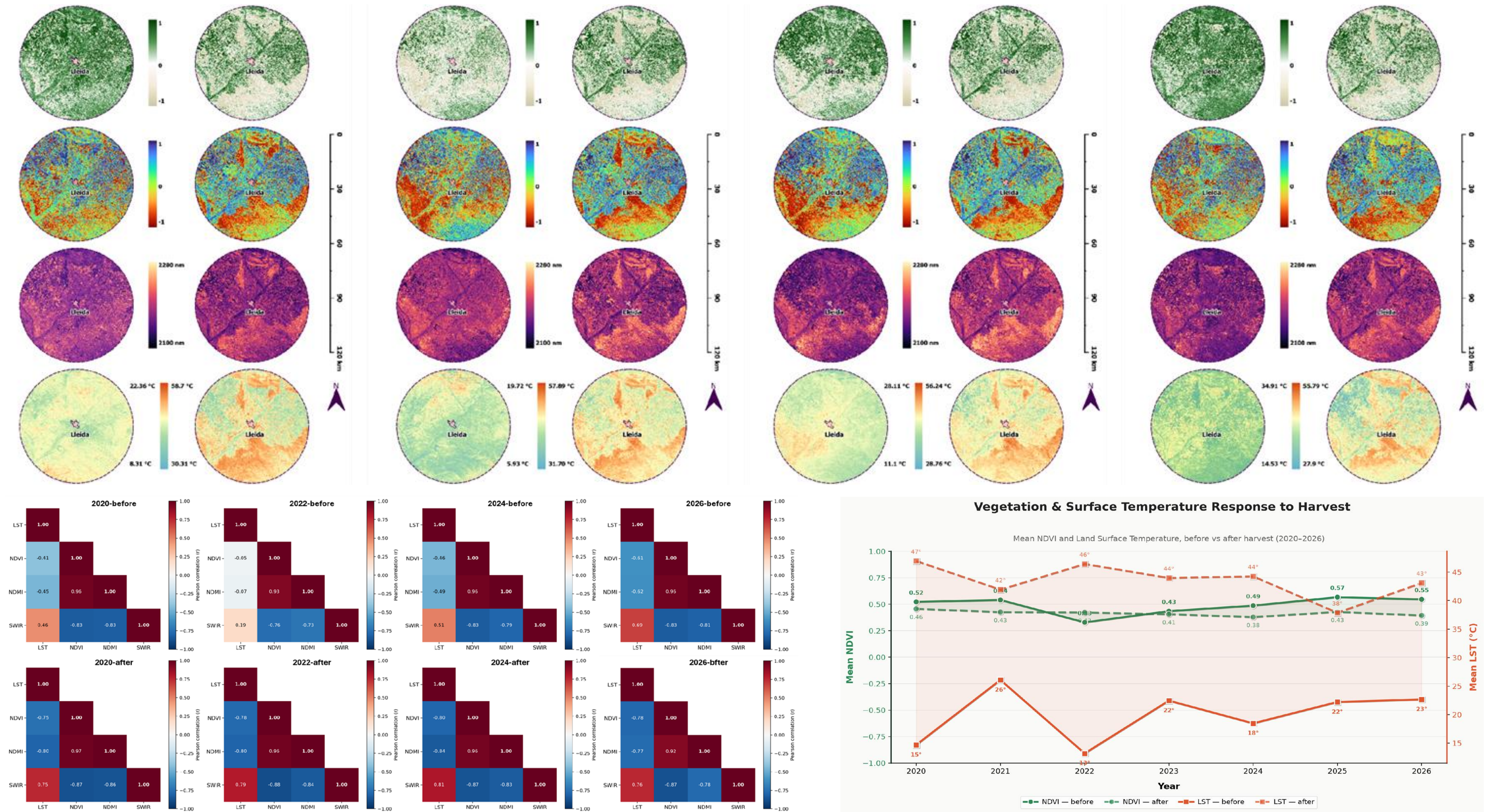
Methodology

One cloud-free Landsat 8/9 Collection 2 Level-2 scene was selected per year per period (pre-harvest: **February–May**; post-harvest: **June–July**), covering **Lleida** and its surrounding **agricultural plain**. **LST** was retrieved from the **ST_B10 band** using official **USGS** scale factors and per-pixel QA_PIXEL cloud masking. Sentinel-2 Level-2A imagery from the same periods provided **NDVI**, **NDMI** and **SWIR Band 12**. All Sentinel-2 layers were reprojected to the Landsat 30 m reference grid using bilinear resampling to enable pixel-wise comparison across sensors. Zonal statistics (mean, minimum, maximum) were computed over the full agricultural AOI and separately over the city boundary polygon. Pixel-wise **Pearson correlation** matrices between LST, NDVI, NDMI, and SWIR were computed for each of the 7 year-period. The entire pipeline uses **GEE** and **Python**, with no proprietary data or software.



Results

Although the presented **results are preliminary** and **require further refinement**, they provide an answer to the initial question and show that the harvesting effect can be monitored using freely available open data. Post-harvest city-level mean LST exceeded **40°C** in all seven years, reaching a peak of **50.5°C** in 2020, against pre-harvest values as low as **10.9°C** in the same year. The spatial maps reveal a visually unambiguous and annually consistent pattern: post-harvest NDVI decreases across the harvested area, NDMI follows in pattern, SWIR reflectance rises inversely, and LST surges in spatial alignment with the areas of greatest vegetation and moisture loss. Post-harvest correlations between LST and NDMI reach **r = -0.84**, between LST and SWIR **r = +0.81**, and between LST and NDVI **r = -0.80**, consistent across all seven years. Critically, pre-harvest correlations between LST and the vegetation/moisture indices are near zero in several years, demonstrating that the spatial structure of the **heating** signal is **harvest-driven, not only a background seasonal effect**. The near-perfect **NDVI–NDMI** correlation (**r > 0.92** in all panels) confirms these indices capture the same vegetation–moisture continuum, while the tight **LST–SWIR** spatial alignment across all years further validates SWIR as a potential early-warning proxy for impending thermal stress.



Next Step

- Acquire **scenes closer to the harvest** date to minimize post-harvest land management interventions (if **cloud-free images** are available)
- Acquire **scenes closer to the harvest** date to **minimize the seasonal effect**
- Integrate **in-situ** radiometric and micrometeorological data to **validate** satellite-derived LST
- Leverage the **regional space-based solutions** and rais the awareness of the need for higher-frequency imagery and improved cloud-gap filling
- Overlay post-harvest LST maps with **city cooling center locations** to assess adequacy of heat shelter distribution
- Integrate crop type maps and **phenological calendars** to disaggregate harvest-driven heat by species and harvest schedule
- Incorporate **wind speed and direction data** to model heat transport pathways from harvested fields toward residential areas
- **YOUR FEEDBACK**