Large-scale land surface disturbance detection for North America using VIIRS Green Vegetation Fraction products

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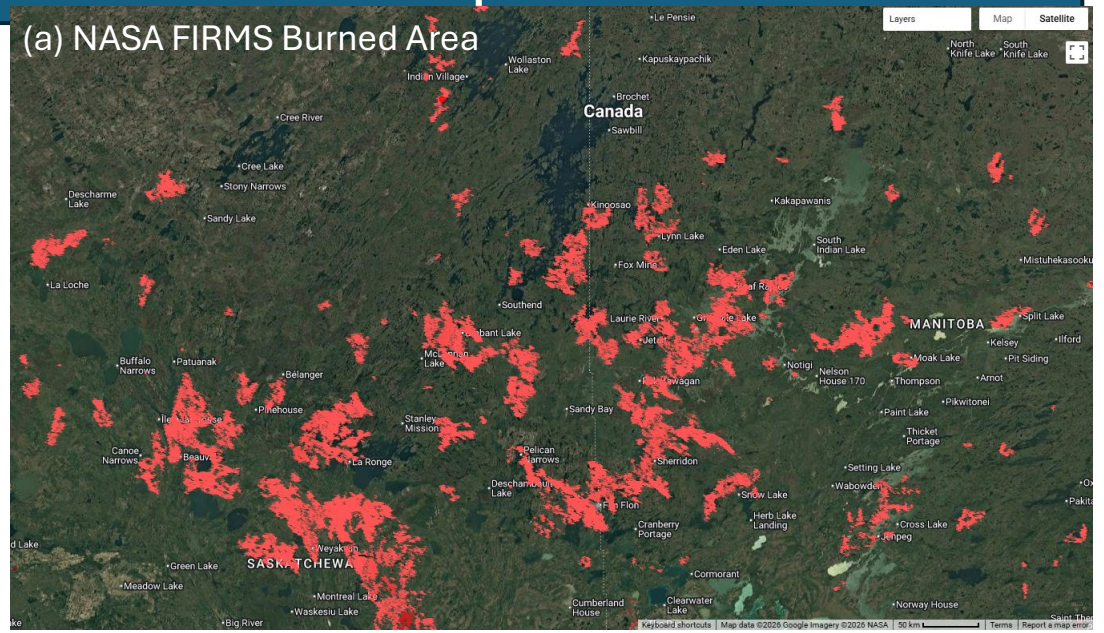
Objective: Build a near-real time land surface disturbance detection framework based on Green Vegetation Fraction (GVF) products

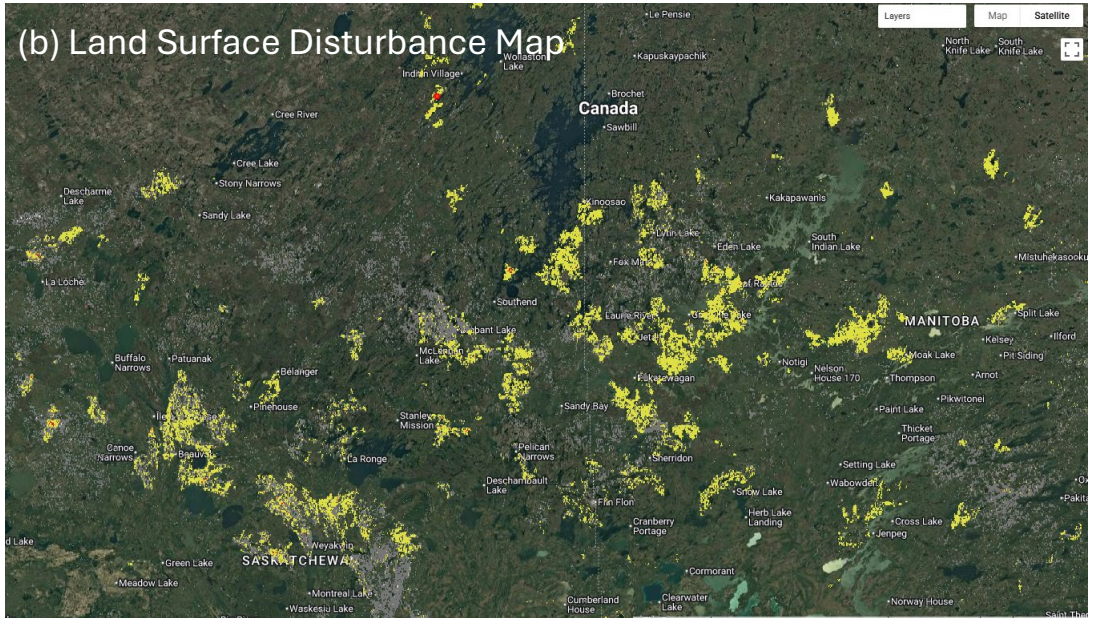
Datasets: Daily 1km NOAA-20 VIIRS Regional GVF from 2023 to 2026

Methods: Take three years GVF data (2023 to 2025) as baseline, calculate 2026 GVF anomalies, track the GVF anomaly magnitude and frequency, build the confidence, flag the disturbance status based on vegetation loss, confidence level and timing

Results: Mapped 2026 land surface disturbances from Jan,1st, updated to Aug.4th 2026. Results were visualized and validated through Google Earth Engine platform. Preliminary validation showed the framework can capture major events, such as wildfires and severe drought.

Example: Figure (a) shows the burned area (red polygon) captured by the NASA FIRMS VIIRS Global Burned Area Product (VNP64A1) from 2025 to 2026 across Saskatchewan and Manitoba, Canada. **Figure (b)** displays the land surface disturbance map on June 9, 2026, derived from VIIRS GVF products. The map records vegetation loss magnitude, confidence, and status (ongoing, recent, or finished).





Summary of vegetation disturbance status
- No disturbance
- <30% loss, low conf, ongoing
- <30% loss, high conf, ongoing
- ≥30% loss, low conf, ongoing
- ≥30% loss, high conf, ongoing
- <30% loss, recent observation
- ≥30% loss, recent observation
- <30% loss, high conf, finished
- ≥30% loss, high conf, finished

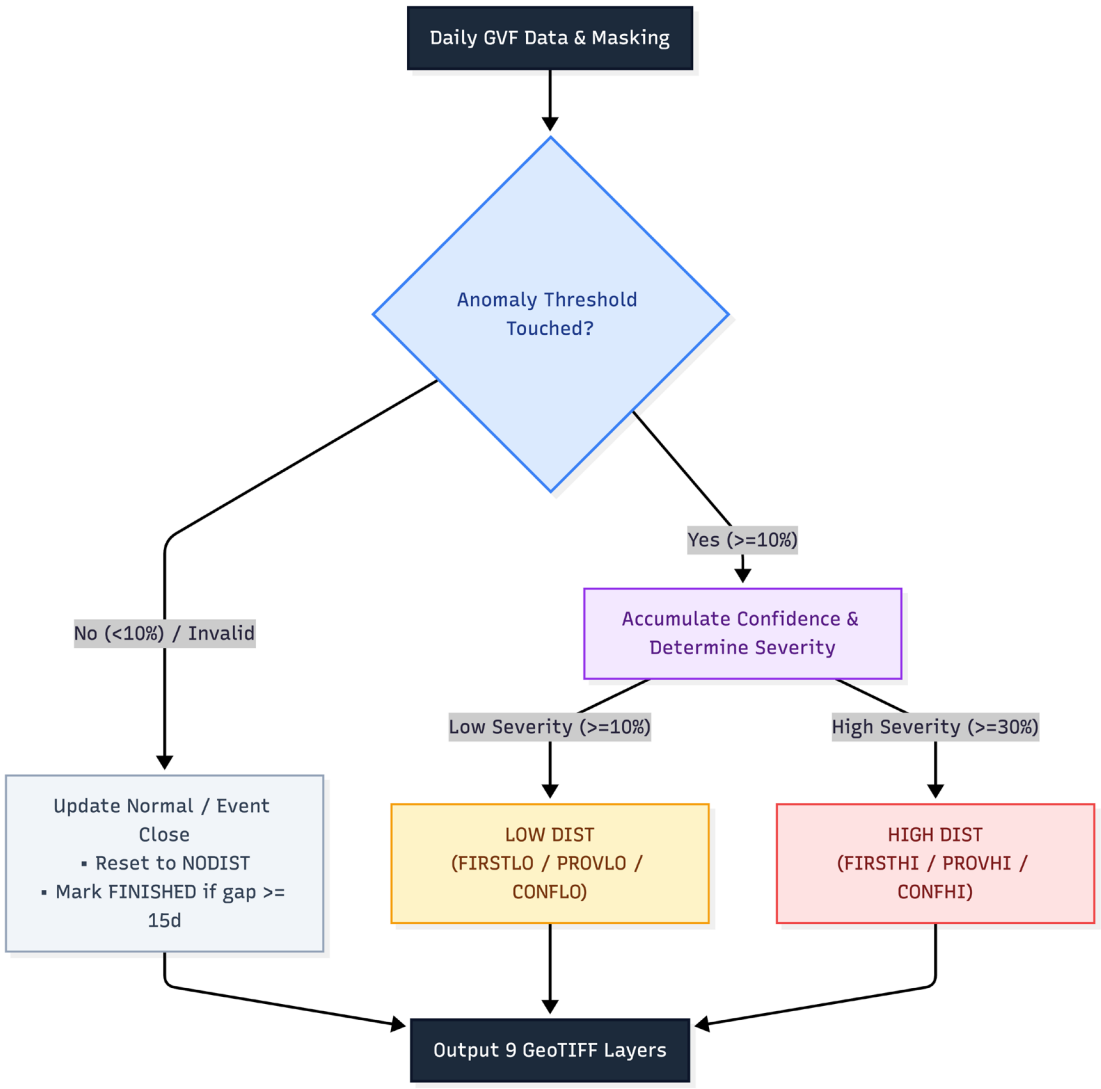


Figure 4. Flowchart of the pixel-wise disturbance detection algorithm.

Table 1. Disturbance status flags and classification scheme.

Code	Status Name	Description
0	NODIST	Normal / No Disturbance detected
1	FIRSTLO	Initial trigger for Low-severity disturbance
2	PROVLO	Provisional ongoing Low-severity disturbance
3	CONFLO	Confirmed ongoing Low-severity disturbance
4	FIRSTHI	Initial trigger for High-severity disturbance
5	PROVHI	Provisional ongoing High-severity disturbance
6	CONFHI	Confirmed ongoing High-severity disturbance
7	CONFLOFIN	Finished Low-severity disturbance event
8	CONFHIFIN	Finished High-severity disturbance event
255	NODATA	Invalid observation / Ocean mask

9 GeoTIFF Outputs

Status Flags: VEG_STATUS, HIST_BASELINE

Event Timing: DURATION, DATE, COUNT, PERCENT, LAST_OBS

Severity Metrics: MAX_ANOMALY, CONFIDENCE

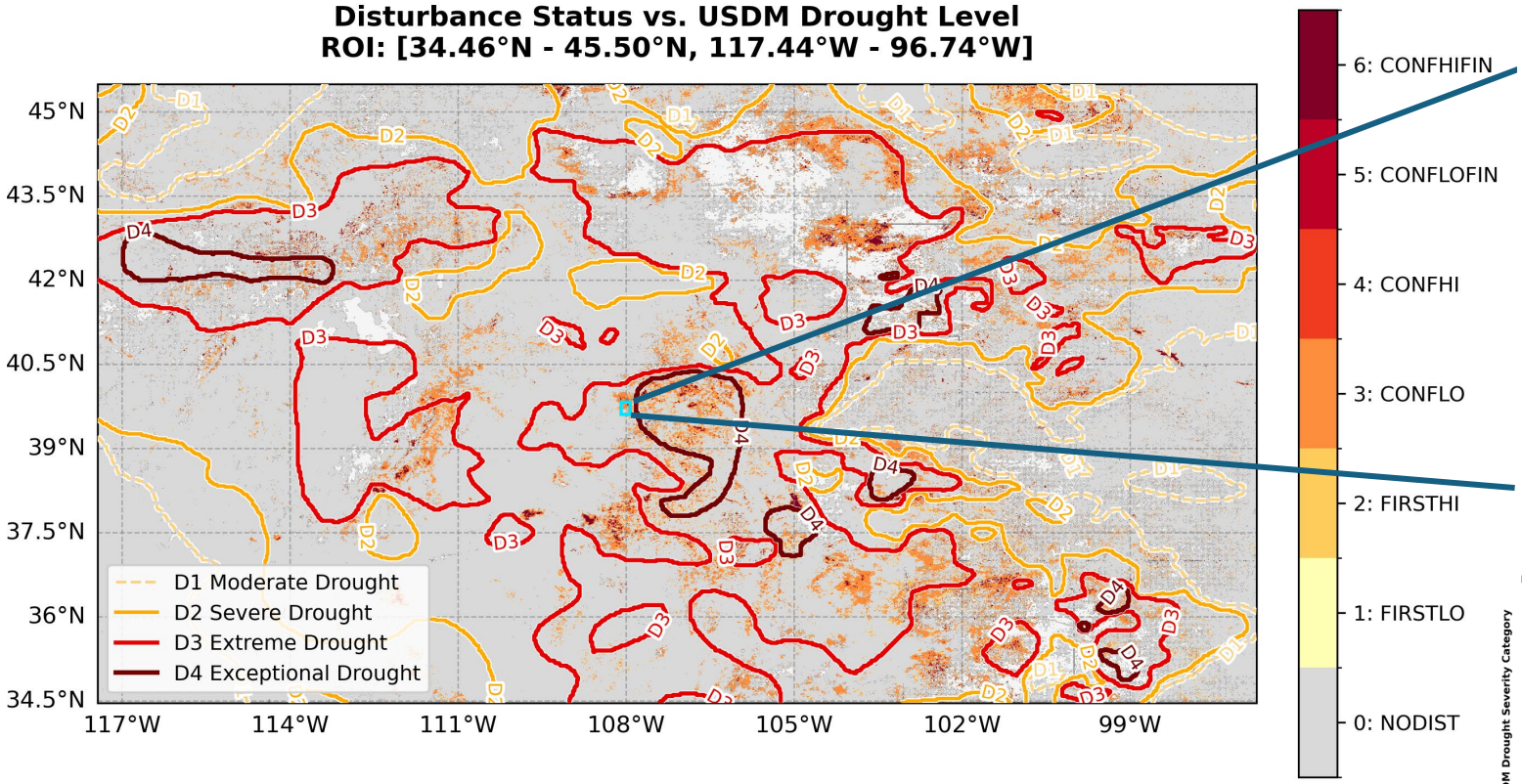


Figure 5. Spatial validation of regional disturbance detection overlaid with USDM drought severity contours.

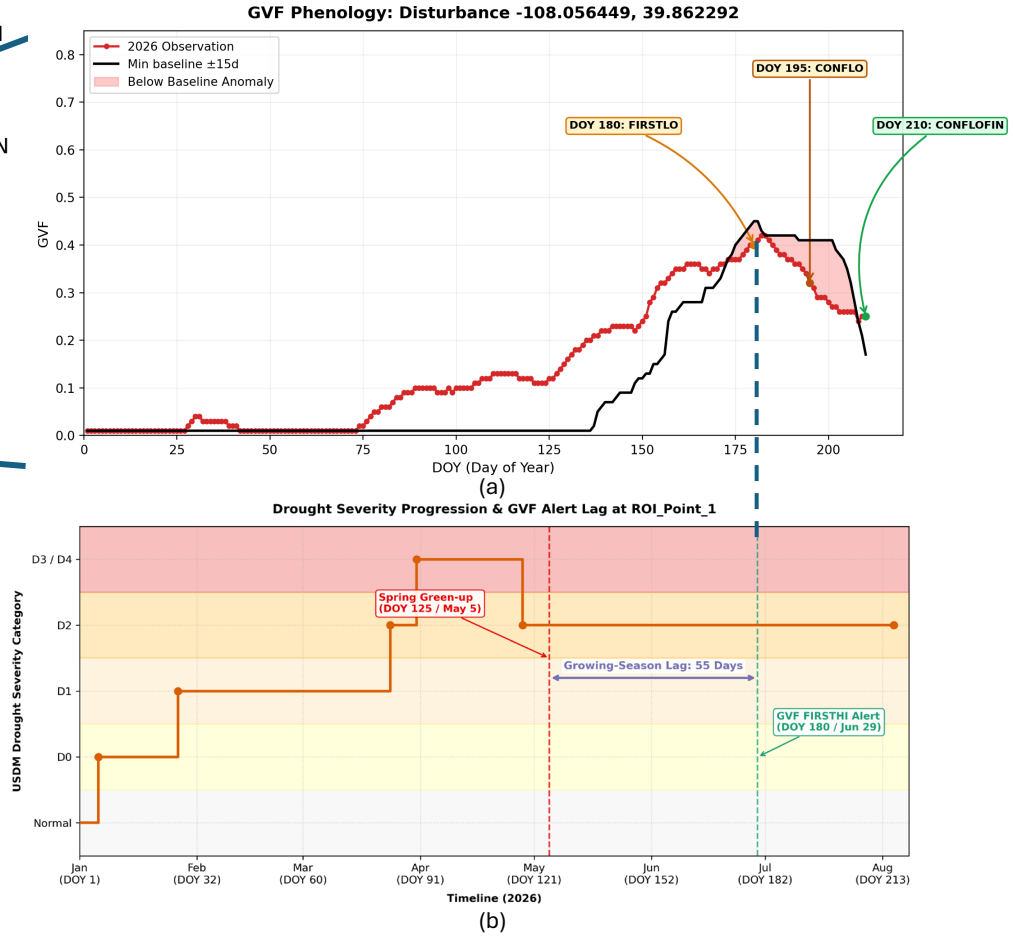


Figure 6. Pixel-level GVF phenology and drought lag.
(a) GVF trajectory and state machine transitions. **(b)** USDM drought severity progression and alert lag.

Drought Situation: USDM confirms continuous D3/D4 extreme drought throughout the 2026 growing season.

Vegetation Response: GVF anomaly was detected **55 days** after spring green-up (DOY 125), reflecting soil moisture depletion under sustained drought.

Algorithm Reaction: State machine confirmed the disturbance within **8 days** of active canopy collapse.

Future Work:

1. Further validated the disturbance map, analyze the commission and omission errors
2. Adjust the workflow and parameters setting in the framework
3. Improve the prototype by revising the current GVF product and adding other product, such as BT, LST
4. Attribution for the disturbance