Examining Vegetation Recovery Time After a Small Scale Disaster using MODIS Data and the OSDC

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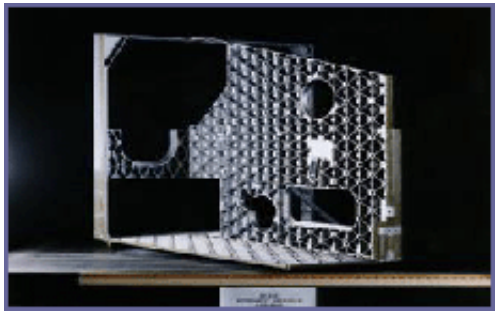
MODIS Normalized Difference Vegetation Index (NDVI)

- Moderate-resolution Imaging Spectroradiometer (MODIS) sensor package on two satellites Terra (1999) and Aqua (2002) providing nearly full Earth coverage every 1-2 days
- NDVI = (Band2 – Band1) / (Band1 + Band2)
  - -1.0 to 1.0 which represents level of healthiness in vegetation
- 32 Day MODIS Bands 1-7 composites from Global Land Cover Facility (UMD)
  - Composites to reduce/remove impact of cloudiness
  - 2001 to 2006 from UMD site, 500m resolution



MODIS Sensor Mainframe

- **MODIS 32 day Band 1-7 Composites loaded into OSDC public data**
  - Can be used for monitoring a variety of changes from fire, floods, severe weather, ice storms, snow, drought, crop production
  - Data is mosaics instead of swaths, much easier for scientists to work with
- **NDVI dips and recoveries could be useful metric for evaluating post-disaster recovery process around the world**
  - **"Develops tools and metrics for evaluating progress against set goals, objectives and milestones." – US FEMA Post-Disaster Recovery Guidelines**

Disaster Case Study Information

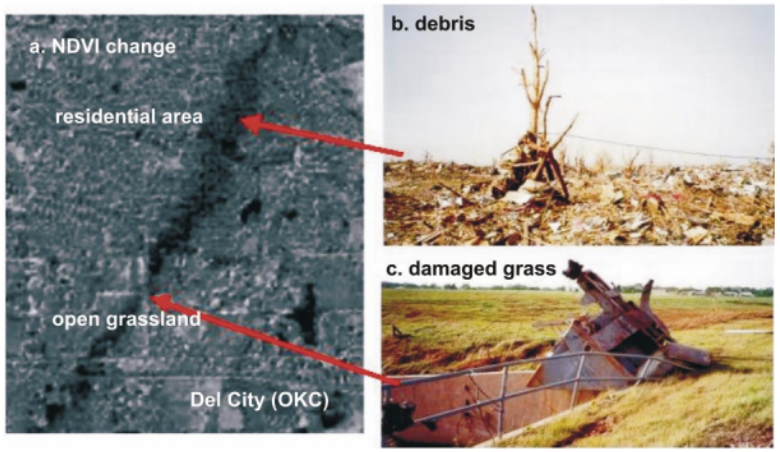
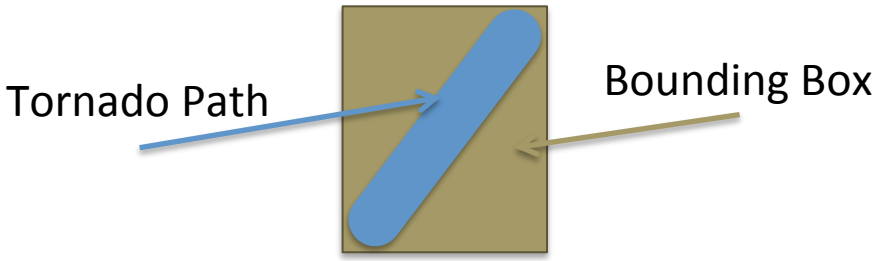


FIG. 11. Comparison of tornado damage in open grassland and a residential area. Widespread debris in the residential area results in a much wider signature in the NDVI change image.

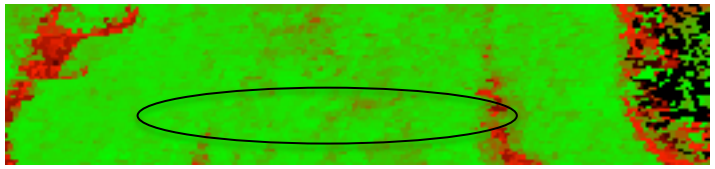
Yuan et al. (2002) shows remotely sensed tornado path

"Although NDVI difference imagery identified vegetation changes in the damage path regions, these signatures were often masked by or confused with natural vegetation changes during the observation period. An unsupervised classification approach identified only portions of the damage track regions subjectively discernable in the imagery, and also included some undisturbed features in the same classification as the storm damage." – Jedlovec et al. (2006)

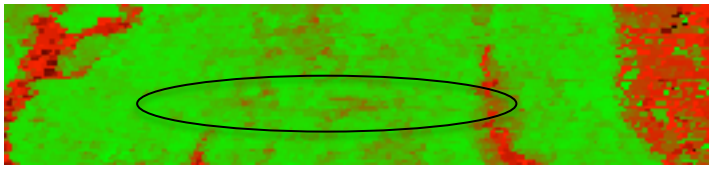
- Use tornado data as "small scale" event.
  - Tornado related impact on NDVI already observed and documented as utility in immediate aftermath of the disaster
  - Tornado start/end locations well documented and can range in scales from a few tens of meters to kilometers
  - Tornado path defines bounding box for region to examine in MODIS data
  - Avoids need for classification, hopefully
- April 28th, 2002 La Plata, Maryland tornado examined for case study
- >30 mile path length, 880 yards wide at times
- Hypothesis: Changes in standard deviation of NDVI extracted for bounding box around path can quantify damage



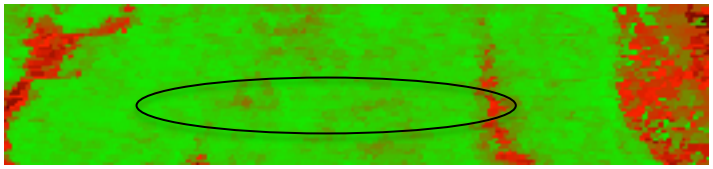
Results



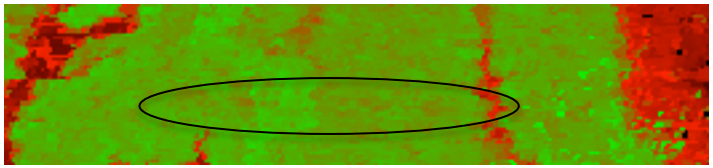
April 2001 (Pre-Tornado)



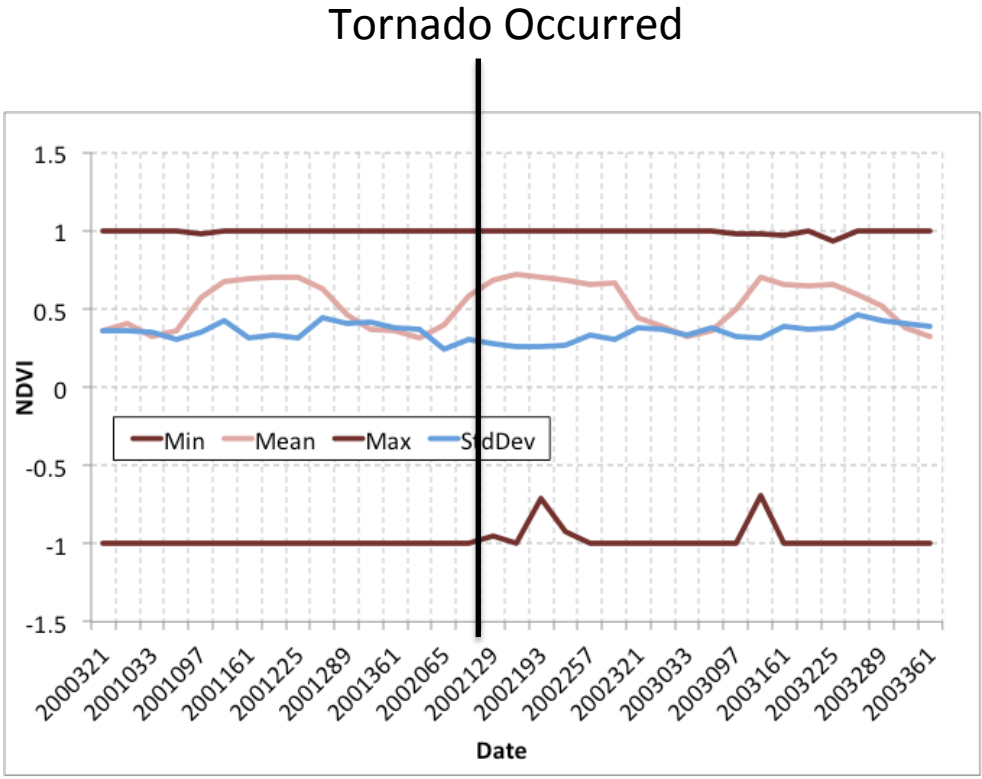
April 2002 (Tornado)

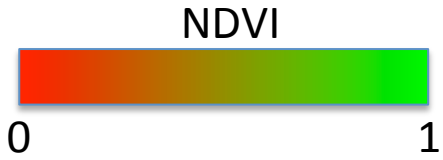


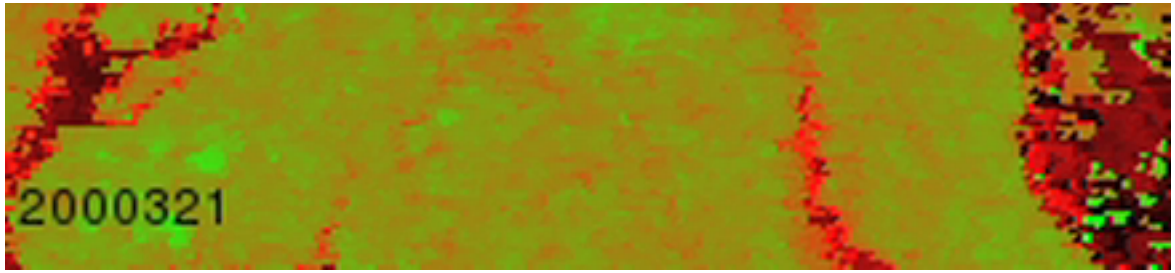
July 2002 (Post-Tornado)



April 2003 (Post-Tornado)







Loop of NDVI from November 2000 to January 2004

Conclusions & Future Work

- 500m 32-day composite MODIS NDVI can detect large tornado damage paths and monitor vegetation regrowth
- Find minimum detectable tornado length & width. May consider processing 250m MODIS data for OSDC
  - Maybe NDVI isn't best best, classification on other band combinations better?
- Simple statistics from tornado damage region aren't useful for monitoring changes
- Develop a "smarter" data-driven method for detecting tornado path & control area, which may refine results
  - K-means clustering? Some other method?
- MODIS NDVI monitoring done for forest fires, may be possible to compare methods & later recovery times
  - Maybe expect different recovery times?
- May be possible to segregate tornado data based on rating and compare recovery time.
  - Possible to infer severity/rating from recovery time?
- Data and processing power available to examine all small-scale vegetation loss events (including non-tornado) as soon as a workable method is identified
- **MODIS data and OSDC resources utilized to examine a cross-disciple question during OSDC-PIRE Workshop in Edinburgh.**