Using UAS Technology to Obtain Aerial Storm Damage Imagery

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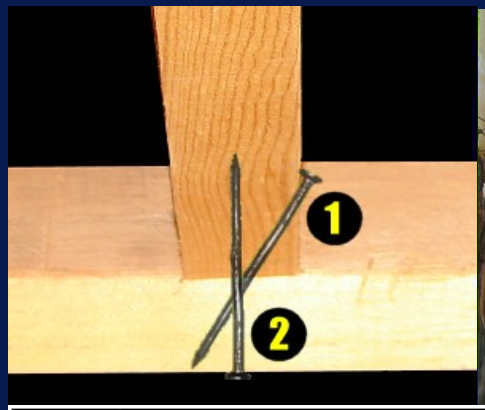
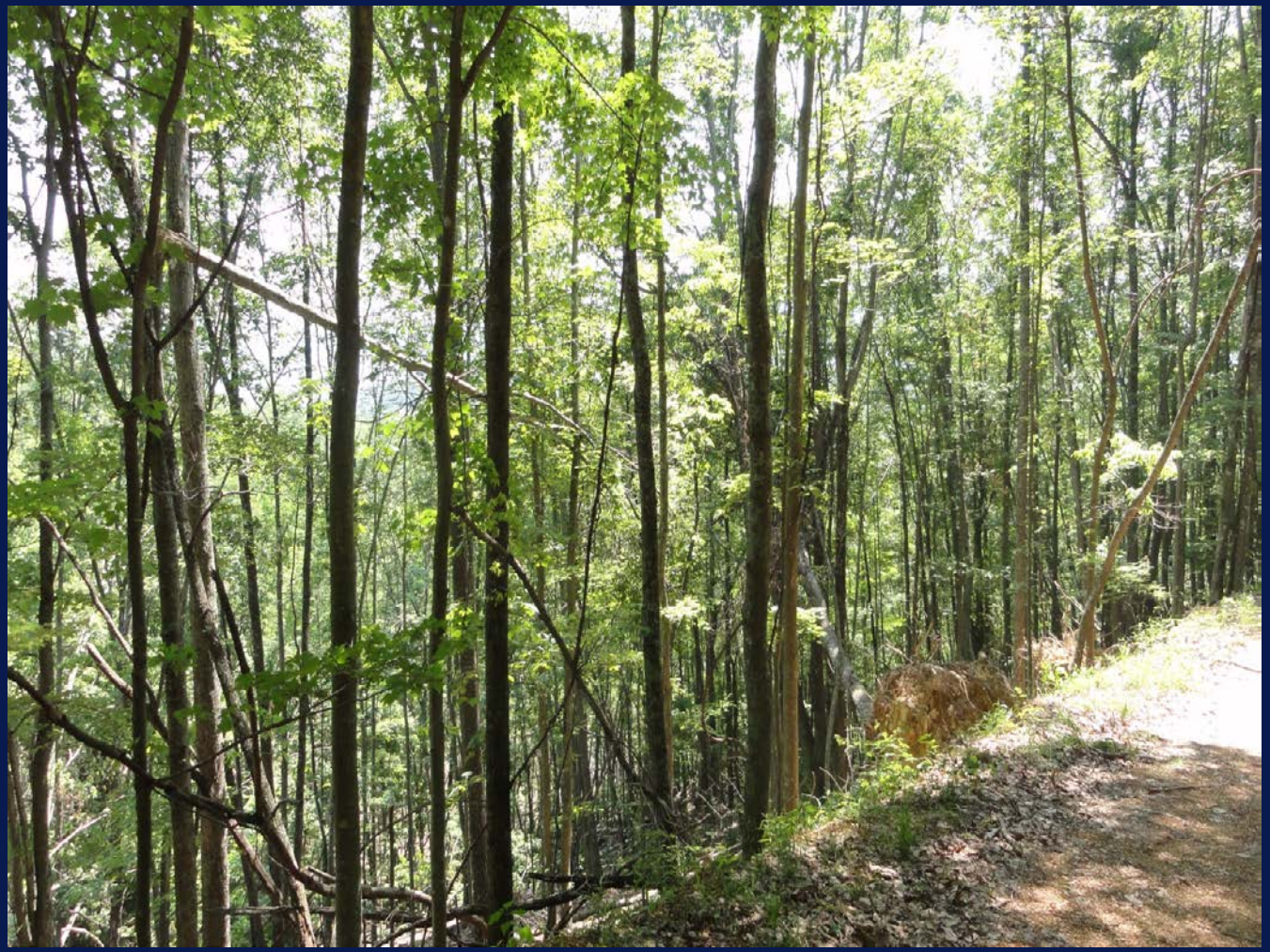


DOD	Damage description	EXP	LB	UB
1	Threshold of visible damage	65	53	80
2	Loss of roof covering material (<20%), gutters and/or awning; loss of vinyl or metal siding	79	63	97
3	Broken glass in doors and windows	96	79	114
4	Uplift of roof deck and loss of significant roof covering (>20%); collapse of chimney; garage doors collapse inward; failure of porch or carport	97	81	116
5	Entire house shifts off foundation	121	103	141
6	Large sections of roof structure removed; most walls remain standing	122	104	142
7	Exterior walls collapsed	132	113	153
8	Most walls collapsed, except small interior rooms	152	127	178
9	All walls	170	142	198
10	Destruction of engineered and/or well constructed residence; slab swept clean	200	165	220

The National Weather Service (NWS) routinely conducts damage surveys following severe weather events.

Observed damage indicators are analyzed to determine a likely cause and intensity. Frequently the best way to view damage is from the air.



What appears to be minor tree damage from the ground (EF1 tornado, Botetourt county Virginia April 27, 2011)

Can be part of a larger path of damage when viewed from above (EF1 tornado, Botetourt county Virginia April 27, 2011)

Traditionally aerial support has come from local emergency services or agencies such as the Civil Air Patrol

Today, UAS (Unmanned Aerial System, aka “Drone”) technology makes it possible to collect and share aerial imagery with high precision in real time!

Why Drones?

- Extremely efficient
- Highly Flexible in the field
- Can focus on very small areas of interest
- Provide high resolution imagery
- Value added digital datasets (3D mapping, NDVI)
- Access to debris fields unsafe for ground inspection
- Not restricted by road network

Exploring Drones for Storm Surveys

- NWS Eastern Region Drone Team (ERDT) Formed Spring 2015
- Team Charter/Motivation: Explore how WFOs could obtain UAS data to support storm damage surveys (Rapid Response Operations)
- Office of Marine & Aviation Operations - Aircraft Operations Center (AOC), and NOAA UAS Program Office (NOAA UASPO)
  - Many calls/correspondences with NOAA UASPO
  - John Walker, JC Coffey, Robbie Hood
  - Invaluable resource, helped navigate complex FAA UAS rules/regulations

Proof of Concept

Appomattox county, Virginia

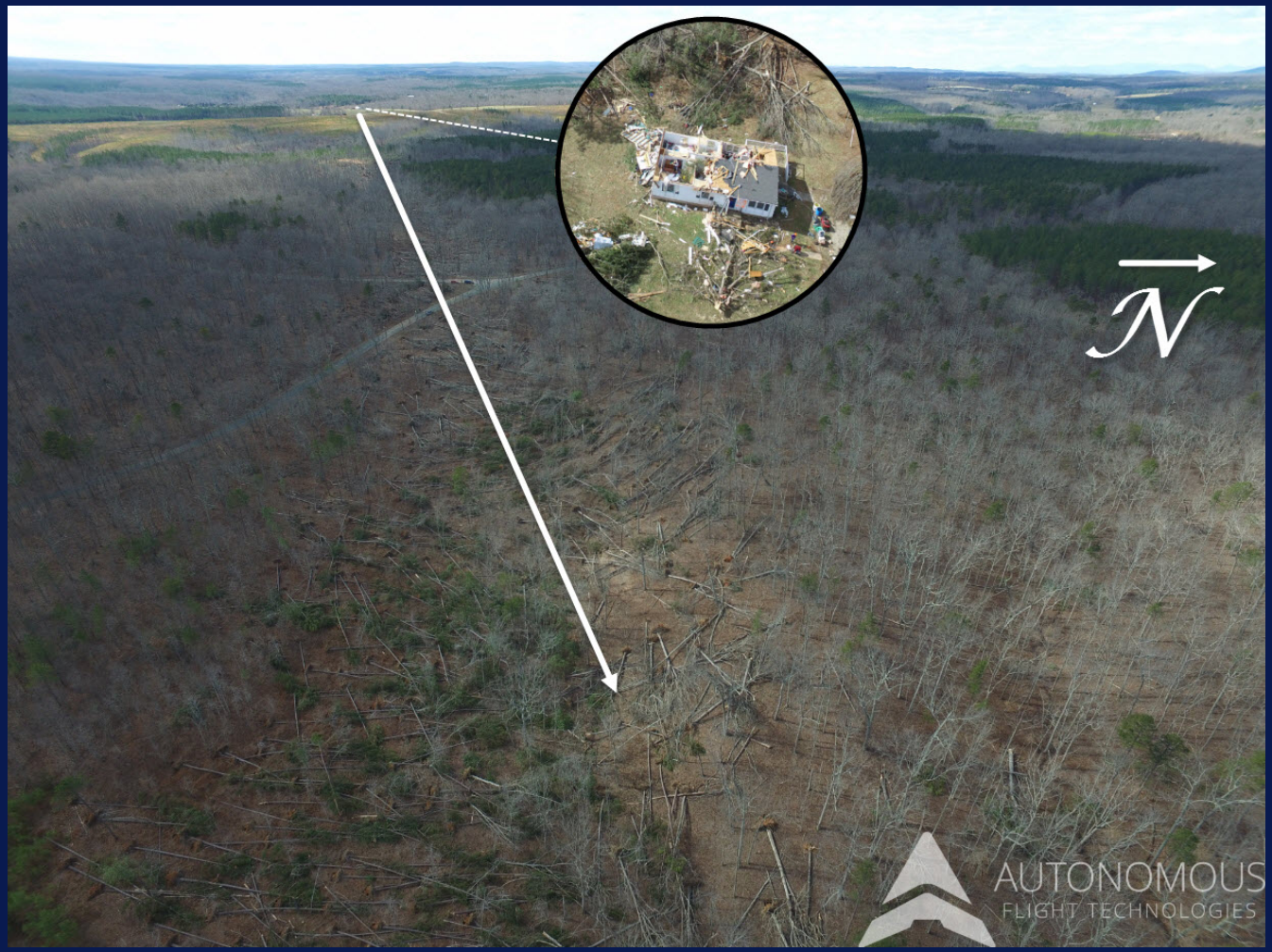
EF-3 Tornado Survey

February 24, 2016

- On Wednesday February 24th, 2016, an EF-3 tornado produced extensive damage in Virginia as it moved across Appomattox county, with the Evergreen area being particularly hard hit.

- NWS Blacksburg conducted damage surveys along the path of the tornado and for the first time used aerial imagery from a drone.

The tornado track was not always well defined from the ground



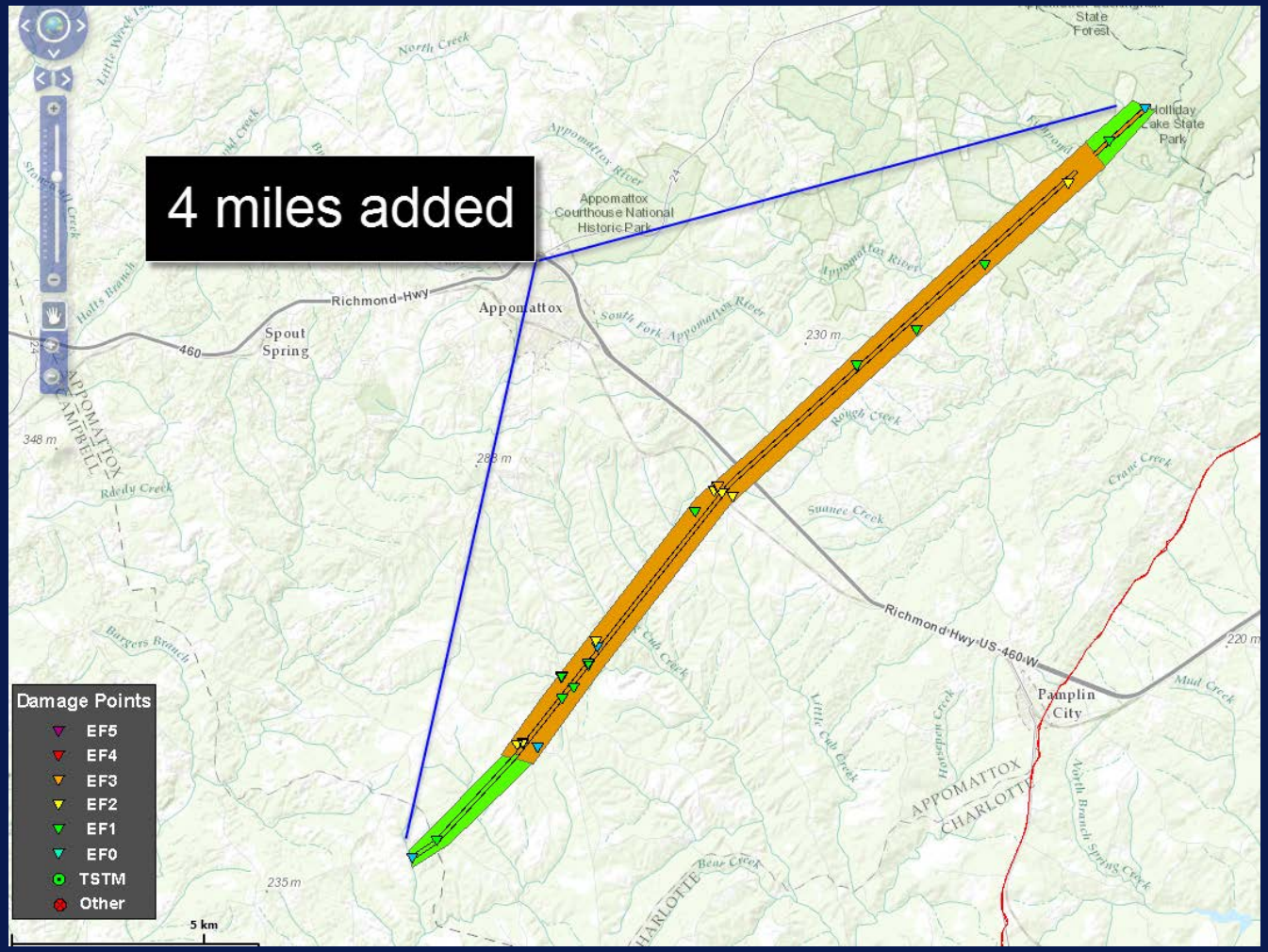
However, the tornado track was clearly visible from the air

The drone was able to see deep into areas of tangled debris not safely accessible from the ground

Convergent patterns of damage indicative of a tornado were easier to see from the air

Positive signatures of rotation were also evident

3D digital rendering of damage in Evergreen, VA



Drone imagery helped to better define the track length, adding 4 miles to the initial ground based estimate

Summary and Conclusions

- Access to aerial drone imagery demonstrated significant benefits
  - increased the surveyed path length 30% by revealing damage not easily viewable/accessible from the ground
  - UAS survey proved to be quicker and more efficient for inspecting remote portions of the tornado track
- The NWS currently has the capability to seamlessly integrate basic aerial imagery into storm damage assessments
  - Aerial images entered into Damage Assessment Toolkit (DAT)
- Thorough coordination with emergency management is critical to the successful use of UAS during a damage survey

Thank You!

Questions?