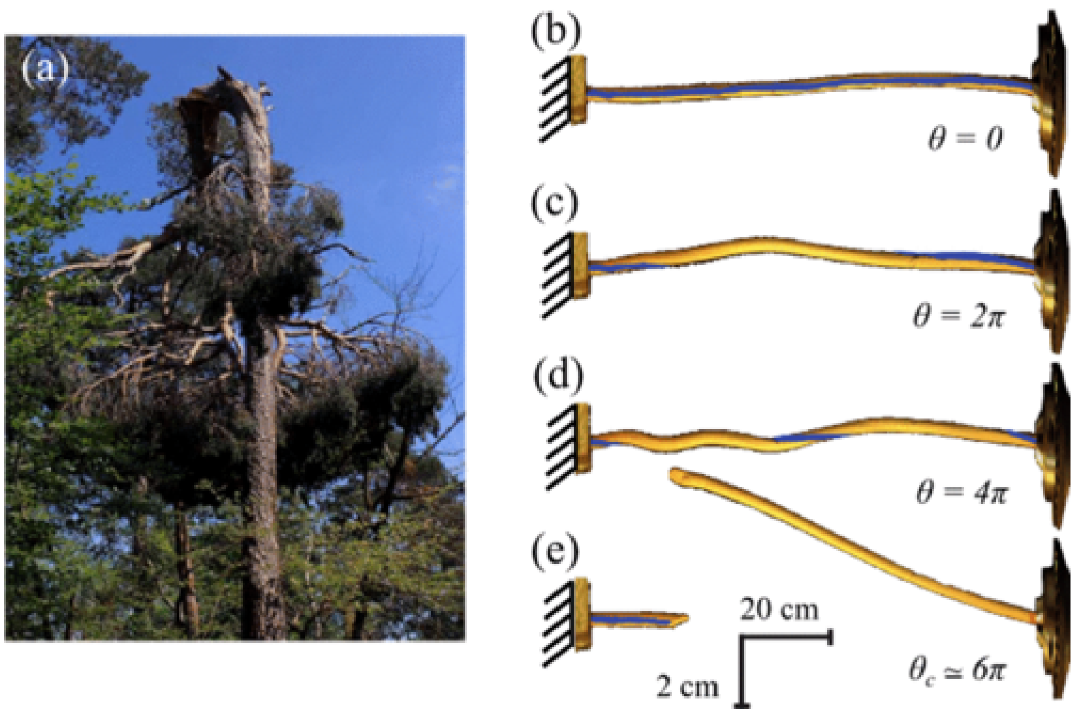
Trees found to break at near the same wind speed regardless of size or species

February 10 2016, by Bob Yirka



Breakage induced by torsion. (a) A tree broken after a trunk torsion. (Photograph: Keraunos, Fontainebleau forest, France, June 2010). (b)–(e) Snapshots from experiments. Wood rod of length L=900 mm and diameter D=4 mm. Snapshots are stretched vertically to emphasize the deformation out of its axis (note the two scale bars). Credit: (c) *Physical Review E* (2016). DOI: 10.1103/PhysRevE.93.023001

(Phys.org)—A small team of researchers with École Polytechnique in France has found that all trees, regardless of size or species, tend to break at near the same wind speed. In their paper published in *Physical Review Letters*, the team describes tests they conducted in a lab and how they came up with a scaling law to describe the point at which a tree will break due to wind stress.

People have noticed for some time that when high winds strike, trees, regardless of size, age or species all seem to snap in a given area—but only when the wind reaches some given speed. Up until now, it has not been clear if all trees snap at the same wind speed, or if there is a gradient of sorts. To find out, the researchers in France conducted experiments where they attached water buckets to wooden rods to measure both their flexibility and the point at which they would break. In so doing, the team found that the rods tended to break at near the same point. Next, the team combined their lab experiments with data collected by others over time that suggested that trees tend to snap when wind speeds reach approximately 42 meters per second.

Using all the information at hand, the team came up with a scaling law to describe when a tree will break due to wind force: ($V \sim D^{0.75}/L$), where V is wind velocity, D is diameter of the wood and L is its length. When applied to trees, rather than just rods, the team found that variance due to physical differences between species was minimal—doubling the size of the tree, for example, made a difference of just 9 percent, and oak trees, notorious for their strength broke at speeds just 10 percent higher than pine.

The researchers explain that the size of a tree does not play a bigger role because they grow at a rate where their height is proportional to diameter, and because the larger a tree grows the more defects in the wood come into play—also as a tree grows larger, more and more of its surface area is exposed to wind forces.

More information: E. Virot et al. Critical wind speed at which trees

break, *Physical Review E* (2016). DOI: 10.1103/PhysRevE.93.023001

ABSTRACT
Data from storms suggest that the critical wind speed at which trees break is constant (≃42m/s), regardless of tree characteristics. We question the physical origin of this observation both experimentally and theoretically. By combining Hooke's law, Griffith's criterion, and tree allometry, we show that the critical wind speed indeed hardly depends on the height, diameter, and elastic properties of trees.