Modeling of Forest Firebreak Formation by Hydrogen Explosions

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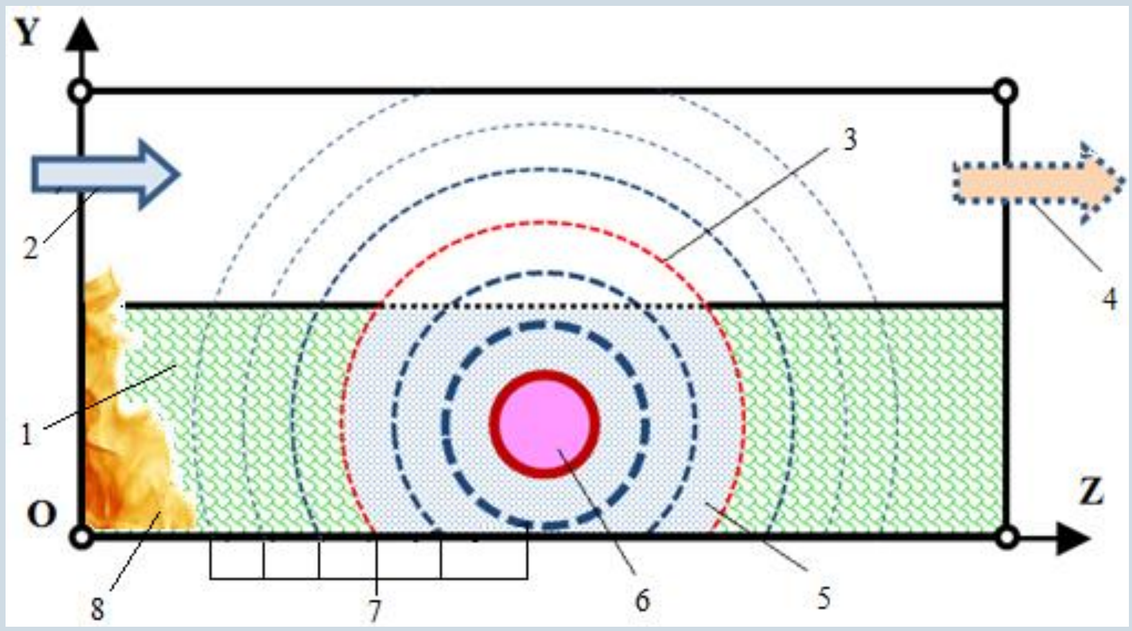
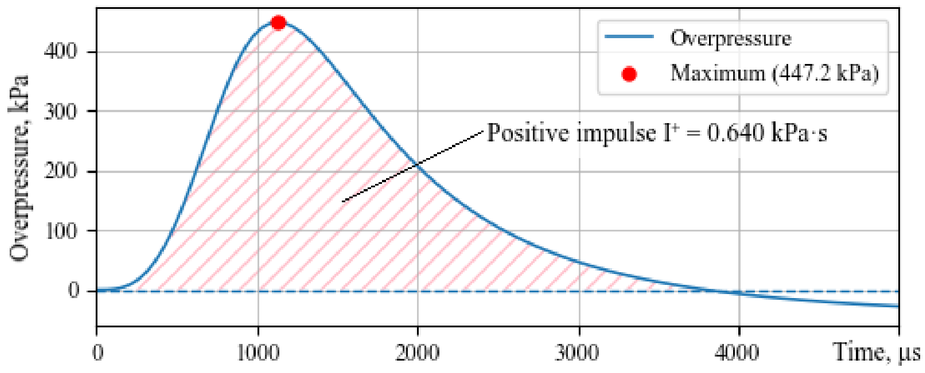
Using explosion modeling and a deterministic method to assess the blast wave's shock effect on forest cover, safety experts can predict the required width of the fire protection zone to prevent the spread of a forest fire.



Schematic diagram of firebreak **zone formation**:
1 – forest massif; 2 – fresh air; 3 – critical pressure for forest damage; 4 – gas-air mixture; 5 – fire-prevention barrier; 6 – compressed combustion products; 7 – front of the fading blast wave; 8 – forest fire.

Method

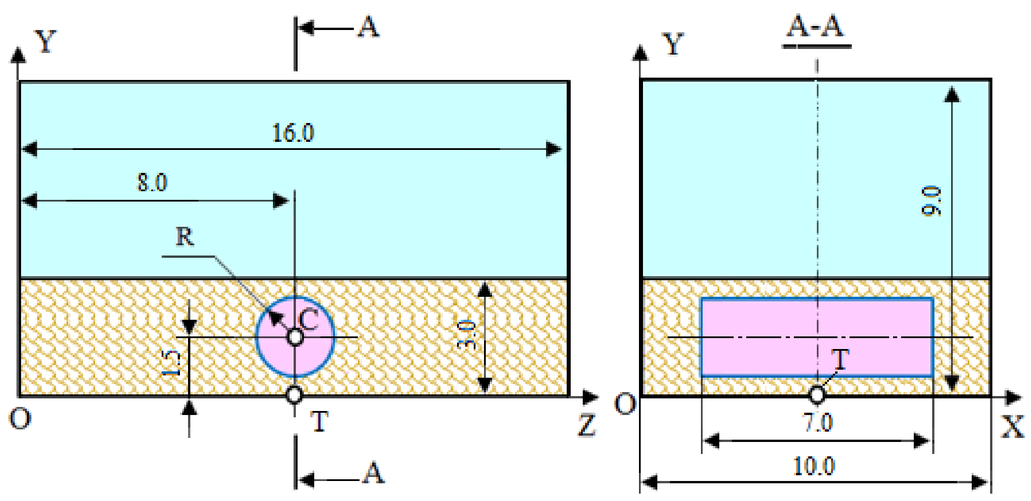


Overpressure time history at one of the control points

Forest-cover damage degree	Maximum overpressure, MPa	Positive impulse, MPa·s
Leaf stripping	≥ 0.02	≥ 0.01
Twig breakage	≥ 0.04	≥ 0.10
Complete tree destruction	≥ 0.10	≥ 0.30

Blast wave thresholds to assess forest-cover damage

Computation experiments data

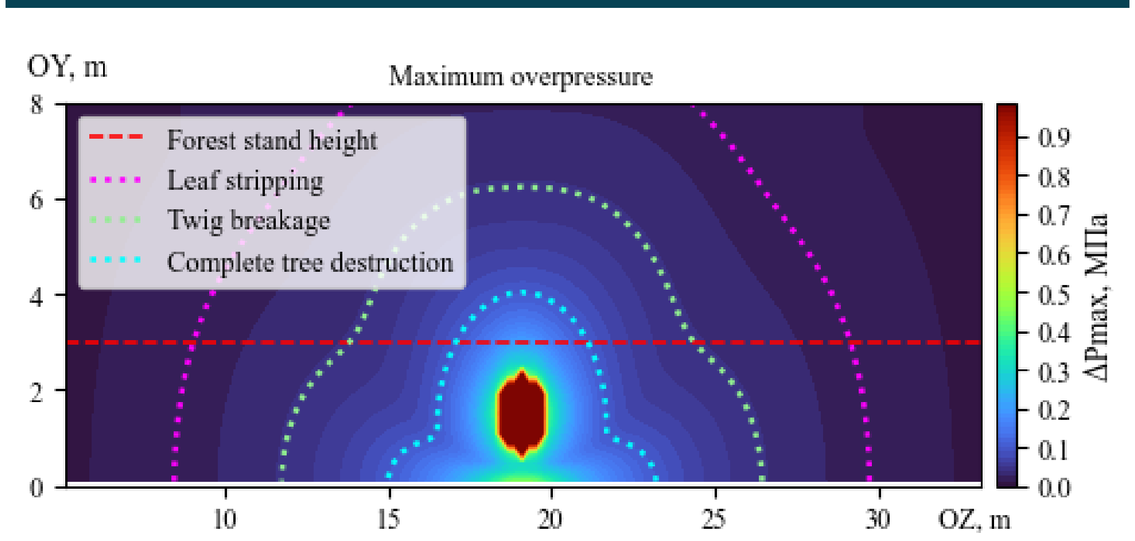


Geometrical scheme of the calculation domain.

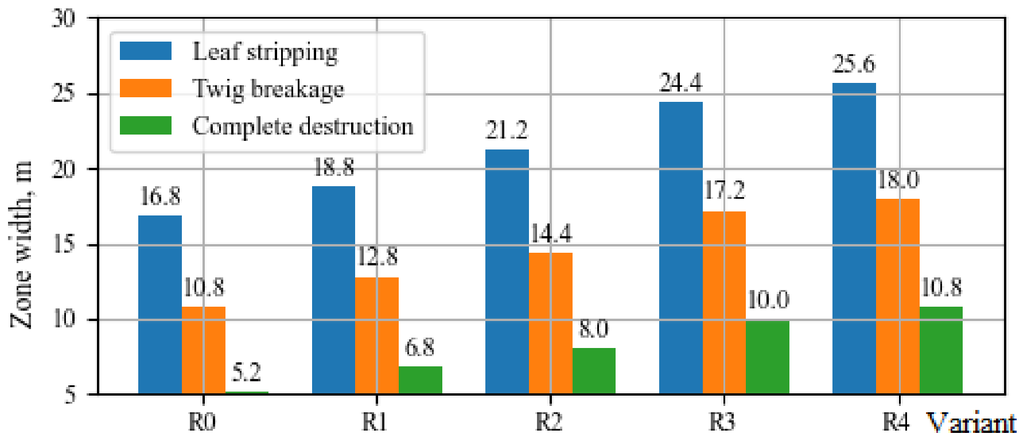
Experiment Parameters	Simulation case identifiers				
Simulation case identifier	R0	R1	R2	R3	R4
Hydrogen charge radius, m	0.6	0.7	0.8	0.9	1,0

Identification of numerical simulation cases.

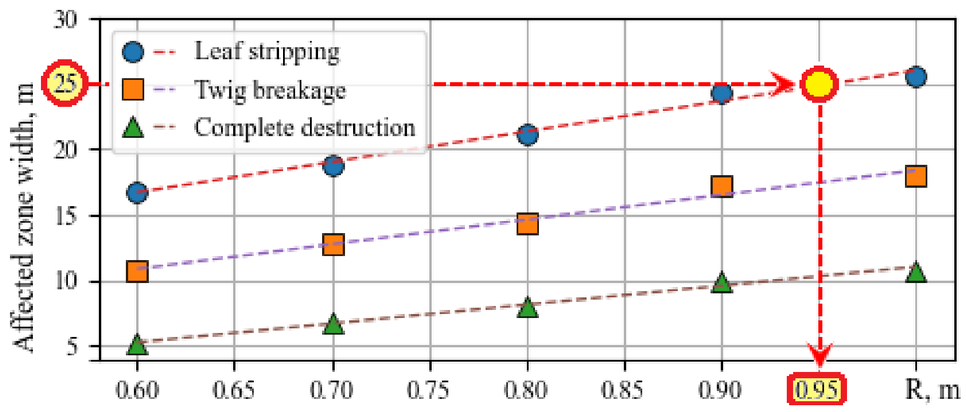
Results



Forest cover damage zones generated by the hose-type hydrogen charge explosion (option R2).



Affected zone widths for different charge radius



Determining the hose radius of the hydrogen charge to create the needed firebreak width.