



GPS Use in Wildland Fire Management

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By its very nature, wildland fire management has a continuing need for knowing specific geographic locations in areas that may be difficult to accurately locate. Prescribed fire management, wildfire detection, dispatching, suppression, and



Using GPS in wildland fire management.

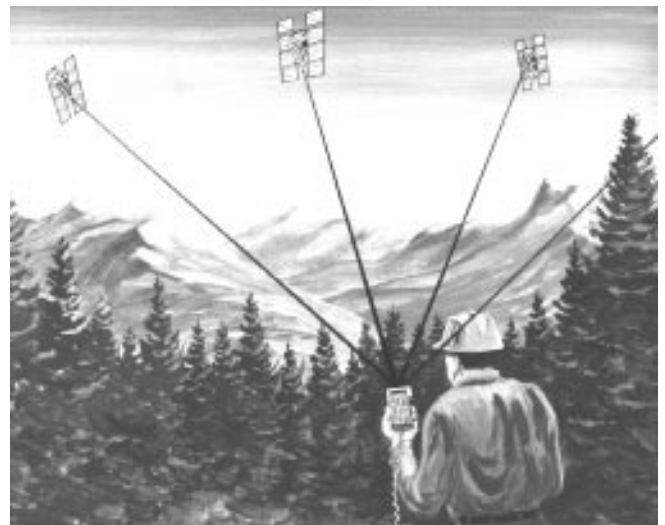
post-fire rehabilitation are often made more difficult by the remote nature of the wildland environment. Global Positioning System (GPS) can be a significant asset to help the wildland fire manager better locate key resources and locations in the wildland fire setting.

Global Positioning System, an all-weather, world-wide, 24-hour-a-day satellite-based radio navigation and positioning system, has become increasingly affordable and user-friendly during the past few years. Lightweight (under 2 pounds), portable equipment that is durable enough for field use, and is easy to use, with a high level of reliability, now costs less than \$1,000.

Based on a constellation of 24 satellites in orbit 11,000 miles above the earth, GPS receivers can consistently identify ground location within 320 feet (100 meters) 95 percent of the time.

The system was developed by the U.S. Department of Defense at a cost of over \$10 billion. Receivers on the ground use these satellites as precise reference points for computing their position. It's comparable to a high-tech version of the old Boy Scout technique of taking compass bearings to known points and then using basic geometry to determine position.

With GPS, the satellites are the known points. Their positions in space are precisely monitored. By measuring the travel time of a signal transmitted from each satellite, a receiver on the ground can determine its distance from that satellite. With simultaneous distance measurements to four satellites, the receiver can compute its exact latitude, longitude, and altitude. GPS signals are free to users on the ground. There is no license fee or requirement for proprietary equipment.



GPS – A satellite based positioning system.



Fire Management Applications

GPS has numerous ground-based applications in wildland fire management, ranging from preparedness planning through suppression activities and into prescribed fire use. Some specific uses of GPS on both prescribed fires and wildfires include:

Preplanning — GPS can be used prior to both prescribed fires and wildfires to locate and map critical resources such as cultural resource sites; bridges and trail improvements; range structures; wildlife snags, critical habitat such as elk wallows, designated superior trees; remote homes and cabins; and section corners.

In addition, specific hazards can be accurately mapped, such as mine shafts; power lines and sub-stations; well sites and pipelines.

Knowledge of the specific location of both the critical resources and specific hazards can be invaluable when scheduling fuel treatment activities as well as for dispatchers and initial attack fire crews on wildfires.



Field observers and line overhead reporting their specific location.

Detection and Dispatching — The use of GPS in wildfire detection and dispatching can be especially valuable, since accurate location reporting and timely initial attack are often closely related to the ultimate size and suppression cost of a fire. Fixing the location of a wildfire discovered by ground personnel or aerial detection using GPS can greatly increase the accuracy of a fire report over existing methods, especially in areas lacking good reference points such as roads, streams, or recognizable facilities, and

when reported by individuals who may be unfamiliar with the terrain. Smokejumper aircraft en route to a fire location often discover other fires, especially soon after active lightning storms pass through an area: the use of GPS in a smokejumper aircraft can help pinpoint the location of multiple ignitions in a small area, and help insure that sufficient ground crews are dispatched for each ignition.

Dispatchers will be able to more accurately record reported wildfire ignitions, and better dispatch suppression forces by the most effective route.

Crews having to leave a road and travel cross-country to a known fire location can use GPS to give them a bearing and distance that is constantly updated enroute to the fire.



Detection of wildfires can be more accurately located through coordinated use of GPS.

Suppression — There are numerous opportunities for GPS to increase the efficiency and effectiveness of our fire suppression activities, especially on those large fires being managed by incident command teams. Some specific applications of hand-held GPS in fire suppression include:

Field Observer — Using GPS can increase their accuracy in locating and reporting critical control points, the fire perimeter, potential helispots and water sources, and safety hazards.

Suppression Overhead Personnel — such as crew supervisors, strike team leaders and division supervisors, can use GPS to request air tanker and helibucket support, accurately report their positions throughout the shift, identify specific hazards such as burning snags, accurately identify spike camp and “coyote” camp locations, and direct medivac to line locations if needed; safety can also be enhanced in fire entrapments since retardant drops can be delivered with pin-point accuracy if both the aircraft and the firefighters on the ground have GPS.



Air tanker drop requests can be pinpointed by ground forces.

Planning Section — personnel are able to use GPS to map a fire’s perimeter and area (from either an airborne platform or on the ground); to identify division breaks, drop points; and to locate isolated improvements needing special protection efforts. GPS can be especially valuable to the planning section when used by line personnel to accurately report either the location of the fire’s edge throughout the burning period, or to pinpoint where line has actually progressed during a shift, rather than where it was planned to be. This allows a timely updating of subsequent incident action plans to more closely reflect real time conditions on the incident. In preparing the medical unit plan (ICS-206), the lat/long of pre-designated medical facilities can be specified so that medivac transport by the more direct flight route can be facilitated easily.



Dispatch coordinators use GPS to plot wildfires.

Mechanized Equipment

The use of GPS with mechanized equipment on wildfires (engines, dozers, water tenders, lowboys, helitenders, crew carriers) offers many valuable opportunities: tracking the location of these resources is often a difficult task on large wildfires, especially when non-local units are assigned to an unfamiliar area. By placing a GPS unit with each of these key pieces of equipment, it is possible to increase coordination needed between maintenance and fuel support vehicles; to identify specific resource protection objectives, and insure that equipment is properly positioned to implement that protection; to give single resource leaders (such as STL-dozers) the ability to pinpoint the locations of resources they find within their area of responsibility; recovery and repair of disabled vehicles can also be expedited with good locations from GPS.



Tracking mechanized equipment is enhanced by GPS.

Aircraft

The use of GPS in aircraft operations on wildfires offers many advantages, both in fixed and rotary wing: air detection flights can more accurately record fire locations, helping to reduce the time needed for initial attack forces to reach a fire; rappel helicopters and smokejumper aircraft equipped with GPS, and dispatched to a specific GPS-located fire, can reduce response time and flight hours, thereby reducing costs; accurately located helispots can direct pilots more effectively, especially those unfamiliar with a specific area; ground forces equipped with GPS can more accurately request air tanker or helibucket drop requests, and helicopters and air tankers equipped with GPS can more accurately respond to those requests; any aircraft over a large fire (helicopter, air tanker, lead plane) can report the location of spot fires and hot spots in a timely and accurate manner; helibucket fill locations can be plotted and used to reduce flight time, especially for new helicopters on an incident; air medivac operations can be enhanced by pinpointing the location of injured firefighters needing air transport; and increased safety of smokejumpers in remote locations by validating locations of jump spots for retrieval if necessary.

A significant amount of work has been done on the use of GPS in aircraft on wildfires. This information will be reviewed and discussed in greater detail in an upcoming Tech Tip focusing on aerial applications of GPS in fire management.



Water sources for helibucket operations located by GPS.



Flight time for heavy lift helicopters can be reduced if specific drop spots are coordinated between air and ground.

Post-Fire

After a wildfire has been controlled, GPS can continue to play an important role in post-fire activities. As incident management teams transition off of a fire, specific locations identified by GPS can be extremely useful to newly arriving personnel needing to check hotspots and spot fires; caches of tools, pumps, hose and other equipment can be referenced for retrieval at a later date; critical rehabilitation needs (for skid trails, creek crossings) can be identified for timely work; the location of damaged resources (fences, buildings, trails and bridges, cultural sites, etc.) can be identified in a timely and accurate manner; severely burned areas or hydrophobic soils can be accurately mapped; and finally the fire perimeter can be easily mapped and areas calculated.



Damage assessment using GPS.





Locations of severely damaged sites are identified for rehab teams.

Prescribed Fire

Hand-held and aircraft-mounted GPS units have numerous applications on both planned ignitions and prescribed natural fires in wildernesses.

As large-scale ecosystem burns (such as the 15,000+ acre “Buchanan Burn” in New Mexico) are planned more often, GPS units can be used to help ignition activities by controlling lighting patterns; to identify critical protection needs such as cultural resource sites, superior trees, sensitive wildlife habitat, T & E plant species locations, range improvements and property corners; to identify water sources for both ground-based and helibucket operations; to identify time sensitive control points that will influence firing

patterns; to locate critical areas for holding and patrol crews; and to maintain accurate locations of assigned resources.

On prescribed natural fires (PNF) in wilderness, many of the uses of GPS identified for wildfires and planned ignitions are also appropriate. In addition, GPS allows the PNF manager to coordinate specific on-the-ground locations with GIS based information sources; to insure that actual fire behavior is consistent with predictions; to quickly and accurately map the fire perimeters; and help assure the safety of monitoring teams by closely monitoring their locations relative to fire location.

Availability of GPS

While technological advances in GPS are occurring at an extremely rapid pace and the price of hand-held receivers is dropping at a similar rate, the availability of GPS units at the field user level is not that wide-spread at this time. If GPS is to reach its potential for use on large scale prescribed burns or wildfires, this problem of availability must be overcome. Fire overhead (down to the crew supervisor level), field observers, line scouts, weather observers, ground support personnel, helicopter managers, engine captains—all will need GPS units assigned to them if the total integration of GPS into the management of an incident is to be achieved. Any crews working in high-risk environments (such as interagency hotshot crews) should be equipped with hand-held GPS.

One potential method to accomplish the increased availability of GPS units on a wildfire incident or prescribed burn is to establish GPS kits in the fire cache system, similar to those that currently exist for personal portable radios. This could help insure full utilization of a limited resource, provide accountability of a sensitive item, and offer skilled maintenance capability after use.

Limited instruction to overhead and other potential users at the incident base camp will provide the skills necessary for the basic operations needed in the field.

Limitations

GPS offers increased reliability for determining location compared to other methods (i.e. topographic map, Loran-C). Since the basis of GPS is signals received from orbiting satellites, anything that limits the reception of those signals will affect the use of GPS. There are certain limitations that user must be aware of:

- *Steep terrain can mask a satellite and block its signal, thereby limiting the number of individual satellite signals that a GPS unit can receive. Since GPS uses the principle of triangulation to plot a position, the greater number of signals results in a more accurate position fix.*

- *A dense timber canopy can cause some signal loss, although slight movement of the GPS antenna may re acquire the lost signal and produce an acceptable position reading. Studies conducted by MTDC under a mixed lodgepole/ponderosa pine stand on the University of Montana Lubrecht Experimental Forest showed an average horizontal position error of 63 feet (19 meters), which falls well within the expected range when selected availability is factored in.*
- *“Selected Availability” (SA) is an error factor introduced intentionally into GPS by the Department of Defense for non-military users. It is their way of “denying accuracy to the enemy”, and detracts from the potential accuracy levels that could be achieved from the GPS units. Specific measures, called “differential GPS”, which can eliminate the effects of SA, is available to users who have greater accuracy requirements.*

For More Information

GPS technology is rapidly changing. If you are interested in general information on GPS, the monthly magazine “GPS World” is a good source. Specific information on natural resources applications of GPS can be obtained from Tony Jasumback, GPS Project Leader at MTDC. Uses and experiences in wildland fire management have been documented in a number of publications, such as Fire Management Notes. For information on these sources, contact Fire Program Leader Dick Mangan at MTDC.