**"WILDFIRES: It's a World Problem"**

- how to prepare for & manage them to be an asset -

by Stephen Skinner (6/2019)

**PREFACE:** As a landowner in the Wildland Urban Interface(WUI) since 2003 & spending a significant amount of time in the Mountains since early childhood, & later realizing there's a strong spiritual value for me at being in this vastness of Nature. Living in the Southwest & seeing what an 8 year long drought has done to these forests, has brought sadness at seeing the dying trees & a much increased occurrence & intensity in Wildfires. I then was on the lookout for a local organization that was trying to reduce the effects of these fires by a quicker response time at putting them out, than just an Army of on the ground firefighters. This lead me to the Topanga based 'Wildfire Research Network'(WRN). After working with them, I realized their approach of solely promoting an expanded use of fixed wing aircraft & helicopters wasn't the entire solution. To stop the devastation that these disasters bring requires the quickest response possible before the scale of the fire builds up so much energy that it will no longer be manageable by any human effort. TIME is the real enemy, so aerospace technologies beyond aircraft must be used. After I realized that satellites & computers must be part of TIME challenging solution, I began searching for which satellites used during the Cold War for sensing heat signatures of hostile missile launches. That list was obtained from the "Union of Concerned Scientists" website. Their list eventually lead me to a retired satellite Engineer from Lockheed, Rich Davies. He with some help from the then Vice President of the U.S., Albert Gore, created 'Western Disaster Center'(WDC). He & other NASA Ames scientists formed the Defense Space Consortium **(1)**. After numerous phone conversations over weeks of persistent questions, some of which was, why couldn't some of these Military tools be usable for a benevolent Civilian use of sensing out Wildfire starts. He eventually asked me if I would like to join his WDC team as "Director of Wildfire Policy". Later after 2 visits to his NASA Ames office, and a brief education on satellite orbiting, I was brought on board to write some papers for their website & give a public lecture on different aspects & strategies on Wildfires". In essence this group pioneered the use of "Remote Sensing for Disaster Management" using aerial vehicles & electromagnetic frequency tools. A fore-runner to the emerging LiDAR survey & Disaster Management system of today. This very high tech system originated as a combination of laser "light" & "radar" merged with airborne vehicles. This LiDAR system should be implemented for surveying the vegetative fire fuel load in all at risk WUI areas, so the data can be part of a Wildfire computer simulations, if a satellite early warning of a fire start has occurred. There are mainframe & PC software that can create these simulations.

LiDAR originated in the early 1960's, shortly after the invention of the laser and combined laser-focused imaging with the ability to calculate distances by measuring the time for a signal to return using appropriate sensors and data acquisition electronics. The general public became aware of the accuracy & usefulness of LiDAR systems in 1971 during the Apollo 15 mission, when astronauts used a laser altimeter to map the surface of the moon. That Military usage might be usable for a benevolent Civilian use of sensing out Wildfire starts.

**WILDFIRE OVERVIEW**: Ever year Wildfires bring tragedies to many people & ever increasing losses to all of us, most unseen compared to sensational ones of life & property loss. Wildfires are among the most pervasive of all the natural disasters, especially for California. Based on studies by the Insurance Service Office (1997), of the 38 costliest U.S. wildfires between 1825-1995, twenty-two were in California. The state ranks 1st in terms of economic losses due to wildfires.

Before continuing with this background of this domestic disaster, lets see Globally how this is a universal problem. Greece & Australia have about the same frequency of fires as California. Canada, China, Indonesia & Chile have serious Wildfire problems. These other countries have Wildfire problems: South Africa, Spain, Israel, Japan, South Korea, India, France, Germany, Poland, New Zealand, Argentina, Brazil, Ecuador, Bolivia & even Hong Kong has had killer Wildfires. Forest wildfires rampaging across Russia are being significantly underreported by authorities, according to analysis of satellite data. Many of their fires occur in the forested Eastern portion of Russia. Their frequency of forest fires has increased 30 - 50% in the last 20 - 30 years. Wildfires have even occurred in Greenland. It appears it's a World problem. It's an issue that should be managed with TIME being of greatest concern to reducing its destruction. Every year Wildfires are causing an increase in property losses. Even in lesser burn years of 2006, the U.S., had 67,743 fire starts amounting to 4.1 million acres with a suppression costs of 2 billion plus in 2006 dollars. The trend has only become worse with: global warming, increased population, Geo-Engineered weather modification & antiquated fire fighting methods.

It appears the fighting Wildfires has become a business for profit for to many. As long as there is a blank check for emergency fire suppression, most fires will be suppressed with to slow of a response in many instances.

Suppression costs are likely to be excessive. The Forest Service is in need of serious reforms. Fire prevention & control efforts have been a part of the work of the Forest Service from the earliest days. In 1908, the 'Forest Fires Emergency Act' authorized the Forest Service to spend whatever necessary to combat the increasing wildfires throughout the country. As once stated by Upton Sinclair (early 19th century author of influence), “It’s difficult to get a man to understand something when his salary depends upon his not understanding of it.” A more recent quote by Calif. Congressman Dana Rohrabacher stated in "Wildfire" periodical, "The U.S.F.S. regulations establishing the requirements for airplane-based firefighting are obviously designed to protect the good old boys & to discourage anyone else with new approaches & new alternatives”.

Before man-made resources & therefore monies are to be dispensed to save or protect natural resources, an inventory method or system needs to be devised to asses what is of real value of all assets within a given geographic region. The size of the region should be determined by its defensibility to a Wildfire threat. The most obvious & easiest assets to measure & record are the manmade. All recorded assets of both man-made & natural resources, needs a G.P.S. location assigned. The natural data assets collected will require many man-hours of work. Those natural vegetative assets are stationary & recordable, versus mobile animal habitat that is dynamic & at best theoretical. Because of the scale of importance Wildfire damage can inflict, it could be perceived as a community responsible effort to collect this data. By promoting the importance for this data as our human responsibility to be stewards of this planet as stated by theologians, we could motivate much of this collection thru voluntarism. This volunteer effort could come from: colleges, universities and environmental groups. Each fire region should be depicted like a U.S.G.S. map with quadrants, sectors & so on. In simple, a grid system that lends itself to digital corresponding information. The plant material should be categorized by commercial timber value, & biomass value for regional cottage industries from residual plant material for heat fuel & composting. Maybe the most important part of the survey won't be the cataloging of assets, but the inventory of the fuel loads that are present in each Fire Region. Thus those that are carrying out the survey must understand what are the predominant plant species, the plant density & to a lesser extent the maturity level of these plants. The ultimate goal of each Regions survey is to estimate the potential fuel load in each measured area. The residual plant material should also be part of the survey. Referring to "residual plant material" means plant litter that has fallen on the ground, as well as maintenance pruning. It's apparent that these tasks will require some knowledgeable people to supervise the masses of help needed to do a survey in a timely fashion.

The other tasks beyond all the data categorizing & computer downloading, is prioritizing how the software should evaluate a hierarchy of importance to make efficient judgment of data. Some suggestions are listed below.

Mapping of fuel load, if this requires a long & costly process, then prioritize as follows:

A - closet to population, referred to as Wildland Urban Interface (densities will adjust needs)
B - closest to assets of public concern (parks & monuments)
C - closest to important economic assets (i.e., good timber resource)
D - public valued visual assets
E – private structures

(some of the above is done in partial by the Dept. of Interior’s “A Cohesive Fuels Strategy Plan")

There's another category of value beyond these physical ones, a system for "visual resource management" as stated by the B.L.M.(Bureau of Land Management) & the U.S.F.S. "Visual Management System". Both of these systems are putting a measurable value to aesthetics & a sanctuary value to open space. This is a REAL value as the World becomes more crowded. After all the assets have been identified & assigned a G.P.S. location, then a dollar value needs to be applied so as to evaluate the cost/benefit for fighting Wildfires.

Response time is the real enemy, it is the one factor that we can control. This can only happen thru technology and having ground troops take a lesser role, just as discovered by the military with the transformation of Army to Army Air Corp to Air Force as the most effective to way to win a war. Ground forces should be to maintain & cleanup after the battle is won from the air. Aerospace & computer tools will react to a harmful situation much faster than sole human decision makers & ground troops.

Bring tax-paid military tools (assets) into multi-role uses for fighting Wildfires. Those tools can be used 3 – 4x as much during a 24/7 need as the present tools used. In fact some of the Military tools are of a non-stop potential. Response time is the one factor that we can control. Aviation & its derivatives are the systematic tools to bring this problem to a National asset, because of a potential World demand. Computers, aerial surveillance (real time) and aircraft can be the technology answer. The cost is surprisingly low, because most of it already exists as unrelated tools to various government groups. The government should be using multi-tasking tools to serve more public needs than as the sole use of a particular organization. A couple examples of tax paid tools that should be used for more tax paid needs, rather than exclusive use of a sole agency is the C-17 (cargo airlifter) & the SBIRS infrared surveillance satellites. These satellites are for the Defense Support Program to warn against hostile missile launches. This infrared system of satellites is ideally suited to detection of wildfires, especially in remote areas. The C-17 is the closest aircraft in our US inventory that is capable of being a purpose built aerial fire-fighting tool. To compare it to what is in use or even being evaluated by the U.S.F.S., is like comparing “Fat Albert” to “Michael Jordon”. We can’t rely on government accountability to be their own self critic. I believe changes are

needed to make our tax funded agencies to start representing us in a more cost effective manner, won't happen unless we become involved. Demand a more analytical approach rather than a subjective one to wildfire suppression. Start with monitoring response time and climatic conditions from fire ignition to suppression efforts, forensic analysis by using Photogrammetry. This calculation of when & where the fire started could be a combination of incident data gathering by a Photogrammetry system on board the "Regional Verification/Initial Douser aircraft". The incident climatic conditions would be with satellites & emerging technologies. This is necessary to evaluate the correct tools needed to greatly reduce a wildfire occurrence. In other words, to modernize to the best technological capabilities where it's cost effective. Also to reevaluate who should be doing suppression tasks. Measuring aerial suppression equipment effectiveness (aircraft) by the "full cycle support capacity method". This is a quantitative analytical system of aircraft effectiveness. This criteria would be: take off from any field(inc. austere) fields within 100 miles of the fire & drop / reload potential per hour: take-off, out-flight, drop-transfer, in-flight, reload & stage. This evaluation should be in all conditions: night, smoke, dust. In less words, no visibility. A battle condition tool. Maybe you start with what it can do per hour. This speed needs to relate to load capacity & possibly with austere field capabilities.

**A New Method to Battle Time**

An early warning would be given by the Space-Based Infrared System (SBIRS) satellite system that would be shared with the existing Military users. Ultimately you want the system to not signal a fire alert when its a small size like a campfire, maybe something at a scale of .10acre(about 20 x 20ft) being the smallest. Then the next level of verification that a fire has started, would be sending out a "Regional Verification/Initial Douser" aircraft. That being a modified F18E/F carrier type fighter for that task. This aircraft is suitable for this role because it's rugged for carrier opera-tions, which makes it durable for all the buffeting that a Wildfire can bring. It has a reasonably slow stall speed (85 - 90mph depending on air density, flight wt. & angle of attack) as needed for carrier landings, which will help the aircraft maintain flight in super-heated low lift atmosphere of Wildfires. Its fighter speed will get it to an incident quickly and still allow a slow speed to make an appraisal of the fire situation. That being verification & dousing drop from its **3** 'Sargent Fletcher' drop tanks; center-line/wing tanks with a 990gal. total capacity, which is referred to as an airborne tanker by adding an external "buddy tanker system". The reaction to a potential Wildfire incident should be based on more time efficient tools than just SBIRS & quick response aircraft, Computers with software that will integrate data of : site weather conditions & topography, plant fuel B.T.U heat potential & natural/man-made assets all play into another software integration as commanded by a highly trained human. The final goal is how to respond to each unique incident with the question, what tools should be used for the most effective COST to BENEFIT for this incident. In some cases it maybe left to burn as a landscape fire regenerative incident or a very aggressive attack to extinguish. Periodical training thru a computer simulated Wildfire that evaluates the speed & cost effectively that an incident commander reacts to each Wildfire incident. In a logical comparison, are fighter pilots intensively trained to operate their costly tool with training & simulation? Then why shouldn't an incident commander & duty officers be regularly trained & evaluated to perform their job. This same software that simulates a Wildfire for training could be the same tool used in a REAL Wildfire incident, the difference being the computer program can be set to com-press the TIME factor into a fraction of a REAL INCIDENT. The training maybe a 1-2 hour simulation as compared to a real life 1 to 2 week event. The compressed time that this fire simulation can be created thru the software can use the known B.T.U. (British Thermal Unit) of the plant fuel load of the region being evaluated with real time weather conditions, and predict the burn rate & how the topography will generate its own wind conditions that will effect a forecast of how the fire will behave in regard to speed, direction & what the expected B.T.U. energy that will be generated. This tool package would be a major factor on predicting the response needed. There are 2 variables to add into the predication of the fire behavior that will be a challenge to quantify & algorithms integrate into the computer program; the moisture content of the plant material & residual aluminum oxide as a by product of any Geoengineering atmospheric spraying that has been done in the fire region being evaluated. This residual will coat plants and act as a fire accelerant, as well as percolate into the soil to hinder the effectively that plant root systems can properly function. The presence of these metallic nano particulates in the soil will hinder plant health & may even promote plant die-off & cause less water uptake & therefore less moisture content in the plant, which increases the fuel poten-tial of the Fire Region. The aerial surveillance LiDAR system would be a tool that could quantify the moisture content of the plant material & residual aluminum oxide.

The hierarchy of initiating a response to a suspect Wildfire incident should be thru National Interagency Fire Center (NIFC), located in Boise, Idaho. There should always be a duty officer assigned 24/7 to receive any SBIRS information & to feed its GPS location to the appropriate Fire Region for a hand off to evaluate the appropriate response. In the beginning stage of evaluation, it could be reviewed by the NIFC duty officer & a Regional duty officer. If it escalates to become a potential incident for assignment to a Incident Commander, then a thorough computer run should determine the coarse of action. This computer run, is actually a Wildfire simulation using: fuel load, topography, incident site weather conditions & run thru the main frame based HIGRAD or the FIRETEC software. Additional software that might be used is **FARSITE**, a 'Windows' based fire growth simulation modeling system. It uses spatial information on topography and fuels along with weather and wind files. It incorporates existing models for surface fire, crown fire, spotting, post-frontal combustion, and fire acceleration into a 2-dimensional fire growth model.

If the decision is to scramble a 'Verification/Initial Douser' aircraft, and then if that aircraft validates a continued threat after an initial dousing, it should then call in the aerial tankers. This aircraft would come back for a 2nd pass to validate the fires status again & record forensic data by Photogrametry. The total Tanker force to be called in could be calculated by a

computer forecasting ("looking forward") run. This computer run would determine the potential B.T.U. that could be generated by the fuel load & all other factors effecting the heat potential of the analyzed area. Each Tanker could have a B.T.U. rating per delivery. This can be calculated from the ??? of the fluid being delivered (**research needed**), the liquid capacity, its dispersal method & rate. The dispersal apparatus should be adjustable to optimize the flow rate & particle size to optimize its effectively to lower the heat(measured in B.T.U.'s) of the Wildfire.

Finally to understand the COST to BENEFIT of RESPONSE TIME, require all wildfires to have recorded response time from ignition to having the proper tools on the incident. This may sometimes require some fire forensic analysis. Again a computer system run to calculate when & where the fire started. The most critical factor we can control in Wildfire suppression, is response time. In regard to the COST/BENEFIT factor, a basis for the first iteration of a software already exists in a strategy game known as "Wildfire" (ver. 1.0). This software evaluates the effectiveness of different tools used to combat a Wildfire. In other words it gives a summary at the end the Wildfire situation & gives the person an effectiveness rating. This effectiveness is related as well to its timeliness.

There's recently a more automated way to collect fuel load data thru the LiDAR method. Which is a surveying method that measures distance to a target by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor. Differences in laser return times and wavelengths can then be used to make digital 3-D representations of the target. This system doesn't just measure distance, but its a very effective tool for evaluating soil composition, vegetative density & analyzing plant health by multi-spectral scanning. This material analysis is based on Spectrophotometry, a tool that hinges on the quantitative analysis of molecules depending on how much light is absorbed by colored compounds. Spectrophotometry uses **photometers**, known as spectrophotometers, that can measure a light beam's intensity as a function of its color (wavelength). Important features of spectrophotometers are spectral bandwidth (the range of colors it can transmit through the test sample), the percentage of sample-transmission, the logarithmic range of sample-absorption, and sometimes a percentage of reflectance measurement. The absorption of light is due to the interaction of light with the electronic and vibrational modes of molecules. Each type of molecule has an individual set of energy levels associated with the makeup of its chemical bonds and nuclei, and thus will absorb light of specific wavelengths, or energies, resulting in unique spectral properties. This is based upon its specific and distinct makeup. A finger print!

NIST (National Institute of Standards &Technology)has developed & distributed Standard Reference Data(SRD) in Chemistry, Engineering, Fluids and Condensed Phases, Material Sciences, Mathematical and Computer Sciences and Physics. A catalog of NIST is public, web interface SRD databases as a source for these LiDAR surveys.
**REF.** www.nist.gov/fusion-search?s=atomic+spectral+line+data+base&op=

Basics of Multispectral Imagery : Every surface reflects back some of the light that it receives. Objects having different surface features reflect or absorb the sun's radiation in different ways. The ratio of reflected light to incident light is known as reflectance and is expressed as a percentage.

The name LiDAR, now used as an acronym of light detection and ranging (sometimes light imaging, detection, and ranging), was originally a blend of the word light and radar. LiDAR sometimes is called 3D laser scanning, a special combination of a 3D scanning and laser scanning. It has terrestrial, airborne, and mobile applications. LiDAR is commonly used to make high-resolution maps, with applications in geodesy, geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, atmospheric physics, laser guidance, airborne laser swath mapping (ALSM), and laser altimetry.

**Biomass management reform:** to support & bring to reality a statement made by the Dept. of Interior. "Without expanding the ability of the private sector to remove biomass from public lands, we cannot address the excessive fuels problem in a timely and efficient way. We cannot solve the fire problem by relying exclusively on federally funded prescribed burns, for both economic and environmental reasons. Nor can we adequately reduce hazardous fuels simply through other direct Federal actions, because Federal dollars are limited and responsibilities are shared by Federal, State, Tribal, local, and private land managers alike." To accomplish this thru fuels reduction public permits of under growth removal (i.e.: diseased trees & at some future time a forest biomass industry), we must develop a criteria first for what type equipment & cost to operate to make this activity profitable. Maybe hydrogen or autonomous solar electric powered chainsaws. These new tools could come about thru an "X-Prize" method to foster creation to application. Issues of noise & minimal to no impact on the forest are of prime concern. It's possible ! The use of biomass should be emphasized as much as possible since it not only helps our Wildfire mitigation, but also the National energy problem. It's also more appealing to the N.E.P.A. (National Environmental Protection Agency), because it's cleaner than just burning in the outdoors. Also according to Forest Service studies, for every dollar spent on prevention it results in $5-7 saved on suppression costs.

Issues of noise & minimal to no impact on the forest are of prime concern. Many of the changes that are needed will have to be incremental. As the technologies & methods are developed, a larger amount of the forest can be managed with minimal impact. To make this happen the dirigible (airship) needs to be reintroduced. There are twenty-three manufacturers worldwide currently designing or in the process of building airships **(2)**.These new

dirigibles would be quiet different than the old. The only commonality is their basic shape. Even D.A.R.P.A. (Defense Advanced Research Projects Agency) is involved with airship projects. Cycloidal prop propulsion, non-conductive skins & auto G.P.S. navigation, would be some of the new innovations, such as 'Aviation Weather Decision Support System' (AWDSS). This is a detection & forecasting of wind shear experienced by aircraft while arriving wind profiler produces automatic, near continuous monitoring of the encountering wind field. This system could allow for under powered as compared to the wind forces exerted on its large surface area, to in effect move the "Titanic" airship away from icebergs of the sky.

It's possible! The use of biomass should be emphasized as much as possible since it not only helps our wildfire mitigation, but also the National energy problem. It's also more appealing to the N.E.P.A. (National Environmental Protection Agency), because it's cleaner than prescribed burns. A large demand for local available fuels (biomass residue) could be fostered if greater production numbers (resulting in lower initial costs) of multi-fuel high efficiency boilers (wood/petroleum) came to market. They exist in Europe, but need the initial cost to be reduced thru contract buying (coop type purchase) or Calif. Energy Commission (C.E.C.) rebates. This would help toward forest community energy autonomy. This biomass solution would also lead to more local jobs & other new technology solutions that could be brought to market. WDC has a more detailed knowledge of these subjects taken in this article & look forward to your participation to a solution to a growing Global problem.

**Insurance Reform & Recognition:** Demand that insurance companies recognize the wildfire problem and bring rates that support prevention (fire proof building, retro building systems, and the level of technological suppression in your region). As of 2004, my research question to people in the Home Owners Insurance Business revealed they weren't valuing innovation.

There's another category of value beyond these physical ones, A system for "Visual Resource Management" as stated by the B.L.M.(Bureau of Land Management) & the U.S.F.S. "Visual Management System". Both of these systems are putting a measurable value to aesthetics & a sanctuary value to open space. This is a REAL value as the World becomes more crowded. After all the assets have been identified & assigned a G.P.S. location, then a dollar value needs to be applied so as to evaluate the cost/benefit for fighting Wildfires.

The scale of loses from Wildfires is becoming to common with today's methods of fighting them. We can change this all too common scenario by:

Act on how response time is the real enemy. This can only happen thru technology & having ground troops take a lesser role, just as discovered by the military with the transformation of Army to Army Air Corp to Air Force as the most effective to way to win a war. Ground forces should be to maintain & cleanup after the battle is won from the air.

- Aerospace & computer tools will react to a harmful situation much faster than sole human decision makers and ground troops
- Bring tax-paid military tools (assets) into multi-role uses for fighting Wildfires. Those tools can be used 3 – 4x as much during a 24/7 need as the present tools used. In fact some of the Military tools are of a non-stop potential.
- Evolve these new tools into an iteration that allows a World service or commercial sales of them to mitigate this growing World problem, that's a function of a growing population & drought / warming climate in general.
- Recognize from a maximum efficient Wildfire mitigation response, this would also lead to tools that should be exported worldwide. This solves a World problem & becomes an asset to our overall trade deficit, which would boost an industry that was once our industrial bases "crown jewel". That was Aerospace! Which was the origin of the Computer Industry?
- Bio-Mass management & site effective building methods also play a crucial role in the long term & cost effective mitigation methods. This involves the stewardship of the U.S.F.S. & its equals, & new technology tools that are greener, which also mean that they have much better life-cycle cost.
- The use of Bio-Mass should be emphasized as much as possible since it not only helps our Wildfire mitigation, but also the National energy problem as well creating regional Cottage Industry jobs.
- To solve this World problem, we need knowledge, discussion & public involvement; to bring democratic changes that will only occur as a united group. For future knowledge or insight contact **director@wrn.solutions**.

**Final Statement:** Do we want to continue to tolerate mediocrity & let tragedies continue or get involved to move to better methods. Consider this, that the scars of Wildfires are usually felt much longer than those from other disasters which man can repair, but we can't bring a beautiful Natural setting back within our lives and often even in our children's lives.

Wildfires are among the most pervasive of all the natural disasters, especially for California. Every year Wildfires... property loss. Even in lesser burn years of 2006, there was 77,100 fire starts amounting to 9.2 million acres with a suppression costs of 2 billion plus in 2006 dollars. The trend has only become worse with: global worming, increased population, Geoengineered weather modification & antiquated fire fighting methods. The Forest Service... efforts.

It appears the fighting Wildfires has become a business for profit for to many. As long as there is a blank check for emergency fire suppression, most fires will be suppressed and Wildland fire use will be limited. Suppression costs are likely to be excessive The Forest Service is in need of serious reforms.

Fire prevention and control efforts have been a part of the work of the Forest Service from the earliest days. In 1908, the Forest Fires Emergency Act authorized the Forest Service to spend whatever necessary to combat the increasing wildfires throughout the country.

As once stated by Upton Sinclair (early 19th century author of influence), “It’s difficult to get a man to understand something when his salary depends upon his not understanding of it.” A more recent quote by Calif. Congressman Dana Rohrabacher as stated in "Wildfire" periodical, "The U.S.F.S. regulations establishing the requirements for airplane-based firefighting are obviously designed to protect the good old boys & to discourage anyone else with new approaches & new alternatives”.

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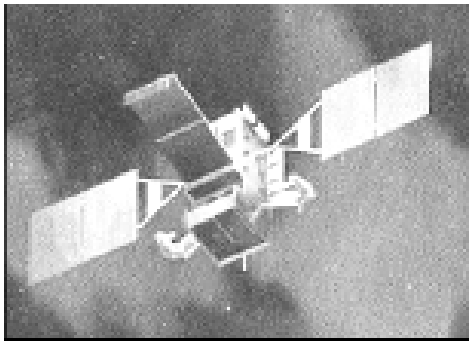
**(1)** "Remote Sensing, Technologies Teamed for Disaster Management", Space News- June 22/1997.
"An Integration of Remote Sensing, GIS, and Information Distribution for Wildfire Information Distribution for Wildfire Detection & Management", published in the American Society of Photogrammetry and Remote Sensing -- PE&RS Journal, Vol. 64, No. 10, October 1998
**(2)** https://spot.colorado.edu/~dziadeck/airship/manufacturers.htm

# AEROSPACE TOOLS that should be used

F-18 with 'buddy tanks' used as a "Regional Verification/ Douser"

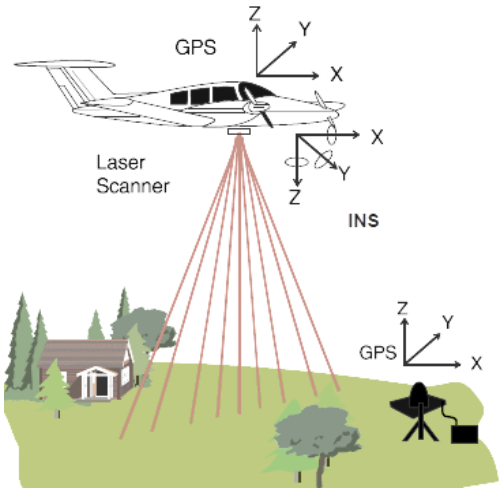


SBIRS heat seeking satellites

"Carter Copter" a hybrid gyro-copter as improvement to heavy lift helicopters

C17 used as an 'aerial tanker'

Conceptual airship for "biomass management" operations in remote areas




LiDAR data gathering survey system

For more info. see wrn.solutions. There's an established resistance to bring the appropriate changes about. Unfortunately it will take many hours of volunteer work and money for this technology input. **WRNS** (Wildfire Research Network SOLUTIONS) is a 501(c)3 non profit Institution for PUBLIC BENIFIT thru science and education.