The Aviation Use Summary (AUS): Analytics to Inform Decisions and Manage Risk

Crystal Stonesifer
Aviation Challenges

– Modern fleet brings new capabilities and missions
– Modern fire suppression environment brings different pressures and objectives
– Technology readily available to track aircraft actions
– Relationship between effectiveness and risk
– Risk transfer from ground to aviation an important consideration
  • Unintentional vs. deliberative
Federal Wildland Firefighter Fatalities (Agency and Contract; 2011-2020)

- 25% Driving
- 16% Medical Emergency
- 13% Hazard tree/Snag
- 11% Entrapment/Burnover
- 30% Aviation

Number of Aircraft Related Fatalities in Wildland Fire By Year

- 2011: 1
- 2012: 8
- 2013: 7
- 2014: 5
- 2015: 3
- 2016: 2
- 2017: 1
- 2018: 1
- 2019: 4
- 2020: 5

https://www.wildfirelessons.net/viewdocument/annual-incident-review-summaries
Aviation Costs

Data source: USFS Aviation Business Systems and NIFC

Stonesifer et al. 2021, Forests 12(8); https://doi.org/10.3390/f12081078
Soberanes Fire Learning Review

Aircraft Assignments

- VLAT
- T1-2 LAT
- T3 ME AT
- FIXED WING: ASM/AIR TAC/LEAD
- T1 HELI
- T2 HELI
- T3 HELI

Airtanker Drops

Monterrey ~ 5 mi.

Pacific Ocean

California

Map showing aircraft assignments and drops during the Soberanes Fire.
Soberanes Fire – Airtanker Drop Lines

Example inset map to highlight drop detail
Aviation and Risk Management Assistance (RMA)

- Line Officer Support
- Large or Complex Fire Support
- Strategic Risk Management
- Alignment of Tactics with Strategy
- Risk-Informed Decision-making
- Land and Resource Mgmt Objectives
- Opportunities for Beneficial Fire
- Cohesive Strategy
- Minimize Firefighter Exposure
- Line Officer Experience
- Advanced Analytics
- Trade-off Analyses
- Science Delivery

Risk Management Assistance (RMA) is designed to assist agency administrators/Line officers and incident commanders by providing access to experienced line officers, personnel skilled in risk management, fire operations, and enhanced fire analytics to improve fire management responses through a risk informed process. RMA products and personnel strengthen the ability to examine alternative strategies that better consider the exposure trade-offs, assess risk to highly valued resources and assets, and seek opportunities for realizing the beneficial effects of fire. The intent is to apply existing and emerging decision support tools coupled with risk management expertise to improve the overall effectiveness and efficiency of wildfire response.

Ordering RMA:

Further information on RMA products and delivery mechanisms are available via the RMA Dashboard and RMA SharePoint Site. With the increasing use of RMA analytics, the demand on the RMA analytics group has been substantial. PLEASE use the resources available (i.e., the Dashboard and the SharePoint site), and only request additional support if remote delivery or in-person assistance is required. Contact Julian Atsumo (303-866-8450) or Rick Stratton (rick.stratton@usda.gov) for more information.
Aviation Use Summary (AUS) Defined

- Decision support framework for managers to help ensure alignment of tactical actions with incident strategy
- Collection of user-friendly analytics – maps, tables, charts, narrative descriptions, Google Earth and GIS datasets, etc.
- Customized for user needs
- Integral part of Risk Management Assistance (RMA)
  - Comprehensive, objective, non-specialized overview
  - Aircraft (airtanker) use
  - Summary for a large incident or broader area of interest

Is This Flight Necessary? The Aviation Use Summary (AUS): A Framework for Strategic, Risk-informed Aviation Decision Support
Stonesifer et. al, 2021. Forests 12(8)

https://www.mdpi.com/1999-4907/12/8/1078
AUS Data

- Resource order data (ROSS/IROC) - interagency, all aircraft
- Aviation Business System (ABS) & Inc. Business System (IBS)
- Automated Flight Following (AFF)
- WFDSS fire behavior outputs
- Values at risk
- Boundaries
- Fuels/Slope/Terrain (LANDFIRE)
- Retardant Avoidance spatial data
- Potential Control Location (PCL)
- Suppression Difficultly Index (SDI)
- Additional Telemetry Unit (ATU) drop event data
- And others ...
AUS Process

- Requests placed via RMA dashboard
  - Informal requests create challenges
  - What are your specific needs or concerns?
  - What is your key deadline?
- Analyst coordinator (Rick Stratton) is POC
- Customized AUS produced
  - Summary of activity from incident start through end of previous day
  - Basic to complex range of products
  - Drop data inclusion or summary of missing data is foundational
- User feedback is key

https://wfmrda.nwcg.gov/rma
Pine Gulch Fire (COGRD-000307)
Aviation Use Summary (AUS), 8/15/20

- Aircraft assignment and use data summarized from incident start (7/31) through 8/14/20
- Crystal Stonesifer, crystal.s.stonesifer@usda.gov
Pine Gulch Fire (COGRD-000307) airtanker drop activity overview map, drops by date, 7/31 – 8/14/20*

*does not reflect drop activity from SEATs, MAFFs or Colorado state contract airtankers

52 cumulative incident drops from USFS contract LATs, most from the 1st week
• 45 full and 6 split loads
• No VLAT drop records

USFS airtankers fully represented in data but potential missing drop data from Colorado contract aircraft, MAFFs DOI SEATs, and all Agency and partner helicopters

Retardant drop statistics calculated from ATU:
• ~10.3 miles
• ~139,500 gallons

Data through 8/14

<table>
<thead>
<tr>
<th>Drop Date</th>
<th>Full</th>
<th>Split</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/1</td>
<td>5</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>8/2</td>
<td>18</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>8/3</td>
<td>14</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>8/4</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>8/5</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>8/9</td>
<td>3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
<td>6</td>
<td>52</td>
</tr>
</tbody>
</table>
Pine Gulch Fire (COGRD-000307) airtanker drop activity map, 080520_2130 perimeter

*does not reflect drop activity from SEATs, MAFFs or Colorado state contract airtankers

49 of the 52 incident drop records through 8/14 occurred on 8/5 or earlier

DISCLAIMER: Drop lines are derived from GPS coordinates for door opening and closing events recorded by Additional Telemetry Units (ATU) on USFS contract aircraft. Mapping intent is for strategic scale overview. Maps may contain uncleaned drop data and are subject to revision. Data are not fully representative of all aircraft activities and only show a proportion of total incident use. crystal.s.stonesifer@usda.gov

Data through 8/14
Pine Gulch Fire (COGRD-000307) USFS airtanker drop activity* (7/31 – 8/14) and Potential Control Locations (PCL)

*does not reflect drop activity from SEATs, MAFFs, or Colorado state contract airtankers

DISCLAIMER: Drop lines are derived from GPS coordinates for door opening and closing events recorded by Additional Telemetry Units (ATU) on USFS contract aircraft. Mapping intent is for strategic scale overview. Maps may contain uncleaned drop data and are subject to revision. Data are not fully representative of all aircraft activities and only show a proportion of total incident use. crystal.s.stonesifer@usda.gov

Data through 8/14
Additional AUS Analytics

Airtanker Drop Lines and:

Potential Control Locations (PCL)  
Suppression Difficulty Index (SDI)

O'Connor et al., 2017; IJWF; https://doi.org/10.1071/WF16135
Rodriguez y Silva et al. 2020; IJWF; https://doi.org/10.1071/WF19042

Stonesifer et al. 2021, Forests 12(8); https://doi.org/10.3390/f12081078
Resource Assignment Timeline
<table>
<thead>
<tr>
<th>Burning Period Category</th>
<th>Slope Steepness Category</th>
<th>Proportion by slope category</th>
<th>Severe Fire Danger Index</th>
<th>Slope Steepness Category</th>
<th>Grass</th>
<th>Brush</th>
<th>Timber</th>
<th>Proportion by slope category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1200</td>
<td>&lt; 5%</td>
<td>0.0% 0.0% 0.0%</td>
<td>LOW</td>
<td>LOW</td>
<td>0.1% 0.0% 0.0%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1200 - 1500</td>
<td>&lt; 5%</td>
<td>0.0% 0.0% 0.0%</td>
<td>MODERATE</td>
<td>LOW</td>
<td>0.2% 0.2% 0.1%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1500 - 1800</td>
<td>&lt; 5%</td>
<td>0.0% 0.0% 0.0%</td>
<td>HIGH</td>
<td>MODERATE</td>
<td>1.5% 0.8% 0.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After 1800</td>
<td>&lt; 5%</td>
<td>0.0% 0.0% 0.0%</td>
<td>VERY HIGH</td>
<td>MODERATE</td>
<td>2.7% 1.3% 1.6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 - 15%</td>
<td>0.0% 0.0% 0.0%</td>
<td>SEVERE</td>
<td>MODERATE</td>
<td>2.9% 1.1% 2.5%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 - 25%</td>
<td>0.0% 0.0% 0.0%</td>
<td></td>
<td>HIGH</td>
<td>2.0% 0.5% 1.5%</td>
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</tr>
<tr>
<td></td>
<td>&gt; 25%</td>
<td>0.0% 0.0% 0.0%</td>
<td></td>
<td>VERY HIGH</td>
<td>6.9% 1.7% 20.7%</td>
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<tr>
<td></td>
<td></td>
<td>1.7% 0.0% 3.4%</td>
<td></td>
<td>SEVERE</td>
<td>11.2% 0.0% 29.3%</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Proportion by Fuel Type</td>
<td></td>
<td>25.9% 3.4% 70.7%</td>
<td></td>
<td>Proportion by Fuel Type</td>
<td>25.9% 3.4% 70.7%</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
## Aviation: Daily Strategy Check-in

<table>
<thead>
<tr>
<th># Aircraft</th>
<th>Flight hours</th>
<th>Gallons retardant/gallons water</th>
<th># Drops (fixed wing only)</th>
<th>Tactical mission e.g., direct, indirect, support crews, pre-treat, check, contingency</th>
<th>Key effectiveness notes from ground (DIVS/Crews feedback and/or HMGB feedback from pilots - What could we do differently?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2/3 Helicopters</td>
<td></td>
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</tr>
<tr>
<td>T1 Helicopters</td>
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<tr>
<td>Scoopers</td>
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<tr>
<td>T3/4 Airtankers</td>
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<tr>
<td>LATS</td>
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<tr>
<td>VLATS</td>
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<tr>
<td><strong>Cumulative incident total</strong></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Aircraft</th>
<th>Strategic objectives</th>
<th>Anticipated conditions of drops (time, location, wx, fire behavior, fuels, etc.)</th>
<th>Contingency Conditions/situations requiring additional resource commitments</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2/3 Helicopters</td>
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<tr>
<td>VLATS</td>
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</tr>
</tbody>
</table>

Incident name: __________________ Incident number: ______________ Date/range activity summarized for: __________

Incident Commander: ________________________ Agency Administrator: __________________________ Date: _______
Established AUS Use Cases

– In development and use since 2017
– > 70 different fires or broader areas throughout the western US
  • Sometimes, multiple requests from single incidents
– Single incidents, complexes, forests, regions ...
– Post-fire inquiries
  • Learning reviews
  • Retardant application reporting
– Themes:
  • Cost-apportionment
  • Misapplication tracking
  • Effectiveness
  • Location and volume of use
  • Public communication tool
Starting mid-June, we will post summary aviation use information by GACC weekly to this site. This information will contain drop locations for reporting air tankers and helicopters. Users will be able to download a zipped ESRI shapefile and use it in a GIS, Google Earth, or the RMA Dashboard. Special thanks to Crystal Stonesifer.
Future of AUS

- Near real-time delivery of national scale data
- Automation of analytics
- Current availability in EGP?
- Complete feedback loop, not just passive data delivery

![Diagram of objectives, plan, use, and outcome]

**DROP SUMMARY MAP**

**Select aircraft type:** Dropdown list of aircraft categories (heli by type, vlat, lat, scooper)

**Edit date range:**
- Between: 1/1/20
- and: 12/31/20

**Select spatial extent other than map extent (optional):** Dropdown list of active incidents with perimeters, regions, GACC, and states

**Radio boxes to select products to display? Some analytics will be more relevant and certain scales.**
Questions?

Contact: crystal.s.stonesifer@usda.gov

Aviation Use Summary paper: https://www.mdpi.com/1999-4907/12/8/1078

Risk Management Assistance Dashboard: https://wfmrda.nwcg.gov/rma

Risk Management Assistance paper: https://www.mdpi.com/1999-4907/12/10/1407

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