Improving Shrub and Grass Fuel Maps using Remotely Sensed Data to Support Fire Risk Assessments

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Partner: LANDFIRE

Project Summary: Shrub and grassland ecosystems are prone to fire events, but we have not been able to characterize them very well. Our primary objectives are to: (1) Improve upon shrub and grassland mapping for fire applications; (2) Develop intra-seasonal fuel data sets in shrub and grassland areas; (3) Determine how improvements in shrub and grassland data layers improve fire behavior model results.

Earth Observations applied: We are using a combination of Landsat and MODIS data, augmented with data collected in the field.
Purpose and Objective

Shrub and grassland ecosystems in the western United States are very prone to fire events, yet available data for assessing fire risk in these areas are inadequate. It is clear that we need to develop better understanding of the conditions that lead wildland fire in shrub and grasslands. Our primary objectives are to (1) improve upon shrub and grassland mapping for fire applications; (2) Develop intraseasonal fuel data sets in shrub and grassland areas using a combination of Landsat and MODIS data, and (3) Determine the degree that improvements in shrub and grassland data layers will alter and improve fire model result structures.

Societal Benefit Area(s): Disasters, Ecosystems, Climate
Geographic Focus: Western US

Targeted End-Users: Fire Managers, LANDFIRE

Approach

We are using optical remote sensing to characterize intrannual and inter-annual fuel conditions in shrub and grasslands within the Great Basin of the western US. The differentials in greenness between spring and late summer are very indicative of fire risk, with higher differentials equating to higher risk. We are using STARFM modeling to help integrate the high spatial resolution data of Landsat (30 m) with the high temporal frequency data from MODIS. Satellite-derived NDVI data will be converted to biomass, which is desired by many in the fire community, and this will provide information on burnable fuels. Field data are being collected and analyzed to help develop the biomass data layers, and ecological and biogeochemical modeling will be used to assess the fuel products that are developed. Our primary target groups of this work include LANDFIRE and other fire management and assessment groups.

Key Milestones

<table>
<thead>
<tr>
<th>Milestone Statement</th>
<th>Date</th>
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<tr>
<td>Conduct data mining research to determine relationship among remote sensing data, fires, and climate variables in Great Basin</td>
<td>09/15</td>
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<tr>
<td>Collect biomass data (over two field seasons) and integrate with remotely sensed data to generate biomass estimates for the Great Basin</td>
<td>10/16</td>
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<tr>
<td>Improve upon STARFM modeling to facilitate integration of MODIS and Landsat data for generating seasonal fuel estimates for the Great Basin</td>
<td>09/16</td>
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<tr>
<td>Operationally generate western US shrub and grassland seasonal fuel assessments</td>
<td>09/17</td>
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ARL Start = 1  
ARL Most Recent = 5  
ARL Goal = 9
Biggest Achievement or Advancement to Date

Early spring Landsat 8 (StarFM), 2015

May Mosaic; Great Basin

Close-up of area in blue box to left
Biggest Achievement or Advancement to Date

Spring Landsat 8 (StarFM), 2015

June Mosaic; Great Basin

Close-up of area in blue box to left
Biggest Achievement or Advancement to Date

August Mosaic; Great Basin

This last mosaic-merge took fewer than two days to develop.
Biggest Achievement or Advancement to Date

Grass and shrub conditions

Red = High greenness
Orange = Medium greenness
Yellow = Low greenness

Early spring NDVI class, 2015
Biggest Achievement or Advancement to Date

Spring NDVI class, 2015

Grass and shrub conditions
- Red = High greenness
- Orange = Medium greenness
- Yellow = Low greenness
Grass and shrub conditions
Red = High greenness
Orange = Medium greenness
Yellow = Low greenness

Summer NDVI class, 2015

Biggest Achievement or Advancement to Date
Challenges: Great Mosaic Merges! But now what?

Now that we can generate the image mosaics (and do so efficiently, which has been a challenge unto itself!), how do we convert this information into data relevant to the fire community?

Answer: Through the acquisition of field information by students (photo from during 2015 field season)
Partner Interactions

• We have had discussions with LANDFIRE’s Fuel Team, and have a good indication of the types of data layers that they can use.

• We have had discussions with LANDFIRE Management, and the business leads are aware of our progress as of November 2015.

• Just recently we arrived at the point whereby we can generate the requisite merged Landsat-MODIS mosaics necessary for conducting the next steps, and are in the process of converting to data useable by the Fuel Team.

• THE BALL IS CURRENTLY IN OUR COURT (Jumped the gun on the sports analogy!)
Summary of Challenges; Problems; Objective Analysis

1) While we have demonstrated that we can generate data depicting changes in grass/shrub condition, need to convert to useable units by Fuels Team (solution: more field data; will be collecting more during upcoming field season)

2) We have been operating under the “If you build it, they will come” mentality. We are close to having “built it”, so now we need to convince LANDFIRE Fuel Team that this offers them a viable solution (solution: communication)

Summary of Positive Progress

1) Much progress has been made with operationalizing the use of STARFM. We can generate products “quickly”. A “user’s manual” has been developed, which will help facilitate its use.

2) We have one year’s field data acquisitions completed. We will be able to use this information to calibrate our data sets.

3) Incremental progress has been made in improving “Rangeland Vegetation Simulator,” which will help us to quantify and assess fuels.

Overall Assessment

We are making good progress. This upcoming field season will be important.
Record rainfall triggered fuel model changes
To GR2/GS2
From GR1/GS1:
Ash Creek fire broke out > 350,000ac burned

Temporal dynamics of fine fuels drive fire activity! In rangelands
Fire behavior and fire size increase dramatically with wet weather. The LANDFIRE products should be updated to reflect these fuel conditions.
Future goals.

1) Field collection in FY 2016 (no anticipated problems)

2) Generate spring 2016 Great Basin Landsat-MODIS merges so that Fuels Team has the data for the upcoming field season (no anticipated problems)

3) Develop algorithms to convert imagery to biomass/cover (No major anticipated problems, but there will likely be precision issues)

More on future goals.

4) Integrate our information with the Rangeland Vegetation Simulator

5) Integrate work with that of LANDFIRE (this may be the biggest challenge that we face at this point).

Help from NASA management: Stay tuned. Much of the success of the project hinges on the next ½ year, and our ability to work well with LANDFIRE management and team.

Budget progress and future plans to spend down the funding by year.

\[ ARL_{\text{Start}} = 1 \quad ARL_{\text{Most Recent}} = 5 \text{ (nearing 6)} \quad ARL_{\text{Goal}} = 9 \]

Note: Whatever problems that we may or may not have with this project, these will not be due to funding issues. I do worry about the long-term viability of MODIS. Will VIIRS be an effective substitute?
Relevant Publications, Awards, Accomplishments

• We have been in “model development, “code refinement”, and “data generation and analysis” modes this past year.
• Post-Salt Lake City Science Team Meeting Presentations:
• Journal papers are anticipated, but these are in the “TBD” category.
• Major accomplishments include:
  – STARFM operationalization (large area mosaics can be generated efficiently)
  – Field data acquisition and analysis
  – Rangeland Vegetation Simulator refinement
Hua Shi

These are the two team members who have made the early parts of this project a success. Hua has the responsibility of being chief “data cruncher” and analyst, and Ray has been the “code guy,” responsible for running and improving STARFM. Both have been resourceful and dedicated team members, and they get a gold star!
Status of the Project

• So far, we are mostly on target with what we are trying to accomplish
• But….We are reaching some critical junctures in the project (e.g. upcoming field season, upcoming fire season, modeling activities anticipated, will what we are doing be adopted by LANDFIRE?....)

You’ve got to be very careful if you don’t know where you’re going, because you might not get there!

Yogi Berra

(We are trying to be very careful, and I think that we know where we’re going!)