



The Cost-Effectiveness of Satellite Earth Observations to Inform a Post-Wildfire Response

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How do satellite data applications yield socioeconomically-meaningful benefits?



Benefits =

Outcomes for people and the environment

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Outcomes for people and the environment



Burn Area Emergency Response (BAER) Assessment Process

Assembles a team of experts who identify, map, and field verify soil burn severity (SBS) for a wildfire

- BAER team recommends mitigation measures to help offset potential threats from secondary impacts post-fire. Use the information to support determination of SBS.
- Understanding SBS helps prioritize post-wildfire response activities.
- Assessment protocol leads to the development of a post-wildfire emergency stabilization plan.

BAER process includes:

- Collecting satellite imagery
- Creating a Burned Area Reflectance Classifications (BARC) map for the BAER team
- Classifying soil burn severity with field validation
- Defining the emergency in the burned region and implementing treatments



Analysis summary

Retrospective analysis focuses on the **cost savings realized with Landsat imagery**

- Reduces need for expenditures for commercial imagery or helicopters as the primary tool for data collection.

Cases:

- **Reference** - Current BAER assessment process is dependent on Landsat imagery.
- **Counterfactual** - Landsat imagery is unavailable; instead data input is collected from helicopters and/or commercial satellite imagery.

Example: 2013 Elk Complex Fire, Boise National Forest, Idaho that burned 130,960 ac (73,232 ha).

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Analysis summary

Costs:

BARC production cost: Analyst labor, hardware, software, satellite imagery

BAER assessment cost: Team management and coordination, analyst labor, field work, GIS and IT for SBS map, helicopter rental and operations.

Quantifying VOI:

Incident savings: Application in a specific decision context. Landsat imagery reduces incident operational costs for production of a BARC map.

Program savings: Estimated savings of using Landsat imagery for BARC map production and BAER response over a 5-year period.

Assumptions:

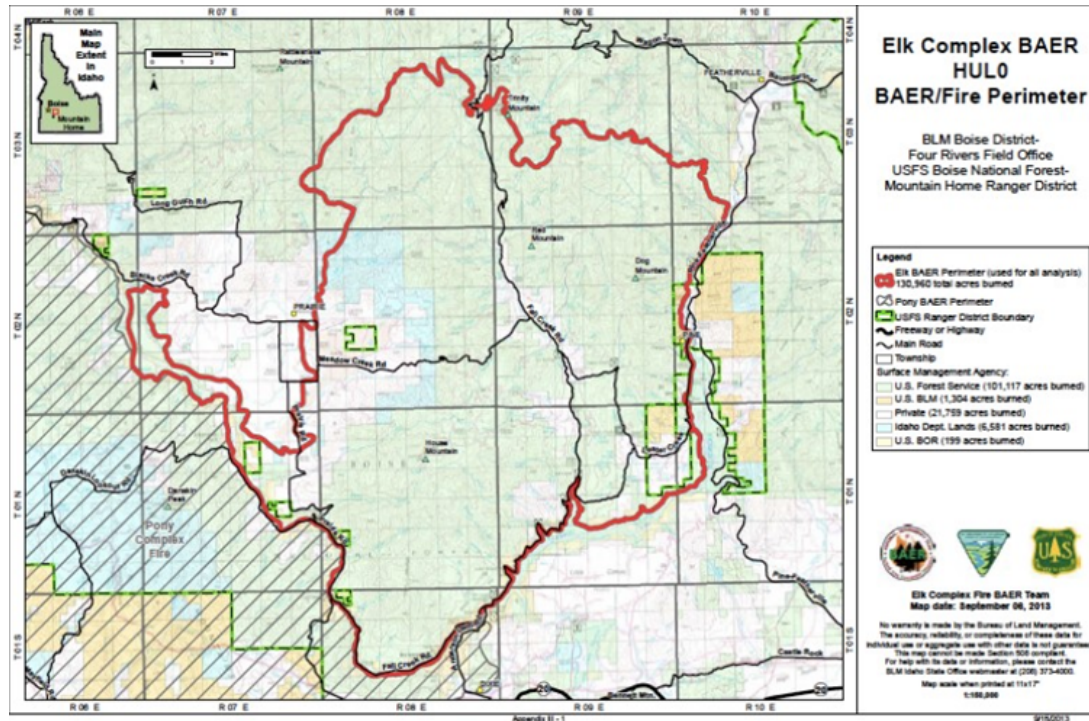
- 150 incident requests per year for BARC products.
- Wildfires are same size/complexity as Elk Complex.
- Two scenes acquired (pre- and post-fire) for a BARC request.
- No significant economies of scale to savings in aggregating from an incident request to annual rate.
- Hardware is a 1-time upfront investment and operating costs occur in years 1 – 5.
- Discount rate is 3.5%.
- Cost savings initiate in first year after investment.

Although helicopters are used as the primary means for imagery in one of the counterfactual cases, they are employed for a variety of purposes in both the reference and counterfactual cases with varying intensities by a BAER team to generate burn severity classifications.

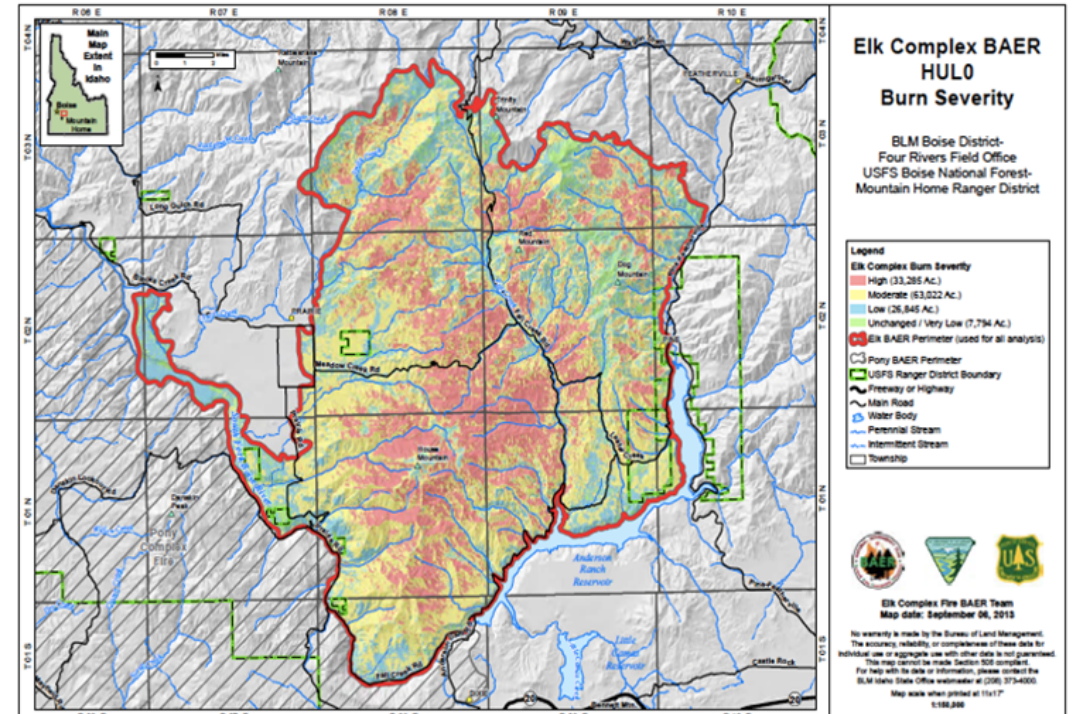


2013 Elk Fire: Boise National Forest, Idaho

Pre-fire map

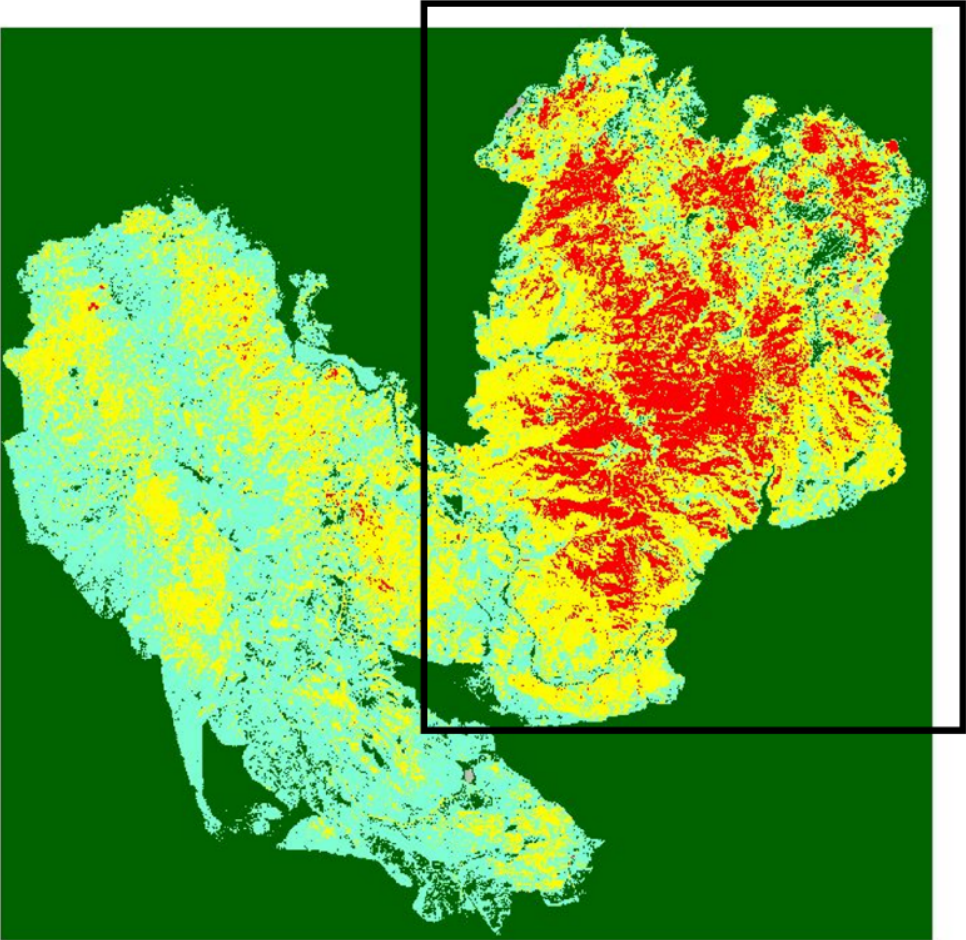
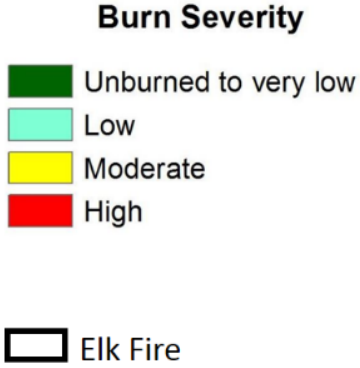


Burn severity map



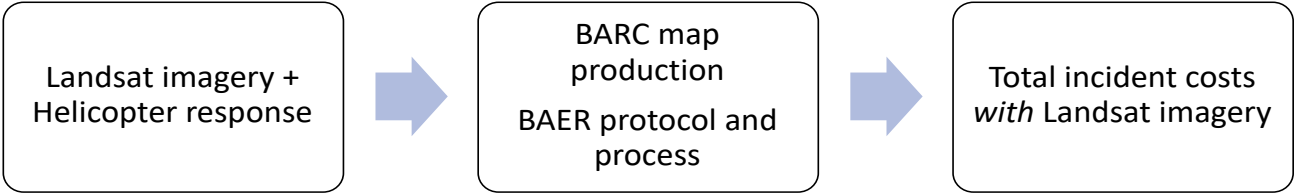
2013 Elk Complex Fire: Boise National Forest, Idaho

Burned Area Reflectance Classification (BARC) map based on Landsat imagery

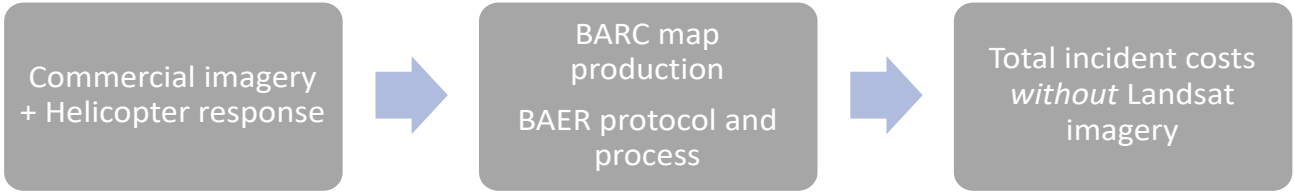


Calculating cost savings

Reference Case



Counterfactual Case A



Counterfactual Case B

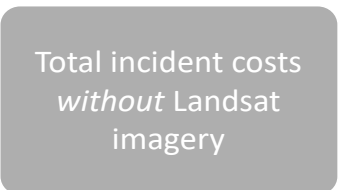


Cost savings under Counterfactual Case A

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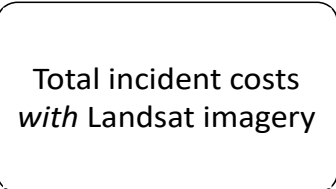


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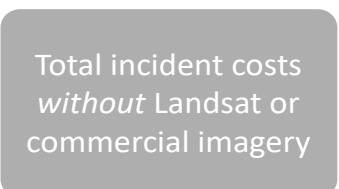


Cost savings under Counterfactual Case B

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Results: Counterfactual Case A

Costs savings from using **commercial imagery** to prioritize post-wildfire response activities for the 2013 Elk Fire

- **Existing information:** Helicopters
- **New information:** Helicopters and commercial imagery
- **Estimated benefit:**
 - **Cost savings per incident:** Over **\$11,000**
 - **Cost savings over 5 years:** About **\$8 million** (net present value at 3.5% discount rate)

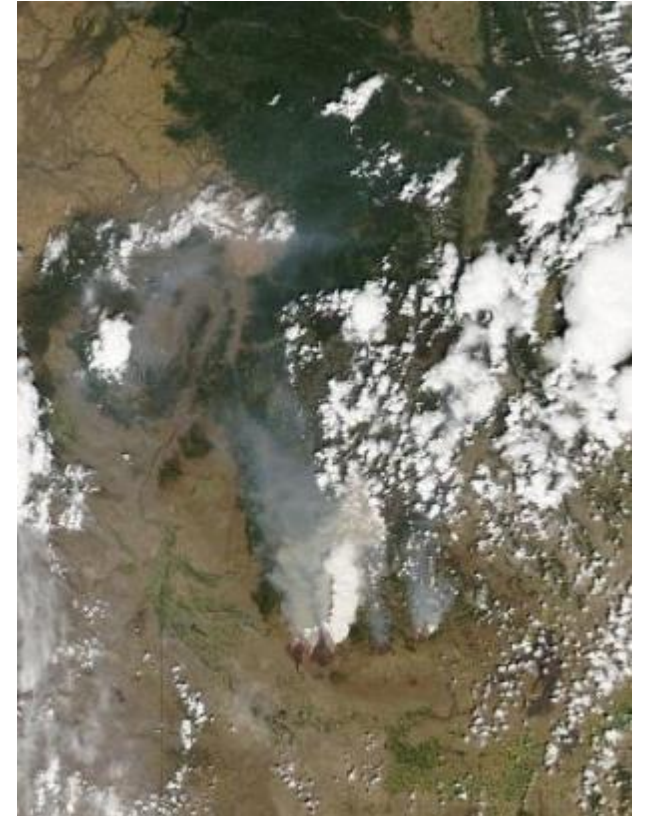


Image courtesy of Jeff Schmalz, LANCE/EOSDIS MODIS Rapid Response Team at NASA GSFC: Central Idaho, August 10, 2013

Acknowledgements: This research was supported through NASA cooperative agreement number NNX17AD26A with RFF to estimate the value of information obtained from satellite-based remote sensing.



Results: Counterfactual Case B

Costs savings from using **Landsat imagery** to prioritize post-wildfire response activities for the 2013 Elk Fire

- **Existing information:** Helicopters
- **New information:** Helicopters and Landsat imagery
- **Estimated benefit:**
 - **Cost savings per incident:** Over **\$51,000**
 - **Cost savings over 5 years:** About **\$35 million** (net present value at 3.5% discount rate)

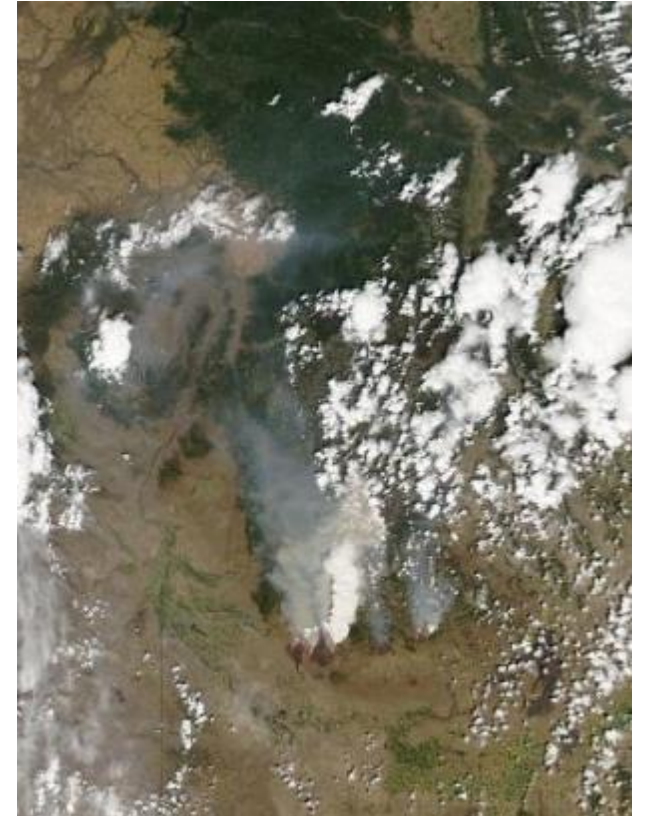


Image courtesy of Jeff Schmaltz, LANCE/EOSDIS MODIS Rapid Response Team at NASA GSFC: Central Idaho, August 10, 2013

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A five-year cooperative agreement between RFF and NASA



Collaborating with the Earth science community to quantify and communicate how satellite information benefits people and the environment when we use it to make decisions



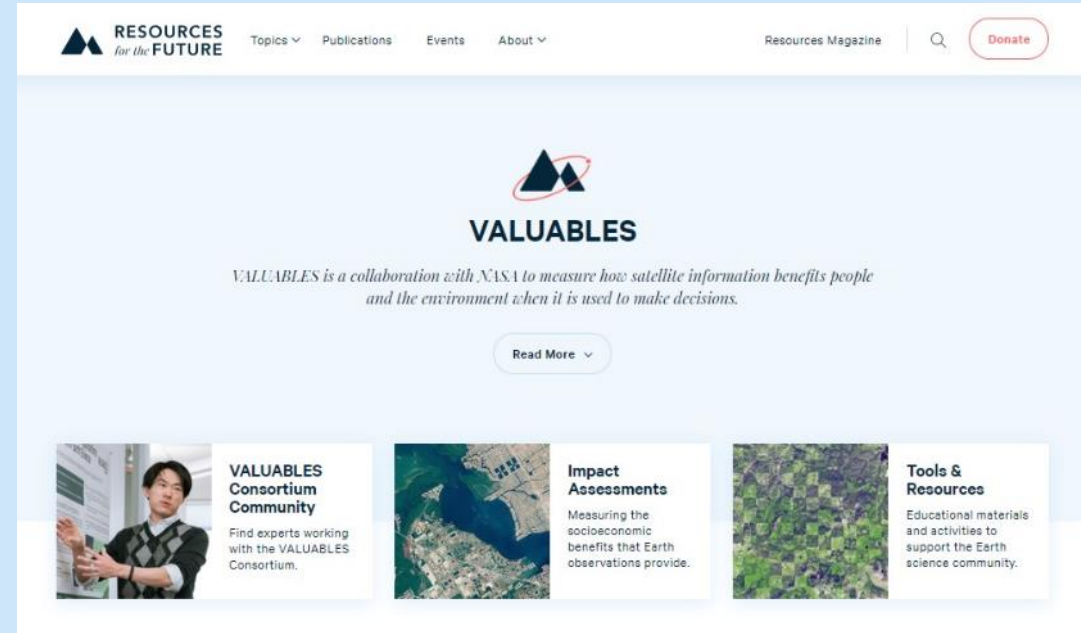


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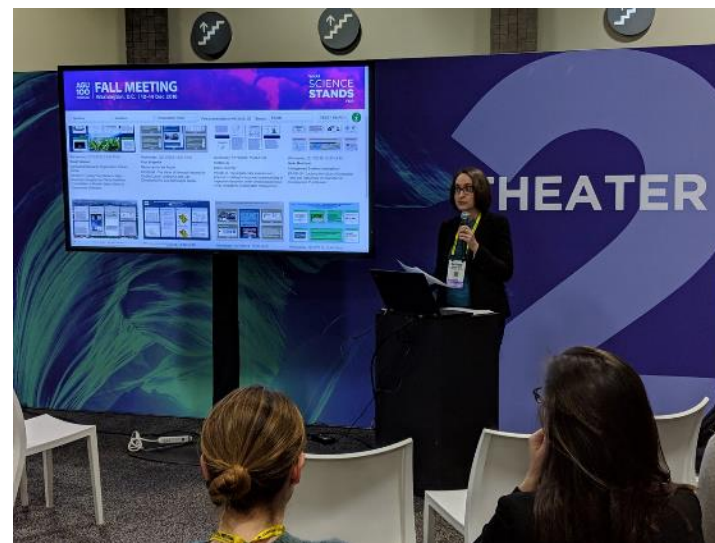
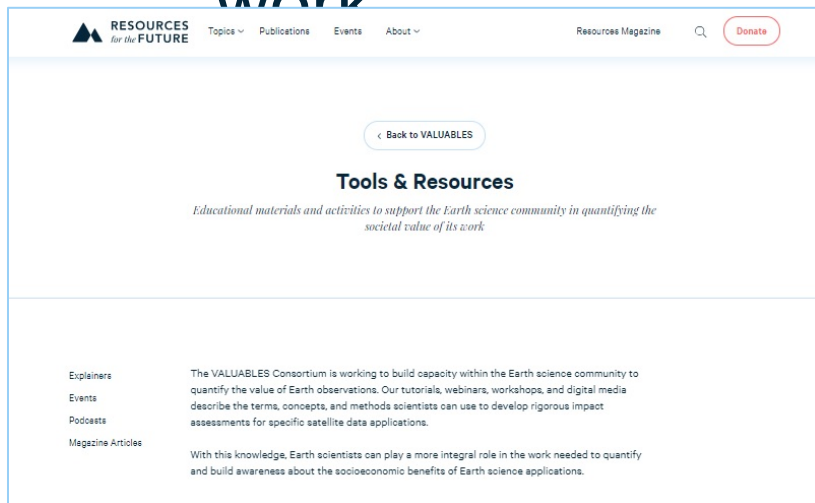
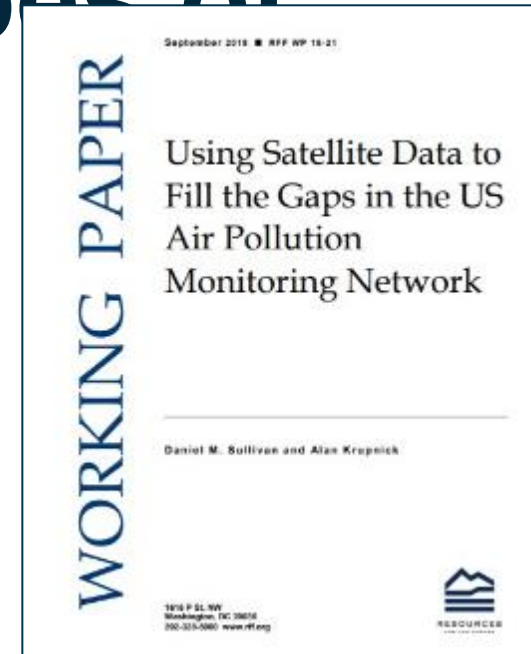
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VALUABLES focuses on two types of activities

1. Conducting **impact assessments**
2. Developing **educational materials and activities** to build capacity within the Earth science community to quantify the value of its work



Impact Assessments

Measuring the socioeconomic benefits that Earth observations provide when people use them to make decisions

