The NASA Earth Science Division supports basic and applied research on the Earth system and its processes.

Primary efforts are to characterize, understand, and improve predictions of the Earth system.

In parallel with research, NASA pursues innovative and practical uses of Earth science data and results to inform and support decisions of government, business, and civil society.
The national strategy outlined here has as its overarching objective a program of scientific discovery and development of applications that will enhance economic competitiveness, protect life and property, and assist in the stewardship of the planet for this and future generations.

Earth Science Decadal Survey
NASA Earth Science Division

Michael Freilich, Director
Peg Luce, Deputy Director
Pat Jacobberger-Jellison, Inter-Org Coordination

Research
Jack Kaye, Director
Lucia Tsaoussi, Deputy

Flight Programs
 Steve Volz, Director
Steve Neeck, Deputy
(includes Data Systems)

Applied Sciences
Lawrence Friedl, Director

Earth Science Technology Office
 George Komar, Director
Robert Bauer, Deputy
(@ GSFC)

as of Jan. 2012
*IPA or Contractor; ^F. Lindsay and N. Searby on detail.

Additional people serve as Deputy Program Applications leads for satellite missions.
Applications Areas

Emphasis in 4 Applications Areas

Health & Air Quality

Water Resources

Disasters

Ecological Forecasting

Support opportunities in 5 additional areas

Agriculture

Climate

Weather

Energy

Oceans
Observations to Knowledge Products

“from photons to electrons to neurons”
Applied Sciences Wildland Fire Element

Research Opportunities in Space and Earth Sciences

ROSES-2011

A.35 Wildland Fires
The objective of the Wildfire solicitation was to select applications and applied research projects to improve decision-making activities and actions on topics related to wildland fires, such as wildfires, rangeland fires, and prescribed fires.

Successful projects must advance organizations’ use and application of Earth observations in analysis and assessments, management strategies and actions, business practices, and policy analysis and decisions associated with wildland fires.
## NASA Funding (FY12-16)

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Amount of NASA Funding (FY12-16)</td>
<td>$6 M total</td>
</tr>
<tr>
<td></td>
<td>(Stage 1: ~1.5M; Stage 2: ~4.5M)</td>
</tr>
<tr>
<td>Anticipated Number of Stage 1 Awards</td>
<td>9-13 projects</td>
</tr>
<tr>
<td>Expected Range of Stage 1 Award per project</td>
<td>$120K - $170K</td>
</tr>
<tr>
<td>Period of Performance (Stage 1)</td>
<td>1 year</td>
</tr>
<tr>
<td>Expected Project Start Date (Stage 1)</td>
<td>6 months after proposal due date.</td>
</tr>
<tr>
<td>Contributions from Partner Organizations (Stage 1)</td>
<td>Strongly encouraged. However, partner funding does not count toward funding level guidelines.</td>
</tr>
<tr>
<td>Anticipated Number of Stage 2 Awards</td>
<td>4-6 projects</td>
</tr>
<tr>
<td>Expected Range of Stage 2 Awards per project (NASA funding)</td>
<td>$275K - $450K</td>
</tr>
<tr>
<td></td>
<td>(per annum funding scenarios depend on partnerships/cost sharing levels)</td>
</tr>
<tr>
<td>Period of Performance (Stage 2)</td>
<td>3 years</td>
</tr>
<tr>
<td>Expected Project Start Date (Stage 2)</td>
<td>18-20 months after proposal due date</td>
</tr>
<tr>
<td>Contributions from Partner Organizations (Stage 2)</td>
<td>Transition plan with resource commitments from partner organizations is expected</td>
</tr>
</tbody>
</table>
Applied Sciences Program
ROSES-2011: A.35 Wildland Fires

Improve decision-making activities and actions on topics related to wildland fires, such as wildfires, rangeland fires, and prescribed fires.

SOLICITATION OBJECTIVES

DEVELOP A TWO-PHASE APPROACH

PHASE 1: FEASIBILITY -
• Develop baseline, fire-related applications tools, information, models, or technologies;
• Early partnership engagement

PHASE 2: IMPLEMENTATION -
• Transitioning feasible, beneficial applications to an operational status with the partner organization and/or end users.
• Focuses investments on projects with high-reward potential.
• Prioritizes partners with commitment to adopting project results.

RESULTS
Feasibility-to-Decision Support Projects

A two-stage approach to identify more high-reward projects with strong commitment by partner organizations. **Start with multiple feasibility studies** of possible applications ideas. After a year, the Program selects a subset of successful studies to pursue as **in-depth applications projects**.

Approach generates numerous applications ideas and focuses investments on those with high-reward potential.

Approach prioritizes partners’ “skin-in-the-game” to increase their involvement in project and commitment to adopting the project results.

<table>
<thead>
<tr>
<th>Year</th>
<th>Stage</th>
<th>Activity</th>
<th>NASA Share</th>
<th>Partner Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>Feasibility</td>
<td>Prove out application potential</td>
<td>100%</td>
<td>Optional</td>
</tr>
<tr>
<td>Year 2</td>
<td>Decision Support</td>
<td>Develop application</td>
<td>~80%</td>
<td>~20%</td>
</tr>
<tr>
<td>Year 3</td>
<td>Decision Support</td>
<td>Continue development</td>
<td>~60-70%</td>
<td>~30-40%</td>
</tr>
<tr>
<td>Year 4</td>
<td>Decision Support</td>
<td>Complete application and transition</td>
<td>~30-40%</td>
<td>~60-70%</td>
</tr>
</tbody>
</table>
Applications Readiness Levels (ARL)

9. Approved, Operational Deployment and Use in Decision Making
8. Application Completed and Qualified
7. Application Prototype in Partners’ Decision Making
6. Demonstrate in Relevant Environment
5. Validation in Relevant Environment
4. Initial Integration and Verification
3. Proof of Application Concept
2. Application Concept
1. Basic Research

Partner Demonstration and Transition

Discovery and Feasibility
Development, Test, and Validation
Phase 1 Projects: Feasibility Stage

RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery

Daily Forecasts of Wildland Fire Impacts on Air Quality in the Pacific Northwest: Enhancing the Air Indicator Report for Public Awareness and Community Tracking (AIRPACT) Decision Support System

Utilization of Multi-Sensor Active Fire Detections to Map Fires in the US. The Future of Monitoring Trends in Burn Severity

Enhanced Wildland Fire Management Decision Support Using Lidar-Infused LANDFIRE Data

Enhancing Wildland Fire Decision Support and Warning Systems

Applications of satellite measurements to improve prescribed fire management

Improving national shrub and grass fuel maps using remotely sensed data and biogeochemical modeling to support fire risk assessments

Improving agricultural and wildland fire source emission products and access to information for atmospheric science and smoke modeling applications

Linking remote sensing and process-based hydrological models to increase understanding of wildfire effects on watersheds and improve post-fire remediation efforts.

Classification of Whitebark Pine and Spruce-fir Forests to Improve Wildland Fire Decision Support Tools in the USFS Northern Region

A Prototype System for Predicting Insect and Climate-Induced Impacts On Fire Hazard in Complex Terrain

An integrated forest and fire monitoring and forecasting system for improved forest management in the tropics

Wildland Fire Behavior and Risk Prediction

Wildfire risk and treatment effectiveness of protecting highly valued resources and assets with fuels management

Development of New Geospatial Tools for Wildland Fire Management and Risk Reduction

AFTEERS: Automated Fuels Treatment Effectiveness Evaluation Using Remote-Sensing Information

Development and application of spatially refined remote sensing active fire data sets in support of fire monitoring, management and planning
Key Questions for Evaluation

Is it feasible?
Is it valuable?
Is there commitment?

A successful project needs to be technically achievable, useful, and wanted.
# Phase II Projects: Implementation Stage

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holden, Zachary</td>
<td>USDA FS Rocky Mountain Research Station</td>
<td>A Prototype System for Predicting Insect and Climate-Induced Impacts On Fire Hazard in Complex Terrain</td>
</tr>
<tr>
<td>Howard, Stephen</td>
<td>USGS-EROS</td>
<td>Utilization of Multi-Sensor Active Fire Detections to Map Fires in the US. The Future of Monitoring Trends in Burn Severity (MTBS)</td>
</tr>
<tr>
<td>Miller, Mary Ellen</td>
<td>Michigan Tech</td>
<td>Linking remote sensing and process-based hydrological models to increase understanding of wildfire effects on watersheds and improve post-fire remediation efforts.</td>
</tr>
<tr>
<td>Peterson, Birgit</td>
<td>USGS EROS Center</td>
<td>Enhanced Wildland Fire Management Decision Support Using Lidar-Infused LANDFIRE Data</td>
</tr>
<tr>
<td>Schranz, Sher</td>
<td>Colorado State University</td>
<td>Wildland Fire Behavior and Risk Prediction</td>
</tr>
<tr>
<td>Schroeder, Wilfrid</td>
<td>University of Maryland</td>
<td>Development and application of spatially refined remote sensing active fire data sets in support of fire monitoring, management and planning</td>
</tr>
<tr>
<td>Tabor, Karyn</td>
<td>Conservation International</td>
<td>An integrated forest and fire monitoring and forecasting system for improved forest management in the tropics</td>
</tr>
<tr>
<td>Vogelmann, James</td>
<td>National Center for Earth Resources Observation and Science</td>
<td>Improving national shrub and grass fuel maps using remotely sensed data and biogeochemical modeling to support fire risk assessments</td>
</tr>
<tr>
<td>Weber, Keith</td>
<td>Idaho State University</td>
<td>RECOVER: Rehabilitation Capability Convergence for Ecosystem Recovery</td>
</tr>
</tbody>
</table>
NASA AMS Sensor to USFS Fire Operations

- NASA Autonomous Modular Sensor (AMS) transferred to the USFS National Infrared Operations (NIROPS) and USFS Remote Sensing Applications Center (RSAC) for operational support to fire and other research / applications needs.
- AMS installed on a USFS Cessna Citation jet (FY2013); 2013: Flew a series of missions in support of data collection for partners in USDA Ag Research and the USGS Water Quality. 2014: AMS flown over spring 2014 wildfires (SW US) to support Incident Teams with R/T data.
- USFS funds engineering staff support (from NASA-Ames) for AMS SW / HW and calibrations.

http://nirops.fs.fed.us/ams/
NASA Wildfire Efforts: A Seat at the Table.....

NASA ASP has a seat at a number of different tables, national and international committees task forces, and forum with a focus on wildfires. These include:

- Group on Earth Observations (GEO), Global Wildfire Information System (GWIS);
- National Science & Technology Council (NSTC) Subcommittee on Disaster Reduction (SDR) Wildland Fire Science and Technology Task Force (WFST TF);
- Interagency Arctic Research Policy Committee (IARPC); Wildfire Implementation Team (WIT); Develop white paper on fire imaging assets;
- NRC, Div. of Earth & Life Sciences, Wildfire Study Team;
- Technical Organization Committee of ISRSE 36, Berlin, Germany; organizing sessions on Wildfire Observations and Systems.
- Pecora 19; Organized Special Session on NASA ASP – Wildfire program;
- IUFRO World Congress 2014, NASA sponsor and vendor display;
- Exploring joint solicitation with Joint Fire Science Program (JFSP);
<table>
<thead>
<tr>
<th>INSTRUMENT</th>
<th>RESPONSIBLE AGENCY</th>
<th>SYSTEM</th>
<th>VIABLE MWIR CHANNELS</th>
<th>SATURATION TEMPERATURE</th>
<th>FOV</th>
<th>IFOV (milliradians)</th>
<th>COLLECTION FREQUENCY</th>
<th>WEBSITE</th>
<th>Deliver R/T Data</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMS</td>
<td>USFS, on loan from NASA</td>
<td>Airborne</td>
<td>Band 11 (3.63 - 3.79 μm)</td>
<td>628K (255°C)</td>
<td>80 deg</td>
<td>1.25 / 2.5</td>
<td>variable / operational by USFS</td>
<td><a href="http://neps.fs.fed.us/ams">http://neps.fs.fed.us/ams</a></td>
<td>Yes</td>
<td>Operates on USFS aircraft (2019)</td>
</tr>
<tr>
<td>MASTER (NASA)</td>
<td>NASA</td>
<td>Airborne</td>
<td>Band 8 (3.7 μm)</td>
<td>568K (295 – 310°C)</td>
<td>86 deg</td>
<td>2.5</td>
<td>requested through NASA AERONET program office</td>
<td><a href="http://airboresciencenasa.nasa.gov/instrument/MASTER">http://airboresciencenasa.nasa.gov/instrument/MASTER</a></td>
<td>Possible (with mods)</td>
<td>NASA research instrument, not operational; can be ordered for scientific collection missions. Operates on NASA ER-2 and other platforms.</td>
</tr>
<tr>
<td>eMAS (NASA)</td>
<td>NASA</td>
<td>Airborne</td>
<td>ML (3.63 - 3.655 μm)</td>
<td>??</td>
<td>86 deg</td>
<td>2.5</td>
<td>same as MASTER</td>
<td><a href="http://mas.arc.nasa.gov/index.html">http://mas.arc.nasa.gov/index.html</a></td>
<td>Yes, with mods</td>
<td>NASA research instrument, not operational; can be ordered for scientific collection missions.</td>
</tr>
<tr>
<td>AVIRIS (NASA)</td>
<td>NASA</td>
<td>Airborne</td>
<td>None</td>
<td>N/A</td>
<td>34 deg</td>
<td>1.00</td>
<td>same as MASTER</td>
<td><a href="http://aviris.jpl.nasa.gov/index.html">http://aviris.jpl.nasa.gov/index.html</a></td>
<td>N/A</td>
<td>AVIRIS can acquire hyperspectral data (224 bands) can be used for post-fire vegetation analysis</td>
</tr>
<tr>
<td>WAI (NASA SBIR; XIOMAS, LLC)</td>
<td>NASA-Ames Research Center</td>
<td>Airborne</td>
<td>(4.4 - 5.4 μm)</td>
<td>Temperature threshold has not been measured</td>
<td>90 deg</td>
<td>0.33</td>
<td>to be operational with USFS in 2014</td>
<td>Possible</td>
<td>iJuly 2013, in fire imaging testing for USFS on aircraft,</td>
<td></td>
</tr>
<tr>
<td>MODIS (NASA)</td>
<td>NASA</td>
<td>Satellite</td>
<td>Band 21 (3.920 - 3.989 μm)</td>
<td>355K (61.85°C)</td>
<td>2130 km</td>
<td>2400m spatial</td>
<td>10m resolution; 30m spectral</td>
<td><a href="http://modis.gsfc.nasa.gov/about/">http://modis.gsfc.nasa.gov/about/</a></td>
<td>R/T Fire info: <a href="http://activefiremaps.fs.fed.us/">http://activefiremaps.fs.fed.us/</a></td>
<td>Operates on two platforms (AQUA and TERRA), allowing multiple collections per day</td>
</tr>
<tr>
<td>VIIRS</td>
<td>NOAA / NASA / DoD</td>
<td>Satellite</td>
<td>Band M13 (4.05 μm)</td>
<td>360K (307°C)</td>
<td>3040 km</td>
<td>730m spatial</td>
<td>2 times daily</td>
<td><a href="http://viirs.jpl.nasa.gov/index.html">http://viirs.jpl.nasa.gov/index.html</a></td>
<td>R/T Fire info: <a href="http://activefiremaps.fs.fed.us/">http://activefiremaps.fs.fed.us/</a></td>
<td>Operational fire product delivered to USFS, 24 hr version is used on MODIS (delivered to USFS)</td>
</tr>
<tr>
<td>ALI</td>
<td>NASA / USGS</td>
<td>Satellite</td>
<td>None</td>
<td>N/A</td>
<td>37nm x 42μm</td>
<td>12m spatial; 30m spectral</td>
<td>5-day, but more frequent with multiple look angles</td>
<td><a href="http://fci.usgs.gov/laars/nlsx/all">http://fci.usgs.gov/laars/nlsx/all</a></td>
<td>Yes, under contract</td>
<td>ALI: Advanced Land Imaging; Flies on EO-1 Satellite; tool kit / sensor technology demonstrator for LDCM (Landsat 8); Has &quot;pointing mode&quot; for frequent revisit coverage</td>
</tr>
<tr>
<td>Landsat 8 (OLI / TIRS)</td>
<td>NASA / USGS</td>
<td>Satellite</td>
<td>None; though TIR at; 10.8 and 12.0 μm can sense fire data</td>
<td>N/A; 360K in TIRS</td>
<td>1853m</td>
<td>15m bands; 30m spectral; 120m TIR</td>
<td>16 days</td>
<td><a href="http://www.nasa.gov/content/landsat-8-instruments/">http://www.nasa.gov/content/landsat-8-instruments/</a></td>
<td>LRT from acquisition</td>
<td>Instruments that compose the Landsat 8 satellite system; ALI: Operational Land imaging; TIRS: Thermal Infrared Sensor</td>
</tr>
<tr>
<td>OLS (DMSP)</td>
<td>DoD / A.F. Space and Missile System Center</td>
<td>Satellite</td>
<td>None (has LWIR Band)</td>
<td>30K in LWIR</td>
<td>3600 km</td>
<td>560m-1.1 km</td>
<td>2.4 times daily</td>
<td><a href="http://geogc.nasa.gov/ogd/ols.html">http://geogc.nasa.gov/ogd/ols.html</a></td>
<td>Special acquisitions / permissions</td>
<td>&quot;Night lights&quot; satellite imaging system, capable of fire imaging</td>
</tr>
<tr>
<td>GOES Imager</td>
<td>NOAA</td>
<td>Satellite</td>
<td>Band 2 (4μm)</td>
<td>367 K in MIR</td>
<td>Full disk</td>
<td>4km</td>
<td>Every 15 minutes (7.5 minutes in rapid scan mode)</td>
<td><a href="http://goessci.noaa.gov/GOES15/ml/imag.html">http://goessci.noaa.gov/GOES15/ml/imag.html</a></td>
<td>Yes</td>
<td>Pior imagery, well-off-nitrogen and minimally useful</td>
</tr>
<tr>
<td>AVHRR</td>
<td>NOAA</td>
<td>Satellite</td>
<td>Band 3 (4μm)</td>
<td>320 - 333 K in MIR</td>
<td>3000 Km</td>
<td>1000m</td>
<td>Up to 10 times daily</td>
<td><a href="http://nccs.ges.noaa.gov/NOGEO/goesField/avhrr.html">http://nccs.ges.noaa.gov/NOGEO/goesField/avhrr.html</a></td>
<td>Yes, direct broadcast capable</td>
<td>Next launch on Metop-C (2013)</td>
</tr>
<tr>
<td>HypVis (planned 2022 launch)</td>
<td>NASA</td>
<td>Satellite</td>
<td>Band 3 (4μm)</td>
<td>400 K in LSWIR (1200 - 1400 K in MIR)</td>
<td>600km</td>
<td>60m</td>
<td>5 days</td>
<td><a href="http://hypvis.jpl.nasa.gov/">http://hypvis.jpl.nasa.gov/</a></td>
<td>Direct broadcast capable</td>
<td>Launch 2022?</td>
</tr>
<tr>
<td>GOES R/S Advanced Baseline Imager</td>
<td>NOAA</td>
<td>Satellite</td>
<td>Band 7 (4μm)</td>
<td>400 K in MIR</td>
<td>Full disk</td>
<td>2km</td>
<td>Up to 12 times hourly</td>
<td><a href="http://www.goes-r.noaa.gov/spacesegment/ab.html">http://www.goes-r.noaa.gov/spacesegment/ab.html</a></td>
<td>Yes</td>
<td>First launch in 2015</td>
</tr>
<tr>
<td>Sentinel-3 SLSTR</td>
<td>ESA</td>
<td>Satellite</td>
<td>?</td>
<td>?</td>
<td>1400m</td>
<td>1km</td>
<td>2 days</td>
<td>?</td>
<td>?</td>
<td>Launch in 2014</td>
</tr>
<tr>
<td>GCOM-C SLG</td>
<td>JAXA</td>
<td>Satellite</td>
<td>None; though TIR at 12.8 μm can sense fire detection data</td>
<td>?</td>
<td>1150km</td>
<td>500m</td>
<td>2 days</td>
<td>?</td>
<td>?</td>
<td>First launch in 2014</td>
</tr>
</tbody>
</table>
OBJECTIVES
This report details NASA orbital (and various other ESA, JAXA, and other country / agency assets) and sub-orbital (airborne) imaging / sensing system assets that have applicable uses for the observation of wildfires in the arctic region (and elsewhere). The accompanying table and description of systems are provided to support the Interagency Arctic Research and Policy Committee (IARPC), Wildfire Implementation Team (WIT), which is a multi-agency group chartered with investigating the frequency and severity of wildfires in the arctic as a component of understanding high latitude terrestrial ecosystem process, ecosystem services and climate feedbacks. The Wildfire initiative is identified in section 3.2: Research Initiatives, of the draft IARPC Arctic Research Plan: FY2013-2017. This report is also responsive to the five-year plans for federally-sponsored research in the arctic region, where the IARPC identified seven over-archching categories to form the basis of a national policy for Arctic research and that will especially benefit from interagency collaboration; one of those categories is the “Observing Systems” category. This report supports that beneficial-needs assessment.
Dear Colleagues and Friends,

Once again I have the pleasure to invite you to attend the VII International Conference on Forest Fire Research and its related events that will be held in Coimbra, Portugal, from November 17th to 20th, 2014. The Conference will provide an update on the developments in forest fire science and technology and an opportunity to meet persons and institutions to promote cooperation in research and management. This conference follows its previous editions that have been held every four years since 1990, in Coimbra, Portugal.

The scope of the conference will be mainly:

- To bring together scientists and practitioners from various parts of the world working on different aspects of forest fire research.
- To present the latest research findings and developments in forest fire science and technology.
- To facilitate the exchange of ideas and cooperation among researchers and practitioners.

For more information about the event, please visit the conference website at http://adai.pt/icffr/2014.
Welcome

You are invited to the 36th International Symposium on Remote Sensing of Environment (ISRSE), which will take place on May 11-15, 2015 in Berlin, Germany. This 36th Symposium will represent a major event in the long series of internationally recognized ISRSE meetings. The overall theme of the symposium is the use of Earth Observation systems and related Remote Sensing techniques for understanding and managing the Earth environment and resources.

ISRSE-36 takes place at a significant moment. The process to define the UN global development agenda post 2015 with its Sustainability Development Goals will be finalized in 2015. The Future Earth initiative has been created as a global platform to deliver solution-orientated research for sustainability. One of its key challenges is innovative approaches to integrate knowledge systems (data, observation, modelling, etc.), including remote sensing of the environment. A second Hyogo Framework of Action with its goal to substantially reduce disaster losses is set to be launched in 2015, where Earth observation approaches play an increasing role in making societies resilient to disasters. The global Group on Earth Observations (GEO), together with its partners, such as the Committee on Earth Observing Satellite (CEOS), addresses all of these political and scientific agendas while it currently prepares for its second implementation phase 2016-2025. ISRSE-36 will be an excellent forum to present results from past and current scientific achievements related to those international developments, as well as to discuss future plans for them. ISRSE-36 will feature recent milestones in the development of Earth observation programmes addressing sustainable development, global environmental issues and resilience to disasters.
Xiomas Wide Area Imager (WAI) Sensor Head (Phase 3)

- **TMAS**
  - 110 degree field of view (same as MODIS)
  - 94 meter spatial resolution (similar to ASTER)
  - 3 Spectral Bands (more can be added in Phase III)

Xiomas Thermal Mapping Airborne Simulator (TMAS) Phase 2

- Operating at the same altitude and velocity as MODIS
- the TMAS will have the same capability to map the globe every one to two days.
NASA / USFS Wildfire Sensor SBIRs

- LWIR (8 to 9 um)
- MWIR (4 – 5 um)
- SWIR 1.6 um (optional)
- 600 urad instantaneous field of view
- ground sample distance of approximately 14 feet from our notional operating altitude of 23,000 feet.
- At this altitude the system will be capable of detecting a 6 inch by 6 inch 600 degree C fire.
- 9 Mile Diameter Field of Regard
- ~1200 K Saturation Point in MWIR

Xiomas Staring Wide Area Imager (StareWAI) Phase 2
Questions?

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1.202.358.7200  
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