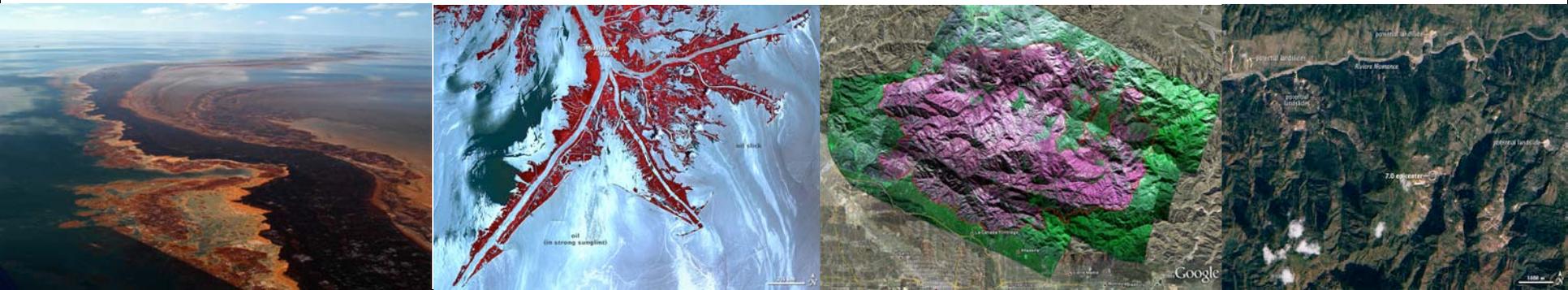


# NASA's Applied Sciences Natural Disasters Program

Jason L. Kessler  
SERVIR Project





# Presentation Outline

- **Programmatic Background**
- **Current Projects**
- **Developing a Natural Disasters Response Plan**

# Applied Sciences Program

## Overview of Program



**NASA**

Mr. Charles Bolden

**Science Mission Directorate**

Dr. Ed Weiler

**Earth Science Division**

Dr. Michael Freilich

**Research  
Program**

Dr. Jack Kaye

**Applied Sciences  
Program**

Mr. Lawrence Friedl (acting)

**Flight  
Program**

Mr. Steve Volz

- Natural Disasters
- Public Health
- Weather - Aviation
- Air Quality

- Agricultural Efficiency
- Ecological Forecasting
- Climate
- Water Resources



# Applied Sciences Program

## *Program Elements*



**Agricultural  
Efficiency**  
(Doorn)



**Air Quality**  
(Friedl/Neil)



**Climate**  
(crosscutting)



**Natural Disasters**  
(Goodman/Donnellan)



**Ecological  
Forecasting**  
(Turner)



**Public Health**  
(Haynes)



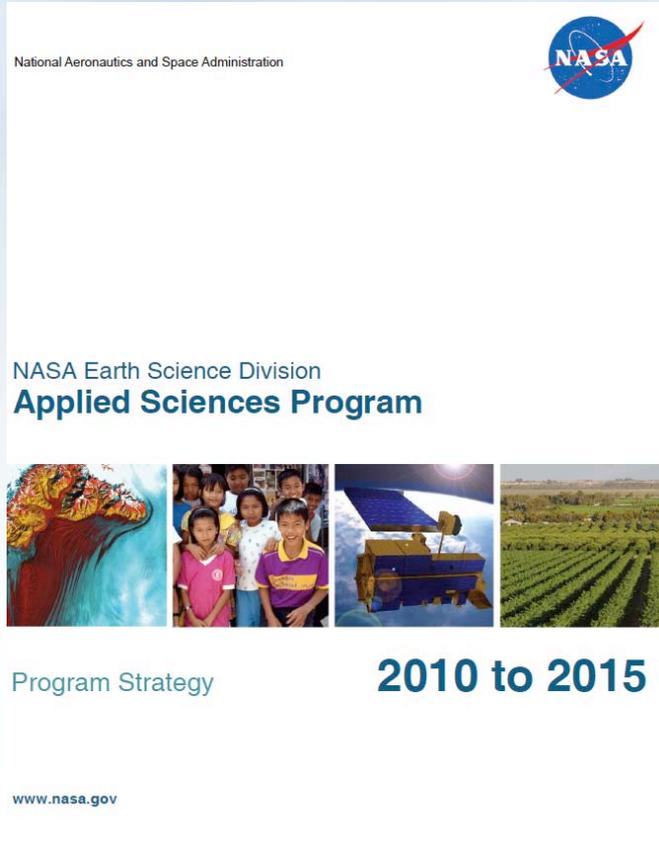
**Water  
Resources**  
(Doorn)



**Aviation  
Weather**  
(Haynes)

# Applied Sciences Program

## Overview of Program



### Vision:

- Achieve the greatest possible utility of NASA's investment in Earth science and observations by enabling its application to practical societal needs.

### Mission

- Advance the realization of societal and economic benefits from NASA Earth science by identifying societal needs, conducting applied research and development, and collaborating with application developers and users.

# Applied Sciences Program

## Strategic Goals



National Aeronautics and Space Administration



NASA Earth Science Division  
**Applied Sciences Program**



Program Strategy

**2010 to 2015**

[www.nasa.gov](http://www.nasa.gov)

- 1. Enhance Applications Research:** Advance the use of NASA Earth science in policy making, resource management and planning, and disaster response.
- 2. Increase Collaboration:** Establish a flexible program structure to meet diverse partner needs and applications objectives.
- 3. Accelerate Applications:** Ensure that NASA's flight missions plan for and support applications goals in conjunction with their science goals, starting with mission planning and extending through the mission life cycle.



# Applied Sciences Program

## *Strategic Functions*

The program seems to serve **three** primary functions for Applied Sciences, ESD & NASA:

### **Science advancement and Technology transfer**

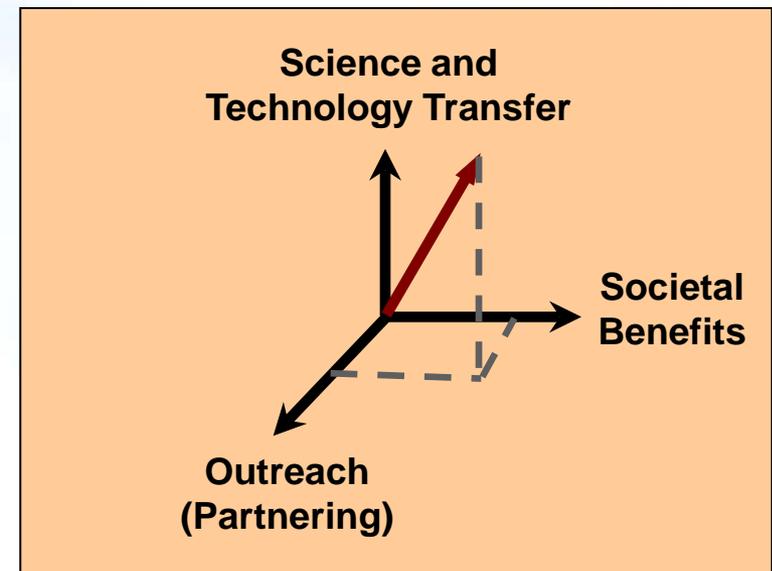
Applications projects can further scientific techniques (e.g., data assimilation, data fusion); interoperability standards drive technology; projects reduce perceived risk of its use and support transfer to private sector; operational use can provide testing and feedback on research algorithms and products; promote innovation.

### **Societal Benefits**

The Program serves the nation and society by helping partners improve their decision making – natural resource management, public safety and health, disaster warnings, etc.

### **Outreach (Partnerships)**

Projects facilitating partners' sustained use of Earth science products helps induce demand for Earth science data and research. Applications of the products to policy and management issues shows the relevance of Earth science to key stakeholders.





# Applied Sciences Program

## *Program Strategy: Implementation Menu*

### **Adaptable approach enables Program to:**

- Address needs across the spectrum of technical maturity levels and applications areas;
- Address global change through applied research and by providing NASA research results, downscaled predictive models, and assessment and monitoring tools to inform impact assessments, adaptation and mitigation planning, and policy development;
- Conduct interdisciplinary research and development to solve complex problems and enable advanced information systems that integrate observations and information from multiple sources;
- Provide opportunities for innovation and high-risk, high-payoff research;
- Collaborate with user organizations of differing experience levels and technical capacities for using NASA Earth observations and research;
- Provide opportunities for the applications communities to participate in planning for Earth science flight missions.

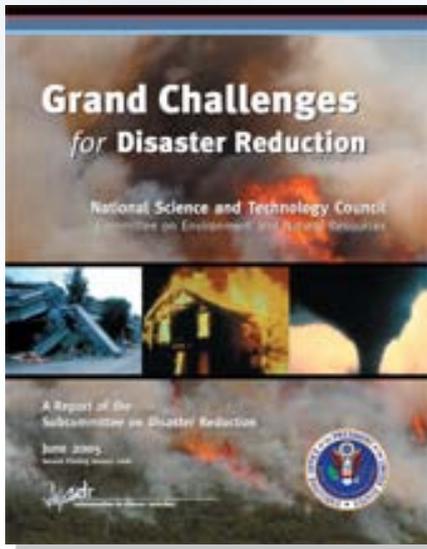


# Natural Disasters Focus

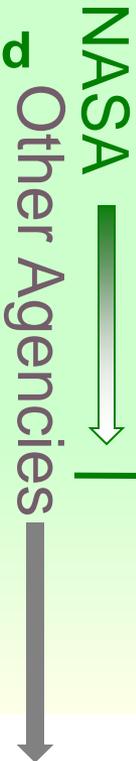
Supports the White House Office of Science and Technology Policy (OSTP) Committee on Environment and Natural Resources (CENR) **Subcommittee on Disaster Reduction (SDR)**

## •Six Grand Challenges:

- ① Provide hazard and disaster information where and when it is needed
- ② Understand the natural processes that produce hazards
- ③ Develop hazard mitigation strategies and technologies
- ④ Recognize and reduce vulnerability of interdependent critical infrastructure
- ⑤ Assess disaster resilience using standard methods
- ⑥ Promote risk-wise behavior



Applied Sciences Natural Disasters Program





# Disasters Objective and Contributions

*To bring NASA capabilities in the area of spaceborne and airborne platforms and observations, higher level data products, and modeling and analysis to improve forecasting, mitigation, and response to natural disasters*

- As an agency with spaceborne, airborne, and modeling and analysis capabilities NASA can specifically contribute the SDR Grand Challenges:
  - ① **Provide hazard and disaster information where and when it is needed**
- As a research agency NASA can specifically contribute to the SDR Grand Challenges:
  - ② **Understand the natural processes that produce hazards**
  - ③ **Develop hazard mitigation strategies and technologies**
  - ④ **Recognize and reduce vulnerability of interdependent critical infrastructure**



# Natural Disasters as Defined in *Grand Challenges for Disaster Reduction* (<http://www.sdr.gov>)

- **Earth Surface**

- Volcano
- Earthquake
- Tsunami
- Coastal Inundation
- Flood
- Landslide and Debris Flow
- Wildland Fire

- **Weather**

- Hurricane
- Tornado
- Winter Storm
- Heat wave
- Drought

NASA funds projects in many of these areas

- **Health and Well-Being**

- *Technological Disasters*
- *Human and Ecosystem Health*



# Natural Disaster Area Challenges

- **NASA is a research agency**
  - In the event of a disaster, NASA evaluates available assets that are appropriate for both science and/or first response
- **Some overlap between disaster response and science research and analysis**
  - Immediate need for information greater for disaster response than for science
- **Transferring application research results to end-users**
  - Requires existing partnerships and collaborations
  - Is facilitated by joint projects and simulations
    - Develop communication and identify existing gaps



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# Applied Science ROSES Calls

## ROSES 2007 & 2008

### A.18 Decision Support through Earth Science Research Results

Results-oriented projects focused on the integration of Earth science research results into decision making activities related to one or more of the eight applications areas.

Overall objective:

Sustained use of Earth science products in decision making activities and an assessment of the value and benefit of the Earth science products.

### A.19 Earth Science Applications Feasibility Studies

Short-term, feasibility studies of applications of Earth science research results that will improve decision-making activities.

Overall objective:

Generate and test preliminary ideas for applications of Earth science products to determine their potential value and readiness for a more in-depth project



# Natural Disaster Program Current Projects

Earthquake	
<b>Active Fault Detection and Evaluation from Multispectral Imagery and LiDAR</b>	<b>Earthquake Disaster Evaluation and Response</b>
Florante Perez Department of Conservation, California Geological Survey Cal. Department of Conservation <b>FEASIBILITY 2008</b>	Margaret Glasscoe Jet Propulsion Laboratory  USGS, CGS, OES <b>DECISIONS 2008</b>
Hurricane	
<b>U.S. Hurricane Landfall and Climate: Reinsurance Decision Support</b>	<b>Enhanced Decision Making using NASA Data within NOAA, NWS, and FEMA</b>
Timothy Hall Goddard Institute for Space Studies, NASA GSFC <b>FEASIBILITY 2008</b>	Dave Jones StormCenter Communications, Inc. NWS SR HQ, FEMA REGION VI, MSFC <b>DECISIONS 2008</b>
Wildland Fires	
<b>Predicting Forest Fire from Microwave Sensing of Fuel Loads</b>	<b>Wildfire Research and Applications Partnership (WRAP)</b>
Sassan Saatchi University of California-Los Angeles <b>FEASIBILITY 2008</b>	Vince Ambrosia California State Univ – Monterey Bay NASA Ames and NASA Dryden <b>ARRA 2010</b>



# Natural Disaster Program Current Projects

<b>Tsunami</b>	<b>Floods / Landslides</b>
<b>GPS-aided Real-Time Earthquake and Tsunami Alert System (GREAT)</b>	<b>Global Flood and Landslide Monitoring / Forecasting Using Satellite Observations</b>
Yoaz Bar-Sever Jet Propulsion Laboratory	Fritz Policelli and Bob Adler NASA GSFC and University of Maryland
<b>DECISIONS 2007</b>	<b>DECISIONS 2007</b>

<b>Technological</b>	
<b>Monitoring Levees and Subsidence in the Sacramento-San Joaquin Delta Using UAVSAR</b>	<b>Development of Remote Sensing-Assisted Natural and Technological Hazards Decision Support Systems</b>
Cathleen Jones  Jet Propulsion Laboratory Cal. Dept. of Water Resources; USGS	John Jensen, Michael Hodgson and Susan Cutter University of South Carolina
<b>DECISIONS 2008</b>	<b>DECISIONS 2007</b>

## **Human Health and Homeland Security**

### **Atmospheric Stability Analysis for Homeland Security Applications**

Stephen Lord & Jeff McQueen  
NOAA National Centers for Environmental Prediction

**DECISIONS 2007**

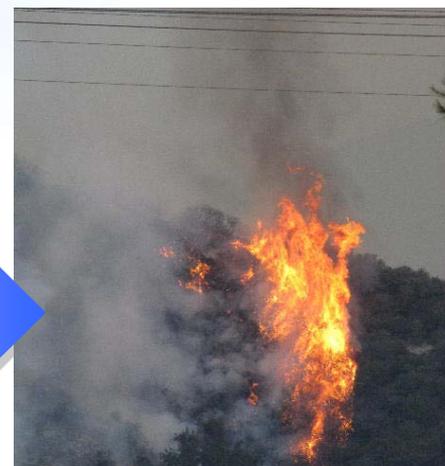
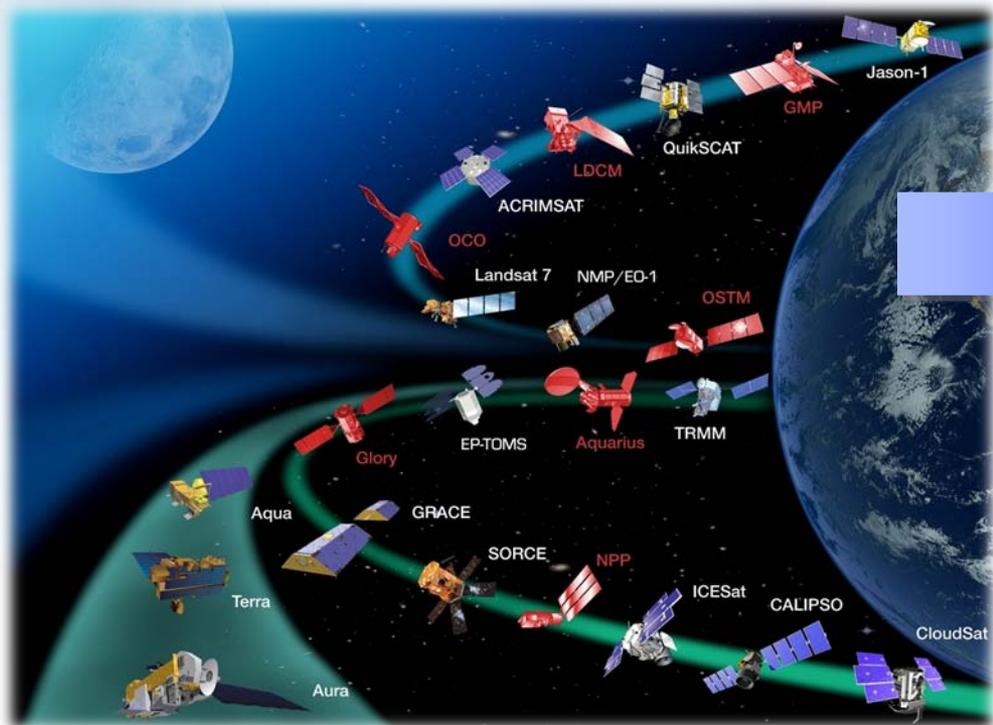


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# Natural Disasters Plan

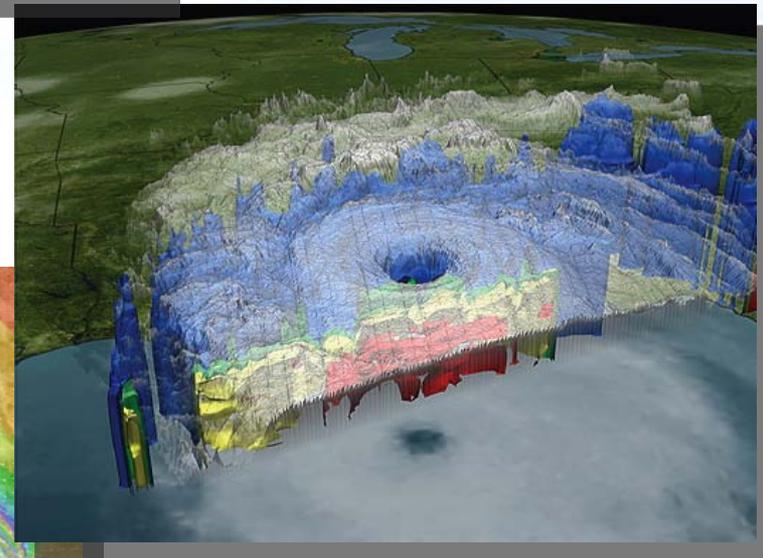
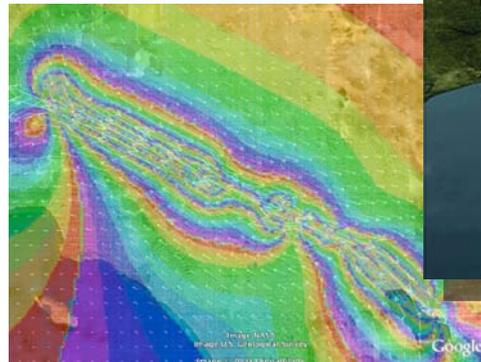
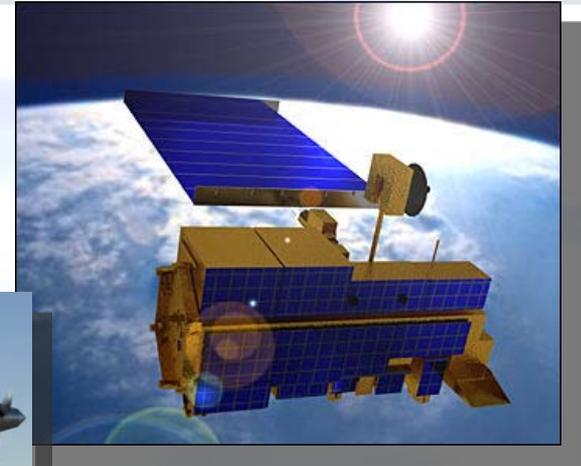
- Develop a NASA Natural Disasters Response plan in 2010
- Flow NASA observations to the end user, as appropriate
- Be responsive to natural disasters within the context NASA's mission
- Understand and catalogue NASA capabilities and end users





# Catalogue NASA Capabilities for Disaster Response

- Spaceborne
  - Existing and Formulation missions: MODIS, Landsat, TRMM, EO-1, JASON, GPM...
  - Decadal Survey Missions: SMAP, DESDynI, HypIRI
- Airborne Instruments
  - UAVSAR – Radar
  - LVIS – Lidar
  - AMS, MASTER – Thermal Infrared
  - HIWRAP, APR2, HAMSR, HIRAD, PALS
  - MAPIR – Active and passive microwave
- Data processing and analysis
- Modeling and analysis





# Major Challenge: Transfer Capabilities to End Users

How do we flow capabilities from NASA research to end-users at other agencies and organizations?

- Build on existing partnerships and collaborations
- Keep dialogue open through interagency cooperation
  - OSTP / Subcommittee on Disaster Reduction
  - National Academies of Science / Disaster Roundtable
- Incentivize partnerships with other agencies and organizations
  - Joint solicitations
  - Required participation in NASA Applied Sciences calls
- Joint participation in workshops
  - Earth Observing Missions Applications Workshop (Feb 2010)
  - Natural Academies of Science Disasters Workshop (July 2010)
- Simulated exercises develop communication and identify gaps
- Engagement at the state level?



# Summary

- Fully utilize current and near-term airborne and spaceborne assets and capabilities
  - NASA spaceborne instruments are for research but can be applied to natural disaster response as appropriate
  - NASA airborne instruments can be targeted specifically for disaster response
    - **Could impact research programs**
- Better flow of information improves disaster response
  - Catalog capability, product, applicable disaster, points of contact
  - **Ownership needs to come from the highest level of NASA – unpredictable and irregular nature of disasters requires contingency funding for disaster response**



## Summary (2/2)

- Build-in transfer of applicable natural disaster research capabilities to operational functionality at other agencies (e.g., USFS, NOAA, FEMA ...) at the outset, whenever possible
- For the Decadal Survey Missions, opportunities exist to identify needs and requirements early in the mission design process
  - Need to understand additional needs and commitments for meeting the needs of the disaster community
  - Opportunity to maximize disaster response and mitigation from the Decadal Survey Missions
  - Additional needs or capabilities may require agency contributions