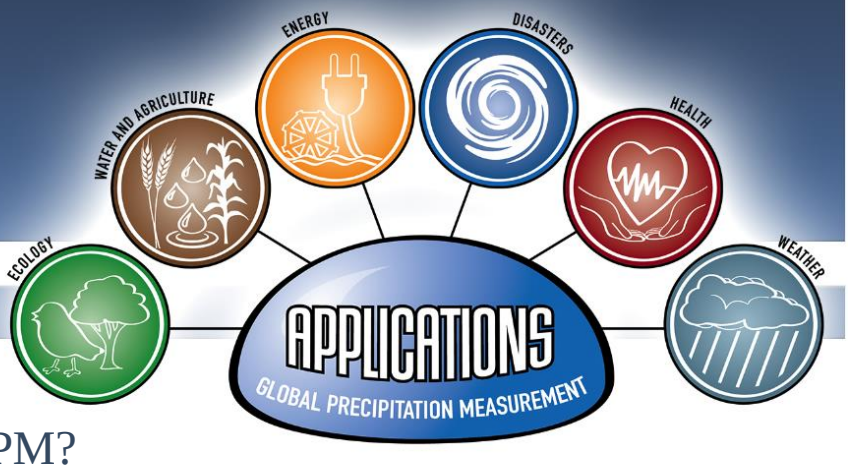
GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

gpm.nasa.gov/applications



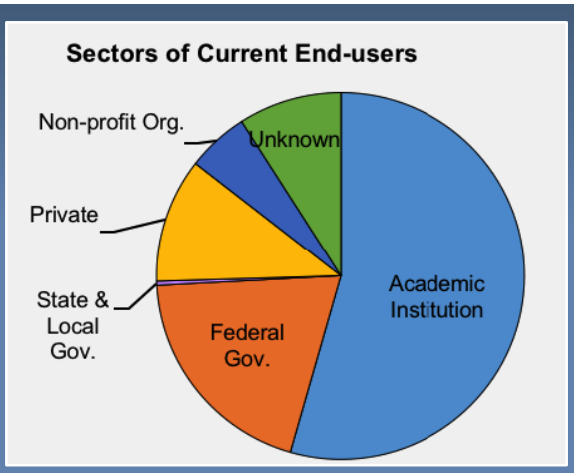
Single day satellite precipitation totals for South America from the multi-satellite GPM IMERG data product.

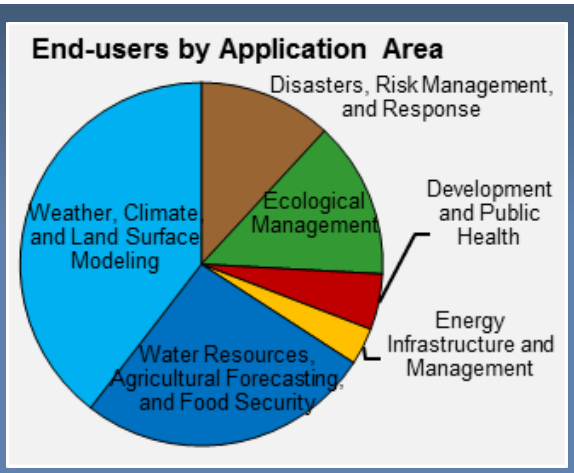
What is GPM?

The Global Precipitation Measurement (GPM) mission, initiated by NASA and the Japan Aerospace Exploration Agency (JAXA), is an international network of satellites that provide the next-generation global observations of precipitation from space. Building upon the success of the Tropical Rainfall Measuring Mission (TRMM), the GPM concept centers on the deployment of a "Core" satellite carrying an advanced radar / radiometer system to measure precipitation ranging from light rain to heavy rain and snow over the latitude band 65°N–65°S. The GPM Core Observatory serves as a reference standard to unify precipitation measurements from a constellation of satellites and ground systems from partner agencies around the globe. These measurements provide high-quality merged data on rain and snow worldwide every 30 minutes.

Applications: Using Precipitation Data in the Real World

Humans are directly impacted by changes in precipitation on a range of scales. An increase in rainfall can cause flooding and/or landslides that affect individual homes, cities, or even entire countries. Drought conditions can impact a region's susceptibility to wildfire or diminish crop yields for local farmers—both of which can have cascading effects on the local to global economy. Access to accurate estimates of precipitation can improve our understanding of growing seasons or indicate where international aid agencies should deliver resources. Among other uses, GPM and TRMM datasets have been used by end-users from universities, government agencies, national and international non-profit organizations, and private companies for a range of diverse applications across societal benefit areas including numerical weather prediction and public health research.





Have Ideas? Get Involved!

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Current GPM & TRMM users by sector and societal benefit area.

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Data Access

Overview of GPM Data Products

Level	Name	Description	Resolution		Coverage	Latency
			Space	Time		
GPM Level 1	1B-GMI	GMI T_b	Varies by channel	16 orbits per day	Latitudes 70˚N-70˚S, past week (NRT)	1 h (NRT); 6 h (prod.)
	1C-GMI	Calibrated GMI T_b	Varies by channel	16 orbits per day	Latitudes 70˚N-70˚S, past week (NRT)	1 h (NRT); 6 h (prod.)
GPM Level 2	2A-DPR	DPR Ka and Ku single-orbit rainfall estimates	5km x 5km (at nadir), 125-m vertical resolution	16 orbits per day	Latitudes 67˚N-67˚S, Mar 2014-present	20-120 min (NRT); 24 h (prod.)
	2A-GPROF-GMI	GMI single-orbit rainfall estimates	11km x 18km	16 orbits per day	Orbital, 70˚N- 70˚S	1 h (NRT); 40 h (prod.)
	2B-CMB	Combined GMI + DPR single orbit rainfall estimates	5km x 5km (at nadir), 250-m vertical resolution	16 orbits per day	Orbital 67˚N-67˚S	3 h (NRT); 40 h (prod.)
GPM Level 3	IMERG	Integrated Multi-satellite Retrievals for GPM	0.1˚ x 0.1˚	30 min	Gridded 60˚N- 60˚S	4-5 h (NRT/Early run)
						14-15 h (NRT/Late run)
						3 months (prod./Final run)

Have Ideas? Get Involved!

- The GPM Applications team is always looking for case studies to expand our portfolio and provide qualitative and quantitative examples of how GPM data is supporting decision making as well as where we can improve. Please don't hesitate to contact us at gpm.nasa.gov/contact
- For more information on GPM Applications, trainings, and workshops: gpm.nasa.gov/applications

GET DATA

GLOBAL PRECIPITATION MEASUREMENT

New Users Start Here

Precipitation data are freely available to the public in a variety of formats and through several different archives at NASA, outlined at: gpm.nasa.gov/data-access

1. **Register** at registration.pps.eosdis.nasa.gov Registration is free and is required to gain access to the PPS TRMM/GPM FTP data archives.
2. **Direct data access:** PPS's STORM system allows users to search for GPM, partner, and TRMM data; order custom subsets; and set up subscriptions for routine access. STORM provides GPM data in HDF5 and GeoTIFF formats storm.pps.eosdis.nasa.gov/storm
3. **Visualization and analysis tools** are available through the Goddard Earth Sciences Data and Information Services Center, GES DISC; daac.gsfc.nasa.gov, and through the PMM website, gpm.nasa.gov/data-access/visualization
4. **Information on data available and formats:** gpm.nasa.gov/data-access/downloads
5. **Questions?** Please read the frequently ask questions (FAQs) at gpm.nasa.gov/data-access/faq. If you still have questions you can contact the GPM team at gpm.nasa.gov/contact

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Water Resources, Agricultural Forecasting & Food Security

Growing human population, increased demand for water and energy, and a changing climate have contributed to expanded concerns centered on freshwater resources and food supply and production. Both water resource managers and the agricultural community need to know the amount and distribution of seasonal rainfall and the timing of the onset of rainfall to prepare for freshwater shortages and forecast crop yields. Remotely sensed precipitation estimates play a key role in predicting changes in freshwater supply and agricultural forecasting. The Water Resources, Agricultural Forecasting, and Food Security Applications area promotes the use of precipitation data from the GPM constellation to analyze and forecast changes that affect water resources and its subsequent impact on agricultural productivity.

Photo Credit: USDA FAS

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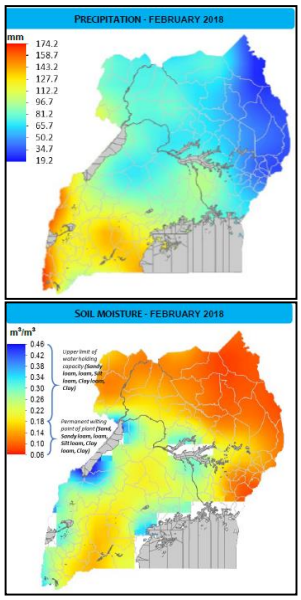
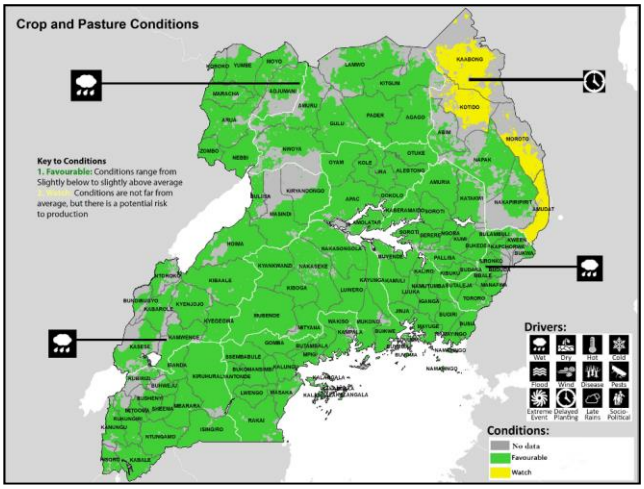
CASE STUDY: Monitoring Crop Conditions throughout Uganda





U-NIEWS, Vol. 2, Issue No. 17: Maps created with satellite precipitation data (top left) and soil moisture (bottom left) for February 2018. Crop and pasture conditions using satellite data as variables (right).

The National Emergency Coordination and Operations Centre (NECOC), with the support of United Nations Development Programme (UNDP), is Uganda's central facility for early warning and the coordination of emergency and crisis response and recovery action. NECOC provides publicly available monthly bulletins, U-NIEWS (Uganda National Integrated Multi Hazard Early Warning System), to understand crop and pasture conditions, food insecurity, weather/climate forecast and to determine anticipated disasters while providing disaster management and humanitarian aid information.

Each month, NASA rainfall data are combined with soil moisture, temperature, and evapotranspiration data to analyze crop and pasture conditions of Uganda at the national and sub-national level to determine crop production risks. This information enables NECOC and UNDP to determine probability of food insecurity and other disasters to issue warnings and alerts. The data is analyzed and shared among government departments, parliament ministers, diplomatic missions, academics, development partners, UN Agencies, NGOs, farmer organizations, and the public via emails.

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Ecological Management

Ecological management is critical for maintaining and repairing ecological systems so the systems reliably supply human needs while conserving and sustaining ecological services and diversity. Satellite observations can provide critical information relevant to the distribution of ecosystems and their resident species. Natural resource managers and scientists use this information to understand patterns of biodiversity, how biodiversity is changing, drivers of changes, and to predict impacts of environmental changes on ecological systems. The Ecological Management Applications area encourages the use of satellite precipitation data from the GPM constellation to analyze and forecast changes that affect ecosystems and to develop effective resource management strategies.

Credit: Hattie Bartlam-Brooks

NASA precipitation data used to predict zebra migrations in Botswana.

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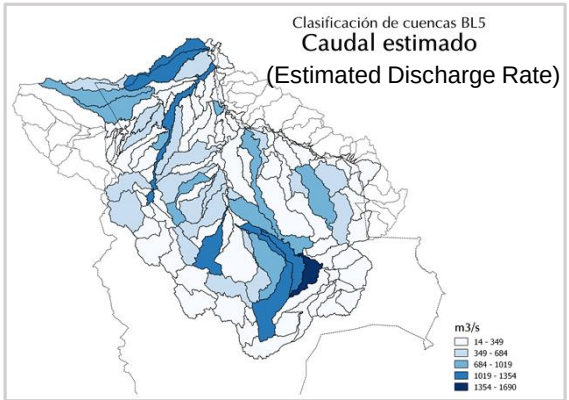
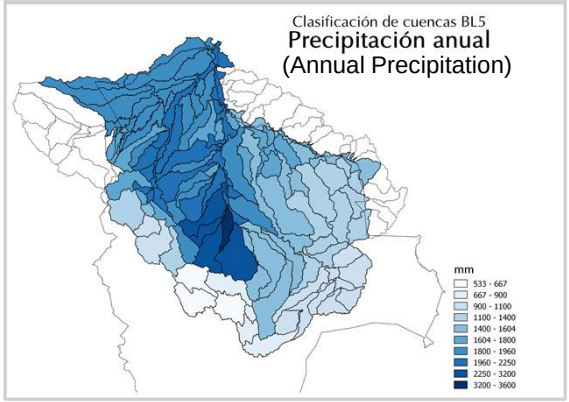
CASE STUDY: Strengthening the Mitigation Hierarchy in the Amazon

WCS

The large-scale development of agriculture, mining, oil & gas, hydroelectric dams, timber and fisheries in the Amazon have set the stage for environmental research, planning and management of aquatic ecosystems. To address this issue, the Wildlife Conservation Society (WCS) in Bolivia are using over 17 years of precipitation data (1998-2015) from NASA's Tropical Rainfall Measuring Mission (TRMM) and Global Precipitation Measurement Mission (GPM) to collect rainfall totals and estimate potential discharge rates throughout the Bolivian Amazon. This information will enable WCS Bolivia to identify endangered river basins, which will then provide decision makers a useful framework to implement a mitigation hierarchy approach. This approach will be a useful guide to limit negative impacts on biodiversity such as dam implementation in Bolivia.

Map of Bolivia (above). Red circle denotes area that GPM data is used to identify endangered river basins.





Estimated discharge rates (top right) and annual precipitation (bottom right) in the Bolivian Amazon.

Credit: Miranda G, Molina J, Sanjinés D & Painter L. in prep. (WCS Bolivia).

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Development and Public Health

Precipitation extremes, from heavy rainfall to droughts, pose great risks to a country's economic development and their societal health. Throughout the world, standing water and flooding as a result from heavy rainfall has created vulnerabilities to waterborne disease outbreaks, indoor air quality problems, to infrastructure damage including roads, buildings, and industrial facilities. Drought and extreme heat conditions have been associated with a broad set of health hazards including degraded air and water quality, have impacted human migration, and have damaged transportation such as roads, rail lines, and airport runways. The Development and Public Health Applications area encourages the use of satellite precipitation data from the GPM mission in development decisions and public health, particularly involving socioeconomic development issues and infectious diseases.

Photo Credit: U.S. Peace Corps

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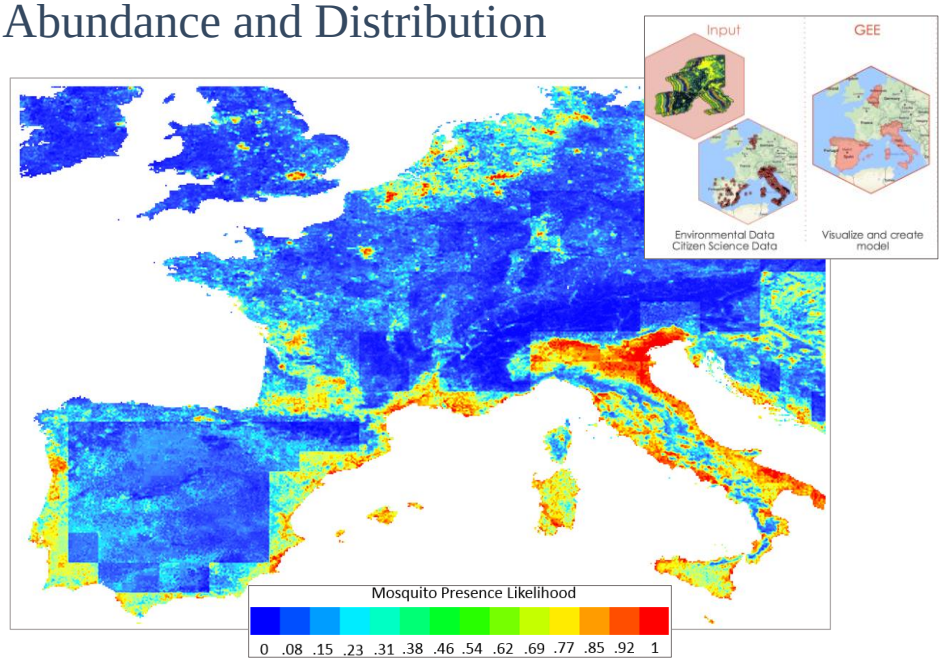
CASE STUDY: Monitoring Mosquito Abundance and Distribution



Input factors for habitat suitability model (environmental data and citizen science data) (top right). Map shows mosquito habitat suitability in Western Europe (left). For more information: develop.larc.nasa.gov/2018/spring/WesternEuropeHealthAQII

The NASA Develop program, a program that addresses environmental and public policy issues with NASA data, is working with multiple organizations to integrate NASA Earth observations with citizen science data from Western Europe to understand the location and timing of disease outbreaks and improve outbreak predictions. NASA and partners are working towards a shared, coordinated platform and protocol to leverage citizen science for the global surveillance and control of disease-carrying mosquitoes. Specifically, data from citizen science and environmental data from NASA Earth observations, including precipitation (from GPM IMERG), elevation, humidity, land cover, soil moisture, and land surface temperature will be used as parameters for a mosquito habitat suitability model and incorporated into a open-source interactive map. The tool will assist policy makers and public health officials in identifying environmental factors associated with mosquito outbreaks and deciding where to focus disease mitigation efforts.

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

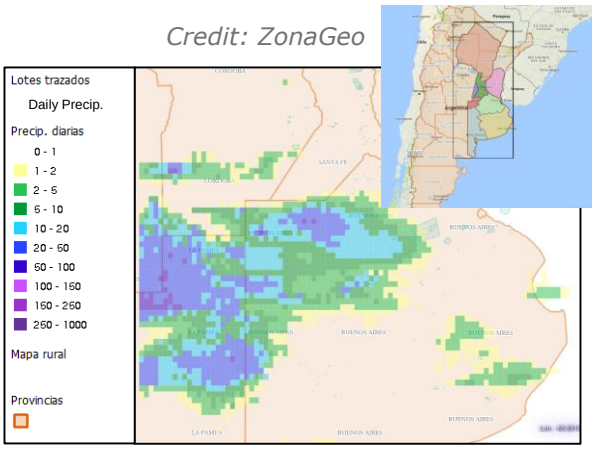
Disasters and Risk Management

Too much or too little rain can have huge impacts on people around the world. According to the Intergovernmental Panel on Climate Change Fifth Assessment (IPCC, 2014), an increase in the average global temperature is very likely to lead to changes in precipitation and atmospheric moisture, including shifts towards more frequent, extreme precipitation events and more frequent droughts. The Disasters, Risk Management and Response Applications area promotes the use of precipitation data from GPM satellites to improve forecasting capabilities of, preparation for, response to, and recovery from natural hazards such as tropical cyclones, floods, droughts, wildfires, landslides, and other extreme weather events.

CASE STUDY: Precipitation Data Supports Agro-Hail Insurance in Argentina

ZonaGeo, a geospatial technology company, is using NASA's GPM precipitation data to evaluate accumulated daily rainfall in northeast Argentina as a value added product for clients of agro hail insurance companies including Tero Granizo of Paraná Seguros. Tero Granizo ("granizo" meaning hail) is an online platform of Paraná Seguros that allows customers to quote, contract and manage hail insurance from electronic devices. Over 200 clients are insured by Paraná Seguros, and as a result use GPM products developed by ZonaGeo.

Credit: ZonaGeo



NASA precipitation used to quote agro-hail insurance in NE Argentina. Black rectangle (above left) denotes area that GPM data is used for insurance quotes. Daily precipitation (in mm) for January 26, 2018 (each cell 10Km x 10Km) for NW Buenos Aires, NE La Pampa, and southern Cordoba provinces (above right) . Green cells represent final insurance clients' assured land.

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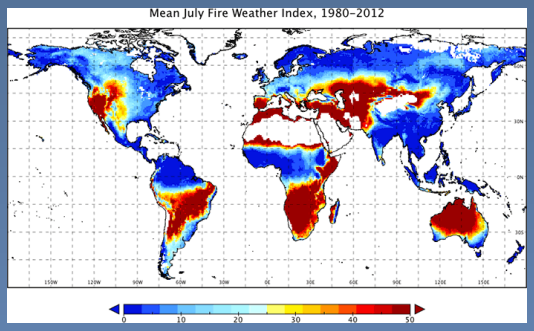
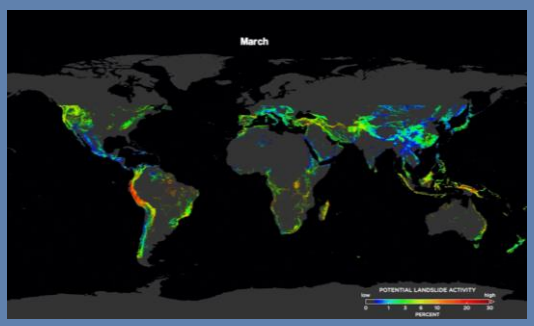
Using GPM Precipitation Data in Near-Real-Time

Determining where, when, and how natural hazards may vary and affect people at the global scale is fundamental to formulating mitigation strategies, appropriate and timely responses, and robust recovery plans. Specifically, NASA near-real-time precipitation estimates are used for regional assessments of current and potential wildfires and landslide activity.



The Global Fire WEather Database (GFWED) integrates different weather factors, including TRMM and GPM data, to help track potential of extreme fire behavior in low latitudes.



Potential landslide activity by month averaged over the last 15 years (above image).

GPM precipitation estimates are used as an input for the Land-slide Hazard Assessment for Situational Awareness (LHASA). LHASA is intended to provide situational awareness of landslide hazards in near real time.

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Energy Infrastructure and Management

In many areas, energy infrastructure assets have suffered damage or disruption in services from a variety of climate-related impacts, such as extreme precipitation events, higher temperatures, drought, and rising sea levels. For example, warmer temperatures and little rainfall can cause changes in peak streamflow conditions that affect hydropower generation. Heavy precipitation events and flooding can impact a region's energy infrastructures, including electric grid equipment, which has cascading effects on freshwater supplies and emergency services. The Energy Infrastructure and Management Applications area promotes the use of satellite precipitation data from the GPM constellation for key decisions or analyses within the energy sector, including the use of climatology data in the prediction of energy demand, development, harvest, and production of non/renewable energy resources, and load forecasting.

Photo Credit: USAID

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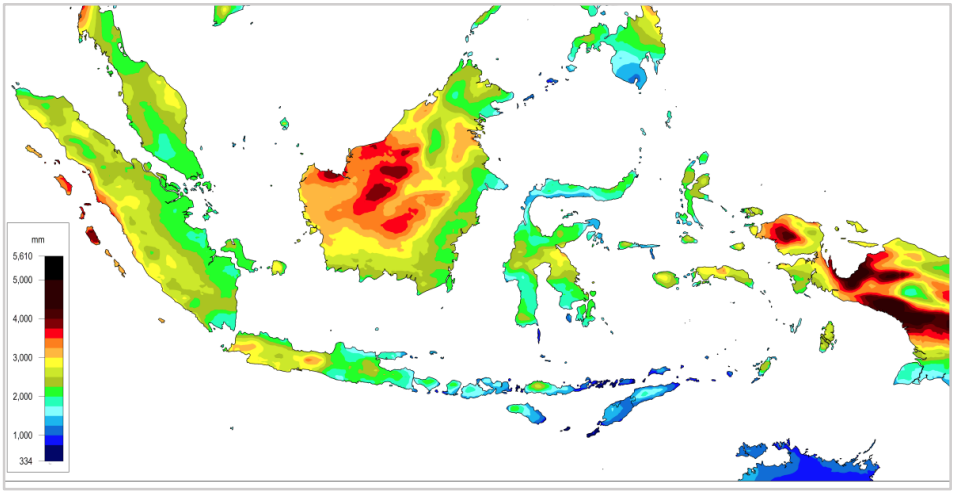
CASE STUDY: Driving Hydropower Generation in Indonesia



Average annual rainfall in Indonesia, 2014 – 2017, GPM IMERG (INDONESIA HYDRO™ CONSULT)

Availability of flow is an important factor in the planning and the development of a hydropower plant to estimate its capacity and energy production. To determine flow availability, hydrological modeling is carried out which consists of multiple inputs including rainfall, discharge, ground slope, vegetation, and evapotranspiration. To address one input, INDONESIA HYDRO™ CONSULT is using NASA's TRMM and GPM IMERG precipitation data as a variable in the development of hydropower plants throughout Indonesia and it surroundings where rivers are either ungauged or quality of records from the gauging stations are unreliable.

Kincang Hydropower Project; Location: Banjarnegara, Central Java, Indonesia (INDONESIA HYDRO™ CONSULT)

GLOBAL PRECIPITATION MEASUREMENT MISSION APPLICATIONS

Weather, Climate and Land Surface Modeling

Earth's climate is changing. The accumulation of greenhouse gases has affected the oceans and ice systems as well as the atmosphere, which in turn impacts the water cycle. To predict future changes in weather and climate and estimate environmental variables, scientists use sophisticated computer models. These models rely on available global data to describe the conditions that exist today to project how conditions may change in the future. GPM's Weather, Climate, and Land Surface Modeling Applications area promotes the use of precipitation measurements from GPM satellites to help model future behavior of precipitation patterns and climate.

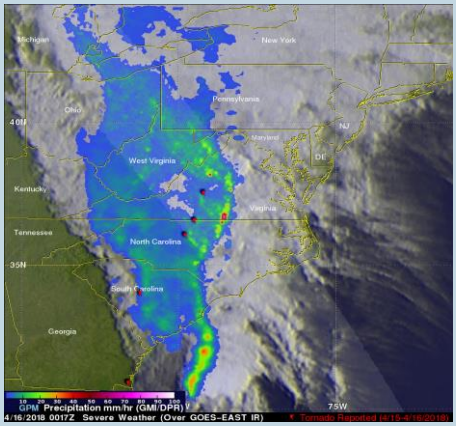


Photo Credit: NASA, Hal Pierce

GPM satellite precipitation totals in Eastern U.S. recorded on 4/16/2018.

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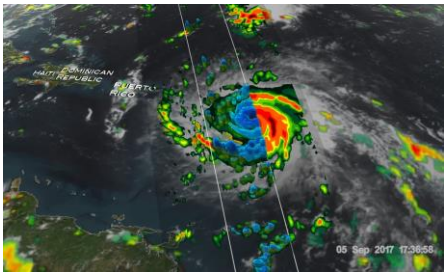
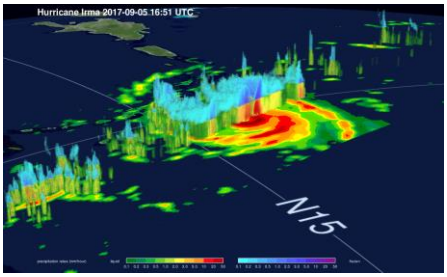
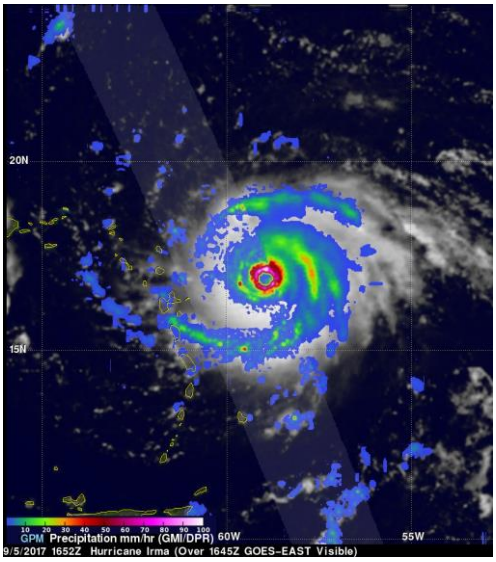
CASE STUDY: Monitoring Hurricane Irma with GPM







The GPM core observatory satellite had an exceptional view of hurricane Irma's eye when it flew above on September 5, 2017 at 12:52 PM AST (1652 UTC). Images (top left and right) show rainfall analysis that was derived from GPM's GMI and DPR data. Irma was approaching the Leeward Islands with maximum sustained winds of about 178 mph (155 kts). This made Irma a dangerous category five hurricane on the Saffir-Simpson hurricane wind scale. Intense rainfall is shown within Irma's nearly circular eye. GPM's DPR (shown in lighter shades) uncloaked precipitation that was falling at a rate of more than 10.8 inches (274 mm) per hour in the solid ring of powerful storms within Irma's eye wall. GPM's DPR Ku band data (bottom left) revealed that the tallest thunderstorms were found to the southwest of Irma's eye.

Hurricane Irma was the strongest Atlantic basin hurricane ever recorded outside the Gulf of Mexico and the Caribbean Sea. NASA GPM's Microwave Imager (GMI) and Dual-Frequency Precipitation Radar (DPR) instruments were used to help understand the locations and intensity of heavy precipitation within hurricane Irma. Specifically, imagery from GMI was used to help understand the state of Irma as it approached the Caribbean. GMI observations documented an eyewall replacement cycle that impacted the intensity and development of the storm. This information was provided to NOAA's National Hurricane Center, which transitions NASA, NOAA, and other partner data to operational weather forecasting partners.