

M. Harris, K. Aur, N. McMahon

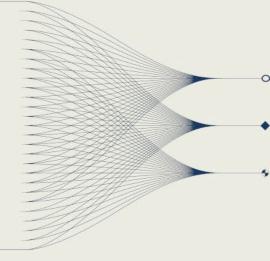
Sandia National Laboratories



···························· INTRODUCTION AND MAIN RESULTS

Sandia National Laboratories is developing the Geophysical Monitoring System (GMS) for modernization of the United States National Data Center waveform processing system.

The GMS effort is developing interactive analysis capabilities, referred to as IAN, to replace the aging Analyst Review Station (ARS) used by IDC analysts to review events and create the IDC bulletins.







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Introduction

The GMS effort is developing interactive analysis capabilities, referred to as IAN, to replace the aging Analyst Review Station (ARS) used by IDC analysts to review events and create the IDC bulletins.

GMS Interactive Analysis (IAN) now includes capabilities to filter, rotate, and beam station data, measure the azimuth and slowness of signal detections using frequency-wavenumber (FK) spectra, measure signal amplitude, create and locate events, and estimate event magnitude.

GMS is deployed using a cloud-ready Kubernetes containerized platform, hardened for cyber security accreditation.

The United States is providing the common architecture and processing components of GMS as a contribution-in-kind to accelerate progress on International Data Centre (IDC) Re-engineering.

The current release is PI27, posted to GitHub in January 2025.

The next release will be PI31, in preparation, expected in September 2025.

Open source releases of GMS are available on GitHub: https://github.com/SNL-GMS

Analysis Features

IAN can display the base data types needed for SHI analysis, and includes capabilities to filter, rotate, and beam station data, measure the azimuth and slowness of signal detections using frequency-wavenumber (FK) spectra, measure signal amplitude, create and locate events, and estimate event magnitude.

User Experience

IAN uses modern web technology, accessed with a common web browser. Display are flexible and customizable. Data and user operations are fully synchronized across all displays, with consistent user experience design.





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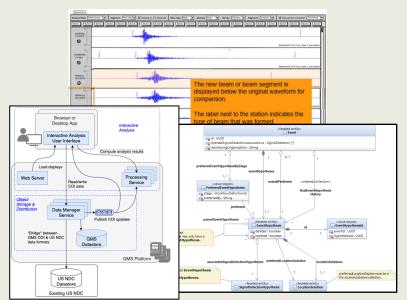
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Product Design

GMS is a large software development project with several development teams, plus architecture, geoscience, platform, and test teams.

Product Management defines and prioritizes a capability roadmap, and along with user experience and architecture develops product guidance for developers in the form of descriptions, storyboards, and architecture designs.

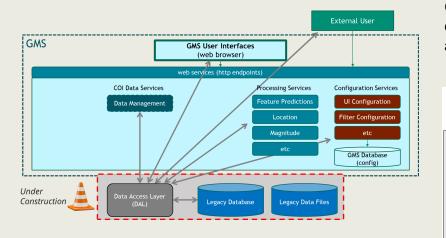
GMS regularly engages with SHI analysts and other users to improve IAN designs.



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Architecture

GMS is a service-oriented, distributed web application. Data services provide access to stored data (in this case from the legacy database) to GMS applications like IAN. Processing and configuration services also support analysis operations. External users can also access these services.



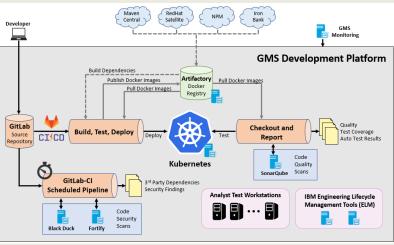


Development and Deployment

GMS uses agile development practices, working in two week iterations. GMS developers manage code and workflow in GitLab.

We use GitLab Continuous Integration / Continuous Deployment (CI/CD) to automate software build, test, and deployment pipelines.

GME is deployed using a cloud-ready Kubernetes containerized platform, hardened for cyber security accreditation.







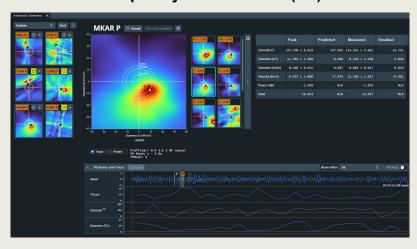


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Example IAN Displays

Frequency-Wavenumber (FK)



Amplitude

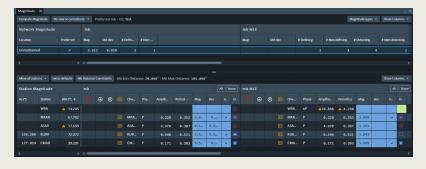


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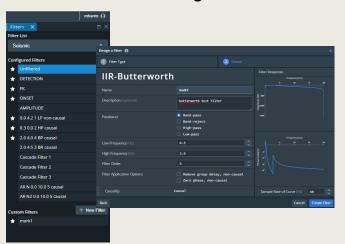
GMS uses the LocOO3D location software.

Magnitude





Filtering



Beamforming and Rotation

Create Event Beams ()			×							
Input Stations If non are selected, create beams for all leaded array. None selected, Using all stations without P.			Rotate Waveforms ()							
stations without the current phase Input Channels If none are selected, use default configured channels for the selected station.		Rotated Waveform Inputs Choose whether to rotate using specific stations/channels at the time of a predict phase, or to use signal detection arrival times and default channels.	Using selected signal detections Using selected stations/channels and phase NIA Nove selected. Using all stations.							
Phase (current phase) Beam for this phase at the predicted time										
Lead time	9 : 91 : 00									
Duration Duration of the event beam	0 : 05 : 00									
Prefilter Fiter to apply before beaming	Unfiltered									
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Interpolation method How to align samples	Nearest sample Interpolated			14.97867						
No stations selected				-91.322248						
	Create beams with default settings: 🖸 Cancel	Create bean	Waveform lead and duration Choose whether to use the default lead/duration per station and phase, or set outtons values.	Default configured per station/phase Custom lead & duration						
			Lead Time (seconds) Lead time before the predicted phase, arrival time, or start of loaded time range							
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			No stations selected Because no stations are selected, using all valid star			6				
			Creater	otated waveforms with default configuration:	cel	Rotat				

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