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# Data Analytics Automation to Support Pump and Treat Shutdown Evaluation

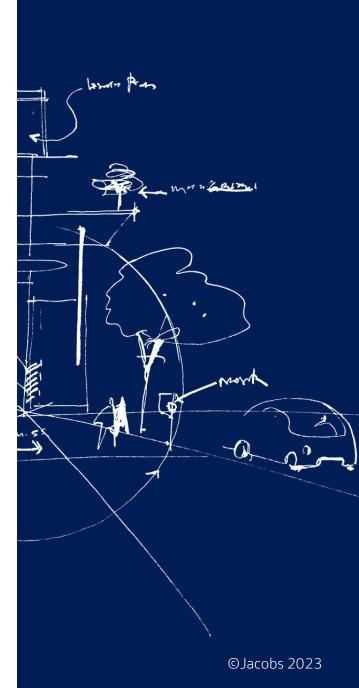
Presented by Tom Palaia

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RemTech<sup>™</sup> Symposium, 11 October 2023

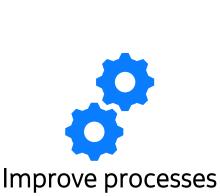
### Agenda

- Introduction
  - Why automate data analysis and decision making?
  - What does data analytics automation look like?
  - How is automation done?
- Plume stability evaluation (PSE) case study
  - Objectives of the pump and treat shutdown evaluation
  - Project-specific data flows
  - Scope of automation
  - Results
- Technology-level takeaway messages
- Look to the future of automation



#### Introduction – Why automate data analysis and decision making?





Upgrade tools and techniques Improve data quality Keep up with large data streams

Maintain a well-informed project team Enable real-time decision making Minimize hang-ups due to slow data analysis

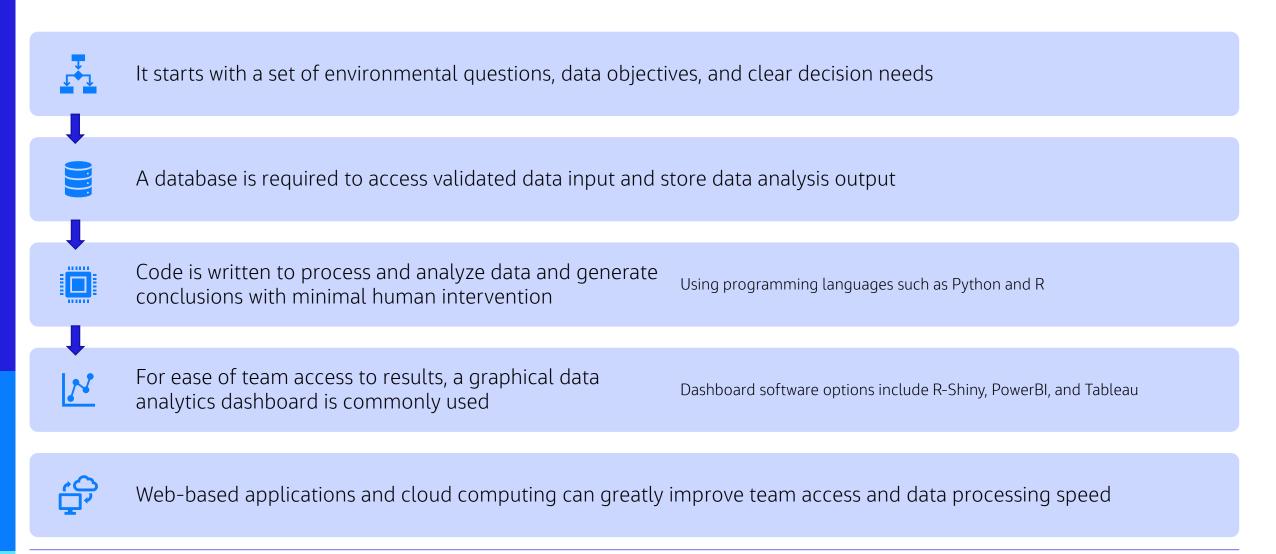


#### Drive better decisions

Increased data scrutiny Better defined decision logic

#### What does data analytics automation look like? SCADA 🚯 git **R** Shiny ORACLE Shiny Enterprise dashboards Financials Version Control Cutting edge visualization and analysis **EQuIS**<sup>™</sup> **U** ≊USGS Cloud-based delivery Secure internal/external Power BI access portal **Microsoft Business Intelligence** R Azure NASA ctech OPINE Earth Volumetric Studio (EVS) Mobile Interactive 3D CSM Web Scenes Data geotech Collection SDE rmarkda: **Microsoft Azure** Geospatial 10 01 Blob Storage Automated Reporting

#### How is automation done?



#### Plume stability evaluation (PSE) automation case study



- Former industrial facility on an island in the Caribbean
- For ~30-years, a pump and treat (P&T) system addressed a contaminated groundwater plume containing petroleumbased DNAPL (petroDNAPL)
  - Aged and diminished in effectiveness, required off-island disposal of a hazardous waste
- Hypothesis formed and lines of evidence provided to support a shutdown and plume stability evaluation
- Regulator granted approval to shut down P&T system for 3years for PSE of petroDNAPL and associated groundwater plume

#### Objectives of the pump and treat shutdown evaluation



Observe petroDNAPL distribution and dissolved contaminant concentrations under ambient conditions without pumping



Quantify the potential for plume expansion without P&T



Evaluate the effectiveness of natural processes to contain the petroDNAPL and dissolved phase impacts



Establish a baseline for transition to an alternative remedy

#### Unacceptable instability decision criteria

Monitoring data compared with clear instability criteria to generate PSE conclusions

		Unacceptable Condition	Criteria				
		Offsite petroDNAPL migration (lateral)	New petroDNAPL observation in wells without prior in-well petroDNAPL detection and "clean" soil boring logs				
PL	Primary	Offsite petroDNAPL migration (vertical)	New petroDNAPL observation in well screens that appear vertically disconnected from observed petroDNAPL in soil boring logs and without prior in-well petroDNAPL detection				
petroDNAPL		Onsite petroDNAPL migration (laterally distal)	New petroDNAPL observation in distal, downgradient wells without prior in-well petroDNAPL detection and "clean" soil boring logs				
pet	<b>m</b>	Onsite petroDNAPL mobility (potentially non- migrating)	New petroDNAPL observation in wells previously noted as containing petroDNAPL				
	Secor	Onsite petroDNAPL migration (vertical)	New petroDNAPL observation in well screens that appear vertically disconnected from observed petroDNAPL in soil boring logs and without prior in-well petroDNAPL detection				
	σ	Offsite migration of multiple COCs	Exceedance in well without prior exceedances and "clean" soil boring logs				
se	Prim	Onsite migration of multiple COCs (distal)	Exceedance in south perimeter well				
-Pha		Onsite dissolved COC migration	Exceedance in downgradient wells without prior exceedances and "clean" soil boring logs				
Dissolved-	ondary	Onsite dissolved COC migration	Exceedance AND statistically significant increasing trends by MK in wells proximal to petroDNAPL footprint without prior exceedances				
Diss	2	Onsite dissolved COC migration	Thiessen polygons and plume moment analysis show: - a statistically significant increase (i.e., p-value < 0.05) in Unit 2 plume mass, AND - a consistently, downgradient advancing center of mass that has traveled greater than 30% the baseline and post-earthquake plume length				

### Project-specific data and workflows

- On the order of 100,000 data records were evaluated at a high frequency to support decision making throughout the PSE
- Daily to weekly data flows were completely digitized from field to database including:
  - In-well petroDNAPL thickness
  - Groundwater analytical data (16 contaminants of concern, multitude water quality parameters)
  - Daily rainfall
  - Earthquake occurrences
- Inventory scripts (code) were developed to inventory and QC data
- Evaluation of stability decision criteria was automated using logic scripts, hosted in web-based dashboard which also automatically updated visuals, data plots, plume maps, and other reports



Database

**Decision Criteria Script** 



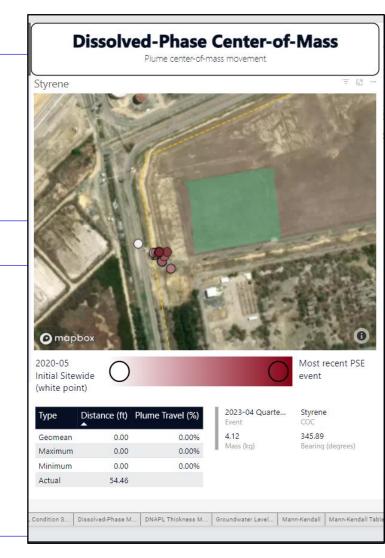
#### Scope of automation for data analytics and decision making

#### Automated data analytics

- Mann-Kendall trend statistics
- Thiessen polygon plume moment calculations mass and center of mass

#### Automated decisions

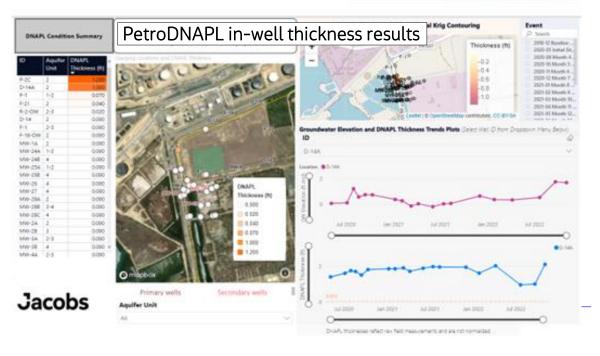
- Identification of unacceptable conditions for in-well petroDNAPL presence in "trigger" wells
- Identification of unacceptable dissolved phase concentrations in "trigger" wells
- Identification of unacceptable dissolved phase geospatial distribution



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#### Decision criteria summary for petroDNAPL SE Overview Thickness Results = Well NP1 NP2 NP3 NS1 NS2 Count Event 14.01 List 10 8-12 Baselva Gaugi... . lizne None None 8 2010-12 Bateline Gaugerg 0-05 today threadly .... 2.6 8 2020-05 millel Silenide Gal None None None 0-Dit Month 4 Gauge. None None p-to Menth 5 Group. 17-40 hone 8 2020-07 Breakly 4 Gauginy Name . D-11 Month & Gauge P-4C Note Note 8 2020-07 Biveekly 8 Gauging D-12 Month T Gauge P-48 5-D1 Month & Geop. P-2A 8 2020-06 Biweekly 7 Gauging Note Note 1-82 Month 9 Gaugea 2020-09 Month & Gauging hinter . 1,0144 MW-31 1-ELMAND 15-Cal. MW-28 Note Name II 2020-10 Month 5 Gauging 1-D4 Month 11-Date: MW-28C 8 2020-11 Month & Deuping 1-25 Martin 12 Gau **Name** None: Primary wells Secondary wells 1-DEMAND 12-DAL MW-288 8 3020-12 Month 7 Gauging National 10004 North A r-c? worth 14 Cash. MW-25A 8 2521-07 Month & Geuging Fill Month 13 Cal. MW-27 8: 3121-02 Moreth & Dauging histe hore 5-11 Guetter # Grog... MW-218 DNAPL Condition . NP1 NP2 NP3 NS1 NS2 2-62 Quarter 7 Daug. 10 Intellate specific hit das press 56W-254 2-64 Guarter & Gaug Total 1 2-07 Quarter 8 Gaug-10.000 2-16 Company G. Condition 2-11 Quarter 10 Call NPT Description New observation of DNAPL (>0.03-foot thickness) in wells without prior in-well DNAPL detection and "clean" soil boring logs (e.g. MW-ACODS 28A, MW-288, and P-2A).

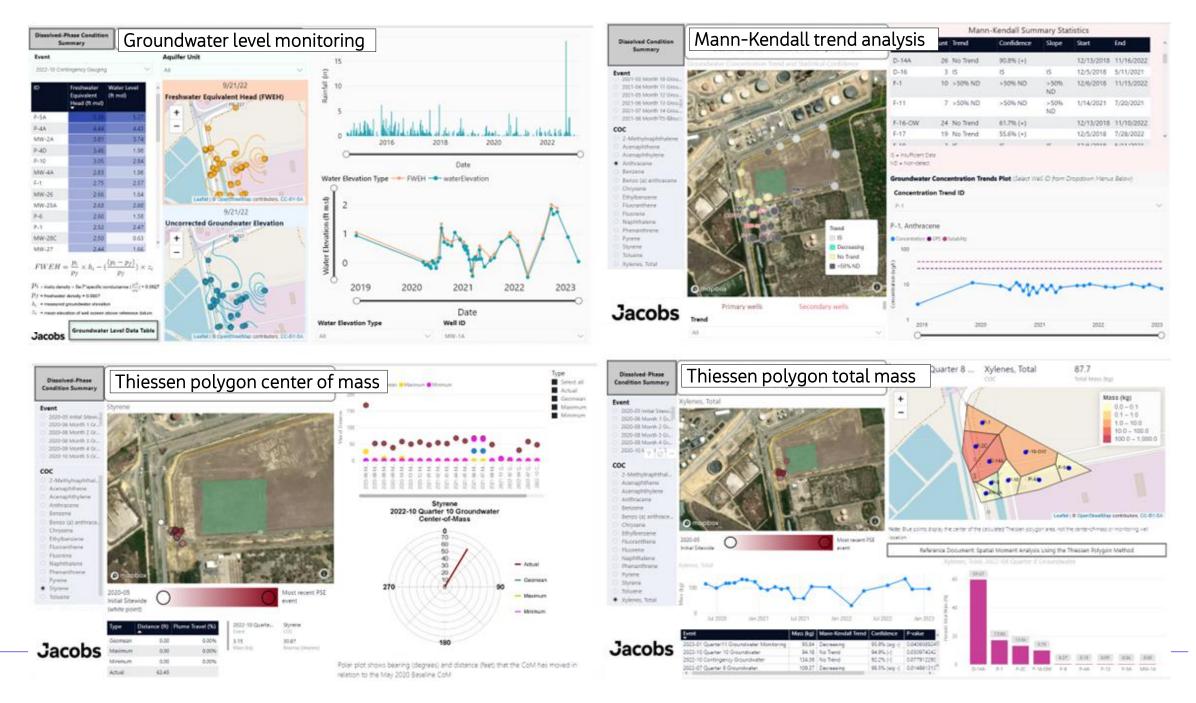


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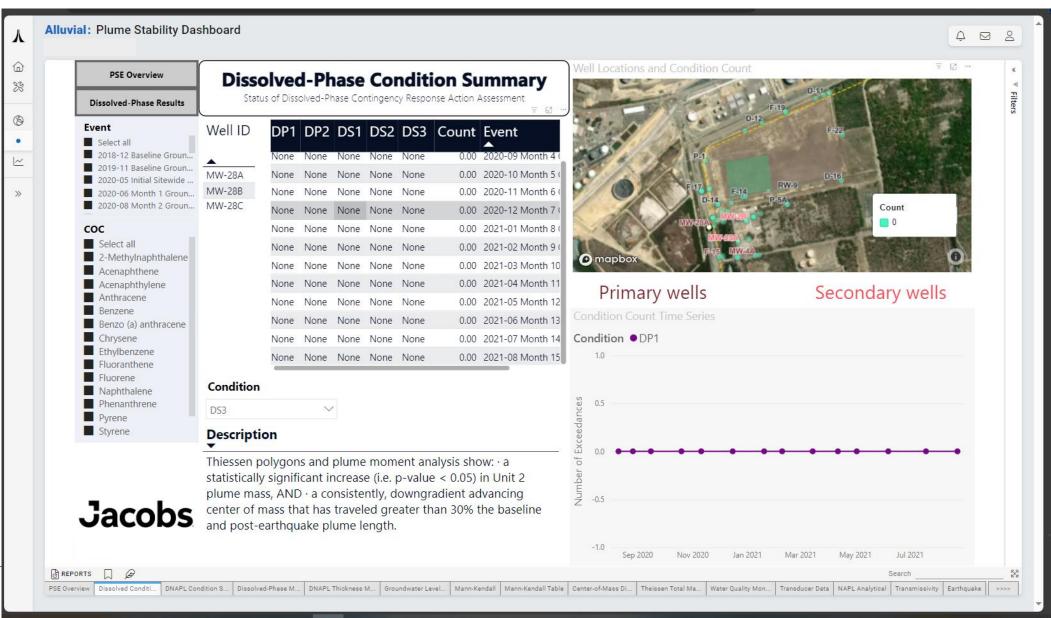
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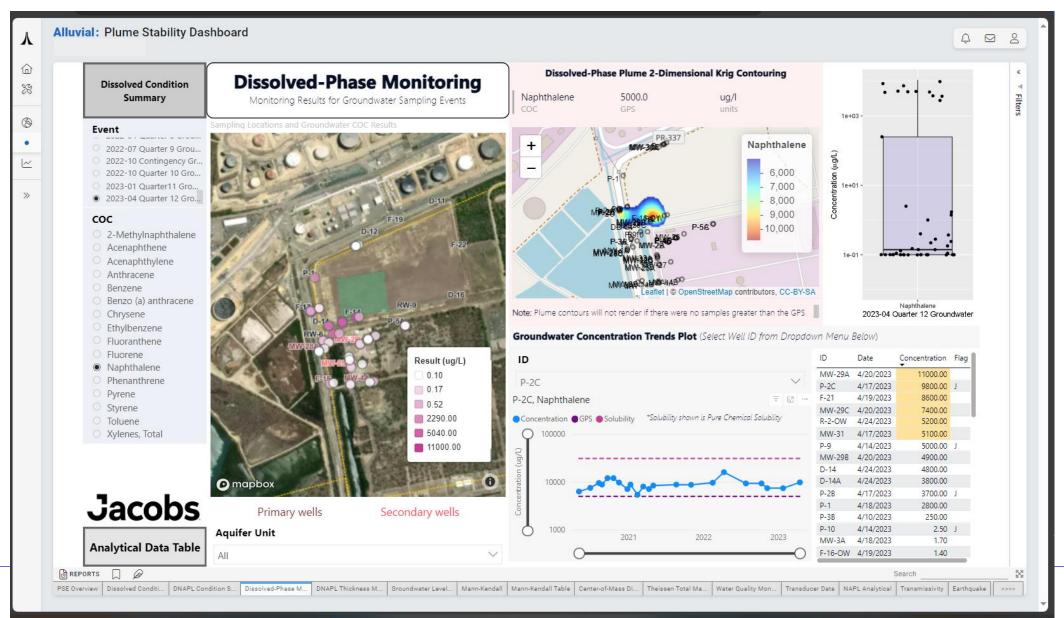


#### Decision criteria summary for dissolved-phase



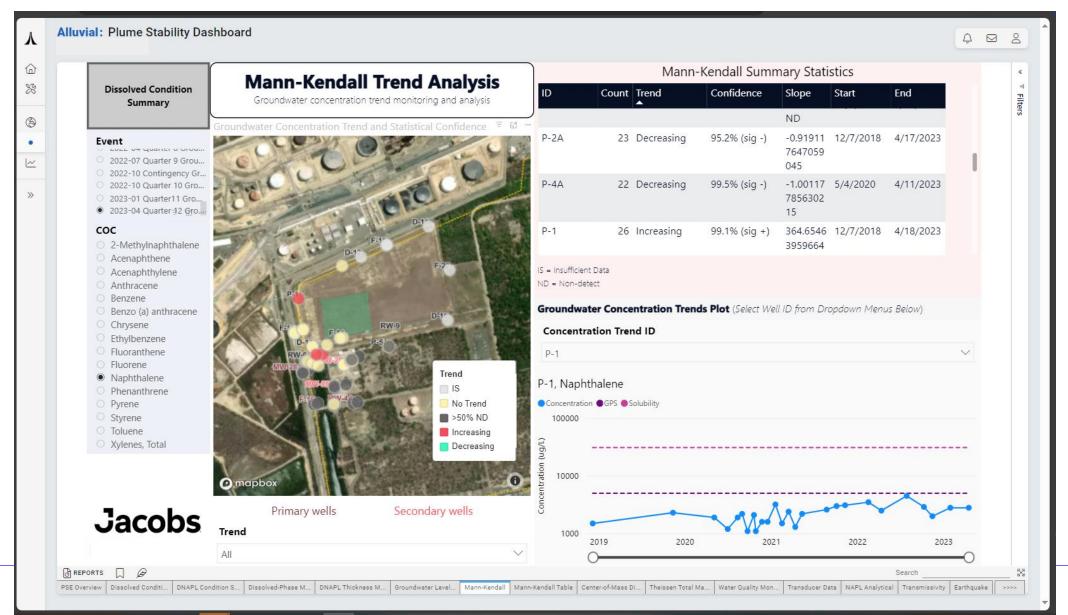
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#### **Dissolved-phase concentration results**



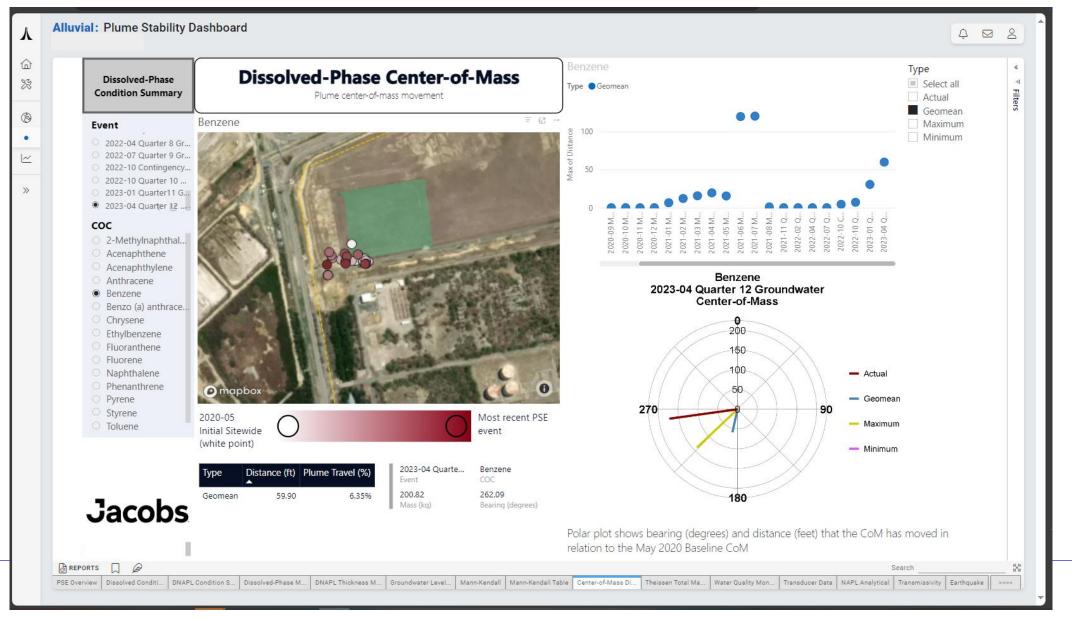
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#### Mann-Kendall trend analysis



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#### Thiessen polygon center of mass tracking



#### PSE automation case study – Results

- Data analytics automation successfully processed a very large data set to a firm conclusion
  - Output multiple lines of evidence to demonstrate plume stability
  - No primary unacceptable instability observed during P&T shutdown
    - Some dynamics in the secondary petroDNAPL conditions, but explained by site disturbances (i.e., earthquakes and hurricanes)
- Entire project team (including client and regulator) accessed the results and used the dashboard
  - Data analytics dashboard provided transparent access and facilitated regulatory concurrence on key decisions
- Results convinced the regulators to extend P&T system shutdown into remedy selection phase
- Reaffirmed value of digitization from field to report to provide the data needed to automate thorough decisions

#### Takeaway learnings

Data analytics and
decision automation
is effective and
powerful

# Provides fast data evaluation results

Viable method for processing large site monitoring data streams

Drives 100% digitization of data streams used to make decisions Requires humans – consistency, attentive database stewardship, and QC Investment required, but ultimately reduces data evaluation costs

#### The EXCITING future of automation

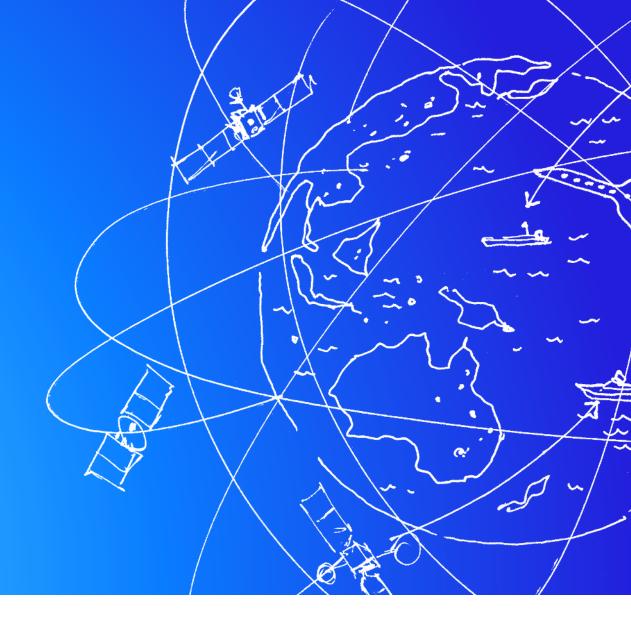




## Field sensors

# Report automation

# The end.



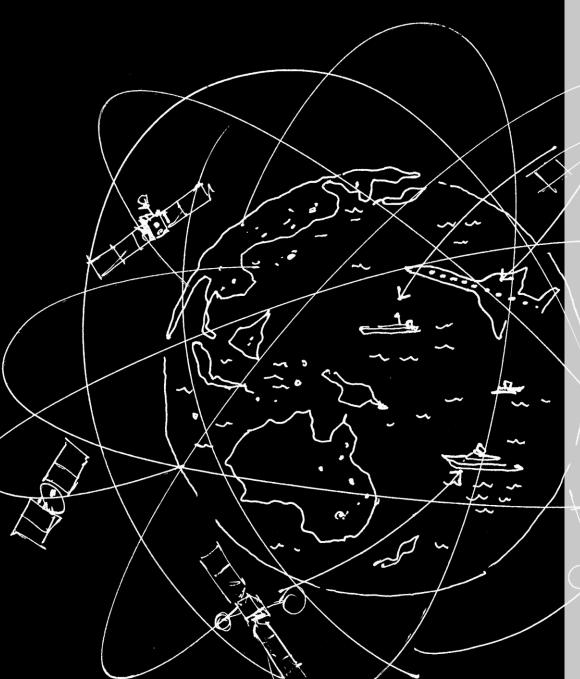
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# How can data analytics automation apply throughout the remediation life cycle?

