

SUVA

Climate Resilience Pathways:

Water Security and WASH in Asia Pacific

Harnessing diverse data for water, WASH and resilience decision-making

Rosie Sanderson, Christopher Saili, Mary Alalo, Kasmin Raju

TUESDAY 29TH APRIL – 09:00

ROOM 1 – ID22



Pacific
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Communauté
du Pacifique





Welcome and session overview

- Introduction
- Short presentations from our four speakers
- Breakout to “World Café” session
- 10 minutes at each table (timed)
- Thanks and close

Welcome and session overview

- Digital Earth Pacific – Kamsin Raju
- The Pacific Community (SPC) – Mary Alolo
- Kahuto Pacific – Christopher Saili
- International WaterCentre – Rosie Sanderson



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International
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Digital Earth
PACIFIC



KAHUTO

Harnessing Diverse Data on Water Resources and Hazards

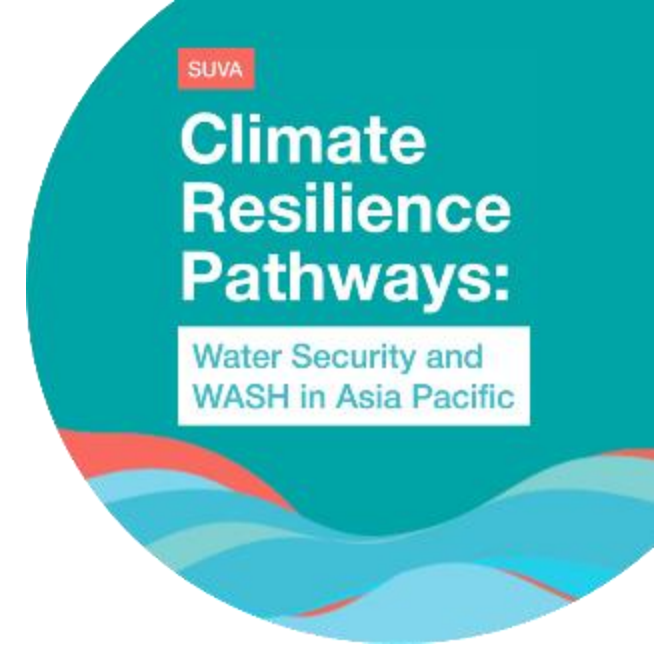
Water Observations from Space: Supporting Resilience in the Pacific

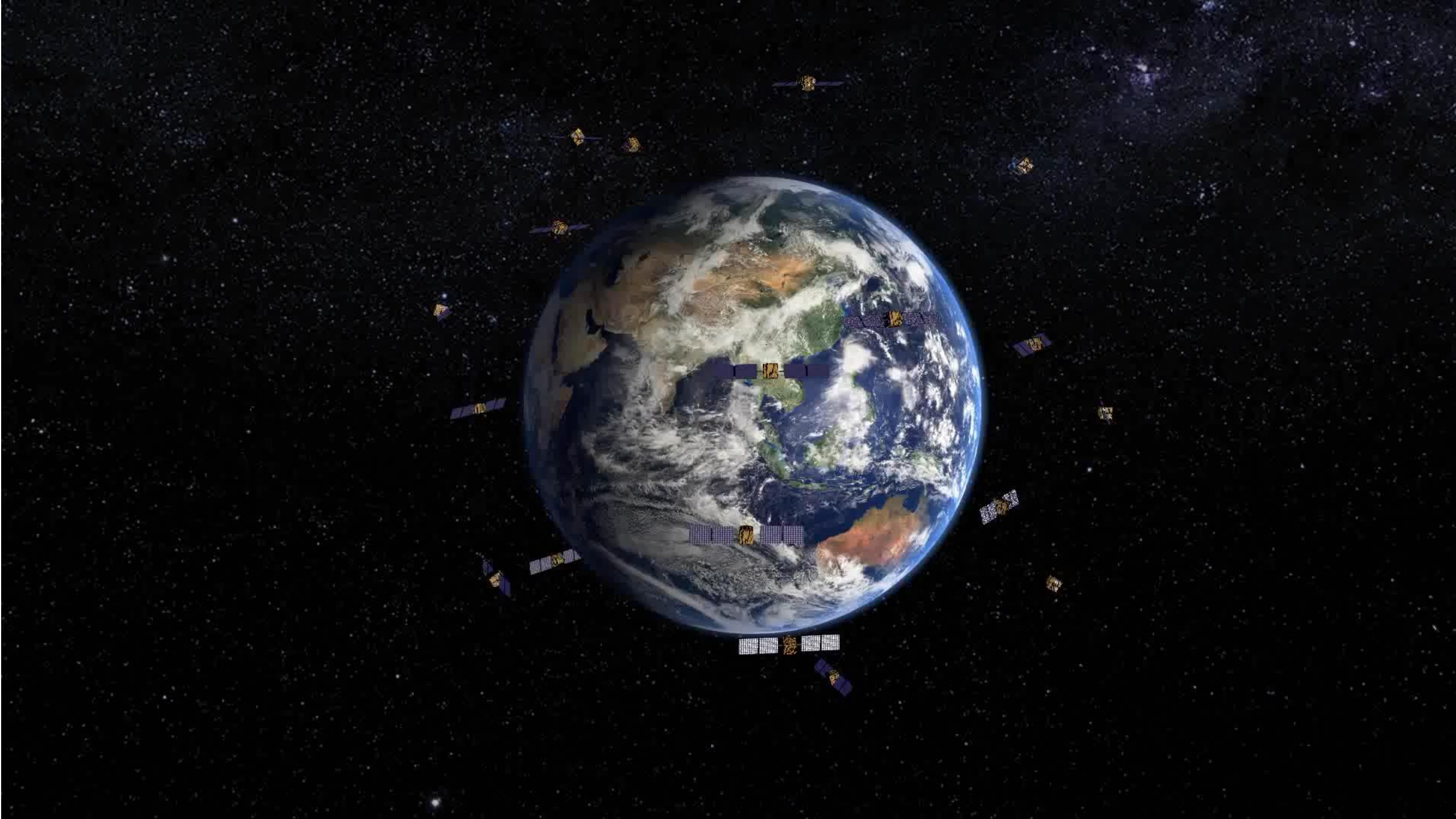
Kamsin Raju

Earth Observation Technical Officer

Pacific Community (SPC)

kamsinr@spc.int





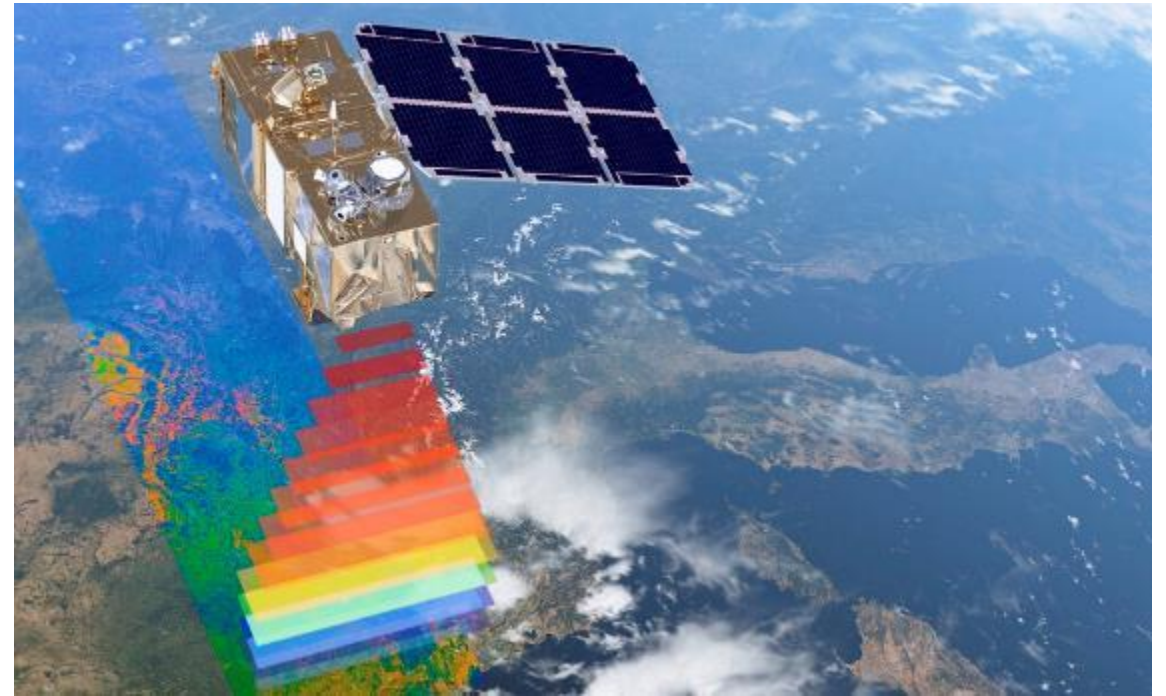
What is Earth Observations?

Earth observations are data and information collected about our planet:

- Earth's Surface,
- Oceans
- Atmosphere
Climate Variables

The data can come from:

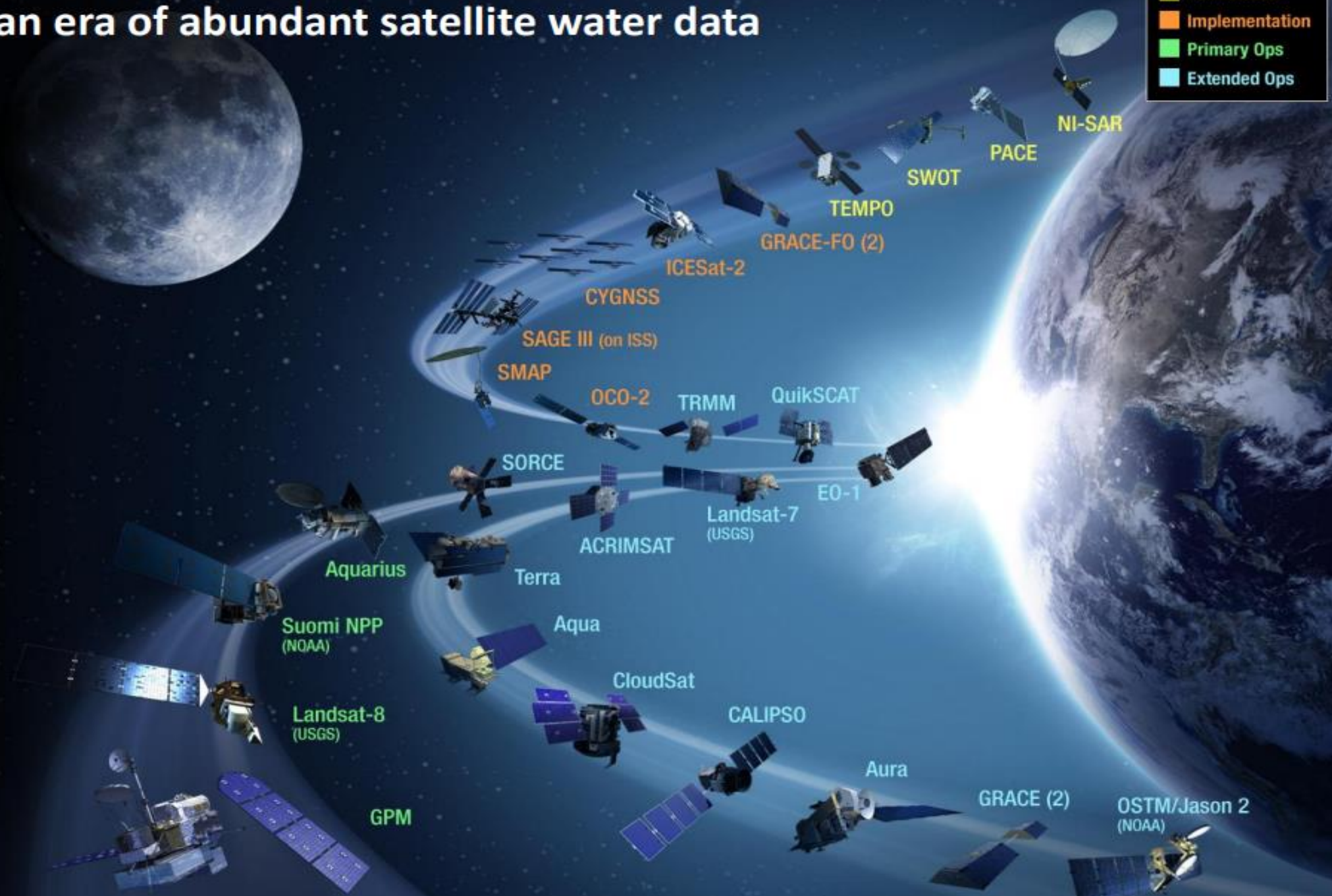
- sensors in space (satellite)
- sensors in the air (planes, drones)
- sensors on the ground (e.g. air quality instruments)
- citizen science



EO data are used for monitoring and assessing the status of, and changes in, the natural and manmade environment.

We live in an era of abundant satellite water data

- Formulation
- Implementation
- Primary Ops
- Extended Ops



(Courtesy of NASA)

Why Observe Water from Space



Pacific nations face rising climate and water-related risks



Ground monitoring is limited—space-based data fills critical gaps



Satellite data offers consistent, scalable, and near real-time information

Key Benefits for the Pacific



Better Planning



Faster Disaster Response



Smarter Waste Management

Digital Earth Pacific

The **Digital Earth Pacific (DEP)** is a public digital infrastructure, an operational Earth observation system that uses decades of satellite data to show how local environments are changing over time.



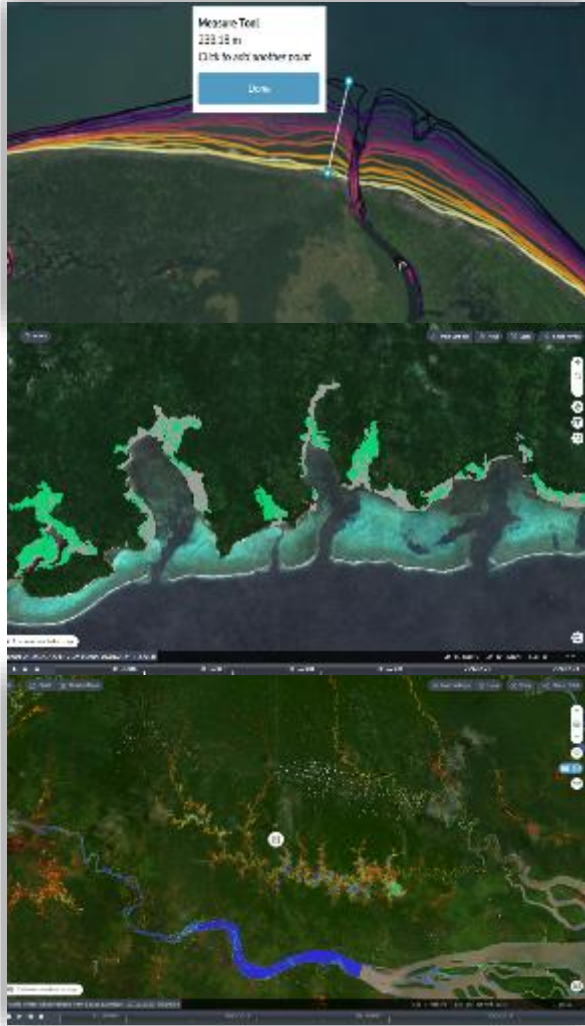
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Digital Earth
PACIFIC

www.digitalearthpacific.org

Launched Regional Products



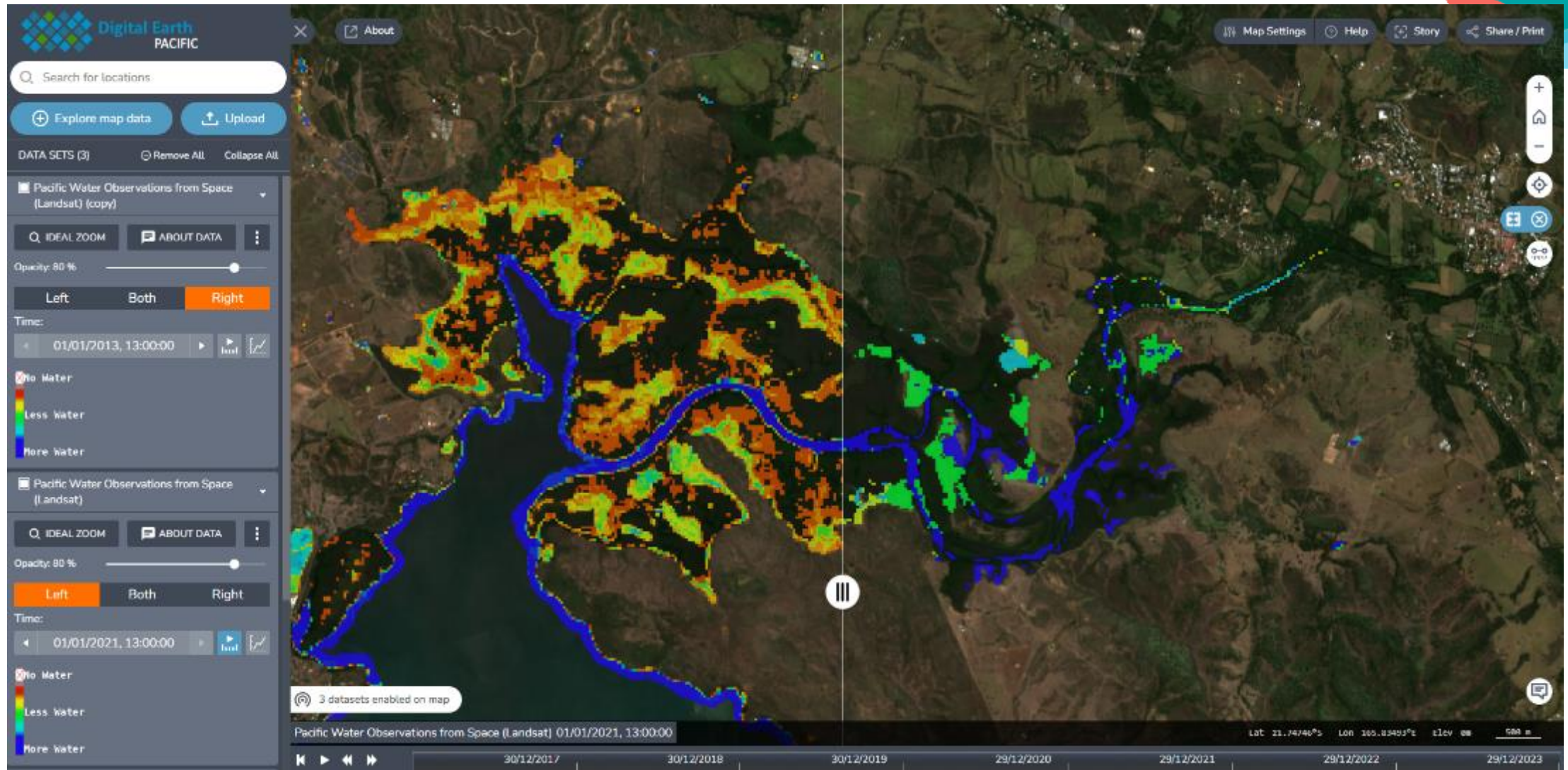
- 22 years of Pacific coastline change
- ~ 34k km of coastline for the Pacific (22 PICTS)
- ~ 10% of global coastlines

- 7 years of Pacific mangrove data
- Illustrates loss and recovery

- 10 years of Water Observations from Space (WOfS)
- Useful for understanding flood zones and water security



Water Observations from Space

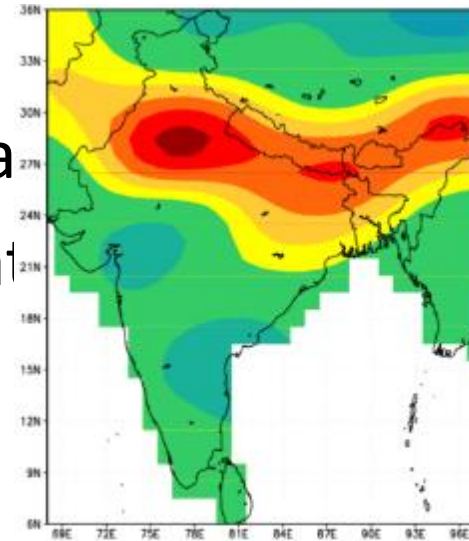
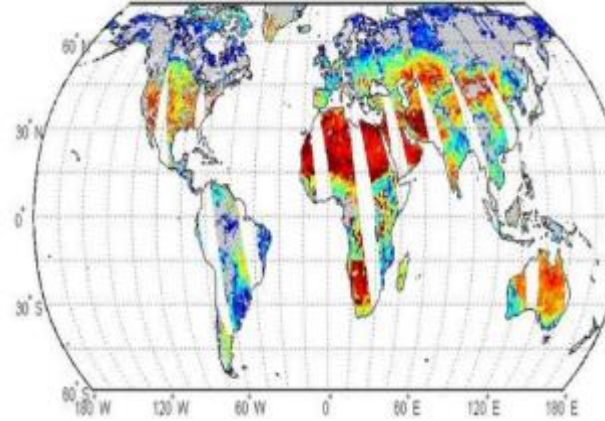


Annual summary of temporal and spatial extent of water bodies. In New Caledonia you can see how the amount of water has changed over recent years. Using WoFs you are able to detect flood plains, it can be used for drought monitoring, disaster planning, and water security.

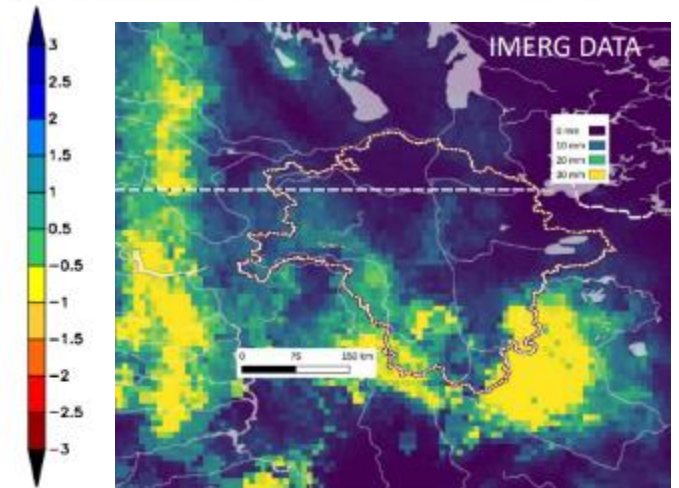
Prospects for Water Resources Management

Sustainably Managing Water, Ca & Supply

- Groundwater Aquifers and depletion/recharge rates
- Drought early warning & soil moisture indicators
- Water quality (turbidity, sediment, a
- Rainfall & Runoff Trends (via integrat
- Catchment Health Tracking
- Reservoir and Lake Storages



Rate of change in TWS (cm/mo.) (after Rodell)



Prospects for Water Resources Management

Supporting Early Warning, Preparedness & Response



Flood Mapping



Cyclone Impact Assessments



Sea Level Anomalies & Coastal Inundation



Shoreline Change & Coastal Erosion



Early Warning System Data Feeds

Project Plugins

Layers Panel

- Low Estimated Impact
 - Dry (≤ 0 m)
 - Wet (0 m - 0.2 m)
 - Flooded (≥ 0.2 m)
- Medium Estimated Impact
 - Dry (≤ 0 m)
 - Wet (0 m - 1.0 m)
 - Flooded (≥ 1.0 m)
- High Estimated Impact
 - Dry (≤ 0 m)
 - Wet (0 m - 1.5 m)
 - Flooded (≥ 1.5 m)
- Merged.shp
 - Extreme
 - High
 - Medium
 - Low
 - Dry
- Extreme Estimated Impact
 - Dry (≤ 0 m)
 - Wet (0 m - 2.0 m)
 - Flooded (≥ 2.0 m)
- Nadi Buildings
- Nadi Flood 2012
 - 0.176936
 - 1.751296
 - 3.325657
 - 4.900017
 - 6.474377
 - 8.048738
 - 9.623098
 - 11.076354
 - 12.287400



PacSAFE 3.2.1

Show question form



Analysis Results

In the event of nadi flood 2012 how many nadi buildings might be flooded

Flooded	4,314
Wet	130
Dry	3,232
Affected buildings	4,444
Unaffected buildings	3,232
Total	7,676

Building type	Flooded	Wet	Dry	Total
Commercial - accommodation	84	1	130	214
Commercial - general commercial	265	6	159	430
Commercial - out building	15	4	11	30
Industrial - general industrial	92	3	17	112
Infrastructure	12	0	13	25
Other	78	2	77	157
Public - education	57	0	53	110
Public - general public facility	31	1	14	46
Public - government	33	2	27	62
Public - health care services	7	0	24	31
Public - religion	33	0	22	55
Residential - out building	657	17	304	1,000
Residential - permanent dwelling multi family	204	13	219	436
Residential - permanent	2,726	81	2,063	4,800

Help About Print... Run

Challenges and Opportunities

Challenges



Data capacity



Internet access



Local training



Opportunities



Regional collaboration



Custom tools



Community resilience

Thank you!



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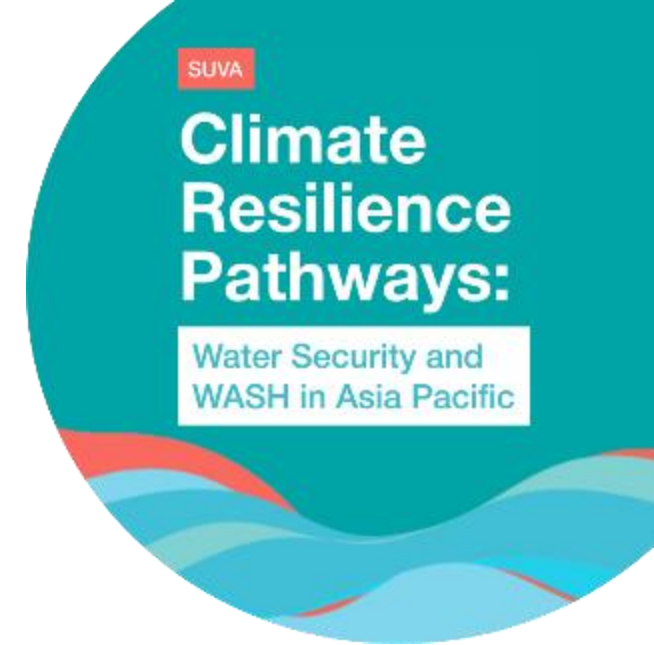
KAHUTO

Harnessing Diverse Data on Water Resources and Hazards

Majuro Atoll Model – 3d printed maps

Mary Alolo

Coordinator - Building Regional Action and Cooperation on Water Security
Pacific Community (SPC)



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**Lense Contours -
meters below surface**

- 2.5
- 5
- 7.5
- 10
- 12.5
- 15



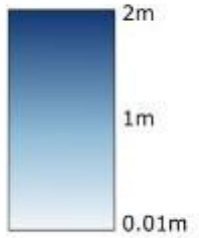
Groundwater
galleries
and wells



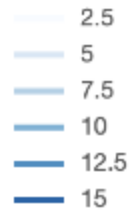


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Inundation level



Lense Contours -
meters below surface



Groundwater
galleries
and wells

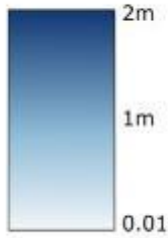


RP
100 yr

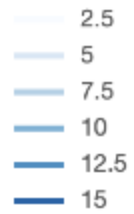


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Inundation level



Lense Contours -
meters below surface



Groundwater
galleries
and wells



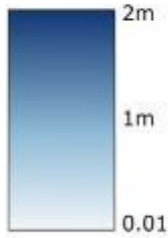
RP
10 yr

SLR
25cm

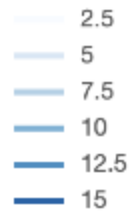


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Inundation level



Lense Contours -
meters below surface



Groundwater
galleries
and wells



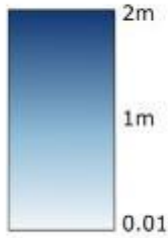
RP
25 yr

SLR
25cm

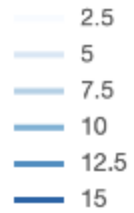


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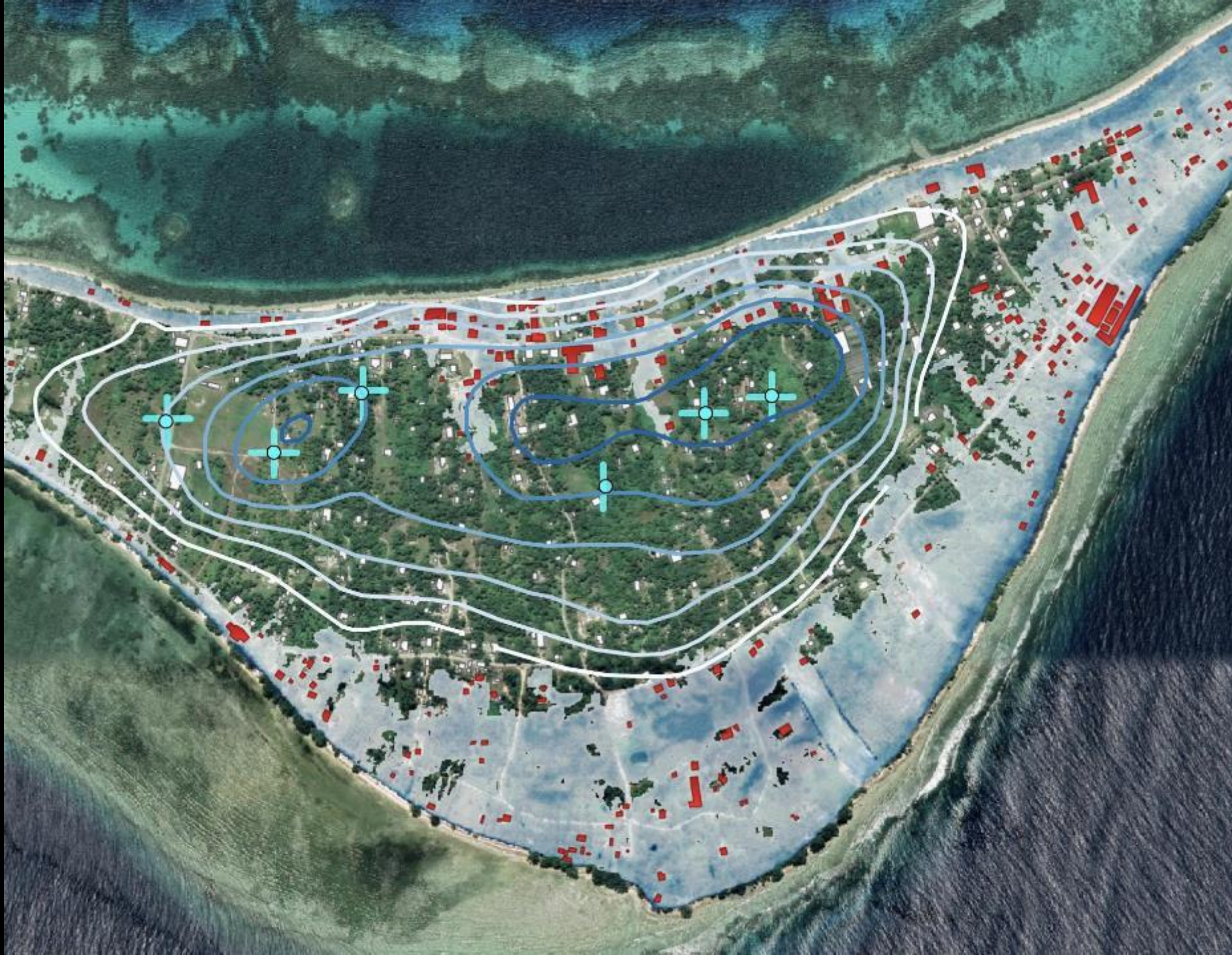
Inundation level



Lense Contours -
meters below surface



Groundwater
galleries
and wells



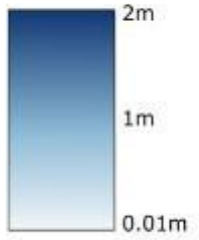
RP
50 yr

SLR
25cm

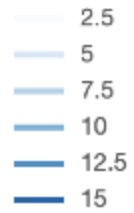


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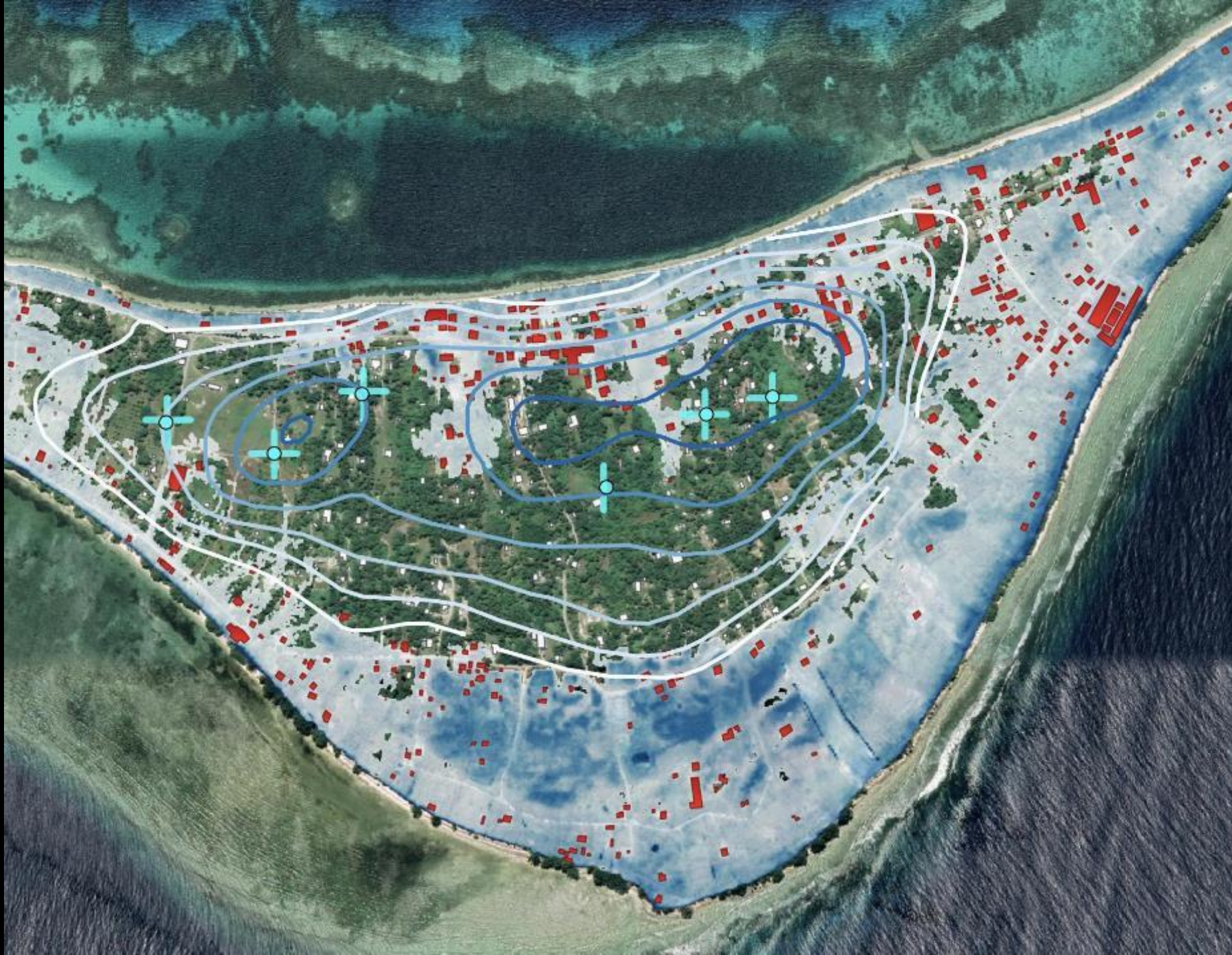
Inundation level



Lense Contours -
meters below surface



Groundwater
galleries
and wells



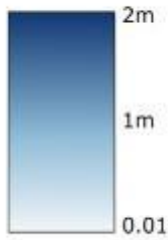
RP
100 yr

SLR
25cm

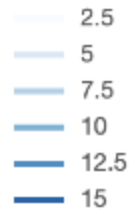


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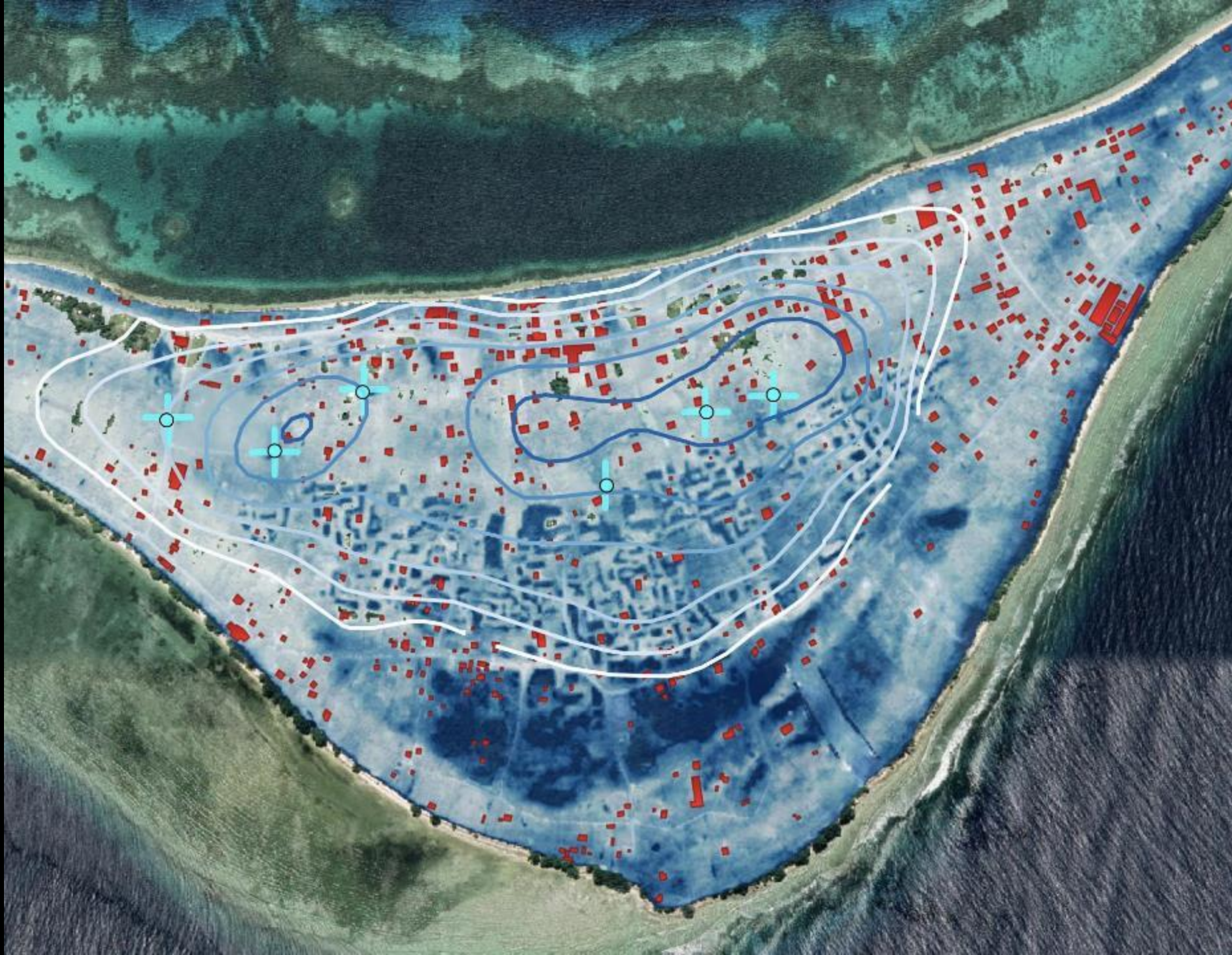
Inundation level



Lense Contours -
meters below surface



Groundwater
galleries
and wells



RP
100 yr

SLR
50 cm

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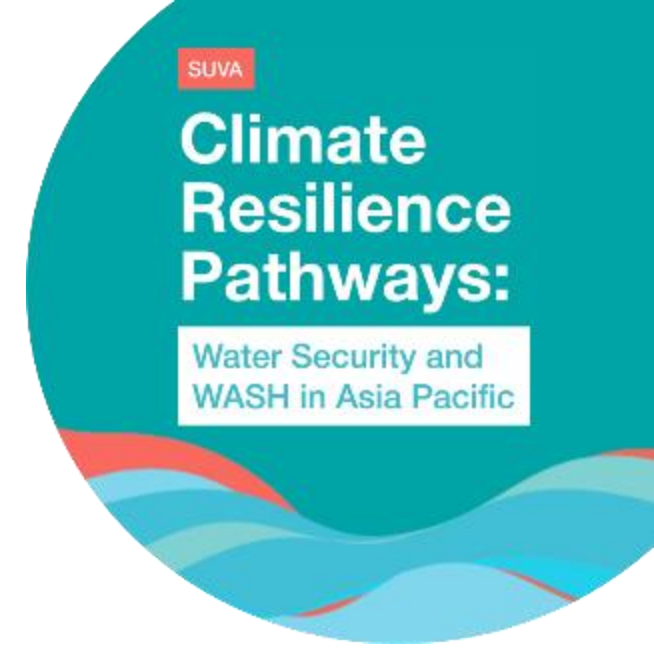
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Using Geospatial Data and Digital Solutions to improve Climate Resilience WASH

Chris Saili

Kahuto Pacific - Moana Data Service



Moana Data Service



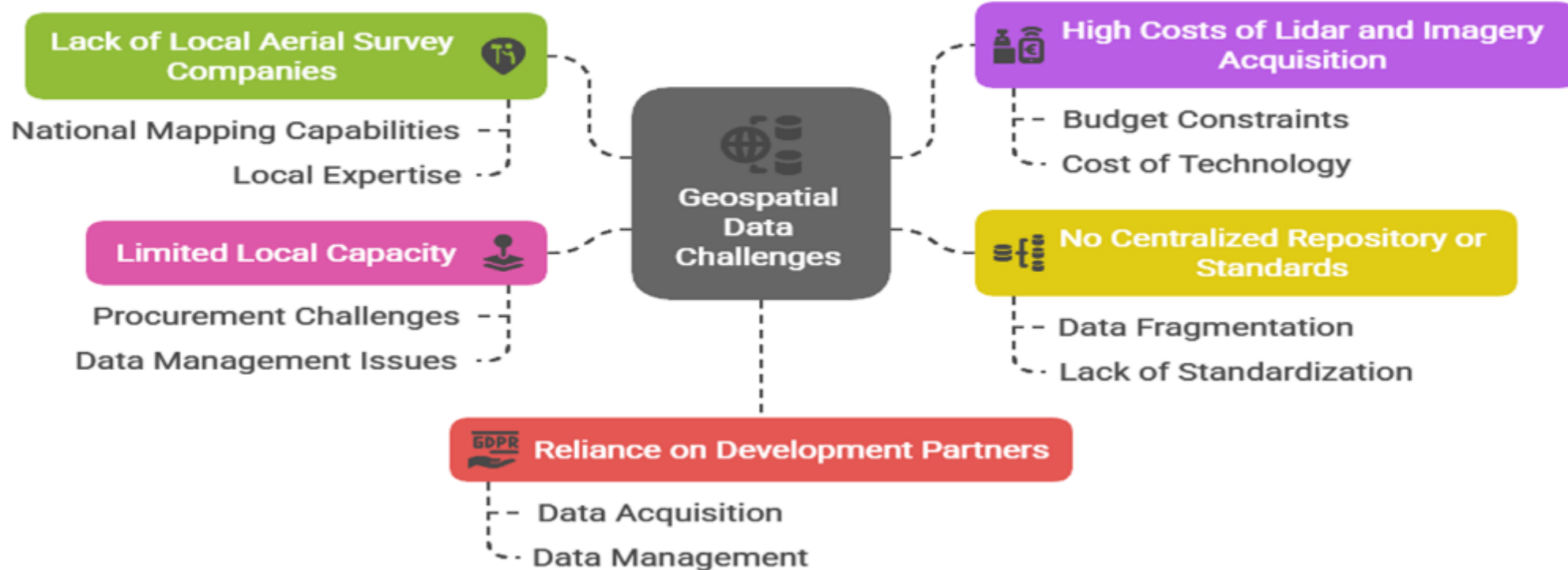
The **Moana Data Service** is a locally led initiative designed to **decrease the cost and increase the accessibility** of high-resolution **geospatial- LiDAR, ground penetrating radar and echosounding data** for **decision-makers** across the **Pacific Islands**.



Bridging the Pacific Data Gap



Addressing Geospatial Data Challenges in the Pacific



National LiDAR and Imagery Mapping



• For Users

- Easy access to comprehensive geospatial data
- Improved decision-making with accurate information
- Enhanced collaboration through shared data

• For Organizations

- Streamlined data management
- Cost savings from reduced data duplication
- Better public service delivery

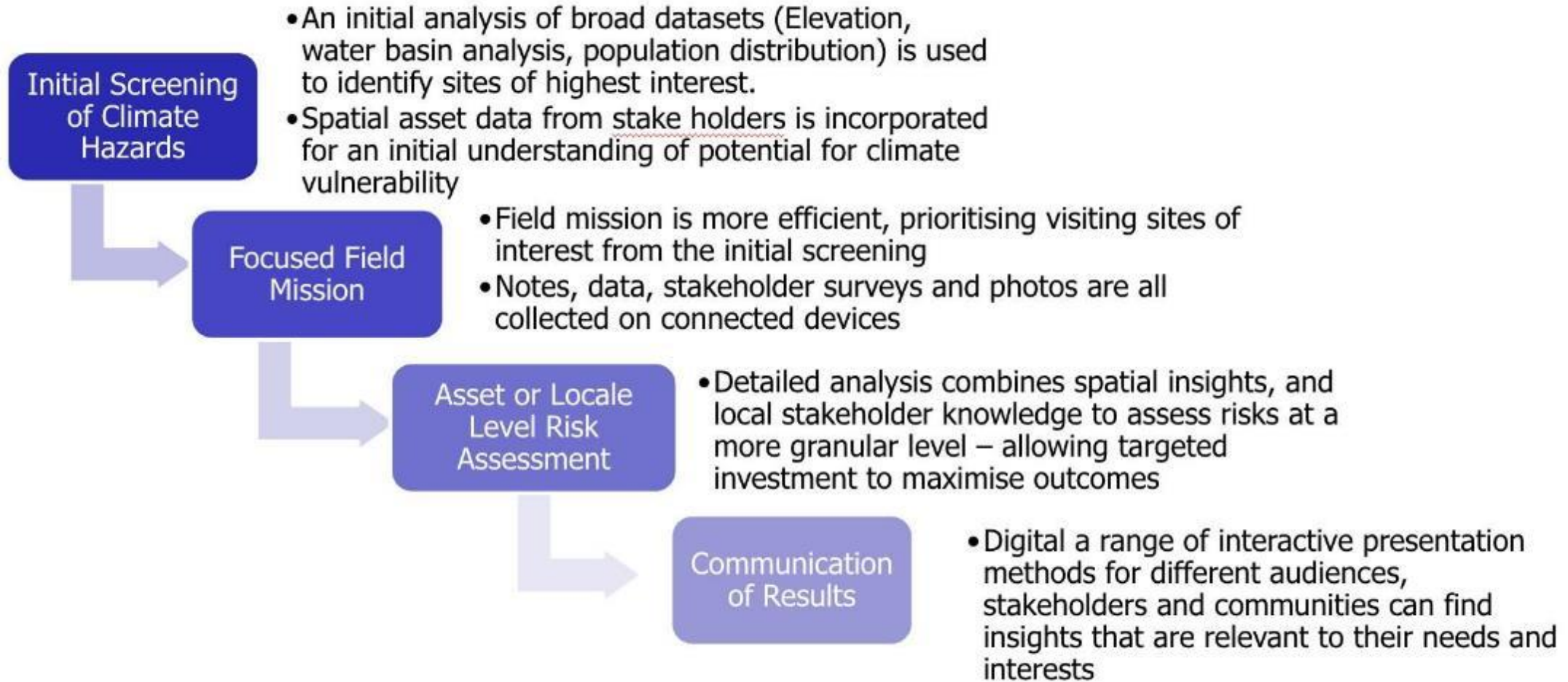


WASH and Climate Risk



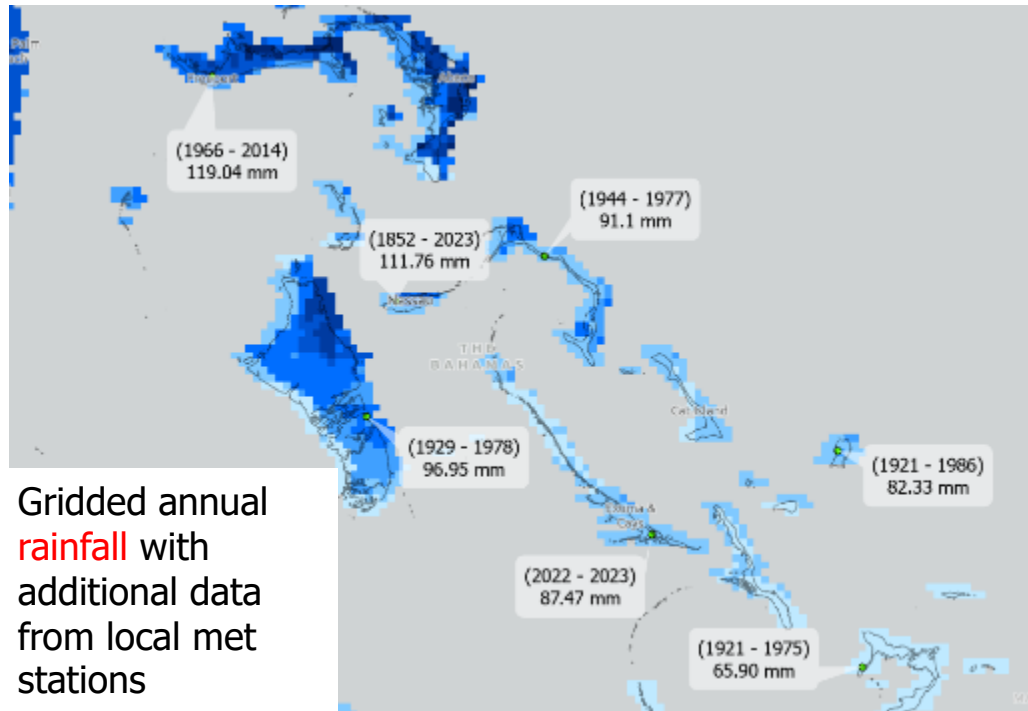
- WASH Climate Resilience requires an understanding of climate risk to water resources, water supply and sanitation infrastructure and user communities
- Understanding of climate risks enables identification of risk reduction measures, whose delivery results in improved climate resilience
- Climate Risk = Hazard x Exposure x Vulnerability
- But ... SIDS are very data space
- Digital technology can provide insights into:
 - Hazard identification and mapping
 - Infrastructure asset location and mapping
 - Community stakeholder location and mapping
 - Analysis of exposure and vulnerability
 - And thus risk assessment

An Integrated Solution

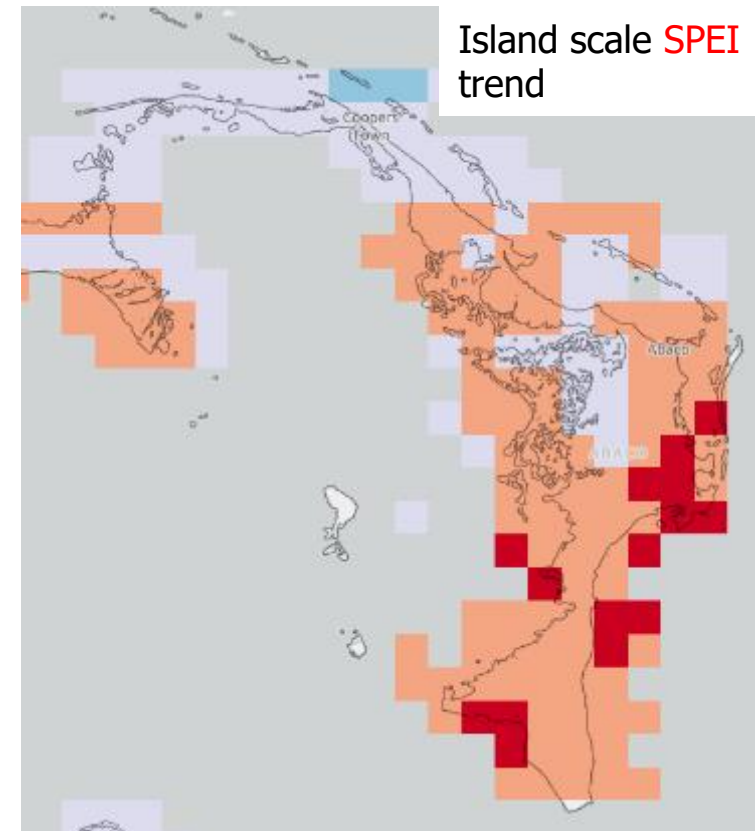


Large scale satellite data analysis

- Understanding national distribution of climatic trends from global satellites
- Enables identification of more vulnerable islands
- Eg drought vulnerability in The Bahamas
- Still relevant at island scale, depending on size



Gridded annual rainfall with additional data from local met stations

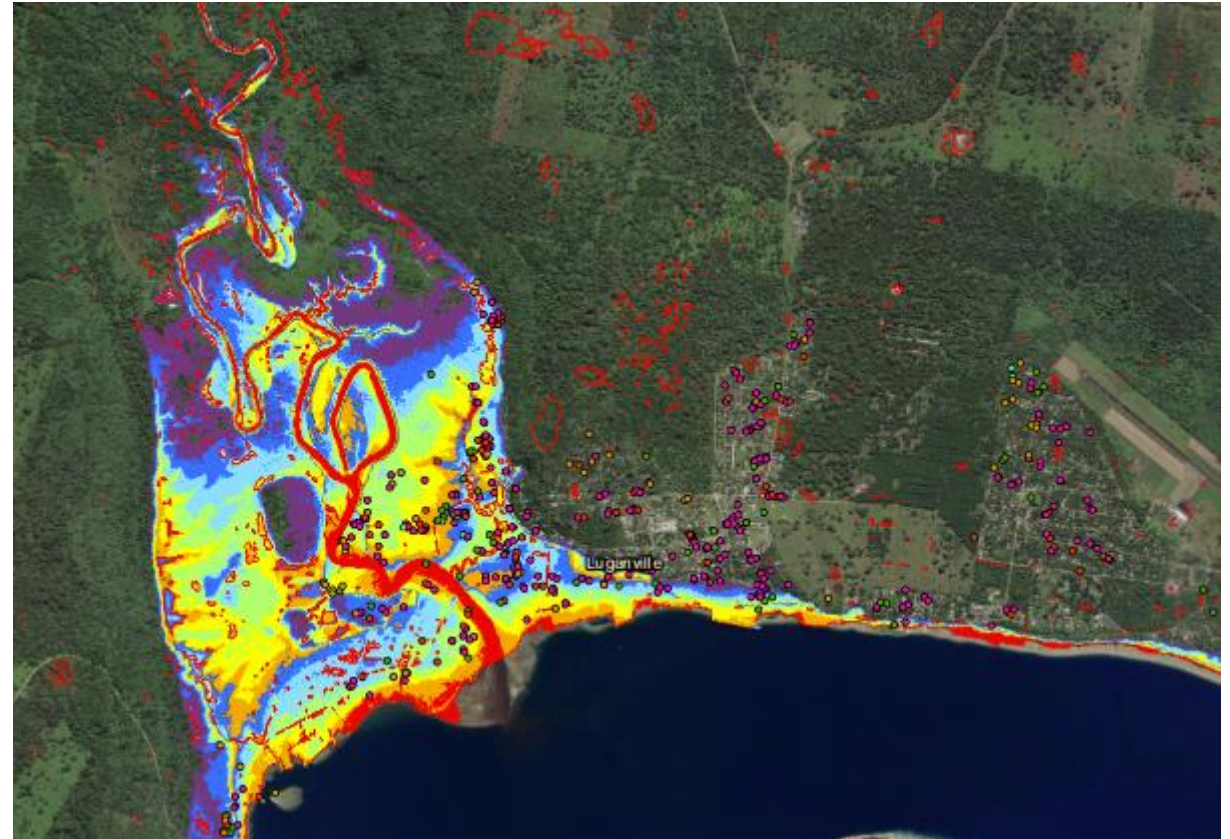


Island scale SPEI trend

Medium scale LiDAR data analysis

- Town, coastline or small island or town scale topography and aerial photography
- Terrain analysis informs hazard identification and mapping
 - Elevation – river flooding, storm surge, tsunami
 - Slope – landslides, erosion, turbidity
 - Overland rainfall run-off routes – rainfall flooding
 - Terrain depressions – sinkholes, lava tubes
- Supports exposure mapping
 - Dots are households
 - Georeferenced data responses from WASH surveys (eg rainwater tank volume xxx litres)

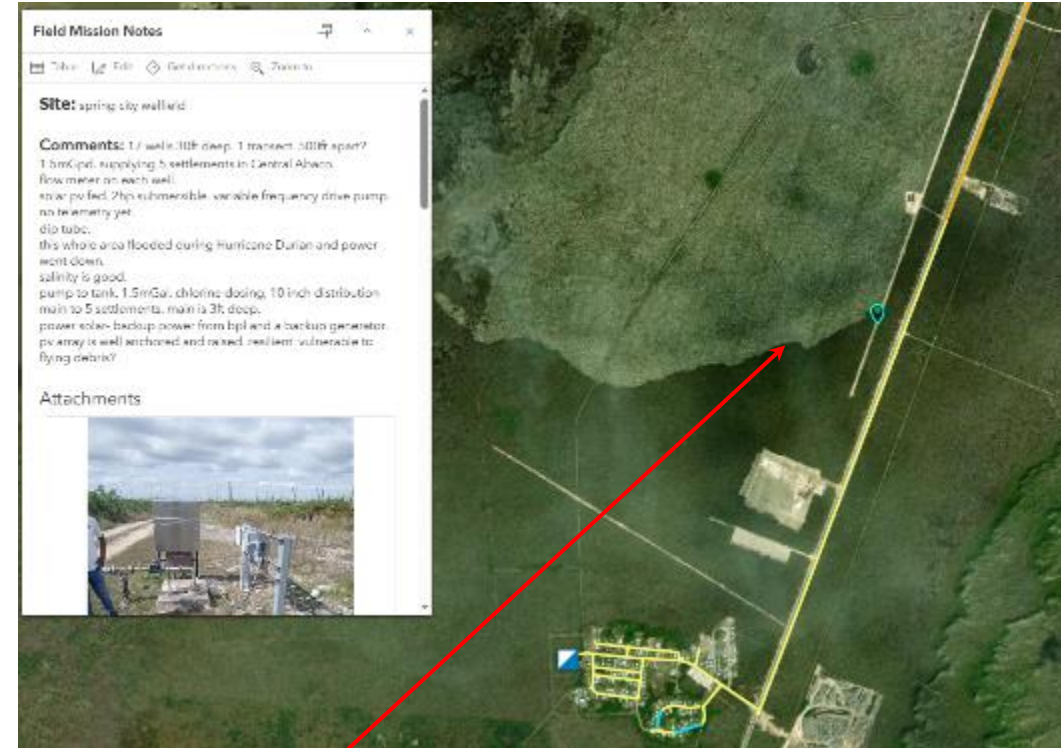
Sinkholes



Connect directly to Field Mission

We deploy mobile applications to assist our field staff

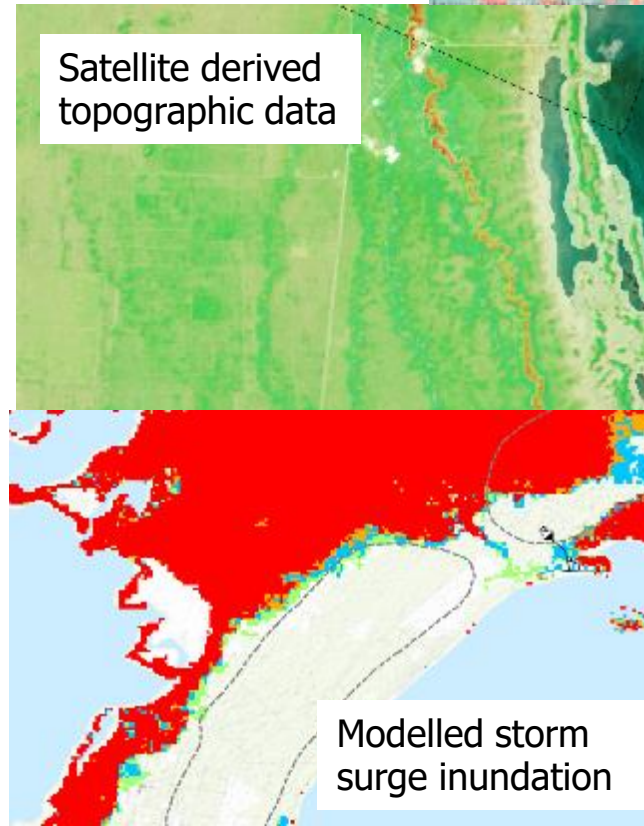
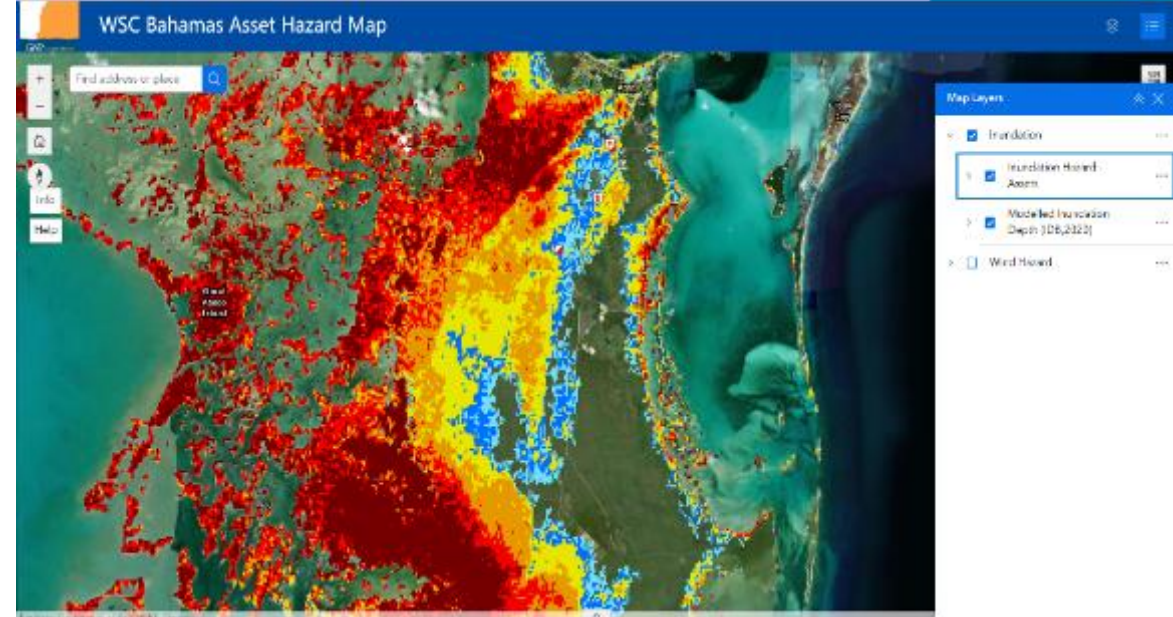
- View analysis in the field
- Collect notes, photos and more, in a single application
- Points are spatially referenced and stored online, creating a single source of truth for all collaborators to work from. Control and sharing of the data is simple from the central database
- Enables office-based staff to provide easy support to field mission via updates to the app
- Off-line support for remote areas



Wellfield on-site notes –
green flag location –
overlaid on satellite image
and infrastructure asset
data set

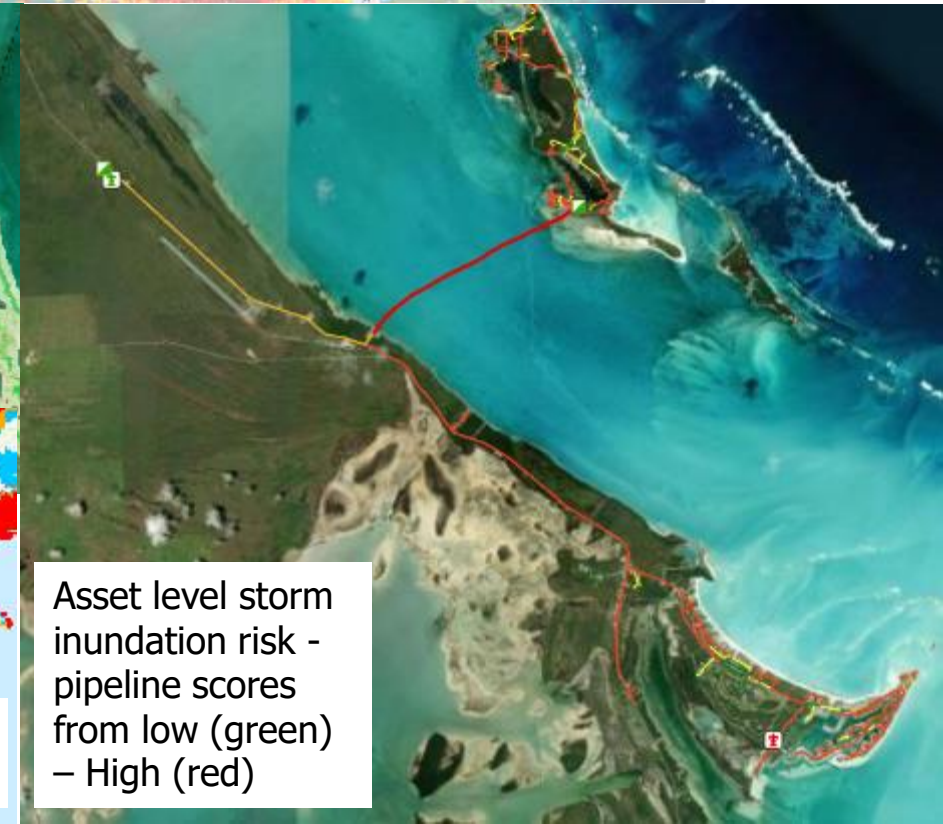
Risk Assessment & Visualisation

- Hazard mapping, asset mapping and exposure
- Multiple datasets are analysed to assess climatic risks from different sources eg rainfall and storm surge flooding
- Different size similar hazards can be assessed at multiple locations eg 1 in 50 Year vs 1 in 100 Year storm surge inundation depth
- Results are all displayed in an interactive web view to simplify access to the wealth of insights generated
- Analysis is completed on an asset-by-asset basis but can be summarised by system or island where needed.
- Points can be placed along linear assets (e.g. pipelines) to assess how risks may change spatially. This allows more targeted intervention e.g. replacement or burying of specific segments of pipeline.



Satellite derived topographic data

Modelled storm surge inundation



Asset level storm inundation risk - pipeline scores from low (green) – High (red)

Risk Assessment Analysis

- Risk quantification
 - Likelihood and consequence
- Informs identification of risk reduction measure options
 - Better than high/medium/low risk classification
 - Eg SOPs for frequent low impact
 - Eg CAPEX investment for rare catastrophic
 - Can select based upon budget constraints
- Enables systematic and transparent prioritization of risk reduction measures
 - Numerical comparison of risks

		CONSEQUENCE					
		1	2	5	10	20	
		Minimal	Minor	Moderate	Significant	Catastrophic	
		Limited/ no cost to recover. OR Disruptions to a system for less than a week	Limited cost to repair or replace OR Disruptions to a system for 1 to 2 weeks	Moderate cost to repair or replace OR Disruptions to a system for 2 to 4 weeks	High cost to repair or replace OR Disruptions to a system from 1 month to 3 months	Very high cost (e.g. replacing a major asset) OR Disruptions to a system for more than 3 months	
LIKELIHOOD							
5	Frequent and regular	Multiple times per year	5	10	25	50	100
4	Common	Around once a year	4	8	20	40	80
3	Rare	Once every 10 years	3	6	15	30	60
2	Very rare	Once every 50 years	2	4	10	20	40
1	Extremely rare	Once every 100 years	1	2	5	10	20

Use Case



- Use Case 3: Catchment Management for Safe Water Supply

- *Land Use Monitoring*: Surface models help detect forest loss, erosion-prone slopes, and encroachment areas.
- *Terrain Analysis*: Provides understanding of how the terrain influences runoff and potential sedimentation or pollution of water sources

***Visual*: Catchment boundary overlaid on DTM to demonstrate how mapping allows for communities to protect their water sources from contamination/degradation**

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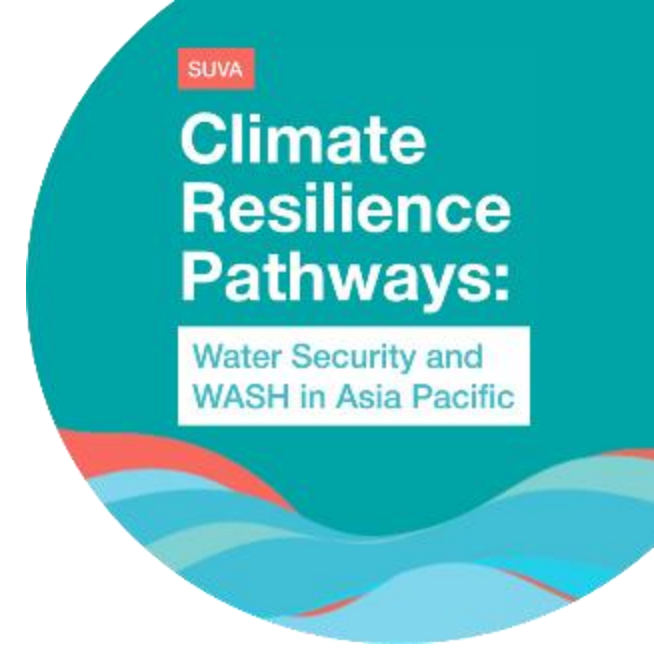
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Data4Decision-Making Session

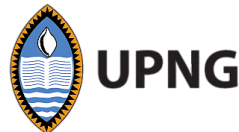
Using spatial and participatory data for WASH planning in informal settlements



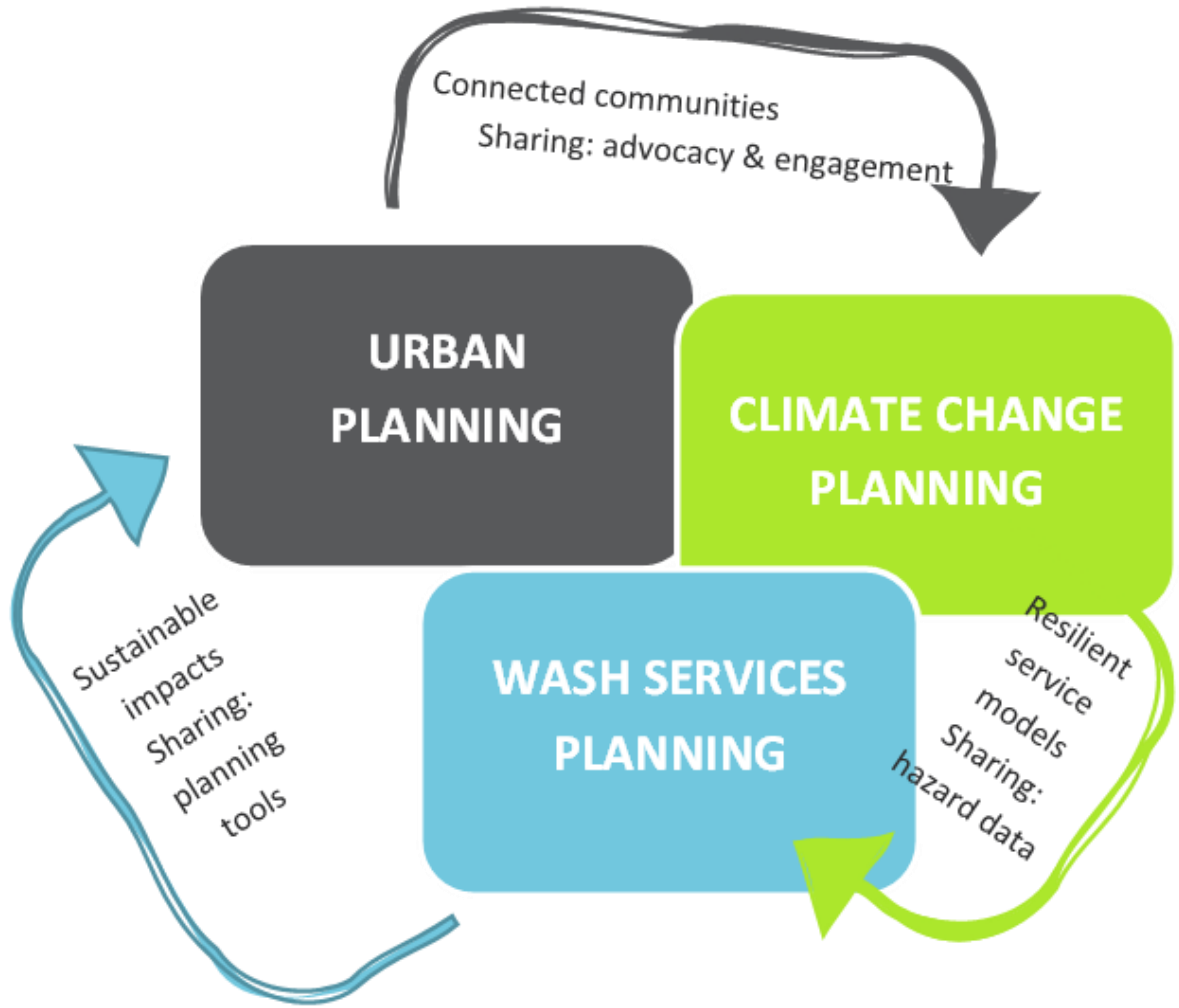
Rosie Sanderson

Researcher & Environmental Engineer

International WaterCentre at Griffith University



Context to our research

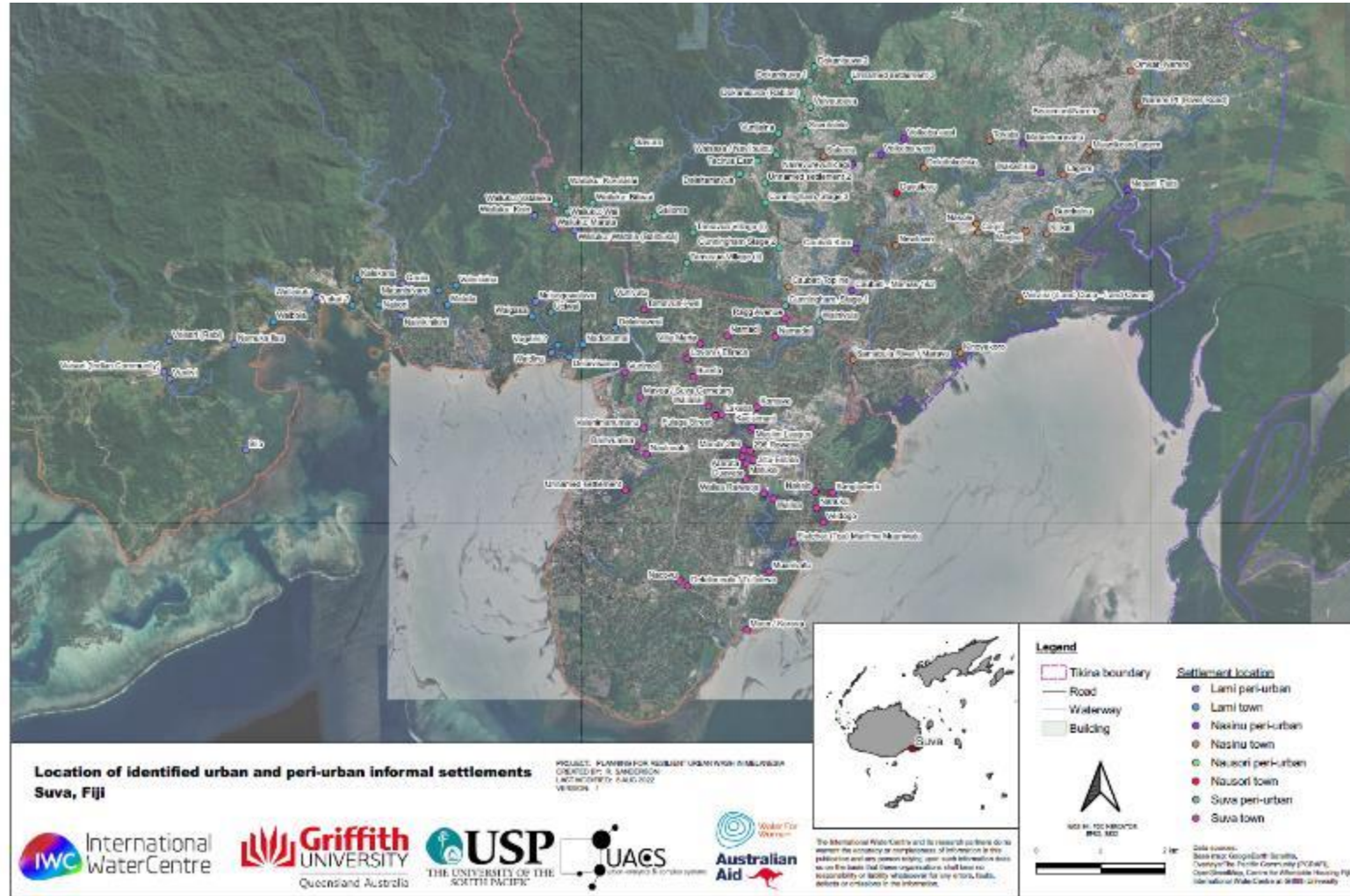


What data, information, communication and tools can support **planning (decision-making)** for improved **(climate-resilient & inclusive) water and sanitation** in urban informal settlements?

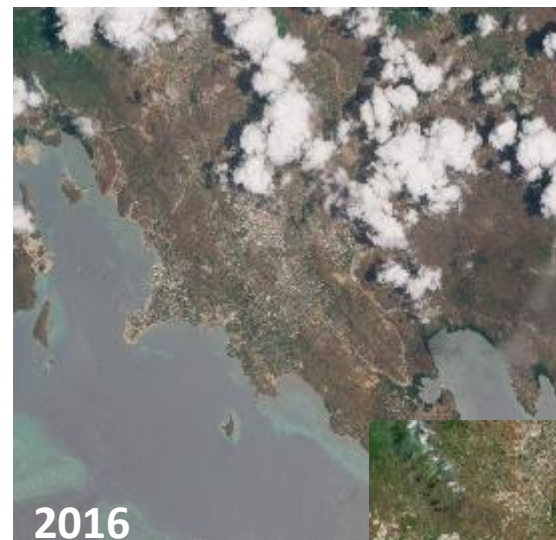
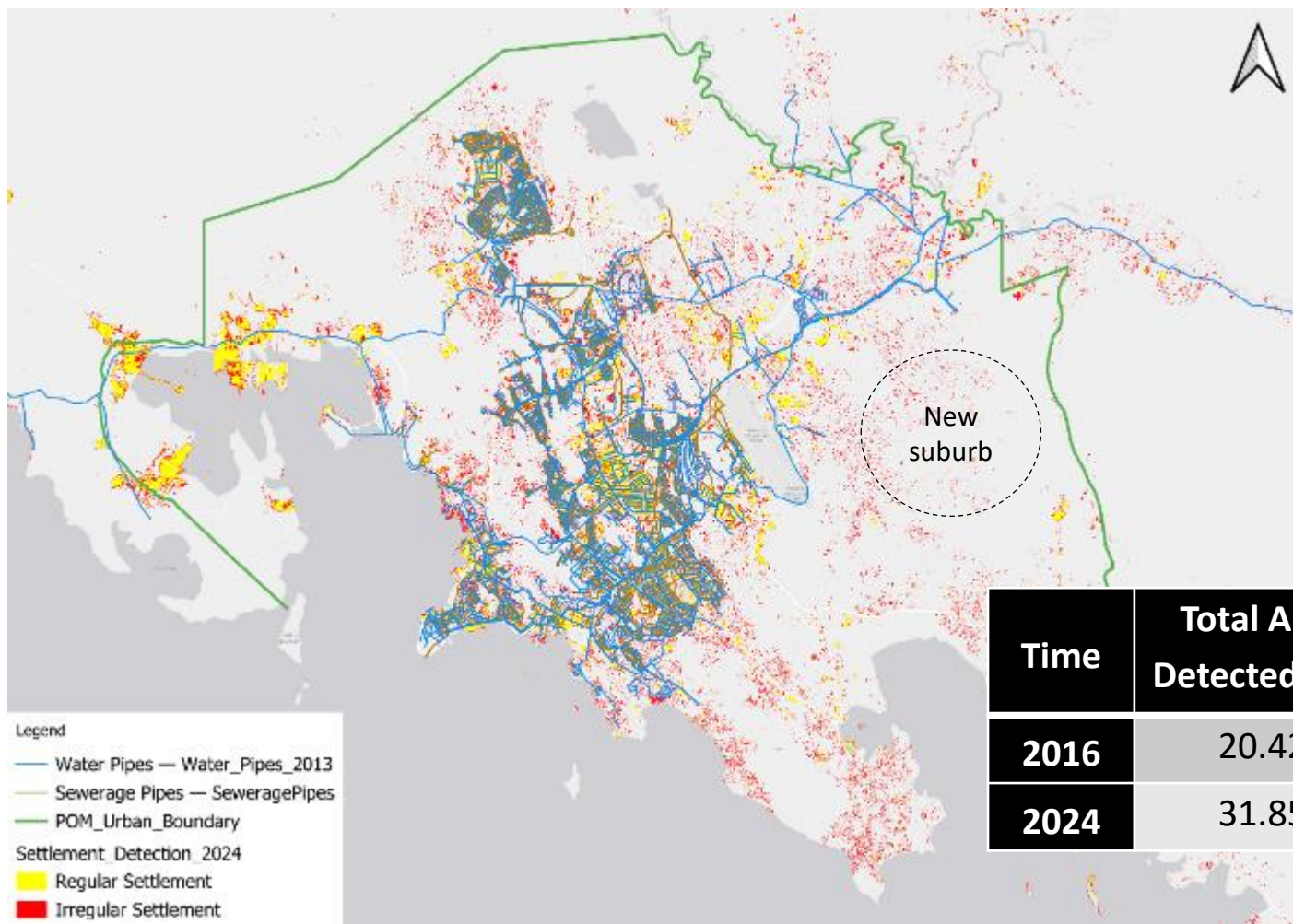
Why use spatial data in this work?

- **Locate** and spatially **characterise settlements** (WASH, tenure, environment, population, demographics etc)
- **Visualise** and locate community-based and local data (e.g. HHS, WM, PGIS)
- Explore and **characterise climate-related risk** (impacts, hazards, exposure, vulnerability)
- Explore and **characterise resilience** (comparing HHS to remote sensed data)
- Design or promote spatial tools to support **risk informed decision-making**

Data use example one – settlement locations



Data use example one – settlement locations



Time	Total Area Detected km ²	Number of Buildings
2016	20.42	60,059
2024	31.85	93,677

Data use example one – settlement locations



A screenshot of a web-based training course interface. The top navigation bar includes logos for International Water Centre, Griffith University, USP, SINU, UACS, WaterAid, and Australian Aid, followed by the Pacific GeoWASHUS logo. The main content area is titled "Model Setup > Step 2 - QGIS Installation and Familiarisation". Below this, a large graphic features the text "Module 2" and "Climate-resilient Inclusive urban WASH in Melanesian Pacific Online Community of Practice and technicians training sessions Autonomous Settlement Detection". A play button icon is overlaid on the graphic. Below the graphic, the text "QGIS Installation & familiarisation:" is followed by a list of topics: "Software installation" and "Software interface and tools familiarisation". A sidebar on the left lists course sections: Overview, Introduction (1/1 steps), Model Setup (2/2 steps), Satellite Imagery Extraction (1/1 steps), Model Training (2/2 steps), and Model Results (1/1 steps). The "Step 2 - QGIS Installation and Familiarisation" section is highlighted. At the bottom of the main content area, there is a "Click to Stop" button and the text "Step completed. Keep it up!".

FREE TRAINING AVAILABLE

<https://www.pacificgeowashus.com/>

Data use example two – HH surveys and risk

Hazards

- **Climate hazard data** – tidal inundation, coastal flood, river flood, inundation, flow paths, tropical cyclone, tsunami, heavy rain, drought, severe wind, landslide (rainfall trigger), landslide (earthquake trigger)
- **Environmental proxies** – distance to waterways, bluespot analysis, groundwater quality, soil type, veg cover, slope, height above SL

Impacts

Loss of service impacts – wellbeing, health, social, educational, economic

Exposure

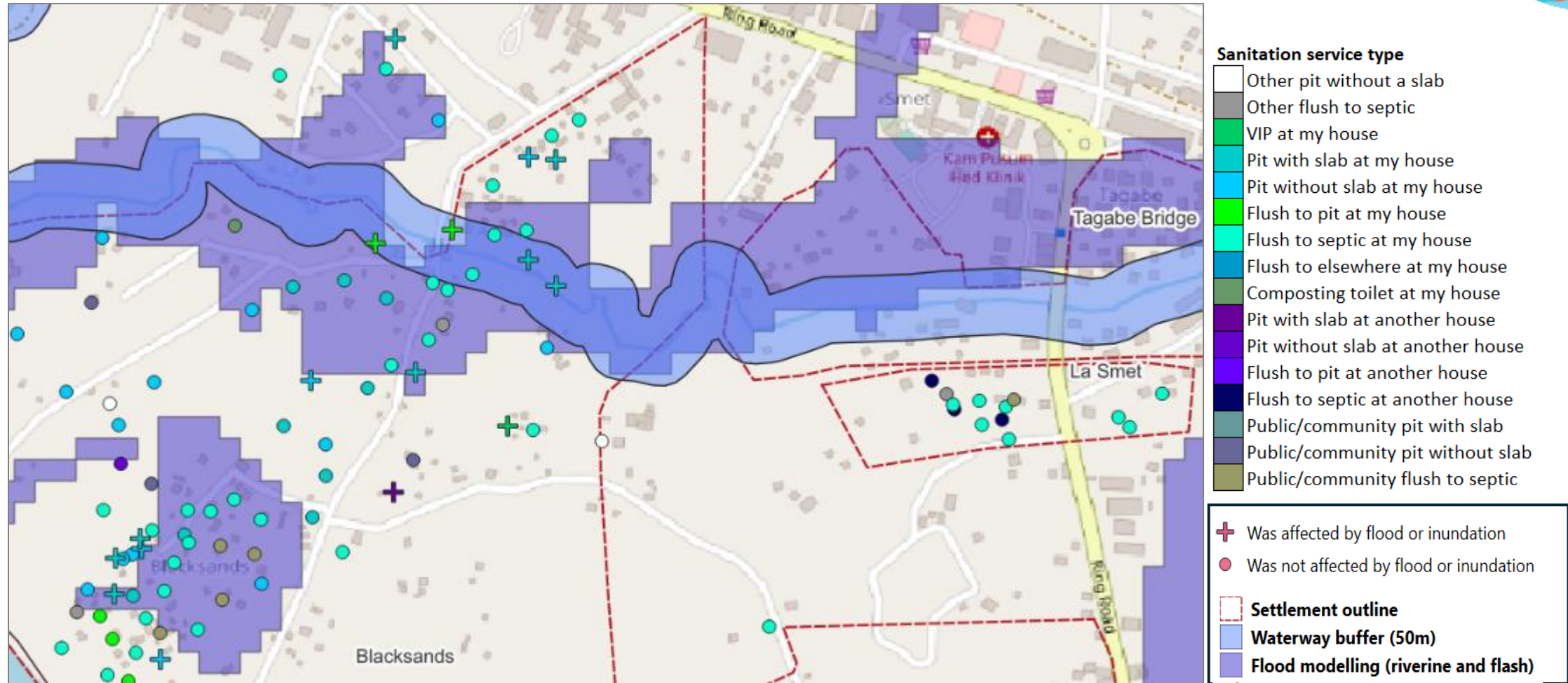
- **Base maps** – satellite imagery
- **Demographics** – population, distribution, composition, household size
- **Urban planning** – administrative boundaries, road networks, building footprints

Vulnerability (and capacity!)

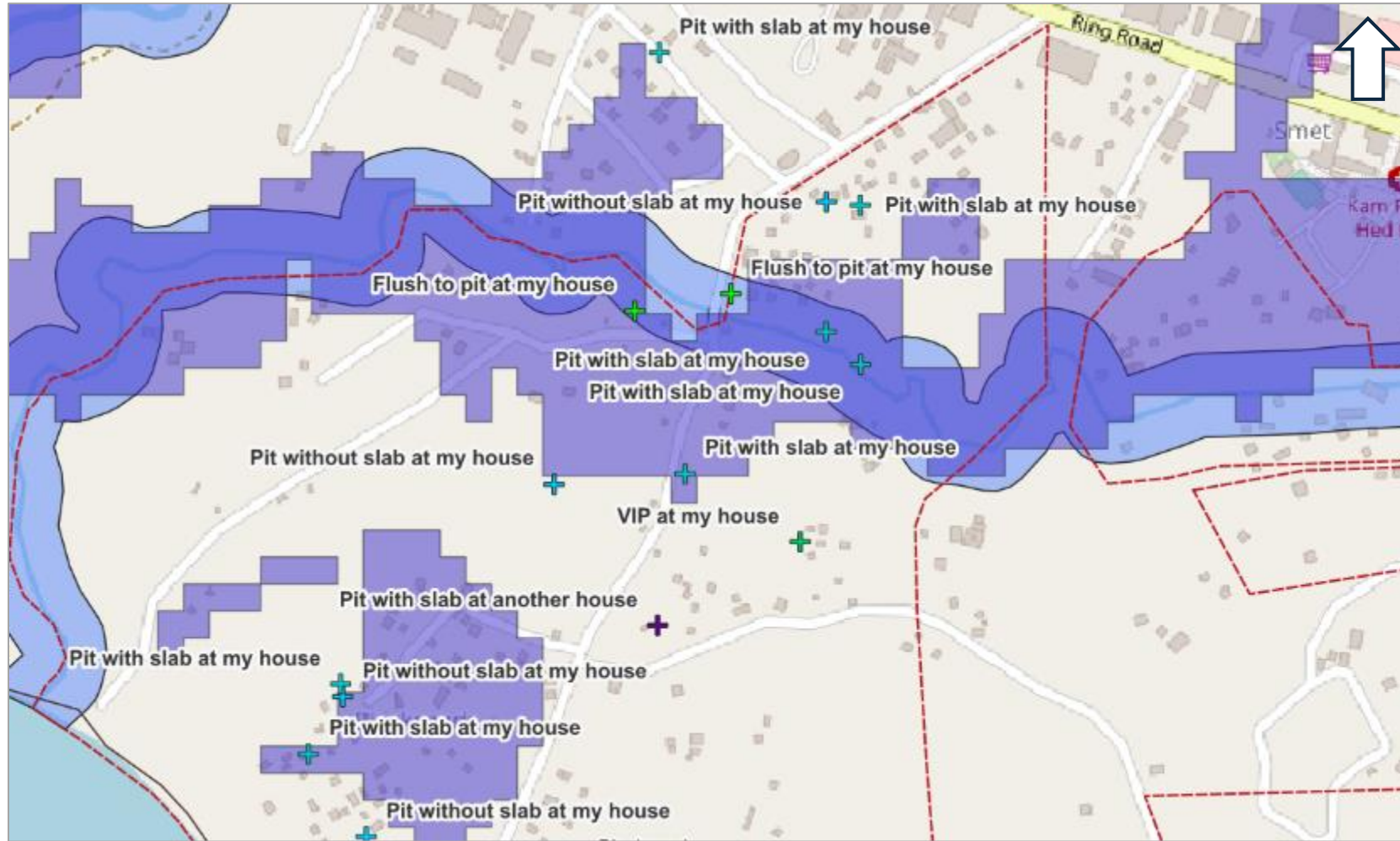
- **Base maps** –topography/DEMs
- **Demographics** – population, distribution, composition, household size
- **Urban planning** – administrative boundaries, land tenure, road networks, household density,
- **WASH** – water access, sanitation access, distribution networks, stormwater networks, groundwater use, water catchment zones, point source pollutants
- (includes HH survey data)



Data use example two – HH surveys & hazards



Data use example two – HH surveys & hazards

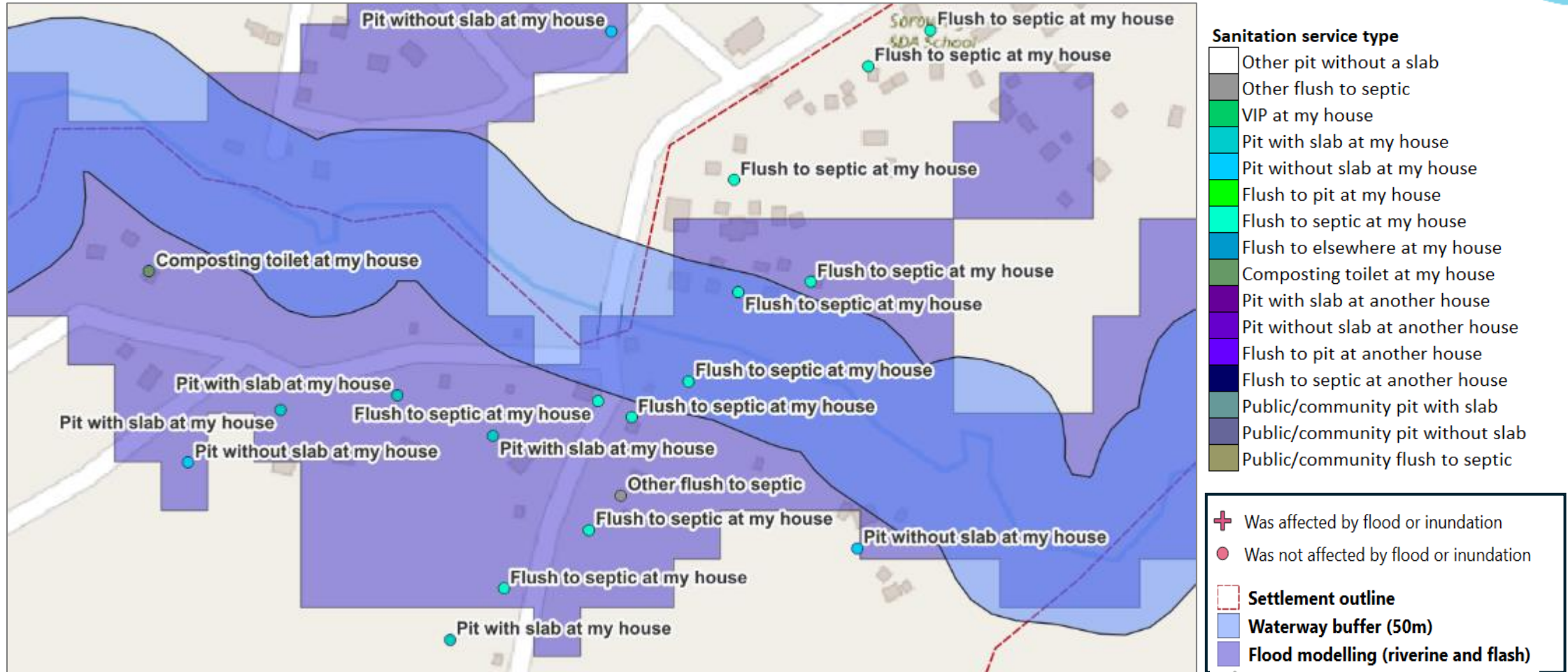


Sanitation service type

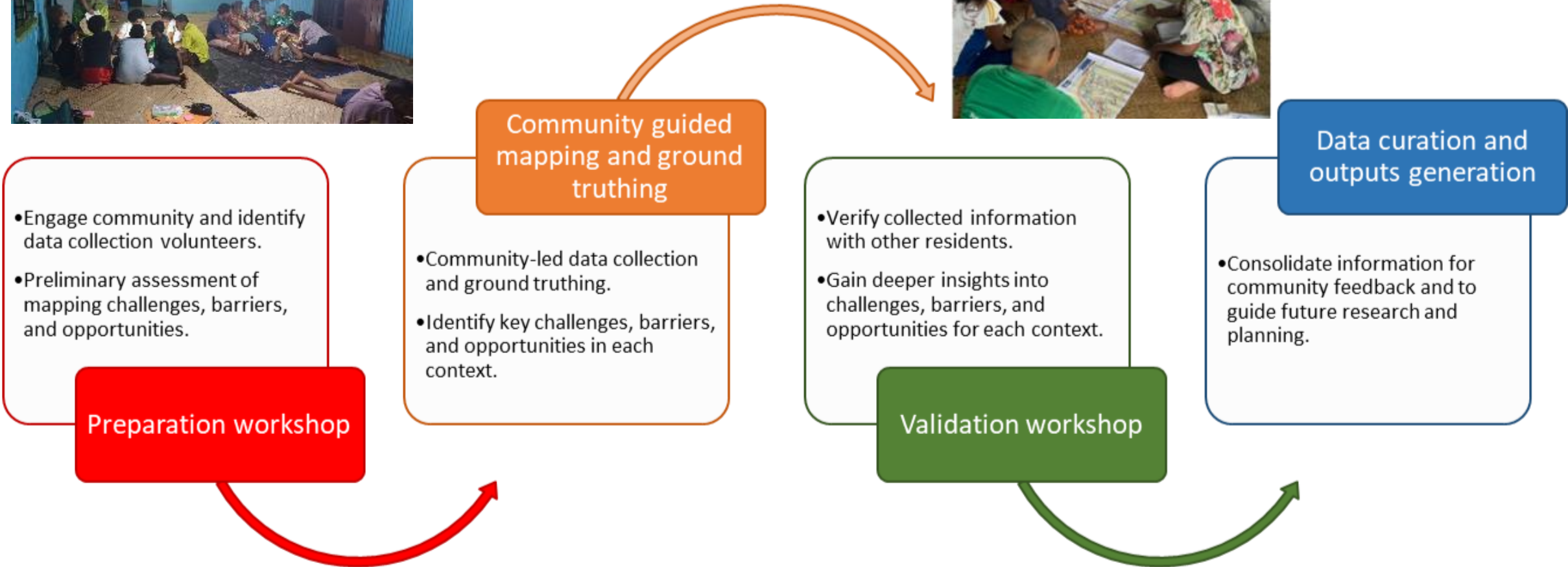
- Other pit without a slab
- Other flush to septic
- VIP at my house
- Pit with slab at my house
- Pit without slab at my house
- Flush to pit at my house
- Flush to septic at my house
- Flush to elsewhere at my house
- Composting toilet at my house
- Pit with slab at another house
- Pit without slab at another house
- Flush to pit at another house
- Flush to septic at another house
- Public/community pit with slab
- Public/community pit without slab
- Public/community flush to septic

- + Was affected by flood or inundation
- Was not affected by flood or inundation
- Settlement outline
- Waterway buffer (50m)
- Flood modelling (riverine and flash)

Data use example two – HH surveys & hazards



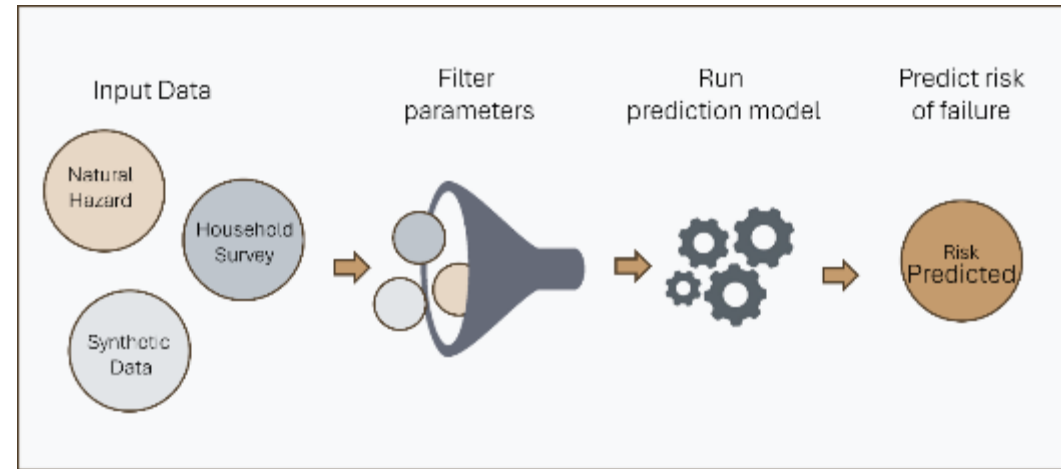
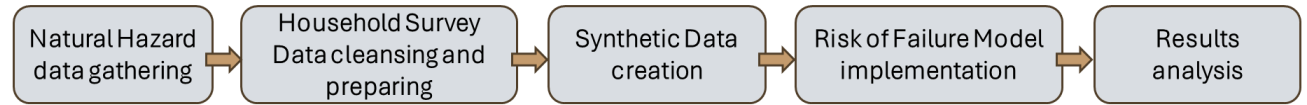
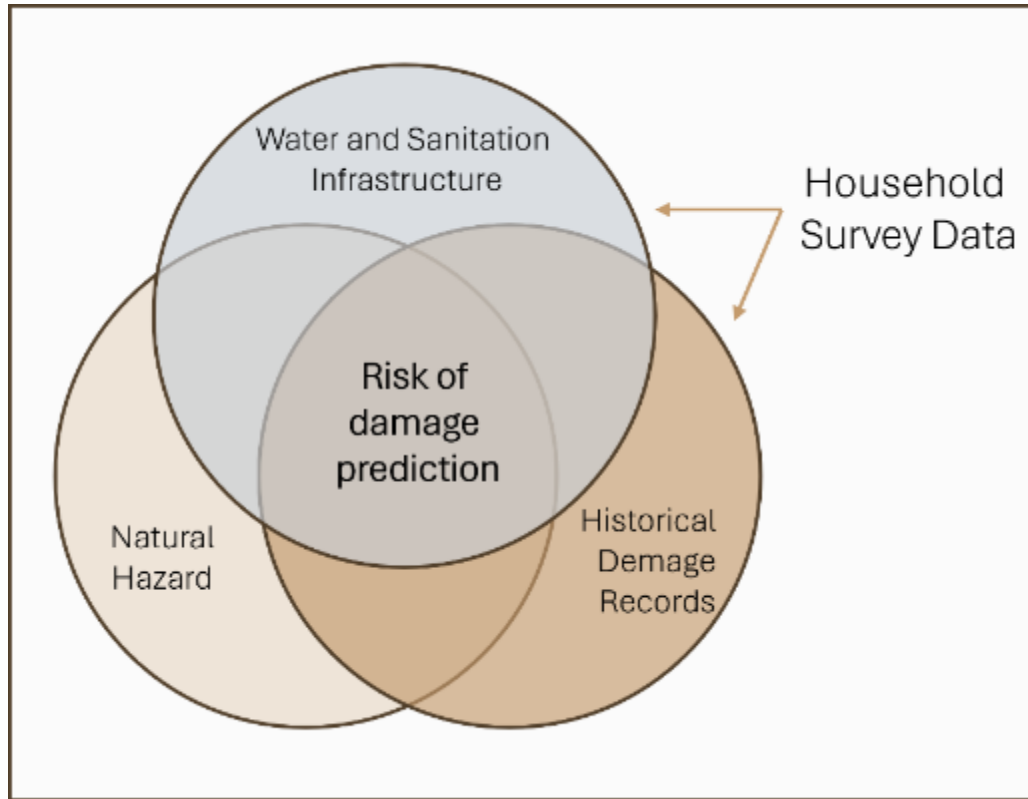
Data use example three – participatory mapping for planning



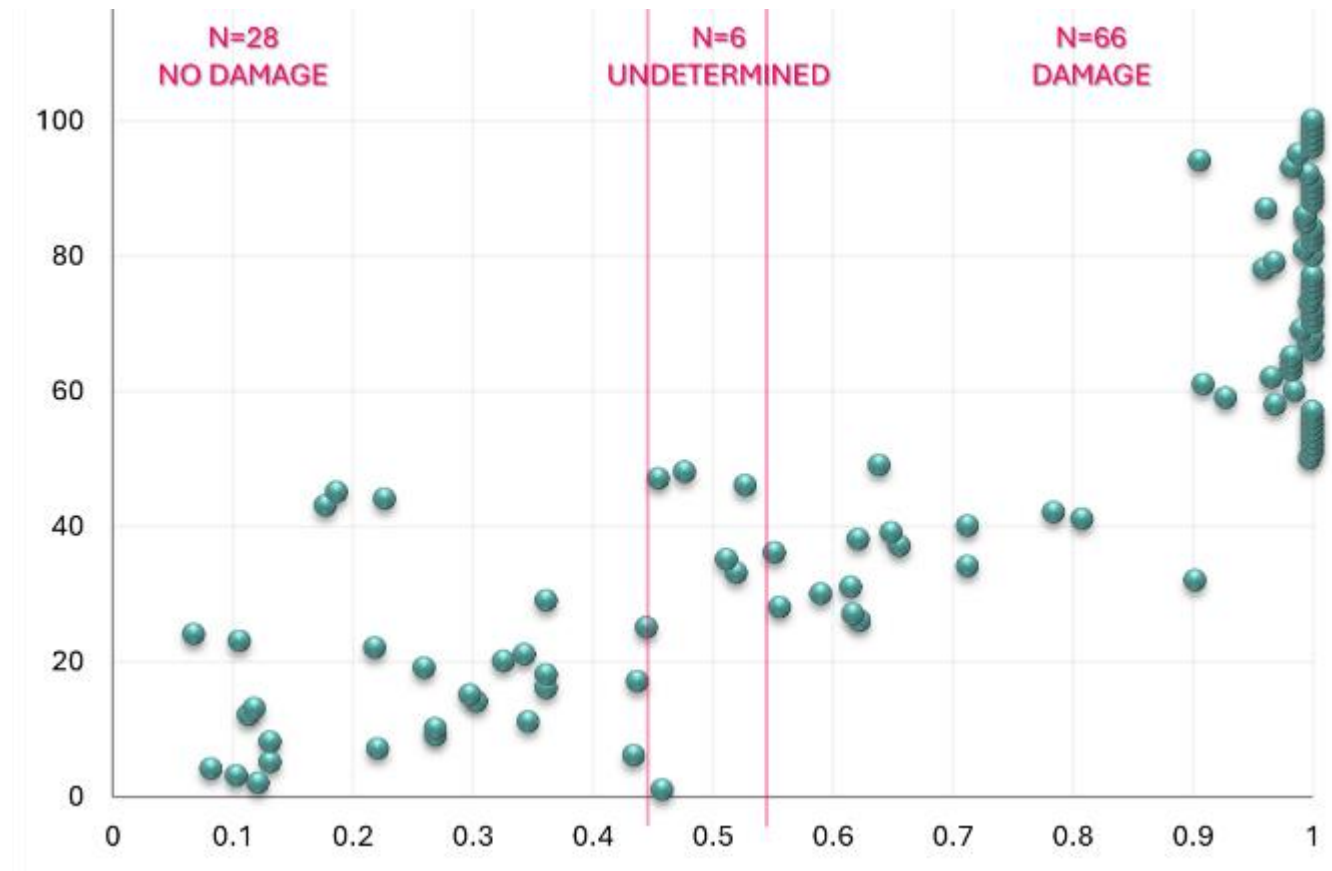
Data use example three – participatory mapping for planning



Data use example four – risk of damage modelling



Data use example four – risk of damage modelling



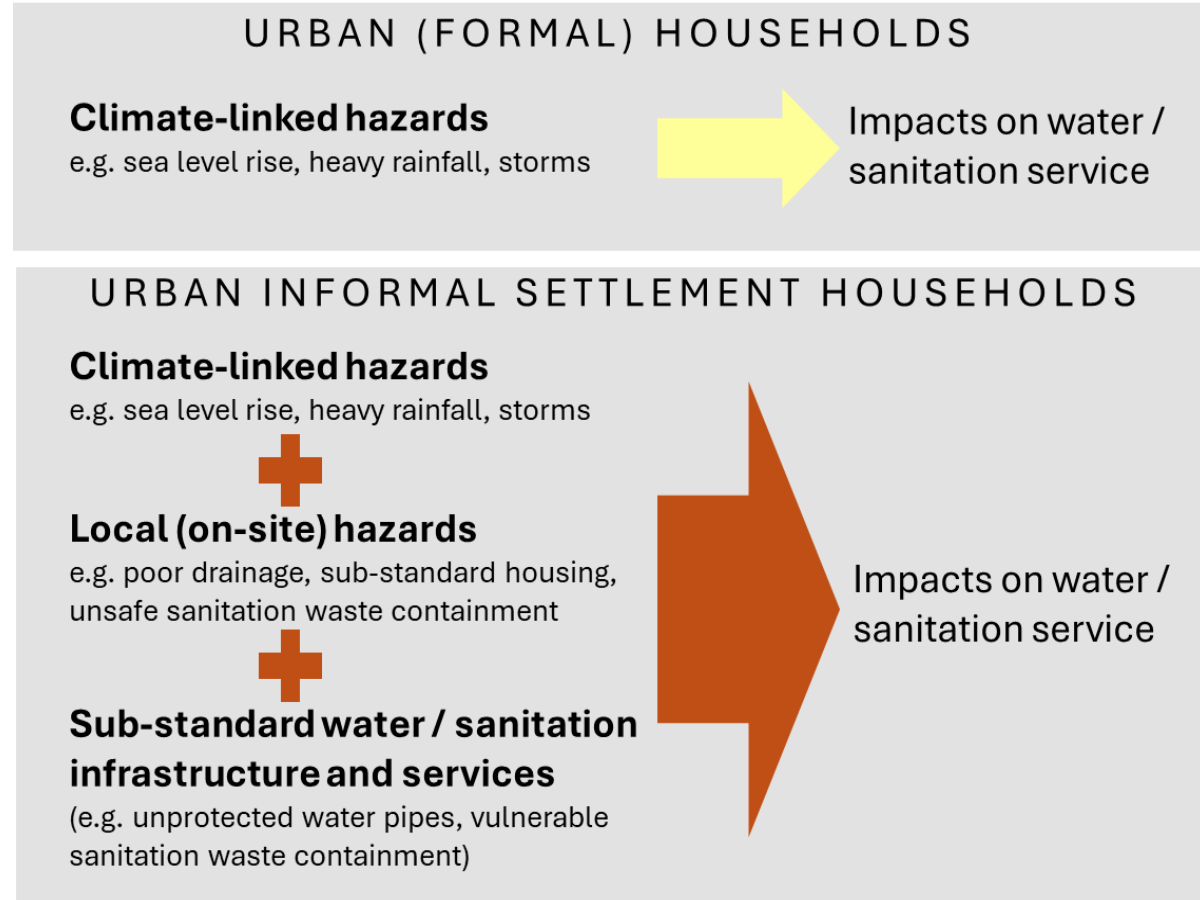
Barriers to use across all examples

- Up to date data
- The right resolution for the right use / downscaling
- Ensuring locally collected data quality & consistency
- Integration of datasets
- Trust in data – community to decision-makers

Conclusion

Integrating different types of data, including spatial, can help understand intersections between **local hazards** and **climate hazards**

Also helps establish a common understanding to groundtruth.



SUVA

Climate Resilience Pathways:

Water Security and WASH in Asia Pacific

Harnessing diverse data for water, WASH and resilience decision-making

World Café Session – 9:45-10:25

TUESDAY 29TH APRIL – 09:00

ROOM 1 – ID22



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