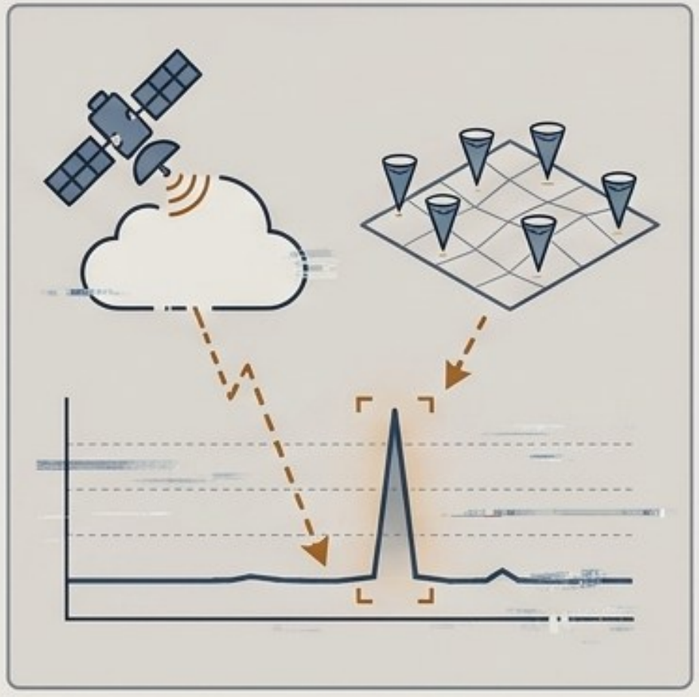
The Operational Gap in Asia-Pacific Flood Response

The crisis isn’t a lack of maps—it is a lack of timely, locally interpretable evidence that accounts for uncertainty.

FRAGMENTED INPUTS



Asynchronous arrivals of SAR, optical, and gauge data.

HIDDEN UNCERTAINTY



Overconfident alerts that mask missing information and spatial errors.

FALSE PRECISION



Informal data combinations leading to unsupported street-level claims and automation bias.



NADI: Nowcasting & Analytics for Disaster Intelligence

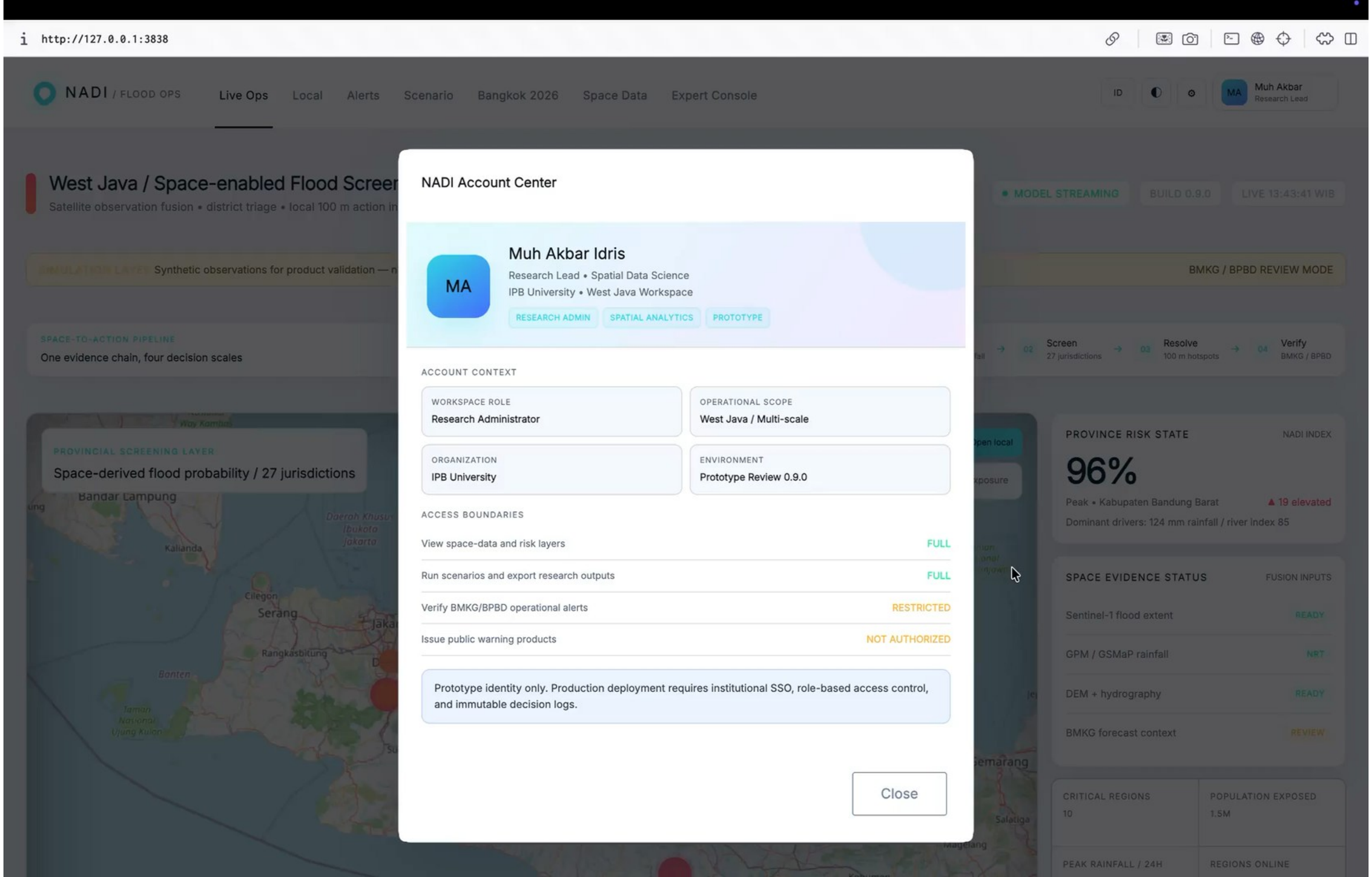
A Sentinel-Site-Calibrated, Space-Enabled Flood Decision Service

Closing the gap between space observation and authorized action.

IPB University | Universitas Sulawesi Barat | BMKG Climatology Station of West Java

Prepared for: UNISEC Global Space Innovation Challenge

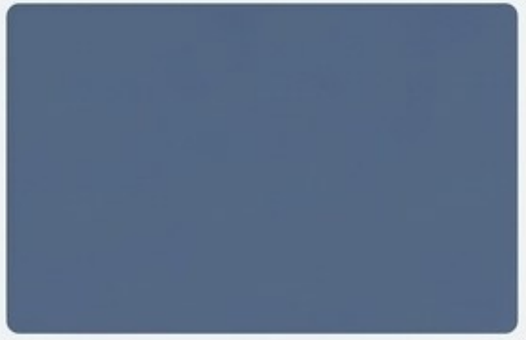
Muh Akbar Idris · Prof. Dr. Ir. Muhammad Nur Aidi · Rakhmat Prasetia


http://127.0.0.1:3838
NADI / FLOOD OPS
Live Ops
Local
Alerts
Scenario
Bangkok 2026
Space Data
Expert Console
ID
MA
Muh Akbar
Research Lead
West Java / Space-enabled Flood Screer
Satellite observation fusion • district triage • local 100 m action in
MODEL STREAMING
BUILD 0.9.0
LIVE 13:43:41 WIB
Synthetic observations for product validation — n
BMKG / BPBD REVIEW MODE
SPACE-TO-ACTION PIPELINE
One evidence chain, four decision scales
02 Screen
27 jurisdictions
03 Resolve
100 m hotspots
04 Verify
BMKG / BPBD
PROVINCIAL SCREENING LAYER
Space-derived flood probability / 27 jurisdictions
Bandar Lampung
Kalianda
Cilegon
Serang
Rangkasbitung
Banten
Taman Nasional Ujung Kulon
Daerah Khusus Ibukota Jakarta
Semarang
Salatiga
Magelang
PROVINCE RISK STATE
NADI INDEX
96%
Peak • Kabupaten Bandung Barat
▲ 19 elevated
Dominant drivers: 124 mm rainfall / river index 85
SPACE EVIDENCE STATUS
FUSION INPUTS
Sentinel-1 flood extent
READY
GPM / GSMaP rainfall
NRT
DEM + hydrography
READY
BMKG forecast context
REVIEW
CRITICAL REGIONS
10
POPULATION EXPOSED
1.5M
PEAK RAINFALL / 24H
REGIONS ONLINE
NADI Account Center
MA
Muh Akbar Idris
Research Lead • Spatial Data Science
IPB University • West Java Workspace
RESEARCH ADMIN
SPATIAL ANALYTICS
PROTOTYPE
ACCOUNT CONTEXT
WORKSPACE ROLE
Research Administrator
OPERATIONAL SCOPE
West Java / Multi-scale
ORGANIZATION
IPB University
ENVIRONMENT
Prototype Review 0.9.0
ACCESS BOUNDARIES
View space-data and risk layers
FULL
Run scenarios and export research outputs
FULL
Verify BMKG/BPBD operational alerts
RESTRICTED
Issue public warning products
NOT AUTHORIZED
Prototype identity only. Production deployment requires institutional SSO, role-based access control, and immutable decision logs.
Close

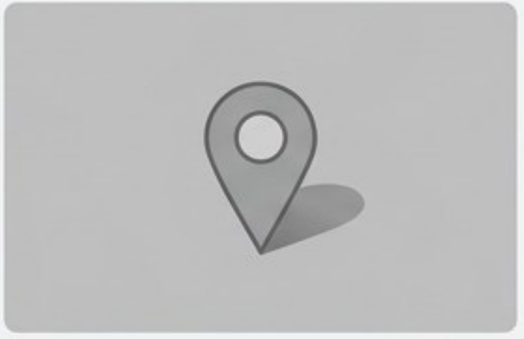
Redefining the Evidence Layer: Status Quo vs. NADI

Shifting from black-box inundation maps to a calibrated, uncertainty-aware decision support service.

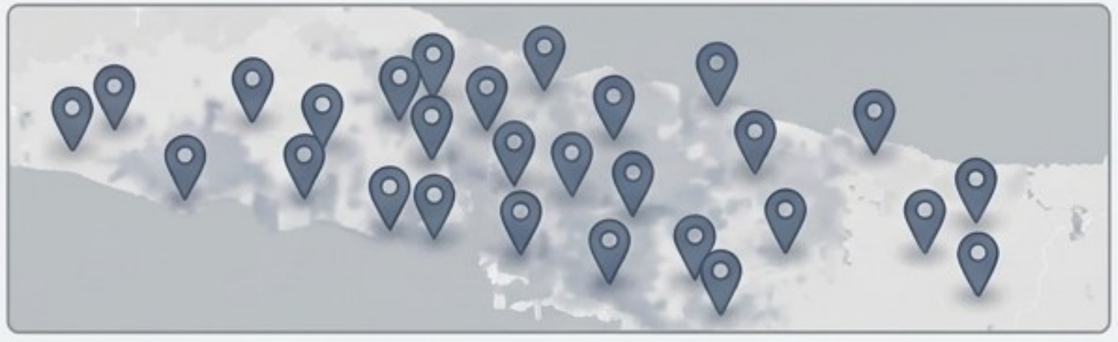
Status Quo



Binary inundation labels

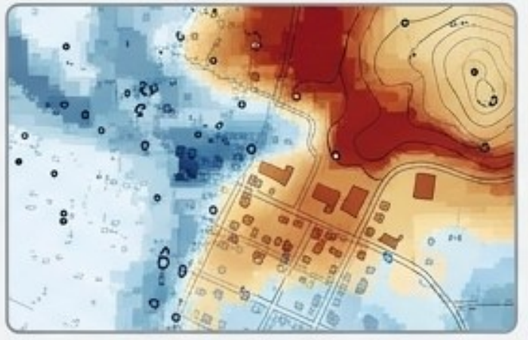


Ignores data age and confidence



Assumes universal map validity

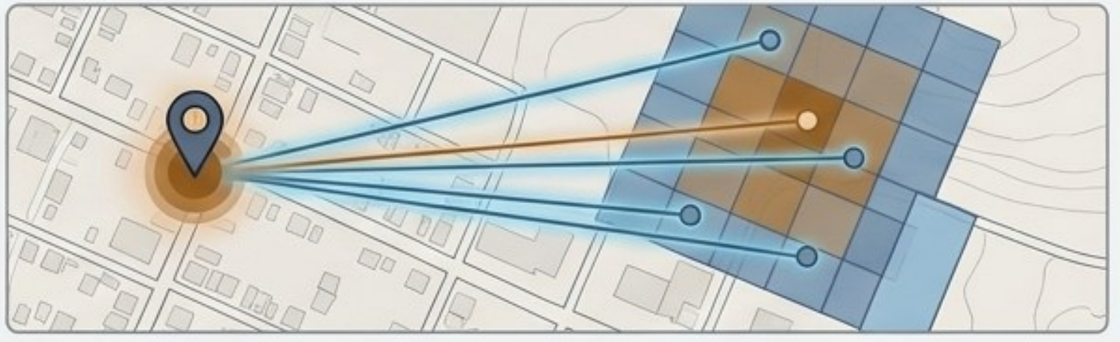
NADI Approach



Calibrated flood probabilities



Explicit data-age and confidence overlays

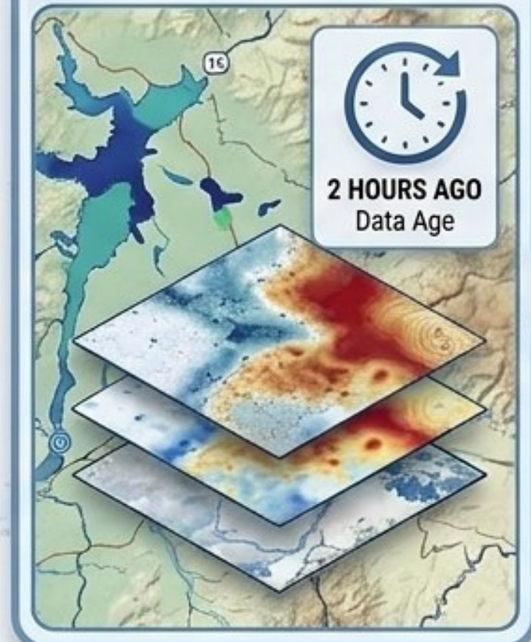


Sentinel-anchored local calibration

Transforming Probabilities into Priorities

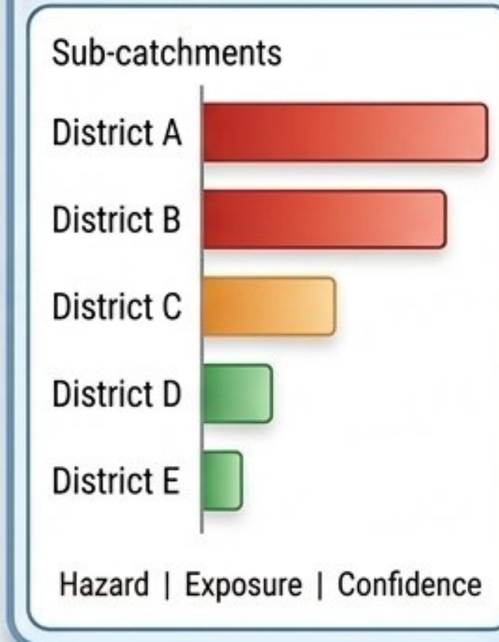
NADI processes fused data through a four-step triage and verification queue.

1. Observe



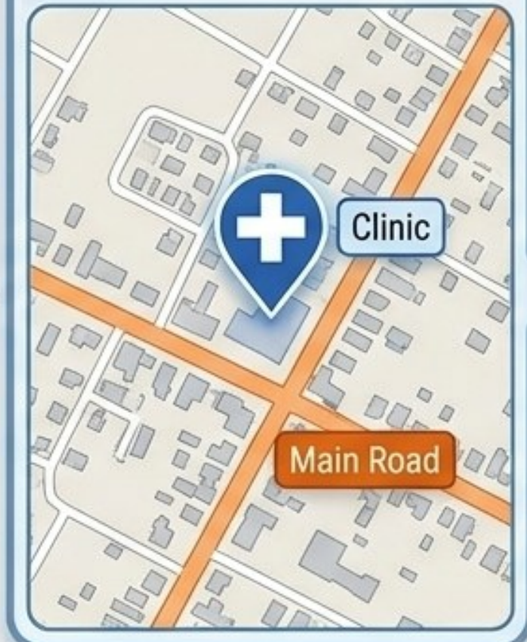
Harmonize spatial evidence

2. Screen



Triage and rank districts by hazard, exposure, and confidence. This is a priority queue, not a warning.

3. Resolve



Isolate local grid cells and identify critical infrastructure exposure.

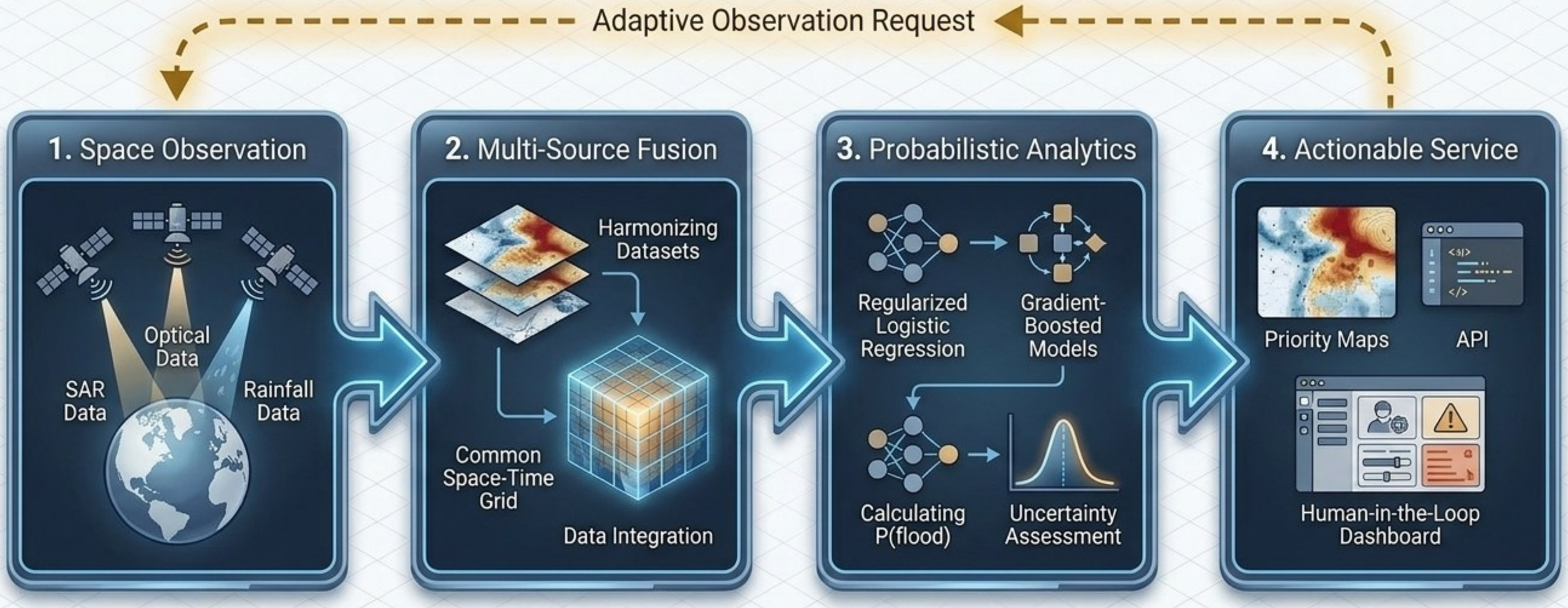
4. Verify



Route signals to human review; verified field outcomes automatically recalibrate the model.

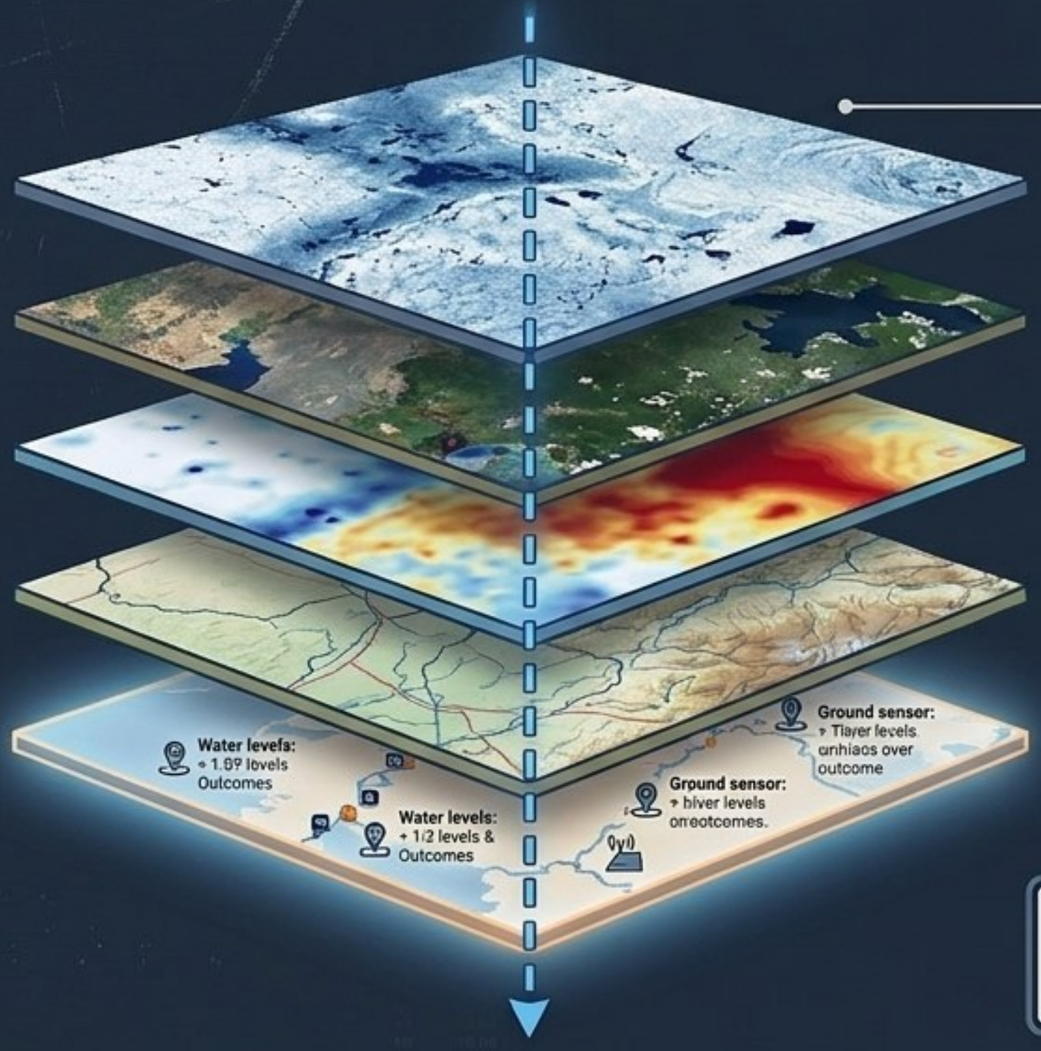
The NADI Scientific Workflow

A closed-loop architecture bridging space observation to adaptive local action.



The Data Engine: Multi-Source Fusion

Harmonizing heterogeneous space and ground evidence onto a common space-time grid.



Space (SAR): Sentinel-1
(Cloud-independent surface-water change).

Space (Optical): Sentinel-2
(Land cover, permanent-water context).

Hydro-Meteorological: GPM IMERG / GSMaP / BMKG radar (Precipitation & antecedent rainfall).

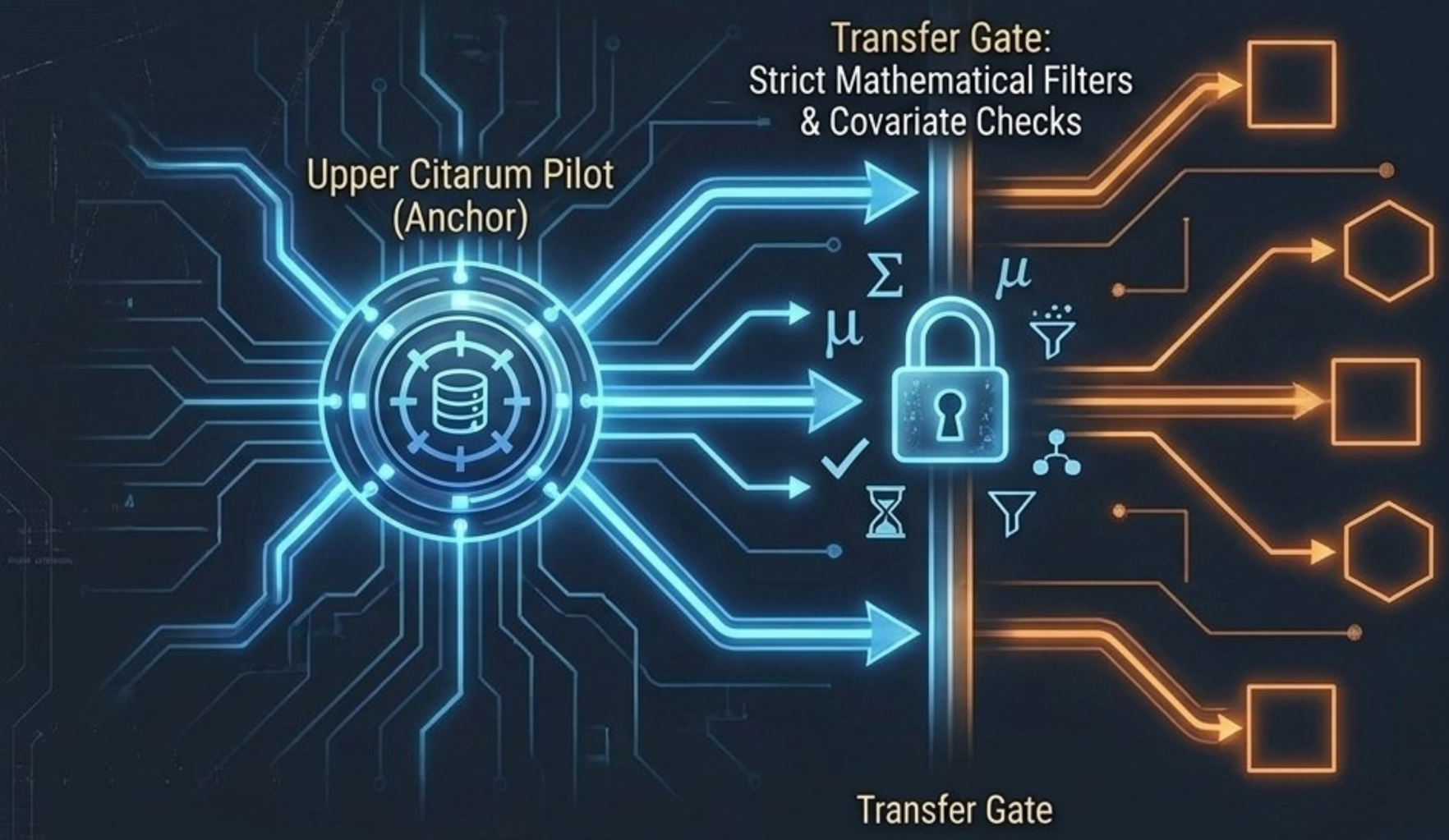
Context: SRTM DEM / Copernicus, OpenStreetMap
(Terrain, drainage, roads, exposure).

Ground Anchor: Sentinel-site ground truth
(Time-stamped river levels & verified outcomes).

All layers maintain provenance, acquisition time, and quality flags.
Retrospective evaluation prevents hindsight leakage.

Core Innovation: Sentinel-Anchored Transfer

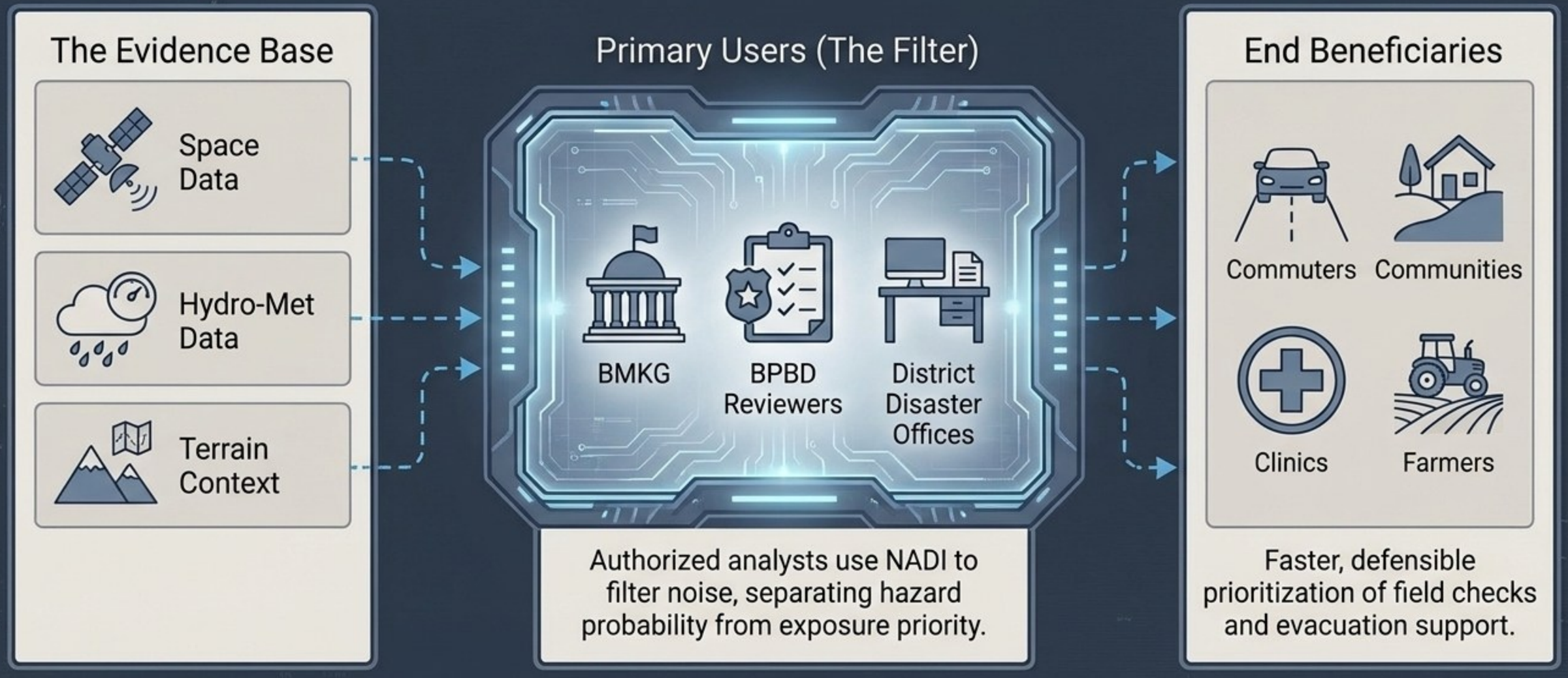
NADI rejects universal mapping claims in favor of a gated, geographically calibrated scaling protocol.



- ✓ 1. Anchor Training: Multi-event data around the sentinel site trains and calibrates the pilot model.
- ✓ 2. Internal Robustness: Withheld locations and events test internal model strength.
- ✓ 3. The Transfer Gate: Neighboring areas are screened. Transfer is only accepted after passing covariate shift checks, calibration loss limits, and a minimum local validation set.

The Information Value Chain

NADI provides a reproducible evidence layer for authorized human review, not a public warning system.



Designing for Operational Reality

Treating satellite limitations and uncertainty as rigorous system constraints, not hidden flaws.

LIMITATIONS	SYSTEMIC MITIGATIONS
Single-Site Representativeness	**Constraint**: Does not claim universal validity. Enforces withheld-area testing and recalibration via the Transfer Gate.
Observation Latency & Speckle	**Constraint**: Interface explicitly exposes confidence, data age, and observation gaps alongside every candidate signal.
Scale Mismatch	**Constraint**: Refuses unsupported street-level precision claims, even when ingesting fine grid data.
Operational & Ethical Risk	**Constraint**: Implements role-based access, audit logs, and human-in-the-loop approval to combat automation bias and false alarms.

Performance Evaluation & Expected Impact

Defining success for the 12-week Proof of Concept against established baselines.

15%

Brier-score improvement over the strongest baseline.

> 0.80

Spatial Recall at a partner-approved threshold.

< 60

minutes processing latency after required inputs arrive.



Baseline Comparison: Evaluated against rainfall-only and static-susceptibility models.

Impact Summary: Faster prioritization of field checks, reproducible calibration testing, and transparent event archives for after-action review.

Implementation & Handover

Delivering a reproducible, validated decision-support prototype.

Phase 1:
Operational co-design, data audit, and retrospective event assembly.

Phase 2:
Pilot modeling, calibration, and rigorous transfer testing.

Phase 3:
Dashboard intergration, controlled review exercise, and handover.

"NADI is not another black-box flood map. It is a reproducible evidence layer that empowers authorized human action."

The Future: Adaptive Flood Observation Service

Closing the loop by triggering machine-readable satellite tasking requests when intelligence gaps occur.

$$[Risk] + [Information\ Gap] = [Value\ of\ Information]$$

Trigger: High VoI score generates Machine-Readable Tasking Request



Request Parameters: Area of interest, time window, sensor preference (higher-revisit SAR), required resolution, and expected decision value.



Broker matches request -> Satellite acquires data -> Calibrated model updates decision layer.

Thank You

For your attention and support

Special acknowledgement for data provision and technical support

BMKG

Hydrometeorological and climate data support

iQPS

Space-based data and technical support

IPB University — Bogor Indonesia —

UNISEC GLOBAL
University Space Engineering Consortium

lpdp

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