



National Challenges & The PLUVIA Strategic Solution

Digital transformation of weather modification operations from conventional manual protocols into an IoT-driven, Radar-AI, and Big Data telemetry aerial command infrastructure.



Conventional Operational Bottlenecks

Major impediments in forest fire mitigation & water security

- 01
Airspace Command Blind-Spots
Ground control loses real-time visibility into aircraft status when entering severe convective storm clouds (Cumulonimbus).
- 02
Manual Seeding Chemical Bookkeeping
Inability to verify precise dispersal quantities of hygroscopic agents (NaCl/CaCl2), leading to budget and resource ambiguity.
- 03
Delayed Post-Mission Evaluation
Absence of telemetry flight blackboxes causes rainfall effectiveness audits to take days of post-processing.

83.4%

Rainmaking Success Rate

< 350ms

SATCOM Telemetry Latency



Integrated PLUVIA Solution

Next-generation command architecture with optimal efficiency

- 01
Hybrid Datalink (Starlink + Iridium + 4G)
Live streaming of 4 aircraft camera angles and 20+ telemetry parameters uninterrupted across national remote airspace.
- 02
Precision Cloud Seeding Cockpit HUD
Pilots utilize digital EFB interface to actuate chemical valves & monitor real-time dispersal flow rate (L/hour) automatically.
- 03
Mission Replay & AI Doppler Correlation
The system scrubs historical flight paths and directly correlates flare triggers with Doppler radar rainfall enhancement data.

100%

Chemical Payload Audit Trail

User Roles & Access Governance Architecture (7 Roles)

Each stakeholder operates within dedicated workstations and capabilities tailored for operational integrity, data classification, and seamless inter-agency coordination.

Role / Designation	Target User	Primary Accessible Modules	Strategic Function & Responsibilities	Access Level
COMMANDER	Mission Commander / Agency Chief (Disaster Agency, Air Force)	GCR, Analytics, Mission Replay, Executive Reports, Audit Log	Authorizes fleet deployment, reviews chemical budgets, scrubs blackbox telemetry, and signs off tactical SOPs.	STRATEGIC
OPERATOR	Flight Operations Officer (FOO) at GCR	GCR, Live Video, Telemetry Stream, Fleet Map, Mission Dispatch	Monitors cockpit live instruments, supervises 4-angle avionics feeds, manages engine/GPS alerts, and directs datalink.	TACTICAL
PILOT	Test / Mission Pilot (Casa C-212 / Piper)	Pilot Control Panel HUD, Datalink Messaging, Weather	Actuates seeding dispensers, navigates target cloud corridors, and verifies in-flight operational status.	FLIGHT CREW
WEATHER ANALYST	Meteorologist / Cloud Physicist (BMKG / Research Inst)	Doppler Weather Radar, Cb Cloud Analysis, Seeding Viability	Identifies convective cloud cells, evaluates wind updrafts, and prescribes coordinates for flare ignition.	SCIENTIFIC
MAINTENANCE	Chief Avionics Engineer & Aircraft Technicians	Maintenance Logs, Engine Hours, Starlink & Sensor Health	Tracks airframe lifecycle, calibrates chemical nozzles, and inspects Iridium SATCOM & ADS-B Out transponders.	TECHNICAL
ADMIN	Super Admin & Cyber Operations	User Management, Password Reset, Audit Logs, Localization	Manages personnel credentials, rotates security tokens, reviews IP forensics, and configures multi-language settings.	SUPER ADMIN
VIEWER	Regional Governors, VVIP Observers & Stakeholders	Fleet Map (Read-Only), Global Mission Status, Weather Map	Public oversight and government observer visibility without risk of operational intervention.	READ-ONLY

COMMANDER: Strategic Command, Replay & Analytics

Executive suite enabling mission commanders to evaluate weather modification effectiveness, flight hour yields, chemical efficiency, and 3D flight trajectory replays.

https://pluvia.system/analytics



PLUVIA

Mission System

SISTEM ONLINE

UTAMA

Ground Control Room

MISI

Manajemen Misi

OPERASIONAL

Armada

Live Video

Telemetri

Cuaca & Radar

47

TOTAL MISI

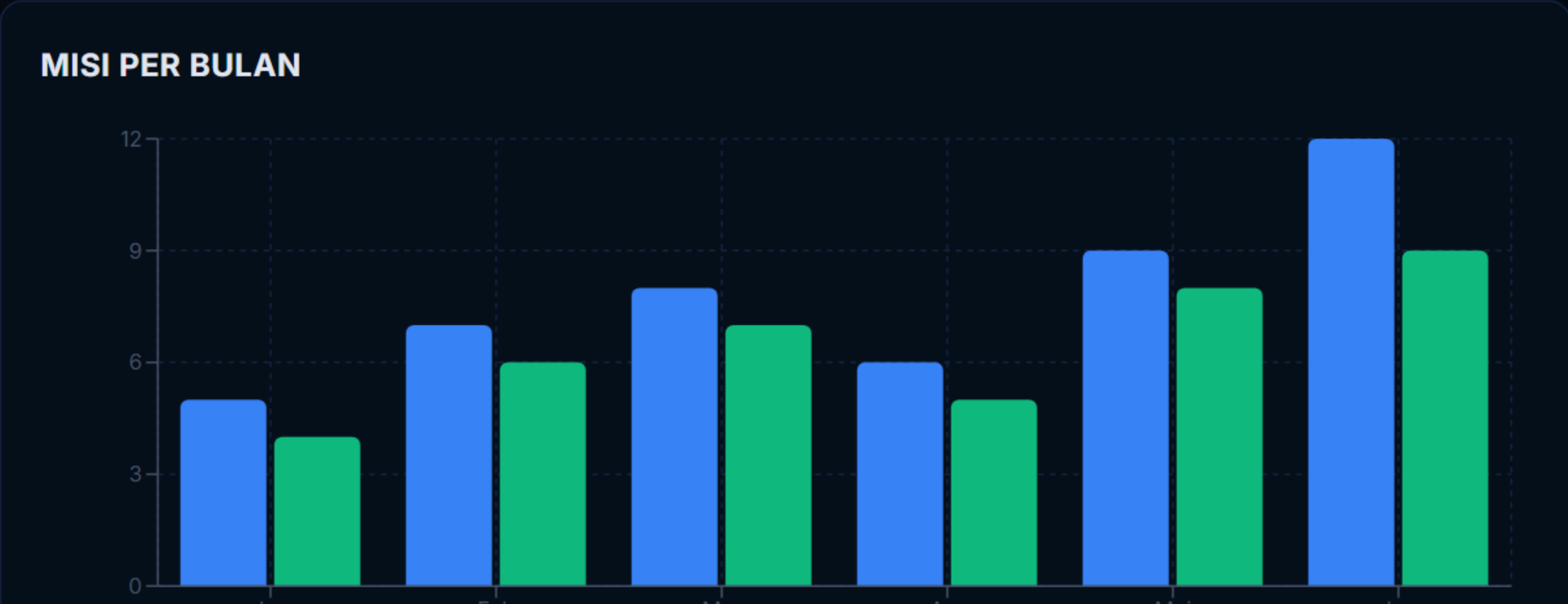
83%

TINGKAT SUKSES

342.5

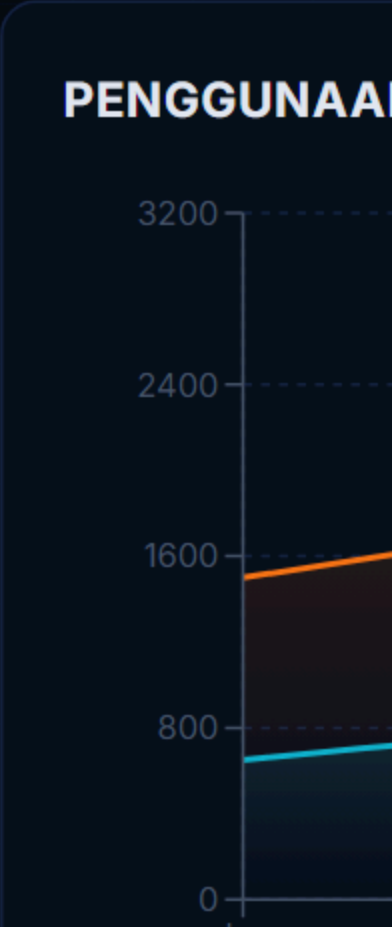
JAM TERBANG

MISI PER BULAN



Bulan	Misi	Tingkat Sukses
Jan	5	4
Feb	7	6
Mar	8	7
Apr	6	5
Mei	9	8
Jun	12	9

PENGUNAAN



Waktu	Penggunaan 1	Penggunaan 2
Jan	1500	700
Feb	1600	800
Mar	1700	900
Apr	1800	1000
Mei	1900	1100
Jun	2000	1200

Tactical command post delivering 4 synchronized live camera feeds (Nose, Underbelly, Left Wing Flare, Right Wing Nozzle) and high-frequency flight telemetry.

<https://pluvia.system/gcr>

Aviation cockpit interface engineered for Electronic Flight Bag (EFB) tablets, built to withstand severe convective turbulence with tactile digital seeding actuators.

<https://pluvia.system/pilot-control>



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 **Telemetri**

 Cuaca & Radar



Simulasi kontrol kokpit pesawat, aktivasi nozzle penyemai awan, dan komunikasi real-time dengan Ground Control.



KONTROL SISTEM PENYEMAIAN AWAN

Aktivasi Burner Utama

Semburan garam higroskopis

ACTIVE – IGNITED

112 °C

4.2 bar

Dispenser Flare

Lontaran garam bertekanan tinggi

LUNCURKAN 1 FLARE

VOLUME ALIRAN DISPERSI SEMAI

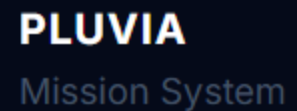
0 L/M (MIN)

5.0 L/M (RATA-RATA)

4.2 Li

Meteorological intelligence station integrating Doppler radar reflectivity layers, Himawari satellite data, and Cumulonimbus (Cb) convective cloud identification.

<https://pluvia.system/weather>



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Pantau intensitas curah hujan, persebaran awan Cumulonimbus, dan kondisi atmosfer darat secara real-time.

MOCK RADAR NOWCASTING (HALIM 200KM RANGE)

MAINTENANCE: Airframe Health, Engines & SATCOM

Preventive airworthiness lifecycle system tracking engine hours, chemical nozzle calibrations, Starlink aviation terminals, and ADS-B transponder integrity.

<https://pluvia.system/maintenance>



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MODUL MAINTENANCE PESAWAT

Pantau jam terbang, jadwal inspeksi, kalibrasi perangkat, dan status komponen seluruh armada.



4

TOTAL ARMADA



2

NORMAL



1

PERINGATAN

Cari kode atau tipe pesawat...



T1 — Casa C-212

ID: ac-t1

JAM OPERASI & JADWAL

```
Jam Mesin: 1245.6 jam
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Jam Oli: 124.2 jam
```

🕒Inspeksi Terakhir: 30 Sep 2026, 20.46

🕒 Inspeksi Berikutnya: 30 Okt 2026, 20.46

 STATUS PERAI

Kamera:

☞ Satcom:

📶 Starlink:

⦿Iridium:

ADMIN & VIEWER: Governance, Security & Audit Logs

Enterprise user management with immutable audit trails, credential lifecycle controls, and dynamic multi-language localization (English, Indonesian, Thai).

https://pluvia.system/admin/users



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ADMIN PANEL

Manajemen User

Buat, kelola, dan atur akses user sistem

8

TOTAL USER

8

AKTIF

Cari username atau email...

USERNAME	EMAIL	ROLE	STATUS
AD admin	admin@drmaa.go.id	ADMIN	AKTIF
OP operator01	operator01@drmaa.go.id	OPERATOR	AKTIF
OP operator02	operator02@drmaa.go.id	OPERATOR	AKTIF
PI pilot.t1	pilot.t1@drmaa.go.id	PILOT	AKTIF

Tactical Airspace GIS Fleet Map

Simultaneous multi-aircraft tracking on high-resolution GIS geospatial layers with mission polygon boundaries, target cloud waypoints, and heading vectors.

<https://pluvia.system/map>

Sub-Second Aerial Flight Telemetry Stream

Streaming cockpit avionics instrumentation and in-cloud atmospheric dynamics to the ground command post with sub-second latency through military encrypted channels.

https://pluvia.system/telemetry



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ALTITUDO

8.500 kaki

MSL (Mean Sea Level)

KECEPATAN UDARA

165 knot

IAS (Indicated Airspeed)

GROUND SPEED

145 knot

GSP (Ground Speed)

TEMP. UDARA LUAR

-12 °C

OAT (Outside Air Temp)

KELEMBABAN

85 %

RH (Relative Humidity)

TEKANAN

264 hPa

Barometric Pressure

SEMAI TERLEPAS

14.5 Liter

NaCl / CaCl2 Released

LAJU DISPERSI

4.2 L/mnt

Bahan Penyemai Awan

SISA BAHAN BAKAR

72 %

Fuel Percentage Remaining

Weather Modification Mission Lifecycle (9 SOP Stages)

Digital end-to-end workflow spanning operational planning, tactical sortie execution, and post-flight precipitation evaluation.

01
PLANNED
Cloud evaluation by Weather Analyst, payload budgeting (NaCl/CaCl2), and aircraft assignment (T1/T2).

02
BRIEFING
Flight crew synchronization with GCR regarding wind shear, safety corridors, and mission time windows.

03
TAXI & TAKEOFF
Starlink/4G transponder activation on the tarmac; initial video handshake and telemetry check with GCR.

04
ENROUTE
Sortie navigates toward the target sector while ground controllers monitor engine parameters and SATCOM link.

05
CLOUD SEARCH
Pilots and meteorologists pinpoint Cumulus Congestus cells with strong convective updrafts at 8,000–10,000 ft.

06
SEEDING DISCHARGE
Pilot triggers dispenser valve. Wing cameras stream flare ignition/spray. Expended chemical deducted in real-time.

07
RETURN & LANDING
Aircraft returns to base following payload expenditure. Fuel verification and flare rack safe-down procedures.

08
COMPLETED
Ground meteorological radar verifies surface precipitation. Mission log locked and digitally signed by Commander.

09
AUDIT & REPLAY
Flight data archived into Mission Replay module for scientific research and government budget auditing.

Technical Specifications & Defense-Grade Security

Engineered on high-performance cloud frameworks with full capability to operate independently in public clouds or Air-Gapped Tactical Mobile Command Units (TMCU).



Next-Gen Web Architecture

Powered by **Next.js 16 (Turbopack Engine)** and pure TypeScript for zero-latency rendering across multi-monitor GCR arrays.

- ✓ Turbopack Sub-Second Compilation
- ✓ Tailwind CSS Native Dark UI Tokens
- ✓ React Server Components Performance
- ✓ Responsive Touch EFB Cockpit Mode



High-Availability Database

Dual connection architecture utilizing **Prisma ORM** and **PostgreSQL Enterprise** (Direct + Connection Pooler).

- ✓ Connection Pooling Transaction Mode
- ✓ Strict Foreign-Key Cascading Rules
- ✓ Automated Time-Series Telemetry Table
- ✓ Zero-Downtime Migration Pipeline



Cybersecurity & Datalink

End-to-end encryption securing military aircraft positions, payload telemetry, and preventing unauthorized interception.

- ✓ AES-256 Video Stream Encryption
- ✓ Dual-Failover Starlink to Iridium
- ✓ Hardware Security Module (HSM) Support
- ✓ Air-Gapped Local Deployment Support

Why PLUVIA is the Proven National Standard

A tested platform ready to maximize weather modification efficacy, prevent economic losses from wildfire and drought, and secure national aerospace technological sovereignty.

Strategic Investment Benefits:

-  Up to 35% Seeding Budget Savings
Precision cloud targeting eliminates wasteful dispersal over non-convective clouds, conserving tons of hygroscopic payload.
-  Maximized Aircrew & Airframe Safety
GCR operators vector pilots clear of structural microburst hazards before airframe limits are exceeded.
-  Sovereign Technological Autonomy
100% independent codebase free from foreign export restrictions, fully auditable by state defense and cybersecurity agencies.

3-Phase Implementation Plan:

- PHASE 1 **Pilot Fleet Integration (Months 1-2)**
Avionics gateway hardware installation & GCR workstation training for initial 4 aircraft.
- PHASE 2 **National Airbase Expansion (Months 3-4)**
Deployment across major military and civilian airbases across Sumatra, Java, and Kalimantan.
- PHASE 3 **AI Autonomous Cloud Seeding (Month 5+)**
Implementation of automated flight route suggestions driven by convective prediction models.

CONSULTATION & LIVE DEMONSTRATION
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