ICGA2026 2026 INTERNATIONAL CONFERENCE ON GREEN AVIATION

Keynote Research

RESEARCH PRESENTATION

Numerical Analysis and Passive Glide Control of a Fixed-Wing UAV for Disaster Management Applications in Pakistan

CFD-informed, energy-aware aerial reconnaissance for disaster response

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Institute of Space Technology, Islamabad.

International Conference on Green Aviation 2026

About the Speaker



Engr. Dr. Muhammad Umer Sohail

PhD Aerospace Engineering

Assistant Professor (TTS)
Institute of Space Technology

HEC Approved Supervisor

"CFD, Aerodynamics, Turbomachinery and Machine Learning for Aerospace"

Research & Technical Expertise

- Turbomachines
- Aerodynamics
- Computational Fluid Dynamics
- Machine Learning & ANN
- Aero Propulsion
- UAV / Aircraft Design & Optimization

Research Interests

- Turbomachines
- Aerodynamics
- Computational Fluid Dynamics
- Machine Learning
- Aero Propulsion

Selected Contributions

- 26 SCI-indexed journal articles listed in the CV across aerospace, CFD, turbomachinery, energy and machine learning.
- Principal Investigator on 11 completed industrial-based projects with NESCOM/DESTO, NASTP, POF, ATLS and IST.
- Head of R&D, Aeronautic & Astronautics Department, IST (2021–present).
- HEC Approved Supervisor and registered PEC Mechanical Engineer.
- Reviewer for MDPI journals, Journal of Applied Fluid Mechanics, IBCAST and Nature Scientific Reports.



Engr. Dr. Muhammad Umer Sohail
PhD Aerospace Engineering
Assistant Professor (TTS), IST

COMPLETED PROJECTS

Industrial Projects Completed as Principal Investigator

Aircraft Design • CFD • UAVs • Propulsion • Optimization

1 Design of Control Algorithm for Captive Trajectory System



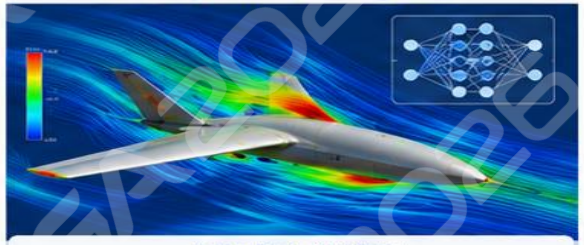
NESCOM (DESTO)

2 Design & Fabrication of High-Altitude Long-Endurance (HALE) UAVs



AsRa Tech (NASTP)

3 Machine Learning-Driven Optimization of UAV Aerodynamics Using CFD



AsRa Tech (NASTP)

4 Design & Fabrication of Miniature Heli Drone



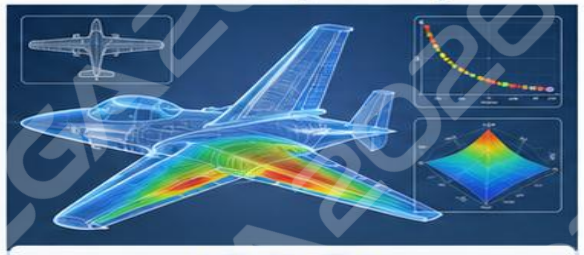
Indus Aero Electronics (NASTP)

5 Design & Fabrication of MALE UAV



BoRM (IST)

6 Multidisciplinary Design Optimization Framework for Aircraft Conceptual Design



NESCOM (AWC)

7 Design & CFD Analysis of 4-Seat Variant of SAAB MFI-17 Aircraft



ATLS Pvt. Ltd.

8 Multidisciplinary Design Optimization of an Aircraft Propeller for UAV Application



NESCOM

Pakistan's Multi-Hazard Landscape

Hydrometeorological, geophysical and climate-related hazards all demand fast situational awareness

FLOODS
riverine • flash • urban

EARTHQUAKES
active tectonic setting

DROUGHT
arid & semi-arid zones

HEATWAVES
extreme summer heat

LANDSLIDES
mountain corridors

GLOFs
northern glaciated valleys

CYCLONES
Arabian Sea coast

NDMA lists all seven among the principal hazards of Pakistan

Different hazards, one shared need: fast, safe, current information when roads and communications fail

Source: National Disaster Management Authority (Pakistan), "Pakistan's Hazard Landscape," 2026.

Three Disasters, One Access Problem

Large affected populations, damaged access routes, disrupted services and urgent information needs

2005 Kashmir Earthquake

~73,000 deaths

More than 570,000 houses damaged. Mountainous terrain complicated access and reconstruction.

2010 Floods

20 M+ people affected

Almost 20% of Pakistan's landmass impacted.

2022 Floods

33 M people affected

>1,730 deaths, >8 M displaced; damage and economic losses exceeded US$30 billion.

Why this matters for aerial response

Flooding isolates settlements and cuts roads and bridges, so rapid ground reconnaissance is difficult. Aerial systems restore situational awareness when access is constrained.

PRIORITY INFORMATION PRODUCTS

- Flood extent
- Road / bridge status
- Isolated settlements
- Relief-route recon
- Infrastructure damage
- Water pathways

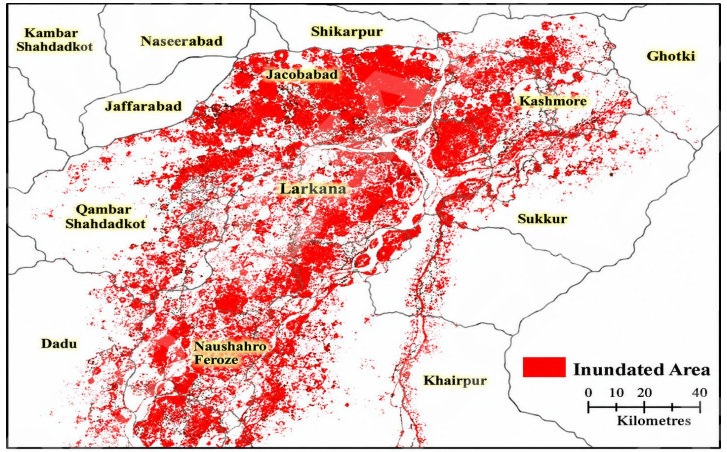
Sources: World Bank Pakistan Disaster Risk Management Program; World Bank/ADB/EU/UN/GoP 2022 Floods PDNA; World Bank press release, 28 Oct 2022.

Real Incident – 2022 Floods

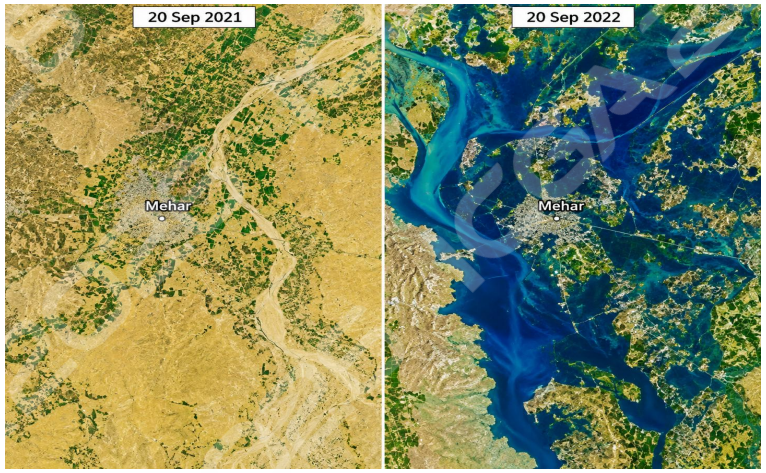
Sindh, Aug–Sep 2022: what responders saw from the air and from space



Sindh flooding, 10 Sep 2022



Larkana District flood map-August 2022



Mehar: before and after

Large areas fully submerged versus normal conditions a year

Where this UAV fits Satellites give the big picture, but revisit time and cloud limit them. Khairpur Nathan Shah was cut off with 150,000+ residents stranded; a fixed-wing UAV can fly its own wide-area survey of cut roads, isolated settlements and water pathways on demand.

Sources: USAF/AFCENT photo 2003079528; Copernicus Image of the Day (node/12172, node/12230); The New Arab, Pakistan floods, Dec 2023.

Mountain Hazards & Access

When valleys and roads fail, ground access fails first



2005 Earthquake – Balakot: Balakot 2005 earthquake relief photograph showing Pakistani soldiers carrying tents away from a U.S. Army CH-47



2010 Attabad Landslide
Hunza River dammed; ~5 km of the Karakoram Highway submerged. NASA.

>3,000
glacial lakes in GB & KP

33
identified as hazardous

7.1 M
people exposed to GLOF risk

Terrain challenge
Narrow valleys, steep slopes and damaged roads delay ground access after GLOFs, landslides and earthquakes.

UAV opportunity
Rapid corridor reconnaissance, bridge/road inspection, slope monitoring and georeferenced imagery.

Design implication
Range, gust tolerance and safe motor-off behavior matter most in remote terrain.

Where this UAV fits Five days after the 2005 quake, areas north of Balakot were still unreached; at Attabad ~3,000 people were cut off. Corridor reconnaissance of valleys, roads and bridges is a fixed-wing UAV's strongest use case.

Sources: UNDP Pakistan GLOF-II Project Brief, 2025; NDMA hazard landscape, 2026; NASA Earth Observatory; U.S. Navy/Air Force photo archive.

Where the UAV Fits in Response

This work focuses on response; the same platform supports preparedness and recovery data collection

MITIGATION	PREPAREDNESS	RESPONSE	RECOVERY
hazard mapping • terrain & infrastructure baseline	route planning • pre-event imagery • exercise support	rapid mapping • search support • access assessment	damage assessment • progress monitoring • reconstruction survey

SIX WAYS UAVs HELP AFTER A DISASTER

1. Rapid overview
Acquire current imagery without waiting for ground access.

2. Safer reconnaissance
Observe unstable areas before committing responders.

3. Search support
Visual or thermal cues for victim/location search where conditions permit.

4. Mapping & assessment
Georeferenced imagery for flood, debris and structural damage.

5. Communications support
Temporary relay or aerial base station in research and field concepts.

6. Repeat observation
Re-fly the same corridor to track changing conditions.

Sources: NDMA disaster-management framework and 2026 planning documents; Daud et al., Science & Justice 62(1), 2022; Wilderness & Environmental Medicine, 2023.

From Disaster Need to Requirement

Every engineering choice traces back to a disaster-response need

DISASTER NEED	MISSION REQUIREMENT	ENGINEERING RESPONSE
Large affected area	Range + endurance	**high L/D • low drag**
Broken roads / remote valleys	Independent aerial access	**fixed-wing reach • safe glide**
Wind / turbulence	Robust stability	**gust rejection • actuator margin**
Need for repeatable maps	Predictable flight path	**trim + closed-loop control**
Power / logistics constraints	Energy efficiency	**passive glide • optimized mission**
Evidence for command center	Traceable models	**CFD → dynamics → mission chain**

Why fixed-wing? Strong for wide-area and corridor reconnaissance where range and endurance matter. Multirotors remain better for hover and close inspection, so this platform complements them rather than replacing them.

Engineering synthesis; mission roles consistent with disaster-UAV review literature (Remote Sensing 15(13), 2023; Science & Justice, 2022).

Energy Endurance & Passive Glide

Motor-off segments stretch a fixed battery budget, if altitude, lift and control margins allow

$R \approx h \times L/D$
glide range from release height

0 W
propulsive power when passive

1 km
release height studied

Energy reserve

Small electric UAVs fly on a fixed energy budget, and extra battery adds mass, wing loading and stall speed. Motor-off segments cut propulsive power and preserve battery for sensors and comms.

Graceful degradation

A stable glide mode is a controlled energy-management option if propulsion is reduced or unavailable. Motor-off is also the riskiest phase: low altitude, gusts, no thrust.

Environmental lift

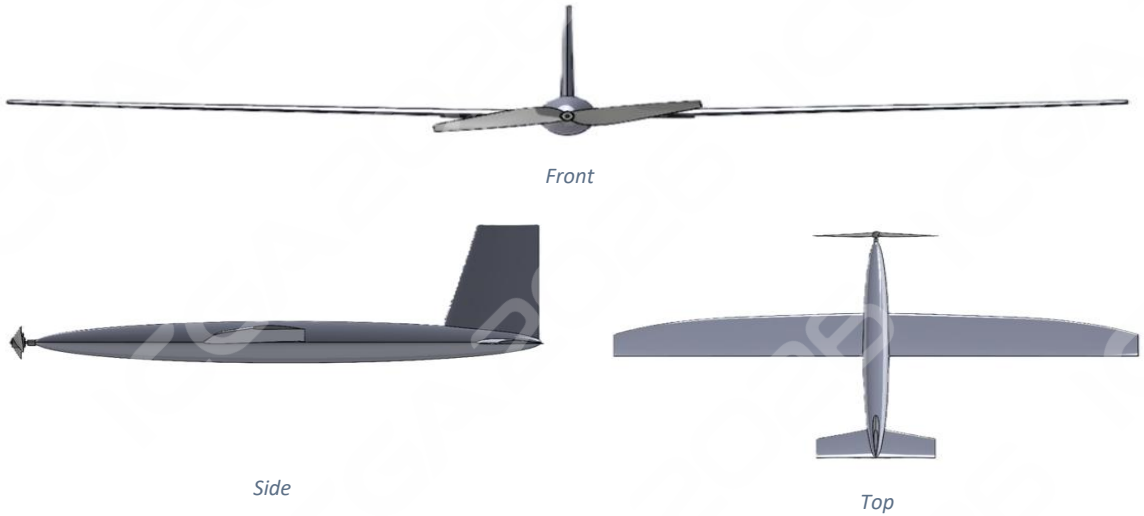
Thermal or ridge lift can extend modeled passive range when conditions are favorable and known.

Passive glide is not a universal endurance solution. It needs altitude, aerodynamic performance, safe airspace, suitable weather and validated control margins.

Quantitative glide results are from the original ICGA research deck; disaster-response interpretation is application framing, not a field-validated claim.

Final Geometry & CAD

3 m span, aspect ratio 12.77, 4.0 kg design mass, SD7037 low-Re airfoil



3.00 m wingspan	**0.705 m²** wing area (CAD)
12.77 aspect ratio	**4.0 kg** design mass
55.7 N/m² wing loading	**8.55 m/s** prelim. stall estimate
12% MAC static margin	**SD7037** low-Re airfoil

Tapered wing (root 0.32 m, tip 0.15 m, 2° dihedral), conventional tail. CG at 28% MAC, neutral point target 40% MAC.

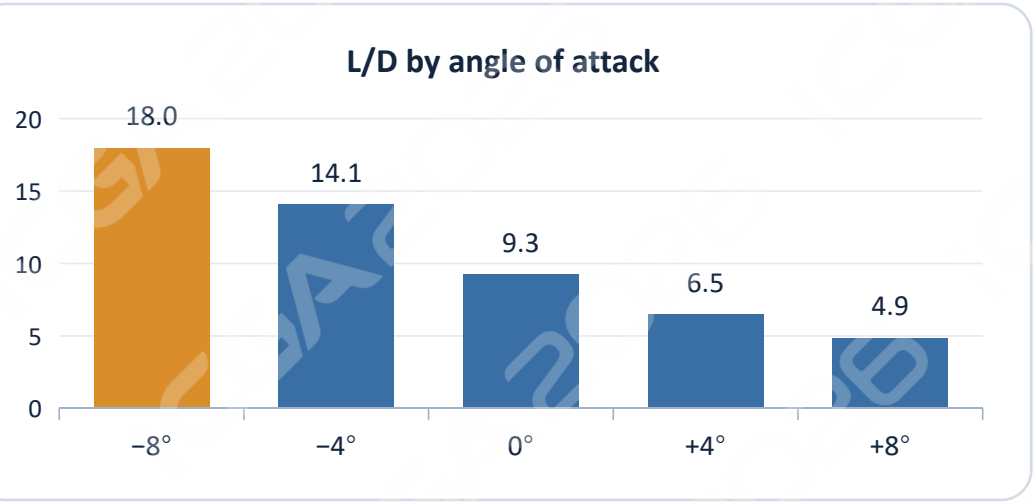
Geometry and CAD from the original uploaded ICGA presentation.

Performance Parameters

Parameter	Selected value
Flight condition	Hot-day low-altitude UAV, 1 km above sea level
Ambient temperature	30-40 deg C, design value 35 deg C
Air density used	rho = 1.1117 kg/m3
Cruise speed	11.5 m/s
Payload	0.5 kg actual payload
Total payload + avionics	1.0 kg
Estimated MTOW	4.0 kg
Battery for 3-hour class endurance	4S 16-22 Ah LiPo/Li-ion, 4S 22Ah used for sizing
Required cruise thrust	about 3.0 N at 10 m/s
Required cruise electrical power	about 63 W at 10 m/s
Required climb thrust, 1 m/s climb	about 6.9 N
Required climb electrical power	about 134 W
Installed propulsion recommendation	300-500 W motor with static thrust margin >= 12-15 N

Aerodynamic Results & Stability

L/D of 18 gives an 18 km still-air reference from 1 km, and the airframe is statically stable



AoA	CL	CD	Cm	L/D
−8°	0.180	0.0100	−0.031	**18.00**
−4°	0.169	0.0120	−0.041	14.07
0°	0.210	0.0226	−0.060	9.28
+4°	0.250	0.0384	−0.080	6.51
+8°	0.410	0.0842	−0.574	4.87

0.579 /rad
dCL/dα (local secant)

−0.275 /rad
dCm/dα: statically stable

18 km
R = 1000 m × 18

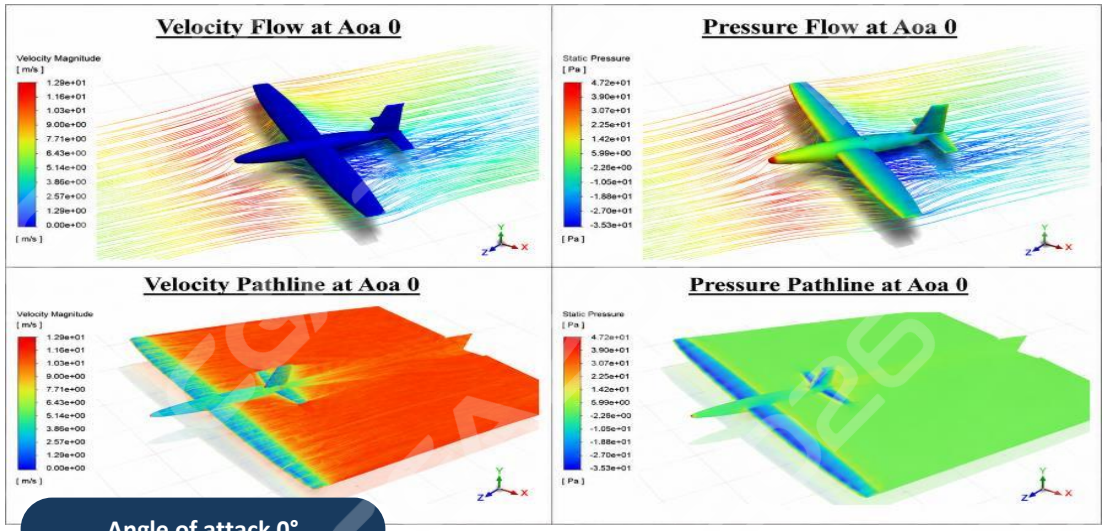
How to read it

- Negative dCm/dα agrees with the 12% MAC static margin.
- A common area error cancels in L/D, so this check cannot expose it.
- Stall and CLmax are unresolved: no stall-speed claim is made.

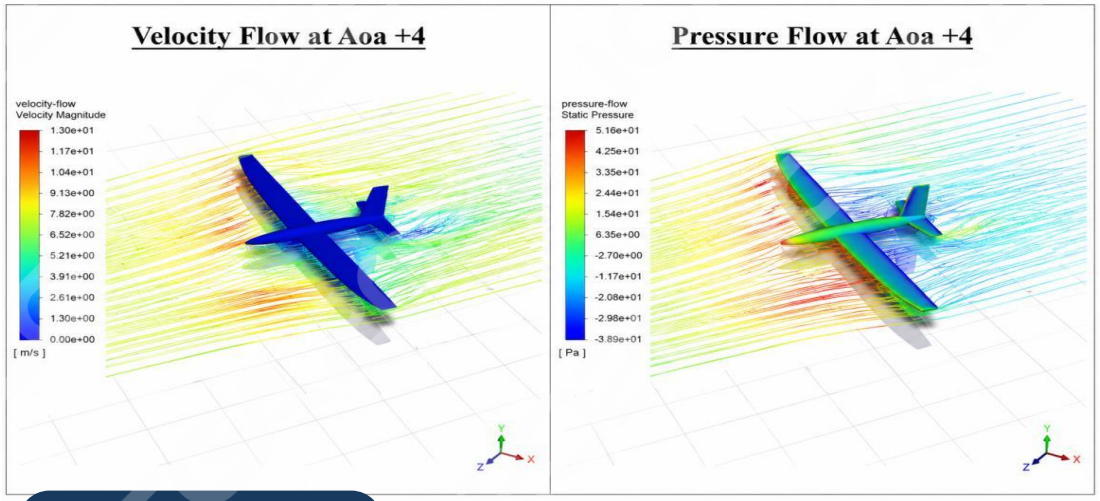
Technical content from the original uploaded ICGA presentation. L/D = 18 is the best of five points, not a proven global optimum.

Flow Visualization

Velocity and pressure fields at 0° and +4° angle of attack



Angle of attack 0°



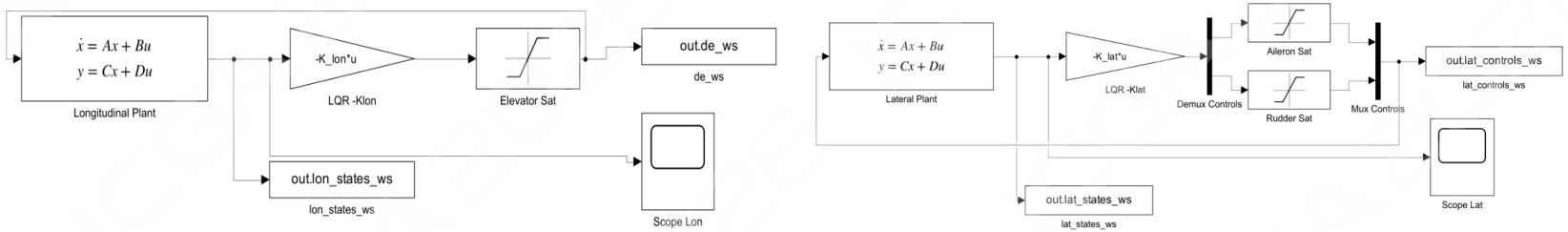
Angle of attack +4°

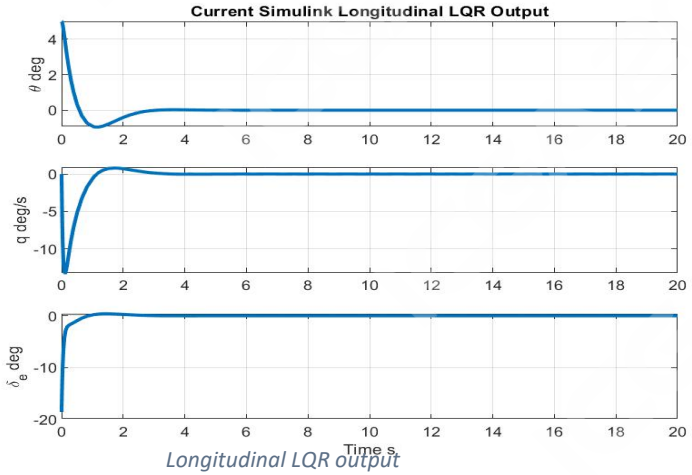
Pathlines and surface pressure support the CFD setup; quantitative claims rest on the CL, CD, Cm sweep, not on these images.

Ansys Fluent results from the original uploaded ICGA presentation. Flow images serve as qualitative plausibility checks only.

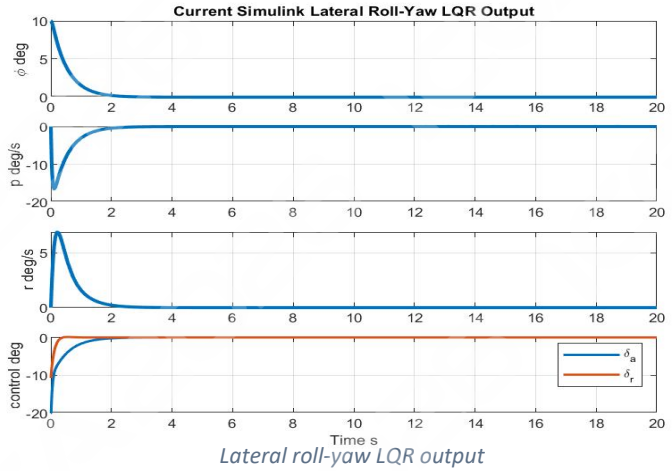
Simulink Verification

Closed-loop responses settle in seconds, but aileron authority is thin in large upsets





Longitudinal LQR output



Lateral roll-yaw LQR output

≈ 4 s

5° pitch upset

Settles in ≈ 4 s; elevator peak 18.57° of 20° limit.

2–3 s

10° bank upset

Settles in ≈ 2–3 s; rudder peak 10.7°; aileron reaches its 20° limit.

Implication little aileron authority in reserve for large or combined upsets.

Pakistan Mission Environments

Two representative lift environments built from ERA5 data

Cholistan
Thermal lift (heat-flux, Deardorff)

Window	19 Jun 2025, 10–12 UTC
Mean updraft	0.446 m/s (0.15 factor)
Track	090°, east
Data	ERA5 single + pressure level, 1 s tables

Suleiman Range
Ridge lift (terrain-gradient)

Window	18 May 2025, 11–13 UTC
Mean updraft	0.148 m/s
Track	325°, along ridge
Data	ERA5 + terrain slope 1.25°

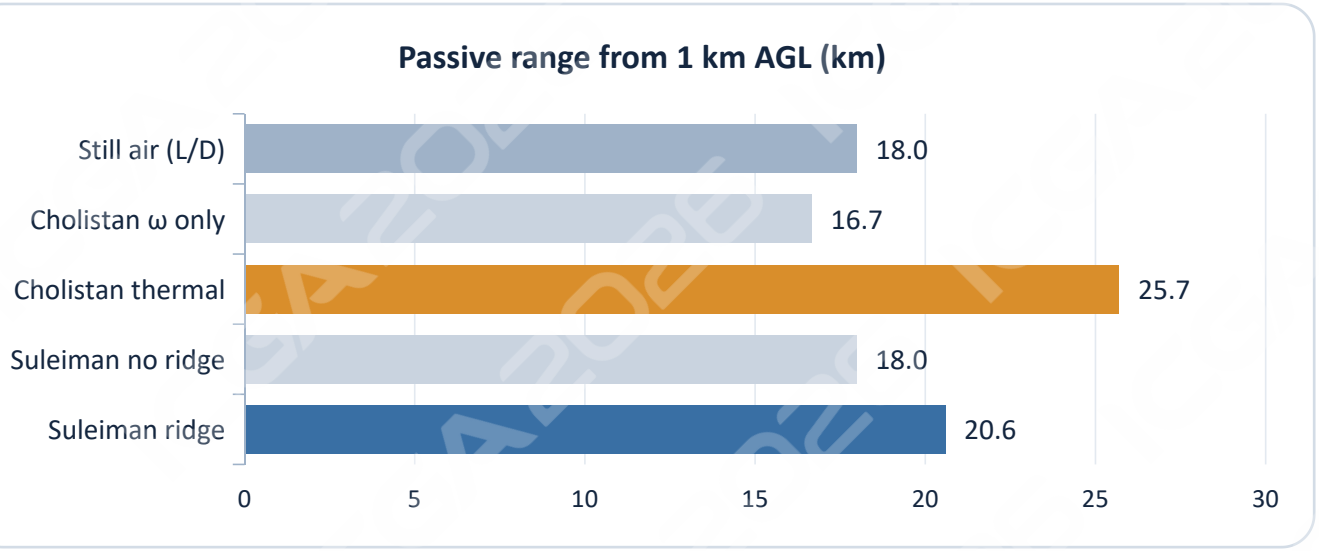
MISSION SEQUENCE

Ground roll → Climb to 1 km AGL → Motor off → Glide to ground

Representative thermal and ridge-lift environments used for mission analysis; these are not actual disaster sorties.

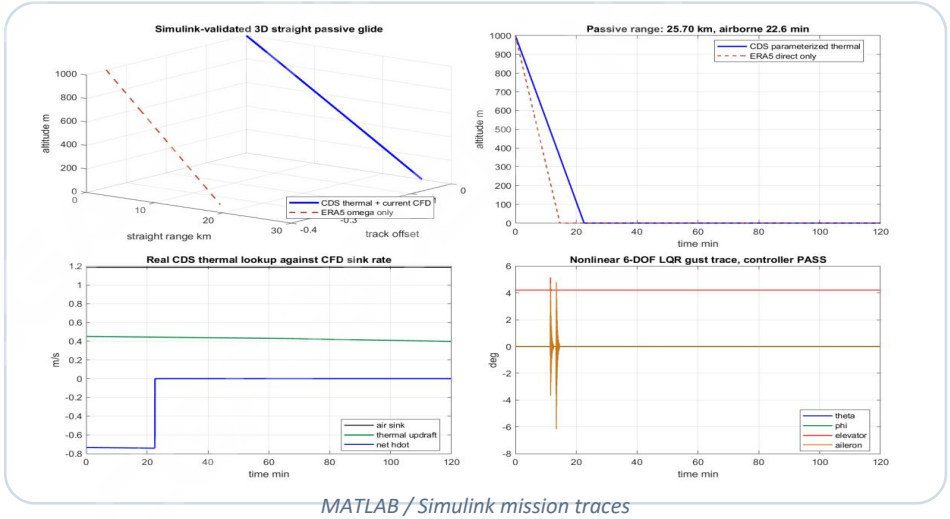
Mission Results – Passive Range

Thermal lift lifts the modeled passive range from 18 km to 25.7 km; ridge lift to 20.6 km



36.42 km
Cholistan total route

32.70 km
Suleiman total route

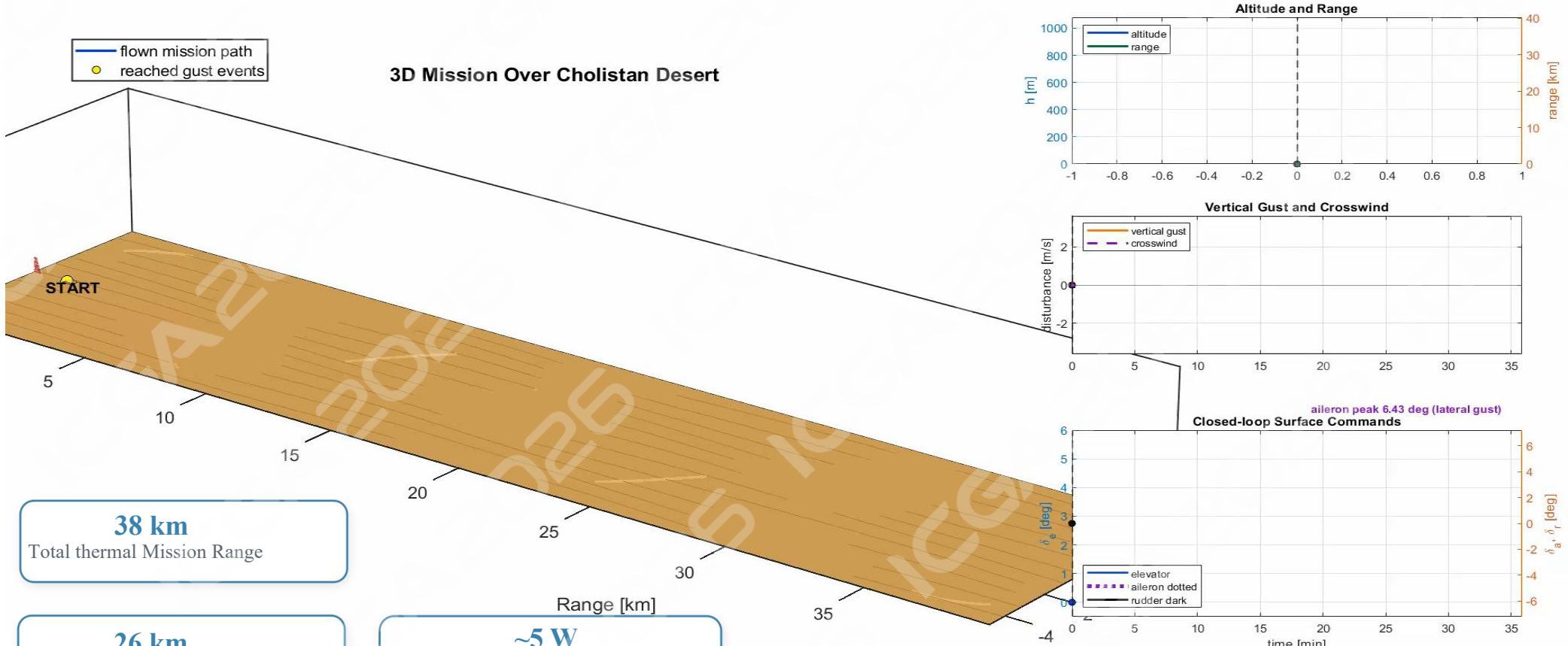


MATLAB / Simulink mission traces

Thermal case: 22.6 min airborne, net sink 0.738 m/s. Ridge adds +2.61 km (+14.5%). MATLAB and Simulink agree within 5.5 m and 4.3 m.

Modeled passive ranges from 1 km AGL, not certified disaster-response radii. Technical content from the original uploaded ICGA presentation.

TAXI / GROUND ROLL: THROTTLE 90% | t 0.0 min | h 0 m | range 0.00 km

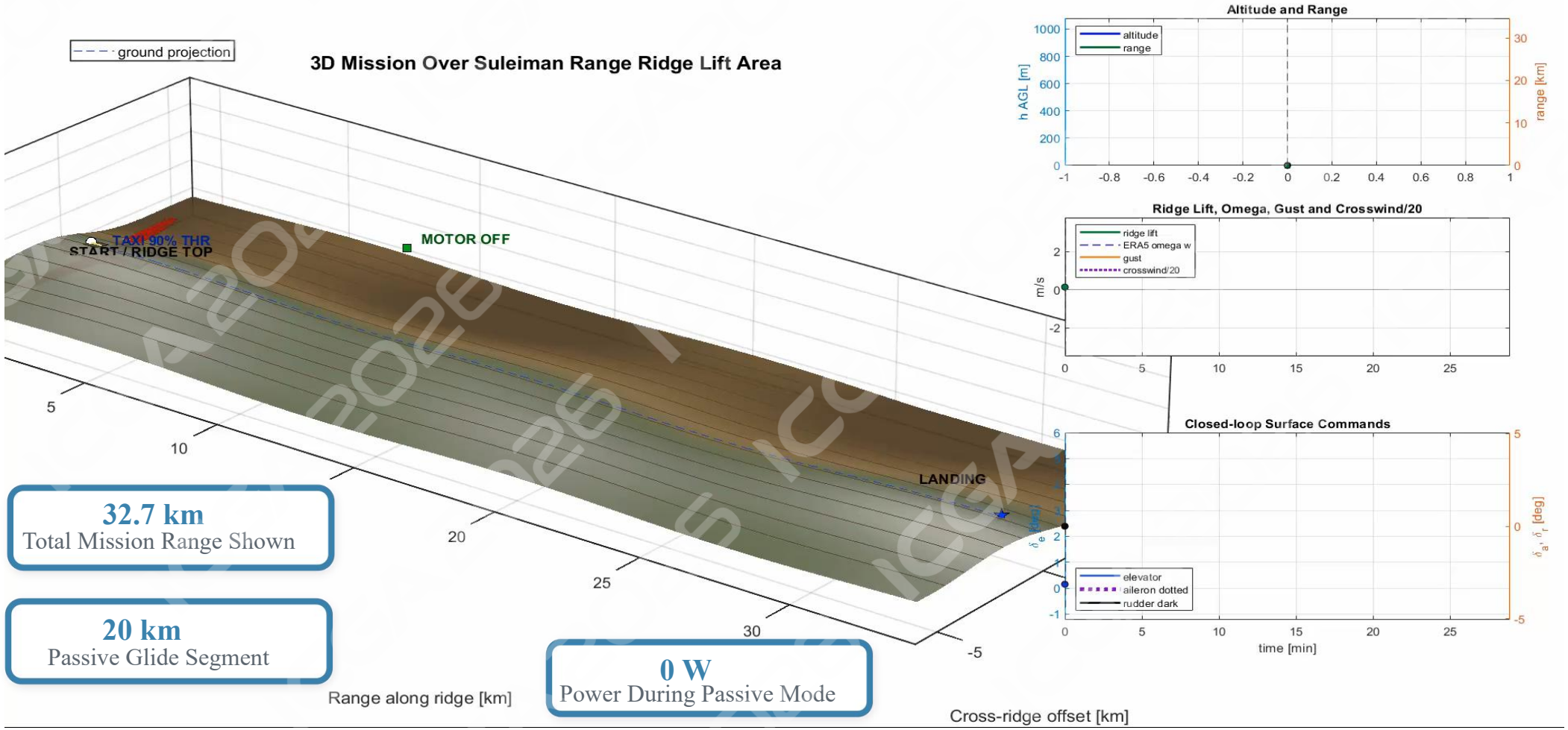


38 km
Total thermal Mission Range

26 km
Passive Glide Segment

~5 W
Aux. Power During Passive Mode

TAXI / RIDGE-TOP ROLL | t 0.0 min | h 0 m AGL | range 0.00 km | ridge w 0.14 m/s | final 32.70 km



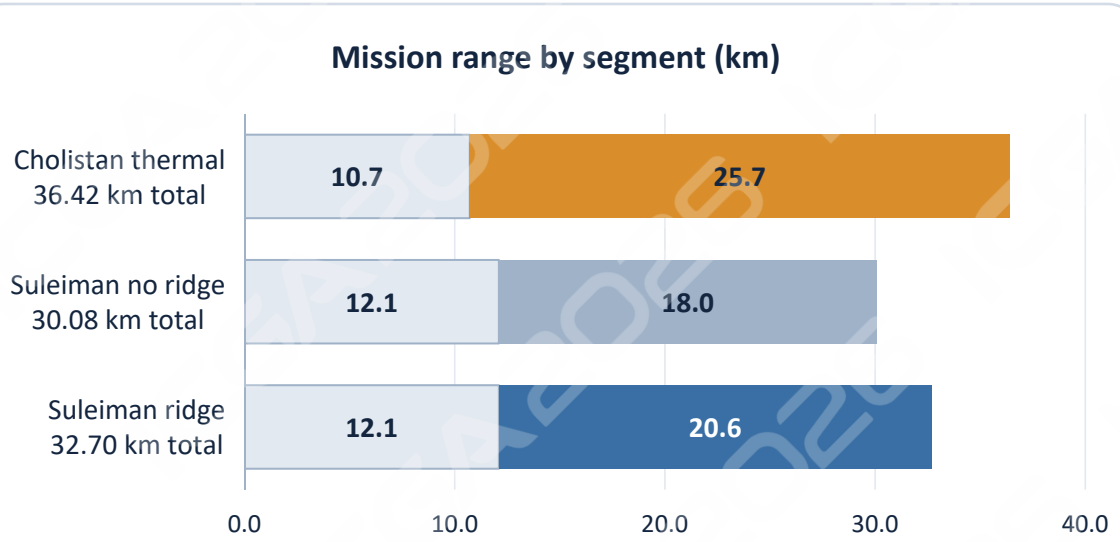
32.7 km
Total Mission Range Shown

20 km
Passive Glide Segment

0 W
Power During Passive Mode

Discussion – Thermal vs Ridge Lift

Thermal adds ~3× the range of ridge lift here because its updraft is ~3× stronger



Light bars = powered taxi + climb before motor-off; solid bars = passive glide. Totals: 36.42, 30.08 and 32.70 km, so quote passive and total ranges separately.

Cholistan – thermal

+7.7 km

vs 18 km still-air reference (+43%)

Mean updraft **0.446 m/s**

Passive time **22.6 min**

Lift model **Heat flux × 0.15 usability factor**

Suleiman – ridge

+2.61 km

vs no-ridge 17.99 km (+14.5%)

Mean updraft **0.148 m/s**

Passive time **16.3 min (+2.07)**

Lift model **ERA5 terrain slope 1.25° × 100 m wind**

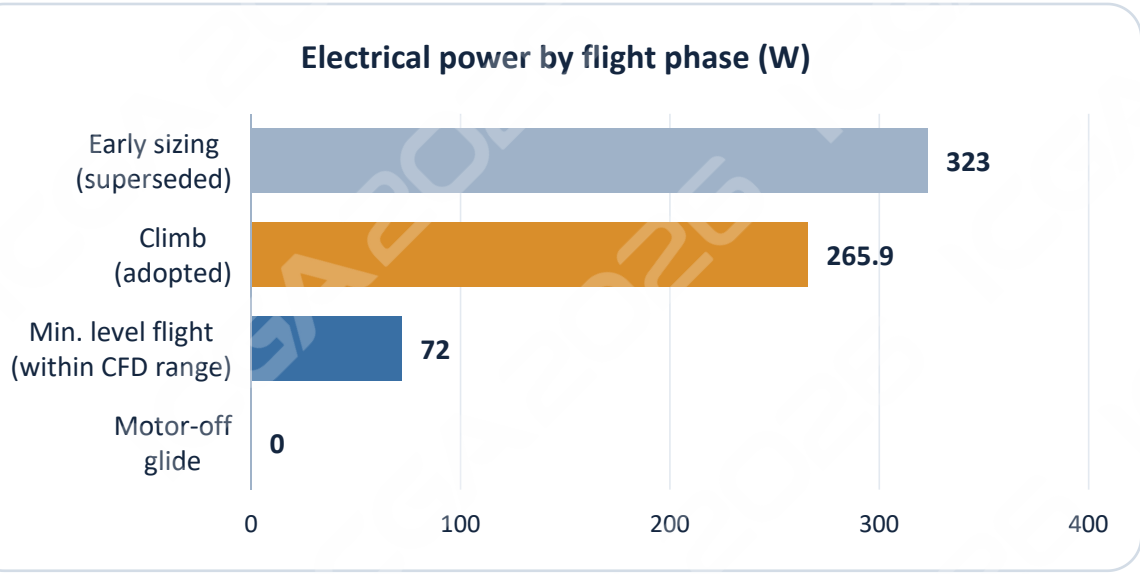
Read with care

Each gain rests on one ERA5 window per site, and Cholistan on a 0.15 usability factor that is an assumption, not a measurement. ERA5 cannot resolve a single thermal or ridge. This is not a claim that thermal beats ridge lift.

Sources: thesis Ch. 8 (Tables 8.6–8.9; ERA5 windows 19 Jun and 18 May 2025). Modeled values, not field-validated sorties. Percent gain vs 18 km is derived.

Results – Power & Energy

Powered climb needs 265.9 W; the motor-off glide that follows needs no propulsive power



Superseded: 323 W early sizing. Rejected: 104 W and 91 W from STK Aviator (propulsion model too simplified). Adopted: 265.9 W from CFD-based forces.

10.80 N
climb thrust at 16 m/s airspeed, 1.5 m/s climb

265.9 W
electrical input at η = 0.65

666.7 s
1,000 m climb after a 12 s ground roll

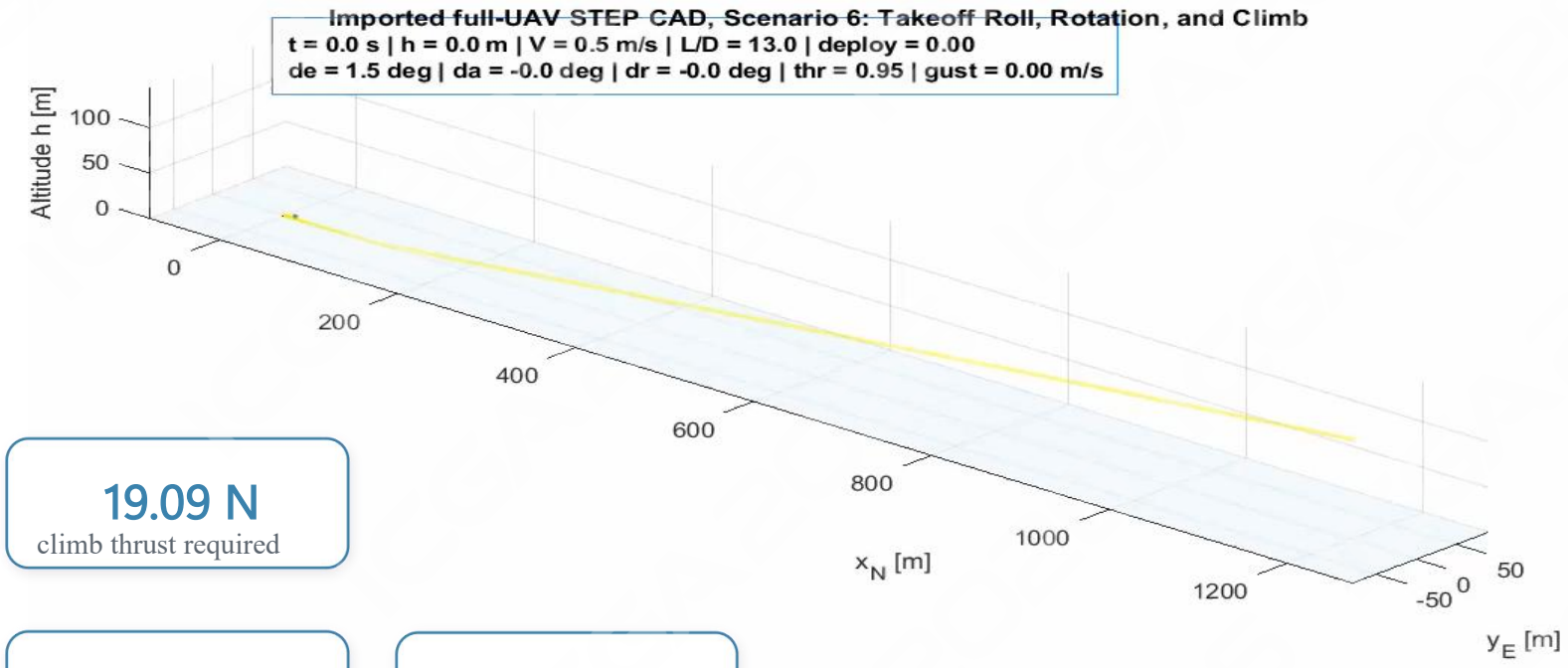
≈ 49 Wh
climb energy (derived: 265.9 W × 666.7 s)

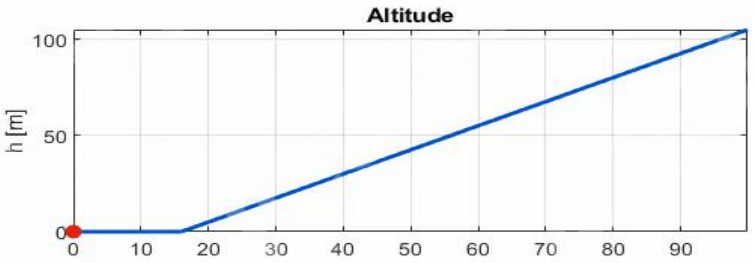
What this means

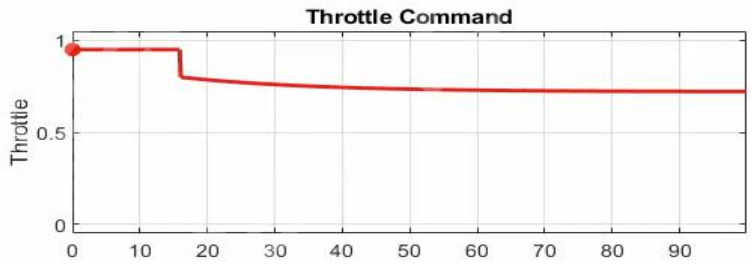
Climb is the energy-hungry phase. The 25.7 km (thermal) or 20.6 km (ridge) glide that follows needs 0 W of propulsion. Servo, receiver and flight-computer loads remain and have not been measured, so no battery-endurance claim is made yet.

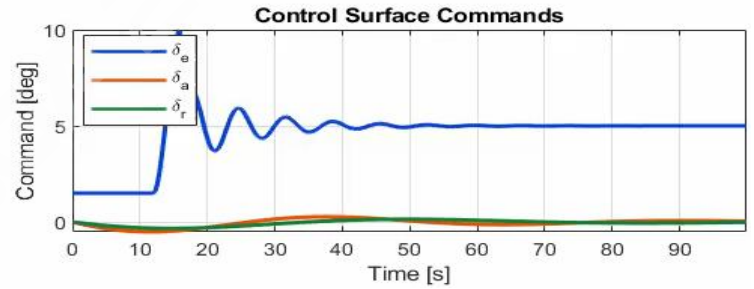
Sources: thesis Ch. 8 (Table 8.7) and Ch. 7 (Aviator rejection). Climb energy is derived and excludes ground roll and auxiliary loads.

Scenario 2 : Takeoff Roll, Rotation and Climb









19.09 N
climb thrust required

323 W
estimated climb power

11.31 min
time to 1000 m

Discussion – Do the Tools Agree?

Cross-checks catch implementation and data-transfer errors; they do not prove the physics

Cross-check	Result	What it confirms	What it does not confirm
18 km still-air reference	Same 18 km from the CFD hand calculation, an STK-only route and the MATLAB no-ridge case (17.985 km)	L/D arithmetic and release-height handling are consistent	CFD polar accuracy: a common reference-area error cancels in L/D
MATLAB vs Simulink	25.705 vs 25.699 km (5.5 m); 32.696 vs 32.691 km (4.3 m)	Both tools integrate the same rates to the same range	That the lift and sink rates are physically right; the residual is 1 s sampling
MATLAB → STK replay	36.420 km and 32.696 km transferred exactly; orientation corrected, access and AER reported	Orientation, geodetic position, access and AER geometry	Forces, controller action or power: STK replays a trajectory, it does not solve one
Nonlinear vs linear LQR	Nonlinear gust run settles in the 2–3 s the poles predict; 13 of 13 cases stable	The linearization is a fair local model with saturation active	Measured servo rate limits, delay and backlash; final derivatives

Net reading: traceable (ERA5 variable → 1 s lookup → range), cross-checked and consistent; external validation is still to come.

Sources: thesis Ch. 7, 8, 9 and the Ch. 10 cross-chapter consistency check.

Where the UAV Is Effective

STK-modeled for floods and mountain corridors; GLOF and heat/drought are the next scenarios to run

Flood reconnaissance

Sindh / Balochistan

STK-modeled

Need Map flood extent, cut roads and bridges, isolated settlements and relief routes.

36.42 km route • 25.7 km thermal passive range (18 km in still air)

Earthquake & landslide corridors

Valleys, bridges, road cuts

STK-modeled

Need Inspect valley access, bridges and slope failures where ground movement is slow or hazardous.

32.70 km route • 20.6 km ridge passive range (+2.61 km, +14.5%)

GLOF & high-mountain valleys

GB and KP: 33 hazardous lakes, 7.1 M exposed

Proposed

Need Valley reconnaissance, channel and blockage mapping, access-route status.

Same STK replay method; needs GB/KP terrain and cold, high-altitude validation

Heatwave, wildfire & drought

Broad-area surveillance

Proposed

Need Thermal hotspot reconnaissance, fire-edge mapping, water-point and vegetation-stress imagery.

Same airframe and route tools; not yet modeled

STK replays modeled trajectories; it does not certify payload, endurance or field performance.

Sources: Pakistan Floods 2022 PDNA; World Bank 2005 earthquake case study; UNDP GLOF-II brief, 2025; NDMA summer-hazard planning. Range values from the uploaded ICGA deck.

System Integration & Workflow

The UAV feeds the existing three-tier command structure, it does not create a parallel one

FEDERAL NDMA	Mission standards • inter-agency tasking • national common operating picture
PROVINCIAL PDMAs	Prioritize districts • allocate teams • integrate UAV data into provincial response
DISTRICT DDMAs	Define local targets • launch/recovery coordination • relay findings to incident command

1 Task
incident objectives, priority locations

2 Plan
airspace • route • weather • launch/recovery

3 Fly
powered transit + survey; passive glide where appropriate

4 Process
georeference • QC • rapid map / detections

5 Deliver
GIS / command center • priority findings

6 Re-task
repeat changes • new priority zones

A disaster-ready system needs both the aircraft and the information workflow: the value is the decision product delivered to responders.

Sources: NDMA National Disaster Management Plan, 2026; NDM Act 2010 three-tier system. Proposed workflow, not a current NDMA SOP.

Deployment & Safe Operation

What must travel with the UAV, and what limits how it can be used

WHAT MUST TRAVEL WITH THE UAV

AIR VEHICLE
airframe • propulsion • control surfaces • spares

PAYLOAD
RGB / thermal / other mission sensor

GROUND CONTROL
laptop / GCS • mission planning • telemetry

POWER
batteries • field charging • power budget

COMMS
telemetry • data link • backup communications

FIELD SUPPORT
launch/recovery kit • tools • weather check • safety gear

DATA
storage • georeferencing • rapid mapping templates

PEOPLE
pilot/operator • payload analyst • incident liaison

CONSTRAINTS & RESPONSIBLE USE

Weather & terrain Wind, rain, visibility, density altitude and landing options may invalidate a route.

Airspace Helicopters, military, relief aircraft and other drones: deconfliction is essential.

Comms & GNSS Datalink loss, GNSS degradation and terrain masking need lost-link logic.

Privacy & data Imagery may capture homes or victims; control access and retention.

Model limits Results are simulation-based; payload, endurance and field performance are not certified.

Regulatory approval Confirm mission permissions with current Pakistan aviation requirements.

Proposed deployment architecture; regulatory details must be verified against current Pakistan aviation requirements before any field operation.

Discussion – What the Results Support

Results support model-in-the-loop feasibility; reconciled inputs and measurements come next

Supported by the evidence

18 km reference: L/D = 18, best of five CFD points

Control: all poles stable; peak gust errors 0.817° and 0.361°

Robustness: 13 of 13 cases stable, commands inside limits

Consistency: MATLAB–Simulink within 5.5 m and 4.3 m; STK geometry replay

Provisional: model assumptions

Thermal strength: 0.15 usability factor is not measured

Weather scale: ERA5 cells cannot resolve one thermal or ridge

Derivatives: dynamic and control values are preliminary

Climb power: 265.9 W is first-principles, not measured

Open items to close first

Reference area: mission model uses 0.96 m^2, CAD gives 0.705 m^2; reconcile, then re-trim and re-run

CFD polar: −8° to +8° only, so no stall or CLmax claim

Actuators and mass: CAD inertias, servo rate, delay, backlash

Energy: auxiliary load and battery endurance unmeasured

Not claimed: flight-validated performance, certified response radii, or full-envelope robustness.

Sources: thesis evidence-boundary statements in Ch. 4, 5, 8, 9, 10 and 11.

Future Work: Full-Scale HAPS Deployment

From low-scale UAV validation to a 20 km solar-assisted stratospheric platform.

20 km
Stratospheric Altitude

Cholistan / Thar
High-Solar Desert Zones

Months
Flying Target

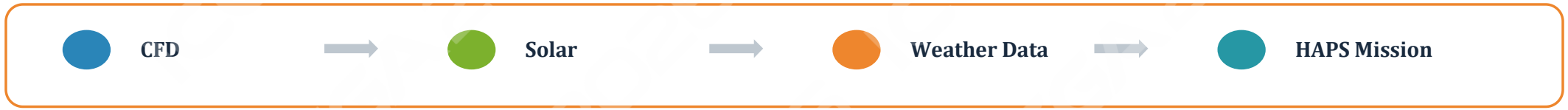
Solar + Battery
Day/night energy balance

Technical Scope

- High-altitude.
- Solar power sizing
- Station-keeping control

Applications

- 5G networks / emergency relay
- Surveillance and reconnaissance
- Weather and thermal monitoring



Boundary: full HAPS deployment needs high-altitude CFD, solar-energy and atmospheric validation.



ANNEXURES

Annexures

STK Scenario Cholistan



STK Cholistan Mission Reports

5 Jul 2026 16:19:14
Civil Air Patrol Use Only
Aircraft-FYP_STK_ONLY_cholistan_UAV-To-Facility-FYP_cholistan_STKOnly_Start: Inview Azimuth, Elevation, & Range

FYP_STK_ONLY_cholistan_UAV-To-FYP_cholistan_STKOnly_Start - AER reported in the object's default AER frame

Time (UTCG)	Azimuth (deg)	Elevation (deg)	Range (km)
25 Jun 2026 07:01:33.269	180.033	-0.006	0.597678
25 Jun 2026 07:01:43.000	180.029	-1.131	0.743333
25 Jun 2026 07:01:53.000	180.027	-1.905	0.893215
25 Jun 2026 07:02:03.000	180.026	-2.457	1.043215
25 Jun 2026 07:02:13.000	180.024	-2.870	1.193286

Global Statistics

Min Elevation	25 Jun 2026 07:12:00.000	180.004	-5.432	10.014402
Max Elevation	25 Jun 2026 07:01:33.269	180.033	-0.006	0.597678
Mean Elevation			-2.816	
Min Range	25 Jun 2026 07:01:33.269	180.033	-0.006	0.597678
Max Range	25 Jun 2026 07:36:33.678	179.982	-0.236	26.237267
Mean Range				14.348803

Azimuth, **E**levation, **R**ange report

STK reports LOS direction and slant range to ground facility

Max

STK Scenario Suleiman Range



STK Suleiman Mission Reports

5 Jul 2026 16:21:27
Civil Air Patrol Use Only
Aircraft-FYP_STK_ONLY_suleiman_UAV-To-Facility-FYP_suleiman_STKOnly_Start: Inview Azimuth, Elevation, & Range

FYP_STK_ONLY_suleiman_UAV-To-FYP_suleiman_STKOnly_Start - AER reported in the object's default AER frame

Time (UTCG)	Azimuth (deg)	Elevation (deg)	Range (km)
25 Jun 2026 07:01:27.833	180.019	0.132	0.514742
25 Jun 2026 07:01:37.000	180.017	-1.077	0.651535
25 Jun 2026 07:01:47.000	180.016	-1.924	0.800965

STK reports LOS direction and slant range to ground facility

Global Statistics

Min Elevation	25 Jun 2026 07:11:59.999	180.010	-5.354	9.983563
Max Elevation	25 Jun 2026 07:01:27.833	180.019	0.132	0.514742
Mean Elevation			-2.731	
Min Range	25 Jun 2026 07:01:27.833	180.019	0.132	0.514742
Max Range	25 Jun 2026 07:36:42.853	179.989	-0.099	26.254978
Mean Range				14.287688

Max

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Access dates and publication years should be rechecked before final conference submission.

PHOTO AND IMAGERY CREDITS

U.S. Air Force / AFCENT (Sindh flooding, 10 Sep 2022); EU Copernicus Sentinel-1 and Sentinel-2; U.S. Navy photo by PH2 T. Smith (Balakot, 2005); NASA Earth Observatory (Attabad lake, 2010).