Iceland Liechtenstein Norway grants

The final conference of the POLNOR-LEADER project

TS110 Research Platform

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NORCE

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SkyTech eLab

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RESEARCH PLATFORM

TS110

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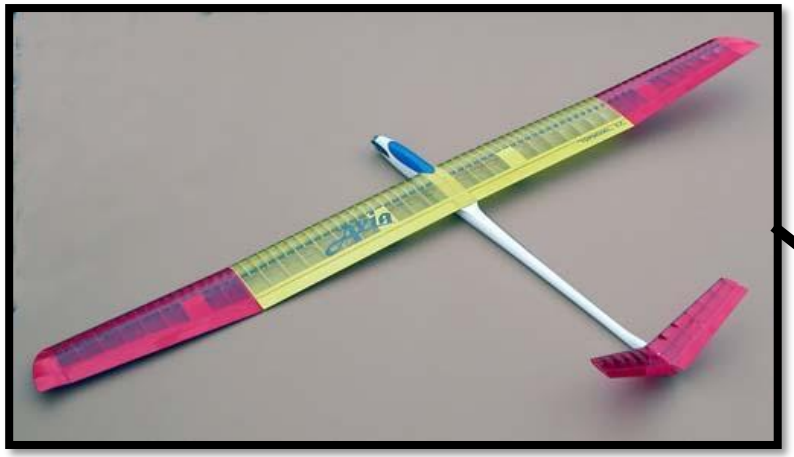
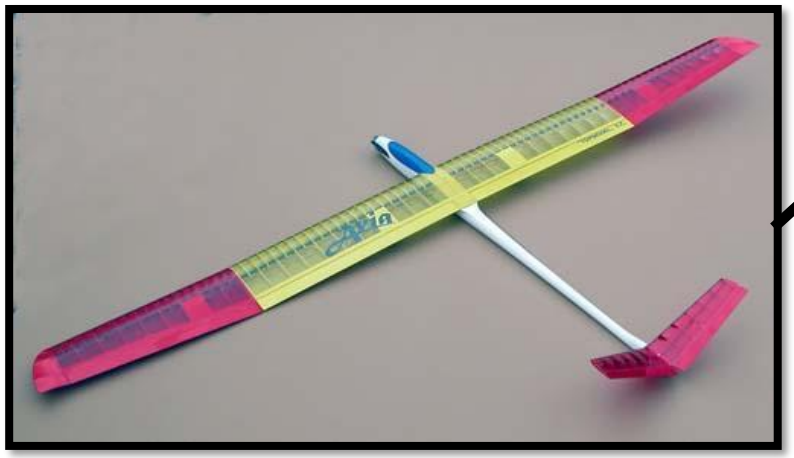
MOTIVATION

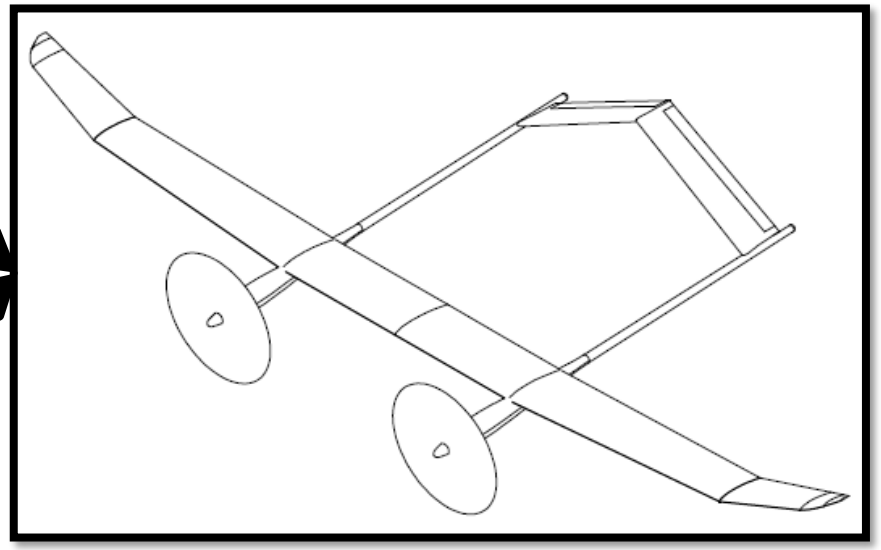
TS110

- Checking the configuration, performing experimental flights of this type of airframe
- Software development platform (we didn't have to wait for TS17)
- Cheaper, faster in repair and modification than TS17
- It should still serve as a research platform before we do final tests on TS17
- To practice pilot skills of this type of fixed wing aircraft

TS110







HOW WAS IT BUILT?

TS110

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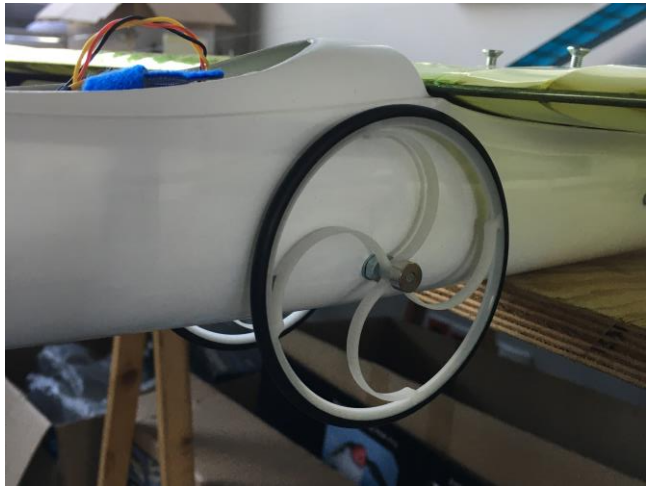

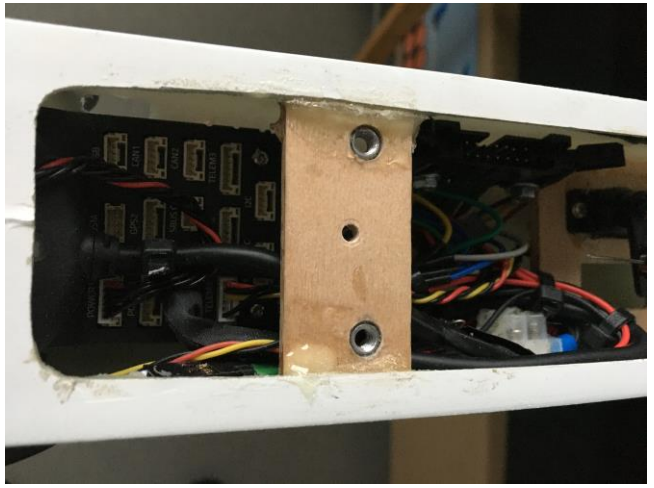

GEOMETRICS

TS110

- Wingspan: 2,5m
- Length: 1,3m
- Fuselage seperation: 0,815m
- TOM: 2-3kg
- Wing airfoil: MH 32 MOD
- Wing area: 46dm^2
- Winglet angle: 10^o
- Tail airfoil: NACA 0009 MOD
- Tail angle: 120^o

- Max. static thrust: 3,5kg
- Set thrust: 1,6kg
- Stall speed: 5-6m/s
- Hand launch
- Landing on elastic wheels

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EQUIPMENT

TS110

- AutoPilot: PixHawk 6C (ArduPilot)
- RC, Telem: RFDesign 868x
- Drive system:
  - Motor: Dualsky GLIDER 3036EG-11, KV1370, 372W, max. 31A
  - ESC: FOXY G2 R-40SB
  - Prop.: Aeronaut 10/6 carbon-plastic
  - Battery:
    - 2 x Dualsky LiPo 3S, 2700mAh
    - 2 x Li-Ion 3S2P, 7000mAh
- Servos:
  - Hitec HS-82MG (flaps)
  - Hitec HS-65MG (rudder, ailerons)

- FrSky sensors:
  - ASS-100 (airspeed)
  - FCS-40A (current)
  - FLVSS 2-6S (voltage)
  - RPM: 1 000-30 000
  - Temp.: -20-250^{o}C
  - Vari-N: 1m resolution

Research methodology

- Flights without AutoPilot in manual mode (take-off/landing, loiter)
- Autopilot flights with stabilization
- Return-To-Home trials
- Trials with(out) ailerons
- Waypoint flights with(out) ailerons
- Differential thrust tests
- Take-off and landing with (without) flaps
- Comparative test of missions with(out) ailerons, with(out) thrust differentiation

First tests

- RC only
- Tests:
  - Hand launch
  - Take-off and landing
  - Manual flights
  - With(out) ailerons
  - Spin trial and recovery with ailerons

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Advanced tests

- Flight modes:
  - With(out) ailerons and flaps
  - Manual, Stabilized
  - RTH, Waipoints
  - Differential thrust

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Landing

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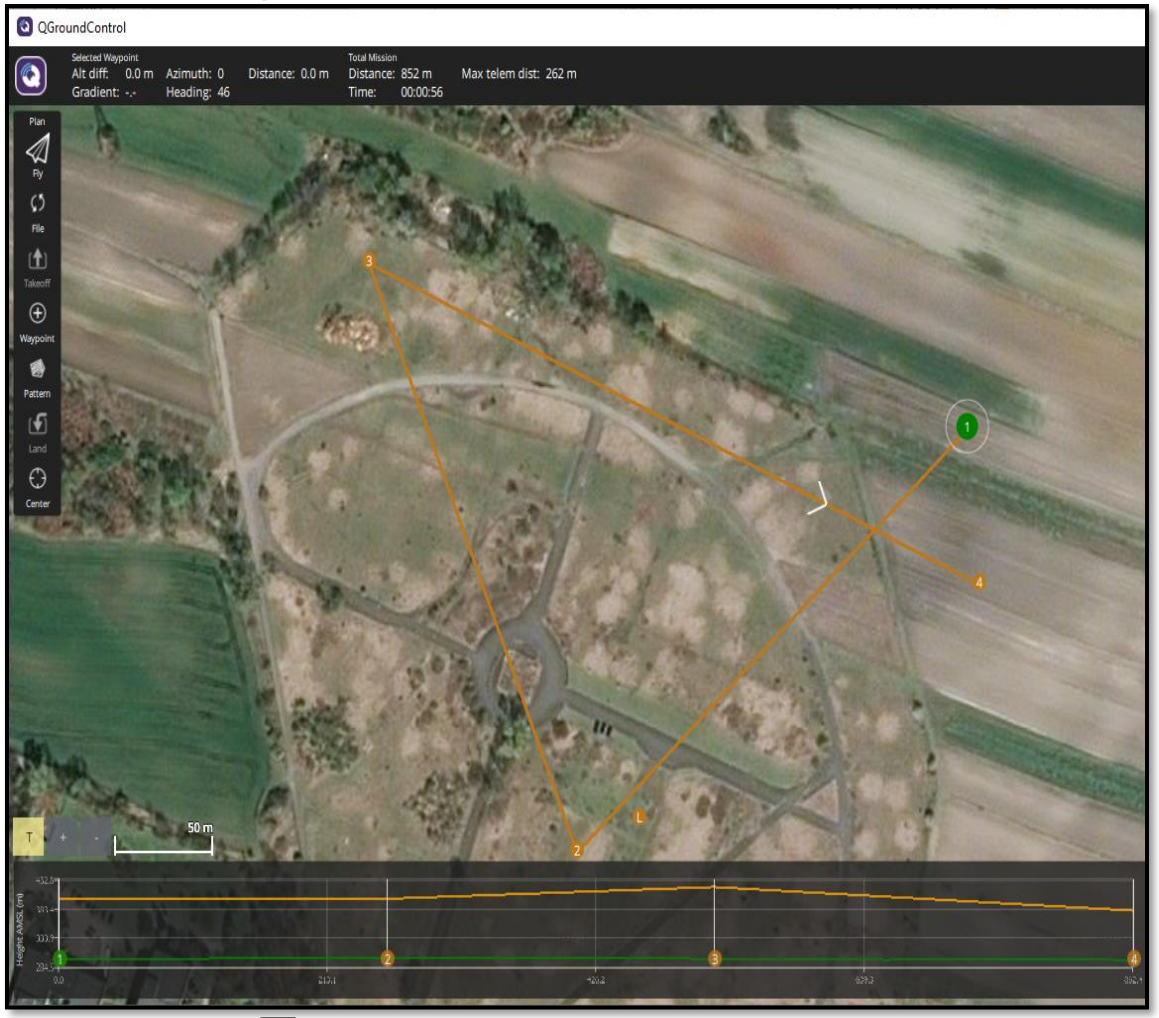
Comparative test

- Goal: to evaluate and compare fixed wing behavior in flight
- Scenarios:
  - Ailerons, No Differential thrust
  - Ailerons, Differential thrust
  - No Ailerons, Differential thrust
  - No Ailerons, No Differential thrust
- Missions:
  - Waypoints (max. 20m altitude difference)
  - Loiter (max. 100m altitude difference, spiral climbing)

PLAN

Waypoints mission



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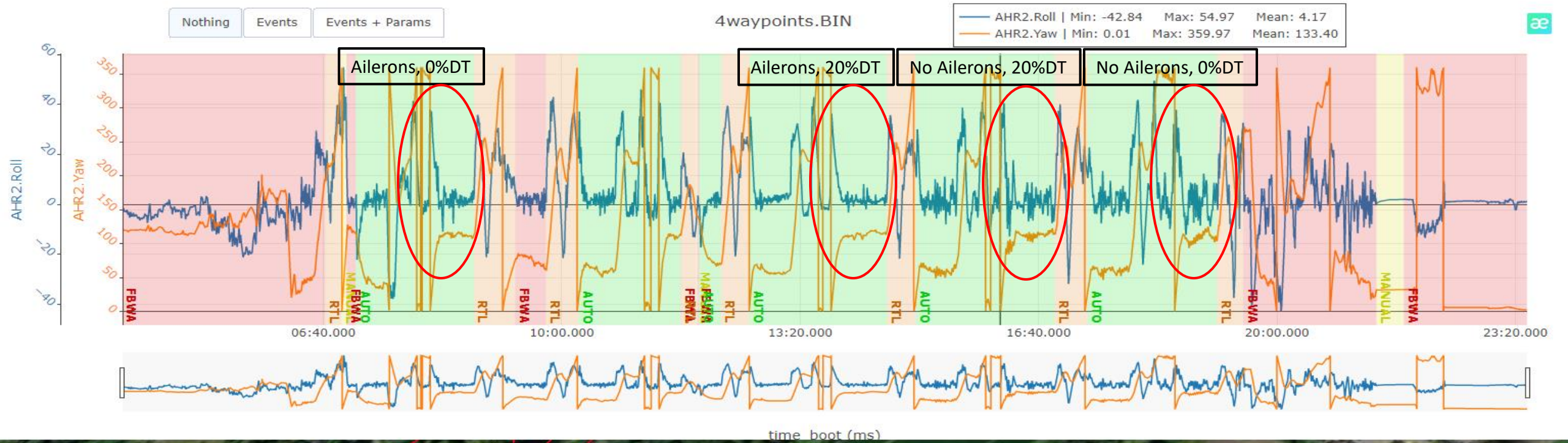
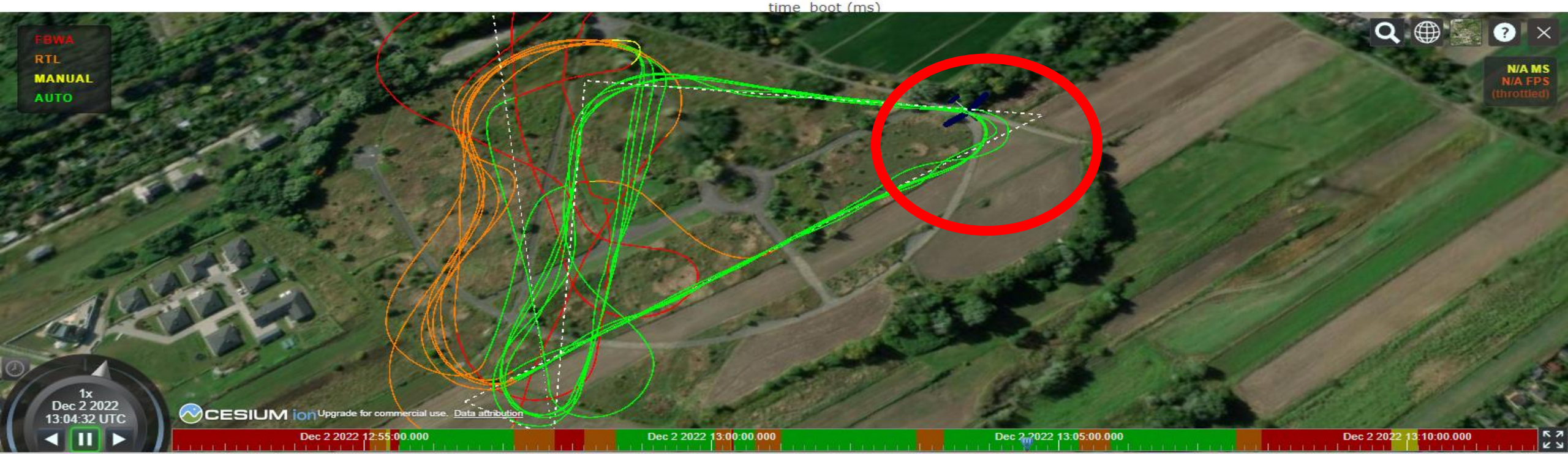
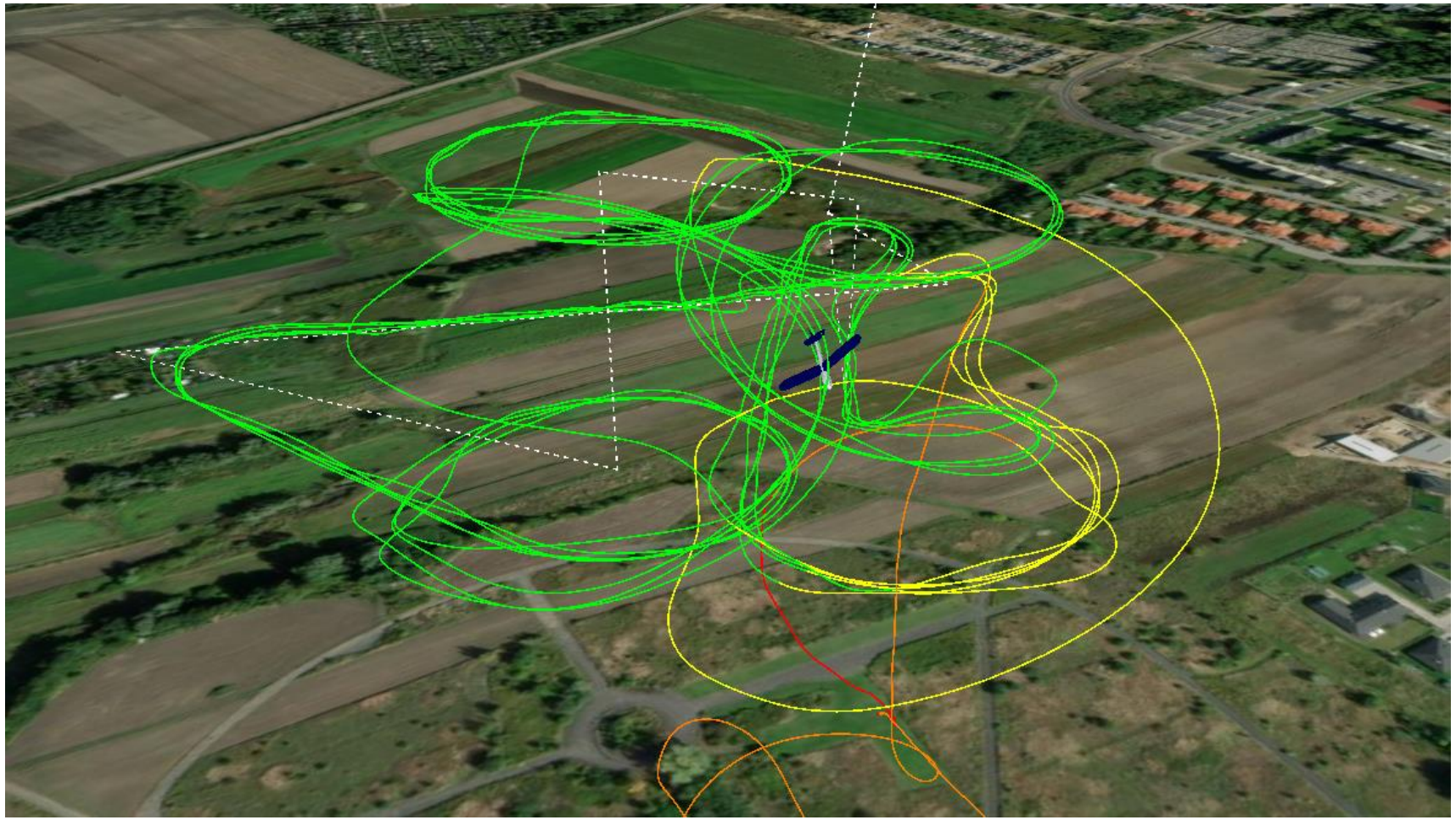

Nothing
Events
Events + Params
4waypoints.BIN
AHR2.Roll | Min: -42.84 Max: 54.97 Mean: 4.17
AHR2.Yaw | Min: 0.01 Max: 359.97 Mean: 133.40
Ailerons, 0%DT
Ailerons, 20%DT
No Ailerons, 20%DT
No Ailerons, 0%DT
AHR2.Roll
AHR2.Yaw
FBWA
RTL
MANUAL
AUTO
06:40.000
10:00.000
13:20.000
16:40.000
20:00.000
23:20.000
time_boot (ms)


FBWA
RTL
MANUAL
AUTO
N/A MS
N/A FPS
(throttled)
1x
Dec 2 2022
13:04:32 UTC
CESIUM ion
Upgrade for commercial use. Data attribution
Dec 2 2022 12:55:00.000
Dec 2 2022 13:00:00.000
Dec 2 2022 13:05:00.000
Dec 2 2022 13:10:00.000

RESULTS

Loiter missions



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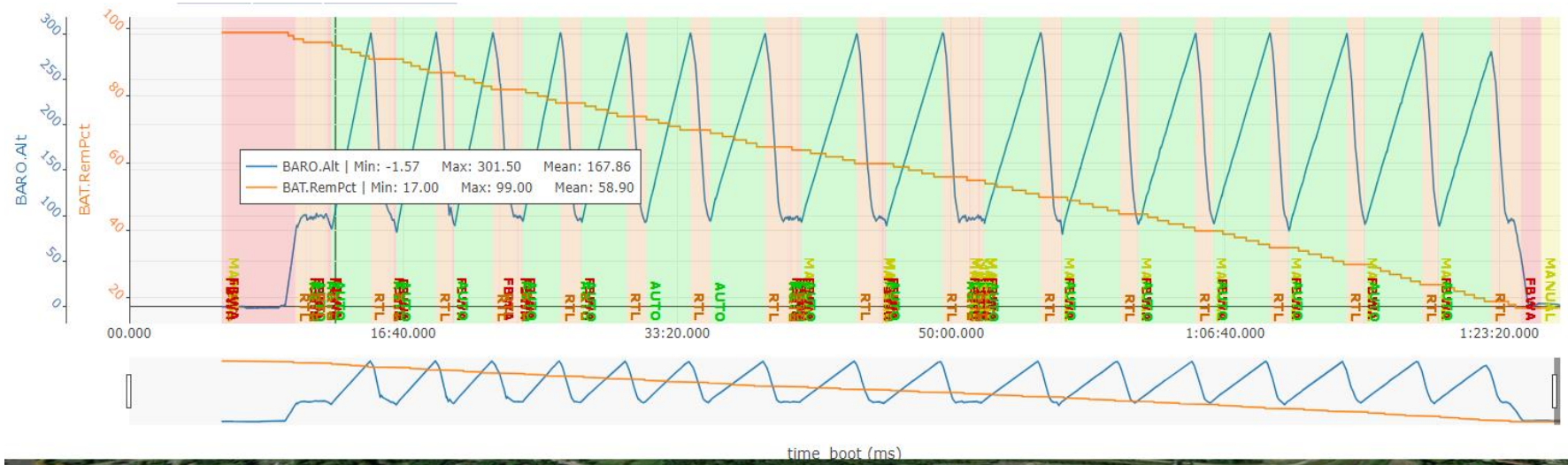
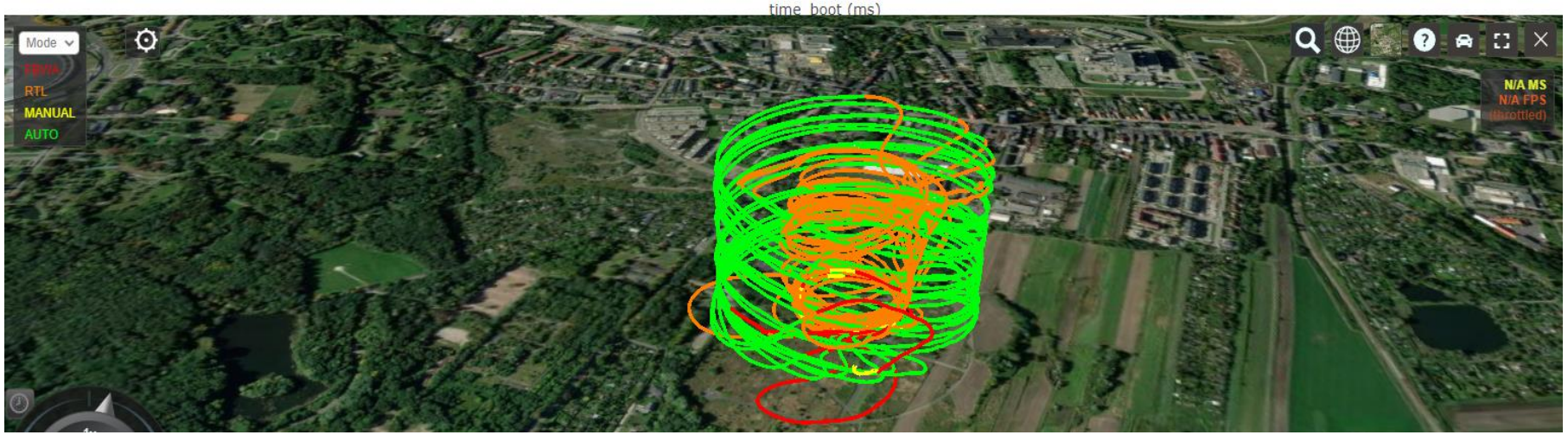
RESULTS

Preliminary climbing tests





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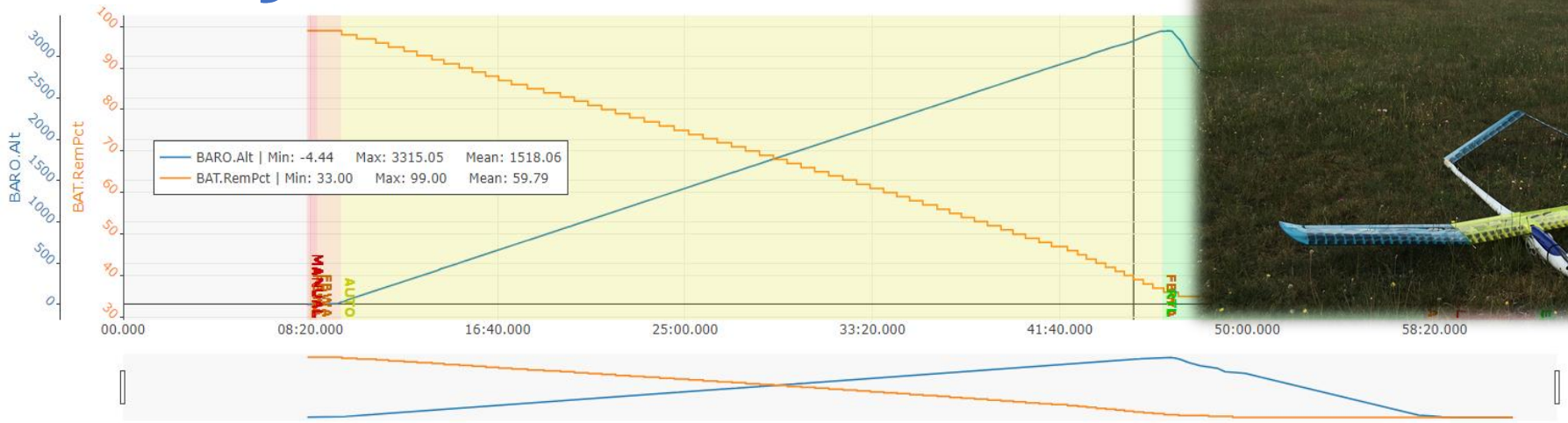
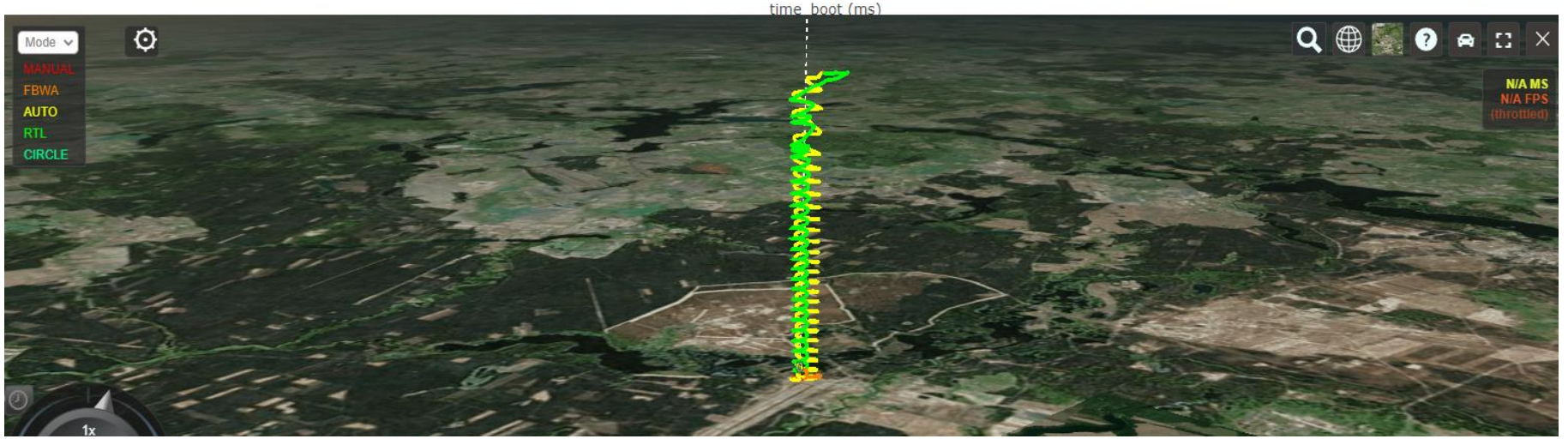
RESULTS

Final climbing tests





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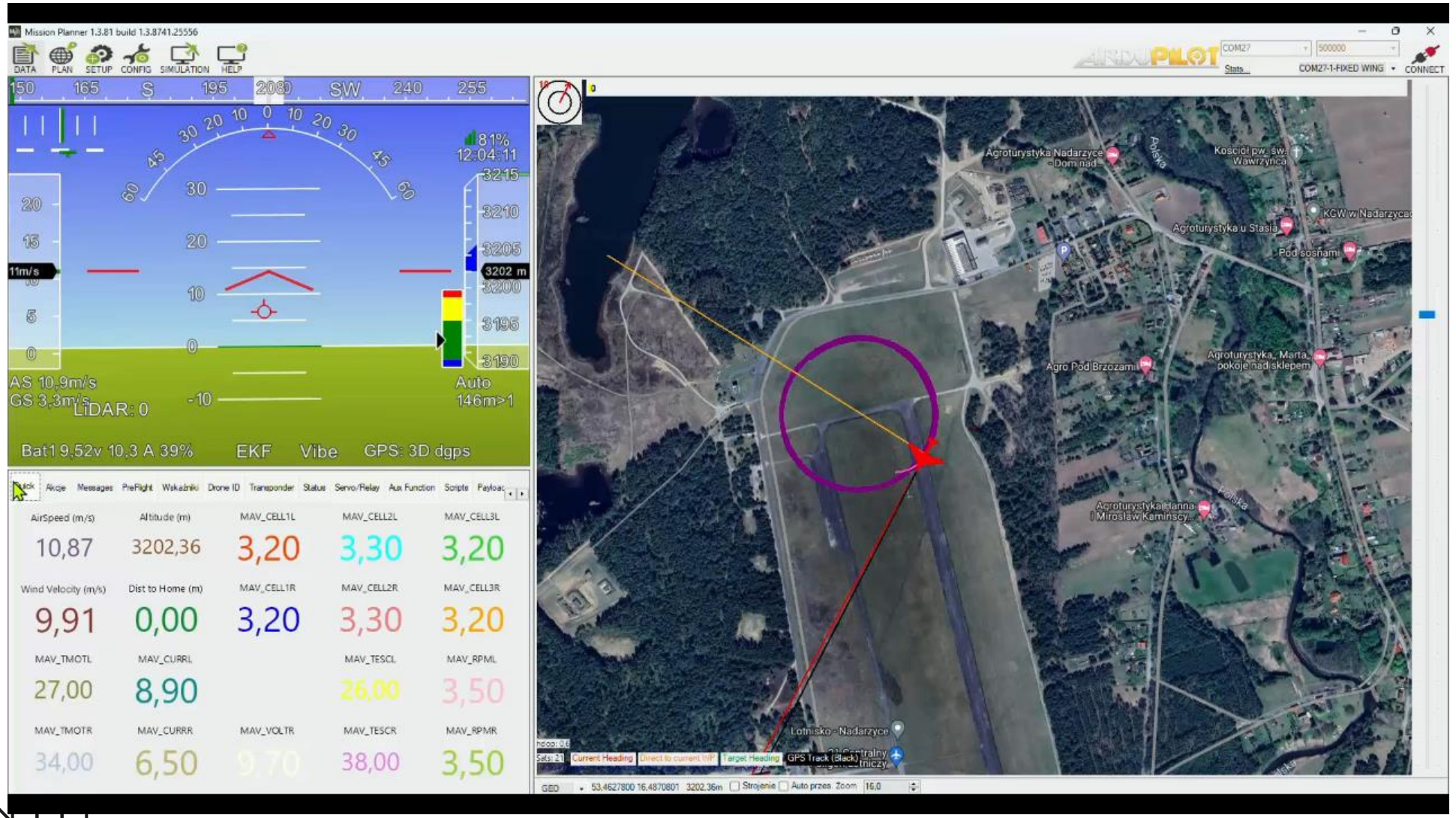
RESULTS

Final climbing tests



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Flights on 21 CPL

Conclusions

- The drone without ailerons and with the thrust differentiation performs turns in a quite properly coordinated manner.
- Side wind resistance is low.
- Landing and take-off (no flaps) correct and flat - requires high landing and take-off speed.
- The drone requires a precisely planned landing approach path and take-off path.
- The turn radius without ailerons is larger than in the classic control system.

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Norway
grants

Thank you!

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