GSA Horizon 2020
RNP – AR 0.15 Approach

LSHK Interlaken
Switzerland

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EASA 11th Rotorcraft Symposium

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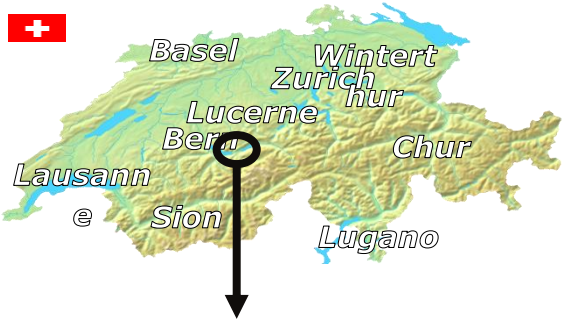
1. Where

Interlaken, Switzerland



1. Where

Brienzersee
Unterseen
Interlaken
Bönigen
Thunersee
rega
Wilderswil

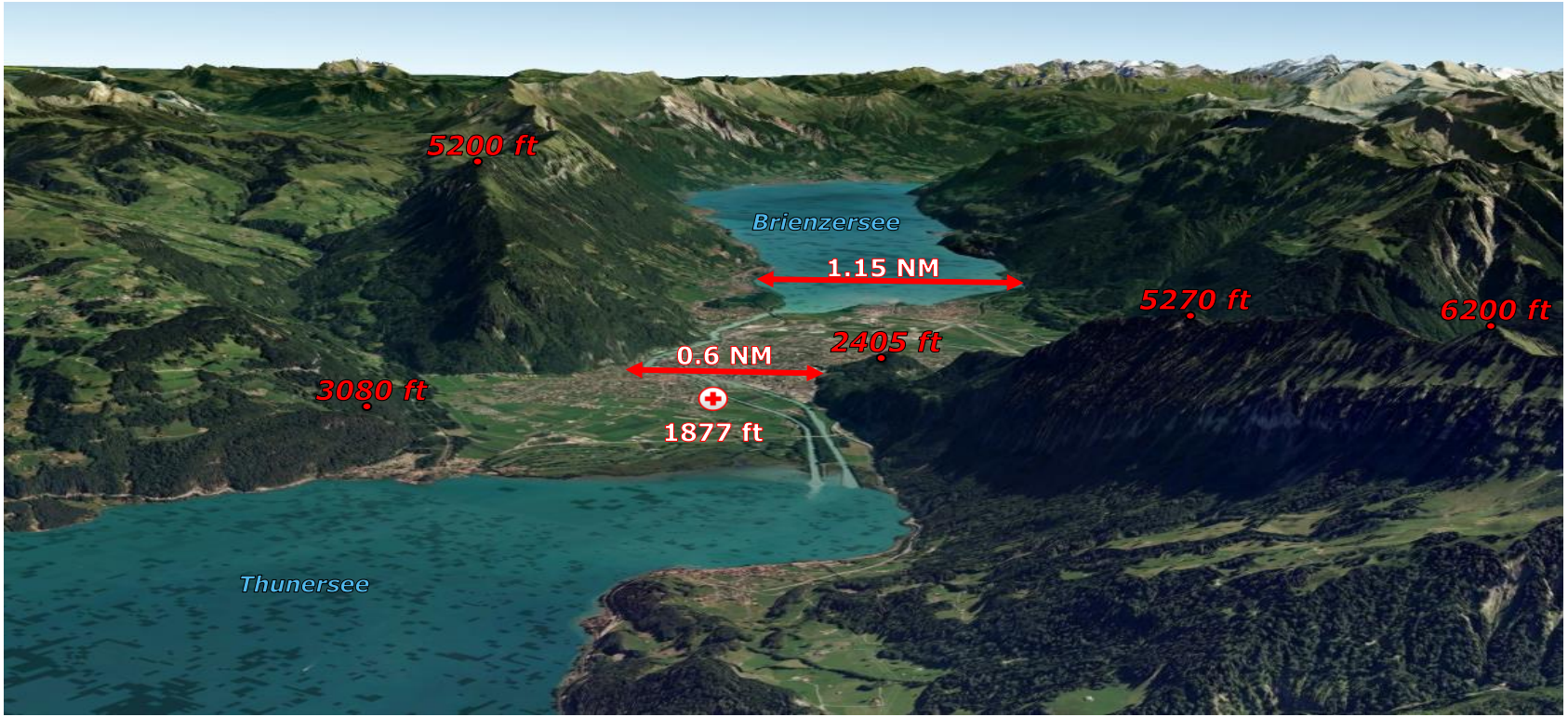
1. Where

Hospital Interlaken
LSHK

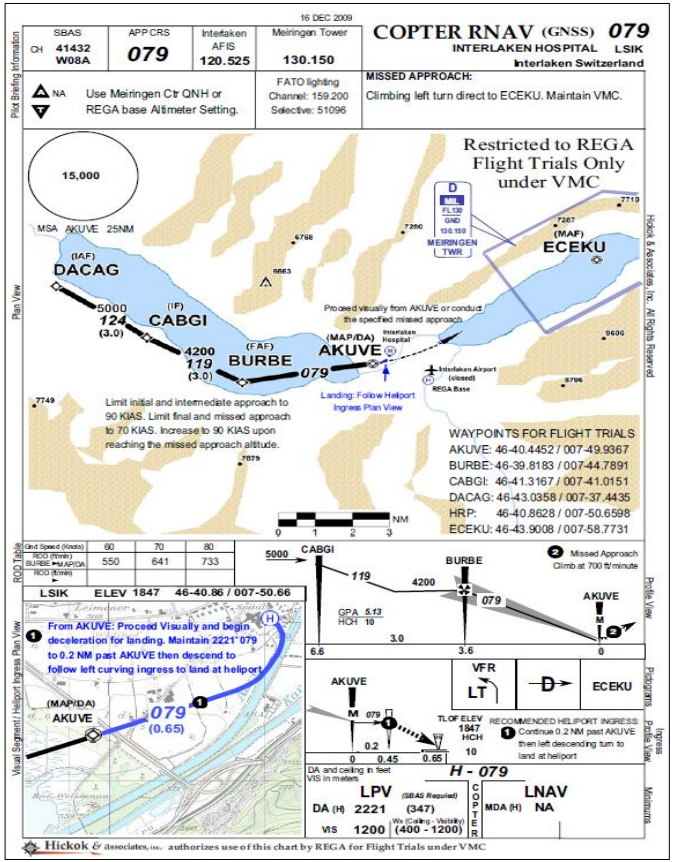
N 46° 40' 51''
E 07° 50' 39''
1877ft

2. "History"

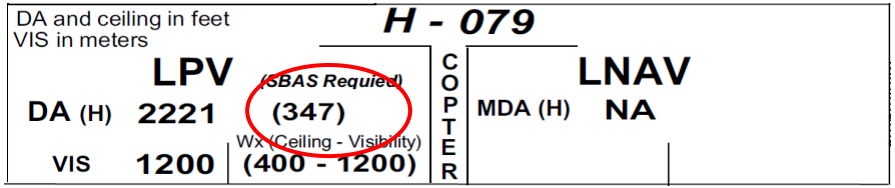
Interlaken ≡ Challenging scenario



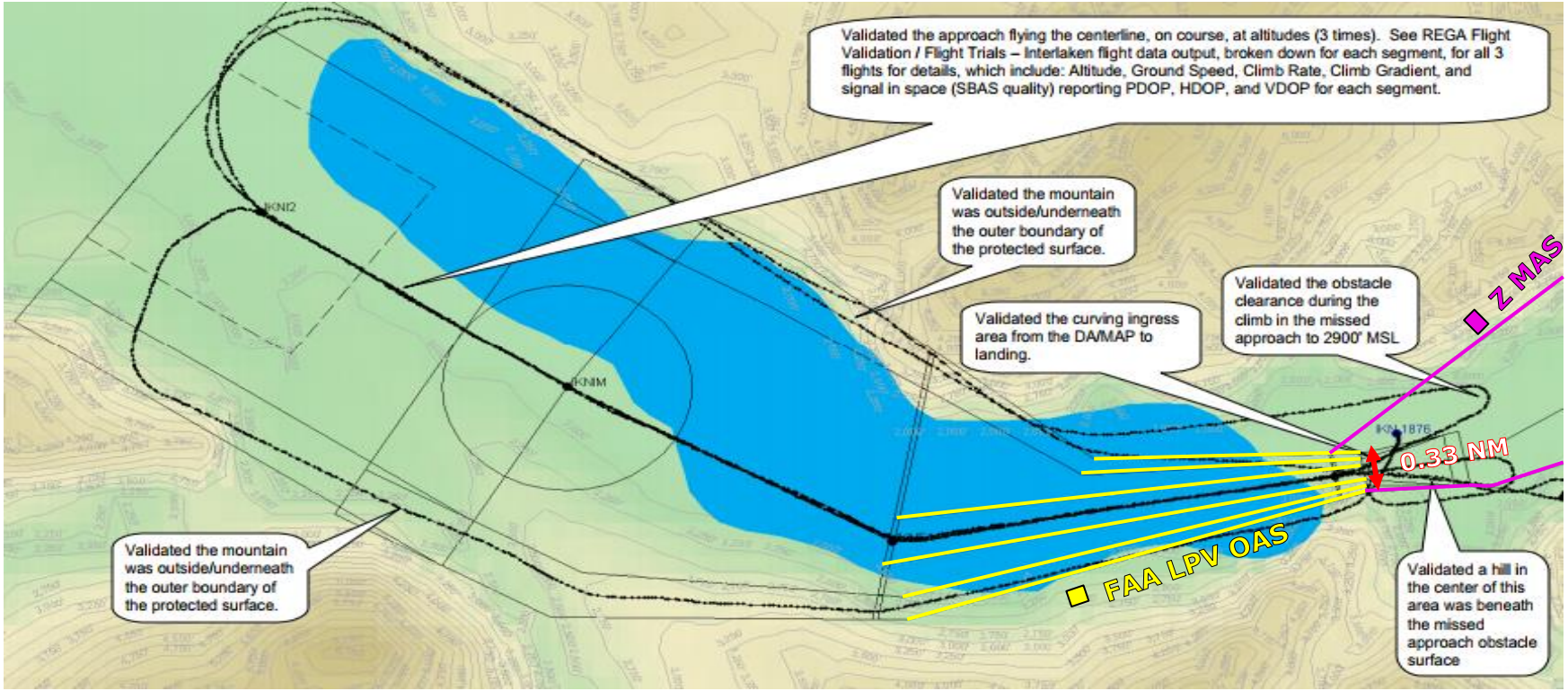
2. "History"



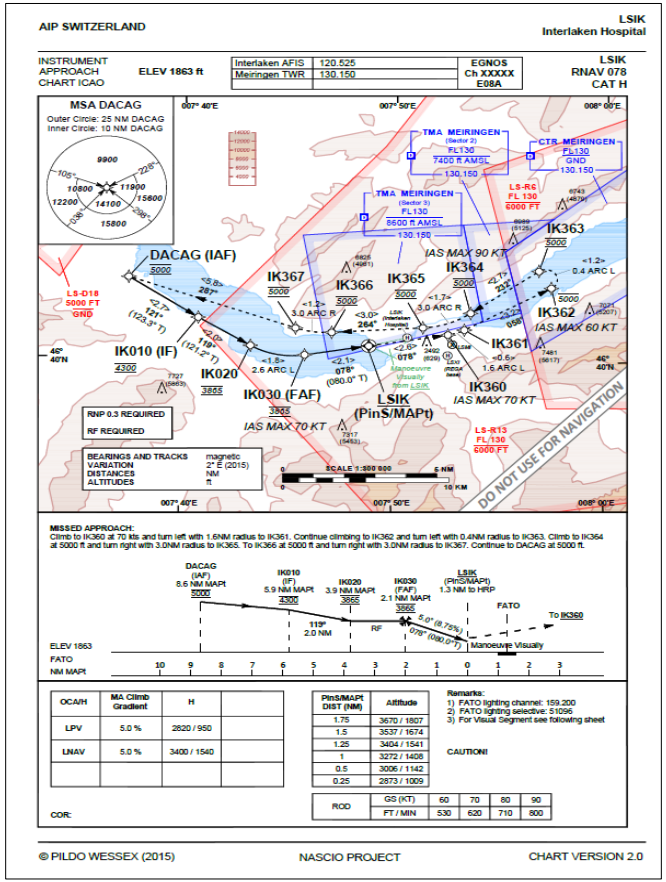
- **Main features:**
  - DEC 2009
  - FAA criteria
  - RNP APCH
  - GPA 5.13º
  - MAS towards Brienzersee to ECEKU and maintain VMC
  - MACG 8%



2. "History"


Validated the approach flying the centerline, on course, at altitudes (3 times). See REGA Flight Validation / Flight Trials – Interlaken flight data output, broken down for each segment, for all 3 flights for details, which include: Altitude, Ground Speed, Climb Rate, Climb Gradient, and signal in space (SBAS quality) reporting PDOP, HDOP, and VDOP for each segment.
Validated the mountain was outside/underneath the outer boundary of the protected surface.
Validated the obstacle clearance during the climb in the missed approach to 2900' MSL
Validated the curving ingress area from the DA/MAP to landing.
Z MAS
0.33 NM
FAA LPV OAS
Validated the mountain was outside/underneath the outer boundary of the protected surface.
Validated a hill in the center of this area was beneath the missed approach obstacle surface
IKNI2
IKNIM

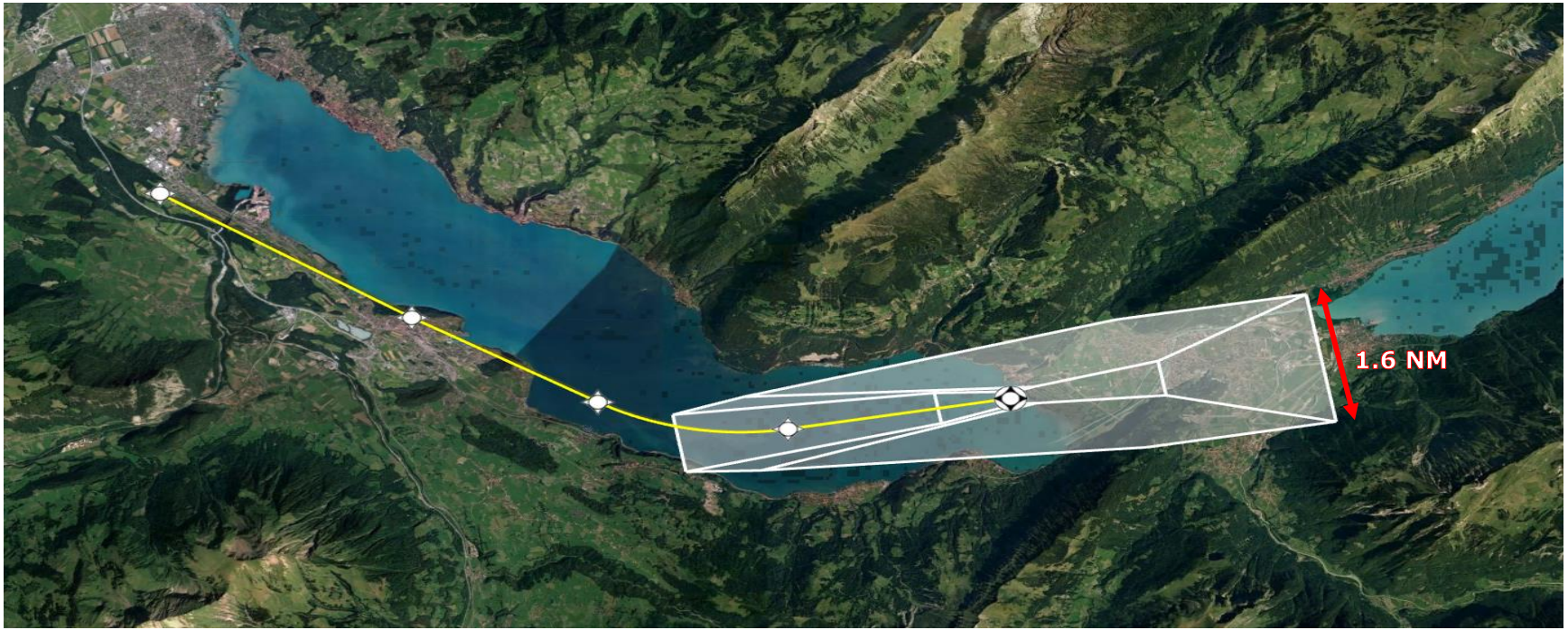
2. "History"



- **Main features:**
  - AUG 2015
  - RNP 0.3 + RNP APCH (FAS) + RF legs
  - MOC increased 100%
  - GPA 5º
  - MAS towards Brienzersee and turn back to IAF
  - MACG 5%

OCA/H	MA Climb Gradient	H
LPV	5.0 %	2820 / 950
LNAV	5.0 %	3400 / 1540

2. "History"



2. "History"

- Complex orography and weather
- Low freezing levels
- High operation altitude
- 24h rescue service

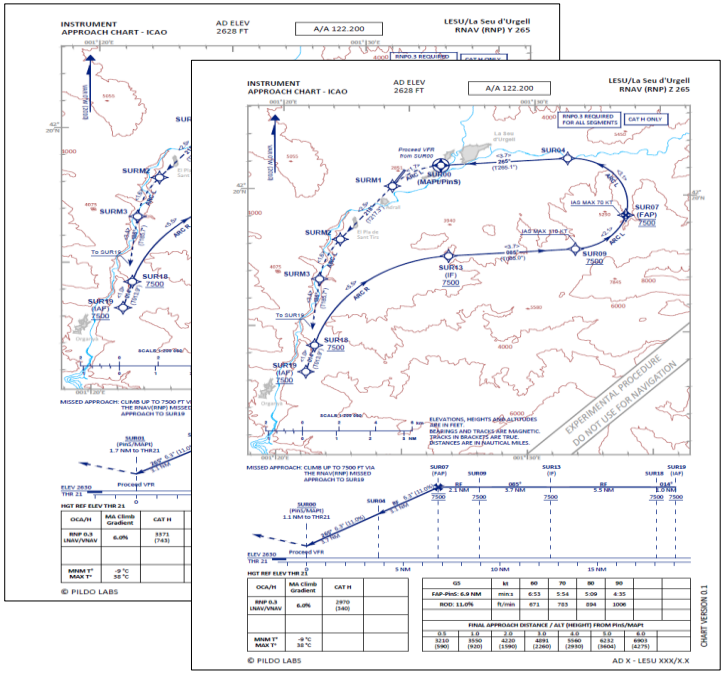
PinS + RNP APCH not enough to obtain acceptable OCA/H at some places in Swiss Alps

rega

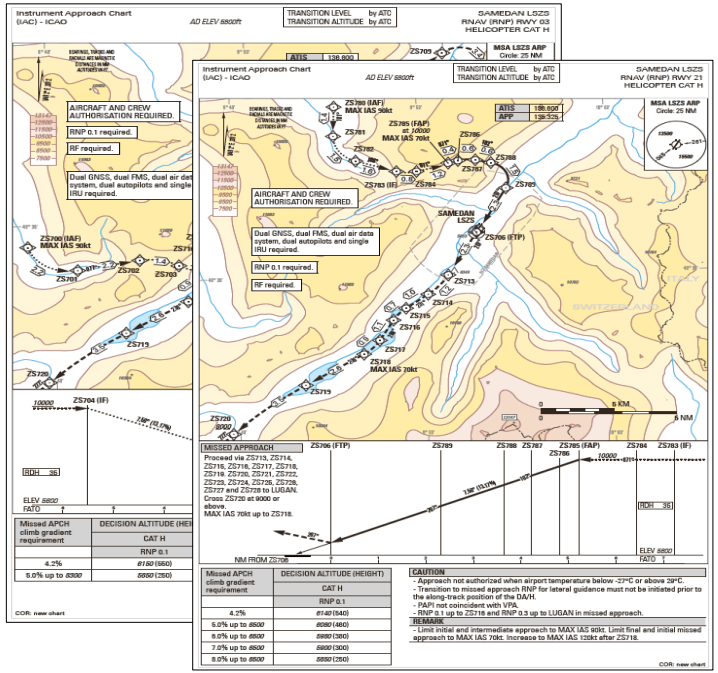
PinS + RNP-AR

2. "History"

LESU PinS RNP-AR 0.3



LSZS PinS RNP-AR 0.1



3. Instrument Approach Procedures IAP

- **Design technical requirements:**
  - APCH coming from Thunersee
  - MAS towards Brienzersee and return to IAF (avoid CTR Meiringen)
  - PinS + RNP-AR
  - RF legs based on AW109-SP RFM performance if necessary
  - MAX MACG 8%
  - MAX AOB 25º
  - MNM/MAX temp. -20/40ºC

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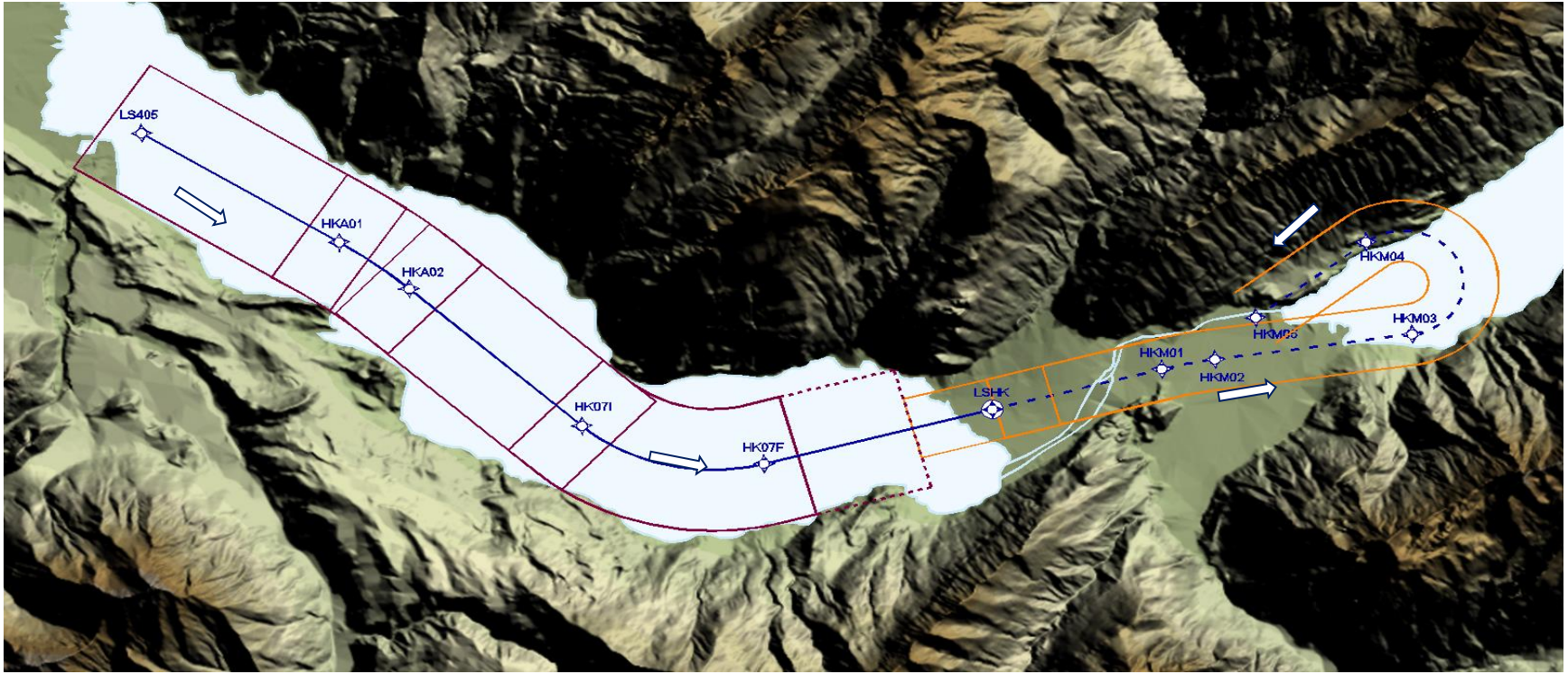
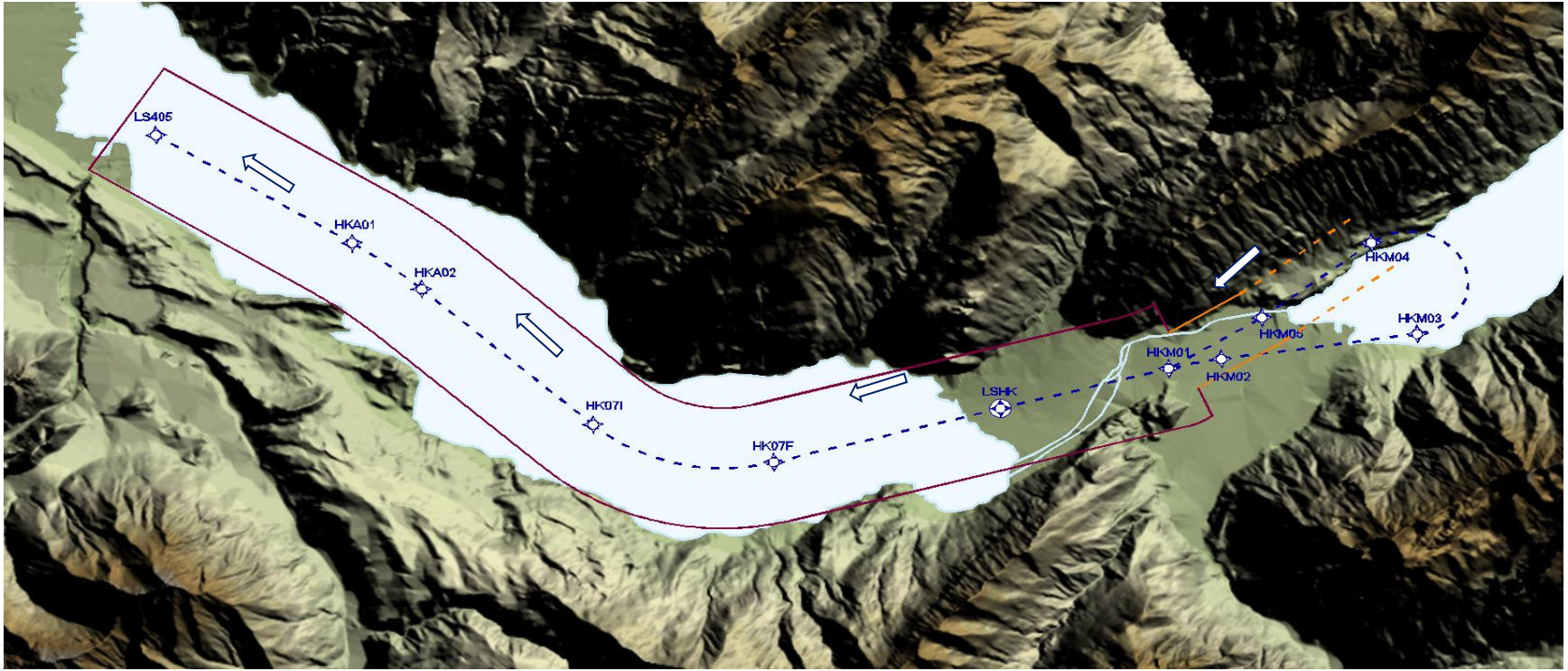
HORIZON 2020

3. Instrument Approach Procedures IAP



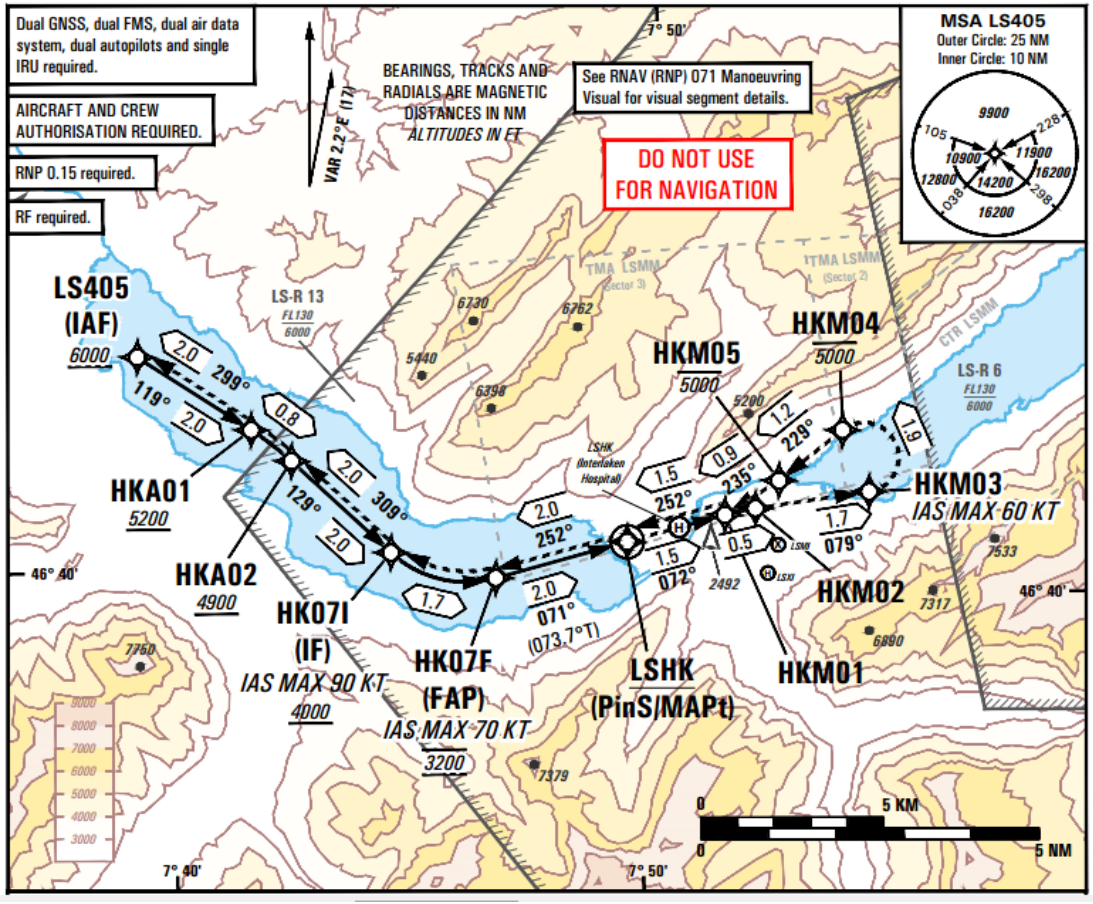
- RNP 0.3
- RNP 0.15

3. Instrument Approach Procedures IAP



- RNP 0.3
- RNP 0.15

3. Instrument Approach Procedures IAP



Rega AW109 SP
AMC 20-26

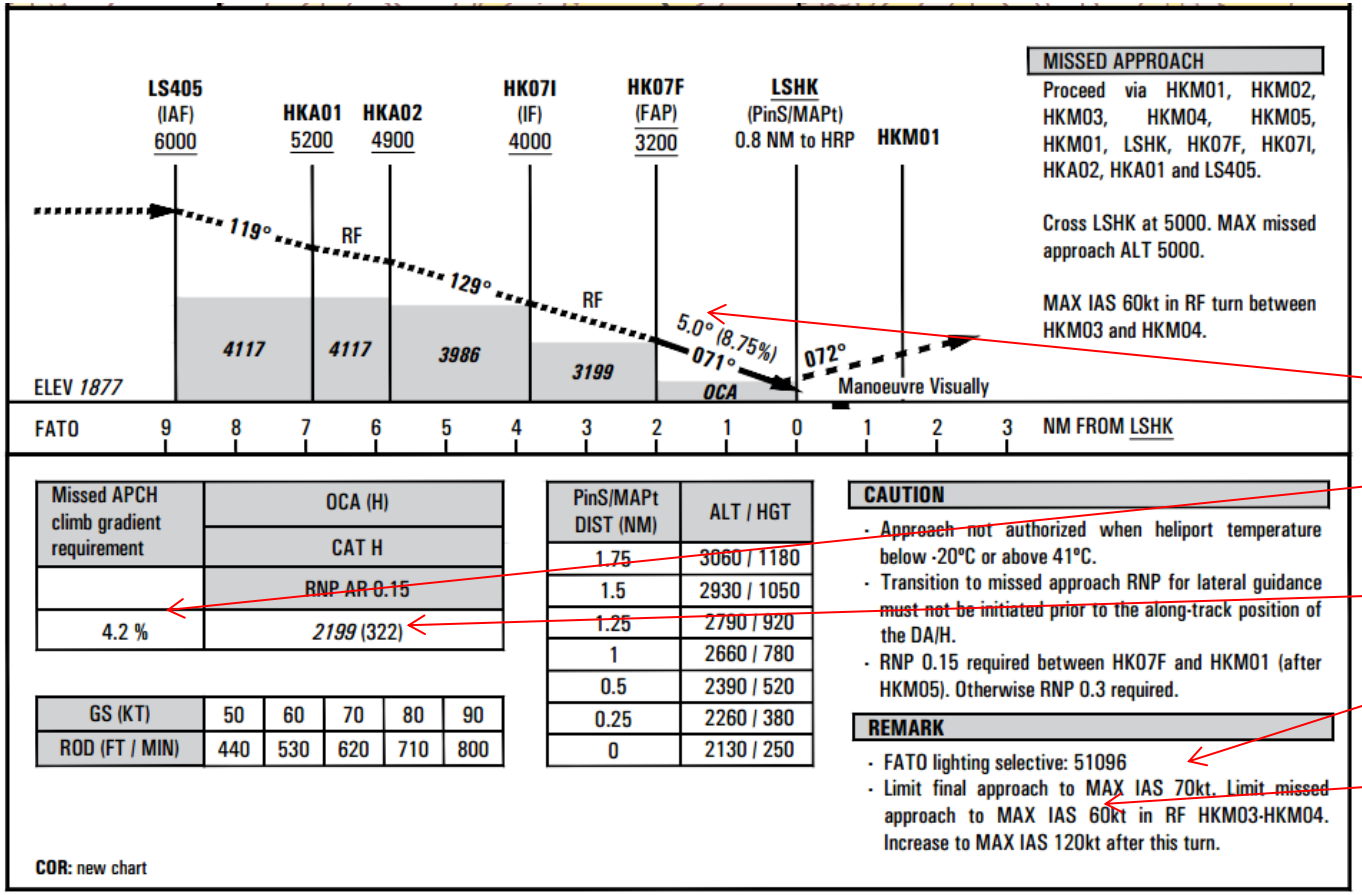
Dual GNSS (SBAS) ✓
Dual FMS ✓
Dual Air Data system✓
RF required✓
DO-178B, Level-A SW ✓

(IRU?) Ø → 2 AHRS ?

RNP 0.15 Ø CoA

SBAS VNAV

3. Instrument Approach Procedures IAP



AW109Sp
VminI IAS 45 kt

Minimum RF
800 ft

GPA 5°

MACG 4.2%

OCH 322 ft

Final ISA 70 kt

MAS IAS 60 kt

rega

3. Instrument Approach Procedures IAP

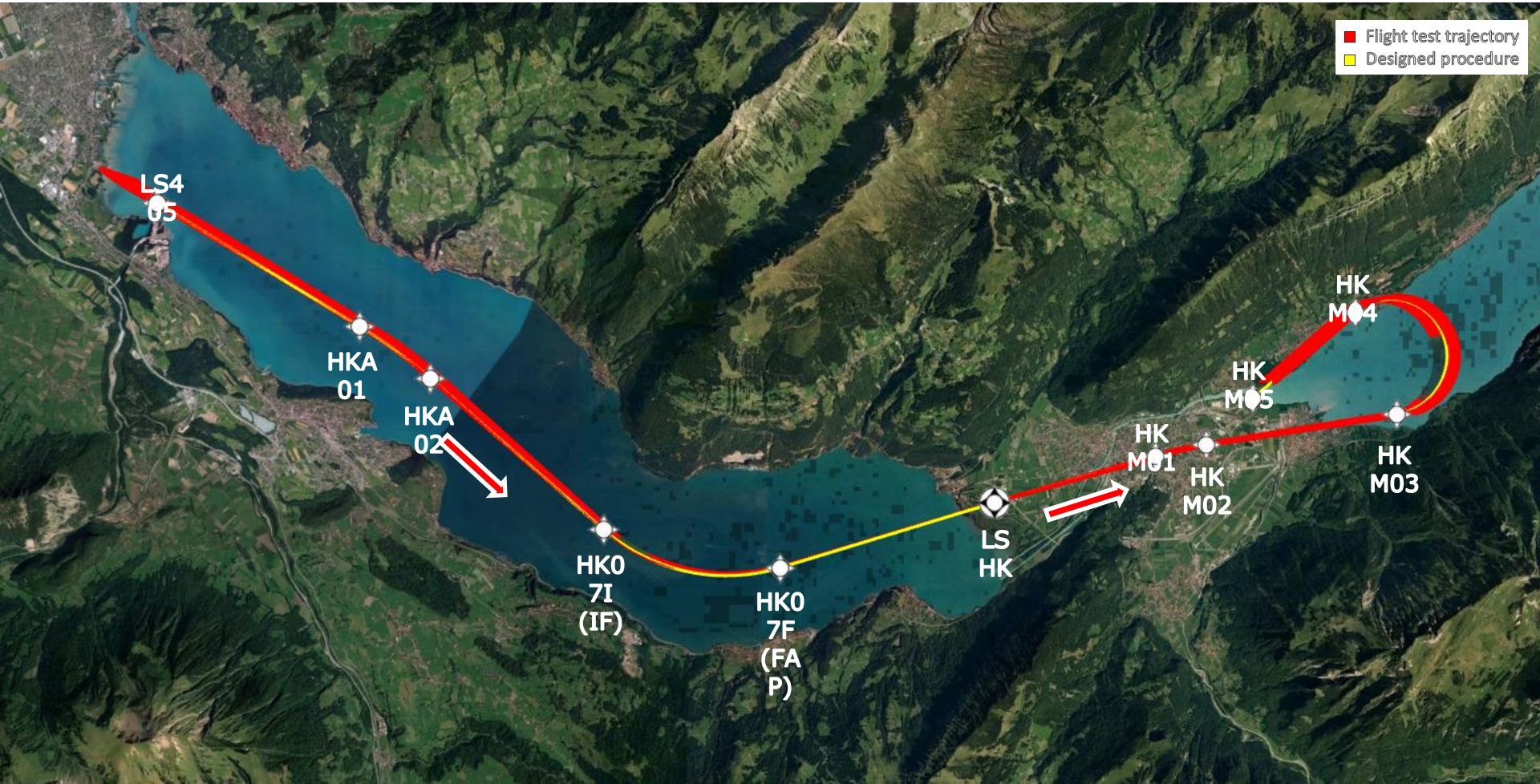
Main Design Deviations from ICAO RNP-AR FW Standards:

- PinS concept + RNP-AR
- APCH RNP value < 0.3
- MAS MACG > 2.5%
- MAS MAX length with RNP value < 1.0 exceeded
- Tailwind considered in HKM03-HKM04 RF turn
- Visual segment: construction and OCS penetration

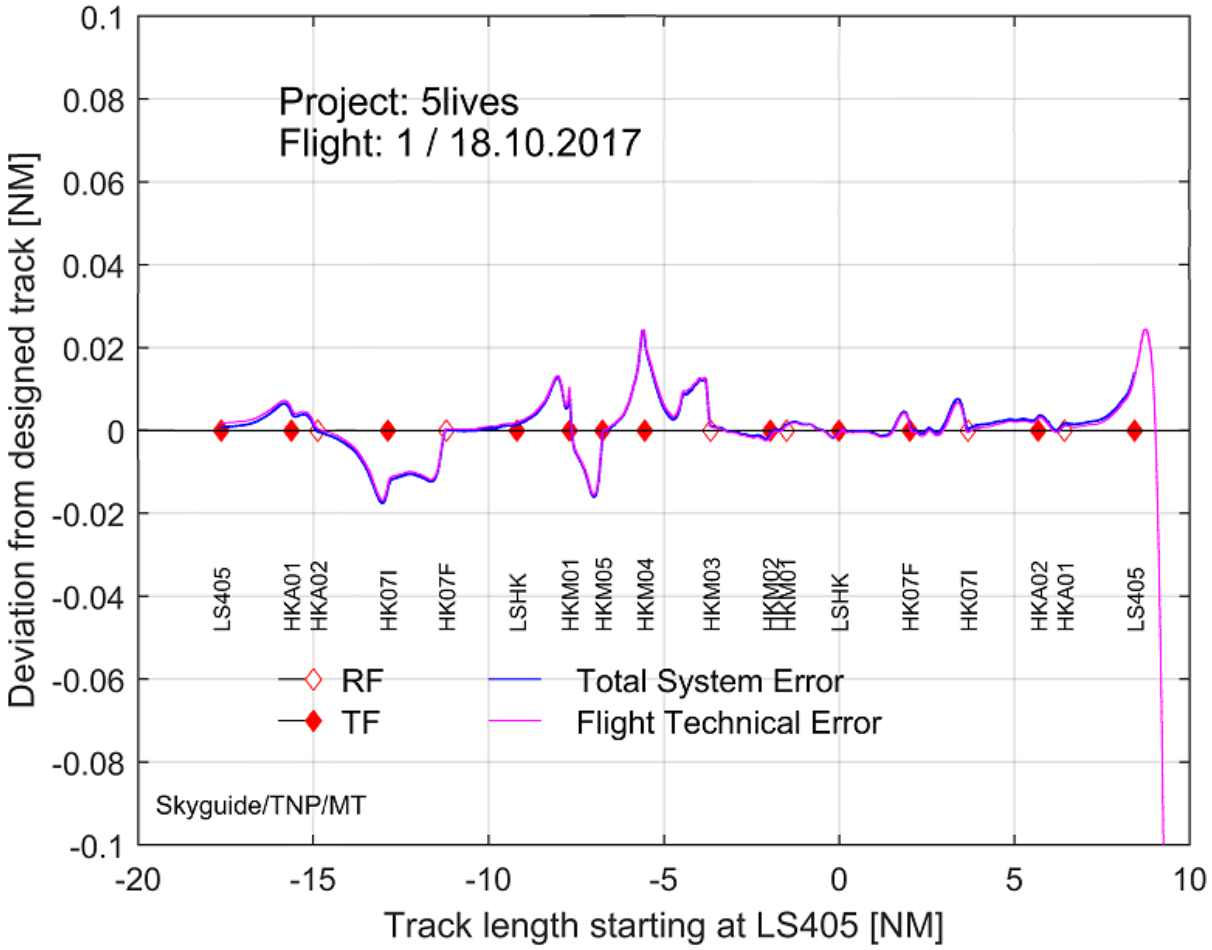
4. Primary results of flight campaign

rega

1st FLIGHT


Flight test trajectory
Designed procedure
LS4
05
HKA
01
HKA
02
HK0
7I
(IF)
HK0
7F
(FA
P)
LS
HK
HK
M01
HK
M02
HK
M03
HK
M04
HK
M05

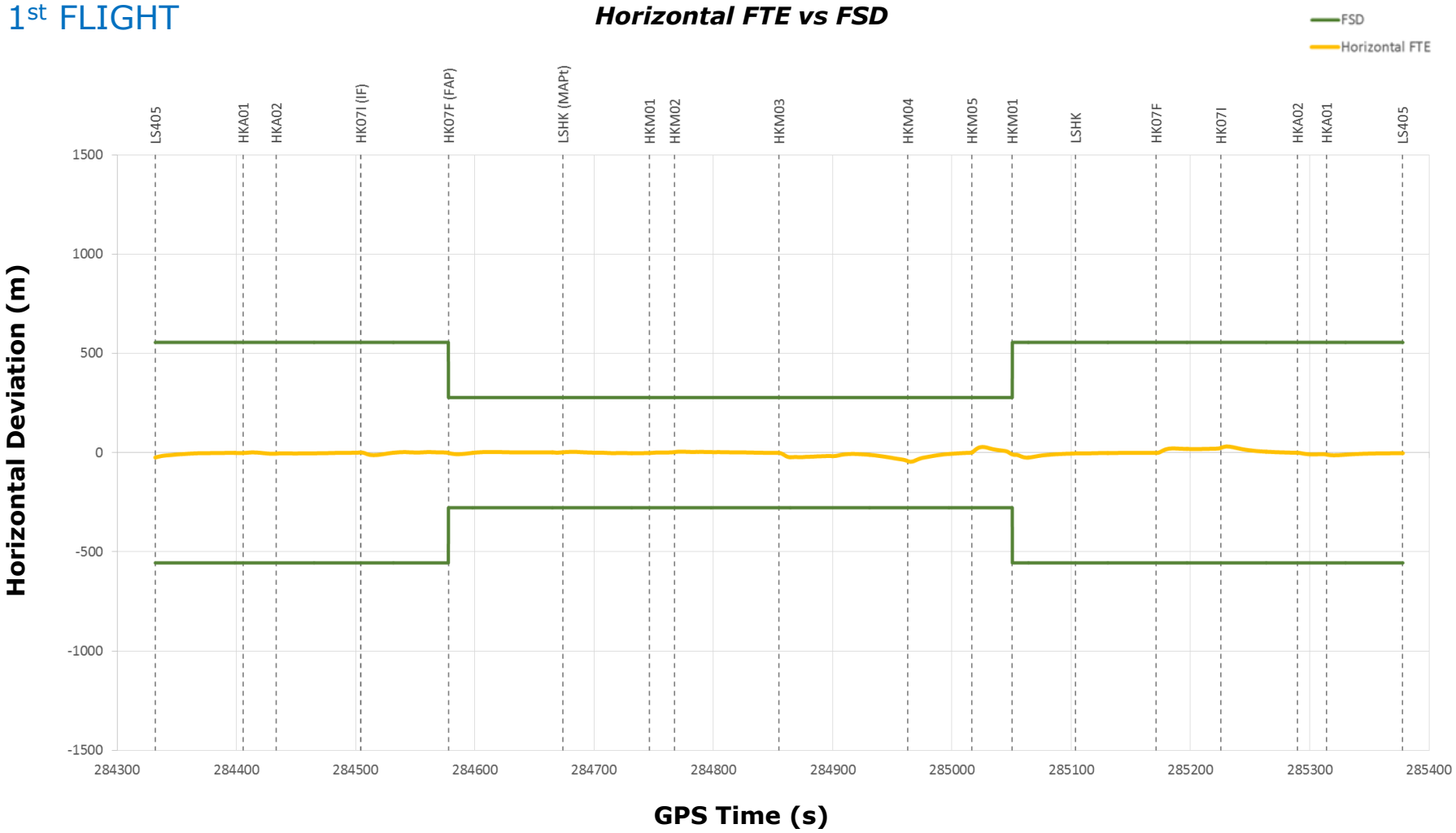
4. Primary results of flight campaign


Project: 5lives
Flight: 1 / 18.10.2017
Deviation from designed track [NM]
Track length starting at LS405 [NM]
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
-20
-15
-10
-5
0
5
10
LS405
HKA01
HKA02
HK07I
HK07F
LSHK
HKM01
HKM05
HKM04
HKM03
HKM02
HKM01
LSHK
HK07F
HK07I
HKA02
HKA01
LS405
RF
TF
Total System Error
Flight Technical Error
Skyguide/TNP/MT

TSE < 0.025NM

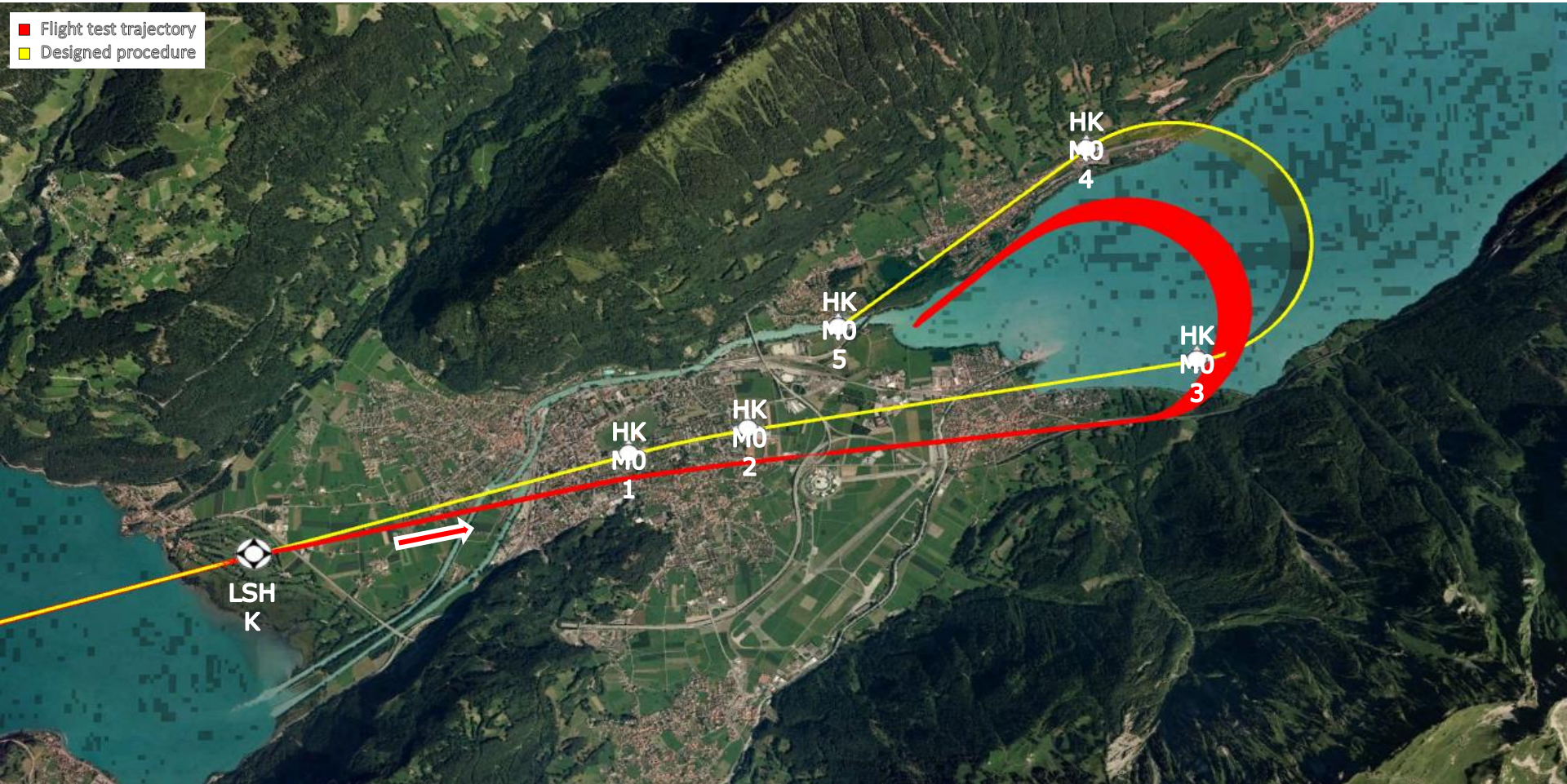
4. Primary results of flight campaign

1st FLIGHT

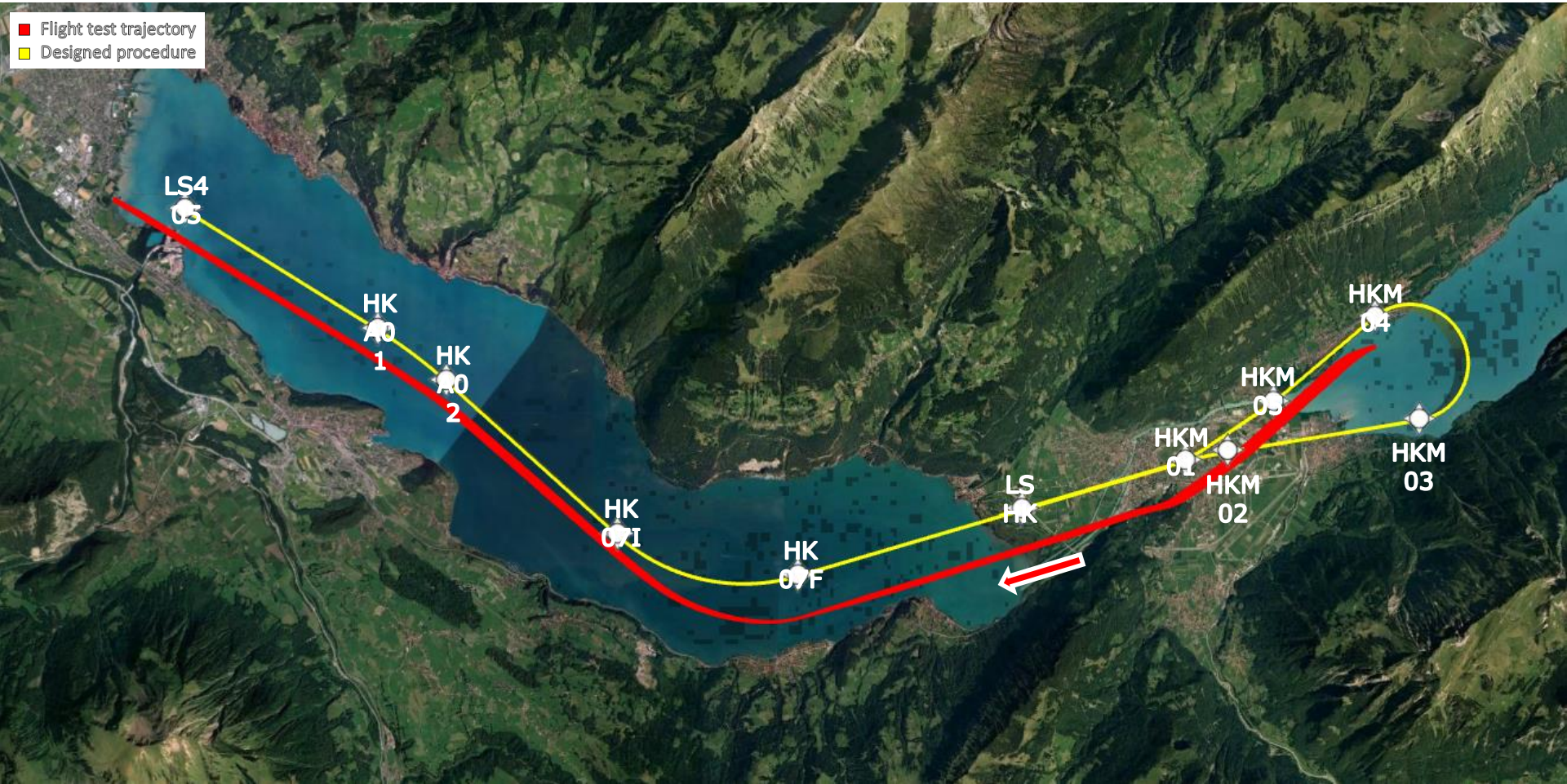

Horizontal FTE vs FSD
FSD
Horizontal FTE
LS405
HKA01
HKA02
HK07I (IF)
HK07F (FAP)
LSHK (MAPt)
HKM01
HKM02
HKM03
HKM04
HKM05
HKM01
LSHK
HK07F
HK07I
HKA02
HKA01
LS405
1500
1000
500
0
-500
-1000
-1500
Horizontal Deviation (m)
284300
284400
284500
284600
284700
284800
284900
285000
285100
285200
285300
285400
GPS Time (s)

Flight # 2 no GNSS

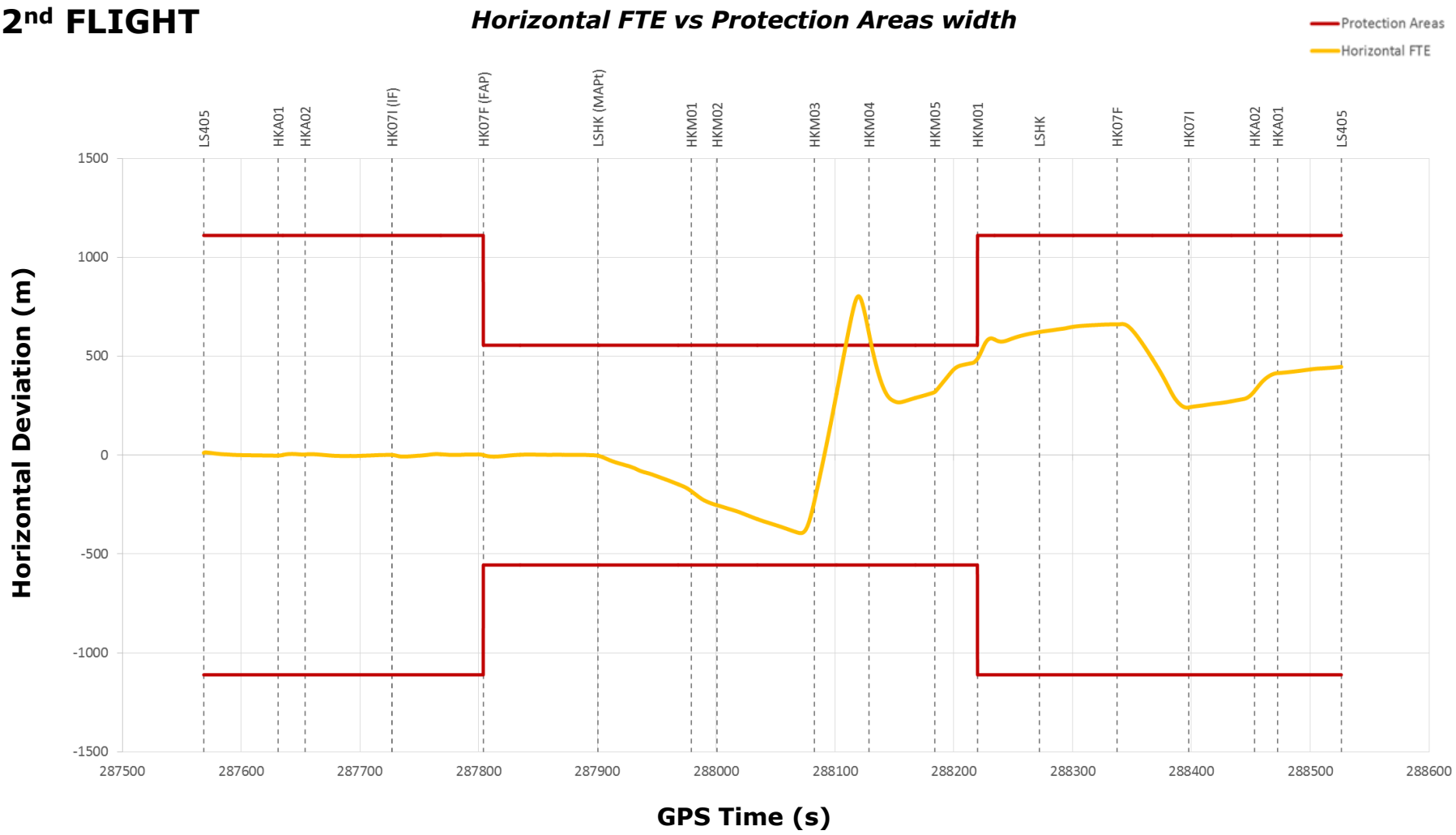
2nd FLIGHT No GNSS

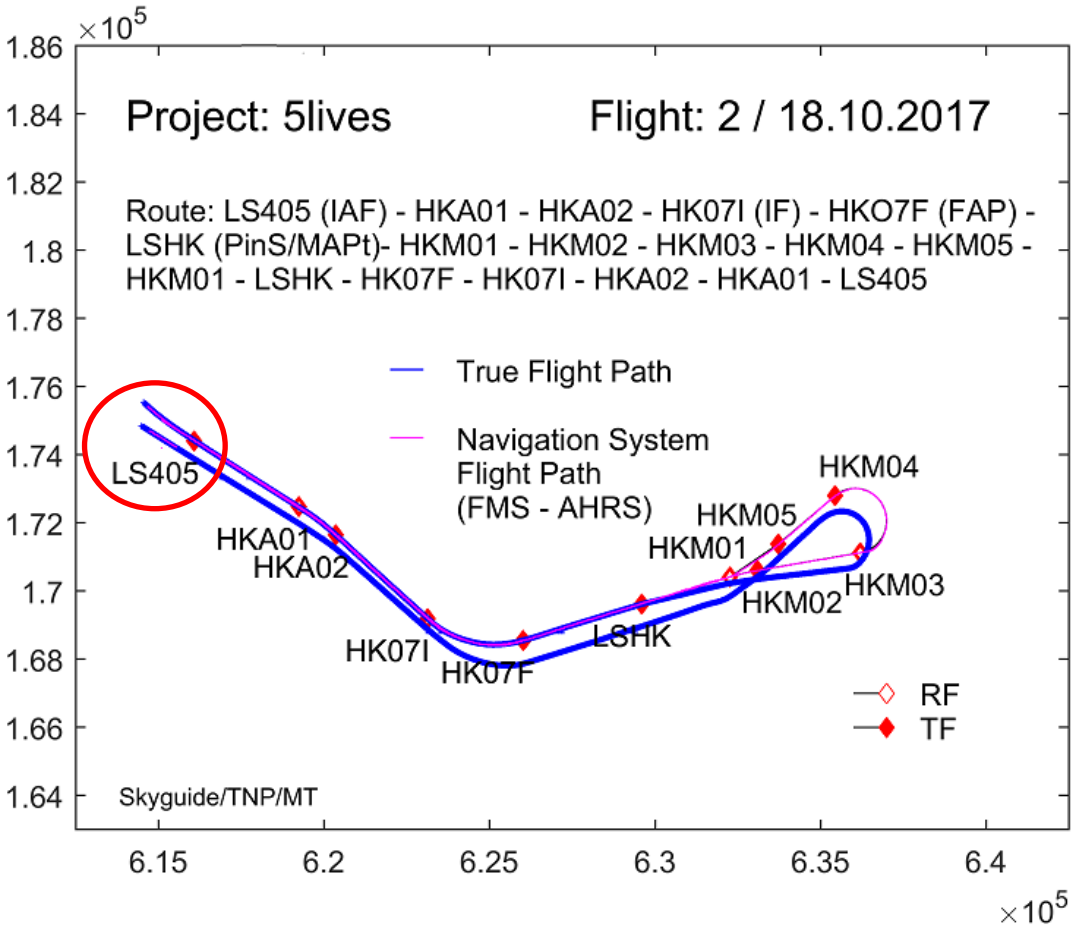


2nd FLIGHT no GNSS



2nd FLIGHT


Horizontal FTE vs Protection Areas width
Protection Areas
Horizontal FTE
LS405
HKA01
HKA02
HK07I (IF)
HK07F (FAP)
LSHK (MAPt)
HKM01
HKM02
HKM03
HKM04
HKM05
HKM01
LSHK
HK07F
HK07I
HKA02
HKA01
LS405
1500
1000
500
0
-500
-1000
-1500
Horizontal Deviation (m)
287500
287600
287700
287800
287900
288000
288100
288200
288300
288400
288500
288600
GPS Time (s)



TSE < 0.45NM

FTE small

NSE main

5. Take Home Messages

in order to better serve the community by helicopter air rescue operation in AWO, in remote and hostile environment, we need in near future:

- Dedicated Helicopter RNP-AR PinS criteria (ICAO)
- Helicopter RNP–AR certification requirements (EASA)
- GNSS (not only GPS/SBAS) multi constellation receivers (GLONASS) (EASA)
- ATC Service keep up procedural ability (EuroControl)

Thank you for your kind attention