APAC ionospheric threat model

Mitigation using the GAST D validation assumptions.

29-Jan-2020

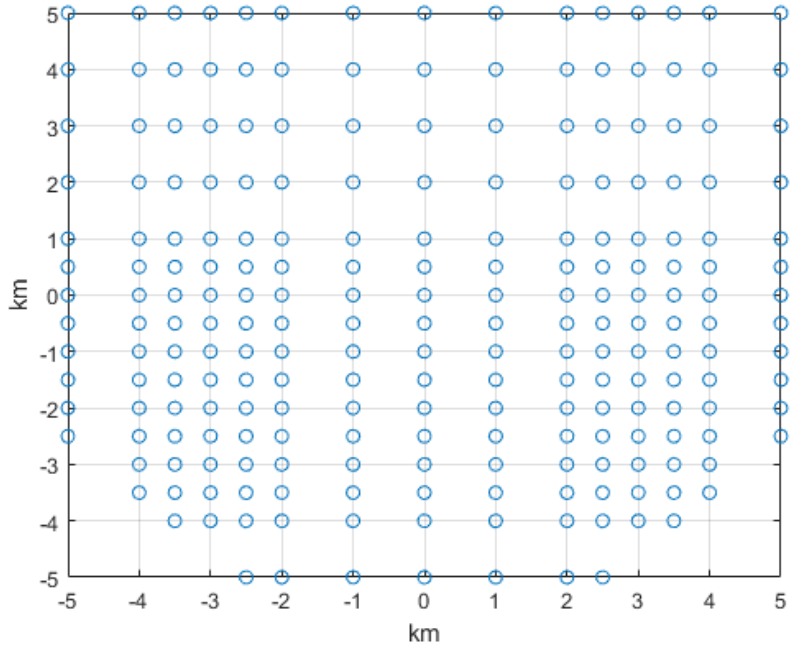
Introduction

GAST D validation of ionospheric threat mitigation

- In the GAST D validation exhaustive simulations were performed to show that the ionospheric threat was mitigated taking credit for a set of integrity monitors.
- Airborne monitors:
  - DSIGMA
- Ground monitors:
  - IGM
  - CCD
- GAST D validation assumptions are used for the integrity monitors in the following results.

Ionospheric Threat Model

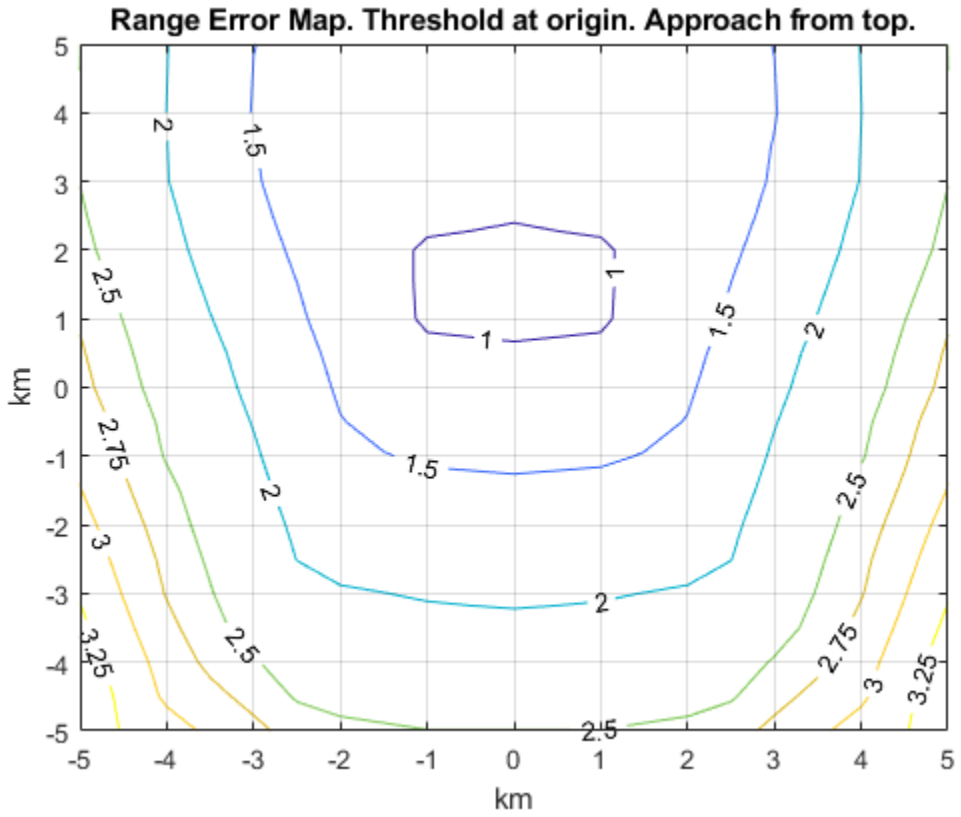
- ICAO and APAC ionospheric front models used in the simulations.
- Ground station grid at top right.
- LTP at origin.
- Approach from top along the y axis (x=0).



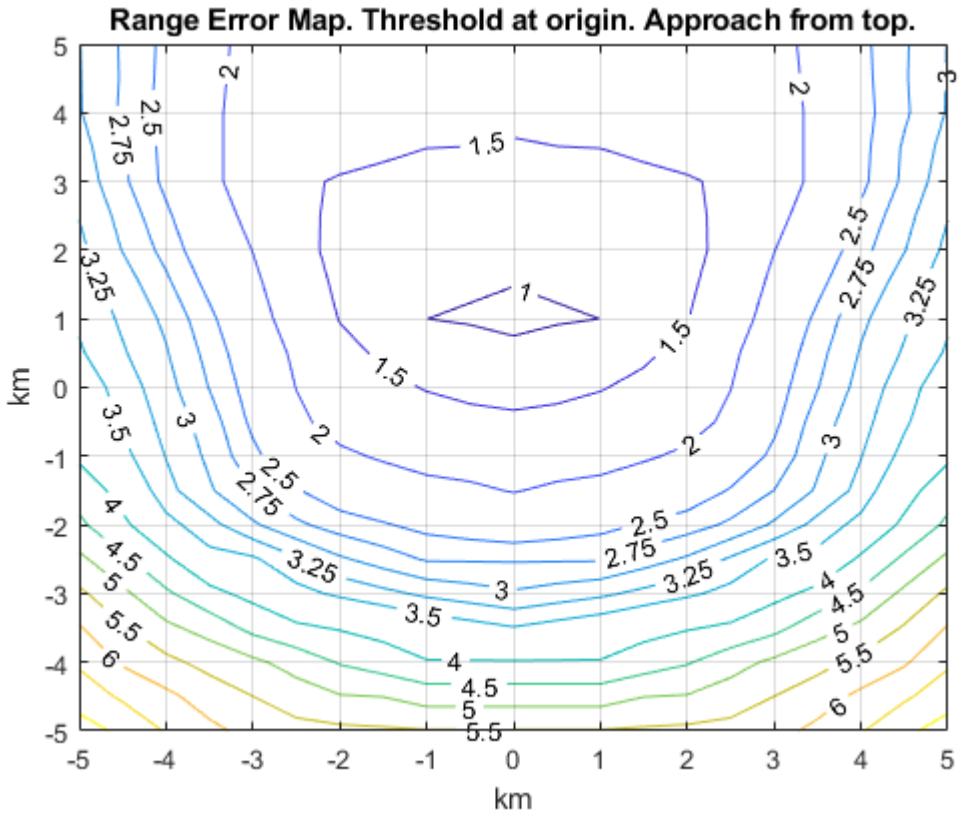
	ICAO GAST D validation	APAC
Gradient range (resolution)	200 – 500 mm/km (20 mm/km)	200 – 600 mm/km (20 mm/km)
Velocity range (resolution)	0 – 250 m/s (10 m/s)	0 – 250 m/s (10 m/s)
Width range (resolution)	25 – 75 km (5 km)	10 – 75 km (5 km)
Direction range (resolution)	0 – 180 deg (15 deg)	0 – 180 deg (15 deg)
Depth	50 m	35 m
Number of data points for time of impact (starting position of front)	200	200

Range Error Map

ICAO model

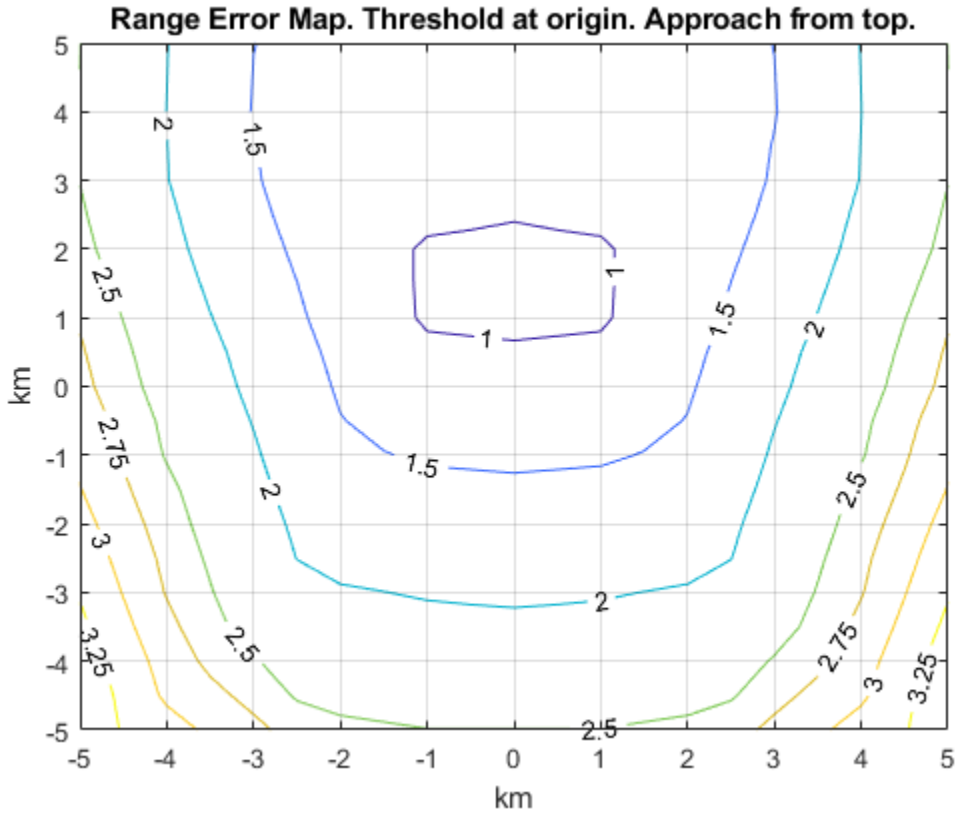


APAC model

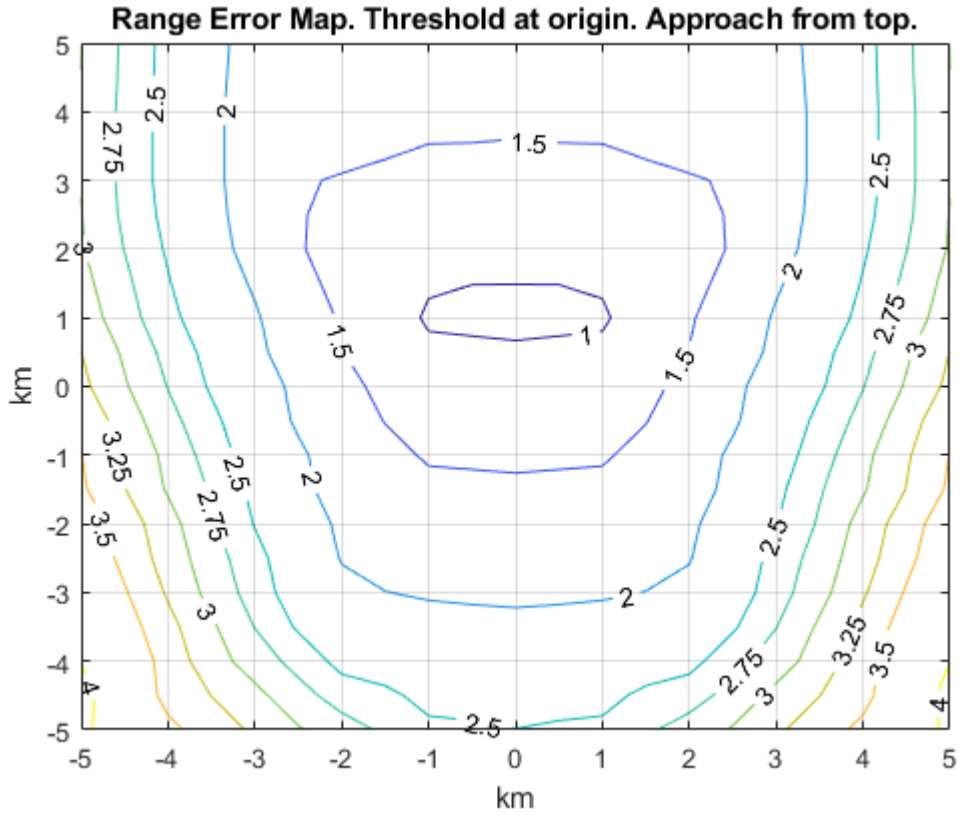


Range Error Maps with 25 km minimum width

Max gradient:
500 mm/km (ICAO)



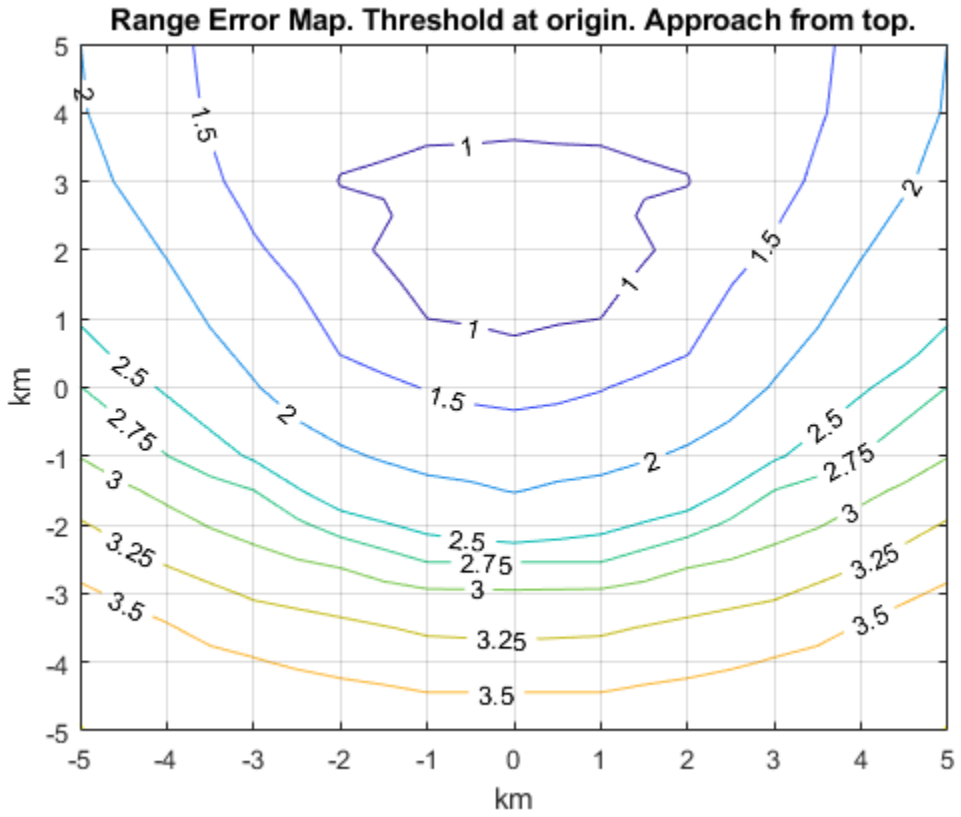
600 mm/km



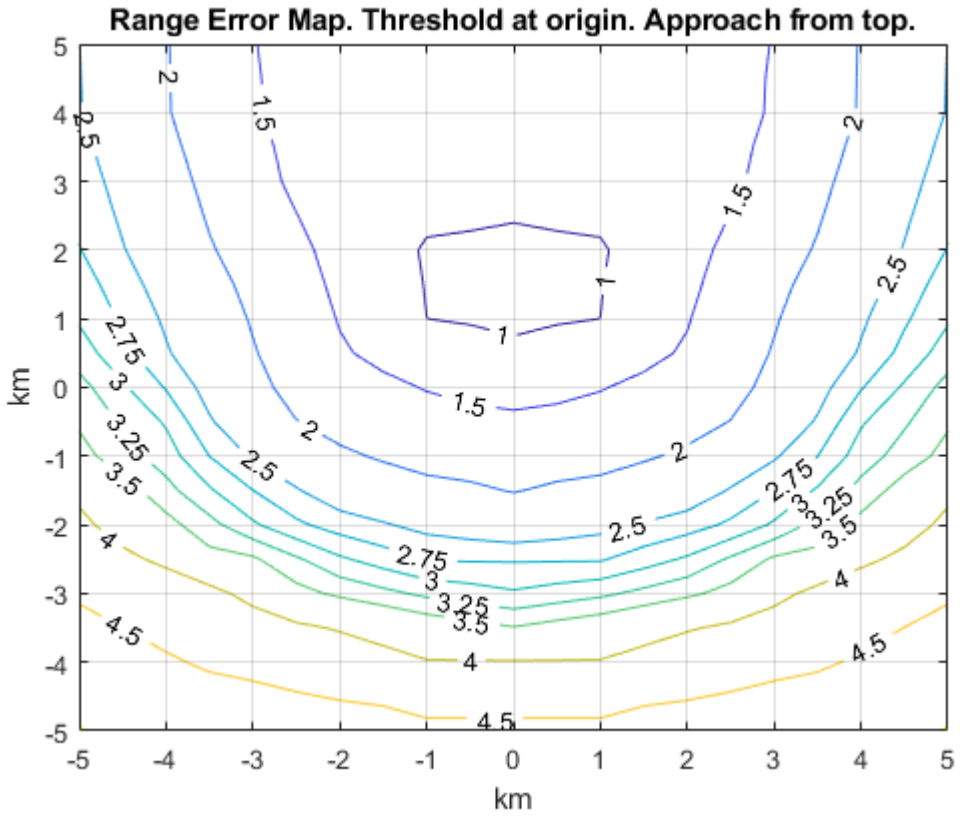
Max gradient primarily influences error in the left/right direction.

Range Error Maps with 10 km minimum width

Max gradient:
400 mm/km



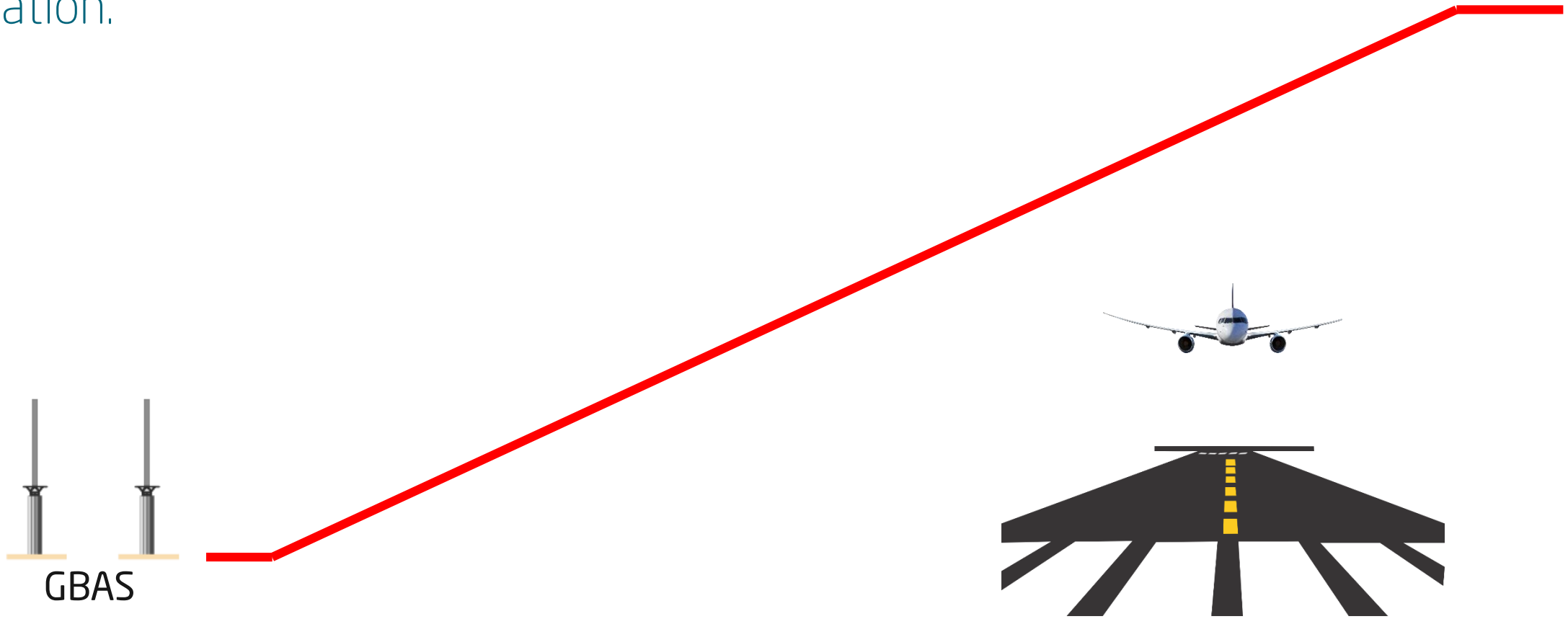
500 mm/km



Min width primarily influences error in the up/down (runway) direction.

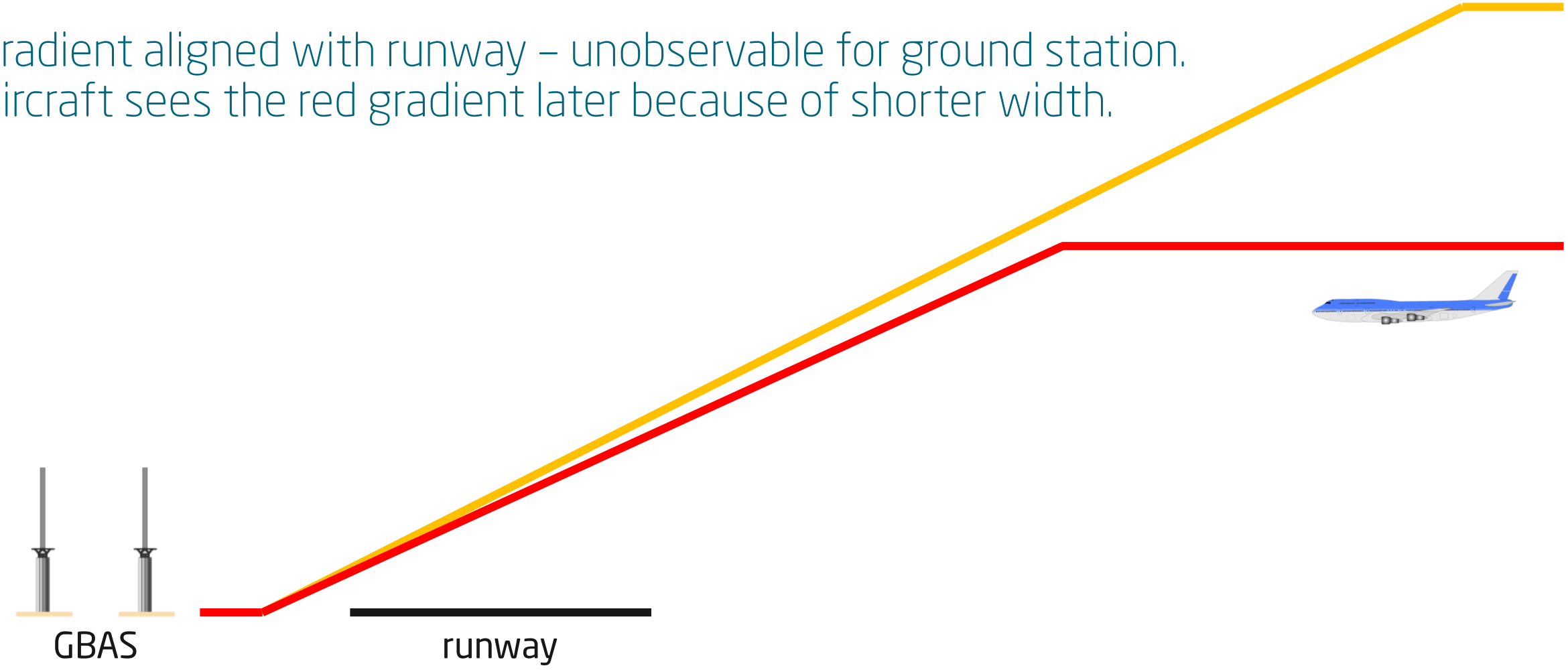
Case 1 - Error driven by max gradient

Gradient perpendicular to runway – unobservable for both aircraft and ground station.



Case 2 - Error driven by min width

Gradient aligned with runway – unobservable for ground station.
Aircraft sees the red gradient later because of shorter width.



Conclusions

- APAC ionospheric threat model results in reduced flexibility for the GBAS ground station location with respect to the ICAO model to get a range error smaller than 2.75m – 2.5 km to 3.5 km distance to LTP vs 5 km to 6 km.
- The combination of larger gradients and smaller widths is believed to cause the observed differences.
  - Smaller widths allow more in-between cases (front between ground station and aircraft) with respect to the ICAO model, and some of these cases are more severe.
  - Some further investigation into the differences should be considered.

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