

Use of TAWS in Difficult Environment by Small Operators

Yasuo Ishihara

Honeywell

Standard GPWS Modes

Mode 1: Excessive Descent Rate

Clearance vs. descent rate

Mode 2: Rising Terrain

Clearance vs. closure rate

Mode 3: Descent After Takeoff

Clearance vs. altitude loss

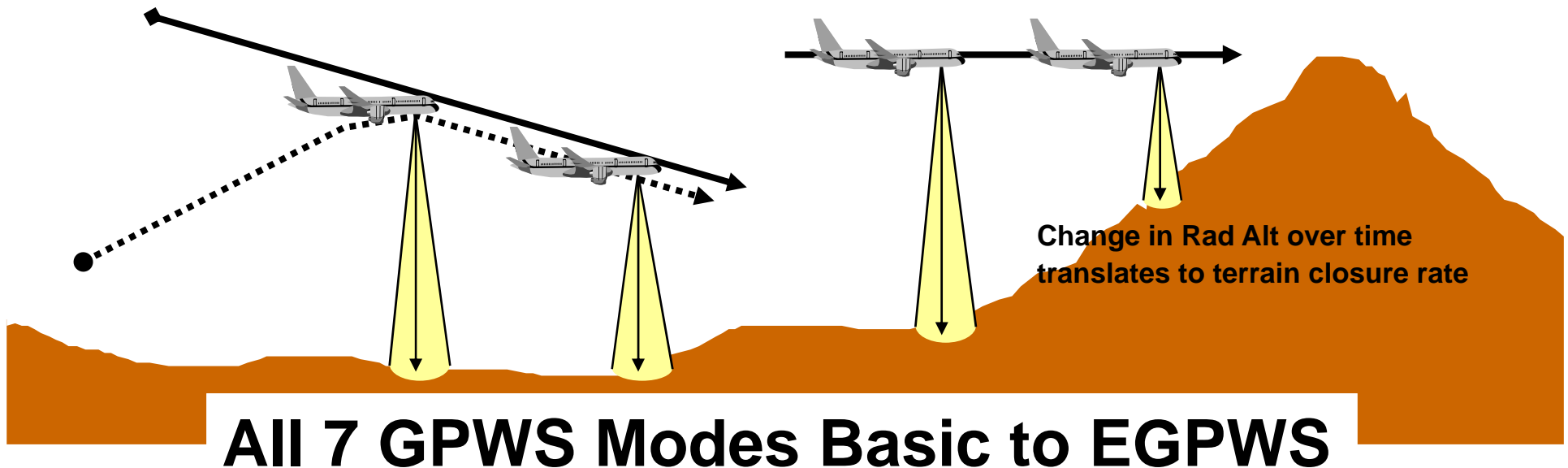
Mode 4: Terrain Clearance

Clearance vs. air speed

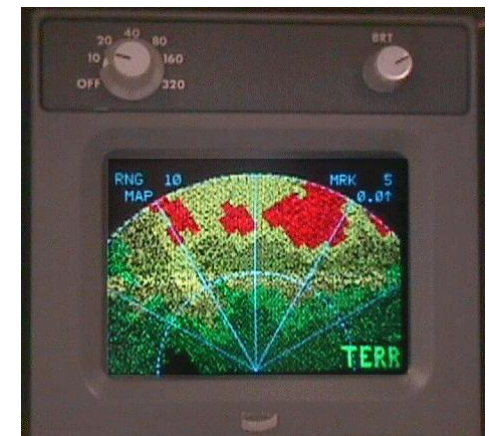
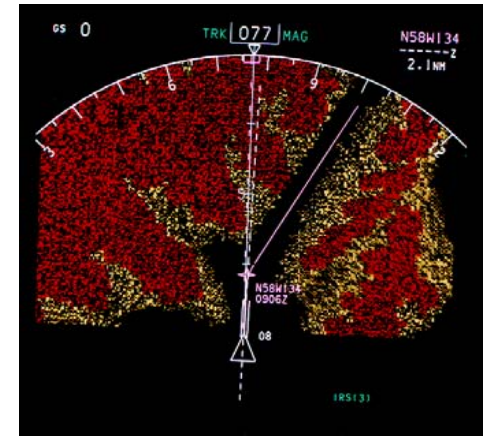
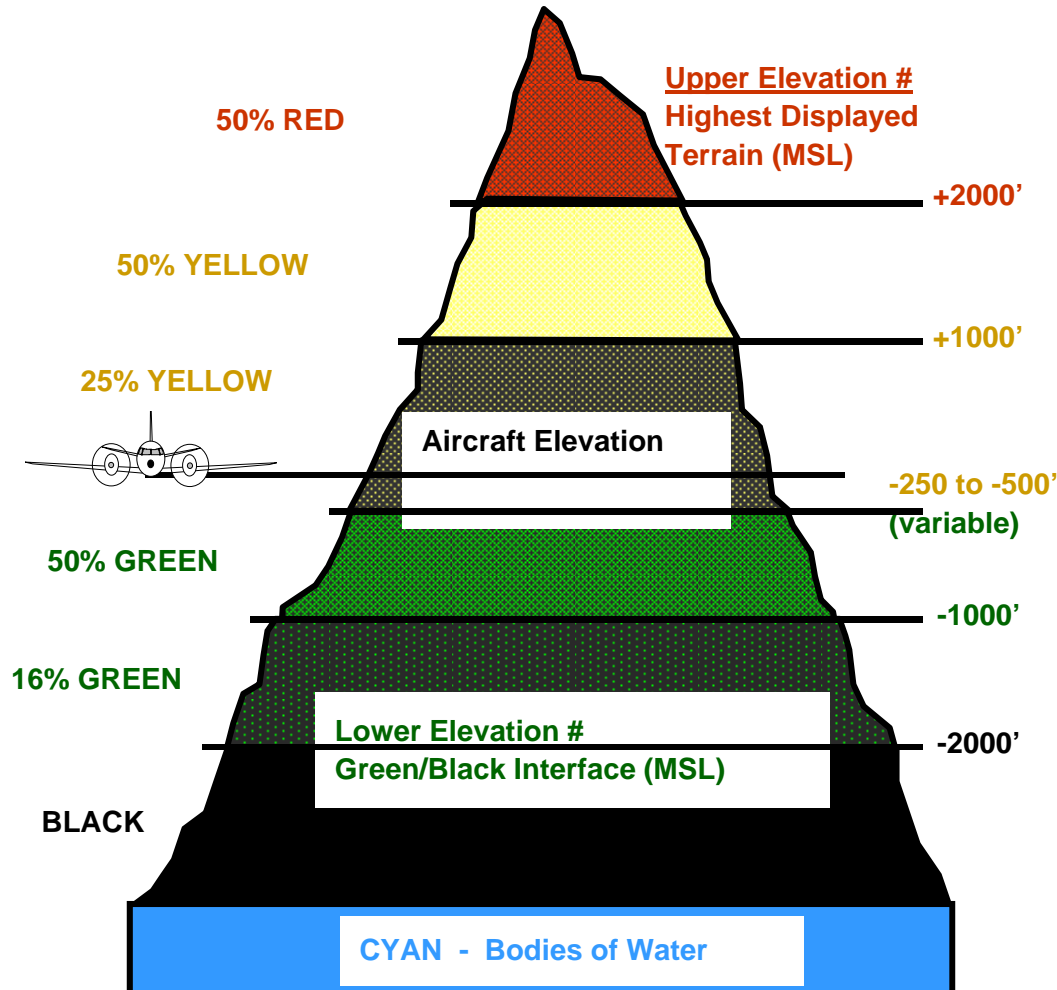
Mode 5: Descent Below Glideslope

Mode 6: Altitude/Bank Angle Callouts

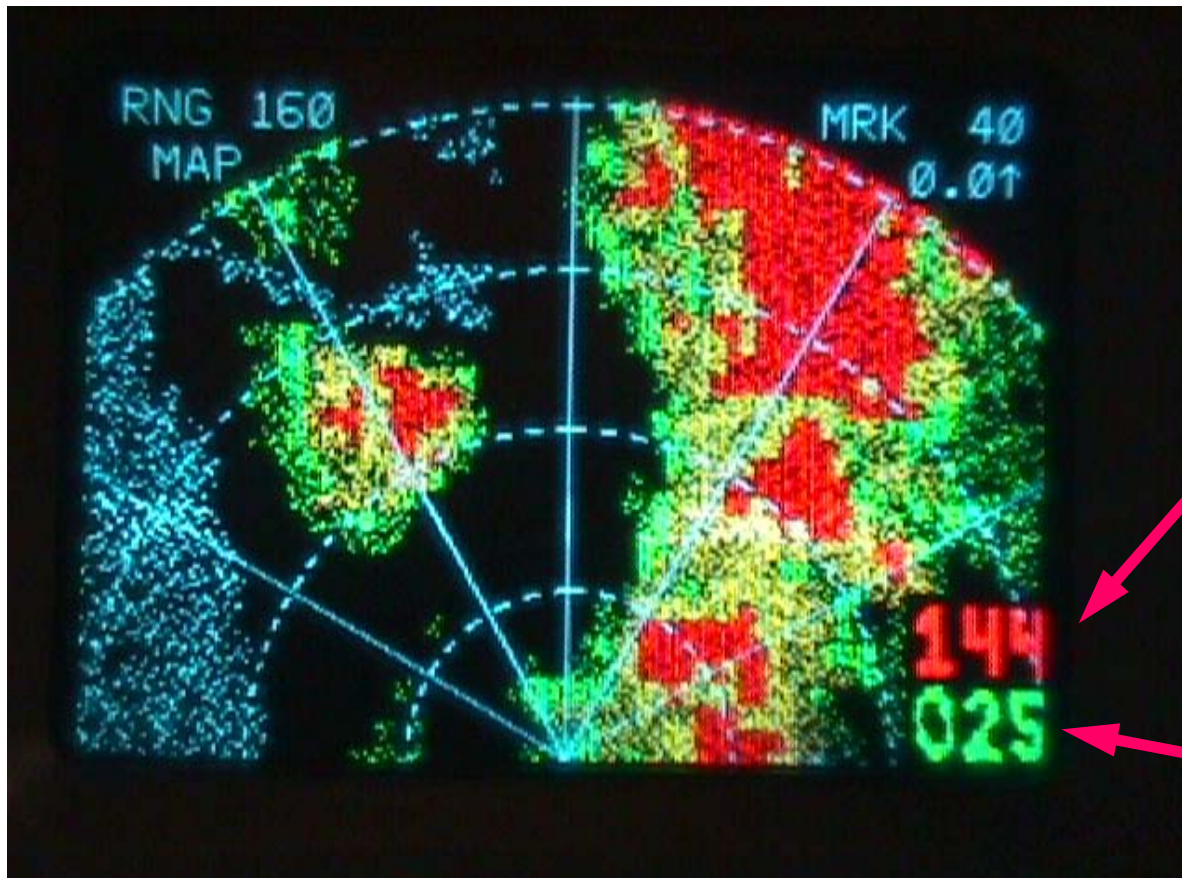
Mode 7: (Reactive) Windshear



Terrain Awareness Display



Terrain Awareness Display

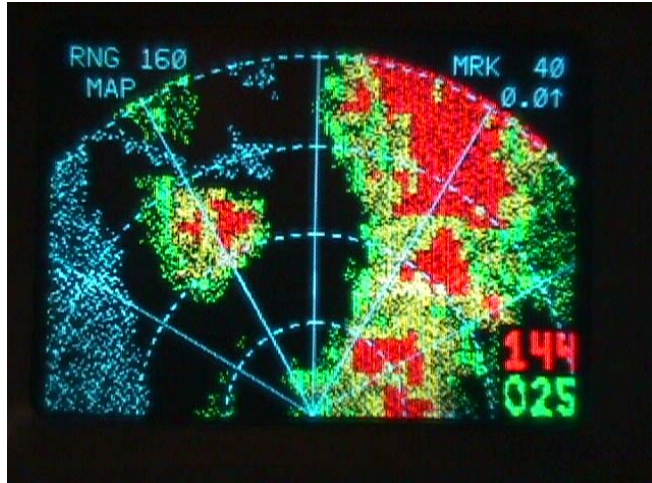


**Highest Elevation
within the display
(x 100 ft)**

**Elevation of
Green/Black boundary
(x 100 ft)**

Terrain Awareness Display

Aircraft Altitude: 4,500 Ft MSL



Aircraft Altitude: 8,000 Ft MSL



Aircraft Altitude: 10,000 Ft MSL

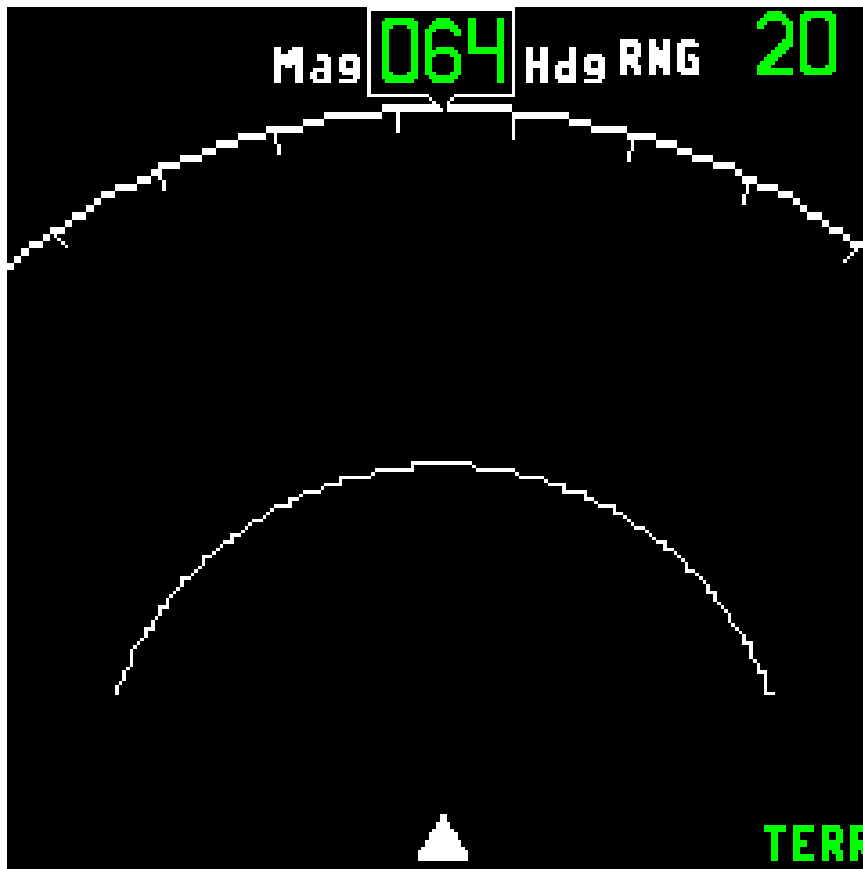


Aircraft Altitude: 20,000 Ft MSL

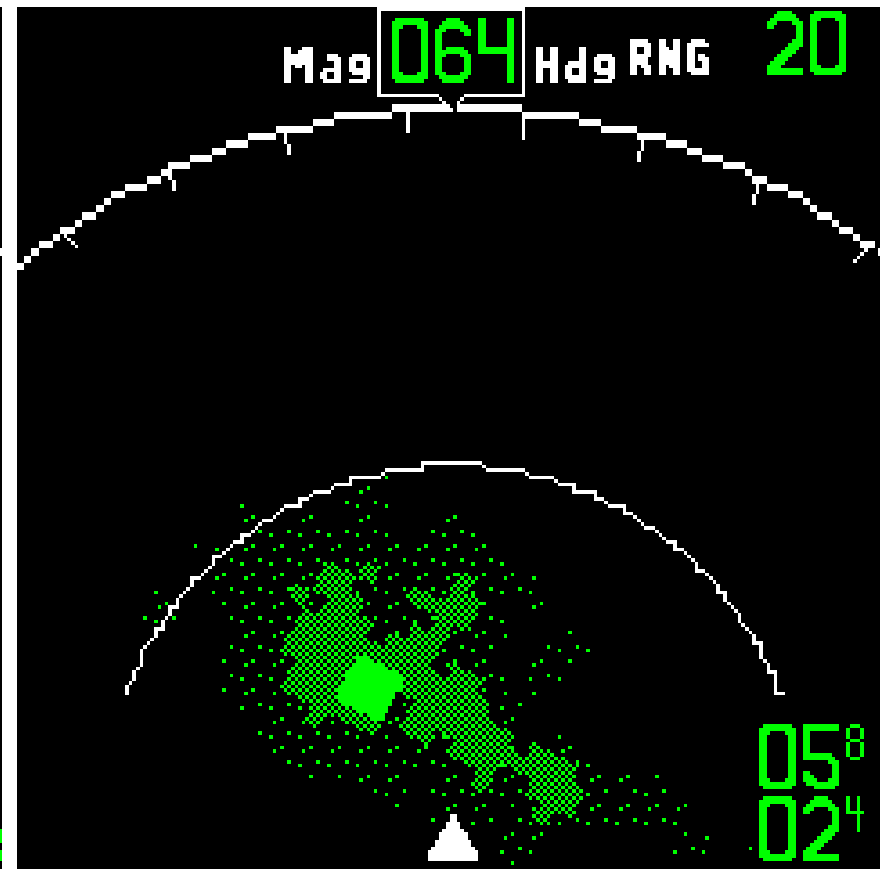


Standard Terrain Display vs. 'PEAKS' Display

At Cruise Altitude
(e.g., Top of Descent)

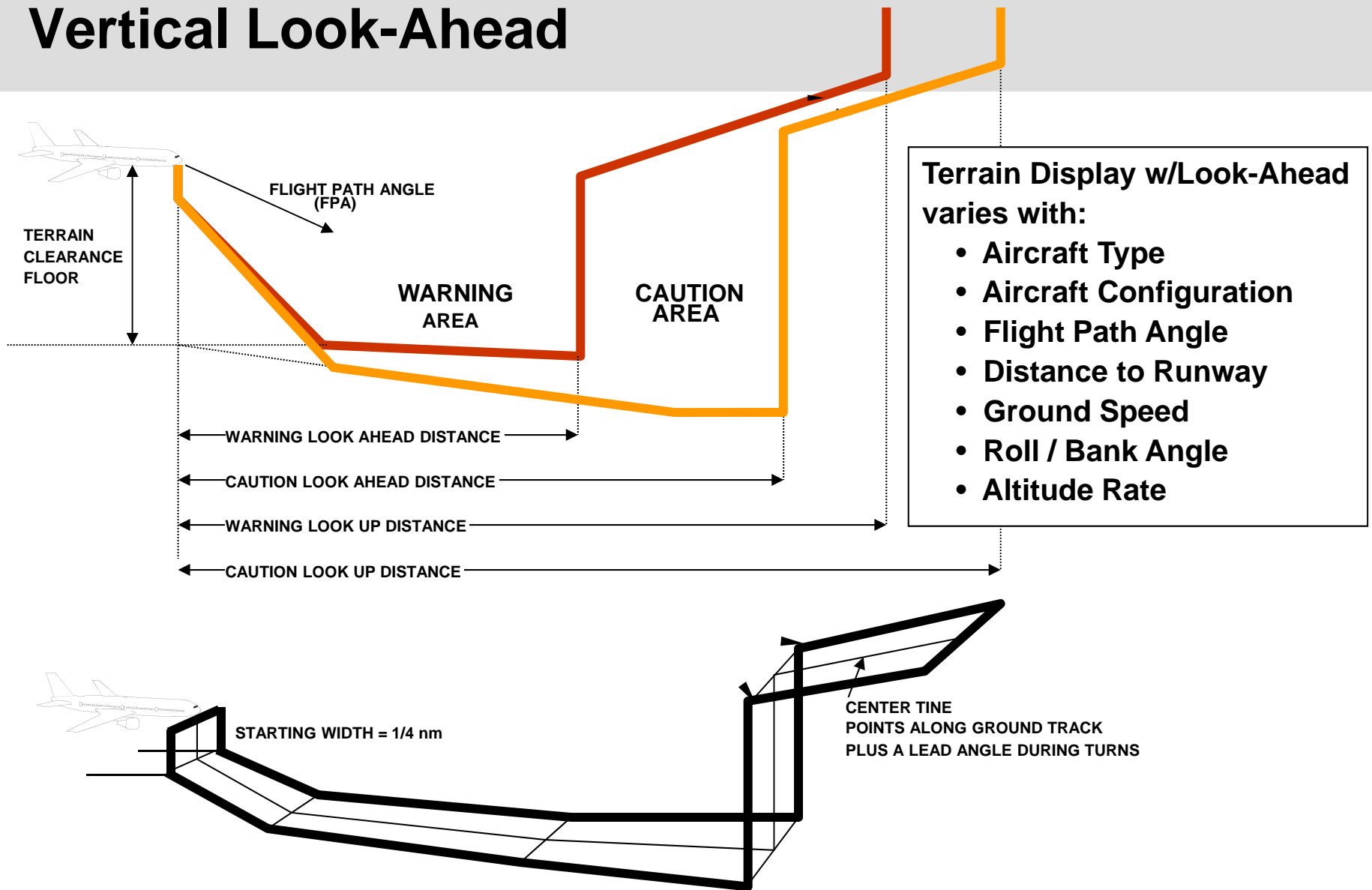


Standard Display

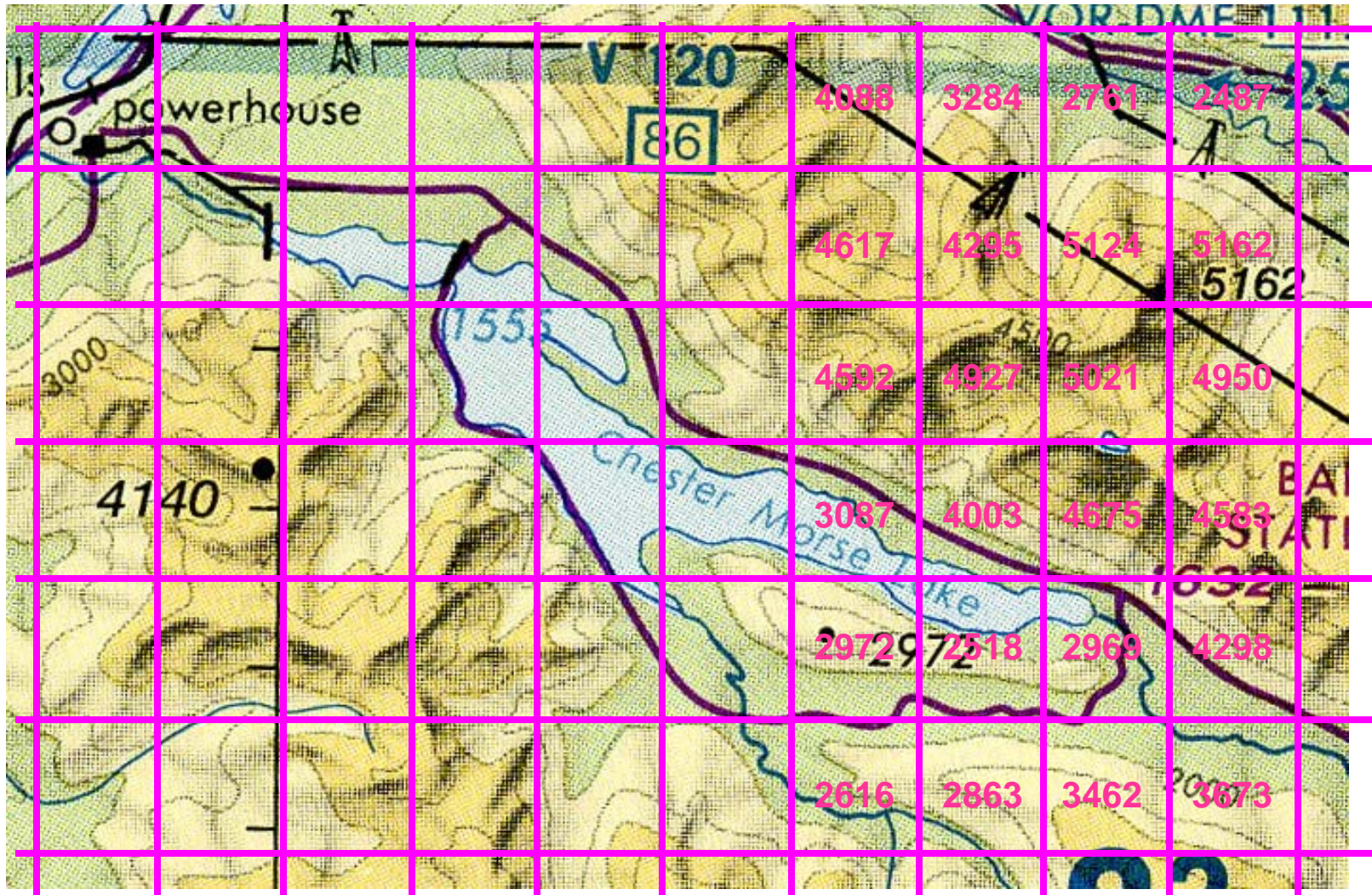


PEAKS Display

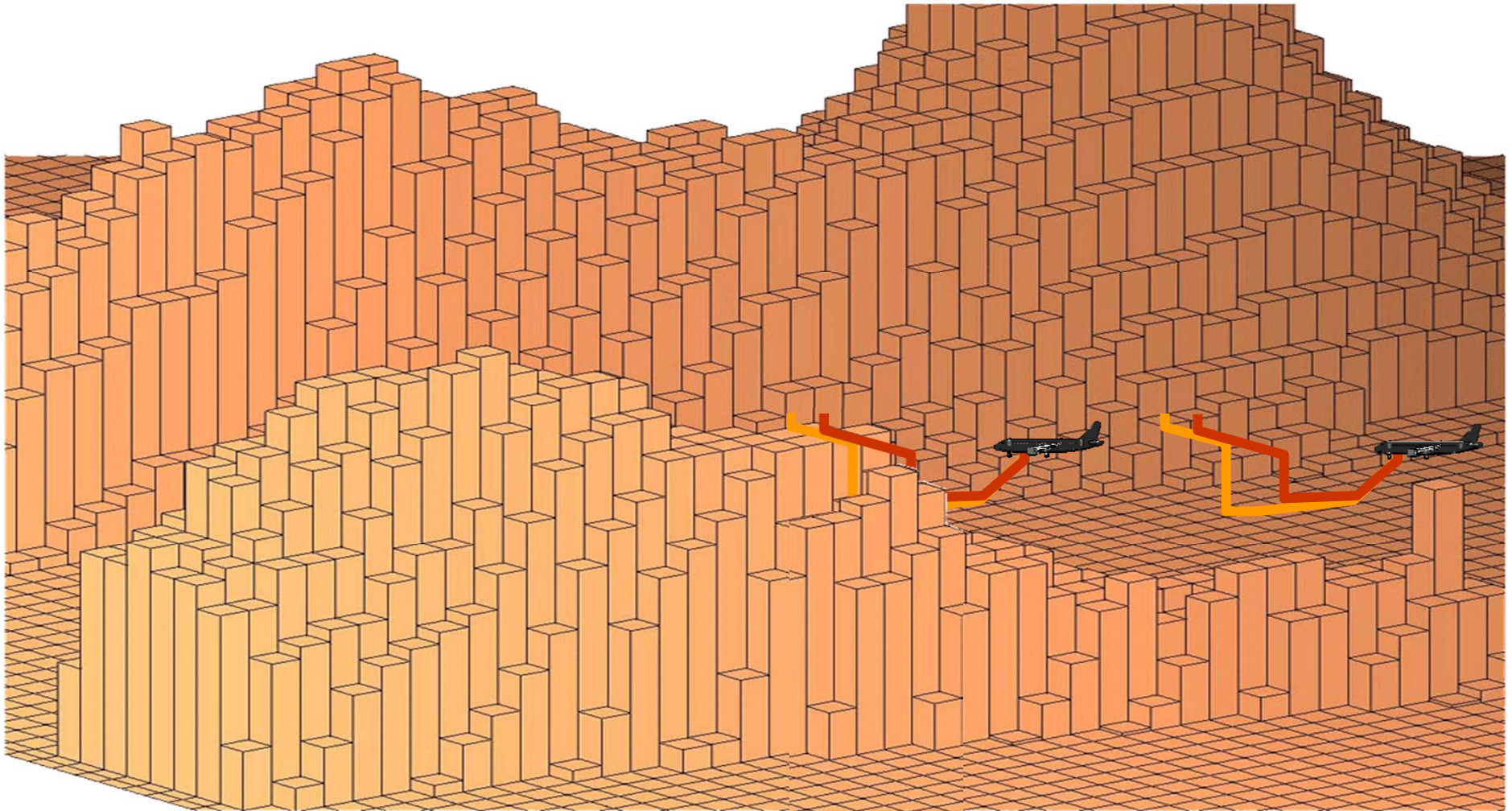
Vertical Look-Ahead



Terrain Database



Terrain Database & Look Ahead Algorithm



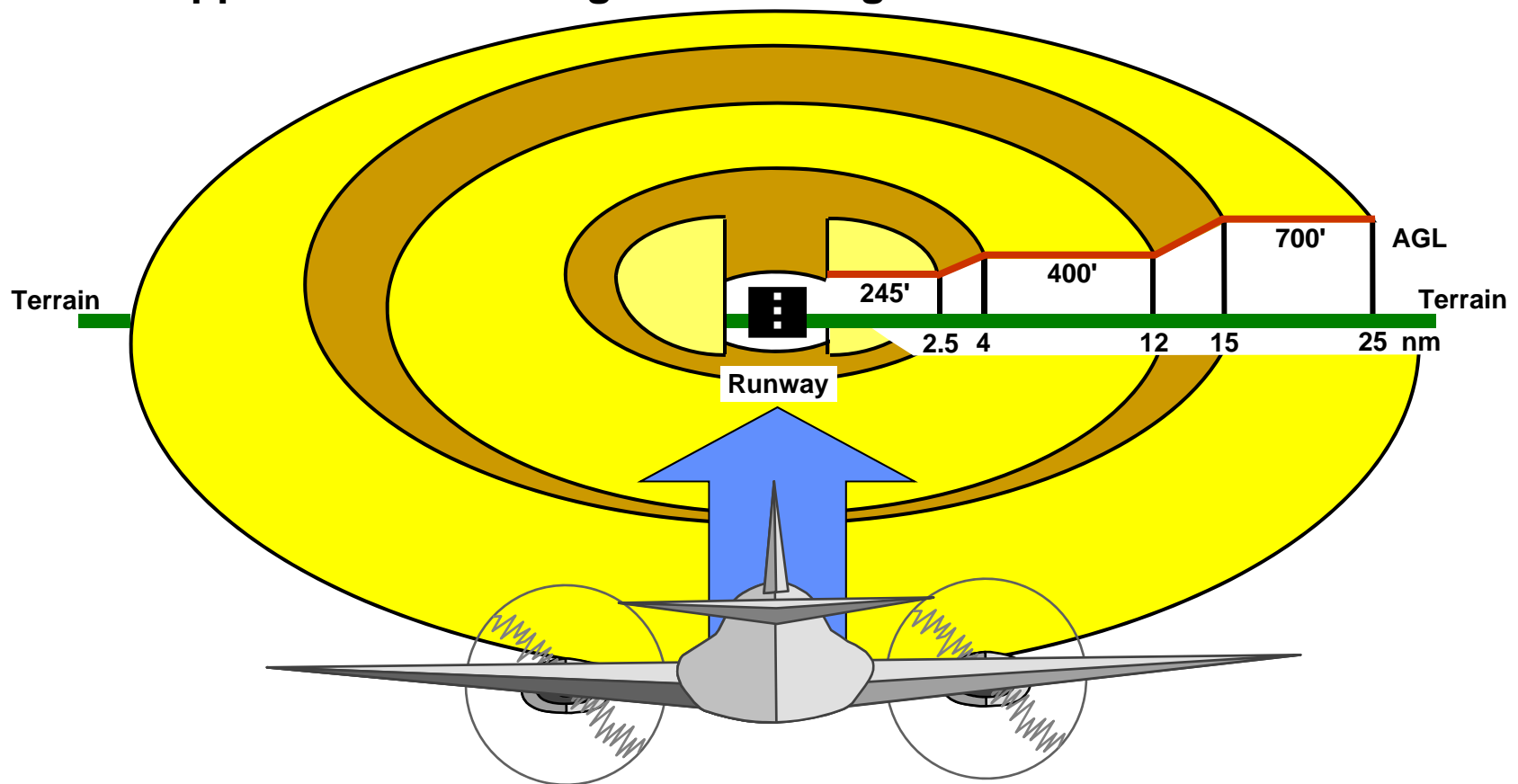
Obstacle Alert

- EGPWS can also provide Obstacle Alert if obstacles are defined in the terrain/obstacle database



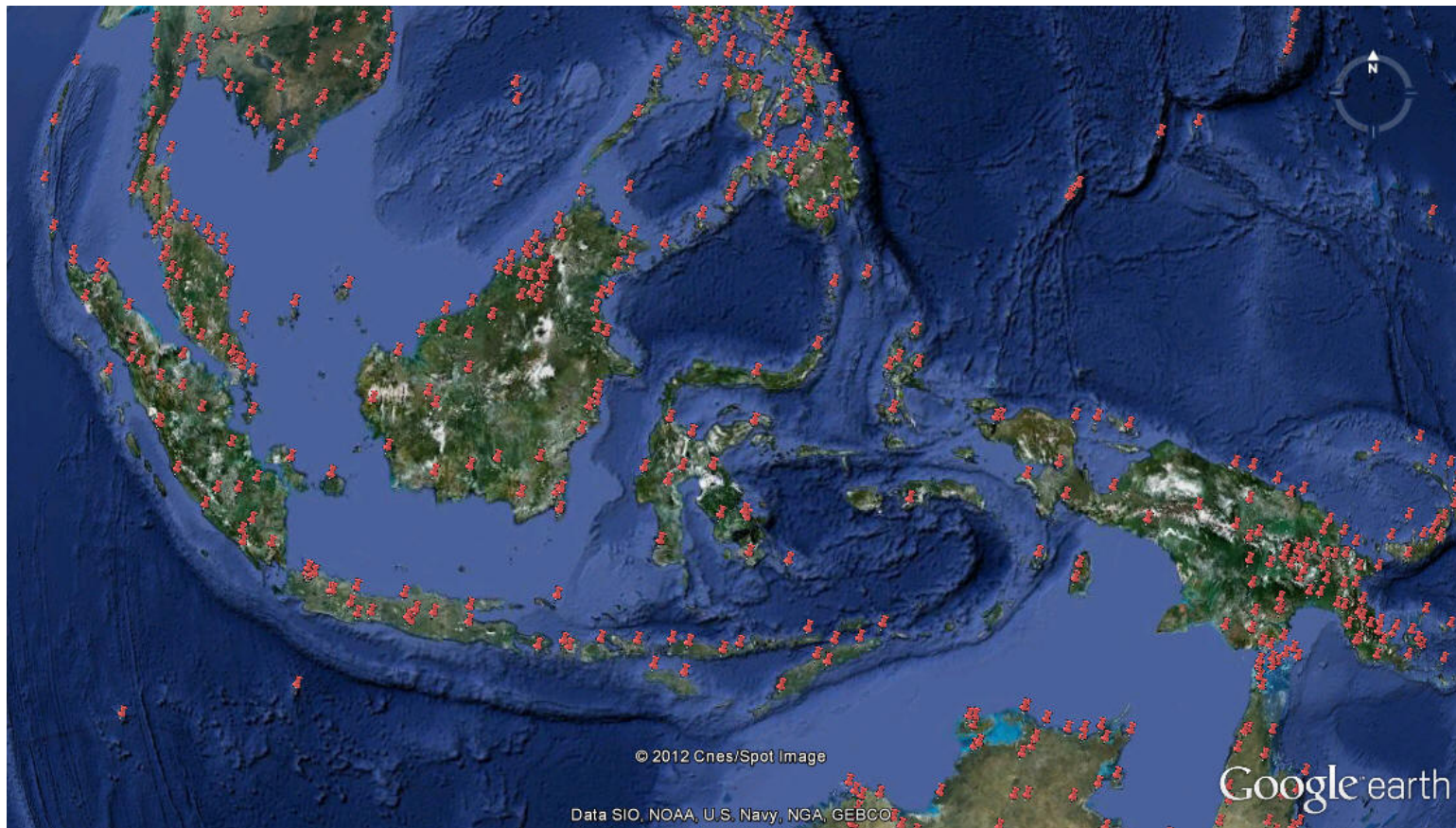
Terrain Clearance Floor

- Compares aircraft position / heading vs. database
- Provides protection even in landing configuration
- Mapped to surrounding terrain using AGL



Runway Database

- **About 20,000 runways are in EGPWS Runway Database**
 - Runway must be defined in the EGPWS database



EGPWS Family



EGPWS LRUs (from left-to-right)

★ *MK V EGPWS*

★ *MK VII EGPWS*

★ *MK VI EGPWS / MK VIII EGPWS*

} **Class A**

★ *KGP-560*

} **Class B**

TAWS Mandate (FAA)

- **FAA**

TSO C151 Class	Operating Rule (Turbine)	# Pax Seats	GPWS Modes (see Note)	Terrain/Airport Database	Terrain Clearance Floor	Look-Ahead Algorithms	Terrain Display	Allowed Position Source(s)
A	121 (125/129)	Independent	1-thru-6	Required	Required	Required	Required	FMS or GPS
A	135	10 or more	1-thru-6	Required	Required	Required	Required	GPS
B	135	6-to-9	1,3,6	Required	Required	Required	Optional	GPS
B	91	6 or more	1,3,6	Required	Required	Required	Optional	GPS

Note: Mode 1 = Excessive Descent Rate
 Mode 2 = Rising Terrain
 Mode 3 = Descent After Takeoff

Mode 4 = Terrain Clearance
 Mode 5 = Descent Below Glideslope
 Mode 6 = Altitude Call-outs & Bank Angle

TAWS Mandate (ICAO)

- ICAO Annex 6, Part 1, Amendment

- New Aircraft

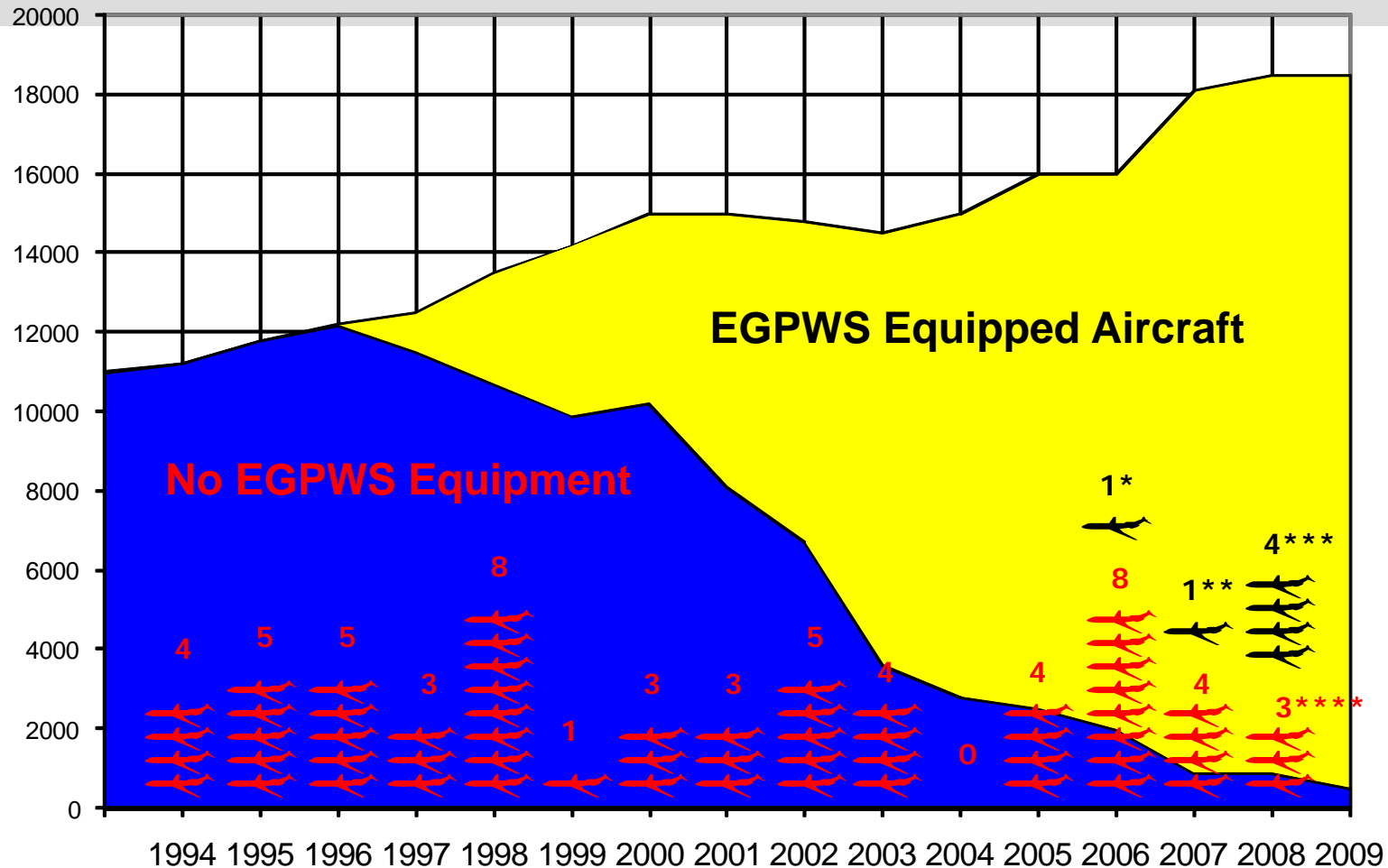
6.15.5 All turbine-engined aeroplanes of a MCTM in excess of 15,000 kg or authorized to carry more than 30 passengers, for which the individual certificate airworthiness is first issued on or after 1 January 2001, shall be equipped with GPWS which has a **predictive terrain hazard warning function**.

- In-Service Aircraft

6.15.6 From 1 January 2003, all turbine-engined aeroplanes of a MCTM in excess of 15,000 kg or authorized to carry more than 30 passengers shall be equipped with a GPWS which has a **predictive terrain hazard warning function**.

6.15.7 Recommendation.-All turbine-engined aeroplanes of a MCTM in excess of 5,700 kg or authorized to carry more than nine passengers, should be equipped with a GPWS which has a **predictive terrain hazard warning function**.

GPWS Versus E-GPWS Active World's Large Commercial Jet Fleet



* One aircraft was flown into the water with the pilot suffering from spatial disorientation. E-GPWS provided 15 seconds of warning.

** One aircraft was flown into a mountain with E-GPWS inoperative.

*** Three aircraft flown into the ground, possible loss of control, E-GPWS inhibited.

**** One aircraft flown into a mountain with E-GPWS inoperative.

**** Three aircraft not equipped with EGPWS

Provided by Don Bateman, Honeywell

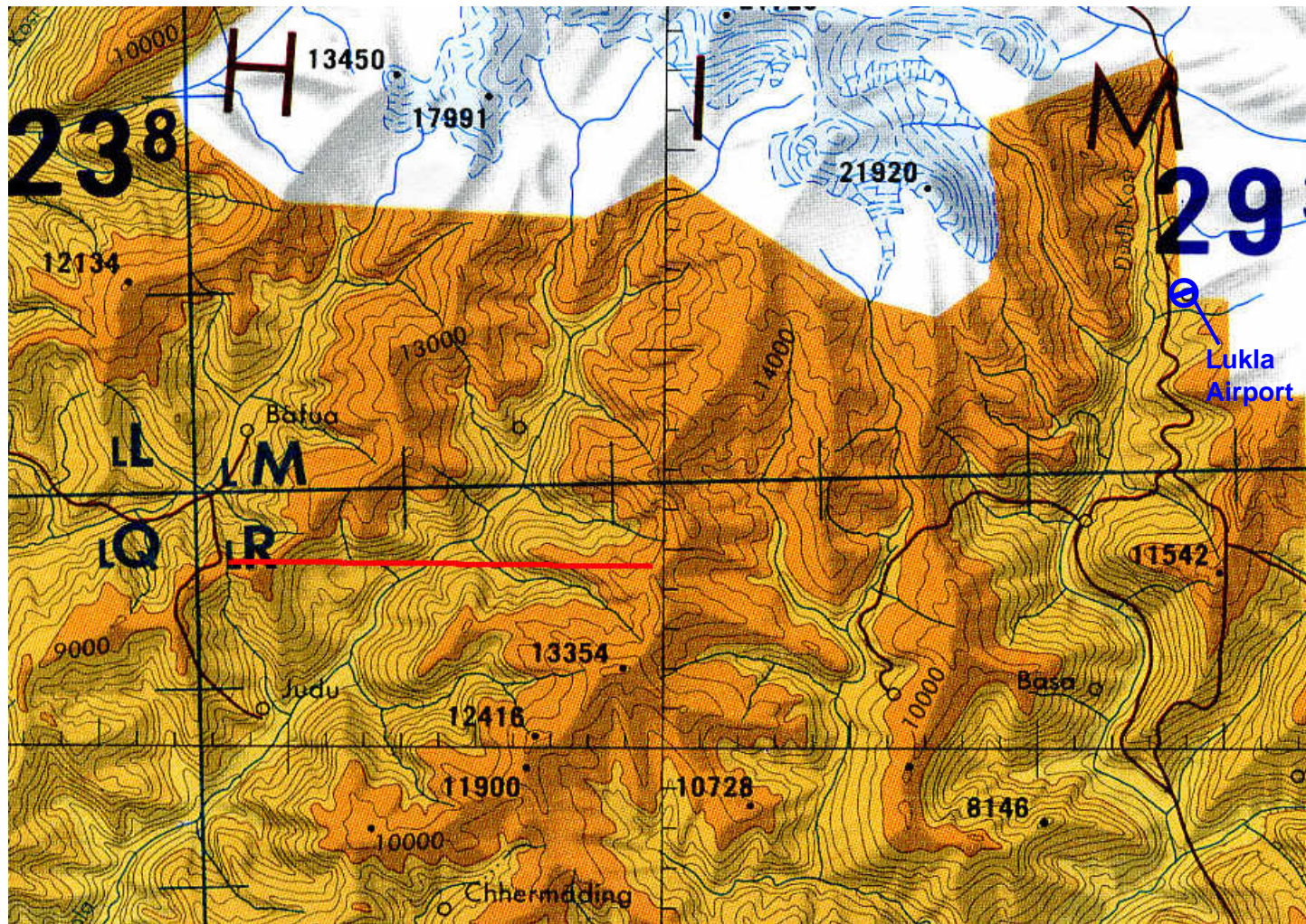
Commercial Jets & Turbo Prop Accidents in 2011

Date	Place	Aircraft	Comments	Fatalities	TAWS Equipped
1/9/2011	Orumieh, Iran	B727-200	Crashed 8 NM short of Runway 21 during a missed ILS approach while in a turn at night and poor visibility in snow. There was a possible or loss of power in two engines at 13 NM with a turn back to the airfield. There was a possible stall in turn.	78	NO (Only GPWS)
2/2/2011	Tegucigalpa, Honduras	L-410	Crashed into a mountain at the 5,400 foot level in poor weather at about 5 NM short of runway 02 after a last minute ATC clearance from runway 20 to a VORDME approach to Runway 02	14	NO
2/2/2011	Muhinga, Congo	L-410	Flew into Mont Biega at about 8,800 feet altitude after take-off from Kavuma.	2	NO
2/8/2011	Robberg, South Africa	PC-12	Crashed into the sea during a missed approach. EGPWS had been giving INOP light for many previous flights but the problem was not corrected.	9	YES
5/7/2011	Kaimana, Indonesia	MA60	Crashed by 1500 feet short of runway 19 during a VFR approach in rain with thick fog. Bank angle increased to 38 degrees. Possible Loss of Control?	27	YES
6/20/2011	Petrozavodsk, Russia	Tu-134A	Hit a tree about 3,000 feet short and right of the centre line and crashed short on a road 2,600 feet short and to the right of the Runway 01 threshold during a NDB final approach at night in poor visibility.	44	NO
7/6/2011	Kabul, Afganistan	IL-76	Struck the side of a mountain at the 12,100 foot MSL level at night 13.5 NM short on an approach to Bagram Air Force Base.	9	NO
7/10/2011	Kinsangani, Congo	B727-100	Missed runway 31 by about 300 meters and crashed in bush during VORDME daylight approach in poor visibility and weather.	63	NO (Only GPWS)
8/9/2011	Blagoveshchensk, Russia	An-24	Crashed about 250 meters east of runway 36. Continued approach below DH without visual reference.	0	NO
8/20/2011	Resolute Bay, Canada	B737-200	Crashed about 1 NM east of runway 35T into a hill during an apparently incorrect approach track using 'YRB' VOR/DME which is located 1 NM east of the runway.	12	NO (Only GPWS)
9/7/2011	Trinidad, Bolivia	Fairchild SA227	Crashed during a procedure turn to during a VOR approach about 10 NM on the center line, but short of runway	8	NO
9/25/2011	Kathmandu, Nepal	Beech 1900D	<i>Crashed into a mountainous ridge on approach to Kathmandu. Possible VMC into IMC and possible last moment attempt to pull up.</i>	19	NO (Only GPWS)
9/29/2011	Kutacane, Indonesia	CASA C212	crashed into a mountain on approach at the 5,500 foot level. Possible VMC into IMC and possible last moment attempt to pull up.	18	NO

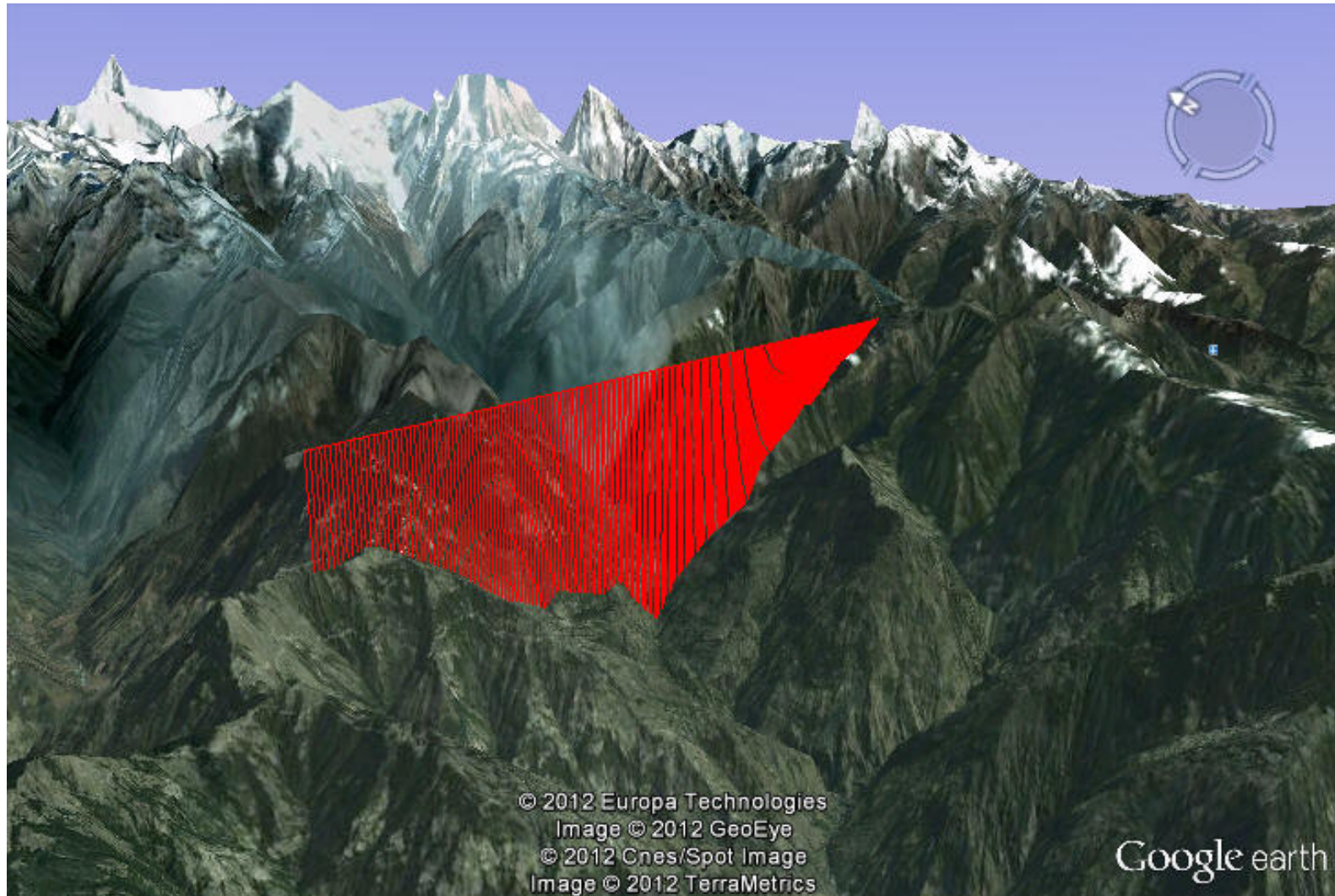
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Controlled Flight Into Terrain Accidents

Controlled Flight Into Terrain (Accident 1)



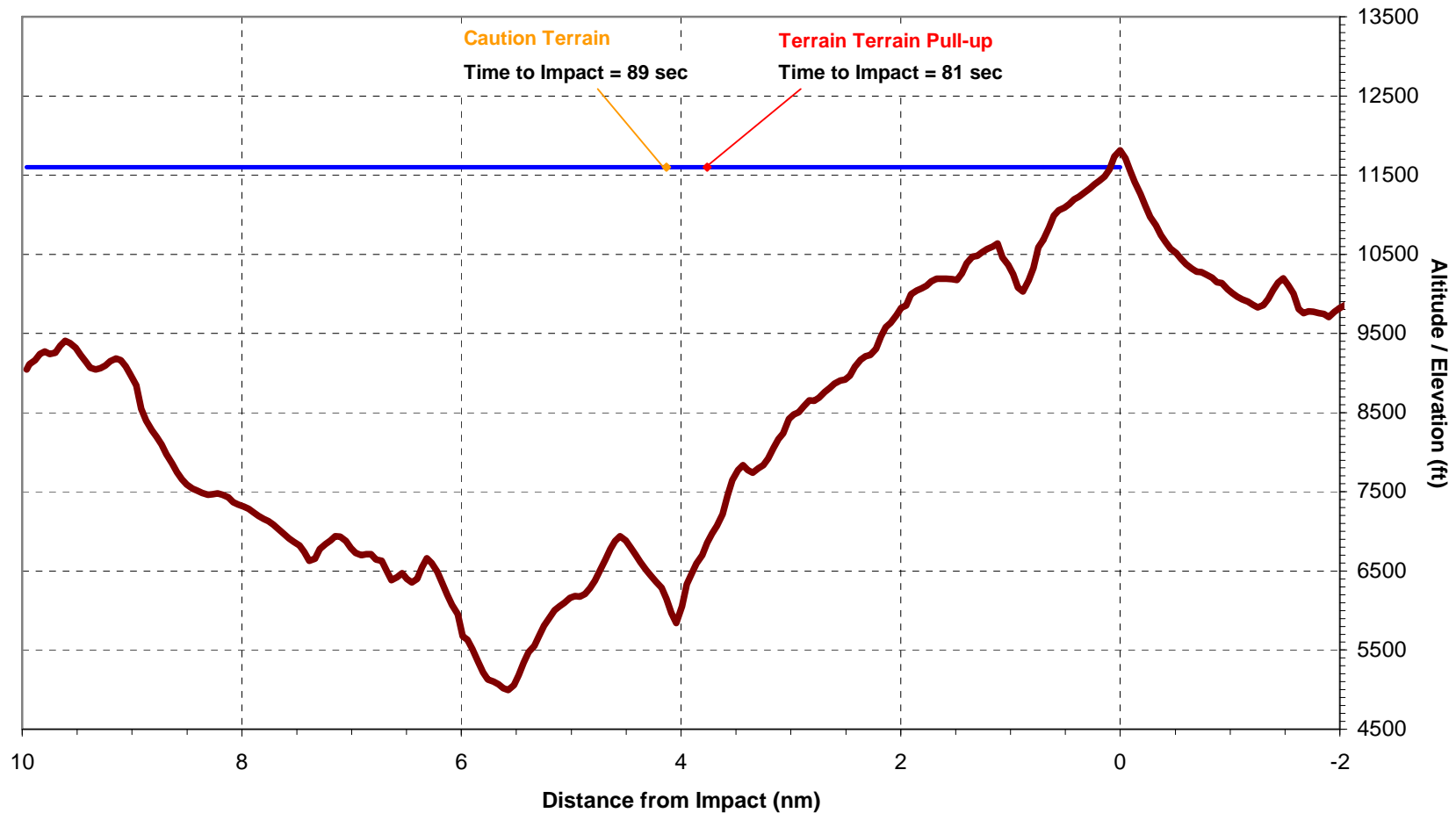
Controlled Flight Into Terrain (Accident 1)



Controlled Flight Into Terrain (Accident 1)

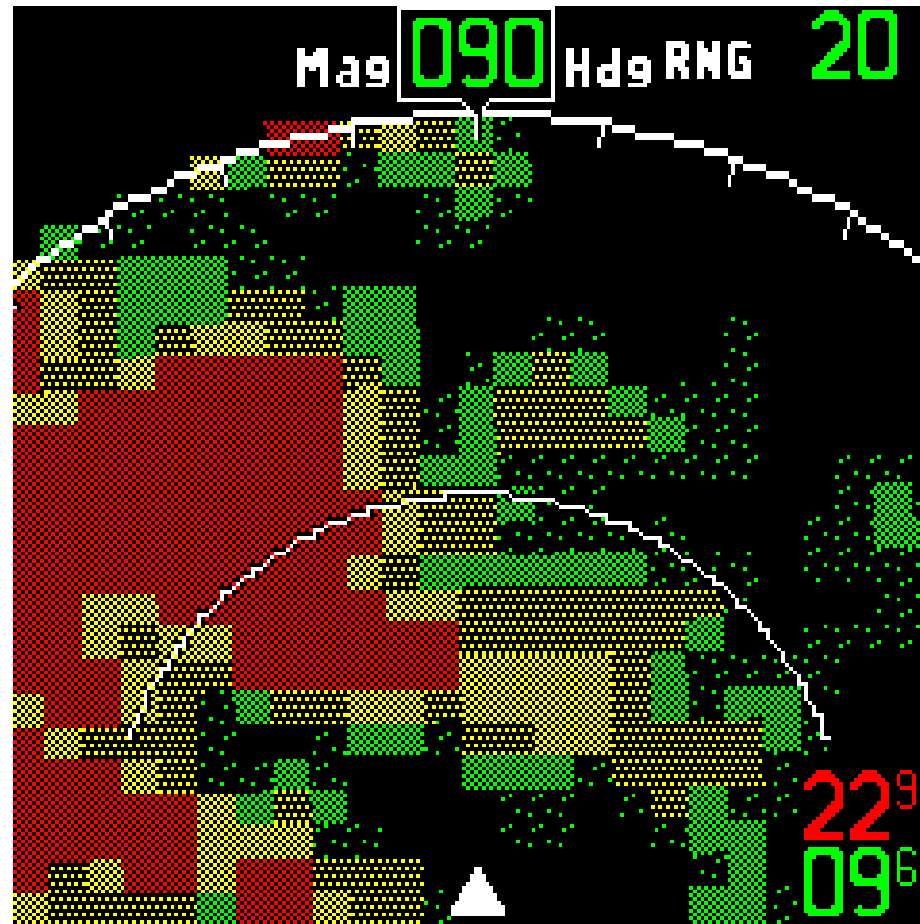
Lukla, Nepal (VNLK)
Accident: May 25, 2004
DHC6-300

(Probable Flight Profile)



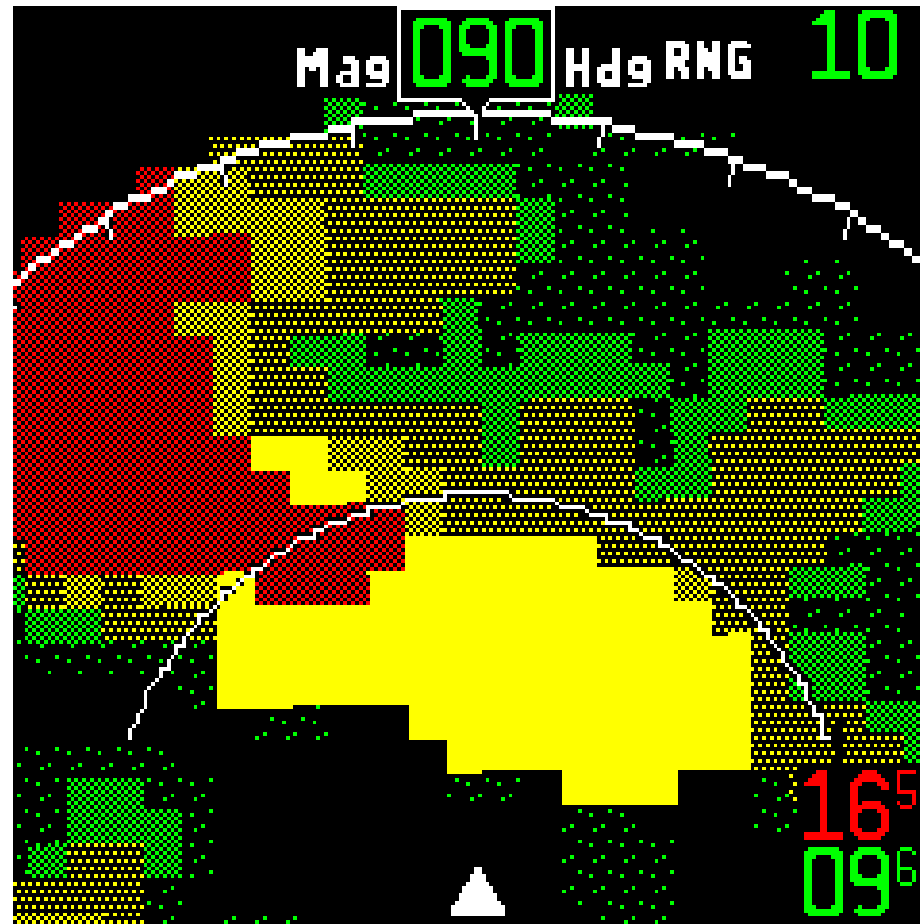
Controlled Flight Into Terrain (Accident 1)

2 minutes before impact



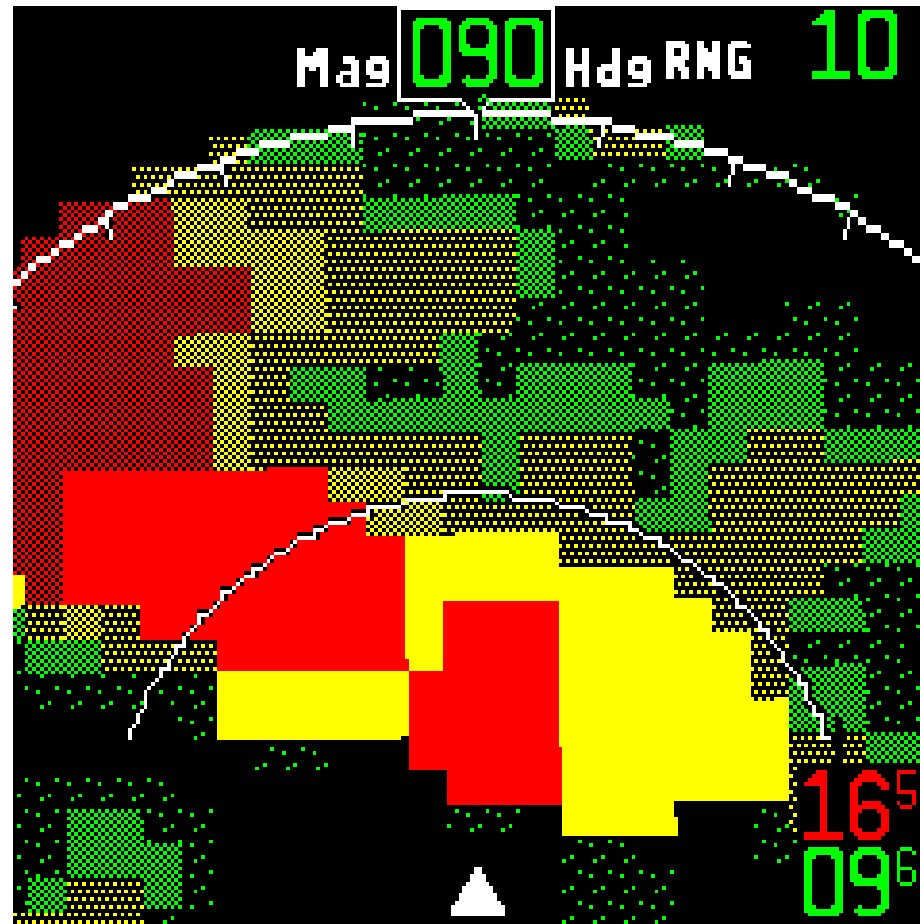
Controlled Flight Into Terrain (Accident 1)

Terrain Alert at 89 seconds before impact

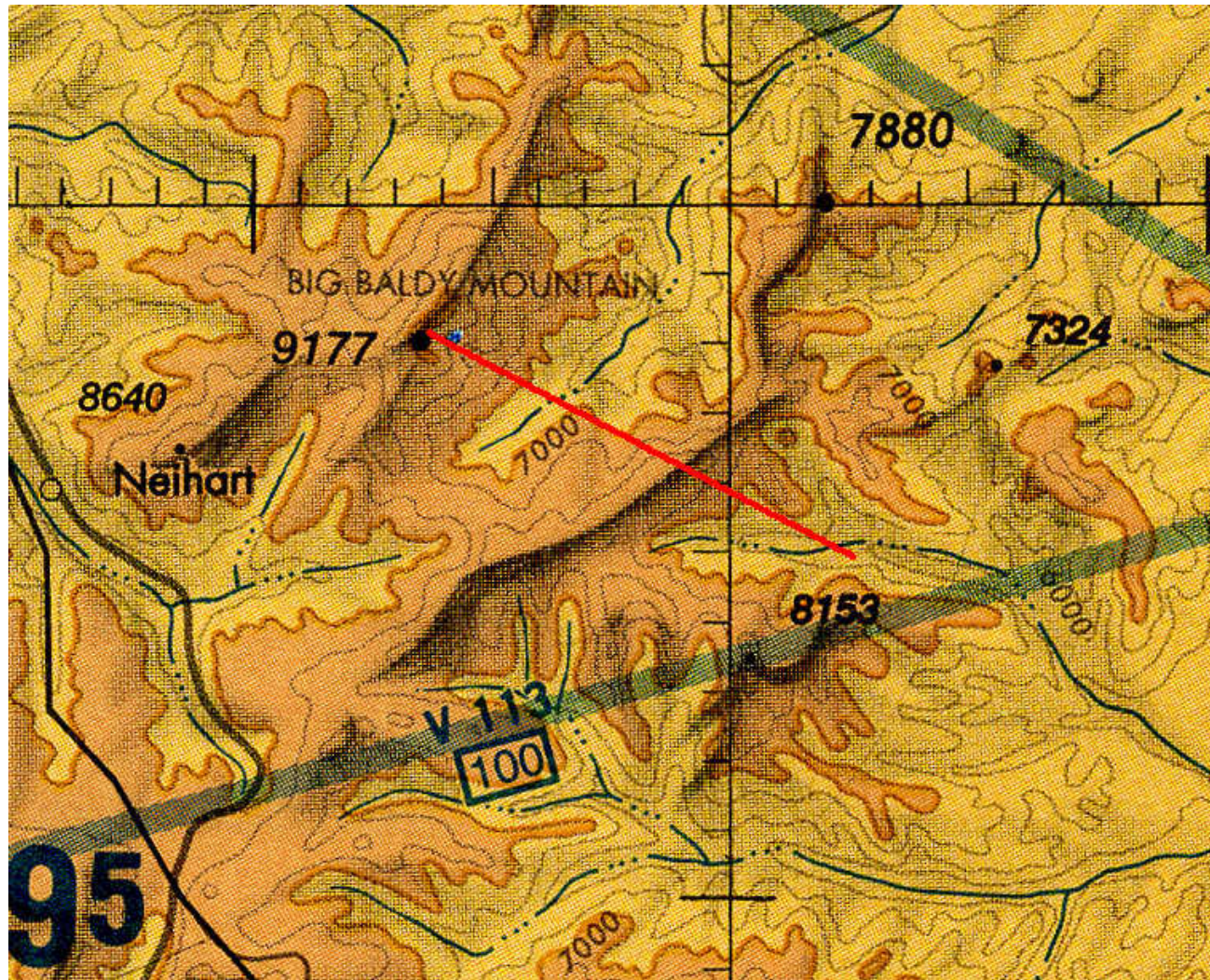


Controlled Flight Into Terrain (Accident 1)

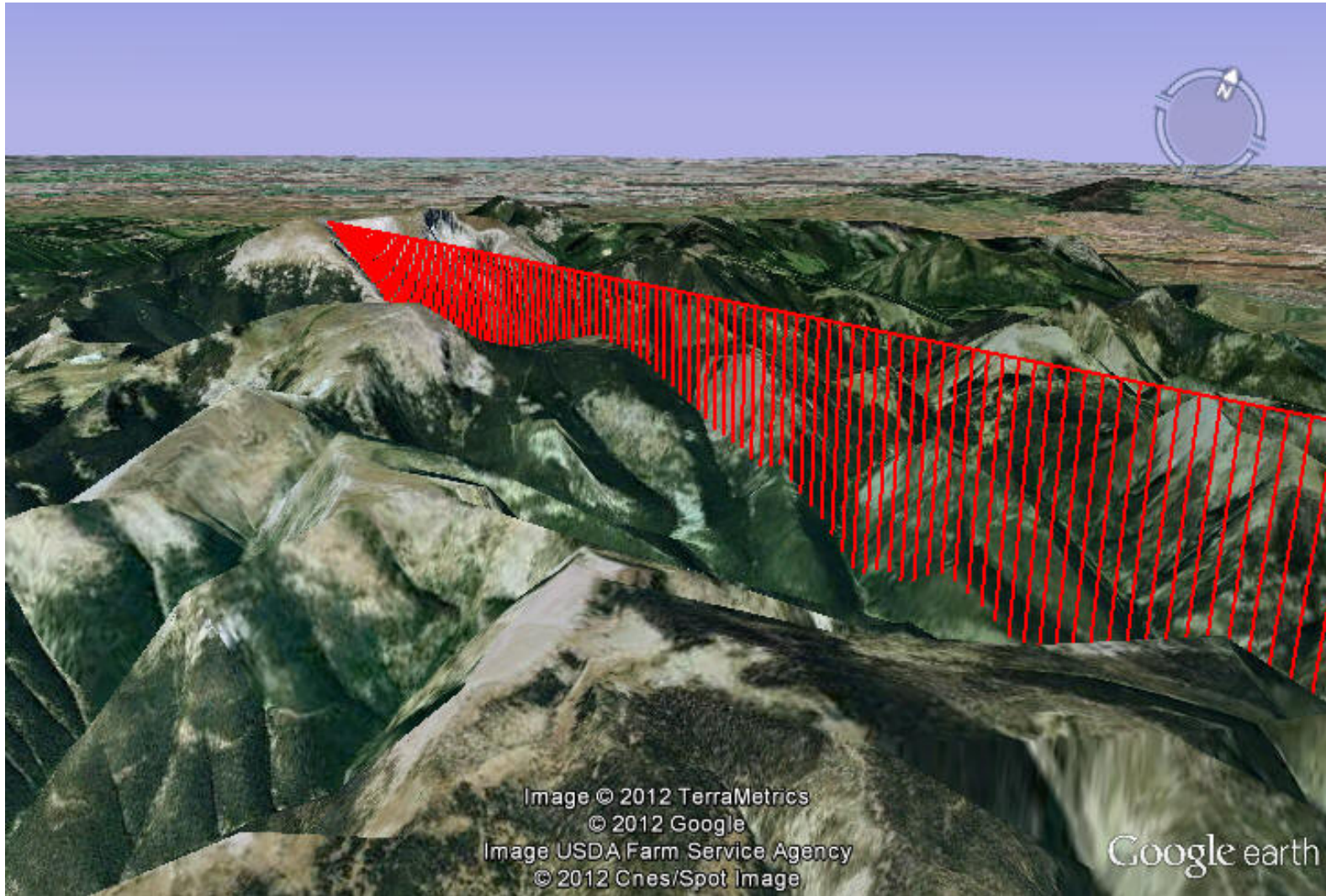
Terrain Warning at 81 seconds before impact



Controlled Flight Into Terrain (Accident 2)

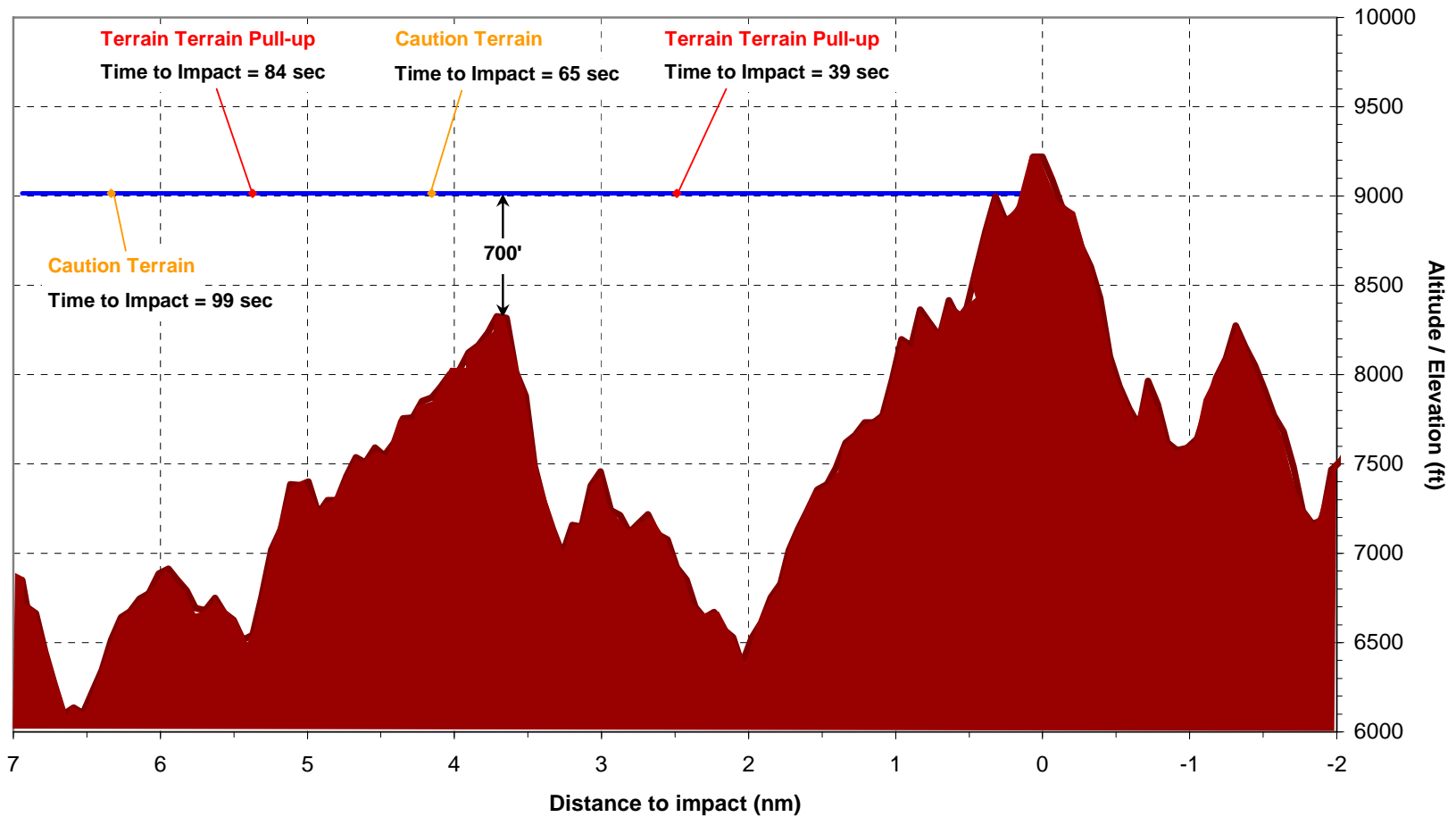


Controlled Flight Into Terrain (Accident 2)



Controlled Flight Into Terrain (Accident 2)

Neihart, MT, USA
 Accident: August 17, 2004
 Beech 99
 (Probable Flight Profile)



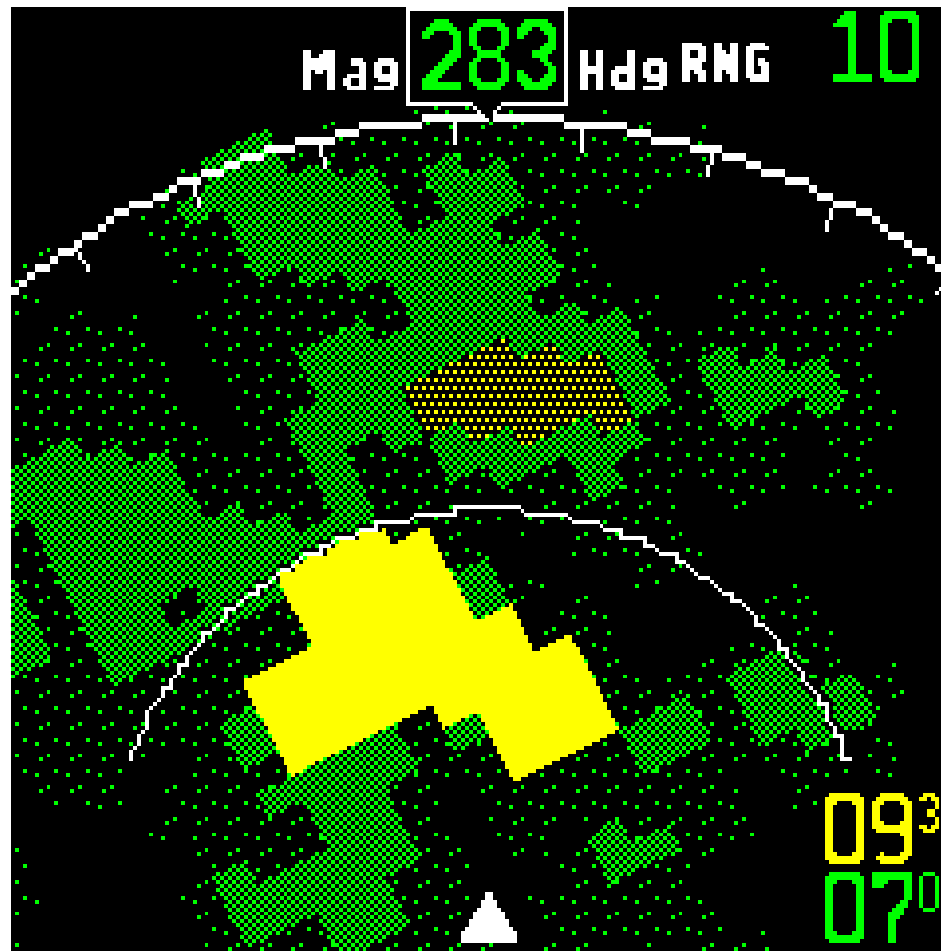
Controlled Flight Into Terrain (Accident 2)

Before Terrain Alert



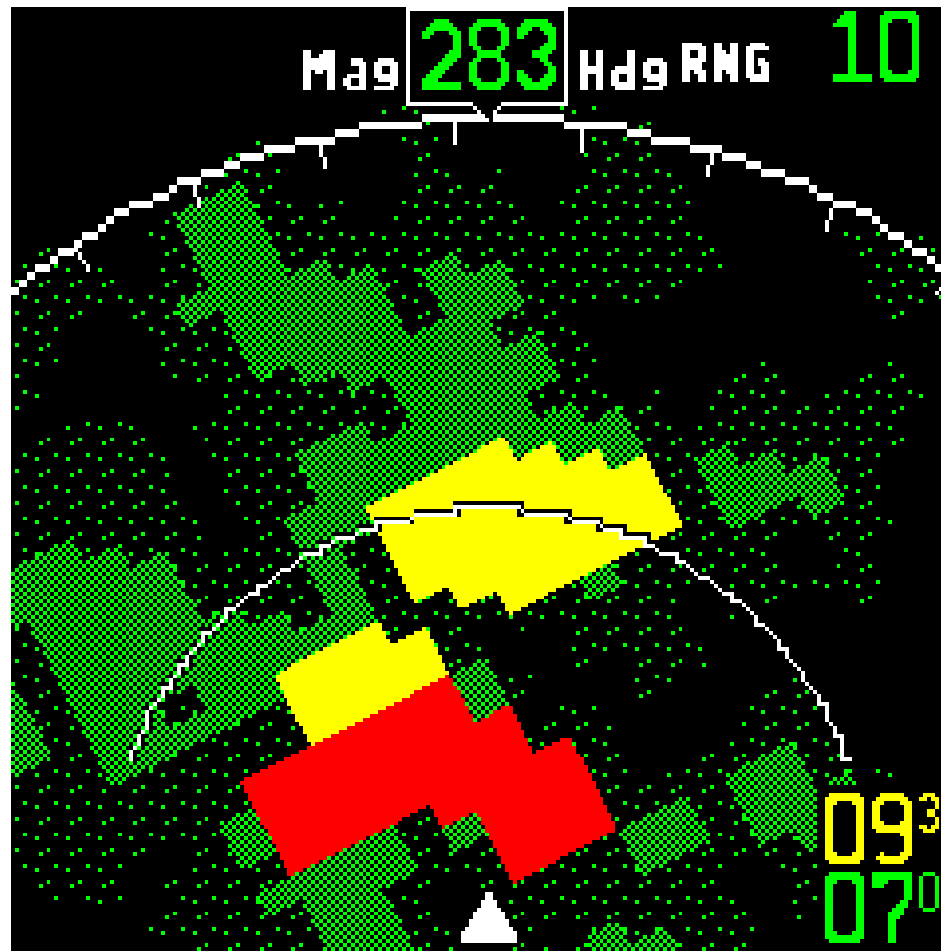
Controlled Flight Into Terrain (Accident 2)

Terrain Alert at 99 seconds before impact



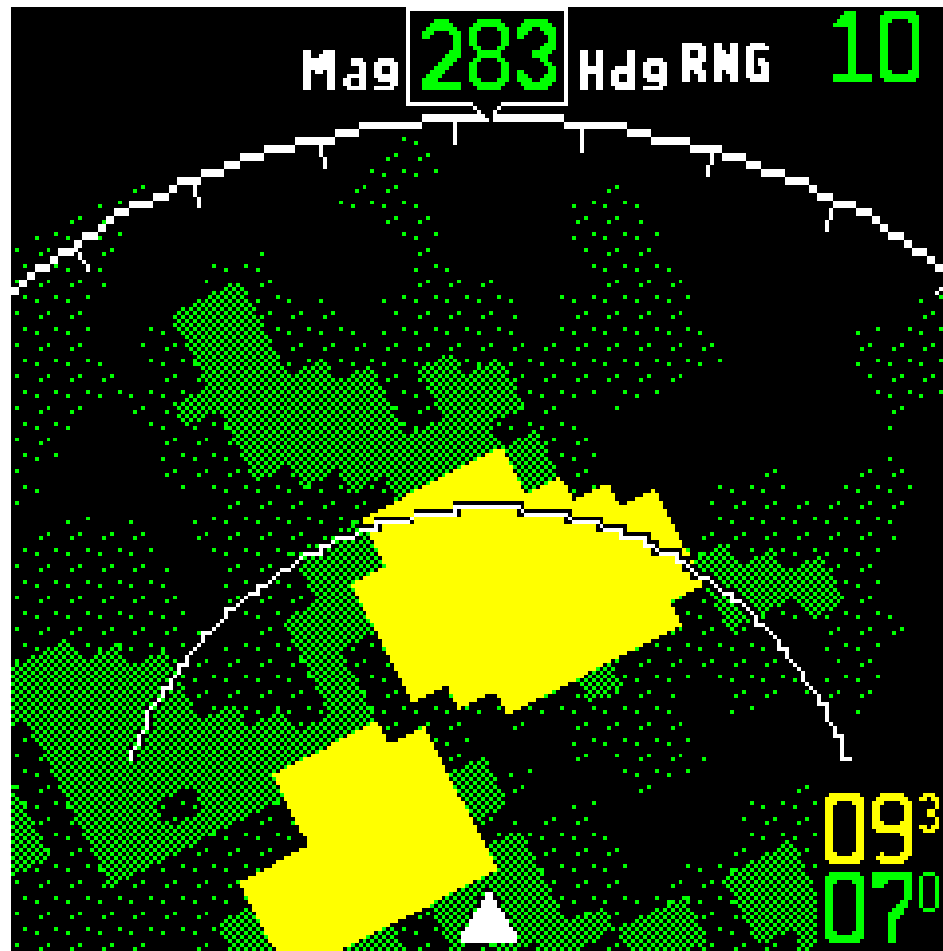
Controlled Flight Into Terrain (Accident 2)

Terrain Warning at 84 seconds before impact



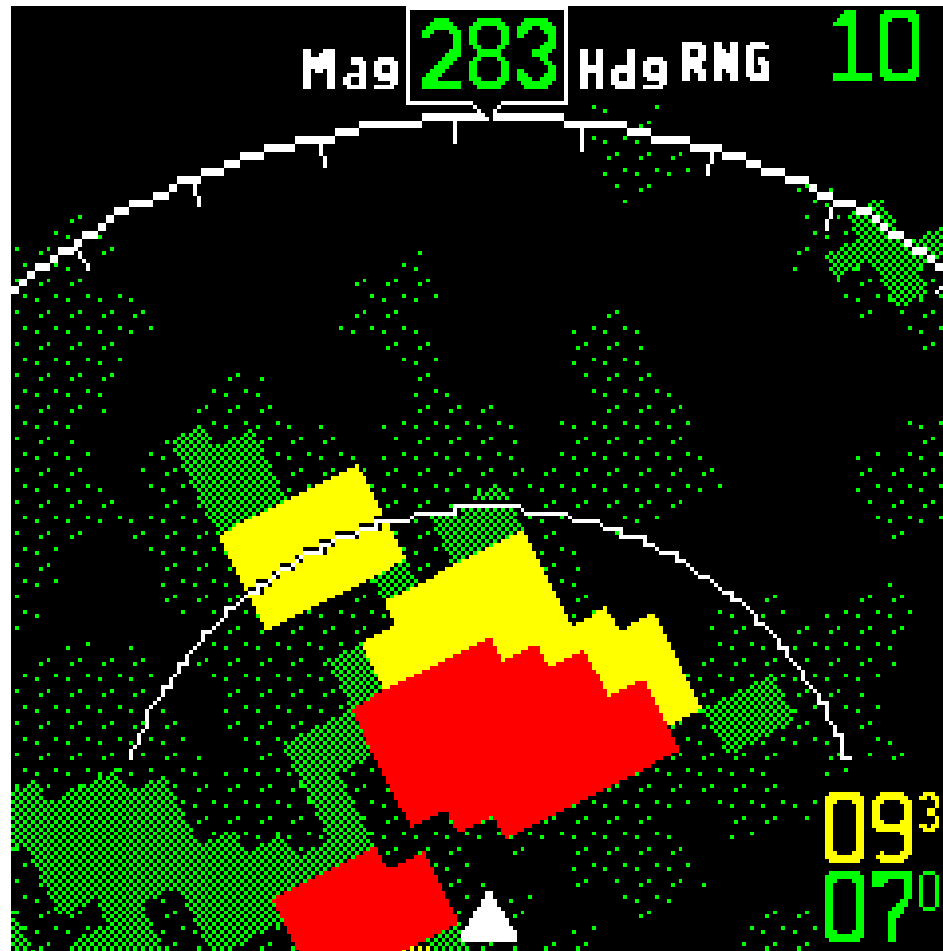
Controlled Flight Into Terrain (Accident 2)

Terrain Alert at 65 seconds before impact



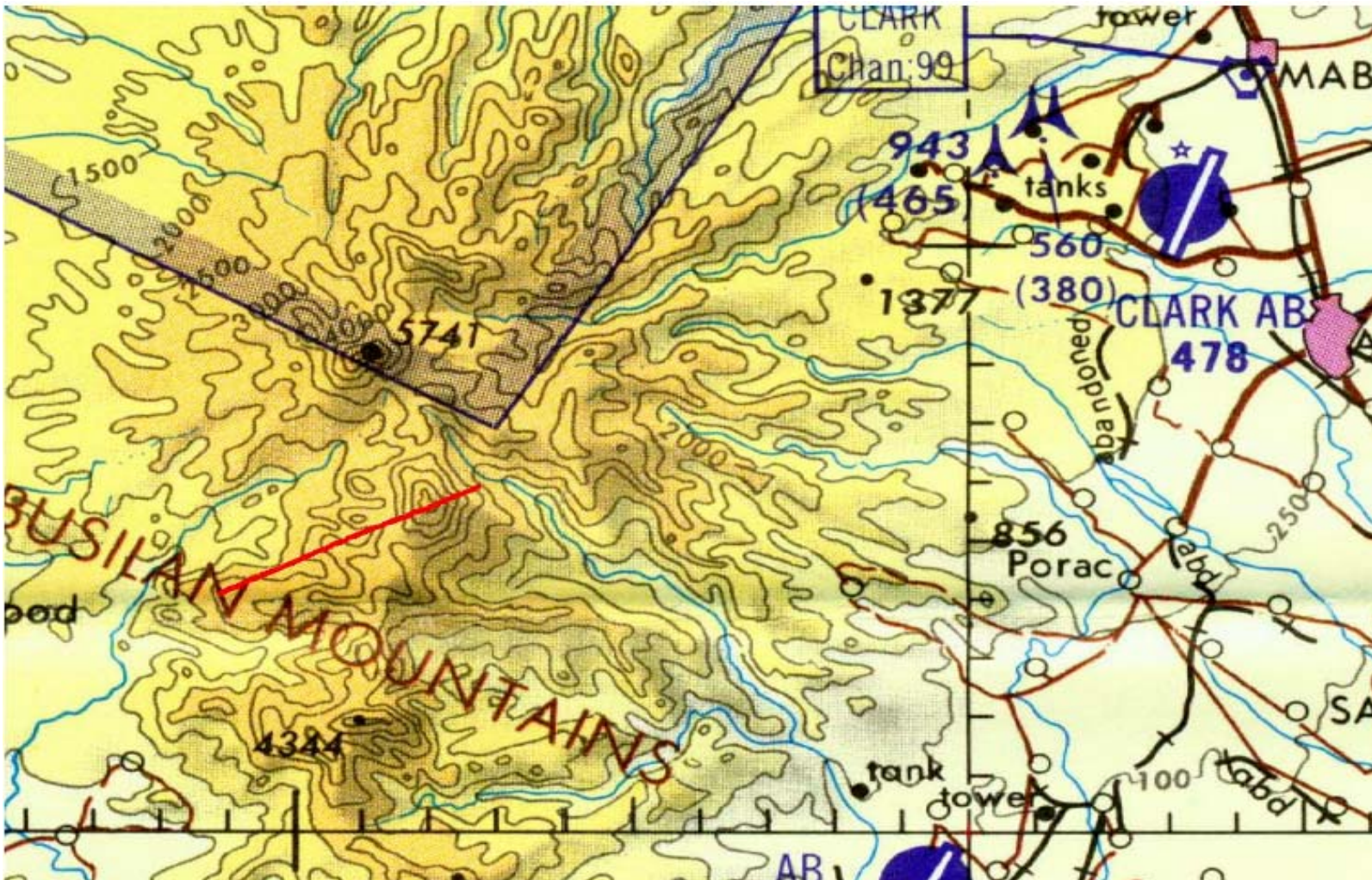
Controlled Flight Into Terrain (Accident 2)

Terrain Warning at 39 seconds before impact

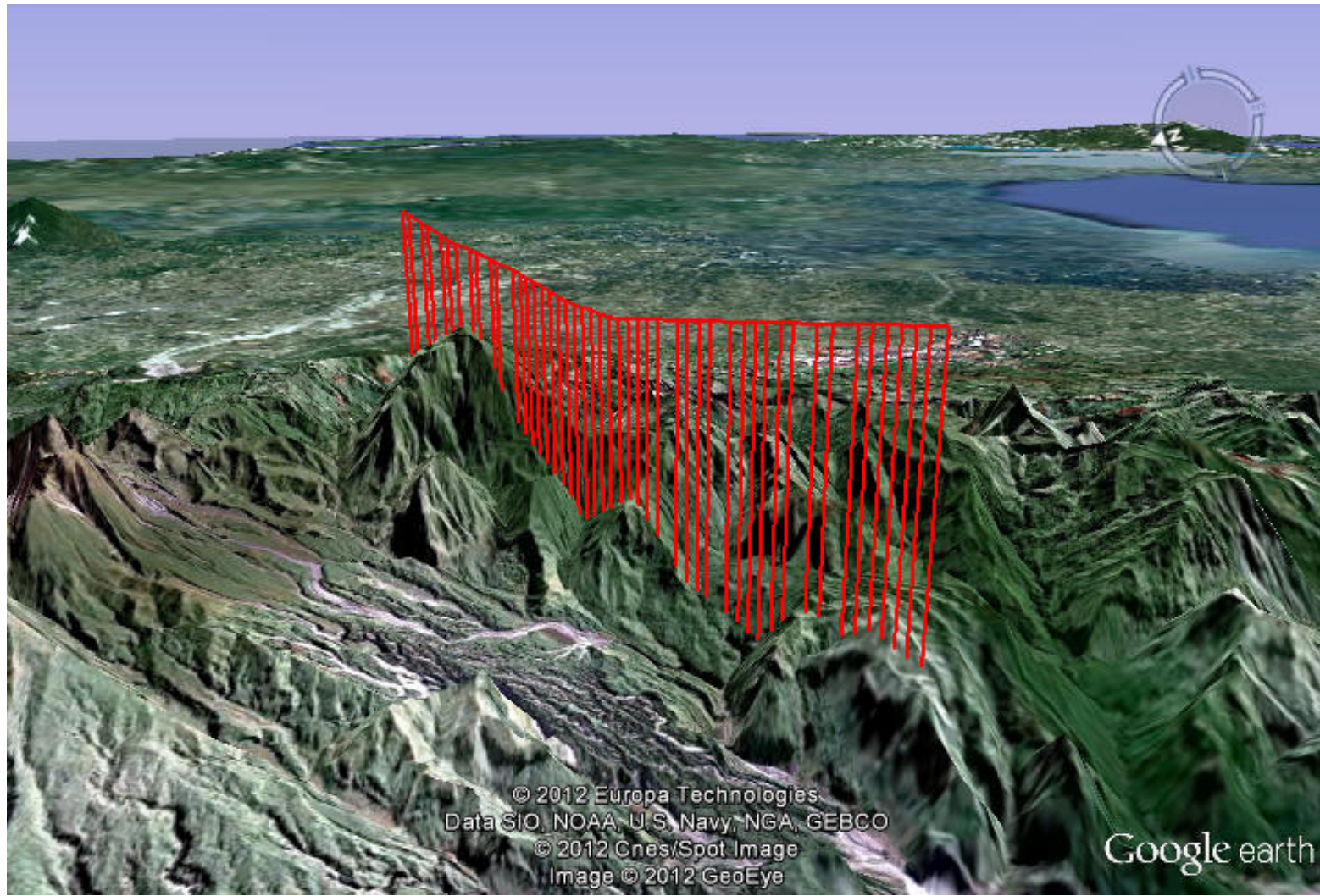


EGPWS Incident With Positive Outcome

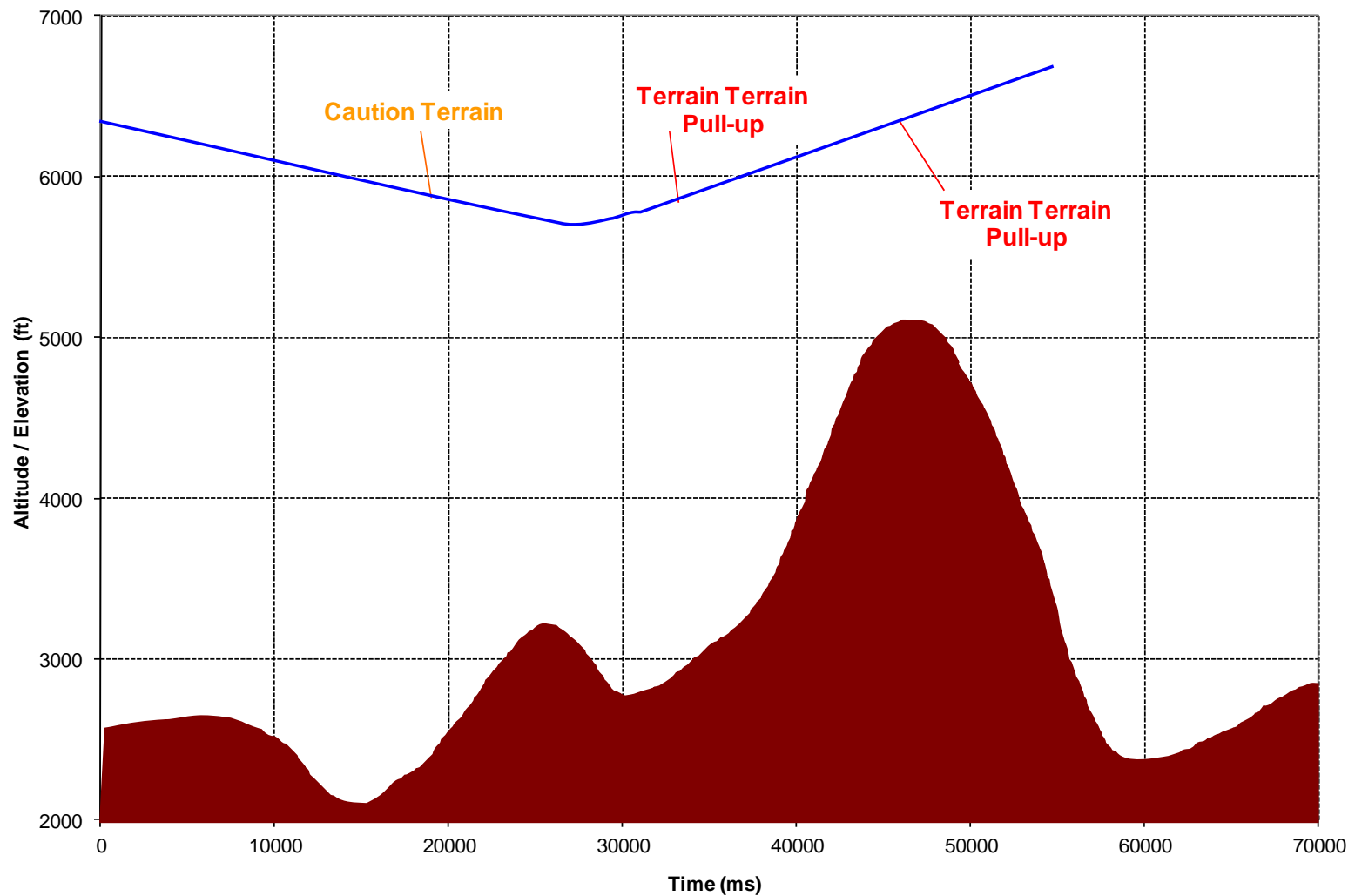
Controlled Flight Toward Terrain (Event 1)



Controlled Flight Toward Terrain (Event 1)

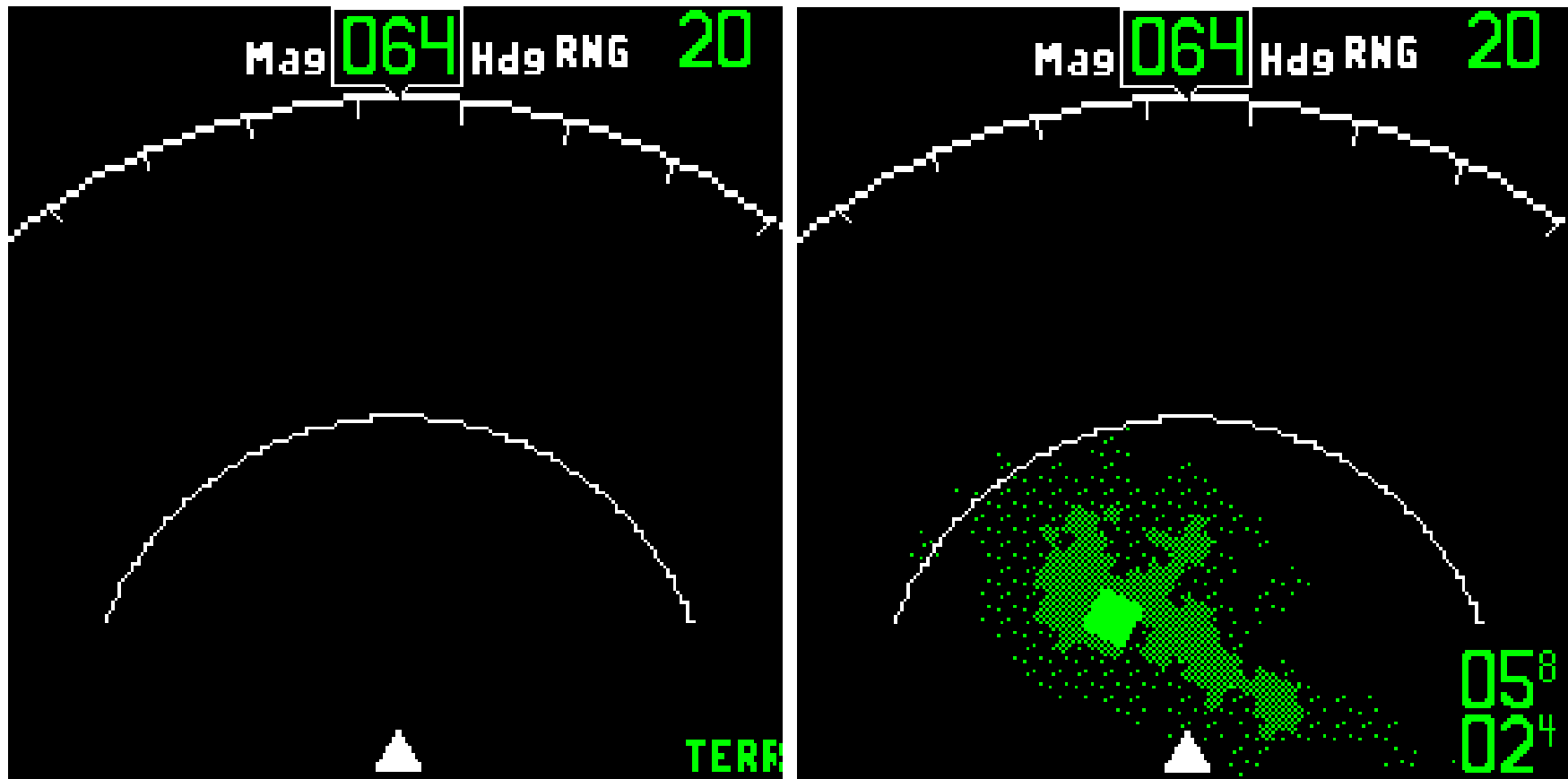


Controlled Flight Toward Terrain (Event 1)



Controlled Flight Toward Terrain (Event 1)

At 8,000 feet

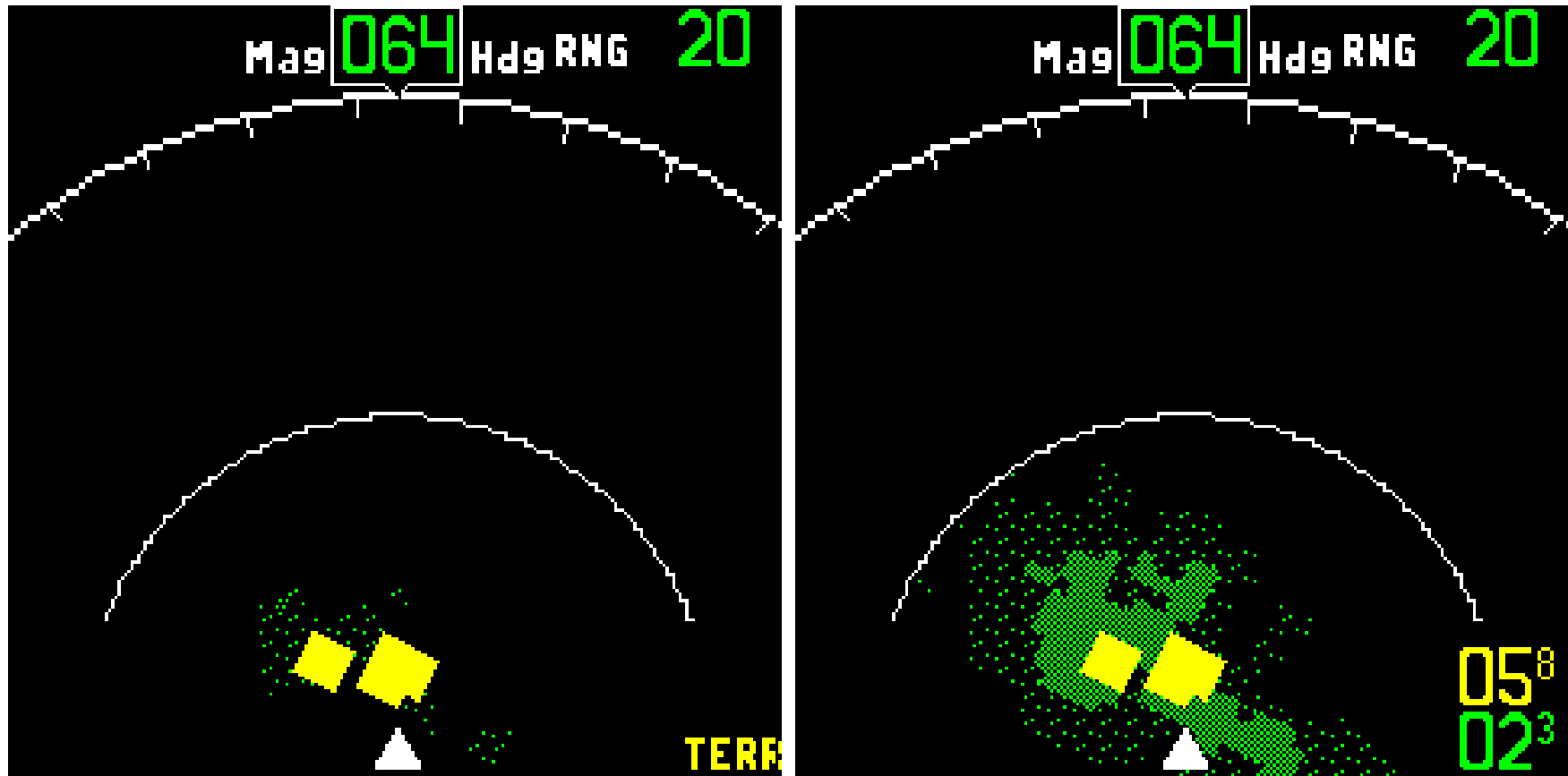


Standard Display

PEAKS Display

Controlled Flight Toward Terrain (Event 1)

Terrain Caution at 5,880 feet

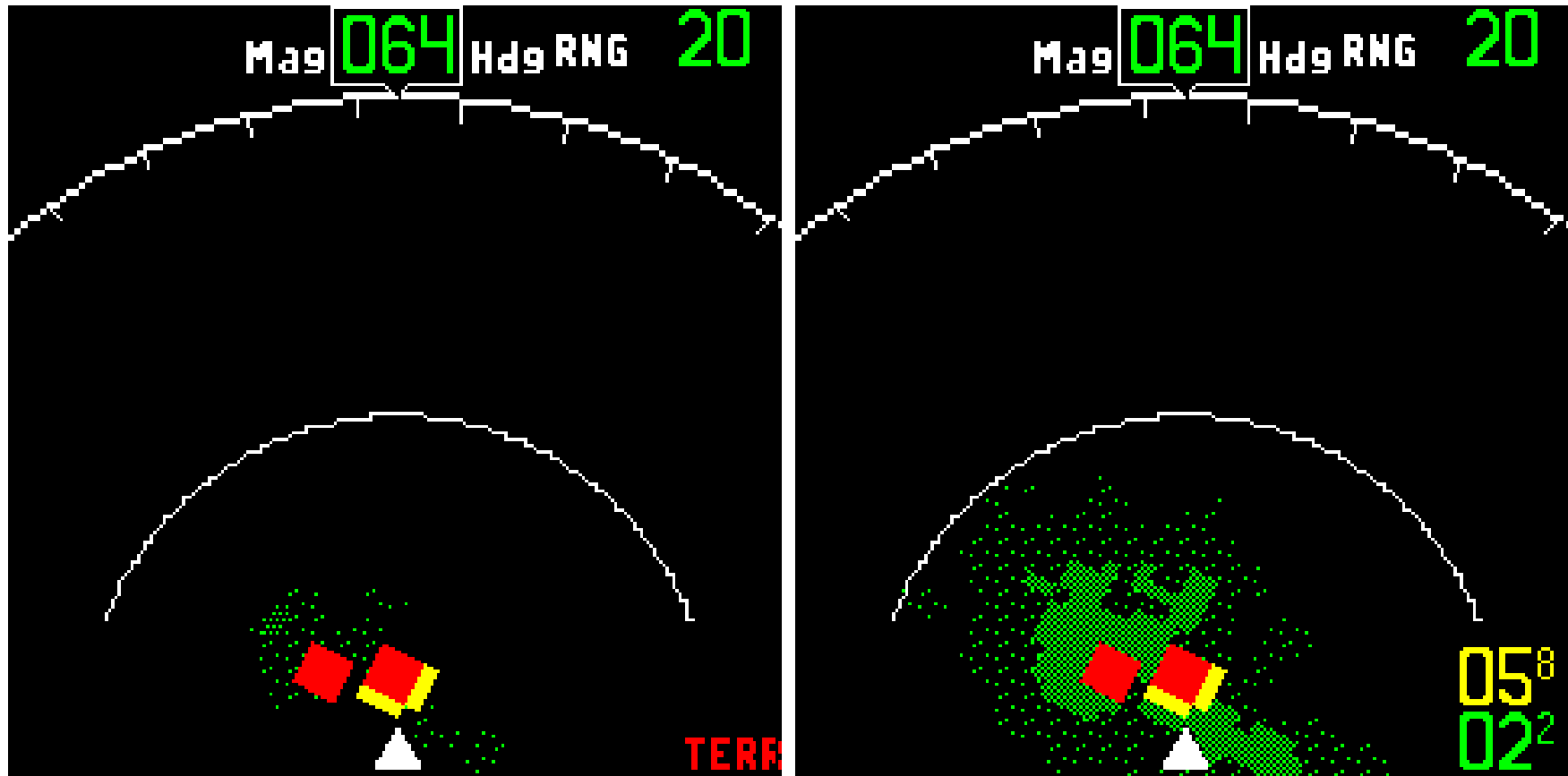


Standard Display

PEAKS Display

Controlled Flight Toward Terrain (Event 1)

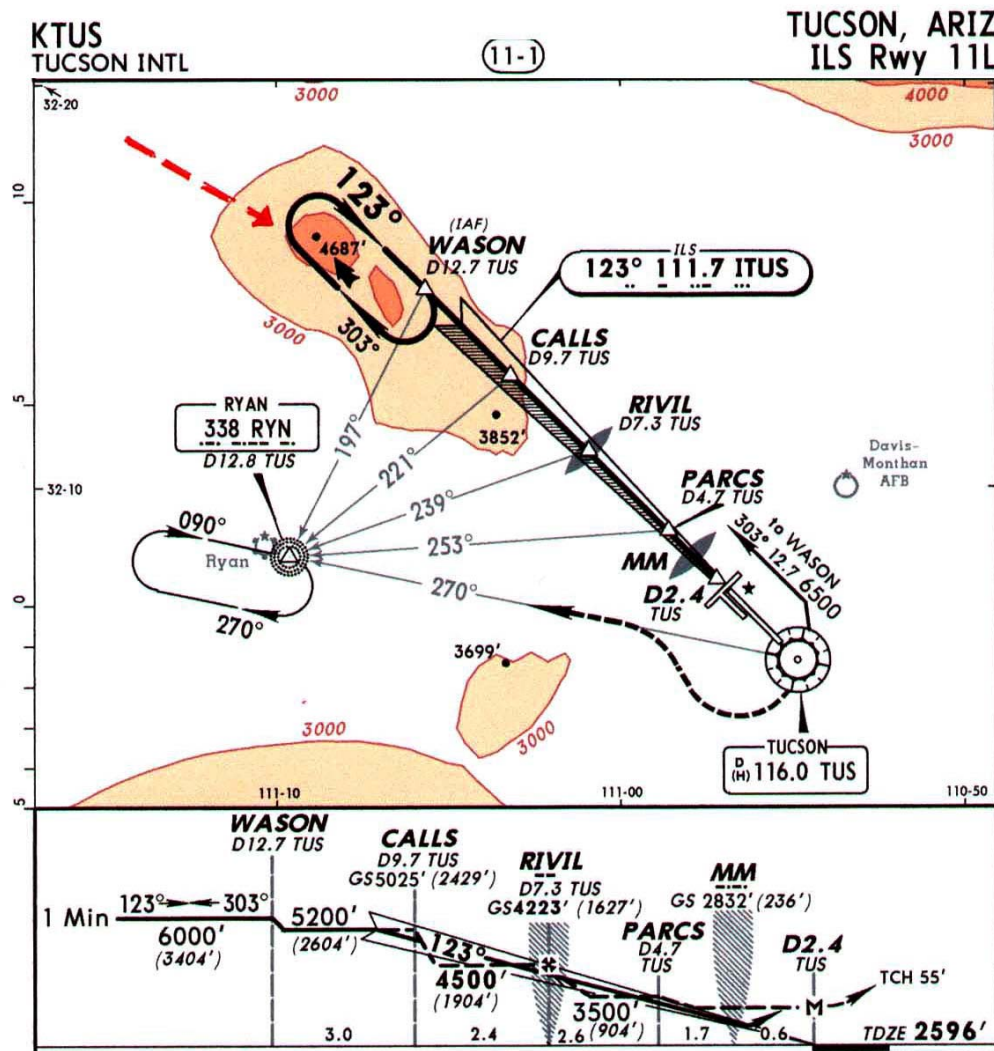
Terrain Warning at 5,790 feet



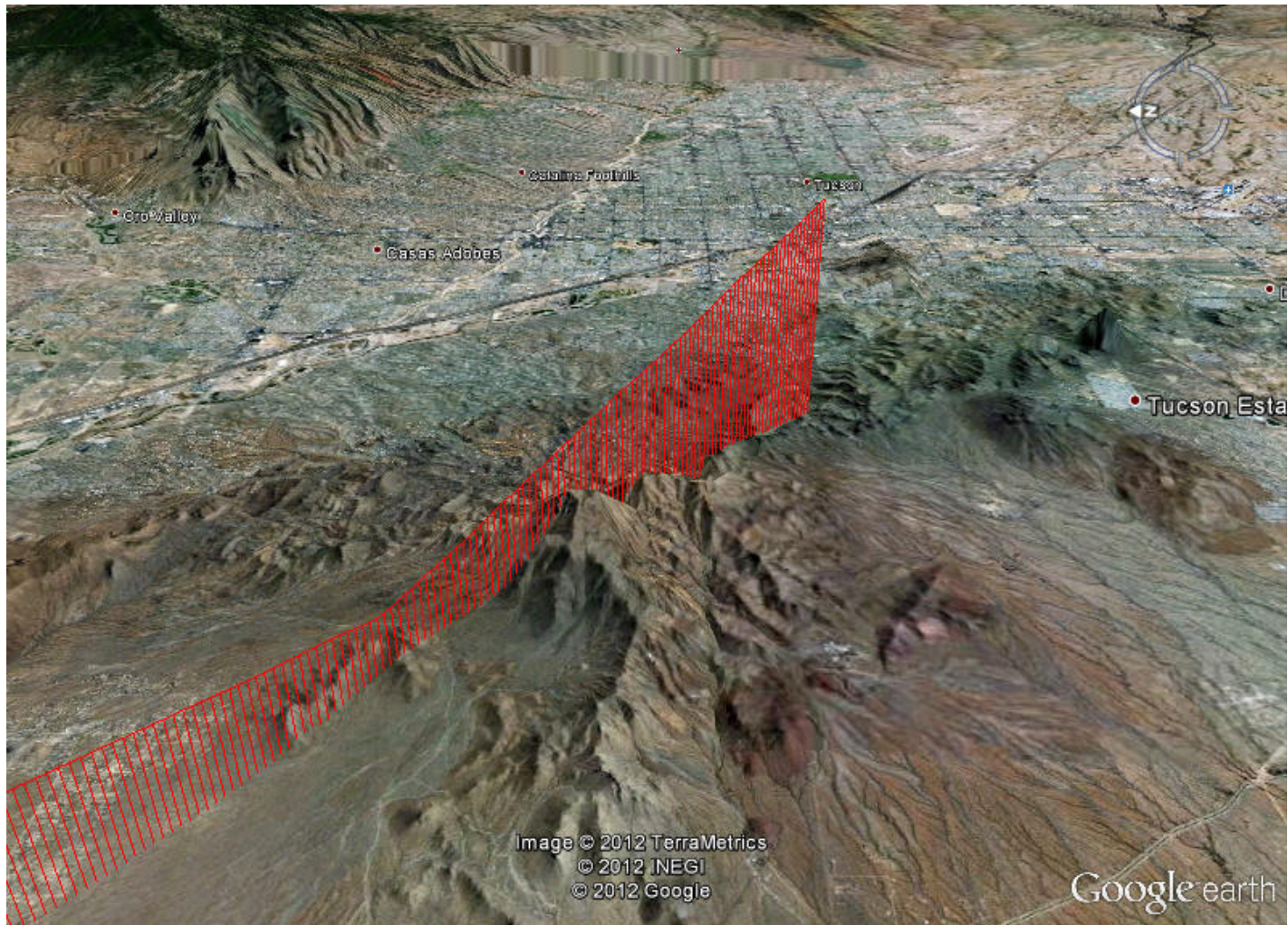
Standard Display

PEAKS Display

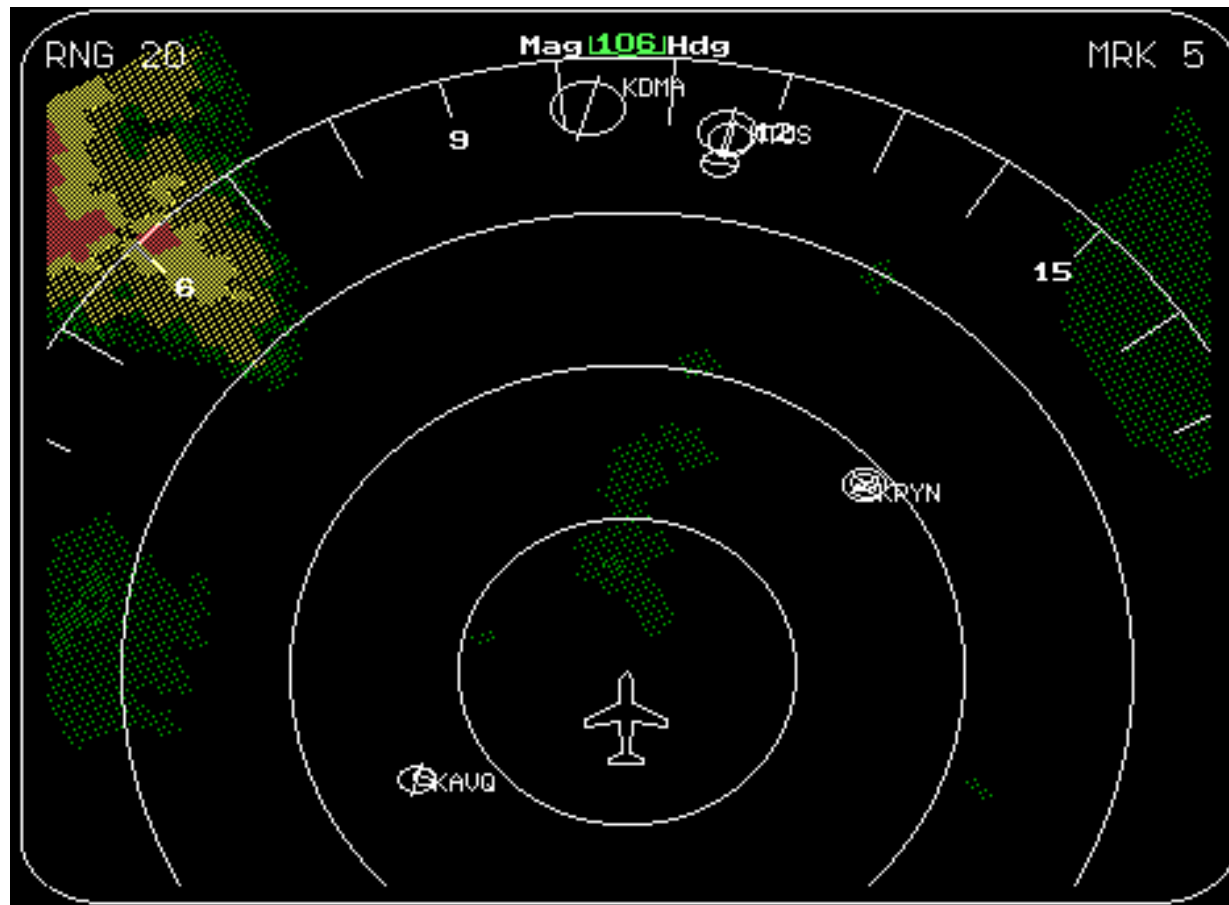
Controlled Flight Toward Terrain (Event 2)



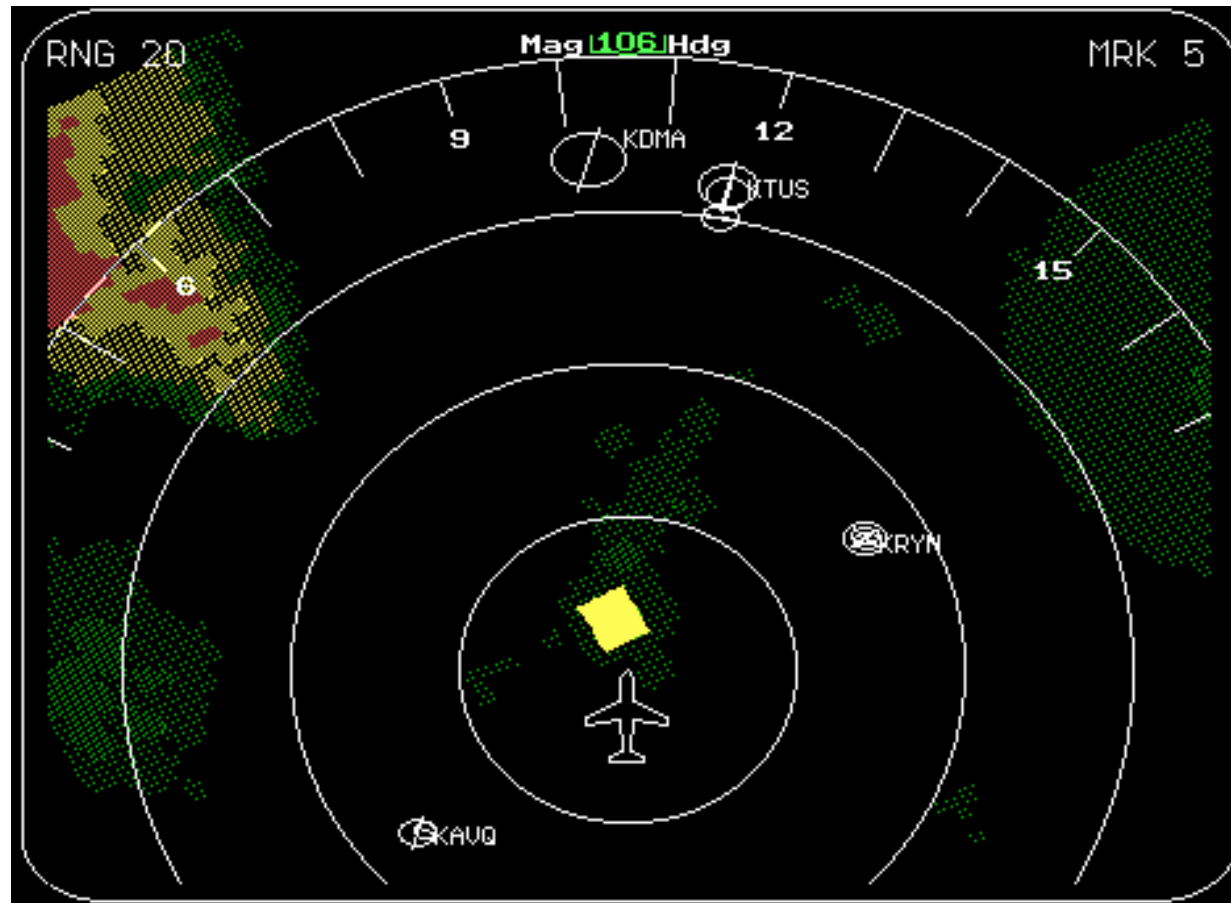
Controlled Flight Toward Terrain (Event 2)



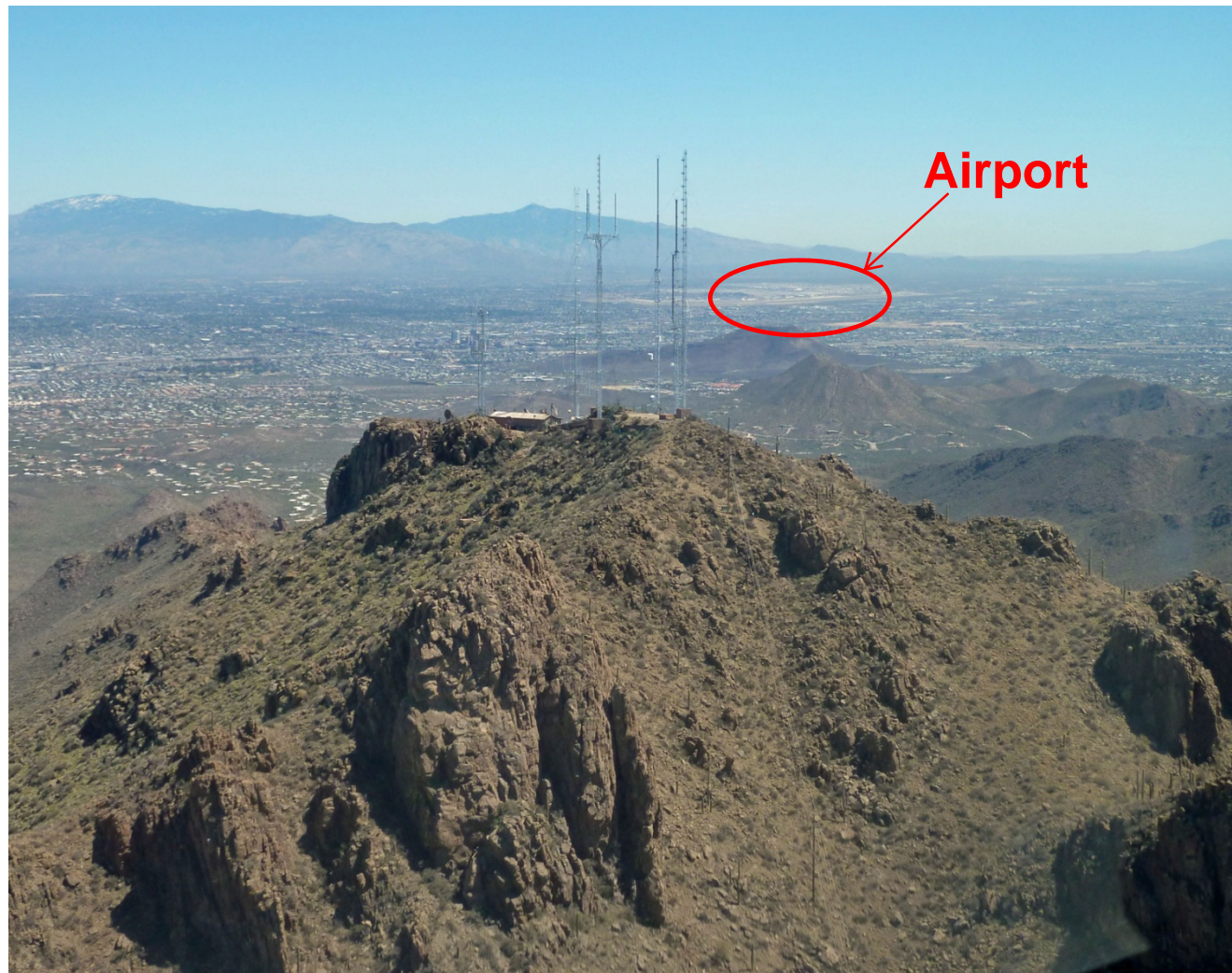
Controlled Flight Toward Terrain (Event 2)



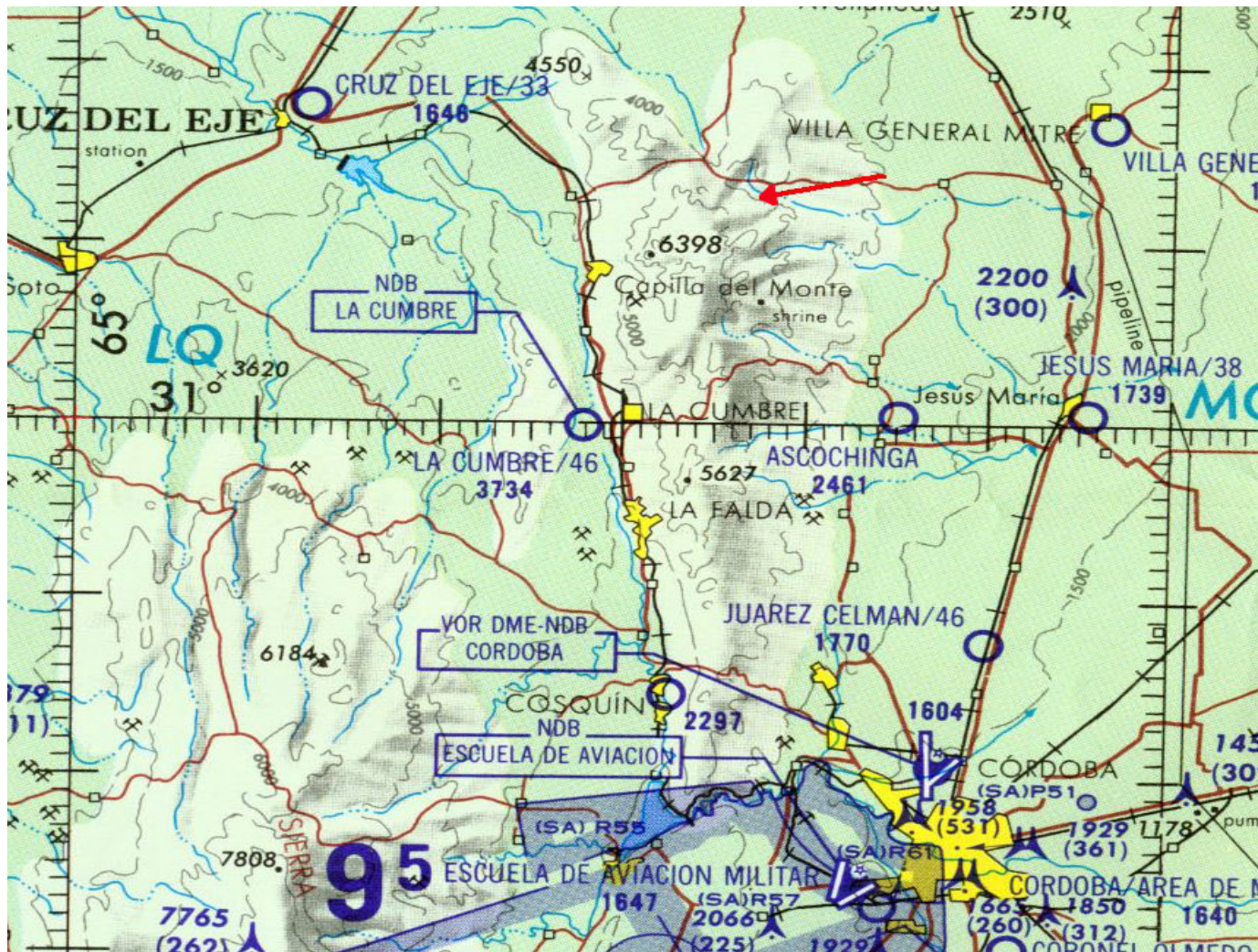
Controlled Flight Toward Terrain (Event 2)



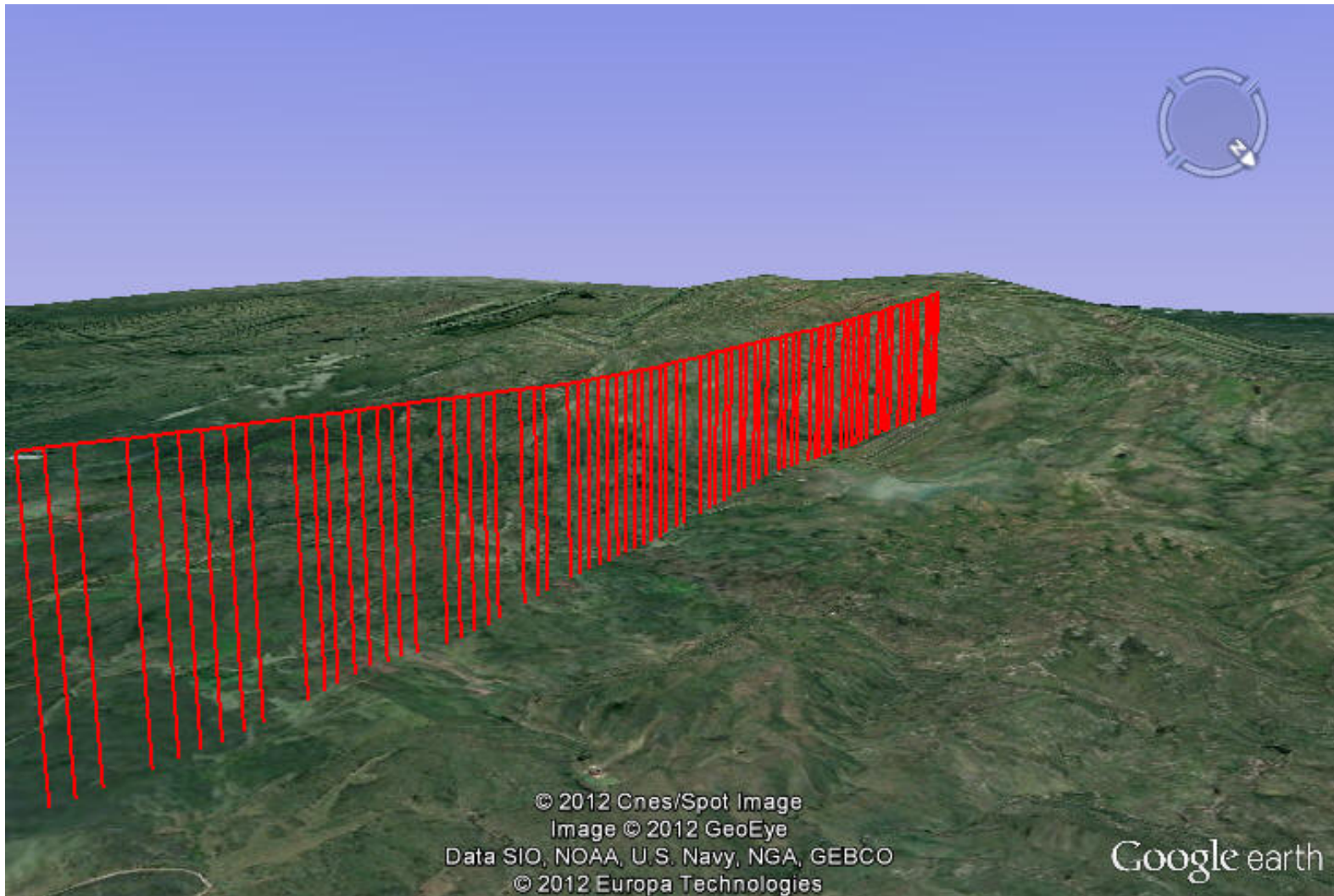
Controlled Flight Toward Terrain (Event 2)



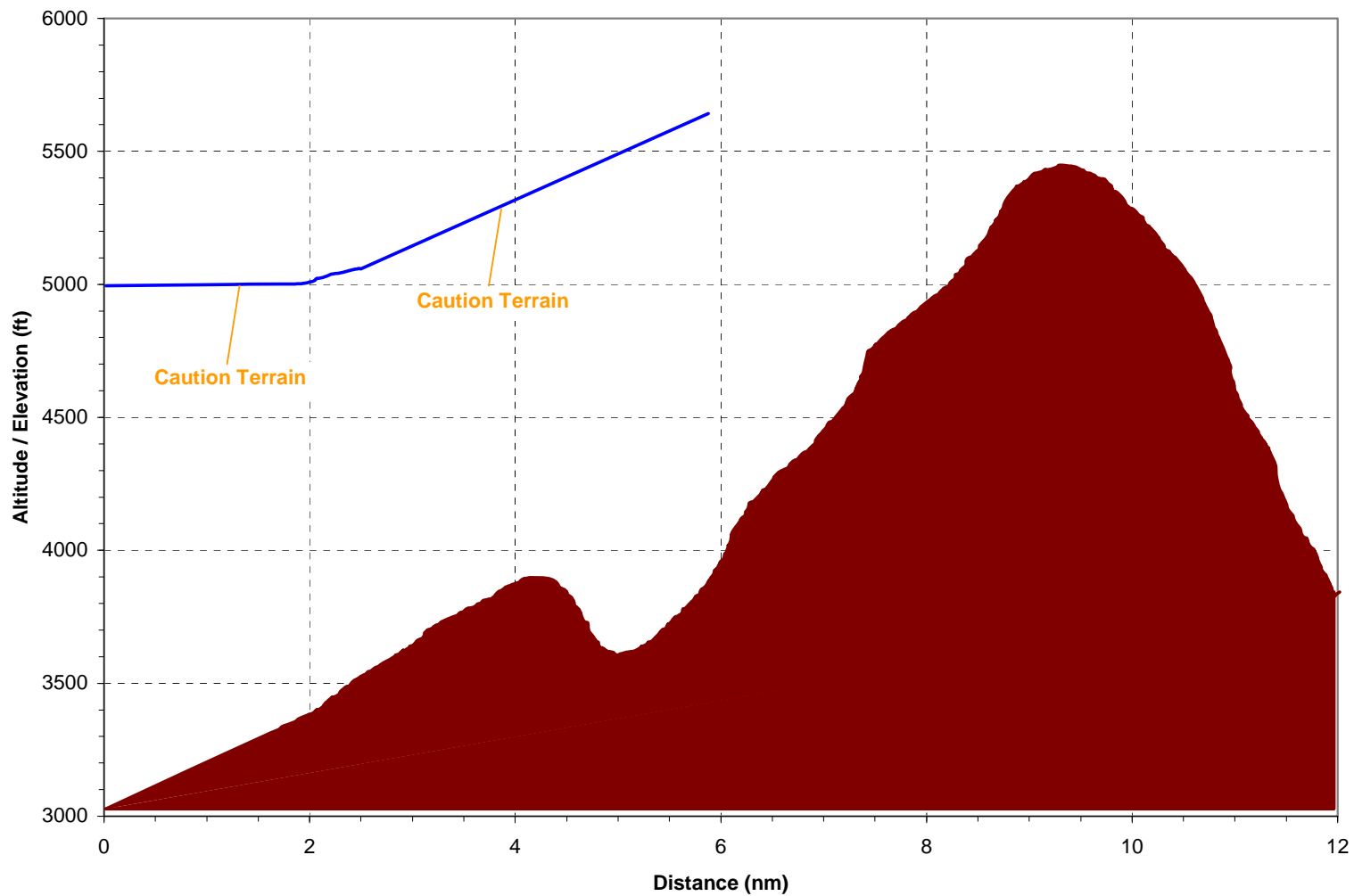
Controlled Flight Toward Terrain (Event 3)



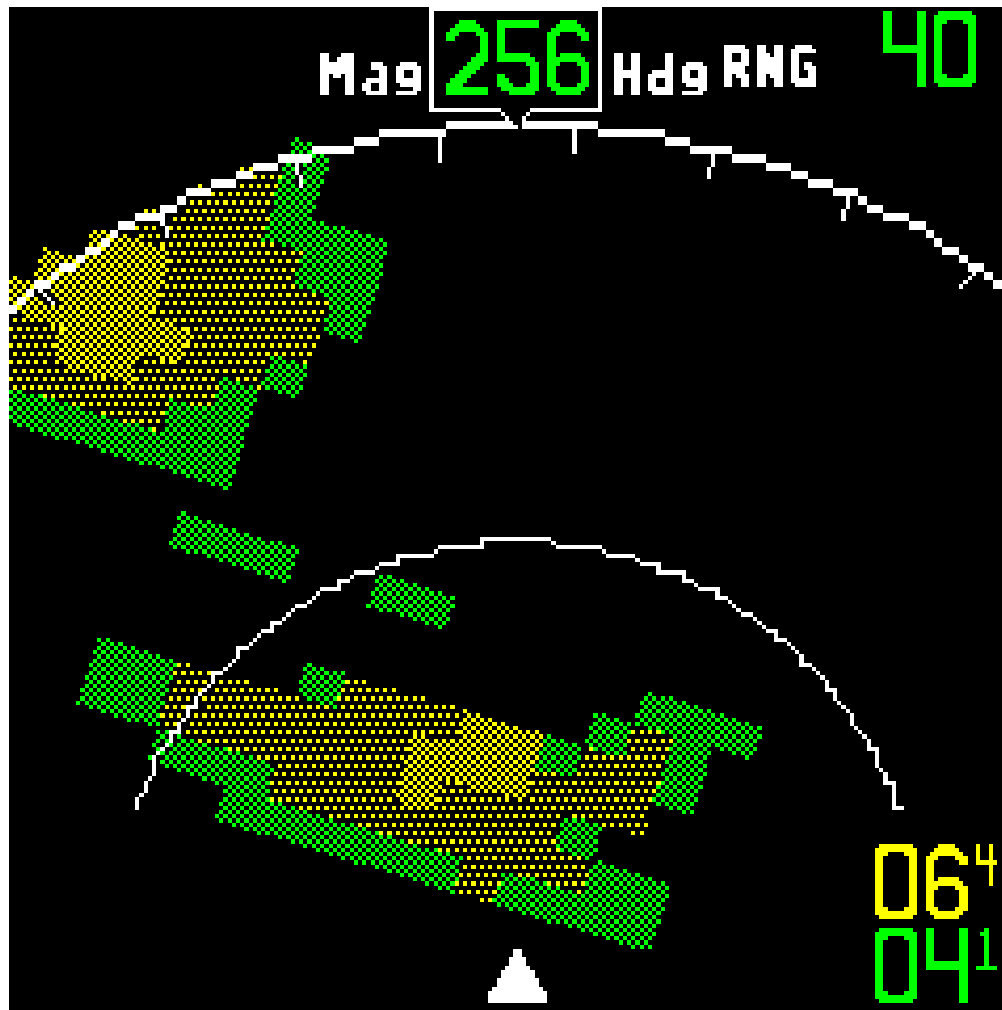
Controlled Flight Toward Terrain (Event 3)



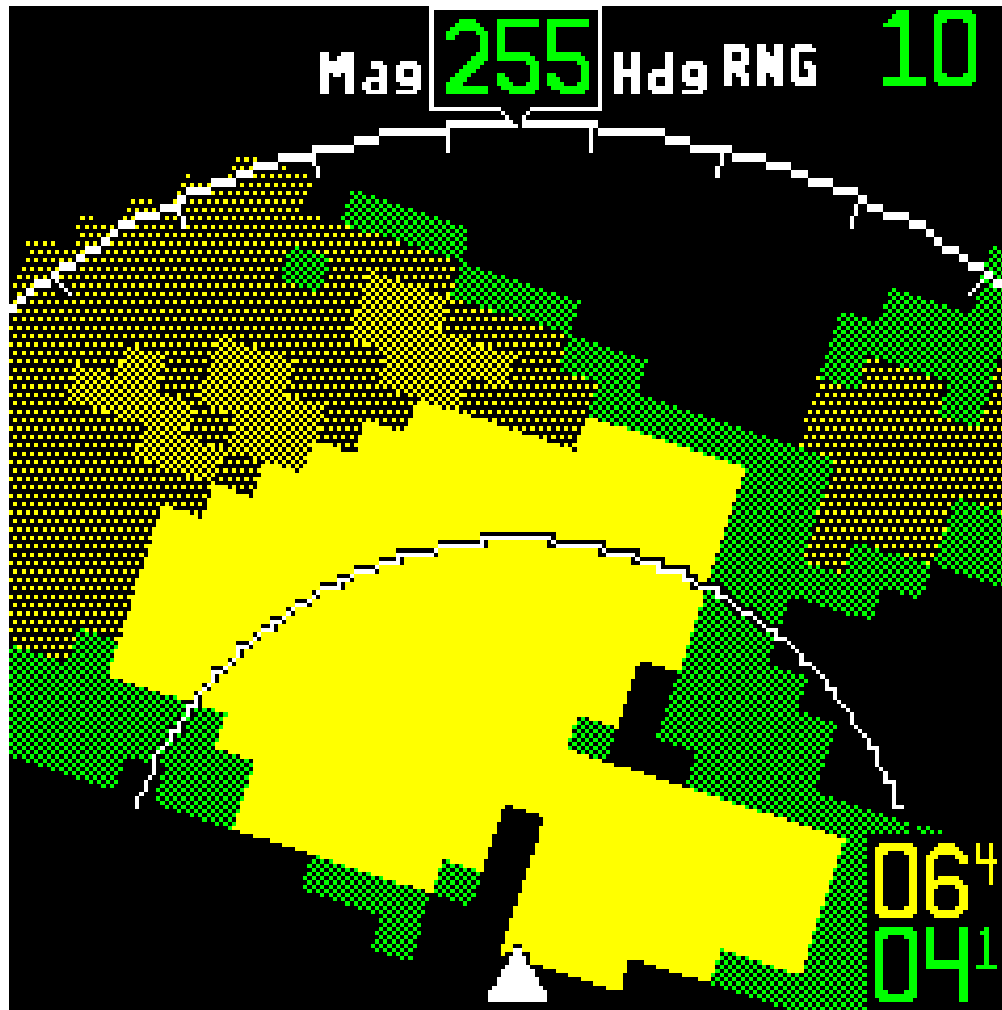
Controlled Flight Toward Terrain (Event 3)



Controlled Flight Toward Terrain (Event 3)



Controlled Flight Toward Terrain (Event 3)



Recommendations

- ***Training***

- Use the events in this presentation to illustrate to the pilot that many CFIT 'Traps' exist out in the real world of flying.
- Use some of these events to help illustrate to the pilot, the usefulness of EGPWS, but also its limitations.

- ***Operational Procedures***

- As a SOP, one cockpit display should display terrain during all phase of flight, and the other on weather, if significant convective weather exists.

Recommendations

- ***Keeping EGPWS Current***

- **By procedural practice and process, update the EGPWS Terrain/Obstacle/Runway database and software to the latest available**
 - ◆ Database is released typically 4 times a year
- **If your operating runway is not in the EGPWS database, notify Honeywell with details in order to add the runway in the next database release.**

- ***Aircraft Position Source***

- ***GPS should be used for the position source to EGPWS***

Questions ?