ADVANCED TECHNOLOGY:

Tricks and Traps

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What makes an aircraft "advanced?"

In the panel:

- **IFR-certified GPS w/ moving map**
- **Autopilot**
- **In-flight weather data (NEXRAD, METARs, TAFs, CWAs, satellite)**

Other options:

- **Airframe parachute**
- **Envelope protection**

Another characteristic is redundancy of critical systems.

In this example, a small stand-by dog backs up the primary dog in case of emergency.

Increased situation awareness, highly capable autopilots, GPS navigation, in-cockpit weather …

Have all these advances made flying safer?

So far, it’s almost impossible to tell!

Why? Consider:

Fatal and non-fatal accident rates have remained unchanged for the past 10 years.

In that time, factory-built TAAs have increased from zero to about 10% of the piston fleet.

If the TAA accident rate was 20% lower, the overall accident rate would drop just 2%

- Hard to detect!

Other impediments:

- No estimates of flight time by make and model, never mind avionics configuration – can’t compare accident rates
- Sweeping differences in composition of fleets:
  - Almost all Cirrus, Columbia/Corvalis built w/ glass
  - Almost all Skyhawks, Archers built w/ analog
  - Almost everything built w/ glass since 2005
- Characteristic differences in ownership, patterns of use make accidents-per-aircraft comparisons problematic.

Still *more* impediments:

- No way to track aftermarket or experimental aircraft glass-panel installations
- Popularity of portable electronics has brought MFD capabilities into all-analog cockpits
  - Dedicated portable GPS with weather datalink
  - Cell phones/PDAs with moving maps, datalink
  - Tablet computers providing GPS moving maps, georeferenced approach plates, weather, traffic, flight planning, entertainment, espresso makers …
- Rapid change over the past five years makes a "clean" TAA-vs.-traditional comparison nearly impossible

Increased safety?
Or greater utility?

Maybe the real effect has been to extend existing safety margins to a wider range of flights

- **Are drivers with antilock brakes more inclined to tailgate?**

Again, we *just don't have the data* to know whether more IFR/MVFR/night flights are being completed safely in TAAs

WHAT WE DO KNOW:

New capabilities =
New opportunities

… for MISCHIEF!

Why?

This is where two fundamental principles intersect:

1) Clarke's Rule:

Any sufficiently advanced technology is indistinguishable from MAGIC.

– Dr. Arthur C. Clarke

2) Murphy's Law:

Anything that can go wrong WILL go wrong, and it will do so at the worst possible time.

– Prof. F. W. Murphy

The Consequences:

If you don't know how it works, it's hard to know what it's trying to do. Well, watch out! What it's doing is watching for the chance to bite you.

Trap No. 1: “Do what I mean!”

Moral: If you’re going to let the autopilot do your flying, you’d better know how to speak its language.

Accident No. CEN09FA267
April 28, 2009: Mayfield Village, Ohio
Two fatalities

Aircraft: 2007 Cirrus SR22 w/Avidyne Entegra
Pilot: Private (ASEL, AMEL, IFR), 1,350 hours
Weather: 01008KT 4SM BR –RA OVC002
07/06 A3038

CEN09FA267 (continued)

Took off from Cuyahoga County (KCGF) at 16:12 local time on IFR clearance to Buffalo

Instructed by tower to fly runway heading, maintain 3,000, and contact departure

Never completed hand-off

Crashed 4½ minutes after takeoff in a wooded area 3 miles east of the airport

Flight track data was downloaded from panel

CEN09FA267: Chronology

16:11:55 Lifted off from Runway 06

16:12:00 Autopilot engaged at 61 feet agl

16:12:28 Began right turn at 397 agl

Turn continued for 1:20. Altitude varied between 397 and 941 agl

16:13:48 Rolled out heading 210 degrees, banked 70 degrees right, 172 knots

16:13:50 Rolled wings level at 322 agl. Pitch attitude begins changing from -9 to +54 degrees, airspeed 65 knots

CEN09FA267: Chronology (cont.)

16:14:09	Airspeed 50 knots at 1,821 agl Pitch drops from +50 to -60 degrees Heading changes from 200 to 045 Autopilot is disconnected
16:14:17	Descent ends at 1,221 agl Begins climb; A/S drops from 150 kt
16:14:34	A/S 60 knots, banked 76 degrees left Pitch drops from +19 to -44 degrees Heading changes from 070 to 300
16:14:55	A/S 115 knots, pitch attitude +12 Rolls 75º right and reverses course Autopilot heading mode re-engaged

CEN09FA267: The end

16:15:20	Airspeed 75 knots at 2,071 agl Pitch attitude +50 degrees Rolls from left bank to right bank Autopilot heading mode disengaged
16:15:30	Altitude reaches 2,321 agl Airspeed drops to 50 knots Pitch attitude -55, bank 75 degrees left
16:15:44	Final data point 0.2 miles from site Pitch attitude -30 degrees Bank 120 degrees right

CEN09FA267: What went wrong?

Pilot bought Cirrus 6 months before.
Had 400 hours instrument time in Mooneys, Beech Duke, and Cessna 172s.
Prior to 15-hour VFR factory transition course, had flown only 20 hours in previous year (4 IFR)

Autopilot initially bugged for 850 fpm climb to 3,000 msl – but engaged in “altitude hold” instead of “altitude preselect” mode at 61 agl (which reset vertical speed bug to 0)

Multiple attempts to reset altitude and VS bugs in first 2:10 as aircraft went further out of control

POP QUIZ!

If the autopilot starts trying to put the aircraft somewhere you don't want it, what are the *FIRST TWO THINGS* you do?

Also: 3 hours earlier, the pilot had missed 3 ILS approaches into KCGF because he couldn't capture the glideslope (landed on the 4th try)

Extra Credit:

If fumbling with the panel caused you to miss 3 straight approaches, would you consider it a good idea to fly *any more hard IFR* that day?

Trap No. 2: Juicy but not fresh

Moral: Storms don't sit still, and datalink radar only shows you where they were.

Accident No. ERA12FA376
May 31, 2012: Macon, Mississippi
One fatality

Aircraft: 2001 Hawker Beechcraft A36
Pilot: Private (ASEL, IFR), 342 hours, 32 IMC
Weather: 24007G22KT 4SM +TSRA
SCT011 BKN026 BKN040
20/18 A2979 LTG DSNT ALQS

ERA12FA376 (continued)

Took off from St. Petersburg-Clearwater, Florida (KPIE) at 14:15 local time on IFR clearance to Norman, Oklahoma (KOUN)

No record of briefing, but law partner said pilot routinely used ForeFlight on iPad

At 16:25, level at FL 200 under control of Memphis Center

Controller advised of extreme precipitation extending north/south at 12 o’clock, 85 miles

ERA12FA376 (continued)

Pilot: “Roger, I’m looking at that trying to see if there is any way I can get through it … and I’m starting to think there is.”

Controller advised of “a break in the extreme portion of the precip” with moderate to heavy still in the area at heading 330, 115 miles

Pilot requested, received deviation towards gap

At 16:33, controller asked whether flight had weather radar. Pilot: “NEXRAD composite.” (Plus Strikefinder, Honeywell KMD-550 MFD)

ERA12FA376 (continued)

Four convective SIGMETs in effect covering parts of eight states

Between 16:36 and 16:47, pilot requested a series of descents “to keep out of the ice,” eventually levelling at 12,000

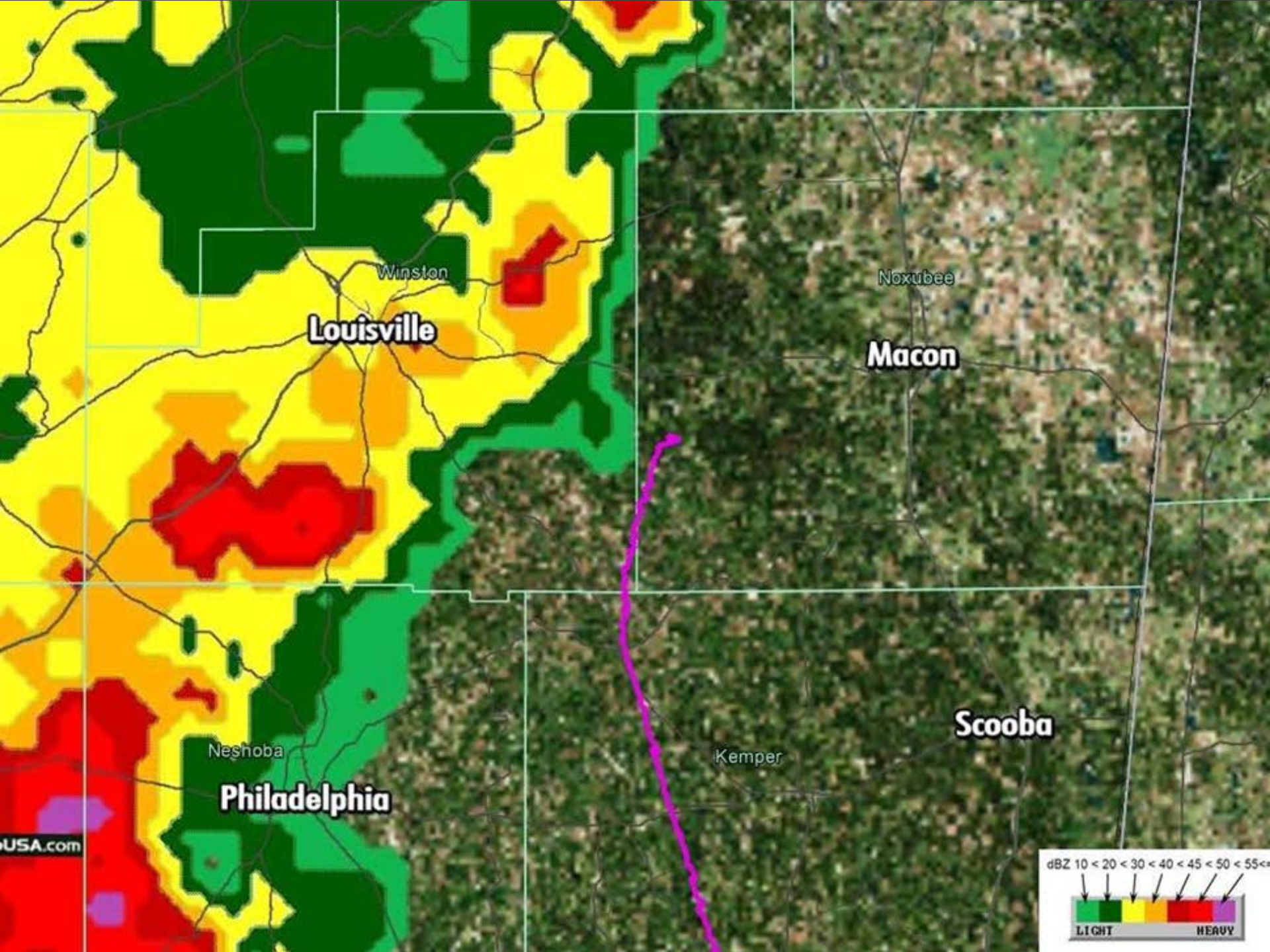
Pilot reported turning “a little more to the right” at 16:53 “because that cell’s filled in,” but saw another “about 10 miles north.” Current conditions were +40º F, “no ice or precip.”

ERA12FA376 (continued)

At 16:56:27, the Bonanza disappeared from ATC radar. The controller tried to contact the pilot again but got no response.

Wreckage was found scattered along a debris path a mile and a quarter long, indicating an in-flight break-up.

The most recent NEXRAD image available in the cockpit would have appeared to be 1-2 minutes old and showed the airplane clear of precipitation:


Winston
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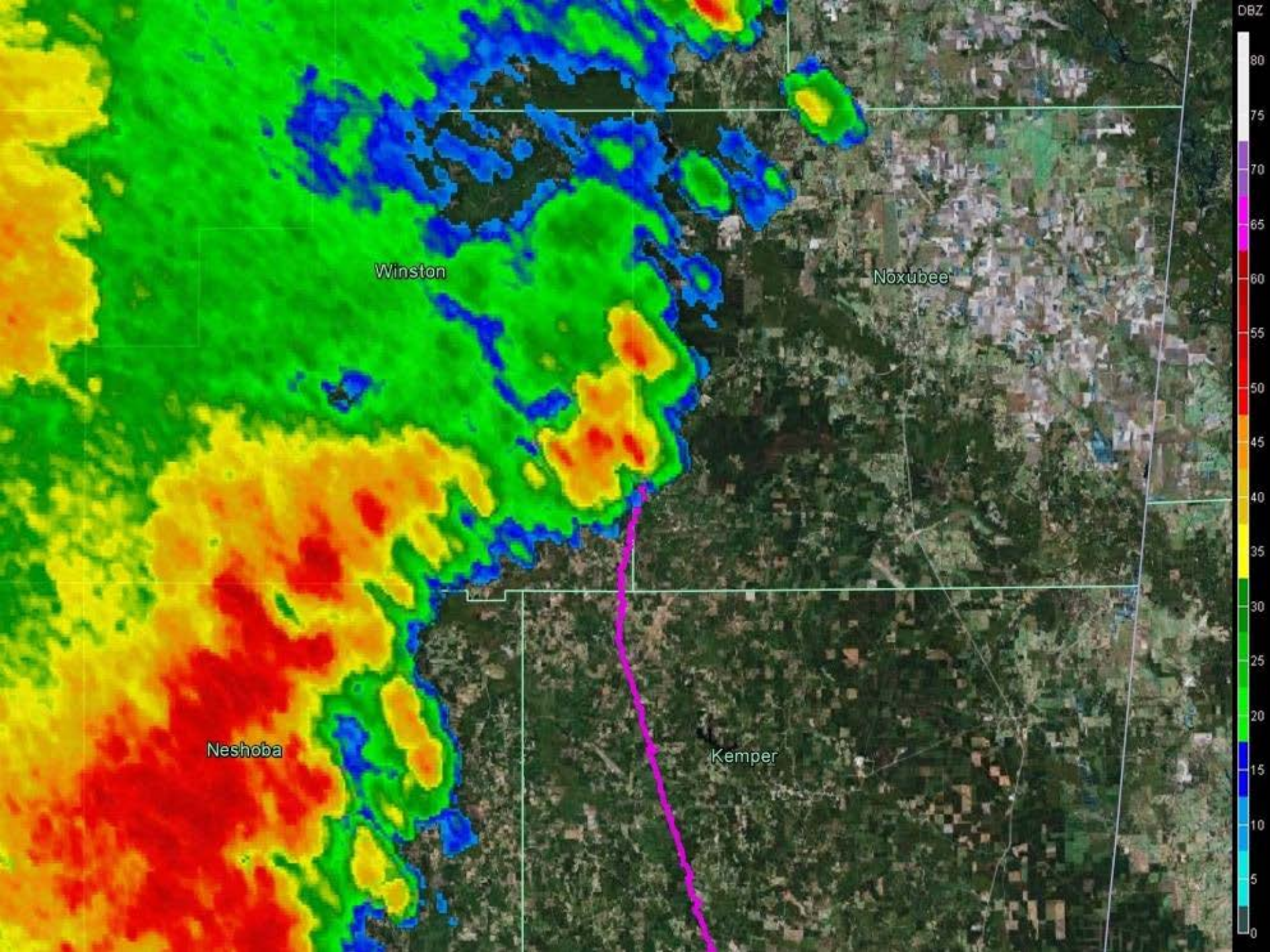
dBZ 10 < 20 < 30 < 40 < 45 < 50 < 55<
LIGHT
HEAVY

ERA12FA376 (continued)

… when in fact the raw images had been obtained at least 6-7 minutes earlier.

Real-time ground-based radar showed that the Bonanza had penetrated an area of Level 5 precipitation.

Radar downloads help identify large areas you want to stay at least 20 miles away from – allowing for the fact that they're moving and that severe turbulence may propagate ahead


Winston
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Trap No. 3:
Watch where you're going!

Moral: You won't see it when you're not looking.

Accident No. ERA12FA030
October 16, 2011: Danbury, Connecticut
One fatality

Aircraft: 2008 Cirrus SR22
Pilot: Private (ASEL, AMEL, IFR), 2,300 hours
Weather: 20008KT 10SM SCT090 OVC110
16/05 A2975

ERA12FA030 (continued)

Departed from Easton, Maryland (KESN) at 18:45 local time on IFR clearance to Danbury, Connecticut (KDXR)

Reported field in sight at 20:04 and was told to change to tower frequency

Tower cleared pilot to land on Runway 26

No communications after readback of landing clearance

ERA12FA030 (continued)

Threshold of Runway 26 is displaced 734 feet due to 300-foot hill ¾ mile out on final

Top of the hill is marked by a 100-foot hazard beacon tower with flashing red lights

The Cirrus flew directly into the tower

The airport manager and an off-airport witness reported the lights were working

Accident occurred 2 hours after sunset, 90 minutes after end of civil evening twilight

ERA12FA030: So what happened?

Pertinent facts:

- **No evidence pilot had previously flown into KDXR**
- **Airplane was equipped with TAWS-B and synthetic vision; both were engaged**
- **Both relied on same database – which only showed towers over *200* feet high**
- **Synthetic vision *did* show the hill**

Inquiring minds want to know:
Where was the pilot looking?

Clearly, not out the windshield!

Was he trying to fly the approach and land using only the synthetic vision?

Whatever the reason, he was heads-down when he needed to be heads-up

Synthetic vision, moving maps, WX display are all potential distractions

Okay, how about some *good* news?

Well, if you insist…

By their own account, the founders of Cirrus Design set out to build the world's safest light airplane.

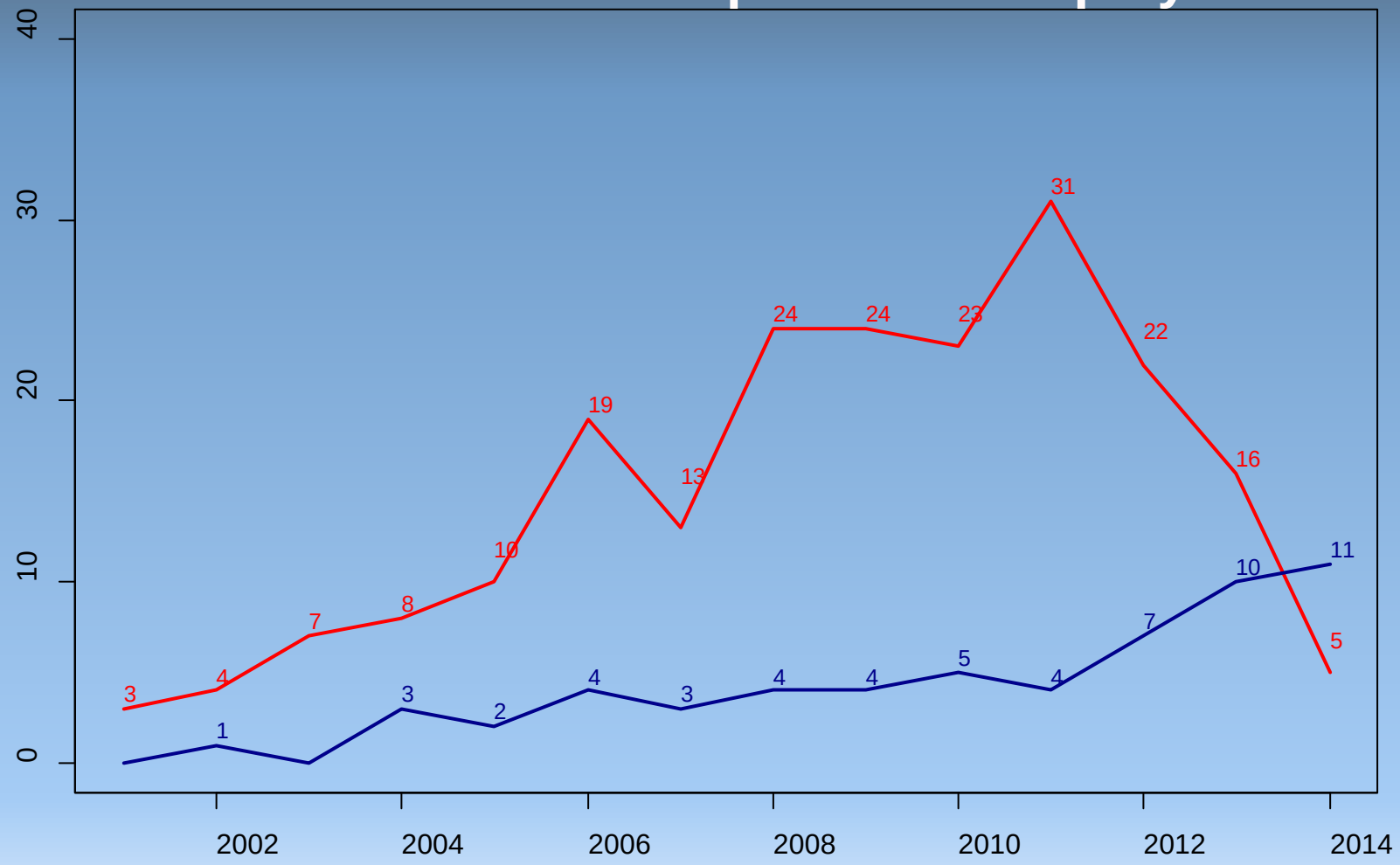
By that measure, the company's early history was disappointing.

Some good news:
That's begun to turn around.

At this year's annual meeting, the Cirrus Owners and Pilots Association reported that worldwide, fatalities in Cirrus accidents have dropped from 31 in 2011 to just 5 so far this year …

… while attempted CAPS parachute deployments have tripled during the same period.

Cirrus fatalities vs. parachute deployments wo



Data courtesy of COPA

U.S. Cirrus accidents have decreased from 23 in 2011 to 14 so far this year.

The total number of fatal accidents plus parachute deployments has dropped from 14 to 9.

Industry sources point to increased emphasis on stick-and-rudder skills in transition training and energetic club/ factory support for recurrent training

So … Have all these innovations made us safer?

Or enabled us to complete more flights?

If not quite yet, the potential's there.

Realizing it requires awareness of technology's limitations – including its vulnerability to misuse

The best equipment still can't make up for the worst decisions.

RESOURCES:

On-line courses:

IFR Insights: Cockpit Weather

GPS for IFR Operations

IFR Chart Challenge: RNAV Approach

ADS-B for General Aviation: The Basics

Pilot Safety Announcement:

iPanel

RESOURCES (continued):

Safety Advisor:

GPS from the Ground Up

Accident Case Studies

Time Lapse

Delayed Reaction

Safety Video

Datalink Weather: From Concept to Cockpit