

TrendBox200™

Structural Trend Monitor /
Flight Tracking System

OPERATING MANUAL



REVISION LOG

Rev	Date	DESCRIPTION
-	01 MAR 2010	Initial Release
A	09 April 2010	Updated Operating Temperature

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1. Introduction

Congratulations on your purchase of the TrendBox200™, the premier general aviation aircraft usage, flight tracking, and airframe trend monitor. Combined with flightframe.net™, you have the most powerful and useful pieces of equipment for tracking your flights, viewing past excursions, logging your maintenance and hours, all while monitoring your overall airframe usage. In addition, you now have the ability to share your flight experiences and statistics with an on-line community, upload photographs and videos of flights, and view replays of your flights using Google™ Earth via the integrated GPS.

The TrendBox200™ is intended for use in conjunction with flightframe.net™. The TrendBox200™ is the data recording device, which records the data used by flightframe.net™ for structural trend monitoring and flight tracking. The TrendBox200™ measures GPS data, accelerations in three axes, rotation rate in the pitch and roll axes, and records it onto a removable SD card for easy portability between the aircraft and a personal computer (PC), for upload to flightframe.net™.

1.1 Enclosed Equipment

TrendBox200™
Active GPS antenna
2 GB SD card
Power cable

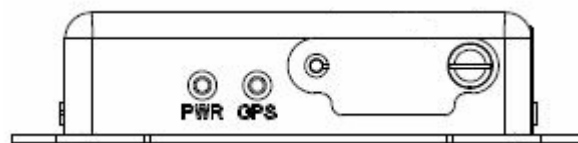


Figure 1 – TrendBox200™ front

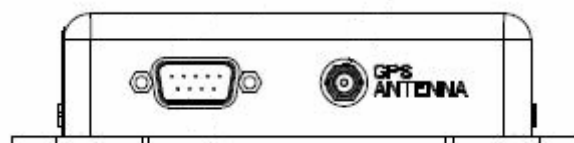


Figure 2 – TrendBox200™ back

2. TrendBox200™ Location

The TrendBox200™ is intended to be positioned in an accessible, but out of the way location to avoid inadvertent movement of the unit while data is being recorded. Since one of the purposes of the TrendBox200™ is to record aircraft accelerations, an inaccurate assessment of the structural response of the airframe may occur if the TrendBox200™ is moved or jolted during flight. The TrendBox200™ must be accessible to maintain access to the SD card slot.

2.1 TrendBox200™ Installation Guidelines

Following the guidelines on the TrendBox200™ external labels, the unit is to be positioned with the SD card slot facing toward the nose of the aircraft with the gold tabs down toward the floor. The most accurate data will be collected if the TrendBox200™ is oriented within the tolerances shown on the labels. Both the top and side labels specify that the TrendBox200™ shall be positioned within ± 5 degrees of the aircraft centerline. It is preferable to position the TrendBox200™ approximately within the CG (center-of-gravity) range of the aircraft.



If the TrendBox200™ is not positioned within the tolerances shown on the labels, degradation in performance will occur. Please contact Epps Aviation at (770) 458-9851 for assistance if unit must be positioned outside of these tolerances.



The TrendBox200™ should be placed on a relatively rigid structure to avoid undesired vibrations from being transmitted to the unit. Avoid locations that may shift during flight such as tray tables or other components not rigidly attached to the airframe. The TrendBox200™ should not be placed on soft components such as seats or other cushions.

Preferred locations include the floor, underneath a seat, or a shelf that is rigidly mounted on at least two sides (preferably three). Alternately, the TrendBox200™ may be placed on a rack or panel, as long as the rack or panel is rigidly connected to the airframe. Strips of Velcro adhered to the bottom of the TrendBox200™ as well as the structure may be used to prevent movement in flight.



It is possible to position the TrendBox200™ with the SD card slot facing the tail of the aircraft. If it is desired to position the unit with the SD card slot facing the tail of the aircraft, please contact Epps Aviation for assistance.



Ensure that the TrendBox200™ is positioned to avoid it becoming detached and posing a hazard during flight. Ensure that the TrendBox200™ is not positioned in such a way as to impede the egress from the aircraft in an emergency.

2.2 Power Supply

The TrendBox200™ accepts 11-33 VDC and draws up to 200mA at 28 VDC. A DB-9 connector provides the power supply interface to the unit through pins 1 (power) and 3 (ground). Figure 3 shows the pin-out of the DB-9 connector, J1, at the rear of the unit.

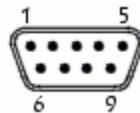


Figure 3 – TrendBox200™ connector J1

A power supply cable which interfaces to the aircraft through an aircraft accessory plug is enclosed with the TrendBox200™. A replacement power cable may be purchased from **Shadin Avionics**.

Since TrendBox200™ operation requires a constant power source, obtaining power from a circuit that is subject to outages during flight is not desirable. Incomplete data may be collected as a result.

2.3 GPS Antenna

The TrendBox200™ uses an on-board GPS engine to collect aircraft position and altitude data, as well as time and date information; therefore it is necessary to place the GPS antenna with a clear view of the sky. The GPS antenna is designed to be placed in the interior of the aircraft, and should not be mounted externally.



It is not recommended to use the TrendBox200™ without the GPS antenna connected on multiple flights as SD card file corruption may occur.



Place the GPS antenna to ensure that it does not pose a threat of becoming detached during flight. Ensure that the GPS antenna cable is routed to not impede egress from the aircraft.

Under normal circumstances, the GPS signal is acquired within one minute of power application to the TrendBox200™. The signal may take longer to acquire if the aircraft is moving during the acquisition period.

3. System Operation

Upon power application to the TrendBox200™, a data file begins to be recorded. This data file will continue to be recorded until power is removed from the unit or the SD card is full, at which point no more data will be collected until files are deleted from the card. Data files record at the rate of approximately 3MB per hour. Multiple data files may be recorded onto the SD card within the limits of available space. With the supplied 2GB SD card, over 650 hours of data and up to 512 data files may be collected on a single SD card. Additional and replacement SD cards may be purchased from Shadin Avionics.



The SD card that is supplied with the TrendBox200™ has been tested for compatibility. A user supplied SD card may be used, but system functionality may be impaired.

Under normal operation the “PWR” LED on the front of the TrendBox200™ will flash at two second intervals, indicating that data is being collected.



If the “PWR” LED rapidly flashes, an SD card error has occurred. Please see the Troubleshooting section below.



Do not remove the SD card when the TrendBox200™ is collecting data as SD card corruption may occur.

The “GPS” LED indicates when the on-board GPS engine has acquired a satellite lock. The TrendBox200™ will record the aircraft position and altitude (WGS84 geodetic ellipsoid).

After a flight and the TrendBox200™ has been powered down, the SD card may be removed from the unit (push in to remove) and connected to a PC using an SD card reader (not included). Data files may be transferred to a folder on the PC for upload to flightframe.net™ at a later time, or may be uploaded directly to flightframe.net™. The instructions for uploading files are contained within the online help guide at flightframe.net™. The file names on the SD card contain critical information for flightframe.net™. These file names should not be modified.

After data is uploaded to the PC or flightframe.net™, it is recommended that all of the files be deleted from the SD card. It is recommended that the SD card is used solely for the purposes of TrendBox200™ data collection.

4. Troubleshooting

1. “PWR” LED fails to illuminate

- Power cord disconnected
 - Check and tighten power connection at rear of unit
 - Check and tighten aircraft power connection
- Aircraft power supply circuit open
 - Check circuit breaker / fuse
 - Check voltage at aircraft supply connection

2. “PWR” LED remains steady (on or off) for a prolonged period or flashes rapidly

- SD card incompatible with unit
 - SD card must be formatted with the FAT16 (MS-DOS FAT) file system
 - SD card must be 2GB or smaller (no SDHC cards)
- SD card not installed in unit
 - Install SD card
- SD card not fully engaged in unit
 - Firmly press on SD card to engage until “click” is heard
- Cycle power to the unit
 - Remove power, wait 5 seconds, then re-apply power to the unit

3. No flight position or altitude displayed at flightframe.net™

- GPS antenna not connected
 - Connect or tighten GPS connection at unit
- No GPS reception
 - Reposition antenna to an alternate location within the aircraft
- GPS never acquires signal
 - Wait until “GPS” LED illuminates before moving aircraft

- Faulty GPS antenna
 - Replace with new antenna. Replacement antenna may be purchased from Shadin Avionics

4. Poor GPS track

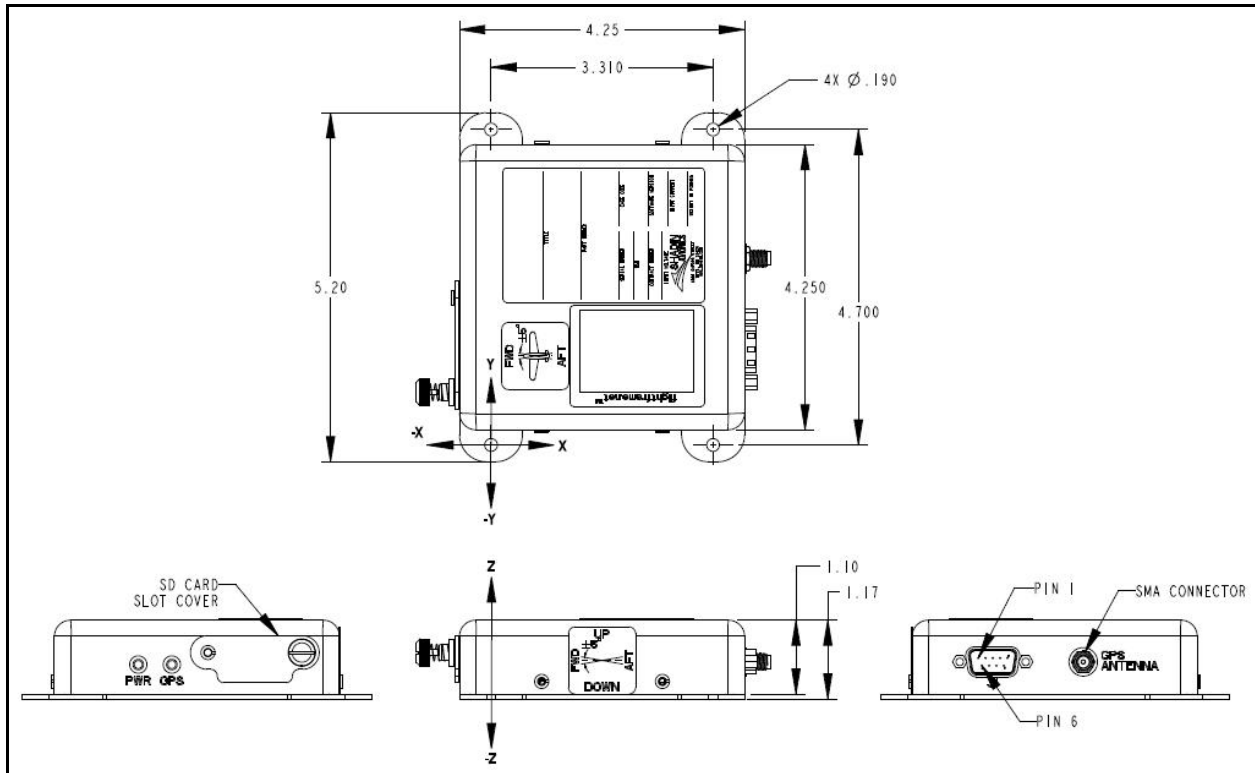
- GPS antenna does not have a clear view of the sky
 - Reposition antenna to an alternate location within the aircraft
- Aircraft was flown with high-G maneuvers
 - Reduce the G-level of maneuvers

5. No data collected

- SD card incompatible with unit
 - See item number 2 in Troubleshooting section
- Power momentarily applied to unit
 - Power must be applied to the unit for approximately 1 ½ minutes for a file to appear on the SD card
- Power cord disconnected
 - Check and tighten power connection at rear of unit and at aircraft supply connection
- Aircraft power supply circuit open
 - Check circuit breaker / fuse
 - Check voltage at aircraft supply connection

If the problem is not solved with any of the previous solutions, please contact Shadin Avionics Technical Support at (800) 388-2849 or at service@shadin.com.

5. Physical and Electrical Characteristics



Input voltage:	11-33 VDC
Maximum supply current @ 28 VDC:	200mA
Measured Weight:	0.6 lbs
Environmental:	
Operating Temperature:	0°C to +40°C
Storage Temperature:	-55°C to +85°C

TrendBox200™ Part Number	965310
Accessory Power Cable Part Number	443303-00

6. Warranty Information

LIMITED WARRANTY

a. Warranty Period. For all Products purchased by Buyer, the Warranty Period shall be twelve (12) months from the date of shipment to Buyer.

b. During the Warranty Period, Seller warrants that:

1) All Products will be free from defects in materials and workmanship or defects due to design

c. For any failure covered by this limited warranty, Seller shall repair or replace, at Seller's option, the defective Product. Buyer will promptly notify Seller of any failure that occurs during Warranty Period and request an RMA from Seller and provide the reason for return in writing if Buyer returns the product for repair or replacement. Failure to provide such notice will relieve Seller of its warranty obligations.

d. Repair or replacement of a defective Product is the sole and only remedy under this warranty. In case of replacing a defective original Product, Seller will warrant the replacement Product for the remaining Warranty Period of the original Product

e. During the Warranty Period, replacement Products will be shipped on a no-charge basis on condition that all defective Products must be returned immediately upon receipt of replacement Products. Failure to return the defective Products promptly will result in an invoice for the full price of the replacement Product.

f. This limited warranty is void if failure has resulted from:

i) Misuse, mishandling, accident or neglect, noncompliance with Seller Product operating environment or operation specifications, abuse and misapplication;

ii) Improper packing or handling of the Product during handling by Buyer;

iii) Unauthorized modification to the Product, attempts to install or de-install or perform unauthorized maintenance or repair by any person that is not the Seller personnel; or

iv) An act or event beyond Seller's reasonable control and without Seller's fault or negligence, including but not limited to fires, explosions, floods, earthquakes, power outage or inappropriate transportation, acts of God, war or terrorism.

g. Buyer is responsible for any damages caused by inappropriate transportation.

h. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR OF FITNESS

FOR A PARTICULAR PURPOSE. BUYER'S EXCLUSIVE REMEDY FOR BREACH OF WARRANTY IS REPAIR OR REPLACEMENT, AT SELLER'S OPTION. ANY LAWSUIT BY BUYER AGAINST SELLER, ITS OFFICERS, DIRECTORS, EMPLOYEES, OR AFFILIATES, ARISING OUT OF OR RELATING TO WARRANTY CLAIMS REGARDING THE SUBJECT PRODUCT, SHALL BE FILED WITHIN ONE YEAR FROM SHIPMENT OF THE SUBJECT PRODUCT TO BUYER BY SELLER.

i) Notwithstanding the above, Seller provides no warranties (1) on any Products or portion thereof which is based on the Buyer's design; or (2) respecting any larger system of which the Seller's Product is only a component or part; and (3) non-Seller supplied replacement or repaired parts or Products.

Structural Trend Monitor / Flight Tracking System (TrendBox200™)

Part Number: _____

Serial Number: _____

Activation Date: _____

NOTES:



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Toll Free: (800) 462-0104
Main Fax: (770) 451-5345
Web Site: www.eppsaviation.com



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Marietta, GA 30066
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Web Site: www.tda-i.com



flightframe™ *Turning Data Into Decision* 

flightframe.net TrendBox200

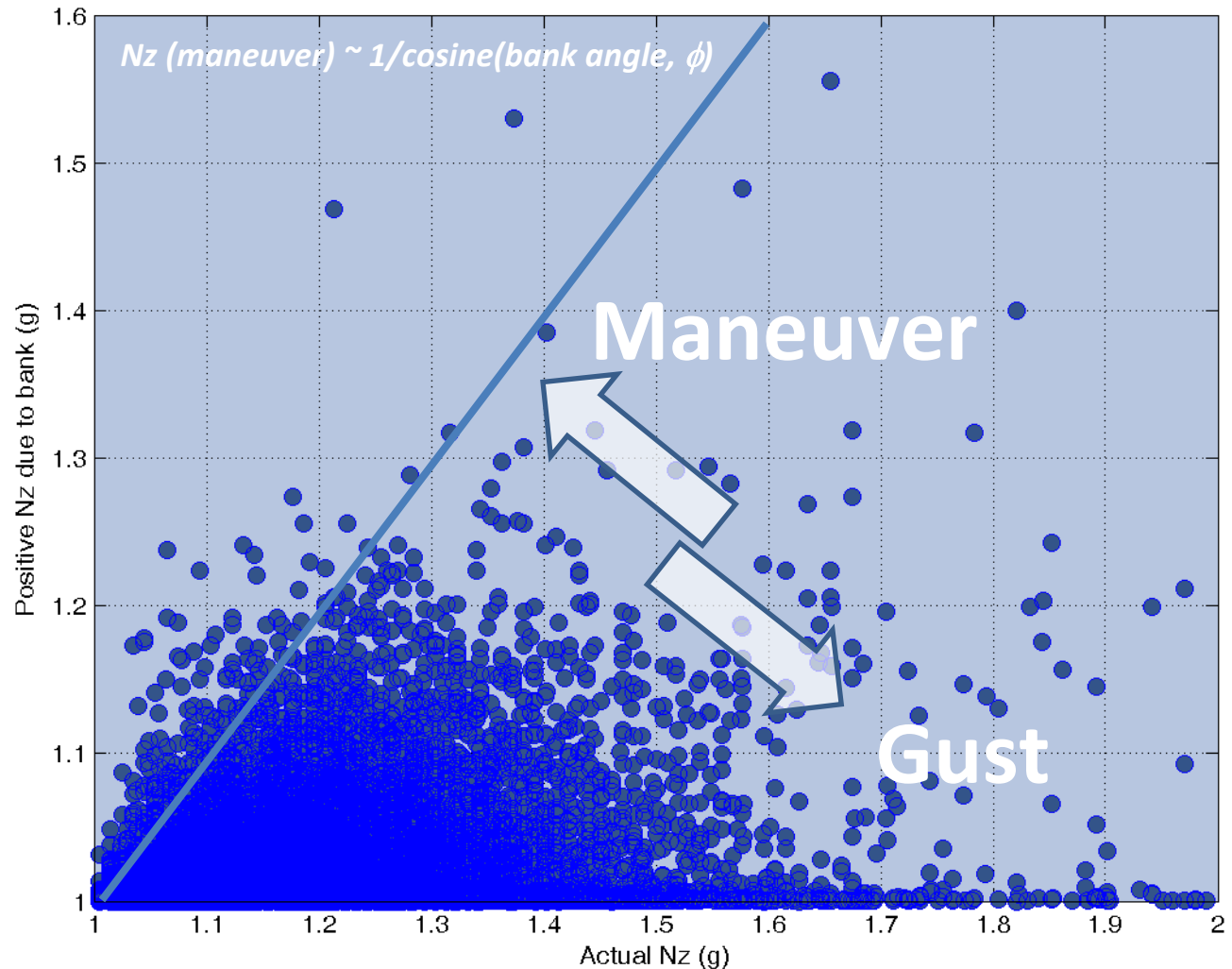
General aviation flight statistics

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- All charts discussed herein are based on actual flight data captured across 12 distinct aircraft (varying types and models)

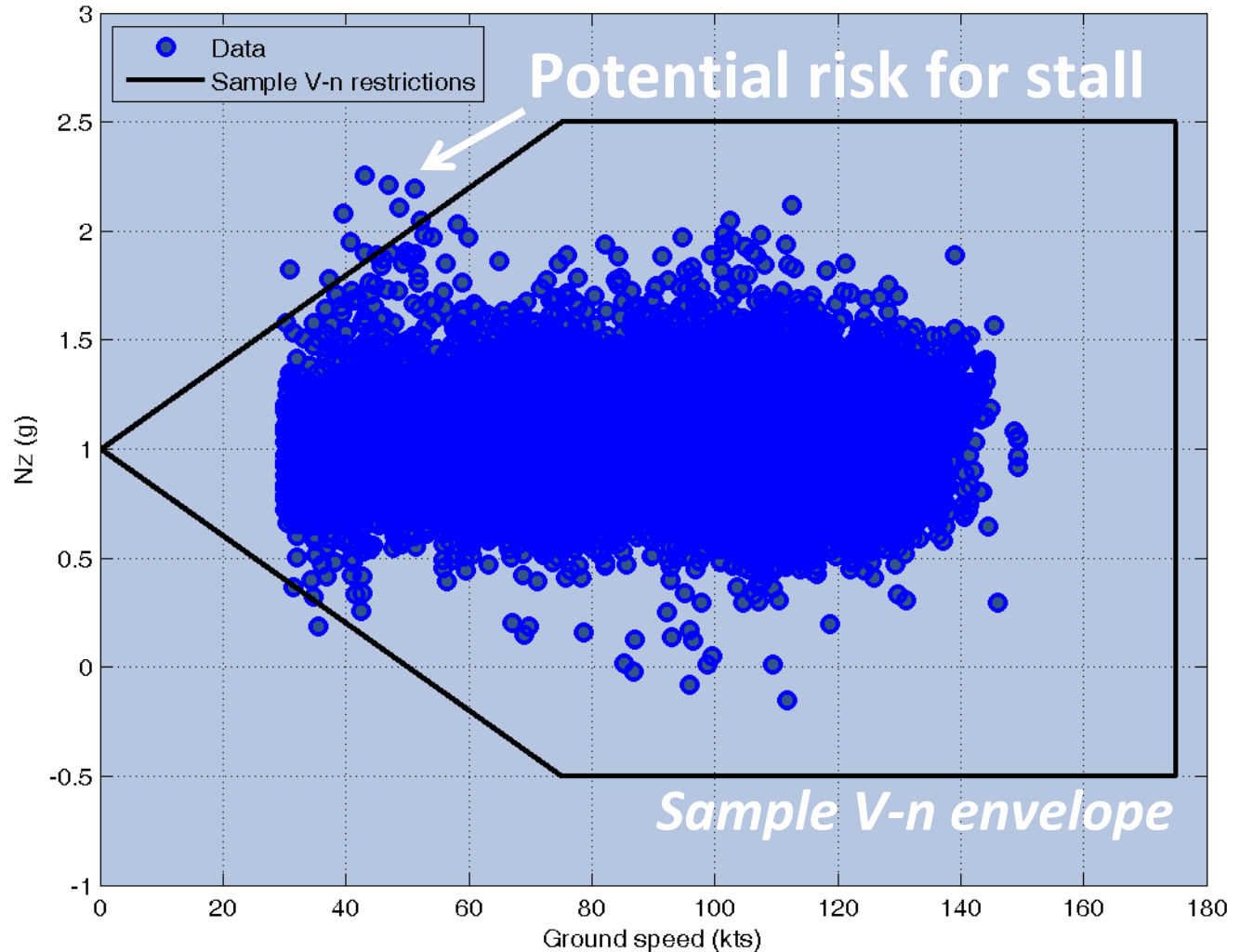
Vertical g's: gust and maneuver

- By measuring g's and computing bank, effects due to pilot-induced maneuvers and environmental gust (turbulence) can be determined
- Both are essential for damage estimates/safety, but for different reasons
 - Maneuvers are lower occurrence, higher magnitude
 - Gust is higher occurrence, lower magnitude



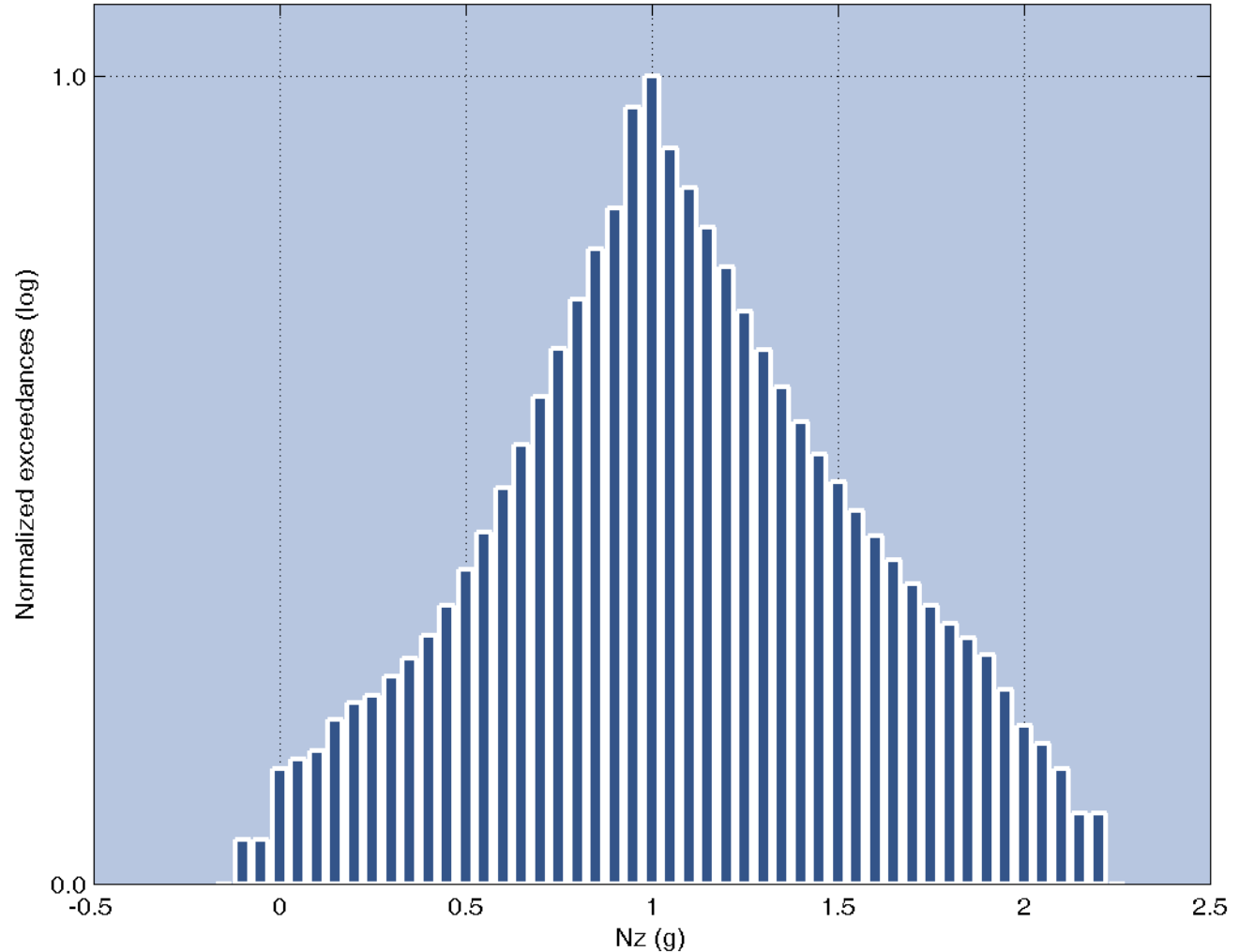
V-n diagram (speed-g's)

- A V-n diagram (speed v. g's envelope) can be computed for each flight
- This can be used to look for outliers or safety risks



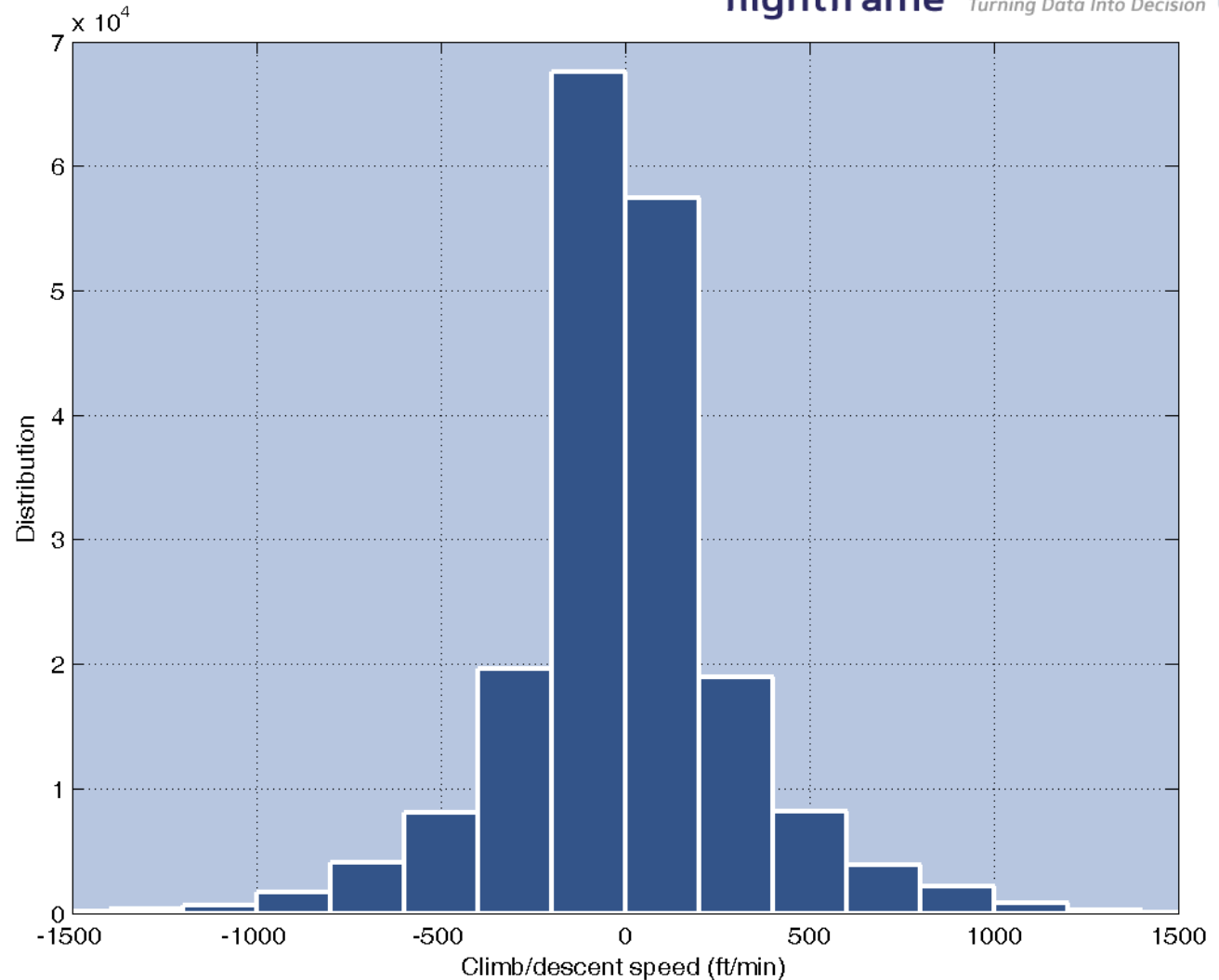
Vertical g's distribution

- Nz exceedances (g's at-or=above a given level) are an excellent metric used for airframe health monitoring
- Outliers and atypical trends can be identified
- Both high-g's as well as high occurrences of lower-g's are important and must be tracked



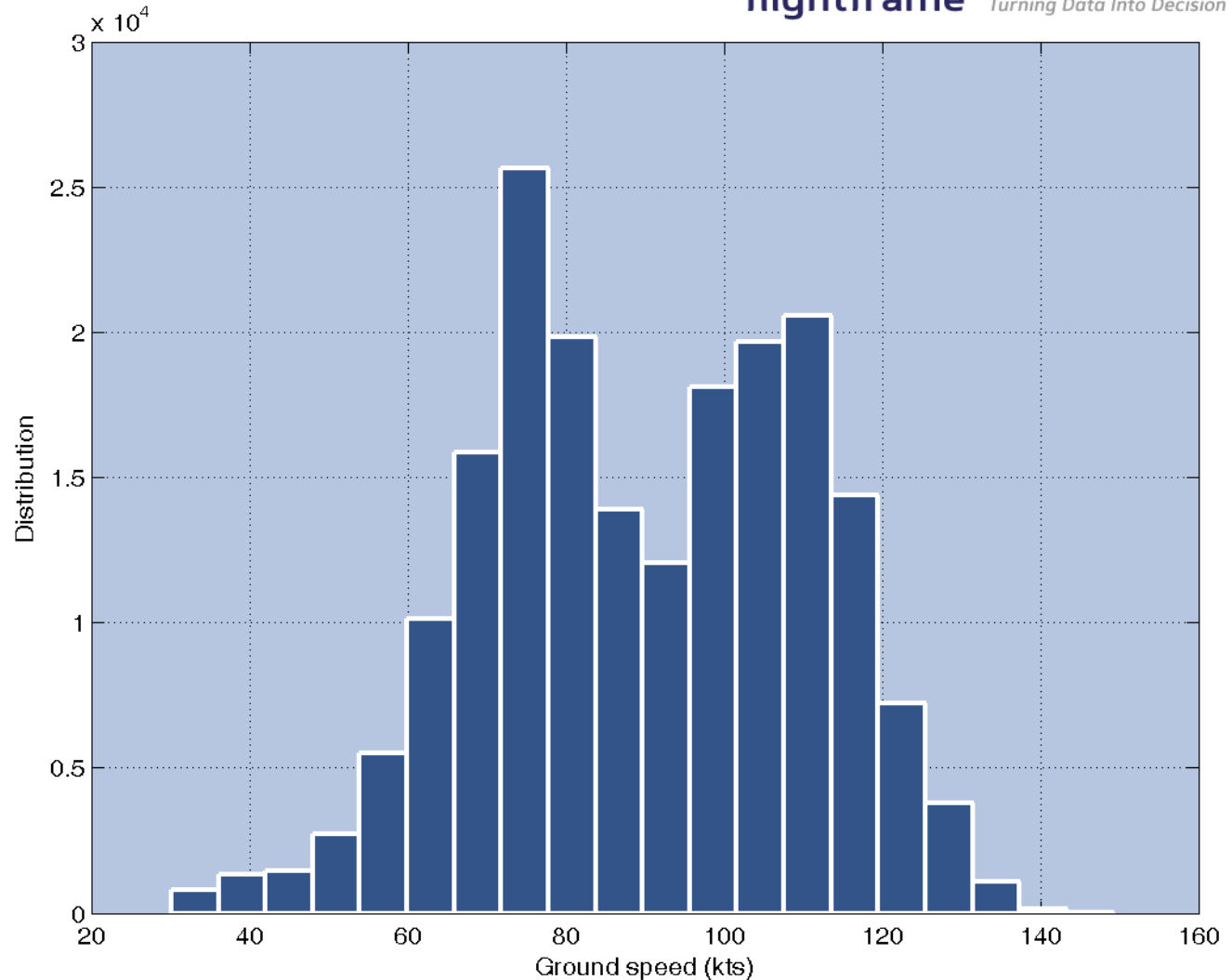
Climb/descent speed distribution

- Distributions of climb and descent rates affect both safety and performance



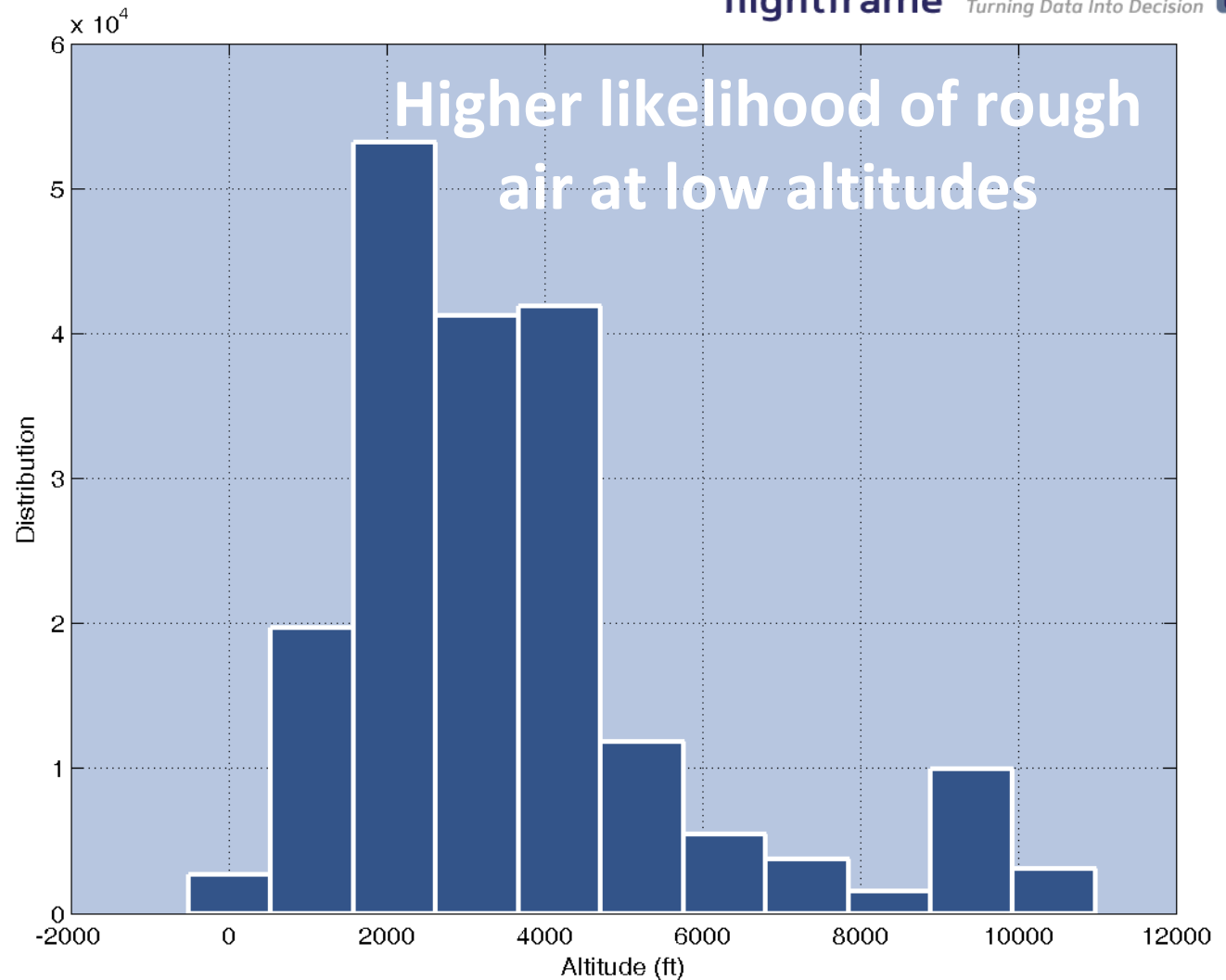
Ground speed distribution

- Distributions of vehicle speed affect both safety and performance



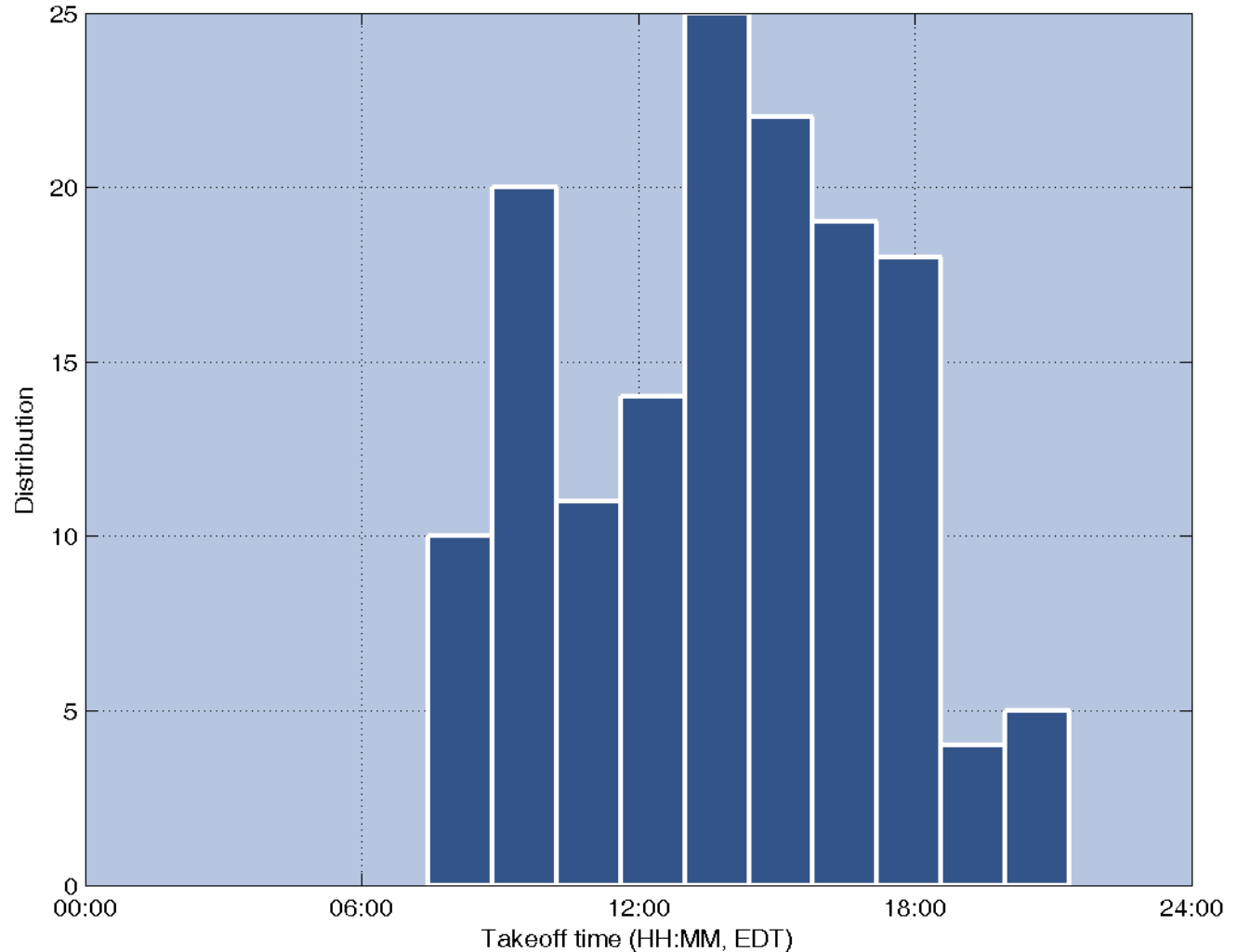
Altitude distribution

- The distribution of altitude affects both safety and performance



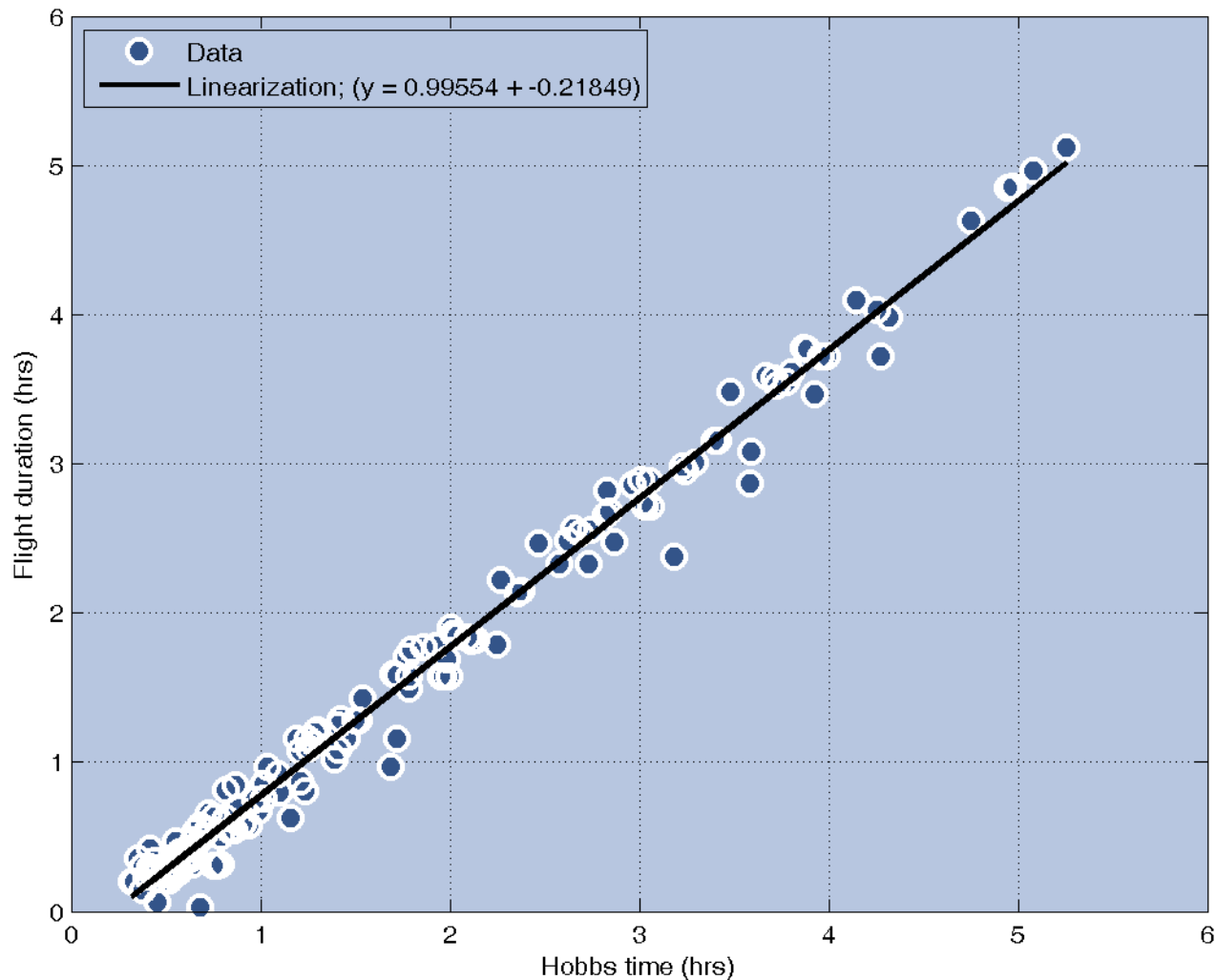
Takeoff time

- Statistical models of traffic patterns can be developed based on airport, time-of-day, season, etc.



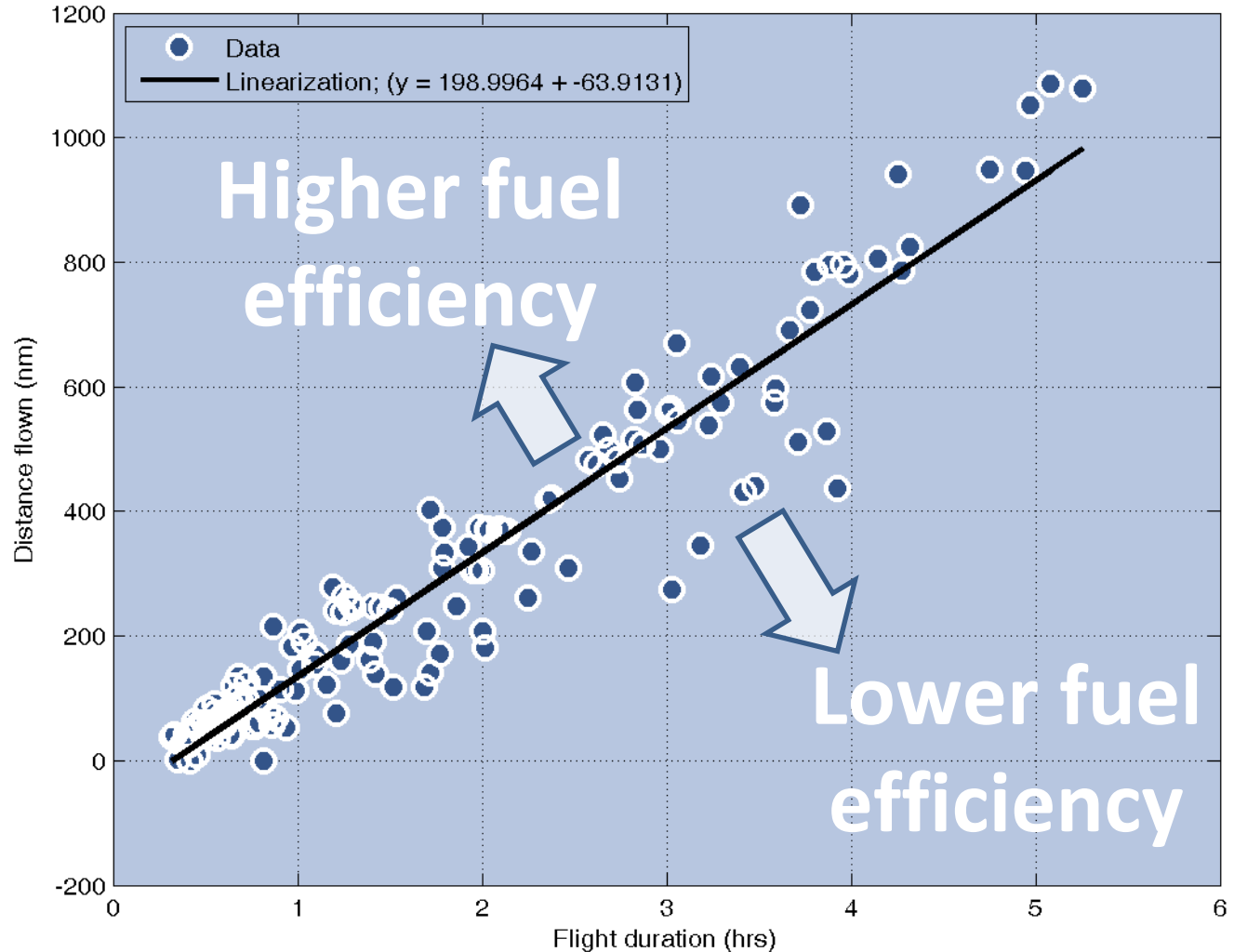
Hobbs time v. flight duration

- Pilots often cite the need to differentiate between Hobbs time and actual flight time
- The trends show good linearity with a fairly predictable pre-/post-flight ground segments



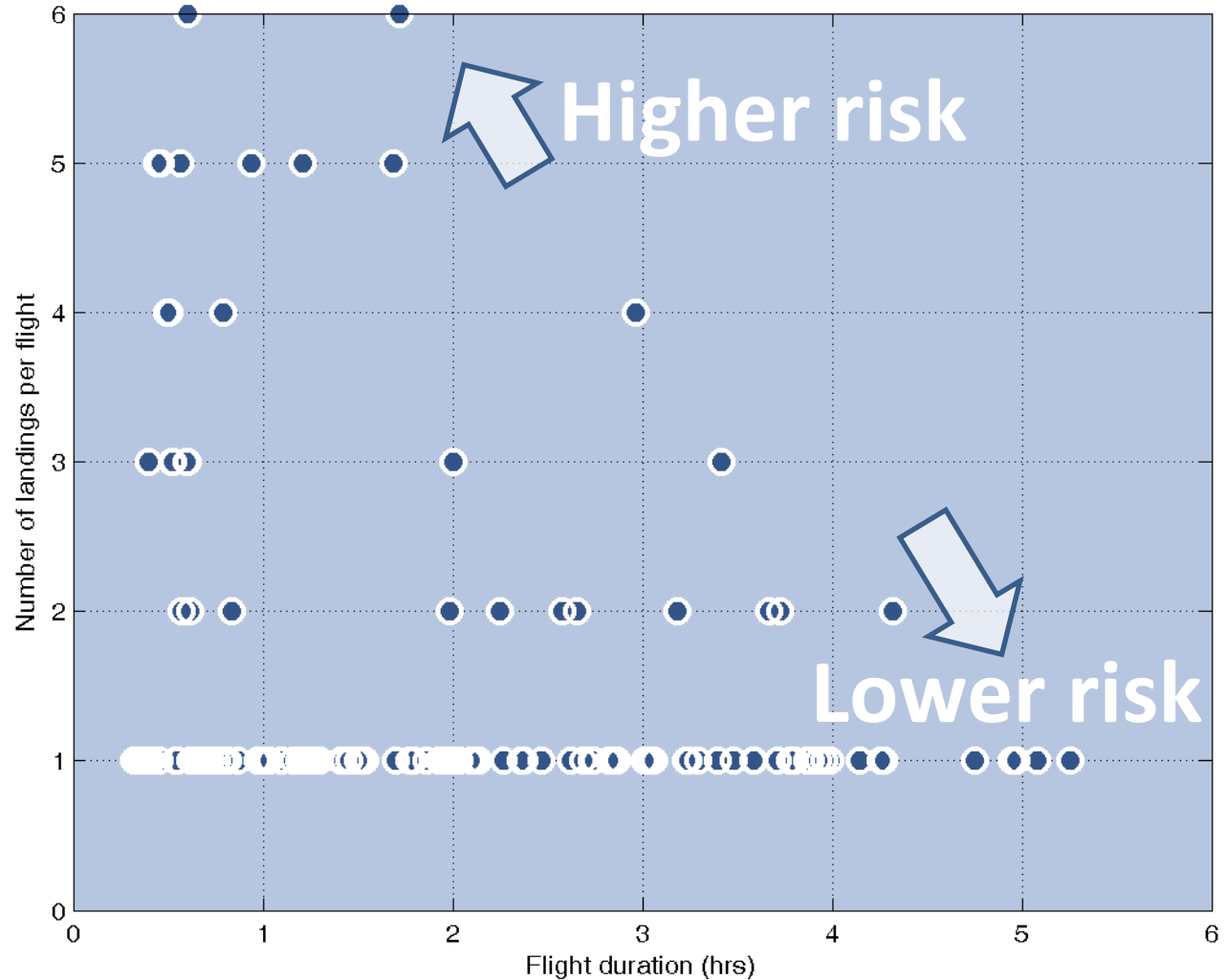
Flight duration v. distance

- For a given aircraft, flight duration v. actual distance can be used to assess fuel efficiency
- Access to these trends help owners and operators improve their operations and reduce costs



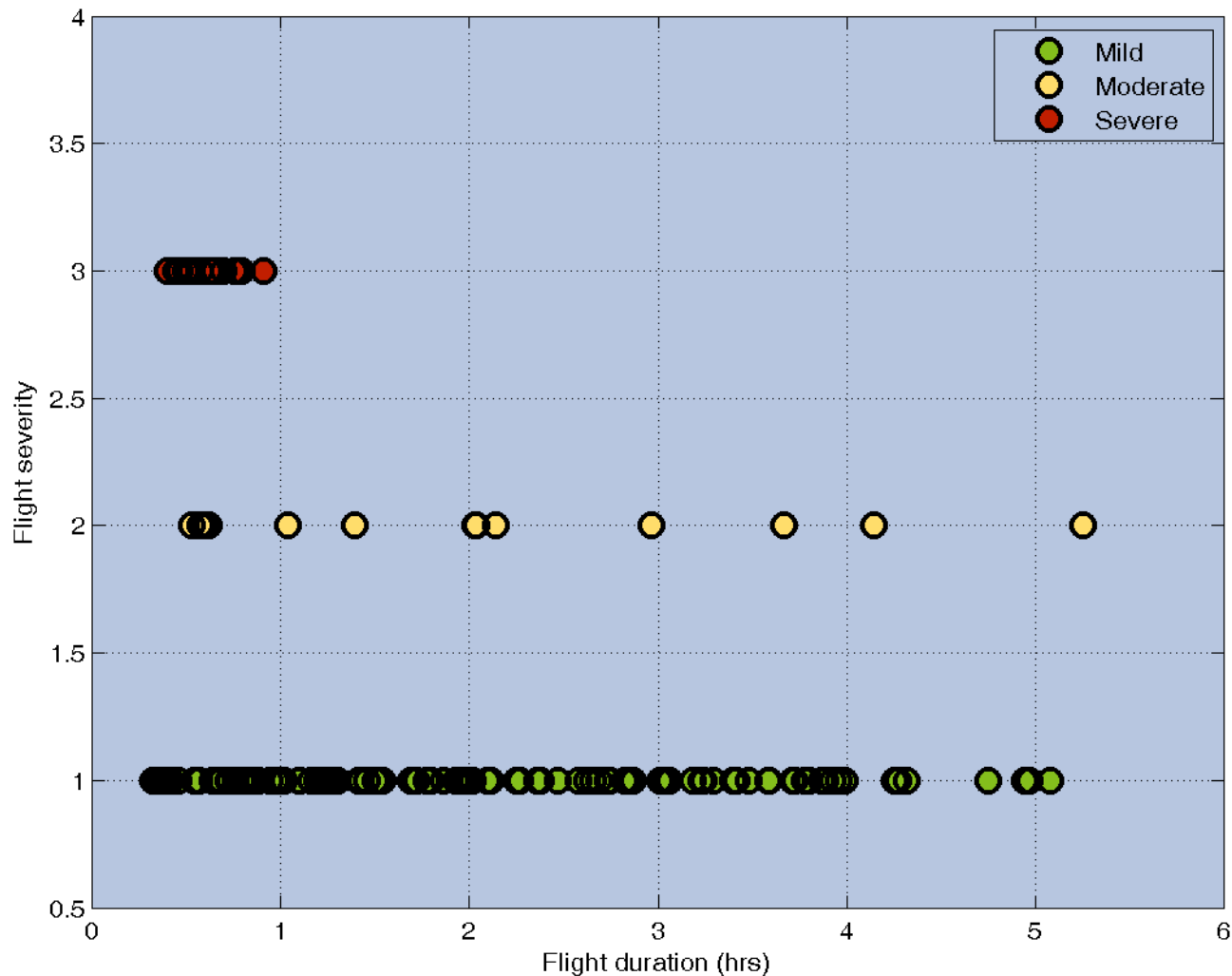
Number of landings

- Landings per flight (or per hour) are a good metric for airframe health monitoring
- Higher landing rates negatively impact airframe health and increase likelihood of an accident



Flight severity

- flightframe.net computes a flight severity for each flight
- Severity is a relative weighting from 1 (good) to 4 (bad)
- Based on g's, landings, turbulence, etc.
- Excellent, easy-to-understand metric for airframe health



Max g's per flight

- This chart shows the broad distribution of max g's per flight
- This stresses the importance of monitoring the usage of each individual airframe

