Lima FDA Seminar

Presented by Paul DUBOIS
AIRBUS - Airline SMS & FDA Assistance

PROCESSING

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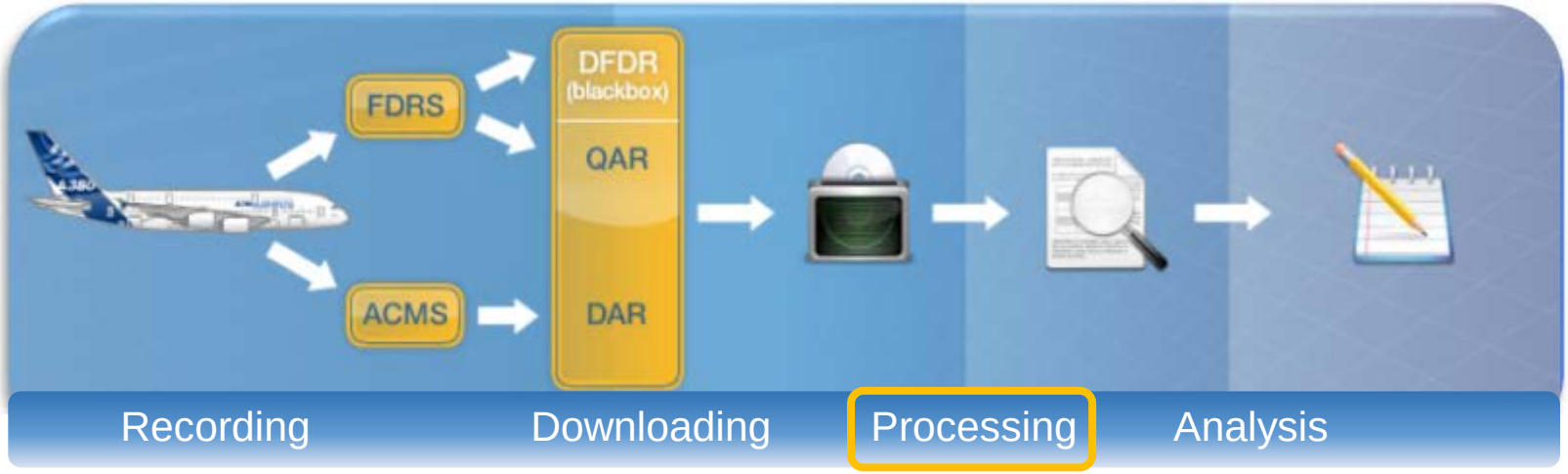
PROCESSING - INTRODUCTION



011010100011
RAW data

Altitude, Speed,
Pitch angle & Event…

FDA tool

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PROCESSING - INTRODUCTION

This module aims at describing the way binary data, extracted from the A/C avionic network, are treated in order to generate **relevant safety information**.

PROCESSING THE DATA

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Be aware

Parameters extracted from avionic buses have not been designed for FDA uses.

Consequence

Sizeable amount of work is needed in order to generate information of a high quality level.

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PROCESSING

FLIGHT ANALYSIS PROGRAM - FAP

PARAMETERS

EVENT DESIGN

FDA TOOL - AIRFASE

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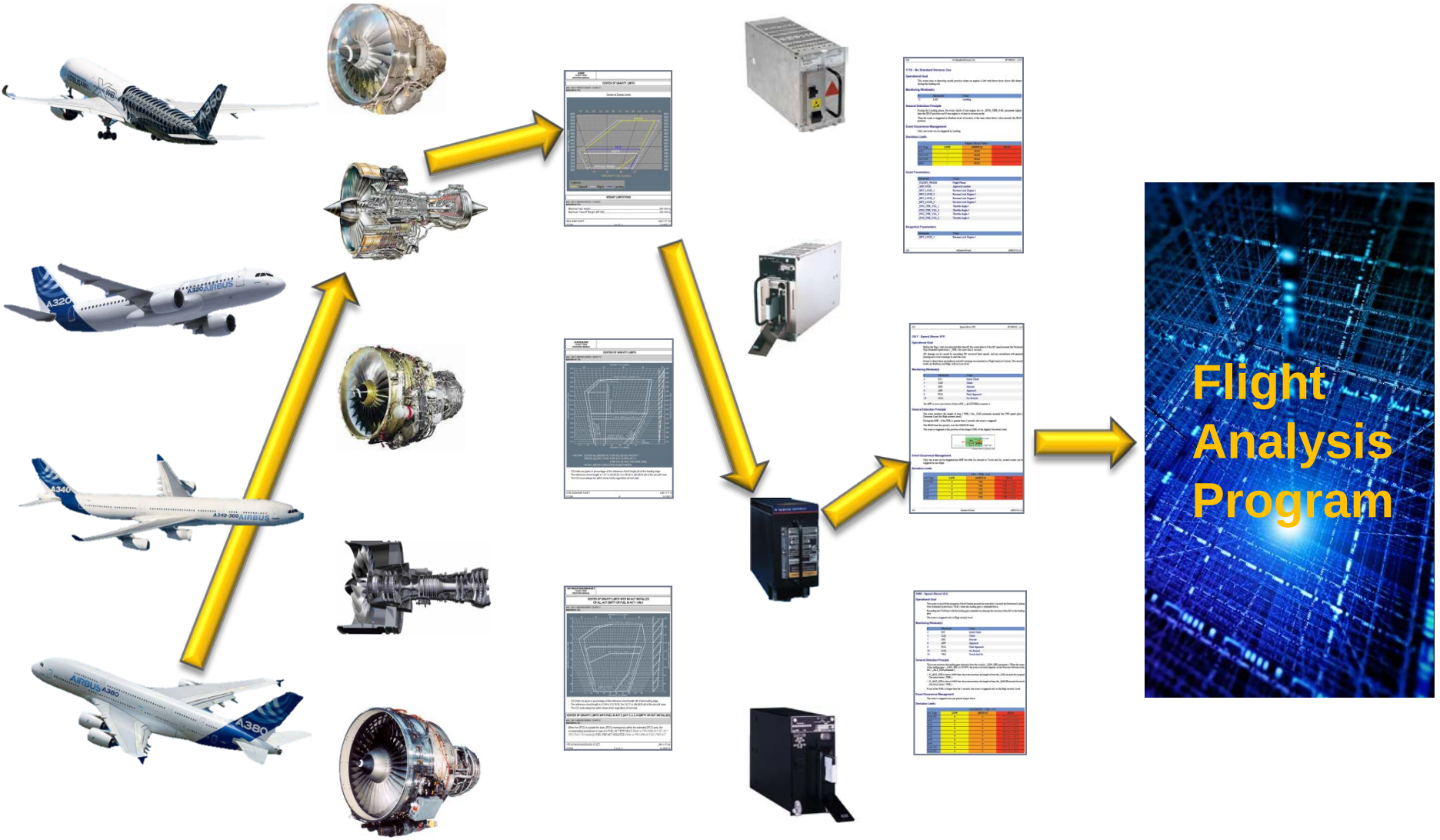
PROCESSING - FLIGHT ANALYSIS PROGRAM



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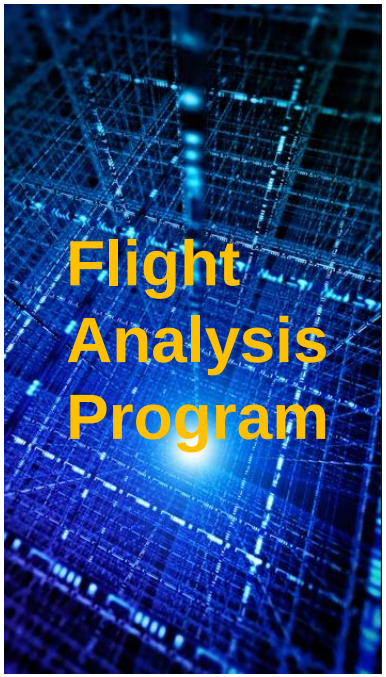
PROCESSING - FLIGHT ANALYSIS PROGRAM



The decoding program, used for actual exploitable values recovery, must be refined and validated by expert engineers and pilots for operational legibility.

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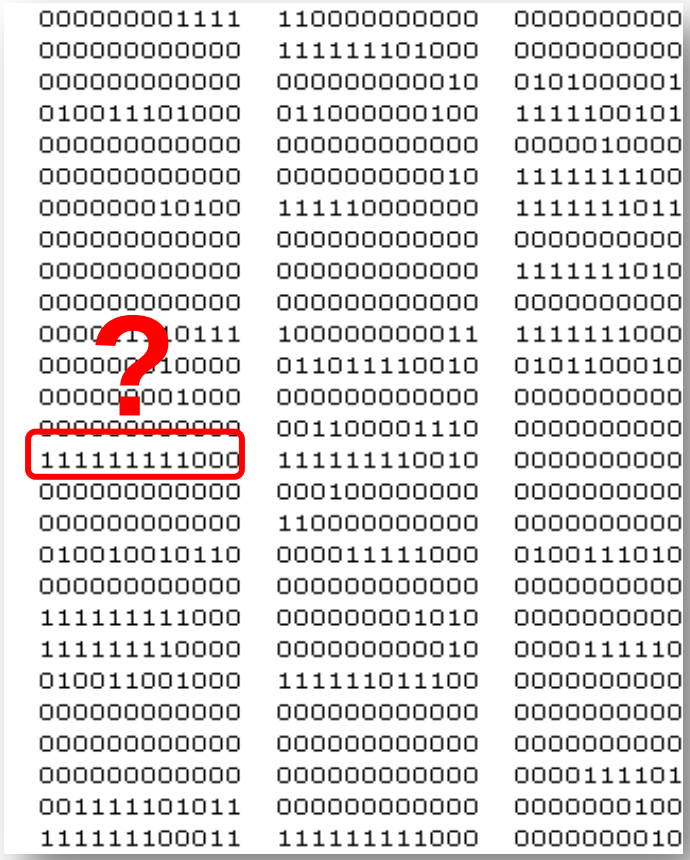
PROCESSING - FLIGHT ANALYSIS PROGRAM

FRAME Definition

- ➔ Number of **W**ord **P**er **S**econd
  from 64 to 2048 WPS
- ➔ Number of acquired parameters
  between 250 and 3000
- ➔ Sampling rate
  From1/64 Hertz to 8 Hertz



For one aircraft type you can have several different frames and so it will need several different FAP.

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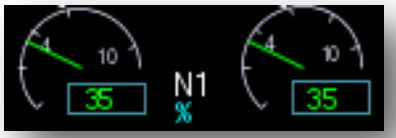
FLEET OPERATIONAL LIMITS

➔ A/C Type

➔ Key Values

Geometry / Engines / Weights Limitations

➔ Events threshold definition



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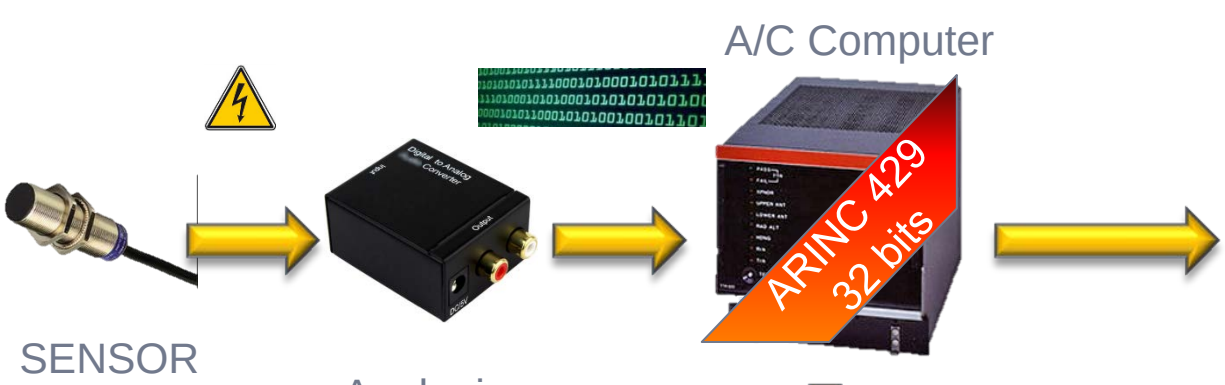
PROCESSING - PARAMETERS



A/C Systems

FDIMU

FDIMU: **Flight Data Interface and Management Unit**

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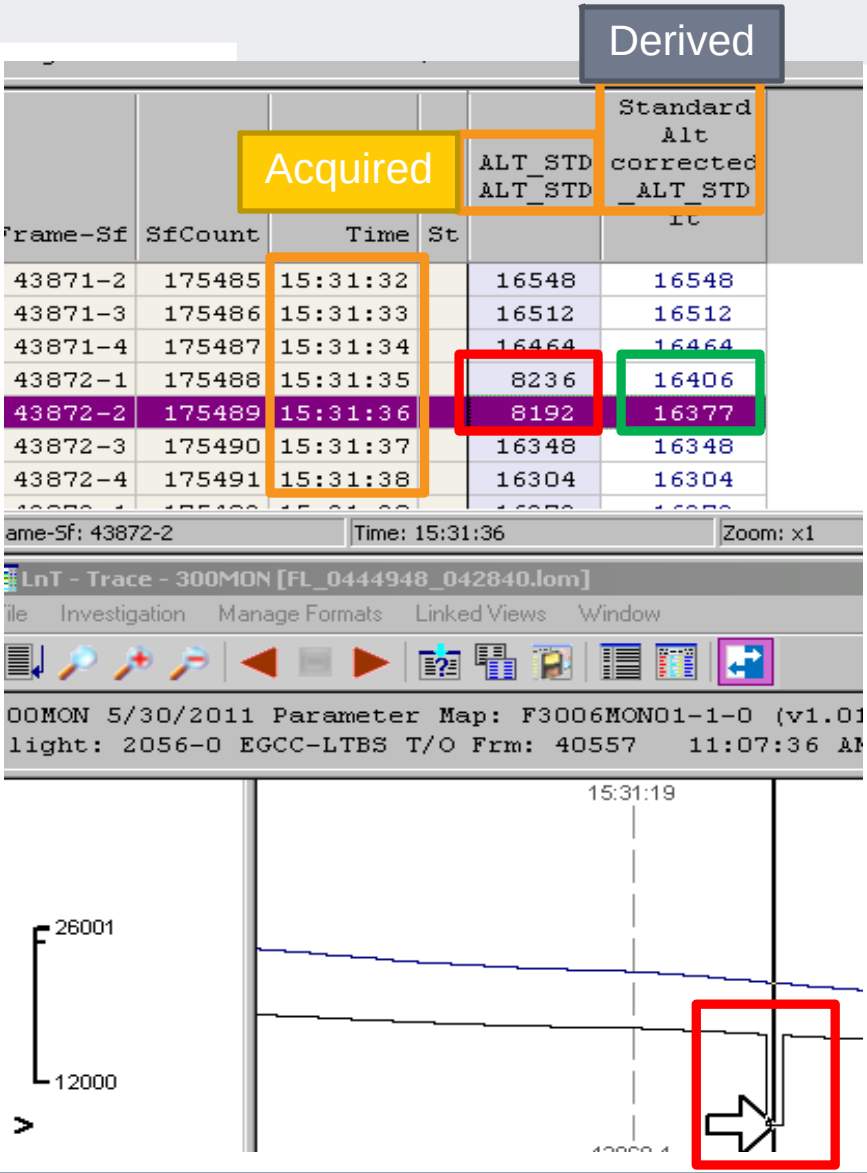
PROCESSING - PARAMETERS

They must be **derived** to become exploitable into the FDA tool

This derivation allows:

➔ Automatic wrong parameter filtering



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PROCESSING - PARAMETERS

The derivation also allows:

➔ new parameter development

<u>example</u>: vertical speed derived from altitude

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PROCESSING - PARAMETERS

Parameters can be derived rather simply

Boolean Example

0 = FALSE

1 = TRUE

Derived Parameter = Acquired Parameter

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PROCESSING - PARAMETERS

Parameters can be more complex

Binary Example

➔Some can be read quite straightforward:

Derived Parameter
=
Acquired Parameter x Coefficient
+
Offset

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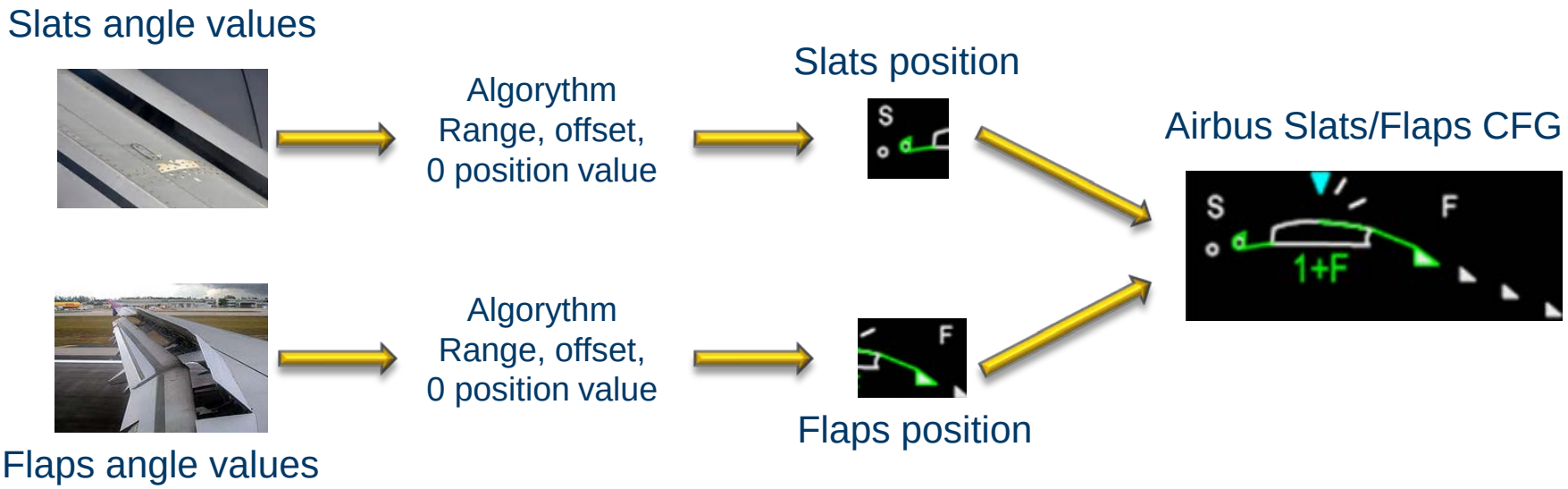
PROCESSING - PARAMETERS

Parameters can be more complex

➔ Some others are even more complex:

Configuration Example



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Purpose of an FDA tool

Identify **Non-Desired** flight conditions

This is a situation where an aircraft goes **beyond its expected operational envelope**

Such an occurrence is called an EVENT

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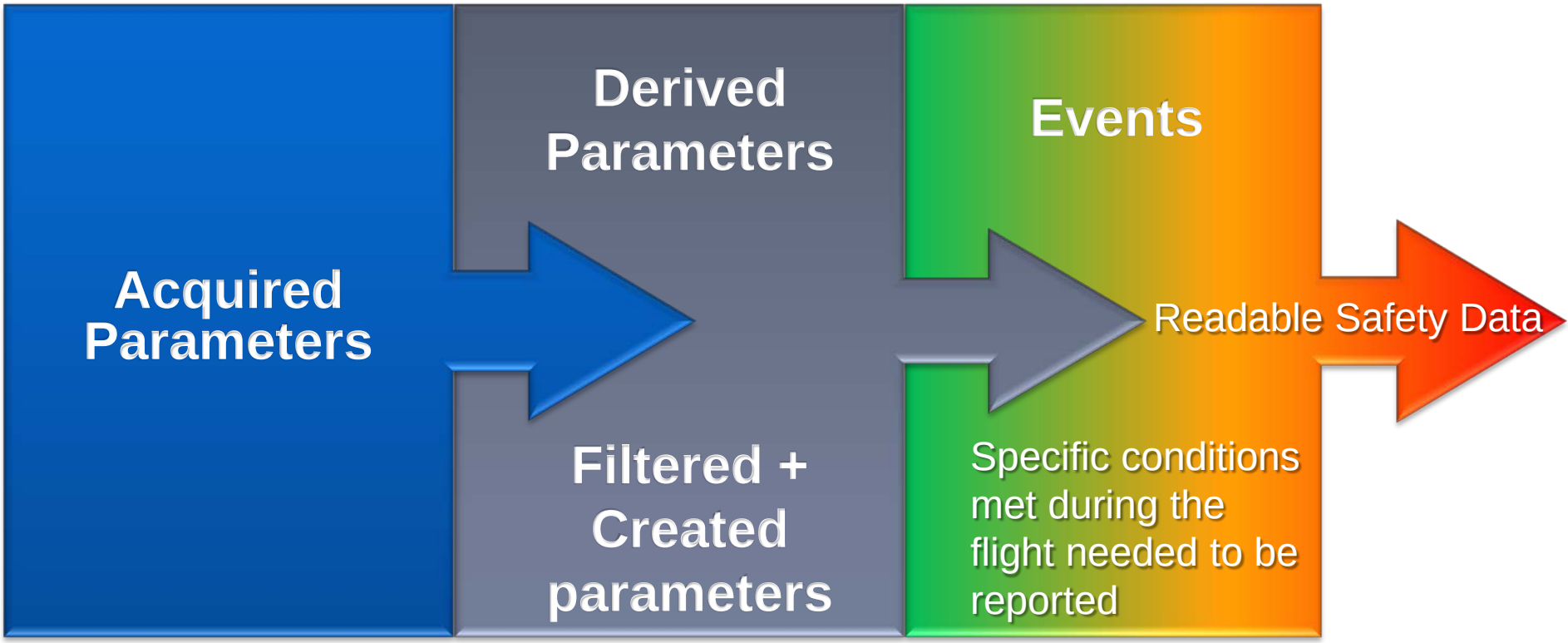
PROCESSING – EVENT DESIGN



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PROCESSING – EVENT DESIGN

DOC 10000
Manual on **Flight Data Analysis Programmes** (FDAP)

Chapter 2 Description para 2.3 Processing Data

- ➔ Exceedance detection
- ➔ Routine measurements
- ➔ Incident investigation
- ➔ Continuing airworthiness
- ➔ Integrated safety analysis.

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PROCESSING – EVENT DESIGN

➔ Exceedance detection

- « such as **deviations** from flight **manual limits or SOPs**…
  A set of **core events**/parameters establishes the main areas of interest to an operator »

- « Exceedance data provides factual information which complement crew and engineering reports »

- « Operators may also modify the standard set of core events to account for unique situations they regulary experience or for the SOPs they use ».

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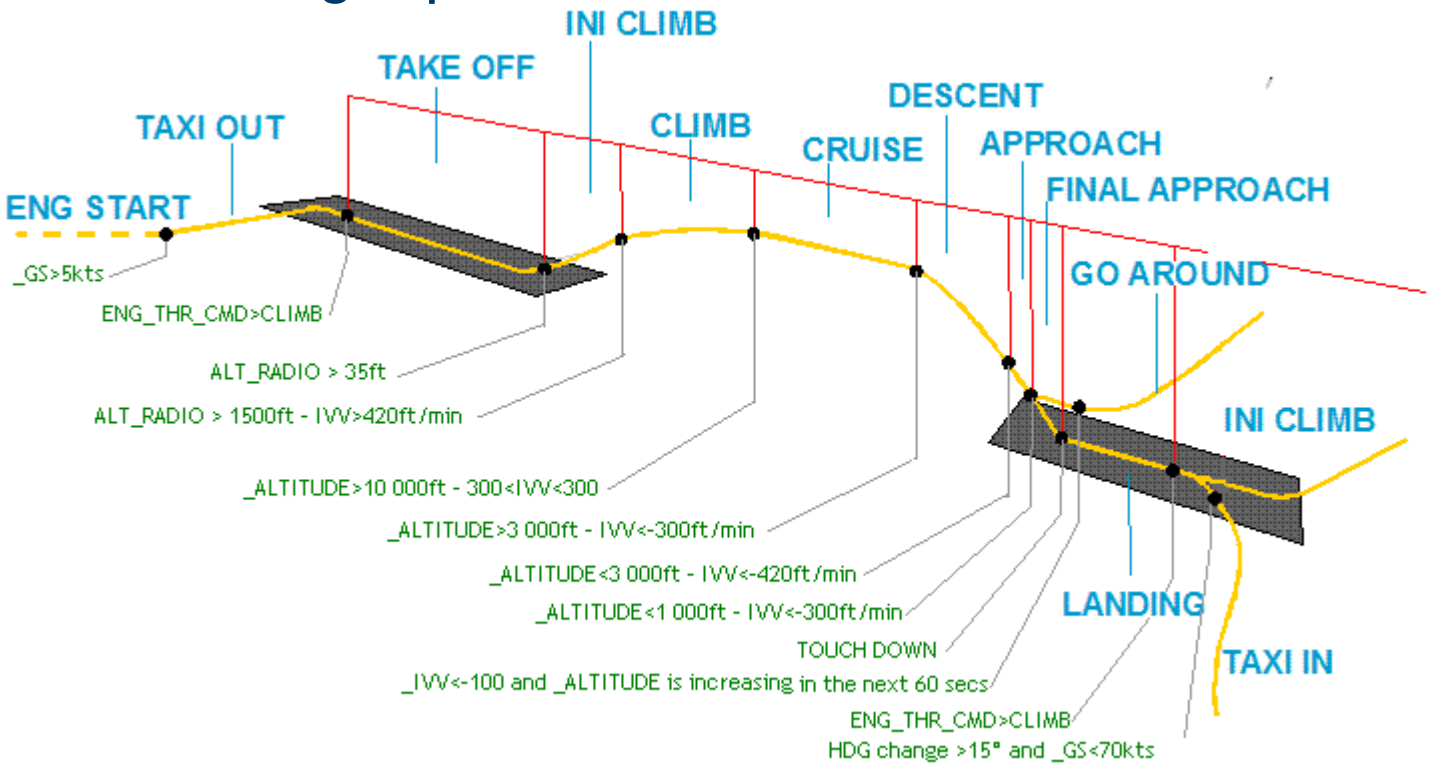
PROCESSING – EVENT DESIGN

The **Flight Phase** information is one of the most central parameter of the system.

The **Flight Phases** split the data stream according recognized operational flight phases.



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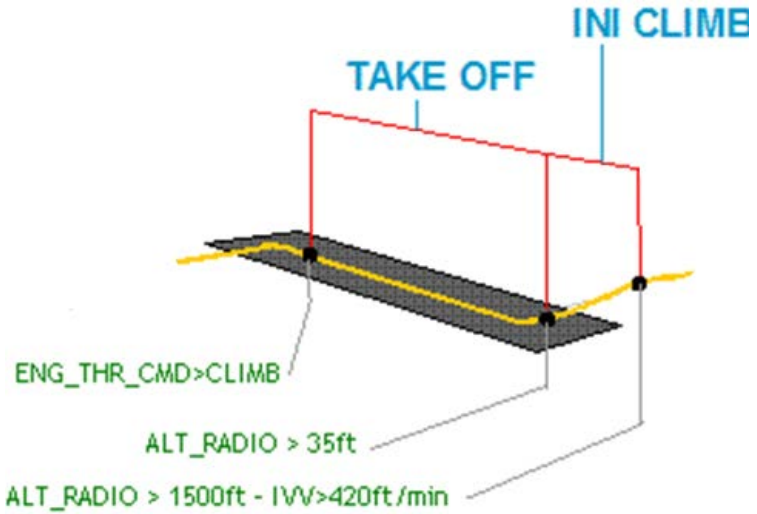
PROCESSING – EVENT DESIGN

What are the **associated hazards**?

Low energy after lift off

- **1100 - Pitch High at Takeoff**
- **1101 - Pitch Rate High at Takeoff**
- **1915 - Overweight Takeoff**
- **1934 - Takeoff Configuration Warning**
- **2020 - Over Rotation at Takeoff**



Windshear

- **1500 - Vertical Acceleration High at Takeoff**
- **1903 - Windshear Warning**

Being out of protected trajectory

- **1990 - GPS Primary Lost**

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Expected Operational Envelope

EVENT programming

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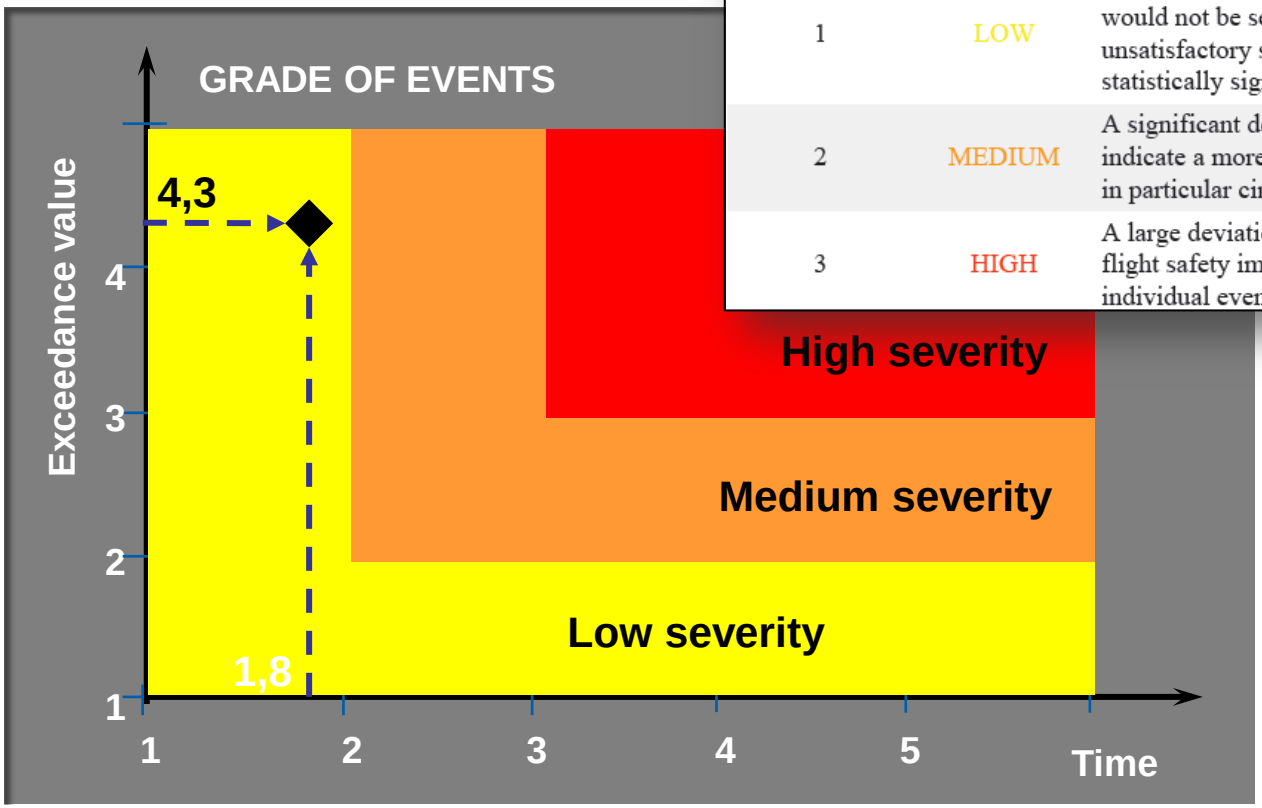
PROCESSING – EVENT DESIGN

EVENT programming is based on two basic attributes of flight parameters: **magnitude** and **duration**:

Level	Name	Description
1	LOW	A small deviation from the Standard Flight Profile, which would not be serious individually, but which can indicate an unsatisfactory safety situation if occurring in specific areas in statistically significant numbers.
2	MEDIUM	A significant deviation from the Standard Flight Profile that may indicate a more serious situation, especially if occurring regularly in particular circumstances.
3	HIGH	A large deviation from the Standard Flight Profile that may have flight safety implications and which should be investigated as an individual event.



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PROCESSING - EVENT DESIGN

2 types of Event

Single Event :

- ✓ Measures an exceeding deviation
- ✓ Triggers a severity level

Combined event :

- ✓ Combination of single events that highlight typical hazard
- ✓ Triggers a severity level

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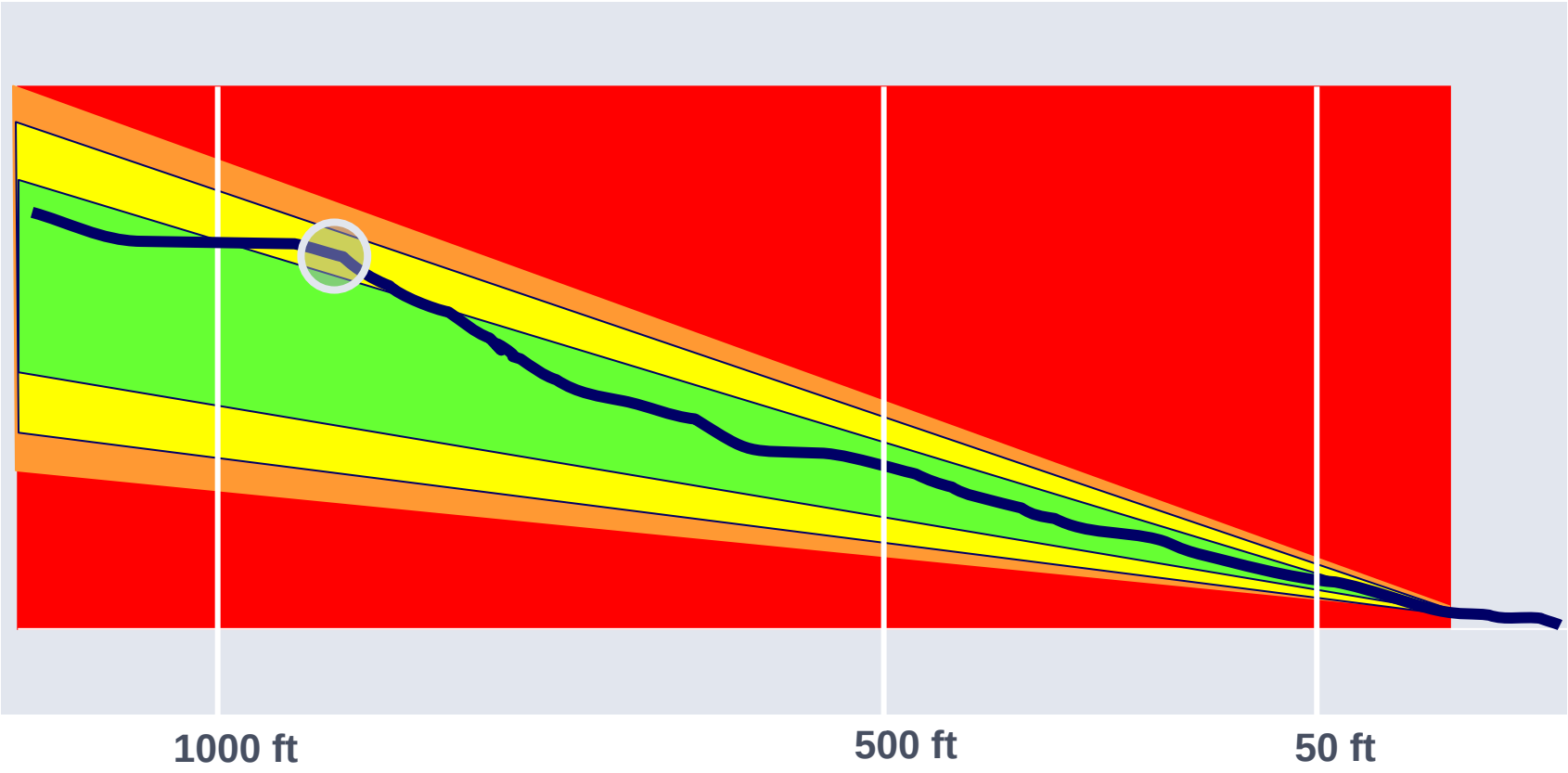
PROCESSING - EVENT DESIGN

SINGLE EVENT

Ex: **Yellow event:** Glideslope high between 1000ft and 500ft



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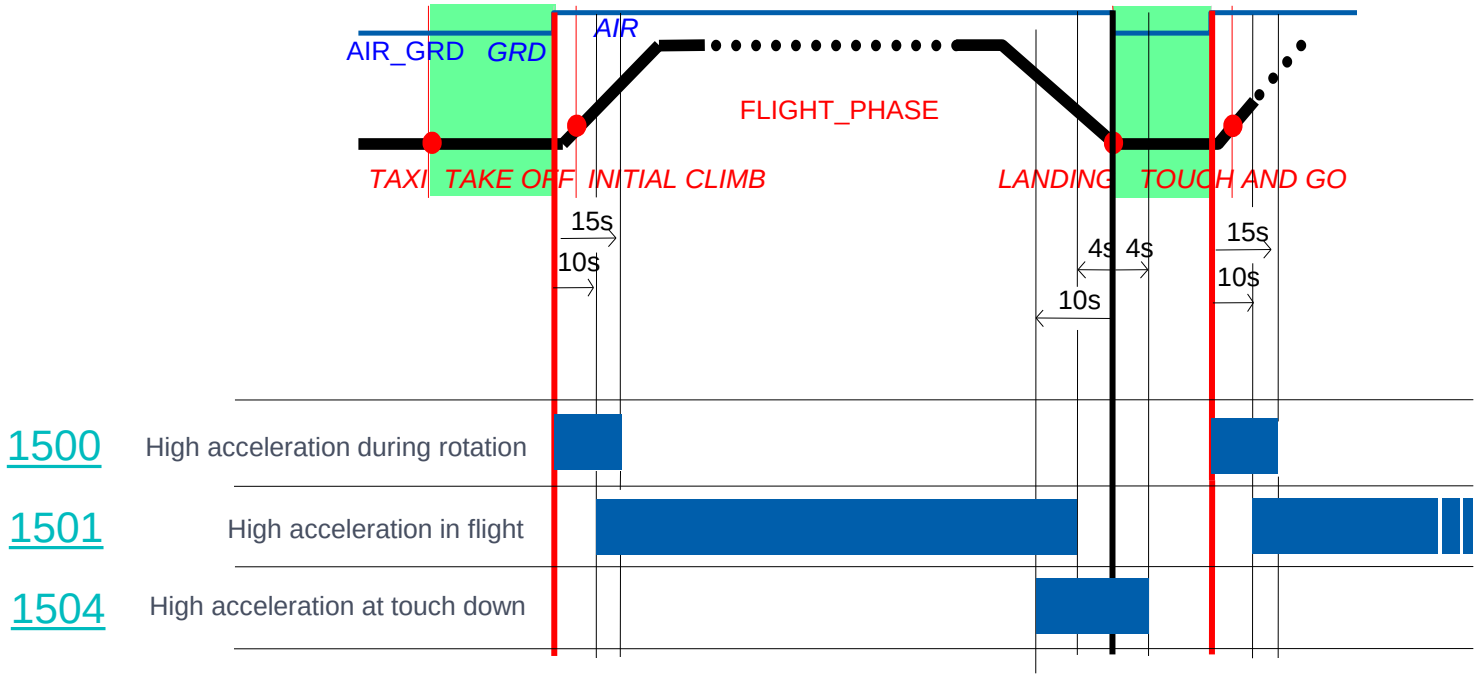
PROCESSING - EVENT DESIGN

A parameter can be used for several event definitions with different thresholds.

15xx - Vertical Acceleration



The Deviation Definition 1500 monitors the vertical acceleration during the rotation phase
The Deviation Definition 1501 monitors the vertical acceleration during the flight except the rotation and landing portions sections of the flight
The Deviation Definition 1504 monitors the vertical acceleration at touch down

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15xx - Vertical Acceleration

1500 - Vertical Acceleration High at Takeoff

LOW	MEDIUM	HIGH
1.35 G	1.4 G	1.45 G

1501 - Vertical Acceleration High in Flight

LOW	MEDIUM	HIGH
1.4 G ; 0.6 G	1.6 G ; 0.4 G	1.8 G ; 0.2 G

1504 - Vertical Acceleration High at Touchdown

LOW	MEDIUM	HIGH
1.5 G	1.6 G	1.75 G

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15xx - Vertical Acceleration

1504 - Vertical Acceleration High at Touchdown

LOW	MEDIUM	HIGH
1.5 G	1.6 G	1.75 G

This event detects High G landings by monitoring Touch-downs exceeding a Vertical Acceleration of 1.5G.

A severe High G landing might indicate, but not always, a hard landing as per the maintenance definition.

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15xx - Vertical Acceleration

1504 - Vertical Acceleration High at Touchdown

LOW	MEDIUM	HIGH
1.5 G	1.6 G	1.75 G

The first vertical acceleration delta from which a maintenance action could be requested is 0.75G (A330).

This is why the 1.75G vertical acceleration value has been chosen.

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15xx - Vertical Acceleration

1504 - Vertical Acceleration High at Touchdown

LOW	MEDIUM	HIGH
1.5 G	1.6 G	1.75 G

The event development and algorithms of computation need, as far as possible, to be simple and operationally meaningful.

Events are assessed via comparison, simulation and/or flight tests.

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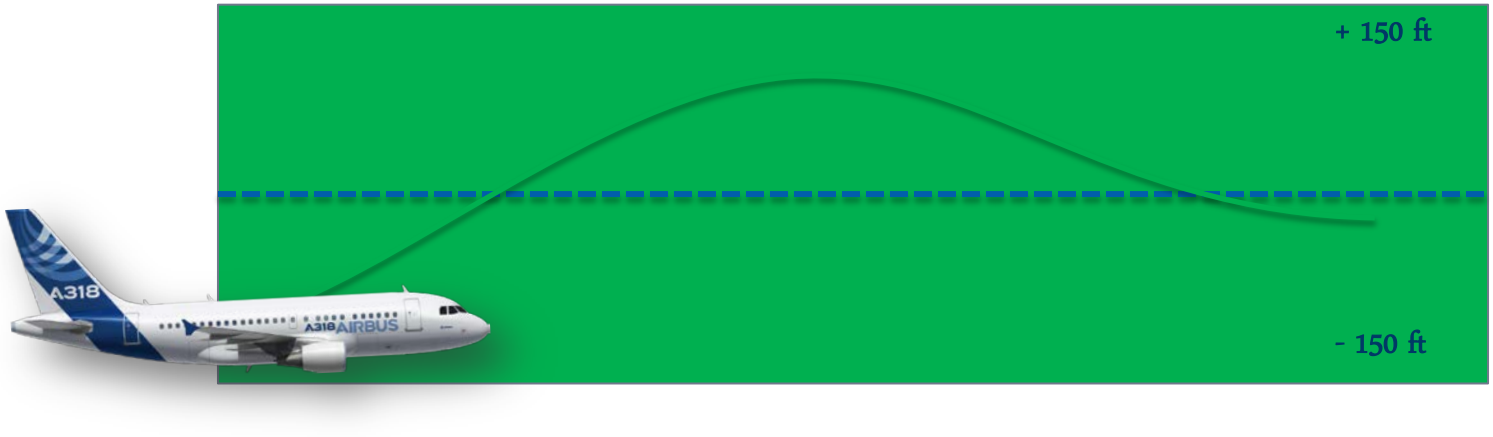
PROCESSING - EVENT DESIGN

1919 - Level Bust

No Event raised when remaining inside the zone



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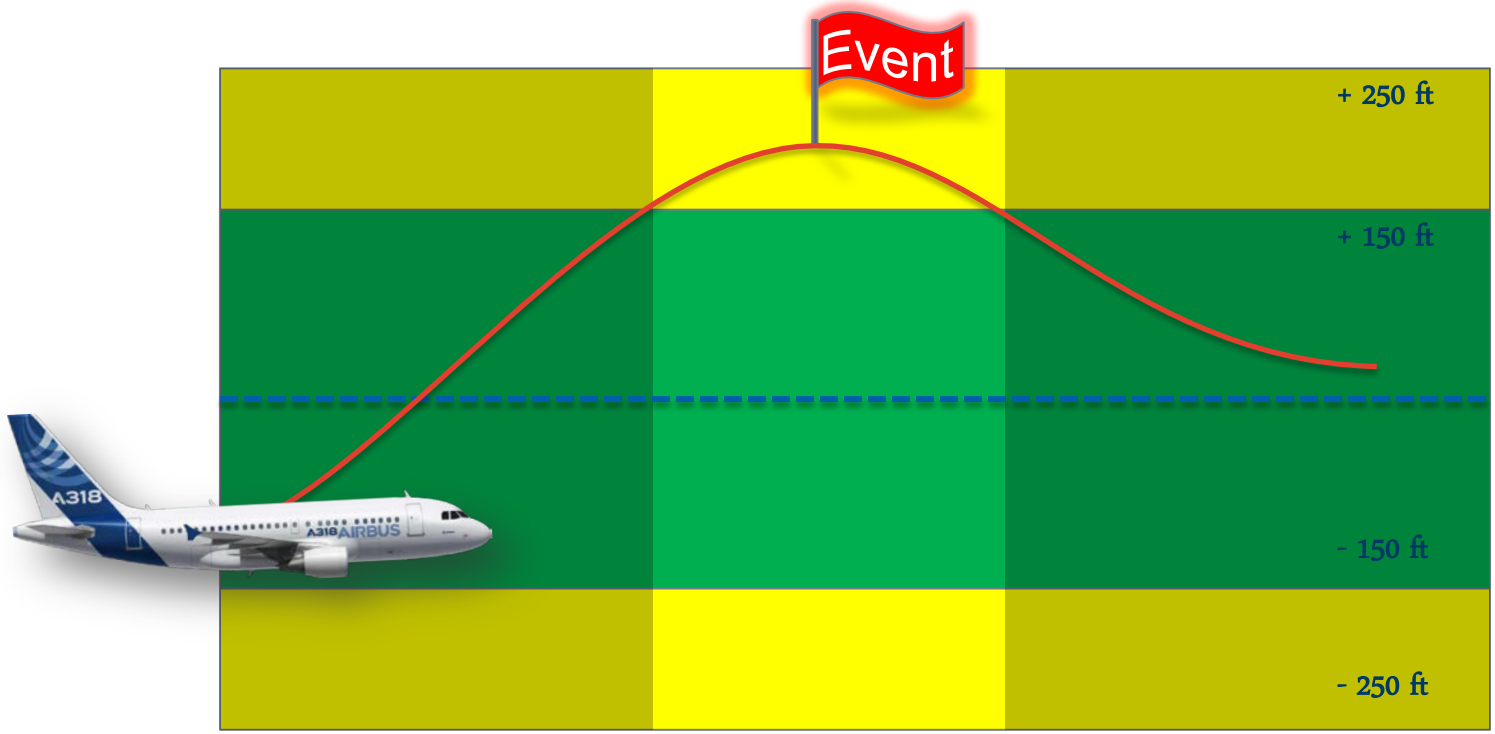
PROCESSING - EVENT DESIGN

1919 - Level Bust

Event raised when entering and escaping the zone



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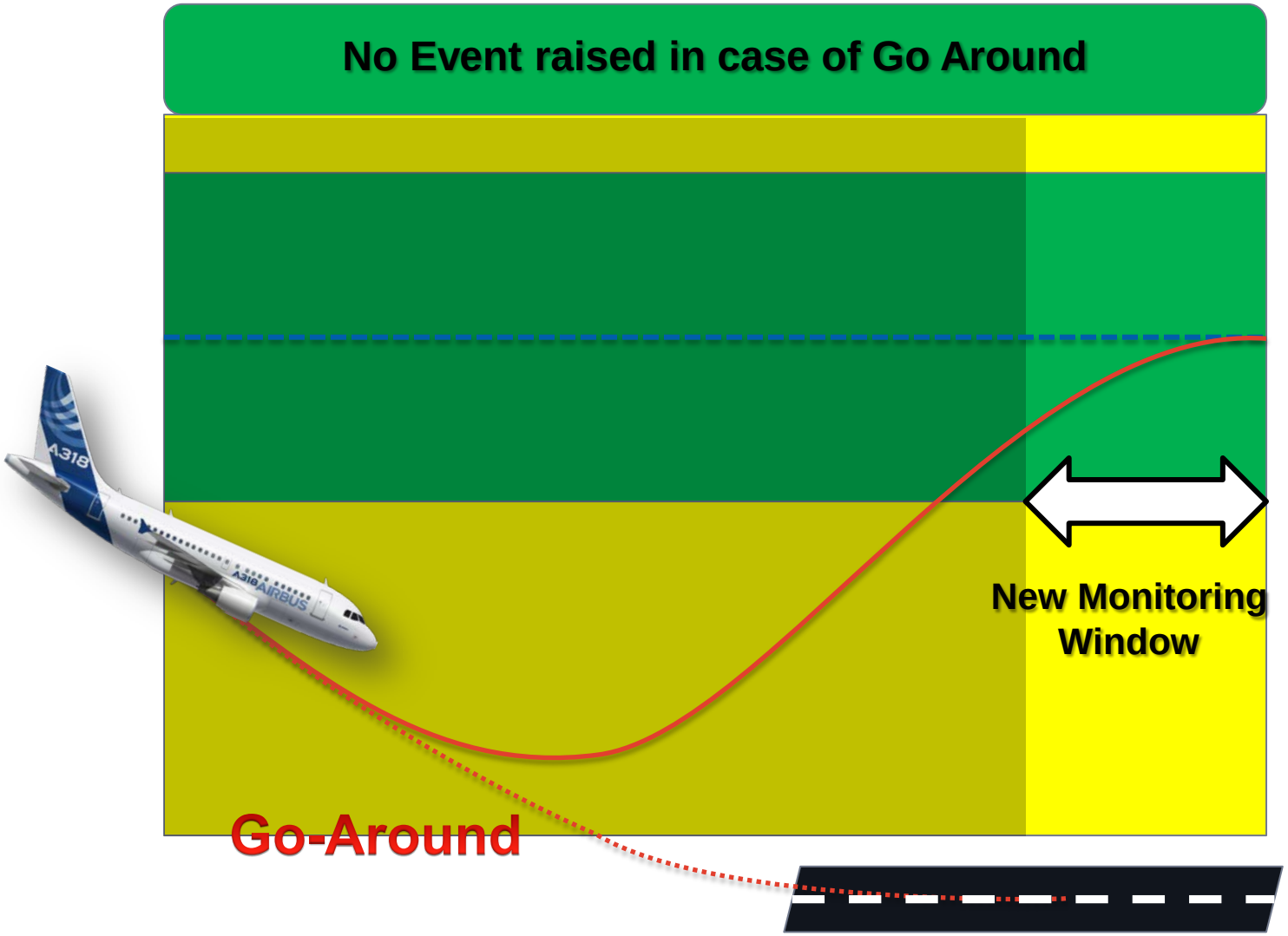
PROCESSING - EVENT DESIGN

1919 - Level Bust



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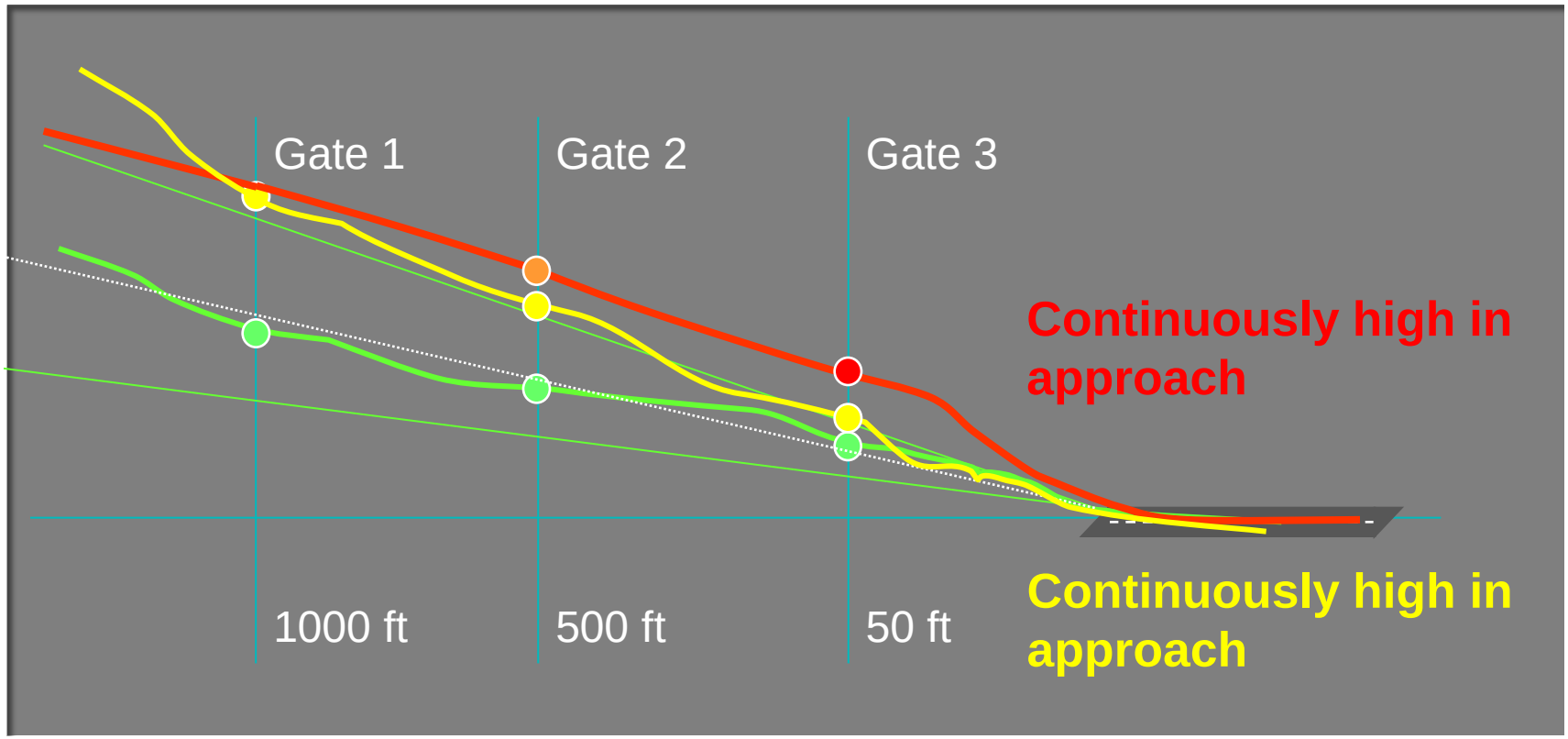
2) Combined event:

➔ Several single events can be associated to unveil an undesirable situation



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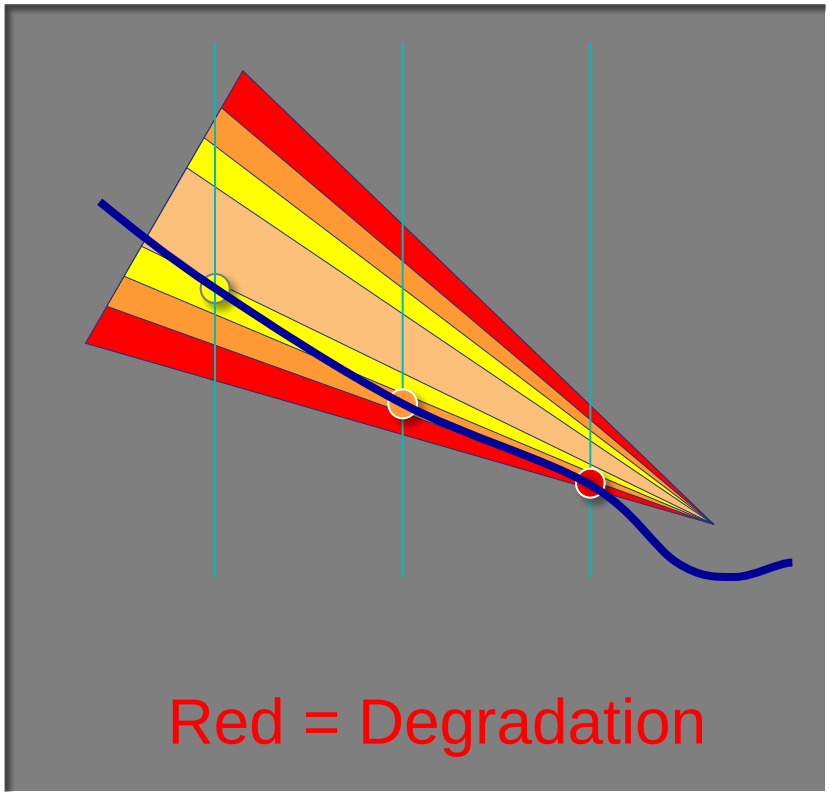
PROCESSING - EVENT DESIGN

Combined events are rated with the **sum of the severity** of the relevant single events, but ALSO by **analyzing the trend** of the **severity** of the events.



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PROCESSING

FLIGHT ANALYSIS PROGRAM - FAP

PARAMETERS

EVENT DESIGN

FDA TOOL - AIRFASE

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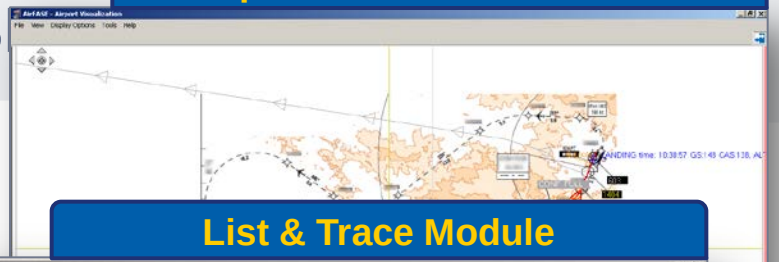
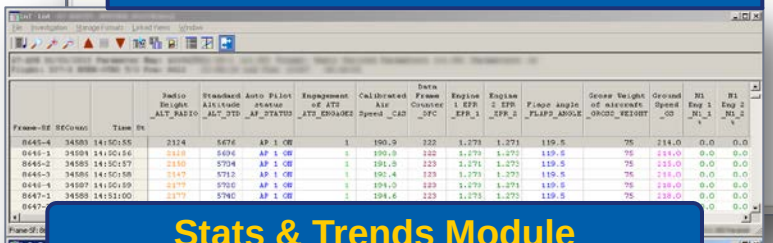
PROCESSING - FDA TOOL - AIRFASE

Airport Visualization Module

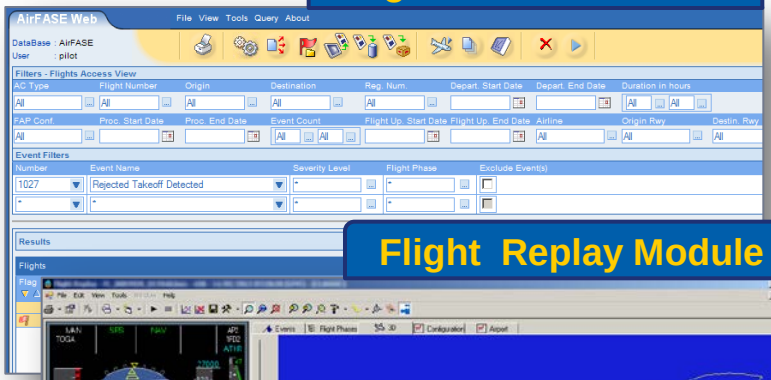


List & Trace Module

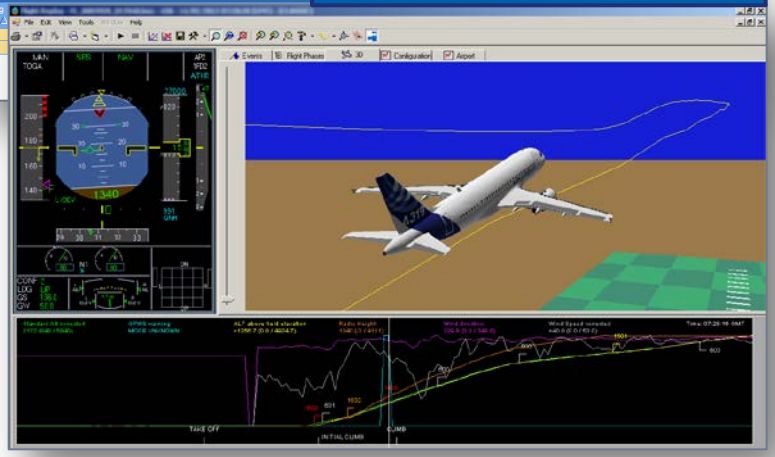


Stats & Trends Module

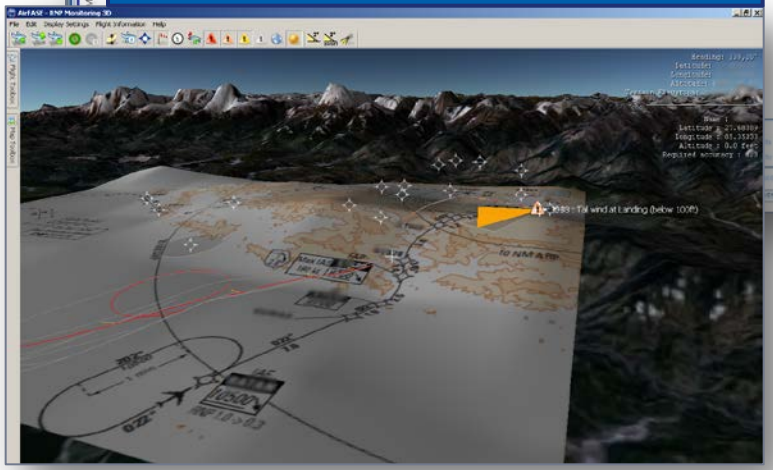
Flight Access Module



Flight Replay Module



RNP Monitoring Module



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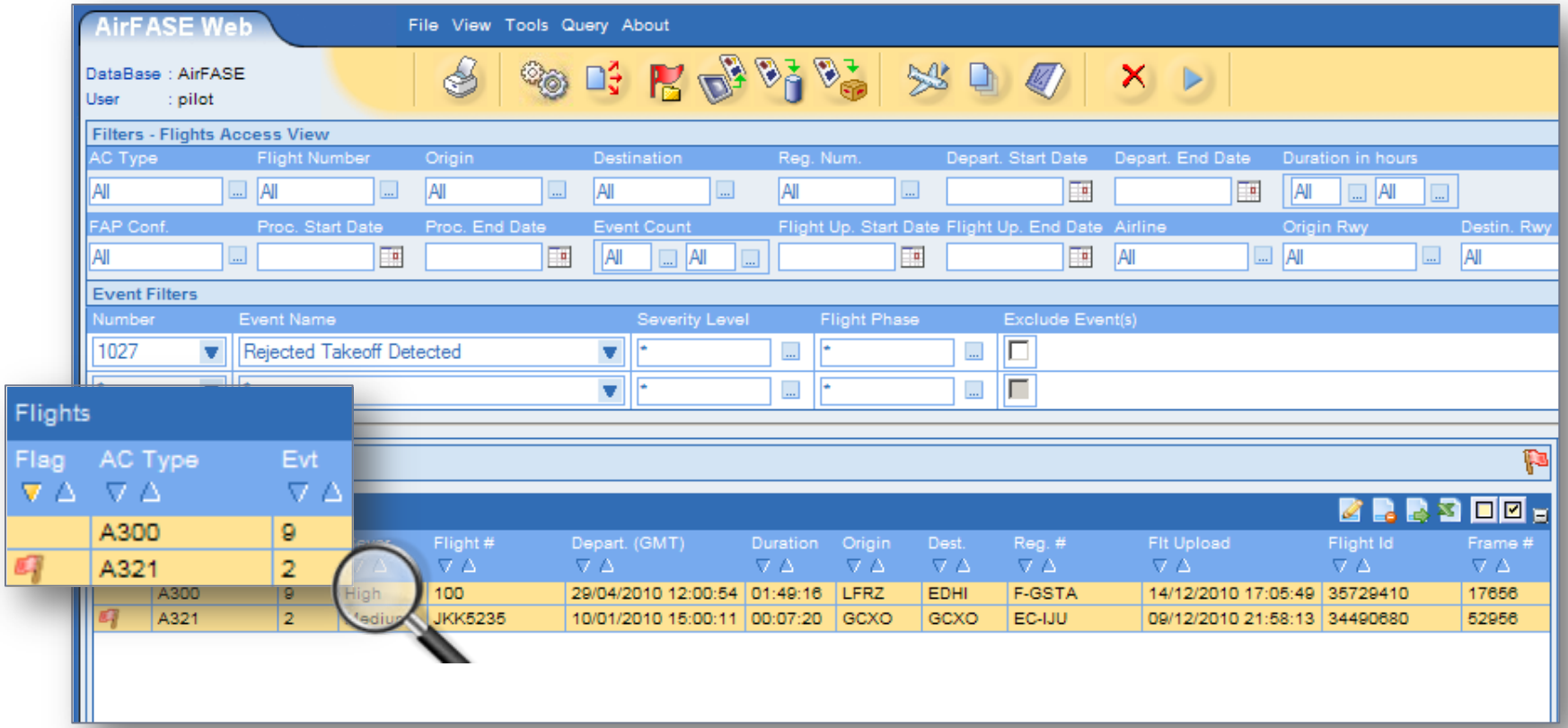
Flight Access Module



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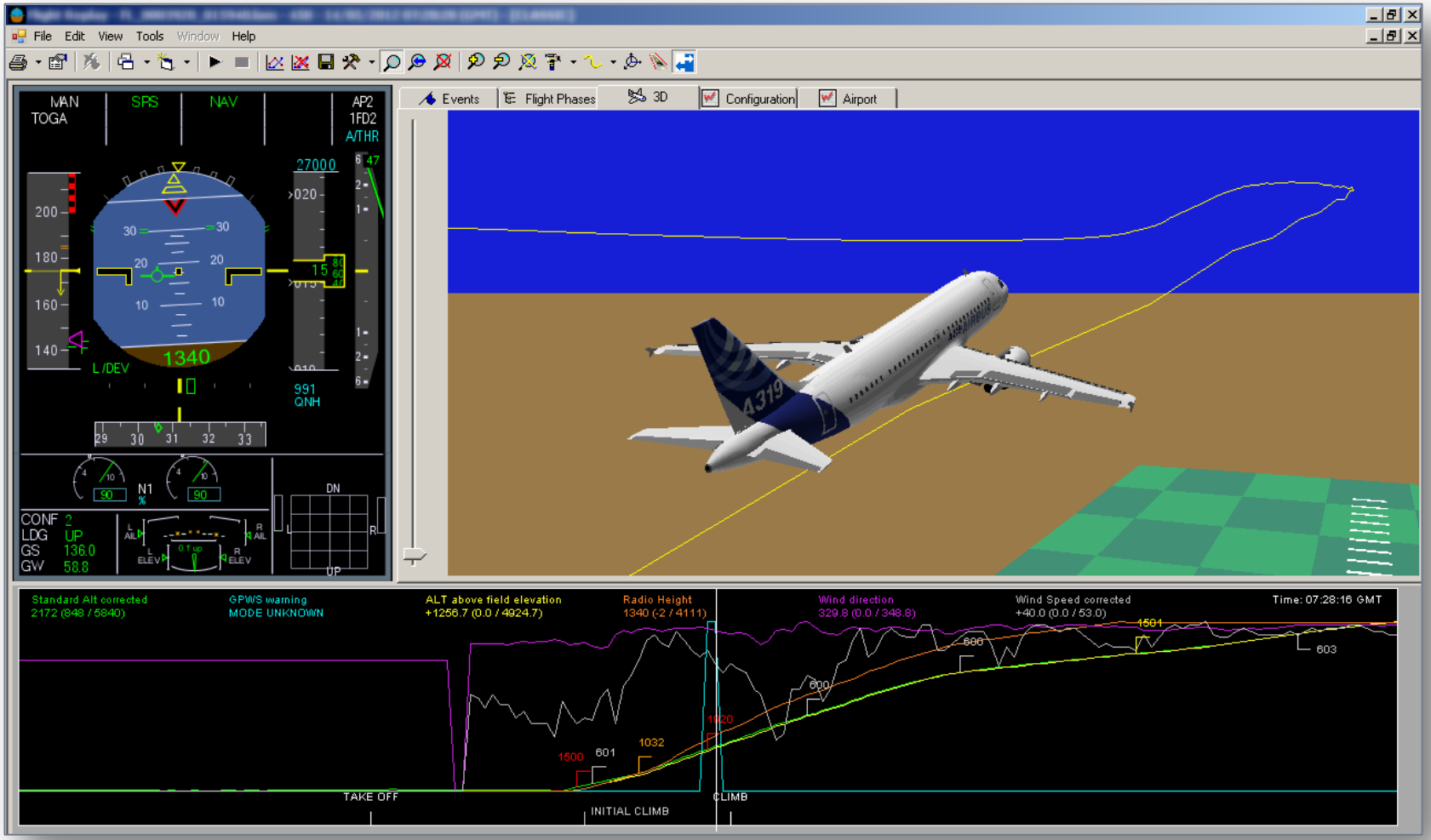
Flight Replay



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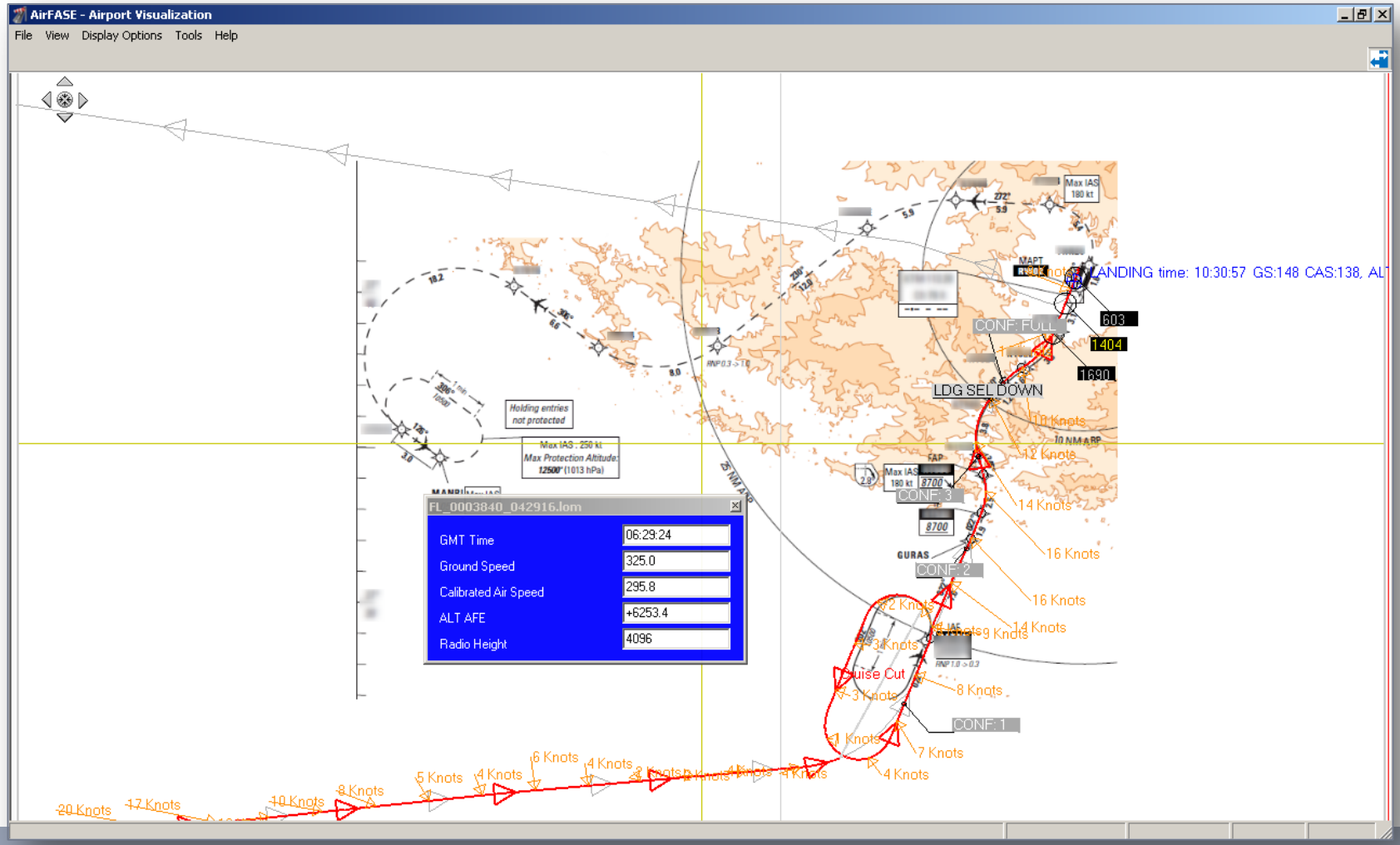
Airport Visualization



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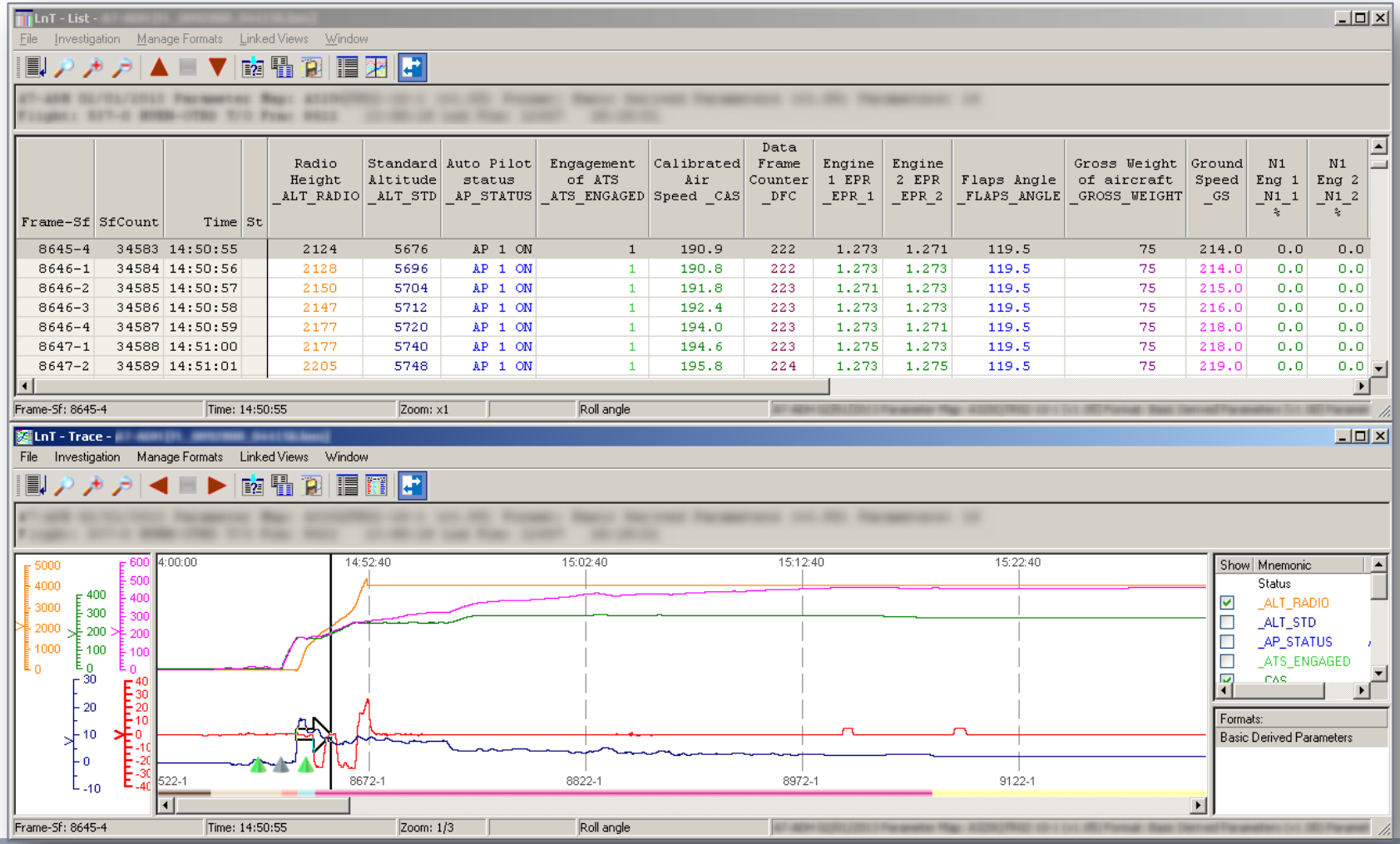
List & Trace Module



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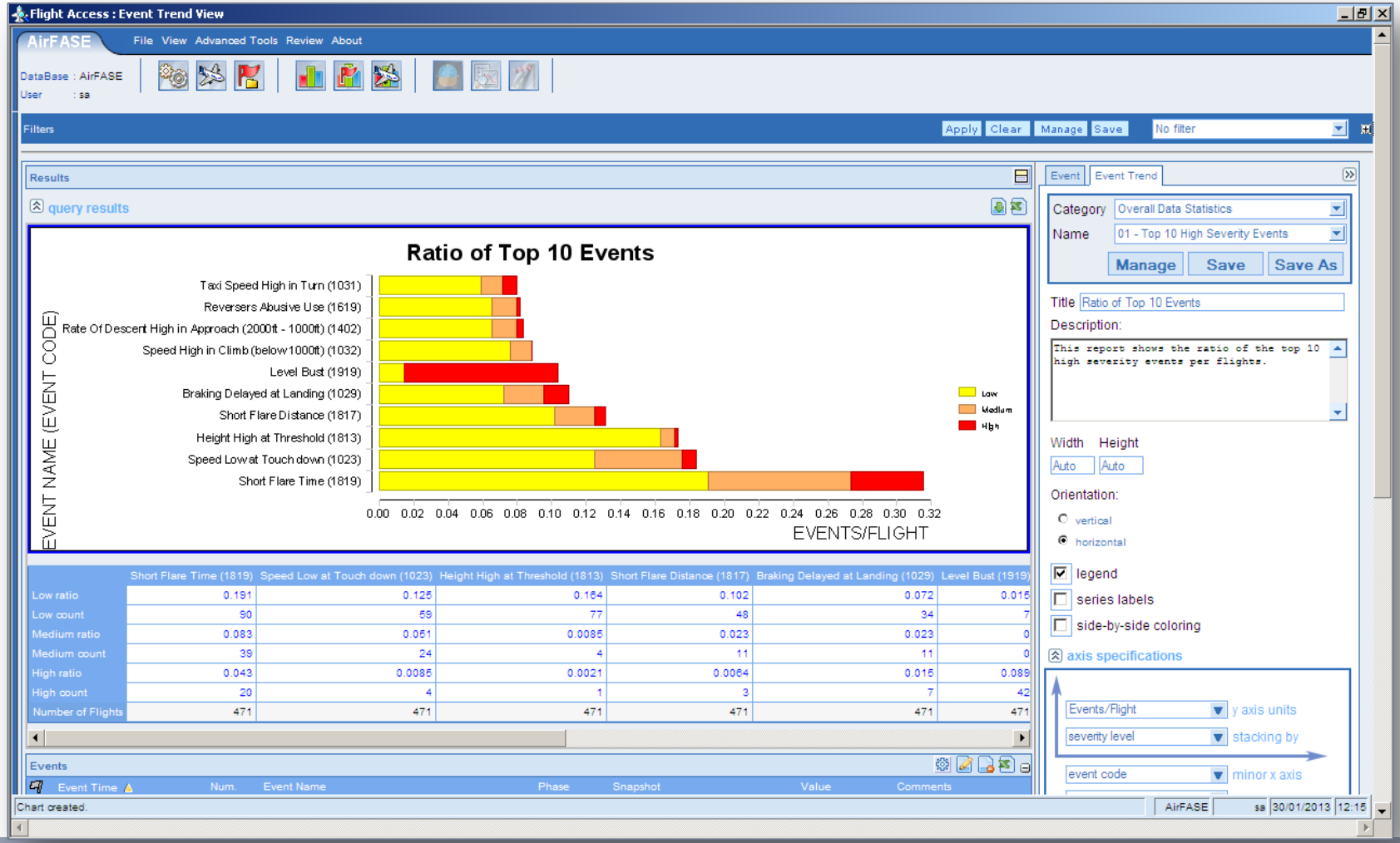
Stats & Trends Module



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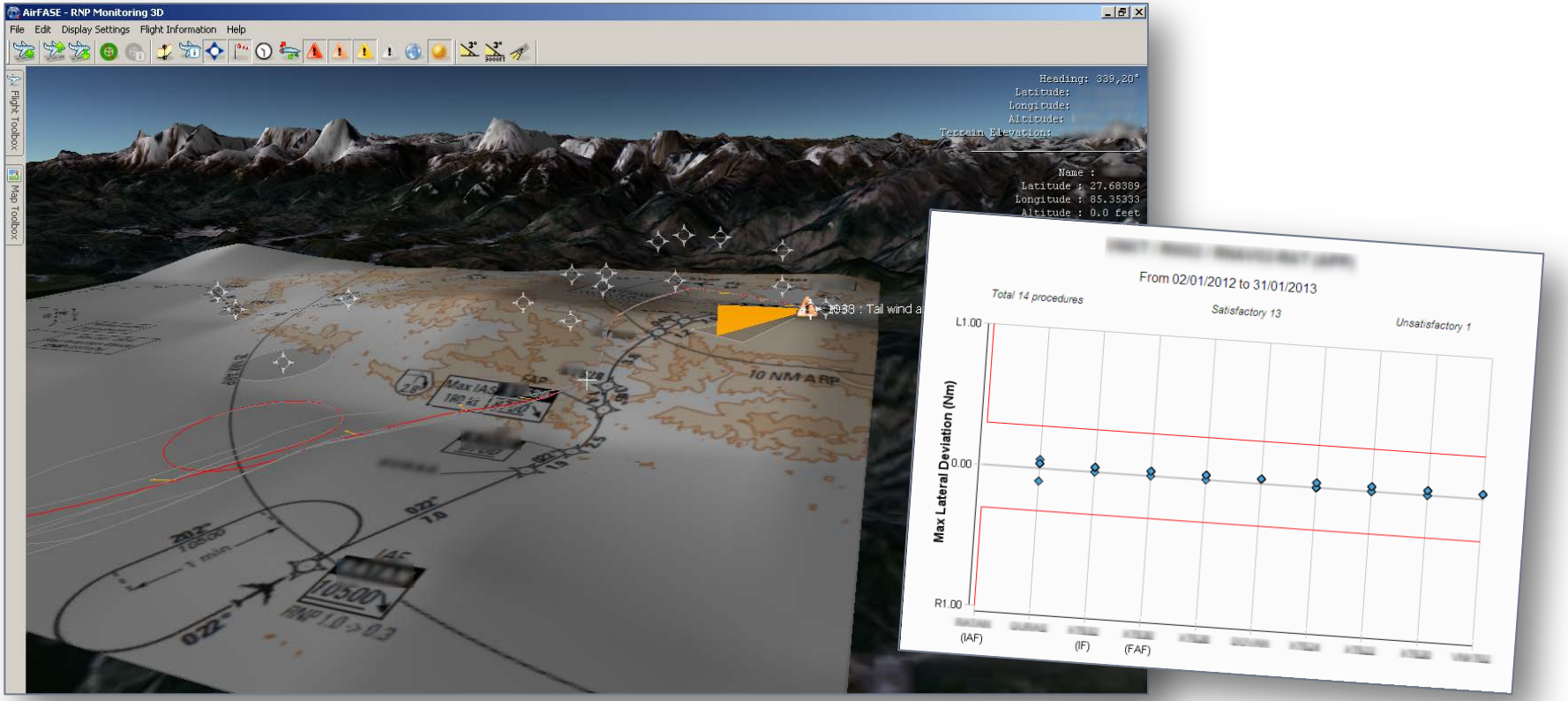
RNP Monitoring Module*



*: Optional

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PROCESSING - FDA TOOL - AIRFASE

The FDA tool is very powerful.

It will tell you

WHAT happened,

but not **WHY** it happened…

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PROCESSING - FDA TOOL - AIRFASE

The FDA tool has some limitations.

It is partially:

- ➔ Blind
  - ➔ Deaf
    - ➔ Dumb

It needs human expertise for the analysis of the data.

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