RDECOM

US Army Research, Development & Engineering Command

Weather Impacts and Routing Services in Support of Airspace Management Operations

(for the Army)

ARL

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**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

Outline

- Army Airspace Management Ops
  - Tactical Airspace Integration System (TAIS)

- Weather Impacts
  - My Weather Impacts Decision Aid (MyWIDA)

- Routing
  - Atmospheric Impacts Routing (AIR)

- TAIS / ARL Web Services Interoperation

- Summary

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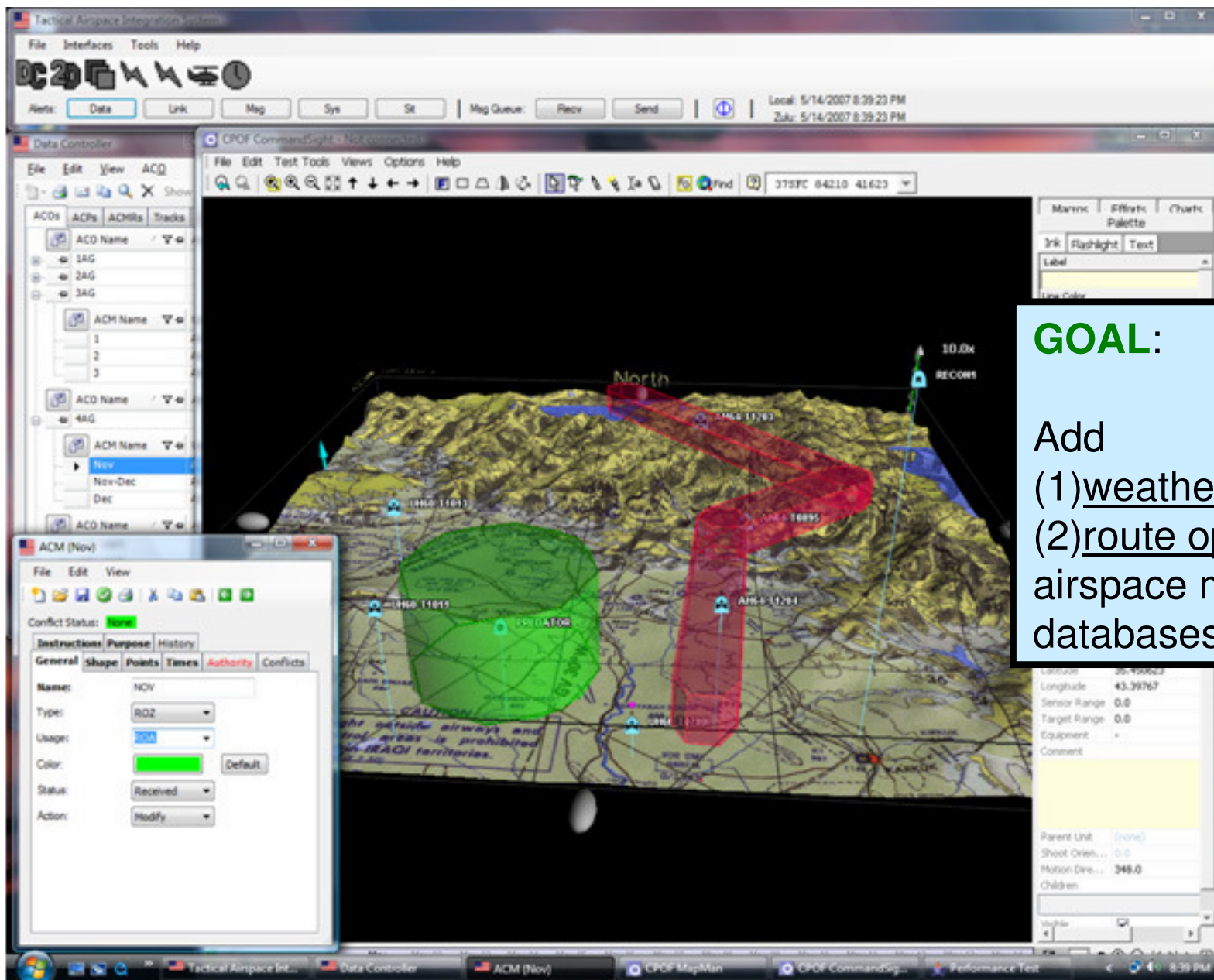# Tactical Airspace Integration System (TAIS)

TAIS Mission

Provide automated Airspace Command and Control and enroute Air Traffic Services to users.
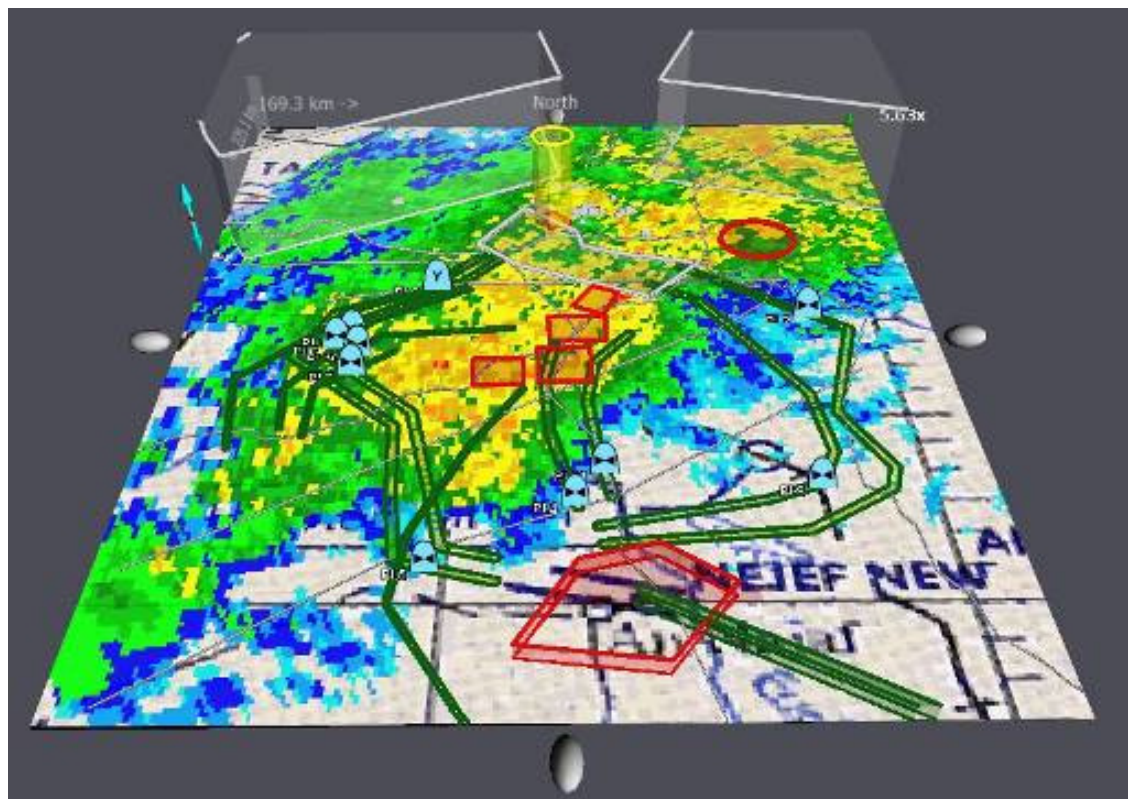
When Current Ops domains and Airtracks are displayed, operational impacts of weather on the airspace become readily apparent.

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TAIS Visualizer

GOAL:

Add
(1) <u>weather impacts</u> and
(2) <u>route optimization</u> to
airspace management
databases & depictions

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STEP 1: Weather Impacts

MyWIDA = **My** **W**eather **I**mpacts **D**ecision **A**id

- Provides weather impacts on assets (missions, operations, systems, equipment, resources, infrastructure).
  - Compares critical thresholds (rules) against observed/forecast values.
  - **FOR AVIATION**: Allows users to create mission-specific critical thresholds tailored for individual aircraft, routes, and airspace domains.
- Results presented as red/yellow/green "stoplight" depictions of unfavorable/marginal/favorable weather conditions.
- Fielded operationally in the Army.
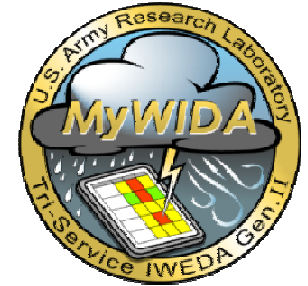
MyWIDA v1 Map Depiction
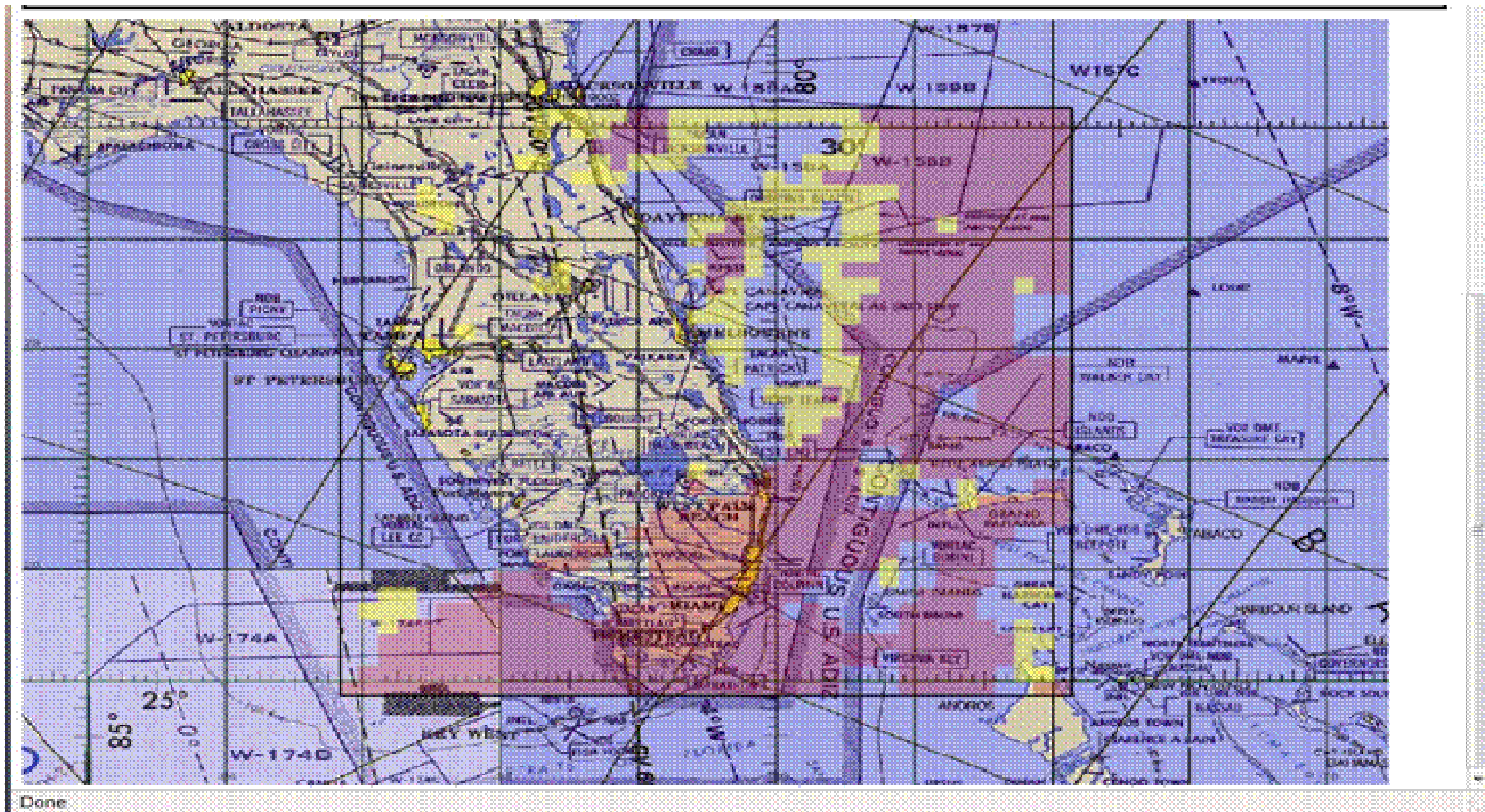
MyWIDA Summary

MyWIDA v1

- Portable/Tactical: Runs on Windows PC/Laptop systems.
- LAN connectivity needed for data retrieval.
- Selectable Area Of Interest, Forecast Periods, & Model Data.
- Beta version available now for testing.

MyWIDA v2
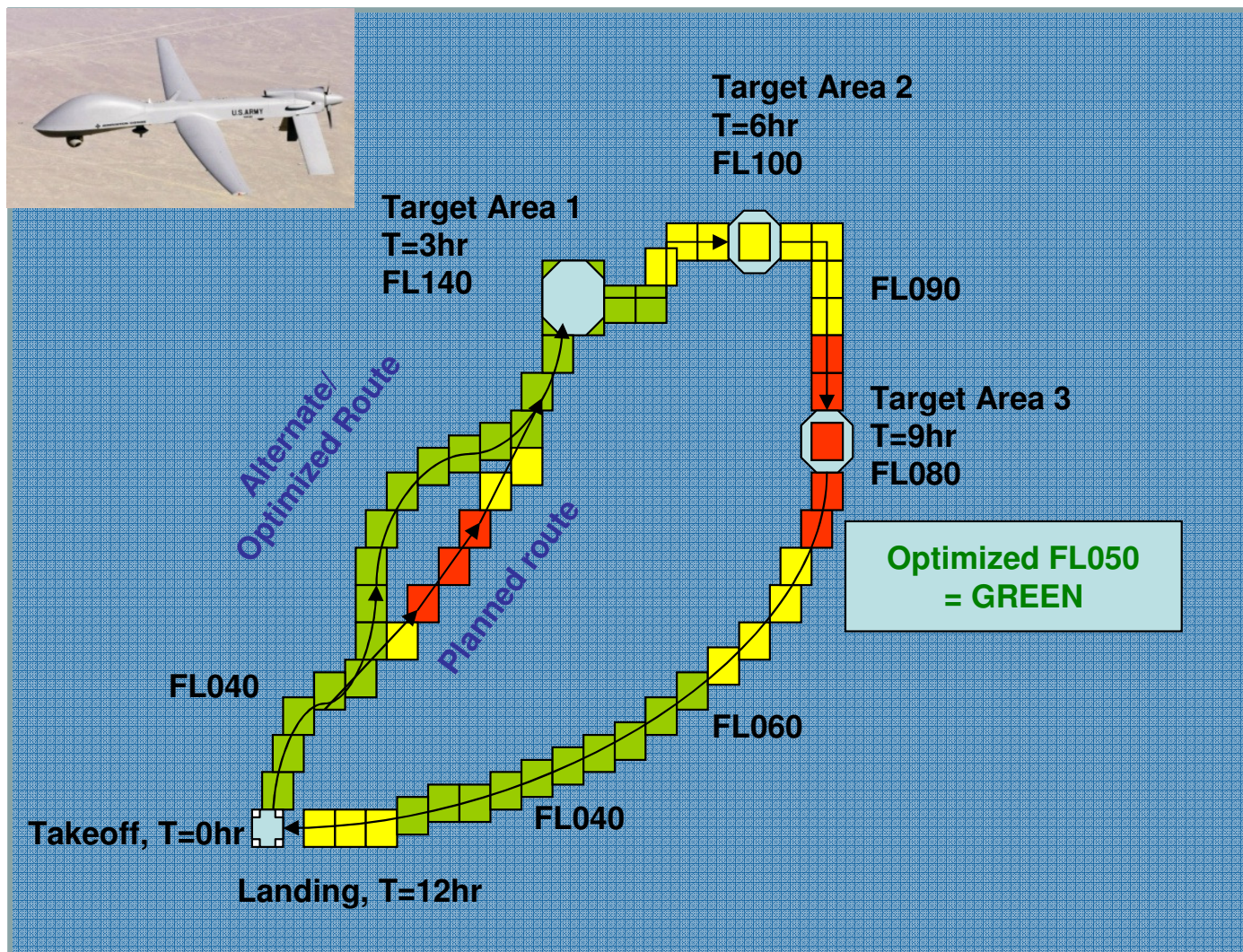
- Web Services implementation.
- Multiple forecast data sources: NWS, AF, Navy, etc.
- Multiple AOIs and more color granularity for R-Y-G transitions.
- 3D/4D visualizations via Google Earth and/or other options.
- Data output formats aligning with industry standards (XML, KML, etc.).

- **MyWIDA will be providing weather impacts data for TAIS**

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STEP 2: Route Optimization

Target Area 2
T=6hr
FL100

Target Area 1
T=3hr
FL140

FL090

Alternate/ Optimized Route

Target Area 3
T=9hr
FL080

Planned route

Optimized FL050 = GREEN

FL040

FL060

FL040

Takeoff, T=0hr

Landing, T=12hr

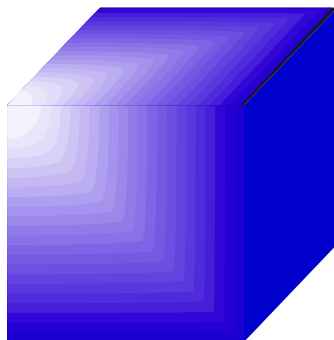TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Route Optimization Concept

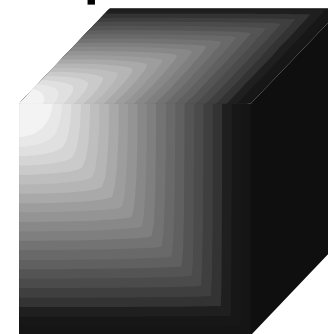**New 4D Weather Forecast Grid**

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Aircraft-Specific Weather Impacts Threshold Rules

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4D Weather Impacts Grid

Altered Flt Path (if needed)

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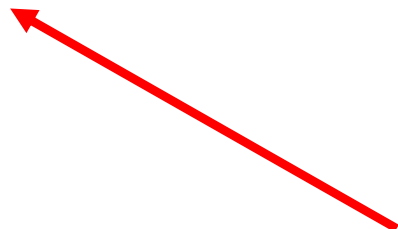
New Flt Path Options; Avoiding Enrte Hazards

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PATH OPTIMIZATION ALGORITHM

Initial/Current Flight Path

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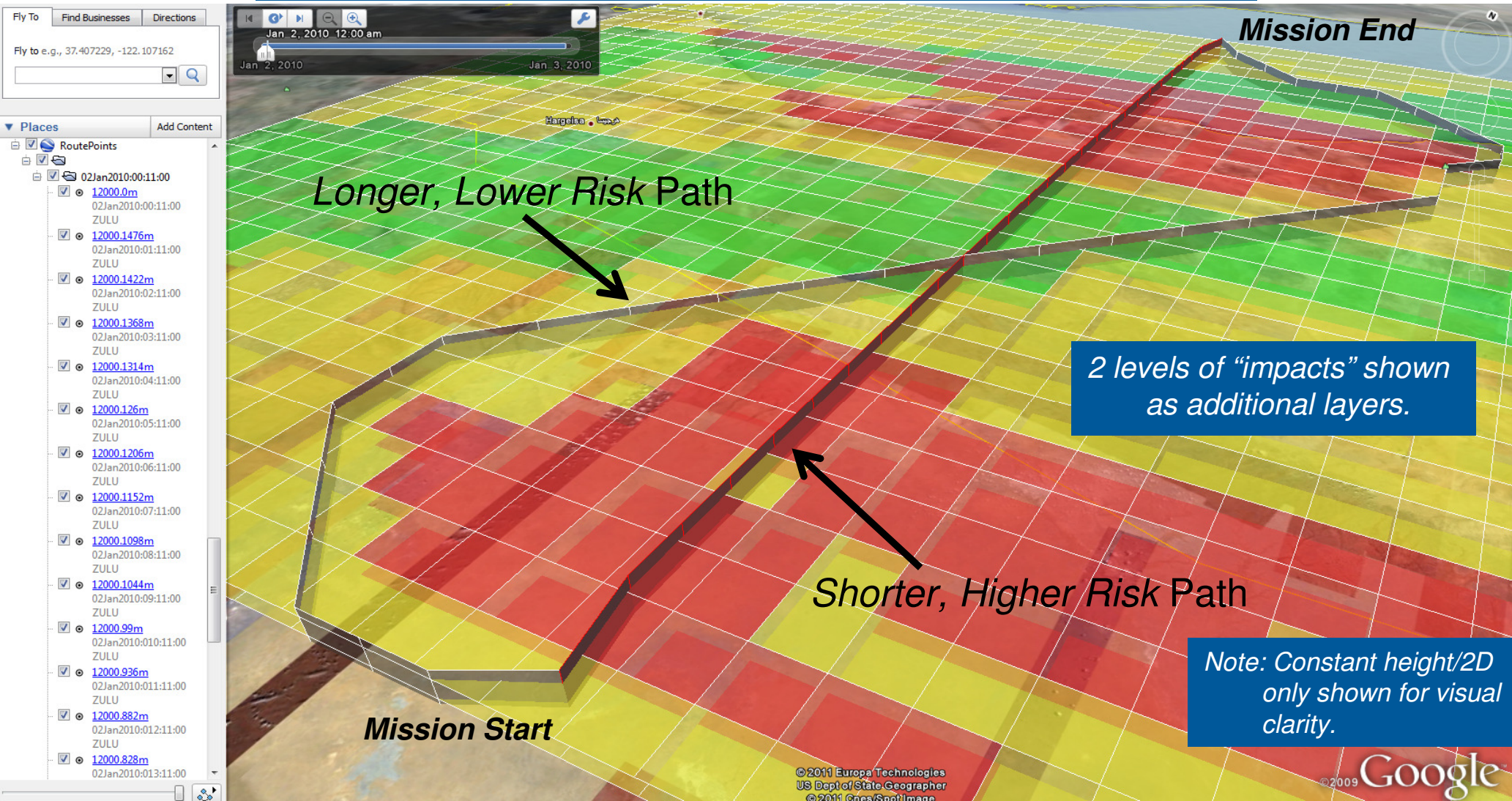
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Route Optimization via the AIR app

- *AIR* calculates an optimized air system route based on <u>atmospheric impacts and obstacles</u> along the path. *Path optimization employs A* search algorithm. Data structures support other algorithms (e.g., D*).*

- *<u>AIR Qualities</u>*:
  - Written in Java (platform independent).
  - Ingests 3D/4D weather "impact" gridded databases.
  - Allows 3D volumes to be avoided → weather "objects," airspace conflicts, restricted airspace/aviation corridors; other obstacles represented as 3D volumes.
  - Generate output in industry standard Google Earth/Maps Keyhole Markup Language (KML).

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AIR Visualization

**AIR-generated 4D flight paths as "playback files"
(Google Earth KML output format)**

Mission End

Longer, Lower Risk Path

2 levels of "impacts" shown as additional layers.

Shorter, Higher Risk Path

Note: Constant height/2D only shown for visual clarity.

Mission Start

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AIR Current Status

- **AIR** *Web Service* (and reference client) prototype developed and successfully test-deployed on web service application server (Glassfish).

- **AIR** *View standalone (w/GUI)*:
  - Output:
    - 2D plot (Java 2D graphics) including move time (hrs) and distance (km).
    - Google Earth KML output of optimized path.
    - Google Earth "fly-thru tour" along optimized path.
  - Can run from a CD.

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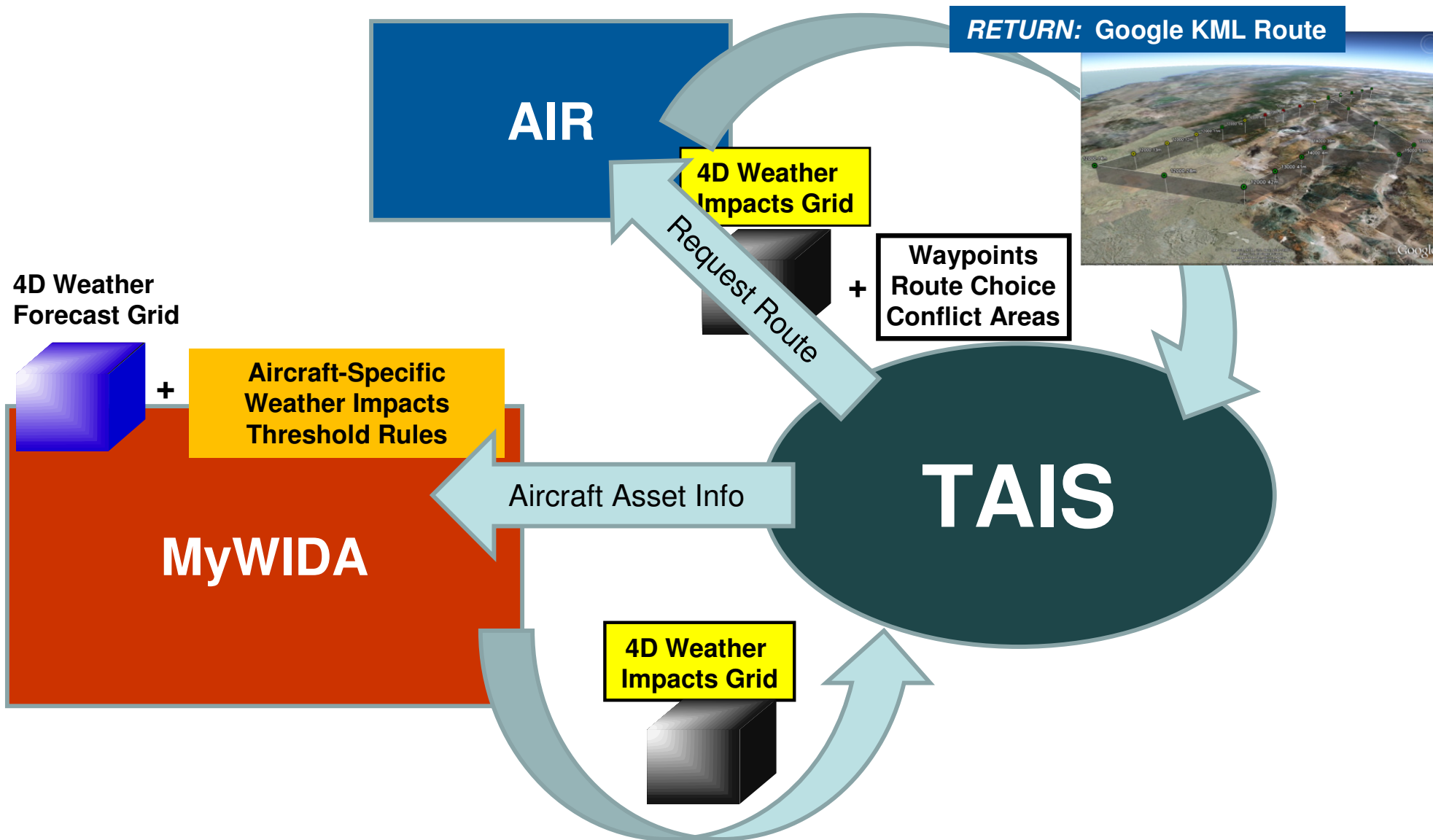
AIR Current Status

AIR – *Current Capabilities:*

- User inputs:
  - Path (two or more waypoints) and aircraft speed (m/s).
  - Choice of "lower risk" or "higher risk" routes.
  - Boundaries – vertical, horizontal, or 3D volume (e.g., restricted airspace and "no-fly" zones).
- Output:
  - Google Earth/Maps KML AIR-generated *optimized path*.
- Prototype Demonstration:
  - Calculates approximately 1000 potential paths/routes per second in 3D space.
  - Successfully tested on multiple platforms (Windows, Linux).

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TAIS, 3D Weather Impacts, and AIR

AIR

RETURN: Google KML Route

4D Weather Impacts Grid

Request Route

+ Waypoints Route Choice Conflict Areas

4D Weather Forecast Grid

+ Aircraft-Specific Weather Impacts Threshold Rules

Aircraft Asset Info

MyWIDA

TAIS

4D Weather Impacts Grid

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Summary

- We're on the way to successful integration of weather impacts grids and air route optimization into Army airspace management.
- Weather impacts capability (MyWIDA) <u>suitable for a wide variety of decision-making needs</u>, not just aviation.
- The Atmospheric Impacts Routing (AIR) application and web service are being transitioned to Army operators this year.
    - AF Weather Agency will also receive the AIR app this year.
- AIR and MyWIDA output = industry standard Google KML.

→ MyWIDA and AIR technologies are suitable for non-DoD applications.

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