

Background

Single Pilot Under Distributed Simulations (SPUDS):

Conduct research to assess and develop resources for the flight crew, ground operators, and automated research technologies in order to make single pilot operations possible.

Motivation

Address pilot shortage and reduce costs.

Solution

Develop tools and operations to evaluate the safety and efficiency of reduced crew operations.

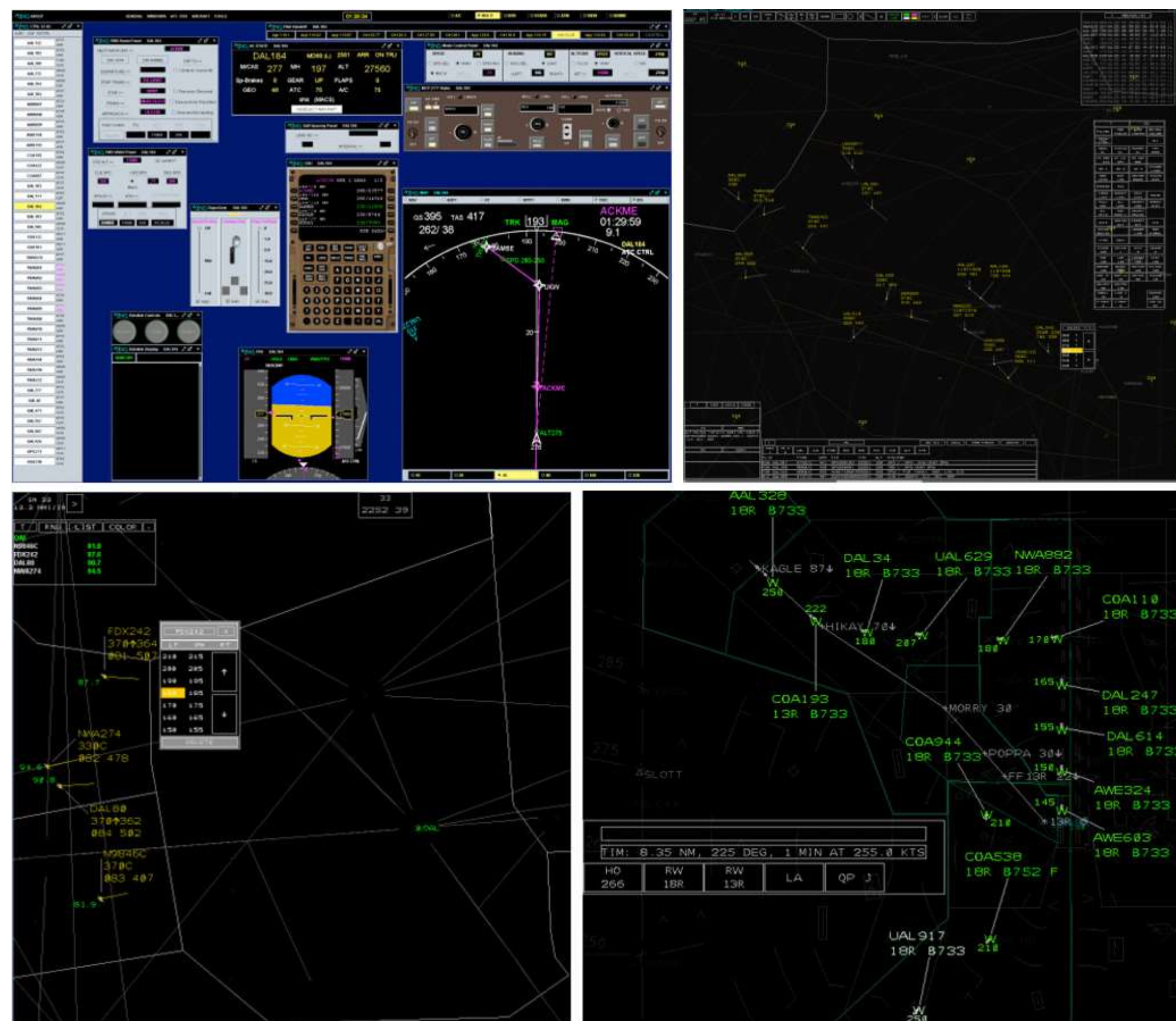
Target Outcome

A single pilot on board who will be assisted by both automation and a ground operator to match or increase the current level of safety and efficiency in the National Airspace System.

Platforms

MACS

The Multi Aircraft Control System (MACS) is the software platform which provides the simulation environment.



Its flexibility and functionality make it capable of emulating a variety of displays and tools.

- An air traffic simulator
- A medium fidelity flight deck with full flight management system (FMS) capabilities
- A high fidelity air traffic controller workstation with advanced automation (Oceanic, Center, and TRACON)
- An experiment control station
- A data collection system
- A scenario generation tool
- A rapid prototyping environment for new air traffic control and management automation
- A rapid prototyping environment for flight deck automation
- An analysis tool
- A system to participate or control large scale distributed simulations with many operators
- A standalone application to assess and demonstrate new ATM concepts on any state-of-the-art computer

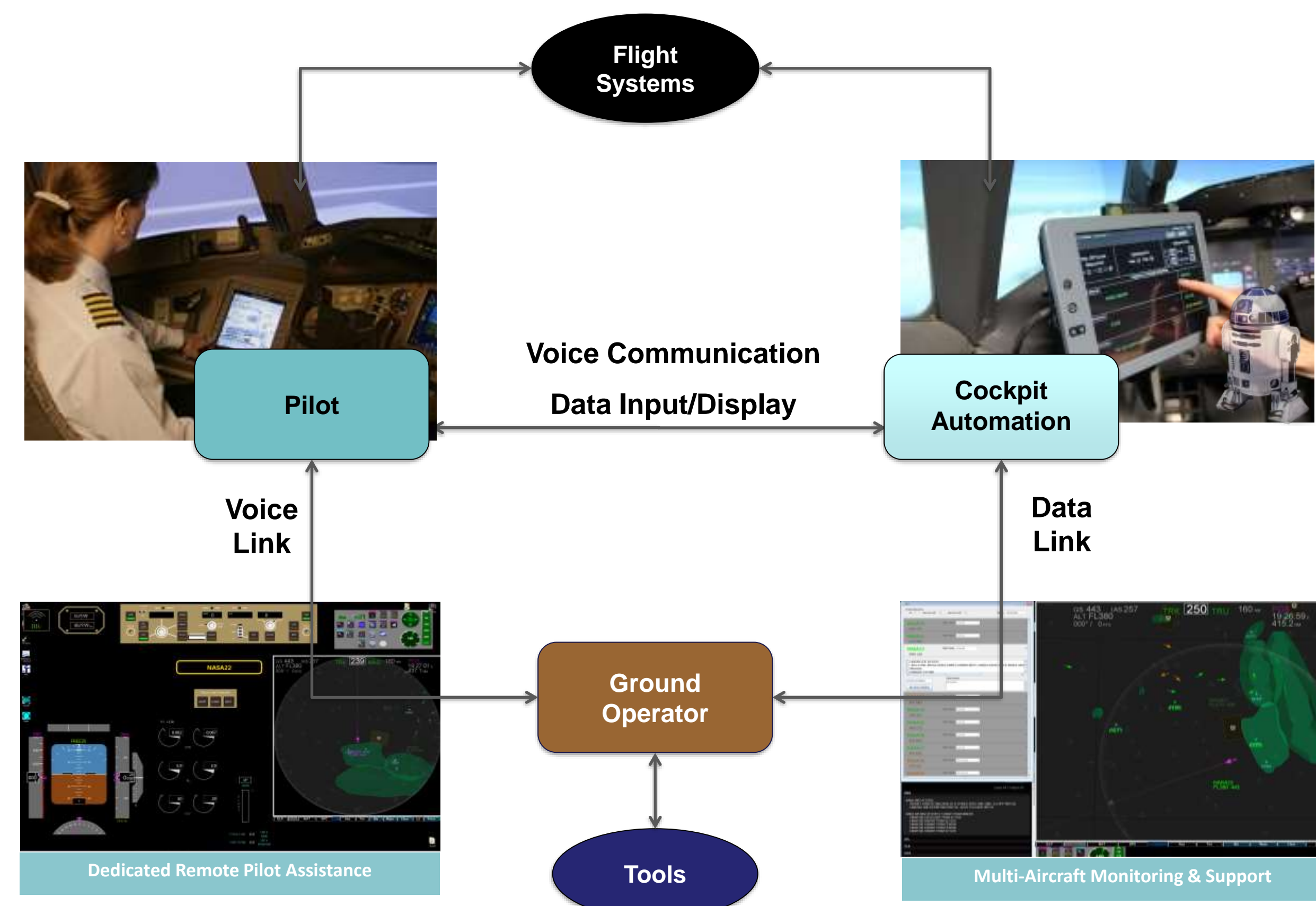
Scenario Development

Task

Aid in the creation of scenarios that will portray air traffic in the summer and winter seasons of the Western region of the United States

Method

- Created database that included flight plans derived from current scheduled commercial routes
- Airport and runway information gathered for the Western region of the United States using the U.S. Terminal Procedures Publication charts
- Scenarios developed using MACS
- Weather was implemented into the scenarios using StormGen
 - Monitored number of aircraft entering and exiting weather cells
- Created METARS for simulated weather disturbance advisories at different intervals of the scenario
- In order to assess pilot, ground operator, and automation tools' ability to mitigate off nominal situations, we plan to:
 - Include severe weather disturbances within the simulation
 - Simulate emergency events such as passenger illness or aircraft malfunction



Weather Development

Background

StormGen is a program for creating weather for NASA's MACS. It expedites the weather creation process by giving the user the tools to generate weather cells (Wx cells) via graphical user-interface.

Key Functions

- Generate realistic weather in computer simulation environments for experimental research.
- Provide airspace researchers with meaningful data to aid in the design of automated technology.
- Understanding the weather decision-making process of pilots and air traffic control operators.

Weather Development (cont'd)

Design

- The design of summer and winter weather cells were created according to National Oceanic and Atmospheric Administration (NOAA) radar maps.
- Morphing and shaping of weather cells between frames (rotate, resize, shift, shells, smooth, propagate, dissipate) was designed to replicate Wx cell size and intensity (according to colors).
- Exports weather files in different formats to be used in other systems (e.g., NASA's MACS, Cockpit Situation Display).

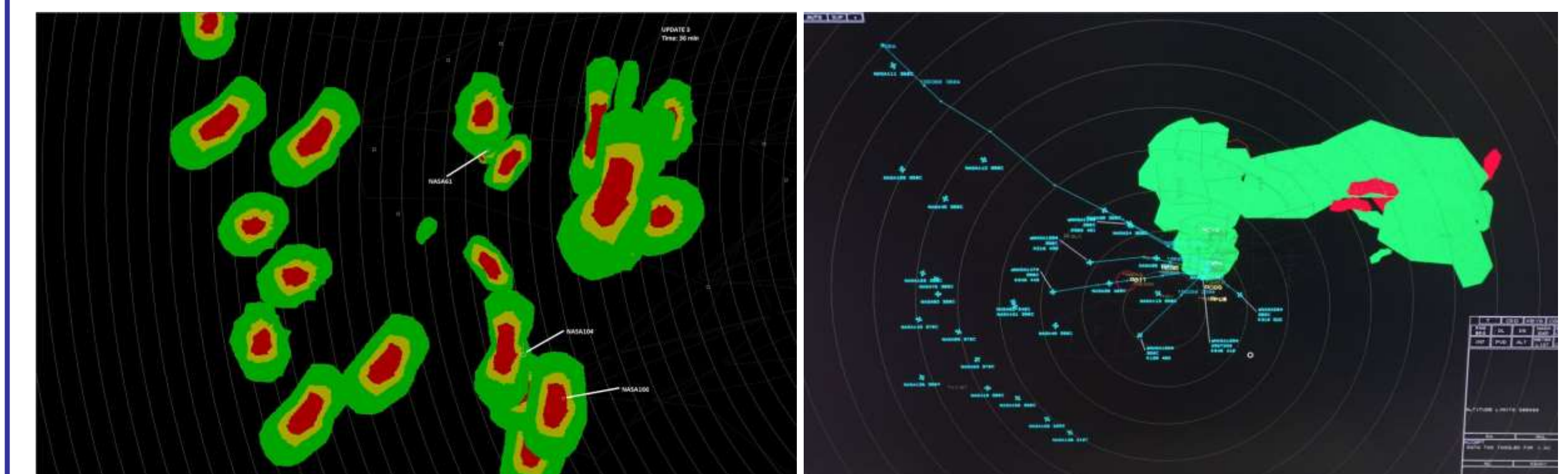


Figure 3. Images of summer and winter weather in RCO scenarios

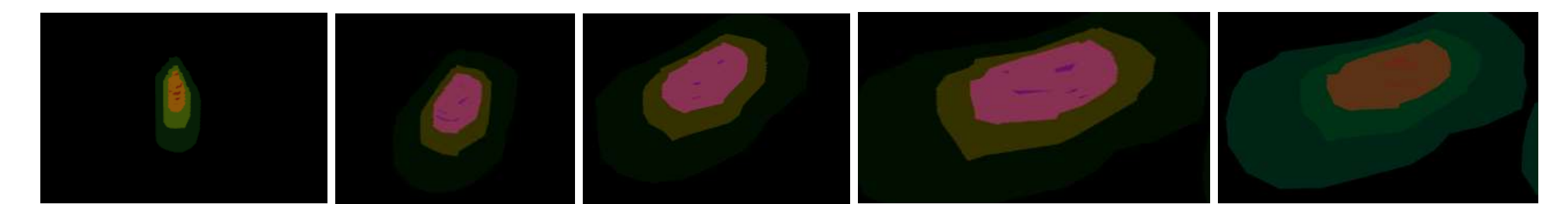


Figure 4. Images of a large summer Wx cell dissipating through 5 frames

Limitations

- Delayed Wx cell updates (gap in frames).
- Telecommunication technology limitations (Over-The-Air delays).
- Pilot resistance against new technology (careers).

Applications/Benefits

- Weather development compatibility across different flight simulation platforms, legacy methods led to data loss when transferring templates across different simulation platforms.
- Help improve weather information in automation technology and understanding pilot decision making capabilities.
- Reduce flight delays and improve quality of flights.

METARS

Meteorological Terminal Aviation Routine Weather Reports: (METARs) were created and updated at different intervals of the simulation.

Example METAR

SPECI KLAX 132053Z 19012KT 3SM OVC022 -TSRA 17/15
A3010 RMK AO2 SLP185 T0168014458026

References

- Johnson, W. (2015). Reduced Crew Operations (RCO) [PowerPoint slides].
- Kraut, J., Quinonez, T., Wu, S., Johnson, W., & Battiste, V. (2012). StormGen: A Proposed Solution to Weather Simulation in NextGen Research. Humansystems, Xx.http://humansystems.arc.nasa.gov/publications/StormGenAProposed_2012.pdf
- Prevot, T., Smith, N., Palmer, E., Mercer, J., Lee, P., Homola, J., & Callantine, T. (2006, August). The airspace operations laboratory (AOL) at NASA ames research center. In *Proceedings of the AIAA Modeling and Simulation Technologies Conference*.