Weather-Technology-in-the-Cockpit (WTIC) Program Weather State Change Notification and Use of Portable Weather Application Study

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GA Weather State-Change Notifications

Purpose

- To assess the potential benefits of weather state-change notifications (provided by tactile vibration) on pilots' behavior and Weather Situation Awareness (WSA)

- To assess pilot sensitivity to weather symbology changes on topological, visual flight rules (VFR), and instrument flight rules (IFR) aeronautical map backgrounds during a change-detection experiment
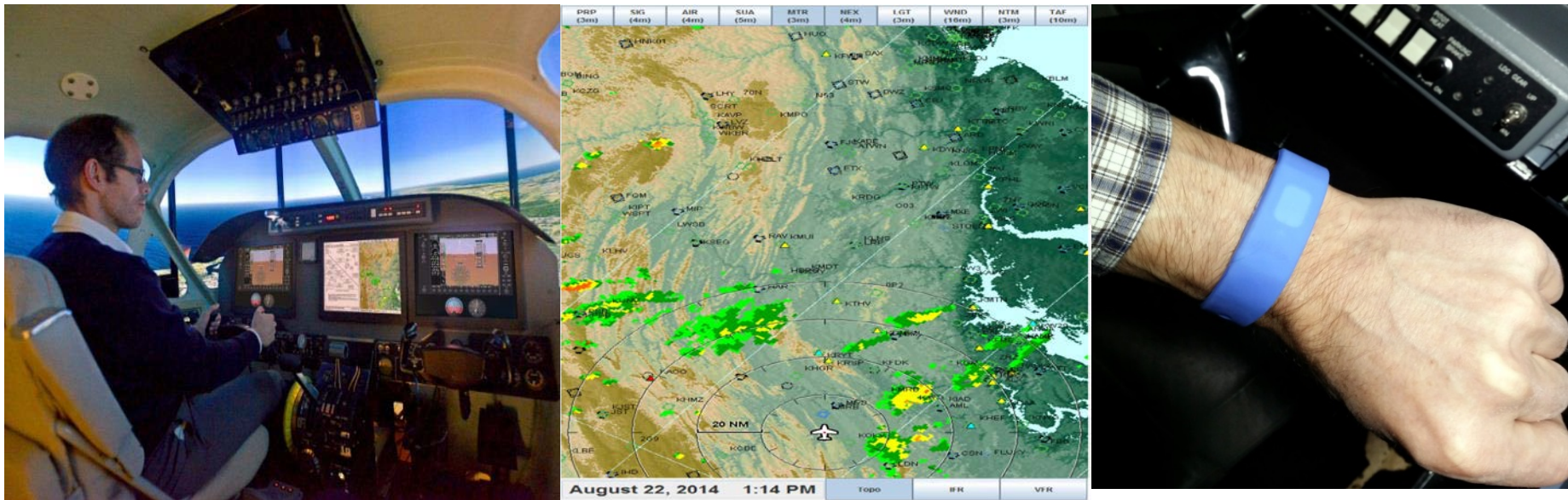
GA Weather State-Change Notifications

When you are ready to start the next trial,

press the Spacebar

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Results

- The *Experimental* group had higher WSA than the *Control* group:
  - Communication of weather presentation information (100 vs. 58)
  - Communication of maneuver/course change information (411 vs. 330)
  - "Out-the-window" weather communications with the "pilot following" (427 vs. 373)
  - This supports the hypothesis that weather state-change notifications result in earlier and more accurate recognition of weather state-changes and thereby positively improves participant WSA

- However, the *Experimental* and the *Control* groups kept similar distances to severe weather – well below the recommended 20 miles
  - failing to follow current FAA guidelines

- There were 22% more instances of VFR flights into instrument meteorological conditions (IMC) in the *Control* group

- Data captured by the functional near-infrared (fNIR) showed higher levels of cognitive workload in the *Control* group compared to the *Experimental* group

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Results cont.

- We attribute the reduced cognitive load in the *Experimental* group to increased participant WSA. Because of the state-change notifications (bracelet vibrations), participants were more attentive to information on the weather presentation, which enhanced planning and decision-making and reduced cognitive load.

Change-detection experiment

Participant discrimination performance (symbol absent vs. symbol present) was generally low on the topological, IFR, and VFR map backgrounds:

- METAR symbols ~ 25% correct discriminations
- SUA area ~ 60-70% correct discriminations
- Precipitation area ~ 85-90% correct discriminations

Conclusions

- Weather state-change notifications improved WSA and reduced cognitive workload
- However, these improvements did not translate to changes in participants' weather-avoidance behavior
- Control and Experimental groups flew too closely to hazardous weather compared to what is recommended in current FAA guidelines (20 miles)
- This indicates gaps in either pilot understanding of the information or gaps in pilot decision making

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GA Portable Weather Application Study

Purpose

- To examine the potential benefits and effect on pilot flying behavior from the use of portable weather presentations
- To assess pilot sensitivity to weather symbology changes

GA Portable Weather Application Study

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press the Spacebar

GA Portable Weather Application Study

Results

- Increased WSA for the *Experimental* group using the portable weather application
  - Communication of weather information (137 vs. 16 communications for the *Control* group)
  - Communication of landmarks and airfields (51 vs. 41 communications for the *Control* group)
- Aircraft distance-to-weather
- *Experimental* group had credibly greater distances to hazardous weather than the *Control* group
  - Nevertheless, both groups flew too closely to hazardous weather compared to what is recommended in current Federal Aviation Administration (FAA) guidelines
- We found a higher cognitive engagement for the *Experimental* group
  - Possibly reflecting an increased flight planning and decision-making on part of the participants
- We found a credibly higher cognitive engagement (prefrontal oxygenation levels) for the *Experimental* group
  - Possibly reflecting an increased flight planning and decision-making on part of the participants
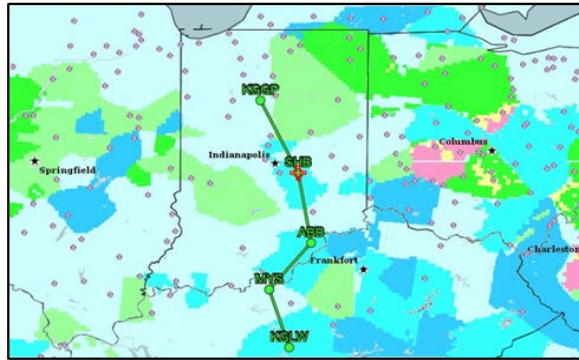
GA Portable Weather Application Study

Results continued…

- Change-detection experiment
  - Symbol discrimination performance (symbol absent vs. symbol present) was low for most conditions
    - Cloud ceiling areas (colored patches) ~ 95% correct discriminations

    - PIREP symbols ~ 55% correct discriminations

GA Portable Weather Application Study

Conclusions

- Overall, the study outcome supports our hypothesis that the portable weather application can be used without degrading pilot performance on safety-related flight tasks, actions, and decisions

- The result also shows that an increased WSA does not automatically transfer over to improved flight behavior

- Participants could learn and operate the portable weather application with relative ease, but training is necessary to help pilots translate weather information into improved flight behavior strategies

- The outcome from the change-detection experiment shows that work is still needed to optimize the symbology for portable cockpit weather presentations
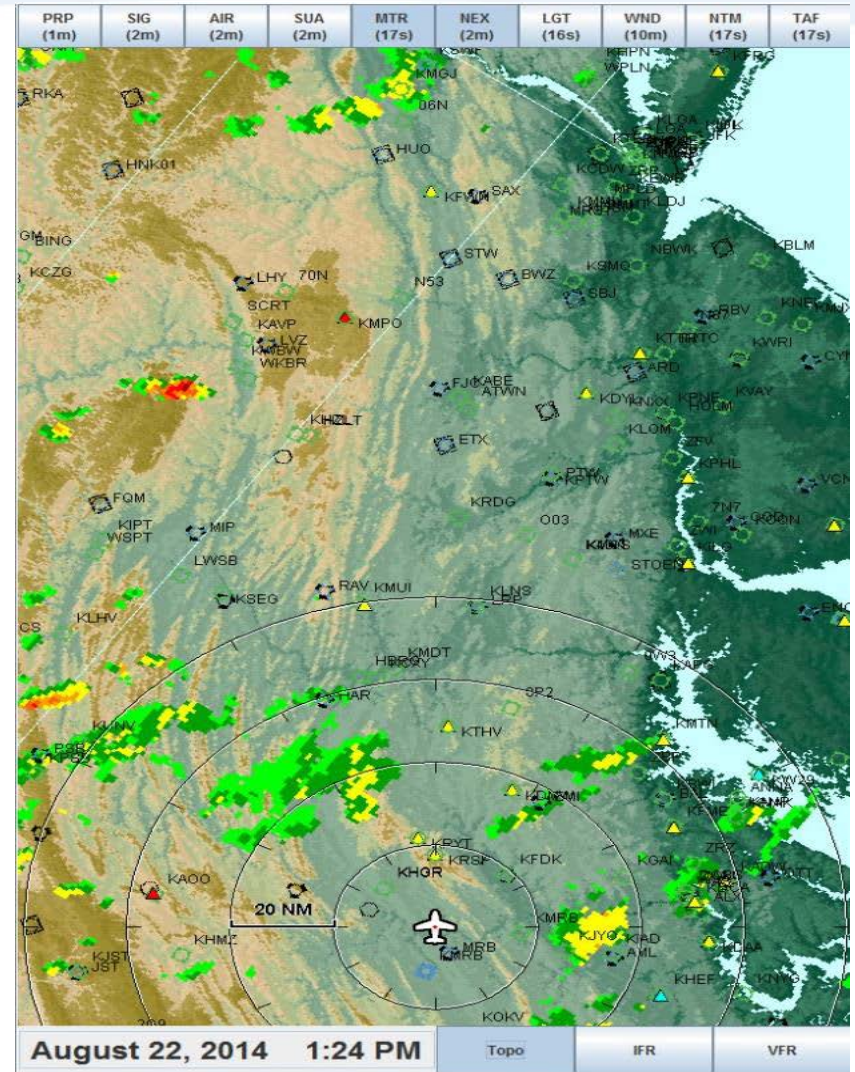
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Contact Information

- **Ian Johnson**
  - **FAA / ANG-C61**
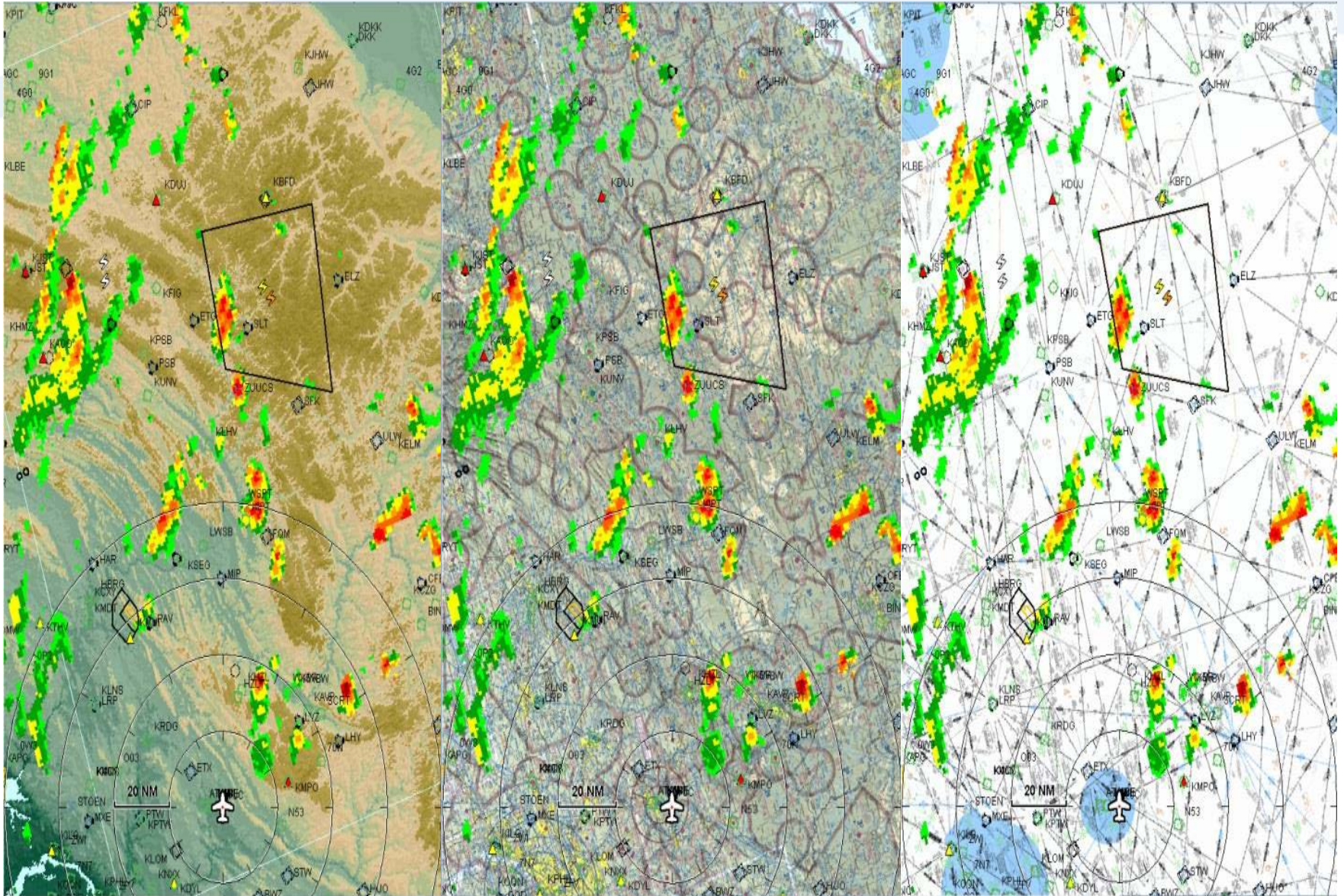 - **Ian.Johnson@faa.gov**
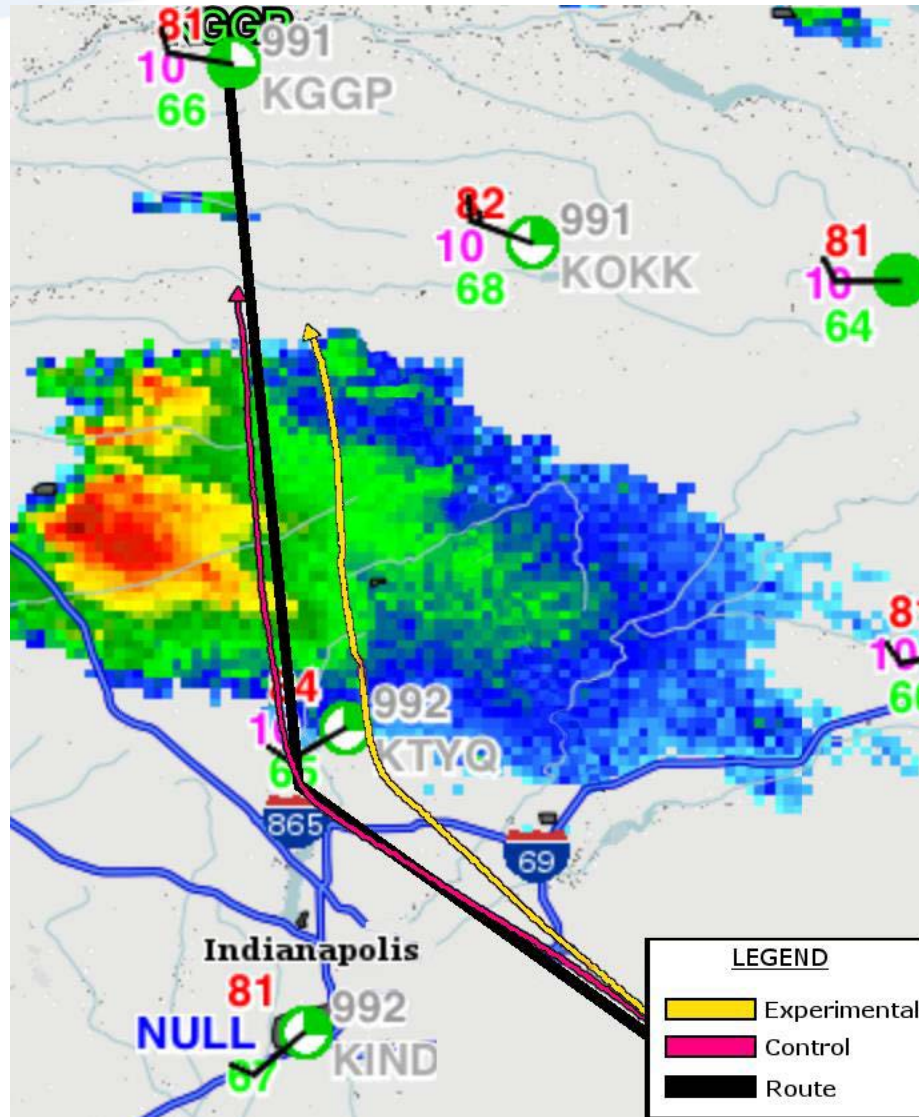 - **Ph. (202) 267-2795**

Backup Slides

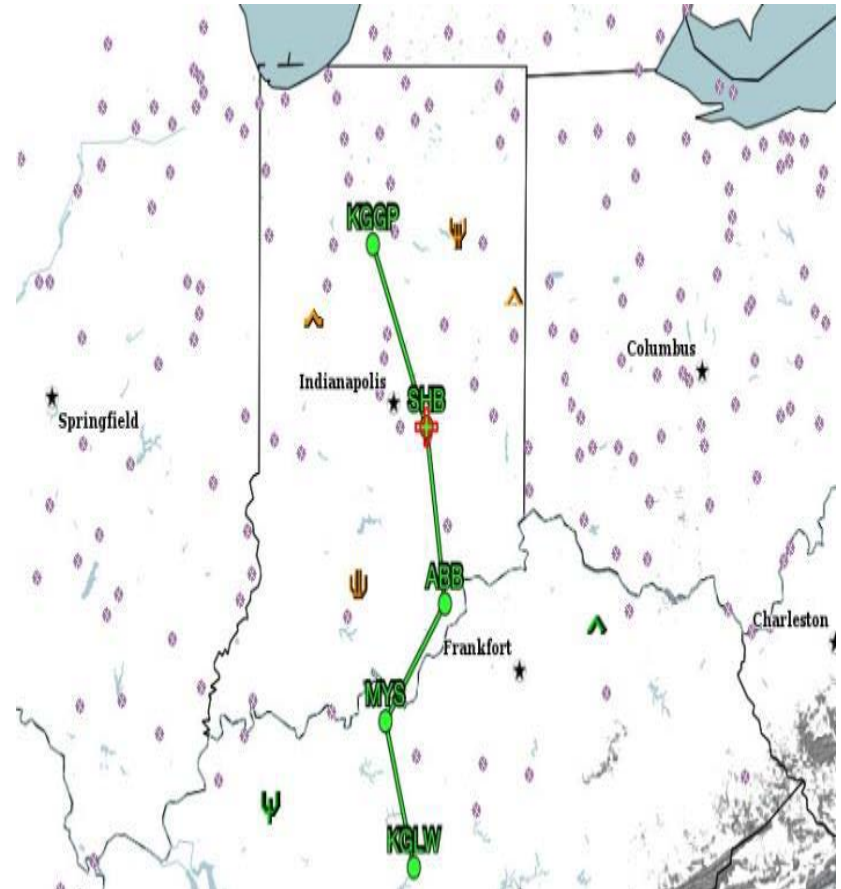# WX State-Change Notification

Change-Detection display

Distance from Weather

Portable Weather Display

Portable Weather Display