Information on ACRP

- www.TRB.org/ACRP
- Regular news and updates on:
  - Upcoming and ongoing research projects
  - New publications
  - Success stories
  - Announcements
  - Webinars
- Find ACRP on Facebook and LinkedIn
Upcoming ACRP Webinars

Stay tuned for more information about the 2016 ACRP webinar series:

http://www.trb.org/ACRP/ACRPwebinars.aspx
Opportunities to Get Involved!

- ACRP’s Champion program is a new initiative!
- Designed to help early- to mid-career, young professionals grow and excel within the airport industry.
- Airport industry executives sponsor promising young professionals within their organizations to become ACRP Champions.
- Visit ACRP’s website to learn more.
Additional ACRP Publications Available on this Topic

- **ACRP Report 56** – Practical Greenhouse Gas Emission Reduction Strategies for Airports
- **ACRP Report 64** – Evaluating Alternatives For Aircraft Ground Power, Heating, and Air Conditioning
- **ACRP Report 71** – Guidance for Quantifying the Contribution of Airport Emissions to Local Air Quality
- **ACRP Report 119** – Airport Sustainability Practices: Tools for Evaluating, Measuring, and Implementing

You can learn more about these publications by visiting [www.trb.org/publications](http://www.trb.org/publications)
TRB Aviation Group Committee Overview

Environmental Impacts of Aviation (AV030)

Jennifer Salerno, Committee Chair
What is TRB’s Aviation Group?

• The Aviation Group consists of nine committees that...
  o propose research
  o share research findings
  o sponsor special activities, programs, and events
  o provide a forum for transportation professionals to discuss today’s and tomorrow’s aviation-related issues.
TRB’s Aviation Group Committees

- Intergovernmental Relations in Aviation (AV010)
- Aviation System Planning (AV020)
- Environmental Impacts of Aviation (AV030)
- Aviation Economics and Forecasting (AV040)
- Airport Terminals and Ground Access (AV050)
- Airfield and Airspace Capacity and Delay (AV060)
- Aircraft/Airport Compatibility (AV070)
- Light Commercial and General Aviation (AV080)
- Aviation Security and Emergency Management (AV090)
Environmental Impacts of Aviation (AV030)

• The Committee on the Environmental Impacts of Aviation (also known as AV030) focuses on environmental issues central to airport planning, design, construction, and operations, as well as to related aviation system and aviation technology development issues.

• 2016 TRB Annual Meeting
  • Vulnerability Assessment at Airports panel
  • (Airport) Environmental Modeling in the Real World
Ways to Get Involved

• Contact the committee chair
  o Jennifer Salerno
    Salerno_Jennifer@bah.com

• Visit our website:
  https://sites.google.com/site/trbav030/?pli=1

• Become a “friend” of the committee
  o Join the committee email distribution list
  o Volunteer to review research papers, work on a committee project or give a presentation
  o Participate in committee meetings

More information is available at:
http://www.trb.org/aviation1/trbcommittees.aspx
Today’s Speakers

Moderated by Jennifer Salerno, Environmental Impacts of Aviation, TRB Aviation Committee (AV030)

1) ACRP 02-40: Climate Change Risk Assessment and Adaptation Planning at Airports
   • Mathew Mampara, Dewberry

2) ACRP Synthesis 33: Airport Climate Adaptation and Resilience
   • Chris Baglin, PPC
ACRP 02-40
Climate Change Risk Assessment and Adaptation Planning at Airports

Mathew Mampara, PE and Krista Rand Dewberry
Project Team

- Dewberry
- Gresham Smith and Partners
- GCR Corporation
- Richard Marchi
“The objective of this research is to develop a climate change adaptation guidebook for airports that…

– identifies potential impacts from climate change;

– assesses related airport risks; and

– provides guidance for managing related uncertainty, developing a prioritized action plan, and implementing the action plan as an adaptive management process.”
ACRP 02-40: Guidebook and Tool

- How to mainstream climate change adaptation into existing airport processes and frameworks
- A tool and guidelines for performing a climate risk assessment
  - Airport Climate Risk Operational Screening (ACROS)
- Site- and asset-specific adaptation options
- Published November 2015
Climate Change Adaptation Planning Process

1. Initiate the Adaptation Planning Process
   - Establish a Stakeholder Advisory Committee
   - Set Climate Resilience Goals
   - Identify Audience and Destination for Adaptation Plan and Related Work Products

2. Develop an Adaptation Plan (Independent or Supported by the ACROS Tool)
   - Assess Baseline Climate and Projected Climate Changes
   - Identify Critical Assets and Operations
   - Inventory Asset and Operational Vulnerabilities
   - Prioritize Risks and Incorporate into Stand-Alone or Mainstreamed Documents

3. Refine and Monitor
   - Climate Information: Update as New Data, Models, and Higher Resolution Information Become Available
   - Criticality: Refine Over Time
   - Vulnerabilities: Update to Reflect Changes in Condition and Design Specifications
   - Activities: Monitor and Revise on 3-5 Year Time Scale or as Needed
Internal Stakeholders

- Executive Management
- Engineering
- Planning
- Operations and Maintenance
- Environmental, Sustainability, and Resilience
- Finance
- Risk Management/Legal
- Emergency Operations
Chapter 8 Mainstreaming Adaptation Strategies

8.1 Safety Management Systems
8.2 Disaster, Business Recovery, and Emergency Response Planning
8.3 Risk Management Processes
8.4 Master Plans, Sustainable Planning, and Activities
8.5 Programming and Conceptual Design Processes
8.6 Disaster and Business Recovery Planning
8.7 Transportation Planning Frameworks
  8.7.1 Design and Construction
8.8 Business Continuity Planning
### ACROS = Airport Climate Risk Operational Screening Tool

<table>
<thead>
<tr>
<th>SERVICE CATEGORY</th>
<th>ASSET TYPE</th>
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<tbody>
<tr>
<td>Aircraft / GSE</td>
<td>Ground Equipment</td>
</tr>
<tr>
<td>General Aviation</td>
<td>Buildings</td>
</tr>
<tr>
<td>Facilities</td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td>Utilities</td>
</tr>
</tbody>
</table>

- **Surveys, SME Input and Adaptation Research**
- **Airport Asset Matrix**
- **Climate Information**
- **Risk Screening, Planning Mechanisms and Adaptation Options**

About 700 different impacts identified.
Research Results - Vectors

• Choosing operationally relevant climate indices is essential

• Multiple models allow us to estimate confidence
Research Results – Testing the Tool
Research Results – Beta Test Results

Software
– Identified & repaired breaks; troubleshooting instructions

Aesthetics & Layout
– Improved labeling; adjusted tile sizing

Content
– Added new vectors (SLR and heating/cooling) based on user feedback

User Experience
– Added tool tips; revised definitions of criticality and vulnerability

Wider Application
– Enterprise-level users have different needs than engineering and O&M
Tool Demonstration

![ACROS](image)

**Search Airport by FAA ID**

Please enter your airport using the three-letter FAA identifier.

Airport FAA ID: [Enter]

Airport Name: [Enter]

Airport Region: [Enter]

[Ok]
Using Risk Assessment Results

<table>
<thead>
<tr>
<th>OVERALL RISK</th>
<th>SERVICE: Commercial Passenger Terminal Facilities</th>
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<tbody>
<tr>
<td></td>
<td><strong>Impact Risk</strong></td>
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</tbody>
</table>
Mainstreaming Example: The Master Plan

1. Pre-Planning
2. Public Involvement
3. Environmental Considerations
4. Existing Conditions
5. Aviation Forecasts
6. Facility Requirements
7. Alternatives Development and Evaluation
8. Airport Layout Plans
9. Facilities Implementation Plan
10. Financial Feasibility Analysis
Further Research

• Quantifying the cost of adaptation strategies.
• Improving understanding of asset failure thresholds and system vulnerability—within a single airport.
• Improving understanding of cascading impacts between airports.
• Modeling the effects of climate change on forecasted demand.
• Understanding the role insurance plays in resourcing climate adaptation.
• Accessibility of climate data for in-depth local studies.
For additional information:

Climate Change Adaptation Planning: Risk Assessment for Airports

http://www.trb.org/Main/Blurbs/173554.aspx

• Mathew Mampara
  o Mmampara@dewberry.com
Chris Baglin, JD, MPH
Principal Investigator

- Principal, PPC
- Attorney and Former Director, Office of Policy Analysis, US Department of the Interior
- Association of Climate Change Officers
  - Member
  - Instructor
- Member of TRB subcommittees, including
  - ABR 10(2) Subcommittee on Risk and Planning, Resiliency Section, Standing Committee on Critical Transportation Infrastructure Protection
ACRP Synthesis 33 Panel

Susanne Desroches, Port Authority of NY & NJ, Panel Chair
Rand Decker, Northern Arizona University
Steve Grossman, Jacksonville Aviation Authority
Kristi McKenney, Port of Oakland – Oakland International Airport
Mark Norman, Transportation Research Board
John Putnam, Kaplan, Kirsch, and Rockwell
Eddie Tovar, Dallas/Fort Worth International Airport Board
Thomas Cuddy, FAA Liaison
Patrick Magnotta, FAA Liaison
Christine Gerencher, TRB Liaison
Gail Staba, ACRP Senior Program Officer
ACRP Synthesis 33: Airport Climate Adaption and Resilience

- Identifies the risks to airports from climate change hazards
- Presents eight cases illustrating diverse approaches to addressing climate risks
- Explains uncertainties to consider in decision-making
- Provides an annotated bibliography to familiarize readers with the broad range of issues climate change presents
- Published June 2012
Hotter days, heavier rainfall, increased snow and ice, and more intense storms are expected under climate change.

70% of airport delays are the result of extreme weather, and such weather events are on the increase.

- In 2011, the United States witnessed a record 12 weather/climate disasters, each costing $1 billion or more.
- How airports respond to these events influences future planning.

By explicitly addressing the climate risks, airports can enhance the benefits from present day investments in maintenance, data collection, capital improvements, etc.
ACRP Synthesis 33: Approach

• Review of current climate adaptation and resilience activities relating to airports and other infrastructure

• Study of the physical, business, security and financial risks to airports

• Methods:
  • Survey
  • Interviews for case examples
  • Desk top research for list of impacts and annotated bibliography
ACRP Synthesis 33: Research Results

- Extensive list of impacts & responses (Desk top research)

**TABLE 1: POTENTIAL CLIMATE CHANGE EFFECTS AND ILLUSTRATIVE RESPONSES FOR AIRPORTS**

<table>
<thead>
<tr>
<th>Climate Change Phenomenon</th>
<th>Change in Environmental Condition</th>
<th>Airport Asset or Activity</th>
<th>Primary Impact</th>
<th>Effect of Impact</th>
<th>Illustrative Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Change</td>
<td>More hot days</td>
<td>Take-off</td>
<td>Hotter days, when combined with moisture, can reduce airplane performance, increasing the runway length needed for take-off and climbing ability, particularly at high altitudes and/or hot weather airports (Peterson et al. 2008; Love et al. 2010; Shein 2008)</td>
<td>Delays and cancellations due to need to limit daytime flights (Peterson et al. 2008; TRB 2008; Shein 2008)</td>
<td>Alternate or new routes or schedules (Shein 2008)</td>
</tr>
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<td></td>
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<td></td>
<td>Limits on payload (TRB 2008; Shein 2008)</td>
<td>Improved engine design (CCSP 2008)</td>
</tr>
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<td></td>
<td>Use of greater thrust, leading to more noise (Burbidge et al. 2011), increased fuel use and greenhouse gas emissions (Evaluating the Risk Assessment . . . 2011)</td>
<td>Longer runways (Schwartz 2011; Klin et al. 2011; Stewart et al. 2011)</td>
</tr>
<tr>
<td>Temperature Change</td>
<td>More hot days</td>
<td>Airfield, access roads, vehicles</td>
<td>Pavement buckling (e.g., concrete expansion while retaining rigid) (Peterson et al. 2008); Loss of non-concrete pavement integrity (e.g., tarmac melt) (TRB 2008); Heat-related weathering of fleet</td>
<td>Decreased utility of pavement (Peterson et al. 2008); Increase in foreign object damage on airfield; e.g., from weathered tires (Evaluating the Risk Assessment . . . 2011)</td>
<td>Pavement damage</td>
</tr>
</tbody>
</table>

- Load restrictions for certain pavement (CCSP 2008; Peterson et al. 2008)
- At 40–100 years in the future, better maintenance strategies (Meyer 2008)
- Replace road and bridge expansion joints (Schwartz 2011)
- At 40–100 years in the future, possible significant impact on pavement and structural design; need
# ACRP Synthesis 33: Research Results

<table>
<thead>
<tr>
<th>Temperature changes</th>
<th>Precipitation changes</th>
<th>Extreme events</th>
<th>Sea level rise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat-related effects on lift-off load limits, at high altitude or hot weather airports</td>
<td>Heavier, more intense rain events more flooding and erosion</td>
<td>More intense storms, with possible decrease in their number</td>
<td>A long term issue when on its own</td>
</tr>
<tr>
<td>Heat-related weathering and buckling of pavements and concrete facilities</td>
<td>Combined with increased temperatures, less snow and ice</td>
<td>More lightening events</td>
<td>A near term issue when combined with increased storm events</td>
</tr>
<tr>
<td>Health and safety limitations on construction and similar activities</td>
<td>Combined with increased temperatures, more drought</td>
<td>More thunderstorms</td>
<td>Subsidence, uplift and other factors will mediate sea level rise impacts, positively or negatively</td>
</tr>
<tr>
<td>Impacts on landscaping, wildlife management</td>
<td>Change in the freeze/thaw cycle</td>
<td>More severe winter storms</td>
<td></td>
</tr>
</tbody>
</table>
Some integration of climate risk into existing processes (Survey)

- Design standards for physical assets
- Design criteria for single project (ad hoc)
- Capital Improvement Plan
- Organizational decision making
- Disaster management/emergency response
- Master Plan in development
What’s driving action (Survey and Interviews):

• **Internal Advocates**
  – Executive as champion
  – Program-level advocate
  – Professional judgment of technical staff

• **External Motivators**
  – State, regional, and local adaptation planning efforts and work products
    » *Respondents were much more likely to name climate change effects that they expected airborne (rather than locally or regionally)*
  – Federal grants in support of planning frameworks
  – Model adaptation guidance from professional societies

• **Direct Experience**
  – Awareness raised from sustainability and greenhouse gas mitigation activities
  – Severe weather events and related costs
    » *Most respondents believed weather-related disruptions were increasing, even without a direct attribution to climate change*
Case Examples (Survey, Interviews, Desk-top Research)

**State of Alaska:**
- Addressing climate change effects in the present day
- Congressional leadership, state climate change task force, and highly-motivated public servants coordinated to rationalize the approach to addressing risks to scores of village airports

**Jacksonville Airport Authority:**
- Airport-level climate change planning.
- New CEO with sustainability agenda empowers technical staff to develop a White Paper on climate risks and adaptation
San Diego County Regional Airport Authority:
- Regional climate change planning
- Senior managers of a coastal airport brought into a Steering Committee project studying regional vulnerabilities

Hartsfield-Jackson Atlanta International Airport:
- Put process in place for development of a Climate Action Plan.
- Through an FAA grant developed a Sustainability Management Plan that includes roadmap for a Climate Action Plan, among others.
Oakland International Airport:

- Project design with a view to climate change
- Through participation in sub-regional adaptation planning process, planners received sea level rise modeling and designed perimeter dike to accept additional load in the future

Toronto-Pearson International Airport:

- Climate change awareness leads to flexibility in infrastructure and program decision-making
- Used the engineering profession’s climate change analysis protocol to progress design criteria past simple use of the historical record
Dallas-Fort Worth Airport:
- Bad outcomes from weather/climate extremes (snow storm, drought) as catalyst
- Accelerated review of two funding proposals:
  - $10m for snow removal equipment
  - $18m for a reclaimed water pipeline

Jackson Municipal Airport Authority:
- Standard Operating Procedures relating to extreme weather
- A case example details an airport’s response to and lessons learned
Cases provide narratives for

- Socializing new topic
- Demonstrating different scales of response by airports
- Using/introducing terminology
Survey

- Responses from peer airports
- Snap shot in time
- The questions to ask about own airport
ACRP Synthesis 33: Putting Results into Action

Annotated bibliography

• Supports initial scoping of issues
• Addresses common terminology, recognized methods, thought leadership
• Covers airport and transportation sector viewpoint
Table of impacts

- Identifies likely outcomes from projected environmental changes
- Suggests impacts and provides illustrative responses
- Tool to use when conducting a vulnerability assessment
ACRP Synthesis 33:
Putting Results into Action

Discussion of uncertainties
• Includes discussion of climate information needs of survey respondents

Categories of action on climate change impacts
• Ad Hoc
• High level strategy
• Compliance with government directives
• Risk analysis
• Use of existing funding streams
• Incorporation of climate risk into existing decision processes

Recommendations
For additional information:

ACRP Synthesis 33: Airport Climate Adaptation and Resilience

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  - 571 271 1115