A changing climate in brief

Assessing the 3 aspects of **vulnerability** to climate change

- **Sensitivity** to climate and non-climate risks
- **Exposures**, especially due to geographic proximity
  - Determinants of **adaptive capacity**

Designing and implementing **adaptation** measures

**Communicating risks**

Identifying **research needs**
Older adults are identified as a population that is especially vulnerable to the impacts of climate change. During the coming decades, a rapidly growing population of seniors and accelerating changes in climate converge to make both issues, and their interactions, more significant and timely.

Average temperatures in the U.S. have increased by 1.5°F since 1st records in 1895. The past decade was the nation’s warmest.

Since 1900, rain and snow and heavy downpours have increased. Projections call for more frequent and intense rainfall events.

Some weather extremes, such as heat waves, floods, droughts and wildfires have become more common and more severe.

Since 1980, the strength of North Atlantic hurricanes has increased.

Other trends in severe storms are less certain, including those of convective storms, such as high winds, tornadoes, and hail storms.

By 2100, some coastal zones will be inundated by rising sea levels (with increases of 7-23 inches) and by storm surge.

Ice is melting, including glaciers, permafrost, and Arctic sea ice.

A Framework for Understanding Climate Change

ASSESS VULNERABILITY

IMPLEMENT ADAPTATION

COMMUNICATE RISK

IDENTIFY RESEARCH NEEDS
The vulnerability of older adults is a function of the character, magnitude, and rate of climate variability and change to which a population is exposed, its sensitivity to those changes, and its adaptive capacity, i.e., its ability to adapt to or cope with change.

Source: IPCC Fourth Assessment Report, 2007
The risks resulting from climate change will not be evenly distributed. Certain groups will be affected more than others, including:

- Children, especially the very young
- Older adults, especially those 85 and older
- The impoverished
- Those living alone
- Those with chronic medical or mental health conditions
- Those with mobility or cognitive deficits or functional limitations
- Certain occupational groups, especially outdoor workers
- Recent migrants, immigrants and evacuees
Assessing the Sensitivity to Climate Change by Age, Minority Group, Poverty, Physiological Status, and other Non-Climate Factors
Ages 65+ from 1900-2010 with Projections to 2050

Note: Data for 2010-2050 are projections of the population. Reference population: These data refer to the resident population. Source: U.S. Census Bureau, Decennial Census and Projections.
Older Americans are Growing More Diverse

Although the older population in the U.S. is not as racially and ethnically diverse as the younger population, it is projected to experience a substantial increase in diversity (as measured by % minority) over the next 40 years.

- The 65-and-older population is projected to be 39.1% minority in 2050, up from 20.7% in 2012.

- The 85-and-older population is projected to be 29.7% minority in 2050, up from 16.3% in 2012.

Source: U.S. Census projections, 2012
% Age 65 + with Income Below 100% of Poverty Threshold in 2010

National Average = 9%

NOTE: Data were pooled over three years.
### Sensitivity Aggravated by Non-climate Stressors

<table>
<thead>
<tr>
<th>Non-climate stressors</th>
<th>Impacts</th>
<th>When it matters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic health conditions</td>
<td>disease-related vulnerability (↑ cardiovascular disease, obesity, diabetes, and ↓ mobility)</td>
<td>Heat waves</td>
</tr>
<tr>
<td></td>
<td>need for routine medications</td>
<td>Disaster response</td>
</tr>
<tr>
<td>Social isolation</td>
<td>↓ adaptation, ↑ need for support</td>
<td>Disaster response</td>
</tr>
<tr>
<td>Depression</td>
<td>↑ withdrawal, apathy</td>
<td>Disaster preparedness and response</td>
</tr>
<tr>
<td>Attachment to home and belongings (esp. pets)</td>
<td>↑ reluctance to relocate</td>
<td>Emergency evacuation</td>
</tr>
<tr>
<td>Poverty and limited income</td>
<td>↑ reluctance regarding voluntary adaptive measures</td>
<td>Disaster preparedness</td>
</tr>
<tr>
<td></td>
<td>↑ inability to pay for higher energy costs</td>
<td>Deprivation</td>
</tr>
<tr>
<td>Communication barriers</td>
<td>↓ awareness of emergency conditions and evacuation needs</td>
<td>Disaster preparedness and response</td>
</tr>
</tbody>
</table>

## Sensitivity Aggravated by Physiological Change

<table>
<thead>
<tr>
<th>Changes in physiology with age</th>
<th>Health effects</th>
<th>When it matters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skin:</strong> ↓ vasculature</td>
<td>↓ thermoregulation</td>
<td>Heat waves</td>
</tr>
<tr>
<td>↓ sweating</td>
<td></td>
<td></td>
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<tr>
<td><strong>Cardiovascular:</strong> ↓ vascular tone</td>
<td>↓ thermoregulation</td>
<td>Heat waves</td>
</tr>
<tr>
<td>↓ adrenergic function</td>
<td>↓ tolerance of dehydration</td>
<td></td>
</tr>
<tr>
<td>Immune: ↓ immune function</td>
<td>↑ risk of infection</td>
<td>Vector-borne disease</td>
</tr>
<tr>
<td>Pulmonary: ↓ flow and volume</td>
<td>↓ pulmonary reserve</td>
<td>Ozone</td>
</tr>
<tr>
<td>↓ oxygenation</td>
<td>↑ airway &amp; parenchymal disease</td>
<td>Allergens</td>
</tr>
<tr>
<td>↓ cough efficacy</td>
<td></td>
<td>Wildfire smoke</td>
</tr>
<tr>
<td>Muscular: ↓ muscle mass</td>
<td>↑ frailty</td>
<td>Disaster response</td>
</tr>
<tr>
<td><strong>Nervous:</strong> ↓ perfusion</td>
<td>↑ cognitive and memory loss</td>
<td>Disaster response</td>
</tr>
<tr>
<td>↑ plaques and tangles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skeletal: ↑ arthritic changes</td>
<td>↓ mobility</td>
<td>Disaster response</td>
</tr>
<tr>
<td>Renal: ↓ concentration and GFR</td>
<td>↓ fluid balance</td>
<td>Heat waves</td>
</tr>
</tbody>
</table>

Source: Gamble et al. 2013 and Frumkin et al. 2012
A variety of factors can increase the vulnerability of demographic groups to health effects from climate change. For example, there are more people who have asthma or chronic respiratory diseases such as COPD, which make them more sensitive to climate-related health impacts. Since 1980, deaths from chronic respiratory diseases have increased by 50%.

Data from CDC; Health E-Stat; U.S. Census Bureau 2010, 2012; and Akinbami et al. 2011)
There are an increasing number of older adults who are obese and/or have diabetes. These conditions put them at greater risk from climate-related health effects, especially with respect to exposures to extreme heat and other extreme weather events.

Data from CDC; Health E-Stat; U.S. Census Bureau 2010, 2012
**Exposures** Related to the Geographic Proximity to Climate Extremes
Exposure by Location: Weather Extremes in 2012

**SNOW PACK**
3rd smallest winter snow cover extent. Below-average snowpack was observed for much of the West.

**WARM**
Warmest year on record for the nation. 19 states record warm. The 4th warmest winter, warmest spring, and 2nd warmest summer contributed to 2012 having an average temperature 3.2°F above average and 1.0°F above the previous record warm year of 1998.

**WILDFIRES**
Over 9.2 million acres burned nationwide during 2012. CO experienced its most costly fire on record in June. The Whitewater-Baldy fire was the largest on record for NM.

**DROUGHT**
The 2012 drought peaked in July with over 60% (PDSI) of the nation experiencing drought conditions, comparable to the drought episodes of the 1950s. Corn and soybean crops failed across a large portion of the Great Plains and Midwest. Water levels along the Mississippi approached record lows and slowed commercial shipping.

**COLD**
Coldest January on record in AK. The monthly average temperature in Bettles was -35.6°F. Snowiest winter in Anchorage with 134.5 inches.

**FLOOD**
Storms caused record flooding in and around Duluth, MN on June 20th with over 8 inches of rainfall observed in 24 hours. Rivers in the area reached their highest levels on record.

**TORNADOES**
An early season tornado outbreak on March 2-3 in IN, OH, WV, and KY resulted in 42 fatalities. This was the deadliest tornado outbreak of 2012.

**POST-TROPICAL CYCLONE SANDY**
Made landfall near Atlantic City, NJ with sustained winds of 80 mph in late October. Recorded storm surge along NJ and NY coasts along with heavy rain and snow. Over 8 million people lost power, 131 fatalities.

**STORMS**
A straight-line wind storm called a derecho caused significant damage from IN to MD. Over 250,000 customers lost power, including the densely populated Washington, D.C. area.

**STORMS**
On March 9th a storm system brought severe weather to HI. A rare tornado hit Oahu. Largest hailstone on record for the state in Oahu.

**HURRICANE ISAAC**
Made landfall near the mouth of the Mississippi River in late August with winds of 80 mph. Significant storm surge and flooding rains along the Gulf Coast. 9 fatalities.

**WET**
Florida had its wettest summer on record, partially due to Hurricane Isaac and Tropical Storm Debby. Seasonal precipitation was 140 percent of average.

NOAA’s National Climatic Data Center
FACT: Hurricane Sandy resulted in 159 deaths along the Atlantic seaboard in 2012. Hurricane Katrina caused 1,833 deaths along the Gulf Coast in 2005.

IMPACT: Most hurricane victims are from vulnerable populations, such as hospital and nursing-home patients, older adults who require care in their homes, individuals with disabilities, or those who are unable to evacuate or seek shelter.
Exposure to Wildfires

- Weather and long-term drought conditions contribute to wildfire incidence and severity.

- A 400% increase in Western wildfires has been observed in the past 20 years.

- Health risks are determined by the intensity and speed with which the fire advances and the distance travelled by the smoke plume, especially over densely populated areas.

- There have been relatively few direct deaths from wildfire, but notable increases in emergency medical visits for smoke-related respiratory illnesses exacerbated by exposure to fine particulate matter near and downwind of the fire.
An aging population and settlement in vulnerable areas, amplify risks associated with climate change.

ICLUS data project that older adults are increasingly likely to live in major urban areas in the Northeast, the Midwest, and on the West Coast, in hot and arid locations in the Southwest, and in coastal zones along the Atlantic seaboard and the Gulf of Mexico.
The 3rd aspect of vulnerability is **adaptive capacity** – i.e., the ability of a system to adjust to climate change, to moderate potential damages, to take advantage of opportunities, or to cope with consequences.

Source: IPCC Fourth Assessment Report, 2007
Non-Climate “Individual” Factors that may Affect Adaptive Capacity

- Living in poverty
- Educational attainment and literacy
- Pre-existing disabilities and chronic illnesses
- Loss of loved ones
- Inability to manage activities of daily living
- Social isolation
- Inadequate emergency preparedness
Non-climate “Community” Factors that may Affect Adaptive Capacity

- Technology development (esp. communication and medical advances)
- Condition of infrastructure and the built environment and the continuity of energy and other utilities
- How the property and casualty insurance industry is (or isn’t) responding to climate change
Successful adaptation may be achieved through:

- Promoting **co-benefits and sustainability**
- Understanding **barriers and limits** to adaptation
- Measuring the **cost and strategic effectiveness** of alternative adaptation strategies
- Assessing the **generalizability and transferability** across adaptations
- Identifying **lessons learned** and adopting **best practices**
Near-term Adaptations for Older Adults

- “Aging-friendly” physical designs in homes & neighborhoods
- Registries and maps to identify and locate at-risk older adults to facilitate emergency notification and response
- “Portable” electronic medical records
- Targeted services to address specific needs (such as access to medicine, meals, drinking water, cooling centers, buddy systems, and transportation)
- Adaptation is promoted when there are engaged caregivers to provide for personal needs.
# Adaptation Strategies by Weather Extreme

<table>
<thead>
<tr>
<th>Weather extreme</th>
<th>Health effects</th>
<th>Potential for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat waves</td>
<td>Deaths from heat stroke, dehydration, exacerbation of cardio-pulmonary diseases, failed thermoregulation</td>
<td>Improved acclimatization or tolerance to heat over time / widespread use of AC / neighborhood cooling centers</td>
</tr>
<tr>
<td>Air pollution</td>
<td>Increased ground level ozone and PM and smoke from wildfires / exacerbation of underlying cardio-pulmonary diseases, e.g., asthma and COPD</td>
<td>Reduction of fossil fuel use with decrease in GHG emissions and ambient air pollutants / containment of wildfires</td>
</tr>
<tr>
<td>Tropical Storms</td>
<td>Storm-related injuries and deaths / extensive property loss and damage / forced evacuation and relocation / mental illness (especially PTSD)</td>
<td>Improved early warning systems / flood policies that discourage rebuilding and resettling in coastal zones</td>
</tr>
<tr>
<td>Flooding</td>
<td>Contamination of drinking water / indoor mold and respiratory illnesses / forced evacuation and relocation / mental illness (PTSD)</td>
<td>Improved early warning systems / flood policies that discourage rebuilding and resettling in riverine flood zones</td>
</tr>
</tbody>
</table>

Communicating Climate Risks

- Learn how older adults acquire information, form opinions, and develop perceptions of risk.
- Assess the knowledge, attitudes, and behavior of older adults to understand how they respond to climate change.
- Improve the effectiveness of communication materials:
  - Rely on simple, repetitive messages,
  - Employ trusted sources, including multiple media, older-adult networks and organizations and “peer messengers,”
  - Make explicit the connections between human health impacts and climate risks.
Challenges for Communicating Risks

- Invisible causes
- Distant impacts in space and time
- Insulation of modern humans from their environment
- Delayed or absent gratification for taking action
- Complexity and uncertainty of the climate system
- Collective and personal self-interest prefers the status quo

Identifying Research Needs

- Assess vulnerability by characterizing the nature and extent of exposure, sensitivity, and adaptive capacity.
- Evaluate non-climate factors that interact with climate-related factors.
- Develop map overlays to locate vulnerable populations and improve services to sensitive elderly.
- Assess the costs and benefits of impacts, adaptation, and mitigation.
- Use scenarios of climate, land use, and demographics to project future impacts.
- Understand the potential for thresholds or non-linear effects.
- Determine how to minimize the risks of irreversible or catastrophic impacts.
Older Americans are a diverse and rapidly growing population.

- They are living longer, are more educated, are enjoying greater prosperity, and are more politically active.
- Yet, they suffer significant health and income disparities along the lines of race and ethnicity, gender, and age.
- The “oldest old” are an especially high-risk group.

Older Americans are disproportionately affected by threats to health and well-being posed by climate change.
A society grows great when old men plant trees in whose shade they know they shall never rest.

— Greek proverb
With questions or comments, please contact:

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Emerging Issues: Next Steps

Aim

*Identify potential university priorities related to global challenge themes and their intersections*
The McDonnell International Scholars Academy

Presents

The Role of Research Universities in Addressing Global Challenges

Emerging Issues: Next Steps
Concurrent Breakout Discussions

Aging  |  Knight Center, Room 340
Food & Water  |  Bauer Hall, Room 150
Energy & Environment  |  Anheuser Busch Hall, Room 204
Public Health  |  Bauer Hall, Room 160