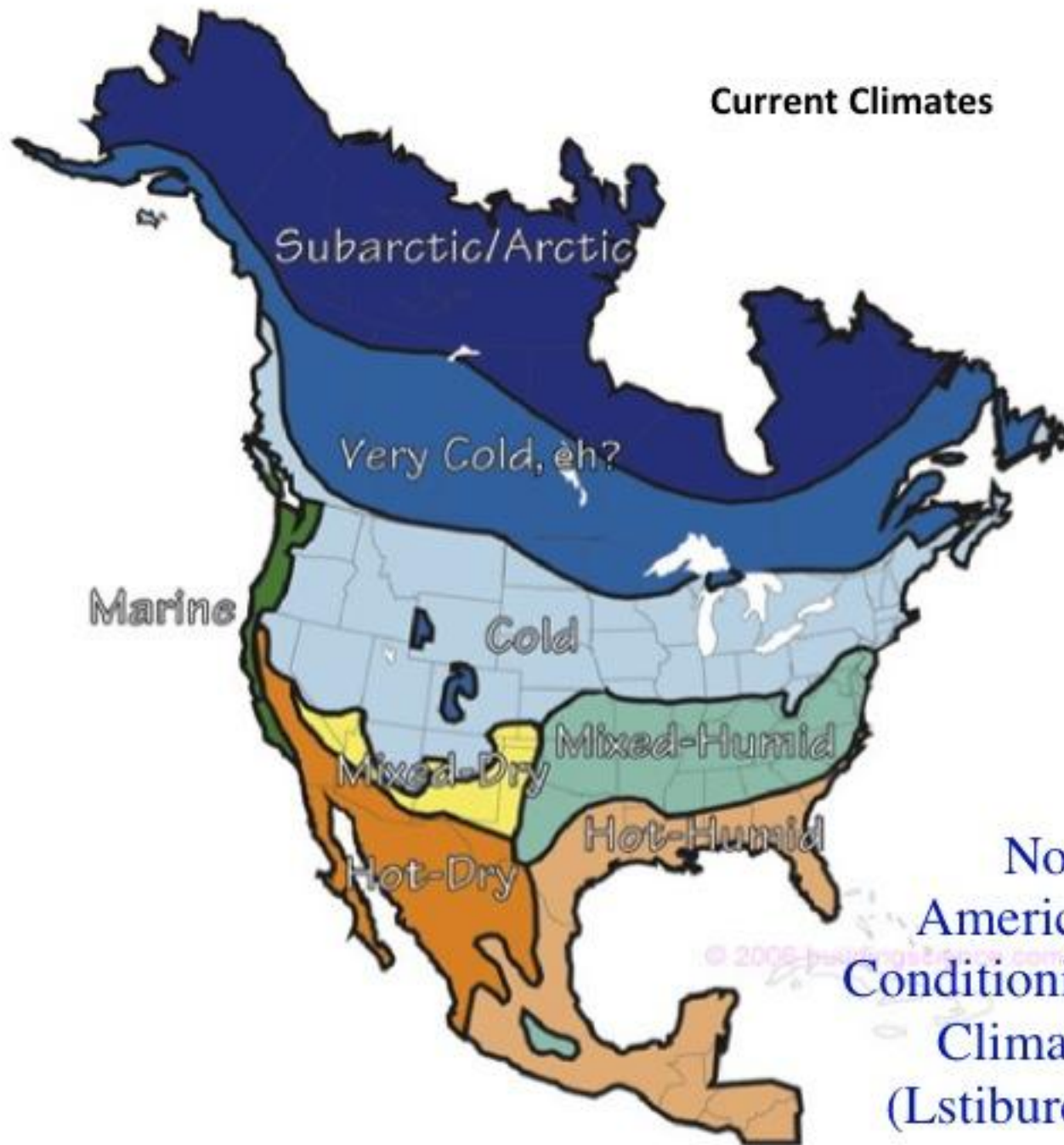


Climate Considerations for Indoor Microbial Growth

- Current Climates
 - Liquid water
 - Humidity-condensation
- Changing Climates
 - Changes in rain, floods and storms
 - Changes in cooling and dehumidification requirements



Current Climates

Subarctic/Arctic

Very Cold, eh?

Marine

Cold

Mixed-Dry

Mixed-Humid

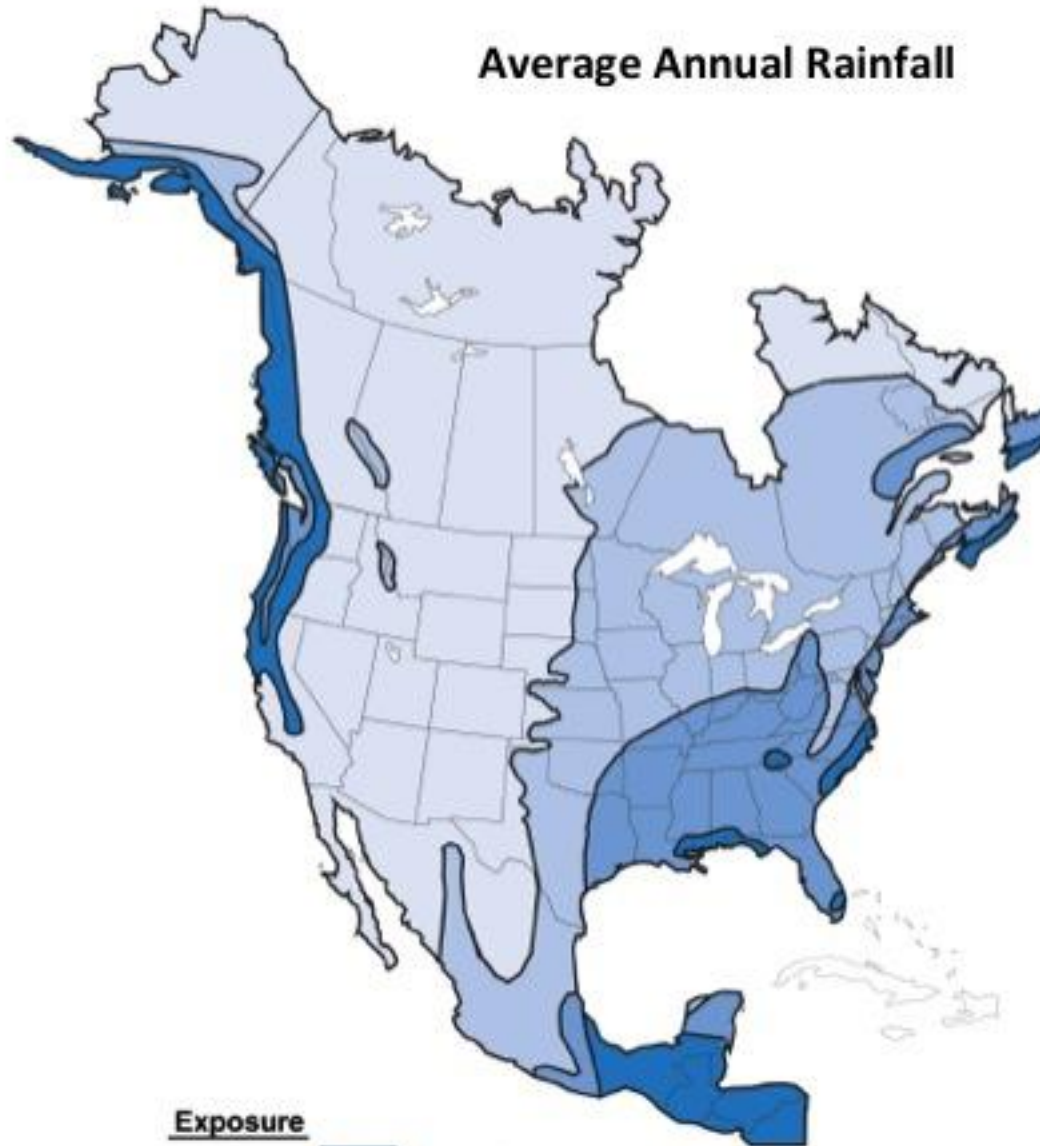
Hot-Dry

Hot-Humid

North
American
Conditioning
Climates
(Lstiburek)

© 2008

Average Annual Rainfall



Exposure

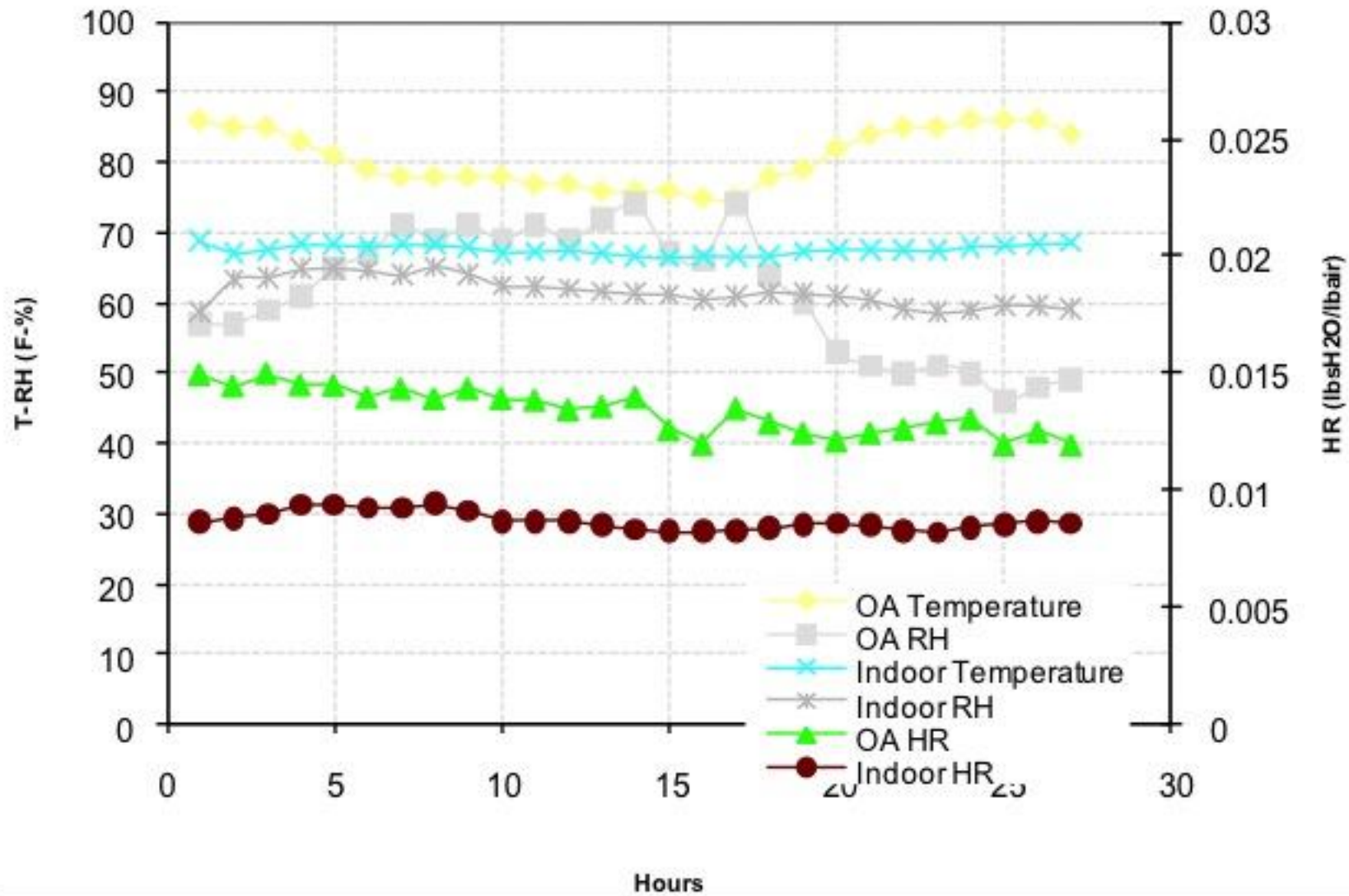
Extreme	Over 60"
High	40" - 60"
Moderate	20" - 40"
Low	Under 20"

Source: Lallburek, Joseph (2006)
"Water Management Guide"

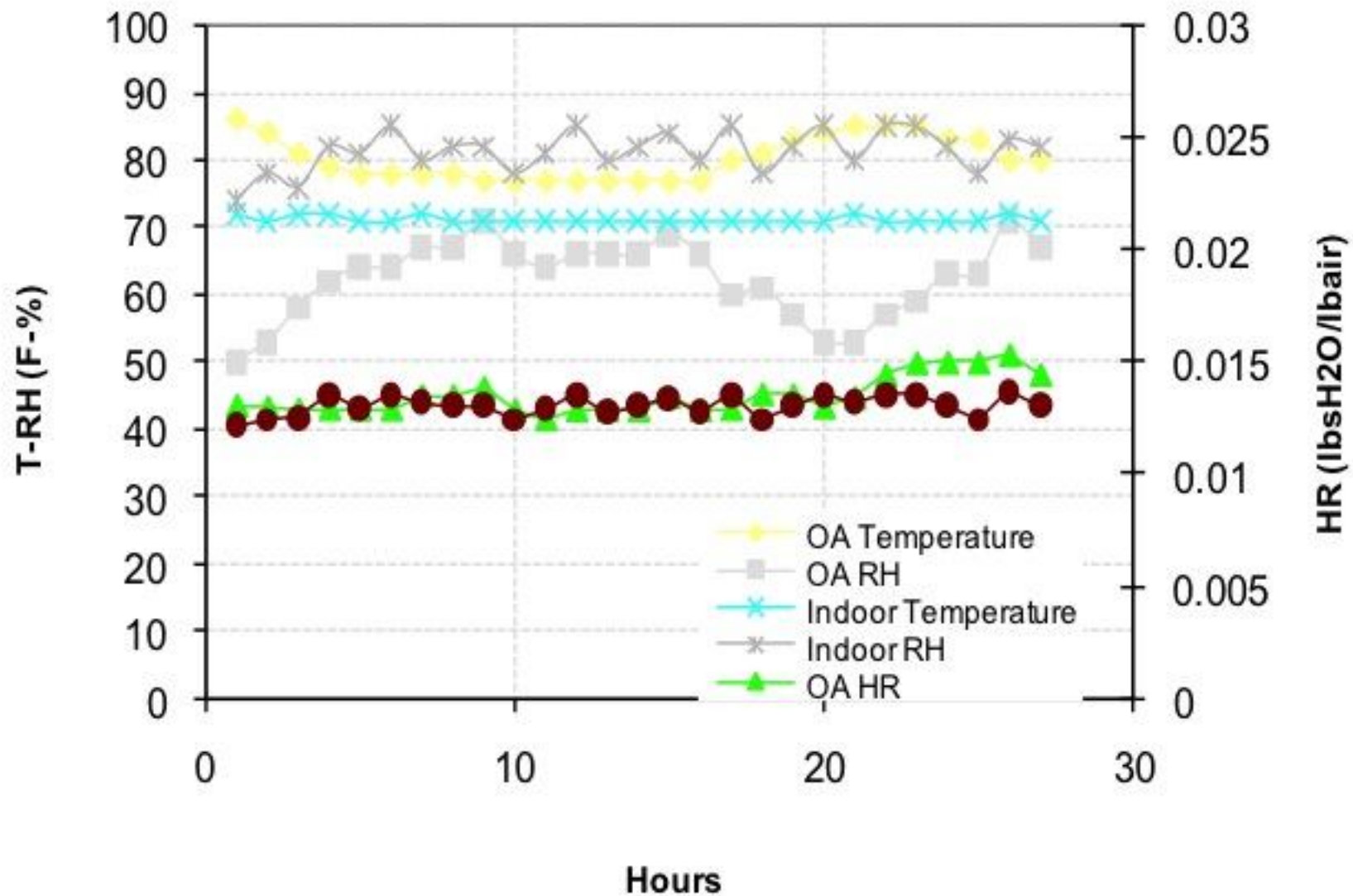
Indoor Climate

- Thermal comfort zone:
 - 70 degrees F to 85 degrees F
 - 20% to 80% RH
- Actual surface temperatures in building vary

Correctly Sized AC Cools and Dehumidifies



2X oversized AC cools but does not dehumidify



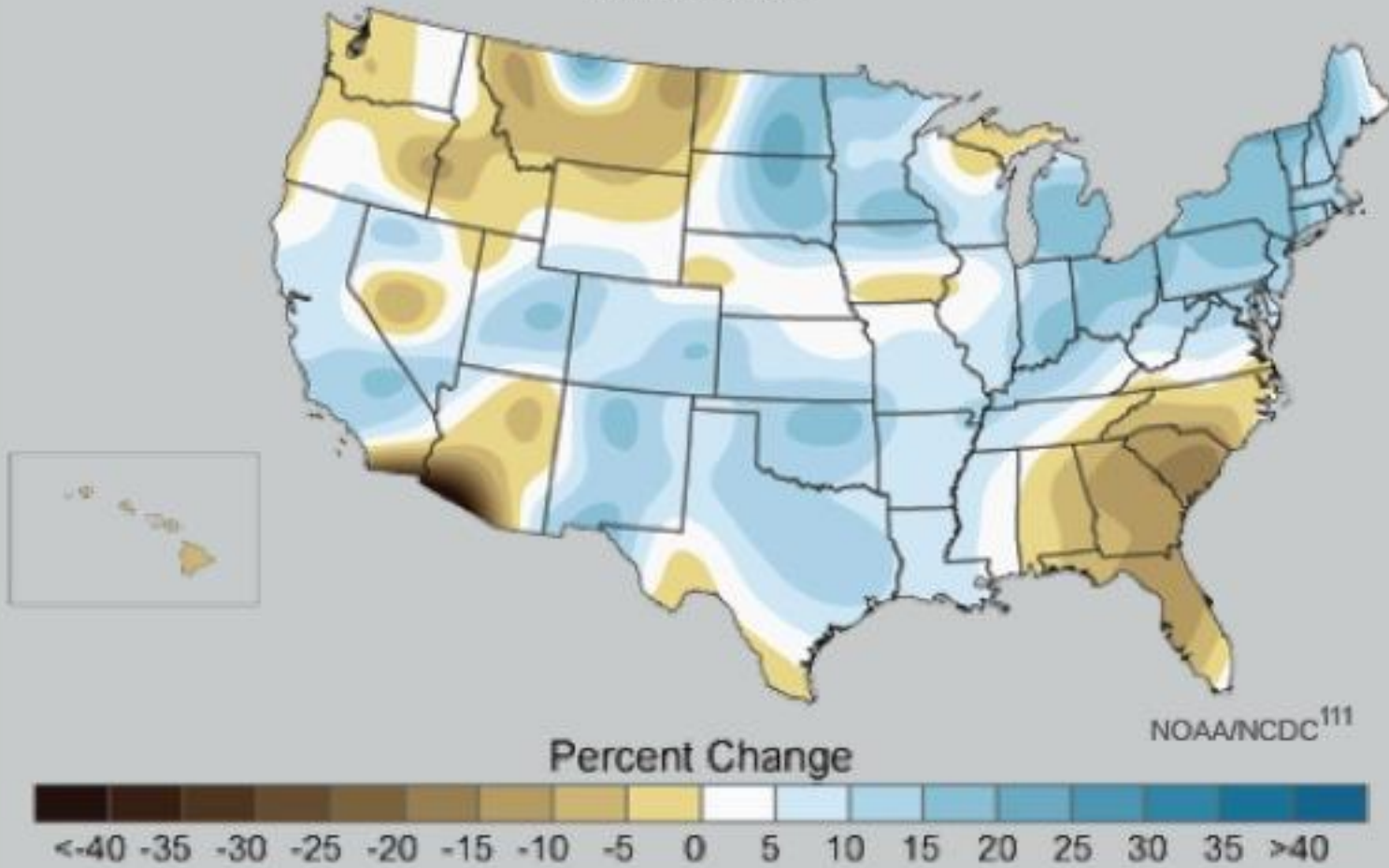
Changing Climate

- Recent changes
- Projected Changes



Moisture damage from increasing heavy rains, storms and floods

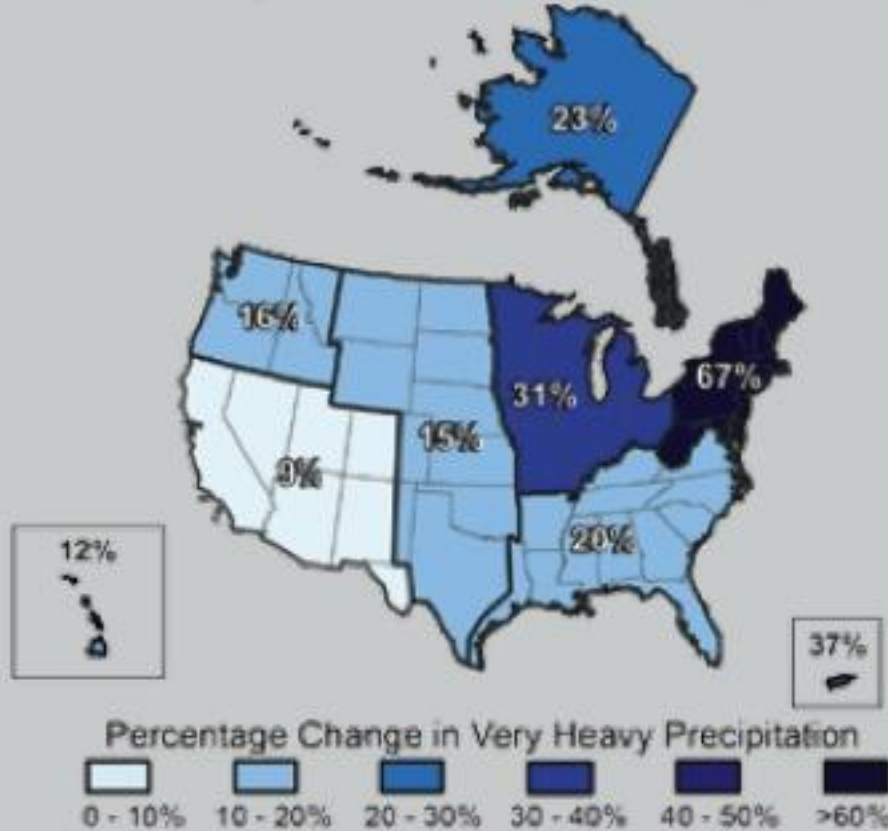
Observed Change in Annual Average Precipitation 1958 to 2008



NOAA/NCDC¹¹¹

While U.S. annual average precipitation has increased about 5 percent over the past 50 years, there have been important regional differences as shown above.

Increases in Amounts of Very Heavy Precipitation (1958 to 2007)



Updated from Groisman et al.¹¹³

The map shows percent increases in the amount falling in very heavy precipitation events (defined as the heaviest 1 percent of all daily events) from 1958 to 2007 for each region. There are clear trends toward more very heavy precipitation for the nation as a whole, and particularly in the Northeast and Midwest.

Potential Climatic Changes

- Temperature and moisture - some locations will become:
 - warmer others cooler
 - dryer or wetter
- Severe weather events may become frequent or more severe:
 - More extremes in temperature and rainfall
 - Increase in hurricanes and floods
- Rising sea level
- Source: Global Climate Change Impacts of the United States, US Global Change Research Program

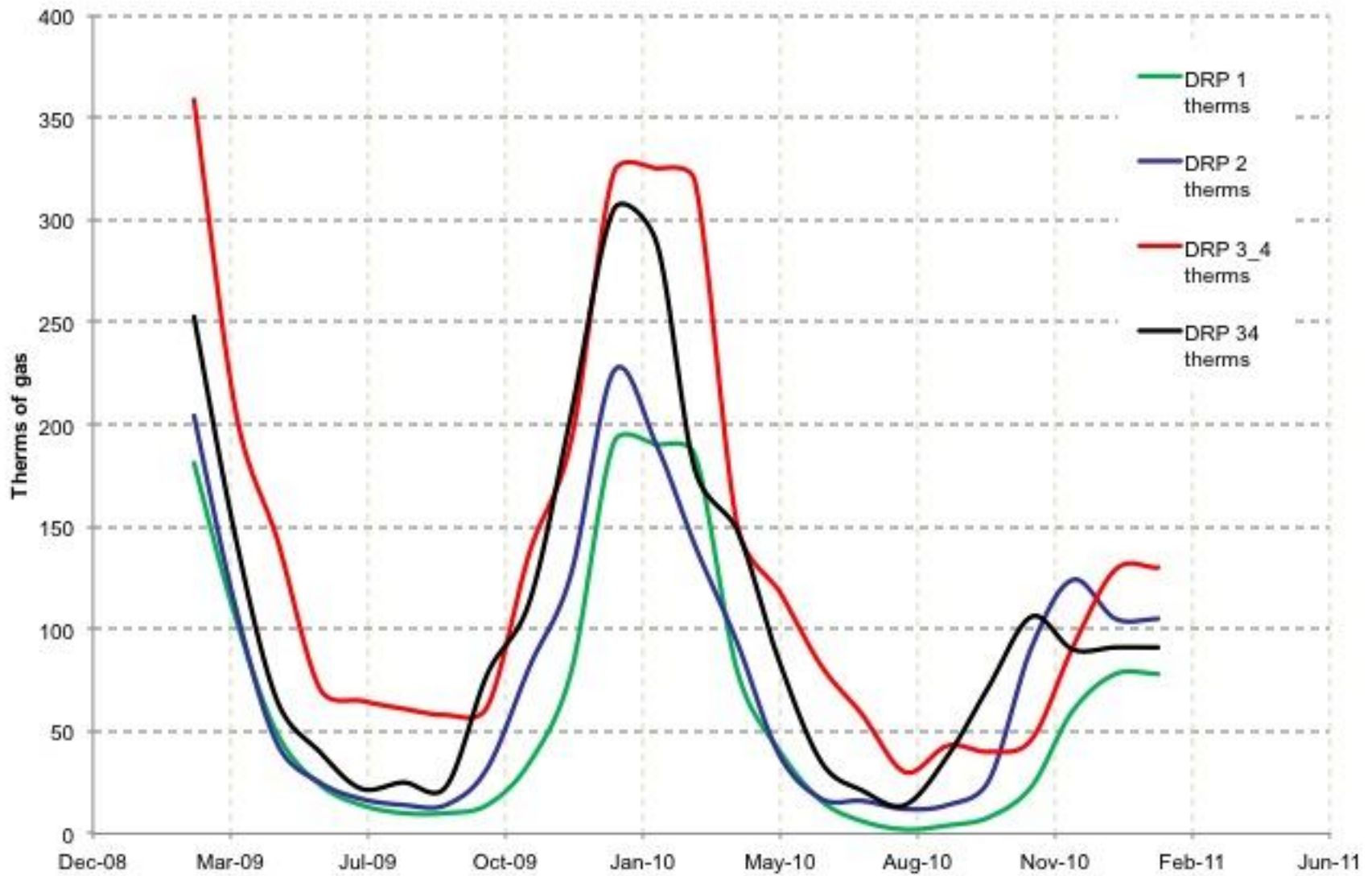
Buildings both contribute to and are impacted by climate change.

- the building sector accounts for approximately 48% of annual GHG (greenhouse gas) emissions
- The indoor environment in buildings is impacted as a consequence of climate change and as a consequence of our efforts to reduce GHG emissions from building related activities

Weatherization Retrofits That *Are Likely* to Negatively Affect IAQ* Include:

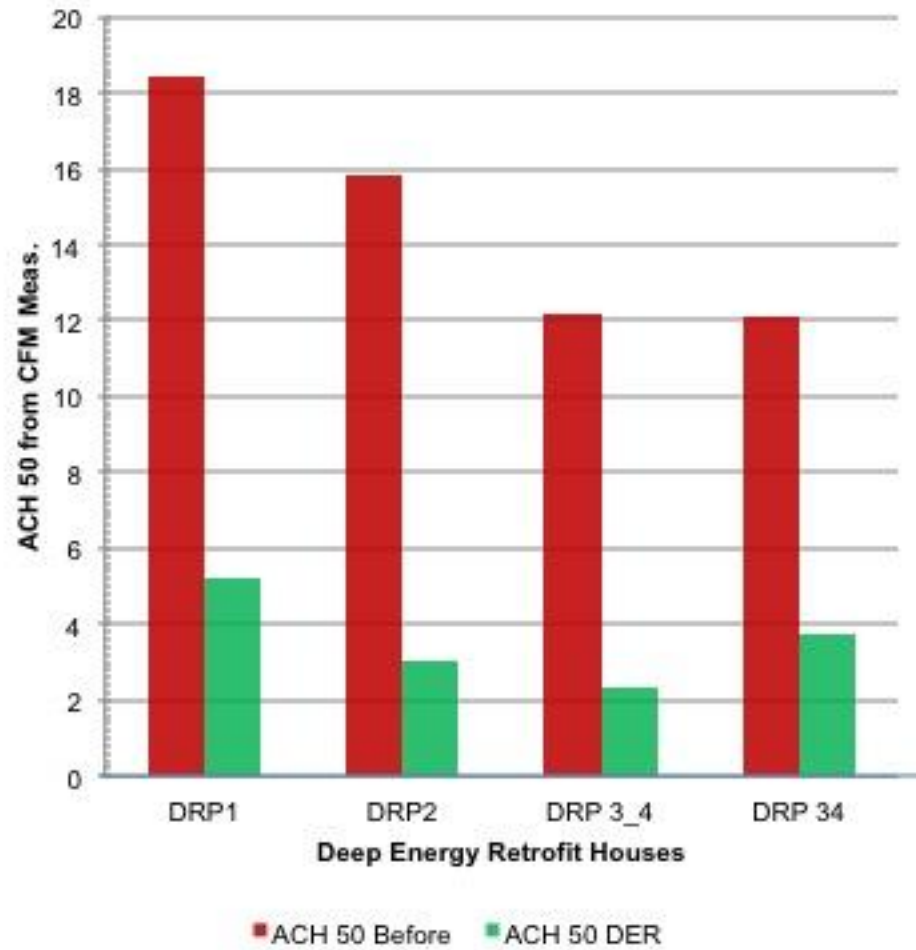
- ***Air sealing***, including replacing windows
 - Likely increases indoor humidity (heating and cooling)
 - May cause spillage/backdrafting
 - May cause a greater fraction of make-up air to come from attached garage, basement, or crawl space
- ***Insulation*** in cavities reduces drying, aggravating existing rain or plumbing leaks; may cause AC short-cycling
- ***Replacing*** an atmospherically vented natural draft furnace, boiler or hot water heater with a high efficiency sealed combustion unit may (*will?*) lower ventilation rates

* Unless measures are taken to maintain good IEQ



Greg Pedrick, NYSERDA DER project, VEIC

Change in Air Flow



Greg Pedrick, NYSERDA DER project, VEIC

Energy conservation measures in new and retrofitted homes

EPA's Market Share for Energy Star Qualified Homes Reaches 25 Percent

Release Date: 09/20/2011

WASHINGTON – The U.S. Environmental Protection Agency (EPA) announced today that 25 percent of all single-family homes built nationally in 2010 earned EPA's Energy Star, up from 21 percent in 2009. In partnership with its stakeholders, EPA continues to help American home buyers invest in high performing homes that save money on their utility bills and help protect the environment. Since 1995 approximately 1.2 million new homes have earned EPA's Energy Star, representing savings of nearly \$350 million on utility bills while avoiding greenhouse gas emissions equivalent to those from more than 450,000 vehicles.

Increased use of air conditioning

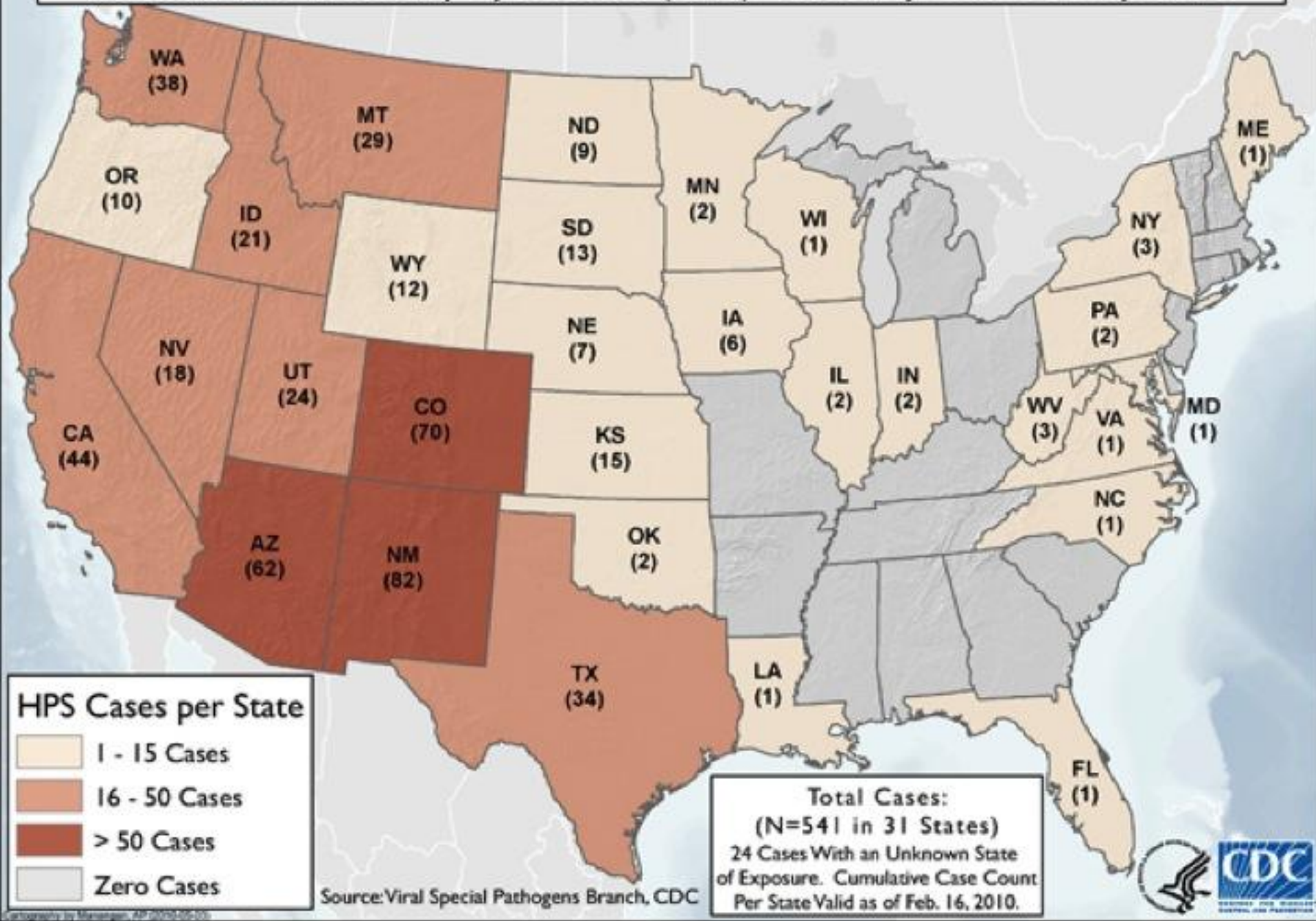
- This has already happened as the result of market forces
- It has resulted in increased indoor moisture problems
- Increased use of air conditioning increases GHG emissions (CO₂ and refrigerants)
- **Energy efficient cooling strategies with good part-load dehumidification performance**

Organisms may expand their range:

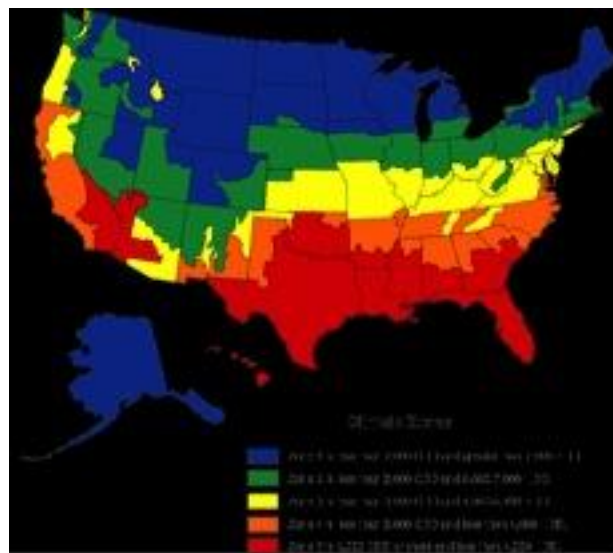
Impacts Related to Climate Change

- Organisms that contribute to the onset or aggravation of disease or impact IAQ directly e.g. Rodents; mosquitoes; dust mites; roaches
- Organisms that lead to the pre-mature failure of buildings may expand their range, e.g. termites
- Increased pesticide use in and around buildings is a likely response to both situations
- **Design and maintain buildings and landscapes to be resistant to pest species colonization**

Hantavirus Pulmonary Syndrome (HPS) Cases, by State of Exposure



Agency by Message, AP/2003/05/20



Subterranean Termite Zones of North America



strategies

- Energy efficient cooling strategies with good part-load dehumidification performance
- Design and maintain buildings and landscapes to be resistant to pest species colonization
- Provide effective, economic mold clean-up in existing houses
- Design flood resistant buildings for changing flood zones
- Design for operation during extended power failure
- Provide for IAQ in emergency shelters
- Reduce sources of indoor air contaminants
- Provide minimum recommended ventilation rates
- Manage indoor dewpoint/relative humidity
- Design enclosures to work in all US climates (Enclosure must control condensation in both heating and cooling mode)
- Change behavior to reduce energy use and improve IAQ