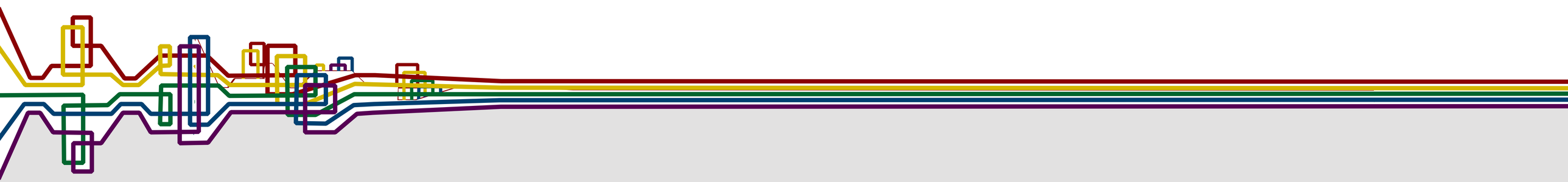
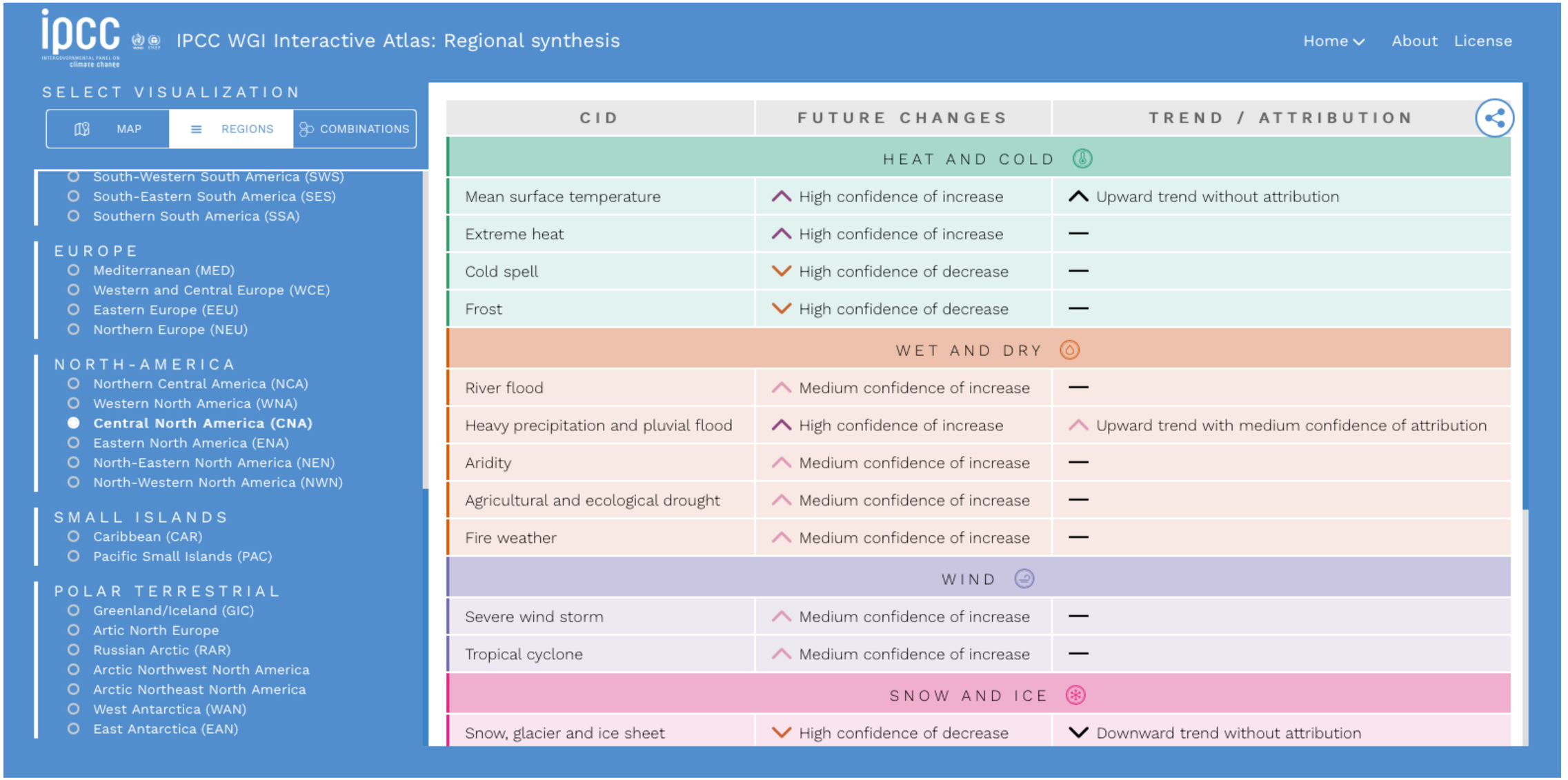
DESIGNING FOR RESILIENCE WITH THE

B3 GUIDELINES

Richard Graves AIA, Director, Center for Sustainable Building Research, University of Minnesota

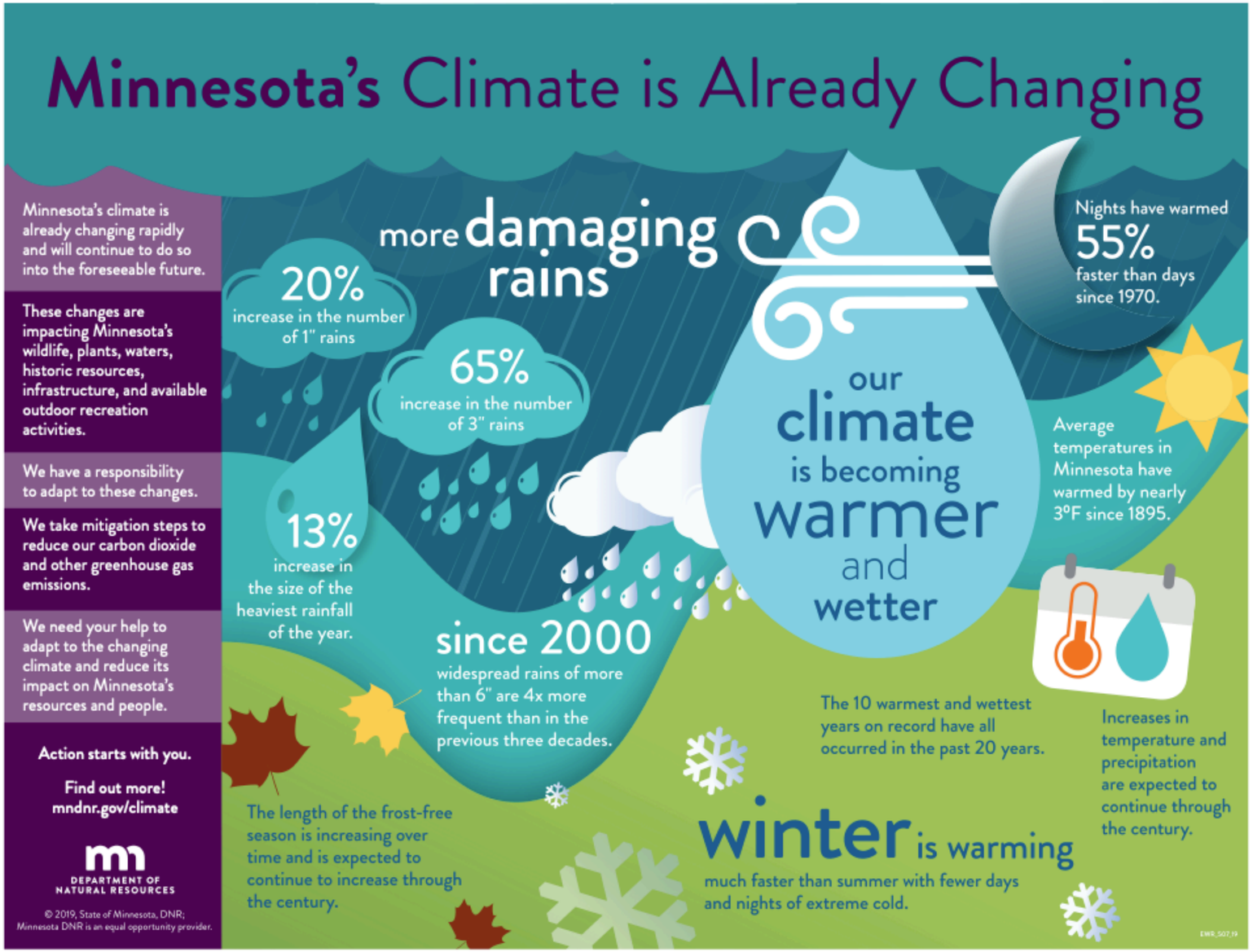


Potential Future Weather Changes



International Panel on Climate Change, Sixth Assessment - Regional Synthesis

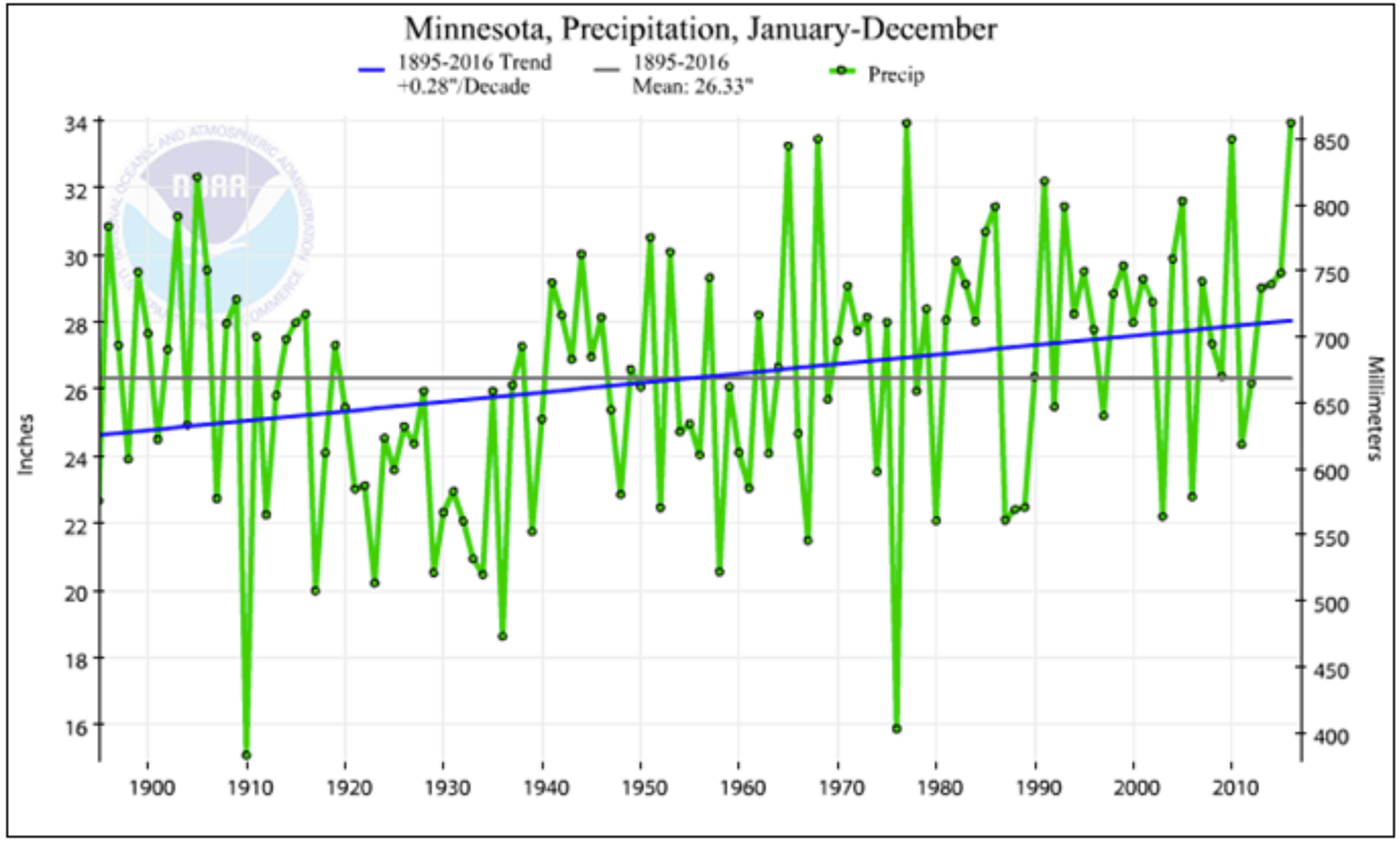
Potential Future Weather Changes



Minnesota Department of Natural Resources

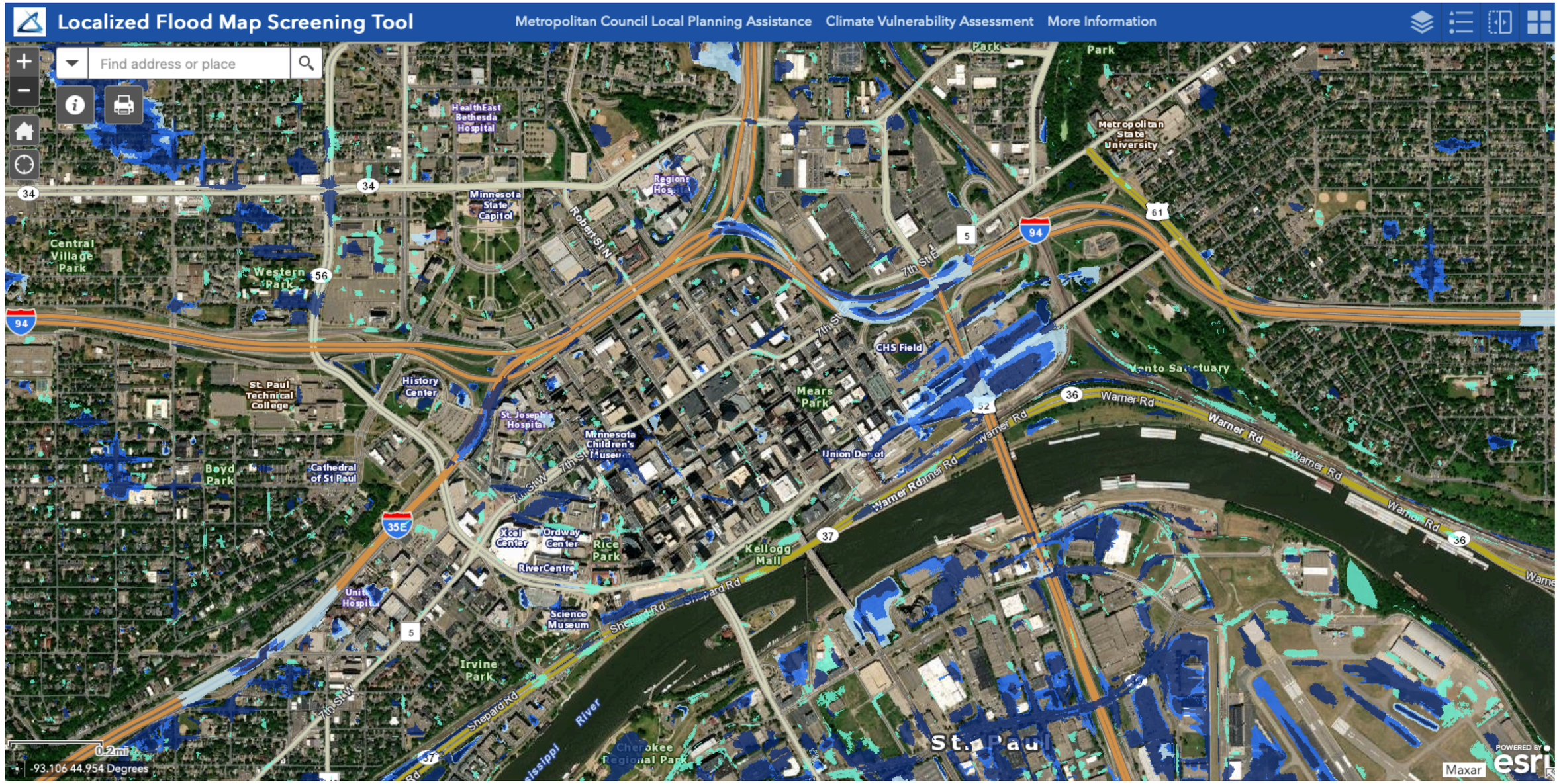
Potential Future Weather Changes

Precipitation has been increasing in Minnesota over the last century, as shown in the Figure below, which illustrates historic annual precipitation, from 1865-2016.



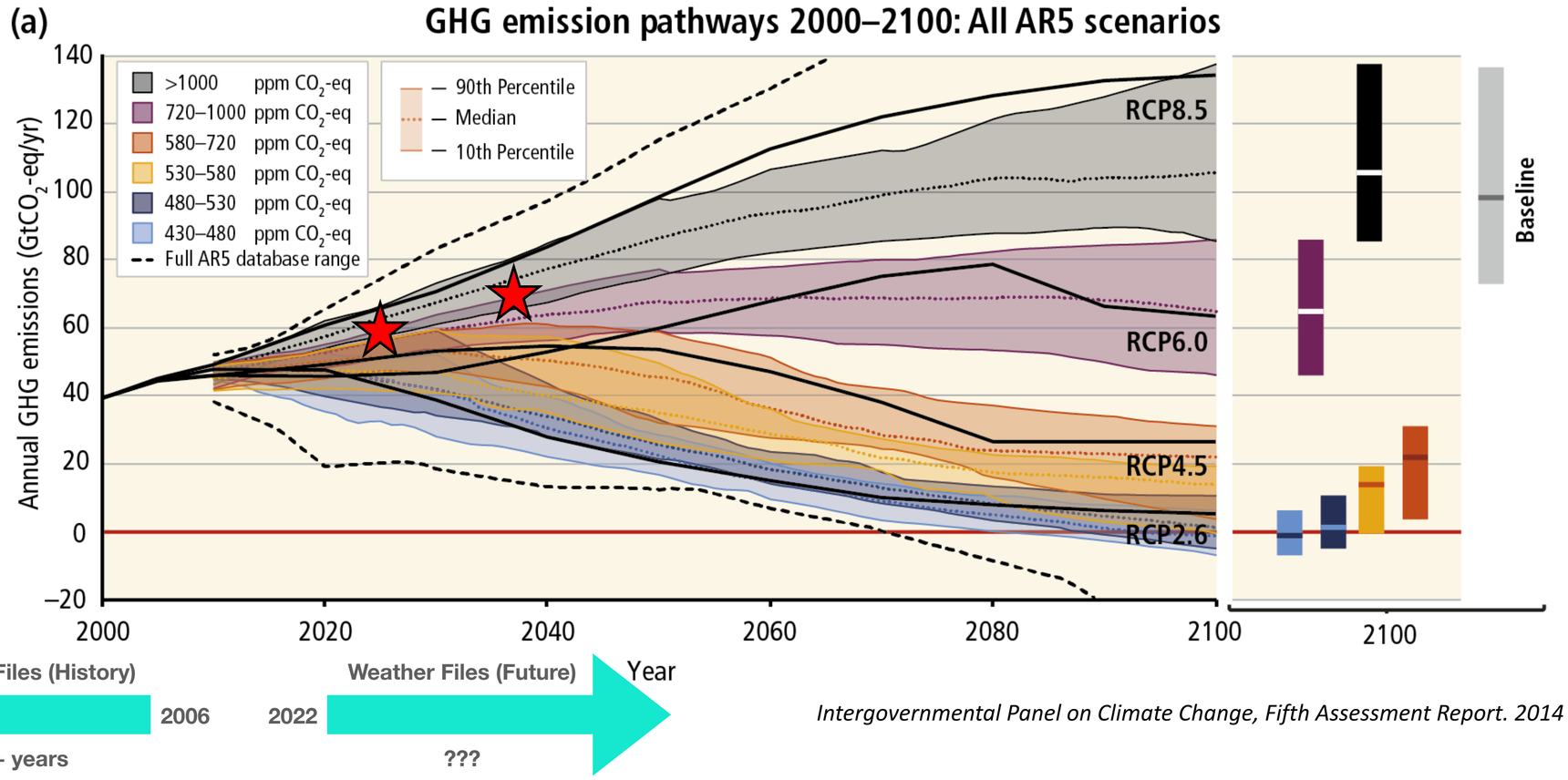
National Weather Service: https://www.weather.gov/wrh/Climate?wfo=mpx

Potential Future Weather Changes



https://metrocouncil.maps.arcgis.com/apps/webappviewer/index.html?id=100fa3012dcc4e288a74cbf4d95027bf

Potential Future Weather Changes



Intergovernmental Panel on Climate Change, Fifth Assessment Report. 2014

Potential Future Weather Changes

Strategy	Hours: Actual and Percentage					
	Now		2030		2040	
Comfort	942	11%	885	10%	936	11%
Sun Shading of Windows	586	7%	778	9%	817	9%
High Thermal Mass	154	2%	217	2%	240	3%
High Thermal Mass Night Flushed	154	2%	228	3%	256	3%
Direct Evaporative Cooling	109	1%	179	2%	198	2%
Two-Stage Evaporative Cooling	111	1%	192	2%	216	2%
Natural Ventilation Cooling	104	1%	162	2%	170	2%
Fan-Forced Ventilation Cooling	72	1%	104	1%	106	1%
Internal Heat Gain	1589	18%	1353	15%	1361	16%
Passive Solar Direct Gain Low Mass	899	10%	826	9%	796	9%
Passive Solar Direct Gain High Mass	624	7%	559	6%	539	6%
Wind Protection of Outdoor Spaces	259	3%	254	3%	249	3%
Humidification Only	0	0%	0	0%	0	0%
Dehumidification Only	491	6%	659	8%	692	8%
Cooling, add dehumidification if needed	305	3%	549	6%	604	7%
Heating, add humidification if needed	4791	55%	4545	52%	4436	51%

Predicted Effectiveness of Comfort Strategies for Minneapolis / Saint Paul – Climate Consultant, UCLA Energy Design Tools Group

Potential Future Weather Changes

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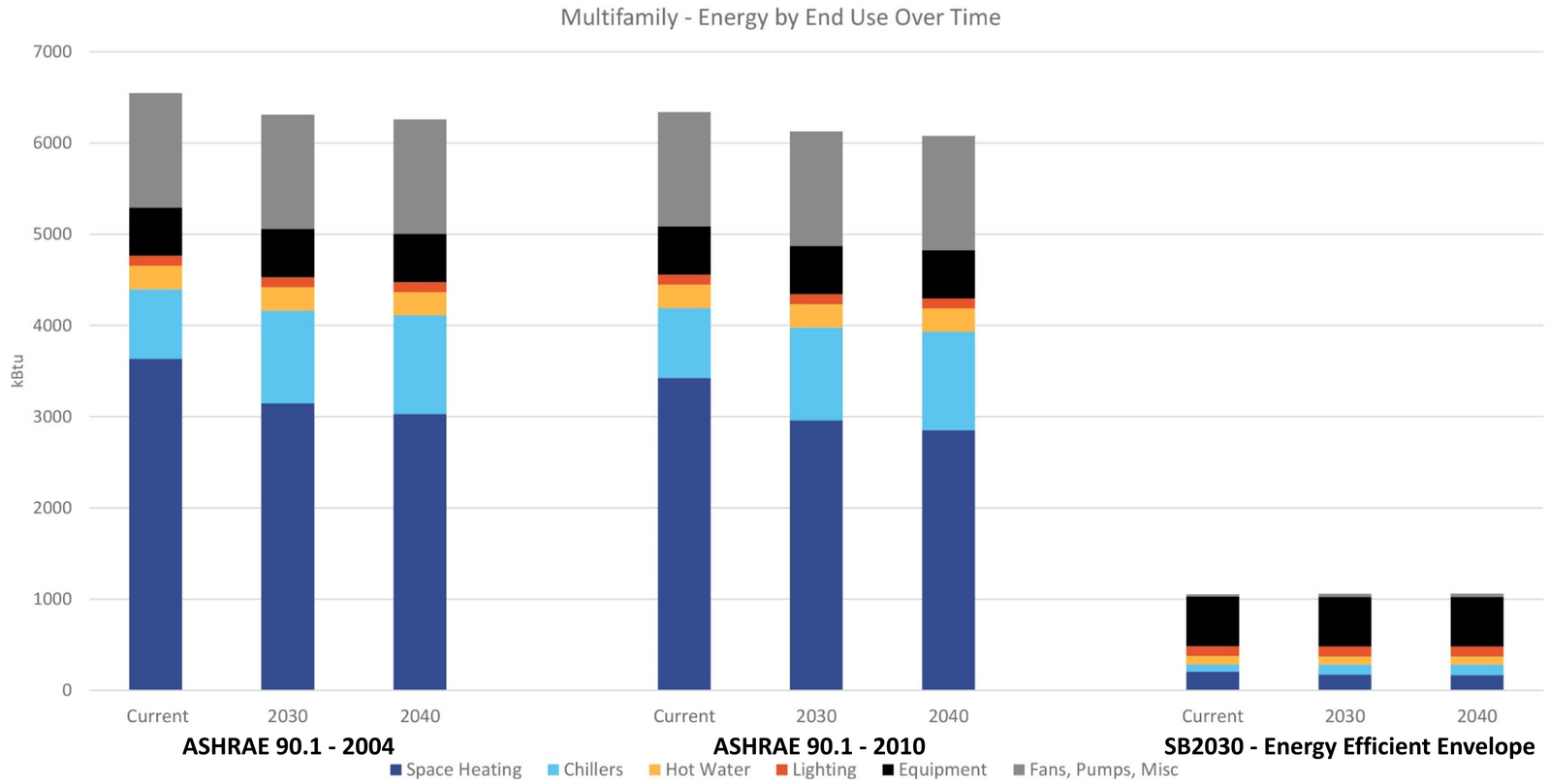
Predicted Effectiveness of Comfort Strategies for Minneapolis / Saint Paul – Climate Consultant, UCLA Energy Design Tools Group

Potential Future Weather Changes

- Energy use in code buildings decreases over time
- Increase in cooling load is outweighed by decrease in heating loads
- Energy use in high performing buildings stable over time



Needed Research

- Downscaling of Global Weather Data to Minnesota
- Application of Weather Data to Design and Operations
- Impact of Changing Climate of Energy Efficiency and Design
- Impact of Changing Climate on Site and Water Desig
- Assessment of Additional Risks and Impacts
- Other?