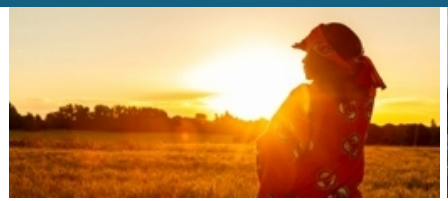
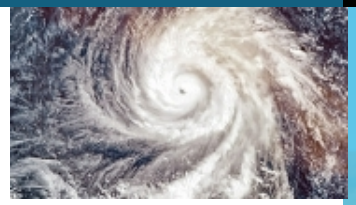
SAND2022-16677C

Sandia National Laboratories

Climate and National Security

A perspective from Sandia National Laboratories





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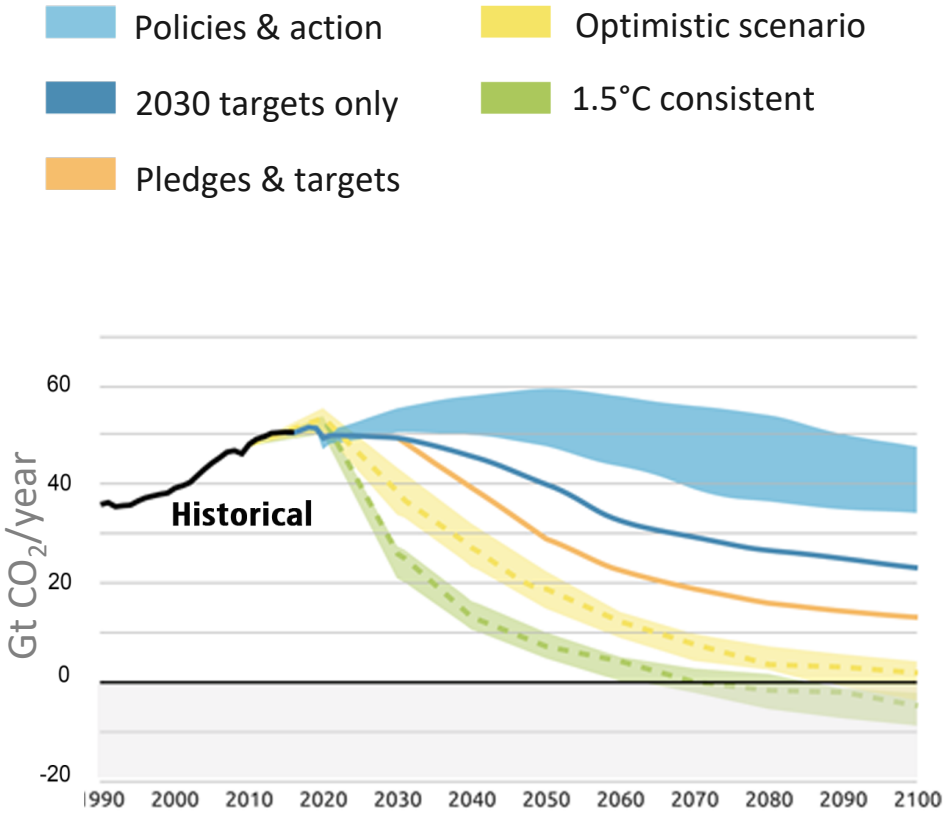
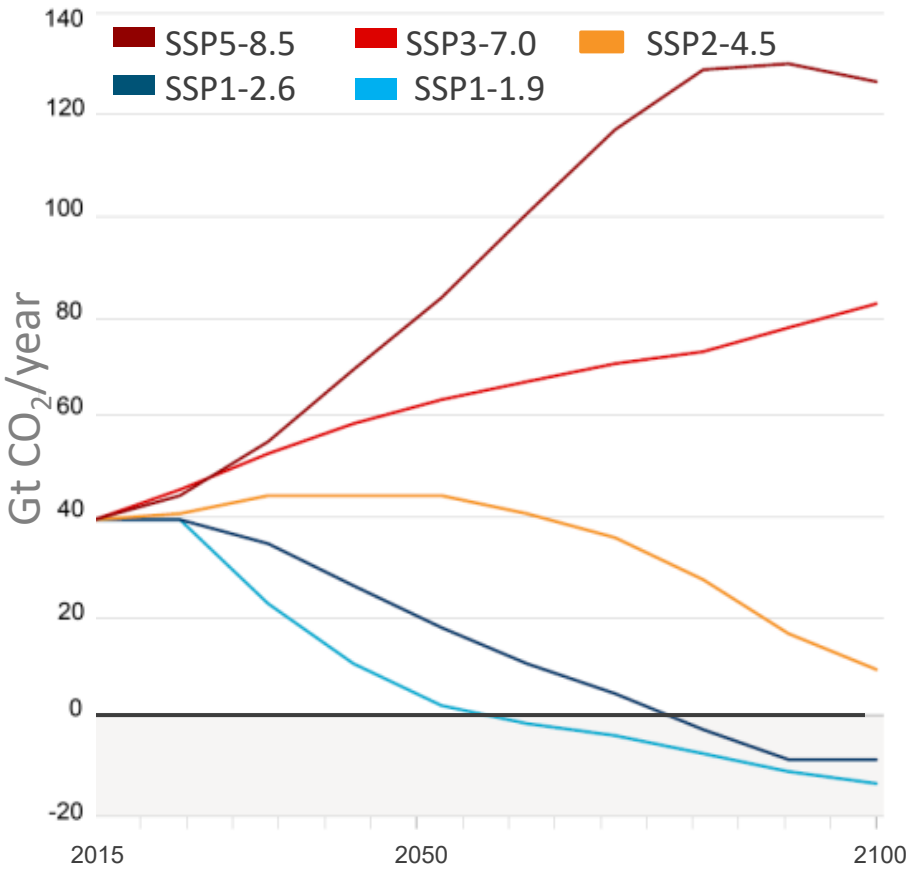
Every ***likely*** future this century will exceed 2.0°C

Paris Accord relevant yearly emission projections (1)



Emission scenarios: Projections of the Representative Concentration Pathways (2)



Global average surface temperature anomaly from pre -industrial (3)

Avg (5%, 95%)

4.4°C (3.3, 5.7)

3.6°C (2.8, 4.6)

2.7°C (2.1, 3.5)

1.8°C (1.3, 2.4)

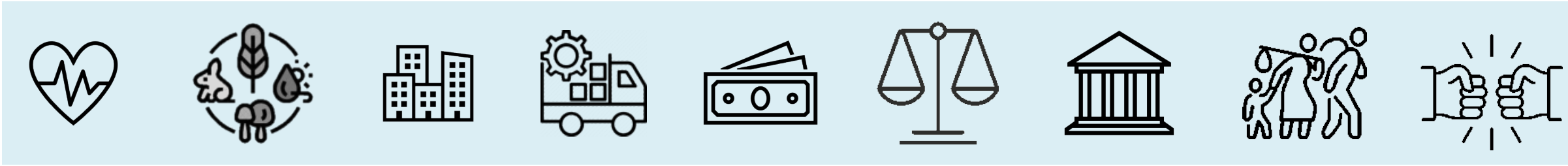
1.4°C (1.0, 1.8)

1 Zhongming, Z., et al. (2021). "Global update: Projected warming from Paris pledges drops to 2.4 degrees after US Summit: analysis." https://climateanalytics.org/latest/global-update-projected-warming-from-paris-pledges-drops-to-24-degrees-after-us-summit-analysis/

2 Intergovernmental Panel on Climate Change (2021). Climate Change 2021: The Physical Science Basis: The Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Figure SPM 4

3 Intergovernmental Panel on Climate Change (2021). Climate Change 2021: The Physical Science Basis: The Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Table SPM.1

Resulting climate risks are multi-faceted, interconnected, and, in the globally connected world, multiply to create significant security threats…



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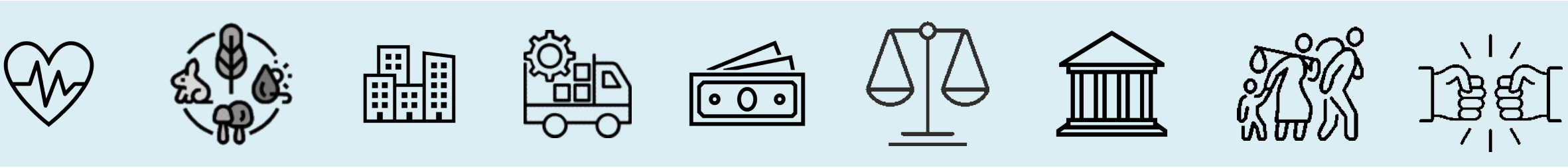


…Requiring a broad scope of activities and advances to address the climate crisis

Awareness

Monitor, Project, Assess

Evaluate the coupled climate-human system to support risk analyses and prioritize efforts

Coordination

Communicate, Negotiate, Regulate

Coordinate and inspire US, international, and personal actions to address environmental and social vulnerabilities equitably

Response

Adapt, Mitigate, Intervene

Implement scalable and effective technical and operational solutions to prevent and ameliorate the risks of climate change

Enforcement

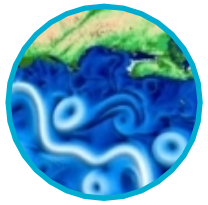
Incentivize, Detect, Attribute, Counter

Encourage and ensure a multilateral, cooperative approach to minimizing the impacts of climate change

Scientific and engineering pursuits underpin these activities and advances to address the climate crisis

Awareness is a foundational task for the other activities and is achieved through:

Monitor: Collect observations to enhance knowledge of and projection accuracy for climate and human conditions



Project: Model climate and human systems to anticipate future impacts and response efficacy

Assess: Establish climate risk and empower decision-makers with response options

Technical & operational **responses** are composed of innovations and research in:

Adapt: Pro- and re-actively reduce susceptibility to climate impacts affecting both human and natural systems

Mitigate: Decrease the anthropogenic sources contributing to climate change

Intervene: Undertake deliberate, large-scale actions to modify the Earth's climate system

Scientific and engineering pursuits underpin these activities and advances to address the climate crisis

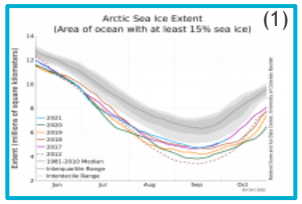
Effective **coordination** relies upon consensus scientific results with quantified uncertainty to enable:

Communicate: Convey the scientific results that are critical to a community with concise messaging

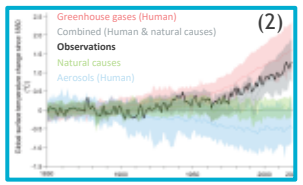
Negotiate: Prepare risk analyses establishing trade-offs between options

Regulate: Equip decision-makers with quantified returns and risks for given options

Multilateral and cooperative approaches are supported by **enforcement** capabilities achieved through:



Detect: Analyze observations to identify anomalous signatures designating a change



Attribute: Determine relative contribution of a particular factor to the measured change or impact

Incentivize/Counter: Technological and/or political responses capable of encouraging cessation of change-responsible factor, or negating/stopping the change-responsible factor

1 National Snow & Ice Data Center (2021). http://nsidc.org/arcticseaicenews/2021/10/september-turning/
2 Intergovernmental Panel on Climate Change (2021). Climate Change 2021: The Physical Science Basis: The Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 3. FAQ3.1, Figure 1