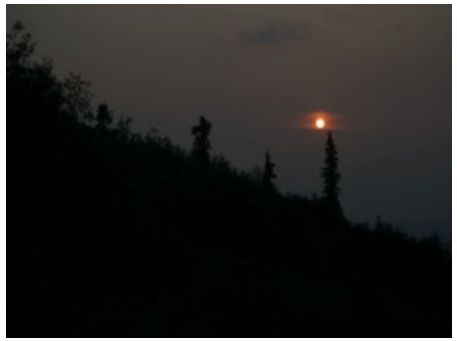
Vulnerability assessment

Jeremy Littell, USGS / Alaska CASC

What’s the difference?

- Climate (change) impacts assessment
- Climate (change) vulnerability assessment
- Climate risk assessment
- Threat assessment
- Climate adaptation plan

ANSWER: In practice, they overlap! The definition depends on who is using it and for what purpose.



Are we already living in the riskier future?

Extreme events (or changes) Happen because of climate…

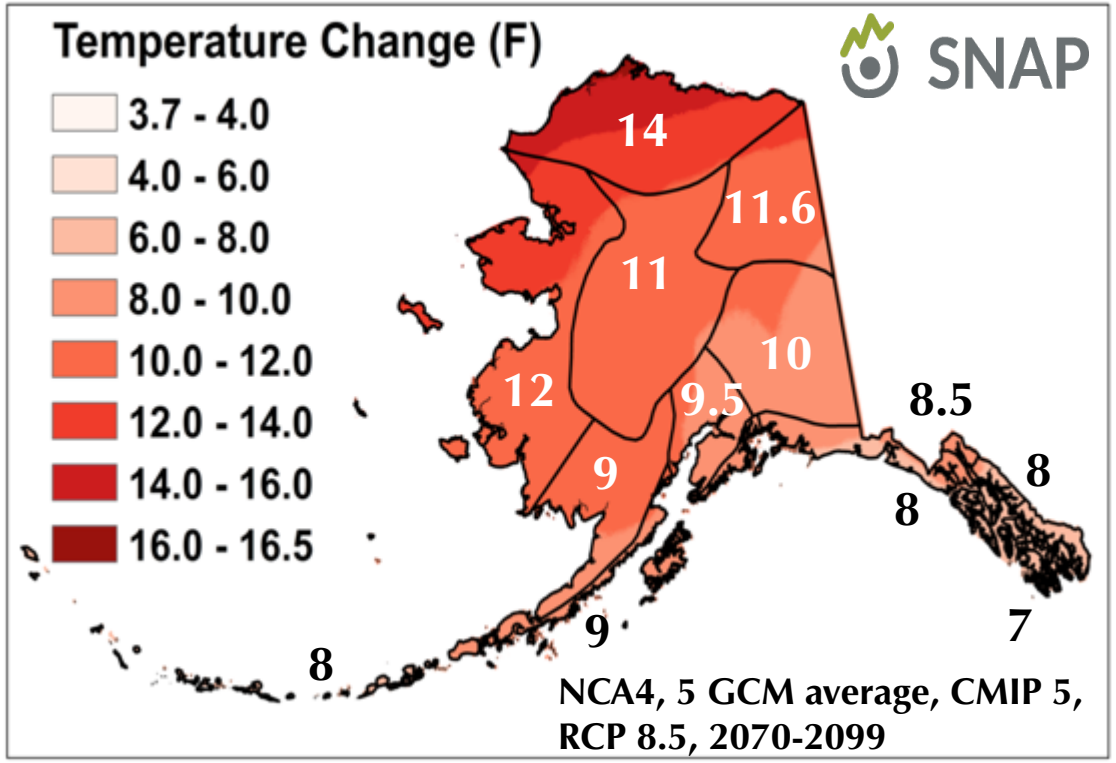
HAZARD

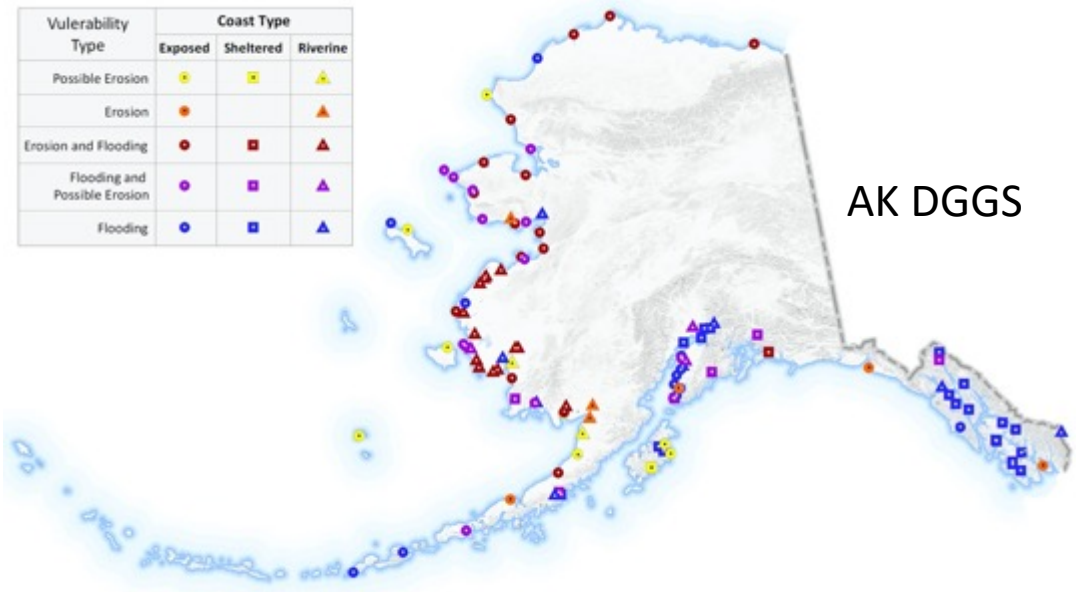
…and have impacts on things important to people….

EXPOSURE

…and those impacts vary with circumstance, economics, resilience.

VULNERABILITY





AK DGGS

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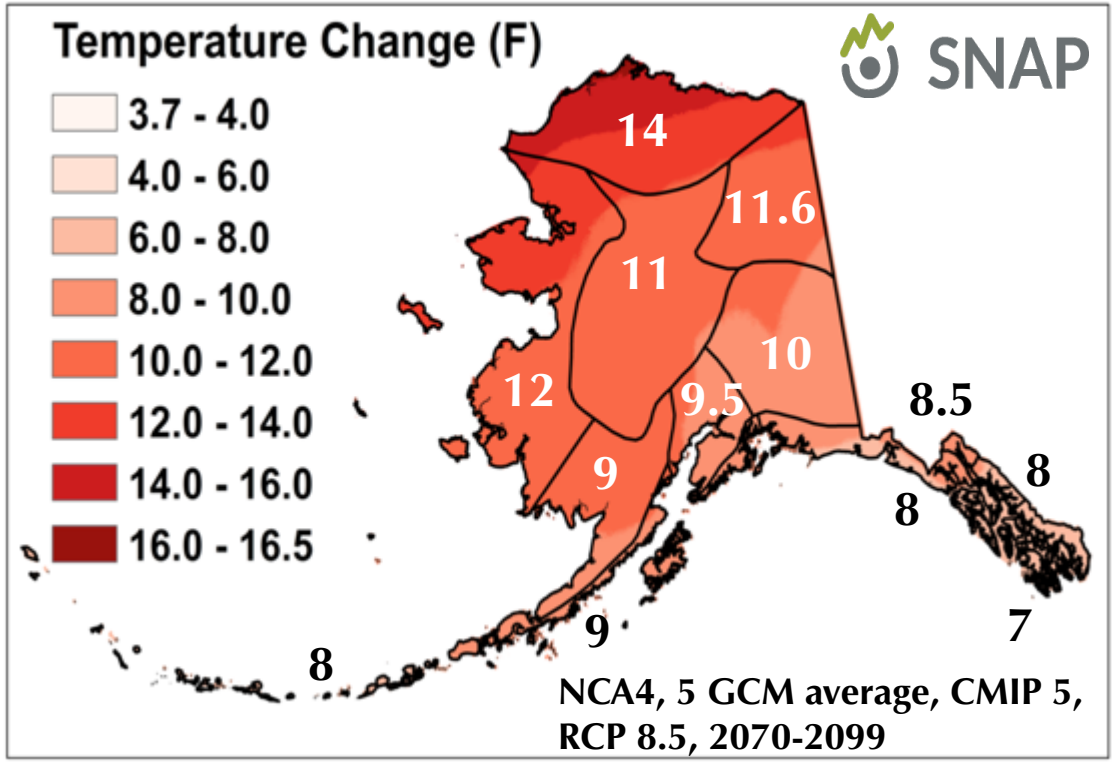
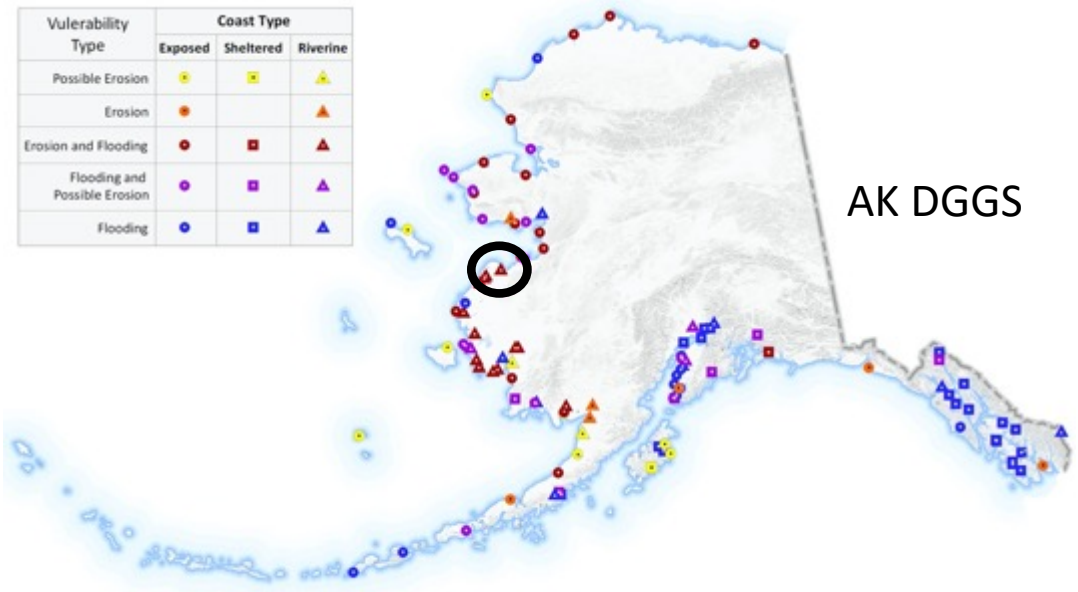
VULNERABILITY





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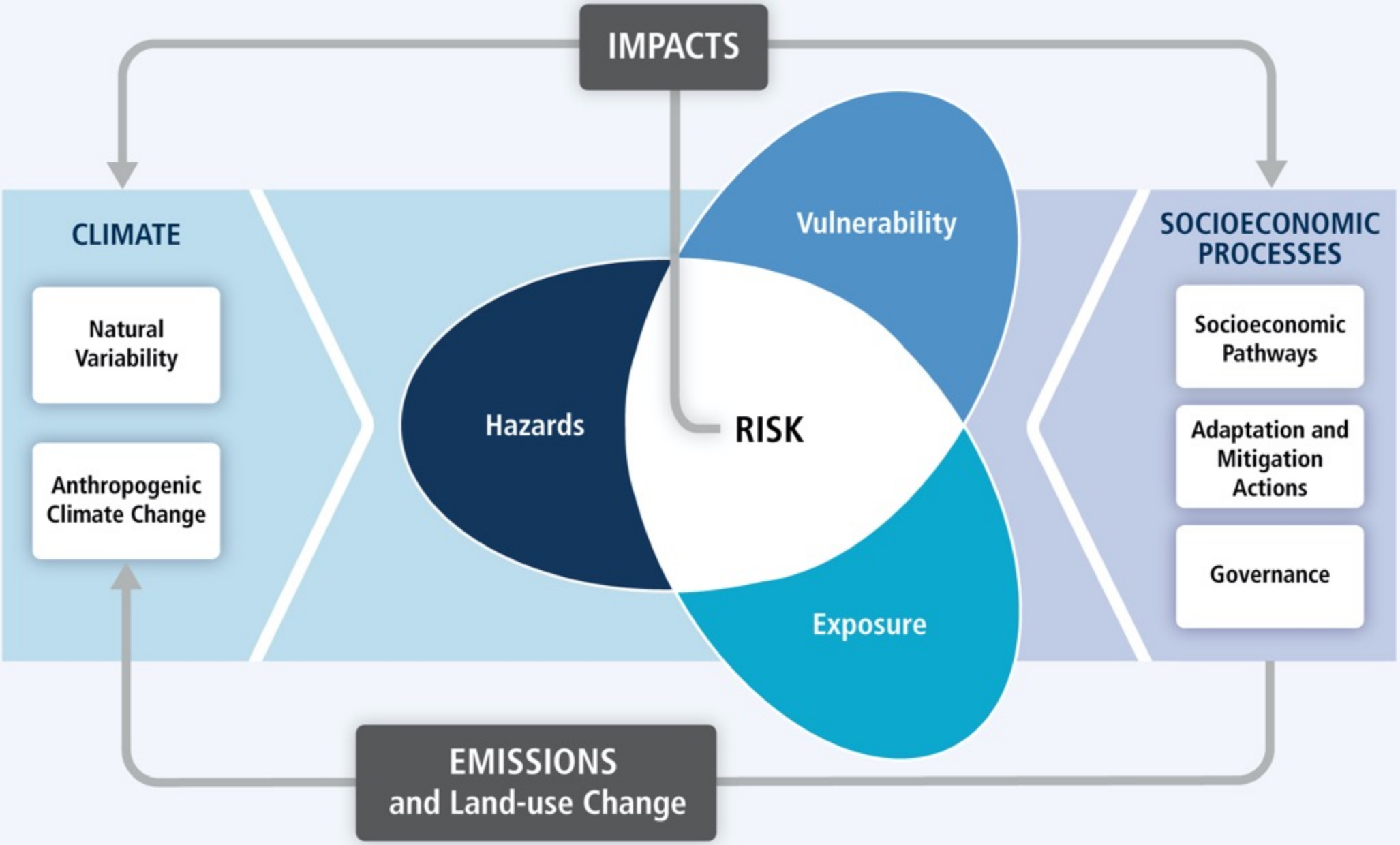
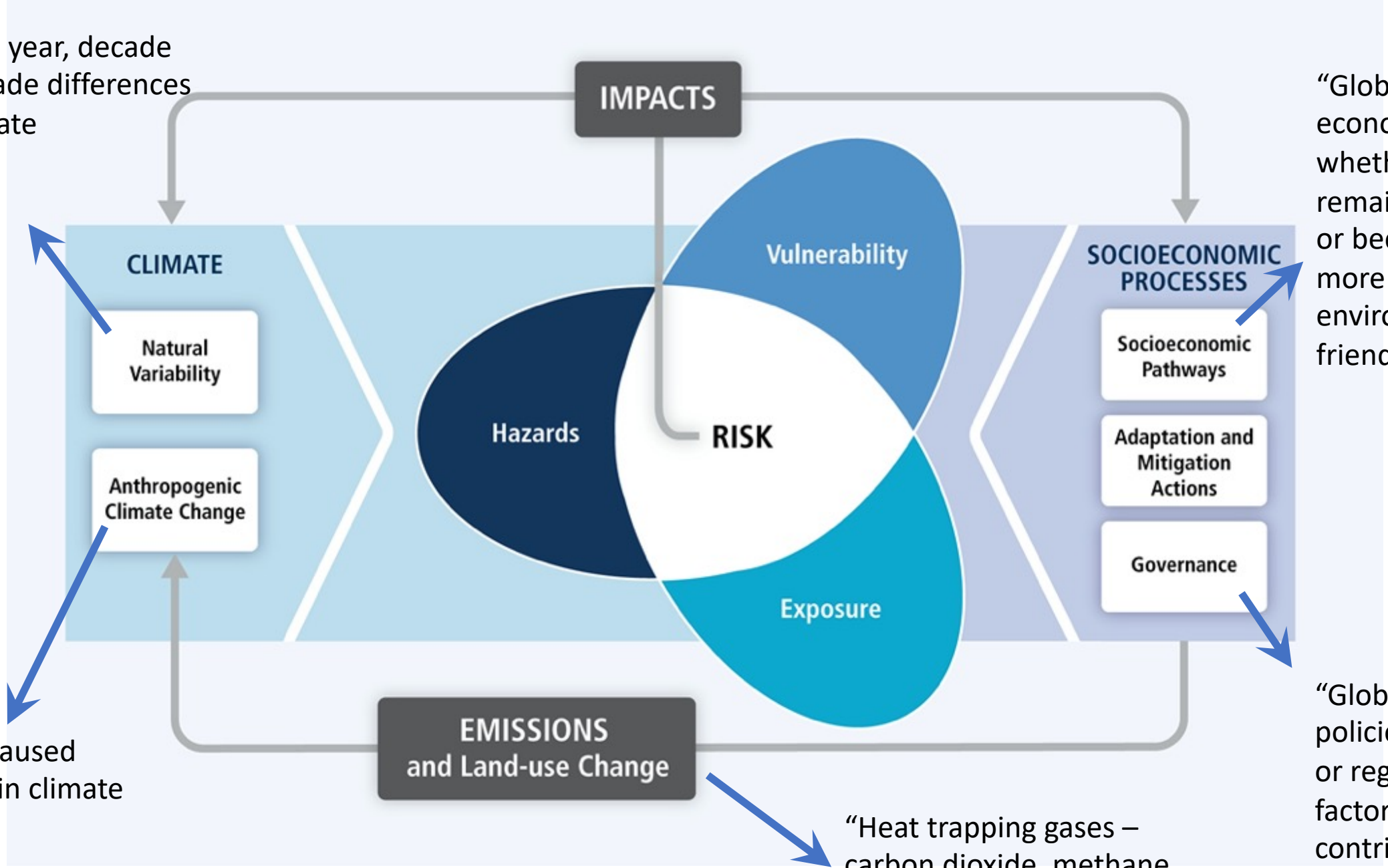

IMPACTS
CLIMATE
Natural Variability
Anthropogenic Climate Change
Hazards
Vulnerability
RISK
Exposure
SOCIOECONOMIC PROCESSES
Socioeconomic Pathways
Adaptation and Mitigation Actions
Governance
EMISSIONS and Land-use Change

Year to year, decade to decade differences in climate



"Global human economy – whether it remains as it is or becomes more environmentally friendly"

Human caused changes in climate

"Global-to-local policies that limit or regulate the factors that contribute to climate change"

"Heat trapping gases – carbon dioxide, methane, others"

Climate change definition of ‘vulnerability’ includes:

- **Likely to be impacted or harmed?**
  - What kinds of hazards exist, what impacts could occur, and how likely are they? (Sensitivity)
  - How big a change will occur in the things that are affected? (Exposure)

- **Ability to cope or adapt – called “adaptive capacity**”
  - If those impacts occur, are people/communities resilient to them?
  - Can things be done ahead of time to minimize harm? (Adaptation)

What’s in a vulnerability assessment?

- **Exposure:** A description or analysis of climate change driven hazards (temperature, rainfall/snow changes) that affect a place, process, species, people, etc.

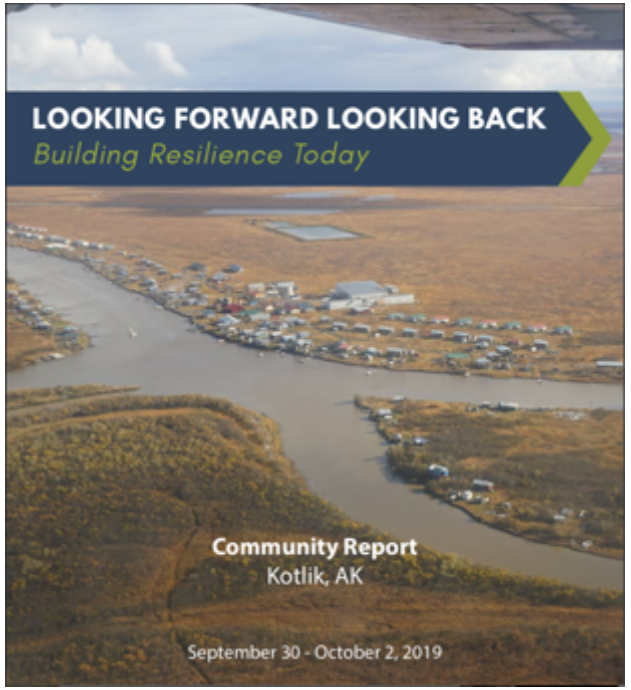
- **Sensitivity:** How the hazards affect the whole system and how it will respond (or at least the parts people are most concerned about)

- **Adaptive capacity:** The ability of the ‘system’ (both people and nature) to deal with the impacts.

Example: Kotlik flooding

- **EXPOSURE**: Changes in climate (temperature, storminess) are causing changes in permafrost, sea ice, and flood risk.

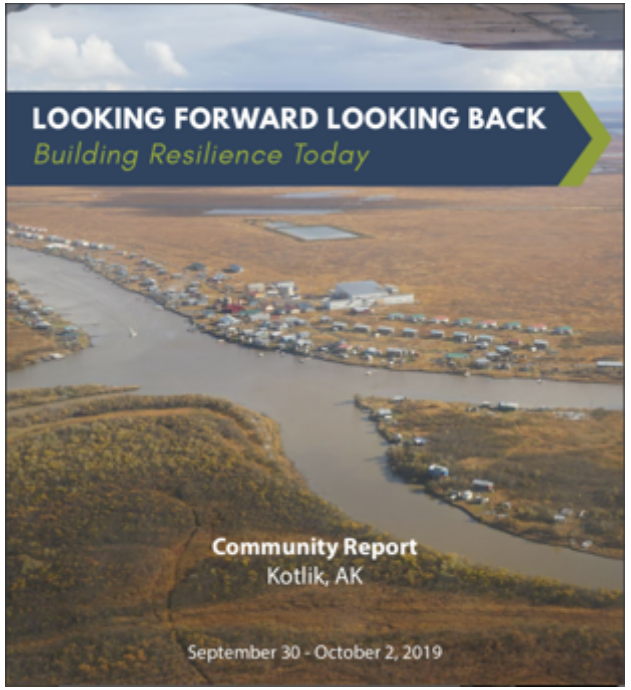
Nov. 11, 2013. (Patricia Okitkun / courtesy Alaska Dispatch)



Example: Kotlik flooding

- **SENSITIVITY**: Permafrost thaw has caused sinking land and increased erosion. Combined with changes in sea ice and potentially storminess, this has increased the size of floods and how much of the community can be flooded in a flood event.

Nov. 11, 2013. (Patricia Okitkun / courtesy Alaska Dispatch)



Example: Kotlik flooding

- **Adaptive Capacity**:
  - Current: shore stabilization efforts / armoring. Moving houses back from eroding areas. Increased preparedness for floods (forecasts, getting ready).
  - Future: Relocation of community?

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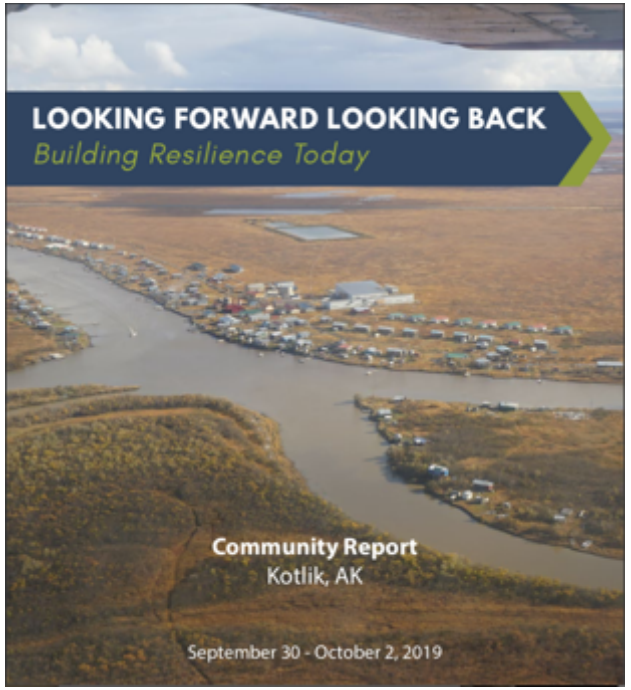
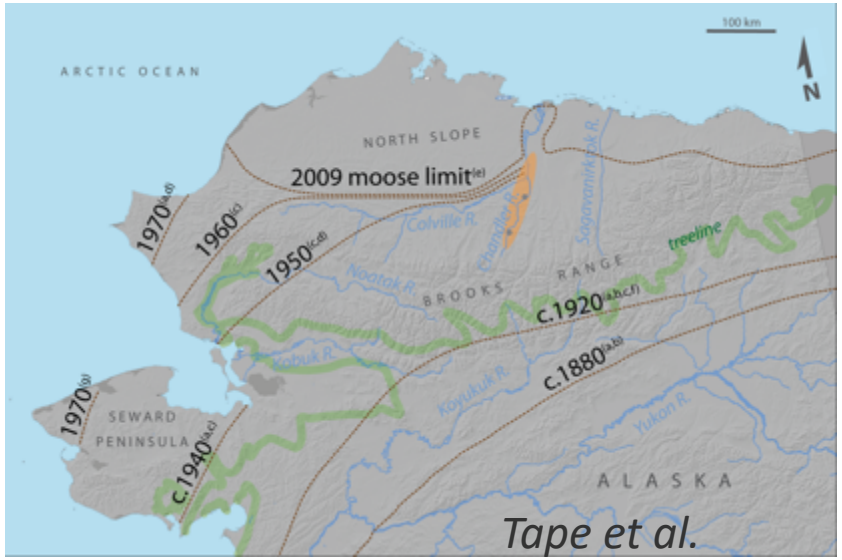


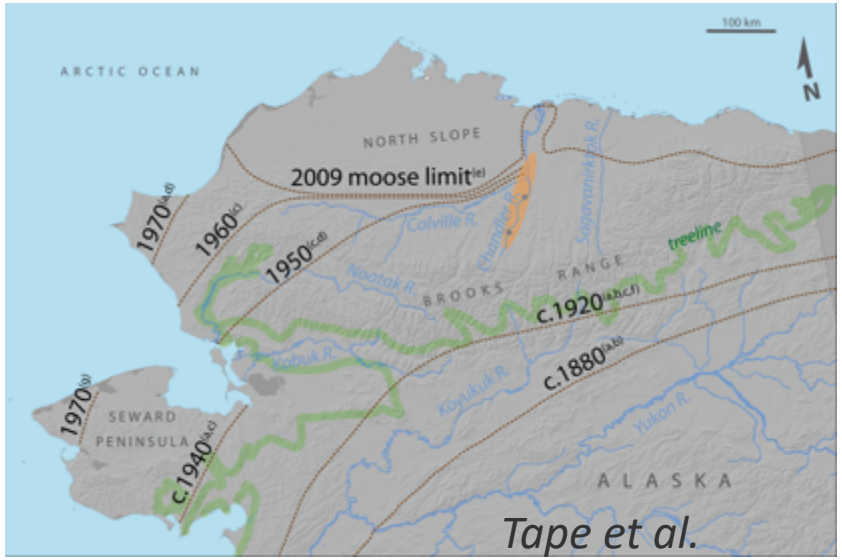
An example: changing caribou and moose populations

- **EXPOSURE**: Changes in climate (temperature, precipitation, snow, ice conditions) are causing changes in tundra habitat.



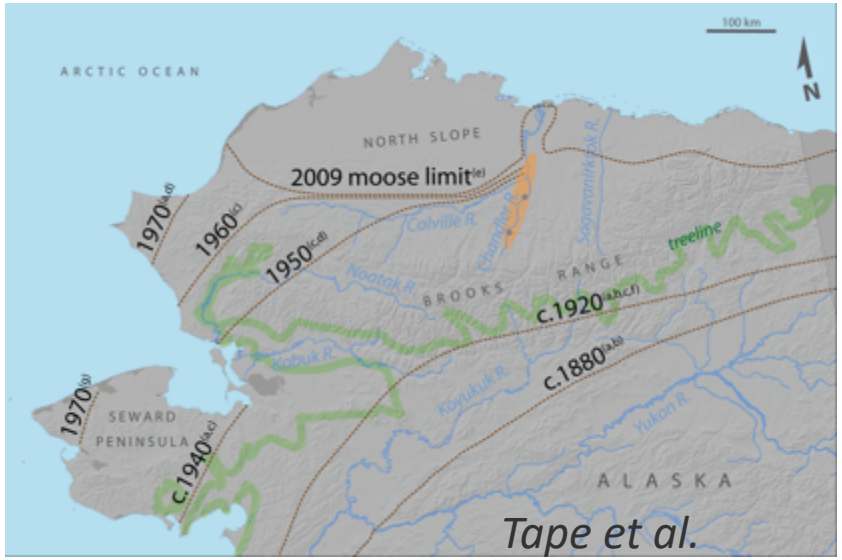
An example: changing caribou and moose populations

- **SENSITIVITY**: These changes and conditions (trees and shrubs invading, bringing fire with them) favor moose and do not favor caribou. Also, rain-on-snow and deeper snow favor moose more than caribou. There are maybe fewer caribou, or their migration patterns change. Harvest timing and predictability are thus changing for both species in some locations, possibly less caribou and more moose.



An example: changing caribou and moose populations

- **ADAPTIVE CAPACITY**:
  - Do people want to switch from caribou to moose? Is it even possible in all places?
  - Are harvest regulations changeable to accommodate timing and availability?
  - How will this change in the future with additional climate change?
  - What combination of knowledges will help us anticipate these changes and adapt to them?
  - Are reindeer an option?

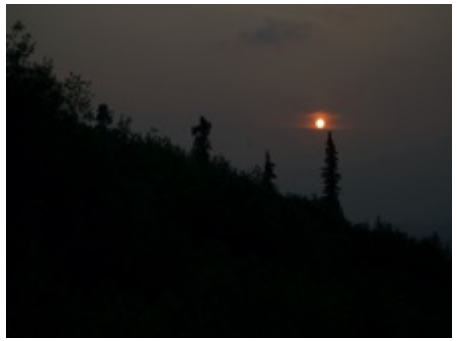


Community or regional vulnerability assessment

A vulnerability assessment will often work through many such examples.

Community health, traditional harvests, impacts to structures, future economic development can all be incorporated into a vulnerability assessment. The key is to address the exposure, sensitivity, and adaptive capacity for each priority or resource.

This takes people to make it happen, and regional dialogues and partnerships can help spread the effort out some and increase the benefits of working together.



How does all this fit together? Recommended reading for a general, global, climate change overview is available from the IPCC at this link: https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgII_spm_en.pdf

Vulnerability assessment definitions

IPCC: https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_wgII_spm_en.pdf

USDA Climate Hubs: https://www.climatehubs.usda.gov/actions-and-resources/vulnerability-assessment

NOAA Fisheries: https://www.fisheries.noaa.gov/national/climate/climate-vulnerability-assessments

USAID: https://pdf.usaid.gov/pdf_docs/PA00KZ84.pdf

US CRT (municipal / transportation): https://toolkit.climate.gov/tool/climate-change-extreme-weather-vulnerability-assessment-framework

Vulnerability assessments:

Karuk tribe: https://karuktribeclimatechangeprojects.com/climate-vulnerabilty-assessment/

Training / examples:

Climate Impacts Group Tribal Vulnerability Assessment Resources: https://cig.uw.edu/resources/tribal-vulnerability-assessment-resources/

Related webinar: https://www.usgs.gov/ecosystems/climate-adaptation-science-centers/science/webinar-tribal-resources-climate-change?qt-science_center_objects=0#qt-science_center_objects

ITEP: http://www7.nau.edu/itep/main/tcc/Mindmap/TribalAdaptationPlans