AN AGENT-CENTERED DECISION-ANALYTIC APPROACH TO CLIMATE CHANGE ADAPTATION

Mary Huisenga, William Travis and Katherine Clifford
University of Colorado at Boulder
correspondence: william.travis@colorado.edu

CENTER FOR SCIENCE & TECHNOLOGY POLICY RESEARCH

Western Water Assessment

CIRES

University of Colorado Boulder

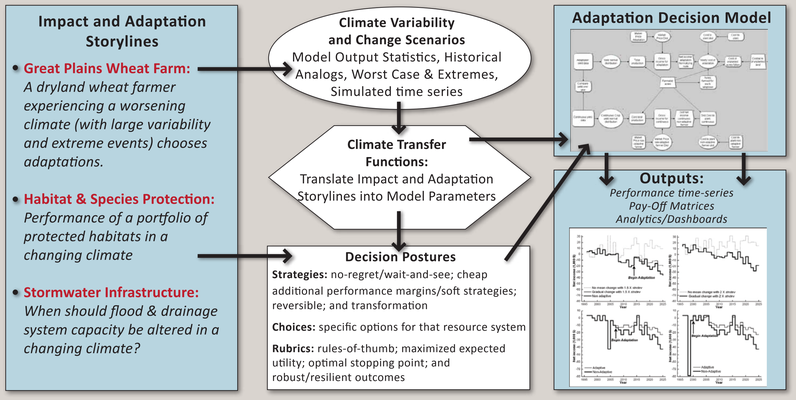
A "WORK IN PROGRESS" POSTER

We set out to develop decision models for adaptation to climate variability and change, and use them to test hypotheses about the type, pace and payoff of adaptations made by resource decision-makers such as farmers, ranchers, conservationists, and infrastructure managers as they experience climate change and, especially, extreme climate events. First results for a Great Plains dryland wheat farm are reported here.

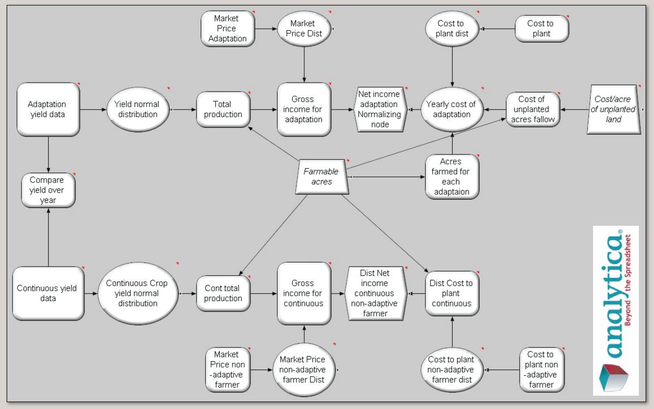
A CLIMATE ADAPTATION TEST BED

We fashioned a "test bed" of analytic tools centered on simulation and decision-analysis software, plus climate scenario generators, and analytic and visualization tools, to facilitate testing of multiple hypotheses about how such resource management systems will adapt to climate change. The Climate Impacts and Adaptation Test-Bed includes:

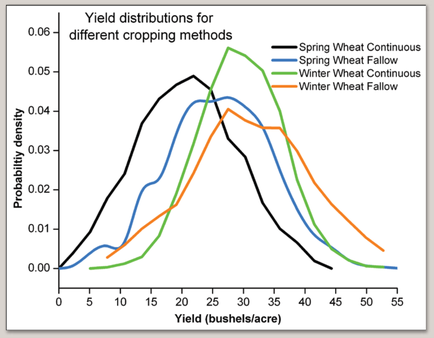
- Impact and adaptation storylines associated with climate sensitive sectors like farming, conservation, and infrastructure.
- Methods for creating climate scenarios (model output statistics; historical analogs) and for translating them into resource impacts (expert elicitation, impact models) structured to test adaptation sensitivity and to give particular attention to rate of change, variability, skewness, and extreme events.
- A decision-analytic framework combining traditional dimensions of risk and uncertainty with decision time-series simulation to test ideas about pacing and "go points" as climate changes based on several decision postures:
  - Strategies: no-regret/wait-and-see; cheap performance margins/soft strategies; reversible; and transformational
  - Choices: specific options for that resource system
  - Rubrics: rules-of-thumb; maximized expected utility; optimal stopping point; and robust/resilient outcomes



ADAPTING ON THE FARM

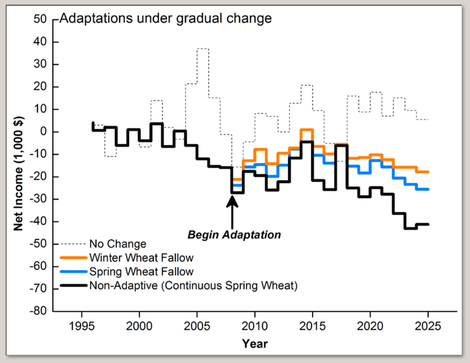


We tested hypotheses about the timing and pace of adaption in response to different profiles of climate change, especially extreme events superimposed on a gradually or rapidly worsening climate, expressed in yield and income variation for a dryland wheat farm in the U.S. Great Plains. Scenarios include gradual and rapid change, with typical or increased noise (standard deviation), and with extreme events stepped through the simulation. Adaptation choices range from cheap adjustments to transformation, and include switching crops and/or cultivation methods. In the model runs reported here we apply a rule-of-thumb income threshold for adaptation derived from recent financial performance of actual farms in the region. Negative net income drives adaptation which quickens with the rate of change but is slowed by larger noise. Extreme years evoke adaptation sooner than gradual change alone (see results to the right).



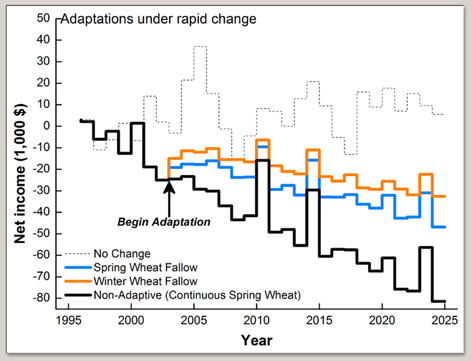
Adaptations are translated into alternative yield distributions, and at the adaptive "Go Point" the farmer starts to draw from a different yield distribution.

RESULTS



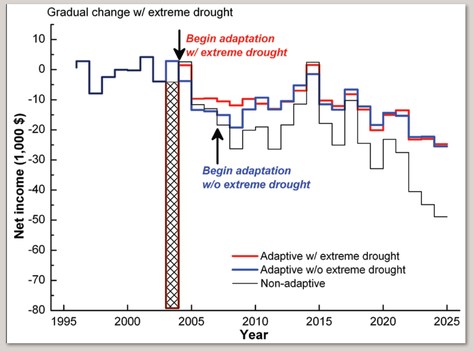
Gradual climate worsening:

Adaptation occurs 10-15 years into the gradual change scenario, and the more drastic change, from continuous spring wheat to winter wheat, pays off.



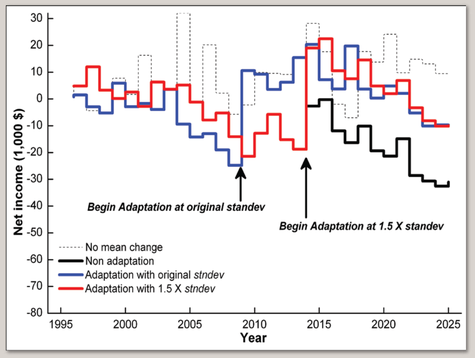
Rapid climate worsening:

Adaptation occurs **5 years earlier** because the signal of change is so much stronger in the rapid change scenario.



Extreme drought (occurring in this run in 2004), **tripped adaptation any year** that it occurred before the non-drought adaptation "Go Point".

A more typical drought advanced adaptation only when it occurred within a few years of the non-drought adaptation "Go Point".



Increased variability (original standard deviation X 1.5) on top of gradual climate worsening **delays the adaptation "Go Point"**.