**National Climate Assessment: Agriculture Chapter**

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Ag is a very broad field. Think of all the different types of food & fiber, crops and livestock produced. Climate has diverse impacts both direct and indirect. Only the more important and sweeping issues listed.

Traceable accounts are intended to identify and assess sources of information on key issues. They include questions like: why is it of interest or importance?, how likely is it to happen (risk-framing)?, what are key uncertainties?. We identified these 5 general traceable accounts:

- Abiotic: $CO_2$, T, P changes affect and in some cases stress crops/livestock. Detail of changes uncertain; interactions (e.g. animal/rangeland); adaptation likely on short term.
- Biotic: Exacerbate pest pressures; pollination, growth cycles altered. Timing matters but is uncertain; interactions (e.g. pests and ag product); departures from past equilibria.
- Natural resources: Soil fertility/erosion losses; water availability (e.g. ground water drops; less snow 'banking') Precipitation changes: shifts, timing & intensity uncertain; adaptation limited and already started (e.g. drip)
- Extreme events: Thresholds matter & differ quite a bit between commodities; combinations matter (high RH with high T); timing can be more critical than magnitude(e.g. slight freeze at blossom ) Simulation of extremes (esp. combinations) uncertain; rarity introduces uncertainty
- Economics: Larger market forces; adaptation has costs (e.g. changing crops, water delivery); infrastructure and critical size issues; regulation. Quantifying complex interactions of market sectors uncertain; economic value of ecological services uncertain

The chapter had 6 sections. Below are a few of the items mentioned in each section. Some of the research needs might fit within the new U.S. CLIVAR science planning and/or goals.

- Introduction: Ag is 300$B enterprise; climate change a major challenge though ag is resilient on short term
- Ag Crops & livestock responses: $CO_2$ affects plant growth (crop & weeds); interactions (soil, water avail, T, etc.); some adaptation possible; crop zone shifts (e.g. chilling hours figs.)
- Impacts on soil and water: Erosion (increased rainfall intensity); tillage; water demand versus availability
- Extreme events: impacts greatest at early development & harvest; other phenological issues (e.g. bolting); conditioning livestock

- Adaptation and economics: Adaptation & pest control have costs & need infrastructure;
- Research needs
  - Quantify interactions of T, rh, soil water, $CO_2$ on growth/yield variation across species
  - Develop management tools/systems (crops & livestock) for variability & extremes
  - Evaluate climate change on pests (insect, disease, weeds) range and crop interaction
  - Integrated assessment of various adaptation strategies & improved modeling
  - Better define future climate change on sufficient ranges of space & time scales (e.g. timing & duration) especially for extremes (esp. combinations of weather variables)