Climate Component of the Kansas EPSCoR project

Main Goals

1. **How will climate impact society and environment**

   What will be the local temporal and spatial expression of temperature and precipitation change? How will these changes impact local water resources?

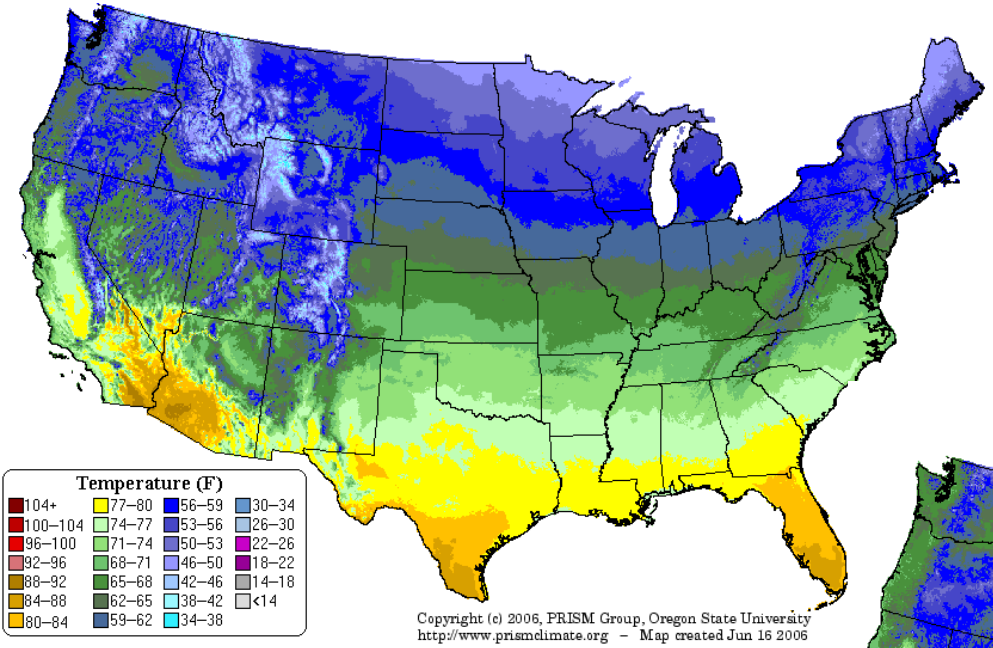
   How will the combined impacts of changes in temperature and precipitation impact agricultural systems and thus the economy of Kansas and the Great Plains?

2. **How will society affect climate**

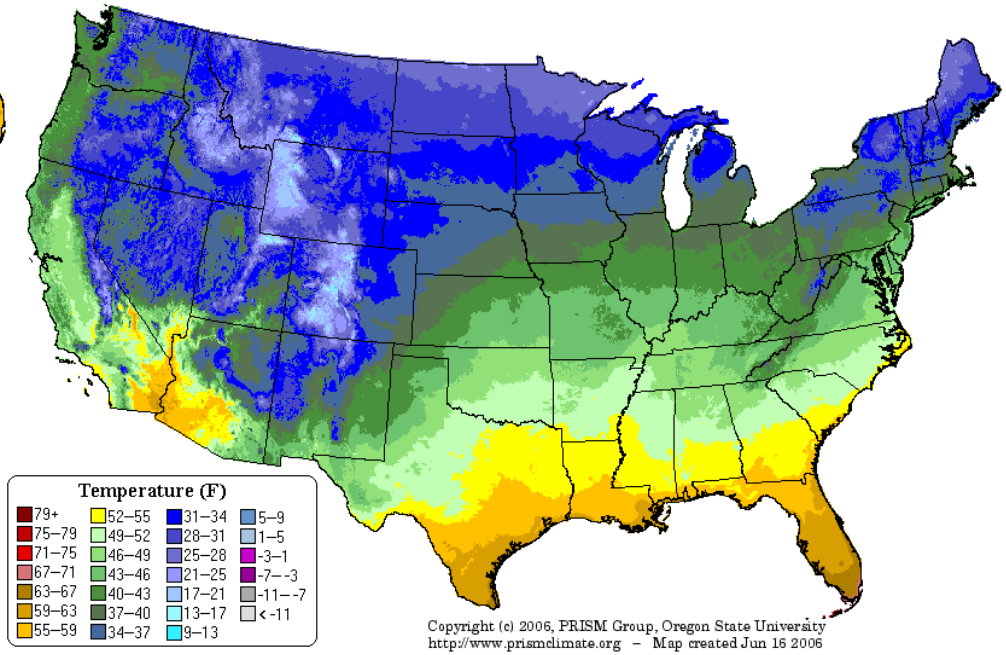
   How might extensive biofuel production impact climate change and water resources availability in Kansas and the central Great Plains?

Background on Kansas Climate

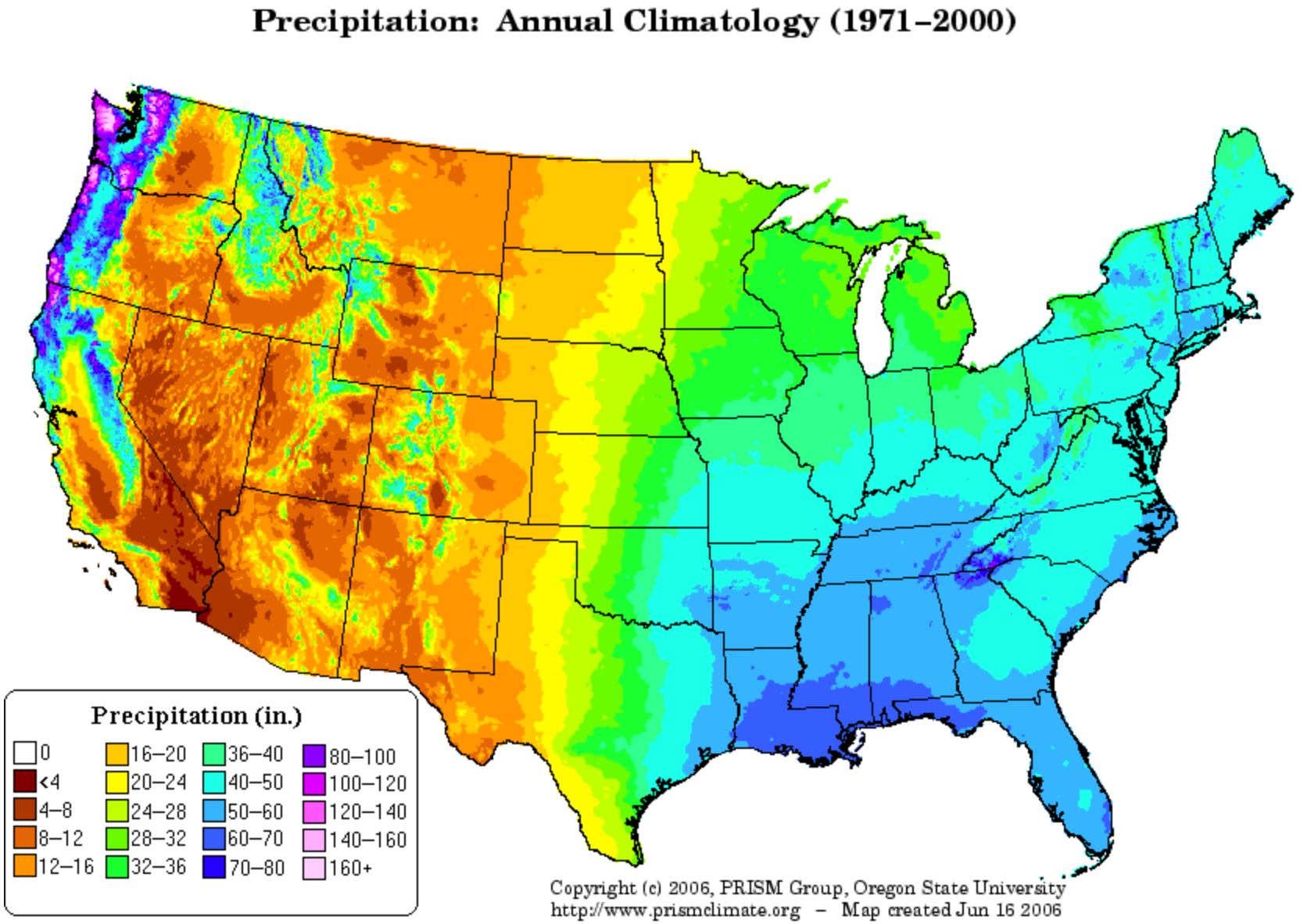
Maximum Temperature: Annual Climatology (1971–2000)



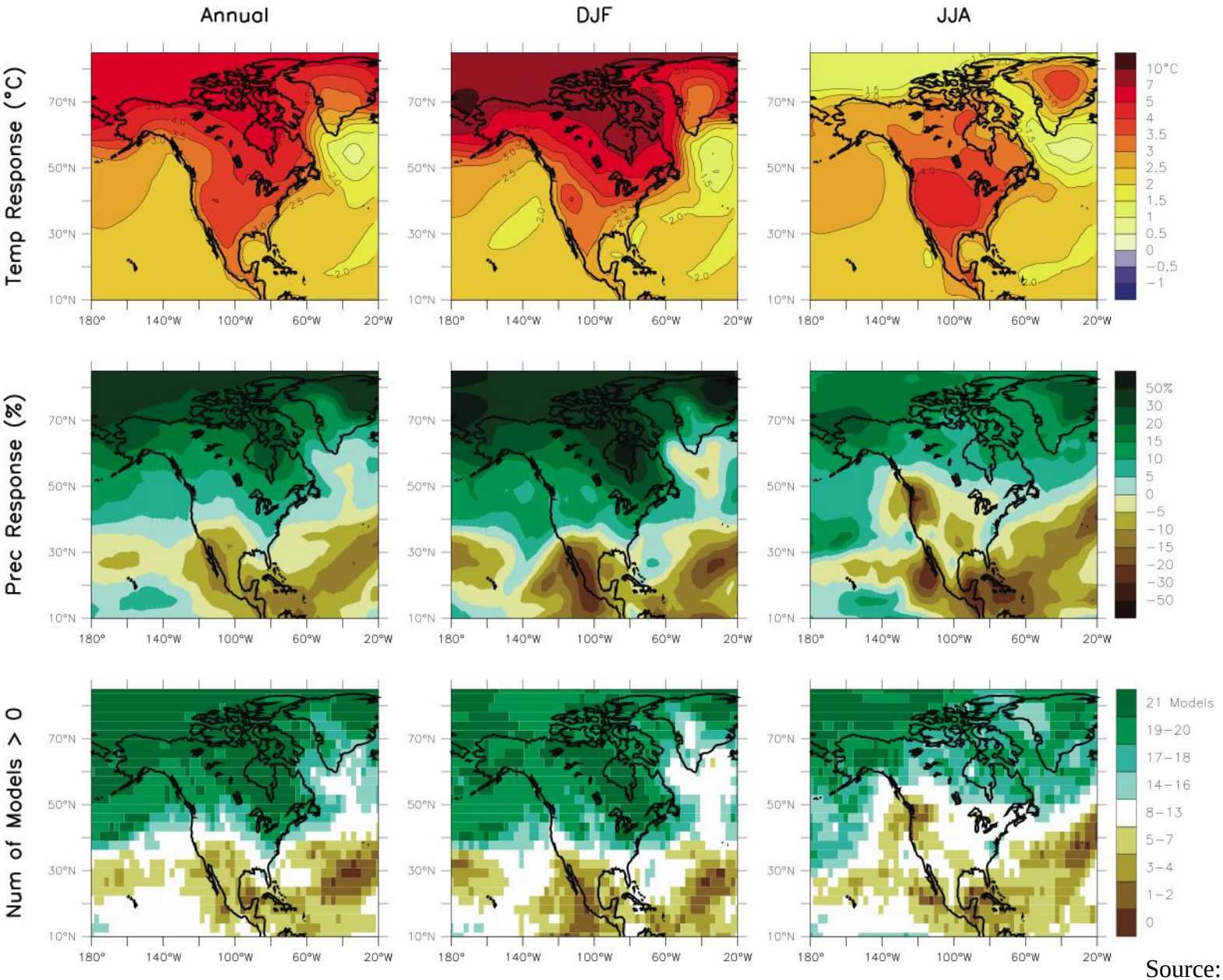
Minimum Temperature: Annual Climatology (1971–2000)



Background on Kansas Climate

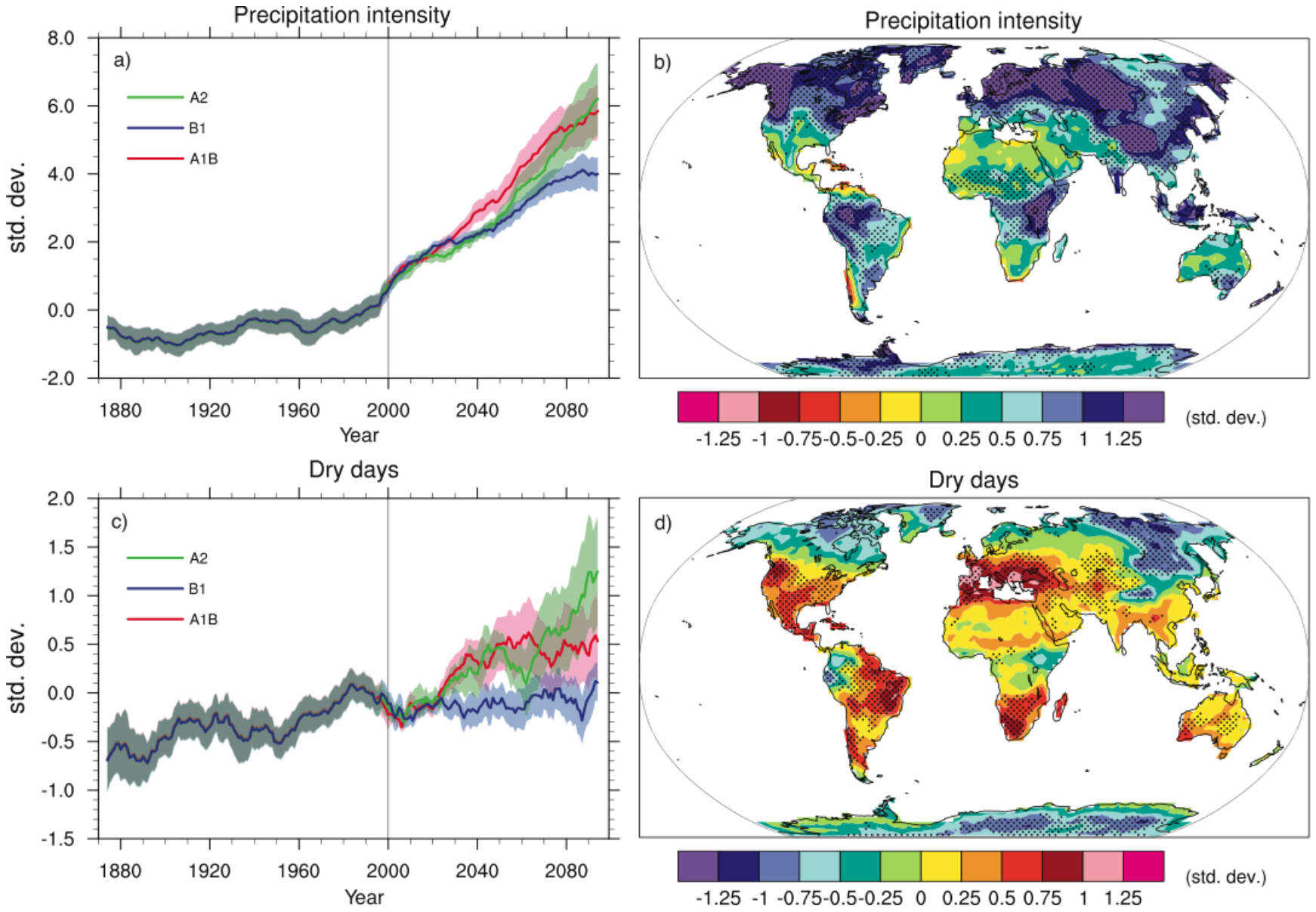


IPCC based climate projections for Kansas



Source: IPCC 2007

Timing and distribution



Source: IPCC 2007

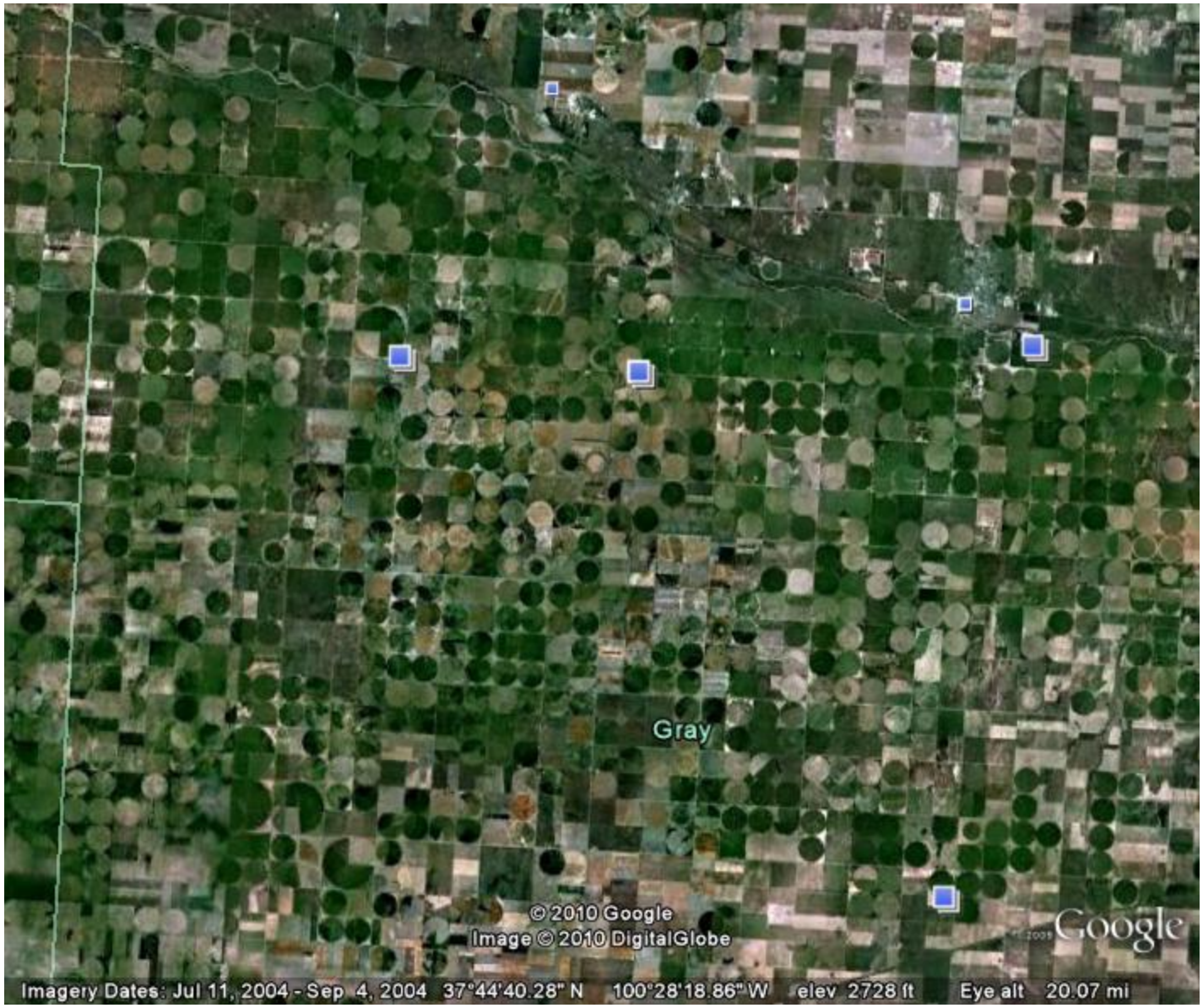
What next for Kansas Climate change

IPCC models are great to look at the global picture but:

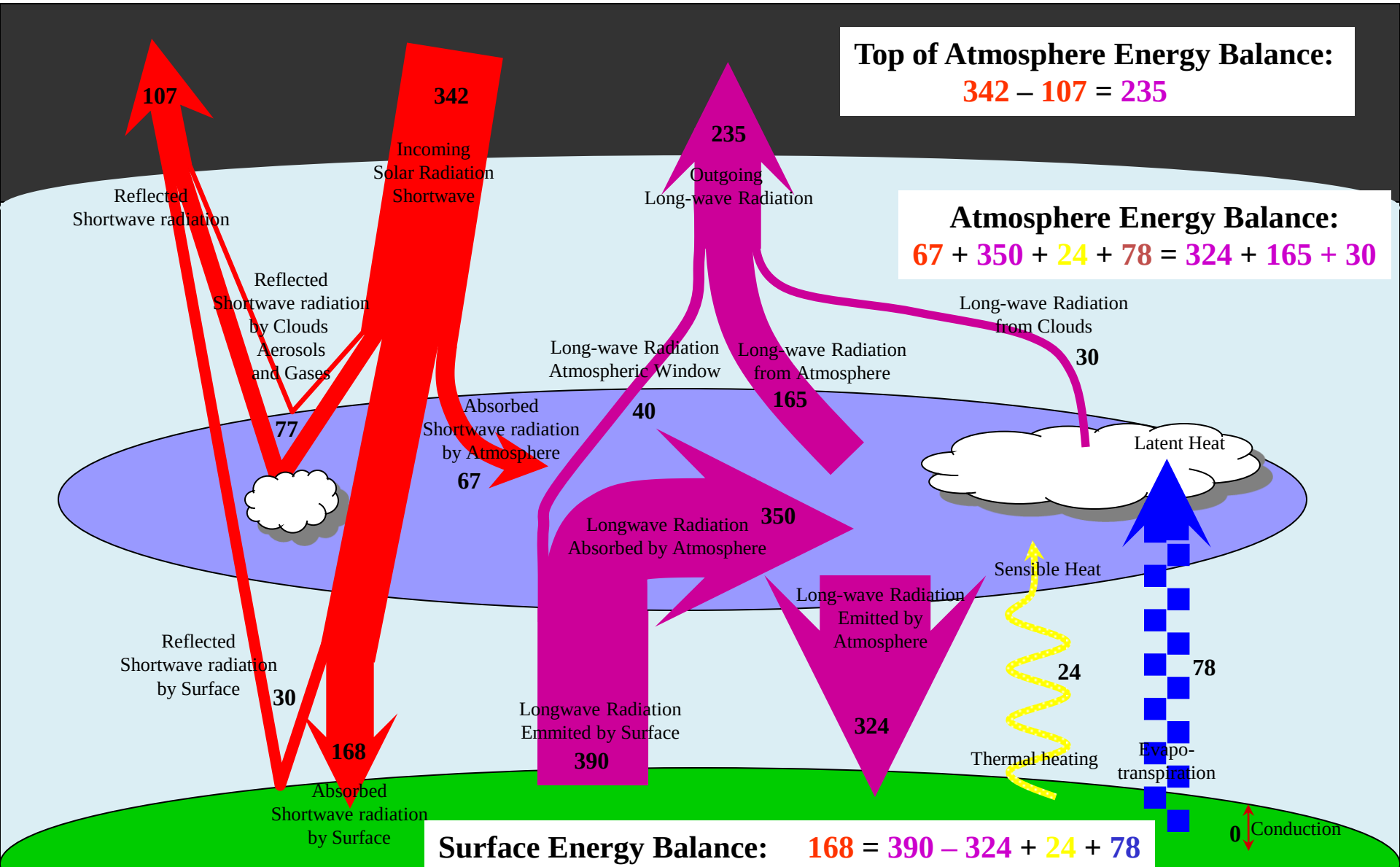
- Do not include potential local climate impacts
  - Irrigation

- To crude to get at specific weather related phenomena e.g.:
  - Local moisture changes and their impacts on:
    - cloud cover
    - local precipitation
    - storm intensity
  - Local temperature regimes

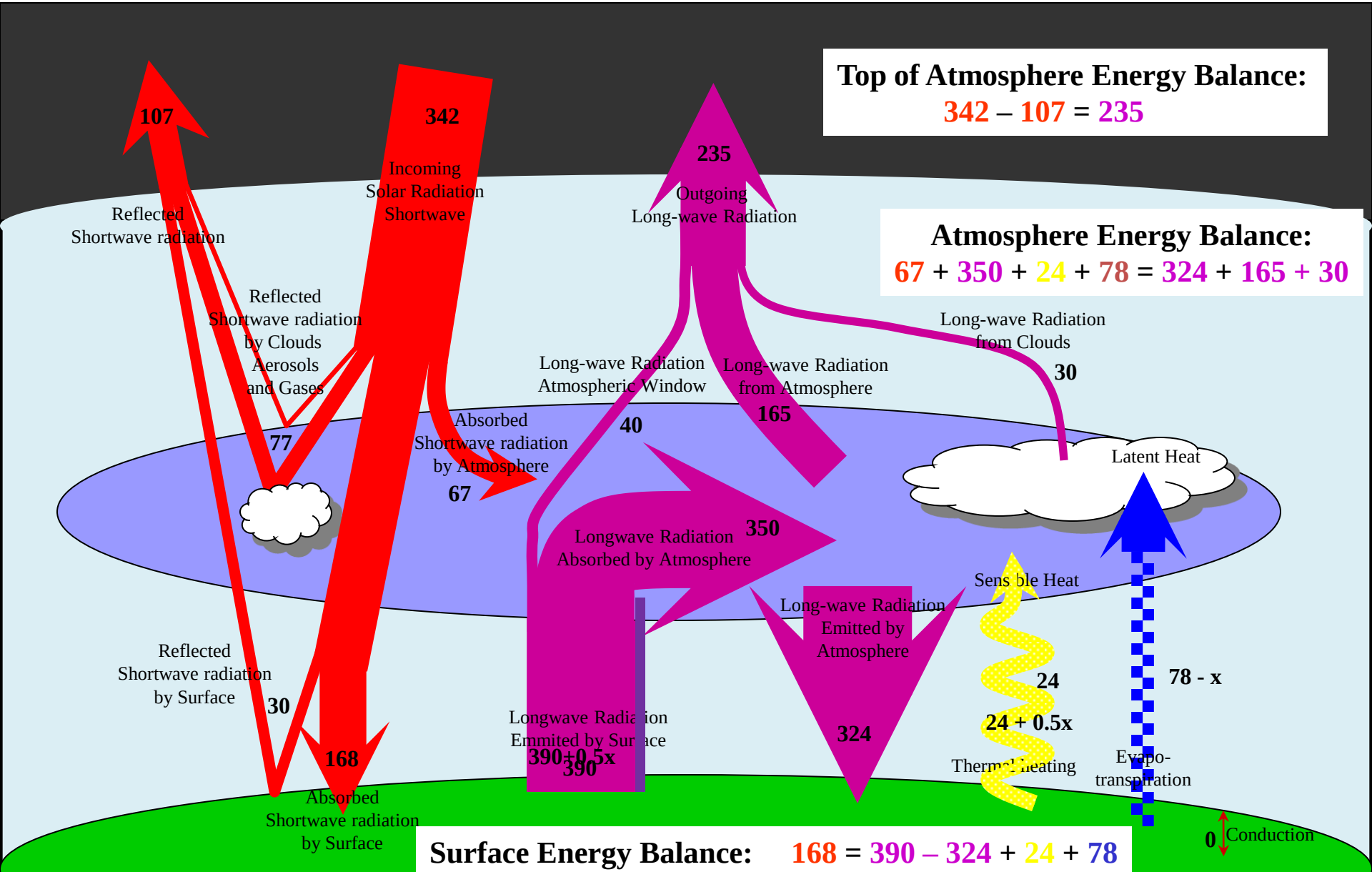
Irrigation as part of the equation



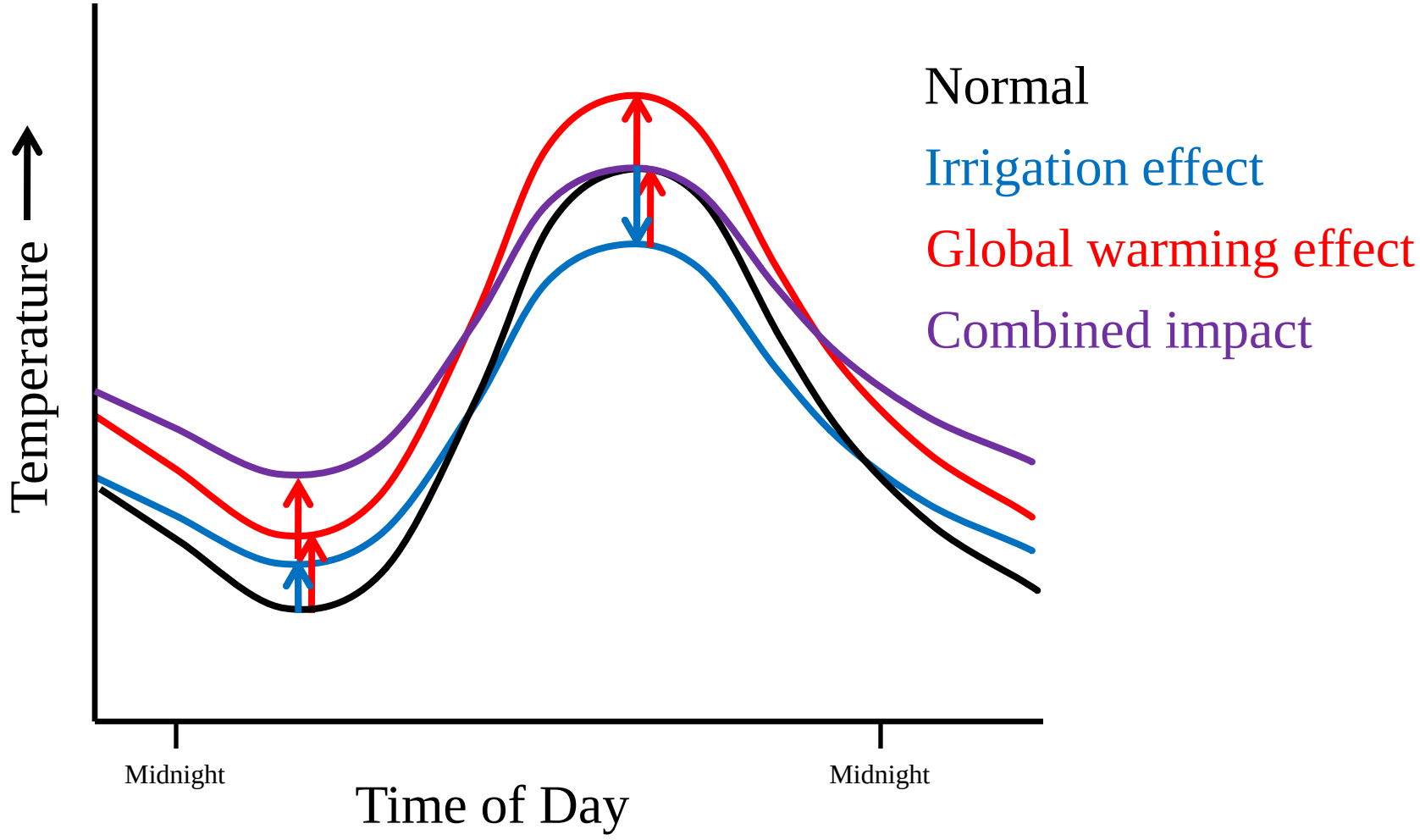
Global Average Energy Balance



Dry Land Average Energy Balance



Impact of climate change and irrigation on daily temperatures



Climate Component of the Kansas EPSCoR project

Implementation of climate analyses

1. **Statistical analysis**
   - Develop time series of historical information (observed data)
   - Use extreme events statistical analysis
     - historical
     - present day

2. **Mesoscale modeling**
   - Low resolution (50 km) datasets
     - Present day control (NARCCAP: 1971-2000)
     - Future scenarios (NARCCAP: 2041-2070)
   - High resolution (4km) – specific short time intervals
     - Create WRF Present day (NCEP-1979-2004/NARR)
     - Create WRF historical experiment (NCEP)
     - Downscaling of GCM data
       - Present day CCSM (land cover)
       - Historical comparison (20th Century runs; ensemble sensitivity)
       - Future scenario runs (SRES/RCP and ensemble issues)

Mesoscale Downscaling Approach

Input 1: Atmospheric Boundary conditions

1. NCEP/NARR reanalysis data 1972-2005

2. CCSM Climate scenario data

Historical/present day (20th Century Runs)

Change scenarios (SRES A1B/A2 or RCP 6.5/8.0)

Downscaling with WRF

Specific time frames and conditions

e.g. Summer/crop period conditions

Select irrigation scenarios to assess impact

On soil moisture and regional moisture gradients

Input 2: Surface Boundary Conditions

1. **Present day US land cover**
2. **Kansas present day land cover (Egbert et al.)**
3. **Future land cover (modified Egbert et al.)**
4. **IPCC scenario land cover**

Post processing

Daily data

- *Temperature*
- *Precipitation*
- *Other*

Hydrologic variables

Provide data information for:

Crop model parameters

Statistical analysis of extreme events

Analysis of soil moisture conditions

Impact of regional dynamics

Solar/Wind/Energy variables

Develop story line scenarios for interviews

Characterize modified temperature and precipitation regimes for specific regions/counties of Kansas

Indigenous links

Climate Component of the Kansas EPSCoR project

Objective 1:

Develop relevant climate change scenarios for KS and the central Great Plains by assessing the joint variability and feedback mechanisms that exist between soil moisture, vegetation and regional precipitation.

- Model validation and comparison with observations
- Statistical analyses of historical, present day and future scenarios
- Emphasis on extreme events analysis
- Create data for crop models
- Create data for solar/wind conditions for Nano-technology/Energy component
- Create scenario descriptions for Kansas

Objective 2:

Specific research questions for the climate group that will use high resolution simulations:

- Is there a soil moisture and/or vegetation feedback on regional precipitation?
- How will seasonal rainfall and its timing differ under various climate change scenarios?
- How will the spatial distribution of precipitation, vegetation, and soil moisture evolve as climate changes?
- What are the implications for regional water and C cycling?