

Using Tree-Ring Data to Examine Climate Change Impacts on Streamflow in Boulder Creek

Workshop: Application of Tree-Ring Data to Water Management

KC Hallett
Stratus Consulting
Boulder, CO
May 14, 2007

The big picture:
How sensitive is Boulder's water supply to climate change?

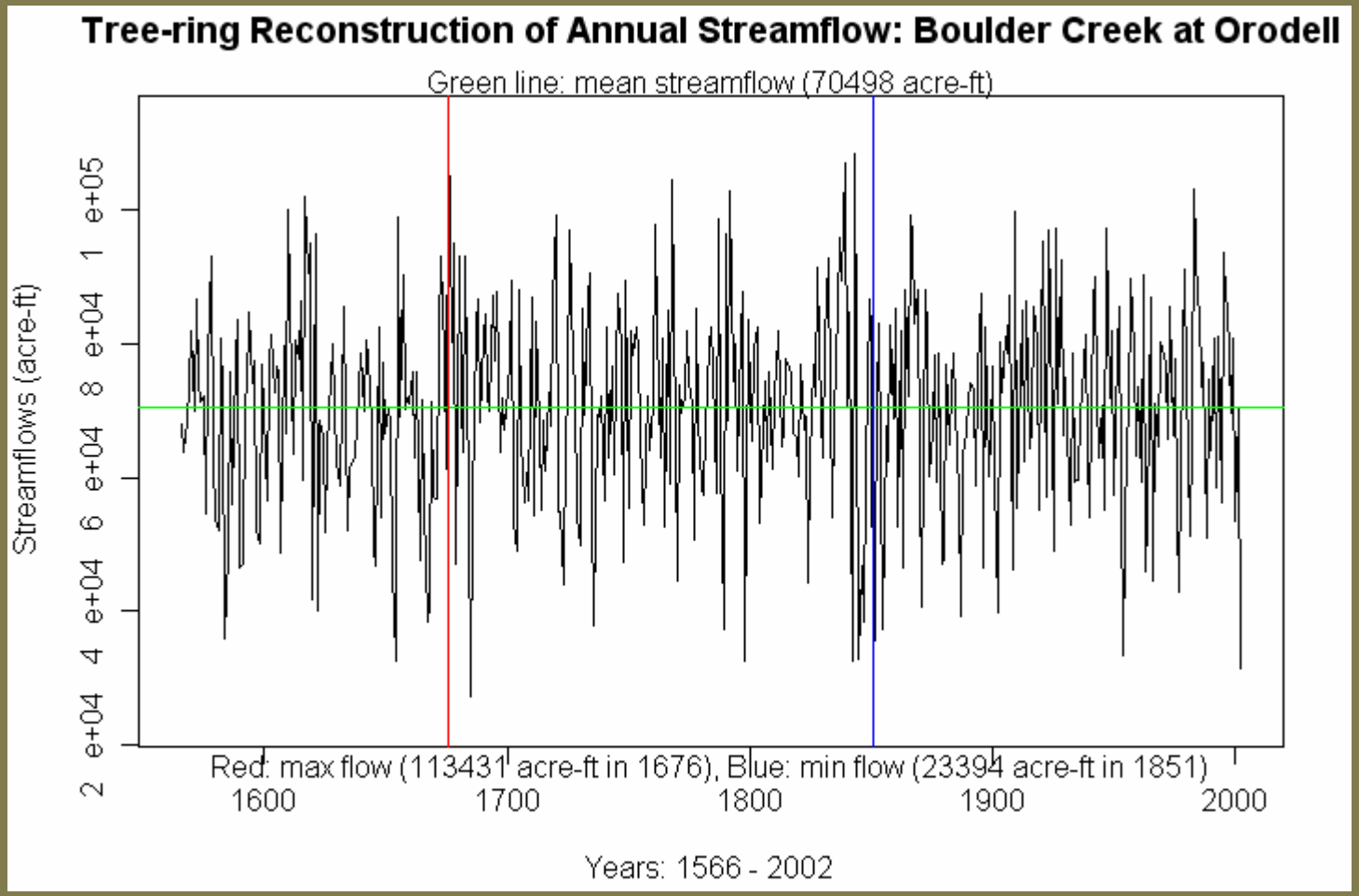
- Hydrosphere will ultimately model Boulder's water supply

- Our goal: model likely streamflow (under several climate change scenarios) at various input locations for Hydrosphere's model
  - WATBAL(updated by Dr. Strzepek for this project)

Climate change and variability

- **Climate change scenarios:**
  - Changes in temperature and precipitation
  - Several GCMs (from NCAR)
    - Dry (GFDL0)
    - Middle (GFDL1)
    - Wet (CCCma)
    - Average
  - Three emission scenarios (SRES)
    - A2 (high)
    - A1B (midrange)
    - B1 (low)
  - Two future time periods: 2030 & 2070
- **Tree-ring data**
  - Over 400 years of annual streamflow
  - Historic variability

Historic variability



What data is available ?

(1) Tree-ring reconstruction of annual streamflow: Boulder Creek at Orodell (Connie Woodhouse)

(2) Corrected annual virgin streamflow: Boulder Creek near Orodell (Lee Rozaklis)

(3) Monthly mean temperature and precipitation, Niwot Ridge – C1 (Mark Losleben, INSTAAR) & Boulder (NOAA)

What data is available ?

(1) Tree-ring reconstruction of annual streamflow: Boulder Creek at Orodell (Connie Woodhouse)

(2) Corrected annual virgin streamflow: Boulder Creek near Orodell (Lee Rozaklis)

(3) Monthly mean temperature and precipitation, Niwot Ridge – C1 (Mark Losleben, INSTAAR) & Boulder (NOAA)

(4) There is a 50 year period over which the available data overlap (1953 – 2002)

We used the data from this 50-yr period to simulate an ensemble of 437-yr long climate records that are "conditioned*" on the annual streamflows (SF) from the tree-ring reconstruction

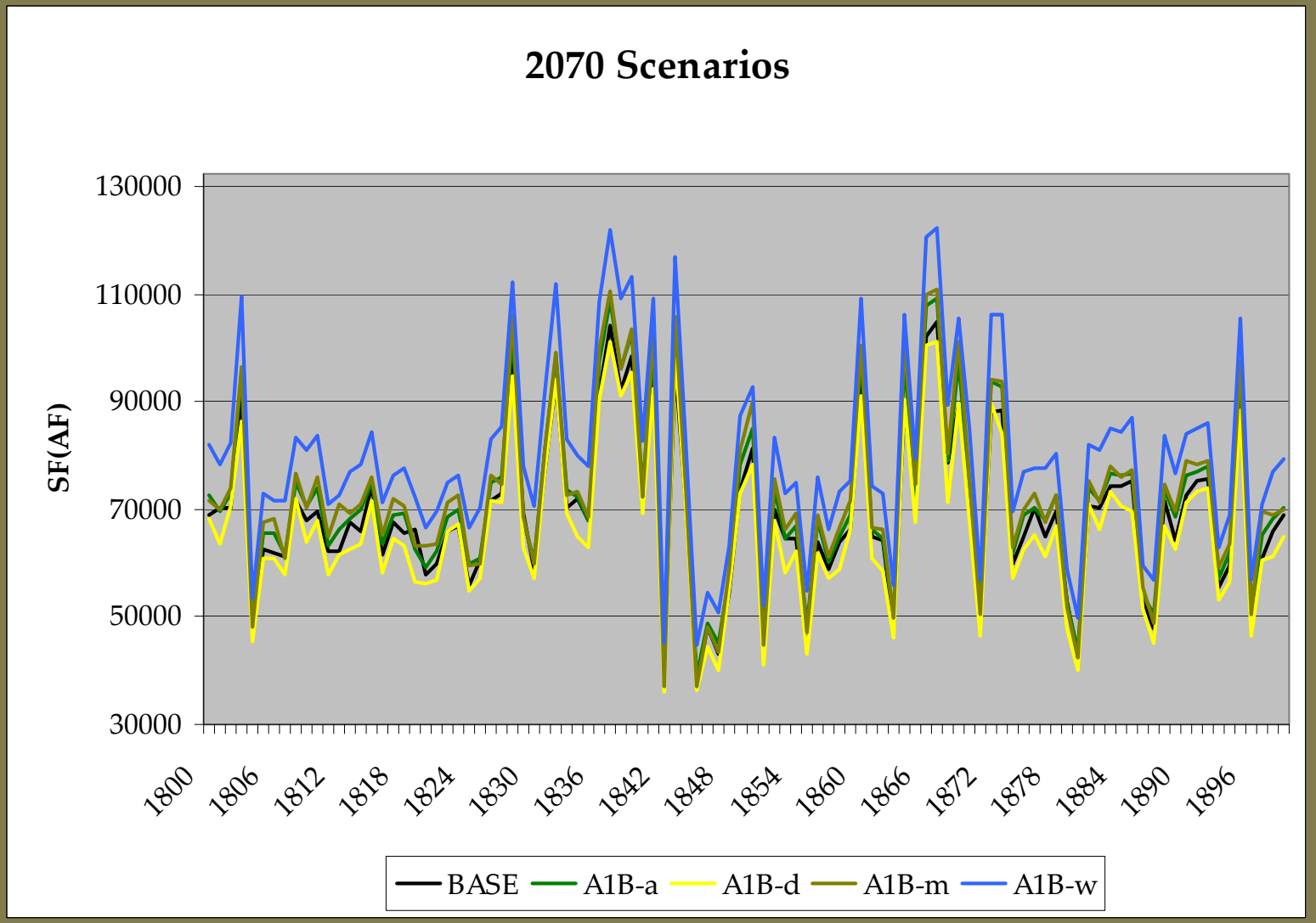
- **WHY?**
  - We are interested in a SF record that reflects the variability in the tree-ring reconstruction
  - AND for which we know the monthly T and P that led to each year's SF
- **HOW?**
  - Utilize a non-parametric, "nearest neighbor" bootstrapping technique (under guidance from Dr. Rajagopalan)
  - Simulated record was generated from the 50-year record for which we have measured SF, T & P

* Conditioned as "wet", "normal" or "dry"

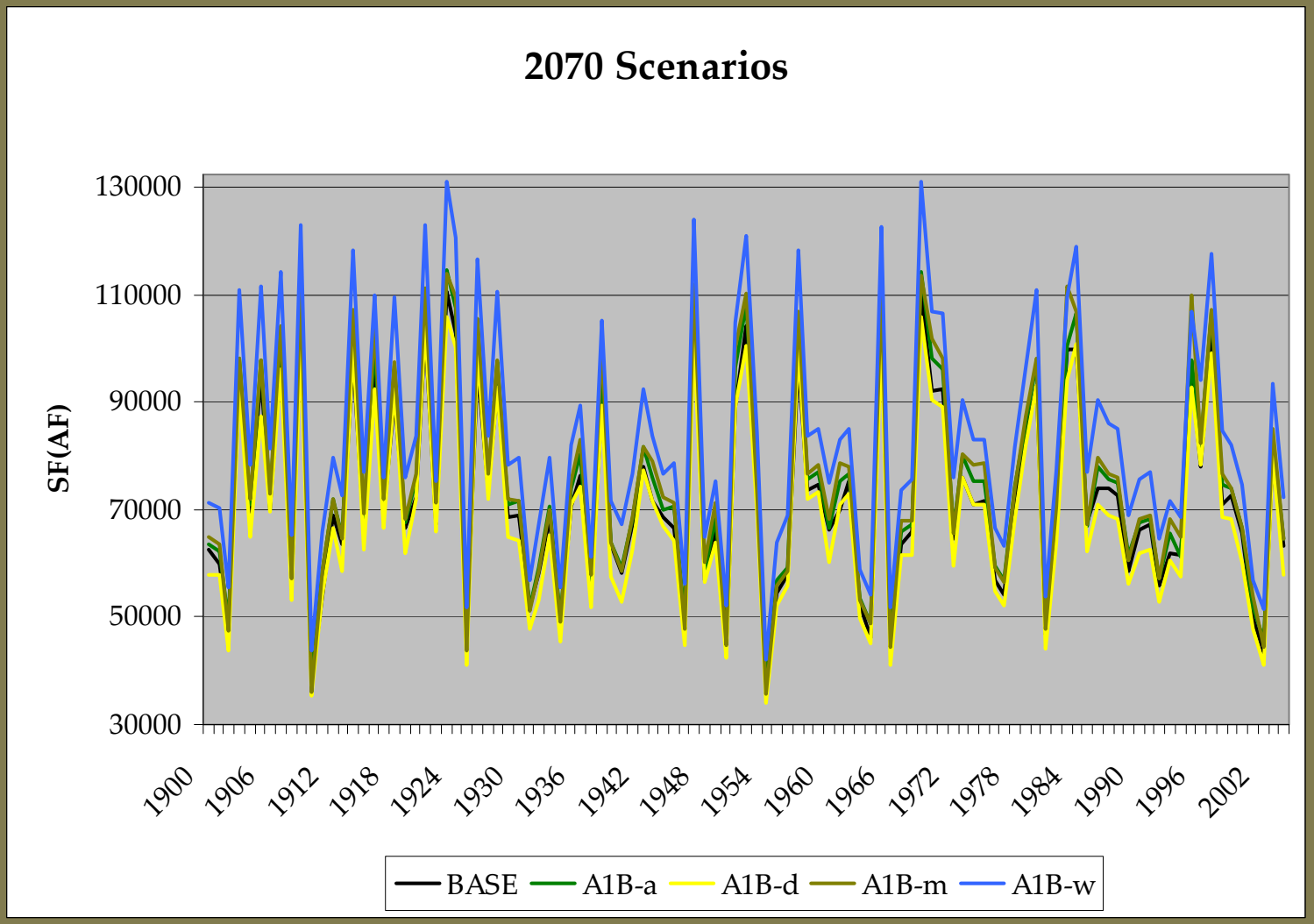
Application

- Ran the ensemble of climate records through Watbal
  - Result: 1000 simulated 437-yr long SF records ("Base" case)
- Imposed climate change scenarios on the ensemble; ran those through Watbal
  - Result: 1000 simulated 437-yr long SF records for each scenario

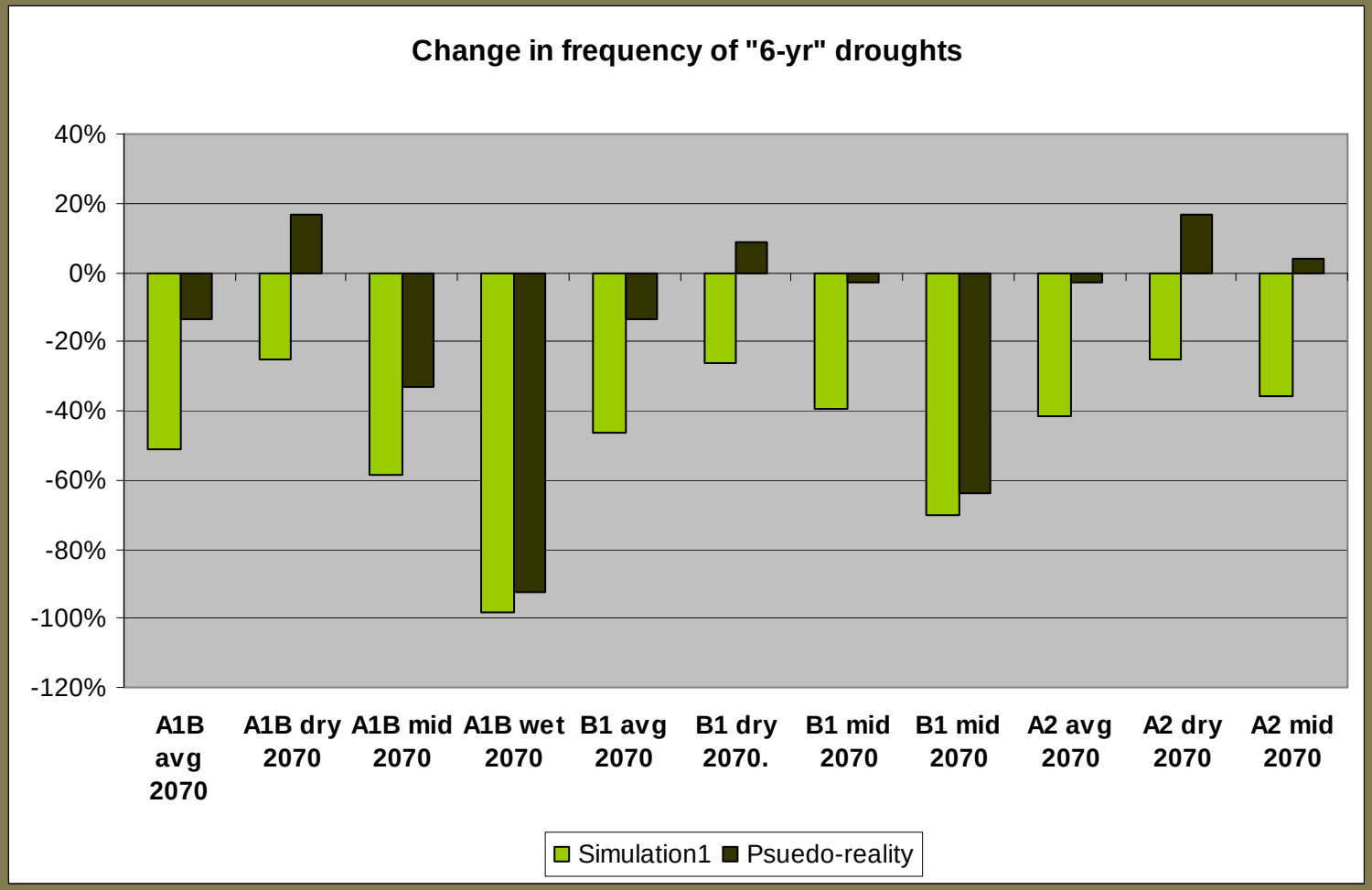
Preliminary Results (one simulation)



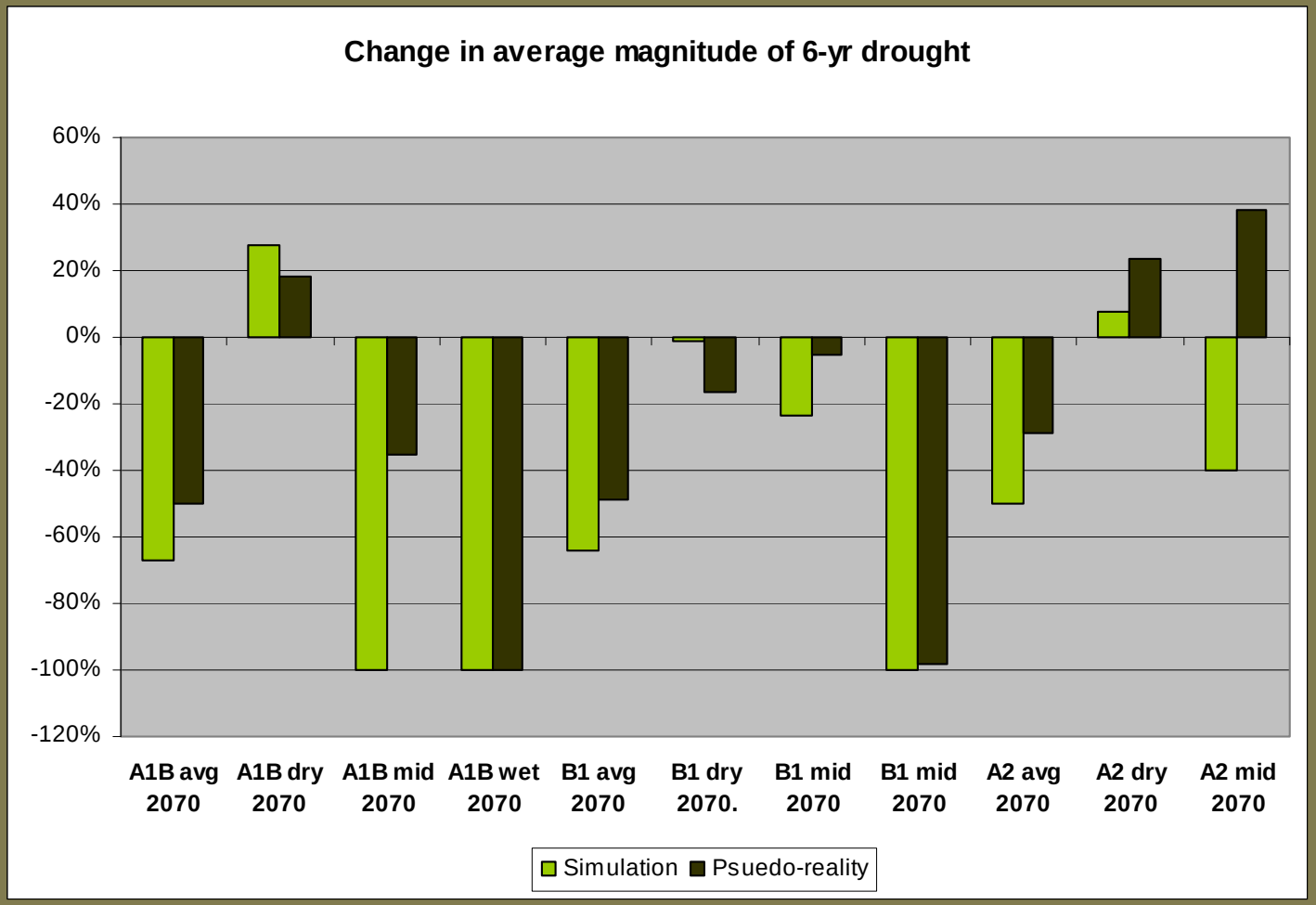
Preliminary Results (one simulation)



Preliminary results



Preliminary results



Next steps

- Possible additional analysis
- Send simulated streamflow records (under climate change) to Hydrosphere; discover how these potential climatic changes will affect Boulder's water supply

Thank-you

Questions?

KHallett@StratusConsulting.com