Obstacles to Promoting the Use of Alternative Normals

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WORKSHOP ON ALTERNATIVE CLIMATE NORMALS AND IMPACTS TO THE ENERGY INDUSTRY

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Outline

- Introduction and background
  - Alternative normals in natural gas rate cases
- NCDC role as "official" neutral broker of alternative normals
  - Public characterization of alternative normals
  - Emphasizing the necessity of homogeneous series for normals
- Common errors in challenges to alternative normal performance (in decreasing threat)
  - Misrepresenting hinge/OCN methodology as *a posteriori* detection of change points/slopes
  - Failure to understand basic error statistics of hinge/OCN
  - Direct performance evaluation (retroactive real-time) on pre-1990s cases
  - Mixing climates geographically and/or seasonally (**not** a problem for most natural gas rate cases)
- Concluding remarks
- Note: Time record examples herein were produced by Larry Loos, contractor to and formerly of Black & Veatch Corporation.

Introduction and Background

- December 2006: Briefed NCDC staff on "Empirical Estimation and Extrapolation of Climatic Trends: First Steps towards Dynamic Normals"
- November 2007: "Estimation and Extrapolation of Climate Normals and Climatic Trends" published in Journal of Applied Meteorology and Climatology
- January 2008: Retired from NWS
- January 2009: Optimal Normals Webcast
- 2008-2012: Argued for alternative normals for natural gas rate cases in Colorado, Iowa, Michigan, Minnesota, Missouri, and Nebraska (twice)

NCDC role: Public characterization of alternatives

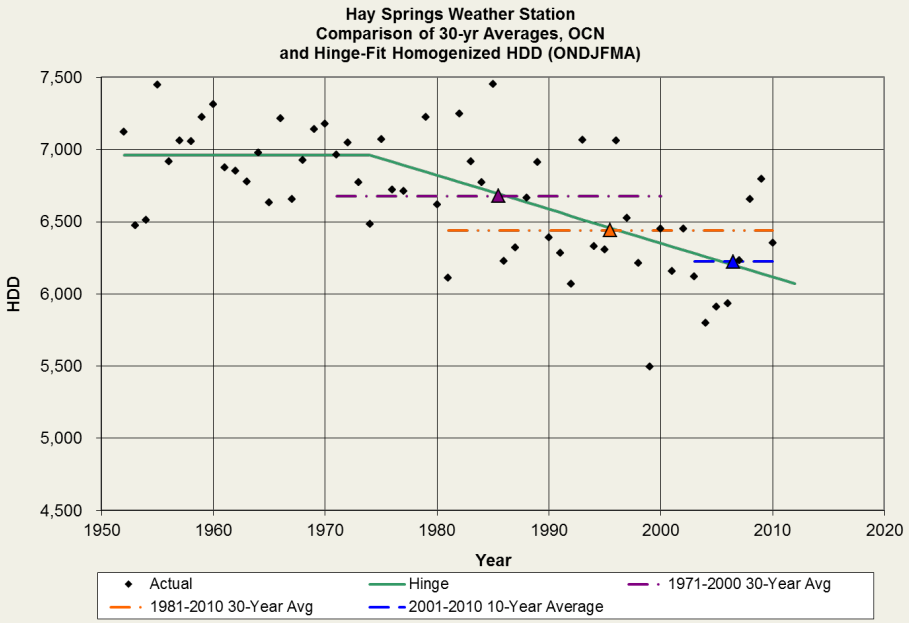
- From June 2009 Optimal Normals Webcast:
  - Why Optimal Normals?
    - Provide alternatives to the Traditional 30-Year Normals
      - **Experimental** Products
      - Supplement, **Not Replace**, 30-Year Normals

- From NCDC website: NOAA's 1981-2010 Climate Normals
  - How do the Normals compare to Alternative Normals and Dynamic Normals?
    - There are no plans to discontinue the computation of official Normals every ten years in response to results obtained from the Alternative Normals project.

NCDC role: Public characterization of alternatives

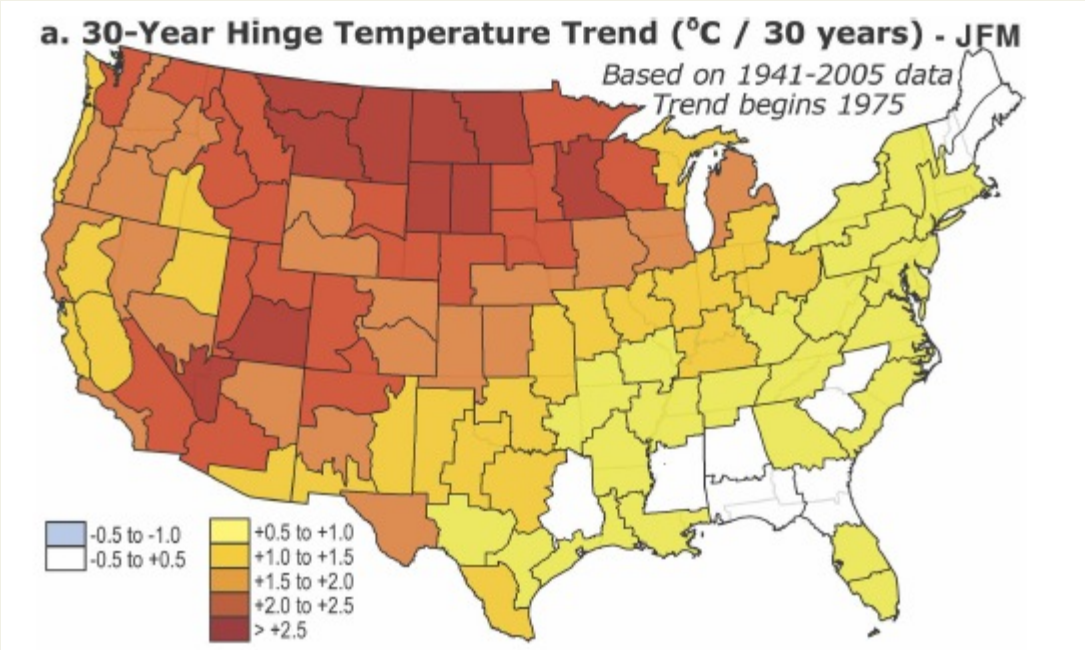
- Experimental?
  - Off-putting to public commissions.
  - Almost 10 papers have been published analyzing OCN since the 1950s.
  - OCN is a formal part of NOAA's Climate Prediction Center forecast operations.
  - The hinge fit is a specific model to represent normals changing as a result of global climate change, with defensible error estimates.
  - NCDC is becoming familiar with alternatives and evaluating them, but in what respect are they experimental?

- Supplement, not replace, 30-year normals?
- How about in this case?



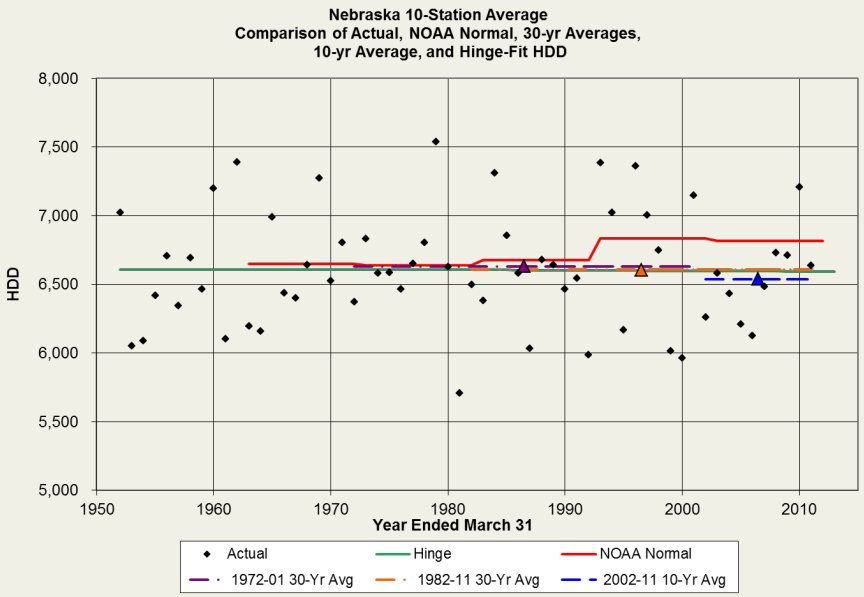
NCDC role: Public characterization of alternatives

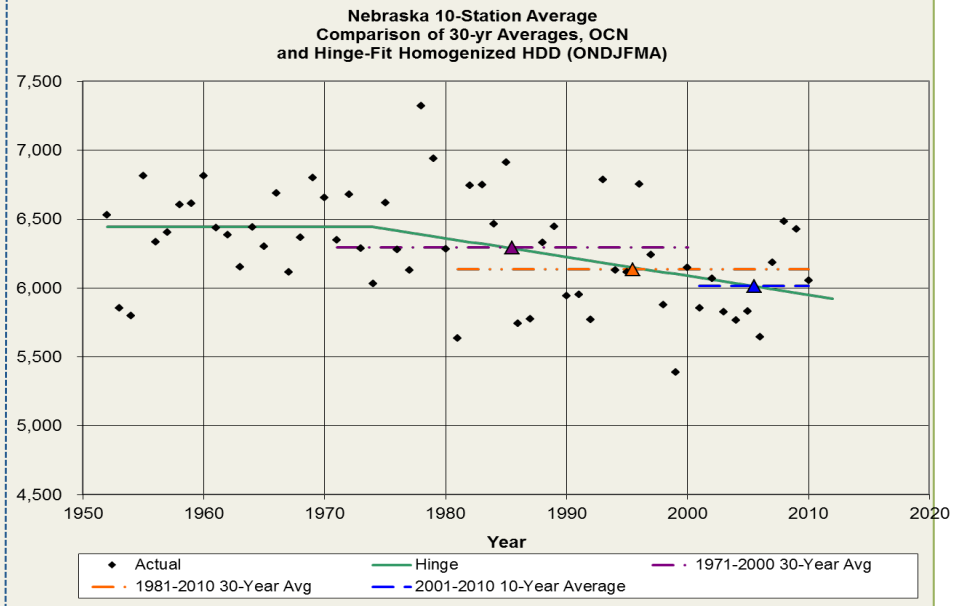
- Supplement, not replace, 30-year normals?
- How about in the Winter over most of the US?



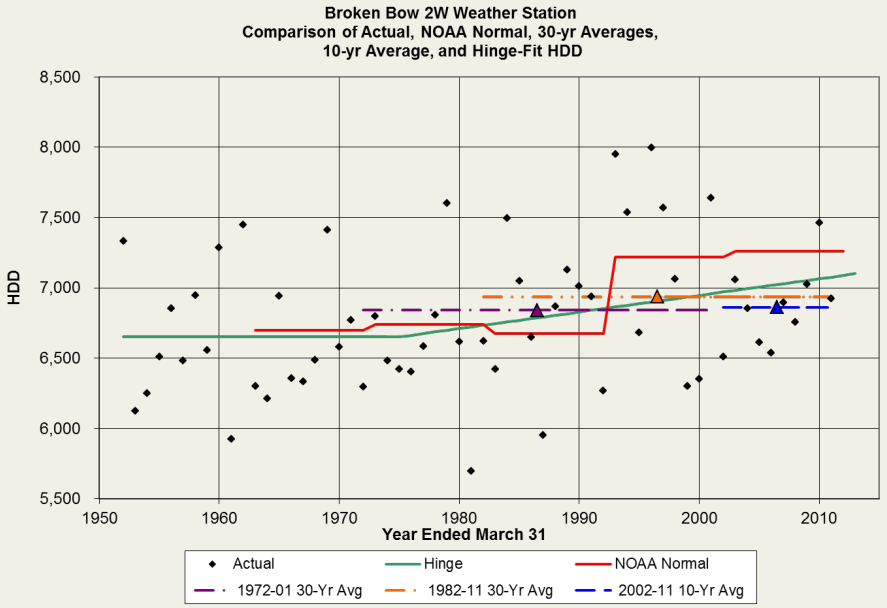
- Why not "Supplement, and for many applications, replace 30-year normals?"

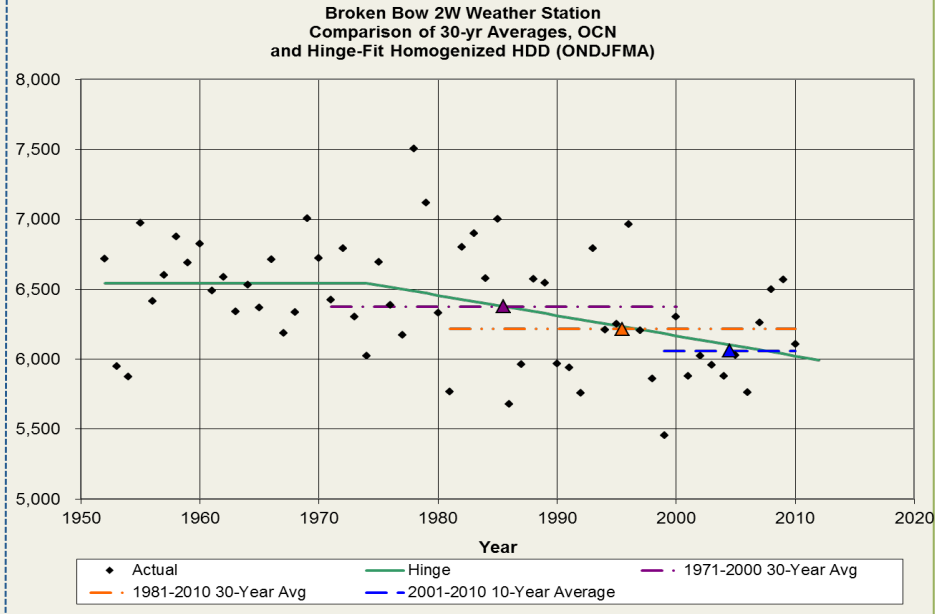
NCDC role: Emphasizing homogeneous series for normals



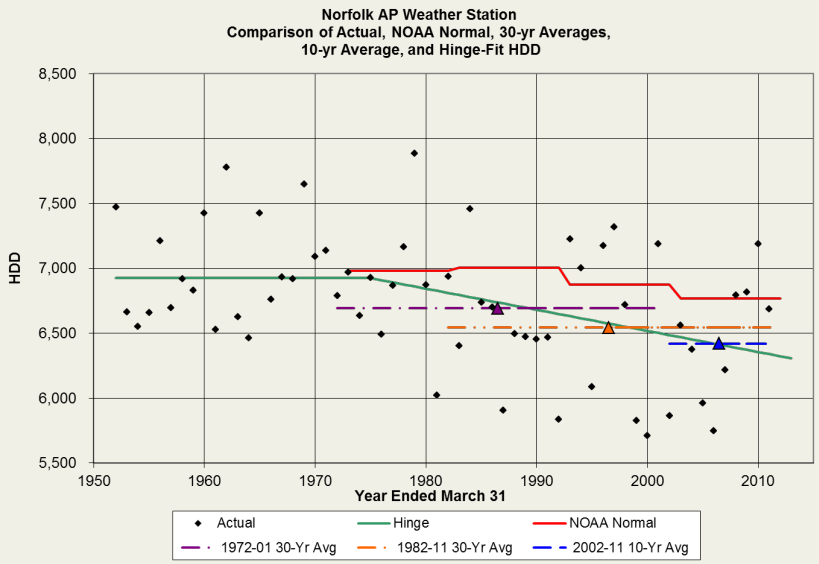


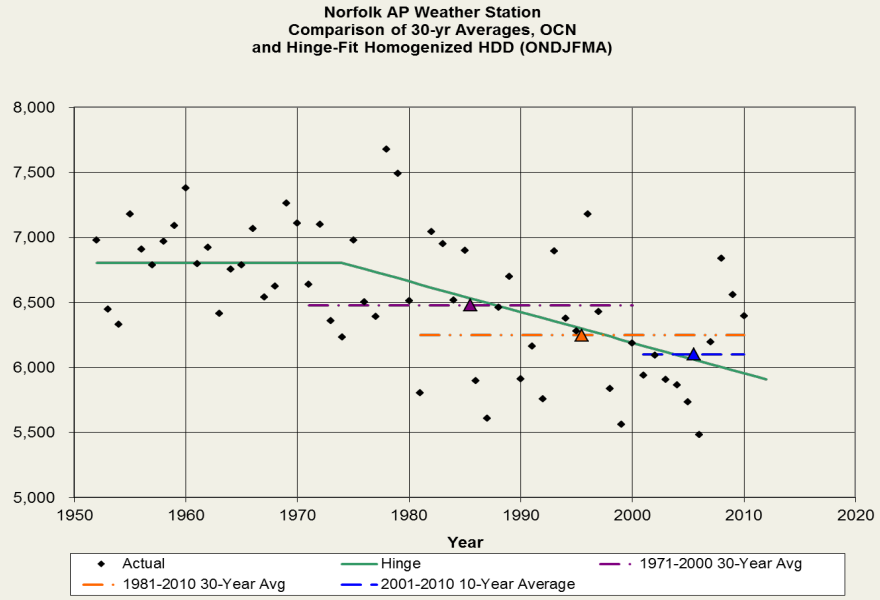
NCDC role: Emphasizing homogeneous series for normals



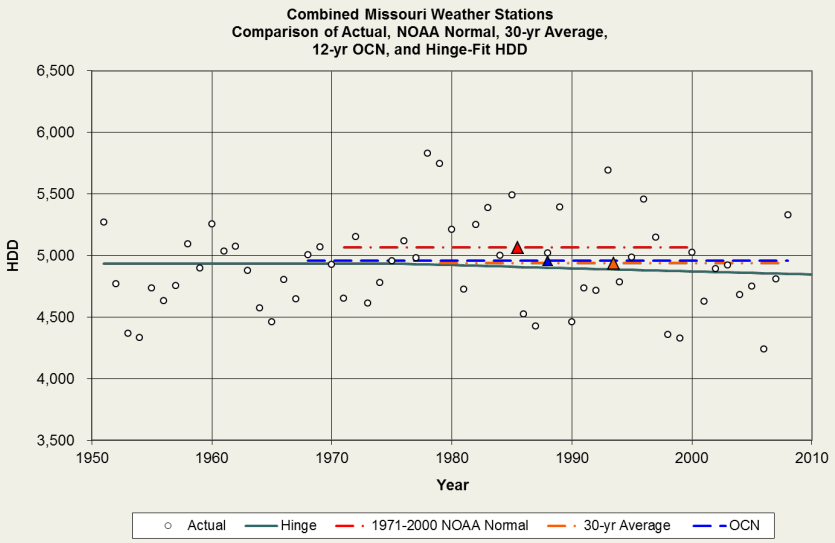


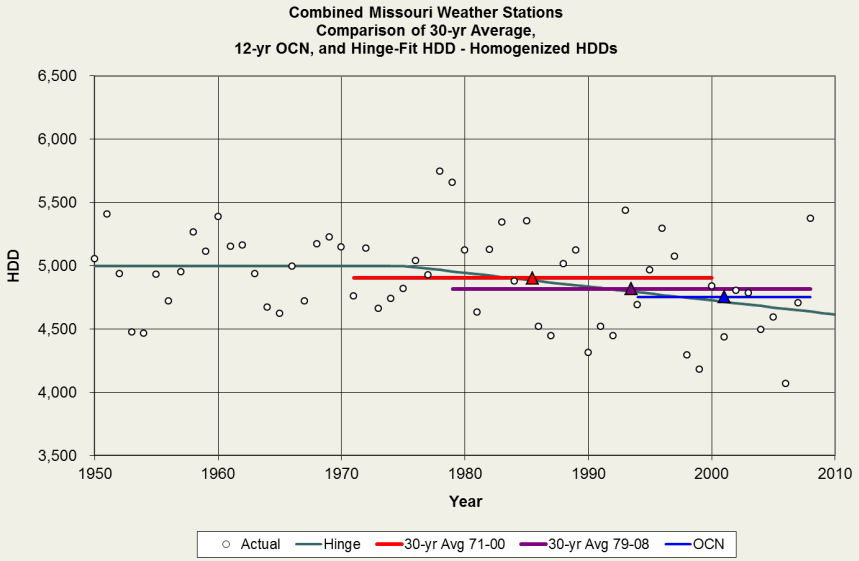
NCDC role: Emphasizing homogeneous series for normals





NCDC role: Emphasizing homogeneous series for normals





NCDC role: Emphasizing homogeneous series for normals

- Suggestions:
  - Emphasize (in multiple website locations) that temperature-based normals must be based on homogeneous records
  - Provide daily homogenized series at as many stations as possible
  - Develop HDD normals (traditional and alternative) from homogenized series

Common errors in challenges to alternative normal performance: ***a posteriori* curve fitting**

- For almost any station record, *a posteriori* you can use some curve-fitting algorithm to fit the data better than the hinge fit or selectively choose data to discount it.
  - Examples encountered in various rate cases are full or partial period trends, smoothers, change-point algorithms, step-functions, and "double hinges."
  - Almost none of these have a legitimate physical basis!

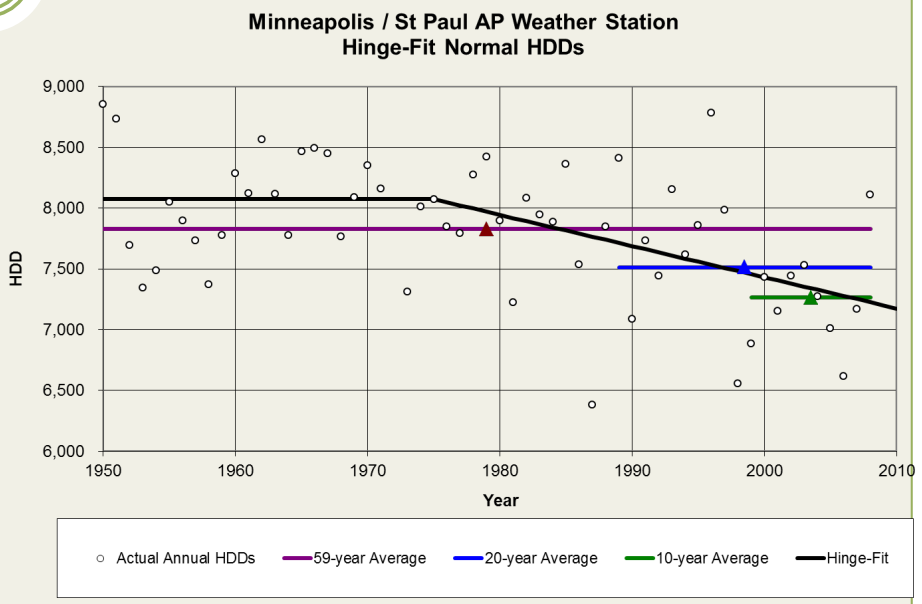
- The hinge fit has a solid physical basis supported by an enormous body of observational and modeling evidence.

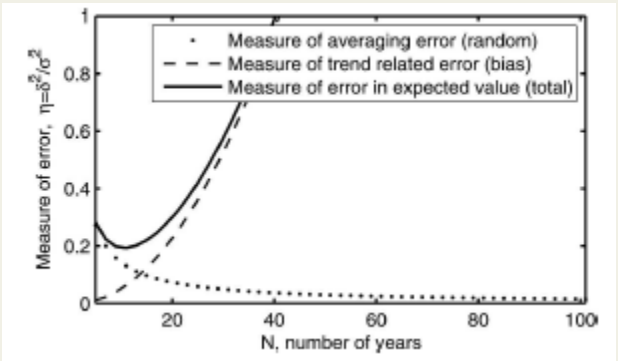
- The hinge fit is an *a priori* model, not after-the-fact curve fitting, to represent local changes in normals related to global climate change.

- Universally, it represents homogeneous temperature records from 1940 to the present better than any other model.

Common errors in challenges to alternative normal performance: **misunderstood error statistics**

- OCN:
  - Well understood:
    - Shorter averaging periods have larger sampling error and larger year-to-year instability
  - Poorly grasped:
    - In a changing climate, shorter averaging periods have smaller bias error.
    - The OCN is the best trade-off between sampling and bias errors.





Common errors in challenges to alternative normal performance: **misunderstood error statistics**

- Hinge Fit:
  - Poorly grasped:
    - It is the most stable of all considered alternatives because it fits up to 72 years of data.
    - The expected error of its post-1975 trend is far smaller than a simple post-1975 linear trend fit (because pre-1975 eliminates the sensitivity to one end of the trend).

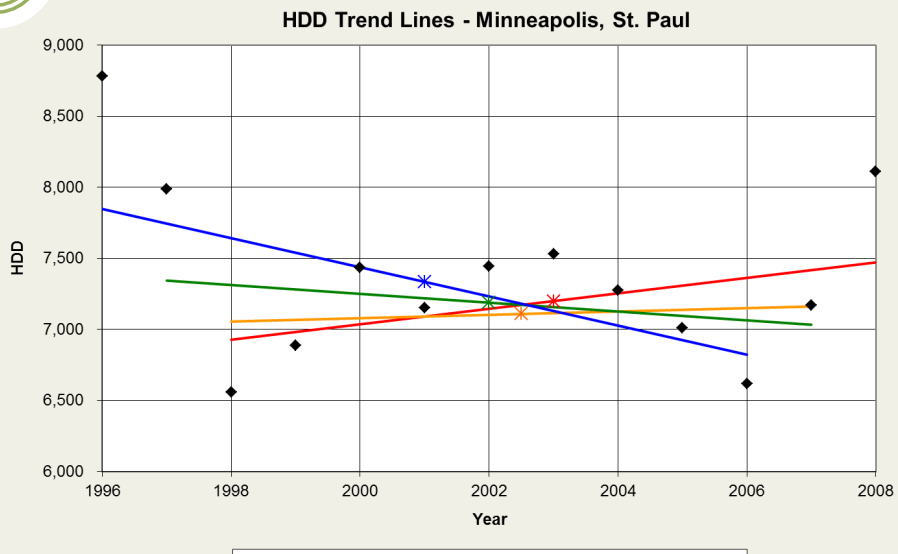


TABLE 3. The maximum lead (yr) τ_{max} with acceptable error $\eta \leq 0.25$ for different 1-yr lag autocorrelation g and different projections of an underlying linear-trending normal estimated from climate time series models. Results for the hinge fit (trend period is 30 yr, the same as for the linear fit) are for generalized least squares, which yields small gains over the ordinary least squares results from the Monte Carlo experiment.

	τ_{max}			
g	Hinge fit ($N = 65$ yr)	Linear fit ($N = 30$ yr)	OCN ($\beta = 0.03$)	OCN ($\beta = 0.05$)
0.0	14	7	8	3
0.1	10	5	7	2
0.2	7	3	6	2
0.3	4	1	5	1
0.5	—	—	2	—

Common errors in challenges to alternative normal performance: **evaluation on pre-1990s cases**

- Retroactive real-time evaluation: Updating 1 year at a time and applying to next year:
  - Always underestimates current real advantage of say 10- or 20-year averages and Hinge Fit over a 30-year normal if pre-2005 cases are used.
    - Because modern climate change began in the 1970s.
  - Underestimation increases as earlier cases are used.
  - Underestimation is especially severe for the hinge fit if pre-1995 cases are used.
    - Because trend estimation errors grow more rapidly as trend period decreases.

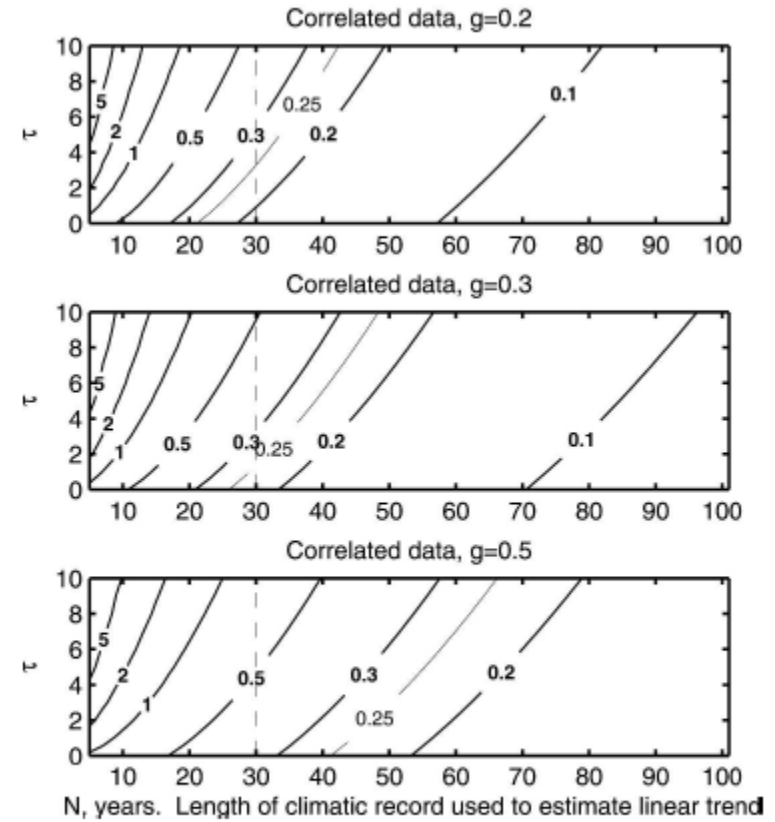
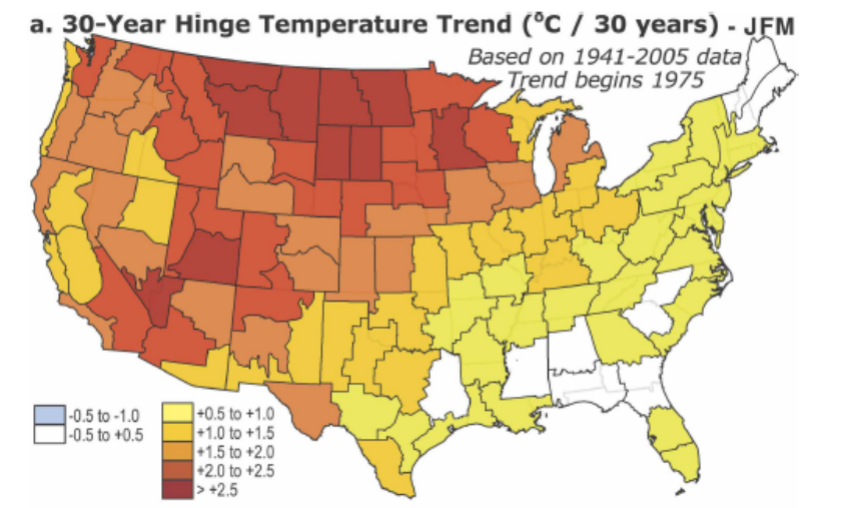
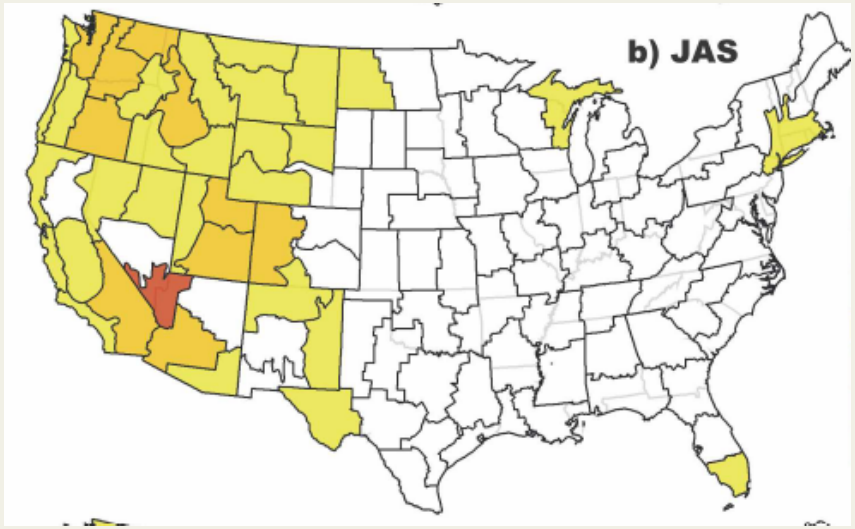


FIG. 4. Estimates of $\eta(N, g, \tau)$, the error for extrapolated expected value $Y(t_0 + \tau)$ beyond the end of time interval of N yr utilized to estimate parameters of linear trend; τ is in years.

Common errors in challenges to alternative normal performance: **mixing climates geographically and/or seasonally**

Advantages of OCN and Hinge Fit decrease as cases with little or no climate change are mixed in.





Concluding remarks

- Energy companies in the mid-West and High Plains at least are highly motivated to employ alternative normals.
- Promoting alternatives for these clients requires thorough insight, patience and a thick skin.
- NCDC can enormously facilitate the process by not characterizing alternatives as “experimental,” acknowledging the egregious inadequacy of traditional normals in many cases, and institutionalizing the alternatives as well as homogenized records.
- Alternative normals will be a harder sell to regulatory commissions for natural gas providers in the East and Southeast.
- Electrical providers with large AC-related demand can exploit alternative normals for long-term planning but may not be as motivated to use them in rate cases.