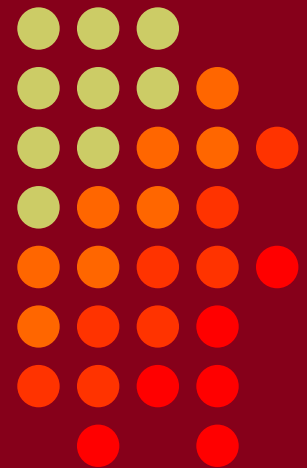


Quality Assessment of Colorado's Long-Term Temperature Data

Nolan Doesken

State Climatologist, Colorado Climate Center
Atmospheric Science Department
Colorado State University

Presented November 17, 2006, Camp George West, Golden,
Colorado



Systematic weather data collection began in the South Platte Basin and in other parts of Colorado in the early 1870s



(FORM 4.)

WAR DEPARTMENT.

SIGNAL SERVICE, U. S. ARMY.

DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE.

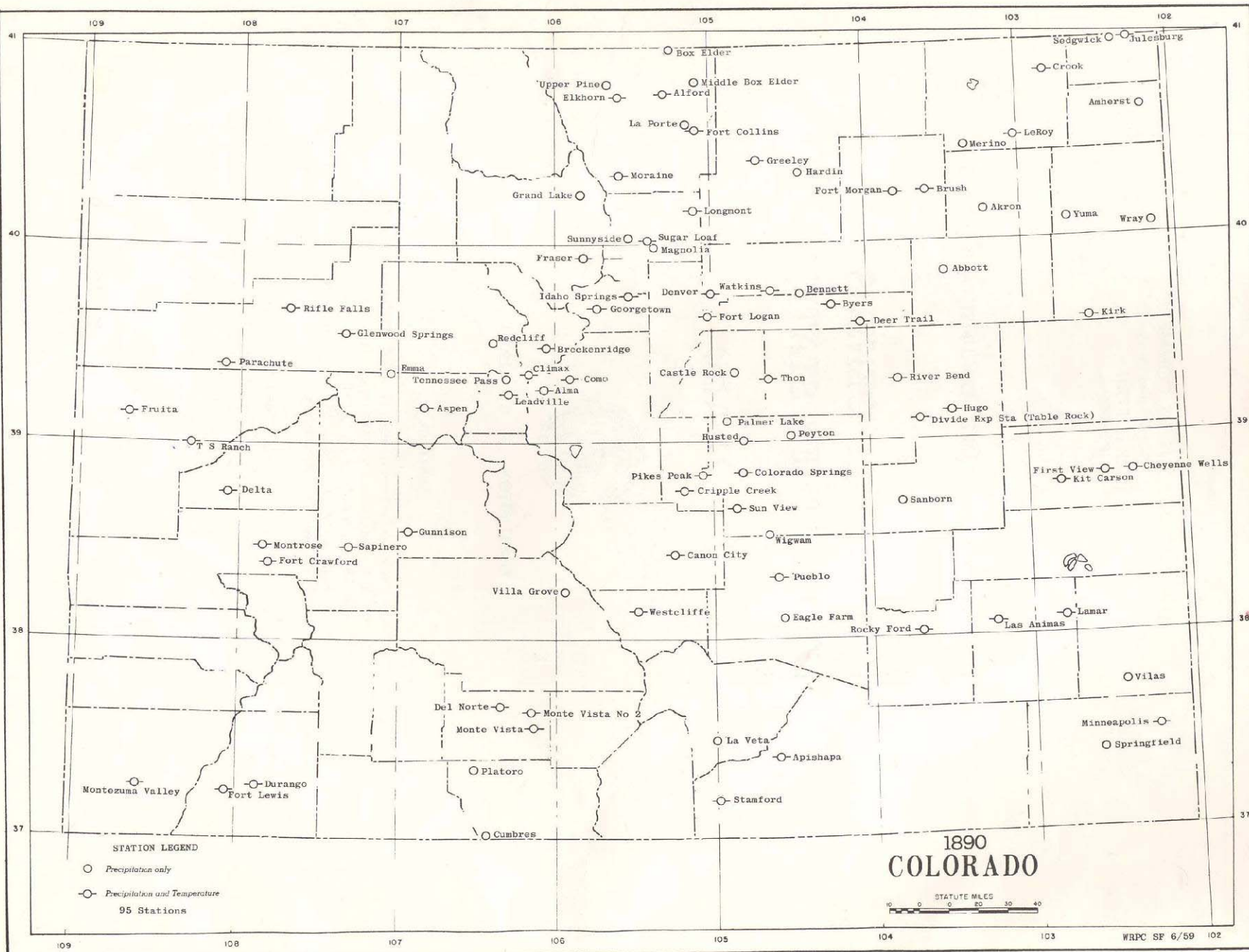
METEOROLOGICAL RECORD for the *Month* ending *Nov. 25th 1871* at *Denver* Col. *Ter.*

Date of Observation.	Time of Observation.	Height of Barometer.	Height of attached Thermometers	Reduced Barometer.	THERMOMETER. (OPEN AIR)		Direction of wind.	Velocity of wind in miles per hour.	Pressure of wind. Pounds per square foot.	Amount of cloud.	Direction in which upper clouds move.	Rain (or snow) commenced. (Time.)	Rain (or snow) ended. (Time.)	Amount of rain or melted snow.	REMARKS.	
					Dry Bulb.	Wet Bulb.										
<i>1871</i>																
<i>Sunday Nov 19</i>	<i>5:43 a.m.</i>	<i>25.00</i>	<i>57 22</i>	<i>30.07</i>	<i>22 21 76</i>	<i>14</i>	<i>Calms</i>	<i>0</i>	<i>0</i>	<i>4/4</i>					<i>Light Snow</i>	
	<i>2:43 p.m.</i>	<i>25.09</i>	<i>63 36</i>	<i>29.97</i>	<i>36 35 64</i>	<i>14</i>	<i>S</i>	<i>2</i>	<i>.02</i>	<i>0</i>					<i>Clear</i>	
	<i>4:43 p.m.</i>	<i>25.12</i>	<i>58 14</i>	<i>30.28</i>	<i>14 12 64</i>	<i>14</i>	<i>S</i>	<i>11</i>	<i>.60</i>	<i>0</i>					<i>Light Snow</i>	
<i>Monday Nov 20</i>	<i>5:43 a.m.</i>	<i>25.00</i>	<i>57 22</i>	<i>30.07</i>	<i>22 21 76</i>	<i>14</i>	<i>Calms</i>	<i>0</i>	<i>0</i>	<i>4/4</i>		<i>8:30 a.m.</i>	<i>8:00 a.m.</i>	<i>Black</i>	<i>Light Snow</i>	
	<i>2:43 p.m.</i>	<i>25.09</i>	<i>63 36</i>	<i>29.97</i>	<i>36 30 46</i>	<i>14</i>	<i>S</i>	<i>2</i>	<i>.02</i>	<i>0</i>	<i>72</i>				<i>Clear</i>	
	<i>4:43 p.m.</i>	<i>25.12</i>	<i>58 14</i>	<i>30.28</i>	<i>14 12 64</i>	<i>14</i>	<i>S</i>	<i>11</i>	<i>.60</i>	<i>0</i>					<i>Light Snow</i>	
<i>Tuesday Nov 21</i>	<i>5:43 a.m.</i>	<i>24.99</i>	<i>50 21</i>	<i>30.07</i>	<i>21 19 78</i>	<i>14</i>	<i>S</i>	<i>13</i>	<i>.84</i>	<i>1/4</i>	<i>24</i>				<i>Stratus</i>	
	<i>2:43 p.m.</i>	<i>24.88</i>	<i>56 43</i>	<i>29.67</i>	<i>43 34 28</i>	<i>18</i>	<i>NW</i>	<i>10</i>	<i>1.62</i>	<i>4/4</i>	<i>103</i>				<i>Stratus</i>	
	<i>4:43 p.m.</i>	<i>24.88</i>	<i>58 39</i>	<i>29.70</i>	<i>39 34 53</i>	<i>18</i>	<i>NW</i>	<i>2</i>	<i>.02</i>	<i>4/4</i>	<i>34.3</i>				<i>Stratus</i>	
<i>Wednesday Nov 22</i>	<i>5:43 a.m.</i>	<i>24.70</i>	<i>55 31</i>	<i>29.59</i>	<i>34 29 79</i>	<i>18</i>	<i>S.W.</i>	<i>4</i>	<i>.08</i>	<i>4/4</i>	<i>97</i>				<i>"</i>	
	<i>2:43 p.m.</i>	<i>24.37</i>	<i>62 35</i>	<i>29.30</i>	<i>35 32 70</i>	<i>18</i>	<i>W</i>	<i>2</i>	<i>.02</i>	<i>4/4</i>	<i>32.3</i>	<i>3:00 p.m.</i>		<i>.26</i>	<i>Light Snow</i>	
	<i>4:43 p.m.</i>	<i>24.71</i>	<i>61 31</i>	<i>29.59</i>	<i>31 30 89</i>	<i>18</i>	<i>S</i>	<i>10</i>	<i>.50</i>	<i>4/4</i>	<i>90</i>	<i>10:30 a.m.</i>			<i>Stratus</i>	
<i>Thursday Nov 23</i>	<i>5:43 a.m.</i>	<i>24.54</i>	<i>55 25</i>	<i>29.47</i>	<i>25 24 87</i>	<i>18</i>	<i>S</i>	<i>6</i>	<i>.18</i>	<i>4/4</i>	<i>30</i>				<i>Light Snow</i>	
	<i>2:43 p.m.</i>	<i>24.31</i>	<i>63 34</i>	<i>29.06</i>	<i>34 33 89</i>	<i>18</i>	<i>N.W.</i>	<i>5</i>	<i>.12</i>	<i>4/4</i>	<i>SE</i>				<i>"</i>	
	<i>4:43 p.m.</i>	<i>24.20</i>	<i>60 31</i>	<i>28.97</i>	<i>31 30 89</i>	<i>18</i>	<i>S</i>	<i>9</i>	<i>.40</i>	<i>3/4</i>	<i>101</i>		<i>8 a.m.</i>	<i>.21</i>	<i>Cloudy</i>	
<i>Friday Nov 24</i>	<i>5:43 a.m.</i>	<i>24.36</i>	<i>56 32</i>	<i>29.17</i>	<i>32 32 100</i>	<i>18</i>	<i>S.W.</i>	<i>4</i>	<i>.08</i>	<i>4/4</i>	<i>33.7</i>				<i>Fog</i>	
	<i>2:43 p.m.</i>	<i>24.37</i>	<i>70 42</i>	<i>29.04</i>	<i>42 37 58</i>	<i>18</i>	<i>S</i>	<i>2</i>	<i>.02</i>	<i>2/4</i>	<i>58</i>				<i>Stratus</i>	
	<i>4:43 p.m.</i>	<i>24.38</i>	<i>65 27</i>	<i>29.23</i>	<i>27 27 100</i>	<i>18</i>	<i>N.W.</i>	<i>2</i>	<i>.02</i>	<i>4/4</i>	<i>32.7</i>				<i>Stratus</i>	
<i>Saturday Nov 25</i>	<i>5:43 a.m.</i>	<i>24.37</i>	<i>58 32</i>	<i>29.17</i>	<i>32 28 64</i>	<i>18</i>	<i>S.W.</i>	<i>7</i>	<i>.24</i>	<i>1/4</i>					<i>Stratus</i>	
	<i>2:43 p.m.</i>	<i>24.42</i>	<i>70 49</i>	<i>29.03</i>	<i>49 39 31</i>	<i>18</i>	<i>S.E.</i>	<i>2</i>	<i>.02</i>	<i>1/4</i>					<i>Stratus</i>	
	<i>4:43 p.m.</i>	<i>24.60</i>	<i>68 17</i>	<i>29.60</i>	<i>17 15 75</i>	<i>18</i>	<i>N.E.</i>	<i>18</i>	<i>1.62</i>	<i>3/4</i>					<i>Light scud fl</i>	

2391

Denver November 19-25, 1871 *Henry J. Taylor, Observer*

Colorado Weather Stations in 1890

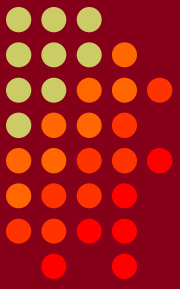




The U.S. Weather Bureau/National Weather Service has faithfully maintained an oft taken for granted network of weather stations in Colorado and across the country – the Cooperative Observer Network

Photo by Christopher Davey

The NWS stations remain the backbone network for long-term climate monitoring



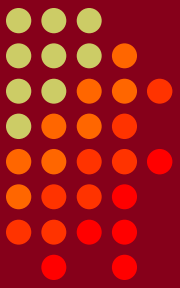
From Kelly Redmond, WRCC

Approximately 5000 daily max/min temperature stations, 8000 daily precipitation stations, 3000 automated hourly precipitation stations.

Confidently detecting climatic trends is much more challenging and difficult than determining spatial patterns, seasonal cycles, or year-to-year variations



We can find many frustrating limitations to our climate records –

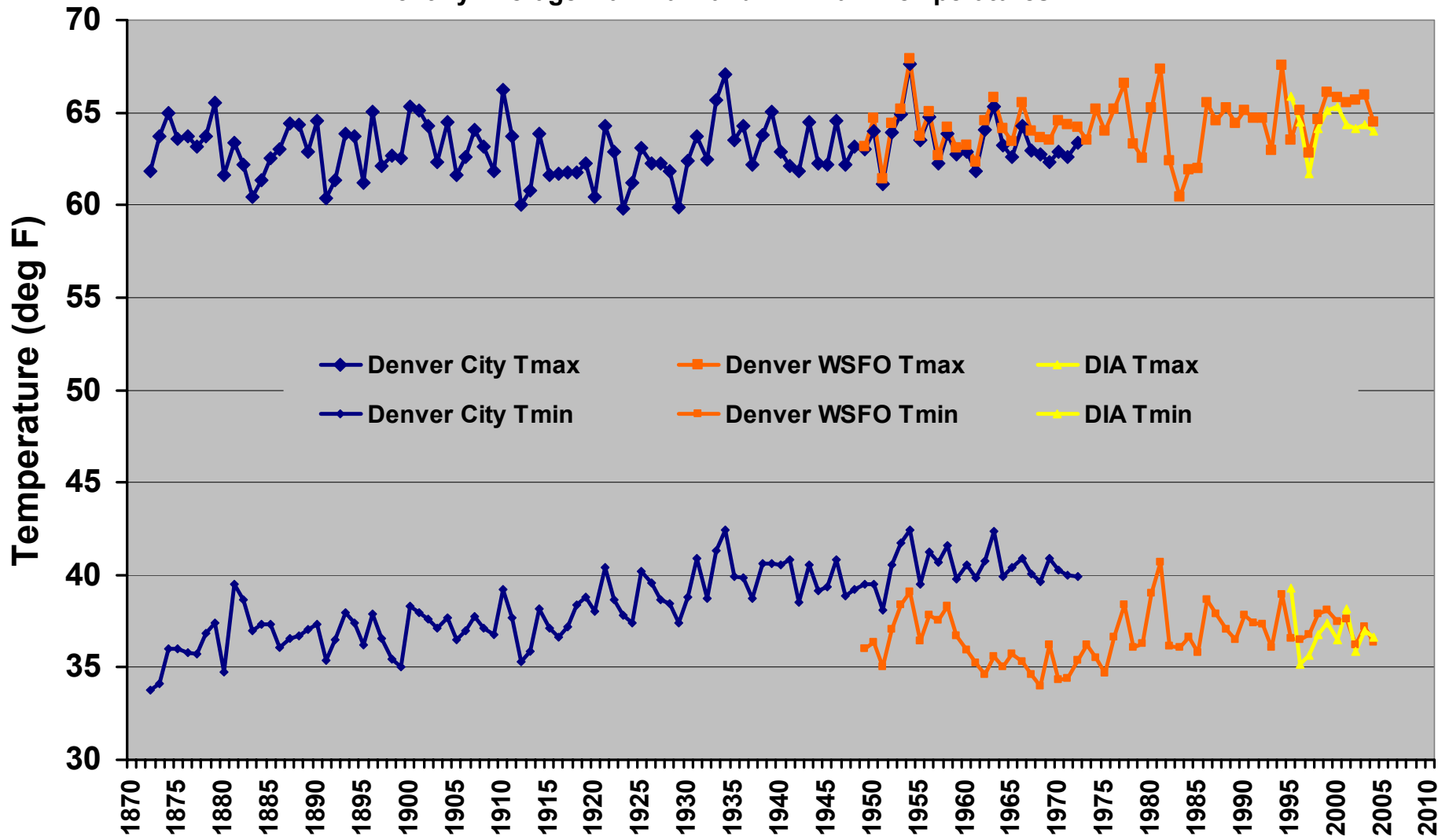


- Changing weather station locations
- Changing environments around weather stations
- Changing instrumentation (LIG to MMTS)
- “Time of Observation” changes
- Aging and changing weather observers

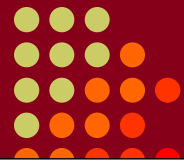
Denver All Stations



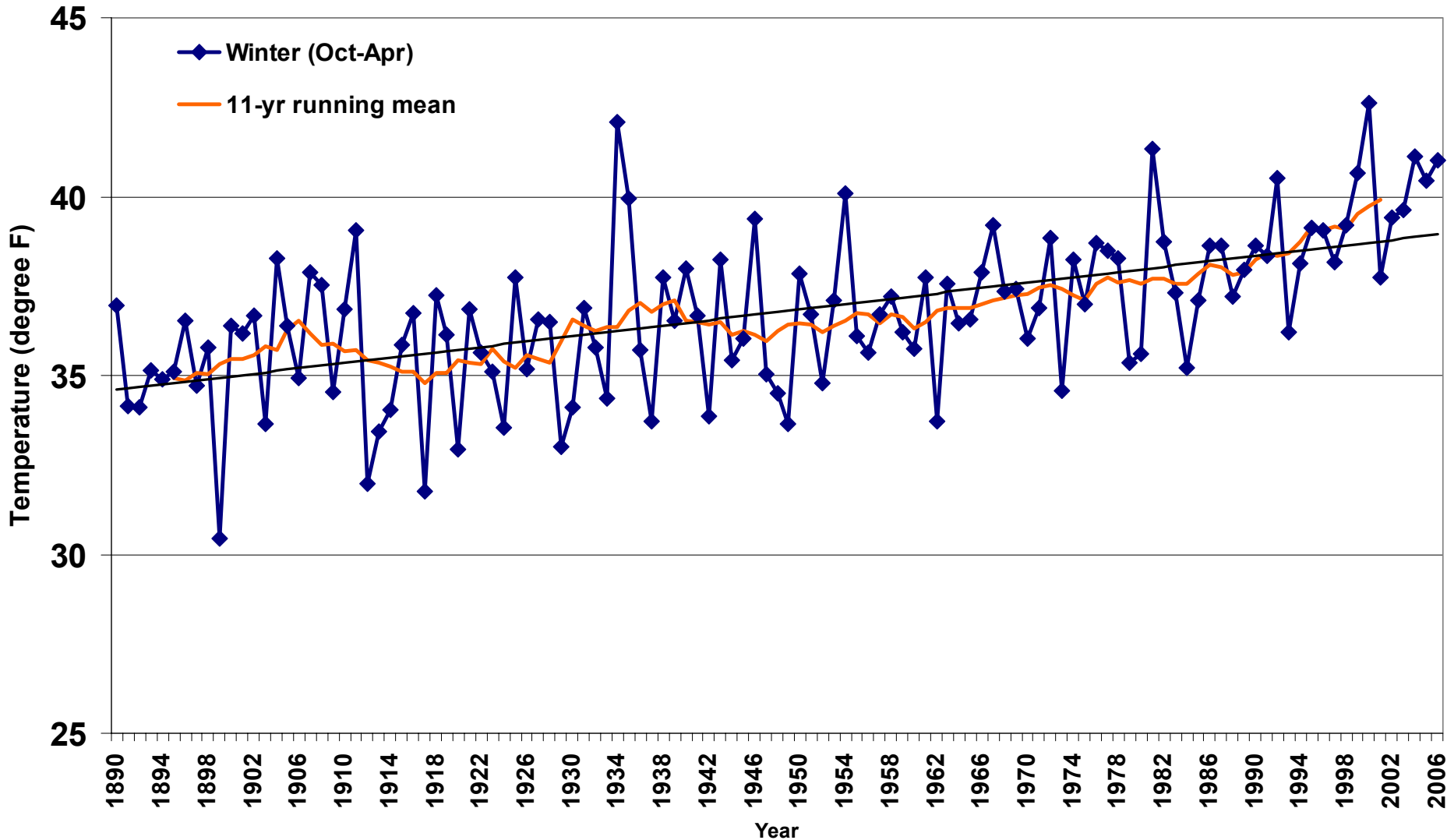
Denver (all 3 stations)
Monthly Average Maximum and Minimum Temperatures



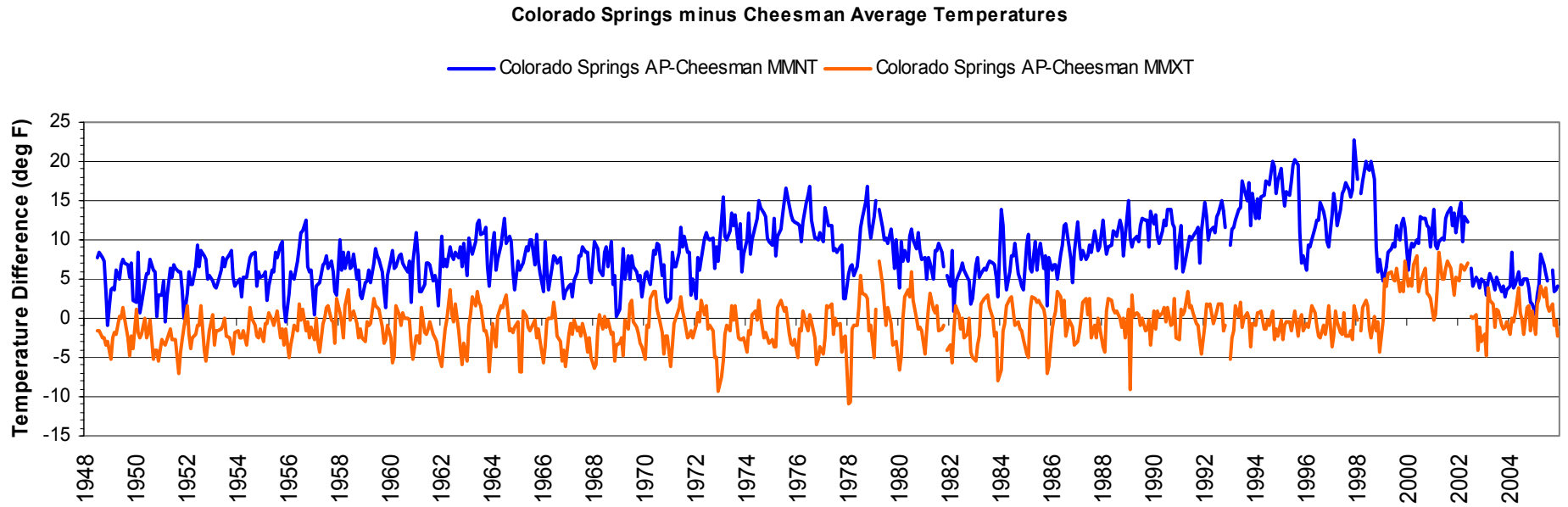
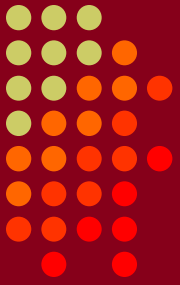
Fort Collins Winter Temperatures



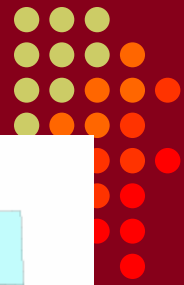
Water Year Average Temperatures for Winter (Oct-Apr)
1890 - 2006



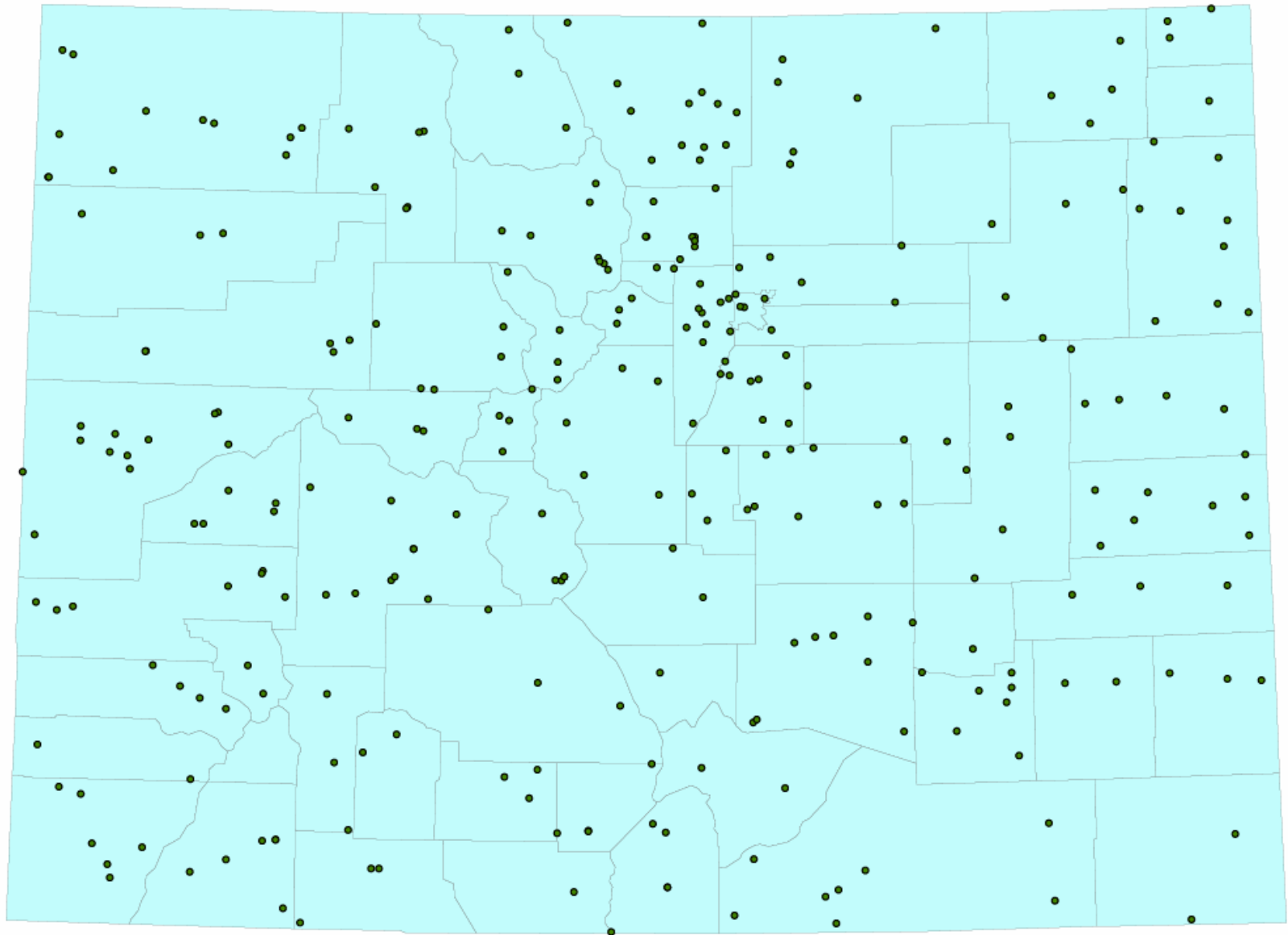
Colorado Springs – Cheesman Monthly Temperature Difference



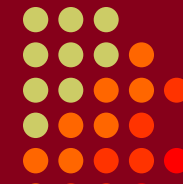
Colorado Cooperative Stations



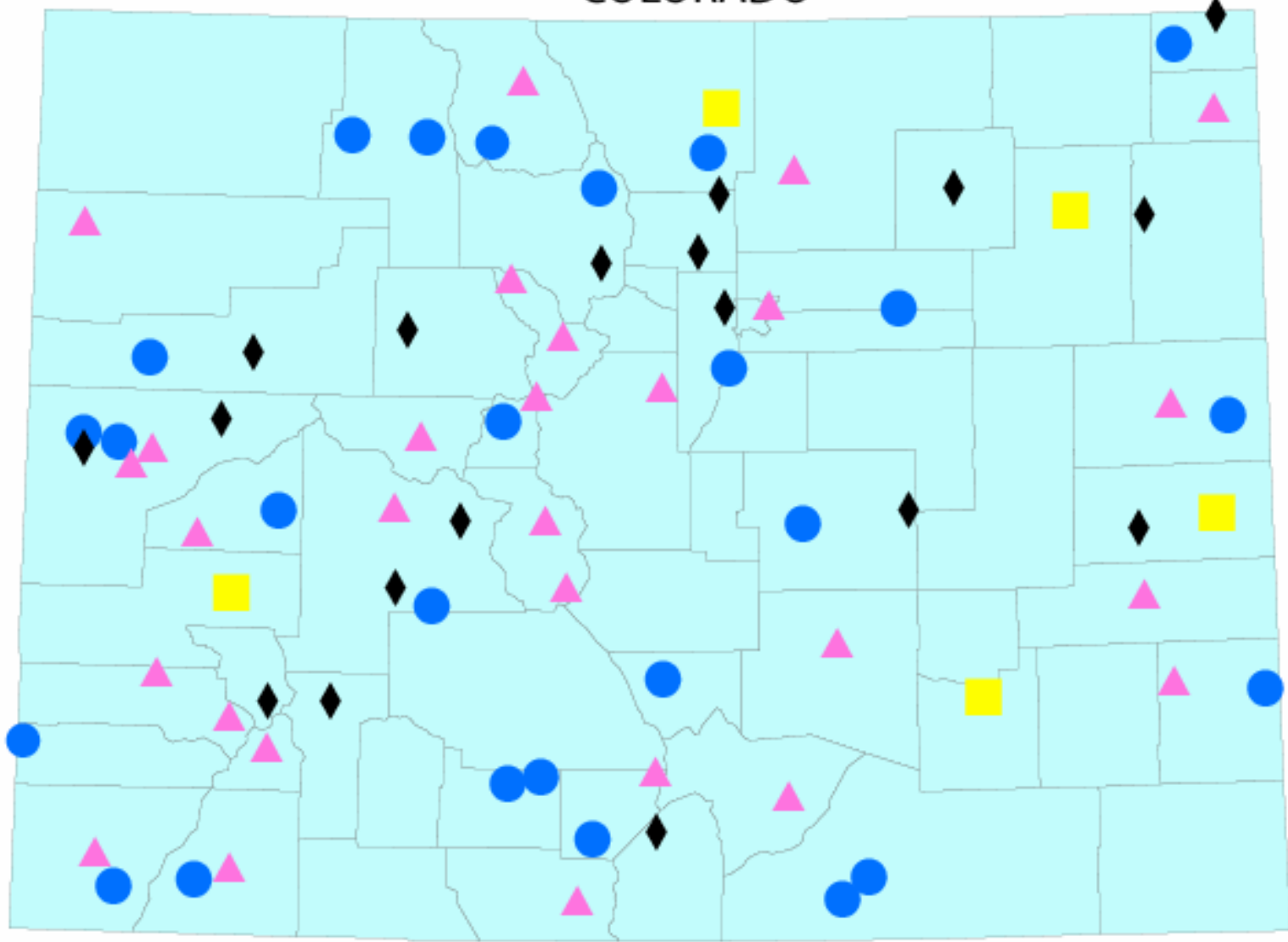
COLORADO



Long-Term Analysis Stations



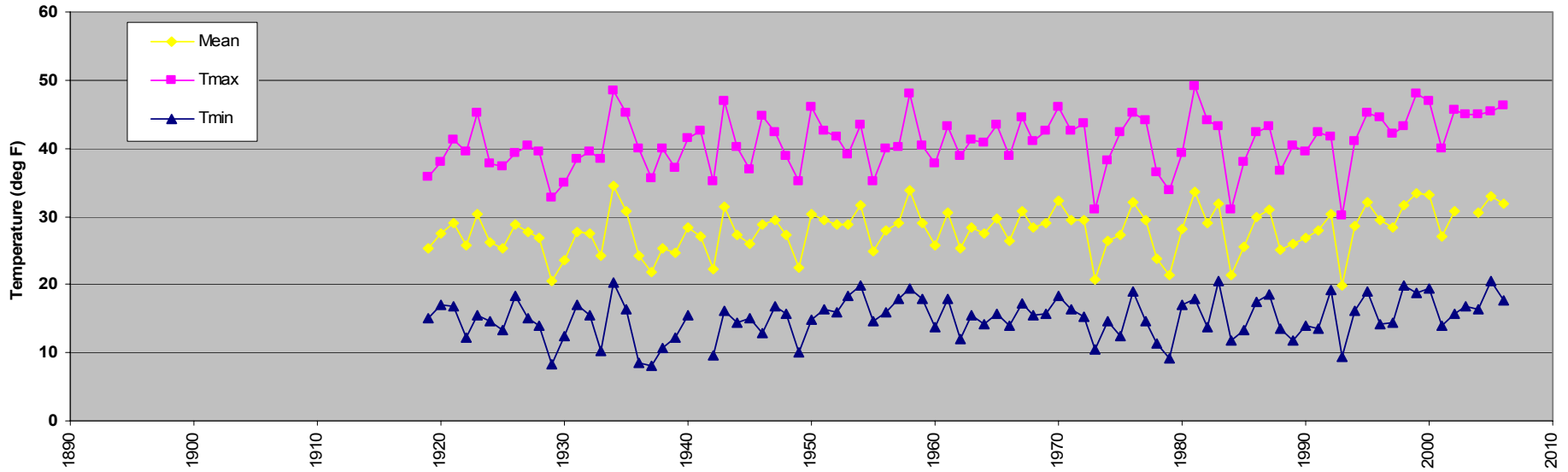
COLORADO



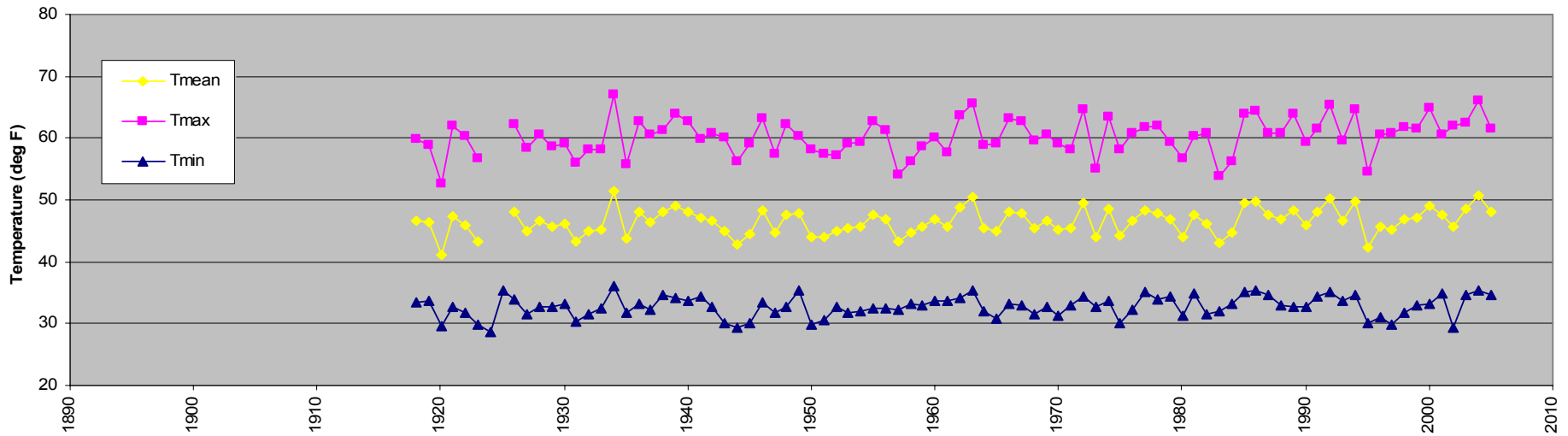
Legend

- ▲ Good
- ◆ Useful
- Better
- Best

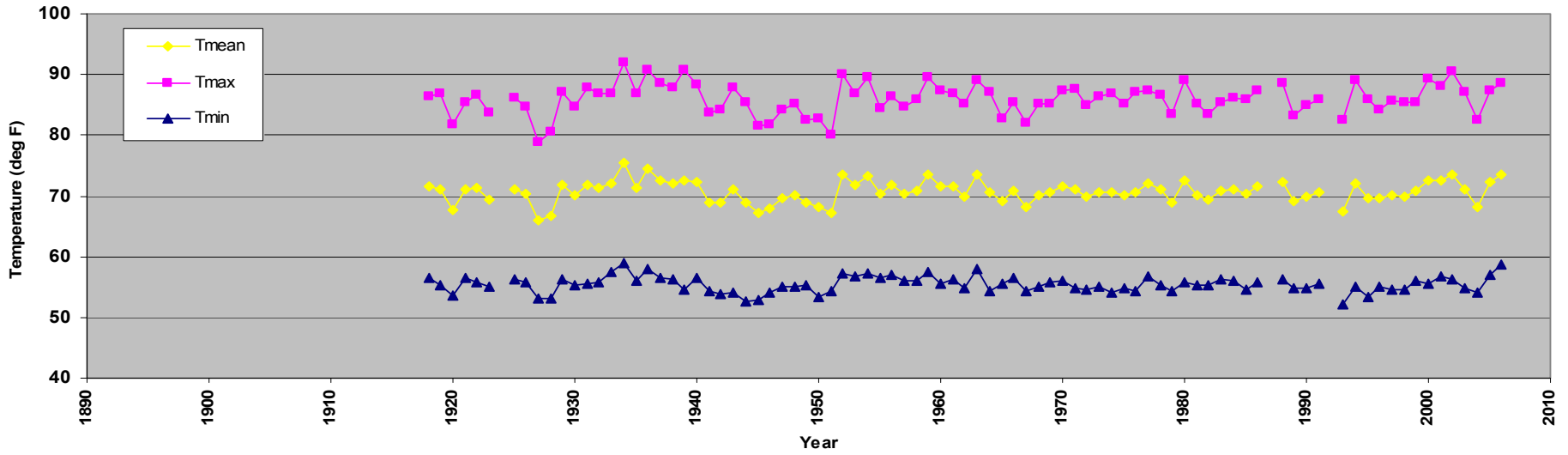
Akron 4E Winter (DJF) Temperatures



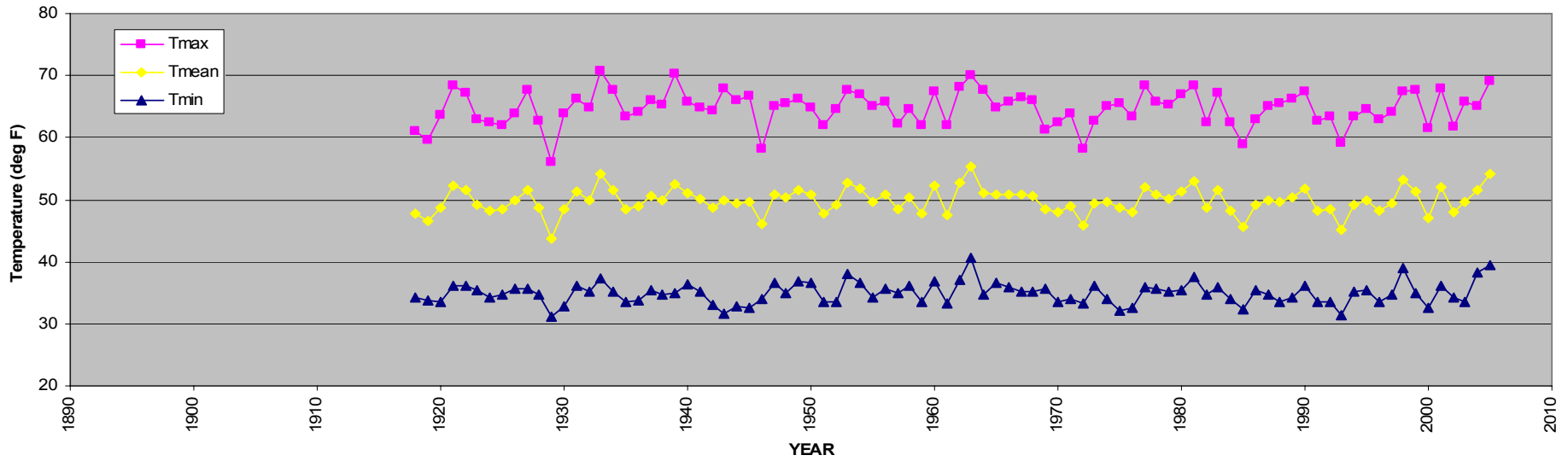
Akron 4E Spring (MAM) Temperatures



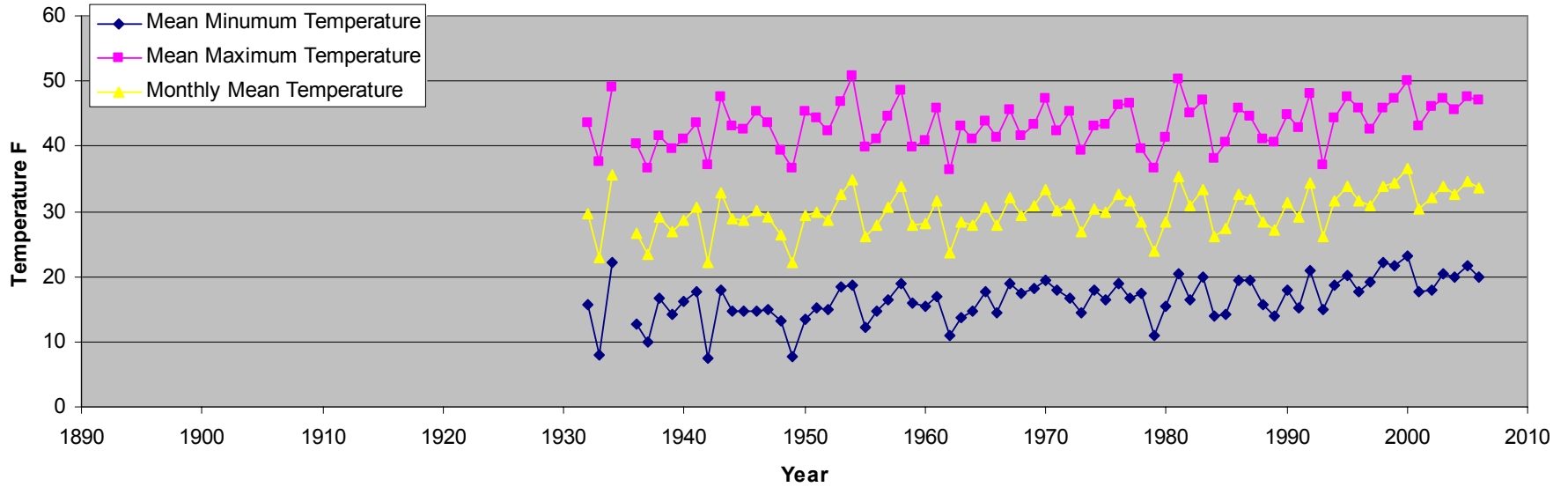
Akron 4E Summer (JJA) Temperatures



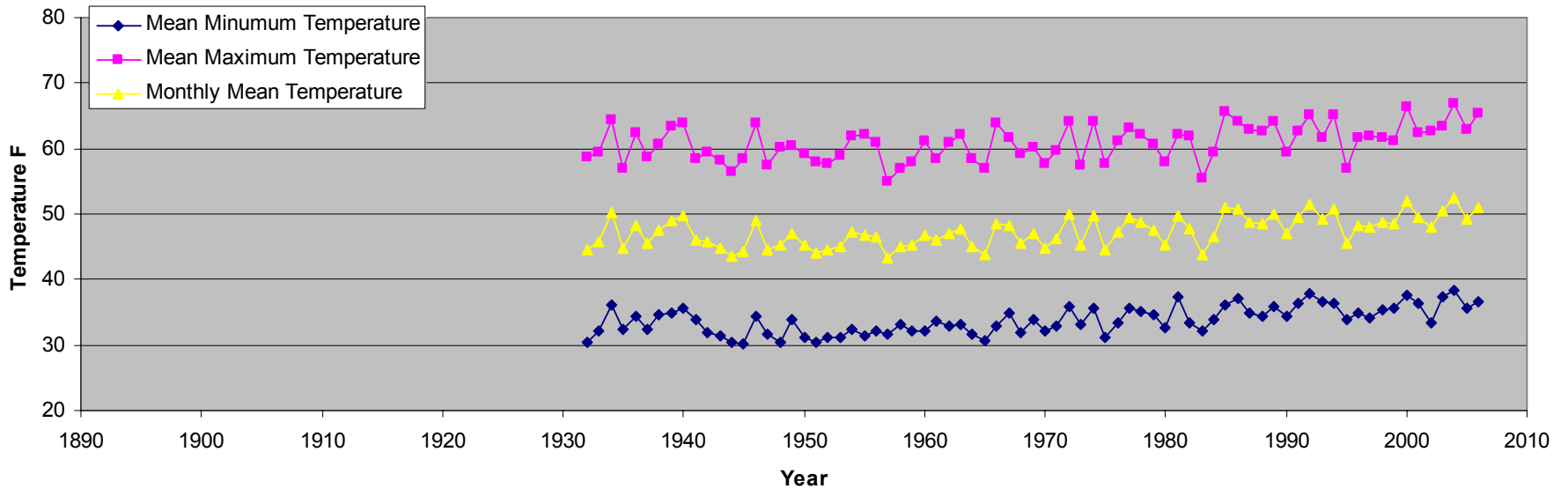
Akron 4E Fall (SON) Temperatures



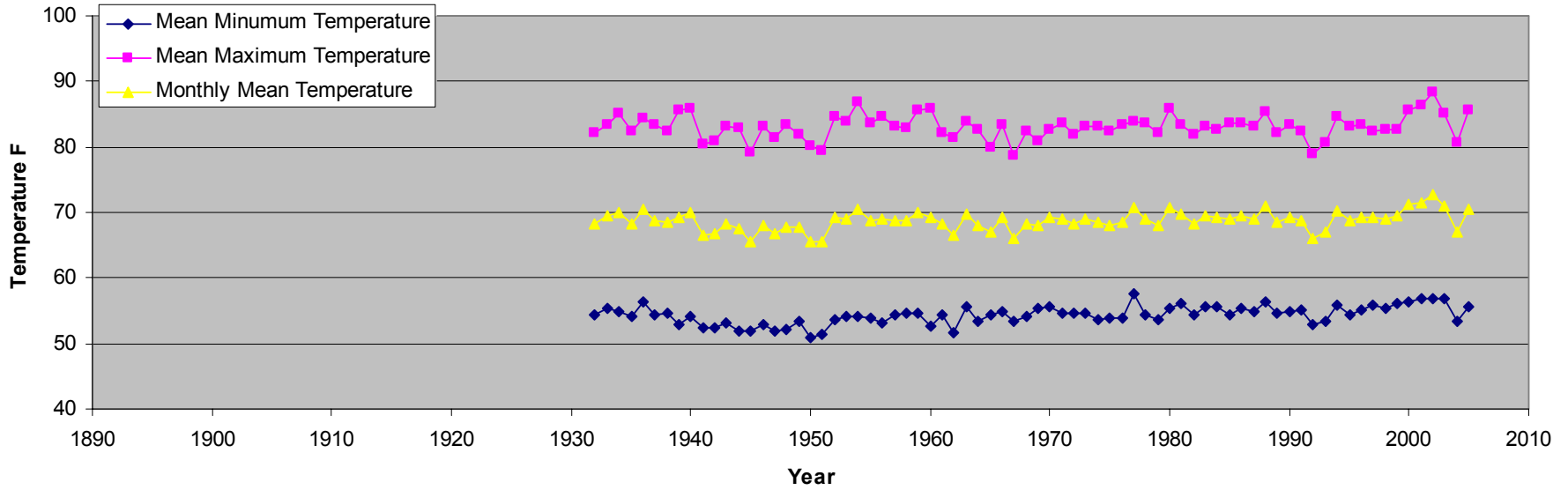
Fort Collins, CO Winter Temperatures



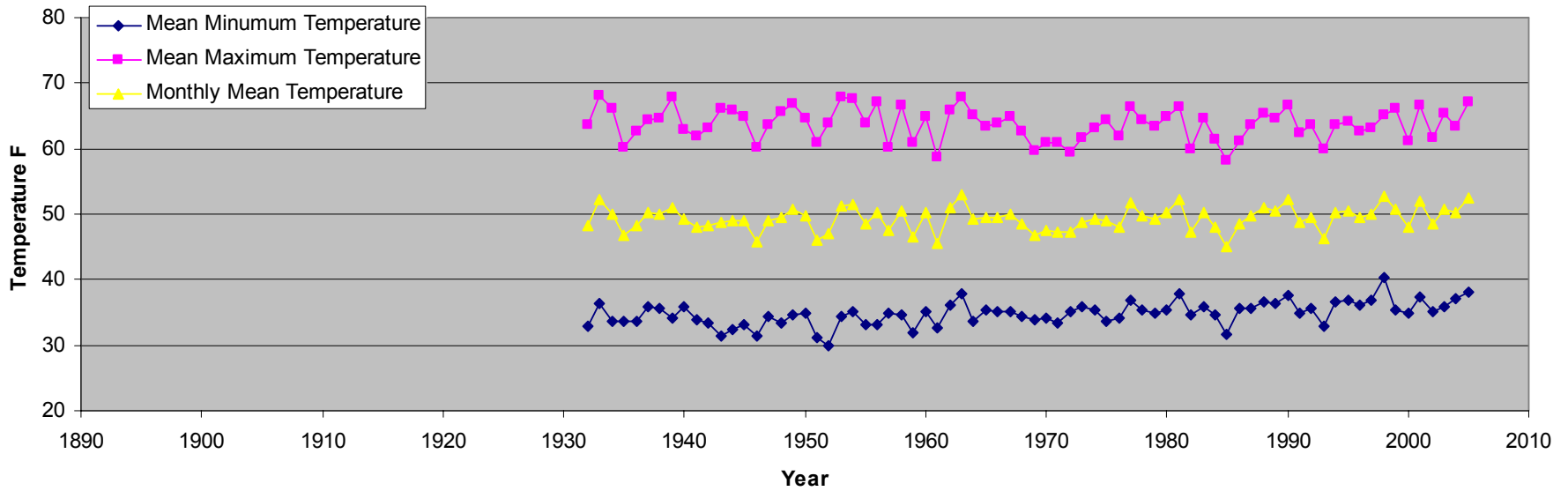
Fort Collins, CO Spring Temperatures



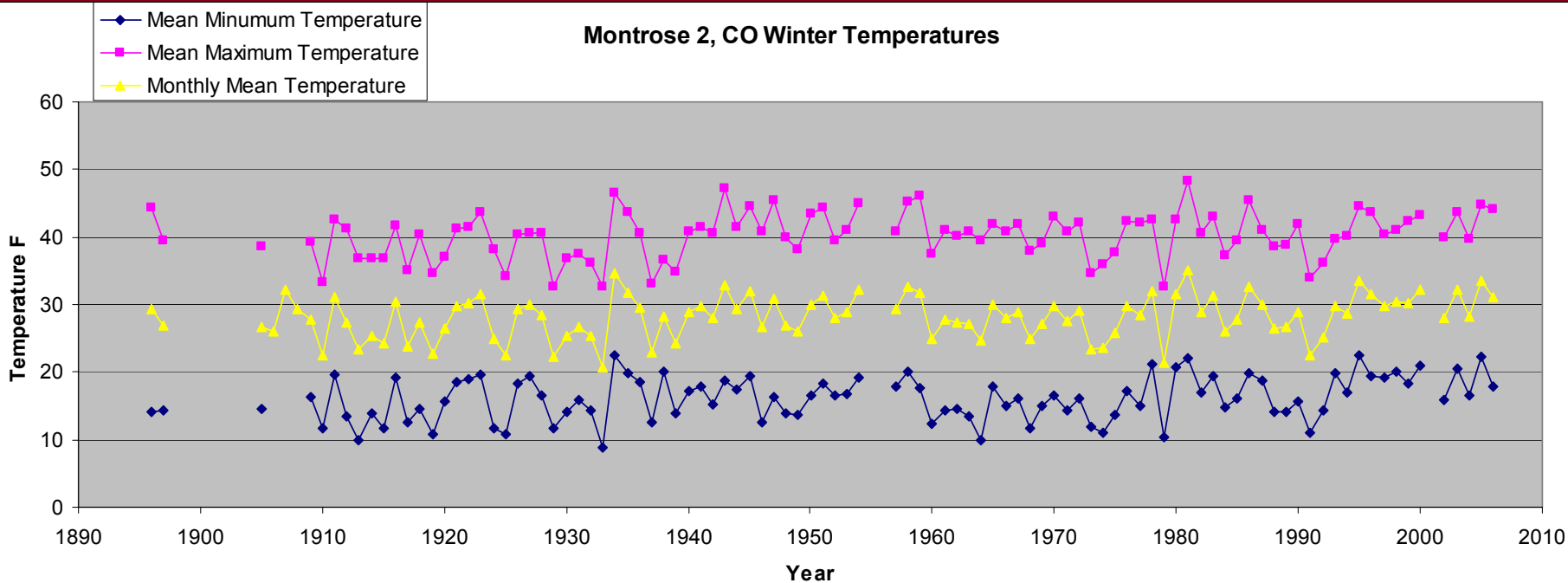
Fort Collins, CO Summer Temperatures



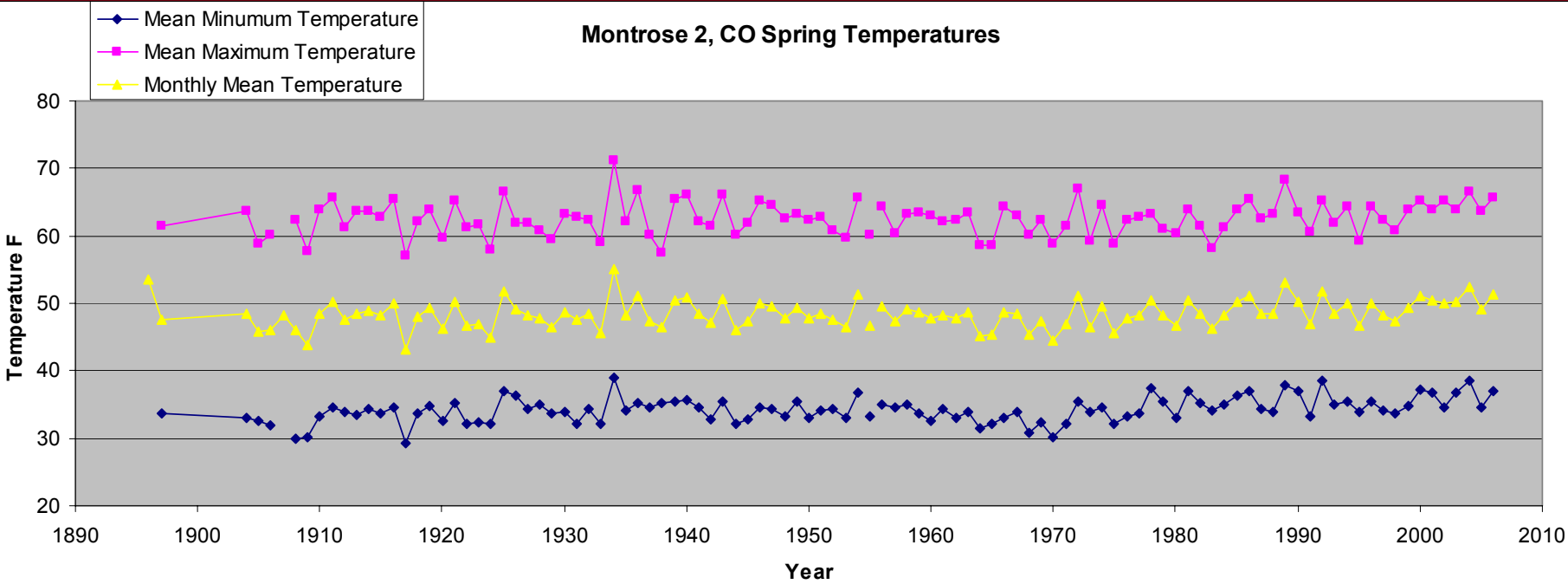
Fort Collins, CO Fall Temperatures



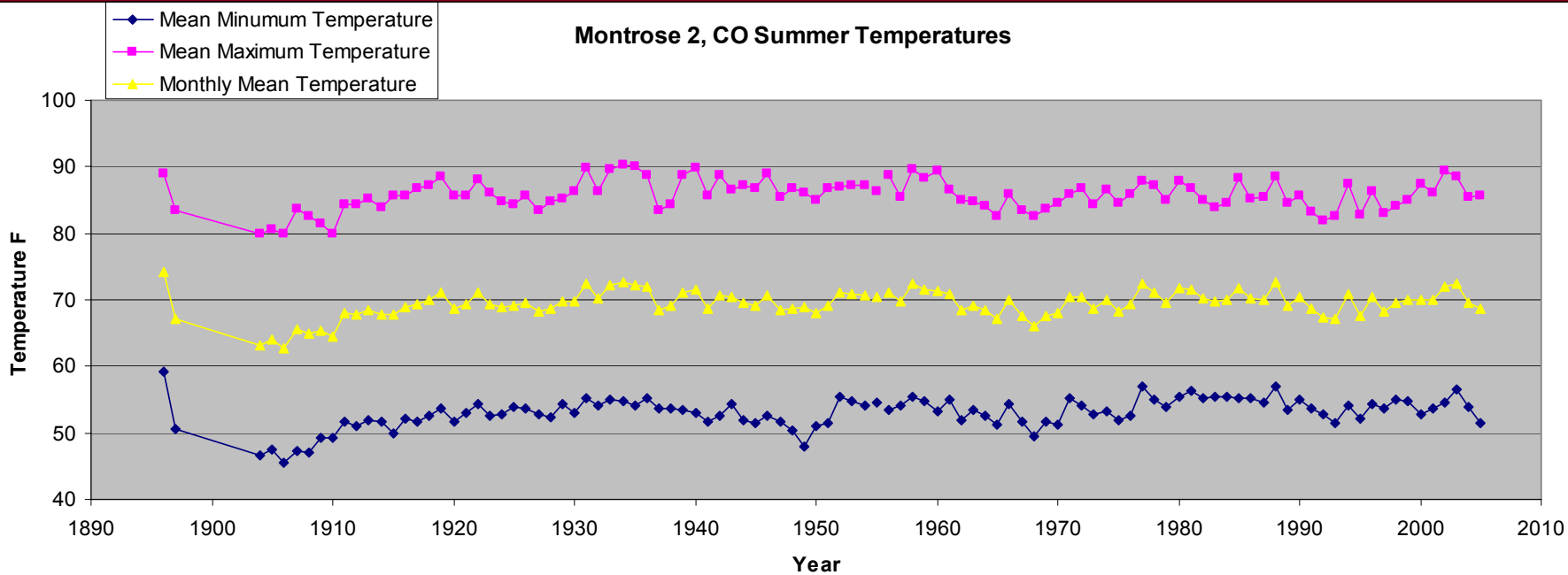
Montrose 2, CO Winter Temperatures



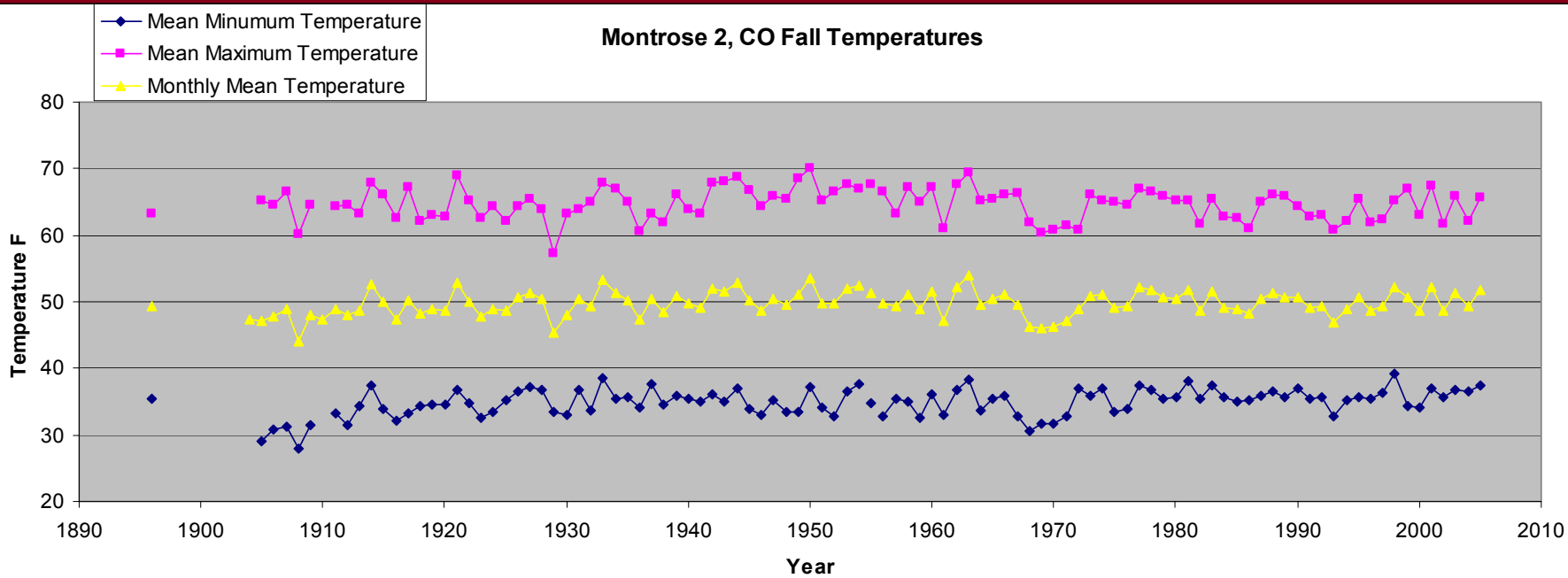
Montrose 2, CO Spring Temperatures



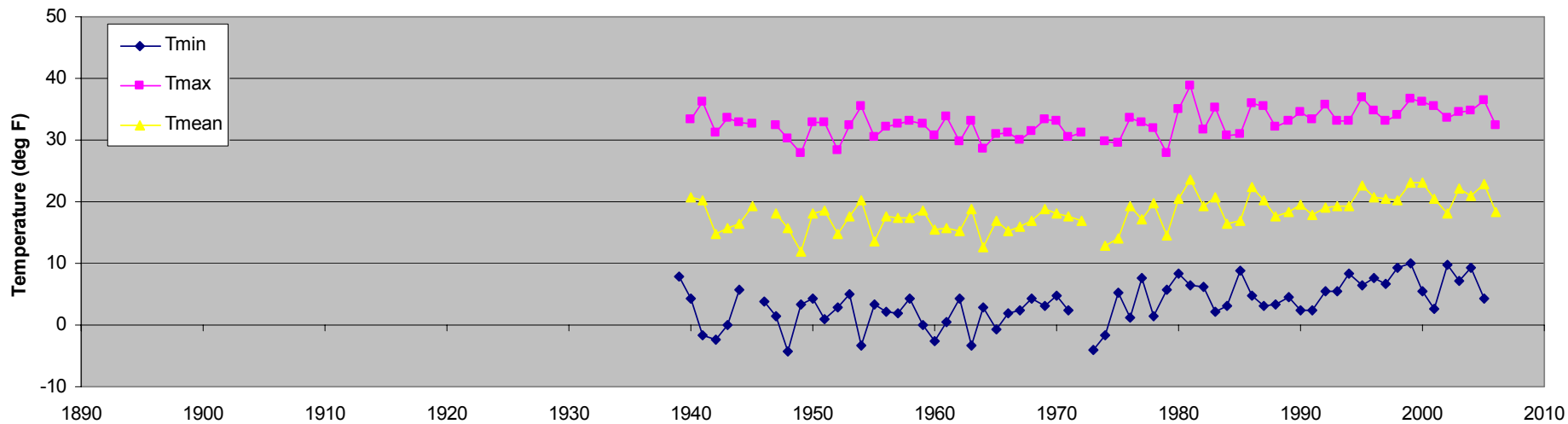
Montrose 2, CO Summer Temperatures



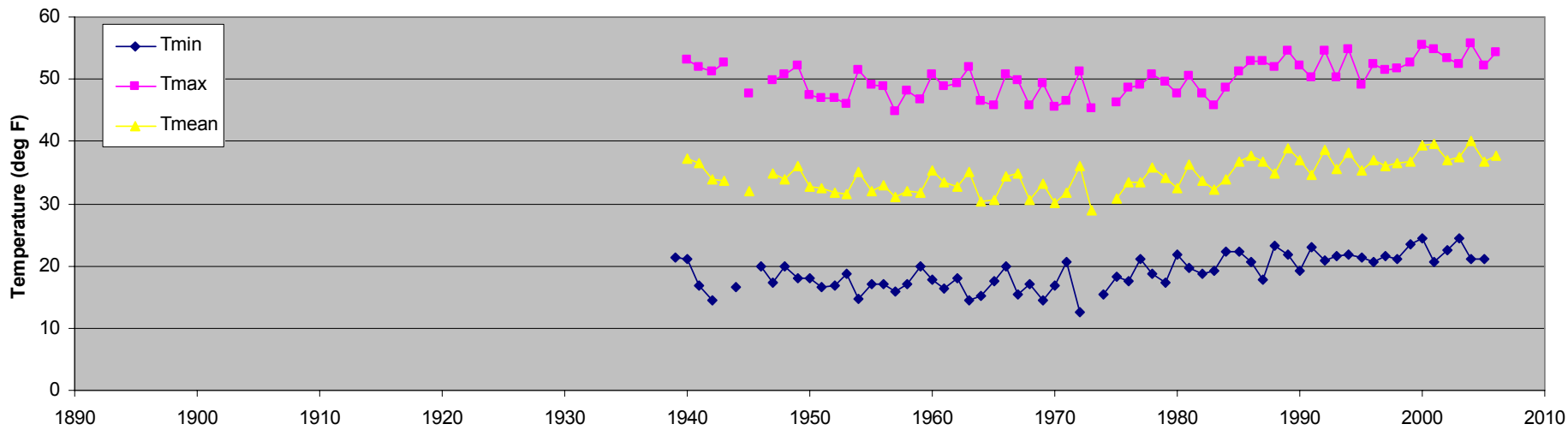
Montrose 2, CO Fall Temperatures



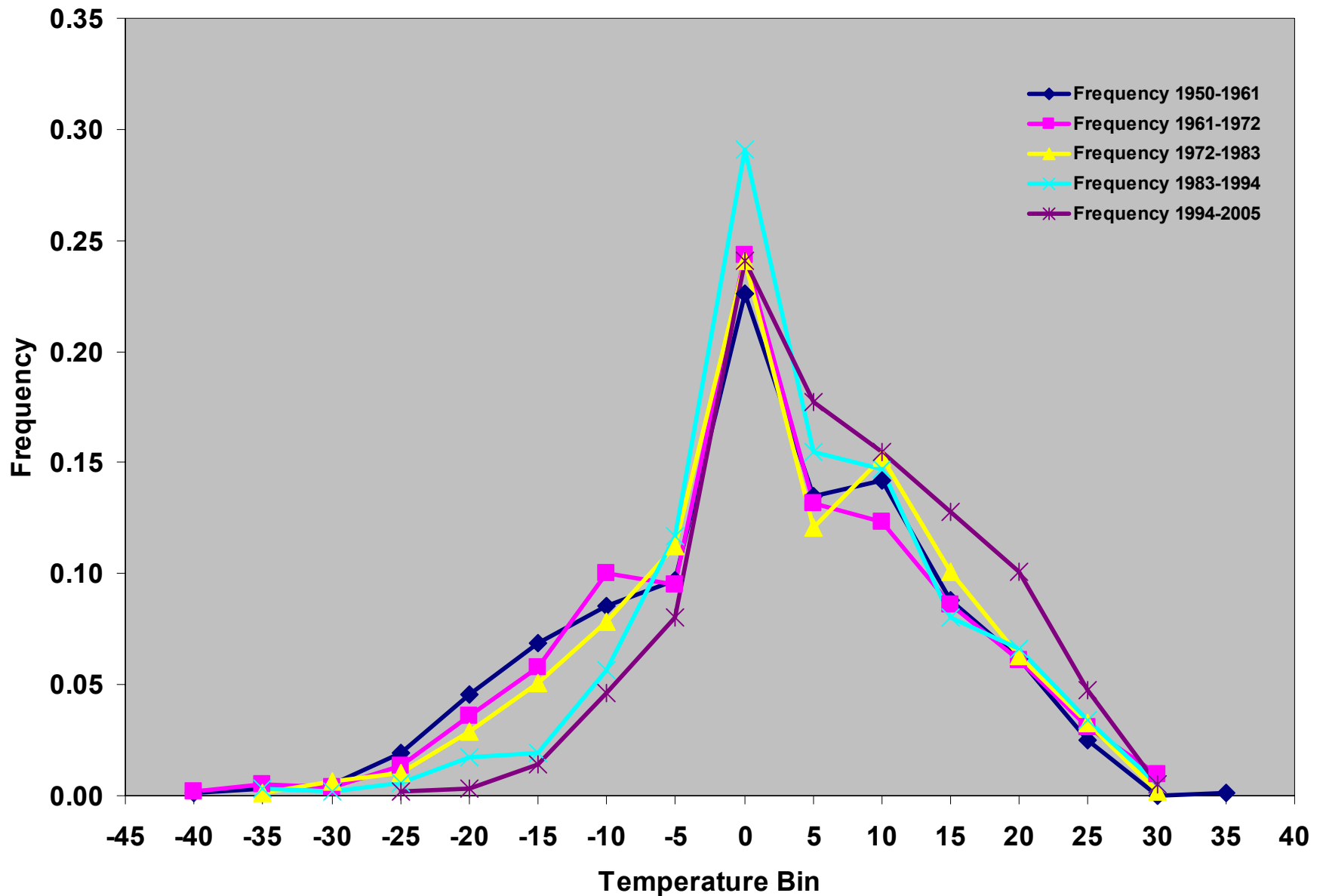
Grand Lake 1N Winter (DJF) Temperatures



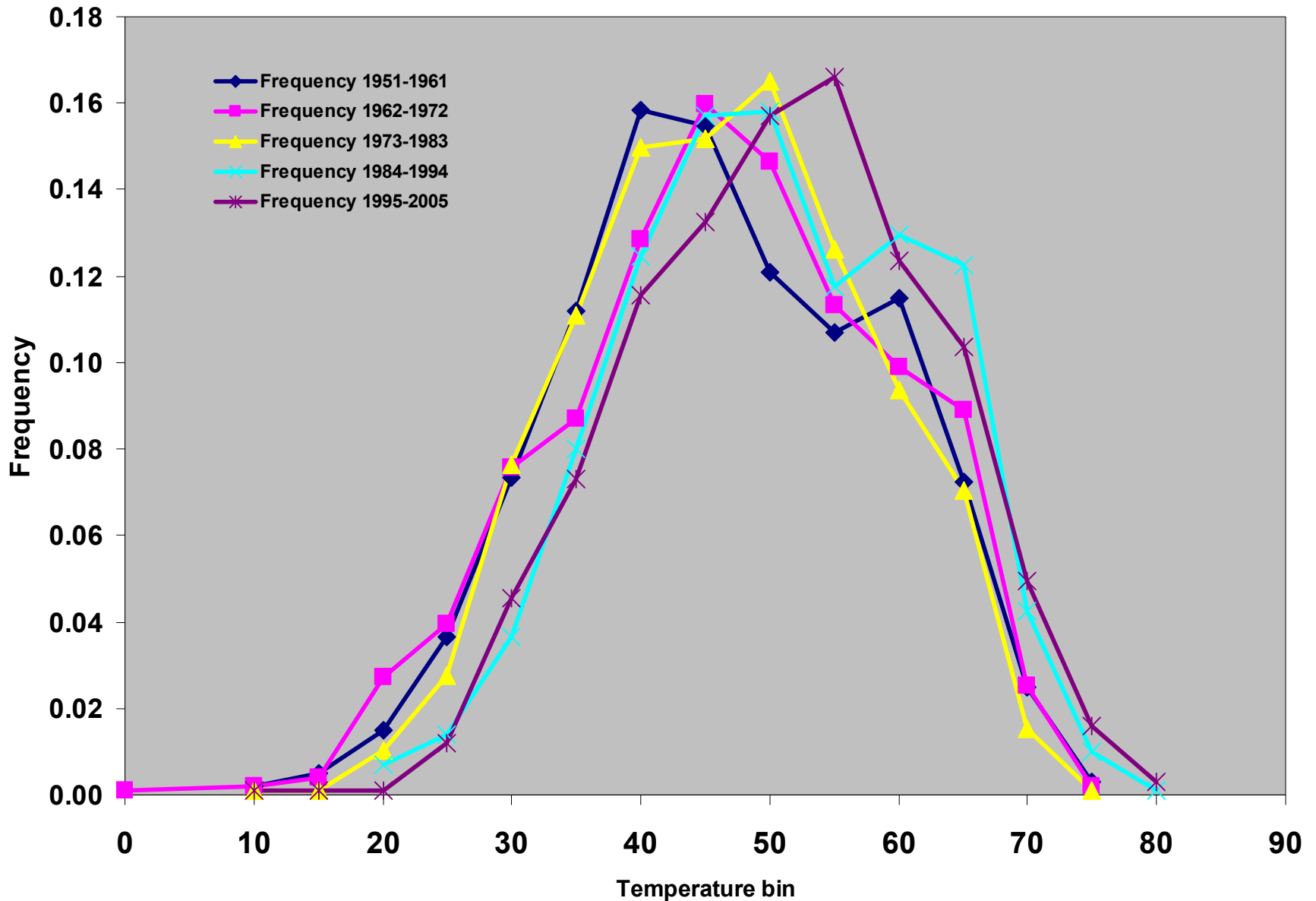
Grand Lake 1N Spring (MAM) Temperatures



Grand Lake, CO Winter Daily Minimum Temperature Distribution (5 degree bins)

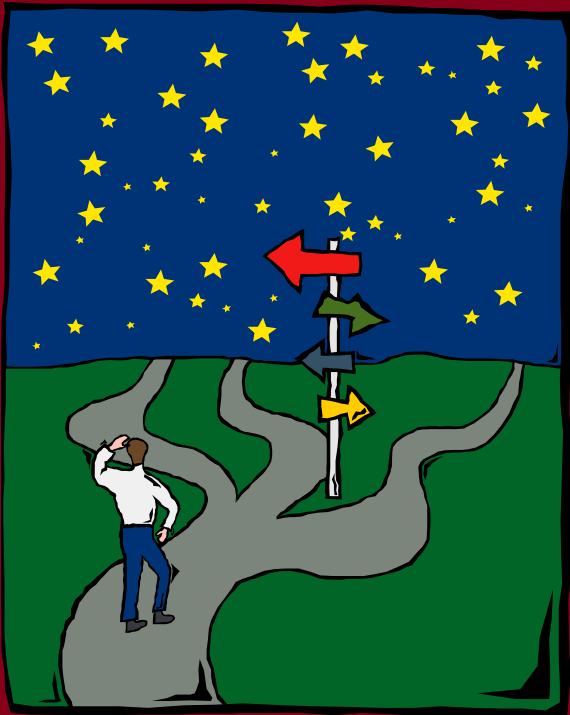


Grand Lake, CO Spring Daily Maximum Temperature Distribution (5 degree bins)





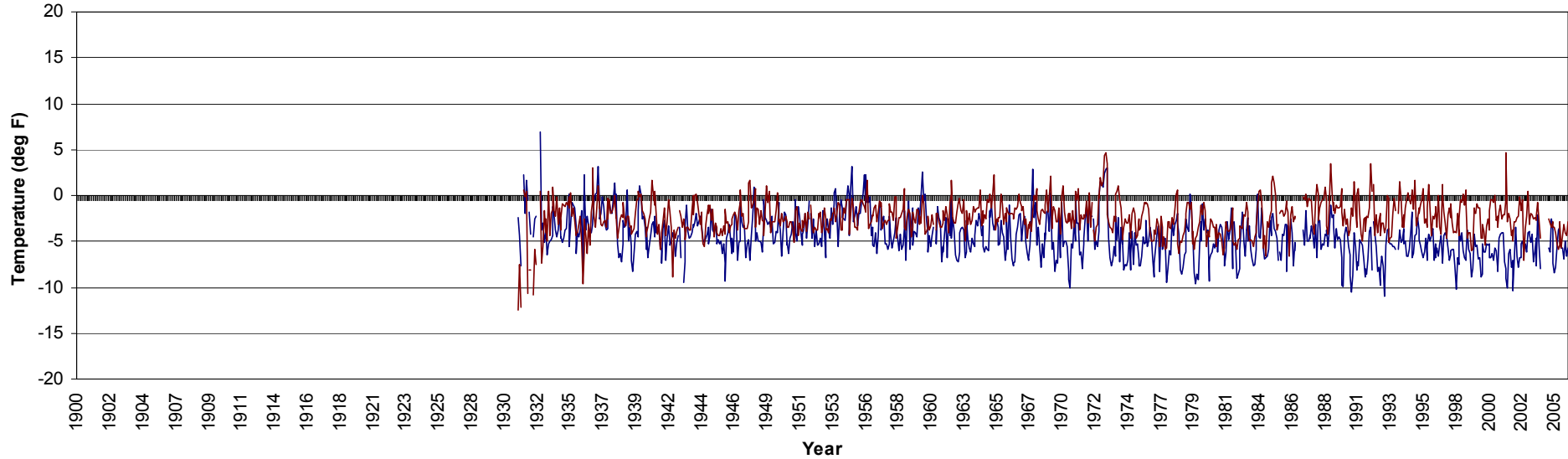
**With even the
best stations,
there is
uncertainty**



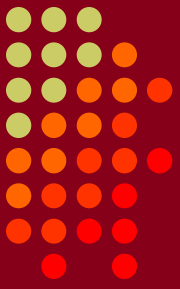
Steamboat – Hayden Monthly Temperature Differences



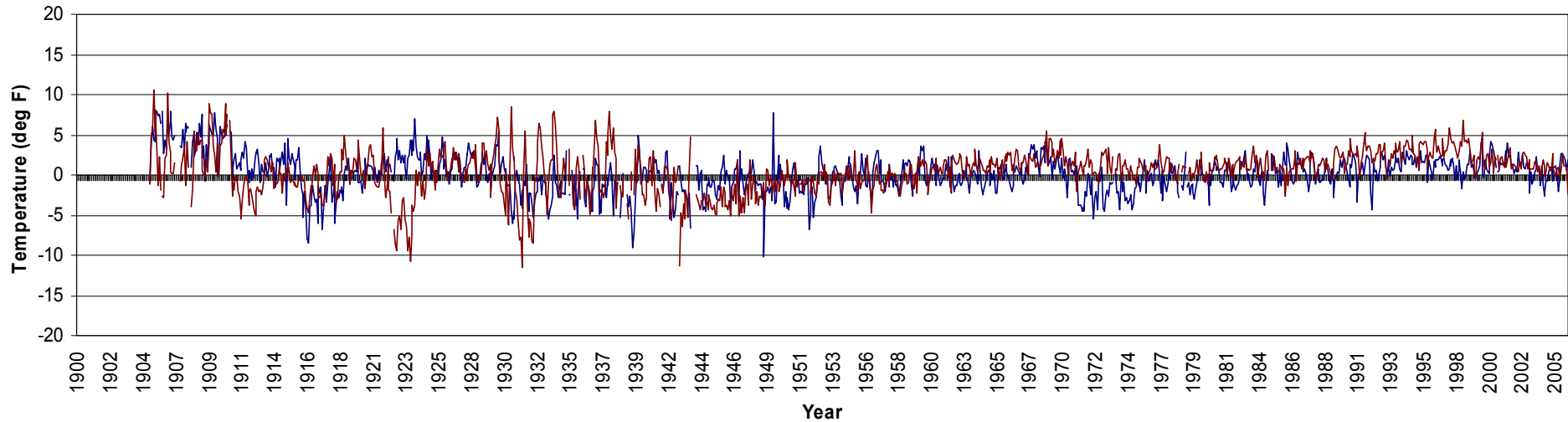
Monthly Mean Temperature Difference: Steamboat Springs minus Hayden (1931-2005)



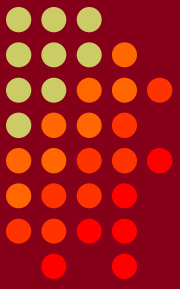
Paonia – Montrose Monthly Temperature Differences



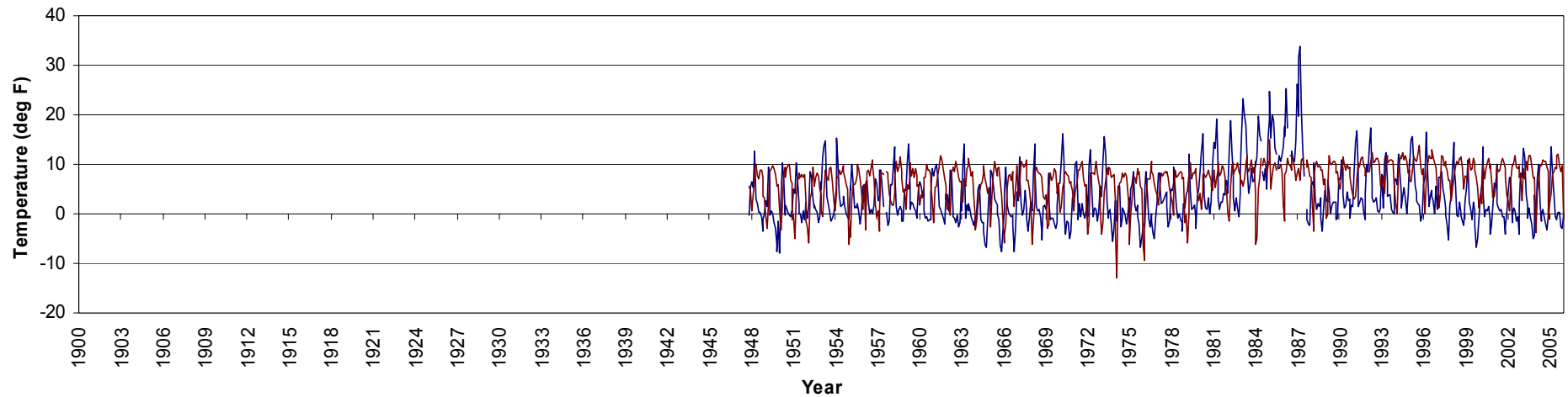
Monthly Mean Temperature Difference: Paonia minus Montrose No 2 (1900-2005)



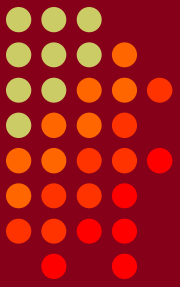
Cochetopa Creek – Taylor Park Monthly Temperature Differences



Monthly Mean Temperature Difference: Cochetopa Creek minus Taylor Park (1947-2005)



Klaus,



Take it from Here!