Analysis Methods in Atmospheric and Oceanic Science

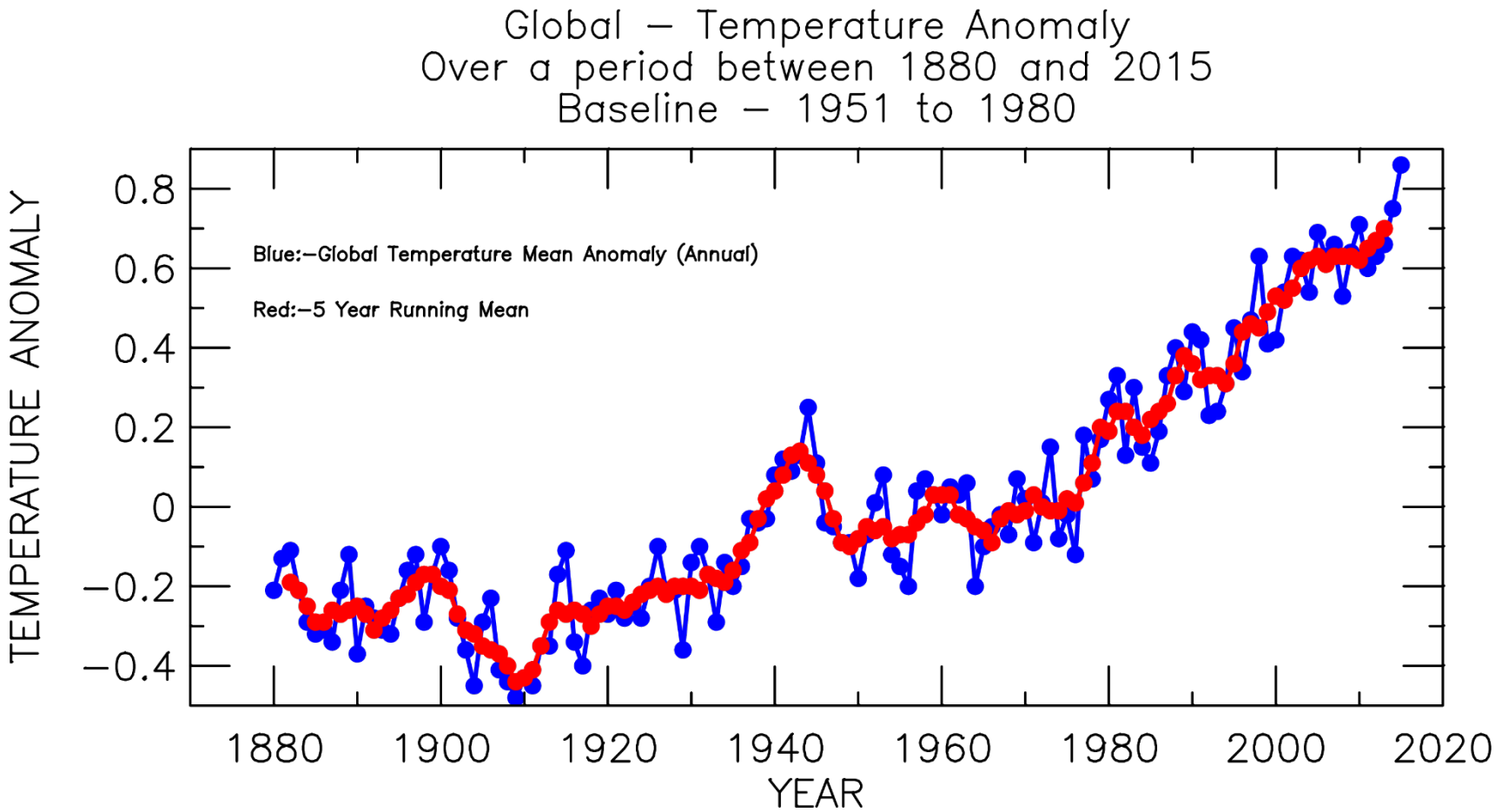
AOSC 652

Least Squares Analysis, Statistical Regression, & Spline Fitting: Week 5, Day 3

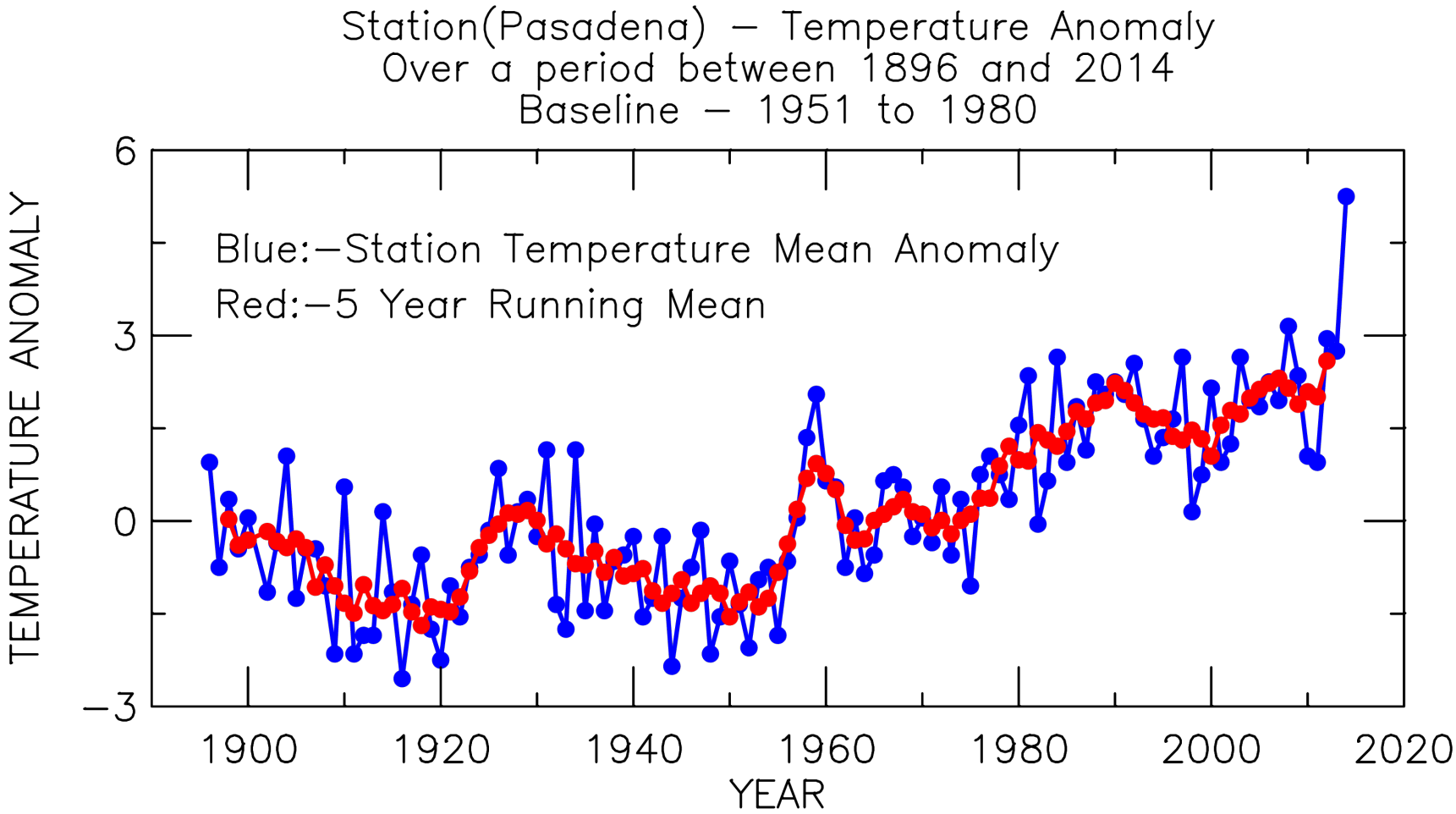
- **Review prior assignment**
- **General help with HW #5**

30 Sep 2016

AOSC 652: Assignment 4b



AOSC 652: Assignment 4b



```
 SUBROUTINE baseline(bline,temp,ntemp)
! This subroutine will calculate the "baseline" temperature for the weather station.  It is calculated as the average of
! the annual mean surface temperatures from 1951-1980, which is similar to the global  temperature data to which
! this will be compared.  The thirty-year time period is consistent with how climate is determined for a region.
! Inputs: temp (ctemp from main), ntemp (nmax_years from main)
! Output: bline
! Note: The start and stop subscripts were determined by figuring out the position of that year in the list of years
!       For example,
!       Year - Start Year + 1 = Desired Subscript
!       1951 - 1885 + 1       = 67
!       1980 - 1885 + 1       = 96
!       Number of years = 96 - 67 + 1 = 30
       IMPLICIT DOUBLE PRECISION (a-h,o-z)
       DIMENSION temp(ntemp)
       bline=0.0
       ipts=0
       DO itemp=67,96
            bline=bline+temp(itemp)
            ipts=ipts+1
       ENDDO
       npts=ipts
       IF(npts.gt.0) THEN
          bline=bline/float(npts)
      ELSE
      ENDIF
      RETURN
      END
```

```
 SUBROUTINE baseline(bline,temp,ntemp)
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       DIMENSION temp(ntemp)
       bline=0.0
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       DO itemp=67,96
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         bline=bline/float(npts)
      ELSE
      ENDIF
      RETURN
      END
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       DIMENSION temp(ntemp)
       bline=0.0
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       DO itemp=67,96
            bline=bline+temp(itemp)
            ipts=ipts+1
       ENDDO
       npts=ipts
       IF(npts.gt.0) THEN
         bline=bline/float(npts)
      ELSE
      ENDIF
      RETURN
      END
```

Will this work for data from other stations ?

Student Code

```
C These two do loops search through year array to find
C the elements corresponding to 1951 and 1980 and storing
C them as new integer variables, locL and locH, to be used later.
      do ipts=1,npts
        if (year(ipts).eq.1951) then
          locL = ipts
        endif
      enddo
      do ipts=1,npts
        if (year(ipts).eq.1980) then
          locH = ipts
        endif
      enddo
        sum=0.
       do ipts=locL,locH
         sum= sum+Tempmean(ipts)
       enddo
C  Baseline defined as average over 30 years (1951-1980)
        baseline=sum/30.
        write(*,*)baseline
```

Student Code

```
C These two do loops search through year array to find
C the elements corresponding to 1951 and 1980 and storing
C them as new integer variables, locL and locH, to be used later.
      do ipts=1,npts
        if (year(ipts).eq.1951) then
          locL = ipts
        endif
      enddo
      do ipts=1,npts
        if (year(ipts).eq.1980) then
          locH = ipts
        endif
      enddo
        sum=0.
       do ipts=locL,locH
         sum= sum+Tempmean(ipts)
       enddo
C  Baseline defined as average over 30 years (1951-1980)
        baseline=sum/30.
        write(*,*)baseline
```

Will this work if student changes start and end years, in these two statements

Student Code

```
C These two do loops search through year array to find
C the elements corresponding to 1951 and 1980 and storing
C them as new integer variables, locL and locH, to be used later.
      do ipts=1,npts
        if (year(ipts).eq.1951.) then
          locL = ipts
        endif
      enddo
      do ipts=1,npts
        if (year(ipts).eq.1980.) then
          locH = ipts
        endif
      enddo
        sum=0.
       do ipts=locL,locH
         sum= sum+Tempmean(ipts)
       enddo
C  Baseline defined as average over 30 years (1951-1980)
         baseline=sum/float(locH – locL + 1)
        write(*,*)baseline
```

Student Code

```
C   Compute baseline - average of temperature from 1951–1980

      baseline_sum=0.

      do ipts=1,npts
            if (year(ipts).ge.1951.and.year(ipts).le.1980) then
                  baseline_sum=baseline_sum+temperc(ipts)
            endif
      enddo

      baseline=baseline_sum/30.

C     Subtract baseline temperature from each data point

      do ipts=1,npts
            temperanom(ipts)=temperc(ipts)–baseline
      enddo
```

Student Code

```
C   Compute baseline - average of temperature from 1951–1980

      baseline_sum=0.

      do ipts=1,npts
            if (year(ipts).ge.1951..and.year(ipts).le.1980.) then
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      enddo

      baseline=baseline_sum/30.

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      do ipts=1,npts
            temperanom(ipts)=temperc(ipts)–baseline
      enddo
```

Student Code

```
C   Compute baseline - average of temperature from 1951–1980

      baseline_sum=0.
      icount=0
      do ipts=1,npts
            if (year(ipts).ge.1951..and.year(ipts).le.1980.) then
                  if temperc(ipts).ne.–999.) then
     +                  baseline_sum=baseline_sum+temperc(ipts)
                        icount=icount+1
                  endif
            endif
      enddo

      baseline=baseline_sum/float(icount)

C    Subtract baseline temperature from each data point

      do ipts=1,npts
            temperanom(ipts)=temperc(ipts)–baseline
      enddo
```

Student Code

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C   Compute baseline - average of temperature from 1951–1980

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      icount=0
      do ipts=1,npts
            if (year(ipts).ge.1951..and.year(ipts).le.1980.) then
                  if temperc(ipts).ne.–999.) then
     +                  baseline_sum=baseline_sum+temperc(ipts)
                        icount=icount+1
                  endif
            endif
      enddo
      if(icount.ne.0) then
            baseline=baseline_sum/float(icount)
      else
            write(*,*)'icount = 0, can not find baseline'
            stop
      endif
C     Subtract baseline temperature from each data point
      do ipts=1,npts
            temperanom(ipts)=temperc(ipts)–baseline
      enddo
```

```
      read(1,*,err=110,end=110)ttt1,ttt2
       if(ttt1.ne.–999.and.ttt2.ne.–999.) then
            year(ipts)=ttt1
            temper(ipts)=((ttt2 – 32.0)*(5.0/9.0))
            if (1951.le.ttt1.and.ttt1.le.1980.)then
            sum=sum+((ttt2 – 32.0)*(5.0/9.0))
C      This conditional statement filters the station temperature data
C      to only use the data between years 1951 and 1980 for baseline
C      calculation. If the condition is met, then the corresponding
C      temperature value can be used to calculate the baseline.
             endif
            ipts=ipts+1
      endif
      goto 100

110    continue
      close(unit=1)
      npts=ipts–1

      write(6,702)npts,namein(1:len_namein)
702    format('Read ',I3,' points from file ',A,)

      baseline=sum/31.
      print*,baseline
C      Declare a value for the basline. This is the temperterature
C      reading that meets the above conditional statement (has to be
C      from 1951-1980) divded by the number of years which is the
C      baseline time period.
      do ipts=1,npts
            anom(ipts)=temper(ipts) – baseline
C      Do loop that that runs the calculation for anomaly
      enddo
```

```
      read(1,*,err=110,end=110)ttt1,ttt2
       if(ttt1.ne.–999.and.ttt2.ne.–999.) then
            ttt3=((ttt2 – 32.0)*(5.0/9.0))
            temper(ipts)=ttt3
            if (1951.le.ttt1.and.ttt1.le.1980.)then
            sum=sum+ ttt3
C      This conditional statement filters the station temperature data
C      to only use the data between years 1951 and 1980 for baseline
C      calculation. If the condition is met, then the corresponding
C      temperature value can be used to calculate the baseline.
             endif
            ipts=ipts+1
      endif
      goto 100

110     continue
      close(unit=1)
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      write(6,702)npts,namein(1:len_namein)
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      print*,baseline
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C      reading that meets the above conditional statement (has to be
C      from 1951-1980) divded by the number of years which is the
C      baseline time period.
      do ipts=1,npts
            anom(ipts)=temper(ipts) – baseline
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            temper(ipts)=ttt3
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            sum=sum+ ttt3
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C      to only use the data between years 1951 and 1980 for baseline
C      calculation. If the condition is met, then the corresponding
C      temperature value can be used to calculate the baseline.
             endif
            ipts=ipts+1
      endif
      goto 100

110    continue
      close(unit=1)
      npts=ipts–1

      write(6,702)npts,namein(1:len_namein)
702    format('Read ',I3,' points from file ',A,)

      baseline=sum/30.
      print*,baseline
C      Declare a value for the basline. This is the temperterature
C      reading that meets the above conditional statement (has to be
C      from 1951-1980) divded by the number of years which is the
C      baseline time period.
      do ipts=1,npts
            anom(ipts)=temper(ipts) – baseline
C      Do loop that that runs the calculation for anomaly
      enddo
```

Student Code

```
        write(99,750)namein(1:len_namein)
750     format('3,4',/,
     + 'Year,Temp. Anomoly,5 Year Running Mean',/,
     + 'Data records from Uniontown, PA ',/,
     + 'Data file at - ', A13)


C     Find iyr mean
      npts_array=npts_array_max
      do ipts=1,npts
            xmean=–999
            if(ipts.ge.3.and.ipts.le.(npts-2)) then
                  array(1)=T_anom(ipts-2)
                  array(2)=T_anom(ipts-1)
                  array(3)=T_anom(ipts)
                  array(4)=T_anom(ipts+1)
                  array(5)=T_anom(ipts+2)
                  call mean(xmean,array,npts_array)
            endif
      write(99,760)Year(ipts),(T_anom(ipts)/(9./5.)),(xmean/(9./5.))
      enddo
760   format(F5.0,1X,F7.2,1X,F7.2)
```

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        write(99,750)namein(1:len_namein)
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                  array(5)=T_anom(ipts+2)
                  call mean(xmean,array,npts_array)
            endif
            write(99,760)Year(ipts),(T_anom(ipts)/(9./5.)),(xmean/(9./5.))
      enddo
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     + 'Year,Temp. Anomoly,5 Year Running Mean',/,
     + 'Data records from Uniontown, PA ',/,
     + 'Data file at - ', A13)


C     Find iyr mean
      npts_array=npts_array_max
      do ipts=1,npts
            xmean=–999
            xmean_degC=–999.
            if(ipts.ge.3.and.ipts.le.(npts-2)) then
                  array(1)=T_anom(ipts-2)
                  array(2)=T_anom(ipts-1)
                  array(3)=T_anom(ipts)
                  array(4)=T_anom(ipts+1)
                  array(5)=T_anom(ipts+2)
                  call mean(xmean,array,npts_array)
                  xmean_degC=xmean/(9./5.)
            endif
      write(99,760)Year(ipts),(T_anom(ipts)/(9./5.)),xmean_degC
      enddo
760   format(F5.0,1X,F7.2,1X,F7.2)
```

Student Code

```
        write(99,750)namein(1:len_namein),iyy,imm,idd,ctime
750     format('3,5',/,
     +  'Year,GMST Anomaly (C),5 Yr Running Mean (C)',/
     +  'Data read from file ',A,/,
     +  'GMST Anomaly from GISS, using baseline of 1951 to 1980',/,
     +  'File created on 9/27/16')

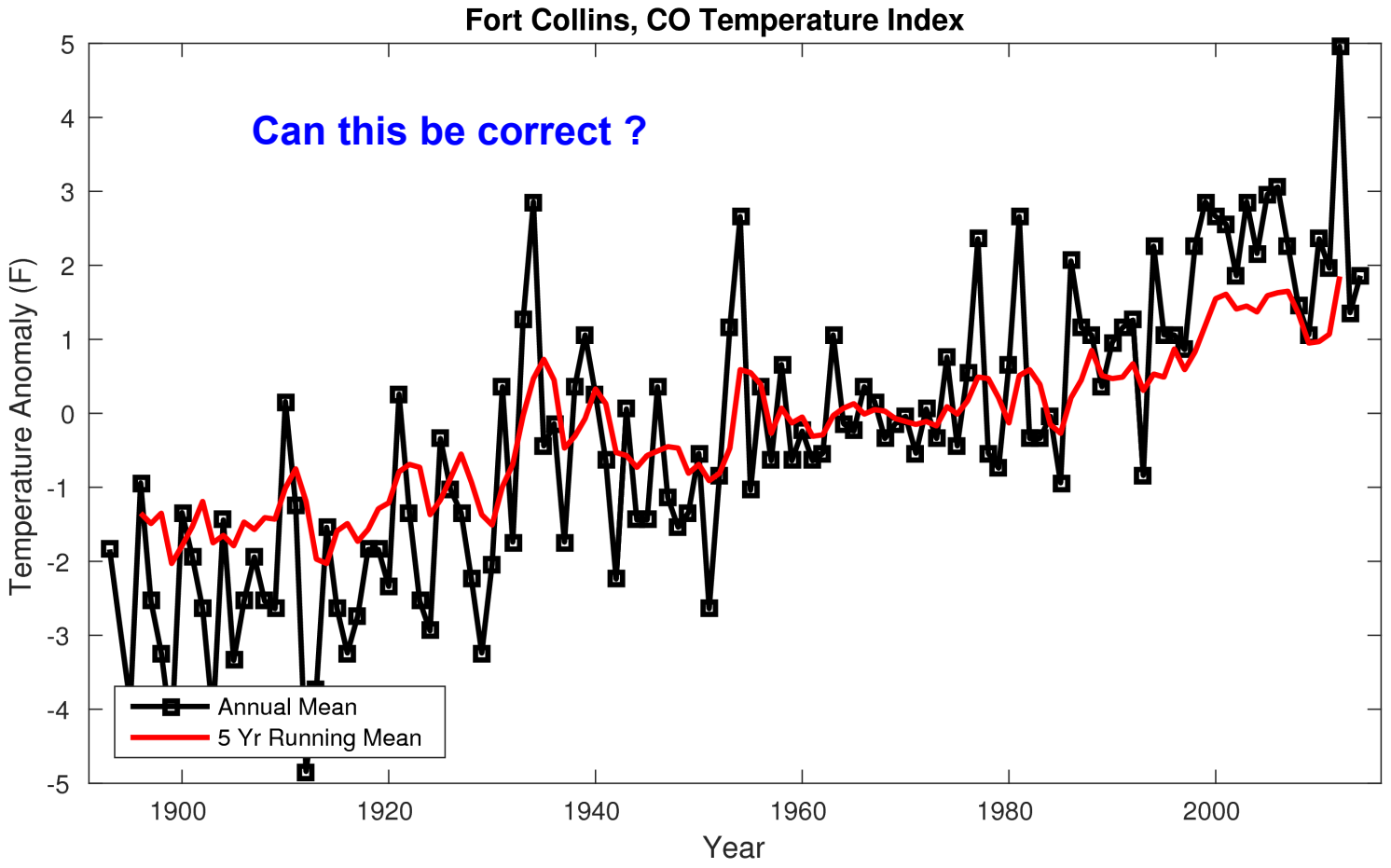
        npts_array=npts_array_max
          do ipts=1,npts
            xmean=–999.
            if(ipts.ge.3.and.ipts.le.(npts-2))then
                  array(1)=anom(ipts–2)
                  array(2)=anom(ipts–2)
                  array(3)=anom(ipts)
                  array(4)=anom(ipts+1)
                  array(5)=anom(ipts+2)
                  call mean(xmean,array,npts_array)
C       Subroutine mean is called to calculate the 5 year running mean anomaly.
            endif
            write(99,760)year(ipts),anom(ipts),xmean
          enddo
760     format(F5.0,1X,F7.2,1X,F7.2)
```

Student Code

```
        write(99,750)namein(1:len_namein),iyy,imm,idd,ctime
750     format('3,5',/,
     +  'Year,GMST Anomaly (C),5 Yr Running Mean (C)',/
     +  'Data read from file ',A,/,
     +  'GMST Anomaly from GISS, using baseline of 1951 to 1980',/,
     +  'File created on 9/27/16')

        npts_array=npts_array_max
          do ipts=1,npts
            xmean=–999.
            if(ipts.ge.3.and.ipts.le.(npts-2))then
                  array(1)=anom(ipts–2)
                  array(2)=anom(ipts–1)
                  array(3)=anom(ipts)
                  array(4)=anom(ipts+1)
                  array(5)=anom(ipts+2)
                  call mean(xmean,array,npts_array)
C       Subroutine mean is called to calculate the 5 year running mean anomaly.
            endif
            write(99,760)year(ipts),anom(ipts),xmean
          enddo
760     format(F5.0,1X,F7.2,1X,F7.2)
```

AOSC 652: Assignment 4b



```
! First loop calculates the 1951–1980 averages from those respective years
! Will be used to calculate anomalies and 5yr running average anomalies
! initialize our array totavg to 0
      totavg=0
      do ipts=1,npts
            if(year(ipts).ge.1951.and.year(ipts).le.1980) then
                  totavg=totavg+temper(ipts)
            endif
      enddo
! divides total temperatures added together by the number of years.
! This is a 30 year average, so divide by 30. Call this variable
! baseline
!      baseline=totavg/30
      print *,baseline
! Loop finds station T anomaly & 5yr running mean of station T anomaly
      do ipts=1,npts
! Calculates the array of anomalies for each year by subtracting from
! the baseline first
            anom(ipts)=temper(ipts) – baseline
            xmean= – 999. !puts 999 for years it cant be calculated
            if(ipts.ge.3.and.ipts.le.(npts – 2)) then
                  array(1)=anom(ipts – 2)
                  array(2)=anom(ipts – 1)
                  array(3)=anom(ipts)
                  array(4)=anom(ipts+1)
                  array(5)=anom(ipts+2)
                  call mean(xmean,array,npts_array)
            endif

            write(99,760)year(ipts),temper(ipts),anom(ipts),xmean
      enddo
! formatting for the output file
760     format(I4,1X,F7.2,1X,F7.2,1X,F7.2,1X,F7.2)
```

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! First loop calculates the 1951–1980 averages from those respective years
! Will be used to calculate anomalies and 5yr running average anomalies
! initialize our array totavg to 0
      totavg=0
      do ipts=1,npts
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                  totavg=totavg+temper(ipts)
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      enddo
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! This is a 30 year average, so divide by 30. Call this variable
! baseline
!      baseline=totavg/30
      print *,baseline
! Loop finds station T anomaly & 5yr running mean of station T anomaly
      do ipts=1,npts
! Calculates the array of anomalies for each year by subtracting from
! the baseline first
            anom(ipts)=temper(ipts) – baseline
            xmean= – 999. !puts 999 for years it cant be calculated
            if(ipts.ge.3.and.ipts.le.(npts – 2)) then
                  array(1)=anom(ipts – 2)
                  array(2)=anom(ipts – 1)
                  array(3)=anom(ipts)
                  array(4)=anom(ipts+1)
                  array(5)=anom(ipts+2)
                  call mean(xmean,array,npts_array)
            endif

            write(99,760)year(ipts),temper(ipts),anom(ipts),xmean
      enddo
! formatting for the output file
760     format(I4,1X,F7.2,1X,F7.2,1X,F7.2,1X,F7.2)
```

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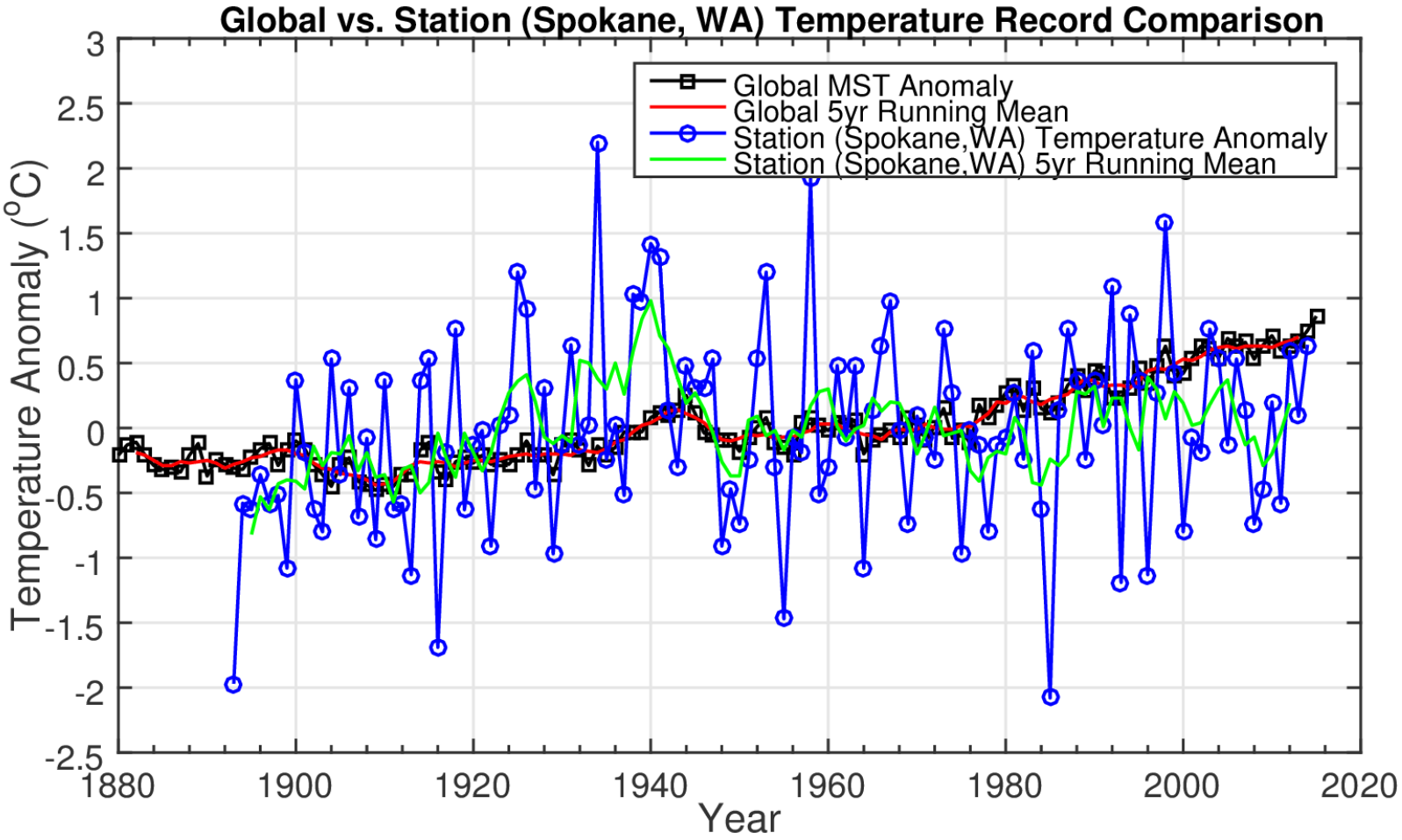

The main similarity between the global anomaly trend and the station anomaly trend is the positive slope of the trajectory over time. However, the station has experience a larger annual variance from the baseline temperature. This could be due to climate change having a greater impact on the temperature of the mid-latitude station compared to the "smoothing" apparent in the temperature of the entire globe, which accounts for diverse climates.