

Analysis Methods in Atmospheric and Oceanic Science

AOSC 652

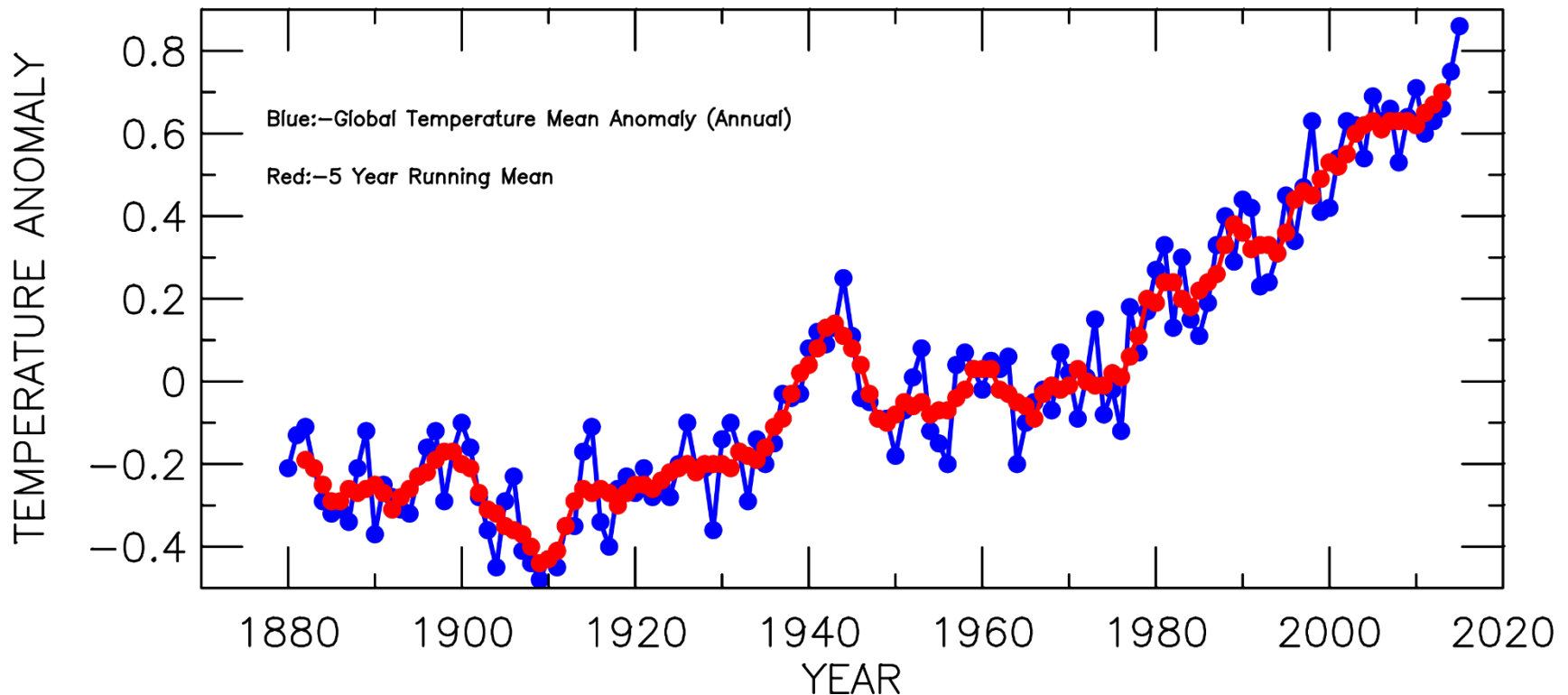
Least Squares Analysis, Statistical Regression, & Spline Fitting: Week 5, Day 3

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

30 Sep 2016

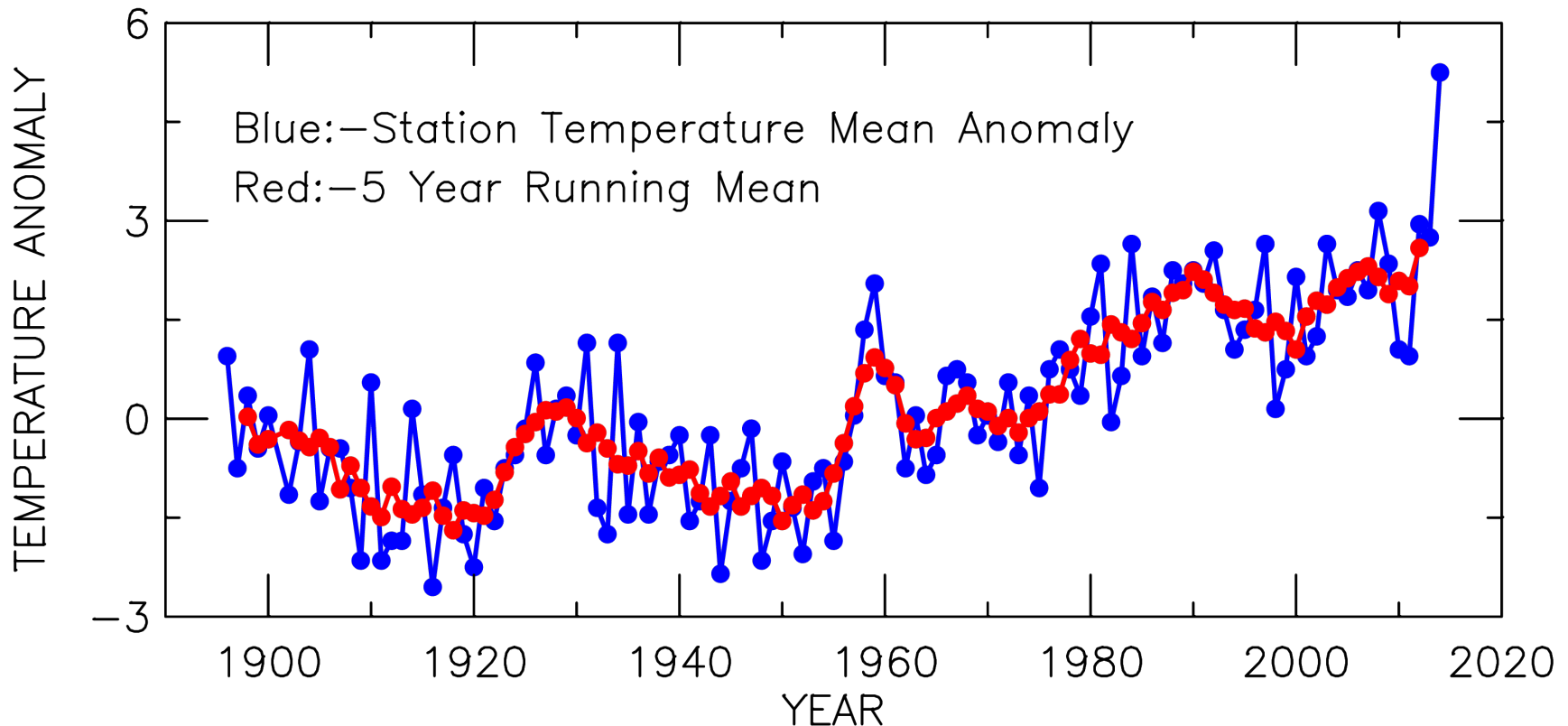
AOSC 652: Assignment 4b

Global – Temperature Anomaly
Over a period between 1880 and 2015
Baseline – 1951 to 1980



AOSC 652: Assignment 4b

Station(Pasadena) – Temperature Anomaly
Over a period between 1896 and 2014
Baseline – 1951 to 1980



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)

! 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
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ENDIF

RETURN

END

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! 1980 - 1885 + 1 = 96

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IMPLICIT DOUBLE PRECISION (a-h,o-z)

DIMENSION temp(ntemp)

bline=0.0

ipts=0

DO itemp=67,96

Will this work for data from other stations ?

 bline=bline+temp(itemp)

 ipts=ipts+1

ENDDO

npts=ipts

IF(npts.gt.0) THEN

 bline=bline/float(npts)

ELSE

ENDIF

RETURN

END

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
```

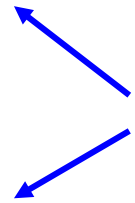
C Baseline defined as average over 30 years (1951-1980)
baseline=sum/30.
write(*,*)baseline

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 ipt=1,npts
  if (year(ipt).eq.1951) then
    locL = ipt
  endif
enddo
do ipt=1,npts
  if (year(ipt).eq.1980) then
    locH = ipt
  endif
enddo
sum=0.
do ipt=locL,locH
  sum= sum+Tempmean(ipt)
enddo
```

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



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 ipt=1,npts
  if (year(ipt).eq.1951.) then
    locL = ipt
  endif
enddo
do ipt=1,npts
  if (year(ipt).eq.1980.) then
    locH = ipt
  endif
enddo
sum=0.
do ipt=locL,locH
  sum= sum+Tempmean(ipt)
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

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baseline_sum=0.
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```
do ipts=1,npts
  if (year(ipts).ge.1951..and.year(ipts).le.1980.) then
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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 ipt=1,npts  
    if (year(ipt).ge.1951..and.year(ipt).le.1980.) then  
        if temperc(ipt).ne.-999.) then  
+           baseline_sum=baseline_sum+temperc(ipt)  
           icount=icount+1  
        endif  
    endif  
enddo  
  
baseline=baseline_sum/float(icount)
```

C Subtract baseline temperature from each data point

```
do ipt=1,npts  
    temperanom(ipt)=temperc(ipt)-baseline  
enddo
```

Student Code

C Compute baseline - average of temperature from 1951–1980

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baseline_sum=0.  
icount=0  
do ipt=1,npts  
    if (year(ipt).ge.1951..and.year(ipt).le.1980.) then  
        if temperc(ipt).ne.-999.) then  
+           baseline_sum=baseline_sum+temperc(ipt)  
           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 ipt=1,npts  
    temperanom(ipt)=temperc(ipt)-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 baseline. 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)
    npts=ipts-1

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    print*,baseline
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    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)
    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 baseline. 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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        + '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')

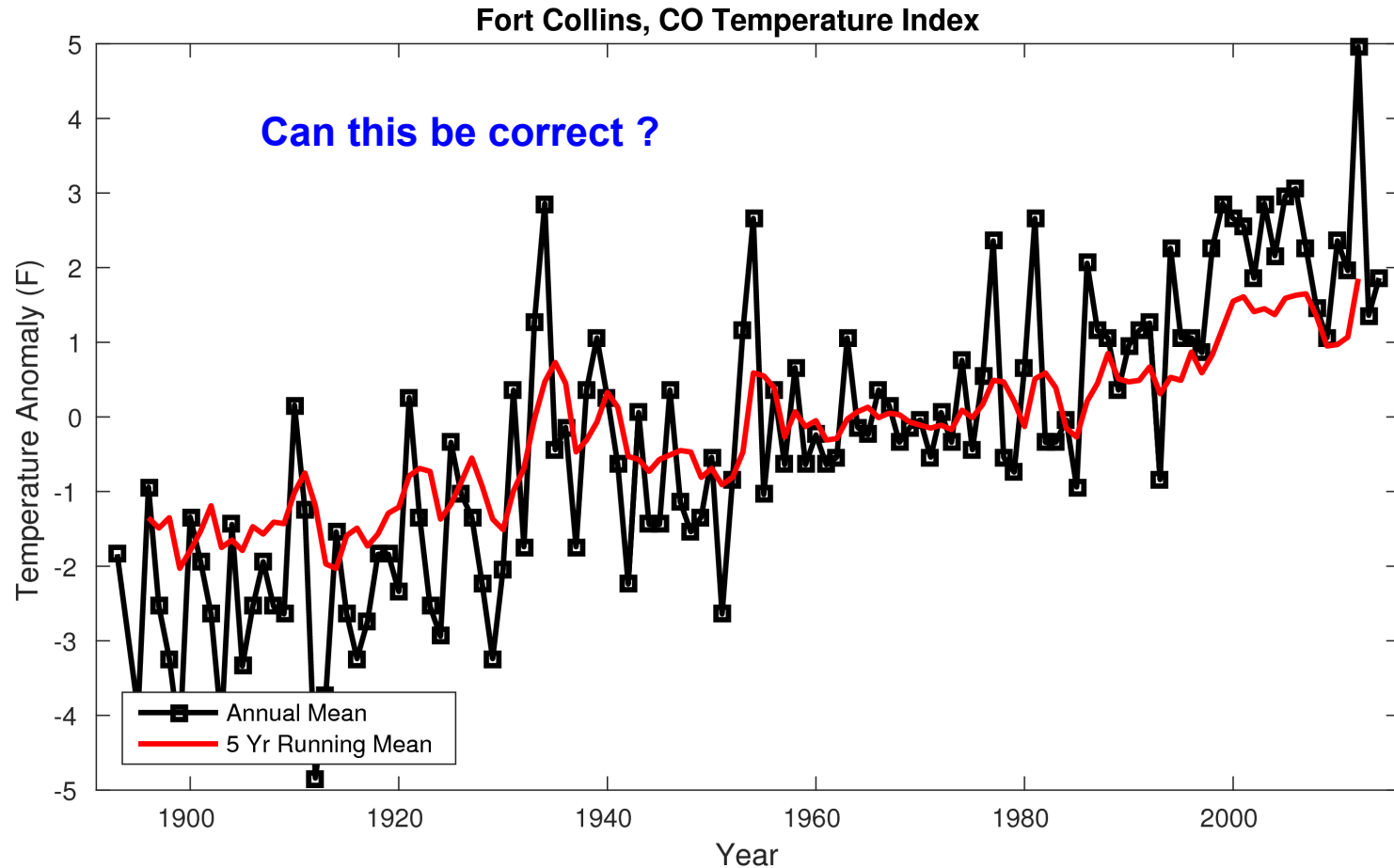
npts_array=npts_array_max
do ipts=1,npts
    xmean=-999.
    if(ipts.ge.3.and.ipts.le.(npts-2))then
        array(1)=anom(ipts-2)
        array(2)=anom(ipts-2)
        array(3)=anom(ipts)
        array(4)=anom(ipts+1)
        array(5)=anom(ipts+2)
        call mean(xmean,array,npts_array)
C    Subroutine 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,etime
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)
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    array(5)=anom(ipts+2)
    call mean(xmean,array,npts_array)
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  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)

```



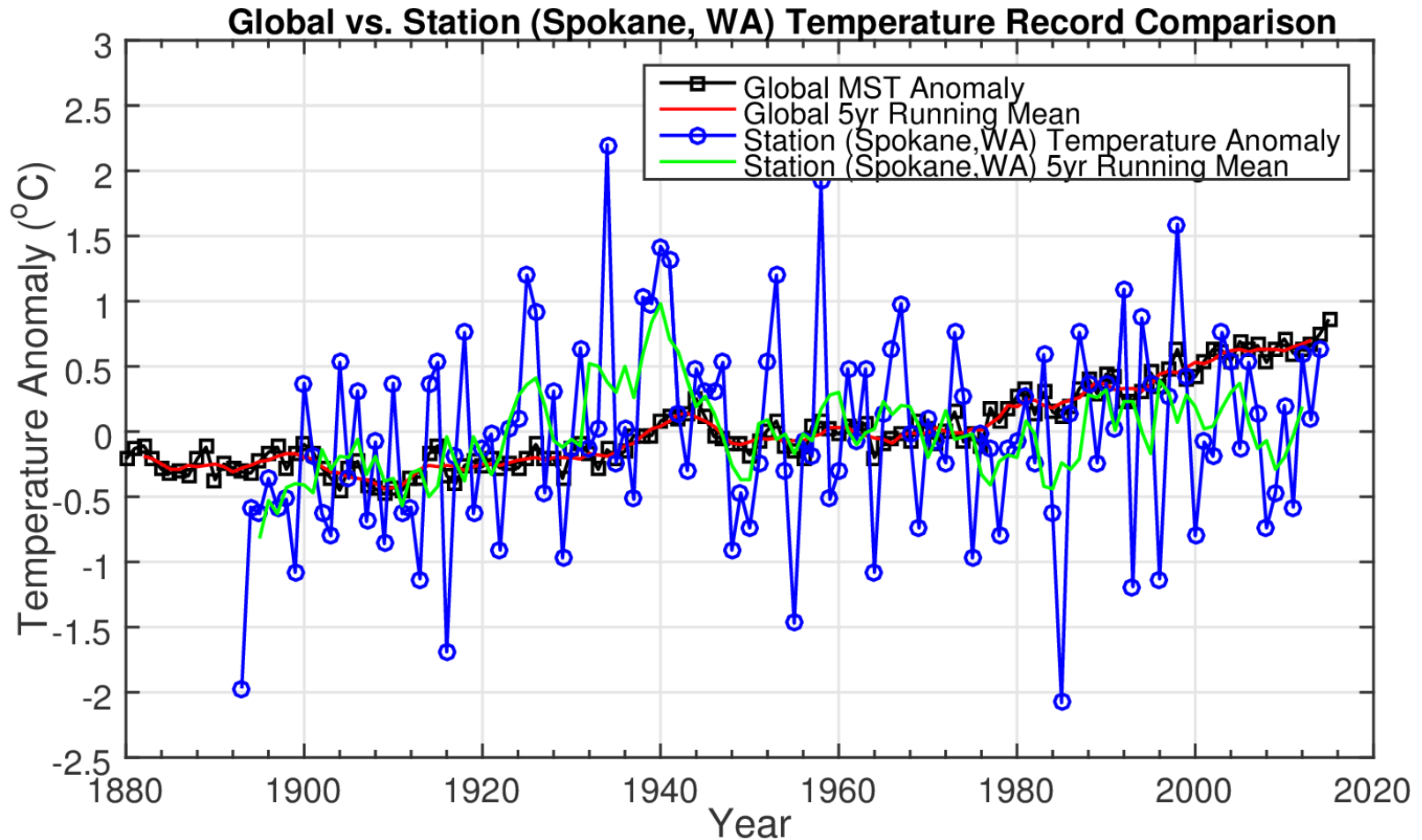
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! the baseline first
        anom(ipts)=temper(ipts) – baseline
        xmean= – 999. !puts 999 for years it cant be calculated
        if(ipts.ge.3.and.ipts.le.(npts – 2)) then
            array(1)=anom(ipts – 2)
            array(2)=anom(ipts – 1)
            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)

```

AOSC 652: Assignment 4b



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.