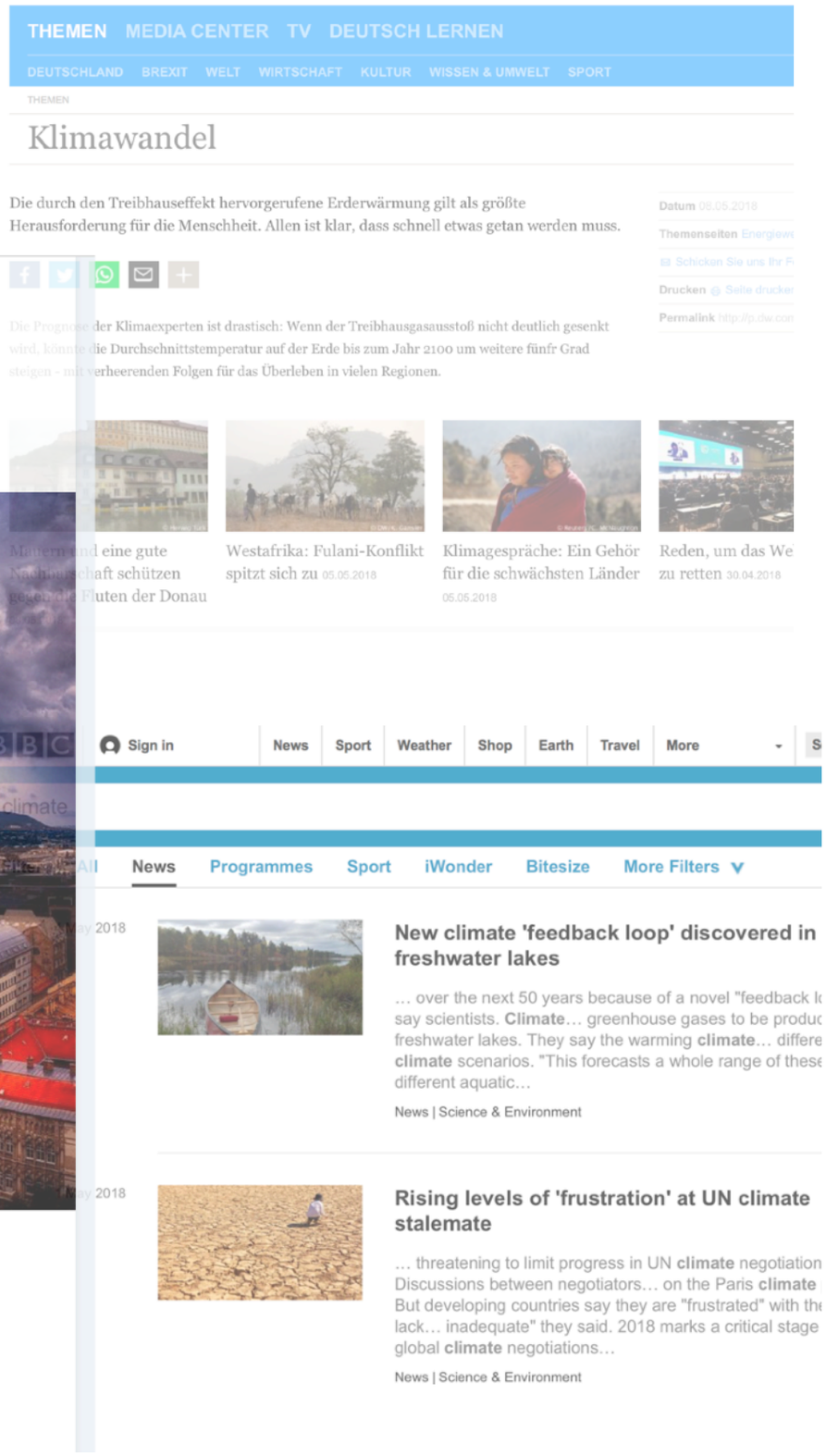
CLIMATE CHANGE WILL STRIKE BUDAPEST CRITICALLY

Posted by Gergely Lajtai-Szabó | Jul 9, 2017 | Society | 0

Summers are becoming hotter and hotter since the Industrial Revolution. If humanity cannot decrease the use of carbon-dioxide and other greenhouse gases, the temperature will keep on rising. This phenomenon seems to affect Budapest in particular, according to 24.hu.



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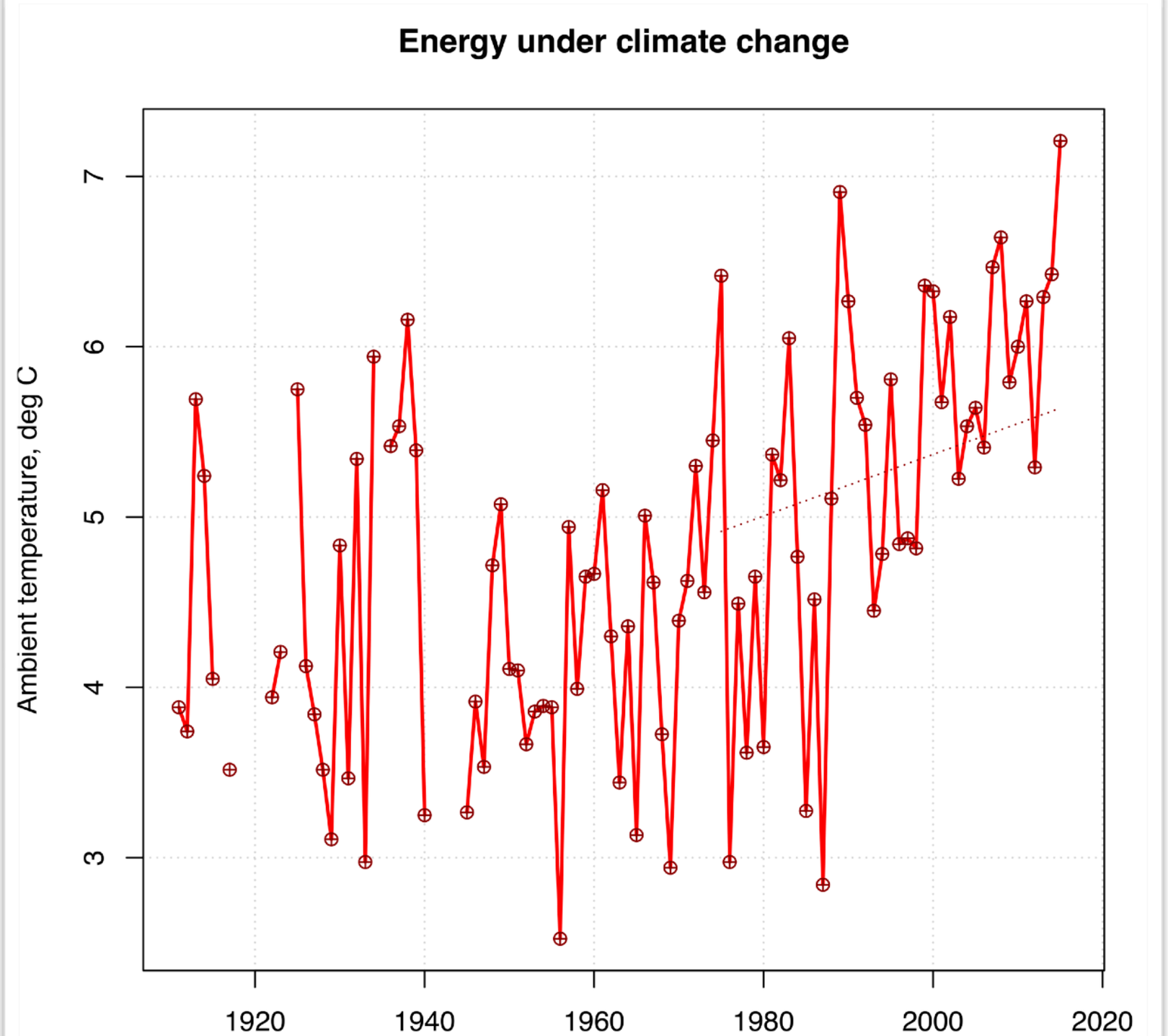
Climate problems need accurate treatment


Energy under climate change
Ambient temperature, deg C
3
4
5
6
7
1920
1940
1960
1980
2000
2020

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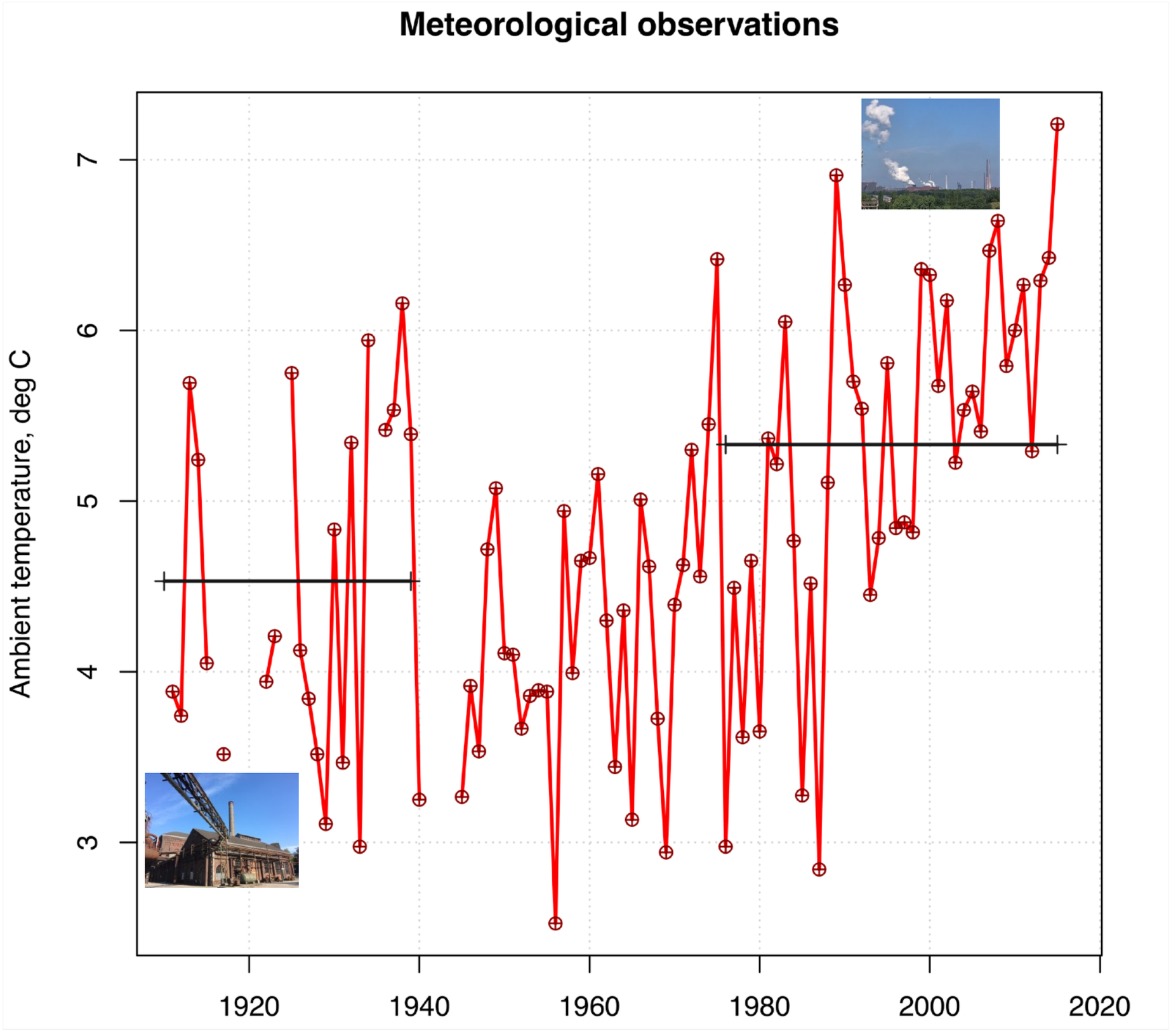

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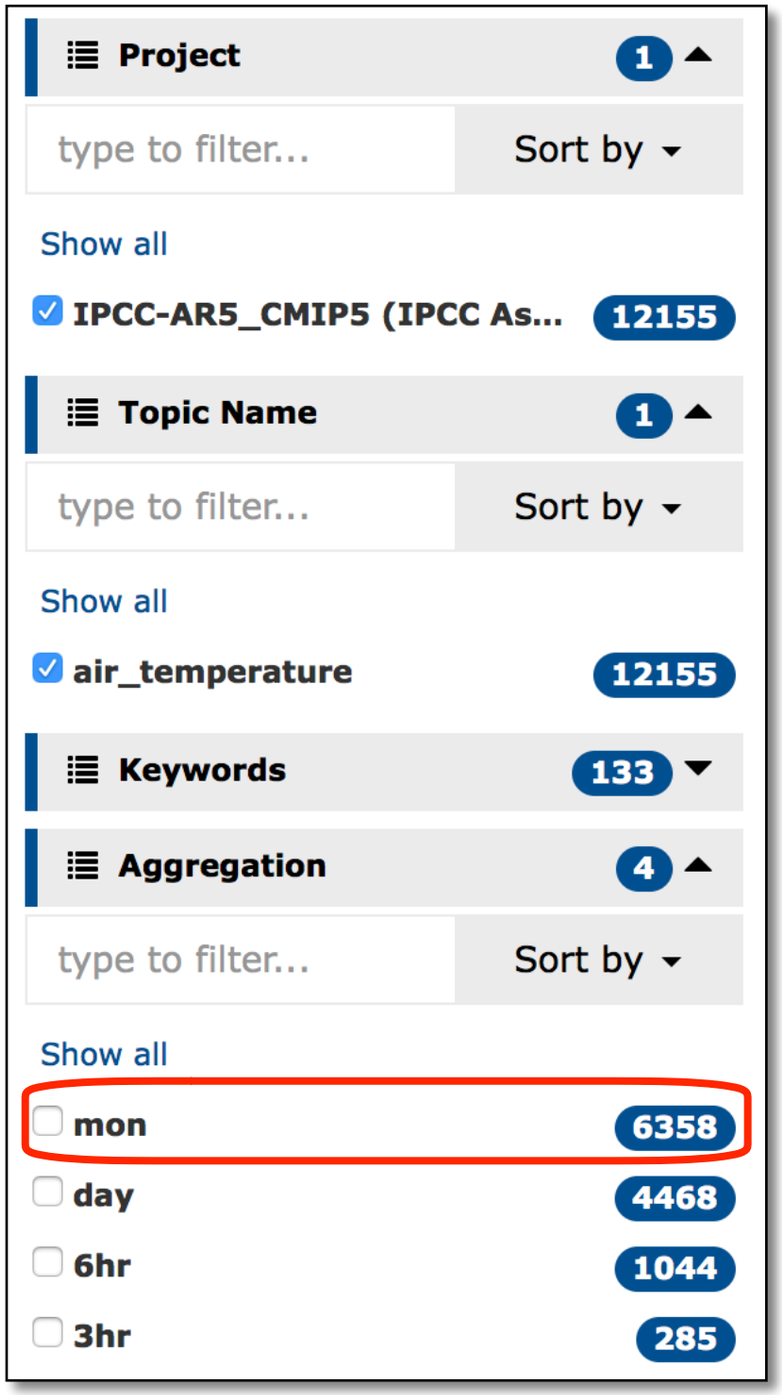
DATASET



CMIP5 simulation data

- netCDF format
- spatial: global area
- temporary resolution?

Multi-annual averages are of interest

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R-MINDED APPROACH

Classic R, ::raster, ::RCMIP5

1) *set the items' ids to select*
2) *subset*
3) *apply a function (spacial averaging)*

```r
# 1) set a processed month
month_nL <- 3L

# 2) subset the data
months_nc <- as.numeric(format(time_nc_date, "%m"))
nc_dates_slctd <- time_nc_date[which(months_nc %in% month_nL)]
T_3D_array_slctd <- T_3D_array_to_process[ , , which(months_nc %in% month_nL)]

# 3) make calculations
T_time_series_slctd <- sapply(function(i) mean(T_3D_array_slctd[, , i]),
    X = seq(along.with = T_3D_array_slctd[1, 1, ]))
```

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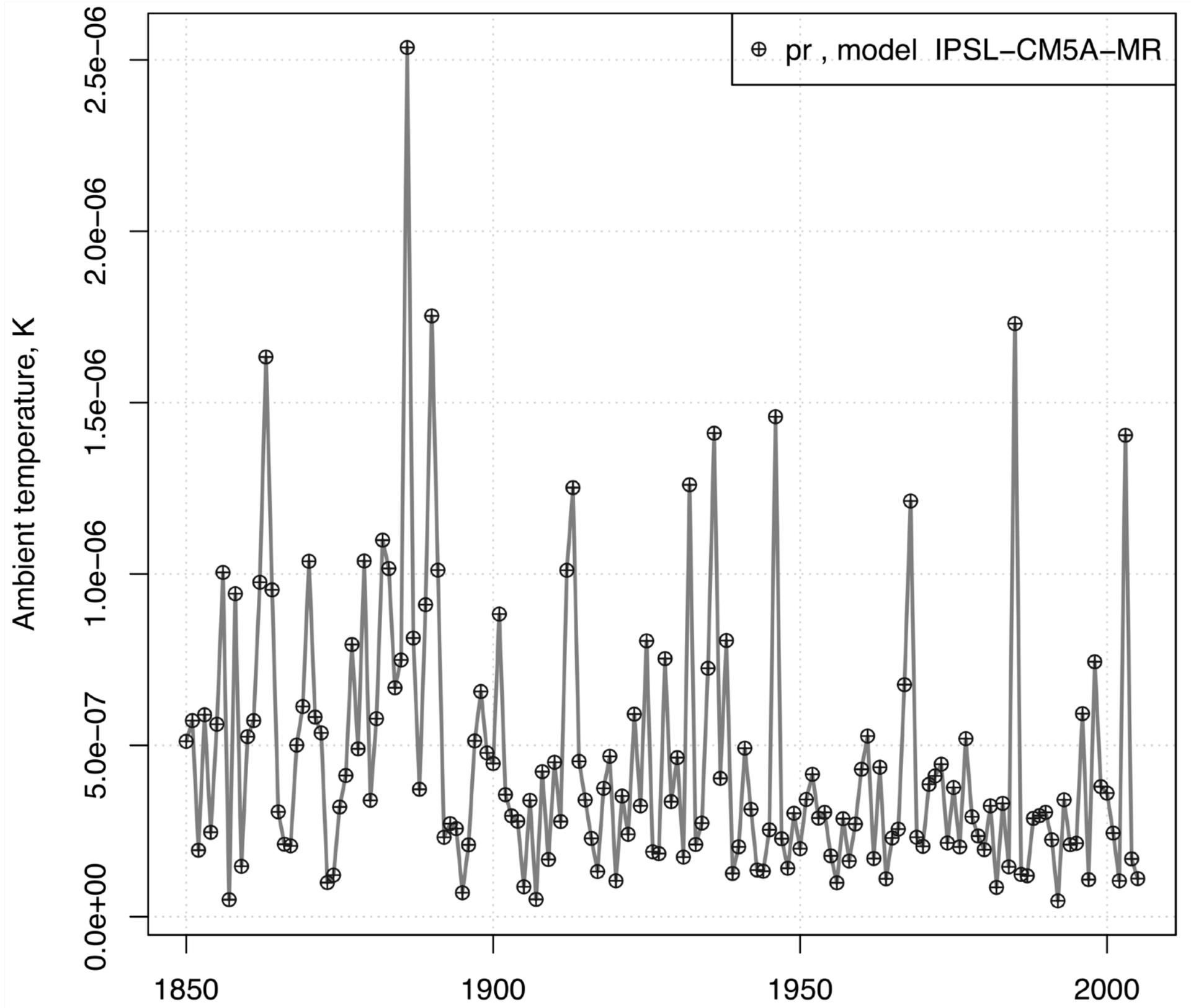

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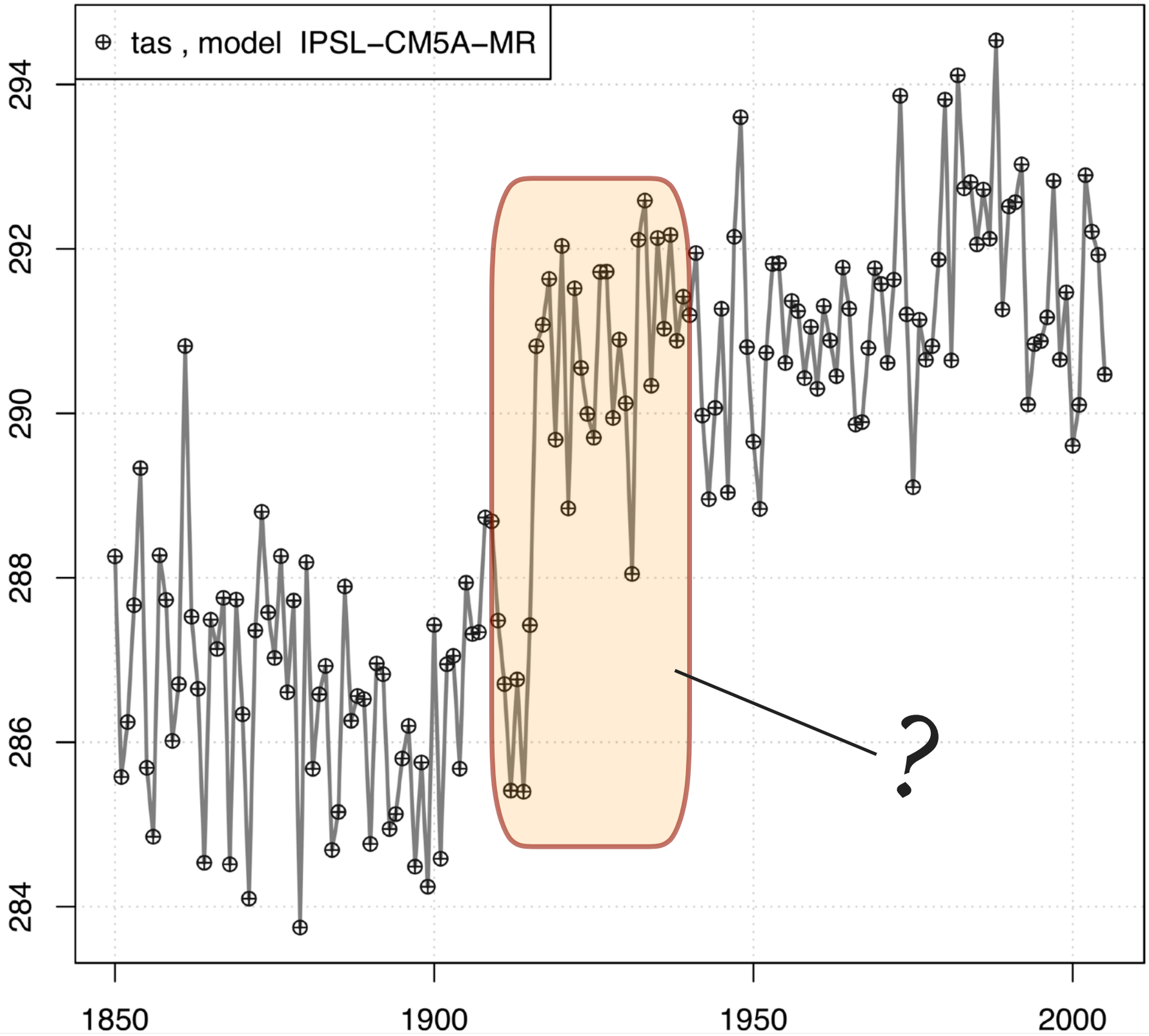
tas , model IPSL−CM5A−MR
294
292
290
288
286
284
1850
1900
1950
2000
?

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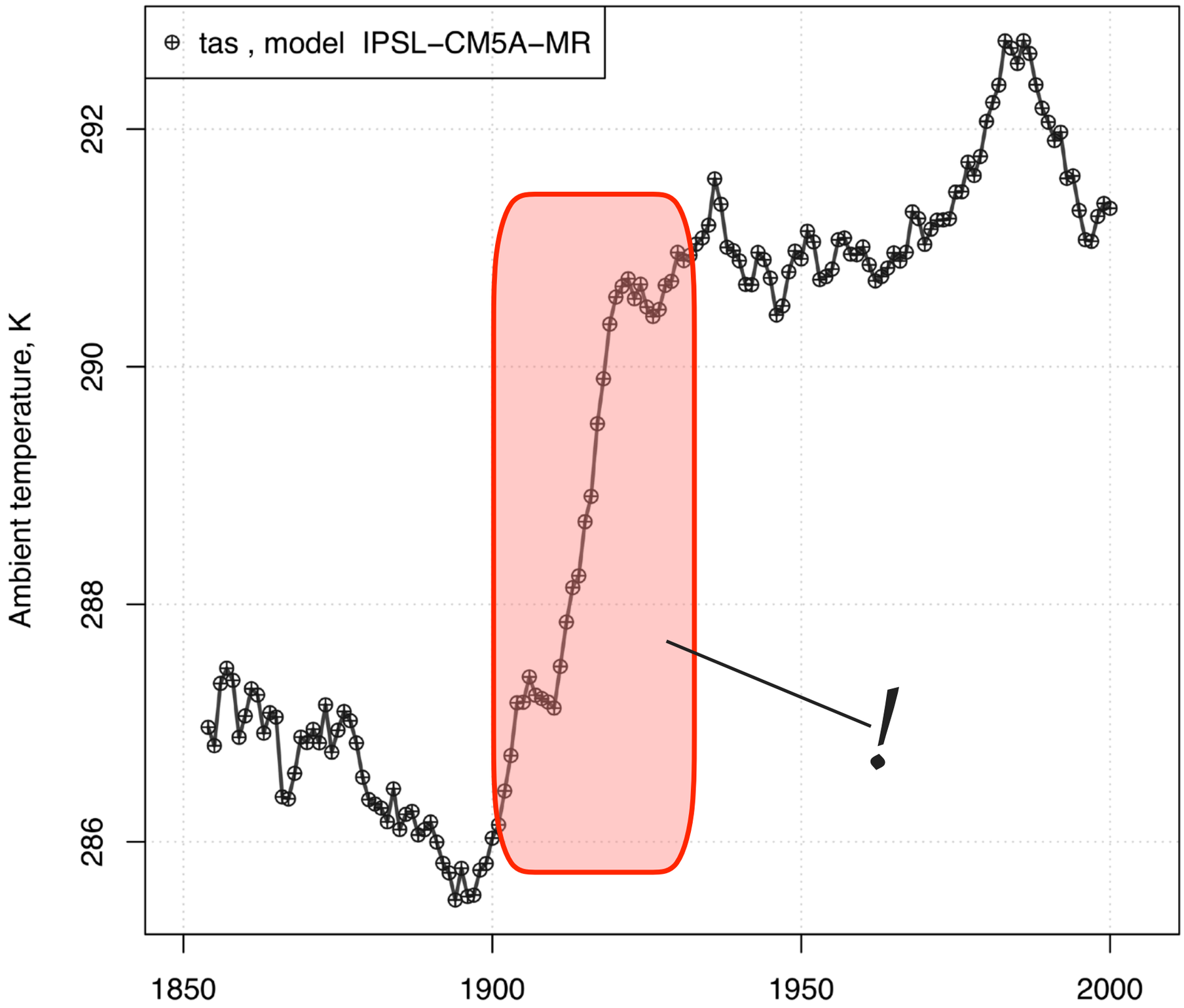
tas , model IPSL−CM5A−MR
Ambient temperature, K
292
290
288
286
1850
1900
1950
2000
!

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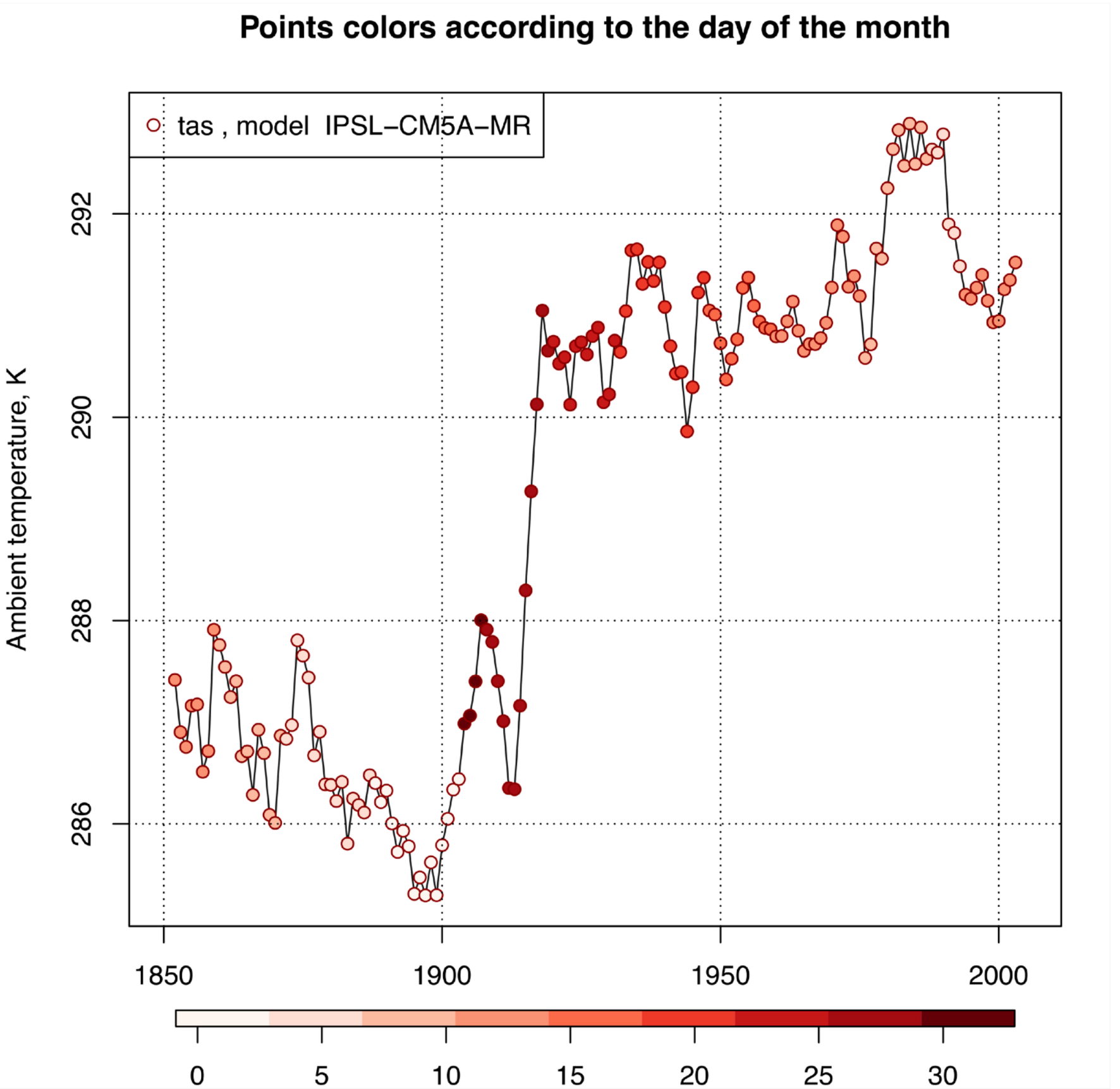

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SOLUTION

Use interpolation to regular seasonally time

instead of

```
04" "1901-03-04" "1902-03-04" "1903-03-04" "1904-03-03" "1905-03-03" "1906-03-03" "1907-03-03" "1908-03-02" "1909-03-02"
02" "1911-03-02" "1912-03-01" "1913-03-01" "1914-03-01" "1915-03-01" "1916-03-31" "1917-03-31" "1918-03-31" "1919-03-31"
30" "1921-03-30" "1922-03-30" "1923-03-30" "1924-03-29" "1925-03-29" "1926-03-29" "1927-03-29" "1928-03-28" "1929-03-28"
```

work with

```
     [,50]         [,51]         [,52]         [,53]         [,54]         [,55]         [,56]
[1,] "1899-02-03" "1900-02-03" "1901-02-03" "1902-02-03" "1903-02-03" "1904-02-03" "1905-02-02"
[2,] "1899-03-04" "1900-03-04" "1901-03-04" "1902-03-04" "1903-03-04" "1904-03-03" "1905-03-03"
[3,] "1899-04-04" "1900-04-04" "1901-04-04" "1902-04-04" "1903-04-04" "1904-04-03" "1905-04-03"
     [,57]         [,58]         [,59]         [,60]         [,61]         [,62]         [,63]
[1,] "1906-02-02" "1907-02-02" "1908-02-02" "1909-02-01" "1910-02-01" "1911-02-01" "1912-02-01"
[2,] "1906-03-03" "1907-03-03" "1908-03-02" "1909-03-02" "1910-03-02" "1911-03-02" "1912-03-01"
[3,] "1906-04-03" "1907-04-03" "1908-04-02" "1909-04-02" "1910-04-02" "1911-04-02" "1912-04-01"
     [,64]         [,65]         [,66]         [,67]         [,68]         [,69]         [,70]
[1,] "1913-01-31" "1914-01-31" "1915-01-31" "1916-02-29" "1917-02-28" "1918-02-28" "1919-02-28"
[2,] "1913-03-01" "1914-03-01" "1915-03-01" "1916-03-31" "1917-03-31" "1918-03-31" "1919-03-31"
[3,] "1913-04-01" "1914-04-01" "1915-04-01" "1916-04-30" "1917-04-30" "1918-04-30" "1919-04-30"
     [,71]         [,72]         [,73]         [,74]         [,75]         [,76]         [,77]
[1,] "1920-02-28" "1921-02-27" "1922-02-27" "1923-02-27" "1924-02-27" "1925-02-26" "1926-02-26"
[2,] "1920-03-30" "1921-03-30" "1922-03-30" "1923-03-30" "1924-03-29" "1925-03-29" "1926-03-29"
[3,] "1920-04-29" "1921-04-29" "1922-04-29" "1923-04-29" "1924-04-28" "1925-04-28" "1926-04-28"
     [,78]         [,79]         [,80]         [,81]         [,82]         [,83]         [,84]
[1,] "1927-02-26" "1928-02-26" "1929-02-25" "1930-02-25" "1931-02-25" "1932-02-25" "1933-02-24"
```

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SOLUTION

```r
# 1) construct an interpolating function
# @ind_to_interp is a three-column matrix of indices to interpolate from
# @regular_date is a list data sequences to interpolate to
# @param_3D is a 3D array to process
Month_Approx <- function(i, indices_to_int, regular_date, param_3D) {
    tau_intp_from <- time_nc_date[indices_to_int[i, ]]
    dates_seq_into <- regular_date[[i]]
    T_3D_array_intp_from <- param_3D[ , , indices_to_int[i, ]]
    T_area_avr_intp_from <- lapply(function(j) mean(param_3D[ , , indices_to_int[i, j]]),
        X = seq(along.with = indices_to_int[i, ]))
    appr_res <- approx(x = tau_intp_from, y = T_area_avr_intp_from, xout = regular_date[[i]])
    T_res <- mean(appr_res$y)
    return(T_res)
}

# 2) set a data sequence
first_month_day <- ymd(paste(as.numeric(format(nc_dates_slctd, "%Y")), month_nL, 1, sep = "-"))
last_month_day <- ymd(paste(as.numeric(format(nc_dates_slctd, "%Y")),
    (month_nL + 1), 1, sep = "-")) - 1
dates_seq_intp_to <- lapply(function(k) seq.Date(from = first_month_day[k],
    to = last_month_day[k], by = 1), X = 1:length(nc_dates_slctd))


# 3) interpolate the monthly-aggregated value for all selected years
T_monthly_intpd <- sapply(function(i) Month_Approx(i, indices_to_int = ind_to_interp,
    regular_date = dates_seq_intp_to, param_3D = T_3D_array_to_process),
    X = 1:length(nc_dates_slctd))
```

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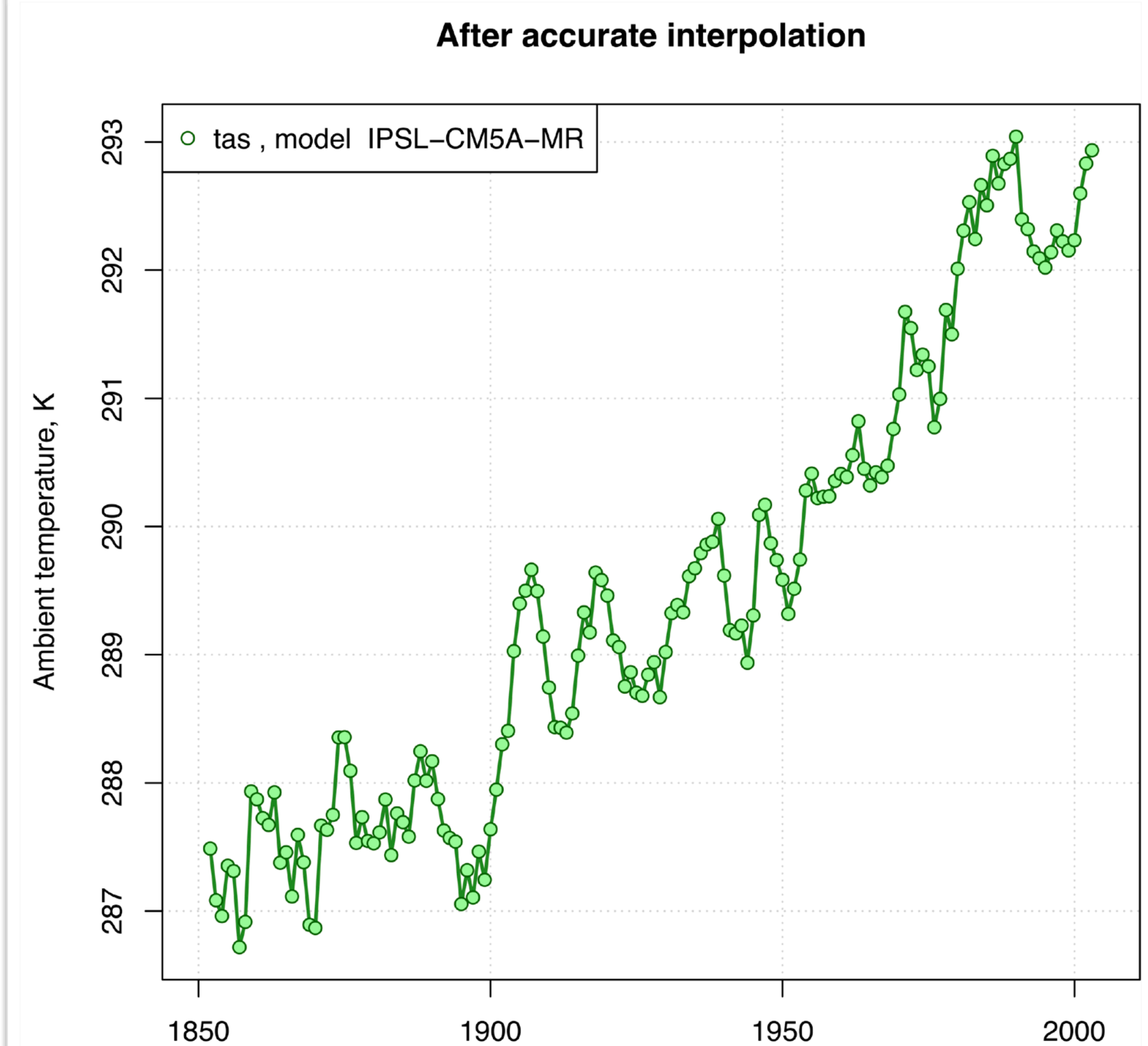

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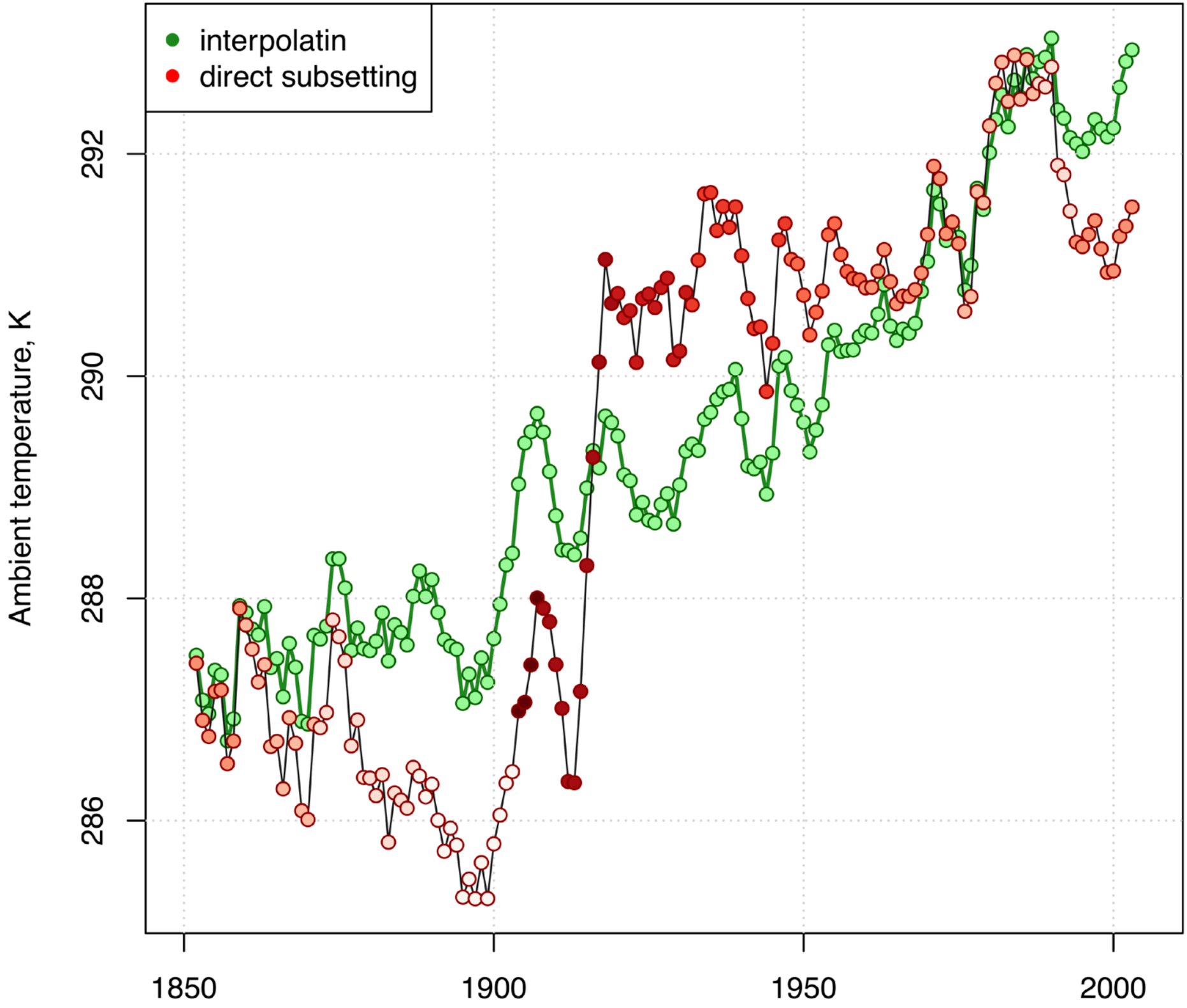

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SUMMARY

Modellers have right to their own way of thinking

Practical points to be kept in mind while work with netCDF

1) quick-and-easy solutions may be dangerous

2) careful examination of netCDF structure is essential

3) implementation to netCDF/CMIP5 packages?

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Many thanks for your attention!

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