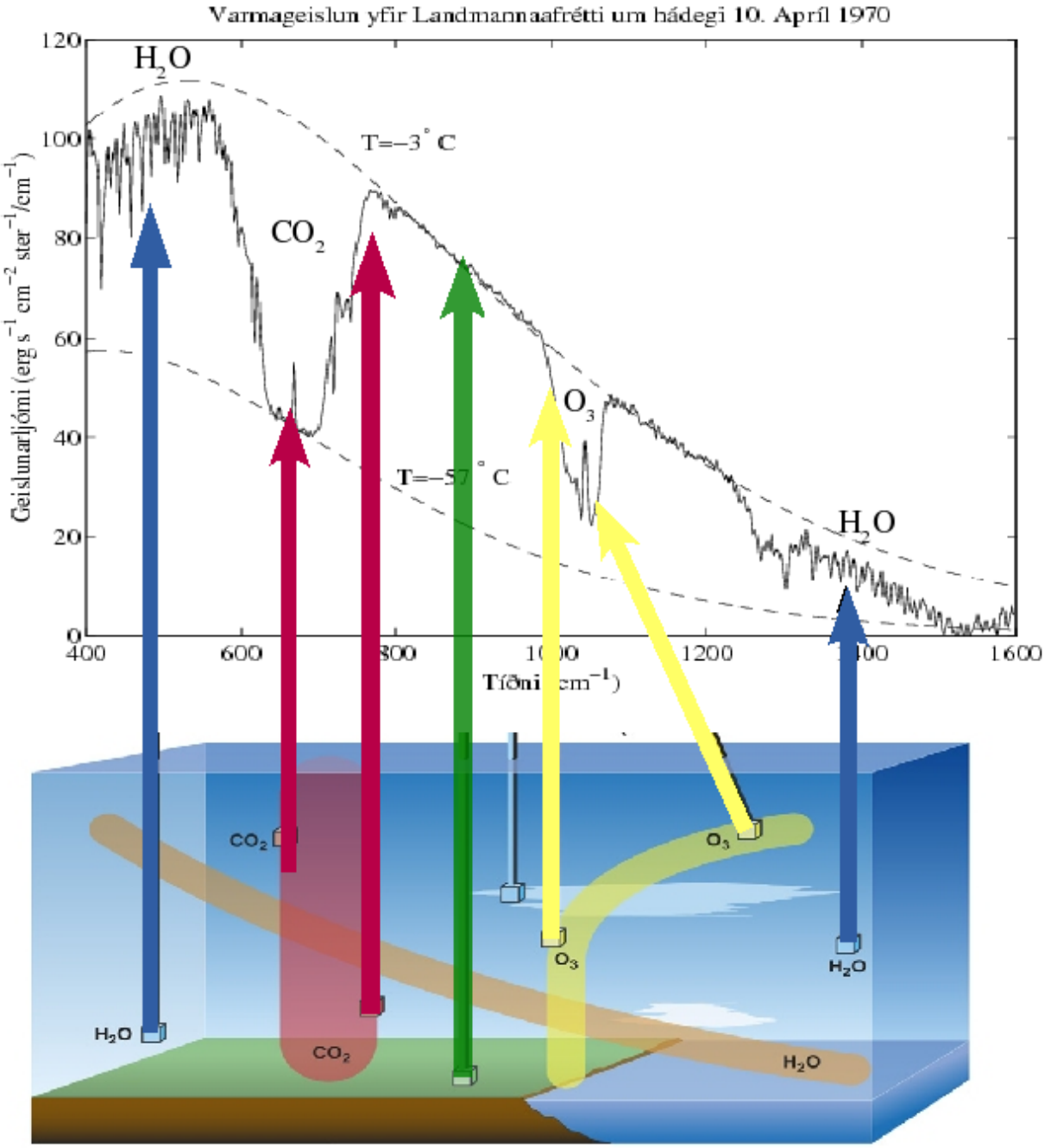
Online models

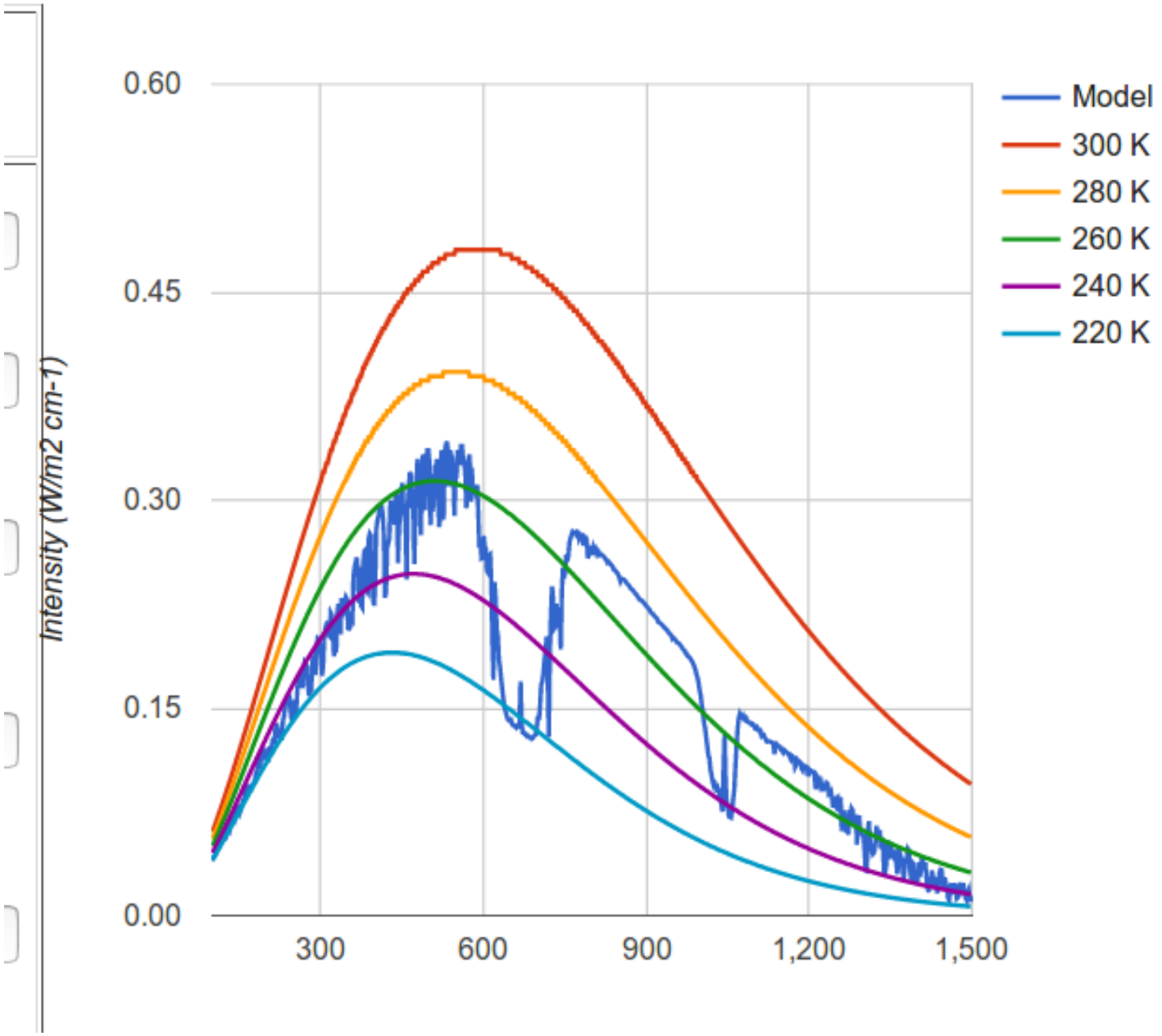
- We will now play with two online models
  - One of them does the radiative transfer calculations for an atmosphere with a prescribed temperature profile and chemical composition.
- The other one is an intergrated assessment models
  - Both are provided by the University of Chicago
  - David Archer uses them in his book
    - Global warming, understanding the forecast
    - You can also take the free coursera course he teaches.
      - See http://climatemodels.uchicago.edu/

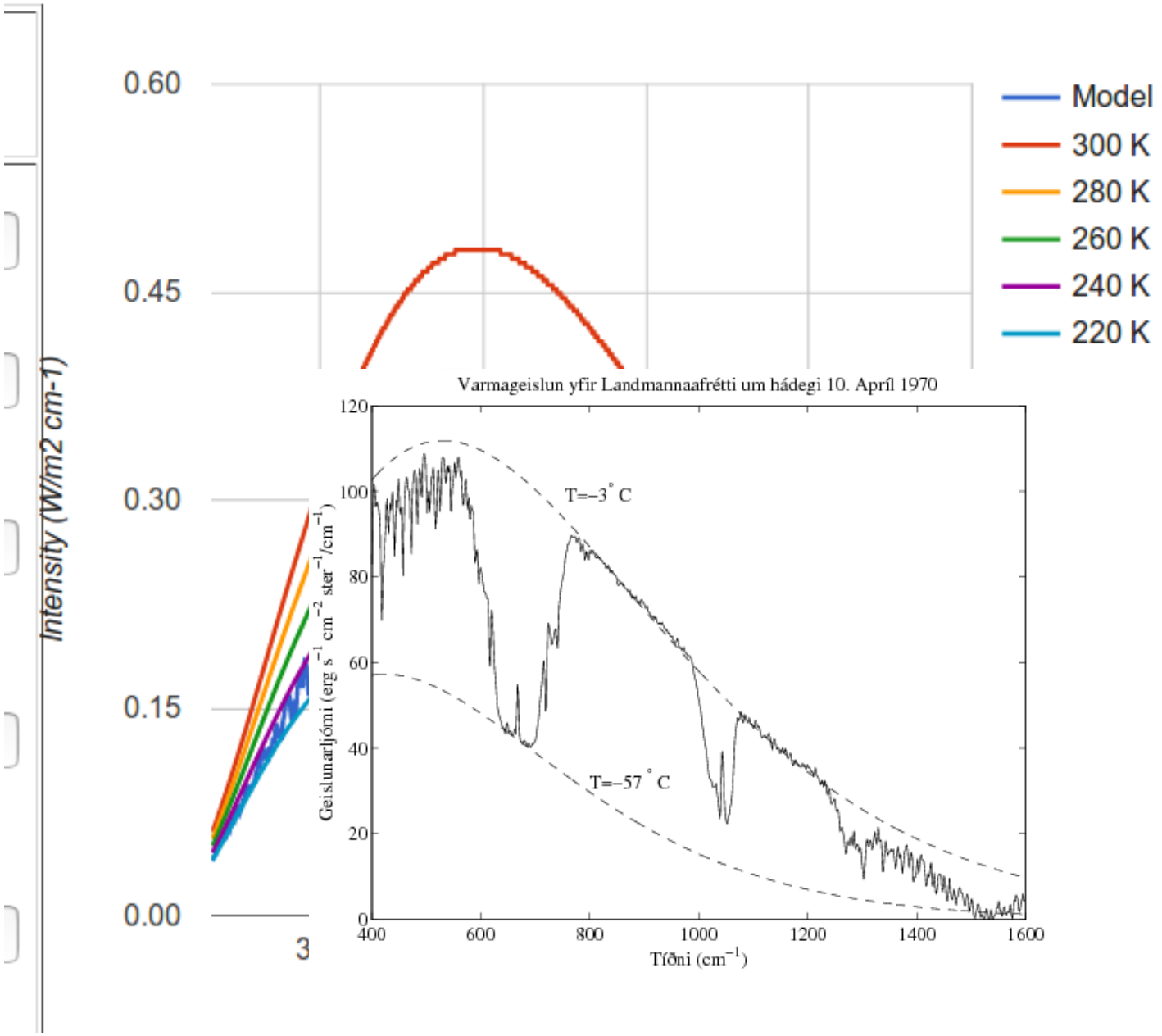
Remember this one?

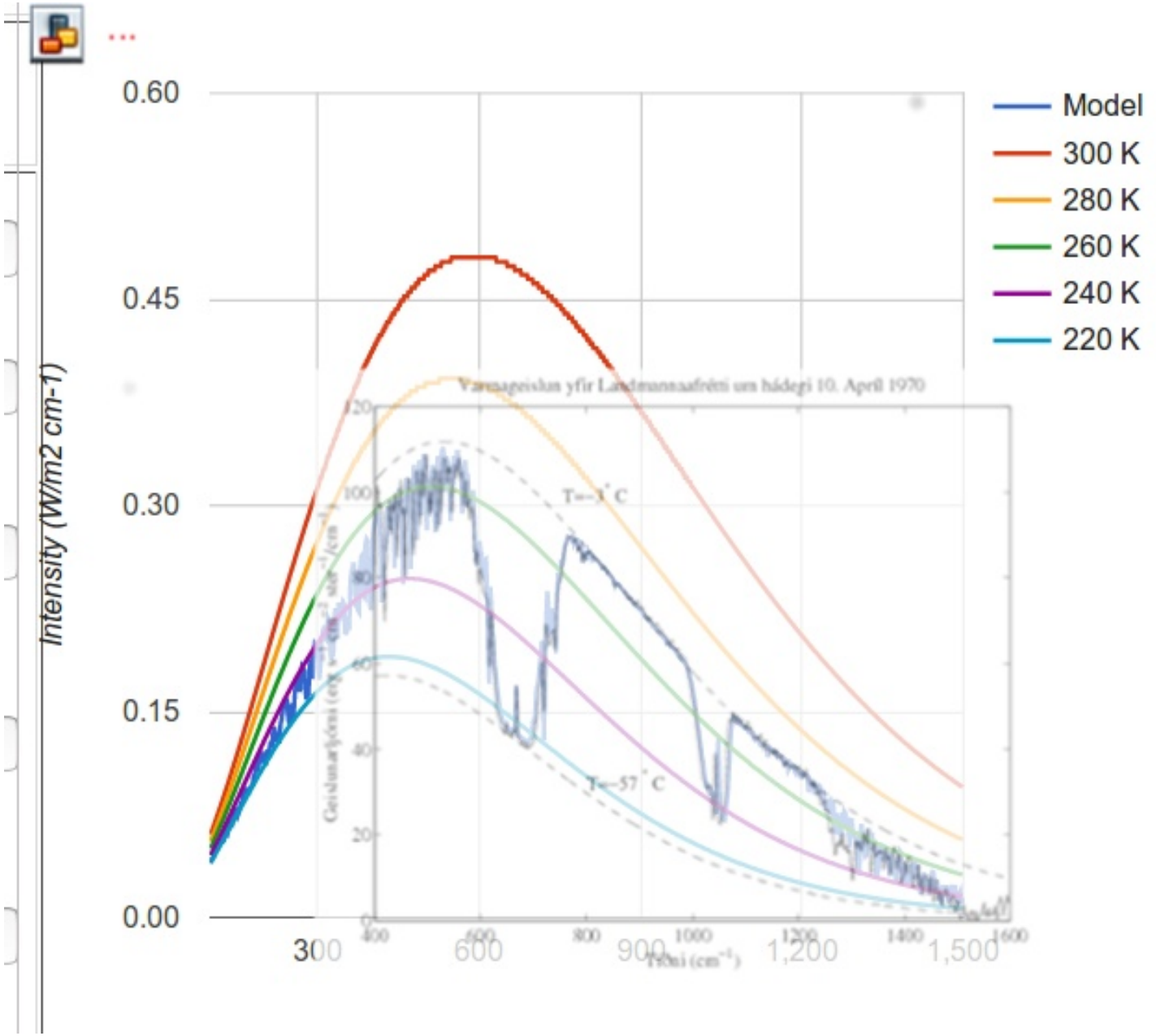


Lets look at this again

- Go to http://climatemodels.uchicago.edu/models.html
- And examine this in Modtran
  - Lets use CO2 at 328 ppm
  - Subarctic winter and altitude of 100 km looking down, No Clouds
  - The T offset has to be played with until the model tells us that ground temperature is 270 K


0.60
0.45
0.30
0.15
0.00
Intensity (W/m2 cm-1)
300
600
900
1,200
1,500
Model
300 K
280 K
260 K
240 K
220 K


Intensity (W/m2 cm-1)
0.60
0.45
0.30
0.15
0.00
Model
300 K
280 K
260 K
240 K
220 K
Varmageislun yfir Landmannaafrétti um hádegi 10. Apríl 1970
Geislunarljómi (erg s^{-1} cm^{-2} ster^{-1}/cm^{-1})
T=–3° C
T=–57° C
Tíðni (cm^{-1})
0
20
40
60
80
100
120
400
600
800
1000
1200
1400
1600


0.60
0.45
0.30
0.15
0.00
Intensity (W/m2 cm-1)
300
600
900
1,200
1,500
Model
300 K
280 K
260 K
240 K
220 K

Lets look at this again

- Go to http://climatemodels.uchicago.edu/models.html
- And examine this in Modtran
  - Lets use CO2 at 328 ppm
  - Subarctic winter and altitude of 100 km looking down
  - The T offset has to be played with until the model tells us that ground temperature is 270 K
- If the comparison does not impress you, - then you have no soul!
  - Note that we have not tuned the tropospheric temperature profile, or other gasses. With those more correct we might get an even better fit.

Integrated Assessment Models

- Go to http://climatemodels.uchicago.edu/models.html
- And examine ISAM
  - Notice there is one input panel and two output panels. You can select which variable you want to examine
  - You can make your own emission scenarios by typing in the numbers, or you can use the for preset scenarios
    - Lets examine the relationship between cumulative fossil fuel emissions and warming

ISAM

- For each scenario we examine the raw data and pick out Cumulative Fossil Fuel (cum fos) and transient temperature change from 1765 (TEM)
- Record these and plot the outcome.

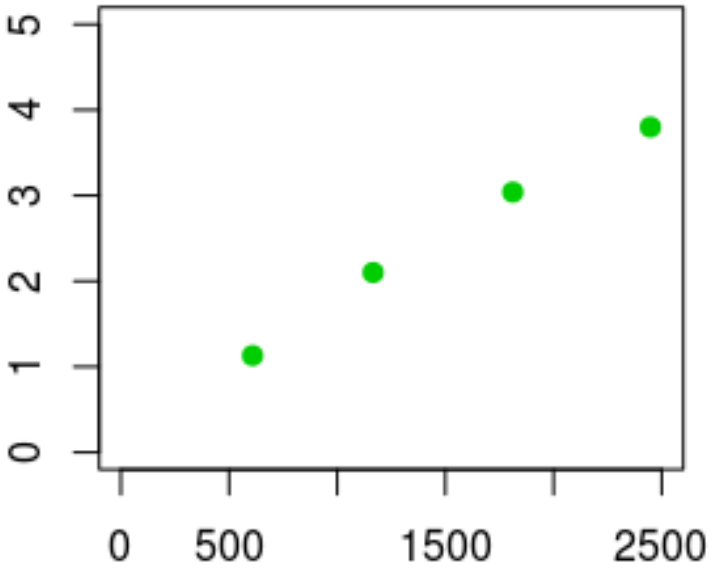
ISAM

- For each scenario we examine the raw data and pick out Cumulative Fossil Fuel (cum fos) and transient temperature change from 1765 (TEM)
- Record these and plot the outcome.
  - I get

Scenario	Cum emissions in 2100	Temp. change in 2100
Low B. U.	1166	2.1
Med B. U.	1812	3.0
High B. U.	2448	3.8
Rampdown	609	1.1

ISAM

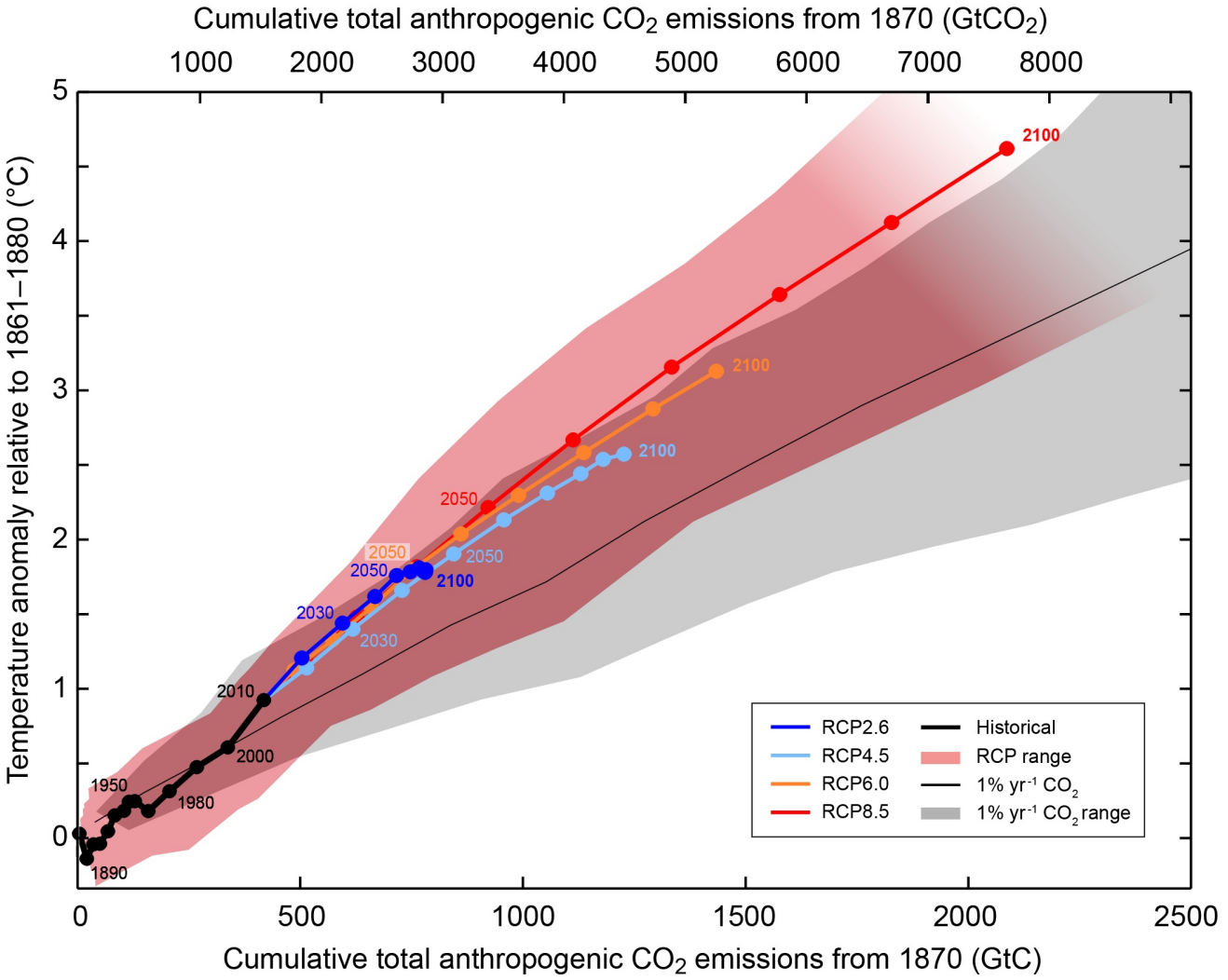
- For each scenario we examine the raw data and pick out Cumulative Fossil Fuel (cum fos) and transient temperature change from 1765 (TEM)
- Record these and plot the outcome.
  - I get

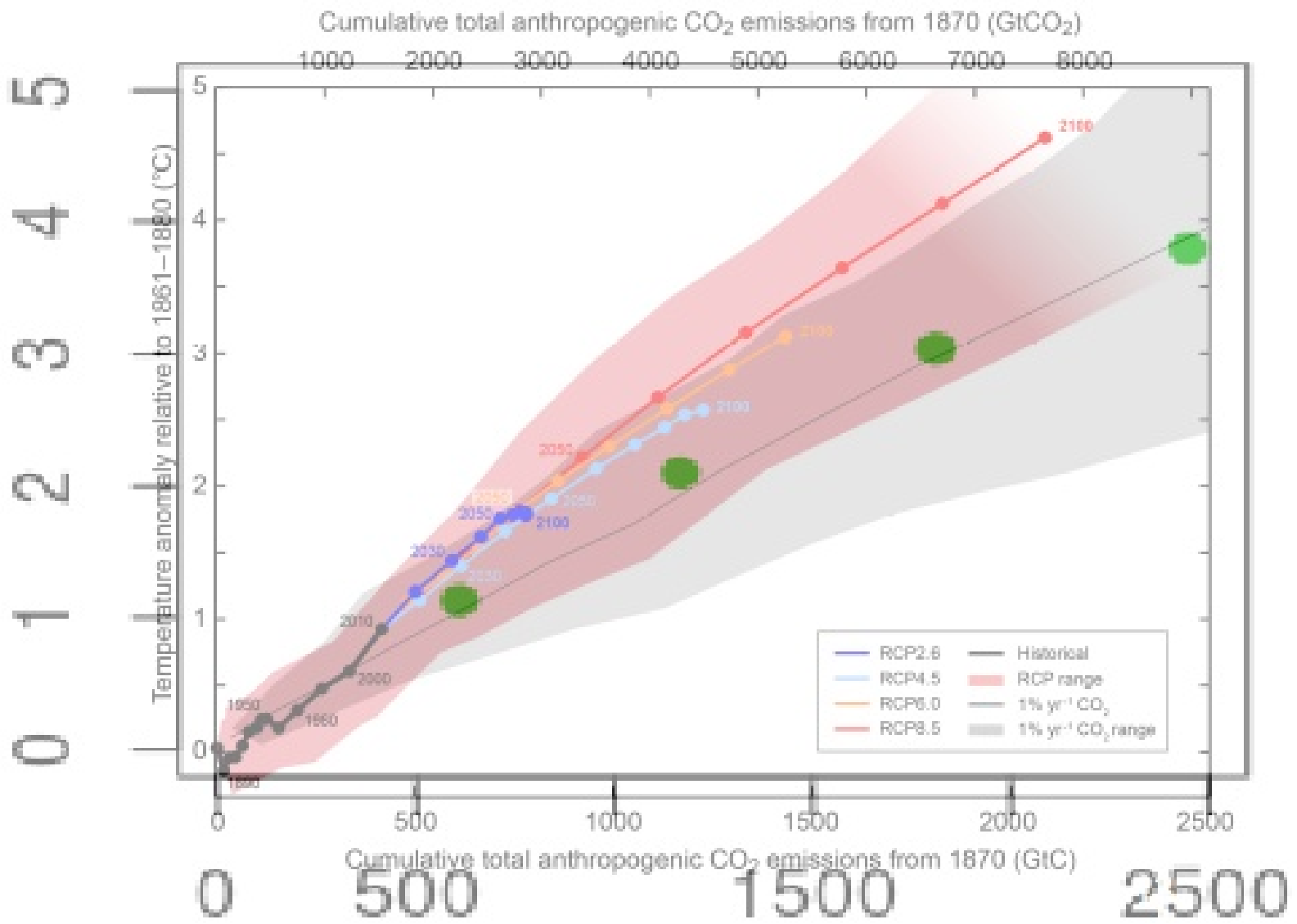


You can add more points with your own emission scenarios

Why this?

- Consider this picture from the AR5 WG1 report




Cumulative total anthropogenic CO_2 emissions from 1870 ($GtCO_2$)
1000
2000
3000
4000
5000
6000
7000
8000
Temperature anomaly relative to 1861–1880 (°C)
0
1
2
3
4
5
1950
1900
1850
2000
2010
2030
2050
2100
RCP2.6
RCP4.5
RCP6.0
RCP8.5
Historical
RCP range
1% yr^{-1} CO_2
1% yr^{-1} CO_2 range
0
500
1000
1500
2000
2500
Cumulative total anthropogenic CO_2 emissions from 1870 (GtC)
0
500
1500
2500

ISAM vs Coupled Climate Models

- ISAM tends to follow the coupled models for the 1% increase scenario
  - Slightly faster increase than RCP85
- You can examine the growth rate of CO2 in ISAM output
  - The high B U grows at roughly 1% per yearafter 2000
  - The medium B U grows at rougly 0.7% per year after 2000
  - Also you could examine the TEQ values instead of TEM
- How do you think this model performs?