Section 2: page 3-28

Testing the IPCC climate models

Here we analyze all available model output simulations relative to the global average surface temperature (tas) prepared for IPCC Fourth Assessment climate of the 20th Century experiment (20C3M), which use all known (natural plus anthropogenic) climatic forcings. The simulations obtained with 25 GCM models are collected by the Program for Climate Model Diagnosis and Intercomparison (PCMDI), the JSC/CLIVAR Working Group on Coupled Modelling (WGCM) and their Coupled Model Intercomparison Project (CMIP) and Climate Simulation Panel for organizing the model data analysis activity, and the IPCC WG1 TSU for technical support. All simulations can be downloaded from Climate Explorer at:

http://climexp.knmi.nl/selectfield_co2.cgi?

Documentations about the models can be found at:

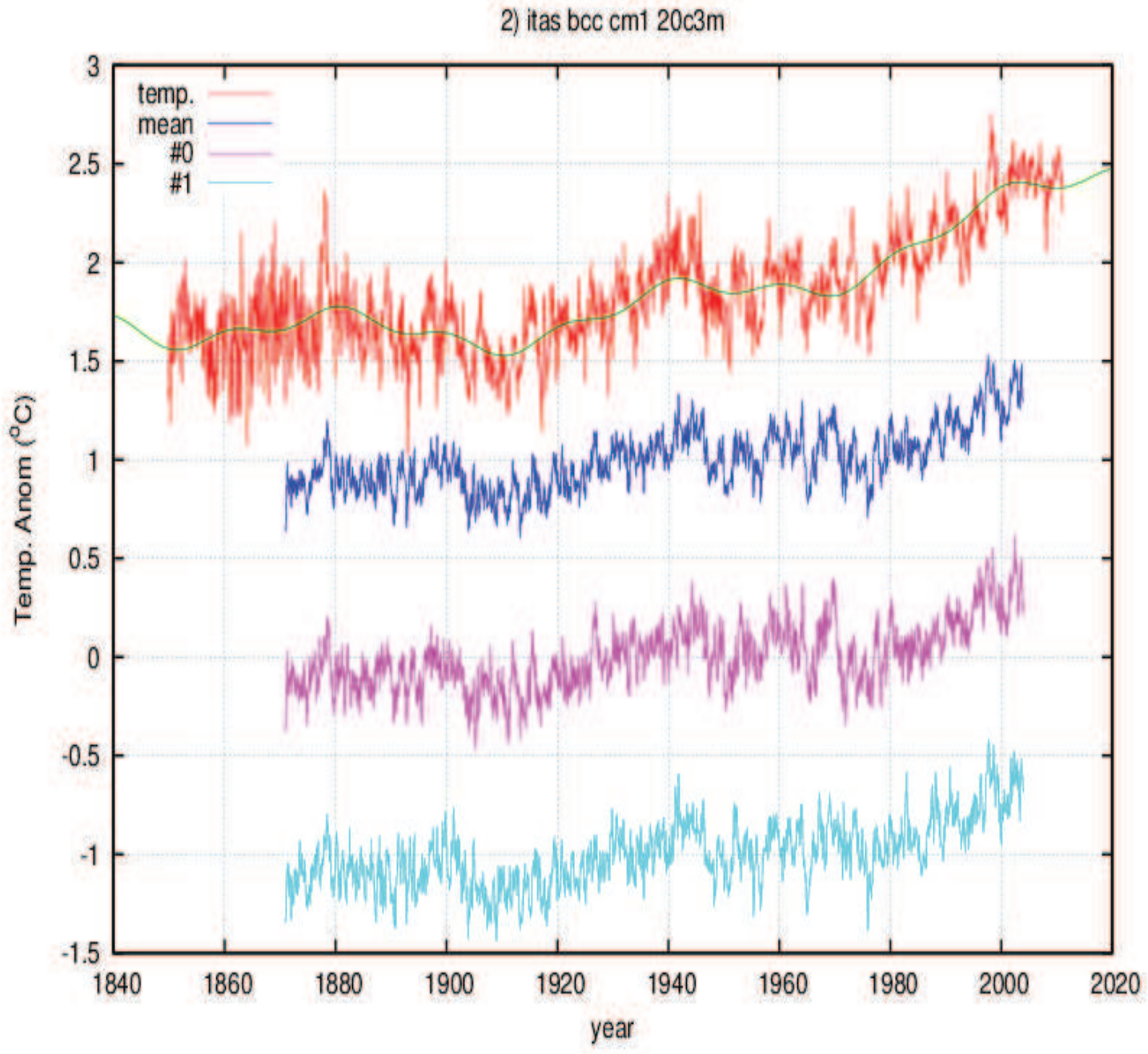
http://www-pcmdi.llnl.gov/ipcc/model_documentation/ipcc_model_documentation.php

We fit the computer simulations with Eq. 5 in the main paper to find the relative amplitude factor “a”, “b” and “c” of the 60 and 20-year cyclical modulations of the global surface temperature and of the upward trend, respectively, as reproduced by the computer simulation. A value of the regression factor close to 1 indicates that the model simulation well reproduces the correspondent pattern modulation of the temperature. The result of the analysis relative to 26 different computer model simulation is depicted in the tables and the regression coefficients for the mean model run are reported in Table 1 and in Figure 4 in the main paper.

Each figure depicts several curves vertically displaced for visual convenience: in red the global surface temperature (the green curve is Eq. 3 + Eq. 4 in the paper); in blue the mean of the individual runs of a given GCM (in the case only one run is available it would coincide with the mean); the curves below the blue curve correspond to the individual runs numbered as in the original files as #0, #1, #2 etc.

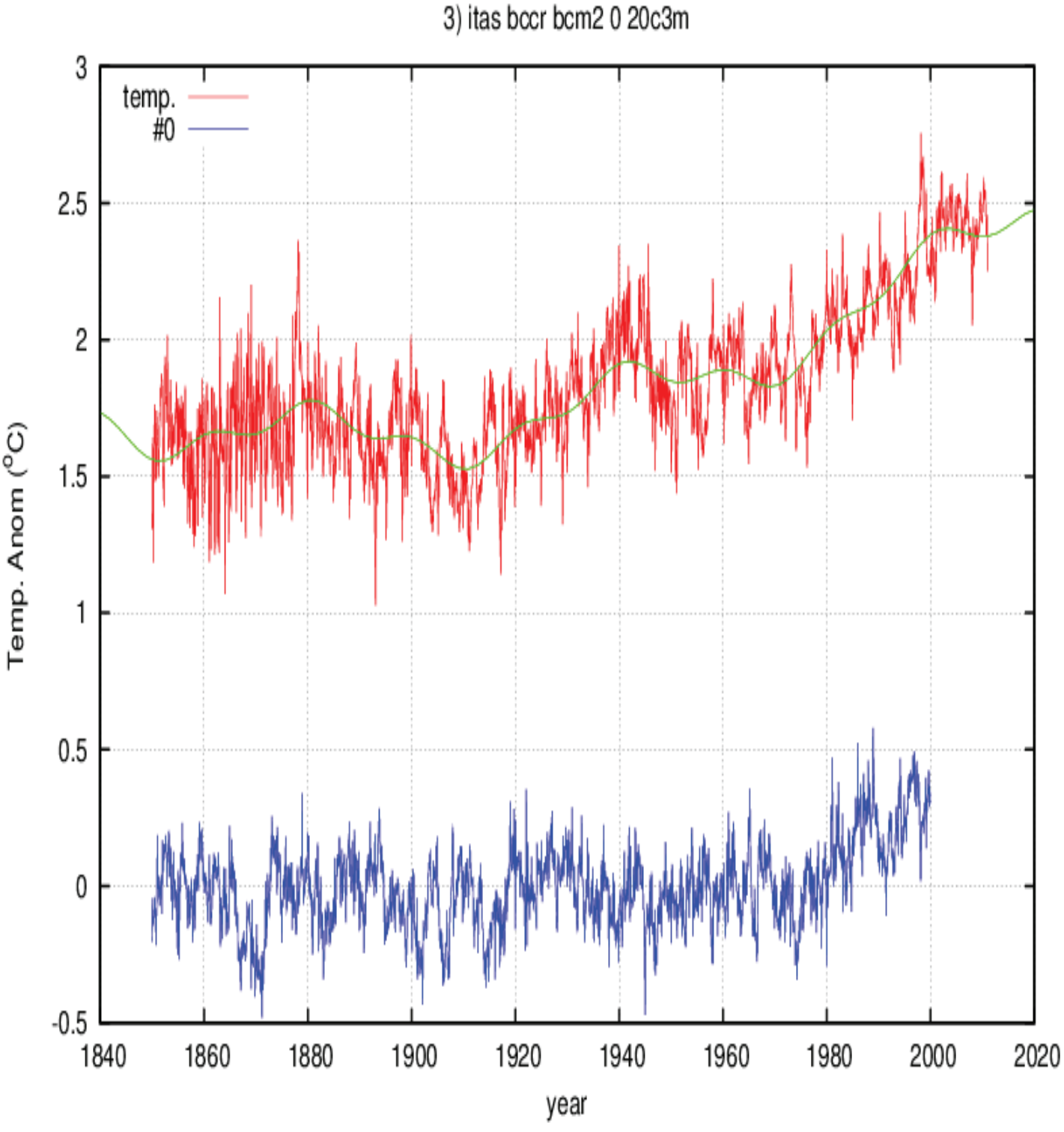
The tables below each figure report the regression coefficients “a”, “b”, “c” and “d” with the corresponding error. The last column of each table report the reduced χ^2 test, values close to 1 would indicate that the model well agrees with the 60-year cycle, 20-year cycle and upward trend observed in the temperature.

Note that the χ^2 values are always much larger than 1 and that the average values for the regression coefficients are “a = 0.30 +/- 0.22” and “b = 0.035 +/- 0.41”, which indicates that the models do not reproduce the 60 and 20-year temperature cyclical modulation. In many cases a simple visual comparison suggests significant discrepancies between the global surface temperature patterns and the model output.



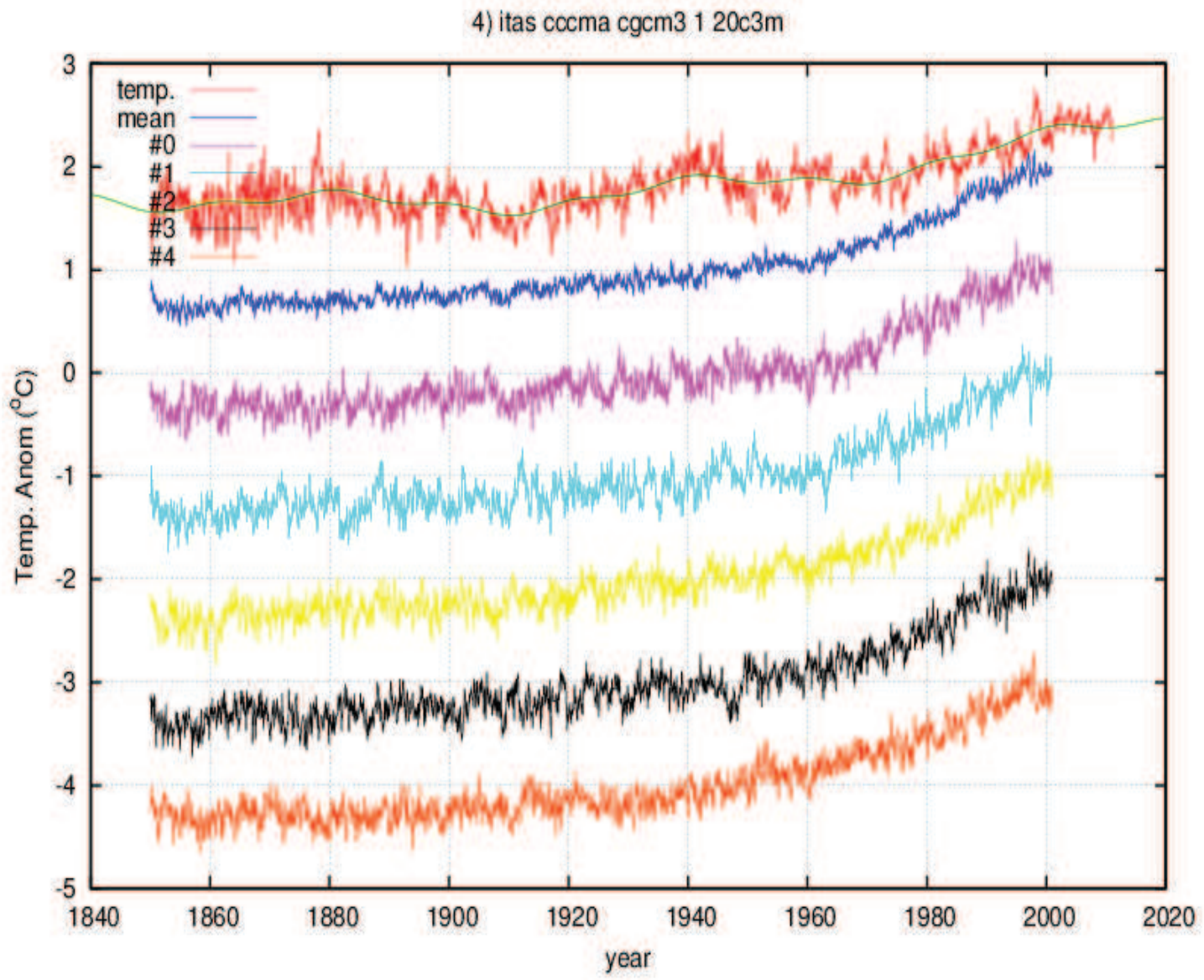
Institution: Beijing Climate Center, China

model	n.	a	err	b	err	c	err	d	err	X^2
BCC CM1	mean	0.63	0.03	0.69	0.09	0.54	0.02	0.08	0.004	109
BCC CM1	0	0.66	0.04	0.68	0.11	0.52	0.02	0.08	0.004	112
BCC CM1	1	0.59	0.04	0.70	0.10	0.55	0.02	0.09	0.004	105



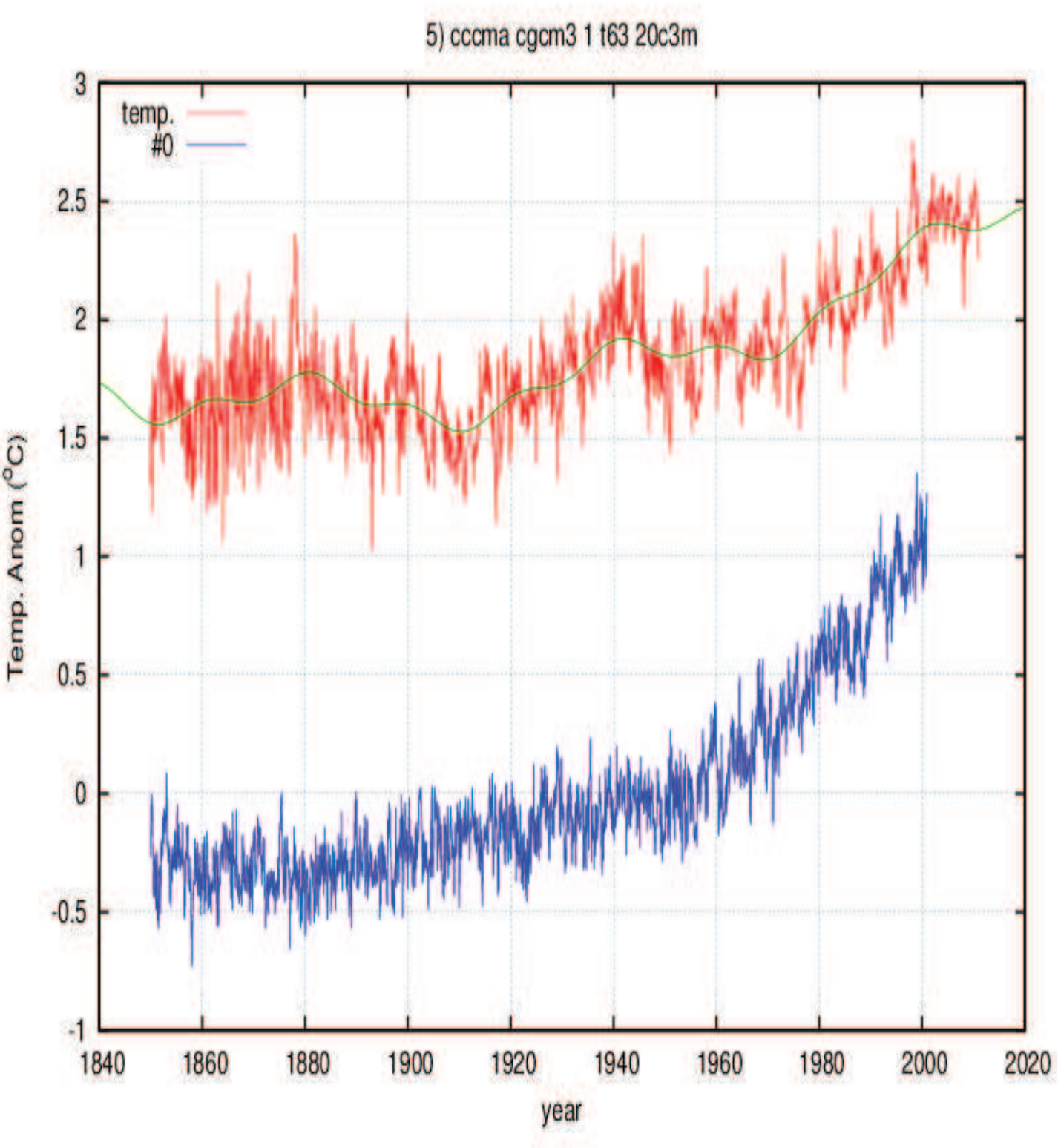
Institution: Bjerknes Center for Climate Research, Norway
Note that the simulation is practically flat until 1970.
The simulated decadal oscillations appear artificial and unrelated to the actual observation.

model	n.	a	err	b	err	c	err	d	err	X^2
BCCR BCM2.0	0	0.29	0.05	0.06	0.11	0.40	0.02	0.08	0.005	202



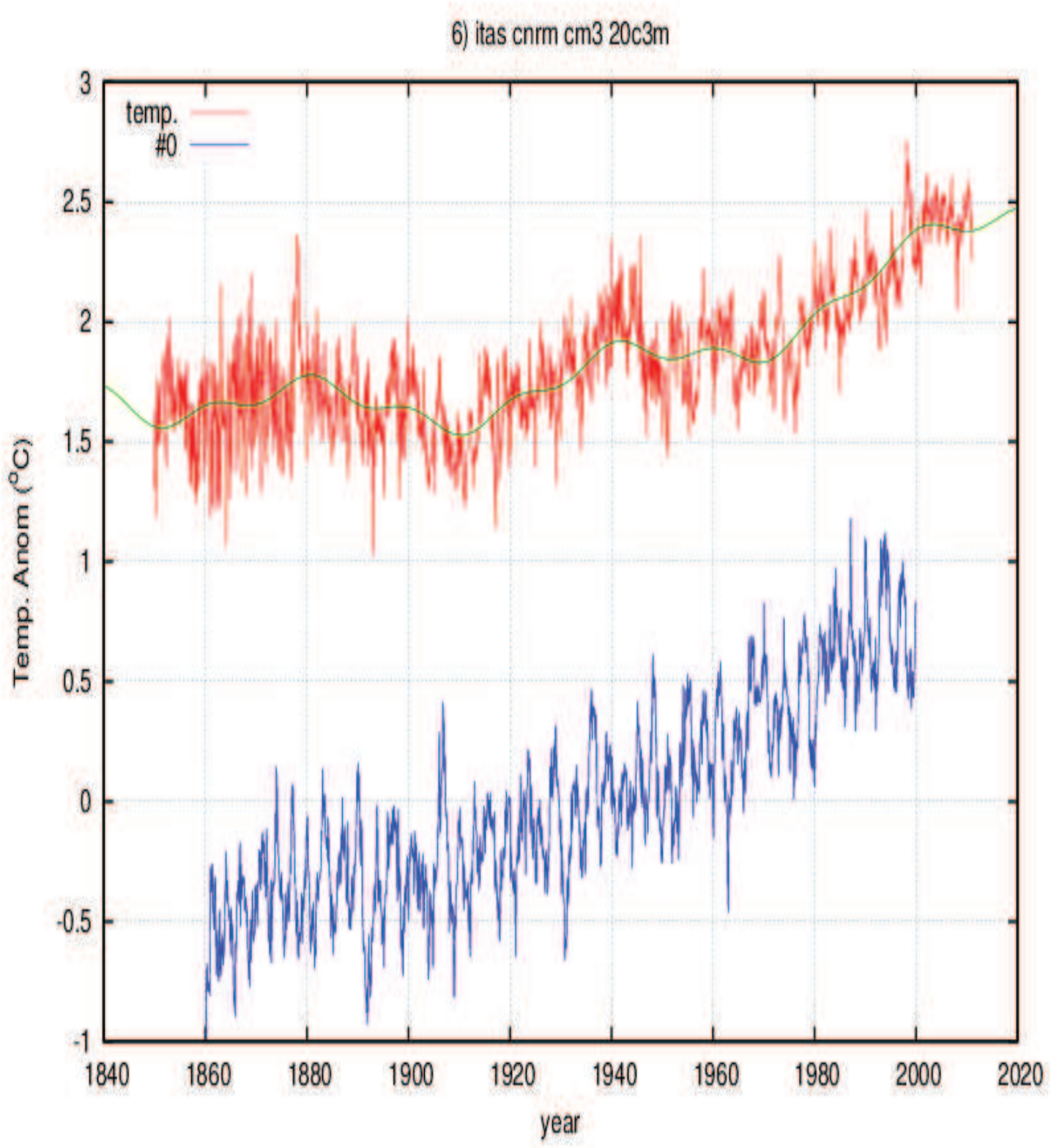
Institution: Canadian Centre for Climate Modelling & Analysis, Canada
Note that the simulations increase quite monotonically without any multidecadal dynamics.

model	n.	a	err	b	err	c	err	d	err	X^2
CGCM3.1 (T47)	mean	0.35	0.03	-0.28	0.07	2.02	0.01	0.40	0.003	753
CGCM3.1 (T47)	0	0.33	0.05	0.16	0.12	2.00	0.02	0.40	0.005	449
CGCM3.1 (T47)	1	0.47	0.05	-0.85	0.12	2.00	0.02	0.40	0.005	468
CGCM3.1 (T47)	2	0.54	0.05	-0.22	0.12	2.00	0.02	0.40	0.005	441
CGCM3.1 (T47)	3	0.33	0.05	-0.05	0.12	2.00	0.02	0.40	0.005	454
CGCM3.1 (T47)	4	0.06	0.05	-0.45	0.12	1.97	0.02	0.39	0.005	471



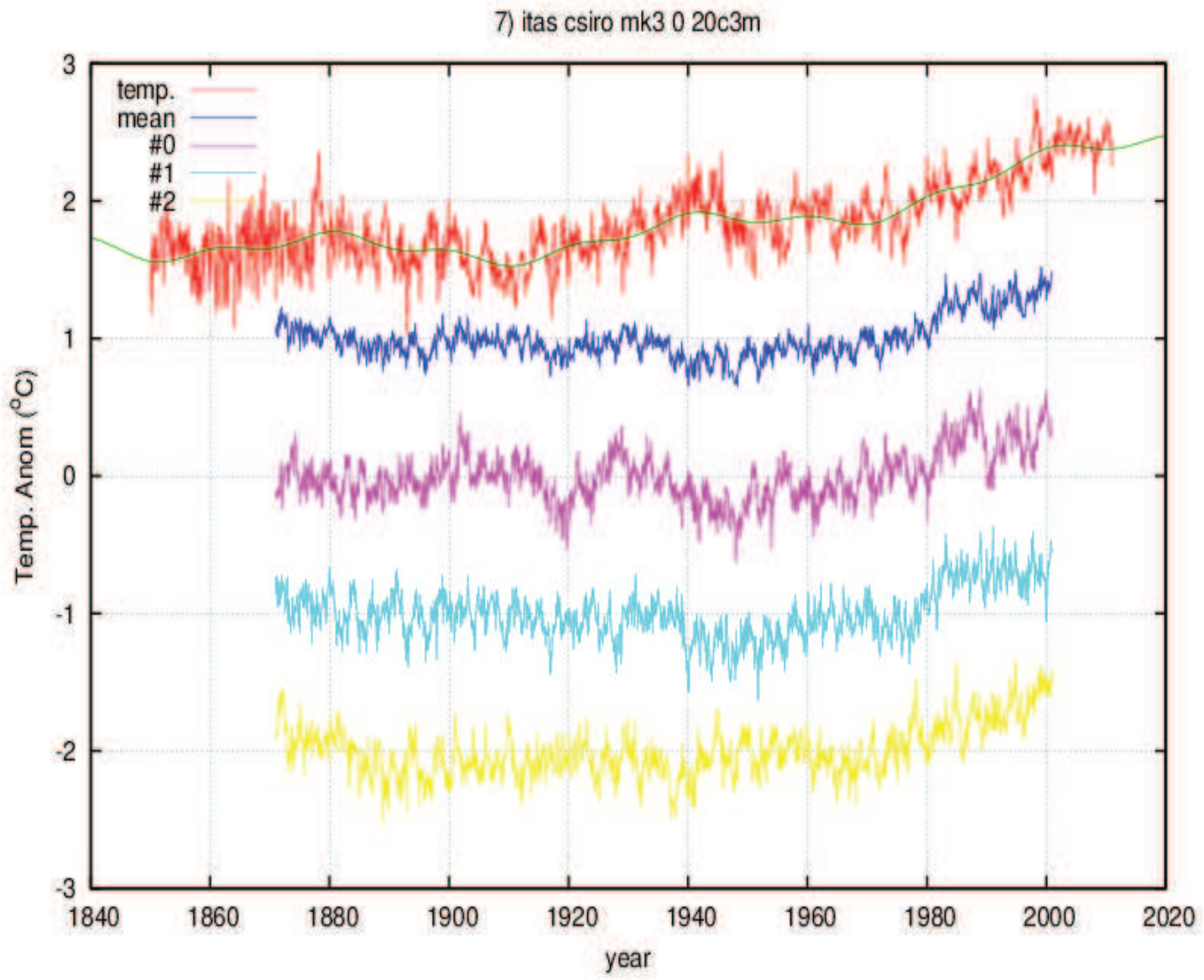
Institution: Canadian Centre for Climate Modelling & Analysis, Canada
Note that the simulations increase quite monotonically without any multidecadal dynamics.

model	n.	a	err	b	err	c	err	d	err	X^2
CGCM3.1 (T63)	0	0.11	0.05	0.05	0.11	2.07	0.02	0.40	0.005	536



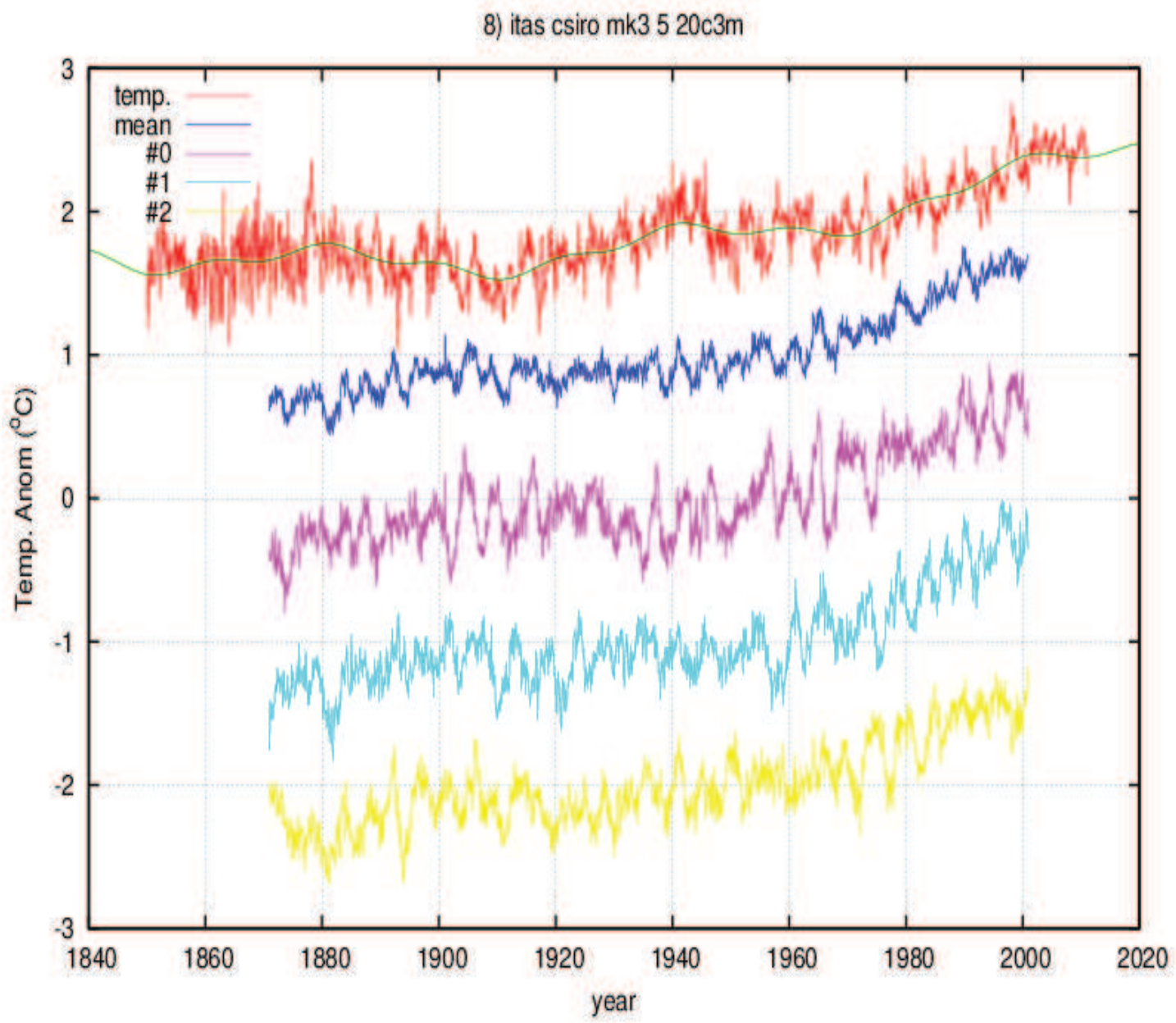
Institution: Météo-France / Centre National de Recherches Météorologiques, France
Note that the simulations increase quite monotonically without any multidecadal dynamics.
The large 3-5 year oscillations appear quite artificial and unrlated to the real ENSO oscillations.

model	n.	a	err	b	err	c	err	d	err	X^2
CNRM CM3	0	-0.01	0.07	-0.27	0.18	2.02	0.03	0.39	0.008	322



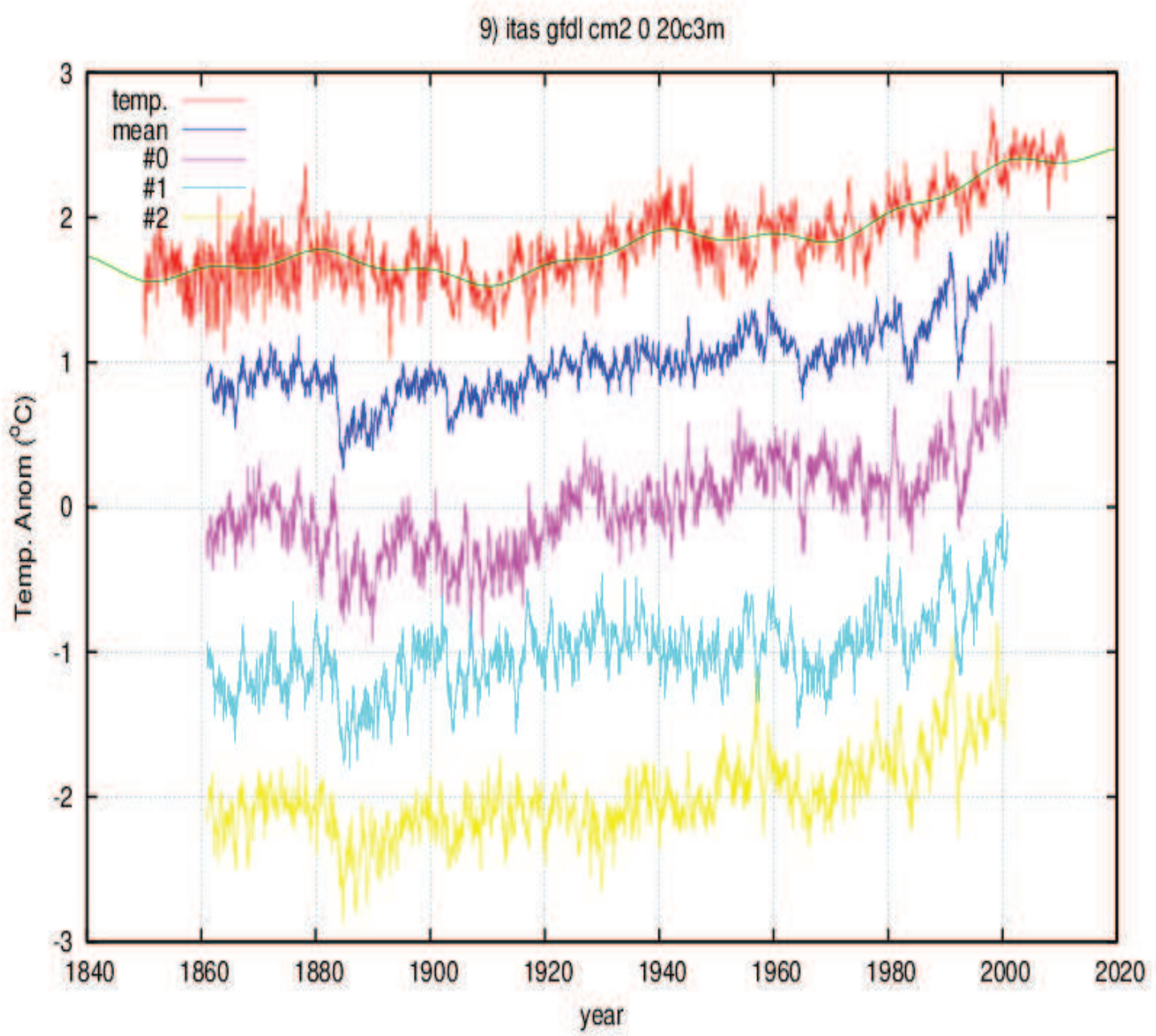
Institution: CSIRO Atmospheric Research, Australia
Note that the simulations increase quite monotonically without any multidecadal dynamics.
The simulations present large multi-decadal oscillations unrelated to the real observations

model	n.	a	err	b	err	c	err	d	err	X^2
CSIRO MK3.0	mean	0.30	0.04	-0.12	0.11	0.48	0.02	0.08	0.004	176
CSIRO MK3.0	0	0.06	0.06	-0.68	0.15	0.46	0.02	0.08	0.006	203
CSIRO MK3.0	1	0.27	0.06	-0.02	0.15	0.42	0.02	0.07	0.006	186
CSIRO MK3.0	2	0.58	0.05	0.33	0.14	0.57	0.02	0.10	0.005	98



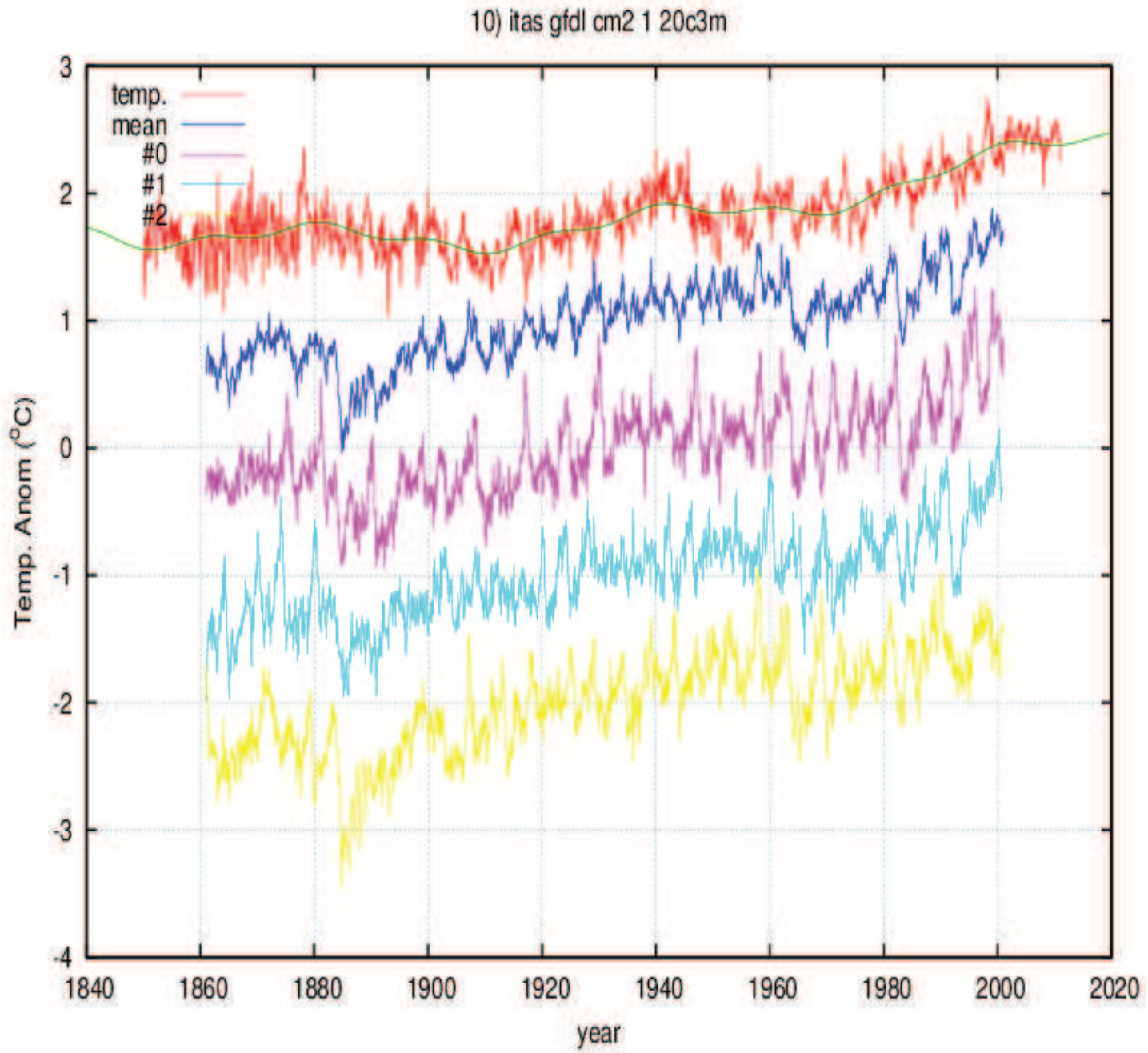
Institution: CSIRO Atmospheric Research, Australia
Note that the simulations increase quite monotonically without any multidecadal dynamics.
The large 3-5 year oscillations appear quite artificial and unrlated to the real ENSO oscillations.

model	n.	a	err	b	err	c	err	d	err	X^2
CSIRO MK3.5	mean	-0.19	0.04	-0.19	0.10	1.38	0.02	0.25	0.004	197
CSIRO MK3.5	0	-0.51	0.06	0.47	0.16	1.40	0.02	0.26	0.006	195
CSIRO MK3.5	1	0.12	0.06	-0.37	0.16	1.42	0.02	0.25	0.006	131
CSIRO MK3.5	2	-0.18	0.06	-0.69	0.14	1.30	0.02	0.23	0.006	143



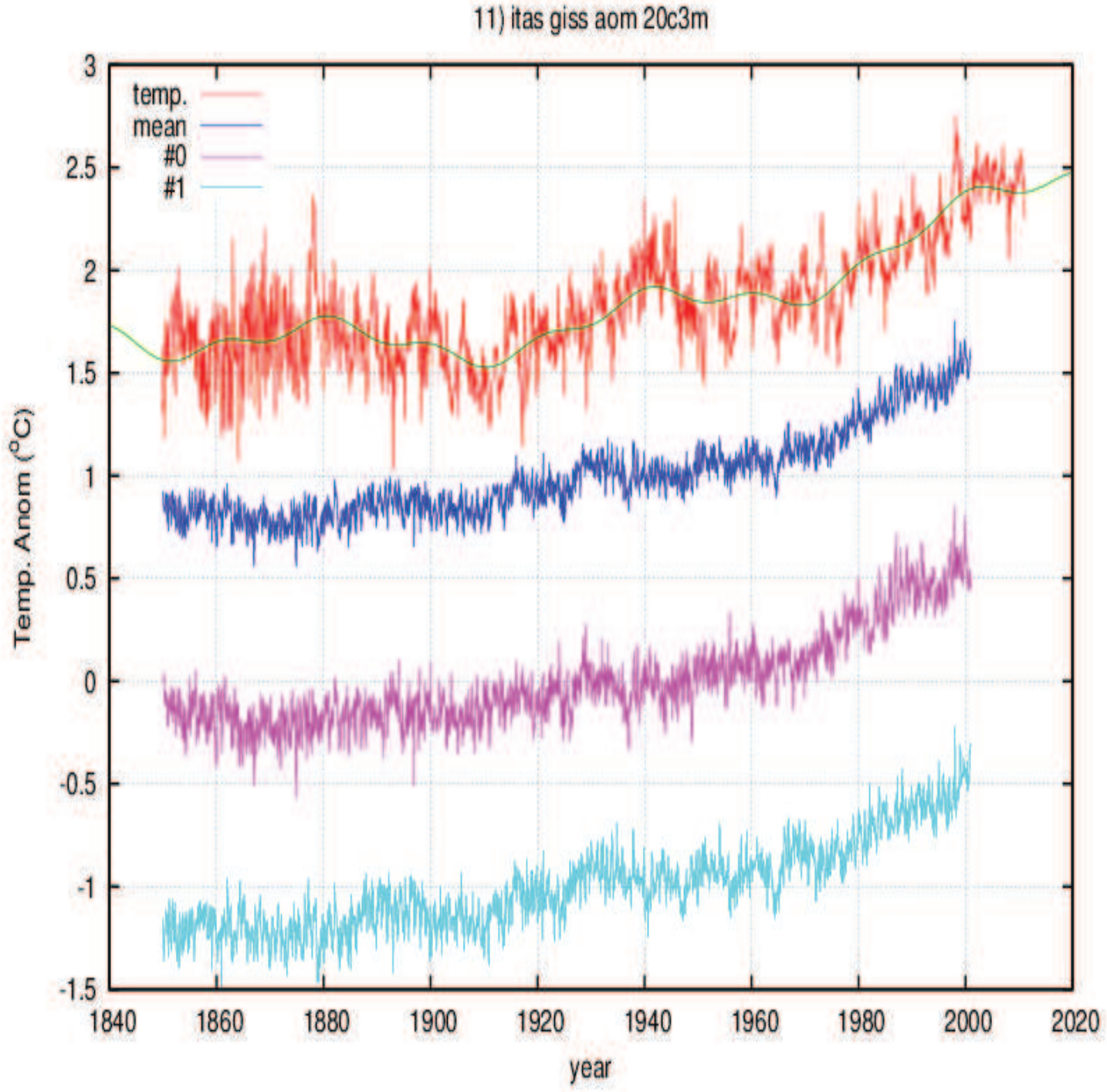
Institution: US Dept. of Commerce / NOAA / Geophysical Fluid Dynamics Laboratory, USA
Note that the simulations present a multidecadal dynamics not related to the observation.
There are very large volcano cooling spikes and signatures not observed in the temperature data.

model	n.	a	err	b	err	c	err	d	err	X^2
GFDL CM2.0	mean	0.44	0.05	0.90	0.12	1.12	0.02	0.21	0.005	28
GFDL CM2.0	0	0.70	0.07	0.38	0.18	1.30	0.03	0.24	0.007	29
GFDL CM2.0	1	0.38	0.07	1.53	0.18	0.91	0.03	0.17	0.007	24
GFDL CM2.0	2	0.24	0.06	0.79	0.16	1.16	0.02	0.22	0.006	44



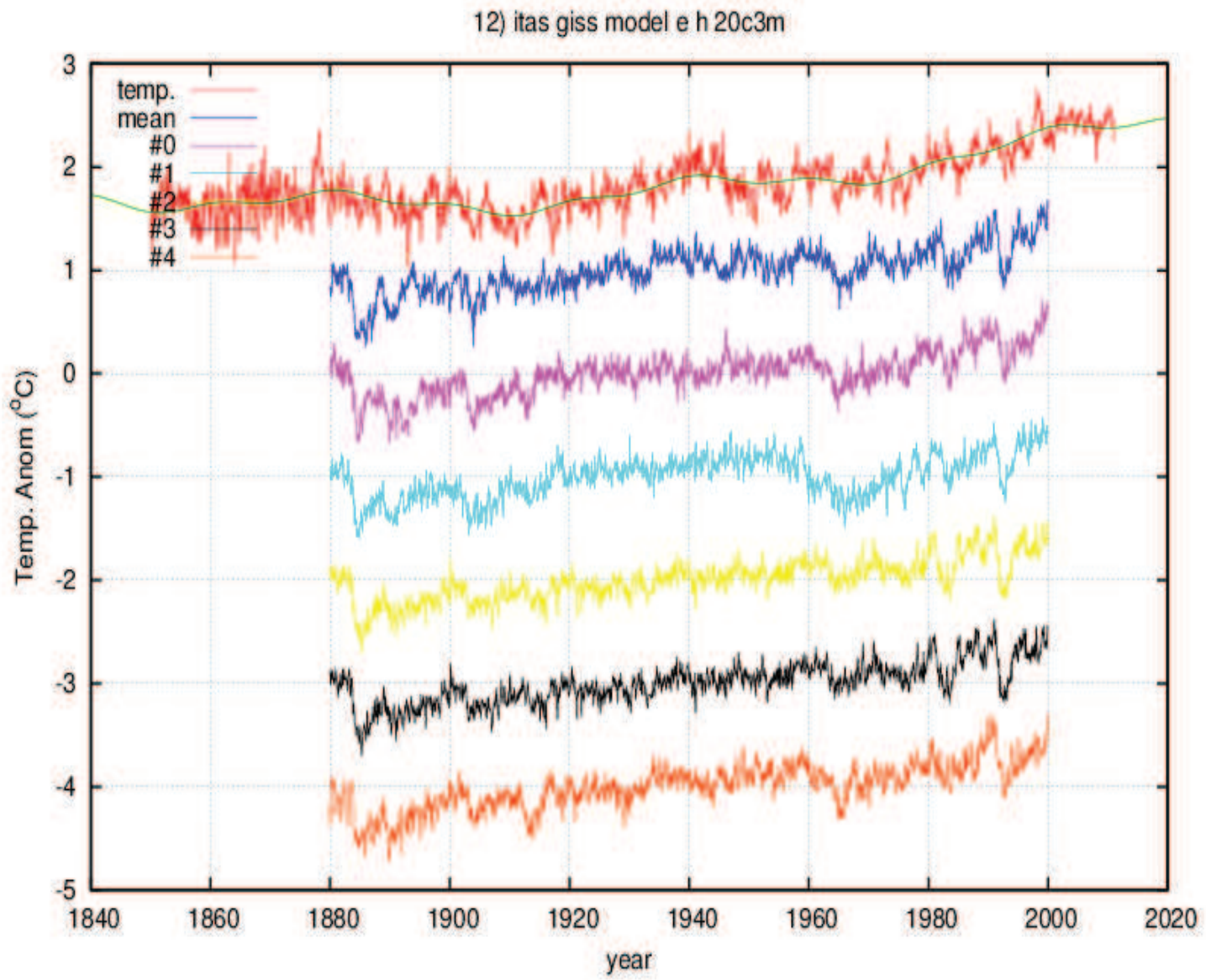
Institution: US Dept. of Commerce / NOAA / Geophysical Fluid Dynamics Laboratory, USA
Note that the simulations present a large 3-5 year oscillations and multidecadal dynamics not related to the observation. There are very large volcano cooling spikes and signatures not observed in the temperature data.

model	n.	a	err	b	err	c	err	d	err	X^2
GFDL CM2.1	mean	0.37	0.07	0.75	0.17	1.37	0.03	0.26	0.007	53
GFDL CM2.1	0	0.77	0.09	1.19	0.22	1.38	0.03	0.26	0.009	37
GFDL CM2.1	1	0.43	0.09	0.52	0.21	1.29	0.03	0.24	0.009	33
GFDL CM2.1	2	-0.10	0.10	0.53	0.25	1.45	0.04	0.28	0.010	67



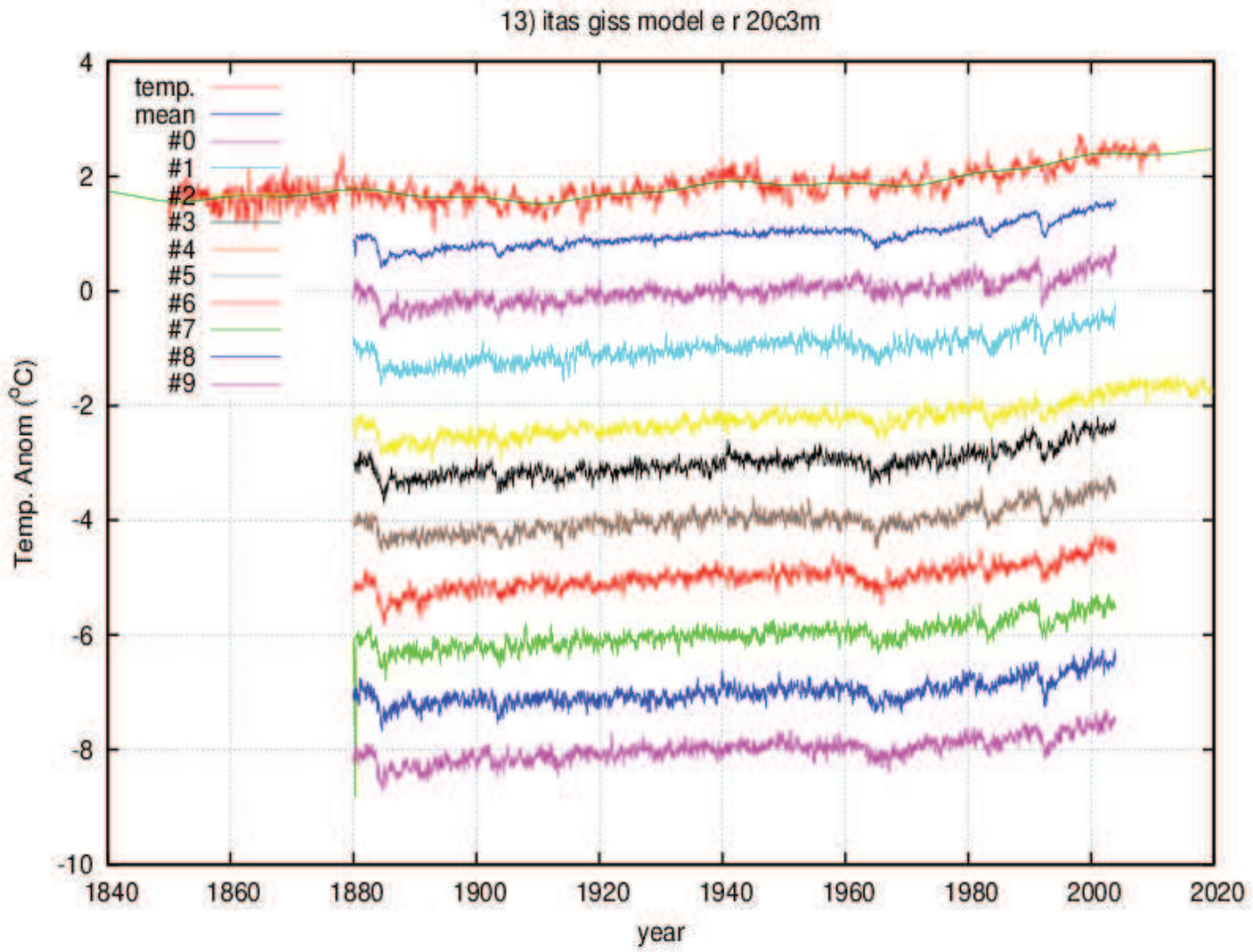
Institution: NASA / Goddard Institute for Space Studies, USA
Note that the simulations increase quite monotonically without any multidecadal dynamics.

model	n.	a	err	b	err	c	err	d	err	X^2
GISS AOM	mean	0.22	0.03	-0.14	0.06	1.10	0.01	0.22	0.003	93
GISS AOM	0	0.14	0.03	-0.10	0.08	1.15	0.01	0.23	0.003	110
GISS AOM	1	0.30	0.03	-0.18	0.09	1.05	0.01	0.21	0.004	74



Institution: NASA / Goddard Institute for Space Studies, USA
Note that the simulations increase monotonically with a dynamics not related to the observation. There are very large volcano cooling spikes and signatures not observed in the temperature data.

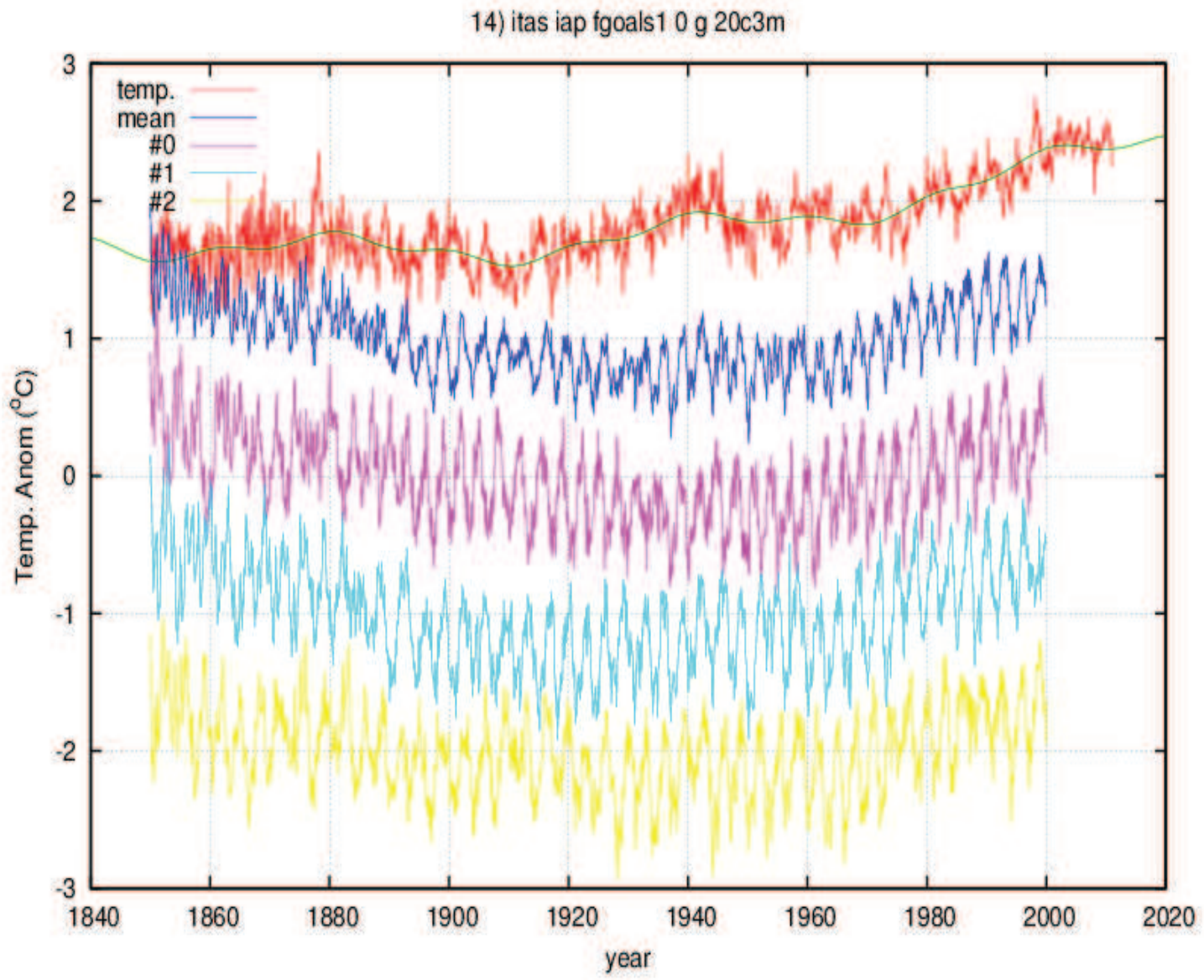
model	n.	a	err	b	err	c	err	d	err	X^2
GISS EH	mean	0.48	0.04	0.96	0.11	0.80	0.02	0.14	0.004	43
GISS EH	0	0.52	0.05	1.19	0.13	0.84	0.02	0.14	0.005	30
GISS EH	1	1.02	0.06	0.99	0.15	0.57	0.02	0.10	0.006	81
GISS EH	2	0.16	0.05	0.96	0.12	0.84	0.02	0.14	0.005	63
GISS EH	3	0.24	0.06	1.01	0.14	0.90	0.02	0.15	0.005	39
GISS EH	4	0.44	0.06	0.65	0.14	0.83	0.02	0.14	0.005	34



Institution: NASA / Goddard Institute for Space Studies, USA

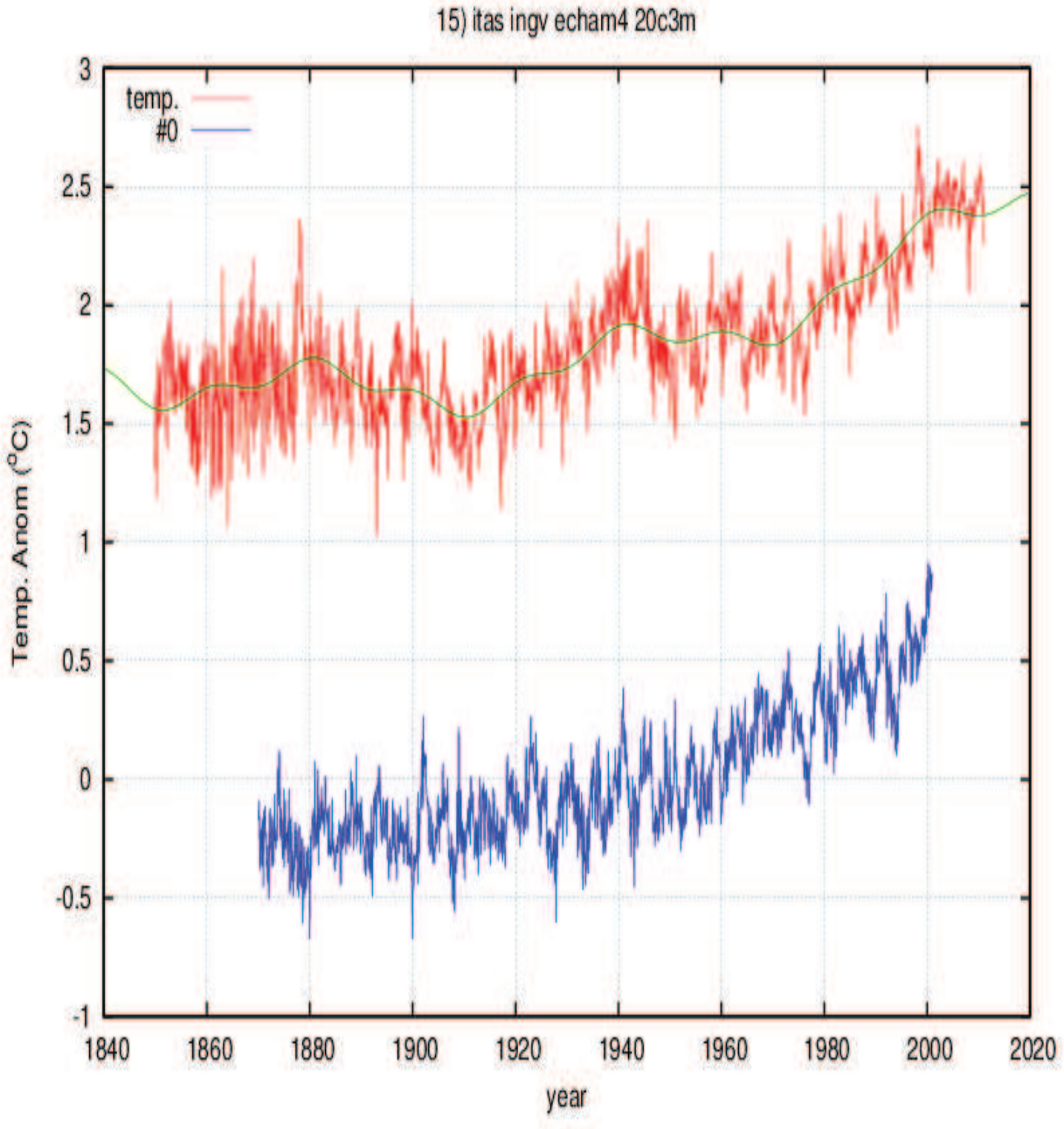
Note that the simulations increase monotonically with a dynamics not related to the observation. There are very large volcano cooling spikes and signatures not observed in the temperature data.

model	n.	a	err	b	err	c	err	d	err	X^2
GISS ER	mean	0.47	0.04	0.80	0.08	0.90	0.02	0.11	0.004	31
GISS ER	0	0.23	0.05	1.22	0.12	0.84	0.02	0.13	0.004	57
GISS ER	1	0.54	0.05	0.69	0.12	0.95	0.02	0.15	0.004	19
GISS ER	2	0.40	0.05	0.21	0.12	0.52	0.01	-0.18	0.004	222
GISS ER	3	0.73	0.05	0.87	0.11	0.99	0.02	0.15	0.004	6
GISS ER	4	0.76	0.05	0.78	0.12	0.88	0.02	0.13	0.004	12
GISS ER	5	0.37	0.05	0.81	0.13	0.89	0.02	0.14	0.005	35
GISS ER	6	0.30	0.06	0.16	0.14	0.99	0.02	0.15	0.005	36
GISS ER	7	0.57	0.05	0.97	0.11	0.80	0.02	0.12	0.004	32
GISS ER	8	0.36	0.05	0.83	0.12	0.82	0.02	0.12	0.004	45



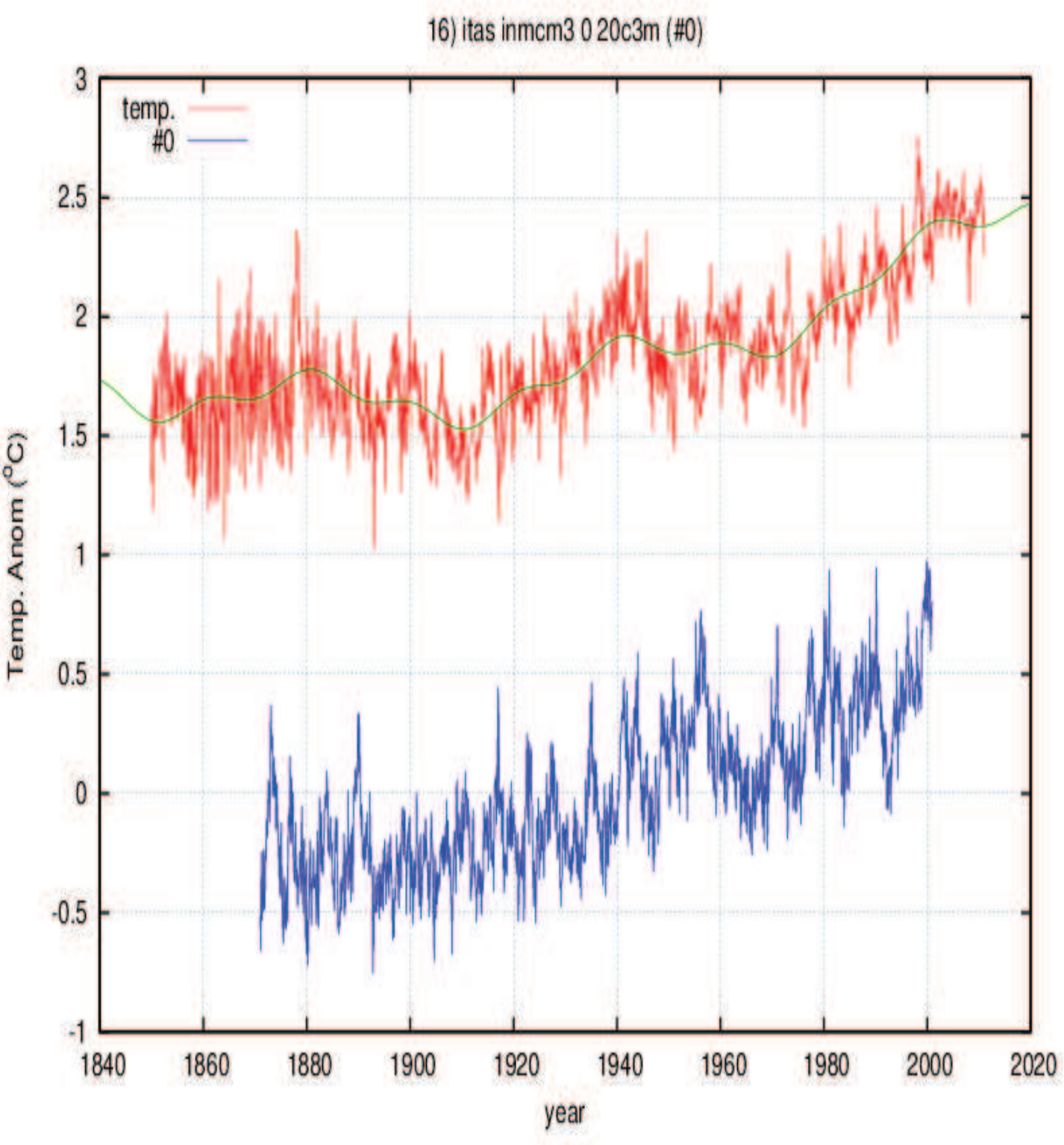
Institution: LASG / Institute of Atmospheric Physics, China
The simulations do not appear to have any similarity with the data at all time scales.

model	n.	a	err	b	err	c	err	d	err	X^2
FGOALS g1.0	mean	0.10	0.09	-0.15	0.21	0.28	0.03	0.06	0.009	171
FGOALS g1.0	0	-0.07	0.11	-0.51	0.27	0.14	0.04	0.03	0.012	162
FGOALS g1.0	1	0.29	0.12	-0.02	0.30	0.40	0.05	0.08	0.013	57
FGOALS g1.0	2	0.08	0.10	0.09	0.26	0.29	0.04	0.06	0.011	114



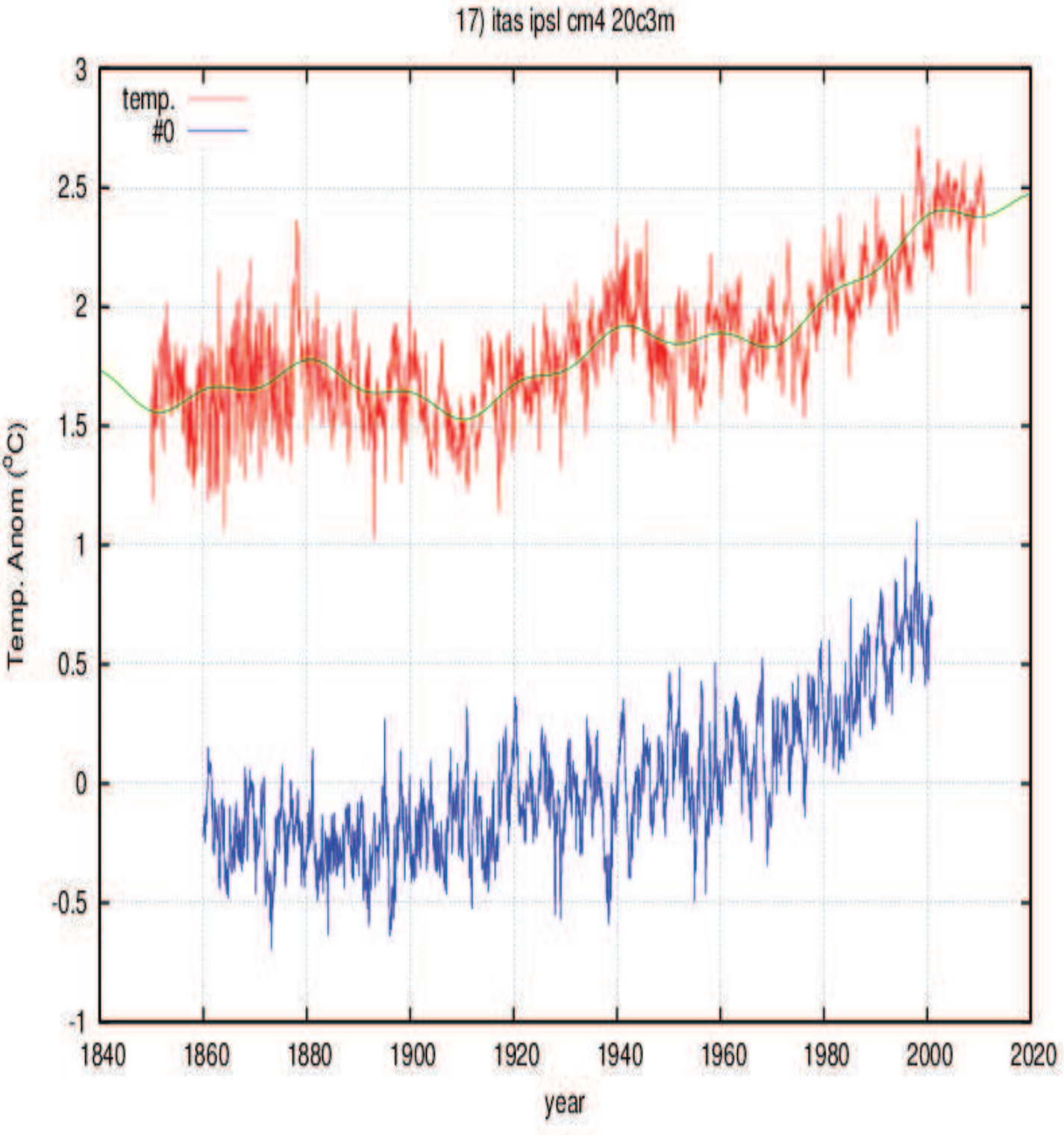
Institution: Instituto Nazionale di Geofisica e Vulcanologia, Italy
Note that the simulation increases quite monotonically without any multidecadal dynamics.

model	n.	a	err	b	err	c	err	d	err	X^2
INVG ECHAM4	0	-0.12	0.05	0.37	0.12	1.34	0.02	0.24	0.005	138



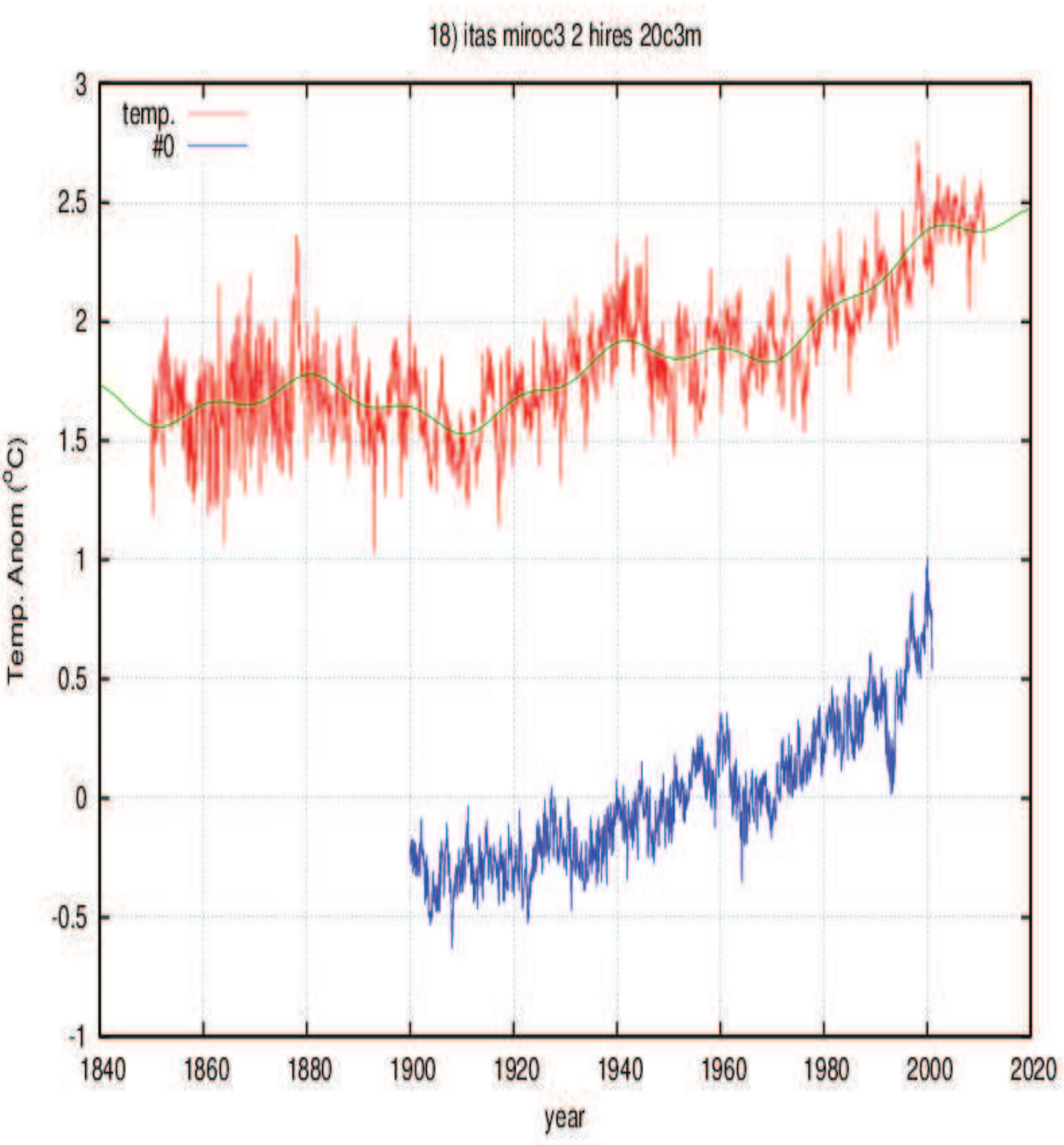
Institution: Institute for Numerical Mathematics, Russia
Note that the simulation increases quite monotonically with a decadal and multidecadal dynamics quite unrelated to the observations.

model	n.	a	err	b	err	c	err	d	err	X^2
INM CM3.0	0	0.30	0.07	0.47	0.18	1.34	0.03	0.24	0.007	54



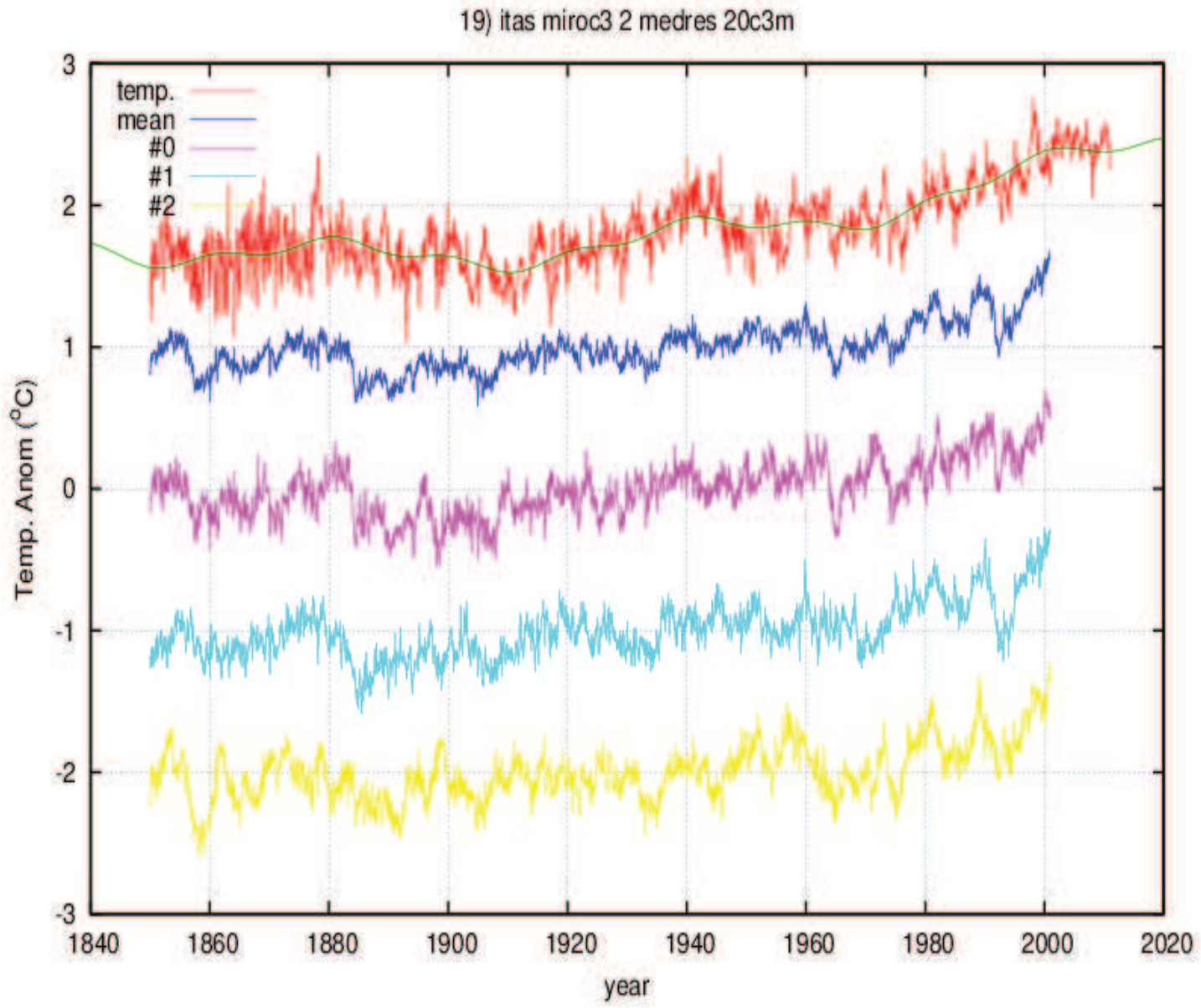
Institution: Institute Simon-Pierre LaPlace, France
Note that the simulation increases quite monotonically with a fluctuating dynamics quite unrelated to the observations.

model	n.	a	err	b	err	c	err	d	err	X^2
IPSL CM4	0	0.13	0.06	0.05	0.14	1.37	0.02	0.26	0.006	107



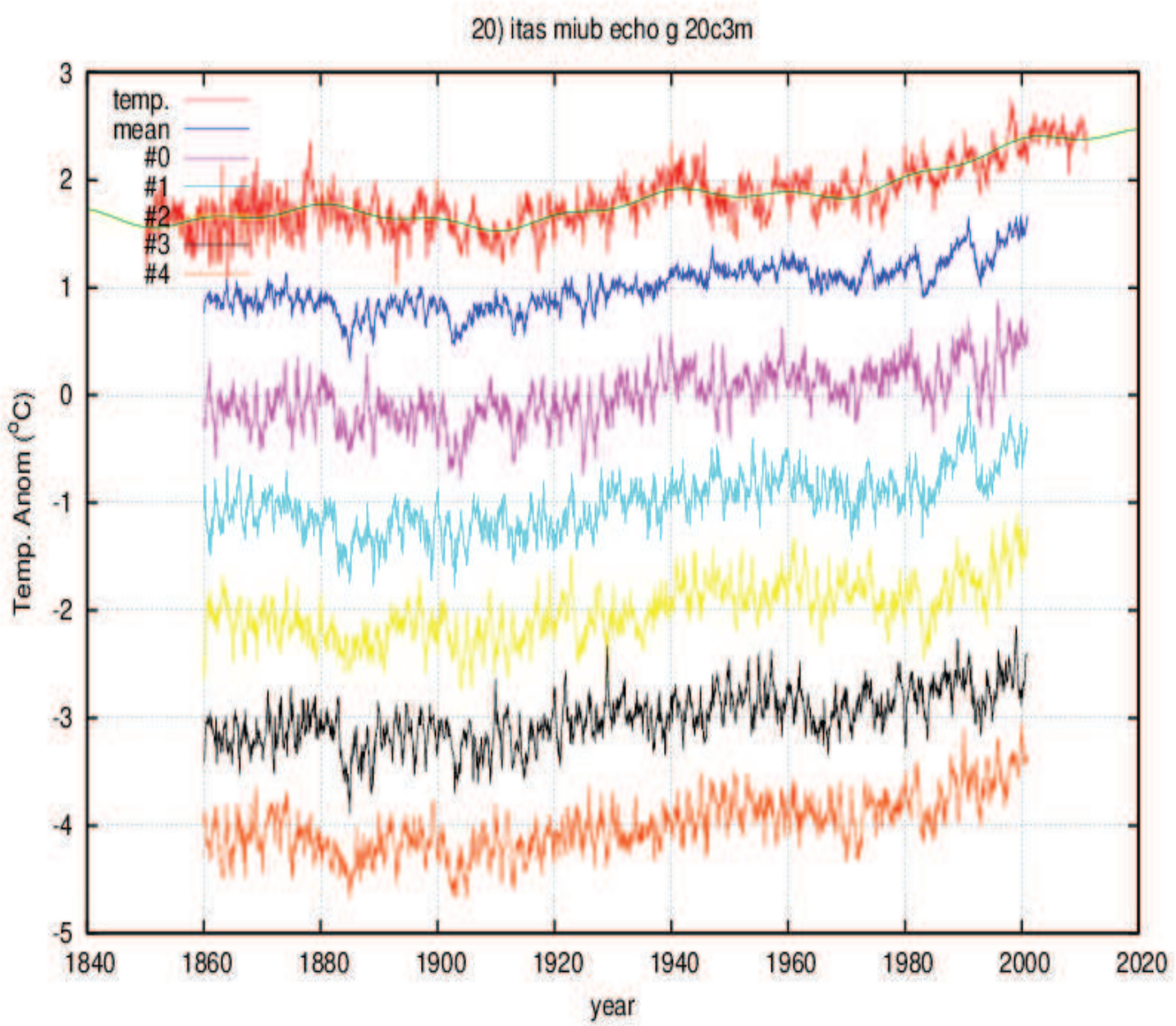
Institution: Center for Climate System Research (The University of Tokyo), Japan
Note that the simulation increases quite monotonically with a fluctuating dynamics quite unrelated to the observations and large volcano cooling spikes not observed in the temperature.

model	n.	a	err	b	err	c	err	d	err	X^2
MIROC3. 2 Hires	0	0.35	0.05	0.92	0.12	1.43	0.02	0.19	0.004	104



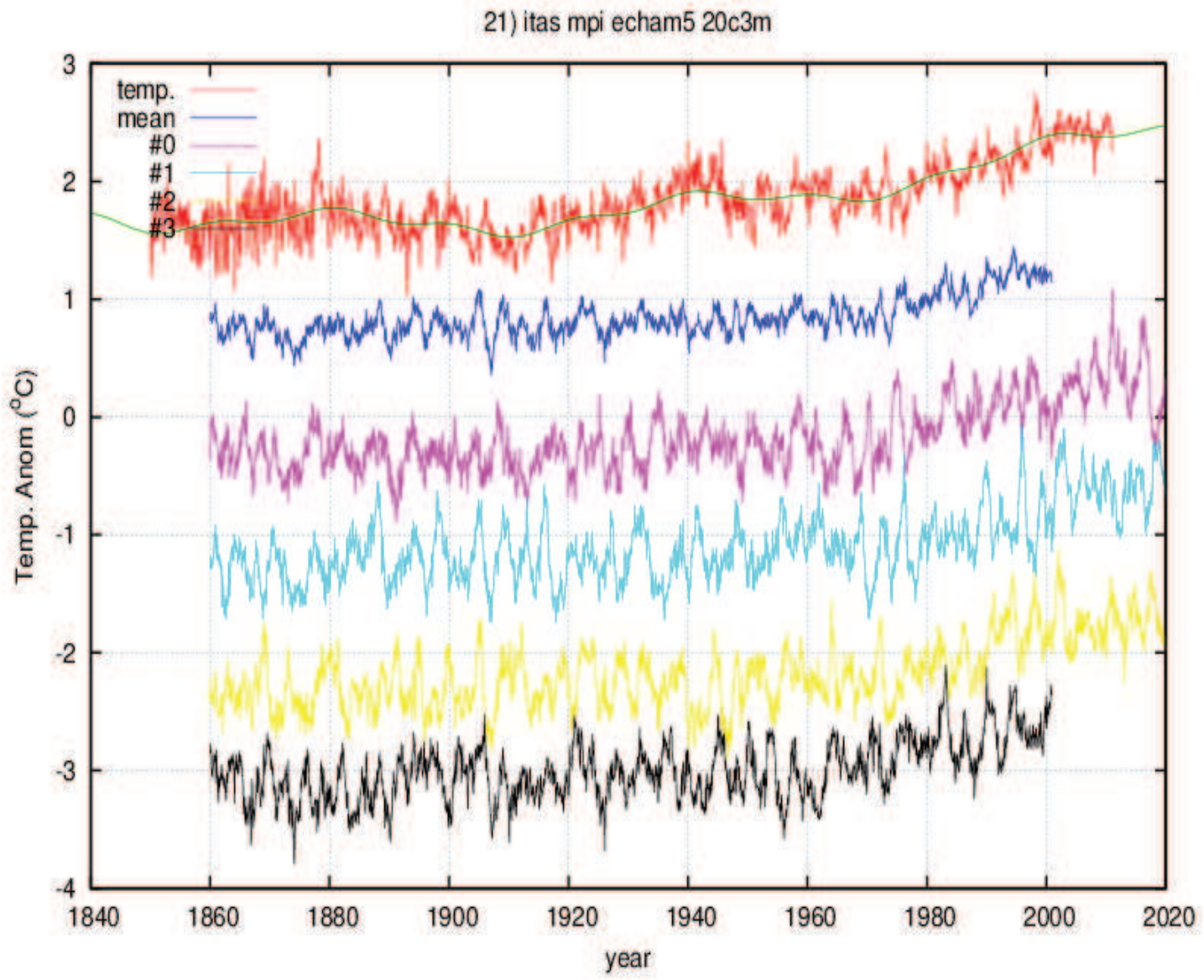
Institution: Center for Climate System Research (The University of Tokyo), Japan
Note that the simulations present a decadal and multidecadal dynamics quite unrelated to the observations and some large volcano cooling spikes not observed in the temperature.

model	n.	a	err	b	err	c	err	d	err	X^2
MIROC3. 2 Medres	mean	0.34	0.03	0.76	0.09	0.72	0.01	0.14	0.004	104
MIROC3. 2 Medres	0	0.44	0.05	0.49	0.11	0.77	0.02	0.15	0.005	50
MIROC3. 2 Medres	1	0.30	0.05	1.40	0.11	0.75	0.02	0.15	0.005	69
MIROC3. 2 Medres	2	0.29	0.05	0.40	0.13	0.65	0.02	0.13	0.006	94



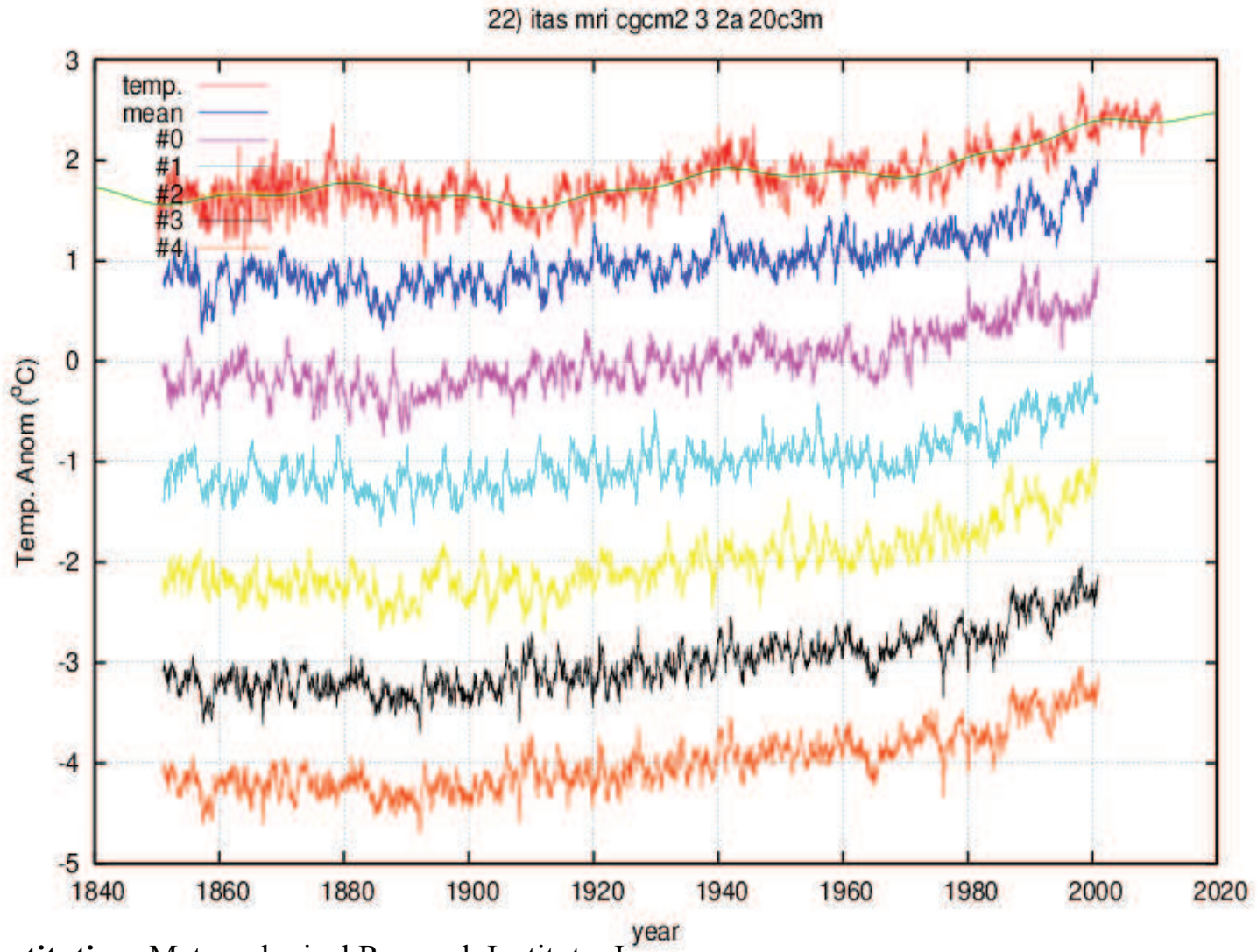
Institution: Meteorological Institute of the University of Bonn, Meteorological Research Institute of KMA, and Model and Data group, Germany / Korea
Note that the simulations present 2-3 year large oscillations, a decadal and multidecadal dynamics and some large volcano spikes unrelated to the observations

model	n.	a	err	b	err	c	err	d	err	X^2
ECHO G	mean	0.58	0.04	0.16	0.10	0.98	0.02	0.18	0.004	26
ECHO G	0	0.66	0.07	0.87	0.16	0.94	0.03	0.18	0.006	8
ECHO G	1	0.68	0.06	-0.63	0.16	1.07	0.03	0.20	0.006	29
ECHO G	2	0.42	0.07	0.57	0.17	0.96	0.03	0.18	0.007	19
ECHO G	3	0.51	0.06	0.21	0.15	0.89	0.03	0.17	0.006	24
ECHO G	4	0.64	0.06	-0.23	0.15	1.06	0.03	0.20	0.006	22



Institution: Max Planck Institute for Meteorology, Germany
Note that the simulations are almost flat until 1970. There are large 3-5 year oscillations that appear quite different from the ENSO oscillations.

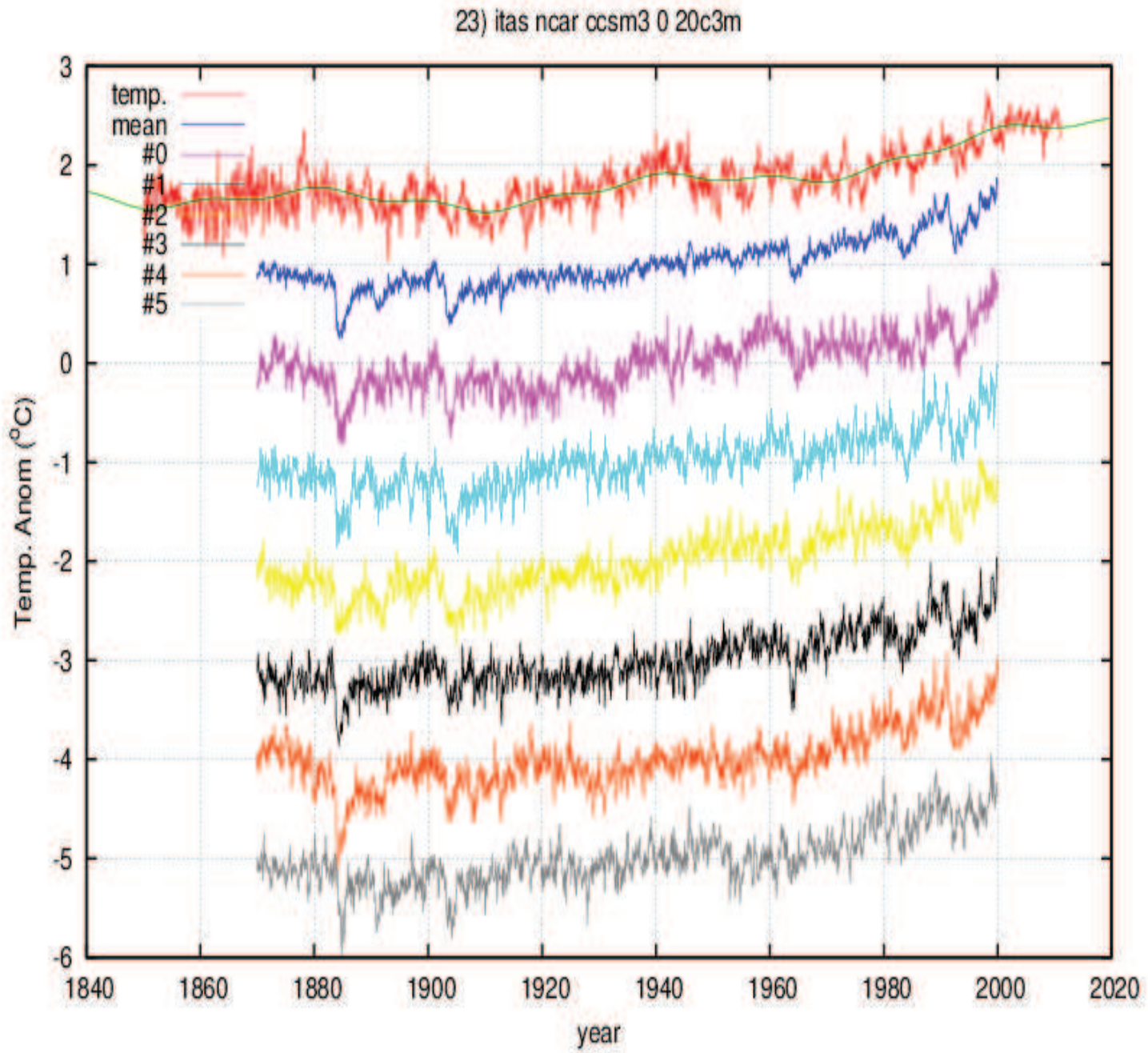
model	n.	a	err	b	err	c	err	d	err	X^2
ECHAM5/ MPI-OM	mean	0.19	0.04	0.31	0.09	0.70	0.02	-0.02	0.004	104
ECHAM5/ MPI-OM	0	0.69	0.06	0.32	0.15	0.43	0.01	-0.12	0.005	260
ECHAM5/ MPI-OM	1	0.32	0.07	0.09	0.16	0.43	0.01	-0.12	0.005	279
ECHAM5/ MPI-OM	2	0.32	0.07	0.46	0.17	0.71	0.02	-0.01	0.005	62
ECHAM5/ MPI-OM	3	-0.09	0.07	0.30	0.17	0.78	0.03	0.15	0.007	74



Institution: Meteorological Research Institute, Japan

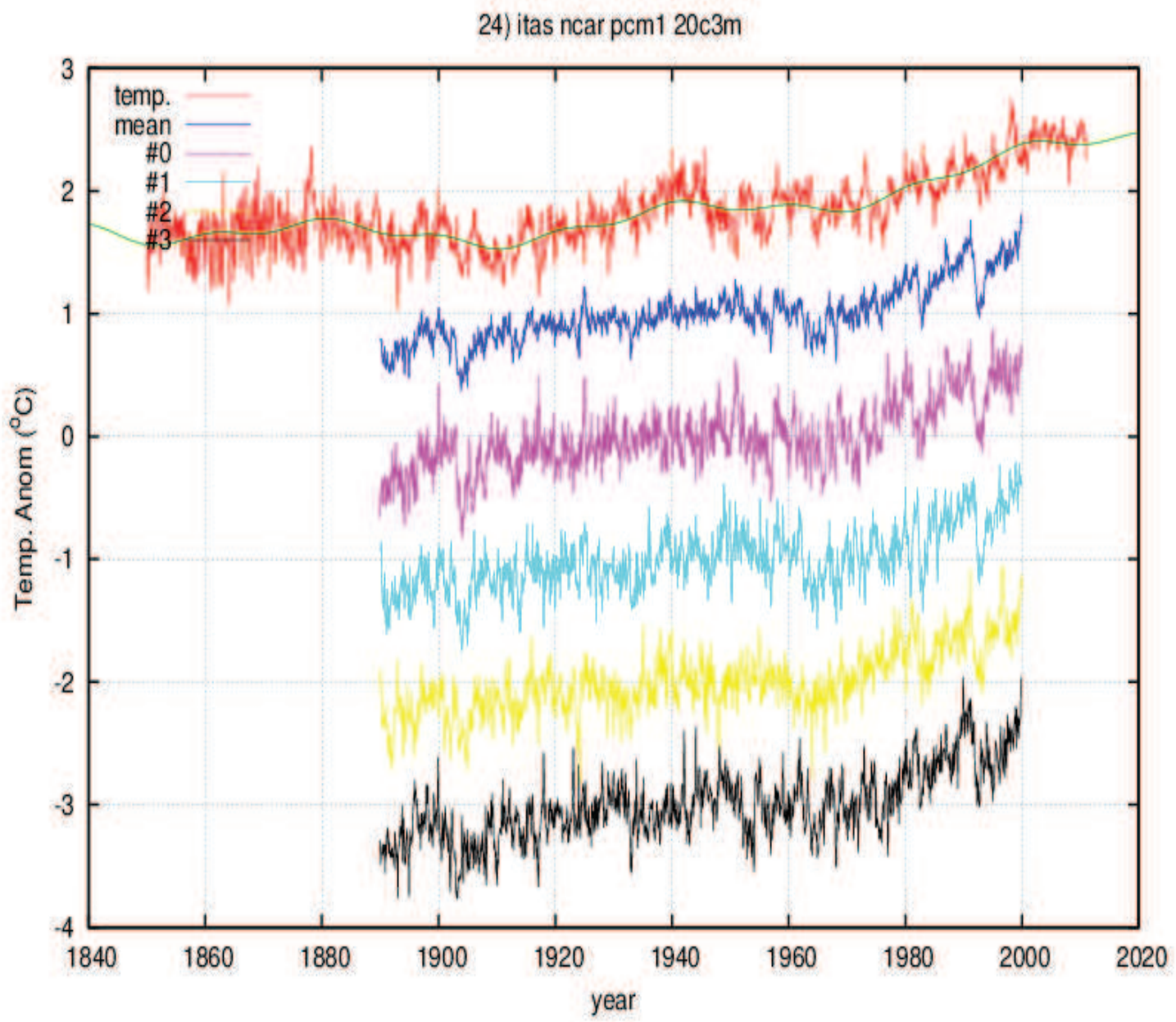
Note that the simulations increase quite monotonically without any multidecadal dynamics.

model	n.	a	err	b	err	c	err	d	err	X^2
MRI CGCM 2.3.2	mean	0.31	0.03	0.03	0.07	1.36	0.01	0.27	0.004	149
MRI CGCM 2.3.2	0	0.05	0.05	0.23	0.13	1.37	0.02	0.27	0.005	125
MRI CGCM 2.3.2	1	0.44	0.05	-0.32	0.13	1.21	0.02	0.24	0.005	58
MRI CGCM 2.3.2	2	0.46	0.05	0.34	0.13	1.54	0.02	0.31	0.005	143
MRI CGCM 2.3.2	3	0.31	0.05	-0.43	0.12	0.14	0.02	0.28	0.005	373
MRI CGCM 2.3.2	4	0.29	0.05	0.30	0.12	1.33	0.02	0.26	0.005	85



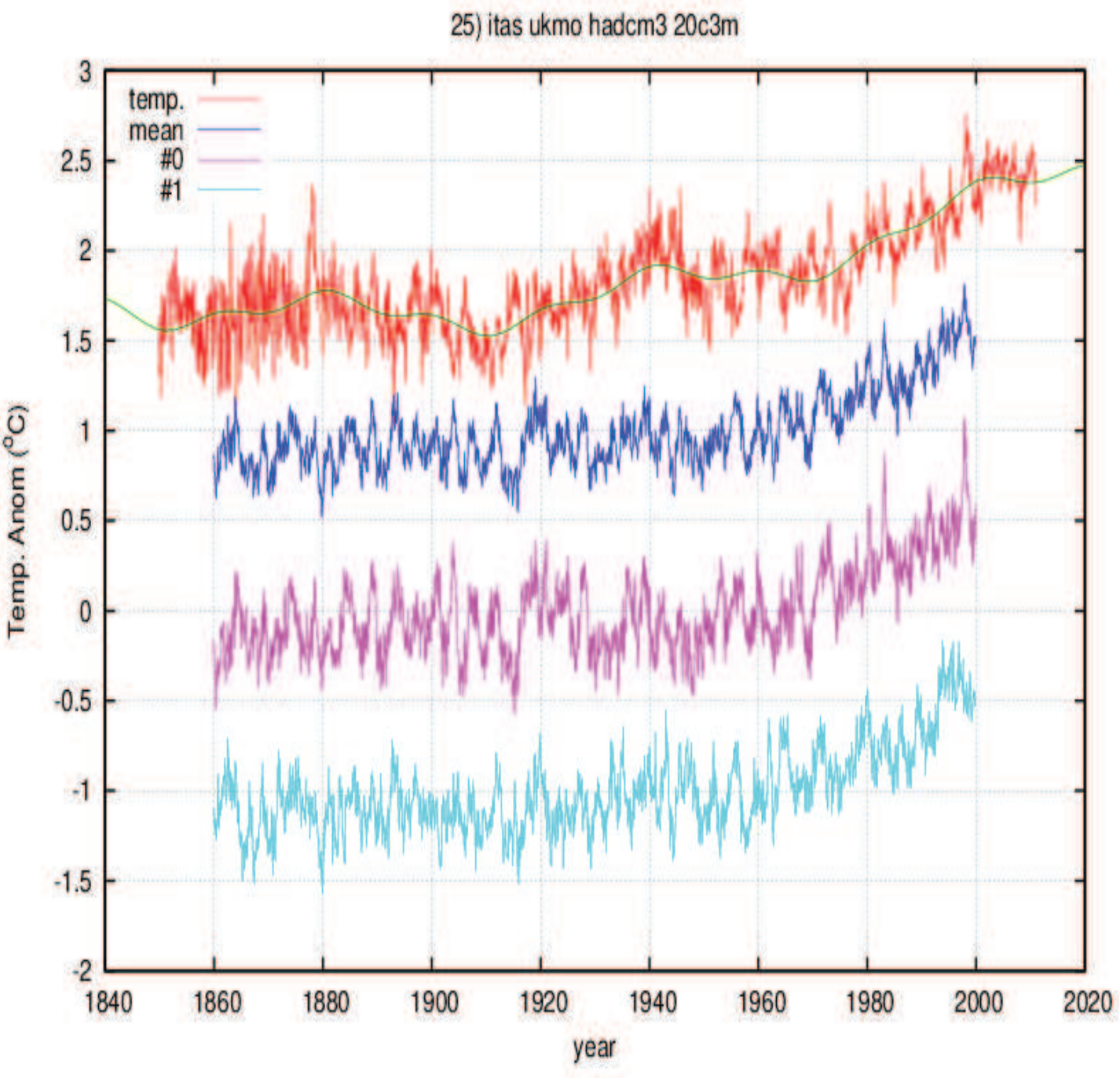
Institution: National Center for Atmospheric Research, USA (NCAR)
Note that the simulations increase monotonically with a dynamics not related to the observation. There are very large volcano cooling spikes and signatures not observed in the temperature data.

model	n.	a	err	b	err	c	err	d	err	X^2
CCSM3.0	mean	0.34	0.04	0.43	0.10	1.29	0.02	0.24	0.004	76
CCSM3.0	0	0.45	0.06	0.52	0.16	1.14	0.03	0.21	0.006	25
CCSM3.0	1	0.56	0.06	0.63	0.16	1.28	0.02	0.23	0.006	44
CCSM3.0	2	0.40	0.06	0.14	0.15	1.59	0.02	0.29	0.006	149
CCSM3.0	3	-0.10	0.06	0.02	0.14	1.28	0.02	0.24	0.006	109
CCSM3.0	4	0.28	0.07	0.84	0.17	1.24	0.03	0.23	0.007	39
CCSM3.0	5	0.45	0.06	0.46	0.15	1.24	0.03	0.22	0.006	34



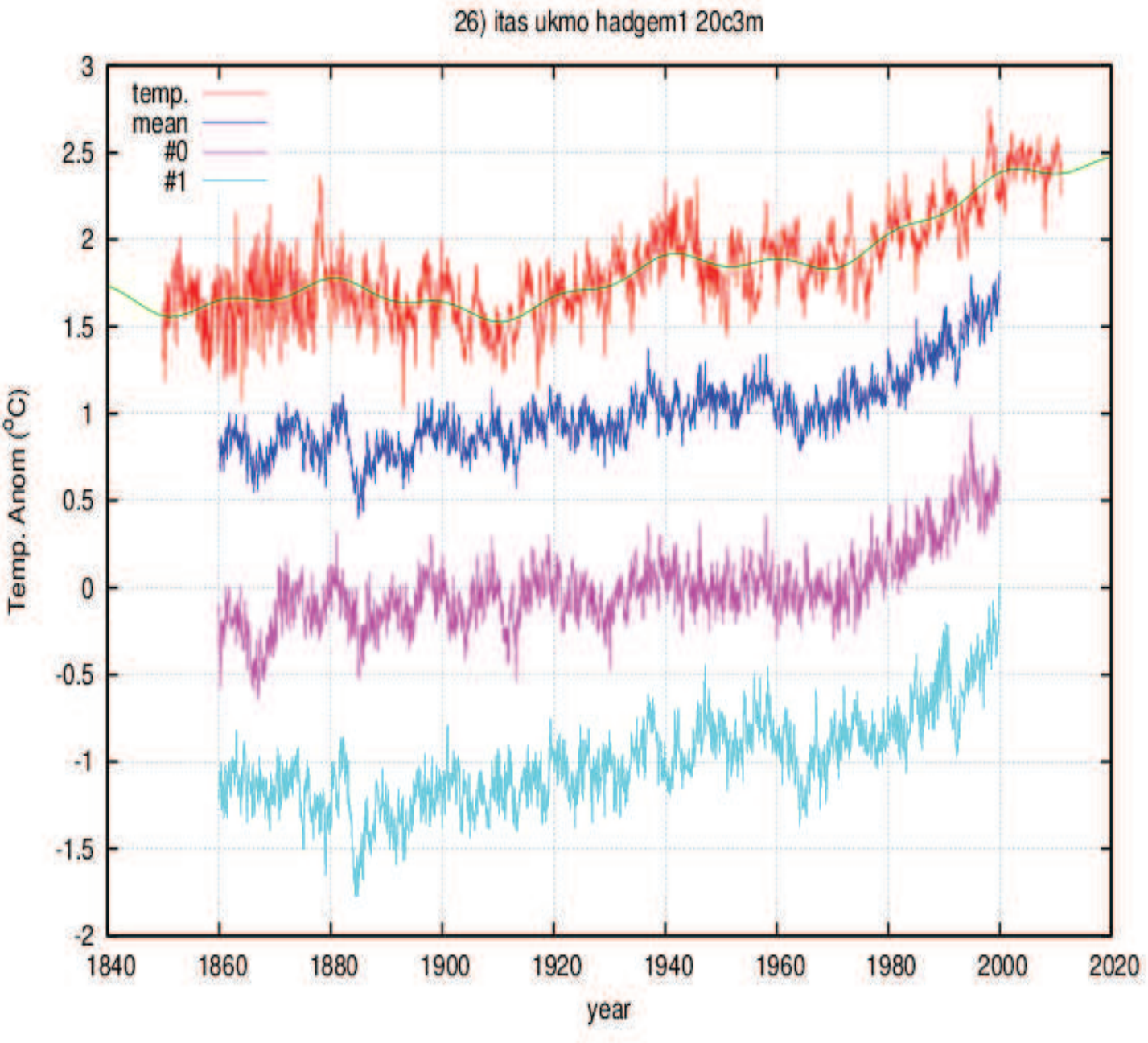
Institution: National Center for Atmospheric Research, USA (NCAR)
The simulations present a multidecadal dynamics and some large volcano spikes not observed in the data

model	n.	a	err	b	err	c	err	d	err	X^2
PCM	mean	0.77	0.05	0.49	0.12	1.00	0.02	0.16	0.004	7
PCM	0	0.71	0.08	0.45	0.19	1.02	0.03	0.16	0.007	6
PCM	1	0.86	0.08	0.57	0.18	0.86	0.03	0.14	0.007	8
PCM	2	0.57	0.07	0.85	0.17	1.02	0.03	0.16	0.006	10
PCM	3	0.94	0.08	0.10	0.19	1.10	0.03	0.17	0.007	7



Institution: Hadley Centre for Climate Prediction and Research / Met Office, UK
Note that the simulations are almost flat until1970.

model	n.	a	err	b	err	c	err	d	err	X^2
UKMO HADCM3	mean	0.28	0.05	0.56	0.11	0.94	0.02	0.18	0.005	42
UKMO HADCM3	0	0.13	0.06	0.75	0.15	0.90	0.03	0.18	0.006	47
UKMO HADCM3	1	0.42	0.06	0.36	0.13	0.97	0.02	0.19	0.006	25



Institution: Hadley Centre for Climate Prediction and Research / Met Office, UK.
The simulations show some multidecadal dynamics not related to the observations and some too large volcano spikes.

model	n.	a	err	b	err	c	err	d	err	X^2
UKMO HADGEM1	mean	0.52	0.04	0.63	0.10	1.05	0.02	0.20	0.004	24
UKMO HADGEM1	0	0.61	0.05	0.80	0.13	0.91	0.02	0.17	0.005	16
UKMO HADGEM1	1	0.44	0.06	0.45	0.14	1.18	0.02	0.23	0.005	35