Christine Symington

Global Warming: The Science of Climate Change
David Archer
December 12, 2013

Meteorological Station Temperature Comparison to IPCC findings and Climate Models

Introduction

For my Term Project, I chose the following project:
Select a set of meteorological stations that represent all climate zones and average them to estimate the global mean temperature evolution of the past decades, and compare it with the global mean estimate from the IPCC. Evaluate how different climate models driven by the historical and natural-only climate forcings do in their hindcasts.

Analysis

Search Criteria for Stations:

To ensure analysis results that could detect a meaningful trend, I selected a set of meteorological stations from each climate zone that had 5 or more stations with the most continuous temperature data beginning in 1900 and ending in 2008 or later.   These stations had the most consistent availability of temperature data for the time periods of 1900-1950, 1950-2011, and 1900-2011.   Additionally, I selected stations from as many geographical locations and elevations within a climate zone to obtain a representative sample. See Appendix for url of station lists.
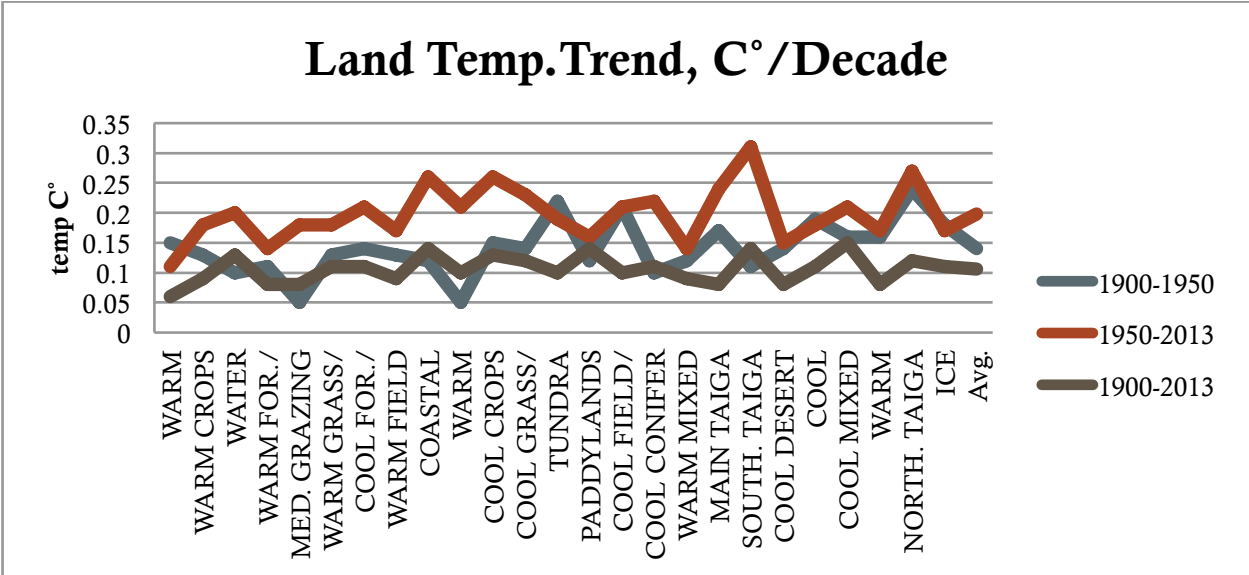
Land Temp.Trend, C°/Decade

Table 1

Temperature Trend, °C / Decade				
	1900-1950	1950-2013	1900-2013	Total Stations
WARM DECIDUOUS	0.15	0.11	0.06	9
WARM CROPS	0.13	0.18	0.09	20
WATER	0.1	0.2	0.13	19
WARM FOR./FIELD	0.11	0.14	0.08	11
MED. GRAZING	0.05	0.18	0.08	5
WARM GRASS/SHRUB	0.13	0.18	0.11	7
COOL FOR./FIELD	0.14	0.21	0.11	10
WARM FIELD WOODS	0.13	0.17	0.09	10
COASTAL EDGES	0.12	0.26	0.14	12
WARM IRRIGATED	0.05	0.21	0.1	9
COOL CROPS	0.15	0.26	0.13	12
COOL GRASS/SHRUB	0.14	0.23	0.12	10
TUNDRA	0.22	0.19	0.1	7
PADDYLANDS	0.12	0.16	0.14	7
COOL FIELD/WOODS	0.21	0.21	0.1	11
COOL CONIFER	0.1	0.22	0.11	13
WARM MIXED	0.12	0.14	0.09	11
MAIN TAIGA	0.17	0.24	0.08	7
SOUTH. TAIGA	0.11	0.31	0.14	6
COOL DESERT	0.14	0.15	0.08	9
COOL IRRIGATED	0.19	0.18	0.11	5
COOL MIXED	0.16	0.21	0.15	13
WARM CONIFER	0.16	0.17	0.08	5
NORTHTAIGA	0.24	0.27	0.12	5
Avg.	0.139	0.199	0.106	233

The average land surface temperature trend of the 233 meteorological stations covering 24 climate zones for the time period of 1900-2013 experienced an average temperature increase of 0.106 C°. The average temperature change for the time period of 1900-1950 was an increase of 0.139 C°. The average temperature change for the time period of 1950-2013 was an increase of 0.199 C°. The average temperature has increased since 1900 with a greater average increase in the last 6 decades.

Comparison to the IPCC Global Average Surface Temperature:

The Intergovernmental Panel on Climate Change states in the Summary for Policymakers that the global average surface temperature (land and ocean) has increased, especially since about 1950. The IPCC states that land surface in particular has increased by approx. 1.25 C° since 1900 with most of the increase occurring after 1950. This analysis observes the same trend with an average land temperature increase of .106 C° since 1900 and an increase of 0.199 C° since 1950 compared to an increase of 0.139 C° between 1900-1950.

Evaluation of Climate Models:

Table 2

| | Historical | | | Historical Nat | | |
Model	1900-1950	1950-2013	1900-2013	1900-1950	1950-2013	1900-2013
bcc-csm1-1	0.12	0.28	0.13	0.05	0.03	0.03
BNU-ESM	0.14	0.27	0.15	0.07	0.07	0.02
CanESM2	0.05	0.19	0.06	0.01	-0.03	-0.02
CCSM4	0.14	0.19	0.1	0.01	0.01	-0.1
CNRM-CM5	0.06	0.17	0.08	0.03	0	0.01
CSIRO-Mk3-6	0.1	0.07	0.02	0.02	0.08	0.02
GISS-E2_H	0.16	0.06	0.08	0.04	-0.02	-0.01
IPSL-CM5A	0.08	0.22	0.12	0.13	-0.01	0.01
MIROC-ESM	0.17	0.11	0.06	0.05	-0.01	0.01
MRI-CGCM3	0.07	0.08	0.06	-0.03	-0.01	-0.01
NorESM1-M	0.08	0.14	0.07	0.08	0.03	0.02
Avg.	0.106	0.162	0.085	0.042	0.013	-0.002

Table 2 shows the temperature trend assumptions of the 233 meteorological stations using the 11 climate models under two scenarios: 1) historical with human climate forcings and 2) historical with natural climate forcings only.

Table 3

Temperature Trend, C°/Decade			
	1900-1950	1950-2013	1900-2013
Hist.	0.106	0.162	0.085
Hist. Nat	0.042	0.013	-0.002
Sample Meteorological Stations	0.139	0.199	0.106

Table 3 compares the surface temperature trend of the climate models to those of the sample meteorological stations. According to the climate models, the temperature trend for the time period of 1950-2013 should have been 0.013 C° increase with natural climate forcings and an increase of 0.162 C° human climate forcings. The sample meteorological stations observed an increase of 0.199 C°, a 23% increase to the human climate forcing scenario and a 1430% increase to the natural climate forcing scenario. This result suggests that the temperature trend recorded for the period of 1950-2013 is greater than the composite models predict given natural climate forcings and especially with human climate forcings.

Summary:

The surface temperature data used in this analysis shows an increasing trend from the time period of 1900-2013, especially from 1950-2013. This would support the statement from the IPCC that global temperatures have increased dramatically since 1950. This average surface temperature trend in this analysis is also slightly higher than the composite climate models predict given human forcings and considerable higher than they predict given only natural forcings.

Bibliography

IPCC, 2013: Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Appendix

url of meteorological stations used in the analysis

http://climatemodels.uchicago.edu/timeseries/#HmKrRPBgMFjQEyBeRKxODCFBBBG
KClDFFIEHODFQZVMCTYICEKErBaRBoBkCCDGFEBaGJDFCCNDLDDGDoCRN
BlYEbCGdKhKiCkHGnDlIrBhBeIDDOBfBiBoLIDcDCwBzIBoECxBjByDDBqGDQGJ
RHCElFVBbCFGHFuJSBFGXSGEEQGDgHQTLBoYBbHELBpBhBbJOKQLBpOGZIC
BOCRGDGFRFbFSBpCcFwCgFaXBwIpBmEmCDFCBrQKQNGUGYBYBfBDOCECC
FiCQRIBvBfZLDSBFXSBrUSBBCdIpCDMLByBBn