Roger Caiazza 2014 RGGI Operating Plan Comments

These are my personal comments on the proposed 2014 RGGI Operating Plan. The following comments are my personal opinion. In no way do they reflect the position of any of my employers, either present or past, nor do they reflect the position of the Environmental Energy Alliance of New York (EEANY) member companies.

In summary, RGGI Operating Plan funds should be used as effectively as possible and should also include a metric to insure that NY climate change policies are not at the expense of those least able to pay any additional costs incurred. The ultimate goals of New York State climate change programs should be to reduce energy use, develop the technology to create a self-sustaining non-fossil fueled economy, and develop strategies to adapt to extreme weather events. Note that I do not support any greenhouse gas mitigation programs because the benefits of those reductions have not been quantified.

<u>Plan Effectiveness and Policy Cost Tracking</u>

My over-arching concern is that the RGGI money must be spent effectively. In that regard, Table 2. Summary of Expected Cumulative Annualized Program Benefits through December 31, 2013 in NYSERDA's report New York's Regional Greenhouse Gas Initiative-Funded Programs Annual Report Quarter Ending December 31, 2013, Final Report April 2014 is instructive. The dollars per ton of CO2 emissions lifetime savings ranges from $9 to $435. Preference in future funding should be given to those programs that have provided the lowest CO2 emissions lifetime savings. For example, if $100 per ton is used as a cutoff, the Solar Thermal Incentive Program, NYSERDA Photovoltaic Initiative, LIPA Photovoltaic and Efficiency Initiative, and the Regional Economic Development & GHG Reduction programs are candidates for funding cuts.

There was a brief discussion during the stakeholder meeting on May 9 about allocating funds beyond those projected in the budget. I recommend that those excess funds be allocated first to the programs with the lowest CO2 emissions lifetime savings per ton. Also note that this metric in Table 2 can be used to evaluate overall program effectiveness. The table claims that overall the programs are reducing CO2 lifetime emissions at a cost of $52 per ton. However that calculation does not include the costs of all the programs or the administrative costs which drive the cost per ton up to $59 per ton.

New York State climate change policies have not developed a specific metric to insure that costs are not impacting those least able to pay. In the draft energy plan for example, the Improved Energy Affordability metric is proposed but no numbers are provided and it may not provide that protection. A metric that tracks whether the Energy Plan disproportionately disadvantages Environmental Justice (EJ) households due to energy price increases is needed. In the United Kingdom, Ireland and New Zealand (for instance), a household is said to be in "fuel poverty"[1] when its members cannot afford to keep adequately warm at reasonable cost, given their income. In the UK, fuel poverty is said to occur when a household needs to spend more than 10% of its income to maintain an "adequate heating regime". An example in this country is the Columbus Ohio community service organization, Impact Community Action, which provides assistance when energy bills are six percent of a person's income.

New York's climate change programs will affect not only fuel for heating but also electricity use so I recommend that a parameter called "energy poverty" be defined as those households who pay six percent or more of their total income for heat and electricity. It is generally agreed by economists that taxing energy is regressive because poor people live in older, less insulated households, have less fuel-efficient vehicles, and use older and more energy-consuming appliances. So the poor spend more of their money on power as a share of annual earnings. When energy prices go up, the effect is felt more by the poor than the rest of society. If that parameter or metric were available and updated on a regular basis, it could be used to track EJ household energy cost impacts. If that parameter changes over time, plans could be adjusted to minimize those effects. I recommend that the RGGI operating plan include funding for this specific parameter or something similar.

Reduce Energy Use

Energy conservation and energy efficiency are true "no regrets" policies. Importantly, those programs are the most direct way to insure that those least able to pay the added costs of RGGI and ratepayers in general receive benefits from the proceeds. NYSERDA has also shown that these programs are reducing CO2 lifetime emissions cost-effectively. However, there should be much more emphasis on helping households with low incomes and others who could use help. The fact that only 16,320 households have been helped suggests that more outreach is necessary. Therefore, I recommend that the operating plan include an outreach program to find homeowners who could benefit from this support. If nothing else, have someone go out in the winter, look for houses with excessive icicles and then target them for increased weatherization and insulation.

From a purely anecdotal standpoint I believe there is enormous potential in New York City for energy conservation and energy efficiency projects. Eight years ago my son moved to Brooklyn and has lived in four apartments in that time. None of the apartments had anything approaching state of the art energy conservation, e.g. no thermal windows. Most troubling to

[1] See http://en.wikipedia.org/wiki/Fuel_poverty

me is that in two instances the apartment building had just be rehabilitated. The State is missing a golden opportunity to work with rehabilitation contractors to incorporate state of the art energy conservation features when buildings are renovated if his experience is any indicator of the situation.

Self-sustaining Non-fossil Fueled Economy

I define self-sustaining alternatives as those that do not require subsidies. I believe that the "solution" to avoid the continued use of fossil fuels is a cheaper alternative. When that happens then the alternatives will be used and become self-sustaining. NYSERDA is an ideal organization to harness the intellectual power of New York to develop those technologies. Some portion of the RGGI money should be allocated to long term development of promising non-fossil fuel technology. NYSERDA should first define what would constitute a breakthrough for non-fossil fuel technology costs and then develop a funding mechanism that minimizes up front picking of the technology.

Adaptation Strategies

The ClimAID analysis has done a good job of identifying extreme weather risks. Clearly, New York State is presently a long way from being resilient to existing extreme weather events. Climate change may affect future extreme weather risks but because New York cannot handle existing weather risks adaptation to those events is a "no regrets" policy and should be encouraged. I support continued evaluation of climate to better define NY's climate but do not support regional climate modeling future projections. Climate model results have too large uncertainties to provide additional value beyond what has already been done. A more detailed comment on my rationale for no more modeling support and specific climate analysis is included at the end of my comments.

GHG Mitigation Programs

I believe that mitigating greenhouse gases should <u>not</u> be a goal of New York State climate policies but I am willing to change my mind if the State can show reasonable benefits of New York State reductions. To date, none of the New York State climate initiatives have actually quantified the expected benefits of the mitigation programs proposed. I believe that it is incumbent on the State to quantify the expected changes, particularly in light of the resources available to the State for the "no regrets" policies described above. The RGGI operating plan should prove the value of greenhouse gas mitigation before funding any projects that mitigate GHG emissions using technology that must be subsidized. That money is better spent on the "no regrets" policies described above.

For example, in the absence of any State analysis I have adapted data for the New York State emissions in Table 1 to show the potential benefits of mitigation from the analysis available at http://scienceandpublicpolicy.org/originals/state_by_state.html . The original analysis of U.S. and state by state carbon dioxide 2010 emissions relative to global emissions quantifies the relative numbers and the potential "savings" in future global temperature and global sea level rise from a complete cessation of all CO2 emissions.

This analysis shows current growth rate in CO2 emissions from other countries of the world will quickly subsume any reductions in New York State CO2 emissions. According to data from the U.S. Energy Information Administration (EIA) and based on trends in CO2 emissions growth over the past decade, global growth will completely replace an elimination of all 2010 CO2 emissions from New York State in 79 days. For the emissions reductions proposed in the energy plan (reduce the intensity of its carbon emissions from the energy sector by 50 percent by 2030), global growth will completely replace the expected reductions in less than five days. The NYSERDA operating plan status report claims GHG emission reductions of 2,653,226 tons. Global growth will completely replace those reductions in 1.2 days.

Furthermore, using assumptions based on the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports we can estimate the actual impact to global warming. If all the New York State 2010 emissions of 173 million tons are eliminated the ultimate impact on projected global temperature rise would be a reduction, or a "savings," of approximately 0.0025°C by the year 2050 and 0.0053°C by the year 2100. Those values are smaller than the detection level of most thermometers.

Clearly, if the effects of the expected emissions reductions on global temperature rise are so small that they cannot be reasonably expected to be measured, then the potential effect on the purported environmental impacts of climate change in New York State will be similarly small. If the State has a different assessment of the potential impacts of this plan then it should be provided. Otherwise, it appears that the rationale to make investments in any greenhouse gas mitigation programs is inappropriate.

Table 1: Analysis of Predicted Effect of New York Energy Plan CO2 Emissions Reductions and Potential “Savings” in Future Global Temperature and Global Sea Level Rise Based on 2010 Global Emissions

Scenario	CO2 Emissions Million Metric Tons	Percentage of Global Total	Time Until Total Emissions Subsumed by Global Growth: Global Growth	China Growth	Temperature "Savings" Deg C: 2050	2100	Sea-Level "Savings" (cm): 2050	2100
NY Observed 2010	172.8	0.55%	79	121	0.0025	0.0053	0.0184	0.0552
US Observed 2010	5,631.30	17.88%	2,563	3,954	0.0830	0.1720	0.6000	1.8000
	NY Reduction							
All NY 50% reduction	86.4	0.27%	39	61	0.0013	0.0026	0.0092	0.0276
All NY 80% reduction	138.24	0.44%	63	97	0.0020	0.0042	0.0147	0.0442
Energy Sector 50% reduction	10	0.03%	4.6	7.0	0.0001	0.0003	0.0011	0.0032
RGGI Status Report	2.653226	0.01%	1.2	1.9	0.0000	0.0001	0.0003	0.0008

Based on “Analysis of US And State-By-State Carbon Dioxide Emissions (For 2010) and Potential “Savings” In Future Global Temperature And Global Sea Level Rise From a Complete Cessation of All CO2 Emissions”, Paul Knappenberger, 2013.

Using assumptions based on the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports, if the U.S. as a whole stopped emitting all carbon dioxide (CO2) emissions immediately, the ultimate impact on projected global temperature rise would be a reduction, or a “savings,” of approximately 0.08°C by the year 2050 and 0.17°C by the year 2100— amounts that are, for all intents and purposes, negligible.

The impact of a complete and immediate cessation of all CO2 emissions from the U.S. on projections of future sea level rise would be similarly small—a reduction of the projected sea level rise of only 0.6cm by 2050 and 1.8cm (less than one inch) by the year 2100.

The current growth rate in CO2 emissions from other countries of the world will quickly subsume any reductions in U.S. CO2 emissions. According to data from the U.S. Energy Information Administration (EIA) and based on trends in CO2 emissions growth over the past decade, global growth will completely replace an elimination of all CO2 emissions from the U.S. in just 7 years, while growth in emissions from China alone will subsume an elimination of all U.S. emissions in just under 11 years.

The climate change calculations are performed using the MAGICC climate model simulator (MAGICC: Model for the Assessment of Greenhouse-gas Induced Climate Change). MAGICC was developed by scientists at the National Center for Atmospheric Research under funding by the U.S. Environmental Protection Agency and other organizations. MAGICC is itself a collection of simple gas-cycle, climate, and ice-melt models that is designed to emulate the output of complex climate models. MAGICC produces projections of the global average temperature and sea level change under user configurable emissions scenarios and model parameters. There are many parameters that can be altered when running MAGICC, including the climate sensitivity (how much warming the model produces from a doubling of CO2 concentration) and the size of the effect produced by aerosols. In all cases, the MAGICC default settings were used (for example, a climate sensitivity of 3.0°C), which represent the middle-of-the-road estimates for these parameter values.

Also, assumptions about the U.S. emissions pathways were made as prescribed by the original IPCC scenarios in order to obtain the baseline U.S. emissions to which the emissions reduction schedule could be applied—taking U.S. emissions to zero (starting from 2010 levels) by the year 2020 and keeping them there to 2100 (the end of the simulation).

Climate Modeling and Climate Monitoring

I do not believe that there is any value in any future climate modeling projections using RGGI funds. I recommend that ClimAID not include any future funding for that work. The money spent on the modeling would be better allocated if it were used to improve historical climate analysis of New York.

Climate Modeling

I am a retired meteorologist with over 40 years of experience. The ClimAID projections of regional impacts are based on models that are incredibly complex and can never be verified. I personally don't have much confidence in those climate models. At one point in my career I evaluated air quality models against monitored results where the predicted maximum concentrations matched observed maximum concentrations but the meteorological conditions were different. The fact that the much simpler models (based on field studies and not theory) got the right answer for the wrong reason suggests to me that climate models could very easily have the same flaw. Furthermore, in my graduate level weather analysis and forecasting class the lab project to develop a simple weather forecast model gave me an appreciation of the simplifications and parameterization difficulties inherent in even the simplest weather models. As a result it does not surprise me in the least that the model predictions are diverging from the observations.

My viewpoint was echoed by someone with a much better background in complex modeling. Dr. Robert G. Brown, Duke University writes that in addition to the modeling problems there is an inherent flaw that perpetuates the process. He writes "solving the problem the GCMs are trying to solve is a grand challenge problem in computer science. It isn't at all surprising that the solutions so far don't work very well. It would rather be surprising if they did. We don't even have the data needed to intelligently initialize the models we have got, and those models almost certainly have a completely inadequate spatiotemporal resolution on an insanely stupid, non-rescalable gridding of a sphere."

In addition, my position is supported by Dr. Roger Pielke, Sr. who responded "No" to the following question: "Are skillful (value-added) regional and local multi-decadal predictions of changes in climate statistics for use by the water resource, food, energy, human health and ecosystem impact communities available at present?" He summarizes the current state of modeling and the use of regional models to downscale for multi-decadal projections, as reported in Pielke and Wilby (2012)[2]:

1. The multi-decadal global climate model projection must include all first-order climate forcings and feedbacks, which, unfortunately, they do not.

2. Current global multi-decadal predictions are unable to skillfully simulate regional forcing by major atmospheric circulation features such as from El Niño and La Niña and the South Asian monsoon , much less changes in the statistics of these climate features. These features play a major role of climate impacts at the regional and local scales.

3. While regional climate downscaling yields higher spatial resolution, the downscaling is strongly dependent on the lateral boundary conditions and the methods used to constrain the regional climate model variables to the coarser spatial scale information from the parent global models. Large-scale climate errors in the global models are retained and could even be amplified by the higher-spatial- resolution regional models. If the global multi-decadal climate model predictions do not accurately predict large-scale circulation features, for instance, they cannot provide accurate lateral boundary conditions and interior nudging to regional climate models. The presence of higher spatial resolution information in the regional models, beyond what can be accomplished by interpolation of the global model output to a finer grid mesh, is only an illusion of added skill.

4. Apart from variable grid approaches, regional models do not have the domain scale (or two-way interaction between the regional and global models) to improve predictions of the larger-scale atmospheric features. This means that if the regional model significantly alters the atmospheric and/or ocean circulations, there is no way for this information to affect larger scale circulation features that are being fed into the regional model through the lateral boundary conditions and nudging.

5. The lateral boundary conditions for input to regional downscaling require regional-scale information from a global forecast model. However the global model does not have this regional-scale information due to its limited spatial resolution. This is, however, a logical paradox because the regional model needs something that can be acquired only by a regional model (or regional observations). Therefore, the acquisition of lateral boundary conditions with the needed spatial resolution becomes logically impossible. Thus, even with the higher resolution analyses of terrain and land use in the regional domain, the errors and uncertainty from the larger model still persist, rendering the added simulated spatial details inaccurate.

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[2] Pielke Sr., R.A., and R.L. Wilby, 2012: Regional climate downscaling – what's the point? Eos Forum, 93, No. 5, 52-53, doi:10.1029/2012EO050008. http://pielkeclimatesci.files.wordpress.com/2012/02/r-361.pdf

Climate Monitoring Summary

Earlier this year I reviewed Section 1.2.5 Historical Analysis in the NYSERDA "Responding to Climate Change in New York State: The ClimAID Integrated Assessment For Effective Climate Change Adaptation In New York State" (ClimAID) report published in 2011 in the Annals of the New York Academy of Sciences, Volume 1244. My focus was on historical trends in seasonal and annual average temperature contained in Section 1.2.5 Historical Analysis and I am including it here because the analysis indicated that there are some specific things the operating plan should support in the future.

This results of my review found that the description of the historical climate in the original CimAid report did not adequately address the uncertainties of the historical data record. There are important differences between the results from the historical data set used in the report and a second more recent data set. Those differences extend beyond the results themselves to the data records. The uncertainty of historical trends issue was not raised in the report.

I discussed my findings with Dr. Bader after I was unable to reproduce the historical data analyses in the paper. Ultimately we found that the original analysis used a different data set than the most recent version that I used to calculate trends. Importantly another data set for historical climate trend analysis has come out since the original analysis too.

RGGI Operating Plan Recommendations

The remainder of these comments provide support for the following recommendations:

- The USHCN data used in the ClimAID report does not address site-specific issues so it should not be used exclusively in future updates to the historical climate reports. Even the BEST data set that purports to address those issues needs to be refined for New York specific trend analyses. Resolving issues with both data sets should be included in the RGGI operating plan.
- New York climatic trends should be prepared for true climatic regions of the state and that analysis should be funded by the RGGI Operating plan
- A database with station historical documentation would be invaluable to try to determine the impact of site-specific issues and should be included in the RGGI operating plan.
- Any adjustment methodology that tries to remove site-specific issues should incorporate not only climatic regime but also station quality. This would be a useful contribution to the literature and should be support by the RGGI operating plan

All of these recommendations should be a higher priority than any additional climate modeling.

Analyses

The trend analysis in of Section 1.2.5 Historical Analysis in the ClimAID report was conducted at one station with a long data record in each of seven regions using data from the United States Historical Climatology Network (USHCN). USHCN data are corrected for time of observation and change in observation practice through time. Note that those corrections and others are implemented across many stations and many years so the process is necessarily automated as much as possible. Missing data are filled in using "optimized spatial interpolation" but the report notes that those interpolations have been shown not to affect trends. More concerning is the fact that the data product is not specifically adjusted for urbanization.

The data from the seven stations was processed to produce three historical trend tables in the ClimAID report. There were some trend comparisons that begged for explanation. In particular, New York City and Port Jervis are not all that far apart and my initial impression is that they would be affected by the same weather patterns so trends at the two stations would be similar. However, over the period 1901 to 2000, all the seasonal trends and the annual trend were positive and significant at the 99% level for New York City but only the winter trend was significant at the 95% level at Port Jervis. Assuming that Central Park has been affected more by urbanization than Port Jervis and knowing that the data product used is not specifically adjusted for urbanization, suggests that a detailed review is appropriate.

Irrespective of the data analysis, my first concern is that I do not think that the seven ClimAID climate regions are representative. From the standpoint of climatic characterization, Region 5 which extends from Westchester County, north above Albany and then west to Madison County is inappropriate. The storm systems and geographic climate drivers are significantly different between Westchester County and Oneida County. It would have been more appropriate to use the already established New York Climate Divisions shown in Fig. 1.

Since the publication of this document a historical climate network specifically developed to address site-specific issues has been developed. The Berkeley Earth Surface Temperature (BEST) Study was founded in early 2010 with the goal of addressing concerns site specific issues. Four of these concerns are relevant to this analysis: potential biases from data selection, data adjustment, poor station quality, and the urban heat island effect. Therefore, at a minimum, future updates to the analyses used in the ClimAID report should include the BEST data as input to the trend analyses. However, as will be shown in this analysis, there still are issues with the BEST data processing techniques. In particular, it may be asking too much of any processing system that handles data from 17,444 active stations, 18,863 former stations and has over 14 million monthly observations to address all site-specific situations in New York State.

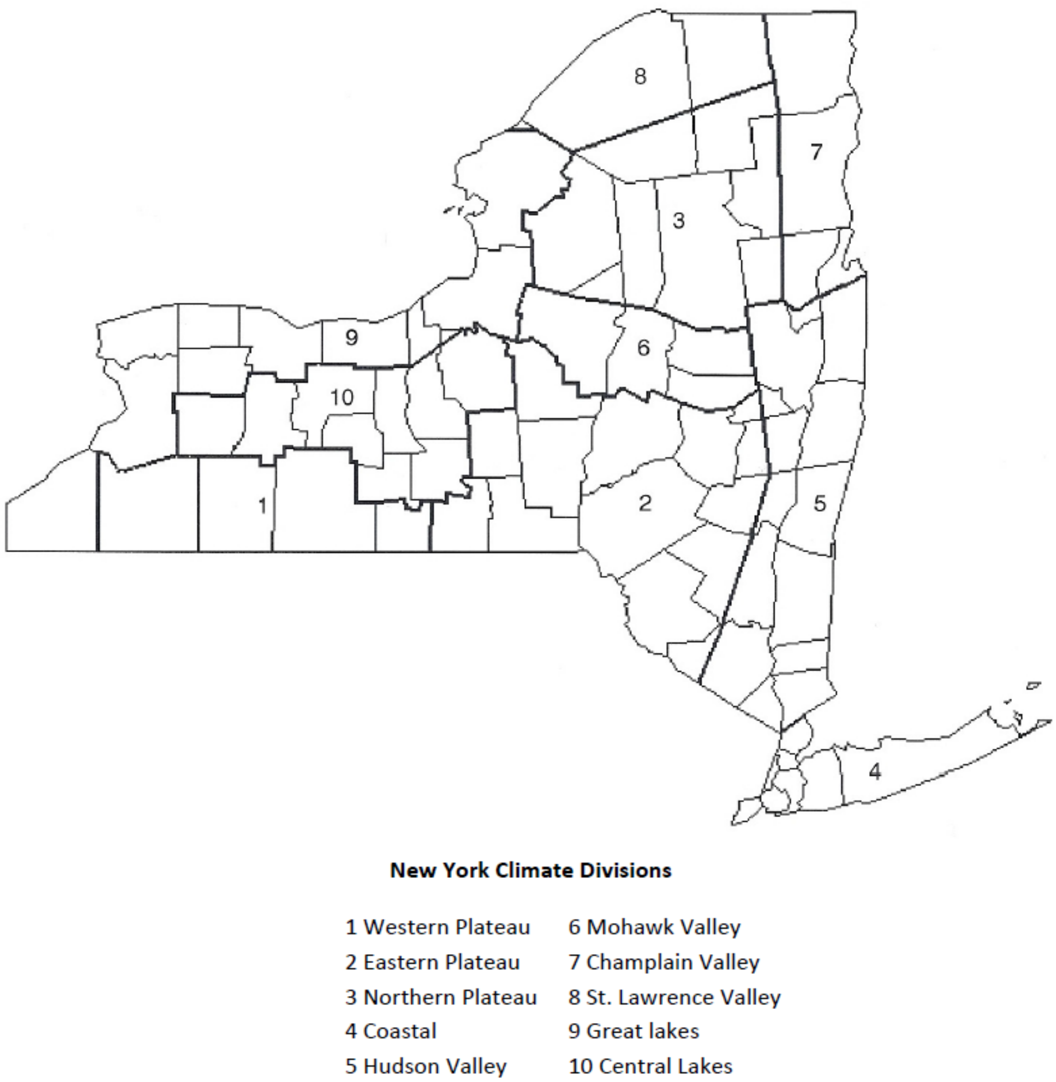

Figure 1: New York State Climate Division Map

In order to review the historical trend analyses, USHCN New York station data were downloaded from the Oak Ridge National Laboratory's Carbon Dioxide Information Analysis Center (http://cdiac.ornl.gov/epubs/ndp/ushcn/ushcn_map_interface.html). Initially the data used for the seven stations in Section 1.2.5 were downloaded but additional station data were added later. As shown in Table 1, the trends listed in the ClimAID report for the seven stations are different for different versions of the USHCN data set. The trends are determined by running a linear regression on the data available with the USHCN adjusted annual temperature as the dependent variable and year as the independent variable and assuming that the slope of the regression equaled the climatic trend. While there are more statistically significant trends in the data set used for my analysis, note that one of them is negative. Clearly there is a difference in the data.

Table 1: Observed Climate Trends in New York Using Annual Averages (1901 - 2000)

	USHCN later version		ClimAID Report	
Station	Decadal Trend	Significance	Decadal Trend	Significance
Albany	0.15	Significant at 95%	0.18	Significant at 99%
Elmira	0.06		0.01	
Indian Lake	-0.41	Significant at 95%	0.15	Significant at 99%
New York City	0.31	Significant at 95%	0.39	Significant at 99%
Port Jervis	0.33	Significant at 95%	0.06	
Rochester	0.28	Significant at 95%	0.20	Significant at 99%
Watertown	0.17	Significant at 95%	0.17	Significant at 99%

Similarly, data from the BEST open database (http://berkeleyearth.lbl.gov/station-list/) was downloaded for the same seven locations. Note, however, that the BEST data processing approach merges station data from very similar locales into a single file. Therefore, I took the longest station record available at Albany, Elmira, Indian Lake, New York City, Port Jervis, Rochester and Watertown. Moreover, annual average data are not available from this data base. As a result, direct comparison with the annual trends are not possible. In Table 2, monthly data from the later version of the USHCN network and the BEST network were used to calculate century climate trends. Of note is the fact that there are large differences in the results between the two approaches at some sites.

Table 2: Observed Climate Trends in New York Using Monthly Averages (1901 - 2000)

	USHCN Data		BEST Data	
BEST	Decadal Trend	95% Significance	Decadal Trend	95% Significance
Albany	0.180		0.172	
Elmira	0.163		0.078	
Indian Lake	0.172		0.192	
NYC	0.189		0.325	Significant
Port Jervis	0.151		0.343	Significant
Rochester	0.185		0.302	
Watertown	0.226		0.186	

For consistency with the BEST issues this review considered four aspects of the study for potential biases: data selection, data adjustment, poor station quality, and the urban heat island effect. The remainder of this analysis addresses each one.

For the purposes of this study, I assumed that data selection refers to the locations used to characterize the climate of New York. As mentioned earlier, I believe it would be more appropriate to characterize the state's climate using New York Climate Divisions than the NYSERDA regions used. Within whatever region chosen a prime criterion is the length of the record. A complete review of the length of record for each station within the climatic regions was beyond my scope of analysis.

Data adjustment is controversial and necessary. Changes to the monitoring equipment, methodology, and reporting times all can affect the data and, unfortunately may not be documented completely. Also important are changes to the land use in the vicinity of the monitoring location. If all these factors were constant over the period of record there would not be any issues but the fact is that they have changed everywhere. Both the USHCN (http://cdiac.ornl.gov/epubs/ndp/ushcn/monthly_doc.html#steps) and BEST (http://berkeleyearth.org/about-data-set) data adjustment methodologies are described in detail at their respective web sites.

Station quality in a global network has to address differences in equipment. It is presumed that differences in monitoring equipment is a relatively minor factor within the New York station data. Ultimately, the original site location process or changes to the land-use in the vicinity of the monitor may also result in poor station quality. In other words the data measurements may reflect those impacts more than any climatic trends. In the worst case no amount of data adjustments can tease out the climatic trend relative to those impacts. The urban heat island is a prime example of land use changes affecting the data record. As buildings and roads replace open space the local climate changes.

In a limited scale network analysis such as this one focused only on New York I recommend that preference should be given to those stations with the least potential for these impacts. When trying to characterize long term trends preference should also be given to those stations that have the least land-use change near the station. I recommend that the RGGI operating plan support in-depth analysis to find the most appropriate trend stations in New York, as part of the New York Climate Change Clearinghouse project.

In order to test whether site-specific factors affect station data in New York I analyzed data from all five USHCN stations in the Northern Plateau NY Climate Division where I would expect the same temperature trend and, compared to the rest of the state, less urbanization. In addition to Indian Lake I analyzed data from: Lake Placid, Lowville, Tupper Lake, and Wanakena.

None of these could be considered cities but there still is a possibility that local-scale factors affected the temperature trends.

In order to check my assumption of minimal site-specific impacts, I looked at the station locations using Google Earth and the documented locations. This approach has high uncertainties because some of the locations found using this method were very unlikely (e.g., far from any trails, roads, or structures as opposed to somewhere that a monitoring station would be more likely). Nonetheless, the key finding is that Indian Lake is a rural location. There is nothing that could be considered urbanization there now and little signs of even the potential for micro-scale effects from, for example, a parking lot. If the New York Climate Change Clearinghouse could confirm that this monitoring location has not been subject to significant local-scale effects then it would be a valuable test for the adjustment methodologies. In the meantime I can only guess at the implications.

The first site-specific factor analysis was to look at the trends at all five stations from five different data sets: USHCN Raw, USHCN Adjusted for time of observation changes, USHCN with all adjustments, BEST Raw; and BEST with all adjustments (Table 3). The USHCN and BEST raw data do not match in my data sets. BEST data are reported in deg C and USHCN are reported in deg F so my unit change calculation rounding could be part of the problem but spot checking the data revealed some significant outliers in the BEST data. For example at Indian Lake the May 1901 BEST raw data value is 4.333 deg C or 39.8 deg F. The USHCN raw data value is 52.8 deg F. For the BEST raw data to be correct May would have to be three degrees colder than the April value which is unlikely. I tried calculating trends with the BEST outliers greater than two deg F manually changed to the USHCN values but the trends still did not match as I would expect from the raw data. I would also nominate reconciliation of this issue for inclusion in the New York Climate Change Clearinghouse task.

The trend results for all five data sets from January 1901 to December 2000 are listed in Table 3. As before, I simply ran a linear regression on the data available with the monthly temperature as the dependent variable and year fraction per month as the independent variable and assumed that the slope of the regression equaled the climatic trend. Note that the only trend that is significant at the 95% level or greater is the Lake Placid BEST raw data for all the months.

If the only factor affecting the temperature trends was some regional or global effect, then I would expect all the trends in the same climatic region to be similar. For all the data, the USHCN raw data range is smaller than the BEST raw data range and the two USHCN adjusted values so those values are closest to what is expected. The BEST adjusted data has an even smaller range but the adjustments in that processing system change the trend range from the raw data (0.5 deg F) to 0.1 deg F for the adjusted data. This is where the Indian Lake metadata would be invaluable. If Indian Lake is and has been relatively immune from local scale impacts, then the regional homogenization routine in BEST should not be converting the data trend from -0.08 to 0.17. I suspect that the regional adjustments in the BEST algorithm are affecting the trend adjustments too much in this instance and if it could be confirmed would argue that site quality should be considered in their approach.

Table 3: Decadal Trends New York Northern Plateau Stations for 1901 to 2000
*** denotes trend significant at the 95% or greater level**

All Months	**USHCN Raw deg F**		**USHCN Tobs deg F**		**USHCN Adjusted deg F**		**Best Raw deg F**		**Best Adjusted deg F**	
Indian Lake	0.192		-0.104		0.128		-0.081		0.172	
Lake Placid	0.252		0.288		0.240		0.405	*	0.209	
Lowville	0.229		0.056		0.017		0.139		0.272	
Tupper Lake	0.086		0.130		0.211		0.108		0.285	
Wanakena	0.188		0.114		0.173		0.101		0.176	
Regional Avg.									0.192	

July Only	**USHCN Raw deg F**		**USHCN Tobs deg F**		**USHCN Adjusted deg F**		**Best Raw deg F**		**Best Adjusted deg F**	
Indian Lake	-0.045		-0.196	*	-0.109		-0.193	*	0.085	
Lake Placid	0.134		0.145		0.126		0.255	*	0.068	
Lowville	0.140		-0.059		-0.090		0.186		0.094	
Tupper Lake	-0.052		-0.006		-0.006		-0.007		0.127	
Wanakena	0.161	*	0.102		0.124		0.096		0.091	
Regional Avg.									0.085	

January Only	**USHCN Raw deg F**		**USHCN Tobs deg F**		**USHCN Adjusted deg F**		**Best Raw deg F**		**Best Adjusted deg F**	
Indian Lake	0.067		-0.260		0.054		-0.276		0.012	
Lake Placid	0.068		0.051		-0.020		0.244		0.023	
Lowville	-0.026		-0.185		-0.259		-0.134		0.028	
Tupper Lake	-0.101		-0.309		-0.110		-0.287		-0.082	
Wanakena	-0.009		-0.149		-0.004		-0.147		-0.033	
Regional Avg.									0.012	

Another adjustment factor consideration is that the USHCN and BEST methodologies don't adjust in the same direction. USHCN trends are less for the adjusted data at four out of five stations. BEST trends are larger for four out of five stations.

I have also included the trends for all the July and all the January data. I chose to do the middle of the meteorological extreme seasons to try to simplify the analysis. There are four significant trends in the July data and none in the January data. None of the significant trends are associated with the adjusted data. The same large adjustments from the BEST raw data to the adjusted values occurs for both sets of data. The raw USHCN data has a lower range across the stations than either of the other USHCN data sets.

From the standpoint of the comparison to the ClimAID report, these results suggest that more analysis as part of the RGGI operating plan is appropriate. In the original report, Indian Lake is supposed to be warming at 0.15 deg F over the period 1901 to 2000 at the 99% significance level. When I calculated a trend using annual data the trend was -0.41 at the 95% significance level. As shown in Table 3 when using monthly data, the trends range from -1.04 to 0.192 depending upon the data set used.

The second site-specific factor analysis compared each station relative to the regional mean over a long time period (Table 4). The USHCN database had data for all five stations from January 1893 to December 2012 suitable for this analysis. I extracted thirty years of monthly data for the 30-year periods 1893-1922 and 1983-2012 and compared the means between those two periods. For example, the 95% confidence interval for the regional mean temperature was 37.9 to 41.7 in the 1893-1922 climatic period and was 40.0 to 43.7 in the 1983 to 2012 climatic period. Clearly temperature is increasing but the t-test that compares the means of the two samples shows that there is not a statistically significant difference between the two means. All that suggests is that over the time period between the two means there hasn't been enough warming to make it statistically significant.

My hypothesis is that the t-test can be used to check station local-scale impacts. In particular, if there hasn't been any local impacts at a site, then the relative difference between the station and the regional means should be the same for both climatic periods. So for the same time periods I calculated the difference between the monthly regional mean and station value and compared the 30-year means. Only the Indian Lake means are the same and because the t-test assumes that the variance in the two periods is the same and the F-test suggests that is not true so is not a robust result. Thus I cannot claim that there haven't been local impacts at any of these sites. The regional mean does pass the test but note that if local effects at the stations are occurring that likely means that the regional mean is affected too.

Table 4: For the regional mean - station data: Is there a difference between the mean 1893 and 1922 data and the mean 1983-2012 data?

	1893 - 1922		1983-2012		Difference of Means		t test to compare means				
	95.0% confidence interval for mean		95.0% confidence interval for mean		95.0% confidence interval for mean				Null Hypothesis Alpha = 0.05	Means Different?	F-Test Standard Deviation
	Low	High	Low	High	Low	High	t	P value			
Regional Mean	37.9	41.7	40.0	43.7	-4.7	0.5	-1.6	0.1194	No	No	Reasonable
Regional Mean - Indian Lake	0.3	0.5	0.4	0.6	-0.2	0.0	-1.5	0.1382	No	No	Questionable
Regional Mean - Lake Placid	2.0	2.2	1.2	1.4	0.7	1.0	13.4	0.0000	Reject	Yes	Reasonable
Regional Mean - Lowville	-0.5	-0.4	-0.7	-0.6	0.1	0.3	3.7	0.0002	Reject	Yes	Reasonable
Regional Mean - Tupper Lake	-0.4	-0.3	0.3	0.4	-0.8	-0.6	-14.1	0.0000	Reject	Yes	Reasonable
Regional Mean - Wanakena	-1.8	-1.7	-1.6	-1.4	-0.4	-0.1	-3.6	0.0003	Reject	Yes	Questionable