

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.

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President's Message

Hello everyone and welcome to ASHRAE LI February meeting!

This month we are returning to an **IN-PERSON** meeting at our usual spot, the Westbury Manor. Hopefully we can keep up the in-person meetings through the end of the year.

The ASHRAE AHR Expo wrapped up last week, I hope that it went well for all that attended!

We are in the middle of our Membership Battle! See details below in our membership promotion segment and help the chapter by promoting membership in your company. Membership has been struggling the last few years in ASHRAE as a whole – although our chapter has been doing quite well despite the last few years difficulties. Please keep your membership up to date and remind your peers to do the same. Our biggest challenge as the BOG is minimizing the amount of lapsed members. Take a look at the history section below – 30 years of consecutive membership (and age 65) earns you a spot in the Life Members Club of ASHRAE!

Make sure to view the GGAC article below as well – there is some good information on the new Local Laws.

We will be finalizing a few YEA and membership events for the spring, and we will update as soon as we have dates nailed down.

Please keep an eye on the website, <u>www.ashraeli.com</u>, for the most up to date information on monthly presentations, upcoming events, etc.

If anyone is interested in joining a committee, please reach out to anyone on the board of governors. We are always looking for volunteers!

Regards,

Matthew Vitrano President - Long Island Chapter

CHAPTER MONTHLY MEETING

DATE:	Tuesday, February 8, 2022
TIME:	6:00 PM - Cocktails/Dinner 7:00 PM - Dinner Presentation 8:45 PM - Conclusion
LOCATION:	Westbury Manor 1100 Jericho Tpke. Westbury, NY 11590
FEES: Members - Guest - Student -	\$50.00 \$60.00 \$15.00

Check the ASHRAE Website for Society news and to join/renew membership! <u>http://www.ashraeli.com</u>

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Long Island Chapter Officers & Committees

ASHRAE 2020/2021 OFFICERS

POSITION	NAME	PHONE	EMAIL
President	Matthew Vitrano	516.319.9325	<u>c006@ashrae.net</u>
President-Elect	Murat Bayramoglu	631.312.8818	c006pe@ashrae.net
Vice President	Michael Nigro	212.643.9055	c006vp@ashrae.net
Treasurer	Elizabeth Jedrlinic	516.490.1621	c006tr@ashrae.net
Secretary	Matthew Catan	407.489.6684	c006sec@ashrae.net
Board of Governors	Michael Razzano	516.805.3084	c006bog1@ashrae.net
Board of Governors	Zhigang Xu		c006bog2@ashrae.net
Board of Governors	Rich Smith		c006bog3@ashrae.net
Board of Governors	Michael S. Gerazounis	212.643.9055	c006bog4@ashrae.net
Board of Governors	James Hanna	718.269.3768	c006bog5@ashrae.net

ASHRAE 2020/2021 COMMITTEES

COMMITTEE	NAME	PHONE	EMAIL
Programs & Special Events	Murat Bayramoglu	631.312.8818	c006pe@ashrae.net
Membership (MP)	Michael Razzano	516.805.3084	c006mep@ashrae.net
Refrigeration	Andrew Dubel		c006ref@ashrae.net
Chapter Technology Trans- fer (CTTC)	Murat Bayramoglu	631.312.8818	c006cttc@ashrae.net
Grassroots Government	James Hanna	718.269.3768	<u>c006ggac@ashrae.net</u>
Newsletter Editor	Liset Cordero	212.643.9055	c006ne@ashrae.net
Research Promotion (RP)	Michael Nigro	212.643.9055	c006rp@ashrae.net
Historian	Elizabeth Jedrlinic	516.490.1621	c006his@ashrae.net
Student Activities (SA)	Matthew Catan	407.489.6684	c006sa@ashrae.net
Young Engineers in ASHRAE (YEA)	Michael S. Gerazounis	212.643.9055	<u>c006yea@ashrae.net</u>
Webmaster	Frank Paradiso	631.632.2792	c006web@ashrae.net
Nominating	Michael Gerazounis, PE, LEED AP	212.643.9055	nominating@ashraeli.org
Reception & Attendance	Zhigang Xu / Matt Catan / Michael S. Gerazuonis		reception@ashraeli.org
PR & Engineering Joint	Andrew Manos, LEED AP	631.632.2792	pr@ashraeli.org
Golf Outing	Peter Gerazounis, PE LEED AP	212.643.9055	golf@ashraeli.org
Awards	Brian Simkins	203.261.8100	c006ha@ashrae.net
	ASHRAE LI, P.O. Box 7	9, Commack, NY 1172	25

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Chapter Monthly Meeting - Program for	2021/2022
September 14, 2021 * At Westbury Manor	March 8, 2022 * At Westbury Manor
Dinner Presentation – Fan Fundamentals Presenter: Andy Siegelson	Dinner Presentation— HVAC Noise Control Presenter: Dan LaForgia ** 1 PDH **
Refrigeration Night	Student Activities Night YEA Night
October 12, 2021 * At Westbury Manor 🗸	April 12, 2022
Dinner Presentation — PPRCT Pipe and Fitting Systems for HVAC Water Distribution and Compressed Air Distribution Presenter: Jordan Stern **1 PDH**	Dinner Presentation— TBD Presenter: TBD **1 PDH**
November 9, 2021 * At Westbury Manor	May 2, 2022 * Cherry Valley Club, Garden City, NY
Dinner Presentation— Critical Environment Air Distribution Appli-	ANNUAL GOLF OUTING
cations Presenter: Larry Scholl, CEM, LEED AP BD+C	
1 PDH	
Membership Promotion Student Activities Night and YEA Night Resource Promotion Night	
December 14, 2021 * At Westbury Manor V	May 10, 2022
Dinner Presentation— Eliminating the High Cost of Over	Annual Field Trip
Presenter: Rick Smith **1 PDH**	
January 11, 2022 * At Westbury Manor V	June 14, 2022 * At Westbury Manor
Dinner Presentation— Duct System Acoustics	Free Buffet Dinner for Members
Presenter: Patrick J. Brooks, MBA, P.E. ASHRAE DISTINGUISHED LECTURER **1 PDH**	PAST PRESIDENTS NIGHT & OFFICER INSTALLATION
	STUDENT SCHOLARSHIPS TO BE AWARDED ASHRAE History Quiz and prize Give-A-Ways
January 29 - February 2, 2022 🗸	June 2022 - TBD (4pm-8pm) * Dixie II @ Captree State
ASHRAE Winter Conference	
	ANNUAL FISHING TRIP
February 8, 2022 * At Westbury Manor	August 2022
Dinner Presentation— Optimizing IAQ and Energy Efficiency Presenter: Joe Maser **1 PDH**	CHAPTERS' REGIONAL CONFERENCE (CRC) REGION I GRANIT STATE
Membership Promotion Night Resource Promotion Night	
February 20-26, 2022	
NATIONAL ENGINEERS WEEK	

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Meeting Program



Dinner Presentation Optimizing IAQ and Energy Efficiency

Presented by

Joe Maser Technical Product Manager



DATE:	TUESDAY, FEBRUARY 8, 2022 (VIRTUAL PRE	SENTAT	ION)
Time:	6:00 PM - Cocktails and Hors D'ouevres 7:00 PM - Dinner Presentations 8:45 PM - Conclusion	Fee:	\$ 20.00 per person
Location:	WESTBURY MANOR (516) 333-7117 1100 Jericho Tpke., Westbury, NY 11590 Directions are posted at @ www.ashraeli.org		
Presentation:	This month's presentation discusses the challengerating building systems under two major segment presenter will detail the investor and employee product 2197), and budget pressures/net operating incom health concerns, safe return to work, employee preserves on how to sell leases will be explained All attendees will receive 1 PDH.	e of bala its: efficie essures, e for imp erforman d througl	ncing health, efficiency, and cost of op- ent buildings and healthy buildings. The regulatory mandates (e.g., codes, roved efficiency. The ideas around ce & productivity, and differentiating hout the presentation.
About our Speaker:	Joe Maser is a detail oriented HVAC designer, de indoor air quality products. His professional exper Healthcare facility HVAC design including infectio in mechanical engineering with experience design ASHRAE indoor air quality procedure.	veloping ience inc n isolatio ning custo	industry leading and science driven cludes: Building system design, n rooms, commissioning. Background om ventilation systems using the

CHAPTER MAY NOT ACT FOR SOCIETY

An International Organization

The Long Island Chapter is looking for presenters for the remainder of the year. Please contact us if you are interested in presenting to our membership.

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THE LONG ISLAND SOUNDER

Long Island Chapter - Past Presidents

958	H. Campbell, Jr. PE	1990	Robert Rabell
959	Clyde Alston, PE	1991	Gerald Berman
960	Sidney Walzer, PE	1992	Donald Stahl
961	Sidney Gayle	1993	Ronald Kilcarr
962	William Kane	1994	Jerald Griliches
963	Louis Bloom	1995	Walter Stark
964	Milton Maxwell	1996	Joe Marino
965	Will Reichenback	1997	Norm Maxwell, PE
966	Joseph Minton, PE	1998	Alan Goerke, PE
967	Irwin Miller	1999	Frank Morgigno
968	Walter Gilroy	2000	Michael Gerazounis, PE, LEED AP
1969	Charles Henry	2001	Ray Schmitt
970	William Wright	2002	Steven M. Stein, PE
1971	Louis Lenz	2003	Andrew Braum, PE
1972	Ronald Levine	2004	Claudio Darras, P.E.
1973	Henry Schulman	2005	Craig D. Marshall, P.E.
1974	Myron Goldberg	2006	John Nally
1975	John N. Haarhaus	2007	Peter Gerazounis, PE, LEED AP
976	Richard K. Ennis	2008	Steven Friedman, PE, HFDP, LEED AP
1977	Kenneth A. Graff	2009	Steven Giammona, P.E., LEED AP
1978	Evans Lizardos, PE, LEED AP	2010	Nancy Román
1979	Albert Edelstein	2011	Carolyn Arote
980	Ralph Butler	2012	Brian Simkins, LEED AP
1981	Robert Rose, PE	2013	Andrew Manos, LEED AP BD+C
982	Timothy Murphy, PE	2014	Richard L. Rosner, P.E.
1983	Leon Taub, PE	2015	Thomas J. Fields, P.E., LEED AP
1984	Raymond Combs	2016	Donald Kane, P.E.
1985	Edward W. Hoffmann	2017	Andrew Dubel, P.E., LEED AP
1986	Jerome T. Norris, PE	2018	Richard Halley
1987	Abe Rubenstein, PE	2019	Frank Paradiso
1988	Michael O'Rourke	2020	James Hanna
1989	Mel Deimel		

			PAOE	e poir	NTS FO	OR 2021	2022			
Chapter Members	Chapter Operations	СТТС	Communi- cations	GGAC	History	Member- ship	Research Promotion	Student Activities	YEA	Chapter PAOE Totals
282	495	700	0	0	120	525	400	125	1,400	3,765

THE LONG ISLAND SOUNDER

Membership Promotion

Well, it's officially a month into the new year and it's check in time for your New Year Resolutions! So, here's your reminder to the commitments you made to yourself. What were they? Are you holding yourself accountable? Some of the most common New Year Resolutions are:

- Improve a relationship
- Learn a new skill, hobby or furthering your education
- Drink less alcohol
- Find another or better job

Well, if any of these looks to be familiar, then membership in the epitome of chapters (AKA the Long Island Chapter) is one of the most perfectly fit group to get you to some of those goals. Through our chapter improve your relationships with colleagues within the industry,

goals. Through our chapter improve your relationships with colleagues within the industry, as well as you could volunteer. Volunteering through research opportunities, fundraising, becoming a committee member, etc....an opportunity to restore and/or build a relationship to volunteering in our great organization are endless!

If learning a new skill, hobby or furthering your education, then you should know that our Long Island chapter offers Professional Development Hours or Continuing Education credits every month. PLUS, there are discounted rates for our members, while you get to enjoy a great meal. This is a great value and convenience for our members that are maintaining their LEED AP or P.E. credentials.

Being a connected community that helps each other, it's a natural fit for anyone looking to advance their career. Within our chapter, our members can network to meet fellow like-minded HVAC professionals. This is critical ASHRAE portion that's important to all participants from the seasoned professional, new members transitioning from students to professional memberships.

As far as the less drinking portion goal...sorry...we might not be able to help you here...BUT three out of the four goals aren't that bad!

As mentioned in previous month's Membership article, we have a "Membership Battle" going on! This is based on your percentage growth at the end of the year. The three (3) categories are:

- Small Firms 15 employees of less
- Medium Firms 16 to 50 employees
- Large Firms over 51 employees

Currently, we have the following companies enrolled in their respective categories:

- Small Firms 15 employees of less
 Stony Brook Engineering
- Medium Firms 16 to 50 employees Rathe Associates Klima NY
- Large Firms over 51 employees
 - H2M MG Engineering Trane



Membership Promotion

If you would like to enroll your company into the "Membership Battle," please contact me and ask your colleagues to update their profile information & RESPECTIVE EMPLOYER.

In the end, we'd like to thank our new members who have considered the benefits of membership and who have decided to join our community. With the continued growth, the Long Island chapter grew in February by three (3) members. Our new members continue to offer a varied skill set that makes them valuable additions to our community. LONG IS-LAND WELCOMES YOU!

I would like to informally welcome our new members this month:

- 1. Daniele Mancini Jr
- 2. Joseph Hayden
- 3. Kurt Vassallo
- 4. Brian Reid
- 5. Angelo DeArmans
- 6. David Shaw
- 7. Michael Steck
- 8. Joseph Karcher

Looking forward to another great month and thank you in advance for your support, time & guidance.

Michael H. Razzano Membership Promotion Chair

Richard Smith Membership Promotion Co-Chair

THE LONG ISLAND SOUNDER

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History

I thought it would be interesting to examine the Life Members Club of ASHRAE from a historical perspective. These are the longest running members of ASHRAE and they have witnessed a lot of the growth, development and change throughout the years.

The objectives of the club are to:

- 1) Uphold the purposes and objectives of the American Society of Heating, Refrigeration and Air-Conditioning Engineers as stated in that Society's Certificate of incorporation.
- 2) Develop and fund an awards program to support education in the fields of heating, ventilating, air conditioning and refrigeration.

The Life Members Club actively seeks nominations, applications, and donations f or a number of awards including the E.K. Campbell Award, Grant-in-Aid Awards and occasional scholarships.

3) Promote fellowship within its membership.

Membership

ASHRAE members who have completed 30 years of cumulative membership and have reached age 65 are automatically members of Life Members Club. No member of the Club is required to pay dues. The Club accomplishes its objectives by obtaining voluntary donations from members.

Meetings

The Life Members Club have a Luncheon Meeting Tuesday at noon during the Winter and Annual meetings.

History of the Life Members Club

https://www.ashrae.org/file%20library/communities/life%20members%20club/life-members-club-history.pdf Manual of Procedures

https://www.ashrae.org/file%20library/communities/life%20members%20club/lmc-mop-20170131.pdf

Elizabeth Jedrlinic History Chair

Michael Razzano History Co-Chair



Student Activities

Overview

We hope everyone is having a nice ~Normalish~ 2022 thus far! We have many fun upcoming event planed for this year!

We just attended the big annual AHR conference in Vegas conference and was it fun! Great to see many friends and co workers from other regions and chapters.

It was also great to see a strong turnout from many of the large manufactures in the industry. The Long Island Chapter had several board members attend plus one Student!

If you are interested in attending a meeting, please reach out and I would be happy to provide all meeting information!

Joke of the Month:

The Optimist!!

	10
Ontimist:	The glass is HALF full
Pessimist:	The glass is HALF empty
Engineer:	The glass is TWICE the size it needs to be
	C MARINA COMPANY AND A PROPERTY

2018-2019 Society Scholarship Recipients Enjoy the 2019 ASHRAE Winter Conference in Atlanta



Pictured left to right: Rex Camit, Seneca Applied Arts & Sciences; Kelsey Moss, University of Nebraska; Jeffery Bogner, Kansas State University; Elena Gowdy, Pennsylvania State University; William Brandon Jacoby, Virginia Tech; Christine Laflin, Kansas State University; Dylan Gu, Pennsylvania State University



Student Activities

46 Society Scholarships Available for 2022-23!

Applications Due December 1, 2022

Through its scholarship program, ASHRAE seeks to motivate students worldwide to pursue an engineering or technology career in the HVAC&R field that will further promote sustainable technology for the built environment. Scholarships range from \$3,000 to \$10,000 and awarded for the academic year following the application deadline beginning with the fall semester. Qualified students are encouraged to apply at **ashrae.org/scholarships**. Now accepting applications for our Undergraduate Engineering, Engineering Technology, Regional/Chapter, & University-specific Scholarships.

Congratulations to the 2021 ASHRAE Student Branch Advisor of the Year:

Mr. Sampath Suranjan Salins!



The ASHRAE Student Activities Committee is proud to dedicate this award to ASHRAE Student Branch Advisors for their outstanding commitment to servicing student members and branches.

As Student Branch Advisor, Mr. Salins has organized various activities including poster competitions and distinguished lecturer visits. The details of some of the activities organized for the Manipal University Student Branch are listed **here**.

#Winning Zone | For Student Competition Information:

2022 Design Competition

The 2022 student competition focuses on a new performing arts building on a university campus located in Sydney, New South Wales, Australia. ASHRAE sponsors these competitions to encourage students to become involved in a profession that is crucial to ensuring a sustainable future for our Earth – the design of energy-efficient HVAC systems.

Link: https://www.ashrae.org/communities/student-zone/competitions/2022-design-competition

2022 Applied Engineering Challenge

As the global pandemic rages on, the need for climate-controlled transport containers for vaccine delivery has become a top priority. The 2022 Setty Family Foundation Applied Engineering Challenge (AEC) is focused on designing an ultra-cold refrigeration system that is capable of being transported to all global locations.

Link: https://www.ashrae.org/communities/student-zone/competitions/2022-applied-engineering- challenge

Student Activities

2022 Building EQ (Building Energy Quotient) Competition

The Student Activities Committee and Building EQ Committee have collaborated to create a new Building EQ competition. Students will have the opportunity to work evaluate and audit building energy consumption for buildings in operation to give the building a Building EQ score using the ASHRAE Building EQ online tools.

Link: https://www.ashrae.org/communities/student-zone/competitions/2022-building-eq-building- energy-quotient-competition

Solar Decathlon

The Solar Decathlon is a collegiate competition that challenges student teams to design and build highly efficient and innovative buildings powered by renewable energy. The combined competition features two tracks, the Design Challenge and the Build Challenge.

Link: https://www.ashrae.org/communities/student-zone/competitions/solar-decathlon-competition

Please reach out for more information If you are interested in participating of any of the above competitions!

Matthew K. Catan Student Activities Chairman

Zhigang Xu Student Activities Co-Chairman



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Grassroots Government Activities Committee (GGAC)

NYC introduce new local laws for 2022.

Local Law 50 of 2022 (Int. No. 2449-A)

A Local Law to amend the administrative code of the city of New York, in relation to penalties for failing to certify correction of immediately hazardous conditions and the reinspection of immediately hazardous conditions at construction sites.

https://www1.nyc.gov/assets/buildings/local_laws/ll50of2022.pdf

Local Law 44 of 2022 (Int. No. 2465-B)

A Local Law to amend the administrative code of the city of New York, in relation to stove safety knobs.

https://www1.nyc.gov/assets/buildings/local_laws/ll44of2022.pdf

Our local chapter is also looking to invite local leaders from surrounding towns and municipalities to our monthly meetings. If you know of any officials looking to get involved, please reach out to a BOG member or myself.

James Hanna Membership Promotion Chair

Rich Smith Membership Promotion Co-Chair

YEA

Registration for the spring leadership weekend is here! This event will be held in Atlanta Georgia from March 25th through the 27th. Registration is \$500 which includes meals and hotels for the event. Transportation to the event is not included with the registration cost. An additional technical tour of ASHRAE's new headquarters is available for \$200 that will take place on Thursday the 24th. Registration for optional tour will include a hotel room and meals for the additional day. For more details, please look online at ASHRAE's YEA events and programs tab.

https://www.ashrae.org/communities/young-engineers-in-ashrae-yea/yea-events-andprograms/yea-leadership-weekend



YEA Leadership Weekend - ASHRAE

YEA Leadership Weekend (Spring 2022) Atlanta, Georgia March 25-27, 2022 Registration will open in late January 2022. Are you interested in expanding your knowledge, meeting fellow engineers and having some fun along the way? www.ashrae.org

Michael S. Gerazounis YEA Chair

Rich Smith YEA Co-Chair



THE LONG ISLAND SOUNDER

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CTTC

We are excited to see all our chapter members **on February 8th, 2022, Tuesday 6:00 PM** at Westbury Manor. The presentation by Joe Maser, who serves as a technical product manager at enVerid, is about "Optimizing IAQ and Energy Efficiency." Mr. Maser, a detail-oriented HVAC designer, developing industry-leading and science-driven indoor air quality products. Professional experience: Building system design, Healthcare facility HVAC design including infection isolation rooms, commissioning. Background in mechanical engineering with experience designing custom ventilation systems using the ASHRAE indoor air quality procedure.

We want to thank Applied Technologies of New York for organizing this presentation. See you all at Westbury Manor.

The following excerpt from ASHRAE's "Science and Technology for the Built Environment" jour-

nal, which gives free access for its members through the ASHRAE website, discusses "Historical Trends in Climatic Design Conditions Based on Observations and Atmospheric Reanalysis' So many scientists and engineers worldwide issue their findings from their building science studies and experiments at this Journal. These studies can be an excellent source for engineers trying to solve any issues or find new ways to implement projects.

In the meantime, don't forget to follow upcoming events on Long Island Sounder Newsletter and social media link:

https://www.linkedin.com/in/ashraeli/

Murat Bayramoglu

CTTC Co-Chair

Historical Trends in Climatic Design Conditions Based on Observations and Atmospheric Reanalysis <u>Michael Roth</u>

Accepted author version posted online: 24 Jan 2022

1 Introduction

Climatic design conditions used in building design — for example, the 99% annual heating dry-bulb temperature — are typically based on the historical record. In the case of the ASHRAE *Handbook*—*Fundamentals* (ASHRAE 2021), hereafter simply the *Handbook*, this period of record is the most recent 25 years, at most. The design conditions are averages over the historical period and thus don't necessarily reflect the next 25 years in which buildings and equipment under design today will operate.

Over the past few releases of the climatic design information associated with the *Handbook*, techniques have been developed and refined (Thevenard and Shephard 2014; Roth 2017) to estimate the year-on-year changes in design conditions currently reported in the *Handbook*. The current release (Roth 2021) takes the next logical step — publishing the historical trends in selected design conditions in the tables that accompany the *Handbook*.

This paper provides the methodology by which the trends are calculated, both for an individual station and on a larger, regional basis together with a comparison to alternative methods. The methodology is first applied to the 9237 stations reported in the *Handbook* and then to alternative global gridded datasets based on atmospheric reanalyses.

2 Trend Analysis Methodology

Thevenard and Shephard (2014) examined temperature trends recorded by stations in the 2013 update of the *Handbook*, largely following the methodology of Helsel and Frans (2006). Specifically, during regular processing of the stations, the annual average, maximum, and minimum values of dry-bulb, dew-point, and wet-bulb temperature, were stored for each year. Trends were then established as the median slope formed from all pairs of yearly values for each statistic and temperature quantity. The significance of these trends was then evaluated via a nonparametric Mann-Kendall test based on the null hypothesis that the slope does not deviate significantly away from zero. On a *station-by-station* basis, Thevenard and Shephard (2014) found that most stations did not show a significant trend regardless of temperature quantity or statistic.

The global signal of climate change is evident, even in the presence of significant interannual variability/noise (e.g. El Nino). However, as one moves to smaller and smaller scales, eventually to the level of a meteorological station, the sig-



CTTC

nal is often difficult to separate from the noise. So, if one moves to a more regional scale (100s of km), one hopes to recover some of the trend signal. To this end, Thevenard and Shephard (2014) grouped stations into 5°×5° cells and repeated the analysis. In many cases there was only one station within a cell while in heavily-populated locations there can be upwards of 100 stations. In this methodology, trends were again found by calculating, for a given cell, the median slope for each station within the cell. The overall trend for that cell was then just the median slope of all the individual station slopes. An equivalent Mann-Kendall test statistic was then formed and assessed for significance. On this regional basis, Thevenard and Shephard (2014) found a much greater likelihood of a significant trend, often becoming ever more probable as the number of stations within each cell increased.

Roth (2017) extended this methodology with a few key changes.

• In order to incorporate the influence of interdependency in the data, the test was corrected to compensate for correlation in regional values.

In order to provide a robust estimate of extrema in the presence of outliers, the minimum and maximum values were replaced with values more associated with design, e.g. the 99% percentile.

Finally, (Roth 2021) finalized the methodology for publication in the *Handbook*, expanding the processing with additional climatic design elements of interest to the practitioner, e.g. heating and cooling degree-days. What follows is a full reporting.



The *Handbook* processing software is focused on the reporting of values representative of a period of time — for the 2021 edition, this was 1994–2019 for most stations. Values reported in the *Handbook* and associated tables are based on accumulating data into frequency "bins" for the case of percentile-based quantities like the 99% annual humidification dew-point temperature, "averages" in the case of quantities like monthly daily-average dry-bulb temperatures, or "sums" in the case of quantities like heating degree-days. Regardless, the interannual change in values is not a focus of the typical climate design element. Thus, the processing software was modified to record annual and monthly values of key elements:

- Heating and cooling degree-days for base temperatures of 10 °C (50 °F) and 18.3 °C (65 °F)
- For each of dry-bulb, dew-point, and wet-bulb temperature:
- o Annual and monthly daily averages;
- o 99% annual and 95% monthly heating and humidification design values; and,
- o 1% annual and 5% monthly cooling, dehumidification, and evaporation design values.

CTTC

Annual and monthly daily averages of dry-bulb temperature range.

It should be noted that, in contrast to typical statistical usage, ASHRAE-defined percentiles are based on exceedance values. That is, a 99% design value is expected to be exceeded 99% of the time over the period in question. Daily temperature ranges are calculated from the hourly records by finding the high and low temperatures for each day and taking the difference.

Data are largely drawn from the Integrated Surface Database (Smith, Lott, and Vose 2011), which merges hourly datasets from worldwide locations, performs standardized quality control, and assembles into a common data format. For Canadian locations, equivalent hourly data are extracted from Environment and Climate Change Canada.¹

In establishing the time series for each station, a great deal of screening and quality control was applied to the individual station data (Roth 2021). This screening involves establishing where stations are physically located, stitching nearby stations together to form longer time series, culling obvious outliers, and in-filling data gaps of up to 6 hours. However, even after this process, station time series can suffer from a number of changes not directly related to the local climate. Equipment can be replaced, be moved, or deterioriate/drift with time. The individual sensors misread during periods of excessive hot/cold temperatures or dry/wet conditions, perhaps conditions the station has never experienced. The exposure of the station, i.e. nearby vegetation or buildings, may change either to due to local construction or from its proximity to larger scale changes (e.g. urbanization). Thus trends established via individual station data may not indicate changes in the climate of the surrounding area but rather due to changes in the station equipment and environs.

It should be noted that some datasets exist for specific values of interest in the public domain. For example, the Had-CRUT5 (Morice et al. 2020) and HadISDH (Willett et al. 2014) provide gridded, historical time series values of the mean monthly dry-bulb and dew-point temperatures, respectively, covering the time period of interest. However, this study required access to hourly values, in order to form the more building-focused percentile values, so the general applicability of the aforementioned datasets is limited. In the next update cycle (2025), it is expected a more thorough examination and comparison of available datasets will be performed.

It should also be noted that the calculation of daily temperature range is prone to the frequency at which a station reports. That is, consider a station that may have reported every 3 hours changing to one that reports every hour. Previously, this station would be less likely to capture either the daily high or low temperature or both and so would tend to report a smaller daily temperature range than if it had reported hourly. Therefore, this station could show a downwards trend in daily temperature range that may be purely the result of a change in procedure.

2.2 Calculation of Decadal Trends

Given a record of the yearly values of the aforementioned elements, decadal trends are then calculated and assessed for significance largely following the methodology of Hirsch and Slack (1984), with the main elements of the procedure repeated here.

Consider a time series of temperature *T* measured at some interval in time, either monthly or annually, either at a single station or a number of stations. For the case of a single station, with annual measurements, this vector is simply: $T = (\left(\begin{array}{c} \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \end{array} \right) \left(\begin{array}{c} \\ \\ \end{array} \right) \left(\begin{array}{c} \\ \end{array} \right) \left($

(1)

where *n* is the number of rows, i.e. years.

For the regional case of *N* stations, each station is tacked on as a new column:

T=[[]]]]T1,1T2,1:Tn,1T1,2T2,2:Tn,2........T1,mT2,m:Tn,m]]]]]]T=[T1,1T1,2...T1,mT2,1T2,2...T2,m::::Tn,1Tn,2...Tn, m]

(2)

where *n* is again the number of rows (years) and *m* is the number of columns, i.e. stations. That is, a matrix formed from columns representing the stations.

For a robust, i.e. more tolerant of outliers, estimate of the trend, for each year/station column, a "Theil-Sen" slope is calculated as the median slope *m* of all possible slopes (yj-yi)/(xj-xi)(yj-yi)/(xj-xi) through all possible pairs of points (x_i, y_j)

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and (x_j, y_j) , ignoring missing values and with tied values treated carefully (Hirsch and Slack 1984). The overall trend is then just the median slope of these median slopes.

For example, the yearly values and all possible pairs/slopes are shown in Figure 1 for annual-average dry-bulb temperatures recorded near Atlanta, GA, USA. The median slope is found and used as the trend value.

While the trend value is the key value, for the purposes of plotting trends, a convention for the calculation of an intercept *b* must be established given the trend *m*. While some implementations use:

b=median(yi)-m·median(xi),b=median(yi)-m·median(xi),

(3)

we have used perhaps a more consistent implementation in which we fit an intercept for every pair of points using the assumed slope *m* and then take the median of the resulting intercepts:

b=median(yi-m·xi)b=median(yi-m·xi)

(4)

Fig. 1 Illustration of slope calculation. The trend slope (dashed line) is the median slope (solid line) of all possible slopes (gray lines) joining pairs of points.



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