### Summary of Effort

I am compiling information on national Heat Health Early Warning / Information Systems across the globe to support the [Workshop on the Development of Climate Information Systems for Heat Health Early Warning](http://joss.ucar.edu/meetings/2015/heat-health-wkshp). This catalog includes information on which agencies and other organizations initiated and maintain the system, which organization issues alerts, and the level of government involved in these activities (city, county, state/province, nation, etc...). I am also interested in the indicator that is being tracked and the trigger/threshold for alerts (eg. wet bulb globe temperature, Humidex, Environmental Stress Index). Much of this information has already been collected for Europe in a [2011 paper by Lowe et al](http://www.mdpi.com/1660-4601/8/12/4623)., so I am focusing on other regions.

Link to catalog spreadsheet: <https://docs.google.com/a/noaa.gov/spreadsheets/d/1QOYVjS-aCBQqMooEO6UpY3fQrDNN44w6jFFB0d3fBq8/edit?usp=sharing>

### Technical Papers: Mechanisms, Triggers, and Evaluative Methods:

* Hajat S, Sheridan SC, Allen MJ, et al. Heat–Health Warning Systems: A Comparison of the Predictive Capacity of Different Approaches to Identifying Dangerously Hot Days. *American Journal of Public Health*. 2010;100(6):1137-1144. [doi:10.2105/AJPH.2009.169748](http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2009.169748).
  + Experiment comparing HHEWS mechanisms and triggers, and their effectiveness, across hypothetical implementation in various cities (Chicago, London, Madrid, Montreal) representative of different climatologies.
* Lowe D, Ebi KL, Forsberg B. Heatwave Early Warning Systems and Adaptation Advice to Reduce Human Health Consequences of Heatwaves. *International Journal of Environmental Research and Public Health*. 2011;8(12):4623-4648. [doi:10.3390/ijerph8124623](http://www.mdpi.com/1660-4601/8/12/4623).
  + Documents HEWS details for 12 European Countries
* Ebi, Kristie L., Thomas J. Teisberg, Laurence S. Kalkstein, Lawrence Robinson, and Rodney F. Weiher. “Heat Watch/Warning Systems Save Lives: Estimated Costs and Benefits for Philadelphia 1995–98.” Bull. Amer. Meteor. Soc. 85, no. 8 (August 2004): 1067–1073. [doi:10.1175/bams-85-8-1067](http://dx.doi.org/10.1175/bams-85-8-1067).
  + Philadelphia heat health system costs and benefits. Not a great/convincing paper but it does provide a bit more background.
* Samenow, Jason. “Excessive Heat Events Guidebook.” EPA 430-B-06-005 (June 2006). <http://www.epa.gov/heatisland/about/pdf/EHEguide_final.pdf>
  + EPA Handbook detailing Philadelphia, Toronto, and Phoenix HHEWS.
* Laurence S. Kalkstein, Paul F. Jamason, J. Scott Greene, Jerry Libby, and Lawrence Robinson, 1996: The philadelphia hot weather-health watch/warning system: development and application, summer 1995. Bull. Amer. Meteor. Soc., 77, 1519–1528. [http://dx.doi.org/10.1175/1520-0477(1996)077<1519:TPHWHW>2.0.CO;2](http://dx.doi.org/10.1175/1520-0477(1996)077%3C1519:TPHWHW%3E2.0.CO;2)
  + Philadelphia’s Heat Health Early Warning System technical details
* Laurence S. Kalkstein, Guanri Tan, and Jon A. Skindlov, 1987: An evaluation of three clustering procedures for use in synoptic climatological classification. *J. Climate Appl. Meteor.*, **26**, 717–730. doi: [http://dx.doi.org/10.1175/1520-0450(1987)026<0717:AEOTCP>2.0.CO;2](http://dx.doi.org/10.1175/1520-0450(1987)026%3C0717:AEOTCP%3E2.0.CO;2)
  + The technical paper backing up the PWWS approach (TSI) Temporal Synoptic Index
* <http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/climat/response-intervention/response-intervention-eng.pdf>
  + Canadian HARS Best Practices Guide with Case Studies on 4 pilots in Canada
* <http://www.nrdc.org/media/2013/130416.asp>
  + Ahmedabad Heat Wave Preparation and Warning System
* <http://www.nrdc.org/health/climate/heat.asp>
  + Summary of US State-level heat health plans.
* <http://journals.ametsoc.org/doi/pdf/10.1175/1520-0477%281996%29077%3C1519%3ATPHWHW%3E2.0.CO%3B2>
* <http://epirev.oxfordjournals.org/content/27/1/115.full>
* <http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-85-8-1067>
* Knowlton, K., Kulkarni, S. P., Azhar, G. S., Mavalankar, D., Jaiswal, A., Connolly, M., … the Ahmedabad Heat and Climate Study Group. (2014). Development and Implementation of South Asia’s First Heat-Health Action Plan in Ahmedabad (Gujarat, India). *International Journal of Environmental Research and Public Health*, *11*(4), 3473–3492. doi:10.3390/ijerph110403473
  + Implementation of
* Martinez, G. S., Imai, C., & Masumo, K. (2011). Local Heat Stroke Prevention Plans in Japan: Characteristics and Elements for Public Health Adaptation to Climate Change. *International Journal of Environmental Research and Public Health*, *8*(12), 4563–4581. doi:10.3390/ijerph8124563
  + Japanese Heat Health Plans / Systems in 5 cities
* Barbara Casati, Abderrahmane Yagouti, and Diane Chaumont, 2013: Regional climate projections of extreme heat events in nine pilot canadian communities for public health planning. *J. Appl. Meteor. Climatol.*, **52**, 2669–2698. doi: <http://dx.doi.org/10.1175/JAMC-D-12-0341.1>
  + .
* Kalkstein, Laurence S., Scott C. Sheridan, and Adam J. Kalkstein. “Heat/Health Warning Systems: Development, Implementation, and Intervention Activities.” Biometeorology for Adaptation to Climate Variability and Change (2009): 33–48. [doi:10.1007/978-1-4020-8921-3\_3](http://publichealth.med.miami.edu/documents/HHWS_Development_book_chapter.pdf).
  + .
* Climate Change CDC video short on heatwaves: <http://weather.climate25.com/project/george-luber/>
* Wu, J., Zhou, Y., Gao, Y., Fu, J. S., Johnson, B. A., Huang, C., … Liu, Y. (2014). Estimation and Uncertainty Analysis of Impacts of Future Heat Waves on Mortality in the Eastern United States. *Environmental Health Perspectives*,*122*(1), 10–16. [doi:10.1289/ehp.1306670](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3888568/)
  + Climate-scale estimate of heat health related mortality in future in US
* Zhang, K., Rood, R. B., Michailidis, G., Oswald, E. M., Schwartz, J. D., Zanobetti, A., … O’Neill, M. S. (2012). Comparing exposure metrics for classifying “dangerous heat” in heat wave and health warning systems.*Environment International*, *46*, 23–29. [doi:10.1016/j.envint.2012.05.001](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3401591/pdf/nihms382878.pdf)
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* Zhang, K., Chen, Y.-H., Schwartz, J. D., Rood, R. B., & O’Neill, M. S. (2014). Using Forecast and Observed Weather Data to Assess Performance of Forecast Products in Identifying Heat Waves and Estimating Heat Wave Effects on Mortality. *Environmental Health Perspectives*, *122*(9), 912–918. doi:10.1289/ehp.1306858
  + .
* Frank C. Curriero, Karlyn S. Heiner, Jonathan M. Samet, Scott L. Zeger, Lisa Strug, and Jonathan A. Patz Temperature and Mortality in 11 Cities of the Eastern United States Am. J. Epidemiol. (2002) 155 (1): 80-87 [doi:10.1093/aje/155.1.80](http://aje.oxfordjournals.org/content/155/1/80.full.pdf+html)
  + .
* Li, M., Gu, S., Bi, P., Yang, J., & Liu, Q. (2015). Heat Waves and Morbidity: Current Knowledge and Further Direction-A Comprehensive Literature Review.*International Journal of Environmental Research and Public Health*, *12*(5), 5256–5283. [doi:10.3390/ijerph120505256](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4454966/)
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* Dunne, John P., Ronald J. Stouffer, and Jasmin G. John. “Reductions in Labour Capacity from Heat Stress Under Climate Warming.” Nature Climate Change (February 24, 2013). [doi:10.1038/nclimate1827](http://www.nature.com/nclimate/journal/v3/n6/full/nclimate1827.html).
  + GFDL paper finding that increased humidity under CC scenarios reduces labor capacity.
* Sherwood, S. C., and M. Huber. “An Adaptability Limit to Climate Change Due to Heat Stress.” Proceedings of the National Academy of Sciences 107, no. 21 (May 3, 2010): 9552–9555. [doi:10.1073/pnas.0913352107](http://www.pnas.org/content/107/21/9552.full).
  + WBGT > 95 is eventually lethal even for healthy individuals
* Zhang, Kai, Yun Li, Joel D. Schwartz, and Marie S. O׳Neill. “What Weather Variables Are Important in Predicting Heat-Related Mortality? A New Application of Statistical Learning Methods.” Environmental Research 132 (July 2014): 350–359. [doi:10.1016/j.envres.2014.04.004](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4091921/pdf/nihms589623.pdf).
  + Apparent temperature is a robust parameter for activating heat alerts, and absolute humidity is an important consideration. Lag parameters were also somewhat predictive.
* Anderson, G. B., & Bell, M. L. (2011). Heat Waves in the United States: Mortality Risk during Heat Waves and Effect Modification by Heat Wave Characteristics in 43 U.S. Communities. Environmental Health Perspectives, 119(2), 210–218. [doi:10.1289/ehp.1002313](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3040608/)
  + Temperature intensity, heat wave duration, mortality displacement, and region of the country are all important considerations.
* Metzger, Kristina B., Kazuhiko Ito, and Thomas D. Matte. “Summer Heat and Mortality in New York City: How Hot Is Too Hot?” Environmental Health Perspectives (September 10, 2009). [doi:10.1289/ehp.0900906](http://dx.doi.org/10.1289/ehp.0900906).
  + In NYC, cubic functions incorporating max heat index and the past 3 days was the best predictor of health outcomes - better than max, min, avg, or synoptic classifications
* Kim, Y.-M., Kim, S., Cheong, H.-K., & Kim, E.-H. (2011). Comparison of Temperature Indexes for the Impact Assessment of Heat Stress on Heat-Related Mortality. *Environmental Health and Toxicology*, *26*, e2011009. [doi:10.5620/eht.2011.26.e2011009](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3214990/)
  + There was no one temperature measure that was superior to the others in summer. To adopt an appropriate temperature index, regional meteorological characteristics and the disease status of population should be considered.
* LeClerc, Jared, and Susan Joslyn. “The Cry Wolf Effect and Weather-Related Decision Making.” Risk Analysis 35, no. 3 (January 27, 2015): 385–395. [doi:10.1111/risa.12336](http://dx.doi.org/10.1111/risa.12336).
* Sheridan, Scott C., and Laurence S. Kalkstein. “Progress in Heat Watch–Warning System Technology.” Bulletin of the American Meteorological Society 85, no. 12 (December 2004): 1931–1941. [doi:10.1175/bams-85-12-1931](http://dx.doi.org/10.1175/bams-85-12-1931).
* Laschewski, G., and G. Jendritzky. "Effects of the thermal environment on human health: an investigation of 30 years of daily mortality data from SW Germany." *Climate Research* 21, no. 1 (2002): 91-103.
  + 30 year German analysis of mortality due to heat.
* <http://www.sciencedirect.com/science/article/pii/S0959378010000749>
* <http://journals.ametsoc.org/doi/full/10.1175/WAF-D-11-00016.1>
* <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3715443/>

### Prior Workshops on Heat Health Early Warning / Information Systems

* Adams, Christopher R. (1996) Heat Wave Workshop Report co-sponsored by NOAA, CDC, and EPA. <http://www.nws.noaa.gov/om/brochures/htwave.pdf>
  + Workshop held 2 decades ago in response to Chicago heat waves
* July 1995 Heat Wave Natural Disaster Survey Report, U.S. Department of 1 Commerce, National Oceanic and Atmospheric Administration, National Weather Service, Silver Spring, Maryland. December 1995. For copies contact: Customer Service Core (W/OM11), NOAA/National Weather Service, 1325 East-West Highway, Room 14362, Silver Spring, MD, 20910, or on the Internet, go to the NWS Office of Meteorology’s Home Page at: <http://www.nws.noaa.gov/os/assessments/pdfs/heat95.pdf>
  + .
* Yagouti, Abderrahmane; Gower, Stephanie; Wilhelmi, Olga. (2013) SIMMER Workshop Report: Integrated Models for Heat-Health Decision Making - Linking Complex Science to Policy for Heat-Health Decision Making. <http://ral.ucar.edu/csap/events/heat-health-decision-making/SIMMER_Toronto-Workshop-Report.pdf>
  + .
* Glantz MH. Usable science 8: early warning systems: do's and don'ts. Report of workshop, 20–23 October 2003, Shanghai, China. Boulder, CO: National Center for Atmospheric Research, 2004. <http://www.riskred.org/fav/glantz2003.pdf>
  + NCAR, NSF, CAMS, NOAA Workshop on EWS.
* DSP Montreal. Heat Health Warning System Workshop – Montreal, Quebec, Canada 2007 – <http://sheridan.geog.kent.edu/pubs/2007-DSP.pdf>

**Synthesis for Workshop:**

The idea of developing heat health plans and early warning systems extends back at least two decades to the Chicago heatwave of 1995 (~750 heat related deaths in 5 days), which triggered a number of workshops and other initiatives to understand how to prevent such extreme death tolls and shocks to resources and services in the future. Chicago is not alone in experiencing extreme heat in the 80’s and 90’s, as St. Louis and Philadelphia also experienced significant challenges during their own heat events in that time period[[1]](#footnote-0). In fact, significant heatwaves were recorded in the US much earlier such as in July 1936 when nearly one thousand people died in the New York area due to a 10-day heat wave, and in 1988 between 4 and 17 thousand Americans died in a large-scale heat wave[[2]](#footnote-1).

Philadelphia was the first in the nation to develop a sophisticated, synoptic heat alert system that classified weather based on health outcomes and issued alerts when an oppressive air mass was present[[3]](#footnote-2).

Agency Involvement

Most heat health systems are operated at the city level, and are owned by either the most localized weather agency office, health and human services office, or emergency preparedness and response office. In Japan alone, there are cities that couch implementation of heat warning systems in a variety of agencies such as the "Crisis Management Division" (Kusatsu), "Department of Health Promotion" (Kumagaya), and the "Education committee" (Machida). In Europe, these systems may be developed by the “Ministry of Health and Sports” (France)”...

The role of the national weather service varies from owner and operator of the system, including issuance of alerts, to a more passive role of simply providing weather information and heat index forecasts to the agency that owns the system such as the public health agency.

Cases:

India - the city of Ahmedabad hosts the Extreme Heat Early Warning System

The US rarely declares heat disasters. According to FEMA[[4]](#footnote-3), the only time heat has been part of a temperature extreme disaster declaration is in Minnesota on 18 August 1995 (Minnesota Severe Storm, Thunderstorm, High Winds, Flooding, Tornadoes, Heat (DR-1064)). The rest have all been cold weather related.

What about an assessment that looks at the current triggers and synoptic categories that cause a heat alert

1. http://www.slate.com/articles/news\_and\_politics/history\_lesson/2005/09/when\_chicago\_baked.html [↑](#footnote-ref-0)
2. http://www.telegraph.co.uk/news/worldnews/northamerica/usa/8653974/Worst-heatwaves-in-history-timeline.html [↑](#footnote-ref-1)
3. http://www.noaanews.noaa.gov/stories2005/s2366.htm [↑](#footnote-ref-2)
4. https://www.fema.gov/disasters?field\_state\_tid\_selective=All&field\_disaster\_type\_term\_tid=6853&  
   field\_disaster\_declaration\_type\_value=All&items\_per\_page=60 [↑](#footnote-ref-3)