Observations and High-Level Requirements Identified during the Chicago Workshop

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Panel 1: Extreme Heat Events - From Weather to Climate Scale Prediction

- Emergency managers require forecasters to be more "surgical" in weather prediction and impacts; need higher resolution for different areas of the city.
    - Need: urban-scale modeling of temperature and Urban Heat Islands
- The more lead-time the better, but media hype exacerbates situation and creates multiple layers of work.
    - Need: integrated predictions with proper confidence intervals and skill information to prevent 'crying wolf'
- Important to bridge the gap between weather and climate timescales so there is enough lead time for necessary interventions.
    - Need: intuitive and understandable information that bridges deterministic and probabilistic predictions
- Link between climate and health sectors is weaker than others (hydro and health, others).
    - Need: to build partnership, shared understanding, and co-developed information between climate and health sectors. Climate experts become fluent in health science and health experts must become fluent in climate science.
- Climate and health are merely two disciplines that exist in this space, but it is a problem requiring transdisciplinary understanding and action.
    - Need: more interdisciplinary graduates.
    - Need: integrated problem solving and decision-making across disciplines
- There are many attributes and parameters of heat waves, and they are all variable. We need to understand how these attributes and parameters influence health at all timescales and to achieve agreement on how and when to apply them flexibly - regions differ.
    - Need: understand the array of parameters and which ones are important for anticipating health outcomes in a variety of climates and conditions [temperature (max, min, avg, percentile), humidity, solar exposure, wind speeds, urban climatology, social variables, adaptive capacity]
    - lag times
    - duration
    - intensity
    - frequency
    - seasonality
    - character (humidity, solar exposure, wind)

Panel 2: Public Health Decisions Across Time Scales

- Public health decisions and activation of response plans require short term information 2-3 days, up to 5-7 days for communications and preparedness.
    - Need: improved understanding and communication of heat-health thresholds, parameters, and interventions at the emergency management time scale.
- Public health also needs decadal information at 10-50 year timeframes for city planning (infrastructure, green space, etc).
    - Need: reliable, fine-scale information about the many attributes of heat waves at climate time scales.
    - Need: climatological heat information to trigger the development of heat plans for areas where no plans currently exist.
- The Seasonal-Subseasonal (4-6 week) lead time useful for the military to plan training exercises. Military applications often require Heat Index rather than solely temperature.
    - Need: reliable predictions at the S2S time scale that can be trusted enough to modify training schedules and other outdoor events (athletics).
    - Need: S2S scale humidity information to couple with temperature and create Heat Index information.
    - Need: planning policies which may be responsive to relative risk of heat-induced hospital visits.
- Public health requires seasonal information to prepare well in advance
    - Need: information to develop plans to increase number of cooling centers, optimize placement, and pre-position mobile assets.
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    - Heat wave probability by month can be used to plan staffing levels.
- Given that people are expected to experience stronger and longer heat waves, public health will need information above current extremes to gauge projected increases.
- Duration of heat waves above a threshold temperature is a clear indicator of time-lagged heat deaths, suggesting a need for this information at all timescales to prepare for both imminent heat waves and climate-scale heat wave statistics.
- There are many approaches to reducing heat risk being employed around the world.
    - Need: a catalog of heat-health interventions with robust information about effectiveness, cost to implement, viability in future climates, implementation methods.
- Public Health Surveillance and Climate Prediction are both important components of early warning and risk reduction but they are actions conducted by different communities
    - Need: to couple surveillance and climate prediction to develop an integrated approach to early warning for heat waves

Panel 3: Heat Exposure and Health Outcomes

- Many Heat Health Early Warning Systems (HHEWS) are in operation, but the effectiveness of the systems is difficult to measure
    - Need to establish methods and protocols for studying the effectiveness of HHWS – one way is to design case control studies that assess the impact of HHWS on mortality and morbidity.
- Mortality is but one adverse health outcome from extreme heat.

    - Need: capture the entire set of health outcomes due to extreme heat, including morbidity, exacerbation of chronic conditions (asthma), reduced labor productivity and lost work days, rescheduling costs or avoidance costs, etc...
- ICD codes only capture simplified cause of death and morbidity information
    - Need: to influence coding norms to include documentation of extreme-heat induced deaths which may be coded with other ultimate proximate causes
    - Need: to discover additional information sets for evaluating heat-health connections including ambulance documentation, military databases, patient noted that are narrative and not coded, OSHA logs.
- Communicating early warning information is complex and doesn't automatically induce preventative behaviors in at-risk populations.
    - Need: evaluate different weather metrics, but also response and prevention strategies that may be independent of weather metrics.
    - Need: help from social scientists and evidence-based studies to identify effective communication strategies.
    - Need: more dialogue and collaboration when there are many states/areas under heat alerts to reduce confusion.
    - Need forecasters to be able to communicate health impacts provided by public health officials.

Modeling and Prediction Breakout Summary

- Need to identify users and specific needs – different users have different vulnerabilities and needs. Different risk models are needed for different groups.
- Need more localized modeling and prediction information.
- Need to identify the most acceptable lead time.
- Need climate information that can give useful guidance in the absence of skillful models.
- Modeling and prediction of health impacts are needed.

Exposure Risk Breakout Summary

- Finer resolution information is required to address community scale impacts.
    - Fine special scale information is needed to identify impacts on vulnerable communities.
    - Need more observations within cities (instead of airports).
    - Models need to be calibrated and validated for different cities.
    - Indoor environments and lack of AC is important to model, along with micro climates around neighborhoods.
    - Need 10yr period of data to do exposure studies at 1km resolution in cities.
- Need to be able to validate health models with health data.
- Need to understand the needs of different sectors: Public health doesn't want to provide information until very close to the event because they want it to be fresh on the minds of the impacted community. Other sectors might be able to use a week-2 forecast (agriculture, sports coaches/clinicians, water resource planners, etc). Every sector needs information at different time scales, which will have a different level of uncertainty.

- Need interpretation services of entire suite of forecast products and data.
- Need to present uncertainty in different formats for different audiences.
- Need to use and assimilate current data – On example is to use 10yr of WRF 1K data, validated against observations to project backwards and do an epidemiological study to identify how health is impacted by temperature.

Observations & Surveillance Breakout Summary

- Need to integrate observations and socio economic vulnerabilities.
- Need humidity climatology.

Requirements Identified During the Town Hall

- Emergency Management
    - Primarily need short-term information. With 50-70% accuracy they can make decisions.
    - Long-term and seasonal information with 6-months lead time would be useful for strategic planning.
- Public Health
    - In the face of uncertainty they need to remain a credible source of health information.
- Media
    - Higher resolution, storm scale modeling is required to accurately notify impacted communities.