# Vulnerability Indices

Data Dictionary

Vulnerability indices have been created in AusEnHealth for each of the extreme heat, extreme cold, and air quality use cases. For each vulnerability index, there are three sub-indices: Exposure, sensitivity, and adaptive capacity. Each of these have been recorded separately and are defined below. For more information, see the Methods Report, hosted at <https://frontiersi.com.au/ausenhealth-digital-twin/>.

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| **Parameter** | **Description and Derivation** |
| E\_HEAT | Exposure sub-index for heat vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant exposure parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| S\_HEAT | Sensitivity sub-index for heat vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant sensitivity parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| A\_HEAT | Adaptive capacity sub-index for heat vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant adaptive parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| HVI | Heat vulnerability index. |
|  | This parameter is derived by averaging the spatial rankings the relevant exposure, sensitivity, and adaptive capacity sub-indices. |
| rHVI | Spatially ranked version of HVI. |
|  | For derivation, see the Spatial Ranking section at the bottom of the document. |
| E\_COLD | Exposure sub-index for cold vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant exposure parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| S\_COLD | Sensitivity sub-index for cold vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant sensitivity parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| A\_COLD | Adaptive capacity sub-index for cold vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant adaptive parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| CVI | Cold vulnerability index. |
|  | This parameter is derived by averaging the spatial rankings the relevant exposure, sensitivity, and adaptive capacity sub-indices. |
| rCVI | Spatially ranked version of CVI |
|  | For derivation, see the Spatial Ranking section at the bottom of the document. |
| E\_AQ | Exposure sub-index for air quality vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant exposure parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| S\_AQ | Sensitivity sub-index for air quality vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant sensitivity parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| A\_AQ | Adaptive capacity sub-index for air quality vulnerability index. |
|  | The parameter is derived by averaging the spatial rankings of all relevant adaptive parameters for a given spatial and temporal resolution. In this calculation, the included parameters are weighted based on their correlation with all-cause mortality. |
| AQVI | Air quality vulnerability index. |
|  | This parameter is derived by averaging the spatial rankings the relevant exposure, sensitivity, and adaptive capacity sub-indices. |
| rAQVI | Spatially ranked version of AQVI. |
|  | For derivation, see the Spatial Ranking section at the bottom of the document. |

## Spatial Ranking

Methodology Applied to all Spatially Ranked Parameters

A number of parameters are converted to spatially ranked percentiles for use in the creation of overall vulnerability indices. As this method is frequently applied, a small summary of the method is given below.

Spatially ranked percentiles are created in AusEnHealth by taking national data for a parameter at a specific time, and using Rstudio’s frank function to produce, in ascending order, indexed spatial ranks. Arguments are selected in the frank function to continue recording missing values (na.last = "keep"), and to set ties as the minimum rank of the set of tied values (ties.method = c("min")). The result is then divided by the number of regions to produce a percentile ranking, which provides a consistent scale from 0 to 1 for index creation.

A spatial percentile represents how high or low that parameter is compared to the rest of Australia at that time. For example, if a region’s temperature spatial percentile is 1 in January 2011, that means that region is the hottest in Australia for the month of January 2011.