Institute for Hygiene and Public Health
WHO Collaborating Centre for Health Promoting Water Management and Risk Communication

Climate, weather and diseases

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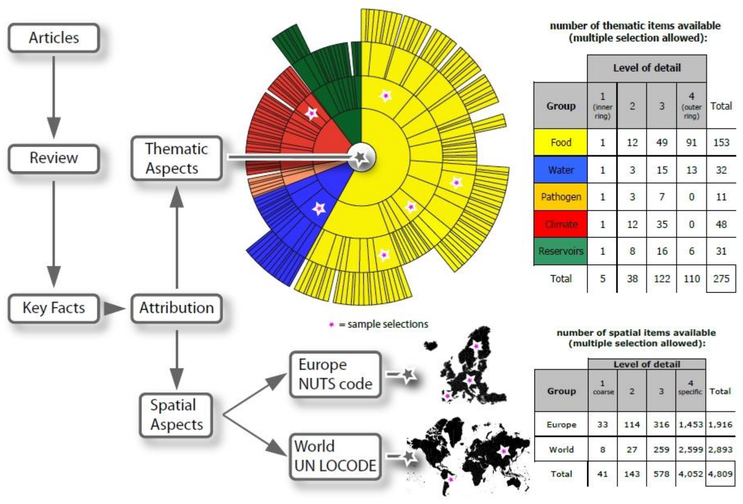
Approach - Literature Review

The overall project, focusing on food- and waterborne diseases like salmonellosis, listeriosis, campyobacteriosis, cryptosporidiosis, virbriosis (non cholera) and Norovirus, needed a systematic review of the latest research results, as far as weather, climate and climate change was concerned.

Methods

The working group decided to install a knowledgebase, which stores the most interesting and consolidated findings (key facts) of scientific articles, which have been examined with a strong focus towards the project's objectives. The knowledgebase is a relational, multitasking MySQL-database, available online, which makes the results of each review available for each other member of the reading group.

Key facts have been attributed using a prepared list of thematic and spatial attributes.



number of thematic items available (multiple selection allowed):

Group	Level of detail 1 (inner ring)	2	3	4 (outer ring)	Total
Food	1	12	49	91	153
Water	1	3	15	13	32
Pathogen	1	3	7	0	11
Climate	1	12	35	0	48
Reservoirs	1	8	16	6	31
Total	5	38	122	110	275

number of spatial items available (multiple selection allowed):

Group	Level of detail 1 coarse	2	3	4 specific	Total
Europe	33	114	316	1,453	1,916
World	8	27	259	2,599	2,893
Total	41	143	578	4,052	4,809

Figure 1:
The review process attributed each key fact with 1 to n thematic attributes, which have been prepared in a hierarchical list. The list includes aspects of food, water, pathogens, climate/weather and reservoirs.
Additionally the key facts are attributed with spatial relations, which include four levels of detail.

Approach - GIS-Analysis

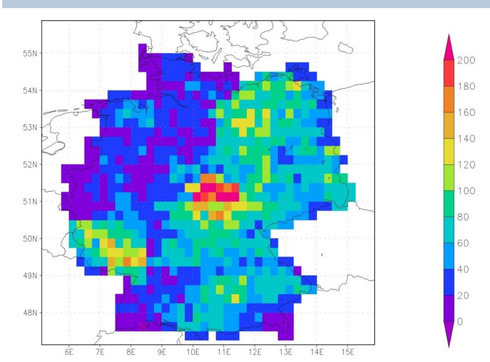
Incidence rates for 6 food- and waterborne diseases may show coincidence with aspects of local, short-term weather conditions, if a time lag is taken into account. A spatio-temporal analysis of recent incidences and weather data is needed to prove the possible correlation.

Methods

Weekly incidence data of salmonellosis, listeriosis, campyobacteriosis, cryptosporidiosis, virbriosis (non cholera) and Norovirus have been collected on a dense spatial resolution from Norway, Sweden, Germany, England/Wales and Switzerland, as far as available. Weather data of daily minimum, mean and maximum temperature and precipitation has been obtained from ECA&D/ENSEMBLES.

Incidence data has been resampled into 0.25x0.25 deg. grid, compatible to weather data. Temporal and spatial regression has been applied, using a field based grid for years 2001-2010.

Figure 3:
Number of cells providing salmonellosis in Germany with incidences >= 5 in years 2001-2010.



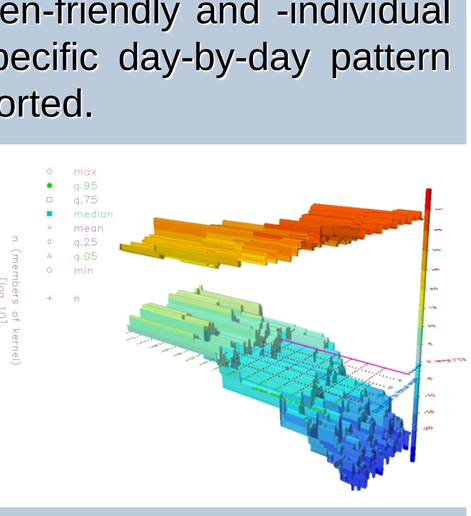
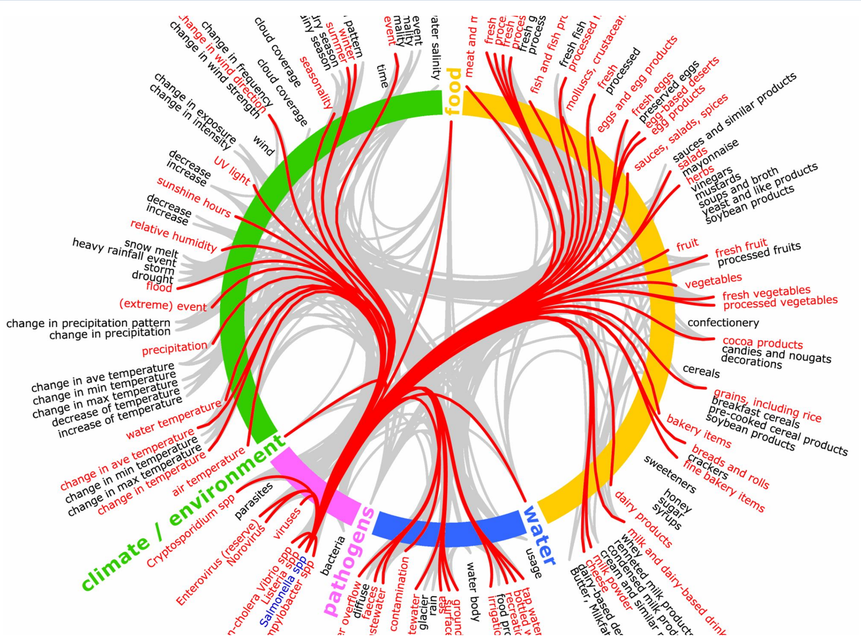


Figure 4:
Number of cells providing cryptosp. In England +Wales with incidences >= 5 in years 2001-09.

Results

The knowledgebase supported a concentrated reading of more than 700 scientific articles from 1998-2009 by a group of reviewers within very short time, as well as the exchange of findings and the creation of fact sheets for each pathogen. A sophisticated data retrieval technique allows to analyze the attribution of key facts and the strength of bindings between attributes.

Figure 2:
An interactive visualisation displays the usage of attributes for a selected theme and figures out the amount of knowledge available in the database.



Results

The statistical analysis unveiled a pathogen specific bandwidth of temperature ranges. Low incidence rates usually develop under unspecified temperatures and high incidences are reported when temperatures stays in-between a pathogen-friendly and -individual optimum. Precipitation is bound to a specific day-by-day pattern before a week with high incidences is reported.

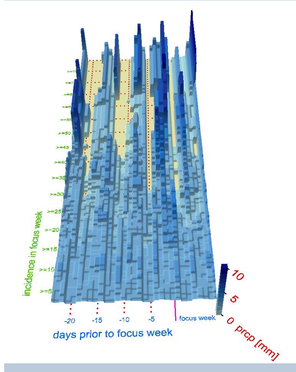


Figure 5: 23-day-history of precipitation in Germany (quartile .75), with respect to incidence-level (x: time-axis, y: incience level, z: precipitation).

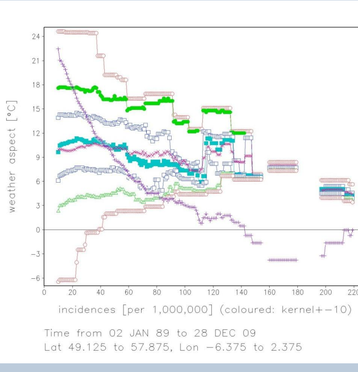


Figure 6:
Cryptosporidiosis-incidences vs. daily mean temperature (average of week before): optimum weather conditions for high incidences.

Figure 7: Maximum of daily maximum temperatures and mimimum of daily miminum temperatures (23-day-history) for salmonellosis in Germany 2001-2010.

Conclusion

The knowledgebase enhances a sustainable availability of knowledge for every member of the group of reviewers, without the necessity of each paper to be read by each scientist.

Conclusion

Weather aspects can explain a portion of incidence rates. The occurrences and probability of certain weather conditions in climate change scenarios may point to future development of diseases.

References

- Semenza J, Höser C, Herbst S, Rechenburg A, Suk J, Frechen T, Kistemann T (2010): Knowledge mapping for climate change and food and waterborne diseases. Crit Rev Environ Sci Techn; accepted for publication in July 2010
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