Growing Degree-Days Mapping for British Columbia

The concept of growing degree-days for mosquito forecasting involves the amount of accumulated heat required for mosquitoes to complete their development from one point in their life cycle to another. This measure of accumulated heat for development is known as physiological time.[1] Mosquitoes are unable to regulate their body temperature and are dependent on the temperature of their surroundings for warmth and growth.

Researchers from Saskatchewan use a base temperature of 16 ^{o}C for *Culex tarsalis*.[2] The simplest form of degree-days calculation is by the rectangle method.[3] Degree-days are accumulated whenever the daily average temperature is above 16 ^{o}C. For example, if the average temperature on May 1st is 18 ^{o}C, 2 degree-days are accumulated since 18-16 ^{o}C = 2 degree-days. No degree-days are accumulated or subtracted if the average daily temperature is less than 16 ^{o}C. This calculation is repeated for every calendar day and a running total is kept for the duration of the growing season or year. August 31st is the approximate end of the growing season for mosquitoes since the shortening of day length will trigger mosquitoes to go into diapause. The number of degree-days required to produce a generation of *Culex tarsalis* varies according to ecosystem type and latitude.

This methodology was applied to BC data in collaboration with UBC Geography and Environment Canada. Climate data from approximately 1000 weather stations between 1971-2000 ("Normals"), and from the 101 active EC weather stations were used in the geostatistical spatial analysis.[4] An obvious bias inherent in most climate data is the location of weather stations in valley bottoms and absence on mountain tops. Therefore, temperature was adjusted for elevation – air temperature decreases with elevation – using the standard lapse rate of 6 ^{o}C per kilometer.

The results of this analysis are the 2005, 2004, 2003 and 30 year average accumulated degree-days maps for BC. As expected, the Okanagan, Upper Columbia River and Thompson regions have the warmest climate in BC. The highly populated Vancouver Lower Mainland and Fraser Valley also have enough heat units to produce multiple generations of *Culex tarsalis*. BC has experienced very hot summers in 2003 and 2004, and virtually every region of the province accumulated higher than average degree-days. Warmer climates translate into greater West Nile virus risk since the development time between mosquito generations are shortened resulting in more generations and higher amplification of the virus. Biting activity of mosquitoes is also increased during warm temperatures.

References:

1. University of California and California State Department of Agriculture and Natural Resources Integrated Pest Management Program. "Degree-Days." Webpage accessed 21 January 2005. http://www.ipm.ucdavis.edu/WEATHER/ddconcepts.html

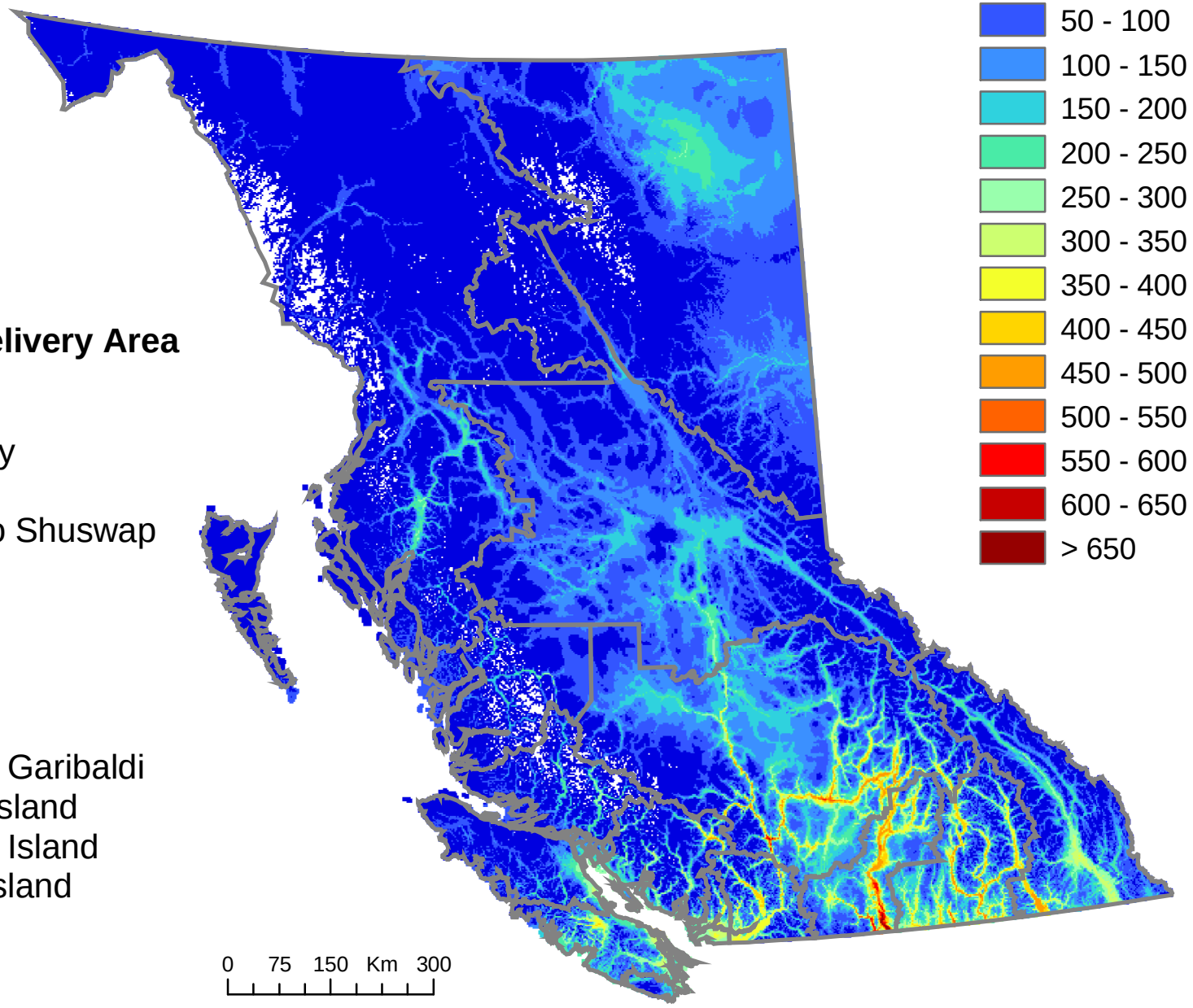
2. Saskatchewan Health and Agriculture Canada. Unpublished data. 2003-2005.

3. University of Illinois Integrated Pest Management. "Degree-Day Calculation". Webpage accessed 21 January 2005. http://ipm.uiuc.edu/degreedays/calculation.html

4. Environment Canada. "Canadian Climate Normals or Averages 1971-2000" and "Canadian Climate Data Online". Webpage accessed 21 January 2005. http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html http://www.climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

August 31, 2005 Accumulated Degree Days over 16°C

4



Max DD	Health Service Delivery Area
492	East Kootenay
517	Kootenay Boundary
701	Okanagan
648	Thompson Cariboo Shuswap
497	Fraser East
378	Fraser North
368	Fraser South
287	Richmond
278	Vancouver
465	North Shore/Coast Garibaldi
239	South Vancouver Island
409	Central Vancouver Island
312	North Vancouver Island
266	Northwest
305	Northern Interior
258	Northeast

August 31, 2004 Accumulated Degree Days over 16°C

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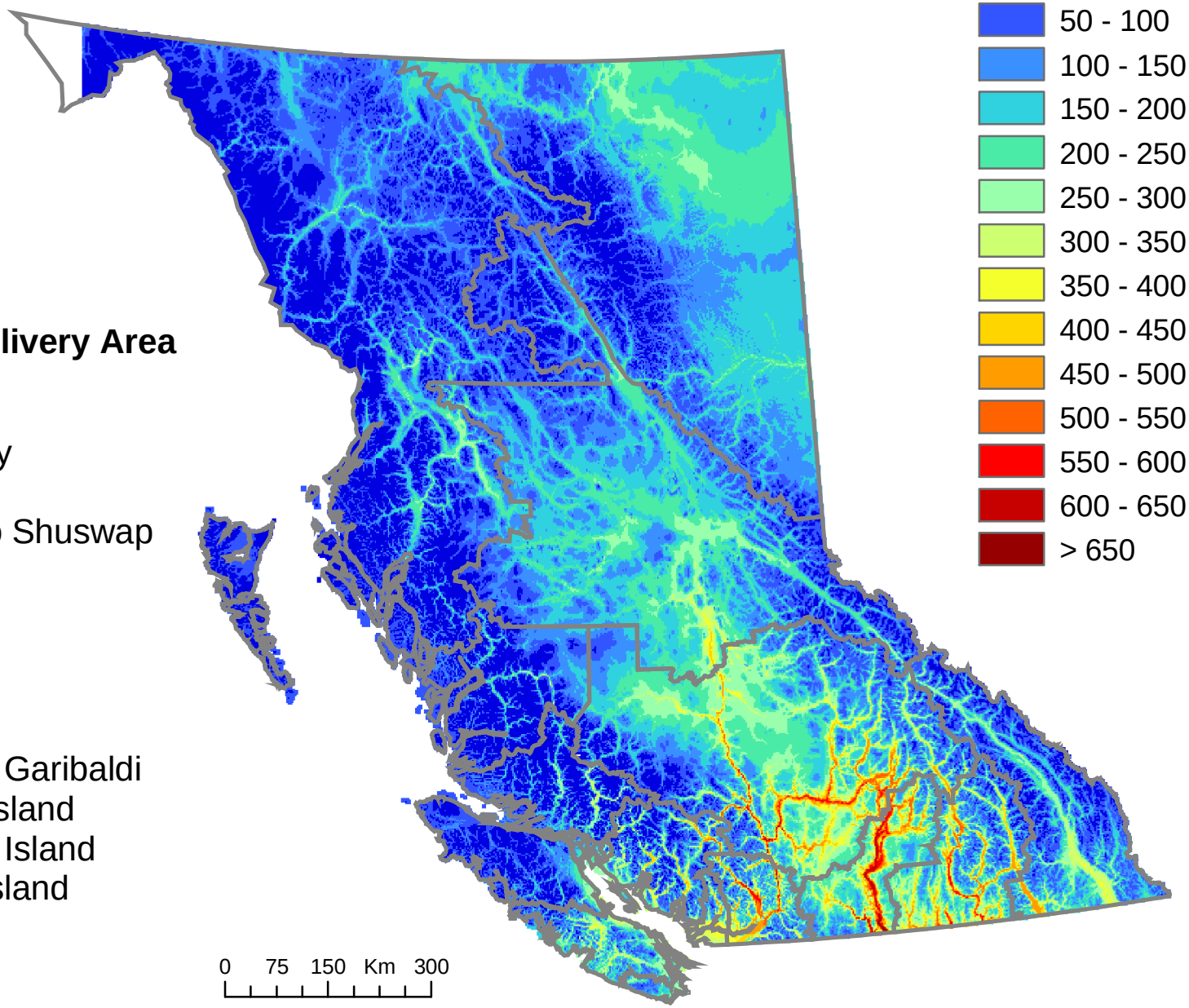
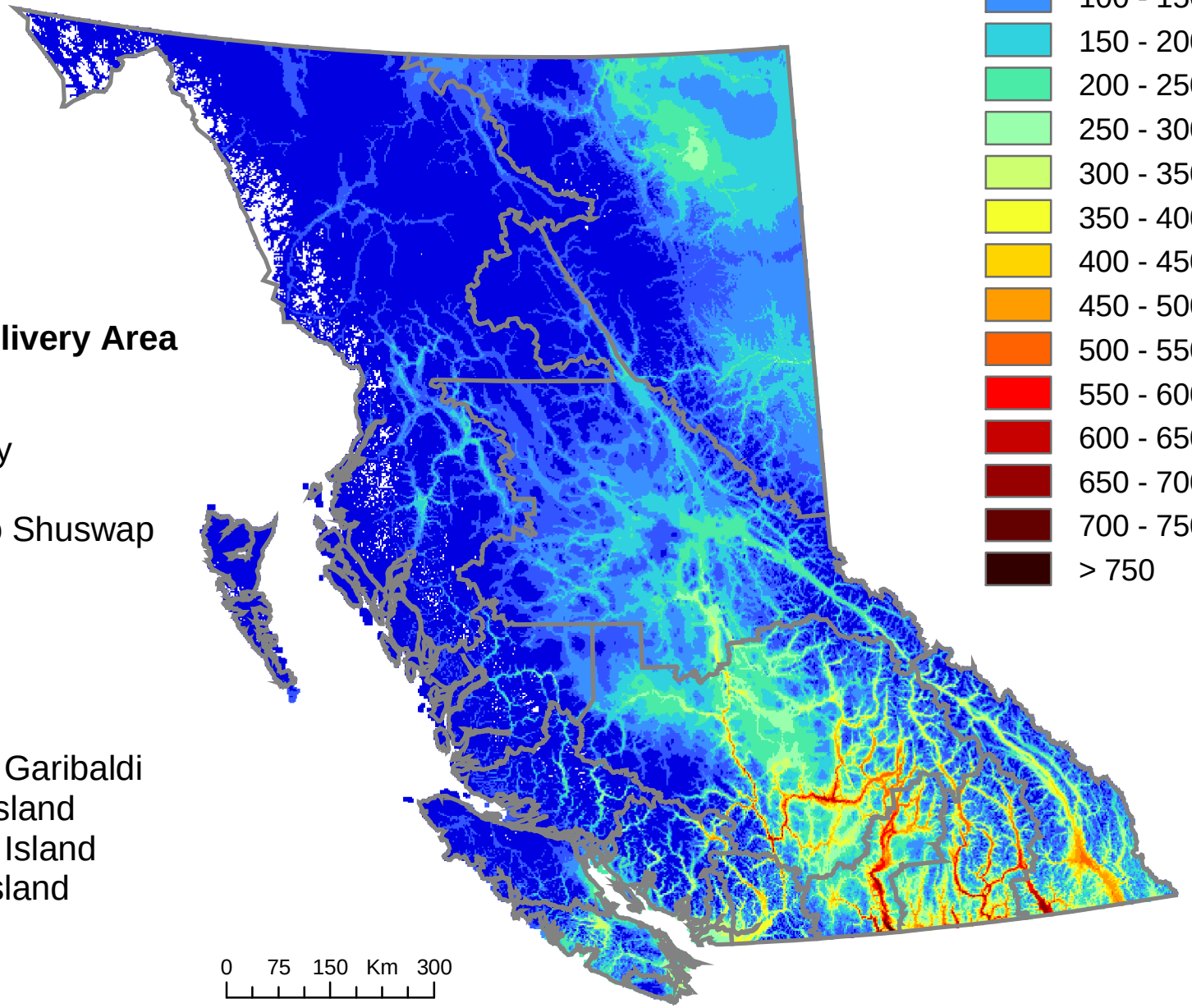


Max DD	Health Service Delivery Area
488	East Kootenay
602	Kootenay Boundary
700	Okanagan
654	Thompson Cariboo Shuswap
640	Fraser East
463	Fraser North
404	Fraser South
362	Richmond
349	Vancouver
514	North Shore/Coast Garibaldi
318	South Vancouver Island
389	Central Vancouver Island
347	North Vancouver Island
309	Northwest
440	Northern Interior
287	Northeast

August 31, 2003 Accumulated Degree Days over 16°C

4

Max DD	Health Service Delivery Area
674	East Kootenay
673	Kootenay Boundary
782	Okanagan
695	Thompson Cariboo Shuswap
542	Fraser East
381	Fraser North
342	Fraser South
293	Richmond
298	Vancouver
503	North Shore/Coast Garibaldi
460	South Vancouver Island
388	Central Vancouver Island
285	North Vancouver Island
214	Northwest
396	Northern Interior
297	Northeast



August 31, 1971-2000 Mean Accumulated Degree Days over 16°C

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Max DD	Health Service Delivery Area
398	East Kootenay
428	Kootenay Boundary
514	Okanagan
509	Thompson Cariboo Shuswap
374	Fraser East
277	Fraser North
238	Fraser South
204	Richmond
187	Vancouver
376	North Shore/Coast Garibaldi
162	South Vancouver Island
220	Central Vancouver Island
278	North Vancouver Island
214	Northwest
293	Northern Interior
189	Northeast