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**The Effect of Climate Variation  
on Infectious Diseases in Humans  
in New Zealand**

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August 2011

# The Effect of Climate Variation on Infectious Diseases in Humans in New Zealand

A thesis presented in partial fulfilment  
of the requirements for the degree of  
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Aleisha Brock  
Submitted August 2011

**Jeremiah 29:11-13**

<sup>11</sup> *“For I know the plans I have for you,” declares the Lord,  
“plans to prosper you and not to harm you, plans to give you hope and a future.*

<sup>12</sup> *Then you will call on me and come and pray to me,  
and I will listen to you.*

<sup>13</sup> *You will seek me and find me when you seek me with all your heart.”*

# Abstract

The emergence and spread of infectious disease are a major issue associated with environmental change. Contributing to this is the effect climate variability and change may play in altering disease risk. The aims of this study were to investigate the association between climate and infectious diseases in humans throughout New Zealand from 1997 - 2007, then use the identified associations to project the burden of disease in 2015, 2040 and 2090 with respect to future climate change scenarios.

The four infectious diseases selected and investigated were campylobacteriosis, cryptosporidiosis, influenza hospitalisations and meningococcal disease. The association of weather variables and other confounders with the incidence risk (IR) of disease were explored using a quasi-Poisson generalized linear model, indicating that weather variables were significantly associated with disease risk. These results, along with expert opinion on epidemiological plausibility, were used to select confounders for the past association models.

Climate variation was associated with the IR of campylobacteriosis and cryptosporidiosis in New Zealand from 1997 - 2007. Campylobacteriosis notifications were found to be positively associated with the weekly absolute humidity. Additionally, campylobacteriosis notification risk factors were increasing beef and dairy density, intermediate and poor drinking water quality, being over 65 years of age and identifying with Pacific Island or Asian ethnicity. Protective factors were being less than 4 years of age and identifying with Maori ethnicity. Cryptosporidiosis notifications were found to be positively associated with the weekly average temperature and negatively associated with the weekly average rainfall. Risk factors for cryptosporidiosis notifications were poor drinking water quality, being less than 4 years of age and living in rural areas. Protective factors were identifying with Maori ethnicity and unknown drinking water quality.

Influenza hospitalisations and meningococcal disease notifications were not significantly associated with past climate variation. Identifying with Maori ethnicity was found to be a risk factor for influenza hospitalisations, with no protective factors identified. Risk factors for meningococcal disease notifications were an increasing social deprivation index (SDI) score,

being less than 4 years of age and identifying with Maori ethnicity. Identifying with Asian ethnicity was a protective factor for meningococcal disease.

The projection calculations of the change in disease incidence from the study period to 2015, 2040 and 2090 were carried out under a combination 3 Intergovernmental Panel of Climate Change (IPCC) climate scenarios (A2, B1 and A1B) and 12 downscaled global climate models. The projected change in campylobacteriosis and cryptosporidiosis suggested increases in the rate of notifications, and a small to no decrease in influenza hospitalisation and meningococcal disease notifications.

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"Men go abroad to wonder at the heights of mountains, at the huge waves of the sea, at the long courses of the rivers, at the vast compass of the ocean, at the circular motions of the stars, and they pass by themselves without wondering." (Saint Augustine, 354 – 430 AD)



# Abbreviations

AH	Absolute humidity
AU	Area unit
AR	Autoregressive term
ARIMA	Autoregressive integrated moving-average model
ARMA	Autoregressive moving-average model
CAR	Conditional autoregressive models
C.I.	Credible Interval
CSF	Cerebrospinal fluid
DHB	District health board
ESR	Institute of Environmental Sciences and Research Ltd.
FRST	Foundation for Research, Science and Technology
GLM	Generalised linear model
HAIFA	The Health Analysis and Information for Action project
MeNZB	Meningococcal B strain vaccination for New Zealand
i.i.d	Identically and independently distributed
IPCC	Intergovernmental Panel on Climate Change
IR	Incidence risk
MA	Moving-average term
MAF	Ministry of Agriculture and Forestry
MCMC	Markov chain Monte Carlo
NIWA	National Institute of Water and Atmospheric Research Ltd.
NZCCC	The New Zealand Climate Change Centre
NZHIS	The New Zealand Health Information Service
OR	Odds ratio
PAR	Population at risk
PCA	Principle component analysis
PCR	Polymerase chain reaction
sARIMA	Seasonal autoregressive integrated moving-average model
SDI	Social deprivation index
VCS	Virtual climate station
VTEC	Verotoxin producing <i>Escherichia coli</i>

# Contents

<b>Abstract</b>	<b>iii</b>
<b>Acknowledgements</b>	<b>v</b>
<b>Abbreviations</b>	<b>vii</b>
<b>Contents</b>	<b>viii</b>
<b>List of Tables</b>	<b>xiii</b>
<b>List of Figures</b>	<b>xvi</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Introduction . . . . .	1
1.1.1 Climate Change . . . . .	1
1.1.2 Health in New Zealand . . . . .	2
1.2 The Health Analysis and Information for Action (HAIFA) Project . . . . .	9
1.3 Purpose and Scope of this Thesis . . . . .	10
<b>2 Statistical Approaches Overview</b>	<b>16</b>
2.1 Introduction . . . . .	16
2.2 Statistical Models . . . . .	17
2.2.1 Poisson Regression . . . . .	17
2.2.2 Time Series Analysis . . . . .	20
2.2.3 Hierarchical Bayesian Model for Space-Time Data . . . . .	22
2.3 Visualisation of Data . . . . .	25
2.3.1 Disease Mapping . . . . .	25
2.3.2 Visualisation Techniques . . . . .	25

---

2.4	Conclusions . . . . .	26
<b>3</b>	<b>Data</b>	<b>27</b>
3.1	Introduction . . . . .	27
3.2	Weather Data . . . . .	27
3.3	Disease Data . . . . .	28
3.4	Demographic Data . . . . .	29
3.4.1	Population at Risk, Age and Gender . . . . .	30
3.4.2	Ethnicity . . . . .	30
3.4.3	District Health Board . . . . .	31
3.4.4	Social Deprivation Index . . . . .	31
3.5	Environmental Data . . . . .	32
3.5.1	Animal Density . . . . .	32
3.5.2	Land Use . . . . .	33
3.5.3	Drinking Water Quality . . . . .	33
3.5.4	Rurality . . . . .	33
3.6	Other Variables . . . . .	33
3.6.1	Influenza Vaccination Coverage . . . . .	33
3.6.2	School Holidays . . . . .	34
<b>4</b>	<b>Selection of Indicator Diseases</b>	<b>41</b>
4.1	Introduction . . . . .	41
4.2	Method . . . . .	41
4.2.1	Data . . . . .	41
4.2.2	Exploratory Data Analysis of Diseases . . . . .	43
4.3	Results . . . . .	44
4.3.1	Exploratory Data Analysis . . . . .	44
4.3.2	Exploratory Data Analysis of Diseases . . . . .	46
4.4	Summary . . . . .	51
<b>5</b>	<b>Variable Screening</b>	<b>69</b>
5.1	Introduction . . . . .	69
5.2	Method . . . . .	69
5.2.1	Data . . . . .	69
5.2.2	Size and Complexity of Dataset . . . . .	71

---

5.2.3	Screening . . . . .	71
5.3	Results . . . . .	74
5.3.1	Campylobacteriosis . . . . .	74
5.3.2	Cryptosporidiosis . . . . .	75
5.3.3	Influenza Hospitalisations . . . . .	75
5.3.4	Meningococcal Disease . . . . .	76
<b>6</b>	<b>Past Association Models</b>	<b>85</b>
6.1	Introduction . . . . .	85
6.1.1	Size and Complexity of Dataset . . . . .	85
6.2	Data . . . . .	86
6.3	Method . . . . .	86
6.3.1	Explanatory Variable Selection . . . . .	86
6.3.2	Modifying the Knorr-Held Richardson Model . . . . .	87
6.3.3	Past Association Models . . . . .	88
6.4	Results . . . . .	90
6.4.1	Explanatory Variable Selection . . . . .	90
6.4.2	Past Association Models . . . . .	90
6.4.3	Posterior Spatial Effects . . . . .	93
<b>7</b>	<b>Projection Calculations</b>	<b>97</b>
7.1	Introduction . . . . .	97
7.2	Data . . . . .	97
7.3	Method . . . . .	100
7.3.1	Projection Calculation . . . . .	100
7.4	Results . . . . .	102
7.4.1	Campylobacteriosis . . . . .	102
7.4.2	Cryptosporidiosis . . . . .	108
7.4.3	Influenza Hospitalisations . . . . .	113
7.4.4	Meningococcal Disease . . . . .	117
<b>8</b>	<b>Discussion</b>	<b>157</b>
8.1	Introduction . . . . .	157
8.2	Key Findings . . . . .	158
8.2.1	Campylobacteriosis . . . . .	159

---

8.2.2	Cryptosporidiosis . . . . .	160
8.2.3	Influenza Hospitalisations . . . . .	161
8.2.4	Meningococcal Disease . . . . .	162
8.3	Issues Encountered . . . . .	163
8.3.1	Data Uncertainty . . . . .	163
8.3.2	Size and Complexity of Dataset . . . . .	167
8.3.3	Statistical Analysis . . . . .	168
8.3.4	Bias . . . . .	171
8.3.5	Confounding . . . . .	172
8.4	Recommendations for Further Research . . . . .	172
8.4.1	Past Association Models . . . . .	172
8.4.2	Projection Calculations . . . . .	173
8.5	Conclusion . . . . .	173
	<b>Bibliography</b>	<b>182</b>

# List of Tables

3.1	Description of Weather Variables . . . . .	28
3.2	New Zealand District Health Boards . . . . .	31
3.3	Description of Demographic Variables . . . . .	32
3.4	Description of Land Use . . . . .	39
3.5	Description of Environmental Variables . . . . .	40
4.1	The Mean and Standard Deviation of Weather Variables . . . . .	44
4.2	The Combined Counts and Incidence Risk of Each Disease . . . . .	46
4.3	Population at Risk from 1997 - 2007 . . . . .	47
5.1	Campylobacteriosis Screening of Weather Variables . . . . .	75
5.2	Campylobacteriosis Screening of Demographic Confounders . . . . .	77
5.3	Campylobacteriosis Screening of Environmental Confounders . . . . .	78
5.4	Campylobacteriosis Screening of Other Confounders . . . . .	78
5.5	Cryptosporidiosis Screening of Weather Variables . . . . .	78
5.6	Cryptosporidiosis Screening of Demographic Confounders . . . . .	79
5.7	Cryptosporidiosis Screening of Environmental Confounders . . . . .	80
5.8	Cryptosporidiosis Screening of Other Confounders . . . . .	80
5.9	Influenza Hospitalisations Screening of Weather Variables . . . . .	80
5.10	Influenza Hospitalisations Screening of Demographic Confounders . . . . .	81
5.11	Influenza Hospitalisations Screening of Environmental Confounders . . . . .	82
5.12	Influenza Hospitalisations Screening of Other Confounders . . . . .	82
5.13	Meningococcal Disease Screening of Weather Variables . . . . .	82
5.14	Meningococcal Disease Screening of Demographic Confounders . . . . .	83
5.15	Meningococcal Disease Screening of Environmental Confounders . . . . .	84
5.16	Meningococcal Disease Screening of Other Confounders . . . . .	84

---

6.1	Campylobacteriosis past association model . . . . .	92
6.2	Cryptosporidiosis past association model . . . . .	93
6.3	Influenza hospitalisations past association model . . . . .	94
6.4	Meningococcal disease past association model . . . . .	95
7.1	Campylobacteriosis Projection Variables . . . . .	103
7.2	Cryptosporidiosis Projection Variables . . . . .	108
7.3	Influenza Hospitalisations Projection Variables . . . . .	113
7.4	Meningococcal Disease Projection Variables . . . . .	117

# List of Figures

1.1	Campylobacteriosis Time Series 1997-2010 . . . . .	12
1.2	Campylobacteriosis Notifications by DHB in 2010 . . . . .	12
1.3	Cryptosporidiosis Time Series 1997-2010 . . . . .	13
1.4	Cryptosporidiosis by DHB 2010 . . . . .	13
1.5	Influenza Hospitalisations by Week Discharged in 2010 . . . . .	14
1.6	Meningococcal Disease Notifications 1990-2010 . . . . .	14
1.7	Outline of Thesis Flow Chart . . . . .	15
3.1	Virtual Climate Station Grids . . . . .	35
3.2	Disease Selection Flow Chart . . . . .	36
3.3	Virtual Climate Station Grids Intersected with Area Units . . . . .	37
3.4	Population at Risk in 2007 . . . . .	38
4.1	Outline of Disease Selection Flow Chart . . . . .	52
4.2	Map of Three Study Regions . . . . .	53
4.3	Average Weekly Rainfall and Days of Rain per Week . . . . .	54
4.4	Average Weekly Temperature and Windspeed . . . . .	55
4.5	Average Absolute Humidity and Weekly Radiation Levels . . . . .	56
4.6	Average and Stratified IR of Campylobacteriosis . . . . .	57
4.7	Average and Stratified IR of Cryptosporidiosis . . . . .	58
4.8	Average and Stratified IR of Giardiasis . . . . .	59
4.9	Average and Stratified IR of Influenza Hospitalisations . . . . .	60
4.10	Raw IR of Legionellosis and Leptospirosis . . . . .	61
4.11	Raw and Average IR of Listeriosis and Rheumatic Fever . . . . .	62
4.12	Average and Stratified IR of Meningococcal Disease . . . . .	63
4.13	Average and Stratified IR of Salmonellosis . . . . .	64
4.14	Raw IR of Shigellosis and Tuberculosis . . . . .	65



---

4.15	Raw IR of VTEC . . . . .	66
4.16	Raw and Average IR of Yersiniosis . . . . .	67
4.17	Cumulative Spectral Analysis . . . . .	68
6.1	Posterior Spatial Effects for each disease . . . . .	96
7.1	Campylobacteriosis A2 Projection 2015 . . . . .	121
7.2	Campylobacteriosis A1B Projection 2015 . . . . .	122
7.3	Campylobacteriosis B1 Projection 2015 . . . . .	123
7.4	Campylobacteriosis A2 Projection 2040 . . . . .	124
7.5	Campylobacteriosis A1B Projection 2040 . . . . .	125
7.6	Campylobacteriosis B1 Projection 2040 . . . . .	126
7.7	Campylobacteriosis A2 Projection 2090 . . . . .	127
7.8	Campylobacteriosis A1B Projection 2090 . . . . .	128
7.9	Campylobacteriosis B1 Projection 2090 . . . . .	129
7.10	Cryptosporidiosis A2 Projection 2015 . . . . .	130
7.11	Cryptosporidiosis A1B Projection 2015 . . . . .	131
7.12	Cryptosporidiosis B1 Projection 2015 . . . . .	132
7.13	Cryptosporidiosis A2 Projection 2040 . . . . .	133
7.14	Cryptosporidiosis A1B Projection 2040 . . . . .	134
7.15	Cryptosporidiosis B1 Projection 2040 . . . . .	135
7.16	Cryptosporidiosis A2 Projection 2090 . . . . .	136
7.17	Cryptosporidiosis A1B Projection 2090 . . . . .	137
7.18	Cryptosporidiosis B1 Projection 2090 . . . . .	138
7.19	Influenza Hospitalisations A2 Projection 2015 . . . . .	139
7.20	Influenza Hospitalisations A1B Projection 2015 . . . . .	140
7.21	Influenza Hospitalisations B1 Projection 2015 . . . . .	141
7.22	Influenza Hospitalisations A2 Projection 2040 . . . . .	142
7.23	Influenza Hospitalisations A1B Projection 2040 . . . . .	143
7.24	Influenza Hospitalisations B1 Projection 2040 . . . . .	144
7.25	Influenza Hospitalisations A2 Projection 2090 . . . . .	145
7.26	Influenza Hospitalisations A1B Projection 2090 . . . . .	146
7.27	Influenza Hospitalisations B1 Projection 2090 . . . . .	147
7.28	Meningococcal Disease A2 Projection 2015 . . . . .	148
7.29	Meningococcal Disease A1B Projection 2015 . . . . .	149

7.30 Meningococcal Disease B1 Projection 2015 . . . . .	150
7.31 Meningococcal Disease A2 Projection 2040 . . . . .	151
7.32 Meningococcal Disease A1B Projection 2040 . . . . .	152
7.33 Meningococcal Disease B1 Projection 2040 . . . . .	153
7.34 Meningococcal Disease A2 Projection 2090 . . . . .	154
7.35 Meningococcal Disease A1B Projection 2090 . . . . .	155
7.36 Meningococcal Disease B1 Projection 2090 . . . . .	156