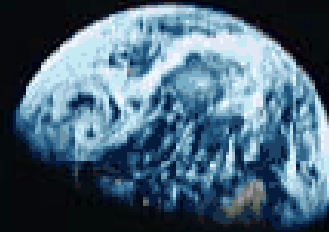


# **Special challenges for public health with climate change and aging populations: Waterborne illness**



**Tim Takaro  
Faculty of Health Sciences  
Simon Fraser University**

# What I will talk about

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## Threats to drinking water resources with Climate Change

- ❖ Sea level rise
- ❖ Extreme weather events
- ❖ Snow, ice and storage capacity



## Human health impacts

- ❖ What is needed for increased adaptive capacity ?
- ❖ Who and where are our vulnerable populations?



# Potential Health Effects of Climate Change in B.C.

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- ✓ Increase in heat stress events
- ✓ Increase in ozone and other air pollutants
- ✓ Drying of woodlands and increase in forest and range fires
- ✓ Shifting infectious disease patterns
  - Vector borne: e.g. Lyme dz.  
West Nile and Hanta virus
- **Water borne diseases**
- Migration from warmer climes



# Increased water stress due to climate change in B.C.

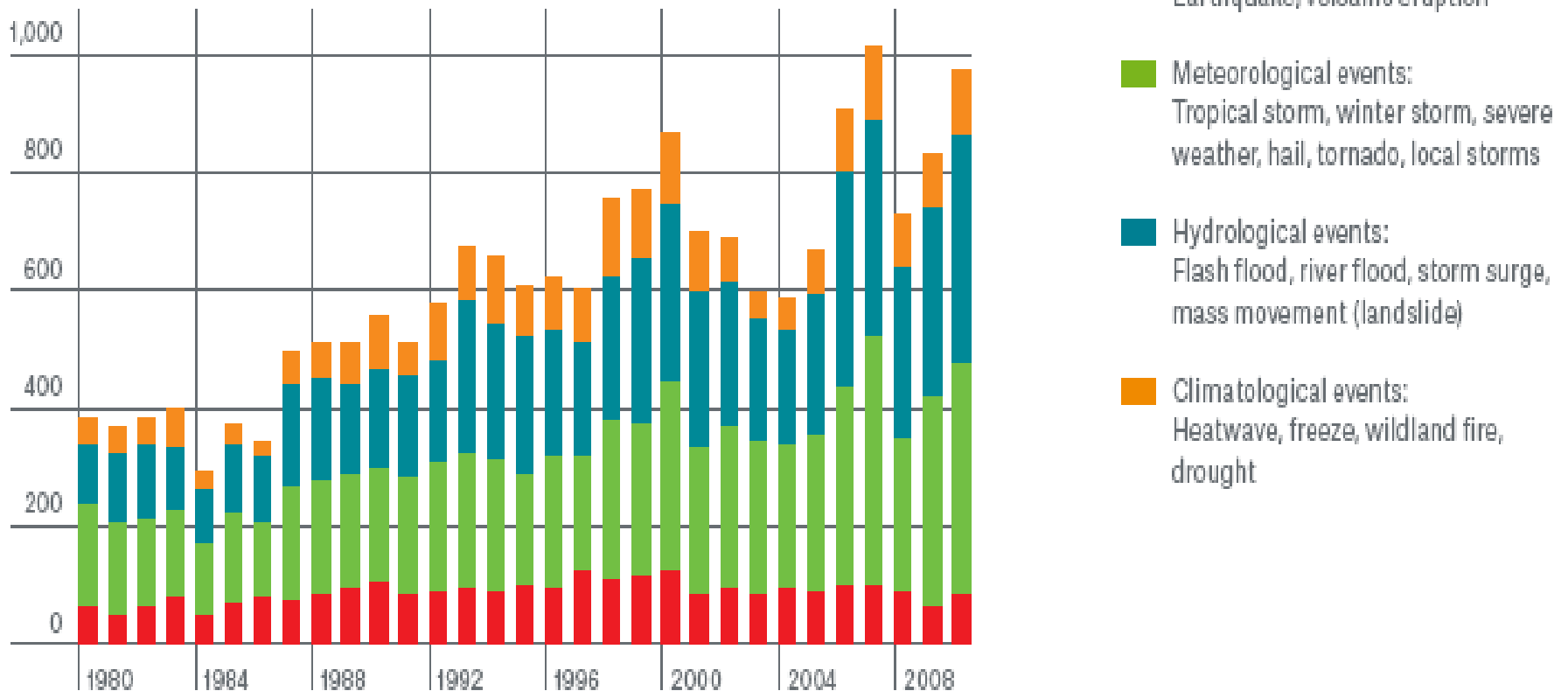
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- Increase in extreme weather events
- Reduced glacial and snow-melt storage
  - Reduced drinking water storage
  - Reduced hydroelectric and irrigation water
  - Threats to river biology
- Sea-Level Rise
  - Salt water intrusion into freshwater supplies
  - Coastal land instability
  - Changes in shellfish and coastal food supplies



# Expect Regional Precipitation Changes

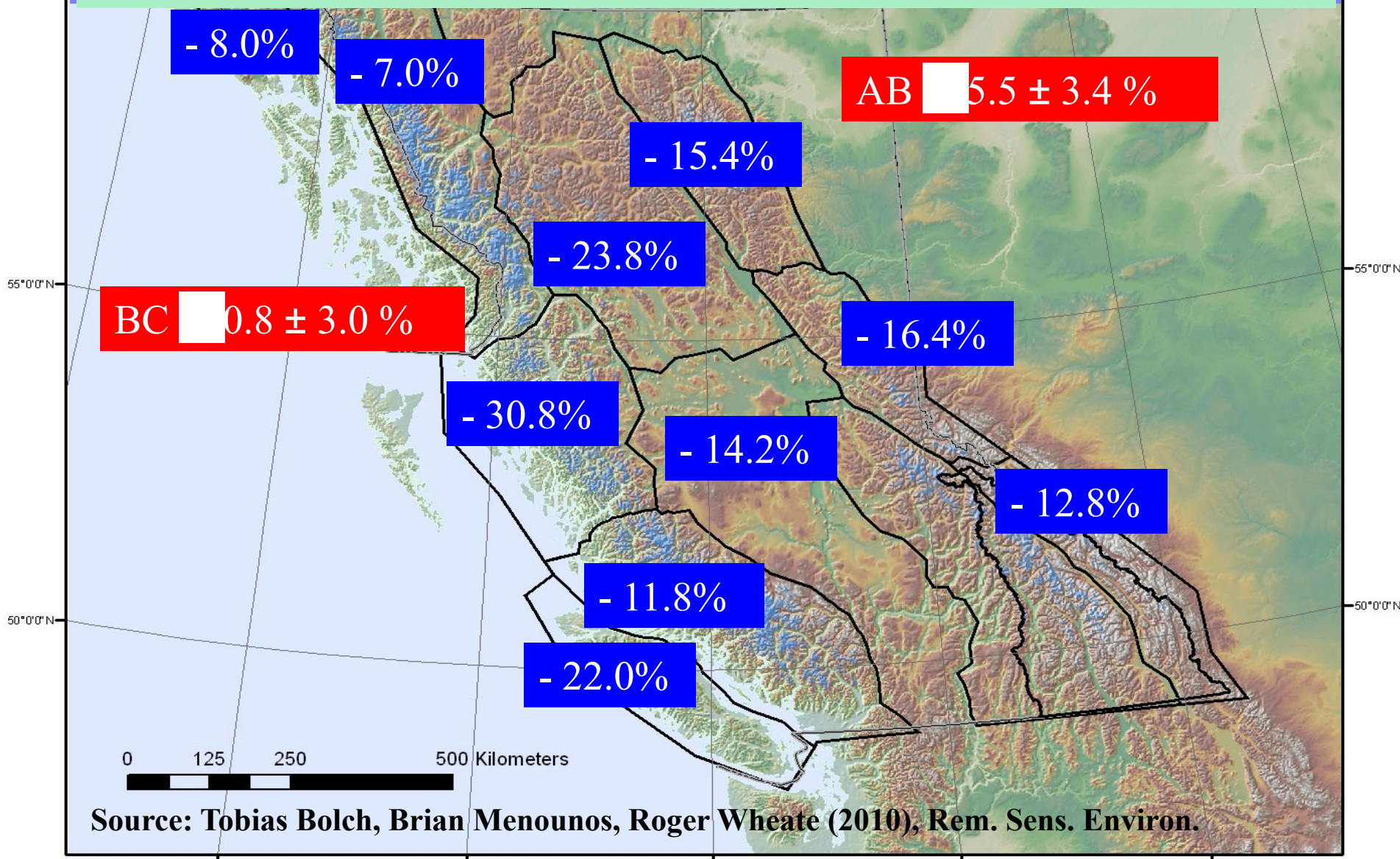
Number of natural catastrophes 1980-2010



- Geophysical events:**  
Earthquake, volcanic eruption
- Meteorological events:**  
Tropical storm, winter storm, severe weather, hail, tornado, local storms
- Hydrological events:**  
Flash flood, river flood, storm surge, mass movement (landslide)
- Climatological events:**  
Heatwave, freeze, wildland fire, drought



# Reduction in glacial surface area in BC and Alberta from 1985 to 2005

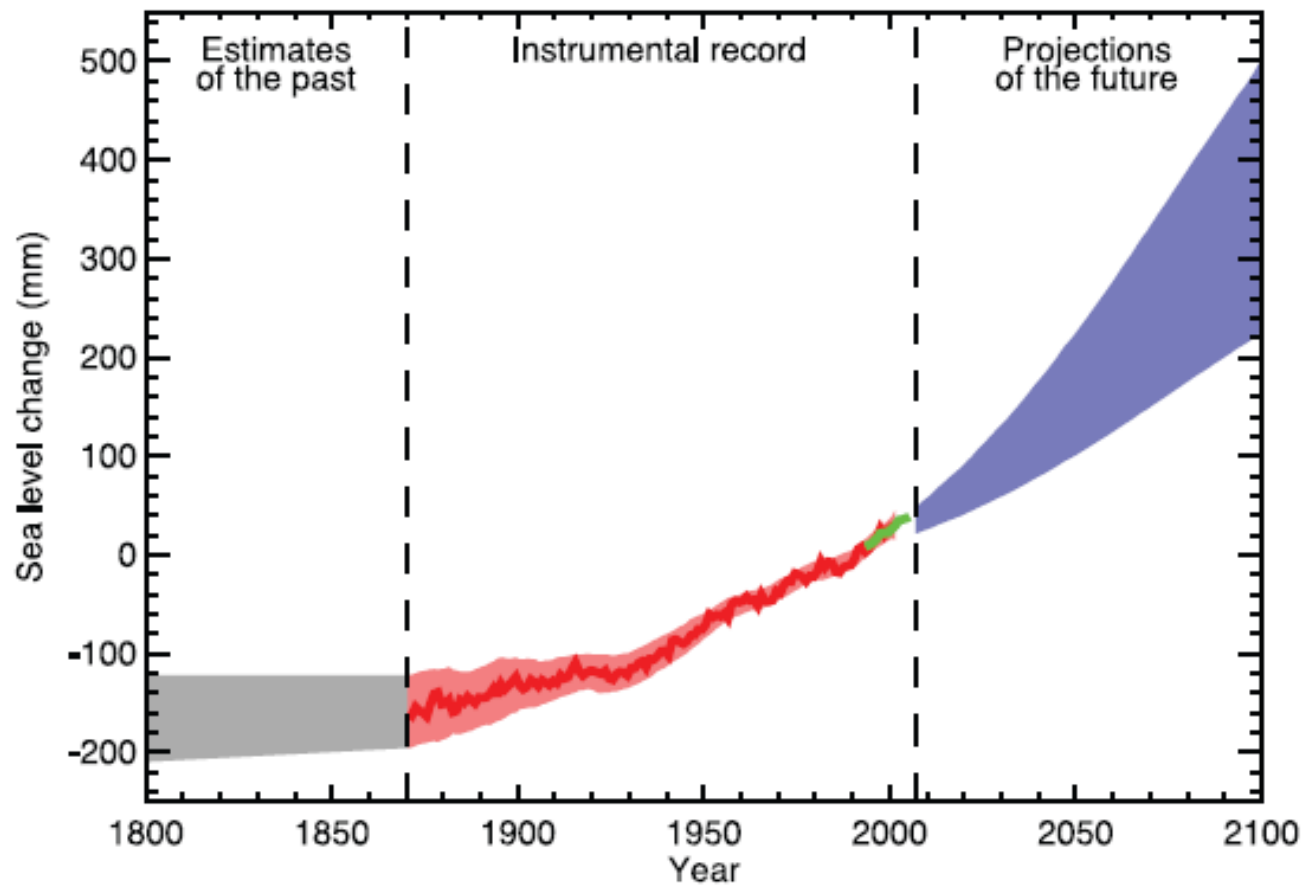


Source: Tobias Bolch, Brian Menounos, Roger Wheate (2010), Rem. Sens. Environ.



**2090s Tier 1 (A2) Mean April 1st Snowline (1074m)**

# Time Series of Mean Sea Level Rise from 1980-1999 mean



IPCC  
2007



# Drinking water and Human Health With a Changing Climate

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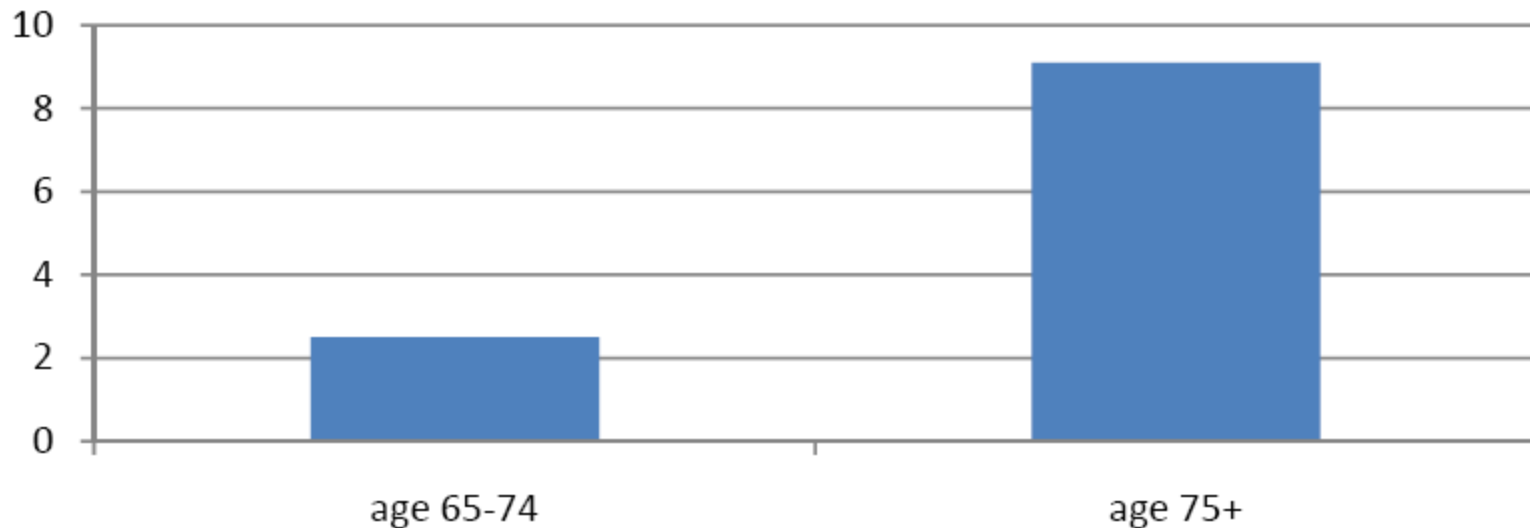
Waterborne gastro-intestinal illness, already a priority public health concern, is expected to increase under climate change conditions

- Currently 2.2 million annual deaths globally, mostly children in developing countries.
- In (over) developed nations, gastrointestinal illness leads to significant morbidity, days of worked missed, and health system burden with elderly particularly vulnerable, particularly with hospitalizations and mortality
- In BC, annual economic burden is estimated at CAN\$514.2 million (Henson, 2008)

# Limited evidence base on risk of waterborne illness in elderly

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**percent increase in hospitalizations for diarrhea with an interquartile range increase in municipal water turbidity**



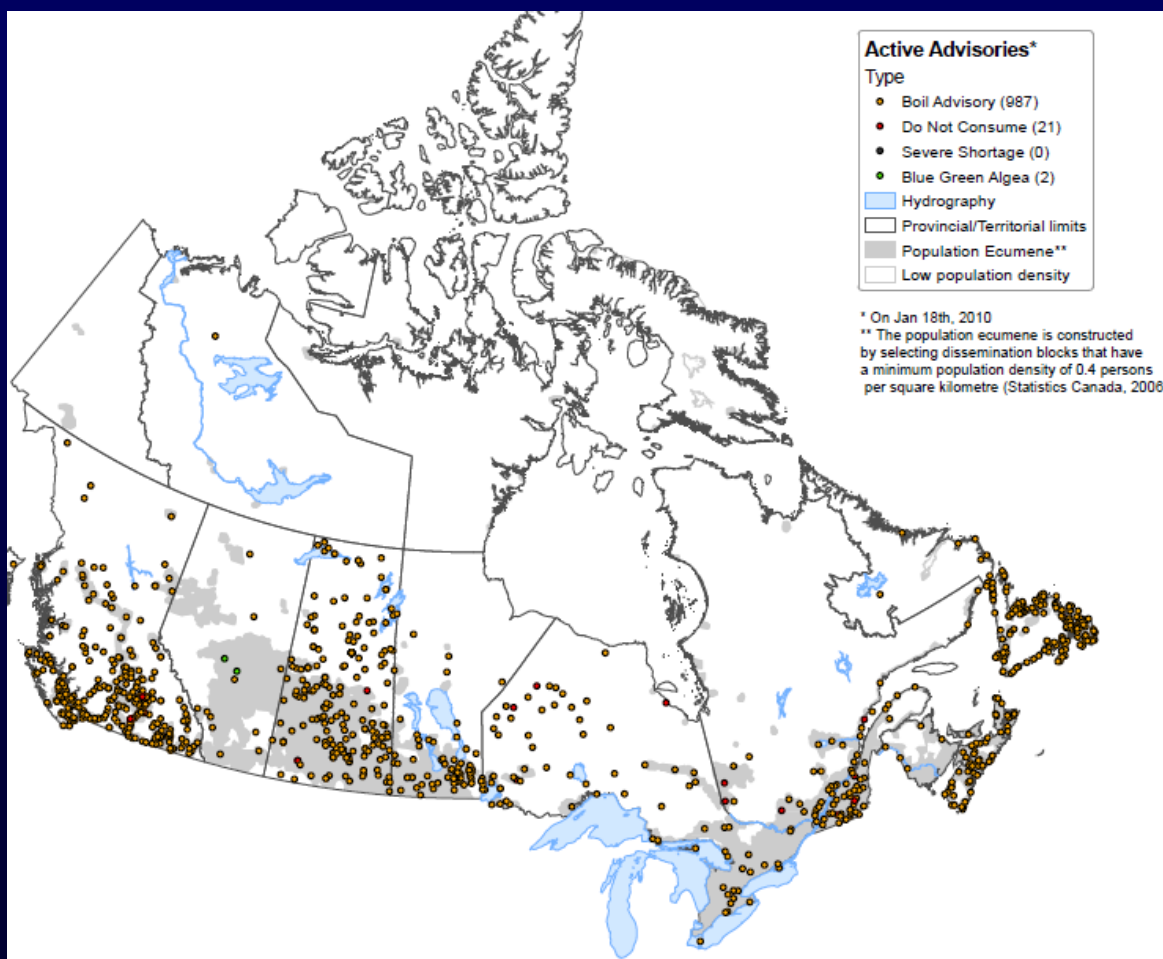
# Why a higher risk of serious diarrheal disease in ages 60 + ?

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- Cryptosporidium, a major waterborne hazard has a shorter incubation period in older persons
- Secondary, person-to-person transmission appears to be greater in elderly, particularly institutionalized elderly.
- Reduced immune response to infectious organisms
- Reduced mobility, thirst response, likelihood to rehydrate and access needed medical care
- ? Reduced response to boil water advisories

# Boil Water Advisories

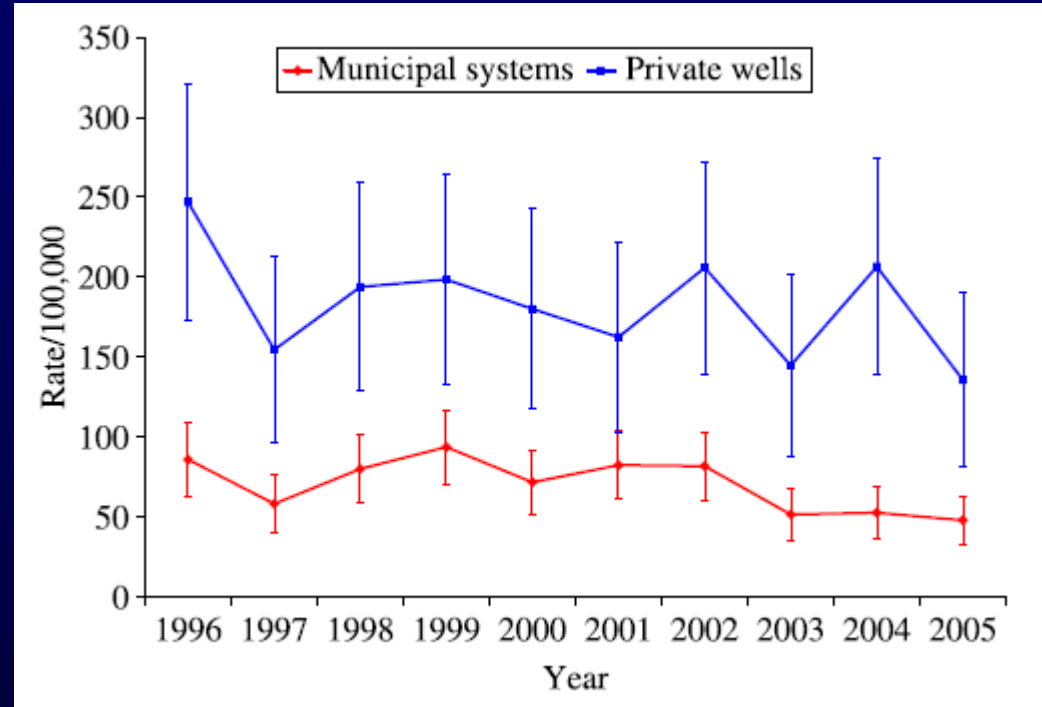
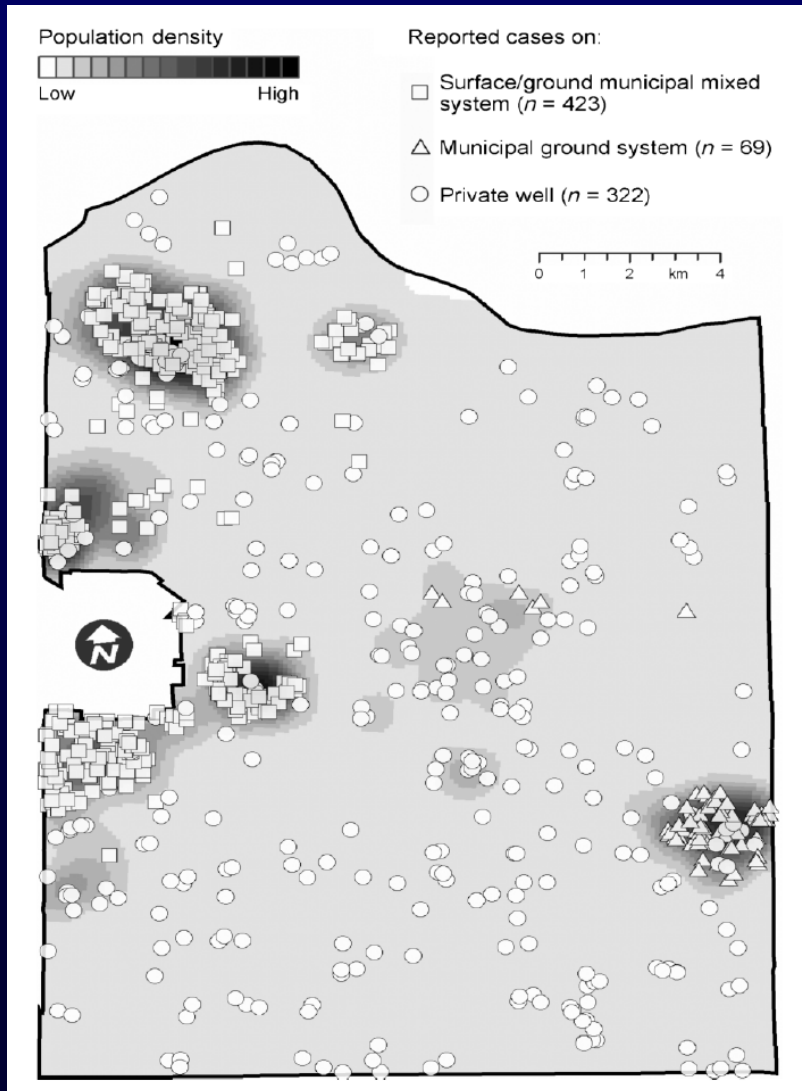
In 2008 , there were more than 1760 boil-water advisories in effect in communities across Canada



*“Advisories are intended to be a precautionary measure in the public health tool kit, but given that some have been in place for at least 5 years, they are apparently being used as a band-aid substitute for treatment” (Eggertson, 2008)*



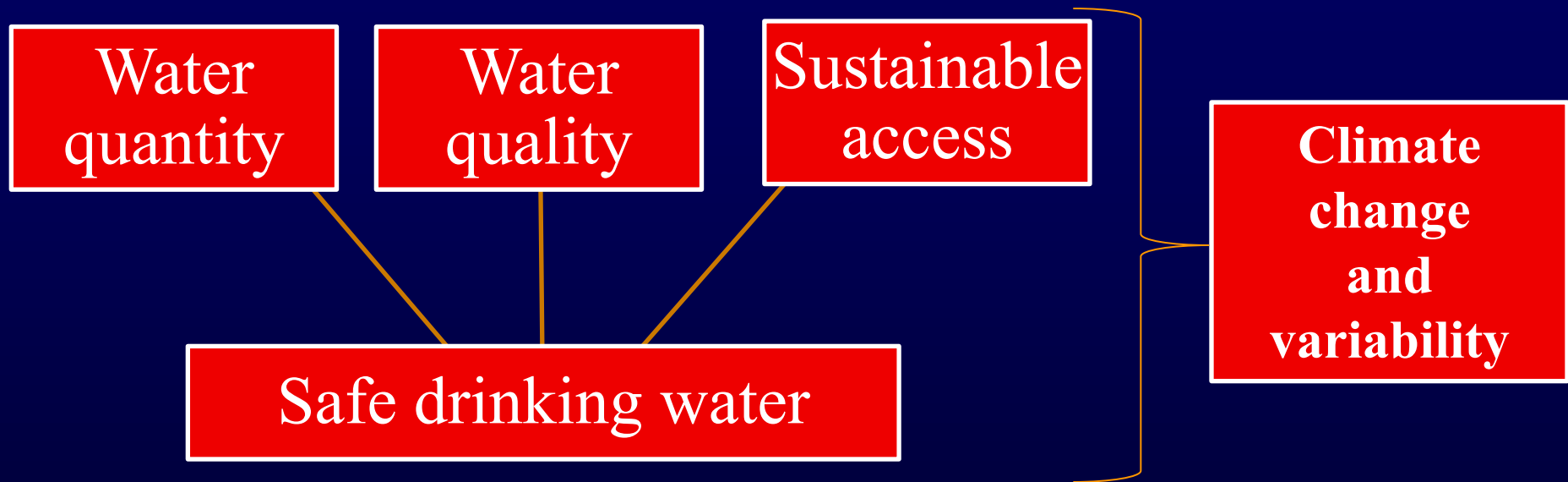
# Waterborne illness in a BC township effected by water source 1996-2006



Combined Average illness rate per 100,000	Municipal GW	Municipal GW + surface	Private well
	8	16	37

# Drinking water and Human Health With a Changing Climate

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*What will be the impacts on elder health and well-being?*

# Drinking water and Human Health With a Changing Climate

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## Seasonality :

*Every disease occurs at any season of the year but some of them more frequently occur and are of greater severity at certain times.*

*(Hippocrates. Aphorisms, III, 19)*

- Changes in geographic distribution and seasonality of infectious disease is likely to be among the first identifiable associations between climate change and health (WHO, 2003)
- Numerous studies have documented seasonal variability in GI illness rates
  - Commonly see peak in warm summer months for bacterial and in early fall for protozoan (Naumova, 2007)

# Drinking water and Human Health With a Changing Climate

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## Precipitation:

- Considerable anecdotal evidence suggesting that precipitation plays a role in the risk of illness ( e.g. Walkerton)
- Relationship between precipitation and GI illness has proven challenging to quantify
- Studies have shown that extreme precipitation events are associated with water-borne outbreaks
  - In the US, fifty-one percent of waterborne outbreaks between 1948 through 1998 were preceded by precipitation events above the 90th percentile and 68% by events above the 80th percentile (Curreiro, 2001).



# Drinking water and Human Health With a Changing Climate in BC

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Study Title: Water Quality and Human Health in a Changing Climate: Gastro-intestinal Illness in Small Communities in BC

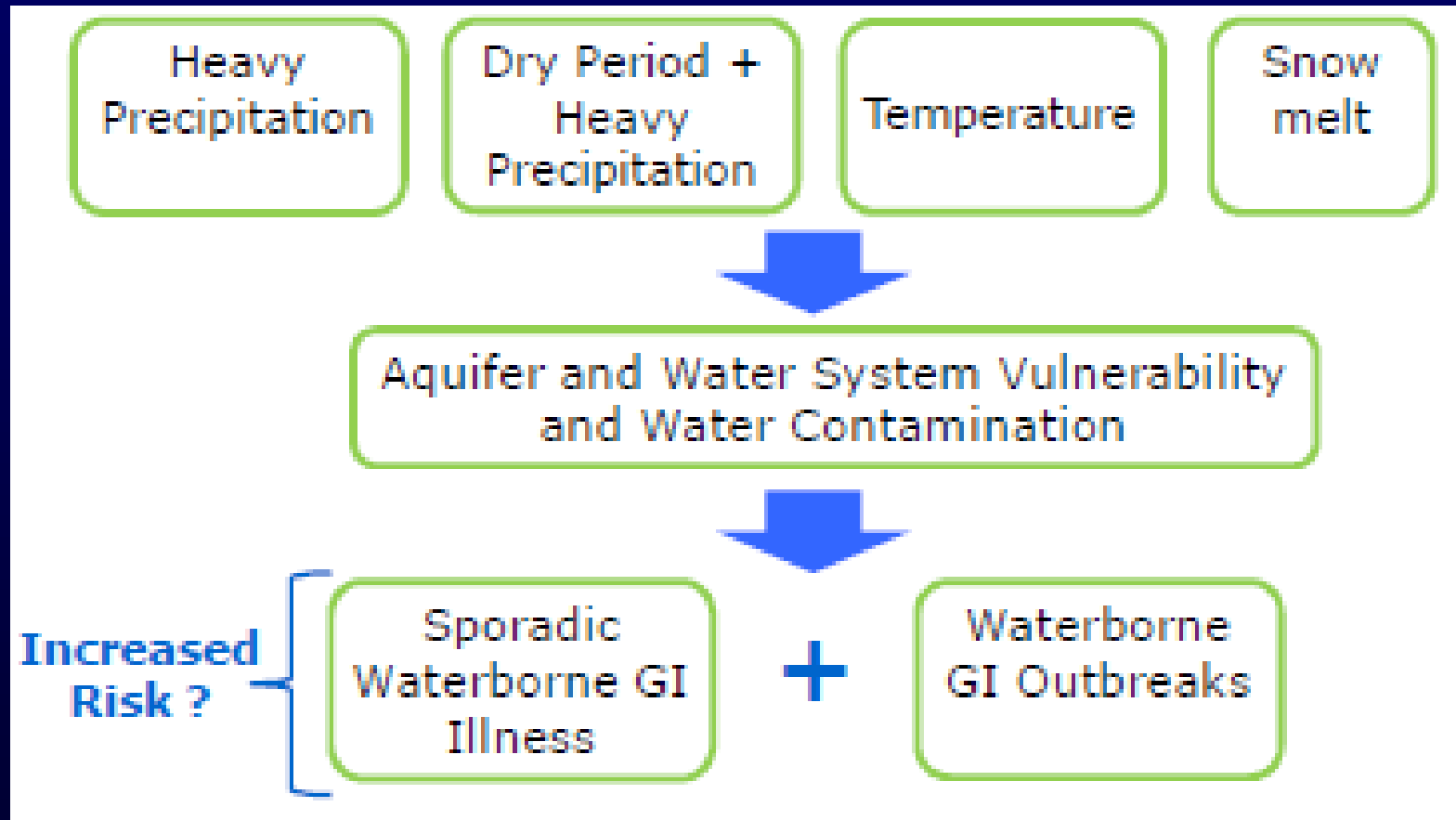
Overarching Goal: Examine potential impacts of future climate change on the risk of waterborne GI illness in small BC communities

Specific aims include:

1. To describe the temporal and spatial distribution of GI illness;
2. To examine and quantify the association between weather events and the risk of GI illness;
3. To establish linkages between characteristics of the aquifer and the drinking water system and the vulnerability for pathogens in water supplies and;
4. To describe the links between water quality , human health, and expected climate change in the context of small BC communities

# Drinking water and Human Health With a Changing Climate in BC

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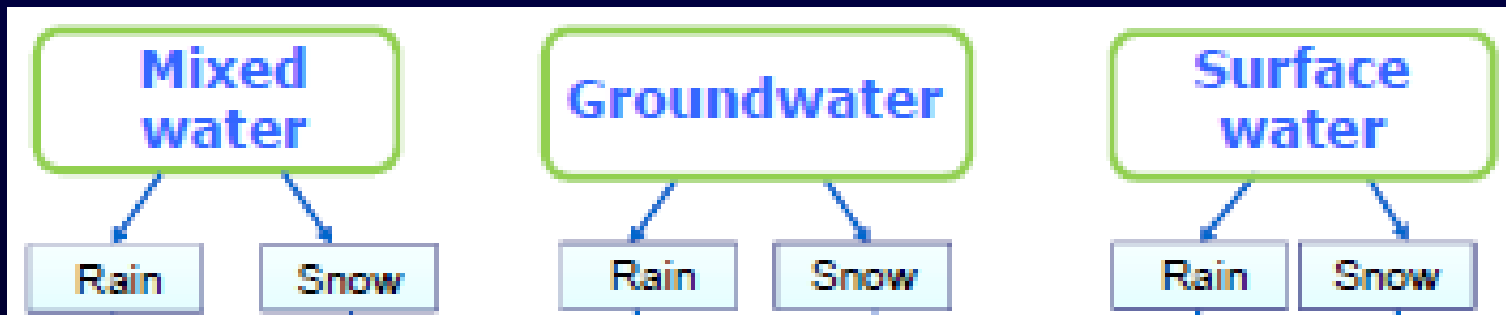


# Drinking water and Human Health With a Changing Climate in BC

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## 8 Study communities:

- Combination of water supply and rain regimes
- Geographic distribution across provinces



# Drinking water and Human Health With a Changing Climate in BC

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## Outcome

### Sporadic GI illness

- Laboratory confirmed cases for 5 types GI illness
- 1998-2010 time series
- Relevant demographic variables linked to cases (i.e. gender , age)
- Source: data from iPHIS (integrated Public Health Information System) managed by the BCCDC.

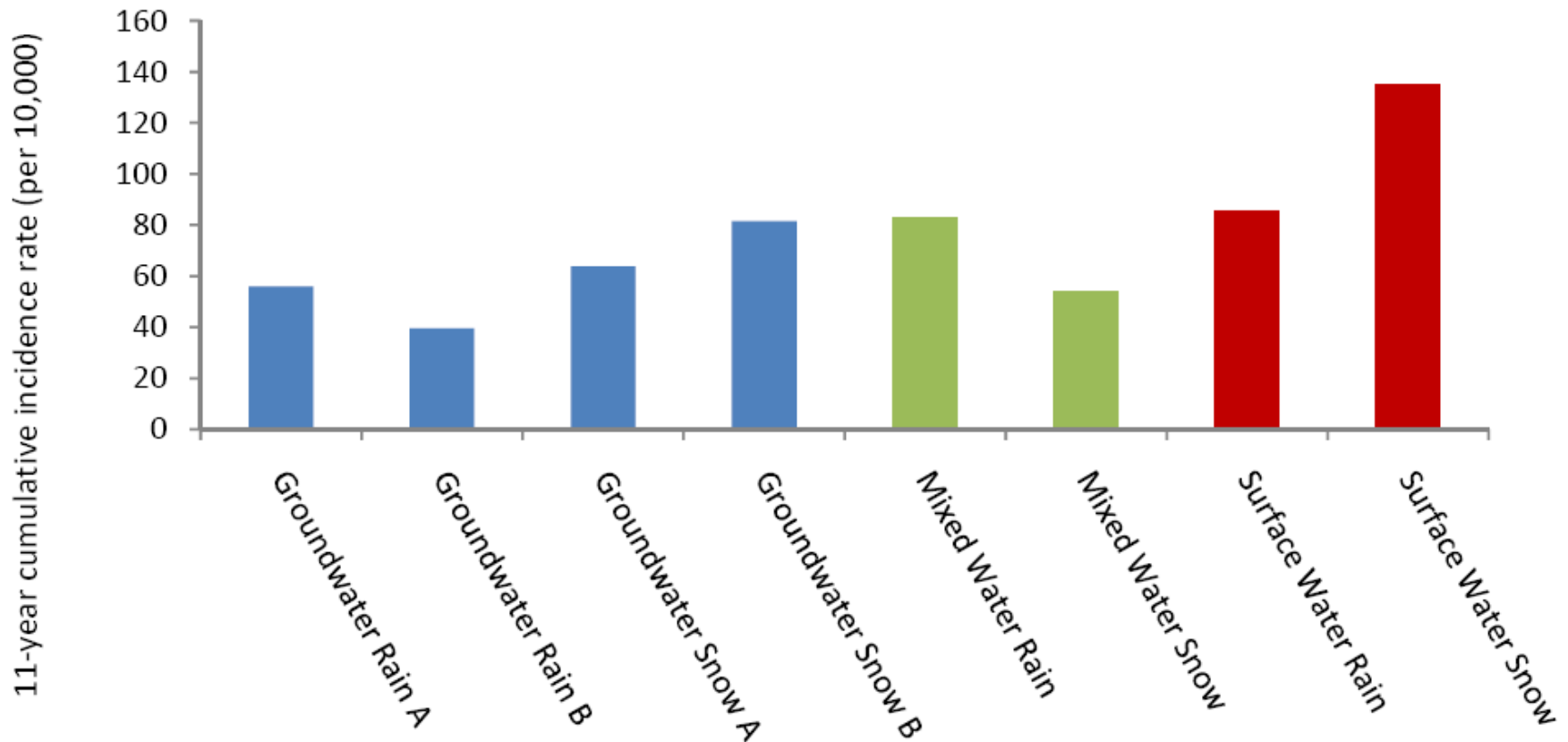
## Predictors

- Weather variables*: Daily precipitation , snow depth, rain , snow , Temperature
- Water source*: Groundwater, surface water
- Water supply*: Municipal system/ private system
- Water system characteristics*: Size, treatment , water shed protection and hydrogeology



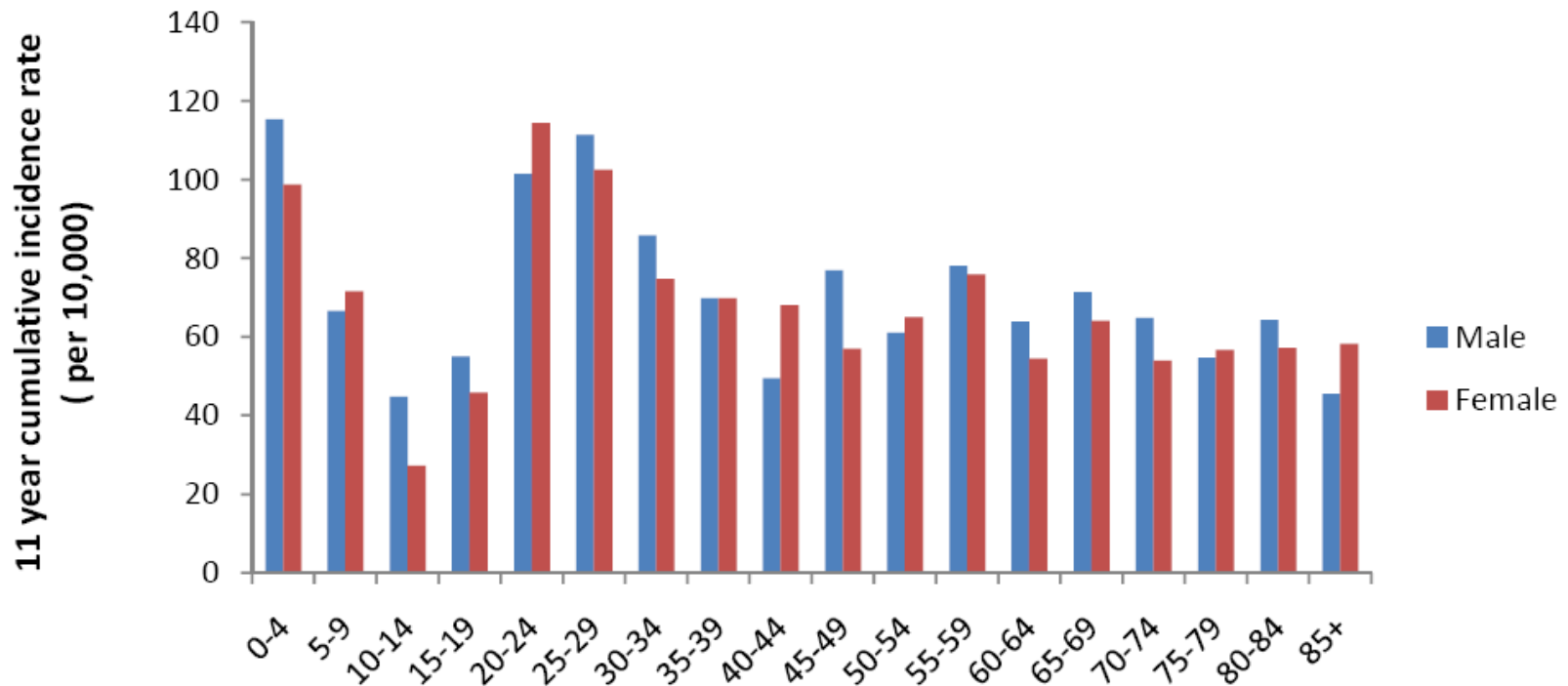
# Waterborne disease rates by age in eight BC study communities

Cumulative Incidence by Study Community  
1999-2010



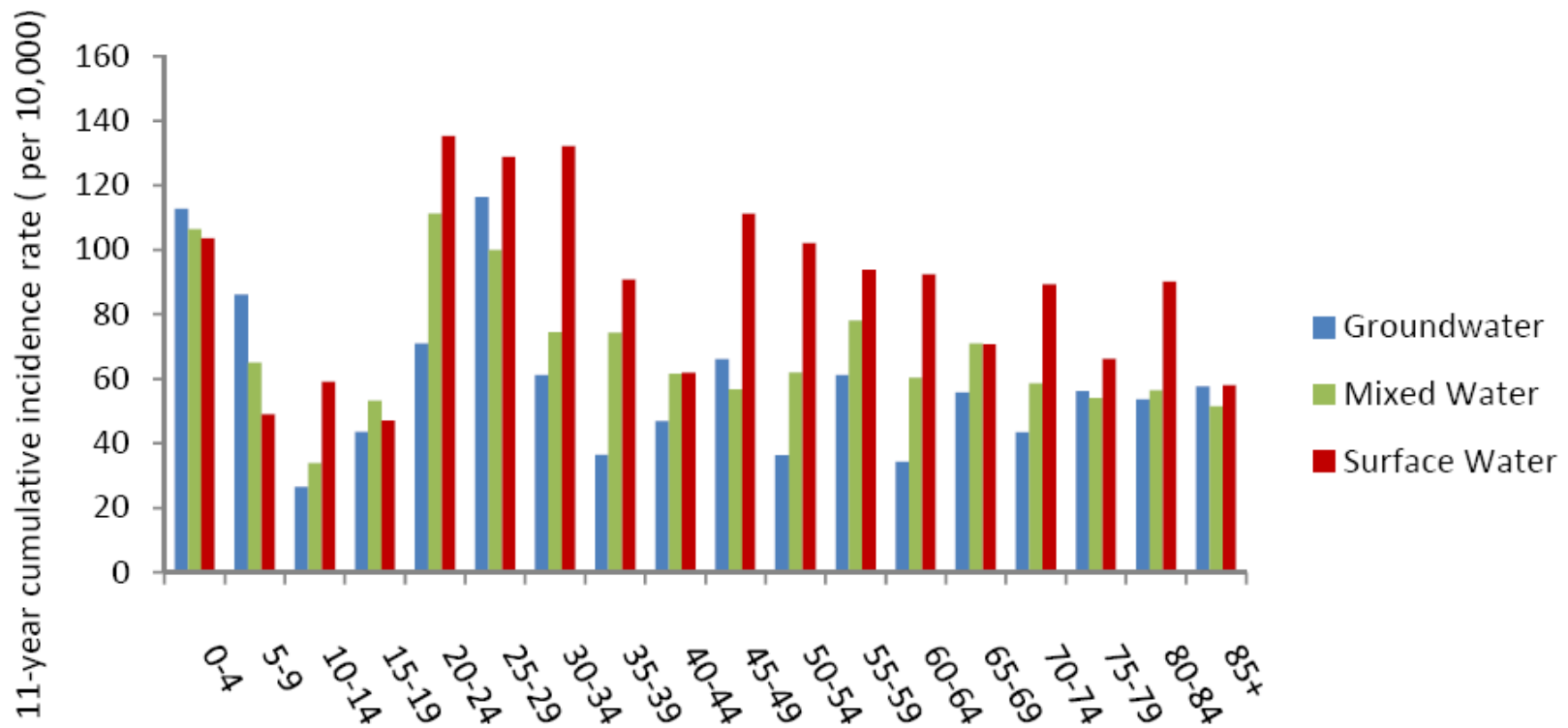
# Waterborne disease rates by age in eight BC study communities

Cumulative Incidence Rate of GI Illness Across Age categories  
1999-2010



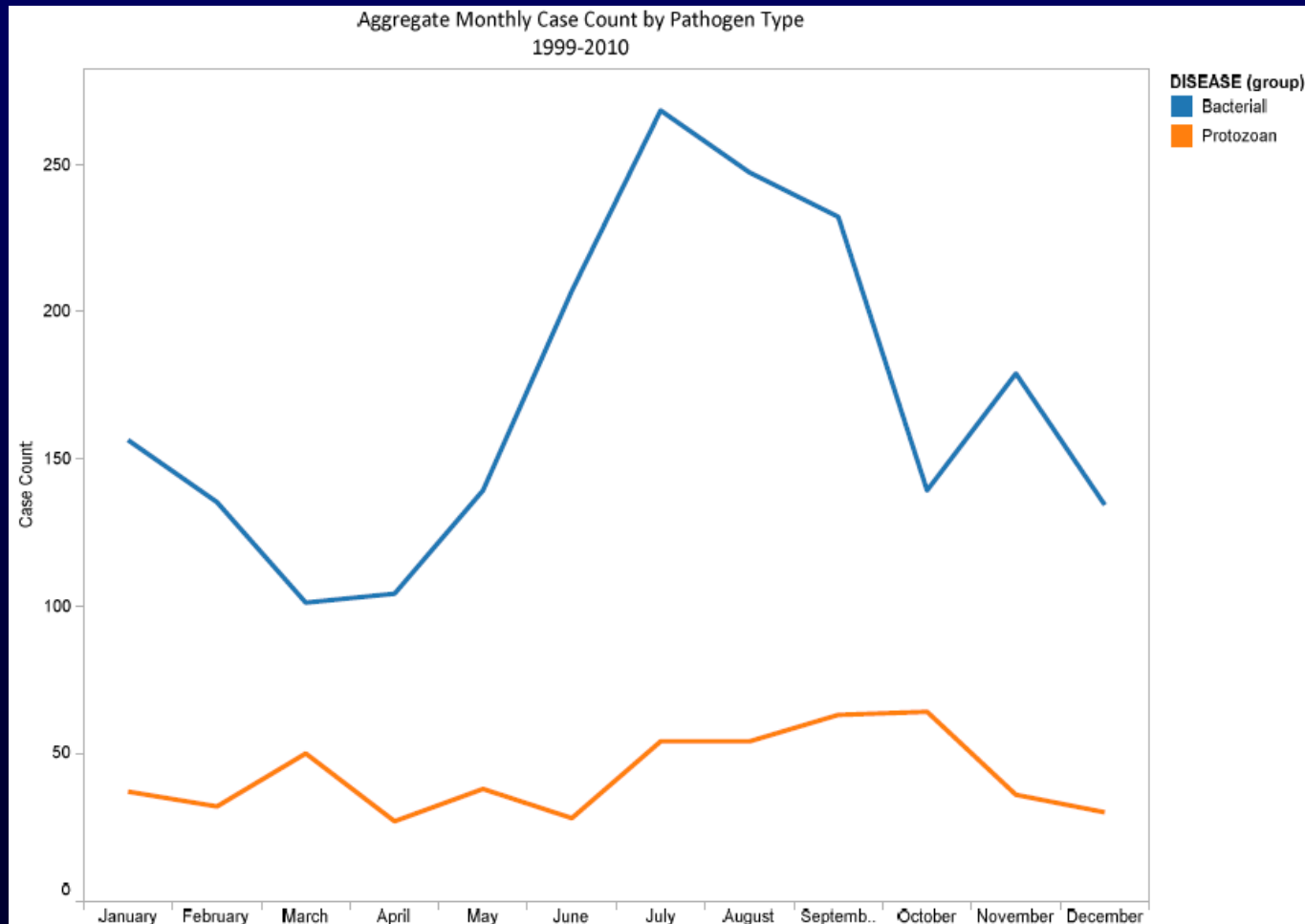
# Waterborne disease rates by age in eight BC study communities

Cumulative Incidence Rate by Community Water Source  
Across Age Categories  
1999-2010



# Drinking water and Human Health With a Changing Climate in BC

## Exploratory analyses: Seasonality...



# Future research needs related to resilience in older populations

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- What are characteristics of extreme weather events that increase drinking water hazards?
- What are water system characteristics that increase vulnerability to extreme events?
- When waterborne hazards increase, what interventions are effective at reducing health risk ?
- Can such interventions be targeted to the vulnerable (isolated) elderly population?



# Acknowledgements

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Zoonotic Disease  
Surveillance

Eleni Galanis, MD, MPH

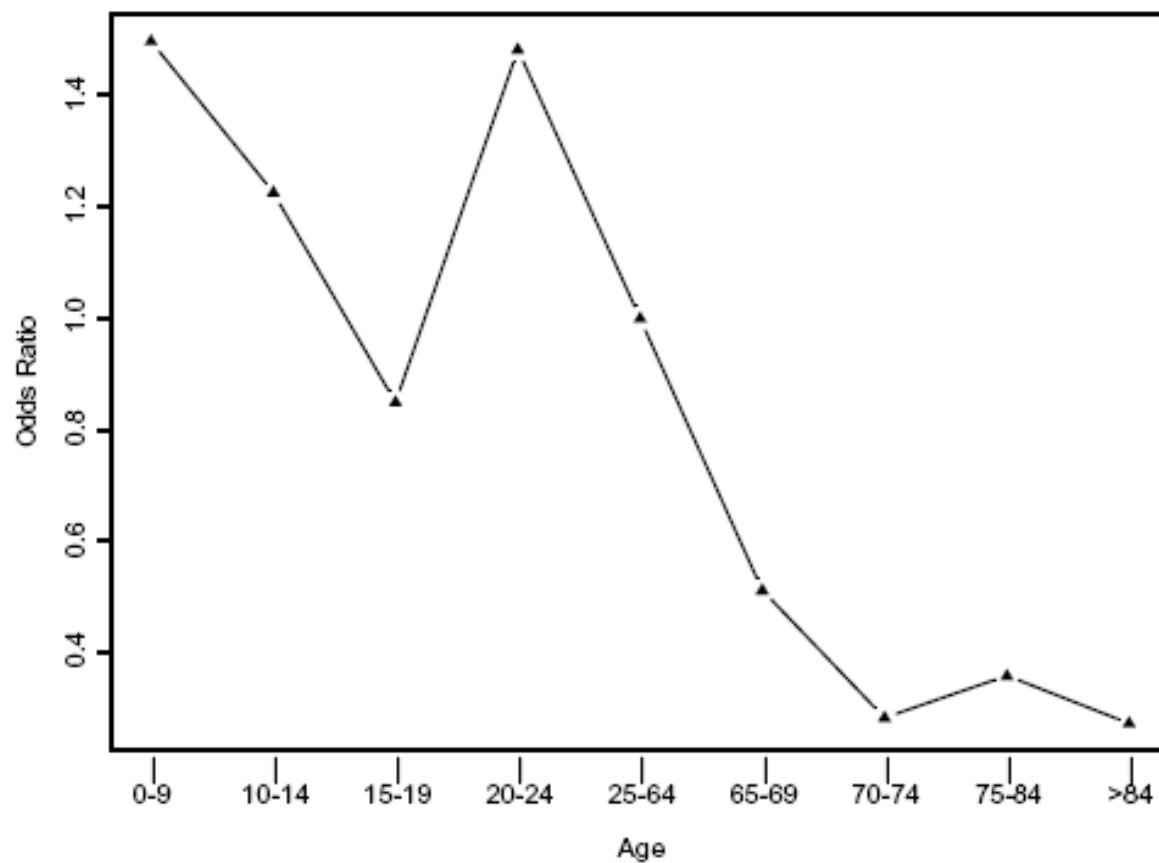
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Advanced Landscape Planning

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Canadian Institute for Health Research

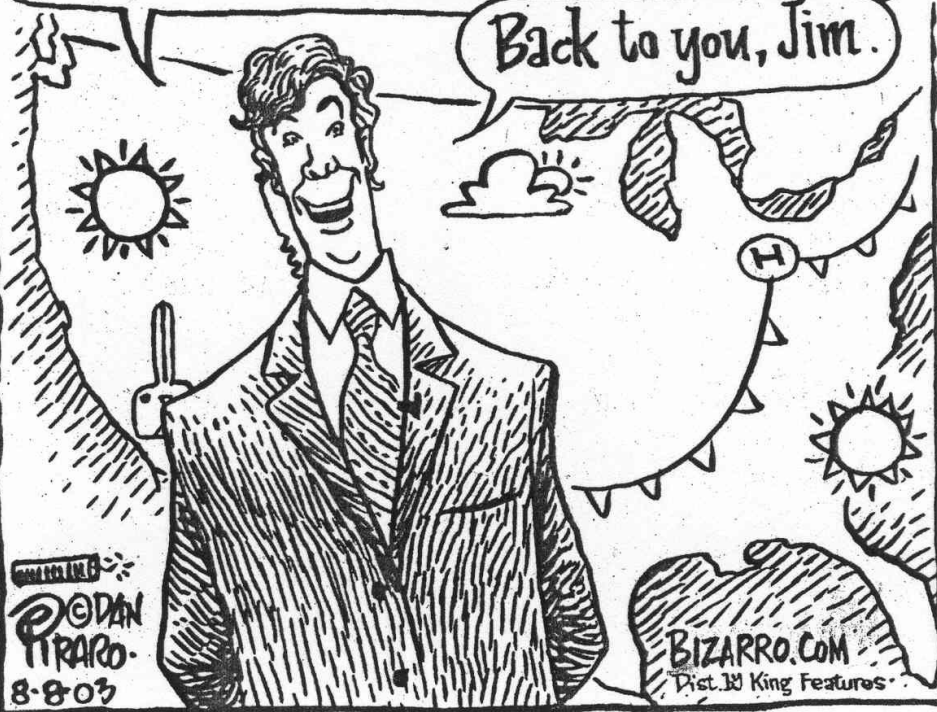




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Our extended forecast includes global warming & the catastrophic end of the human race. But for the weekend, it's looking like sunny skies, mild temperatures, & a general apathy toward environmental concerns.

Back to you, Jim.



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# Absorbing capacity

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- **The ability to absorb the free energy of an event without sustaining damage**
  - **Levees**
  - **Building codes**
  - **Reforestation**
  - **Boarding windows**
  - **Bomb shelters**
  - **Bullet proof vests**
  - **Armor**
  - **Air bags**
- ***Mitigation* is anything done to increase absorbing capacity**

# The Precautionary Principle

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“When an activity raises threats of harm to human health or the environment, *precautionary measures should be taken* even if some cause and effect relationships are not fully established scientifically.”

- The Wingspread Statement, Racine, WI 1998

“If you say nothing until you have high confidence and solid evidence, you’re failing society.”

-Stephen Schneider, Stanford Univ. 2009



# Science Magazine Comments on US Position Following Rejection of Kyoto

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“We are now undertaking a vast experiment with the earth’s climate. We’re not doing it to test a hypothesis or achieve a result, and it doesn’t have a design. We’re doing it because we can’t help it.”

-Donald Kennedy, Editor

2002

# **Climate Change and Human Health: The Limits of our Thinking**

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- **Highly technical and complex**
- **Beyond anyone's experience**
- **Misinformation actively disseminated**
- **Resistance to necessary behavioral changes.**

# Buffering Capacity

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- **The ability of a society to cope with damage and to function despite damage**
- **The ability to maintain essential functions for a change in available resources**
  - **Backup Generators**
  - **Alternate sources of fuel**
  - **Shelters**
  - **Cross-trained personnel**
  - **Wells / rain water**

# WHO Assessment

## Burden of Disease Due to Climate Change

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- **Global climate change since mid-1970s could be cause of over 150,000 deaths/yr.**
- **And 5 Million Disability Adjusted Life-yrs lost.**

### **Due largely to:**

- **Diarrheal disease (temp effects only)**
- **Malaria**
- **Malnutrition**
- **Also, CVD, flooding, NOT direct heat related deaths**