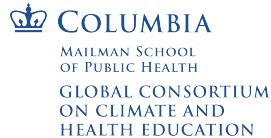


Caribbean Climate and Health Responders Course

Water and Food related illnesses (flooding and drought) - April 20, 2022

Celia Poon-King FFPH, MPH, MBBS
Public Health Consultant



agenda

- the climate change health responder role
- learning objectives
- background – the Caribbean, definitions, climate change and health
- hydrosphere and hydrological cycle and climate change
- infectious pathogens/toxin water and foodborne related disease and climate change
 - in relation to the climate change health responder
- chronic/ water and foodborne related disease and climate change
 - in relation to the climate change health responder

what is the climate change health responder role?

- use your skills to
 - 1) improve patient care and public health practice and
 - 2) serve as the health community's trusted messengers within their institutions, communities, and fields of practice

learning objectives

1. describe how climate change impacts the hydrosphere and the implications for water availability, quality and supply
2. apply knowledge of climate impacts on the hydrologic cycle to the incidence and prevalence of waterborne pathogens including bacteria, parasites and viruses
3. explore case examples of direct impacts of hydrologic changes on salmonella, norovirus, campylobacter, cryptosporidium, leptospirosis, and vibrio, ciguatera poisoning
4. explain how changes to the hydrologic cycle may impact patient health, and steps health professionals can take to reduce this risk
 - explore factors that contribute to individual and community-level vulnerability

learning objectives

5. describe how climate change affects all four dimensions of food security: food availability, stability of food supplies, access to food and food utilization
6. discuss how climate change and variability impacts key underlying causes of undernutrition and household food access
7. explore co-benefits of improving diets to address malnutrition and mitigate climate change
8. discuss relationship between food, animal and plant agriculture and GHG emissions (methane, carbon)
9. discuss the relationship between one health and the steps health responders can take to reduce the risk posed by climate change to their patients
 - explore factors that contribute to individual and community-level vulnerability

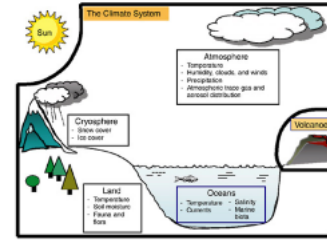
definitions

climate change	"Climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer (1)"
climate variability	way aspects of climate (such as temperature and precipitation) differ from an average (2).
hydrosphere	the component of the climate system composed of liquid surface and subterranean water, such as oceans, seas, rivers, freshwater lakes, underground water, etc (3).
hydrologic cycle	process by which water moves around the earth. The cycle includes evaporation, precipitation, runoff, condensation, transpiration and infiltration (1, 4)

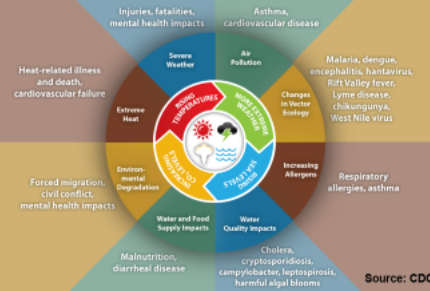
climate system

comprising all the... water - related spheres

- the atmosphere
- the cryosphere
- the hydrosphere



Impact of Climate Change on Human Health



malnutrition and climate change

- climate change and nutrition pathway
- definitions
- food security
- link between undernutrition & household food access
- mitigating climate change and nutrition

definitions

climate change	<i>“Climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer (1)”</i>
climate variability	way aspects of climate (such as temperature and precipitation) differ from an average (2).
hydrosphere	the component of the climate system composed of liquid surface and subterranean water, such as oceans, seas, rivers, freshwater lakes, underground water, etc (3).
hydrologic cycle	process by which water moves around the earth. The cycle includes evaporation, precipitation, runoff, condensation, transpiration and infiltration (1, 4)

climate variability and climate change

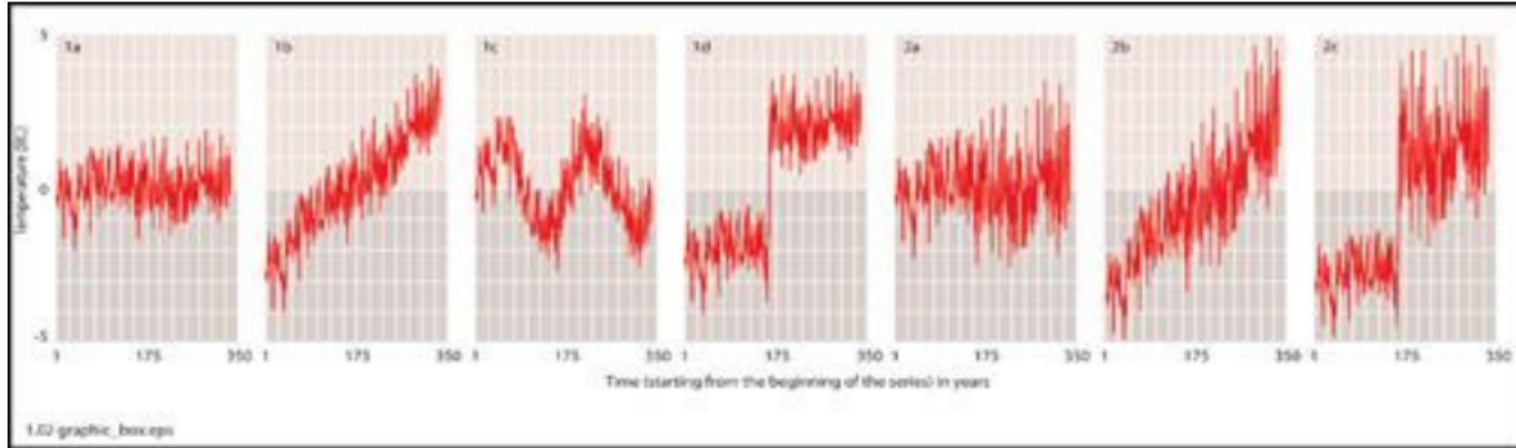
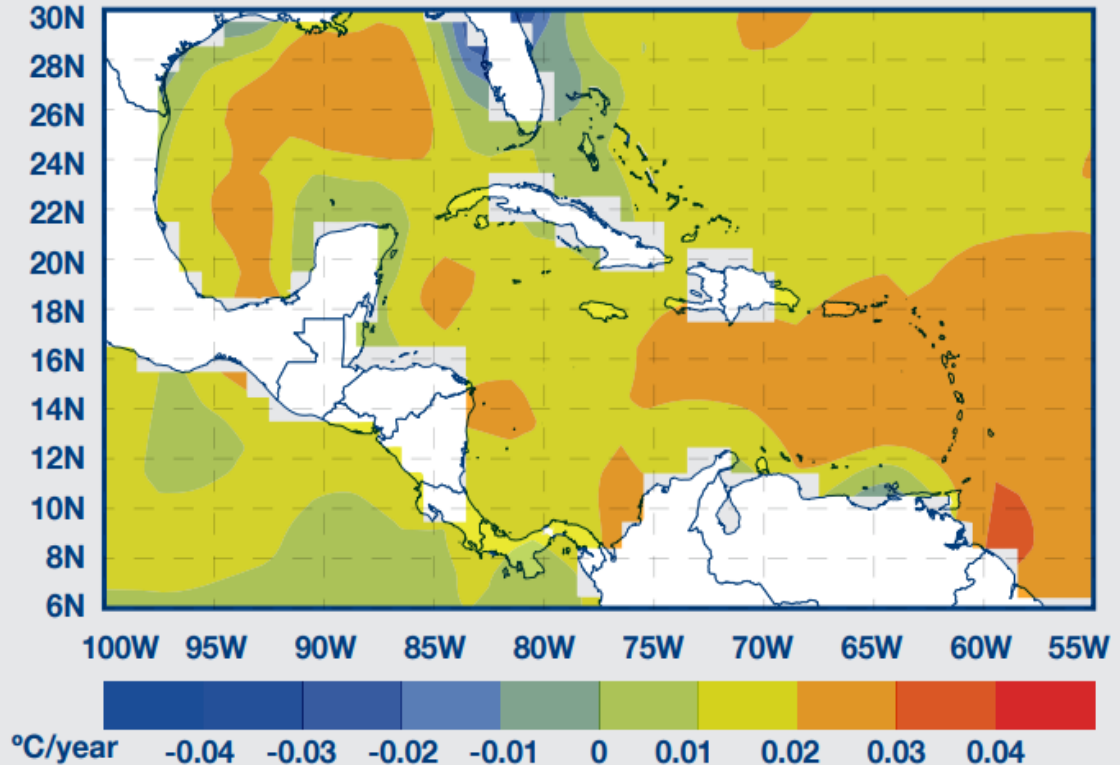


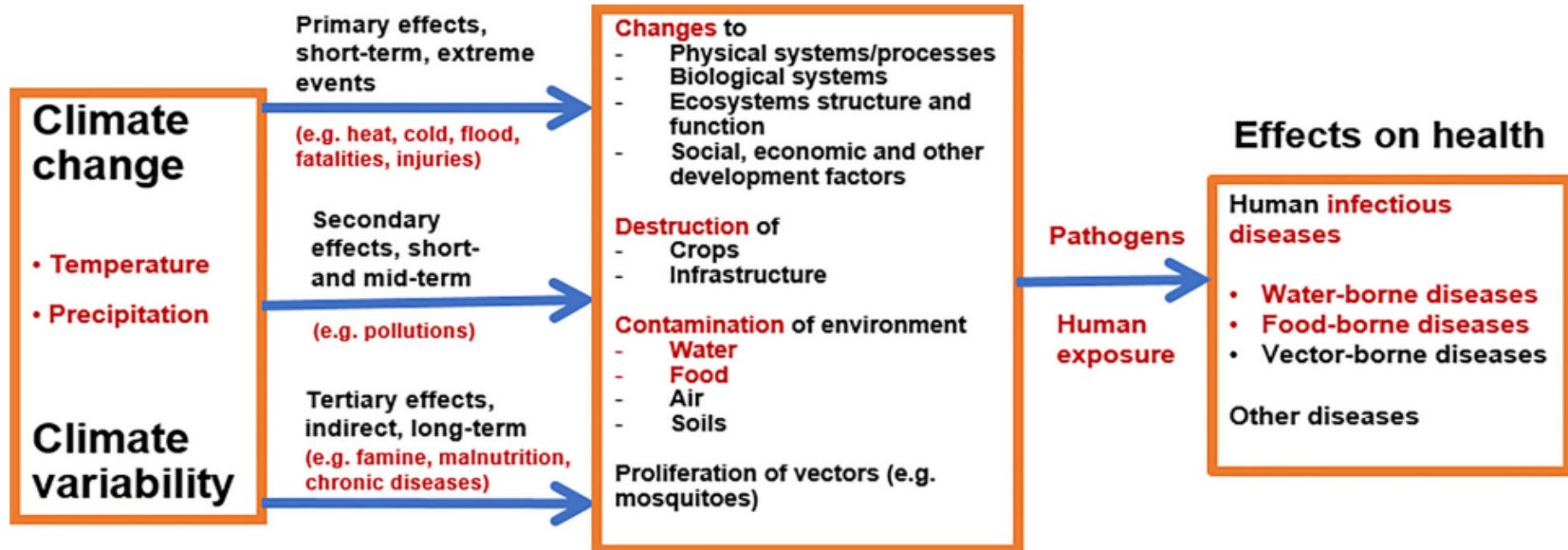
Figure 2.1: Climate variability and climate change
(WMO 2003)

the Caribbean

Detected sea surface temperature trends (per degree Celsius per year) for the Intra-Americas Region over the period 1982– 2016. Data is from NOAA Optimum Interpolation SST Dataset. Source: Adapted from (5)



climate change & health - waterborne and foodborne diseases (paper)



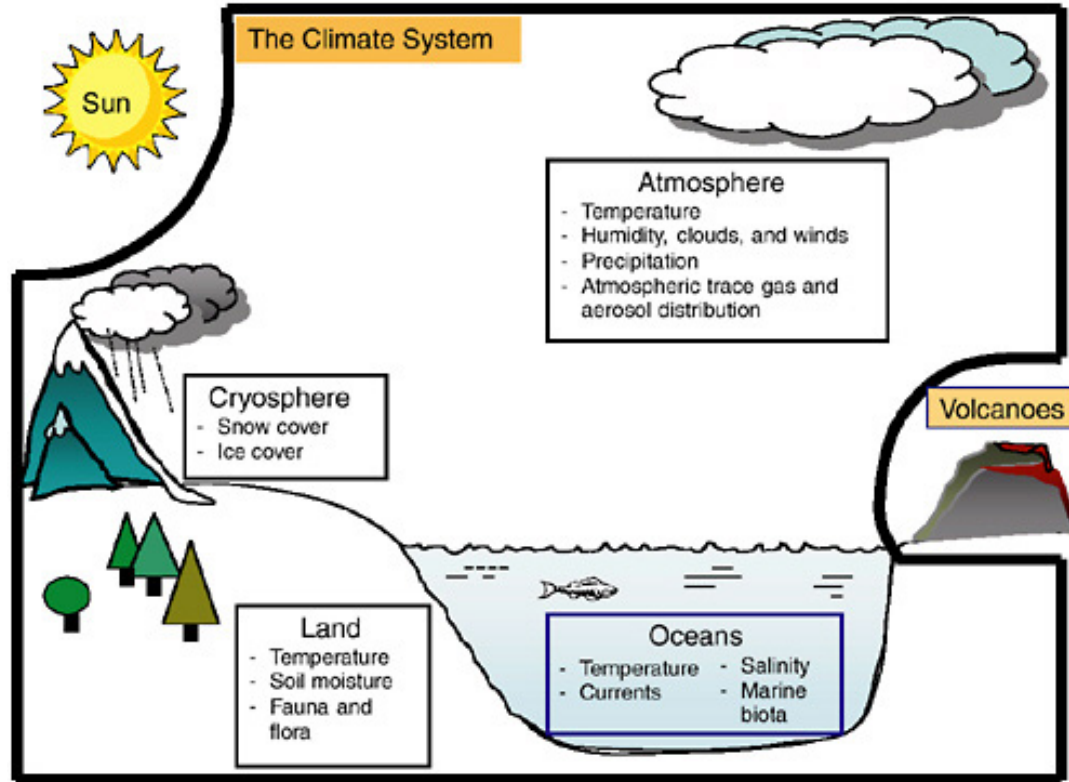
Source: Adapted from (5)

climate system

comprising all the... water

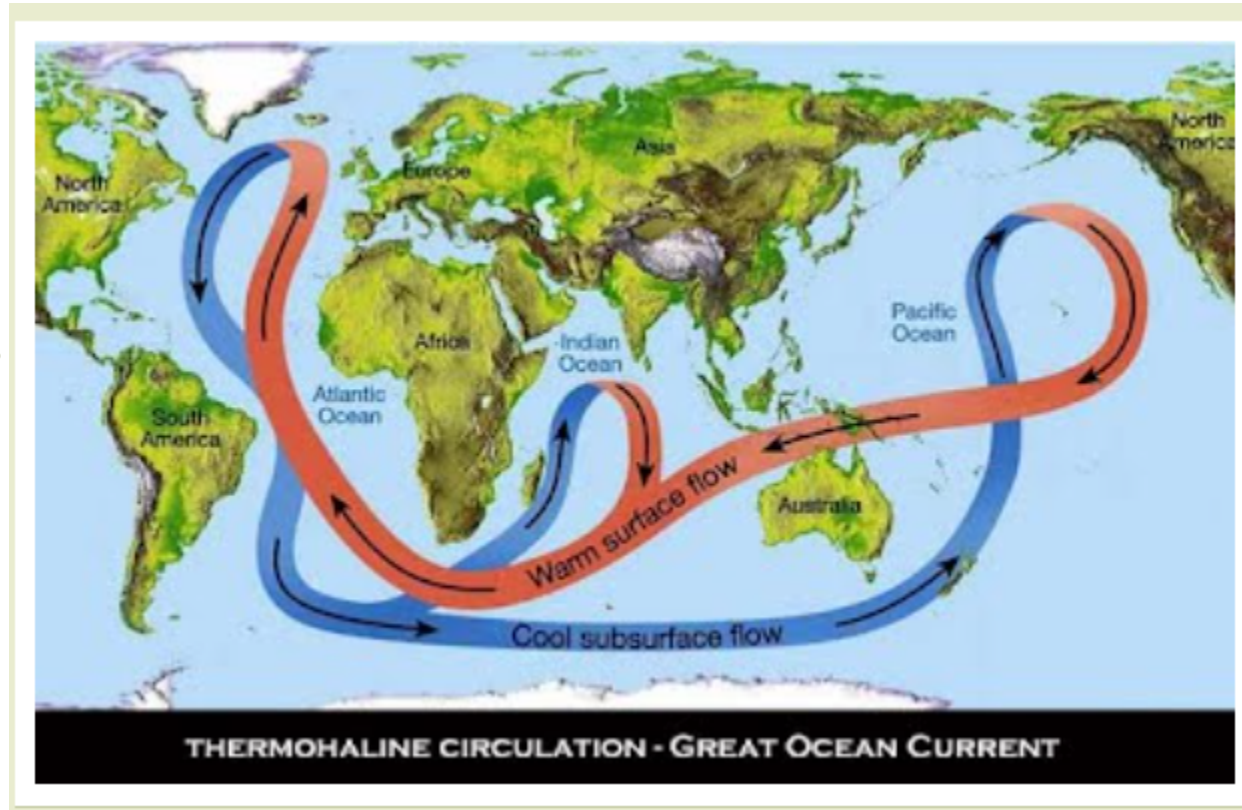
– related spheres

- the atmosphere
- the cryosphere
- the hydrosphere



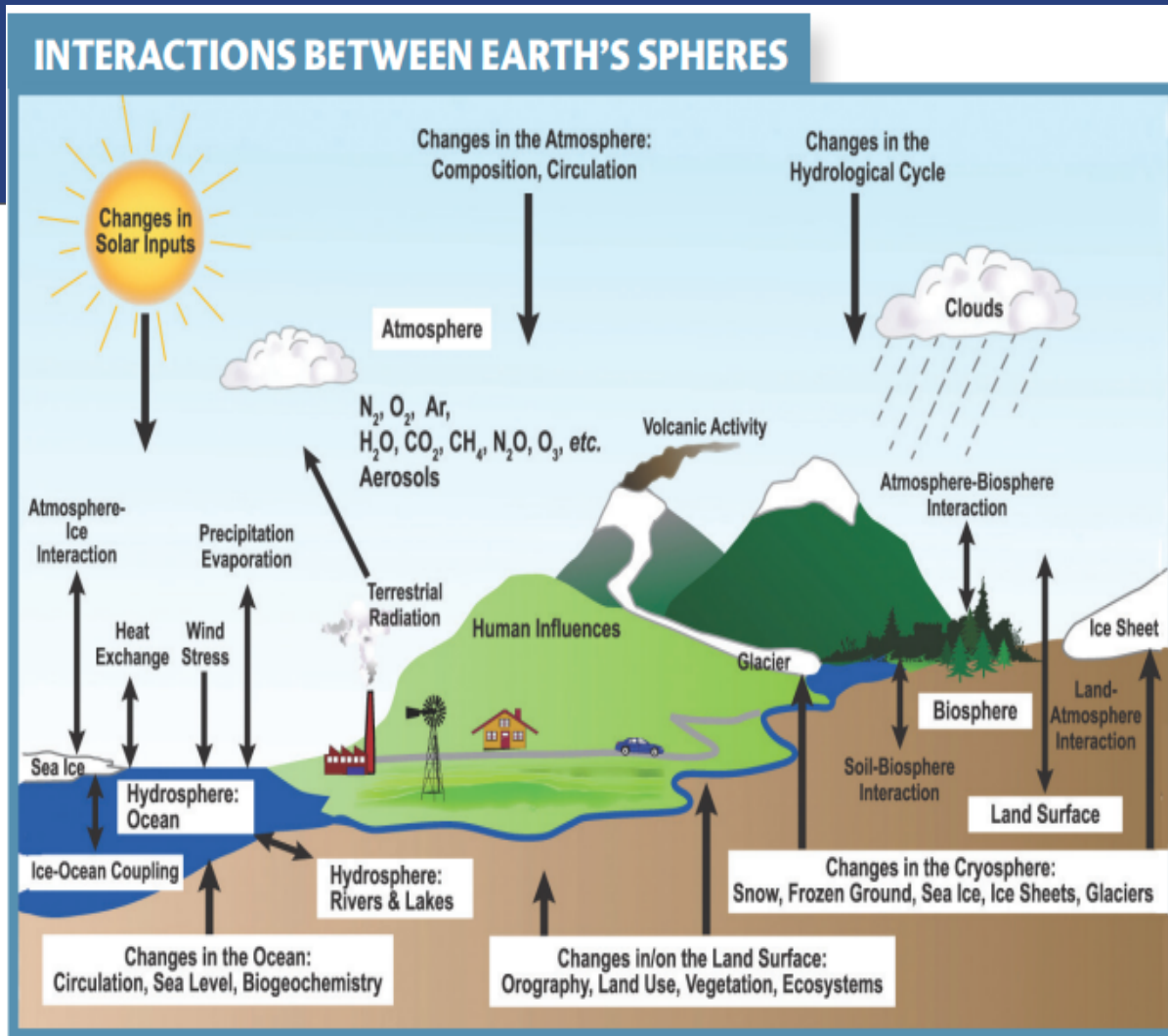
the hydrosphere

- all the water on the planet that can be stored in the oceans, glaciers, rivers, streams, groundwater, or water vapor

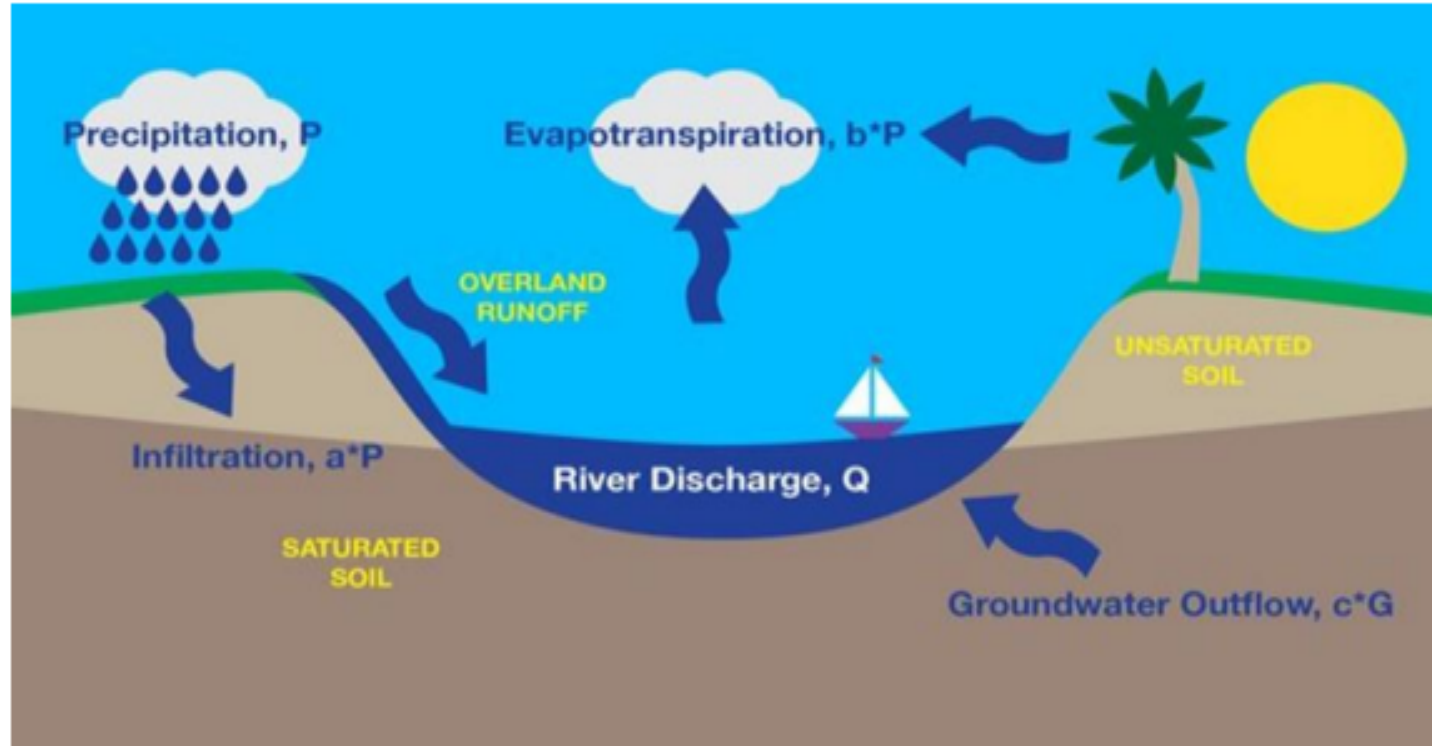


climate change

- global web of relationships
- matter and energy constantly moving between the spheres
- in climate change – matter converter to energy over extended period of time



hydrosphere climate change impacts – Caribbean



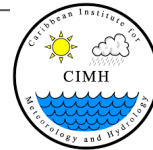
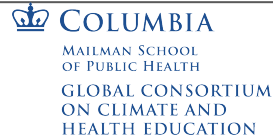
- less water available for domestic; industrial, agricultural use due to
- less rainfall
- lower volumes of water in reservoirs and rivers
- alterations in the timing of rainfall
- intense rainfall, more surface runoff and less infiltration

- pollutants in water courses include fertilizers, pesticides, municipal wastewater
- higher evaporation rates, less water- pollutants become more concentrated • implications for water abstraction/recreational use
- heavy rainfall events – pollutants become diluted
- depends however on the level of pollution in the water body, vs. Level of Pollution in the watershed • Heavy surface runoff can increase pollutant levels

Zoom Poll Question 1

climate change predictions/ forecasts for the Caribbean include:

1. main Caribbean basin- Drier
2. drier & longer dry season with droughts
3. when rain does fall- heavy downpours with floods
4. all of the above

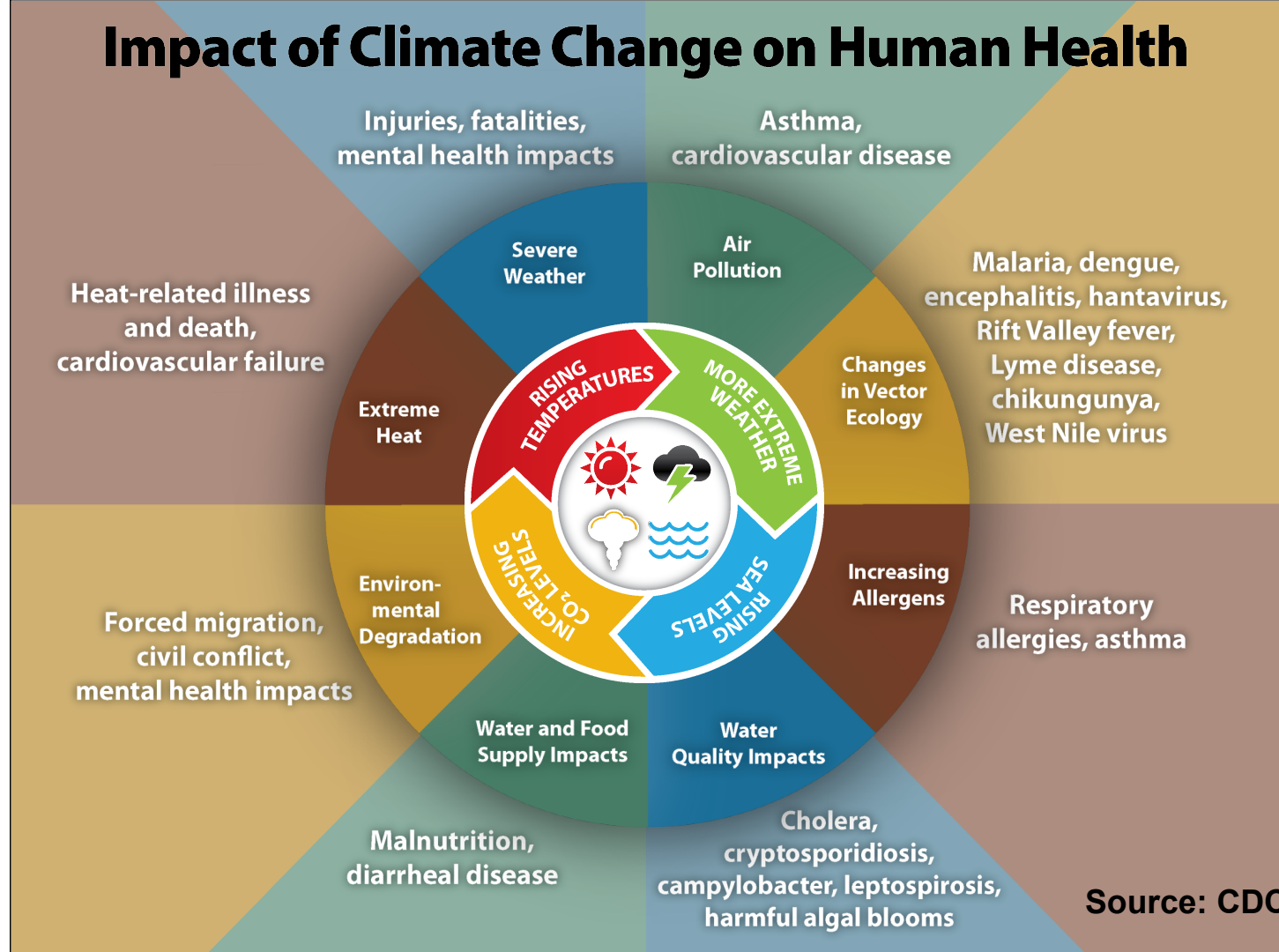


climate change in the Caribbean

- main Caribbean basin- Drier
- possible wetter conditions Northern Caribbean
- drier & longer dry season
- Caribbean region primary rainy season (May- Nov) significantly drier.
- expected overall decrease in annual precipitation of about 12% for Caribbean region
- when rain does fall- heavy downpours
- more intense hurricanes
- decrease access to hydropower



Impact of Climate Change on Human Health



Source: CDC

climate change - waterborne and food borne diseases

1. infectious pathogen/toxin waterborne and foodborne diseases
2. food-borne noncommunicable/chronic disease

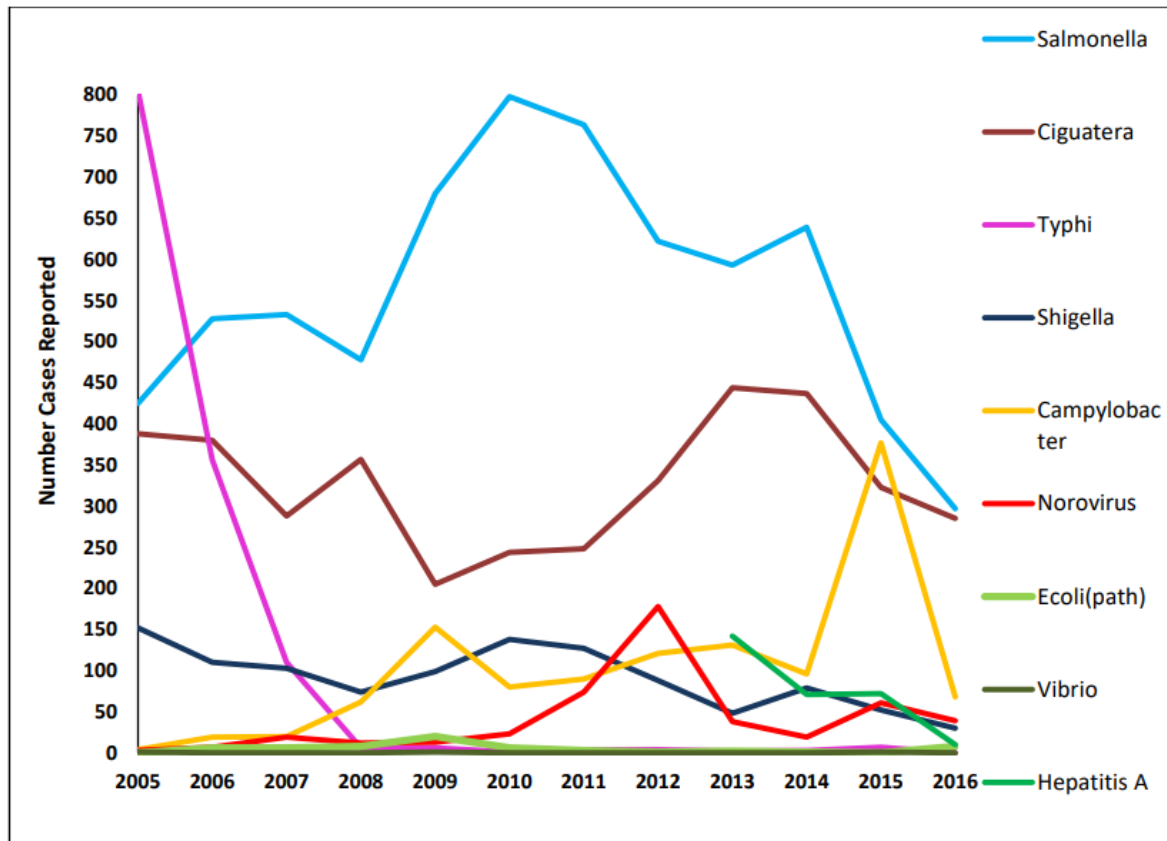
waterborne & foodborne disease pathogens/toxins

- waterborne and foodborne diseases due to pathogens – bacteria, virus, protozoa, helminths - that are spread by the consumption or exposure to contaminated water and food (adapted WHO).
- responsible for of 1.5 million deaths globally (2012). • 58% of that burden in low- and middle-income countries – 842 000 deaths per year
- attributable to unsafe water supply, inadequate sanitation and lack of hygiene

hydrologic cycle & waterborne pathogens

1. waterborne disease outbreaks preceded by precipitation
2. with climate change - heavy precipitation events projected to occur more frequently

in the Caribbean



direct impacts of hydrologic changes

1. salmonella,
2. campylobacter
3. cryptosporidium
4. norovirus
5. vibrio

6. leptospirosis
7. ciguatera poisoning - ciguatoxin

1. direct impacts on salmonella

1. symptoms include: –
 - causes gastroenteritis –
 - nausea/vomiting
 - diarrhea
2. water can become contaminated through faecal pollution
 1. by infected humans but also by
 2. other vertebrates •
3. incidence could increase with warming waters

2. direct impacts on norovirus

Causes acute gastroenteritis in humans

- symptoms
 - Projectile vomiting
 - Watery non-bloody diarrhea
 - Abdominal cramps – Myalgia
- heavy rainfalls/flooding increases infections

**Protect Yourself
from Norovirus!**



**Wash your
hands often**



**Wash fruits &
vegetables**



**Cook shellfish
thoroughly**



**Clean surfaces
& wash laundry**



**When you're sick,
don't prepare food
or care for others**

Share this widget | More info
www.cdc.gov/Norovirus



3. direct impacts on campylobacter

Symptoms include:

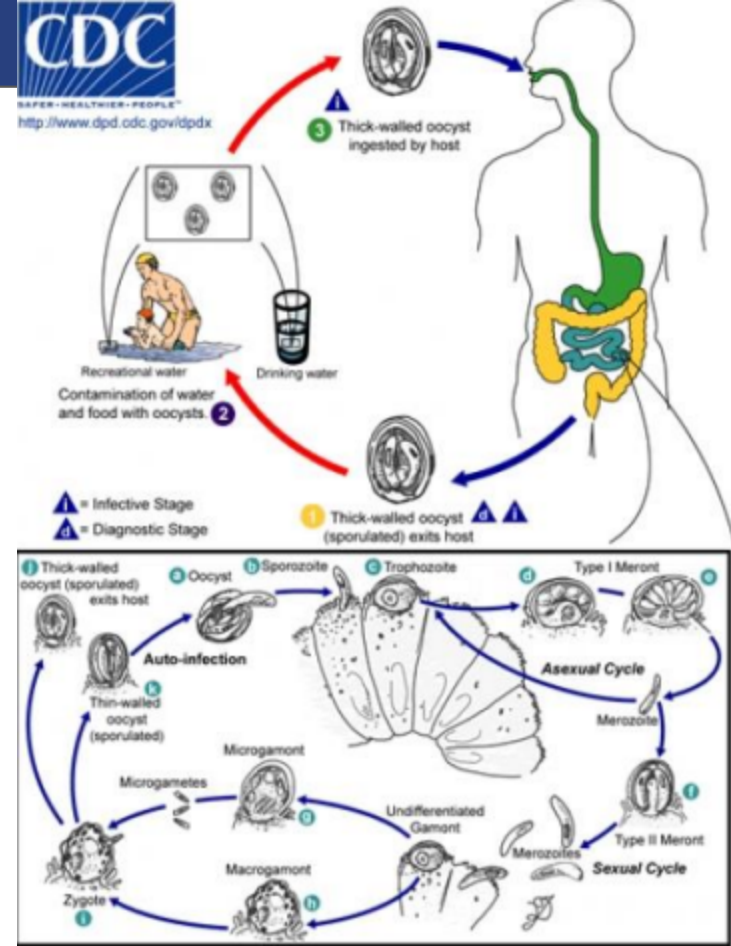
- Watery, bloody diarrhoea
- Abdominal pain
- Fever
- Headache
- Nausea •

Associated with increased air and water temp and heavy precipitation

4. direct impacts on cryptosporidium

Watery diarrhea that can be severe and even life threatening

- Sturdy oocysts: Chlorination ineffective
- Small size: Filtration ineffective • heavy rainfall causes mobilization of oocysts leading to outbreaks



5. direct impacts on Vibrio (Cholera)

1. Pathology and Human Health •

- Acute diarrhea that can kill within hours •
- Highly contagious • Most pressing in Africa and Asia + poor infrastructure •

2. Consequences of Climate Change •

- El Niño → wetter in East Africa → higher incidence •
- Complicated •
 - Less rain in dry areas → unsafe drinking water
 - More rain in dry areas → flooding of sewer system •
 - Less rain in wet areas → decrease flooding •
 - More rain in wet areas → decrease pathogen conc • but increase flooding

5. direct impacts on Vibrio (Cholera)

- ↑ phytoplankton blooms,
- which provide good habitat for the survival and spread of cholera

Vibrio vulnificus & parahaemolyticus

- **Microbial Characteristics**
 - Bacterium
 - Warm coastal waters
 - + salt tolerant
 - Summer and early autumn
- **Consequences of Climate Change**
 - Increase ocean temp→ increase range
 - Increase algal blooms→ increase concentration
 - Higher minimum temps→ uninterrupted growth
- **Pathology and Human Health •**
 - Septicemia of wounds (*V. vulnificus*)
 - Gastrointestinal (*V. parahaemolyticus*)

6. leptospirosis (paper)

- zoonosis usually transmitted through contact with water or soil contaminated with urine from infected animals
- Severe flooding can put individuals at greater risk for contracting leptospirosis in endemic areas (Guyana 2005)
- post event surveillance is important

7. direct impacts on ciguatera poisoning

- usually symptoms appear 1 to 3 hours after consuming contaminated fish.
- abdominal pain, nausea, vomiting, and diarrhea.
- neurological complications appearing 3 to 72 hours later,
 - including a tingling sensation, temperature reversal (cold items feel hot and hot items feel cold),

7. direct impacts on ciguatera poisoning

- itching, metallic taste in the mouth, feeling like teeth are loosening, blurred vision, and even temporary blindness. These symptoms usually last days to several weeks.
- long term - chronic fatigue, depression, muscle pain, headache, a slow or irregular heartbeat, and low blood pressure.

seasonal variation observed with the overgrowth with rising temperature

- Increased water temps
- Nutrient runoff (heavy precip events)
- Ocean upwelling events (dragging of anchors of large ships)

water borne-related diseases, climate, risk

Climate Change	Effects	Consequences	Microbial Risk
Water temperature increase	Replication of marine bacteria (<i>Vibrio</i>)	Bacterial blooms in marine environments	Increased risk
	Die-off of enteric pathogens (e.g., <i>Norovirus</i> , <i>Campylobacter</i>)	Lower concentrations of pathogens in surface water	Decreased risk
	Organic matter and nutrients dissolve better	Challenges for water treatment: less efficient	Increased risk
Precipitation increase	Runoff, sediments, organic matter, nutrients	Challenges for water treatment: less efficient	Increased risk
	Peak concentrations of pathogens in surface water	Challenges for water treatment: less efficient	Increased risk
	Flooding of wells or water treatment plants	Water treatment at risk	Increased risk
	Storm water runoff and combined sewage overflow	Water treatment at risk Recreational water contamination	Increased risk
	Groundwater contamination with fecal pathogens	Water treatment insufficient	Increased risk
Drought	Changes in water sources	Insufficient treatment options	Increased risk
	Concentration of pathogens	Challenges for water treatment: less efficient	Increased risk

Water and food-borne agents: connection to climate

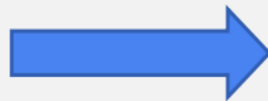
Pathogen groups	Pathogenic agent	Food-borne agents	Water-borne agents	Indirect weather effect	Direct weather effect
Viruses	Enteric viruses (e.g. hepatitis A virus, Coxsackie B virus)	Shellfish	Groundwater	Storms can increase transport from faecal and waste water sources	Survival increases at reduced temperatures and sunlight (ultraviolet) ^a
Bacteria Cyanobacteria Dinoflagellates	Vibrio (e.g. <i>V. vulnificus</i> , <i>V. Parahaemolyticus</i> , <i>V. cholerae</i> non-01; Anabaena spp., Gymnodinium Pseudibuttschia spp.)	Shellfish	Recreational, Wound infections	Enhanced zooplankton blooms	Salinity and temperature associated with growth in marine environment
Protozoa	Enteric protozoa (e.g. Cyclospora, Cryptosporidium)	Fruit and vegetables	Recreational and drinking water	Storms can increase transport from faecal and waste water sources.	Temperature associated with maturation and infectivity of Cyclospora

^a Also applies to bacteria and protozoa.

adapting to Caribbean context and action level



Source: CDC



- **Community connection**
- **Natural resources security**
- **Cultural use**
- **Education**
- **Self-determination**
- **Resilience**



explore factors that contribute to an individual vulnerability

- individual was identified in the separate diseases where possible
- individual promotion of practices is supported

to reduce community-level vulnerability risk

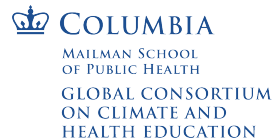
- hygienic practices
- not eating food and vegetables after a flooding event
- ciguatera – change practice of eating certain fish at certain times of the year
 - Avoid eating reef fish over 2.7 kg / 6 lbs or filets of large fish.
 - Do not eat the liver, intestines, heads, and roe of smaller reef fish.

Zoom Poll Question 2

In achieving the course objective to improve patient care and public health practice and serve as the health community's trusted messengers within your institutions, communities, and fields of practice

how do you envisage your role as a 'one health professional' in participating in the implementation of response actions to the climate change crisis in the Caribbean?:

1. advocate
2. developing interventions
3. implementing interventions
4. educator
5. all of the above
6. none of the above



malnutrition and climate change

- climate change and nutrition pathway
- definitions
- food security
- link between undernutrition & household food access
- mitigating climate change and nutrition

BOX 1. Key nutrition-related terms used in this paper

Malnutrition is a broad term that refers to all forms of poor nutrition. Malnutrition is caused by a complex array of factors, including dietary inadequacy (deficiencies, excesses, or imbalances in energy, protein, and micronutrients), infections, and sociocultural factors. Malnutrition includes undernutrition as well as overweight and obesity [15, 19]

Undernutrition exists when a combination of insufficient food intake, health, and care conditions results in one or more of the following: underweight for age, short for age (stunted), thin for height (wasted), or functionally deficient in vitamins and/or minerals (micronutrient malnutrition) [15].

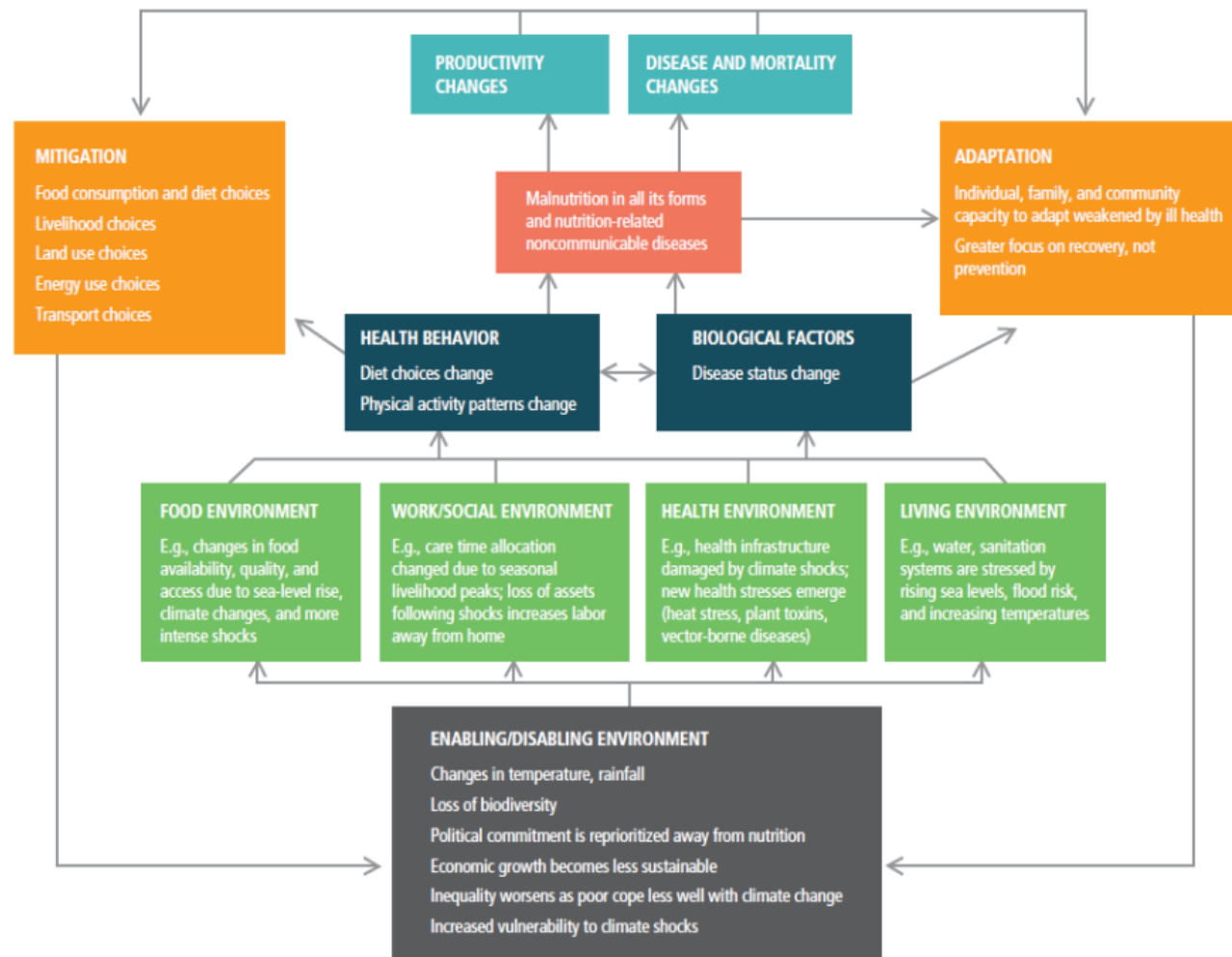
Hunger is a term that literally describes a feeling of discomfort from not eating and which has also been used to describe undernourishment, especially in reference to food insecurity [4].

Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life; household food security is the application of this concept to the family level, with individuals within households as the focus of concern [15, 20, 21].

Nutrition security exists when food security is combined with a sanitary environment, adequate health services, and proper care and feeding practices to ensure a healthy life for all household members [15, 19]

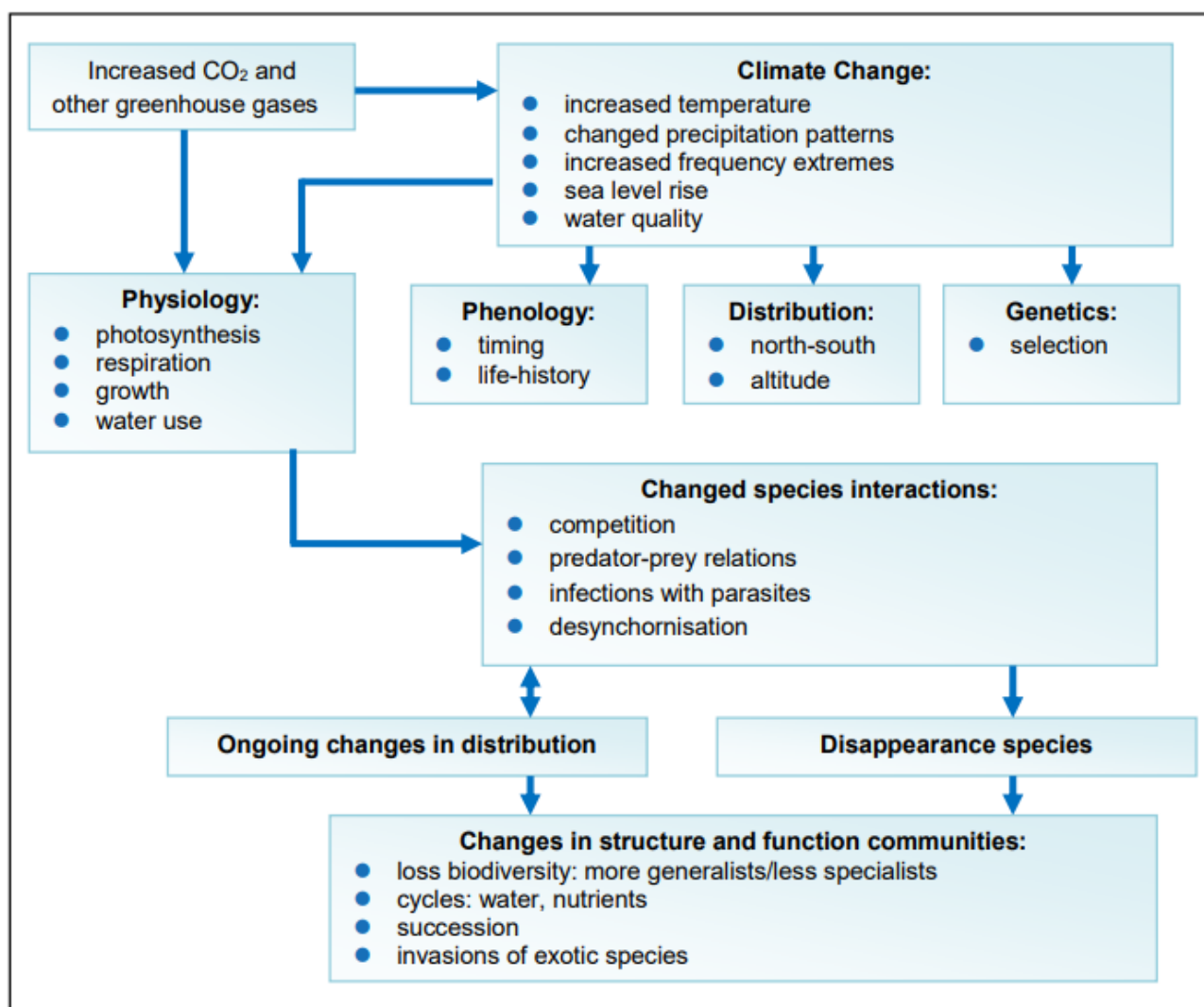
Sustainable diets are those with low environmental impacts that contribute to food and nutrition security and to a healthy life for present and future generations. They are protective of biodiversity and ecosystems, culturally acceptable, accessible, economically fair, and affordable. Sustainable diets are nutritionally adequate, safe, and healthy while optimizing human resources [18].

climate change nutrition pathway



GHG emissions (methane, carbon)

- ecological processes
- increased atmospheric CO₂ levels will affect physiological processes like photosynthesis, respiration, growth, and water use in plants.



5. climate change & food security/Agriculture

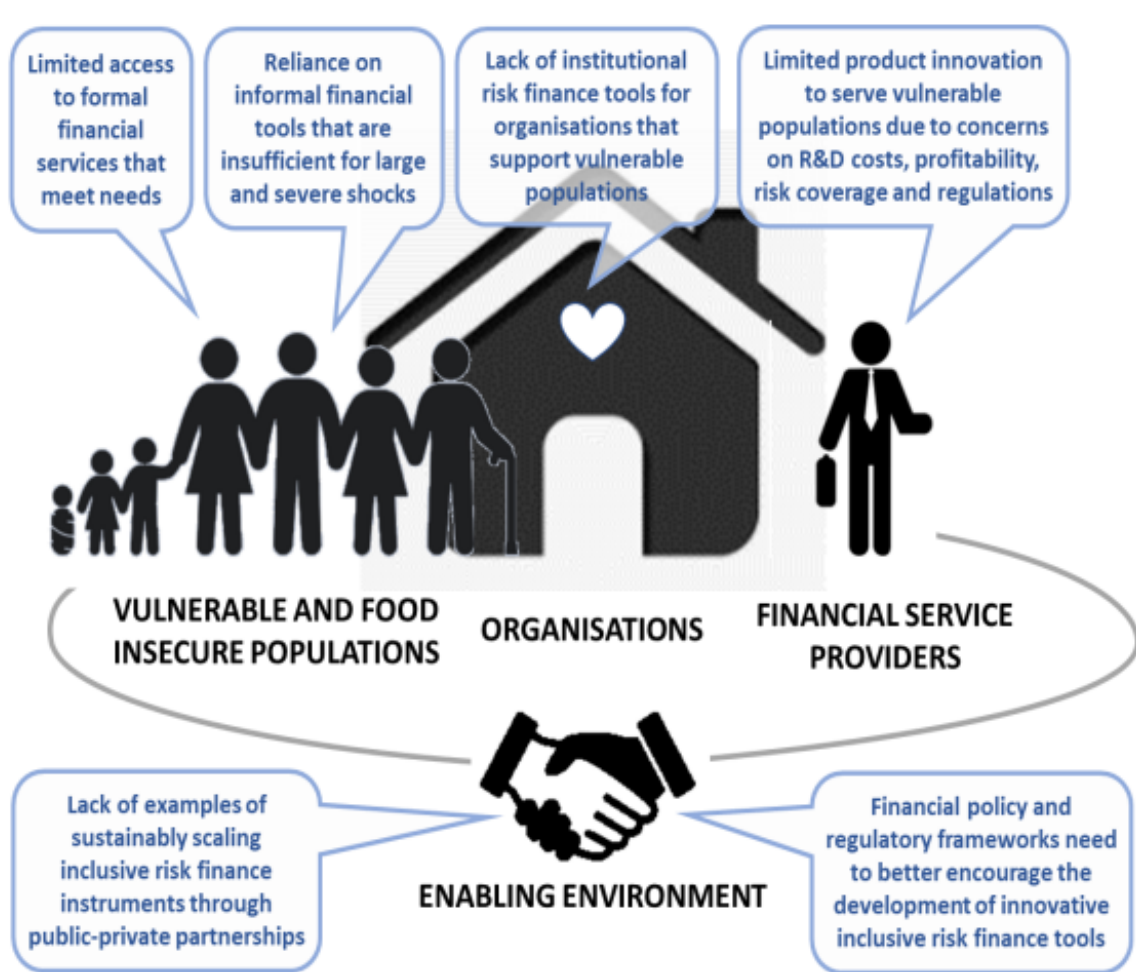
- disrupt stability in the supply of food and
- disrupt people's livelihoods making it more difficult for them to earn a stable income to purchase food
- heavy rains followed by high temperatures promotes bacterial and fungal growth – food not usable



6. undernutrition & household food access

- undernutrition, obesity and climate change – syndemic
- climate change affects food production and availability, access, quality, utilization, and stability of food systems - destroying crop yields and stocks
- extreme weather-related disasters are increasing and reduce the yields of major crops
- higher levels of CO₂ reduce the nutritional value of crops
- a combination of spikes in food prices, reduced incomes, disruption of trade and transport, and damage to market infrastructures hinder vulnerable people's access to food, leading to poor quality, and diversity of diets.

- individual vulnerability



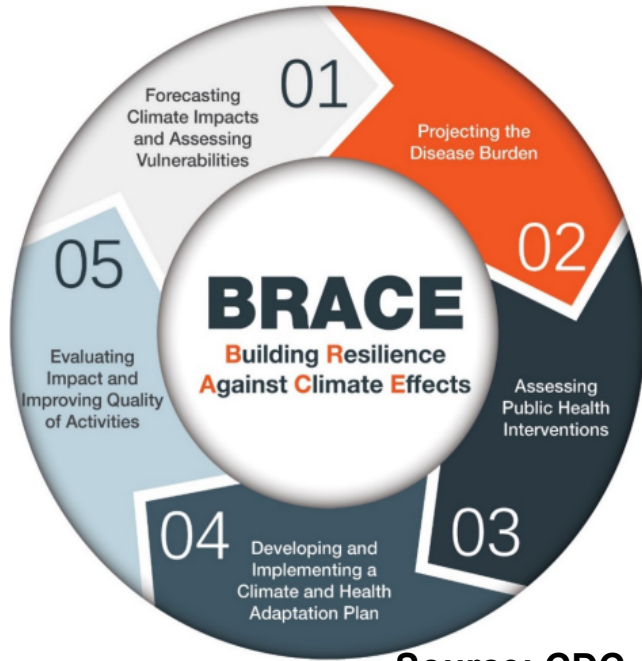
mitigating climate change - co-benefits of improving diets

- address all components of the syndemic – systematically and individually
- a dietary change towards increased adoption of plant-based diets has much stronger mitigation potential, to limit global warming to a less than 2°C increase
- changes in food-production practices could reduce agricultural GHGEs in 2050 by about 10%
- whereas increased consumption of plant-based diets could reduce emissions by up to 80%

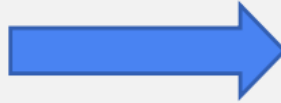


Microsoft Word
Document

adapting to Caribbean context and action level



Source: CDC



- **Community connection**
- **Natural resources security**
- **Cultural use**
- **Education**
- **Self-determination**
- **Resilience**



to reduce this risk of individual vulnerability

- provide finance tools for vulnerable populations to access funding
- mitigation & health promotion



to reduce risk of community-level vulnerability

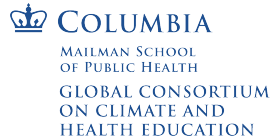
- food-fortification
- transforming food systems to enable healthy and sustainable diets to be available to all
- powering food systems with clean energy would not only improve availability, affordability and sustainability of nutritious food but also contribute to improving nutrition outcomes and reduce emissions
- promoting climate-smart production of crops in communities
 - documenting and disseminating ancestral knowledge
 - creating seedbanks to protect indigenous plants
 - promote production of diverse foods and increase access to ecologically and culturally appropriate food with a view to improve dietary diversity and rebuild livelihoods.

Open-ended question

given your envisaged role in relation to foodborne and water borne diseases and climate change in the Caribbean,

can you identify one action you can take when you get back to you post at work tomorrow to start your journey to decrease the impact of climate change on foodborne and water borne disease in your jurisdiction?

write in one line



conclusion

- hydrosphere and hydrological cycle and climate change
- infectious pathogens/toxin water and foodborne related disease and climate change
 - in relation to the climate change health responder
- chronic/ water and foodborne related disease and climate change
 - in relation to the climate change health responder

References

1. UC Davis. Climate Change Terms and Definitions Online: UC Davis; 2022 [Available from: <https://climatechange.ucdavis.edu/climate/definitions>].
2. UCAR. Climate Variability Online: UCAR; 2022 [Available from: <https://scied.ucar.edu/learning-zone/how-climate-works/climate-variability>].
3. USDA Forest Service. Climate Change Glossary - USDA Forest Service. Online: USDA Forest Service; 2022. p. 28.
4. IUCN. Terminologies Used in Climate Change2011. Available from: Terminologies Used in Climate Change.
5. Taylor M, Stephenson KA, Stephenson T, Jones JJ, Melendez M, Salisbury J, et al. Caribbean Marine Climate Change Report Card 2017. 2017.
6. Cissé G. Food-borne and water-borne diseases under climate change in low- and middle-income countries: Further efforts needed for reducing environmental health exposure risks. *Acta Trop*. 2019;194:181-8.