Climate Change & Extreme Weather: Perception vs Reality

> Madhav Khandekar Expert Reviewer IPCC 2007 Climate Change

Are Extreme Weather (EW) events on the rise?

A short answer: NO!

A long answer: NO! NO! NO!

EW events have always occurred in the earth's climate!

 Present concern re: EW/Global Warming (GW) link is more media hype than reality!



 IPCC: Intergovernmental Panel on Climate Change; A UN Body of scientists (mostly working with various national governments) established in 1988: IPCC has issued climate change documents since 1990.

 NIPCC: Nongovernmental International Panel on climate change (several dozen scientists & specialists in various fields) established in 2007: First comprehensive report in 2009

Mechanics of extreme weather (EW)

IPCC View

- Warmer climate holds more moisture: more rains & floods in some areas; droughts/heat waves in other areas.
- More intense Trop Cyclones
- Increase in extreme rainfall events
- Decrease in cool days/night and frost in Mid-latitudes
- EW are on the rise now due to warming of climate.

NIPPC View

- Extreme weather is an integral part of earth's climate: have occurred throughout recorded history of climate.
- ENSO phases can and do cause EW events world-wide
- Intense interaction between high-lat. cold air with low-lat. warm air produces EW events regionally/locally
- Present 'increase' in EW is perception than reality!

Phenomenon	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood that observed trend is due to human influence	Confidence ^a in trend predicted for 21st century
Cool days / cool nights / frosts: decrease over mid- and high- latitude land areas	Very likely	Likely	High
Warm days / warm nights: increase over mid- and high- latitude land areas	Very likely	Likely (warm nights)	High
Warm spells / heat waves: increase	Likely	More likely than not	High
Proportion of heavy precipitation events: increase over many areas	Likely	More likely than not	High (but a few areas with projected decreases in absolute number of heavy events)
Droughts: increase over low- latitudes (and mid-latitudes in summer)	Likely	More likely than not	Moderate – mid-latitude continental interiors in summer (but sensitive to model land- surface formulation)
Tropical cyclones: increase in intensity	More likely than not since 1970	<i>More likely than</i> <i>not (but with low</i> <i>confidence)</i>	Moderate (few high-resolution models)
Mid- and high-latitude cyclones: increase in most intense storms; storm tracks move polewards	More likely than not	Not assessed	Moderate (intensity not explicitly analysed for all models)
High sea level events: increase (excludes tsunamis)	More likely than not	Not assessed	Moderate (most mid-latitude oceans)

IPCC 2007 Table of Extreme Weather Events

WWE (Warm Weather Extremes) vs CWE (Cold Weather Extremes)

IPCC Projections

Climate Reality

- WWE (heat waves, droughts, rainstorms & floods) to increase in future.
- Milder winters with less snow. Fewer CWE in future.

- WWE have NOT increased anywhere.
- CWE (colder & longer winters, heavy snows) have increased worldwide in last 7-8 years.

Media hype about GW/EW link

May 15, 2018



Windy, with snow flurries. High -2 C

Monday, November 24, 1997

www.thestar.com

Metro Edition

Climate change in Canada: A bleak forecast

Act now or face crisis, report says

BY DAVID VIENNEAU OTTAWA EDITOR

OTTAWA - Climate change in the next century will lead to more illness and death unless steps are taken now to meet the environmental challenge headon, a federal report being re-

Canada can expect warmer temperatures and, depending on the region, either drought or increased rainfall and flooding conditions the report says will have a negative impact on every life form and locale in the coun-

leased today warns.

Heat waves caused by global warming likely will mean "more illness and more deaths, particularly among the young, the el-

Canada and U.S. team up. A7

derly, the frail and the chronically ill, especially in large urban areas in southern Ontario and southern Quebec," the Environment Canada report says. "Furthermore, higher temper-

atures would enhance the production of various secondary air pollutants. As a consequence, there would be an increase in the frequency of allergic and cardio-respiratory disorders caused by these air pollutants." The Canada Country Study:

Climate Impacts and Adaption represents the first national assessment of the environmental, social and economic impact of climate change in Canada. A copy was obtained by The Star. The report, made up of two documents called A National Summary for Policy Makers and

Highlights for Canadians, is being released by Environment Minister Christine Stewart at a major environmental symposium in Toronto.

"Climate change is one of Canada's biggest challenges as we head toward the millennium." Stewart says in the report, which does not identify the authors.

"Scientists from around the

world agree that our climate is warming at an increasingly rapid rate because of higher volumes of greenhouse gases entering the atmosphere."

That could spell disaster for some species. The report says the polar bear, the muskox and the caribou could become extinct, while some vegetation and crops would be threatened and

Please see Call. A23





Cloudy, scattered showers. High 18C.

Friday, May 8, 1998

Weather worse than it used to be: Scientists

Extreme events more frequent scientists agree

BY JOSEPH HALL SCIENCE REPORTER OTTAWA - You can tell your grandparents to hush up. Today's weather is actually worse than it was in their day. May 15, 2018

Scientific evidence strongly suggests that severe hail, flooding, blizzards and ice storms have become far more common in Canada in recent years, a conference on weather disasters was told here yesterday.

And if predictions on global warming effects prove correct, then the spate of natural climatic catastrophies we've suffered in this country over the past few years could become

commonplace, both science and insurance representatives said.

"We are starting to see weather conditions and climate conditions that are foreign to us." Henry Hengeveld, a senior Environment Canada climate change scientist told a federally sponsored forum called Understanding and Coping with Weather Disasters.

"It suggests something is Friends of Science, Calgary

nappening that is different than what we've been accustomed to in the last 50 years."

Hengeveld said, for example, that the average intense rainfall an North America has been rising over the past 60 years and that harsh winter storms on the continent have as much as tripled over the past 20 years. He also said wave height re-

cords showed that Atlantic storms have increased over the

past 50 years, while hurricane populations into formerly baractivity in the Pacific is on the rise.

www.thestar.com

"These are complementary indicators that the weather around the world is changing." Hengeveld said.

Weather-related disasters of all kinds are up sharply in recent years around the globe, he said.

And while part of this might be due to the spread of human ren areas, Hengeveld said migration into more dangerous climatic zones cannot account for the majority of this rise.

Metro Edition

"The trend for disaster losses related to earthquakes has been increasing and that suggests there may a distinct human population (movement) element to this," he says. "But

F Please see Weather-related, A31

NATIONAL POST, MONDAY, NOVEMBER 15, 1999

Canadians warned to brace for more extreme weather

Global warming blamed for natural disasters

BY STEWART BELL

Canadians need to prepare their communities for "extreme weather" events, such as the Manitoba floods and the ice storm, which are occurring more frequently and causing greater damage, according to a paper to be presented at an insurance industry conference today.

Population growth, ageing infrastructure and urbanization have left Canadians increasingly vulnerable to extremes in weather, which are striking more often because of global warming, says the paper by Paul Kovacs, executive director of the Institute for Catastrophic Loss Reduction.

"This is a trend that we should not allow to continue. It is important to take action to address this threat before the impact overwhelms our capacity to recover. It is critical that we build communities that are more resilient and less vulnerable to nature's hazards."

At the Catastrophic Loss Reduction Symposium today in Toronto, scientists, experts and insurance industry members are gathering for the first time to talk about the need the intervent gies for reducing the damage caused by Canada's worsening 1996 – the Saguenay flood, the Red River flood, and the ice storm last year in Quebec and Ontario.

Four million Canadians have been affected by natural disasters since 1996.

"Nature's hazards are affecting millions of people each year, and the damage is rising rapidly in Canada and elsewhere," says Mr. Kovacs. "The major factor pushing damage measures higher is our increasing vulnerability to extreme events."

Scientists contend the accumulation of greenhouse gases in the atmosphere is to blame for the weather trend.

"Those kind of events have been increasing significantly in the past decade or more," said Gordon McBean, assistant deputy minister of the Atmospheric Environment Service and a key speaker at the conference.

"The climate that we had from the '50s to the '80s is not going to be the climate that we have for the next 30 years," Mr. McBean said. "All indications are that these kind of extreme weather events are going to be more prevalent."

Canadians should prepare for increased drought, rainstorms, flooding, winter storms and other potentially damaging gifts from Mother Nature, he said. Strategies to curb the emission of merime gear of py slow the inevitable weather changes, he said.



WILD WEATHER: 2005 said to be the hottest, stormiest and driest year e Climate at record extreme

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May 15, 2018



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Mean Global Temperature variation

May 15, 2018



Global monthly average surface air temperature (thin line) since 1979 according to according to the Hadley Centre for Climate Prediction and Research and the University of East Anglia's <u>Climatic Research Unit (CRU</u>), UK. The thick line is the simple running 37-month average.

May 15, 2018



Failure of Climate Models

May 15, 2018



Heat Waves: North America & Elsewhere

- North America witnessed recurring heat waves in 1920s and 1930s! Highest max temperatures in the 1920s 1930s!
- 2012 & 2016 US summer heat-wave were mild compared to those of 1930s!
- Summer 2003 Western Europe heat-wave was extreme; Dry soil moisture conditions were responsible
- Moscow heat-wave summer 2010 was due to atmospheric blocking
- Pre-Monsoon (April-May) heat waves over India are common & exhibit inter-annual variability
- Heat waves over Australia linked to ENSO phases

Record High Temperatures – U.S.



Figure 25: Extreme temperature values recorded, by state, in the United States since 1880 [Hart 2007]. Note the peaking around 1940 but not during recent decades; it suggests that the 1930s – not the 1990s – were the warmest decade of the twentieth century.

May 15, 2018

'It was like we were living in a furnace'

Continued from B1

air or a deep snowfall?"

Many sidewalks and roadways in Toronto cracked and buckled under the blasting heat; city workers had to sand streets to increase traction hecause the asphalt would melt and cars would skid and crash. Horses carrying milk and bread dropped dead in the streets. People collapsed in factory sweatshops. Some employers shut down operations and sent workers

home. In the country, crops scorched, and in the Niagara peninsula fruit

baked on trees. Meteorologist Morley Thomas, then 18, was in a wheat field on his uncle's farm near London, Ont, They were using a binder pulled by horses.

"One of the horses just dropped over dead. My uncle said we better stop," he recalled.

Star reporter Jocko Thomas, now retired, was sent to the morgue during the heat wave to write down the names of the dead for The Star.

He said he could smell the morgue "miles away," despite the ice blocks used to retard decomposition.

"It was almost unbearable," said Thomas, 87. "There were so many deaths the coroner couldn't keep up."



Toronto's heatwave of '36

A funeral director, who usually dealt with four calls a day, handled more than 25 funerals in 48 hours. Florist D. W. Yaverner told the Toronto Daily Star, "The demand for flowers is heavier than during the war. We have run out three times already and stock is very scaree on account of the heat."

The heat in 1936 didn't have the humidity that Toronto has today, because it began in the prairies. Plus it carried less smog and haze — but it was hotter and probably harder on residents than this week's heat wave because people had fewer menns, like air condition, to cope with it, Environment Canada's Phillips said. People dodged the heat by hiding in their "cellars" and spending nights in parks and on lakeshore beaches, Perkins said.

"People stayed all night on Sunnyside, Cherry, Simcoe and Kew beaches because those were the only cooler places," he said. "We had no fun, no air conditioner then, and you just had to be more creative."

University of Toronto geography professor Jim Lemon, and author of Toronto Since 1918, on Illustrated History, said the sweltering temperatures prompted imen to swim without their bathing tops, which was considered immodest at the time. "The heatwave was a blow against Toronto the Good," he laughed.

The city also allowed ice delivery on Sunday, which struck many citizens as sacrilegious, Phillips said.

An article in the July 9 edition of the Daily Star said 5,000 electric fans were sold that week and ice plants had to increase their staff by 50 per cent to meet demand.

Most people would line up at department stores like Simpson's and a couple of theatres on Yonge St., that had air conditioning, just to get cool. People even reversed the flow of their vacuum cleaners to get some kind of air circulation, Phillips noted.

Dry ice was used to reduce the temperatures in hospital wards.

"The nurses put a rub of ice cubes at the end of the hall to keep us cool," recalled Lilyan Caplan, 92, who just gave birth to her daughter Helen at the then-Toronto Western Hospital on July 6, 1939.

"They couldn't keep the bed dry. They changed the sheets and that's a pleasure for about five minutes, then the sheets were wet again. It was horrible."

But this time, Caplan doesn't have to worry about staying dry.

"I am glad we have air conditioning these days. The heat doesn't bother me any more."

With files from Harold Levy

Figure 2.11 News story on the heat wave in Toronto, July 5-17, 1936. From The Toronto Star, August 9, 2001.

Deadliest heat wave in Canada; 1100 people died July 1936

Highest Recorded Temperatures

- World's highest: 57.8C (136F) Libya 13 Sept 1922
- Canada's highest: 45C Saskatchewan Canadian Prairies, July 1937: Toronto highest 41C July 1936
- ♦ US highest: 56.7C (134F) California 10 July 1913
- Highest on Indian subcontinent: ~128F NW India, 1930s
- Highest in China: 43.4C : September 2006

Thunderstorms & Tornadoes

- Highest thunderstorm/tornado activity in US during 1920s thru 1940s
- Deadliest tornado outbreak: 18 March 1925: 747 dead in 3 mid-western States
- April 5 1936: 216 deaths in Mississippi
- Largest 2-day outbreak; 3-4 April 1974, over 140 tornadoes
- Fewer thunderstorms/tornadoes in last five years



Data Source: NOAA/ NWSStorm Prediction Center

May 15, 2018

Hurricanes, Typhoons & Tropical Cyclones

 Hurricanes & Typhoons show inter-decadal variability, with NO long-term trend! Hurricanes, in fact, have declined in last five years.

 Bay of Bengal tropical cyclones show inter-annual variability; NO trend!

Elsewhere (Australia, South Indian Ocean) NO long-term trend!

Extreme Precipitation

- Extreme precipitation often linked to tropical cyclones/hurricanes: Also in monsoonal climate
- Highest 24-hr: 18Jan1966; 182cm (south Indian Ocean: TC-Hyacinthe)
- Highest one month: July 1861 930cm (Cherrapunji India)
- Highest one year: 1860-61 2647cm (Cherrapunji India)
- Recent studies on "human link to extreme rainfall" are without any merit! (rainfall amounts only ~50-150mm locally: UK, Europe, North America)

Droughts-floods & ENSO

- Warm events (El Nino) in the equatorial Pacific bring summer rains over US/Canadian Prairies
- Cold events (La Nina) linked with drier summer on the Prairies.
- El Nino/La Nina linked to droughts/floods in Indian summer monsoon
- ENSO and PDO-Pacific Decadal Oscillation produce dry/wet conditions over eastern Australia, Indonesia, southeast China and eastern Africa.
- ENSO is the single largest cause of global extreme precipitation events
- Spring flooding in Canada due to snow melt

La Niña and El Niño episodes



May 15, 2018



The 1997/98 El Nino structure at about Sep 1997

May 15, 2018

Summer Monsoon: India and South Asia

 Indian/South Asian Monsoon impacts over two billion people every year

 Major droughts/floods in summer monsoon have occurred irregularly in a 200-year data set: ENSO phase a major driver of south Asian monsoon.

Drought/Flood: Often in Back-to-back years (Ex: 1918/17 : 1941/42: 1987/88: 2009/2010)



All India summer Monsoon rainfall series 1844-1991: curve shows smoothed values obtained by 5-point binomial filter (J of Climate 1993)





ARE WINTER WEATHER EXTREMES ON THE RISE?

May 15, 2018

Are Winter Extremes on the RISE?

Yes! since the new millennium

Europe: 2002/03, 2005/06, 2009/10, 2012 & 2018

North America: 2007/08, 2013/14 & 2017/18

China & Japan: 2008 and 2013

May 15, 2018

2012 JANUARY 12

It's too much snow, even for Alaska

Shovels from Canada will help people buried by a series of storms

DEBRA BLACK STAFF REPORTER

WORLD

Snow isn't all that unusual in Alaska, but this winter the picturesque city of Cordova is literally snowed under - held captive by a string of storms that have crippled the community.

"Being an Alaskan, we're usually prepared for foul weather," Cordova resident and innkeeper Mark Figelski told the Star Wednesday. "We know it is coming, we prepare for it. But this is extreme even by our standards."

Figelski and his family have been forced to remain inside their fishing lodge for the past nine days.

Cordova, a community of 2,200 on the east side of Prince William Sound, is at the heart of a series of storms that have been ravaging parts of Alaska this winter.

The latest storm hit much of south-central Alaska, with avalanches along the Seward Highway closing the only route south out of Anchorage and cutting off the city from neighbourhoods to the south in Girdwood.



National Guardsmen dig out from what has been the biggest snowfall in decades in Cordova. Alaska.

Since November, the fishing community of Cordova has received 447 centimetres of snow and 112 centimetres of rain, making the snow heavier as it piled up to 18 metres high on roofs.

146 centimetres of snow in a year. according to Sam Albanese, spokesperson for the U.S. National Weather Service.

"You have a marine air mass colliding with a polar-type air mass Cordova usually receives about over the mainland, bringing mois-

ture into a cold environment, and it turns into snow," Albanese said.

The community has received so much snow it has run out of scoop snow shovels - a special shovel that makes removing snow from rooftops easier, says Figelski, who owns both the Cordova Rose Lodge and the Cordova Lighthouse Inn.

"In fact, I'm guarding mine," he said with a laugh, explaining that shovels are in such short supply he doesn't dare leave his outside. "You bring it in at night."

To cope with the shortage of shovels - a problem plaguing much of Alaska - the community has turned to the Quebec-based manufacturer, asking for a special order, said Tim Joyce, spokesperson with Cordova Emergency Services.

Those shovels should arrive by Saturday, but another storm was forecast for overnight Wednesday.

The Alaskan National Guard and the Coast Guard are helping the community dig out.

The extreme snowfall has already caused substantial damage. Two warehouses owned by Copper River Seafood collapsed under the weight of snow, Joyce said.

He also said there has been substantial damage from snow loads on private homes and some other commercial buildings. An apartment building had to be evacuated because snow was jamming the doors.

Schools have been closed for a week and are expected to remain closed for another week. With files from Associated Press

Valdez, Alaska received 387 CM of snow in early January 2012

May 15, 2018

Breaking news at calgaryherald.com 24 MARCH 2012 CITY & REGION



A snowboarder enjoys the amazing snow conditions at Sunshine Village. The ski resort has set an alltime record for snowpack at 909 cm as of Friday, with more snow expected to fall by the end of the day.

Snowfall at Sunshine sets resort record

May 15, 2018

Snowstorm in the US January 2016



23 JANUARY 2016

IT'S A MONSTER

A massive blizzard swirled towards eastern US on Friday, with more than 2 feet of snow predicted for Washington alone. Schools were closed, flights were cancelled and a state of emergency was declared across a vast area

STORM'S COMING

If the blizzard dumps as much snow in Washington as forecast, it could surpass a record set in 1922 by a storm that dumped around 2 feet over three days and killed 100 people after a roof collapsed at a theatre

BIG BLIZZARD

National Weather

Service (NWS) meteorologist Paul Kocin compared the storm to "Snowmageddon", the first of two storms that "wiped out" Washington in 2010. Kocin, however, said the weekend timing and the days of warning could help limit deaths and damage this time around

A state of emergency was declared in Tennessee, North Carolina, Virginia, Maryland, Pennsylvania, the District of Columbia and parts of other states, and road crew were out in force

Louis Uccellini, director

of the weather service.

have come together to

create a blizzard with

brutally high winds,

flooding, white-out

conditions and even

snow, when lightning

strikes through a

snowstorm

the possibility of thunder

dangerous inland

said all the elements

\$1 billion

Estimated damages the snowfall, which is expected to continue from Friday to Sunday, could cause

LIFE TAKES A HIT

Millions of residents in the storm's path scrambled to prepare for the weekend, picking bottled water, food and other supplies

The federal government in Washington was closed at noon Friday

More than 4,500 flights

originally scheduled for Friday and Saturday within, into or out of the US have been cancelled, according to flight monitor flightaware.com.

May 15, 2018

Unusual cold wave sweeps across east Asia, 65 killed

Snowfall Hits Taiwan, Japan, China & S Korea

Taipei (Taiwan): Unusually cold weather in eastern Asia has been blamed for more than 65 deaths and disrupted transportation. It brought the first snow to a subtropical city in southern China in almost 50 years.

Temperatures in Taiwan's capital of Taipei plunged to a 16-year low of 4° Celsius, killing 57 mostly elderly people. Most homes in subtropical Taiwan lack central heating, and the cold caused heart trouble and breathing problems for many of the victims, a city official said. Normally, temperatures in Taipei hover around 16°Celsius in January, according to Taiwan's central weather bureau.

The cold snap was blamed in the deaths of 40 people in the capital, Taipei, and 17 in neighbouring New Taipei City. The cold front also left 3.5 inches of snow on Taipei's highest peak.

Heavy snow in western and central Japan left five people dead over the weekend and possibly a sixth on Monday

Kyodo News service said the victims included a woman who fell from a roof while removing snow, a man in a weather-related traffic accident, another man found under a snowplough and a couple that fell into an irrigation channel, apparently while removing snow.

An 88-year-old woman in western Japan's Tottori pre-

May 15, 2018





CHILL AND THRILL: Boats stuck in the frozen waters of Jiaozhou Bay in Qingdao in China's Shandong on Monday. (Above) A mother and daughter play among snow-covered tea bushes in the Pinglin mountain area of New Taipei City, Taiwan

monoxide poisoning when

they turned up the heat in a

greenhouse, Xinhua repor-

ted. The cold spell coincided

with the beginning of the 40-

day travel rush for the Lunar

New Year, which is on Febru-

ary 8 this year, disrupting

tures in the capital, Seoul,

fell to minus 18° Celsius on

Sunday, the lowest since

2001. On Saturday, Jeju Is-

land received 4.7 inches of

In South Korea tempera-

fecture died after a landslide hit her house before dawn on Monday, Kyodo and other media reported. The heavy snow stran-

ded motorists, delayed bullet train service and caused flight cancellations. Most parts of mainland cars, flights and trains.

China experienced their coldest weather in decades over the weekend. The southern city of Guangzhou, which has a humid subtropical climate, saw snow for the first

time since 1967 on Sunday. The cold le trai 2 516 519 no Since since ur deaths - strawberry far sed from Saturday until sed from Saturday until mers who died of carbon

Washington shuts govt offices, NY back on track

New York / Washington: New York City emerged on Sunday from a massive blizzard that paralysed much of the US east coast and left at least 20 dead in several states, while snowy gridlock gripped the nation's capital and surrounding areas. where federal, state and local offices planned to remain closed on Monday. Midtown Manhattar

sprang back to life on a bright and sunny Sunday as residents and tourists rejoiced in the warming sunlight, digging out buried cars, heading to reopened Broadway shows and cavorting in massive drifts left by New York City's second-biggest snowstorm on record.

In Washington, where a traffic ban remained in effect, the recovery got off to a slower start, with the entire metropolitan transit system closed through Sunday.

The US office of personnel management said federal government offices in the Washington area would be shut down on Monday, along with local government offices and public schools in the District of Columbia and its Maryland and Virginia suburbs. Virginia and Maryland state offices also were ordered closed.

Even so, many people wereout in the street. Some skid all of the Lincoln Memorial until security offici-

Massive winter storm batters U.S.

New England and the South blanketed by snow with rain and floods striking the West

JEFFREY COLLINS THE ASSOCIATED PRESS

DURHAM, N.C.—A winter storm that spread ice and snow from Mississippi to Maine is leaving behind cold so bitter that businesses and schools are closing in the South because the region still hasn't thawed.

Four deaths have been blamed on the storm, which dropped more than 30 centimetres of snow in southern New England, caused a former governor to fall on his icy driveway in Mississippi and could bring the lowest temperatures recorded in parts of North Carolina in more than 20 years.

Meanwhile, the West Coast is dealing with the next storm, which brought the potential of a crippling ice storm to western Oregon and heavy rain to the California mountains used to seeing snow this time of year. Forecasters warned of possible mudslides and the worst flooding in



CONNECTICUT STATE POLICE

As many as 20 vehicles crashed in blizzard conditions near Middletown, Conn., Saturday as temperatures plunged across New England and beyond.

more than a decade.

In the east, the worst, lingering problems were expected in North Carolina where up to 25 centimetres of snow and sleet fell in places Saturday. The deep freeze followed.

Forecasters predict temperatures won't get above freezing in much of the state before Tuesday afternoon, a big problem in a place where officials depend on usually mild weather to melt away the ice and snow on less travelled routes. One person died in Montgomery County when a car slid off icy Interstate 73/74 into a tree Sunday morning, Gov. Roy Cooper said.

The National Weather Service said 49.5 centimetres of snow fell on East Bridgewater, Mass., south of Boston, with areas of Rhode Island reporting 30 centimetres of snow. Up to 25 centimetres of snow fell in parts of Connecticut.

School systems across North Carolina went ahead early Sunday and cancelled Monday's classes in part because of icy roads, but also because of bitter cold temperatures making it dangerous for children without proper clothes to wait for buses and difficult to keep buildings warm.

The National Weather Service predicted further low temperatures on Monday morning in Greensboro, N.C. — marking only the 15th time in 13 years of records it has gotten to freezing or lower. Forecasters said the snow cover would lead to the unusually cold readings.

The icy weather also prompted an increase in emergency room visits from falls. In Mississippi, a family spokesperson said 93-year-old former governor William Winter was expected to recover, but remained in serious condition after suffering a concussion when he fell on the steep, icy driveway of his Jackson home. When the thaw comes, however, it will be quick, Highs in the South are

forecast to reach 20 C on Friday.

U.S., Atlantic Canada slammed by storm

Roofs torn off houses, storm-surge flooding as snow, wind pummel cities

SUSAN HAIGH AND DAVE COLLINS THE ASSOCIATED PRESS

HARTFORD, CONN .- A massive winter storm roared into the U.S. East Coast on Thursday, threatening to dump as much as 45 centimetres of snow from the Carolinas to Maine and unleashing hurricane-force winds and flooding that closed schools and offices and halted transportation systems.

The powerful storm also pummelled Atlantic Canada on Thursday, shutting down everything from schools to bridges with an intense mix of high winds, rain and snow.

Forecasters expected the storm to be followed immediately by a blast of face-stinging cold air that could break records in more than two dozen cities and bring wind chills as low as -40 C this weekend.

Social-media images showed one Halifax house with its roof gone, and another building that had partially collapsed.

While parts of Nova Scotia were whipped by wind and rains amid temperatures well above freezing, New Brunswickers faced heavy snow that made it impossible to see across the street. "If you are in your home and don't need to travel, don't travel," said Greg MacCallum, director of New Brunswick's Emergency Measures Organization, who called it a "serious storm."

Environment Canada warned high waves combined with storm surges Fuld parse dar oge slong the coast in Nova Scotia and Prince Edward



Katheryn Shannon walks her dogs in Sag Harbor, N.Y., where they face twisting winds and sideways gusts of snow.

Cold spell has frozen iguanas falling from Florida trees

MIAMI-It's so cold in Florida that iguanas are falling from their perches in suburban trees.

Temperatures dipped below 5 C early Thursday in parts of South Florida, according to the National Weather Service in Miami.

That's chilly enough to immobilize green iguanas common in Miami's suburbs.

images of an iguana on its back on a

Palm Beach Post columnist Frank Cerabino tweeted a photograph of an iguana lying belly-up next to his Elsewhere in Florida, the effects of a states of emergency were in wide swimming pool. WPEC-TV posted Friends were in States of emergency were in wide states of emergency were states of emergency were in wide states of emergency were states of emergency were in wide states of emergency were states

get sluggish when temperatures fall below 10 C, said Kristen Sommers, who oversees the non-native fish and wildlife program for the Florida Fish and Wildlife Conservation Commission. If temperatures drop below that, iguanas freeze up. "It's too cold for them to move," Sommers said.

Well-meaning residents finding stiffened iguanas are advised to leave them alone, as they may feel threatened and bite once they warm up.

SCOTT EISEN/GETTY IMAGES The "bomb cyclone" was expected to dump heavy snows in New England.

ple of heat. More than 100 warming centres were open in 34 towns across Connecticut, Gov. Dannel P. Malloy said.

The high winds caused coastal flooding from Massachusetts to Maine, and the rising waters stranded people in homes and cars.

The Massachusetts National Guard said it helped rescue a woman and her two children from a car in Marshfield. Flooding in Newburyport forced evacuations on Plum Island, and the only road from the island to the mainland was closed, police said. The massive storm began two days ago in the Gulf of Mexico, first hitting the Florida Panhandle.

Wind gusts of 80 to 95 km/h, strong enough to cause downed trees and power lines, are predicted in places where the National Weather Service has issued blizzard warnings. They include the Delmarva Peninsula, which includes parts of Delaware, Virginia and Maryland; coastal New Jersey; eastern Long Island, New York; and coastal eastern New England.

More than two-thirds of flights in and out of New York City and Boston airports were cancelled. The flighttracking site FlightAware reported about 4,900 cancelled flights across the United States.

More than 50 departures and arrivals were cancelled at Halifax Stanfield International Airport. Marine Atlantic also cancelled sailings between Nova Scotia and Newfoundland, while Bay Ferries shelved its crossings between Nova Scotia and New Brunswick.

National Weather Service meteorologist Dan Peterson said record low temperatures were predicted for 28 major cities across New England, It snowed briefly Wednesday in the warned of wind susts hitting almost eastern New York and the mid-At-

ON ONO

February, 6, 2018 to February 27, 2018

From Moscow to Italy



May 15, 2018

Heavy Snowfalls & Extreme Cold since 2012

- 2012 February: Eastern Europe; low temperature -40C, Danube River frozen till early June
- 2013: Heavy snows in Germany & northern France: 50-km long traffic jams on Auto-Bahn: March 2013 coldest in Germany & parts of Poland
- 2013/14: Coldest, longest and snowiest winter over US/Canada in 40 years. Low temp -40C in parts of western Canada: Buffalo (US) received 100cm of snow November 18-19.
- 2015: Coldest February in Toronto; low temp at -35C for several days: Boston USA recorded highest snow, 300cm: Snow avalanches killed 200 people in Afghanistan.

 2016: Major snowstorm in Washington US: Also in Taiwan, heavy snow and extreme cold (January) heavy snows in Canadian Prairies (October)
May 15, 2018

Heavy snows & Extreme cold (Contd)

2017: Winter storm batters US NE & SE; heavy snow In US Southeast; Eastern Europe suffered extreme Cold with 55 deaths; also Italy saw extreme cold With several deaths.

2018: Longest & coldest winter over North America in 40 years. Europe witnessed extreme cold in February.

Winter sent economy into deep freeze, outlook frosty



COLIN MCCONNELL/TORONTO STAR

Mom and baby brave the weather on Queen St E. The worst GTA winter in 20 years kept many consumers at home.

Canada to have lowest first-quarter output in G7 as business reels from season's severe temperatures

DANA FLAVELLE

It's not just the weather that's been frosty. Canada's economic growth has been in the deep freeze this

winter amid repeated lashings of ice and snow. The Greater Toronto Area suffered through the worst winter in two decades, according to Environment Canada. The severe weather shut airports, slowed truck deliveries, stalled construction and kept consumers at home.

It was also blamed for slower job creation, higher heating bills and rising insurance premiums. And it's not over yet.

Environment Canada predicts a colder than normal April. While it will feel warmer because the sun is higher and the days are longer, temperatures will be below average, meteorologist Geoff Coulson said. "I wish I had better news," Coulson said.

While the season is technically almost behind us – March 20 is the official start of spring – Canada is still reeling from its impact, economists say. "Prolonged bouts of cold and significant levels of precipitation have, and are continuing to have, a material impact on output growth," wrote Scotiabank's deputy chief economist Aron Gampel.

Canada's economy is expected to grow just 0.5 per cent in the first three months of this year, a quarterly report by the Organization for Economic Co-Operation and Development predicted earlier this month. That's the lowest growth rate of any G7 country.

The U.S. economy will fare a bit better, rising 1.7 per cent, the OECD predicted, while the G7 is expected to gain 2.2 per cent, mainly on the strength of faster growth in Japan, Germany and the U.K. And more lies ahead.

"The United States and Canada are both also expected to experience an uneven pattern of growth in the near term, owing in part to the disruptive effect of repeated episodes of severe winter weather," the think-tank said.

The impact has varied across economic sectors.

ICY continued on B2

Weather woes: Small and big business feeling chill, B2

E THE GLOBE AND MAIL . THURSDAY, MAY 1, 2014

REPORT ON BUSINESS

FROM PAGE 1

Fed: Winter storms and bitter cold blamed for anemic first-quarter U.S. growth

MAY 1 2014

Ms. Yellen offered no new clues as to when, and under what conditions, the Fed will end more than five years of ultra-low interest rates.

The committee's nine members voted unanimously to preserve some ambiguity about when the bank will start raising its trend-setting federal funds rate, slashed to near-zero in December, 2008.

Ms. Yellen's rosier assessment of the economy came as the **U.S.** Department of Commerce reported Wednesday that the economy stalled in the first quarter, growing at a minuscule 0.1-per-cent annual rate.

Growth was sharply weaker than the 1.2-per-cent consensus expected by economists, due in part to winter storms and bitter cold.

The unexpectedly weak quar-

ter is likely more of an aberration than a sign that the U.S. recovery has fallen off the rails - an assessment endorsed by the Fed.

"Growth in economic activity has picked up recently, after having slowed sharply during the winter in part because of adverse weather," the bank's interest-rate-setting Federal Open Market Committee said in a statement following a two-day meeting.

Bank of Nova Scotia economists Derek Holt and Dov Zigler said the Fed seems to have dismissed the preliminary gross domestic product report as little more than "a weather report." For starters, the GDP estimate

is preliminary, and winter is now over. More recent data, particularly on trade, suggest GDP for the quarter will ultimately

be revised up. Economists expect much stronger growth in April and the rest of the year.

The second bit of good news contained in the report is that consumption grew a healthy 3 per cent annually in the first three months of the year. Consumers make up more than three-quarters of the U.S. economy.

The weakness in the quarter was concentrated in exports (down 7.6 per cent), investment in equipment (off 5.5 per cent), housing (down 5.7 per cent) and inventories.

The export slump was due in large part to an earlier Chinese New Year, which caused many exporters to ship late last year instead of early in 2014. Wells Fargo Securities economist Mark Vitner said recent data showing higher March shipments from

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Growth in economic activity has picked up recently, after having slowed sharply during the winter in part because of adverse weather.

Federal Open Market Committee Statement released after two-day meeting

West Coast U.S. ports will likely trigger large revisions by the Commerce Department.

The big question mark is whether the U.S., like Canada, will bump along at growth of roughly 2.5 per cent a year or start to gather steam.

The Bank of Canada, for example, projects U.S. growth of 2.8 per cent this year, 3.2 per cent in 2015 and 3 per cent in 2016.

One area of concern for the Fed is the housing market. After rebounding strongly last year, several key measures have slowed this year, including housing starts, sales and new mortgage applications.

And that's reason enough for Ms. Yellen not to start committing to higher rates just yet. The Fed's next meeting is set for June 17-18.

Economic Losses due to CWE: Preliminary Estimates

- ♦ 2012/13: Europe: ~ US\$ 50 billion
- 2013/14: US/Canada ~125 billion: Japan/China ~20 billion
- ♦ 2015: US: ~25 Billion; Canada ~5-10 Billion
- 2016: US/Canada ~10 billion; Taiwan/China ~5 billion
- 2017: UK & Europe: ~2-5 Billion; US: ~5-7 Billion; Canada: ~3-5 Billion
- 2018: Europe: ~ 10 Billion: US/Canada ~ 25 Billion

Notable EW events of 1945-1977 (when mean temperature declined)

- 1961 summer monsoon over India: Heaviest floods everywhere! Also East Pakistan (Now Bangladesh) witnessed two powerful cyclones in May! Over 20,000 deaths India & Pakistan!
- Winter 1962-63: One of the Coldest over most of Europe! Rivers in central Europe frozen for weeks!
- August 1969: Hurricane Camille (category 4-5) struck US Gulf Coast killing over 250 people!
- November 1970: tropical cyclone hit Bangladesh killing over 250,000 people! Largest human fatalities in ONE SINGLE WEATHER DISASTER
- April 2-3 1974: largest (147) outbreak of tornadoes in US Midwest ever! Over 250 deaths; property damage over US\$ 1 billion
- December 1976-January 1977: Very cold over most of North America! Southeast US witnessed long cold winter

Beneficial Impacts of More CO2

May 15, 2018



Higher CO2 Levels have boosted grain yield worldwide

May 15, 2018



May 15, 2018



May 15, 2018

CONCLUSIONS

- The link between GW and EW is more perception than reality
- There is NO increase in EW anywhere at present
- Global weather-related disaster losses have declined significantly in last few years.
- Cold Weather Extremes have increased in last six years; this is at odds with IPCC projections of milder winters.
- Increasing Co2 levels have beneficial impacts
- Reducing CO2 levels will be expensive and will have NO impact on earth's climate.

Finally, a lighter side of Global Warming

May 15, 2018

May 15, 2018