Climate Change and Golf Course Management

Climate Change Service
Department of Environment and Natural Resources

Outline

- The Climate Crisis
- Why do we need to adapt?
  - Key findings from the IPCC 6th Assessment Report (AR6)
- What is climate change adaptation?
- Vulnerabilities of Golf Courses to Climate Change
- Climate Change Adaptation Measures for Golf Course Management

Climate change severely impacts people and livelihood around the world.

Source: National Oceanic and Atmospheric Administration (NOAA)


“
The risks are complex, dynamic, and systemic.They will compound and cascade across sectors and scales.
The interventions we need to design to confront this complexity must therefore be transdisciplinary, time-sensitive, and spatially-targeted in order for them to be truly transformational.
DENR Secretary Antonia Loyzaga
On the 3rd UK-PH Climate Change Environment Dialogue
April 13, 2023

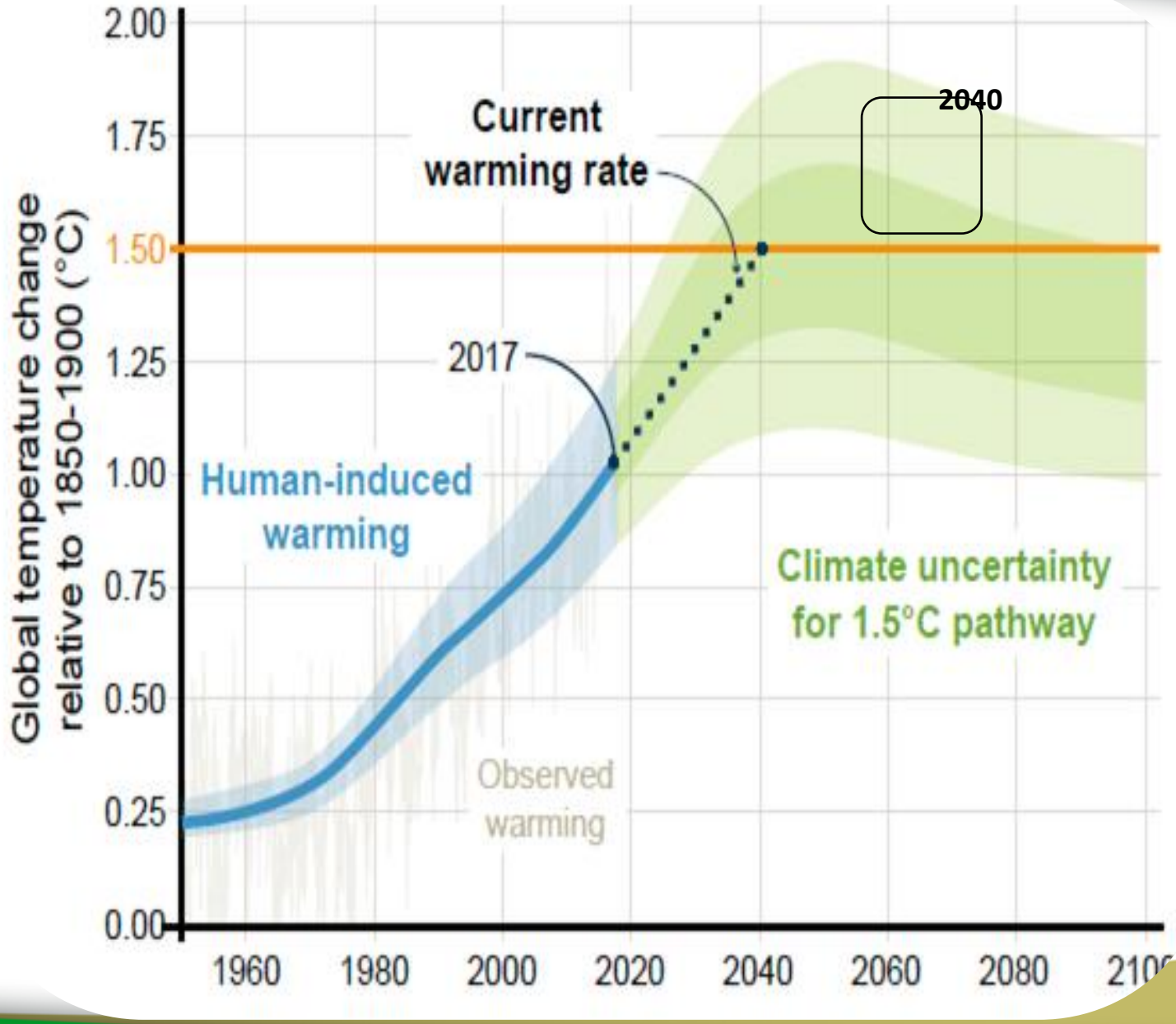
Global Warming Continues at Unprecedented Rate (IPCC AR6)

Global warming of 1.0°C has been reached in 2017

At current warming rate of **0.2°C per decade,** global warming of 1.5°C could be reached **between 2030 and 2052**

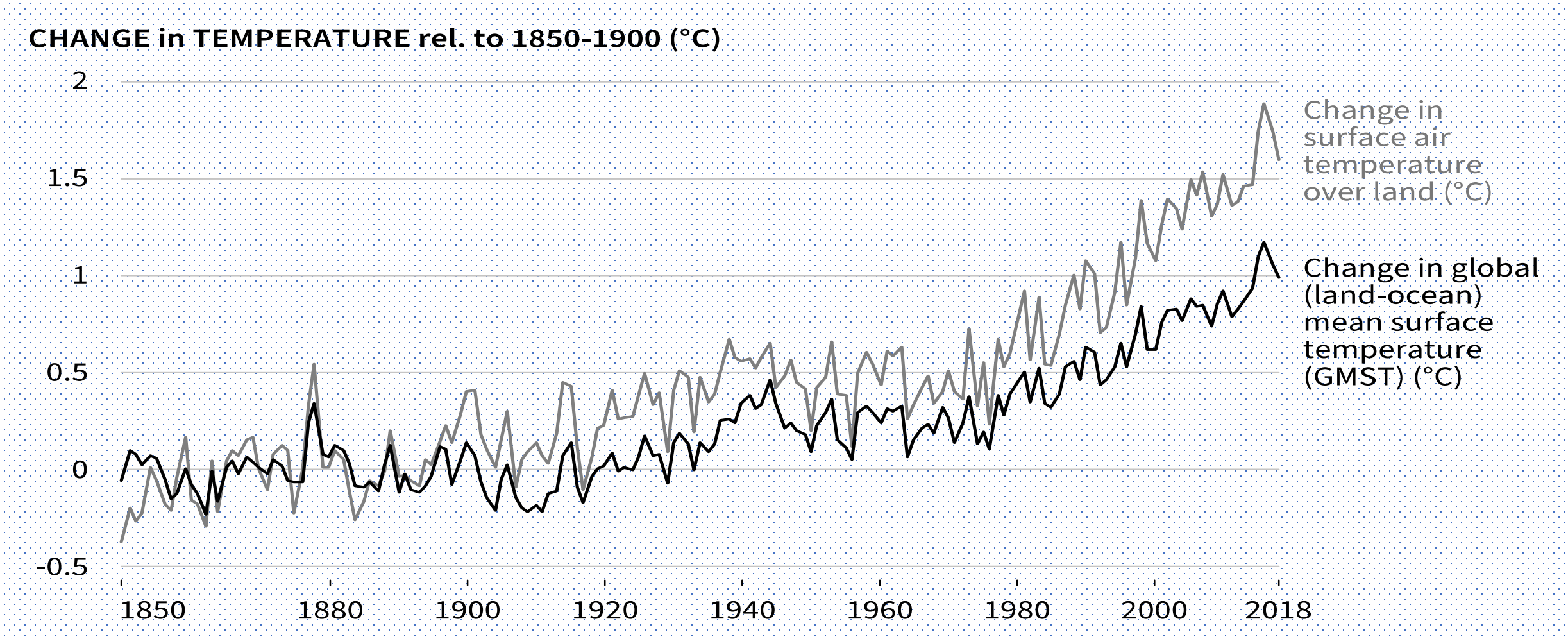
Worst case scenario estimates 3.3-5.7°C temp increase by 2100

Excessive rainfall, droughts, heatwaves, sea level rise, and intense tropical cyclones will continue



Source: Dr. Rex Victor O. Cruz, UP Los Baños

Global Warming Continues at Unprecedented Rate (IPCC AR6)



Source: IPCC, 2019

Source: Dr. Rex Victor O. Cruz, UP Los Baños

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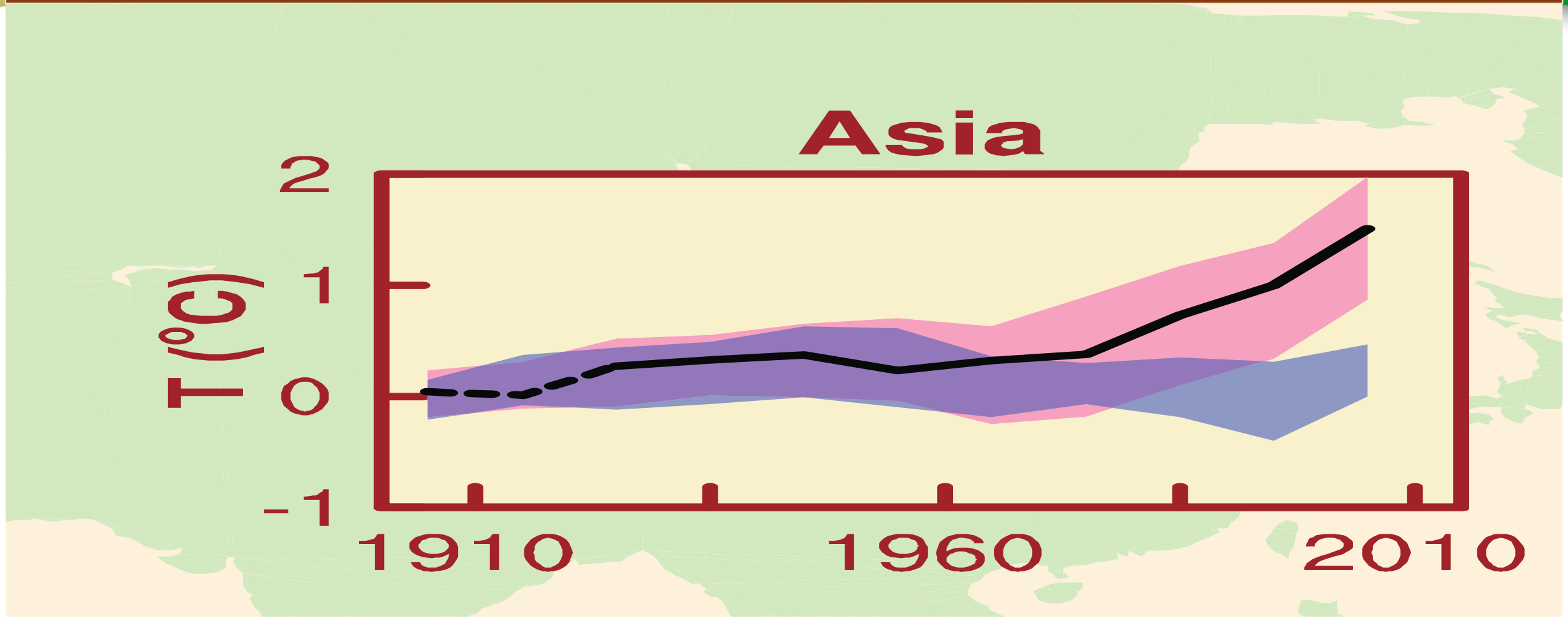
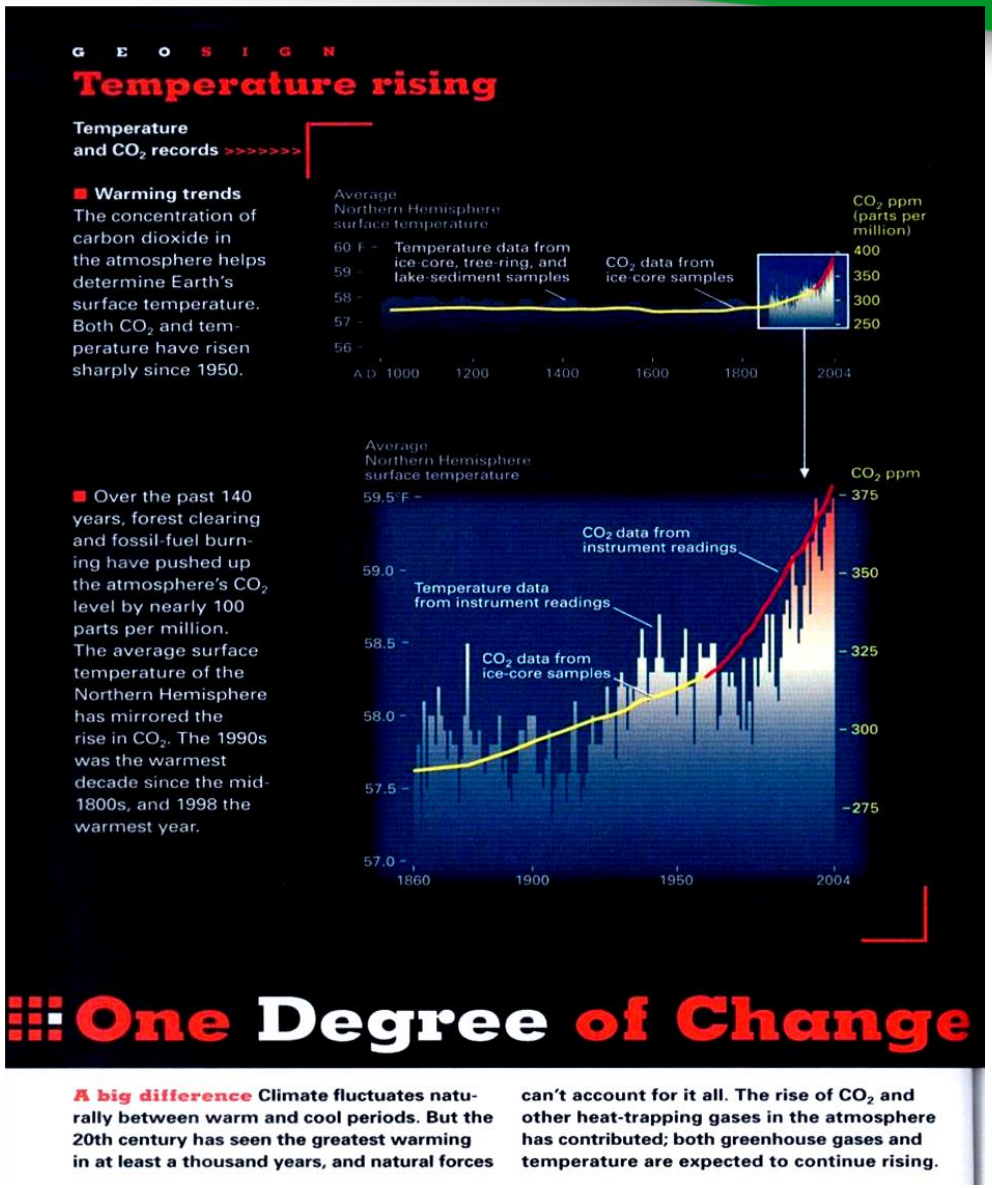


Source: IPCC, 2019

Source: Dr. Rex Victor O. Cruz, UP Los Baños

Effects of Climate Change

- Increase in minimum (nighttime) temperatures, maximum (daytime) temperatures, and **increases in the global mean temperature**.
- Increase in **sea surface temperatures, sea level** and changes in evaporation, and thus, changes in rainfall patterns among others.
- **Extreme** changes in weather patterns



Where are we in the climate crisis?

Typhoon Ulysses

Typhoon Rolly

POINT OF NO RETURN

- Average global temperatures have risen by almost 1°C because of increased human activities

- Planet is getting warmer by 0.2°C per decade, according to a report by the Intergovernmental Panel on Climate Change (IPCC) published in October 2018

POINT OF NO RETURN

- Average global temperatures could rise by 3-4°C by the end of this century if carbon dioxide levels not reduced

- If this tipping point needs to be delayed or tackled, we must limit carbon emissions to keep global temperature rise to less than 2°C within this century

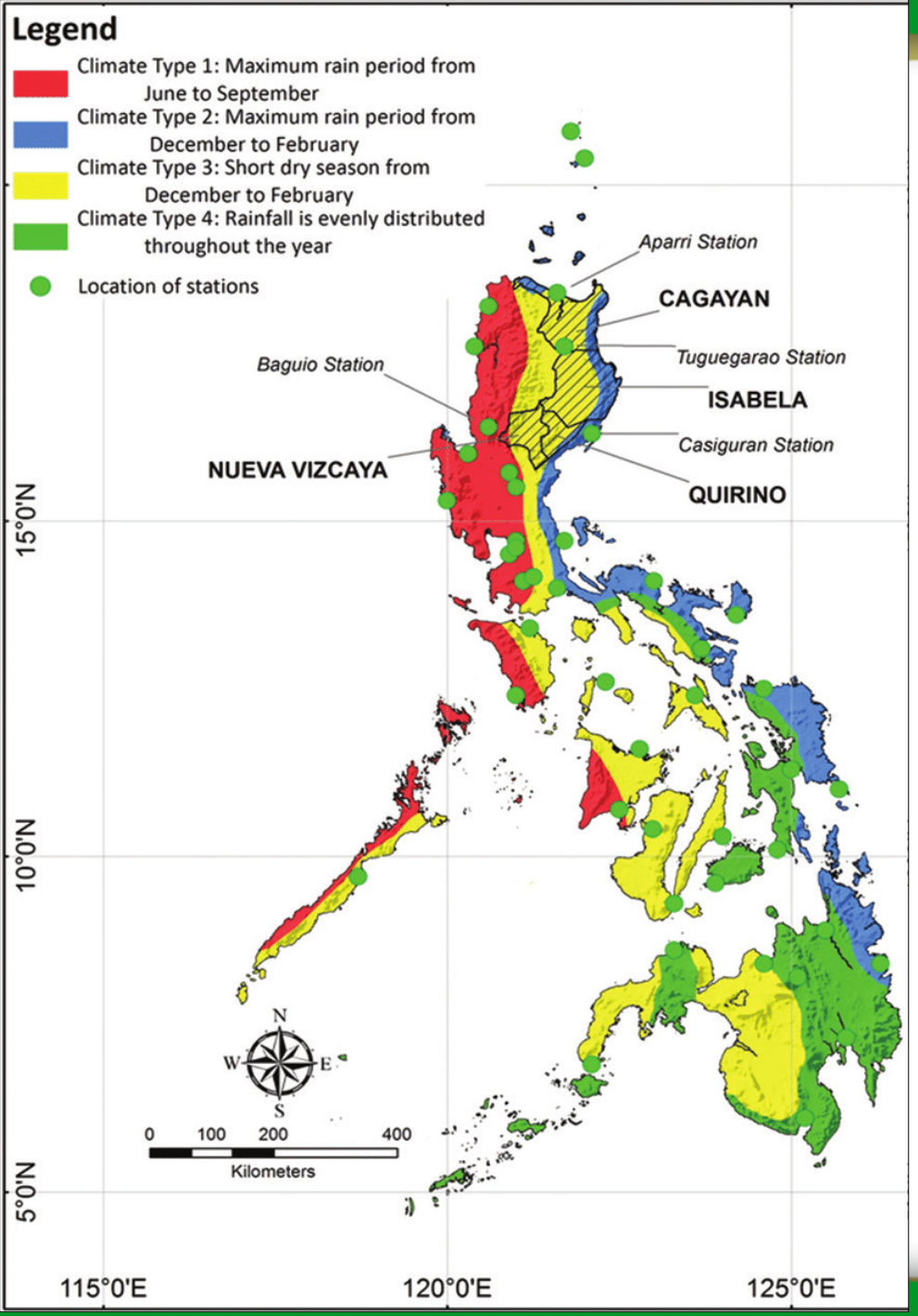
- Human health is inextricably linked with that of animals and the environment

- Warming of the climate is one of the principal drivers of the greatest — and fastest — loss of species diversity

- Seasonality and weather are major factors that control the rate at which viruses such as the flu infect humans.

- Research predicts that rising global temperatures will alter the timing, distribution and severity of disease outbreaks.

The STAR/Michael Varcas



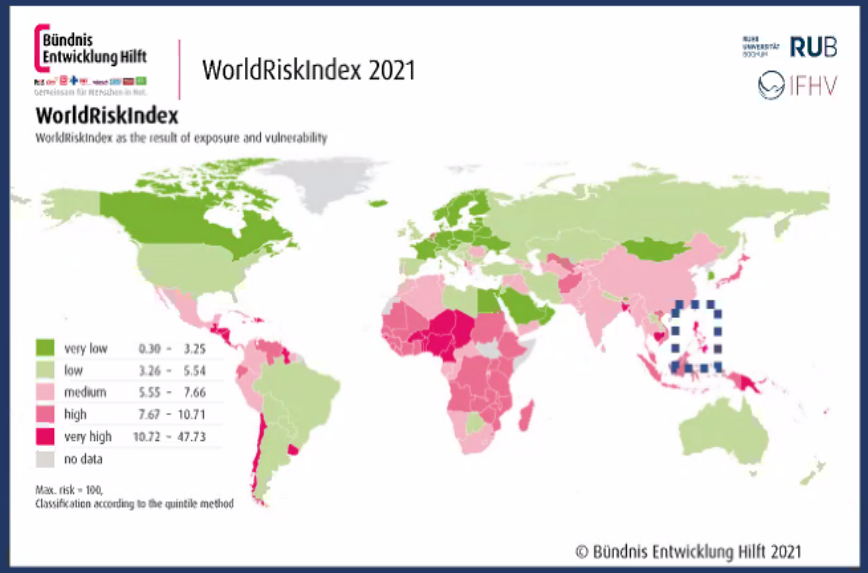
The Philippines is in the most-disaster prone region in the world.

Ranked first out of 193 countries on the list of global disaster risk hotspots (World Risk Index 2022)

Among the 10 countries presently most affected by climate change (2020 Climate Risk Index)

The Philippines : A hotspot for climate risk

- High climate risk: high exposure, high vulnerability, lack of coping capacities (World Risk Report, 2021)



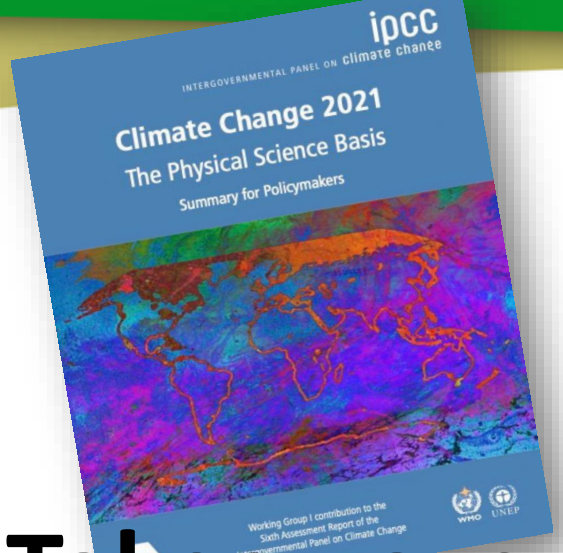
- Storms and floods among top causes of disaster events in the Philippines (EM-DAT, 2020; Table 1 from Brucal et al. 2020)

Table 1. Summary of natural disaster group events in the Philippines, 1990 to January 2020

Disaster type	*Events count*	*Total deaths*	*Total affected*	*Total damage (US$ m)*
Drought	6	8	3,051,969	148.85
Earthquake	25	2,966	6,037,909	511.74
Epidemic	18	2,535	357,714	-
Flood	123	2,269	28,685,696	3,529.50
Insect infestation	1	-	200	-
Landslide	22	2,026	316,262	33.28
Mass movement (dry)	1	11	-	-
Storm	217	29,410	145,915,777	19,791.07
Volcanic activity	18	719	2,056,408	219.85
Wildfire	1	2	300	-
Total	**432**	**39,946**	**186,422,235**	**24,234.29**

Source: EM-DAT (2020), based on most recent database update (30 January 2020)

Sources: https://weltrisikobericht.de/weltrisikobericht-2021-e; https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2020/06/GRI_policy_report_Disaster-impacts-and-financing_Local-insights-from-the-Philippines.pdf



Takeaways from the IPCC 6th Assessment Report

(Source: https://onetreeplanted.org/blogs/stories/5-takeaways-from-the-2021-ipcc-report-on-climate-change)

- Climate change is indisputably human-caused
- 2010-2020 was the hottest decade in 125,000 years **(1.1℃ in 2020)**
- Certain changes we've already seen are **accelerating, irreversible** and **unprecedented.**
- Greenhouse gas emissions are the leading cause of climate change
- Climate events are increasing in severity and number in every region of the planet

By Kelly Levin, Sophie Boehm and Rebecca Carter
https://www.wri.org/insights/ipcc-report-2022-climate-impacts-adaptation-vulnerability

6 Big Findings from the IPCC 2022 Report on Climate Impacts, Adaptation and Vulnerability

1. Climate impacts are already more widespread and severe than expected.

2. We are locked into even worse impacts from climate change in the near-term.

3. Risks will escalate quickly with higher temperatures, often causing irreversible impacts of climate change.

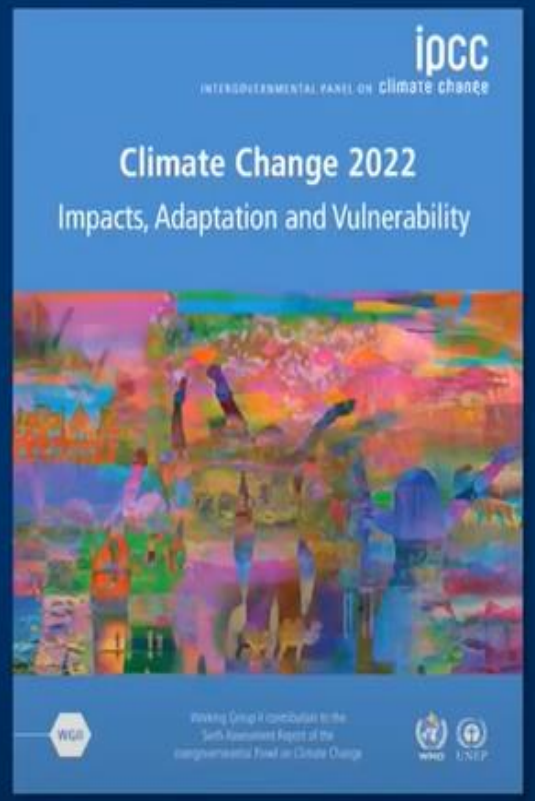
By Kelly Levin, Sophie Boehm and Rebecca Carter
https://www.wri.org/insights/ipcc-report-2022-climate-impacts-adaptation-vulnerability

6 Big Findings from the IPCC 2022 Report on Climate Impacts, Adaptation and Vulnerability

4. Inequity, conflict and development challenges heighten vulnerability to climate risks.

5. Adaptation is crucial. Feasible solutions already exist, but more support must reach vulnerable communities.

6. But some impacts of climate change are already too severe to adapt to. The world needs urgent action now to address losses and damages.



"The scientific evidence is unequivocal: climate change is a threat to human well-being and the health of the planet.

Any further delay in concerted global action will miss the brief, rapidly closing window to secure a liveable future.

This report offers solutions to the world.

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO
UNEP
ANU

Addressing the Impacts of Climate Change

MITIGATION
human intervention to reduce the sources or enhance the sinks of greenhouse gases



ADAPTATION
the process of adjustment to actual or expected climate and its effects

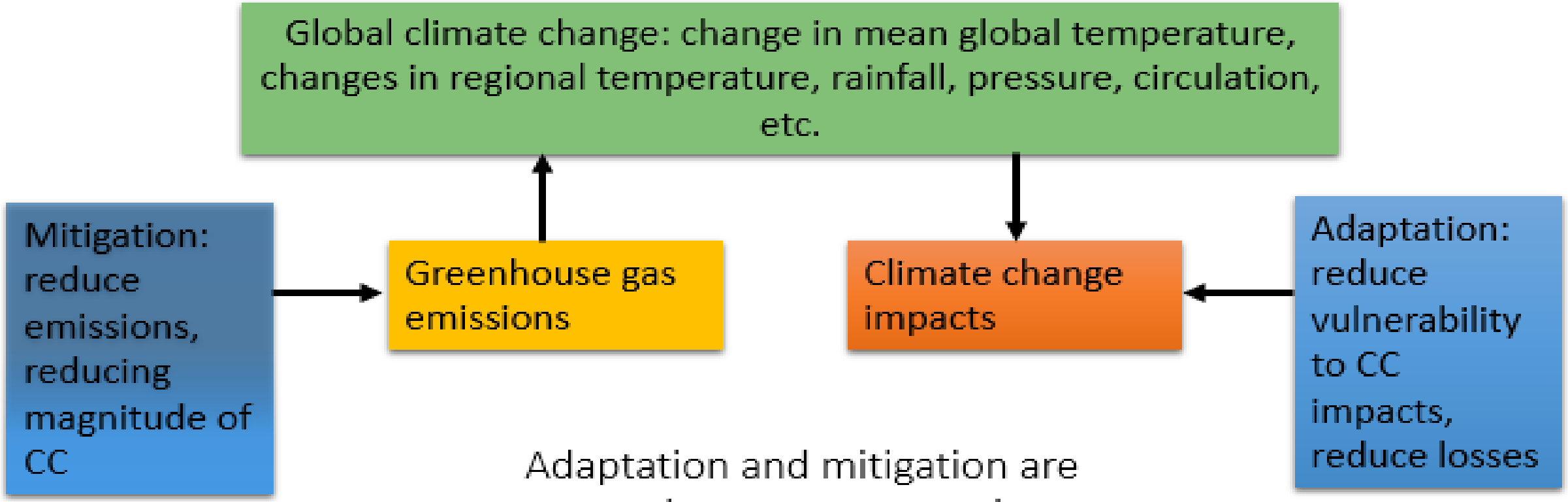

What is climate change adaptation?

- Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which exploits beneficial opportunities (IPCC, 2007)

- Initiative and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects (IPCC-FAR)

Defining adaptation

Adjustments in human and natural systems, in response to actual or expected climate stimuli or their effects, that moderate harm or exploit beneficial opportunities.



Adaptation and mitigation are complementary strategies

Source: UNDP

Types of Adaptation

- **Anticipatory adaptation (proactive)** – takes places before impacts of climate change are observed. Example: early warning systems

- **Autonomous adaptation (spontaneous)** – does not constitute a conscious response to climate stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Example: flood-control program

- **Planned adaptation** – is a result of a deliberate policy decision, based on awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state. Example: construction of sea walls/dikes, identification of drought-resistant crops

In reality, adaptation stands for a ***continuum of approaches*** *and often 'adaptation' activities are linked to more than one category.*

Framing Adaptation

(Categories according to objectives)

Vulnerability Focus

Impact Focus

Development "as usual"/ No-regrets activities

CC-specific activities

1 Addressing drivers of vulnerability	2 Building response capacity	3 Managing Climate risk	4 Confronting climate change
Aim: Increase individual and community buffer capacity	**Aim:** Build robust systems for problem solving	**Aim**: Make use of climate information in decision-making	**Aim**: Respond directly to climate change-related threats

Increasing additional costs = need for robust climate information

Continuum of Approaches for Adaptation

Development „as usual“ / no-regret activities

CC-specific activities

Categories of adaptation objectives / Intervention Areas	Address drivers of vulnerability	Build response capacities	Manage climate risks	Confront climate change effects
	Aim: Individual, community and/or institutional buffer increased	Aim: Robust systems for problem solving exist	Aim: Use information on changing climate for decision making	Aim: Reduce climate change related threats
POLICY	*Enhance cross-sectoral cooperation for sustainable natural resources management*	*Enhance local participation in land-use planning*	*Land-use plans prohibit dwellings in flood-prone areas*	*Relocation of coastal communities in response to sea level rise*
TECHNICAL SOLUTIONS	*Diversification of income strategies in areas prone to drought*	*Upstream reforestation for erosion control and flood prevention*	*Develop eco-corridors based on observed/ projected species migration*	*Construction of artificial reefs to mitigate surges*
CAPACITY DEVELOPMENT	*Increase literacy rates*	*Promoting conservation farming techniques*	*Train authorities to use climate information*	*Train local farmers to cultivate new drought resistant crop varieties.*
	Cross breeding programs to promote livestock	*Analyse past community responses events*	*Provide regional*	*Research and conserve situ*

Increasing additional costs = need for robust climate information

Source: ECO Consult, adapted from http://www.wri.org/publication/weathering-the-storm

Climate Change
and
Golf Course Management

Vulnerability to Impacts of Climate Change

Increasing resiliency to climate change extremes

Heat

Hot and humid climates can bring "moisture stress" when water intake in plants dips below sustainable levels.

Vulnerability to Impacts of Climate Change

Increasing resiliency to climate change extremes

Drought

Courses in the same area can experience very different impacts from a drought, depending on their grass types, irrigation system and water source.

Vulnerability to Impacts of Climate Change

Increasing resiliency to climate change extremes

Cold

Cold weather courses have an increased responsibility to maintain turf health throughout the year in order to prepare the grasses for the hard winter.

Adapting to Climate Change

To minimize the impacts of climate change:

- Evaluate the potential effects of climate change on the playing quality and agronomic condition of the course.
- Devise, adapt and implement sustainable management strategies to minimize the threat of climate change on the course
- Devise long-term plans to provide direction and continuity, which may include appropriate investment in staff and modern turf maintenance machinery
- Communicate to golfers the importance and rationale behind these sustainable maintenance practices

The climate is the overriding influence on the conditioning, playing quality and presentation of the golf course.

Alternative Water Resources

- Reverse osmosis desalination plants
- Use brackish water or ocean water
- Establish rainwater harvesting system

Turf Management

Turf grasses also play an important role in soil stabilization, dust and erosion control by holding the soil in. The fibrous root systems in turf provide excellent netting that reduces dust and stabilizes the soil on flat and slopping surfaces.

Leaching and runoff impacted by:

- Sandy soils and heavy irrigation – increased rates
- Younger turf – increased rates
- Dense turf and aerated soil – decreased rates

Golf Courses and Water Usage

Golf courses are good stewards of the environment. Learn more about how courses are carefully monitoring their use of water to provide a playing surface that is sustainable for the facility and enjoyable for the golfer.

Playing Quality, Turf Health and Water

Turf color and cosmetics have nothing to do with the quality of a playing surface.

Site-specific factors such as variations in soil, terrain and slope affect soil moisture and turf appearance. Superintendents account for these variables to maintain healthy turf.

Golf courses are reducing irrigated acreage in out-of-play areas with minimal impact on playing quality and pace of play.

Superintendents make watering decisions with the use of on-site weather stations and handheld and in-ground moisture sensors.

Firmer, drier courses may have more non-green areas.

Irrigation Systems

Modern irrigation systems apply water more accurately and efficiently than ever before:

- Ensure uniformity and accuracy
- Maintain playability and turf health, not color
- Supplement, not completely replace, natural rainfall
- Manage resources with sophisticated software programs

Drier courses mean:

- Improved playing quality
- Less turf growth
- Fewer resources required for mowing
- Likely reduction in usage of fungicides
- Reduced incidence of disease

Benefits of Turf Ecosystems

- Improve air quality
- Neutralize pollutants
- Absorb and filter rainwater
- Minimize erosion
- Reduce noise pollution
- Provide wildlife habitat
- Capture and filter runoff
- Dissipate heat
- Improve community aesthetics

The USGA supports turfgrass and environmental research, resulting in the release of more than 30 improved turfgrass cultivars, many of which require less water.

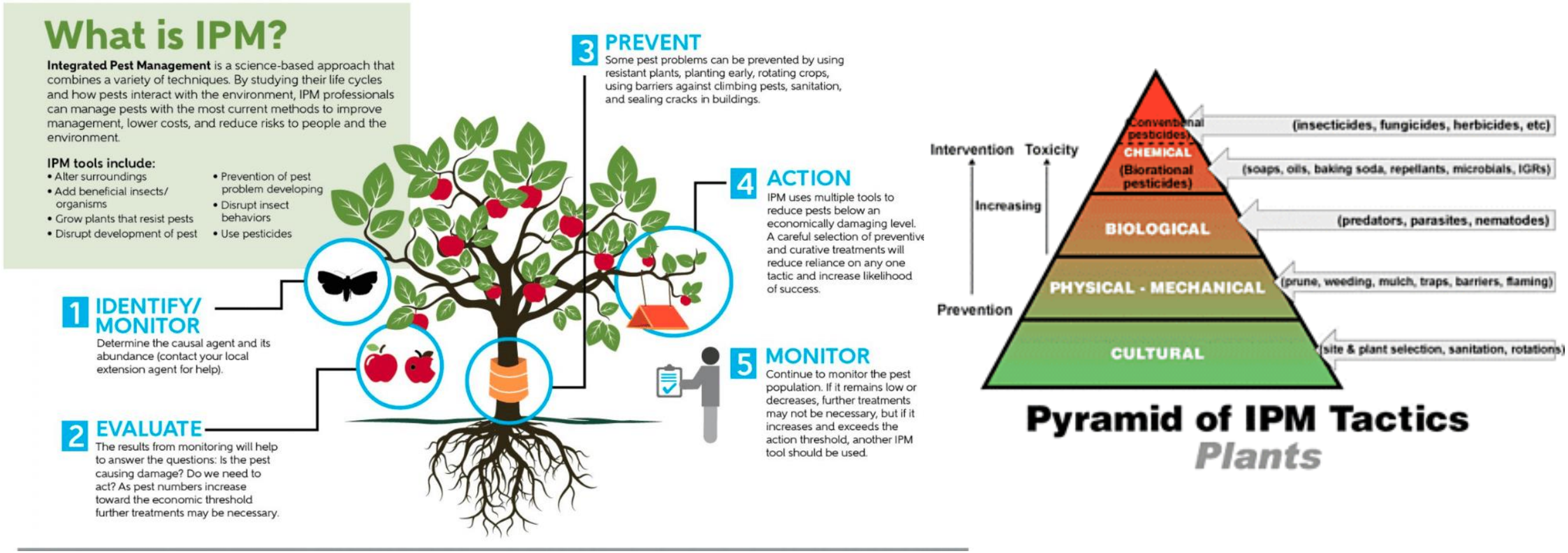
Turfgrass systems filter water, removing nutrients and degrading various chemical and biological contaminants in runoff water — improving water quality, recharging aquifers.

Establishment of Climate/Weather Stations

Weather stations estimate the evapotranspiration (ET) used by the turf over a 24-hour period to aid in scheduling irrigation or, if desired, automatically change irrigation schedules.

They measure the six parameters required to calculate ET: wind speed and direction; solar radiation; temperature; relative humidity; and rainfall.

Integrated Pest Management (IPM)



IPM Courtesy of the Entomological Society of America

An IPM Plan for golf consists of the following:

Cultural Practices – Regular cultural practices that maintain turfgrass as its best to keep it healthy and disease resistant

Grass Type/Species Selection – Turfgrass species and cultivars must be chosen to suit the weather and playing conditions in the local region

Mowing – Turfgrass species and rate of growth directly influence mowing height and frequency

Irrigation – To achieve uniform coverage, inspect the irrigation system to check that all irrigation heads are operational and correctly set.

Fertilizing – The frequency with which fertilizer is applied depends on the turfgrass and the type of fertilizer used.

The window for action is rapidly closing

65% of our carbon budget compatible with a 2°C goal already used

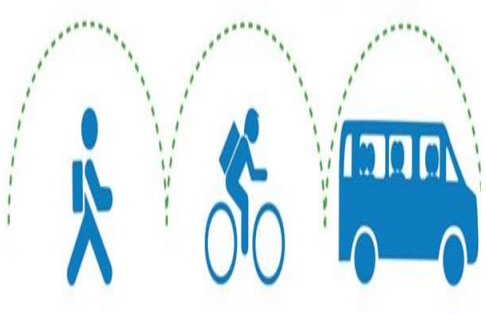
Take urgent action to combat climate change and its impacts.

emissions and adaptation to the remaining risks.

CO_2 emissions in 2013: *9.9 GtC*

Pursuing Cultural and Behavioral Change

Carbon Footprint Reduction Measures



Car-free private travel

Ride Sharing

Shift to low carbon transport/E-vehicles

Grow more trees

Vegetarian Diets

Renewable off-grid Energy

Efficiency Improvement of Food Production

Waste Management

Carbon Footprint Reduction Measures

Efficiency Improvement of Home Appliance

Telework

Reduction of Food Loss

Vehicle Fuel Efficiency Improvement

Green Buildings/ Green Spaces

Reduction of Flights

"Climate change will not be effectively managed until individuals and communities recognise that their behaviour can make a difference."

-The Royal Society, Climate Change: what we know and what we need to know. (2002)

References:

- https://www.usga.org/course-care/water-resource-center/environmental-principles-for-golf-courses-in-the-united-states.html
- https://slideplayer.com/slide/5111823/
- https://www.dte.golf/blog/insecticides
- https://www.philstar.com/business/stock-commentary/2023/05/03/2263258/golf-courses-and-water-scarcity
- https://digitalcommons.law.seattleu.edu/cgi/viewcontent.cgi?article=1090&context=sjel
- https://www.sgeg.org.uk/documents/ClimateChangeandScottishGolfCourses.pdf

Thank you

For your questions / queries:

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