ON THE USE / USEFULNESS OF CLIMATE PROJECTIONS FOR THE FUTURE: SCENARIOS, 2 DEGREES TOPICS TO BE ADDRESSED: UNCERTAINTIES, TRENDS

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The CODATA-RDA Research Data Science Advanced Workshop: Climate Data Sciences (ICTP)
Trieste, Italy. 22nd August 2019

Outline

1) Some concepts related to climate change

2) General steps in the evaluation of the impacts of climate change

3) Adaptation to climate change

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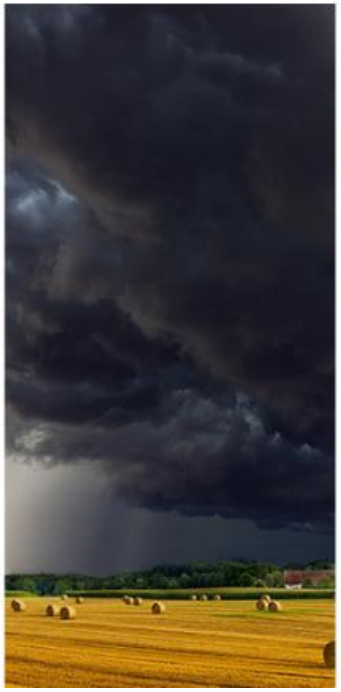


1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

Take a moment and think about the weather today where you are. Is it normal or typical? Is it what you'd expect?

If it's been cool the past few days but the temperature is climbing today, is that weather or climate? Are weather and climate the same thing? Though they are closely related, weather and climate aren't the same thing

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

What exactly is weather?

More specifically, weather is the mix of events that happen each day in our atmosphere. Even though there's only one atmosphere on Earth, the weather isn't the same all around the world. Weather is different in different parts of the world and changes over minutes, hours, days, and weeks.

Most weather happens in the part of Earth's atmosphere that is closest to the ground—called the troposphere. And, there are many different factors that can change the atmosphere in a certain area like air pressure, temperature, humidity, wind speed and direction, and lots of other things. Together, they determine what the weather is like at a given time and location.

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

What exactly is climate?

- Whereas weather refers to short-term changes in the atmosphere, climate describes what the weather is like over a long period of time in a specific area. Different regions can have different climates. To describe the climate of a place, we might say what the temperatures are like during different seasons, how windy it usually is, or how much rain or snow typically falls.

- When scientists talk about climate, they're often looking at averages of precipitation, temperature, humidity, sunshine, wind, and other measures of weather that occur over a long period in a particular place. In some instances, they might look at these averages over 30 years. And, we refer to these three-decade averages of weather observations as Climate Normals.

1) Some concepts related to climate change

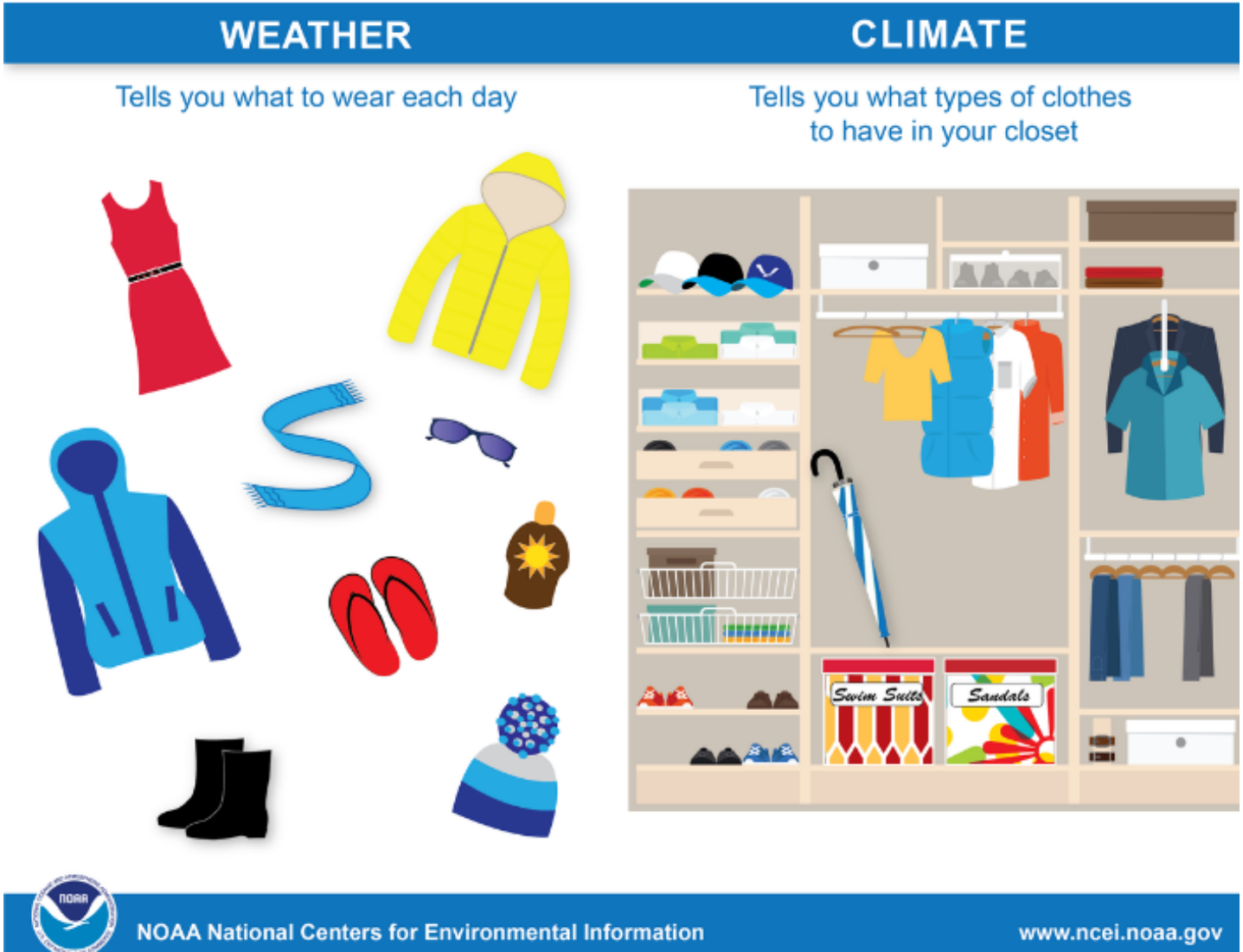
- What's the Difference Between Weather and Climate?
- Looking at Climate Normals can help us describe whether the summers are hot and humid and whether the winters are cold and snowy at a particular place. They can also tell us when we might expect the warmest day of the year or the coldest day of the year at that location. But, while descriptions of an area's climate provide a sense of what to expect, they don't provide any specific details about what the weather will be on any given day.

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

Weather: what to wear each day.

Climate: what types of clothes to have in your closet.



1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

How do weather observations become climate data?

Across the globe, observers and automated stations measure weather conditions at thousands of locations every day of the year. Some observations are made hourly, others just once a day. Over time, these weather observations allow us to quantify long-term average conditions, which provide insight into an area's climate.

If we take the example of the United States, systematic weather records have been kept for over 140 years. With these long-term records, they can detect patterns and trends. So the Nation's official archive for environmental data collect, quality control, and organize these data and make them available online for scientists, decision makers, and you.

1) Some concepts related to climate change

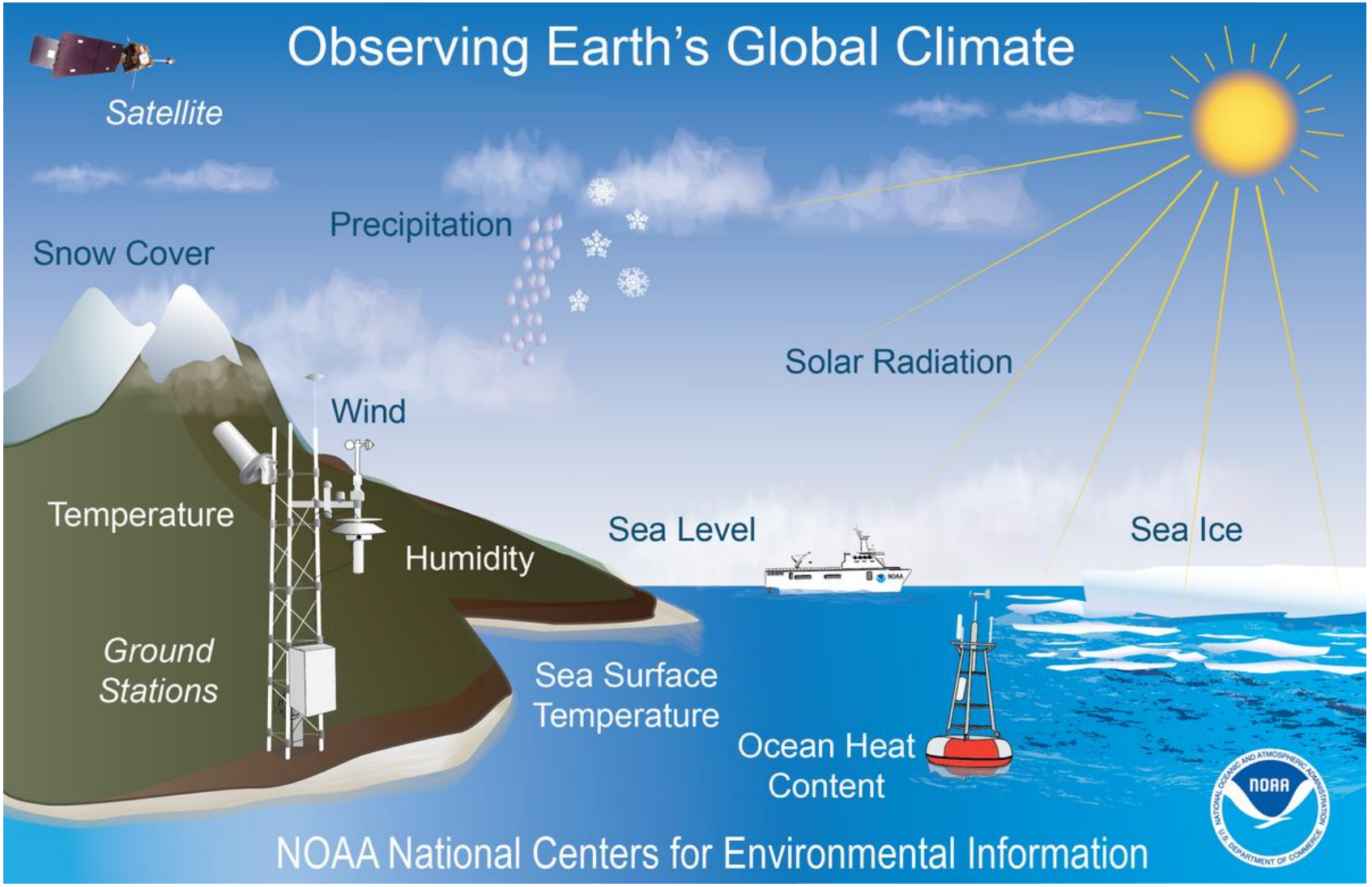
- What's the Difference Between Weather and Climate?

Are regional climates different from the global climate?

Different regions of the world have varying climates. But, we can also describe the climate of an entire planet—referred to as the global climate. Global climate is a description of the climate of a planet as a whole, with all the regional differences averaged. Overall, global climate depends on the amount of energy received by the sun and the amount of energy that is trapped in the system. And, these amounts are different for different planets. Scientists who study Earth's climate look at the factors that affect our planet as a whole.

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?



Video (see Link below in Ackniwledgements)

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

Though they are closely related, weather and climate aren't the same thing. Climate is what you expect. Weather is what actually happens

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

How does the climate change?

While the weather can change in just a few minutes or hours, climate changes over longer time frames.

Today, climates are changing. Our Earth is warming more quickly than it has in the past according to the research of scientists. Hot summer days may be quite typical of climates in many regions of the world, but warming is causing Earth's average global temperature to increase. The amount of solar radiation, the chemistry of the atmosphere, clouds, and the biosphere all affect Earth's climate.

1) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

As global climate changes, weather patterns are changing as well. While it's impossible to say whether a particular day's weather was affected by climate change, it is possible to predict how patterns might change. For example, scientists predict more extreme weather events as Earth's climate warms.

1) Some concepts related to climate change

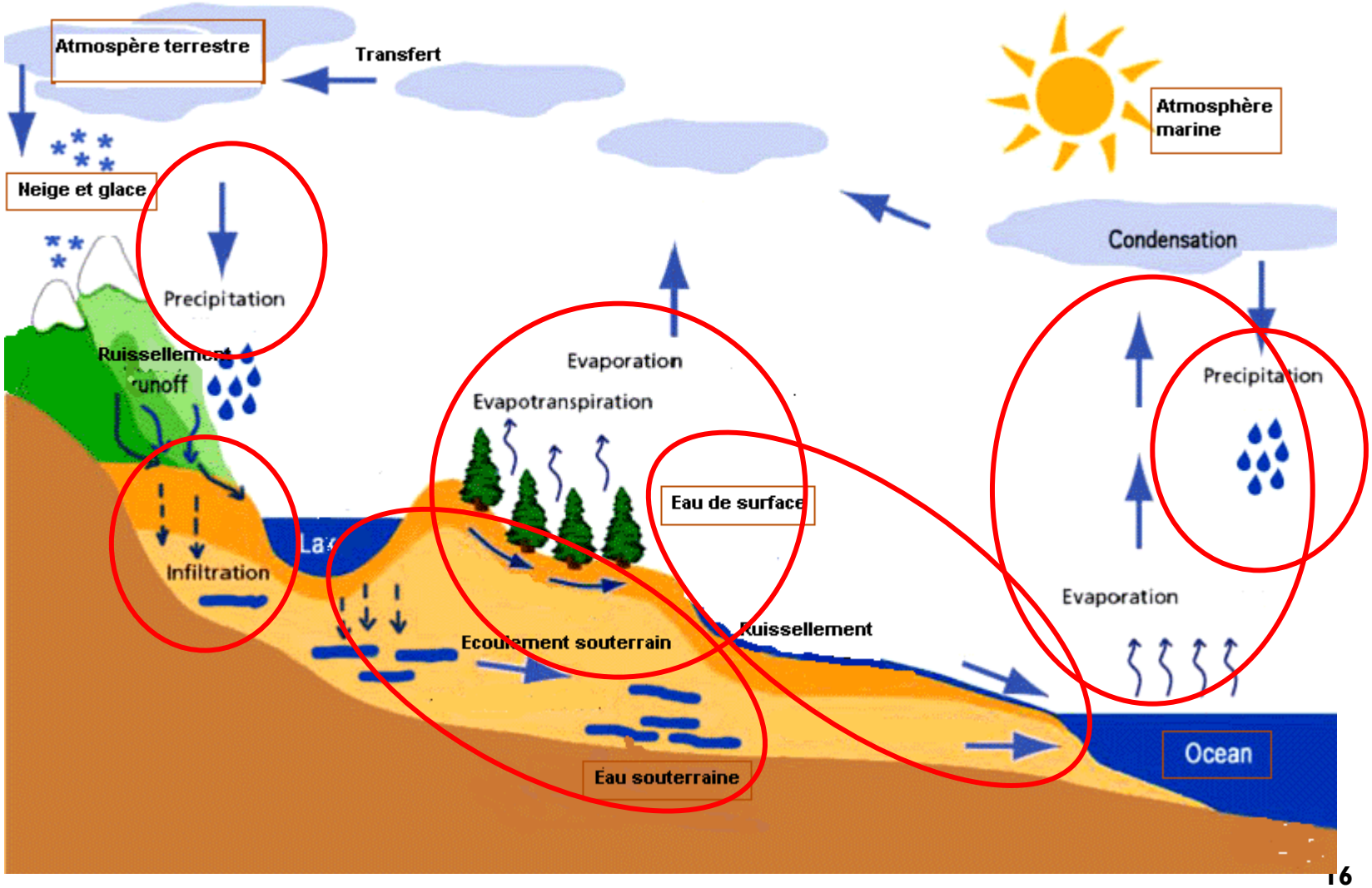
- What's the Difference Between Weather and Climate?

Why do we study climate?

I) Some concepts related to climate change

- What's the Difference Between Weather and Climate?

Why do we study climate? Example of Climate system and water resources



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- What's the Difference Between Weather and Climate?

Why do we study climate?

Climate, climate change, and their impacts on weather events affect people all around the world. Rising global temperatures are expected to further raise sea levels and change precipitation patterns and other local climate conditions.

Changing regional climates could alter forests, crop yields, and water supplies. They could also affect human health, animals, and many types of ecosystems. Deserts may expand into existing rangelands, and features of some of our National Parks and National Forests may be permanently altered.

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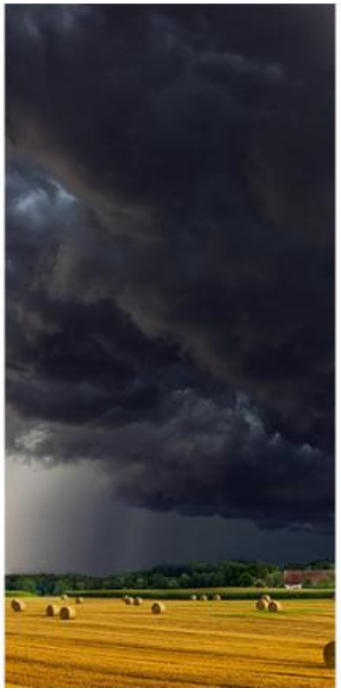
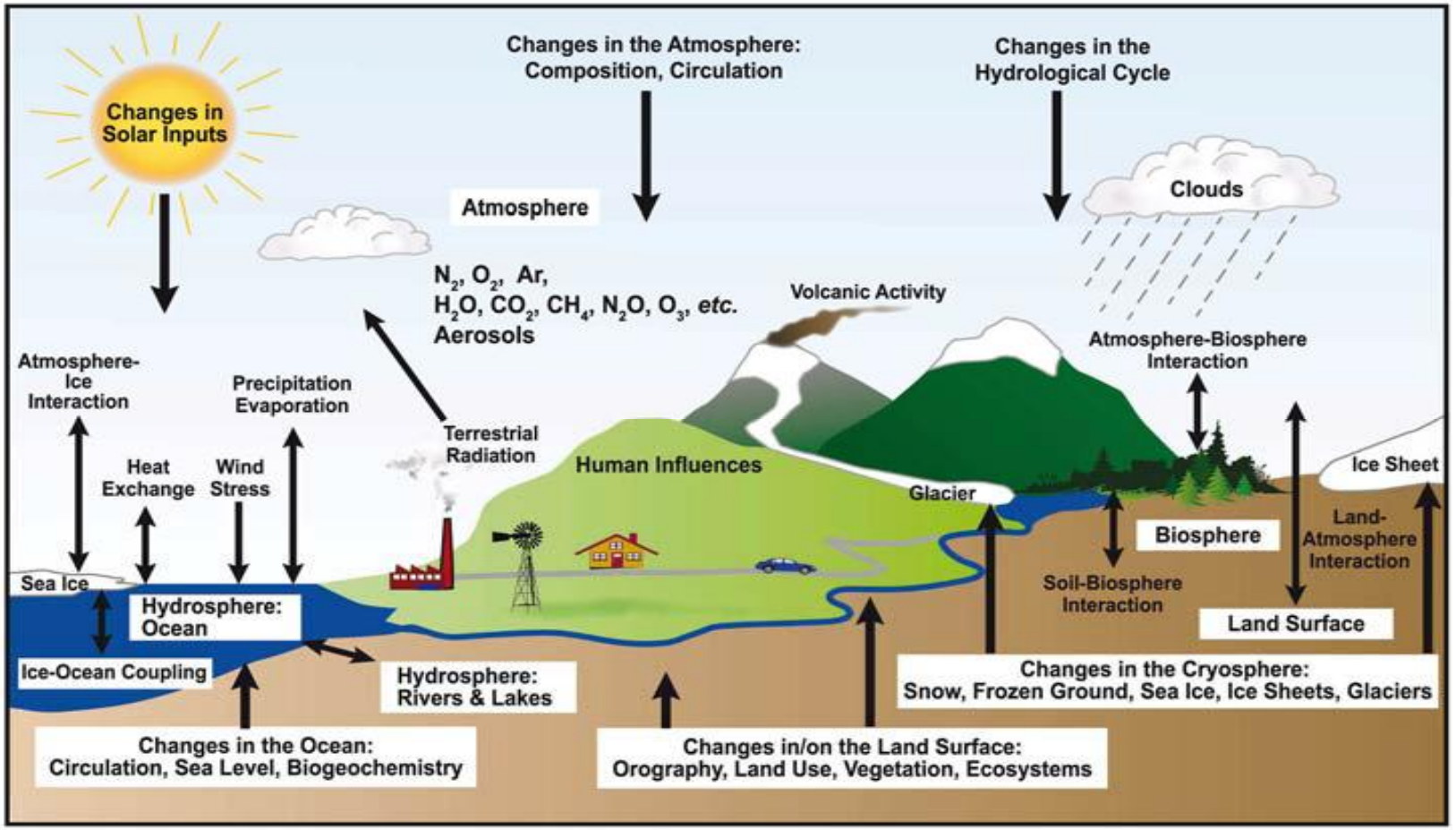


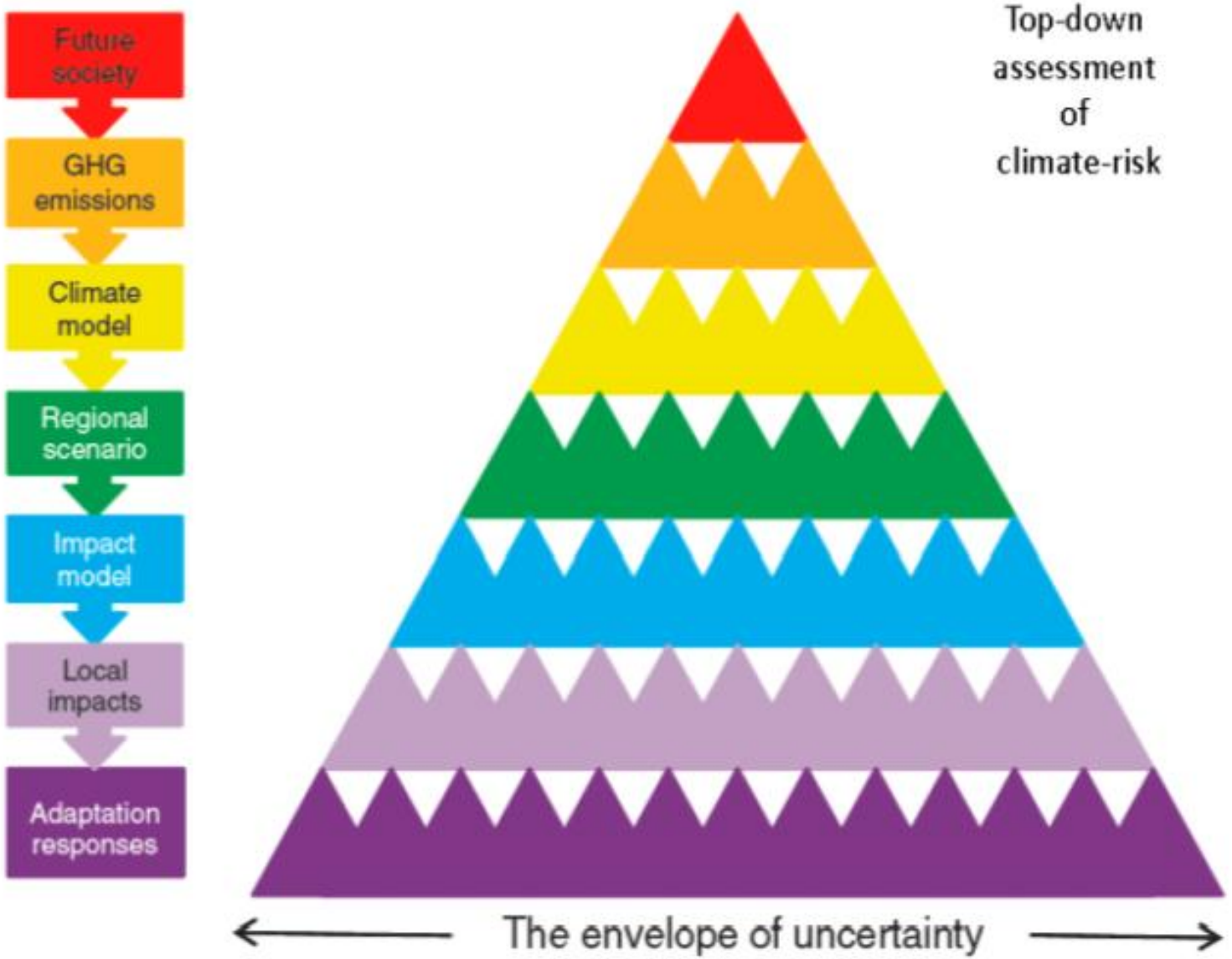
2) General steps in the evaluation of the impacts of climate change



-The Atmosphere/ The Ocean/ The Land Surface

-The Chryosphere/ The Biosphere

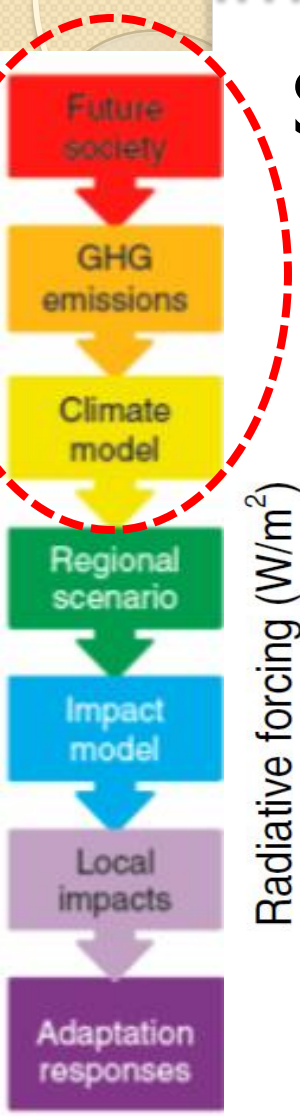
2) General steps in the evaluation of the impacts of climate change

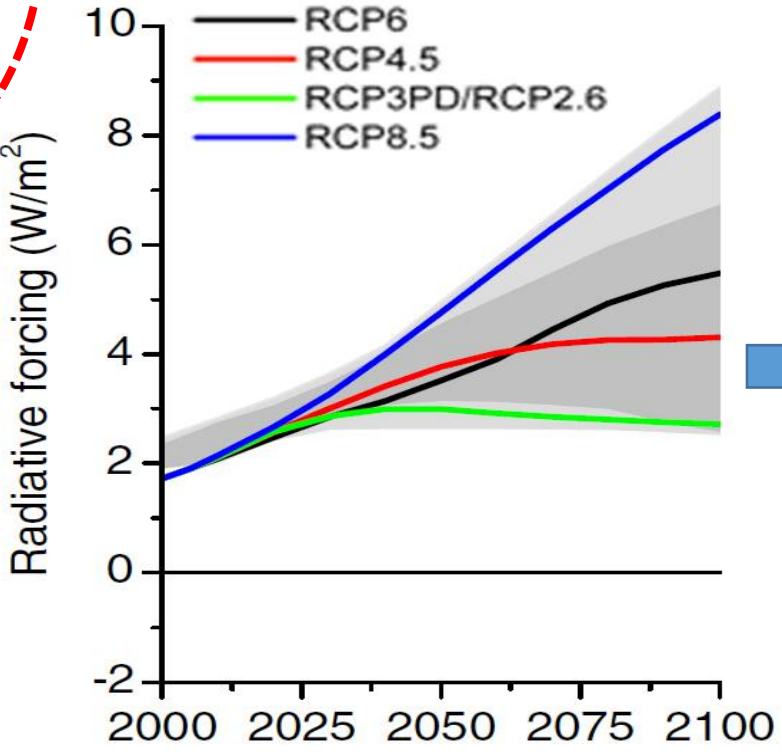


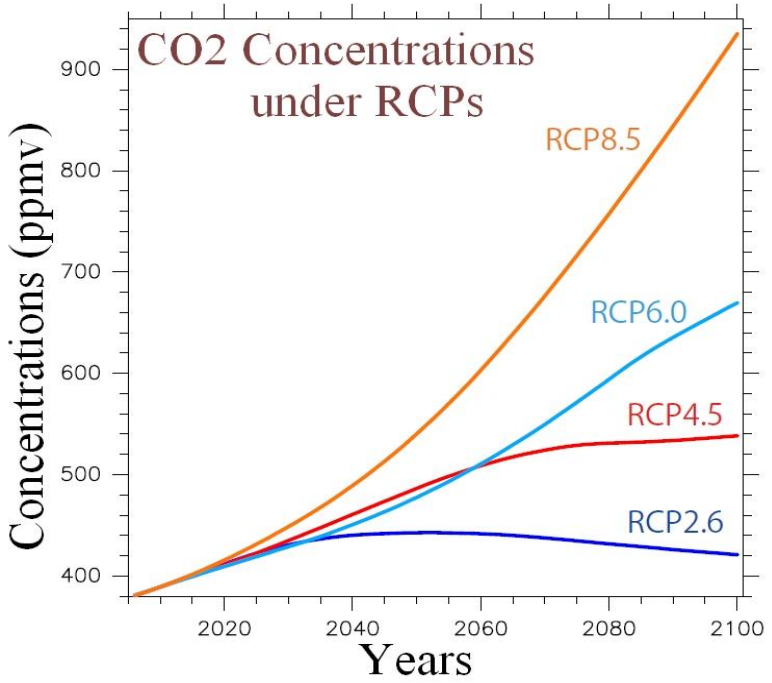
e: Wilby & Dessai (2010, Weather)

2) General steps in the evaluation of the impacts of climate change

Scenarios



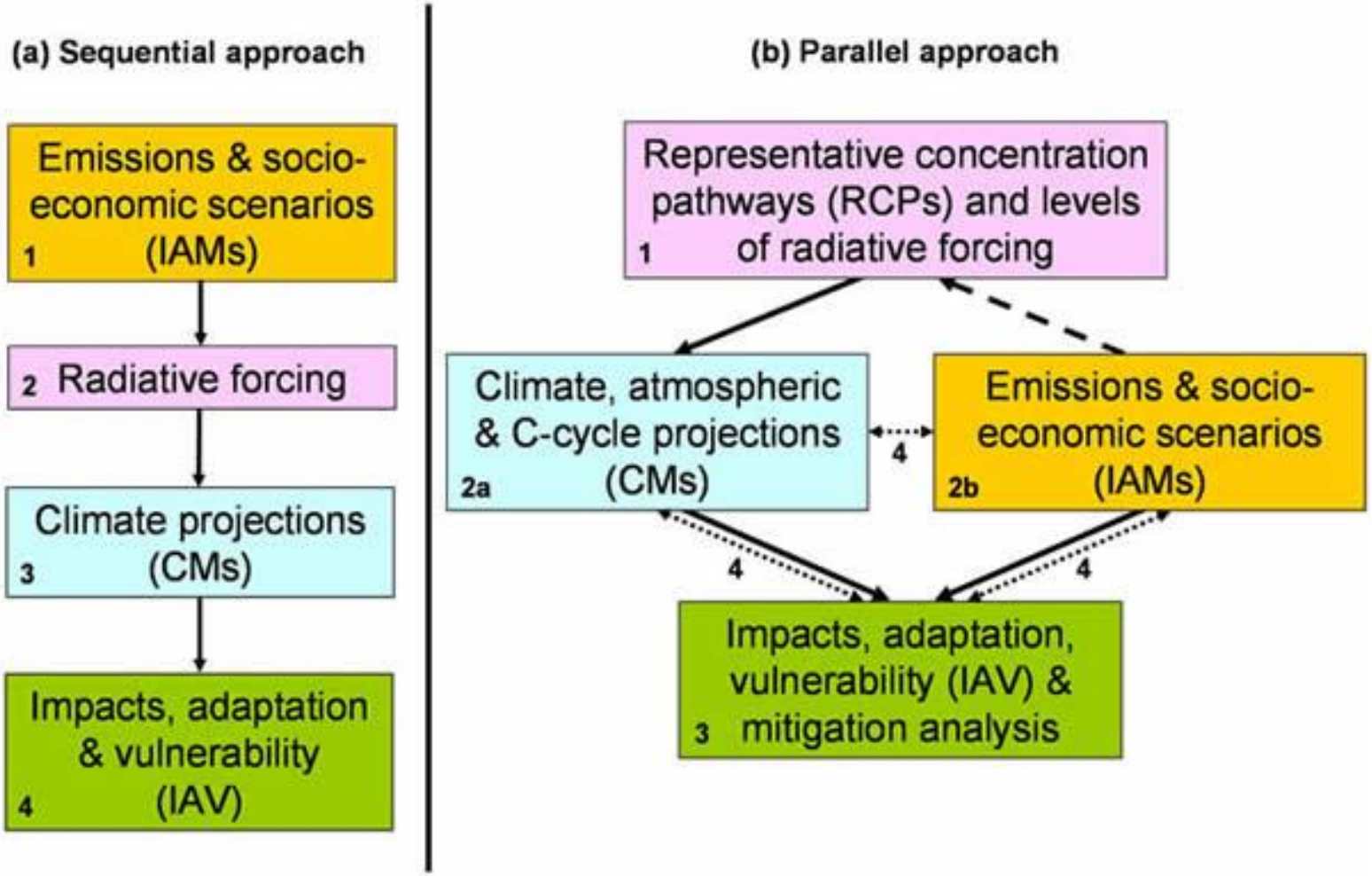




2) General steps in the evaluation of the impacts of climate change

Future society
GHG emissions
Climate model
Regional scenario
Impact model
Local impacts
Adaptation responses

Scenarios: Special Report on Emissions Scenarios (SRES) vs RCPs



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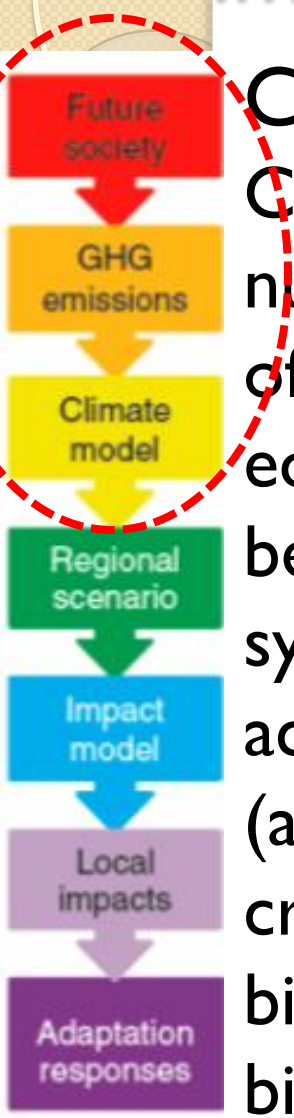
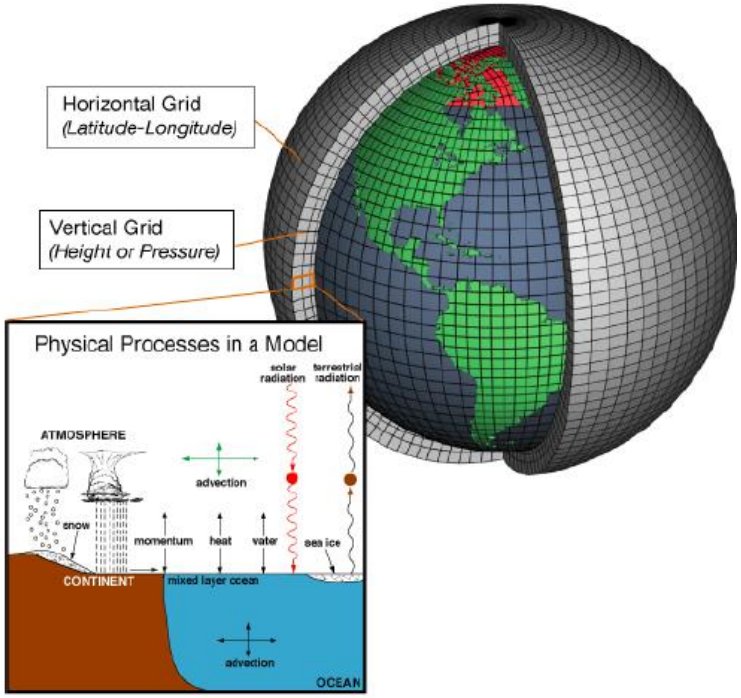


Climate modelling:

Climate Models are numerical representations of the fundamental equations that describe the behavior of the climate system and the interactions across its components (atmosphere, ocean, cryosphere, land surface and biosphere) … now including biogeochemical processes

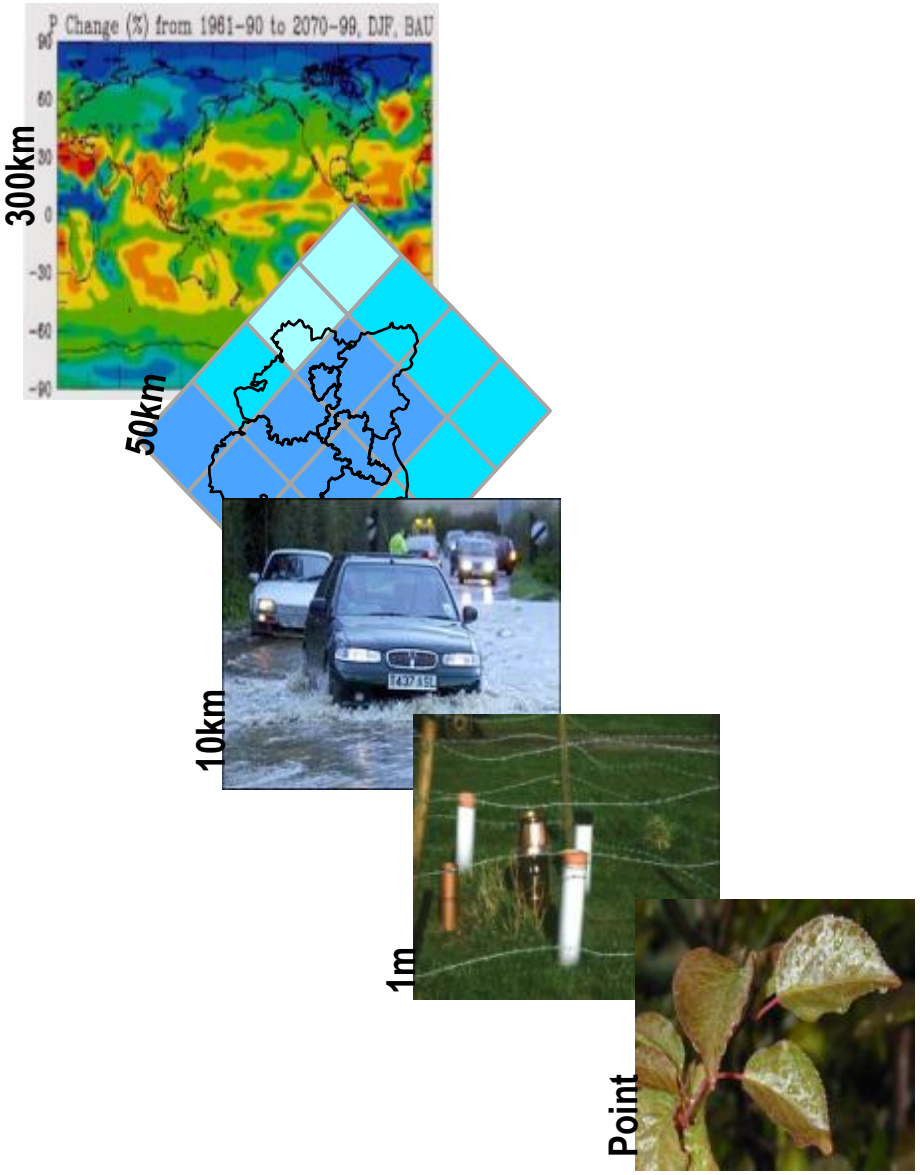


https://upload.wikimedia.org/wikipedia/commons/7/73/AtmosphericModelSchematic.png

2) General steps in the evaluation of the impacts of climate change

Regional downscaling: Moving from Global to regional/local level

- Various sources of uncertainties: bias correction and multi-models ensembles



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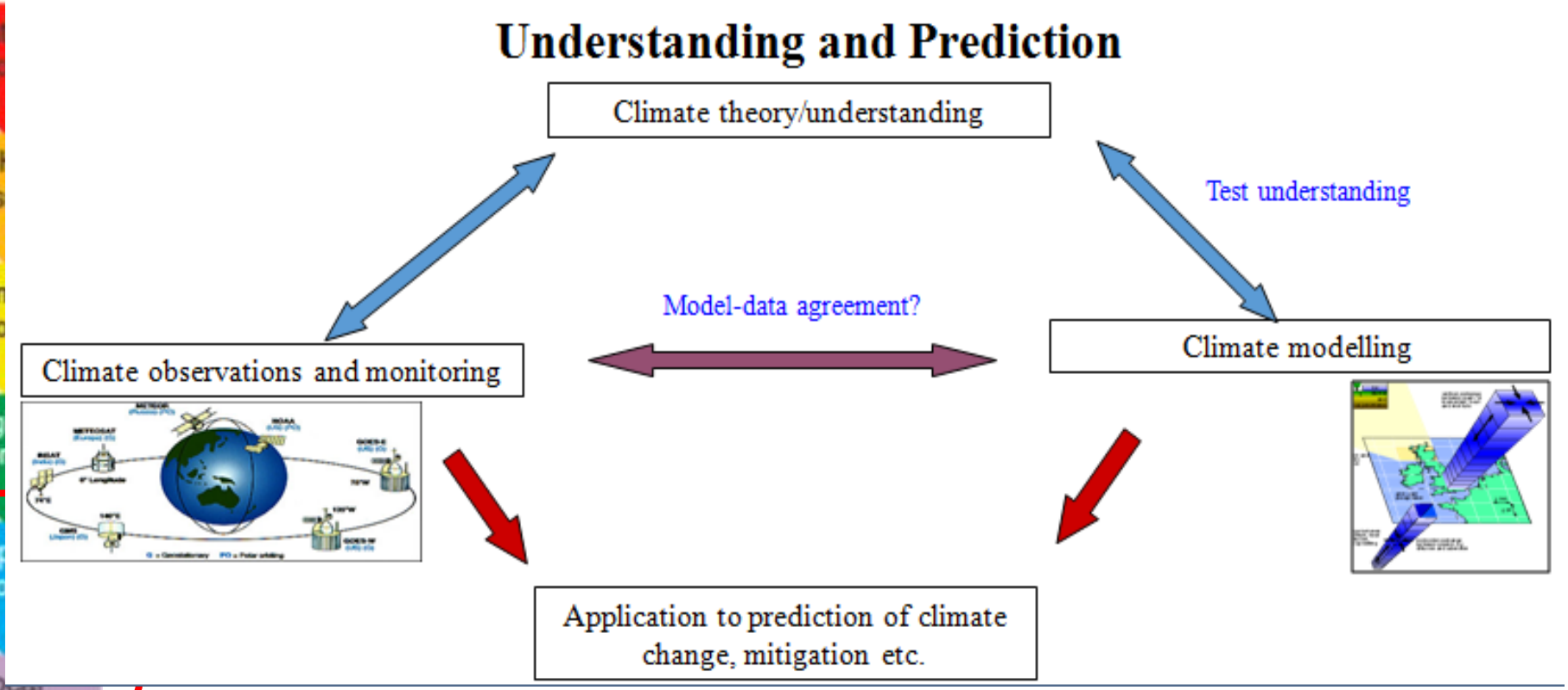

2) General steps in the evaluation of the impacts of climate change

Impacts on water, land, agriculture, transports, health: bad and good (opportunities)

-…(participants inputs)

- India: raising malaria (vector-borne diseases,(rainfall, rainy days,…)

-Ethiopia: multifaceted impacts long and persistent droughts, shortages of surface and groundwater, low sanitation levels, contagious diseases (health), survival of people depending on agriculture, floods, destruction of infrastructure, …

-Extreme events: floods (coast), change in rainfall patterns (cultural cycles of crops, parameters); food security and poverty

- pollution (aerosols): correlation with heat (health)

- Coastal erosion,

- heat waves, unusual flooding, …)

-Good impacts:

-Fruits production (increasing land areas due to reduction of snow falls)

2) General steps in the evaluation of the impacts of climate change

Impacts on water, land, agriculture, transports, health: bad and good (opportunities)

-…(participants inputs)

-India: Fruits production (increasing land areas due to reduction of snow falls): positive economic impacts; decrease mortality and morbidity of aged people in cold regions, decreasing vectors

-(In middle latitudes: increase in yields in wheat,)

-+ Argentina: wine production,

-research: more research

2) General steps in the evaluation of the impacts of climate change

Climate system is unpredictable

We can construct "scenarios" or "projections" but cannot "predict"/ "forecast" climate.

- Climate is not weather. Predicting weather beyond 10 days is like forecasting the next outcome of rolling a dice.
- Climate is the "bigger picture" (e.g. 30-year averages) rather than the short-term state (weather)
- We cannot say what the weather will be like on 6th April 2099, but we can be sure that on average it will be much warmer in the 2090s than today if greenhouse gas concentrations continue to rise

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- **Adaptation** vs **Mitigation ?**

3) Adaptation to climate change

- **Adaptation** vs **Mitigation**
- **Adaptation** and **mitigation** present some notable **differences**, particularly in their objectives.
- **Mitigation** addresses the causes of **climate change** (accumulation of greenhouse gases **in the** atmosphere), whereas **adaptation** addresses the impacts of **climate change**. Both approaches are needed.

3) Adaptation to climate change

What is decision support ?

- Climate change decision support refers to **organized efforts to produce, disseminate, and facilitate the use of data and information in order to improve the quality and efficacy of climate-related decisions** (NRC 2009, Informing Decisions in a Changing Climate).
- National adaptation plans: assess people and countries vulnerabilities for a better adaptation

3) Adaptation to climate change

Decision Making: Priority Setting

No Regrets: benefits regardless of climate change

Low Regrets: important benefits with little additional cost or risk

Win-Win: reduce climate change impacts and provide other benefits

Limitations: Especially at long term/emissions driven
Uncertainty incompletely specified
Difficult choices not addressed

Challenge:
Acting too soon vs. too late
Surprise vs. false alarms

3) Adaptation to climate change

Global Target: Curb greenhouse-gas emissions and limit global temperature increase to between 1.5 and 2 °C;

Limiting global warming to 1.5 °C above pre-industrial levels would be a herculean task, involving rapid, dramatic changes in how governments, industries and societies function, according to the Intergovernmental Panel on Climate Change (IPCC)

The world is on track for around 3 degrees of warming by the end of the century if it doesn't make major reductions in greenhouse-gas emissions. It could breach 1.5 °C some time between 2030 and 2052 if global warming continues at its current rate

3) Adaptation to climate change

Two degrees of warming could destroy ecosystems on around 13% of the world's land area, increasing the risk of extinction for many insects, plants and animals. Holding warming to 1.5 °C would reduce that risk by half.

"Without aggressive action, the world could become an almost impossible place for most people to live in"
Ove Hoegh-Guldberg, University of Queensland in St Lucia, Australia.

Measures include ramping up installation of renewable energy systems such as wind and solar power to provide 70–85% of the world's electricity by 2050, and expanding forests to increase their capacity to pull carbon dioxide from the atmosphere.

In summary:

-Statistical mean changes in mean precipitation, mean, min, max temperature and other variables for a given period (20-30 years) with respect to a reference period

- Statistical mean changes in the frequency and or intensity of extreme events for a given period (20-30 years) with respect to a reference period

- Long-term trend and changes in the variability

- Large uncertainties

-…(participants inputs)

- for building houses or infrastructures: use of better material
- identifying most vulnerable areas, provide extra medical assistance, informing and educating populations
- inform people before extreme events like heat waves
- at national level, implementation of platforms (National Adaptation Plans), identify vulnerable peoples and areas so we can make informed decisions for sound actions.
-Educate people on having good behavior/good practices in using energy, water,
- health : good practices
- Advocate governments to fund research (especially in Africa)

Acknowledgments

The slides were prepared with information mainly retrieved from :

- https://www.ncei.noaa.gov/news/weather-vs-climate
- https://www.youtube.com/watch?v=vH298zSCQzY
- https://www.nature.com/articles/d41586-018-06876-2

- Slides of Mouhamadou Bamba SYLLA; WASCAL Competence Center, Ouaga, Burkina Faso