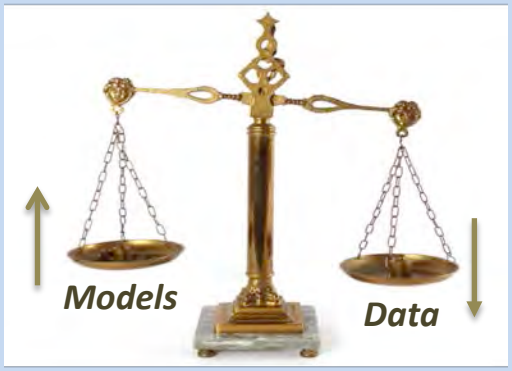
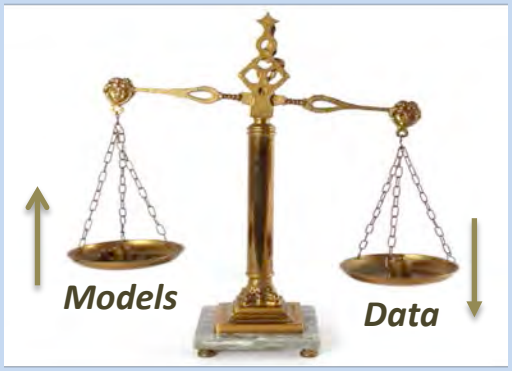


Let The Data Speak

Friends of Science
Annual Climate Science Event
October 2021

*Guus Berkhout**
President of CLINTEL
www.clintel.org

**www.aj-berkhout.com*



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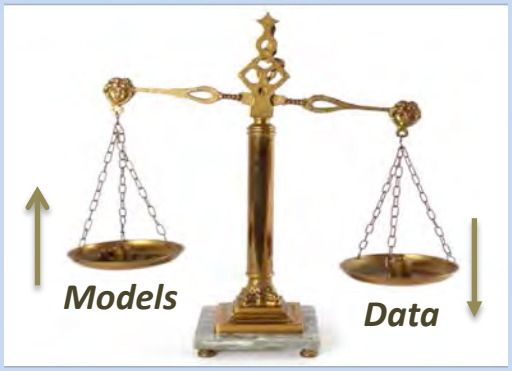

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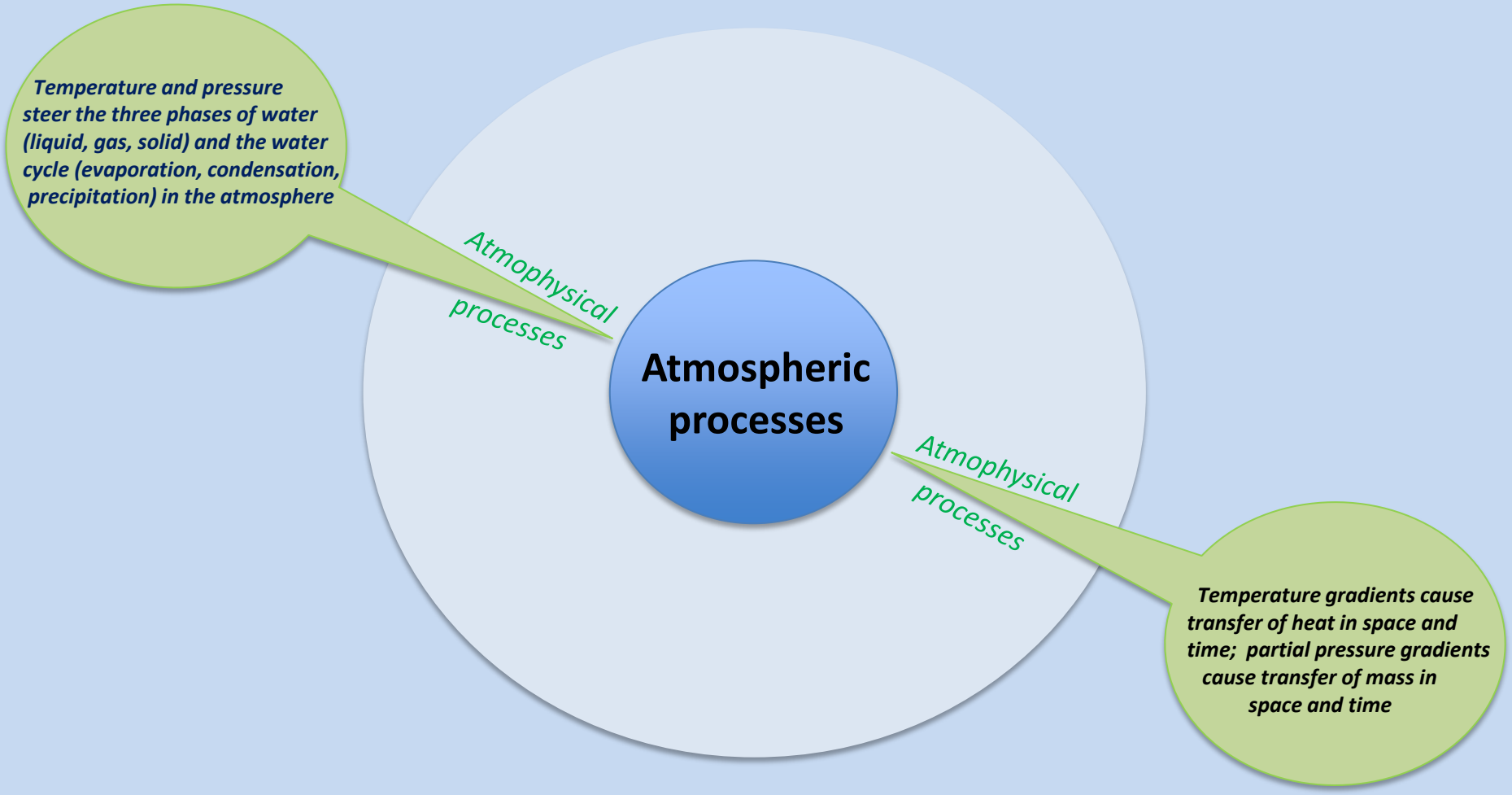
Part I:
Climate System of Planet Earth
The Big Picture

The Earth's atmosphere is a Chaos of moving Material and Energy*



** Is prediction and control of this chaos a scientific challenge or is it a Don Quichotte mission?*

Planet Earth's atmospheric processes are extremely complex (1)

Astrophysical processes

Outer space

Distance-dependent solar irradiation onto a moving, rotating and wiggling planet Earth

Transfer of *radiant energy**

Atmospheric processes

**Solar and cosmic irradiation, radiation back into space*

Planet Earth's atmospheric processes are extremely complex (2)

Astrophysical processes

Outer space

Transfer of *radiant energy*

Atmospheric processes

Contribution of *plate tectonics**

Inner earth

Geological processes

Dynamics in the Earth's mantle cause earthquakes, volcanic eruptions and heat plumes

**Continental drift, mountain building and oceanic trench formation*

Planet Earth's atmospheric processes are extremely complex (3)

Astrophysical processes

Outer space

Transfer of *radiant energy*

Thermohaline Circulation (THC)

Ocean system

Atmospheric processes

Contribution of *plate tectonics*

Inner earth

Geological processes

Planet Earth's atmospheric processes are extremely complex (pre-industrial)

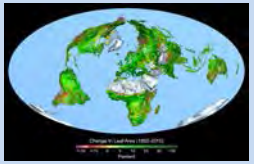
Astrophysical processes

Outer space

Gravitational forces

Gravitational forces

Transfer of *radiant energy*



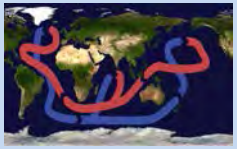
Thermohaline Circulation (THC)

Ocean system

Atmospheric processes

Land system

Bio- physical interaction



Tectonic forces

Contribution of *plate tectonics*

Tectonic forces

Inner earth

Geological processes

Planet Earth's atmospheric processes are extremely complex (today)

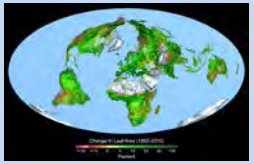
Astrophysical processes

Outer space

Gravitational forces

Gravitational forces

Transfer of *radiant energy*



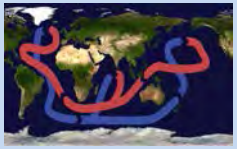
Thermohaline Circulation (THC)

Ocean system

Atmospheric processes

Land system

Bio- physical interaction



Anthropogenic processes

Tectonic forces

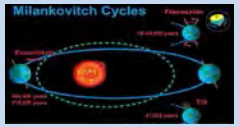
Contribution of *plate tectonics*

Tectonic forces

Inner earth

Geological processes

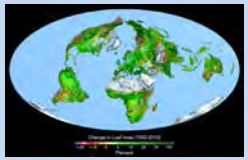
IPCC: Planet Earth's climate changes are caused by anthropogenic activities



Astrophysical processes

Even if the solar radiation is constant, the Earth is moving, rotating and wiggling

Surface condition



Industrial CO_2

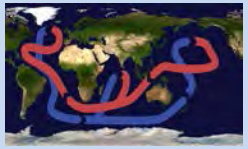
Terrestrial processes

Land-ocean system

Atmospheric processes

Anthropogenic system

Socio-economic processes



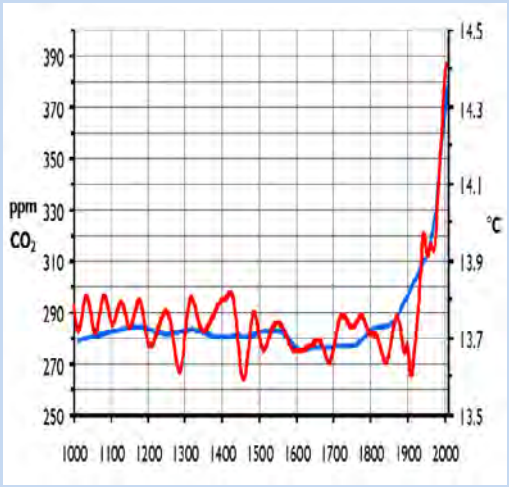
TH Circulation

Industrial smog

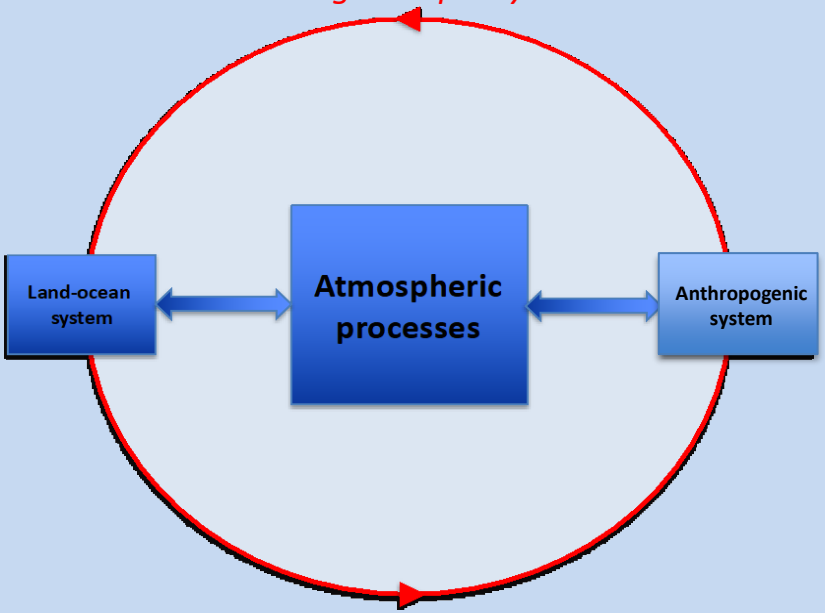
Even if the volcanic activities are zero, the Earth's mantle is full of activity

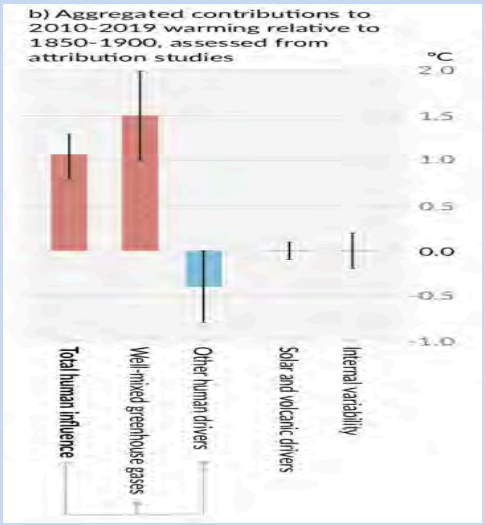
Geological processes

IPCC's hockey stick is back!



CMIP3 (2001), CMIP6 (2021)

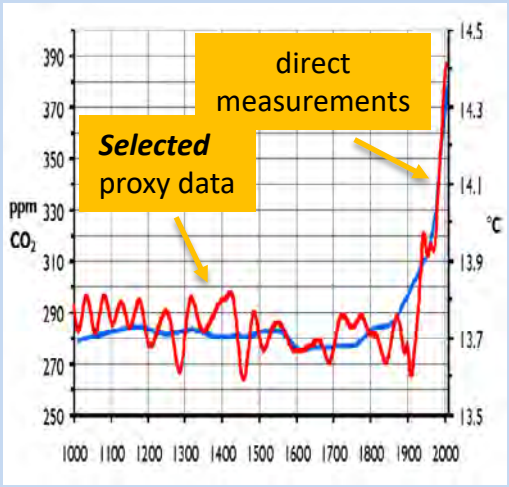




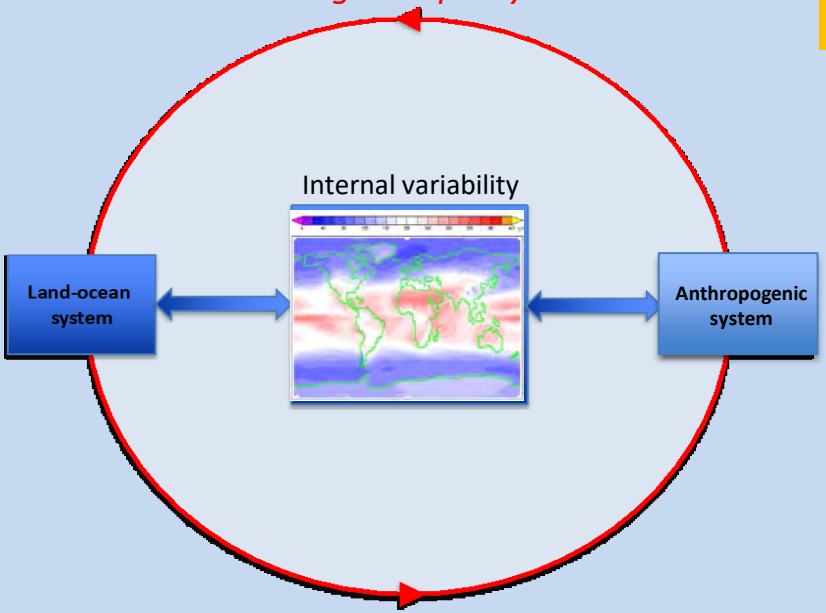
CMIP6 (2021)

According to IPCC, the Earth kept a constant temperature prior to 1900.
It is IPCC's key argument to 'proof' that more CO_2 causes global warming.

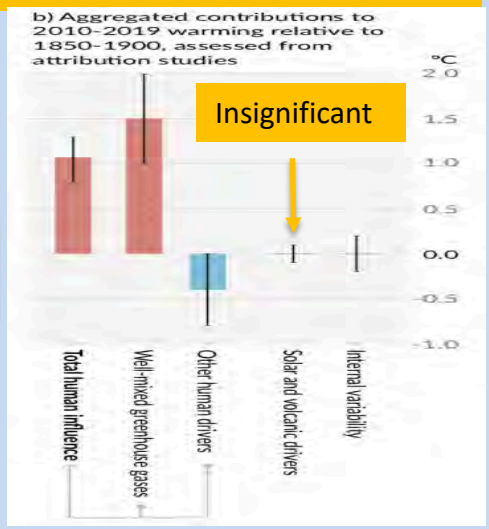
IPCC's hockey stick is back!



CMIP3 (2001), CMIP6 (2021)



No chapter on solar radiation

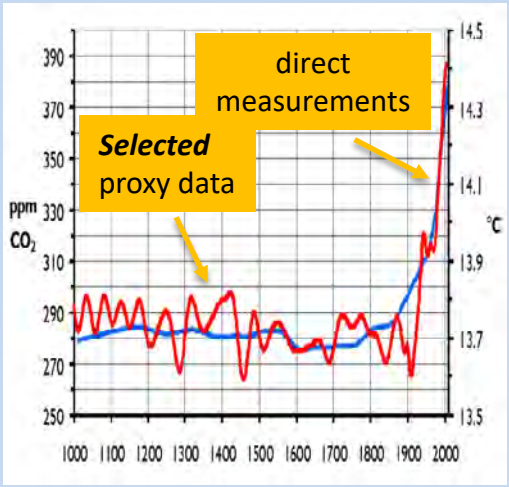


CMIP6 (2021)

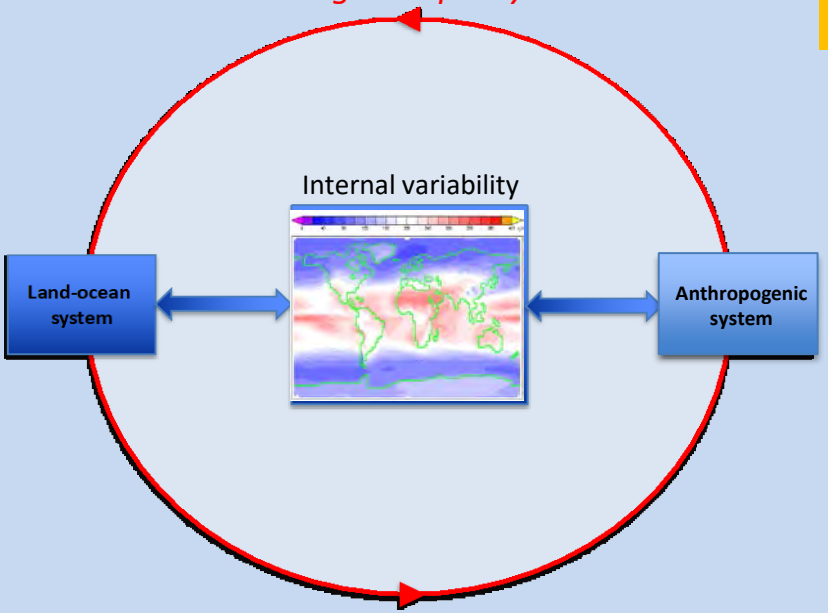
Another key argument in IPCC's proof:
Outer Space and Inner Earth don't play a role in climate change

IPCC's hockey stick is back!

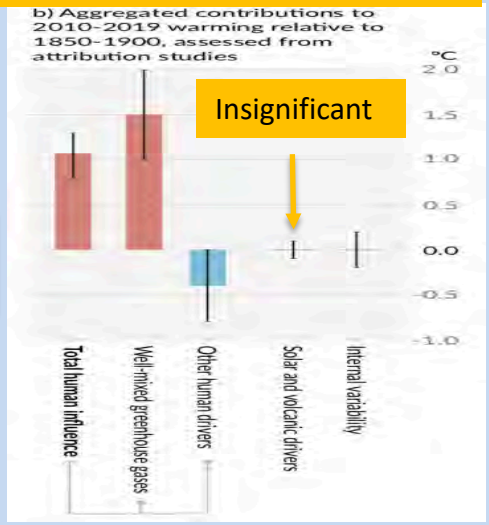
Note the temp scale



CMIP3 (2001), CMIP6 (2021)

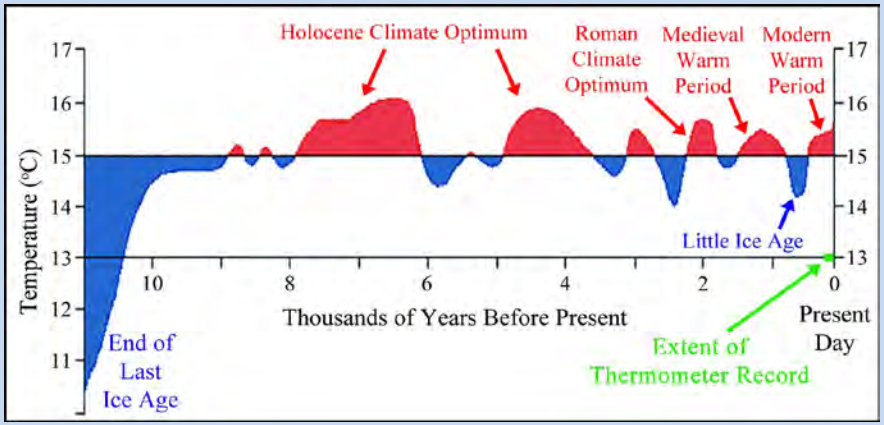


No chapter on solar radiation



CMIP6 (2021)

All proxy data for the past 10.000 yrs



Note the temp scale

Conclusions Part I

1. In the pre-industrial era – comprising 4^{+} billion years – climate change was driven by natural systems only:

outer space, inner earth, continents and oceans*

2. In the (post-)industrial era – comprising ≈200 years – climate change is also driven by an additional system:

the anthropogenic system

****Information on the changes in these systems are hidden in the geological archive***

Conclusions Part I

1. In the pre-industrial era – comprising 4^{+} billion years – climate change was driven by natural systems only:

   outer space, inner earth, continents and oceans

2. In the (post-)industrial era – comprising ≈200 years – climate change is also driven by an additional system:

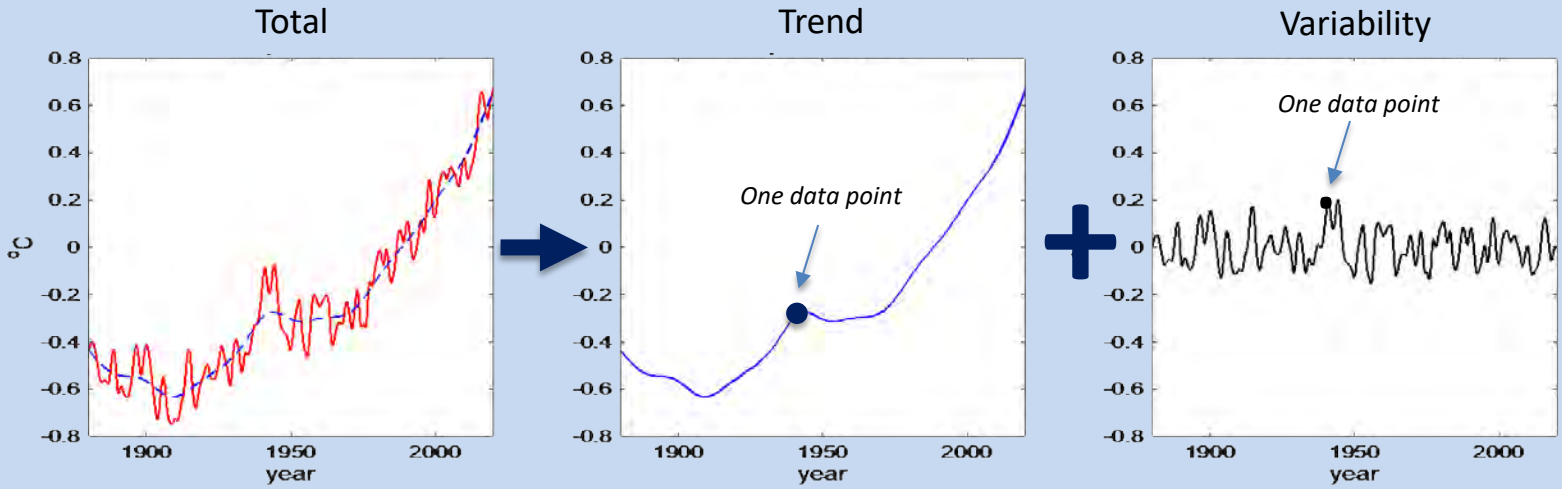
   the anthropogenic system

3. IPCC assumes that the contribution of the natural systems are marginal and that the global warming is primarily human made. However,

   valid scientific arguments have not yet been published

Part II:
Unfolding Global averages

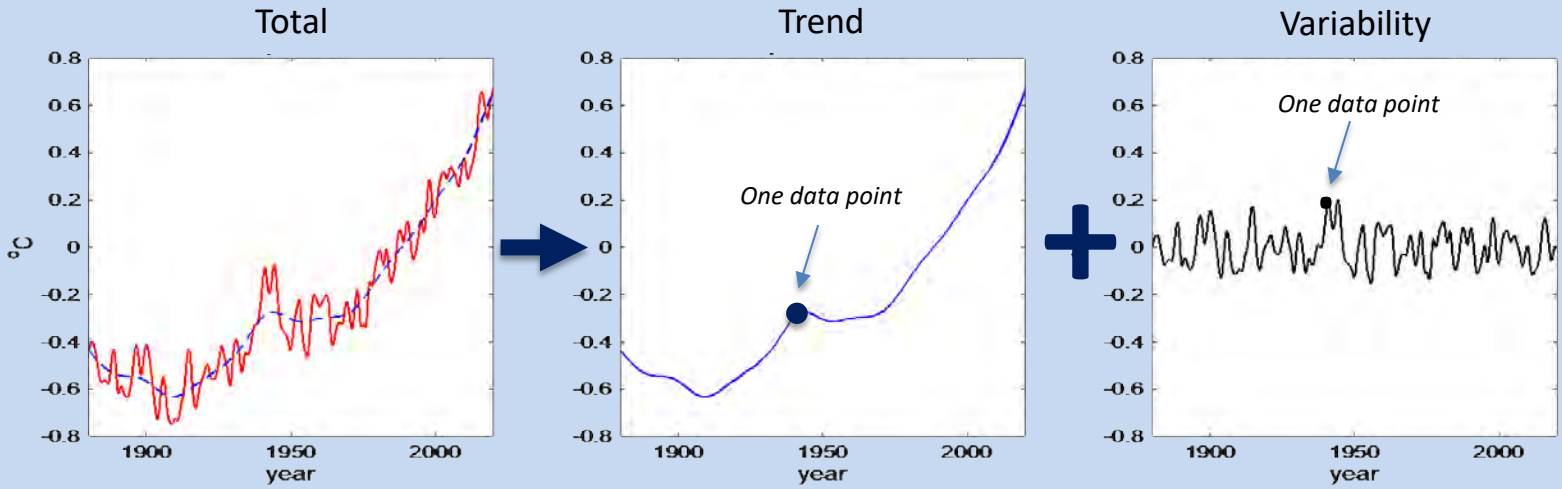
Globally Averaged Temperatures (1880 – 2020)*



Total graph has been decomposed into trend and variability
The trend curve represents the well-known Global Warming curve

*** NOAA global surface temperatures***

Globally Averaged Temperatures (1880 – 2020)



One data point represents the mean of 'all' local temperatures on our planet:

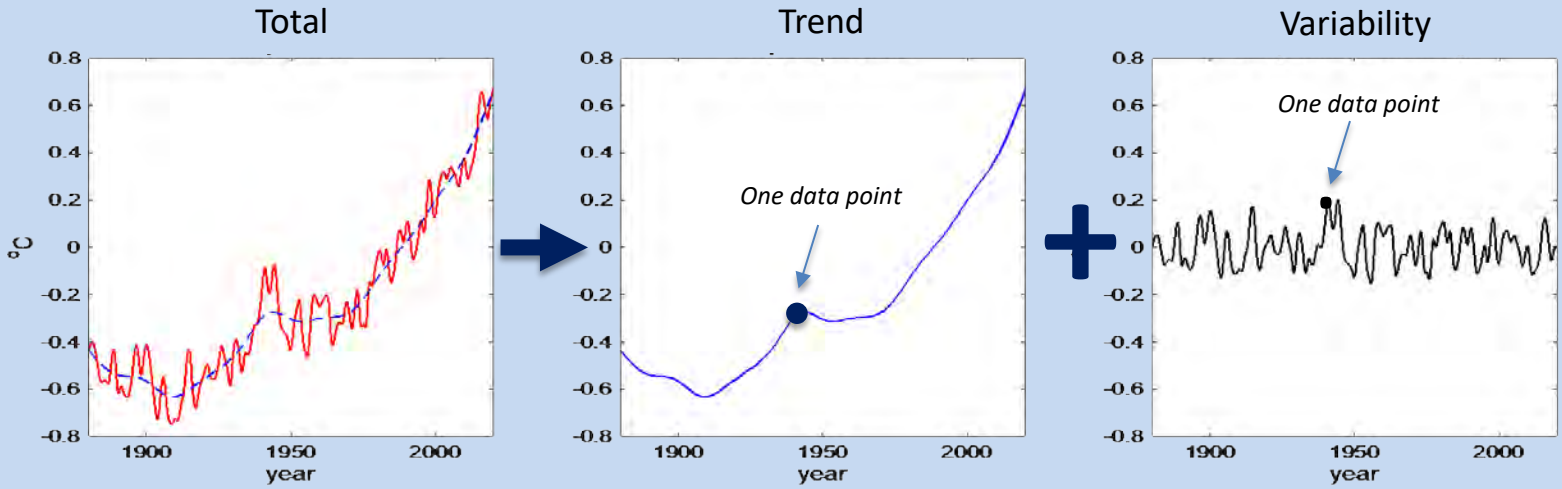
Spatial distribution of data points has a significant influence on the global mean

Earth's surface area is 510 million km²

Temperature sampling is sparse and irregular

(global mean)

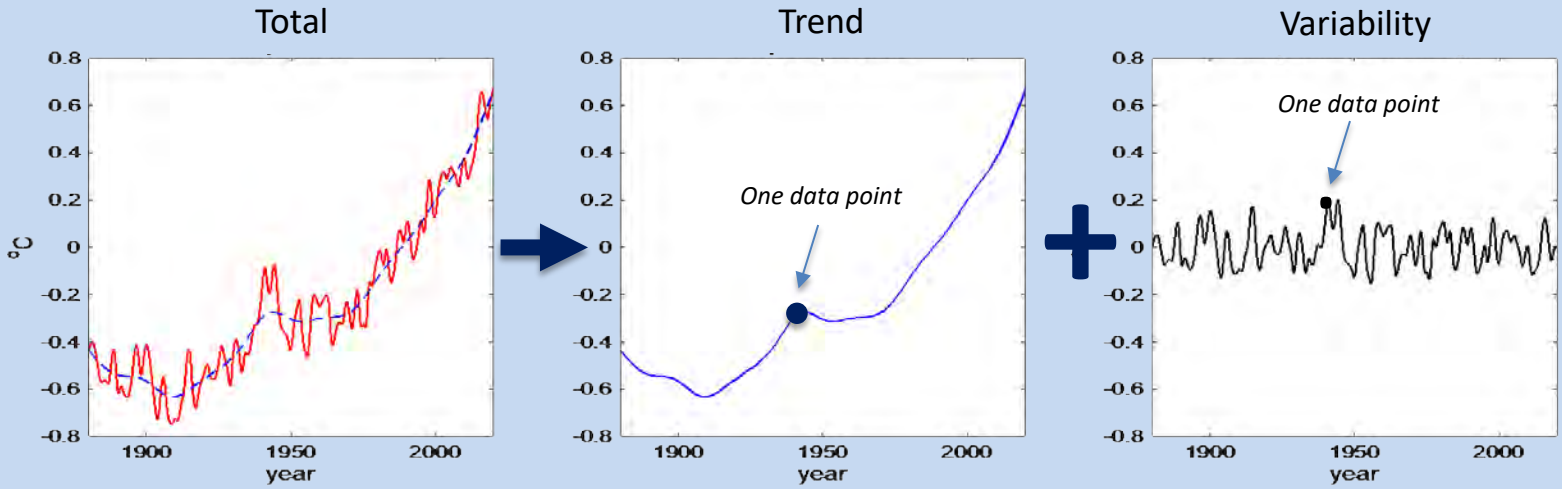
Globally Averaged Temperatures (1880 – 2020)



- **One data point represents the mean of 'all' local temperatures on our planet**
- **If the local temperatures differ significantly, averaging removes a lot of information that is indispensable in climate research:**

In practice, the averaging process is often a black box!

Globally Averaged Temperatures (1880 – 2020)



- **One data point represents the mean of ‘all’ local temperatures on our planet**
- **If the local temperatures differ significantly, averaging removes a lot of information that is indispensable for climate research**
- **The big emphasis on global averages may explain the modest scientific progress in the past 40 years**

In the following, we have a look at the temperature differences around the globe

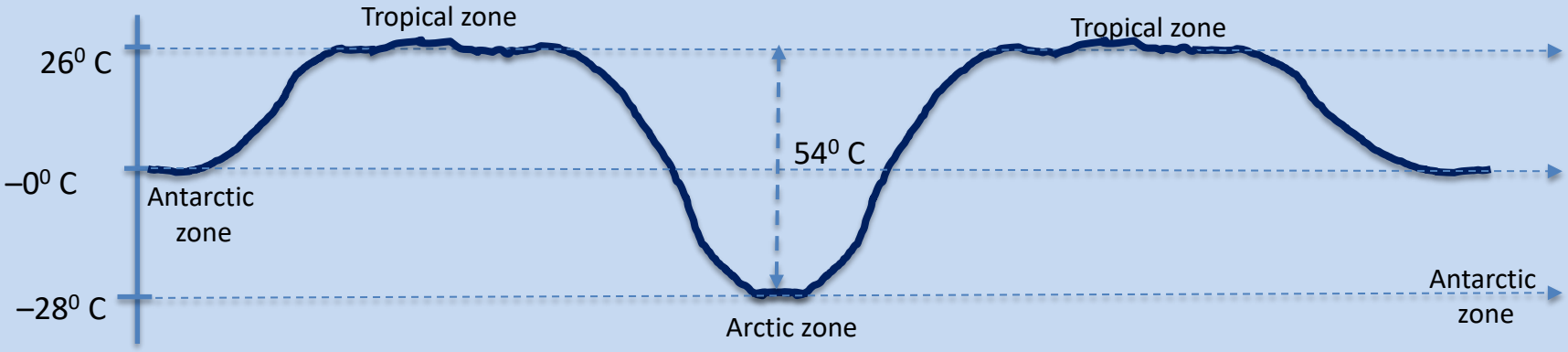
Temperature Journey around the Globe (1)

Summer trip: ***from the North Pole via the Equator to the South Pole and back via the Equator to the North Pole***

Longitudinal →

Temperature changes along a circle of longitude are huge:
– 0⁰ C to +26⁰ C to – 28⁰ C
(CO_2 distribution is around 420 ppm!)

summer



Look at the large temperature differences we find during our summer trip!

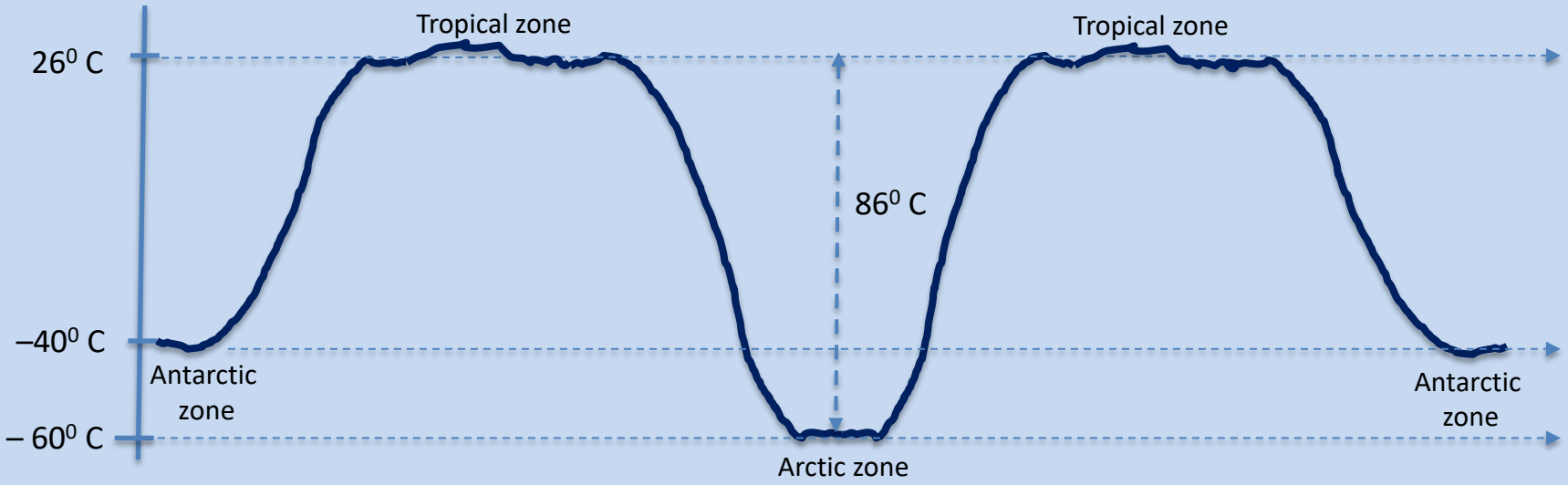
Temperature Journey around the Globe (2)

Winter trip: ***from the North Pole via the Equator to the South Pole and back via the Equator to the North Pole***

Longitudinal →

Temperature changes along a circle of longitude are huge:
– 40⁰ C to +26⁰ C to – 60⁰ C
(CO_2 distribution is around 420 ppm!)

winter

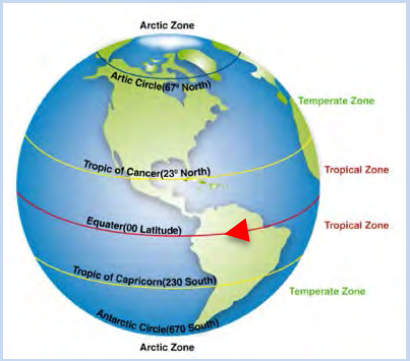


Look at the even larger temperature differences we find during our winter trip!

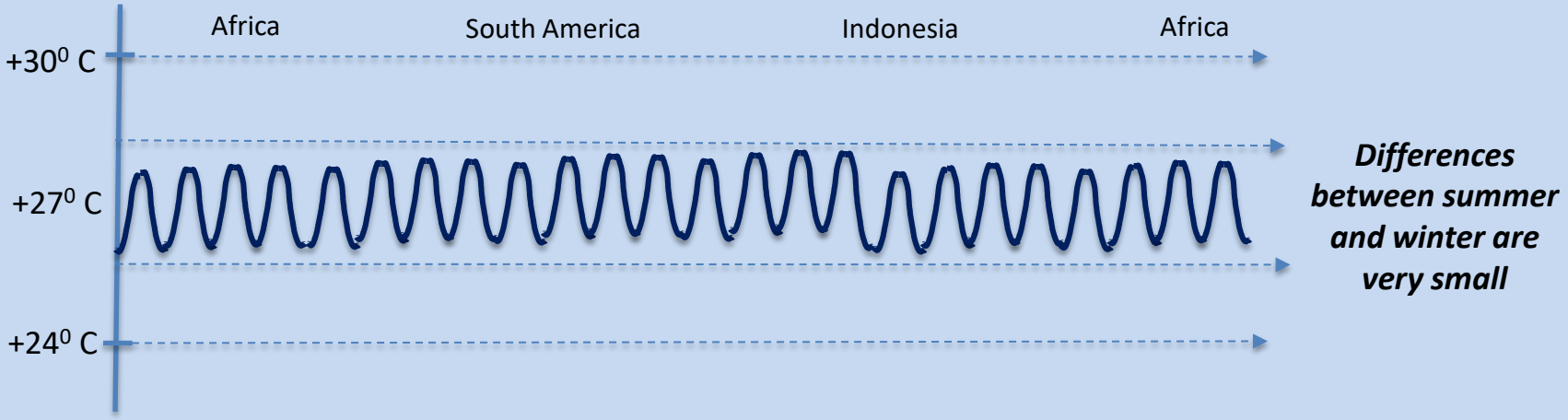
Temperature Journey around the Globe (3)

Equator trip (E-W): ***from Africa via Atlantic Ocean to South America and via Pacific Ocean to Indonesia and back via the Indian Ocean to Africa***

Equator →



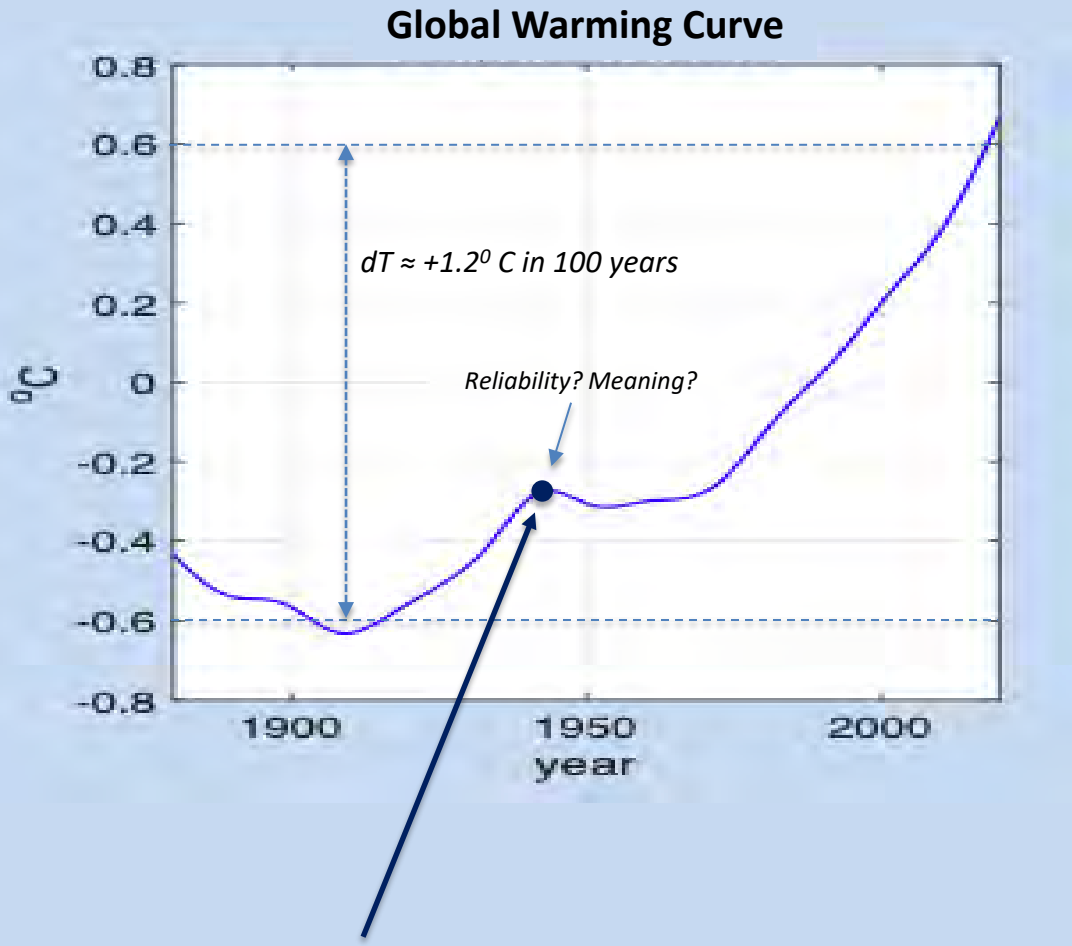
Annual average temperature changes along a circle of latitude are small:
+27± 1⁰ C
along the Equator



Differences between summer and winter are very small

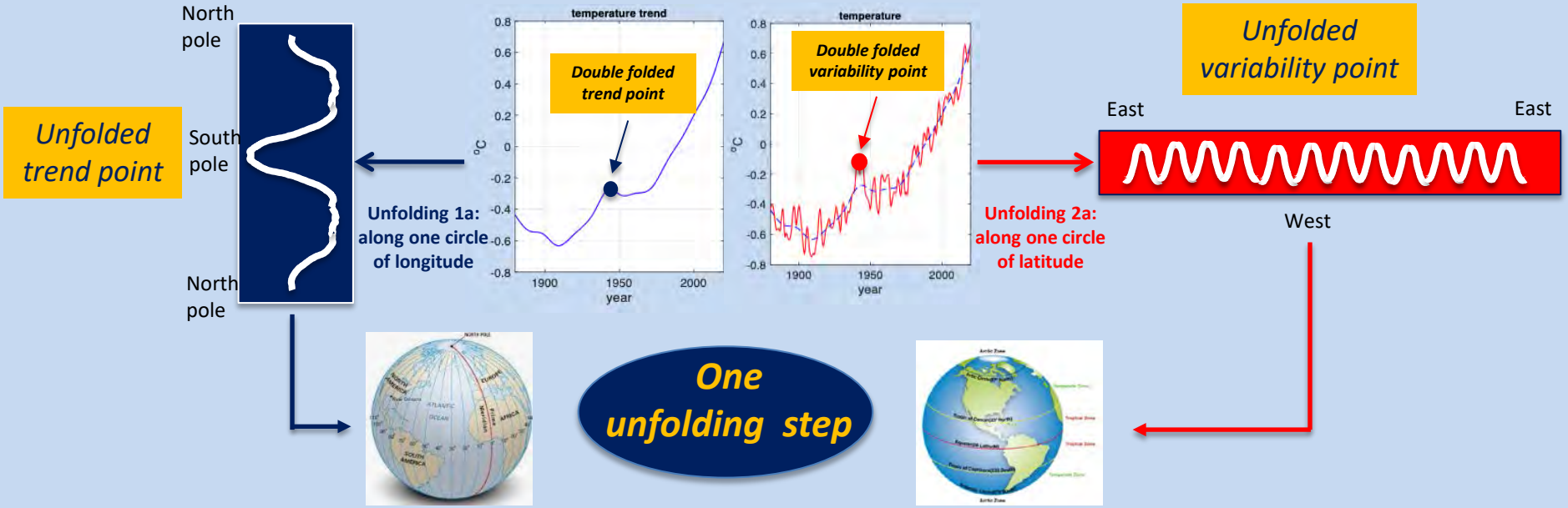
Look at the mild temperature differences we find along the Equator!

Temperature Journey around the Globe (4)



Double average of sparsely, irregularly sampled data with inner changes of about 50⁰ C!

Single *un*folding of global averages

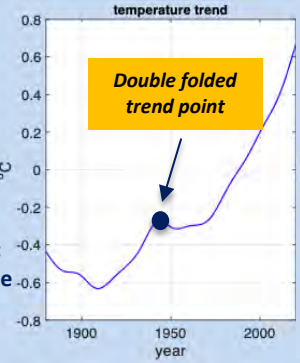


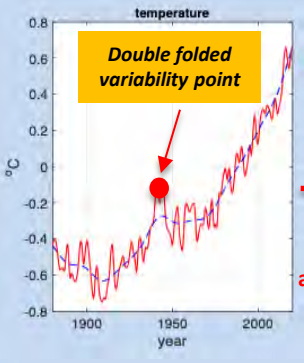
Transformation of a single data point into a N-S and E-W data curve by single 'unfolding' (temperature as example)

Double *un*folding of global averages

Unfolded trend point

Unfolding 1a: along one circle of longitude



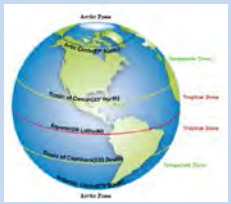


Unfolding 2a: along one circle of latitude

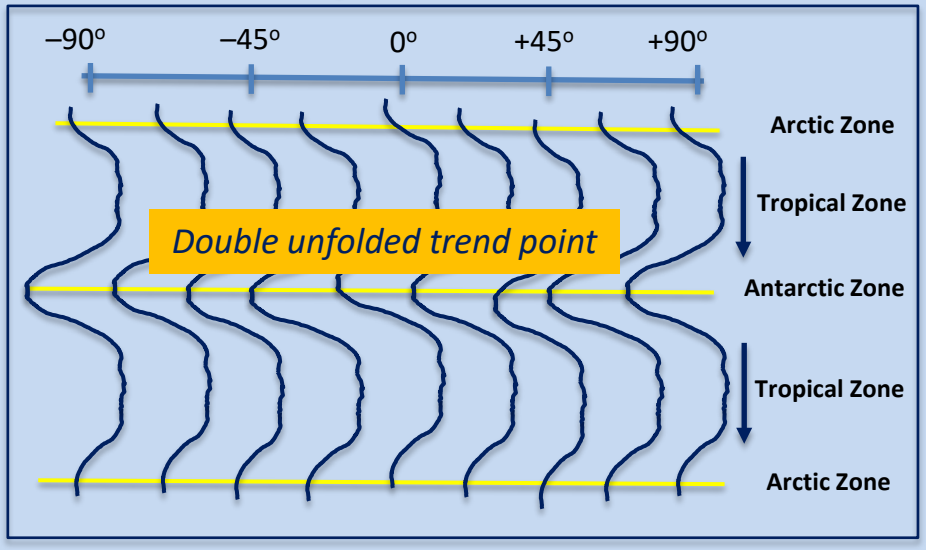
Unfolded variability point

Unfolding 1b: along many circles of longitude

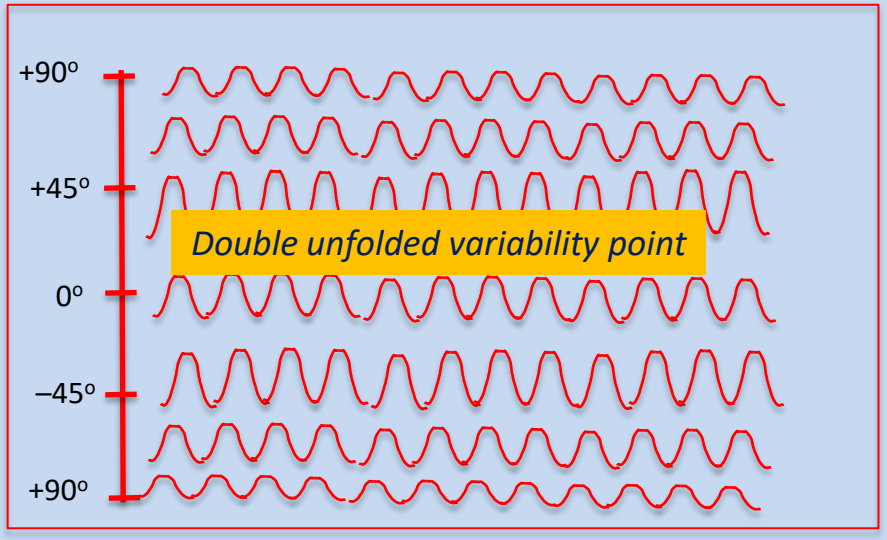
Two unfolding steps



Unfolding 2b: along many circles of latitude



Gather of *N-S* **trend** curves around the planet (N-S image)

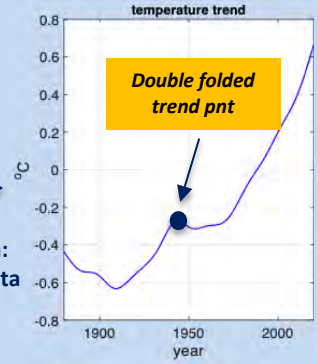


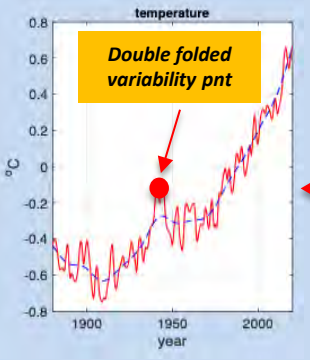
Gather of *E-W* **variability** curves around the planet (E-W image)

Double folding into global averages

Folded N-S trend curve

Folding 1a: into one data point



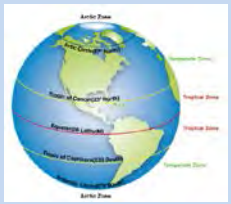


Folding 2a: into one data point

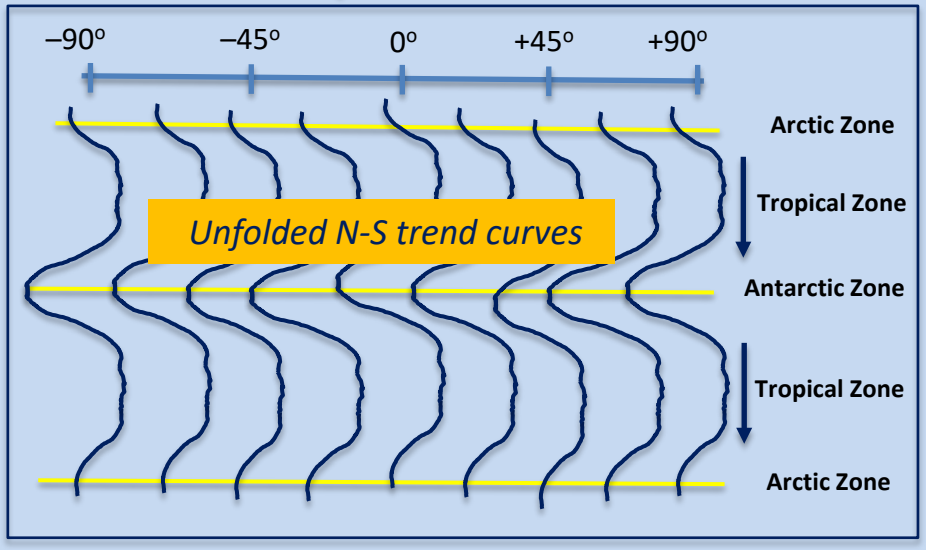
Folded E-W variability curve

Folding 1b: onto one circle of longitude

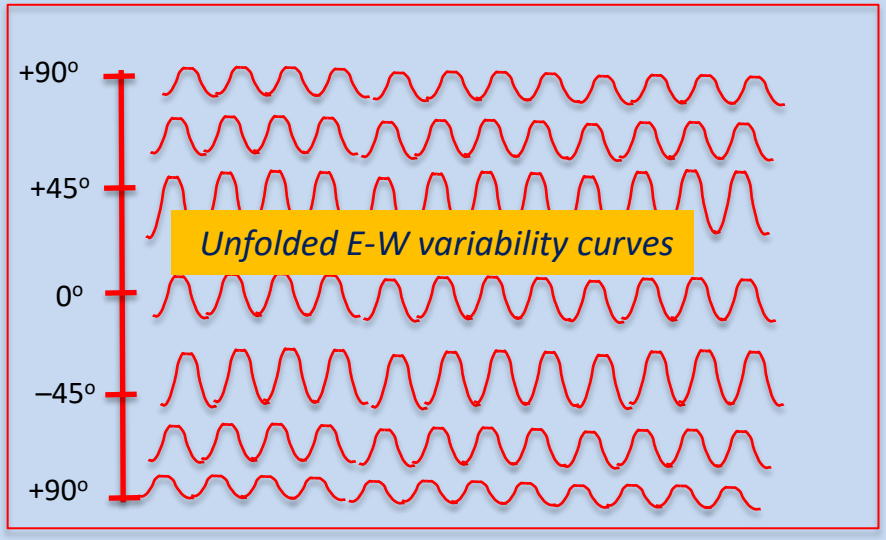
Two folding steps



Folding 2b: onto one circle of latitude



Gather of *N-S* **trend** curves around the planet (N-S image)



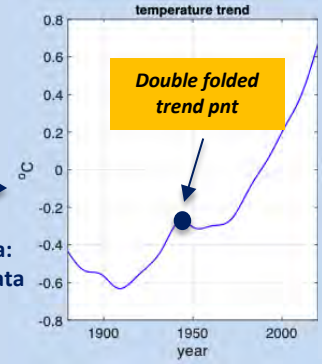
Gather of *E-W* **variability** curves around the planet (E-W image)

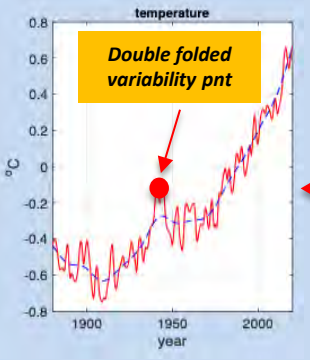
Tens of degrees versus Tenths of degrees

Folded N-S trend curve

≈ 60⁰ C

Folding 1a: into one data point

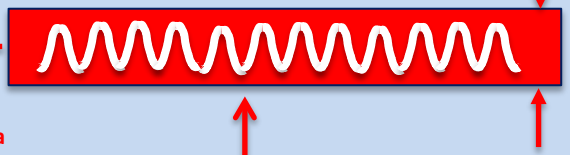




Folding 2a: into one data point

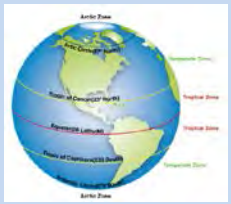
Folded E-W variability curve

± 2⁰ C

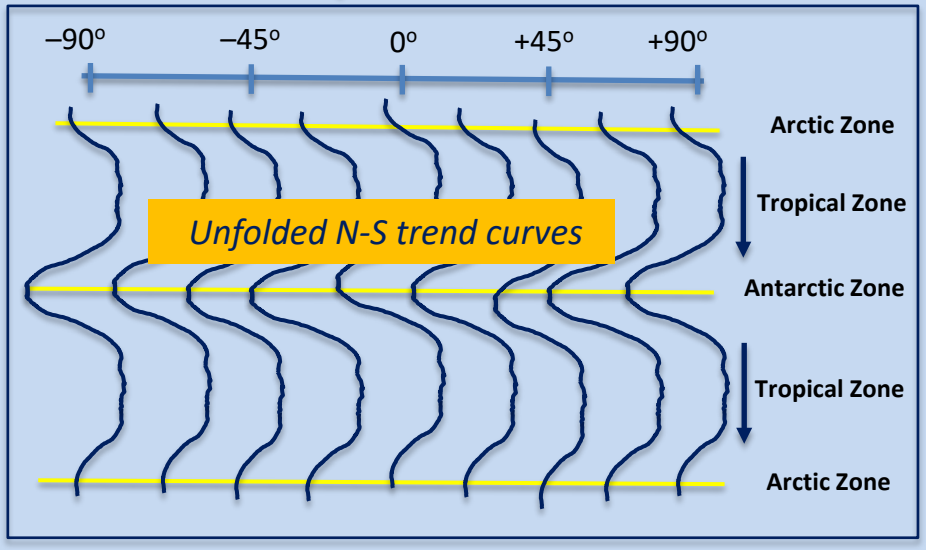


Folding 1b: onto one circle of longitude

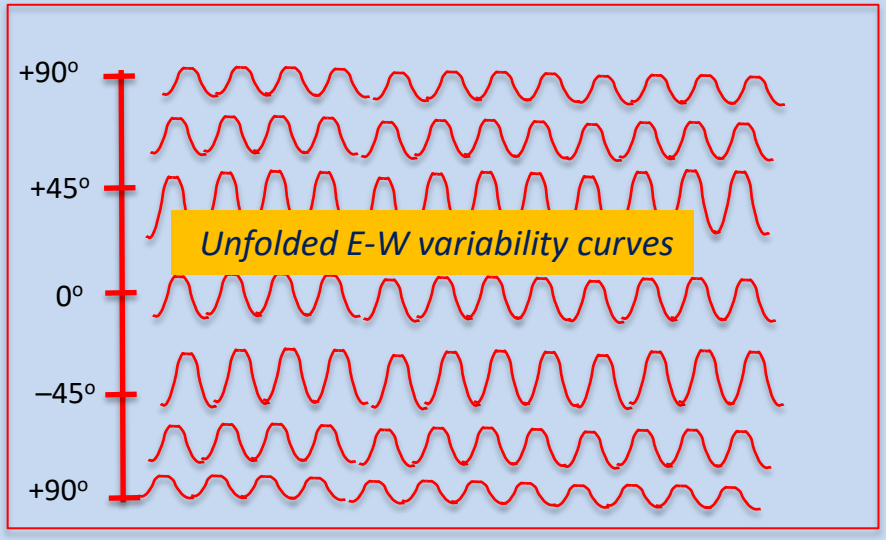
Two folding steps



Folding 2b: onto one circle of latitude



Gather of *N-S* **trend** curves around the planet (N-S image)



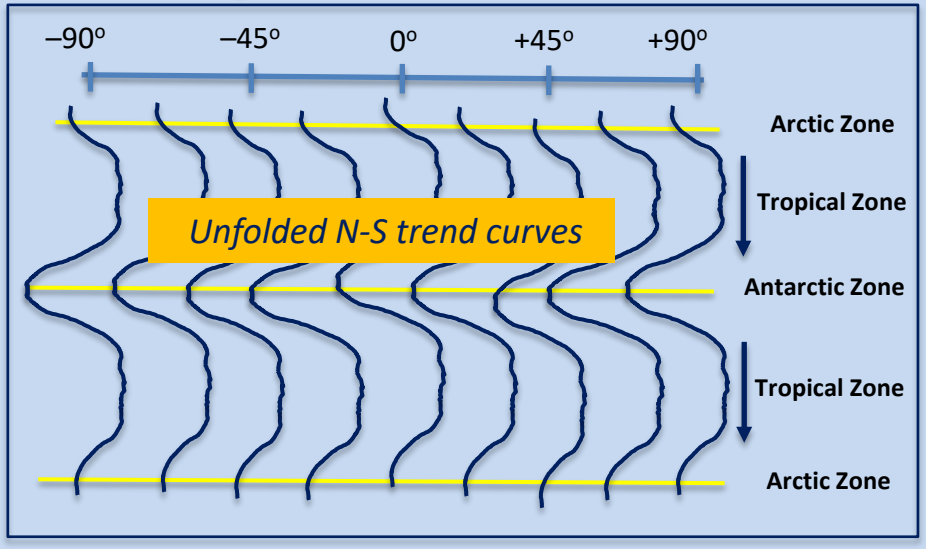
Gather of *E-W* **variability** curves around the planet (E-W image)

Rich Sources of Information

Temperature, humidity, precipitation, wind force

Changes along the circles of longitude are primarily caused by differences in *solar* irradiation in *Watt/m²*

Differences are huge

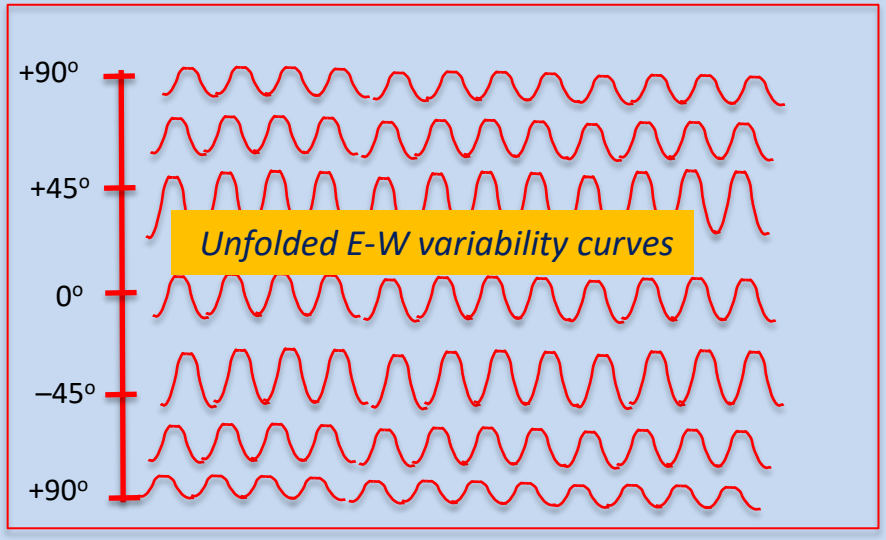


Gather of *N-S* **trend** curves around the planet (N-S image)

Differences are mild

Temperature, humidity, precipitation, wind force

Changes along the circles of latitude are primarily caused by differences in *land-ocean* conditions: humidity on land / THC in oceans

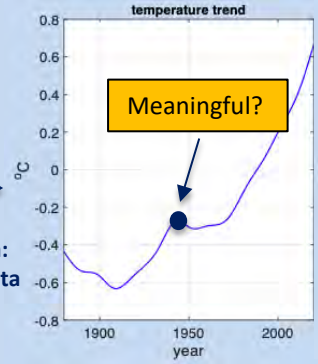


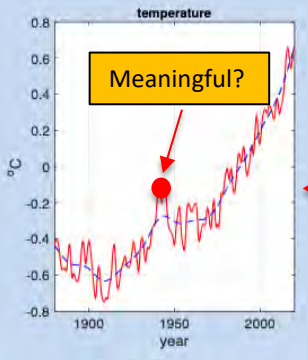
Gather of *E-W* **variability** curves around the planet (E-W image)

Where is the Information?

Information for solar

Folding 1a: into one data point



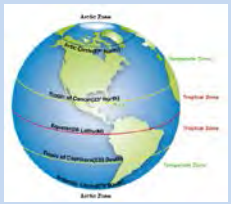


Folding 2a: into one data point

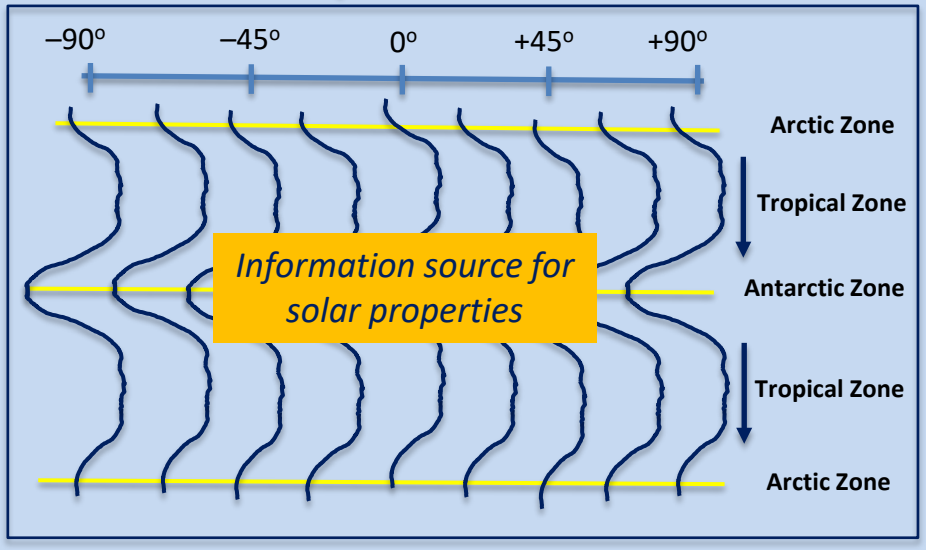
Information for land-ocean

Folding 1b: onto one circle of longitude

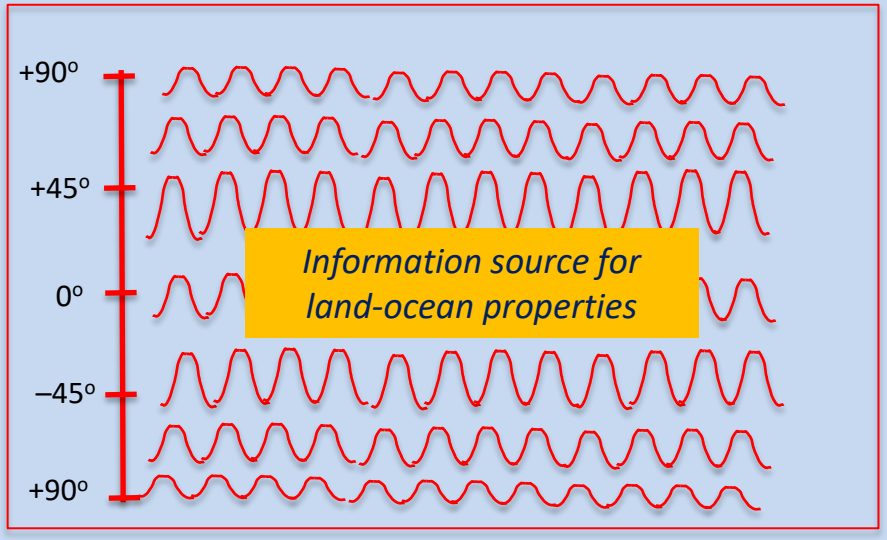
Two folding steps



Folding 2b: onto one circle of latitude



Gather of *N-S* **trend** curves around the planet (N-S image)



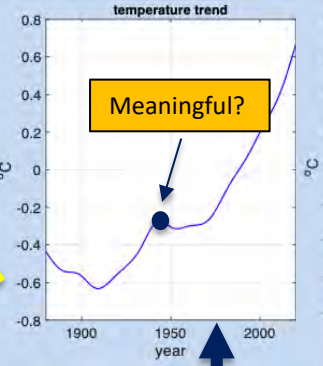
Gather of *E-W* **variability** curves around the planet (E-W image)

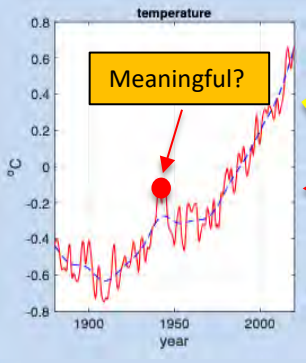
Information Killers

Information for solar

IK #1

Folding 1a: onto one data point





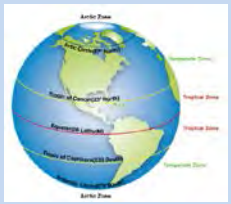
IK #2

Folding 2a: onto one data point

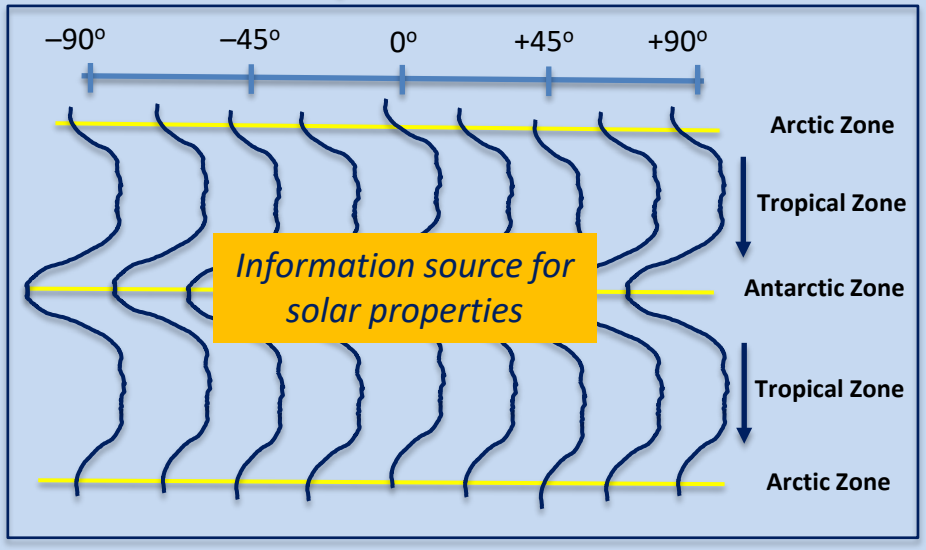
Information for land-ocean

Folding 1b: onto one circle of longitude

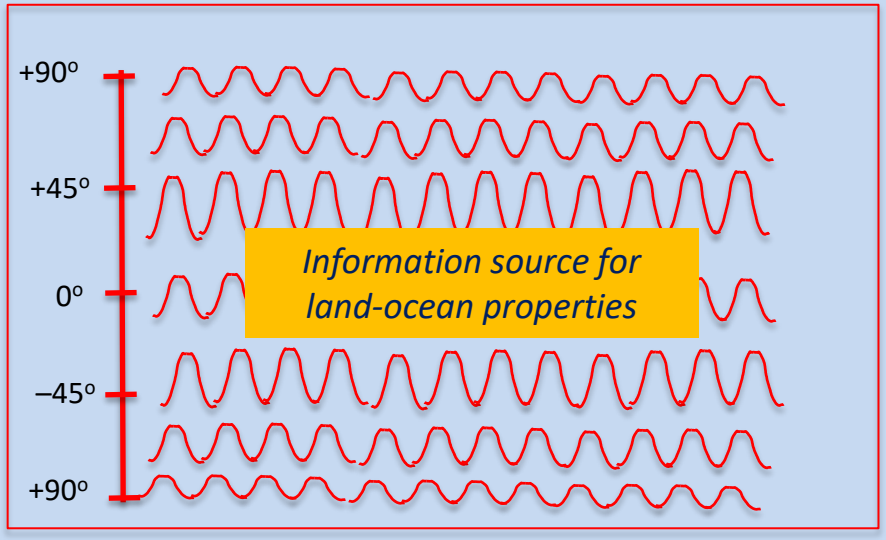
Past 40 yrs ≈ all discussions were based on double global averages!



Folding 2b: onto one circle of latitude



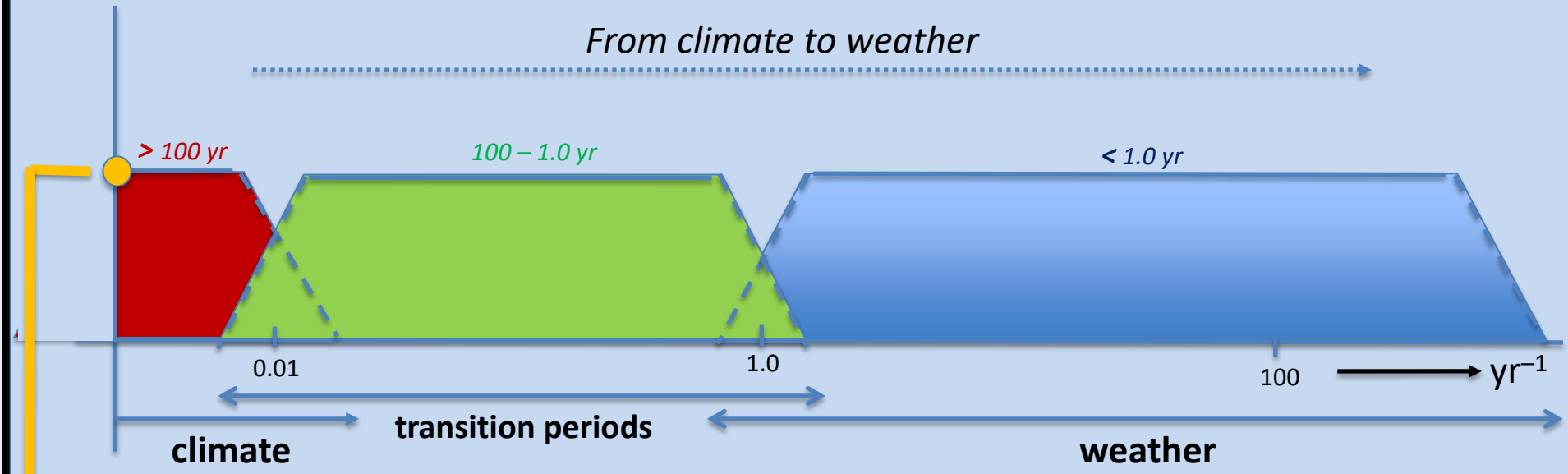
Gather of *N-S* **trend** curves around the planet (N-S image)

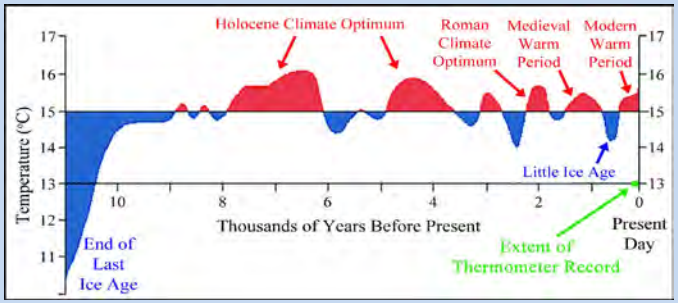


Gather of *E-W* **variability** curves around the planet (E-W image)

To end Part II,
let us make a few short remarks
on multi-scale analysis

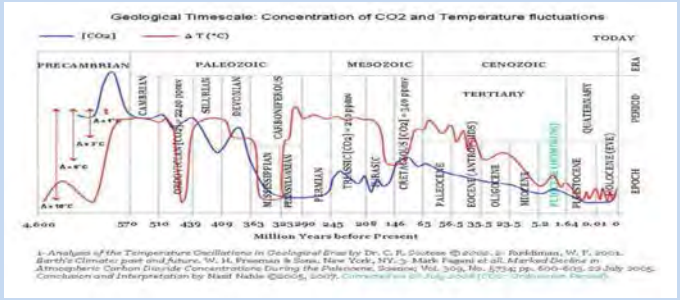
Multi-scale Analysis in Time





Holocene → Epoch

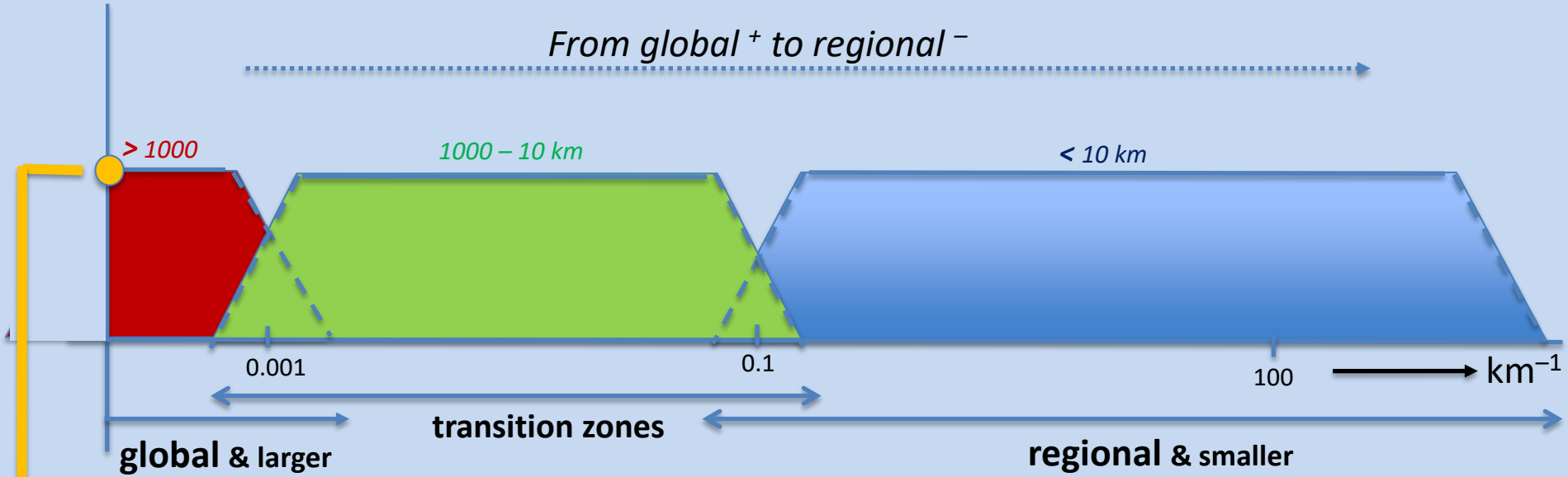
- *Reliable weather forecast: few days*
- *Age of IPCC: 33 yr*
- *Industrial period: 250 yr*
- *Post MWP period: 1000 yr*
- *Post Ice Age period : 10.000 yr*



All geological → Epochs

- *Milankovitch cycle: 100.000 yr*
- *Post Cambrium period: 550 million yr*
- *Age of planet Earth: 4.6 billion yr*
- *Age of the Universe: 13.8 billion yr*

Multi-scale Analysis in Space



Distance between Oslo and Rome: 2500 km

Distance between Northern and Southern Tropics: 5500 km

Distance between North Pole and Equator: 10.000 km

Length of Equator: 40.000 km

Distance to Top of Atmosphere (TOA): 10 km

Distance between Earth and Moon: 384.000 km

Distance between Earth and Sun: 150 million km

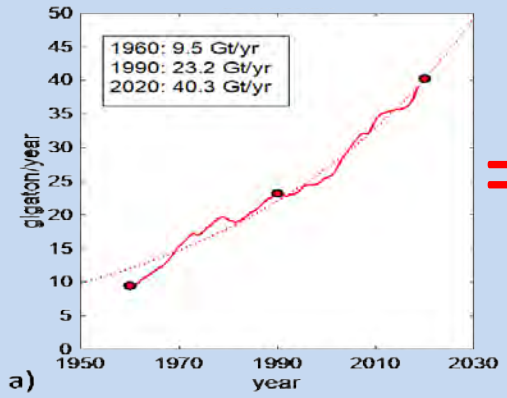
Distance between Earth and Proxima Centauri: 4.2 lightyear

Unlike temperature, CO_2 is well distributed in the Earth's atmosphere, meaning that the double averaging process has a mild influence

Let us have a closer look

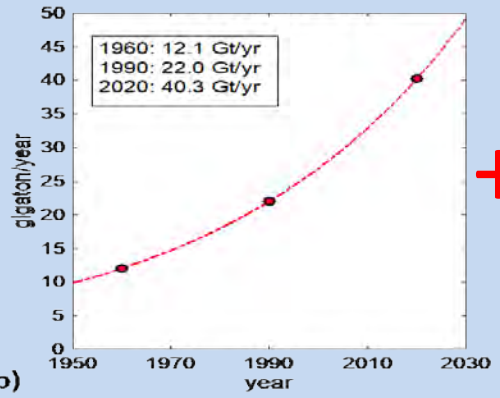
Trends and variability in the CO_2 system (1960 - 2020)

Total



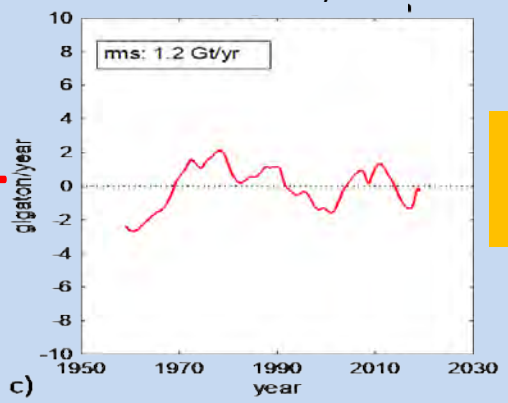
=

Trend



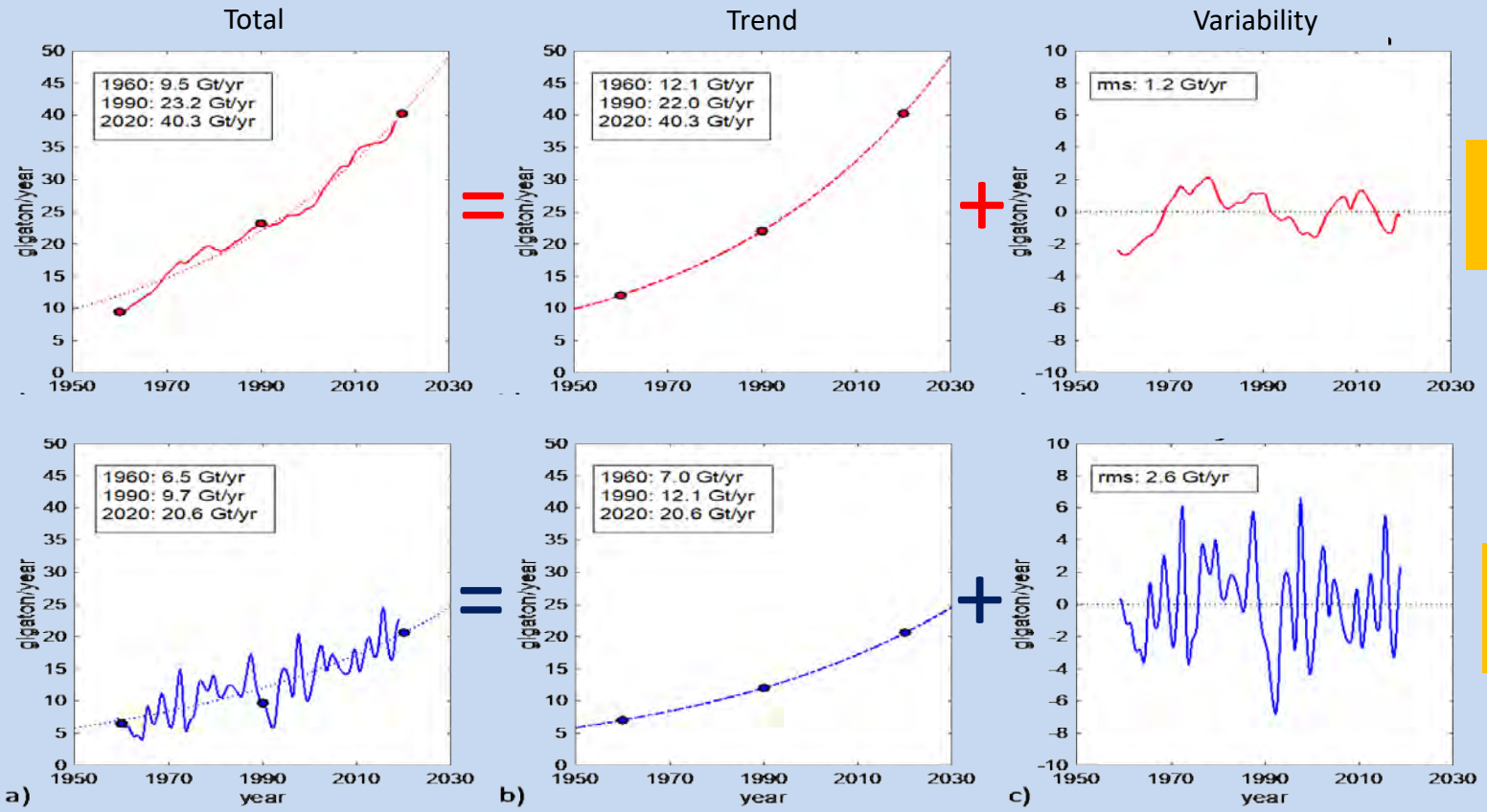
+

Variability



Anthropogenic emission

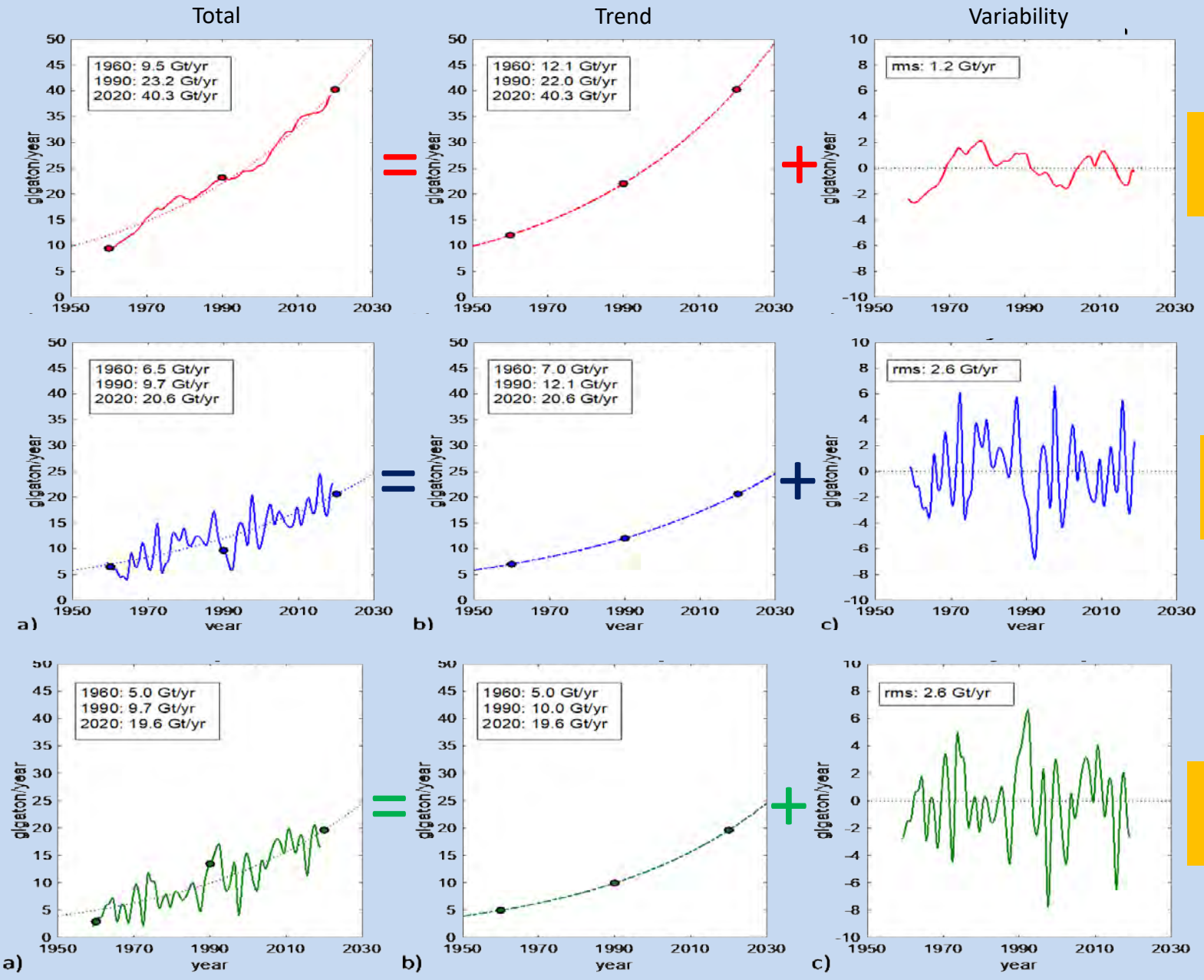
Trends and variability in the CO_2 system (1960 - 2020)



Anthropogenic emission

Atmospheric accumulation

Trends and variability in the CO_2 system (1960 - 2020)



Anthropogenic emission

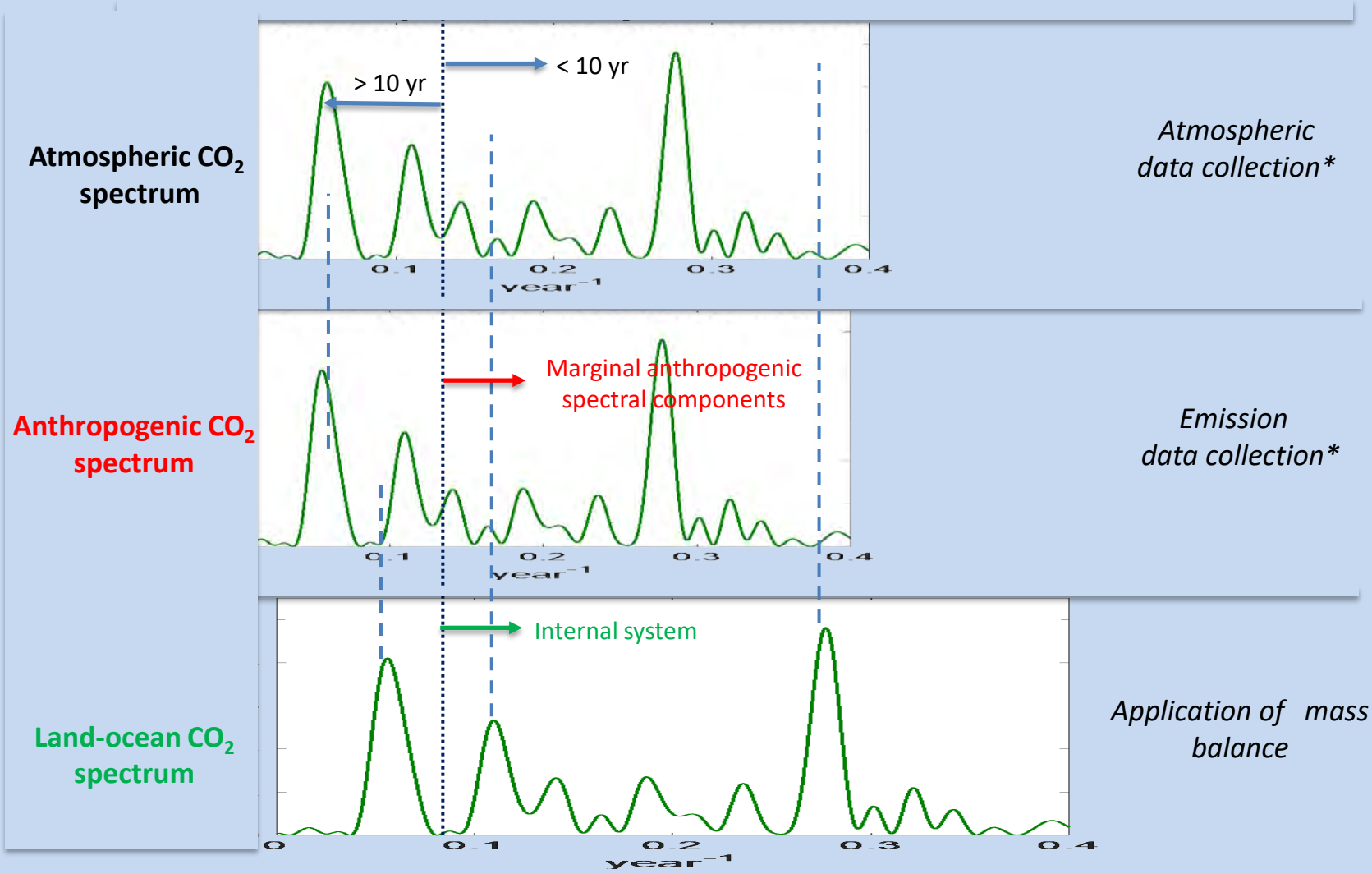
=

Atmospheric accumulation

+

Land-ocean absorption

Spectral property of CO_2 variabilities



Variations with smaller time periods than 10 yr are caused by internal oscillations between the atmosphere and the land-ocean system

**Data collection methods are fully independent*

Part II: Conclusions

- **The double data averaging process is:**
  1. **an information-killing practice (significant changes are averaged out)**
  2. **most sensitive to how observations are collected, selected and pre-processed**

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- **The double data averaging process is:**
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  2. **most sensitive to how observations are collected, selected and pre-processed**

- **High resolution observations ought to be gathered along*:**
  1. **circles of longitude ('North-South image')**
  2. **circles of latitude ('East-West image')**

  Climate scientists should show their modeling results by unfolded images

**Information-based choice, combined with intelligent interpolation*

Part II: Conclusions

- **The double data averaging process is:**
  1. **an information-killing practice (significant changes are averaged out)**
  2. **most sensitive to how observations are collected, selected and pre-processed**

- **High resolution observations ought to be gathered along:**
  1. **circles of longitude ('North-South image')**
  2. **circles of latitude ('East-West image')**

- **Multi-scale analysis of these unfolded images consists of:**
  1. **decomposition[1)] into trends and variabilities (temporal and spatial)**
  2. **decomposition[2)] into spectral components (temporal and spatial)**

  Information on causality can be found in the temporal variabilities.

[1)] of total data [2)] of variability data

Part II: Conclusions

- The double data averaging process is:
  1. an information-killing practice (significant changes are averaged out)
  2. most sensitive to how observations are collected, selected and pre-processed

- High resolution observations ought to be gathered along:
  1. circles of longitude ('North-South image')
  2. circles of latitude ('East-West image')

- Multi-scale analysis of these unfolded images consists of:
  1. decomposition into trends and variabilities (temporal and spatial)
  2. decomposition into spectral components (temporal and spatial)

- Spectral analysis of the CO_2 system reveals that variations with periods between ≈1 and ≈10 yr are dominated by relatively strong internal oscillations between the atmosphere and the land-ocean system.

Part III
The Road Ahead

- **In Part II, I made a plea to improve our data collection and data analysis practices:**

  unfolded and multi-scale

- **To realize this goal, I propose to establish an international* scientific research facility:**

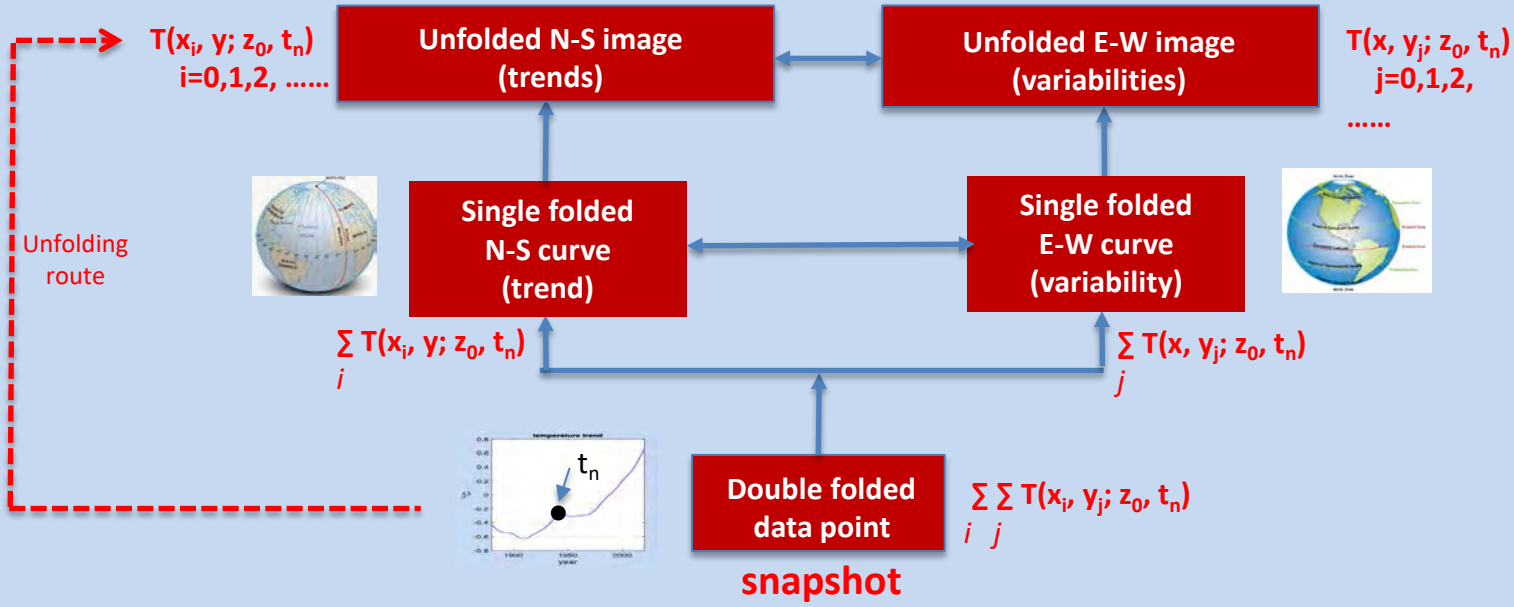
  Laboratory of Climate Imaging (LCI Int)

  that will execute Climate Imaging Research in an objective and truly open manner

** Not Intergovernmental, but International!*

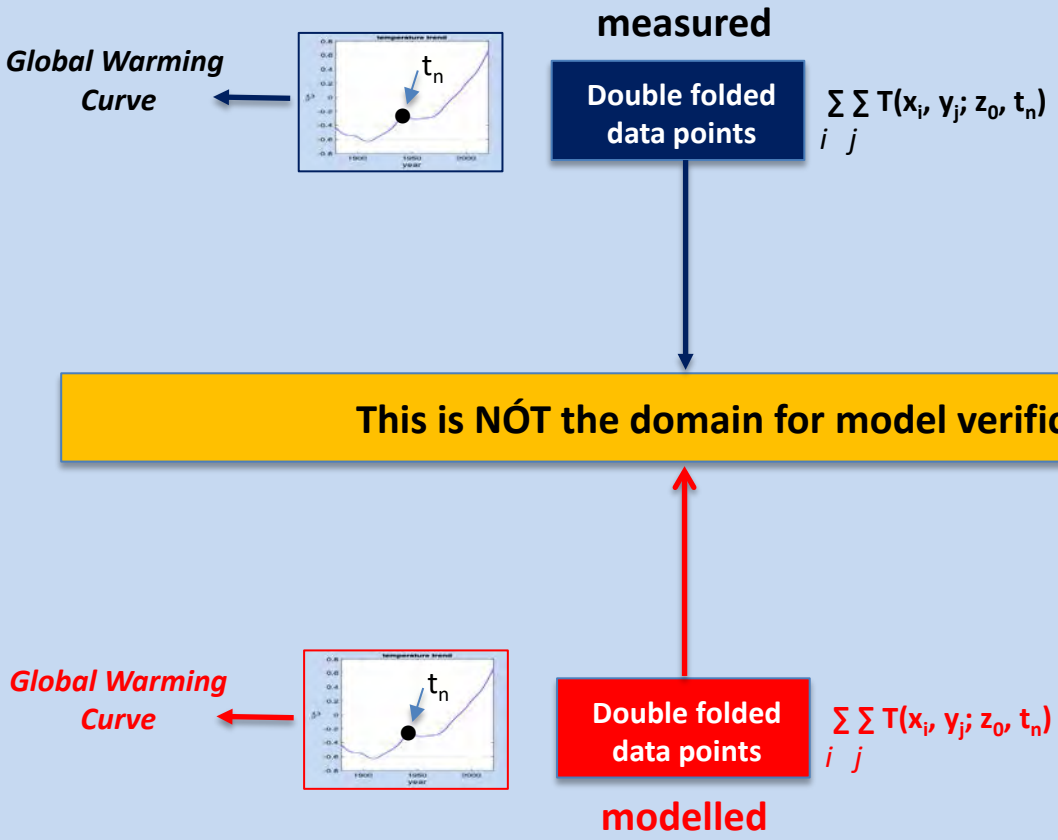
LCI will show the scientific advantages of constructing and analyzing unfolded N-S and E-W images

LCI will invite IPCC to simulate unfolded N-S and E-W images



snapshot
Double folded data point
$\sum_i \sum_j T(x_i, y_j; z_0, t_n)$
t_n
$\sum_i T(x_i, y; z_0, t_n)$
$\sum_j T(x, y_j; z_0, t_n)$
Unfolding route
Single folded N-S curve (trend)
Single folded E-W curve (variability)
measured
$T(x_i, y; z_0, t_n)$ i=0,1,2, ...
Unfolded N-S image (trends)
Unfolded E-W image (variabilities)
$T(x, y_j; z_0, t_n)$ j=0,1,2, ...
This is the domain for model verification: unfolded images
$T(x_i, y; z_0, t_n)$ i=0,1,2, ...
Unfolded N-S image (trends)
Unfolded E-W image (variabilities)
$T(x, y_j; z_0, t_n)$ j=0,1,2, ...
Unfolding route
Single folded N-S curve (trend)
Single folded E-W curve (variability)
modelled
$\sum_i T(x_i, y; z_0, t_n)$
$\sum_j T(x, y_j; z_0, t_n)$
t_n
Double folded data point
$\sum_i \sum_j T(x_i, y_j; z_0, t_n)$
snapshot
LCI Int

Stop with model verification in the *double* averaged domain



Knowledge about causality requires the phase information in variabilities

Phase information is very sensitive to averaging

LCI Int
snapshot
Double folded data point
$\sum_i \sum_j T(x_i, y_j; z_0, t_n)$
Output errors
$\sum_i T(x_i, y; z_0, t_n)$
$\sum_j T(x, y_j; z_0, t_n)$
Folding errors
Single folded N-S curve (trend)
Single folded E-W curve (variability)
measured
$T(x_i, y; z_0, t_n)$ i=0,1,2, ...
Unfolded N-S image (trends)
Unfolded E-W image (variabilities)
$T(x, y_j; z_0, t_n)$ j=0,1,2, ...
Input errors
This is the domain for model verification: unfolded images
Input assumptions
$T(x_i, y; z_0, t_n)$ i=0,1,2, ...
Unfolded N-S image (trends)
Unfolded E-W image (variabilities)
$T(x, y_j; z_0, t_n)$ j=0,1,2, ...
Folding errors
Single folded N-S curve (trend)
Single folded E-W curve (variability)
modelled
$\sum_i T(x_i, y; z_0, t_n)$
$\sum_j T(x, y_j; z_0, t_n)$
Output errors
Double folded data point
$\sum_i \sum_j T(x_i, y_j; z_0, t_n)$
snapshot

LCI Int will be an open imaging lab:

- All sources of input data are published*
- All *LCI* algorithms are released
- All scientists are invited to reconstruct the *LCI* results and suggest improvements

**Avoid mixing proxy data with direct measurements*
Avoid mixing surface data with satellite observations

LCI Int will be an open imaging lab:

- All sources of input data are published
- All *LCI* algorithms are released
- All scientists are invited to reconstruct the *LCI* results and suggest improvements
- *LCI* priority 1: To find out how the global averaging is done in mainstream climate publications
  LCI priority 2: To derive multi-scale causality relationships from unfolded variability data

We start a worldwide crowd funding campaign to finance the imaging activities of *LCI*:

1. **Every global citizen and organization is most welcome to donate**

2. **Well-to-do sympathizers will be approached with the request to double all incoming donations**

Regularly, a progress report will be sent to each donator

LCI Int

Let the Data Speak

scientific

integrity

IPCC

Let the Models Speak

I invite IPCC to cooperate with us in a scientific endeavor to explore the secrets of the Earth's climate system, using the following CLINTEL beliefs:

- ***Full openness on modeling assumptions and data accuracy is a *conditio sine qua non***
- ***Repeatability of research results is a must**
- ***Alternative scientific views are indispensable**

LCI Int

Let the Data Speak

scientific

integrity

IPCC

Let the Models Speak

In addition, in the capacity of president of CLINTEL I invite Universities worldwide to cooperate with us according to CLINTEL's Magna Carta Universitatum 2020. In our Magna Carta a plea is made to freely discuss dissenting climate views.

On behalf of the CLINTEL scientists, I would like to close with the following wish:

"I sincerely hope that a joint theoretical-empirical journey will bring us faster and closer to the scientific truth"