TEIJIN
Human Chemistry, Human Solutions

THE GLOBAL HEAT SUPPLY / DEMAND BALANCE

AND

THE GLOBAL HEAT INVENTORY AND FLOW ANALYSIS

Ton Runneboom

Teijin limited

Kasumigaseki Common Gate West Tower

2-1, Kasumigaseki 3-Chome

Chiyoda-Ku

Tokyo 100-8585

www.Teijin.co.jp

Gordon Feller

Urban Age Institute

870 Estancia

San Rafael

CA 94903

USA

If you want to manage the CO_2 in the atmosphere ..

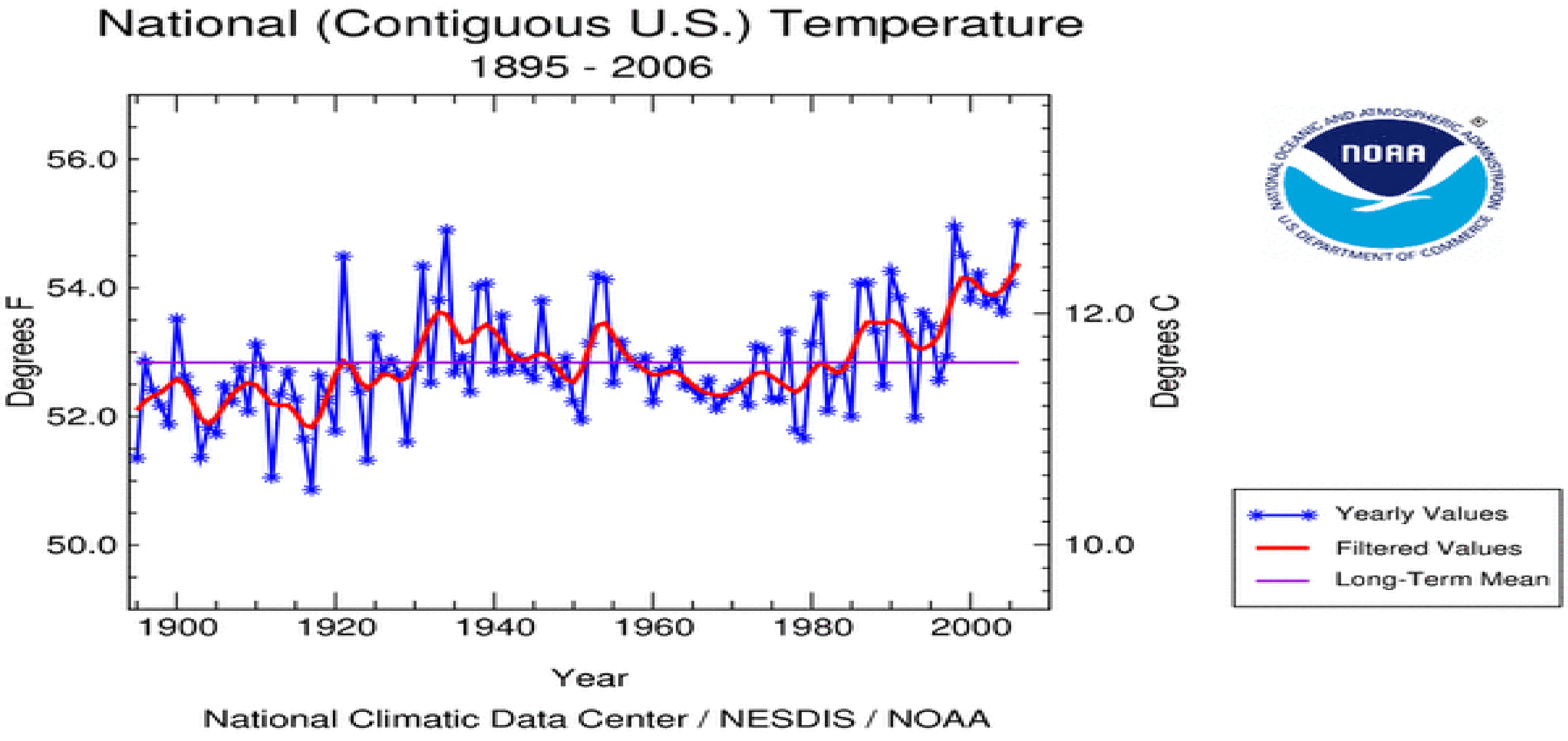
Make a global CO_2 Supply / Demand balance
and
Analyze the Inventories and Flows of CO_2

If you want to manage global warming in the atmosphere …

Make a global Heat Supply / Demand balance
and
Analyze the Inventories and Flows of Heat

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance



Global Heat Balance

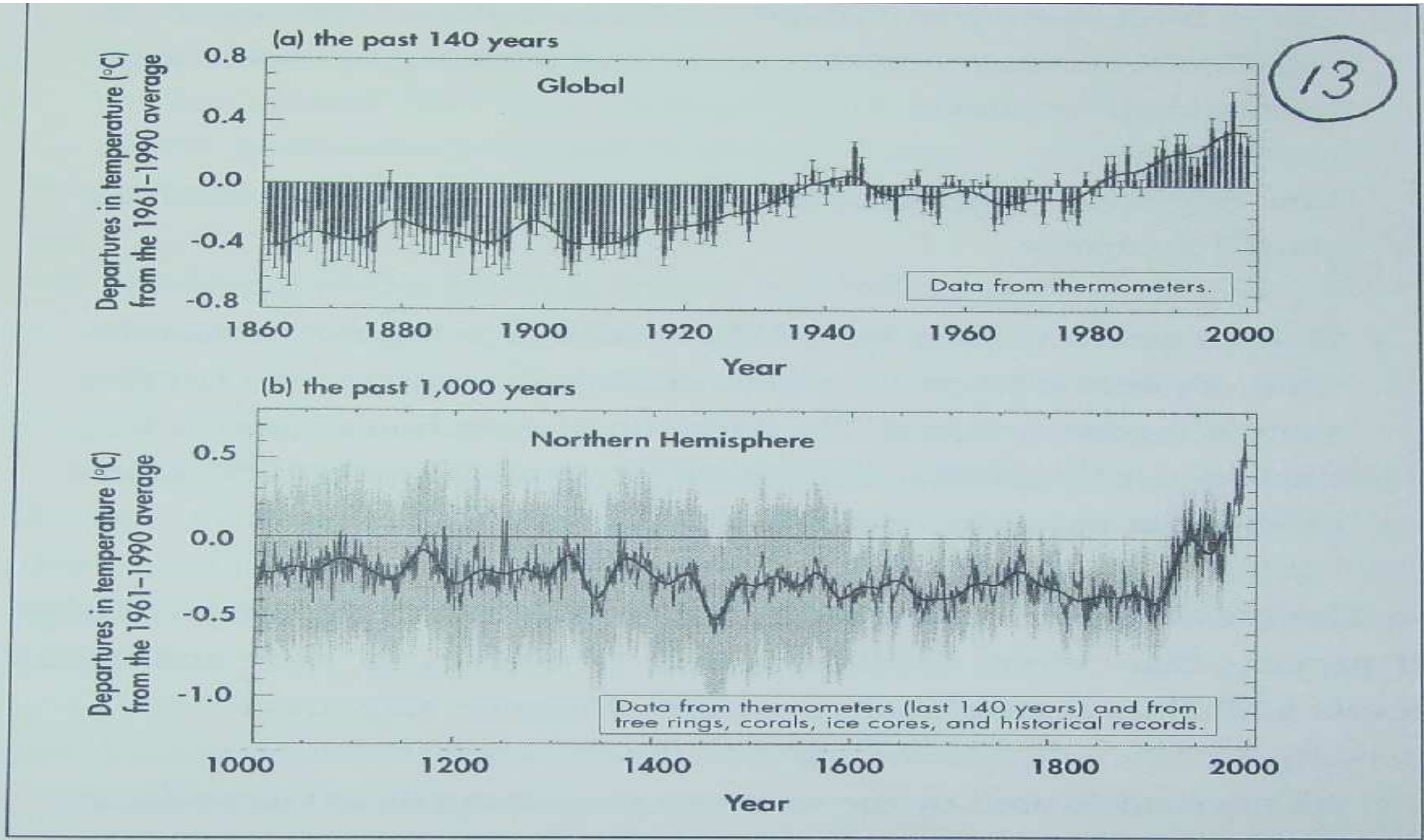
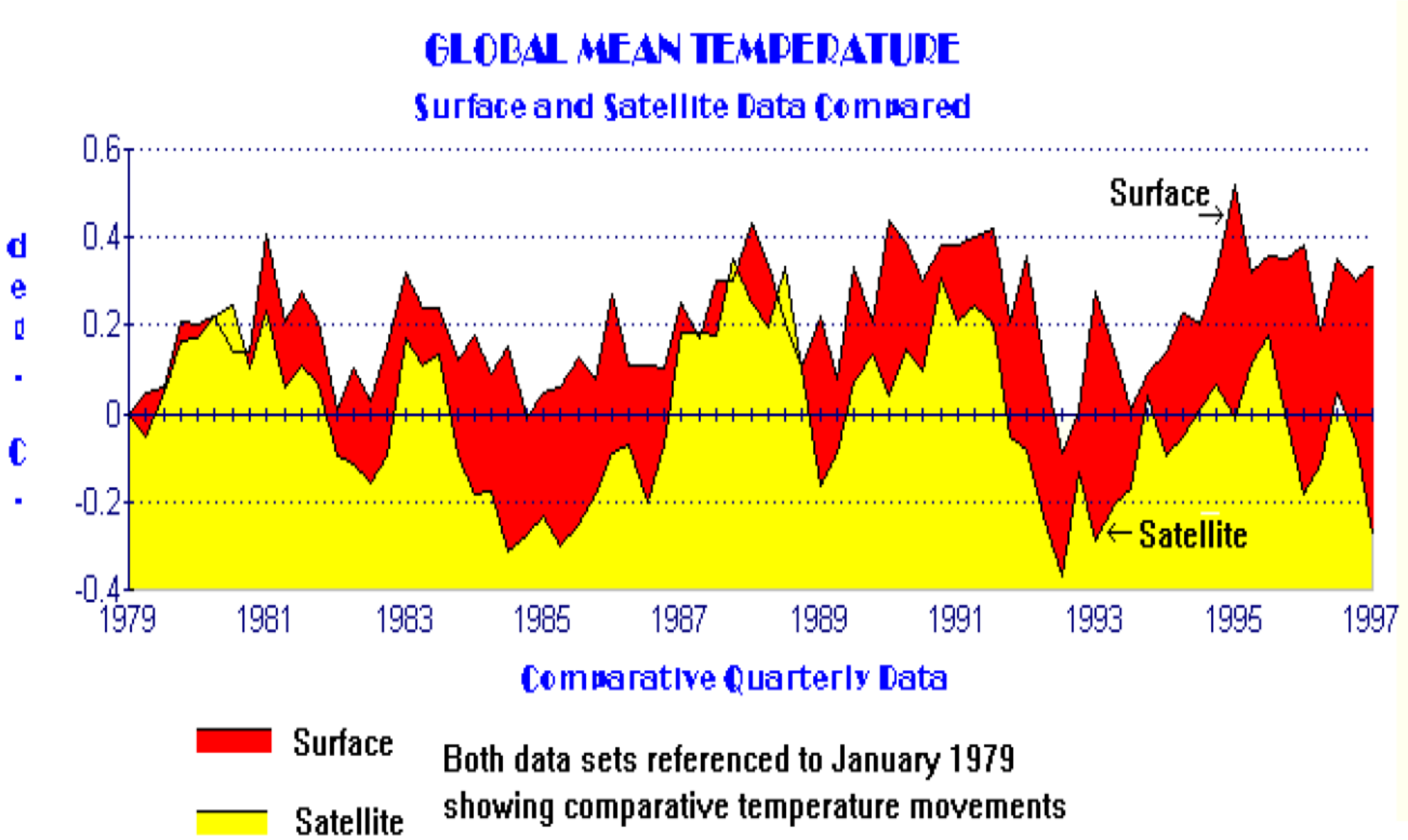


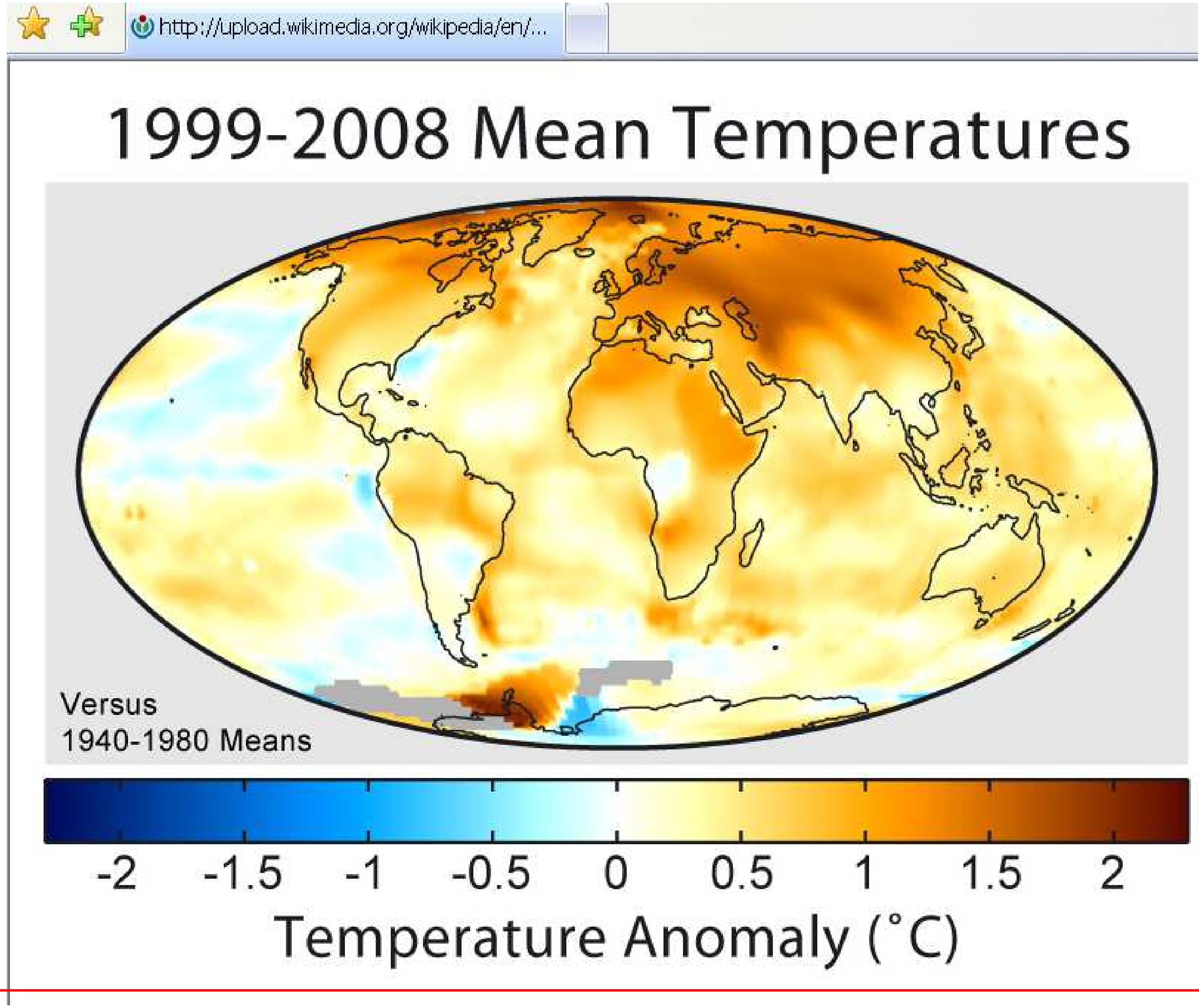
FIGURE 12.1 *Variations of the Earth's Surface Temperature. © 2001 IPCC. Used by permission.*

Global Heat Balance



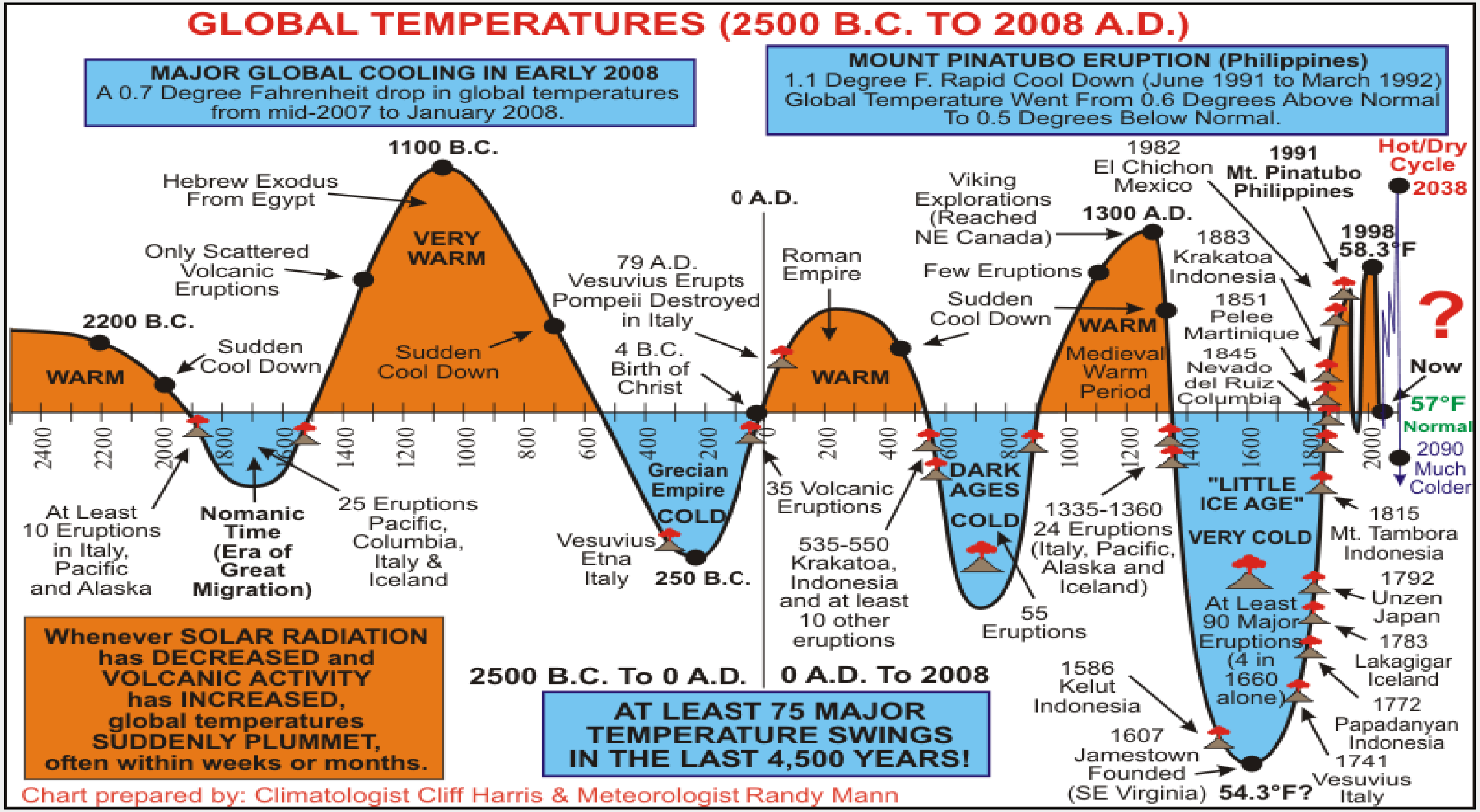
Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance



Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions



There are many opinions of where we are in the cycle , where it will go next or whether the measurements are accurate

However when believing in global warming

Global warming is concerned about up to 0.2 ^{0}C or ^{0}K temperature increase in one year in the lower part of the Atmosphere

Formal policy is to limit to 0.2 degree in 10 years.

Global warming problems could be solved in case there was a mechanism found to lower the temperature in the lower part of the atmosphere ……. by up to 0.2 ^{0}C or ^{0}K in one year.

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Observation

A build-up of 0.2 ^{0}C in one year looks very , very small compared to :

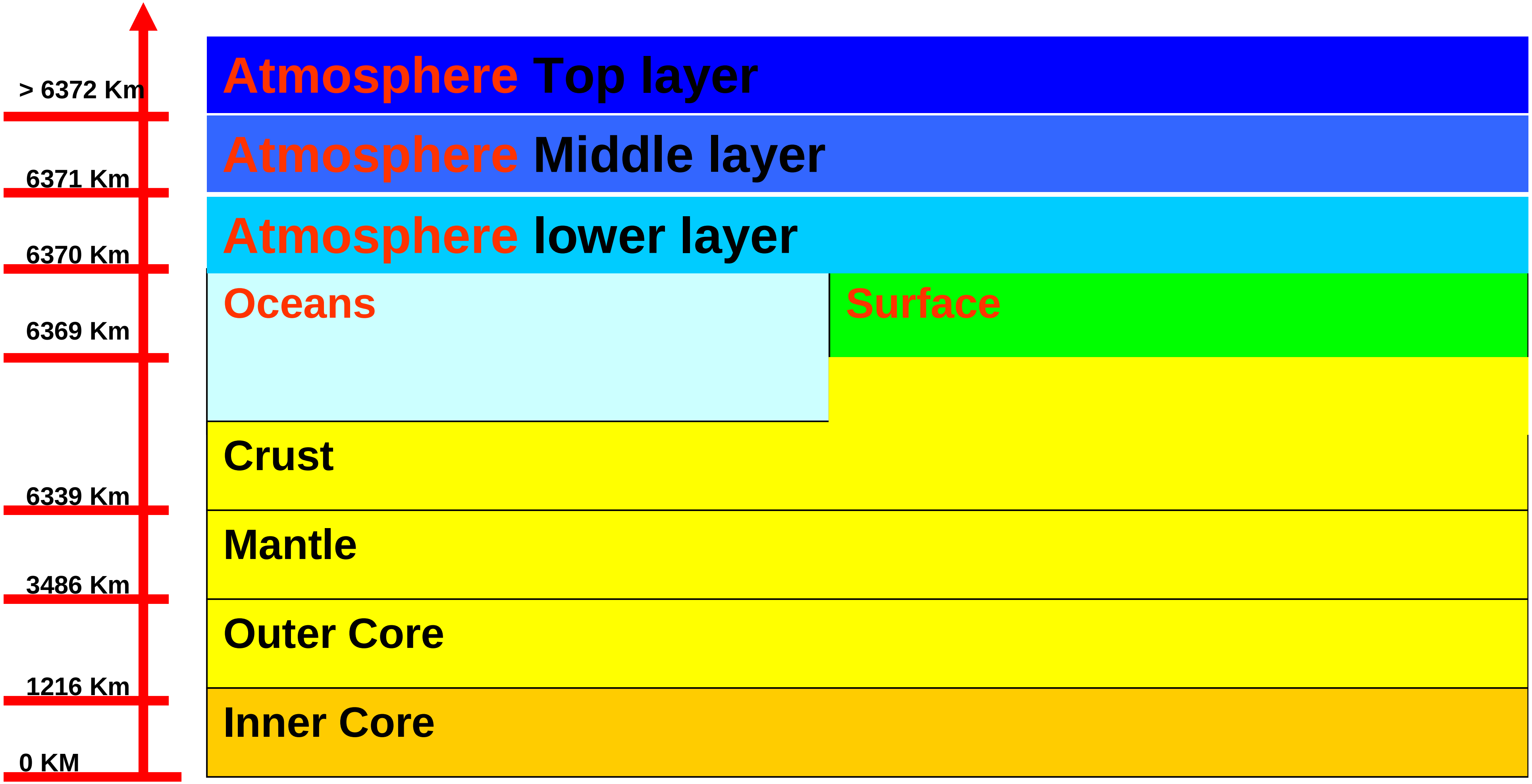
- **The daily temperature fluctuations of 10 to 20 ^{0}C and up to 50 ^{0}C depending on location.**
- **The seasonal temperature fluctuations of up to 80 ^{0}C**

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Storage Areas



Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Storage Areas Average Temperature in ^{0}K

Depth	Heat Storage Area		Average Temperature
> 6372 Km	Atmosphere	Top layer	256 ^{0}K
6371 Km	Atmosphere	Middle layer	282
6370 Km	Atmosphere	Lower layer	289
6369 Km	Oceans 291 ^{0}K	Surface	287
6339 Km	Crust		578
3486 Km	Mantle		3223
1216 Km	Outer Core		4423
0 KM	Inner Core		5073

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content in Storage Areas in 000 Ecal (ExaCal 10^{18}) = Zcal (ZettaCal 10^{21})

Atmosphere	Top layer	165
Atmosphere	Middle layer	37
Atmosphere	Lower layer	46
Oceans	395 000	
Surface		8 700
Crust		5 200 000
Mantle		1 100 000 000
Outer Core		1 200 000 000
Inner Core		58 000 000

> 6372 Km
6371 Km
6370 Km
6369 Km
6339 Km
3486 Km
1216 Km
0 KM

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

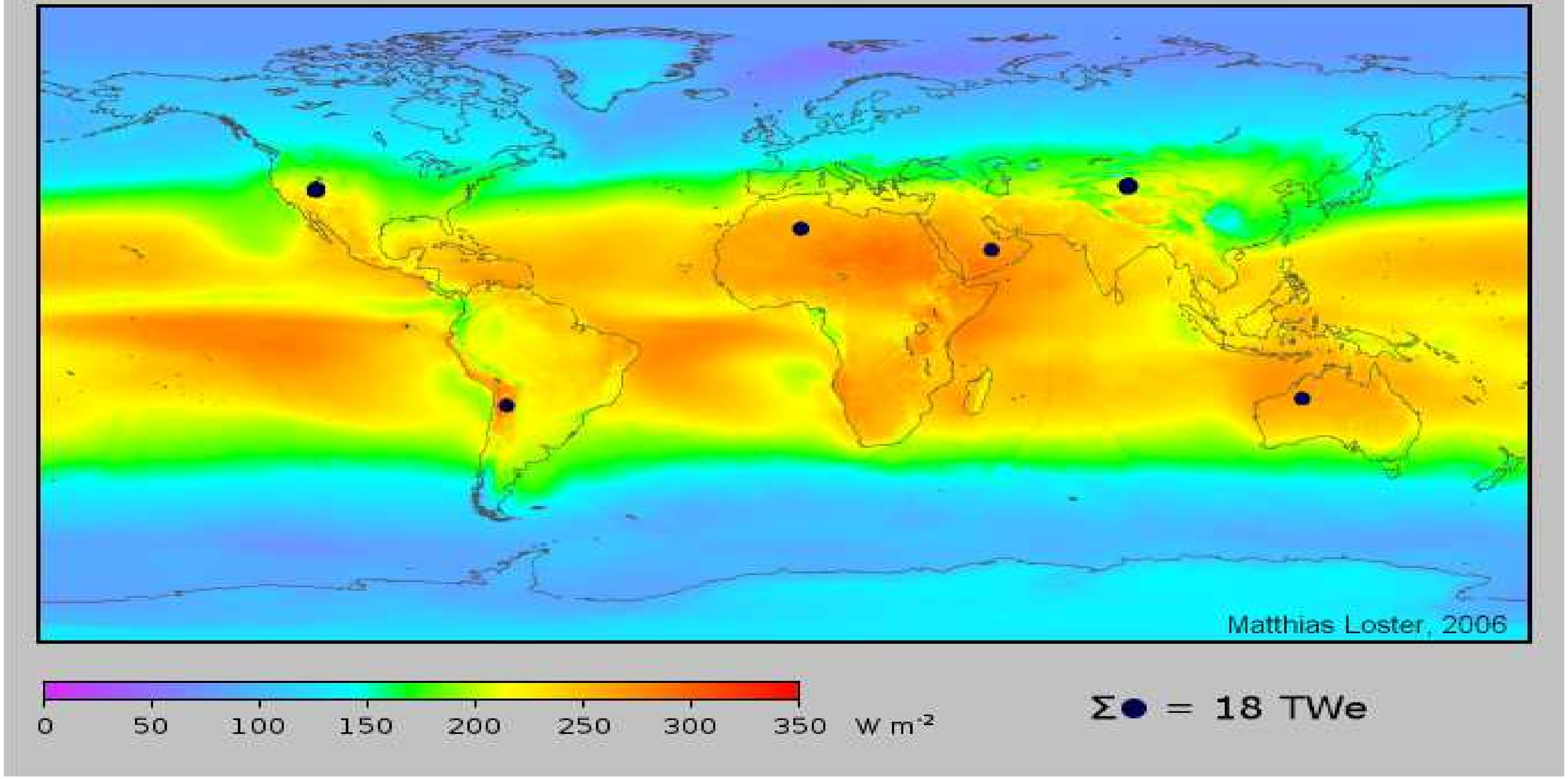
TEIJIN
Human Chemistry, Human Solutions

Heat Content in Storage Areas in Zcal // Zcal necessary to increase a layer by 1 ^{0}C

Km	Storage area		Zcal	1 ^{0}C
> 6372 Km	Atmosphere	Top layer	165	0.64
6371 Km	Atmosphere	Middle layer	37	0.13
6370 Km	Atmosphere	Lower layer	46	0.16
6369 Km	Oceans		395 000	1355
	Surface		8 700	31
6339 Km	Crust		5 200 000	8930
3486 Km	Mantle		1 100 000 000	481 100
1216 Km	Outer Core		1 200 000 000	264 660
0 KM	Inner Core		58 000 000	11 450

Global Heat Balance

Averages day / Night and including clouds | Average is indicated at 240 W / m²

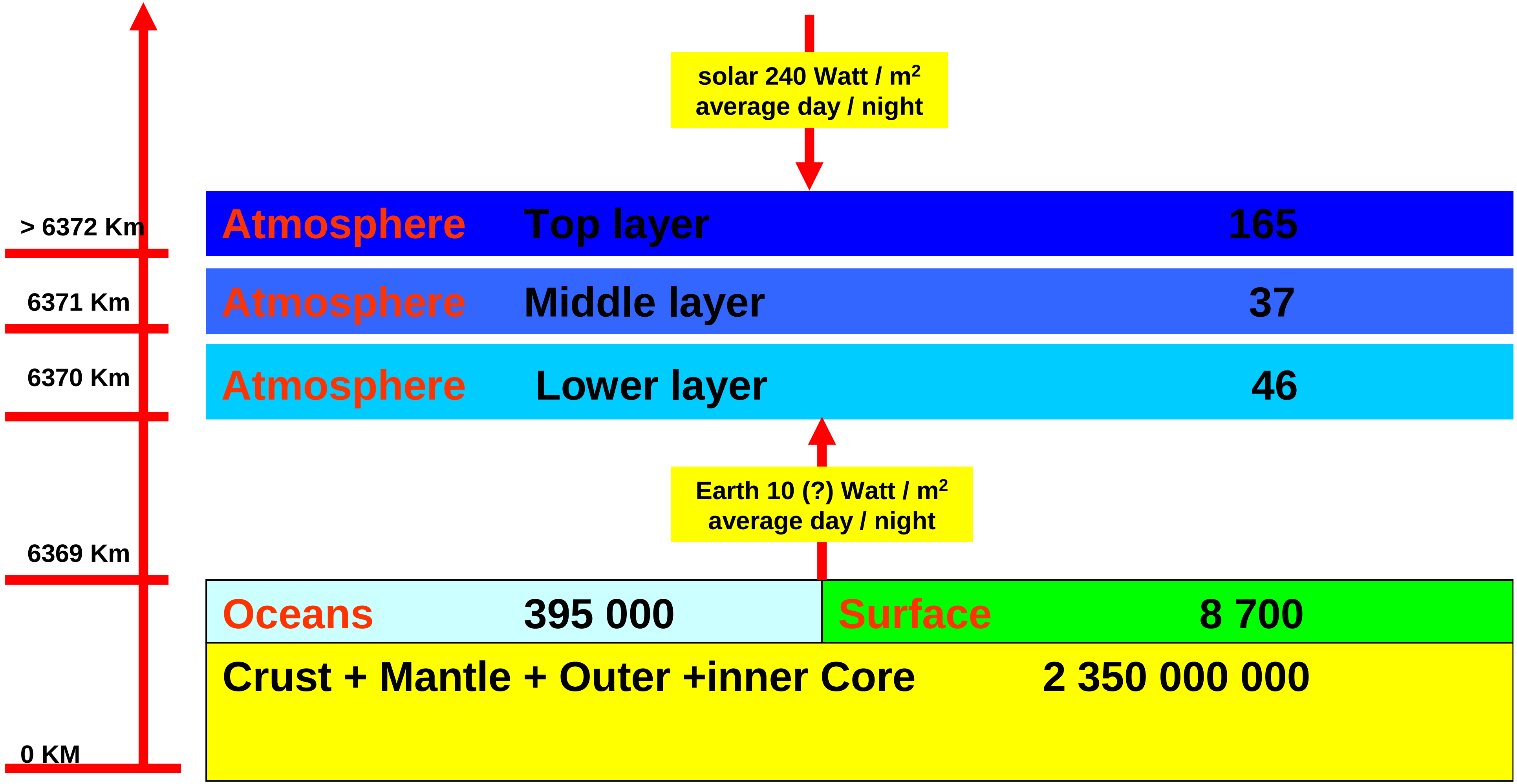


Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content in Zcal and Intensity of Flow in Watt/m^2

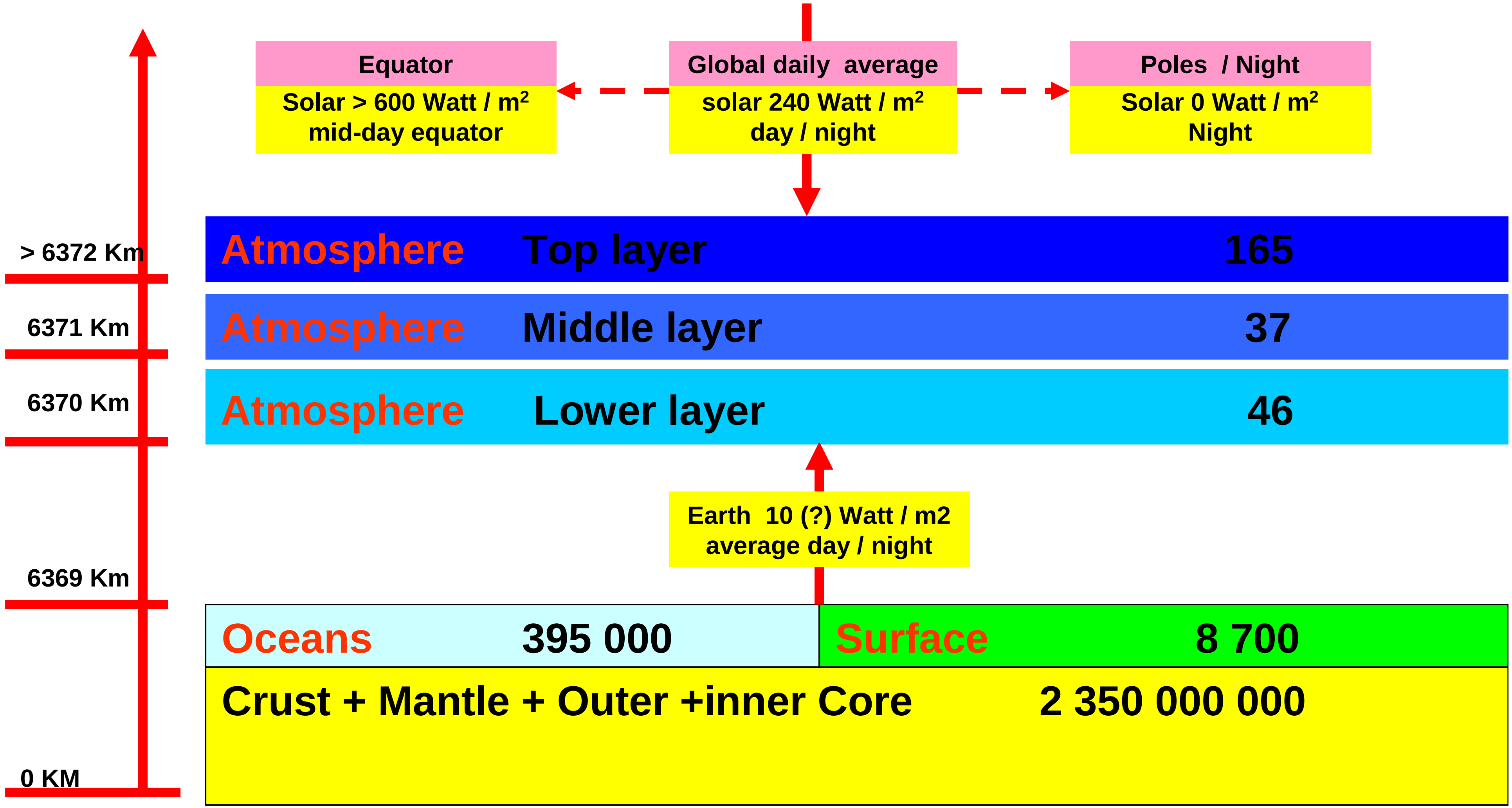


Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content and daily variations of Intensity of Flow …

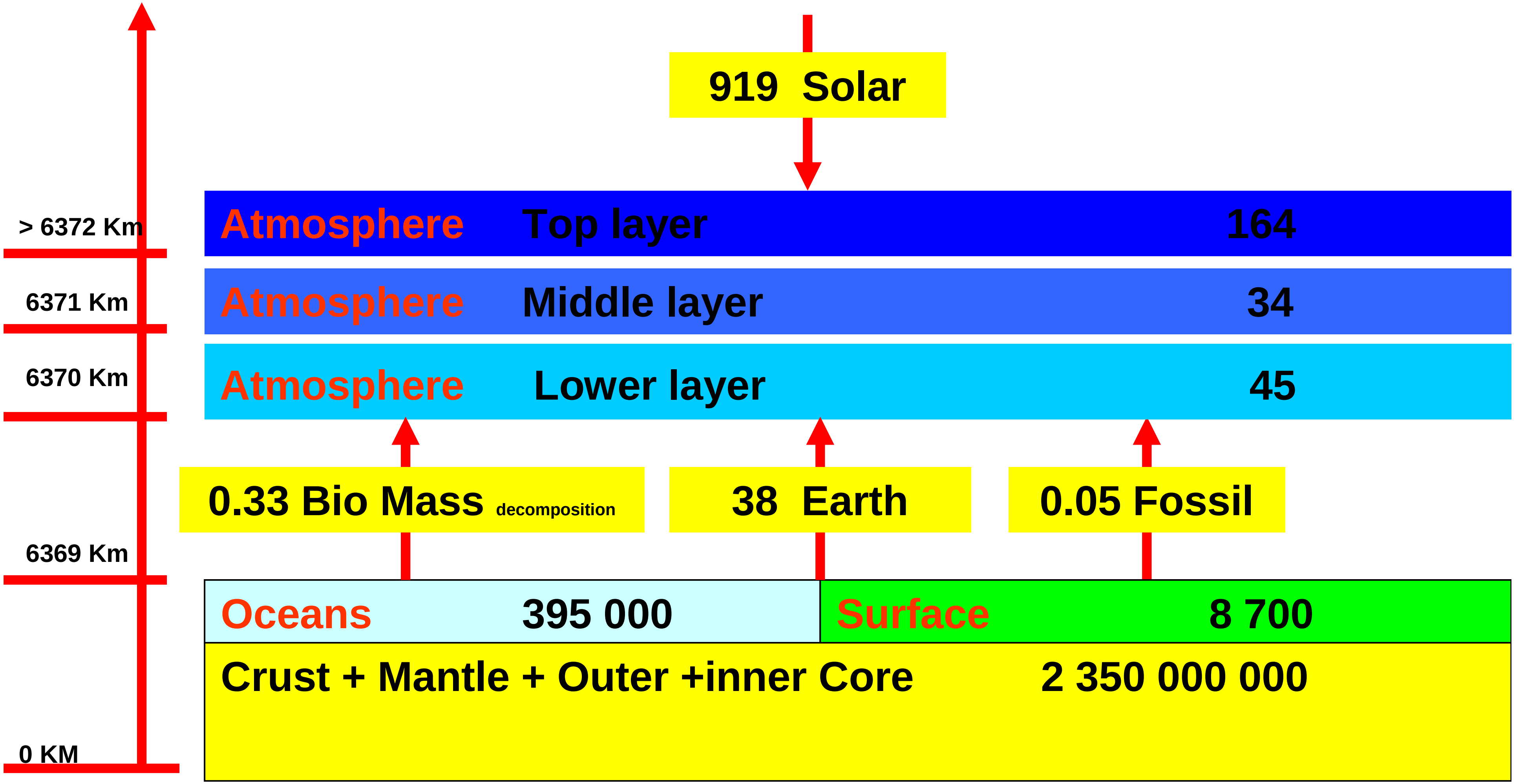


Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

Human Chemistry, Human Solutions

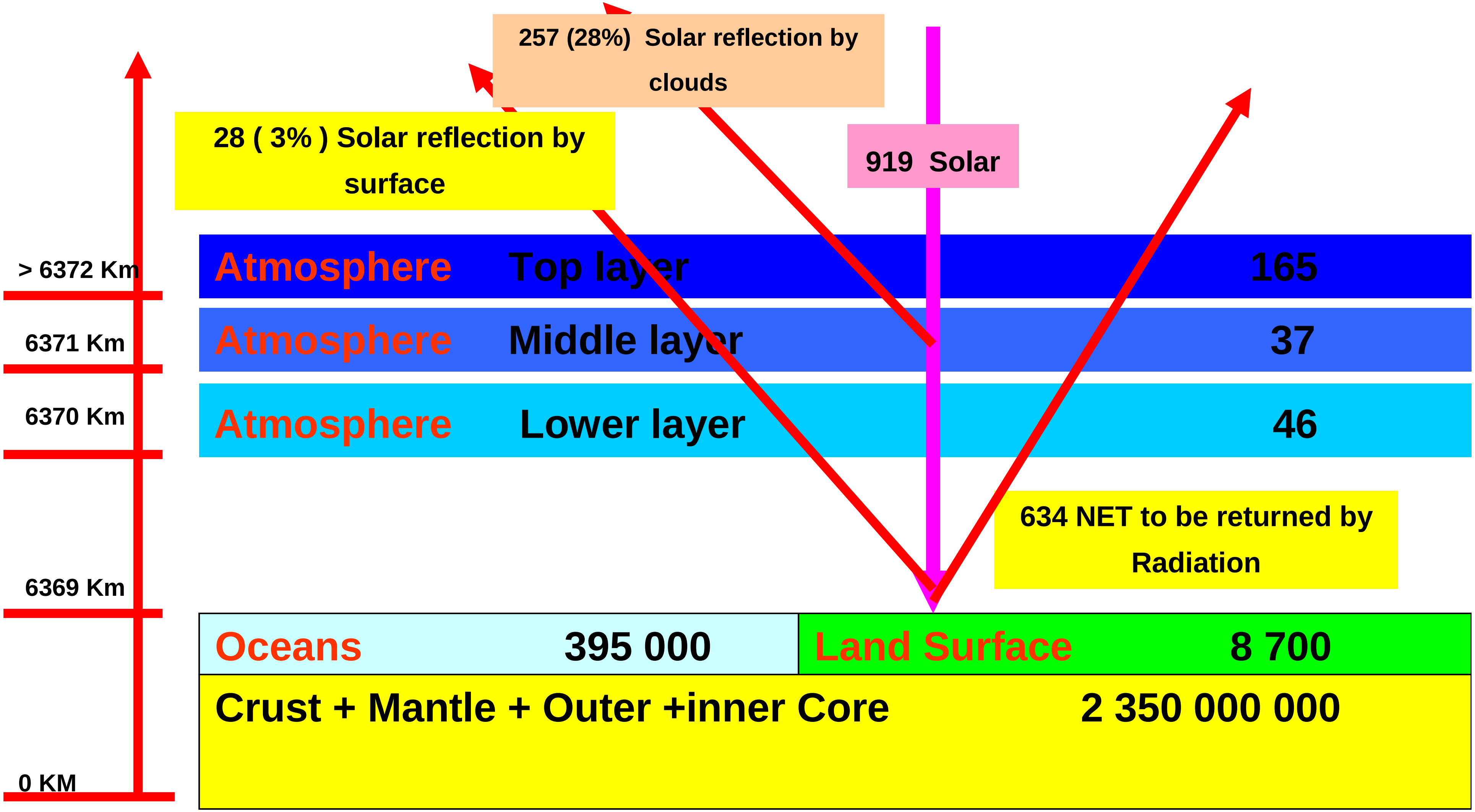
Heat Content and Flow / Year in Zcal



Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

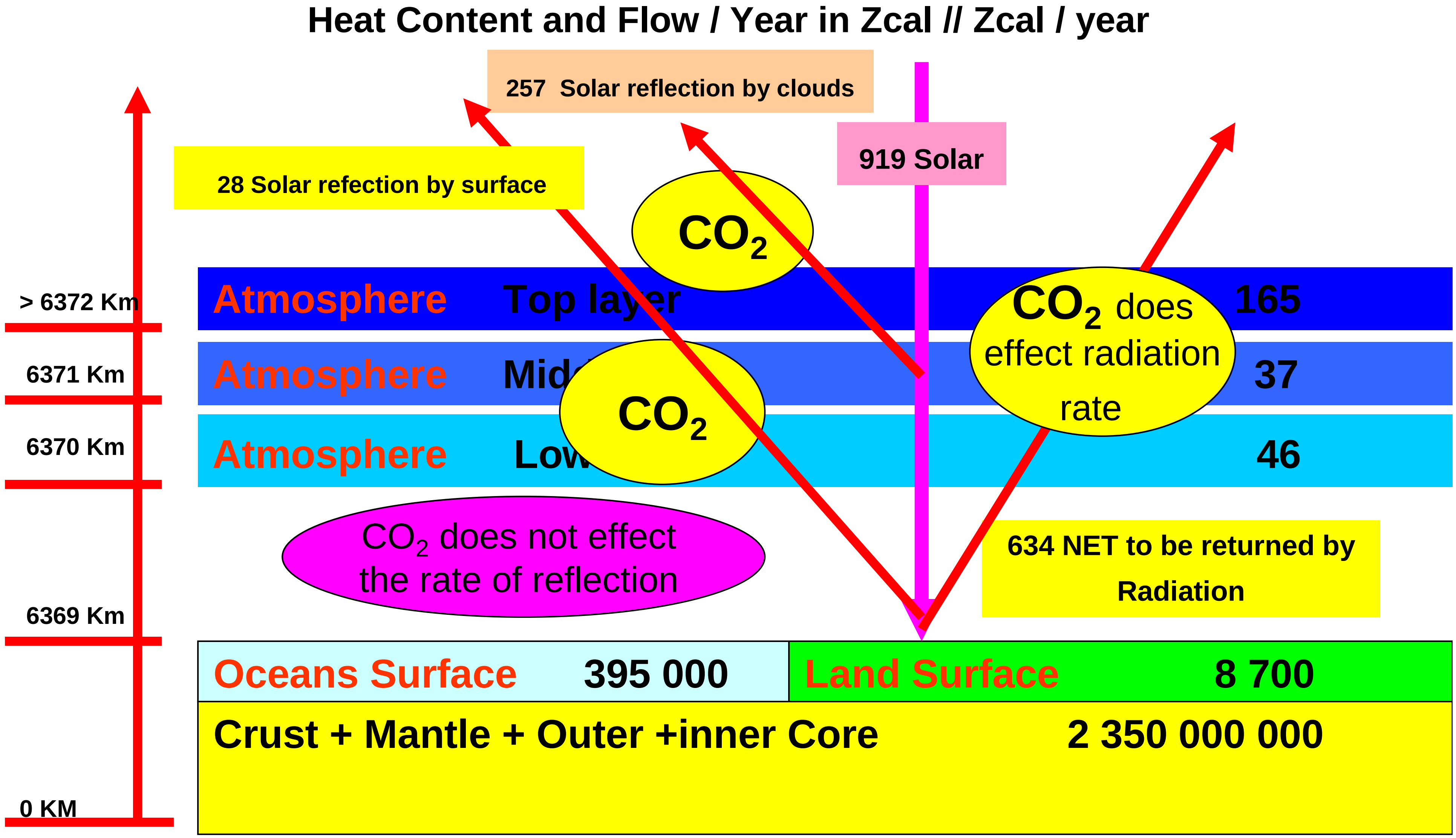
Heat Content and Flow / Year in Zcal



Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

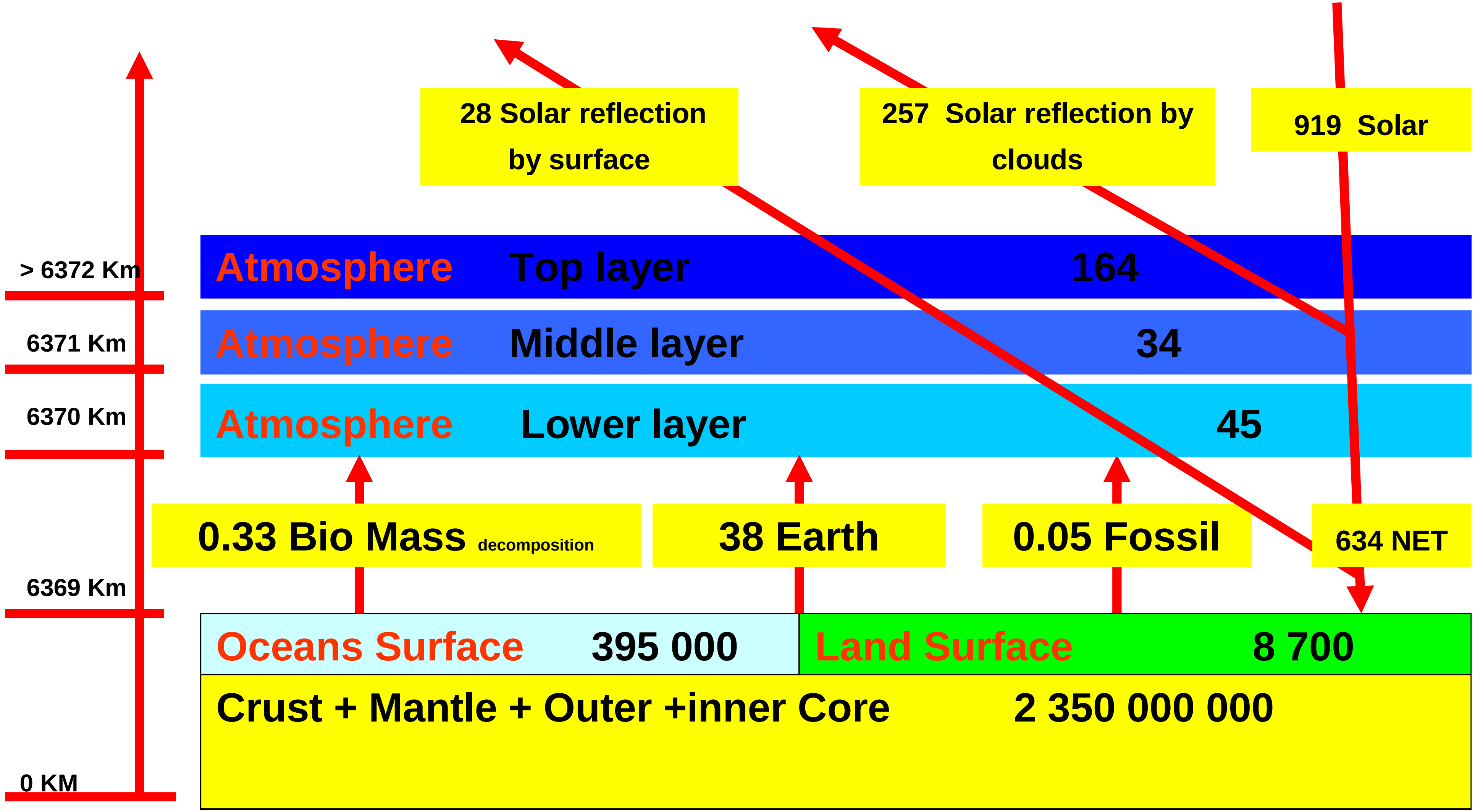


Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content and Flow / Year in Zcal

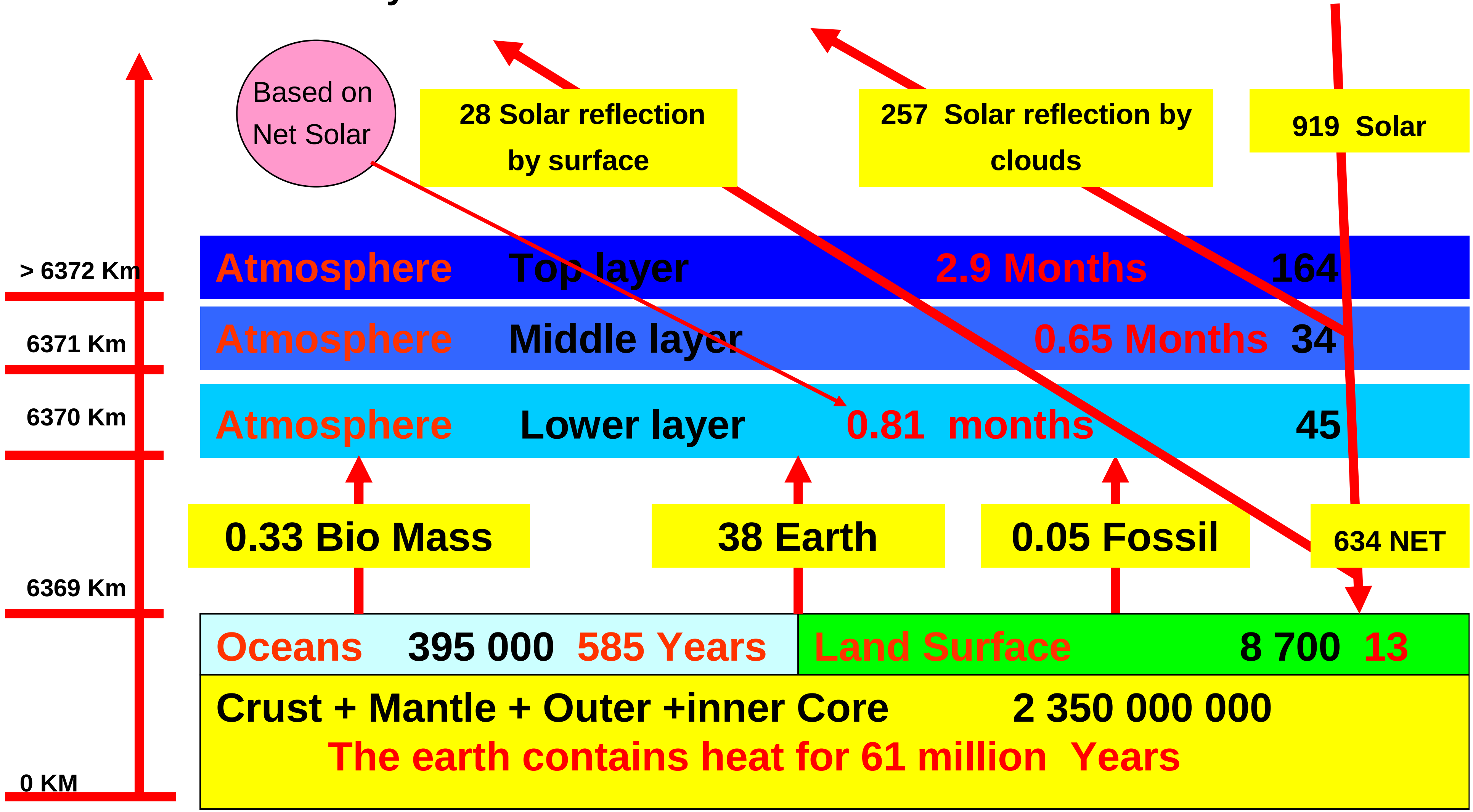


Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Inventory of Heat Content in Time and Flow / Year in Zcal



Global Heat Balance

Observation	Zcal/ Year
Solar Net	634
Earth	38
Fossil Fuel	0.05
Bio Mass decomposition	0.33
Total	**762**

If the heat of one year would be stored in lower part of atmosphere the temperature would increase by 4300 ^{0}K in that year or about 13 ^{0}K per day. 724 ^{0}K when stored in whole atmosphere

If the heat of one year would be stored in the Oceans the temperature would go up by 0.5 ^{0}K

1 degree in 50 years is EU target

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Lower atmosphere temperature goes up by 1 degree K in one year :

This requires 0.16 Zcal heat inventory build-up per year

1 degree over 10 years requires 0.016 Zcal per year heat build up in lower atmosphere

1 degree over 50 years requires 0.003 Zcal

If total atmosphere temperature goes up 1 degree K in 10 years :

This requires 1.0 Zcal / year

1 degree over 10 years requires 0.1 Zcal per year

Ton Runneboom
Ton.Runneboom@teijin.co.jp

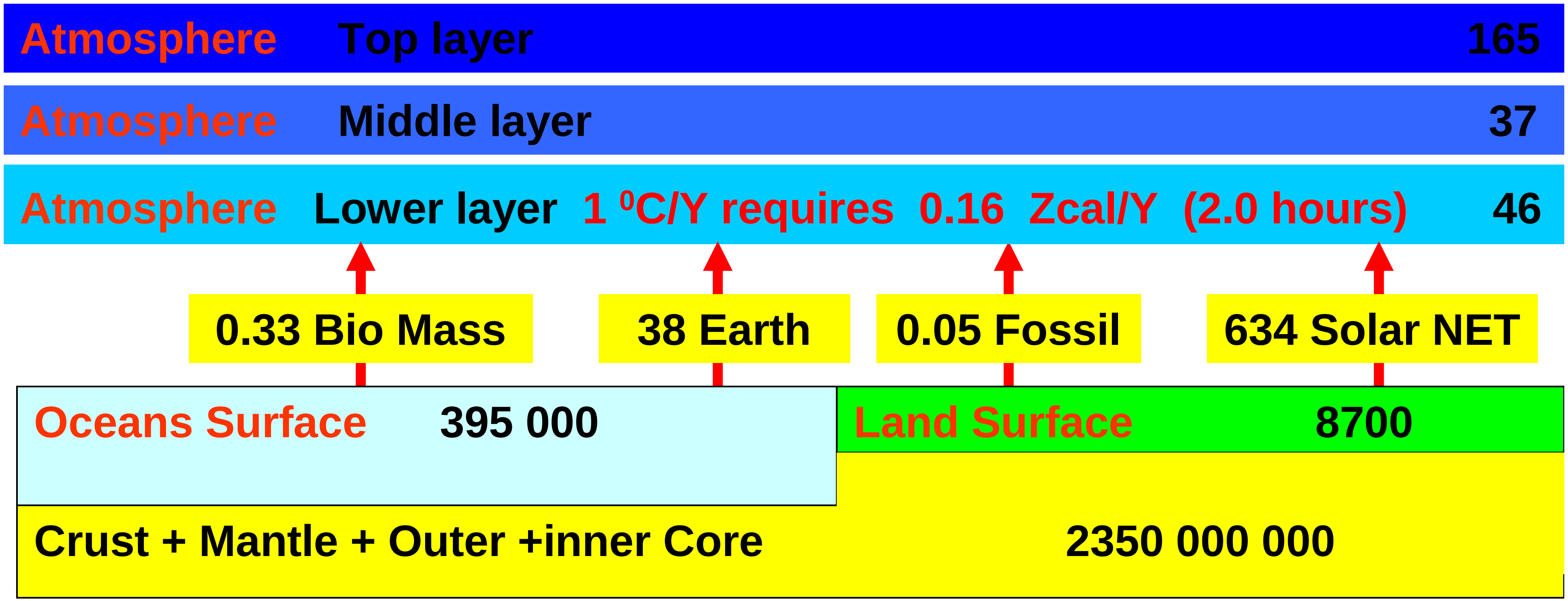
Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Radial Heat, Content and Flow / Year in Zcal

To have no global warming in the lower layer of Atmosphere , which is where the measurements take place, all heat needs to

- **leave the atmosphere**
- **be absorbed by the Oceans**



Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content and Flow / Year in Zcal

To have no global warming in the lower layer of Atmosphere , which is where the measurements take place, all heat needs to

- **leave the atmosphere**
- **be absorbed by the Oceans**

Total minus 0.016

Atmosphere Lower layer

1 degree heat build up / year means 0.16 Zcal / year heat build-up (2.0 hours)

0.1 degree heat build up / year means 0.016 Zcal / year heat build-up (0.20 hours)

0.33 Bio Mass | **38 Earth** | **0.05 Fossil** | **634 Solar NET**

Oceans Surface 395 000

Land Surface 8700

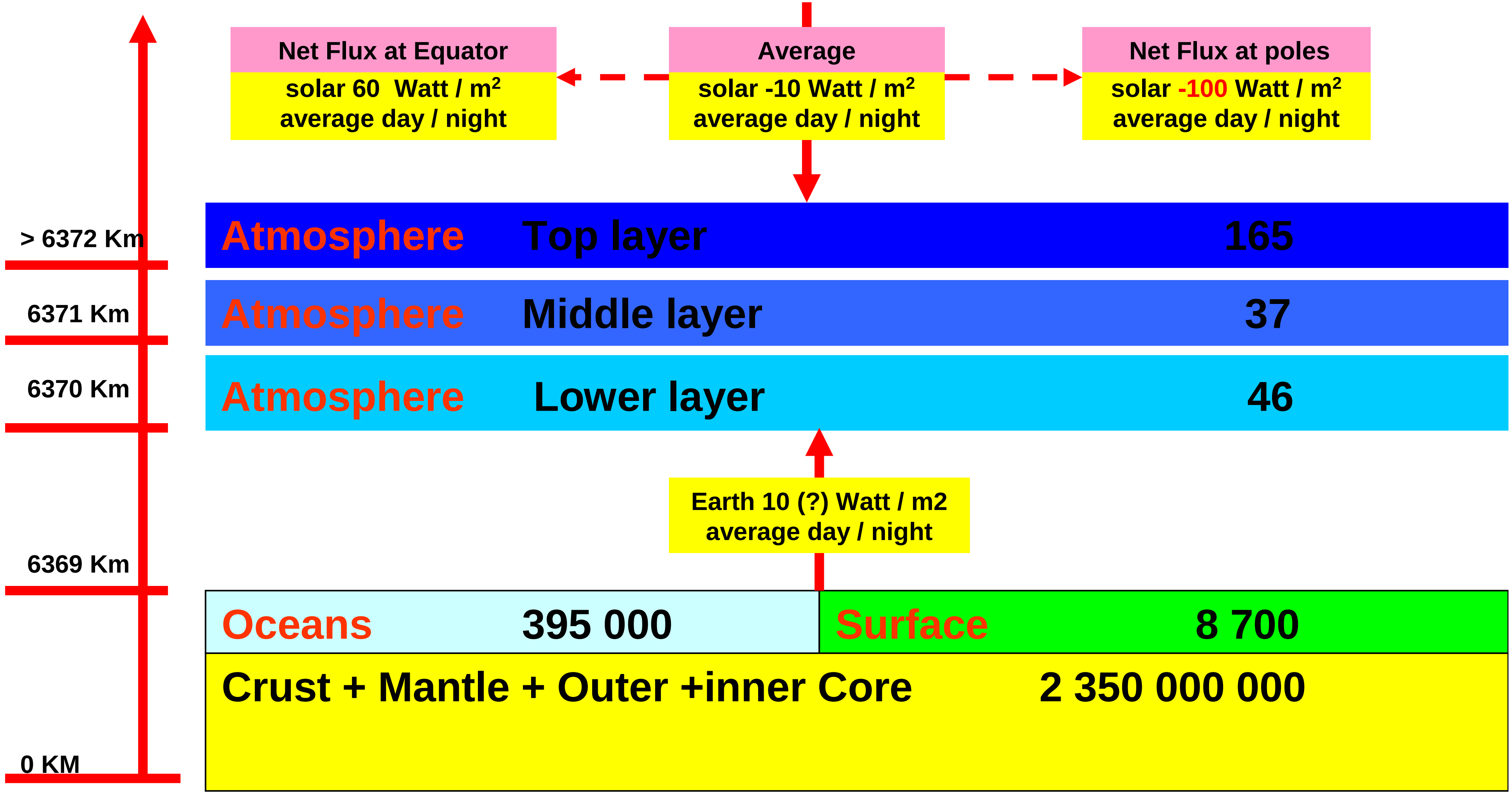
Crust + Mantle + Outer +inner Core 2350 000 000

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content, Net Heat Flux and Intensity of Flow in 000 Ecal Watt/ m²



Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content and Flow / Year in Zcal

To have no global warming in the lower layer of Atmosphere , which is where the measurements take place, all heat needs to

- **leave the atmosphere**
- **be absorbed by the Oceans**

In view of melting ice How much stays in the Oceans ??

Total minus 0.016 ??

Atmosphere **Lower layer**

1 degree heat build up / year means 0.16 Zcal / year heat build-up

0.1 degree heat build up / year means 0.016 Zcal / year heat build-up

0.33 **38** **0.05** **634**

Oceans Surface **395 000**

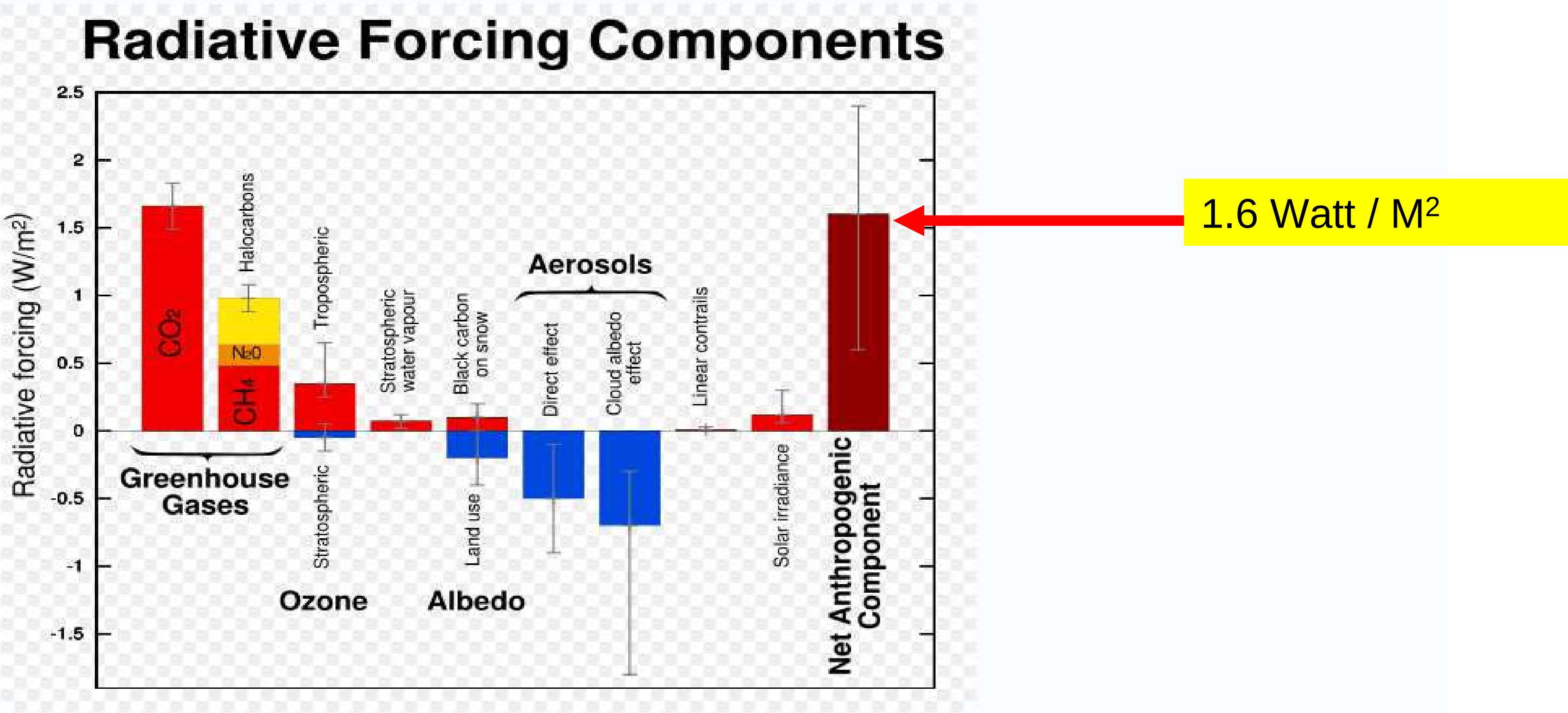
Land Surface **8 700**

Crust + Mantle + Outer +inner Core **2350 000 000**

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

File File history File links



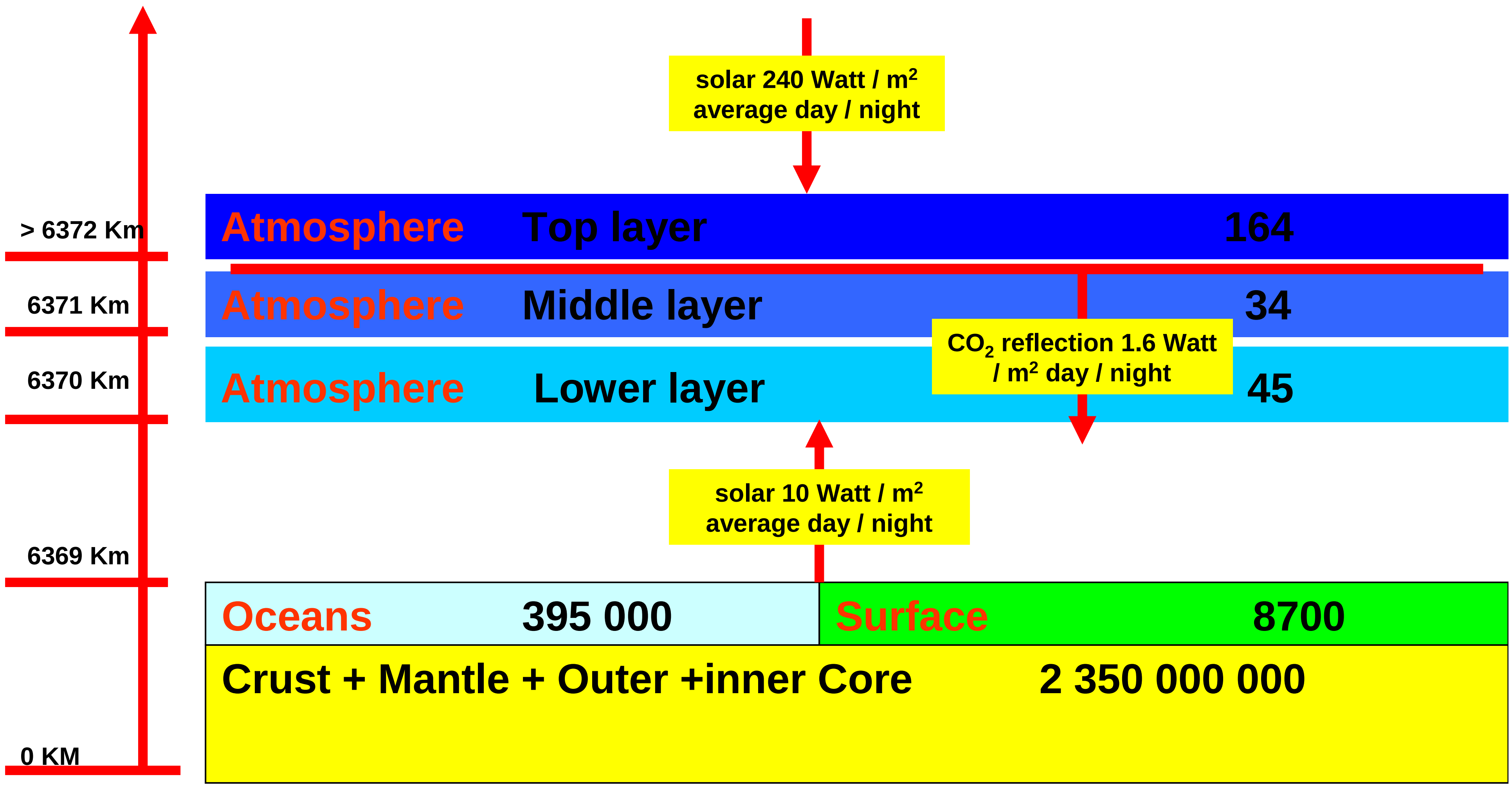
Radiative-forcings.svg (SVG file, nominally 600 × 480 pixels, file size: 58 KB)

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

Human Chemistry, Human Solutions

Heat Content and Intensity of Flow



Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content and Flow / Year in Zcal

To have no global warming in the lower layer of Atmosphere , which is where the measurements take place, all heat needs to

- **leave the atmosphere**
- **be absorbed by the Oceans**

Total minus 0.016

Atmosphere Lower layer

1 degree heat build up / year means 0.16 Zcal / year heat build-up

0.1 degree heat build up / year means 0.016 Zcal / year heat build-up

6.1 CO_2 reflection

0.33 Bio Mass

38 Earth

0.05 Fossil

634 Solar NET

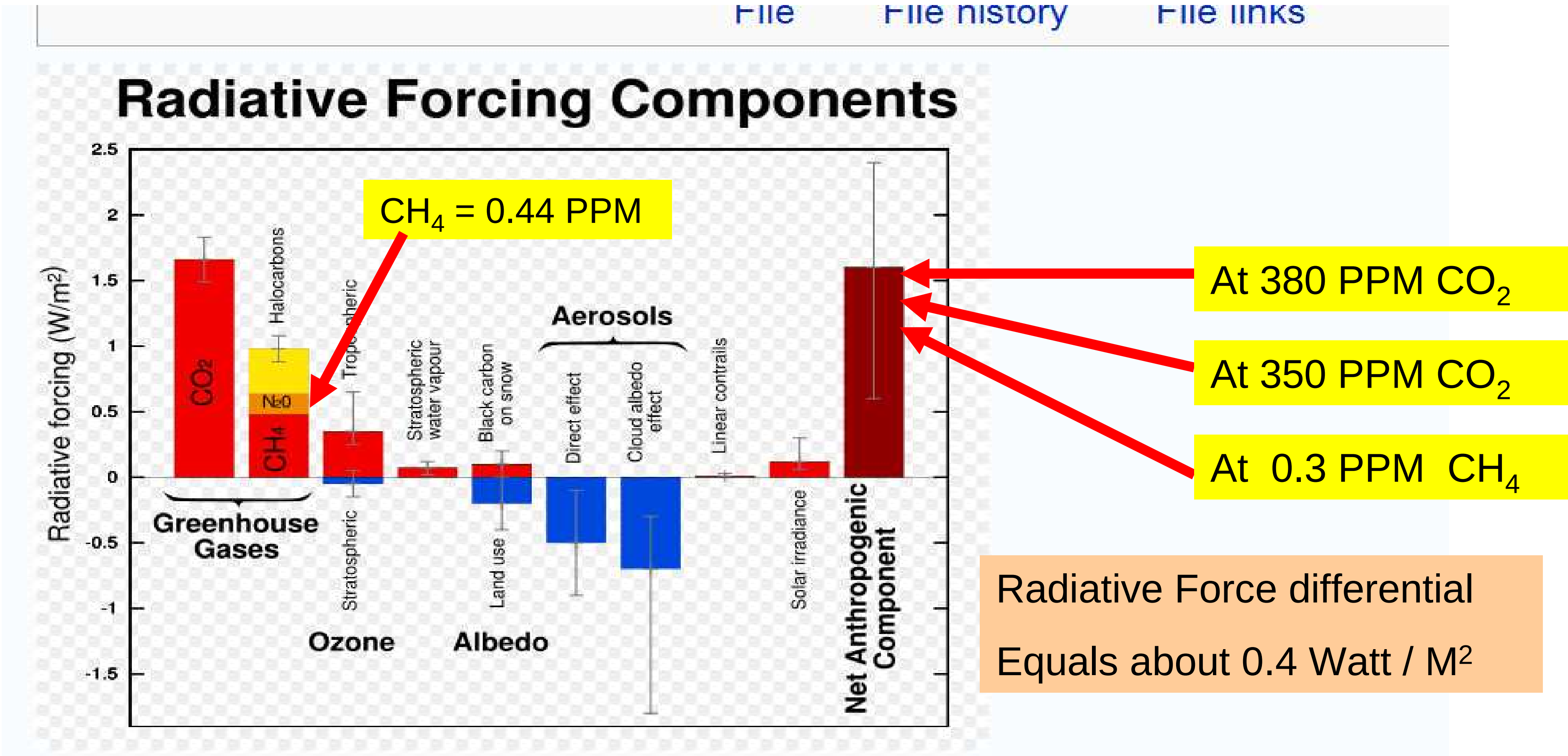
Oceans Surface 395 000

Land Surface 8 700

Crust + Mantle + Outer +inner Core 2 350 000 000

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance



Radiative-forcings.svg (SVG file, nominally 600 × 480 pixels, file size: 58 KB)

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

Heat Content and Flow / Year in 000 Ecal

To have no global warming in the lower layer of Atmosphere , which is where the measurements take place, all heat needs to

- **leave the atmosphere**
- **be absorbed by the Oceans**

Total minus 0.016

Atmosphere Lower layer

1 degree heat build up / year means 0.16 000 Ecal / year heat build-up

0.1 degree heat build up / year means 0.016 000 Ecal / year heat build-up

4.6 CO_2 reflection at 350 ppm CO_2

1.5 CO_2 reflection due to increase in CO_2 to 380 ppm and CH_4 to 0.44 ppm

0.33

38

0.05

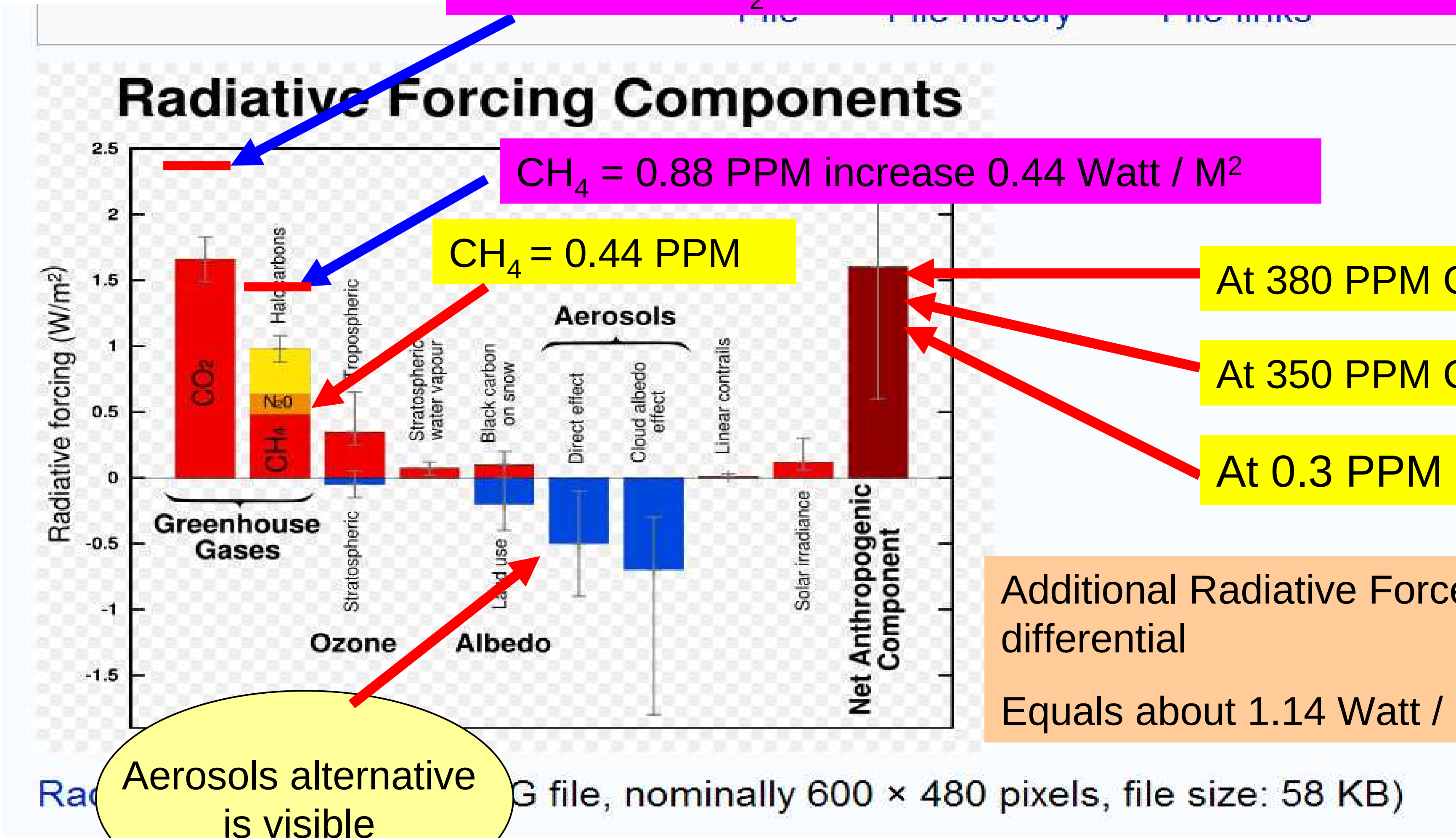
634

Oceans Surface	**395 000**	**Land Surface**	**8 700**
Crust + Mantle + Outer +inner Core	**2 350 000 000**		

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

At 540 PPM CO_2 at 2.4 Watt / M² increase 0.7 Watt /M²



CH_4 = 0.88 PPM increase 0.44 Watt / M²

CH_4 = 0.44 PPM

At 380 PPM CO_2

At 350 PPM CO_2

At 0.3 PPM CH_4

Additional Radiative Force differential

Equals about 1.14 Watt / M²

Aerosols alternative is visible

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

Heat Content and Flow / Year in Zcal

To have no global warming in the lower layer of Atmosphere , which measurements take place, all heat needs to

- **leave the atmosphere**
- **be absorbed by the Oceans**

540 ppm CO²
0.88 ppm CH4

Total minus 0.016

Atmosphere **Lower layer**

1 degree heat build up / year means 0.16 Zcal / year heat build-up

0.1 degree heat build up / year means 0.016 Zcal / year heat build-up

4.6 CO_2 reflection at 350 ppm CO_2

1.5 CO2 and CH4 reflection

4.4 CO2 and CH4 additional reflection

0.33

38

0.05

634

Oceans Surface **395 000**

Land Surface **8 700**

Crust + Mantle + Outer +inner Core **2 350 000 000**

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

Human Chemistry, Human Solutions

Excess CO2 heat flow equals 1 % of solar
Thus shielding 1 % would neutralize the CO2 effect

1.5 + 4.4 = +/- 6.3

540 ppm CO^2
0.88 ppm CH4

…9 Ecal

To have no… , which
measurem…

• leave the at…

•be absorbed by the Oc…

…otal minus 0.016

Atmosphere **Lower layer**

1 degree heat build up / year means 0.16 Zcal / year heat build-up

0.1 degree heat build up / year means 0.016 Zcal / year heat build-up

4.6 CO_2 reflection at 350 ppm CO_2	**1.5 CO2 and CH4 reflection**	**4.4 CO2 and CH4 additional reflection**	**0.33**	**38**	**0.05**	**634**

Oceans Surface 395 000 | **Land Surface 8 700**

Crust + Mantle + Outer +inner Core 2 350 000 000

Global Heat Balance

When looking at the Heat Inventories and Flows and the very small inventory heat build-up of 0.20 hours required to increase the temperature of the lower part of the atmosphere by 0.1 degree per year

and

Also realizing that the Flows have extreme volatility :

- **Daily fluctuations of solar intensity from 600 Watt / M^2 to 0 Watt / M^2**
- **Seasonal fluctuation**
- **High differences in Net Flux between Equator and Poles**
- **Reflection ratio depending on cloud coverage**
- **Reflection ratio depending on dust content (Volcanic activity)**
- **High ratio of Heat transfer through wind and Ocean flows**
- **Greenhouse gas Ratio and the projections**
- **Variations in solar radiation and activity**
- **Variations in heat flow from the core to the surface**

It is clear that there are many opinions and conclusions about global warming , depending on the assumptions made and models used

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

However we have seen that :

Heat build-up in the atmosphere will stay < 0.2 ^{0}C in one year

and

< 0.1 ^{0}C / year over several years …..and official target of < 1 ^{0}C in 50 years

Concepts for shielding solar heat exist and the Kyoto protocol is being renegotiated but will it counteract such build-up and take advantage of the supply side and the demand side of the Heat and CO_2 systems.

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

The biggest global effort is made in the CO_2 and greenhouse gases

In terms of the heat balance a reduction of greenhouse gases would reduce the barrier to radiate heat to the stratosphere.

The present greenhouse and CO_2 programs are focused on the supply side of the CO_2 balance to the atmosphere and are focused on reducing the rate of growth

Reducing the rate of growth in the CO_2 balance means in the heat balance that we continue to increase the barrier to radiate heat to the stratosphere

The CO_2 actions are not moving any Heat to the stratosphere ……. They are only reducing the speed of barrier build-up

Like reducing the building speed with which we add insulation material to a house … we continue to build !!

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

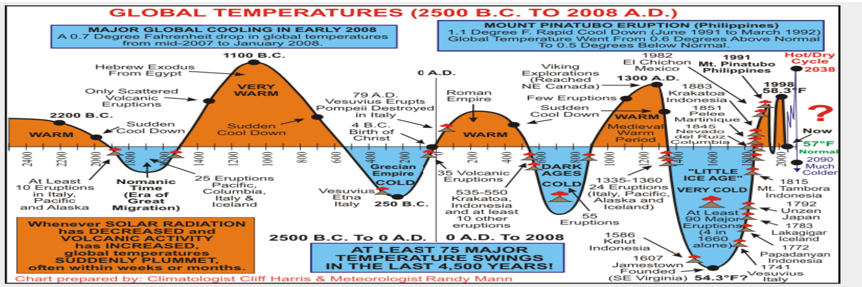
With no program or project to move heat to the stratosphere …..

We rely on nature to control the temperature with the next volcanic eruption or any other accidental or coincidental development outside human control

If we believe in global warming

We are really stuck … waiting for the next good or bad natural event

Unless we find a way to facilitate extra heat flows to the stratosphere , which is the only place where heat must go to contribute to managing global warming.



Window to Space

Ton Runneboom
Ton.Runneboom@teijin.co.jp

If we believe in global warming ……

and want to take control over our destiny

We need not only attack and control CO_2 and greenhouse-gases …… the insulation layer of the earth

But

We also need to attack and control HEAT itself and face up to reality of the HEAT mechanisms

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions

We could make radiation of heat to the stratosphere easier in case warm air could from the ground level be brought into higher levels of the atmosphere.

The higher the heat is located in the atmosphere the easier it will radiate out !!

Warm air is lighter than cold air ….

So let us see whether we can use this phenomena to move warm air to higher levels ….

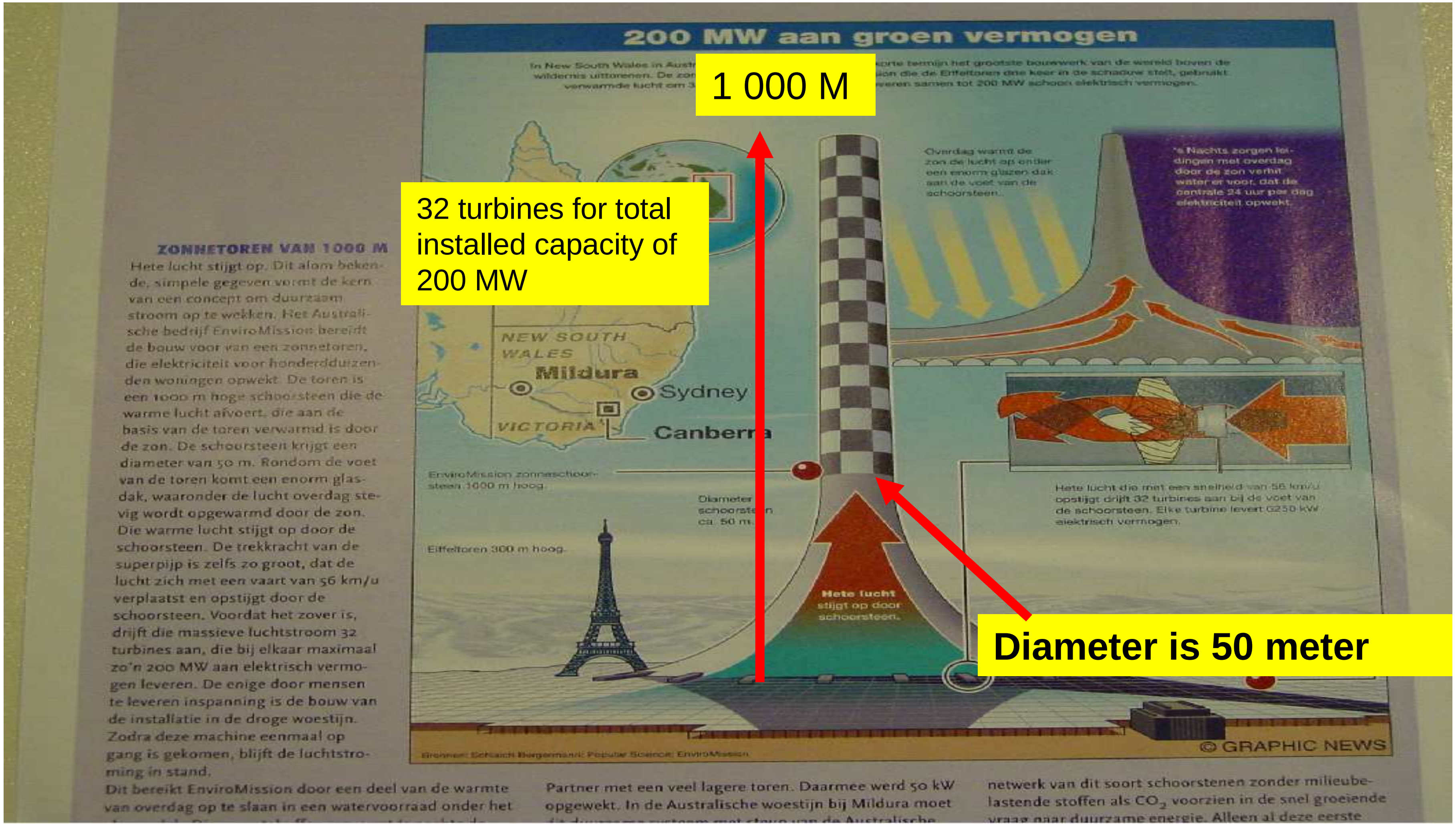
and

Let us see whether this can be done at a large enough scale to make an impact.

So let us see whether we can open the windows to space to get rid of some Heat
Very much the same logic as when your house is too warm

Ton Runneboom
Ton.Runneboom@teijin.co.jp

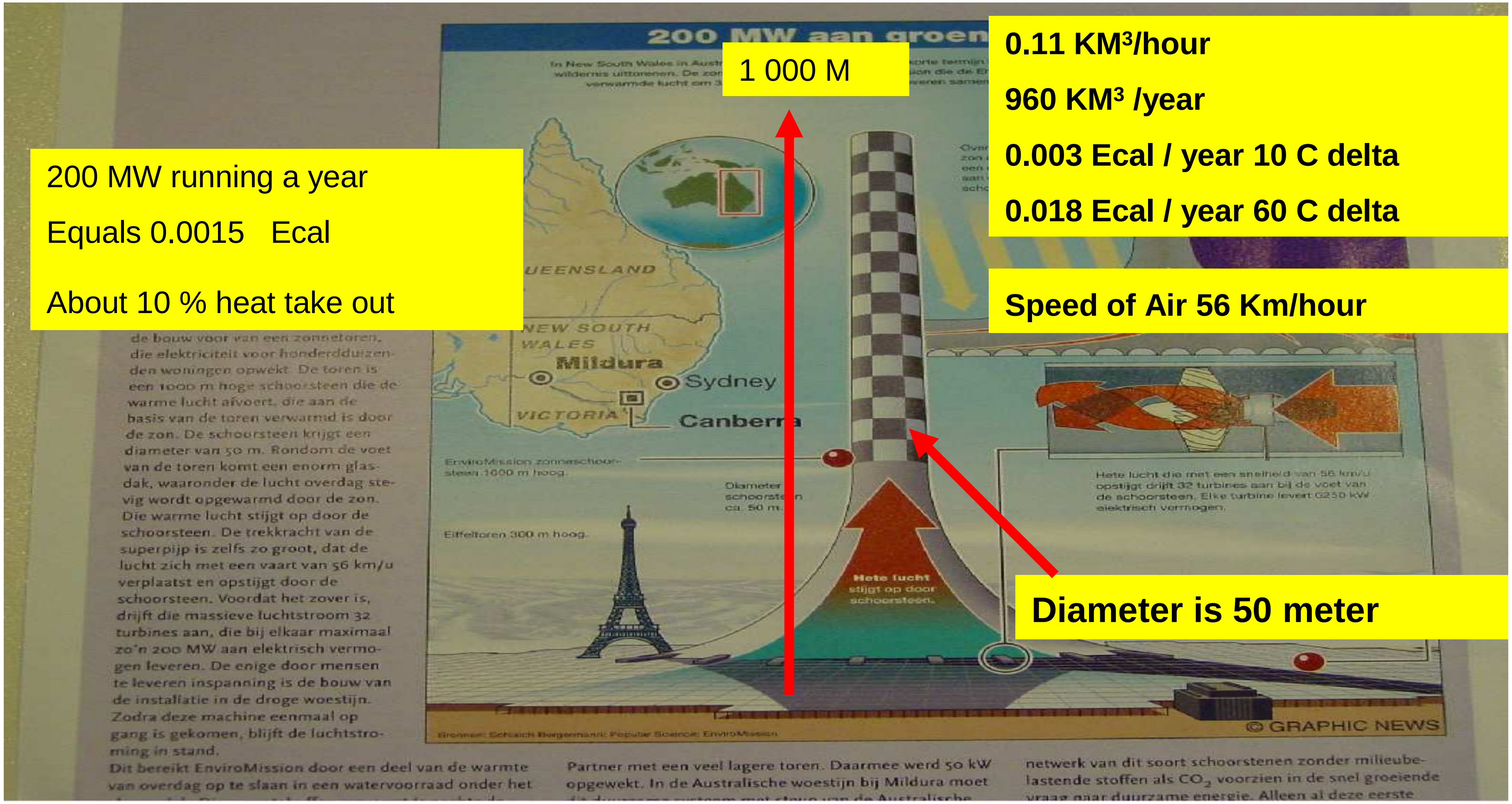
Global Heat Balance



Ton Runneboom
Ton.Runneboom@teijin.co.jp

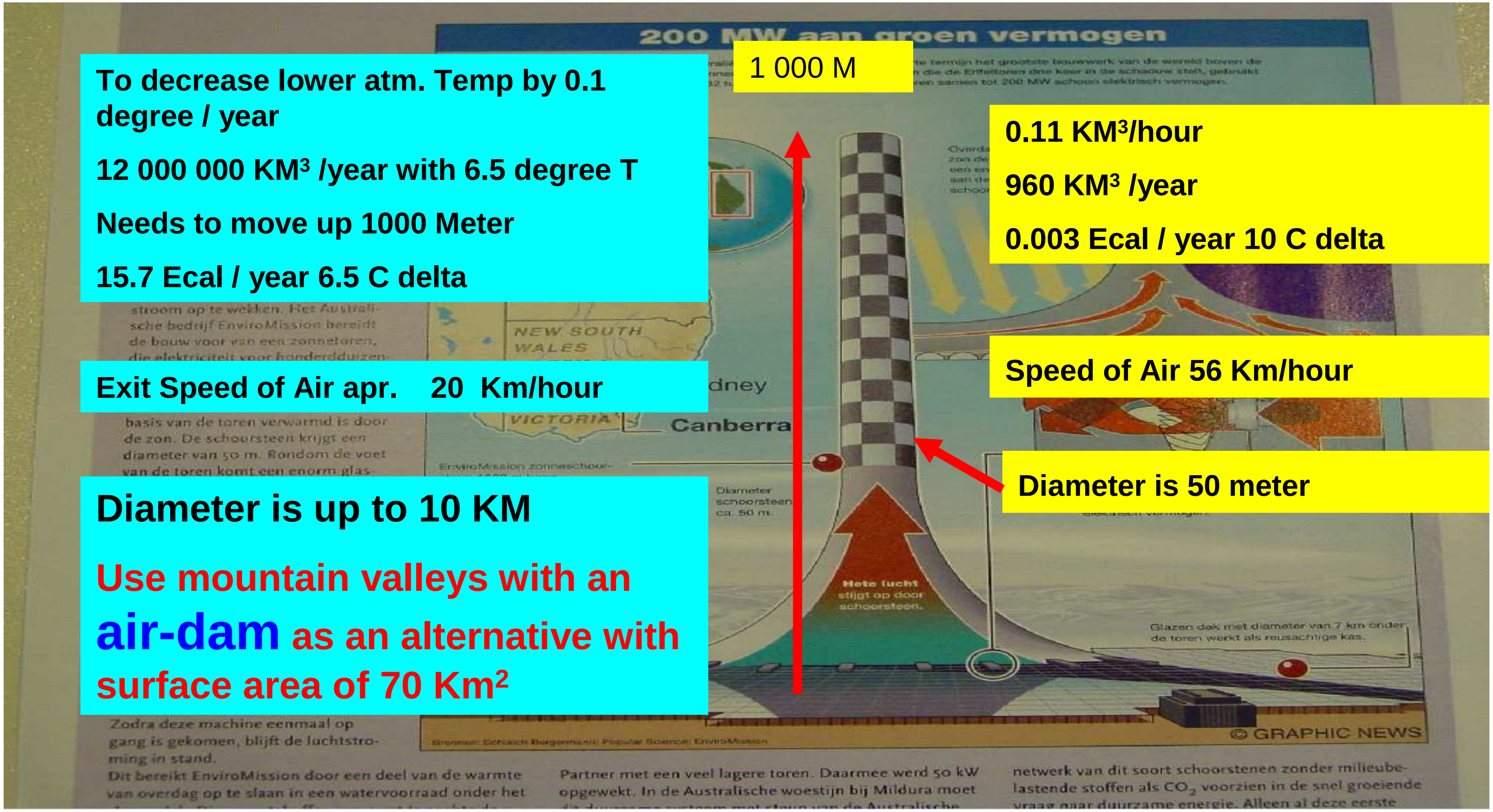
Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions



Global Heat Balance

TEIJIN
Human Chemistry, Human Solutions



To decrease lower atm. Temp by 0.1 degree / year

12 000 000 KM³ /year with 6.5 degree T

Needs to move up 1000 Meter

15.7 Ecal / year 6.5 C delta

Exit Speed of Air apr. 20 Km/hour

Diameter is up to 10 KM

Use mountain valleys with an air-dam as an alternative with surface area of 70 Km²

1 000 M

0.11 KM³/hour

960 KM³ /year

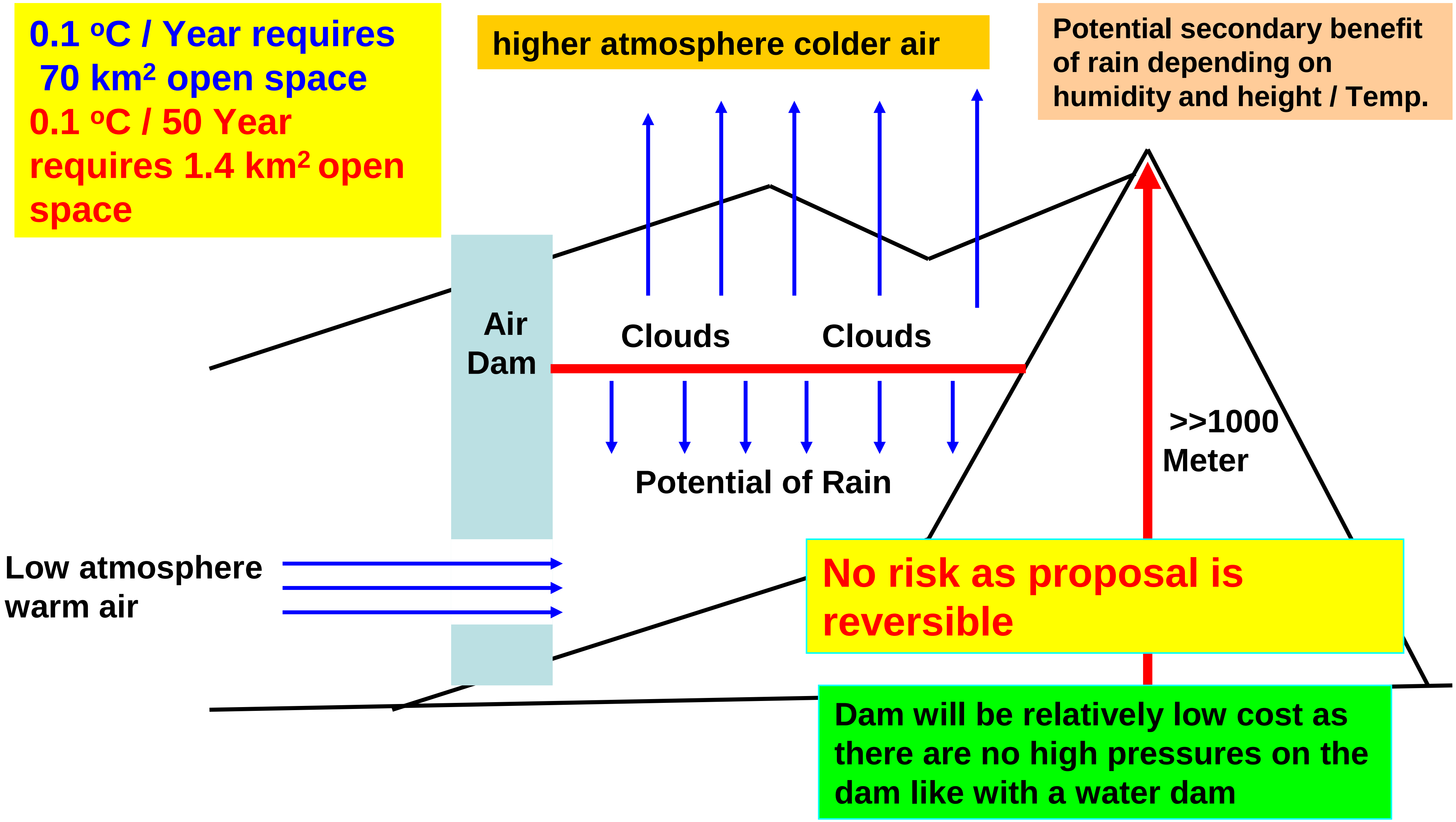
0.003 Ecal / year 10 C delta

Speed of Air 56 Km/hour

Diameter is 50 meter

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance



Ton Runneboom
Ton.Runneboom@teijin.co.jp

Conclusion

Global supply / demand balances and "Inventory and Flow" analysis provides a good overview about the issues whether this concerns CO_2 or Warming.

Inventory and Flow data shows how actions fit together

"Warming neutral" is clearly not identical to "CO_2 neutral"

To achieve "Warming Neutral" a short term , low risk and low cost option could exist by building Air-Dams and thus installing a reversible cooling system for the earth.

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Conclusion

We need multiple actions on supply and demand sides to solve our problems

and

We clearly need to understand the importance of each action and realize that those actions do not compete with each other but all go in the same direction

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

I have used many of your scientific studies , concepts and data to piece this together

That is what industrialists and executives do when they take actions in the businesses they manage … so they decide which way to go without 100 % accurate data but also taking into account the risk elements

In the business of global warming and CO_2 and greenhouse gases we need to do the same …… move in the right direction , with low risk preferably in a reversible way …

True for working on the supply side of CO_2.
True for building air dams to let Heat out.

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Conclusion

We need not only attack and control CO_2 and greenhouse-gases …… the insulation layer of the earth

But

We also need to attack and control HEAT itself and face up to reality of the HEAT mechanisms

Ton Runneboom
Ton.Runneboom@teijin.co.jp

Global Heat Balance

If we believe in global warming ……

and want to take control over our destiny

Warming Neutral looks easier to achieve within a shorter period of time than CO_2 Neutral through disposing excess heat of the lower layers into higher layers of the atmosphere to radiate out to the stratosphere.

CO_2 Neutral can be achieved by working on the supply as well as the demand side over a longer period of time

Trying to achieve Warming Neutral through CO_2 Control looks a long term goal and may well take too much time.

Ton Runneboom
Ton.Runneboom@teijin.co.jp