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Greenland Meltdown

"Greenland may melt faster than most of us think"

Climate Change,
Accelerated Sea Level Rise
Responses

by

Robbert Misdorp

YPCC Initiator;
CCC Production: Initiator, Editor en Co-author;
Advisor EUCC & Resourcefully;
Peer-Reviewer UNEP and IPCC: 2001 & 2007;
Technical Secretary IPCC "Coastal Zones" :1989-1994;
Chief Engineer - Rijkswaterstaat/Min.V&W:1978-2004
UNESCO – expert, Nile Delta:, 1972 – 1977

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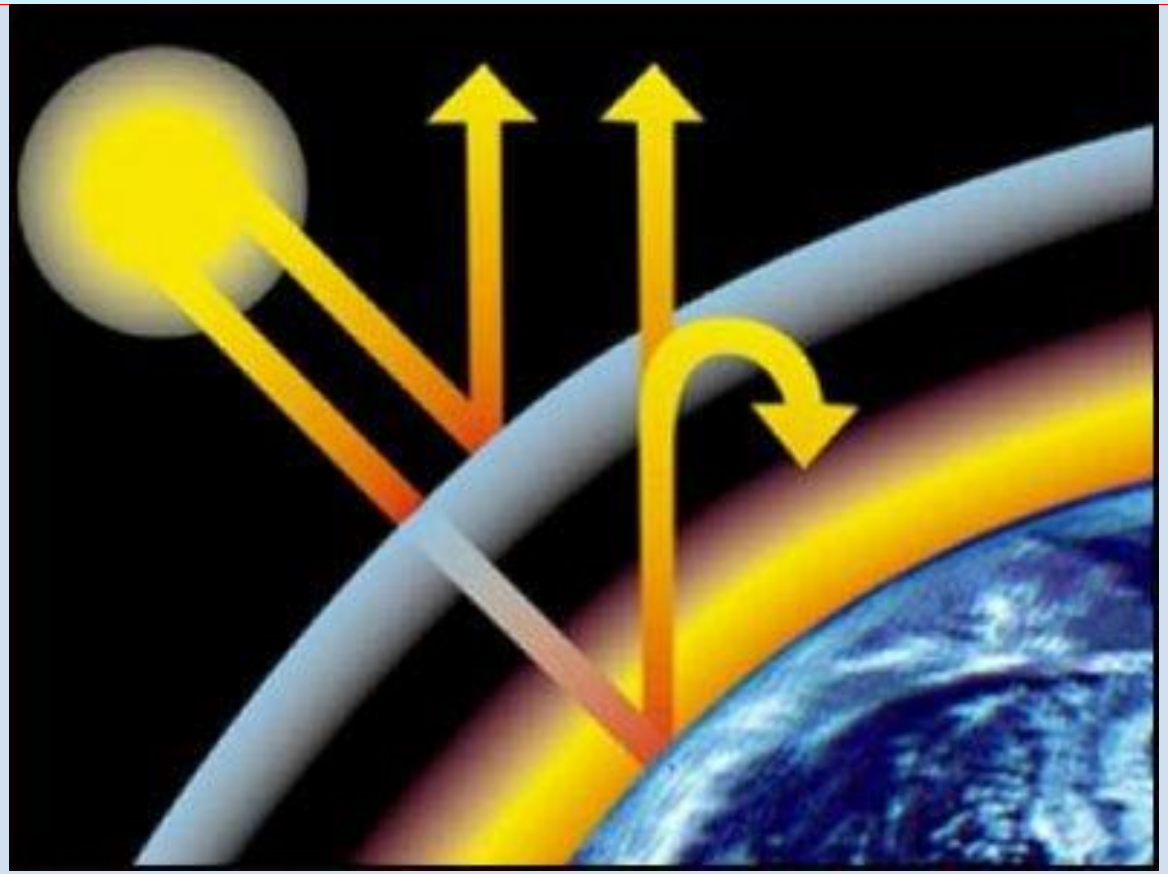
Climate Change

The atmosferic systeem:

Greenhouse -Effect -> Warming



GK-Gassen:

Watervapour

CO_2

CH_4

N_2O

[http://www.astroforum.nl/astrowiki/index.php/Broeikaseffect]

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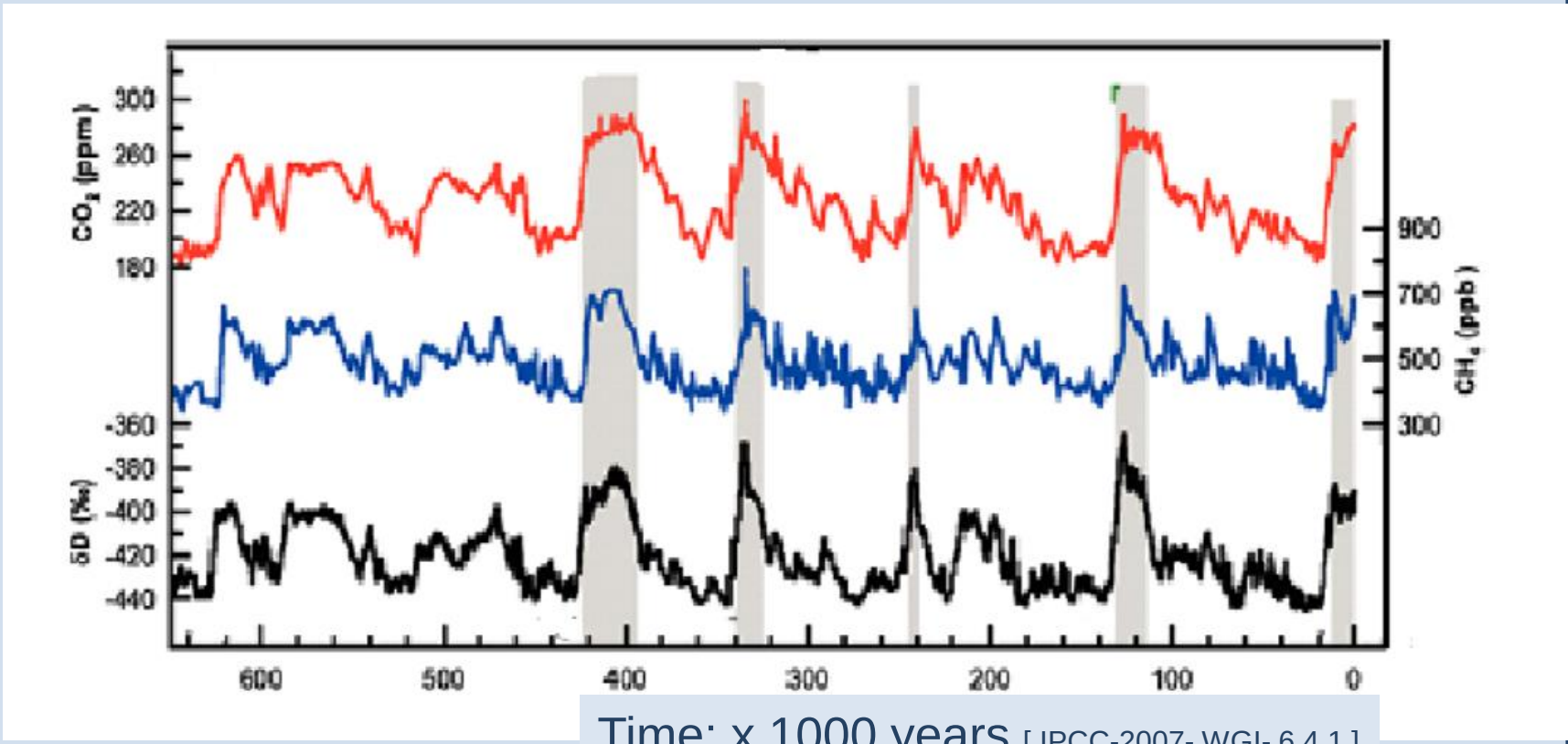
CO_2 , CH_4 & Temperature



Time: x 1000 years [IPCC-2007- WGI- 6.4.1]

Interglaciale periodes: high δD (black) proxy Temperature, CH_4 en CO_2 values,
Glacial periodes: low values; max. last glacial :: sea level: - …m

δD <->T http://uwpcc.washington.edu/documents/PCC/icecore_temp_uwinhs_schoenemann_draft_lowres.pdf

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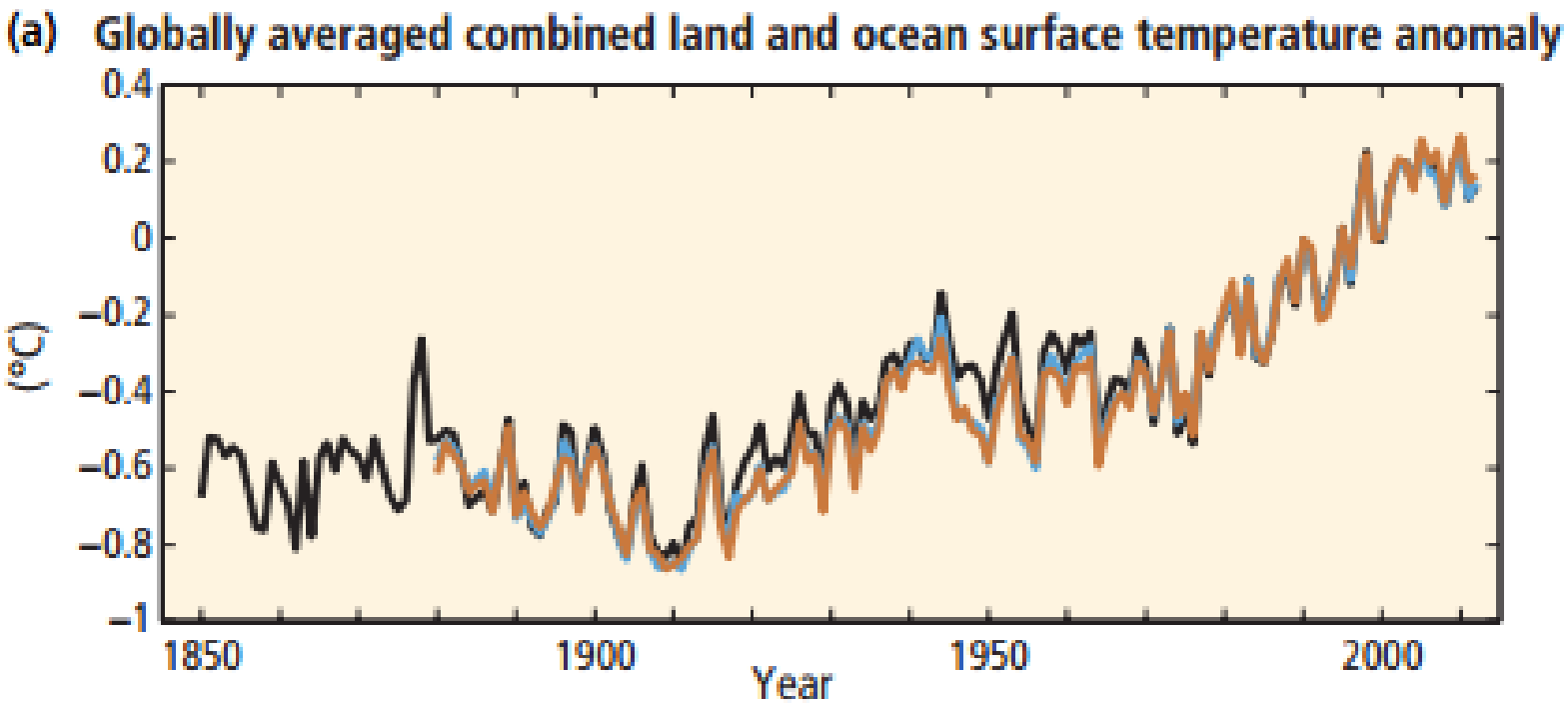
Global temperature increase in 20th century

Circa 0,9 degrees Celsius



https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf

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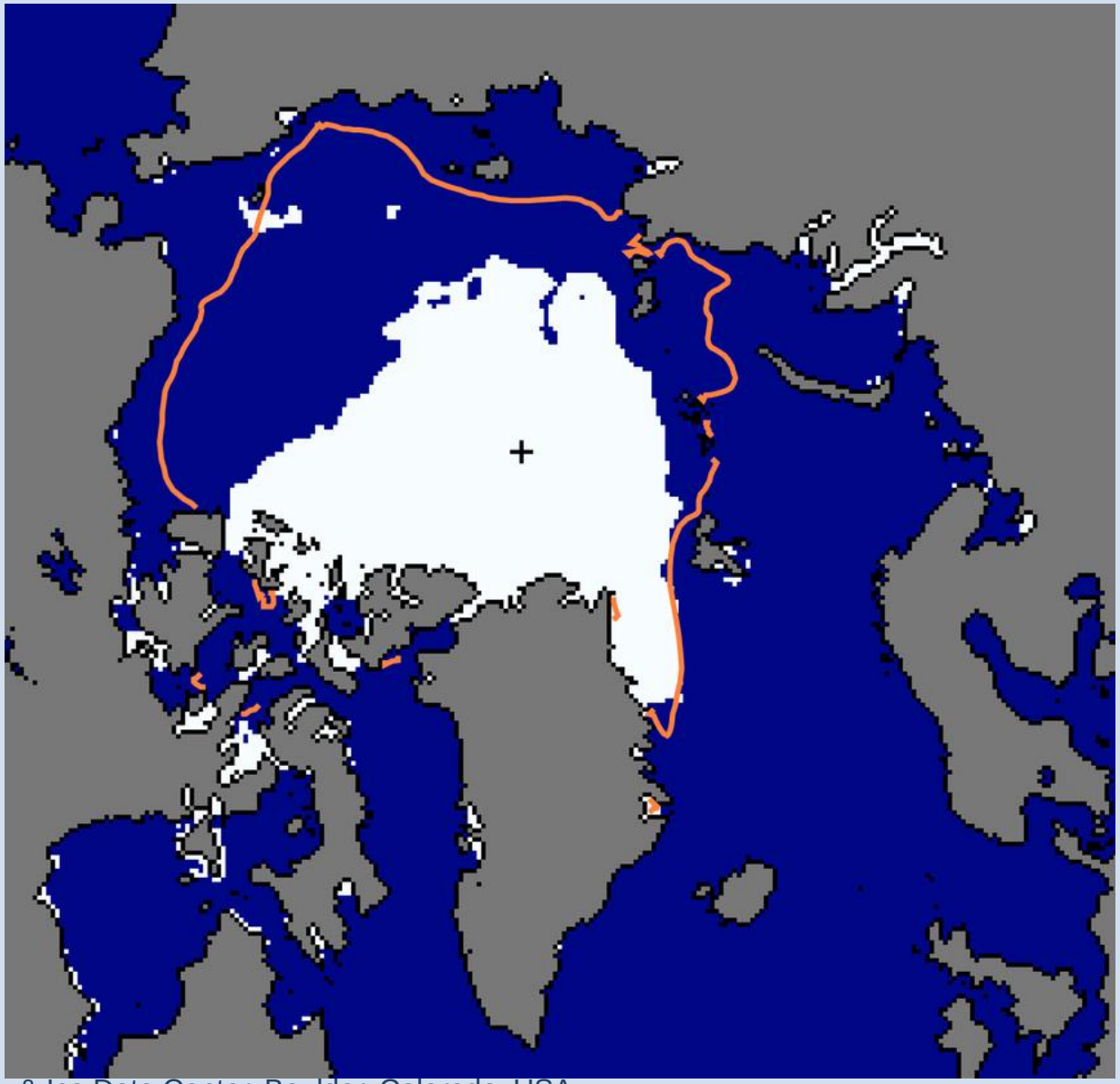
Arctic Sea Ice extent

in GIS mode

26 August 2012



median
1979–2000

National Snow & Ice Data Center, Boulder, Colorado, USA

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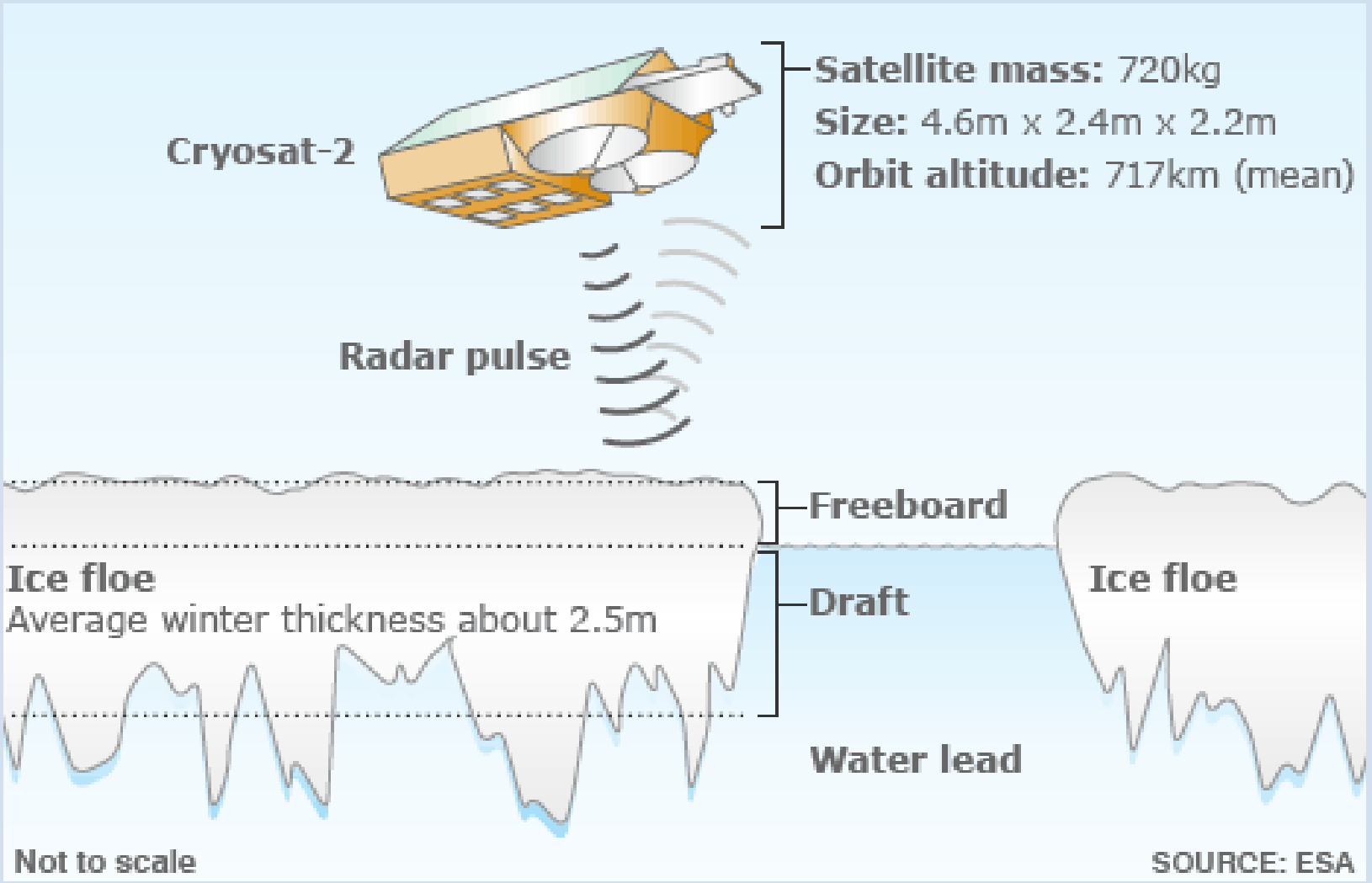
E S A – Cryosatellite -2

measuring Ice thickness



Reference : http://news.bbc.co.uk/2/hi/8609428.stm

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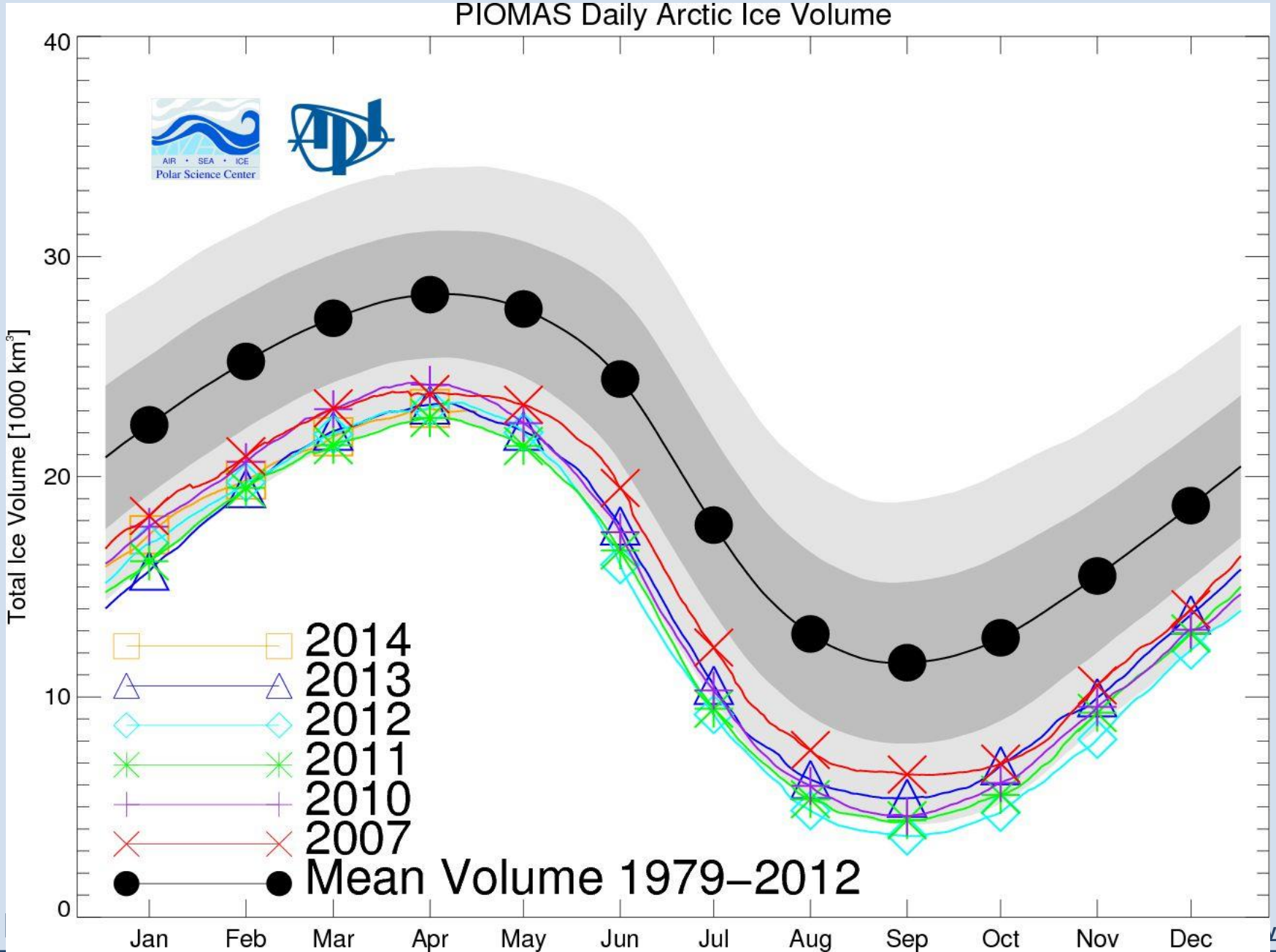
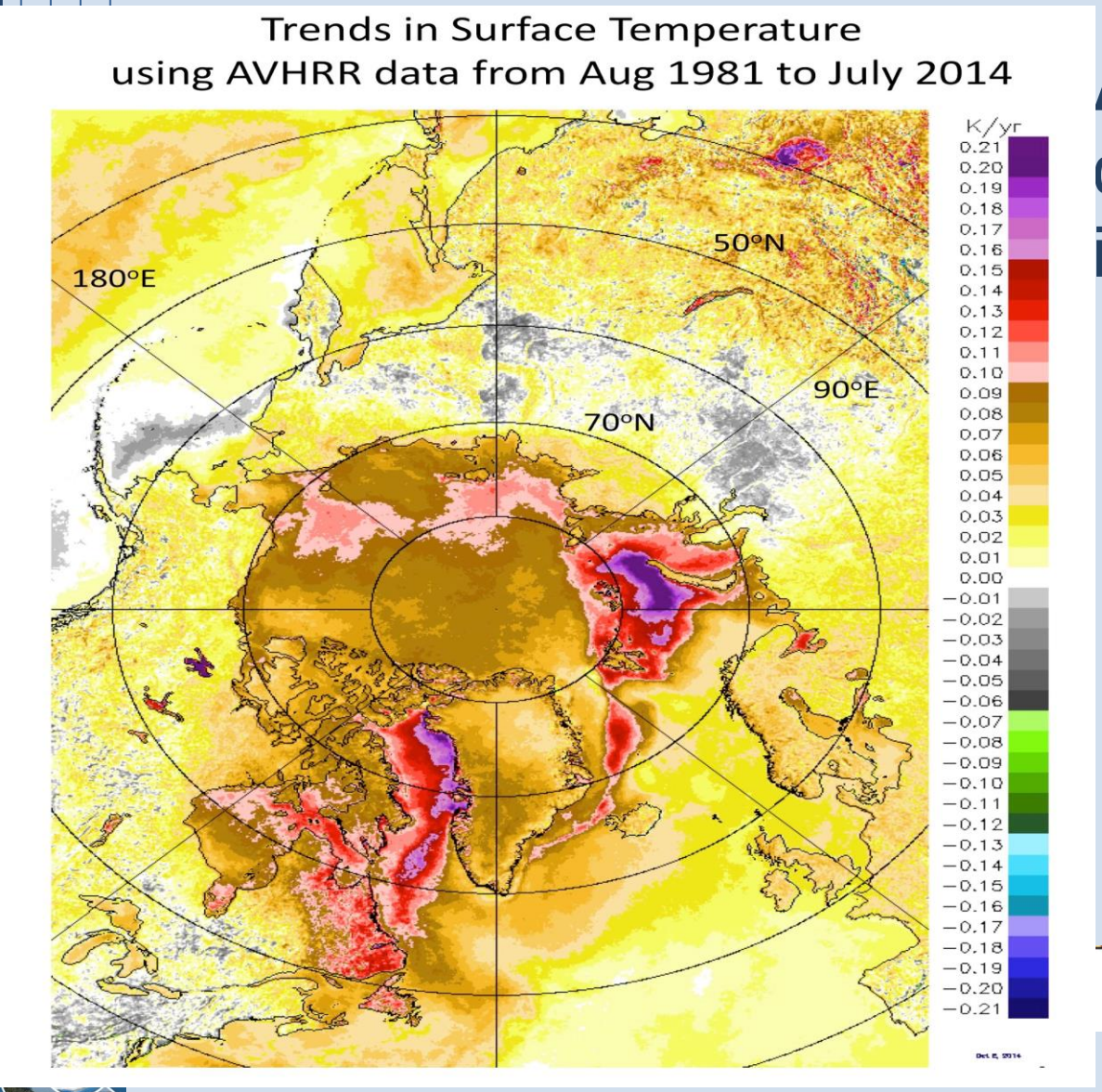
Arctic Sea Ice volume dynamics



Arctic Ocean region warming



ASI melt ::
decreasing albedo ::
increasing **T**emp:

2^0 Celsius/decade

affecting the

Greenland
Ice
Sheet

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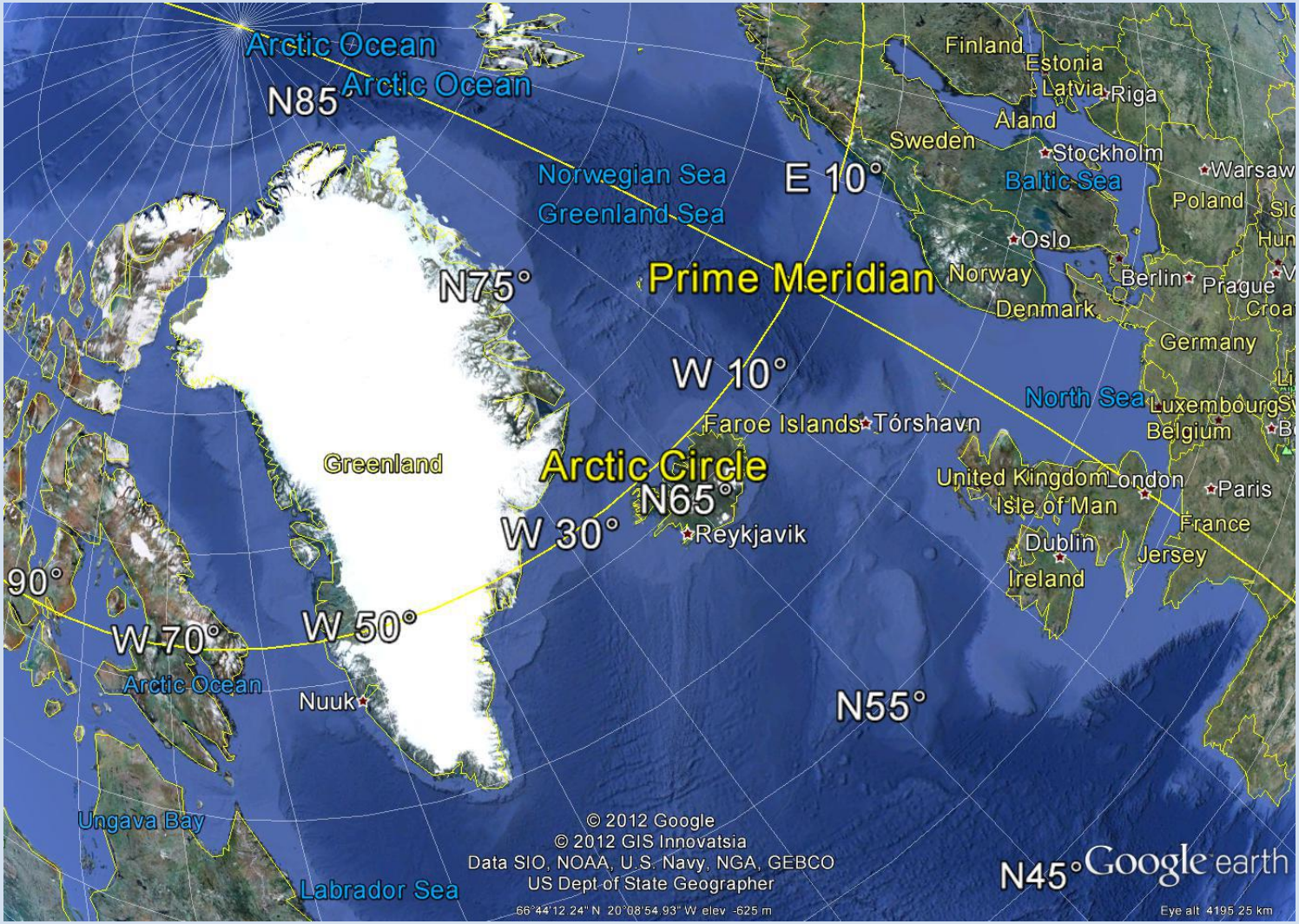
Greenland Ice Sheet - GrIS

Maximum length: 2600 km, width: 1100km & max. thickness: 3.5km



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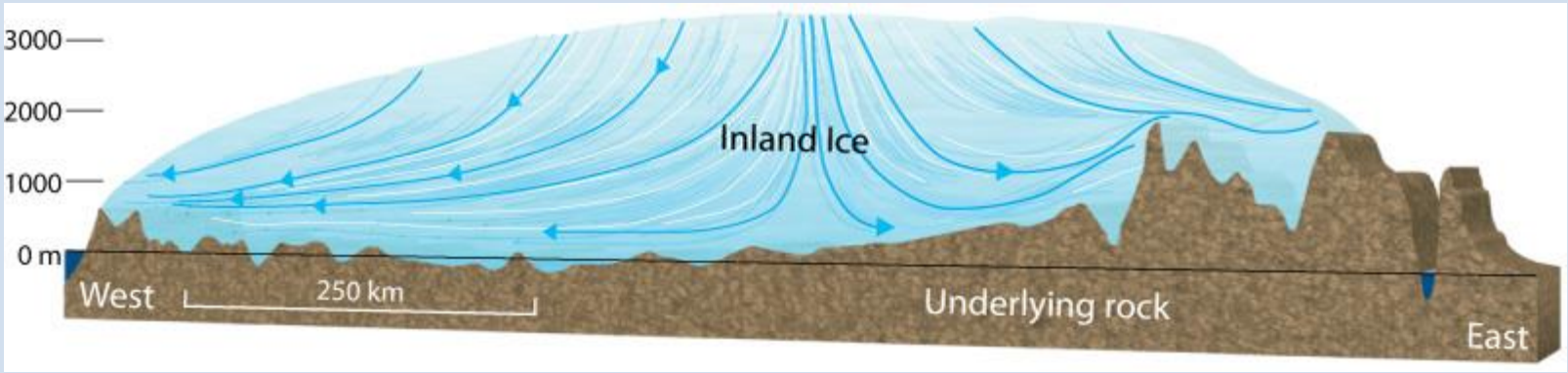
Cross section of Greenland



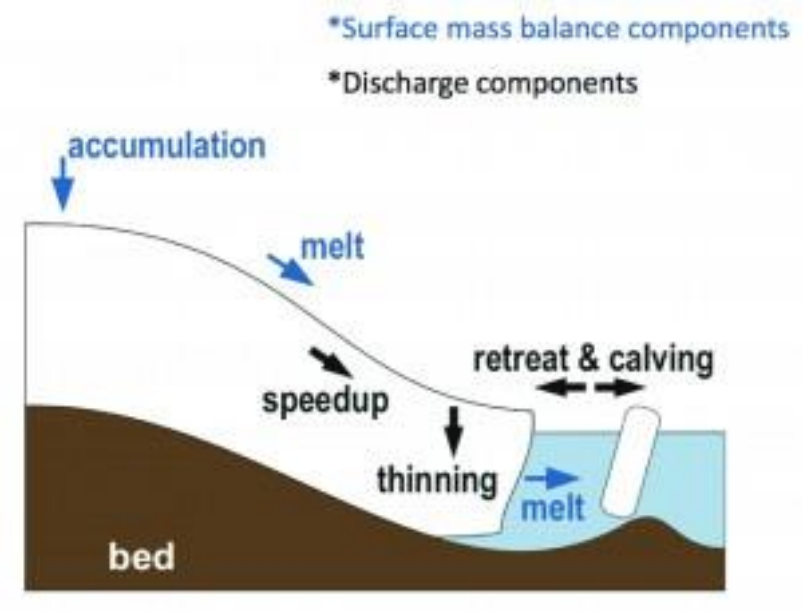
Ice Sheet dynamics

Melting entire ice sheet :: global sea level rise of 7.2 m

(Illustration: Carsten E. Thuesen;
http://www.geus.dk/viden_om/voii/ilulissat-uk/voii05-uk.html)

Two processes reducing the GrIS Ice volume

1. **Melting**: transferring ice into water moulins & supra-glacial lakes → thinning the ice sheet
2. **Discharge**: calving of the ice front via icebergs → retreat of the ice front.



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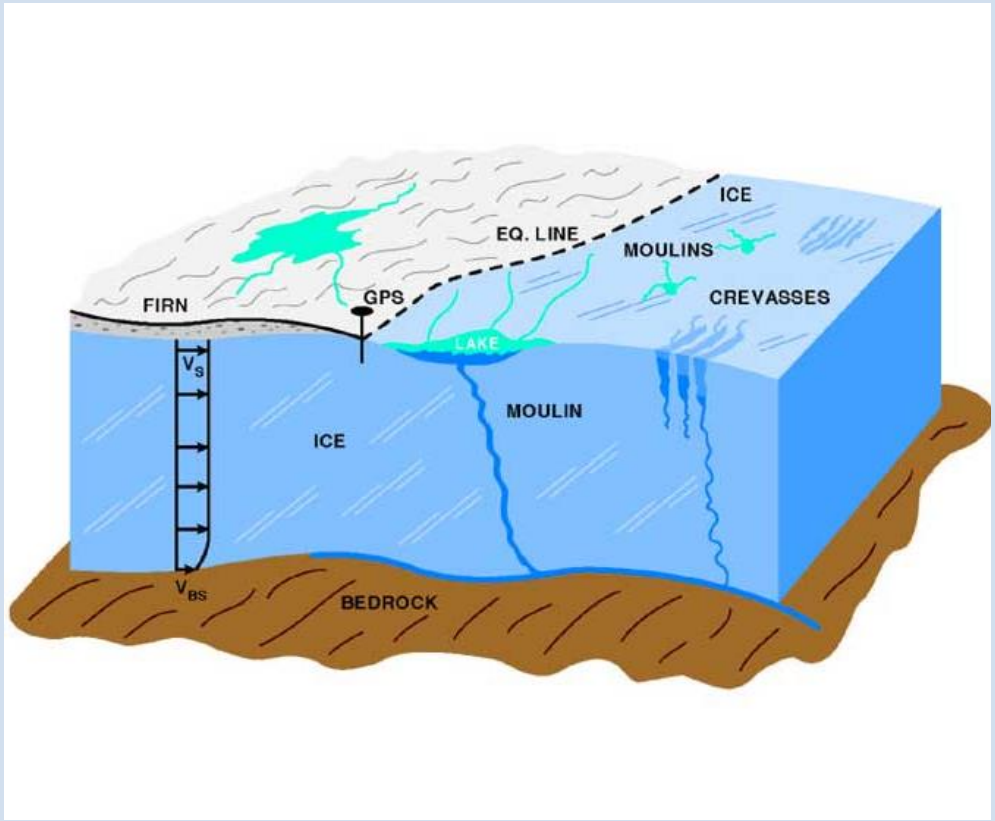
Melting process of the GrIS

Summer meltwater stream flowing into a large **'moulin',**



Moulins transport water = heat to the bedrock, enhancing lubrication and increasing instability.

Photo Courtesy: Roger J. Braithwaite, University of Manchester, UK
2008

“Supra-glacial” lakes

Many 10,000 of large surface lakes drained during a short period, summer 2012, as a response to the large scale meltwater production

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Animation: Draining of a supra glacier lake,

a slipping glacier & formation of icebergs =

an important acceleration of the melting process

difficult to math. model and to predict

https://www.youtube.com/watch?v=oiPT1Vy03As (Promice: Programme for Monitoring of the GrIS, Denmark)

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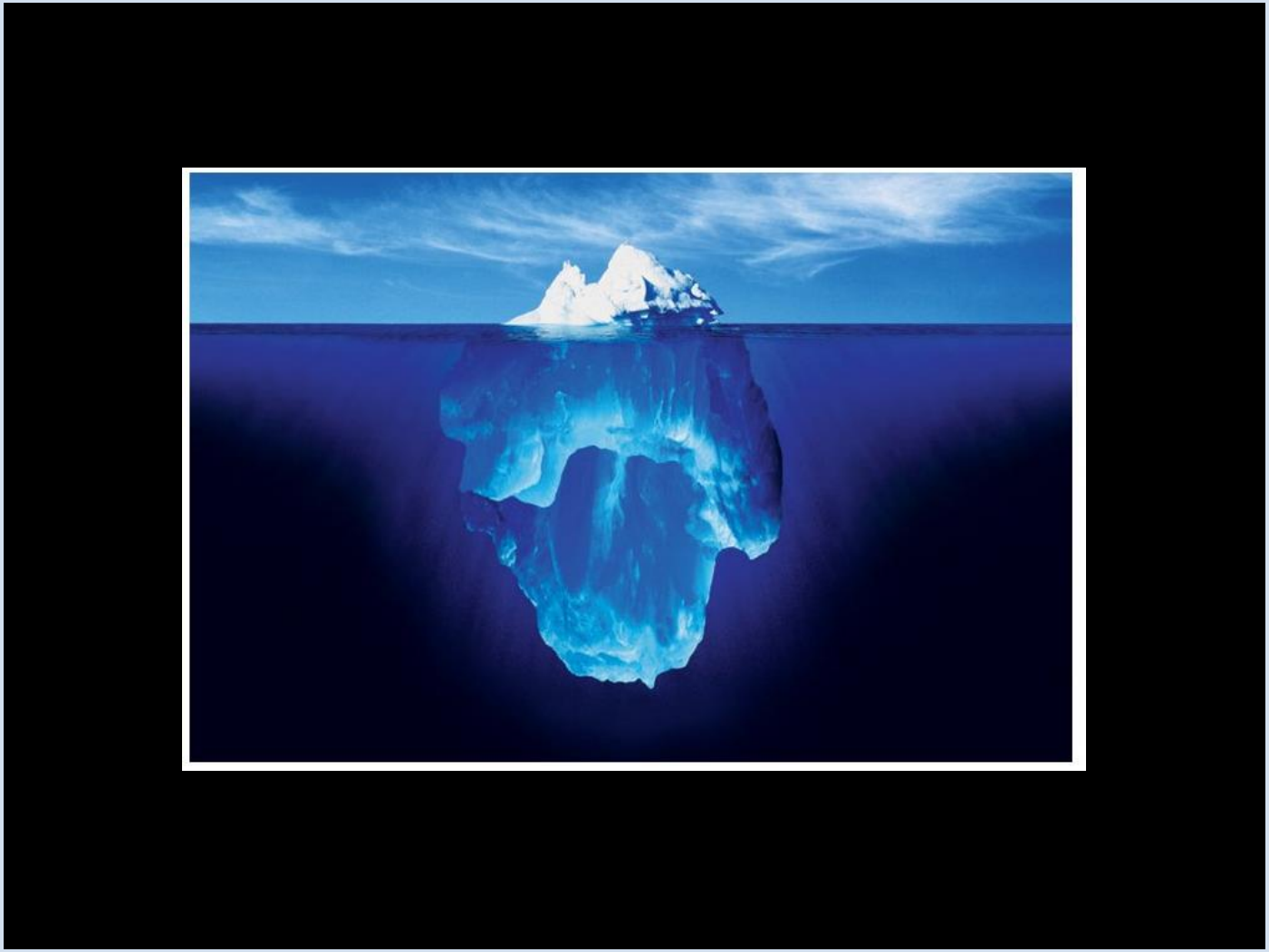
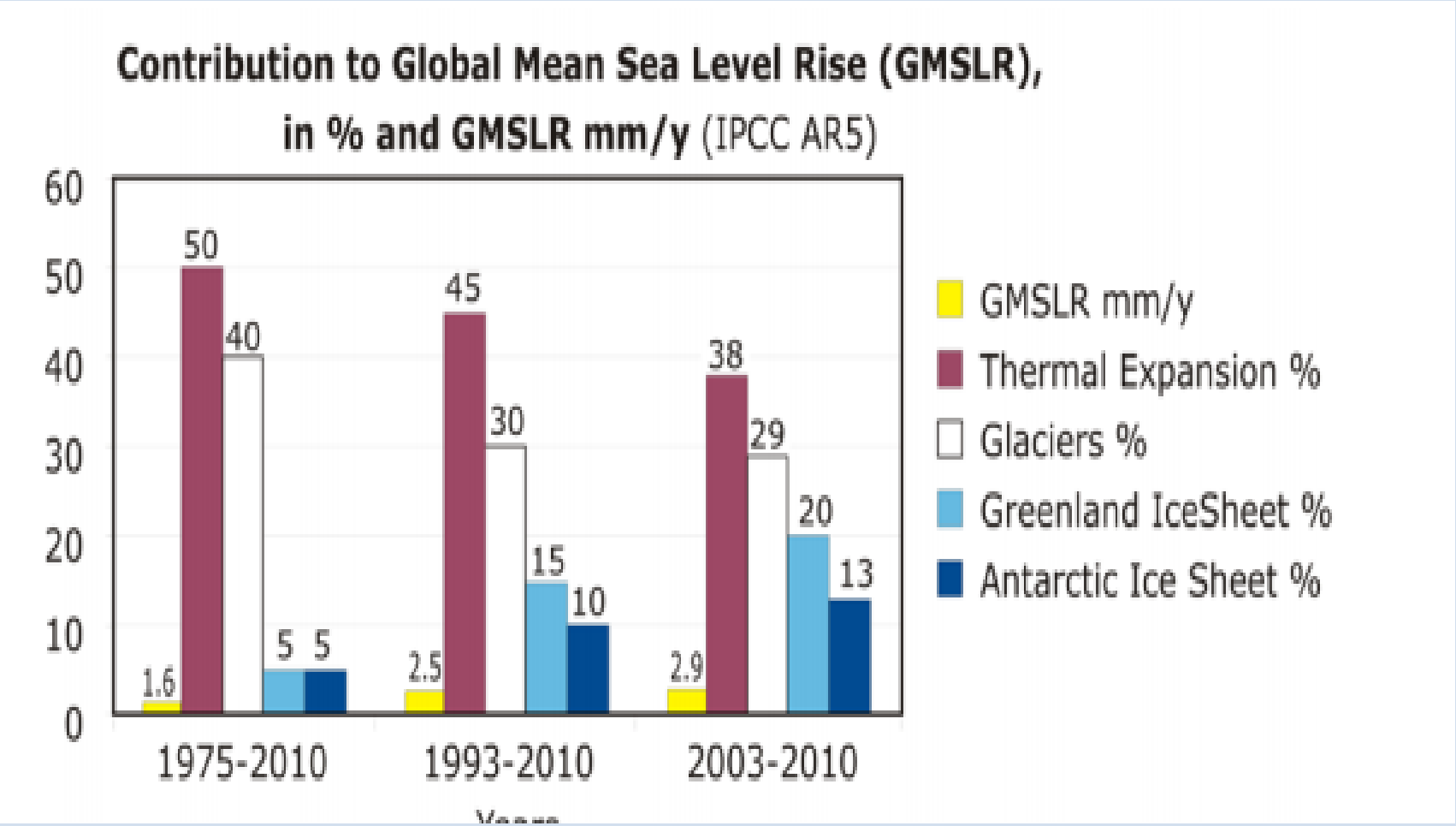
Iceberg Collapse, Sermilik Fjord, East-Greenland



Steve Behaeghe: https://www.youtube.com/watch?v=9-2tHtgv8Go

Sea Level Rise: contributing factors



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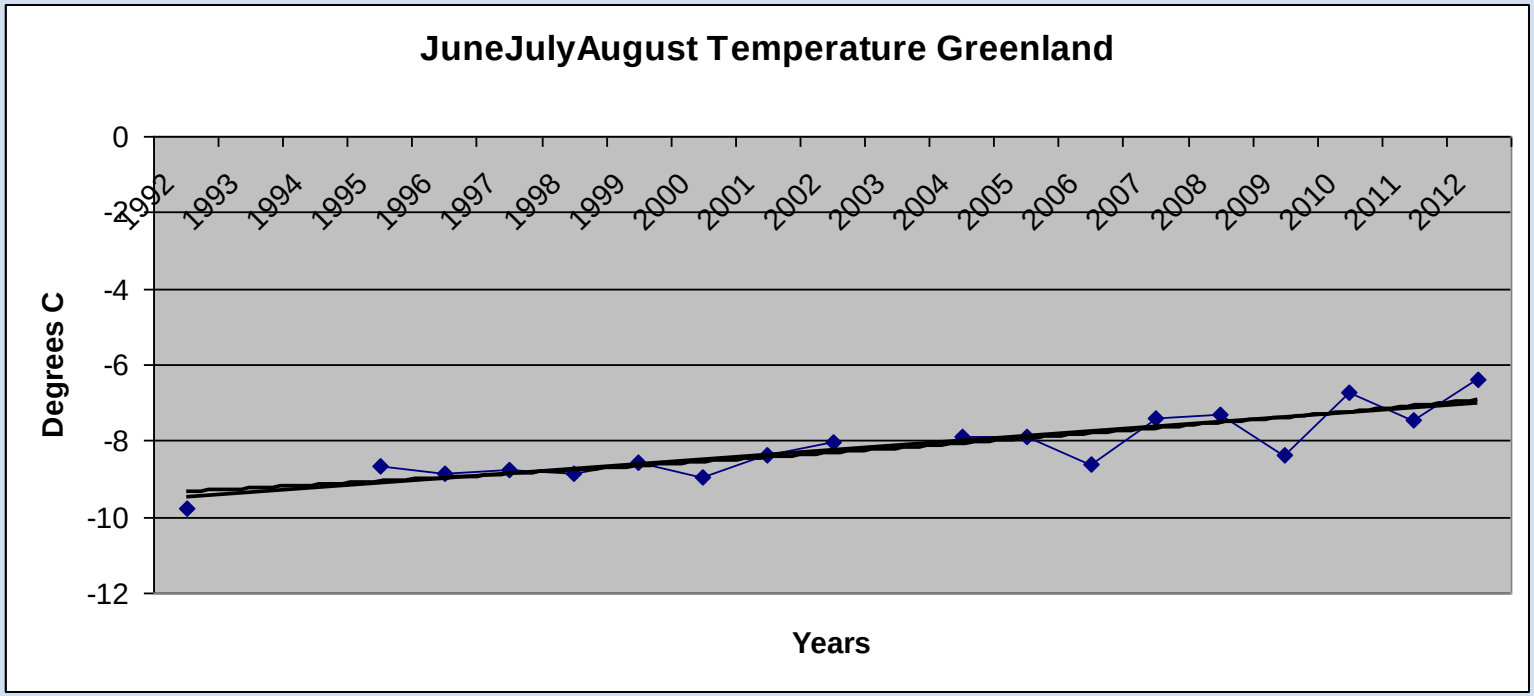
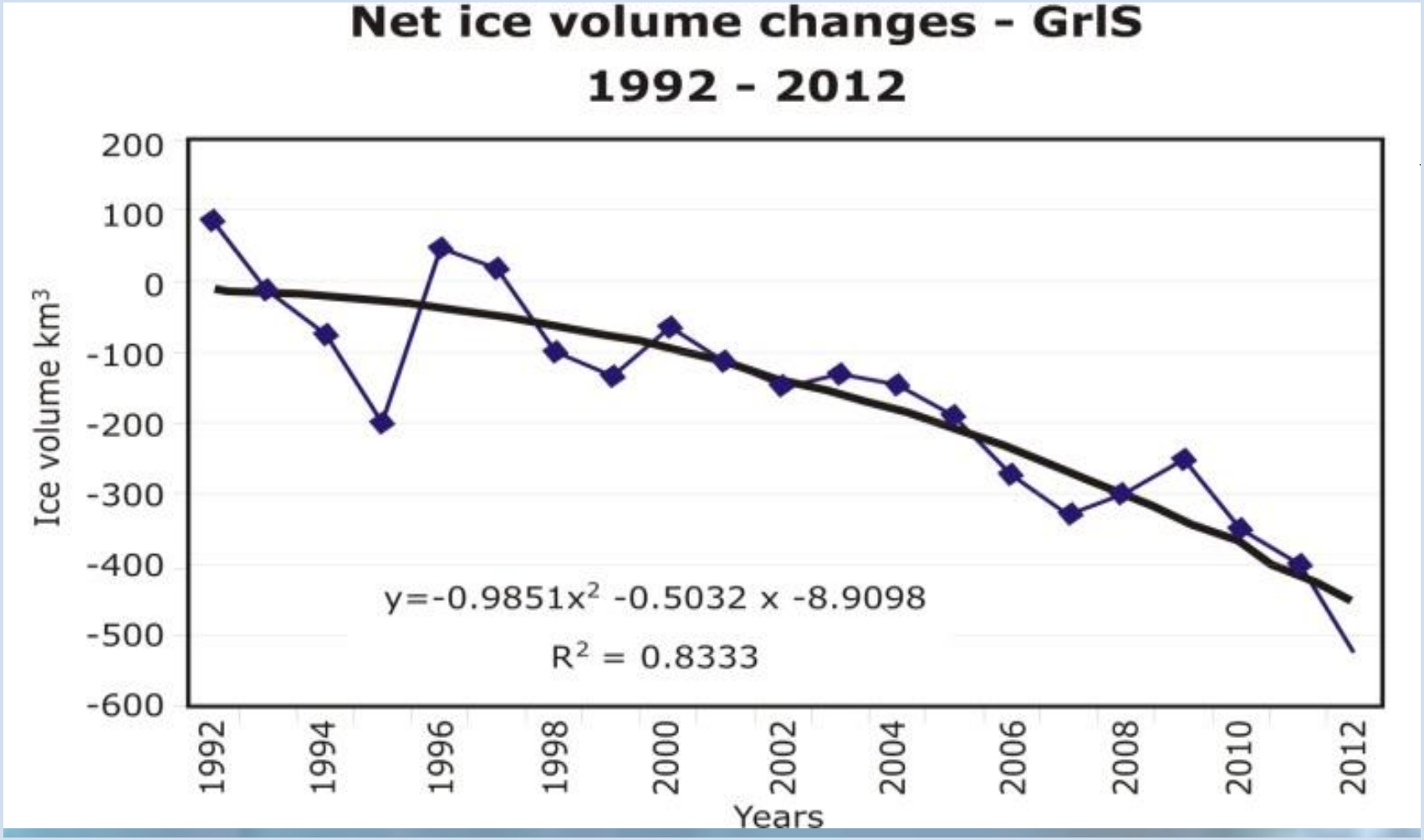
Summer Temperature Greenland 1992 - 2012



Melting rate Greenland Ice Sheet



Two “Sleeping Giants”

- **Melting West Antarctic Ice Sheet** :: 5 m SLR

  Start of accelerated melting (>> 1mm SLR/y)

  expected not before 2100

- **Thawing of Arctic permafrost area**

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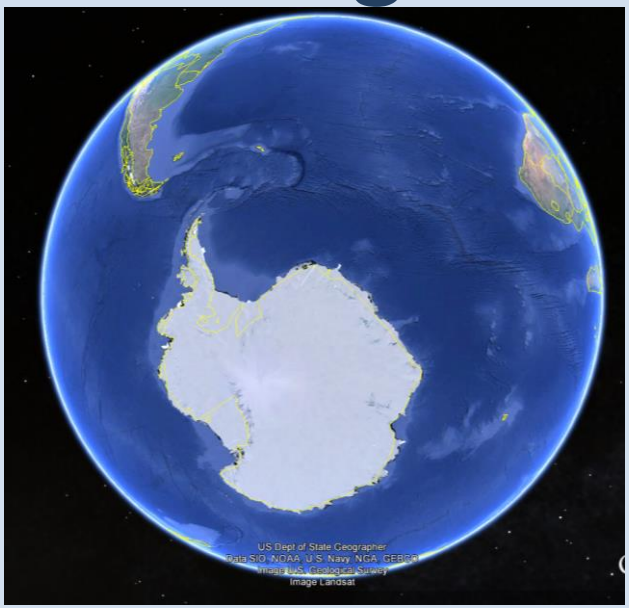
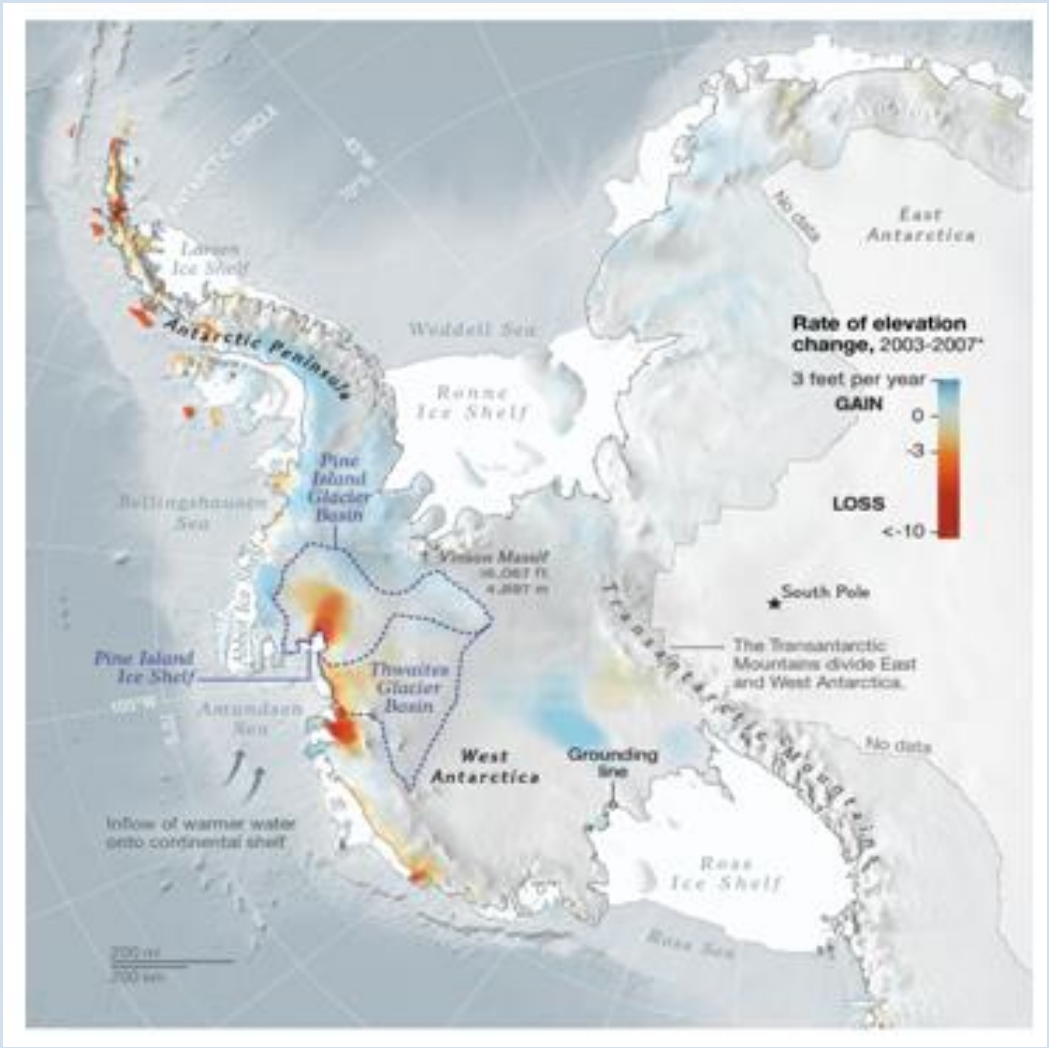
Melting of West Antarctic Ice Sheet





Thawing and Decomposing permafrost around the Arctic Sea

Preliminary results of new Alaska research estimating the CH_4 role:

- **About 20 million km² permafrost** area around the Arctic Sea,
- **Permafrost is thawing** at a large scale and increasingly fast,
- Anoxic, bacterial decomposition of permafrost releases CH_4,
- CH_4 is a GHG: 25 more powerful than CO_2,
- Quantity CH_4: twice as much in permafrost region than in the atmosphere.

Release of inflammable CH_4 in refrozen lakes, Permafrost region, Alaska.

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See for more information Alaska VPRO video - US research:

the thawing of the permafrost in Alaska and the release of GHG,

Three episodes:
19.00 – 19.26,
33.00 – 33.10,
48.00 – 48.45

http://www.npo.nl/klimaatjagers-alaska/08-09-2013/VPWON_1181315

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Concluding: Melting GrIS and SLR

Looking at the effects of :

- the strong increase of melting last 2 decades,
- the slipping outlet glaciers,
- the quadratic regression Temperature versus Melt,
- the potential impacts of the two ”Sleeping Giants”:

We conclude that a Global Accelerated Sea Level Rise of

1.5 m / 21st Century should be considered as not unlikely

Responses

Two types of responses:

1)Mitigation:

reducing the GBG emissions

2) Adaptation:

in case mitigation efforts are too late or insuficient

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CO_2-uitstoot groeit wereldwijd niet meer …….een primeur!!?

De economie groeit inmiddels zonder dat er meer broeikasgassen worden uitgestoten….IEA:

Voor het tweede jaar op een rij is de jaarlijkse hoeveelheid CO_2-gasse die vrijkomt als gevolg

van het wereldwijde **energieverbruik** namelijk gelijk gebleven.

16 maart 2016: http://nos.nl/artikel/2093187-co2-uitstoot-groeit-wereldwijd-niet-meer.html

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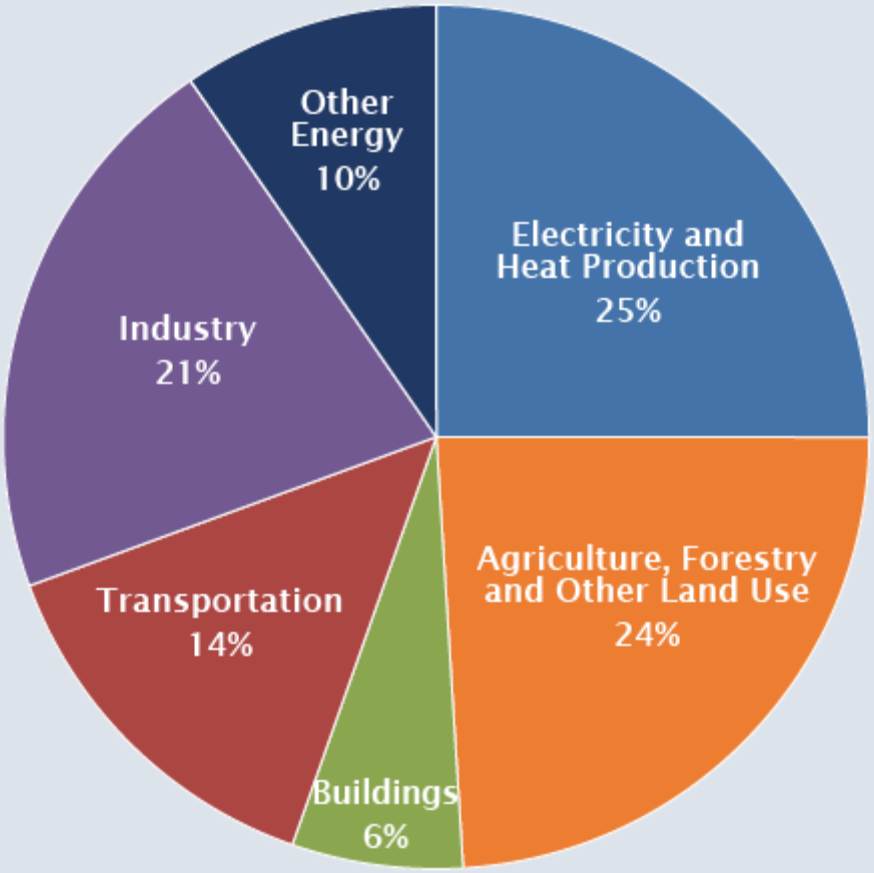
CO_2-uitstoot groeit wereldwijd niet meer …….een primeur??

Mondiale uitstoot per economische sector – 2010



Electriciteit en Warmte productie = 25%

IPCC 2014

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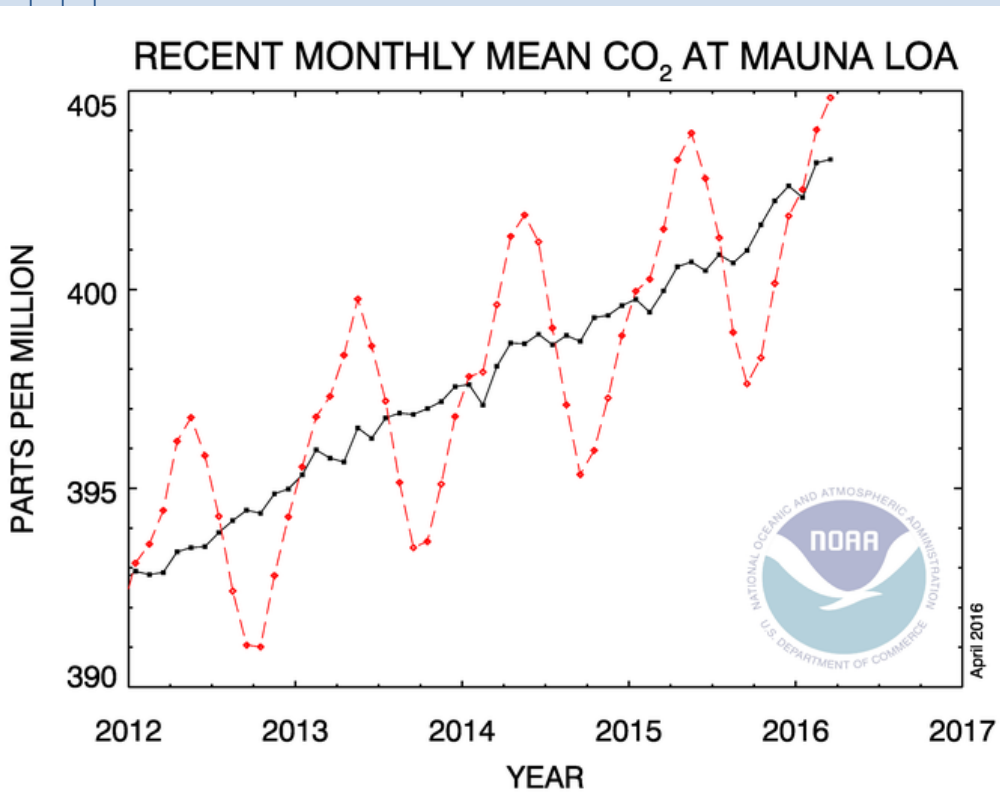
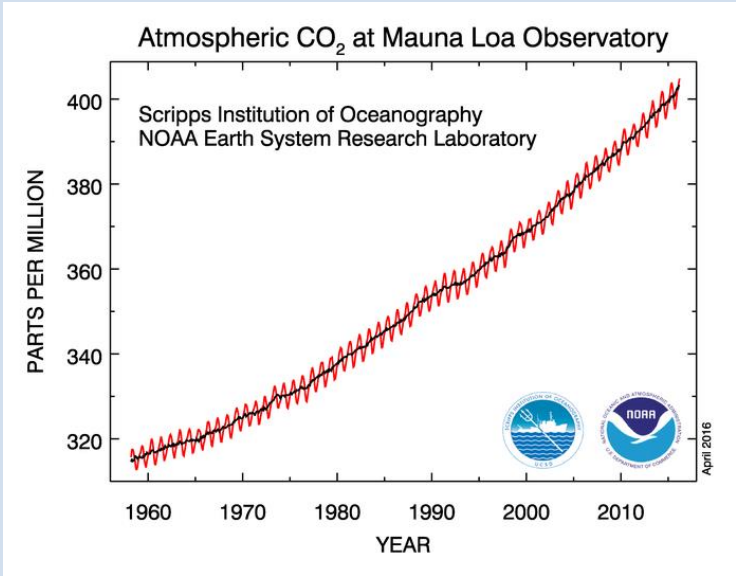
CO_2-uitstoot groeit wereldwijd niet meer …….een primeur??

De mondiale CO_2 Concentratie metingen op Hawaii:

March 2016: 404.83 ppm
March 2015: 401.52 ppm
Last updated: April 5, 2016





http://www.esrl.noaa.gov/gmd/ccgg/trends/index.html

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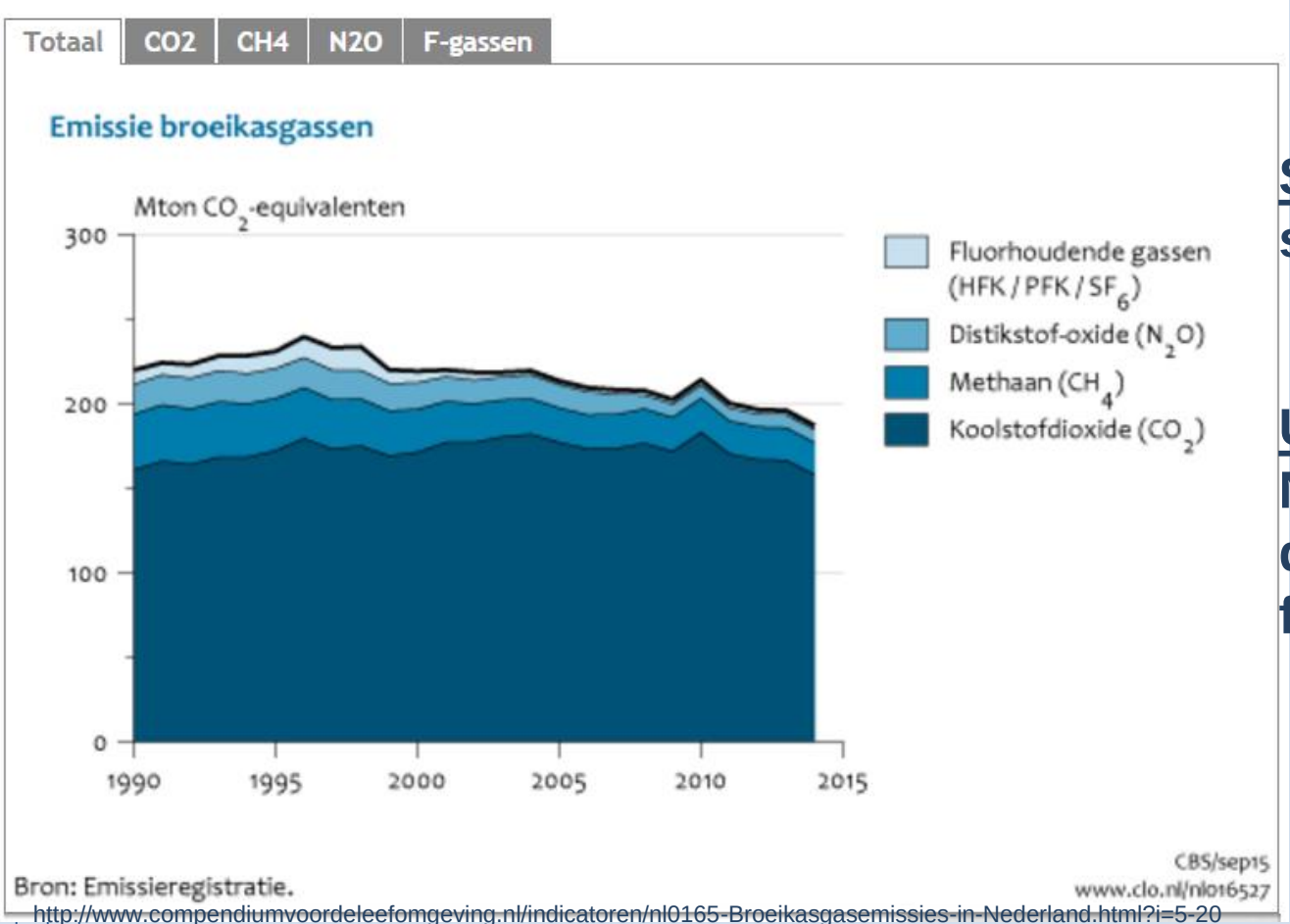
GKG emissions the Netherlands 1990 - 2014



http://www.compendiumvoordeleefomgeving.nl/indicatoren/nl0165-Broeikasgasemissies-in-Nederland.html?i=5-20

Small decrease since 2005;

Unique Court case:
Neth. State needs to decrease emission from 220->165Mt CO_2e

in 2020

A lot of mitigating work ahead in the Netherlands before 2020 and thereafter!

http://www.urgenda.nl/en/report-2030/

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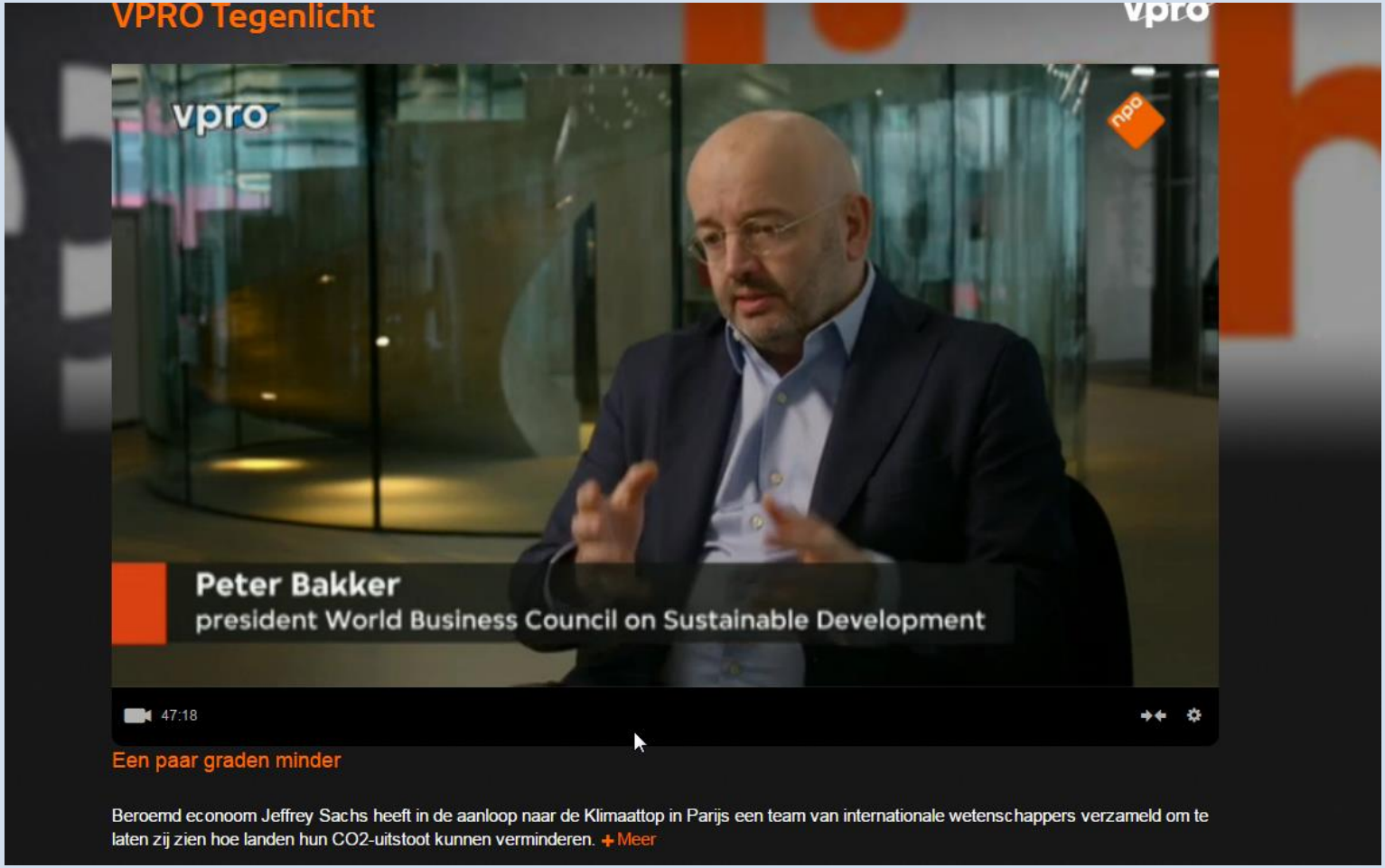
Mitigation –

CO_2 uitstoot verlagen nu … !



http://www.npo.nl/vpro-tegenlicht/22-11-2015/VPWON_1232896: 4.25 – 5.55min

Conclusions
Mitigation measures

1. Mitigation, no-regret measures needed:
   much more efforts in sustainable energy production

2. Parties involved: government+ business community + public

3. Global Business Community now alert and able to act

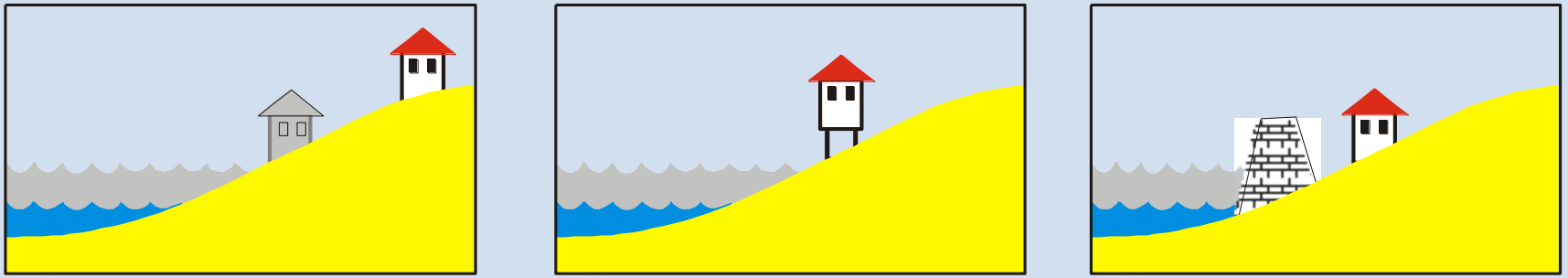
4. Large global changes ahead: not threathening but can be turned in economical beneficial opportunities creating new types of employment.

Adaptive coastal measures

Integrated Coastal Zone Management
-> Adaptive Strategies

Current situation and sea level

RETREAT **ACCOMMODATE** **PROTECT**



Future adaptive responses with sea level rise (IPCC, 1992)

Reference: CCC Chapter II-3-5: "Coastal Defence Guide", http://www.coastalcooperation.net/part-II/II-3-5-f.pdf

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Thank for your attention

However……

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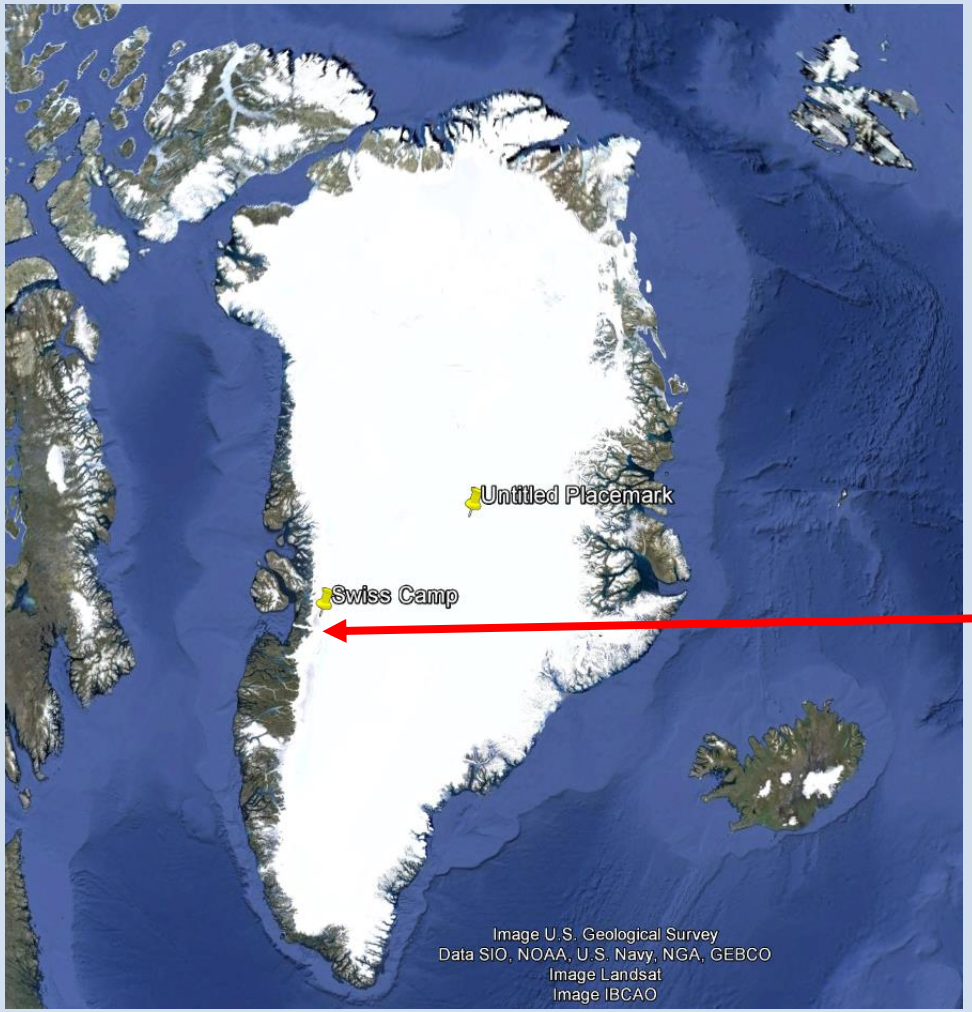
Finally once more Greenland



Jacobshavn Ice Fjord

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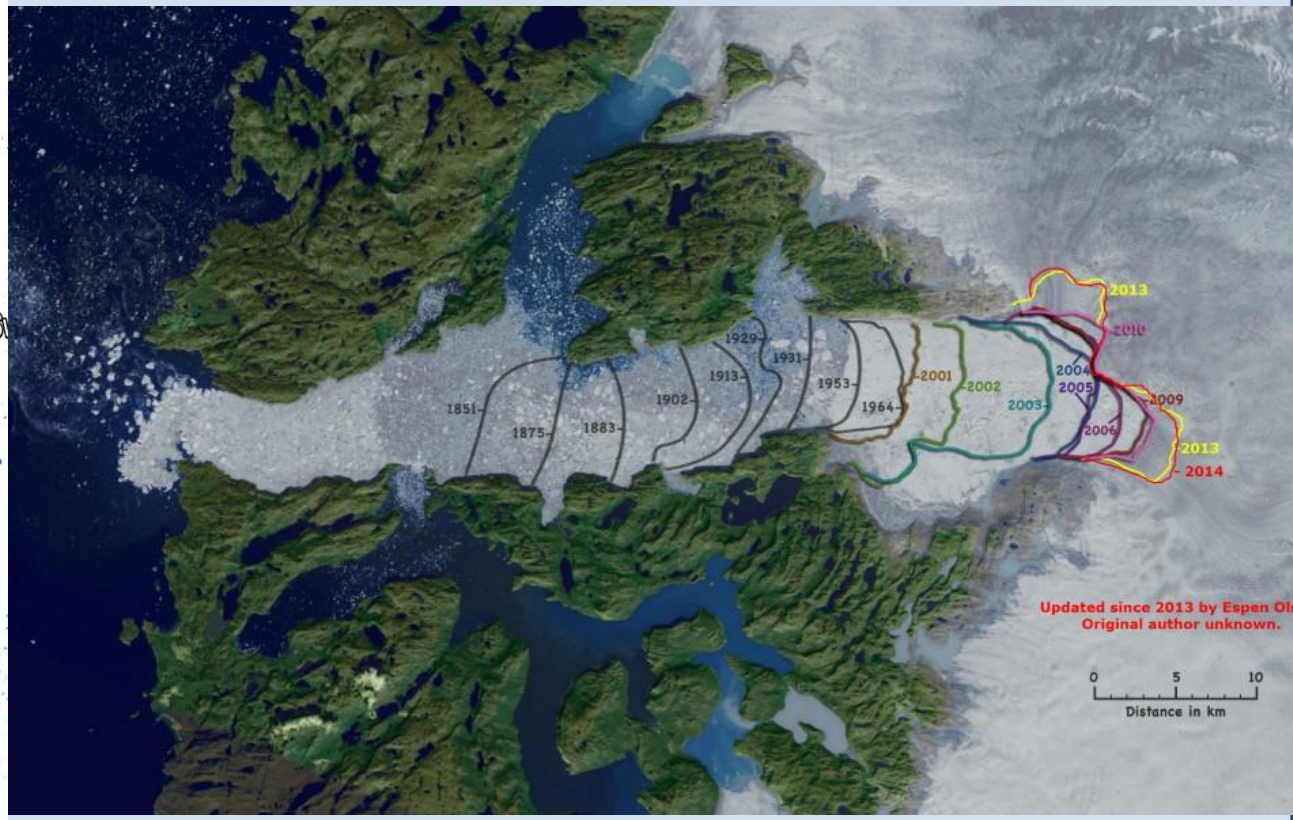
Greenland: Jakobshavn Isbræ



Jacobshavn icefront,
ca 100 m hoog

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Greenland: Jacobshavn glacier calving

28 Mei 2008, in 75 minuten: ca 1 mijl terugschrijding over een 3 mijl breedte met een ca 3000 feet ijsdikte = ca 10 km^3 ijs

Jacobshavn Glacier:

6% draining GrIS=

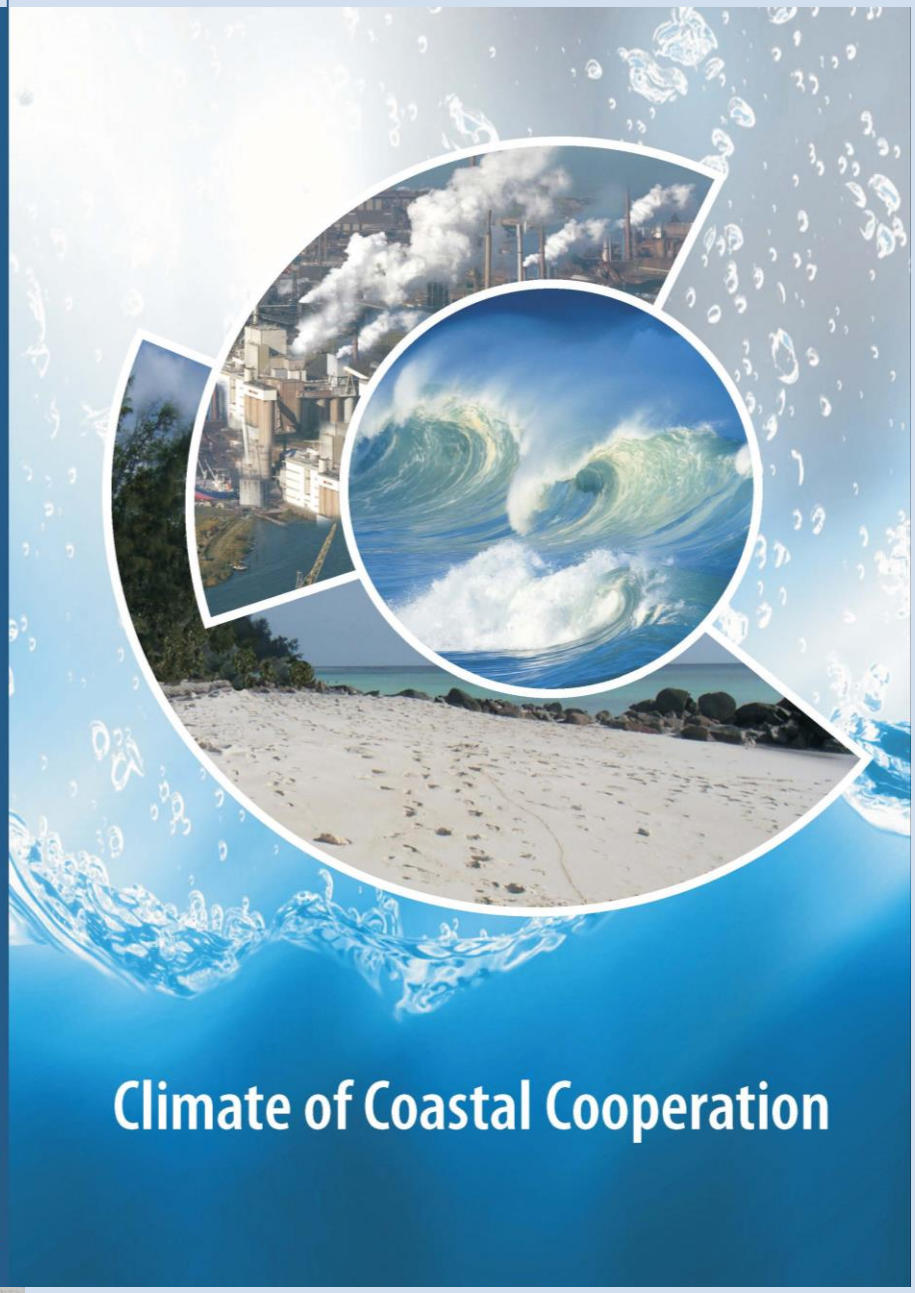
15-20 km^3 ijs

in 2012

http://wn.com/jakobshavn_glacier

http://greatwhitecon.info/2015/02/shock-news-massive-calving-of-jakobshavn-isbrae/

Meer informatie:



CCC Production:

Book (208 p)

+

Internet Publication (> 900p)

Intro's by high level executives;

33 Cases from Europe and Asia;

7 Interactive GIS based Training Tools & Manuals;

8 Examples of innovative, adaptive coastal measures;

101 International co-authors with their e-mail Addresses.

http://www.coastalcooperation.net/

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Thank for your attention

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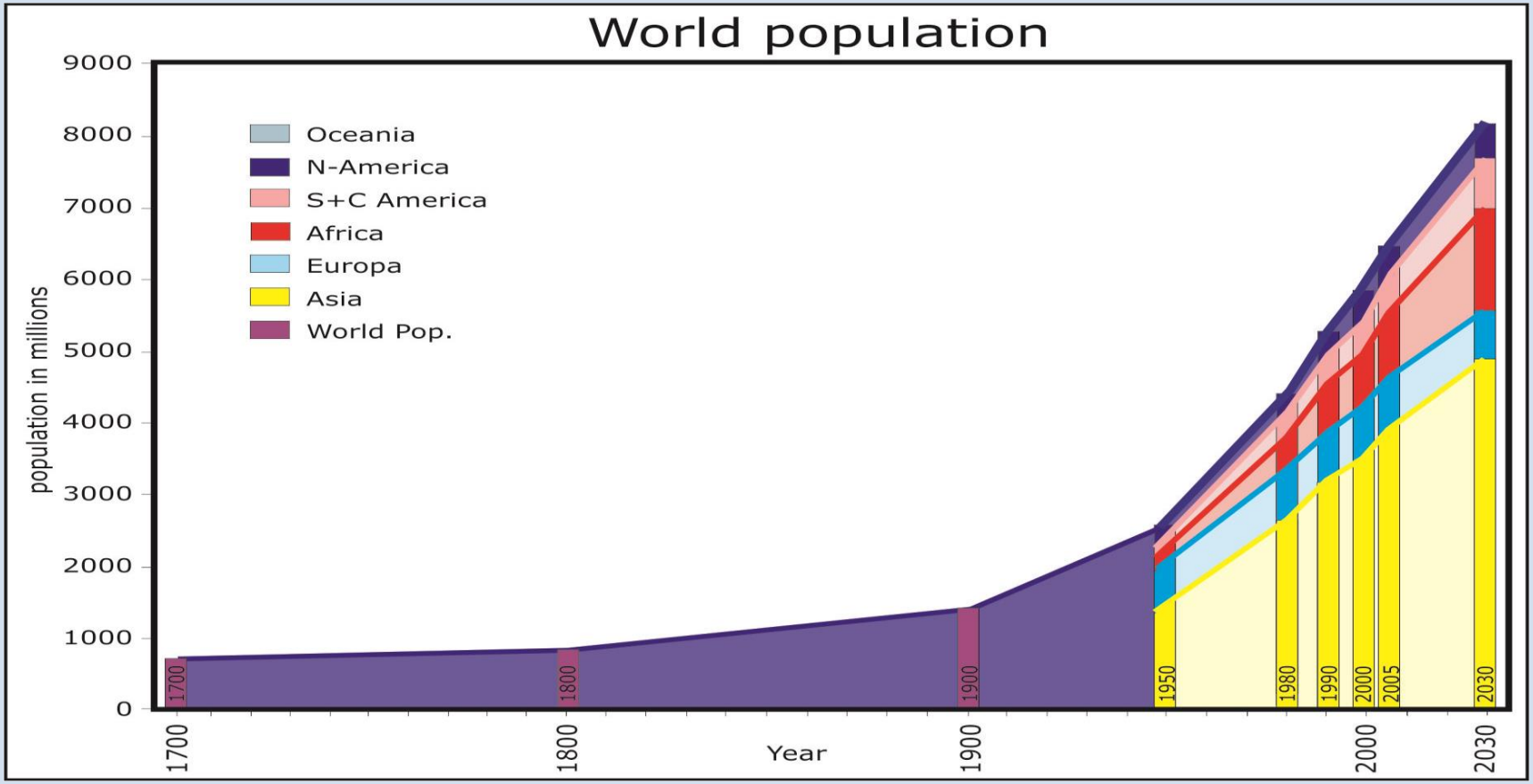
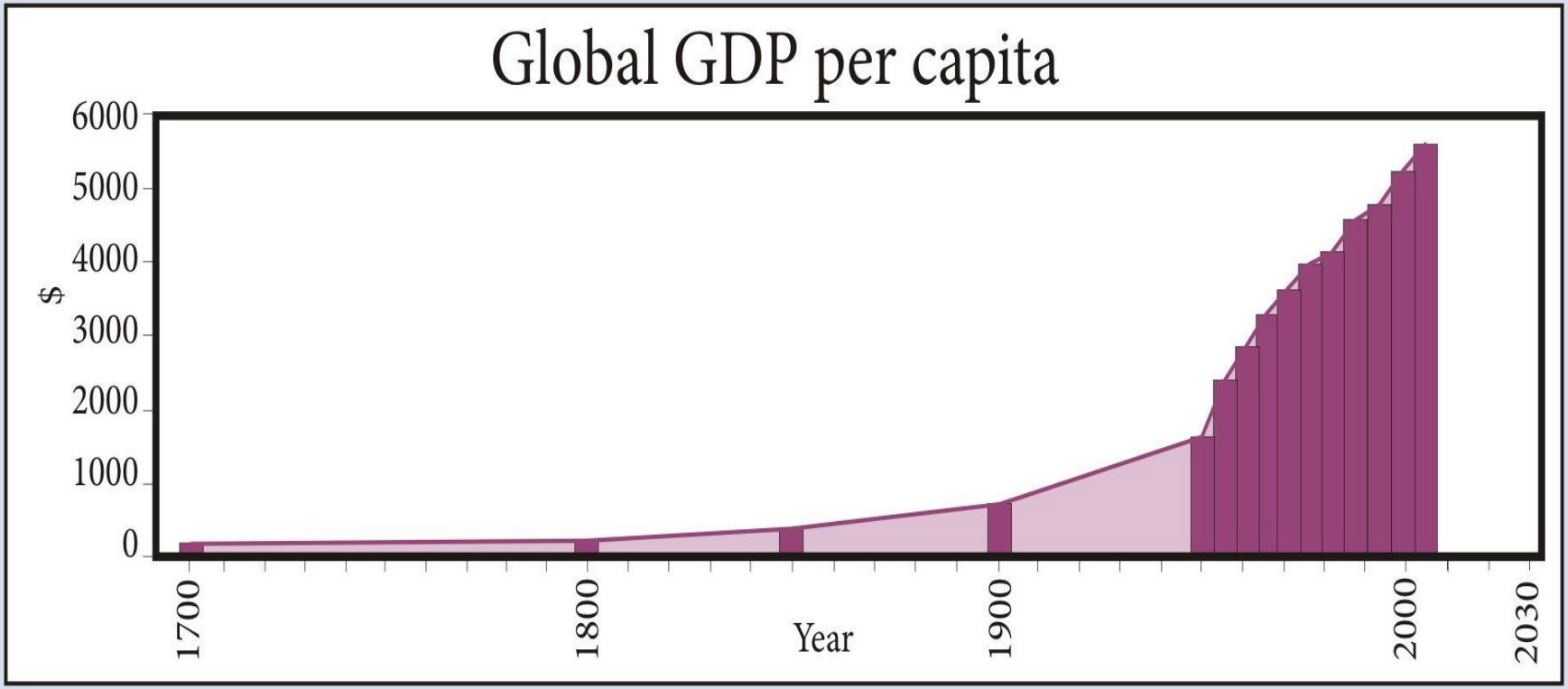
Strong growth of Population



Half of the world population lives in CZ

Strong Economic development



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Hartelijke dank met een

Oproep:

Laten we voorkomen dat
zulke grote afkalvingen 1 x per week geschieden,

want dan zullen onze kleinkinderen zeker

1,5m mondiale zeespiegelstijging/eeuw

ervaren en

nog vele andere impacts!

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Mitigation measures

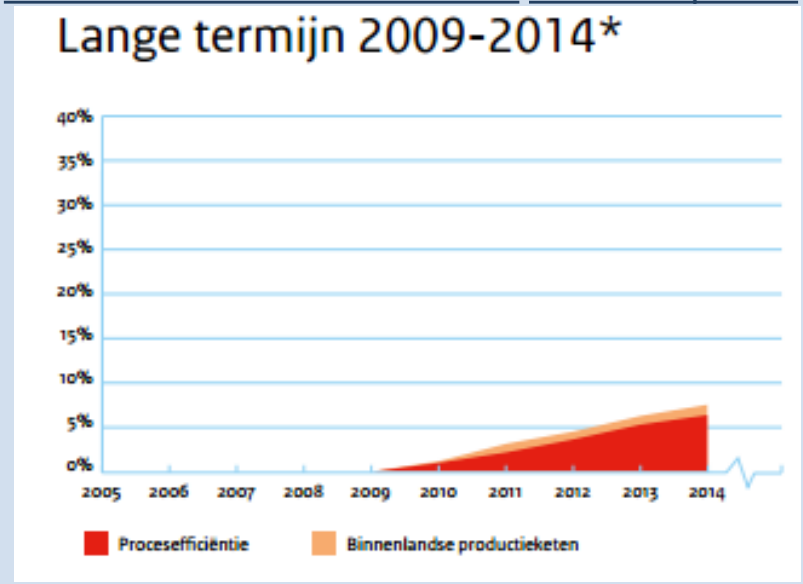
Gericht op vermindering van BKG emissies

Voorbeeld : Nederlandse overheid en bedrijven

Meerjarenafspraken energie-efficiëntie – Resultaten 2014

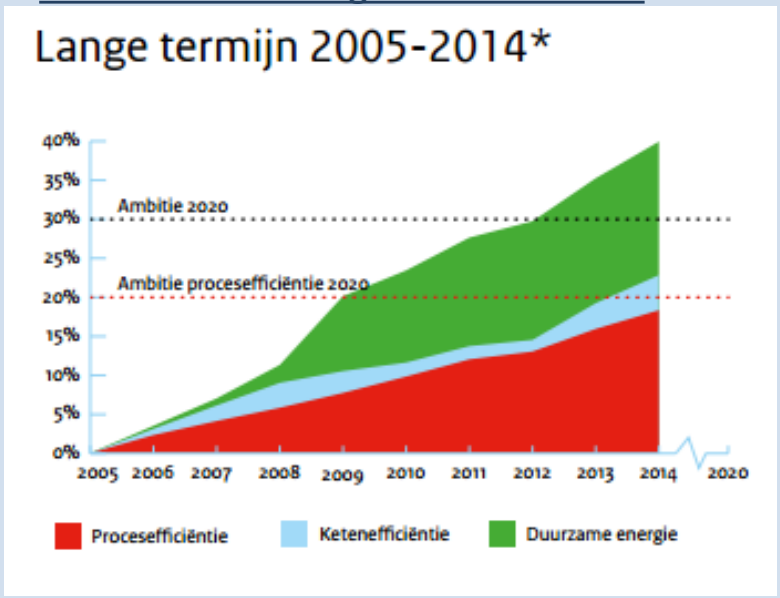
Totaal 1.082 energie convenanten:

MEE-2014 : Grote Industrieën - ETS- verplicht:



Besparing tov referentiejaar 2009:
47,7 PJ (7,8% in totaal, gemiddeld 1,6% per jaar)

MJA3-2014: Overige convenanten:



Besparing tov referentiejaar 2005:
49,7 PJ (21,2% in totaal, gemiddeld 2,4% per jaar).

https://www.rvo.nl/sites/default/files/2015/10/150138-01%20RVO%20Populaire%20samenvatting%20reslut%20broch_A4_13.pdf

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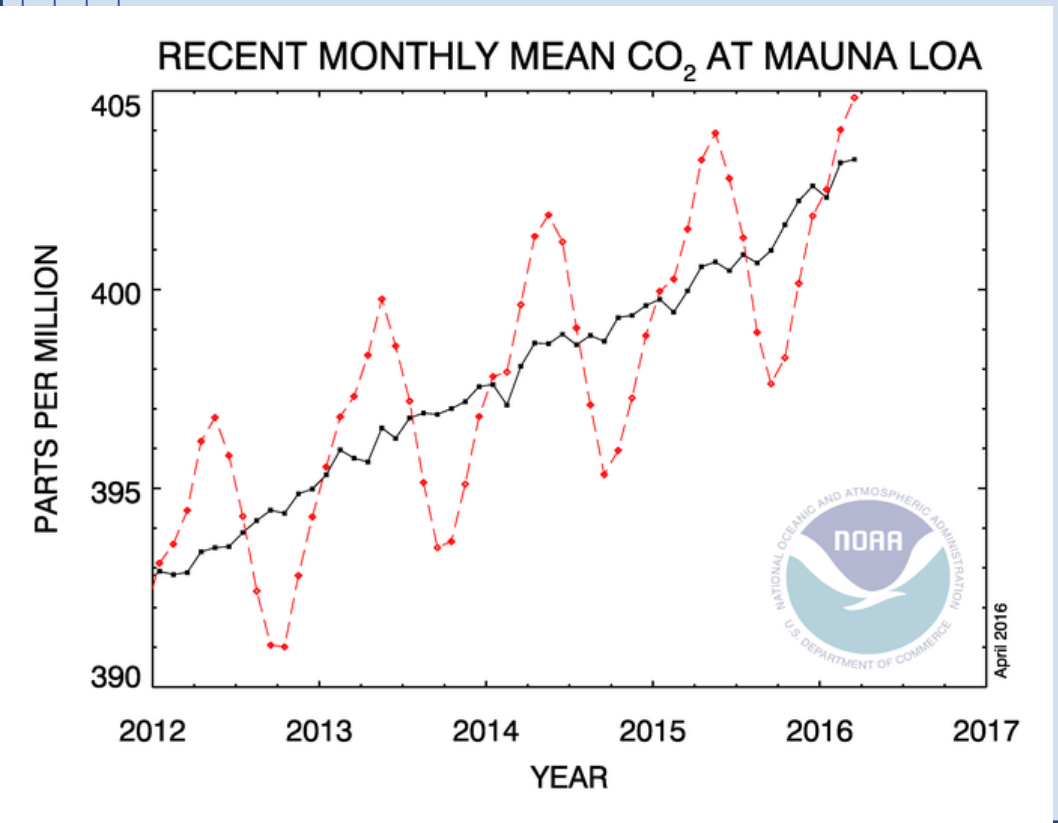

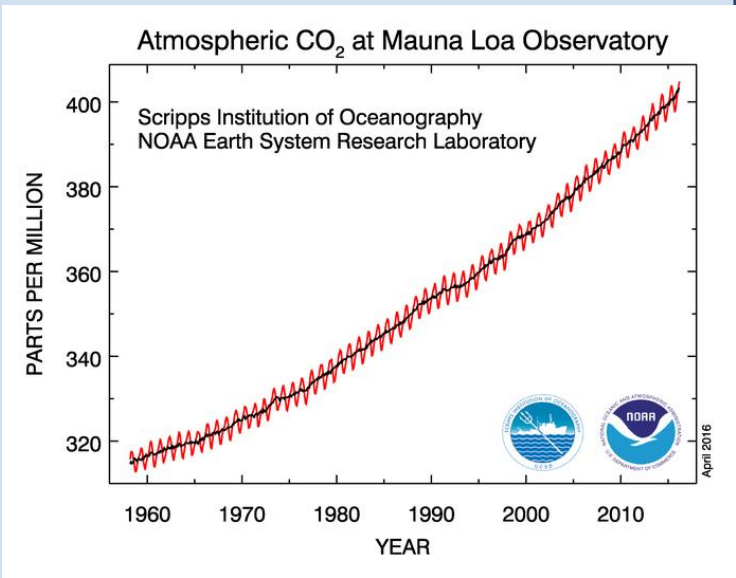

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