Summary of thesis scientific results

Analysis of evaluation and error estimation of the global data for temperature and sea level, and the problems in their determination

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Summary

The development of global climate has been a topic of great discussion in science, the public, and foremost in politics for a number of years. It has been suspected that man has contributed significantly to an increase in global temperature by emitting so-called greenhouse gases, namely CO2. This is claimed to be harmful for nature and for human development. Here, as a rule, when global climate is discussed, everything gets reduced to the development of the mean global temperature. As a consequence of the temperature increase of approx. 0.7°± 0.1°C over the last century, which was calculated with great effort[1], fear is now being expressed that this warming is having an impact on global sea level increase. Accordingly, studies are being carried out and published concerning the impacts a global mean sea level increase could have. It has been determined to have risen (over an entire century) at a rate of approximately 1.8 ± 0.4 mm/year. This rate, it is estimated, has accelerated dramatically especially during the last decade - by a factor of 4. This work shows that based on the type of available data, their quantity, and methods used, as is the case with temperature, it is not possible to give the sea level with an accuracy that is claimed. Thus the result is that all conclusions and correlations based on this data, which are from causes considered to be important, lie within the range of uncertainties and thus can only be regarded as very rough estimates. For this reason they can be only considered as conjecture and thus must be taken with great caution.

Work Thesis 1-1:

The hypothesis of global temperature rise (IPCC, Hadley, CRU, GISS, etc.) is based on incomplete data sets that have systematic errors throughout, at times gross errors. Neither absolute temperatures nor temperature changes of 1/10°C can be reliably determined by the above mentioned institutions.

1 Remark: In German literature temperature differences are denoted in absolute degrees Kelvin. In the often cited Anglo-American literature it is often cited in degrees Celsius and occasionally also in °F. For uniformity, here only the unit of °C is given, unless stated otherwise in quoted information.

On Global Temperature

On temperature the IPCC in its official AR4 2007 (Assessment Report 4) published the time series of average global temperature over the last 160 years based on data collections and calculations from the Climate Research Unit (CRU) of the English University of East Anglia. The CRU is one of the commissioned climate institutes that works in close cooperation with the British Hadley Centre and officially determines the average global temperature. In the often published graphic (see Fig. 1), a confidence interval is given for the calculated mean value (as to [Brohan et al. 2006]) that is 95% for the uncertainty of the main curve from -0.09 to +0.11°C until 1905 and to ± 0.08°C until 2005. The term "confidence interval" comes from the field of statistics and this refined statistical method was used for the calculation of the data. The raw data collection of local temperatures is subject to a variety of influences and thus entail inherent errors or deviations[2]. Only a small part of which, namely the random errors - for which there is a sufficiently large data repository available, allows to be determined by the application of statistical methods and error theory. These involve primarily reading and instrument errors. The largest portion, systematic and gross errors, must either be carefully corrected or accompanied by corresponding error ranges. The correction attempts by the scientists involved in compensating for systematic errors, for example because of the urban heat island (UHI) effect arising from altered land use, are automated and inflexible according to certain and few criteria because of the huge and often incomplete data amounts. Inflexible means they follow only a few and rigid requirements that do not allow real corrections because of a lack of knowledge regarding the boundary conditions. In addition the few corrective algorithms are unavoidably schematically designed. Correction often takes place at a desk, without any on-site viewing. The necessary metadata, which describe the boundary conditions of the raw data, are rarely available. Thus the corrections that do take place often lead to the wrong results. Other essential criteria are not recorded or are simply defined away.
As this will be illustrated, this occurs among the differences in the various Stevenson screen designs and with regards to the actual search of the real outside temperature.

The systematic errors that arise from the UHI effect and altered land use are considerable and dominant. Ultimately, the world's population has increased from approximately 1.5 billion in 1900 to almost 7 billion today, and that with a massively increased standard of living. About 50% of the world's population today live in cities, which are growing accordingly. It will be shown that this effect manifests itself in multiple ways. It shifts the temperature at the measurement location **upwards** from a few tenths of a degree to several degrees Celsius, and thus adds to the sought "real" temperature values. Attempts to correct for the UHI using complex corrective methods (in the range of 0.05°C to 0.1°C partially done) must be viewed as a failure. Its determined magnitude[3] is suspected to be in the range of at least +0.2°C to +0.4 °C, or likely higher. When looking at the American US Historical Climatology Network (USHCN) and using the classification of the US Climate Reference Network, the impacts from altered ground and surrounding area conditions during the course of the last 120 years shows there is a potential for an excess of up to 5°C.

The constantly changing number of measurement stations, their distribution over the surface of the globe, and their time used all have had a considerable impact on the quality of the results. The British Met Office even writes at its website that the land stations selected for determining the global temperature were uniformly distributed over the globe[4]. But that is true only for a very small part of the land surface, and also for short time spans. That is why the temperature course determined using this data has a distinct dependency (see Figure 35) on the number and location. One also has to consider that not only the number of measuring stations decreased significantly over the last 2 decades, but that this large decrease occurred for the most part in rural locations, outside of large cities and towns (Figure 35 right) and so shows that first and foremost urban (and thus higher) temperatures were

2 For describing the type of uncertainty, Brohan et.al. [Brohan et al. 2006] refers to the philosophic definition of this term from former US Defense Minister Donald Rumsfeld and made it his own: *"A definitive assessment of uncertainties is impossible because it is always possible that some unknown error has contaminated the data, and no quantitative allowance can be made for such unknowns. There are, however, several known limitations in the data, and estimates of the likely effects of these limitations can be made (Defense Secretary Rumsfeld, press conference June 6, 2002, London}.* Rumsfeld defined this as follows: *There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we now know we don't know. But there are also unknown unknowns. These are things we do not know we don't know.*

3 Also see: http://www.john-daly.com/graytemp/surftemp.htm Literature reference there also listed in Table 10.

4 Met Office(Quelle: http://www.metoffice.gov.uk/corporate/pressoffice/2009/pr20091205.html*)…The subset of stations is evenly distributed across the globe and provides a fair representation of changes in mean temperature on a global scale over land*.

measured, and not the originally sought temperature without social-economic impact. The errors that thus resulted are even estimated at +0.5 to 0.6°C according to the American National Atmospheric and Oceanic Administration (NOAA).

Neither on land nor sea is the real air temperature determined inside weather screens and weather stations. Rather, almost always too high a temperature is recorded. This ranges from a few tenths to several degrees over the real air temperature. The consequence alone of this is that the true suspected mean temperature of the earth must be considerably less than the temperature that is given. It is likely 1 to 1.5 °C less than the global mean. But even this value is not known. Kiehl et al [Kiehl 1997] pegged the global mean temperature at 15°C (288 K) and used this value for the energetic assignments of the various components of mean energy budgets for the earth. Jones et al suspects that the real global temperature is 14`C, i.e. 13.4°C for the southern hemisphere and 14.6°C for the northern hemisphere [Jones,1999]. The Goddard Institute of Space Science (GISS) avoids the exact determination of the mean temperature from measured data and refers to model results at its question and answer page[5]. "*For the global mean, the most trusted models produce a value of roughly 14° Celsius, i.e. 57.2 F, but it may easily be anywhere between 56 and 58 F (12.8 ºC to 14.4 ºC) and regionally, let alone locally, the situation is even worse.* This also leads to e.g. considerable uncertainly in the radiation budget, as the given differences result in considerable radiation differences that are many times higher than the total calculated anthropogenic climate forcings (radiative forcings RF).

The measurement and reading errors (on average over long periods) of local stations are in a range of ± 0.1 °C and more.[6]

The deviation amount of temperature measurements on land, due to the varying heights of the screens, as to Geiger [GEIGER, 1950] (and K. Brocks), when the air conditions are still, follow a double logarithmic gradient. In Central Europe, taken alone, depending on the mean and the generation of anomalies, this can generate a difference of approx. -0.05 to -0.5°C. The lower a measurement station with respect to the ground surface, the higher the temperature. However it is also very much dependent on the gradually changing, mostly counter-acting ground properties, and so can easily have a value of +1°C and higher. See Table 2 and Figure 12 (with the value of the measurement height of the existing measurement stations and the influence of the ground surface). Also at sea it is dependent on the height of the measurement station. In still air conditions, the deviations are determined to be approximately -0.01°C/m. Unlike land stations, the height at sea is not fixed, and depends on the size of the ship and the extent that it is loaded. For a bridge height of 20m, which is not unusual, we have a deviation of approx. -0.2 °C. Then the counter-acting surface error also has to be introduced. Above the bridge height, the available measured data tell us little or nothing. As an alternative to the difficult to determine air temperature (**MAT** Marine Air Temperature and **NMAT Night** Marine Air Temperature) at sea, the seemingly easier to determine upper layer sea water temperature **(**Sea Surface Temperature **SST)** is generally used. Yet in the literature there is no evidence as to why the **SST** can be used as a substitute for air temperature. The two media react physically very differently to the addition of heat. Still, there are studies on this that show very differing trends. At air temperatures under -2 °C[7], which is normal with the (few) winter temperature measurements in the high northern and southern latitudes, the SST provide values that are too high (likely a reason for the shown increase of SST in Figure 33). That means that by using the SST, the mean temperatures are shifted considerably higher because the **SST** on average is at least 0.3 °C [Kent, 1998] warmer than the air.

The numerous various algorithms in use for determining the mean values all deliver very different results for the same "real" temperature. Worldwide more than 100 arithmetic mean calculation methods have been used, with the emphasis on the algorithms such as to the Mannheimer Stunden, the Wild´sche 6 h Turnus and the max/min method. It is correct that errors caused therein do reduce in the trend in large data repositories as do the anomalies that result thereof. This is especially true for higher latitudes and often cloudy weather. But they do not balance each other out. At tropical and subtropical latitudes and on clear sunny days at all latitudes, the error can be 1 to 2°C. Despite calculating the mean and anomalies, it always ends up with a magnitude of
approx. + 0.4 °C (s. Figure 20 ff), with a tendency of being more.

As mentioned above, the calculation of only mean values leads to many anomalies (see Annex 2 on Anomalies)

5 http://data.giss.nasa.gov/gistemp/abs_temp.html

6 Jürgen Pelz "*Anmerkungen zur Prüfung von Daten und Ergebnissen von Modellrechnungen unter Verwendung der Statistik und d*er *Informationstheorie*" Supplement to the Berliner Weather Map of 7 December 1995; p. 5: *"If for example you wish to precisely determine the daily mean temperature within ± 0.1 K, the interval between the measurements must not be more than 15 minutes. For an accuracy of 2-3°K, the climate intervals are enough."* [Pelz, 1995b]

7 The freezing point of sea water with an average salt content of 3.5 % is on average -1.9°C.

and not to a compensation of existing systematic and gross errors as is often believed [Brohan et al. 2006]. It does sporadically reduce occurring systematic and gross errors, but does not reduce it to zero. To the contrary, the presence of these errors influences, even if often just slightly, the mean value of the reference temperature. But they significantly influence to a greater extent the incline and deviation of the calculated trends. Because of the consistency of the most important errors, without its own periodic behaviour, they however do not influence the oscillation of the temperature series, and the deviation difference itself only to a slight extent. This explains why, despite the often large errors, one often detects pronounced oscillations in the temperature profile. Assigning plausible causes to these oscillations is currently the subject of further studies, e.g. of the solar influence.

It is an often used practice to calculate time series of simple anomalies and then to extrapolate these time series (which are assumed to be correct) to little known or completely unknown locations and times. In doing so, the faulty or (partly) unknown time series gets impressed or destroyed by the values of the reference data series. Thus the signal of the sought series disappears, if it existed at all. The result is thus useless. Yet, this practice is used often[8], at least by authors like Parker and Jones, as they wrote in e-mails to the author. Parker sent Figure 32 as a confirmation and wrote: *"I agree that SST has major physical differences from air temperature. But one aim of our blended data is to give an indication of the state of global warming, and this is better done using SST rather than NMAT because the quality of the SST data is better, even though NMAT is more physically compatible with land surface air temperature than is SST. Fortunately, over the vast proportion of the oceans, away from coasts, SST and NMAT are highly correlated. The global SST anomaly (blue) and NMAT anomaly (green) curves in the attached plot illustrate this."* However, as shown, these plots are not very usable because no independent datasets were used for their calculation. If one does this, then the result looks very different. See Figure 33. Because of the rapidly growing doubt on the correctness of the presented global temperature calculations in recent times, the leading British Met-Office announced on 24 February 2010 the datasets and the methods used for calculation would be subjected to a comprehensive review.[9]

Working Hypothesis 1-2

Global temperature, as an arithmetic mean, has no direct physical meaning. Its numerical calculation in global models provides a fictitious magnitude and is inappropriate as a criterion for the impact of anthropogenic CO2 on global temperature changes.

Climate models and determining global temperature

In this thesis, it will also be shown that the many different climate models used by the IPCC, though highly complex and technically sophisticated, still suffer from major methodical deficiencies. These can neither be removed fundamentally or approximately. Due to the lack of a validated comprehensive physical climate theory, many of the magnitudes to be determined cannot be calculated from the known laws of nature, and thus are determined by directly intervening in the calculation process and by rough estimation. Even when someone claims, although there are no such findings, that the results of calculations of **one** model for **one** grid cell, physically correct, correspond to a (physical) temperature of this area, this physical property is completely destroyed by the multiple accumulation of averages and anomalies due to the involvement of all other grid cells and from many different models. The magnitudes that are computed this way are for this reason a numerical value with no basis on reality. As this also applies for the only inaccurately calculated global temperature, both values can indeed by combined arithmetically, yet have no validity. This applies especially for the sought after correlation between the anthropogenic and natural CO2 and the existing temperature. The magnitude of influence is too small, and the possible interrelations are for the most part unknown. Despite assertions to the contrary, neither a direct measurement nor a signal isolation has taken place. The present data do not indicate this. For this reason neither observation nor model results allow this interrelationship to be made. It will also not improve when mean values of mean values from a wide variety of model results are again determined using the multi-model mean method, (which is even more remote from physics). These mean values can illustrate everything or nothing. They are nothing more than time series from whatever values that happen to have the temperature unit of measure, but are not temperatures. For this reason hereinafter the symbol for the global mean temperature is denoted with T*. A mean value cannot have an influence on an existing or future temperature distribution. But, as is already known, very different temperature distributions can yield identical mean values.

[8] Privat email of an IPCC lead author to an author Autor dated 2 June 2009 : ***„..... Think in ANOMALIES and not absolute temperatures."***
Another author at the same time period: *The calculations are all done using anomalies (relative to 1961-1990 climatology), substantially avoiding the problem you raise regarding temperatures below zero*.

[9] Source: Climategate Fallout: Met Office To Reassess, Open Up Temperature Data, http://www.thegwpf.org/climategate/575-climategatefall-out-met-office-to-reassess-open-up-temperature-data.html

Global mean sea level GMSL
Thesis 2-1

The global mean sea level figures from the pages of the IPCC, PIK, etc. are much too inaccurate to reliably allow a determination of dependency on global temperature.

Global Mean Sea Level

It will be shown that an exact determination of GMSL is very difficult, and fundamentally an impossible task. Even more difficult is the definite determination of sea level rise (or drop) over time. Different authors using the same datasets arrive at completely different results. That is why it is no surprise that leading specialists in the field such as Douglas [Douglas, 1994] illustrated in great detail that e.g. Barnett (1984), Emery and Aubry (1991) Pirazzoli (1993) arrived to the conclusion that *"the determination of a single sea-level curve of global applicability is an illusory task."* Or, sea level expert W. Siefert in Hamburg recently said in an interview: *"When examined closely, sea level is being exposed more and more as a pure mathematical prop, inadequate, and foremost not very meaningful. Especially when it is to be used as a sole standard of measure, or when it can be used to derive horror scenarios…*[10]*"*

Douglas himself agrees with this pessimistic view only to a limited extent and hoped to see better research instruments that would bring better and more reliable results in the years ahead. With the possibilities presented by satellite altimetry, these results are now at hand. Yet, it turns out that only controversial results have been produced and that no really reliable findings will be gained. With the knowledge of the exact geoid-form of the earth and the detected topology of the ocean thereof, where even in the open sea many meters difference in height of sea level are measured in not so distant from each other areas, new factors of influence unknown up to now come into play. These findings are summarised by Cazenave et al. [Cazenave,2004] in the words: *"…for the past 50 years, sea-level trends caused by change in ocean heat storage also show high regional variability,"…."…has led to questions about whether the rate of 20th-century sea-level rise, based* ***on poorly distributed historical tide gauges, is really representative of the true global mean.***[11]*"* And a little later, independent of the many new instruments and techniques that can now be used to find the sought signal of global warming on GMSL, they consequently state *"these tools seem to have raised more questions than they have answered."*

It will also be shown that a measurement with an accuracy of a few tenths of a millimetre per year as well as the Relative Sea Level (RSL) and the GMSL are not possible (except with the latest measuring techniques). The generally used illustration of this unit of measure in "mm" is misleading. The IPCC, many experts, publicly informed media and laymen are falsely claiming an accuracy that simply cannot be reached. Also when these figures are computed using only mean value determination, the sea level can be given accurately only to a centimetre, and often several centimetres - and often times not even that. Munk [Munk, 2003] confirms this, writing: *"the jury is still out on the interpretation of the tide gauge records."*

The only thing certain is that the statistical construct of GMSL over the last 120 years has risen around 1 to 2 mm/year, or more correctly said: between 10 and 20 cm/century. There the error is in the scale of the measured value, and is likely even higher. While Mörner expects a mean rise of 10 cm/century, the IPCC sees approx. 19 cm/century. The IPCC sees an increase in the trend over the last 20 years, while others, as will be shown, explicitly exclude such an increase (acceleration).

Many systematic errors, generated by the influence of barometric pressure, the density of the water head, the accuracy of determining the reference point of measurements for sea level measurement, the influence of data sets of various lengths or contaminated data sets, the rapidly occurring shifting of tectonic plates and their vertical components etc., thought having been occasionally examined regarding calculation of GMSL, their quantification and their correction have not yet been satisfactorily solved. These errors have been examined in detail in this thesis. All indications show that these errors, due to their systematic nature and because they are mostly subtle, cannot be determined on the scale of the sought sea level rise. They could only be given in accordance to scientific tradition. But that has rarely taken place. Credible figures on the attainable accuracy are as a rule, the exception, e.g. with Mörner +10 ± 10 cm by the year 2100 (or + 5 ± 15 cm) [Mörner, 2004].

10 Source *Emder Zeitung, Sonntagsblatt*, 26 February 1995. Prof. Dr. Winfried Siefert, sea level expert, worked years at the Hamburg authorities for economics and transportation, power and port building
11 Emphasis by the author

Thesis 2-2

Observed changes in GMSL over the last centuries have less to do with the change in global temperature, and more to do with tectonic shifts and other magnitudes of influence. Examples: Micronesia and others.

Assigning the causes of sea level rise

Detailed attempts to describe the entire increase GMSL are made by the IPCC and others by breaking it down into components. With great caution and respect, one has to consider this approach as a failure. Cazenave et.al [Cazenave, 2004] is quoted on this: *"…for the past 50 years, sea-level trends caused by change in ocean heat storage also show high regional variability," …."..has led to questions about whether the rate of 20th-century sea-level rise, based* ***on poorly distributed historical tide gauges, is really representative of the true global mean***." The estimates for eustatic and steric components cannot be brought in agreement with the observed data. The movement of single tectonic plates with speeds in the range of more than 15 cm/year, the vertical components thereof, which can decisively impact the volume of the ocean above it, is certainly a cause of the observed changes in RSL and thus GMSL. But recording these changes and quantitively attributing them to a source has not been possible up to now.

As will be shown in detail, explanations can be found (for all measurement locations) that can be attributed to natural changes (glacial isostatic adjustment GIA / post glacial rebound PGR or other tectonic shifts) or, similar to the UHI for temperature, attributed indeed to man-made causes, but have social-economic causes. A greenhouse effect is not needed for this.

Also a temperature-dependency is not detectable in the past over the last 1000 years, as impressively shown by Storch et. al [Storch, 2008]. That means projections on the future development of the GMSL are purely speculative because of the great lack of understanding of the involved processes and the lack of data. Nothing makes this more explicit than the wide range of estimates among the IPCC lead authors (e.g. Rahmstorf) and other specialists: Jevreva, Mörner or Singer. See Figure 62.

Rahmstorf [Rahmstorf, 2007a] using a semi-empirical approach believes a maximum of 140 cm is possible by the end of the century, Hansen estimates up to 600 cm under certain conditions, the IPCC estimates between 14 to 59 cm (final), Singer 18-20 cm, and Mörner [Mörner, 2004] only 10 cm.
This is surely why the IPCC, which normally speaks clearly, is unusually reserved on this topic: (AR4 of WG I **Observations: Oceanic Climate Change and Sea Level** on page 410 Chapter ***5.5.2.)…****there is* ***an increasing opinion*** *that the best estimate lies closer to 2 mm/yr than to 1 mm/yr.*

Conclusion: Neither are the data series from the measurement stations sufficient for determining the average global temperature nor are the climate models able to predict the future because of inaccurate and incomplete data and a host of other reasons. Furthermore the attempt to determine the rise in global mean sea level with an accuracy of better than ± 10 cm/century has not been successful. Breaking down the rise into components and assigning a respective rise to each, especially to temperature rise, is not possible. Each assignment is too speculative.

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Literature overview:
1. Brohan, PK,J. J. Harris, I., Tett S. F. B.; & Jones, P. D. (2005) Uncertainty estimates in regional and global observed temperature changes: a new dataset from 1850. HadCRUT 3 HadCRUT 3:1 to 35.
2. Cazenave, AaN, R.S. (2004) Present-day sea level change: observations and causes. Reviews of Geophysics 42
3. Douglas, BC (1994) Global sea level change: Determination and interpretation. Rev Geophys 33
4. GEIGER, RUDOLF (1950) *DAS KLIMA DER BODENNAHEN LUFTSCHICHT*. FRIEDR. VIEWEG & SOHN, BRAUNSCHWEIG
5. Jones, PDN, M, Parker, D. E. S.Martin, Rigor, I. G. (**1999**) SURFACE AIR TEMPERATURE AND ITS CHANGES OVER THE PAST 150 YEARS
Reviews of Geophysics *37*:173–199.
6. Kent, ECKAaB, David I. (1998) Assessing Biases in Recent in situ SST and Marine Air Temperature.
7. Kiehl, JTT, Kevin E. (1997) Earth's Annual Global Mean Energy Budget. Bulletin of the American Meteorological Society *Vol. 78, No. 2,*:197–208.
8. Mörner, N-A (2004) Estimating future sea level changes from past records. Global and Planetary Change 40:49 – 54.
9. Munk (2003) Uncertainties about Temporal Changes in Ocean Properties, their Effects on Sea Level, and What they Imply about Global Warming. Science Volume 6, Number 28:
10. Pelz, J (1995) *Anmerkungen zur Prüfung von Daten und Ergebnissen von Modellrechnungen unter Verwendung der Statistik und der Informationstheorie. Beilage zur Berliner Wetterkarte 7.12.1995*
11. Rahmstorf, S a (2007) A semi-empirical approach to projecting future sea-level rise. *Science* **315**:368–370.
12. Storch, HvZ, Eduardo González-Rouco,Jesús F. (2008) Relationship between global mean sea-level and global mean temperature in a climate simulation of the past millennium. Ocean Dynamics