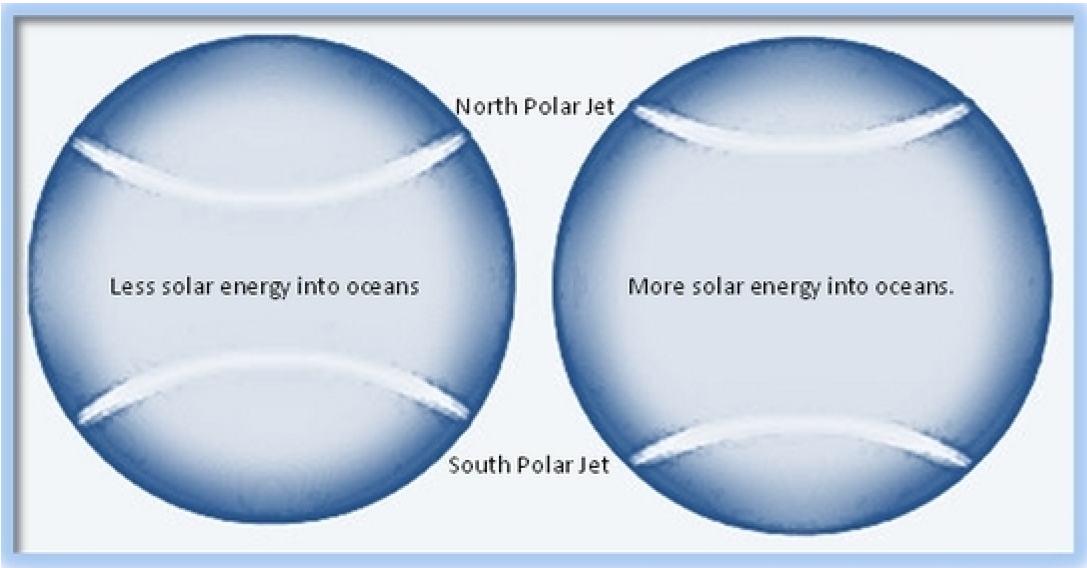


Inactive Sun : Earth system losing energy, jets equatorward, more douds, high albedo.

Active Sun: Earth system gaining energy. jets poleward, less douds, low albedo.

How The Sun Could Control Earth's Temperature

by

Stephen Wilde.

Introduction:

The Holy Grail of climatology has always been to ascertain whether, and if so how, the sun might affect the Earth's energy budget to cause the climate swings observed throughout history despite the apparent inadequacy of the tiny variations in Total Solar Irradiance (TSI) that occur from one series of solar cycles to another.

I think that there is a plausible mechanism whereby those tiny solar changes could be amplified enough by natural features of the Earth's climate system to achieve the observed outcome.

This article also shows how the theory of Anthropogenic Global Warming (AGW) has failed to account for the various real world observations that have been accumulating since the late 1990s. The ideas set out in this article provide a potential solution and progress my earlier New Climate Model found here:

New Climate Model (First Review) by focusing on the effect of solar variability.

Evidence for the failure of current theories and climate models.

i) The level of CO_2 in the atmosphere continues to rise slowly but the tropospheric warming trend appears to have stalled since 1998 and may be about to change to a cooling trend. AGW theory anticipated an increasing rate of tropospheric warming as CO_2 accumulated in the atmosphere but that is clearly not happening. Much has been made of recent years having been warmer in the troposphere than other years in the temperature record but since we are near the top of a natural warming curve similar to the Mediaeval Warm Period or the Roman Warm Period that is hardly a cause for concern. Indeed there is some evidence that we have not yet matched the warmth of the Mediaeval Warm Period.

ii) During the late 20th century warming trend the stratosphere was observed to cool and that was also supposed to be in accordance with AGW. However since the 90s that cooling has ceased and the stratospheric temperature trend is now one of slight warming:

http://www.jstage.jst.go.jp/article/sola/5/0/53/_pdf

"The evidence for the cooling trend in the stratosphere may need to be revisited. This study presents evidence that the stratosphere has been slightly warming since 1996."

iii) The jetstreams moved poleward in accordance with AGW theory:

http://www.msnbc.msn.com/id/24228037/

"From 1979 to 2001, the Northern Hemisphere's jet stream moved northward on average at a rate of about 1.25 miles a year, according to the paper published Friday in the journal Geophysical Research Letters."

However, it is becoming clear that since at least 2001 the jets have been moving back equatorward again despite increasing CO2 levels.

iv) During the warming spell global cloudiness decreased as did global albedo (reflectivity as seen from space) which is consistent with poleward shifting jets but the Earthshine project now shows us that both global cloudiness and global albedo are increasing again since the late 90s:

http://bbso.njit.edu/Research/EarthShine/literature/Palle_etal_2006_EOS.pdf

Increased cloudiness and albedo are indications that the climate system is receiving less solar energy overall and is therefore a sign of reducing energy content for the system as a whole contrary to AGW theory.

It will be interesting to see what happens to ocean heat content over the next few years. There are suggestions that it recently peaked and may start to trend down and if does turn downwards that will confirm the significance of the cloudiness and albedo changes.

v) Standard climatology proposes that, when the sun is more active, all the layers of the atmosphere warm and, when the sun is less active, all the layers of the atmosphere cool. That did not happen during the recent warming spell. Whilst the thermosphere and troposphere warmed from the more active sun the stratosphere and mesosphere actually cooled. Now that the sun is less active that cooling trend in the stratosphere has changed to a warming trend so it is likely that the stratosphere and mesosphere actually respond to changes in the level of solar variability oppositely to the thermosphere and troposphere as part of an entirely natural process. Standard climatology has proposed that human CO2 and / or CFCs upset what was assumed to be the natural order of things. This article will try to show that that basic assumption which has been incorporated into all current climate models and theories may be wrong.

The false premise.

Before I describing what I believe to be the truth about the solar effect on the global energy budget I must first set out exactly what has gone wrong because only by understanding that can a reader evaluate the merit of my alternative hypothesis.

It has long been assumed that stratospheric temperatures are set by the heat generating effect of incoming solar ultra violet radiation (UV) on ozone in the stratosphere. When the sun is more active there is more UV and the stratosphere becomes warmer. The amounts of ozone and UV are generally sufficient to maintain a temperature inversion from the tropopause up through the stratosphere to the stratopause.

However that is as far as standard climatology and AGW theory go. Everything is based on the premise that since the UV/ozone reactions lead to a warmer stratosphere then more UV from a more active sun should make the stratosphere even warmer. I suspect that premise to be mistaken.

There are two substantial problems with that scenario:

i) The stratosphere and the mesosphere actually cooled when the sun was more active and are now warming now that the sun is less active. There must be something else going on to account for that.

ii) The jet streams moved poleward and the **polar vortexes shrank** when the sun was more active. That is a critical point for diagnostic purposes and I need to explain in some detail why it is so critical.

Jet Stream Behaviour.

(a) The conventional view:

The standard explanation for jet stream shifts relies solely on differential heating of the stratosphere by UV warming of ozone in the stratosphere. However I think that may be only a part of the picture and only one component of a larger scenario that additionally requires the involvement of a separate solar proton effect in the upper atmosphere and modulating effects from the oceans.

Thus it is normally proposed that a more active sun warms the stratosphere above the equator more than the stratosphere above the poles (but both locations are supposed to warm) so that the height of the tropopause at the equator descends and pushes the jets poleward. I do not consider that to be a sufficient explanation because:

i) Taking the stratosphere as a whole (rather than splitting it into latitudinal sections) it actually appears to have cooled during the late 20th century period of more active sun and now appears to be warming slightly with a less active sun.

ii) If the stratosphere above the poles also warmed as proposed at the same time as the stratosphere above the equator warmed then the tropopause at the poles would also have descended and would have provided more resistance to the poleward shift of the jets than was actually observed.

iii) The distance of the jet stream latitudinal shifting from the peak of the Mediaeval Warm Period to the depths of the Little Ice Age is in my opinion far greater than could be explained simply by the small differential between solar effects on UV at the equator and solar effects on UV at the poles.

iv) The solar effect on stratospheric ozone on the height of the tropopause at the equator would be heavily modulated by ocean surface temperatures so that the poleward pressure on the jet streams would be inconsistent. In fact I think that the effect of ocean sea surface variability on the height of the tropopause at the equator would be far greater than the solar UV effects.

v) The actual shrinking of the polar vortexes seems unlikely just from poleward pressure from the slightly lower tropopause at the equator given that the polar tropopause should also have been lowering to some extent (but less) at the same time. More likely some additional process from above encouraged the polar vortex to shrink at the same time as the jets were pushed poleward.

<u>(b) The alternative view:</u>

My proposition is that instead the latitudinal shifts are a result of two separate forces acting together (hence the high mobility of the jets latitudinally) when the sun is more active with one being a cooling effect at high levels over the poles pulling the jets poleward and the other being a warming effect at low levels over the equator pushing the jets poleward at the same time. The cooling effect appears to be dominant over longer time periods to give the observed cooling of the stratosphere and mesosphere when the sun is more active. Nonetheless there is still **overall system warming with the more active sun** because of the extra energy going into the oceans due to the jets shifting poleward thereby reducing total cloudiness and albedo as shown in the illustration at the head of this article.

In this article I am discussing the global net energy balance of the stratosphere and mesosphere combined which is a product of the balance between top down solar proton effects in the mesosphere and bottom up UV effects in the stratosphere.

The latitudinal position of the jet streams and indeed all the air circulation systems is set by an interaction between the rate of energy being released by the oceans to the air and the rate of energy loss to space from the atmosphere.

In this article I am limiting my attention to the latter which I propose to show is highly dependent on the level of solar activity.

The top down solar effect on the jets is provided via the size and intensity of the atmospheric polar vortexes, one at each pole.

That size and intensity is set by the height of the tropopause at the poles. When the tropopause rises the polar vortex becomes deeper but less extensive at the surface (jets shift poleward). When the tropopause at the poles falls the polar vortex becomes shallower but more extensive at the surface (jets shift equatorward).

The height of the tropopause is set by the size of the temperature differential between surface and stratosphere. For a uniform body of air basic physics applied to the characteristics of the Earth's atmosphere dictate a fixed rate of cooling as one goes higher. That is known as the lapse rate. Thus if the temperature differential between the surface and the stratosphere increases the tropopause must rise. If the differential decreases then the tropopause must fall.

"Suppose, for example, that the surface temperature and the tropospheric temperature gradient are given and that the temperature of the stratosphere varies. Then, a cold stratosphere will be associated with a high tropopause (low tropopause pressure), and a warm stratosphere will correspond to a low tropopause (high tropopause pressure)."

from here page 14:

http://journals.ametsoc.org/doi/pdf/10.1175/1520-0442(2001)014%3C3117%3ATTITPR%3E2.0.CO%3B2

Note that the solar UV warming effect on ozone in the stratosphere becomes weaker as one approaches the poles whereas the solar proton destruction of ozone in the mesosphere becomes stronger as one approaches the poles. I suggest that within the polar vortex (poleward of the mid latitude jets) the solar proton effect becomes dominant and affects the height of the polar tropopause more than does the solar UV effect but due to the reversed sign of the solar proton effect (cooling) as compared to the UV effect (warming) both processes act on the jets the same way.

The temperature differential between surface and stratosphere will increase either if the surface warms or if the stratosphere cools so a higher tropopause (globally averaged – never mind the latitudinal variations) and a poleward shift of the jets is consistent either with AGW theory which proposes a warming of the troposphere from human CO2 or in accordance with my hypothesis which proposes a cooling of the stratosphere from some natural solar induced process when the sun is more active.

So which is it – natural or anthropogenic ?

The jets were more poleward during the Mediaeval Warm Period hence the reported Viking settlements in Greenland so the temperature differential from surface to stratosphere must have increased then too and at that time there was no significant warming in the troposphere from human emissions thus the cause of the poleward jets back then must have been a net cooling of the stratosphere from entirely natural causes at a time of (then as now) a more active sun.

On the basis of logic and observations and contrary to AGW theory it must be the case that the stratosphere cools naturally when the sun is more active and warms naturally when the sun is less active.

Maunder Minimum jets were well south of what we see today and we know that from ship's records. MWP jets were north of even what they were in the 1990's because the Vikings could settle Greenland back then.

That suggests two things:

i) The jet shifts are natural.

ii) If the jets went poleward recently with a cooling stratosphere then they did so during the MWP too.

So the jets naturally go poleward when the stratosphere cools and it cools most when the sun is most active.

The jets tell us that the assumption of a warming sign for the natural solar effect on the stratosphere is wrong. We just need to work out why.

AGW theory is therefore falsified by the observed behaviour of the jet streams before the modern era.

Thus we need a mechanism as to why that should be the case and I now go on to suggest one.

The truth.

There is a known process in the mesosphere (above 50Km) whereby charged particles know as solar protons are drawn in at the poles (being charged particles they come in along the magnetic field lines). The quantities vary with the strength and intensity of the solar wind which in turn varies with the level of solar activity.

Those particles are very effective at destroying ozone in the mesosphere so when the sun is more active then more ozone is destroyed (cooling mesosphere) and when the sun is less active less ozone is destroyed (warming mesosphere).

That this process is actually going on with a reverse sign solar effect in the mesosphere (active sun causing cooling and quiet sun causing warming) has been discovered by Dr. Joanna Haigh who found that despite the quiet sun the amount of ozone in the mesosphere has been increasing with, presumably, a warming effect in the mesosphere.

http://www.nature.com/nature/journal/v467/n7316/full/nature09426.html

"a significant decline from 2004 to 2007 in stratospheric ozone below an altitude of 45km, with an **increase** above this altitude."

During a solar storm up to 70% of the ozone in the mesosphere can be destroyed with a sizeable temperature effect. So the temperature of the mesosphere will vary oppositely to the level of solar activity. Cooling when the sun is more active and warming when the sun is less active.

http://earthobservatory.nasa.gov/Newsroom/view.php?old=200108015015

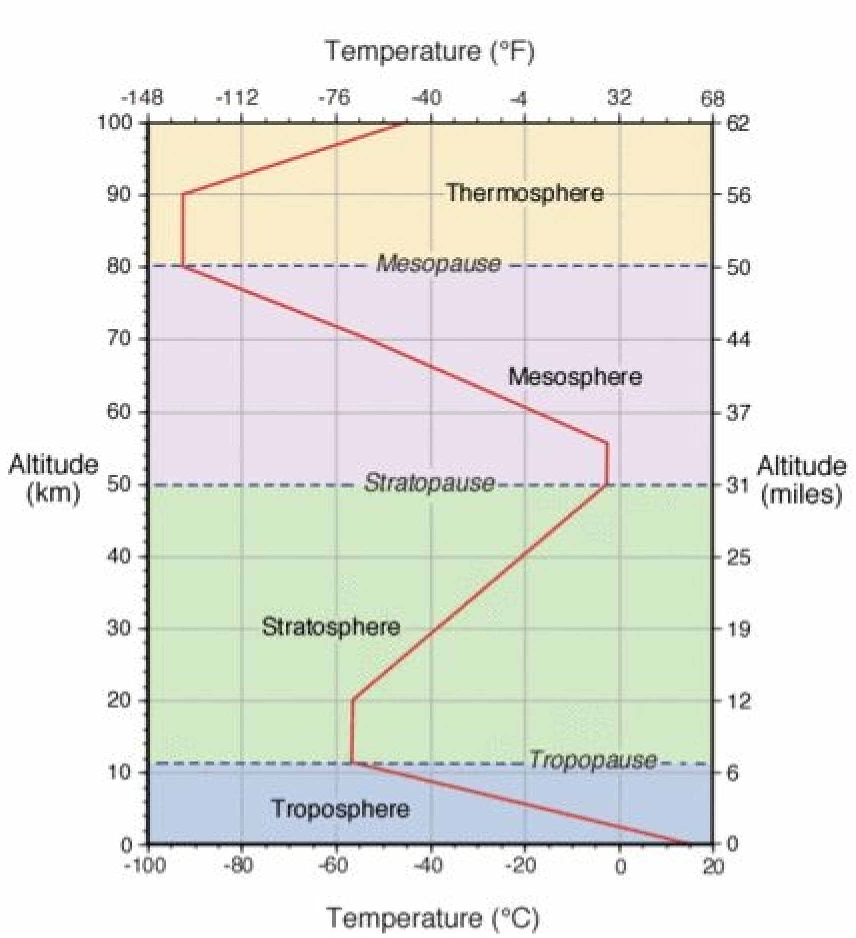
"When the sun's protons hit the atmosphere they break up molecules of nitrogen gas and water vapour. When nitrogen gas molecules split apart, they can create molecules, called nitrogen oxides, which can last several weeks to months depending on where they end up in the atmosphere. Once formed, the nitrogen oxides react quickly with ozone and reduce its amounts. When atmospheric winds blow them down into the middle stratosphere, they can stay there for months, and continue to keep ozone at a reduced level."

The most likely solution to the observation that the stratosphere as a whole shows net cooling naturally when the sun is more active is to propose that **the cooling effect in the upper atmosphere of the increased number of solar protons when the sun is more active is greater than the warming effect of more UV in the stratosphere below**.

I will now try to show how it probably works:

How Changing Solar Activity Affects The Energy Content Of The Layers Of The Atmosphere.

1) The 'Normal' representation: is how the structure of the atmosphere is normally displayed showing the various layers, the heights of each layer and the temperature profile that normally prevails from surface to space.



Picture credit:

http://www.eoearth.org/article/Atmosphere_layers

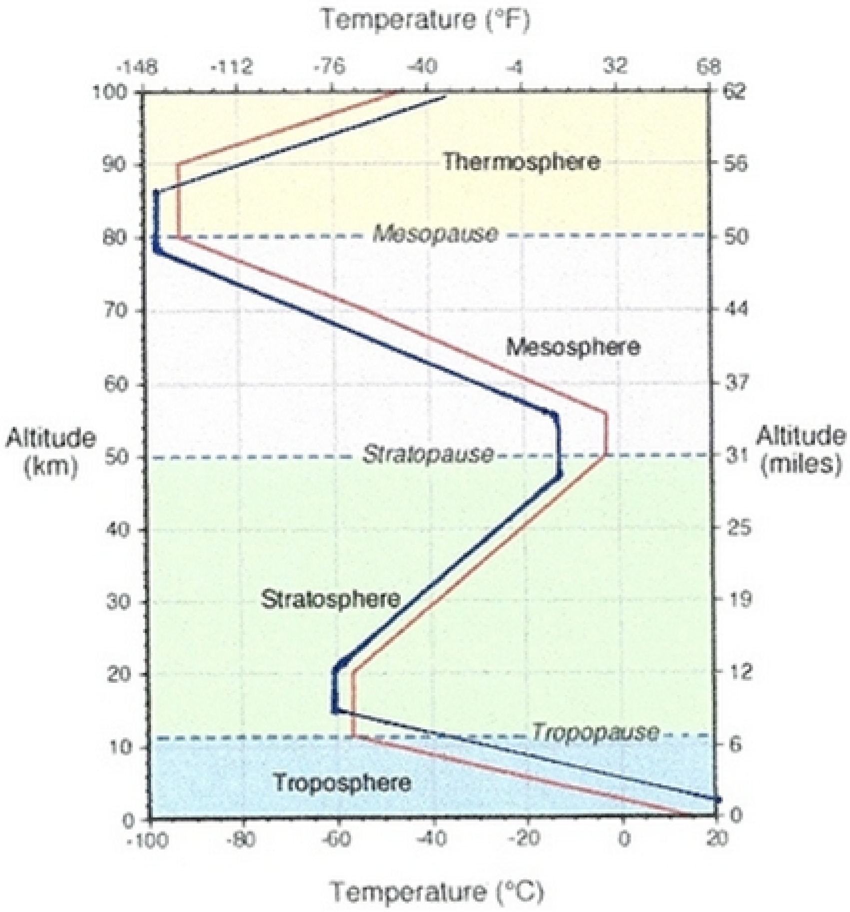
Conventional climatology assumes that when the sun becomes more active or less active then all the layers warm or cool in tandem so that the above structure is maintained.

However that does not fit with actual observations because throughout the late 20th century period of a more active sun the thermosphere and troposphere both warmed but the stratosphere and mesosphere were seen to cool.

Something else must be happening. The solar variations appear to have had different effects on different layers, which is supposed to be impossible.

<u>2) When the sun is more active.</u>

This is what must happen to accord with observations



The above blue line shows what happens. It is not drawn to scale. The sideways displacement is for the purpose of graphical clarity only and is of no significance. It is the vertical shifts that are significant. The heights at the lower levels are displaced upward and at the higher levels the heights are displaced downward. The total depth of mesosphere and stratosphere reduces whereas the depths of both thermosphere and troposphere increase.

The following events occur when the sun is more active:

i) An increase in solar radiation warms the thermosphere thereby reducing the temperature differential between mesopause and stratopause so that the mesopause falls in height.

ii) An increase in solar protons destroys more ozone in the mesosphere which cools.

iii) The cooling mesosphere draws energy up from the stratosphere which also cools despite the warming effect of extra ultra violet radiation acting on the ozone in the stratosphere.

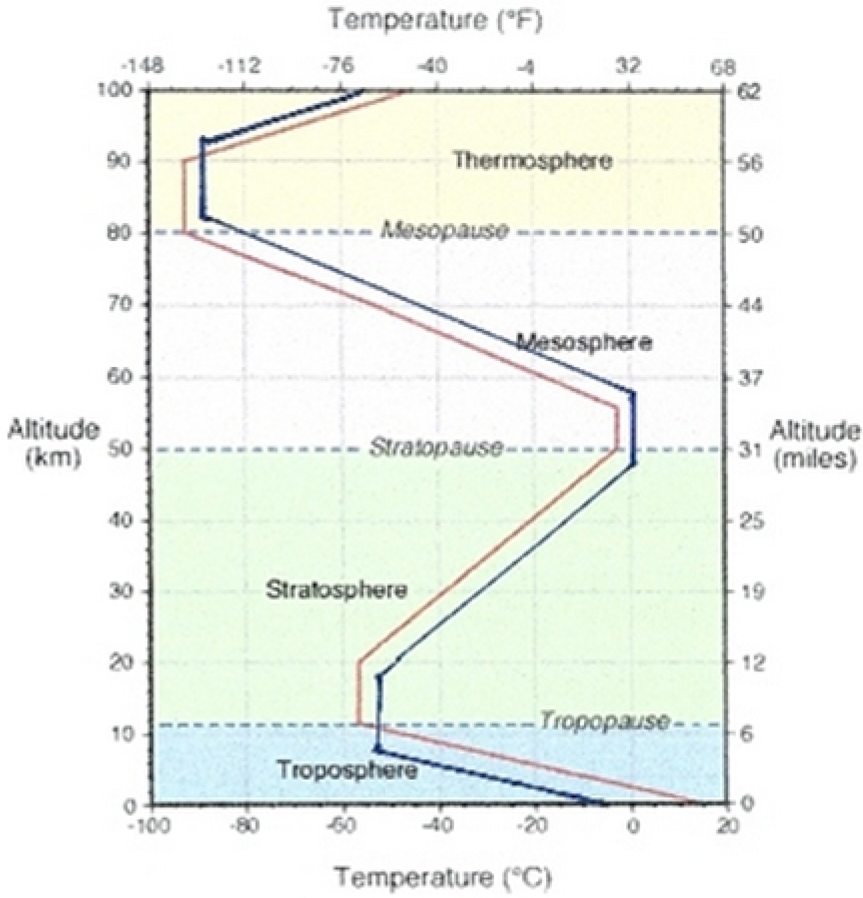
iv) The cooling stratosphere increases the temperature differential between surface and stratosphere so the tropopause rises thereby drawing the air circulation systems in the troposphere poleward as the polar vortex shrinks horizontally but deepens vertically.

v) The poleward shift of the air circulation systems allows more solar energy into the oceans and onto the land by reducing cloud quantities and albedo so the troposphere warms.

Note however that the observed temperature effect within the troposphere will also be modulated by the sea surface temperatures at the time which can either supplement or offset the effect of the solar changes.

3) When the sun is less active.

This is what must happen to accord with observations. A situation that mirrors all that happens when the sun is more active.



Summary:

By applying the above described mechanism an active sun causes the jets to move poleward thus 'opening the window blinds' for an increase in solar energy reaching and entering the oceans with the system showing a net energy gain overall.

A quiet sun causes the jets to move equatorward thus 'closing the window blinds' for a decrease in solar energy reaching and entering the oceans with the system showing a net energy loss overall.

This is the climate narrative that best fits real world changes over the past ten years together with the conditions that prevailed pre 2000.

Thus do tiny changes in solar activity nonetheless produce significant energy budget effects on the Earth system by varying the strength and intensity of the proton bearing solar wind.

With solar protons being charged particles this scenario also provides support for those who have perceived climate correlations with the strength of the solar wind and with variations in the Earth's magnetic fields.

There are also implications for the variability in the size of the polar ozone holes but that is beyond the scope of this article.