Recognizing Incorrect and Insignificant Meteorological Theories

“Fear is the most basic emotion we have. Fear is primal. Fear sells.” ~ Mel Brooks

Most of the popular commodity publications tend to lean a bit heavy on fear, hype, and conviction when forecasting weather events. It’s no coincidence that they also tend to lack any scientific basis or logical rationale for their high conviction cold takes.

In this follow-up to my first report on the fundamentals of meteorological forecasting in commodity markets, we’re going to dive into a few of the common meteorological mistakes -- as well as the outright gobblygook nonsense -- that we routinely see peddled in many commodity reports.

We’ll discuss the popular sun cycles, planetary alignments, and more… Alright, let’s dive in.

Fact vs. Fiction

"There is nothing as boring as the truth." ~ Charles Bukowski

Meteorology done right is several parts boring to one part excitement.

Atmospheric effects follow the Pareto principle, where *eighty percent* of the variance in a distribution (temperature and precipitation anomalies) can be explained by less than *twenty percent* of the phenomena. That 20% being the regular run-of-the-mill “boring” atmospheric occurrences we discussed in the prior piece.

Despite these “atmospheric power rankings”, commodity publications routinely highlight the *sexier* sounding narratives of influential multi-planetary alignments and sunspot oscillations as principal drivers for a coming cold or warm spell.

But alas, there are scientifically verifiable local effects that explain the vast majority of variance in weather pattern orientation. These are the tried-and-true factors that make or break seasonal forecasts.

Central Concept 1 | Planetary Alignments and Terrestrial Effects

Does the location of Jupiter or Mars in relation to Earth, affect the level of precipitation in Angola?

This is a popular one that I regularly see, and there is a grain of truth to the idea.

You see, the large distances between planetary bodies follow the “inverse-square laws” of physics, meaning there are diminishing effects from gravitational and magnetic forces.

However, the time and scale at which these forces operate are vastly different than those we routinely see touted in the media.

The effects from these oscillatory cycles are felt not over the span of a few years but over a semi-geological timescale. Kent *et al.* (2018) [1] discovered that a cycle 405,000 years in length leads to changes in Earth’s climate due to the orientation of Jupiter and Venus’ gravitational fields.

Earth is approximately 200,000 years into this cycle, featuring temperature and precipitation extremes at both ends. Given that we’re not at the beginning or end of this cycle, the effects which Jupiter and Venus’ have on Earth’s climate are minuscule and relatively unvarying over a human timescale.

And it’s not just Jupiter and Venus, but the impact of other multi-planetary alignments operate on this timescale too. So while the alignment of planets *does* impact the climate, it does so on a *very* long and slow-moving timescale, which makes considering the alignment of Uranus and Earth when analyzing the grains market, a pointless exercise.

Central Concept 2 | Sunspot Cycles and Comparisons to the Maunder Minimum

The sun goes through ‘Solar Cycles,’ altering the ultraviolet radiation that eventually makes its way to earth.

These Solar Cycles have an approximate period of 11-years, and the amount of energy variation deviates by approximately 0.15% between sunspot cycle minimum and sunspot cycle maximum.

When this energy variance is high or low over an extended period of time. It can combine with other effects and produce a rare ‘perfect storm’ or sorts.

The most notable period where a significant variation in expected sunspot activity took place began in the 17th century and lasted midway through the 18th century. Coined the ‘Maunder Minimum,’ there were very few sunspots recorded, and Europe and North America went into a “Little Ice Age.”

It wasn’t just a bit colder than usual... The North American continent suffered from *extreme* drought as well. Explorers from Europe arrived to find the mid-Atlantic portion of what is now the eastern United States to be in dire straits:

> “In quite another condition than expected … not because he was at fault in his description of it, but because Our Lord has chastised it with six years of famine and death, which has brought it about that there is much less population than usual.” [7]

This period was later recorded to be the driest in 770 years.

Europe wasn’t spared either. The Thames River underwent a deep freeze, crippling the shipping industry and leading to widescale famine. A report from the period describes the situation:

> "Hunger pinches their cheeks, as deep into the flesh as it doth into yours here. You cry out here, you are undone for coals: and we complain, we shall die for want of wood." [7]

Gustav Spörer, an astronomer in the 19th century, describes just how rare of an event this was [6]:

> “He (Spörer) found less than 50 (sunspots), whereas in any typical 30-year interval during the past hundred years there have been between 40,000 and 50,000 spots reported.”

So the mini ice age was not a fun time to be alive. Especially in the Northern hemisphere.

With that said… The scientific literature [2] [3] casts doubt on the idea that sunspot activity was the *primary* factor responsible for deeply colder temperatures. Instead, the evidence suggests it was a confluence of factors, as outlined below:

1. Large volcanic eruptions in the years leading up to the Maunder Minimum cast ash into the atmosphere, initially cooling it. Note the increased volcanic activity in Greenland (red-circled region) in the figure below.

2. Sunspot activity *exacerbated* the effect of the ash, cooling the atmosphere further to a point where sea ice increased in the area.

3. The cooling of the atmosphere enabled ice to form and sink south, altering ocean currents, which are responsible for transporting heat and maintaining climate regimes for continents.

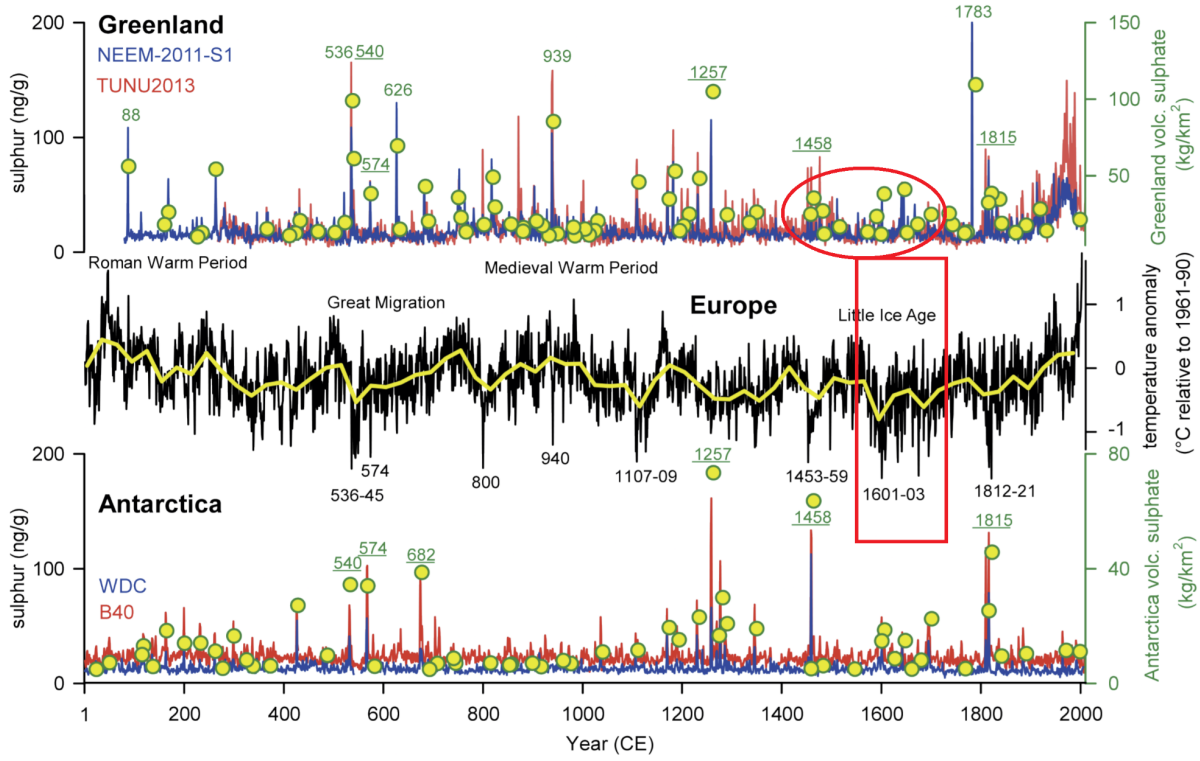


Image Source: https://bit.ly/3kdzFis (Figure 2)

This 'perfect storm' has not occurred since. Currently, volcanic activity is within its historical range (bottom trace of the figure below). This significantly minimizes the risk of a significant amount of ash resulting in a precursor event for an anomalous flux in the sun's energy emissions:

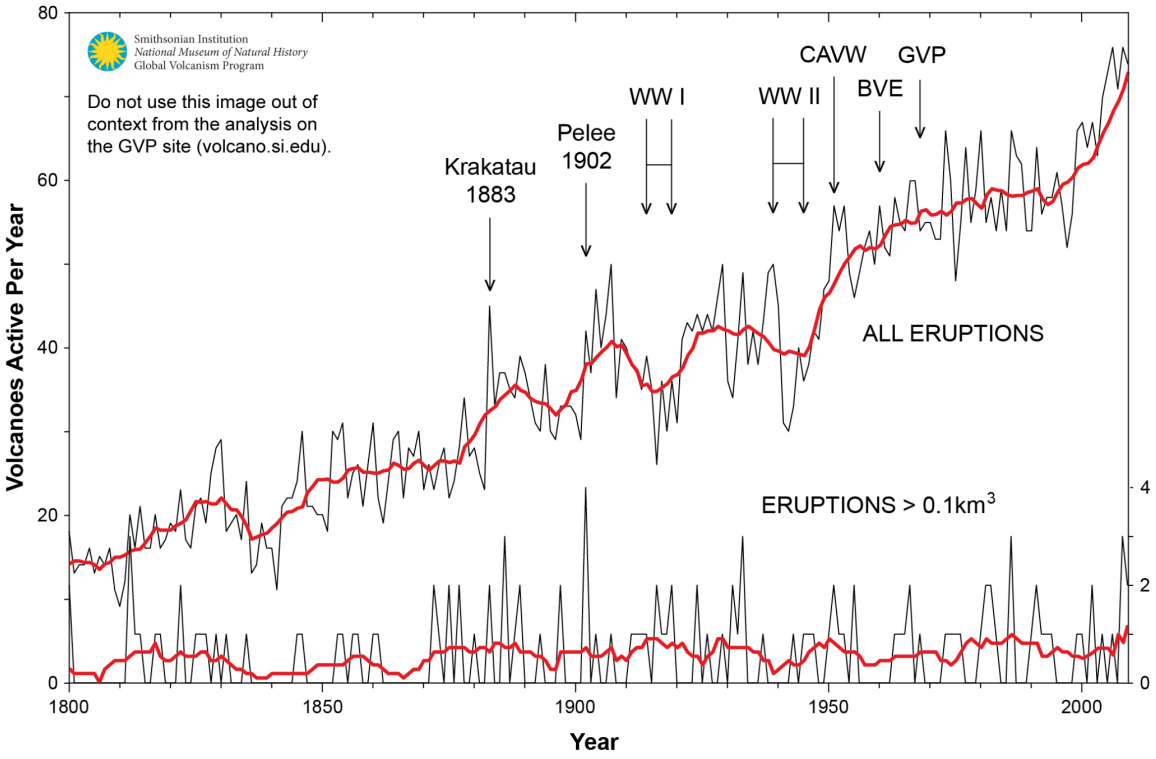


Image Source: https://s.si.edu/39gp2EZ

The sun recently completed one of its 11-year solar/sunspot cycles. The last cycle dubbed “Solar Cycle 24”, by the Space Weather Prediction Center, featured some of the lowest levels of sunspot activity observed in several decades.

The sun is now starting to see an increase in sunspot activity. The Space Weather Prediction Center recently came out with a new report claiming that “Solar Cycle 25” will likely break the decline in solar activity observed over the last several years.
This decreases the chances that we see an extended drop in sunspot activity.

To conclude, given that the sun is waking up in terms of its sunspot activity, and volcanic activity is within normal levels, we lack the combination of celestial and geological events to prime an event like the Maunder Minimum or anything remotely close to it.

As such, any report referencing or predicting a period of weather that is remotely on par with a ‘Maunder Minimum’ event should be taken with a large degree of caution/skepticism.

Main Concept II | Sudden Stratospheric Warming Events

This doesn’t mean the sun is celestially bipolar with respect to how it affects Earth in terms of no effect or famine. Its impact may not be significant but it can nudge the weather on earth at times.

Recent research suggests these nudges in solar activity occasionally have an impact on the stratosphere [4]. Termed as a ‘Sudden Stratospheric Warming Event,’ (SSWE) the literature points to a statistical relationship between the two.

It is hypothesized that changes in solar activity alter the vertical distribution of wind propagation patterns and ozone makeup in the atmosphere.

Table 1. Values of the correlation coefficient between solar activity and MSSWs for different proxies. The number of subintervals is the same for all calculations.

	American sunspot numbers	Lyman-alpha flux	3.2 cm flux	8 cm flux	10.7 cm flux	15 cm flux	30 cm flux
ERA-40/ERA-Interim	0.58; 86.66 %	0.54; 83.36 %	0.62; 89.86 %	0.44; 72.32 %	0.63; 90.68 %	0.45; 74.21 %	0.59; 87.72 %
NCEP–NCAR-I	0.49; 78.00 %	0.58; 86.57 %	0.64; 91.35 %	0.43; 70.93 %	0.55; 83.80 %	0.35; 60.65 %	0.71; 95.17 %

This research seems to paint a much clearer picture with regard to how the sun’s radiation fluxes translate to the stratosphere and eventually down to the troposphere (where our weather happens).

Like ENSO and the MJO (which were discussed in our introductory primer), SSWEs have a large influence in winter. Think of SSWEs like an atmospheric gut punch; these disrupt the prior arrangement of weather patterns. If they're of significant strength and positioned correctly, these can team up with other atmospheric phenomena and shunt the polar vortex southward from its arctic domain, or pave the way for warmer weather to prevail.

As you may have guessed by their name, these events aren't packaged with a large amount of lead time, ten days at most. When one occurs, it calls for a reassessment and a potential adjustment of any previously published atmospheric thesis.

Main Concept III | Climate Change

Remember Kent, who discovered the 405,000-year solar cycle?

He, along with other climate scientists, recognize the effect that climate change plays in distorting extra-terrestrial effects; "It's pretty far down on the list of so many other things that can affect climate on times scales that matter to us," Kent said.

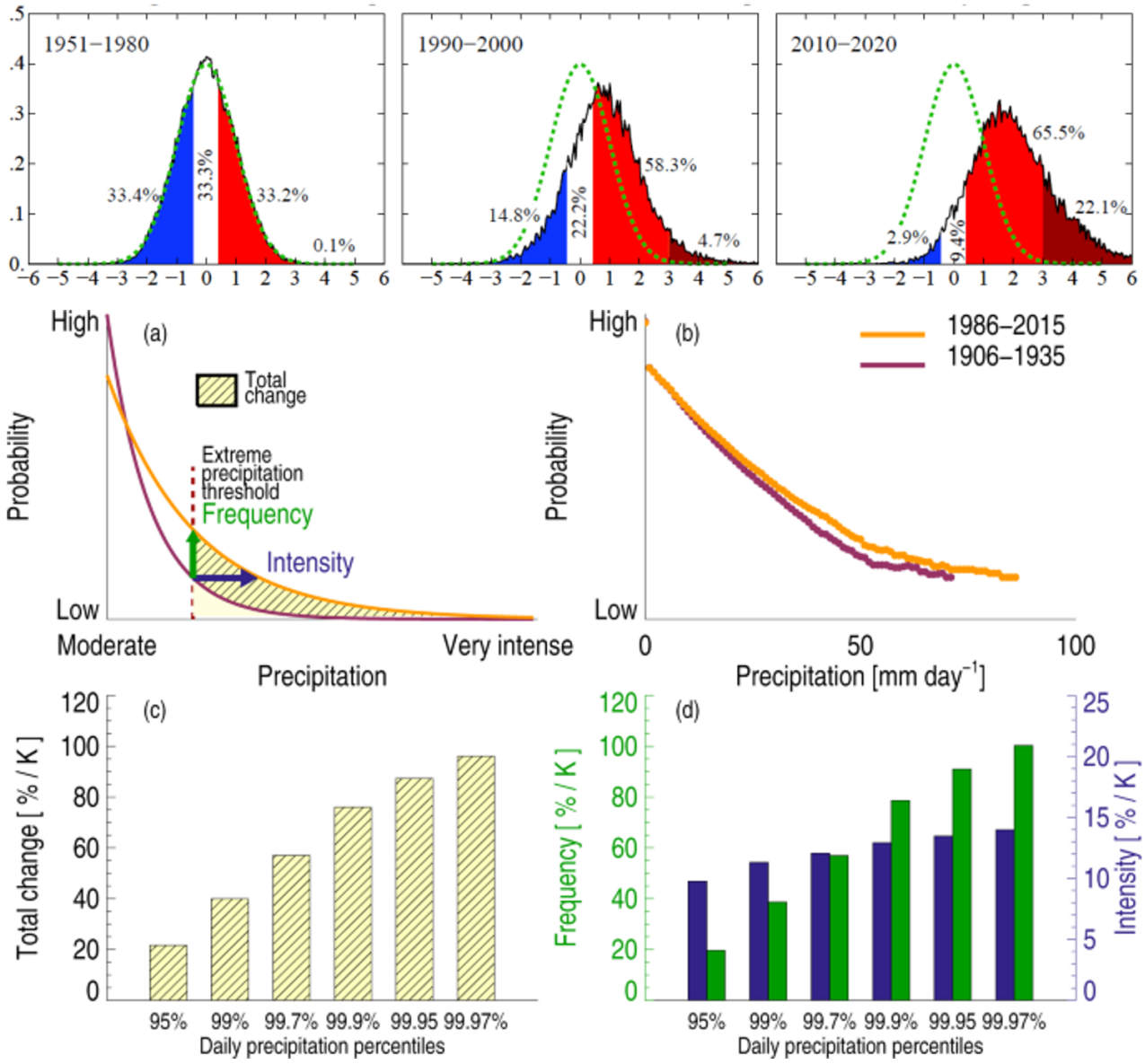
I agree.

While the climate will continue to change independent of human effect, as it always does. Humans are not completely off the hook.

The introduction of carbon dioxide and other greenhouse gases into the atmosphere does impact the climate -- though there's much debate on the *significance* of this impact. But as the human impact on the climate grows, we should continue to see a slight reorientation of weather patterns in addition to a yet-to-be-discovered amount of alteration with respect to oceanic currents.

This reorientation is magnitudes more impactful than the relative change and effect of those longer planetary cycles we referenced above.

While the effects of climate change aren't realized overnight, the figure below shows the slow uptrend in surface temperatures in addition to shifting rainfall intensity toward extremes.



At figure top [5], note how the right tail (hotter temperatures) are trending further to the right with respect to the 1951-1980 period. The bottom two-thirds of the figure shows how both frequency and intensity of extreme precipitation events (flash floods) occur at a higher rate and intensity. This impacts commodities via washouts and floods of crops during critical periods in the crop lifecycle.

Climate change is a slow-moving but increasingly influential trend. While there's no way we can know the *exact* effects, due to the extreme complexity of the system. There is a high chance we will continue to see an increasing variance in seasonal weather trends. Variance that will have large impacts on food production and energy consumption, amongst other things.

To summarize, the main atmospheric effects responsible for explaining the variation in local and global weather patterns are:

1 - **ENSO** (primer)
2 - **MJO** (primer)
3 - **Solar Cycles**
4 - **Sudden Stratospheric Warming Events**
5 - **Climate Change**

The market doesn't care about phrasing for clicks. It cares about the truth. Our goal at Macro Ops is to highlight that truth and make informed predictions, citing past, current, and future events to maximize our analytical edge.

Your Commodity (and Weatherman) Operator,

Steve

Referenced Images and Publications

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[2] Miller *et al*. 2012. "Abrupt onset of the Little Ice Age triggered by volcanism and sustained by sea-ice/ocean feedbacks"
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[3] "Unusual Volcanic Episode Rapidly Triggered Little Ice Age, Researchers Find"
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[4] "Notes on the correlation between sudden stratospheric warmings and solar activity"
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[5] Fig. 5: Temperature and Precipitation Anomaly Distribution
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[6] Spörer Maunder Minimum Description
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[7] Historical Accounts on the Maunder Minimum Description
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