TWO WEEK AND FOUR WEEK WEATHER CYCLES AND LUNAR – SOLAR EFFECTS UPON PACIFIC NORTHWEST WEATHER

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INTRODUCTION

Of all Pacific Northwest climate oscillations, from days to a few thousand years in length, the most pronounced (both in temperature and precipitation) are found in the 10-to-30-day range. This interval can be further broken down into a 10 to 15 day and 25-to-30-day oscillation.

These two week and four week oscillations are apparently influenced by phases of the moon, and the rotation of the sun. Most of us are quite aware that the moon has a New Moon to New Moon (or Full-Full) rotation every month (29.5 days). Few of us know that the sun actually rotates on its own axis (like the earth in 24 hours), as observed on earth at 27.3 days. The rotation actually extends clear out into the solar system, on an axis of positive and negative polarity, passing the earth on a 27.3 day cycle and 1/2 that on a 13.65 day cycle (+-), called Solar Sector Boundary Passages (SSB or Interplanetary Magnetic Field [IMF]).

PERCENT RESPONSE TO WESTERN WASHINGTON WEATHER: The results show that Western Washington weather responds to the Sun and the Moon at about 3 percent. At Solar 11 year MAX or Lunar 18.6 year MAX, the response averages about 7-10 percent. At the same MIN, the response is about 5 percent. The greatest response is to the 18.6 year Lunar MAX, with Western Washington temperature in Winter (N,D,J,F), amplitude about 15% and Average Daily Temperature 11 percent (about 3 to 7 times increase from normal). (These results are from an estimate of Coefficient of Variation from the Solar or Lunar Phase, Standard Deviation divided by the average monthly Standard Deviation).

METHODS-DATA: This study used the standardized average daily temperature and also amplitude of daily temperature 1900-2020 in Western Washington (10 station average, geographically separated, 120 years).

Lunar phase and Solar Sector Boundary passage are from constant data. The solar sector boundary Passage and Lunar phase can be roughly estimated. As felt on earth earth, the Solar Passage averages 27.2753 DAYS, using a base year (beginning at solar sector commencement) of 01/04.73/1900 (19000104.73) Jan 4.73, 1900 (lag from a set rhythm +-0.1862 days). The lunar Synodic month is 29.5305888844 (year 2000: 29.53058770576?) days in length (mean solar days), and aligns at Full Moon and New Moon about every 14.765 days, with a base year (beginning with New Moon) of JAN 0.933474, 1900 (about 10:30PM on Jan 1, 1900; lag from a set rhythm +-0.3149 days, period length varies from 28.5-30.5 days).

MIXING OF THE SUN AND THE MOON:

Since the period lengths are so overlapping, a 27.3 day and 29.5 day cycle, it seems to be quite confusing on how identify the two separately. This is one major obstacle in identifying their affect upon our earth's climate.

However, they merge once a year. The sun cycle and lunar cycle merge at day one again, every 354.5 days. So, every Lunar x12 and Solar x13 cycles is where they merge again – this gives us an opportunity to analyze the 12 lunar vs 13 Solar on a many year basis.

The correlation of the moon and solar sector boundary passage with Western Washington climate was analyzed on a monthly basis. Combining the sun and the moon to observed Western Washington weather may double the normal correlation, over 5 percent on average to over 25% during Lunar MAX, and accounting for variability, may be even double that – needs further investigation.

The observed sun and moon combined data are very similar to the simple combined average sun and moon for each day. This makes for a much simpler analysis.

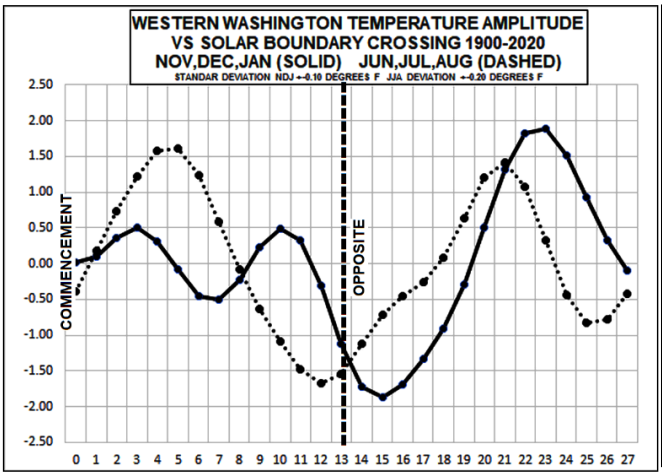
WINTER VS SUMMER:

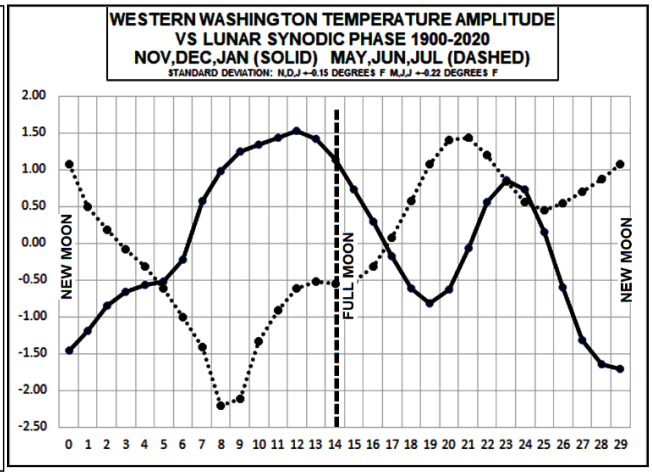
The following are charts showing average Winter and Summer for the Lunar synodic phase and also Solar Sector Boundary Passages. Several interesting features:

While the Solar Sector boundary Winter and Summer amplitude are nearly identical, the temperature is nearly opposite Winter-Summer. Just the opposite for the moon, where temperature is nearly the same Winter and

Summer, but amplitude is opposite. Thus, solar dry-cold winter, dry-warm summer, and Lunar dry-cold winter vs wet-warm summer.

Solar vs temperature amplitude (cloudiness) has a pronounced two cycle per 27 days both Winter and Summer.





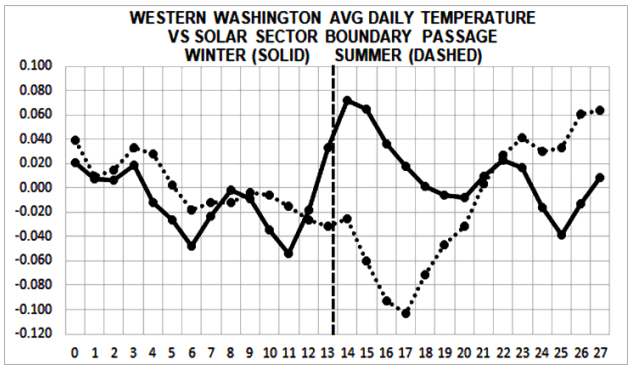
These charts can summarize the Lunar and Solar effect upon W Washington weather, as follows:

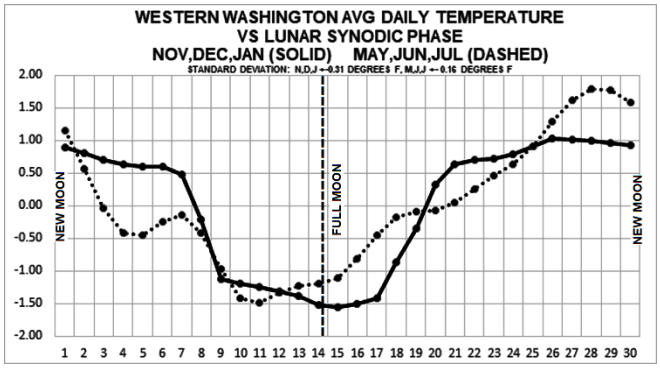
LUNAR:

- Warmest 10 days before to 6 days after New Moon Winter and Summer.
- Coldest 6 days before to 3 days after Full Moon Winter and Summer.
- Clearest 7 days before to 2 days after Full Moon in Winter (and 8-10 days after Full Moon), and clearest 5 days after Full Moon until 4 days after New Moon in Summer.
- Most Cloudy 3 days before to 5 days after New Moon in Winter and 7-12 days after New Moon in Summer.

SOLAR:

- Temperature is opposite in phase between winter and summer, while the amplitude (cloudy/clear) is somewhat the same.
- Warmest 1 day before to 5 days after Opposite in Winter, and 3-10 days after Commencement and 6-11 days after Opposite in Winter.
- Coldest 3-11 days after Commencement in Winter, and 2 days before to 5 days after Opposite in Summer.Clearest 7-1 day before Commencement in Winter, and 3-8 days after Commencement and 5-10 days after Opposite in Summer.
- Clearest in summer 2-7 days after Commencement and 7-10 days after Opposite. In Winter clearest 7-13 days after Opposite.
- Most Cloudy 0-5 days after Opposite in Winter, and 4 days before to 3 days after Opposite in Summer.





<u>MAXIMUM AND MINIMUM TIMING ESTIMATE (11 year SOLAR and 18.6 year LUNAR NODAL):</u>

The timing of the 11 year solar cycle MAX and MIN can be estimated using formulas. Lag from a set rhythm of 11.063 years, base year for MAX 2014.74 (period length MAX-MIN 6.02YRS, MIN-MAX 5.04YEARS) . The 11 year solar cycle lags from a set rhythm varies significantly with an 88 year and 208 year cycles. The 88 year cycle MAX Base year 1968, period 88.0 years (STDEV +-0.5 year). The 208.0 year cycle lag from a set rhythm,

Base year MAX 2004.5, amplitude +1 year earlier at MAX, -1 year lagging at MIN, and varies from that at +-0.85 YEARS) (the 208.0 year cycle varies significantly with a 2400 year cycle).

The timing of the 18.6 year Lunar Nodal cycle is 18.6133019052 years in length. Lunar Nodal lag from a set rhythm, with a base year at MAX 2006.464915.

SOLAR BOUNDARY PASSAGE and the 11 year SOLAR CYCLE

- The largest response is the 11 year Solar Maximum, with an amplitude (cloudy/clear) 2-7 days after each Commencement and Opposite. Cloudiest 0-5 days before Commencement and Opposite. The 11 year Minimum is reverse that of Maximum, and about half the response.
- Temperature response is greatest in at the 11 year Solar Maximum, clearest 4-7 days after Commencement and also Opposite. The 11 year minimum is about the same, but a lesser response.
- In Winter the largest Average Daily Temperature response to the 11 year solar cycle is at the Minimum, with warmer temperature after the Opposite and colder after Commencement, and reverse for the Maximum, with warmer temperatures after Commencement, and colder after Opposite.
- In Winter the largest Amplitude response to the 11 year solar cycle is at the Maximum, with clearest skies before Commencement, similar to Minimum, and cloudiest at the Opposite.

LUNAR SYNODIC PHASE AND THE 18.6 YEAR LUNAR NODAL CYCLE

- The largest response to the 18.6 year cycle is with the MAXIMUM (when the Moon is furthest north) of the Lunar Synodic Cycle (3-7 times the average Synodic Phase).
- In Summer it is warmer and drier during at the Nodal Maximum, 3-5 days after the New Moon and 3-11 days after the Full Moon.
- Temperature in Summer is much warmer at the minimum, with little response to the Synodic phase (vs at Maximum).
- In Winter, at the Nodal Maximum, it is warmer, but cloudier 3-9 days after the New Moon, and after the Full Moon.
- In Winter, at the Nodal Maximum, it is colder and drier 6 days before to 3 days after the Full Moon.
- In Summer, at the Nodal Minimum, it is warmer at the same times as at the Maximum, but the amplitude (dry vs wet, is somewhat similar in phase to the Maximum, but much lesser a variation.

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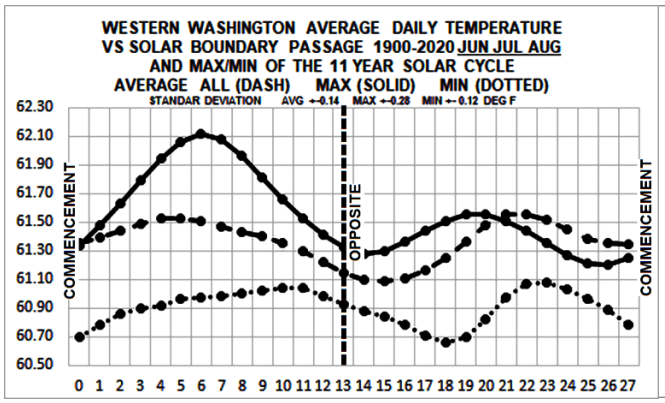
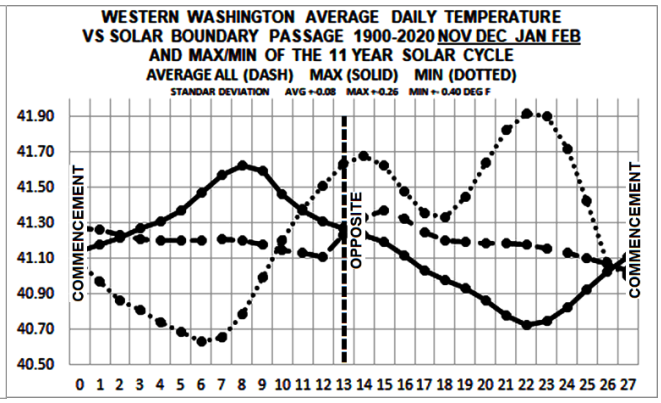

WESTERN WASHINGTON AVERAGE DAILY TEMPERATURE
VS SOLAR BOUNDARY PASSAGE 1900-2020 JUN JUL AUG
AND MAX/MIN OF THE 11 YEAR SOLAR CYCLE
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
$TANDAR DEVIATION AVG +-0.14 MAX +-0.28 MIN +- 0.12 DEG F
COMMENCEMENT
OPPOSITE
COMMENCEMENT


WESTERN WASHINGTON AVERAGE DAILY TEMPERATURE
VS SOLAR BOUNDARY PASSAGE 1900-2020 NOV DEC JAN FEB
AND MAX/MIN OF THE 11 YEAR SOLAR CYCLE
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.08 MAX +-0.26 MIN +- 0.40 DEG F
COMMENCEMENT
OPPOSITE
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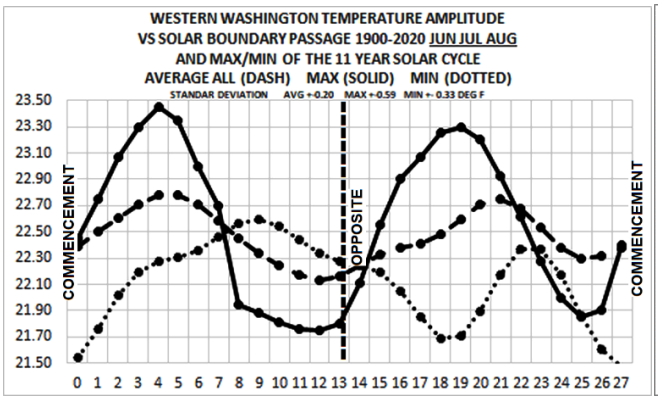
WESTERN WASHINGTON TEMPERATURE AMPLITUDE
VS SOLAR BOUNDARY PASSAGE 1900-2020 JUN JUL AUG
AND MAX/MIN OF THE 11 YEAR SOLAR CYCLE
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.20 MAX +-0.59 MIN +- 0.33 DEG F
COMMENCEMENT
OPPOSITE
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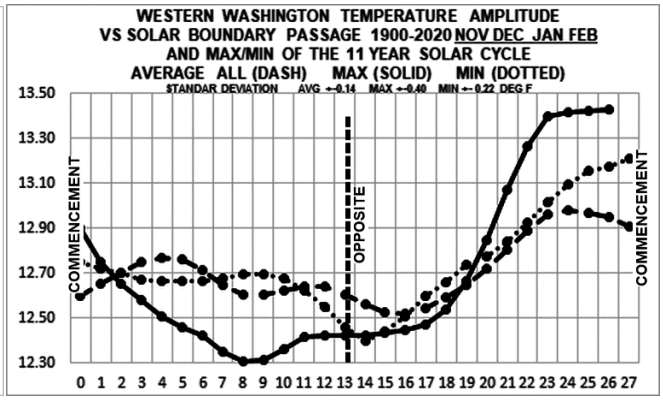
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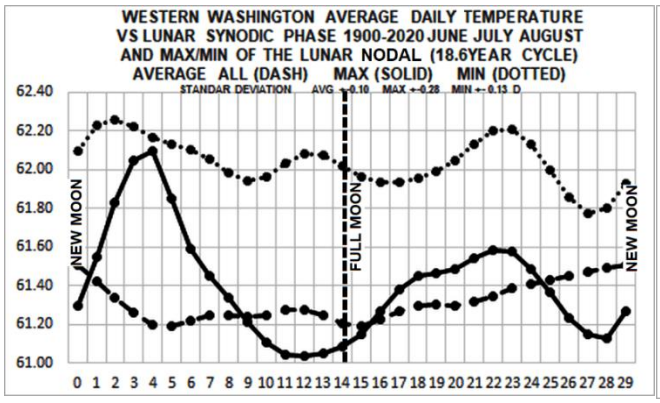
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.14 MAX +-0.40 MIN +- 0.22 DEG F
COMMENCEMENT
OPPOSITE
COMMENCEMENT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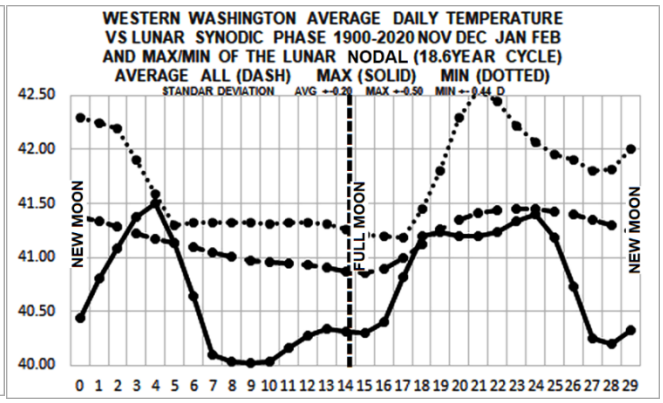
VS LUNAR SYNODIC PHASE 1900-2020 JUNE JULY AUGUST
AND MAX/MIN OF THE LUNAR NODAL (18.6YEAR CYCLE)
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.10 MAX +-0.28 MIN +- 0.13 D
NEW MOON
FULL MOON
NEW MOON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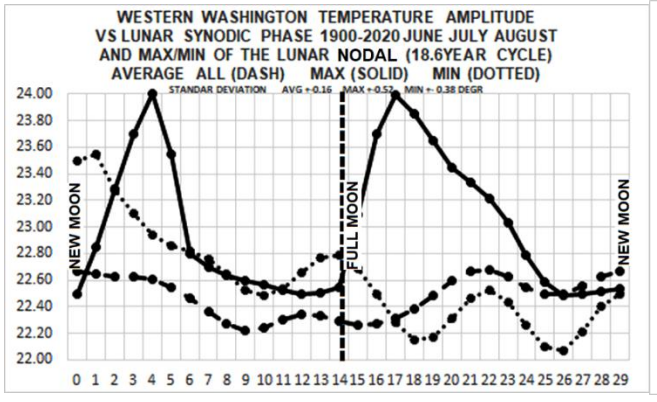
AND MAX/MIN OF THE LUNAR NODAL (18.6YEAR CYCLE)
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.20 MAX +-0.50 MIN +- 0.44 D
NEW MOON
FULL MOON
NEW MOON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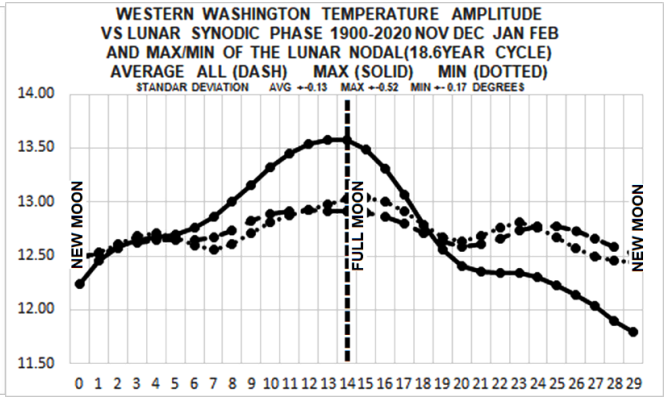
AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.16 MAX +-0.52 MIN +- 0.38 DEGR
NEW MOON
FULL MOON
NEW MOON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AVERAGE ALL (DASH) MAX (SOLID) MIN (DOTTED)
STANDAR DEVIATION AVG +-0.13 MAX +-0.52 MIN +- 0.17 DEGREES
NEW MOON
FULL MOON
NEW MOON

TWO WEEK TO FOUR WEEK OSCILLATIONS

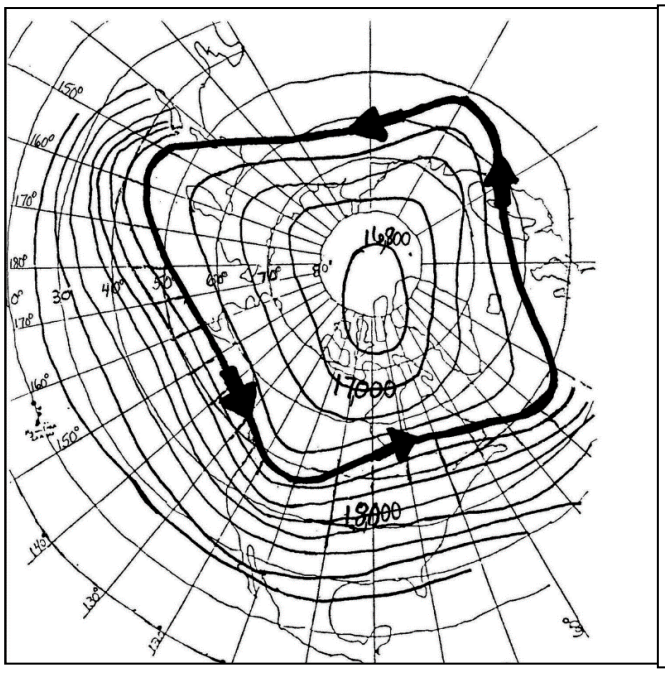
POSITIVE PHASE–ARCTIC OSCILLATION

STRONG VORTEX- STRONG WESTERLY FLOW

Lower Arctic Air Pressure
EXTREMELY COLD AIR CONFINED TO ARCTIC
WARM MIDDLE LATITUDES

COLD PACIFIC NORTHWEST

About 18,00 feet altitude (500 mbar)



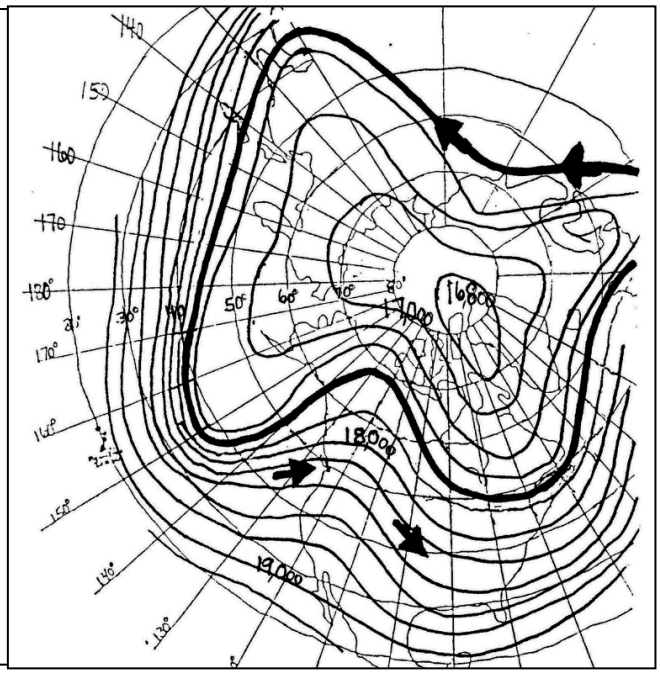
NEGATIVE PHASE–ARCTIC OSCILLATION

WEAK VORTEX – WEAK WESTERLY FLOW

Higher Arctic Air Pressure
COLD AIR SPILLS INTO MIDDLE LATTITUDES
WARM MIDDLE LATITUDE AIR SPILLS INTO ARCTIC

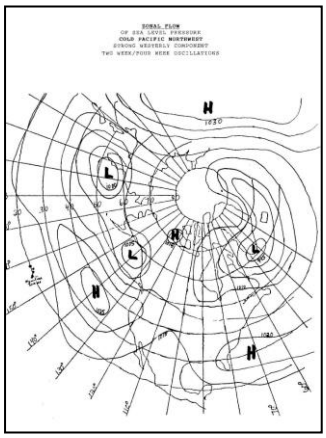
WARM PACIFIC NORTHWEST

About 18,000 feet altitude (500 mbar)

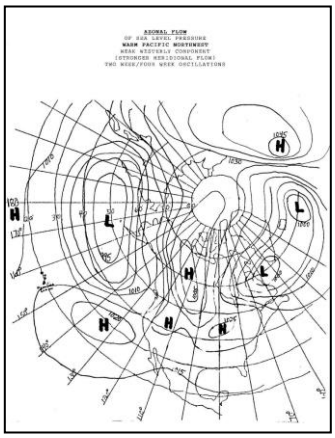


Lower Polar pressure indicates increased momentum and High Zonal flow, whereas, High Polar pressure indicates reduced momentum and Low Zonal flow.

The two week and four week cycles are similar in character, being associated with planetary wave patterns varying from increases or decreases in the flow of upper level westerlies. During weak upper level westerlies (weak zonal flow), a ridge of high pressure develops over North America and low pressure develops over the Pacific, bringing a southwesterly flow of air and warmer temperatures over our area. When the upper level westerlies are strong (high zonal flow) the low pressure over the Pacific is weakened, allowing a more west/ northwest flow of air and cooler temperatures.



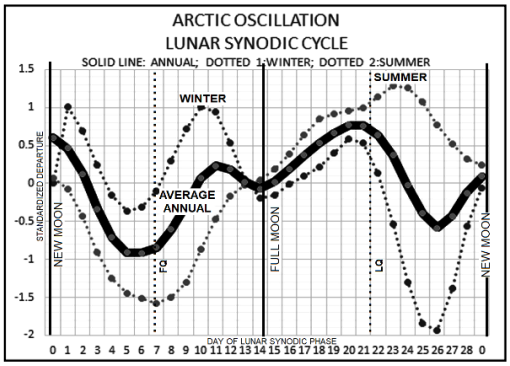
Sea Level Pressure
Arctic Positive Phase



Sea Level Pressure
Arctic Negative Phase

Atmospheric winds at the 500 MB level (about 18,000 feet) follow a somewhat circular path around the North Pole during high zonal flow, whereas during weak winds, atmospheric flow is more easily perturbed by continental barriers. In the Northern Hemisphere, the two Continental masses divert incoming winds in a northerly flow around and over the Continent, with high pressure on the lee side of mountain ranges, and lower pressure in front. This creates two main atmospheric waves in the Northern Hemisphere known as Rossby Waves (Planetary Waves of orographically forced nature), with the greatest amplitude via the jet stream flow. The pattern of variation resembles a mobile cyclonic wave train originating in the jet stream entrance region. Northern Hemisphere response is greatest over the North/Northeast Pacific and dissipates as the wave travels Southeastward across North America and into the tropics, or moves into Western Europe.

The Arctic Oscillation appears as a circular pattern of sea-level pressure anomalies centered at the poles. The continents and large landmasses disrupt the circular structure at the Arctic Pole, but anomalies around the Antarctic pole are nearly circular.

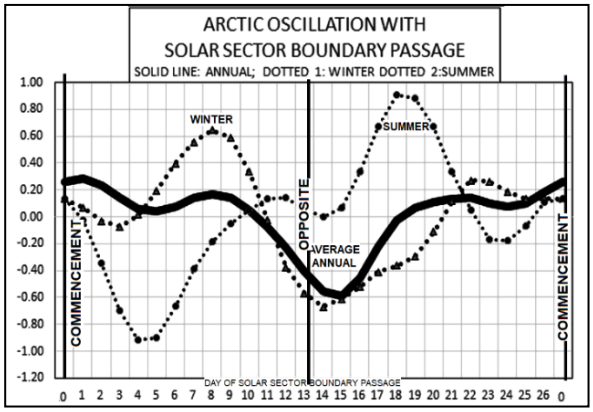


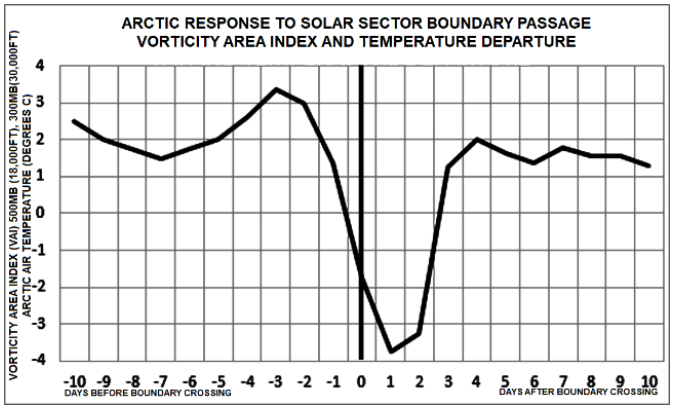
ARCTIC OSCILLATION - LUNAR CORRELATION

Polar regions exhibit strong lunar phase modulation with higher temperatures occurring near full moon and lower temperatures at new moon.

SOLAR SECTOR BOUNDARY CORRELATION

SOLAR SECTOR BOUNDARY PASSAGE AND THE TROPOSHERIC TEMPERATURE RESPONSE IN NORTHERN HEMISPHERE WINTERS. The polar temperature reaches a minimum on the first half-day after the passage of SSBs in Winter, below the 500mb level, and this variation spreads to 70*N. The whole heating in middle latitudes (60-35*N) is almost equal to the whole cooling in the polar region (90-65*) at each le





AVG Winter Arctic Response to Solar Sector Boundary Passage
Northern Hemisphere Vorticity Area Index (VAI)
and Arctic Temperature (500mb) Departure

Vorticity Area Index (VAI) is a measure of low pressure troughs in Northern Hemisphere at latitudes >20 deg. The greatest winter Stratospheric winds are in the upper Stratosphere (or higher – above 100,000 feet). The appearance of the Stratospheric polar vortex each winter is in response to the large-scale temperature gradients between the midlatitudes and the pole.

TRANSMISION FROM SPACE TO THE SURFACE OF THE EARTH

The solar induced response at the earth has the greatest coherency over the geomagnetic North Pole above about 50,000 feet to the Magnetosphere. The Solar response is also transmitted via UV radiation in the earth's mesosphere and stratosphere. Above about 50,000 feet the response resembles the same two dimensional scale as the polar vortex itself, with strongest amplitude and coherency centered over the North Pole, a 180 degree phase transition centered near mid-latitudes (40 - 60 North).

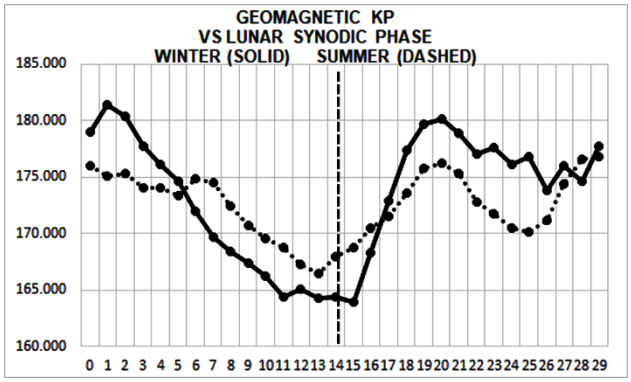
One way that earth can be affected by the sun or moon is the influence of cosmic rays on cloud formation. The amount of cosmic rays can vary with the intensity of activity of the solar wind, not allowing so many cosmic rays to reach earth. Few cosmic rays mean fewer clouds will be formed; therefore, the Earth will be warmer. During less activity, more cosmic rays can come in, meaning more clouds, reflecting sunlight, and a cooler Earth.

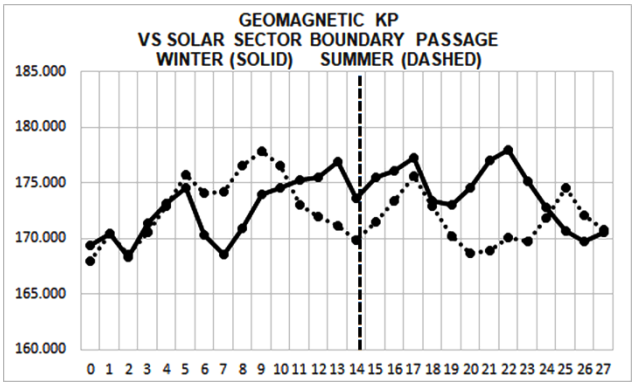
The current density in the global circuit is large at the surfaces of clouds. The charge transfers to droplets, some of which evaporate at the cloud-clear air boundary. Mixing of the charged evaporation nuclei forms more droplets in several types of clouds.

The main effect of geomagnetic disturbances would be to increase westerly zonal winds from the North Pacific. In the Troposphere, an increase of Zonal winds to the lee of continental mountain ranges (eastern Canada), increases or decreases in response to geomagnetic events.

Geomagnetic Correlation (1932-2001)

In Winter the Solar Sector Boundary is only about 2/3 the intensity as the Lunar effect on the earths geomagnetic field. In the summer they are about equal.

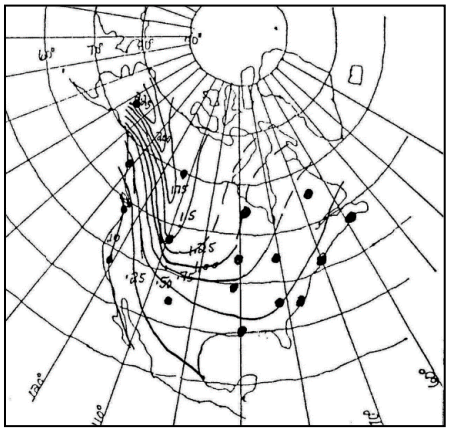




LUNAR SYNODIC ROTATION **SOLAR SECTOR BOUNDARY PASSAGE**

LUNAR

When the moon is overhead, Earth's atmosphere bulges towards, due to its gravitational pull. It is believed that higher atmospheric air pressure increases the temperature of air particle on earth, which increases the amount of moisture that those particles can contain. It is less likely to result in precipitation, as the moisture capacity affects the amount of rain and lower humidity.



AMPLITUDE OF TWO WEEK AND FOUR WEEK SURFACE TEMPERATURE

(WINTERS 1931-1965) Extracted from Polowchak and Panofsky 1968)