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Ray Garnett: 2016 Recipient of Andrew Thomson Prize in Applied Meteorology  
Canadian Meteorological and Oceanographic Society

## **Ray Garnett Climate and Crop Letter**

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### **Highlights Since the Last Letter**

\* Wheat yield and quality are expected to decline in Australia and Argentina related to recent dry/hot weather in Australia and wet/cool conditions in Argentina;

\* Global wheat production is expected to fall below 730 mln tonnes in 2018 representing a 30 mln tonne shortfall below 2017;

\* Evidence of global cooling is apparent in recent months (Please see Appendix).

### **Canadian Prairies**

#### **Spring Wheat and Canola**

*Summary: The third week of October brought good dry harvesting weather though cool weather prevailed over the eastern prairies.*

October 15-21 brought very dry weather to the region amidst warmer than normal temperatures.

For the month ending October 21, precipitation was in excess of 115% of normal in Alberta south of Edmonton, northwestern Saskatchewan and western Manitoba. Amounts exceeded 150% of normal east and south of Calgary in Alberta and in an area bounded by Regina, Dauphin and Portage La Prairie.

Harvesting progress by province was as follows:

In Alberta at October 16, all crops 51%, spring wheat 51%, barley 54%, canola 30%;

In Saskatchewan at October 15 all crops 82% vs the 5 yr average 91%, spring wheat 72%, canola 67%; and

In Manitoba at October 22, 99% of the spring wheat and 95% of the canola crops were harvested.

At October 15, the worth of unharvested crop was estimated at \$3 bln. Soil moisture recharge for the 2019 crop is lacking in most of Alberta and east central Saskatchewan.

### **U.S.**

#### **Winter Wheat, Corn and Soybeans**

*Summary: Harvesting of corn, soybeans and winter wheat planting progress.*

October 15-21 brought colder than normal weather to the corn, soybean and winter

wheat areas and good soil moisture recharge to the Oklahoma and Texas.

Central U.S. has been colder than normal for the past month with extreme cold sinking into the hard red winter region this past week.

Harvesting progress of the above crops as of October 1 was as follows: Corn 49% complete versus the average of 47%; Soybeans 53% complete versus the five year average of 69%.

Rains in excess of 150% of normal in early October will have continued to hinder the soybean harvest to the extent yield estimates could fall.

Winter wheat was 72% planted versus the average of 77%. Planting was well behind in Kansas.

Soil moisture recharge since September 1 has been well above normal in all three grain growing areas.

### **Other Global Impacts**

#### **Argentina: Wheat**

*Summary: Excessive rainfall appears to have resulted in very poor quality.*

With wheat now in the latter stages of the heading, the southern half of the wheat area received well above normal rainfall October 15-21. Temperatures were above normal.

Since September 1, rainfall has been normal to well above which would typically support good yields. However in September, rainfall was 150-400% of normal at heading throughout the grain growing area except for central areas. This likely caused diseases.

Quality is being reported as very poor.

At October 20, overall plant conditions are assessed as poor and yield potential is expected to be lower than 3.0 t/ha (45 bu/ac) below the yield in 2017. A one mln tonne shortfall below last years production is conceivable.

#### **Brazil: Soybeans**

*Summary: The planting of soybeans will be underway.*

#### **Europe (EU): Winter and Spring Grains**

*Summary: Drier and warmer than normal weather favoured corn harvesting and planting of winter wheat.*

Except for wet weather in southern France, dry warmer than normal weather favoured overall favouring corn harvesting and fieldwork generally October 15-21.

Media reports indicate that southern France recently experienced a 1 in 100-year flooding in mid-October. The corn harvest in France is normally past the mid point at this time.

Planting of the 2019 winter wheat crop is currently underway.

Since September 1, soil moisture recharge has been greatly lacking in central France and to a lesser extent in western Germany.

## **FSU: Winter Grains**

*Summary: Warm dry weather favoured field work activity in the European sector in late October.*

Much warmer and drier than normal weather prevailed October 15-21 over the European sector favouring fieldwork. Planting of winter wheat will now be complete.

Since September 1, there has been a lack of soil moisture recharge in northwestern Ukraine, Central and portions of North Caucasus.

In the Siberian sector (east of the Ural Mountains), mid-October brought much above normal rainfall to western portions of Siberia and much of Kazakhstan.

Since September 1, soil moisture recharge has been good in western portions of Siberia while poor in eastern Siberia.

In Kazakhstan, recharge has been highly variable. Harvesting of spring grains is expected to be complete.

## **India: Wheat**

*Summary: Very dry conditions have prevailed during the early part of the planting season.*

October 18-24th brought less than 40% of normal rainfall to the northern wheat area. Similarly, since October 1, rainfall has been less than 40% of normal. Typically, about 20% of the wheat crop is planted at this time.

## **Australia: Wheat**

*Summary: Heat in the eastern half of the continent reduces yield prospects.*

Scattered heavy timely rains in mid October will have stabilized or revived crops in New South Wales during the latter stages heading. Temperatures however were well above normal and will have stressed crops not receiving rainfall.

October rainfall has been highly variable, helpful in some areas while not on others.

At October 20, crops were assessed as very poor in New South Wales and portions of south Australia (32% of the area) while fair in Western Australia (41% of the area).

ACC currently estimates the 2018 wheat yield at 1.51 t/ha (23 bu/ac) which is 19% below the trend of 1.90 t/ha. (28.3 bu/ac). The 2018 wheat crop is shaping up to be the worst since 2007 when the wheat yield was 1.06 t/ha (16 bu/ac).

ACC estimates wheat production at 16.6. mln tonnes compared to 21.3 mln tonnes in 2017, a shortfall of 4.7 mln tonnes.

## **Forecast Verification**

On August 6, 2018 we wrote for the FSU. "Heat has been problematic in the southern European sector since mid-June, reducing winter wheat, spring barley and corn yield potential."

*What Happened?* In October, the USDA reported that corn yields in southern Russia, the largest corn producing area (east of the Ukraine) to be 4.49 t/ha which is 9% below the five year average. Overall yields are 7% below the 2016 and 2017 average of 4.85 t/ha at 4.50 t/ha (72 bu/ac.) Russia typically produces 14mln tonnes of corn and the

shortfall in 2018 is considered to be 2.5 mln tonnes below that.

## Appendix

Given evidence of global cooling in the past year or so, why is a carbon tax being imposed on Canadians?

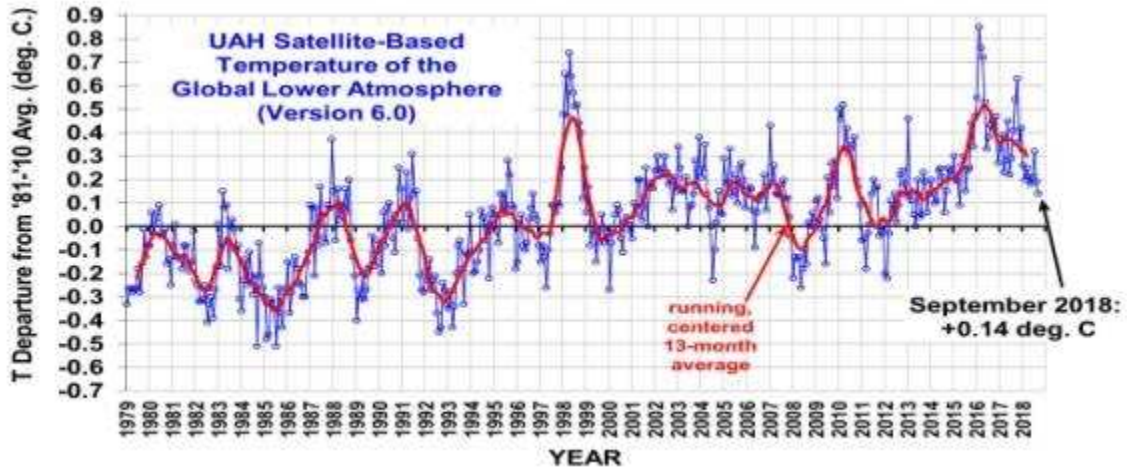


Figure 1  
Google Search: Dr. RoySpencer-Latest Global Temperature

Why is so much trust being put in the International Panel of Climate Change (IPCC) in forecasting of the Earth's climate given their track record? See for yourself.

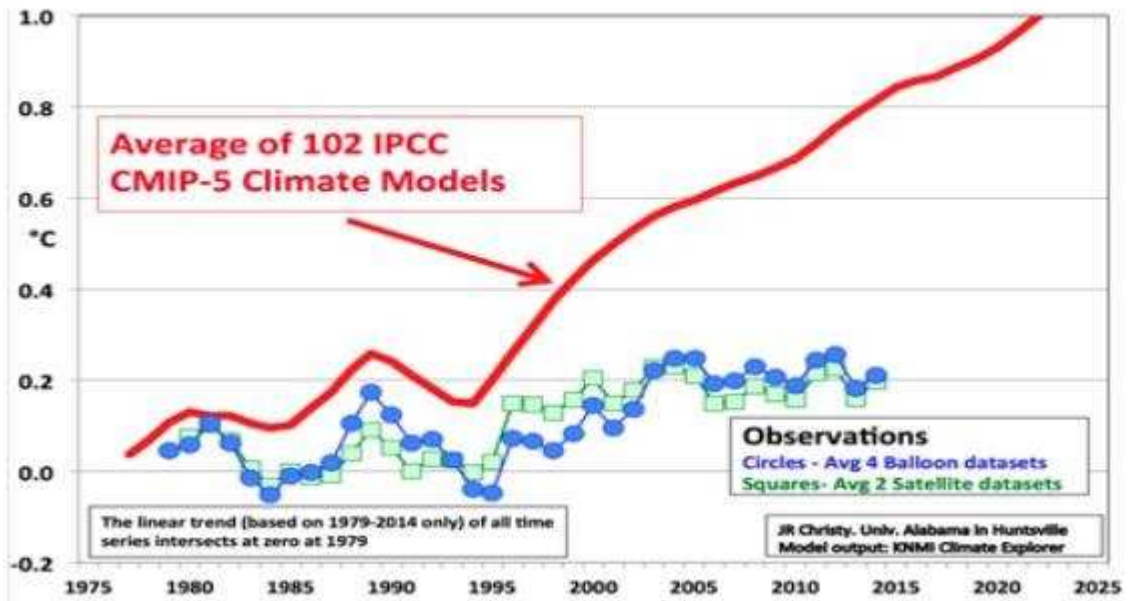


Figure 2  
Source: Garnett, E.R. and Khandekar, M.L.2018

*Feel free to show these graphs to elected officials.*

## Canadian Prairie Agro-Ecological Zones



**Prairie agro ecological zones:** Peace River: Agro-eco region 14: Palliser North: Agro-eco regions 10,11 and 13: Palliser Brown Agro-eco region 12 and Eastern Prairies: Agro-eco region 2.

### Glossary of Terms Used

**Agricultural Drought:** The U.S. Centre for Climate and Environment Assessment defined drought as less than 50% of normal rainfall during two consecutive months of the active growing season in unirrigated areas (dryland). (This assumes normal or above temperatures during the two month period). One cannot ignore the significance of July precipitation in defining agricultural drought on the Canadian prairies. Also, when yield departures from trend are greater than 10% below trend, ACC considers it affected by Agricultural Drought.

**AO:** The **Arctic Oscillation (AO)** consists of 1000 mb height anomalies centred over

the Bering Sea and northwest of Spain with an associated trough over the Arctic. When the oscillation is strong (Blue or of a negative sign as seen on the Climate Prediction website) there are increased and more intense cold air incursions into the Canadian prairie region. The reverse is true when the index is positive.

**AP:** The **AP Index (AP)** is a measure of the general level of geomagnetic activity over the globe for a given day. It is derived from measurements made at a number of stations worldwide of the variation in the geomagnetic field due to currents in the earth's ionosphere and to a lesser extent, in the earth's magnetosphere. An observatory in Neigh, Germany calculates official values of the AP index daily. It is a proxy variable for the solar activity.

**AGW: Anthropogenic Global Warming (AGW)** refuted in six words - "Carbon dioxide is not a pollutant." Source: Plimer, I, 2009. AGW refuted in one sentence - The Roman Warming (250 B.C.-450 A.D.), the Dark Ages (535-900 A.D.), the Medieval Warming (900-1300 A.D.) and Little Ice Age (1280-1825) invalidate all arguments supporting human-induced global warming. Source: Plimer, I, 2009.

**Bermuda High:** Has been described, as an extension of the Azores High a key aspect of the North Atlantic Oscillation (NAO), which is more expansive when the NAO is positive. Agro-Climatic consulting (ACC) contends that a positive (negative) NAO tends to prevent (assist) moisture entering North America through the Gulf of Mexico.

**Carbon dioxide (CO<sub>2</sub>)** is a heavy, colourless, odorless and non-combustible gas, present in the atmosphere and formed during respiration. It is not a pollutant. It makes up 0.04 of 1% of the atmosphere and plants absorb it as they need it to live. It is necessary for photosynthesis. CO<sub>2</sub> has nothing whatever to do with the temperature of the earth though regularly hypothesized as the culprit behind human-induced global warming. Sources: World Book Encyclopedia (1966), Webster Encyclopedic Dictionary (1973), Plimer (2009) and Hughes et al (2014).

**Climate Change Terminology:** Increasing global temperatures up until 2000 were referred to as 'Global Warming' based on the hypothesis that it was being caused by human induced carbon dioxide. After 2000 when global temperatures stopped increasing and carbon dioxide continued to rise the term 'Global Warming' became a public relations problem for the International Panel of Climate Change (IPCC). Proper science would require they consider the null hypothesis. Instead the IPCC moved the goal posts. Hence, the more nebulous term 'Climate Change' came about (Ball, Tim, 2014).

**DeVries-Suess Cycle of 210 Years:** In the early 1950s W.F. Libby and his research team found that carbon 14 was a product of cosmic ray bombardment and went on to develop the radiocarbon method of dating for which he was awarded the Nobel prize in chemistry in 1960. De Vries first demonstrated the time variation in atmospheric inventory of carbon 14 in tree contents in 1958. Suess and Linick further noted that the carbon 14 in the cellulose of wood in an annual tree ring corresponded remarkably well to CO<sub>2</sub> in the atmosphere. Svensmark further elaborates that 'When the sun is lazy, more

cosmic rays reach earth which seeds clouds and carbon 14 production goes up.' When the sun is very active, magnetically speaking, the rate of carbon 14 production is low. Upland peat in southern Scotland provides a climate record over 5500 years revealing a 210-year cycle of alternating wet-cool and warm cycles. Sources: Soon and Yaskel (2003), Svensmark and Calder (2007) and Plimer (2009).

**Eddy Solar Minimum:** Archibald (2014) describes how 11-year Solar Cycles number 24 and 25 became named the Eddy Minimum. Sunspot cycle # 24 began in 2009 with an average of 2 sunspots per month. In 2018 we are in agricultural year 9 of sunspot cycle 24 during which there has been an average of 13 sunspots September 2017 through June of 2018. The Eddy Minimum is being compared to the Dalton solar minimum of 1798-1823 which was a period of global cooling. The Eddy minimum started 211 years after Dalton minimum in 1798. Please also see DeVries-Suess Cycle.

**ENSO: El Nino/Southern Oscillation (ENSO)** in combination with the Indian monsoon system constitutes the largest single source of inter annual climatic variability on a global scale with effects that are wide-ranging and often severe. The Southern Oscillation is the difference in sea level pressure between Darwin and Tahiti. A positive (negative) SOI is indicative of La Niña (El Niño) conditions colder (warmer) than normal sea surface temperatures in the east equatorial Pacific. The Nino 3.4 region is most commonly used.

Bjerknes in the late 1960s fused the southern oscillation (SOI) concept with that of warmer or colder than normal sea surface temperatures in the east equatorial Pacific. Hence, the phenomenon is called the El Nino/Southern Oscillation. Research has shown that if El Nino (La Nina) conditions are evident during the spring and summers months the tendency is to favour (disfavour) rainfall during the Canadian prairie summer months.

**Gleissberg Cycle:** The Gleissberg Cycle has a period of about 87 to 88 years and is confirmed in a 1000-year record of solar (auroral) activity and is also reported in a 9700-year carbon 14 record from tree rings (Diaz and Markgraf, 1992). Landscheidt (2003) computed that the next Gleissberg cycle minimum would occur about 2030. Planet earth is expected to enter a period similar the Dalton or Maunder minimum between 2030-2050 (Personal Communication Dr. N.A. Morner September 8, 2018). Please also see (Morner 2015) amongst selected Research Publications.

**Greenhouse Effect Myth:** It is hypothesized that only greenhouse gases (water vapour and carbon dioxide) absorb infrared heat given off by the earth. This 150-year-old hypothesis falsely claims that Oxygen and Nitrogen do not absorb infrared heat. All gases absorb infrared heat by conduction, convection and radiation. This is the big secret that has been confusing humans for the past 50 years. Source: Hughes et al 2014.

**MJO: The Madden Julian Oscillation (MJO)** is a 30-60 day intra seasonal oscillation (a six week cycle) which travels eastwards at approximately 13 mi/hr (6 m/sec) through the atmosphere over the Indian and Pacific Oceans. A wet phase of enhanced precipitation follows a dry phase where thunderstorm activity is suppressed.

The wettest time of the year over the prairies is around June 21st at high sun when a

trough naturally occurs on the west coast as part of the annual cycle. It is hypothesized that a positive MJO in February at 120° W (near the North American west coast) suppresses June-July precipitation over the Canadian prairies months related to a six-week periodicity. A repetition of a positive the MJO six-week cycle around June 21st would serve to force a ridging pattern acting against the natural troughing resulting in a drier June-July.

**Modified PNA Accumulation Approach** sums only statistically significant months of December, January and May are summed. The sign of the May PNA values is reversed in the summation consistent with capturing sustained forcing.

**NAS:** The **North America snow cover (NAS)** represents the areal extent of snow cover in North America.

**NAO:** The **North Atlantic Oscillation (NAO)**; The positive phase of the NAO reflects below normal heights and pressure across the high latitudes of the North Atlantic (Iceland) and above normal heights and pressure over the central North Atlantic (Azores) Western Europe and the eastern United States. The negative phase reflects an opposite pattern of height anomalies over these regions. See also Bermuda High.

**NP:** The **North Pacific Index (NP)** is the area weighted sea level pressure over the region 30°N -65°N, 160°E-140°W. When this pressure is lower than normal December to August it is conducive to drought.

**PDO:** **Pacific Decadal Oscillation (PDO)** operates through a change in the location of warm and cold water in the Pacific. When the PDO index is positive (negative), waters in the north central Pacific Ocean tend to be cool (warm), and waters along the west coast of North America tend to be warm (cool) which alters the path of the jet stream. The effects of the PDO are most drastic in the Pacific Northwest whereby positive PDO generally correlates with lower (higher) than average rainfall and higher (lower) than average air temperatures over the Canadian prairies. A positive (negative) PDO is conducive to meridian (zonal) flow and drier (wetter) conditions similar to the PNA influence. The positive or negative phase of the PDO can persist a decade or more. The PDO index has been positive since January of 2014.

**PNA:** The **Pacific North American Teleconnection Index (PNA)** is a derivative index of the El Niño/Southern Oscillation index and is typically positive during El Niño and negative during La Niña. A positive (negative) PNA pattern is indicative of a strong (weak) Aleutian Low influence, which in turn forces a ridge (leads to Siberian expresses) over the prairie region. A positive (negative) PNA pattern is associated with mild (cold) winters over the Canadian prairies. During the April to May period research has shown that zonal flow (negative PNA) is associated with wetter cooler weather while meridian flow is associated with drier hotter weather over the Canadian prairies.

**PDSI:** The **Palmer Drought Severity Index (PDSI)** is often used as a measurement of dryness and is based on a supply and demand model of soil moisture. Minus 2 is



moderate drought, minus 3 severe drought and minus 4 severe drought.

**QBO: The Quasi-Biennial Wind Oscillation (QBO)** often referred to as the stratospheric wind reversal was discovered in the early 1960s. Measured at Singapore it is a reversal in winds at the top of the atmosphere blowing one direction for about 13 months and then reversing.

**Ridge:** A ridge can be described as a mountain of warm air at the 500 mb level halfway up into the atmosphere.

**Solar Hibernation:** Solar Hibernation is a historic reduction in the energy output of the Sun that occurs about every 200 years. Earth has been experiencing solar hibernation since 2010 as a consequence of the Eddy solar minimum. Historical solar minimums in the past were as follows: Dalton of 1795-1825, Maunder of 1645-1715, the Sporer of 1450-1540 and Wolf of 1280-1340. These were all periods of global cooling. [Sources: Casey (2014), Archibald (2009) and Plimer (2009).]

**Solar Influence:** Sunspot activity modulates the influence whereby low (high) sunspot activity leads to increased (decreased) cosmic rays, ions, condensation nuclei and clouds on a global scale. It has been demonstrated that cloudiness over the oceans can vary up to 5% between low (20 sunspots per month) and high (150 sunspots per month) sunspot activity. A cloudier earth is shinier, cooler and wetter earth. Solar irradiance is also reduced (increased) with low (high) sunspot activity and surface temperatures tend to be lower (higher.)

**Solar or Sunspot Minimums:** Eddy 2010 to present, Dalton 1785-1825, Maunder 1650-1715, Sporer 1460-1505 and Wolf 1280-1340. These were all periods in which planet earth cooled. The Little Ice Age makes up the period of 1280-1825.

**SOI: The Southern Oscillation Index (SOI).** This is one of the indices for measuring El Nino and it is related to the ocean temperature which in turn affects the sea level pressure of the eastern and central Pacific. In particular, when the pressure measured at Darwin is compared with that measured at Tahiti, the difference between the two can be used to generate an "index" number called S.O.I. When the number is positive we have a La-Nina (or ocean cooling), and when the number is negative we have an El Nino (or ocean warming) in the central and east equatorial Pacific.

**SD or Standard Deviation (SD)** is a measure of the 'spread' of values in a frequency distribution from the mean. In a normal distribution, the probability that a value will be between the limits of one standard deviation is 68% with a 32% probability of it being in one of the tails of the distribution.

**Trough:** A trough is a dip or a valley in the jet stream at 500 mb half way up the atmosphere which initiates low pressure systems steered by the jet stream.

**Volcanoes, Earth Quakes and Solar Hibernation:** Research by the Space and

Science Research Center (SSRC) shows that historically large volcanic eruptions and earthquakes are more likely to take place during solar hibernations. The Mt. Pinatubo volcano of 1991 was followed by summer temperatures in 1992 and 1993 over the Canadian prairies being 2 °C below normal which resulted in poor wheat quality. Sources: Casey 2014 and Garnett and Khandekar 2015. See also Solar Hibernation.

**WP: Western Pacific (WP) Teleconnection Index** is a primary mode of low-frequency variability over the North Pacific in all months in which during winter and spring, the pattern consists of a north-south dipole of anomalies, with one centre over the Kamchatka Peninsula and another broad centre of opposite sign covering portions of southeastern Asia and the western subtropical North Pacific. A third anomaly centre is located over the eastern North Pacific and southwestern U.S. in all seasons. Therefore, strong positive or negative phases of this pattern reflect pronounced zonal and meridional variations in the location and intensity of the entrance region of the Pacific (or East Asian) jet stream.

## **References**

### **Research Publications Related to Long-Lead Forecasting**

Currie, B. W., and Venkatagan P., 1978. *Relationship Between Solar Disturbances and Precipitation on the Canadian Prairies*, Institute of Space and Atmospheric Studies, University of Saskatchewan Archives, Saskatoon.

Garnett, E.R. and Khandekar, M.L., 1992. *The Impact of Large-Scale Atmospheric Circulations and Anomalies on Indian Monsoon Droughts and Floods and World Grain Yields*, Agricultural and Forest Meteorology 61:113-118.

Garnett, E. R., M. L. Khandekar, and J. C. Babb. 1998. *On the utility of ENSO and PNA indices for long-lead forecasting of summer weather over the crop-growing region of the Canadian Prairies*, Theor. Appl. Climatol., 60, 37-45.

Garnett, E.R., 2002. *Long-Lead Forecasting of Precipitation and Wheat Yields in Saskatchewan Using Teleconnection Indices*. 2002. Master's Thesis, Geography Department, Univ. of Saskatchewan Archives, Saskatoon.

Garnett, E.R., Nirupama, N., Haque, C.E. and T.S. Murty, 2006. *Correlates of Canadian Prairie summer rainfall: implications for crop yields*, Climate Research, Vol.32: 25-33.

Garnett, E.R. and Khandekar, M.L., 2015. *Determinants of Summer Weather Extremes over the Canadian Prairies: Implications for Long Lead Grain Forecasting*. Natural Hazards, Vol. 76 (DOI 10.1007/s11069-014-1543-3).

Stone, R, Hammer, G.L. and Marcussen, T., 1996. *Prediction of Global Rainfall Probabilities Using Phases of the Southern Oscillation Index*. Nature 384:252-255.

### **Facts About Carbon Dioxide and the Sun with References**

- 1) CO<sup>2</sup> is not a pollutant. It is a relatively inert gas [7,8];
- 2) CO<sup>2</sup> is a tiny fraction of the atmosphere at 0.04% or .0004[8];

3) CO<sup>2</sup> is essential to life on this earth with sunlight plus water plus CO<sup>2</sup> the basic process that creates all plants [8];

4) Plants need and thrive on CO<sup>2</sup>. -if we want to 'Go Green' we need more rather than less of it for photosynthesis [8];

5) CO<sup>2</sup> has nothing to do with the temperature of the earth [8]; and

6) The Sun controls the temperature of the earth. An absence of sunspots usually makes the earth cooler [8].

### **Recommended Books related to Changing Climate: Or What the United Nations (UN) International Panel of Climate Change (IPCC) is not telling us.**

Archibald, D. 2014. Twilight of Abundance: Why Life in the 21st century will be Nasty, Brutish and Short. Regency Publishing, Washington D.C. 208 pp.

Ball, T. 2014. The Deliberate Corruption of Climate Science. Stairway Press, Mount Vernon, WA 291 pp.

Browning, I. and Garissa, E.M. 1981. Past and Future History: A Planners Guide, Fraser Publishing Company, Burlington, Vermont. 382 pp.

Casey, J.L. 2014. Dark Winter: How the Sun is causing a 30-Year Cold Spell, Humane Books, Boca Raton, Fl. U.S.A. 164 pp.

Diaz, F.D. and Markgraf V.1992. El Nino: Historical and Paleoclimatic Aspects of the Southern Oscillation. Cambridge University Press, New York, N.Y.476 pp.

Fagin, B. 2000. The Little Ice Age: How Climate Made History 1300-1850, Basic Books, 387 Park Avenue South, New York, N.Y. 246 pp.

Hart, M.2015. HUBRIS: The Troubling Science, Economics, and Politics of Climate Change. Complete Desktops R&D Inc, 27 Saddle Cres, Ottawa, Canada. 594 pp.

Hughes, A.M., Khandekar, M.L. and Ollier, C. 2014. About Face: Why the world needs more CO<sup>2</sup>: The Failed Science of Global Warming. Two Harbours Press. Minneapolis, Minnesota. 327 pp.

Plimer, I. 2009. Heaven and Earth: global warming the missing science. Connor Court Publishing Ltd., Ballan, Victoria, Australia. 503 pp.

Soon, W. and Yaskell, H.S. 2003. The Maunder Minimum and the Variable Sun-Earth Connection. World Scientific Publishing Co. Pte Ltd. Singapore. 278 pp.

Svensmark, H. and Calder, N. 2007. The Chilling Stars: A New Theory of Climate Change, Icon Books Ltd. Cambridge, UK. 246 pp.

Winkless, N. and Browning, I. 1975. Climate and the Affairs of Men, Harper's Magazine Press. 228 pp.

### **Selected Research Publications Challenging Human Induced Global Warming**

Archibald, D.C. 2009. *Solar Cycle 24: Expectations and Implications*. Energy & Environment Vol. 20, No. 1&2, 2009.

Fries-Christensen, E and Lessen, K., 1991. *Length of the Solar Cycle: An indicator of Solar Activity Closely Associated with Climate*, Science 254: 1225.

Garnett, E.R. and Khandekar, M.L. 2017. *Weather and Climate Extremes on the Canadian Prairies: An Assessment with a focus on Grain Production*. Environment and Ecological Research 5 (4): 255-268. DOI:10.13189/eer.2017.050402. Reprint available with a google search on E. Ray Garnett

Garnett, E.R. and Khandekar, M.L. 2018. *Increasing Cold Weather Extremes since the New Millennium: An Assessment with a focus on worldwide Economic Impacts*. Modern Environmental Science and Engineering. May 2018, Vol. 4. No 5, pp 427-438 - available upon request

Landscheidt, T. 2003. *New Little Ice Age Instead of Global Warming?* Energy and Environment 14, 327-350.

Morner, N.A. 2015. *The Approaching New Grand Solar Minimum and Little Ice Age climate conditions*. Natural Science, 7, 510-518.

Solheim, J.E. Stordahl, K. and Humlum, O. 2012. *The Long Sunspot Cycle 23 Predicts a Significant Temperature Decrease in Cycle 24*, Journal of Atmospheric and Solar-Terrestrial Physics 80, May 2012.

Svensmark, H. and Friis-Christenson E, 1997. *Variation of Cosmic Ray Flux and Global Cloud Coverage - A Missing link in Solar-Climate Relationships*, Journal of Atmospheric and Solar-Terrestrial Physics, Vol. 59, pp 1225-32

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