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Session : EMRP2.1 Open session on Geomagnetism

Convener: Angelo De Santis
Co-Convener: Mioara Mandea

All contributions that do not fall in the other sessions on Earth's magnetic field studies can be submitted/presented in this session. In particular, we solicit contributions on theory and simulations, instrumentation, laboratory experiments and field measurements, data analysis and interpretation, as well as inversion and modelling techniques.

Geophysical Research Abstracts

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Preliminary report, between seismic swarms, the constant cycles of inflation/ deflation in some volcanic calderas in the world and the minimum and/or solar maximum years

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Abstract

The global communication network and GPS satellites have enabled us to monitor for more than a decade, some of the more sensitive , well-known and highly urbanized volcanic areas around the world. The possibility of electromagnetic coupling between the dynamics of the Earth-Sun and major geophysical events is a topic of research. *[Sytinskii,1987,1989][Casati;Straser,2012][Casey,2010][Charvátová,2010][Jaggar,1931][Jensen,1902,1904][Lyons,1899][Mazzarella;Palumbo,1989][O'Relly,1899][Stothers,1989][Kolvankar,2008]*.However the majority of researchers are orienting their research in one direction. They are attempting to demonstrate a significant EM coupling between the solar dynamics and terrestrial seismicity *[Huzaimy,2011]*. Ignoring a possible relationship between solar dynamics and the dynamics inherent in volcanic calderas.

The scientific references are scarce *[Lyons,1899][Madonia;Gurrieri;Inguaggiato;Giugliano;Romano;Spadaro;Zuccarello,2005][Střeštik,2003]*,however, a study conducted by the Vesuvius Observatory of Naples, notes that the seismic activity on the volcano is closely related to changes in solar activity and the Earth's magnetic field *[Duma;Vilardo,1998]*. We decided to extend the study to many other volcanic calderas in the world in order to generalise the relationship between solar activity and caldera activity and/or deformation of the ground. The list of Northern Hemisphere volcanoes examined is as follows:

- (United States) Long Valley*[California Volcano Observatory -CalVO-]* Yellowstone*[Chang;Smith;Wicks;Puskas;Farrell,2007][Chang;Smith;Farrell;Puskas,2010][Farrell;Smith;Taira;Chang;Puskas,2010][Waite;Smith,2002]*, charts 3a, 3b;Three sister *[Riddick;Schmidt,2011];* Kilauea Hawai *[Baker,Amelung,2012]*;Axialseamount*[Dziak,Haxel,Bohnenstiehl,Chadwick,Nooner,Fowler,Matsumoto,Butterfield,2012]*
- (Alaska) Augustine *[Alaska Volcano Observatory –AVO-]*
- (Japan) Sakurajima *[Iguchi,2012],* chart 2
- (Iceland) Hammarinn,Krisuvik,Askja *[Hreinsdottir;Gunnar,2014],* charts 5,6,7
- (Italy) Campi Flegrei *[INGV,Observatory of Naples,2014],* chart 4

We note that the deformation of volcanoes recorded in GPS logs varies in long, slow geodynamic processes related to the two well-known time periods within the eleven-year cycle of solar magnetic activity: the solar minimum and maximum. We find that the years of minimum (maximum), are coincident with the years in which transition between a phase of deflation (inflation) occurs (chart 1).

Additionally, the seismicity recorded in such areas reaches its peak in the years of solar minimum or maximum (chart 1). However, the total number and magnitude of seismic events is greater during deep solar minima, than maxima, evidenced by increased seismic activity occurring between 2006 and 2010.

This research is only a preliminary study report. Further and more extensive research are needed, in order to formulate a precise hypothesis of the relationship between aspects and magnetic geophysical processes inherent in the restricted volcanic areas . Our aim is to develop a useful technique to connect together with others as part of a toolkit enabling significant prediction of parametric processes.

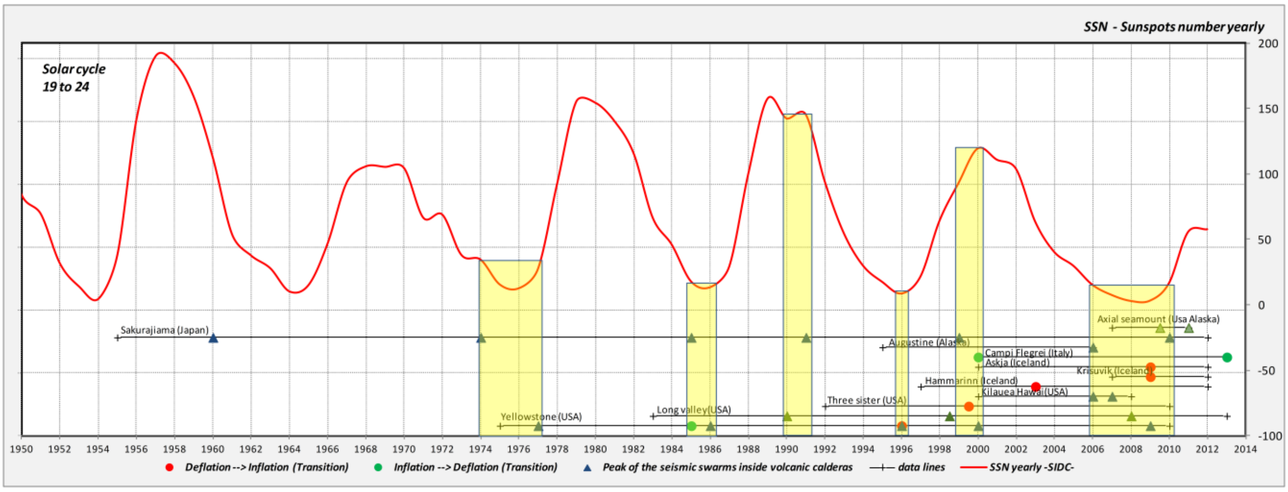

Chart 1 - Correlation between the evolution of the processes inside the volcanic calderas and the solar activity –

Graph outlining solar cycles No.19 to the current No.24 (yearly sunspot number count of the SIDC), showing the peak number of the seismic events and the years of passage or transition from one phase of deflation to a subsequent phase of inflation or vice versa. Analysis of eleven volcanic calderas in the northern hemisphere. The yellow areas, show how the years of solar maximum or solar minimum (For example, from the recent solar minimum from 2006 to 2010) it is easy to identify the change inside volcanic calderas.

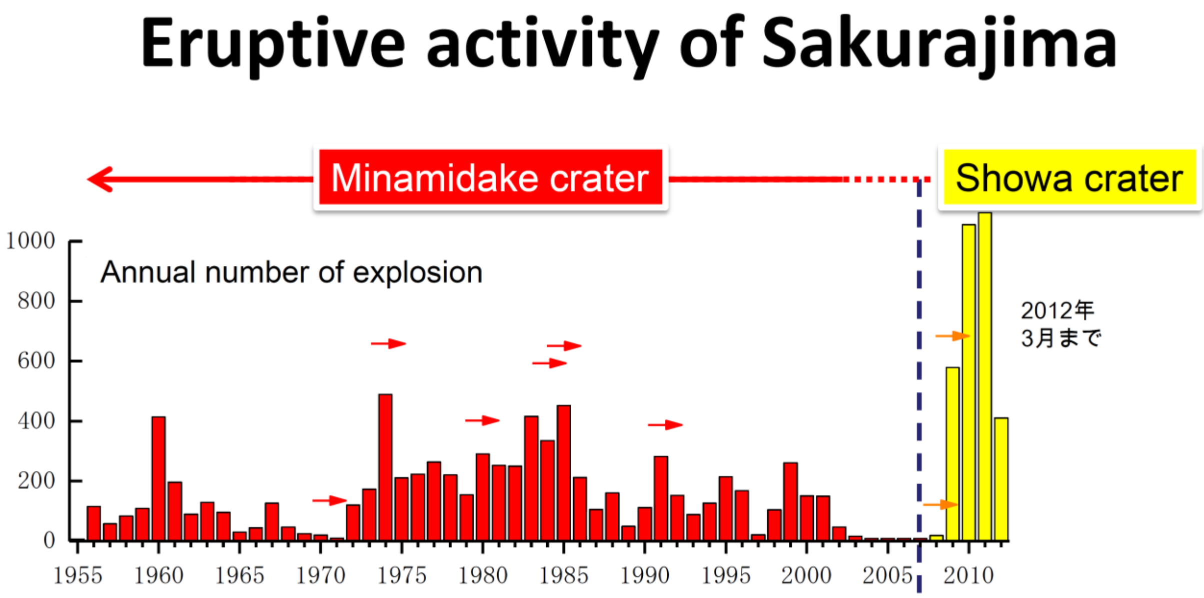

Chart 2 - Sakurajiama volcano – Japan

Annual number of explosions in the Minamidake crater, from 1955 to 2012. The explosive activity of the volcano has dramatically increased, from 2009 to 2010 (start of solar cycle 24). Source: Volcanic activity of Sakurajima volcano, South Kyushu, Japan - Sakurajima Volcano Research Center, DPRI, Kyoto Univ.

Chart 3a & 3b - Yellowstone caldera – USA

Chart 3a shows the increase in the number of seismic events from 1994 to 2000 (high point of the solar peak SC23), and then the decrease until the minimum of the seismic events during 2008-2010, while chart 3b, shows the years of the start of a new series of seismic events (start of solar cycle SC24).

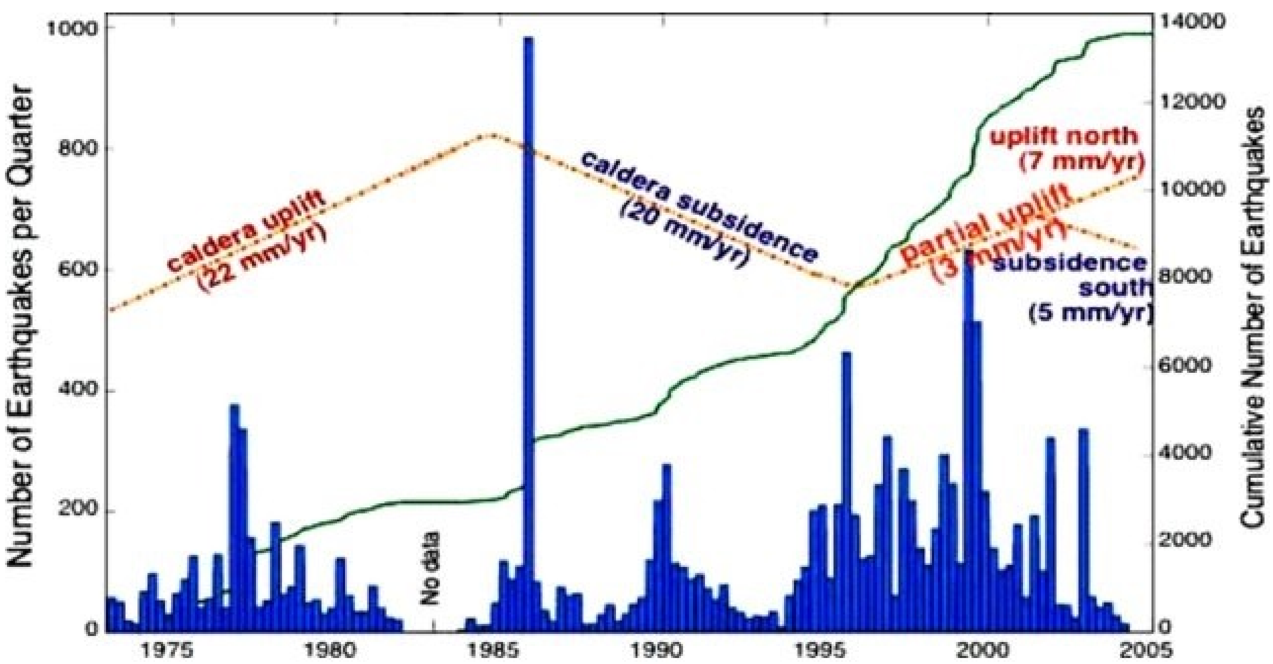

Chart 3a - Plot of recorded earthquake activity (≥ M 1.5) at Yellowstone from 1974 through 2004 (blue bars) along with caldera uplift and subsidence (red dotted line). The green line shows the cumulative num.

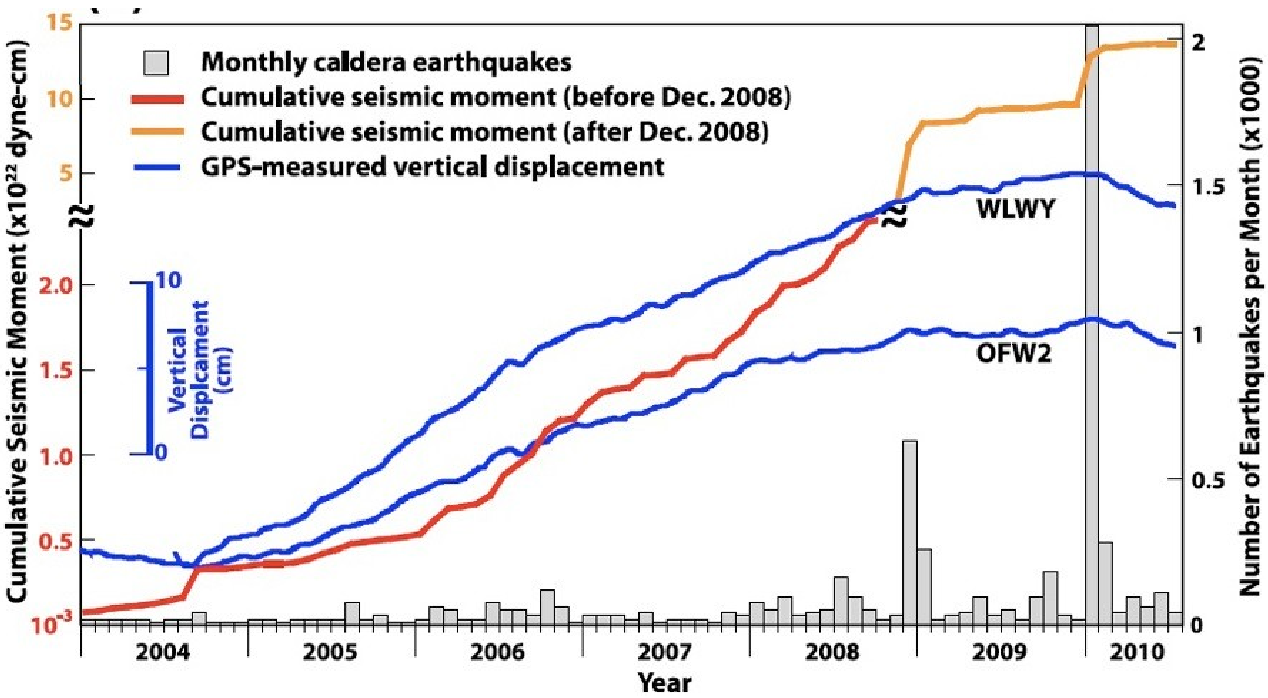

Chart 3b - Comparison of earthquake activity and ground uplift of the Yellowstone caldera, 2003-2010. Uplift of GPS stations WLWY and OFW2 are shown as blue lines (compare with blue scale bar). The histogram (gray bars) shows the number of Yellowstone earthquakes per month (right Y axis), with most activity occurring during the period when the uplift began to slow.

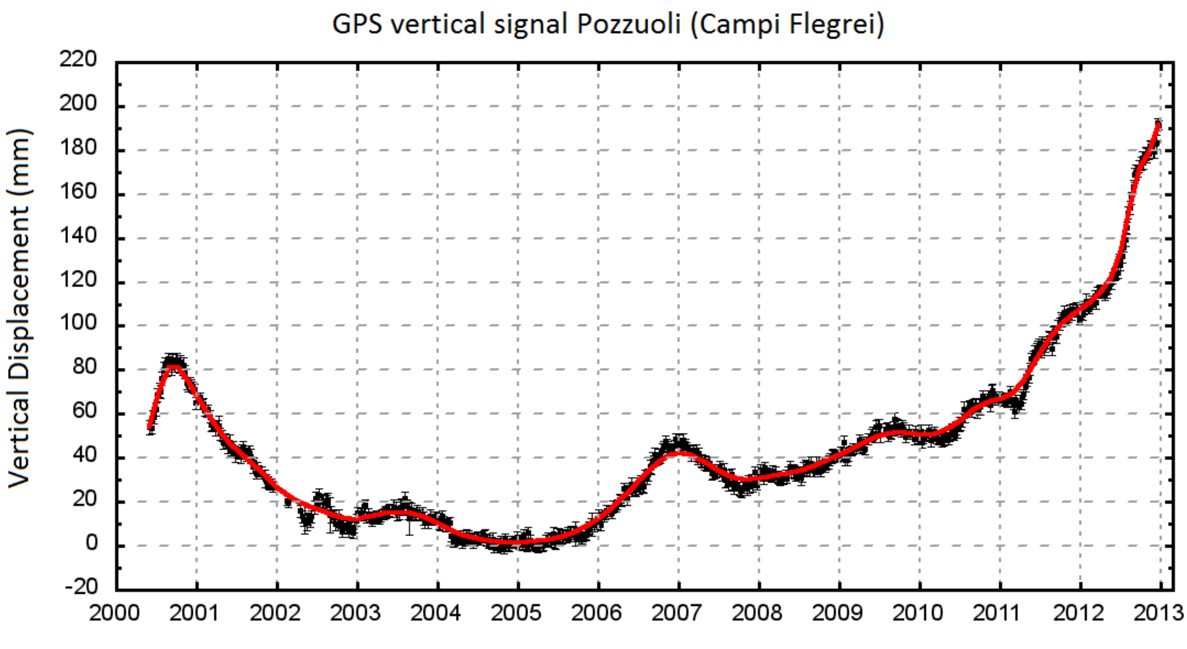

Chart 4 - Pozzuoli - Campi Flegrei volcano – Italy

The year 2000, the first maximum of the solar cycle SC23, appears to be the start of subsidence of the flegrea volcanic area (deflation). The successive rise (inflation) starts between 2006 and 2007, and after a brief pause, recorded between 2007 and 2008, resumes until 2013 (ramp up of the solar cycle SC24).

Time series of weekly changes in the station height of RITE (Pozzuoli) from 2000 to November 2012 – Vesuvian Observatory of the Volcanology and Geophysics National Institute –

Charts 5-6-7 Crustal deformation Iceland volcanoes Authorship of the data : Sigrun Hreinsdottir, IES ;Benedikt Gunnar Ofeigson, IMO

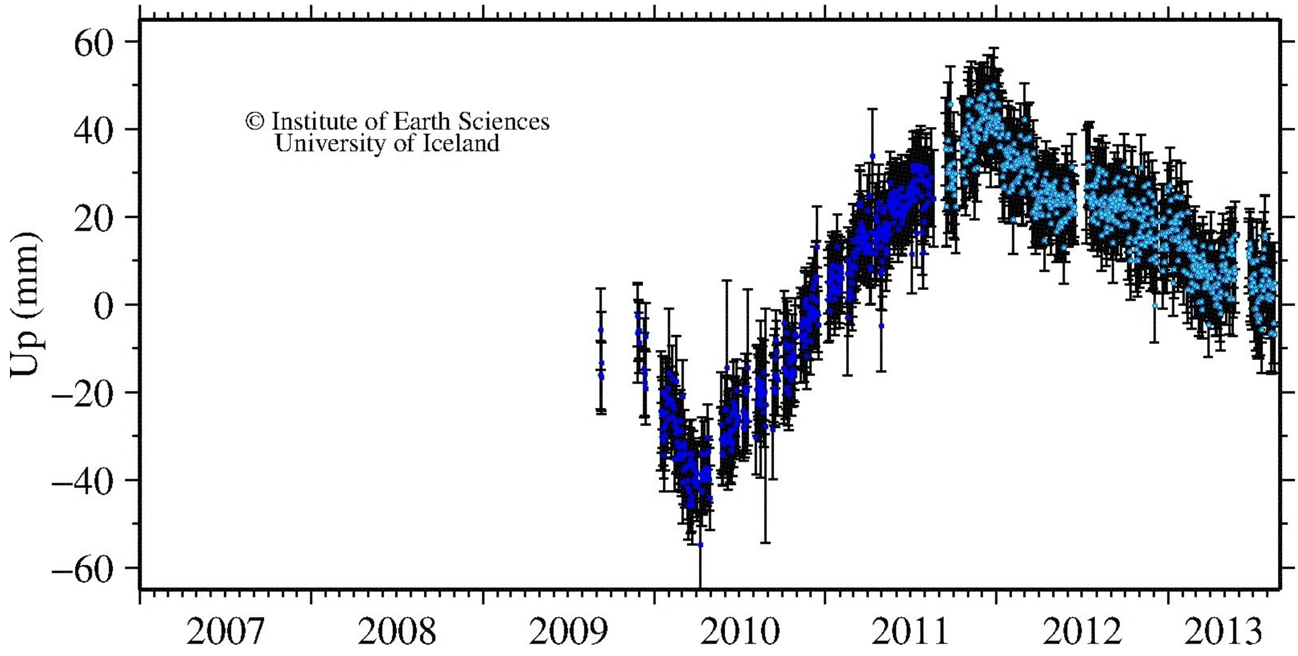

Chart 5 - Krísuvík - The uplift of the volcano, began during the transition from solar cycle SC23 to SC24. GPS Time Series (MOHA) Institute of Earth Sciences, University of Iceland

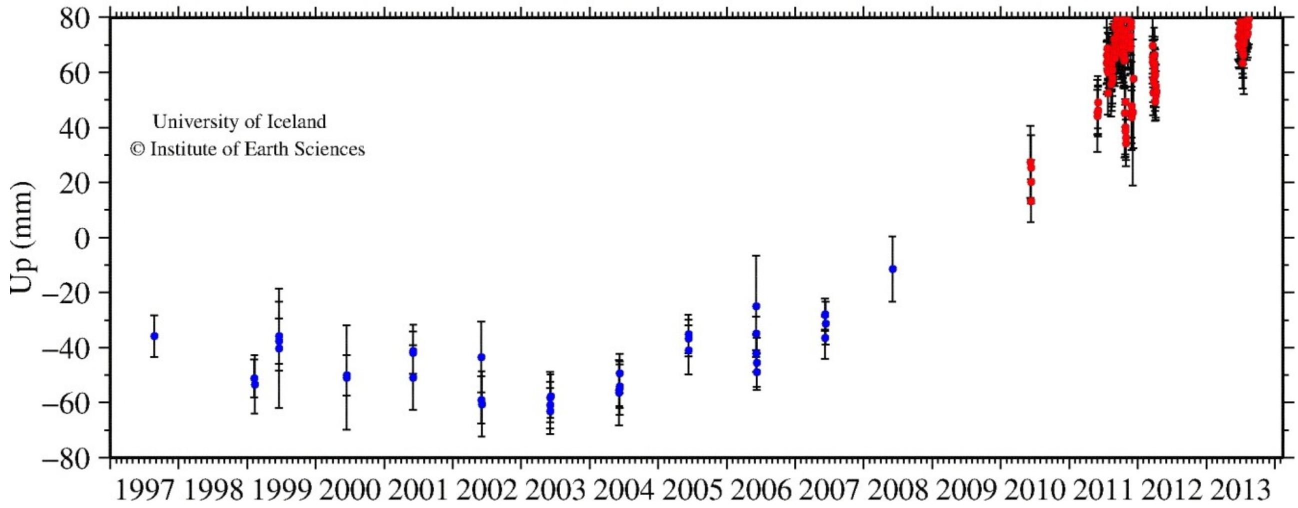

Chart 6 - Hamarinn - An uplift in the area has been recorded, from 2003, (second maximum of the solar cycle 23 to 24). GPS Time Series (HAMA) Institute of Earth Sciences (IES), University of Iceland, Icelandic Meteorogical Office (IMO), and the Iceland Glaciological Society (JORFI).

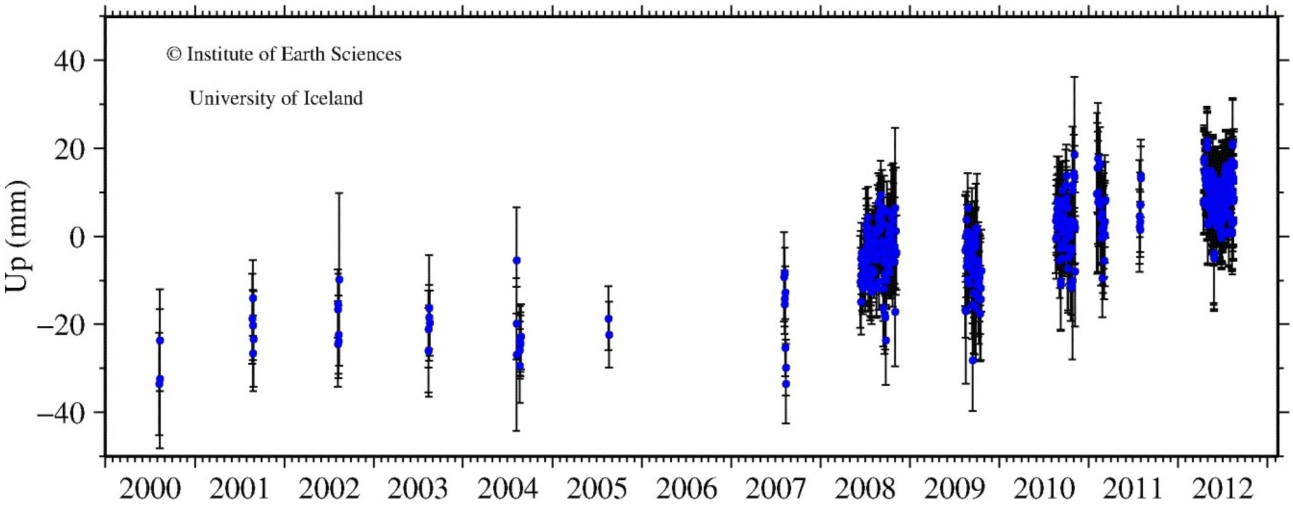

Chart 7 – Askja - The uplift of the volcano, began during the transition from solar cycle SC23 to SC24 and it has continued for the whole rise of solar cycle SC24. Dyngja – GPS Time Series (DYNG) Nordic Volcanological Center, Institute of Earth Sciences (IES), University of Iceland, Icelandic Meteorogical Office (IMO).

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