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El. Kotrotsiou, St. Anastassopoulos

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The relation between aurora borealis and the Arctic's climate change

Ellen Kotrotsiou, 4th senior high school of Karditsa, Greece

INTRODUCTION

The gradual temperature rise of earth has been argued to be a result of the human induced greenhouse effect deteriorating in the past few decades. That being said, one of the causes of climate change could also be the recently observed hyperactivity of the sun[1] as it is also reflected on aurora borealis spectacular appearance. Furthermore, the Aurora borealis is currently affecting the climate of our planet since it also differentiates the way clouds are formed.

SCIENTIFIC QUESTION AND HYPOTHESIS

I am going to study the speculation that the abnormal activity of the sun is gradually affecting the climate of our planet.

MY METHODS

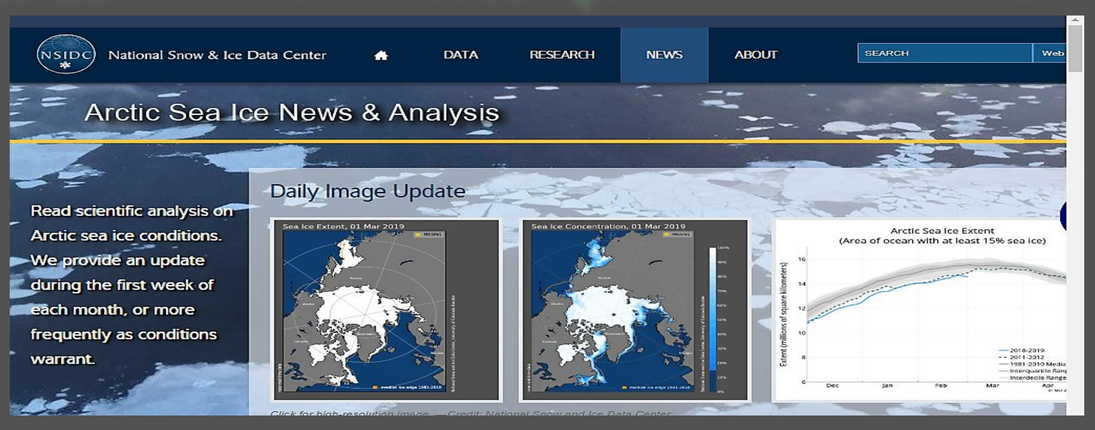
I will compare the activity of the sun, the frequency of the appearance of the northern lights along with the major changes in our climate in the arctic over the last decade. Thus, I can compare any kind of anomaly on the referred data to the major climate changes .I will use specific databases to retrieve recent data concerning the activity of the sun , i.e.: www.spaceweather.com, the climate of our planet, i.e.: http://nsidc.org/arcticseaicenews and also http://ocean.dmi.dk/arctic. Afterwards, I will analyze the following parameters:

1. Solar activity

a) velocity of coronal mass ejections (Km/s),
b) atmosphere's radiation of solar storms (KHz)
c) strength of the magnetic field in the north-south direction of the earth (Bz),
d) proton density (p/cm^3) of solar wind
e) speed (km/s) of solar wind
f) frequency (nights/year) of the northern lights

2. Climate change

a) atmospheric temperature in the arctic, T (°C)
b) ground surface temperature in the arctic (°C)
c) ice extent, a basic indicator of the ice melting (km^2/year)
d) rise of the arctic sea level (mm/year)
e) declination of the snow cover
f) extent of permafrost in the arctic



PILOT STUDY

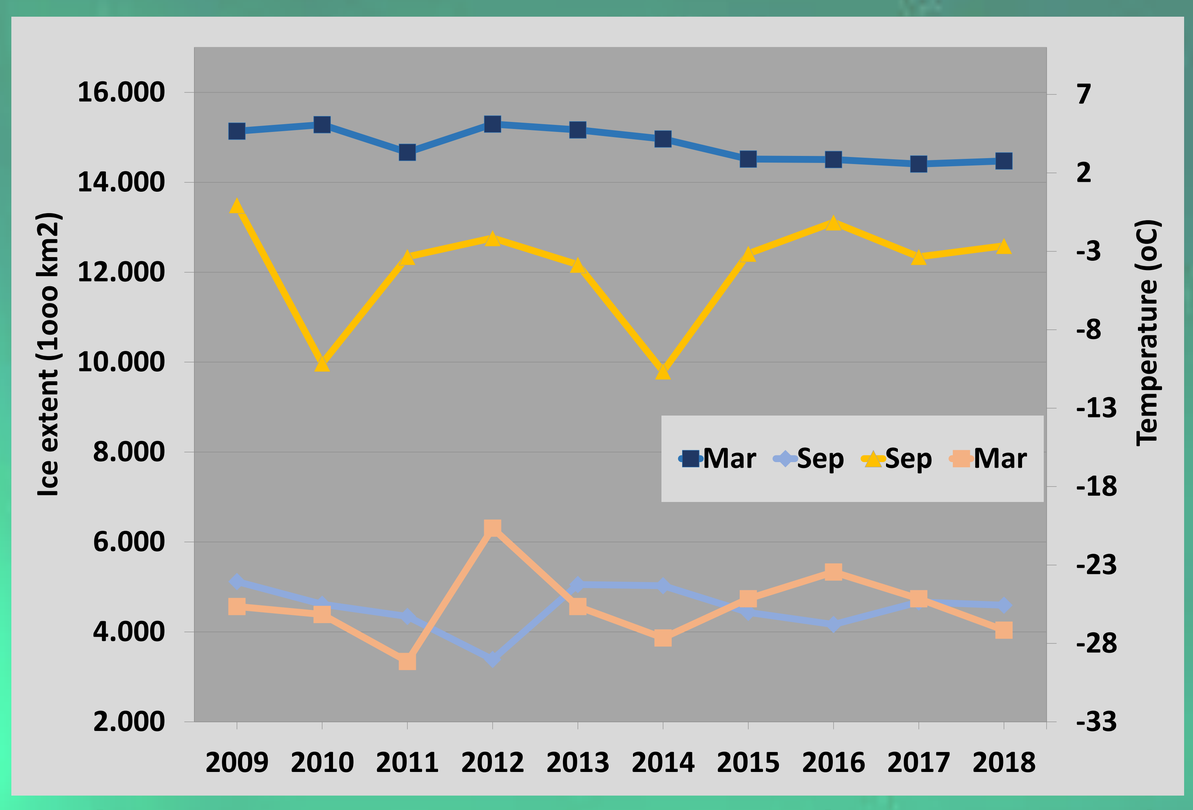
I have recorded, using the above referred databases, mean values of certain parameters in March (minimum T) and September (maximal T) of each year from 2009 to 2018. More specifically, I retrieved data of the arctic atmospheric T (°C) and the ice coverage extent *(Table 1 & Graph 1)* along with the speed and the density of the solar wind *(Table 2 & Graph 2)*.

	Climate			
	Ice extent (1000 km^2)		Temperature (°C)	
Year	Mar	Sep	Mar	Sep
2009	15.136	5.119	-25,65	-0,05
2010	15.283	4.615	-26,15	-10,15
2011	14.667	4.344	-29,15	-3,35
2012	15.294	3.387	-20,65	-2,15
2013	15.167	5.054	-25,65	-3,85
2014	14.964	5.029	-27,65	-10,65
2015	14.517	4.433	-25,15	-3,15
2016	14.507	4.165	-23,45	-1,15
2017	14.406	4.665	-25,15	-3,35
2018	14.475	4.594	-27,15	-2,65

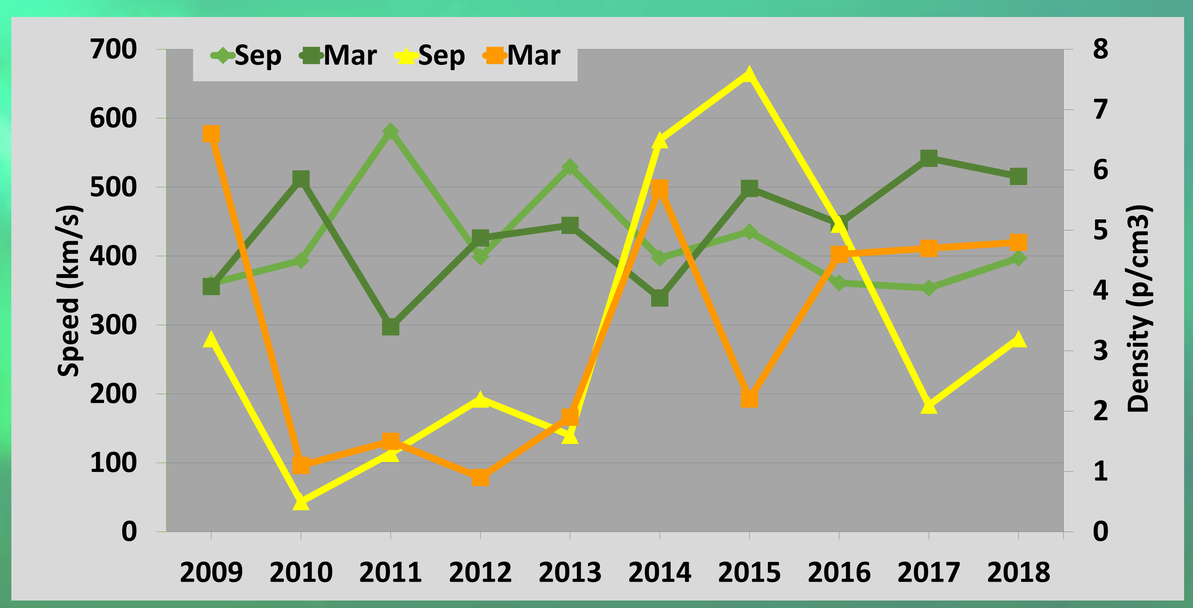
***Table 1**: Maximum - minimum ice extent coverage and temperature in the arctic*

	Solar activity			
	Speed (km/s)		Density (p/cm^3)	
Year	Mar	Sep	Mar	Sep
2009	355,8	360,2	6,6	3,2
2010	511,9	393,6	1,1	0,5
2011	297,4	581,4	1,5	1,3
2012	426,3	398,6	0,9	2,2
2013	444,5	529,7	1,9	1,6
2014	339,2	397,1	5,7	6,5
2015	498,2	435,3	2,2	7,6
2016	447,1	361	4,6	5,1
2017	541,8	353,6	4,7	2,1
2018	515,7	397,2	4,8	3,2

***Table 2**: Speed and density of solar wind during each September and March*



***Graph 1:** Maximum-minimum ice extent coverage and air temperature in the arctic during the time period 2009 - 2018*



***Graph 2**: March and September mean values for speed and density of solar wind in the arctic during the time period 2009 - 2018*

FIRST CONCLUSIONS

My pilot study indicates indeed an explicit gradual increase of the speed and the density of the solar wind, especially in the last 6 years. An analogy between the temperature and ice extent is also noticed, as both the max. (mainly) and min. atmospheric temperatures have been rising while at the same time, the max. ice extent (March) has been diminishing, with an exception in the last 3 years. Yet, the period studied is short to establish clear relation between the rise of temperature with the enhanced solar activity. I will follow further investigation, documenting values of all the referred, in "My methods" section, parameters from even earlier (i.e. 1980) to make more safe conclusions.