Extent-Model (Revision)

Introduction

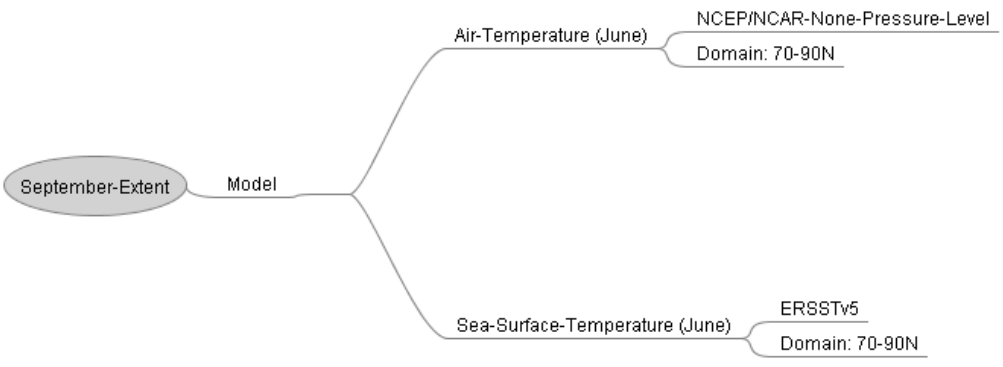
Here i use the Air Temperature(1) and the Sea-Surface-Temperatur(2) to forecast the upcoming Extent Minimum(3) in September, for both the same domain: 70-90 to 0-360E, while the former version of the Model has used for all summer months, the new version is just using June for the forecast with a new methode, it more based on the idea, that the difference between the minimum in september and the minimum a year before is controlled by the difference between the weather (which is here presented as Air and Sea Temperatur) of the June and the June a year before. Calibration Period is 1980-2016 and gives a very good skill of R^2= 0.782, with an first Sigma Error of 0.33 Mio km^2. Since difference betwenn 1979 to 1980 is a massiv outlier(1.44 Mio km^2) which strongly impacts the skill of the Model i therefore decide to drop out this one.

Formal description of the Model:

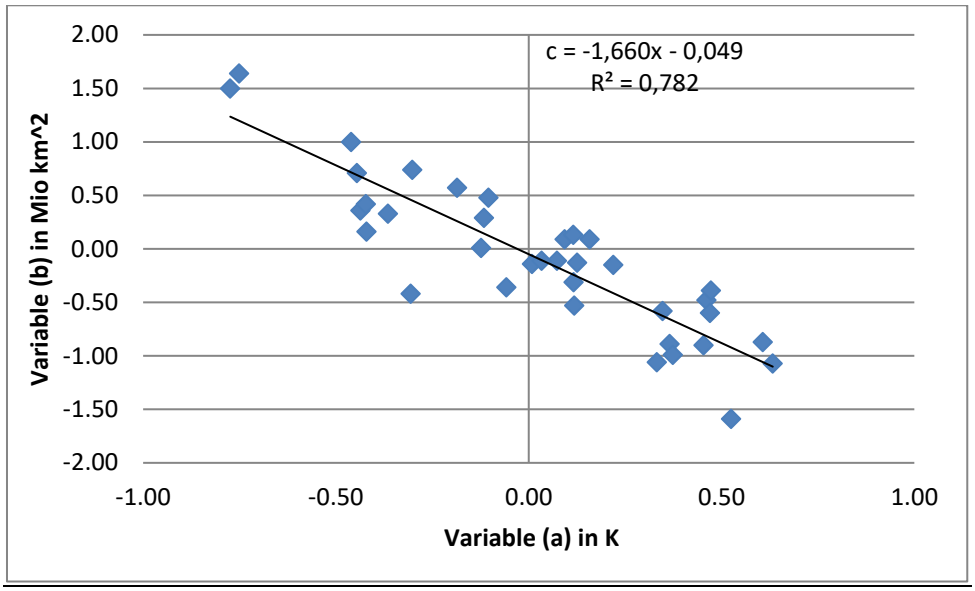
Model-Extent= d+ (a*(a:b)) ⇒ d+(a*c)

a = (Air-Temperatur (t0)- Air-Temperatur (t-1)+ Sea Surface Temperatur (t0)- Sea Surface Temperatur (t-1))/2
b= September-Extent (t=0) - September-Extent (t-1)
c= Coeff a:b
d= = September-Extent(t-1)

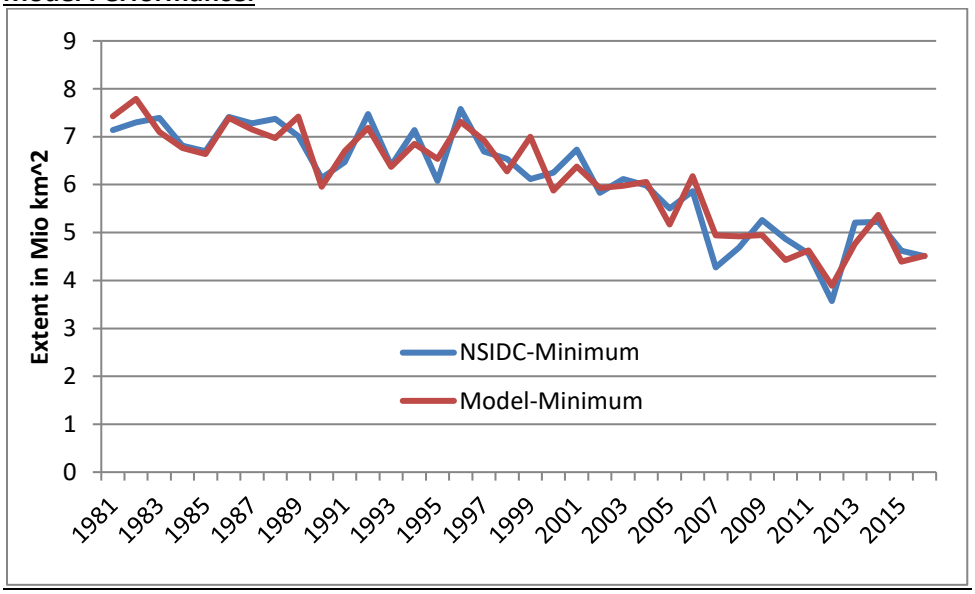
Visual description



Scattern-Plot 1980-2016



Model Performance:



Physical Explanation

Since the Insolation in the arctic is the highest during northern hemisphere summer and albedo in early summer is also high, the most shortwave incoming radiation is reflected by the surface snow and ice. During the June, the albedo decrease to snow and ice-melt, while surface decrease of albedo/Ice-thickness is caused melt ponding on the ice itself, the ice cover of the ocean is also relevant, it takes up the incoming radiation and increase the Sea-Surface-Temperature and melt the ice below the surface. So we can call them Top and Bottom-Melting. Their impact on Ice- thickness is estimate to 48cm (Top) and 52cm (Bottom) with large variability on time and region of arctic ocean (4). Its also to note, that both can interact with each other, strong Top-Melting can increase the Bottom-Melting if albedo is low and ice thin enough to transfer energy to the ocean throughout the ice covered ocean.

With this its seems that june could be good enough to reflect a trigger in snow and ice albedo feedbacks to build up melt power beyond the june itself, i fact (not shown here), if using July and August Data, the skill becomes lower then in June only which can give us the clue that outcome of september extent could a result of preconditioning in June. While generally decrease of sea ice is a result of ongoing climate change, its clearly shown that a early onset in melt season due temperatur in air and seas could explain the variance from minimum to minimum.

Sources:

(1) NCEP-Reanalysis (monthly) on none pressure level
(2) ERSSTv5 (monthly)
(3) NSIDC-Sea-Ice-Extent (monthly)
(4) CRREL/ Report 2014: Variability of Melt