Monitoring of thermocirques and their activity factors on the central part of Yamal Peninsula

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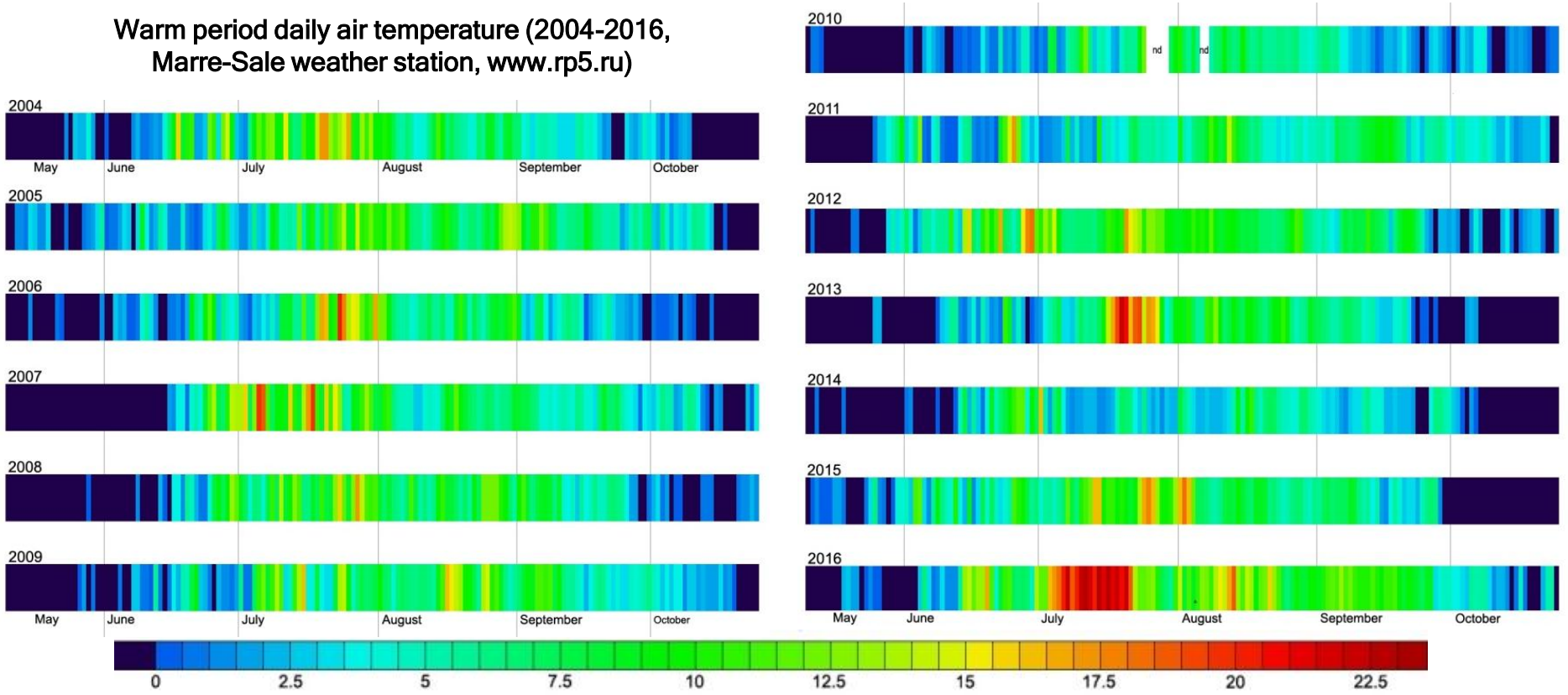
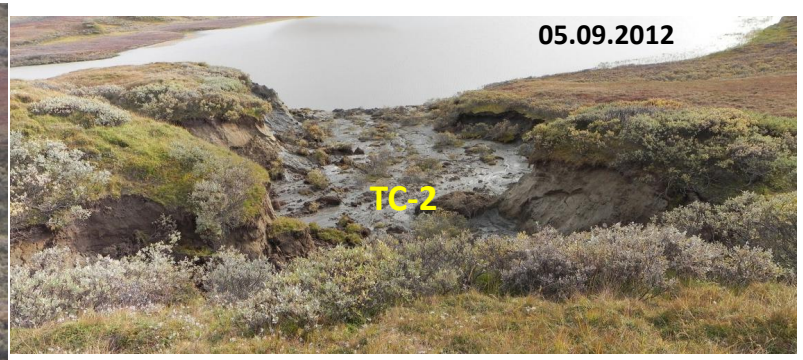
Key site location

Thermocirques on Central Yamal

Climatic factors of cryogenic landsliding activation

Warm period daily air temperature (2004-2016, Marre-Sale weather station, www.rp5.ru)





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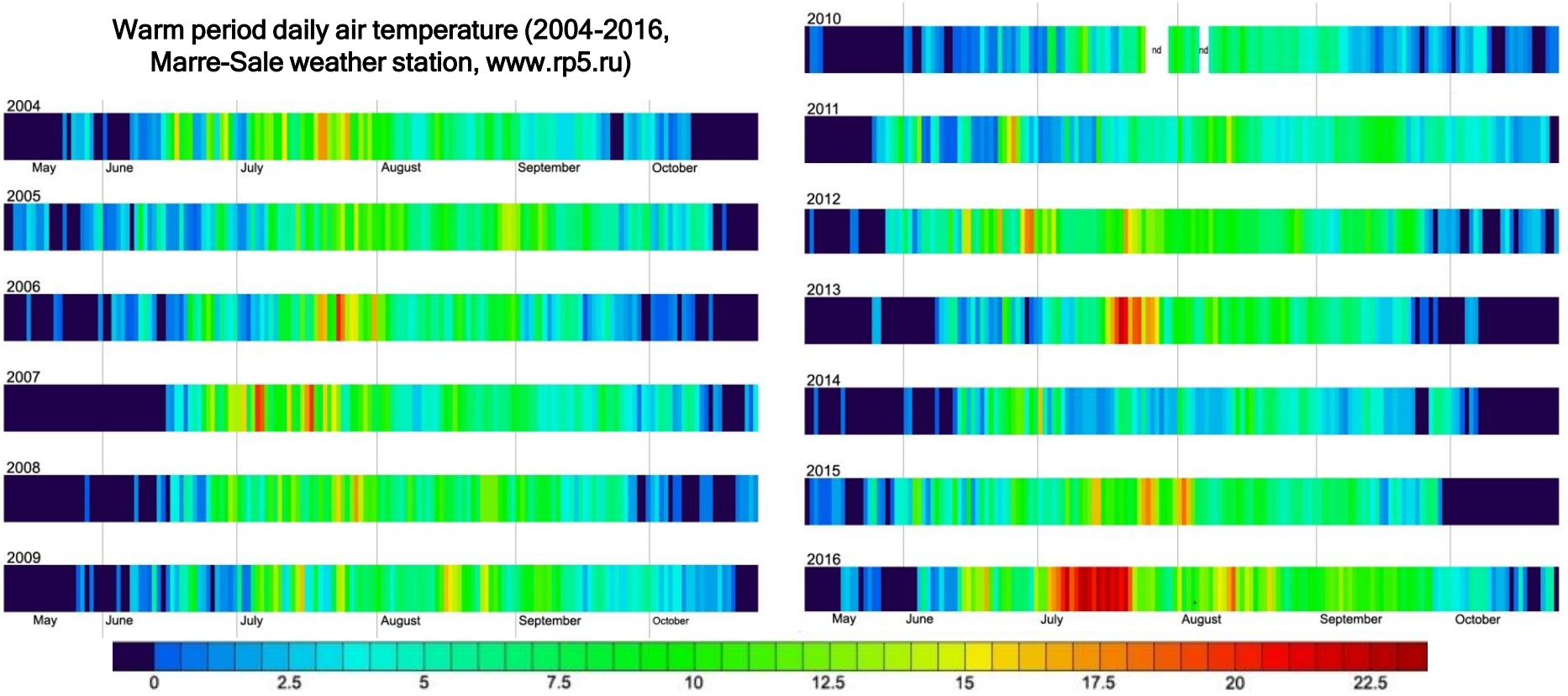
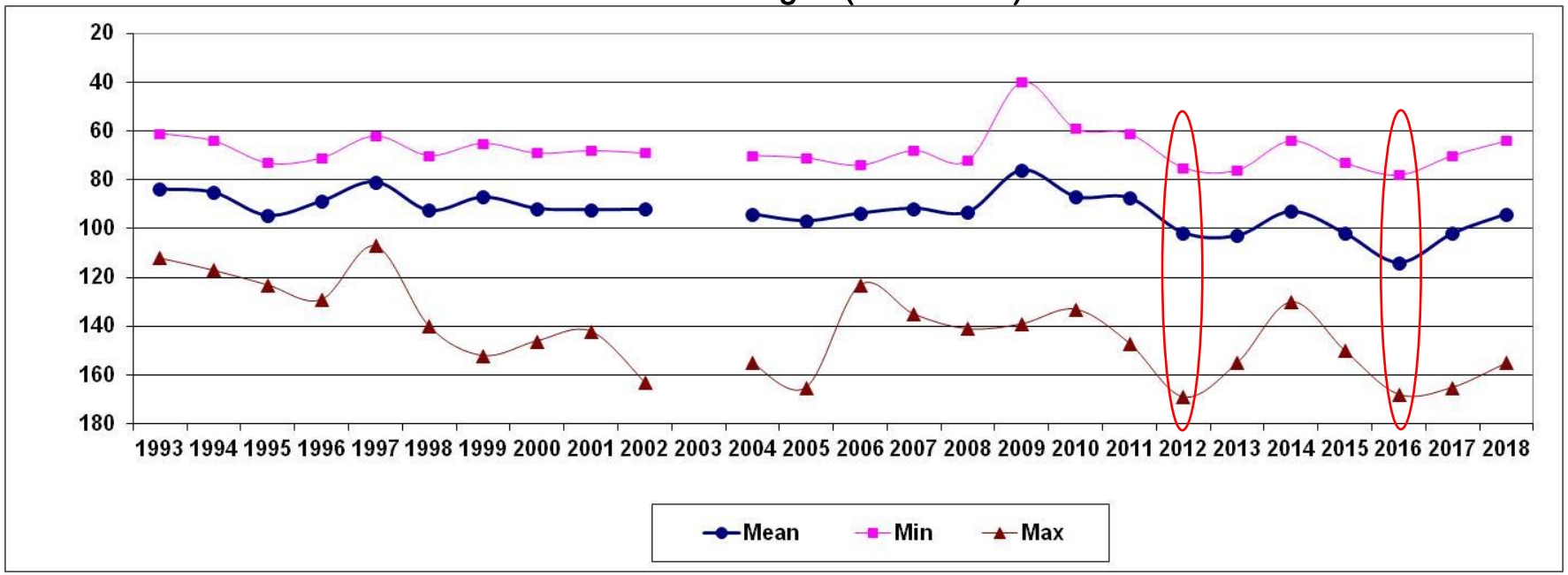
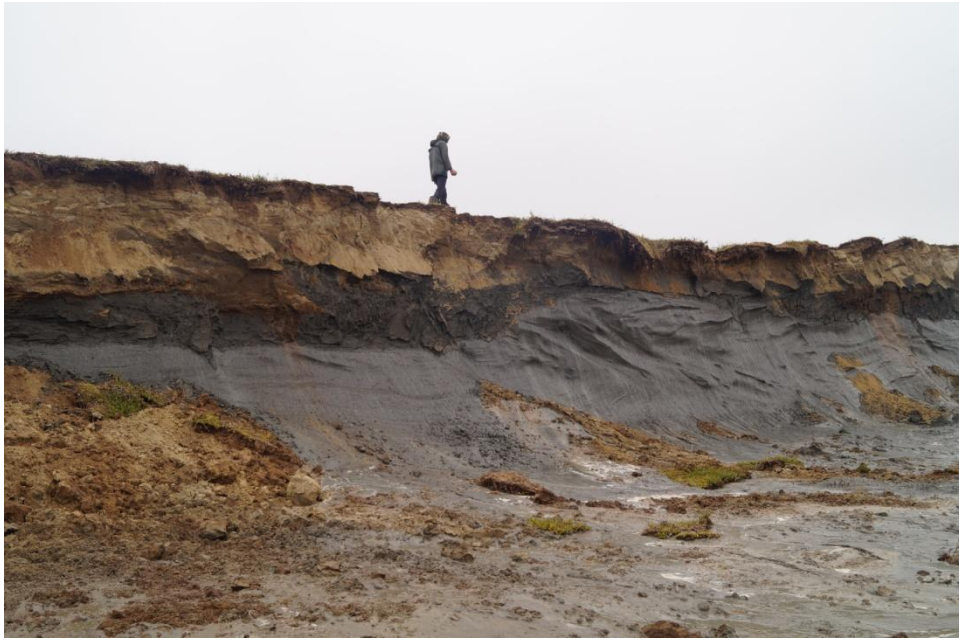


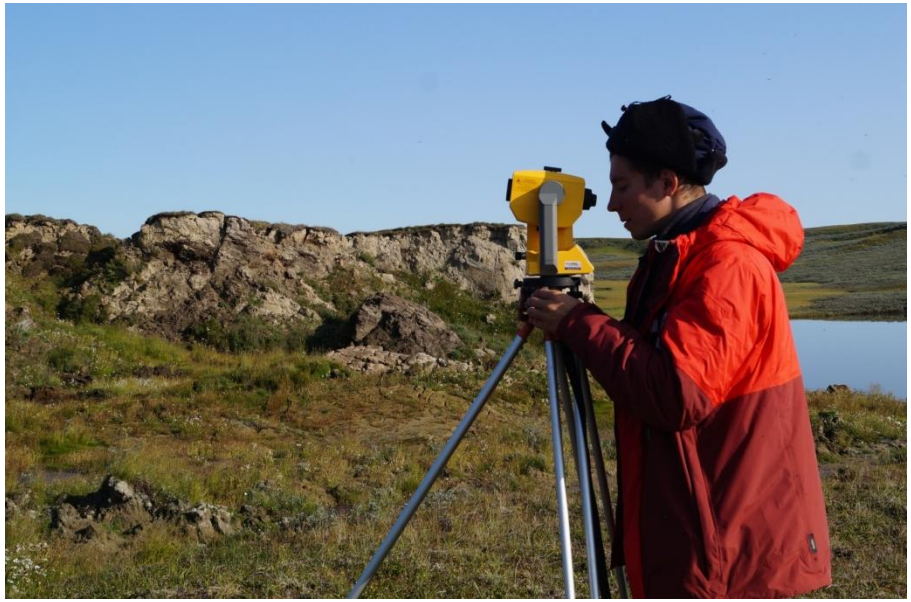
Factors of thermal denudation activation

Summary of active-layer depth measurements
at the CALM grid (1993-2018)

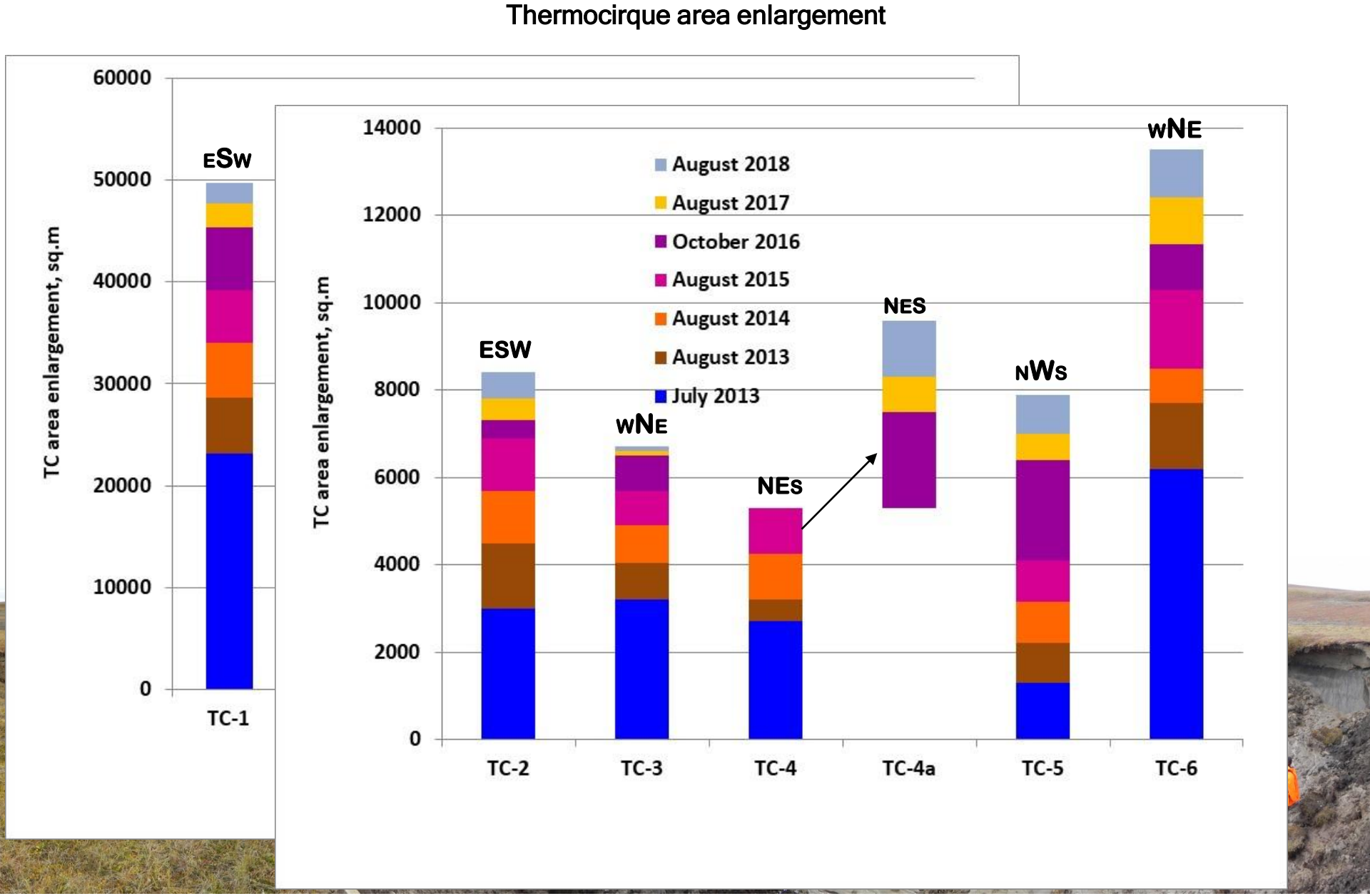


Monitoring of key thermocirques

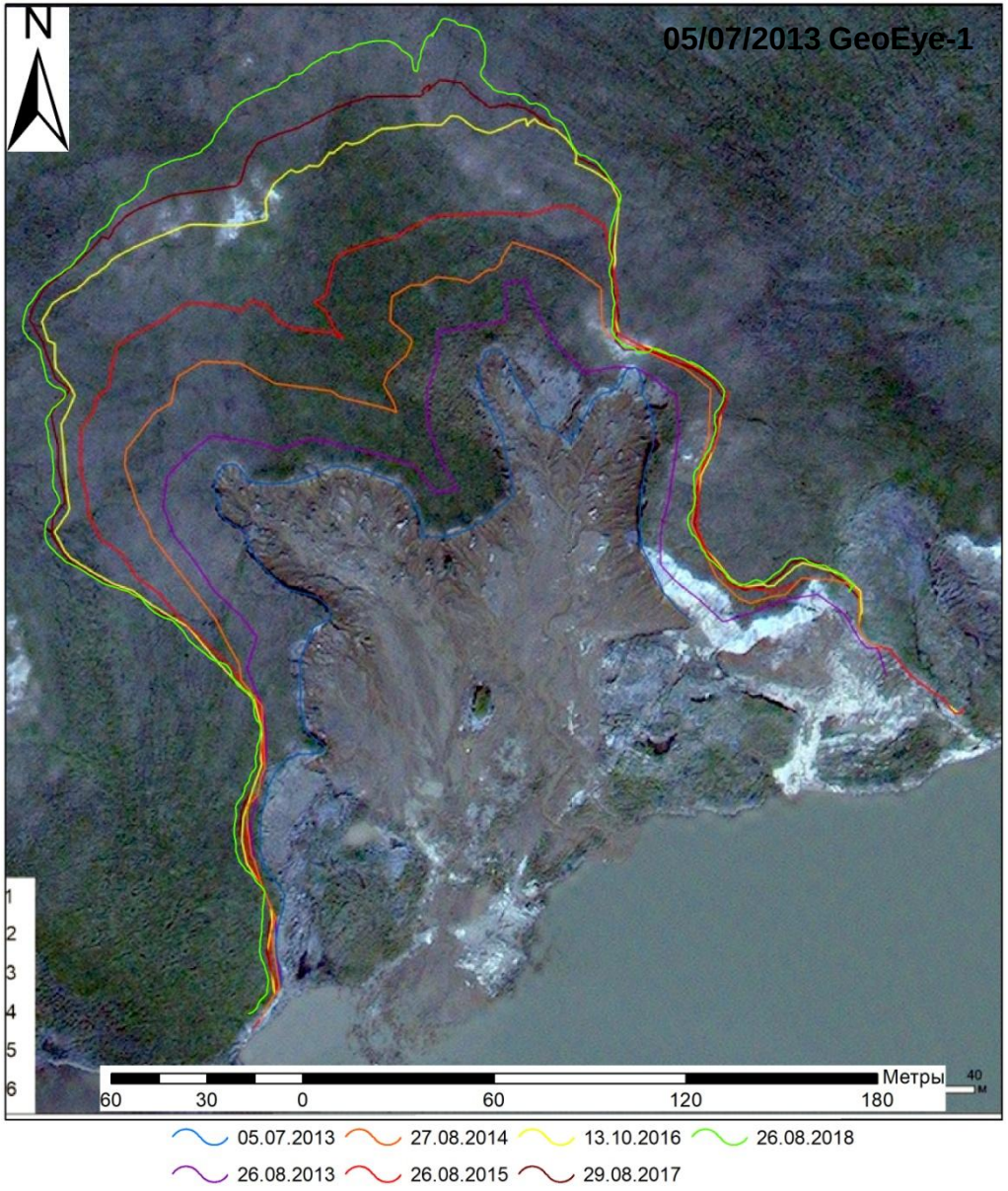


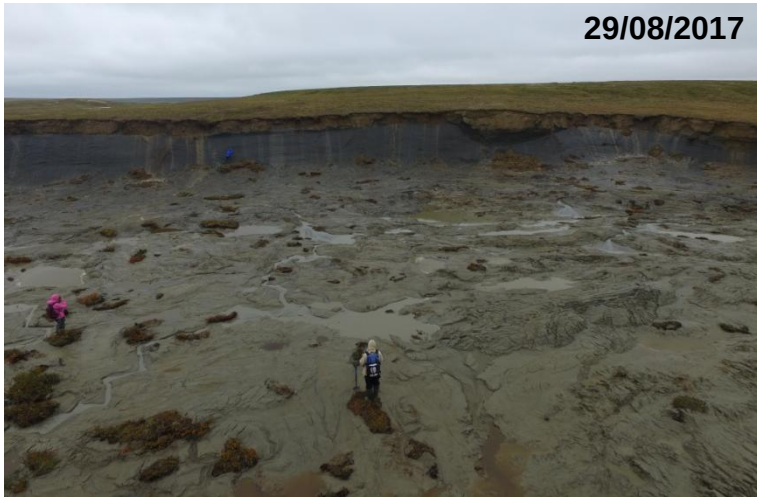


Monitoring of key thermocirques

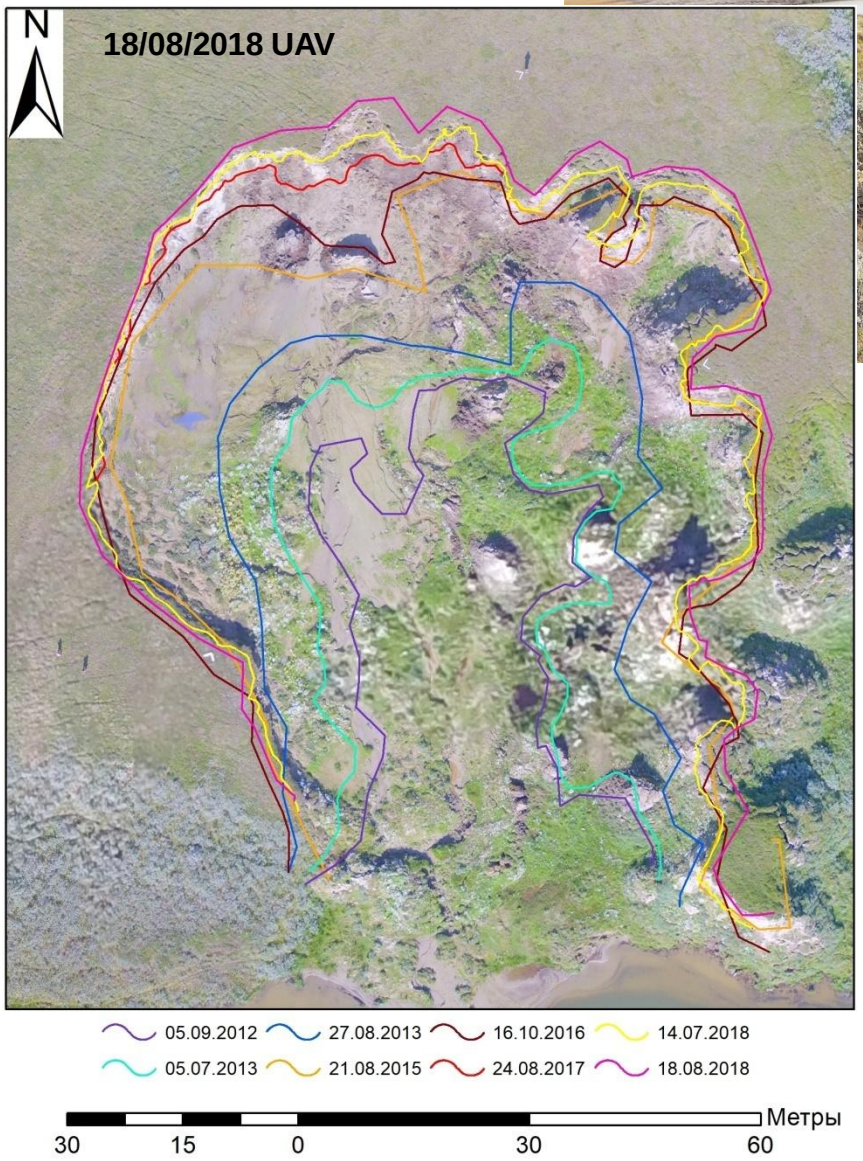


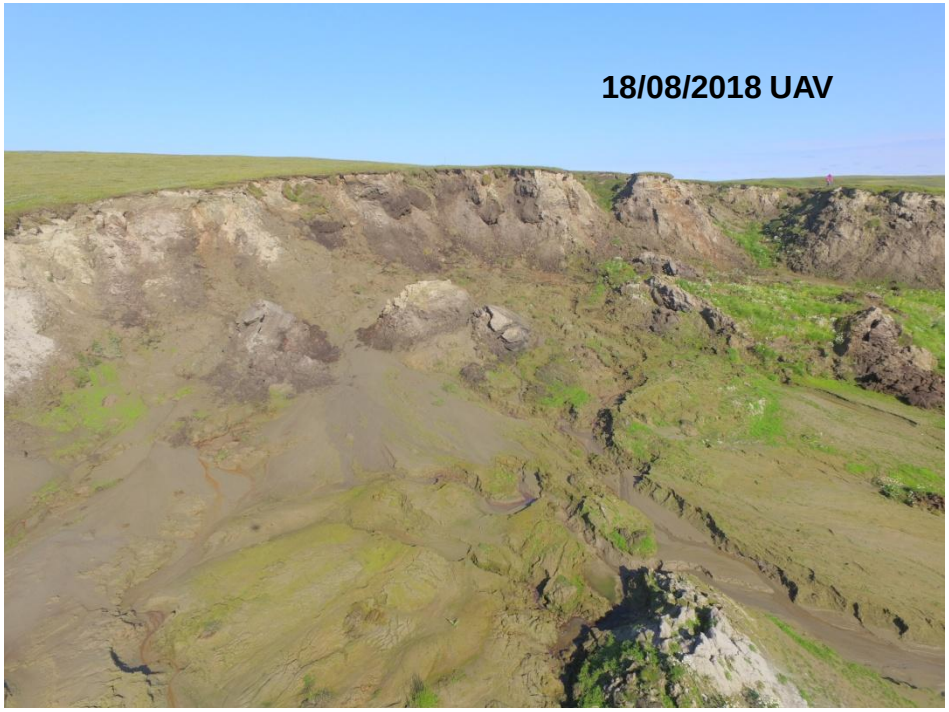
Monitoring of key thermocirques. TC-1



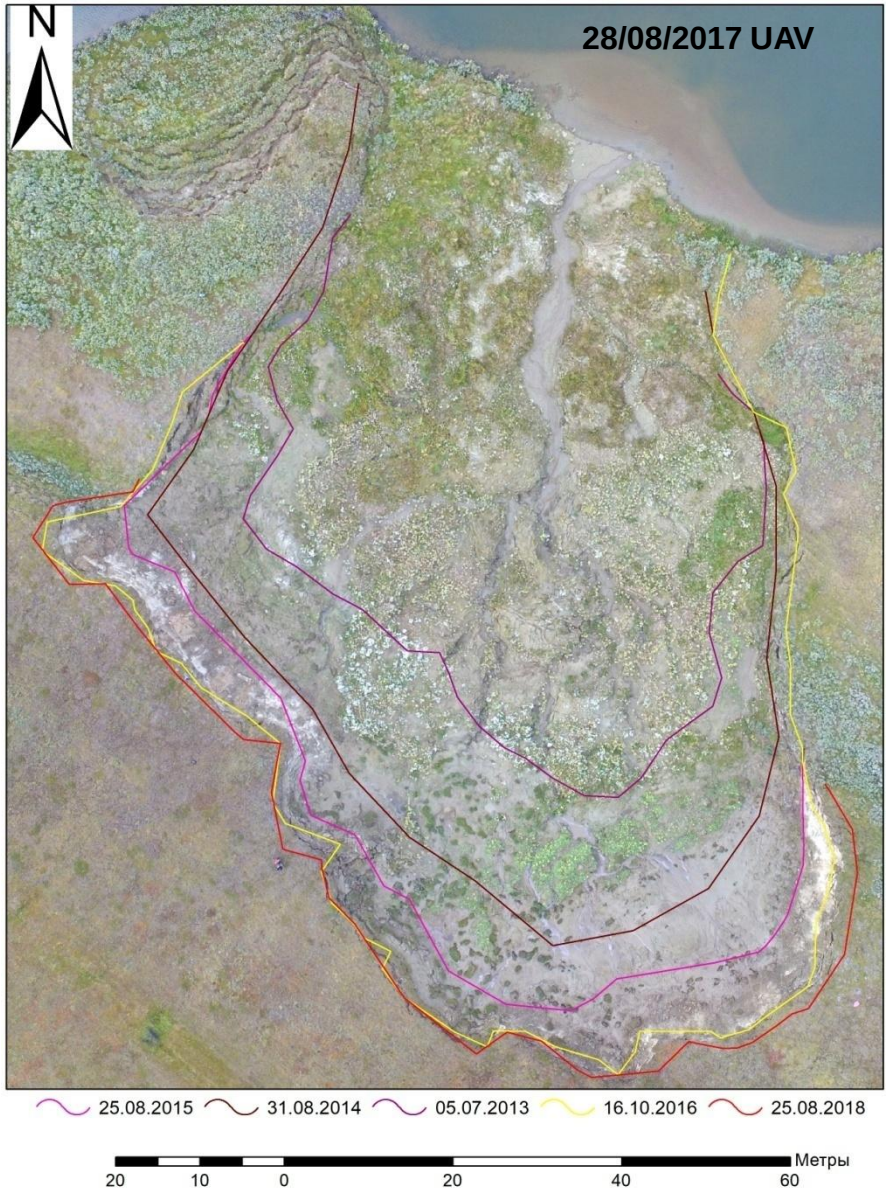


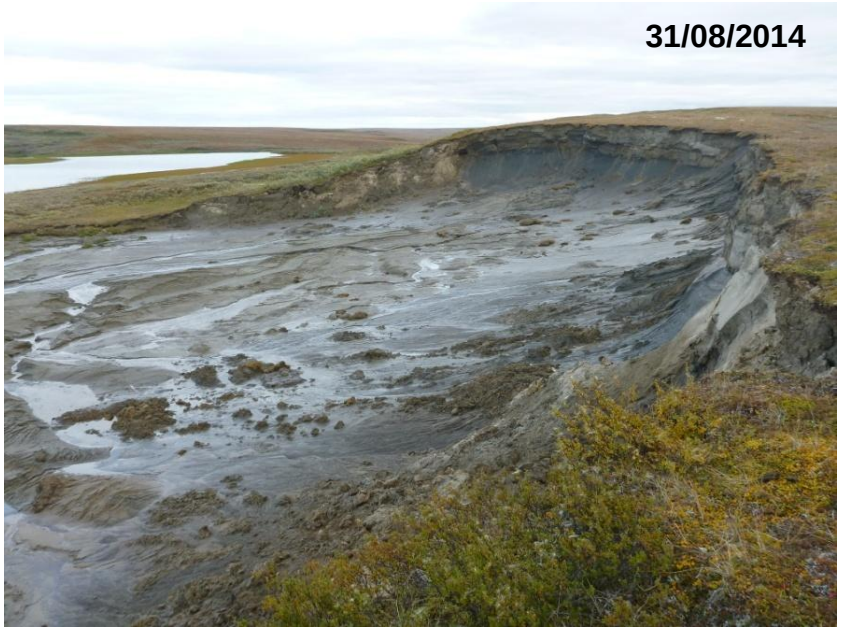
Monitoring of key thermocirques. TC-2

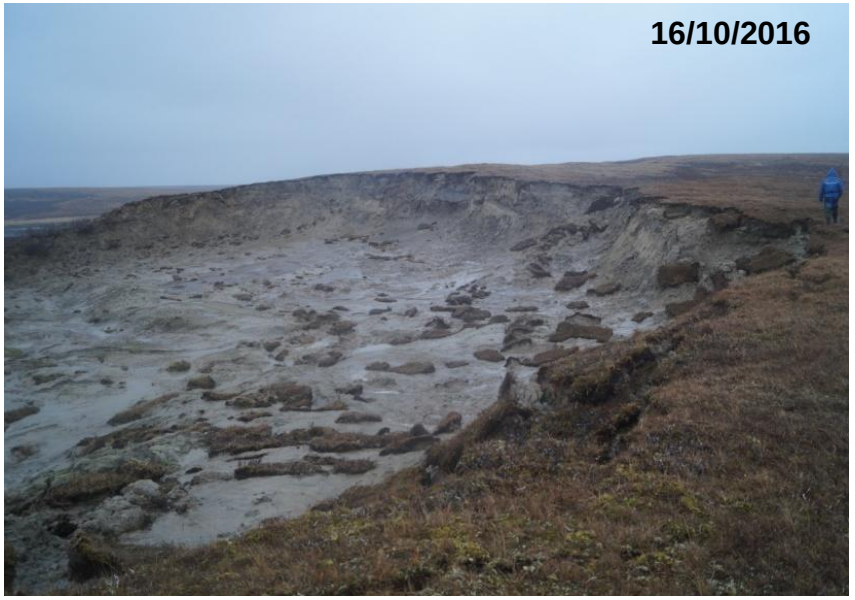




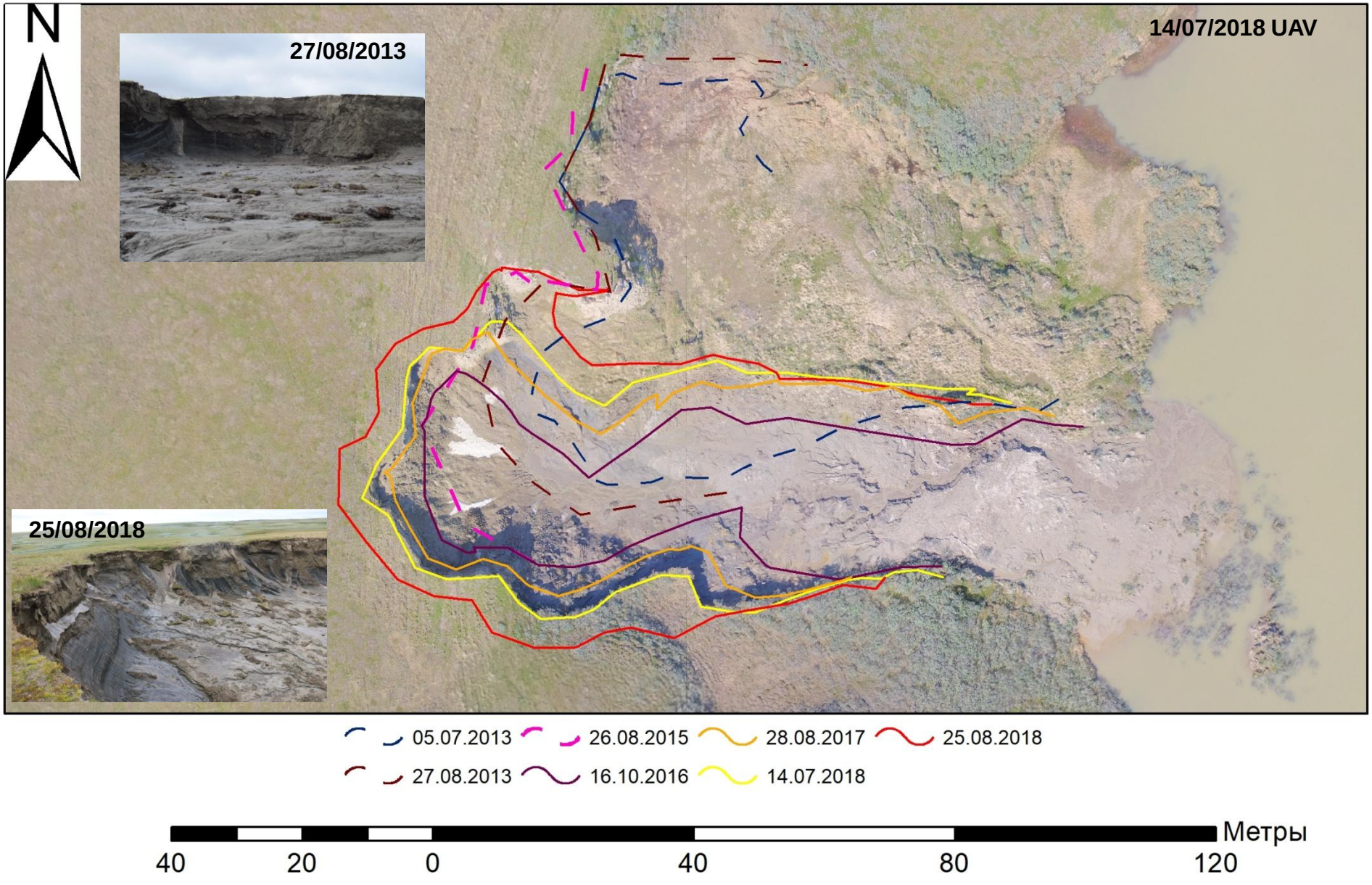
Monitoring of key thermocirques. TC-3



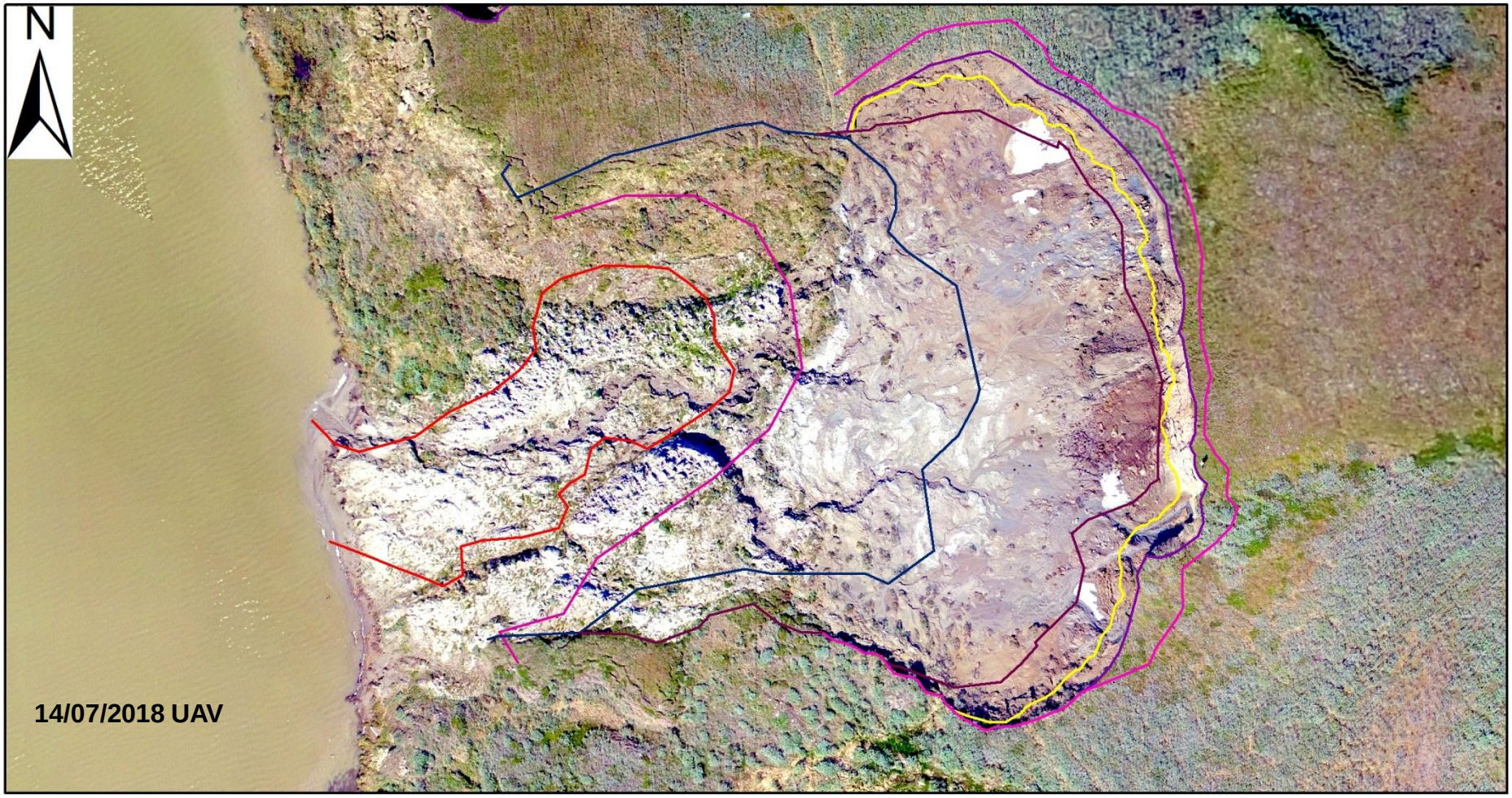




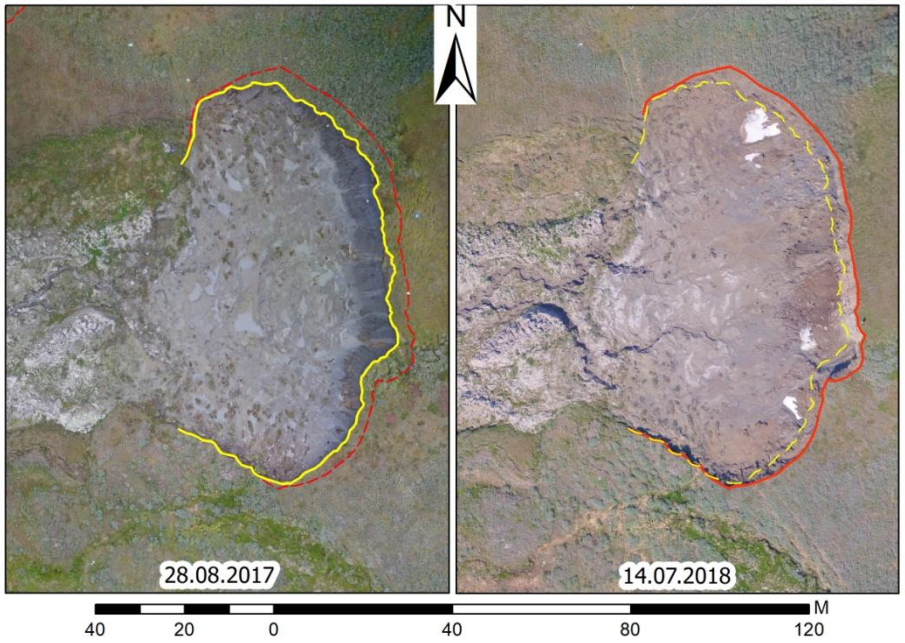
Monitoring of key thermocirques. TC-4,4a

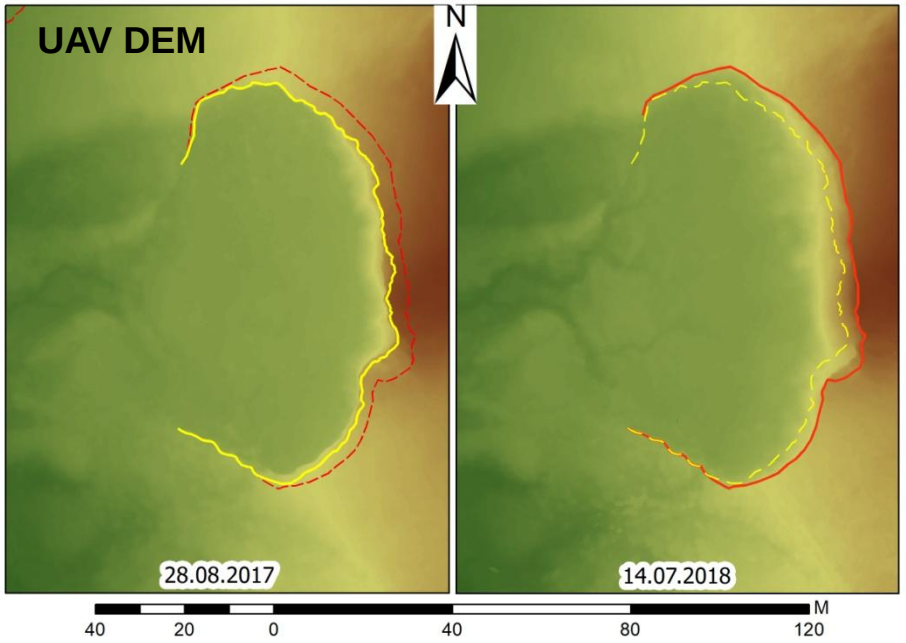


Monitoring of key thermocirques. TC-5

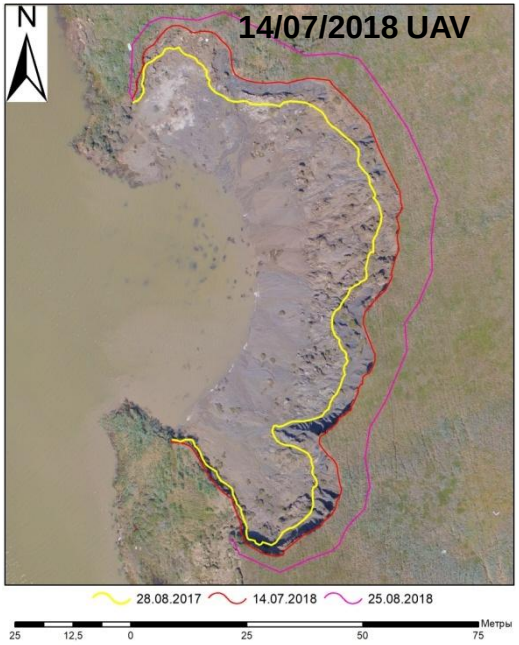


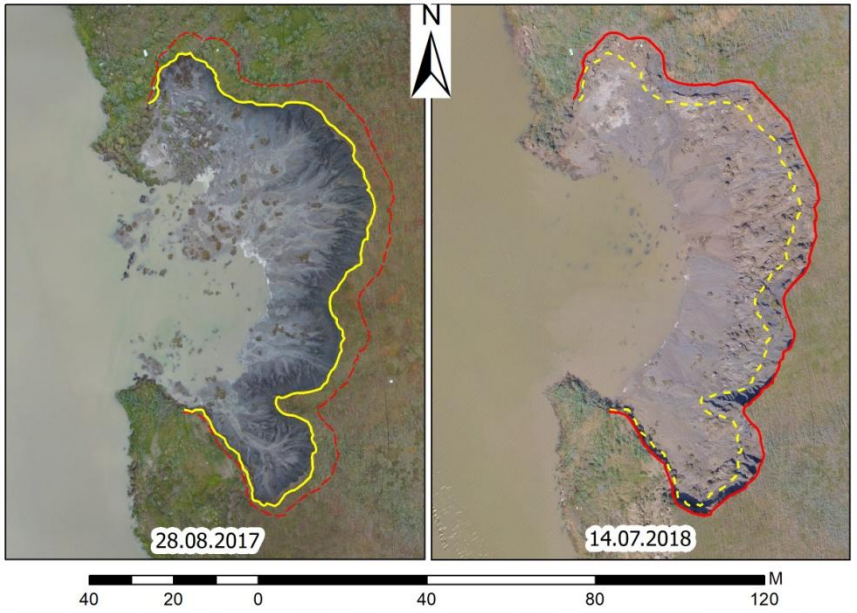
Monitoring of key thermocirques. TC-5

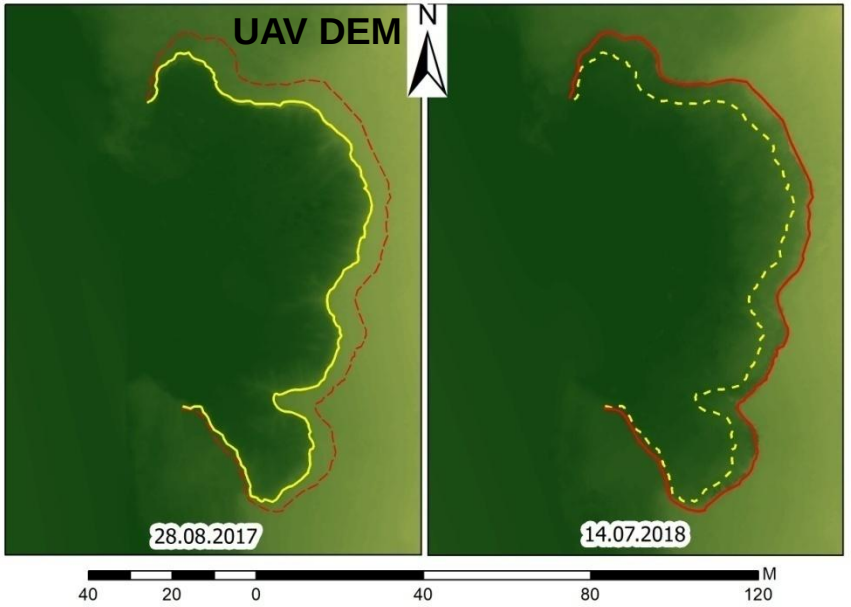




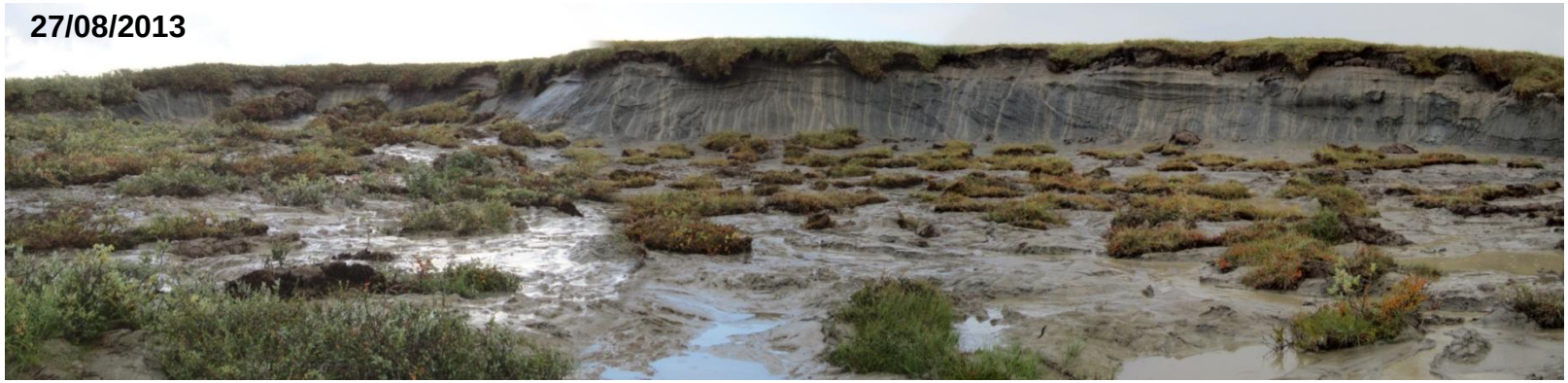
Monitoring of key thermocirques. TC-5n

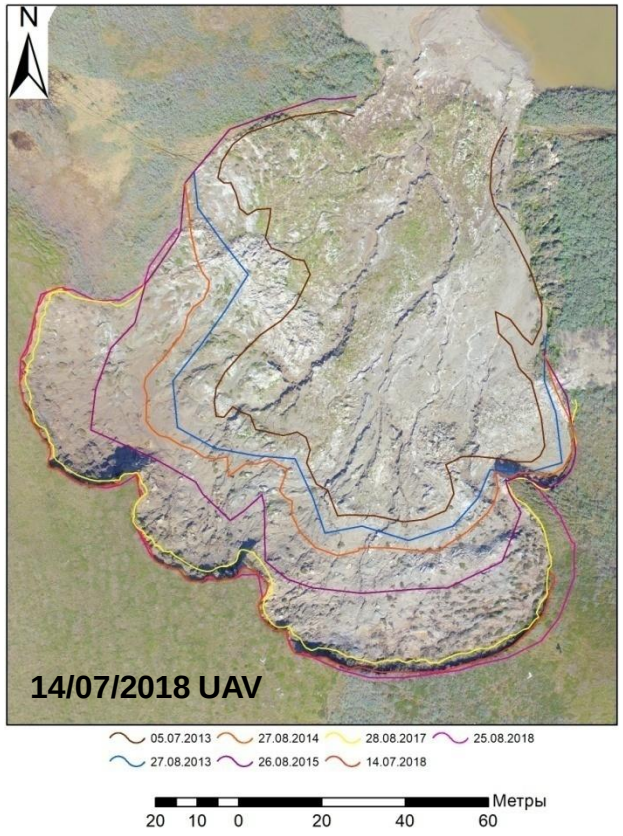


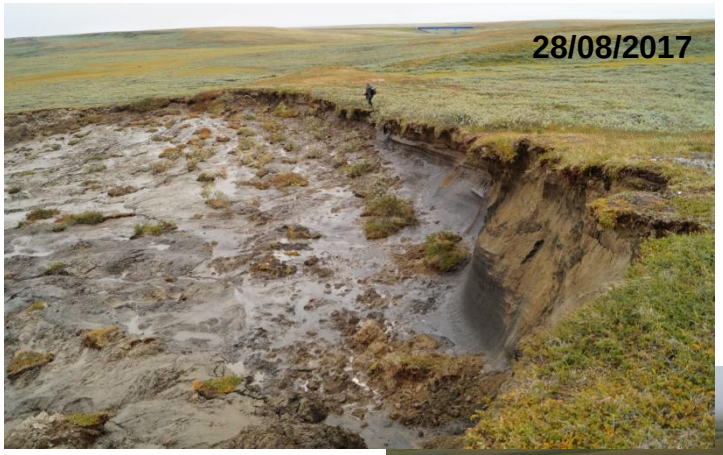


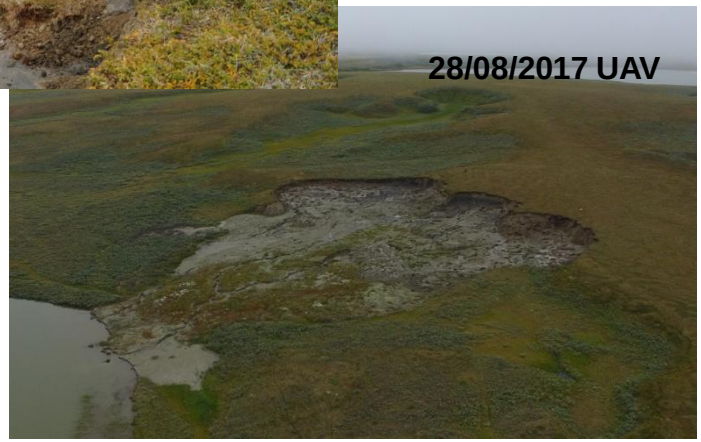


Monitoring of key thermocirques. TC-6

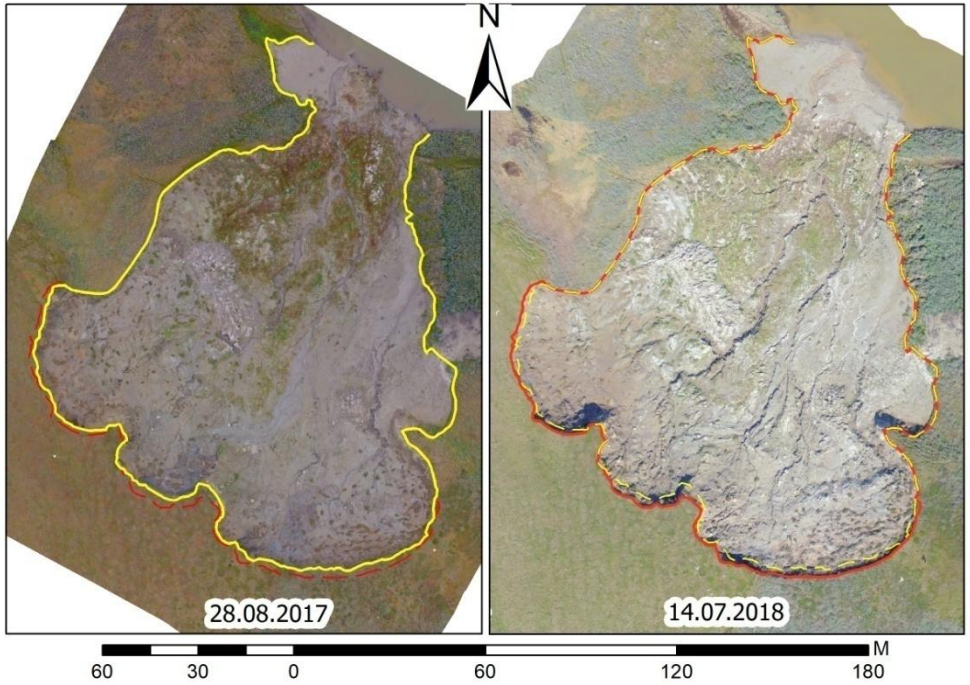


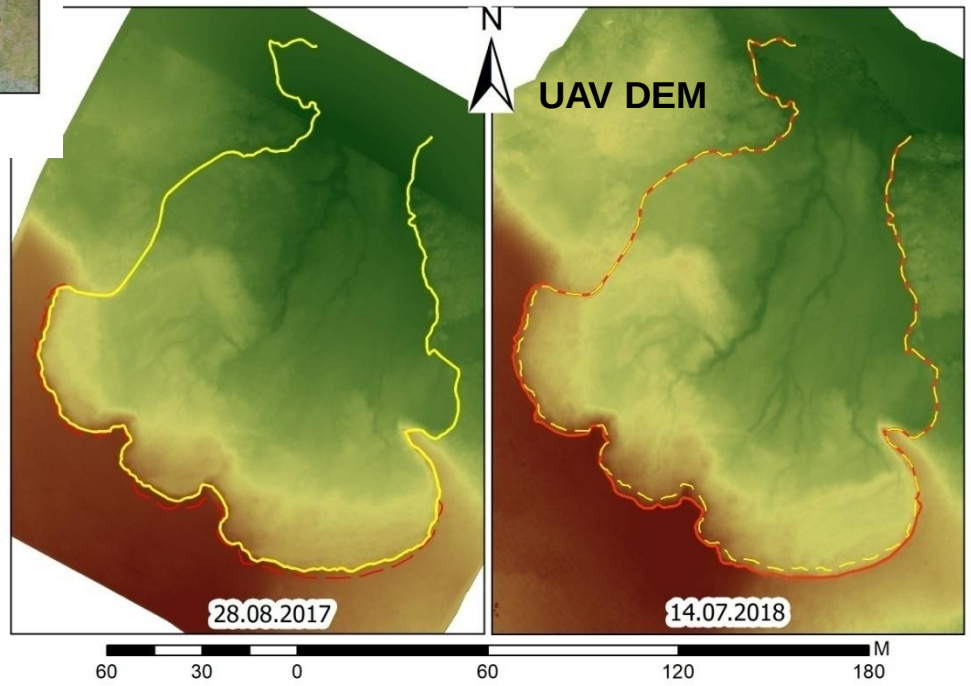






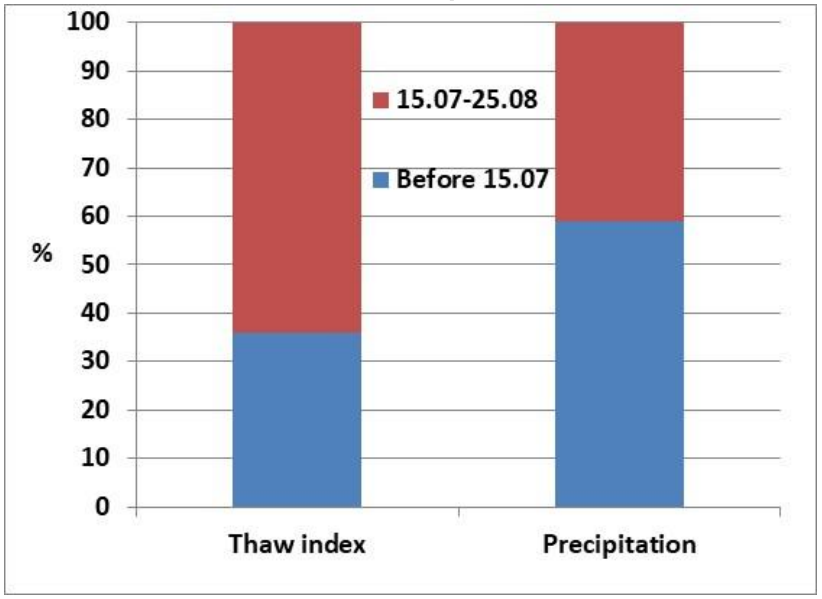
Monitoring of key thermocirques. TC-6





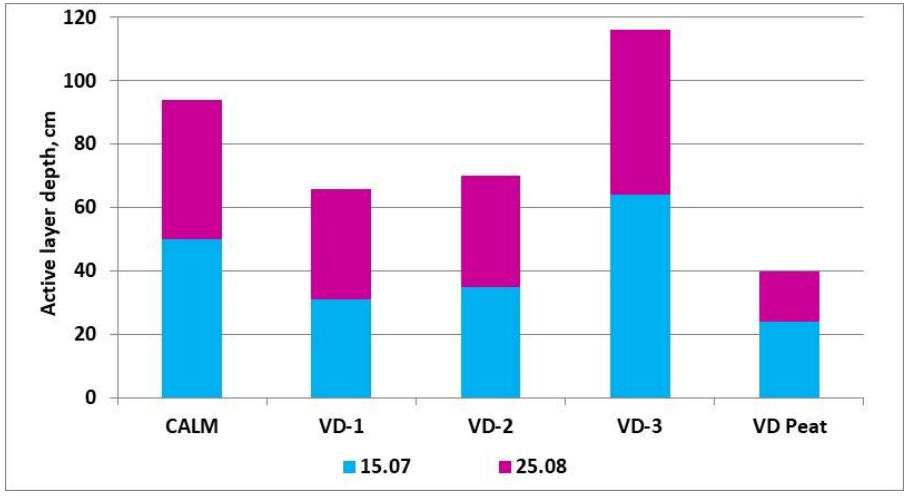
Monitoring of key thermocirques. 2018

Proportion of thaw index and precipitation during 2018 warm period



Active layer depth on Vaskiny Dachi monitoring sites in 2018 г.

cm.

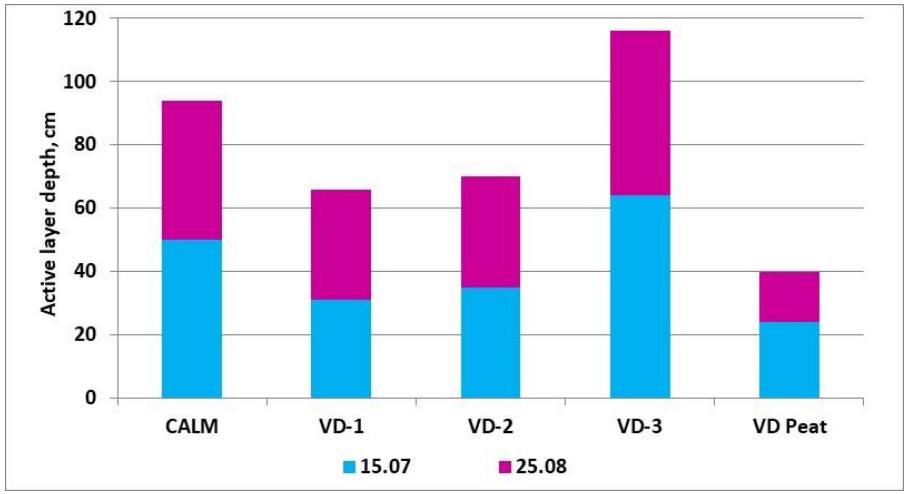


%

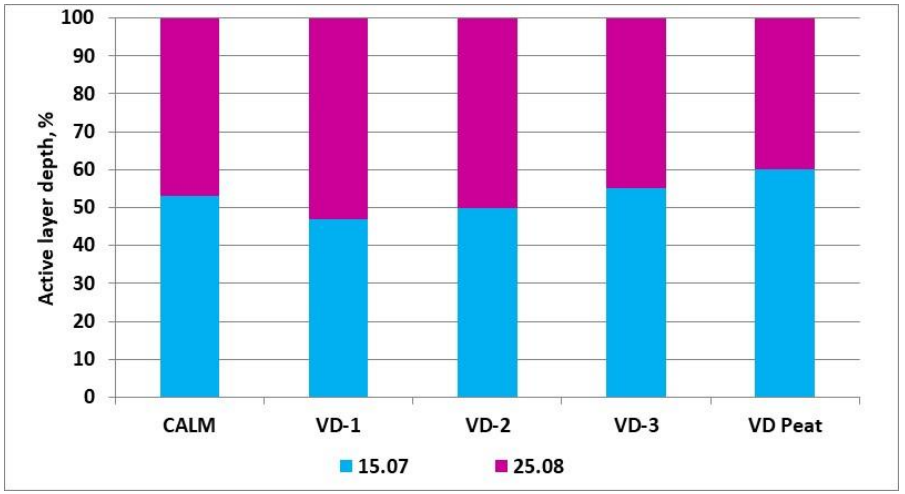
Monitoring of key thermocirques. 2018

Active layer depth on Vaskiny Dachi monitoring sites in 2018 г.

cm

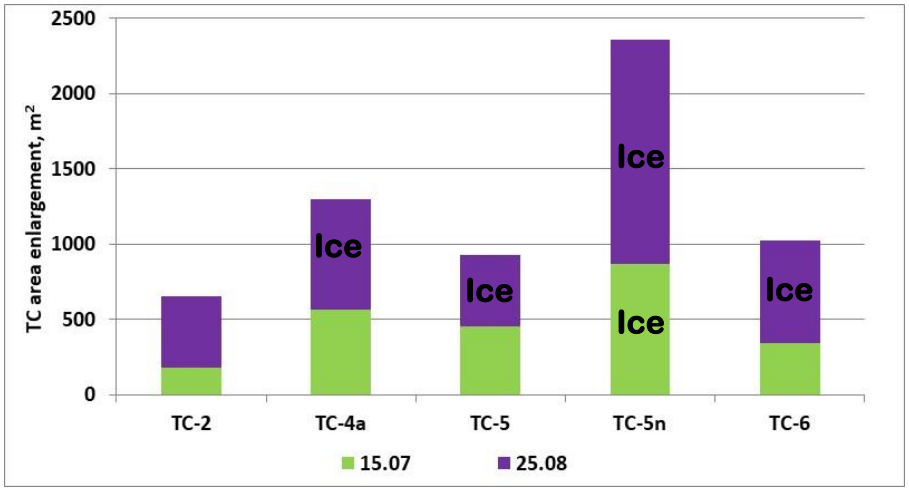


%



Thermocirque area enlargement in 2018

m^2



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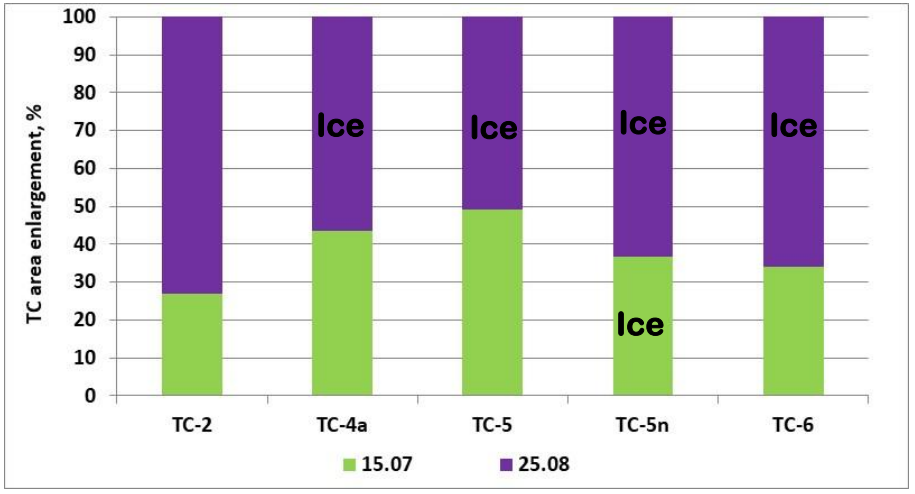
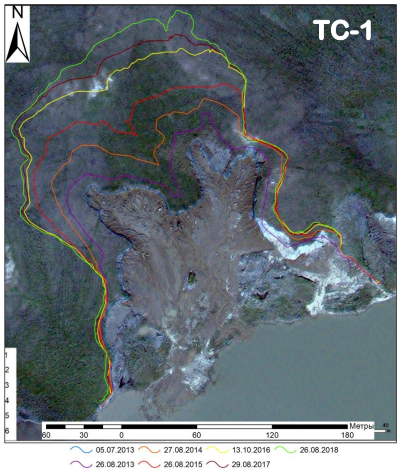
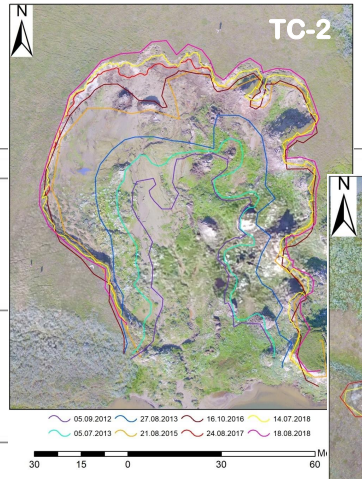
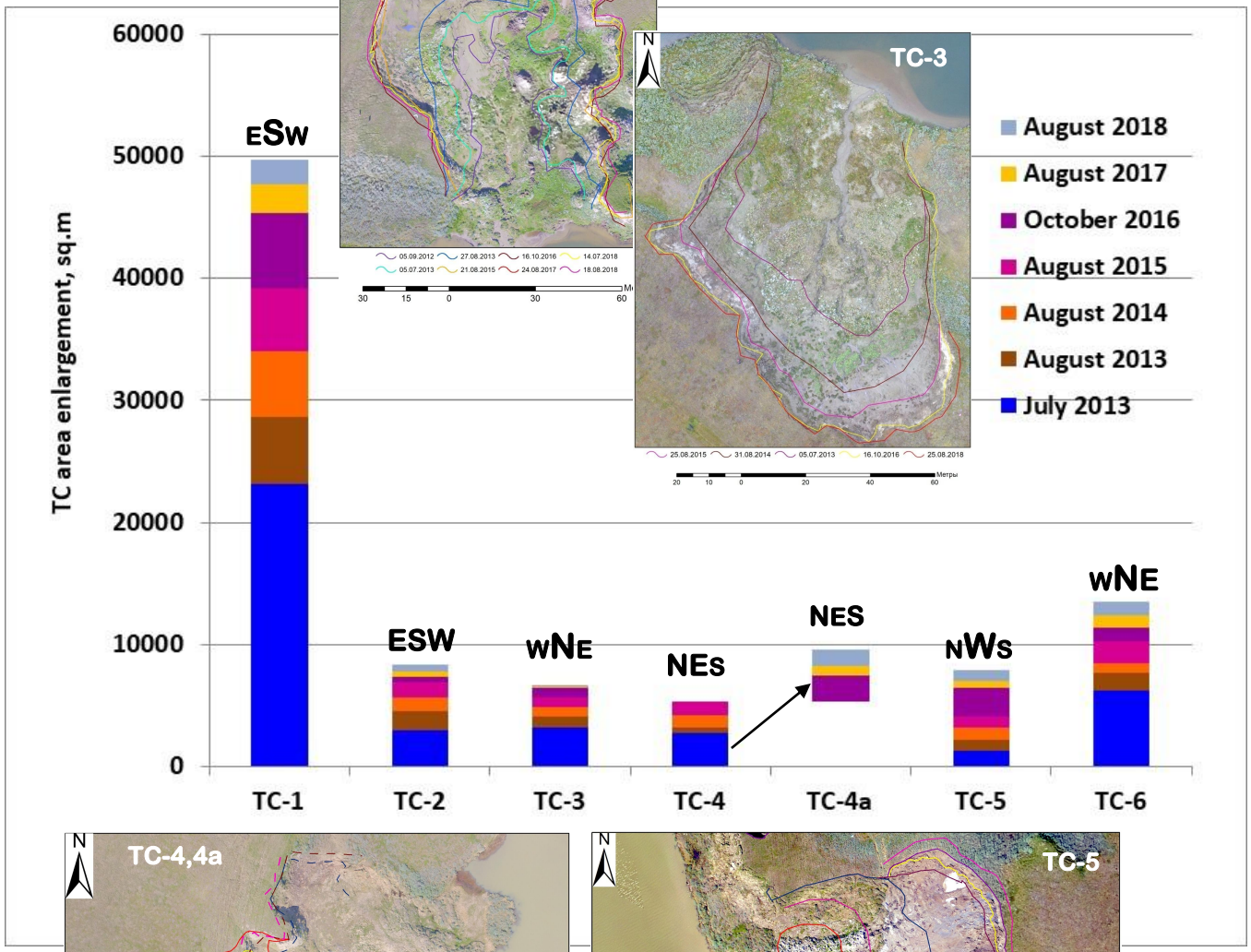


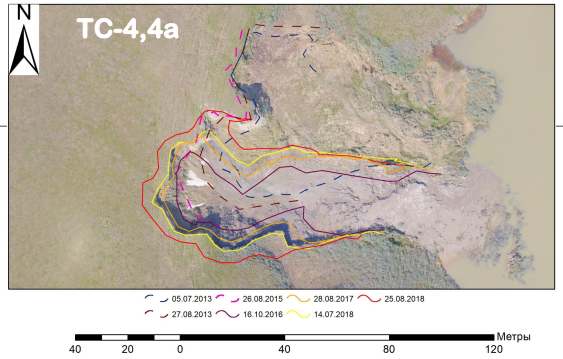

TC-1
N
Метры
05.07.2013 27.08.2014 13.10.2016 26.08.2018
26.08.2013 26.08.2015 29.08.2017

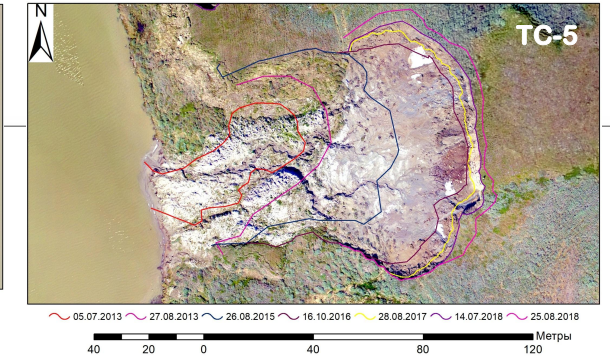

TC-2
N
05.09.2012 27.08.2013 16.10.2016 14.07.2018
05.07.2013 21.08.2015 24.08.2017 18.08.2018

TC-3
N
25.08.2015 31.08.2014 05.07.2013 16.10.2016 25.08.2018
Метры


TC-6
N
05.07.2013 27.08.2014 28.08.2017 25.08.2018
27.08.2013 26.08.2015 14.07.2018
Метры


TC area enlargement, sq.m
60000
50000
40000
30000
20000
10000
0
ESW
ESW
WNE
NES
NES
NWS
WNE
TC-1
TC-2
TC-3
TC-4
TC-4a
TC-5
TC-6
August 2018
August 2017
October 2016
August 2015
August 2014
August 2013
July 2013


TC-4,4a
N
05.07.2013 26.08.2015 28.08.2017 25.08.2018
27.08.2013 16.10.2016 14.07.2018
Метры


TC-5
N
05.07.2013 27.08.2013 26.08.2015 16.10.2016 28.08.2017 14.07.2018 25.08.2018
Метры

Conclusions

According to direct observations in Central Yamal thermocirques activated in 2012 triggered by extremely warm summer of 2012-2013, and expanded at a various rate. The annual rates of thermocirque area enlargement for 7 years of monitoring since 2012-2013 vary from less 1 to 6 thousand sq.m, and depend in part on climatic features of each year. Those kept stable after 2012, activated or re-activated in even warmer 2016.

Other controls of thermocirque growth are: slope aspect (southern-facing slopes are retreating faster), size and position of tabular ground ice in the section (the thicker is the layer and the closer to the surface, the faster growth rate).

While the coastal thermocirques grow under the additional action of the waves, inland thermocirques may rely only on the warming trend and amount of available water to help sediment flow away from thermocirque bottom. If the summer temperature rise is not accompanied by significant atmospheric precipitation, then sediment yield and removal are slowed down by landslide bodies in the transition zone. In this case thermocirque may stabilize in a short time and re-activate due to occasional exposure of tabular ground ice at the next extreme air temperature event and possible man-made effect.

FURTHER STUDY

- monitoring of key thermocirques

- multivariate retrospective analysis retreat rates

- remote spatial analysis

- statistical analysis

Thank you for your attention!

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- Russian Foundation for Basic Research (RFBR) grant 18-05-60222
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