Haplic Kastanozems Chromic of the North-West Caspian region under climate change conditions

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INTRODUCTION

The present mitigation of climate brings to the fore the topic of regional landscapes' response to external disturbances of the environment, which is especially important for arid and subarid regions with high risk agriculture.
Global climate warming affects all regions and can lead to unexpected environmental consequences. The peculiarity of some arid regions is presence of mobile easily soluble salts in the soils, subject to seasonal and long-term dynamics. Based on the position on pedogenesis as an integration of SPP - specific pedogenic processes (Targulian, Krasilnikov, 2007) - the dynamics of soil salts can be considered as a reversible SPP in accordance with groundwater dynamics, depending on Caspian sea level changes and determined by mutually reversible multidirectional climate trends.

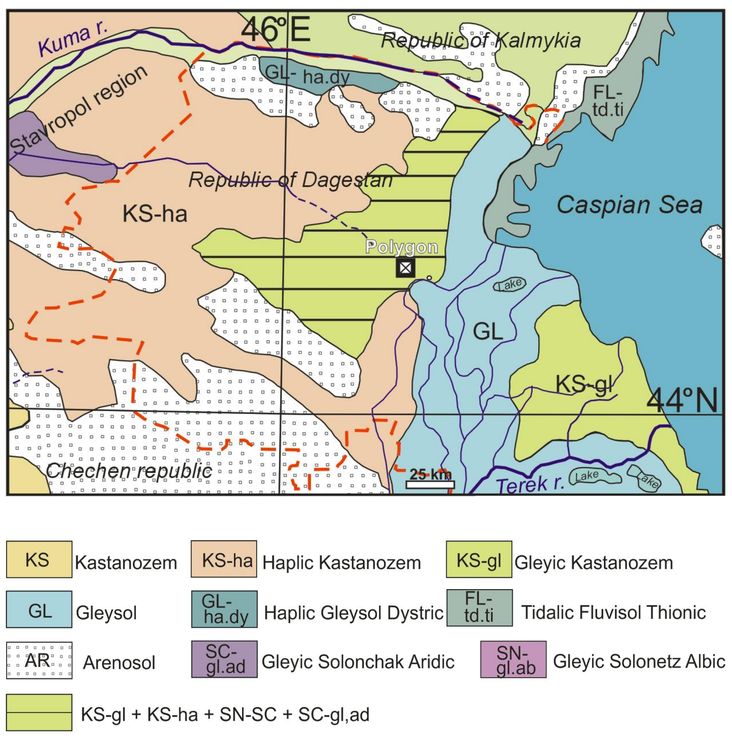

Fig 1. A part of Soil cover map (by soil-db.ru). North-West Caspian region and localization of test polygon.

METHODOLOGY

The soil identification and the degree of salinity coincide to WRB: ST - strongly salty, MO - moderately salty, Sl - slightly salty, N - not salty (Fig 1, 4). Textural classes is based on Soil classification of Russia: the percentage of physical clay (ph.cl.) - amounts of soil particles from 10 μm and less in fine earth fraction: light loam - 30 % and less ph.cl. The moisture content was determined by Selyaninov hydrothermal coefficient (HTC) - the ratio of the sum of precipitation in millimeters for a period with temperatures above 10°C to the sum of temperature indicators in °C for the same period of time.

RESULTS

Over the past 30 years, two climate trends can be distinguished in the North-West Caspian region: from the late 1980s to 2010 with an increasing in precipitation (P) and in average temperatures (T); from 2010 to the present - a relative decreasing in P and T (Fig 2).

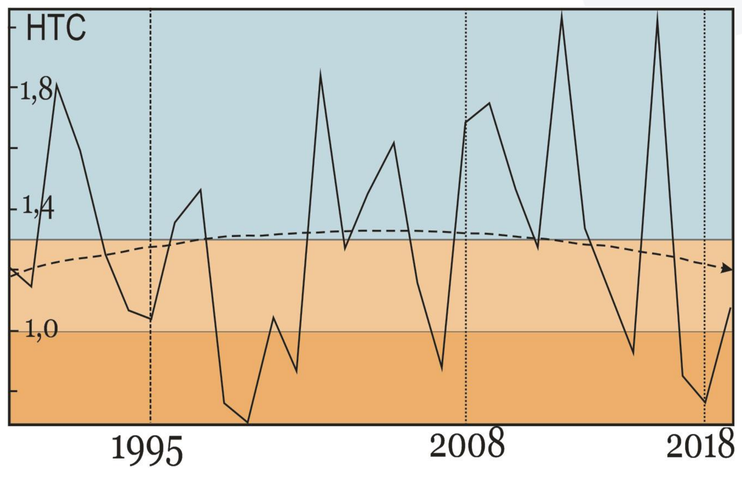

Fig 2. The dynamics of moisture content by Selyaninov: arid (0.7-1.0); slightly arid (1.0-1.3); humid (> 1.3). The village of Kochubey, Tarumovsky district, Dagestan, Russia.

Like climate trends are typical also for other regions with similar climate conditions (Ergina, Zhuk, 2019). Soil pits were laid on dominant and subordinate relief positions on Haplic Kastanozems Chromic endosalic underlying with fluvial deposits covering marine ones (Fig. 3.).
Groundwater level (hG) is 4-6 meters.
Pit 1 is laid on dominant relief slopes with a relative height (H) = 3.8 m. Texture is light loam - 27.1 % ph.cl., hG is more than 4 m.
Since 1990 up to 2018 the degree of salinity in the upper 0-30 sm soil thickness was decreased by two orders of saline value:
1990→2011→2018 yy.: MO→Sl→N. In the lower 30-70 sm thickness: ST→MO→Sl.

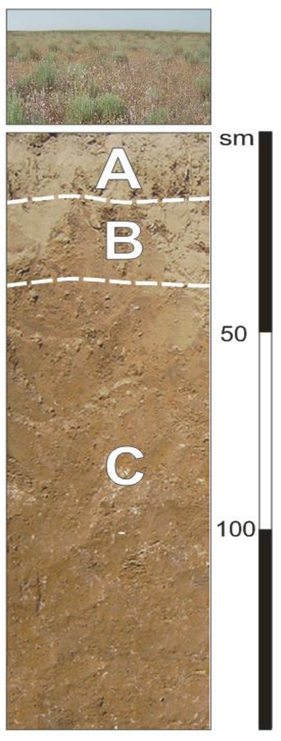

Fig 3. Soil profile of Haplic Kastanozem chromic.

Pit 2 is laid on subordinate slopes. H = 1.5 m. Texture is light loam - 29.3 % ph.cl., hG is less than 4 m.
Since 1990 up to 2018 the degree of salinity in the whole profile was decreased by one order of value: 1990→2011→2018 yy.: MO→MO→Sl (0-30 sm); ST→ ST→MO (30-70 sm).

CONCLUSIONS

Mitigation of climate during 28 years promoted optimization of soil cover properties. In the North-West Caspian region since late 1980-s up to 2018 yy. positive changes have been occurred: upper thicknesses of soil profiles have been desalinated. Decreasing the Caspian Sea level contributed to the lowering of ground water that influenced salt composition of soil profiles.
On Haplic Kastanozems of subordinate slopes, the desalinization of profiles slowed down somewhat compared to the dominant slopes, which can be explained by the still high level of saline groundwater (Fig.4).

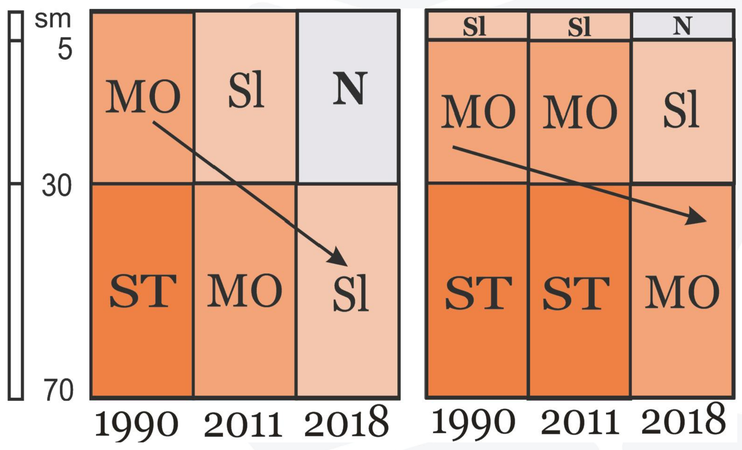

Fig 4. Degrees of Haplic Kastanozems Chromic: dominant slope (left picture), subordinate slope (right picture) .

Of course, the dynamics of soil salts is reversible, but taking into account the direction of soil salts migration can be useful for planning of irrigation norms, which can lead to real human effort savings, water and monetary resources, other environmental and economic benefits.

ACKNOWLEDGEMENTS

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