COMPARISON BETWEEN THERMAL AND DYNAMIC TROPOPAUSE IN SEVERE WEATHER EVENTS

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INTRODUCTION

The tropopause dynamics is involved in the most severe weather events. The tropopause, thin layer between the troposphere and the stratosphere, can be defined in a number of ways, but the most frequent description in meteorology is made using the thermal vertical gradient (thermal tropopause) and the potential vorticity (dynamical tropopause). The aim of this study is to compare the two tropopauses, in respect with severe weather events, in order to choose the most useful one for the operational meteorological forecast. The analysis was focused on 9 weather severe cases in 2017 year. The selected events manifested in south-eastern Europe, including Romania, were characterized by large amounts of precipitation, generally higher than 50 mm in 24 hours and/or wind gusts more than 55 km/h. In addition, the cases were selected if they were associated with a high positive potential vorticity anomaly. Were analyzed the heights of the dynamic tropopause (considering the surface of potential vorticity 2 PVU), and the heights of the thermal tropopause, calculated using the World Meteorological Organization (WMO) definition. The time variations of their phase and amplitude were analyzed and compared.

DATA AND METHODS

For this study were used :
- observational data recorded at the meteorological stations of the Romanian National Meteorological Administration, and OGIMET data for central and south-eastern Europe;
- ERA-Interim data set.

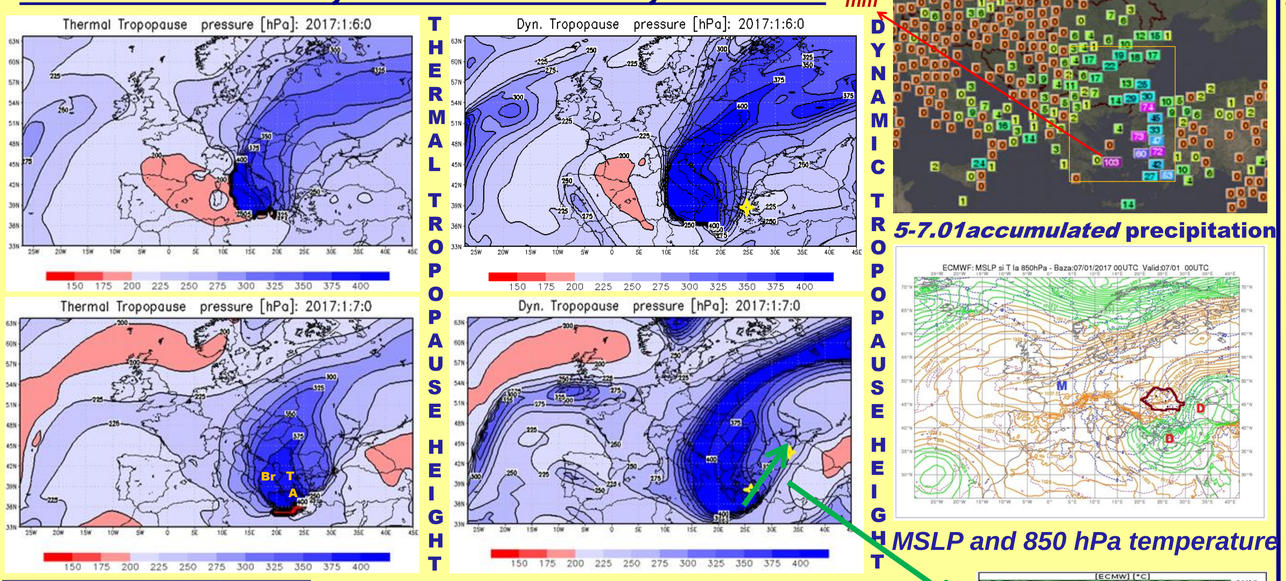
The height of the thermal tropopuse was calculated according to WMO definition and using the same method as Reichler et al., 2003;

The correlation between the two tropopause was done using the Pearson correlation coefficients (r0- zero lag coefficient, rtl - thermal lead corelation coefficient and rdl – dynamic lead correlation coefficient);

In this poster there are only four representative cases presented (in warm and cold season).

RESULTS

1st CASE – 5.01, 00 UTC – 7.01, 18 UTC

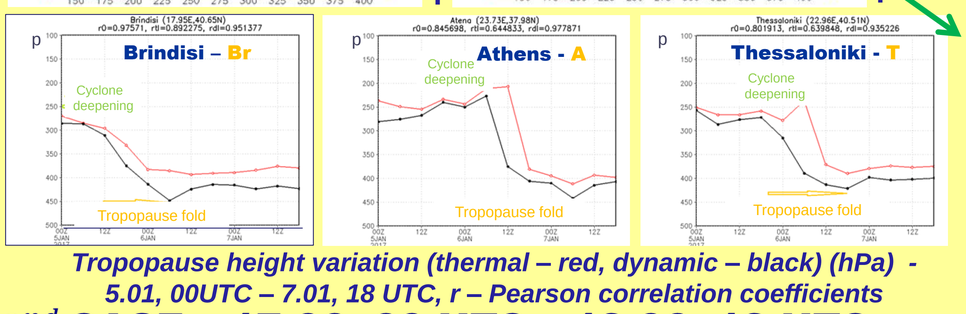


THERMAL TROPOPAUSE HEIGHT

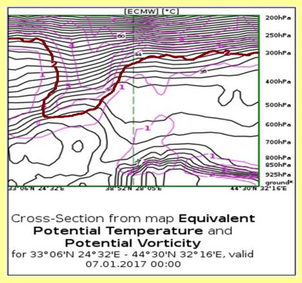
DYNAMIC TROPOPAUSE HEIGHT

5-7.01accumulated **precipitation**

MSLP and 850 hPa temperature

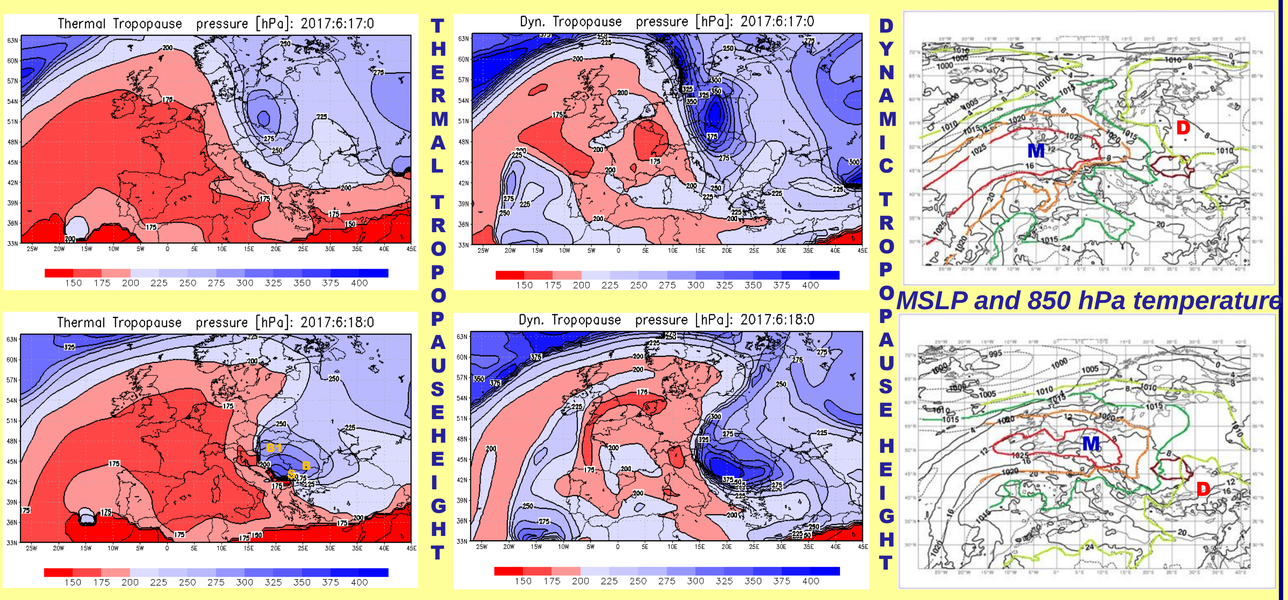


Tropopause height variation (thermal – red, dynamic – black) (hPa) - 5.01, 00UTC – 7.01, 18 UTC, r – Pearson correlation coefficients



cross-section (Eport – Eumetrain)

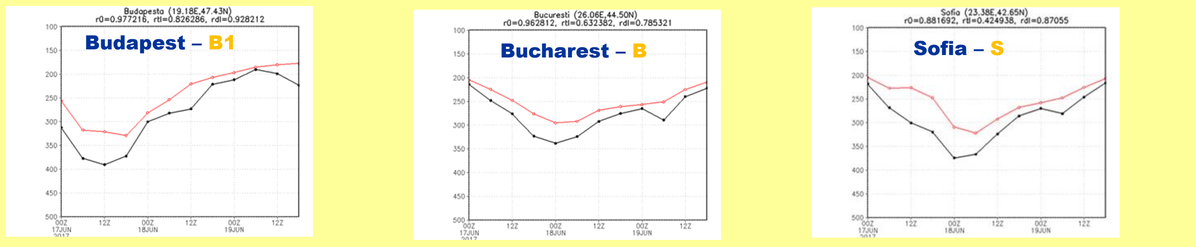
2nd CASE – 17.06, 00 UTC – 18.06, 18 UTC



THERMAL TROPOPAUSE HEIGHT

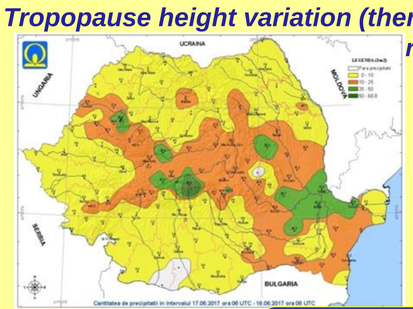
DYNAMIC TROPOPAUSE HEIGHT

MSLP and 850 hPa temperature

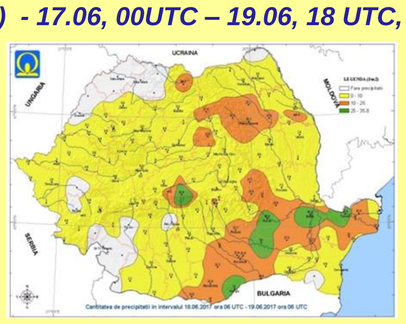


Tropopause height variation (thermal – red, dynamic – black) (hPa) - 17.06, 00UTC – 19.06, 18 UTC, r – Pearson correlation coefficients

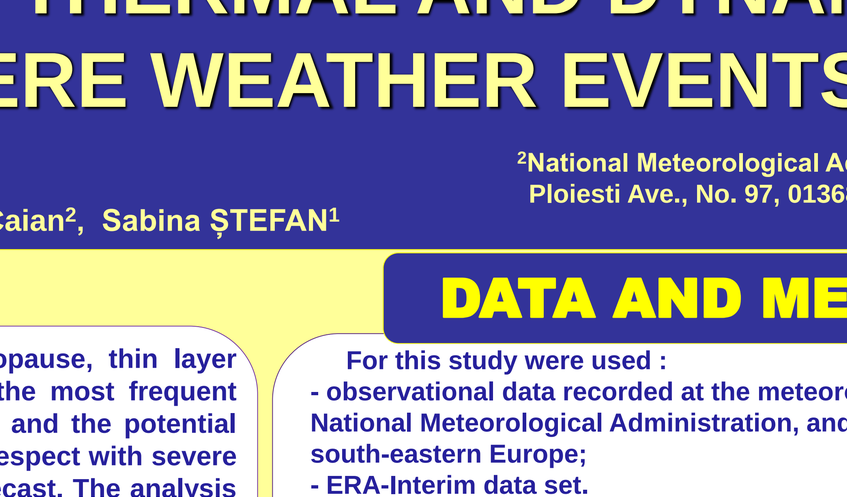
24 h accumulated precipitation



17.06.2017 *18.06.2017*



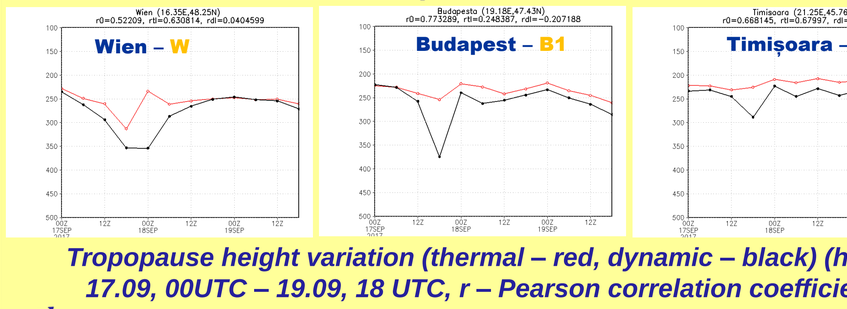
3rd CASE – 17.09, 00 UTC – 18.09, 00 UTC



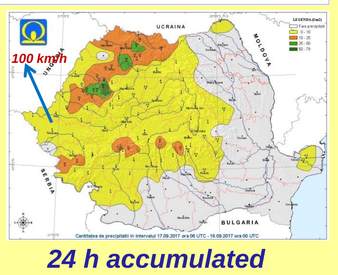
THERMAL TROPOPAUSE HEIGHT

DYNAMIC TROPOPAUSE HEIGHT

MSLP and 850 hPa temperature

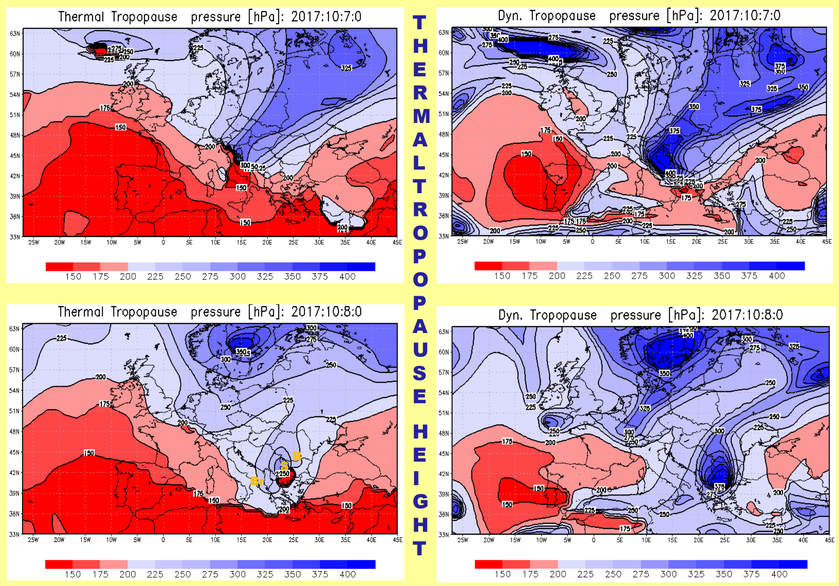


Tropopause height variation (thermal – red, dynamic – black) (hPa) - 17.09, 00UTC – 19.09, 18 UTC, r – Pearson correlation coefficients

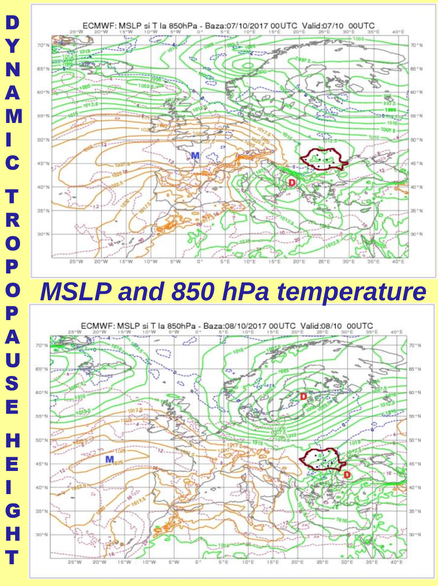


24 h accumulated precipitation

4th CASE 06.10, 18 UTC – 08.10, 18 UTC

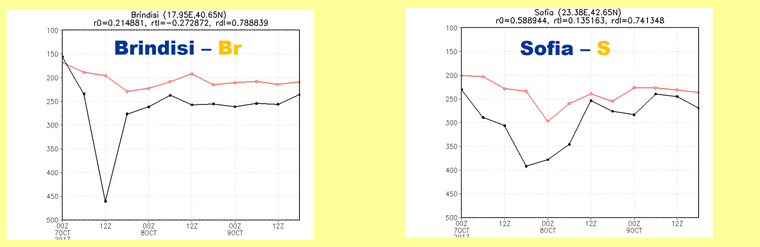


THERMAL TROPOPAUSE HEIGHT



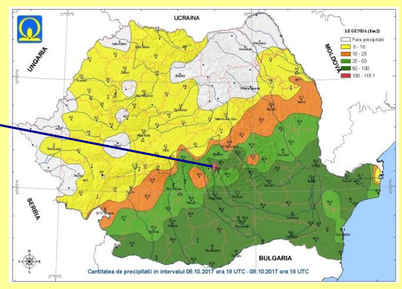
DYNAMIC TROPOPAUSE HEIGHT

MSLP and 850 hPa temperature



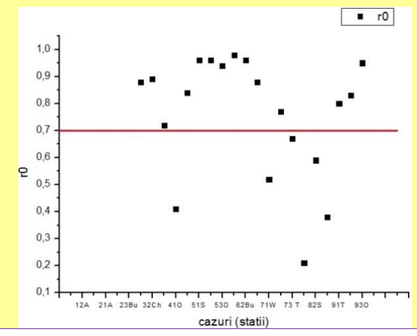
Tropopause height variation (thermal – red, dynamic – black) (hPa) - 7.10, 00 UTC – 9.10, 18 UTC, r – Pearson correlation coefficients

100 mm



48 h accumulated precipitation

Correlation coefficient r0



CONCLUSIONS

- at the occurrence of severe events the dynamical tropopause falling rate is higher than that of thermal tropopause. This result makes dynamical tropopause more suitable for prediction than thermal tropopause;
- in most of the extremly severe events it was oserved that both tropopauses have a sharp drop;
- in the case of phenomena linked by cyclones evolution, both tropopause folds are steeper and deeper than in case of instabilty (more in case of dynamical tropopause);
- in situations with very active cyclones, most of the time, both tropopauses falls simultaneously and fast, while on weaker cyclones, only the fall of dynamic tropopause is evident;
- when the atmosphere is relatively stable, the differences between the two tropopauses are insignificant (regarding evolution and amplitude);
- in most cases, the zero lag corelation between the two data sets, representing the dynamic and thermal tropopause, is good and very good (only in 4 of 26 cases is not so).

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