

## ***Analysis of Monthly Changes in Tropopause Height Layer on Iran***

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### **Extended abstract**

#### **Introduction**

Tropopause is the transitional layer between the troposphere and stratosphere. This layer determines the upper limit of the troposphere and somehow expresses the spatial and temporal variations in the thickness of the layers and the layer indicated his thermodynamic variability. This is the layer that short-term and long-term atmospheric phenomena occur in. In other words, this layer determines the thickness and upper limit of the troposphere layer. Iran in terms of geographical location is on the northern side of the Hadley cells in the general circulation. That's why when handling the extremely cells, we observe changes in the climate of this country. That's why the country is in the range of atmospheric systems of important effects such as (Arabian subtropical high pressure, Siberian high pressure, Azores high pressure, Mediterranean cyclones and Sudan low). This country is located in vicinity of vast deserts of the Arabian Peninsula and Siberia. Existence of two great ranges of Alborz and Zagros Mountains in north and west of Iran and the Dasht-e Kavir and Dasht-e Lut in Central and South East also remarkably influenced the entry and transit systems and mechanisms of precipitation systems. All of these factors caused changes in troposphere and tropopause of Iran . Hence, the tropopause height chowders is reaction of annual and seasonal variability happened in troposphere. If these changes can be estimated, the annual seasonal trends or changes in the troposphere layer can be changed. For this purpose, the maps of the height of the tropopause layer altitude on the slope of Iran in the period 2015-2003 is examined in each month of the year.

#### **Materials and method**

In this study, we have used data from the Atmospheric Infrared depth of (ATMOSPHERIC INFRARED SOUNDER) Moderate-resolution imaging spectro radio meter (MODIS), Aqua,

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Earth Observing System (EOS), and the product (AIRS+AMSU) V006 (AIRX3STD) at GES DISC. This product series of MODIS data in the form of geophysical parameters in the network have been distributed in,  $1 \times 1^\circ$  arc. The data are available for the area ranged from -180 to 180 in longitude and from -90 to 90 in latitude at <http://modaps.nascom.nasa.gov>. After obtaining the images from 2003 to 2015, data were compiled in MATLAB software, and using the World Meteorological Organization Tropopause height values they were calculated for the matrix of size  $12 \times 155$  for each year (155 networks were introduced and 12 months of the year are inscribed on the Iranian border). The image processing was conducted by ArcGIS10.2 and the maps of each month were prepared by kriging with the least amount of errors. The next step is to draw longitudinal profile of the height of the tropopause in 3D Analyst software plugin named slice of the North West (to a maximum height of the tropopause) to the South East of the country (as a minimum altitude of the tropopause). These were drawn for each of the months of the year.

### Results and discussion

The results of this research show that in spring equinox the highest altitude of tropopause layer on Iran belongs to the southeast areas. In this month, the altitude of tropopause layer in southeast Iran is 16475 meters and the lowest altitude with 11008 meters belongs to the areas in northwest Iran. Thus, the highest altitudinal gradient between southeast and north part of Iran was happened and this gradient reached to 5600 meters. This is as thick as the middle troposphere. From May onward, the area of southern elevation of the layer is wider and this condition continues until the end of October. In other words, in a large part of the southern half of Iran, tropopause height variabilities is very negligible. In contrast, in the months of December, January, February, March, April and May (cold months), this condition is observed in northwest Iran. With the spread of cold waves from northern latitudes due to southward expansion of the polar vortex, northern part of Iran in terms of temperature was more homogeneous and tropopause height variations is function of latitude. Thus, this isoheight has eastern and western extension. However, almost in all months iso-height line has northeast-southwest tendency. Due to north-south extension of Zagros Mountains, tropopause isoheight in westward slopes of Zagros Mountains is toward southwestern areas. The highest tropopause isoheight gradient in south Iran was happened in January, February and April. The highest tropopause isoheight gradient was in the centurial part of Iran in March, May and November and in northern part of Iran in June, July, August, September and October. Tropopause height change in the south Iran is very low and in any of the months it is not higher than 520 meters. The highest variation in tropopause height in southern part of Iran was happened in February and the lowest in July. Monthly changes in tropopause altitude in northern part of Iran were very extreme. In some months this change has exceeded 3000 meters. The highest change was happened in June (3490 m) and the lowest occurred in August. In north belt of Iran, tropopause height increases gradually from March and continued for 5 months, and in July it reaches the highest elevation. The highest tropopause height difference between south and north of Iran takes place in February. In this month tropopause height difference was more than 6000 meters. Northward expansion of warm air from vast pester in center of country during the warm months and accumulation in southern slopes of Alborz Mountains caused that isoheight layer in this part of Iran between north east and northwest areas.

**Conclusion**

The height of the tropopause layer of Iran has seasonal fluctuations with the intensity of the incoming topography and activity of the system. However, the impact of the tropopause height changes is more pronounced in the input system from the effects of topography. Although in July, it reaches its peak height. But fluctuations in tropopause height between the south and north parts of the country are minimal. In other months of the year, maximum height of the tropopause in the south and north parts of the country is minimal. In August, the height of the tropopause is in the center of Iran. In the other months of the year, the maximum height of the tropopause is in the South East and the lowest in the North West. During the cold period in the northern slope of the layer it reaches its minimum. During the warm season, the southern slope of the tropopause layer is minimized. This phenomenon has spread in south polar vortex in the Siberian high pressure in cold period of year. The study also showed that during the months of monsoon activity in the South East, it is reduced.

**Keywords:** *height of the tropopause layer, Iran, tropopause, tropopause height profile.*