European Conference on Severe Storms 2015
14–18 September 2015, Wiener Neustadt, Austria
ECSS2015-45

Instabilities and eddy systems in the upper atmosphere

Werner Simon
Rheinische Fachhochschule, Schaevenstraße 1 a-b, D 50939 Köln, Germany (w.simon.314@web.de)

The aim of this presentation is to discuss the physical principles that lead to the development of small-scale vortexes in the upper atmosphere. For this purpose, a mathematical and physical model is developed, which serves as a basis for simulations and their results ([8]).
In the first part of the presentation an overview about atmosphere fluidized systems will be given and the differences between them will be explained ([1] – [5]). In Part 2, the mechanisms leading to the formation of vortexes will be given as well. Moreover, they will be demonstrated and discussed in more detail regarding criteria to atmospheric instabilities ([2], [3]). Here the author will also show a geometric method with the barocline instability areas which can be found in the jet stream. The third part is about the vertical dynamics explained and illustrated based on the Archimedean buoyancy in cumulus clouds and supercells as it comes to the buoyancy of warm (lighter) air currents and sinking of cold (heavier) ones ([3],[6]). Based on this, the criteria for the reinforcement and duration of a vertical movement will be acquired. In the fourth part, the case of cumulus clouds and supercells that enter the height of the troposphere will be considered. At these altitudes there are also jet streams. What happens when strong thunderstorm updrafts collide with the jet stream ([7],[8])? What happens when warm moist air currents collide with dry cold air currents under wind shear? For this, the author provides a mathematical model and simulation studies ([8],[9]).

References:
[1] Bluestein, H.B.: Severe Convective Storms and Tornadoes, Springer (2013)
[2] Etling, D.: Theoretische Meteorologie – Eine Einführung, Springer (2002)
[3] Etling, D.: Wirbelstürme im Visier – Die Physik der Hurrikane, Taifune, Tornadoes und Windhosen, Physik Journal 5 (2006) Nr. 11.
[4] Hantel, M.: Einführung – Theoretische Meteorologie, Springer Spektrum (2013)
[5] Holton, J.R., Hakim, G.J.: An Introduction to Dynamic Meteorology, Fifth Edition, ELSEVIER (2013)
[6] Jones, R.D.: Linear and Nonlinear Propagation of Supercells Storms, JOURNAL OF THE ATMOSPHERIC SCIENCES (2002) Volume 59
[7] Roth, A.: Statistische und analytische Untersuchung des Zusammenhangs zwischen Großwetterlagen und der Entstehung von Tornados unter besonderer Berücksichtigung der Lage und Stärke von Strahlströmen. Diplomarbeit an der Hochschule Darmstadt (2007).
[8] Simon, W.: Physikalische Grundlagen zur Erfassung von Instabilitäten in der Atmosphäre – Extremwetterkongress 2013, Hamburg
[9] Zargartizabi, A.: Stabilitätsanalysen in Strömungen mit mehreren Temperaturbereichen und Wirbelbildungen. Masterarbeit an der Hochschule Ruhr-West Mühlheim (2013).