EMS Annual Meeting Abstracts
Vol. 9, EMS2012-107, 2012
12th EMS / 9th ECAC

Student aerosol climate campaign within the GLOBE program.

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Between spring of 2013 and summer of 2014 in Poland will take place the student aerosol climate campaign (SACC) in frame of international GLOBE (Global Learning and Observations to Benefit the Environment) program. This campaign aims to engage students in measuring, investigating, and understanding the climate system in their local communities and around the world. Drawing on GLOBE protocols and data, as well as other datasets, students take climate-related measurements and investigate research questions about climate.
By participating in this campaign, students will contribute to climate science studies, will connect with scientist from Institute of Geophysics University of Warsaw, Institute of Oceanology from Sopot and Space Research Centre Polish Academy of Science and with other schools and classrooms around the Poland, and be inspired to explore and conduct science investigations of their own as part of their increased awareness of climate-related environmental issues and Earth as a system. We plan to join about 20-25 schools including primary schools, gymnasiums, and high schools. Schools participated in the project will received equipments and educational materials. In addition, teachers these schools will be trained in the field of research. The main scientific arm of the SACC is improve spatial resolution of the aerosol optical depth observations. This quantity in Poland is measured in the Poland-AOD network including only three stations and in one AERONET site. The aerosol optical depth will be measured by simple sun photometers, which are developing at Institute of Geophysics University of Warsaw. This instrument will be similar to the hand held Microtops II sun photometer but much cheaper (about 1000 Euro). Student will be measured direct solar radiation at 4 or 5 wavelengths and next will be computing the aerosol optical depth and the Ǻngstrom exponent. Moreover, observation of sky conditions will be performed such as the cloud fraction, cloud type, sky color, and visibility as well as the basic weather parameters (temperature, pressure, wind, relative humidity). In addition to estimating the visibility, students will be used a simple digital camera.
In meteorology, visibility is the greatest distance at which a black object of suitable dimensions, situated near the ground, can be seen and recognized when observed against a bright background. This subjective definition of visibility is closely related to meteorological optical range which is more accurate. This quantities is defined by the range at which contrast between black object and background is equal 0.02. Due to this definition the contrast of a black object close to horizon can be computed based on a digital picture.
However, this method requires assumption that target is ideal black. If not, the contrast at second distance from target should be known. It requires taking two pictures at some significant distance between location or using similar target located at different range from observer. In case of hill landscape the forest at two different hills can be used as the targets.
Contrast between target and background can be computed for G (green) channel or for gray picture after RGB transformation to gray color map. Using simplest relationship between contrast and the total extinction coefficient is determined. Next using the Koschmieder equation the visibility can be computed. The total extinction coefficient estimated from pixel contrast is a sum of molecular, aerosol scattering and absorption processes in the atmosphere. The molecular scattering can be estimated from pressure, temperature and wavelength data. This allows computing the aerosol extinction coefficient. Described here methodology of the aerosol extinction coefficient estimation is correct only if the horizontal path of the atmosphere doesn't include droplets and ice crystals. Hydrometeors lead to strong reduction of visibility (increase of the total extinction coefficient). Obtained from camera observation the aerosol extinction coefficient will be compared with the aerosol optical depth.
Aerosol optical properties depend on air humidity therefore, in addition to surface relative humidity observation the total water vapor in the whole atmosphere column will be measure by using a very inexpensive IR thermometer. During observation this instrument will be pointed at a cloud-free zenith sky. Method described by Mims et al., (2011) works during the day or night as long as the thermometer is properly calibrated.
Thus, students will be used inexpensive instrument as well as the visual observation for aerosol optical properties and weather condition to better understand of aerosol and water vapor (dominant greenhouse gas) role in weather and climate changes.