

COSTA RICA

OBSERVATIONAL ACTIVITIES

The Laboratorio de Análisis Ambiental, Escuela de Ciencias Ambientales (EDECA), Facultad de Tierra y Mar, Universidad Nacional (UNA) is the main institution in scientific research and monitoring of ozone in Costa Rica. The Laboratorio de Análisis Ambiental-UNA works in collaboration with other National Institutions: Instituto Meteorológico Nacional (IMN), Centro Nacional de Alta Tecnología (CENAT) and Universidad de Costa Rica (UCR). The Department of Physics, Universidad Nacional and the Universidad de Costa Rica (UCR) perform UV measurements.

Column measurements of ozone and other gases/variables relevant to ozone loss

Not available.

Profile measurements of ozone and other gases/variables relevant to ozone loss

Balloon-borne measurements take place at Alajuela, Costa Rica (10.0°N, 84.13°W, 908 m a.s.l).

Ozonosondes

Since 2005, the Alajuela ozonesonde station was officially accepted into the Southern Hemisphere Additional OZonesondes (SHADOZ) network. Weekly ozonesonde soundings have been conducted on a weekly basis, using ECC ozonesondes. Ozonosondes launches are a collaboration between CIRES-University of Colorado/NASA/NOAA and the Laboratorio de Análisis Ambiental-UNA/IMN/CENAT.

Water Vapour Measurements

Since 2005, together with ozone soundings also water vapour soundings have been taken place. Monthly or biweekly soundings have been conducted, using cryogenic chilled-mirror hygrometers that are flown in combination with ozonesondes. Water vapour soundings are a collaboration between CIRES-University of Colorado/NASA/NOAA and the Laboratorio de Análisis Ambiental-UNA/IMN/CENAT.

Radiosondes

Since 2004, radiosondes have been launched on a daily basis. These include sensors of temperature, relative humidity; direction and wind speed. Radiosondes are performed by the UCR in collaboration with the IMN.

UV measurements

The UV measurements are performed by the UNA and UCR.

Broadband measurements

These measurements take at Heredia, Costa Rica (10° 02'N, 84° 09'W; 1050 m). Data has been collected since ~10 years ago by the Departamento de Física of UNA.

Global solar radiation is measured with an Eppley piranometer of spectral precision, model PSP, effective measurement range: 0.295 μm to 2.8 μm .

Infrared radiation of the atmosphere is measured with an Eppley pyrgeometer of spectral precision, model PIR, with effective range: 4 μm to 50 μm .

Narrowband filter instruments

Davis Weather station, Vantage Pro2 Plus is used to measure UV. The UV Sensor measures the sunburning portion of the UV spectrum (290nm - 390 nm). Its spectral response matches very closely the Erythema Action Spectrum (EAS), and was adopted by the Commission Internationale de l'Eclairage (C.I.E.) as the standard representation of the human skin's sensitivity to UV radiation. This equipment is property of the UCR. Measurements have been taken since 3 years ago though data is not yet been analysed.

Spectroradiometers

Not available

Calibration activities

Pre-launch calibration takes place in a regular basis. Vaisala is calibrated at NOAA/CIRES-University of Colorado/NASA.

RESULTS FROM OBSERVATIONS AND ANALYSIS

- Validation of Ozone Measurements from HIRDLS (Nardi *et al.*, 2007).
- Validation of Aura/MLS Water vapour (Vömel *et al.*, 2007).
- Solar radiation maps from Costa Rica (Wright, 2002).
- Involvement of the students in the measurements: Licentiate thesis from SIBAJA, J.P., 2007. Evaluation of the profile of ozone and water vapour concentration in the lower troposphere over Costa Rica, Tutor: Dra. Jéssica M. Valverde Canossa, Universidad Nacional.
- Influence of volcanic emissions on ozone data.

THEORY, MODELLING, AND OTHER RESEARCH

Spectral modelling of the direct, diffuse and global solar radiation (Wright, 2005)

DISSEMINATION OF RESULTS

Data reporting

The ozone profile data collected in Costa Rica is sent to NOAA in Boulder, Colorado. The data from there is then transferred to the SHADOZ (Southern Hemispheric Additional Ozonesondes) archives: <http://croc.gsfc.nasa.gov/shadoz/>.

Information to the public

Vertical ozone profile data is made available after every launch on the SHADOZ website for the scientific community.

Relevant scientific papers

- Vömel, H., Selkirk H. B., Miloshevich L., Valverde-Canossa J., Valdés J., Kyrö E., Kivi R. Stolz W., Grace S. Peng, and Diaz J.A., 2006. Radiation Dry Bias of the Vaisala RS92 Humidity Sensor. *Journal of Atmospheric and Oceanic Technology*.
- H. Vömel, J. E. Barnes, R. N. Forno, M. Fujiwara, F. Hasebe, S. Iwasaki, R.Kivi, N. Komala, E. Kyrö, T. Leblanc, B. Morel, S.-Y. Ogino, W. G. Read, S. C. Ryan, S. Saraspriya, H. Selkirk, M. Shiotani, J. Valverde Canossa, D. N. Whiteman, 2007. Validation of Aura/MLS Water Vapor by Balloon Borne Cryogenic Frostpoint Hygrometer Measurements. Submitted to JGR, March 2007.
- Bruno Nardi, John C. Gille, John J. Barnett, Cora Randall, V. Lynn Harvey, Alison Waterfall, Jolyon Reburn, Thierry Leblanc, Sophie Godin-Beekmann, Tom McGee, Laurence Twigg, Peter Bernath, Bojan Bojkov, Chris Boone, Charles Cavanaugh, Michael Coffey, James Craft, Cheryl Craig, Vincil Dean, Thomas Eden, Gene Francis, Lucien Froidevaux, Chris Halvorson, James Hannigan, Christopher Hepplewhite, Douglas Kinnison, Rashid Khosravi, Charlie Krinsky, Alyn Lambert, Hyunah Lee, Joanne Loh, Steven Massie, Stewart McDermid, Dan Packman, Anne M. Thompson, Brendan Torpy, Jessica Valverde-Canossa, Kaley Walker, Claire Waymark, David N. Whiteman, Jacquelyn C Witte, Greg Young, 2007. Initial Validation of Ozone Measurements from the High Resolution Dynamic Limb Sounder (HIRDLS). Submitted to JGR April 2007.
- Wright, J. 2005. "Modelación espectral de la radiación solar directa, difusa y global en la atmósfera". En prensa *Revista Tópicos Meteorológicos y Oceanográficos*.
- Wright, J. 2002. "Mapas de radiación solar en Costa Rica". *Revista Tópicos Meteorológicos y Oceanográficos* 9(2)79-87.

PROJECTS AND COLLABORATION

The major international collaboration is with CIRES-University of Colorado-NOAA/NASA. Through this project we launch regularly ozone and water vapour sondes. The UNA has participated in a series of projects:

- Observations of the Variability of Ozone and Humidity in the Tropical Tropopause Region in Support of TC4 and AURA Validation. Financed by CIRES-University of Colorado/NOAA, from: 01.07.2007- 31.07.2010.
- Southern Hemisphere ADditional OZonosondes, SHADOZ, Financed by NASA, from: 01.09.2005- not defined.
- Impact of Biogenic emissions on Organic aerosols and Oxidants in the Troposphere – IBOOT, financed by BELGIAN FEDERAL PUBLIC PLANNING SERVICE SCIENCE POLICY, from 15.12.2005 to 15.12.2006.
- Ticosonde/CR-AVE 2006, financed by CIRES-University of Colorado/NOAA/NASA, from: 01.01.2006 to 31.02.2006.
- Ticosonde Veranillo 2006, financed by CIRES-University of Colorado/NOAA/NASA, from: 01.07.2006 to 07.08.2006.
- Ticosonde/Aura-TCSP 2005, financed by CIRES-University of Colorado/NOAA/NASA, from: 08.07.2005 to 25.07.2005.

At La Selva Biological Station flux measurements of CO₂ are taking place in the frame of the CARBONO project, more information at <http://www.fiu.edu/~carbono/>.

FUTURE PLANS

The following activities are planned for the future:

- Continue monitoring vertical ozone profiles under the SHADOZ programme.
- Ozone Climatology.
- Continue monitoring water vapour profiles. This station has the highest frequency of measurements in the tropics.
- Start continuous UV-B monitoring programme at SHADOZ station; this will depend on the help of the Oficina Técnica del ozono.
- Perform Surface ozone measurements.
- Continue with the NASA agreement to include Costa Rica in the MPLNET and AERONET networks.
- Improve the dissemination of data to the public by establishing a webpage.
- The Department of Physics of the UNA and IMN will start measuring UV-B radiation with a Kipp & Zonen radiometer donated by the Oficina Técnica del Ozono.

NEEDS AND RECOMMENDATIONS

We need two computers one for surface ozone measurements and another one to work the ozone and water vapour data and also a better program such as IDL and financial support to travel to meetings, congresses, seminars and workshops abroad. We recommend starting with an UV network in Costa Rica and help with the calibration and maintenance of these equipments.
