

## Brief Resume

**CHRISTOS S. ZEREFOS – Research Center for Atmospheric Physics and Climatology, Academy of Athens**

### ACADEMIC POSITIONS

Head, Research Center for Atmospheric Physics and Climatology of the Academy of Athens (2008-), Professor of Atmospheric Physics and Climatology, National and Kapodistrian University of Athens, Greece (2002-2010), Scientific Collaborator, University of Oslo, Norway (1995), Honorary Fellow (Fulbright Scholar) visiting Professor, University of Minnesota, USA (1985), Visiting Professor, Physics and Astronomy Department, Boston University, Boston USA (1983), Professor of Atmospheric and Environmental Physics, Physics Department, Univ. of Thessaloniki, Greece (1979-2002). In the past 3 decades has supervised 55 masters' and 31 Ph.D. theses.

### AWARDS AND RECOGNITION

Has received a number of internationally recognized awards, among which the title of Honorary Professor of the Physics Department of the Aristotle University of Thessaloniki (2018), the Ioan Ursu Medal of Honor of the Balkan Physical Union (2018), "Honorary Member" of the International Ozone Commission (2016), the Honorary Doctorate Degree, Physics Department, University of Patras (2016), the Yoram Kaufman Award of the AGU Atmospheric Science Section (2015), the French Government Decoration "Commandeur dans l'ordre de Palmes académiques" (2015), the Blaise Pascal Medal, European Academy of Sciences (2015), the Award of the Balkan Physical Union (2015), Professor Emeritus of the National and Kapodistrian University of Athens (2010), the Gold Medal of the City of Thessaloniki (2008), the Honorary Degree of Doctor of Humane Letters, University Division of the American College ANATOLIA, Thessaloniki (2008), Medal of the City of Athens (Athens, 2010), Award Certificate and Letter from UNEP and from IPCC for his substantial contribution to the reports of IPCC, which shared the 2007 Nobel Peace Prize with the former Vice President of USA, Al Gore (2007), Fellow, Institute of Physics (2002), UNEP Honourable Mentions (2013, 1999, 1995), Editors Award for Excellence in Refereeing, American Geophysical Union (1998), Global Ozone Award, UNEP on the 10<sup>th</sup> Anniversary of the Montreal Protocol (1997). Reviewer, IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), Field et al., Cambridge, UK, 582 pp. (2012), Review Editor, Chapter 5: Solar Ultraviolet Irradiance at the Ground, IPCC "Aviation & the Global Atmosphere" Report, Switzerland (1998). In the past 20 years has acted as author, contributor or reviewer in almost all WMO/UNEP Scientific Assessments of Ozone Depletion (*Montreal Protocol Who's Who* <http://www.unep.fr/ozonaction/montrealprotocolwhoswho/PageFlip.asp>).

### SELECTED MEMBERSHIP TO SCIENTIFIC SOCIETIES

Member European Academy of Sciences (2010), Member Georgian Academy of Natural Sciences (2009), Corresponding Member Russian Academy of Natural Sciences (2009), Member Academia Europaea (2008), Member International Academy of Astronautics (Paris, 2008), Member Academy of Athens (2007), Member European Academy of Sciences and Arts (Salzburg, 2002), Foreign Member Norwegian Academy of Sciences and Letters (1998). Secretary International Ozone Commission (2000-2004) and President (2008-2016), President Mariolopoulos-Kanaginis Foundation for the Environmental Sciences (since 2004), President Greek National Committee of the International Union of Geodesy and Geophysics (IUGG) (since 2008) and Member IUGG Council (since 2016), Member High Level Working Group of the Group on Earth Observations (GEO) (since 2008), National

Representative Greek GEO Office (since 2008), Member Board of Directors of the Center for Hellenistic Studies, Library of Alexandria, Coordinator Working Group for the study on the Social, Economic and Environmental Impacts of Climate Change of the Bank of Greece (since 2008), President Board of Directors of "Biomedical Sciences and Technologies S.A." of the Biomedical Research Foundation of the Academy of Athens (since 2008). President-elect of the General Assembly of the Hellenic Foundation for Research and Innovation (2017), Member of the National Council for Climate Change Adaptation of the Ministry of Environment and Energy (2017).

## **SELECTED RESEARCH**

Christos Zerefos became known in the 70s for his studies on the long and short term variability of the ozone layer and related geophysical signals in a global perspective. The relation between solar activity and the lower stratosphere, e.g. his paper with Paul Crutzen "Stratospheric thickness variation over the northern hemisphere ...." (JGR, 1975) was one of the first studies to model the solar activity component in the stratosphere. Working with Harry van Loon, they first observed the El Nino signals in the lower stratosphere ("The southern oscillation in the stratosphere", Mon. Weather Rev., 1982) and in the columnar ozone ("On the relative importance of QBO and El Nino in the revised Dobson total ozone records", JGR, 1992). His early papers on long term trends in stratospheric temperatures and total ozone include one of his most important papers with Stolarski "Measured trends in stratospheric ozone", Science (1992). That paper provided the scientific basis for the strengthening of the phase out of halocarbons. In this work Zerefos played a key role in analyzing ground based data. Recently long-term trends from the lower troposphere to the lower stratosphere have been revisited in Zerefos et al. in ACP (2014).

His papers on the inverse relationship between ozone and UV-B, provided for the first time evidence that UV-B had significant positive trends. "A note on the recent increase of solar UV-B over northern mid latitudes", GRL, 1995, "Optical properties of tropospheric aerosols ...", Appl. Optics, 1997, "Spectral measurements of solar UVB radiation and its relations to total ozone, SO<sub>2</sub>, and clouds", JGR, 1993 as well as his papers on record low total ozone anomalies and the effects of volcanic eruptions (e.g. with Bojkov "Record low total ozone during northern winters of 1992 and 1993", GRL 1993). In the 80s Zerefos pioneered in establishing in Greece regular well calibrated observations of UV spectral irradiance and ozone. In the 90s has pioneered in the establishment of the European UV-B observing network started from his initiative with Anne Webb, Alkis Bais and late Heinz Ott. He has also supported the use of the Brewer spectroradiometer which became a model instrument to measure not only columnar ozone and SO<sub>2</sub> but also UV spectral irradiances. Notable are papers with Bais and McElroy "Solar UV-B with the double and single Brewer ozone spectrophotometers", GRL, 1996 and "Correcting global solar ultraviolet spectra recorded by a Brewer spectroradiometer for its angular response error", Appl. Optics, 1998. In the 90s Zerefos has organized large EU-funded campaigns to study the processes of ozone- aerosol-radiation interactions in the Mediterranean (PAUR Campaigns, I, II, MEDCAPHOT Campaign with Ziomas): "The effect of aerosols on solar UV irradiances during the photochemical activity and solar ultraviolet radiation campaign" with Kylling "The optical properties of tropospheric aerosols determined by Lidar and spectrophotometric measurements (PAUR Campaign)" with Marengo and others. In the 2000s has participated in the MATCH Campaigns joining the European group led by Rex, Schultz and others which studied ozone loss rates inside and outside of the polar vortex (JGR, 2001; GRL, 2000, 2006). On another collaborative project with Stohl et al., studied and reviewed mechanisms of stratosphere-troposphere exchange (JGR, 2003) and with Harris "Trends in stratospheric and free tropospheric

ozone, JGR “Variability of UV-B at four Stations in Europe, GRL, 1997, “Quasi-biennial and longer-term changes in clear sky UV-B solar irradiance”, GRL, 1998, “Further studies on possible volcanic signal to the ozone layer”, JGR, 1994. He has discovered with his colleagues the effects in the stratosphere of the solar eclipses of 1999 (JGR, 2000) and 2006 (ACP, 2007, 2008) presenting evidence of atmospheric gravity waves following the supersonic transport of the moon’s shadow in the ozone layer.

Has served as review Editor of Chapter 5 of the IPCC Aviation Report (1998) and as Reviewer of the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (2013). The paper with Sausen “Aviation radiative forcing in 2000: An update on IPCC”, Met. Z., 2005 and “Solar activity-total column ozone relationships: Observations and model studies with heterogeneous chemistry”, JGR, 1997, “Tropospheric ozone changes at unpolluted and semi polluted regions induced by stratospheric ozone changes”, JGR, 2005 with Isaksen, “Evidence of the impact of aviation on cirrus cloud formation”, Atmos. Chem. Phys., 2003, “Solar dimming and brightening over Thessaloniki, Greece, and Beijing, China”, Tellus B, 2009 and a number of well-received papers are seen in his most cited list of papers. Recently he is analysing data to detect turn around in the ozone and UV-B trends following the phase out of manmade chlorofluorocarbons (e.g. “Evidence of a possible turning point in solar UV-B over Canada, Europe and Japan”, ACP, 2012). Finally, his pioneering work on the use of Red-to-green ratios to detect aerosol in paintings by great masters (Zerefos et al, 2007, 2014) is being widely discussed in scientific and mass media globally. Some of the above papers have been selected as hot spots by the editors of prestigious scientific journals.

#### **Research experience and competitive projects**

Created from zero recognized Institutions, e.g. The Navarino Environmental Observatory (NEO) (2012) with the University of Stockholm and TEMES (<http://navarinoneo.geo.su.se>). The Geostrophysics Museum, National Observatory of Athens, (2008) ([http://www.noa.gr/museum/english/index\\_en.html](http://www.noa.gr/museum/english/index_en.html)). The UNESCO Chair on Natural Hazards (2006). The Graduate Program on Environmental Physics (1991) (<http://www.unesco.org/en/unitwin/access-by-region/europe-and-north-america/greece/unesco-chair-on-natural-hazards-in-the-geosphere-the-hydrosphere-and-the-atmosphere-751/>). The WMO Northern Hemisphere Ozone Mapping Center (1991) and the Laboratory of Atmospheric Physics, Thessaloniki (1981) (<http://lap.physics.auth.gr/ozonemaps2/>).

Has more than 35 years of experience in research and teaching related to global change. Coordinator or partner or consultant to more than 50 research projects funded by internationally recognized organizations.

#### **List of selected recent articles in peer reviewed journals**

1. Zerefos et al., “Detecting volcanic sulfur dioxide plumes in the Northern Hemisphere using the Brewer spectrophotometer, other networks, and satellite observations”, **Atmos. Chem. Phys.**, 17, 551–574, 2017.
2. Papayannis et al., “An overview from hygroscopic aerosols to cloud droplets: The HygrA-CD campaign in the Athens basin”, **Sci. Total Environ.**, 574, 21-223, 2017.
3. Diémoz et al., “Retrieval of aerosol optical depth in the visible range with a Brewer spectrophotometer in Athens”, **Atmos. Meas. Techn.**, 9, 1871-1888, doi:10.5194/amt-9-1871-2016, 2016.
4. Hassinen et al., “Overview of the O3M SAF GOME-2 operational atmospheric composition and UV radiation data products and data availability”, **Atmos. Meas. Techn.**, 9, 383-407, 2016.
5. Luterbacher et al., “European summer temperatures since Roman times”, **Environ. Res. Lett.** 11,

doi:10.1088/1748-9326/11/2/024001, 2016 *Selected in the "Highlights of 2016" collection by the Editors of the Journal.*

6. Dafka et al., "The Etesians: from observations to reanalysis", **Climate Dynamics**, DOI: 10.1007/s00382-01502920-7, 2015.
7. Eskes et al., "Validation of reactive gases and aerosols in MACC global analysis and forecast system", **Geosci. Model Dev.**, 8, 3523-3543, 2015.
8. Founda et al., "Interdecadal variations and trends of the Urban Heat Island in Athens (Greece) and its response to heat waves", **Atmos. Res.**, 161-162, 2015.
9. Inness et al., "Data assimilation of satellite-retrieved ozone, carbon monoxide and nitrogen dioxide with ECMWF's Composition-IFS", **Atmos. Chem. Phys.**, 15, 5275-5303, 2015.
10. Kalabokidis et al., "Effect of climate change projections on forest fire behavior and values-at-risk in southwestern Greece", **Forests**, 6(6): 2214-2240, 2015.
11. Katragkou et al., "Evaluation of near surface ozone over Europe from the MACC reanalysis", **Geosci. Model Dev.**, 8, 2299-2314, 2015.
12. Raptis et al., "Total Ozone Column Measurements using an Ultraviolet Multifilter Radiometer", **Inter. J. of Rem. Sens.**, 36:17, 4469-4482, DOI: 10.1080/01431161.2015.1083631, 2015.
13. Voloudakis et al., "Prediction of climate change impacts on cotton yields in Greece under eight climatic models using the AquaCrop crop simulation model and discriminant function analysis". **Agricultural Water Management**, 147, 116-128, 2015.
14. Wagner et al., "Evaluation of the MACC operational forecast system potential and challenges of global near-real-time modelling with respect to reactive gases in the troposphere", **Atmos. Chem. Phys.**, 14005-14030, <http://www.atmos-chem-phys.net/15/14005/2015/>, doi: 10.5194/acp-15-14005-2015.
15. Eleftheratos et al., "Ozone and spectroradiometric UV changes in the past 20 years over middle and high latitudes", **Atmosphere-Ocean**, doi: 10.1080/07055900.2014.919897, 2014.
16. Isaksen et al., "Atmospheric Ozone and Methane in a Changing Climate", **Atmosphere**, 5, 518-535; doi:[10.3390/atmos5030518](https://doi.org/10.3390/atmos5030518), 2014.
17. Kourtidis et al., "Severe particulate pollution from the deposition practices of the primary materials of a cement plant", **Environ. Science & Poll. Res.**, doi: 10.1007/s11356-014-2696-6, 2014.
18. Poupkou et al., "A modeling study of the impact of the 2007 Greek forest fires on the gaseous pollutant levels in the Eastern Mediterranean", **Atmosph. Res.**, 148, 1-17, 2014.
19. Zerefos et al., "Evidence for an earlier greenhouse cooling effect in the stratosphere before the 1980s over the Northern Hemisphere", **Atmos. Chem. Phys.**, 14, 7705-7720, 2014.
20. Zerefos et al., "Further evidence of important environmental information content in red-to-green ratios as depicted in paintings by great masters", **Atmos. Chem. Phys.**, 14, 2987-3015, 2014. *Selected as "Research Spotlight" by the Editors of the Journal.*
21. Aggelis et al., "Mapping of surface ozone seasonality and trends across Europe during 1997-2006 through kriging interpolation to observational data», **Water, Air & Soil Poll.**, Vol. 224 (4), art. no. 1501, doi: 10.1007/s11270-013-1501-9, 2013.
22. Eleftheratos et al., "Ozone variations derived by a chemical transport model", **Water, Air & Soil Poll.**, Vol. 224 (6), art. no. 1585, 2013.
23. Inness and the MACC team: The MACC reanalysis: an 8 yr data set of atmospheric composition, **Atmos. Chem. Phys.**, 13, 4073-4109, doi:10.5194/acp-13-4073-2013, 2013.
24. Mitsakis et al., "An integrated framework for linking climate change impacts to emergency adaptation strategies for transport networks", **Eur. Transp. Res. Rev.**, 6:103-111, doi: 10.1007/s12544-013-0114-0, 2013.
25. Vrekoussis et al., "Economic Crisis Detected from Space: Air Quality observations over Athens/Greece", **GRL**, Vol. 40, 1-6, doi: 10.1002/grl.50118, 2013.
26. Amiridis et al., "Impact of the 2009 Attica wild fires on the air quality in urban Athens", **Atmos. Envir.**, doi: 10.1016/j.atmosenv.2011.07.056, 2012.

27. Isaksen et al., "Attribution of the Arctic ozone column deficit in March 2011", **Geophys. Res. Lett.**, Vol. 39, L24810, doi:10.1029/2012GL053876, 2012.
28. Zerefos et al., "Evidence of a possible turning point in solar UV-B over Canada, Europe and Japan", **Atmos. Chem. Phys.**, 12, 2469–2477, 2012.
29. Zyryanov et al., "3-D evaluation of tropospheric ozone simulations by an ensemble of regional Chemistry Transport Model", **Atmos. Chem. Phys.**, 12, 3219-3240, 2012.