

**The Professor's scientific fields of interests are** Geoinformation technologies for high resolution spatial analysis of greenhouse gas emissions at the level of point-, line-, and area-type emission sources; methods and GIS technologies for spatial inventories of carbon dioxide, methane, nitrous oxide and other greenhouse gases at the national, regional and local levels, particularly in the sectors of energy, industry, transport, agriculture, forestry and land use change; uncertainty analysis in greenhouse gas inventories; gridded inventories and mapping greenhouse gas emissions; usage of remote sensing data for calibration of bottom-up inventories of greenhouse gases.

**The Professor's research project contribution:**

Austrian-Ukrainian project: "Retrospective analysis of Ukraine's and Austria's greenhouse gas emission inventories: Supporting decision-making for compliance with the Paris Climate Agreement" (2019-2020; scientific leader)

Austrian-Ukrainian project: "Spatio-temporal uncertainty assessment of GHG emission inventories with the specific focus on Austria and Ukraine: Learning in space and time and into the future" (2015-2016; project leader)

Ukrainian-Chinese project: "Spatial inventory of greenhouse gases in residential sector for Chinese and Ukrainian regions to support the effective economic and administrative decision making" (2013-2014; scientific leader)

Grant of EU 7FP "Geoinformation technologies, spatio-temporal approaches, and full carbon account for improving accuracy of GHG inventories" (Marie Curie Project n°247645 FP7-PEOPLE-2009-IRSES) (2010-2014; project co-leader)

Project of the Ministry of Education and Science of Ukraine: "GIS technologies for analysis of sinks and emissions of greenhouse gases in forestry sector for supporting decision-making" (2013-2014; project leader)

Project of the Ministry of Education and Science of Ukraine: "Geoinformation technologies to build regional cadastres of greenhouse gas emissions to support the effective economic and administrative decisions making" (2011-2012; project leader)

Ukrainian-Austrian project: „A cadastre for spatially resolved GHG emissions and their uncertainties" (2011-2012; project leader)

Ukrainian-Austrian project: "Towards a spatially referenced inventory of Kyoto GHG emissions and their uncertainties" (2009-2010; project leader)

## **Publications:**

### BOOKS

Bun R., Charkovska N., Danylo O., Topylko P., Halushchak M., Nahorski Z., Horabik-Pyzel J. Spatial modeling of greenhouse gas emissions from stationary sources, Lviv, PP Soroka T.B. Publ., 2016, 480 pp. ISBN 978-966-2598-74-2

Ometto J.P., Bun R., Jonas M., Nahorski Z. (Eds.) Uncertainties in Greenhouse Gas Inventories - Expanding Our Perspective, Springer 2015, 239 pp. ISBN 978-3-319-15900-3 DOI: 10.1007/978-3-319-15901-0

Bun R., Boychuk Kh., Bun A., Lesiv M. Information technologies for spatial inventory of greenhouse gases in energy sector and uncertainty analysis, Lviv, PP Soroka T., 2012, 464 p. ISBN 978-966-259-800-1

Bun R., Shpak N., Matolych B., Boychuk Kh., Dmytriv K., Yaremchyshyn O. Information technologies for creation of cadastre of greenhouse gas emissions of Lviv region, Lviv, „Ukrpol” Publishing House, 2010, 272 pp. ISBN 978-966-89-55-25-9

### ARTICLES

Oda T., Haga C., Hosomi K., Matsui T., Bun R. Errors and uncertainties associated with the use of unconventional activity data for estimating CO<sub>2</sub> emissions: the case for traffic emissions in Japan. Environmental Research Letters, 2021, vol. 16, Is. 8, 084058. DOI: 10.1088/1748-9326/ac109d

Kinakh V., Oda T., Bun R., Novitska O. Mitigating geolocation errors in nighttime light satellite data and global CO<sub>2</sub> emission gridded data. Mathematical Modeling and Computing, 2021, vol. 8, Is. 2, pp. 304-316. DOI: 10.23939/mmc2021.02.304

Kinakh V., Oda T., Bun R. Formulating a geolocation bias correction for DMSP nighttime lights of global cities. Advances in Intelligent Systems and Computing V, N.Shakhovska and M.O.Medykovskyy (Eds.): 2021, vol. 1293, pp. 383-398. DOI:10.1007/978-3-030-63270-0\_25

Fiehn A., Kostinek J., Eckl M., Klausner T., Galkowski M., Chen J., Gerbig C., Röckmann T., Maazallahi H., Schmidt M., Korben P., Necki J., Jagoda P., Wildmann N., Mallaun C., Bun R., Nickl A.-L., et al. Estimating CH<sub>4</sub>, CO<sub>2</sub>, and CO emissions from coal mining and industrial activities in the Upper Silesian Coal Basin using an aircraft-based mass balance approach, Atmospheric Chemistry and Physics, 2020, 20(21), 12675-12695. DOI: 10.5194/acp-20-12675-2020

Gaughan A.E., Oda T., Sorichetta A., Stevens F.R., Bondarenko M., Bun R., Krauser L., Yetman G., Nghiem S.V. Evaluating nighttime lights and population distribution as proxies for mapping anthropogenic CO<sub>2</sub> emission in Vietnam, Cambodia and Laos. Environmental Research Communication, 2019, 1(9):91006, 15 p. DOI: 10.1088/2515-7620/ab3d91

Oda O., Bun R., Kinakh V., et al. Errors and uncertainties in a gridded carbon dioxide emissions inventory. Mitigation and Adaptation Strategies for Global Change, 2019, Vol. 24, Is. 6, pp. 1007-1050. DOI: 10.1007/s11027-019-09877-2

Gaughan A.E., Oda O., Sorichetta A., Stevens F.R., Bondarenko M., Bun R., Krauser L., Yetman G., Nghiem S.V. Evaluating nighttime lights and population distribution as proxies for mapping

anthropogenic CO<sub>2</sub> emission in Vietnam, Cambodia and Laos. *Environmental Research Communication*, 2019, 1(9):91006. 15 p. DOI: 10.1088/2515-7620/ab3d91

Jonas M., Bun R., Nahorski Z., et al. Quantifying greenhouse gas emissions. *Mitigation and Adaptation Strategies for Global Change* (Springer), 2019, Vol. 24, Is. 6, pp. 839-852. DOI: 10.1007/s11027-019-09867-4

Danylo O., Bun R., See L., Charkovska N. High resolution spatial distribution of greenhouse gas emissions in the residential sector. *Mitigation and Adaptation Strategies for Global Change* (Springer), 2019, Vol. 24, Is. 6, pp. 941-968. DOI: 10.1007/s11027-019-9846-z

Charkovska N., Halushchak M., Bun R., et al. A high-definition spatially explicit modeling approach for national greenhouse gas emissions from industrial processes: Reducing the errors and uncertainties in global emission modelling. *Mitigation and Adaptation Strategies for Global Change* (Springer), 2019, Vol. 24, Is. 6, pp. 907-939. DOI: 10.1007/s11027-018-9836-6

Borodatyi P., Bun R. Geoinformation technology for cloudiness analysis on the territory of Western Ukraine using satellite images. *Bulletin of Lviv Polytechnic National University: Information Systems and Networks*, 2018, Is. 887, pp. 31-42.

Lesiv M., Schepaschenko D., Moltchanova E., Bun R., et al. Spatial distribution of abandoned land in former Soviet Union Countries, *Scientific Data*, 5:180056. DOI: 10.1038/sdata.2018.56

Bun R., Nahorski Z., Horabik-Pyzel J., et al. Development of a high resolution spatial inventory of GHG emissions for Poland from stationary and mobile sources, *Mitigation and Adaptation Strategies For Global Change* (Springer), 2019, Vol. 24, Is. 6, pp. 853-881. DOI: 10.1007/s11027-018-9791-2

Charkovska N., Horabik-Pyzel J., Bun R., et al. High resolution spatial distribution and associated uncertainties of greenhouse gas emissions from the agricultural sector. *Mitigation and Adaptation Strategies for Global Change*, 2019, Vol. 24, Is. 6, pp. 881-905. DOI: 10.1007/s11027-017-9779-3

Kinakh V., Bun R., Danylo O. Geoinformation technology for analysis and visualisation of high spatial resolution greenhouse gas emissions data using a cloud platform. *Advances in Intelligent Systems and Computing II*, vol. 689, Springer, 2018, pp. 217-229. DOI 10.1007/978-3-319-70581-1\_15

Halushchak M., Bun R., Shpak N., Valakh M. Modeling and spatial analysis of greenhouse gas emissions from fuel combustion in the industry sector in Poland, *Econtechmod*, 2016, vol. 5, is. 1, pp. 19-26. ISSN 2084-5715

Danylo O., Buń R., Tymków P. Geospatial modeling of greenhouse gas emissions in the residential sector: A comparison of Western Ukraine and South-Eastern Poland, *Geodesy, Cartography and Aerial Photography*, 2015, n. 81, pp. 131-141. ISSN 0130-1039

Charkovska N.V., Bun R.A., Nahorski Z., Horabik J. Modelling GHG emissions in the mineral products industry in Poland: An uncertainty analysis, *Mathematical Modeling and Computing*, 2015, vol. 2, is. 1, pp. 16-26. ISSN 2312-9794

Halushchak M., Bun R. Spatial modeling and analysis of processes of greenhouse gas emissions from extraction and processing of coal in Poland, *Journal of Lviv Polytechnic National University: Information Systems and Networks*, 2015, vol. 814, pp. 434-443. ISSN 0321-0499

Danylo O., Xu Xiangyang, Bun R., Lesiv M. Modeling greenhouse gas emissions in the residential sector of Western Ukraine using GIS, *Journal of the Lviv State University of Life Safety*, 2014, n. 9, pp. 130-136. ISSN 2078-4643

Ometto J.P., Bun R., Jonas M., Nahorski Z., Gusti M. Uncertainties in greenhouse gases inventories – expanding our perspective, *Climatic Change*, 2014, vol. 124, is. 3, pp. 451-458. ISSN: 0165-0009 DOI: 10.1007/s10584-014-1149-5

Boyчук Kh., Bun R. Regional spatial inventories (cadastres) of GHG emissions in Energy sector: Accounting for uncertainty, *Climatic Change*, 2014, vol. 124, is. 3, pp. 561-574. ISSN: 0165-0009 DOI: 10.1007/s10584-013-1040-9

Charkovska N., Bun R. Modeling and spatial analysis of GHG emission in chemical industry of Poland, *Modeling and Information Technology*, 2013, n. 69, pp. 118-125. ISSN 2309-7647

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Jonas M., Marland G., Winiwarter W., White T., Nahorski Z., Bun R., Nilsson S. Benefits of dealing with uncertainty in greenhouse gas inventories: introduction, *Climatic Change*, Springer Netherlands, 2010, vol. 103, is. 1, pp. 3-18. ISSN: 0165-0009 DOI: 10.1007/s10584-010-9922-6

#### **The Professor's international conferences contribution:**

Oda T., Gensheimer J., Haga C., Hosomi K., Matsui T., Bun R., Turner A.J., et al. Errors and uncertainties associated with mobility and traffic activity data for estimating fossil fuel CO<sub>2</sub> emissions during the COVID-19 pandemic. *Atmospheric Chemistry from a Distance: Real Progress through Virtual Interaction: 16th IGAC Science Conference*, September 12-20, 2021, Boulder, USA.

Oda T., Haga C., Hosomi K., Matsui T., Bun R. Assessing errors and biases in proxy-based low latency traffic CO<sub>2</sub> emission estimates. *Virtual Global Monitoring Annual Conference (eGMAC)*, May 24-28, 2021, Boulder, US.

Kinakh V., Oda T., Bun R. Algorithms for analysis of geolocation error of nightlight satellite data and greenhouse gas data calculated on their basis. *2020 IEEE 15th International Conference on*

Computer Science and Information Technologies (CSIT-2020), September 23-26, 2020, Lviv-Zbarazh, Ukraine.

Bun R. Transport sector and environmental impact: spatial analysis of greenhouse gas emissions in Poland. Proceedings of the 35<sup>th</sup> International Business Information Management Association Conference (IBIMA-2020), April 1-2, 2020, Seville, Spain.

Oda T., Bun R., Feng S., Lauvaux T., et al. Assessing errors and uncertainties in downscaled subnational fossil fuel CO<sub>2</sub> emission estimates. 7<sup>th</sup> North American Carbon Program (NACP) Open Science Meeting, NACP'2020, March 23-26, 2020, McLean, Virginia, US.

Fiehn A., Kostinek J., Eckl M., Galkowski M., Chen J., Gerbig C., Röckmann T., Maazallahi H., Schmidt M., Korben P., Necki J., Wildmann N., Mallaun C., Klausner T., Bun R., Fix A., Roiger A. Emissions of CH<sub>4</sub>, CO<sub>2</sub>, C<sub>2</sub>H<sub>6</sub>, CO and isotopic signatures in the Upper Silesian Coal Basin, Poland. EGU General Assembly 2020, May 4–8, 2020, Vienna, Austria.

Oda T., Bun R., Román M., Wang Z., et al. Downscaling fossil-fuel CO<sub>2</sub> emissions to policy relevant scales: Current errors and biases, expected improvements, and future perspectives. EGU General Assembly 2020, May 3-8 May, 2020, Vienna, Austria.

Oda T., Roman M.O., Shrestha R., Wang Z., Bun R., Lauvaux T., et al. Mapping carbon dioxide emissions from global cities using nightlight lights observed from Space. American Association of Geographers Annual Meeting, April 6-10, 2020, Denver, CO, US.

Gaughan A.E., Oda T., Sorichetta A., Stevens F.R., Bondarenko M., Bun R., et al. Evaluating nighttime lights and population distribution as proxies for mapping anthropogenic CO<sub>2</sub> emission in Vietnam, Cambodia and Laos. AGU Fall Meeting 2019, December 9-13, 2019, San Francisco, US.

Gaughan A.E., Oda T., Sorichetta A., Stevens F.R., Krauser L., Yetman G., Bun R., Bondarenko M., Nghiem S.V. Evaluation of gridded CO<sub>2</sub> emissions from night-time lights compared with geospatially-derived population distributions for Vietnam, Cambodia and Laos. 2019 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), July 28 – August 02, 2019, Yokohama, Japan.

Oda T., Bun R., Kinakh V., et al. Assessing errors and uncertainties in a global high-resolution fossil fuel CO<sub>2</sub> emission dataset. 15th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-15). June 3-5, 2019, Hokkaido, Japan, pp. 97-98.

Gaughan A., Sorichetta A., Stevens F., Krauser L., Oda T., Yetman G., Bun R., Nghiem S. High resolution mapping of gridded CO<sub>2</sub> emissions to population distribution for Vietnam, Cambodia and Laos. 4th Open Science Meeting of the Global Land Programme, April 24-26, 2019, Bern, Switzerland.

Sorichetta A., Gaughan A., Stevens F., Krauser L., Yetman G., Oda T., Bun R. South-East Asia population and CO<sub>2</sub> emission mapping. 4th Open Science Meeting of the Global Land Programme, April 24-26, 2019, Bern, Switzerland.

Oda T., Bun R., Kinakh V., et al. Assessing errors and uncertainties in subnational fossil fuel CO<sub>2</sub> emission estimates: A case for ODIAC. European Geosciences Union General Assembly 2019 (EGU), Vienna, Austria, 7-12 April 2019, Geophysical Research Abstracts, Vol. 21, EGU2019-10195-1, 2019 EGU General Assembly.

Oda T., Lauvaux T., Maksyutov S., Roman M., Wang Z., Feng S., Bun R., Kinakh V., Ott L., Pawson S. U.S. cities in the dark: Mapping human carbon dioxide emissions using observations from space // American Association of Geographers (AAG) Annual Meeting 2019, April 3-7, 2019, Washington DC

Oda T., Bun R., Kinakh V., et al. The use of gridded fossil fuel carbon dioxide emissions inventory for climate mitigation applications: Errors, uncertainties, and current and future challenges. 2018 AGU Fall Meeting, Washington, 10-14 Dec. 2018.

Oda T., Maksyutov S., Ott L., Roman M., Wang Z., Lauvaux T., Feng S., Newman S., Bun R., Nghiem S., Pawson S. Mapping man-made carbon emissions using observations from space, Proc. of the 42nd Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events, "COSPAR 2018", 14-22 July 2018, Pasadena, CA, USA.

Oda T., Maksyutov S., Ott L.E, Roman M.O., Wang Z., Lauvaux T., Feng S., Newman S., Bun R., Pawson S. The ODIAC – A global monthly high-resolution fossil fuel CO<sub>2</sub> emissions data product for tracer transport simulations and surface flux inversions. 14th International Workshop on Greenhouse Gas Measurements from Space (IWGGMS-14), Toronto, Canada, 2018 May 8-10.

Oda T., Maksyutov S., Ott L.E., Roman M.O., Wang Z., Lauvaux T., Feng S., Newmann S., Bun R., Pawson S. The ODIAC – Space-based mapping of fossil fuel carbon dioxide emissions in support of carbon cycle sciences and climate mitigation. European Geosciences Union General Assembly 2018, Vienna, Austria, 8-13 April 2018, Geophysical Research Abstracts, Vol. 20, EGU2018-5552, 2018 EGU General Assembly.

Kinakh V., Bun R., Danylo O. Geoinformation technology of analysis and visualization of spatial data on greenhouse gas emissions using Google Earth Engine, Proceedings of the 12th International Scientific and Technical Conference on Computer Sciences and Information Technologies, CSIT 2017, Lviv, Vezha&KO, 2017, pp. 212-215.

Kinakh V., Bun R., Danylo O. Geoinformation technology of analysis and visualization of spatial data on greenhouse gas emissions using Google Earth Engine, Proc. of the XIIth International Scientific and Technical Conference 'Computer Science and Information Technologies (CSIT'2017), Lviv, Vezha&KO, 2017, pp. 212-215. ISBN 978-1-5386-1638-3

Bun R., Nahorski Z., Horabik-Pyzel J., Danylo O., Charkovska N., Topylko P., Halushchak M., Lesiv M., Striamets O. High resolution spatial inventory of GHG emissions from stationary and mobile sources in Poland: summarized results and uncertainty analysis, 4th International Workshop on Uncertainty in Atmospheric Emissions, 7–9 October 2015, Kraków, Poland: Proceedings, Warszawa, SRI PAS, 2015, pp. 41-48. ISBN 83-894-7557-X

Charkovska N., Bun R., Danylo O., Horabik-Pyzel J., Jonas M. Spatial GHG inventory in the Agriculture sector and uncertainty analysis: A case study for Poland, 4th International Workshop on Uncertainty in Atmospheric Emissions, 7–9 October 2015, Kraków, Poland: Proceedings, Warszawa, SRI PAS, 2015, pp. 16-24. ISBN 83-894-7557-X

Danylo O., Bun R., See L., Topylko P., Xu Xiangyang, Charkovska N., Tymków P. Accounting uncertainty for spatial modeling of greenhouse gas emissions in the residential sector: fuel combustion and heat production, 4th International Workshop on Uncertainty in Atmospheric Emissions, 7–9 October 2015, Kraków, Poland: Proceedings, Warszawa, SRI PAS, 2015, pp. 193-200. ISBN 83-894-7557-X

Topylko P., Halushchak M., Bun R., Oda O., Lesiv M., Danylo O. Spatial greenhouse gas (GHG) inventory and uncertainty analysis: A case study for electricity generation in Poland and Ukraine, 4th International Workshop on Uncertainty in Atmospheric Emissions, 7–9 October 2015, Kraków, Poland: Proceedings, Warszawa, SRI PAS, 2015, pp. 49-56. ISBN 83-894-7557-X

Charkovska N., Halushchak M., Bun R., Jonas M. Uncertainty analysis of GHG spatial inventory from the industrial activity: A case study for Poland, 4th International Workshop on Uncertainty in Atmospheric Emissions, 7–9 October 2015, Kraków, Poland: Proceedings, Warszawa, SRI PAS, 2015, pp. 57-63. ISBN 83-894-7557-X

Charkovska N.V., Bun R.A. Mathematical modeling and spatial analysis of GHG emissions processes from Agriculture sector of Poland, International Conference and Early Carriere Scientists School on Environmental Observations, Modeling and Information Systems (ENVIROMIS-2014), Tomsk, Russia Federation, SCERT, 2014, pp. 76-80. ISBN 978-5-89702-362-2