

# INSIDER

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**INCAS young researchers  
involved in the EUCLID  
mission**

SPACE

**The 38th "Caius Iacob"  
Conference**

EVENT

**Advanced Materials, a future  
solution for a new aerospace  
reality**

RESEARCH



**INCAS**

National Institute for Aerospace Research "Elie Carafoli" - INCAS Bucharest



## ROME0 – mitigation steps on global climate changes

Mitigation of climate change is a key scientific and societal challenge. The 2015 United Nations Climate Change Conference in Paris (COP21) agreed to limit global warming “well below” 2 degrees Celsius and, if possible, below 1.5 degrees Celsius. Reaching this target requires massive reductions of greenhouse gas emissions, far beyond the Intended Nationally Determined Contributions. MEMO<sup>2</sup> (MEthane goes MObile – MEasurements and MOdelling), a European Training Network (MSCA-ETN) with more than 20 collaborators from 7 countries, will contribute to this goal with a focus on methane (CH<sub>4</sub>), one of Europe’s most important sources of energy. CH<sub>4</sub> emissions are a major contributor to Europe’s global warming impact, but Europe’s CH<sub>4</sub> emissions are not well quantified. Effective emission reduction can only be achieved if sources are properly quantified, and mitigation efforts are verified.

Scientific focus will be on the local and regional emissions in various regions of Europe, because this is the scale where emission reductions happen. However, such reductions are at present mostly reported by bottom-up assessment, but not independently confirmed by top-down measurements and models. The main scientific goal of MEMO<sup>2</sup> is to develop and apply innovative experimental and modelling tools, based on recently developed mobile analyzers, on state-of-the-art isotope techniques, and on a hierarchy of models, including newly developed high-resolution dispersion

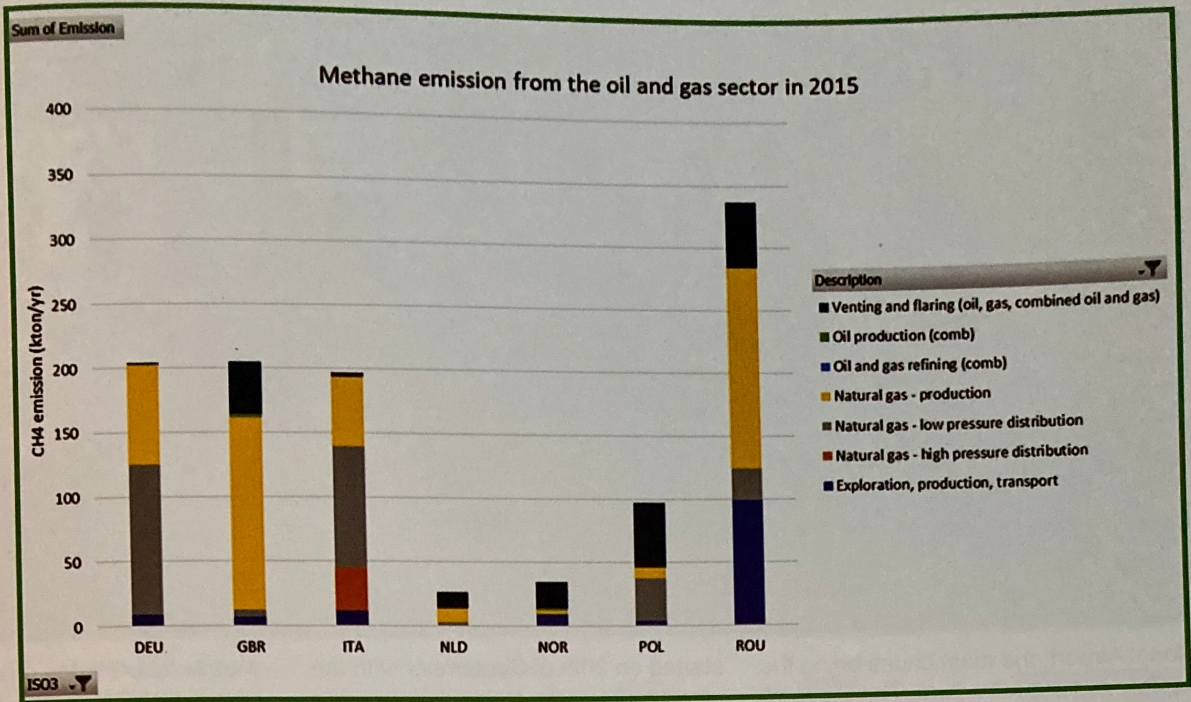
models, to identify and quantify CH<sub>4</sub> emissions from local sources in Europe and use these updated emissions to improve estimates at the European scale.

A dedicated training program includes original actions to reinforce the autonomy (learning-by-doing approaches) and the maturity (student autonomous virtual network) of the MEMO<sup>2</sup> early stage researchers (ESRs). This ensemble of training actions will help them to refine their career plan, either within the scientific community, or in the non-academic sector. MEMO<sup>2</sup> will facil-

itate intensive collaboration between the largely academic greenhouse gas monitoring community and non-academic partners who are responsible for evaluating and reporting greenhouse gas emissions to policy makers.

According to UNFCCC statistics, Romania is one of the European countries that reported highest emissions of CH<sub>4</sub> from the oil and gas sector to the atmosphere, in particular related to CH<sub>4</sub> production and end use. However, the estimates reported by Romania are derived using non-country-specific emission factors (Tier 1 emission

Detailed CH<sub>4</sub> emissions from the Oil & Gas sector for selected countries for 2015 based on the TNO GHGv1.1 inventory. The TNO GHGv1.1 inventory is a recent inventory prepared by TNO in support of the H2020 projects VERIFY and CHE. The methane emissions shown here are based on the National Inventory Reports for 2015 submitted to UNFCCC in 2017. The X axis shows Germany, UK, Italy, Netherlands, Norway, Poland, Romania. Note that emissions from coal production are not shown. The Y axis shows the CH<sub>4</sub> emissions in ktCO<sub>2</sub>e per year.



factors), and there are only very few observations which investigate whether the reported emissions are realistic. Within MEMO<sup>2</sup>, such measurements are provided by our campaign, which we call ROMEO (Romanian Methane Emissions from Oil & gas). They will result in a better experimental quantification of CH<sub>4</sub> emissions from the oil and gas sector in Romania and can help in devising emission mitigation strategies. This is an important issue, not only in this region but globally. If we want the Paris Agreement to succeed and reduction policies being realistic, we urgently need a much better knowledge and much more accurate budgets combining bottom-up and top-down quantification, which is the main goal of the joint campaign in Romania: con-

tributing to those quantifications by not only inventory statistics but quantification on a national and local scale.

ROMEO includes 12 research institutes from 9 EU countries, one American team and three leading Romanian research institutes - the National Institute for Aerospace Research "Elie Carafoli" (INCAS), the National Institute of research and development for optoelectronics (INOE), and the Babeş-Bolyai University in Cluj-Napoca. The main objective is to quantify CH<sub>4</sub> emissions from individual oil and gas production facilities, as well as the integrated CH<sub>4</sub> emission of production basins by atmospheric measurements. The information about CH<sub>4</sub> emissions obtained from ROMEO are

relevant for future climate mitigation policy in Romania and also in the EU with respect to the goals of the 2015 UNFCCC Paris agreement.

INCAS made an important statement at international level with respect to global climate changes by supporting the development and implementation of ROMEO campaign, an extended research campaign having as main objective the quantification of methane emission from individual oil and gas production facilities, as well as the integrated CH<sub>4</sub> emission of production basins through atmospheric measurements. For this purpose, a combined bottom-up and top-down approach was proposed, at three different scales - basin scale, well scale and city scale and a unique infrastructure was employed, that included mobile laboratories, drone and aircrafts fully equipped with sensitive instrument able to collect accurate data sets.

As local co-organizer of ROMEO campaign, INCAS had a glimpse in August, and then in September during city campaign that took place in Bucharest (19th-30th August) and Ploiesti (2nd - 5th September). In the case of Bucharest, three mobile laboratories were used, equipped with sensitive methane and ethane analyzers correctly calibrated for reliable and comparable measurement results and to ensure both a representative coverage and a data sets and samples collection (61 samples further analyzed by Royal Holloway University London - RHUL). During the samplings, an important leakage has been detected, in the proximity of Băneasa Interna-





tional Airport, the main cause being the distribution infrastructure. The research team contacted the distribution company and together sampled the leakage and concluded that rehabilitation of the infrastructure is requested. The instruments used by research group are more sensitive than the ones used by the distribution company, that performs regular checks. In the case of Ploiești, the city was covered almost entirely in only three days of sampling and another 6 samples were also sent to RHUL for analysis. In both cities, the main challenge was represented by infrastructure with tinny streets and one way direction.

Starting with the last week of September, INCAS's research base from Strejnicu Airfield became central core of the October campaign. The activities

started on 30th of September with the preparation of the mobile laboratories, calibration of the instruments and inter-comparisons, general meetings with all the participants for tasks distribution.

In comparison with city campaign, the October campaign involved more participants – 12 research teams, about 70 people from 20 nations, as well as additional infrastructures, e.g., several setups for mobile laboratories and airborne platforms – both manned and unmanned. The participants (2/3 of them directly working in the field and the others supporting the measurement teams) were grouped in two main teams: aircraft team that included INCAS and Scientific Aviation and ground-based teams (East and West). Each ground team includes 5

mobile laboratories driving around and measuring CH<sub>4</sub> using different methods such as drive-by and OMT 33A, and two drones that are performing flights from 3 meters up to 32 meters of altitude.

**Ground-based team East** including researchers from University of Groningen (UG), University of Utrecht (UU), Netherlands Organization for Applied Scientific Research (TNO), Technical University of Denmark (DTU), Babes-Boylai University (UBB) and INCAS focused sampling in area 7 - Ploiești, 6- Târgoviște and 8 - Urziceni, with additional sampling in area 5a – Teleorman / Siliștea Gumești.

**Ground-based team West** including researchers from University of Heidelberg (UHEI), AGH University of Science and Technology (AGH), EMPA - Swiss Federal Laboratories for Materials Science and Technology (EMPA), University of Utrecht (UU), Babes-Boylai University (UBB) and INCAS, focused on sampling in area 4 – Craiova, 2 – Pitești and 5a – Teleorman / Siliștea Gumești, with additional sampling of team AGH and UBB in specific areas of Transylvania. As a short remark, each mobile laboratory has travelled more than 2700km, during more than 15 days of measurements, having sampled around 2000 wells.

With respect to aerial operations, both teams (Science Aviation and INCAS) performed several research flights, the main challenge in this case being the wind speed and direction. For this campaign, INCAS aircraft performed low-altitude raster flights to investigate the spatial distribution of methane





plumes. The Science Aviation aircraft performed 10 upwind and downwind flights including mass balance and facility level quantification over specific areas.

During the campaign, the research teams had the support of oil companies (OMV Petrom) that provided coordinates for several thousands of interest locations and access to some selected ones. Also, the distribution companies were open for collaboration with the research teams.

As a conclusion, ROMEO campaign has been a success, as it was confirmed by Mr. Manfredi Caltagirone, Programme Management Officer at United Nations – Environment Programme in an open letter addressed to INCAS.

