Faculty of Science and Engineering

Profile report: Atmospheric Composition: Greenhouse gases and Hydrogen / Atmosferische samenstelling: broeikasgassen en waterstof

- Discipline: Atmospheric composition
- Level: Assistant professor
- Focus: Research
- Fte: 0,8-1,0 fte

1. Scientific discipline

The field is about the cycling of climate-relevant gases (CO_2, CH_4, N_2O, and also H_2) between the atmosphere and other reservoirs (ocean and terrestrial biosphere, but also chemical reactions and storage) using atmospheric observations and modelling of atmospheric (trace) gas concentrations. Aim of the research is to better understand and quantify the relevant fluxes and sources and sinks of various (anthropogenically enhanced) direct and indirect greenhouse gases on various spatial scales. The work is motivated by effectively contributing to emission reduction, and by stimulating the -correct- use of hydrogen for the energy transition.

2. Vacancy

This position is opened by the board of the Faculty of Science and Engineering in the context of the national 'Sectorplans' Earth and Environmental Sciences (AMW). The position will be embedded in the institute ESRIG, base unit CIO. The position falls within the framework of the faculty's Career Paths in Science and Engineering. As the focus domain of the position is research, the criteria of the career path with a focus on research apply. Please see the link for more information.

3. Selection committee (BAC)

Prof. Nasser Kalantar-Nayestanaki, Director of ESRIG, Chair
Dr. Franco Ruzzenenti, Director Education of ESRIG
Prof. Ulrike Dusek (CIO)
Prof. Harro A.J. Meijer (chair of CIO)
Prof. Wouter Peters (Wageningen University and Research, and CIO)
Dr. Ingrid T. Luijkx (Wageningen University and Research)
Student Master Program Energy and Environmental Sciences, to be appointed

Advisors: Dr. H.A.(Bert) Scheeren (CIO)
Ms. Dorien Smit (HR)

4. Area of expertise

The successful candidate will be responsible for the continuation and innovation of the existing observational efforts of the CIO in the field of atmospheric greenhouses gases, including the indirect greenhouse gas hydrogen (taken together as (i)GHG's), and related tracers. Efforts worldwide are directed towards both insight into the various processes that govern the exchange between the different reservoirs (including chemical degradation), and quantification of the sources and sinks. Specifically in the case of hydrogen still much is unknown about the size and behaviour of both the anthropogenic sources ('leaks') and natural sinks, especially the soil. The research is both scientifically and societally driven, the latter in connection with concerns about the human forcing of climate change, and the energy transition. An example of the latter is improving the quantification of industrial emissions using local observations and inverse Gaussian or Large Eddy Simulation tools.

The CIO's observational programme includes in the first place the atmospheric monitoring station Lutjewad on the Dutch Wadden Sea coast. This station is an ICOS class 2 station for greenhouse gases (CO_2, CH_4, N_2O, SF_6 and in addition CO), with many additional observations, such as a $^{14}CO_2$ program, continuous CO_2 stable isotopes monitoring (including ^{17}O excess), continuous hydrogen, and Radon. Lutjewad is also an aerosol monitoring station. For both the gas and aerosol phase, Lutjewad is one of the three stations in the Netherlands of the national Ruisdael Observatory. Through this program, CIO scientists also perform measurements at other stations in the Netherlands. In addition, flask samples are taken from various places on earth (including for example Antarctica for 2017-2021) and analysed at our well-equipped laboratories. Field campaigns are regularly organised, in the framework of projects, or motivated by a PhD project.

The 'active aircore' system developed at CIO, together with the availability of UAV's ('drones') enables spatially resolved sampling in the vicinity of (potential) sources of (i)GHG's. The CIO was the first group that, with this technique, could determine H_2 emissions from a chemical industry park. Further developments around hydrogen (such as putting hydrogen isotope measurements to use) are ongoing.

The successful candidate will be able to use the above possibilities in innovative ways, and alter and extend them where she deems useful.

The successful candidate has a broad overview over the whole field, as well as a clear "road map" for her own research that will lead to world class, original contributions in peer-reviewed journals. She must identify the optimal way of making full use of all the observational possibilities. As interaction with modelling efforts is important, the candidate can develop her own modelling efforts, and/or collaborate with our partners at the university of Wageningen, or elsewhere.

5. Embedding: institute (and base unit)

The position is embedded in ESRIG and is in the field of atmospheric greenhouse gases, hydrogen and related tracers. The groups within ESRIG are: Centre for Isotope Research (CIO), the Centre for Energy and Environmental Sciences, Geo-Energy, Energy Conversion, Biomimetics and Nuclear Energy. The candidate is embedded in CIO, a group (chair: Prof. Harro Meijer) with three senior scientists, some 15 PhD employees and a large group of technicians and chemical analysts. Instrumentation includes an AMS (Micadas), several IRMS's (a.o. Elementar PrecisIon), a variety of atmospheric mixing ratio instruments (Picarro, Aerodyne, LiCor), optical isotope instruments (Aerodyne, LGR) and GC and EA peripherals. There is a professional in-house production line for active aircores with add-ons, and there are several UAV's available, with qualified pilots. In addition to this, there is also an aerosol lab, for isotope analysis in carbonaceous aerosol.
Within ESRIG, there are several lines of collaboration connected to the energy transition: with the energy conversion and geo-energy groups about hydrogen production, use, storage etc. CIO's side of the work is about (reduction of) emissions to the atmosphere that these activities cause.

6. Local and (inter)national position

Collaborations outside ESRIG, within the faculty, are at the moment connected to CIO's hydrogen emission and hydrogen isotope capabilities. The university's Wubbo Ockels School for Energy and Climate brings groups together from the various disciplines within the university (Law, Economics, Spatial Science, Psychology and Natural Sciences and Engineering) with 'energy transition' as key word.
Nationally, all groups (both academic and institutional) with atmosphere-related research collaborate in the large-scale-infrastructure project Ruisdael. Station Lutjewad is one of the key observational points for this collaboration. With Wageningen University and Research (WUR) there is a long-standing collaboration, successfully combining CIO's observational and WUR's modelling strengths.
Internationally, the CIO is member of the European ICOS network (Lutjewad is a class 2 station). Furthermore, the CIO has been involved for decades in the expert group for stable isotope reference materials, coordinated by the IAEA. As one of the expert labs, CIO has been and still is involved in a series of EURAMET EC projects on reference gases for isotopes in atmospheric CO_2.
Through two so-called Just Transition Fund subsidies (EC funding for regions especially vulnerable to the energy transition), CIO has acquired substantial funding for atmospheric H_2 studies. Collaboration with industry (motivated by interest by industry for emission reduction) is leading to financing successful projects.
Several other EU and national projects around CH_4 sources and sinks have been acquired. Among the most spectacular ones are stratospheric balloon flights in which CIO has played an important role. A new flight is planned in early 2027, in which a vast series of observational tools can be launched.

Outside Europe, this research field is particularly well developed in the USA, but there are also important players active in Australia, Japan, Canada, and China.

7. Expected contributions to education

The candidate will lecture in the teaching programs in Bachelor- and Master levels courses, and contribute to Ph.D. student educational programs. All are taught in English.
In the Bachelor Phase (the first three years of academic education) the contribution will mainly be in the Physics program, especially in the “energy and environment” track. Environmental subjects are atmospheric physics, the climate system, and principles of measurement science, both in general and applied to atmospheric research. Contributions to more general Physics courses are also possible. Supervision of Bachelor students for their final Bachelor thesis work is part of the educational contribution.
In the Master Phase, the position will be mainly involved in the Energy and Environmental Science master program (courses like 'global change', 'Energy, Atmosphere and Resources', 'Experimental Methods in Environmental Science'). This includes the supervision of master students during their final research.
The successful candidate will also be daily supervisor of Ph.D. students and, in a later stadium of her career, act as Ph.D. advisor (“promotor”).

8. Expected contributions to research

The successful candidate is expected to keep the observational program at CIO at the forefront of atmosphere-based (i)GHG research. This includes responsibility for the quality assurance of the observations, and supervision of the technicians involved. The research output is foreseen to be both societally relevant and striving to answering questions about the (i)GHG cycling on a more fundamental level. Examples of the former are more accurate determination of local and regional (i)GHG sources and sinks on land, in particular CH_4 and H_2. Here, existing research and projects presently run at the CIO offer good possibilities. National and international collaboration in Ruisdael and ICOS should be cherished and strongly supported.
An example of a more fundamental issue is the character and size of hydrogen sources and sinks. New initiatives by the researcher are expected, for example in an observation-model interaction. Other, innovative additions to the present activities of CIO, for example new tracer methods (isotopes, new trace gases) or extending the modelling capabilities, are most welcome.

9. Expected contributions to the organisation

The candidate is expected to have an active interest and to provide a positive contribution to the management and organisational tasks of the institute. She will furthermore contribute to the organisation of the faculty, for example by participating in working groups and committees, in the domains of education, research and management. The candidate will contribute to relevant organisational activities on the national and international level.