Ministry of Human Resources and Social Security

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

2018 Helmholtz – OCPC – Program
for the involvement of postdocs in bilateral collaboration projects

PART A

Title of the project:
Water vapor budget in the upper troposphere and lower stratosphere in a changing climate

Helmholtz Centre and institute:
Forschungszentrum Jülich, Institute for Energy and Climate Research: Stratosphere (IEK-7)

Project leader: Dr. Paul Konopka

Web-address: www.fz-juelich.de/iek/iek-7/EN

Description of the project:

Water vapor (H_2O) is the most important greenhouse gas in the Earth's atmosphere and the moistening of the stratosphere represents an important feedback mechanism in the climate system. In particular, even small changes of H_2O in the upper troposphere/lower stratosphere (UTLS) have an impact on surface climate. In spite of its radiative importance, changes and trends in UTLS H_2O are only poorly quantified. In particular the sharp gradients and inhomogeneous distributions of water vapor in the UTLS represent a challenge for current generation global atmospheric models, which often show excessive diffusive cross-tropopause H_2O fluxes and too weak cross-tropospheric gradients.

The Chemical Lagrangian Model of the Stratosphere (CLaMS) provided by IEK-7 is a Chemistry Transport Models (CTM) that is driven by a meteorological reanalyses and that is particularly well suited for resolving strong tracer gradients like those in the vicinity of the tropopause. Meteorological reanalyses are best estimates of the true state of the whole atmosphere in the past. As such, they are widely used to examine the atmospheric processes and variabilities, to detect changes in the climate system and to provide meteorological states for both forecast and historical model runs. CLaMS offline long-term simulations can now be carried out by using three widely accepted reanalysis products: ERA-interim, MERRA-2 and Japanese 55-yr Reanalysis. The robustness and reliability of the representation of H_2O in the UTLS and its trends among the long-term simulations is still an open question.

This project aims to improve our understanding of the processes controlling H_2O in the UTLS. The main goal is to extend the Lagrangian representation of water vapor in CLaMS also to the extra-tropical UTLS by using the recently developed new mixing scheme. Inaccurate representation of mixing in chemistry transport models is still one of the key uncertainties in qualitative understanding of the stratospheric H_2O variability. To validate the model, in-situ measurements, primary of the Jülicher and Beijing instruments will be used. After such optimization, we will carry out long-term simulations with the improved mixing (driven by

the reanalysis products described above) to analyze the variability and trends in the extratropical water vapor over the last 40 years.

Description of existing or sought Chinese collaboration partner institute:
IEK-7 has been actively cooperating with the Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS) in Beijing since 2010, which is also our partner institute in this project. IAP is a leading research institute, not only in China, in the field of the atmospheric sciences, especially in the satellite- (Prof. Yi Liu) and balloon-borne (Prof. Jianchun Bian) observations. Prof. Yi Liu cooperates with IEK-7 within the Helmholtz-CAS joint research group (Climatological impact of increasing anthropogenic emissions over Asia, founded in 2015) and will be our direct Chinese partner in this project. Prof. Jianchun Bian supports another OCPC project at IEK-7 with similar objectives. The long-term balloon-borne water vapor observations from IAP (Prof. Jianchun Bian) will be intensively used in this project. Furthermore, the extension of the Jülicher model CLaMS which is a central point of this project was developed and implemented within the previous cooperation and will be applied in the here proposed activities.

Required qualification of the post-doc:
- PhD in Meteorology, Physics or Atmospheric Chemistry.
- Experience with developing and maintaining large scientific codes
- Experience with geophysical fluid dynamics and numerical methods applied in atmospheric dynamics and chemistry
- Good knowledge of high-level programming language such as Fortran-90, shell scripts, strong background in UNIX systems (and/or Linux)
- Candidates must be able to work effectively in English

PART B

Documents to be provided by the post-doc, necessary for an application to OCPC via a postdoc-station in China, which is affiliated to a research institution like a university:

- Detailed description of the interest in joining the project (motivation letter)
- Curriculum vitae, copies of degrees
- List of publications
- 2 letters of recommendation
- Proof of command of English language

PART C

Additional requirements to be fulfilled by the post-doc:

- Max. age of 35 years
- PhD degree not older than 5 years
- Very good command of the English language
- Strong ability to work independently and in a team