# 2017 Helmholtz – OCPC – Programme
## for the involvement of postdocs in bilateral collaboration projects

**PART A**

**Title of the project:**
Rapid upward transport by tropical cyclones to the tropopause region in the vicinity of the Asian monsoon

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

**Project leader:** Dr. Bärbel Vogel (b.vogel@fz-juelich.de)

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**Description of the project:**

The Asian summer monsoon (ASM) anticyclone is one of the world's largest atmospheric circulation systems. The circulation in the upper troposphere-lower stratosphere (UTLS) during boreal summer spans from South-east Asia to the Middle East. This circulation system is highly important as it strongly impacts concentrations of water vapour, aerosols, ozone and other trace gases in the UTLS with severe consequences for global climate. In spite of its importance, measurements in the monsoon region at greater altitudes (in the UTLS) are scarce. Here balloon measurements by Prof. Bian's group (Chinese Academy of Sciences) within the series of SWOP (sounding water vapour, ozone, and particle) campaigns from 2009 until 2017 (and hopefully beyond) are a notable exception.

Here we propose to combine this unique set of measurements with simulations of the Chemical Lagrangian Model of the Stratosphere (CLaMS) which has been developed at Forschungszentrum Jülich. Simulations in this region require an accurate vertical transport, which is achieved by the diabatic transport implemented in CLaMS down to upper tropospheric altitudes. Further, simulations in this region require a good representation of tracer gradients making CLaMS, with its unique Lagrangian transport core the ideal tool to use.

First studies in Jülich have demonstrated that typhoons, a hitherto overlooked transport mechanism can lift air masses rapidly from the lower troposphere to altitudes high enough to be entrained in the upper monsoon circulation. Validation of this concept has been provided by a case study using three SWOP balloon measurements. The upward transport by tropical cyclones in the monsoon region is particularly important for water vapour because

changes in water vapour in the UTLS have a significant impact on surface climate. Thus it is important to quantify the transport of water vapour by tropical cyclones in the monsoon region.

In the proposed project these studies will be extended in several respects. First the study will be extended to all SWOP measurements since 2009 providing a more profound observational basis. Second, the full CLaMS version will be employed (rather than trajectories hitherto) including the development of a "typhoon tracer" in CLaMS. Third, within the time frame of the project, a new meteorological reanalysis will become available (ERA-5), which will the accuracy of the CLaMS simulation of the relevant convective processes in typhoons (and indeed similar vertical transport mechanism) to be advanced significantly. This will constitute the first use of ERA-5 data in CLaMS.

In summary, by combining the unique set of measurements in the Chinese SWOP campaigns with the simulations of a model (CLaMS) which is tailored precisely to applications in the envisaged region (the upper levels of the Asian monsoon) an big step forward can be made regarding transport processes in the monsoon region. This step will be important for advancing climate predictions.

**Description of existing or sought Chinese collaboration partner institute:**

There is an existing collaboration with the Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS), in particular LAGEO, Prof. Bian's group. Moreover both IEK-7 scientists and Prof. Bian are members of the EU Project StratoClim. In this framework there is an effort to coordinate common measurement strategies for summer 2017, in particular to coordinate Prof. Bian's balloon measurements in Kunming with the Geophysica research aircraft deployments from Nepal, close to the balloon site.

Through the offered PostDoc-project a long-lasting collaboration is sought with a Chinese institution having a research portfolio similar to IAP,CAS which can boost the collaboration between IEK-7 and Chinese scientists to a new level by combining experimental core competences of the partners like SWOP measurements and modelling competences such as CLaMS simulations.

**Required qualification of the post-doc:**

- Ph.D. in atmospheric sciences
- Experience with stratospheric modelling, in particular Lagrangian techniques
- Experience with analysing and conducting atmospheric balloon measurements (ozone, water vapour, and aerosol measurements)
- Additional skills in programming and using graphics tools for diagnosing model output. In particular modern Fortran and IDL.

**PART B**

**Documents to be provided by the post-doc:**

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

**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