The Polar Stratosphere in a Changing Climate (POLSTRACC)

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- Background
  - The future of the development of the Arctic stratosphere is still unpredictable (example: Arctic winter 2004/05)
  - CFCs are slowly declining but the temperature, global circulation and stratospheric water content might change
  - Increased PSC formation (?)
  - Bromine chemistry will become more important
  - Ozone destruction might continue despite the decreasing chlorine content

- Why POLSTRACC ?
  - Most programs (EC and national) seem to focus on understanding the global circulation: transport of water and methane from the troposphere into the stratosphere at low latitudes
  - Last major Arctic field campaign in 2000 and, less extensive, in 2003. No major effort planned so far (but IPY)
  - Comprehensive studies are needed towards the end of this decade

- Mission objectives

  - To monitor in a changing climate the spatial and temporal variability of trace constituents, incl. aerosols, in the lowermost stratosphere during several phases of the polar winter ; assess trace gas budgets etc.
  - To provide global models with accurate data from the deployments to refine their algorithms; to investigate whether the models can reproduce the spatial an temporal changes on ozone and relevant trace gases
  - To complement in a synergetic way satellite observations with dedicated field measurements
  - To better understand changes in the ozone layer in a changing climate

    (subject of several HALO, national and EU initiatives)
  - To improve the predictive capabilities on the development of the ozone layer in the coming 50 years

  - (To test precursors for future satellite experiments)

Deployments

- First winter : 1st Arctic mission with Oberpfaffenhofen as mission base

  Maybe with double flights with just a refuelling stop

  Maybe connected IPY

- Second winter (and repeated every 2 years) : several deployments with Kiruna as mission base

  Kiruna is extremely well suited for aircraft missions, in double flights can be made through the entire polar vortex

  Study several phases of the polar winter

- Antarctic mission from South America (Ushuaia or Punta Arenas) or New Zealand (Christchurch) as part of an international mission.

  Comparison of the measured chemical composition of the Arctic and Antarctic polar vortices and to their outflows in the lowermost stratosphere with model results → identify shortcomings in the models

  The mission might profit from a planned Antarctic Geophysica mission

- Payload and modeling activities

- Payload

  - Combination of in-situ and remote-sensing instruments for precise measurements of the bottom of the vortex and to cover the stratosphere above as well
  - Payload should be able to measure at daytime and during the (polar) night

- Modeling

  - CTMs : for refinement of algorithms , investigations whether the models can reproduce the measured spatial and temporal changes in ozone and relevant trace constituents

  - GCMs : to predict the development of the ozone layer in the next decades

- List of parameters to be measured and instruments which might be available

  - *Temperature* : in-situ and remote (MTP-type)
  - *In-situ chemical and tracer measurements* :
    Ozone : FOX (DLR) and/or the FZK instrument
    Water vapor and total water : FISH (FZJ) or a similar instrument
    Tracers : HAGAR or GhOST (JWGU Frankfurt) and/or TDLAS (MPI-C)
    ClO, Cl2O2, ClNO3, BrO : HALOX (FZJ)
    NO, NOy and/or HNO3 : SIOUX (DLR)
  - *Remote chemical and tracer measurements* :
    Lidars (DLR) : ozone and water measurements
    A mid-infrared limb sounder : GLORIA-AB (new imaging FTS currently developed by FZK and FZJ) :
    distributions of ozone, water, tracers and chemicals in the UTLS, cloud mapping
    A millimeter and/or sub millimeter wave spectrometer : ClO, HCl and others (DLR and/or Uni Bremen)
  - *In-situ aerosol measurements* : FSSP 300, FSSP 1000 (MPI-C and Uni Mainz)
  - *Remote aerosol measurements :* Lidar (DLR)

Modelling activities and models available

- *CTMs*
  CLaMS (FZJ) : Lagrangian CTM
  KASIMA (FZK) : Eulerian CTM
  DLR-ROSE (DLR) : Eulerian CTM with a data assimilation module

- *IGCMs*
  ECHAM5/MESSy (MPI-C / FZK) : GCM with detailed chemistry and the possibility to nudge meteorological analyses for process studies
  ACHAM5 (MPI-Met) : CTM with focus on dynamics