Seasonality of **A**ir mass transport and origin in the **L**owermost **S**tratosphere and the tropically controlled transition region using the HALO **A**ircraft SALSA

A systematic study of the tropically controlled transition layer

A mission proposal for HALO

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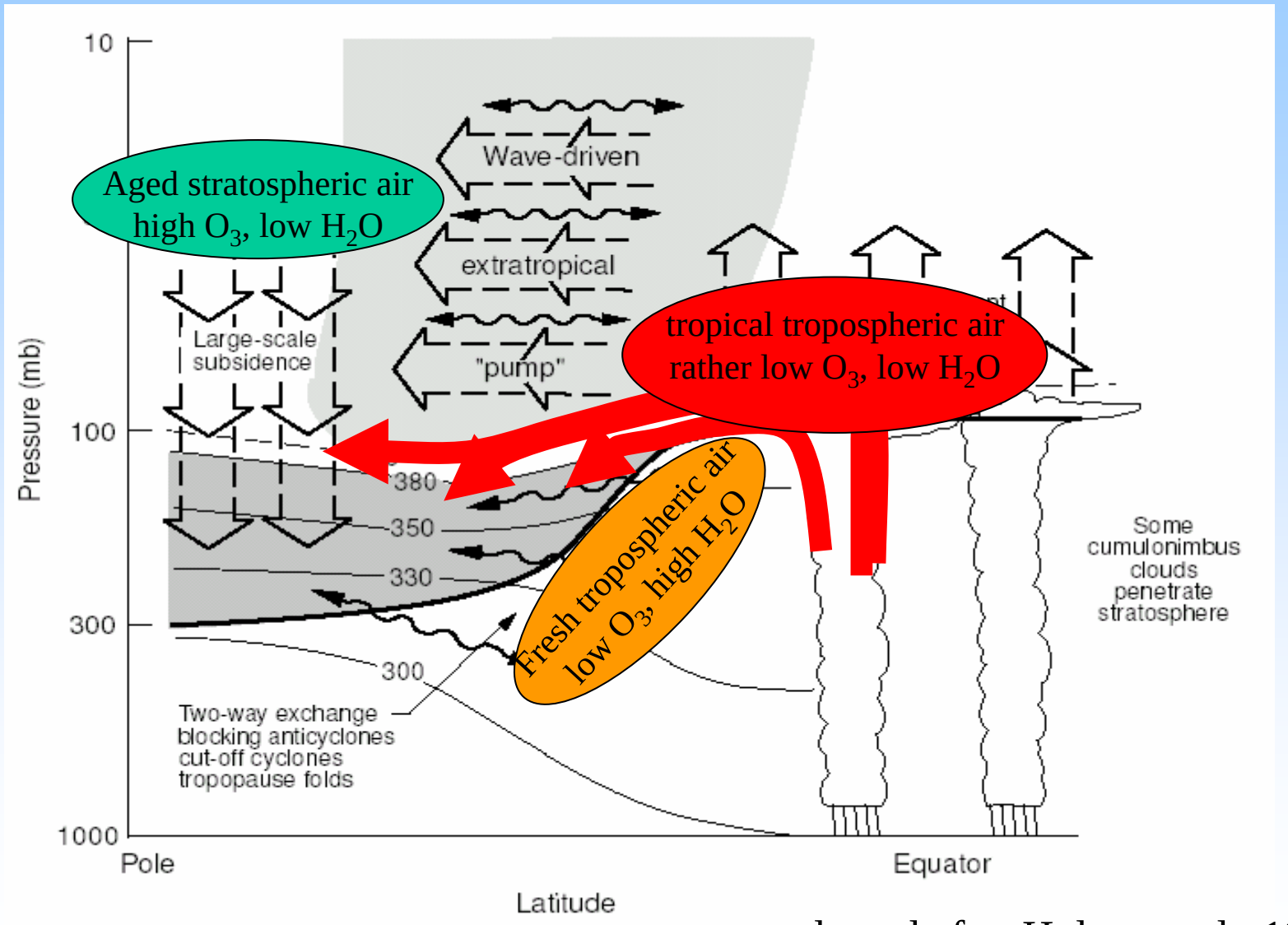
Transport Processes Affecting the lower and lowermost Stratosphere



adapted after Holton et al., 1995

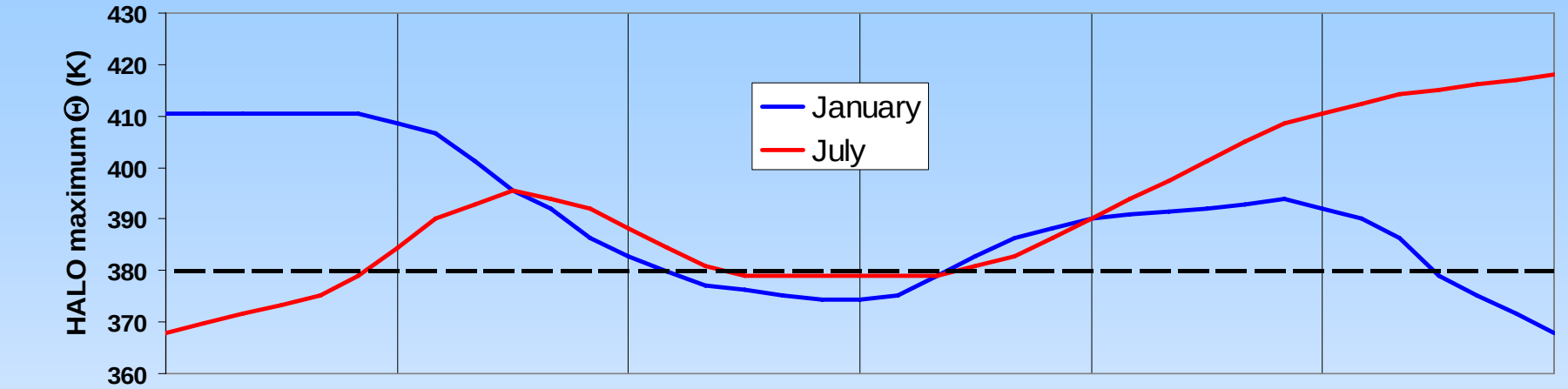
Scientific Objectives and rationale

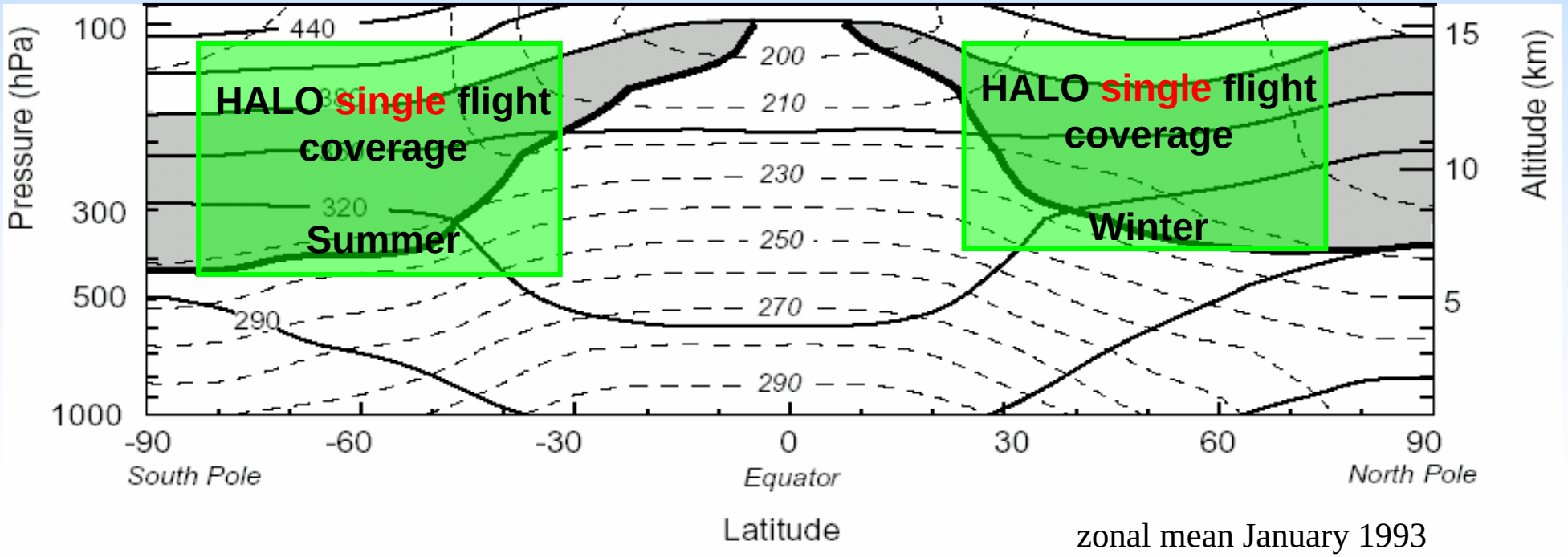
- *To characterise and quantify as a function of altitude, latitude, longitude, and season* the relative roles of diabatic descent of stratospheric air, isentropic exchange of tropospheric air in the extratropics and the input of tropical tropospheric air into the lower and lowermost stratosphere.
- understand the origin of air masses – implications for chemical composition and radiative properties
- understand variability in the composition of the air-masses (seasonality and year to year variations). Important for investigation of possible changes in transport pathways.

Proposed Investigations

- Global and seasonally resolved measurements of the distribution of a suite of tracers with different lifetimes, such as H_2O, O_3, CO_2, CO, N_2O, SF_6, NO_y, CFCs, isotopes and short lived hydrocarbons in the lower and lowermost stratosphere
- Studies employing numerical models such as CTMs, GCMs, trajectory models, data assimilation; meteorological support
- to infer the fractions of air masses from different origins and characteristic transport time scales
  - based on tracer budget studies
  - based on correlation studies
  - based on shifts in seasonal cycles
  - based on modelling studies and intercomparisons with data

The uniqueness of HALO as a platform for global observations in the lower and lowermost stratosphere

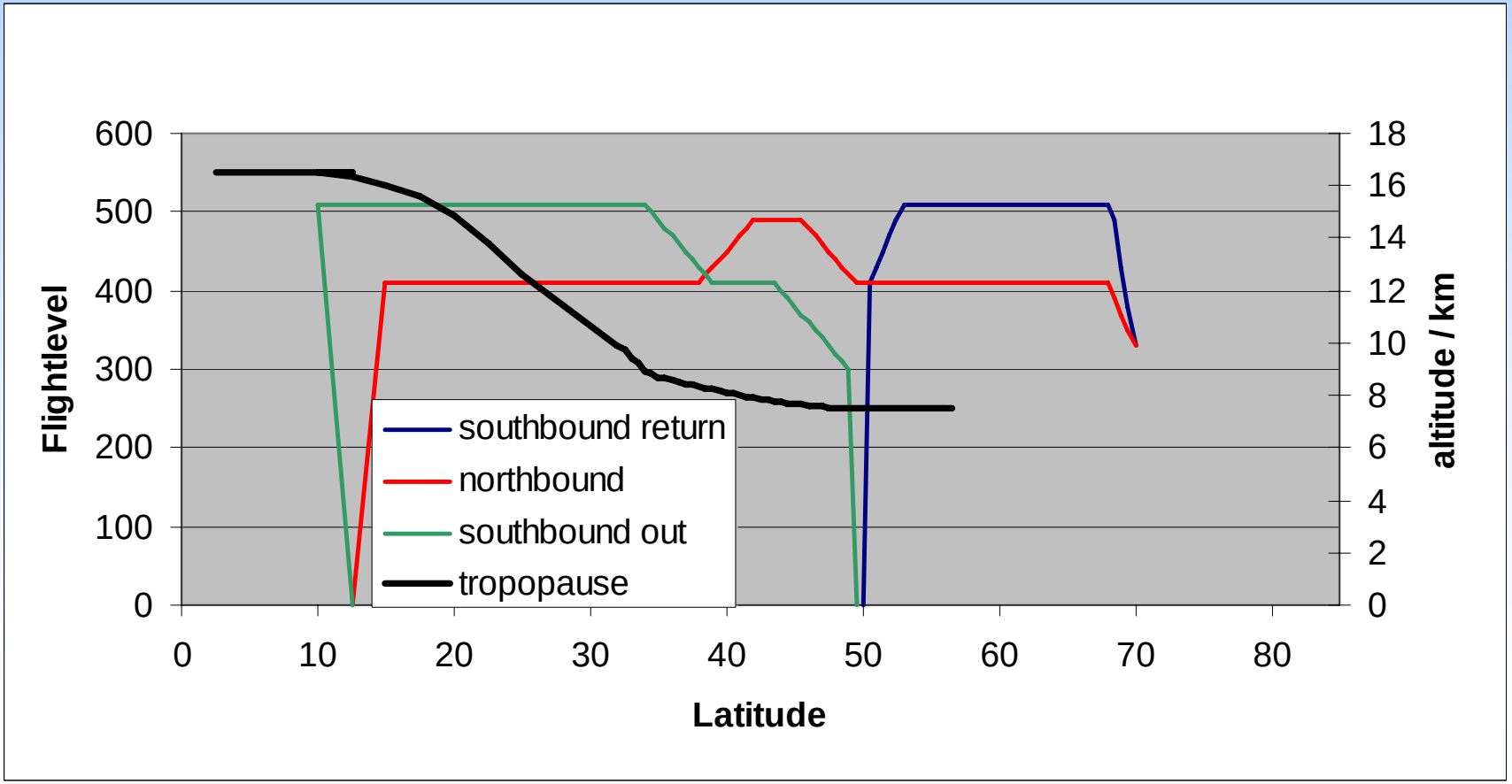




zonal mean January 1993

Proposed HALO measurements

- 6 - 7 campaigns inside a 1 year time period (the more, the better!)
- cover the UT, the LMS, part of the tropically controlled transition layer from the extratropics to the subtropics, TTL composition as input



Proposed Instrumentation

Target Compunds(s)	Institution	Technique	Alternative
NO_y	DLR	CLD	
H_2O	FZJ	Ly-alpha	
Tracers (CFC, SF_6, N_2O, CO)	Univ. Frankfurt	GC	
CO_2	MPI Mainz	NDIR	U. FFM, DLR
CO, CH_4, N2O	MPI Mainz	TDL	
O_3	DLR, FZJ	UV, CLD	FZK
Isotopes	MPIK	Sampler, GC-MS	IUP
Short lived tracers (Aceton, CH_3CN, SO_2)	FZK, DLR	PTRMS	
Short lived (halogenated) gases	U.FFM, MPI	In-situ GC/MS	
In-situ Isotopes?	FZK	TDL	
GLORIA-AB for tracers, SF_6, H_2O, HDO	FZK/FZJ	IR remote sensing	
O_3, H_2O, Aerosols	DLR	DIAL,LIDAR	

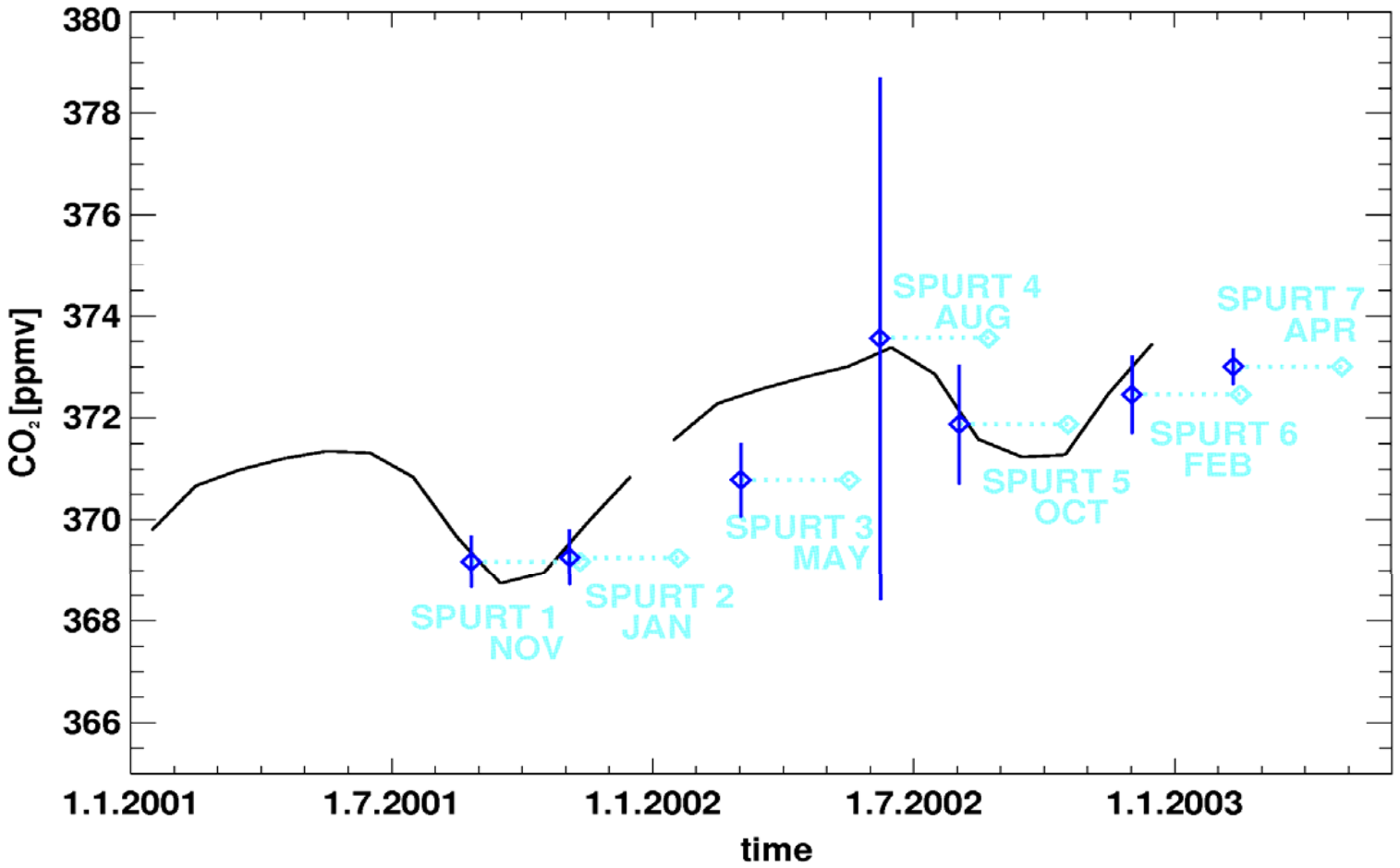
modelling, data assimilation and meteorological support

Model type / study	Institution
Lagrangian Model - CLaMS	FZJ
CTM TM5	MPICH, KNMI
GCM ECHAM	DLR
Meteorological support	Univ. Mainz
Data Assimilation	Univ. Köln

why this is a perfect demonstration mission

- this is a demanding mission: it will demonstrate all capabilities of HALO, i.e. long range, high ceiling altitude and large payload.
- many instruments and model tools proposed in this investigation have proven their reliability before.
- No belly pods or large modifications needed, wing pods optional.
- Results will be available very soon during the mission, as no new algorithms are needed. Yet sufficient innovation due to new instrumentation or combinations (e.g. isotope measurements, in situ GC/MS).
- Scientifically focused and of high scientific interest (lower stratosphere and possible changes in its composition, transport pathways).

Seasonal Cycles – an example



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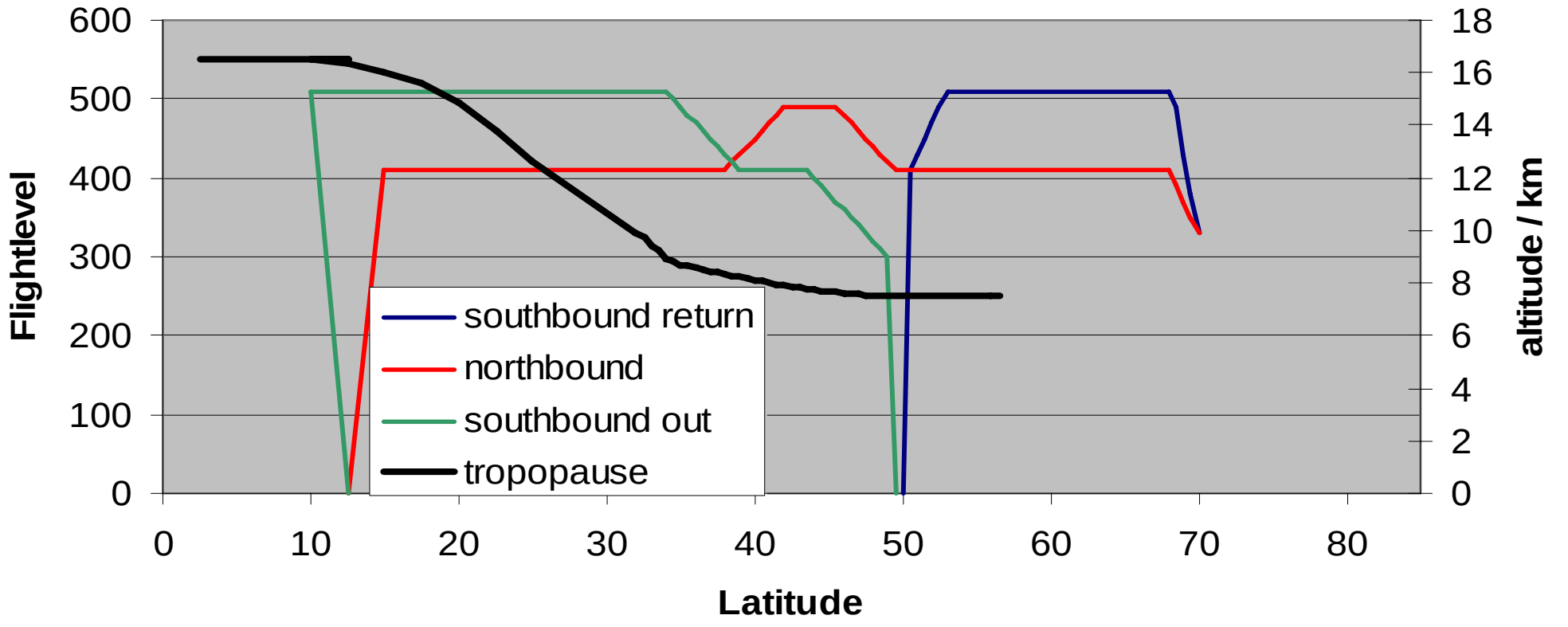
Proposed Flight Route



Itinerary of a typical mission

Lag # Itinerary

Latitudinal cross sections:

1 :	Oberpfaffenhofen	-	tropical airport, 10°N
2:	tropical airport 10°N	-	70 N
3:	70 N	-	Oberpfaffenhofen

Total flight time: approx 20 – 25 hrs per mission
Mission duration: 2 flight days

7 (5) missions over the course of a year (every 2 (3) month)

total: 140 (100) flight hours (spread over 1 - 2 years)

seasonality of lag time“ in the UT/LS