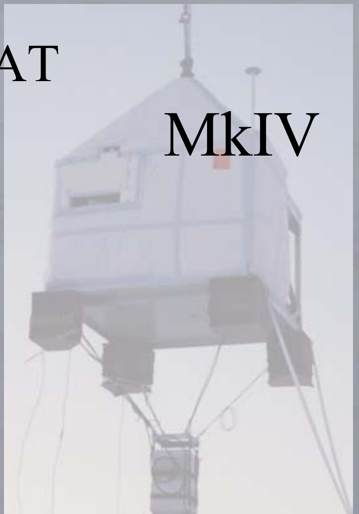
Second SAGE-III Ozone Loss and Validation Experiment (SOLVE-II)

Sites:

- DC-8: Kiruna, Sweden (Jan. 8-Feb. 6, 2003) - Remote and In-situ payload
- Mk-IV + free flyer aerosol & H_2O balloons: Esrange, Sweden (flights in Nov. and March) - Mk-IV interferometer
- Rockets - Schmidlin

Goals:

- Validation of SAGE-III satellite observations
- Correlative measurements with ODIN, POAM and ENVISAT and support for EC Vintersol campaign
- Diagnosis of ozone loss in January 2003
- Investigation of polar stratospheric clouds in mid-winter, particularly large nirtric-acid trihydrate particles



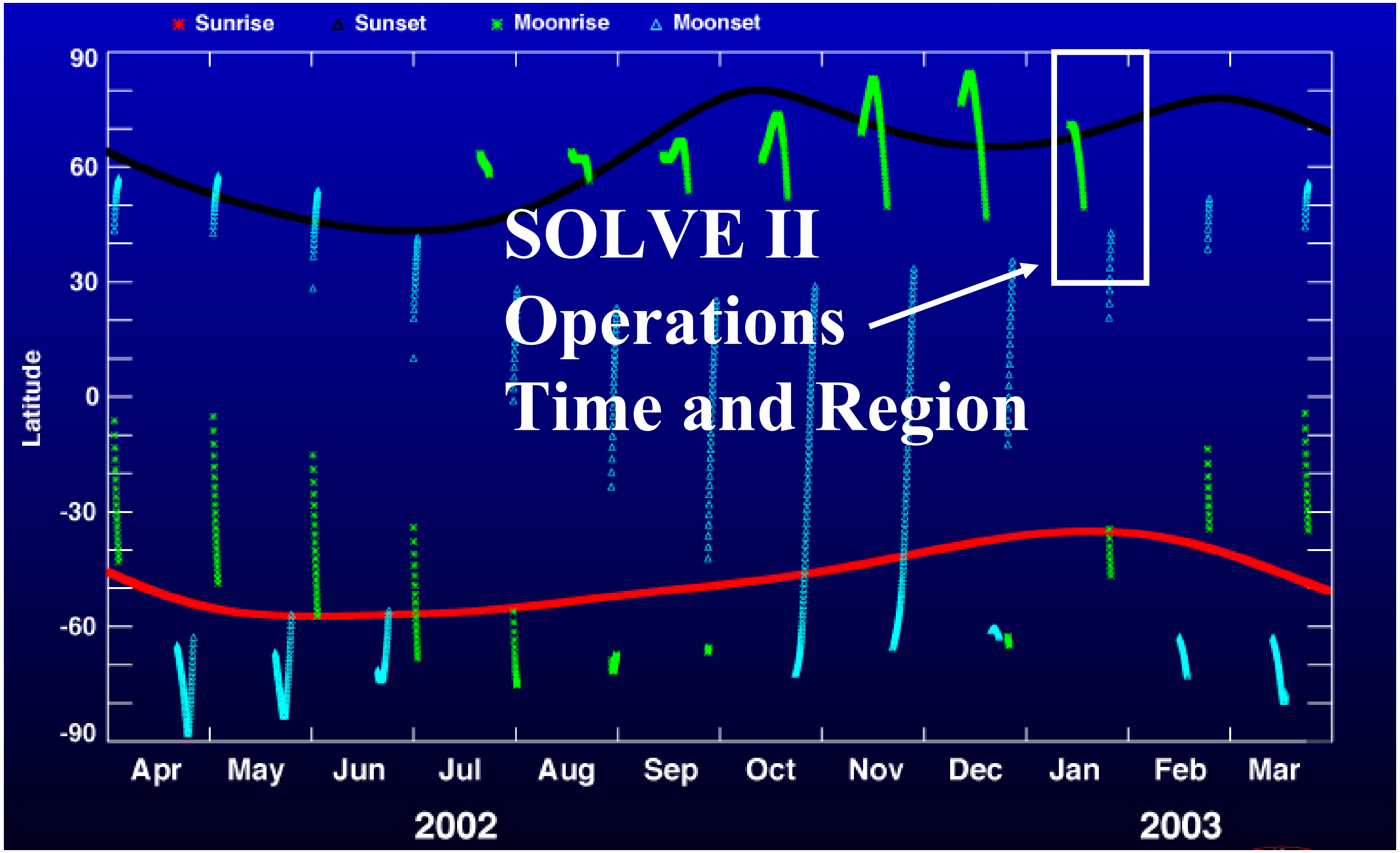
Science Objectives

- Ozone loss in January
  - How do we reconcile differing estimates?
  - Insts: Lidars, Satellites, sondes
- Middleworld transport and dynamics
  - Mass balance (exchange with troposphere)
  - Tracer fields (nitrification)
  - Insts: In situ trace gases and aerosols
- Validation of SAGE III
  - Optical properties of the polar region
  - Insts: UV/Vis/IR
- Detection of polar stratospheric clouds
  - Can we detect polar stratospheric clouds in cold layers?
  - Can we detect larger particles?
  - Insts: Lidars

SAGE-III

- **The third Stratospheric Aerosol and Gas Experiment**
- **Launched on a Meteor-3M on Dec. 10, 2001**
- **SAGE III a grating spectrometer uses an 800 element CCD linear array to provide continuous spectral coverage between 290 and 1030 nm. Additional aerosol information is provided by a discrete photodiode at 1550 nm.**
- **Provides profiles of aerosol extinction, H2O, NO2, O3, and Temperatures**

SAGE III predicts



Payloads

- DC-8 Remote Sensing
  - O_3, Aerosols, T profiles - Arotal (McGee, Burris, & Hostetler)
  - O_3, Aerosols - DIAL (Browell)
  - UV/Vis -DIAS (Shetter)
  - UV/Vis/IR - AATS-14 (Russell)
  - UV/Vis/IR - GAMS-LABS, A-band (Pitts)
  - T profile - MTP (Mahoney)
- DC-8 In-situ
  - Ozone - Fast-Oz (Avery)
  - Aerosols - FCAS/NMAS (Reeves)
  - Aerosols - (Anderson)
  - H_2O, CH_4, N_2O, CO (Diskin)
  - Various - Panther (Elkins)
- Balloon
  - Mk-IV - H_2O, CO_2, O_3, N_2O, CO, CH_4, NO, NO_2, HNO_3, HF, HCl, $ClNO_3$, CFC-12, HCFC-22, HDO, and SF_6 (Toon) + In-situ O_3 (Margitan)
  - Free flyer Aerosols (Deshler) and H_2O (Vömel)
- Super Loki Rockets - Schmidlin

DC-8 Schedule

- **Integration**
  - **11/18 - Travel Day (arrive DFRC)**
  - **11/20 - DC-8 returns from Leonid**
  - **11/21 - Upload begins**
  - **12/04 - Power-Up check**
  - **12/09 - Roll Out**
  - **12/10 - Shakedown Flight**
  - **12/11 - Science team meeting**
  - 12/12 - ORR & Safety briefing
  - 12/13 - 1st 4-hour flight
  - 12/17 - 2nd 4-hour flight
  - 12/18 - MRR
  - 12/19 - Full science check-out, 5-hour
  - 12/20 - Travel Day (depart DFRC)
- **Deployment**
  - 01/02 - Travel Day (arrive DFRC)
  - 01/04 - DFRC ozone flight (8-hour)
  - 01/06 - Pack Day C130 leaves
  - 01/08 - DC-8 transit to Kiruna
  - 01/09 - DC-8 arrive Kiruna
  - 01/12 - first science flight
  - 01/24 Schoeberl arrives to take charge
  - 01/25 Moon rise flight
  - 01/29 - Media day
  - 01/30 - 02/04 Spectral Survey Mode
  - 02/04 - final science flight date
  - 02/06 - Transit to DFRC
  - 02/14 - Download complete

Flight Scenarios

1. Coincident flights with satellite occultations
2. Sun run flights (sunrise and sunset)
3. Inner Vortex Surveys
4. Cross vortex edge to mid-latitude air
5. Quasi-Lagrangian (air parcel following)
6. PSC flights - NAT clouds, mountain waves, Nacreous clouds

Coincident flight with satellite occultation

Flight pattern:
- Temporally and spatial coincidence with occultation
- Initial flight will be sun run, coincident with occultation
- Map region using lidars

Key measurements
- Ozone distribution
- Aerosol and Temperatures
- Solar occulation spectra

Go/No Go
- DIAL or AROTAL operating
- DIAS or AATS or GAMS/LAABS operating

Sun run flights (sunrise and sunset)

Flight pattern:

- Synoptic situation dependent (possible for pure mid-latitude or vortex observations). Highly dependent on outcome of SAGE III coincident measurements.
- Not dependent on satellite occultation

Key measurements

- Ozone distribution
- Aerosol and Temperatures
- Solar occulation spectra

Go/No Go

- 2 of 3 instruments operating (DIAS, AATS, GAMS/LAABS)

Inner Vortex Surveys

Flight pattern:

Deep vortex flights

- Cover a significant fraction of the vortex(radially) in both the lower and middle stratosphere

Key measurements

Ozone distribution

Aerosol and Temperatures

In-situ ozone, water, and trace gases

Go/No Go

DIAL or AROTAL operating

Cross vortex edge to mid-latitudes

Flight pattern:

- Flight is perpendicular to the vortex edge
- - Cover the vortex edge in both the lower and middle stratosphere

Key measurements

- Ozone distribution
- Aerosol and Temperatures
- In-situ ozone, water, and trace gases

Go/No Go

- DIAL or AROTAL operating

Quasi-Lagrangian (air parcel following)

Flight pattern:
- Parallel to flow (or pv) contour
- Start flight pattern or end flight pattern at the occultation point

Key measurements
- Ozone distribution
- Aerosol and Temperatures
- In-situ ozone, water, and trace gases

Go/No Go
- DIAL or AROTAL operating
- If occultation 1 of 3 (GAMS/LAABS, AATS, DIAS)

PSC flights - NAT clouds, mountain waves, Nacreous clouds

Flight pattern:
- Flight is targeted on cold temperature regions or regions of mountain waves

Key measurements
- Ozone distribution
- Aerosol and Temperatures

Go/No Go
- DIAL or AROTAL operating

Geophysica Plans

- 8 Flights total - Arrive on Jan. 11, First flight on Jan. 15, 5 to 5.5 hour flights
  - Chemistry
    - Haloz: ClO, BrO, Cl_2O_2, $ClONO_2$
    - FISH, FLASH: total H_2O and gas phase H_2O
    - Sioux Noy, NO
    - Fozan, fox: O_3
    - HAGAR, ALTO, TDL: long lived tracers
  - Particles
    - FSSP 300, MAS
    - COPAS: CCN
    - MAL, ABLE: particle backscatter profiles
  - Physics
    - UCSE, MTP: P, T, T profiles
- PSC formation and properties
  - Synoptic flights (3 flights)
  - Mountain waves (3 flights)
- Match flights (2 flights)

Science GO/NO GO

1. DC-8 fully operational
2. Arena Arctica ready
3. Either Arotal or DIAL fully operational
4. 2 of 3 solar instruments operational (GAMS/LAABS, DIAS, AATS- 14)
5. Either DIAPER or NMASS/FCAS operational
6. 2 of 3 in-situ operational (FastOZ, DACOM/DLH, PANTHER).

Success Criteria

Ozone loss in January

Acquisition of ozone data from Lidars, Satellites, sondes

Middleworld transport and dynamics

Acquisition of in-situ data that fully covers the middle world

Validation of SAGE III

Optical properties of the air masses in the polar region

Detection of polar stratospheric clouds

Acquisition of Lidar observations of PSCs

Implies at least 6-8 successful flights of the DC-8 with nearly complete sets of observations.

Falcon Plans

Payload
- Olex lidar
  - Aerosol, O_3
  - Measurements used as M55 pathfinder
- ASUR (flew on DC-8 during SOLVE)
  - O_3, ClO, HCl, HNO_3
- AMAX - DOAS
  - O_3, NO_2, BrO, OClO

FTIR Instruments

FTIR Instruments

- Egbert (44.23ºN)
- Kiruna (67.84 ºN)
- Harestua (60.22 ºN)
- Zugspitze (47.5 ºN)
- Jungfraujoch (46.55 ºN)
- Thule (90ºN)
- Kiruna (N)

Quantification and Interpretation of Long-Term UV-Vis observations of the Stratosphere (QUILT)

Strat abundances of O_3, NO_2, OClO, BrO, IO
Quantify O_3 loss
New retrievals including NO_2 profiles
Revisions of historic data
Modeling of O_3 loss and NO_2 and IO
28 stations
NDSC UV-Vis intercomparison at Andøya (6-27 Feb. 2003)

Balloons

Dec. - OMS (MkIV), Mipas, PSC analysis)

Jan.

- Amon + RA (moon UV-vis)
- SDLA (TDL: ch4, h2o, co2)
- ELHYSA (water)
- Spirale

Feb. - end of March

- MIPAS
- TRIPLE
- LPMA/DOAS
- LPMA/CAESR
- SAOZ

Ozonesondes (all winter, ~500 sondes for 2002-3 winter)

Modeling

Campaign Models - all using ECMWF data (1000-0.01 hPa)

- 3-D CTM - SLIMCAT, REPROBUS, KASIMA, TM3, FMI, MIMOSA (high res advective)
- Trajectories - CLaMS (2-D lat vs. lon isentropic), AWI box model
- Full chemistry data assimilation - IASB/BIRA 4D var.

Chemistry-Climate models

- Ekerman- mountain waves
- Goddard Team - Met and trajectory analysis
- Ames Team - Met analysis
- PSC forecasting - Drdla

MAPSCORE

Investigate formation of PSCs
Microphysical models of PSCs
Chemical models of ozone incorporating PSC microphysics
Observing PSCs from satellites

PSC calculations - Niels Larsen (post mission)
PSC modeling - Carslaw (trajectory model + SLIMCAT 3-D CTM advecting HNO_3

Odin

Launched 20 Feb 2001
Sun-synch, 50-50 split with astronomers
Radiometer SMR - millimeter to submillimeter
OSIRIS, 280-800 nm, 3 channel IR imager (mesosphere)
Measurements
Stratospheric mode:

  SMR: O_3, N_2O, HNO_3, ClO, H_2O
  OSIRIS: O_3, NO_2, OClO, BrO, aerosols