Atmospheric Chemistry Experiment

Ozone profiles measured by the ACE satellite

Peter Bernath, Kaley Walker & Tom McElroy

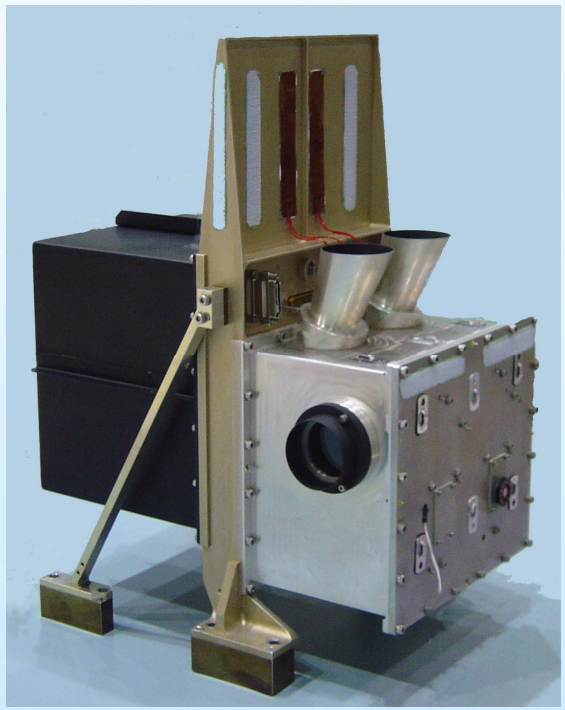
University of York University of Toronto Environment Canada

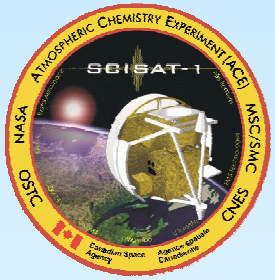
On behalf of the ACE science team…

ACE FTS

ACE / SciSat-1

MAESTRO





Overview

Introduction

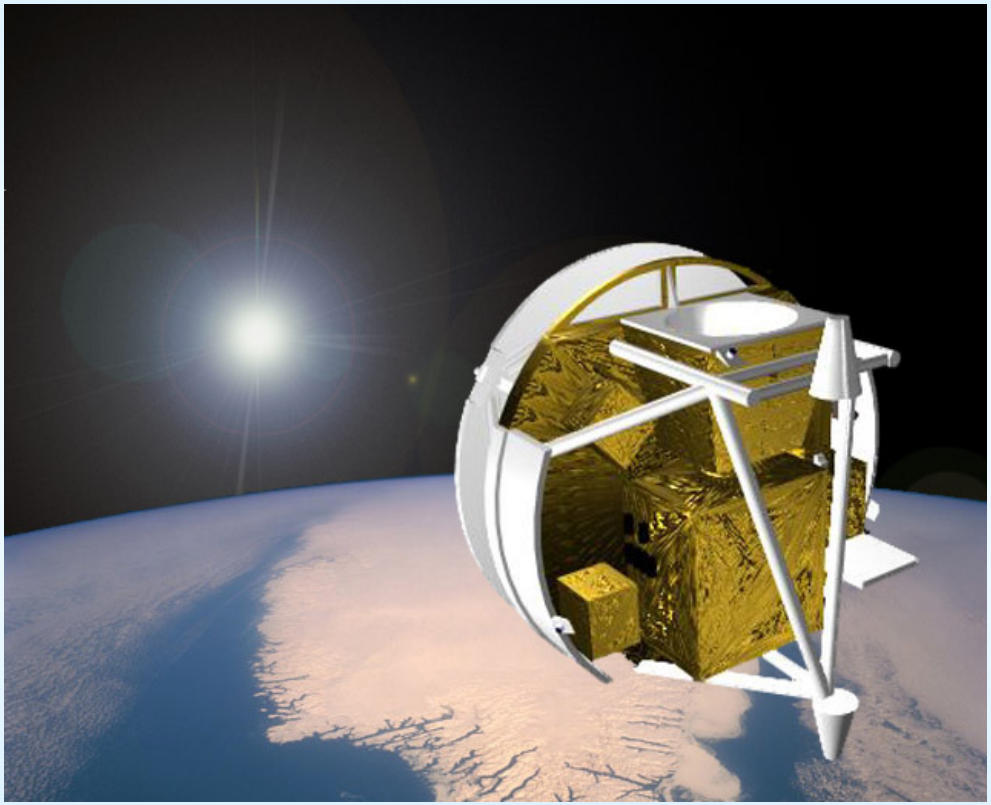
Data Comparison

Discussion of future measurements

Conclusions

August 11, 2003

SCISAT-1 Satellite



Size: 1.12 m dia. x 1 m

Total mass: 152 kg

Total power: 70 W
(from single solar panel)

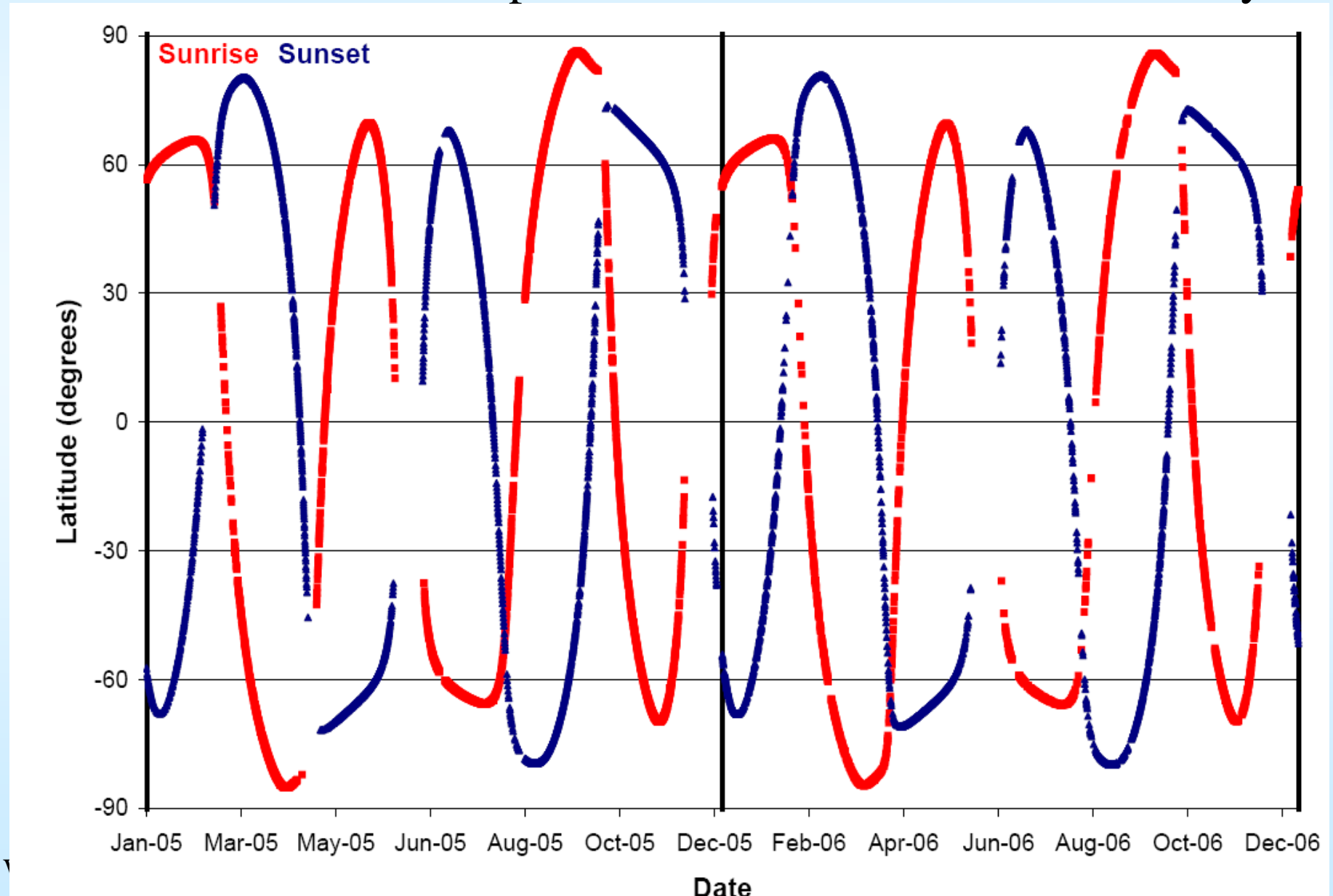
Launch date: 12 August 2003

Launch vehicle: Pegasus XL
(provided by NASA)

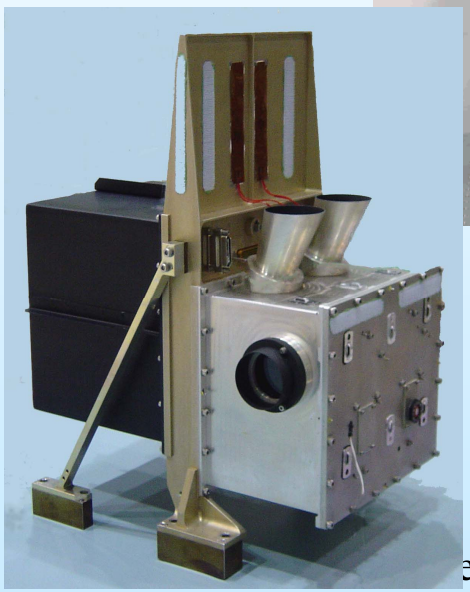
Orbit: 74° inclined circular orbit
at 650 km

ACE Latitude Coverage 2005/2006

Orbit allows repeat of measurement locations each year



SCISAT-1



ACE-FTS:

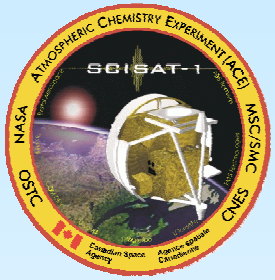
- Fourier transform infrared spectrometer, 2-13 microns at 0.02 cm^{-1} resolution
- 2-channel visible/NIR imager, 0.525 and 1.02 microns

MAESTRO:

- dual UV / visible / NIR grating spectrophotometer, 285 to 1030 nm at ~1-2 nm

Pointing: suntracker in ACE-FTS

Primary measurement mode: solar occultation



ACE Data Products

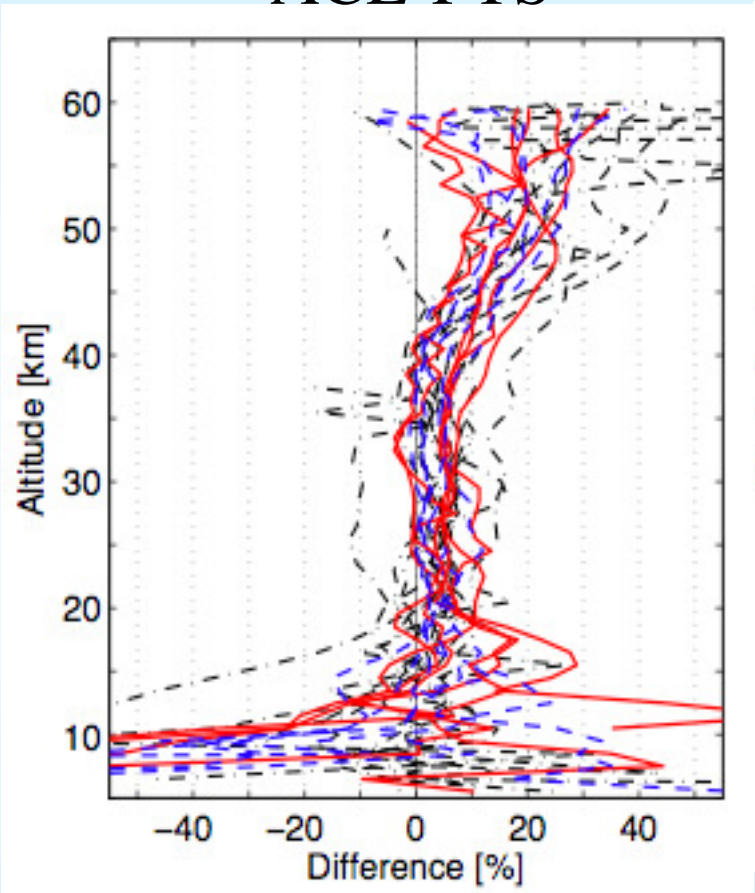
- ACE-FTS profiles (version 2.2 + O_3, N_2O_5 & HDO updates):
  - Baseline: O_3, H_2O, CH_4, N_2O, NO_2, NO, HNO_3, HCl, HF, CO, CFC-11, CFC-12, N_2O_5, $ClONO_2$, T and p from CO_2 lines
  - Other routine: COF_2, CHF_2Cl, CF_4, CH_3Cl, SF_6, OCS, HCN
  - Research: CCl_4, H_2O_2, HO_2NO_2, COClF, $COCl_2$, CCl_2FCClF_2, CH_3CClF_2, ClO, C_2H_2, C_2H_4, C_2H_6, CH_3OH, HCOOH, H_2CO, N_2, (HOCl), additional isotopologues
- IMAGERS profiles (version 2.2):
  - Atmospheric extinction at 0.5 and 1.02 microns (aerosols soon)
- Version 3.0 is now being processed - total number of species (including isotopologues) is almost 60

ACE Ozone Comparisons

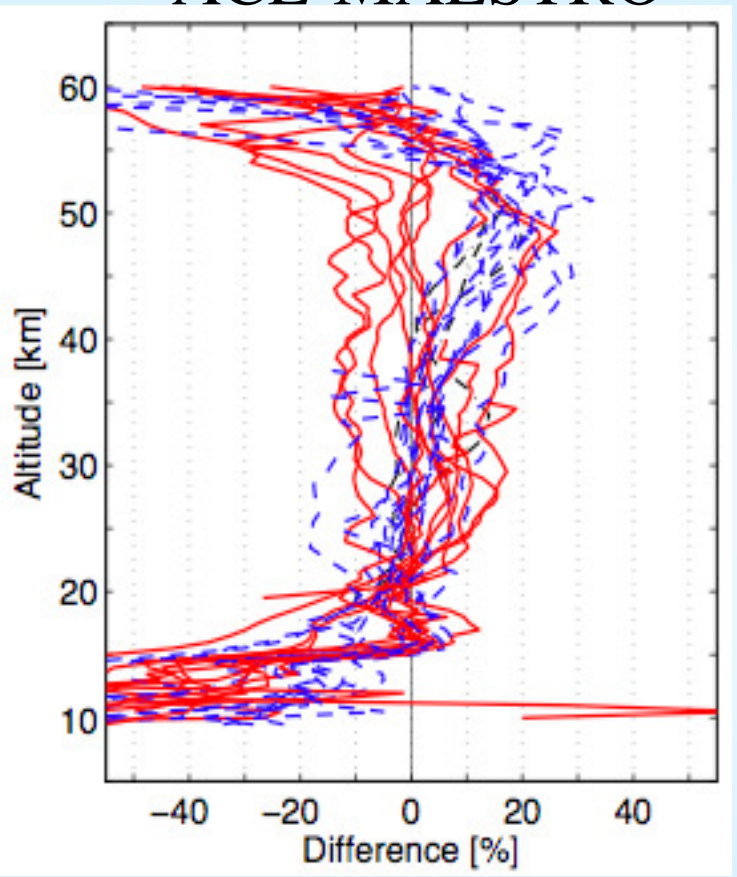
Overview of all profile comparisons versus:

SAGE II, SAGE III, POAM III, HALOE, SMR, OSIRIS, MLS, SABER, ASUR, SCIAMACHY, GOMOS, MWR, MIPAS, Eureka DIAL, ozonesondes

ACE-FTS



ACE-MAESTRO



Agreement: ACE-FTS +5%; ACE-MAESTRO ±5%

Mean calculated as (ACE-comp)/average: Solid red: SR; Dashed blue: SS; Dot-Dash black: both SR/SS; criteria: ±5° lat. and ±10° long. , ±6 hr

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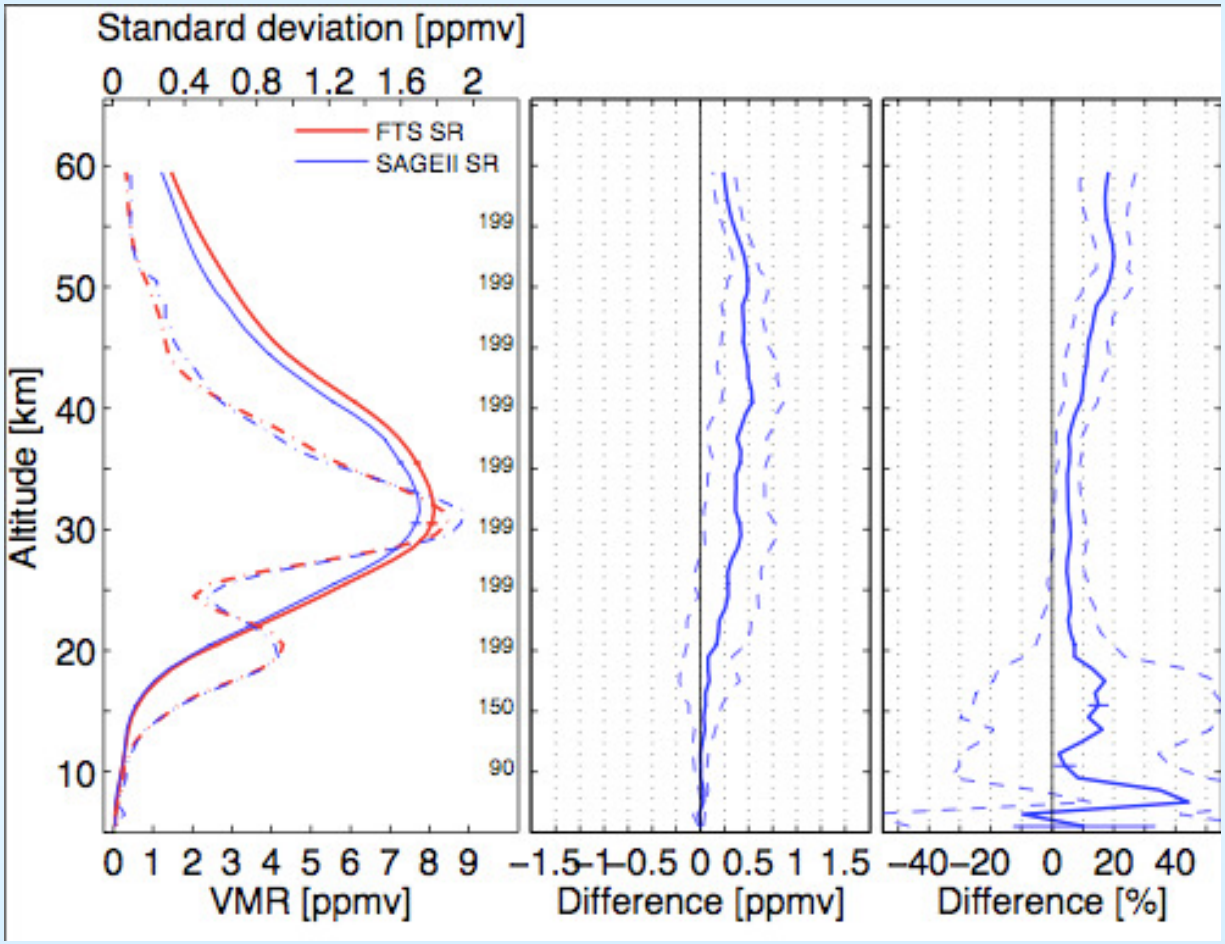
ACE-FTS vs. SAGE II

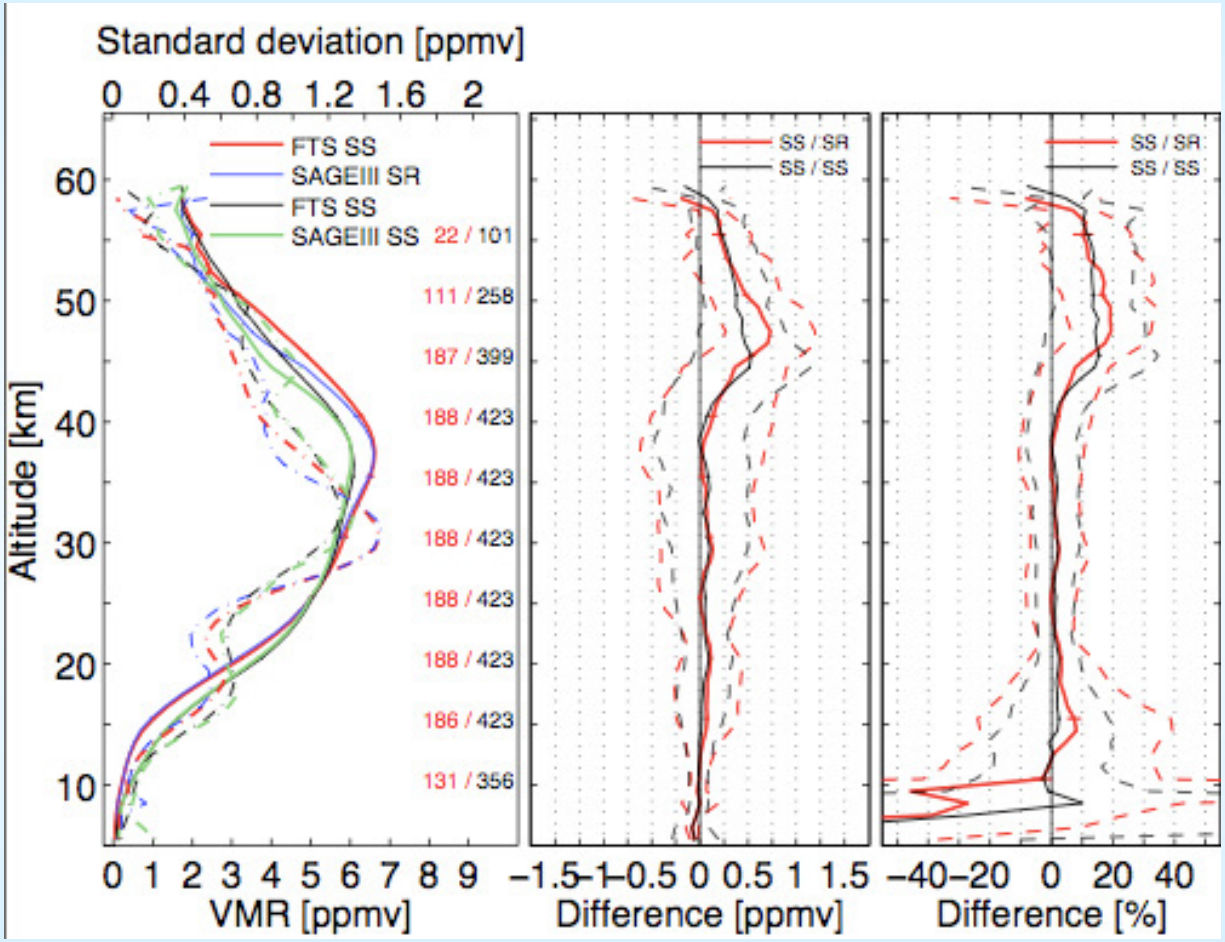


Absolute difference calculated as (ACE-FTS - SAGE II);
Relative difference as (ACE-FTS - SAGE II)/average;
criteria: ±5° lat. and ±10° long. , ±6 hr

- Example of comparison between ACE-FTS (v2.2 ozone update) and SAGE II (v6.20)
- Average differences of +5-6% (ACE-SAGE) between 18 and 42 km for both SR and SS occultations
- Measurement overlap period for coincidences: 9 August 2004 - 6 May 2005

Dupuy *et al.*, ACP, 9, 287-343, 2009

ACE-FTS vs. SAGE III



Absolute difference calculated as (ACE-FTS - SAGE III);
Relative difference as (ACE-FTS - SAGE III)/average;
criteria: ±5° lat. and ±10° long. , ±6 hr

- Example of comparison between ACE-FTS (v2.2 ozone update) and SAGE III (v3.0)
- Mean differences less than ±6% (ACE-SAGE) between 12 and 42 km and generally smaller than ±2% in this range
- Measurement overlap period for coincidences: 21 February 2004 - 9 October 2005

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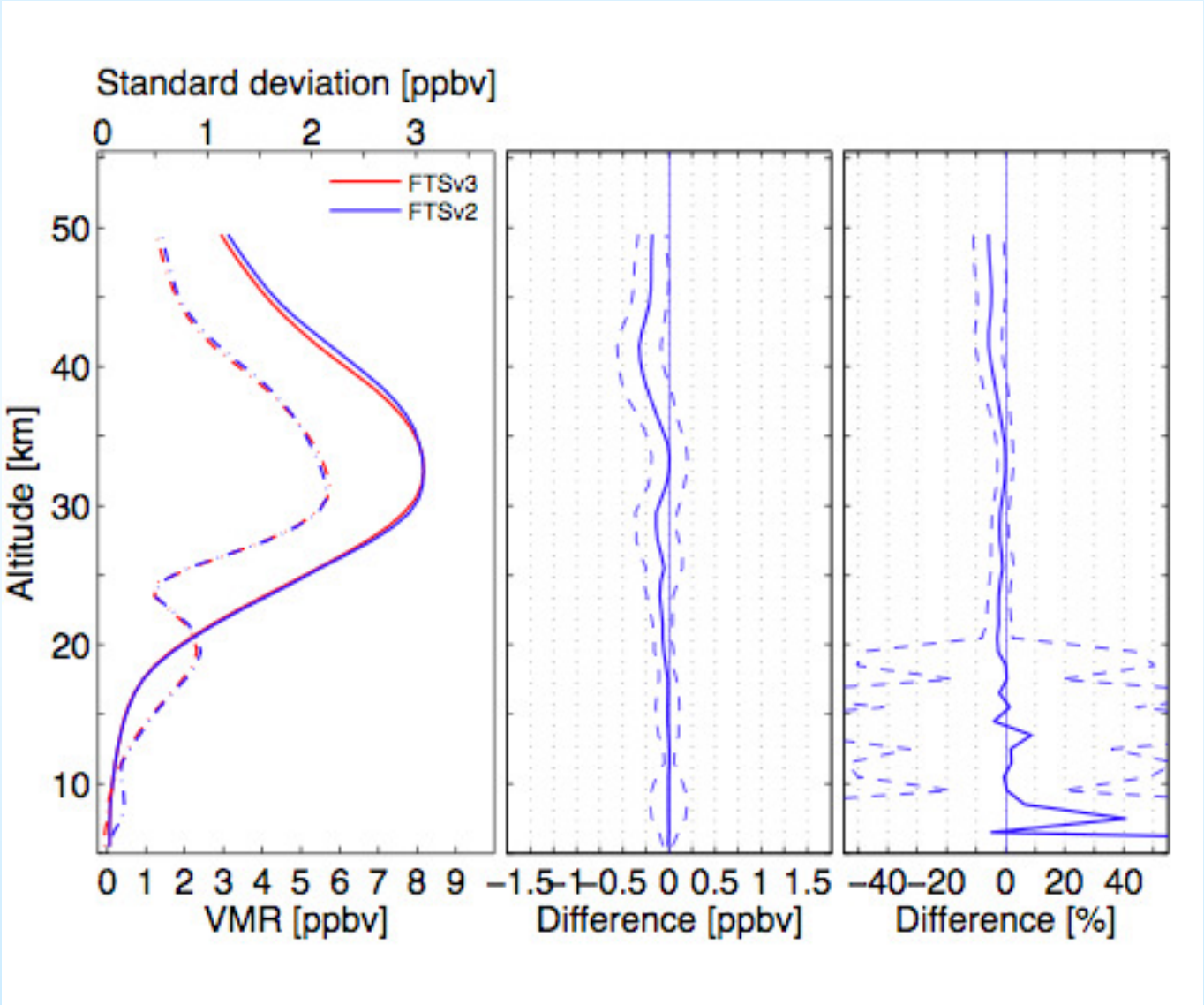
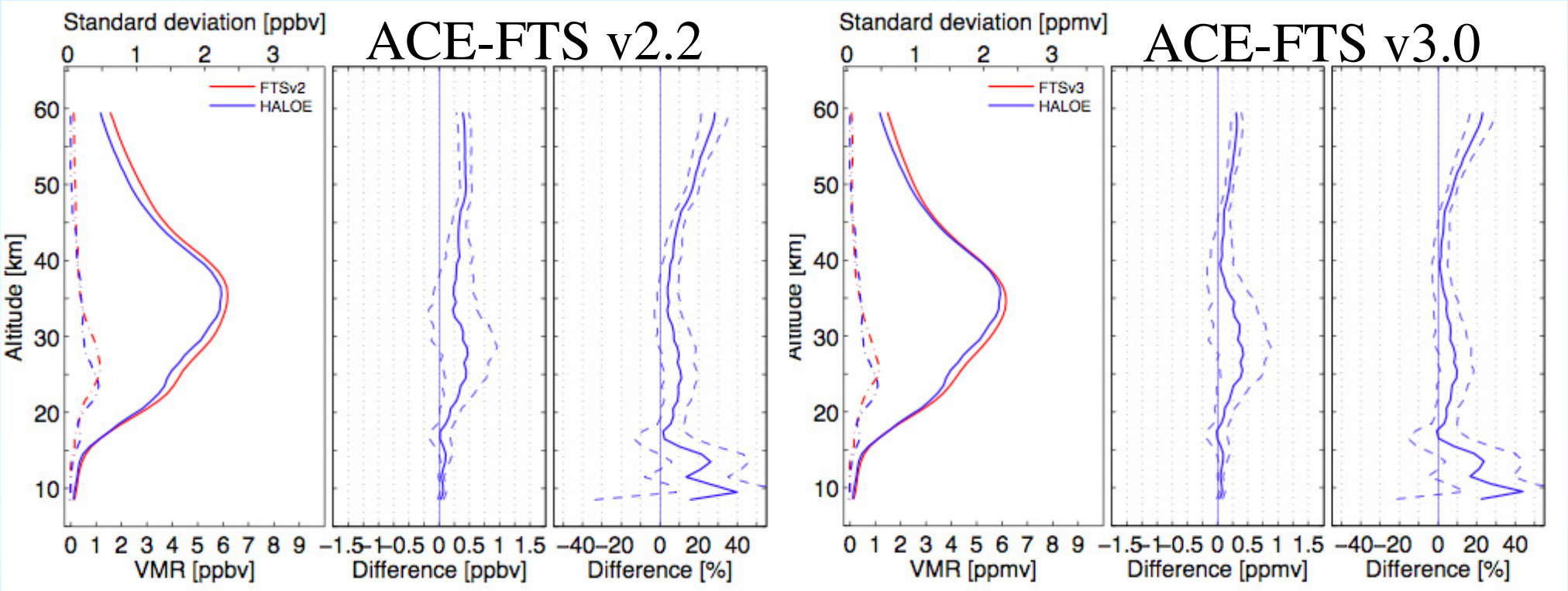
v3.0 versus v2.2 Ozone Update



- Compared to v2.2 Ozone Update, VMRs for v3.0 have decreased by approx. 2-3% between ~15-35 km
- At altitudes above ~35 km, greater decrease in VMRs is seen of ~5%

Claire Waymark in progress

Starting v3.0 Validation - O_3



Comparisons with HALOE v19: southern high latitudes 2004/05

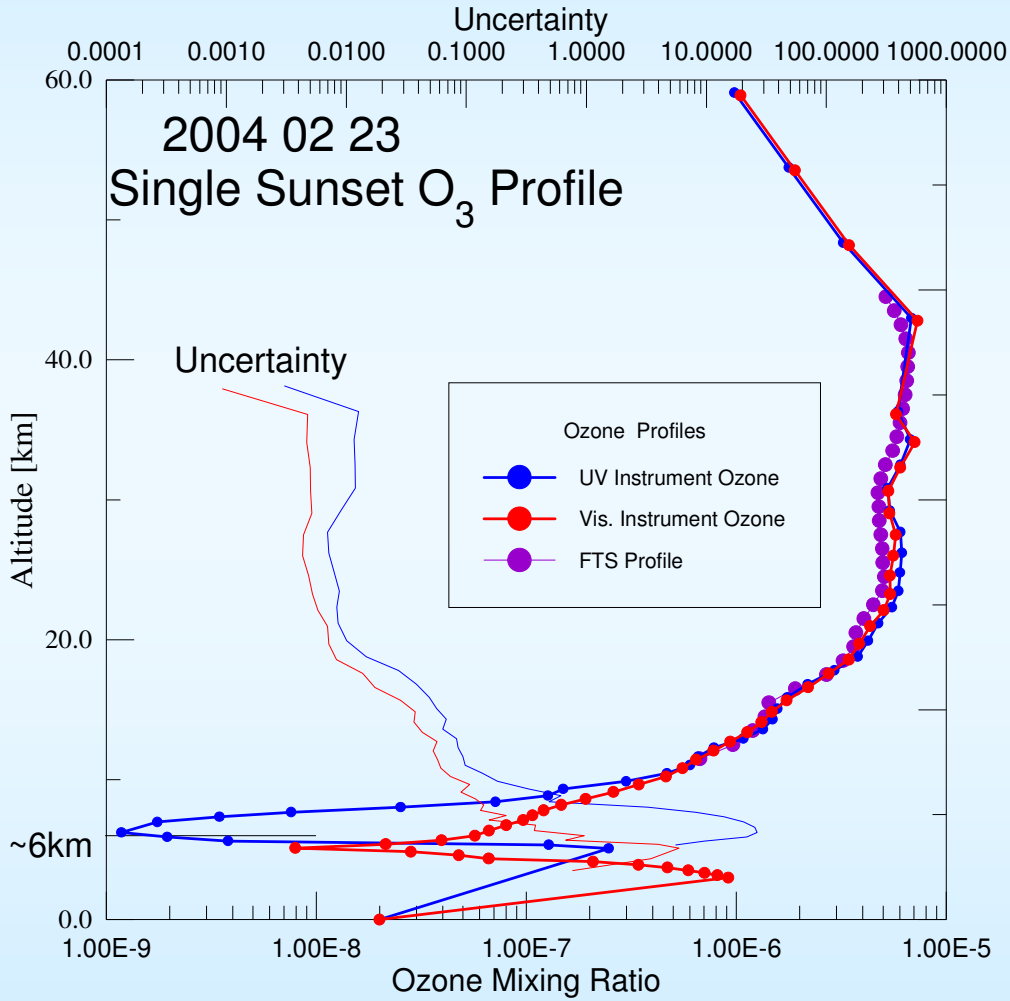
- At altitudes above ~35 km, the percentage differences have decreased by ~5%
- Criteria used: ±5º lat. and ±10º long. , ±6 hr; ~35 profiles

Claire Waymark, in progress

MAESTRO

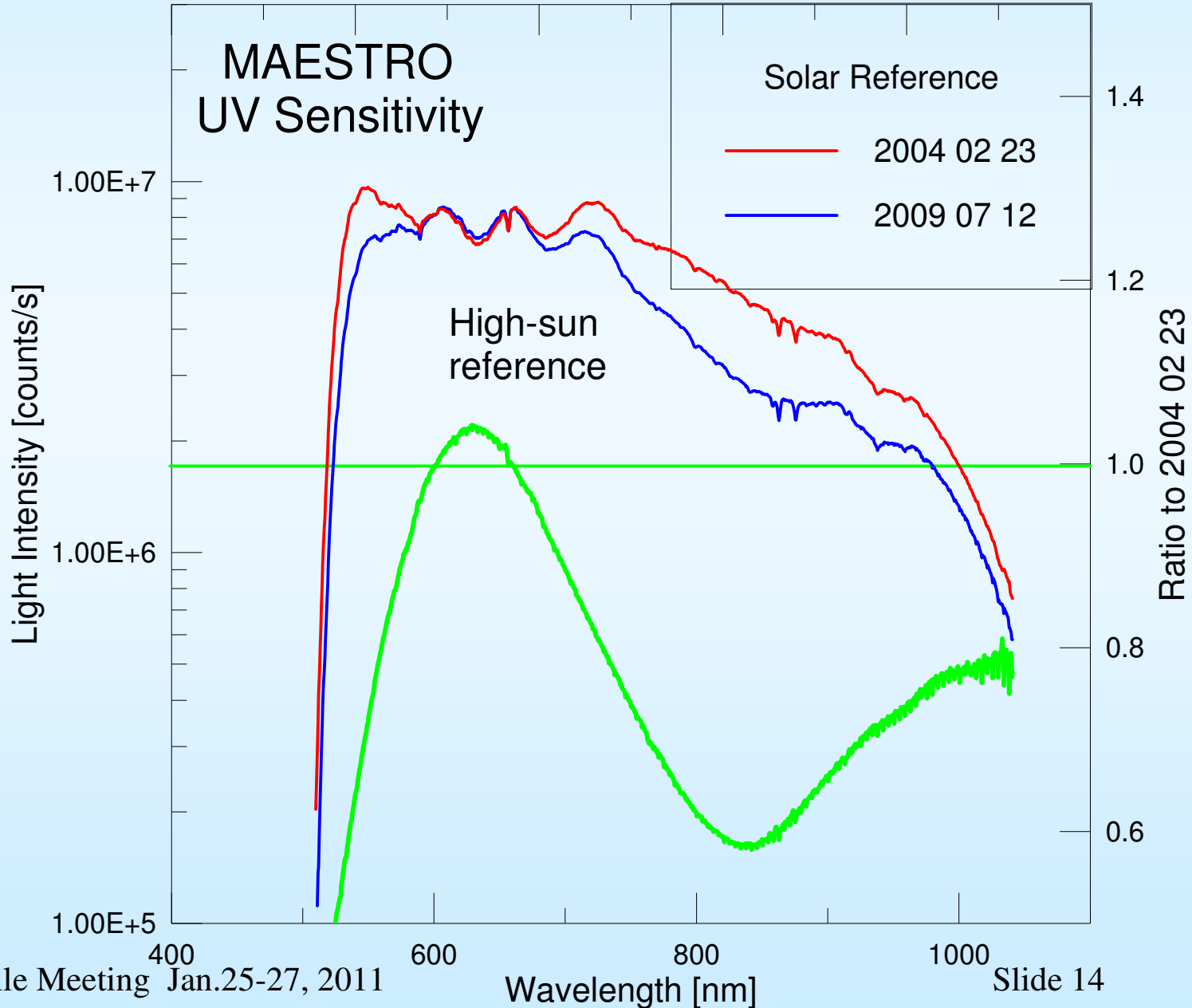
- Dual concave holographic diffraction grating spectrophotometers
- RETICON Photodiode array detectors

- MAESTRO profiles (version 1.2):
  - O_3, NO_2, and total optical depth
- Version 3.0 under test (problems getting the operational version going)
  - Includes aerosol optical depth & profiles
  - Water vapour profiles



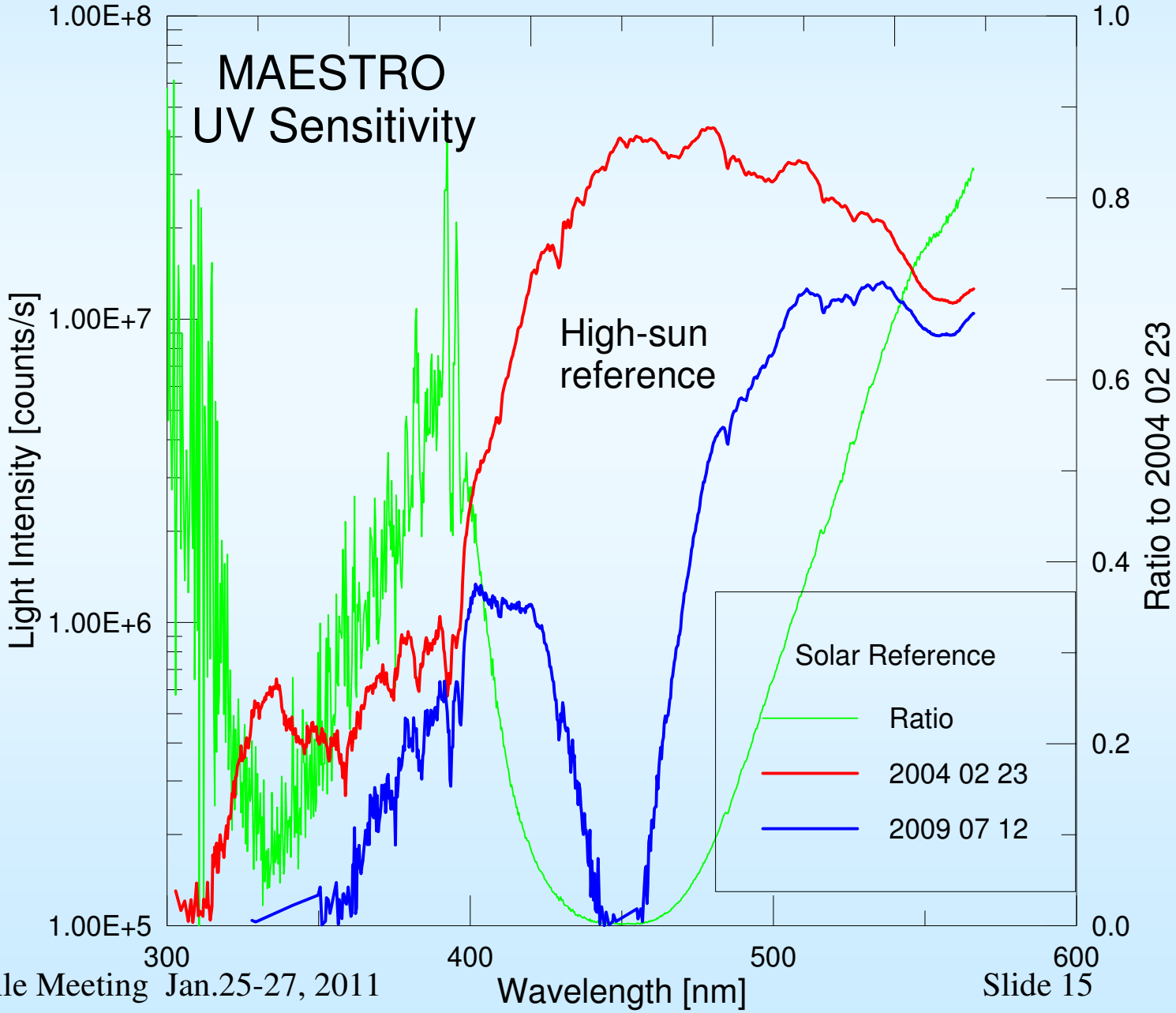
Long-term sensitivity changes - Vis

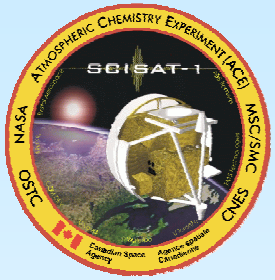
Visible high-sun reference spectra 2004 c.f. 2009



Long-term sensitivity changes - UV

UV
high-sun
reference spectra
2004 c.f. 2009





SOAR

Solar Occultation for Atmospheric Research

Three instruments make up SOAR payload

- SOAR-IR

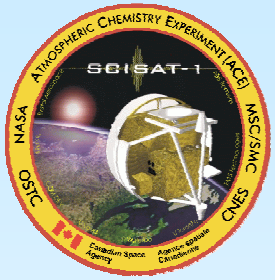
– Infrared Fourier transform spectrometer to measure broad range of species (almost forty) and temperature and pressure Target vertical resolution 1.5 km

- SOAR-OPTICAL

– UV-visible-near-infrared spectrometer to provide very high resolution (~0.5 km) profiles of aerosols and key species

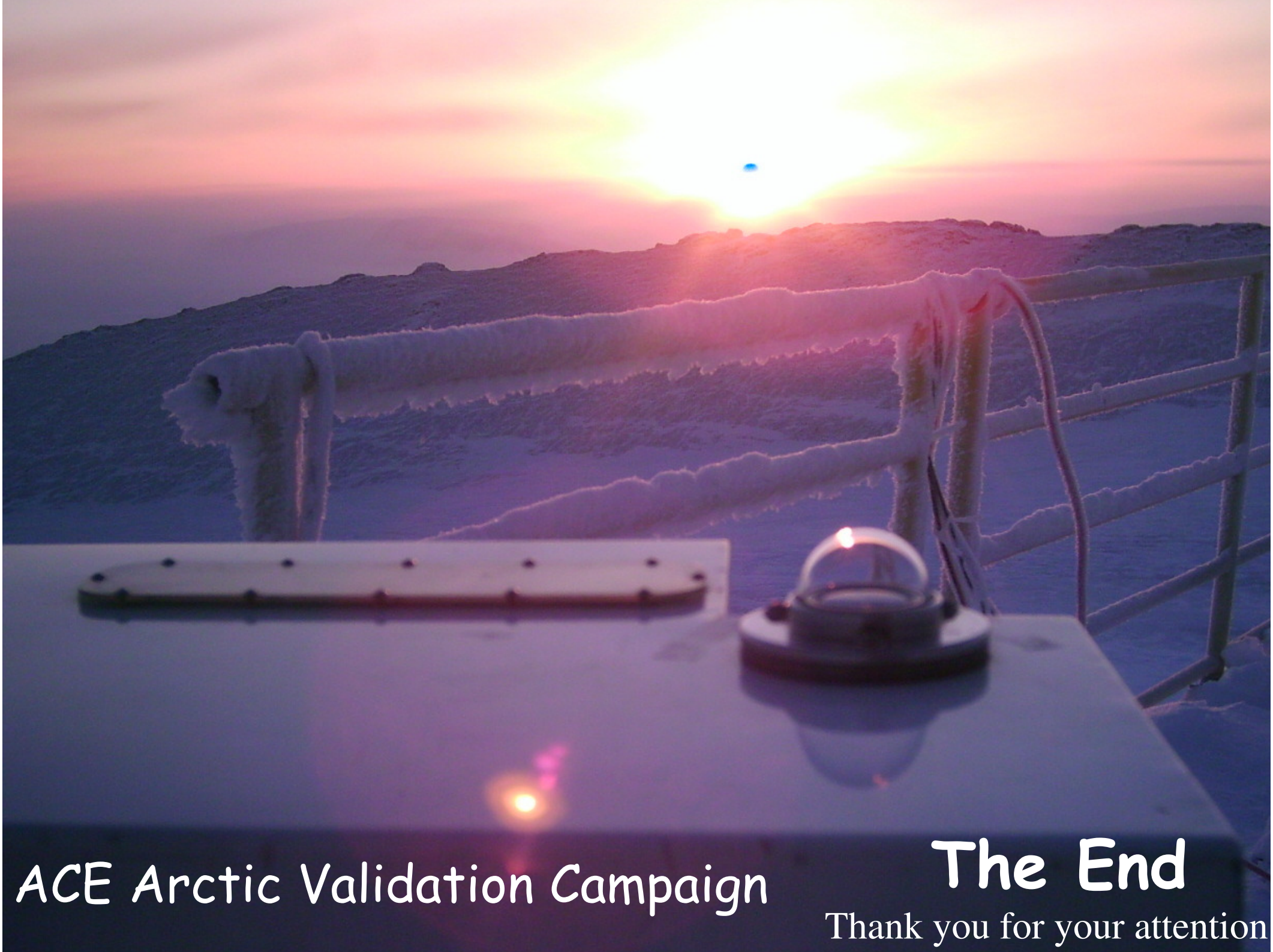
- SOAR-IMAGER

– Solar imaging cameras to provide profiles of aerosols and clouds and enhanced pointing information to derive altitudes, temperatures and densities



Conclusions

- The overlap period with SAGE has provided a good inter-calibration for SAGE v. ACE
- The hardware appears to be robust and stable
- Satellite appears to have experienced little degradation
- A future mission providing this sort of information is needed
- Overlap with ACE is HIGHLY desirable
- The SOAR mission has been proposed but has not been selected
- A small ‘constellation’ of instruments capable of the UV-Vis-NIR component could provide global coverage that would be useable in a data assimilation role


ACE Arctic Validation Campaign
The End
Thank you for your attention