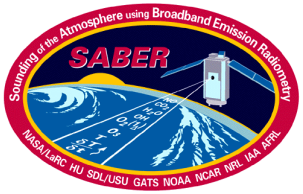

SABER Level 2A Processing

Chris Mertens
Science Data Analyst
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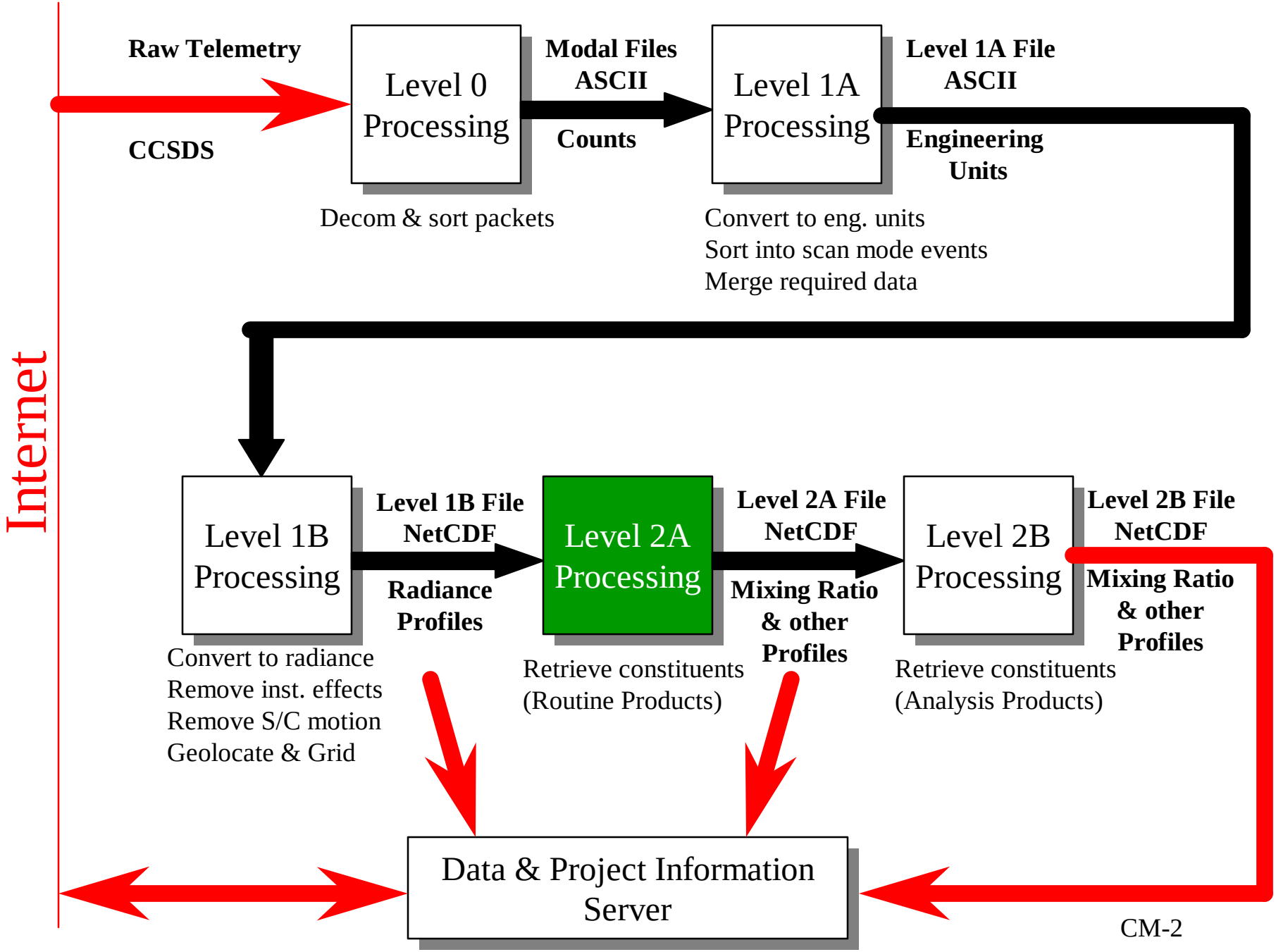

Internet
Raw Telemetry
CCSDS
Level 0 Processing
Decom & sort packets
Modal Files ASCII
Counts
Level 1A Processing
Convert to eng. units
Sort into scan mode events
Merge required data
Level 1A File ASCII
Engineering Units
Level 1B Processing
Convert to radiance
Remove inst. effects
Remove S/C motion
Geolocate & Grid
Level 1B File NetCDF
Radiance Profiles
Level 2A Processing
Retrieve constituents
(Routine Products)
Level 2A File NetCDF
Mixing Ratio & other Profiles
Level 2B Processing
Retrieve constituents
(Analysis Products)
Level 2B File NetCDF
Mixing Ratio & other Profiles
Data & Project Information Server
CM-2

SABER Level 2A Processing Heritage

- GATS Heritage for Level 2A Processing:

Software & Lessons Learned from:

- HALOE Level 2
- LIMS Level 2
- MASDA (LIMS reprocessing) Level 2
- Retrieval Algorithms/Support
  - ISAMS
  - CLAES
  - CRISTA

SABER Level 2A
System Requirements

Input: **Level 1B File (1 per day)**

- Engineering Units
- Grouped by Atmospheric Scan

Output: **Level 2A File (1 per day)**

- Volume mixing ratios and emission rates
- Grouped by Atmospheric Scan

Processing:

- Retrieve Level 2 routine products
  - kinetic temperature, pressure, and density
  - volume mixing rations (vmr)
  - volume emission rates (VER)
- Quality check

SABER Routine Products: Estimated Accuracies and Precisions

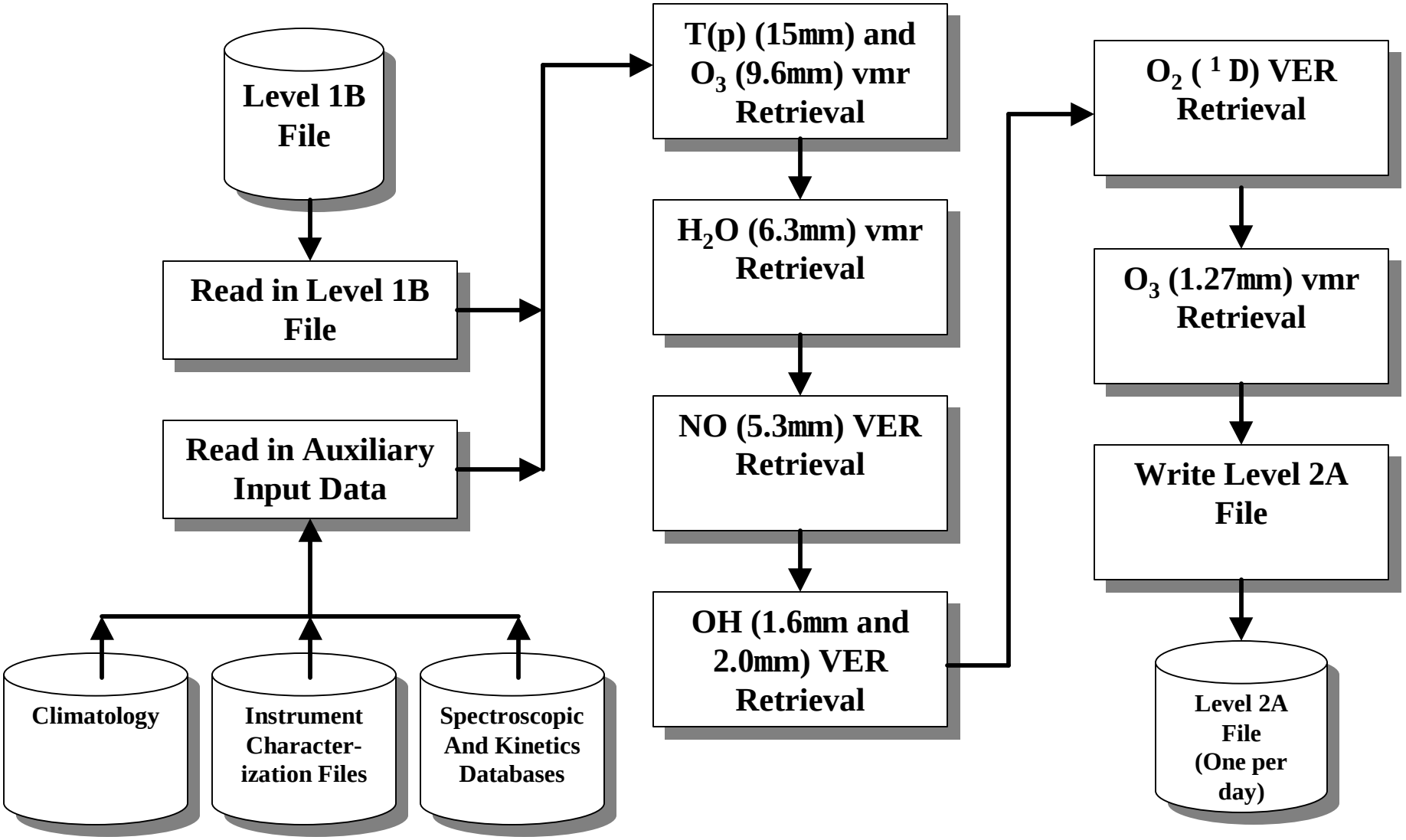
Parameter	Measurement Range	Accuracy	Precision
Temperature	10-130 km	1.5K, 15-80 km 4.0K, 80-100 km	0.5K, 15-70 km 1.0K, 70-80 km 2.0K, 80-100 km
O_3 (9.6μm)*	15-100 km	20%, 15-90 km 30%, 90-100 km	≤ 5%, 15-70 km 20%, 70-90 km
O_3 (1.27μm)**	50-105 km	20%, 50-105 km	10%, 50-85 km 15%, 85-105 km
H_2O (6.3μm)	15-80 km	20%, 15-70 km 30%, 70-80 km	10%, 20-70 km 25%, 70-80 km
OH (ν)+	80-100 km	3%, 80-90 km 5%, 90-100 km	0.1%, 80-90 km 5%, 90-100 km
O_2 ($^1\Delta$)+	50-105 km	3%, 50-90 km	0.05%, 50-70 km 0.2%, 70-80 km 1.0%, 80-90 km
NO(ν)+	90-180 km	5%, 100-170 km	3%, 100-150 km 5%, 150-170 km

* Nighttime accuracy estimates. Daytime accuracy degrades due to Non-LTE.

** Daytime measurement only. Under twilight conditions accuracy degrades due to difference in chemical lifetime of O_3 and radiative lifetime of $O_2(^1\Delta)$.

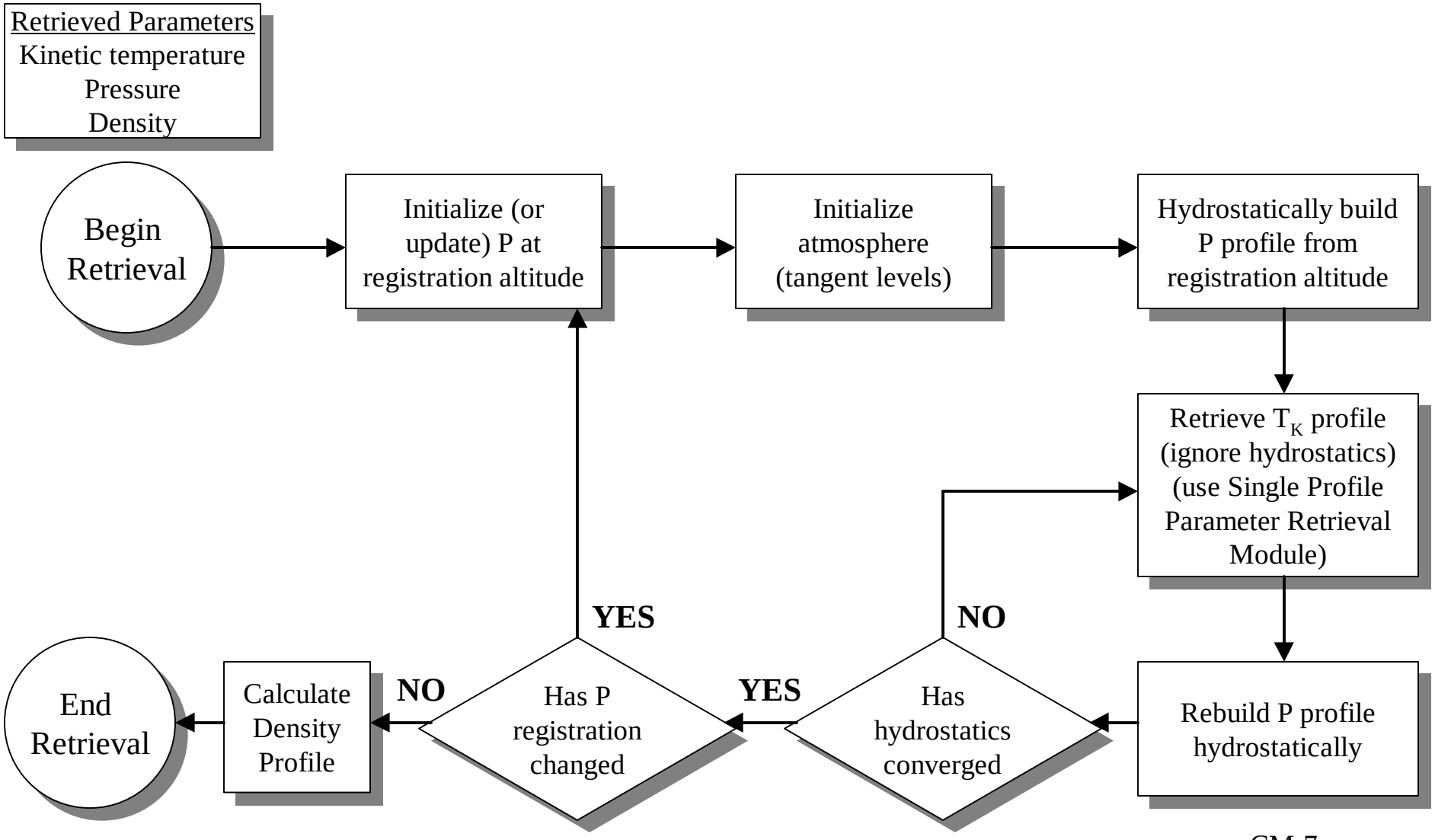
\+ Applies to daytime, nighttime, and twilight.

SABER Level 2A System Design



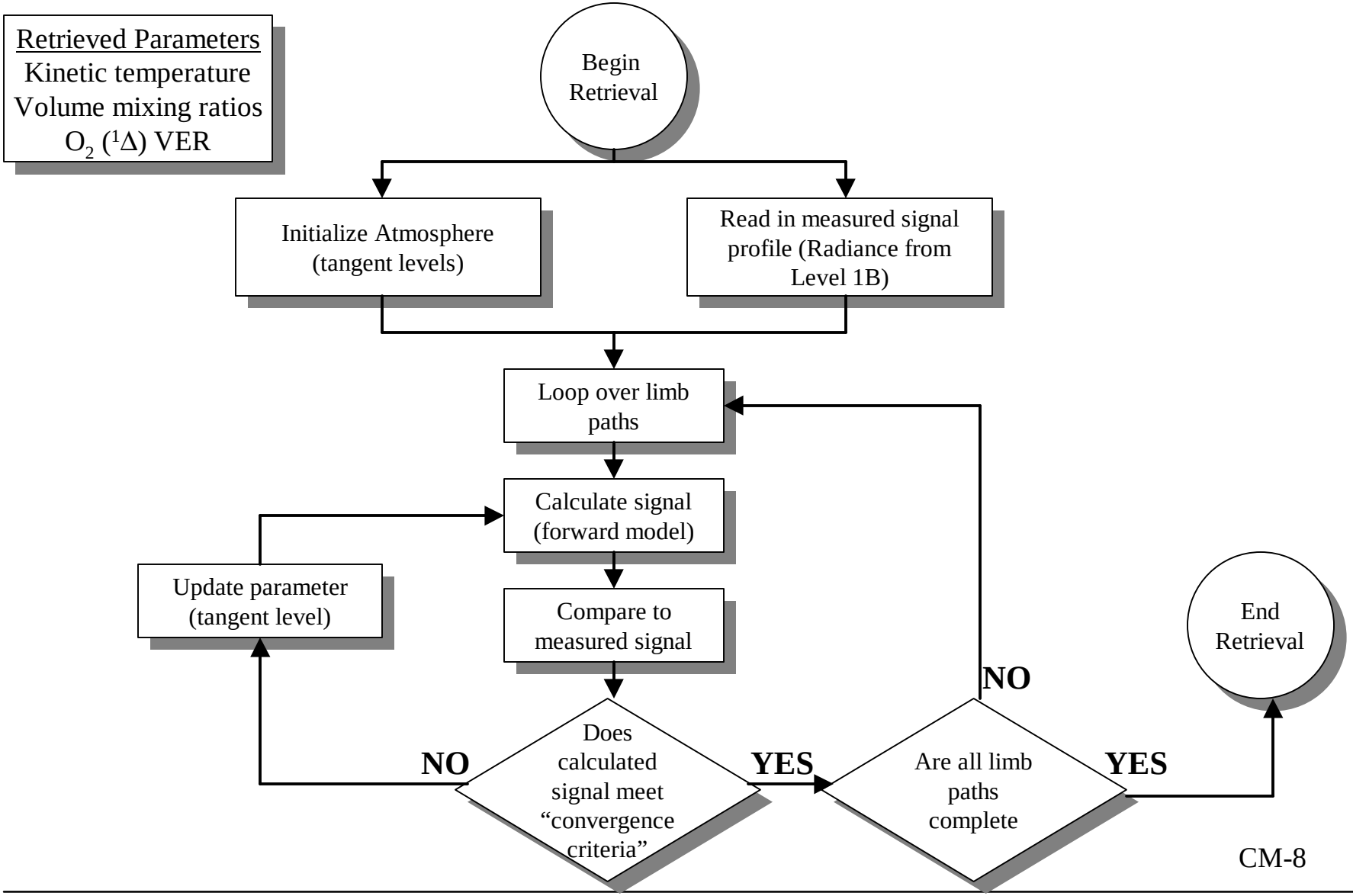
CM-6

SABER Level 2A
Single Profile $T_K(P)$ Retrieval Module (SPTPRM)



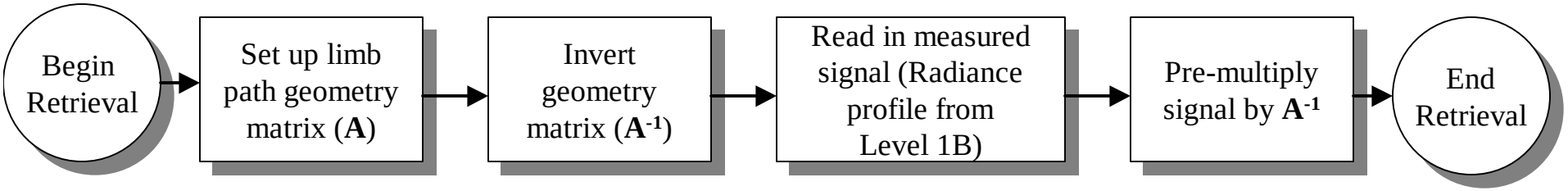
CM-7

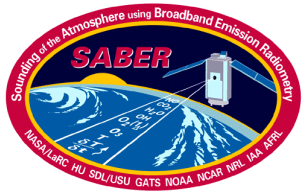
SABER Level 2A
Single Profile Parameter(s) Retrieval Module (SPPRM)



SABER Level 2A
Single Profile VER Retrieval Module (SPVERRM)

Retrieved Parameters
NO (5.3µm) VER
OH (1.6µm) VER
OH (2.0µm) VER





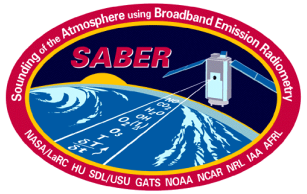
CSCI: Read in Level 1B Files Requirements

Requirements:

(1) Open and read Level 1B NetCDF; file for current day.
(2) Sort and store data by scanning event and channel identification number.

Testing:

Test	Requirement
• Write Level 1B file to Ascii formatted file.	1
• Read in Level 1B NetCDF file and dump to Ascii formatted file.	1
• Make point-by-point comparison of NetCDF-to-Ascii file with direct Ascii file.	1
• Dump data sorted by scanning event and channel identification number. Make point-by-point comparison.	2



CSCI: Read in Auxiliary Files Requirements

Requirements:

(1) Open and read instrument characterization files from Level 1.
(2) Open and read climatological database.
(3) Open and read spectroscopic and kinetics databases.

Testing:

Test	Requirement
• Open and read in data.	1, 2, 3
• Dump data and make point-by-point comparison.	1, 2, 3

CSCI: T(P) (15μm) and O_3 (9.6 μm) Retrieval Requirements

Requirements:

(1) Retrieve T, P, and O_3 vmr for each scanning event supplied by Level 1B file.

(2) Compute ρ and Z from retrieved T(P).

Testing:

Test	Requirement
• Create synthetic Level 1B radiance from model atmosphere.	1
• Retrieve T(P) and O_3 vmr from synthetic radiances.	1
• Compare retrieved and model atmosphere T(P) and O_3 vmr.	1
• Compare computed and model atmosphere ρ and Z.	2

CSCI: H_2O (6.3μm) vmr Retrieval Requirements

Requirements:

(1) Retrieved T(P) as input.
(2) Retrieve H_2O vmr for every scanning event supplied by Level 1B file.

Testing:

Test	Requirement
• Dump input T(P) data and compare to output from respective CSCI.	1
• Create synthetic Level 1B radiances from model atmosphere.	2
• Retrieve H_2O vmr from synthetic radiances.	2
• Compare retrieved and model atmosphere H_2O vmr.	2

CSCI: NO (5.3μm) VER Retrieval Requirements

Requirements:

(1) Retrieved T(P) as input.
(2) Retrieve NO VER for every scanning event supplied by Level 1B file.

Testing:

Test	Requirement
• Dump input T(P) data and compare to output from respective CSCI.	1
• Create synthetic Level 1B radiances from model atmosphere.	2
• Retrieve NO VER from synthetic radiances.	2
• Infer NO vmr and compare to model atmosphere.	2

Requirements:

(1) Retrieved T(P) as input.
(2) Retrieve OH VER for every scanning event supplied by Level 1B file.

Testing:

Test	Requirement
• Dump input T(P) data and compare to output from respective CSCI.	1
• Create synthetic Level 1B radiances from model atmosphere.	2
• Retrieve OH VER from synthetic radiances.	2
• Infer OH vmr and compare to model atmosphere.	2

CSCI: O_2 ($^1\Delta$) (1.27μm) VER Retrieval Requirements

Requirements:

(1) Retrieved T(P) as input.

(2) Retrieve O_2 ($^1\Delta$) VER for every scanning event supplied by Level 1B file.

CSCI: O_2 ($^1\Delta$) VER Retrieval Testing

Testing:

Test	Requirement
• Dump input T(P) data and compare to output from respective CSCI.	1
• Create synthetic Level 1B radiances from model atmosphere.	2
• Retrieve O_2 ($^1\Delta$) VER from synthetic radiances.	2
• Infer O_2 vmr and compare to model atmosphere.	2

CSCI: O_3 (1.27μm) vmr Retrieval Requirements

Requirements:

(1) Retrieved T(P) as input.
(2) Retrieved O_3 (9.6μm) vmr below 50km as input.
(3) Retrieved O_2 ($^1\Delta$) VER as input.
(4) Retrieve O_3 vmr for daytime scanning events supplied by Level 1B file.

CSCI: O_3 (1.27μm) vmr Retrieval Testing

Testing:

Test	Requirement
• Dump input T(P), O_3 vmr, and O_2 ($^1\Delta$) VER data and compare to their respective CSCI's which generated them.	1, 2, 3
• Create synthetic Level 1B radiances from model atmosphere.	4
• Retrieve O_3 (1.27μm) vmr from synthetic radiances.	4
• Compare retrieved O_3 (1.27μm) vmr with model atmosphere.	4

Requirements:

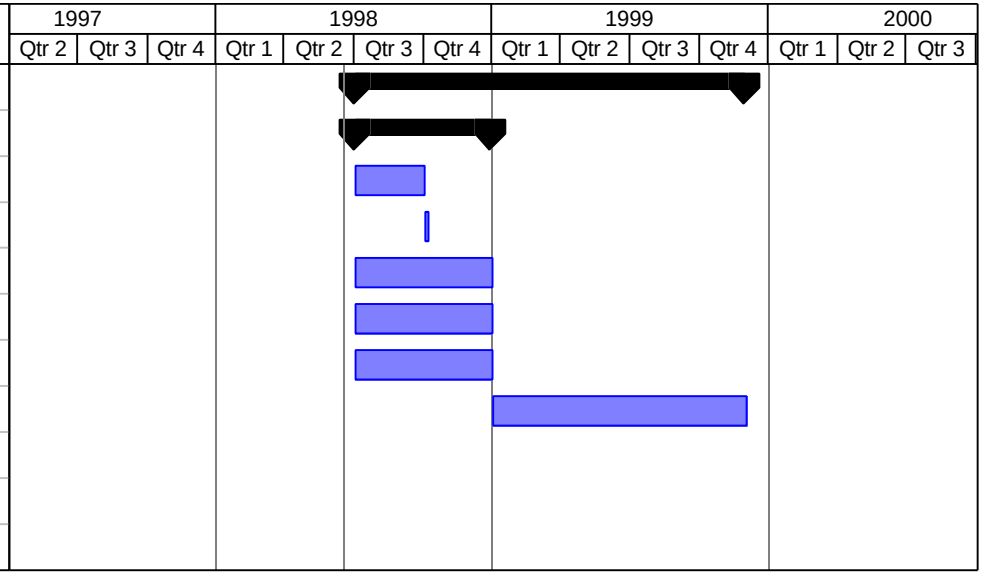
(1) Write Level 2A products to NetCDF file for current day.

Testing:

Test	Requirement
• Write Level 2A file to Ascii formatted file.	1
• Read Level 2A NetCDF file and dump to Ascii formatted file.	1
• Make point-by-point comparison of NetCDF-to-Ascii file with direct Ascii file.	1

SABER Level 2A Processing Schedule

Task Name	Duration	Start	Finish
1.6 Level 2A	**370 days**	**Wed 7/1/98**	**Tue 11/30/99**
Write Level 2A Software	**132 days**	**Wed 7/1/98**	**Thu 12/31/98**
Forward model setup NLTE	13.2 wks	Wed 7/1/98	Wed 9/30/98
Test Forward Model Setups	1 day	Thu 10/1/98	Thu 10/1/98
Volume emission retrieval	26.4 wks	Wed 7/1/98	Thu 12/31/98
Retrieval-LTE	26.4 wks	Wed 7/1/98	Thu 12/31/98
Retrieval-NLTE	26.4 wks	Wed 7/1/98	Thu 12/31/98
Test and Debug	**238 days**	**Fri 1/1/99**	**Tue 11/30/99**



SABER Level 2A Processing Risk/Mitigation

Risk

(1) Staff size.

(2) Non-LTE Retrieval algorithm development challenging.

(3) Non-LTE Retrieval algorithms are computationally time consuming.

Mitigation

(1) GATS inhouse expertise.

- Over a decade of experience developing satellite retrieval systems.

- Lessons learned from LIMS, HALOE, CLAES, ISAMS, and CRISTA.

(2) Close interaction with SABER Science Team members.

- Science team consists of world experts in non-LTE effects and upper atmospheric physics and chemistry.

- Prototype retrieval algorithms in place for all routine products except T_K.

- Prototype T_K retrieval algorithm underway.

(3) Expertise from Science Team members to speed up algorithms, and utilize PVM processing.

SABER Level 2A Processing Summary

- Level 2A Processing design complete.
- Prototype T_K retrieval algorithm underway. Prototype algorithms for remaining routine products in place.
- Utilize GATS inhouse expertise migrating prototype software to operational software.
- Tests and delivery dates scheduled.
- Extensive validation during software development through interaction with Science Team members.