Vincent Van Gogh, "The starry night"

Simulation results of a MC code for atmospheric phenomena

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Atmospheric optical phenomena within EUSO spectral interval (3000 - 4000A)

Airglow

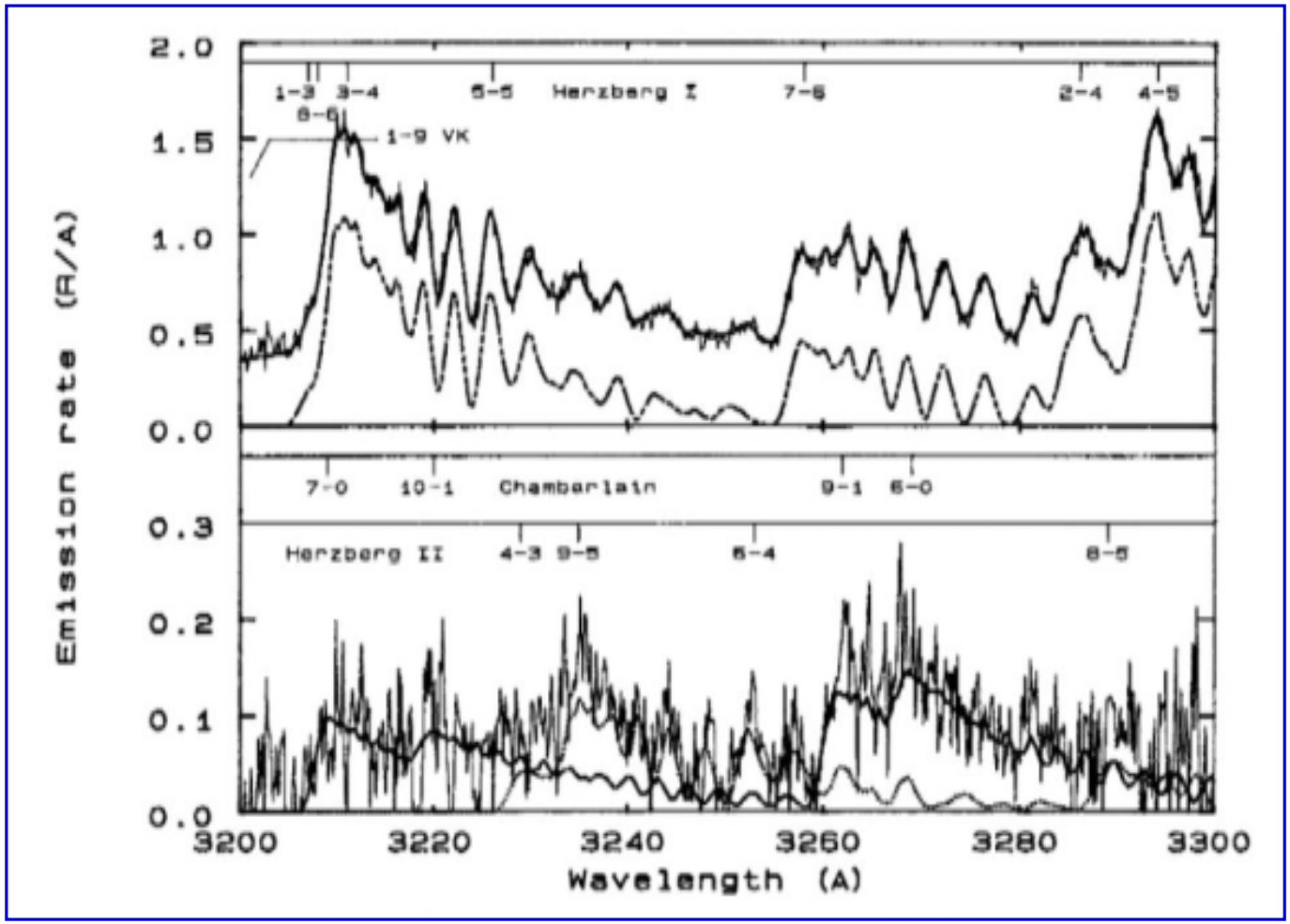
Lightning

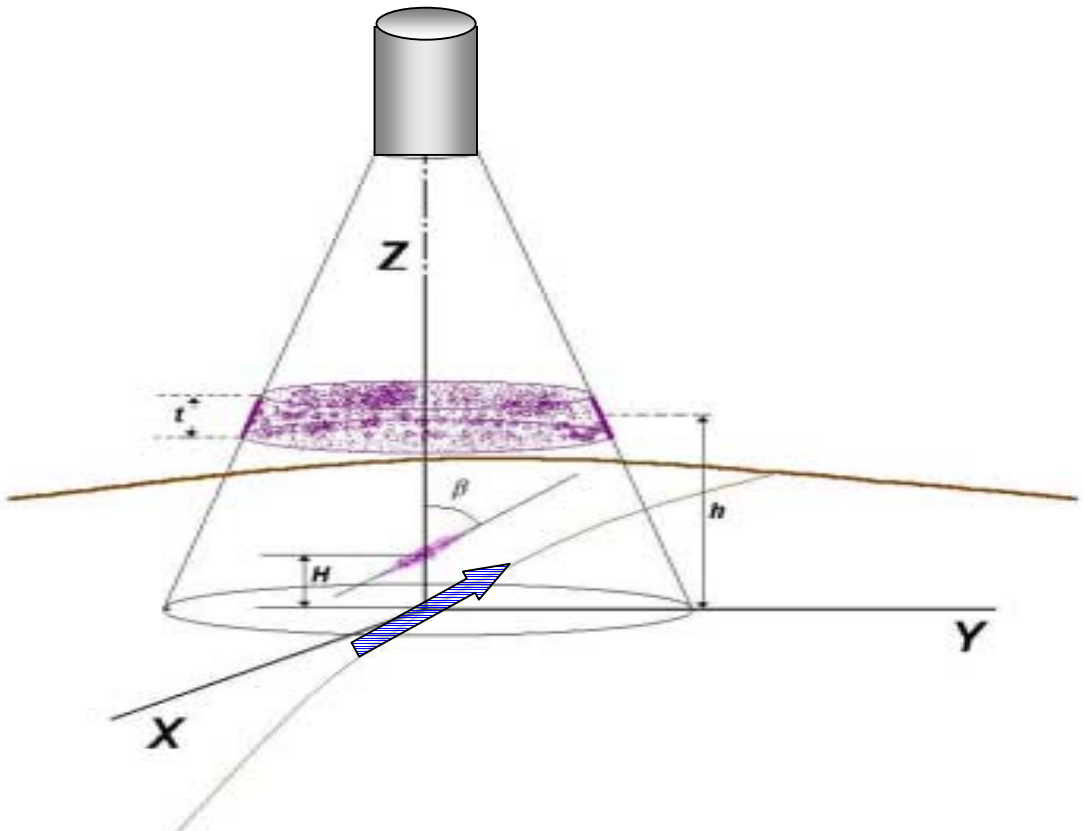
Blue Jets, Blue starters

Meteoroid's tracks

Equatorial aurora

Emissions in the nightglow spectrum




Z
t
β
h
H
Y
X

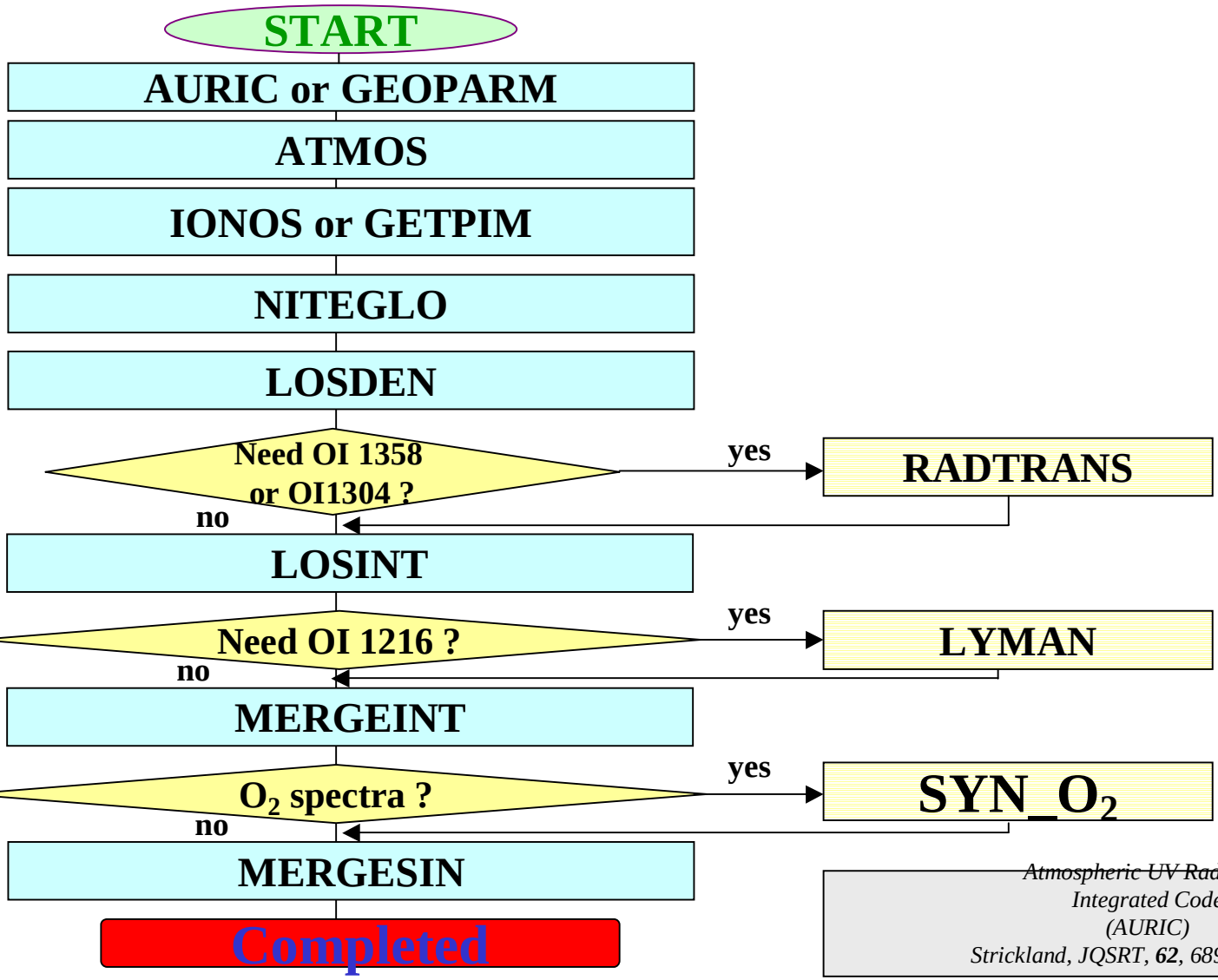
- **Airglow**

Dayglow

atomic	molecular
OI(1305A)	N_2LBH 1250-2400
OI(2972A)	N_2VK 1500-6900
OI(5577A)	N_2^+1NG 3000-7100
OI(6300A)	NOγ 1800-3500
NII(2139A)	

Nightglow

atomic	molecular
OI(1305A)	O_2 Herz I 2400-4900A
OI(2972A)	O_2 Herz II 2500-4700A
OI(6300A)	O_2 Cham 3000-5000A
OI(5577A)	OH, ….



Atmospheric UV Radiance Integrated Code (AURIC)
*Strickland, JQSRT, **62**, 689-742, 1999*

- **GEOPARM** Selected geophys. parameters (from data base or calculated)
- **ATMOS** Atmospheric Model
- **IONOS (or GETPIM)** Ionospheric Model
- **NITEGLO** O, O_2 metastabile densities and volume emission rates
- **LOSDEN** Line of Sight column densities of O and O_2
- **LOSINT** Line of Sight column molecular intensities
- **MERGEINT** Line of Sight collected into single file
- **MERGENSYN** Synthetic spectra and atomic emissions merged (co-added) to form total radiance spectra
- **RADTRANS** Total OI 1304A and 1356A source func. and LoS intensities
- **LYMAN** HI 1216 A source function and LoS intensity
- **SYN_O_2** Syntetic spectra and atomic emissions merged (co-added) to from total radiance spectra

*AURIC, Strickland, JQSRT, **62**, 689-742, 1999*

Permanent

- $I_{EUSO} = I_{EECR} + I_{atmos.emiss.} + I_{atmos.scatt.} + I_{atmos.abs.} + I_{ground\ refl.}$

$+ I_{clouds\ refl.}$

$+ I_{meteoroids.}$

$+ I_{lightning}$

$+ I_{blue\ jets,\ blue\ starters}$

Time limited

PREMAR-2
A Monte Carlo Code for Radiative Transfer in the Earth's Atmosphere

- **Spectral interval** UV-IR
- **Geometry** Spherical atmosphere
  - » multilayers
  - »
- **Atmospheric model accounts** seasons, aerosol loading, ozone profiles, aerosol type, trace gases, geographical area, etc. specific physical conditions in each laye
- **Variance calculations**
- **using batchs & histories** e.g. 100 000 phot. histories = 100 batchs x 1000 histories

PREMAR-2
Monte Carlo Code for Radiative Transfer in the Earth's Atmosphere

The aim: Increasing of the MC calculations efficiency ***E*** reducing

$$E \sim V*T$$

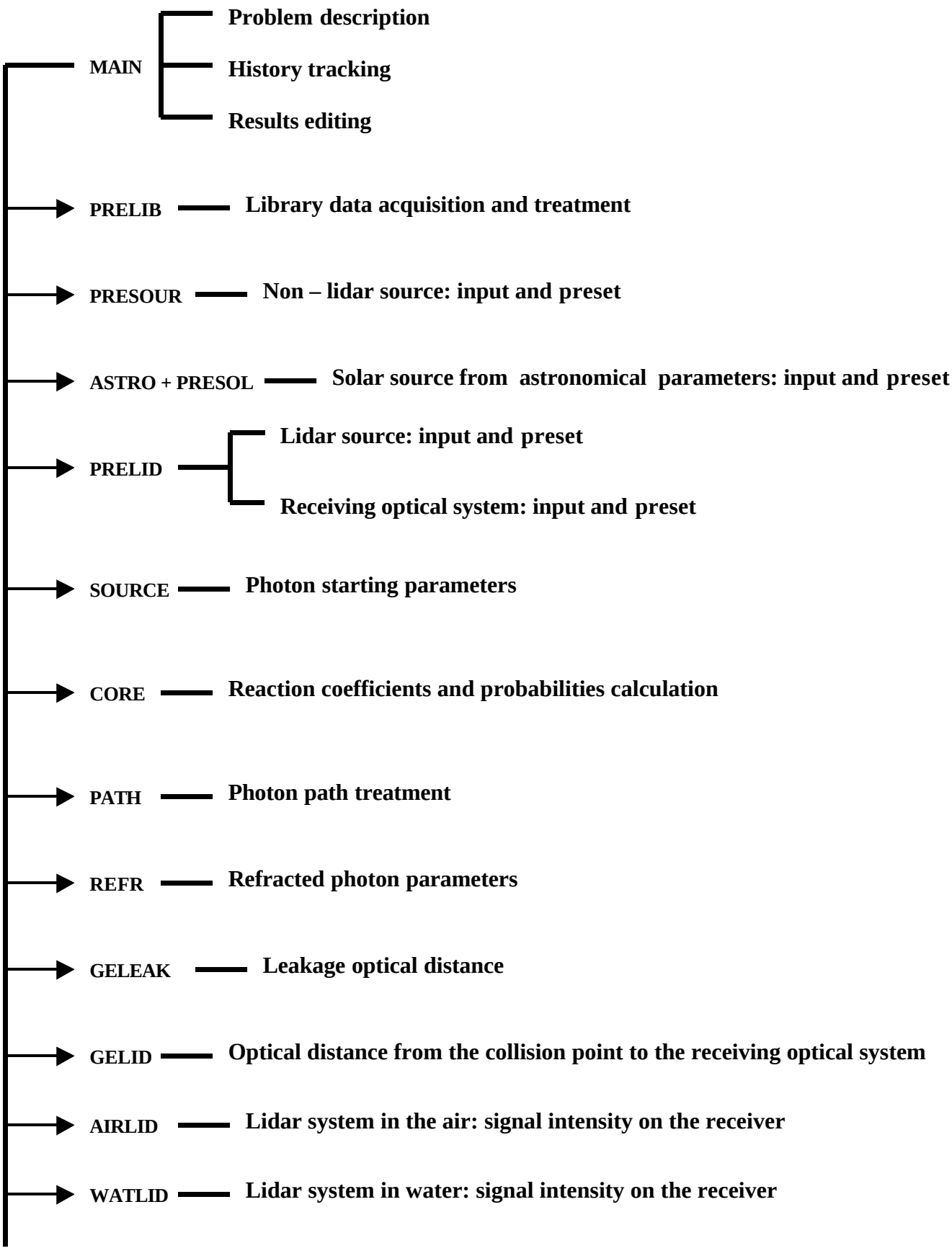
V - variance of the calculations
T - required running time for given V

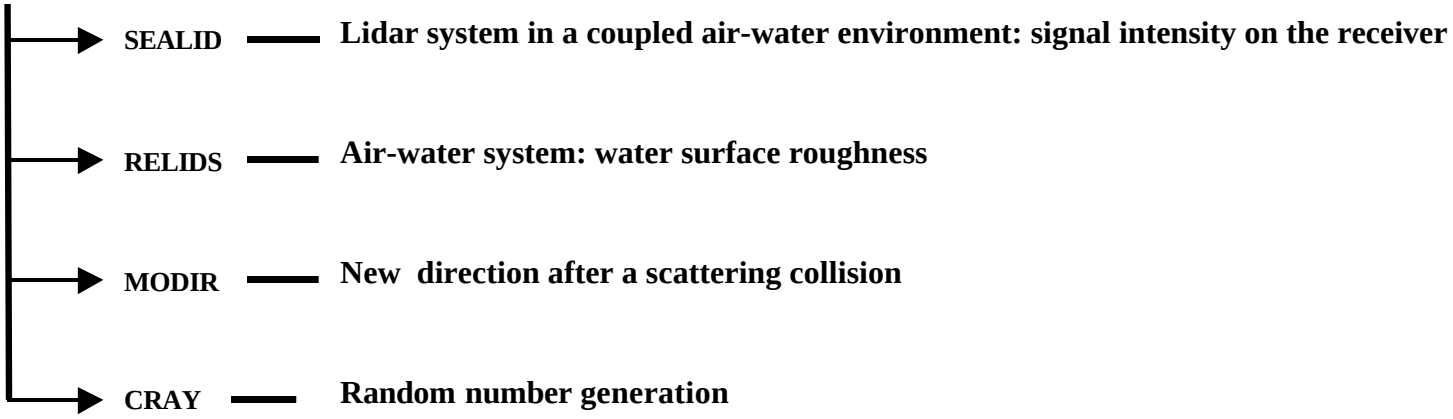
Techniques

- **Forced collisions** — better exploring of the system, allow to increase the collisions of a single particle
- **Local forced collisions** — Allows to avoid the drawbacks cause by particle-reflecting surface interaction
- **Splitting and russian roulette** — Applied to increase the number of the particles entering in a given pre-assigned region and to reduce the number of the particles which must be processed in relatively less important regions;.

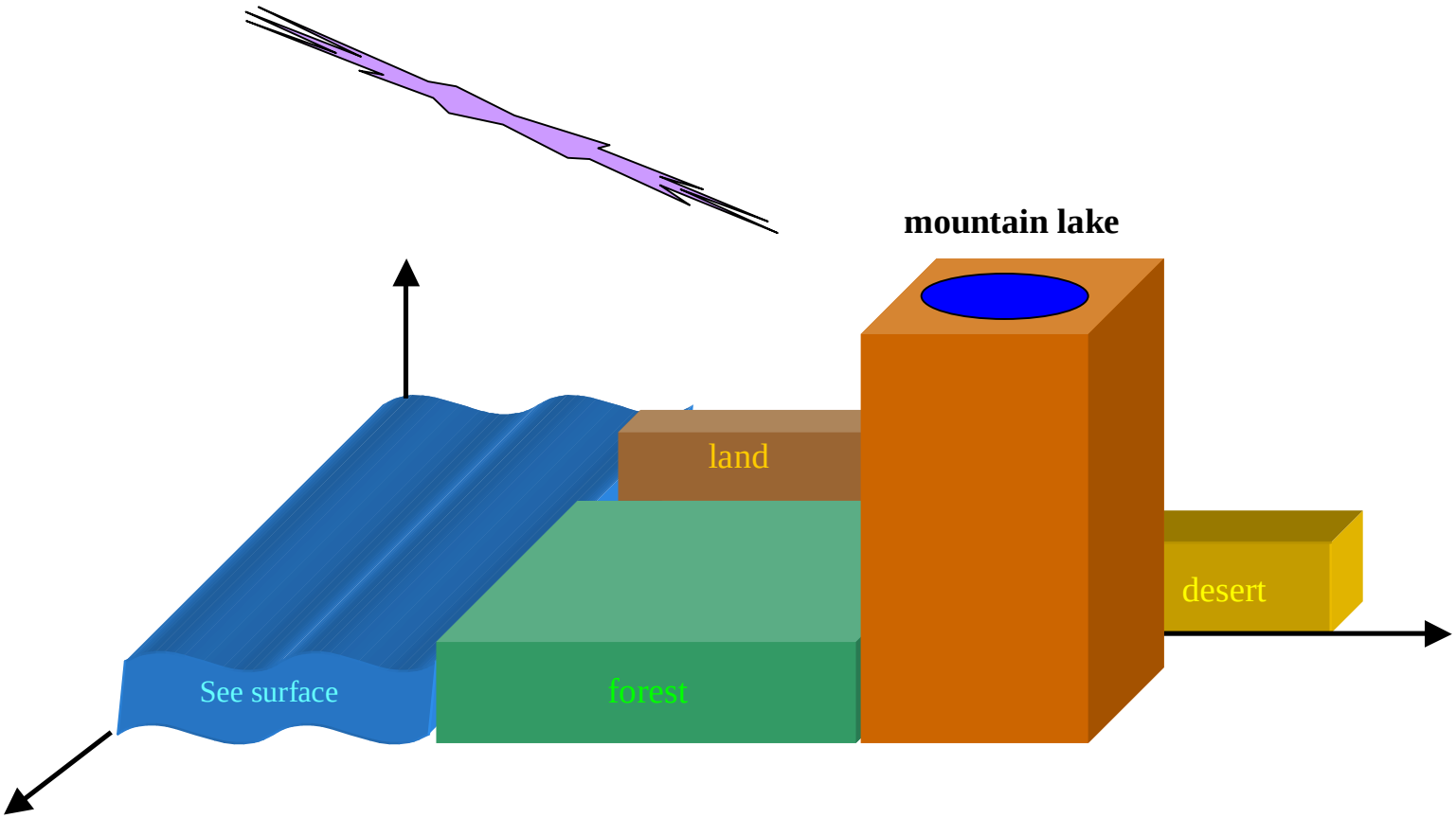
PREMAR-2F

MAIN PROGRAM AND PRINCIPAL SUBRUOTINES

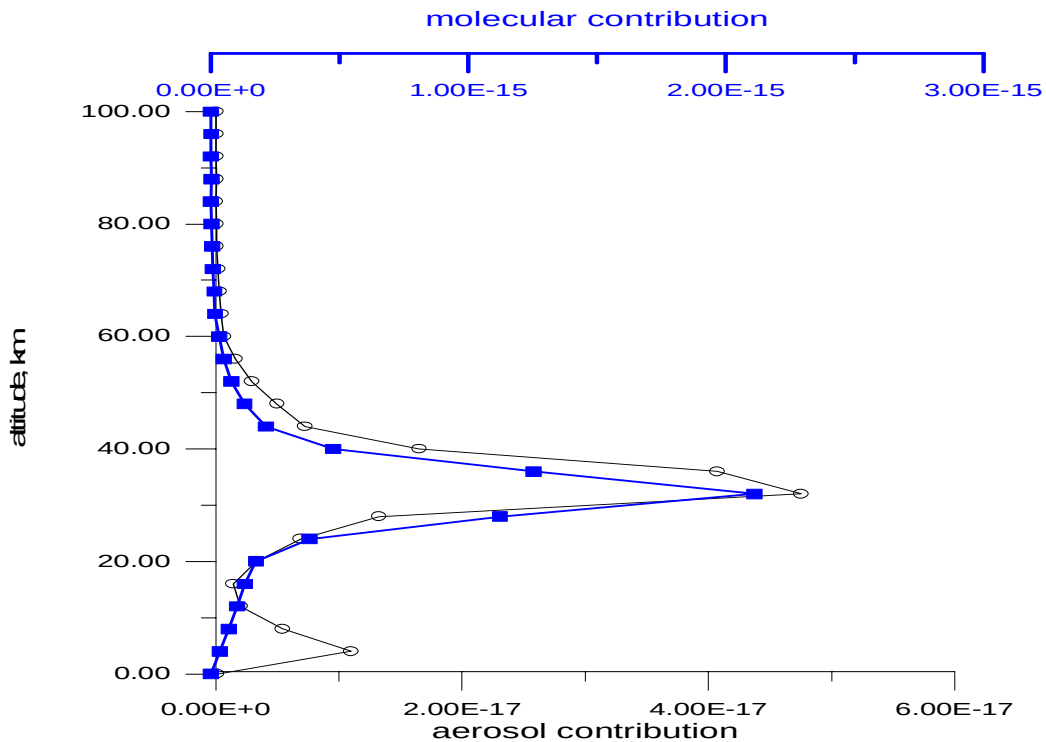


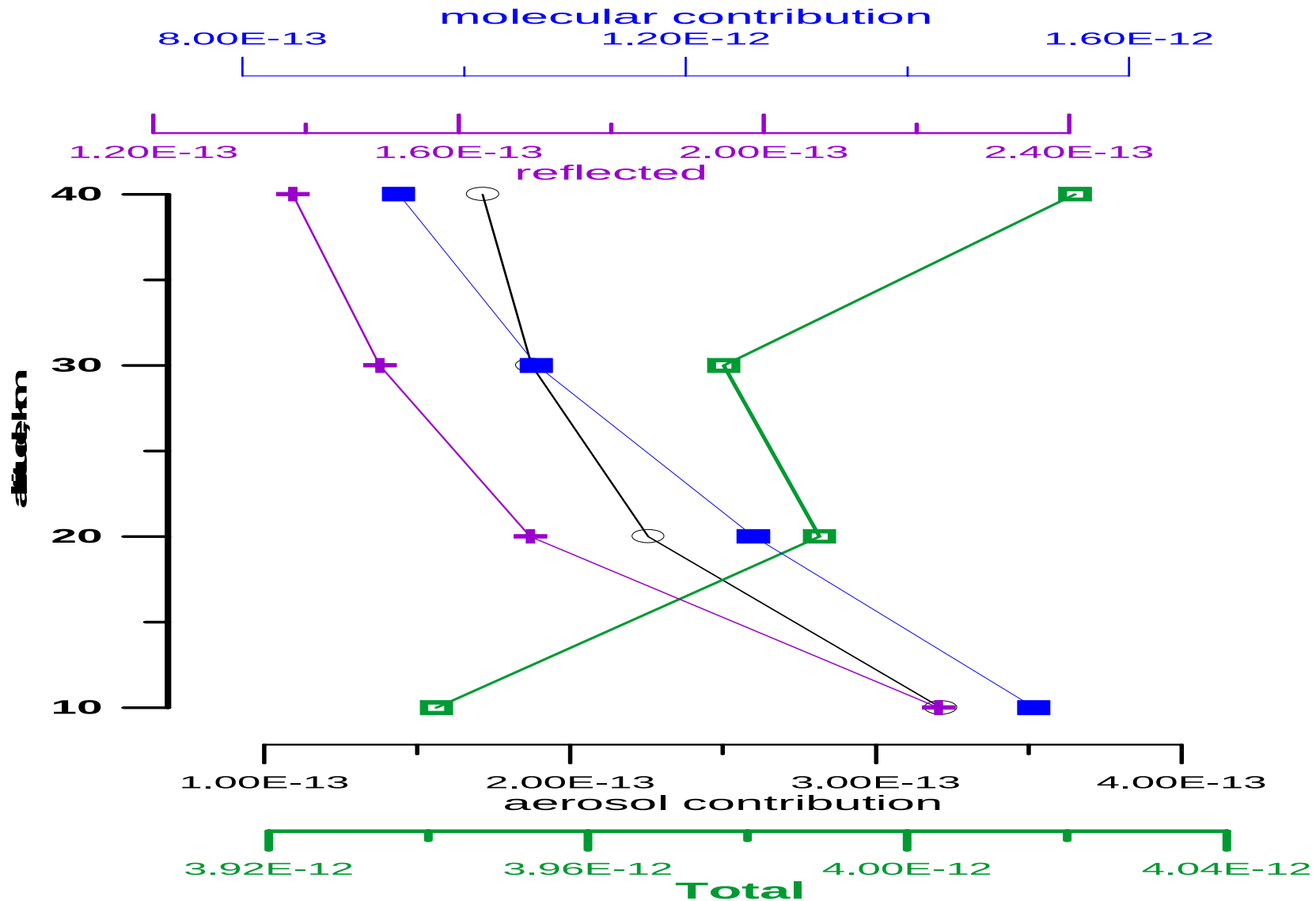

SEALID
Lidar system in a coupled air-water environment: signal intensity on the receiver
RELIDS
Air-water system: water surface roughness
MODIR
New direction after a scattering collision
CRAY
Random number generation

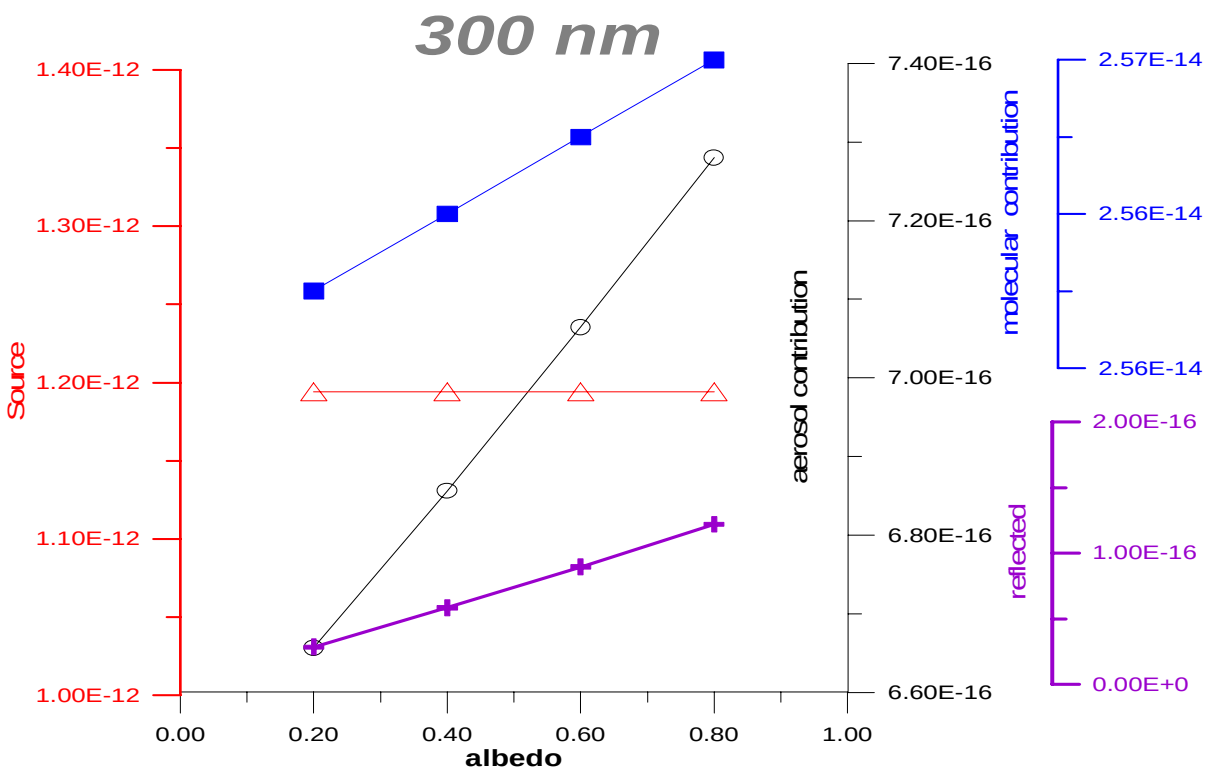
Landscape and albedo simulations

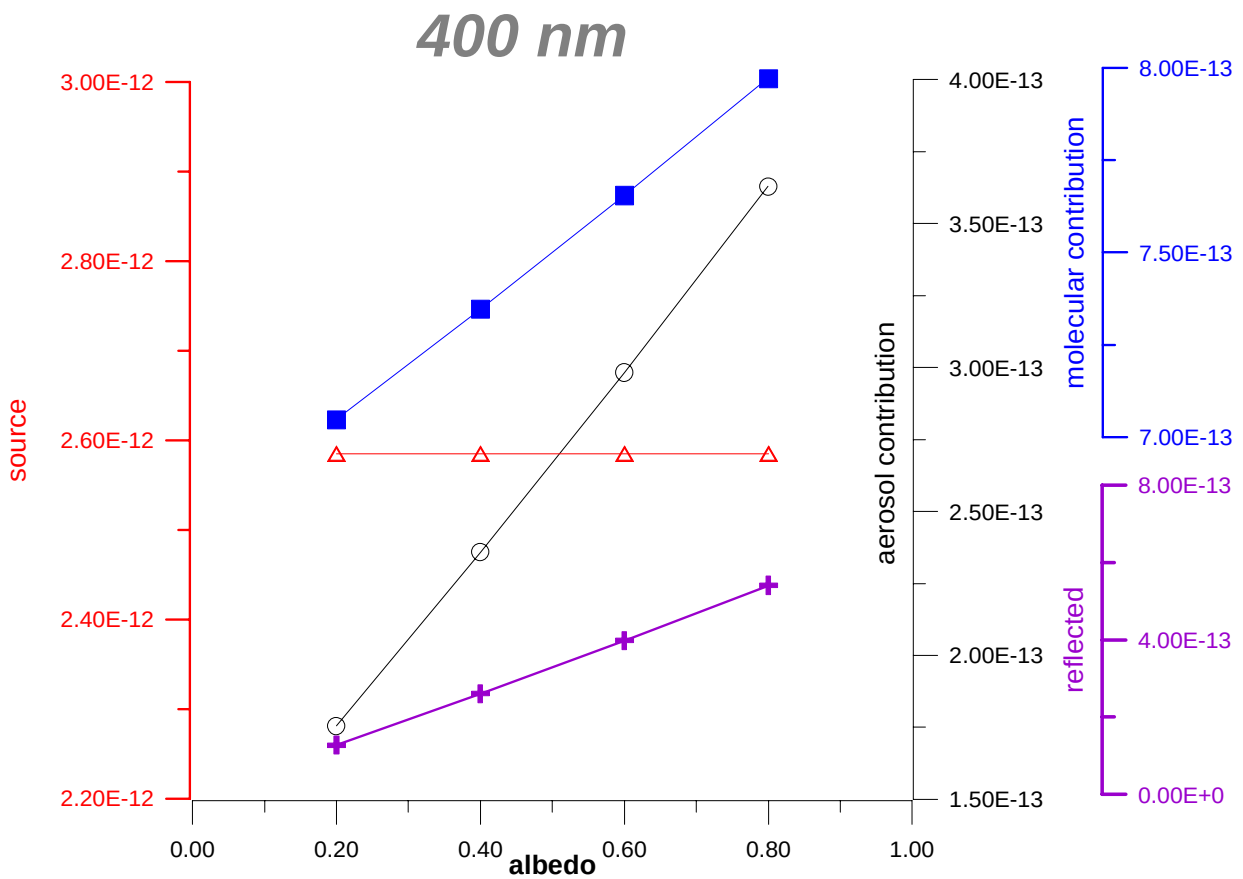


Cylinder, Diameter = 200m,
Length = 10km,
Inclination = 45deg,
Altitude =30 km.




molecular contribution
8.00E-13
1.20E-12
1.60E-12
1.20E-13
1.60E-13
2.00E-13
2.40E-13
reflected
40
30
20
10
1.00E-13
2.00E-13
3.00E-13
4.00E-13
aerosol contribution
3.92E-12
3.96E-12
4.00E-12
4.04E-12
Total


300 nm
1.40E-12
1.30E-12
1.20E-12
1.10E-12
1.00E-12
Source
7.40E-16
7.20E-16
7.00E-16
6.80E-16
6.60E-16
aerosol contribution
2.57E-14
2.56E-14
2.56E-14
molecular contribution
2.00E-16
1.00E-16
0.00E+0
reflected
0.00
0.20
0.40
0.60
0.80
1.00
albedo


400 nm
source
3.00E-12
2.80E-12
2.60E-12
2.40E-12
2.20E-12
aerosol contribution
4.00E-13
3.50E-13
3.00E-13
2.50E-13
2.00E-13
1.50E-13
molecular contribution
8.00E-13
7.50E-13
7.00E-13
reflected
8.00E-13
4.00E-13
0.00E+0
0.00
0.20
0.40
0.60
0.80
1.00
albedo