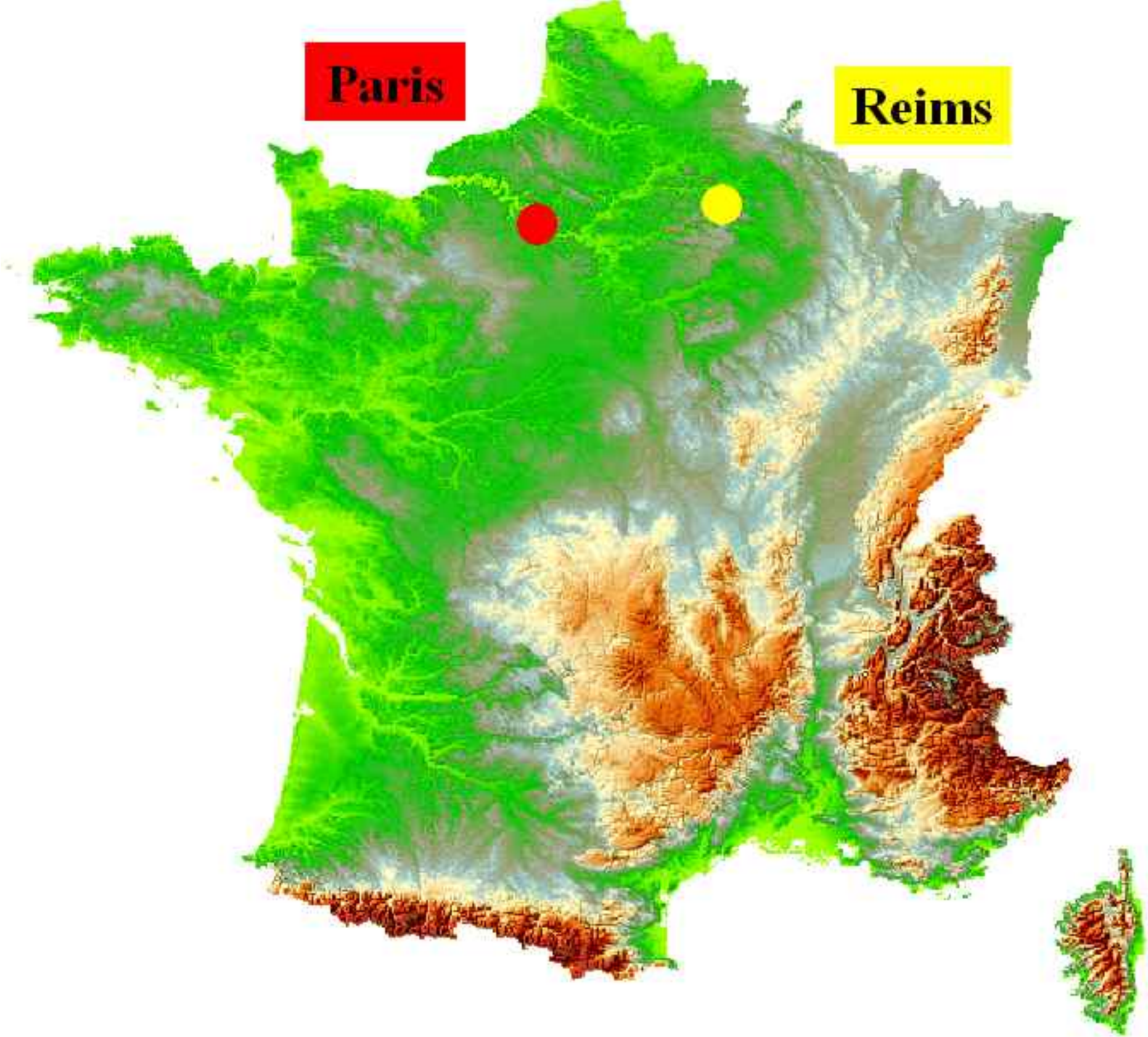

Paris
Reims

Nicole Herman
Applied Physics teacher

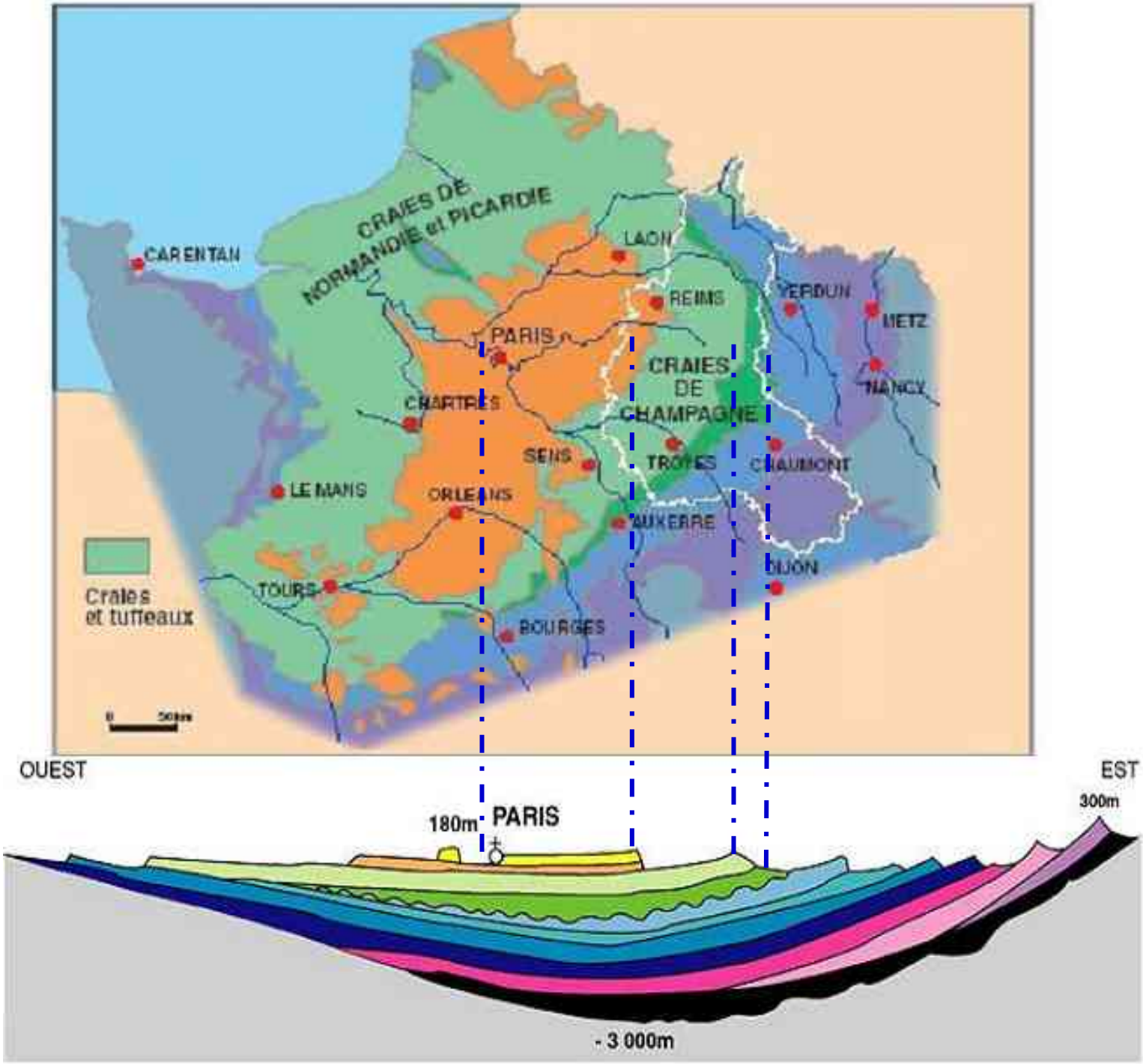
in charge of a scientific workshop
« Space and Environment »

Lycée Roosevelt - Reims

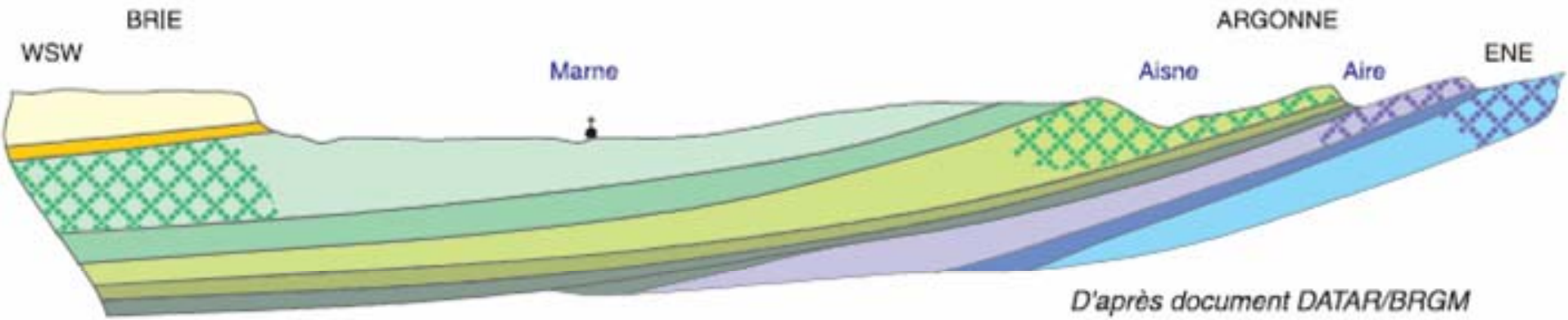
Since 1987, I've been organising workshops for interested students in my school on all the subjects linked with satellite data : local satellite images, oceanographic measurements using drifting buoys... and now a workshop on atmospheric studies. My students (from 15 to 22 years old) organise exhibitions, build slide presentations for national and international competitions and generally present their work every time they do have an opportunity.

Water quality

Groundwaters


CRAIES DE NORMANDIE et PICARDIE
CARENTAN
LAON
REIMS
PARIS
CRAIES DE CHAMPAGNE
CHARTRES
SENS
TROYES
LE MANS
ORLEANS
AUXERRE
TOURS
BOURGES
DIJON
Craies et tuffeaux
OUEST
EST
180m
PARIS
300m
- 3 000m

- Nappes des calcaires tertiaires (Brie, Champigny)
- Couches sablo-argileuses du Sparnacien (nappes captives locales)
- Nappe de la craie, partie libre (Crétacé supérieur)
- Nappe de la craie, partie captive (Crétacé inférieur)
- Craie marneuse, non aquifère
- Craie du Cénomanien inférieur
- Gaize
- Argiles du Gault, non aquifères
- Crétacé inférieur
- Calcaires du Portlandien
- Kimmeridgien
- Lusitanien
- Réseaux aquifères des calcaires jurassiques



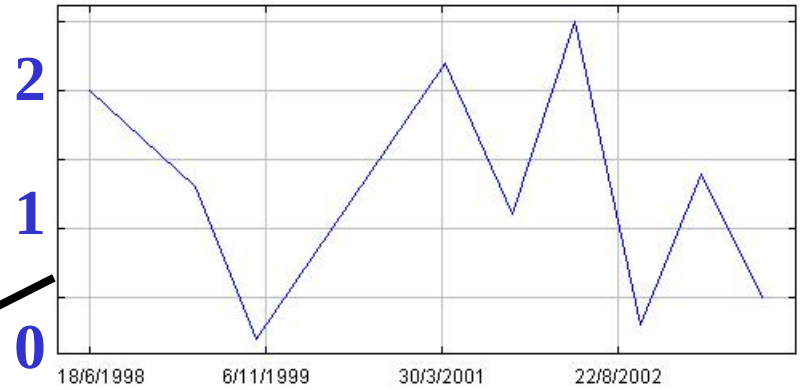
D'après document DATAR/BRGM

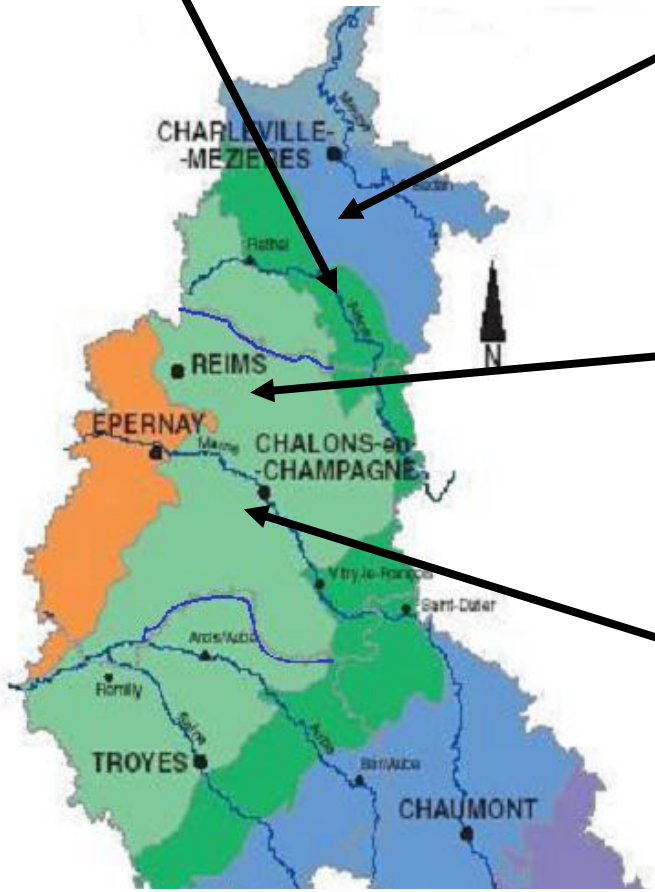
Arable farming

Wheat

Sugar beets

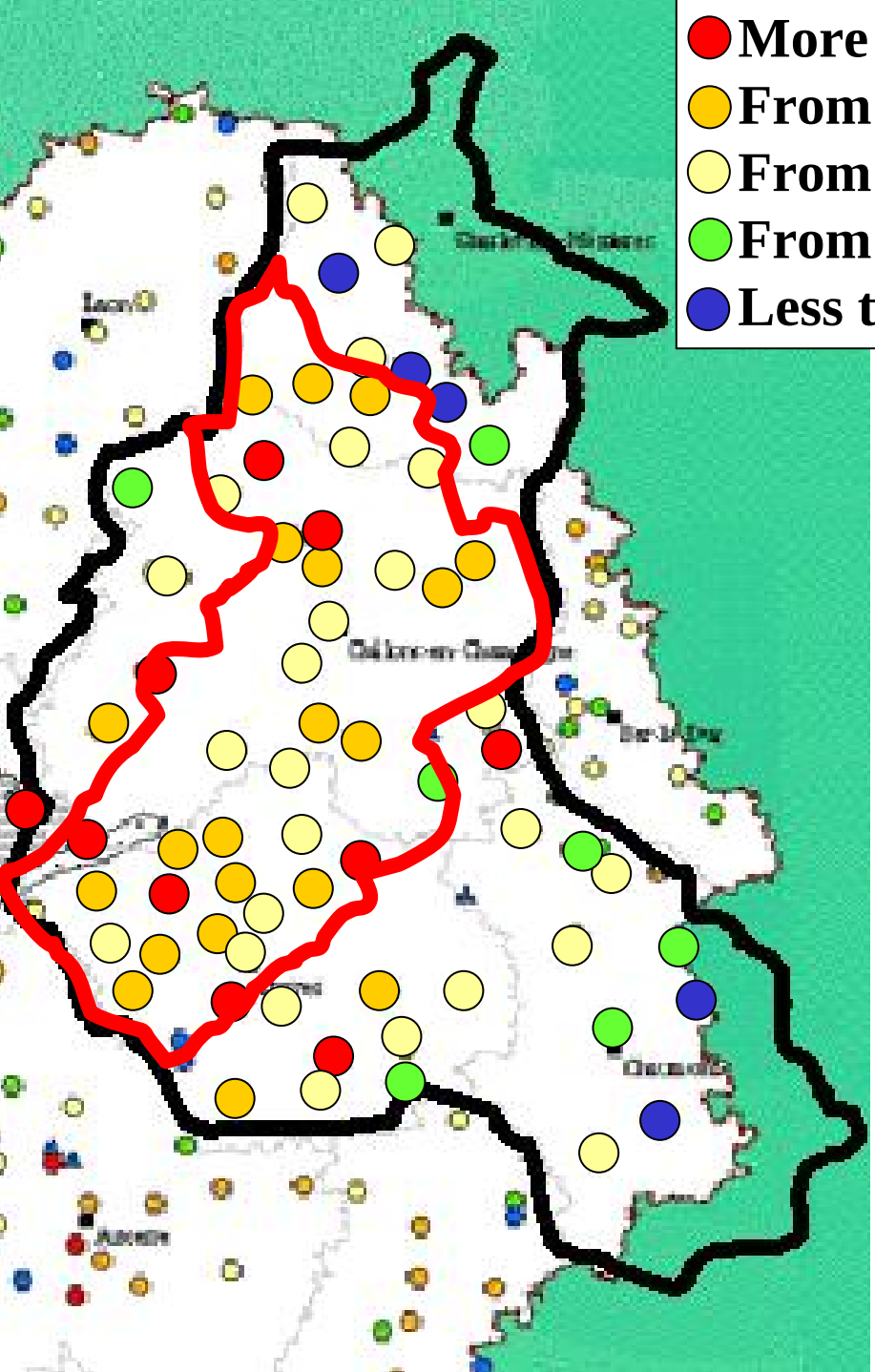
Groundwaters quality

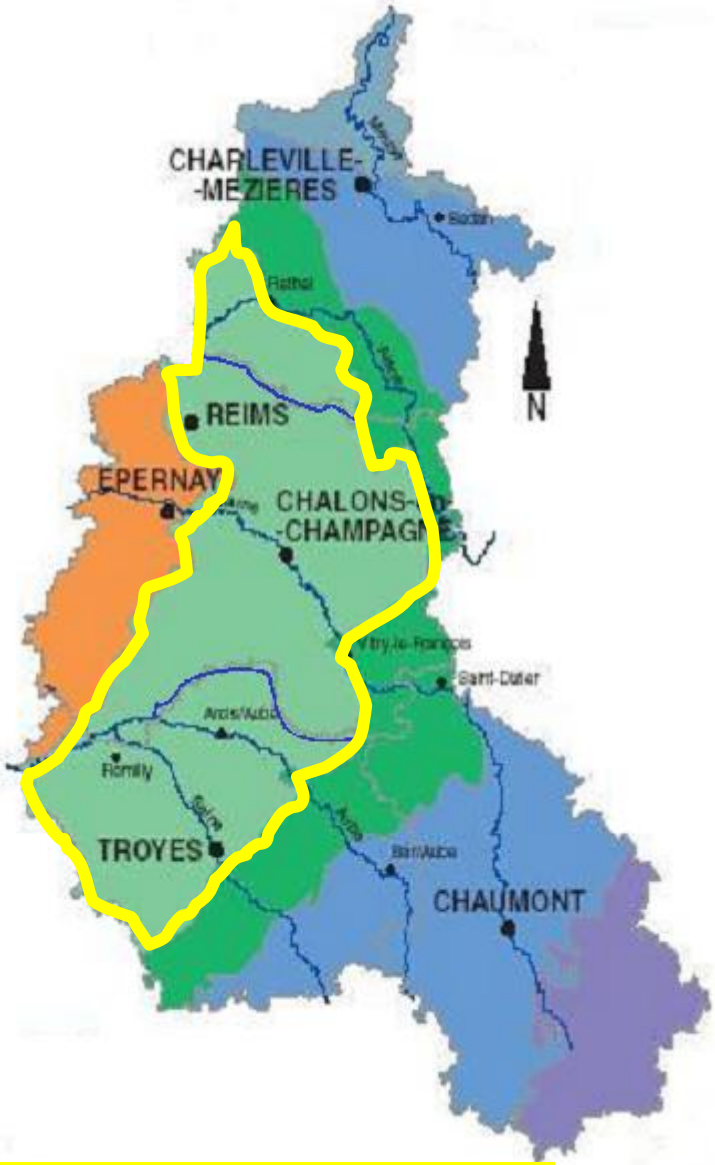




NO_3 en mg/L measured from 1998 untill 2003

European Community maximum value for drinking water: 50 mg/L


More than 50 r
From 40 to 50 r
From 20 to 40 r
From 10 to 20 r
Less than 10 m


CHARLEVILLE-
-MEZIERES
REIMS
EPERNAY
CHALONS-
-CHAMPAGN
TROYES
CHAUMONT
N


Arable farming area

Arable farming…

Fertilizers…

Pesticides, herbicides, fongicides….

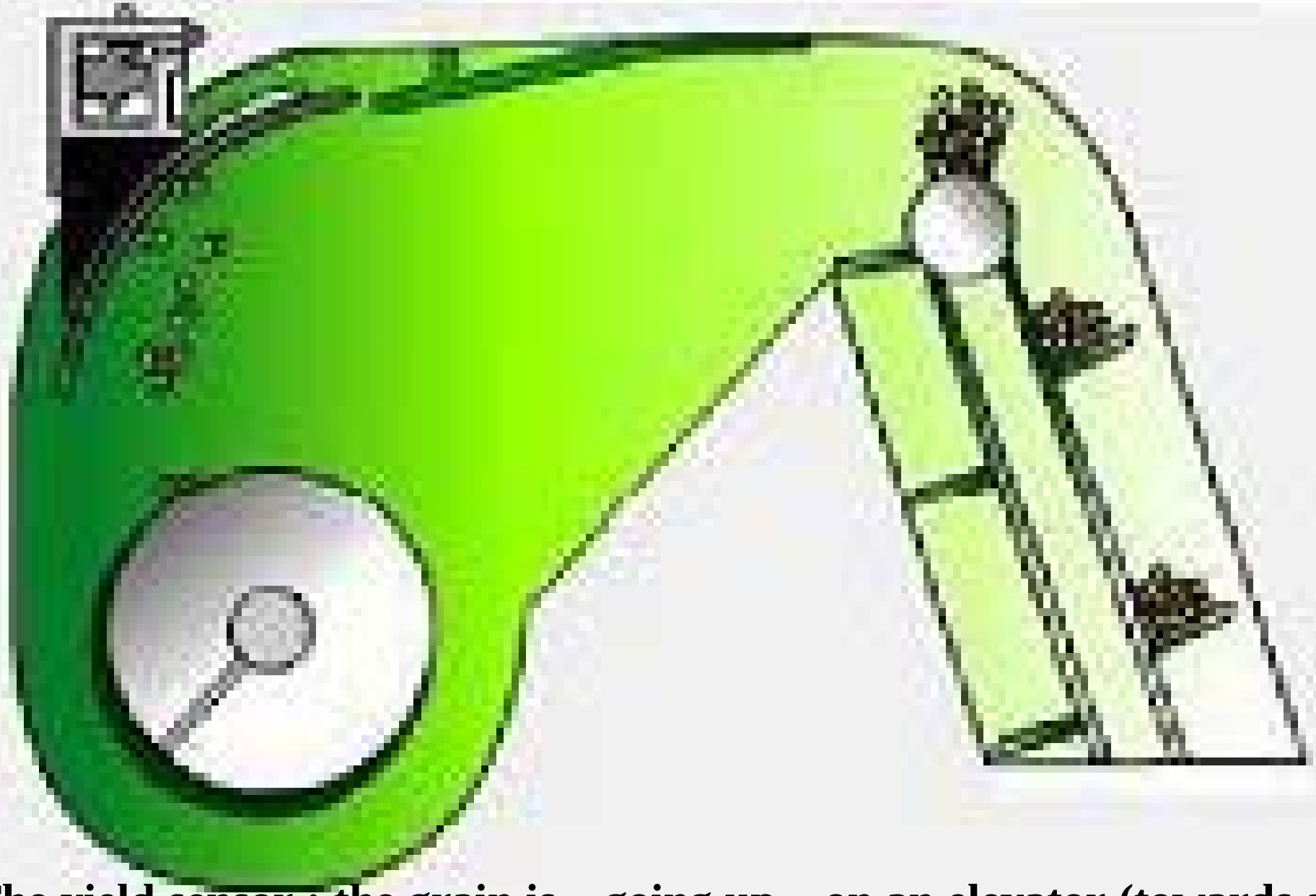
Groundwaters Pollution ?

We want less nitrogen in our groundwaters !!

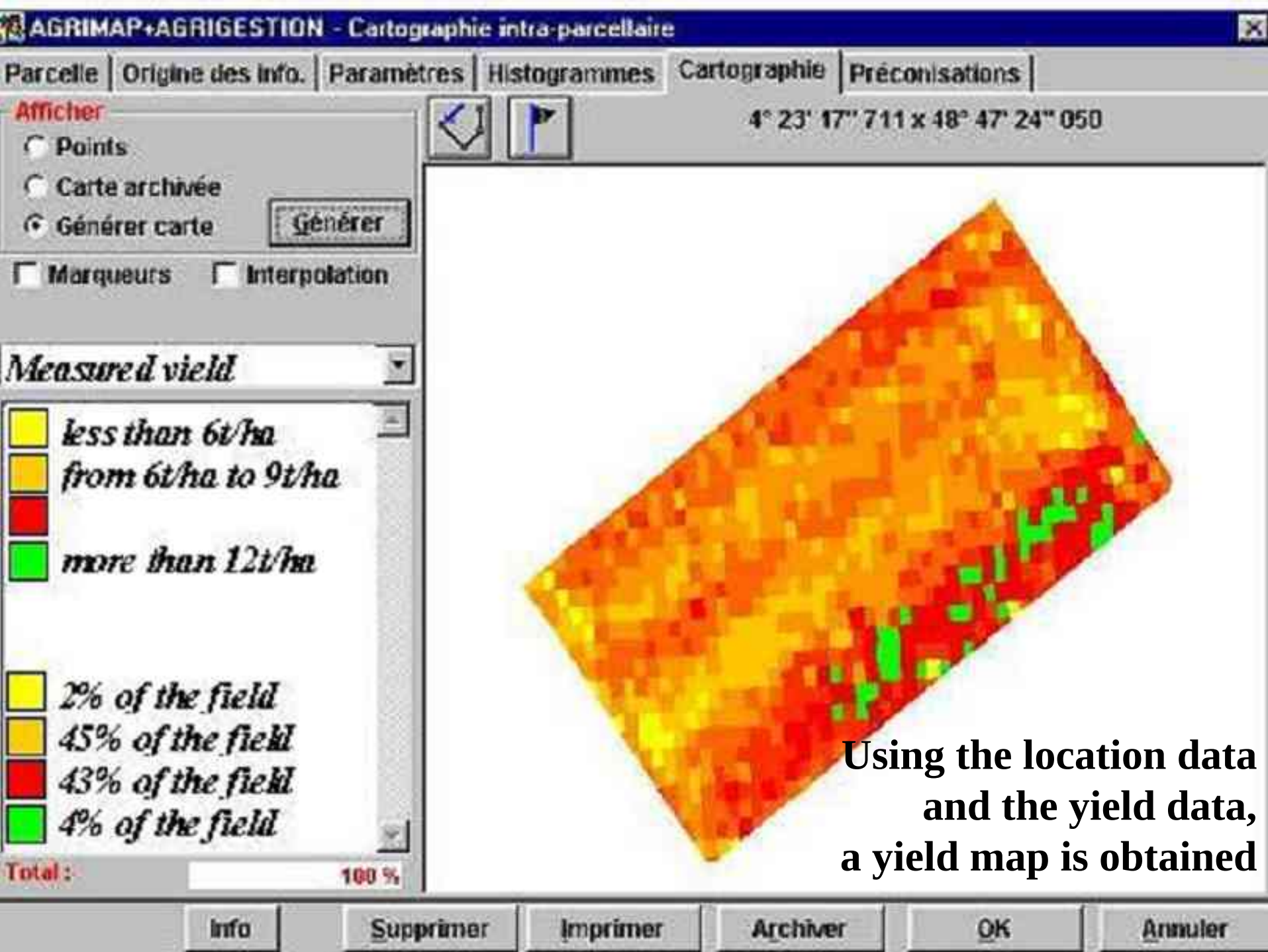
Precision Farming in the Champagne-Ardenne Region

A combine harvester equipped with a GPS receiver

and with a yield sensor (next slide)



The yield sensor : the grain is « going up » on an elevator (towards a storage area). When it reaches the top, it is projected on a « impact device » : the more grain, the more backwards move of the device.


AGRIMAP+AGRIGESTION - Cartographie intra-parcellaire
Parcelle
Origine des info.
Paramètres
Histogrammes
Cartographie
Préconisations
Afficher
Points
Carte archivée
Générer carte
Générer
Marqueurs
Interpolation
4° 23' 17" 711 x 48° 47' 24" 050
Measured yield
less than 6t/ha
from 6t/ha to 9t/ha
more than 12t/ha
2% of the field
45% of the field
43% of the field
4% of the field
Total :
100 %
Info
Supprimer
Imprimer
Archiver
OK
Annuler
Using the location data
and the yield data,
a yield map is obtained

And then, the next year in that field, the fertilizer is sprayed according to the yield map : less fertilizer where the yield has been low with an « usual » fertilizer quantity (the non-used fertilizer in excess will go straight in the groundwater !)

We decided to build our own sprayer with parts that were given to us from a local sprayer manufacter. At first, we couldn’t recognise one part from another, so we scanned the whole school to find people familiar with farming to get information !

We « used » every person who was able to help us : electricity students, automatism teachers, applied physics collegues…

The final tests – I have the same photo but instead of tools, we are carrying champagne glasses ! (but that wasn't serious enough to present to so serious listeners…)

The automated sprayer we built

The quantity sprayed around depends of the location in the « field »

The team in april 2003

At a competition in Toulouse (South West of France 850 km from Reims) in May 2003


Becoming experts in packaging and conditioning ! The sprayer travelled by lorry transport…

At a scientific exhibition, 250 km North East of Reims, in June 2003

Next slide :

Presentation for a national competition in January 2004 : the Physics Olympiads in Paris (150 km East of Reims and before that, in december 2003, we had a selection competition in Lille, 200 km, North West of Reims).

We won a second Prize.


At the Sweden Embassy in Paris,
in May 2005 : we are selected
to represent France
at the Stockholm Junior Prize !

In Sweden, in August 2005


France
How to preserve the
that can't be consumed by the crop?
The facts:
The problem:
Germany
1. Background
2. Effects
3. ACT 2000
4. Determination

3 presentations in front of 3 jurys : the last time, they were beginning to speak English !

A very well organised event : all the students (57 coming from 27 different countries representing the 5 continents) in a Youth Hostel (far away !) and the teachers in city center hotels !

Next slide : they surely learned something from each other…


WEST CO
SWIMMIN
02WINDWARD


WORLD
WATER
WEEK

With the Crown Princess of Sweden

Ready to go
to the Royal Banquet
(and surely meet
the King and the Queen
of Sweden…)

At the French Embassy in Sweden

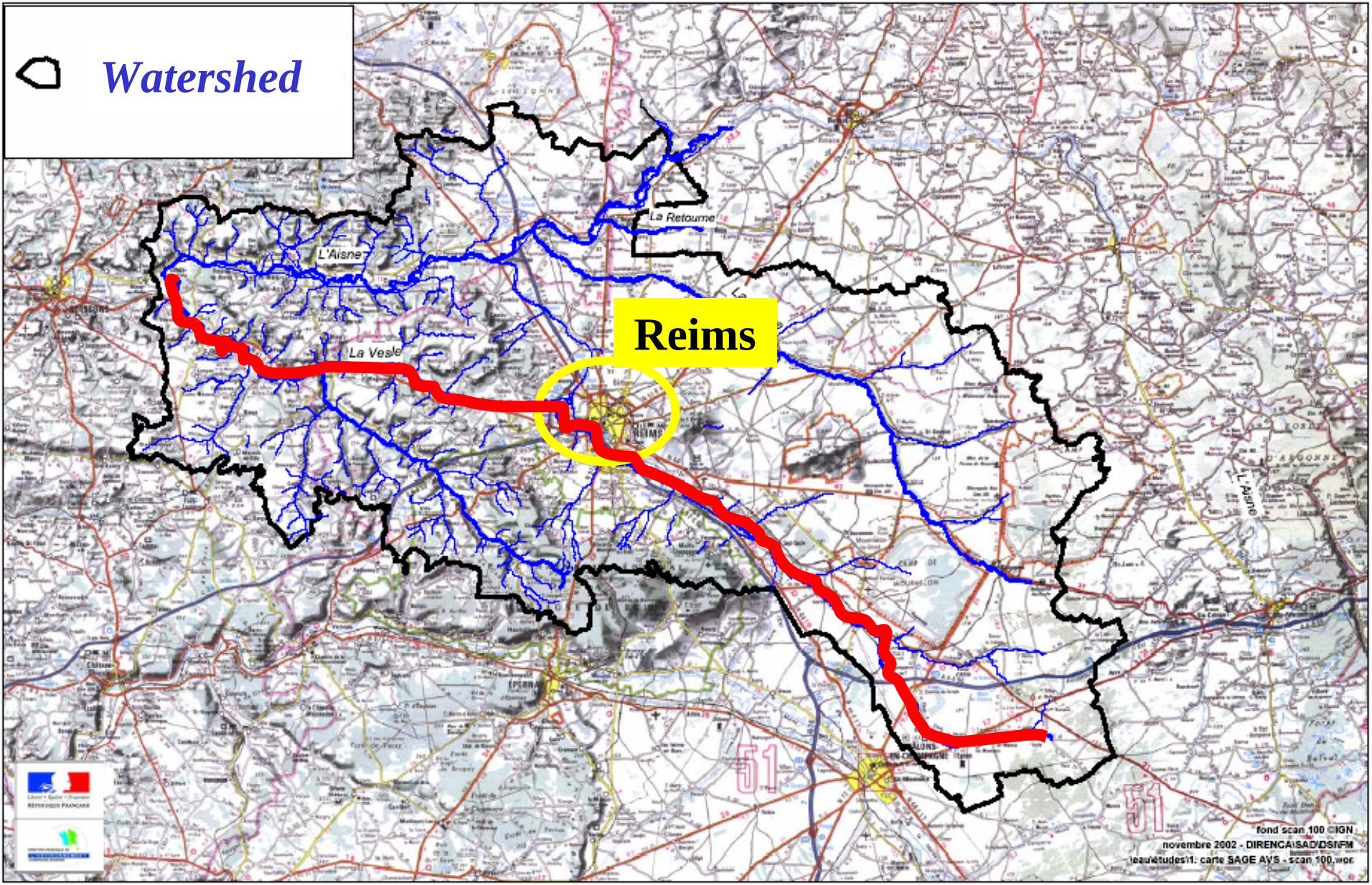
And as usual, transporting boxes of all sorts !

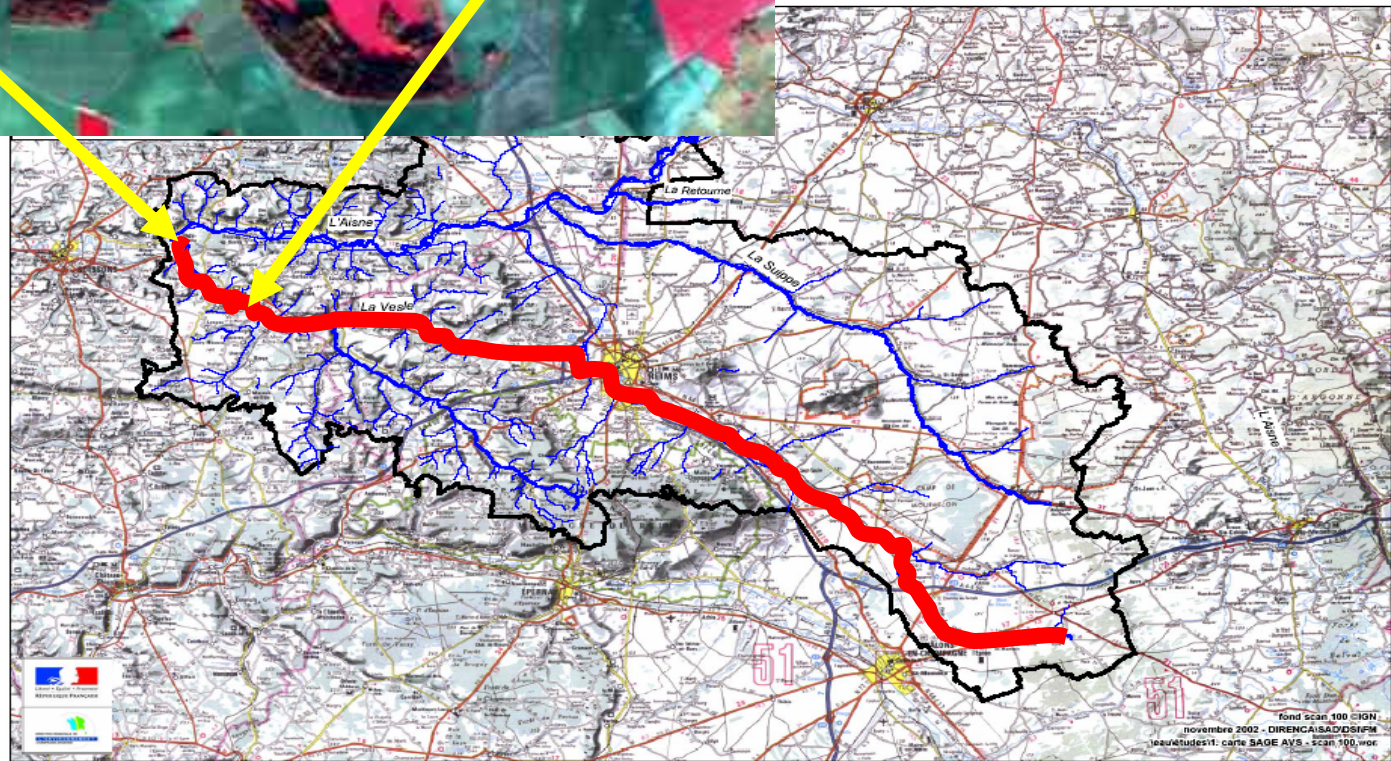
We want less nitrogen
in our groundwaters !!

Protecting wetlands along the Vesle river

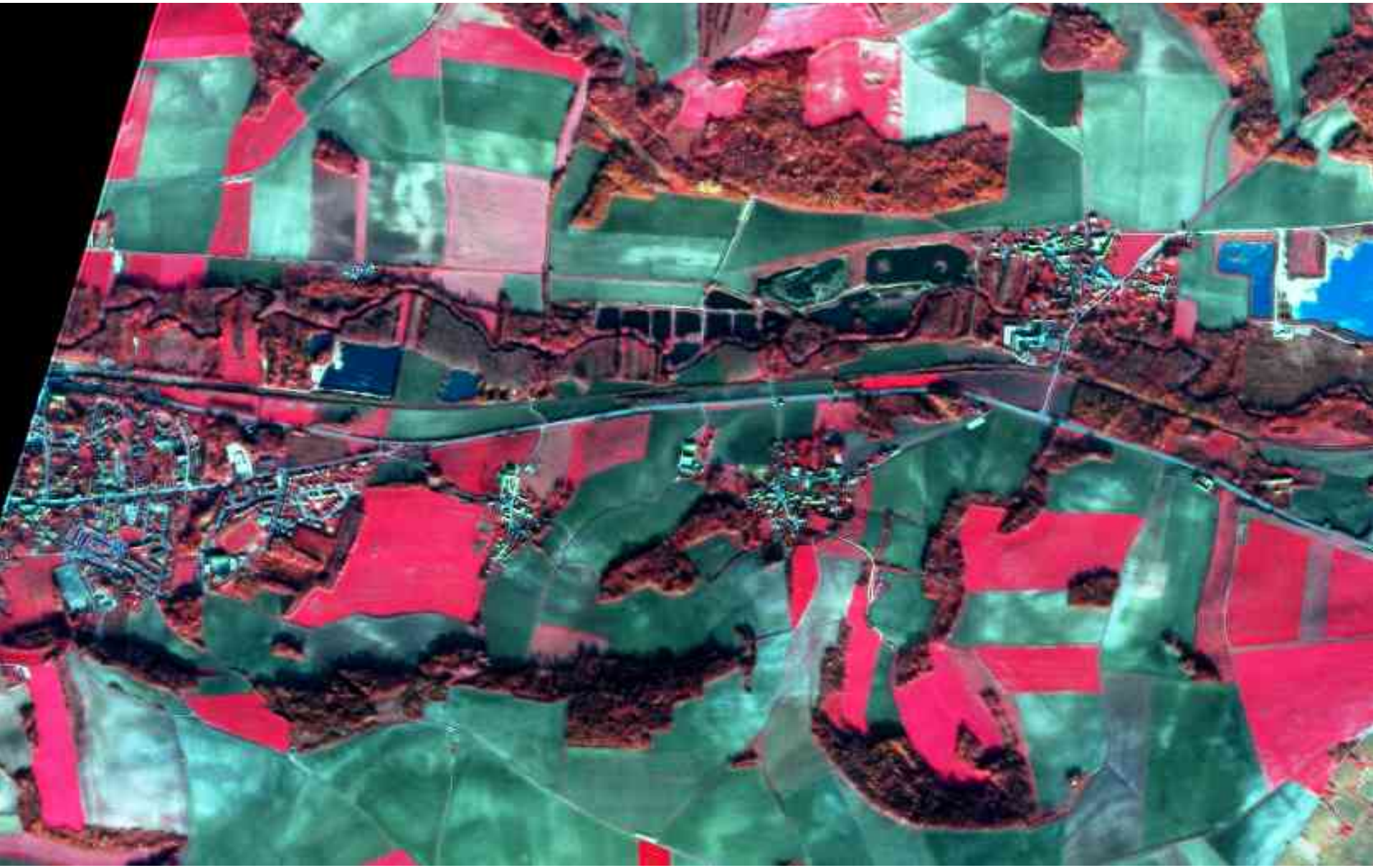
The river Vesle

Aisne – Suippes - Vesle





Using a satellite image to study the riparian zones.




Dark zone = wetland

We want to study that area.

How are we going to manage ?

The answer !

Helium balloon and a camera…

Field trip
in March 2006

Wetlands seen from the ground

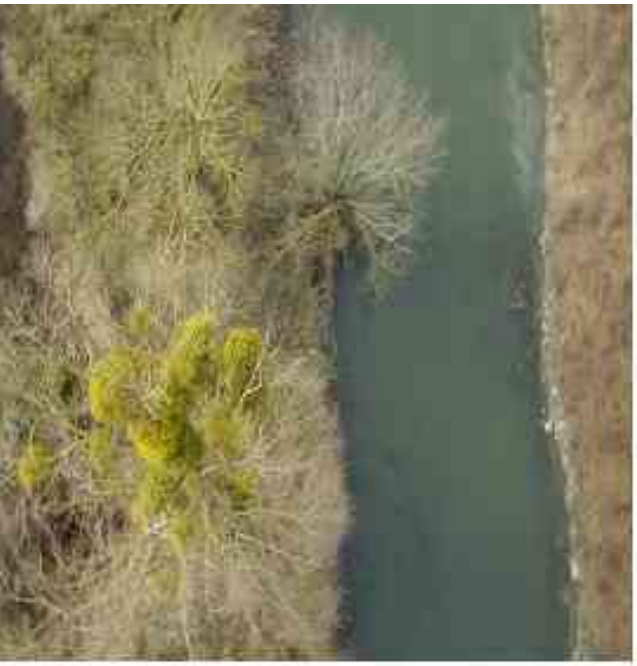
Wetlands seen from above



Abandoned wetlands that are becoming less and less « wet » because of all the shrubs and trees growing by themselves from seeds brought by the wind and pumping water to grow !

Nest slides : well looked after wetlands !

Reeds (not easy to recognise from above !)






Field trip in April 2007


ESPACE
ONNEMENT


ENVIRONNEMENT

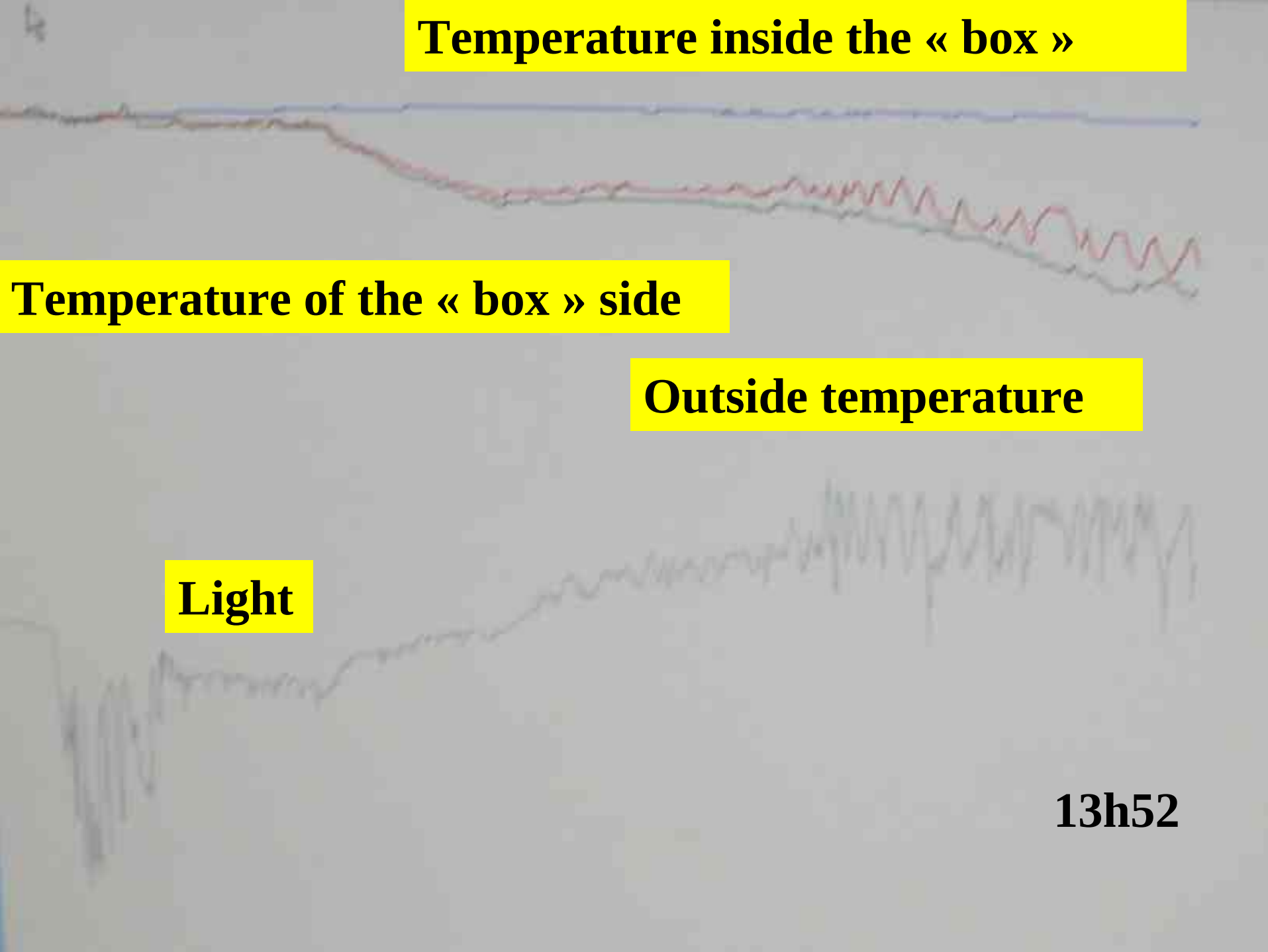
Atmospheric measurements

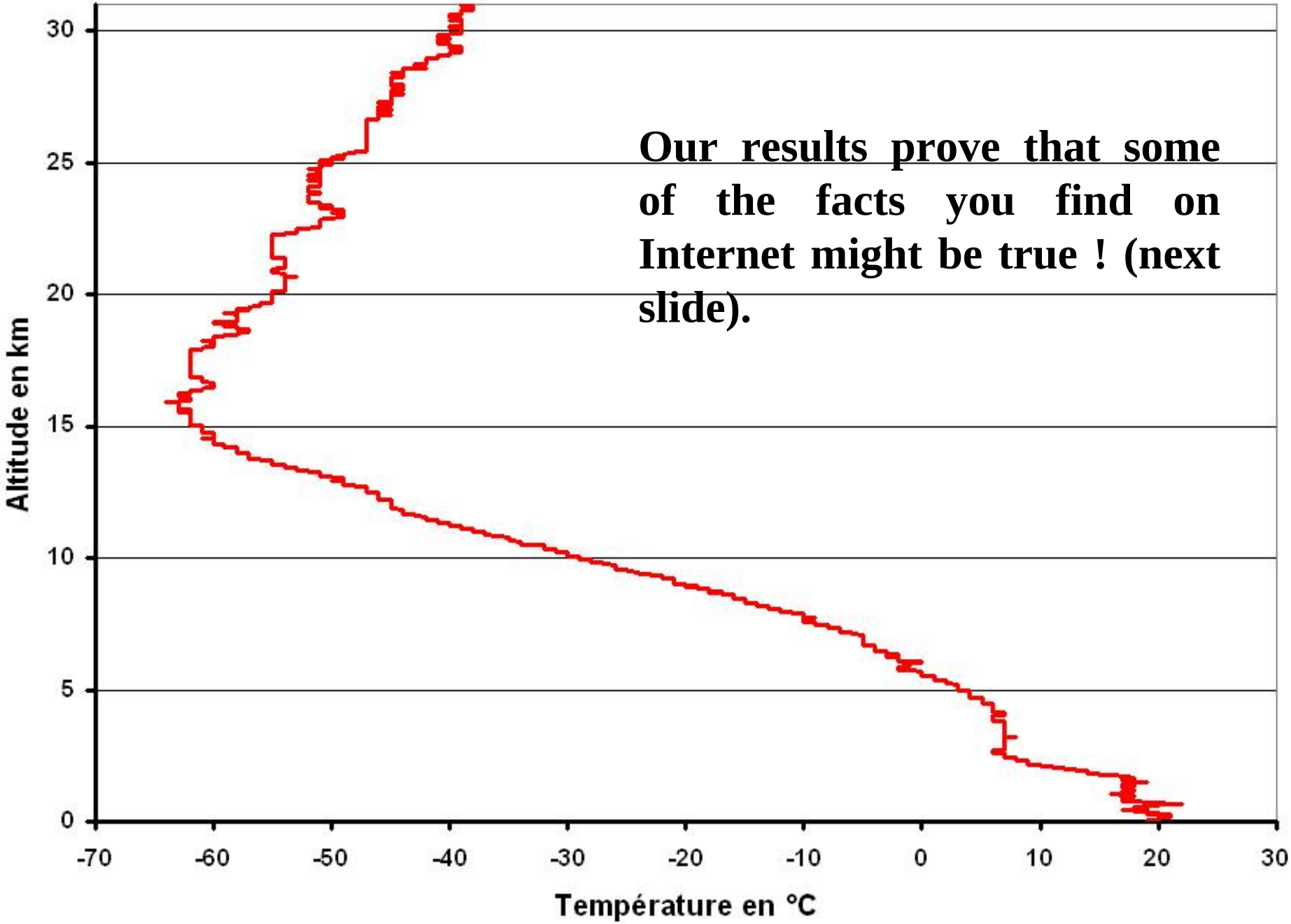
CALISPH'AIR

A GLOBE-CNES project

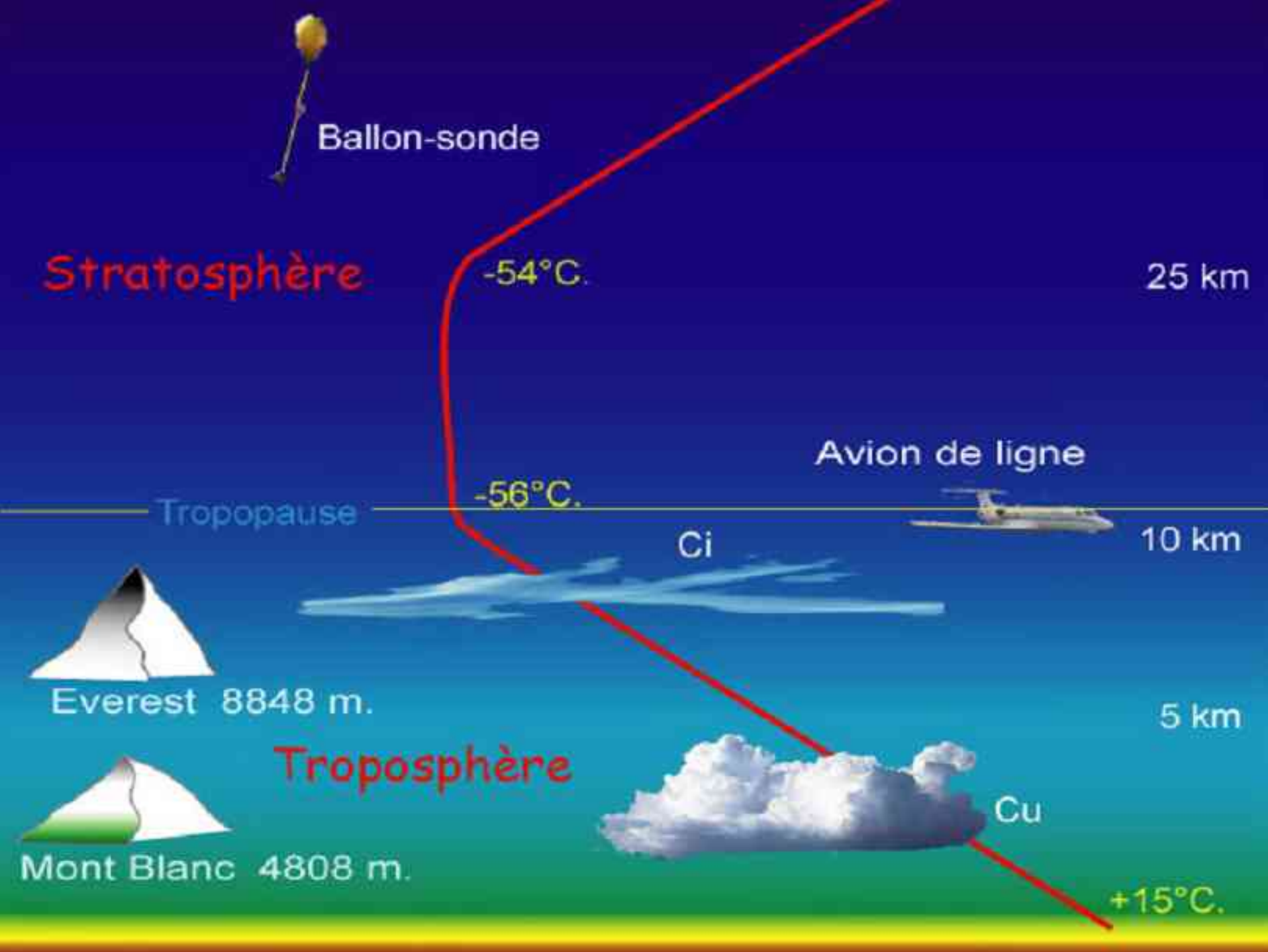
Students, collegues, headmaster and even television !

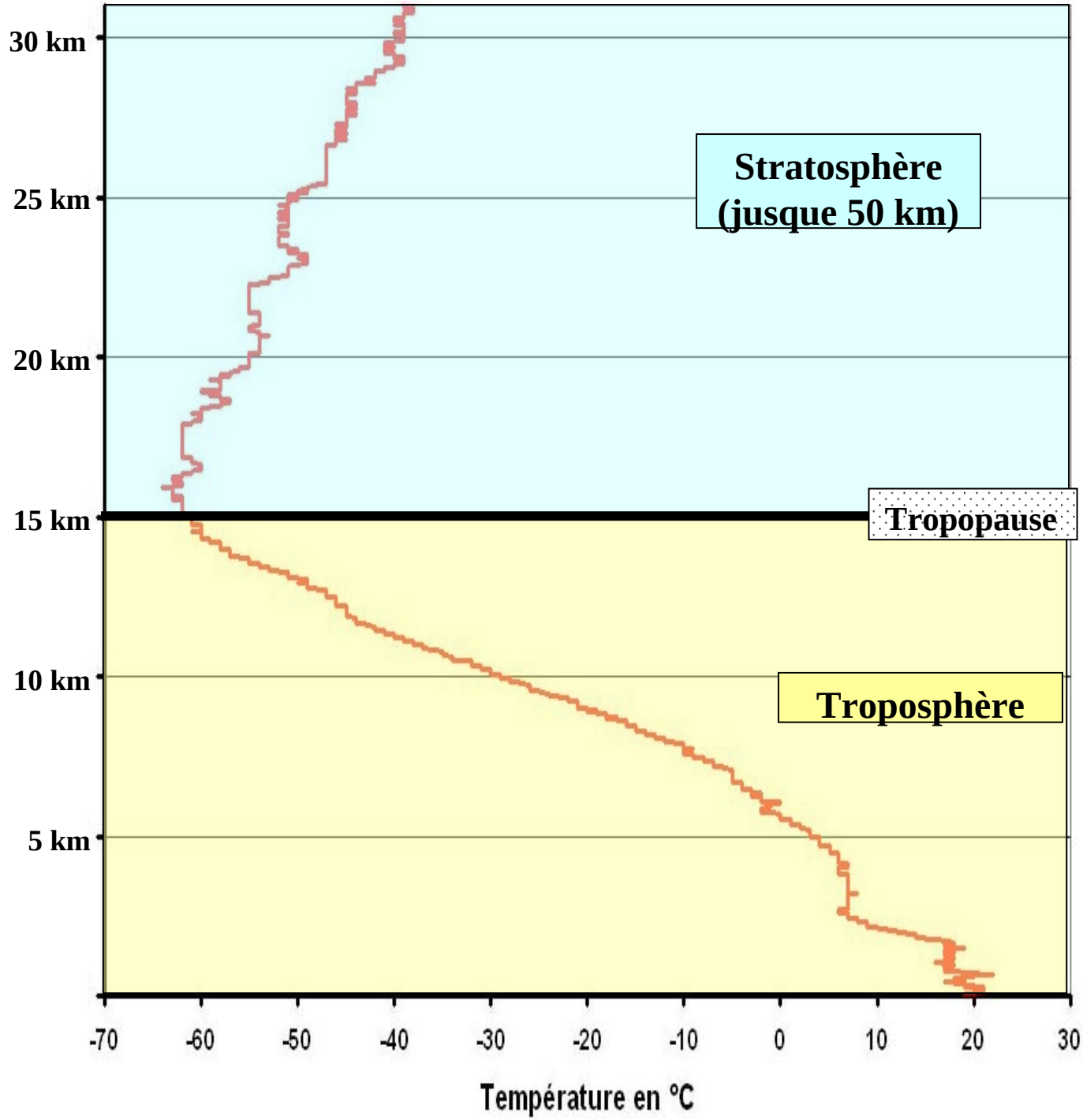
The student in charge of the instruments is waiting patiently as well as the vehicule which is going to collect the data.

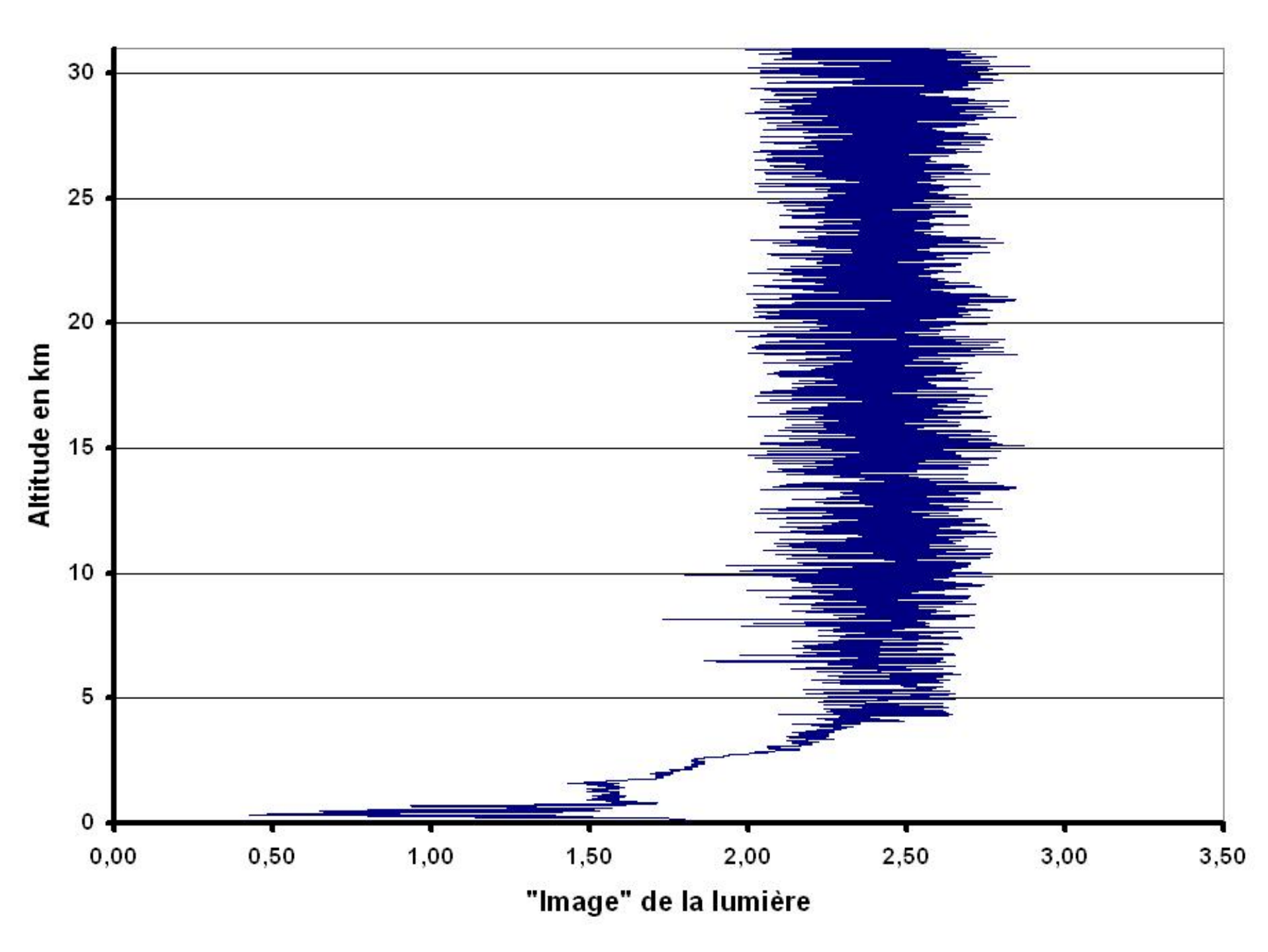

Temperature inside the « box »
Temperature of the « box » side
Outside temperature
Light
13h52

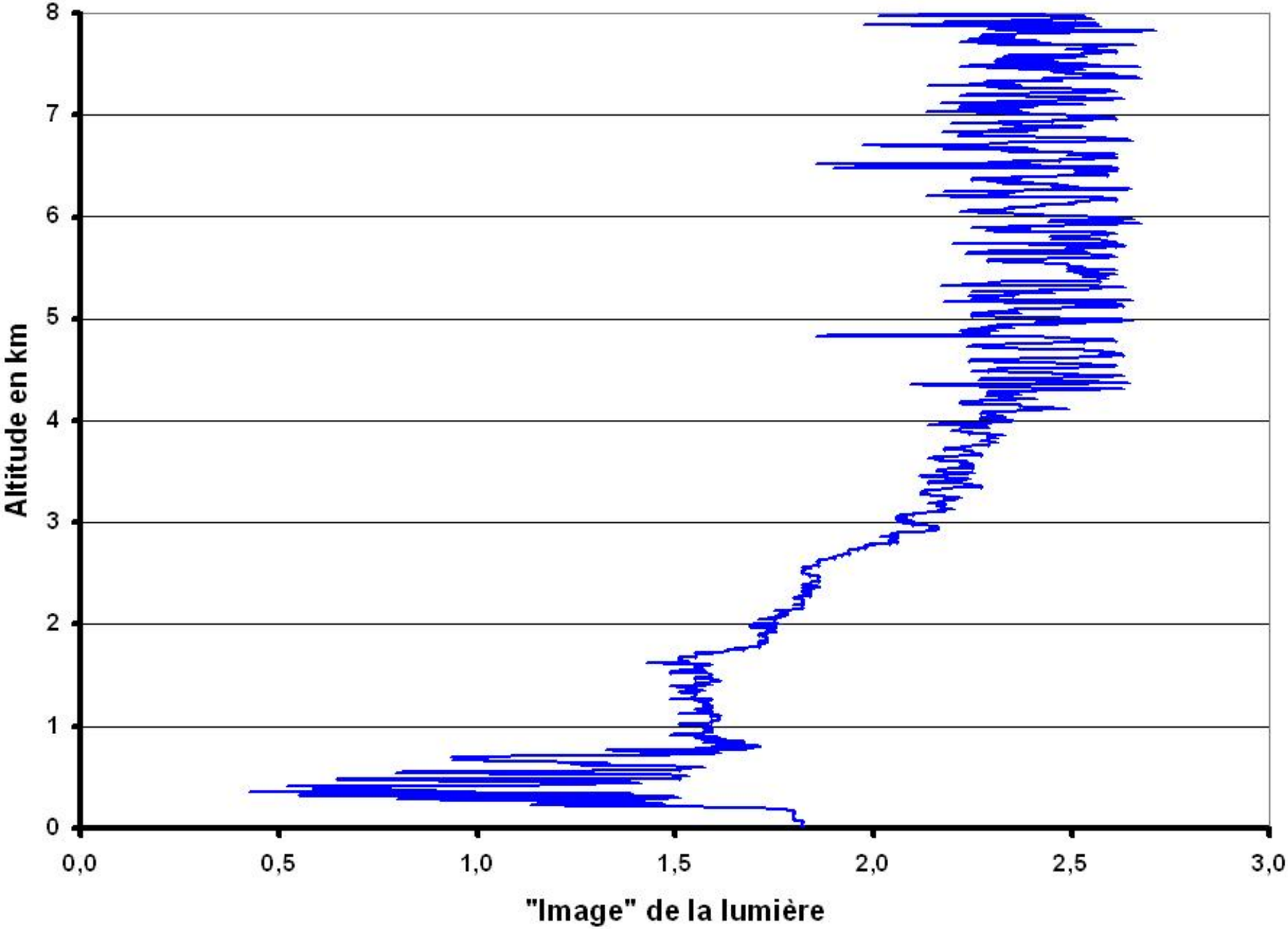


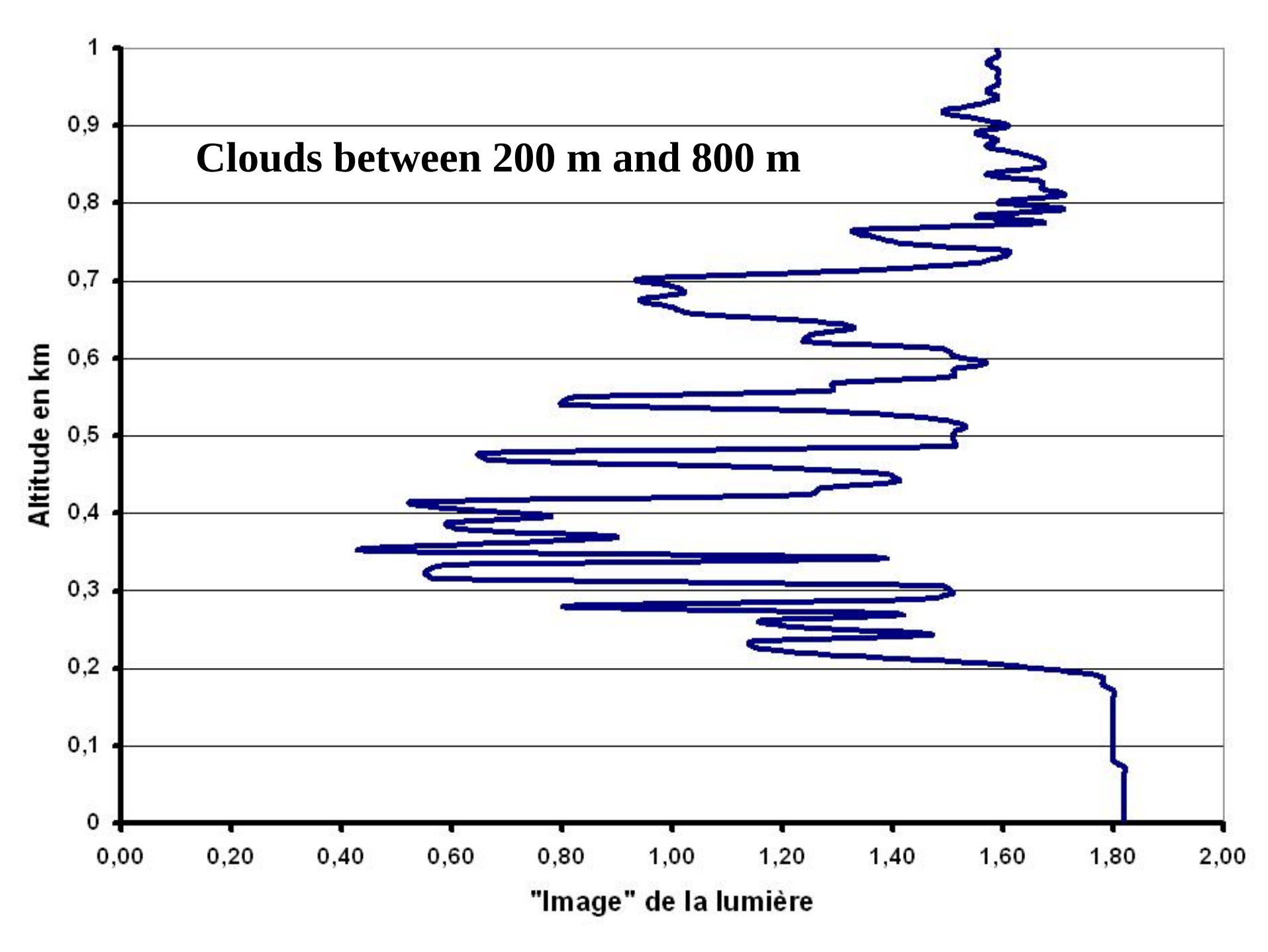
Our results prove that some of the facts you find on Internet might be true ! (next slide).


Ballon-sonde
Stratosphère
-54°C.
25 km
Avion de ligne
-56°C.
Tropopause
Ci
10 km
Everest 8848 m.
5 km
Troposphère
Cu
Mont Blanc 4808 m.
+15°C.


30 km
25 km
20 km
15 km
10 km
5 km
Stratosphère
(jusque 50 km)
Tropopause
Troposphère
-70
-60
-50
-40
-30
-20
-10
0
10
20
30
Température en °C


Altitude en km
30
25
20
15
10
5
0
0,00
0,50
1,00
1,50
2,00
2,50
3,00
3,50
"Image" de la lumière


Altitude en km
8
7
6
5
4
3
2
1
0
0,0
0,5
1,0
1,5
2,0
2,5
3,0
"Image" de la lumière


Clouds between 200 m and 800 m
Altitude en km
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80
2,00
"Image" de la lumière


13h37


13h41

ASTAR 2007

(Arctic Study of Tropospheric Aerosol, Clouds, and Radiation)

ASTAR 2007 is a contribution to the POLARCAT program in the framework of the International Polar Year (IPY) 2007/2008.

POLARCAT : Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate, Chemistry, Aerosols, and Transport.

European Fleet for Airborne Research

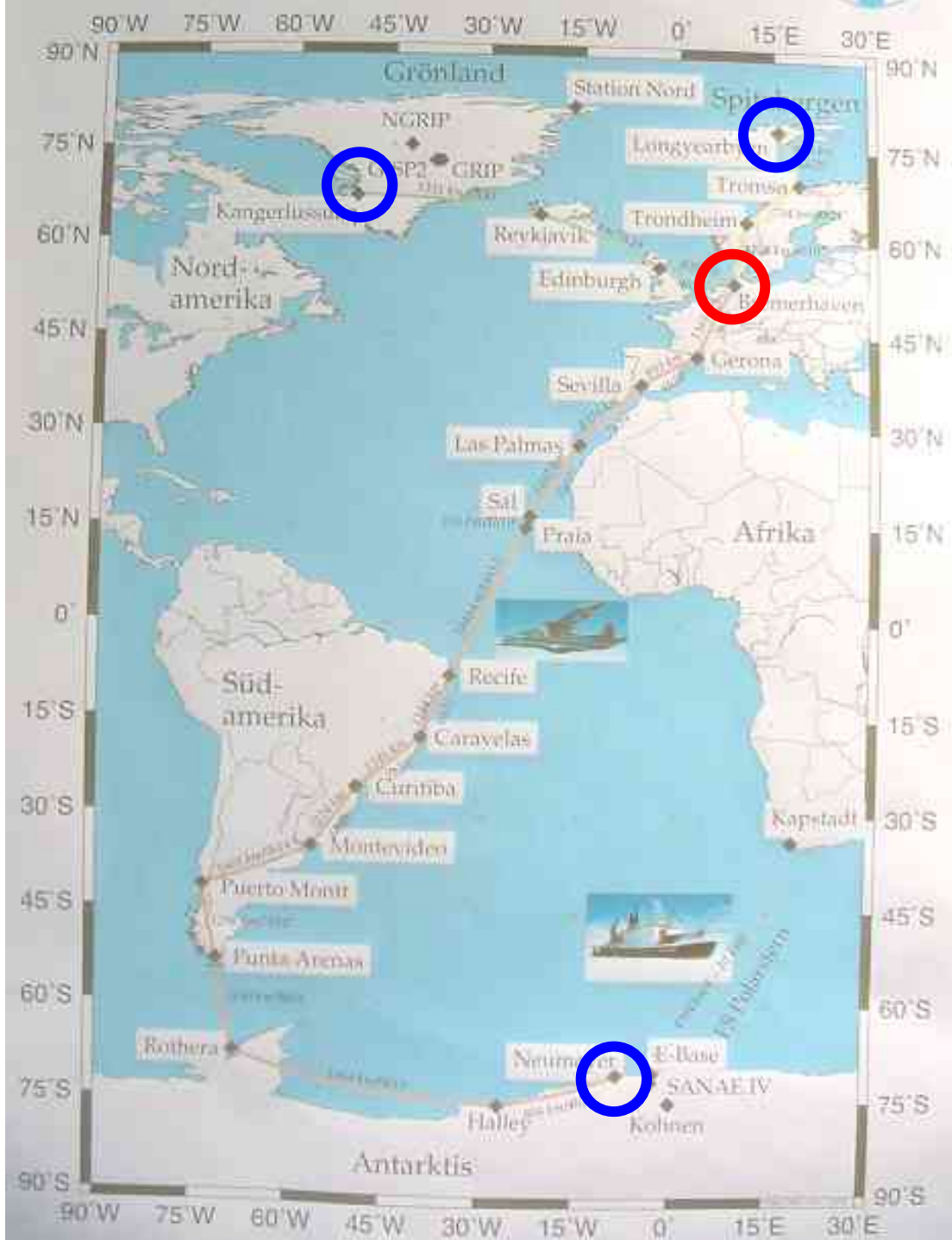
EUFAR aims at integrating the activities of the European fleet of instrumented aircraft in the field of environmental research in the atmospheric, marine, terrestrial and earth sciences.

Clémence and Pauline

The EUFAR project is meant for post-graduate students but I managed to have two 17 years old students accepted… (sweet talking and a well argumented file !)


POLAR 2

Polar 2 is owned by the Alfred Wegener Institute in Bremerhaven (north of Germany) and is regularly used for Arctic and Antarctic missions




POLAR 2
SUMMIT
ANTARCTICA

Cabin

Length : 7,08 m
Width : 1,3 m
Height : 1,5 m

ASTAR 2007 is implemented in the vicinity of Svalbard (Norway) from Longyearbyen airport (78.25° N, 15.49° E).

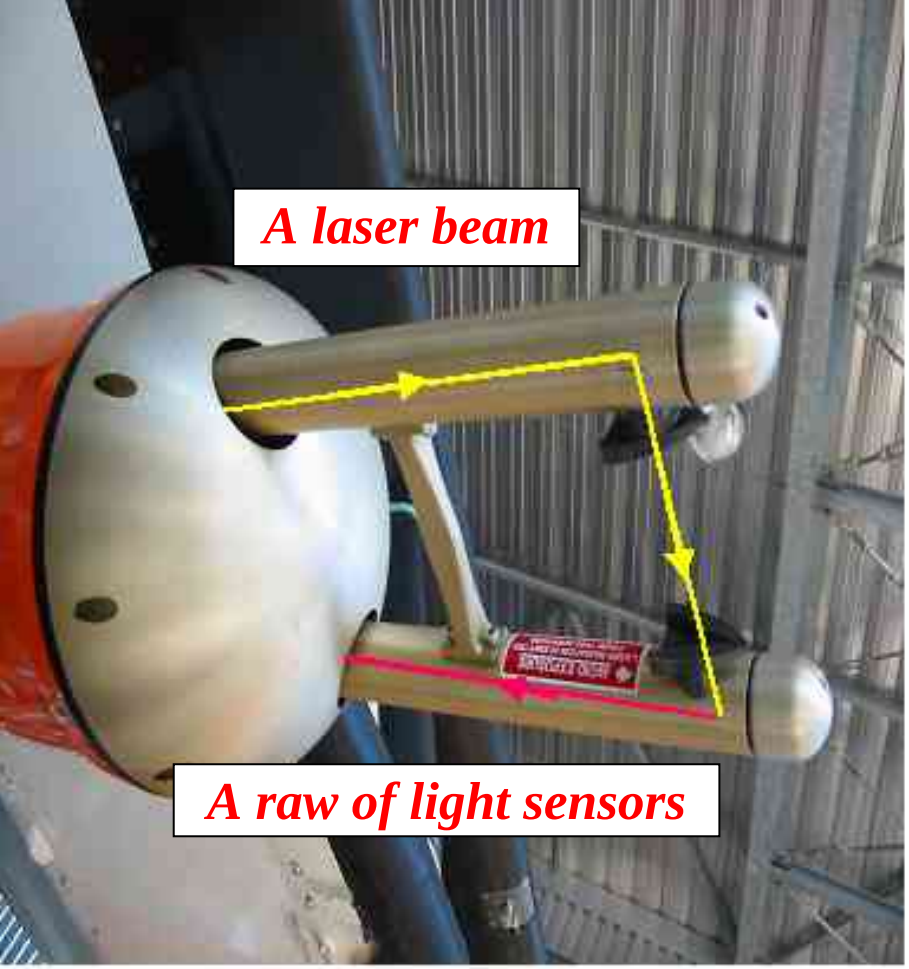
Measurements and Instruments

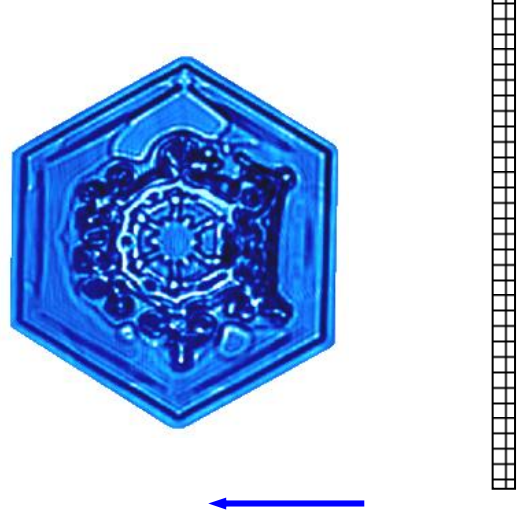
Cloud physical properties

Particle morphology and size,

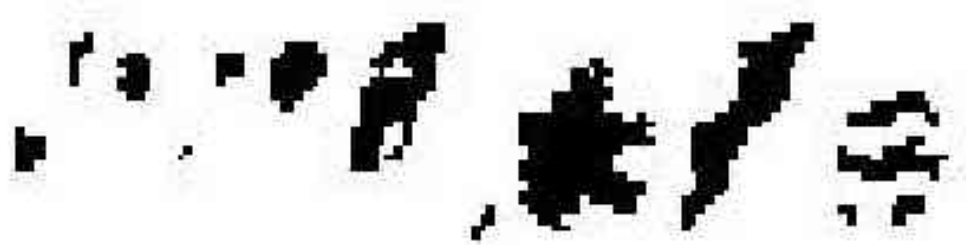
in-cloud partitioning of ice/water content

Intruments are fixed under the wings : they gather data while the plane is flying through clouds or other aerosols



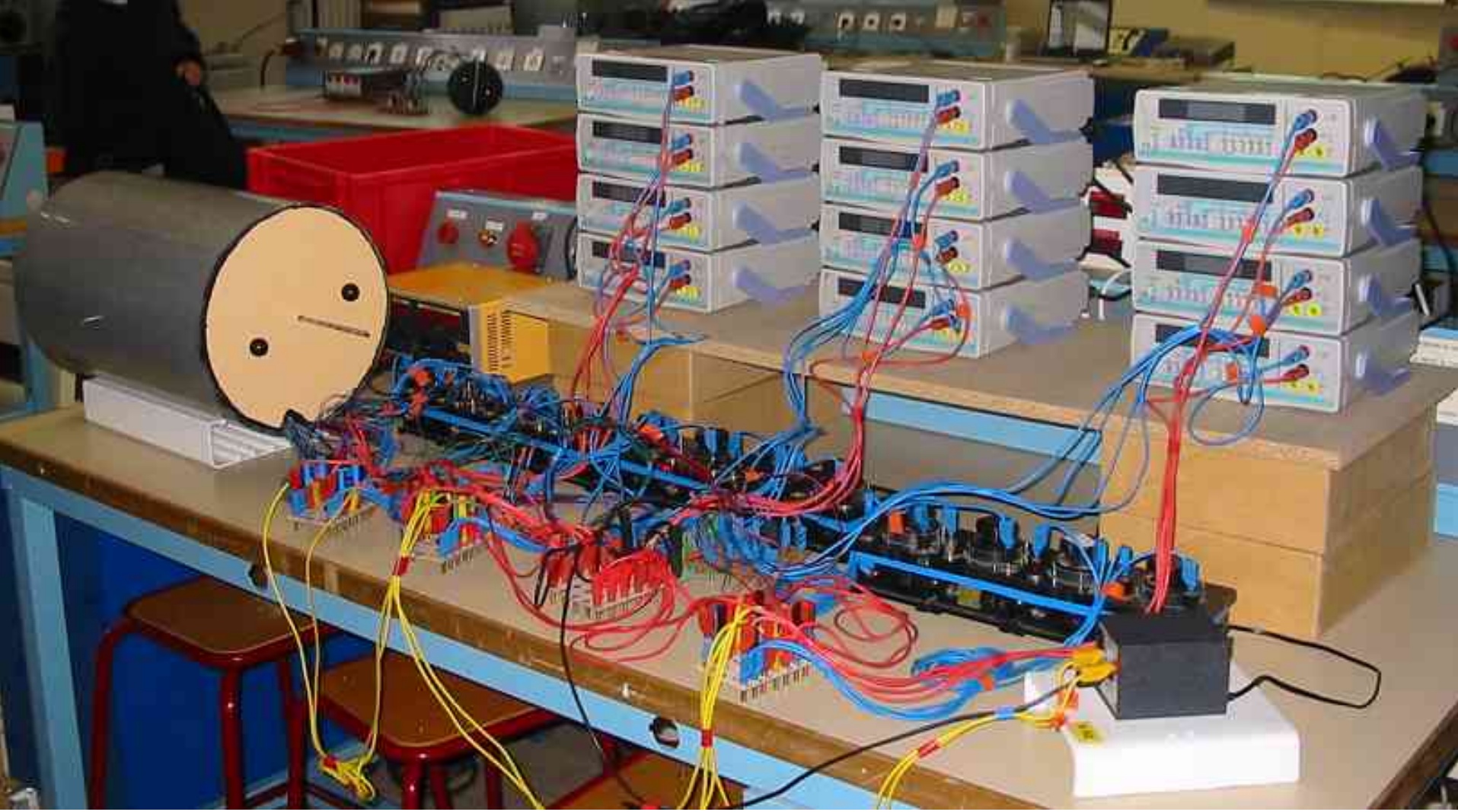


Déplacement relatif
« aérosol – rangée de capteurs embarqués »

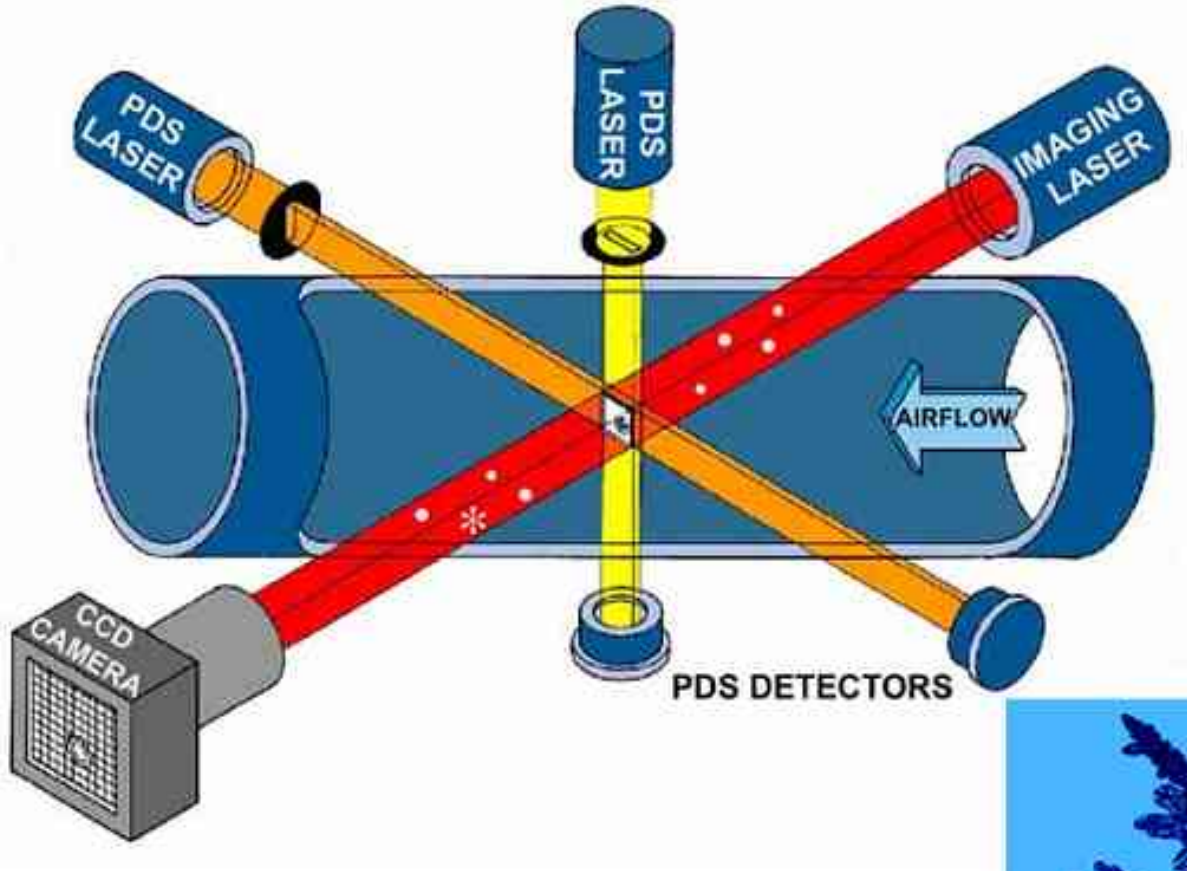


2 dimensions « images » of particles : you can measure their size and their concentration

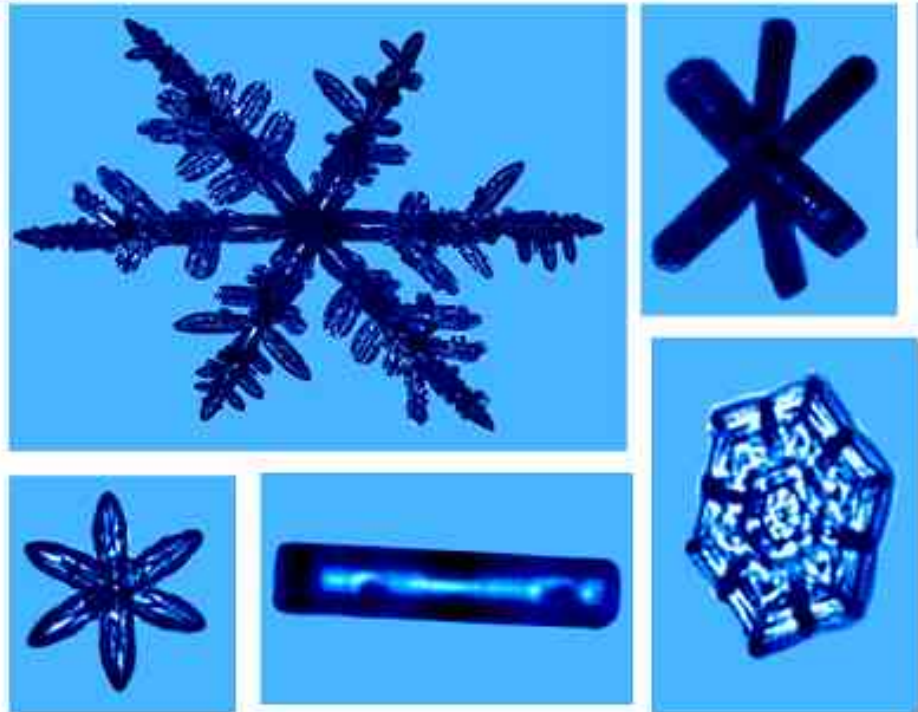
Resolution : 25 µm



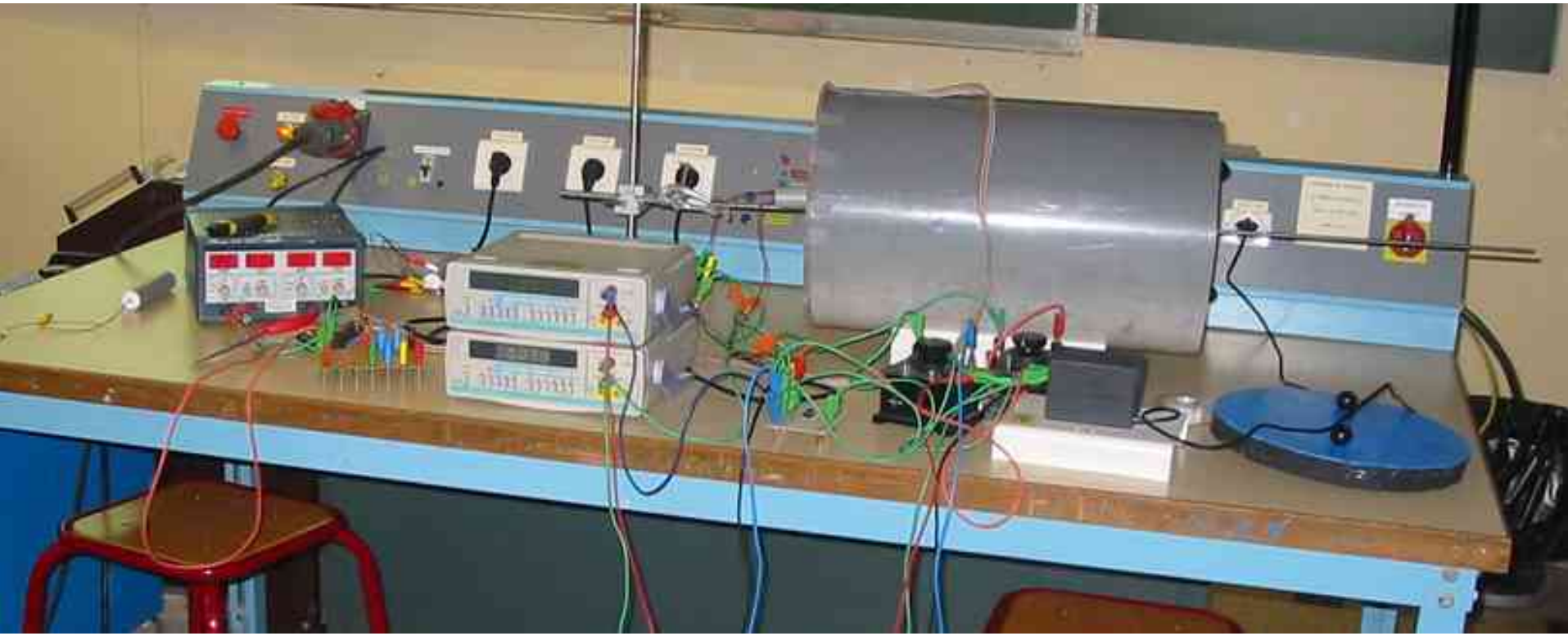
Our experiment doing the same thing (but in a better way of course !)



When the 2 light detectors are occulted, it means a particle is on the light path, so a photo is taken.



Resolution : 2,5 µm



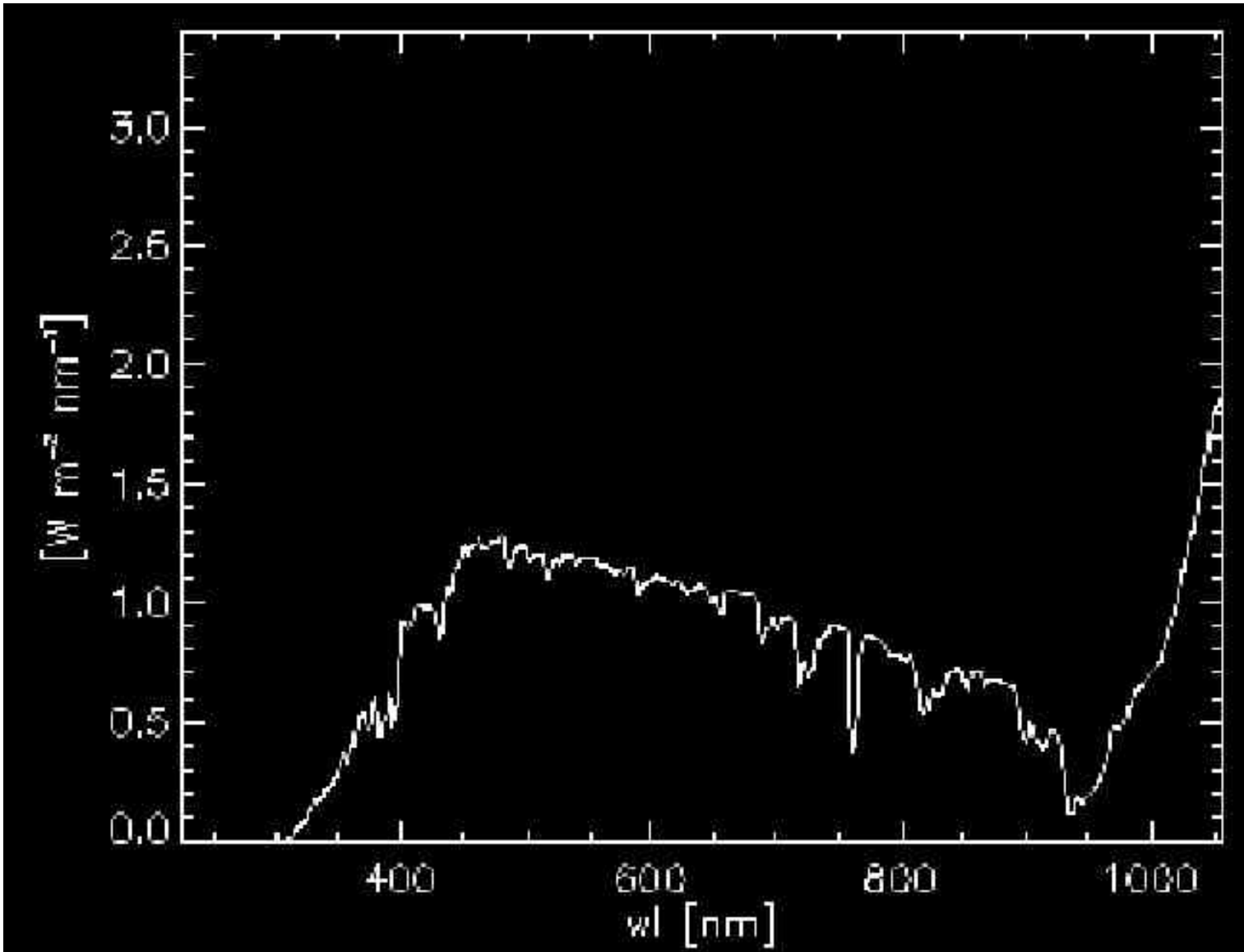
These experiments were presented at the Physics Olympiads in January 2007 (after a selection competition in December 2006) The students won a 4th prize.

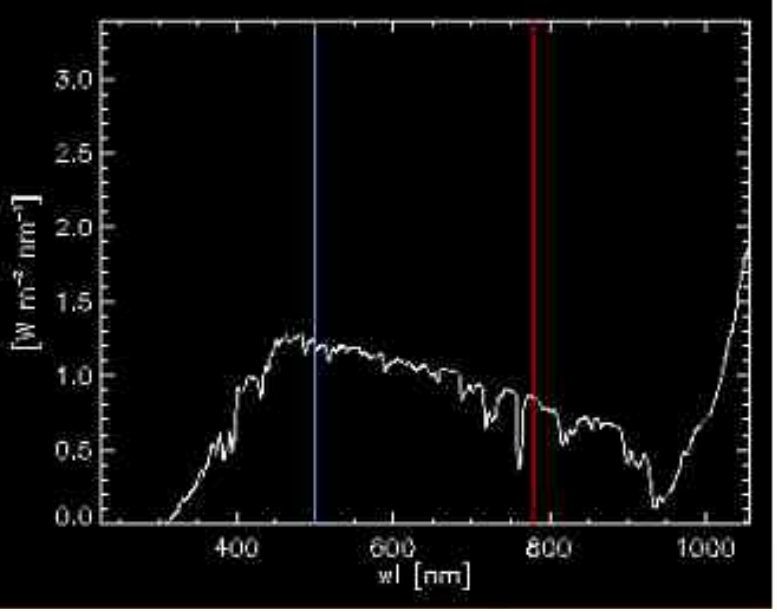
The albedometer

Twice the same instruments : one under the plane measuring light coming from the ground, the other on top of the plane measuring light coming from the Sun.

Two sensors on each instrument : the left one is measuring light from 300 to 1050 nm and the right one, light from 1000 to 3000 nm.

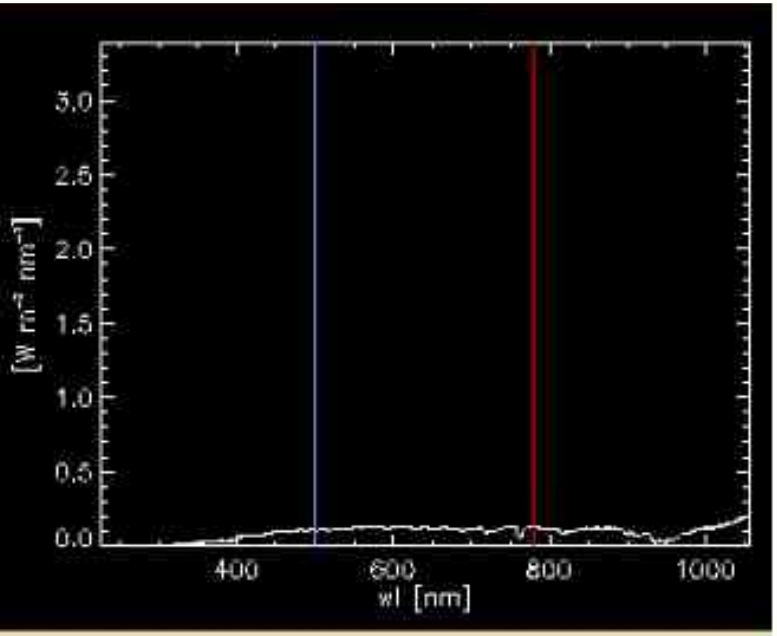
The light beams are splitted in smaller beams and sent on photodiodes : when a photodiode receives light, it creates a current that can be measured (the more light, the more intensity).

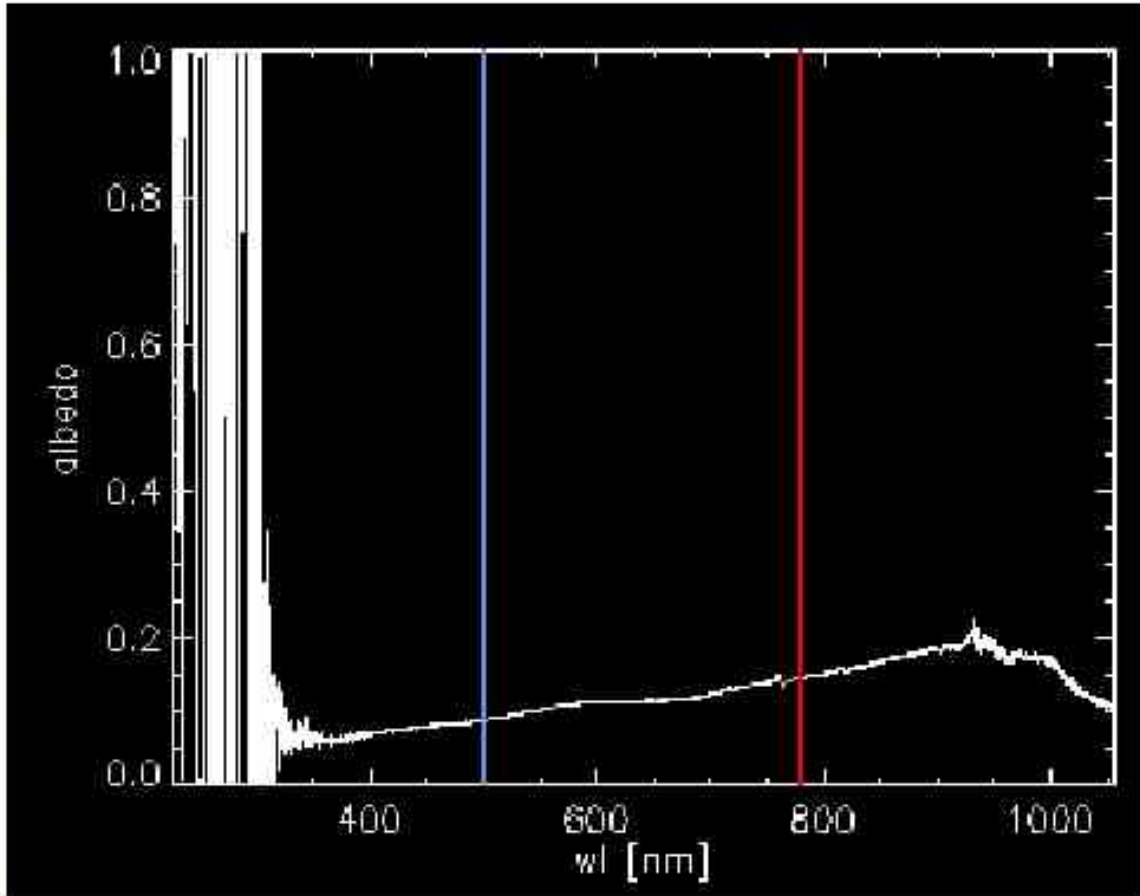




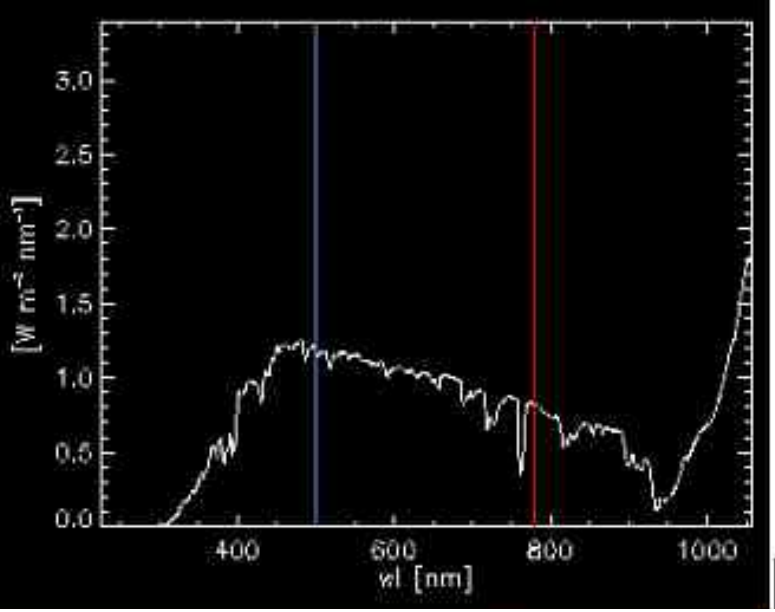
The albedo is the ratio between the 2 results.

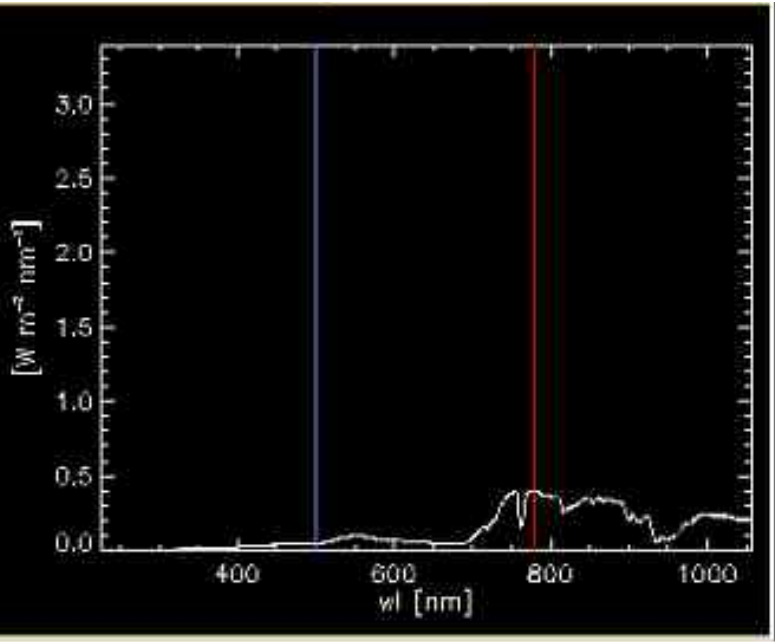
On that exemple, not much light is coming from the ground : the plane is still above the take off strip !

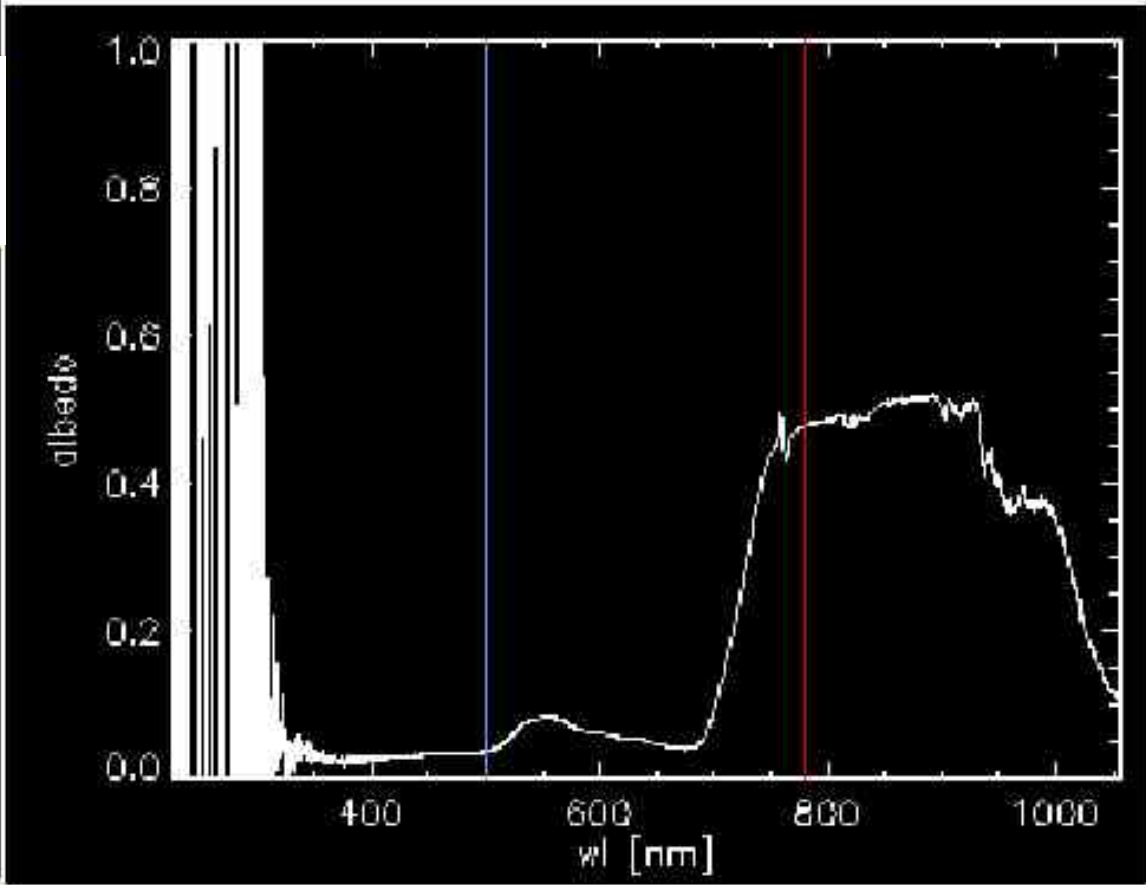




The albedo for a green meadow or a forest.







The axes of each sensor must be really vertical so the support of each instrument is maintened vertical by 3 servomotors correcting in real time the moves of the plane.

She said she was working hard on the top of the plane !

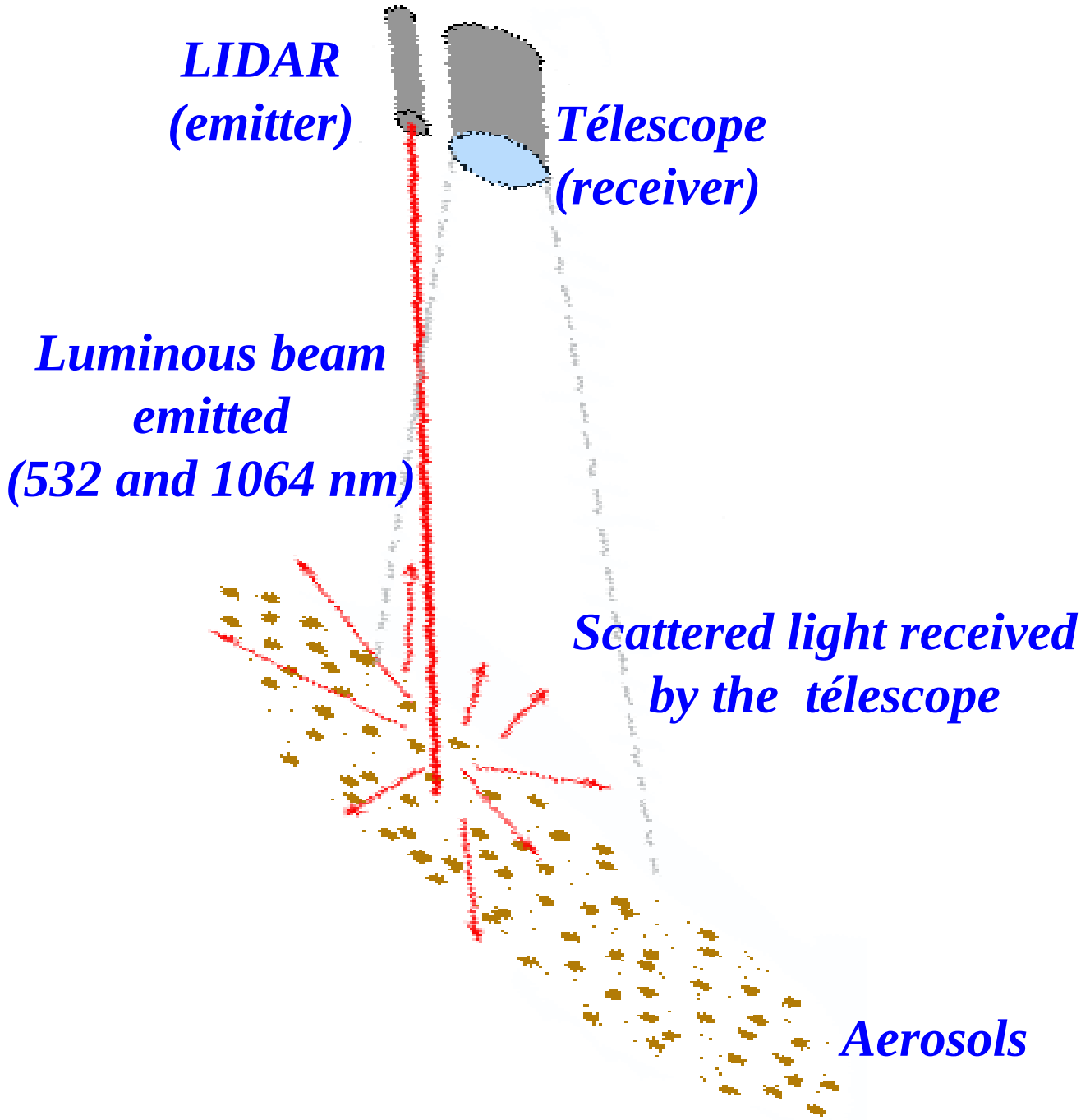
But we knew where the real workers were!

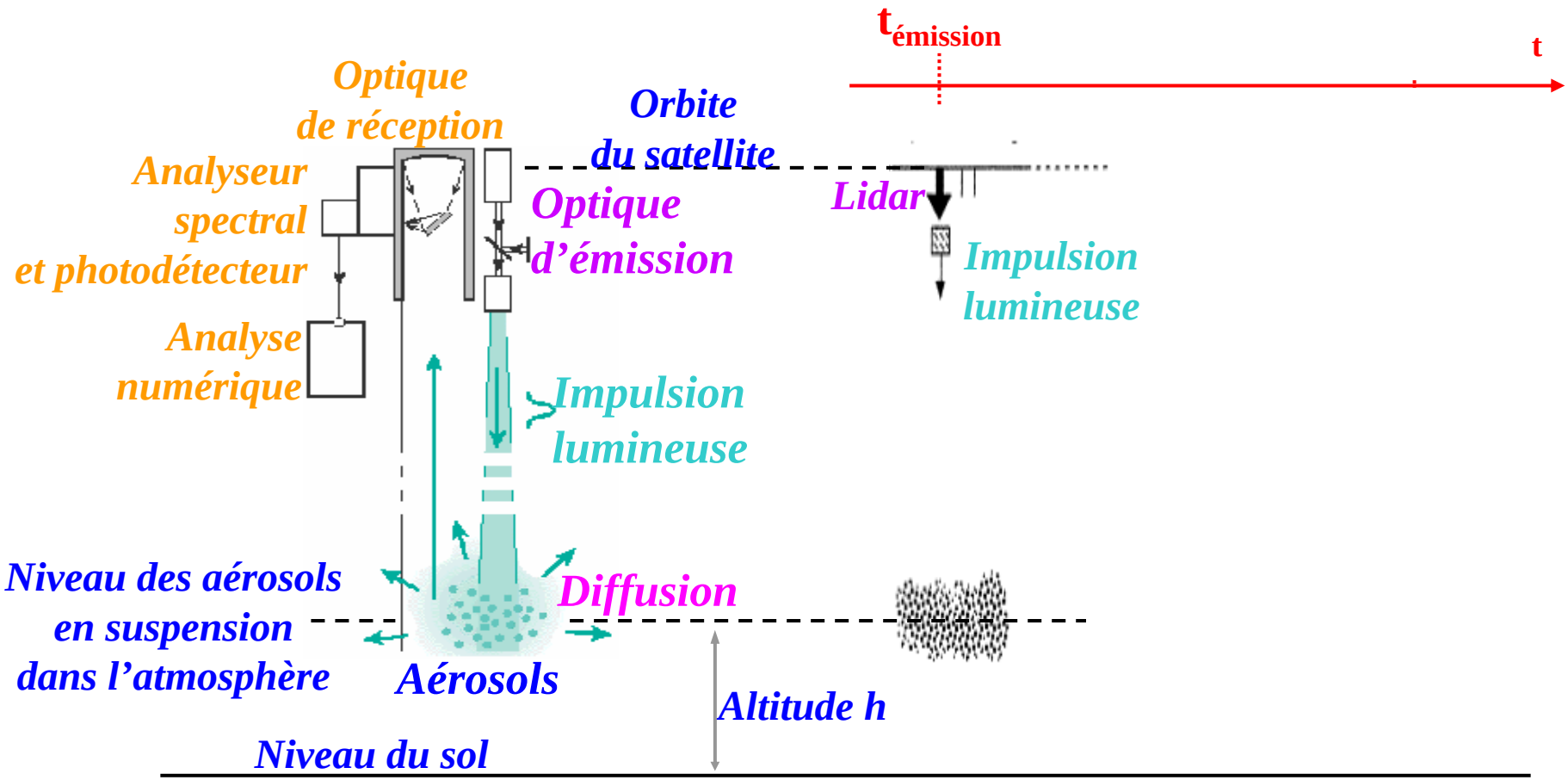
Next slide : The girls were not allowed to fly because they were under age so they took that photo inside the POLAR 2 and stuck a cloud photo taken from the plane on our coming back trip through the plane window and then, back at school, they boasted they flew !

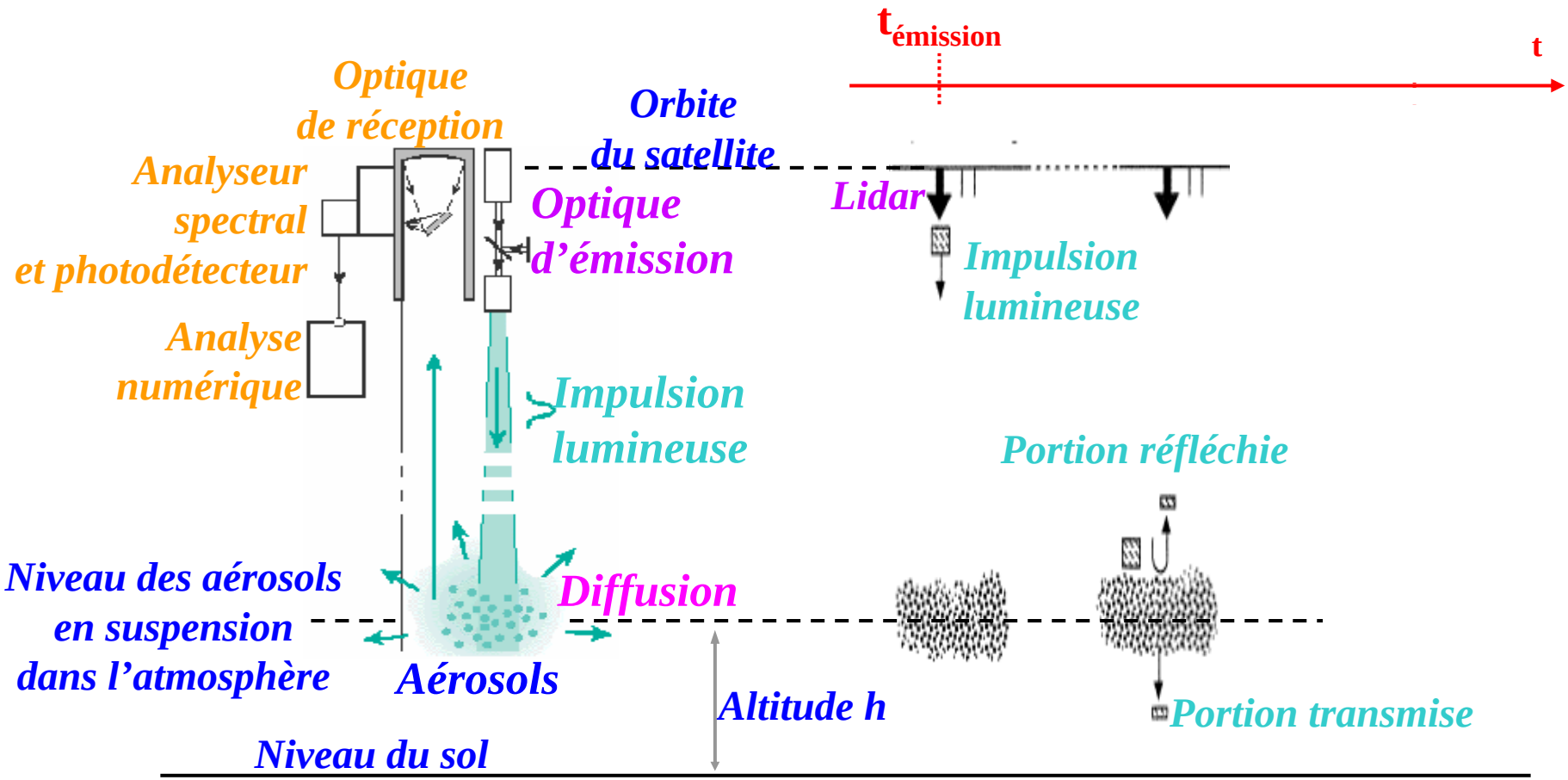
We called that scientific truth…

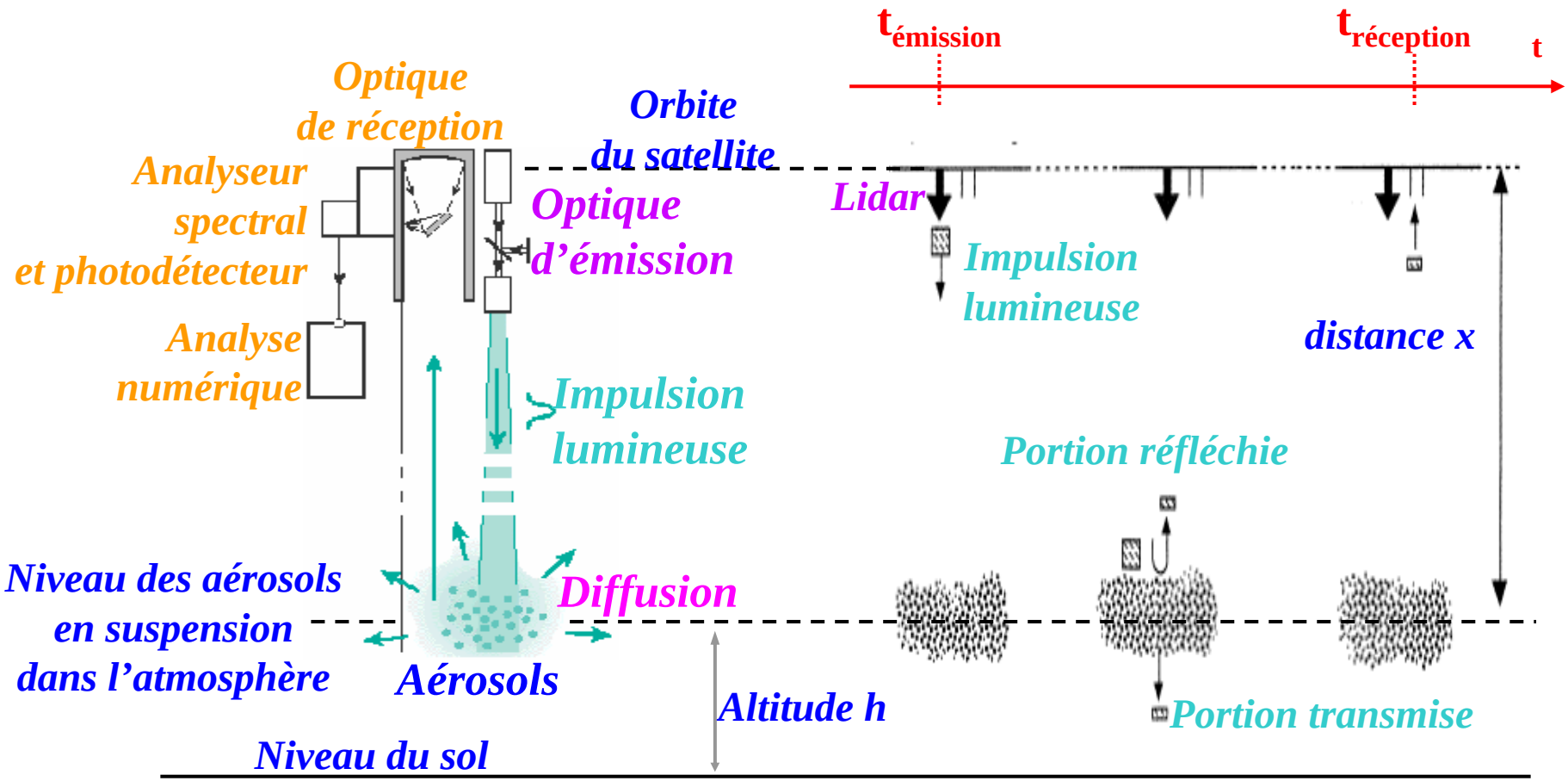
The LIDAR

Calipso send light radiations in the ground direction. It is equipped with a LIDAR


LIDAR
(emitter)
Télescope
(receiver)
Luminous beam
emitted
(532 and 1064 nm)
Scattered light received
by the télescope
Aerosols


t émission
t
Optique
de réception
Orbite
du satellite
Analyseur
spectral
et photodétecteur
Optique
d'émission
Lidar
Impulsion
lumineuse
Analyse
numérique
Impulsion
lumineuse
Niveau des aérosols
en suspension
dans l'atmosphère
Diffusion
Aérosols
Altitude h
Niveau du sol


t émission
t
Optique
de réception
Orbite
du satellite
Analyseur
spectral
et photodétecteur
Optique
d'émission
Lidar
Impulsion
lumineuse
Analyse
numérique
Impulsion
lumineuse
Portion réfléchie
Niveau des aérosols
en suspension
dans l'atmosphère
Diffusion
Aérosols
Altitude h
Portion transmise
Niveau du sol



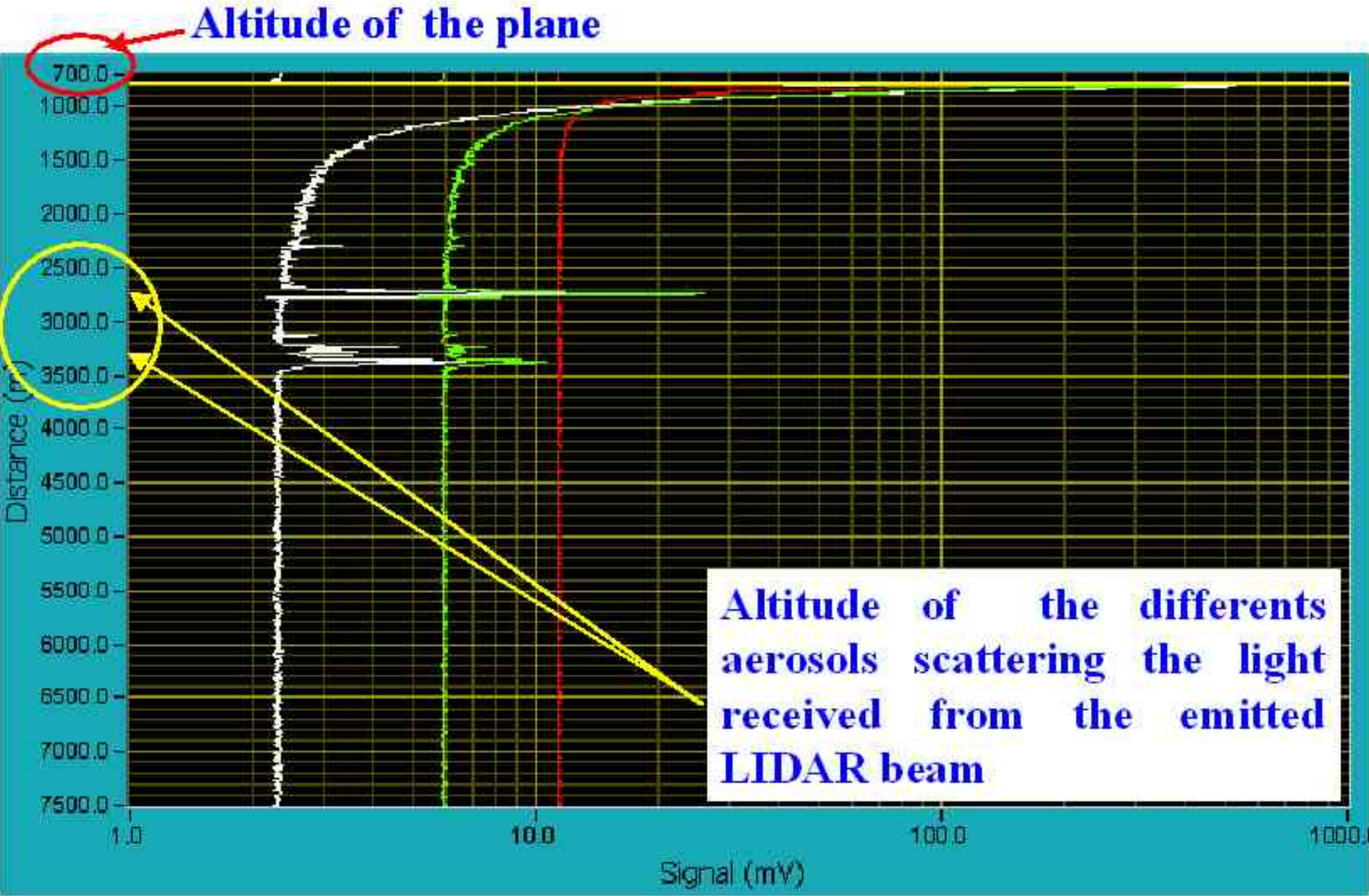
Distance x = c*($t_{réception} - t_{émission}$)/2

Altitude h = altitude de l'orbite du satellite – x = 705 - x

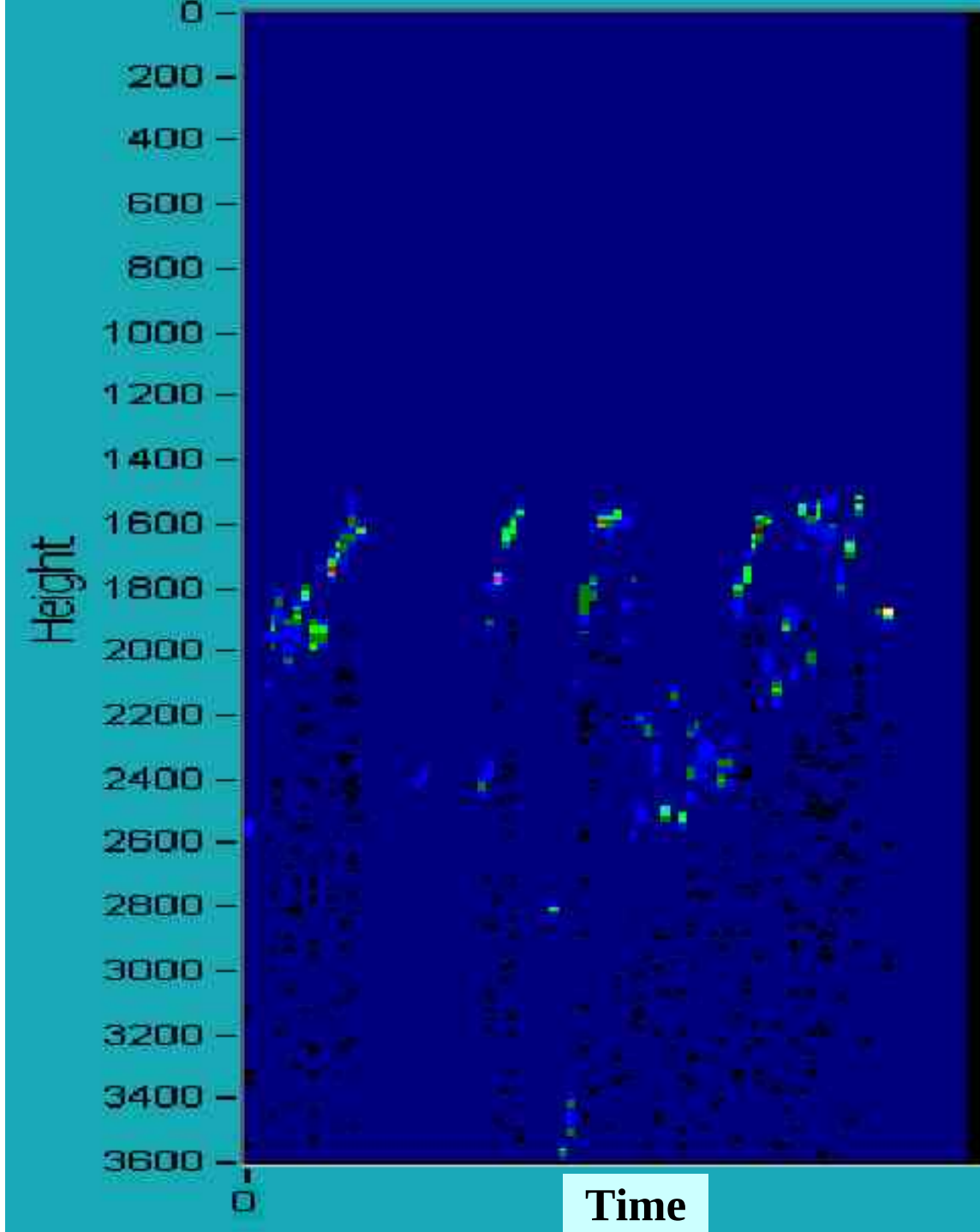
In an « upwelling » position, ready to receive downwards going scattered light.

AMALi – Airborne Mobile Aerosol Lidar

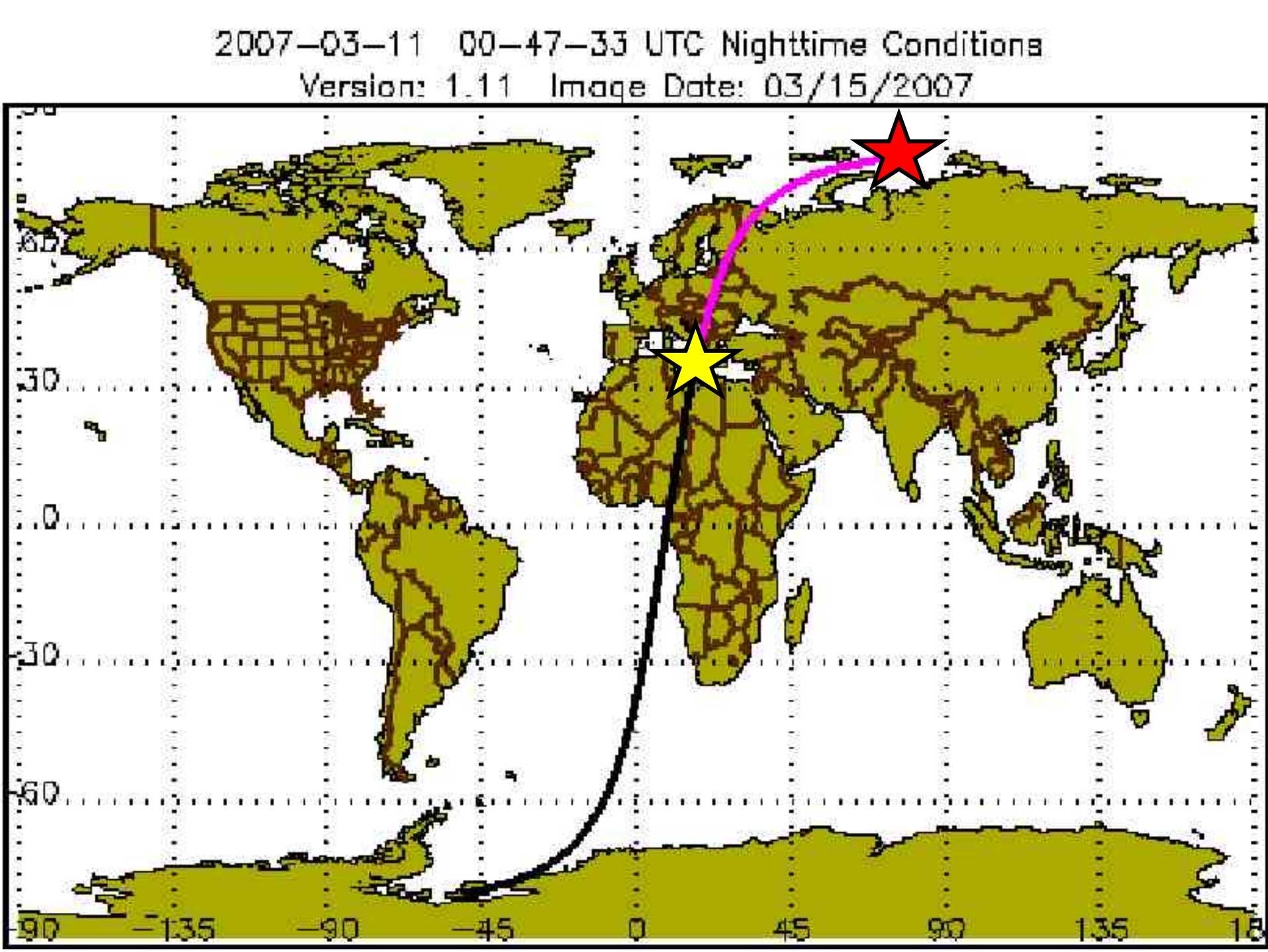
Raw signal (upwards beam)



Backscatter time series
532 nm (green)



The CALIPSO satellite is acquiring that type of data used to create atmospheric profiles giving information concerning clouds and aerosols


2007-03-11 00-47-33 UTC Nighttime Conditions
Version: 1.11 Image Date: 03/15/2007
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-60
-90
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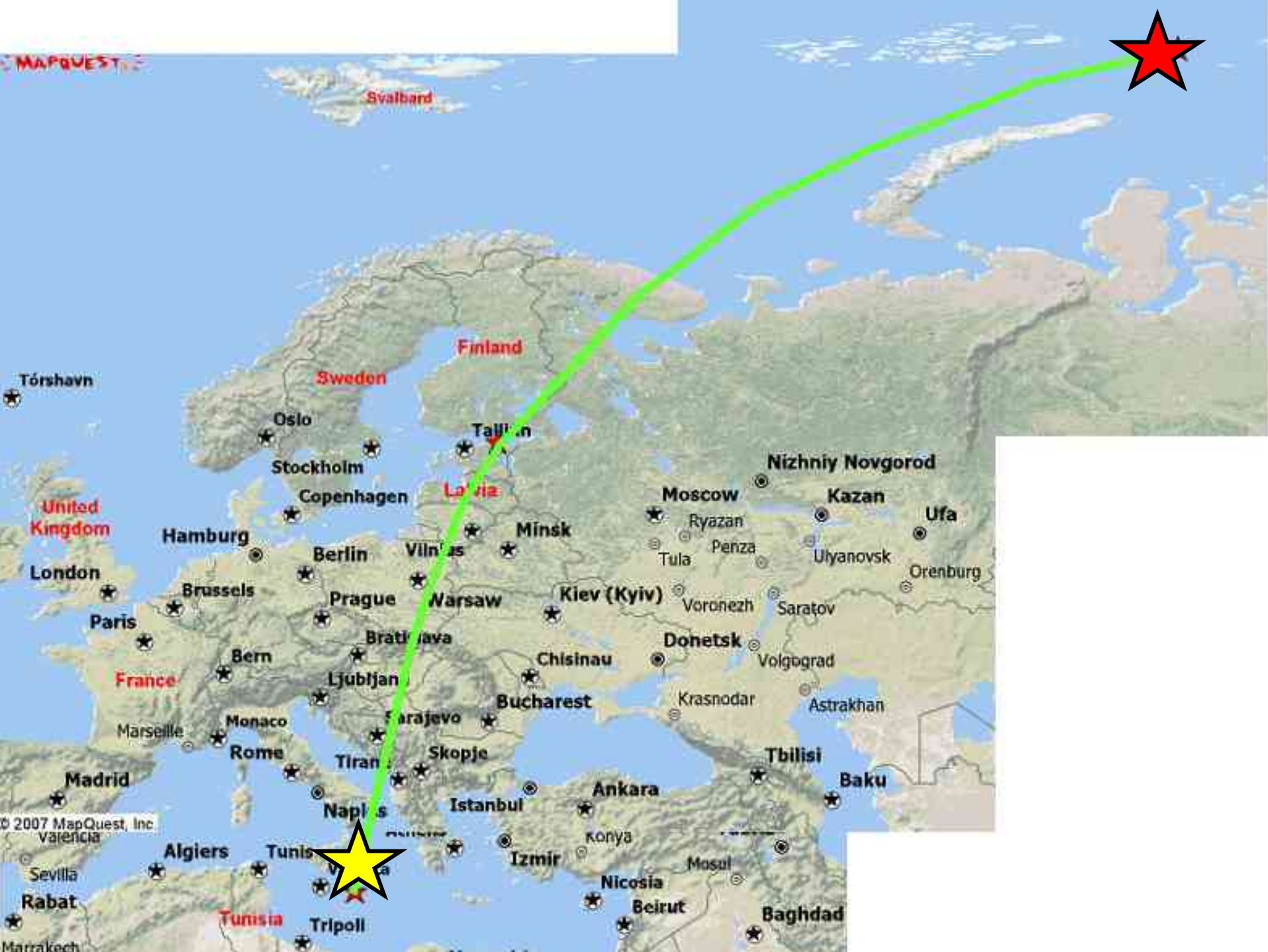
-90
-45
0
45
90
135
18


MAPQUEST
Svalbard
Finland
Sweden
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Berlin
Minsk
London
Brussels
Prague
Warsaw
Paris
Bern
France
Ljubljan
Monaco
Marseille
Rome
Madrid
Valencia
Sevilla
Rabat
Algiers
Tunisia
Tripoli
Bucharest
Chisinau
Skopje
Istanbul
Ankara
Izmir
Konya
Nicosia
Beirut
Baghdad
Mosul
Moscow
Nizhniy Novgorod
Kazan
Ufa
Ryazan
Penza
Tula
Ulyanovsk
Orenburg
Kiev (Kyiv)
Voronezh
Saratov
Donetsk
Volgograd
Krasnodar
Astrakhan
Tbilisi
Baku
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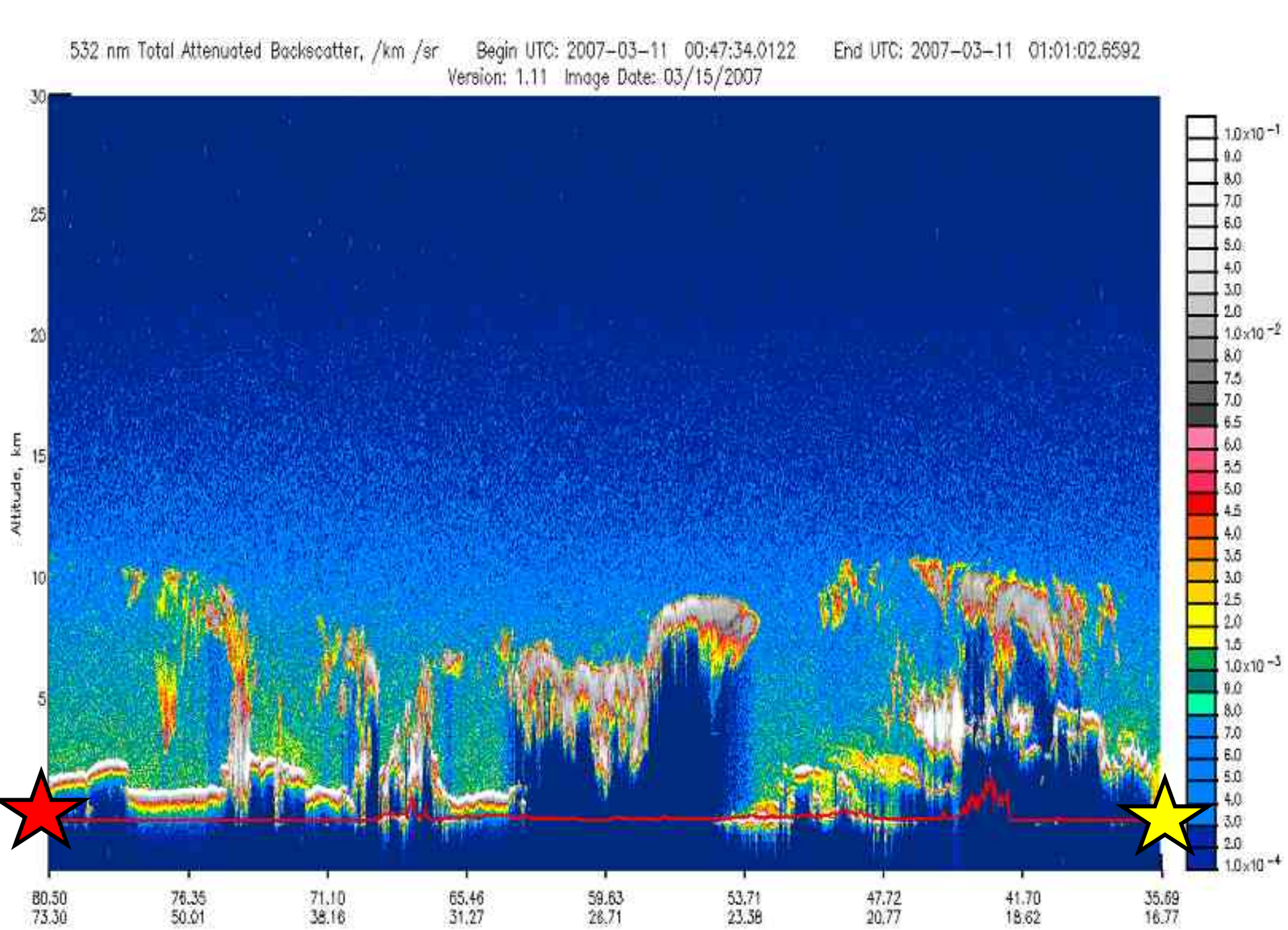
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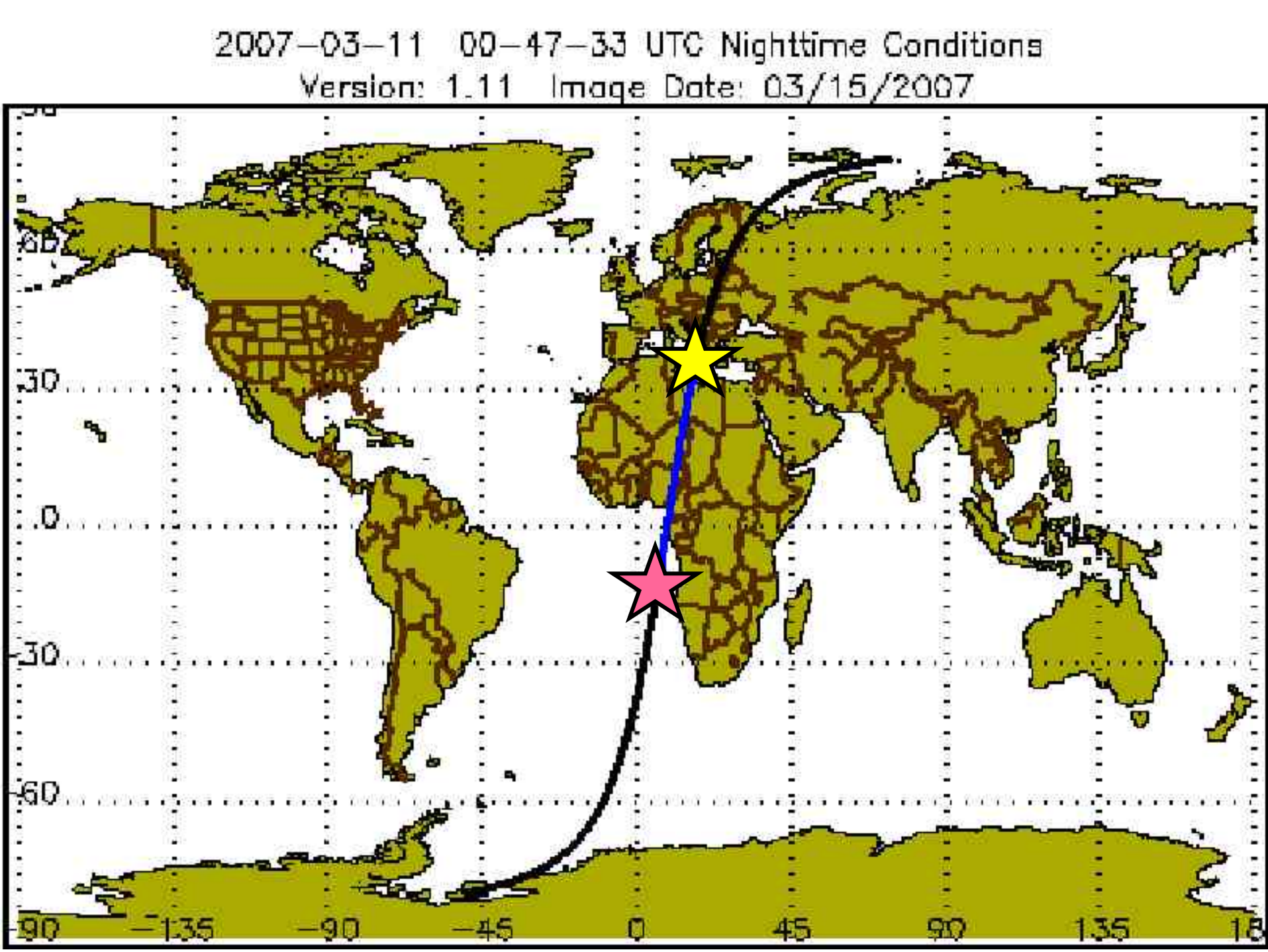
End UTC: 2007-03-11 01:01:02.6592
Version: 1.11 Image Date: 03/15/2007
Altitude, km
30
25
20
15
10
5
1.0x10 -1
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0x10 -3
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -4
80.50
73.30
76.35
50.01
71.10
38.16
65.46
31.27
59.63
28.71
53.71
23.38
47.72
20.77
41.70
18.62
35.69
16.77


2007-03-11 00-47-33 UTC Nighttime Conditions
Version: 1.11 Image Date: 03/15/2007
60
30
0
30
60
-90
-135
-90
-45
0
45
90
135
18


Madrid
Barcelona
Portugal
Valencia
Naples
Sevilla
Algiers
Tunis
Rabat
Tunisia
Marrakech
Athens
Istanbul
Ankara
Yerevan
Izmir
Konya
Tabriz
Baku
Mosul
Nicosia
Beirut
Baghdad
Alexandria
Kuwait City
Cairo
Libya
Egypt
Western Sahara
Saudi Arabia
Jeddah
Nouakchott
Niger
Mali
Praia
Dakar
Khartoum
Sanaa
Niamey
Chad
Asmara
Sudan
Banjul
Bissau
Burkina Faso
Conakry
Benin
Abuj
Addis Ababa
Freetown
Yamoussoukro
Lomé
Porto-Novo
Abidjan
Yaound
Bangui
Malabo
São Tom
Libreville
Uganda
Kenya
Gabon
Kigali
Bujumbura
Nairobi
Kinshasa
Tanzania
Luanda
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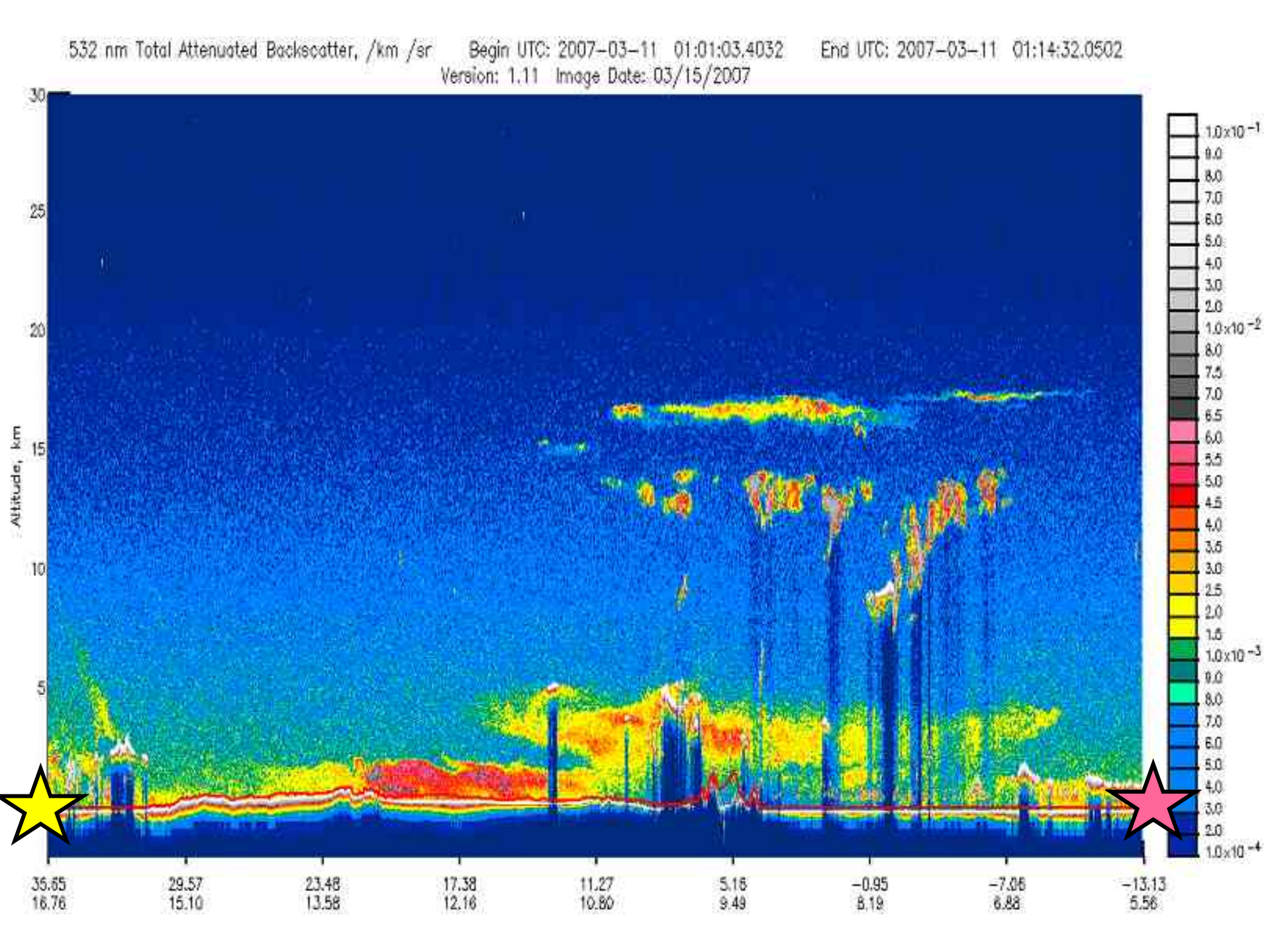
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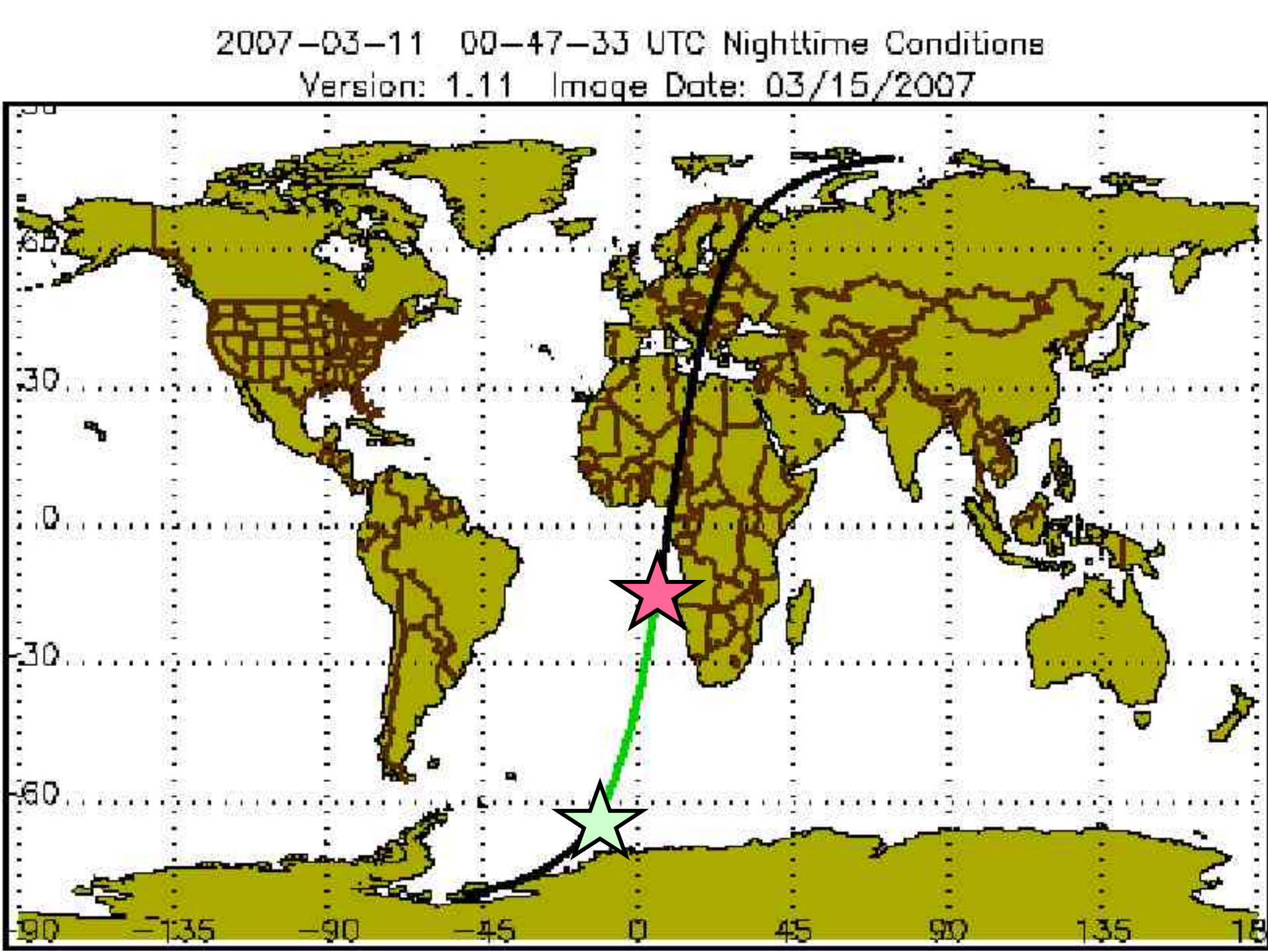
Version: 1.11 Image Date: 03/15/2007
Altitude, km
30
25
20
15
10
5
35.65
16.76
29.57
15.10
23.48
13.58
17.38
12.16
11.27
10.80
5.16
9.49
-0.95
8.19
-7.06
6.88
-13.13
5.56
1.0x10 -1
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0x10 -3
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -4


2007-03-11 00-47-33 UTC Nighttime Conditions
Version: 1.11 Image Date: 03/15/2007
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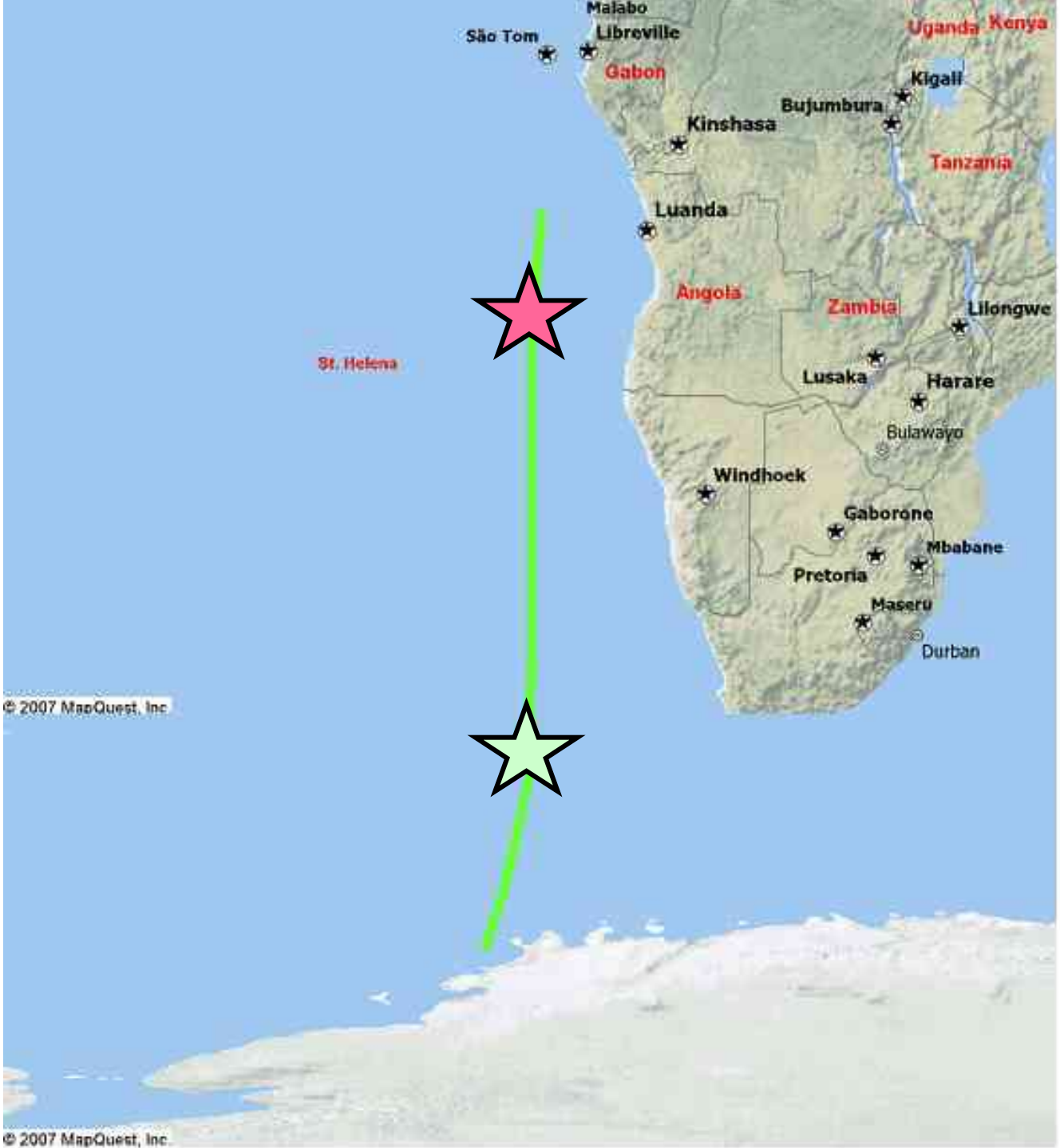
0
30
60
-90
-135
-90
-45
0
45
90
135



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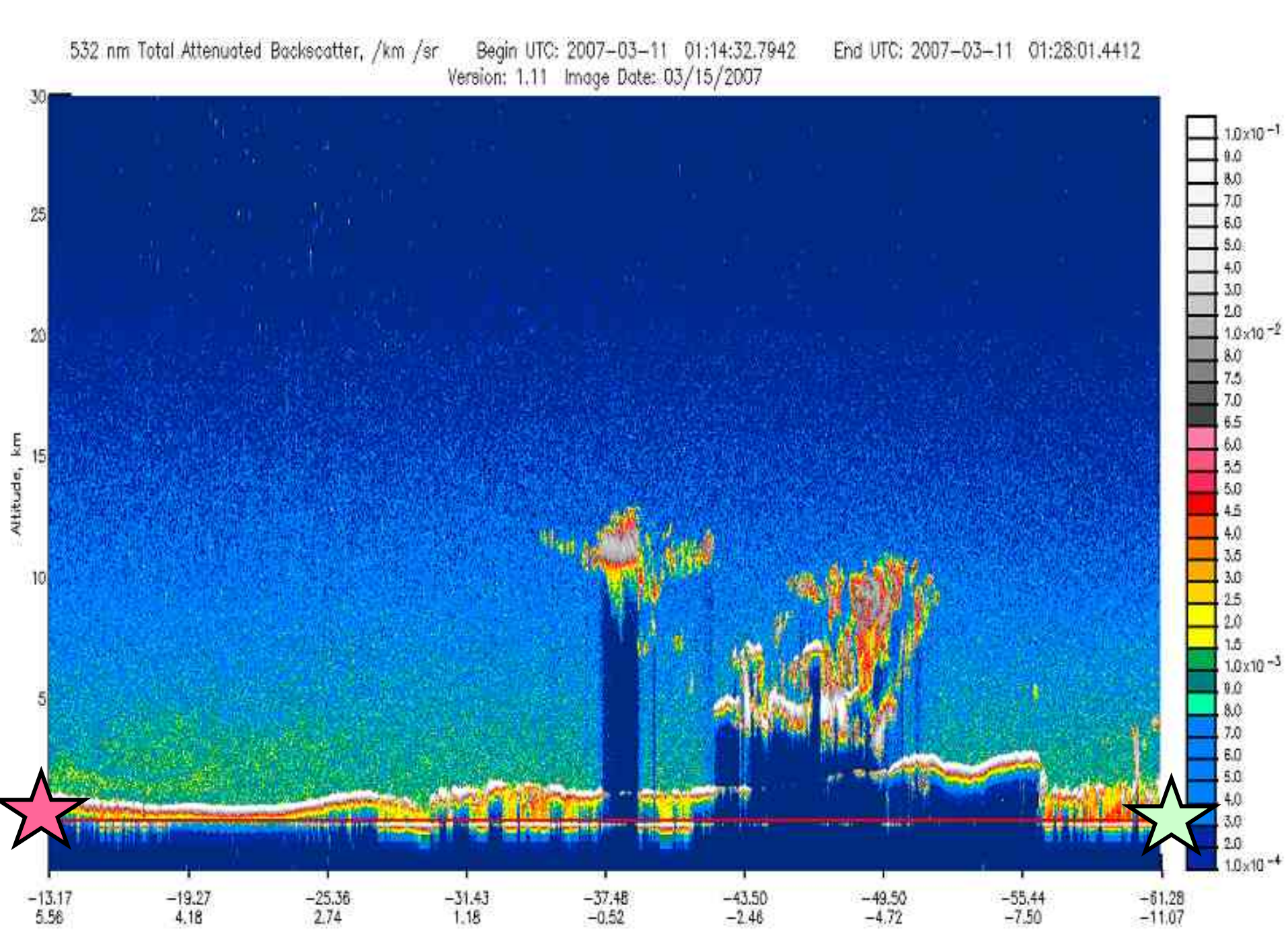
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20
15
10
5
-13.17
5.58
-19.27
4.18
-25.36
2.74
-31.43
1.18
-37.48
-0.52
-43.50
-2.46
-49.50
-4.72
-55.44
-7.50
-61.28
-11.07
1.0x10 -1
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -2
8.0
7.5
7.0
6.5
6.0
5.5
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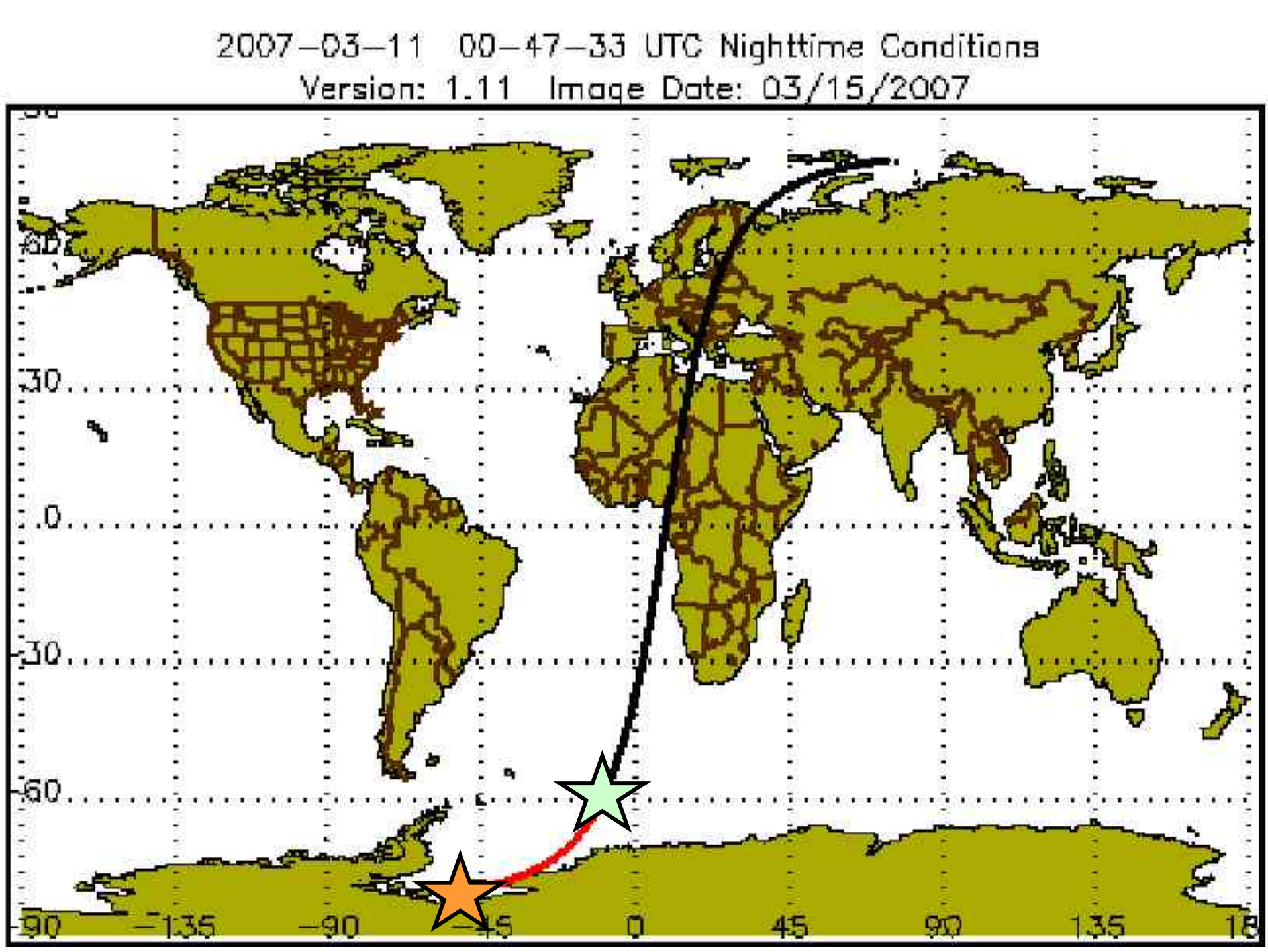
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0x10 -3
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -4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-90
-135
-90
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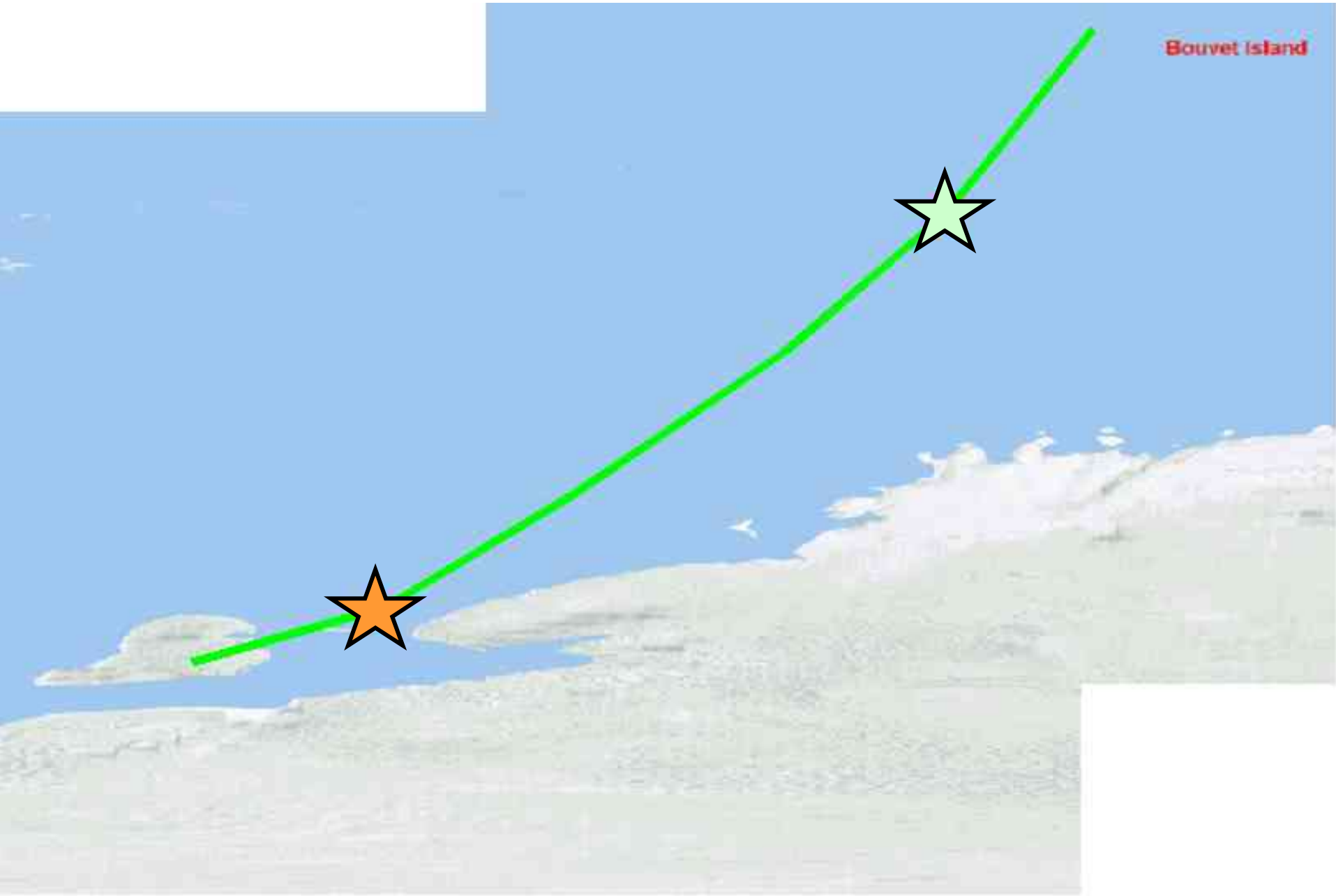
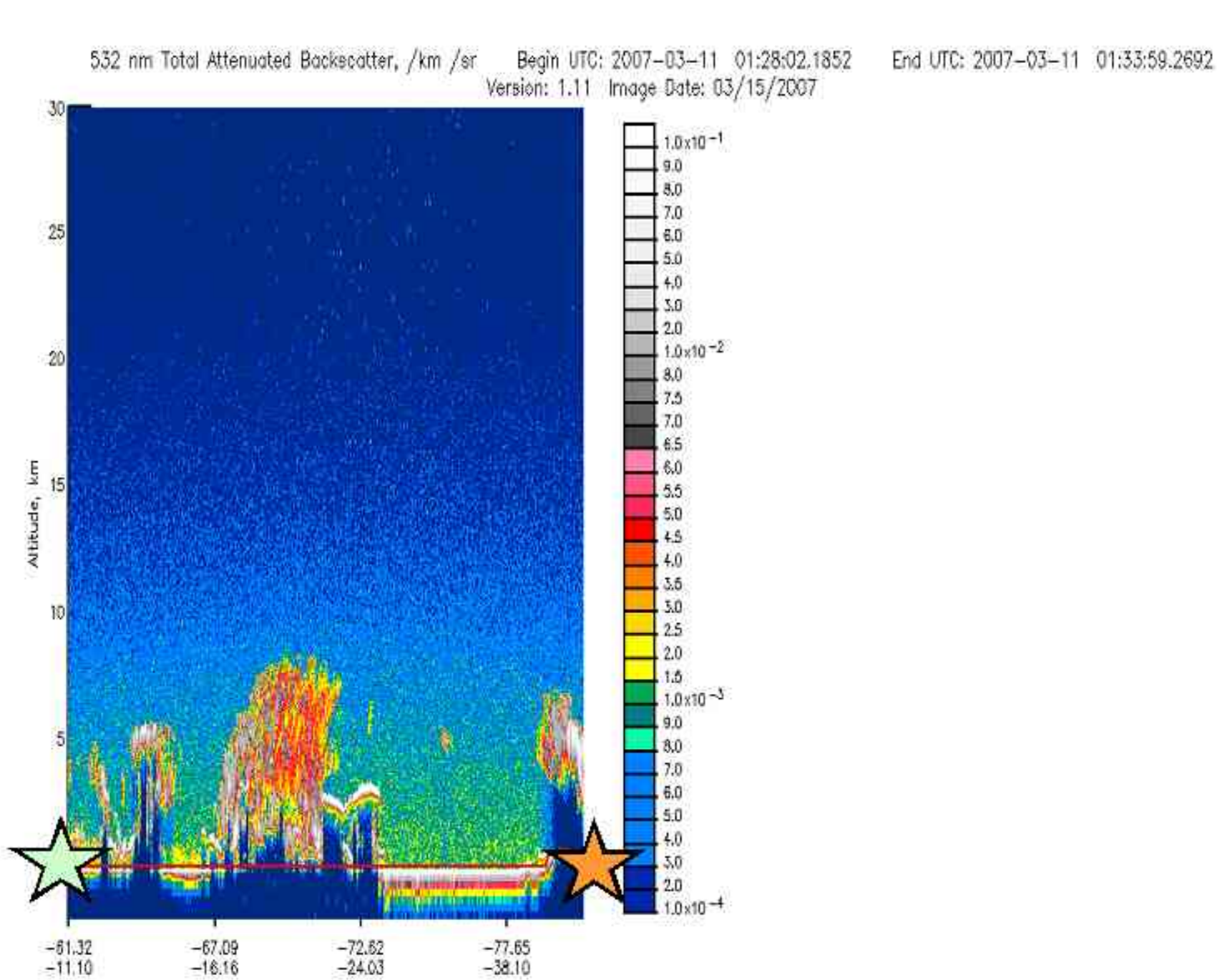
45
90
135
180


Bouvet Island


532 nm Total Attenuated Backscatter, /km /sr
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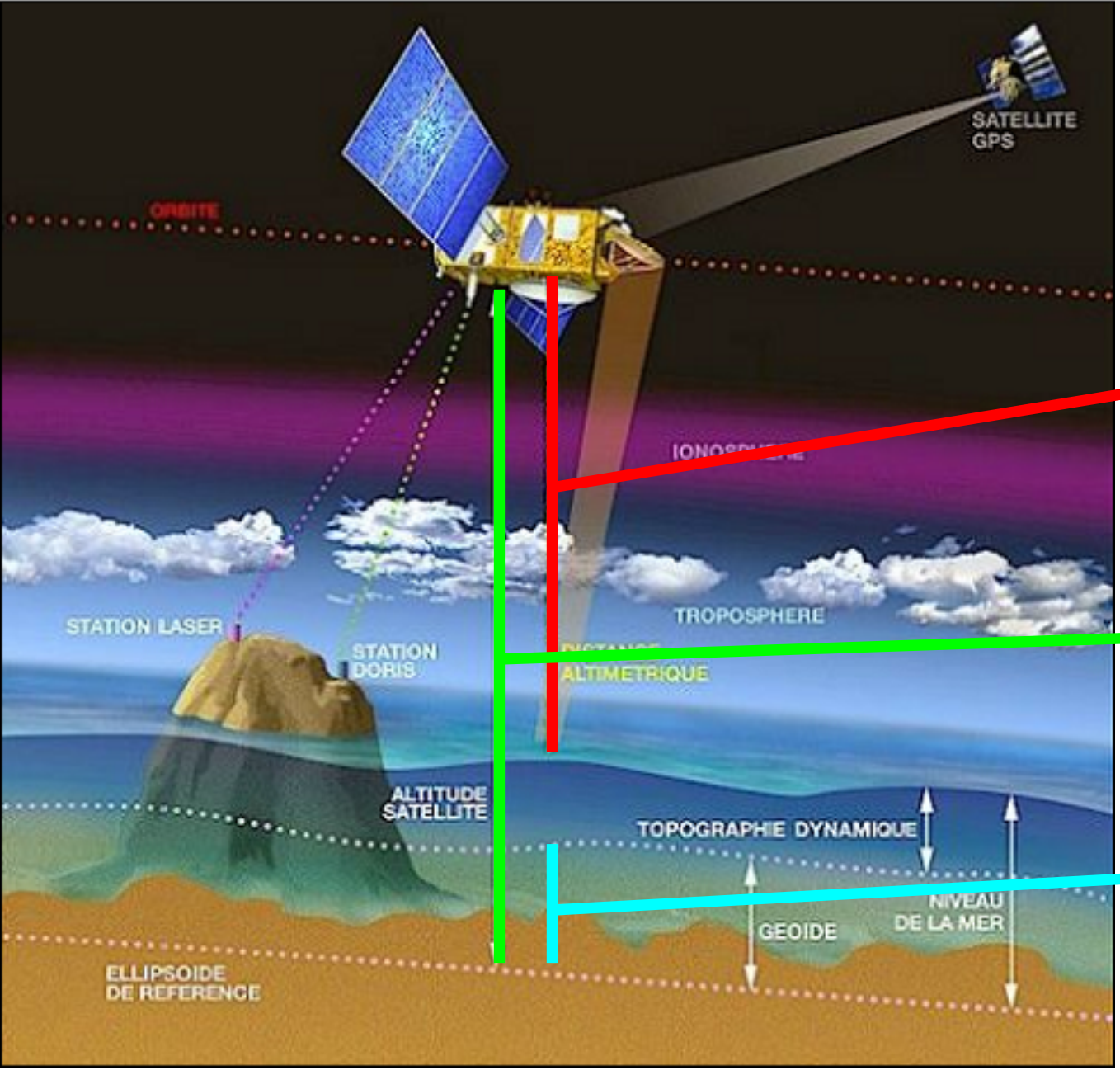
End UTC: 2007-03-11 01:33:59.2692
Version: 1.11 Image Date: 03/15/2007
Altitude, km
30
25
20
15
10
5
1.0x10 -1
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -2
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0x10 -3
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0x10 -4
-61.32
-11.10
-67.09
-16.16
-72.62
-24.03
-77.65
-38.10

Ocean measurements

Altimetric satellites

Monitoring
the ocean level evolution

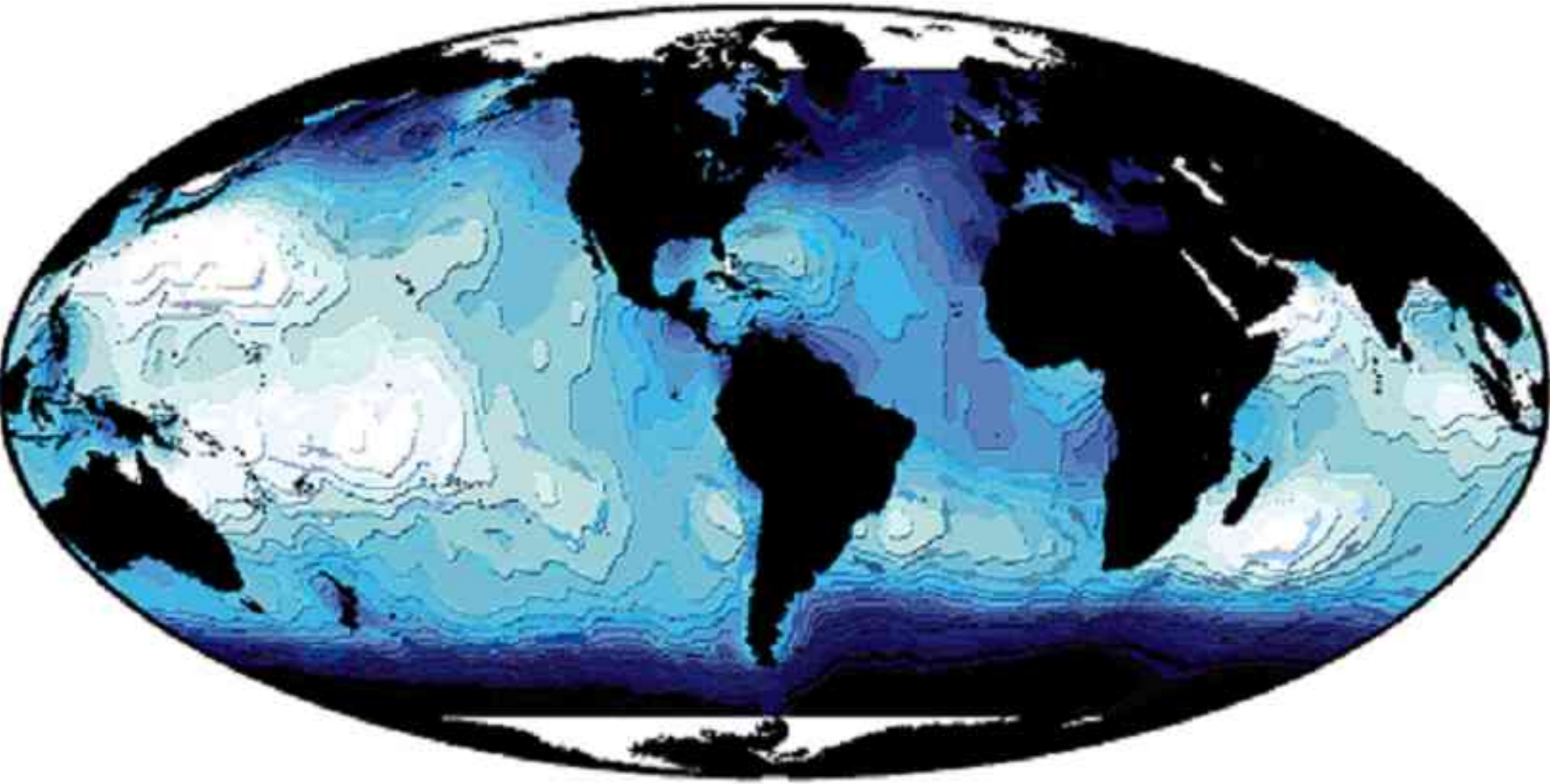


$H_{altimétrie}$

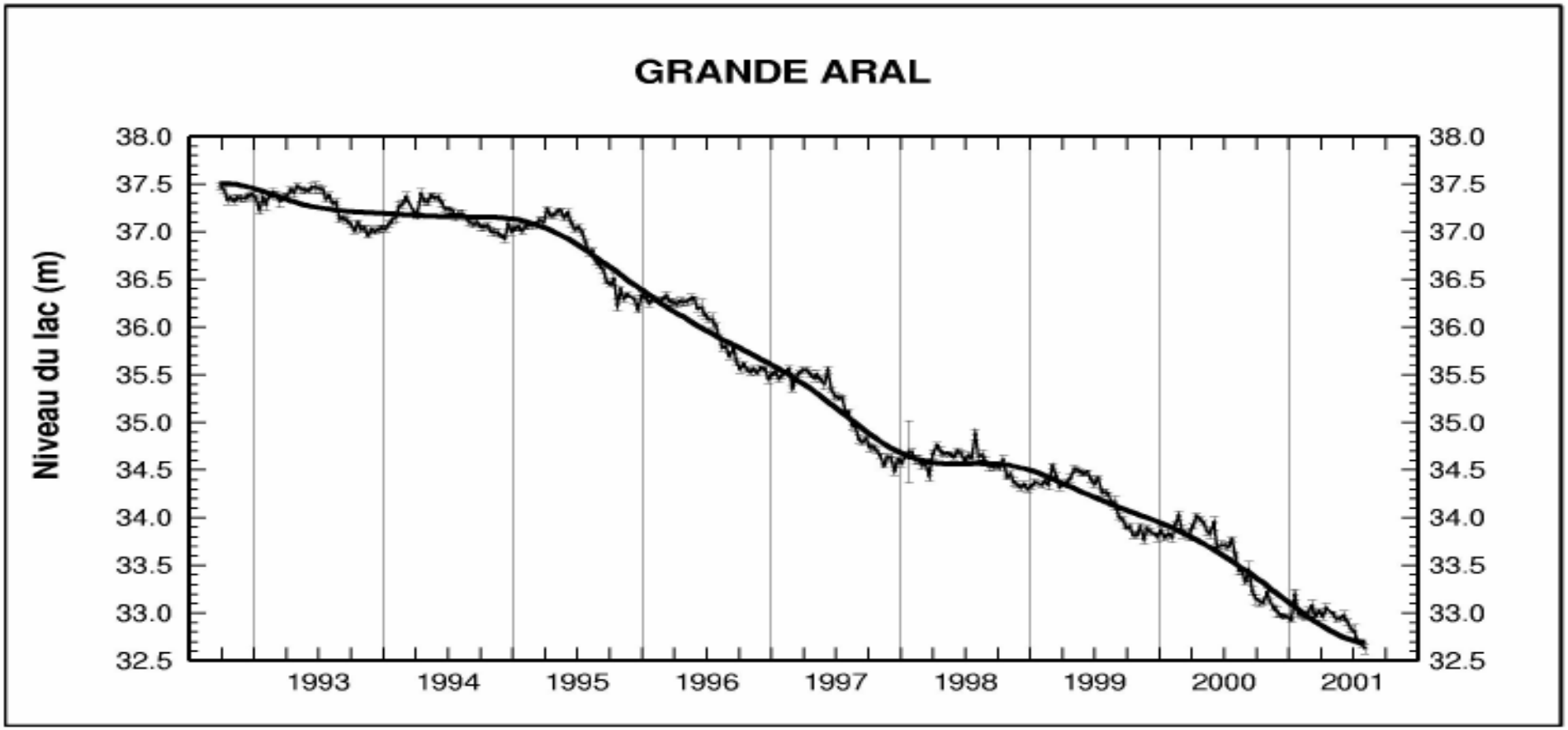
H_{orbite}

$H_{géoïde}$

$$H_{topographie\ dynamique} = H_{orbite} - H_{altimétrie} - H_{géoïde}$$



Niveau de la mer d'Aral



1960

1985

1986

1987

1988

1989

1990

1991

1992

1993

1994

1995

1996

1997

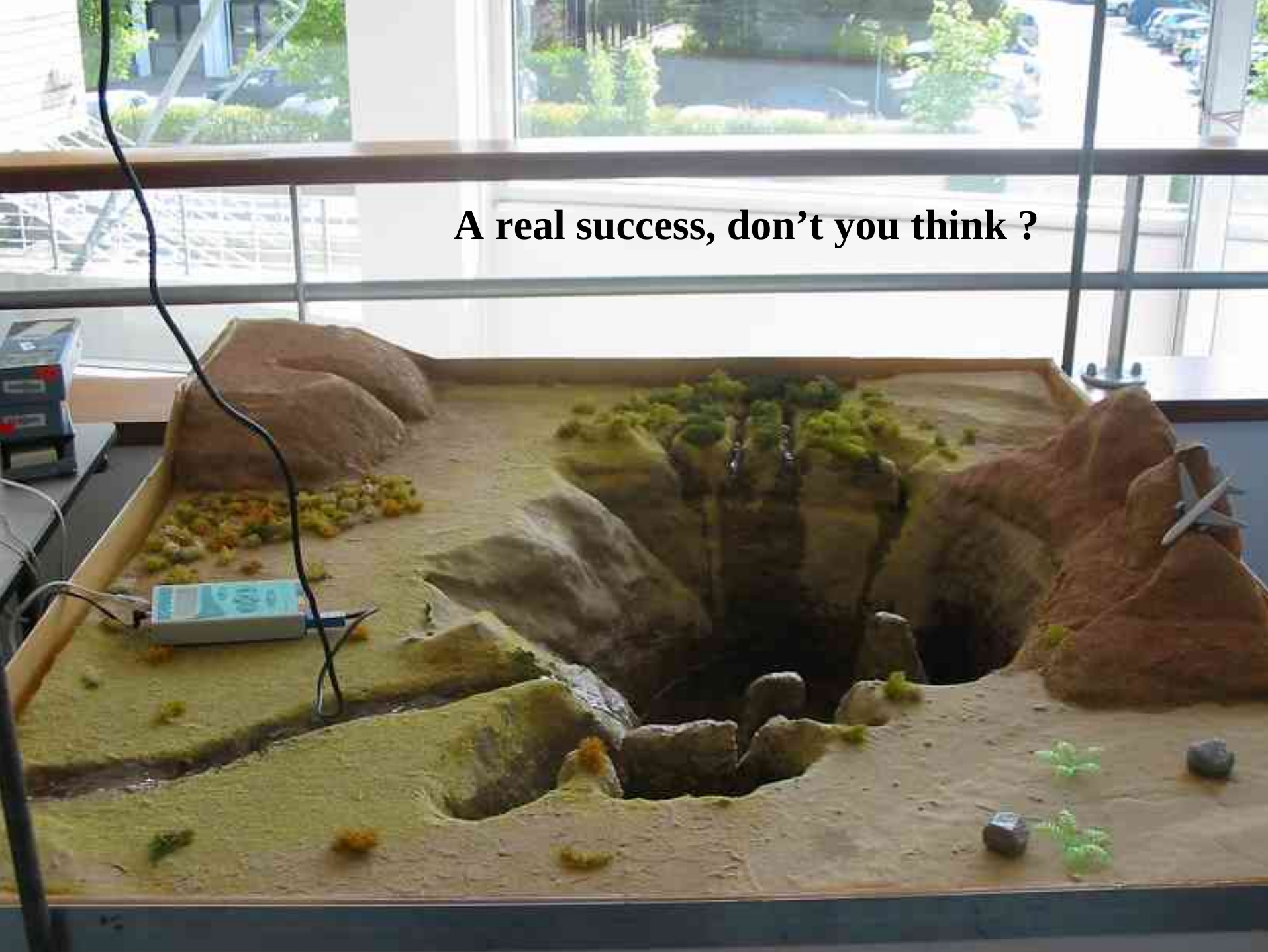
1998

2010


We decided
to build a model
of the Aral Sea

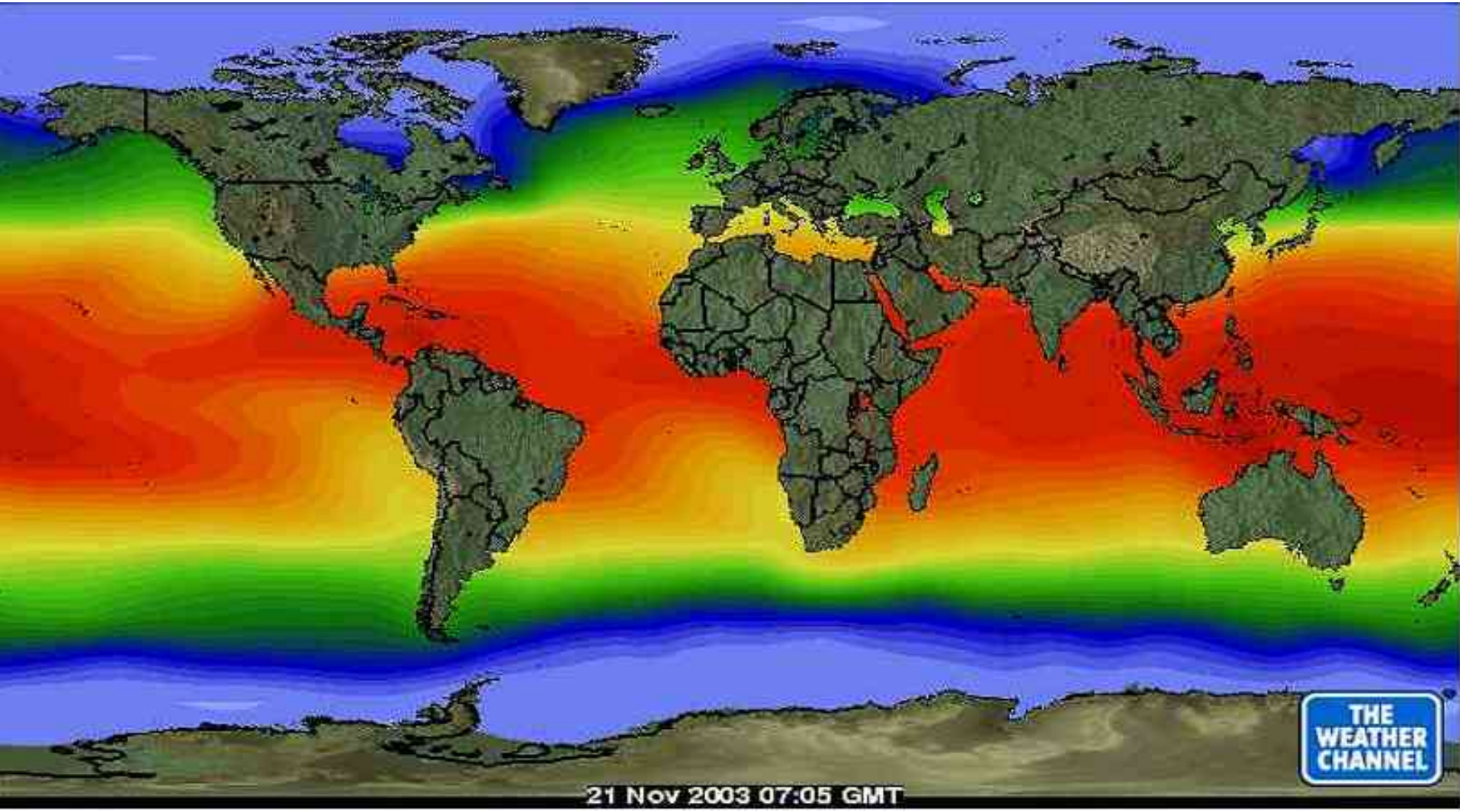
It looks like sweated labour
(and according
to the students,
that's what it was !)

Never believe them…
You can't see me
with the camera
and the whip !


A real success, don’t you think ?

Satellites measuring infrared light emitted by the Earth

Monitoring the sea surface temperature


THE WEATHER CHANNEL
21 Nov 2003 07:05 GMT
Glace marine
0 60 85 90 100%
0 60 85 90 100%
Température de la mer
-2 5 10 15 20 25 30 >35 (°C)
28 41 50 59 68 77 86 >93 (°F)

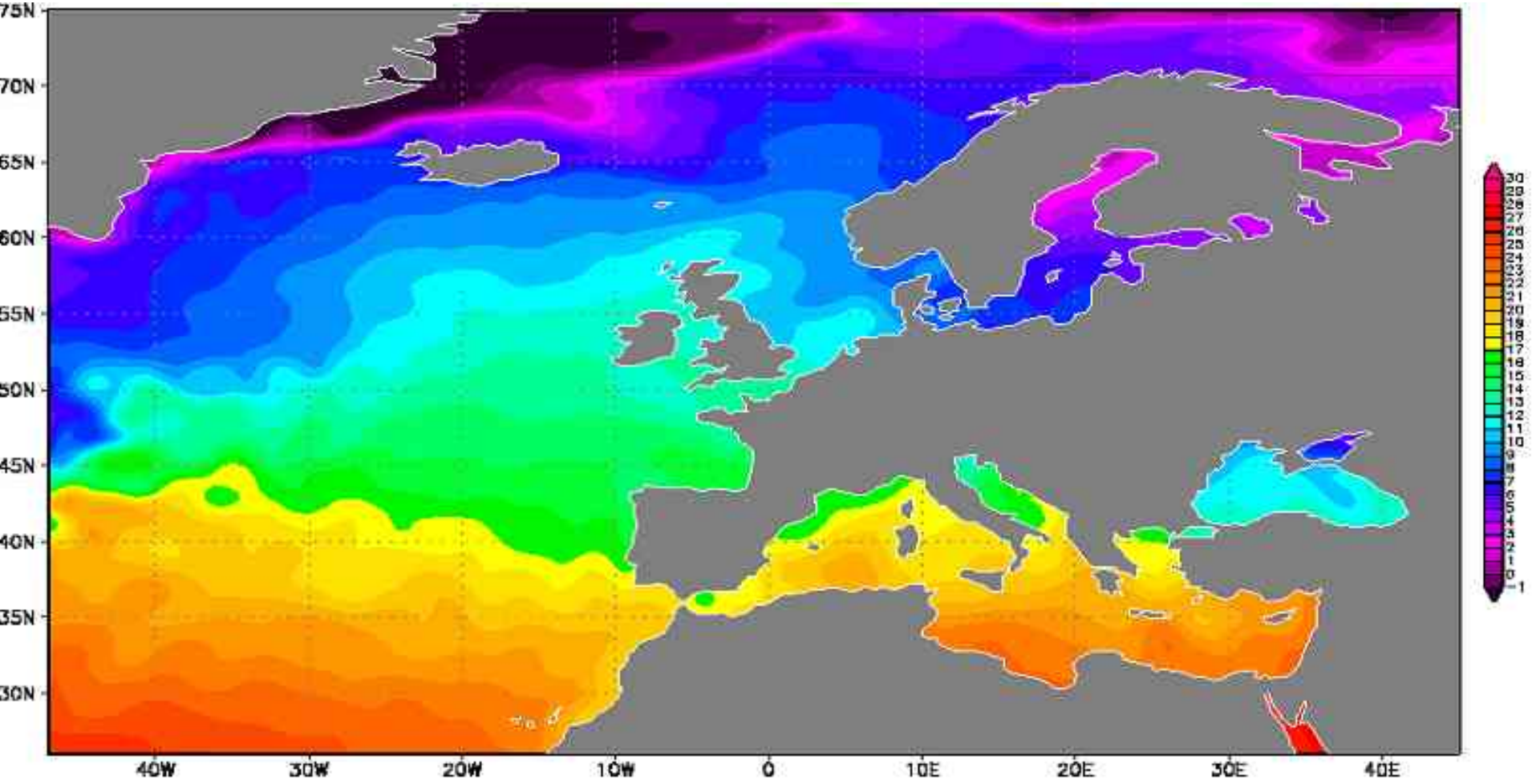
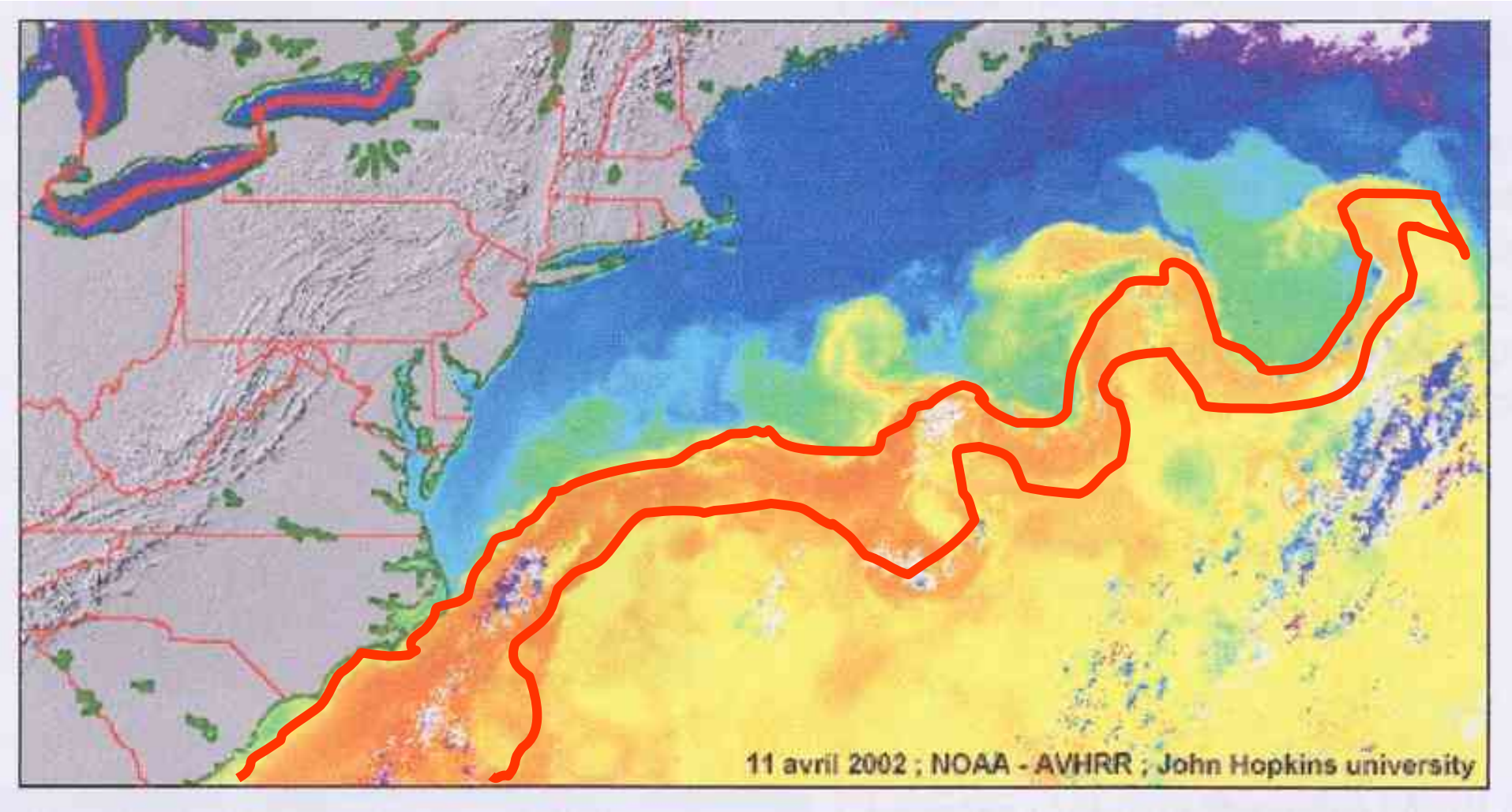

75N
70N
65N
60N
55N
50N
45N
40N
35N
30N
40W
30W
20W
10W
0
10E
20E
30E
40E
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1

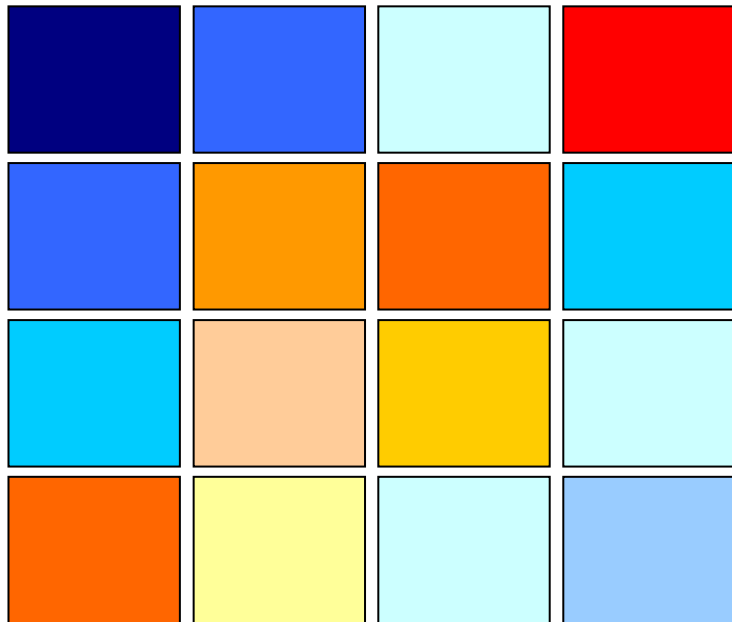
Image du Gulf Stream prise par le satellite NOAA

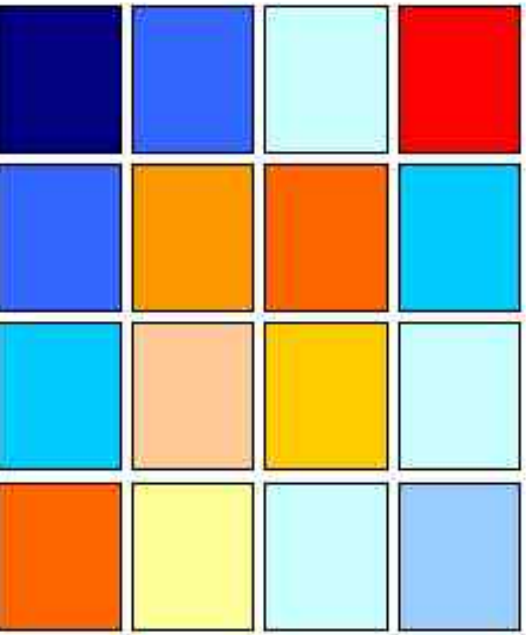


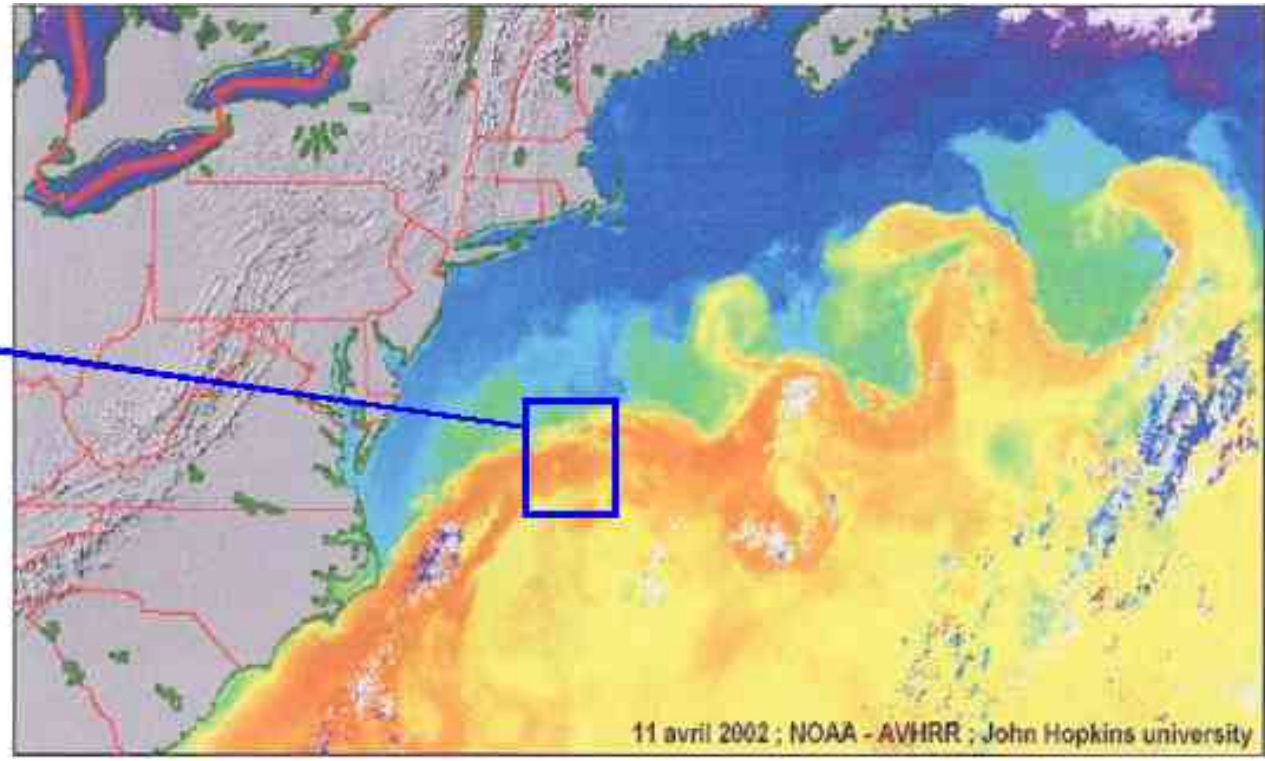
Representing a « static » Gulf Stream, with hot water and ice cubes

Eau froide	Eau froide	Eau froide	Eau chaude
Eau froide	Eau chaude	Eau chaude	Eau froide
Eau froide	Eau chaude	Eau chaude	Eau froide
Eau chaude	Eau chaude	Eau froide	Eau froide

-35	-20	-10	50
-25	25	40	-15
-15	15	20	-10
20	10	-10	-20

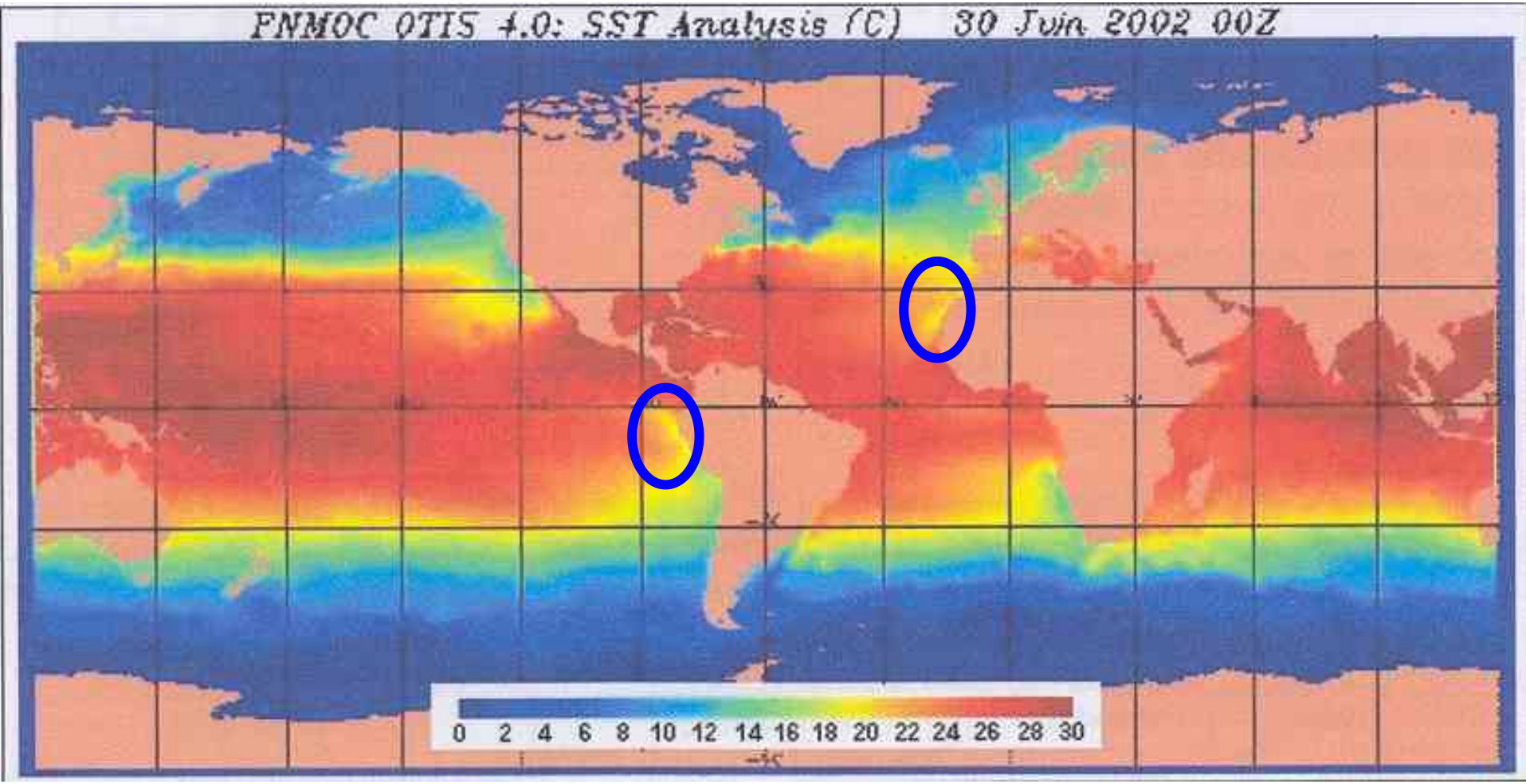





11 avril 2002 ; NOAA - AVHRR ; John Hopkins university

SST maps help to locate upwellings

Upwellings



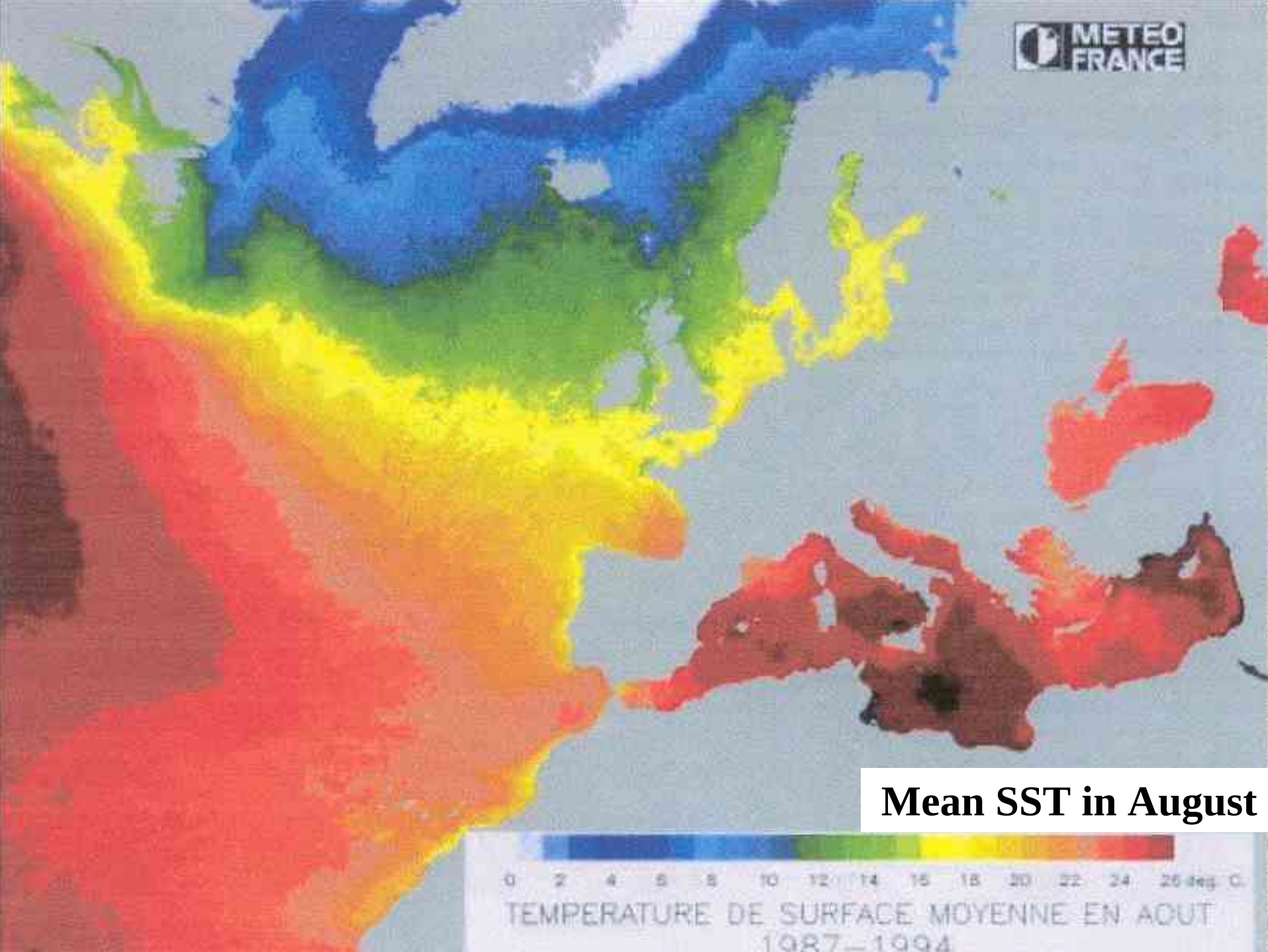
Upwelling zones are good fishing areas

Next slide : going on holidays with you boy or girl friend, you can use a Sea Surface Temperature map to choose your holidays location, but you'd better like to do the same thing !

Two liking fishing : upwelling zones

Two liking swimming in warm water : non upwelling zones

One of each : you are in trouble !



Mean SST in August

These 3 series of experiments (altimetric satellite and the Aral Sea, SST satellite and a static Gulf Stream, drifting buoys) have been presented to the Physics Olympiads in Paris in January 2005 (after a selection competition in Boulogne-sur-Mer on the Channel coast in December 2004)

They won two 4^{th} prizes and one 3^{rd} prize)

And the whole lot went to La Rochelle on the Atlantic coast, 700 km from Reims, for an ARGONAUTICA presentation in May 2005.

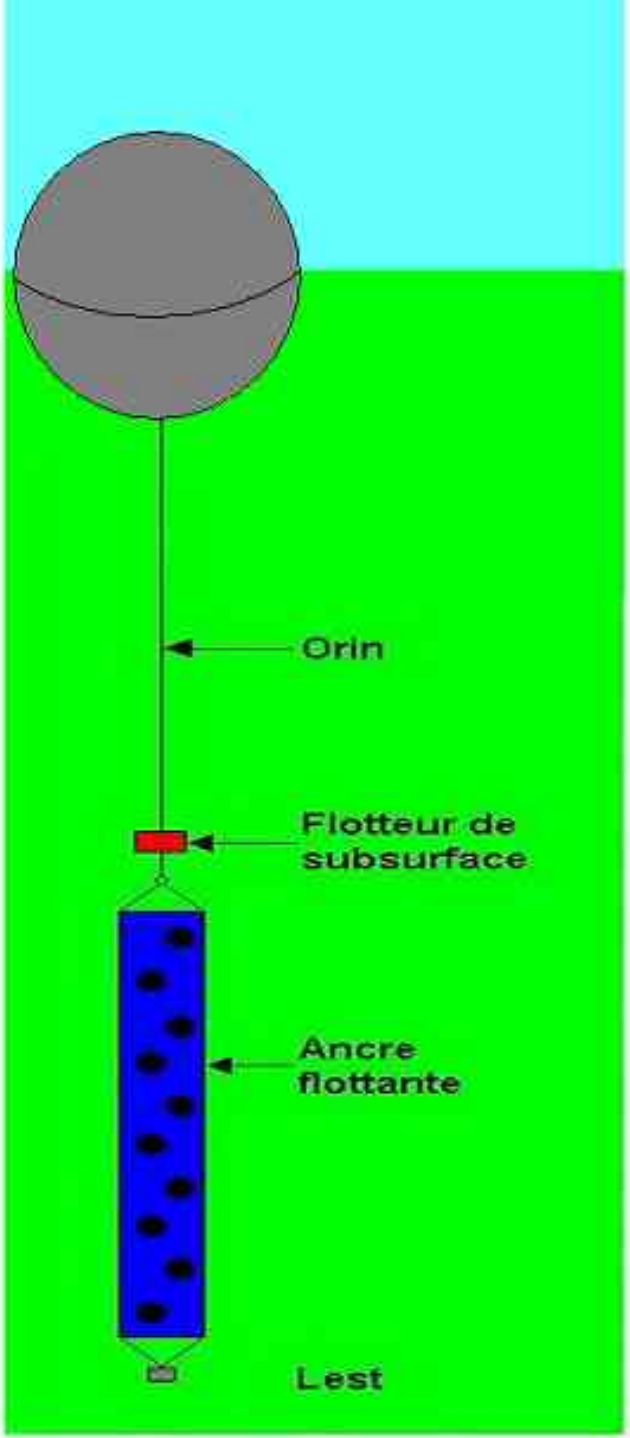
I’m not sure my students are really learning something but they are getting better and better in conditioning and packaging activities as well as in carrying activities !

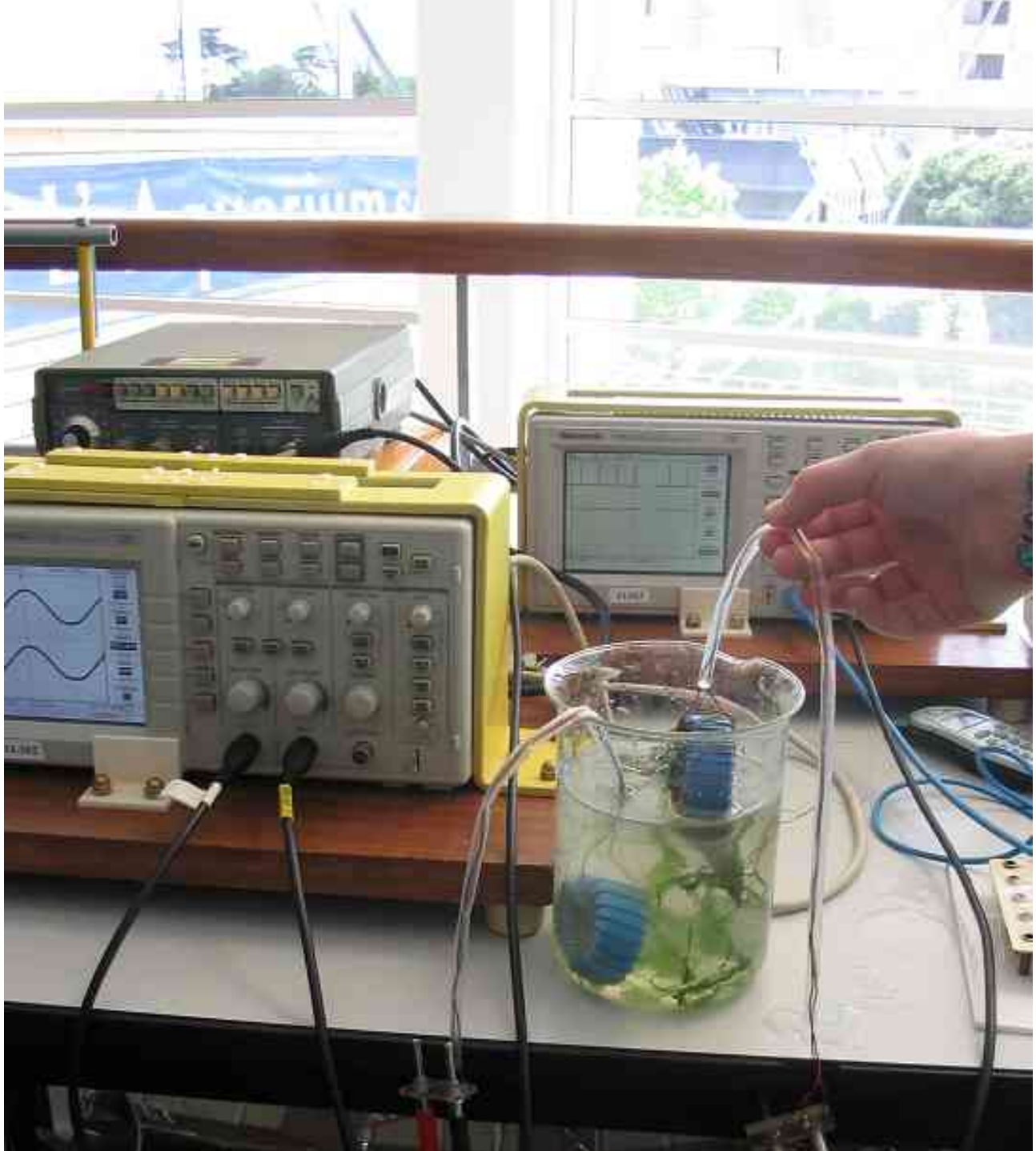
Location satellites

Location and data collecting
The ARGOS system

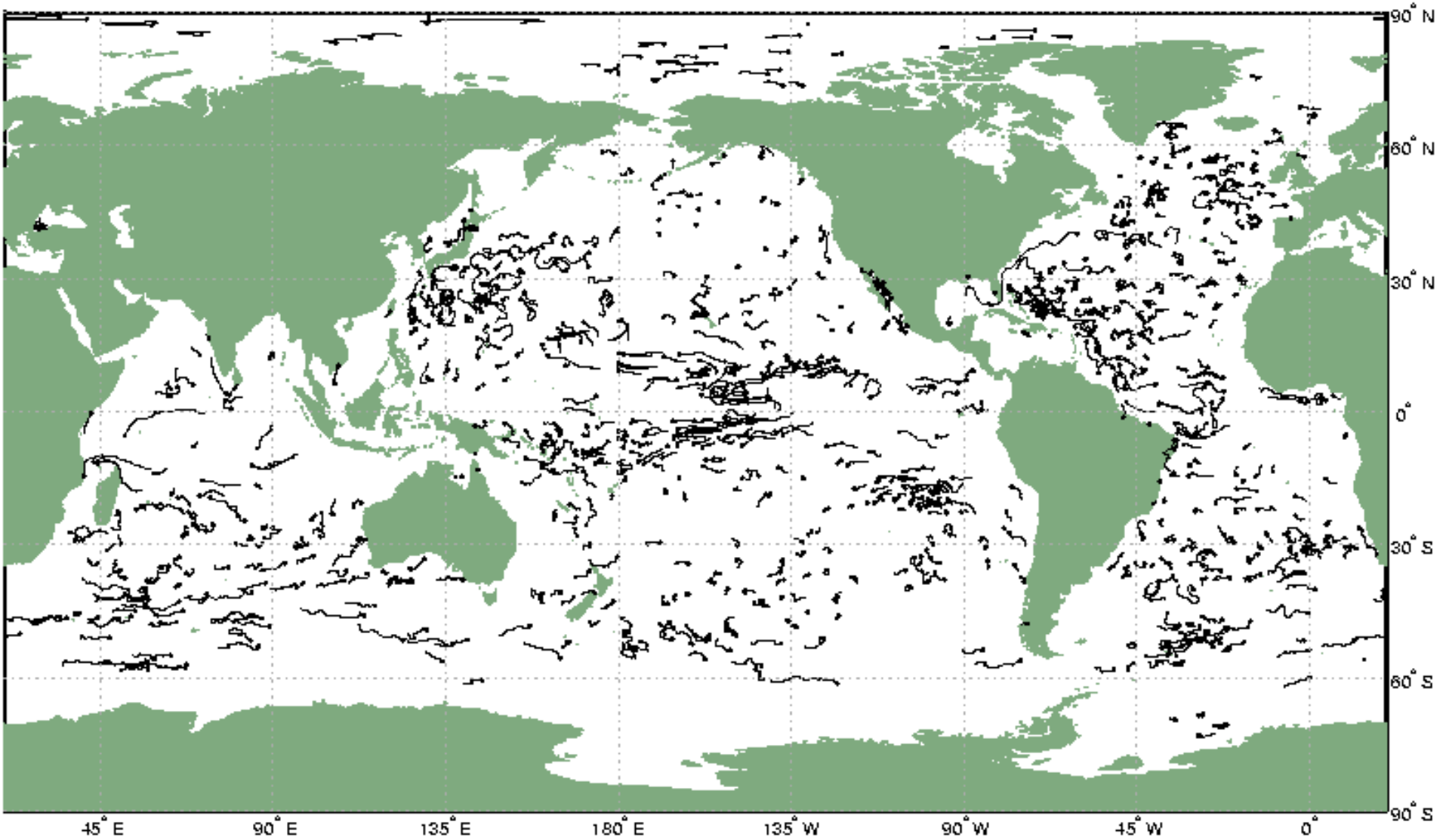
A CNES project for schools

Drifting buoys

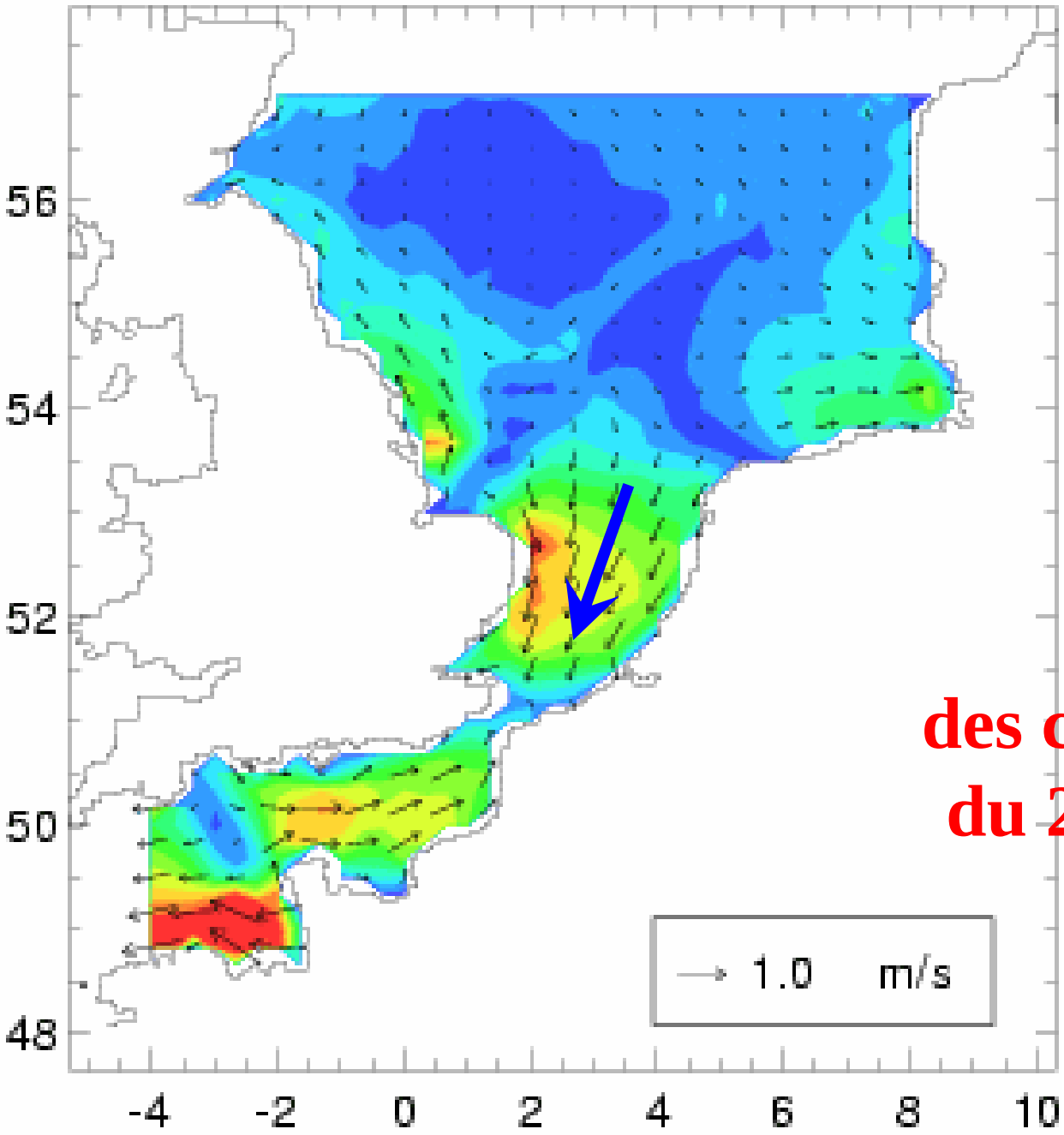

Orin
Flotteur de subsurface
Ancre flottante
Lest



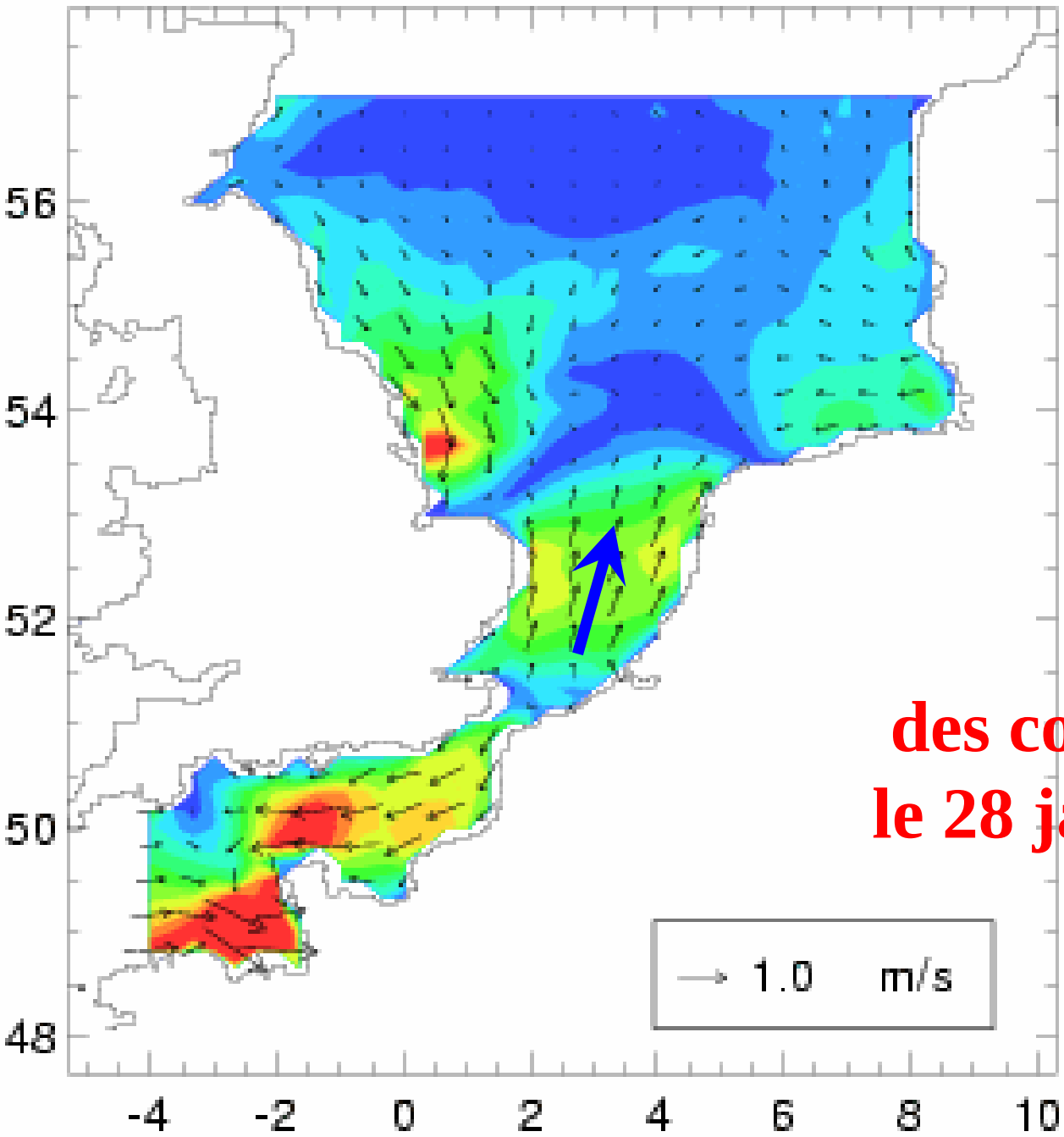
Drifting Buoys/Bouées dérivantes



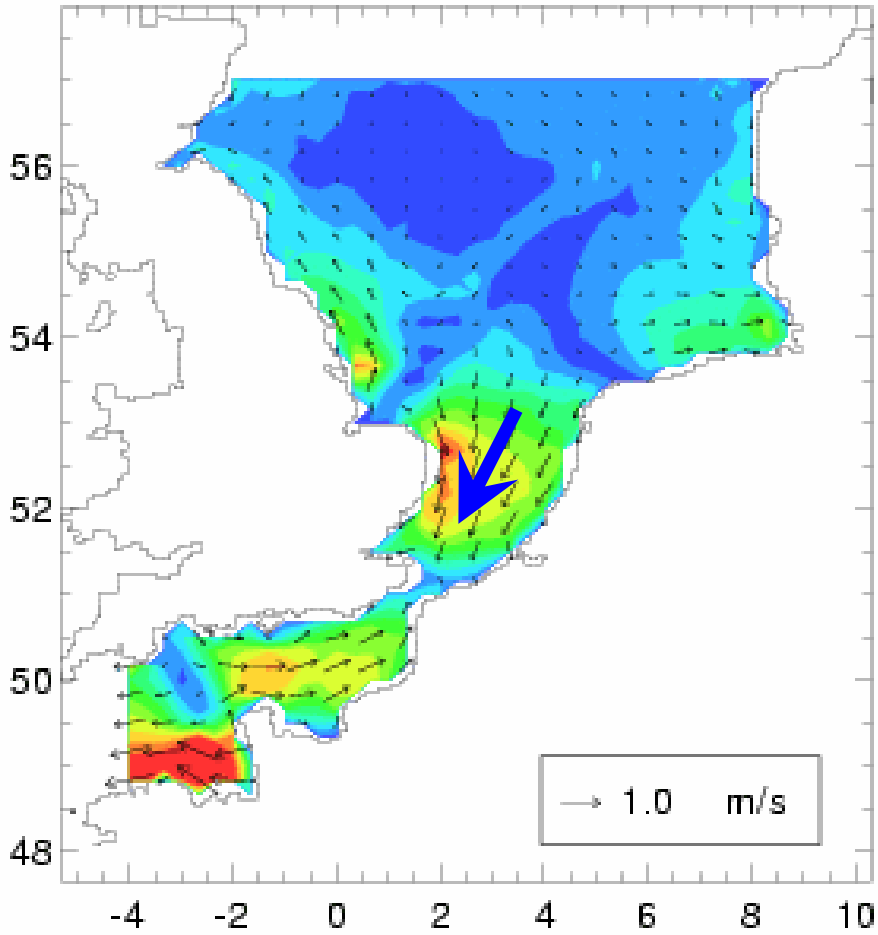
MEDS/SDMM 14–Sep–2004

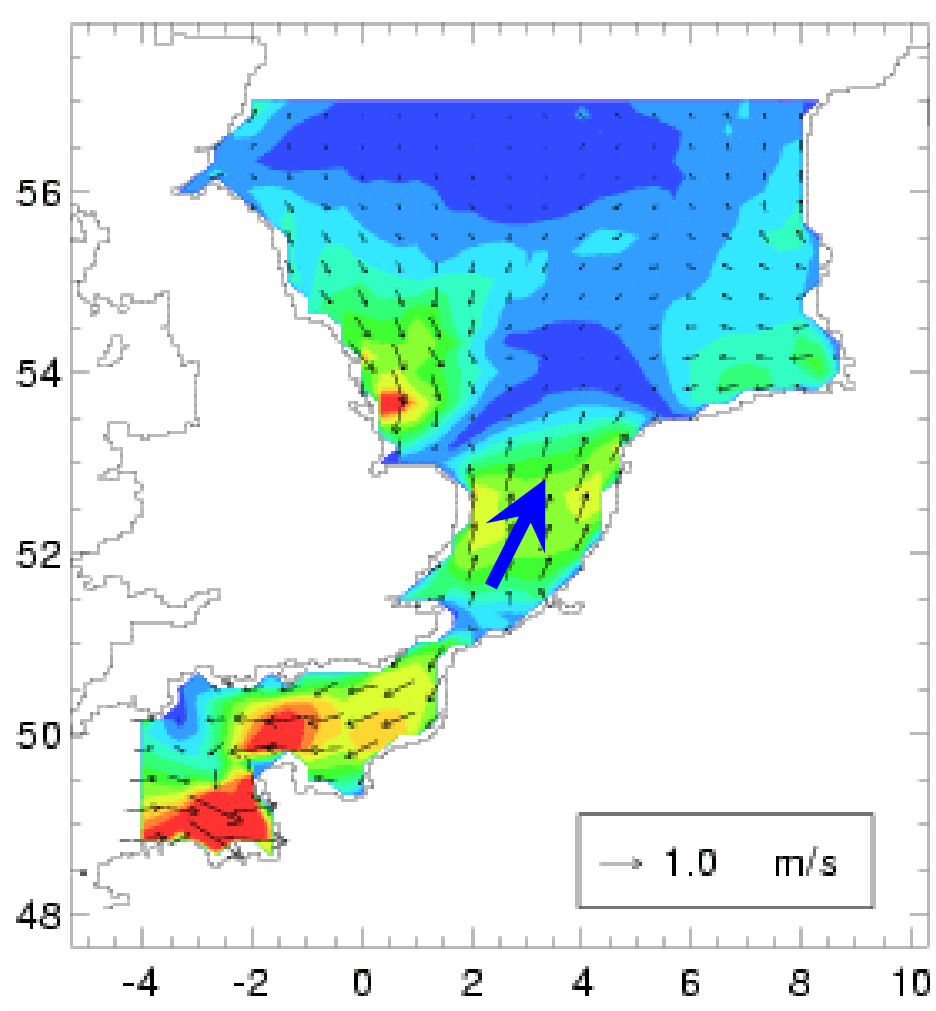


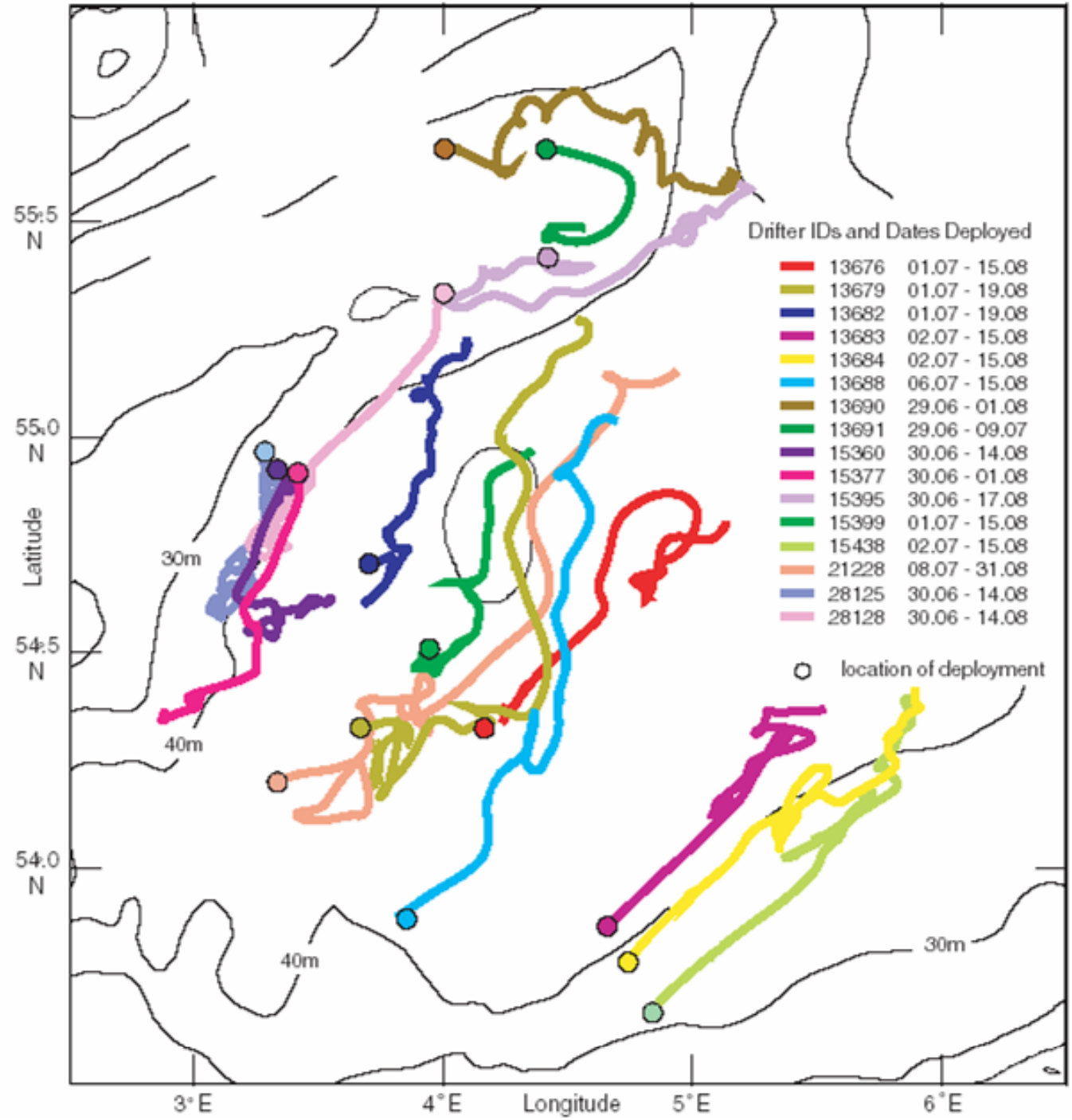
Direction des courants moyens du 28 janvier 2005 à 12h



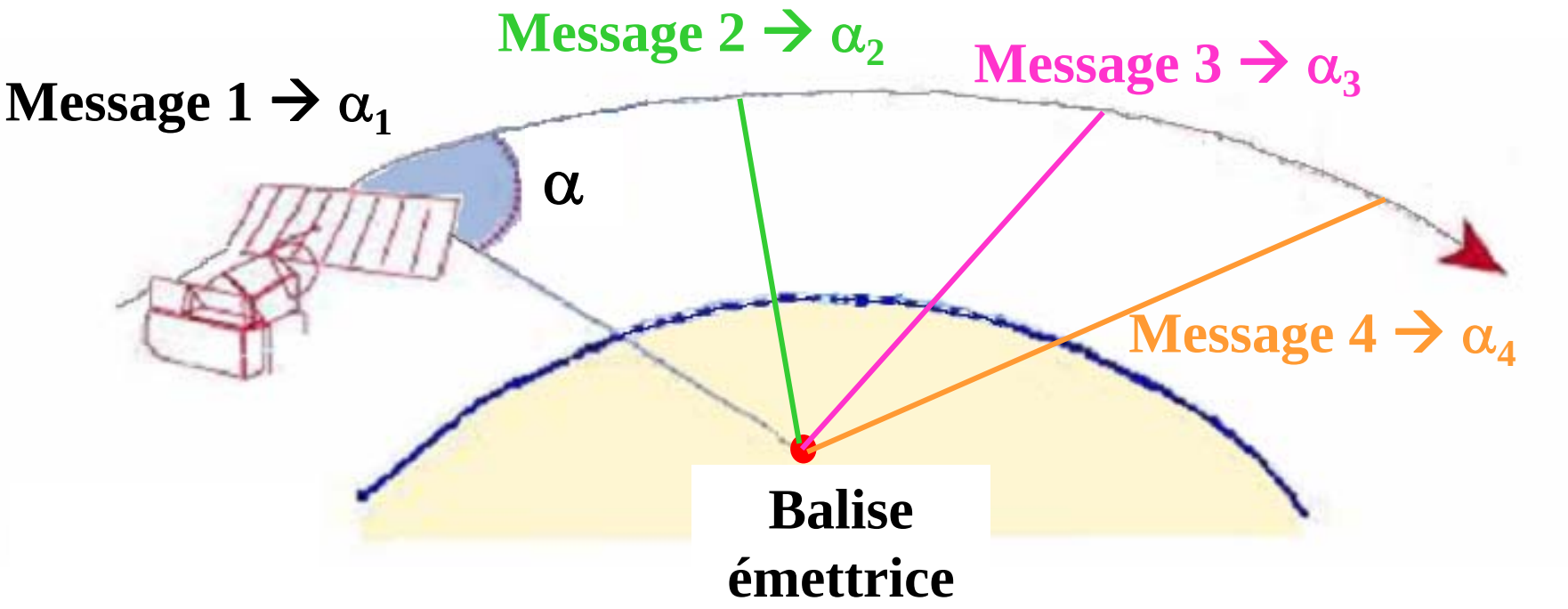
Direction des courants moyens le 28 janvier 2005 à 18h


56
54
52
50
48
-4
-2
0
2
4
6
8
10
1.0 m/s

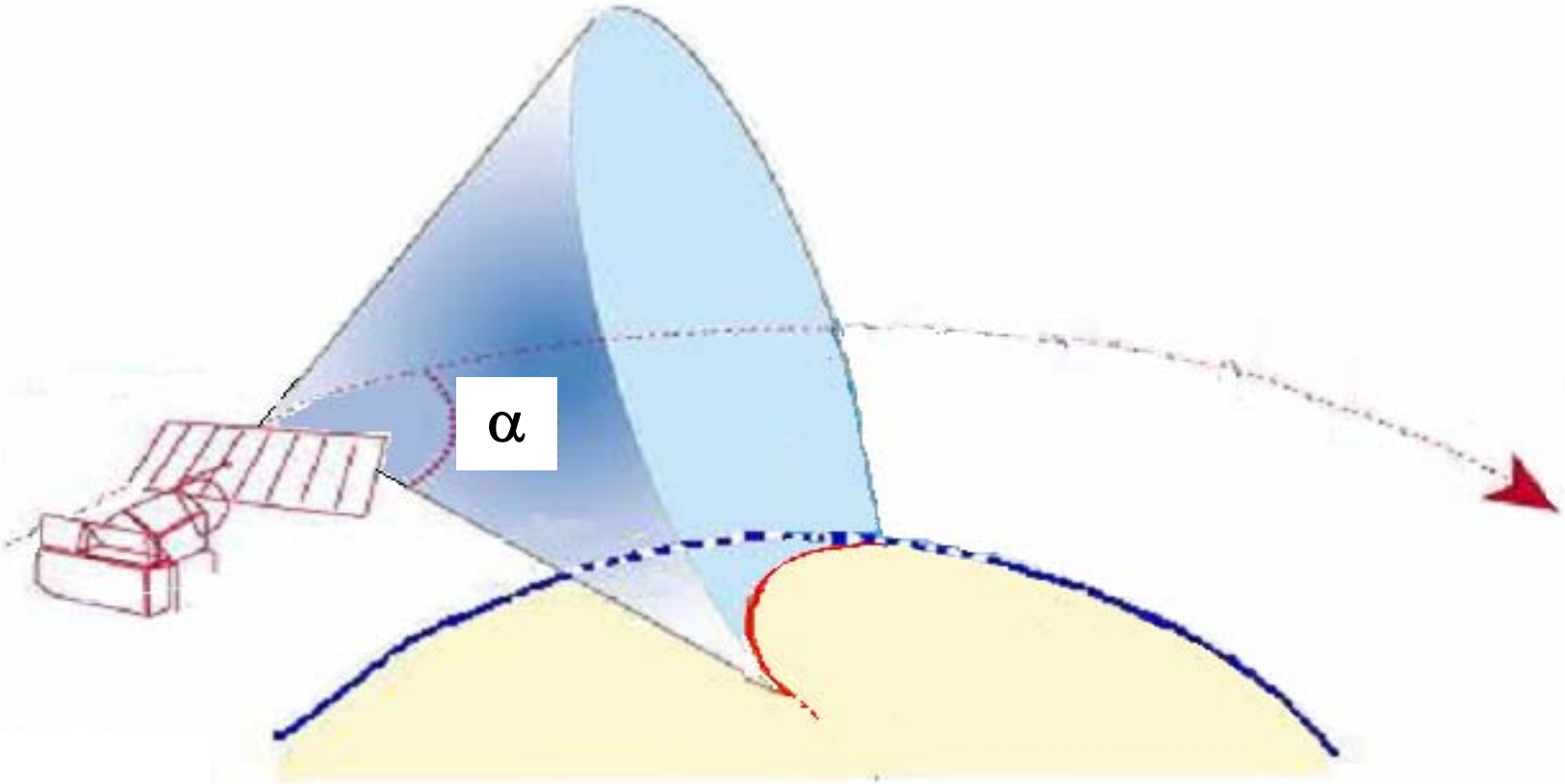

56
54
52
50
48
-4
-2
0
2
4
6
8
10
1.0 m/s


Drifter IDs and Dates Deployed
13676 01.07 - 15.08
13679 01.07 - 19.08
13682 01.07 - 19.08
13683 02.07 - 15.08
13684 02.07 - 15.08
13688 06.07 - 15.08
13690 29.06 - 01.08
13691 29.06 - 09.07
15360 30.06 - 14.08
15377 30.06 - 01.08
15395 30.06 - 17.08
15399 01.07 - 15.08
15438 02.07 - 15.08
21228 08.07 - 31.08
28125 30.06 - 14.08
28128 30.06 - 14.08
location of deployment
30m
40m
40m
30m
55.5 N
55.0 N
54.5 N
54.0 N
Latitude
3° E
4° E
Longitude
5° E
6° E

The buoy is sending messages every 90 seconds. When a satellite equipped with the ARGOS system flies over the buoy area, it received these messages and each message gives an angle (using Doppler Effect theory).



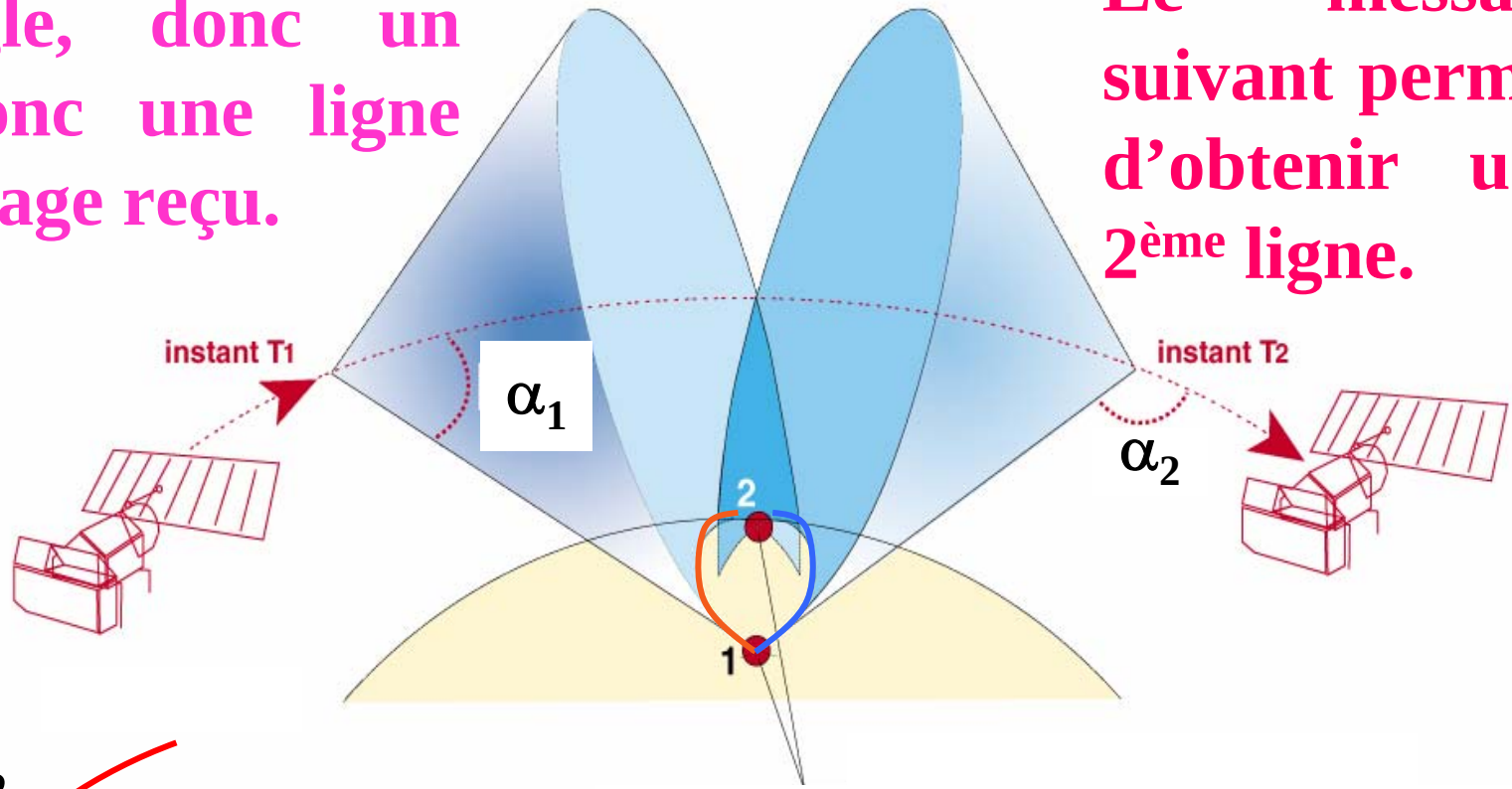
La connaissance de l'angle α permet de définir un cône (axe : direction du vecteur vitesse du satellite, α : demi-angle au sommet du cône).

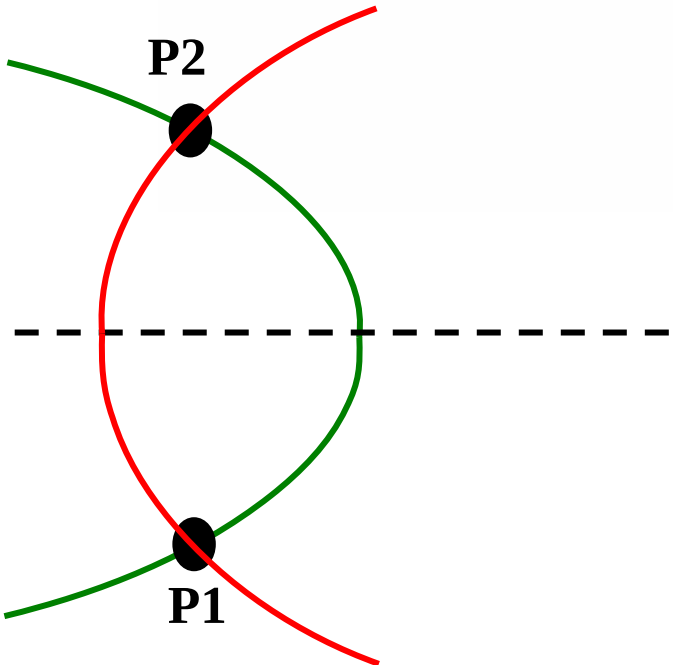


L'intersection de ce cône et de la surface de la Terre donne une ligne, lieu des points où peut se trouver la balise.

Un angle, donc un cône, donc une ligne par message reçu.

Le message suivant permet d'obtenir une 2ème ligne.

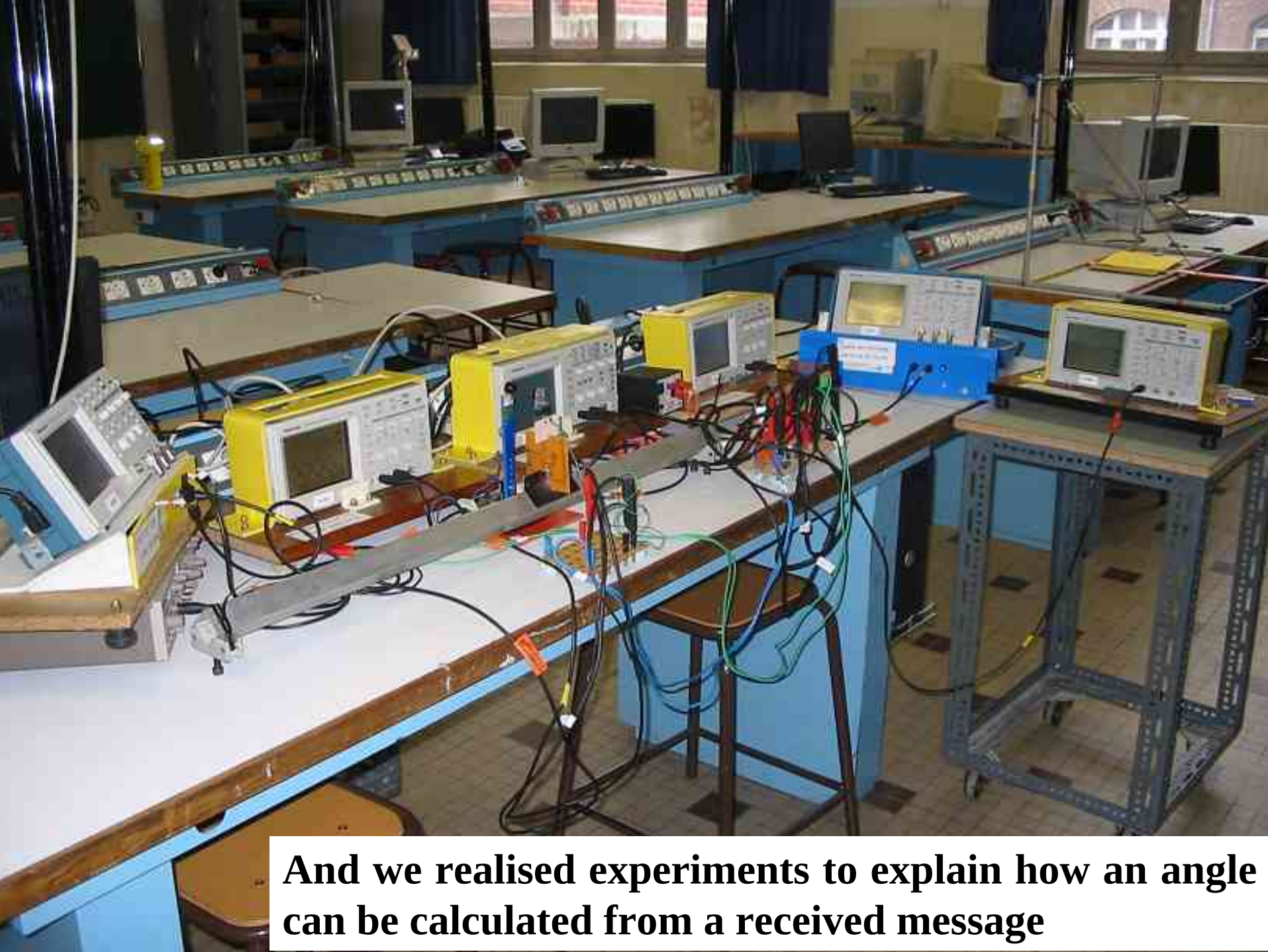




L'intersection des 2 lignes donne 2 points, les points 1 et 2, symétriques par rapport à la trace au sol du satellite.

You need at least 3 angles to find location data : we used a sphere and cones gliding along the satellite orbit to explain that to visitors.


Nicole Herman



And we realised experiments to explain how an angle can be calculated from a received message

And the whole lot (1 m diameter sphere and physics experiments) went to Paris for an Olympiads selection in Paris in December 2005 (without success this time) and then to La Rochelle on the Atlantic coast, 700 km from Reims, for an ARGONAUTICA presentation in May 2006.

And now,what you are all waiting for…

The end !!