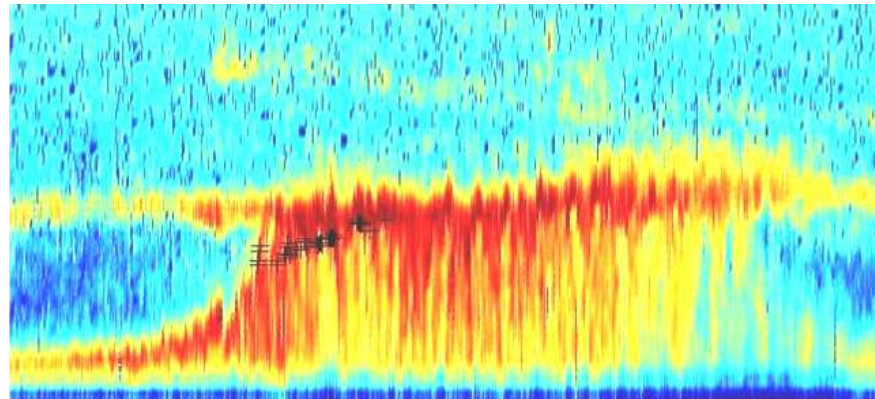
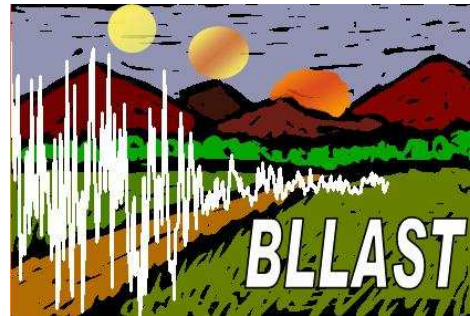
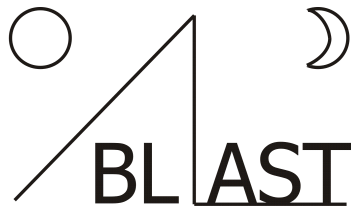
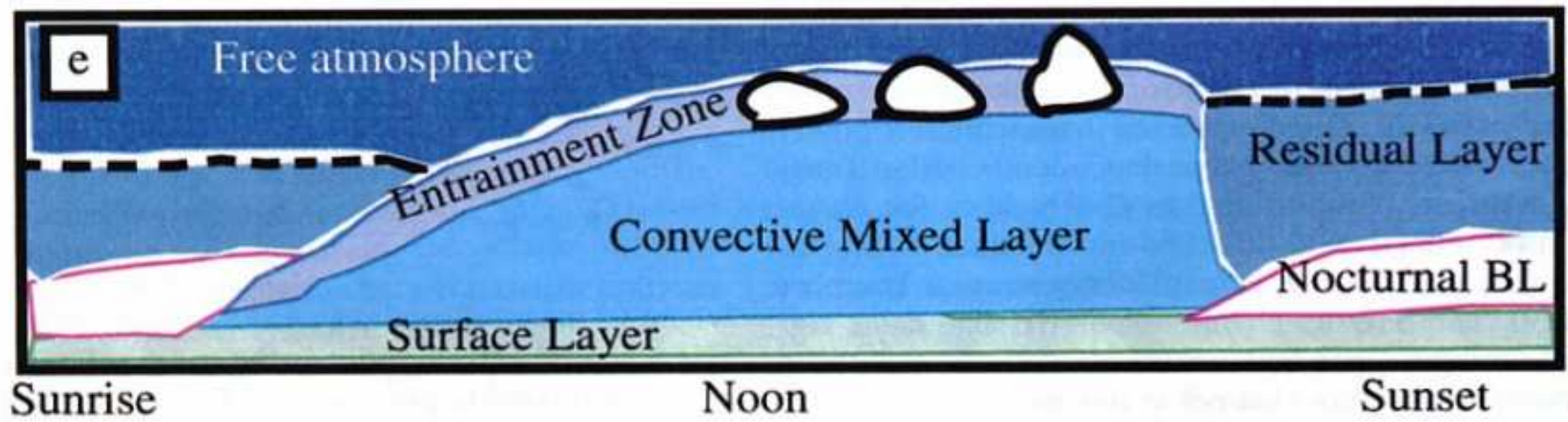


Boundary Layer Late Afternoon and Sunset Turbulence



Late afternoon and evening transitions

Time window of observation



“Late afternoon” starts early... 4 pm local time.. (2 pm UTC)

Exploration window: 2 pm UTC to 9 pm UTC = 7 hours

Sunrise = 6h20 LT = 4h20 UTC

Sunset = 21h40 LT = 19h40 UTC

Exploration needs

- **PBL Vertical structure**

multi-layering, shear, entrainment, stability

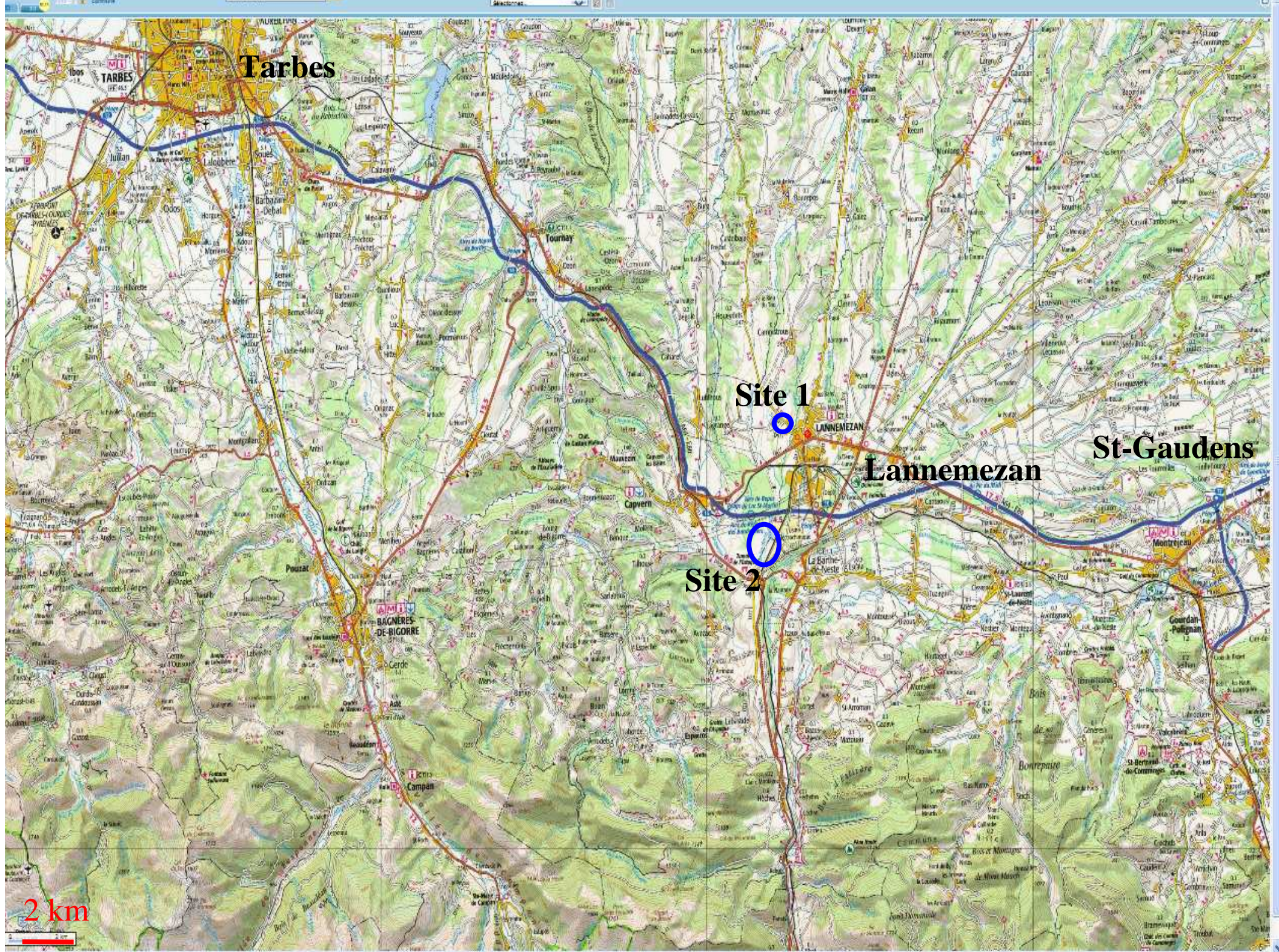
- **Surface layer spatial heterogeneity**

Surface cover heterogeneity, soil moisture, heat storage, energy balance phase shift

- **Radiation divergence**

- **Advection, large scale subsidence, baroclinicity**

- **Gravity waves**



Tarbes

Site 1



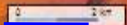
Lannemezan

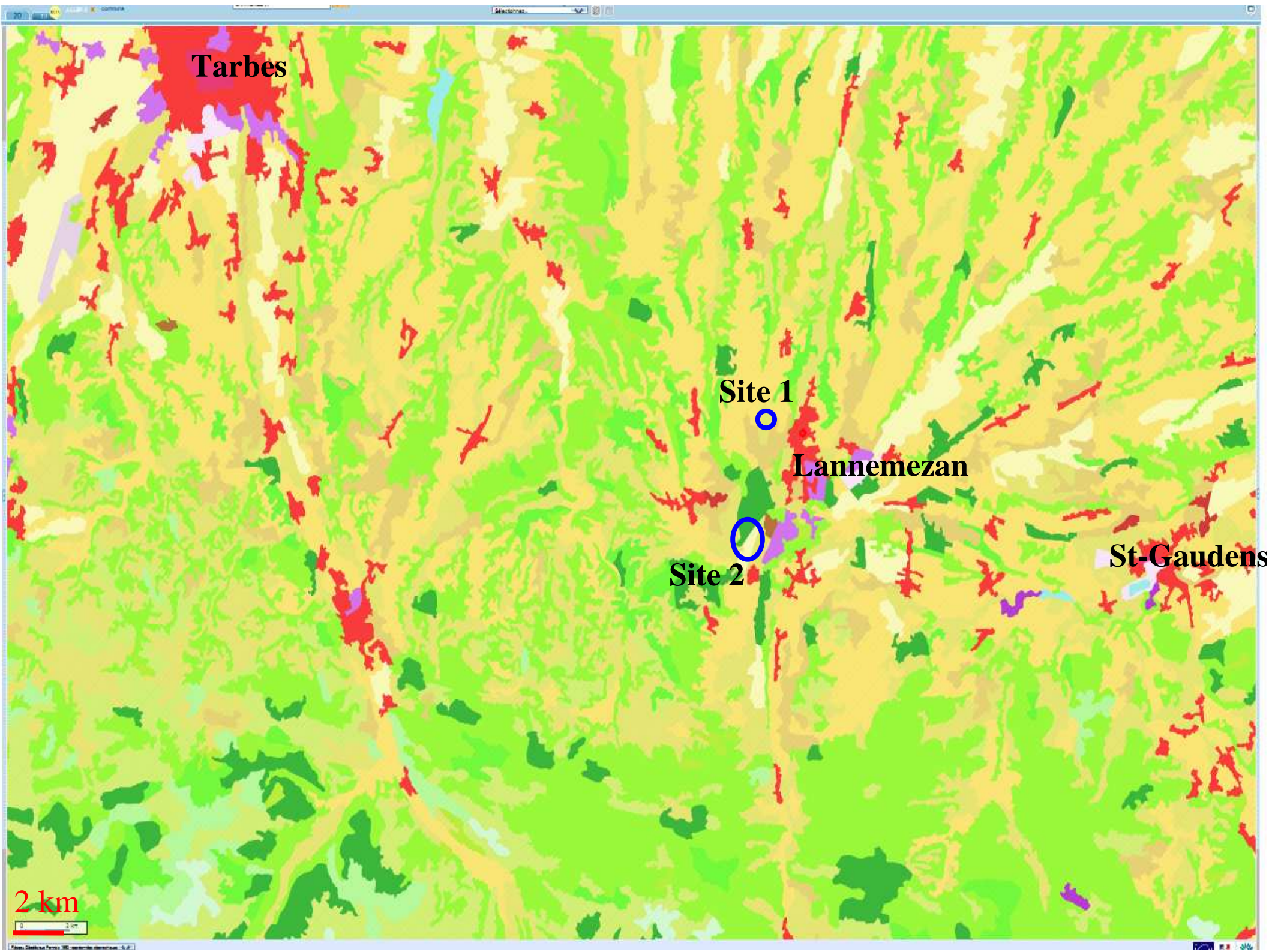
Site 2



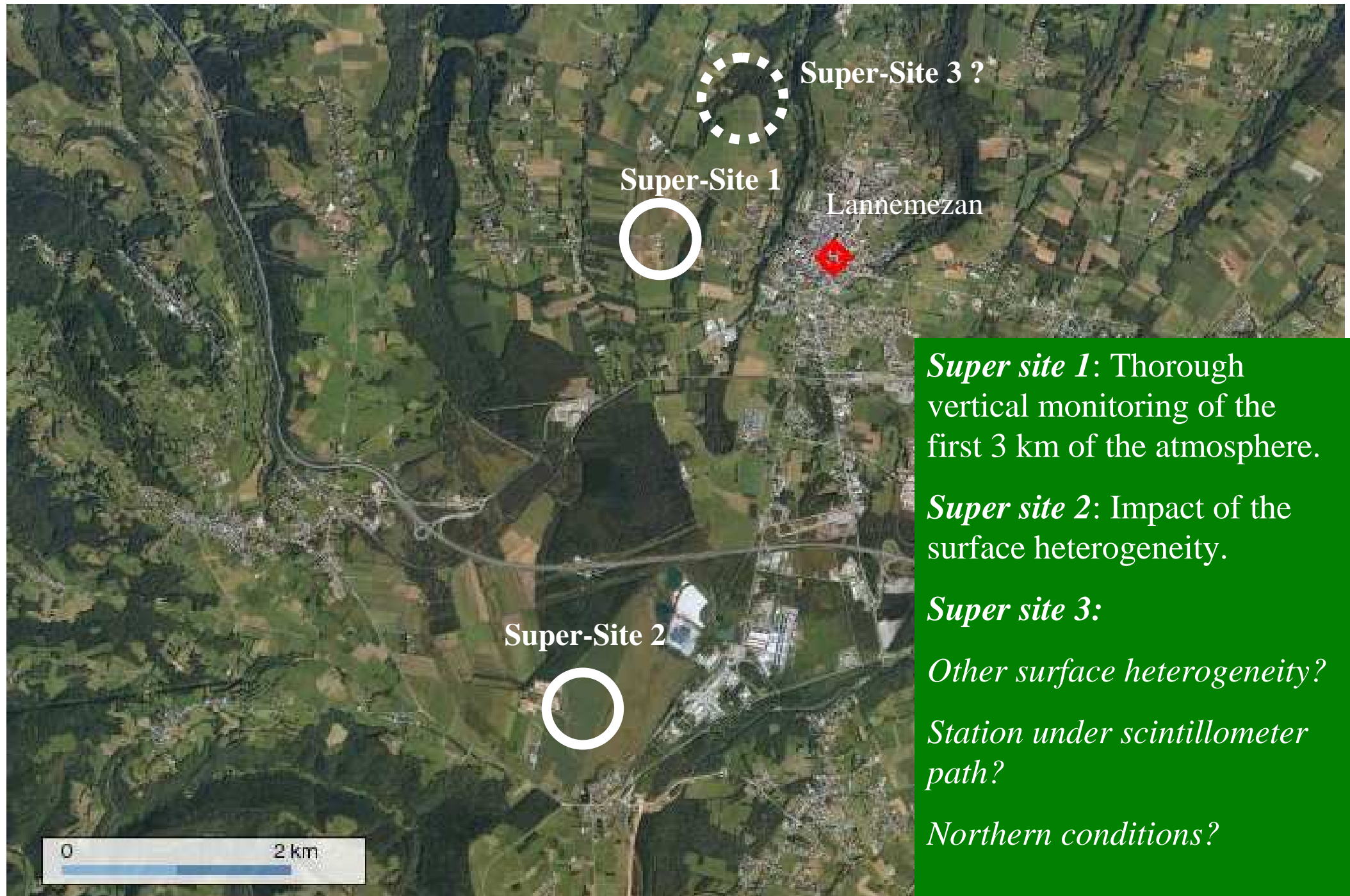
St-Gaudens

2 km





Google-Earth map: General view of the instrumental set-up



Super site 1: Thorough vertical monitoring of the first 3 km of the atmosphere.

Super site 2: Impact of the surface heterogeneity.

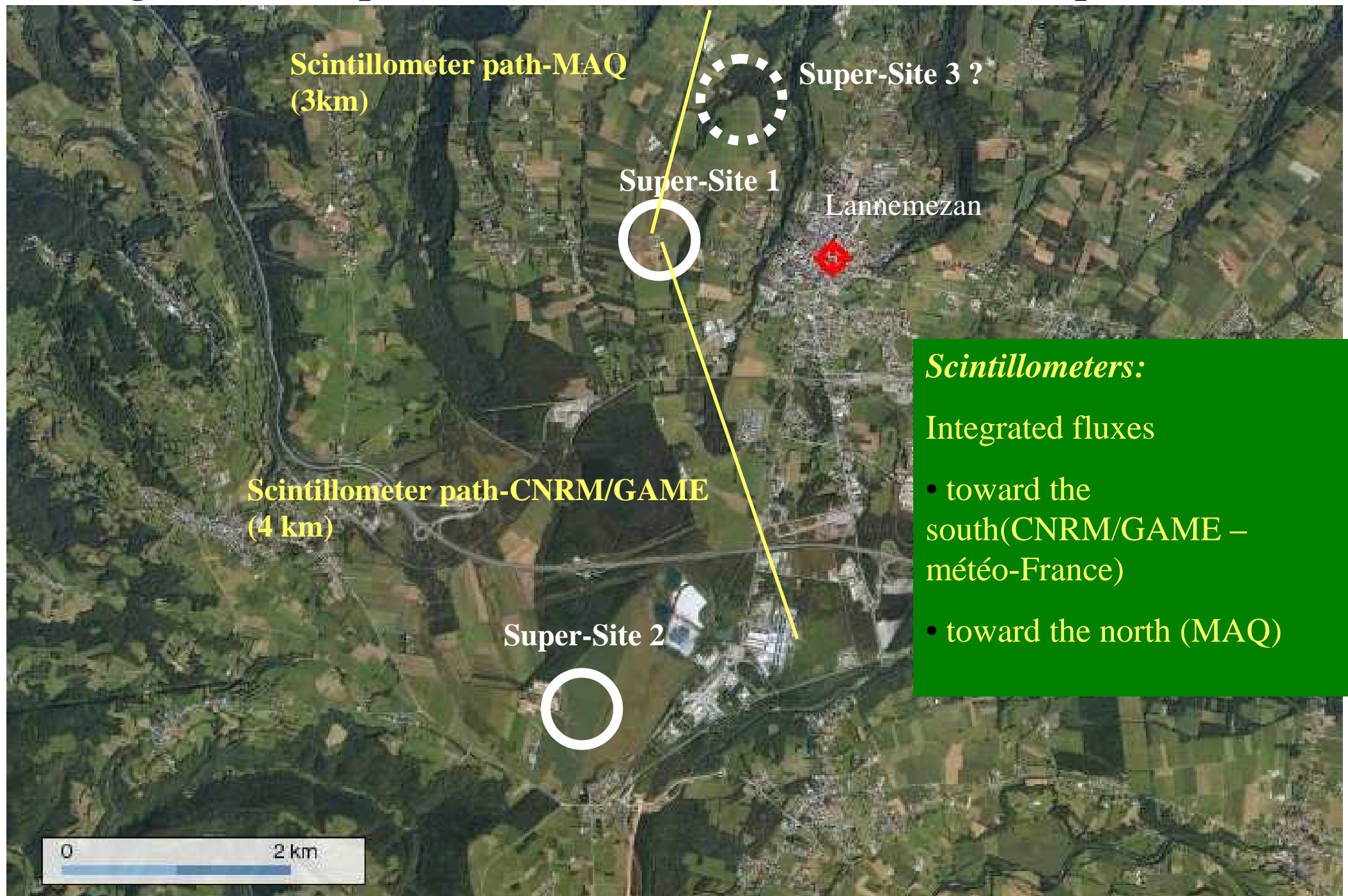
Super site 3:

Other surface heterogeneity?

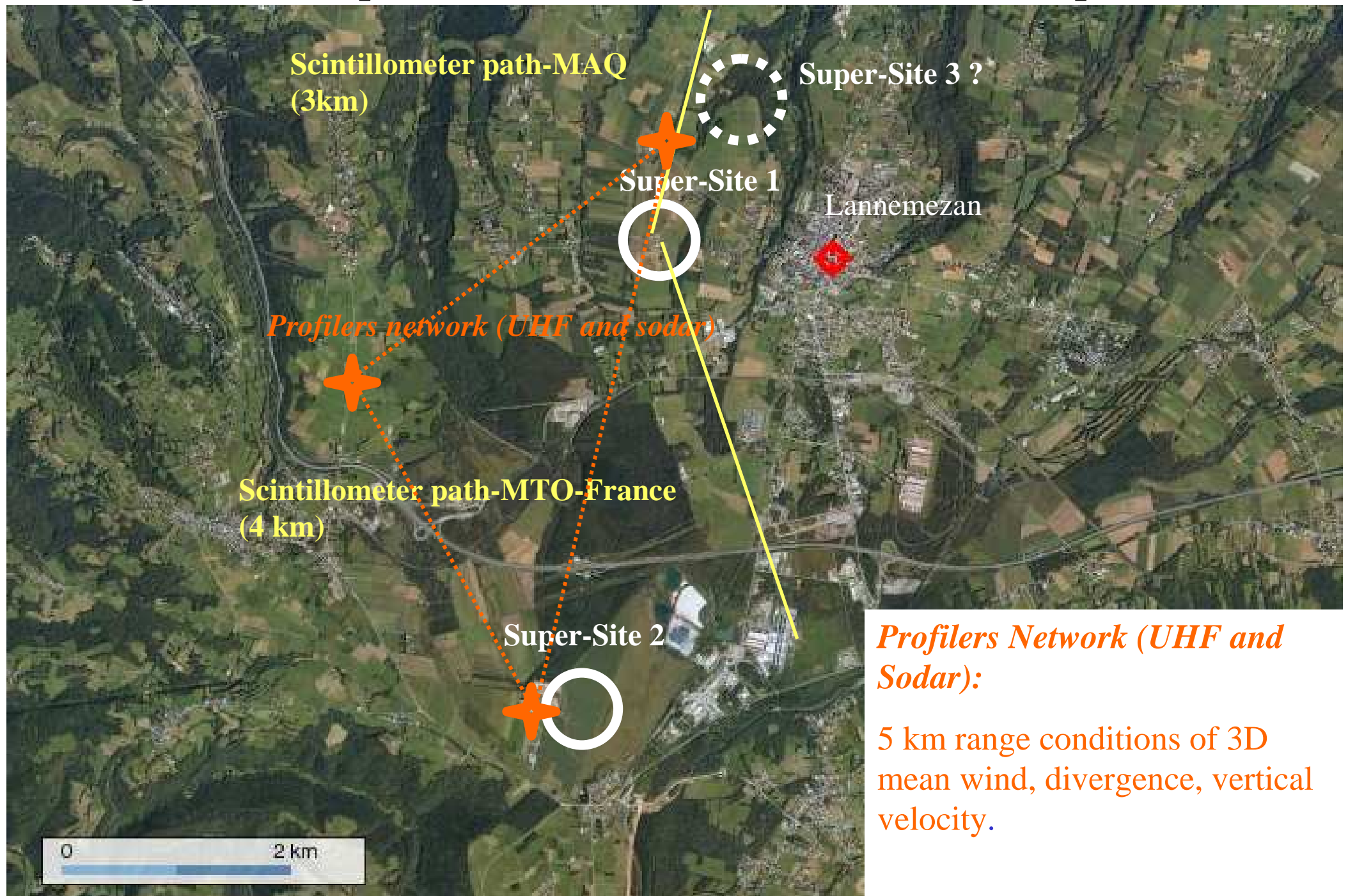
Station under scintillometer path?

Northern conditions?

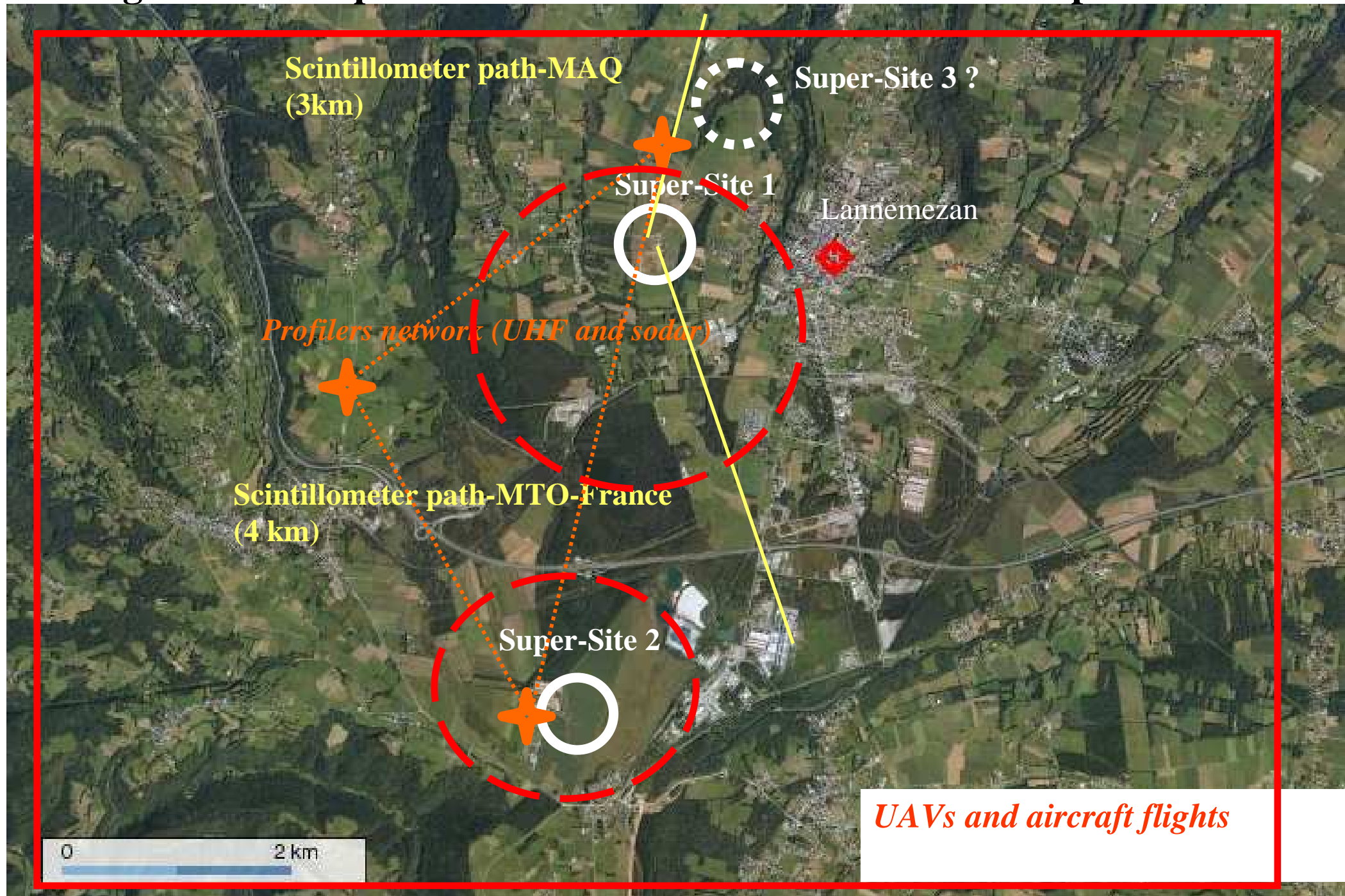
Google-Earth map: General view of the instrumental set-up



Google-Earth map: General view of the instrumental set-up



Google-Earth map: General view of the instrumental set-up



UAVs and aircraft flights

Airplanes

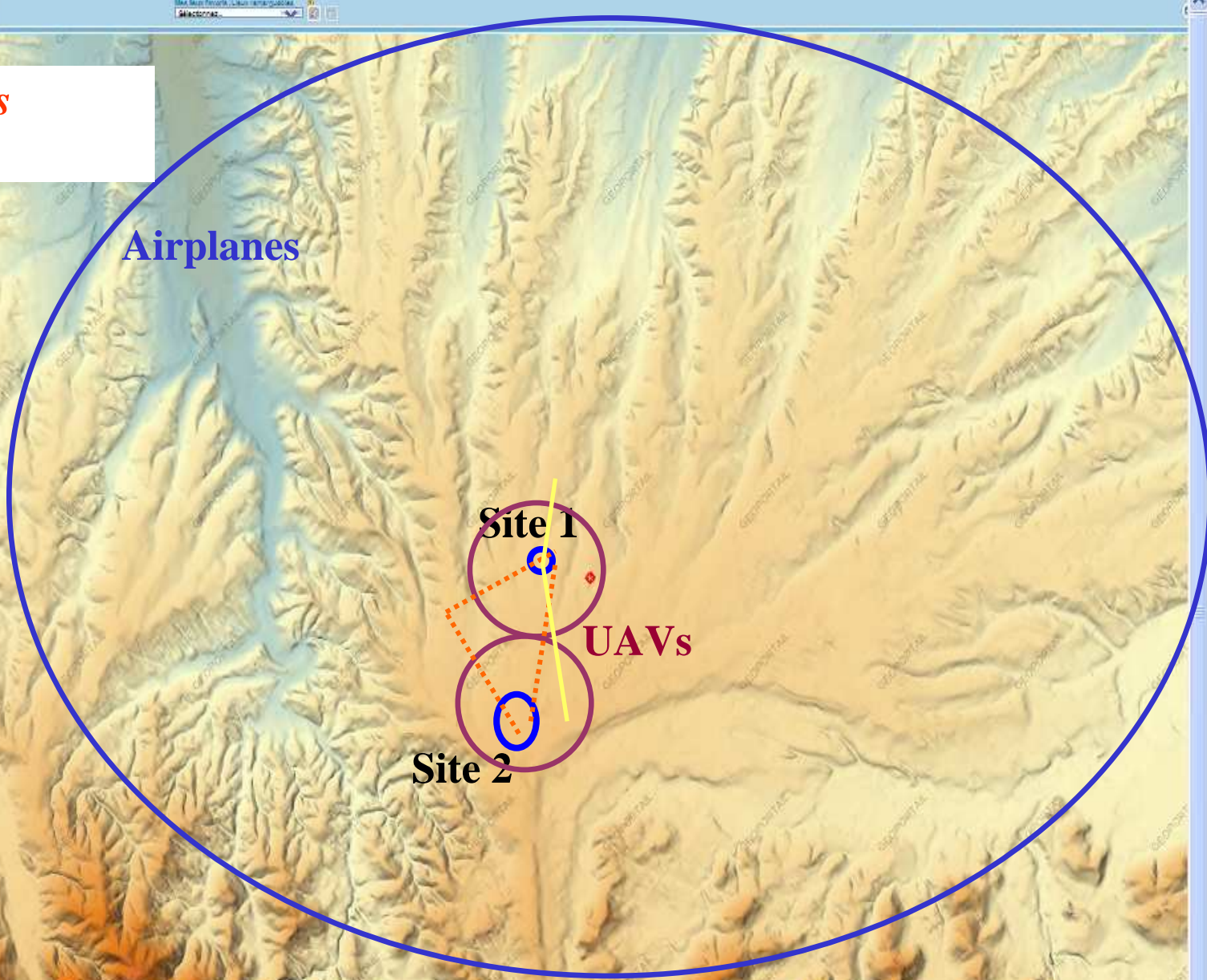
Site 1

UAVs

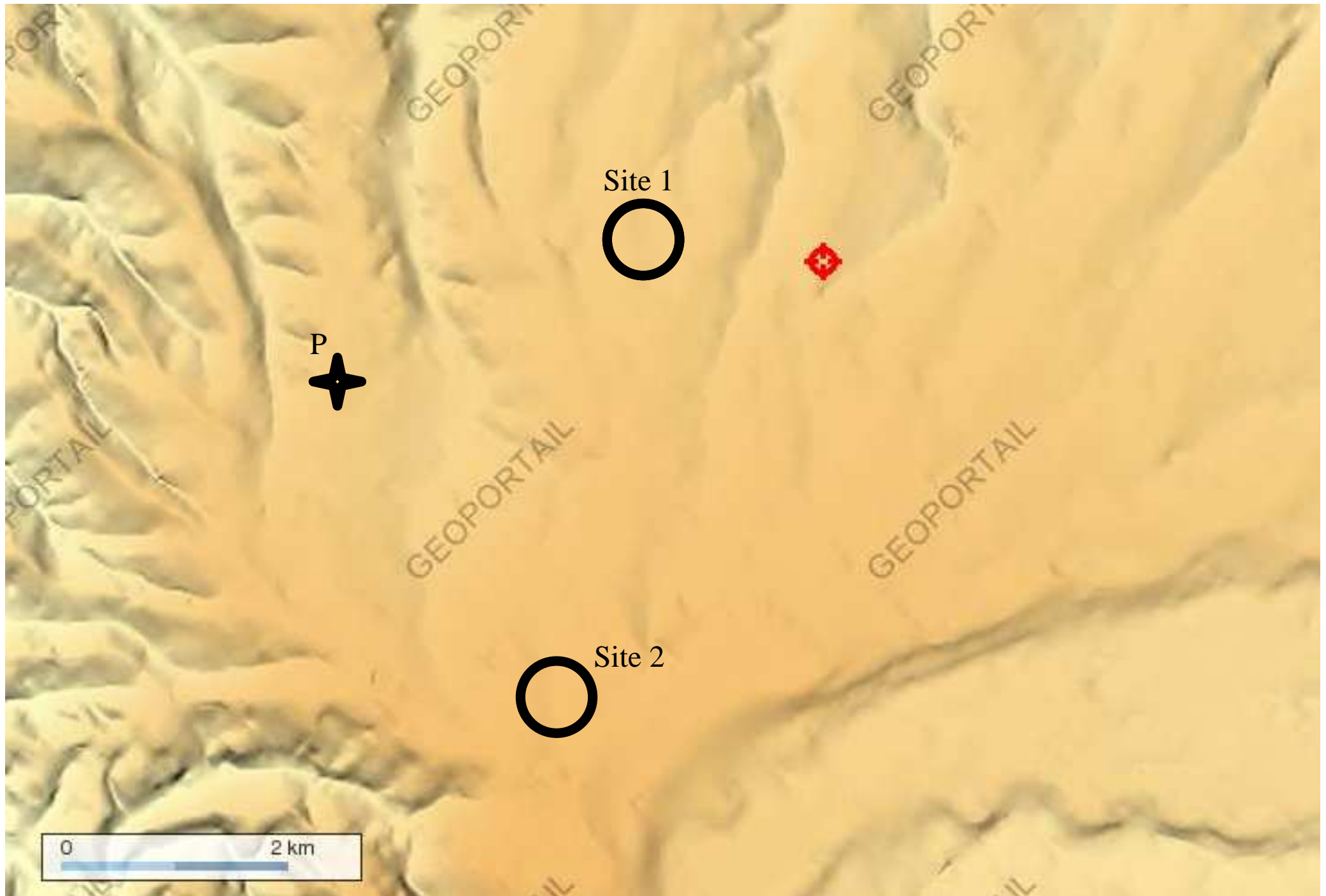
Site 2

2 km

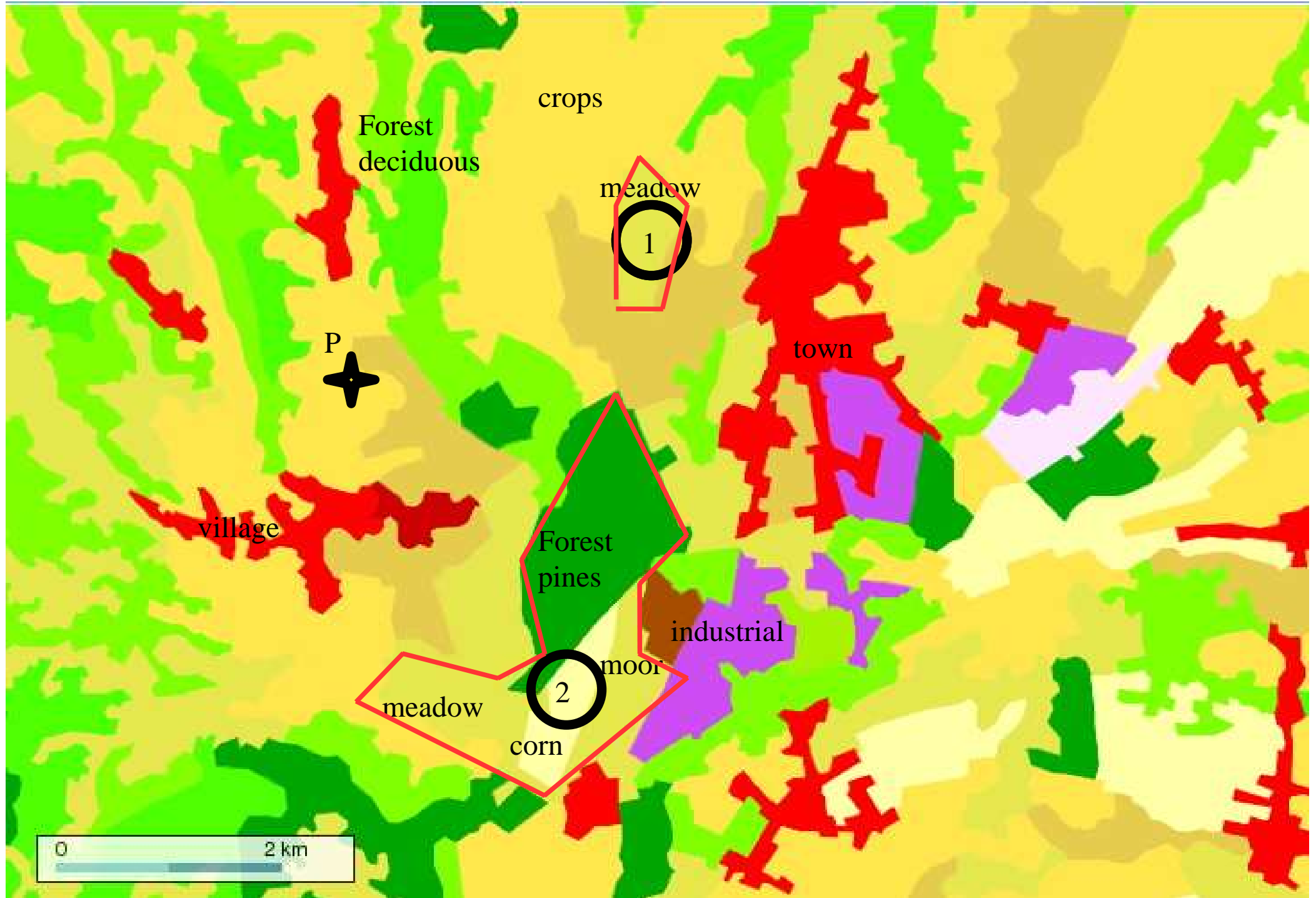
0 2 km

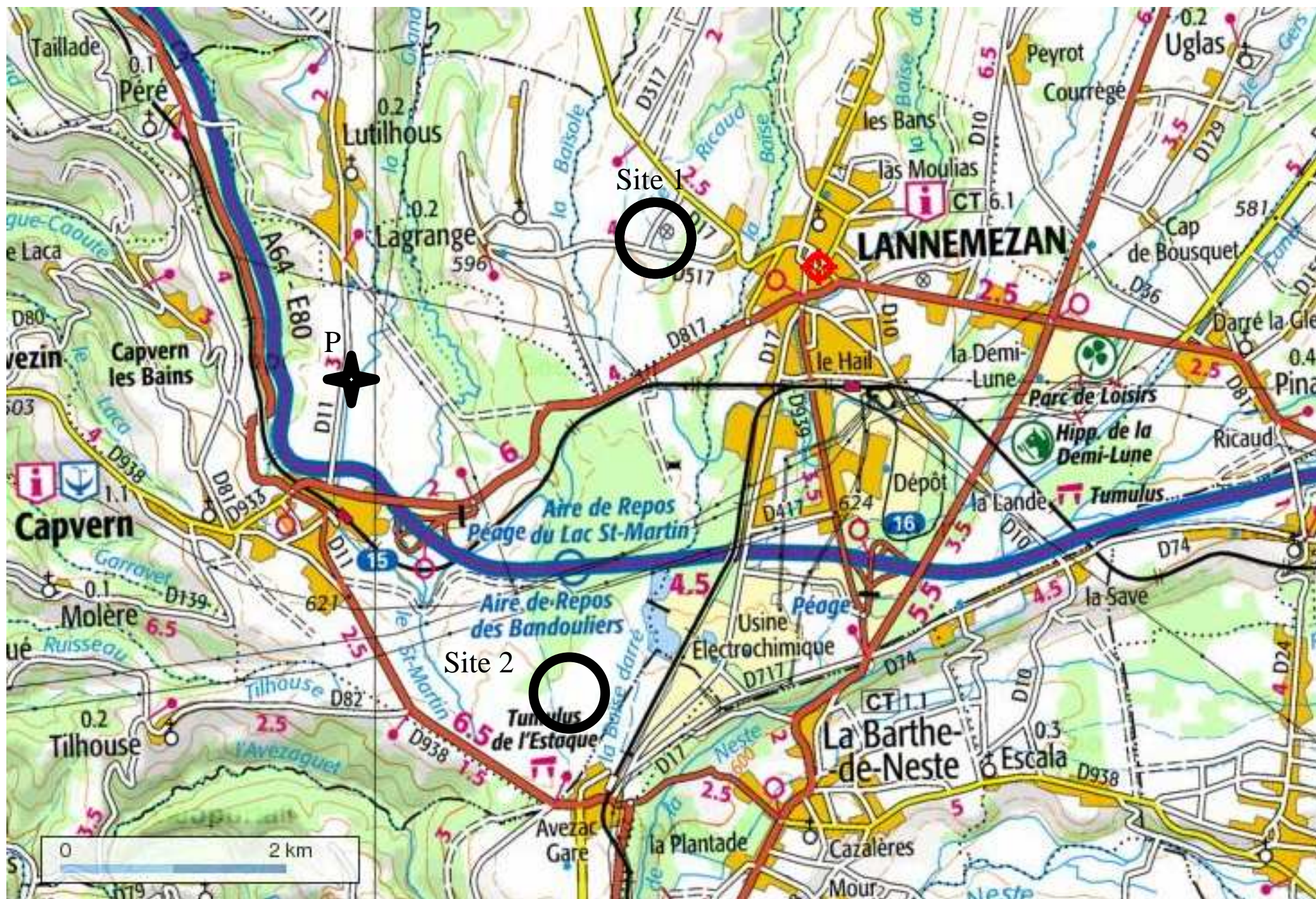


Topography – altitude of the Plateau: ~600 m



Land-use



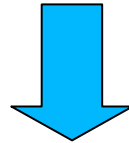


Ground-based instrumentation deployment (F. Lohou)

Super Site 1: Aims addressed

- **Definition of the different layers and their evolution in time.**

- **Monitoring of the turbulence on the vertical**



A thorough monitoring of the first 4 km of the atmosphere

- **Turbulence in the surface layer**

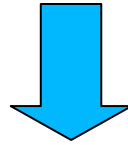
Surface station/ 65-m tower

- **Wind and turbulence vertical profiling**

UHF/ VHF/ lidar

- **Thermodynamical vertical profiling**

RS/ radiometer/ tethered balloon



Added to that

- **Pressure change**

Microbarometers network

- **Aerosols**

Size distribution

- **Radiation divergence**

5 levels of radiation components

Super-Site 1

- 10-m Surface station
- 60m tower
- Tethered balloon
- (M: mean/T: turbulent)

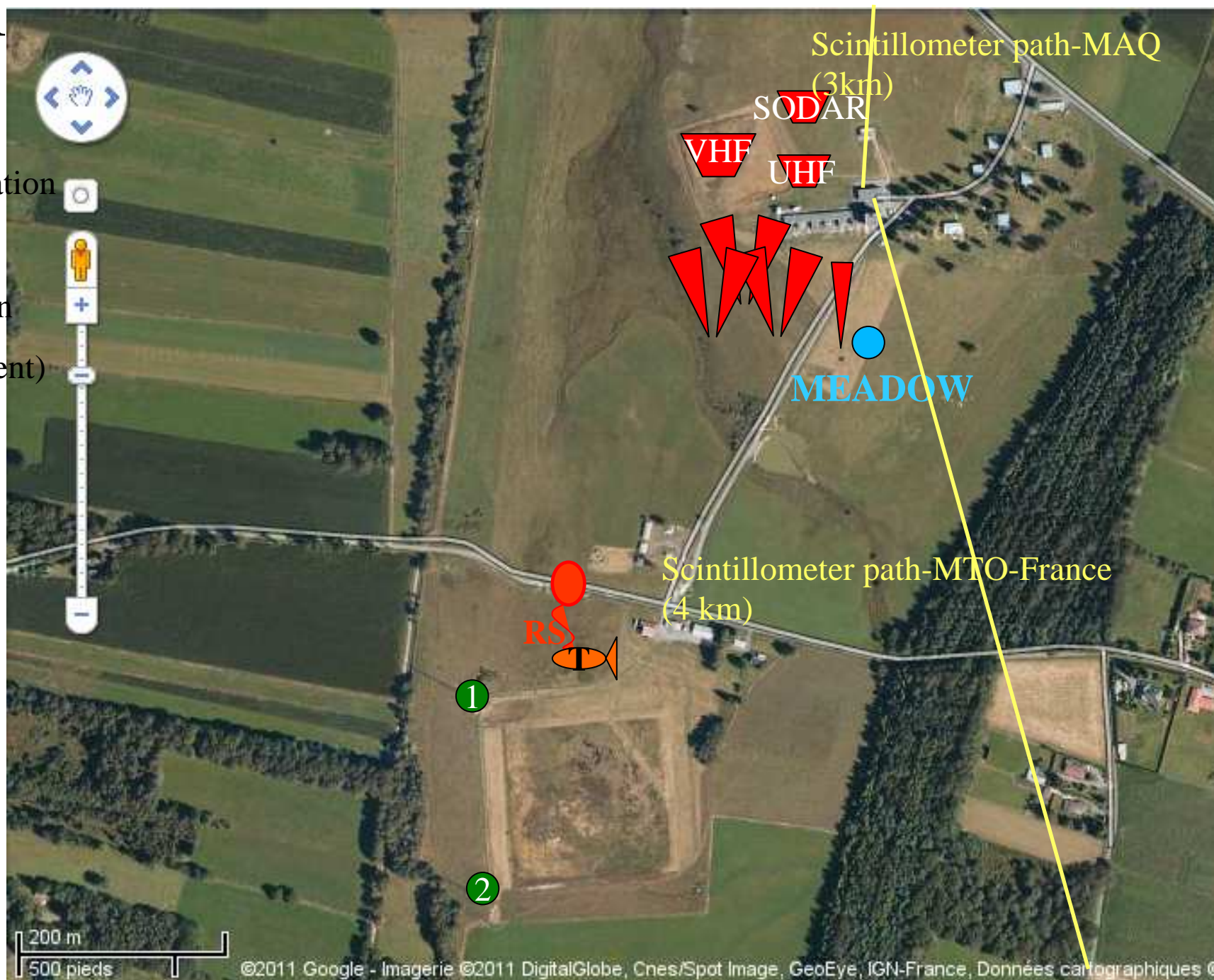
Wind profiler

Lidar

Radiometer

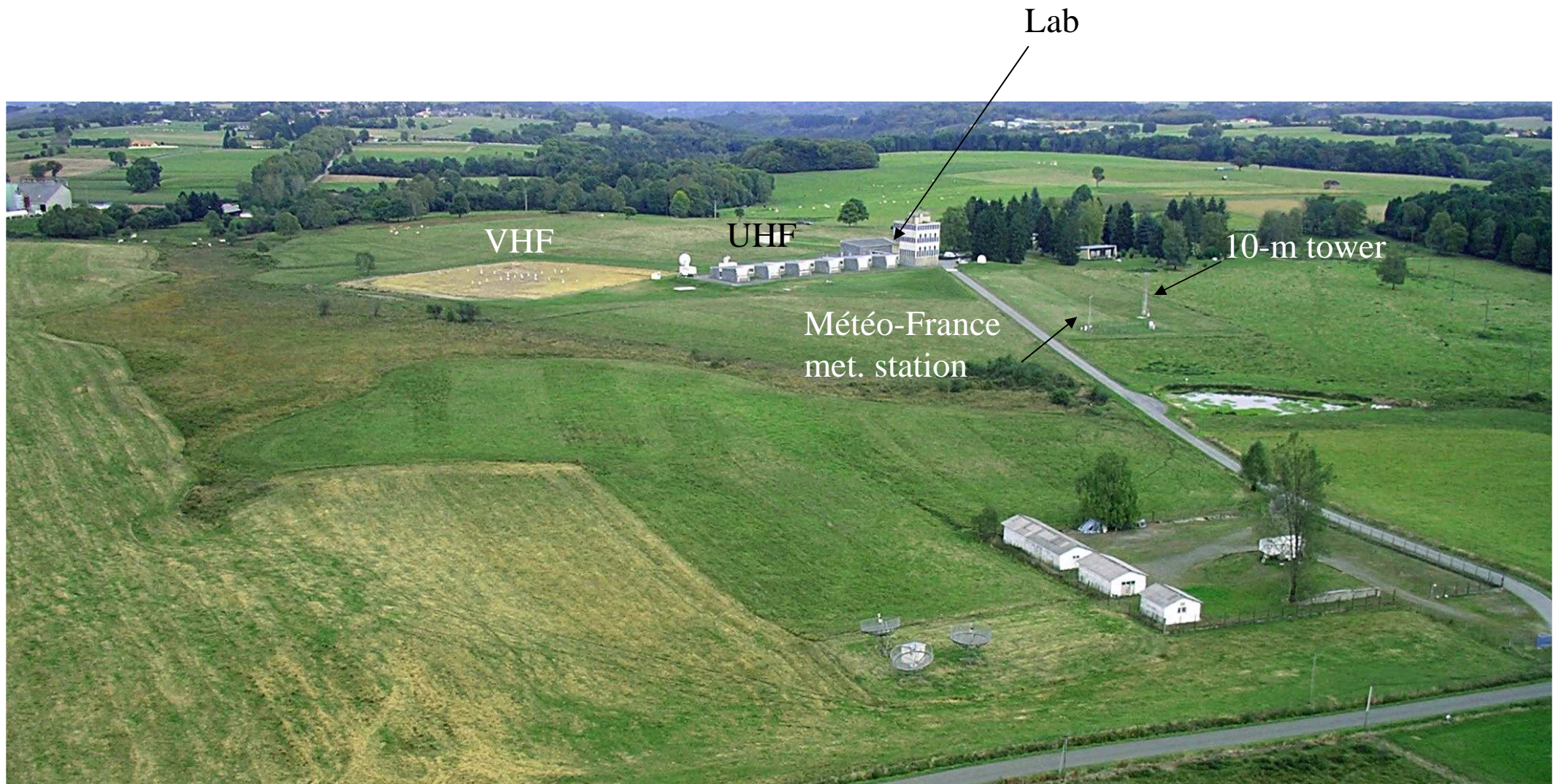
RS Radio-Sounding

Scintillometer



Super-Site 1

View toward the north, from the 65 m tower-1



Super-Site 1: 60-m towers

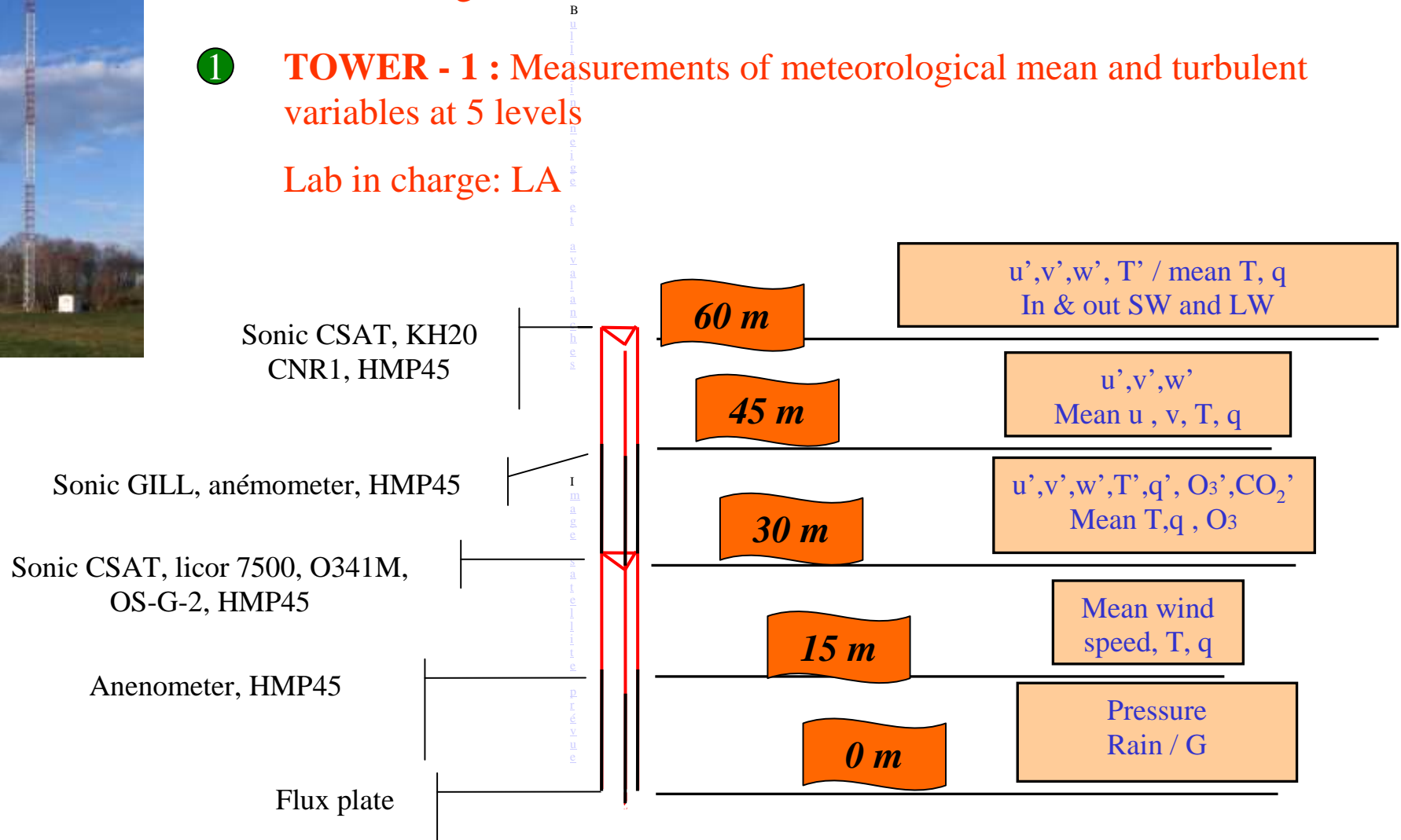


② TOWER - 2 : Smoke experiment

Lab in charge: TU Delft

① TOWER - 1 : Measurements of meteorological mean and turbulent variables at 5 levels

Lab in charge: LA



Super-Site 1: 60-m towers



+ DusTrack (PM2.5)
(Eric/UTAH)

+ 3 CSAT + KH20
(Sorbjan) (NSF
depending)

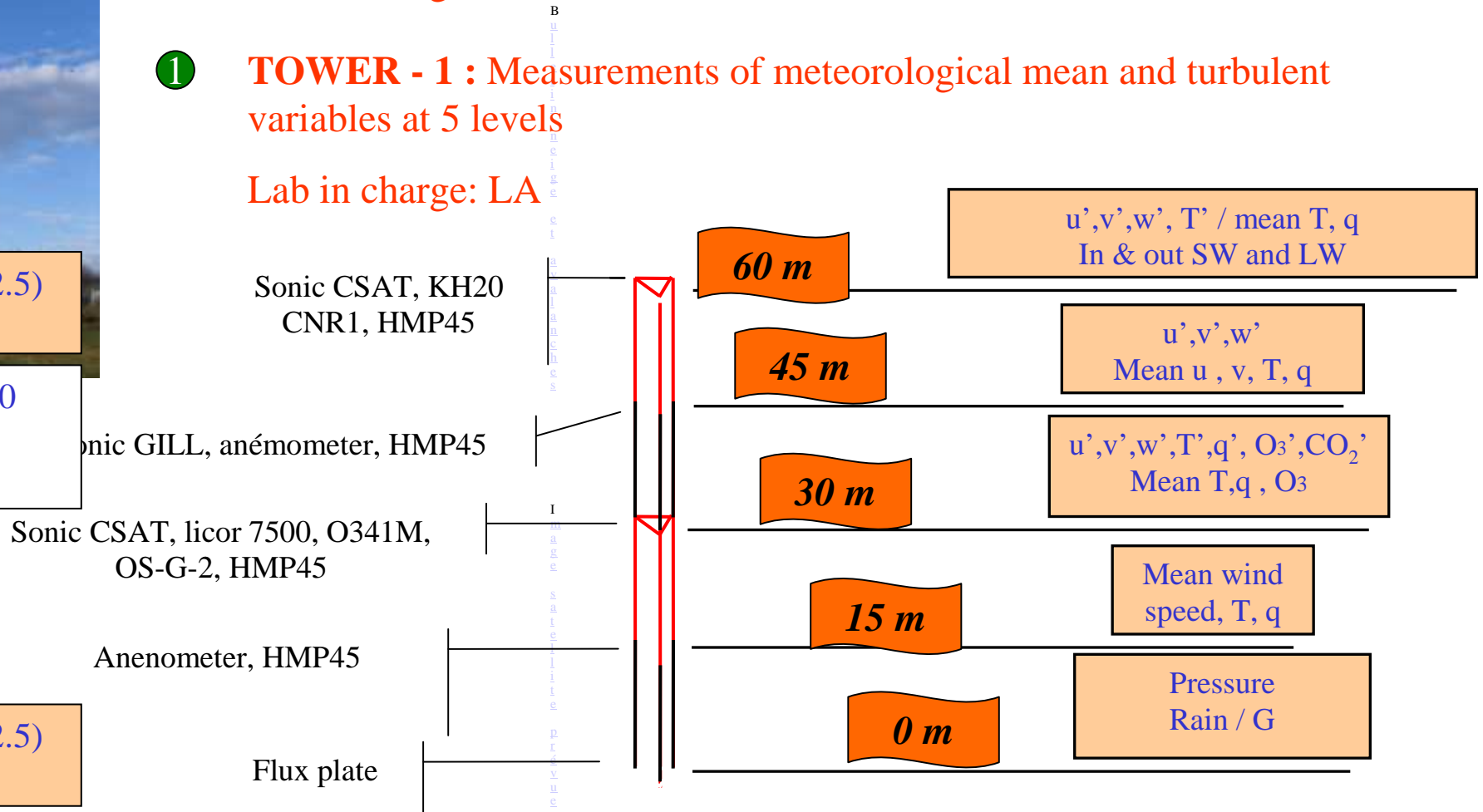
+ DusTrack (PM2.5)
(Eric/UTAH)

② TOWER - 2 : Smoke experiment

Lab in charge: TU Delft

① TOWER - 1 : Measurements of meteorological mean and turbulent variables at 5 levels

Lab in charge: LA



Radiation divergence: 4 radiation components at 5 levels/ Where?

Lab in charge: MAQ Wageningen

Super-Site 1: meadow surface station



Surface stations	Providings	Lab in charge	Priority	Status
Mean Values	$\overline{T}, \overline{q}, \overline{U}, WD$ <i>rain, pressure</i>	METEO France standard Meteorological station	P1	OK
Sonic + Licor	$\overline{T}, \overline{q}, \overline{u_i}, \overline{co_2},$ $\overline{T'^2}, \overline{q'^2}, \overline{u_i'^2}, \overline{co_2'^2},$ $\overline{u_i'T'}, \overline{u_i'q'}$????	P1	
4 radiation components	ISW, OSW ILW, OLW	????	P1	
Surface probes	Temperature Soil moisture	????	P1	
Dust	SMPS (0.01 – 1.1 µm) + OPC (0.3 -20 µm)	LPCA		
Soil Profile	Humidity Temperature	???	P1	
Microbarometers	Pressure	Madrid Univ.	P1	Where

Who wants to implement their surface station at this site?

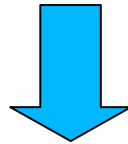
Super-Site 1: Vertical profiling

	Providings	Lab in charge	Priority	remark
Radio-soundings	T, q, U, WD	LA/ GAME ??	P1	OK
Tethered ballon	6 levels / Turbulence	LA / UTAH / CNRM	P1	OK
Ceilometer	Cloud base, CLA height	CNRM/GAME	P1	OK
LIDAR	Raman q	UTAH	P1	OK
	Doppler $\overline{u_i}, \overline{u_i'^2}, zi$	LMD/GAME	P1	
	Aérosol η, zi	LPCA	P1	
Wind profiler	Sodar (60-600m) $\overline{u_i}, \overline{u_i'^2}, \eta$	MAQ or LPCA or Baléares Univ.??	P1	
	UHF (150-4000m) $\overline{u_i}, \overline{u_i'^2}, \varepsilon, \eta, zi$	LA		
	VHF $\overline{u_i}, \overline{u_i'^2}, \varepsilon, \eta, zi$	LA		
	(1500-16000m)			

Super Site 2: Aims addressed

Impact of the surface heterogeneity

- Different timing according the surface energy balance (phase shift)
 - Impact of the induced local breezes
 - role of these heterogenities on turbulence scale



- Soil characteristics

Temperature / humidity

- Energy balance and turbulence characteristics over the surface

3 types of surface cover (crops / corn/ dry moor/ wet moor/ pine forest/ deciduous forest)

- Surface layer vertical structure

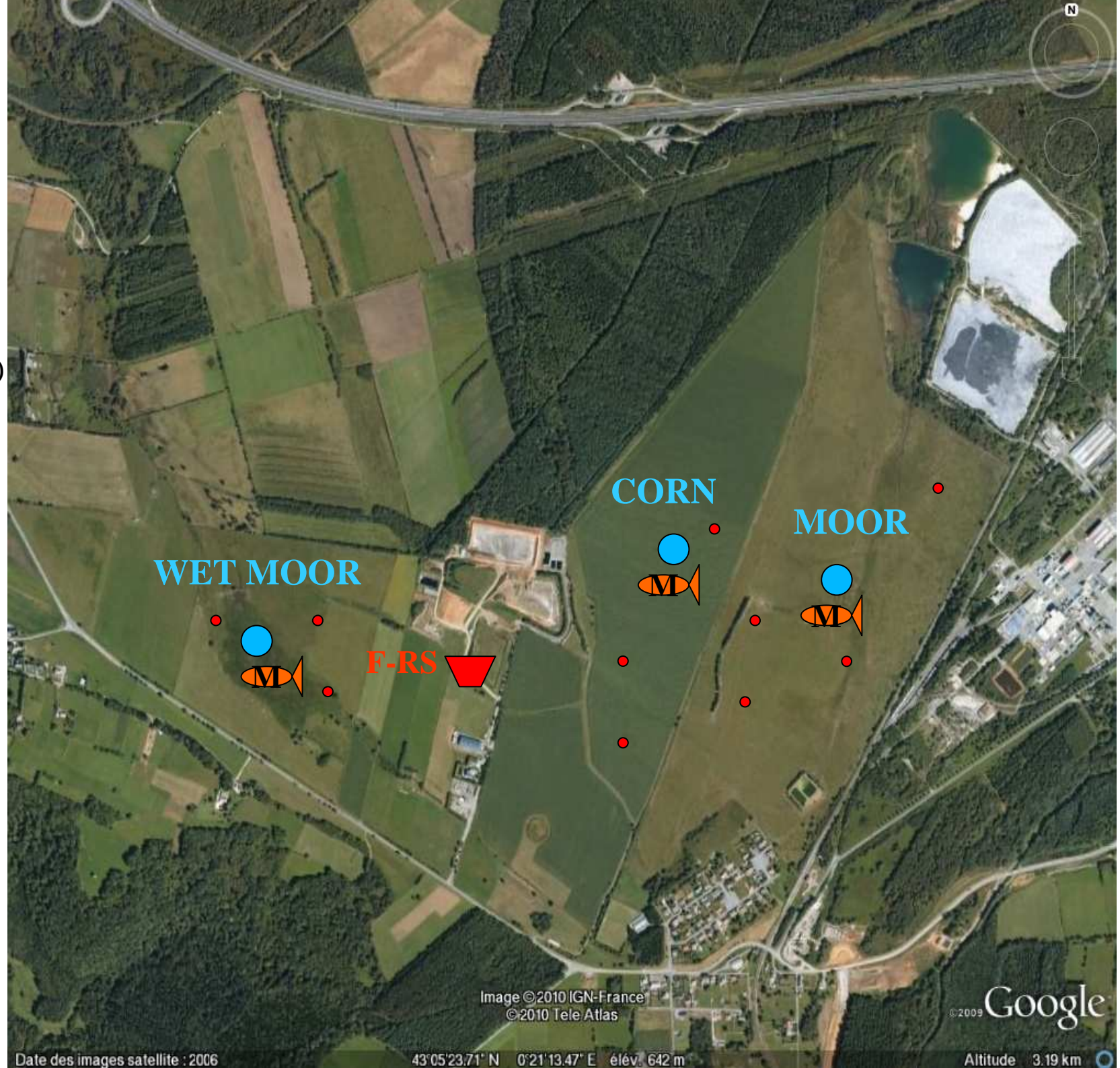
Tethered balloons/ Frequent RS

- wind and turbulent vertical profiling

UHF / sodar ?

Super-Site 2

- Surface station
- 🐟 Tethered balloon
(M: mean/T: turbulent)
- ▼ Wind profiler
- F-RS** Frequent
Radio-Soundings
- Temperature
surface probe network
(NSF depending)



Super-Site 2: corn field



View toward the north



View toward the north



View toward the north-west



Super-Site 2: Moor field

View toward the north-east



View toward the South



Super-Site 2: Wet moor site



Super-Site 2: moor and corn surface stations

Surface stations	Providings	Lab in charge	Priority	remark
Mean Values	$\overline{T}, \overline{q}, \overline{U}, WD$ <i>rain, pressure</i>	GAME	P1	OK
Sonic + Licor (10 m) + 3 sonics in the ISL.	$\overline{T}, \overline{q}, \overline{u_i}, \overline{co_2},$ $\overline{T'^2}, \overline{q'^2}, \overline{u_i'^2}, \overline{co_2'^2},$ $\overline{u_i'T'}, \overline{u_i'q'}$	GAME / UTAH	P1	OK
Radiometer	ISW, OSW ILW, OLW	GAME	P1	OK
Surface probes	Temperature Soil moisture	GAME	P1	OK
Soil properties vertical profiles	Humidity temperature	???	P1	

Alex Graff could be interested in instrumenting the corn site. Could GAME implement their station on the wet moor site in that case?

Super-Site 2: wet moor surface station

Surface stations	Providings	Lab in charge	Priorit y	remark
Mean Values	$\bar{T}, \bar{q}, \bar{U}, WD$ <i>rain, pressure</i>	???	P2	
Sonic + Licor	$\bar{T}, \bar{q}, \bar{u}_i, \bar{co}_2,$ $\overline{T'^2}, \overline{q'^2}, \overline{u_i'^2}, \overline{co_2'^2},$ $\overline{u_i'T'}, \overline{u_i'q'}$???	P1	
Radiometer	ISW, OSW ILW, OLW	???	P1	
Surface probes	Temperature Soil moisture	???	P1	
Soil Profile	Humidity temperature	???	P1	

Who wants to implement their surface station at this site: GAME/
Graff/ Joachim Reuder???

Super-Site 2: Vertical profiling

	Providings	Lab in charge	Priority	remark
Tethered ballon	$\overline{T}, \overline{u_i}, \overline{T'^2},$ $\overline{u_i'^2}, \overline{u_i'T'}$ OR $\overline{T}, \overline{q}, \overline{U}, WD$	MTO- France/GAME	P1	OK
Wind profiler (UHF or soder, has to be determined yet)	Sodar $\overline{u_i}, \overline{u_i'^2}$ UHF $\overline{u_i}, \overline{u_i'^2}, \overline{\epsilon}, \overline{\eta}, \overline{zi}$	MTO- France/GAME	P1	OK
Frequent radio-soundings	T, q, U, WD	MTO- France/GAME	P1	OK

Super-Site 2: Tethered Balloons

How many balloons and what type of soundings

- **(turbulent / mean) ??**
- **Constant level / soundings ??**
- **UAVs and aircrafts constraints ??**

Super-Site 2: Frequency issue

Radiosoundings, Frequent-radiosoundings, tethered-balloon: 400-406 MHz

UAVs: ~ 40MHz, ????

UHF: 1 GHz

VHF: 45 MHz

Super-Site 3

???



Super-Site 3: surface stations

Should we instrument a third heterogenous surface site in the northern part

1/ further away from the town and the industrial area.

2/ would be then smaller patches

3/ UHF authorized on site 3 if needed

**4/ Would be then on the scintillometer path (MAQ)
toward the north**

Aircraft operations
See P. Durand presentation

UAV operations
See J. Cuxart presentation

UAVs – authorization process

Coordination: Catherine Ronflé-Nadaud

- **Will make the proposal for the flying area reservation and authorization (“ZRT”)**
- **Will inform about the project and number of groups who will have to submit an authorization proposal**
- **Each group who will operate an UAV will have to submit their own proposal, to get the “permit to fly”.**

Catherine R-N will send a template and help in the process.

- **NB: easier if you already had the authorization in your own country before**
- **make it clear and safe!**
- **Questions to ask to the French regulator ? (ex: can we fly above the highway ??....)**

IOP Triggering

- Forecast products and report
- Organization of one IOP day
- Schedule and decision process
- Coordinating and secretary teams

Organization – proposition of one IOP day

(LOCAL TIME:)

07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	01	02	03	04	05	06	
RS						RS						RS						RS						
			F1	B1									F2				B2							
									Aircraft and UAV Flights Frequent PTUV soundings TB operation															
Continuous observation of UHF profilers and lidars																								
Continuous surface station measurements																								

F1, F2 = forecasts

B1, B2 = Briefings (forecast report, IOP triggering, observation reports)

RS = standard radio-soundings*

Sunrise = 6h20 LT = 4h20 UTC

Sunset = 21h40 LT = 19h40 UTC

Organization – proposition of one IOP day (J)

(LOCAL TIME:)

07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	01	02	03	04	05	06	
RS						RS						RS						RS						
			F1	B1									F2				B2							
									Aircraft and UAV Flights Frequent PTUV soundings TB operation															
Continuous observation of UHF profilers and lidars																								
Continuous surface station measurements																								

Radio soundings :

- RS at 5 UTC needed/confirmed on J ?
- One more RS at 5 UTC on J+1 ? (“the day after”)

UAV operations in morning and midday ? & overnight ?

Sunrise = 6h20 LT = 4h20 UTC

Sunset = 21h40 LT = 19h40 UTC

Organization for one J-1 non-operating day

(LOCAL TIME:)

07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	01	02	03	04	05	06		
			F1	B1									F2			B2									
Continuous observation of UHF profilers and lidars																									
Continuous surface station measurements																									

J-1 = confirmation/forecasting day for IOP of day J.

Adapt briefings occurrence depending on weather forecast ?

UAV operations for potential non IOP days but fair weather ?

Coordination and reports

- Coordinating PIs: leading briefings and validate the final decisions.
- Secretary PIs: taking notes during briefings (reports on observations, and on decisions taken during the briefings).
- Forecast PIs: organizing, summarizing and presenting the forecast report of the briefing

Coordination and reports

Suggestions for PIs

- Coordinating team

Jordi V. Eric, Marie L. Fabienne L., Pierre D., Jochen R., Joan C.

- Secretary team

Françoise Guichard, Fleur Couvreur, David Pino, Anneke vB.,
Aline von K.,

- Forecast team Gert-Jan S.

working group: Yann S, Eric B. coordinator, secreta.,

> Planning to set up for turns !

Experimental plans document

- *Now is time to write it !*

Writing coordinators: gather the needed contribution and send it to me please (strategy paragraph + instruments info page)

- Document will be put on the web site as soon as it is significantly filled

Budget

- 25 k€ from LEFE program (CNRS-INSU- ocean and atmosphere)
 - > Piper Aztec (SAFIRE) flights (25 h) + 40 standard radiosoundings
- 17 k€ from University Paul Sabatier / Observatoire Midi-Pyrénées
 - > Sky Arrow (IBIMET) flights (25 h) + Météo-France missions
- 15 k€ from Laboratoire d'Aérodynamique (CNRS)
 - > contribution to WUR and TUD experiments // spare flight hours
- *About 45 k€ (??) from EUFAR*
 - > Piper Aztec and Sky Arrow flights (15 h) (Vila Guerau de Arellano and Pino)
- *About 50 k€ (??) from NSF* > E. Pardyjak, M. Parlange, J. Fernando and Z. Sorbjan proposal
- Météo-France participation (instruments, manpower, forecasts, consumables...)
- ES0802-COST contribution (J. Reuder)
- Contributions of all groups who are coming on their own
 - *Could you please send me an estimate of your contribution ?*

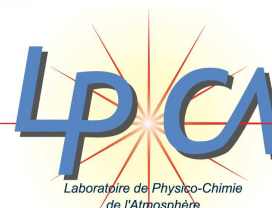
+ Two invited associate professor positions

Budget

TOTAL should be around 250 k€ for the field experiment



UNIVERSITETET I BERG



EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN



Technische Universität Braunschweig

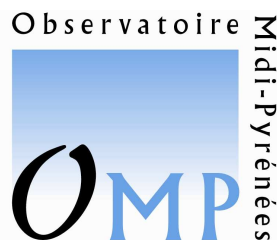
Institute of
Aerospace Systems



Universitat de les
Illes Balears



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH



METEO FRANCE
Toujours un temps d'avance

BLLAST LOGO ?...

