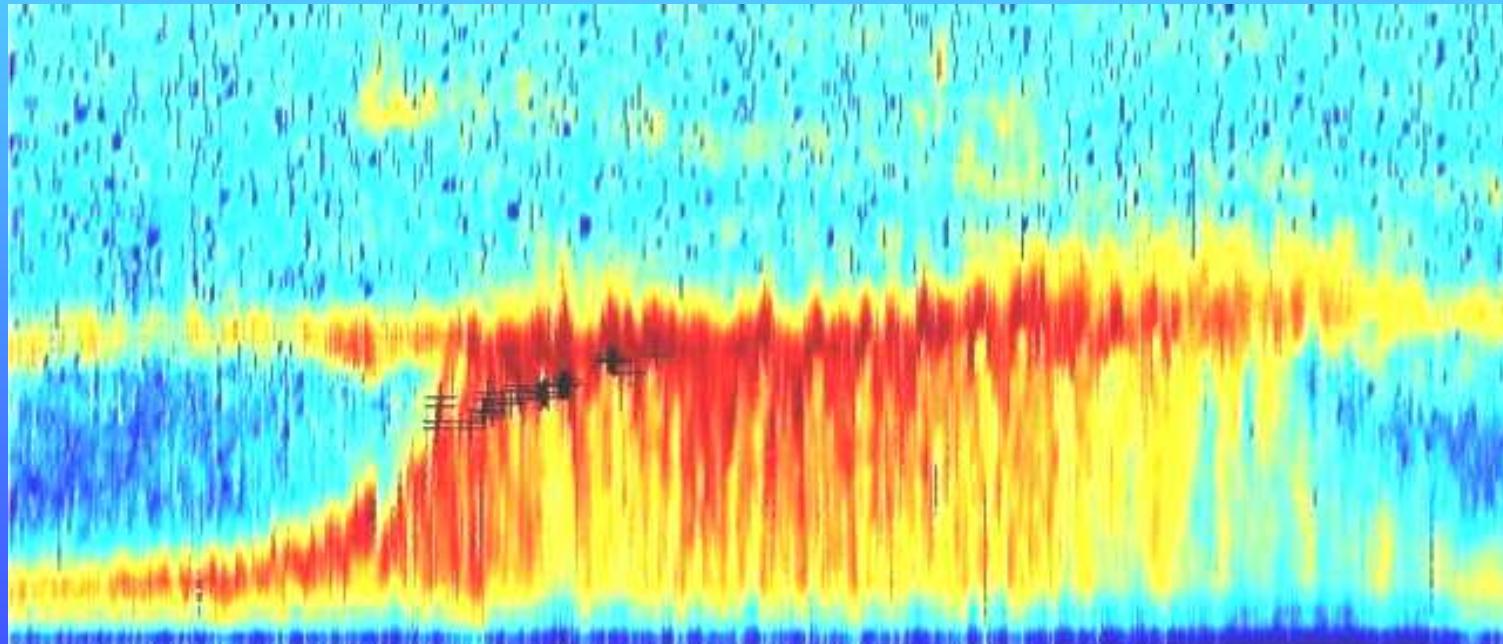


Boundary Layer Late Afternoon and Sunset Turbulence: the BLLAST 2011 experiment

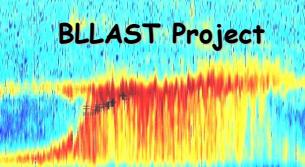
M. Lothon, Lab. Aérologie, FRANCE

D. Pino, BarcelonaTech (UPC), SPAIN



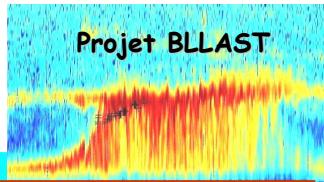
F. Lohou, P. Durand, F. Couvreux, D. Legain, E. Pardyjak, J. Vilà, J. Reuder, P. Augustin, Y. Bezombes, A. van de Boer, J. Cuxart, L. Fleury, B. Gioli, F. Gibert, J. Groebner, O. Hartogensis, A.C van Kroonenberg, S. Martin, G. J. Steeneveld, Y. Seity, C. Yagüe, H. Jonker, W. Angevine, D. Lenschow, Z. Sorbjan, **70 more researchers**

International participants



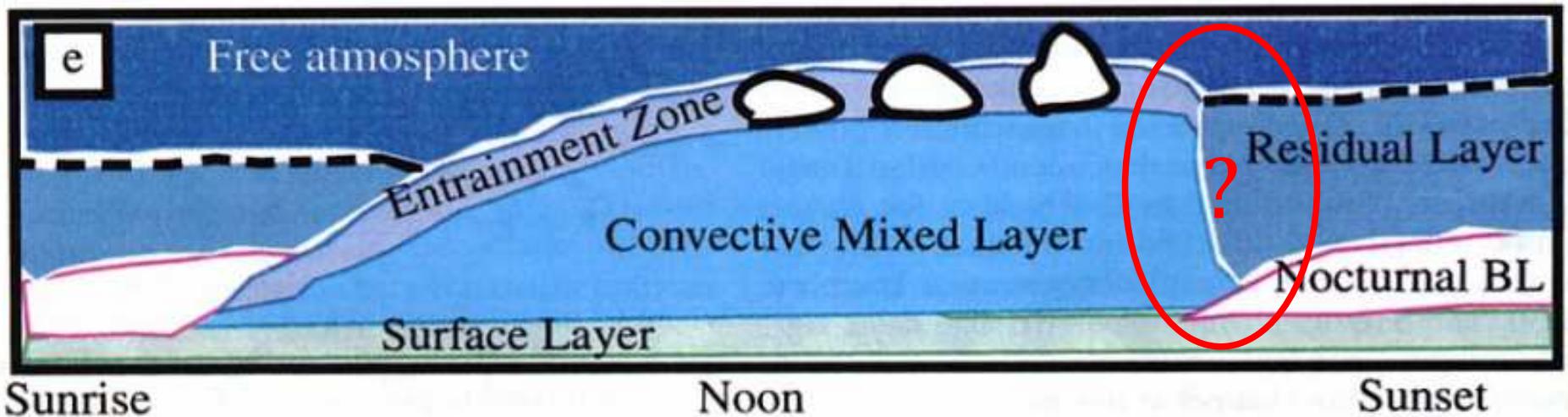
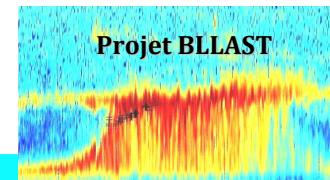
France	<i>LA</i> <i>CNRM</i> <i>IPSL/LMD</i> <i>LPCA</i> <i>SAFIRE</i>	Tethered balloon, UHF profiler, aircraft meas. Balloons, towers, modelling (ARPEGE, AROME) Aerosol and Doppler Lidar. Sodar Aircraft (Piper Aztec)
Germany	<i>Univ. Tübingen</i> <i>Univ. Braunschweig</i> <i>Univ. Bonn</i>	UAS - MASC UAS - M ² AV Soundings
The Netherlands	<i>Univ. Wageningen</i> <i>Univ. Delft</i>	Modelling (LES, WRF) , eddy covariance and scintillometer Modelling (LES-DNS)
Spain	<i>BarcelonaTech (UPC)</i> <i>Univ. Baleares</i> <i>Univ. Comp. Madrid</i>	Modelling (MXL, LES, WRF) Eddy covariance, modelling (MesoNH) Microbarometers
Italy	<i>IBIMET</i>	Aircraft (Sky Arrow)
UK	<i>Univ. Exeter</i>	Modelling (LES)
USA	<i>Univ. Utah</i> <i>UC Davis</i> <i>UC San Diego</i> <i>NCAR & NOAA</i>	Tethered balloon, tower, Raman Lidar Soundings IR camera Expertise, Modelling (WRF)
Norway	<i>Univ. Bergen</i>	UAS – SUMO, modelling (WRF)

OUTLINE



- Issue & objectives
- The 2011 field experiment
- Preliminary results

Issue



Late afternoon transition:

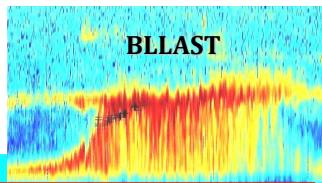
Stull, 1988 - concept

- Progressive shut down of the surface heating
- Stabilization of the temperature profile close to the surface
- Transition from thermal turbulence to mechanical turbulence

Few numerical studies, scarce observations, less than 20 published papers

- PBL decaying still not well understood and represented
- Transitional aspects
- Competition of several weak forcings
- Close to (or beyond) the edge for scaling laws

Scientific Questions



Definition & characterization

of the various layers
(surface layer,
mixed-layer,
residual layer)

Understanding

- *The evolution of turbulence intensity & scales*
- *The role of the various PBL processes*
(entrainment, dynamical turbulence, convection, advection, radiation, ...)
- *The role of surface heterogeneity*

Impact

- *Transport of trace gases and water vapour*
- *Representation of the diurnal cycle by mesoscale models*
- *Evaluation of the forecast models*

Methodology: *Observations* & numerical simulations (mixed-layer model, LES, Mesoscale, NWP)

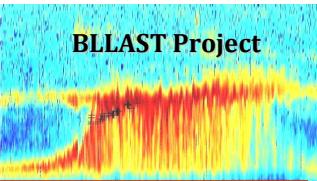


The 2011 field experiment



Field experiment *14 June-8 July 2011*

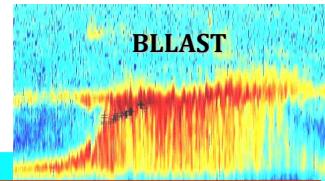
BLLAST Project



Instrumented site of Laboratoire d'Aérologie, Lannemezan, France

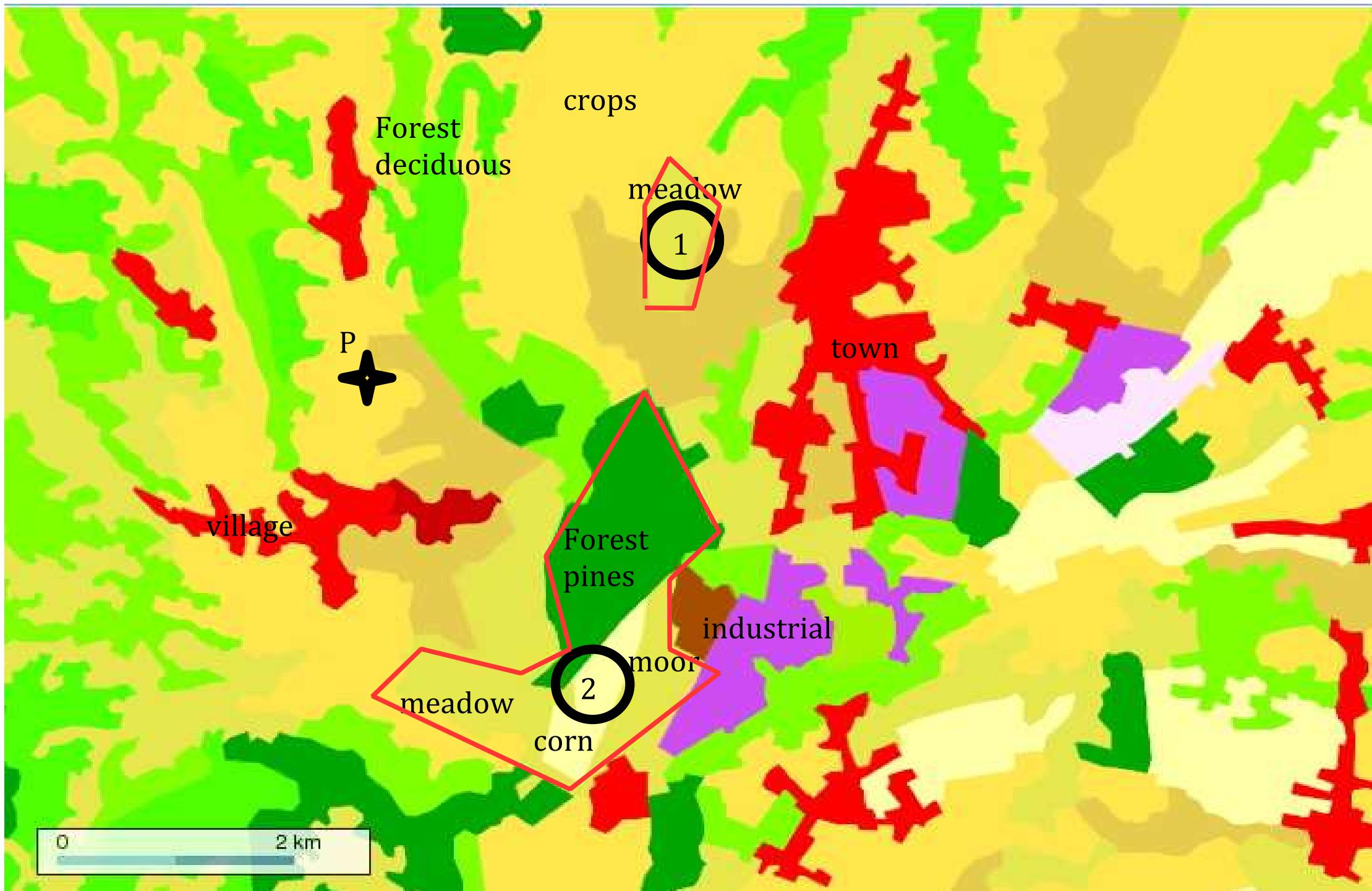


Exploration needs

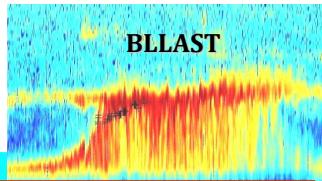


- **PBL Vertical structure**
multi-layering, shear, entrainment, stability
- **Surface layer spatial heterogeneity**
Surface cover heterogeneity, soil moisture, heat storage, energy balance
- **Radiation divergence**
- **Advection, large scale subsidence, baroclinicity**
- **Gravity waves**

Land-use



Field experiment *14 June-8 July 2011*



Supersite 1 (Vertical structure of the BL):

- Up to 9 hourly RS launched from 12 UTC (during IOPs)
- Tethered balloon with turbulence measurements
- 60 m tower with turbulence measurement at 3 levels
- 10 m tower: sonic anemometers at 6 levels
- Sodar, UHF, VHF, MWR, ceilometer
- Backscatter and Doppler lidars
- 3 microbarometers, 8 thermocouples, soil
- Four 2 m masts with EC instruments



Supersite 2 (Surface heterogeneity):

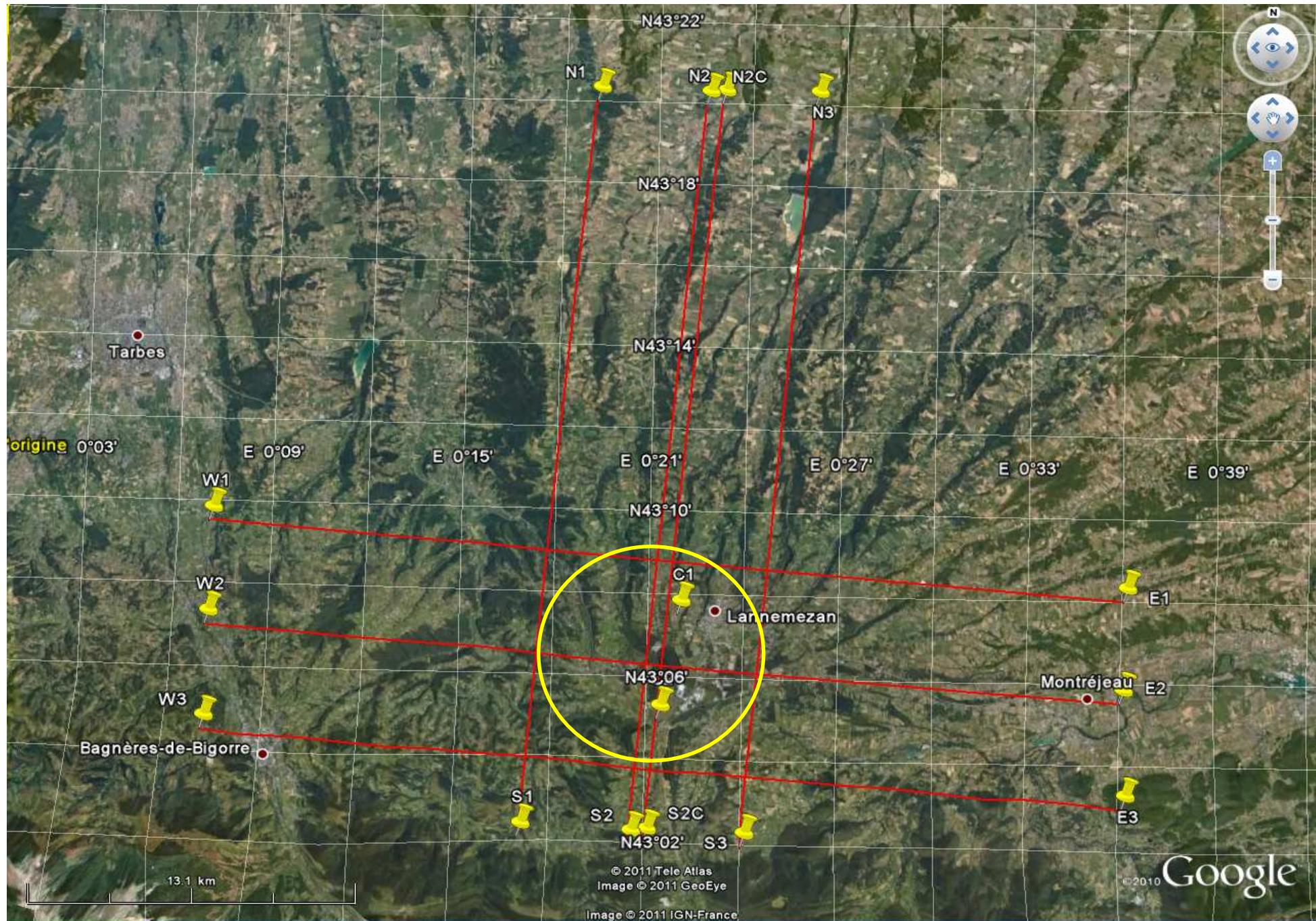
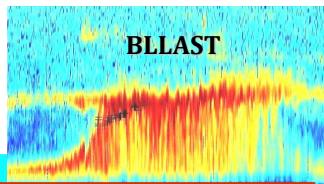
- EC over 3 different surfaces: corn, moor, forest (30 m tower)
- 2 tethered balloons
- Backscatter lidar

3 scintillometers: 30 m, 3 and 4 km

Two airplanes and several UAS simultaneously performing horizontal legs and vertical profiles (first campaign)



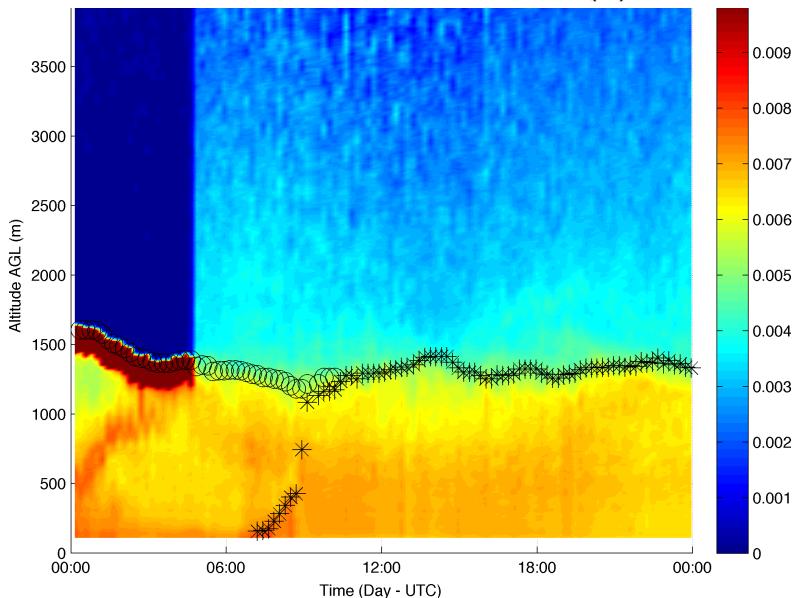
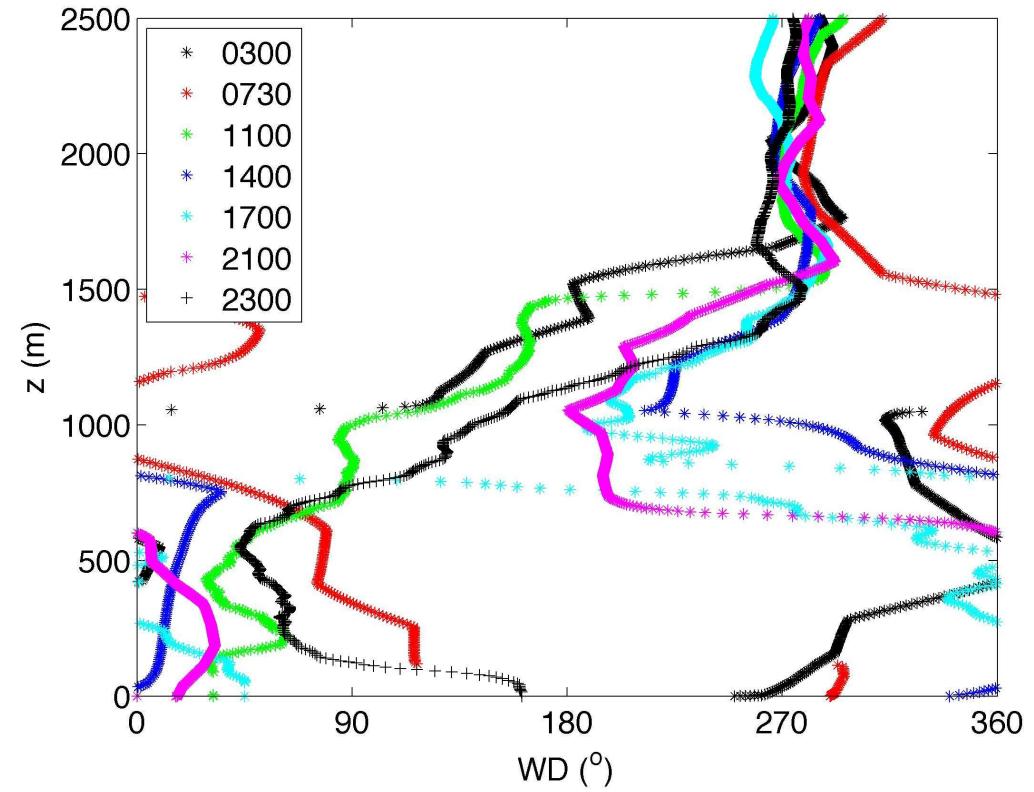
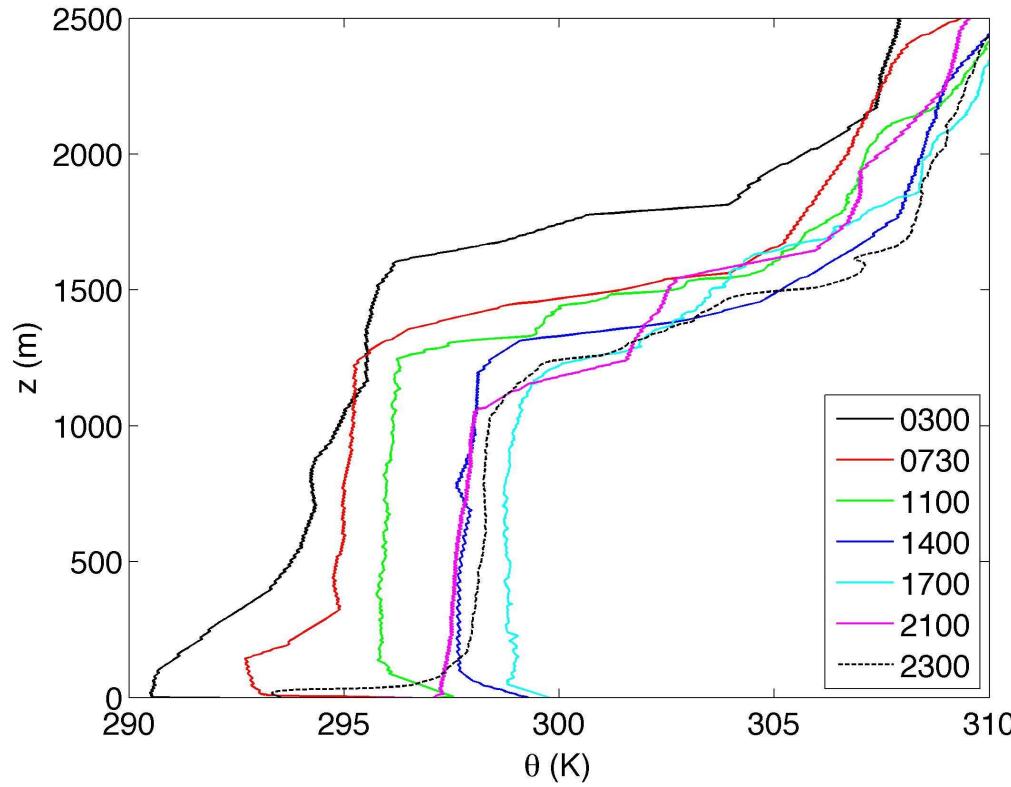
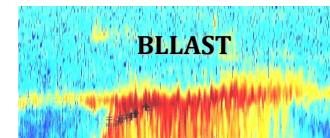
Aircraft flight tracks



Preliminary results

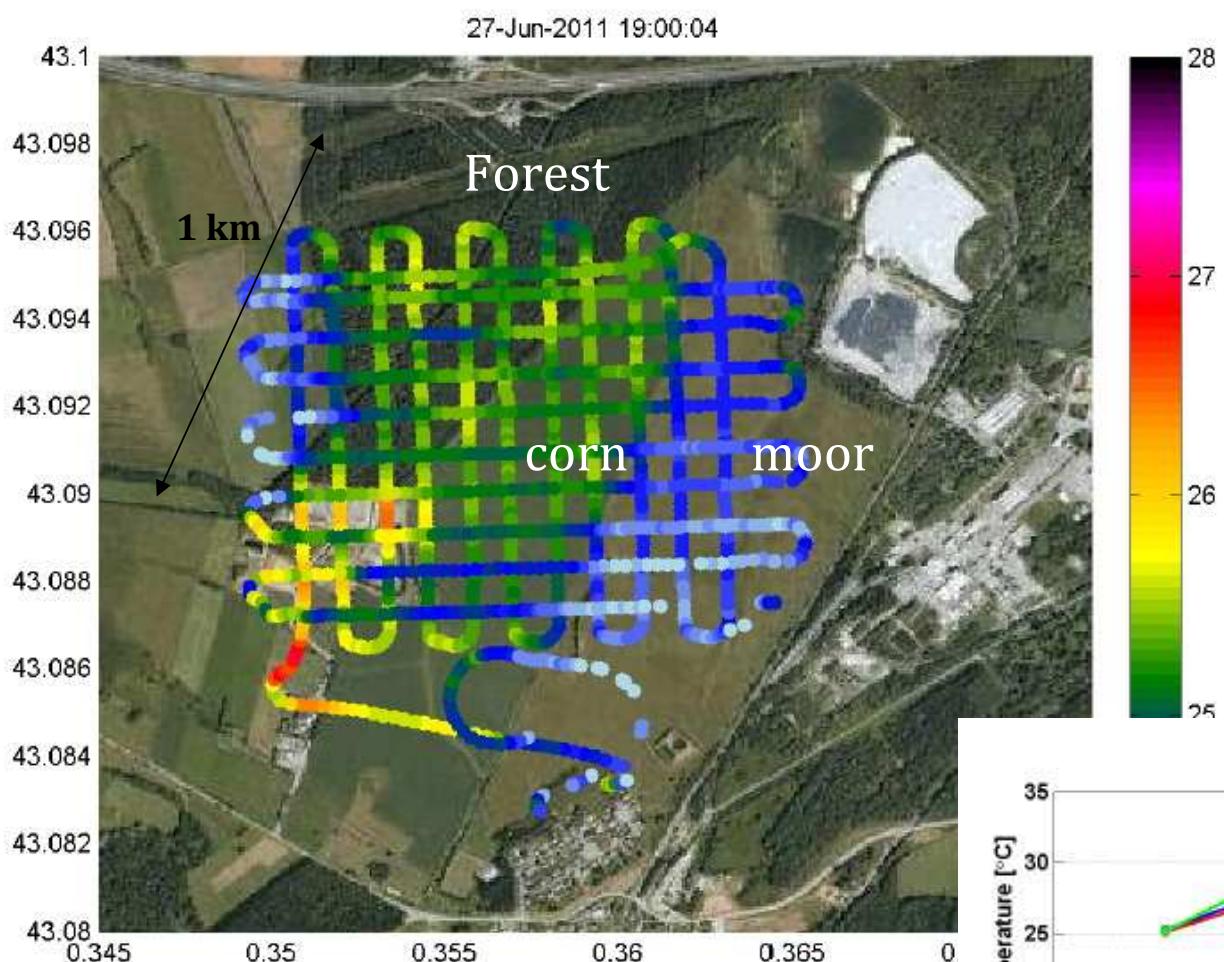
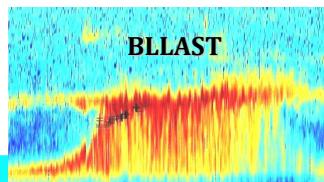
- Vertical structure: RS, LIDAR
- Surface heterogeneity: UAS
- TKE decay: surface, aircraft, LIDAR, UAS

Vertical structure: 1st July 2011

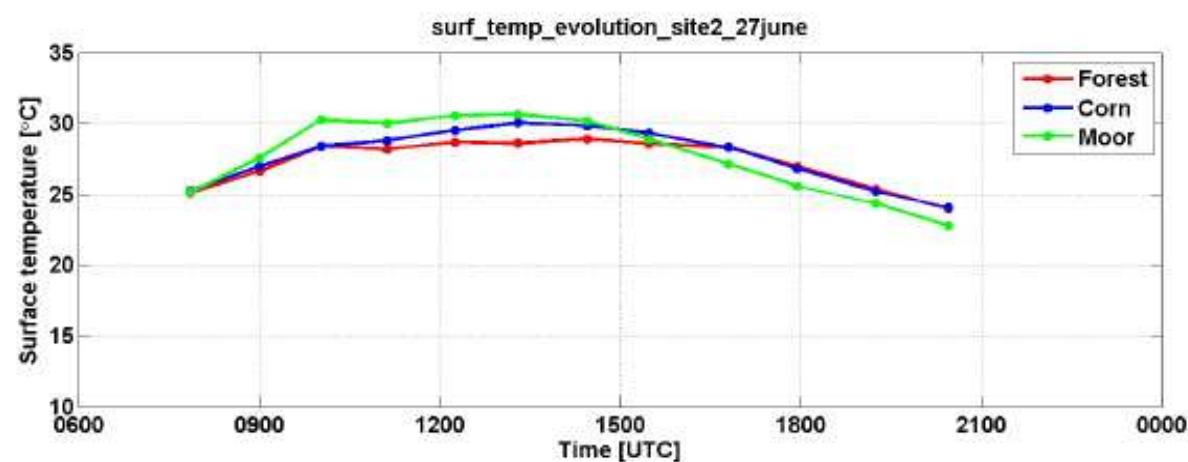


- Residual layer, rapid growth of the BL
- Westerly winds aloft
- NE-SW during day-night in the mixed layer
- Differential shear
- Subsidence

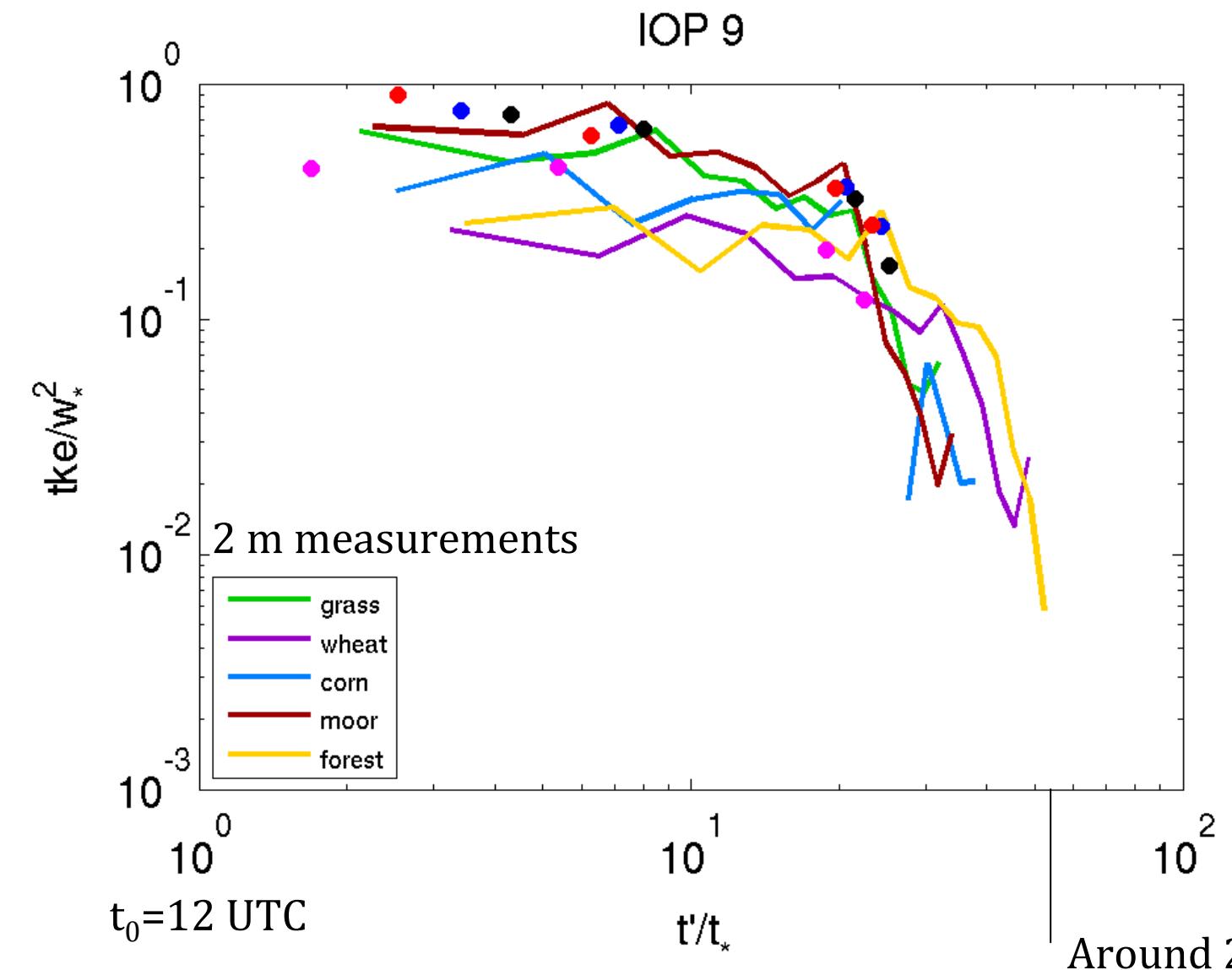
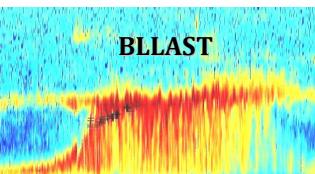
Surface heterogeneity: 27th June 2011



SUMO flying at SS2

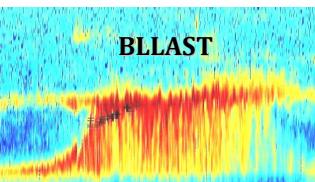


2 m and aircraft: TKE decay 1st July 2011



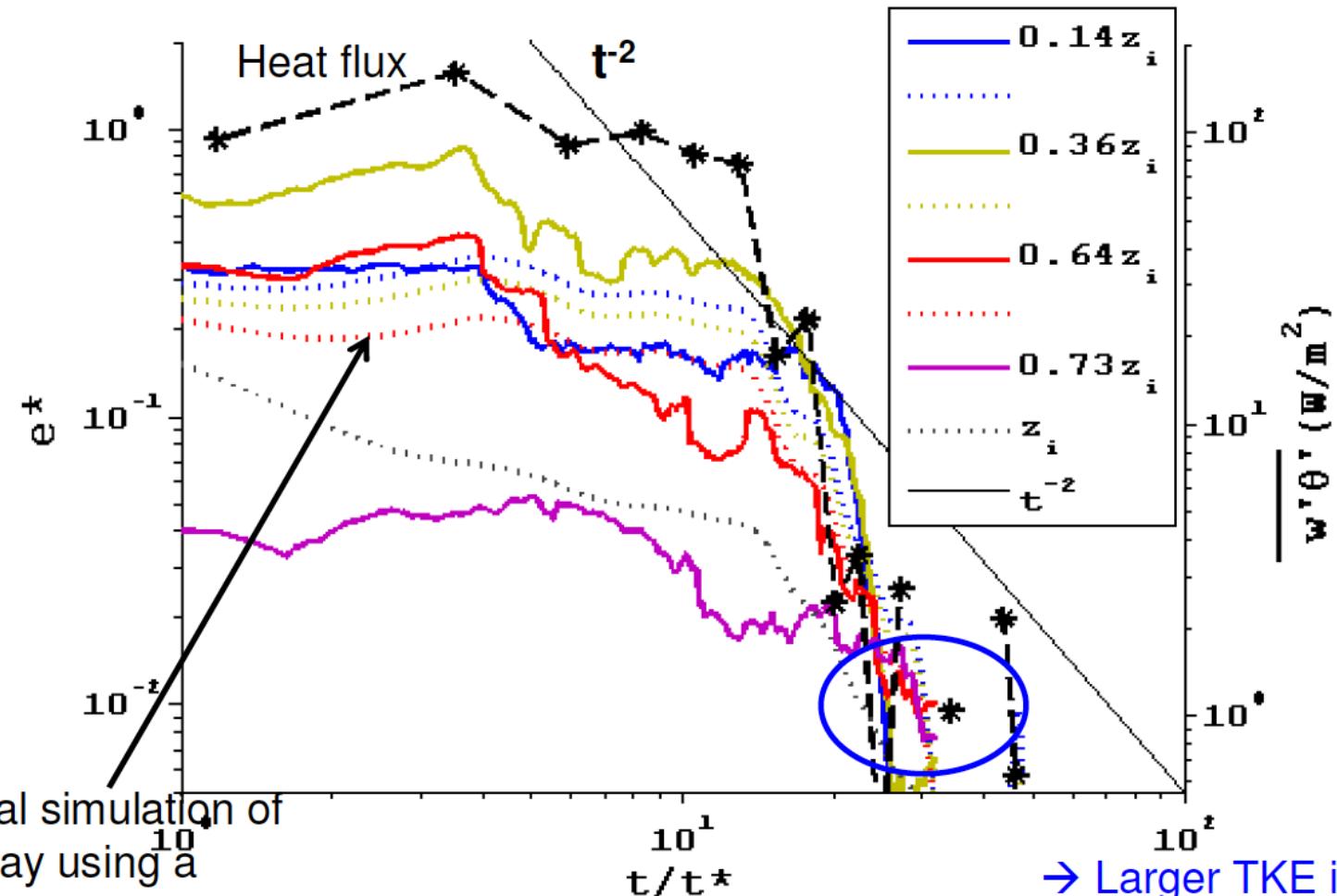
Piper Aztec (points):
Four legs at each height

- magenta = 0.95 zi
- red = 0.7 zi
- blue = 0.45 zi
- black = 0.25 zi



Doppler LIDAR: TKE decay 2nd July 2011

$z_i = 1100 \text{ m}$
 $w^* = 1.44 \text{ m/s}$
 $t^* = 0.21 \text{ h}$
 $t_0 = 13 \text{ UTC}$

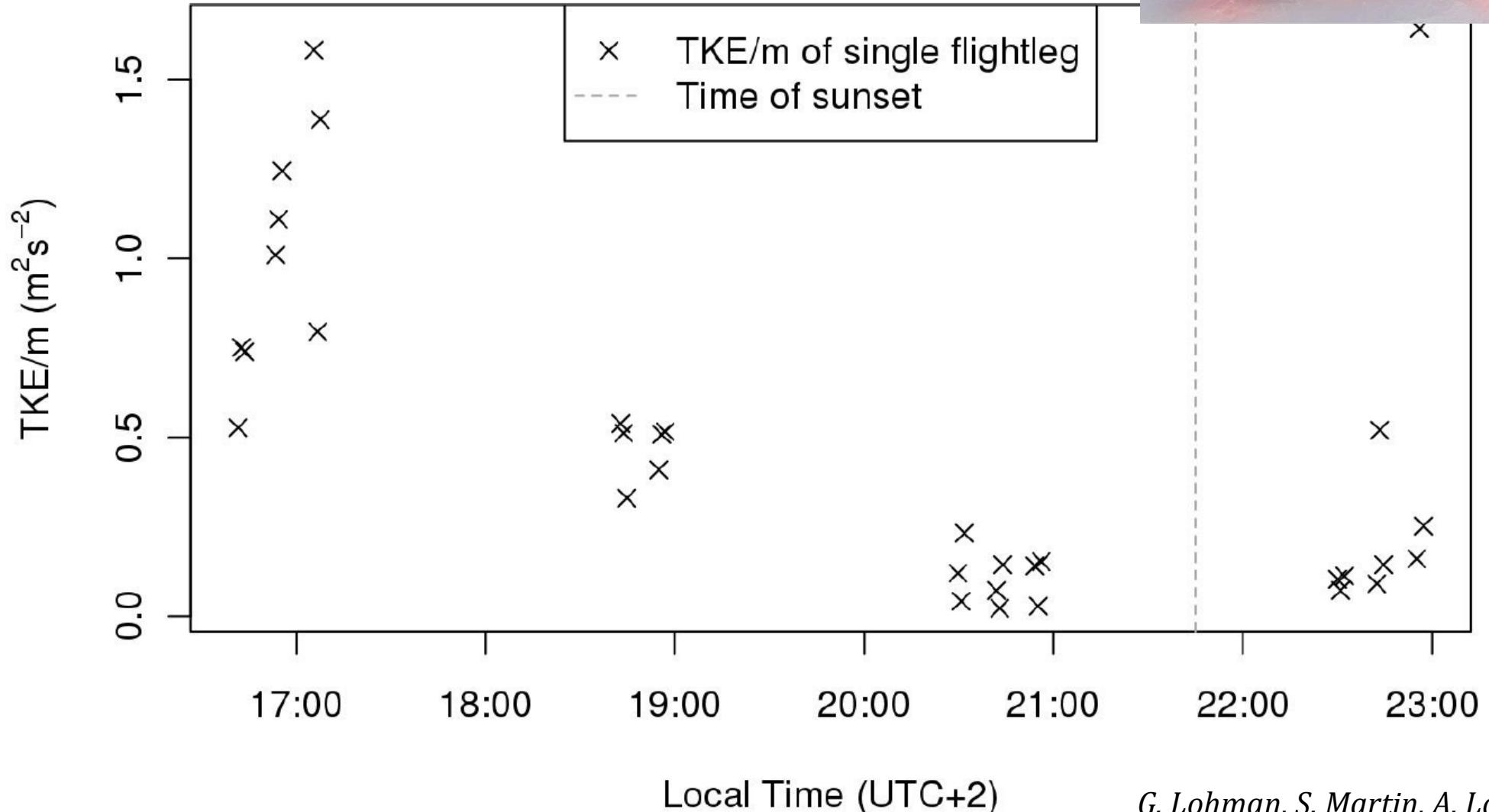
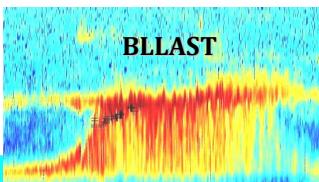


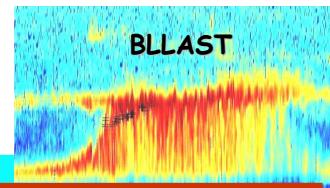
Numerical simulation of
TKE decay using a
linear vertical decrease
of surface heat flux

BLLAST workshop, Firenze, 6-7 February 2012

→ Larger TKE in the
middle of the CBL than at
the bottom

UAS (M²AV): TKE decay 2nd July 2011



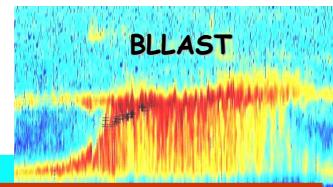


BLLAST related studies at EGU2012:

Poster session this afternoon: **XY671, XY672, XY673**

Additional information: quick looks, other instruments,
model results at:

<http://bllast.sedoo.fr>



Thank you for your attention!



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Observatoire
OMP Midi-Pyrénées

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Toujours un temps d'avance

UC San Diego
Jesse D. and Karen W. Erlichman Chair in Biological Sciences

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Aerospace Systems



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