

GABLS4: an intercomparison case to study the stable boundary layer with surface interactions on the Antarctic plateau.

E. Bazile (CNRM/GAME) ,

F. Couvreux (CNRM/GAME), P. Le Moigne (CNRM/GAME),

C. Genthon (LGGE)

With O. Traullé (DSO), H. Barral (LGGE), W. Maurel (CNRM) ,

G. Canut(VNRM) A.A.M. Holtslag (WU), G. Svensson (SU),

E. Vignon (LGGE), V. Guidard (CNRM/GAME) , T. Vihma (FMI) ...



METEO FRANCE
Toujours un temps d'avance

Outline

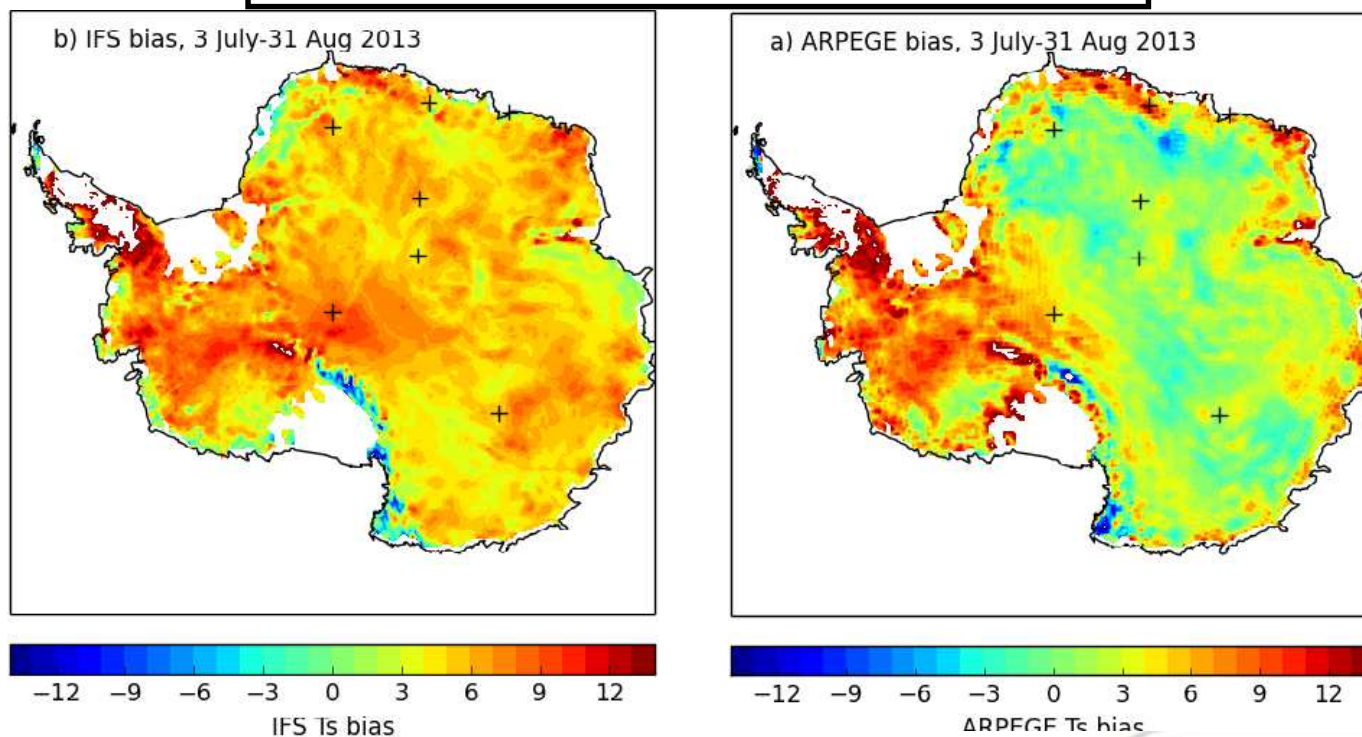
- Motivations
- Why the Antarctic Plateau and DomeC ?
- Intercomparison case:
 - Large scale forcing
 - 1D (SCM) and snow scheme (LSM)
 - Some preliminary results
- Acknowledgments and ...



Motivations

- Under strongly stable stratification and depending on the parametrization used, GCM/NWP models still have an excess of mixing or strong decoupling with the surface → warm or cold bias (Holtslag et al 2013)

Surf Temperature Bias vs Modis data (H. Freville et al. 2014)



Motivations

- Under strongly stable stratification and depending on the parametrization used, GCM/NWP models still have an excess of mixing or strong decoupling with the surface → warm or cold bias (Holtslag et al 2013)
- Some NWP models use a Turbulent Kinetic Energy (TKE) scheme such as ARPEGE, AROME, WRF, DWD, but under strong stable conditions the TKE is underestimated
- Study the transition and the decay of the turbulence... same behaviour with the BLLAST data (see <http://bllast.sedoo.fr/>) ?
- Evaluation of the EFB Closure (Zilitinkevich et al 2013) in a real case with a diurnal cycle and in dry condition ($Q_v \sim 10^{-4}$)

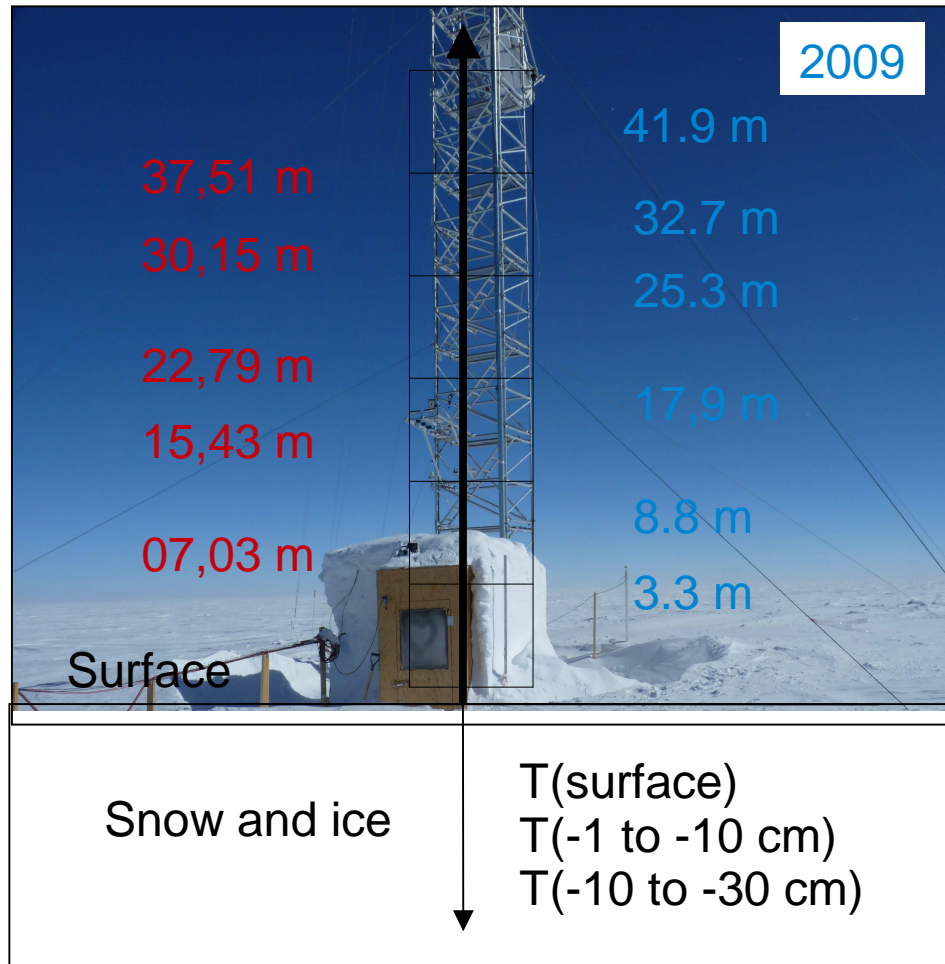


Motivations

- 3 previous GABLS (GEWEX Atmospheric Boundary Study) case:
 - GABLS1 (Cuxart et al. 2006) ideal case only turbulence ($Ri \sim 0.25$) T_s prescribed
 - GABLS2 (Svensson et al 2011) diurnal cycle ($Ri \sim 0.2/0.4$) T_s prescribed
 - GABLS3 (Bosveld et al 2014) composite case from Cabauw data : surface scheme with initial Bowen ratio (Sh/Lh) with ($Ri \sim 0.4/0.6$)
- GABLS4 : Stronger $Ri > 1$, surface interaction, easier initialization only temperature, surface fluxes, TKE observed, 2 radiosondes per day, mast data, ...



Observations: Antarctic Plateau Dome C / Concordia



- High frequency parameters (10 Hz) from 6 ultra-sonic anemometers : 3D Wind components and sonic temperature
- Low frequency parameters (30 min) : air temperature (ventilated and not ventilated), relative humidity, wind speed and direction (Young)
- 1 minute solar radiation components
- Sub and surface temperatures
- Radiometer HAMSTRAD (P. Ricaud)
- RS (1 or 2 per day)
- Alt=3233m

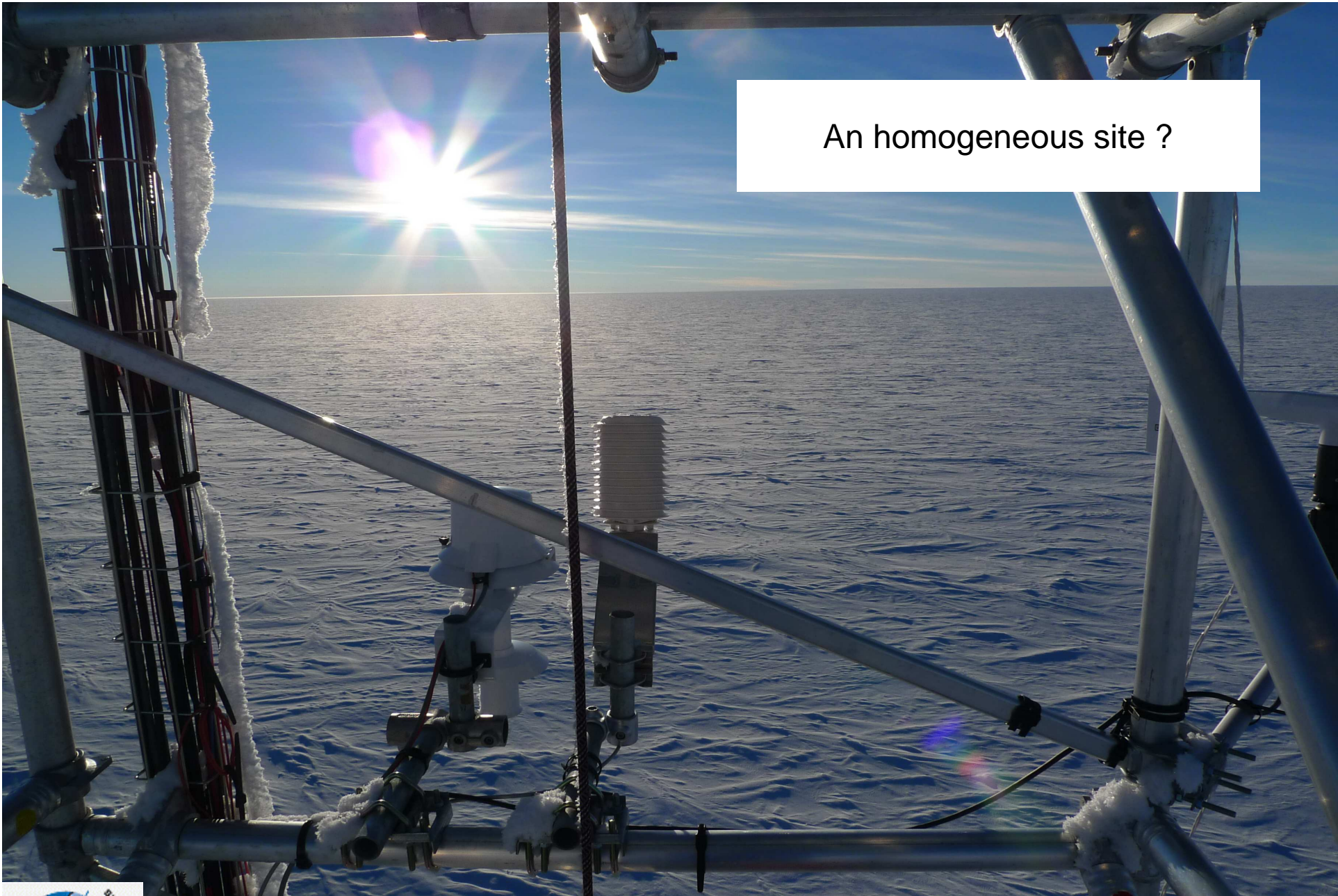


« American » Tower

Aladin-Hirlam All staff meeting / Helsingor (Dk), 13-16 April 2015c



METEO FRANCE
Toujours un temps d'avance



An homogeneous site ?

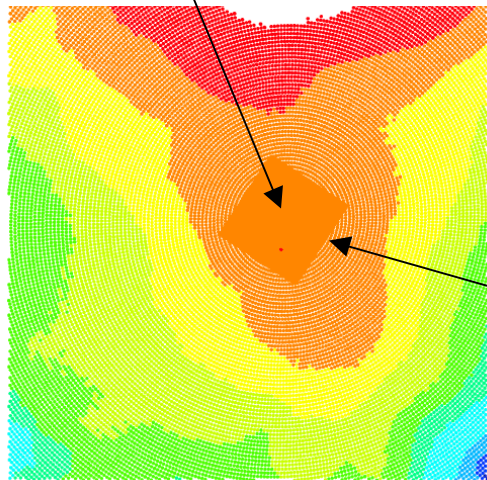
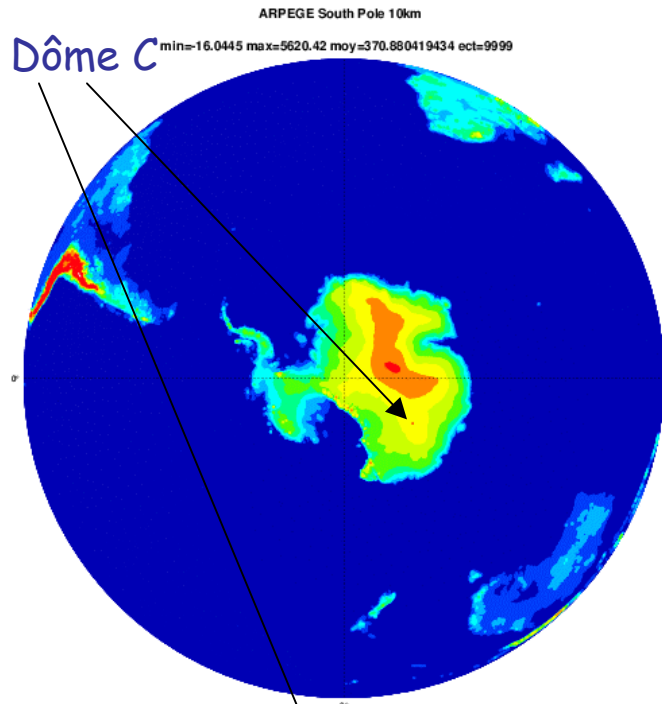


A

LGGE tower 45m



4DVAR ARPEGE-Dome C

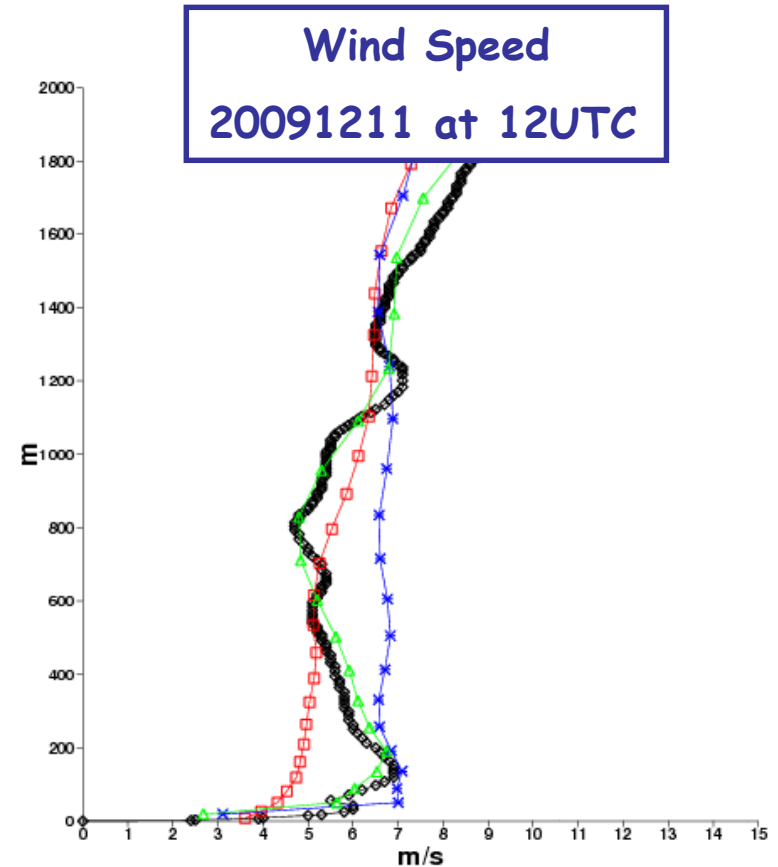
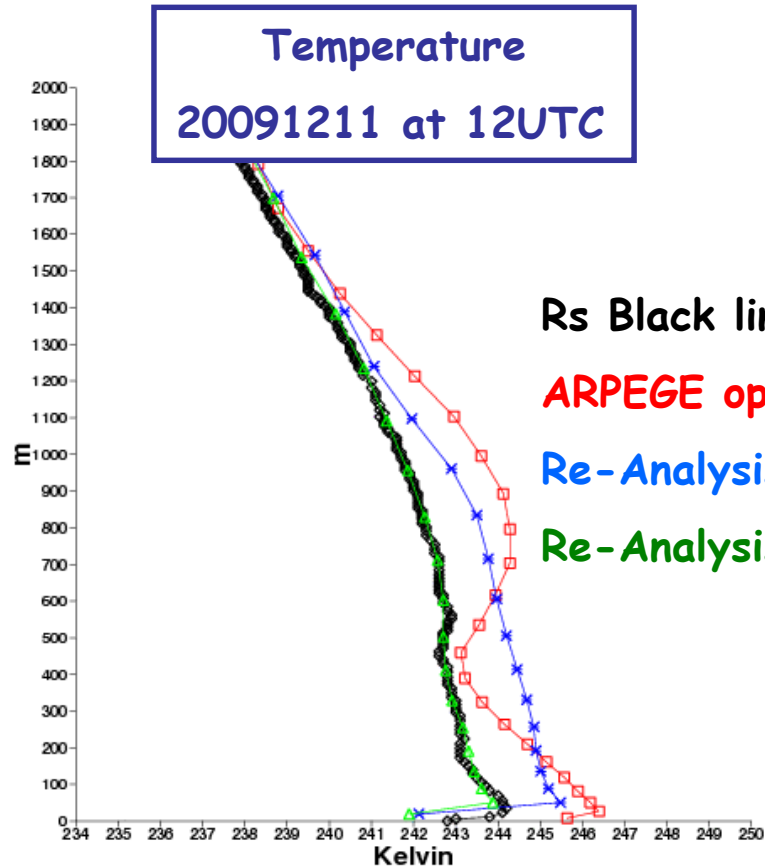


LAM at 2.5km

Lateral boundary condition (LBC) from a 4DVAR re-analysis done with the global model ARPEGE stretched on the south pole (10km) (used and available for the Concordiasi experiment):

- Improvement of the snow scheme
- Using radiosonde at 00UTC and 12UTC (not used in the operational real time analysis in 2009) and all the levels of the sounding data
- **Forcing terms:** computed with several physics package used in a NH Limited Area Model at 2.5 km: AROME (Seity et al, 2011) and with the ARPEGE-ALADIN physics . Two configurations: 60 vertical levels with a time step=60s (SL) and 90 vertical levels with 45s.

Impact of the high resolution sounding data in the 4DVAR re-analysis Arpege for the GABLS4 case

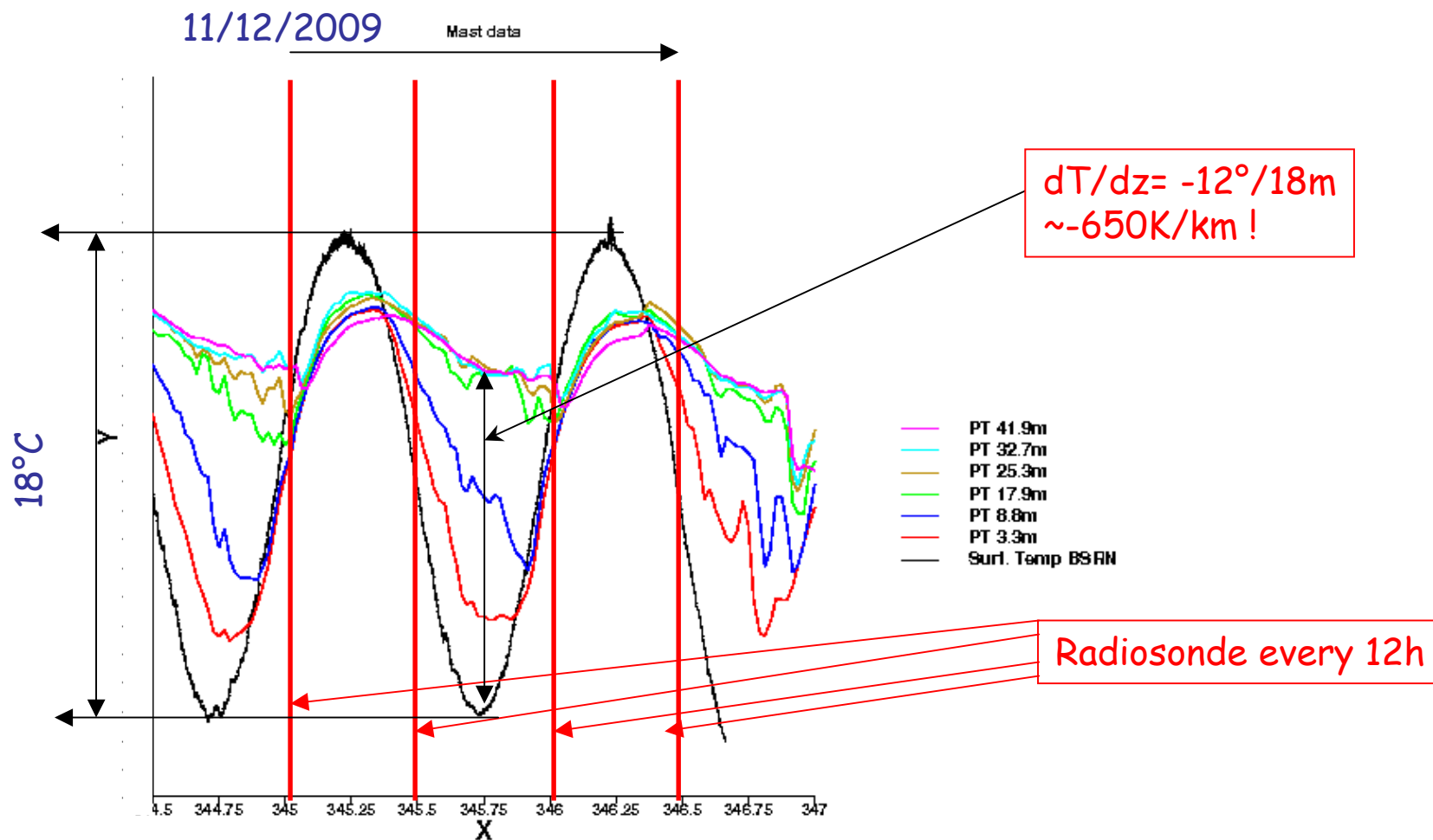


Analyse oper (red line)

4DVar re-analysis done with ARPEGE stretched over the Antarctic Plateau (10km) with high resolution of RS



Temperature evolution (Mast data)



Case study



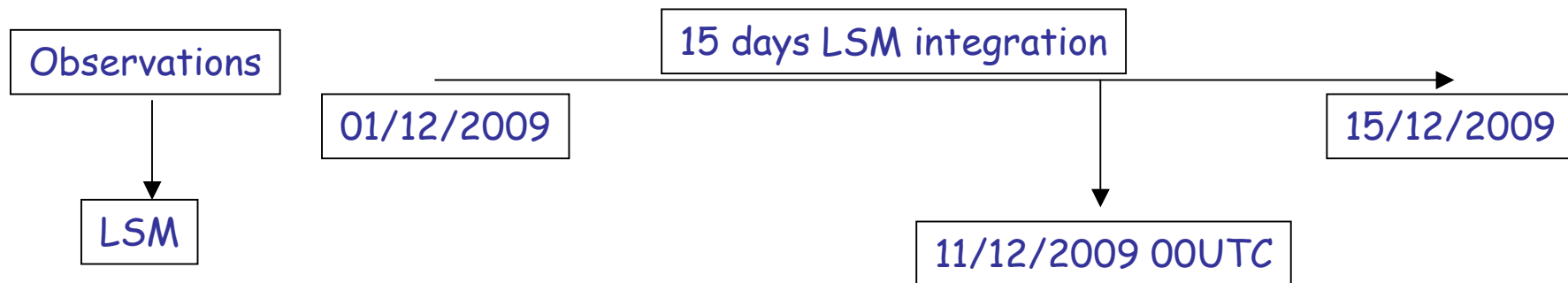
GABLS4: several steps

- **Stage 0:** LSM (snow scheme) driven by observations for 15 days
- **Stage 1:** SCM with all the physics and surface interaction 36h forecast starting the 11th Dec 2009.
- **Stage 2:** LES and SCM same atmospheric forcing used in stage 1 but the surface temperature is prescribed.
- **Stage 3:** LES and SCM. "ideal GABLS4" or simplified: no radiation, no specific humidity, constant geostrophic wind, no advection, T_s prescribed. Easier for the LES community and for other community with DNS or Explicit Algebraic turbulence models (Engineering com.)



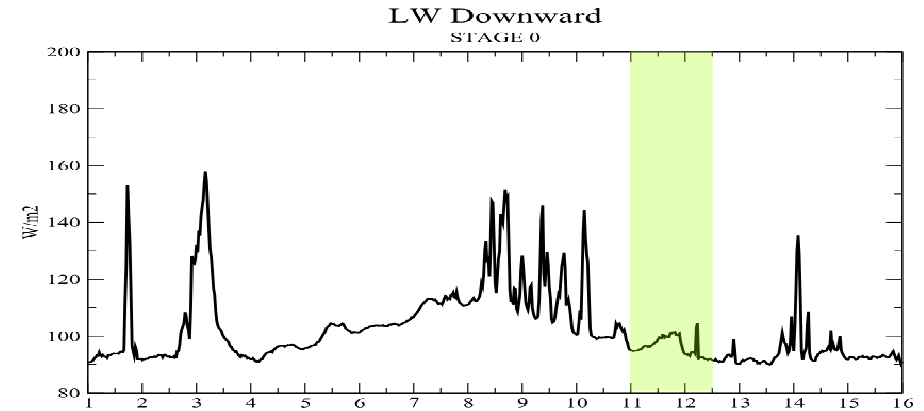
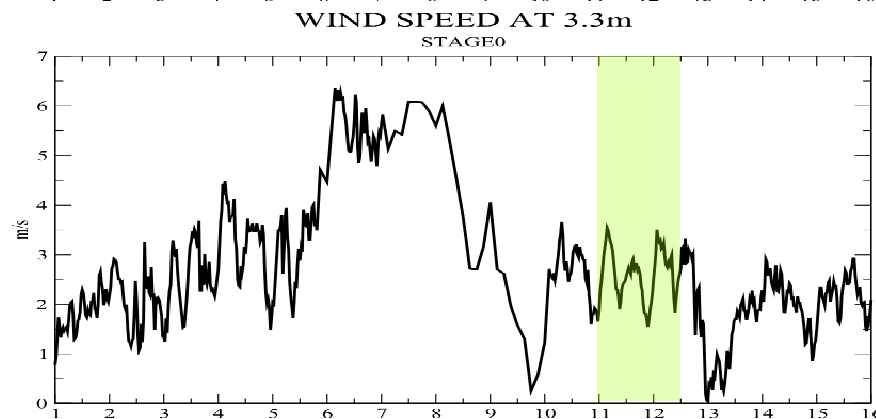
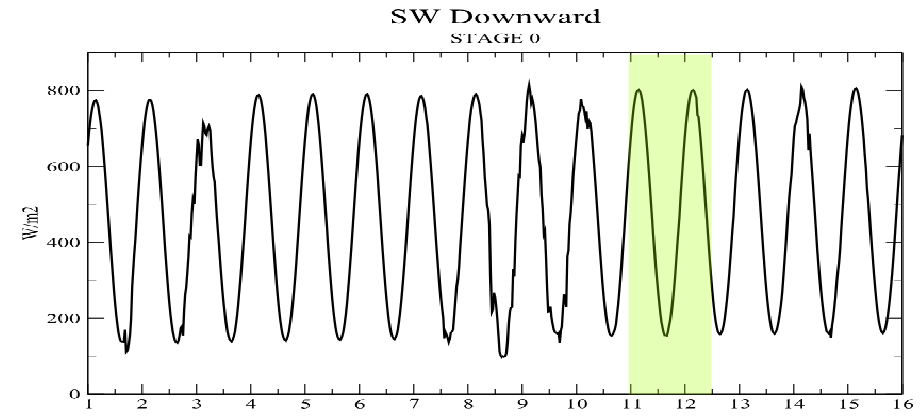
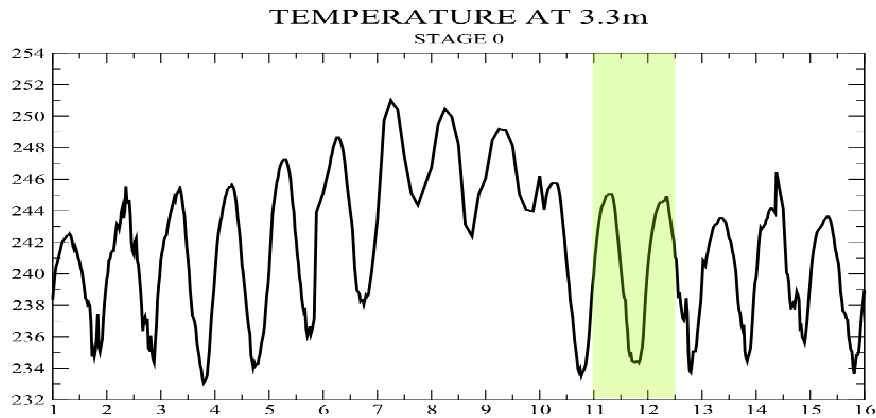
GABLS4 : Stage 0

- For GABLS4 intercomparison, we follow the DICE experiment such as
 - Same NetCdf file with additional output :
 - **Stage 0: LSM forced by observations** (T, Rh, Ws, Wd, SWd, LWd,RR)
 - comparison of snow models during 15 days vs observed temperature profile, surface fluxes
 - Provide the soil initial conditions for stage 1 valid the 11th Dec 2009



GABLS4 : Stage 0

- LSM forced by observations: T, Rh, wind at 3.3m , SWD, LWD, RR



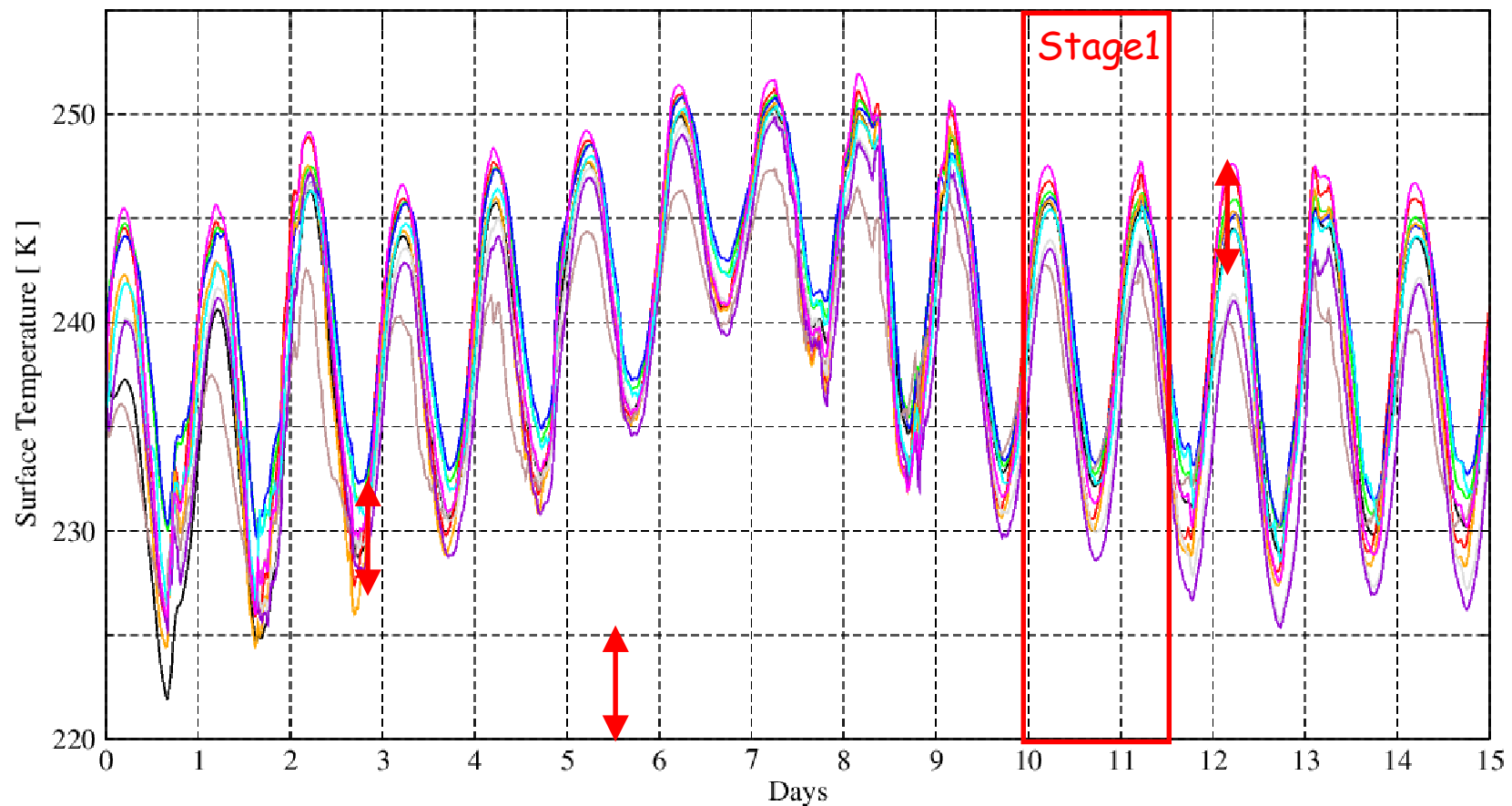
GABLS4 : Stage 0

Organization	Model	Snow layers	People
METOFFICE	Jules	19	john.m.edwards@metoffice.gov.uk
Meteo-France	ISBAES	19	patrick.lemoine@meteo.fr
	CROCUS	19	
	D95	1	
	ARP	1	
LARC	CLM4	5	anning.cheng@nasa.gov
NCEP	NOAH	4	weizhong.zheng@noaa.gov
CMC	GDPS4	1	ayrton.zadra@ec.gc.ca
LGGE	??	19	Etienne Vignon
ECMWF	CHTESSEL	1	emanuel.dutra@ecmwf.int



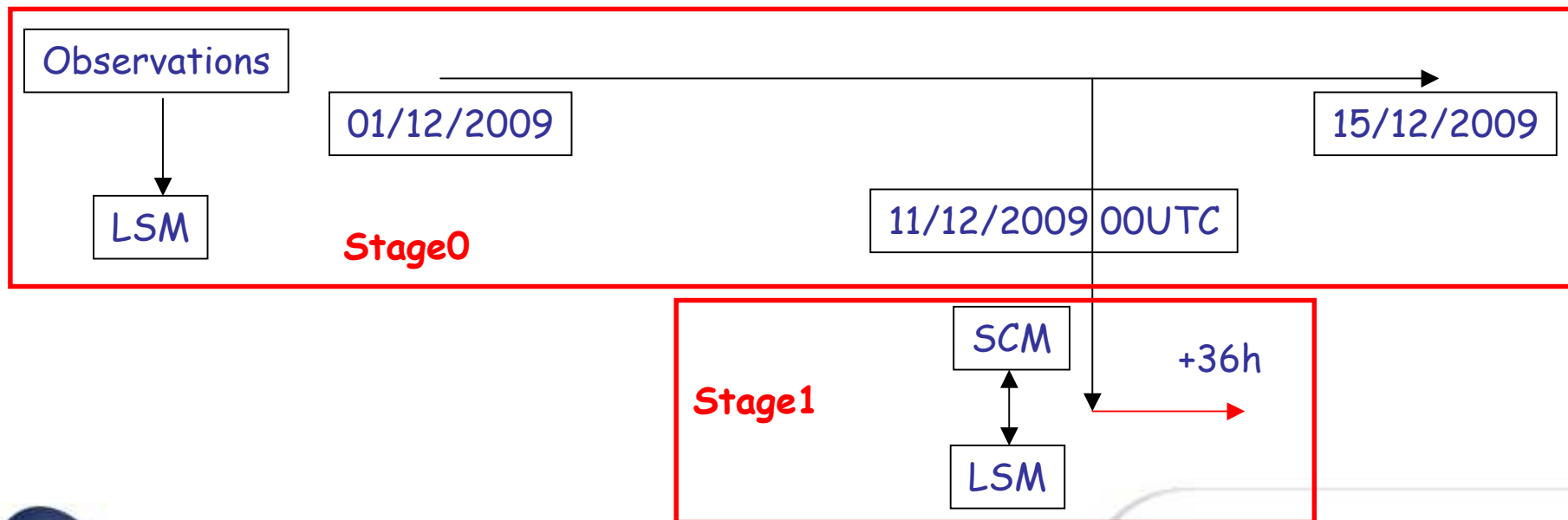
GABLS4 : Stage 0

- Tsurf from the LSM driven by observations. Differences $> 5^{\circ}\text{C}$



GABLS4 : Stage 1

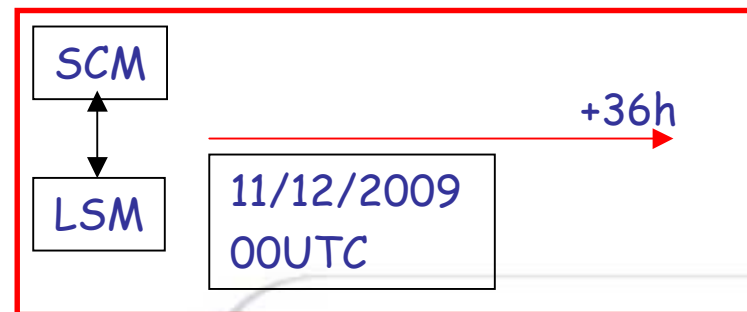
- For GABLS4 intercomparison, we follow the DICE experiment such as
 - Same NetCdf file with additional output :
 - **Stage 0: LSM forced by observations** (T, Rh, Ws, Wd, SWd, LWd,RR)
 - comparison of snow models during 15 days vs observed temperature profile, surface fluxes
 - Provide the soil initial conditions for stage 1 valid the 11th Dec 2009



GABLS4 : Stage 1

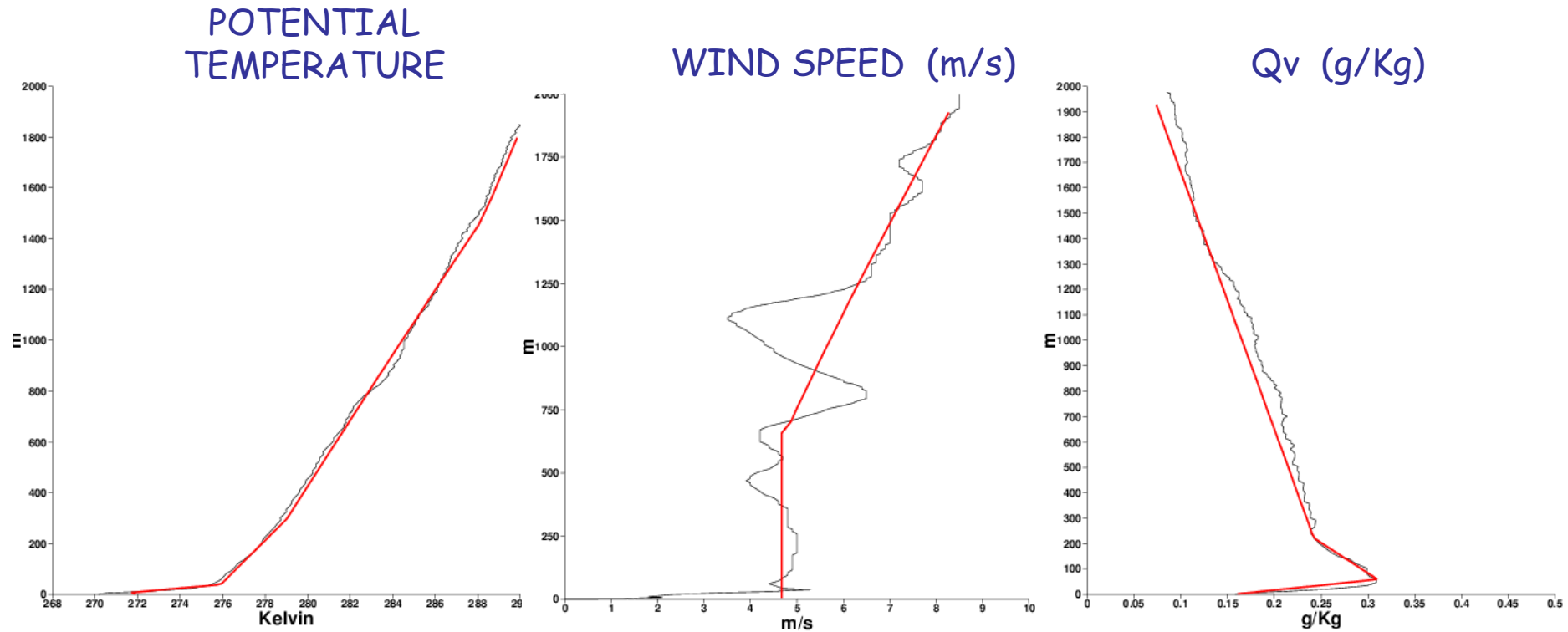
•Stage 1: SCM with the LSM used in Stage 0

- Date 11th December 2009 starting at 00UTC (→ +36h)
- Initial profile coming from the RS for T and Q , the wind is initialized with the geostrophic wind.
- Temperature and humidity advection (hourly)
- Geostrophic wind (hourly)
- Two options:
 - Stage 1a** : use the surface and soil initial conditions from stage 0 experiment.
 - Stage 1b**: use the given surface and soil initial conditions
 - LES are welcome**



GABLS4 : Stage1a and 1b

- Initial profile based on the radiosonde data but simplified (red)

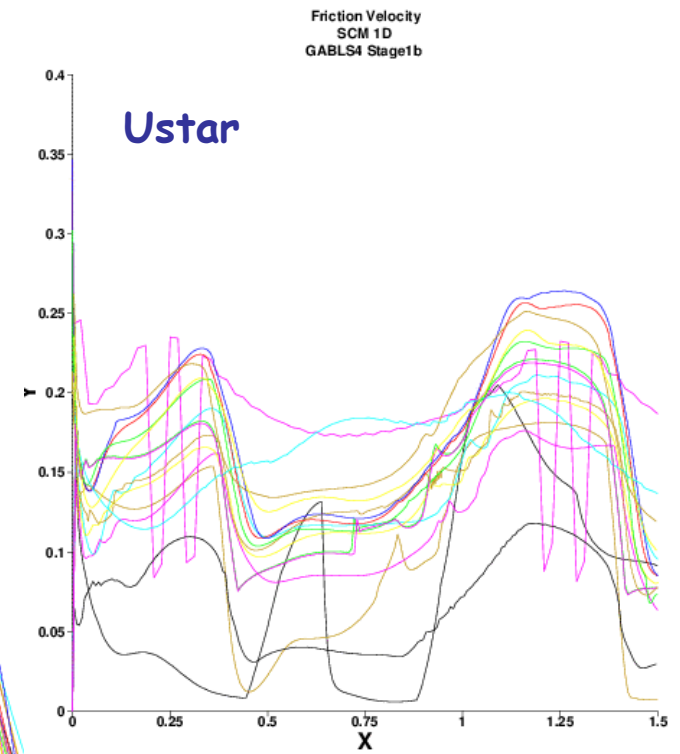
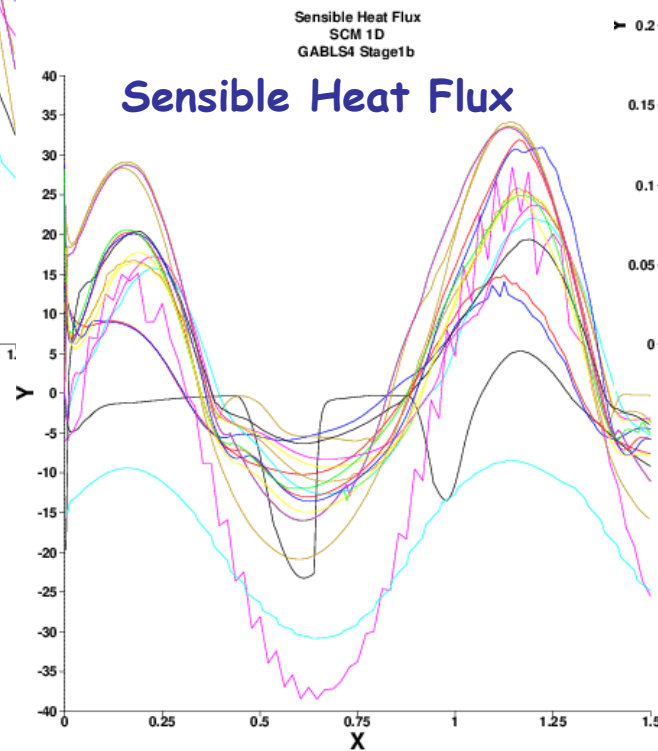
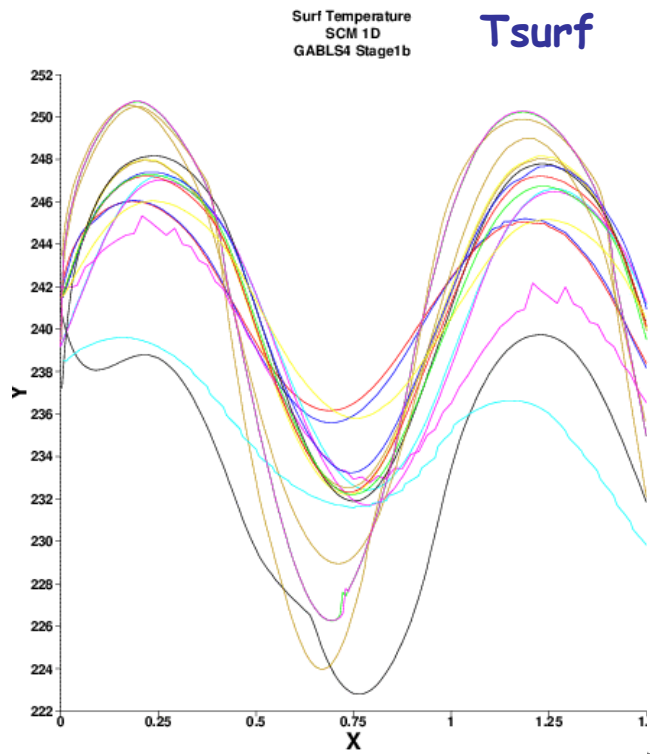


GABLS4 : Participants for SCM

Organization/model 1D	Stage1 (01/2015)	Stage2 (04/2015)	Stage3 (04/2015)	People
METOFFICE (Unified Model)	SCM	Not Yet	Not yet	John M. Edwards
Météo-France AROME	SCM	SCM	SCM	Eric Bazile
ARPEGE	SCM	SCM	SCM	Eric Bazile
ARPEGE-EFB	SCM	SCM	SCM	Eric Bazile
ARPEGE-CLIMAT	SCM	Not Yet	Not Yet	Isabelle Beau
LARC / CAM5-IPHOC	SCM	Not Yet	Not Yet	Anning Cheng (Nasa)
NCEP /GFS	SCM	Not Yet	Not Yet	Weizhong Zheng (NOAA)
CMC (Global version)	SCM	Not Yet	Not Yet	Ayrton Zadra (Canada)
ECMWF (38r2)	SCM	SCM	Not Yet	Irina Sandu
WRF	SCM	Not Yet	Not Yet	Wayne Angevine (CIRES/NOAA)
FMI HARMONIE	SCM	Not Yet	Not Yet	Carl Fortelius
HARMONIE-TTE	SCM	Not Yet	Not Yet	Carl Fortelius
LMD (France) LMDz	SCM	SCM	Not Yet	Etienne Vignon (LGGE)
WRF	SCM	Not Yet	Not Yet	Alex Schroth (U. of Delaware)
Univ. Illes Balears / Méso-Nh	SCM	Not Yet	Not Yet	Maria A. Jimenez
Wageningen Univ.	?	?	?	Gert-Jan Steeneveld & ??

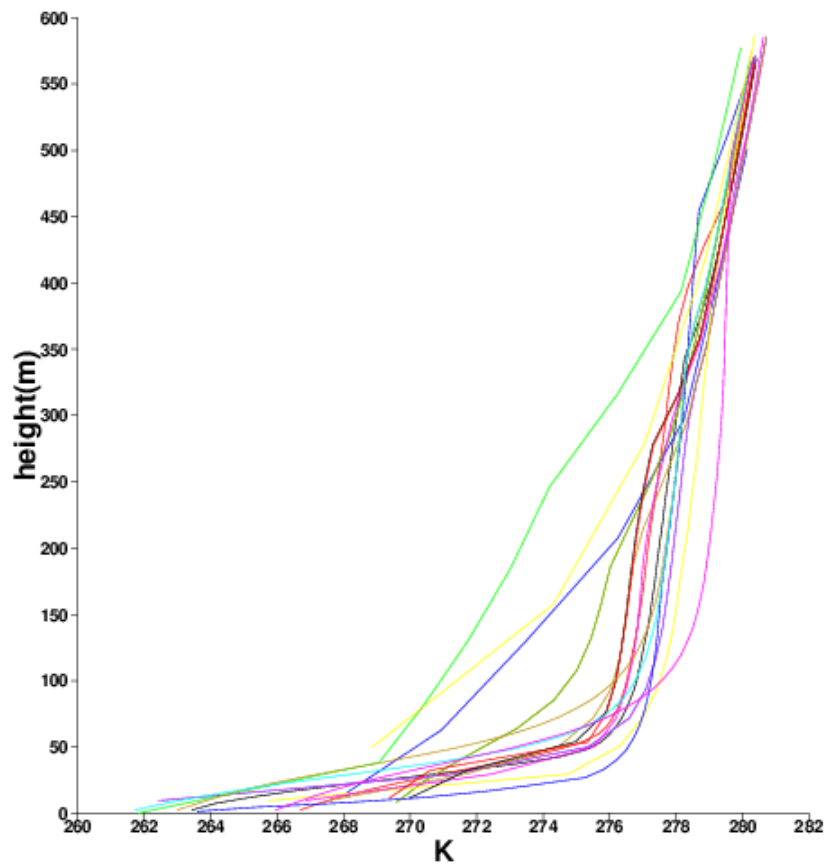


GABLS4 stage1b

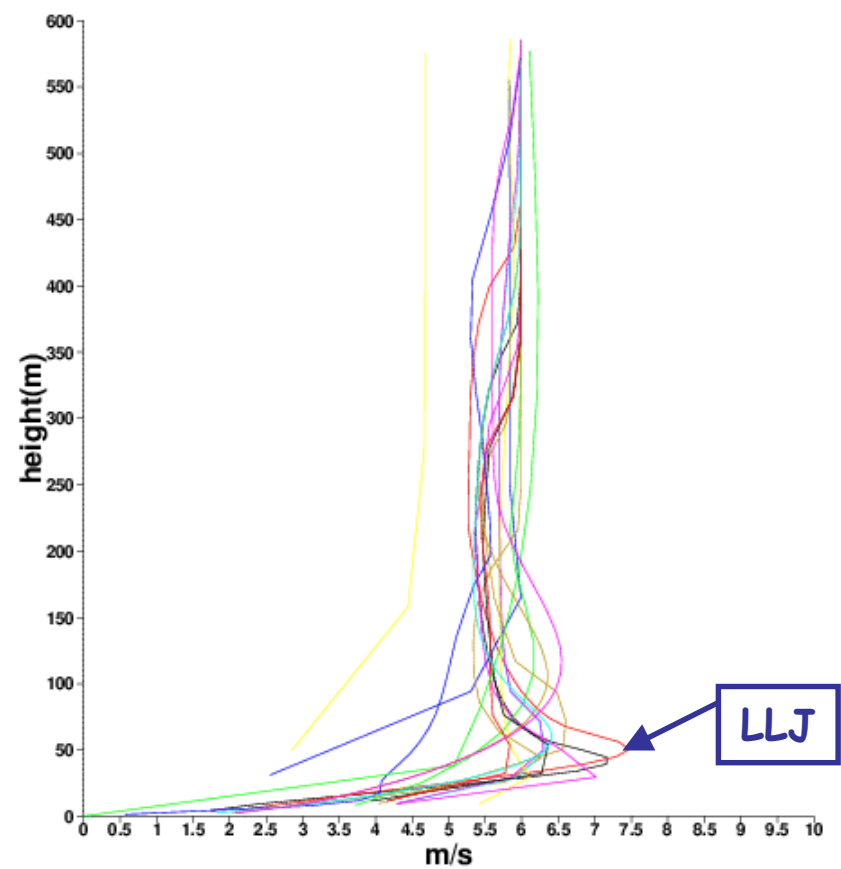


GABLS4 stage1b

Theta at 18TU



Wind Speed at 18TU



GABLS4 : Participants for LES/DNS

Organization/model 1D	Stage1 (01/2015)	Stage2 (04/2015)	Stage3 (04/2015)	People
Météo-France /Méso-NH/LES	yes	yes	Not Yet	Fleur Couvreur
Univ. Hannover / PALM	No	Not Yet	Yes	Bjorn Maronga
UCLA LES	No	Not yet	Not yet	Gorgios Matheou
Univ. of Praha / CLMM	?	?	?	Vladimir Fuka
Russian Academy of Sciences	?	?	?	Andrey Glazunov
Univ. of Eindhoven / DNS	No	Not yet	Not Yet	B.J.H. van de Wiel
MPI LES & DNS	No	Not yet	Not yet	Chiel van Heerwaarden & Bart van Stratum
Linne FLOW Center KTH Stockholm Exp. Algebraic	No	No	Not yet	G. Brethouwer W. Lazeroms
North California State Univ.	No	Not yet	Not Yet	Sukanta Basu



Acknowledgements

• The meteorological profiling observation program at Dome C which provides data for model evaluation / validation for GABLS4, is supported by IPEV (program CALVA), CNRS/INSU (program CLAPA) and OSUG (program CENACLAM). The IPY-CONCORDIASI program, supported by CNES, IPEV and CNRS, provided the rawinsonde data

• People responsible of the observations at DomeC and those who provided the data for the chosen period : Eric Aristidi (Laboratoire Lagrange, Université Nice Sophia Antipolis, France), Christian Lanconelli (ISAC/CNR, Italy), Ghislain Picard and Laurent Arnaud (LGGE, Grenoble, France), Andrea Pellegrini (ENEA, Italy) and Laura Ginoni. We also thanks Eric Brun (Météo-France, CNRM/GAME) and Irina Sandu (ECMWF) as a most valuable beta tester for the atmospheric forcing used in the SCM.

GABLS4 and DICE workshop

Toulouse 20-22 May 2015

This work is supported by the french national programme LEFE/INSU



GABLS-4 : GEWEX Atmospheric Boundary Layer Study

SCM/LSM and LES intercomparison at DomeC (Antarctic Plateau)

E. Bazile(1), F. Couvreux(1), P. Le Moigne(1), C. Genthon (2),

O. Traullé(1*), H. Barral(2), G. Canut(1), A.A.M. Holtslag(3), G. Svensson(4) and T. Vihma(5)

1) Météo-France, CNRM/GAME, Toulouse, France (eric.bazile@meteo.fr)

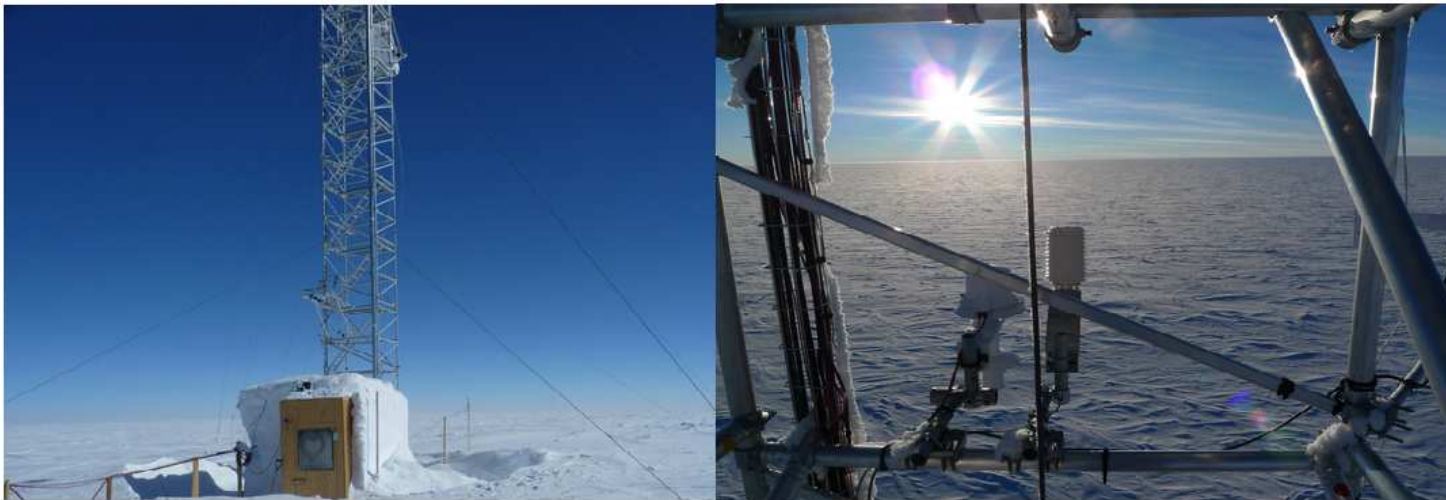
1* currently at IPEV (Dumont d'Urville)

(2) LGGE UMR 5183, Grenoble 38401 France,

(3) Meteorology and Air Quality Section, Wageningen University, the Netherlands,

(4) Department of Meteorology and Bert Bolin Centre for Climate Research, Stockholm University, Stockholm

(5) Finnish Meteorological Institute, Helsinki, Finland,



From O. Traullé (left) and E. Brun (right)

Introduction :



GABLS-4 : GEWEX Atmospheric Boundary Layer Study

SCM/LSM and LES intercomparison at DomeC (Antarctic Plateau)

E. Bazile(1), F. Couvreux(1), P. Le Moigne(1), C. Genthon (2),

O. Traullé(1*), H. Barral(2), G. Canut(1), A.A.M. Holtslag(3), G. Svensson(4) and T. Vihma(5)

1) Météo-France, CNRM/GAME, Toulouse, France (eric.bazile@meteo.fr)

1* currently at IPEV (Dumont d'Urville)

(2) LGGE UMR 5183, Grenoble 38401 France,

(3) Meteorology and Air Quality Section, Wageningen University, the Netherlands,

(4) Department of Meteorology and Bert Bolin Centre for Climate Research, Stockholm University, Stockholm

(5) Finnish Meteorological Institute, Helsinki, Finland,



- If you intend to participate contact : eric.bazile@meteo.fr
- For specific questions related to:
 - stage 0 and LSM: Patrick.LeMoigne@meteo.fr
 - LES: Fleur.Couvreux@meteo.fr