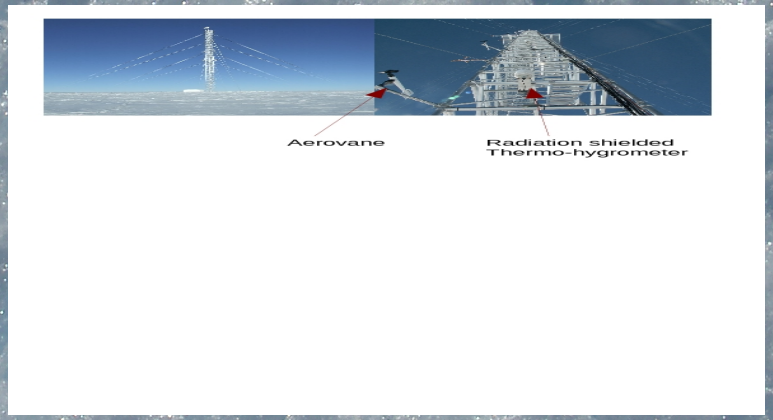
The extreme Antarctic atmospheric boundary layer(s):

Two years of continuous lower atmospheric boundary layer observation at Dome C, Antarctic plateau



Christophe Genthon, Delphine Six, Vincent Favier, Hubert Gallée
Laboratoire de Glaciologie et Géophysique de l'Environnement
CNRS/UJF, Grenoble, France

Olivier Traullé, CNRM, Météo-France, Toulouse, France

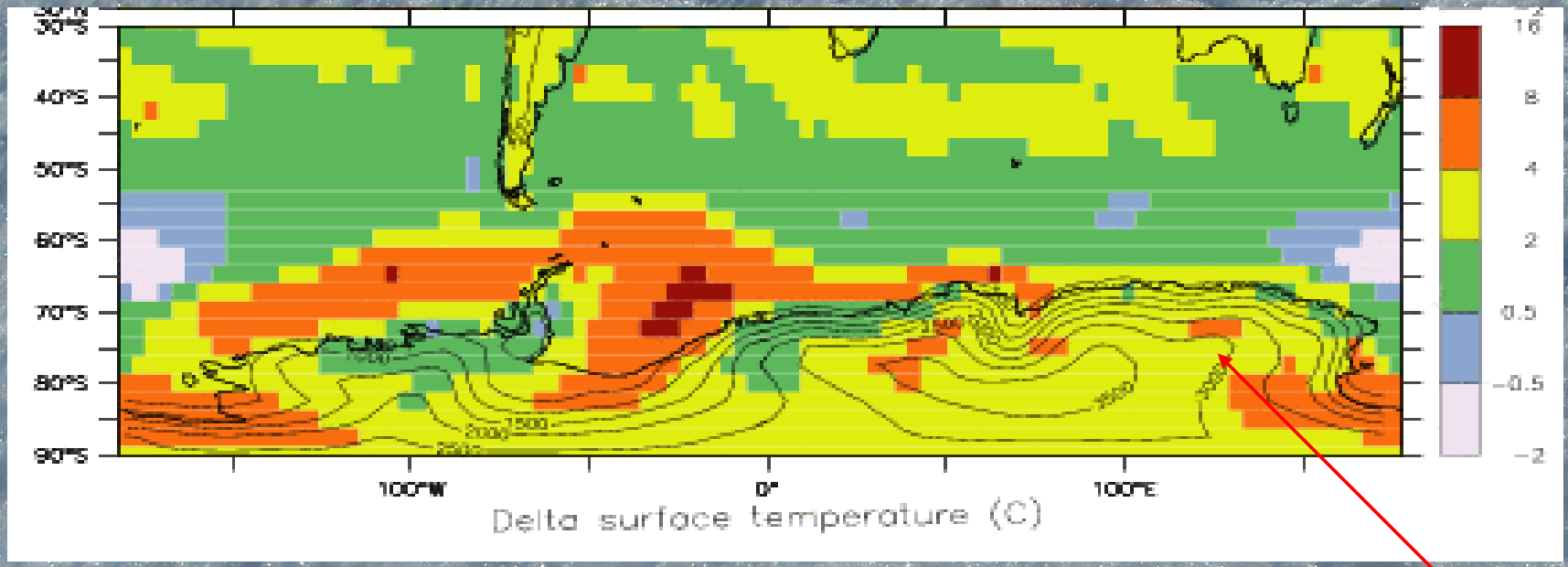
Eric Aristidi, LUAN, Nice France

Climate Change 2007: Working Group I: The Physical Science Basis

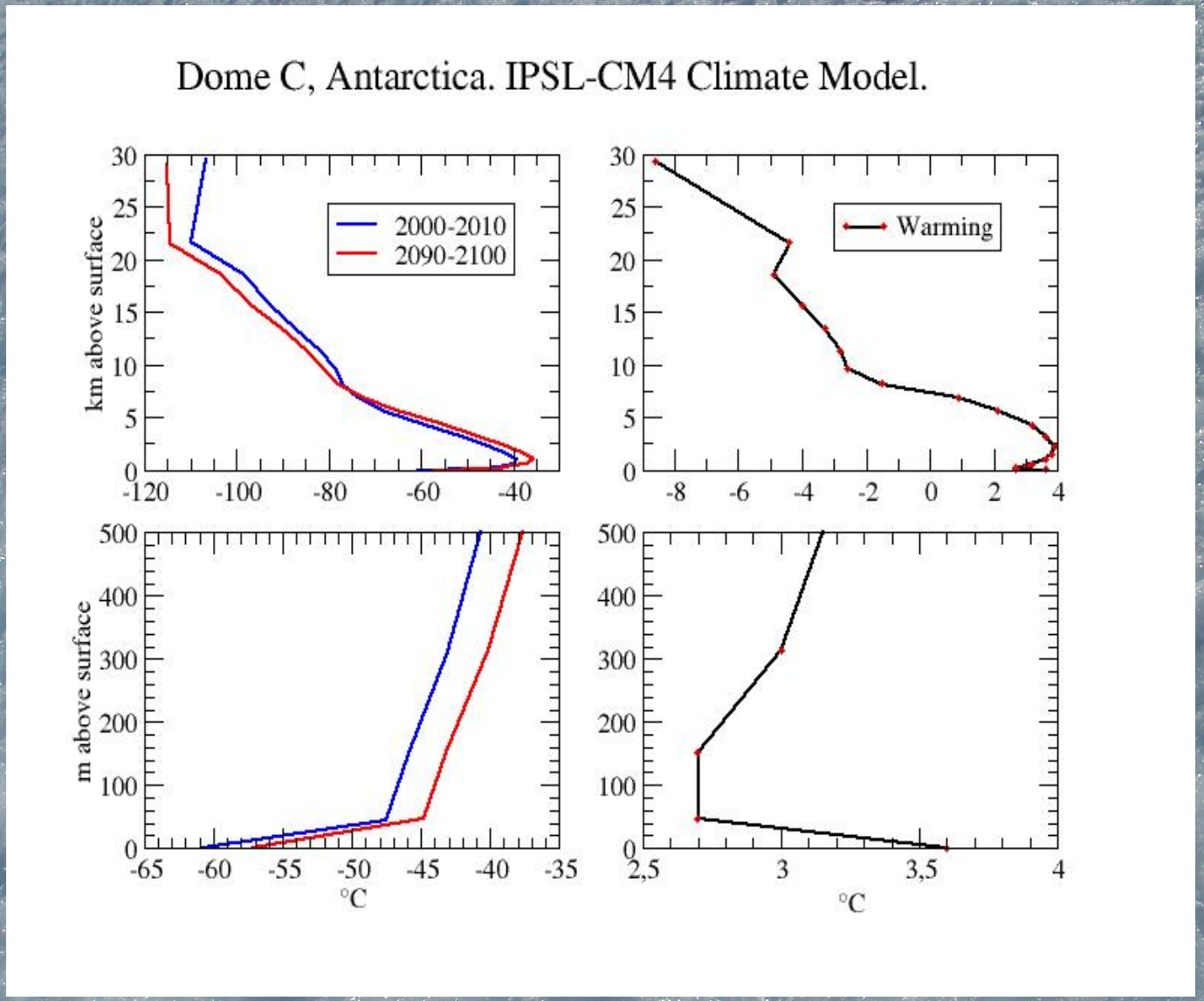
Chapter 11: Regional Climate Projections

11.8 Polar Regions

« ... Processes that are not particularly well represented
in the models are clouds, ***planetary boundary layer processes*** and sea ice... »



Predicted surface warming in winter, 2090/2100 minus 2000/2010
IPSLCM4 (IPCC AR4) earth system model model



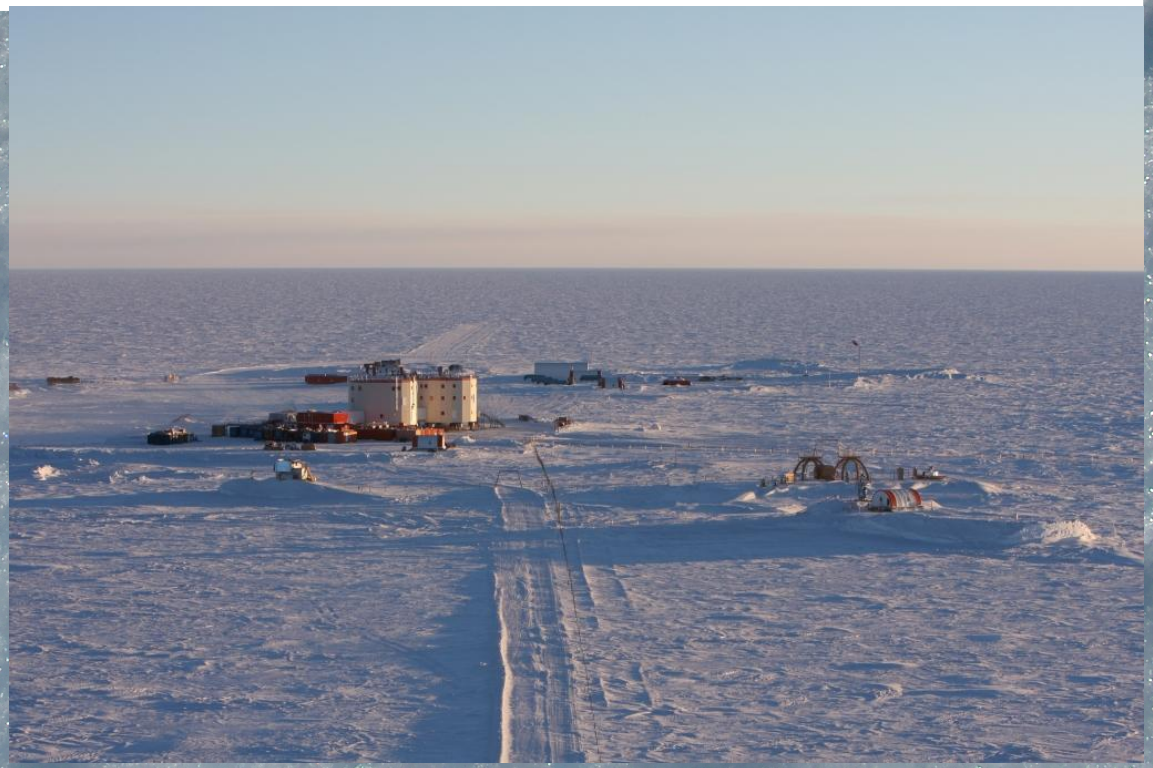
Vertical profile of the winter temperature change, Dome C, Antarctica

Dome C, Antarctica

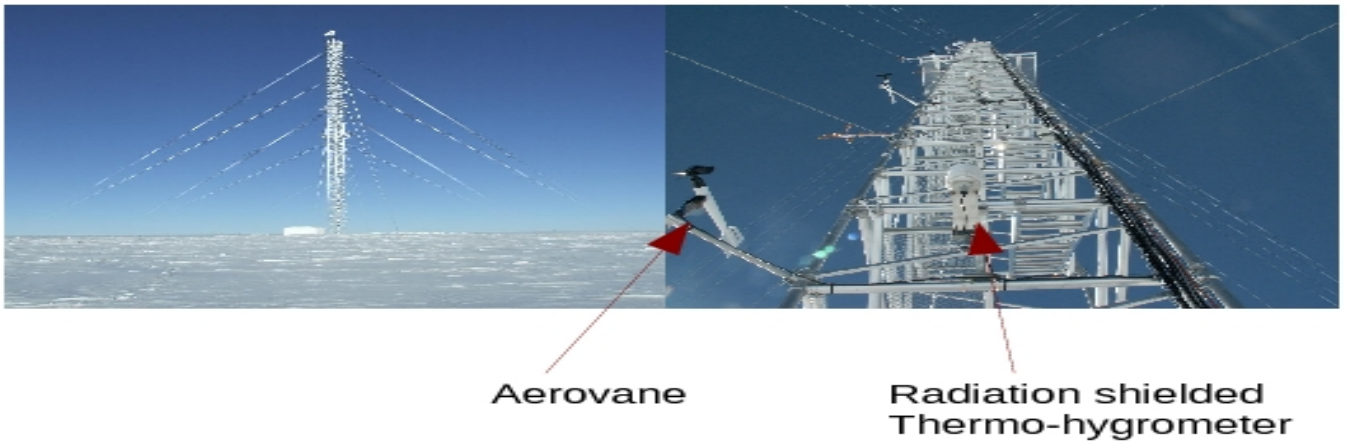
Latitude 75°06.06S Longitude 123°20.74E Altitude 3350m

A permanent station, Concordia, jointly operated by the French and Italian polar institutes (IPEV, PNRA)

Dome C selected as a « special site » for CLMIP5 / IPCC AR5

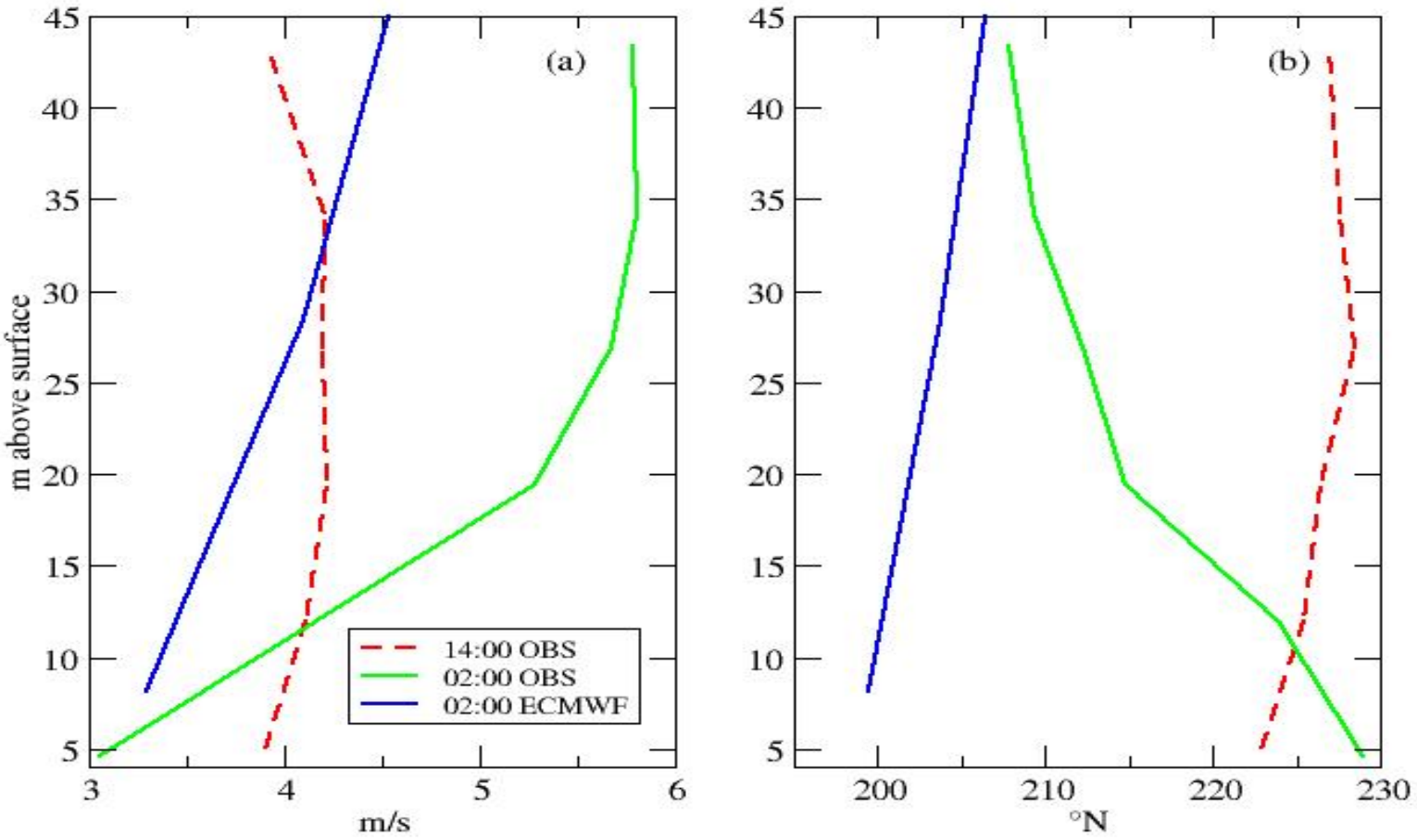


The Concordia permanent station at DomeC



The 45-m tower at Dome C : A unique facility on the plateau

A continuous surface atmospheric boundary layer profiling system, 4 to 44 m above surface, since January 2008

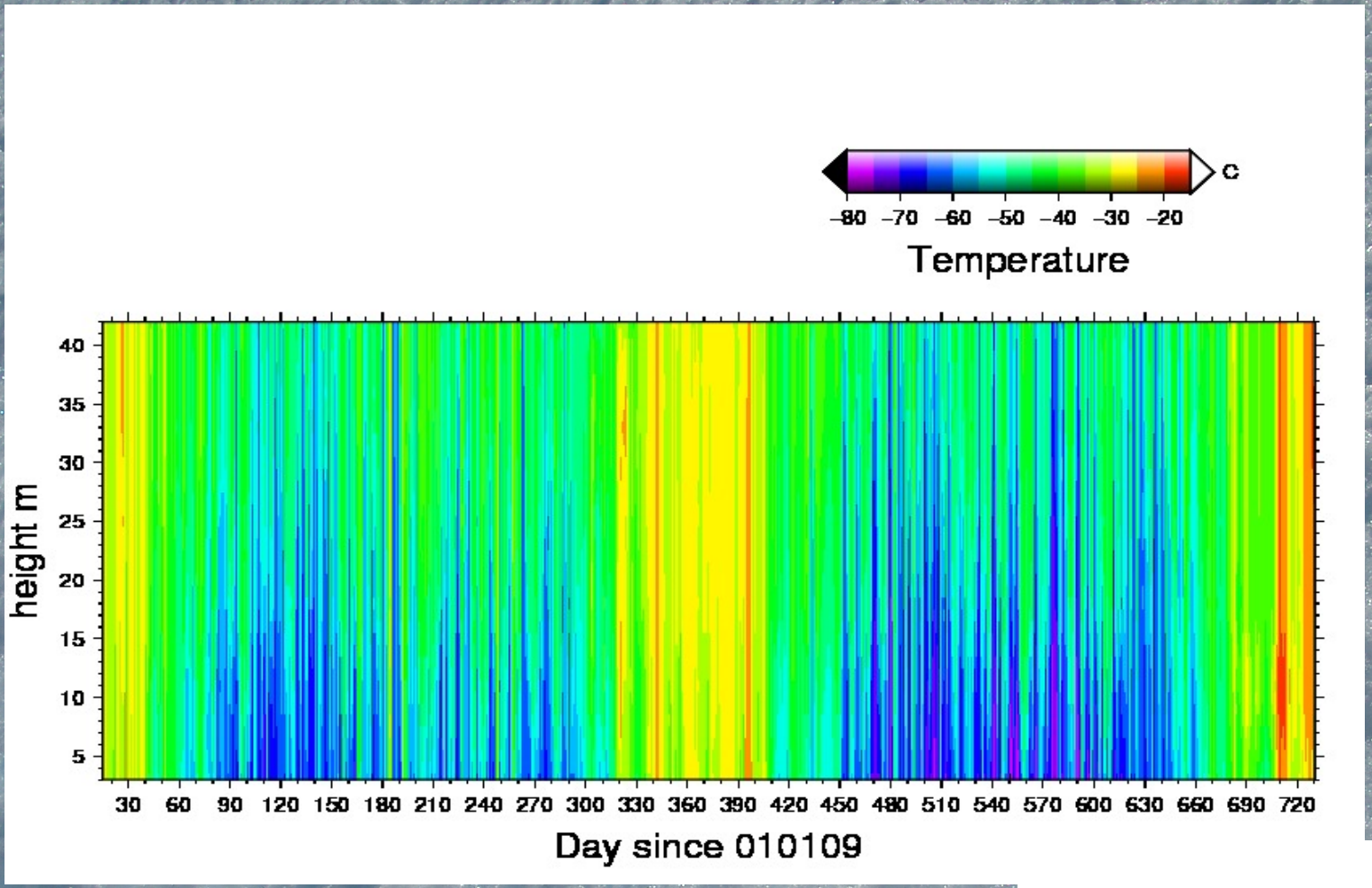


Observed (tower) and analyzed (ECMWF) mean wind profile, January 2008

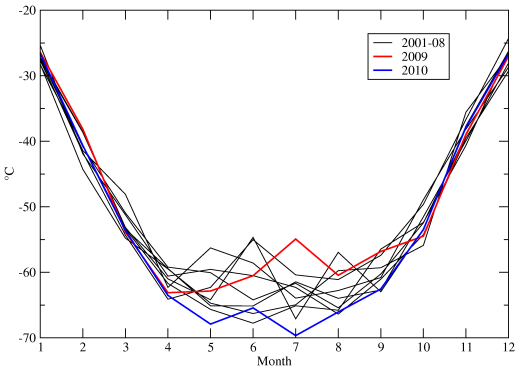
- But this is a tough environment for (men and) instruments : Deep freeze, frost deposition...

-The 2008 recording stopped short in the winter

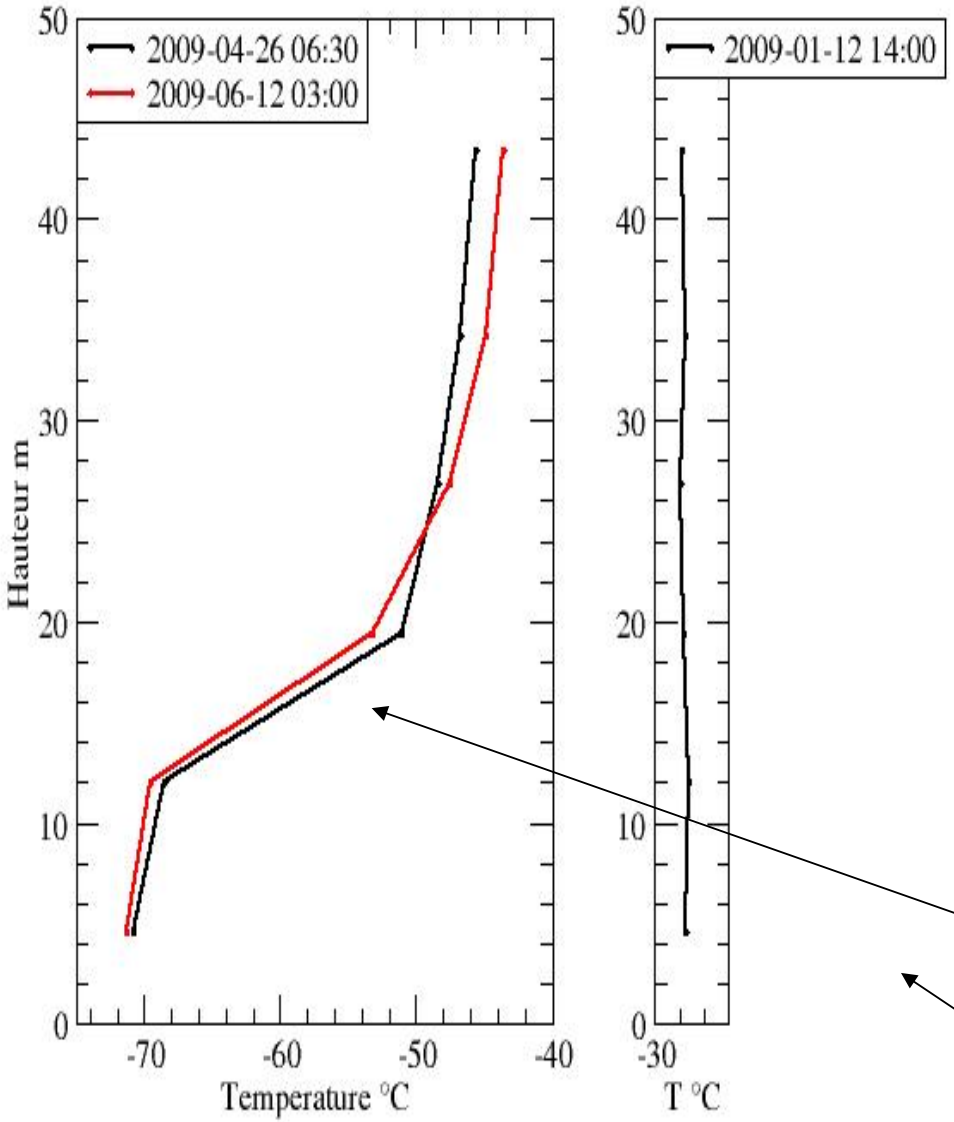
- Some improvements during the 2009 field season =>...

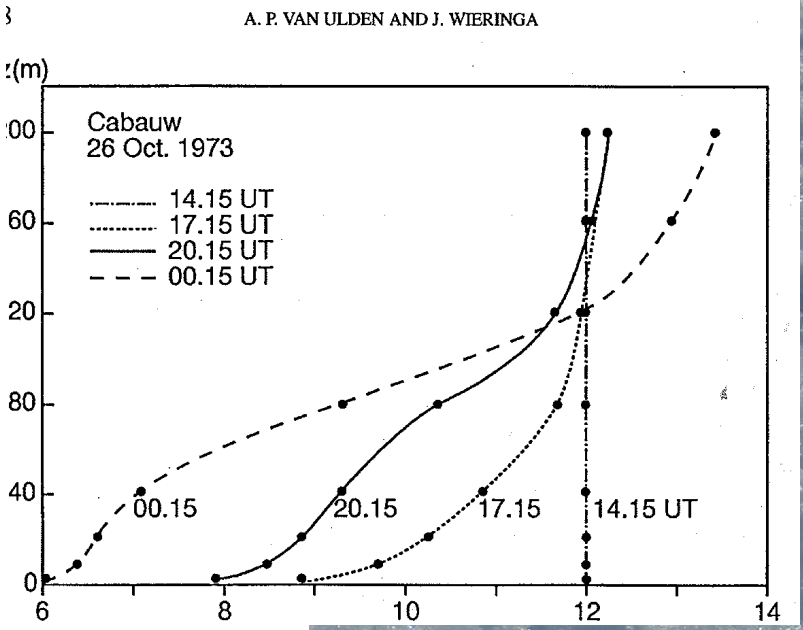


Température 2009-2010



AMRC AWS
2001-2010



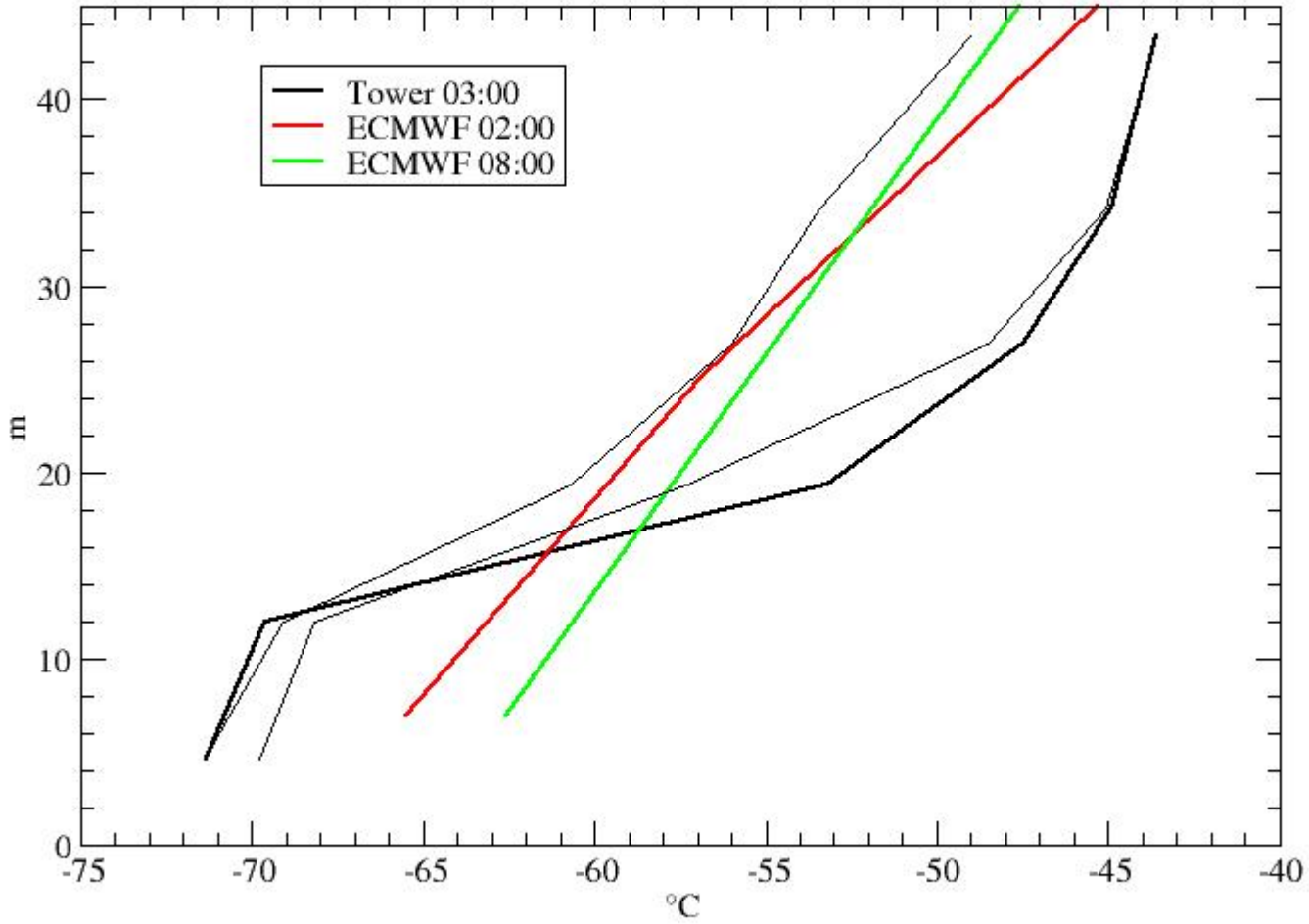


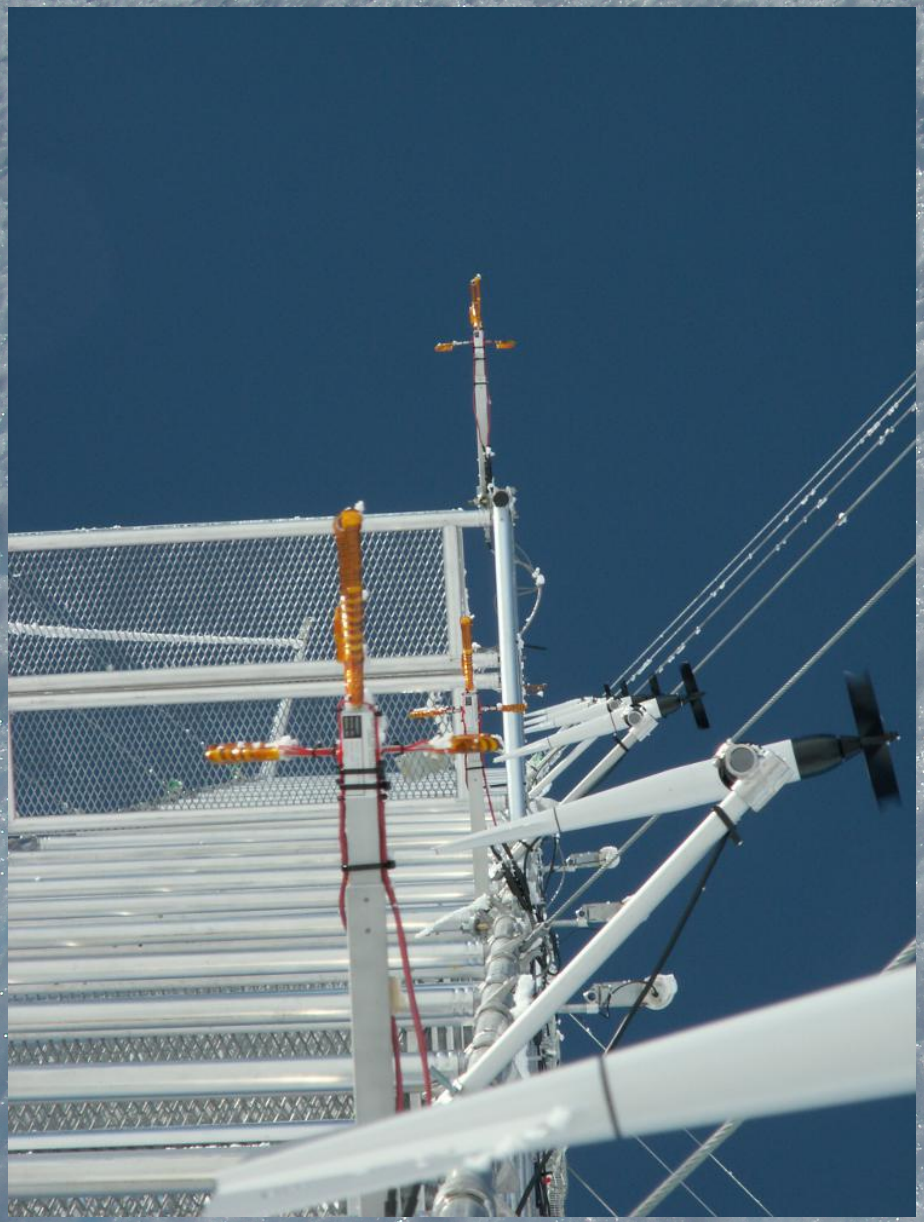
Cabaw, Oct 1973

The most extreme inversions In 2009 winter
More than 2°C / m locally

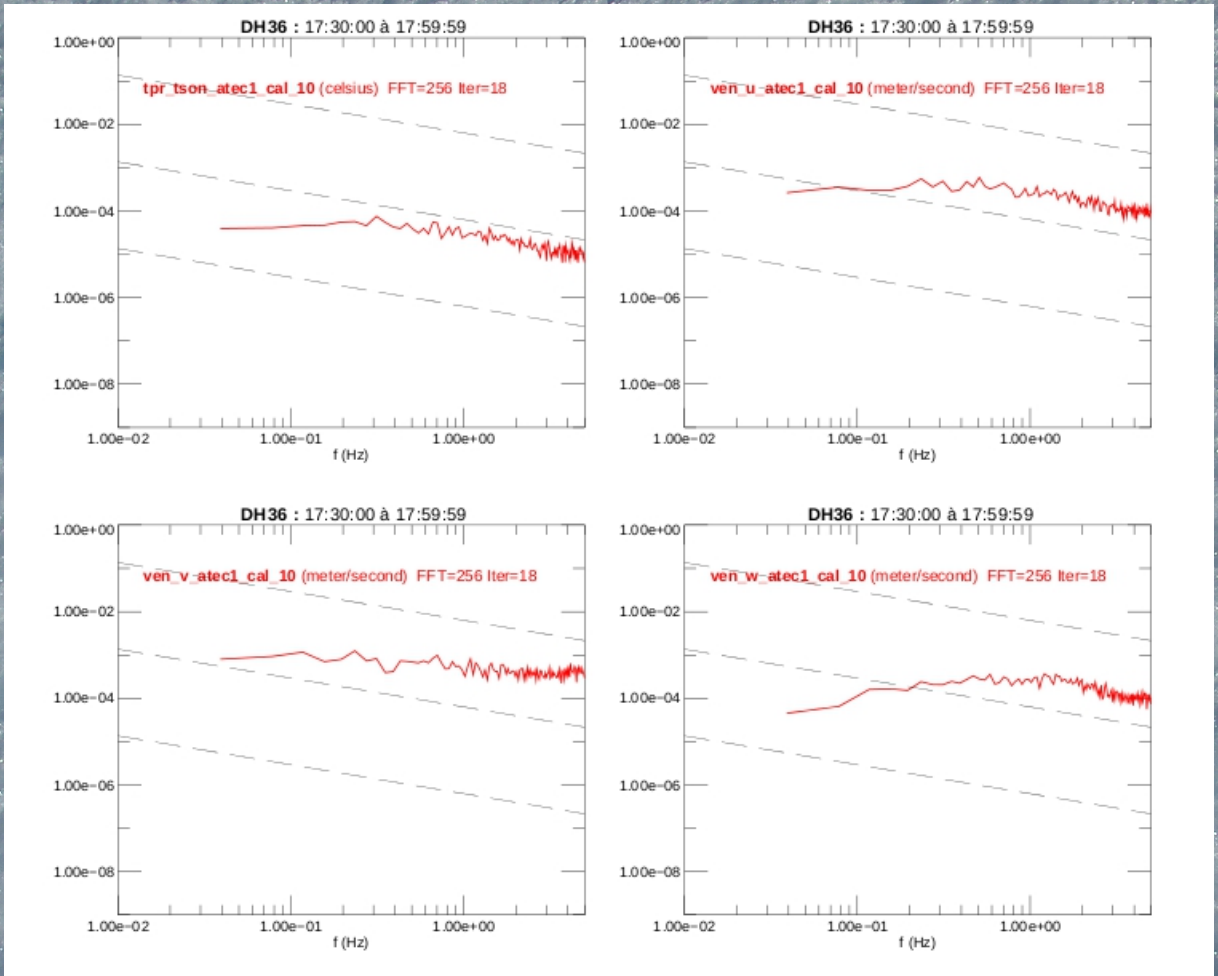
No inversion (convective mixing) in the summer mid-day

12 June 2009 early morning

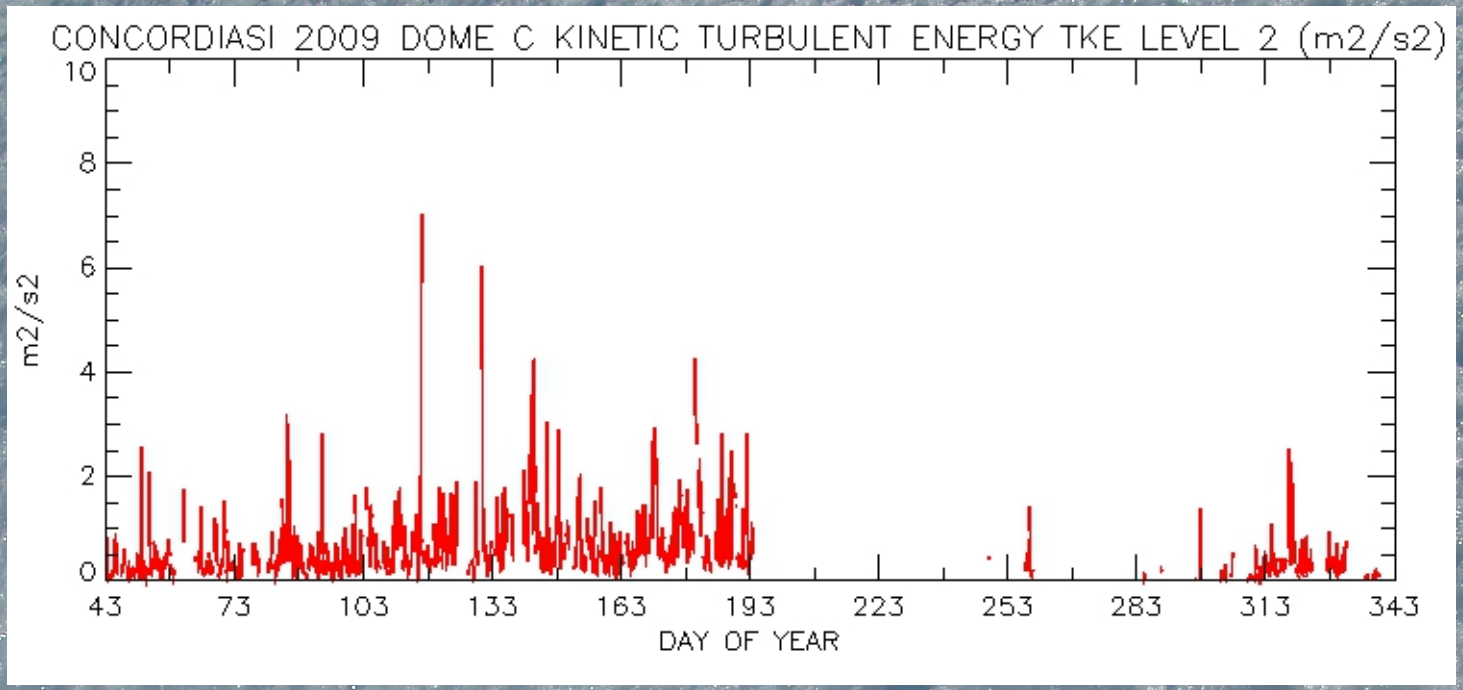


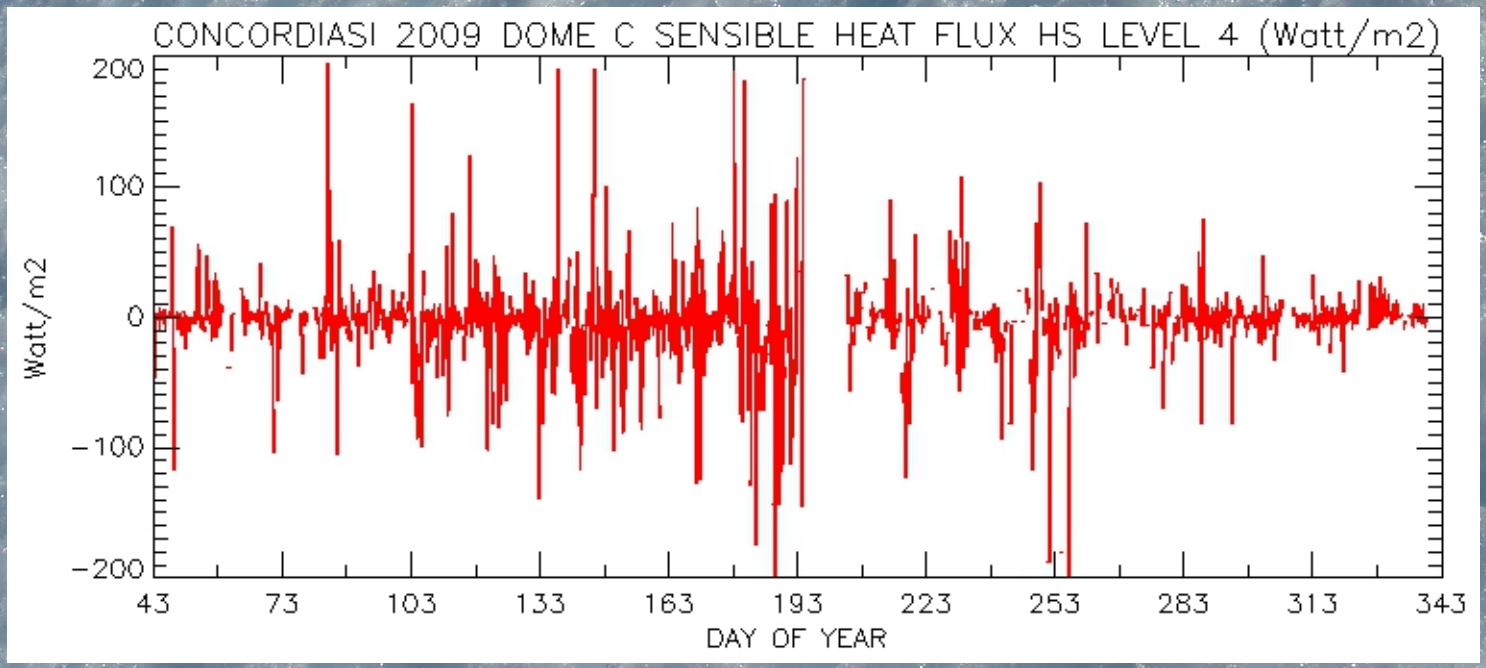


There are also sonic anemo-thermometres on the tower

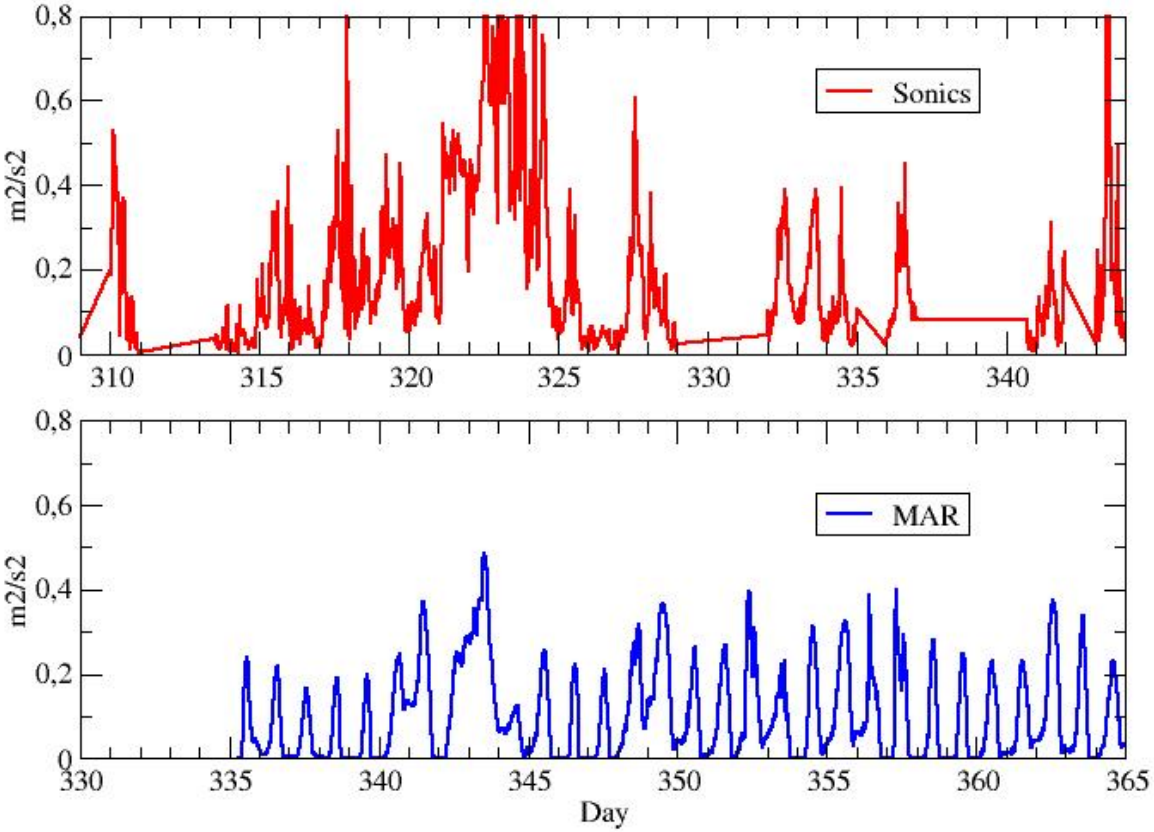


- Power spectral density in agreement with Kolmogorov scaling (5/3)
- But a lot of « corrupt » data => Filtering / correcting essential (O. Traullé)


CONCORDIASI 2009 DOME C KINETIC TURBULENT ENERGY TKE LEVEL 2 (m2/s2)
m2/s2
0
2
4
6
8
10
43
73
103
133
163
193
223
253
283
313
343
DAY OF YEAR


CONCORDIASI 2009 DOME C SENSIBLE HEAT FLUX HS LEVEL 4 (Watt/m2)
Watt/m2
200
100
0
−100
−200
43
73
103
133
163
193
223
253
283
313
343
DAY OF YEAR

Meteorological / climate model evaluation / validation for “extreme polar BL (Dome C special site for CMIP5 / IPCC 5)



(See talk by H. gallée on DC boundary layer modeling with MAR)

Antarctic atmospheric boundary layers are also extreme at the coasts : Katabatic winds

See talks on blowing snow observing campaign and modelling by H. Gallée et al., A. Trouvilliez et al.

Meteorological observation at the coast (Adélie Land) is by no means easier than on the plateau

- Boundary layers are extreme in Antarctica

- A continuous BL profiling system is operated on a 45-m tower at Dome C, Antarctic plateau

- Extreme inversions exceeding 2° / m have been observed

- A full range of boundary layer cases have been sampled, from convective to strongly stable

- A range of instruments / observation are available including sonic thermo-anemometers

- Ideal for model robustness evaluation / validation (homogeneous terrain, relatively flat surface) and to address IPCC concerns in polar regions => Dome C on of the list of « special sites » for CLMIP5 / IPCC5

- Observation are distributed as they are published. After 2009-10 winter data published they will be continuously distributed: http://lgge.osug.fr/~christo/calva/home.shtml (site development in progress)

- Summer 2008 analysed and published (JGR), data distributed

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