



Concordia Astronomy Up-date, June 2007

ARENA sub-mm workshop, Saclay

Er*c Fossat

LUAN





Quelques éléments de logistique

Transport humain: Hercule C130 + Twin-Otter en début de saison de New Zealand à Zuccheli

Astrolabe + Twin-Otter plus tard depuis Hobart par DDU

Twin-Otter + astrolabe au retour

Transport du matos: convois de Bulls depuis DDU

440 T par an, dont la moitié de fuel!!!

Puissance sur place: ~120 kW

Télécomms: dérisoire (50kB et pas en permanence)



How to support Astronomical facilities at Dome C



McMurdo

**Concordia Station
Dome C**

Mid Point

D-85

**Mario Zucchelli
Station
Baia Terra Nova**

C-3

**D-10
Dumont d'Urville**





about the site

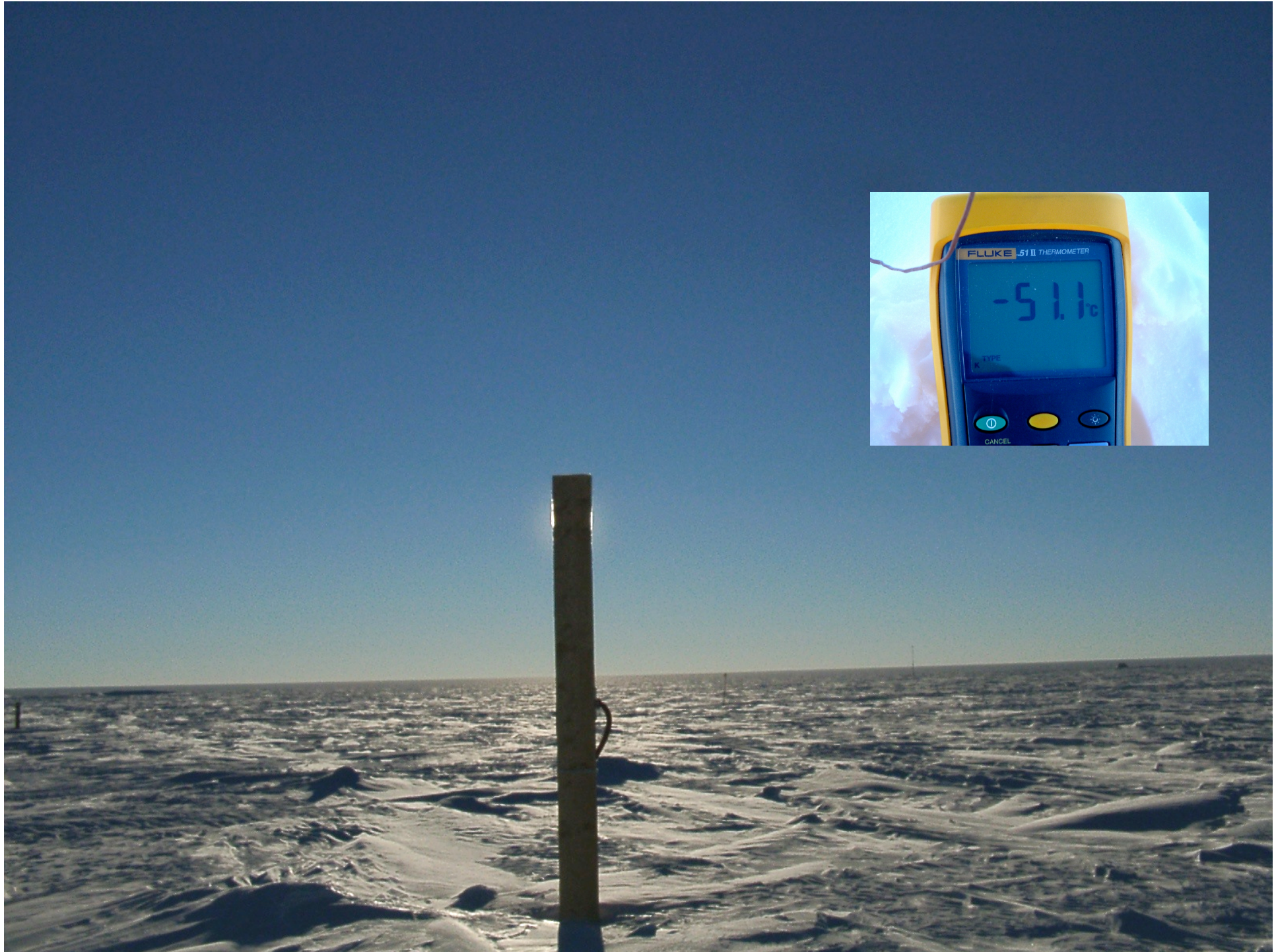
- Cold
- High
- Dry
- → Infra-red
- Long days and long nights
- → Long integration photometry
- Low sky background, all wavelengths
- And daytime sky, absolutely unique

A roadmap to ambitious projects (ARENA)

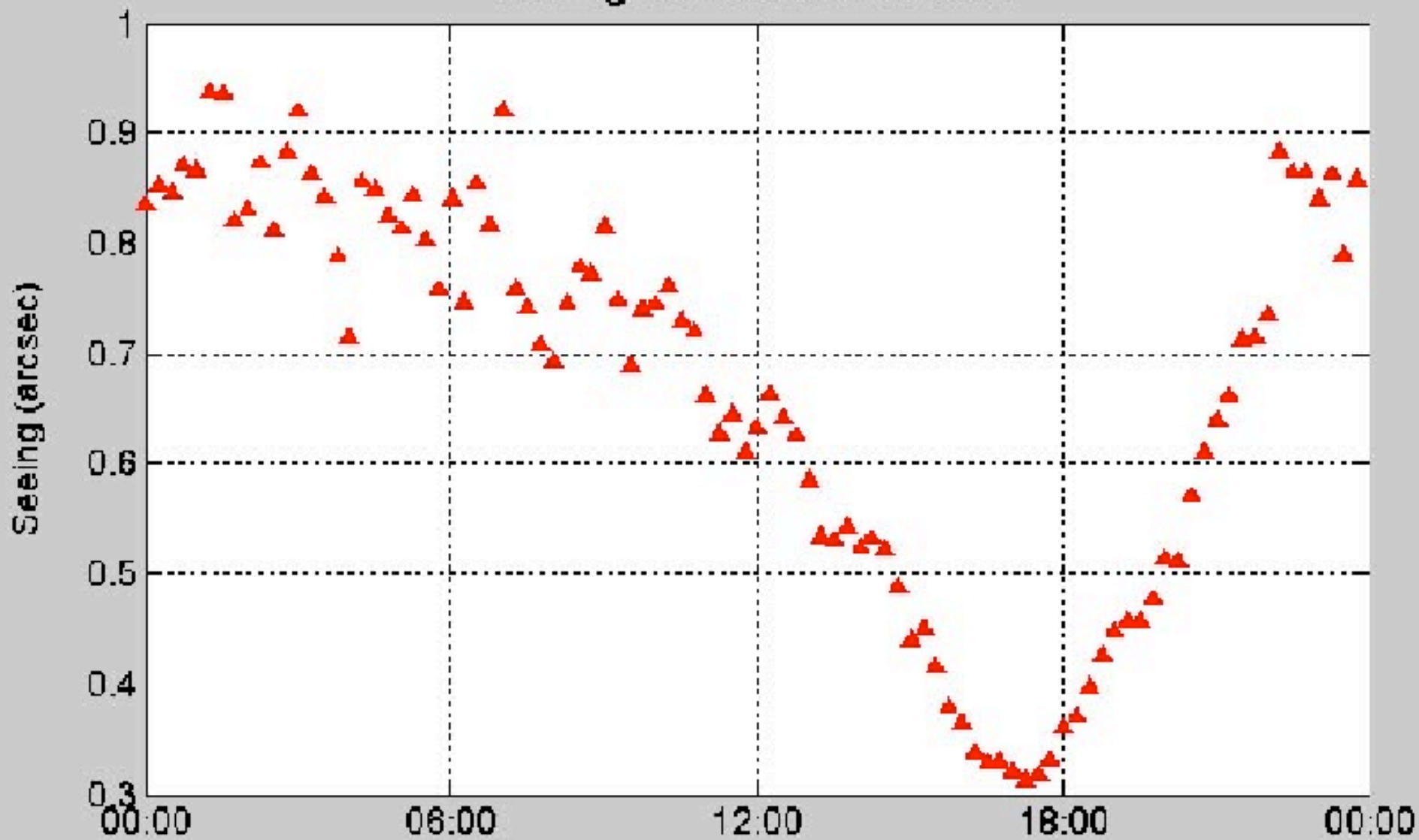
- 1. Solar Astronomy
- 2. Long integration photometry
- 3. Wide field infrared imaging
- 4. High Angular Resolution
- 5. Cosmology, mm and sub-mm

Solar Astronomy

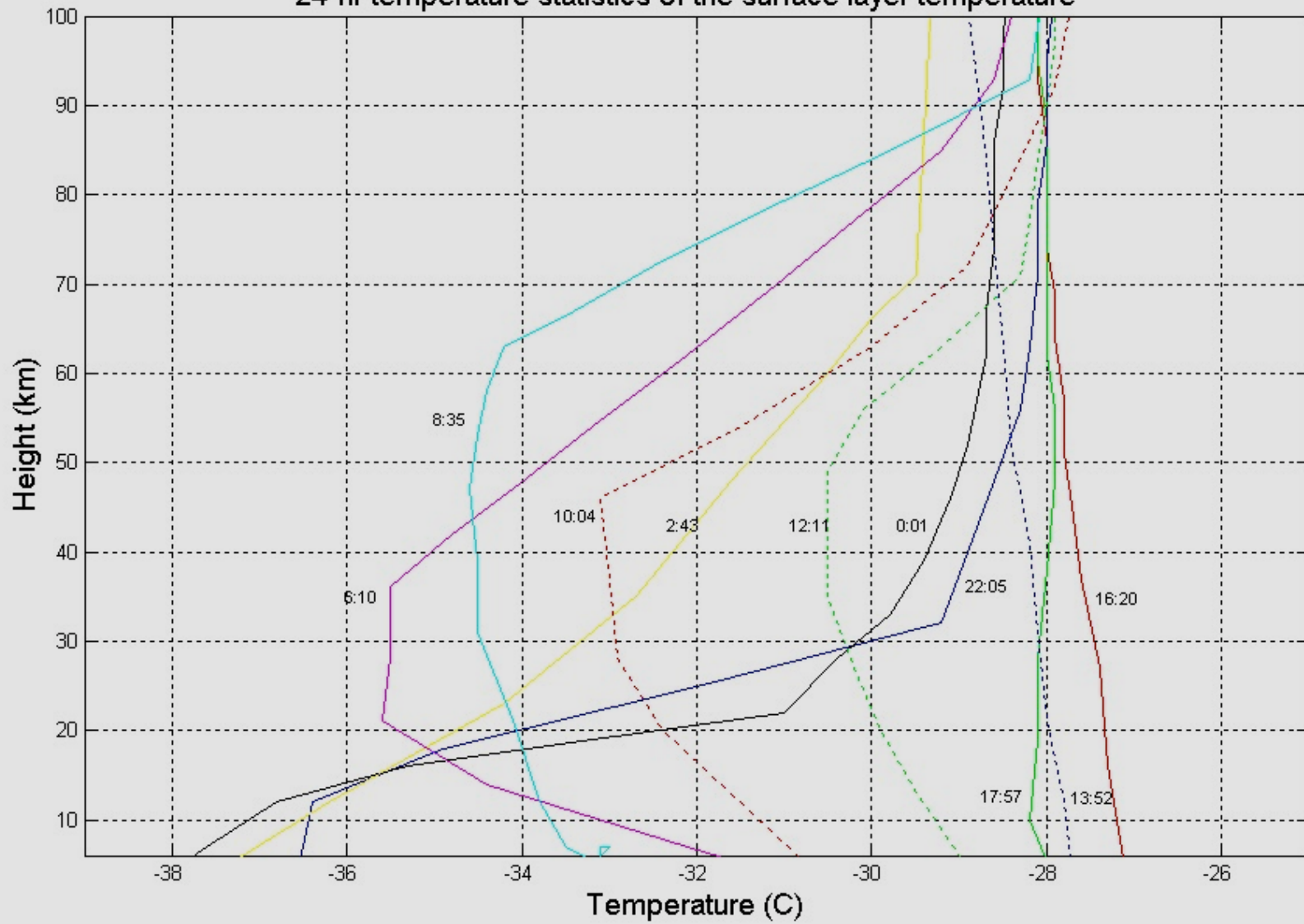
- Once or twice per summer, 2-weeks non stop of coronal sky
- Fantastic seeing, averaging 0.3 arcsec, every day at the same predefined time, 5 pm.
- Science: magnetic fields in solar corona
- Site testing to come: coronal sky quality test
- Coronagraph project
- To be seriously compared to all existing projects, in space and on the ground



Seeing as function of time



24-hr temperature statistics of the surface layer temperature



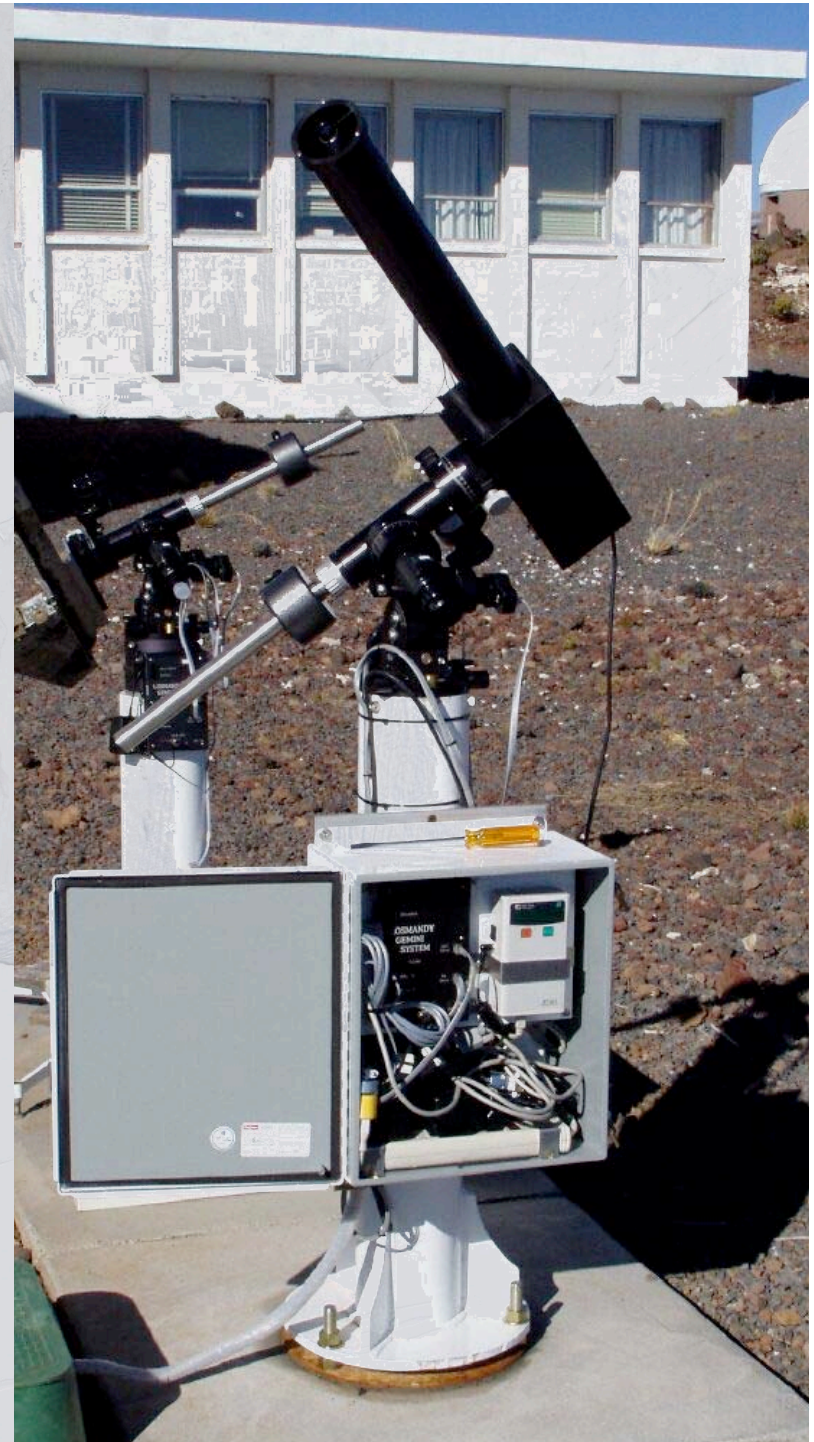
The Sky Brightness Monitor (SBM)

The SBM was built for ATST site testing

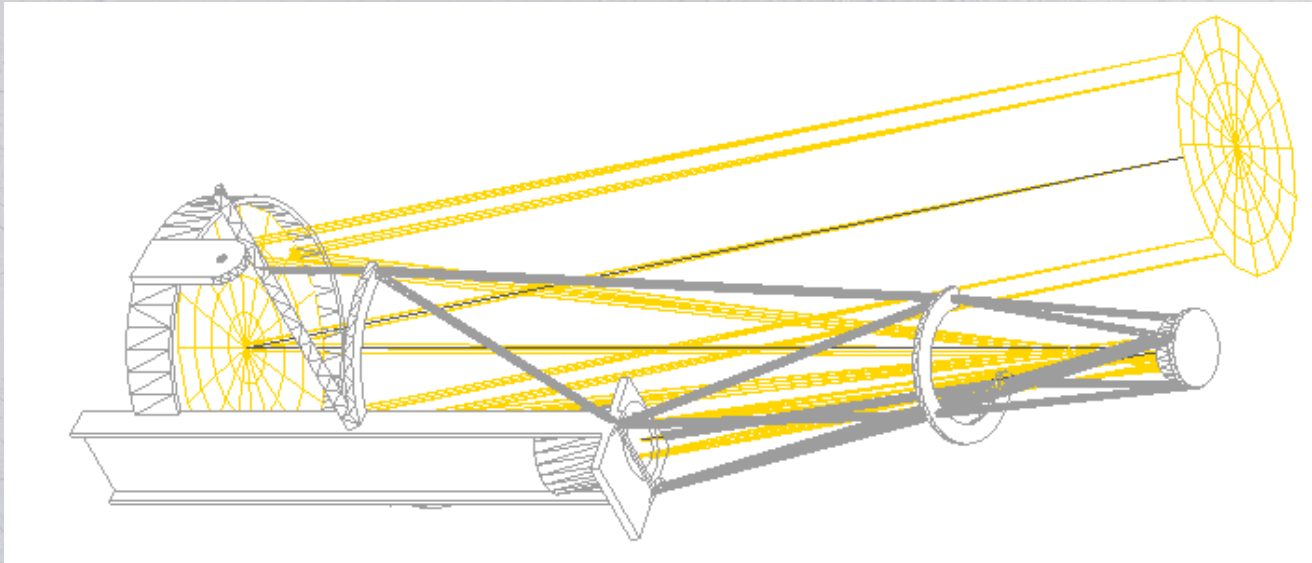
It is a small, automated, externally occulted coronagraph which measures the sky brightness from $4 R_{\text{sol}}$ to $8 R_{\text{sol}}$ from the blue to the near IR.

It will allow direct comparison between Dôme C and the ATST site in terms of coronagraphic quality.

An SBM will be in use at Dome C during the summer 2007/2008 to quantitatively qualify the site.



The coronagraph project



A 50 cm class apodized refracting coronagraph will take advantage of Dome C daytime seeing to image the inner corona with an unprecedented spatial resolution (0.3 arcsec).

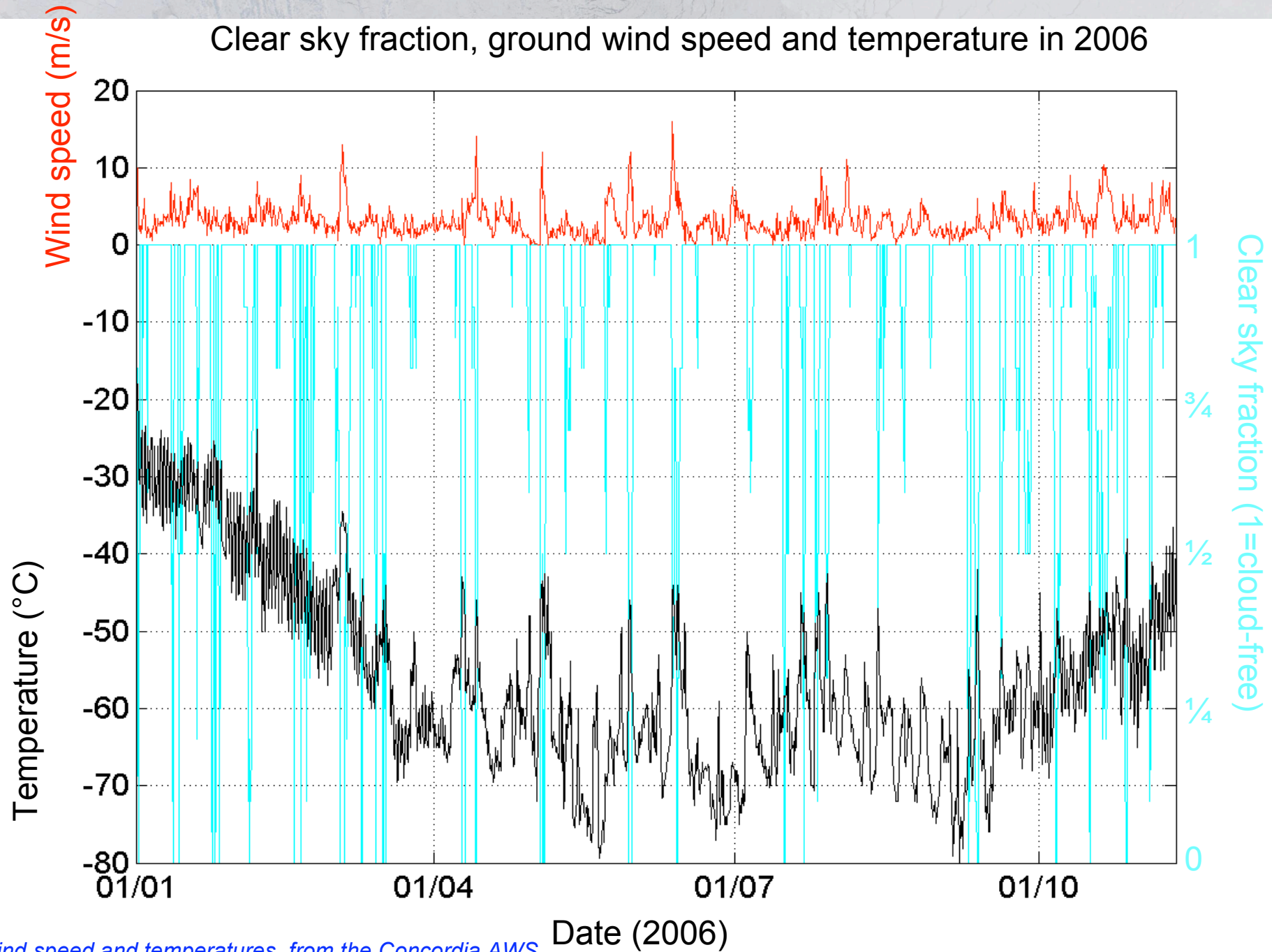
Stokes polarimetry in near IR emission lines will give access to coronal magnetic fields in the very low corona, above active regions, with an excellent spatial resolution (~ 1 arcsec). Such observations are needed to understand the physics of the corona and predict coronal activity which affects earth environment.

High resolution disc observations will also be performed.

Night time long term photometry

- At night a star remains 90% out of clouds
- The scintillation is reduced (by a factor 2.5 to 3.5 in amplitude)
- Science = exoplanet transits and asteroseismology
- A-STEP (Corot-like) to be operated in 2009
- Possibly Ice-T in 2013
- Meanwhile, several precursors: PAIX, Mini-Irait, Star Photometer
- Possible extension to spectroscopy (Siamois)

Clear sky fraction, ground wind speed and temperature in 2006

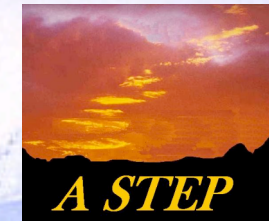


Wind speed and temperatures from the Concordia AWS
meteo station (courtesy L. Agnoletto/A. Pellegrini)



A STEP

Antarctica Search for Transiting Extrasolar Planets



F. Fressin, T. Guillot

Y. Rabbia, A. Blazit, JP. Rivet, J. Gay, D. Albanese, V. Morello, N. Crouzer (OCA - Nice),

*F.X. Schmider, K. Agabi, J-B. Daban, E. Fossat,
L. Abe, C. Combier, F. Janneaux, Y. Fantei (LUAN - Nice)*

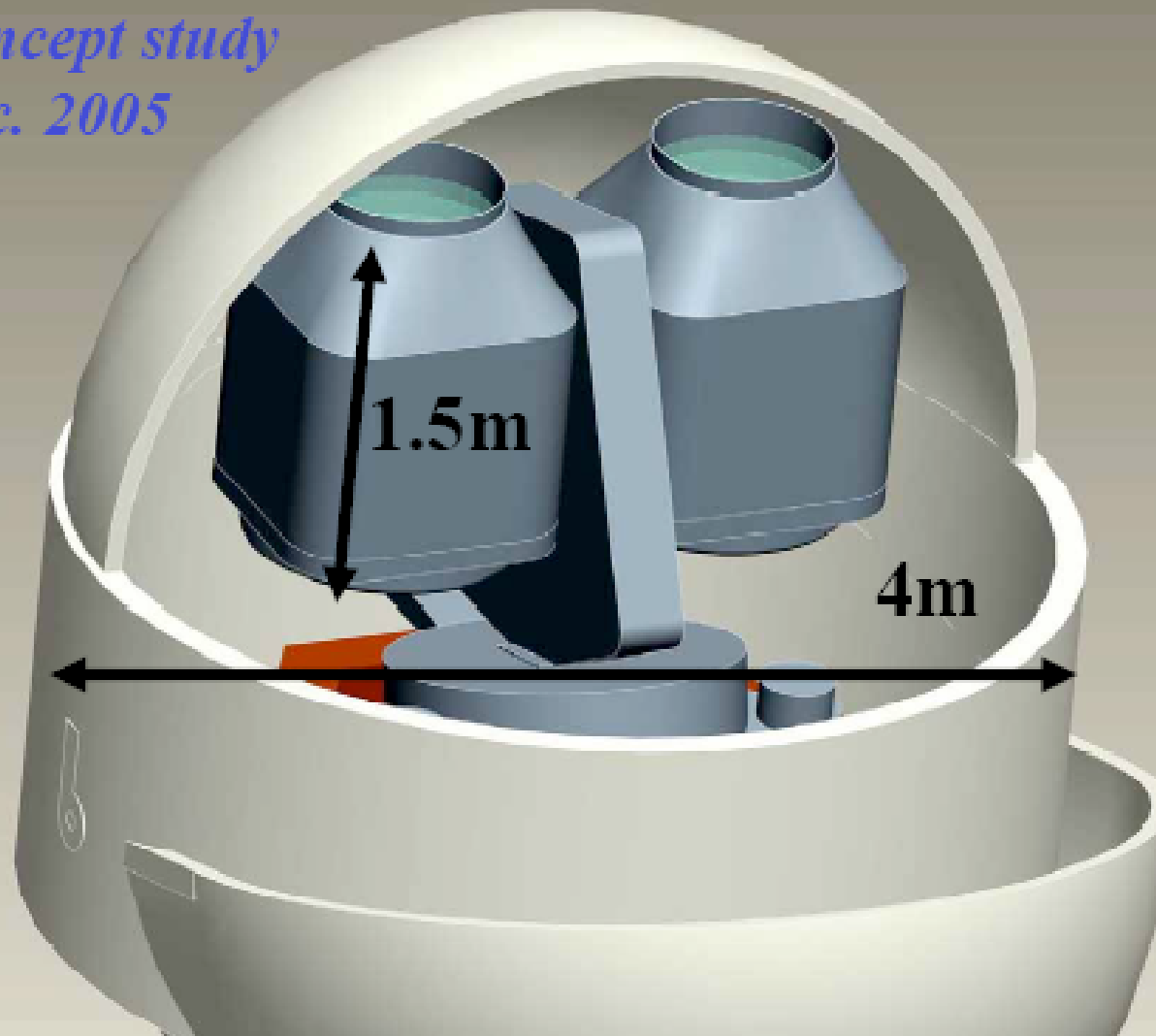
*C. Moutou, F. Bouchy, M. Deleuil, M. Ferrari, A. Llebaria, M. Boer, H. Le Corroler,
A. Klotz, A. Le van Suu, J. Eysseric, C. Carol (OAMP - Marseille),*

A. Erikson, H. Rauer (DLR - Berlin),

F. Pont (Obs. Genève)

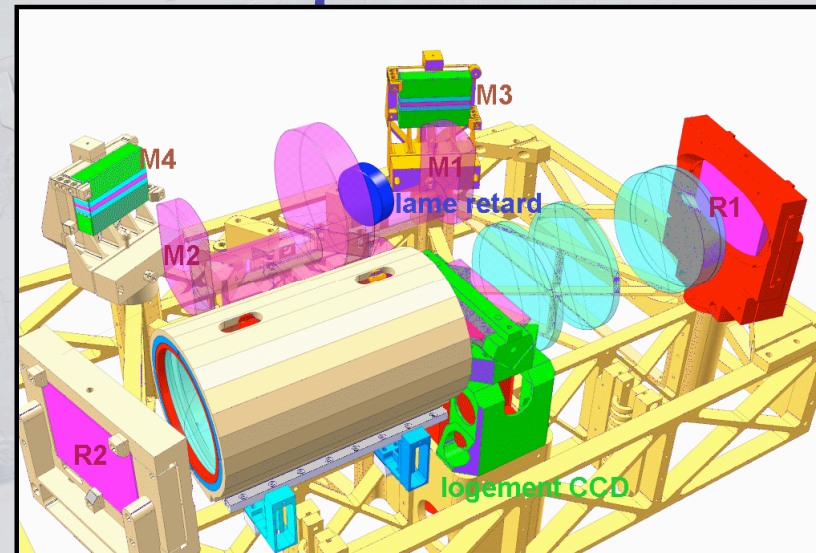
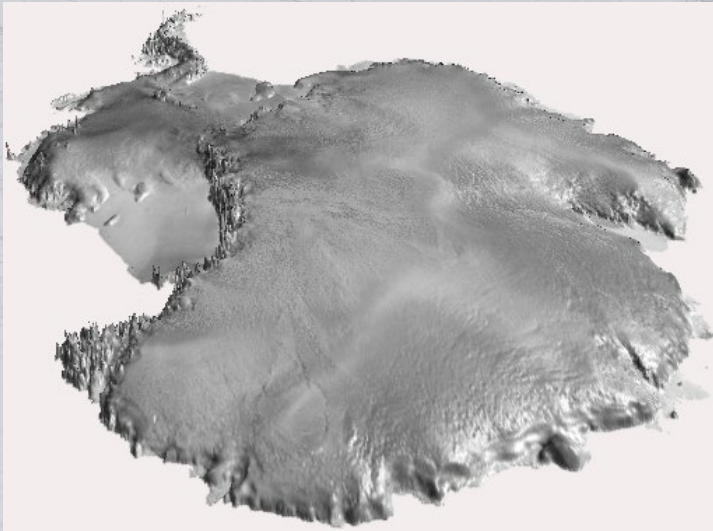
Ice-T

*Concept study
Dec. 2005*



SIAMOIS

Sismomètre Interférentiel A Mesurer les Oscillations des Intérieurs Stellaires
Astérosismologie en Antarctique au Dôme C



Benoît Mosser, Tristan Buey, Claude Catala, Michel Auvergne, Thierry Appourchaux, Annie Baglin, Caroline Barban, Marc-Antoine Dupret, MarieJo Goupil, Jean-Pierre Maillard, Eric Michel, Reza Samadi, Francois-Xavier Schmider, Frédéric Thévenin, Gérard Vauclair, Denis Fappani et al.
Observatoire de Paris/LESIA, IAS, UNSA/LUAN, OMP/LATT, IAP, OCA

Wide field infrared imaging

- Advocated by Nicolas for years that the best spectral windows are 3-5 μ
- A « Vista-like » telescope in this range would seem ideal
- The sky detailed properties remain to be tested, specially during the day
- Projects:
 - PILOT on top of a 30m tower
 - The « Marseille » project, GLAO oriented, closer to the snow level, at first a joint study for wide field and interferometry
 - The precursor: IRAIT

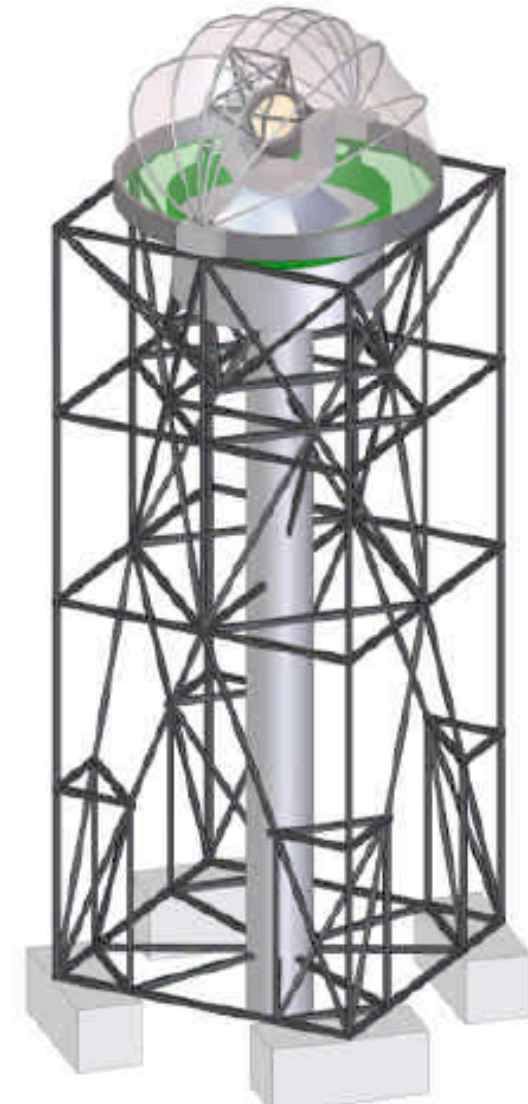
IRAIT

- Opération bien lancée, le télescope a été transféré à Cap Prud'homme la semaine dernière.



Tower Height Considerations

- Fraction of time above turbulent layer***
- Air temperature***
 - working environment***
 - thermal background***
- Air temperature gradient***
- Air temperature temporal variation***
- Relative humidity, susceptibility to frosting***
- Wind speeds***
 - telescope wind shake***
 - tower wind shake***
 - effect on mirror seeing***
- Tower stiffness***
- Cost***
- Delivery + construction logistics***



Dôme C

Réunion préparation FP7

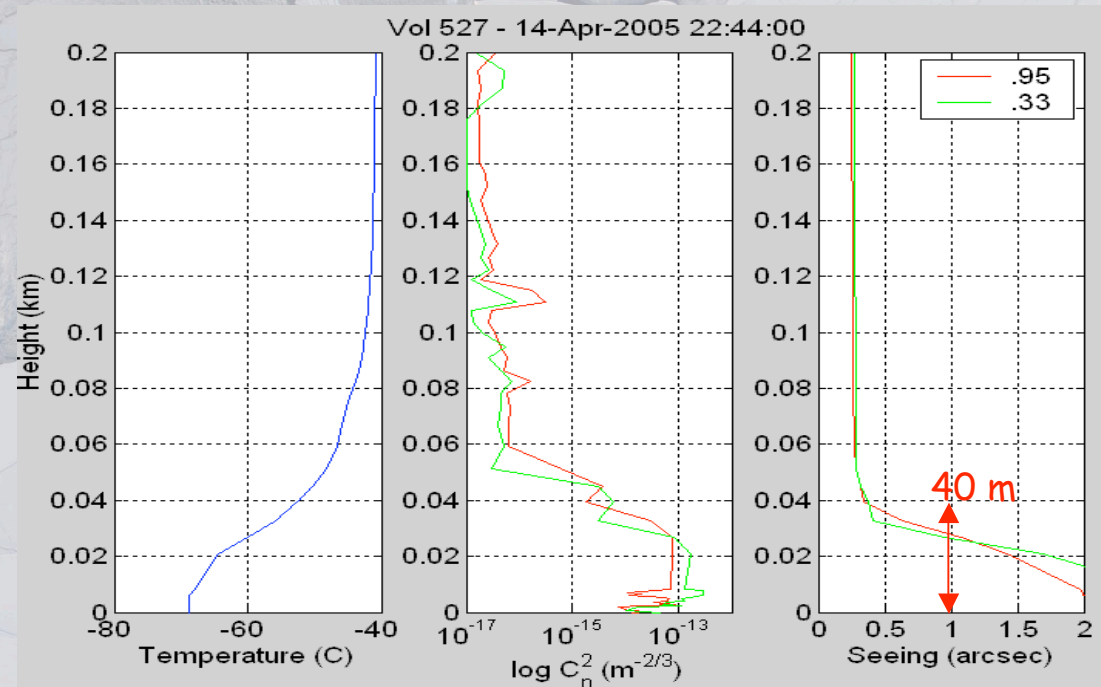
LE DÔME C EN ANTARCTIQUE

*La qualité spatiale
... depuis le sol*



Dôme C et GLAO

- « Seeing » naturel exceptionnel: ~ 200 -300 mas à une altitude de ~ 30 - 50m au-dessus de la glace (3200m).
- Mais « seeing » modeste (1.4'') au niveau de la glace.
- Grands angles isoplanétiques: ~ 6 arcsecs (c-à-d 2 à 3 fois meilleur que les autres sites terrestres).
- Fond infrarouge plus faible (T ~ -70° à -50°) que les autres sites terrestres: meilleure sensibilité
- Absence quasi totale de mauvais temps



Coût « à la louche »

- Telescope dedicated to surveys (over 3 yrs)
- First discussions started within ARENA (Antarctic Research, a European Network for Astronomy, PI. Epchtein)

- Preliminary Cost:

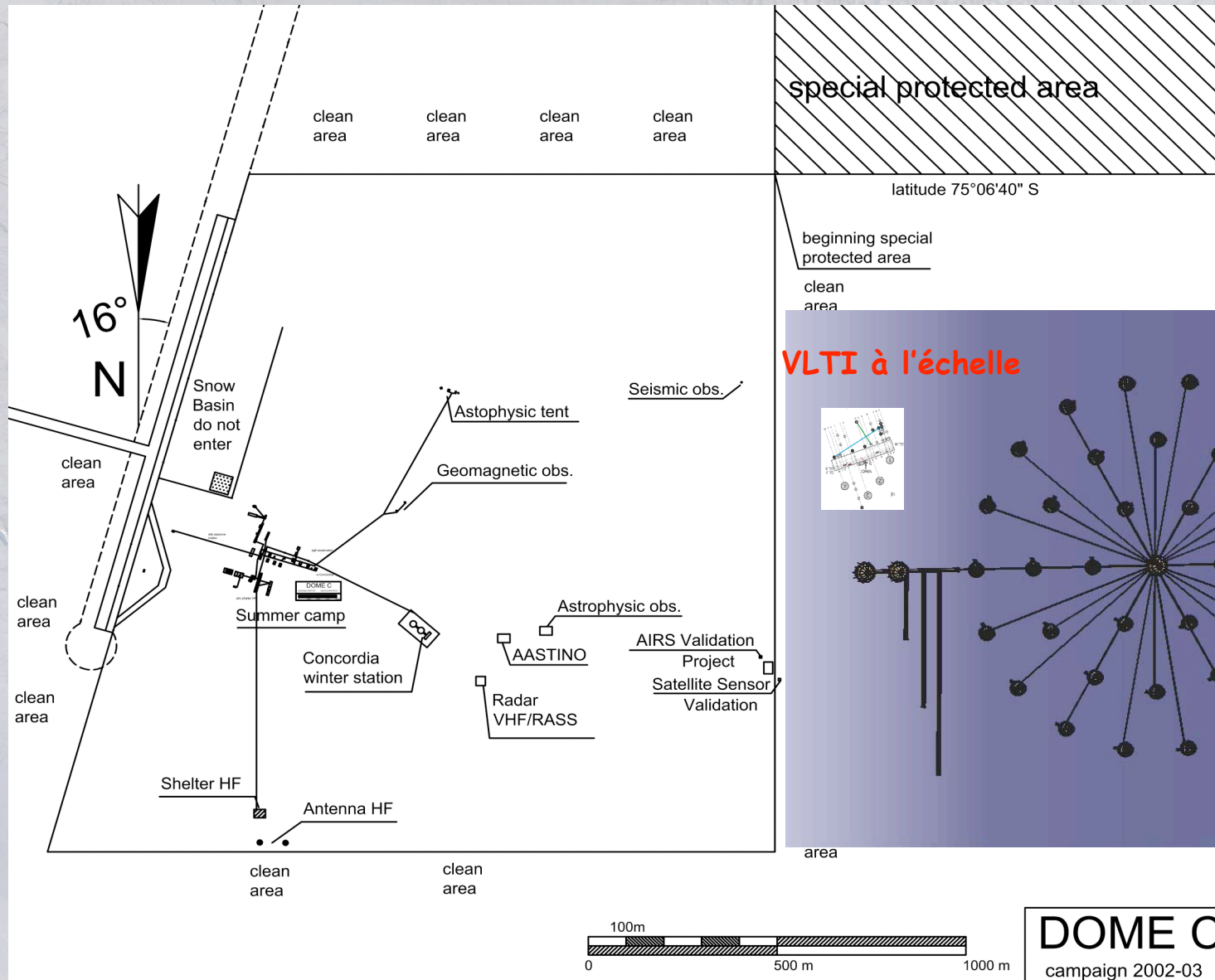
– Telescope:	4 M€
– Detector array	18x0.5M€ per 2kx2k array 1-5μm
– GLAO:	0.5 M€
– Building:	1 M€
– Operations:	2.5 M€ / yr (over 3 yrs)

– Total :	13.0 + 9.0 M€ = 22 M€

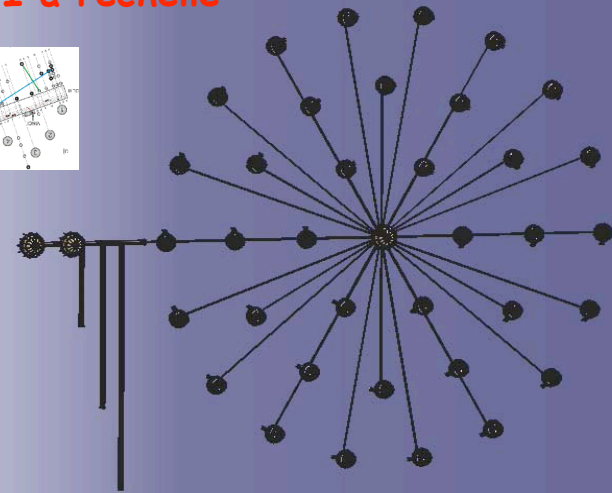
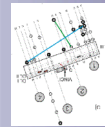
High Angular Resolution Imaging

- Specificities of Concordia seeing:
 - 30-m ground layer
 - Excellent seeing above (0.25 – 0.4 arcsec?)
 - Also slower, more angular coherence, smaller outer scale => much better « piston »
 - On top of 30-m towers of high performance GLAO?
- The next generation of « ALMA-like » optical interferometry could be at Concordia (KEOPS)
- Kilometric multi-aperture imager
- Several precursor projects: Mykerinos, Alladin
- Many technical problems to be addressed on the way...

KEOPS: Recherche d'Exo-Terres < 1kpc



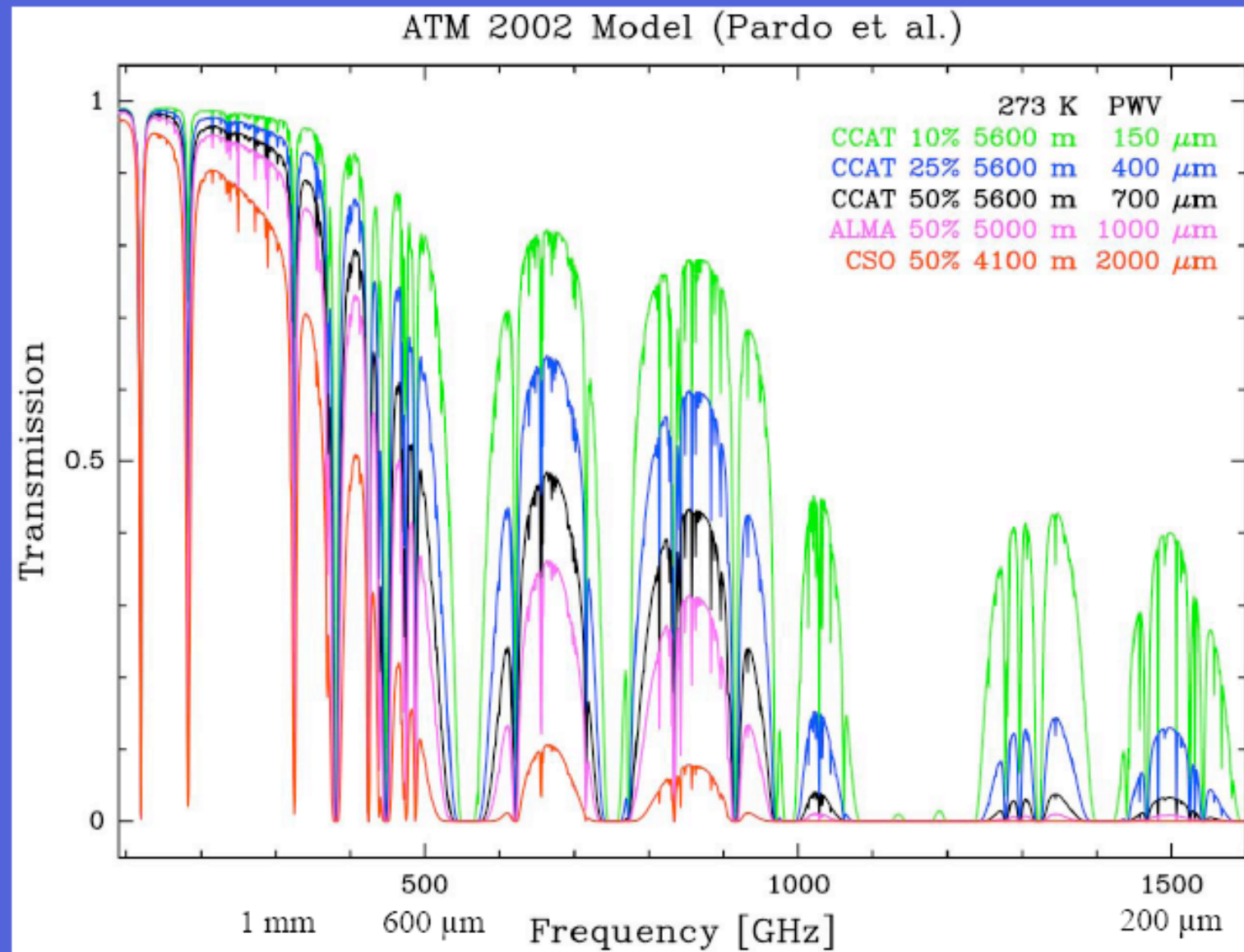
VLTI à l'échelle



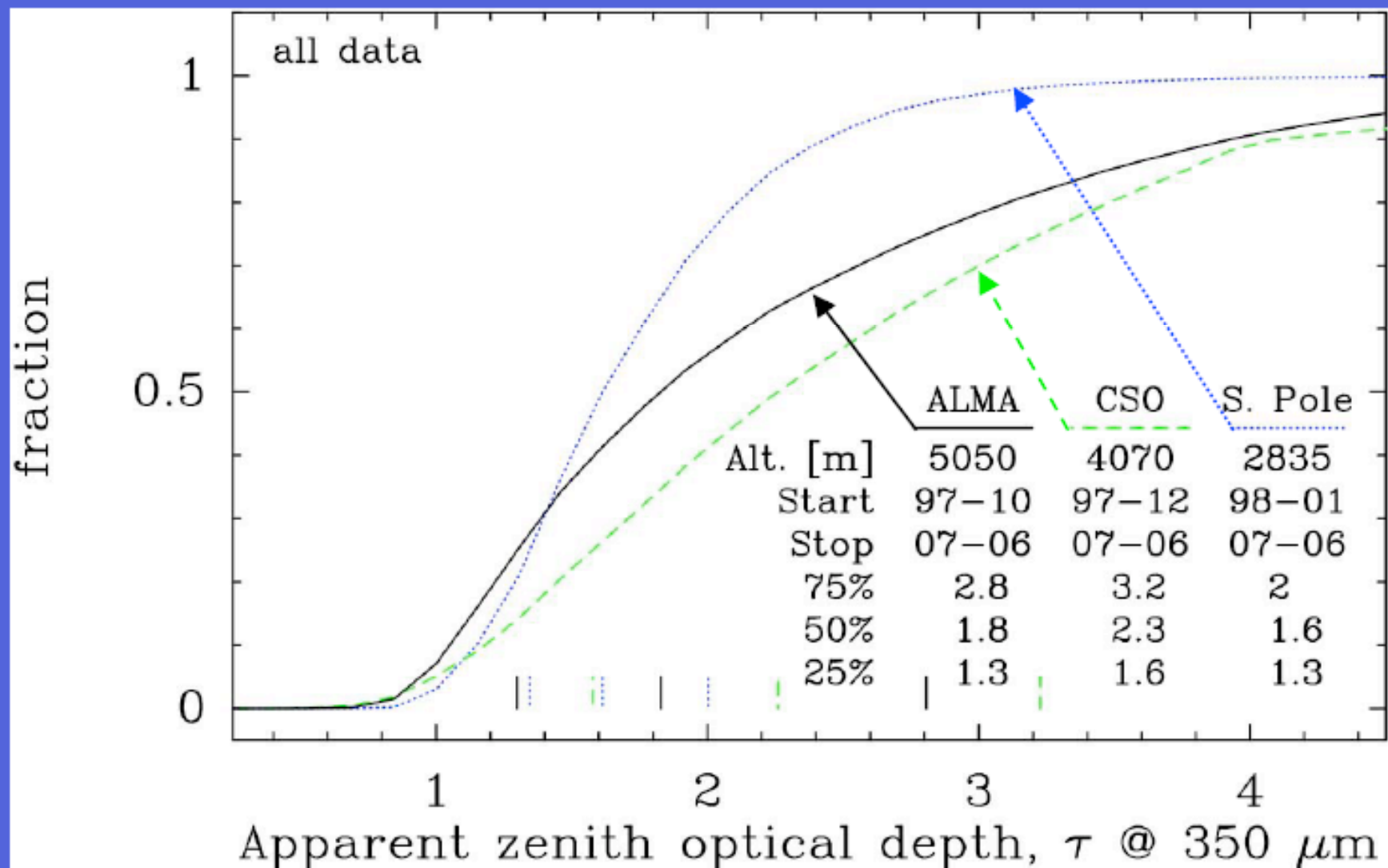
Cosmology: mm and sub-mm

- New windows are statistically opening better than anywhere else
- Much better stability too, even at mm wavelengths
- BRAIN
- COCHISE
- And of course, this meeting

Atmospheric Models



350 μm Transparency Global Comparison

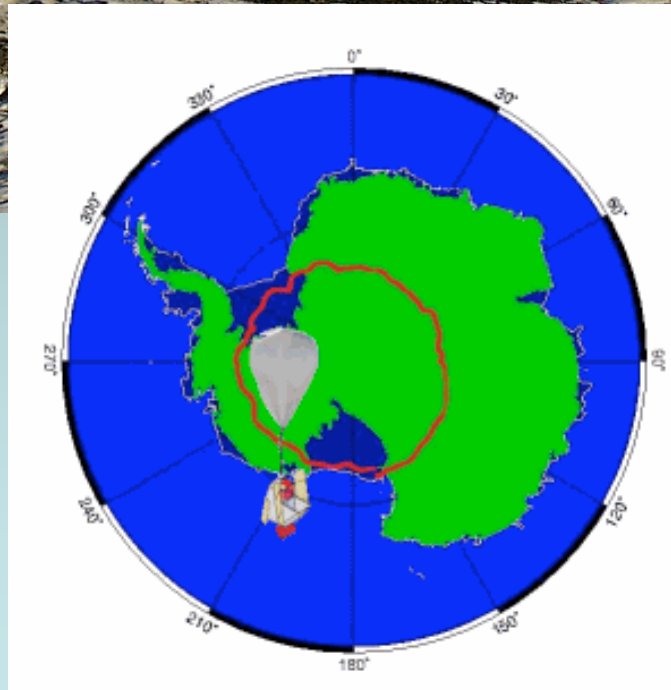
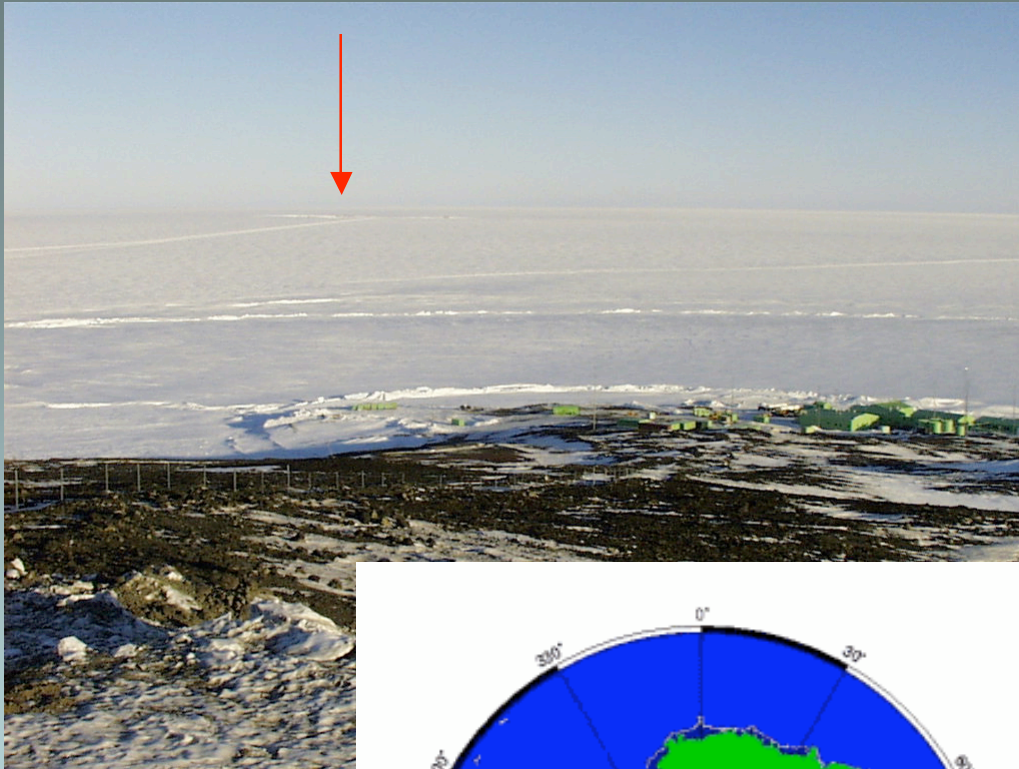




**BRAIN:
a CMB polarization interferometer
in DomeC**

**S.Masi on behalf of the BRAIN collaboration
Rome, Dec. 21st, 2006**

3) La localita'



- L' atmosfera terrestre emette fortemente nelle microonde. Far misure di fondo cosmico da terra e' come voler fare immagini di galassie nel visibile di giorno.
- A quota di pallone stratosferico (37 km) l' emissione dell' atmosfera terrestre e' estremamente ridotta.
- Il pallone stratosferico costa circa 100 volte meno di un satellite.
- La NASA-NSBF lancia palloni stratosferici dall' **antartide**, che circumnavigano il continente in 1-2 settimane. Questo permette di ripetere le misure molte volte, in modo da essere sicuri del risultato.

An infrared and submillimeter telescope for Dome C



Luca Olmi (IRA-INAF)
for the ASO Collaboration:

- IRA-INAF
- IFSI-INAF
- Università' di Milano Bicocca
- Università' di Perugia
- CEA, Saclay

Problem clearly identified: the FROST

- Le givre
- Dans l'air le plus sec du monde !!!!









THz/submm astronomy at Dome C with CEA filled bolometer array

Vincent Minier, Gilles Durand
Pierre-Olivier Lagage, Michel Talvard and the CAMISTIC team
(Service d'Astrophysique, CEA Saclay, France)

Gino Tosti, Maurizio Busso (Perugia, Italy) and the IRAIT team

and
Tony Travouillon
(TMT, CALTECH, USA)

dapnia
SAP

cea

saclay

