Couplage Neige-Atmosphere dans le modèle du CEPMMT: Enseignements de CONCORDIASI et GABLS4

presentée à Toulouse (MF/CIC), le 5 Juin 2015 par

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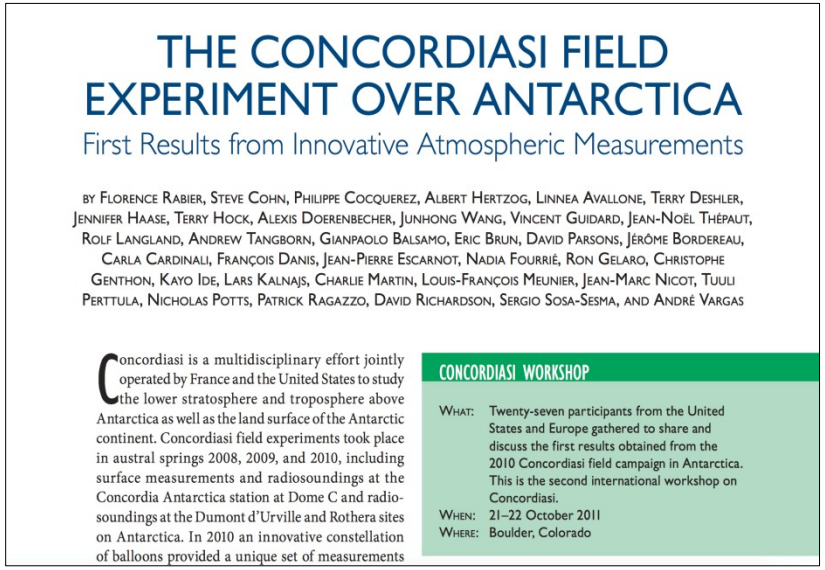
A summary of CONCORDIASI

***An Overview of Concordiasi*: "The Concordiasi project in Antarctica"**
Rabier et al., 2013, BAMS http://dx.doi.org/10.1175/BAMS-D-12-00005.1

Website: www.cnrm.meteo.fr/concordiasi/



THE CONCORDIASI FIELD EXPERIMENT OVER ANTARCTICA

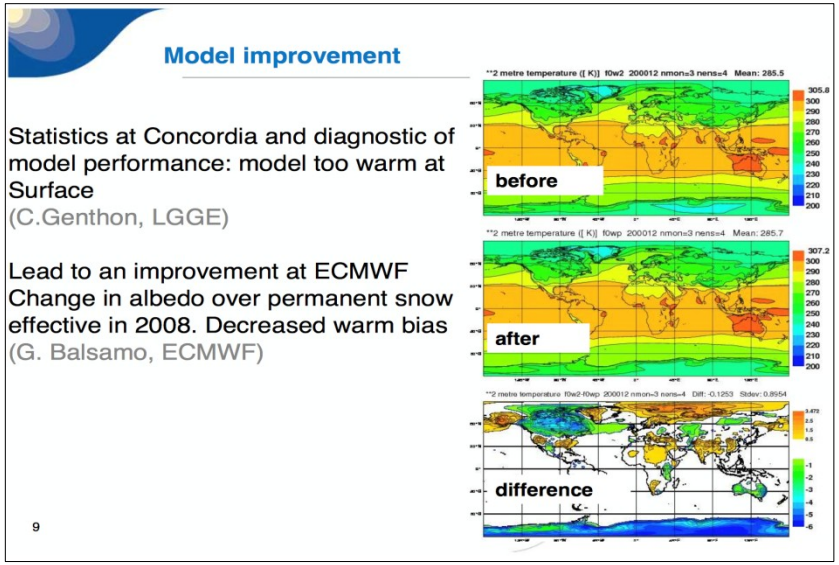
First Results from Innovative Atmospheric Measurements

BY FLORENCE RABIER, STEVE COHN, PHILIPPE COCQUEREZ, ALBERT HERTZOG, LINNEA AVALLONE, TERRY DESHLER, JENNIFER HAASE, TERRY HOCK, ALEXIS DOERENBECHER, JUNHONG WANG, VINCENT GUIDARD, JEAN-NOËL THÉPAUT, ROLF LANGLAND, ANDREW TANGBORN, GIANPAOLO BALSAMO, ERIC BRUN, DAVID PARSONS, JÉRÔME BORDEREAU, CARLA CARDINALI, FRANÇOIS DANIS, JEAN-PIERRE ESCARNOT, NADIA FOURRIÉ, RON GELARO, CHRISTOPHE GENTHON, KAYO IDE, LARS KALNAJS, CHARLIE MARTIN, LOUIS-FRANÇOIS MEUNIER, JEAN-MARC NICOT, TUULI PERTTULA, NICHOLAS POTTS, PATRICK RAGAZZO, DAVID RICHARDSON, SERGIO SOSA-SESMA, AND ANDRÉ VARGAS

Concordiasi is a multidisciplinary effort jointly operated by France and the United States to study the lower stratosphere and troposphere above Antarctica as well as the land surface of the Antarctic continent. Concordiasi field experiments took place in austral springs 2008, 2009, and 2010, including surface measurements and radiosoundings at the Concordia Antarctica station at Dome C and radiosoundings at the Dumont d'Urville and Rothera sites on Antarctica. In 2010 an innovative constellation of balloons provided a unique set of measurements

CONCORDIASI WORKSHOP

WHAT: Twenty-seven participants from the United States and Europe gathered to share and discuss the first results obtained from the 2010 Concordiasi field campaign in Antarctica. This is the second international workshop on Concordiasi.
WHEN: 21–22 October 2011
WHERE: Boulder, Colorado



Extracted from a WMO Presentation at GCW
http://globalcryospherewatch.org

The question we try to address in this presentation with the aid of some examples:
What did CONCORDIASI generate in terms of R&D spin-off up to 5-year after?

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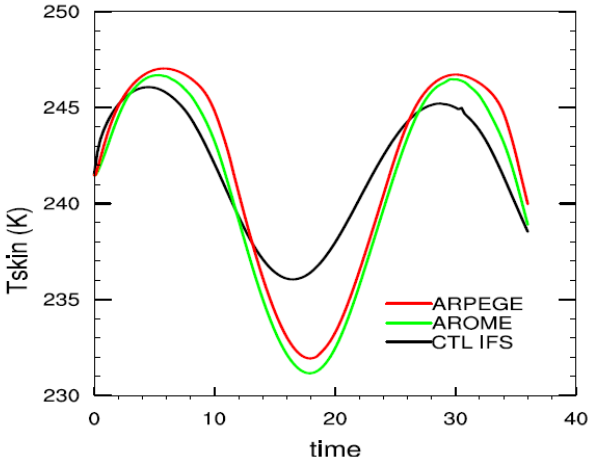
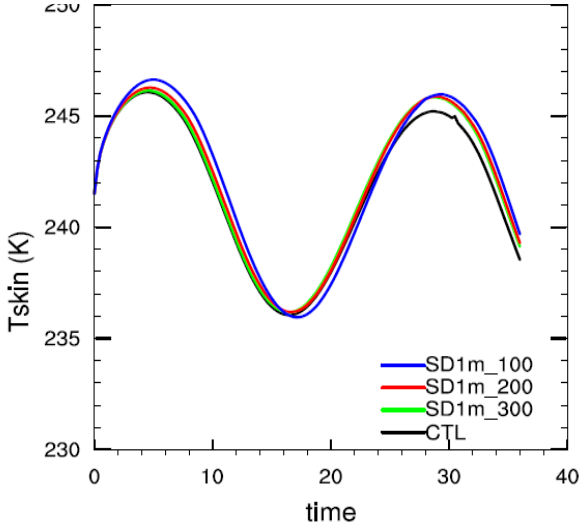
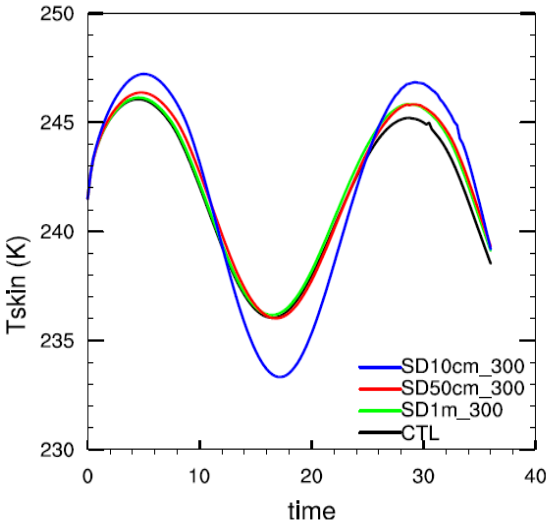
Our first steps in GABLS 4

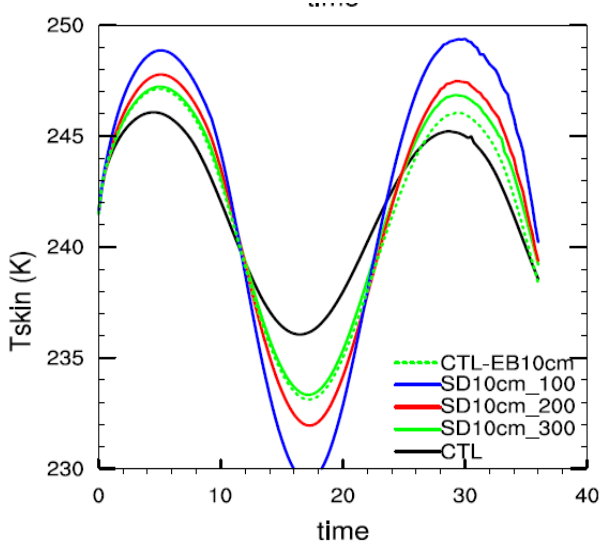


Confirm a warm bias for Antarctica also in recent cycles

CTL config Oper: I10 m de neige sont specifié, avec densité de 300kg/m^3, et Albedo de 0.8







The snow thermal properties and the surface roughness specified in the model are crucial to enhance the amplitude of the diurnal cycle

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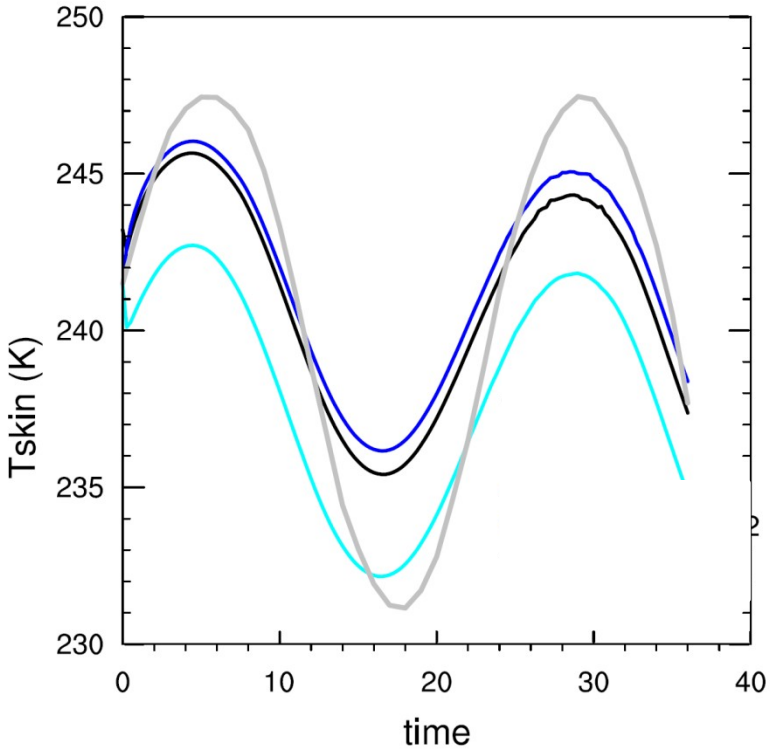
Results for final GABLS4 setup (stage 1)



OBS
CTL-stage 1a
CTL-stage1b (initialized with values given by Eric)
CTL-stage1b-bis (initialized with values interpolated from the initial file)

- As before, too warm between 14-24 hours
- The initialization in stage 1b can lead to lots of differences

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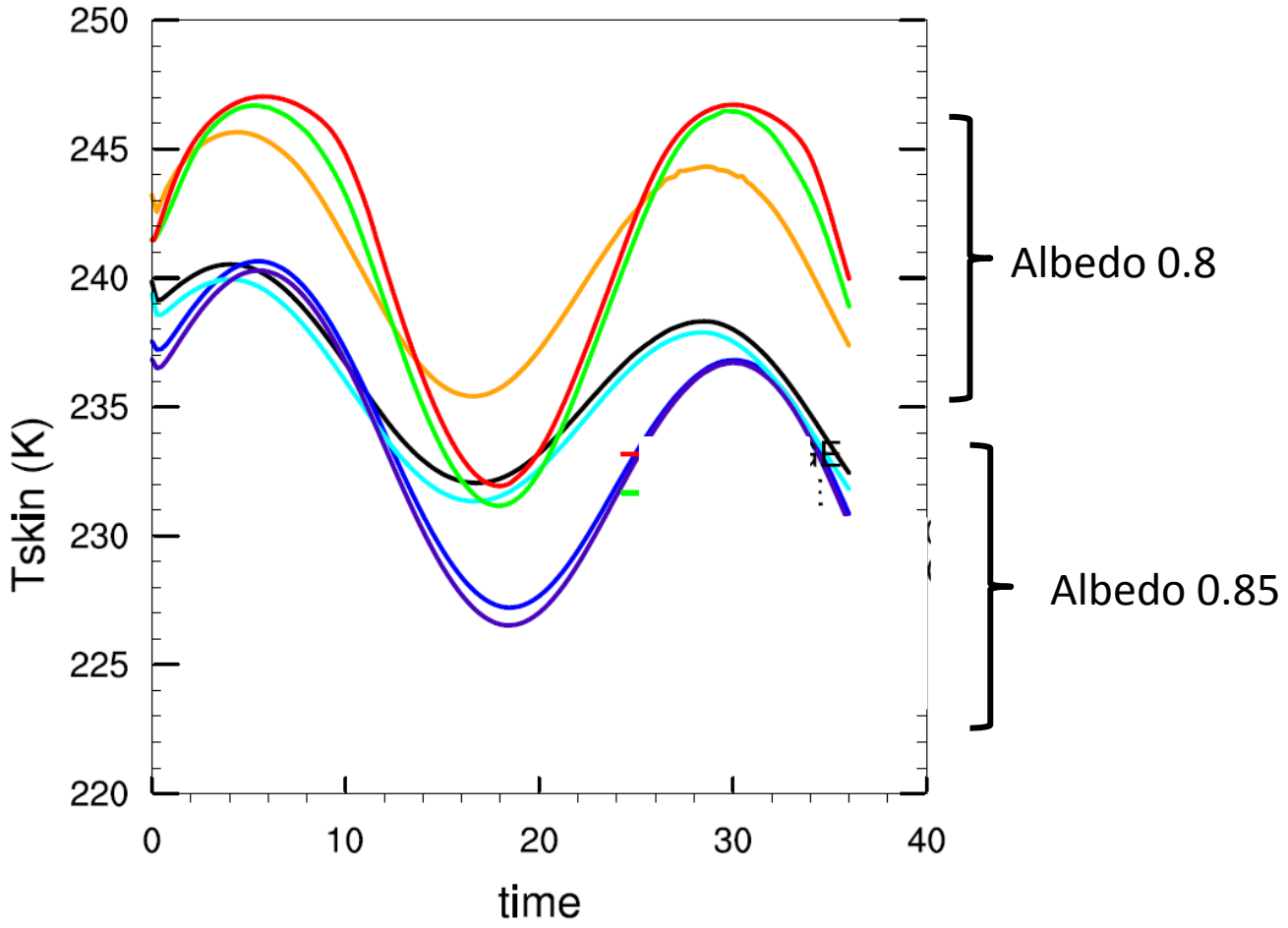
Another sensitivity – The Albedo



- Confirmed the results and sensitivity findings within CONCORDIASI

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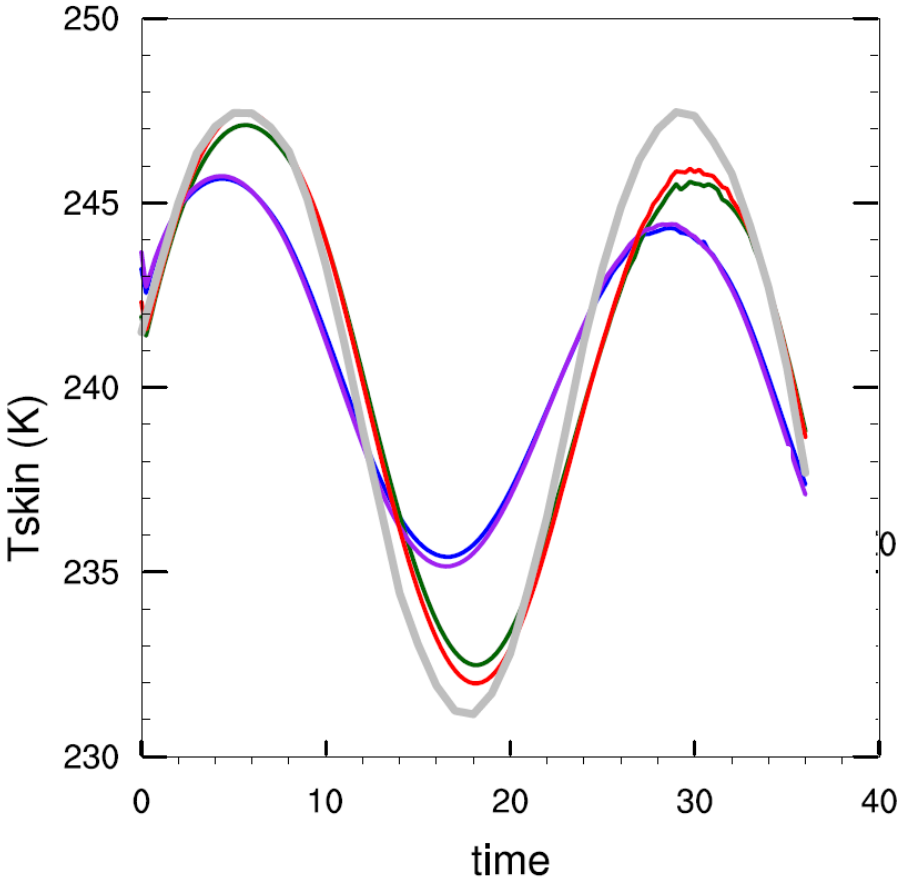
Sensitivity tests final GABLS4 setup (stage 1a)



OBS
CTL
Z0
01B:10 cm of snow for the thermal part and no basal heat flux

01BZ as 01B + momentum roughness from 0.0013 to 0.0001 and heat from 0.00013 to 0.00002

01BZ quite close to the observations now!

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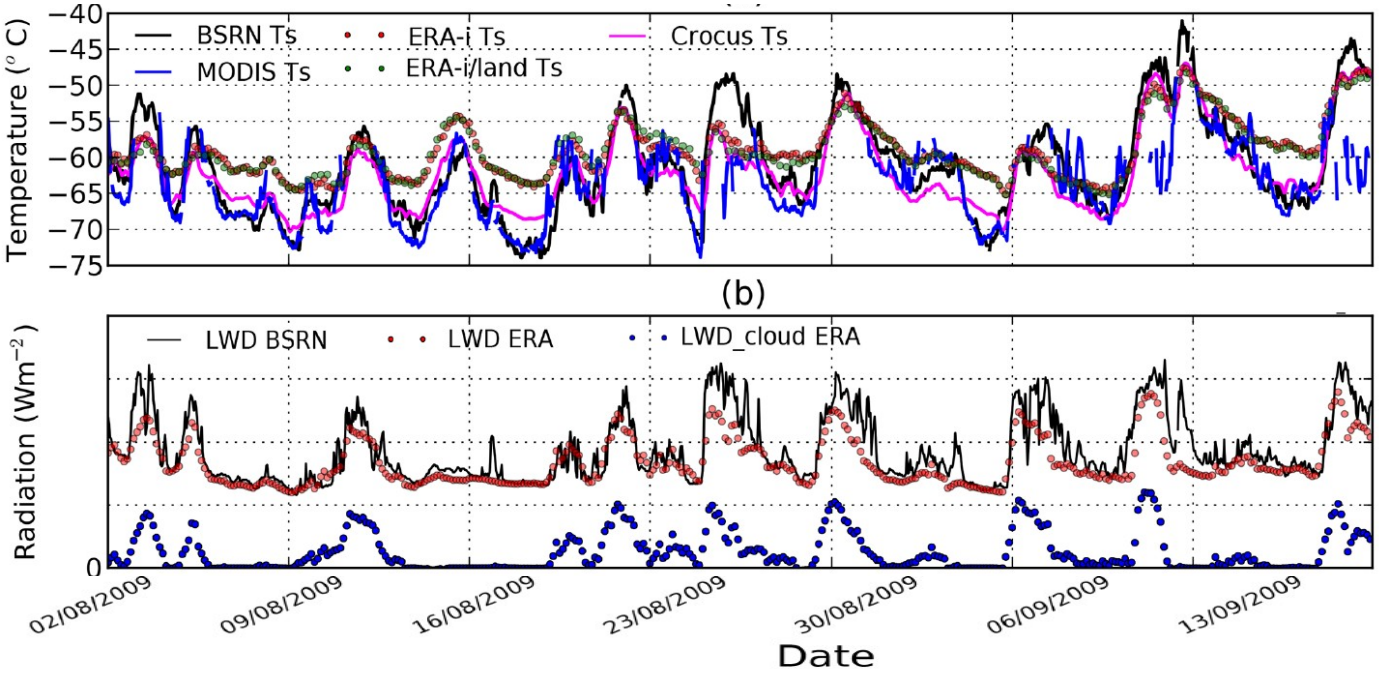
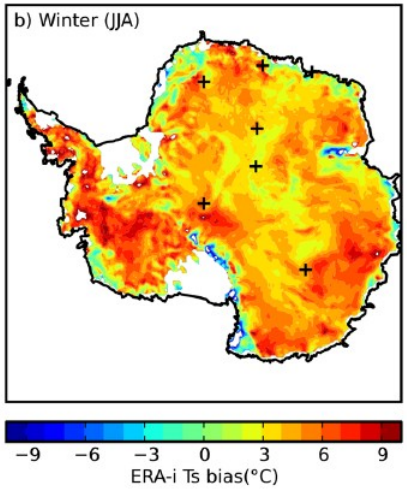
Freville & al. 2014: ERA-INTERIM has a warm bias over Antartica





ERA-Interim warm bias appears to be likely due to an overestimation of the surface exchange coefficients under very stable conditions.

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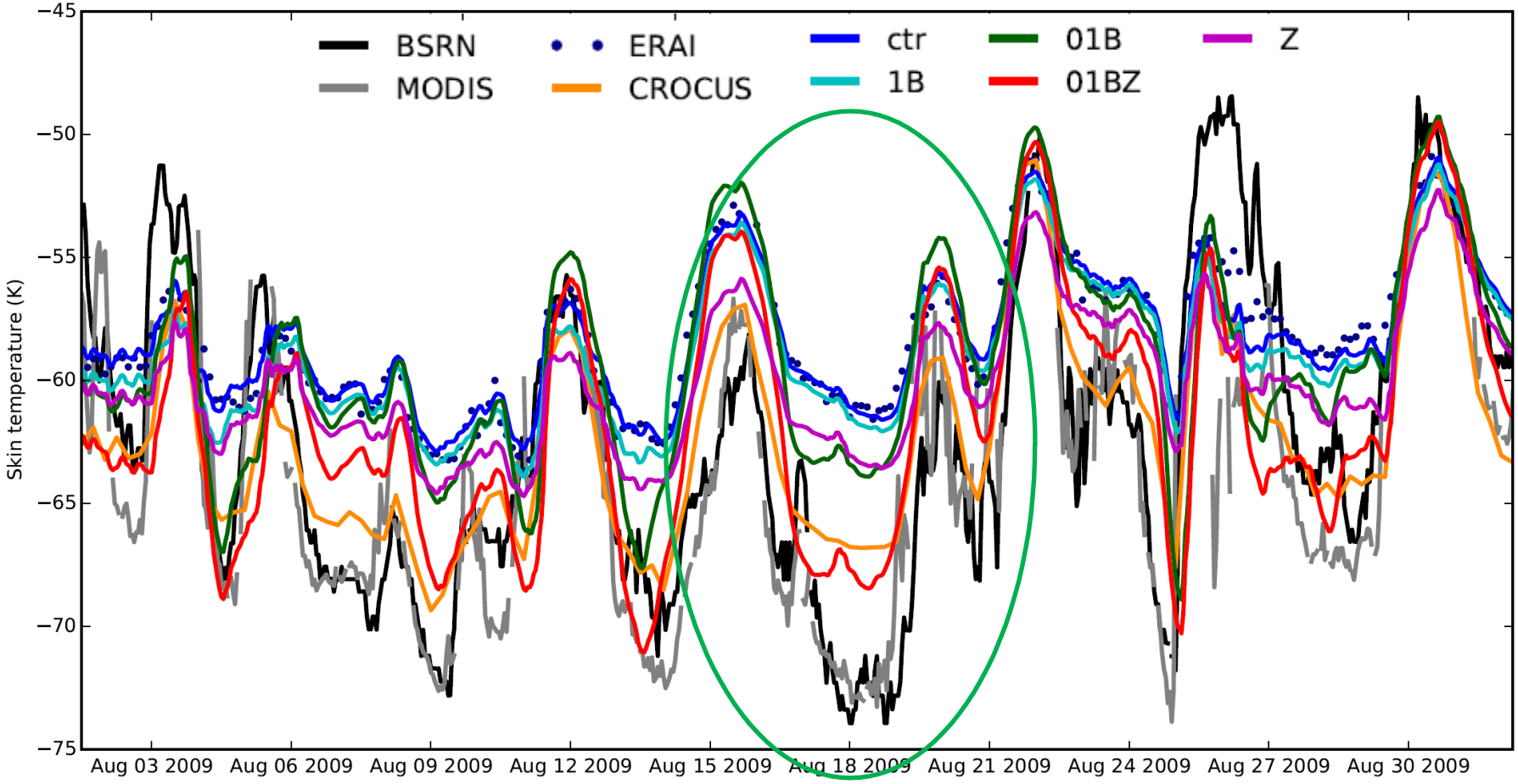
Same tests in the surface off-line model



Similar with GABLS4, 01BZ is the best, but more sensitivity to roughness

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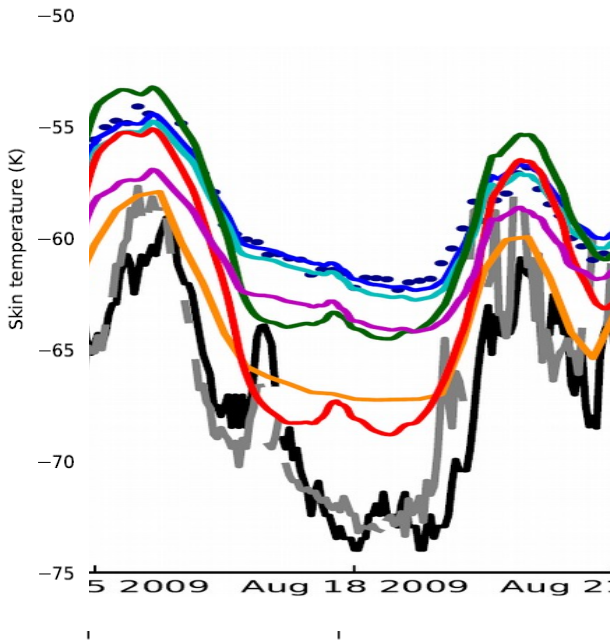
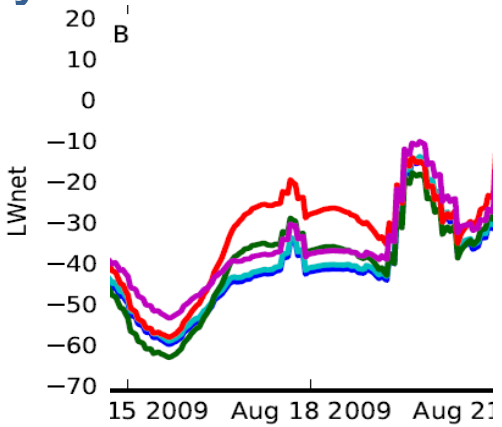
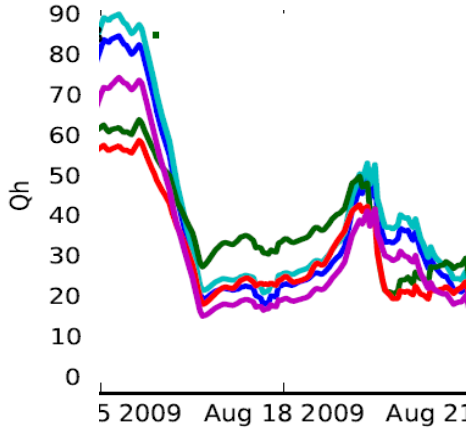
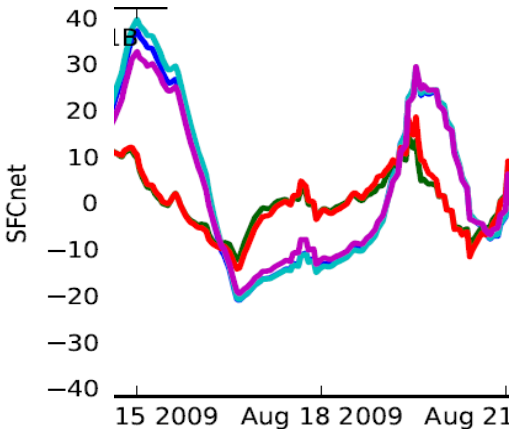
Can this effect be explained all by the fluxes?









01BZ vs CTL less LW longwave cooling, less surface net cooling! However, it is colder because there is less snow to cool down (or smaller thermal inertia)

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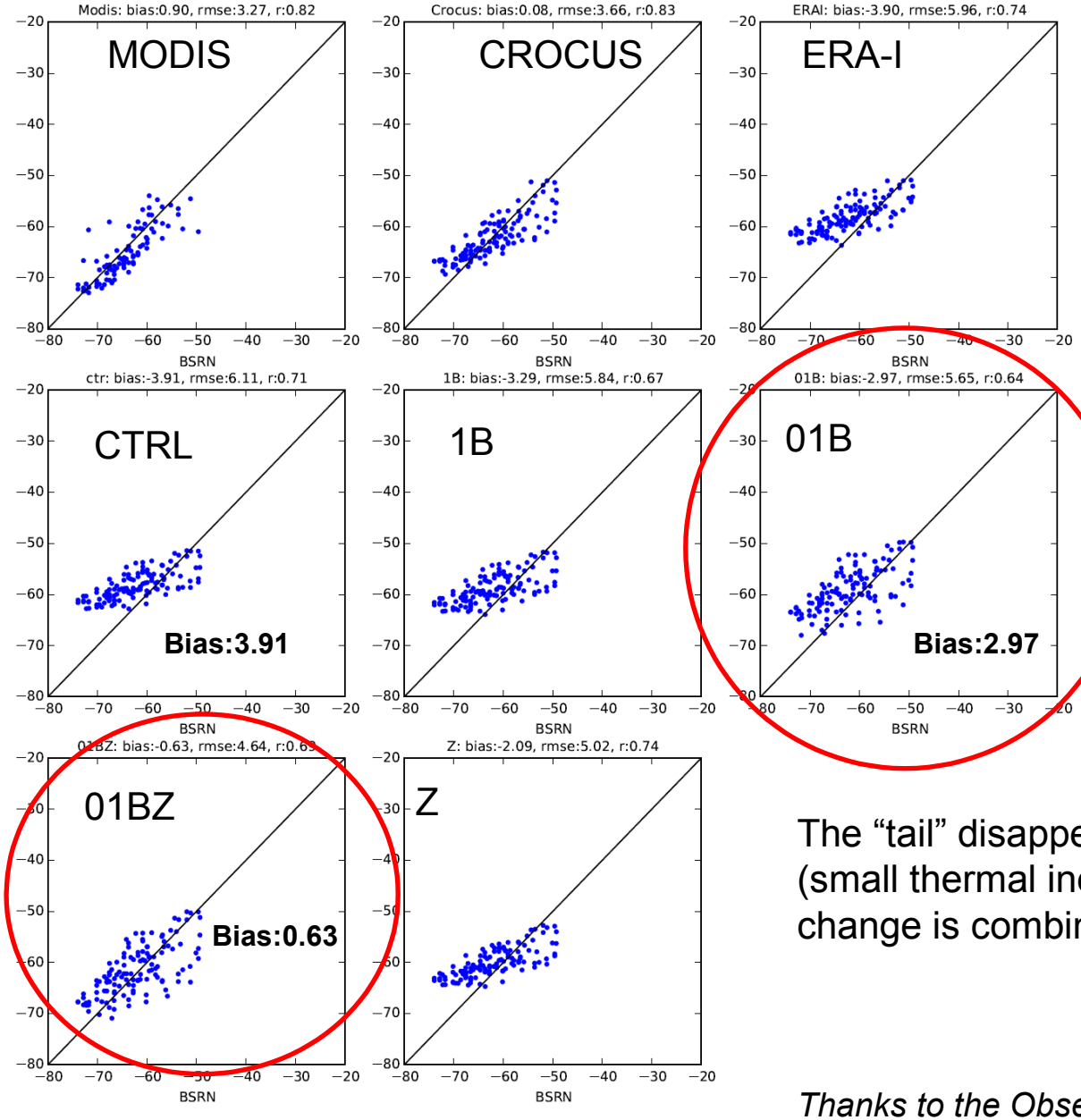

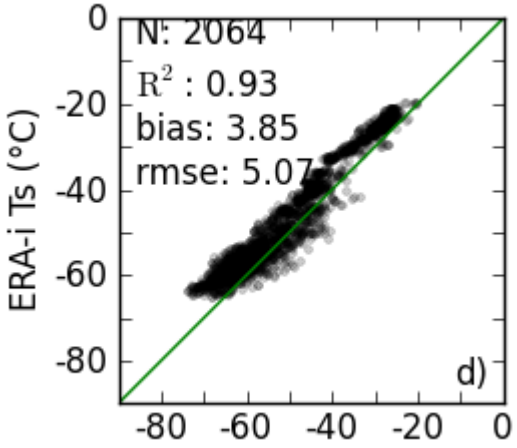

Freville et al. 2014

The “tail” disappears if the snow layer is thin (small thermal inertia), and especially if this change is combined with smaller Z

Thanks to the Observations provided (CNRS)
H. Freville

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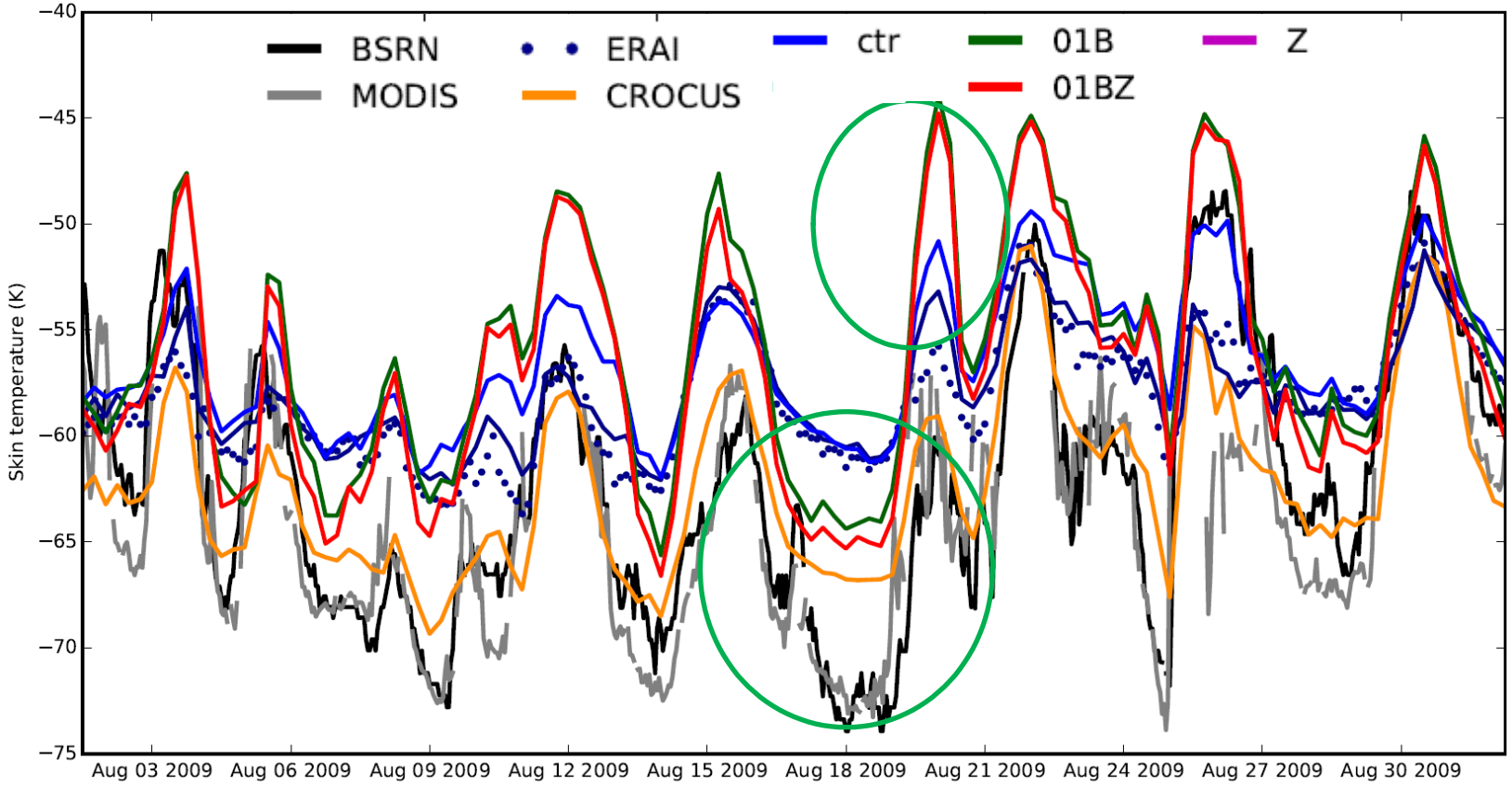
Same tests in 3-D runs (at ERA-I resolution, T255)



Consistent with SCM and offline, amplification of the Tskin variations, due to less thermal inertia, but also less sensitivity to roughness in coupled mode

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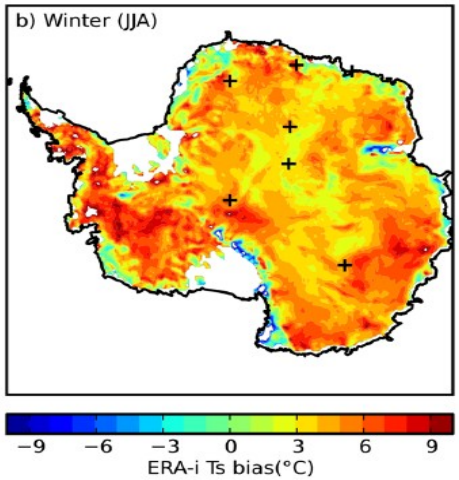
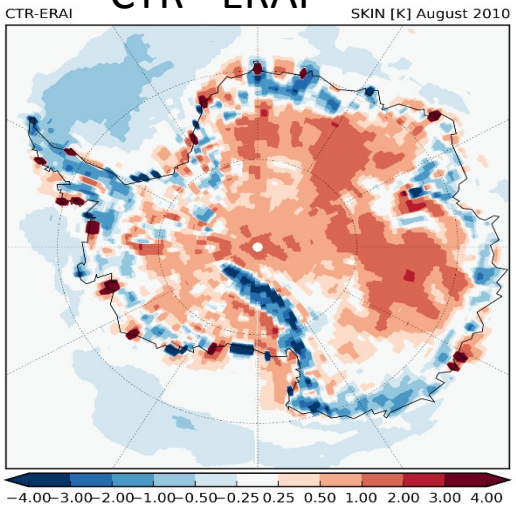
Skin temperature forecast sensitivity (day+1)

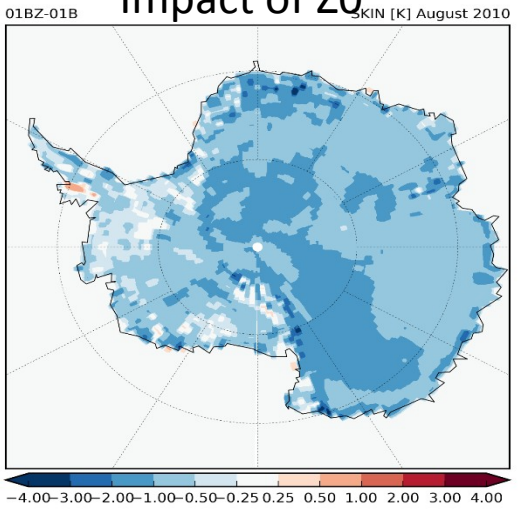


Freville et al. 2014

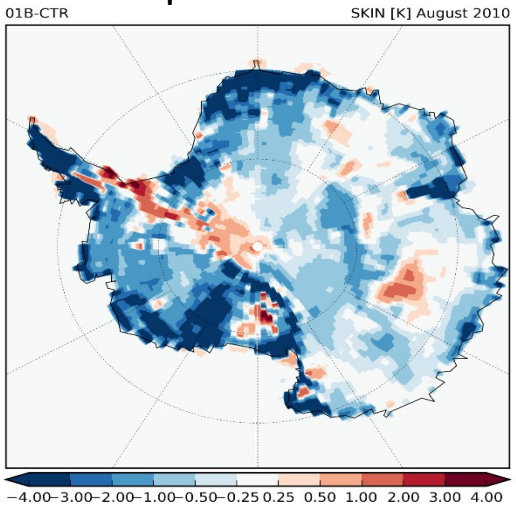
CTR - ERAI



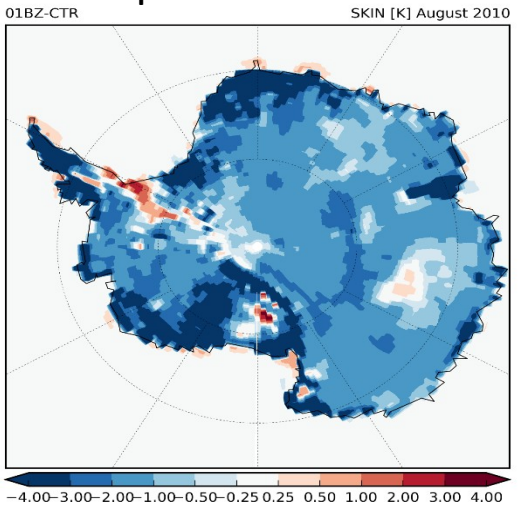
Impact of Z0



Impact of **01B**



Impact of **01B&Z0**



Outcomes research:
Cooling on average can be obtained by **01BZ** runs

The roughness impact is more widespread, **01B** more localized (weather related?)

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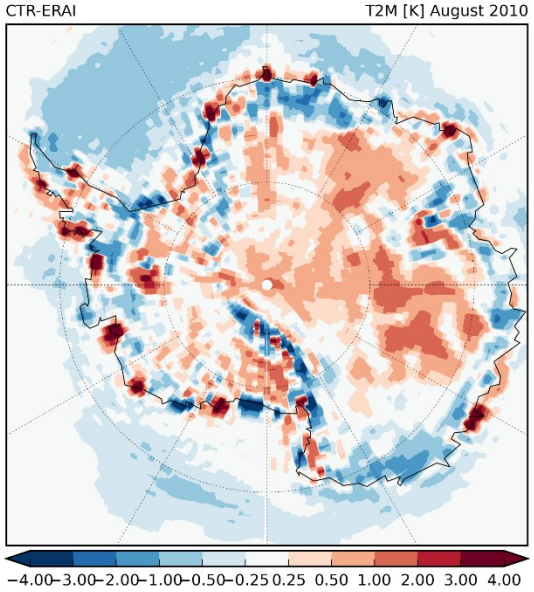
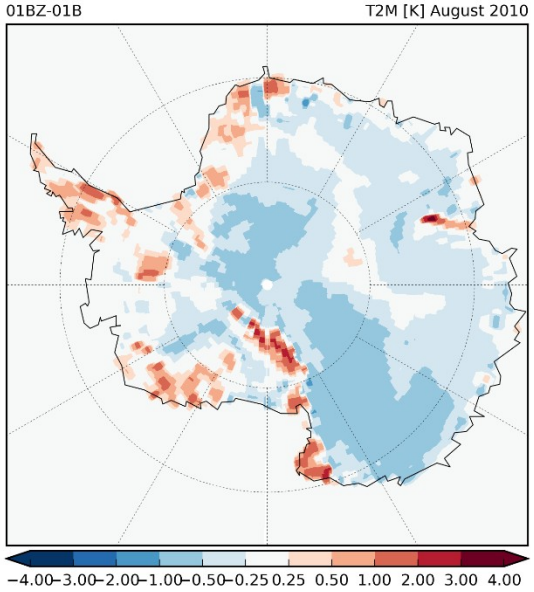
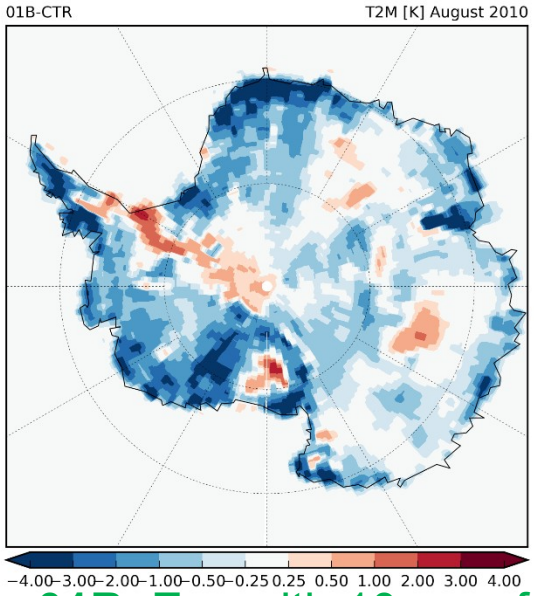
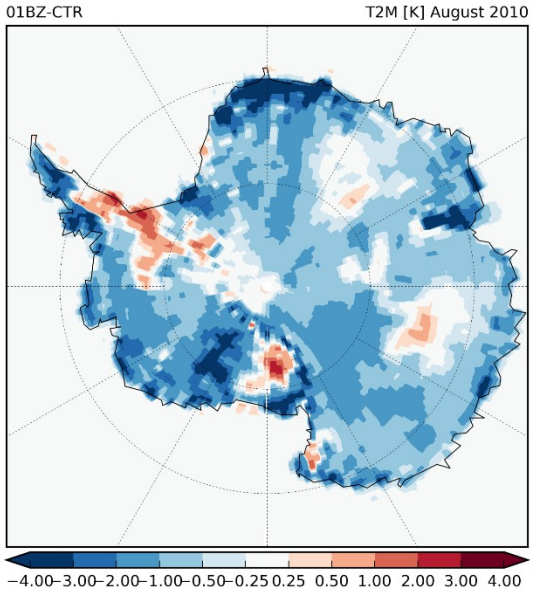
01B: Exp with 10 cm of top snow
01BZ as 01B plus a reduced roughness

2M temperature forecast sensitivity (day+1)







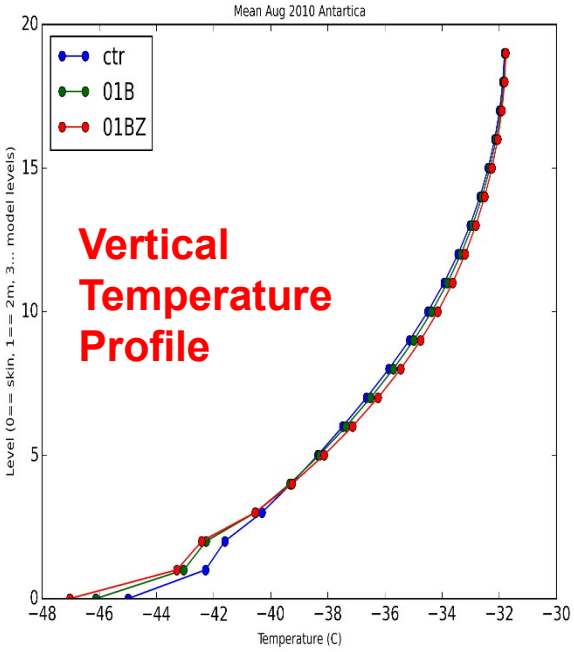


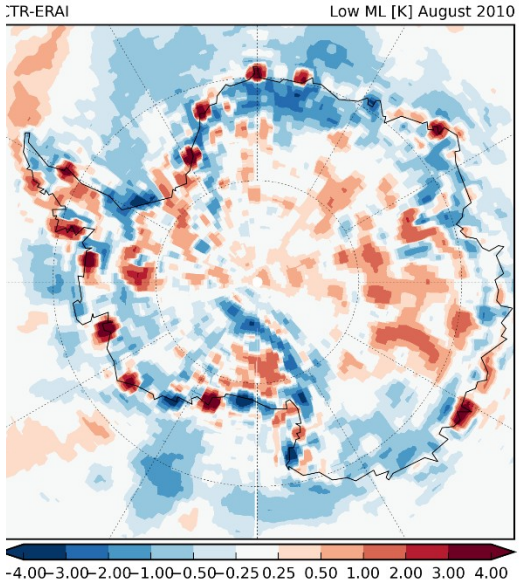
Outcomes research II:
Cooling on average also at 2M be obtained by **01BZ** runs

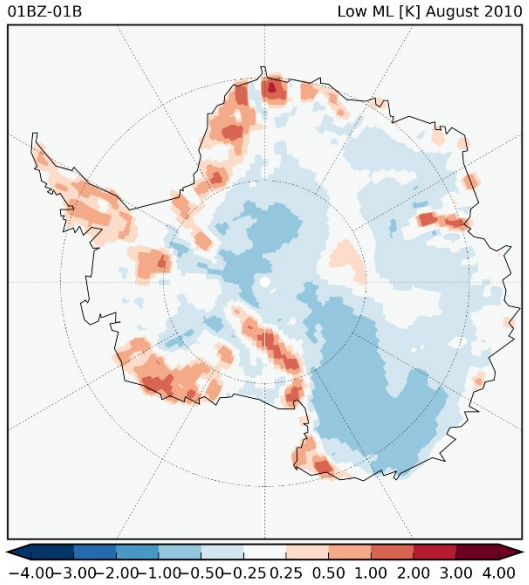
But weaker signal,
As expected…

01B: Exp with 10 cm of top snow
01BZ as 01B plus a reduced roughness

Lowest atmospheric model level temperature (at about 10m)

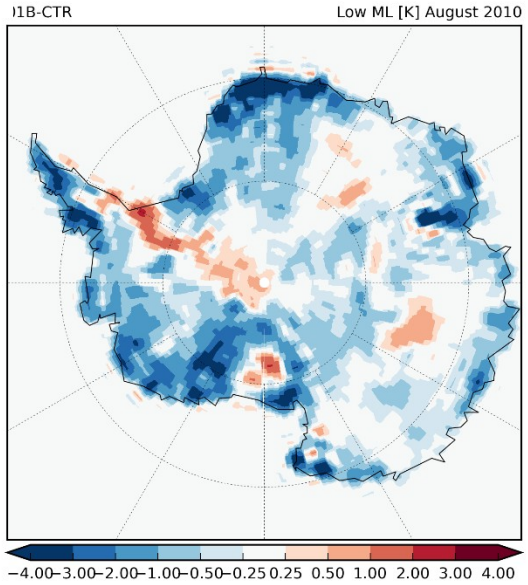


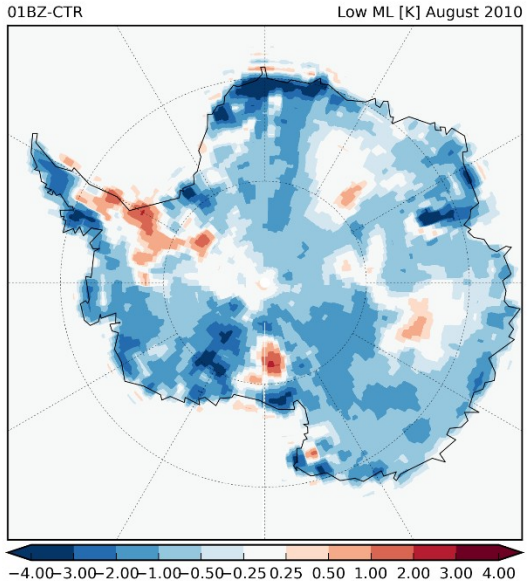




Outcomes research:
The diurnal cycle amplitude Skin-level temperature is much larger than the amplitude of the 10m level.

This is due to the Snow-Atmosphere De-coupling greater in **01BZ**





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Conclusions

- **CONCORDIASI** has triggered great advances that continues well beyond its lifetime or the exciting times of the IOPs!

- There is a “new branch” of literature studies focusing on the Poles and Cryosphere that make larger use of satellite data also for **process understanding** as at the Poles Climate-Change might be perceivable even within one given satellite lifetime (?)

- Our recent findings following **ERA-Interim** revealed shortcomings **over Antarctica** and suggest also strong sensitivity to **snow thermal inertia** and **surface roughness** in extremely stable situations

- The introduction of a multi-layer snow scheme (inspired by the “snow-resolving” models, e.g. like **CROCUS**) is expected to be beneficial to inspire model development

- We may need “**more degrees of freedom**” in the System (for snow-atmosphere coupling) to knock-down Model-bias, and have “**fewer degrees of errors** (in Kelvin), for representing Antarctica surface temperatures (?)

- This has potential to trigger **enhanced satellite data uptake in the future** (e.g. reducing risks of aliasing) with an increased “realism” of surface representation

Merci de votre attention et vos questions

…pour ne pas oublier nos “usagers” d’Antarctique les plus nombreux…