

A Long-term Hindcast simulation with COSMO-CLM² over Antarctica

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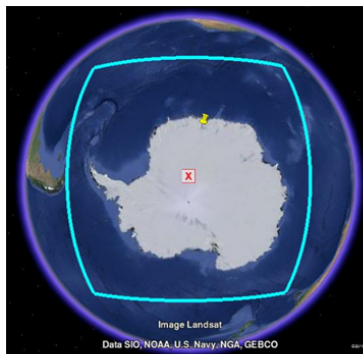
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COSMO-CLM²

- COSMO : non-hydrostatic atmospheric model (Rockel et al., 2008)
- CLM : climate mode
- CLM : coupled to the Community Land Model 4.5
- boundary conditions : Era-Interim
- horizontal resolution : 0.22 degrees
- Antarctic cordex domain
- 30 years run (1987-2016)

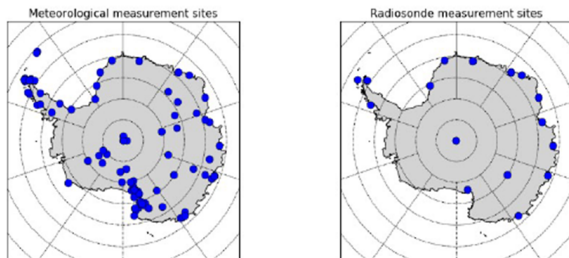
Figure: Cordex domain



Validation against

- Automatic Weather Stations
- station measurements
- balloon measurements (Turner et al., 2004)
- SMB data (Favier 2013), ice core data (Thomas et al. 2017) and reconstruction from B. Medley (in prep.)

Figure: Location of the measurement sites (SCAR, IGRA)



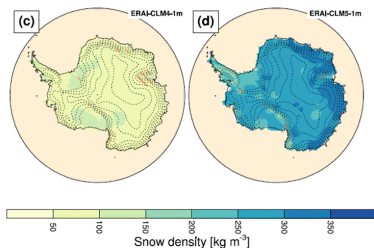
Changes to COSMO

- boundary layer stability coefficients are lowered to get more stable boundary layer and better near-surface temperatures (Cerenzia et al., 2014)
- upper air relaxation for better representation of the tropopause (van de Berg and Medley, 2016)
- implementation of the two-moment scheme + adaptations therein to get better SMB representation (Seifert and Beheng, 2008)
 - adaptations to homogeneous and heterogeneous nucleation (Köhler and Seifert 2015)
 - autoconversion threshold lowered (Ghosh and Jonas, 1998)
 - deposition coefficient lowered (Gierens et al., 2003)

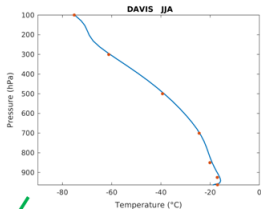
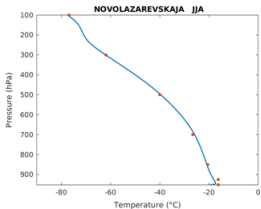
Coupling to CLM 4.5

- adaptations backported from CLM 5.0 (van Kampenhout et al., 2017)
 - snow pack bug
 - wind compaction of snow implemented
 - radiation bug
- roughness length adapted to 10^{-5} (Smeets and van den Broeke, 2008) to represent better katabatics and wind speeds over ice shelves

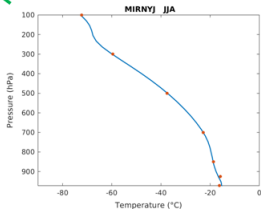
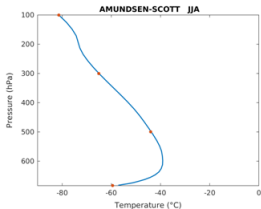
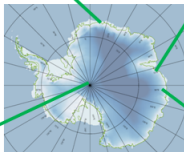
Figure: Annual mean density in the uppermost snow model layer (1979–1998) for CLM4.5 and CLM5.0, from van Kampenhout et al., 2017



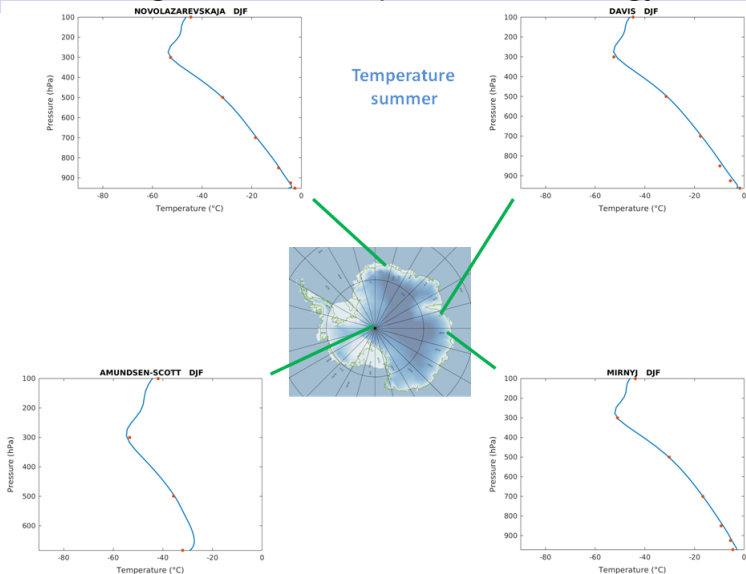
large scale atmospheric climatology



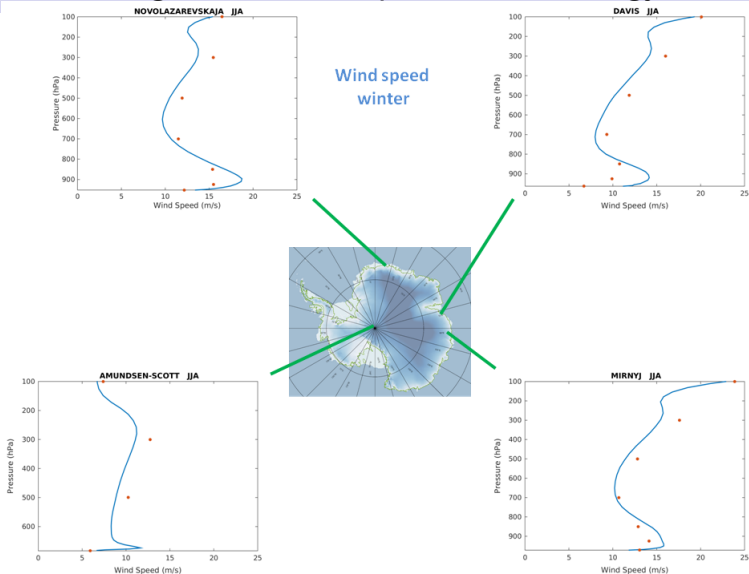
Temperature
winter



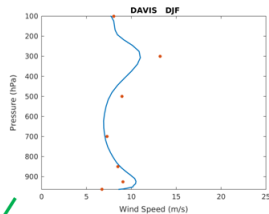
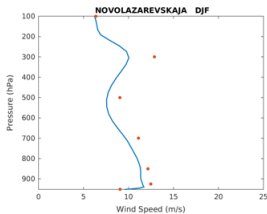
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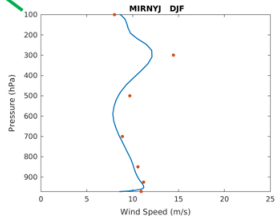
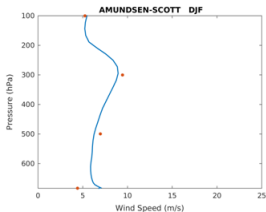
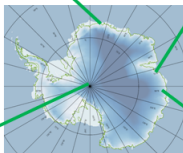
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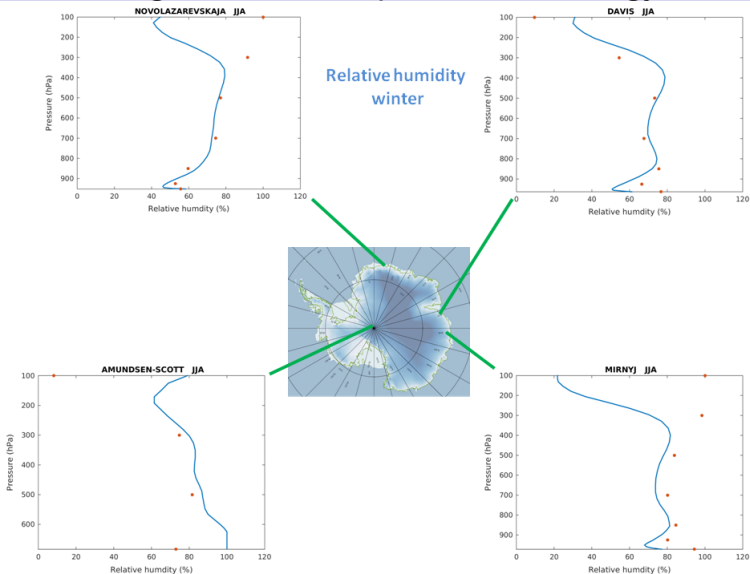
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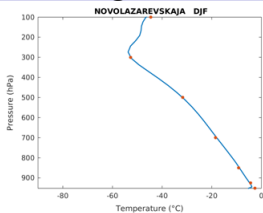
Wind speed
summer



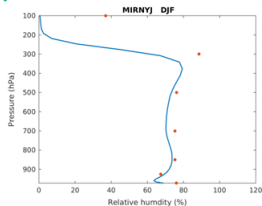
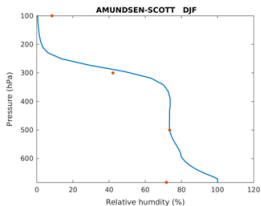
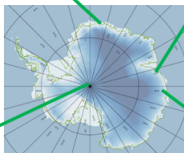
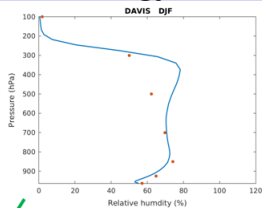
large scale atmospheric climatology



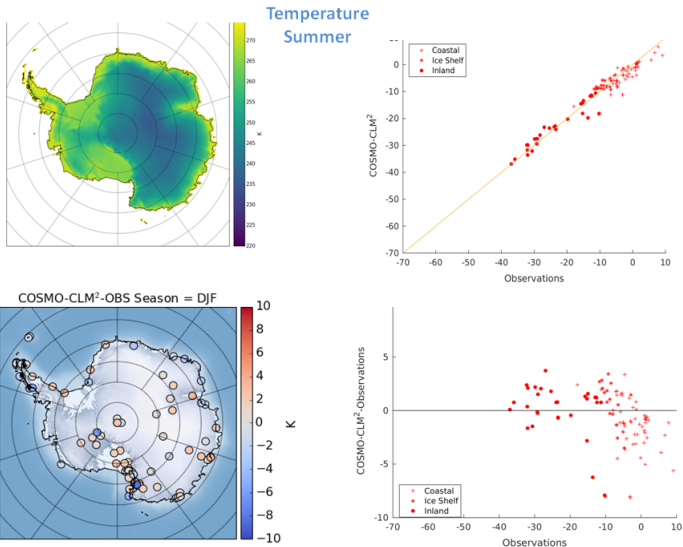
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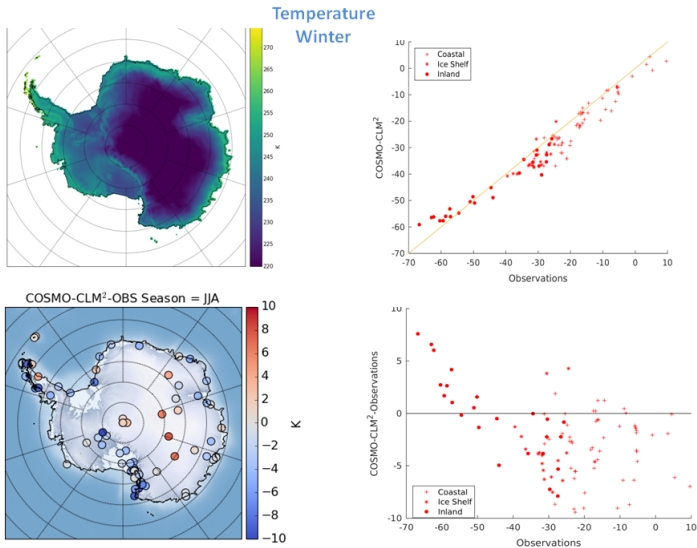
Relative humidity
summer



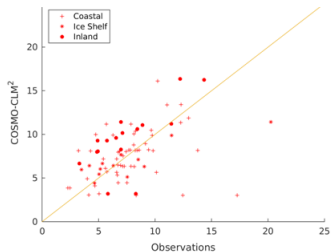
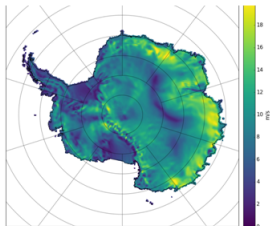
surface climate



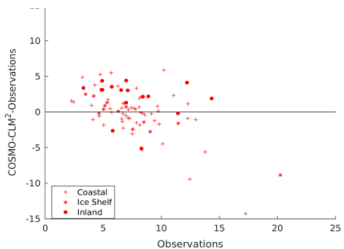
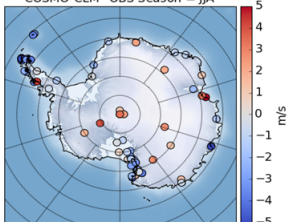
surface climate



surface climate

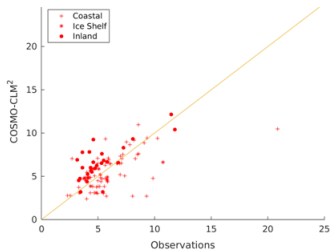
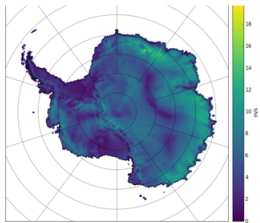
Wind speed
Winter

COSMO-CLM²-OBS Season = JJA

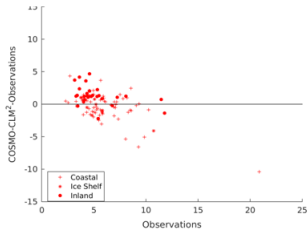
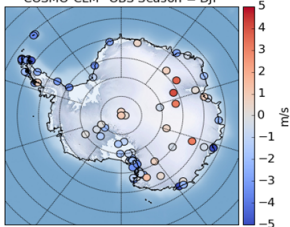


surface climate

Wind speed
Summer

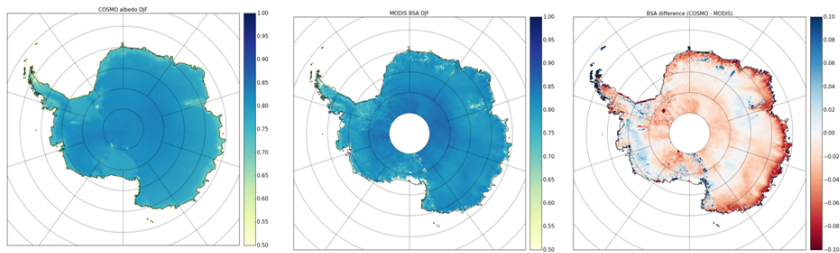


COSMO-CLM²-OBS Season = DJF

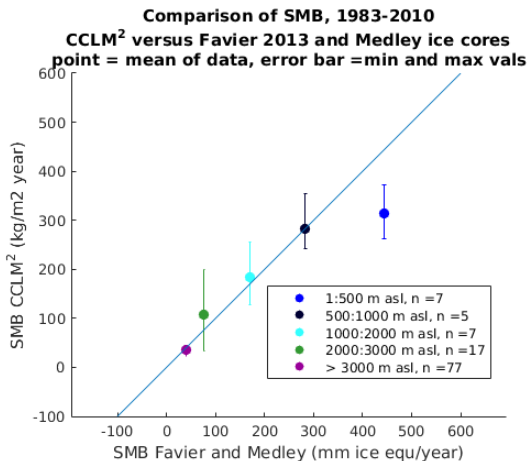


surface climate

Figure: DJF albedo COSMO - MODIS



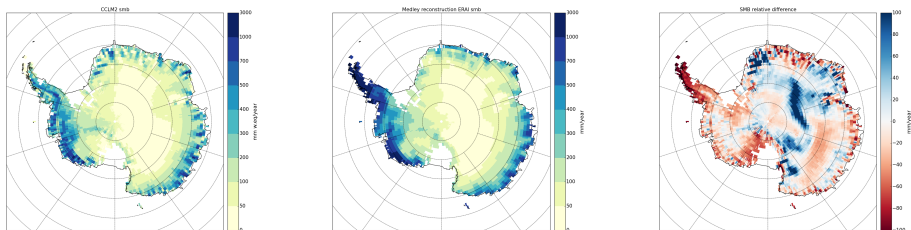
Surface Mass Balance



Surface Mass Balance

Cosmo SMB = snowfall - sublimation (- melt); integrated over 1987-2010

Figure: COSMO versus reconstructed surface mass balance



Conclusion and future work

- COSMO has been adapted adequately to represent the Antarctic climate
- 30 years run (1983-2017) , contribution to the CORDEX effort
- future work :
 - radiation and turbulent fluxes
 - relative humidity at the surface
 - surface mass balance
 - nesting over smaller domain, at higher resolution (2.8 km)
 - clouds and aerosols interactions → snowfall
 - blowing snow scheme → SMB, wind speeds

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