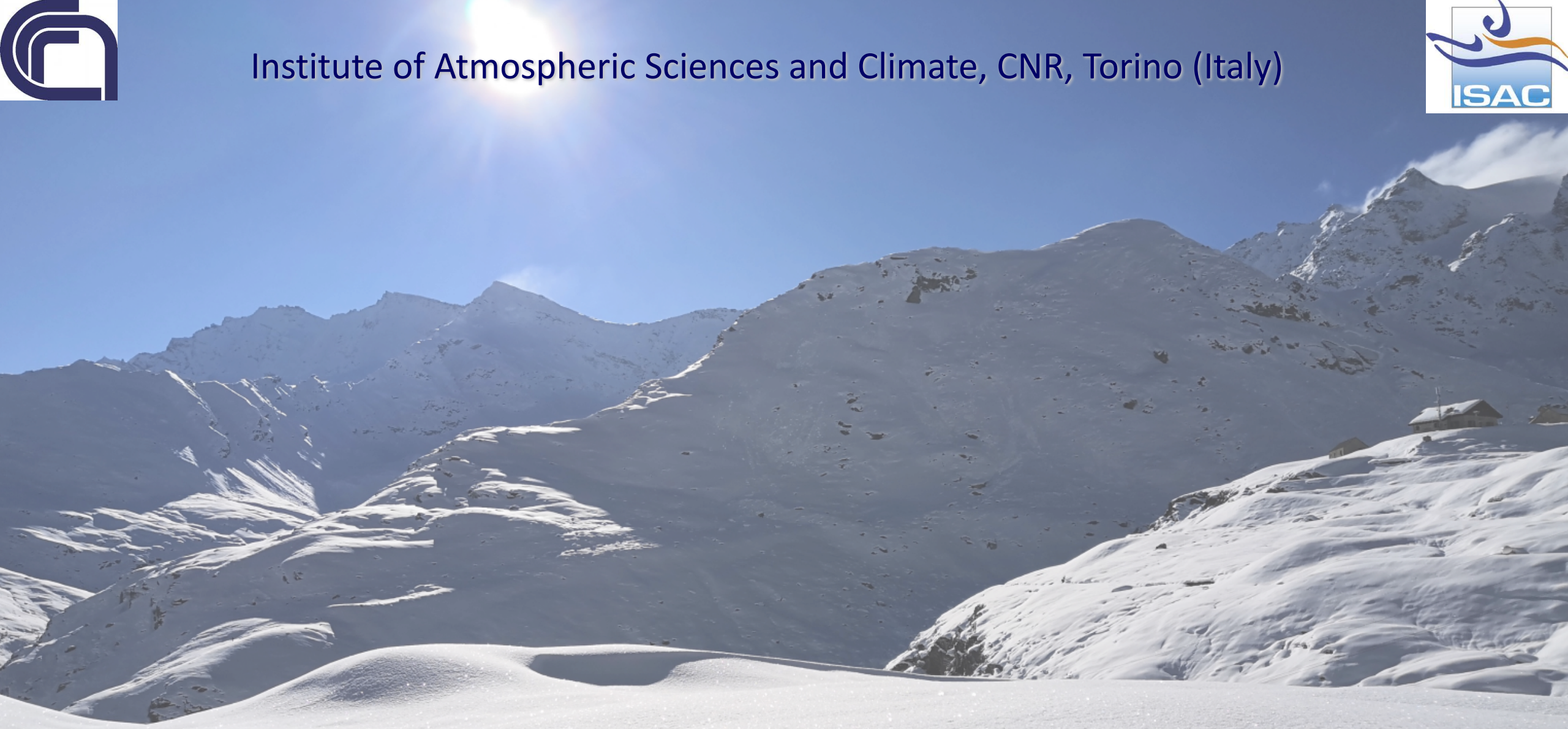
Institute of Atmospheric Sciences and Climate, CNR, Torino (Italy)

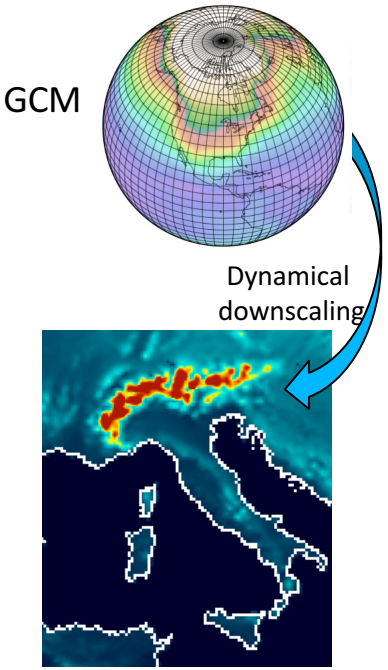


Mountain snowpack simulations across different spatial scales

Silvia Terzago, Elisa Palazzi, Jost von Hardenberg

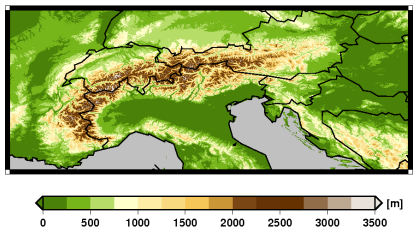
Global and regional climate models scales

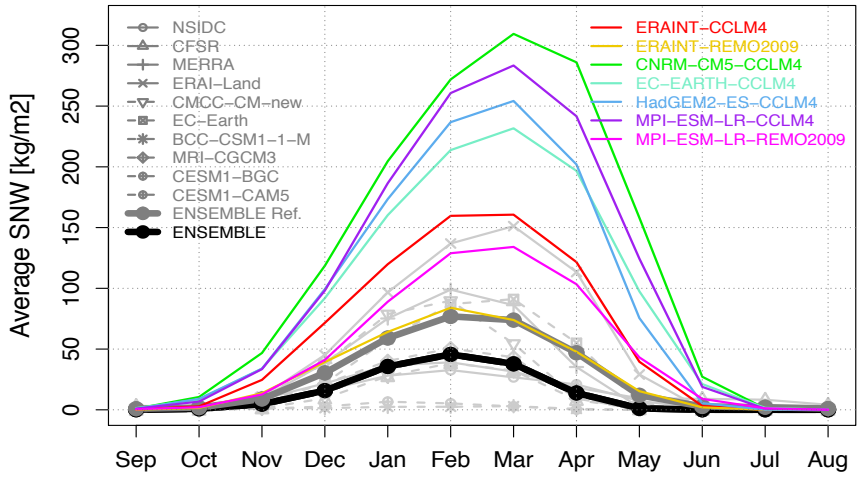
Global and Regional Climate Models simulations from latest available coordinated experiments (CMIP5, CORDEX) have horizontal resolution ~100-10 km
→ insufficient to represent small scale variability of ***snowpack*** in ***mountain*** areas, high elevations are not represented

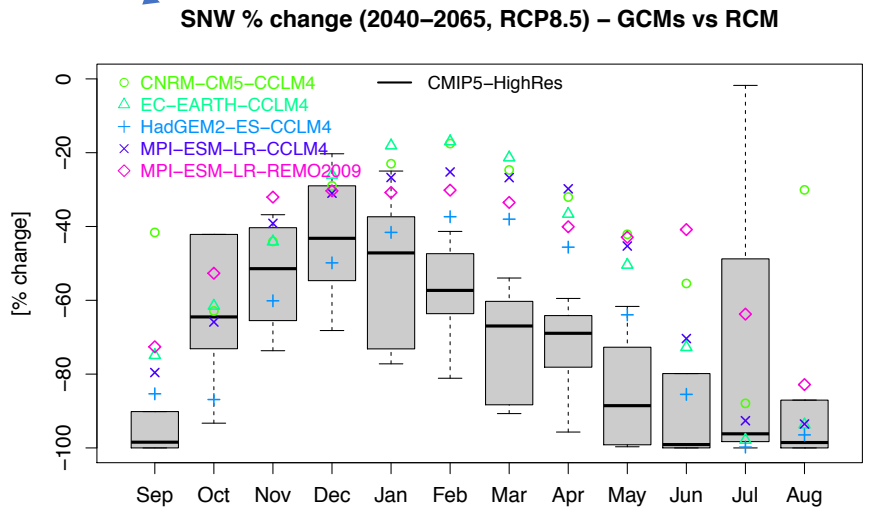


Large uncertainties are found in the representation of the Alpine **snow water equivalent climatology (1980-2005)** and the **expected changes (RCP8.5 2040-2085 vs. 1980-2005)**

EURO-CORDEX
CMIP5



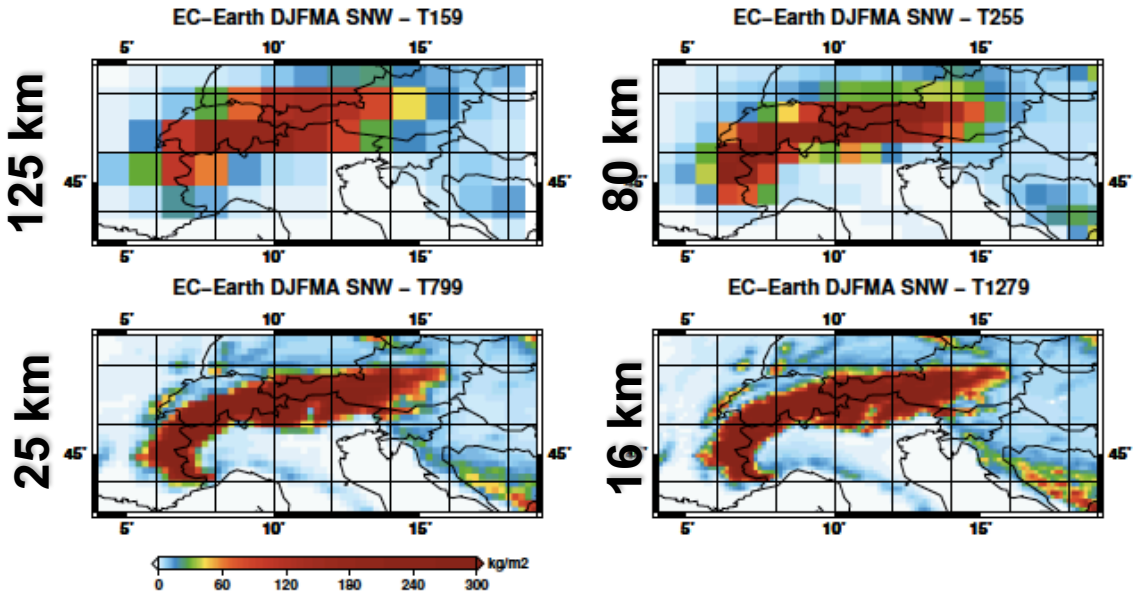




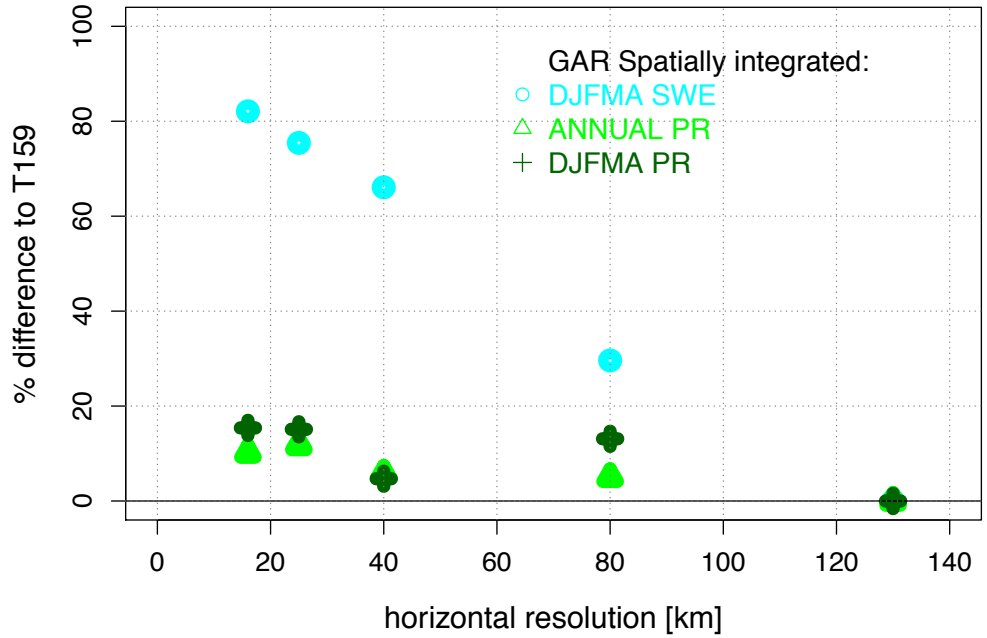
Terzago et al. 2017, The Cryosphere

Impact of the horizontal resolution on SWE

EC-Earth SWE climatologies at different resolutions:



Relative difference of the spatially-integrated DJFMA SNW (total precipitation) at each horizontal resolution with respect to the coarsest resolution (125 km)



CLIMATE SPHINX

http://wilma.to.isac.cnr.it/sphinx/

Km-scale resolution crucial to reliably represent mountain SWE

Perspectives for high-resolution SWE modeling

Regional Climate Model simulations with explicit representation of convection (i.e. Luthi et al., 2019)

- CON: Heavy computational costs
- PRO: Account for Snow feedback on climate

Land-surface/snow models driven by RCM meteorological outputs (off-line simulations) (i.e. Hanzer et al., 2019)

- CON: Snow-Albedo Feedback on climate not represented
- PRO: Bias in meteorological forcings can be accounted for and adjusted

Main open-questions:

- What is the ***snow model complexity*** optimal for this application?
- What is the ***snow model sensitivity*** to errors in the meteorological forcing?

Snow-model sensitivity experiment

We run 6 snow models at the site of Torgnon, 2160 m a.s.l. in NW Italian Alps

Snow model complexity ↑

SNOWPACK
GEOTOP
HTESSEL
UTOPIA
SMASH
S3M

12 experiments in which snow models are driven by meteorological forcing at gradually lower temporal and spatial resolution

- CONTROL RUN
- Temporal resolution
- Spatial resolution
- Bias-adjustment of coarse scale data

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More details on the Poster

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Thank you for your attention!