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Supplement of

Technical note: Evaluation of snow water equivalent from large-scale land-surface products over Italy

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S1 Percentage bias and statistical significance of the annual snow indicators

Figures S1 and S2 complement Figs. 3 and 4 of the main manuscript by adding percentage-bias panels and showing the statistical significance of the mean annual snow water equivalent (SWE) and snow cover duration (SCD) biases. They are provided as separate figures to preserve the legibility of the corresponding figures in the main manuscript.

As described in Sect. 4.1 of the main manuscript, percentage bias was calculated at each cell of the common 9 km grid as 100 × (Product − IT-SNOW)/IT-SNOW, where Product and IT-SNOW denote the corresponding mean annual SWE or SCD values averaged over the 14 snow years. Percentage bias should be interpreted together with the corresponding absolute bias because a small IT-SNOW reference value can cause even a small absolute difference to produce a large percentage value and saturate the colour scale.

Finally, the statistical significance of the mean annual SWE and SCD biases was assessed to determine whether the mean product–reference difference over all the snow years was distinguishable from zero given its interannual variability. At each common-grid cell, the time series of annual mean SWE values from each product were paired by snow year with the corresponding IT-SNOW values, and a two-tailed paired Student's *t*-test was applied to the resulting annual differences. The same procedure was applied to the time series of annual SCD values. Because the tests were repeated across all grid cells, the resulting *p* values were subjected to Benjamini–Hochberg false-discovery-rate screening separately for each product and indicator, using $\alpha_{FDR} = 0.10$ (Benjamini and Hochberg, 1995; Wilks, 2016). This procedure controls the expected proportion of false discoveries among the cells identified as significant. Stippling marks cells where the null hypothesis of a zero mean annual difference was not rejected after screening; at these cells, the paired annual values provide insufficient evidence of a non-zero mean bias. The resulting significance mask is shown in both the absolute- and percentage-bias panels because these panels represent the same underlying product–reference differences.

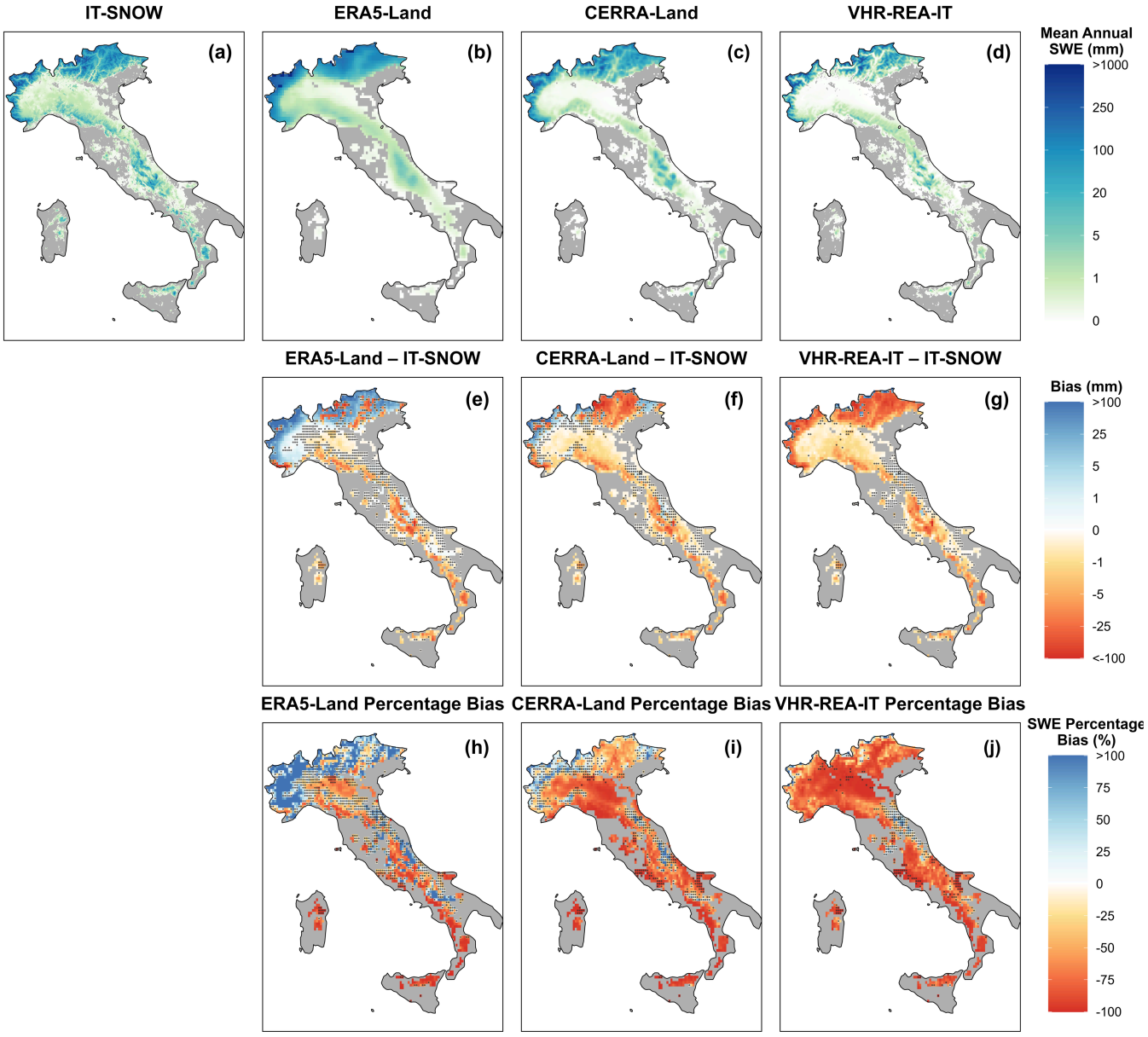


Figure S1. Mean annual snow water equivalent (SWE) for the period September 2010–August 2024. (a–d) Mean annual SWE from IT-SNOW, ERA5-Land, CERRA-Land, and VHR-REA_IT at their respective native resolutions. (e–g) Bias (Product − IT-SNOW), in millimetres, on the common 9-km grid. (h–j) Percentage bias on the common 9 km grid. Stippling in panels (e–j) denotes cells where the mean bias does not differ significantly from zero after false-discovery-rate screening. Grey shading denotes cells outside the analysis domain.

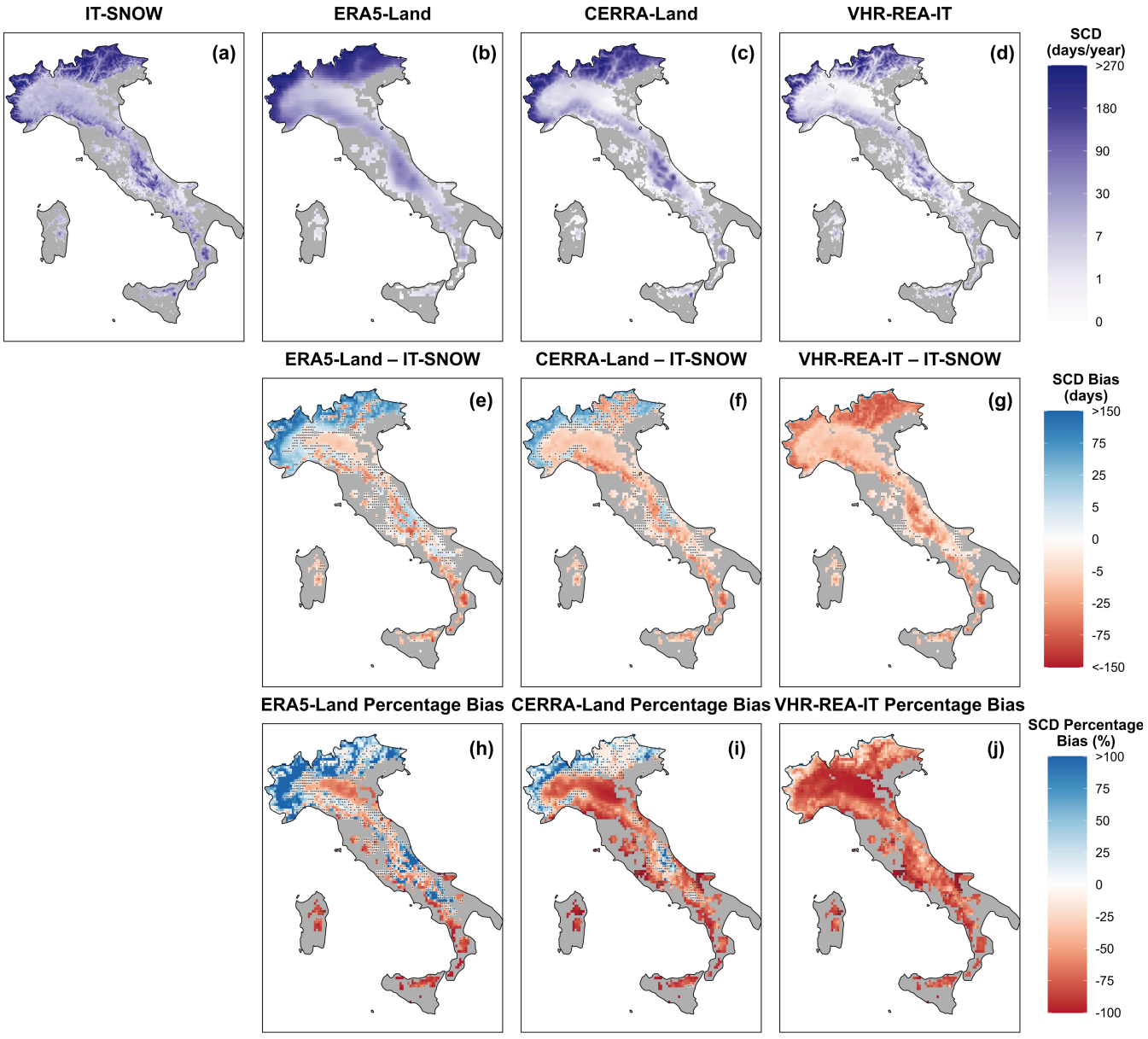


Figure S2. Mean annual snow cover duration (SCD) for the period September 2010–August 2024. (a–d) Mean annual SCD from IT-SNOW, ERA5-Land, CERRA-Land, and VHR-REA_IT at their respective native resolutions. (e–g) Bias (Product − IT-SNOW), in days per year, on the common 9-km grid. (h–j) Percentage bias on the common 9 km grid. Stippling in panels (e–j) denotes cells where the mean bias does not differ significantly from zero after false-discovery-rate screening. Grey shading denotes cells outside the analysis domain.

S2 Statistical significance of the mean annual precipitation and temperature biases

Figures S3 and S4 complement Figs. B1 and B2 of the main manuscript by extending the cellwise significance analysis described in Sect. S1 to biases in mean annual precipitation and mean annual 2-m air temperature relative to SCIA (Sect. 4.2 of the main manuscript). This allows the mapped mean biases to be evaluated relative to interannual variability over all the snow years.

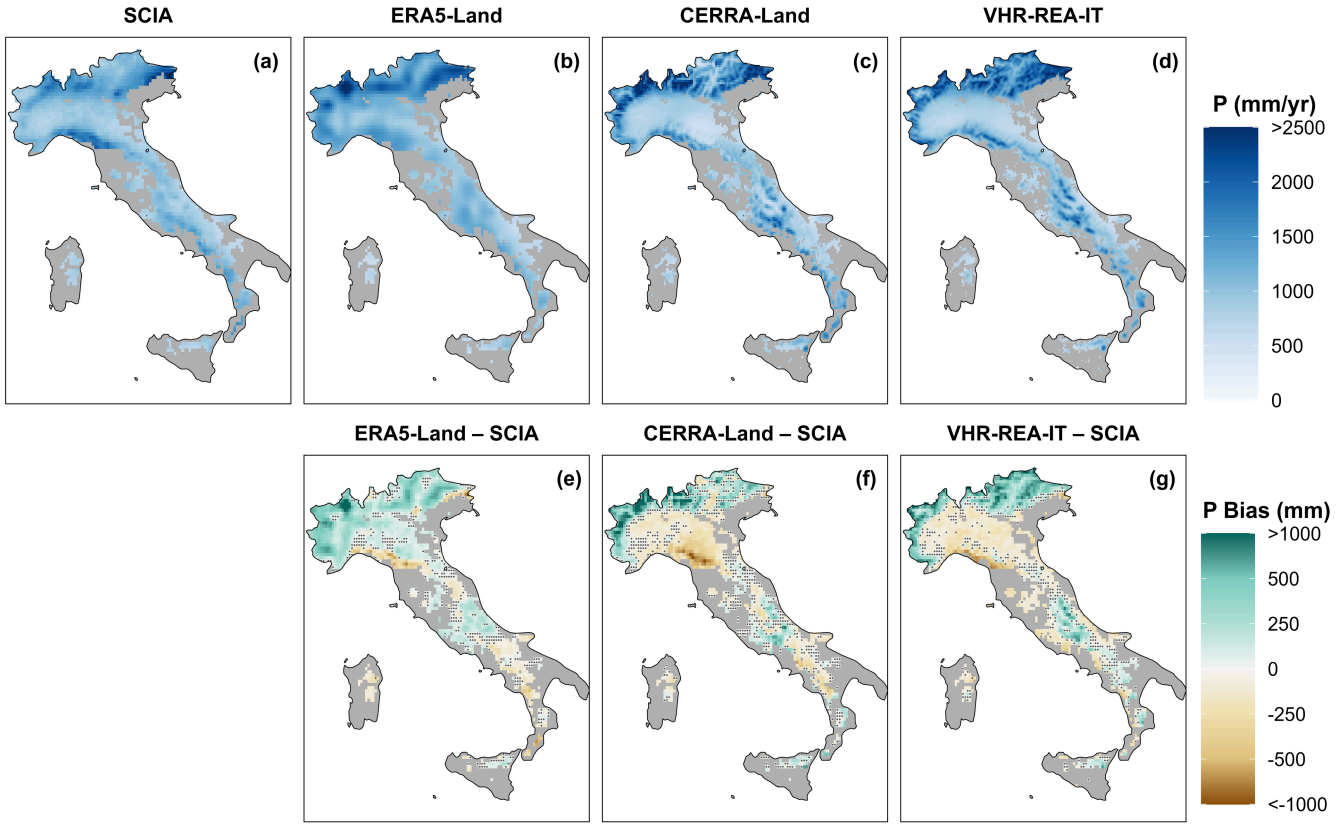


Figure S3. Mean annual precipitation for the period September 2010–August 2024. (a–d) Mean annual precipitation from SCIA, ERA5-Land, CERRA-Land, and VHR-REA_IT at their respective native resolutions. (e–g) Bias (Product − SCIA), in millimetres per year, on the common 9-km grid. Stippling in panels (e–g) denotes cells where the mean bias does not differ significantly from zero after false-discovery-rate screening. Grey shading denotes cells outside the analysis domain.

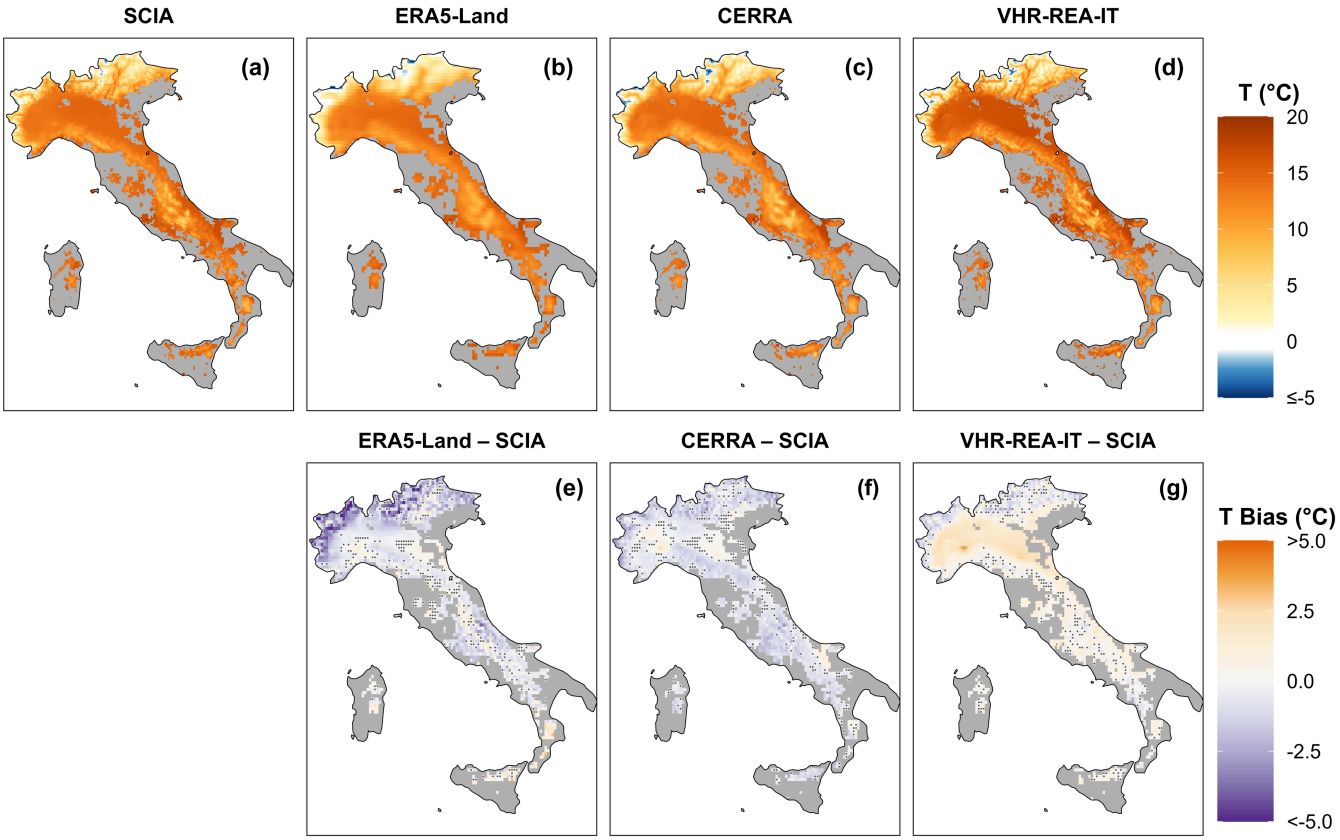


Figure S4. Mean annual 2-m air temperature for the period September 2010–August 2024. (a–d) Mean annual 2-m air temperature from SCIA, ERA5-Land, CERRA-Land, and VHR-REA_IT at their respective native resolutions. (e–g) Bias (Product − SCIA), in degrees Celsius, on the common 9-km grid. Stippling in panels (e–g) denotes cells where the mean bias does not differ significantly from zero after false-discovery-rate screening. Grey shading denotes cells outside the analysis domain.

References

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