Precipitation over southern Africa: Is there consensus among GCMs, RCMs and observational data?

Table S1: Observational datasets used.

Dataset	Resolution	Frequency	Type	Period	Reference
ARC.v2	0.1°	Daily total	Satellite	1983-present	(Novella and Thiaw, 2013)
PERSIANN-CDR	0.25°	Daily total	Satellite	1983-present	(Ashouri et al., 2015)
CMAP	2.5°	Monthly mean	Satellite	1979-present	(Xie and Arkin, 1997)
TAMSAT.v3	0.0375 °	Daily total	Satellite	1983-present	(Tarnavsky et al., 2014; Maidment et al., 2017)
GPCP.v2	2.5°	Monthly mean	Satellite	1979-2015	(Adler et al., 2012)
CRU TS4.01	0.5°	Monthly total	Gauge-Based	1901-2016	(Harris et al., 2014)
GPCC.v7	0.5°	Monthly total	Gauge-Based	1901-2013	(Schneider et al., 2015)
PREC/L	0.5°	Monthly mean	Gauge-Based	1948-2012	(Chen et al., 2002)
UDEL.v4.01	0.5°	Monthly total	Gauge-Based	1900-2014	(Willmott and Matsuura, 1995)
CPC-Unified	0.5°	Daily total	Gauge-Based	1979-present	(Chen et al., 2008)
CHIRPS.v2	0.05°	Daily total	Satellite	1981-present	(Funk et al., 2015)
ERA5	~0.28125 °	Hourly	Reanalysis	1979-present	(C3S, 2017; Hersbach et al., 2020)

Table S2: General circulation models participating in the Coupled Model Intercomparison Project Phase 5 (CMIP5) that were used as forcing fields in the Coordinated Regional Climate Downscaling Experiment (CORDEX) – Africa historical simulations. Data for precipitation were retrieved from the Earth System Grid Federation (https://esgf-data.dkrz.de/projects/esgf-dkrz/). Data for temperature at 850 hPa were retrieved from the Climate Data Store (https://cds.climate.copernicus.eu/#!/home).

GCM	Institute	Ensemble	Latitude Res.	Longitude Res.	References
CanESM2	Canadian Centre for Climate Modelling and Analysis (CCCma)	r1i1p1	2.7906 °	2.8125 °	(CCCma, 2017)
CNRM-CM5	Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique (CERFACS)	r1i1p1	1.40008 °	1.40625 °	(Voldoire et al., 2013)
CSIRO-Mk3-6-0	Commonwealth Scientific and Industrial Research Organization (CSIRO)	r1i1p1	1.8653 °	1.875 °	(Jeffrey et al., 2013)
EC-EARTH	Sveriges Meteorologiska och Hydrologiska Institut (SMHI),	r1i1p1 r12i1p1	1.1215 °	1.125 °	(Hazeleger et al., 2010)

	Danmarks Meteorologiske Insitut (DMI)				
GFDL-ESM-2M GFDL-ESM-2G	National Oceanic and Atmospheric Administration (NOAA)	r1i1p1	2.0225^{o}	2.5^{o}	(Dunne et al., 2012)
HadGEM2-ES	Met Office Hadley Centre	r1i1p1	1.25^{o}	1.875^{o}	(Collins et al., 2011)
IPSL-CM5A-MR IPSL-CM5A-LR	Institut Pierre Simon Laplace (IPSL)	r1i1p1	1.2676^{o} 1.894737^{o}	2.5^{o} 3.75^{o}	(Dufresne et al., 2013)
MIROC5	Atmospheric and Ocean Research Institute (AORI)	r1i1p1	1.4008^{o}	1.40625^{o}	(Watanabe et al., 2010)
MPI-ESM-LR	Max Planck Institute for Meteorology (MPI)	r1i1p1	1.8653^{o}	1.875^{o}	(Giorgetta et al., 2013)
NorESM1-M	EarthClim	r1i1p1	1.894737^{o}	2.5^{o}	(Bentsen et al., 2013)

Table S3: General circulation models participating in the Coupled Model Intercomparison Project Phase 6 (CMIP6). Data were retrieved from the Earth System Grid Federation (https://esgf-data.dkrz.de/projects/esgf-dkrz/). The CMIP6 models used were selected in accordance to their predeseccor CMIP5, so that the 2 ensembles (CMIP5 and CMIP6) would be comparable.

GCM	Institute	Ensemble	Latitude Res.	Longitude Res.	References
CanESM5	Canadian Centre for Climate Modelling and Analysis (CCCma)	r1i1p1f1	2.8^{o}	2.8^{o}	(Swart et al., 2019)
CNRM-CM6-1	Centre Europeen de Recherche et de Formation Avancee en Calcul Scientifique (CERFACS)	r1i1p1f2	1.4^{o}	1.4^{o}	(Voldoire et al., 2019)
EC-EARTH3	Sveriges Meteorologiska och Hydrologiska Institut (SMHI), Danmarks Meteorologiske Insitut (DMI)	r1i1p1f1	0.7^{o}	0.7^{o}	(Massonnet et al., 2020)
GFDL-ESM4	National Oceanic and Atmospheric Administration (NOAA)	r1i1p1f1	1^{o}	1.3^{o}	(Held et al., 2019)
IPSL-CM6A-LR	Institut Pierre Simon Laplace (IPSL)	r1i1p1f1	1.3^{o}	2.5^{o}	-

MIROC6	Atmospheric and Ocean Research Institute (AORI)	r1i1p1f1	1.4 ^{o}	1.4 ^{o}	(Tatebe et al., 2019)
MPI-ESM-2-LR	Max Planck Institute for Meteorology (MPI)	r1i1p1f1	1.9 ^{o}	1.9 ^{o}	(Mauritsen et al., 2019)
NorESM2-LM	EarthClim	r1i1p1f1	1.894737 ^{o}	2.5 ^{o}	(Seland et al., 2020)

Table S4: Regional climate model simulations participating in the Coordinated Regional Climate Downscaling Experiment (CORDEX) – Africa ensemble used in the current analysis. Data were retrieved from the Earth System Grid Federation (https://esgf-data.dkrz.de/projects/esgf-dkrz/).

RCM	Institute	Forcing	Realization	References
CCLM4-8-17.v1	Climate Limited-area Modelling Community (CLMcom)	CNRM-CM5 EC-EARTH HadGEM2-ES MPI-ESM-LR	r1i1p1 r12i1p1 r1i1p1 r1i1p1	(COSMO, 2020)
RACMO22T.v1	Royal Netherlands Meteorological Institute (KNMI)	EC-EARTH EC-EARTH HadGEM2-ES	r1i1p1 r12i1p1 r1i1p1	(van Meijgaard et al., 2008)
RCA4.v1	Swedish Meteorological and Hydrological Institute (SHMI)	CanESM2 CNRM-CM5 CSIRO-Mk3-6-0 EC-EARTH EC-EARTH IPSL-CM5A-MR HadGEM2-ES MPI-ESM-LR NorESM1-M GFDL-ESM2M MIROC5	r1i1p1 r1i1p1 r1i1p1 r12i1p1 r1i1p1 r1i1p1 r1i1p1 r1i1p1 r1i1p1 r1i1p1 r1i1p1	(Samuelsson et al., 2015)
REMO2009.v1	Max Planck Institut (MPI) and Climate Service Center Germany (CSC)	EC-EARTH MPI-ESM-LR IPSL-CM5A-MR MIROC5 HadGEM2-ES GFDL-ESM2G	r12i1p1 r1i1p1 r12i1p1 r1i1p1 r1i1p1 r1i1p1	(Jacob et al., 2012)
CRCM5.v1	Canadian Centre for Climate Modelling and Analysis (CCCma)	CanESM2 MPI-ESM-LR	r1i1p1 r1i1p1	(Scinocca et al., 2015)

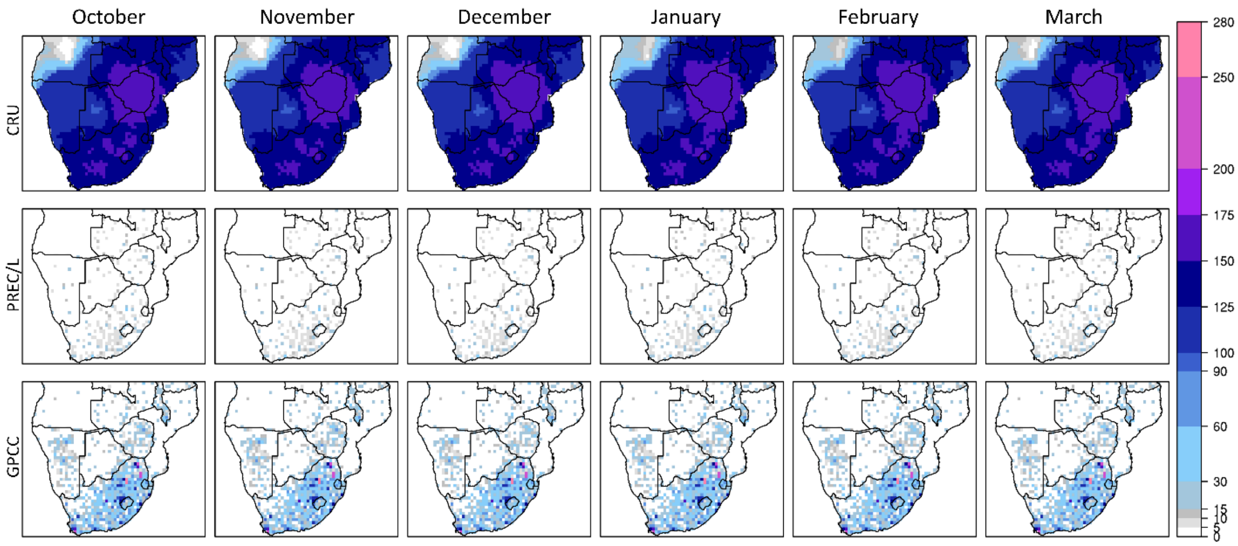

Figure S1. Total number of reporting stations/rain-gauges for each month during the period 1986-2005, used in the interpolation process of each gauge-based product (CRU, PREC/L, GPCC).

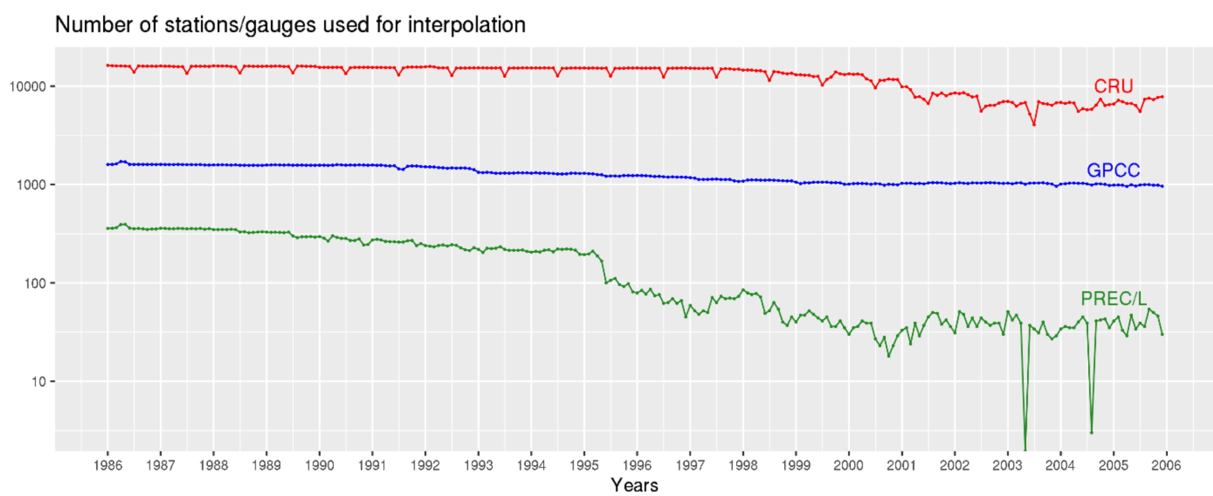

Figure S2. Timeseries of the number of stations/rain-gauges used in 3 gauge-based products, over the southern Africa region (10 ºE to 42 ºE and 10 ºS to 35 ºS).

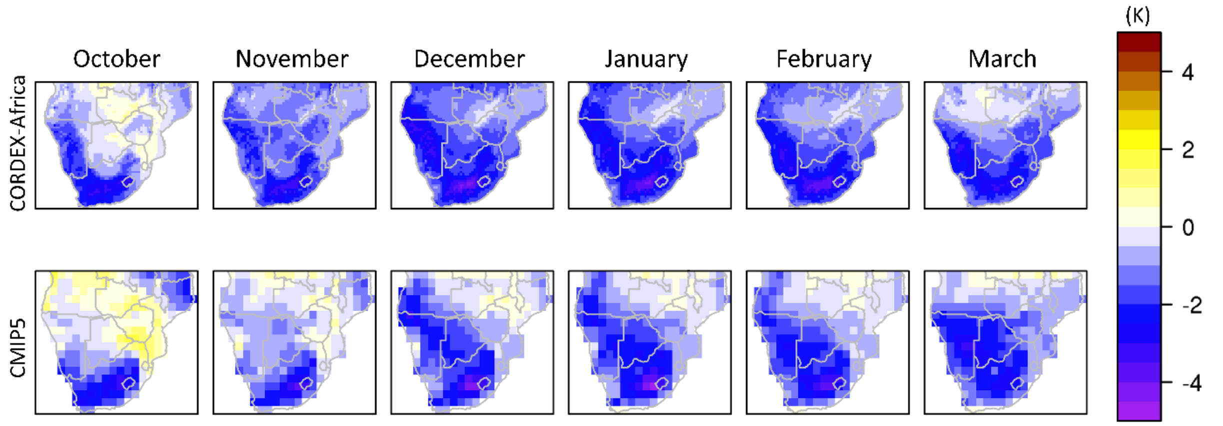

Figure S3. Potential temperature differences at 850 hPa from ERA5. Upper row: CORDEX-Africa – ERA5. Bottom row: CMIP5 – ERA5. CMIP5: Coupled Model Intercomparison Project Phase 5, CORDEX-Africa: Coordinated Regional Climate Downscaling Experiment – Africa domain.

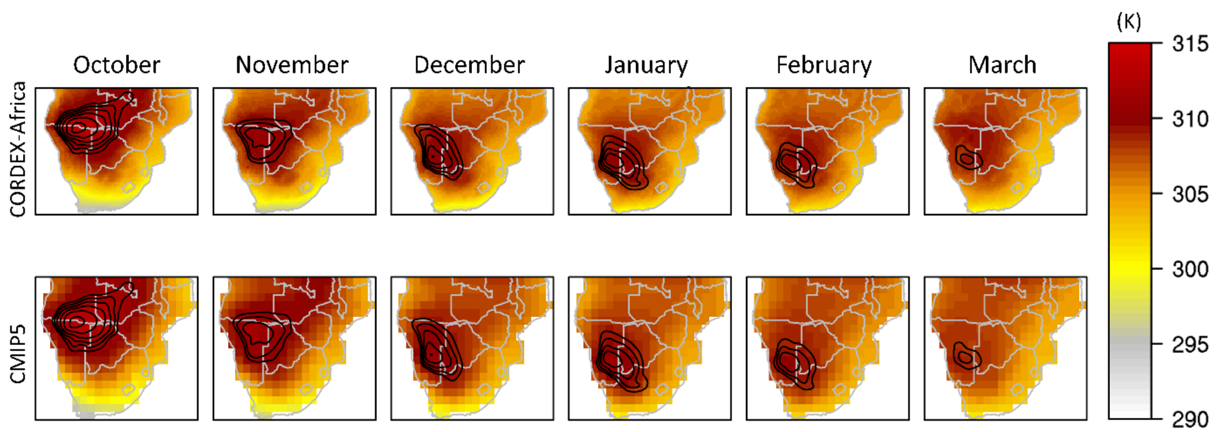

Figure S4. Potential temperature at 850 hPa for CORDEX-Africa (top) and CMIP5 (bottom). Contours display potential temperature at 850 hPa from ERA5. The first contour is at 311 oK with an interval of 0.5 oK. In the CMIP5 ensemble CSIRO, EC-EARTH r1i1p1 and MIROC were not included because ta850 was not available in the Climate Data Store. CMIP5: Coupled Model Intercomparison Project Phase 5, CORDEX-Africa: Coordinated Regional Climate Downscaling Experiment – Africa domain.

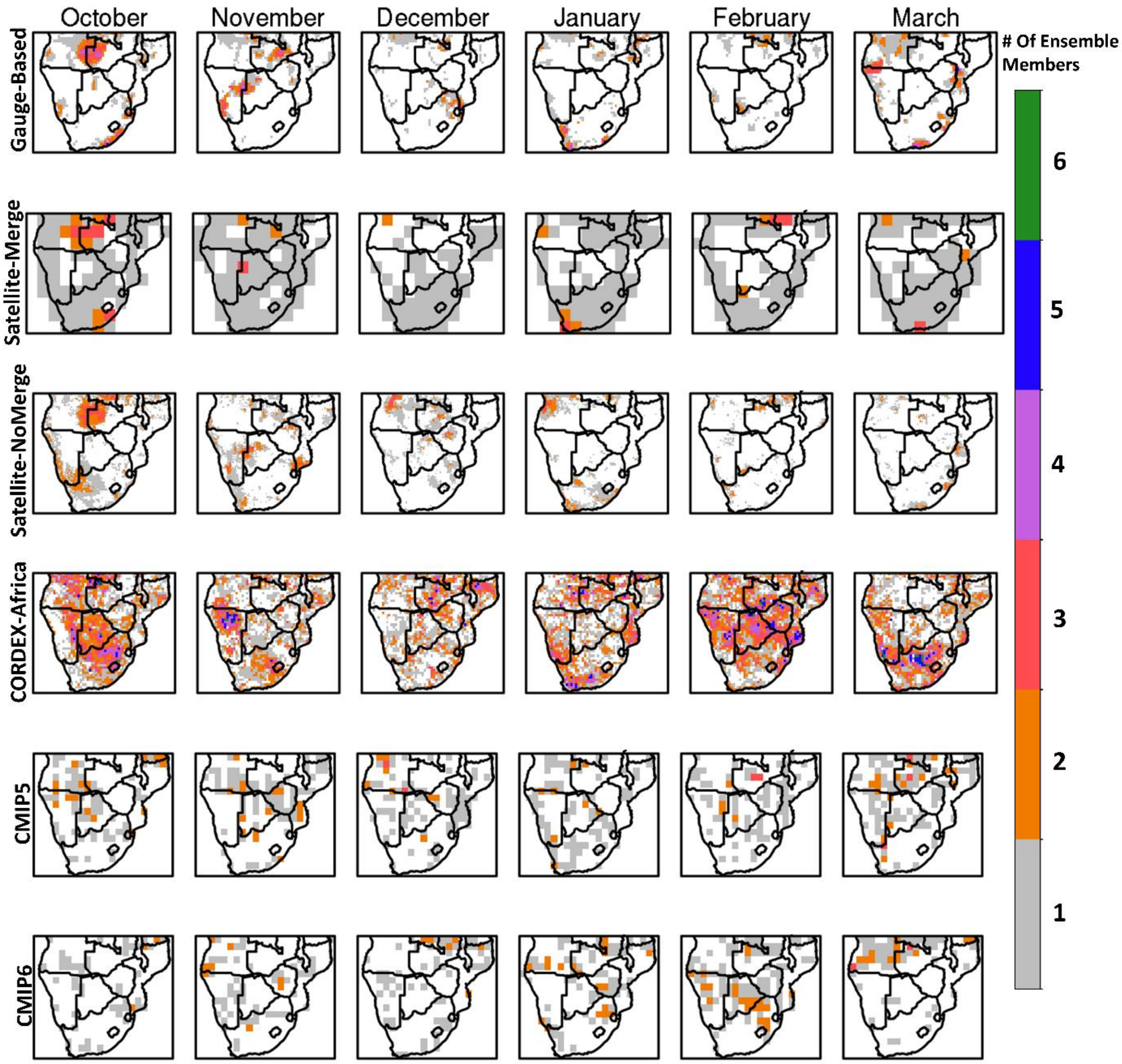

Figure S5. Number of ensemble members yielding statistically significant results for monthly precipitation trends based on the Mann-Kendall test (a=0.05).

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