PROBA-V reprocessing

Validation of Atmospheric Corrections scheme

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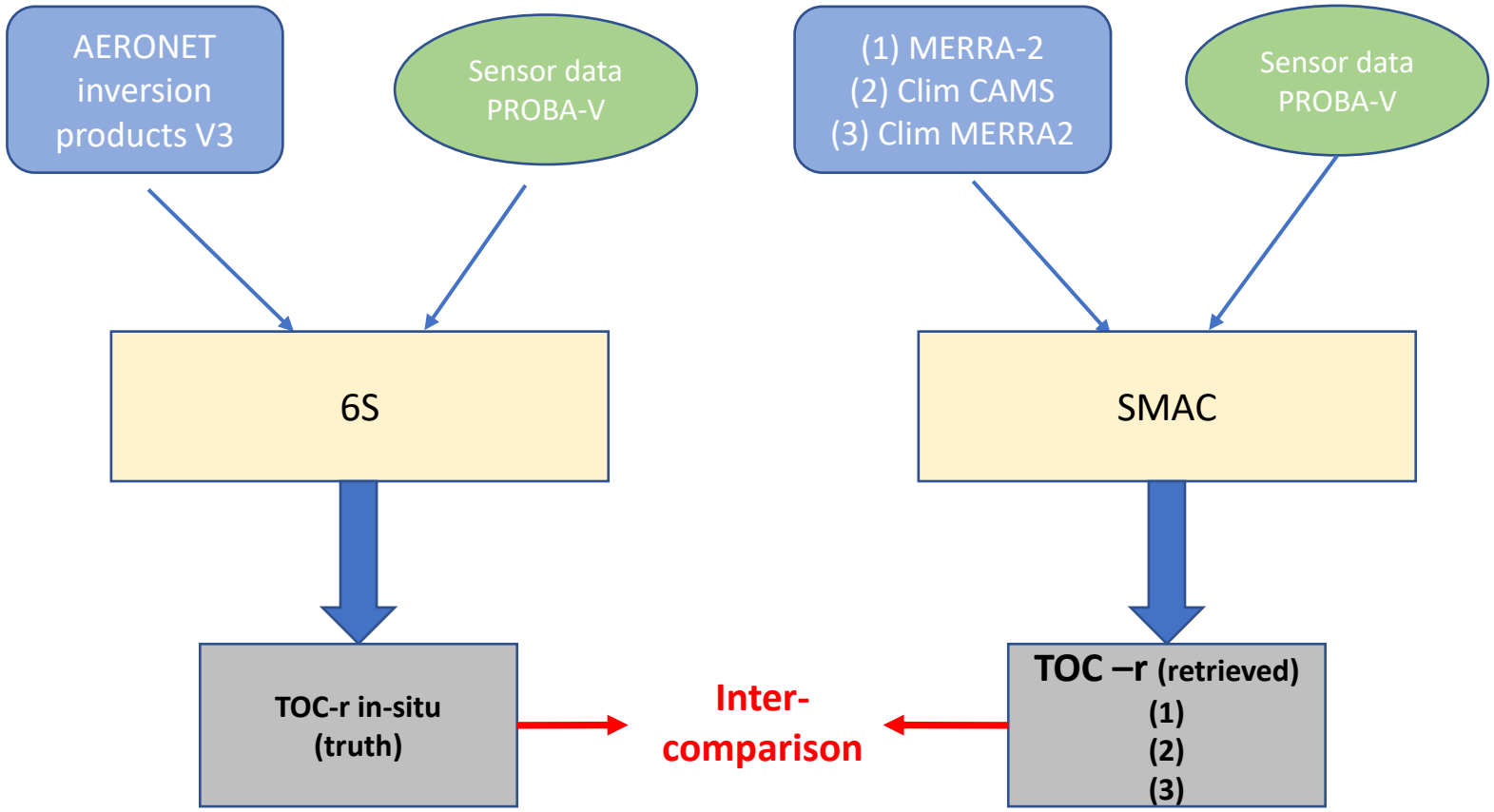
Data and AC modules

- Inputs: PROBA_V (4 bands) TOA reflectances, sun_view geometry, cloud mask. Year 2018. 11 extractions over AERONET sites (9x9 pixels)
- AC modules & ancillary data:
  - Processor: SMAC
  - Ancillary data:
    - MERRA2 daily product (1 hour resolution)
    - CAMS Climatology (per decade, 30p and 50p)
    - MERRA2 climatology (per decade, 30p and 50p)
  - « Truth » or reference: 6S and AERONET Inversion products Version 3
- Outputs: TOC reflectances in the sensor solar-view geometry (not corrected from BRDF).

Methodology (ACIX)



With: $\Delta toc\_r_i = \left(toc\_r_i^{processor} - toc\_r_i^{Aeronet}\right)$

Metrics

Accuracy

$$A = \frac{1}{N}\left(\sum_{i=1}^{N} \Delta toc\_r_i\right)$$

Precision

$$P = \sqrt{\frac{1}{N-1}\left(\sum_{i=1}^{N}\left(\Delta toc\_r_i - A\right)^2\right)}$$

Uncertainty

$$U = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\Delta toc\_r_i\right)^2}$$

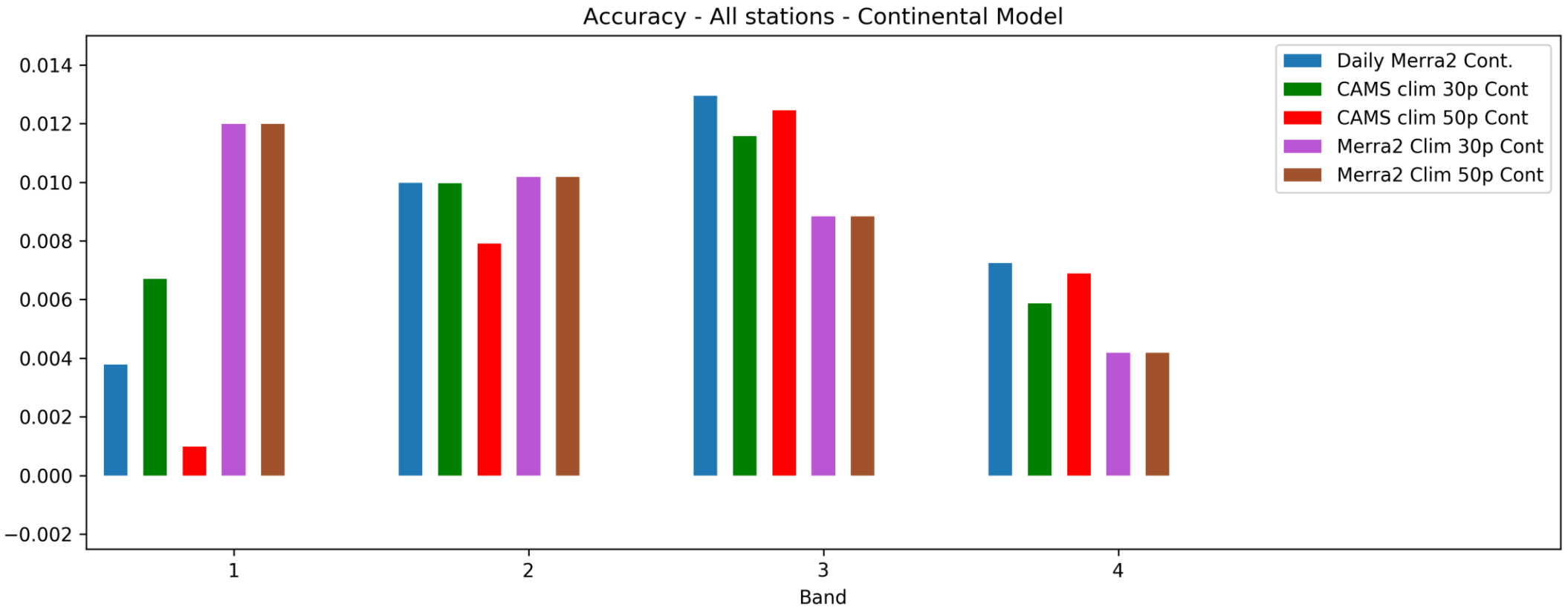
Sensitivity to aerosols ancillary data

- AOT (550 nm) can be from:
  - MERRA-2 1-hour resolution (daily netcdf file) *[daily MERRA2]*
  - Climatology:
    - Built by VITO from CAMS reanalysis (about 10 years) by decade:
      - 30th percentile *[CAMS clim 30p]*
      - 50th percentile *[CAMS clim 50p]*
    - Built from MERRA-2 using same methodology (*[MERRA2 clim 30p and MERRA2 clim 50p]*)
- Only pixels with AOT<1 and SZA<65° are kept

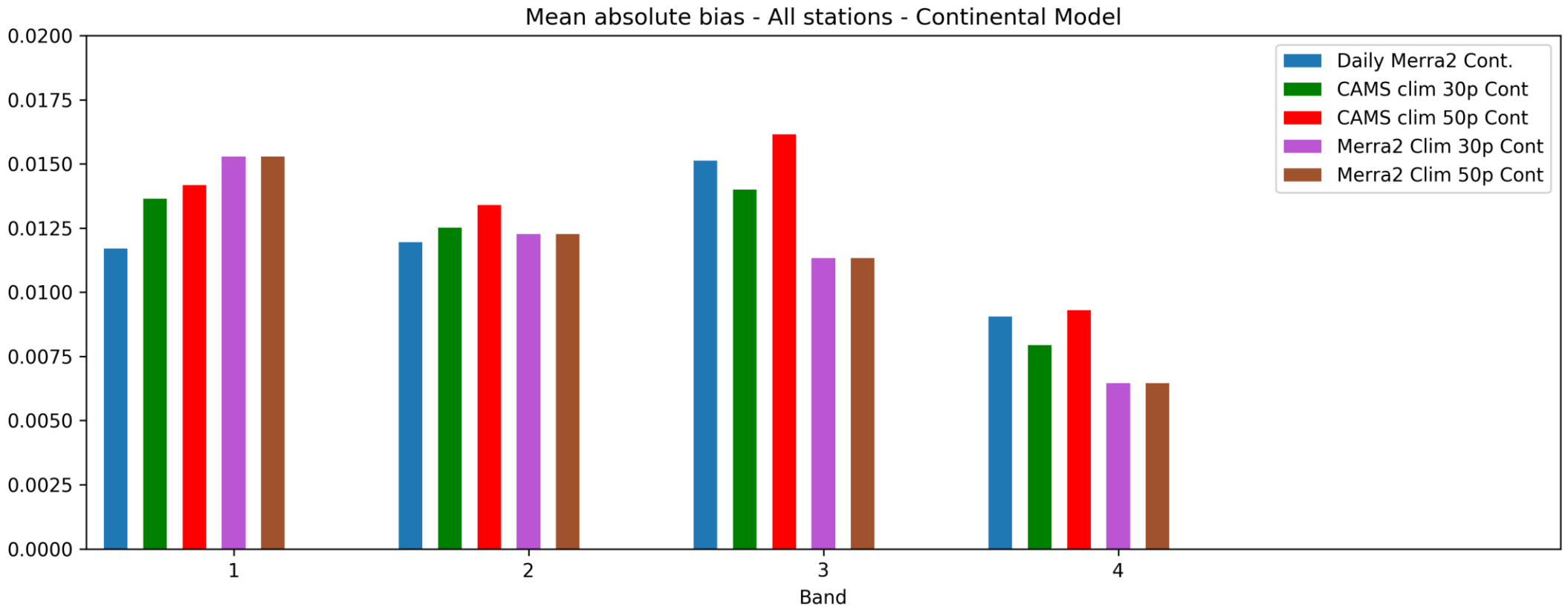
Daily vs. Climatology

First we test the optical thickness input by assuming the aerosol model (Continental model – suffix *[Cont]*)

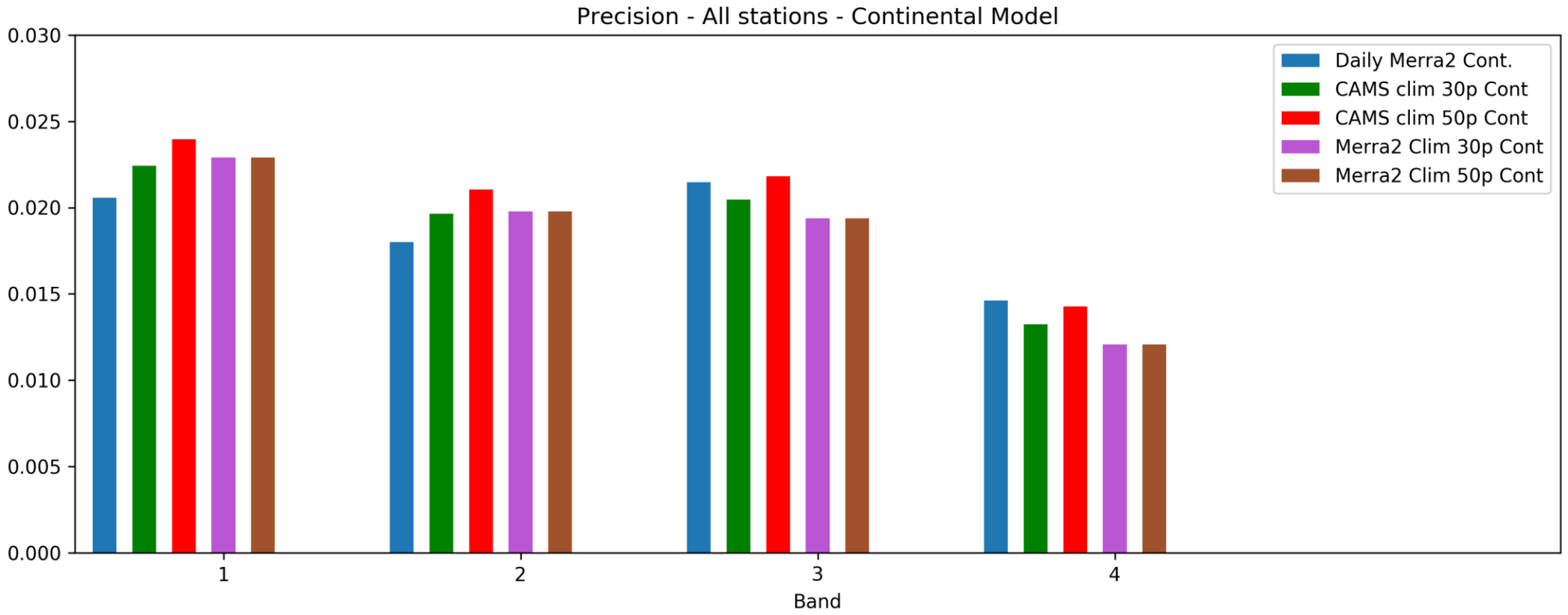
Accuracy (mean bias)



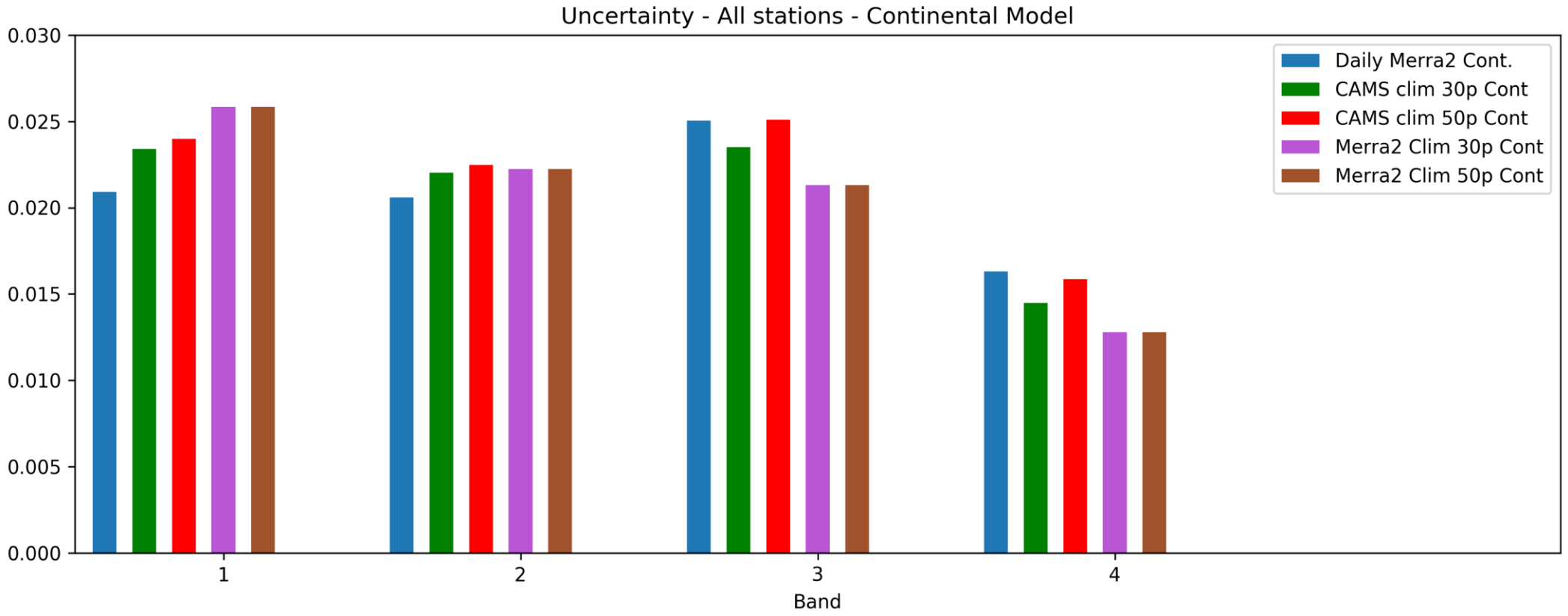
Mean absolute bias



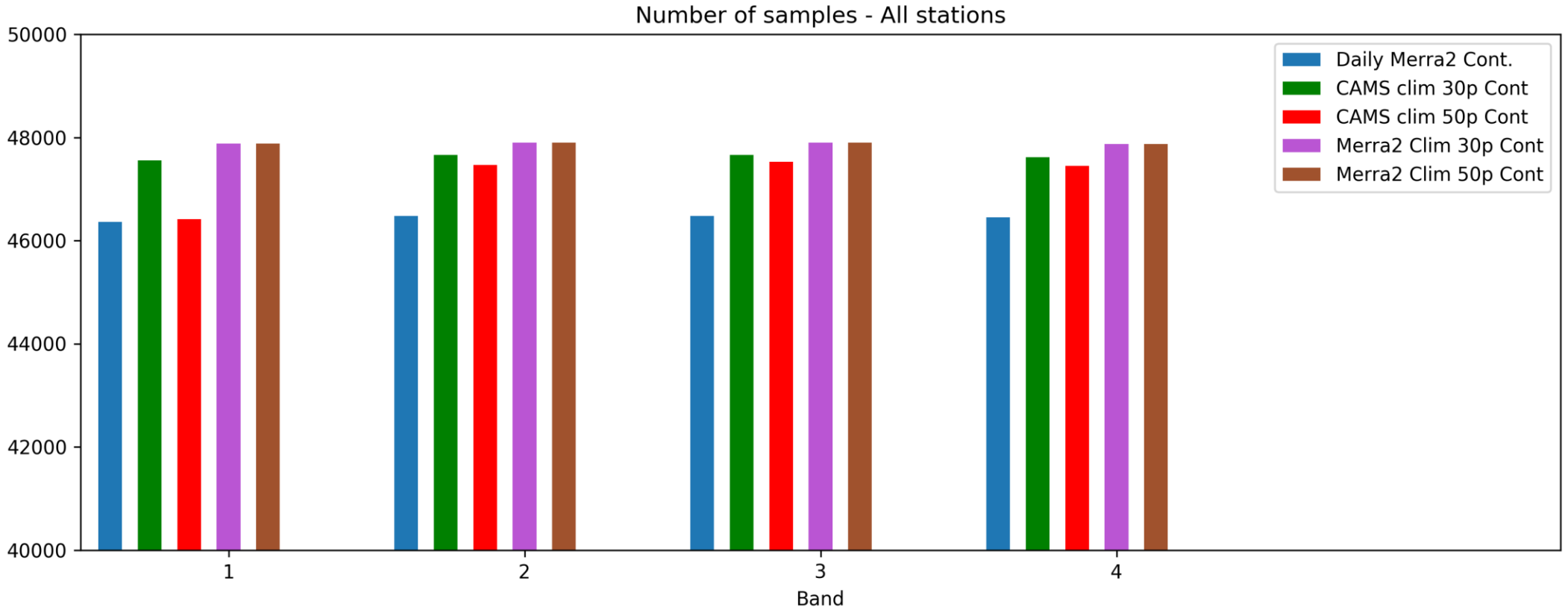
Precision (standard deviation)



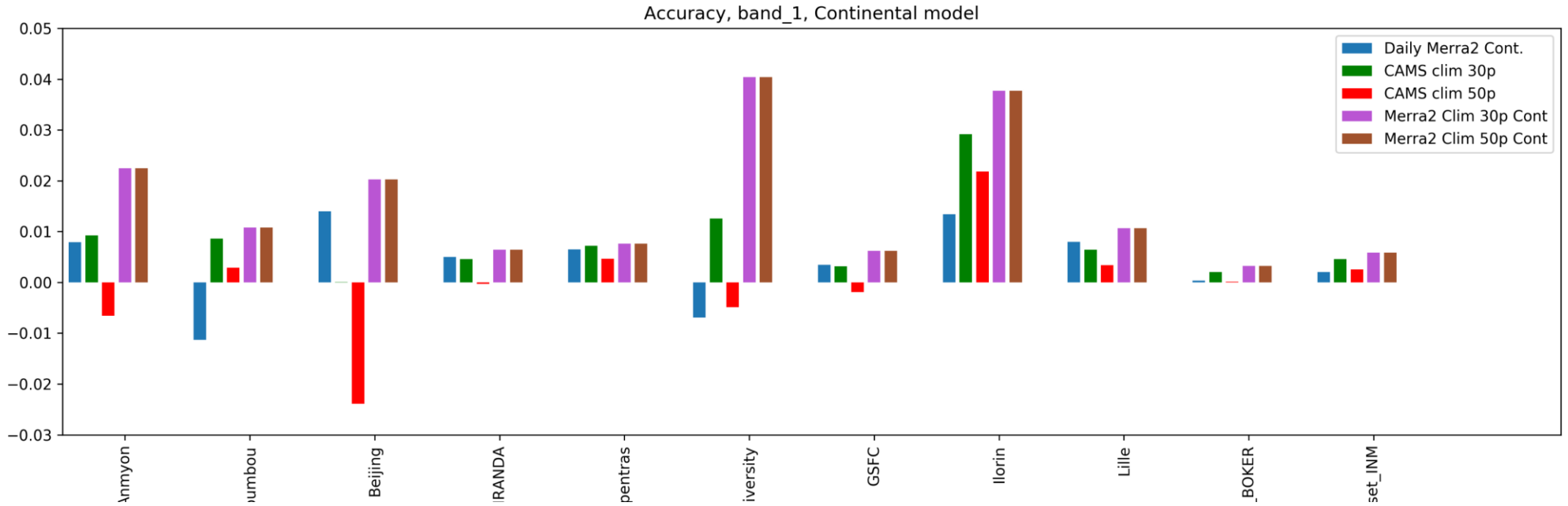
Uncertainty

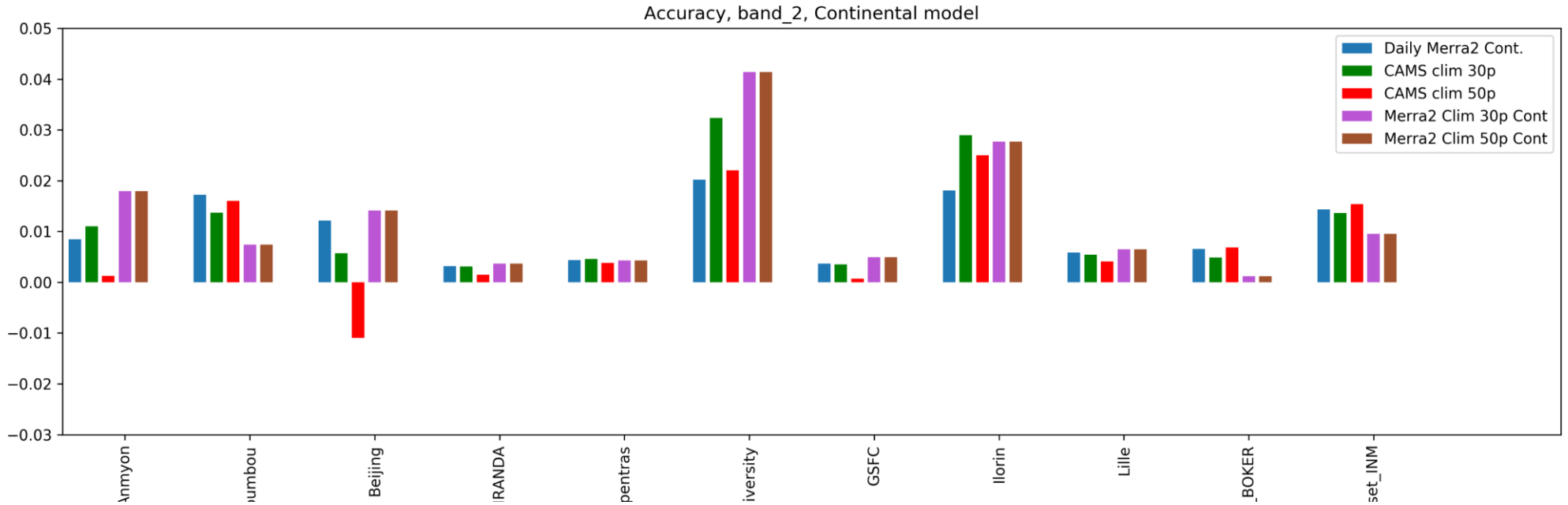


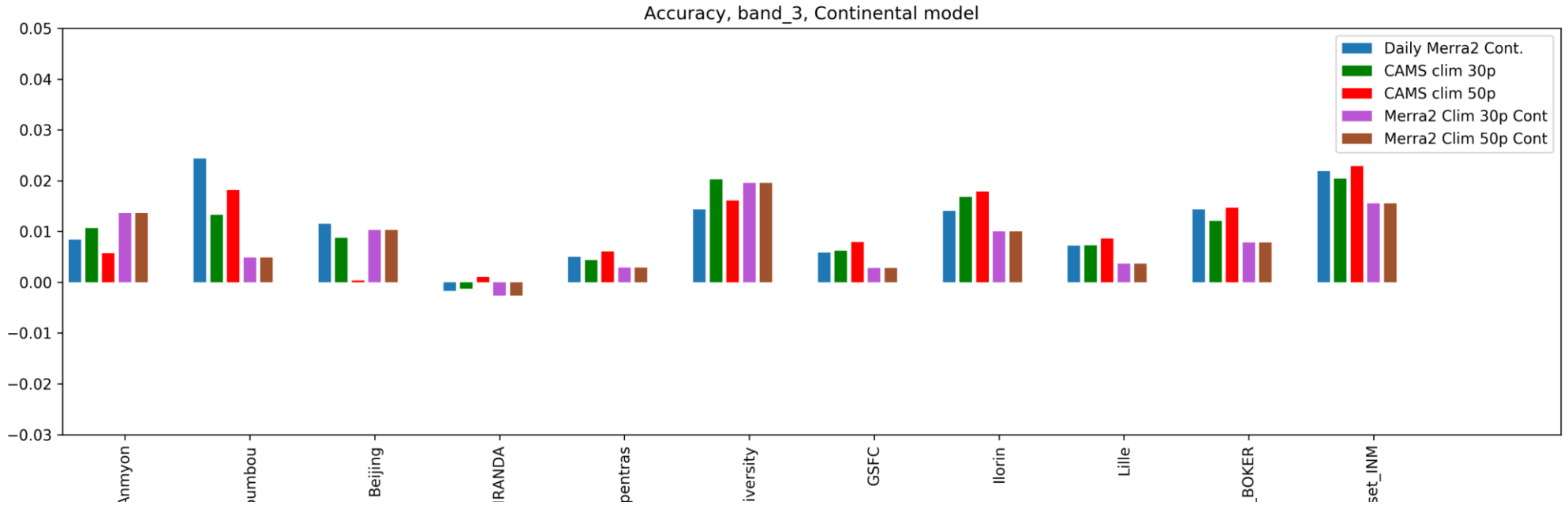
Size of the sample

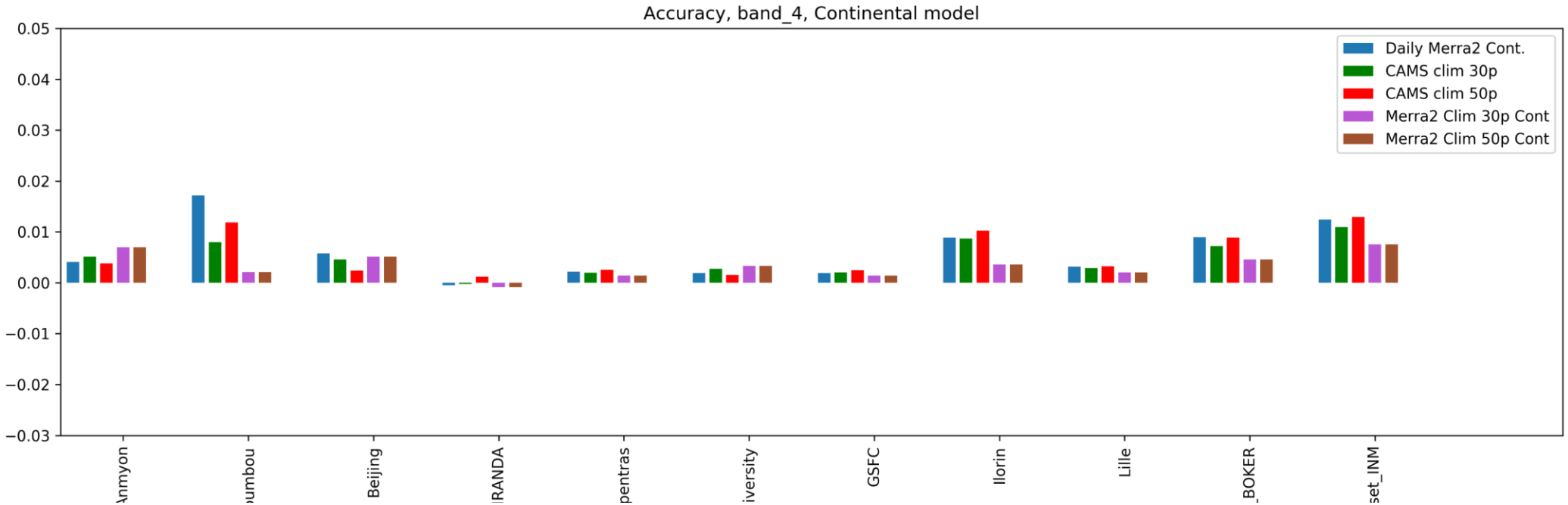


Variability of the accuracy per station




Accuracy, band_2, Continental model
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
Daily Merra2 Cont.
CAMS clim 30p
CAMS clim 50p
Merra2 Clim 30p Cont
Merra2 Clim 50p Cont
Beijing
GSFC
Lille


Accuracy, band_3, Continental model
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
Daily Merra2 Cont.
CAMS clim 30p
CAMS clim 50p
Merra2 Clim 30p Cont
Merra2 Clim 50p Cont
Beijing
GSFC
Lille
_BOKER

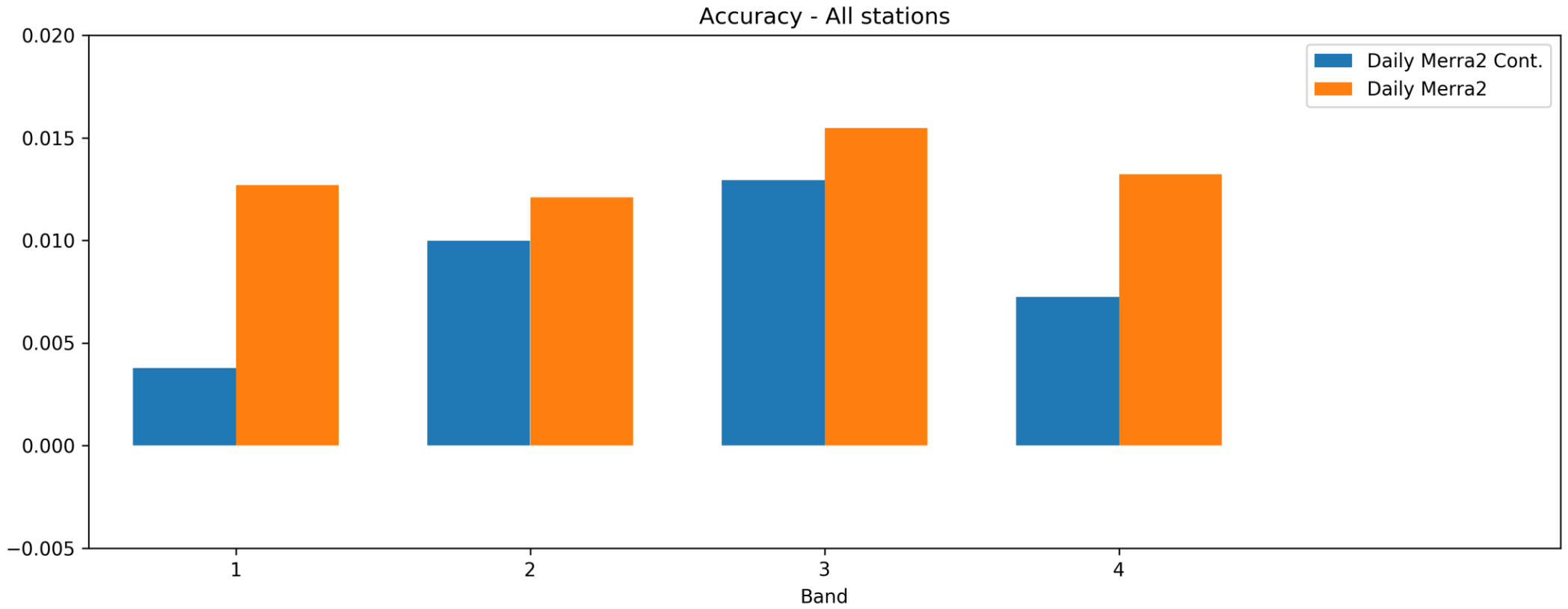

Accuracy, band_4, Continental model
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
Daily Merra2 Cont.
CAMS clim 30p
CAMS clim 50p
Merra2 Clim 30p Cont
Merra2 Clim 50p Cont
Beijing
GSFC
Lille

Fixed Continental vs. Varying aerosol model

We introduce the MERRA-2 derived aerosol optical properties

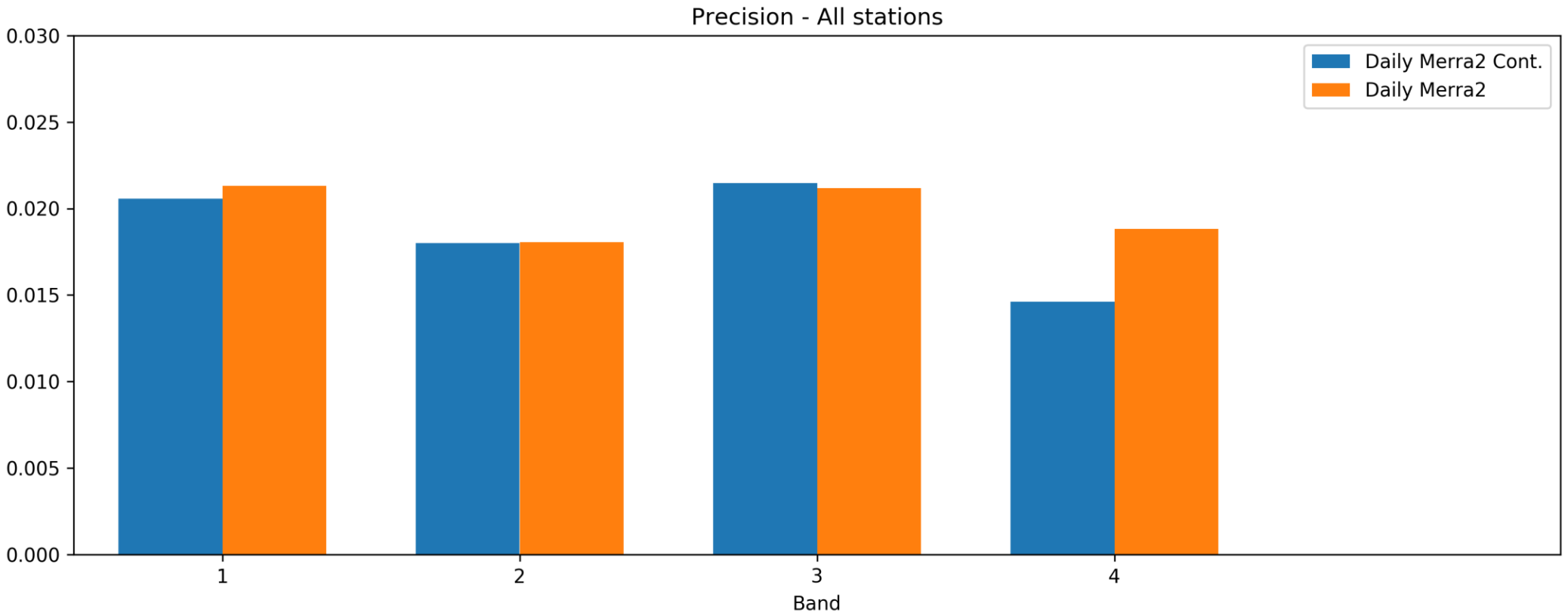
All stations (Accuracy)

Significant impact

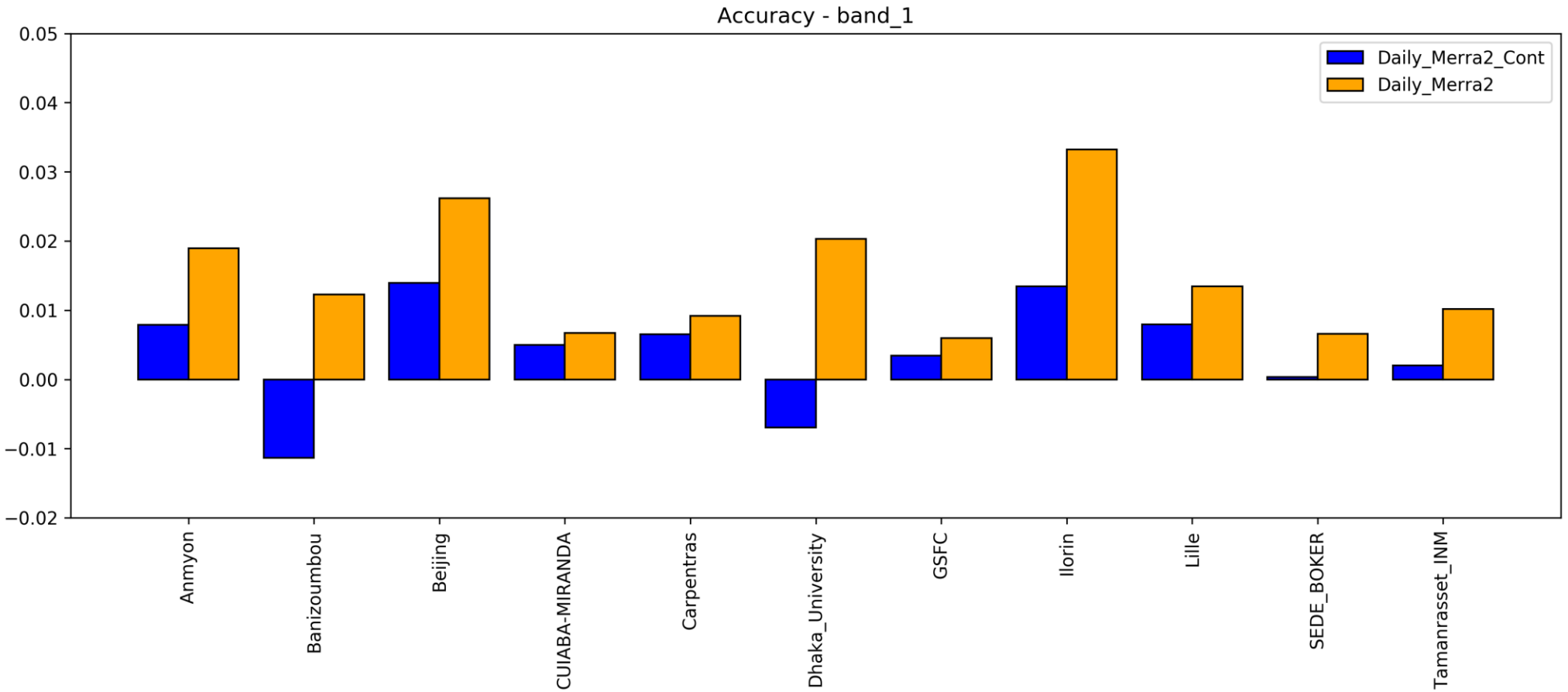


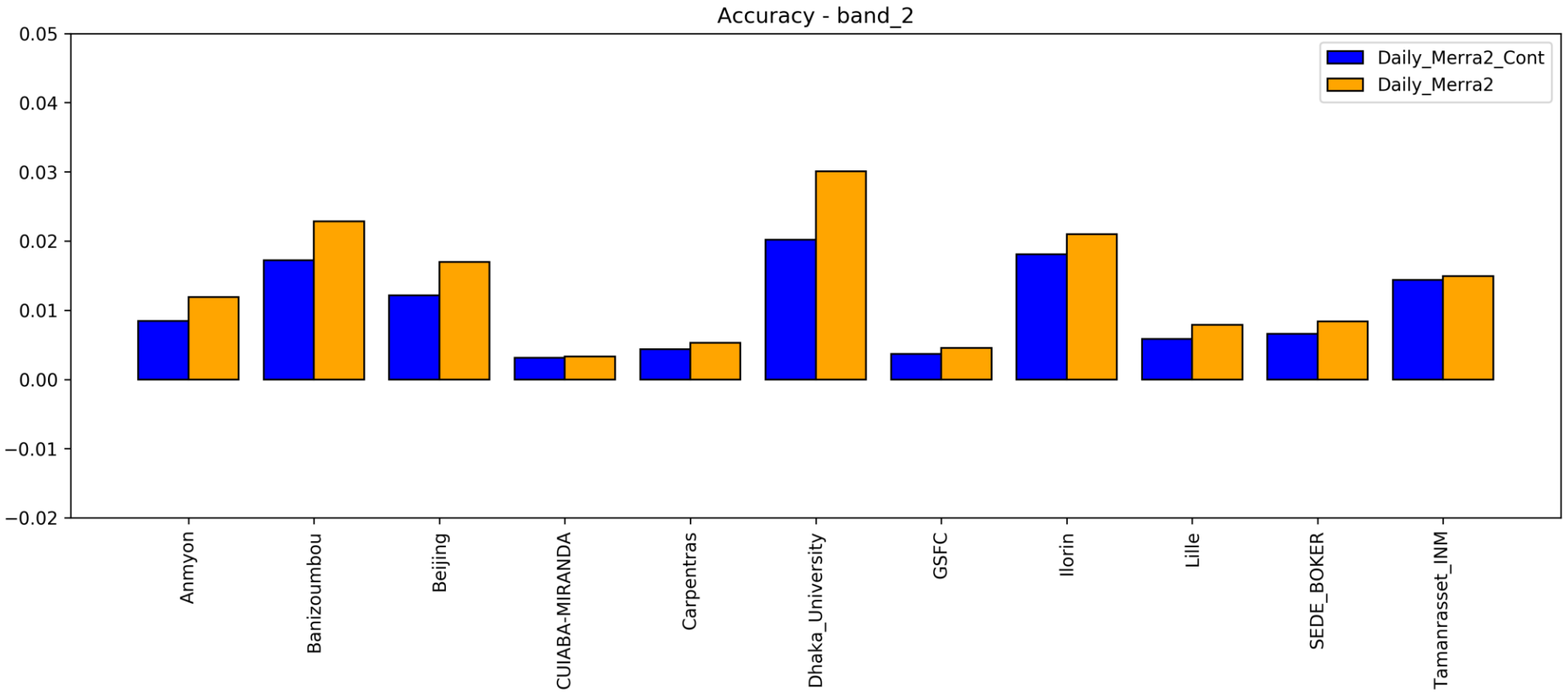
All stations (Precision)

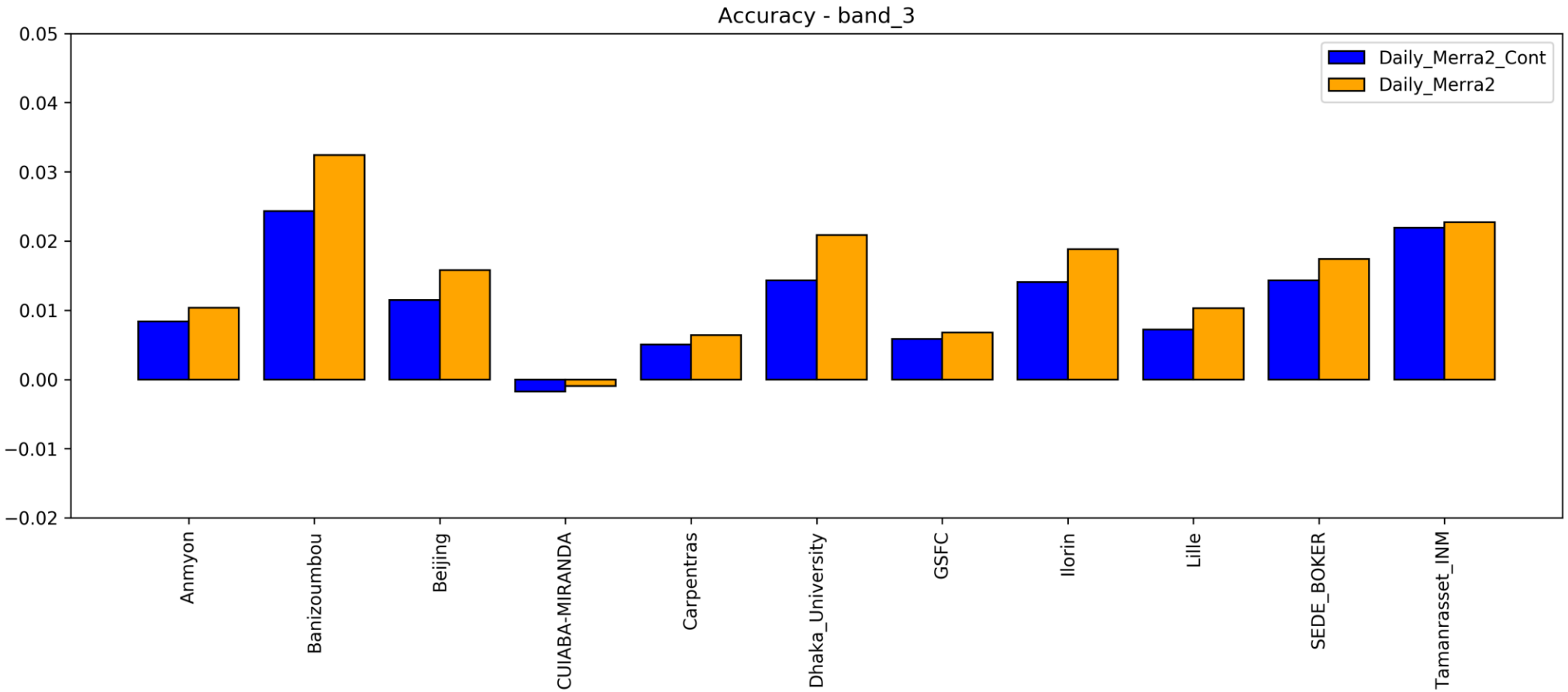
No impact

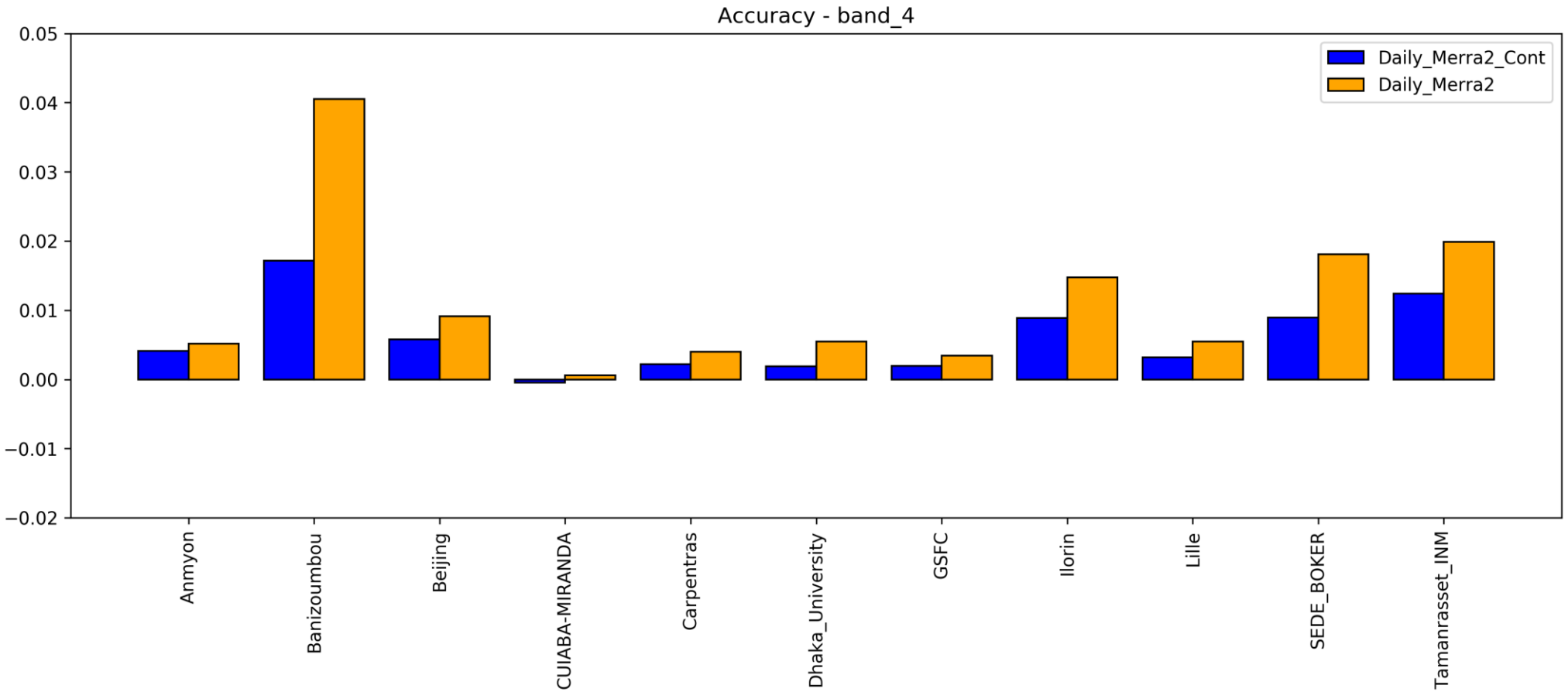


Individual stations accuracies




Accuracy - band_2
Daily_Merra2_Cont
Daily_Merra2
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
Anmyon
Banizoumbou
Beijing
CUIABA-MIRANDA
Carpentras
Dhaka_University
GSFC
Ilorin
Lille
SEDE_BOKER
Tamanrasset_INM


Accuracy - band_3
Daily_Merra2_Cont
Daily_Merra2
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
Anmyon
Banizoumbou
Beijing
CUIABA-MIRANDA
Carpentras
Dhaka_University
GSFC
Ilorin
Lille
SEDE_BOKER
Tamanrasset_INM

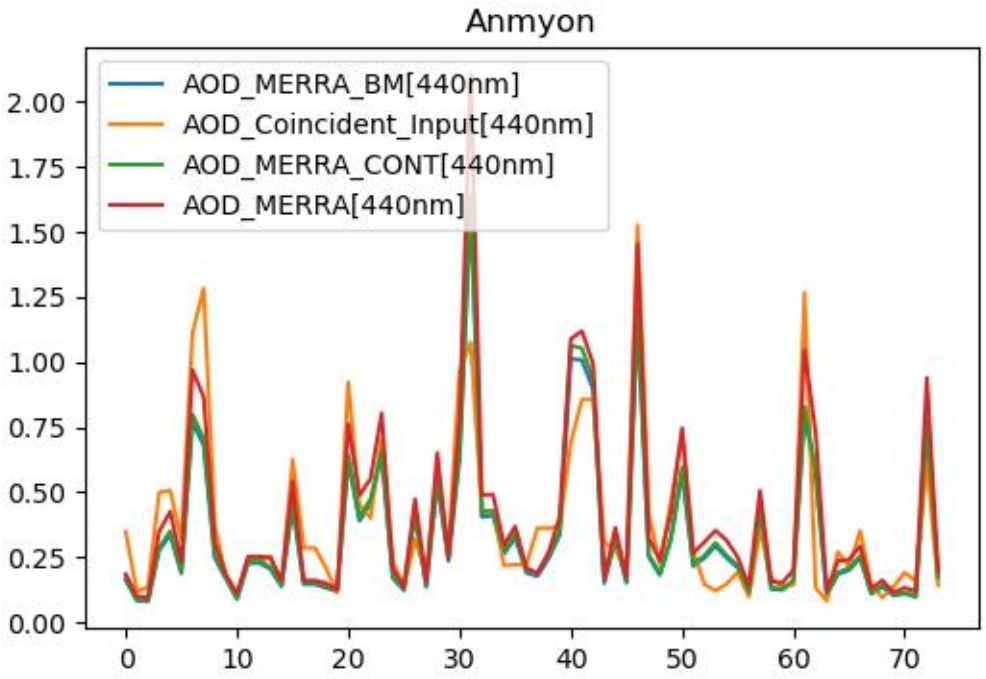

Accuracy - band_4
Daily_Merra2_Cont
Daily_Merra2
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
−0.02
Anmyon
Banizoumbou
Beijing
CUIABA-MIRANDA
Carpentras
Dhaka_University
GSFC
Ilorin
Lille
SEDE_BOKER
Tamanrasset_INM

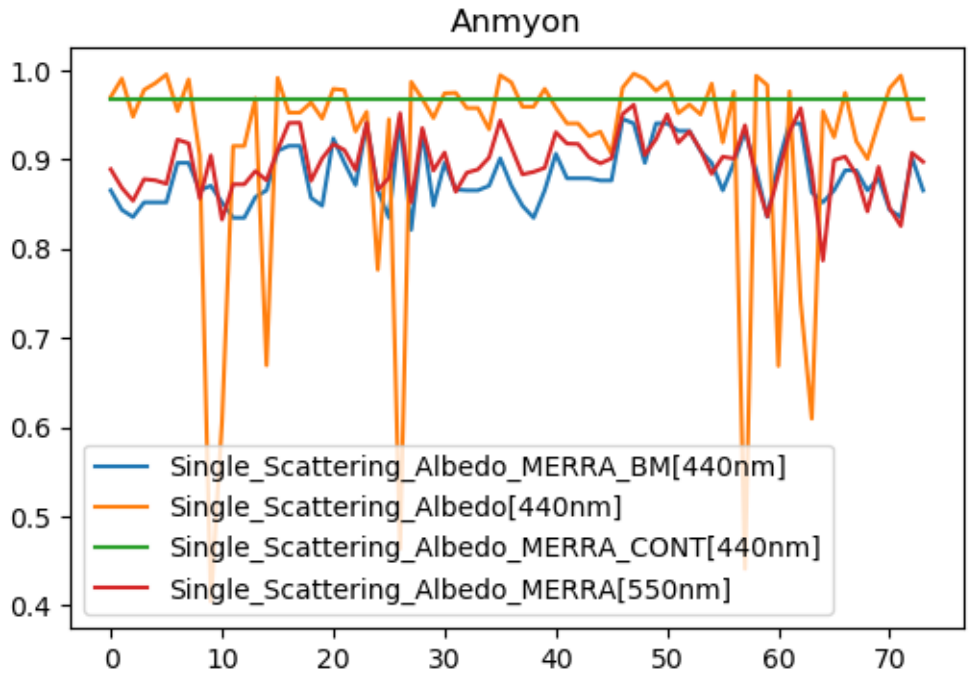
Investigation on MERRA-2 aerosol model

We have compared **AOT** and **single scattering albedo** (« pizero »: ω_0) :

- MERRA-2 derived aerosol optical properties from SMAC coefficients and varying model
- AERONET derived aerosol optical properties
- MERRA-2 derived aerosol optical properties from SMAC coefficients and Continental model
- MERRA-2 aerosol optical properties as delivered in the MERRA product (at 550 nm only for)

With: $\Delta toc\_r_i = \left(toc\_r_i^{processor} - toc\_r_i^{Aeronet}\right)$





Impact on TOC-r

- $\Delta toc\_r_i = \left(toc\_r_i^{processor} - toc\_r_i^{Aeronet}\right)$
- At first :
  - $\rho_{toc}^{processor} = \rho_{toa} - \rho_{aer}^{processor}$
  - $\rho_{toc}^{Aeronet} = \rho_{toa} - \rho_{aer}^{Aeronet}$
  - $\Delta\ \rho_{toc} = \rho_{aer}^{Aeronet} - \rho_{aer}^{processor}$
- With w_0 underestimated sometimes : $\rho_{aer}^{Aeronet} > \rho_{aer}^{processor}$ for a fixed aerosol extinction optical thickness
  - This leads to systematic positive bias
  - But that requires further investigation and is not the only explanation

Conclusions

- APU's are OK and validate the processing chain
  - Shall be extended to the full Aeronet extraction database (40 sites)
- We see a small added-value to use daily ancillary data for aerosols
  - With MERRA-2 data assuming a continental model
  - However the CAMS climatology for AOD at 550 nm is close on average, but less robust when a station by station analysis is performed
- We do not see added value to use a varying aerosol model for the moment. Additional work is needed if we keep this option
- If a decision has to be taken right now, the daily MERRA-2 aerosol product and a continental aerosol model is the best choice