The High Asia Refined Analysis Version 2 (HAR v2)

A New Atmospheric Data Set for the Third Pole Region

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Why a New Version?

The High Asia Refined analysis (HAR, Maussion et al., 2014):

- An atmospheric dataset generated by dynamical downscaling of NCEP-FNL using WRF V3.3.1
- Grid spacing: 30 km, 10 km
- Temporal coverage: October 2000 – October 2014
- Has been comprehensively analyzed and widely applied in many research fields

But:

-> 10 km domain does not cover the whole Tibetan Plateau and Tian Shan

-> temporal coverage is too short for long-term and climatological studies

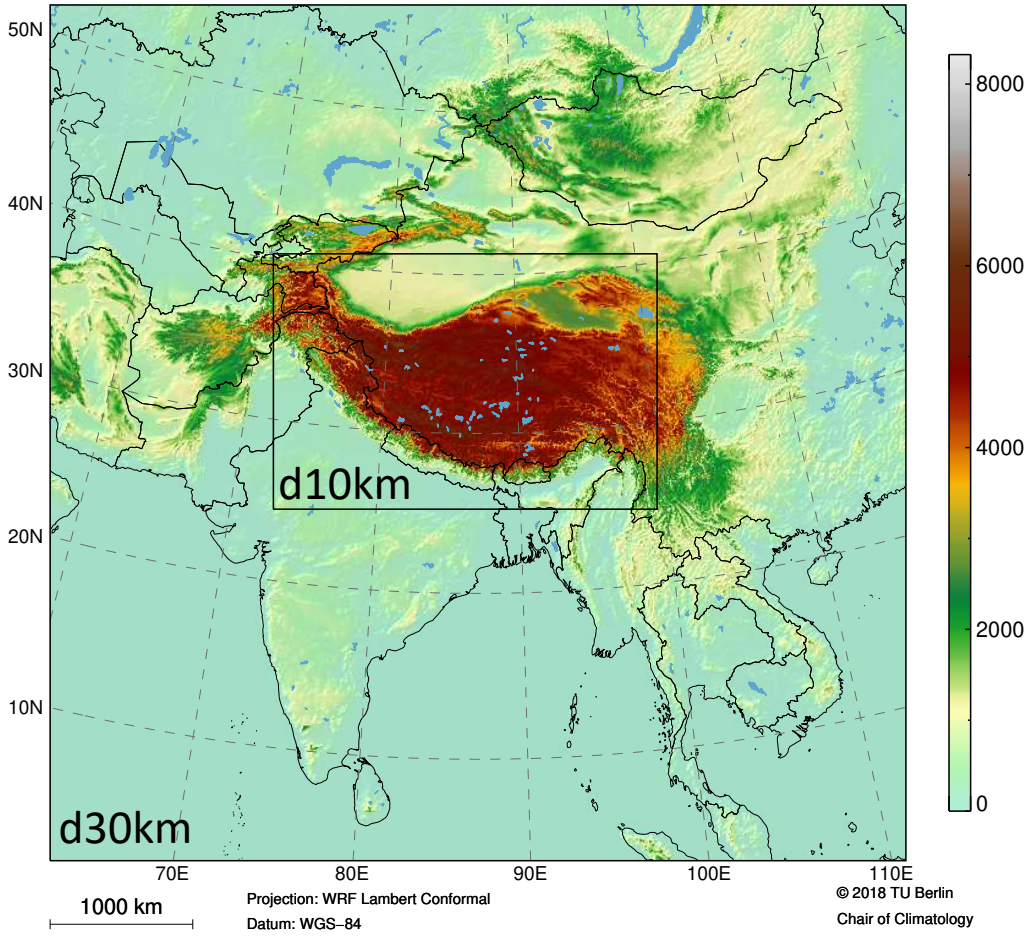


Figure 1. WRF model domains for HAR.

Why a New Version?

The High Asia Refined analysis version 2 (HAR v2):

- Larger domains (Fig. 2)
- Extended temporal coverage

  (1979-present, currently 2004-2018)
- ERA5 from ECMWF as forcing data
- New WRF version 4.1 (Skamarock et al., 2019)

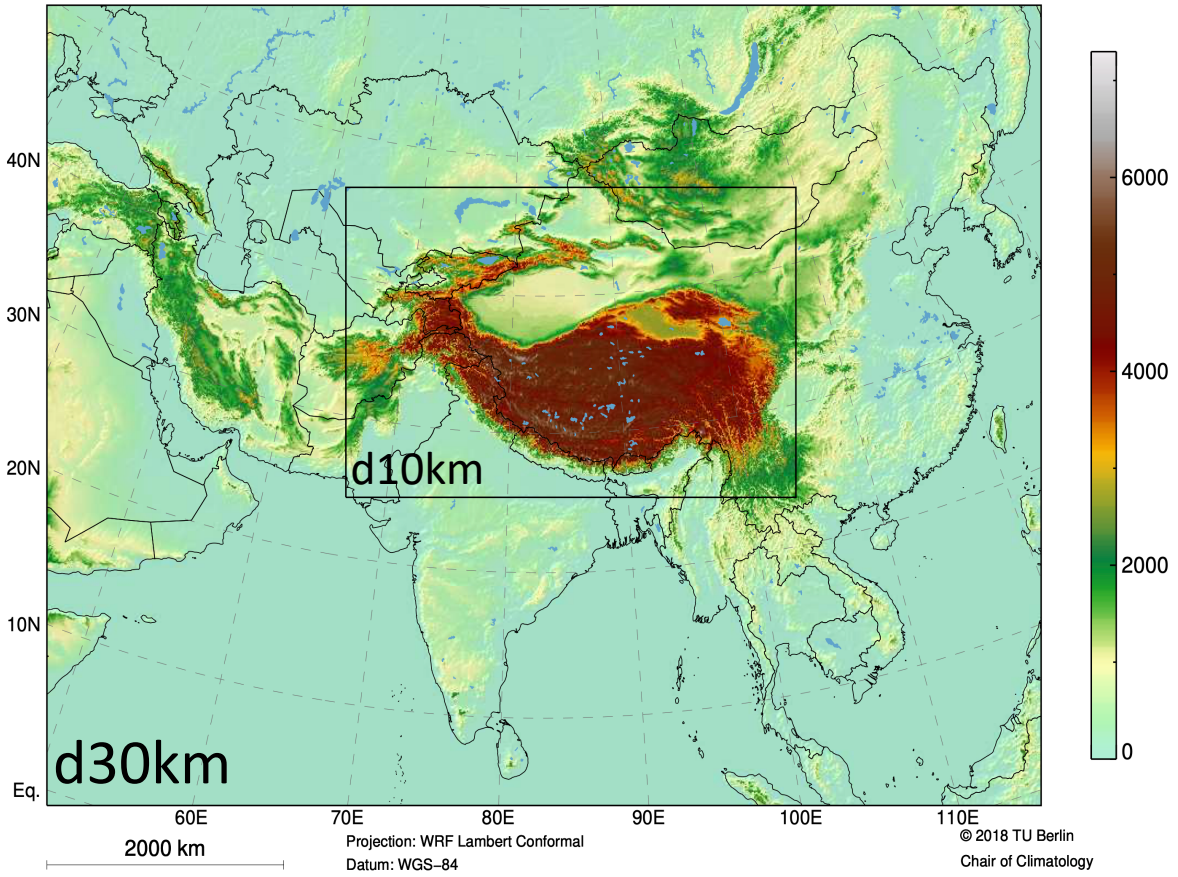


Figure 2. WRF model domains for HAR v2.

WRF Model Setup
General setup

WRF version	WRF V4.1
Projection	Lambert conformal conic
Horizontal grid spacing	Two-way nested domains: 30 km (281 x 217 grid points) 10 km (382 x 253 grid points)
Vertical levels	28 Eta-level
Initial and boundary condition	ERA5
Lake surface temperature	Substituted by daily mean surface air temperature
Initial snow depth	Corrected using JRA-55
Initialization	Daily reinitialization
Runs starting time	Daily at 12:00 UTC
Runs duration	36 h
Spin-up time	12 h

WRF Model Setup
Physical parameterization schemes

Physical parameterization schemes	
Longwave radiation	RRTM scheme
Shortwave radiation	Dudhia scheme
Cumulus	Kain-Fritsch cumulus potential scheme
Microphysics	Morrison 2-moment scheme
Planetary boundary layer	Yonsei University scheme
Land surface model	Unified Noah land surface model
Surface layer	revised MM5 surface layer scheme

WRF Model Setup
Snow depth correction

According to Orsolini et al. (2019):

- ERA5 overestimates snow depth over the Tibetan Plateau
- JRA-55 has an excellent performance among reanalyses regarding snow depth

-> Overestimation of snow depth causes cold bias

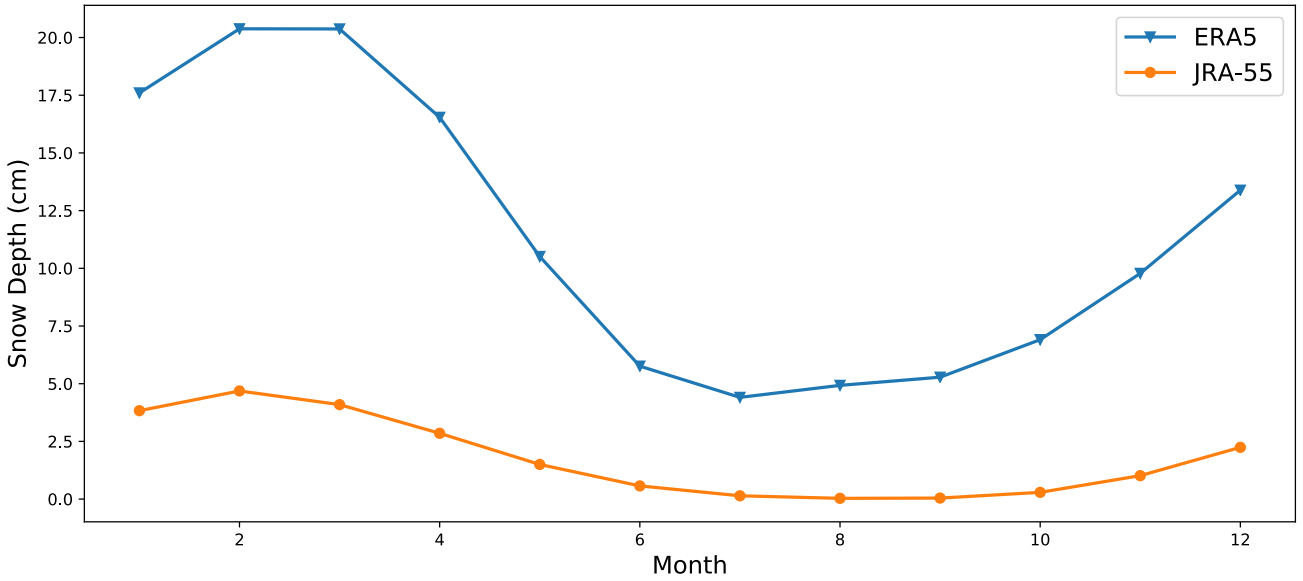


Figure 3. 35-year (1979-2013) mean annual cycle of snow depth from ERA5 and JRA-55 averaged over the whole area of d10km of the HAR v2.

WRF Model Setup
Snow depth correction

JRA-55 is applied to correct snow depth initialized from ERA5:

- Calculate monthly scaling factor as the ratio of snow depth between JRA-55 and ERA5 (Fig. 4)
- Correct the snow depth and snow water equivalent in initial conditions (*wrfinput** files) by multiplying them with the scaling factor of the corresponding month.

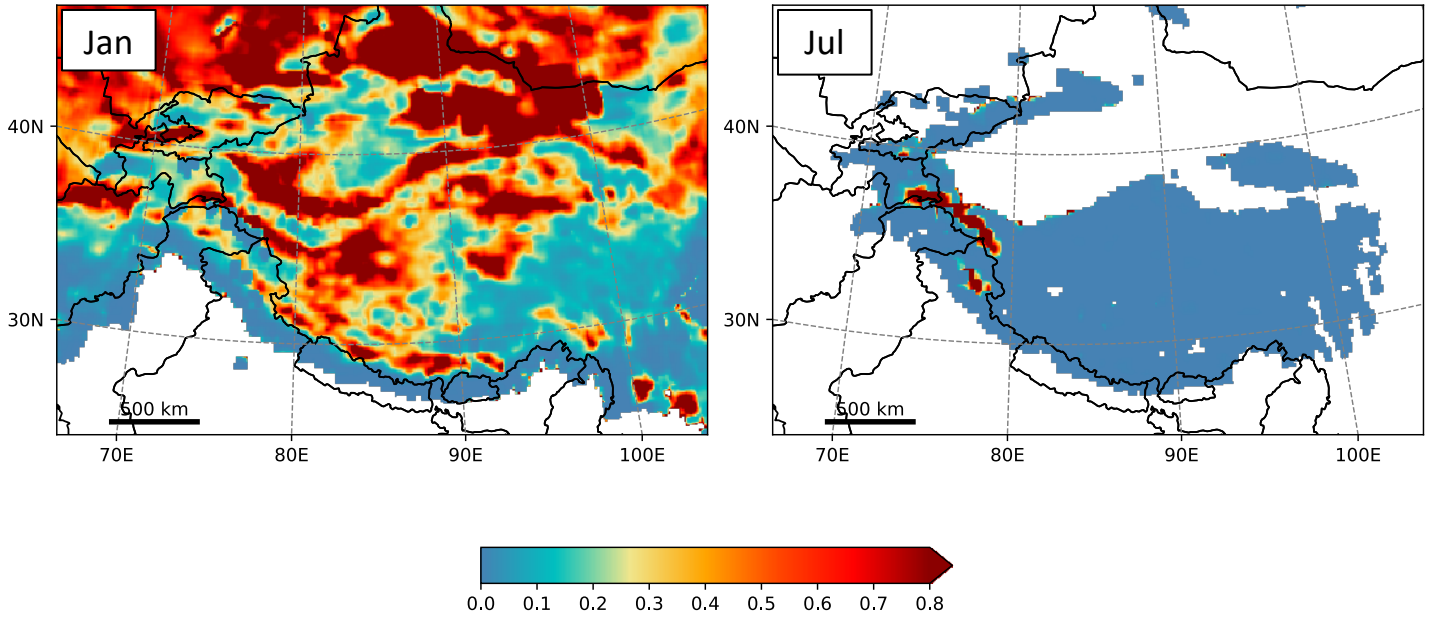


Figure 4. Map of scaling factor for d10km of HAR v2 in January (left) and July (right). The grid points where the value is equal to one are masked out.

WRF Model Setup
Snow depth correction

After correcting snow depth, the winter cold bias is reduced (Fig. 5).

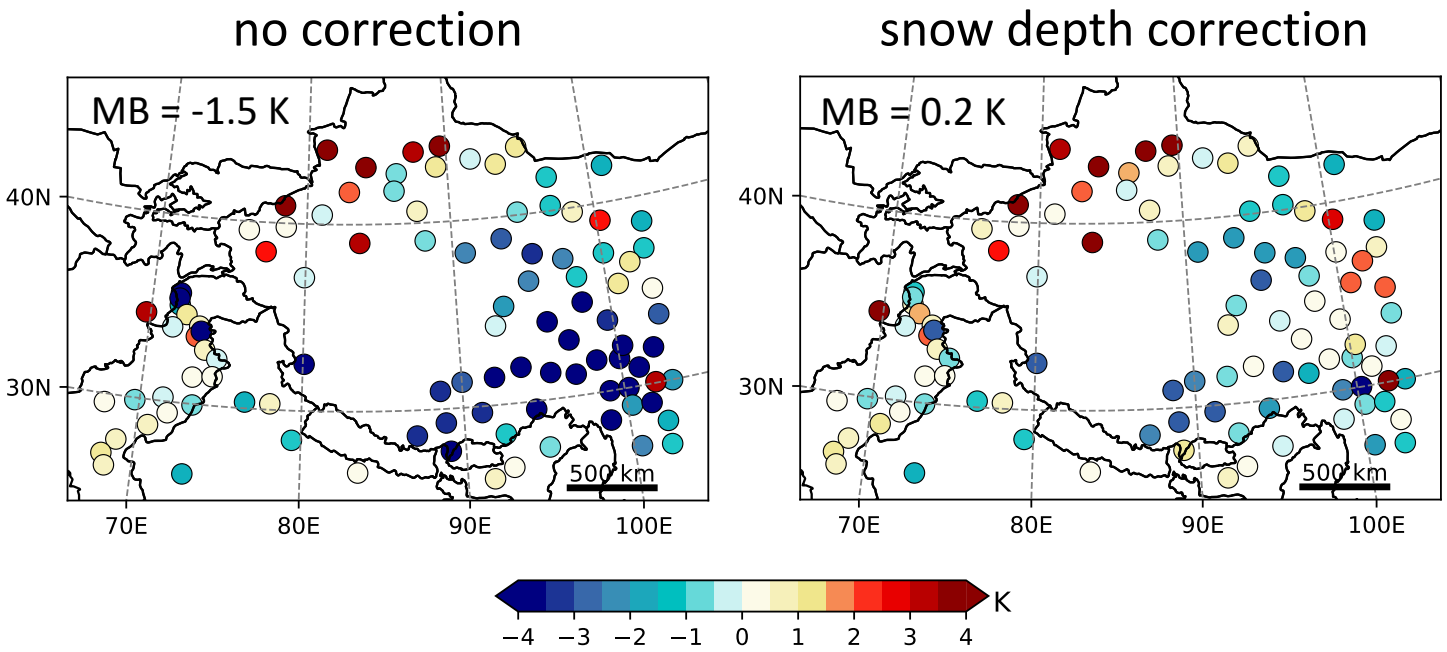


Figure 5. Mean bias (K) of daily air temperature at 2 m in January 2011 at in-situ stations before (left) and after (right) snow depth correction. MB indicates the averaged mean bias over all stations.

Validation

In-situ observations:

- Global Surface Summary of the Day (GSOD)
- Select stations within the 10 km domain of HAR
- Select stations with more than 90% records for both precipitation and air temperature

-> 55 stations available (Fig. 6)

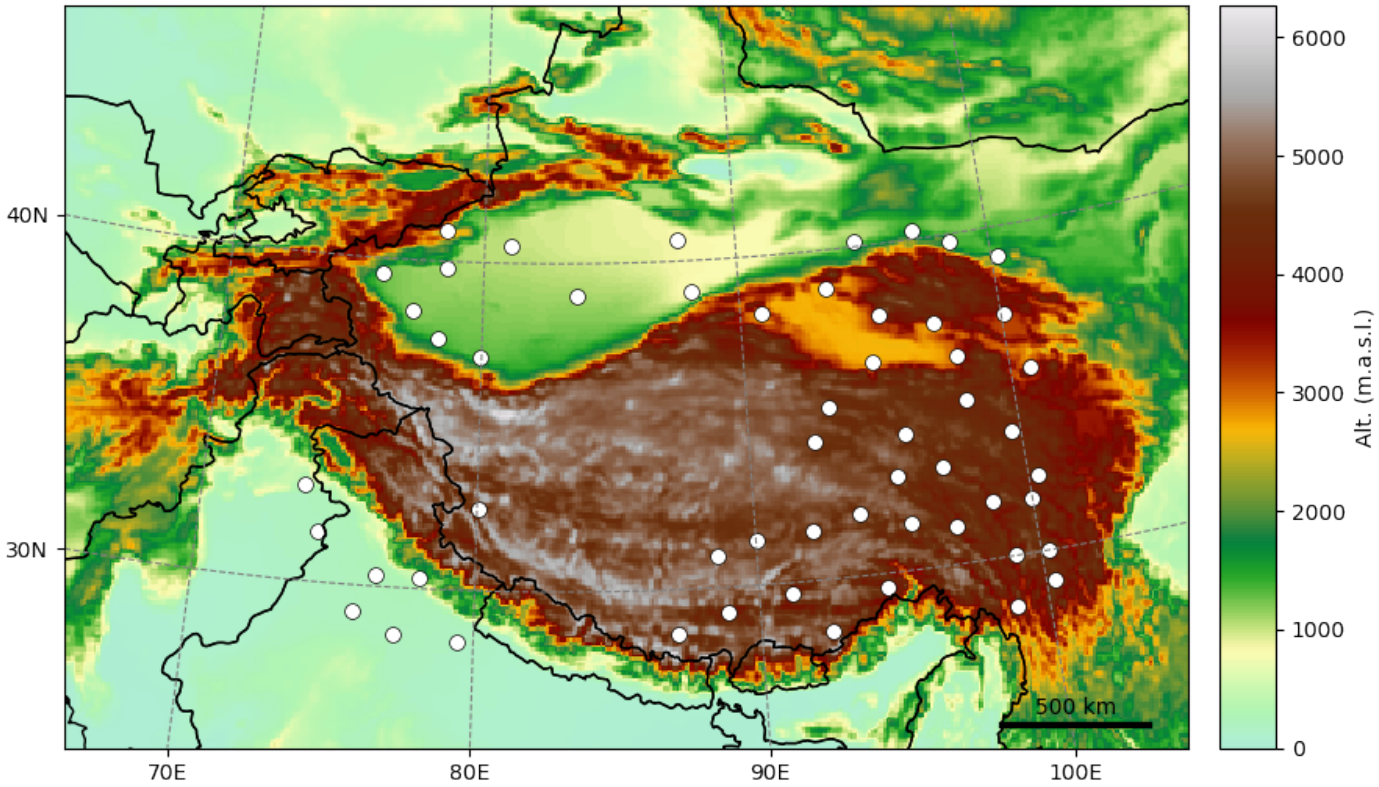


Figure 6. Locations of GSOD stations for model validation.

Validation
Air temperature at 2 m

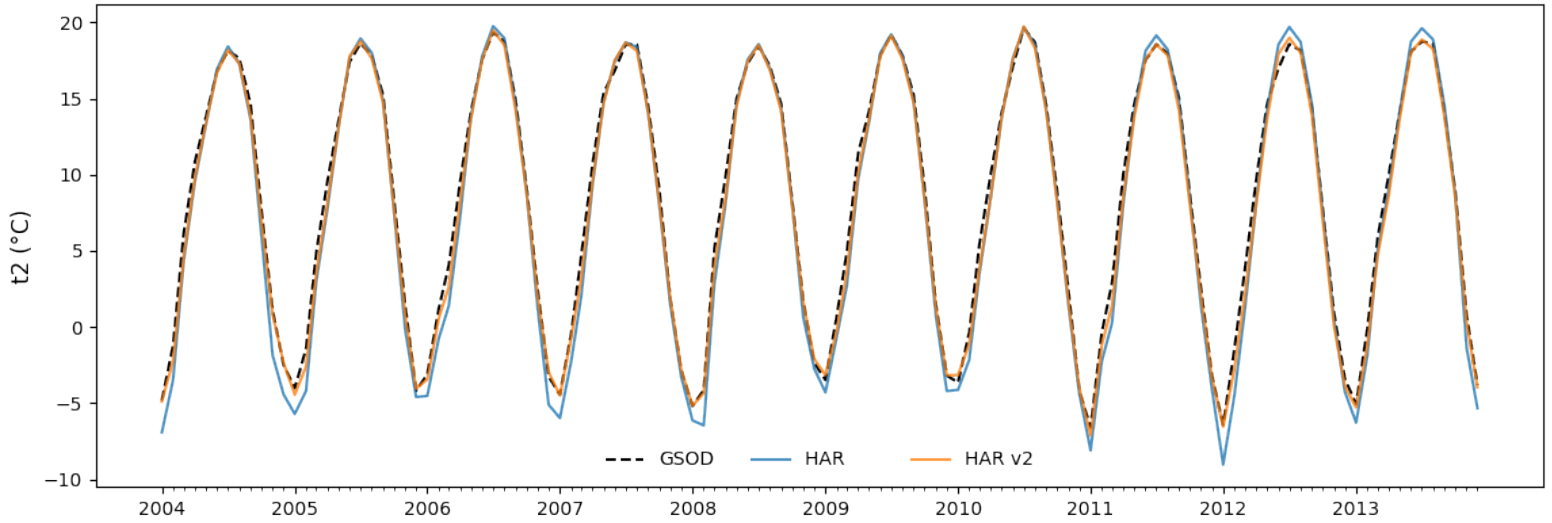


Figure 7. Monthly time series of air temperature at 2 m (℃) from GSOD, HAR and HAR v2.

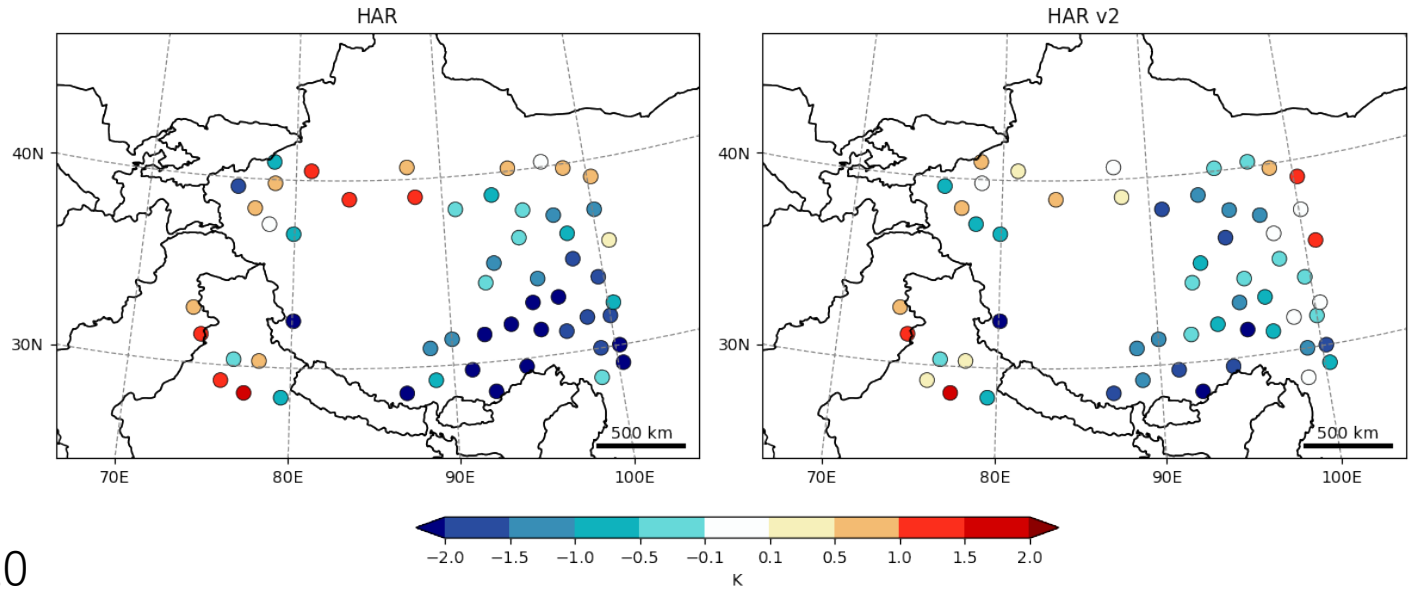


Figure 8. Mean bias (K) of monthly air temperature at 2 m from 2004-2013 for HAR (left) and HAR v2 (right) at GSOD stations.

Validation
Precipitation

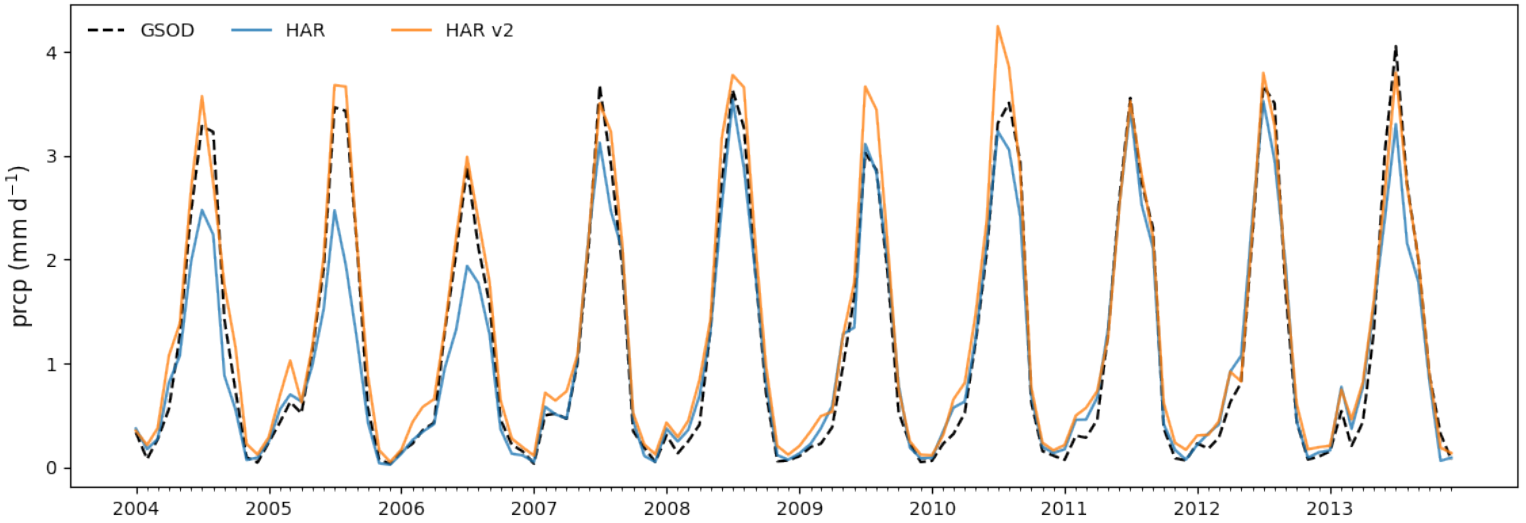


Figure 9. Monthly time series of precipitation (mm d^{-1}) from GSOD, HAR and HAR v2.

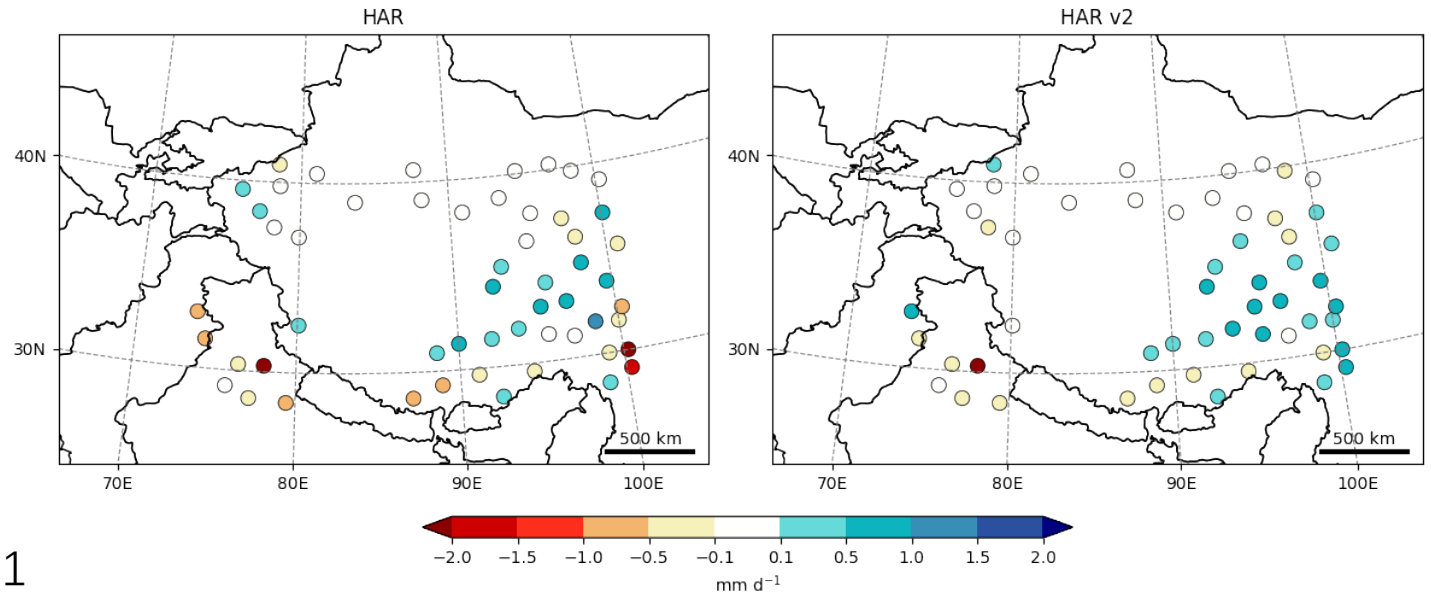


Figure 10. Mean bias (mm d^{-1}) of monthly precipitation from 2004-2013 for HAR (left) and HAR v2 (right) at GSOD stations.

Precipitation Comparison

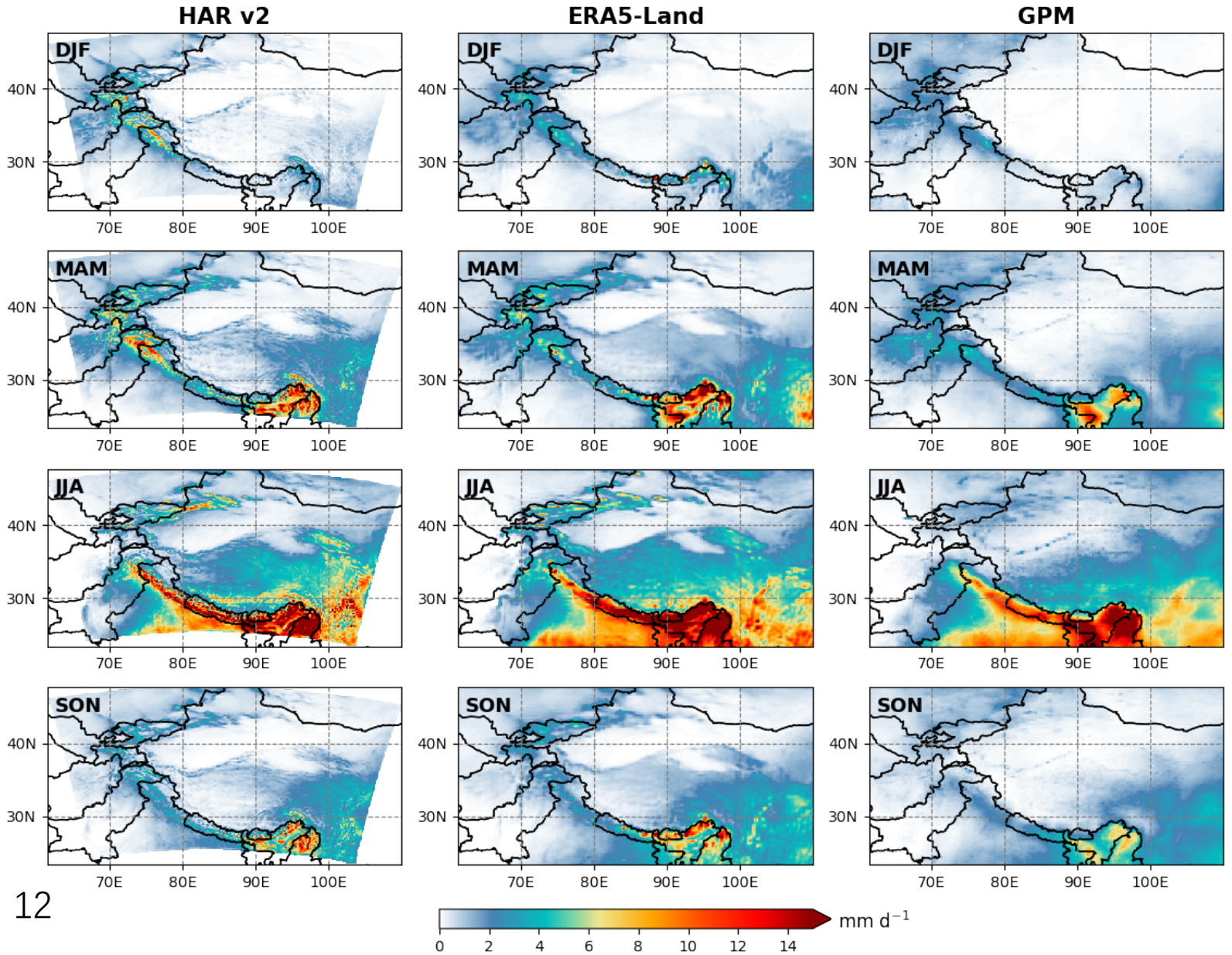


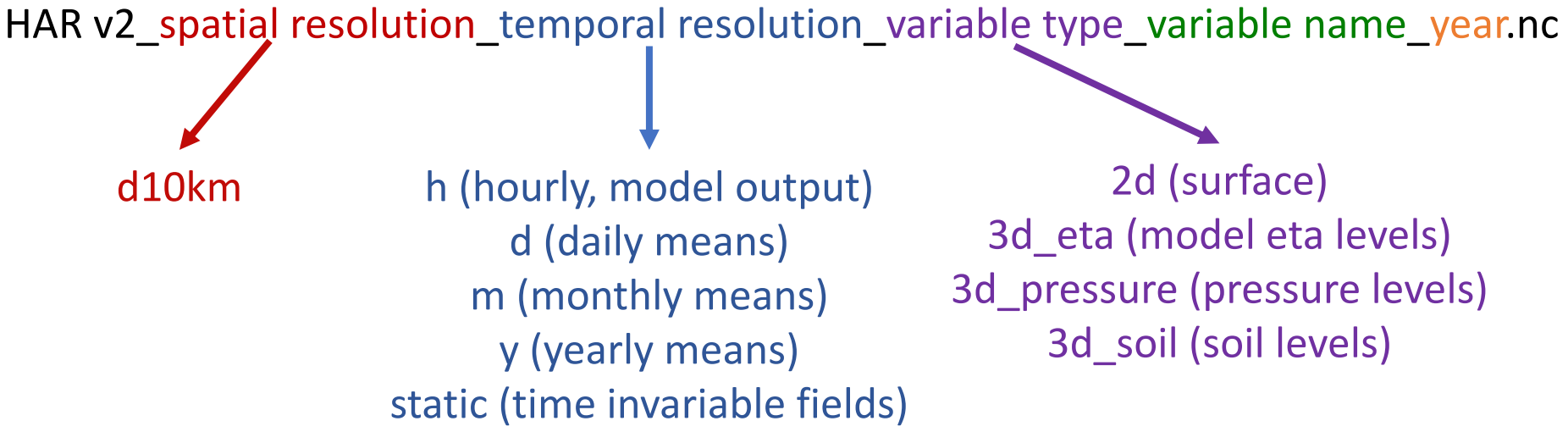
Figure 11. Seasonal mean daily precipitation (mm d^{-1}) from HAR v2, ERA5-Land and GPM averaged from 2015-2018.

How to Download?

- HAR v2 website:

  www.klima.tu-berlin.de/HARv2

- The output of the model is post-processed into *product-files: o*ne single file per variable and per year at various temporal resolutions
- File naming convention:



Contact

We are looking forward to new collaborations towards a better understanding of atmosphere-related processes in High and Central Asia.

For any further questions, please contact:

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