

# DTRF2020: the ITRS 2020 realization of DGFI-TUM

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# Outline

- Input data series
- Processing strategy: overview
- Reduction of non-tidal loading
- Datum realization
- DTRF2020: preliminary results

# Input data

Input data (same as for ITRF2020)

| Technique/Service | #SINEX files* | Time span   | Years |
|-------------------|---------------|-------------|-------|
| VLBI/IVS          | 6210          | 1979-2021.0 | 41    |
| SLR/ILRS          | 1704          | 1983-2021.0 | 38    |
| GNSS/IGS          | 9851          | 1994-2021.0 | 27    |
| DORIS/IDS         | 1456          | 1993-2021.0 | 28    |

\* different temporal resolutions

Parameters included: station coord & EOP

|      | Pole offsets | Pole rates | UT1-UTC | LOD | Nutation offsets |
|------|--------------|------------|---------|-----|------------------|
| IVS  | x            | x          | x       | x   | x                |
| ILRS | x            |            |         | x   |                  |
| IGS  | x            | x          |         | x   |                  |
| IDS  | x            |            |         |     |                  |

## New situation for DTRF2020 compared to DTRF2014

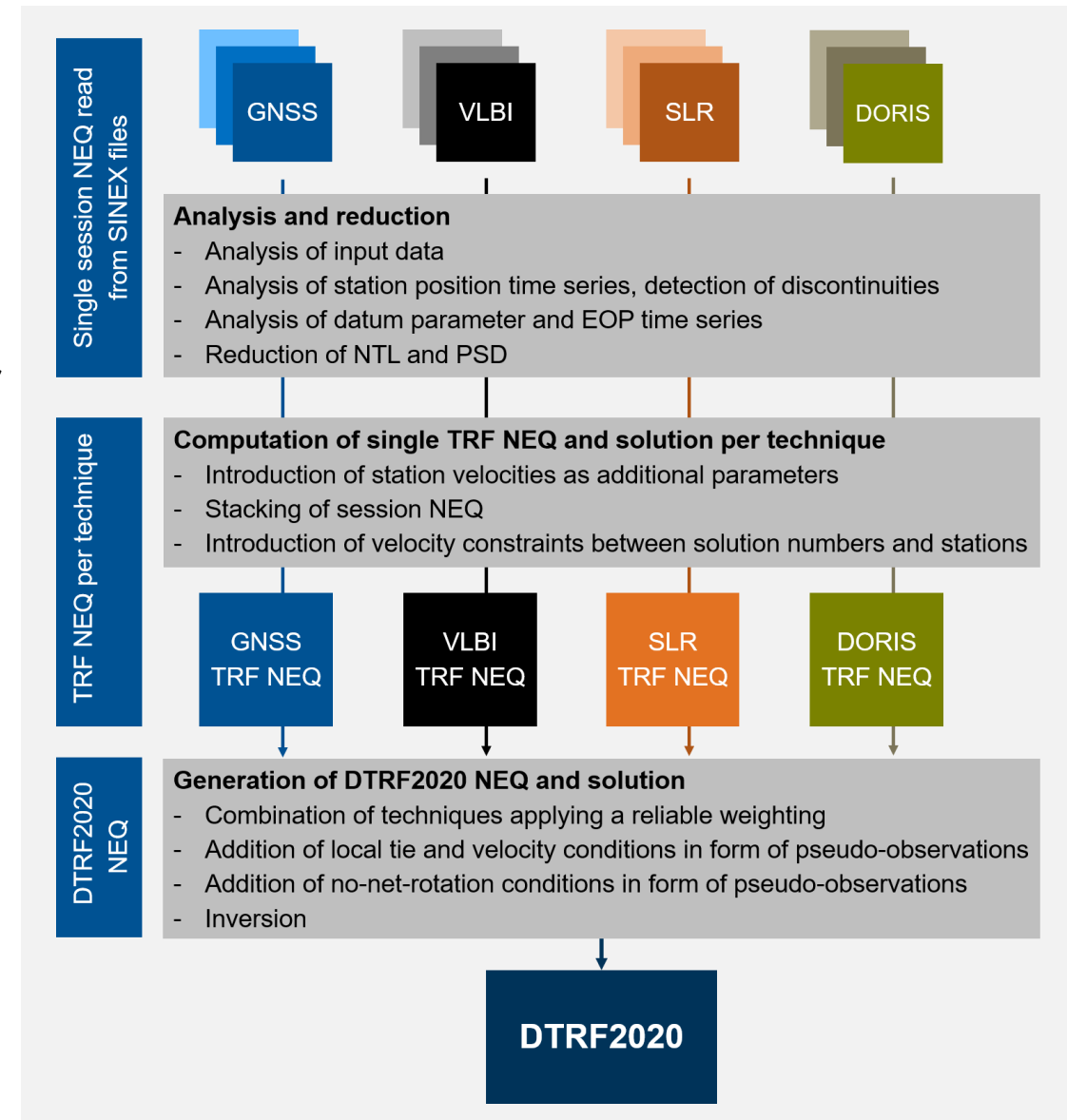
- **longer observation time spans** for each technique
  - **new stations, new satellites, new local ties**
  - **several new models** had been adopted
    - New general models (e.g., secular pole model)
    - New technique-specific models (e.g., GNSS satellite z-PCVs → **GNSS provides now an independent scale realization**)
- **impact on station coordinates, velocities, EOPs as well as on the DTRF geodetic datum is expected**

# Main characteristics of DTRF2020 computation strategy

- based on the **combination of NEQs**
- **Processing line (2step-approach)**
  - 1) analysis of data and computation of one **TRF per technique**
    - reduction of non-tidal loading (NTL) and post-seismic deformation (PSD)
    - analysis of station position time series and datum parameter and EOP time series
    - introduction of station velocities
  - 2) **combination of technique NEQs to DTRF2020 solution**

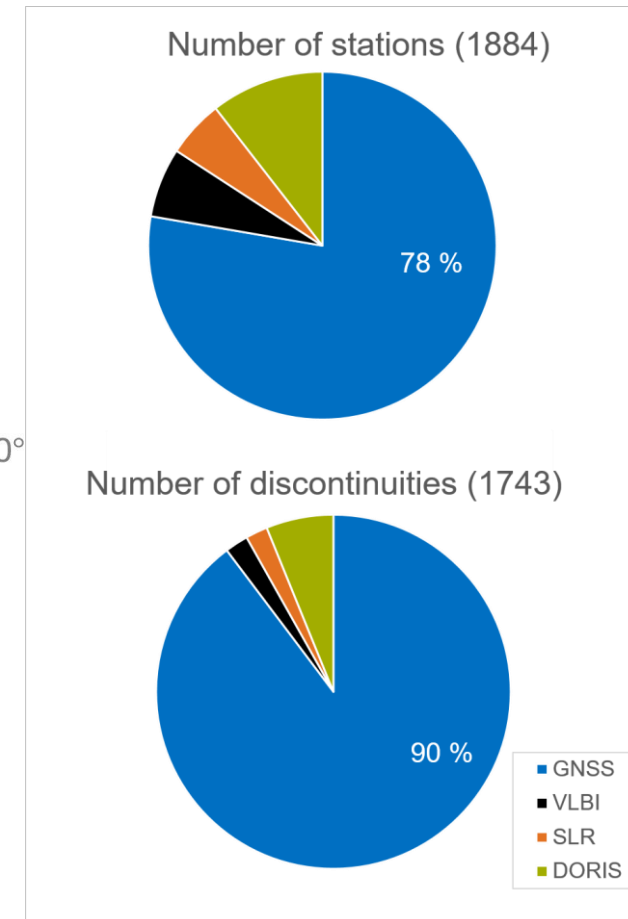
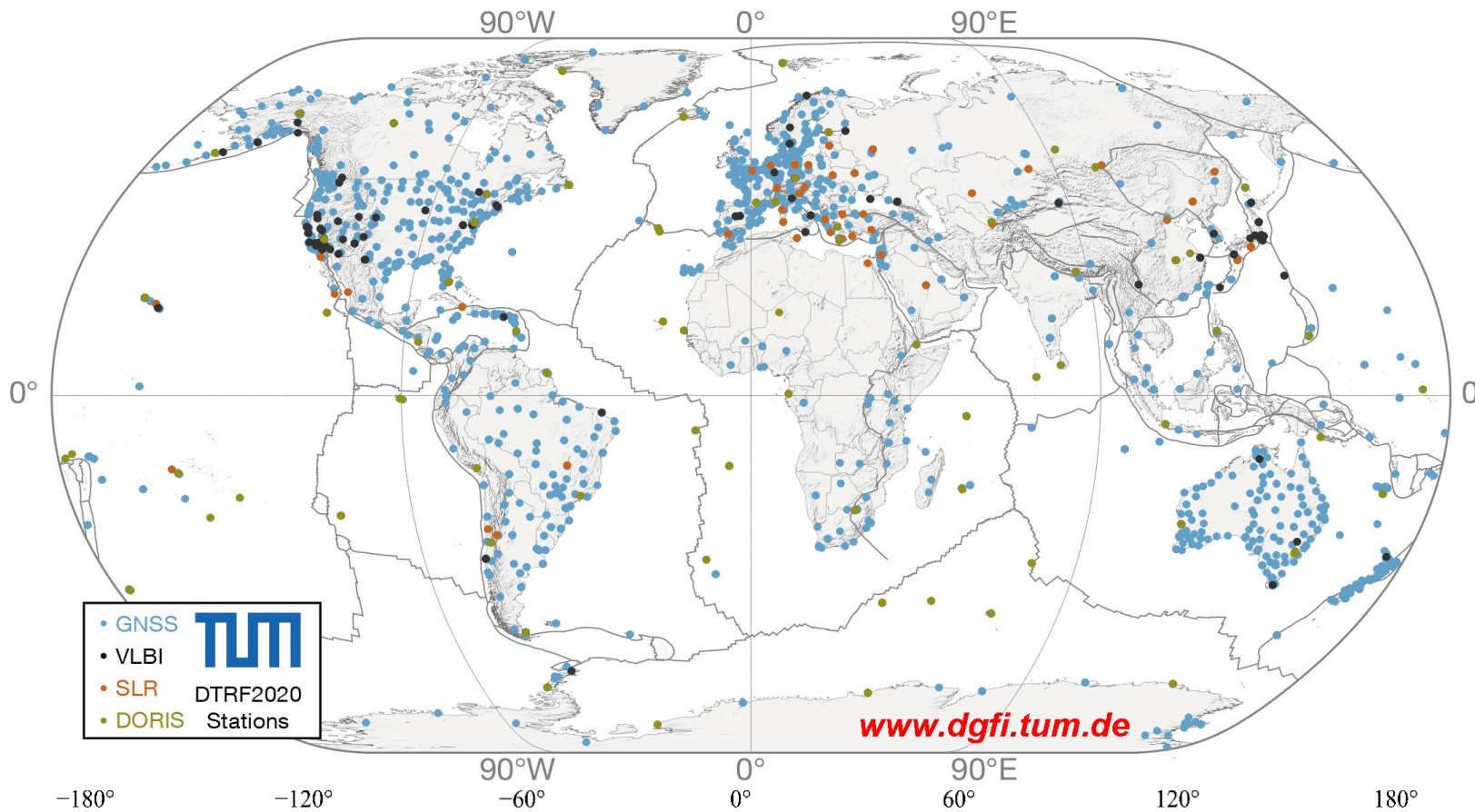
## New in DTRF2020

- **Non-tidal loading (NTL):**  
all three components (atmospheric, hydrological and oceanic) are provided by GGFC and reduced at the NEQ level
- **Post-seismic deformation (PSD):**  
approximated by a combination of logarithmic and exponential functions and reduced at the NEQ level



# DTRF2020 station network: discontinuities

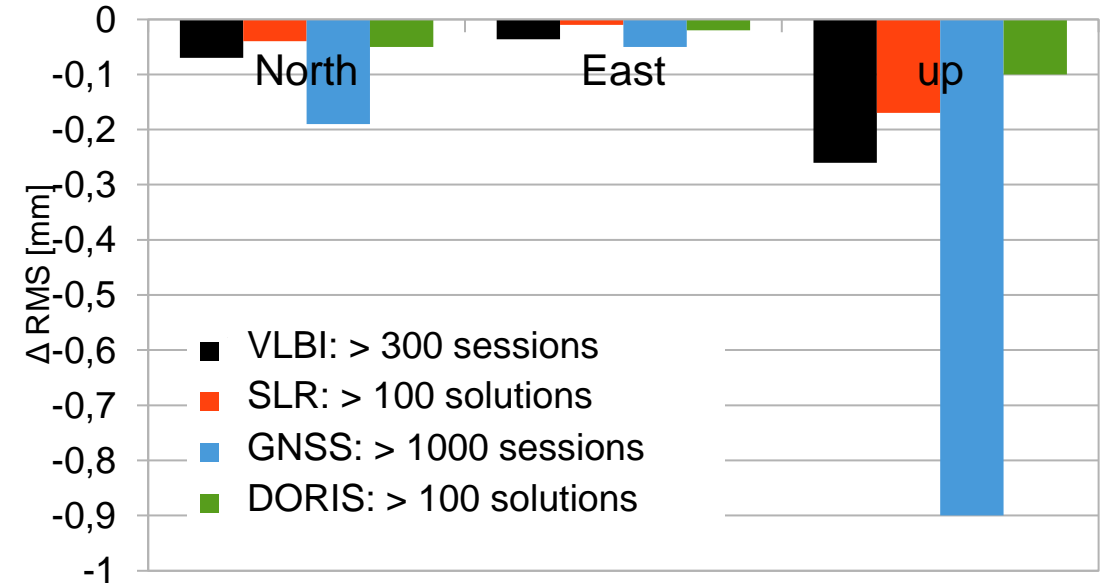
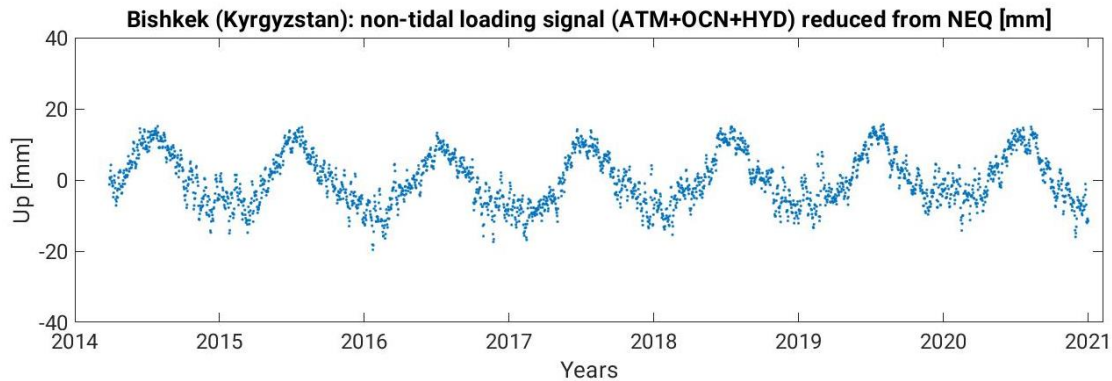
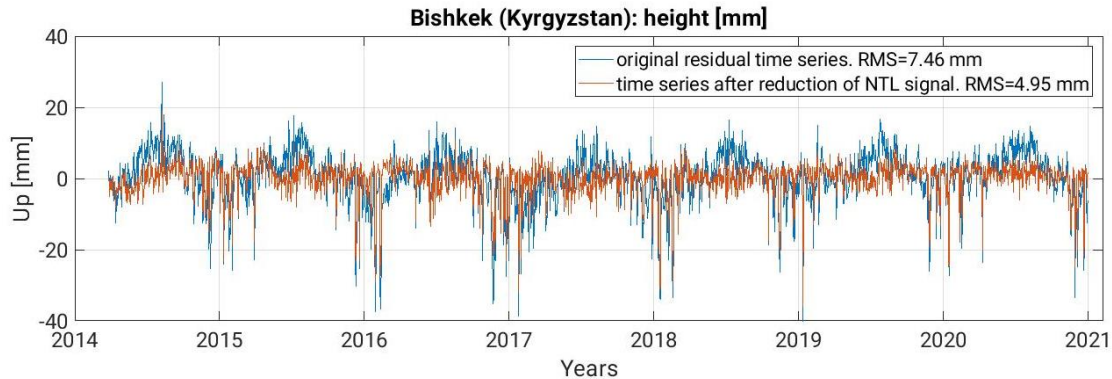
For **DTRF2020** we process data of about 1880 observing stations. GNSS provides by far the largest number of stations.



→ For DORIS we considered discontinuities as well as DORIS intra velocity conditions suggested by Guilhem Moreaux.

# Impact of reducing NTL: station coordinate time series

## Reduction of RMS in particular for the up components

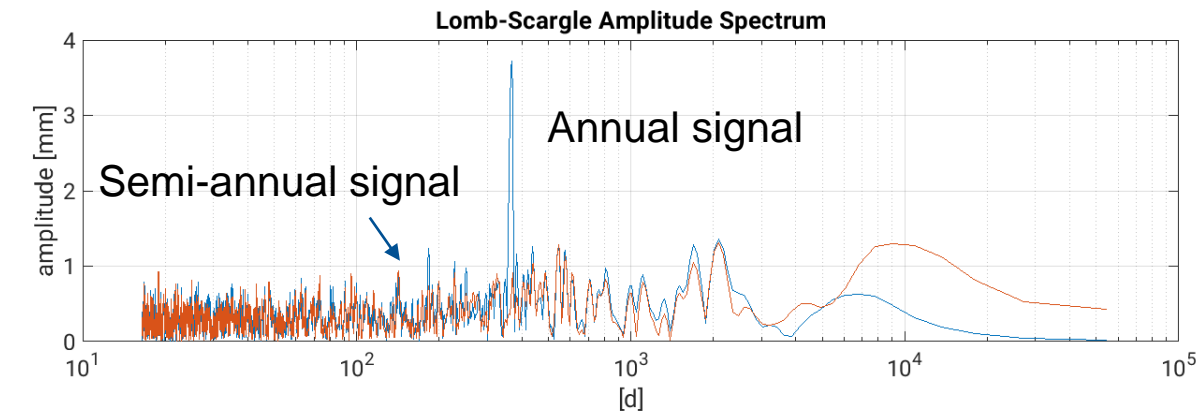
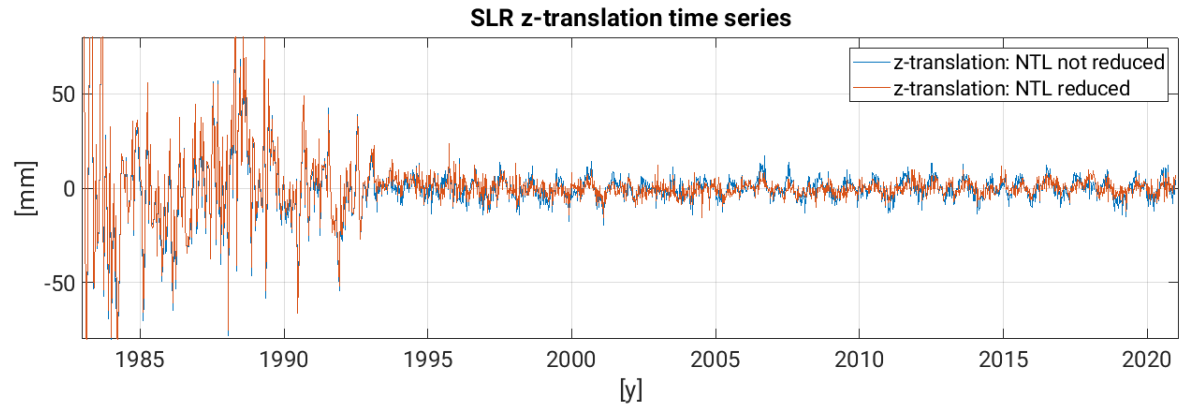


## Median of RMS change [%]

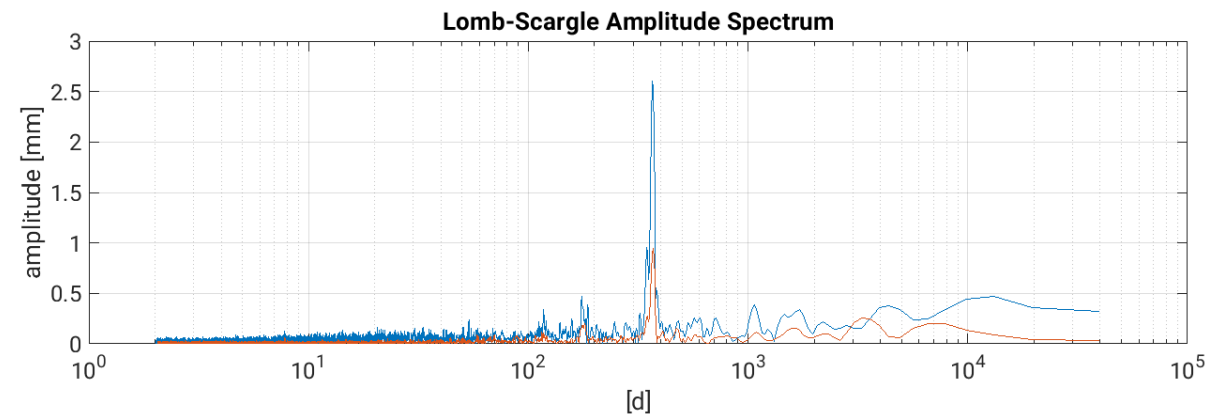
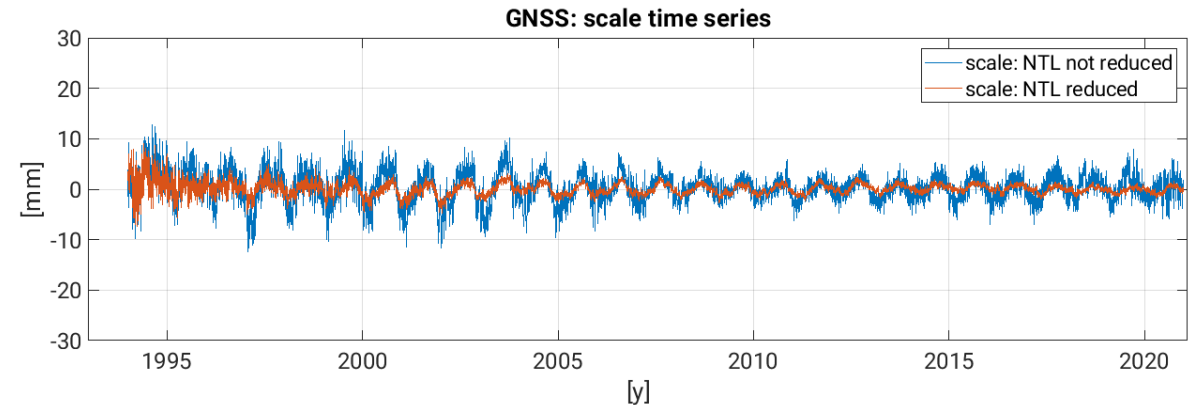
| Technique/<br>Service | #stations | North | East | Up    |
|-----------------------|-----------|-------|------|-------|
| VLBI/IVS              | 72        | -2.2  | -1.3 | -2.1  |
| SLR/ILRS              | 85        | -0.2  | -0.1 | -0.6  |
| GNSS/IGS              | 2256      | -5.5  | -3.3 | -16.7 |
| DORIS/IDS             | 195       | -0.6  | -0.2 | -0.9  |

# Impact of reducing NTL: datum parameters (examples)

## SLR origin, z-component (intrinsic translation time series)



## GNSS scale (intrinsic scale time series)

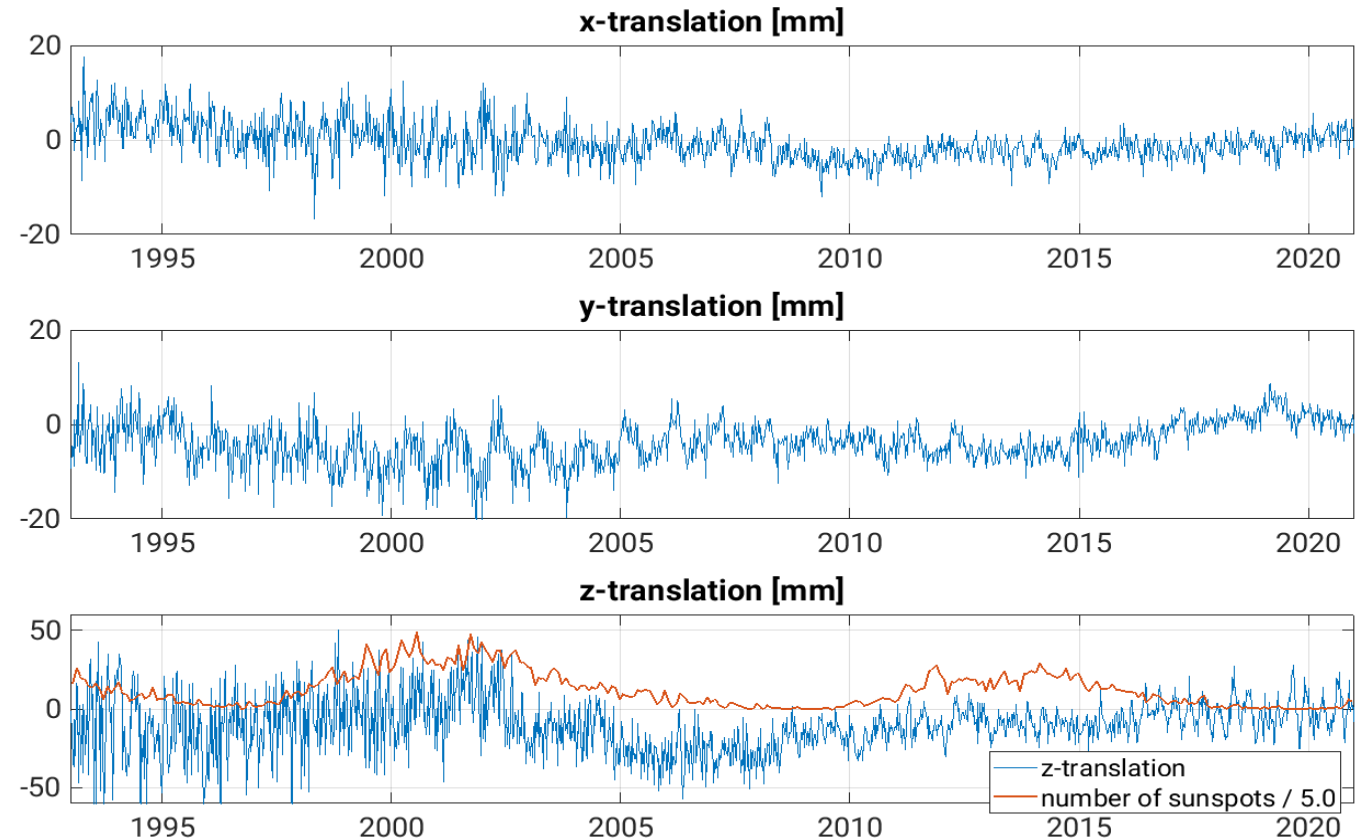
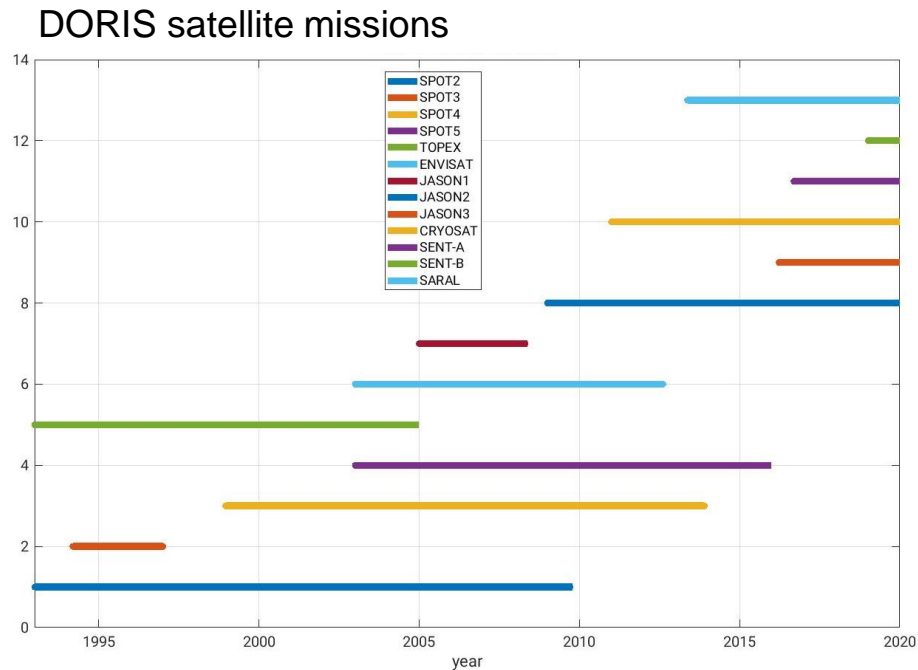


### SLR translation and VLBI, SLR and GNSS scale:

- Reduction of RMS and annual signal. The semi-annual signals is also slightly reduced.

# DORIS datum parameters

## DORIS translation parameter time series w.r.t. DTRF2020



- Only small and time-dependent correlations of translation time series with solar activity.
- Periodic signal with a period of about 115 days at the end of z-translation timeseries. What can be the reason? SAA?



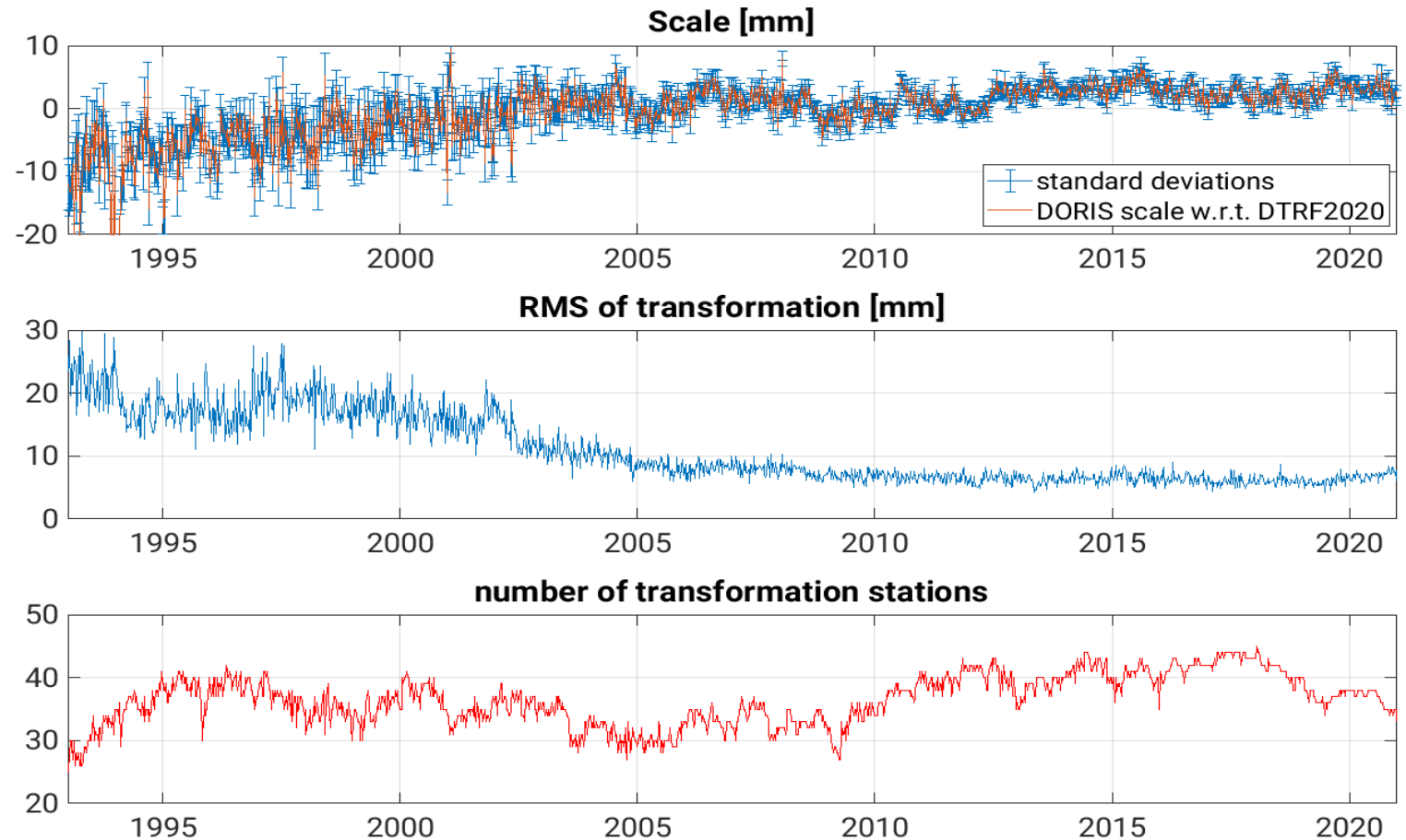
# DORIS datum parameters

## DORIS scale parameter time series w.r.t. DTRF2020 and RMS of transformation

### Scale drift w.r.t. DTRF2020

|             |            |
|-------------|------------|
| 1993 – 2021 | 0.38 mm/yr |
| 2003 – 2021 | 0.17 mm/yr |
| 1993 – 2003 | 0.97 mm/yr |

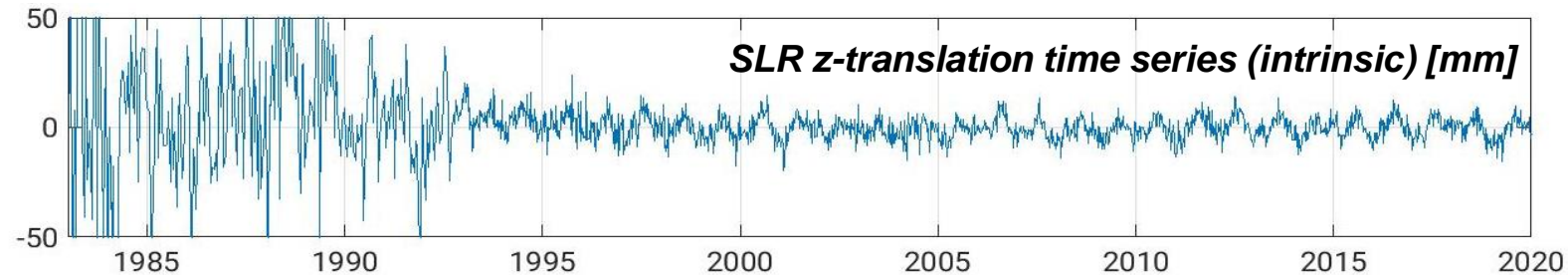
- Scale time series quite stable
- Drift change around 2003.0.  
What can be the reason?



# Datum realization of DTRF2020

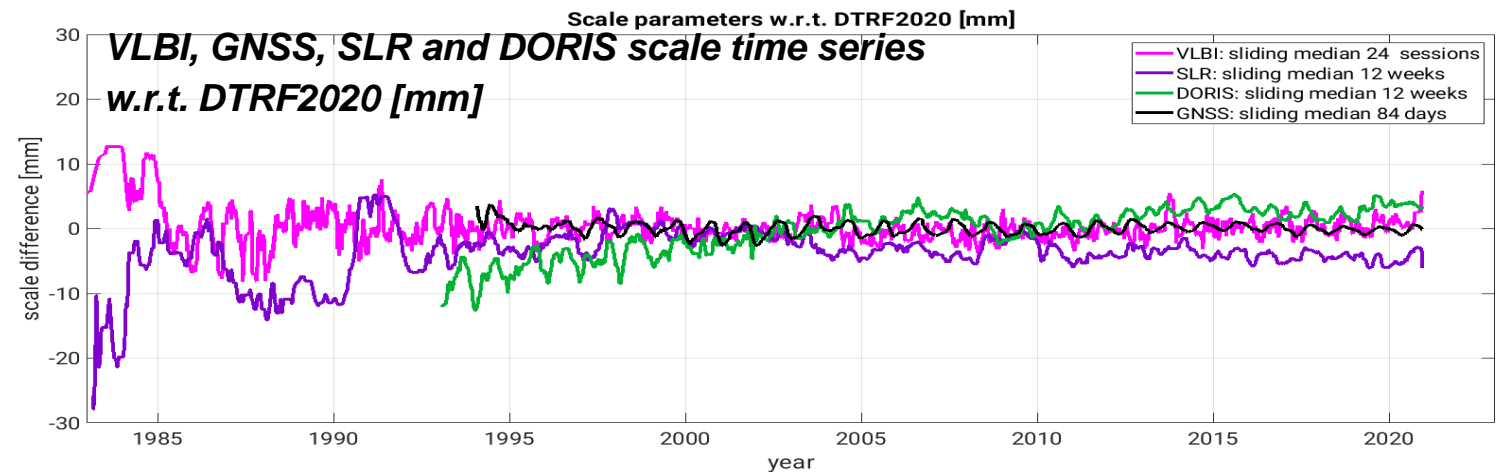
## DTRF2020 origin

- Realized from the full history of SLR observation data



## DTRF2020 scale

- Realized from the full history of VLBI and GNSS observations.
- SLR shows a small offset and drift of 2.2 mm (2010.0) and -0.1 mm/yr and was not included.
- DORIS shows also a small drift w.r.t. VLBI and GNSS



## DTRF2020 orientation

- By no-net-rotation conditions for positions and velocities w.r.t. DTRF2014 using a subset of globally distributed GNSS stations; reference epoch 2010.0

# DTRF2020 preliminary solution

## Transformation of ITRF2020 to DTRF2020, Epoch 2010.0

Positions:

|       | TX [mm] | TY [mm] | TZ [mm] | Scale [mm] | RMS [mm] | #stat |
|-------|---------|---------|---------|------------|----------|-------|
| GNSS  | 1.9     | -2.1    | 0.2     | -4.0       | 0.3      | 104   |
| SLR   | 0.2     | -0.3    | 0.1     | -2.5       | 3.0      | 29    |
| VLBI  | 2.8     | -3.2    | -2.7    | -2.3       | 1.1      | 28    |
| DORIS | 1.6     | -4.6    | -4.1    | -6.6       | 0.7      | 23    |

 good agreement

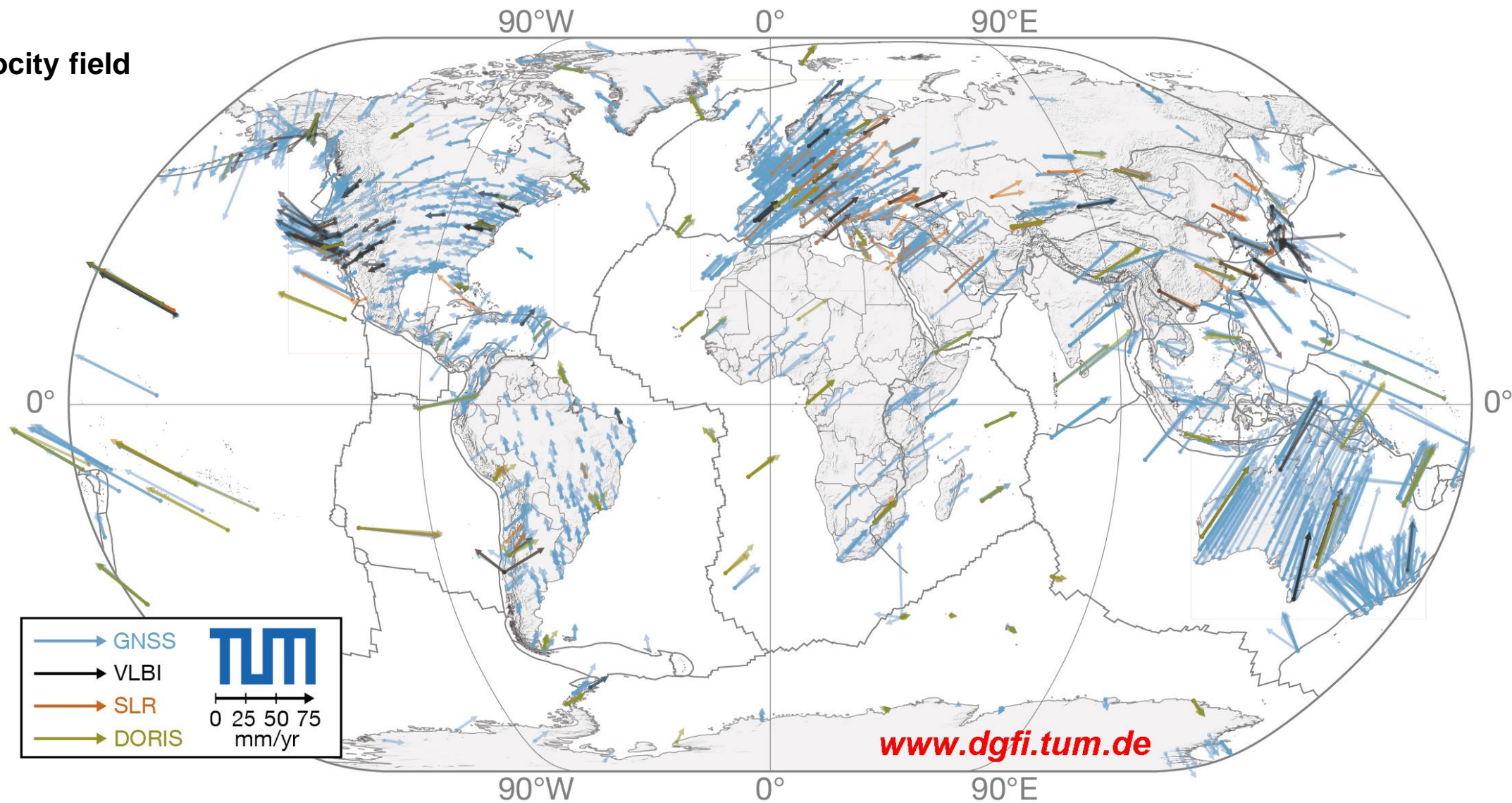
 larger differences

Velocities:

|       | TX [mm/yr] | TY [mm/yr] | TZ [mm/yr] | Scale [mm/yr] | RMS [mm/yr] | #stat |
|-------|------------|------------|------------|---------------|-------------|-------|
| GNSS  | -0.18      | 0.05       | 0.05       | -0.09         | 0.05        | 104   |
| SLR   | 0.05       | -0.12      | 0.00       | -0.11         | 0.26        | 29    |
| VLBI  | -0.10      | -0.10      | 0.03       | -0.12         | 0.15        | 28    |
| DORIS | -0.09      | 0.15       | 0.15       | 0.08          | 0.19        | 23    |

# DTRF2020 preliminary solution

## Horizontal velocity field



# Outlook and DTRF2020 release

## Outlook

- A DTRF2020 preliminary solution will be available within the next weeks.
- Some initial external validations are currently being carried out.

## The DTF2020 release will contain

- SINEX files of the combined solution and per technique (station coordinates only) with full variance-covariance matrix (full SINEX file of DTRF2020 solution on request)
- EOP data file
- NTL model values (time series per station and removed offset and drift)
- PSD: parameters of approximation functions as well as approximation time series
- Station position residual time series
- SLR origin (translation) time series

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Thank you very much for your attention!

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