IVS Checklist for ITRF2020.

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This memo provides a check list for submitting solutions to the IVS combination center. This is based on the checklist for submissions to ITRF2014.

The VLBI solution should adhere to the latest IERS convention. Doing so means that we can easily compare the results from all software packages. The current version is IERS2010, although various parts have been updated. I encourage you to look at: http://iers-conventions.obspm.fr/

Links to required data files can be found on https://ivscc.gsfc.nasa.gov/IVS_AC/IVS-AC_ITRF2020.htm.

If there is something that is unclear, or you have other questions and comments, please contact me at: John.M.Gipson@nasa.gov.

Parametrization Submissions for a given day should include the following in the normal equations. Nuisance parameters such as clocks or atmospheres should be 'squeezed out' prior to submission.	
TRF	All XYZ components of the site.
Sources	Right Ascension and Declination Remove sources if there are less than 4 observations.
EOP (24 hour sessions)	All EOP components: XP, YP, UT1-TAI XP-rate, YP-rate, LOD Nutation X, Nutation Y
EOP (2-3 station networks)	XP, YP, UT1-TAI

New Models for ITRF2020 Some of this information is repeated in other sections for completeness.	
Galactic Aberration	See: https://ivscc.gsfc.nasa.gov/IVS_AC/ITRF2020/Final%20WG8%20Report.pdf
Pole tides	New IERS poletide model (2018) http://iers-conventions.obspm.fr/content/chapter7/icc7.pdf
Gravitational Deformation	Please use gravitational deformation models for those antennas where these are available. A file that gives the deformation as a function of elevation is available at: https://ivscc.gsfc.nasa.gov/IVS_AC/apriori/gravity_deform_model_v2019Nov21.txt
HF-EOP	Use the model by Desai&Sibois/Egbert. Information can be found at: https://ivscc.gsfc.nasa.gov/hfeop_wg/ You should include the effect of UT1 and Polar Motion libration in the a priori. See section 5.5 of: http://iers-conventions.obspm.fr/content/chapter5/icc5.pdf

Sessions

For the IVS submission to ITRF2020 we ask that all IVS Analysis centers submit the same set of sessions. This list will change as more sessions become available. A current list of sessions can be found on https://ivscc.gsfc.nasa.gov/IVS_AC/IVS-AC_ITRF2020.htm.

If you have problems finding any of these sessions, please let me know and I will help track them down.

Conversely, if there is a session that you think should be included but is not, let me know and I will investigate.

Sources

In contrast to previous submissions to ITRF, this submission will include not only station but source positions. If a session has only a few observations of a source the normal equations may become singular. Because of this I recommend the following:

If a source has fewer than 4 good observations, do not use observations involving that source in the normal equations.

Some people have suggested keeping these observations but removing the source from the normal equations. This has the effect of fixing the source at the a priori position which is equivalent to strong constraint on the source position. In a single session this may be alright, but if the data is stacked this can lead to problems. This is why this option is ***STRONGLY discouraged.***

Earth Orientation Modeling

Tidal Variations in X, Y, UT1	Use Desai&Sibois/Egbert for diurnal and sub-diurnal tides. Include UT1 and PM libration terms.
Nutation	IAU2006 (without Free Core Nutation)
Permanent Tide	No correction

Miscellaneous

Relativistic Scale Shapiro Effect	IERS 2010

Station Coordinates

Solid Earth Tide	IERS2010 Conventions
Permanent Tide	No Correction
Love Numbers	h2(freq=0)=0.6078 l2(freq=0)=0.0847
Pole tides	New IERS poletide model (2018) http://iers-conventions.obspm.fr/content/chapter7/icc7.pdf
Ocean loading	TPX07.2 model (recommended by Hans-Georg Scherneck) **Calc11 uses this model.** Or FES2004 **Please indicate which model you use in your solution description.**

Ocean poletide loading	Include.
Atmosphere Pressure Loading	**Apply atmosphere pressure loading.** **Include an extra block in the SINEX files so that loading effects can be removed.** **An example of how to do this is in:** https://ivscc.gsfc.nasa.gov/IVS_AC/IVS-AC_ITRF2020.htm. **Indicate the source of your pressure loading information.**
Other Loading Effects	NONE

Antenna & Station Modeling	
Axis Offsets	A file in Calc/Solve input format that contains axis offset information is available at: https://ivscc.gsfc.nasa.gov/IVS_AC/ITRF2020/gsfc_itrf2020.axo This contains the axis-offsets obtained from survey data if available. If there is no survey data the axis-offsets are from a global solution.
Thermal Expansion	Nothnagel 2008, J. of Geodesy: doi:10.1007/s00190-008-0284-z A file with this information can be found at: https://ivscc.gsfc.nasa.gov/IVS_AC/apriori/antenna-info_Nothnagel_modwe.14dec05.txt A few antennas are missing from this file. Do not apply thermal corrections for these missing antennas.
Gravitational Deformation	Please use gravitational deformation models for those antennas where these are available. A file that gives the deformation as a function of elevation is available at: https://ivscc.gsfc.nasa.gov/IVS_AC/apriori/gravity_deform_model_v2019Nov21.txt
Eccentricities	https://ivscc.gsfc.nasa.gov/IVS_AC/apriori/ECCDAT_v2019Jun12.ecc

Troposphere Modeling This section probably has the greatest variability in terms of acceptable alternatives. This is because recent work indicates that Ray Tracing has the potential to provide superior results to the VMF1/VMF3 mapping function. Another reason is that the met data in the Mark3 databases and corresponding vgosDB is known to be incomplete (some stations have no met data), and in some cases have bad data.	
Apriori Delay	Modified Saastamoinen (Davis et al, 1985) Or Apriori Dry Delay from VMF1 or VMF3 Or Apriori Dry + Wet Delay from VMF1 or VMF3 Or Apriori Delay From Raytracing **Please indicate which a priori delay you use. If your delay comes from ray-tracing, please indicate which program created the results.** **If you use the Saastamoinen, please indicate the source of pressure data.**
Pressure and Temperature	**Please indicate the source of your met data.**

	It is known that some Mark3 databases have missing or incorrect data. Because of this, the use of alternate values for temperature and pressure are acceptable. One option is to use the met data reported in the VM1 or VMF3 files.
Dry Mapping Function	Dry VMF1 or VMF3 OR Dry mapping function from Ray-tracing **Please indicate the source of your met mapping function**.
Wet Mapping Function	Wet VMF1 or VMF3 OR Wet mapping function from Ray-tracing **Please indicate the source of your met data.**
Gradient	Chen-Herring Gradients. OR Gradients from Ray-tracing.
Gradient a-priori	Latest DAO results. A link to the a priori gradient file is at: https://ivscc.gsfc.nasa.gov/IVS_AC/files_IVS-AC/gsfc_dao_gmao.mgr

Reweighting the data.

It is well known that if you use the measurement uncertainty that comes out of the correlator the formal errors are unrealistically small, and chi-square is too large. The later indicates that the presence of un-modeled error. The common approach to this is to inflate the raw measurement uncertainty. There are several acceptable ways of doing this.

Global weighting—add some value (in an RSS sense) to all observations:
Sigma_ij^2→sigma_ij^2+Wt^2
OR
Session dependent weighting:
Sigma^2_ij →sigma^2_ij +Wt^2_a (a depends on the session)
OR
Baseline weighting
Sigma^2_ij^2→ sigma^2_ij+ Wt^2_a,ij (a labels the session, ij the baseline)
OR
Station weighting
Sigma^2_ij→ sigma^2_ij+ Wt^2_a,i + Wt^2_a,j (a labels the session, i and j label the
(a labels the session, ij the baseline)
Please indicate what kind of weighting you use.