



Strategies for Weekly Routine Generation of Combined IERS Products

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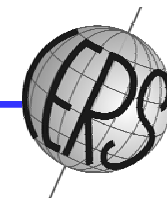
Technical University of Vienna

Vienna, Austria



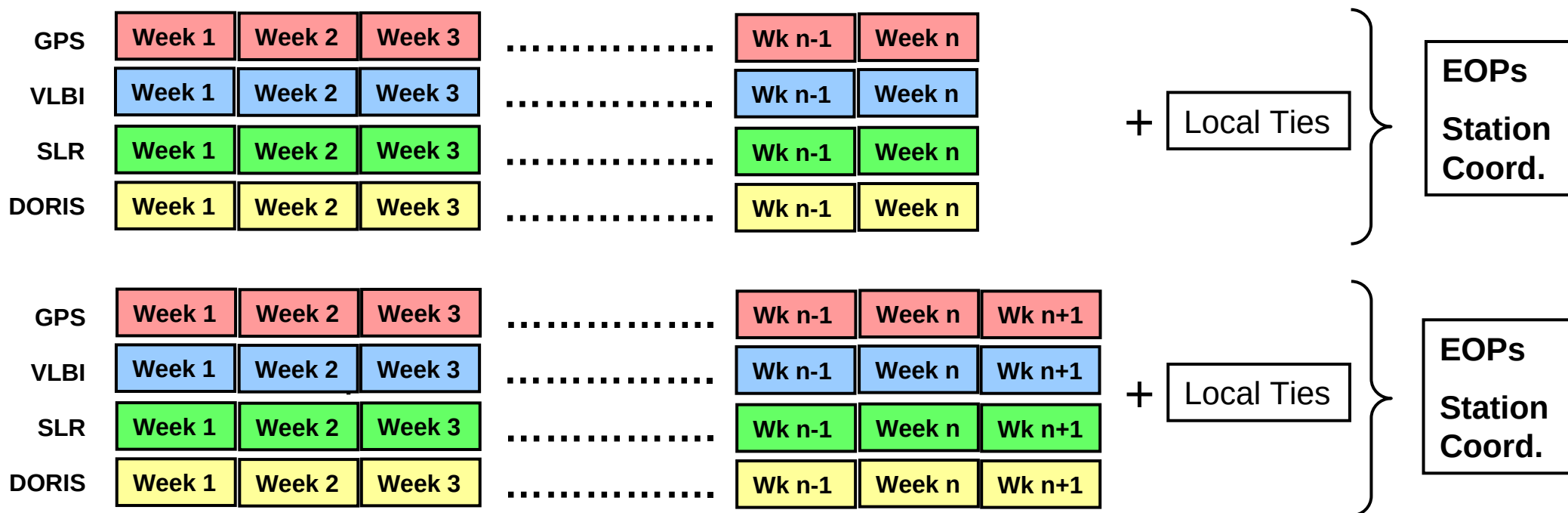
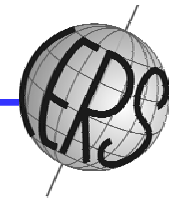
- **General Considerations**
- **Two Weekly Routine Solution Strategies**
- **UT1/LOD (Nutation) Combination Strategies**
- **Schedule**

General Strategy Considerations



- The following strategies should be discussed and, to the extent possible, tested with the SINEX files of the IERS CPP and the long time series
- Once a year a new IERS200x is computed based on a consensus of new standards (models, parameterization, processing strategies, etc.) and based on complete reprocessed and recombined solutions of all techniques
- Routine weekly intra-technique combined solutions should be produced with exactly the standards used for the most recent ITRF200x (in future IERS200x) realization
- Latency envisaged: ca. 2-3 weeks (after the combination of the intra-technique solutions); i.e. reduction of the latency necessary
- Each new weekly solution has to be validated carefully concerning station problems
- Will several Combination Centers produce these inter-technique solutions? Will there be a combination of the combination of the combination?

Strategy 1: Complete and Rigorous (1)



- Every week a full “ITRF/EOP” solution is produced including the new weekly intra-technique combined SINEX files (~ cumulative solution of the IGS)
- Fully correct and rigorous combination using all available information
- Estimation of site coordinates, velocities , geocenter, annual signals, jumps, EOPs as in ITRF2004; detection and monitoring of site problems necessary.

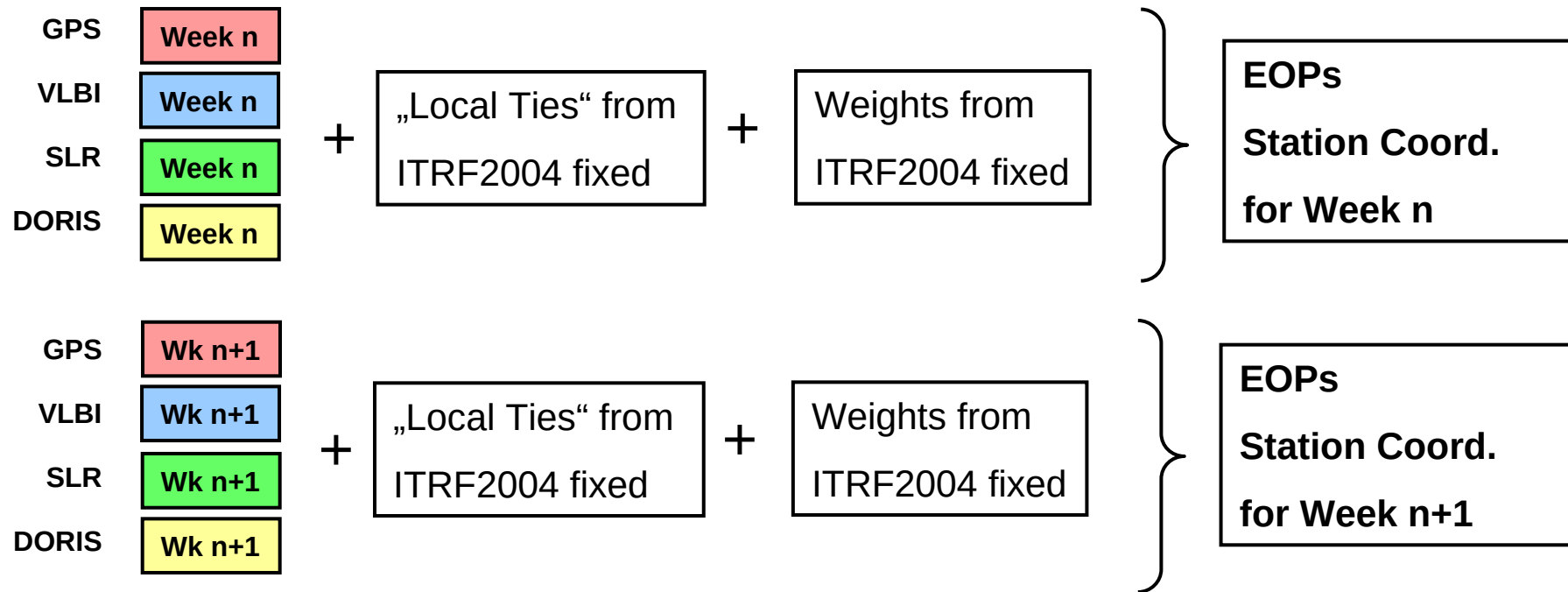
Strategy 1: Complete and Rigorous (2)



- Variance component estimation possible, or weights taken from ITRF2004
- Local ties may be introduced with their variance-covariance information
- Demanding in computer resources (memory, CPU time)
- Can be realized with the strategy developed for ITRF2004
- Weights of local ties may have to be adjusted when the number of weekly solutions increases significantly
- **IERS product:** fully updated time series of EOPs and up-to-date set of site coordinates and velocities (new sites ...), etc. on a weekly basis

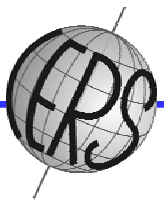
Even if full weekly “ITRF/EOP” solutions will be produced with this strategy, official IERS200x releases should only happen at the most **once a year**.

Strategy 2: Minimal and Weekly (1)



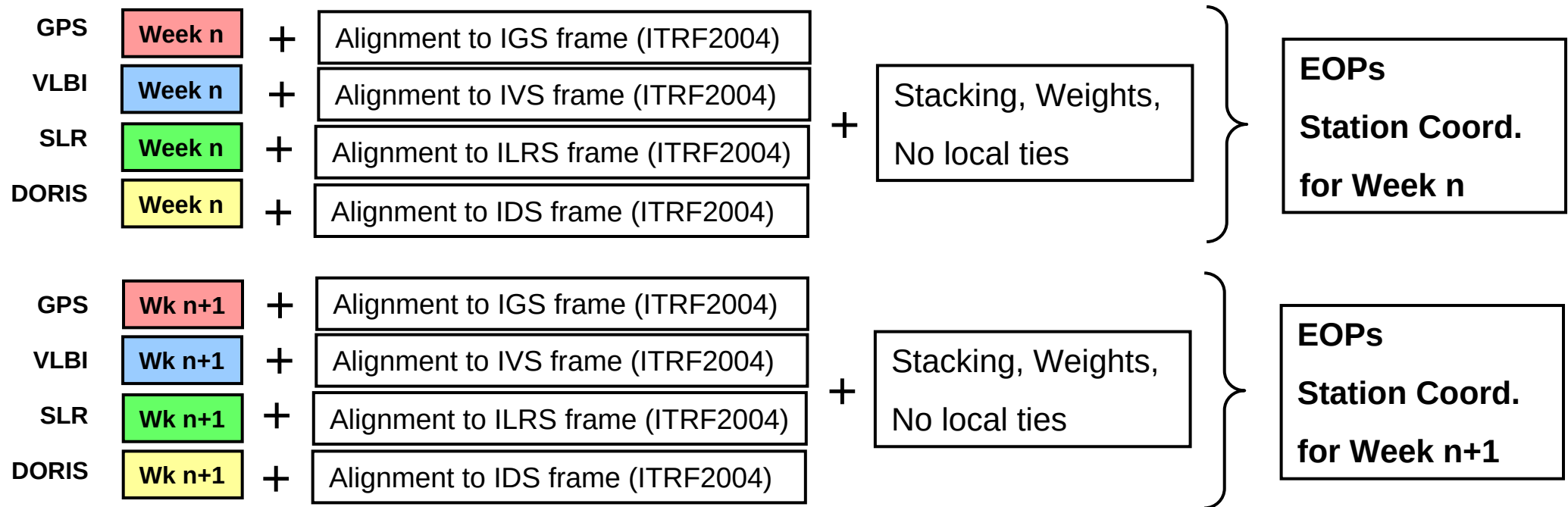
- Every week only the new weekly intra-technique combined SINEX files are processed to obtain the results for this new week
- All informations necessary for the combination (relative weights, local ties, datum, annual signals, ...) are taken from the ITRF2004 (IERS200x) solution and are fixed (compatibility requirement)
- Not a fully correct combination, but fast and efficient

Strategy 2: Minimal and Weekly (2)



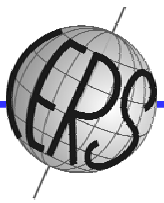
- Estimation of site velocities, annual signals not possible
- Coordinates of more recent sites will start to deviate after one year (quality of the velocities)
- Because of the fixed local ties, the reference frame might be more stable (??)
- Almost no computer resources required (memory, CPU time)
- Can be realized as soon as all the ITRF2004 products are available
- Combination strategy rather is simple, other CC might join
- **IERS product:** most recent week of EOPs and site coordinates (resulting SINEX files are not to be used for further combinations)
- This strategy might be the way to go for rapid daily inter-technique combinations, but is probably sub-optimal for the weekly update cycle

Strategy 3: Semi-Rigorous (1)



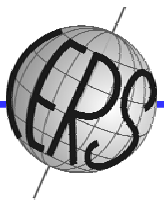
- Technique services produce weekly solutions (SINEX) fully aligned to a technique-specific, ITRF2004-aligned multi-year solution (e.g., IGS: IGB00)
- The combination is done as a pure stacking (no local ties, no additional datum) including weights
- The consistency of the individual technique combined solutions is kept

Strategy 3: Semi-Rigorous (2)



- It might take some time to realize such a strategy by the technique combination centers
- Alternatively the alignment could be done by the IERS CCs
- **IERS product:** most recent week of EOPs and site coordinates (resulting SINEX files are not to be used for further combinations)

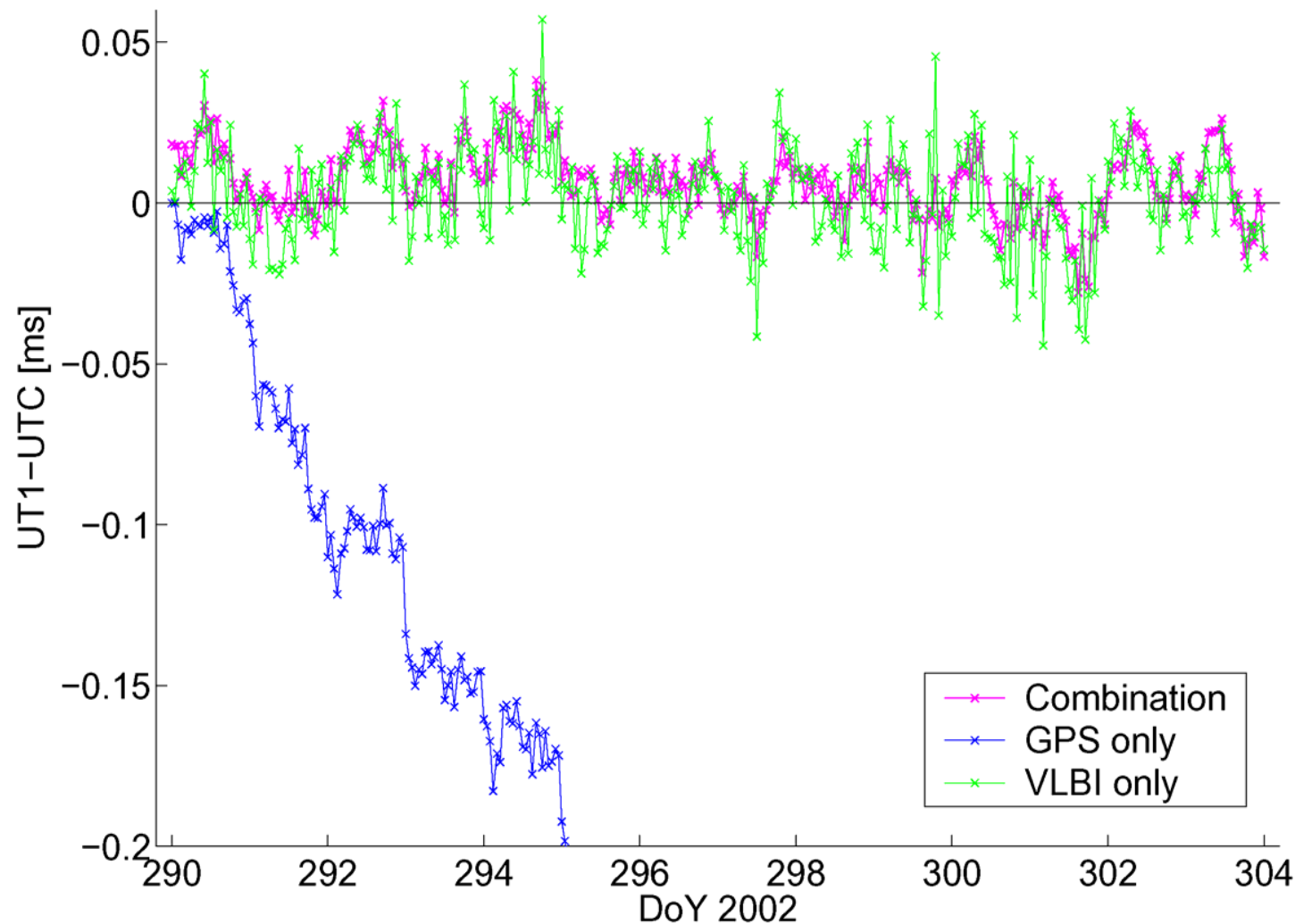
Combination UT1/LOD (and Nutation)



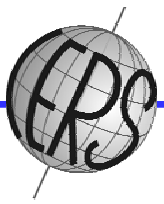
- General remark: no principle difference between UT1/LOD and nutation offsets/rates
- Combination: UT1 from VLBI, LOD from satellite techniques
- LOD from satellite techniques shows systematic effects from orbit modeling problems
- Combination strategy tested with daily, highly consistent CONT'02 solutions: GPS(/SLR) from TU Munich, VLBI from DGFI
- Any constraints on the orbit parameters can destroy the combination of UT1 (VLBI) and LOD (GPS/SLR/DORIS)
- **Formal Errors:**
 - Formal errors of UT1 integrated from LOD grow rapidly with time
 - Formal errors of UT1 from VLBI stay almost constant
- **Initial results:** combination possible without special handling of LOD



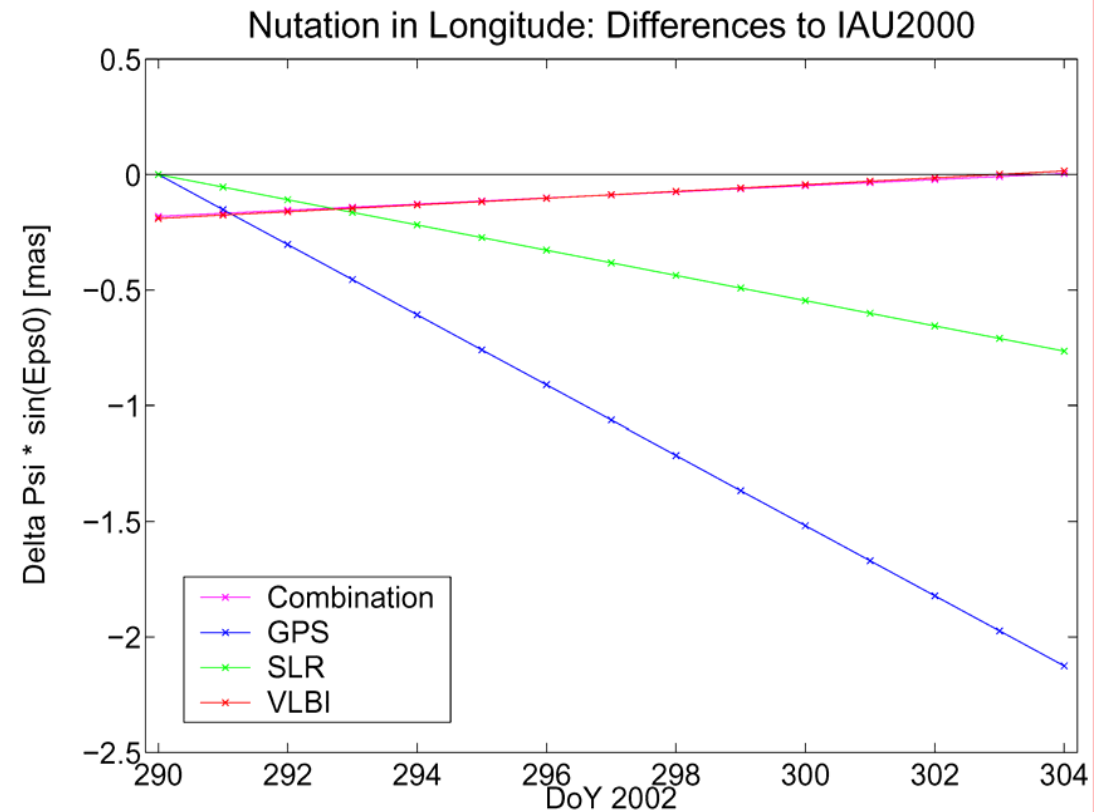
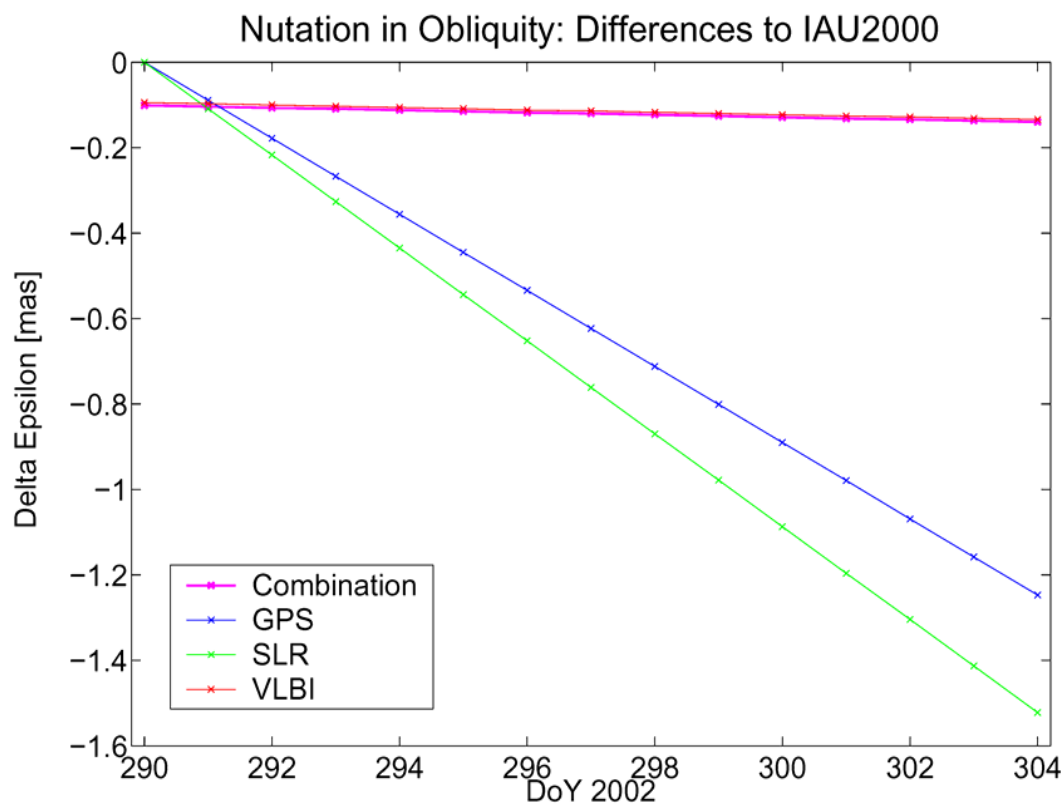
CONT'02: Combination of UT1/LOD



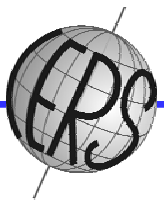
RMS UT1-UTC: **Combination: 0.011 ms**
 GPS: (0.182 ms)
 VLBI: 0.015 ms



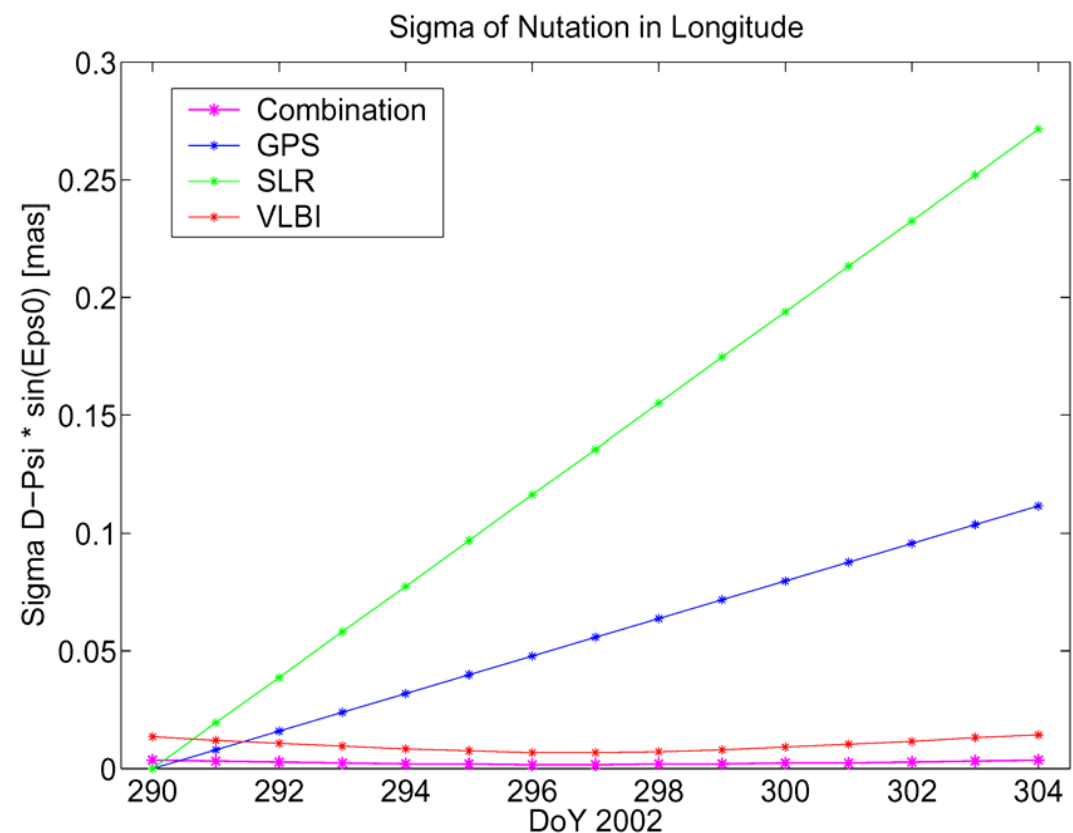
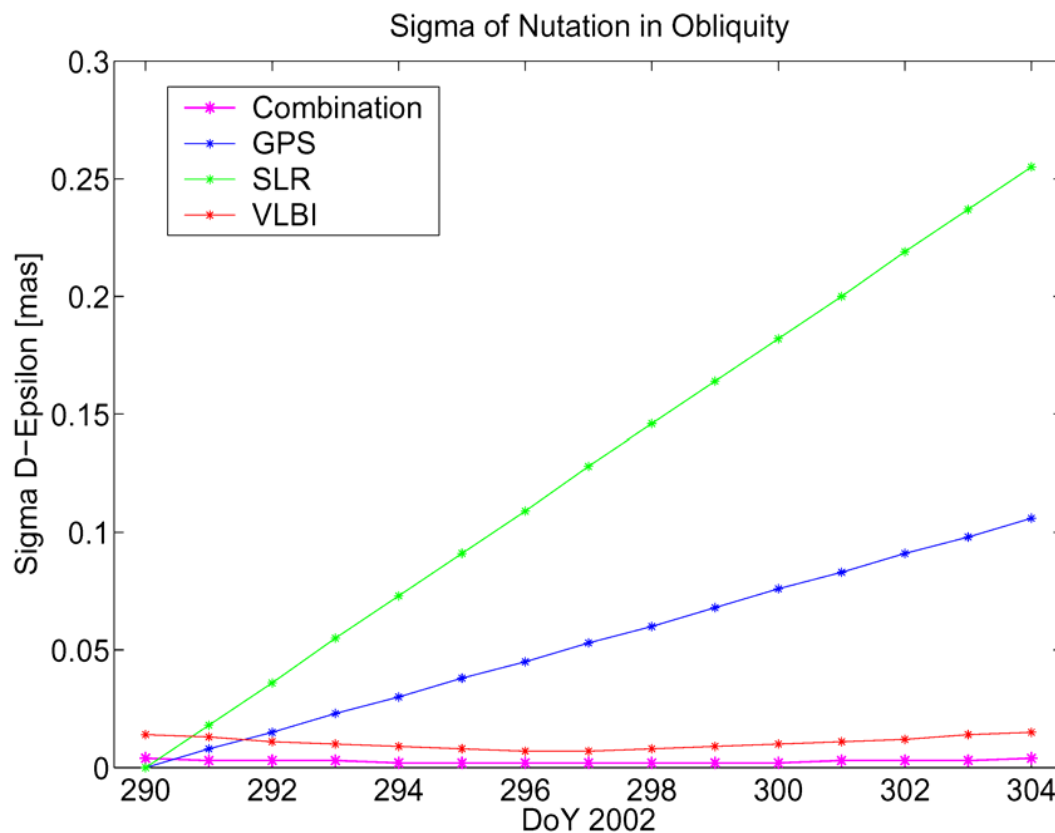
VLBI: 1 offset and 1 drift over 14 days
GPS/SLR: 1 drift over 14 days



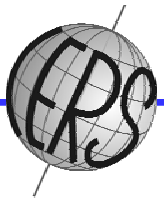
CONT'02: Formal Nutation Errors



Combination is possible due to the rapidly increasing formal errors of GPS/SLR estimates



Combination UT1/LOD (and Nutation)



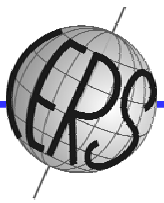
- If the outlined strategy does not work for the weekly SINEX solutions, more difficult procedures have to be considered and tested
 - First, the question of possible constraints in the satellite technique solutions should then be clarified
 - Systematic effects in LOD too large:
 - LOD biases resulting from orbit modeling deficiencies would have to be determined for each individual AC
 - This could not be done on the level of intra-technique combined solutions
 - VLBI is a crucial element in the combination: satellite techniques alone will not be sufficient
- Task of the technique centers doing the intra-technique combination ?
- But support from VLBI and IERS needed ?

Validation of the Weekly Routine Solutions

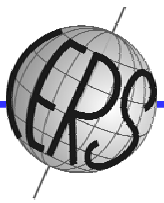


- Validation procedures have to be developed for the weekly routine generation of IERS products
- **Quality checks:** each combination center should have its checks for the quality of the weekly solutions:
 - Comparison with previous solutions
 - Detection of station/antenna etc. problems
 - Monitoring of transformation parameters
 - ...
- **Validation tools:**
 - Repeatability of site coordinates over longer time spans
 - Stability of the reference frame (datum) over longer time spans
 - Validation of EOPs with geophysical fluid information
 - Comparison of troposphere zenith delays from co-located sites

IERS CPP: Schedule



- April 27, 2005:** IERS CPP Meeting at the EGU Meeting in Vienna; Discussion of the next steps (inter-technique combination and validation)
- May-July 2005:** Test of strategies for weekly routine generation of products and for their validation
- August 2005:** Results to be presented at the IAG Scientific Assembly (Cairns, Australia)
- August-October 2005:** Set up routine generation of products and their routine validation
- October 2005:** IERS Workshop 2005: Evaluation of the CPP and discussions concerning the transitions to new IERS products



- **Discuss strategies** for weekly routine IERS products
- Start with weekly generation of (accumulated) **inter-technique solutions**:
 - Who is ready to test strategies for weekly inter-technique combination?
 - Who is ready to routinely generate weekly inter-technique combination?
- Start **validation** of weekly intra-technique and inter-technique combinations
 - Who is ready to validate the weekly inter-technique combinations?
- **Reduce latency** of intra-technique solutions (2 months):
 - What would be a realistic new latency for intra-technique combinations?