ITRF combination issues

ITRF PC

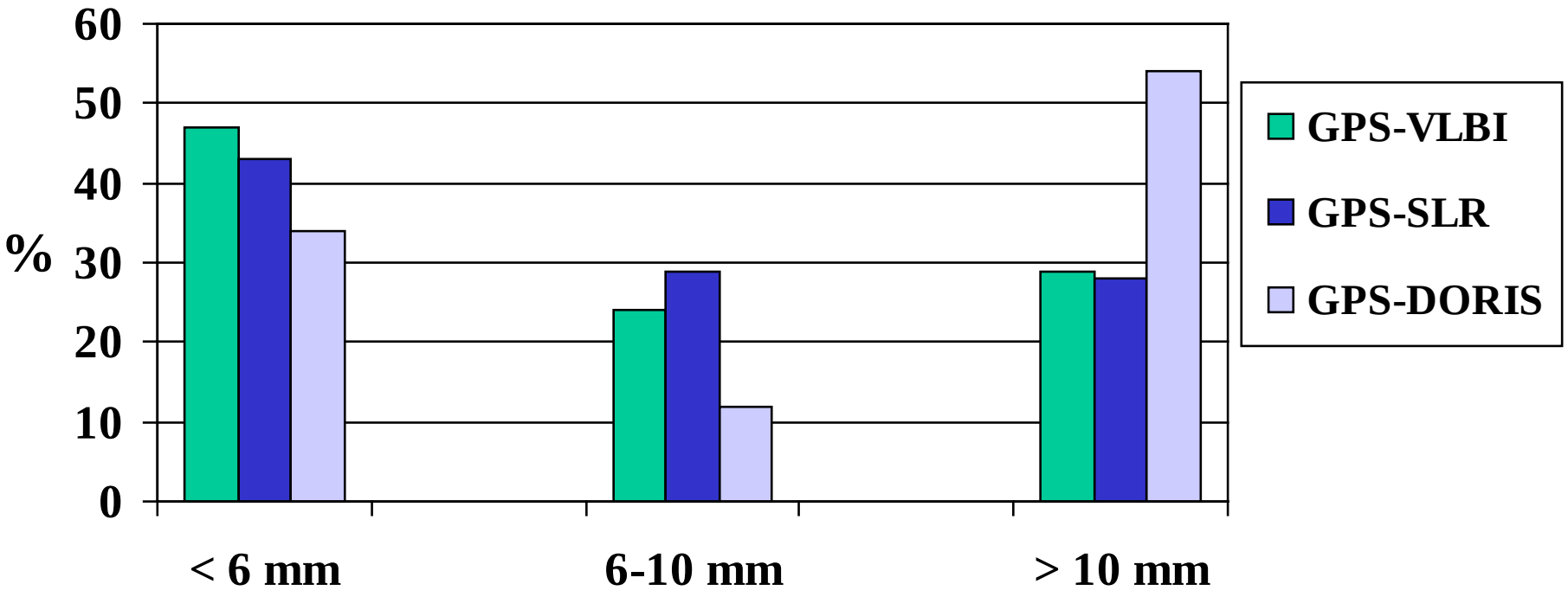
Issues for next ITRFxxxx

- **Laoding effects and the ITRF ?**

- **Other issues ?**

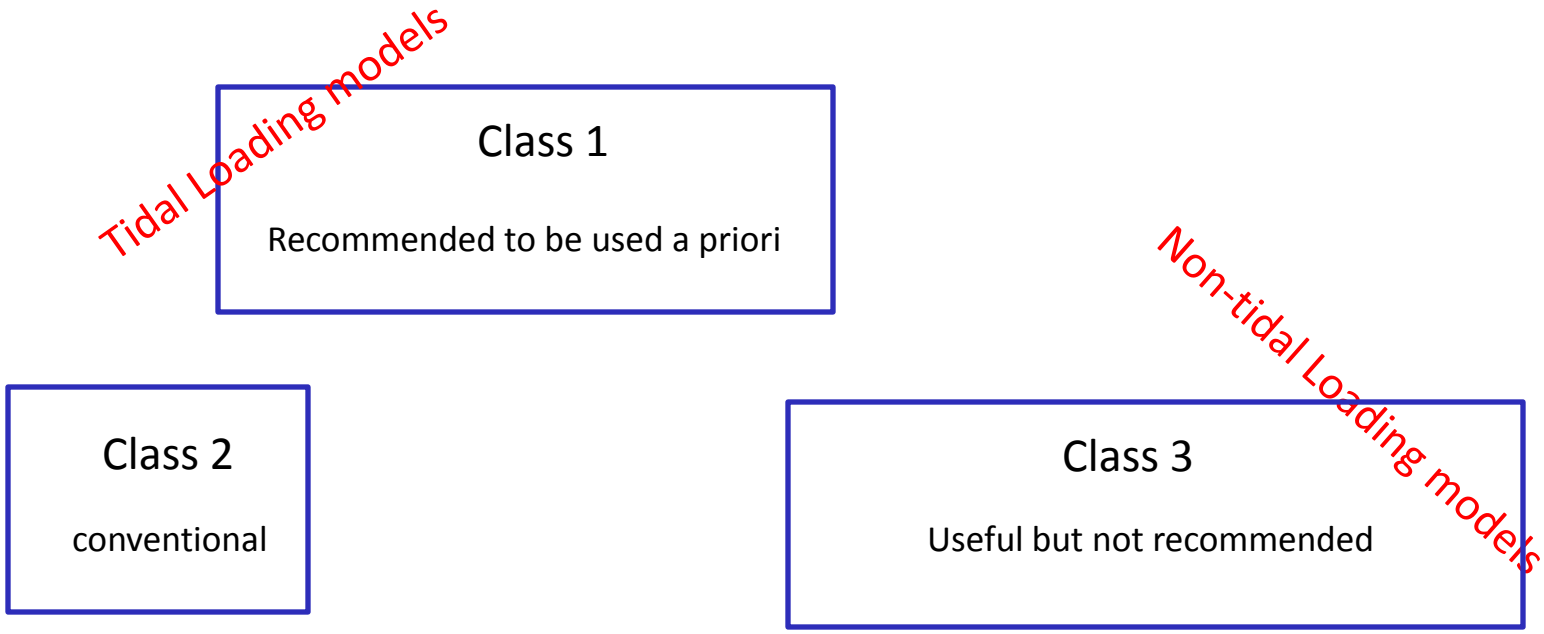
ITRF2008: Consistency btw local ties and space geodesy estimates

ITRF2008: Percentage of tie-SG discrepancies



Loading and ITRF

Background: IERS convention 2010 (Petit and Luzum, 2010)



Current status:

- Everybody recognizes that tidal loading should be considered (IERS conv 2010)
- IVS is in favor of applying non-tidal atmospheric loading models
- IDS already models non-tidal loading (gravity part) to compute satellite orbits but do not use them to model station motion

Loading and ITRF

Questions:

• Should we correct ITRF input data for non-tidal loading effects?
⇒ Uncertainty in water loading. But significant inter-annual effect in some places.

Is the effect of these inter-annual signals so large to justify the use of models which are not yet known to be accurate ?

⇒Small effect of non-tidal ocean loading (except in few places, Williams and Penna, 2011) possible error in the models (Bonin and Chambers, 2011). Few studies about this effect (see Tonie's talk).

• More specifically: Should we correct ITRF input data for non-tidal atmospheric loading effects? Several studies exist but

Unambiguous criteria should be defined to decide if a model should be applied or not. (ratio between signal and error, consistency between different models, threshold on estimated admittance factor, RMS reduction etc…).

Loading and ITRF

Problem:

In the current ITRF construction, it is implicitly assumed that:

1) Loading motions average out
   * Problem for new stations (few data cause biased positions and velocities)
   * inconsistency if a loading model is recommended in the future since loading motion trend will be applied twice (ITRF is biased)
   * Problem if significant inter-annual signals

Problem solved if corrections applied at the observation level or a posteriori before the ITRF construction

Note:
- no significant inter-annual signal in atmospheric loading ?
- Based on the above problem only, should we decide to apply loading models?
  Yes if the models are accurate (see Tonie's talk for discussion)
  but again objective criteria are missing to decide if models are accurate.
- seasonal signals (that are the most powerful) can be partly handled by adding seasonal parameters in the combination model

Loading and ITRF

Problem:

In the current ITRF construction, it is implicitly assumed that:

2) Time-aliased signals are small OR average out as loading motions themselves

Problem solved if corrections applied at the observation level only

Note:
- no such aliased signals are reported so far for non-tidal loading effects. Any experience to report ?
- Models should be also accurate in the sub-daily frequency band

Loading and ITRF

Problem:

In the current ITRF construction, it is implicitly assumed that:

3) No real correlation exists between non-tidal loading and other parameters. This means that If loading signals are absorbed by other parameters than positions, biases on station positions are small or are averaged out

Problem solved if corrections applied at the observation level only

Note:
Correlations reported for
- troposphere parameters if station positions are fixed (Boëhm et al., 2009)
- GPS satellite 1/rev orbital parameters can absorbe loading signals if not constrained enough (Dach et al., 2011)
- but 1/rev should be constrained enough in current processing (at least for CODE group).

=> No clear evidence of this effect yet.

Loading and ITRF

Questions:

- Is the accuracy of the available atmospheric loading models sufficient to apply them in the ITRF construction?

  Answer needed.

  - If yes, at the level of our current understanding, daily a posteriori corrections are sufficient and could be done by ITRF PC (Collilieux et al., 2010). But is it also the case for SLR and DORIS (satellite with lower altitude)?
  - If yes, significant residual seasonal signals will still remain due to other systematic effects (GPS: Collilieux et al., 2011)
  - If no, try to filter loading models and use a posteriori corrections and/or add seasonal parameters

- When do we need an answer to these questions?

- IAG commission 1 working group « Modeling environment loading effects for Reference Frame » (Chair: Collilieux X.) will try to answer some of these issues. Any volunteer to work on these issues is welcome.

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Conclusion

- **Tests & evaluation are still needed**
- **Accuracy of the loading models: atmosphere, ocean and hydrology ?**
- **Agreement on ONE (combined ?) model to ensure consistency among the techniques contributing to the ITRF**
- **The effect on ITRF, as a secular/linear frame is “minor”, except for stations with few data…!**
- **It is still premature to recommend applying loading model for the next ITRF solution**