

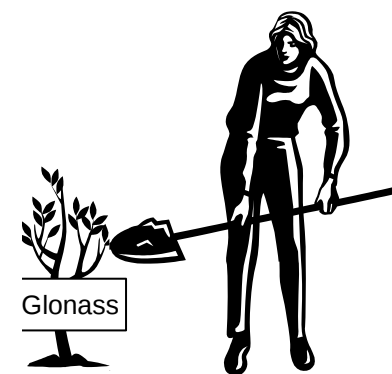
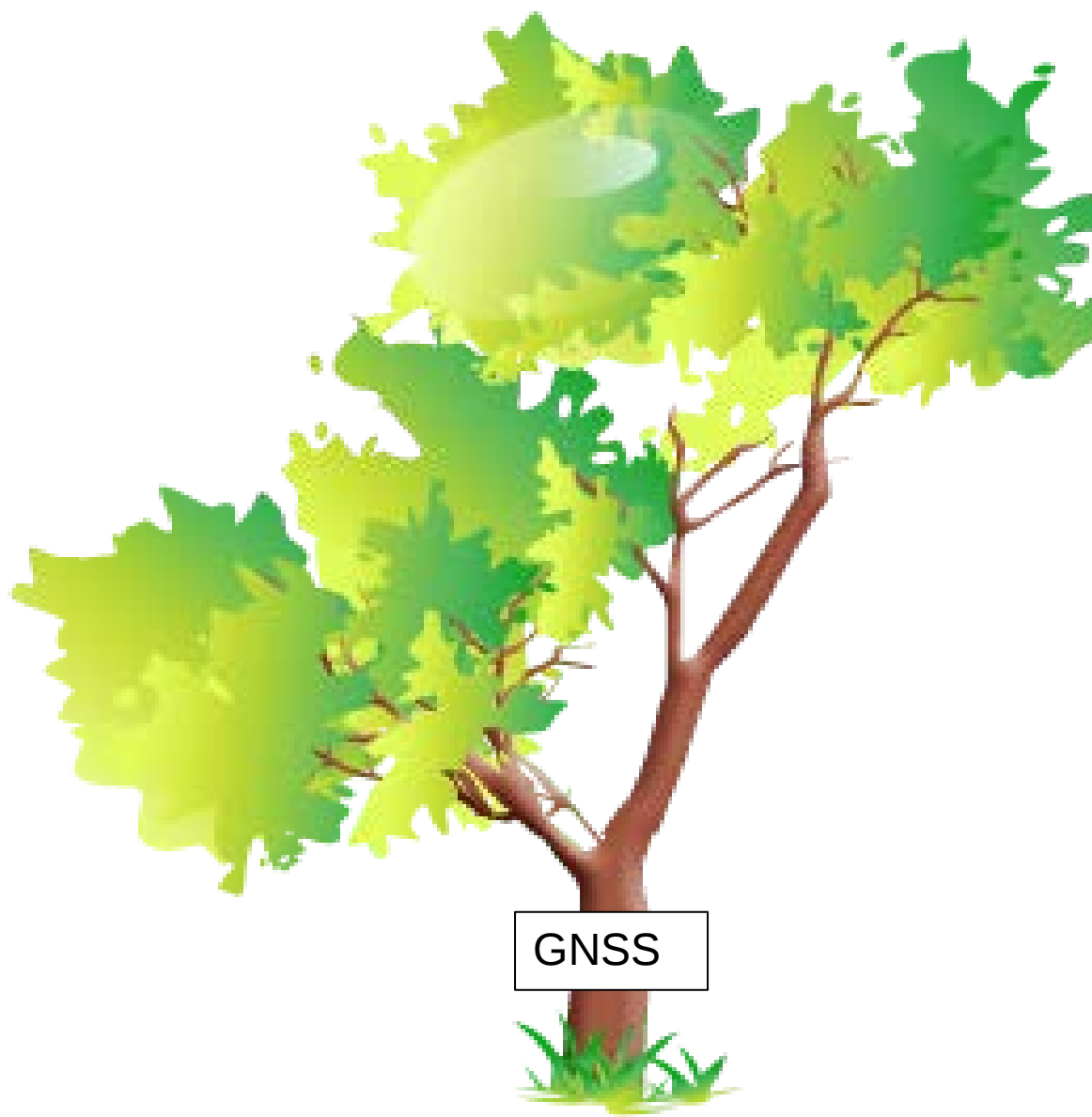
Thinning the branches of the GNSS decision tree

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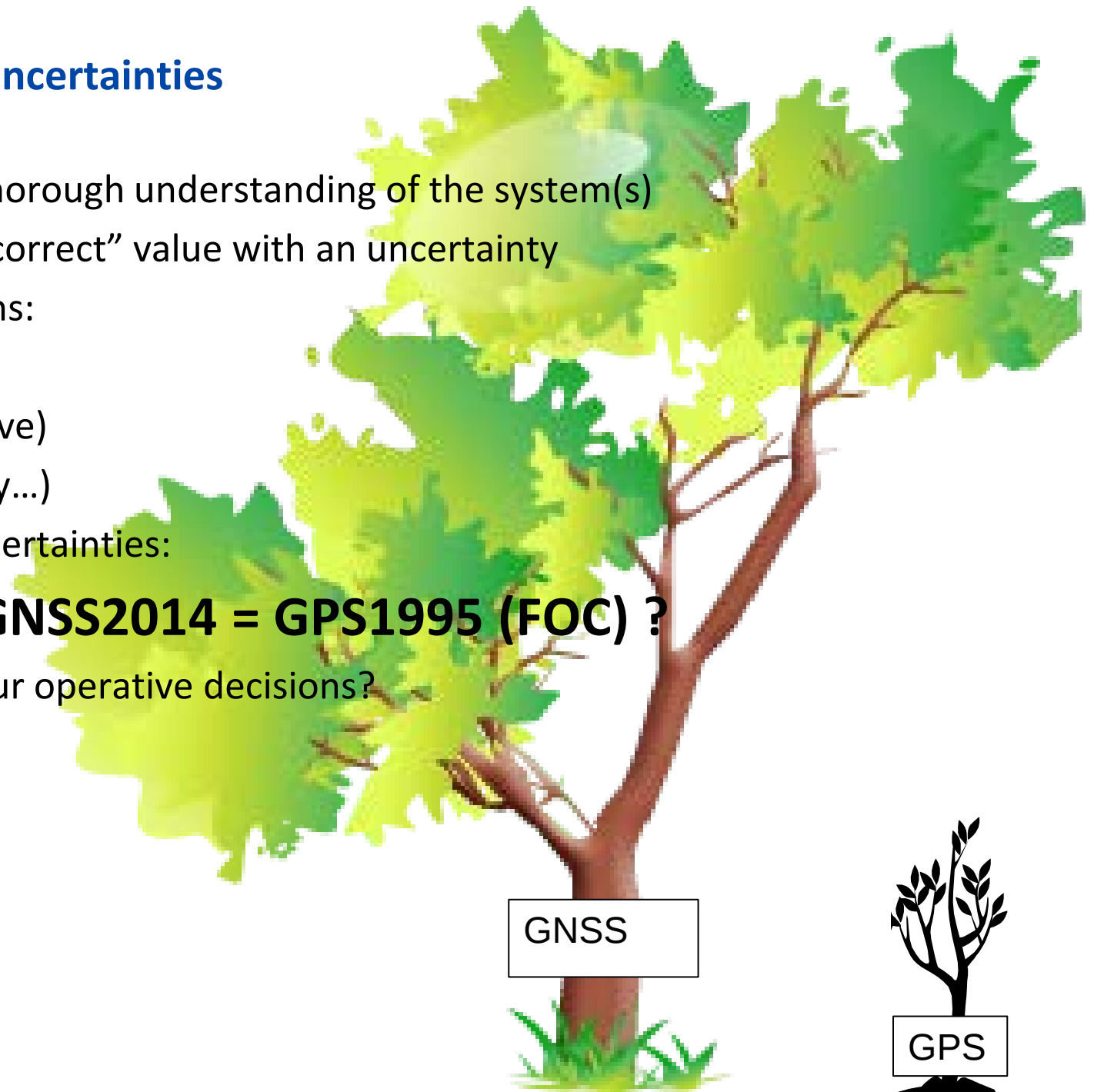


Something about decisions and uncertainties

- Informed decisions are based on thorough understanding of the system(s)
- We associate the philosophically "correct" value with an uncertainty
- General considerations for decisions:
 - Time
 - Cost (reasonably objective)
 - Quality (accuracy, reliability...)
- Main question looking at GNSS uncertainties:

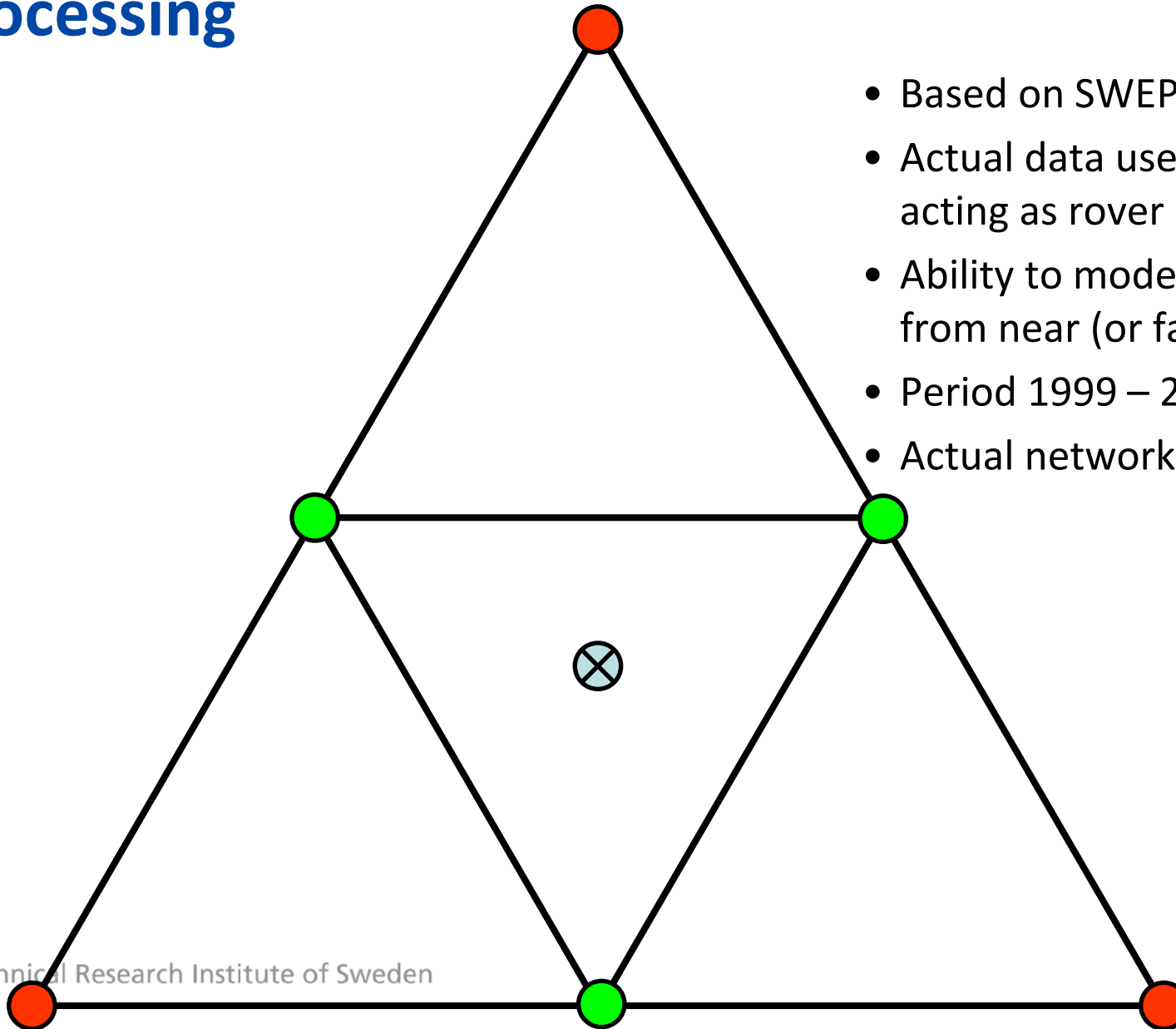
GNSS2014 = GPS1995 (FOC) ?

- If not: Do we need to reevaluate our operative decisions?



Process-perturbing errors in space and time

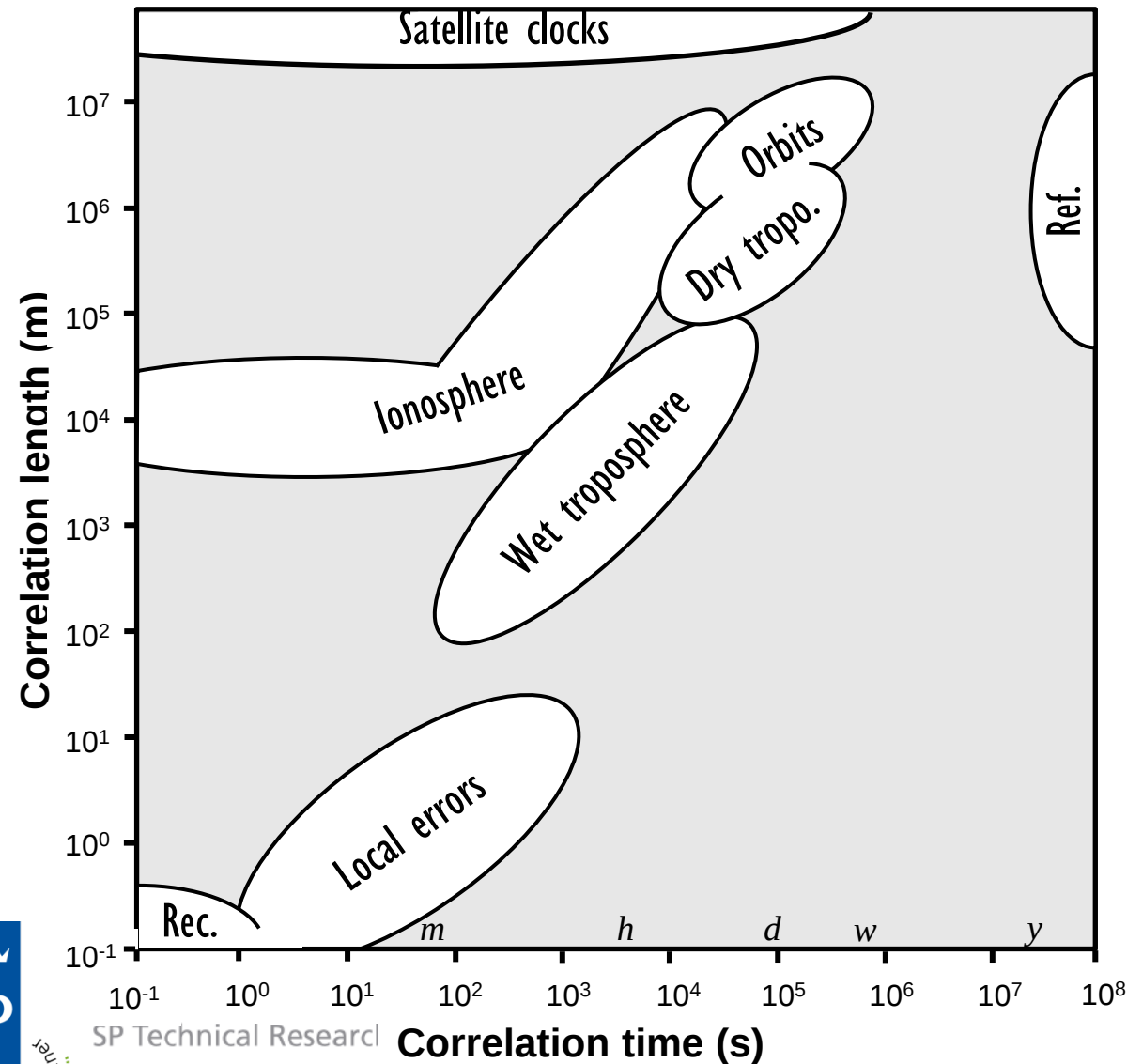
1) Processing



- Based on SWEPOS subnetworks
- Actual data used, recording reference station acting as rover
- Ability to model and interpolate behaviour from near (or far) stations
- Period 1999 – 2011 (+)
- Actual network still being densified

Process-perturbing errors in space and time

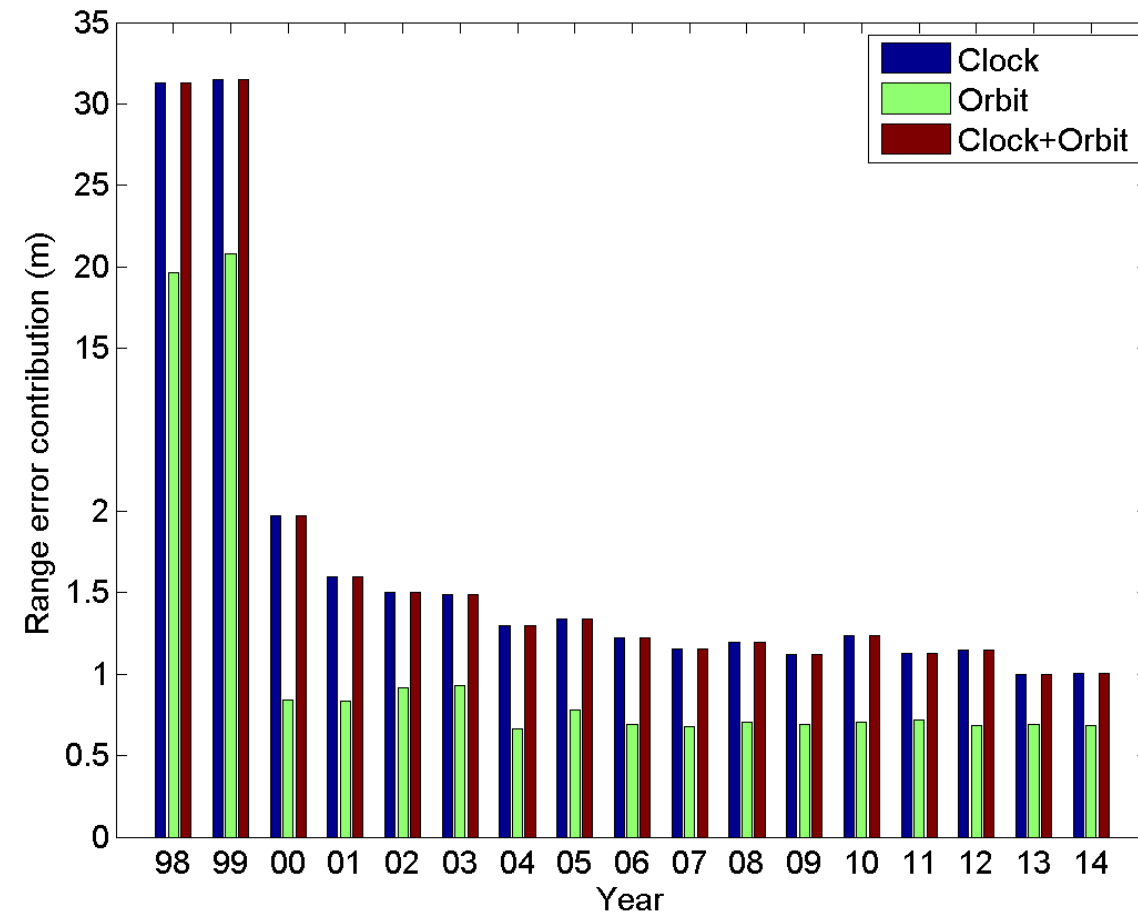
2) Perturbations



- Is it possible to make operative decisions based on our knowledge of the perturbing sources?
 - Distance to a reference indicates how error sources will affect observations
 - At what distances can we (in general terms) neglect an error source and possibly change solving strategies?
 - How long time between independent observations?
- Disclaimer:
 - Indicates the error source in space and time, not the magnitude of the error
 - For guidance only

Process-perturbing errors in space and time

3) Evolution in time: Broadcast errors



- Broadcast parameters-final results (1 week)

- Old news:

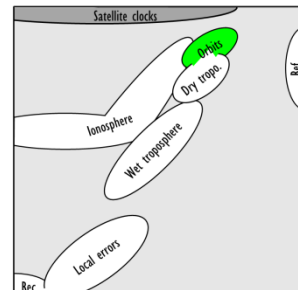
SA removed UTC 2000-05-02 04:05

(future procurement ended by decision 2007) **Then what?**

- Continuously improved broadcast parameters

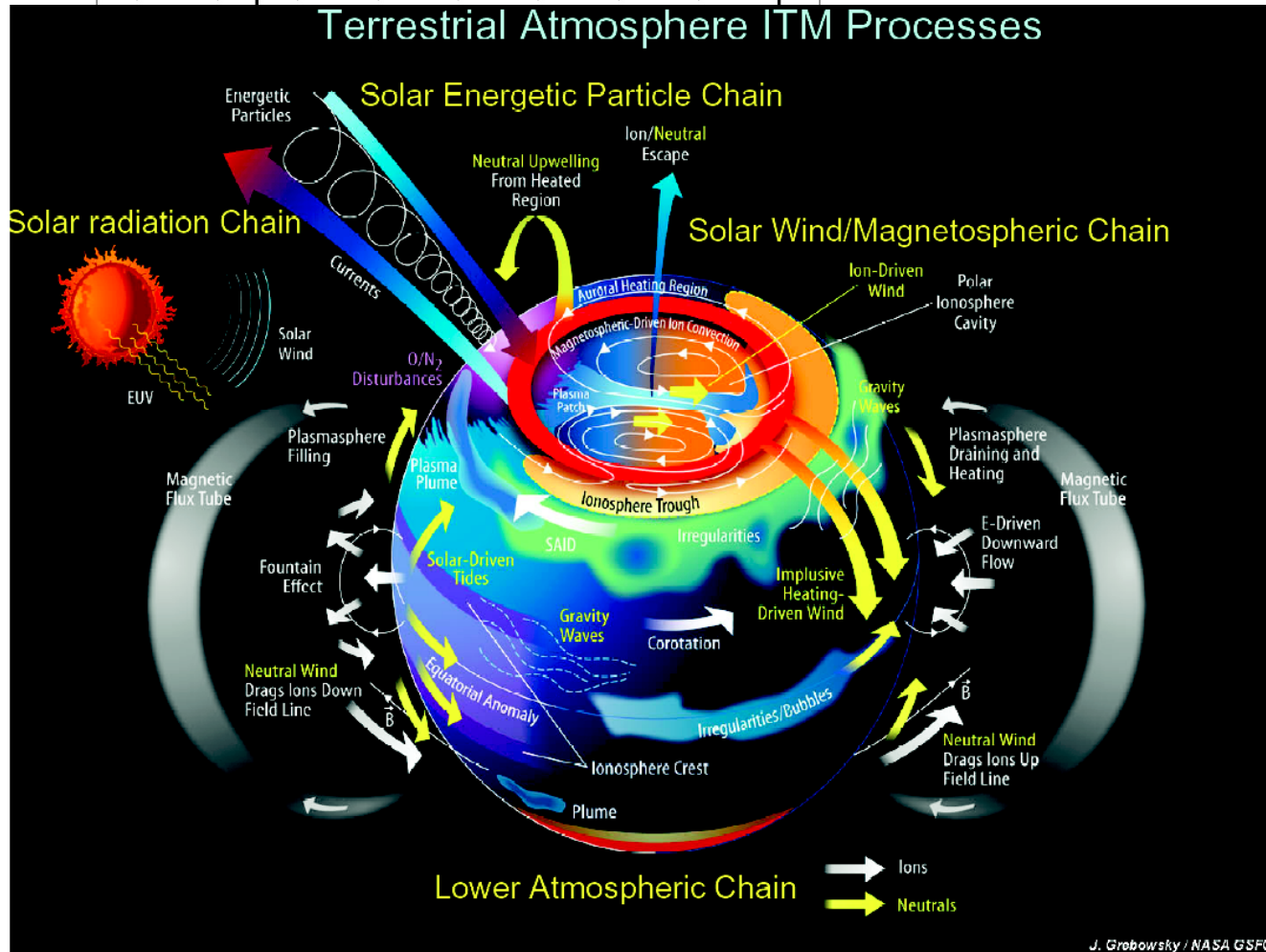
Operative decision 2014: Do we need code corrections?

- When satellite clock errors (and orbits) dominate, DGPS improves results dramatically
- When local errors dominate, differential observations will degrade results
- GNSS 2014: Observations of DGPS worsening L1 positions!
 - hardware dependent
 - other aspects, e.g. reliability might come into play
 - special cases (nice tropo-, ionosphere...)

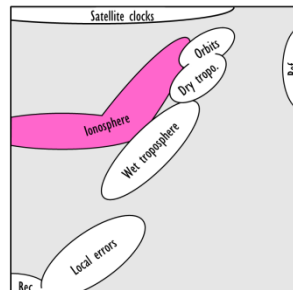
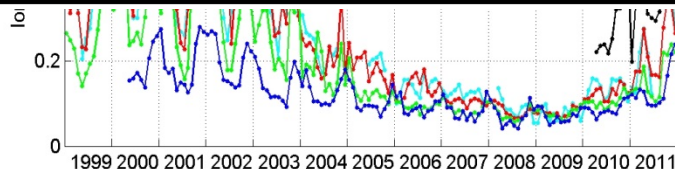


Process-perturbing errors in space and time

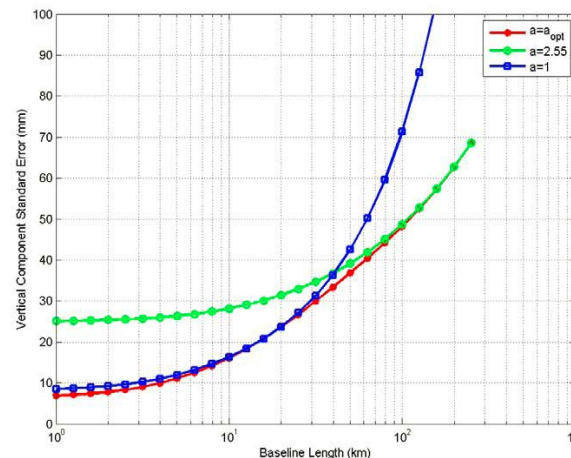
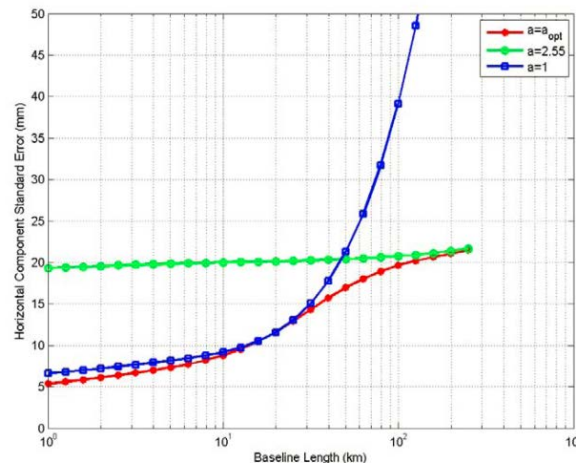
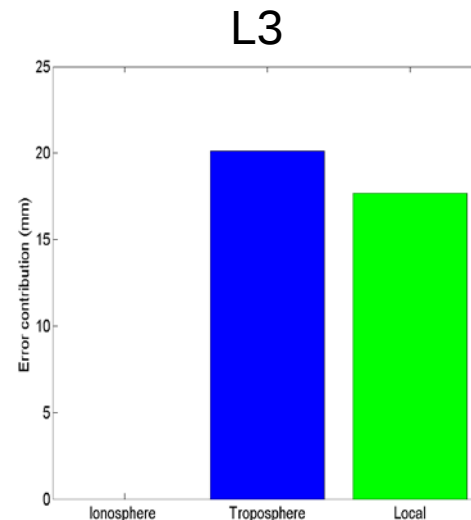
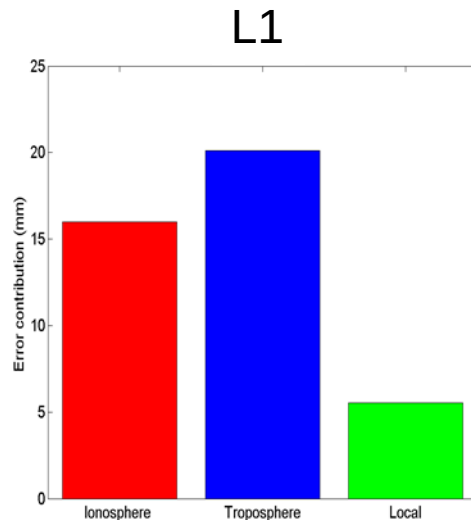
4) Recurring nuisance: Ionosphere



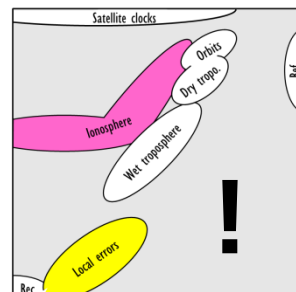
- Ionosphere largest error source on single frequency
- Characteristics
 - Solar and magnetic activity, particularly ill behaved in polar and magnetic equatorial $\pm 15^\circ$ sidebands
 - 11-year periodic sunspot cycle
 - daily large scale pattern
 - rapid scintillations
 - dispersive
- 1 TECU $\approx$ 3 dm range error in vertical
- Broadcast Klobuchar model parameters estimated to reduce $\sim 50\%$ on L1
- Mitigation by L1 + L2 combination L3



Tactical decision 2014: Why not always use ionosphere free solution (L3)?

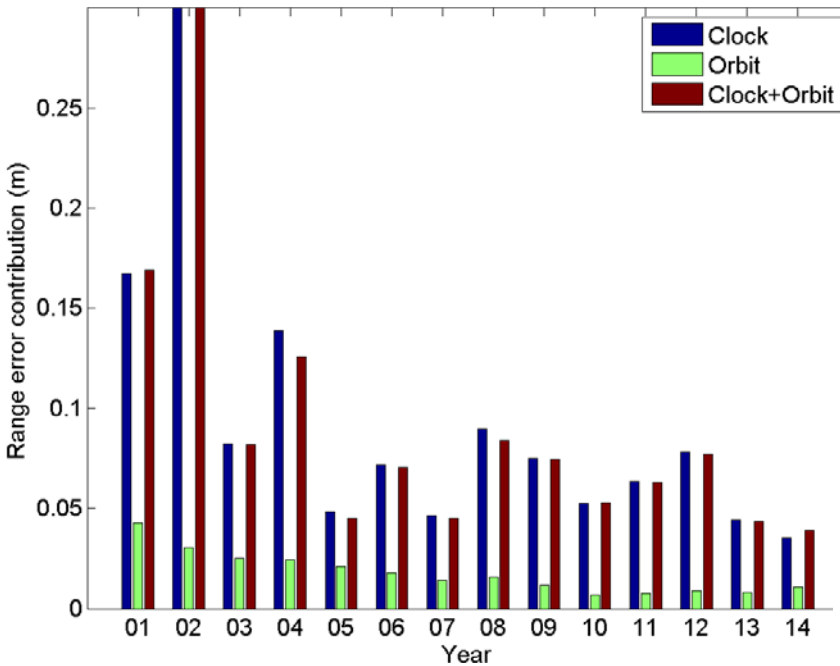


- Not even NKG lunches are free...
 - L3 distorts the signals
 - integer number of wavelengths lost
- $$\hat{l} = a l_1 + b l_2$$
- For L1 processing: $a=1$ $b=0$
- For L3 processing: $a=2,55$ $b=-1,55$
- Consequence of using L3: When ionosphere is removed, local errors are inflated
 - Parameter choice dependent of ionospheric activity
 - Optimal combination exists...

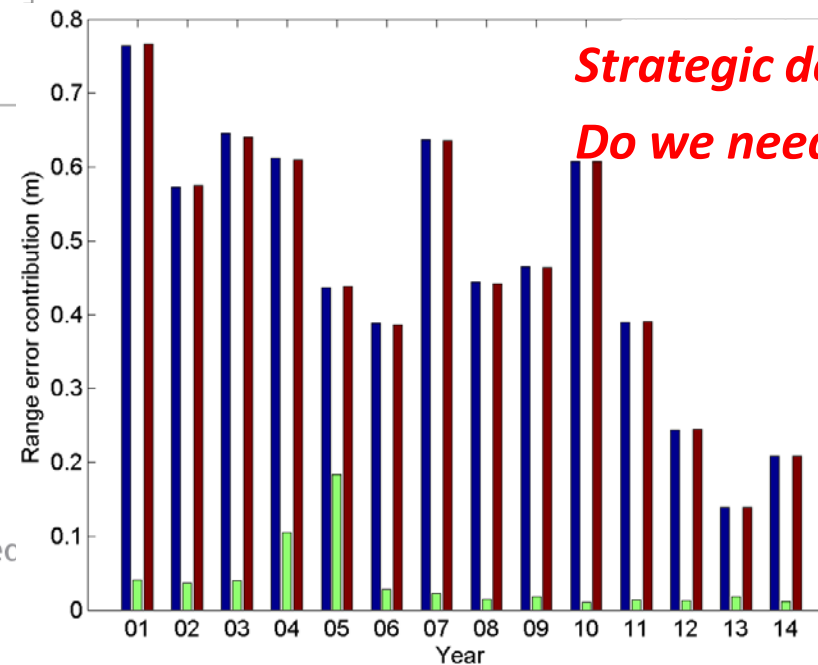


Process-perturbing errors in space and time

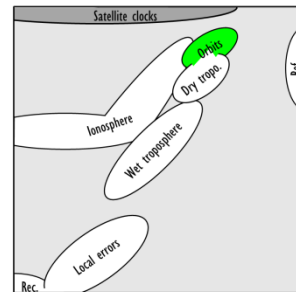
(5) Evolution in time: Orbit and clock processing capabilities

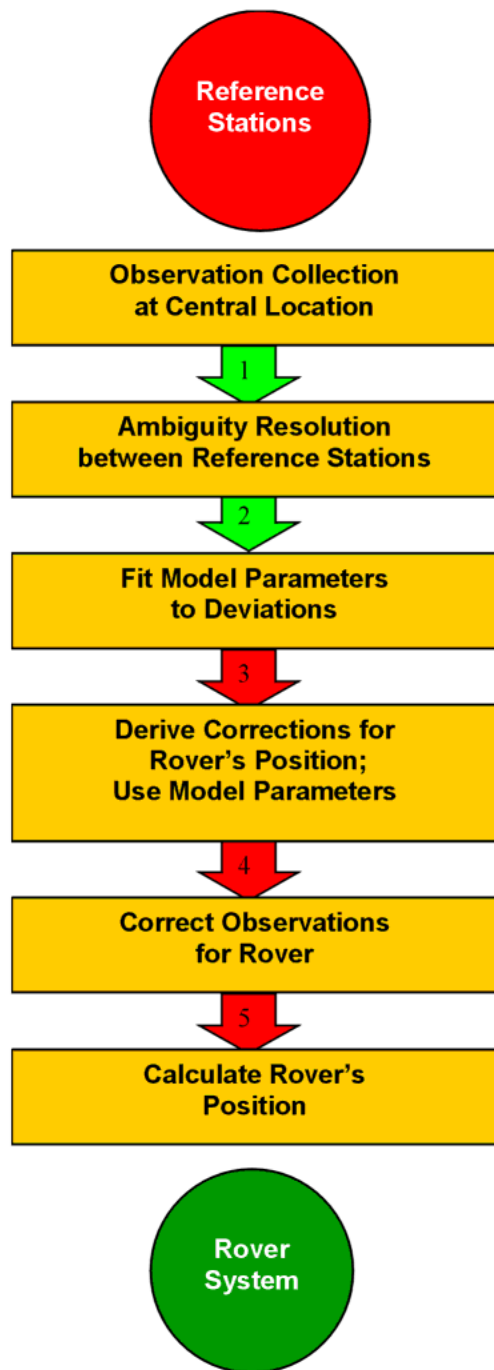


- IGS Ultra rapid product
- Best possible real time capability (systemwise)
- Last possible three hours of estimated values, first three hours of predicted values
- Continuously improving
- Range contributing error from clocks and orbits order of 2 dm



Strategic decision challenge 2020:
Do we need phase corrections?





Strategic decision challenge 2020: Who shall be responsible for processing and communication?

Post processing service

- Interface: 6
- Computational load on Central **very high**
- Communication requirement **high** (down)
- Rover complexity requirement **low**

VRS (NRTK)

- Interface: 4
- Computational load on Central **high**
- Communication requirement **high** (up)
- Rover complexity requirement **medium**

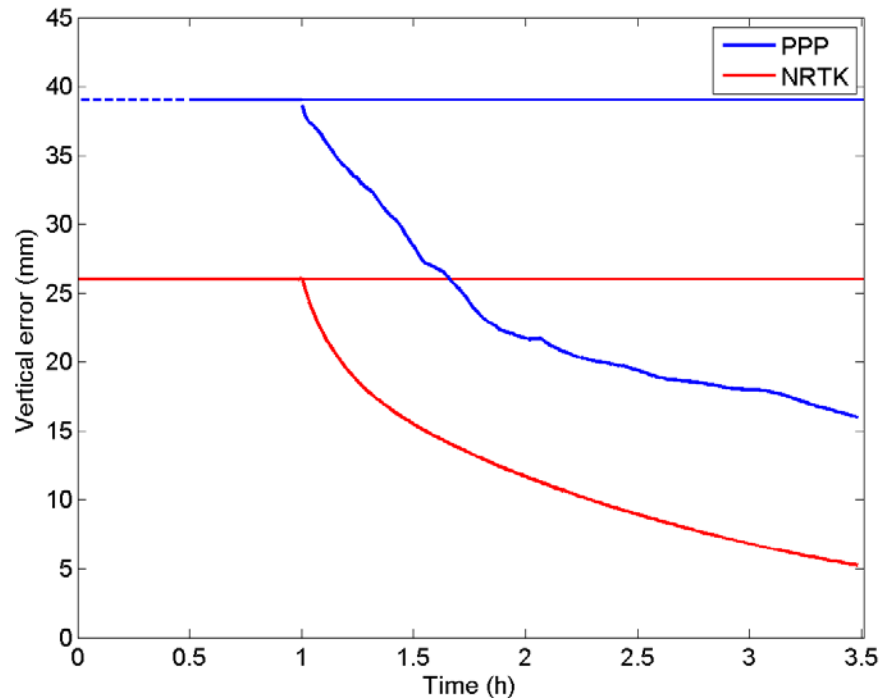
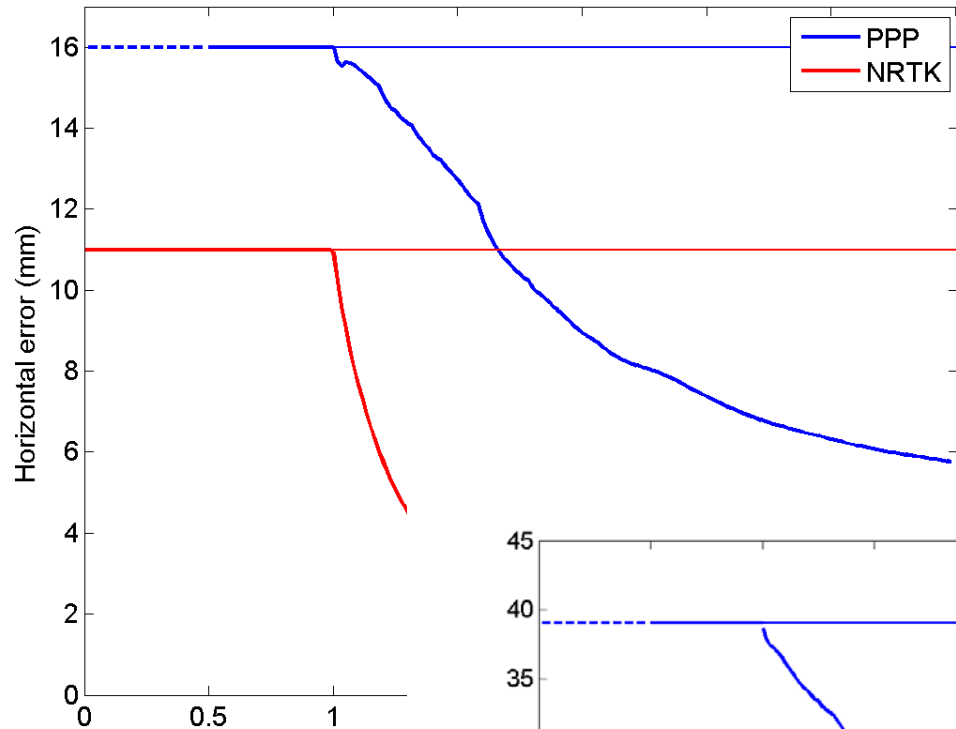
MAC (NRTK)

- Interface: 2
- Computational load on Central **medium**
- Communication requirement **high** (up)
- Rover complexity requirement **medium/high**

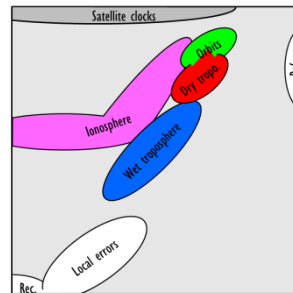
PPP

- Interface: 1
- Computational load on Central **low**
- Communication requirement **medium** (up)
- Rover complexity requirement **very high**

Operative decision 2020: Do we need phase corrections? PPP vs. NRTK



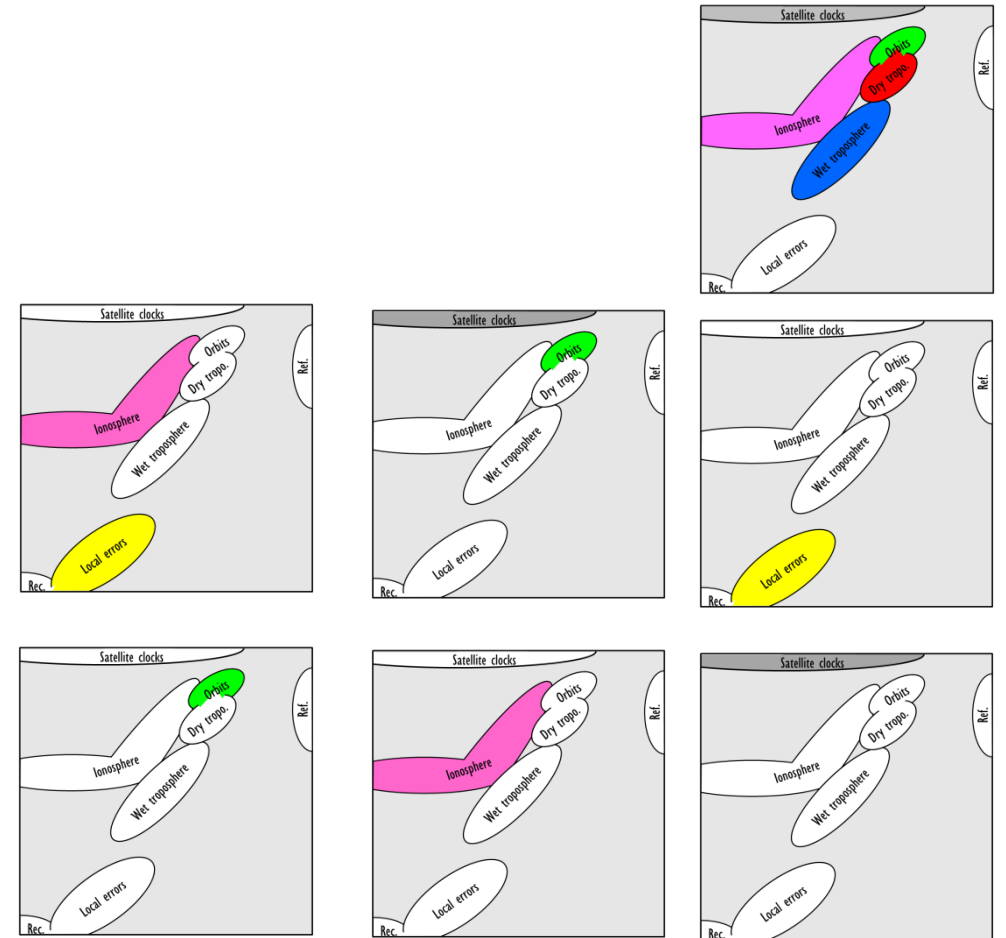
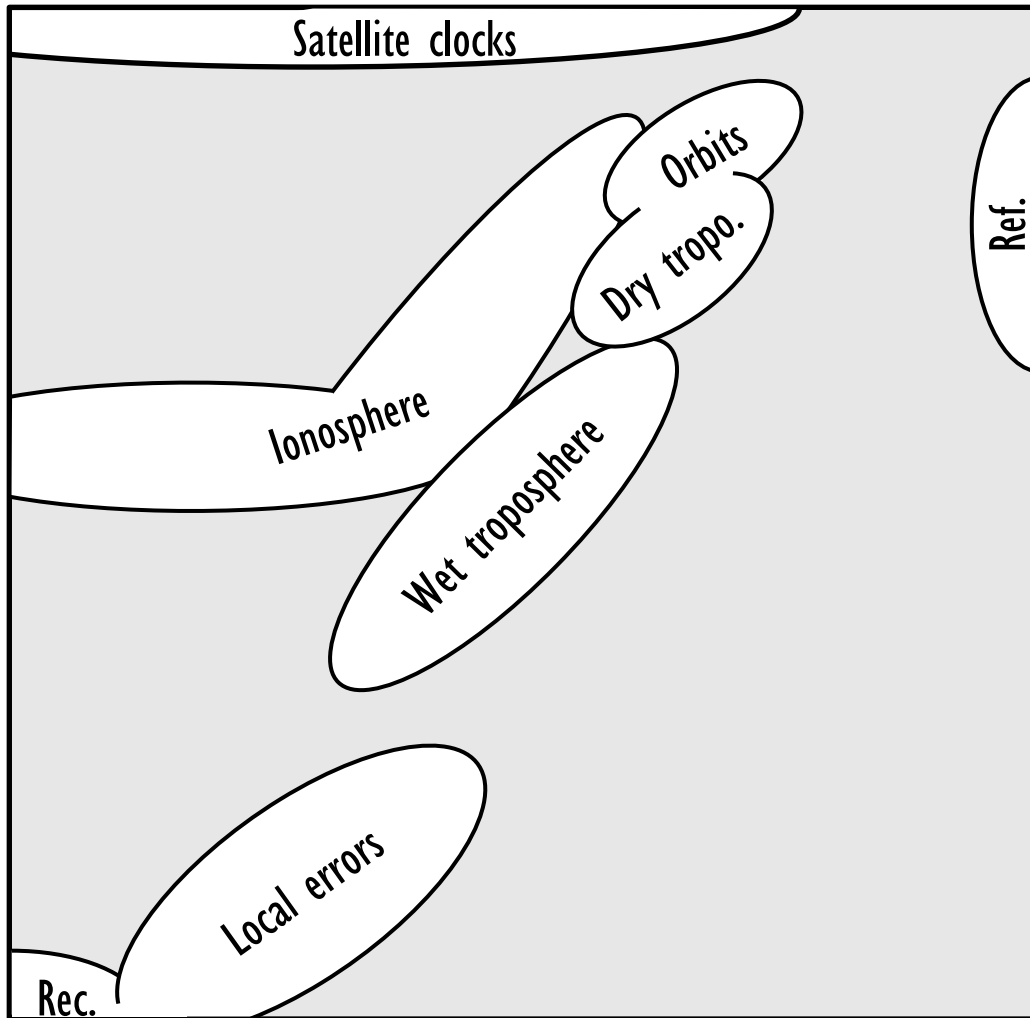
- Current setup used for benchmarking
- Satellite clock + orbit range error 1 cm ?
- Movement 10 m /min hor
1 m / min ver
- Steady state reached after 30 min
- Stop @ 1 hr:
 - NRTK-level reached after STOP + 1 hour





Thanks for your attention!

The beginning



NYTT UTSEENDE PÅ SP:s POWER POINT-PRESENTATIONER

För att få mer levande sidor har vi infört en ny grafisk form för våra presentationer. Den bygger på att bilder i presentationen kombineras med färgplattor enligt en ny färgpalett som visas nedan. De nya färgerna ligger under rubriken "Senaste färger" i programmets färgpalett.

Typsnittet har ändrats till Calibri . Färgen på rubrikerna är blå som tidigare men brödtexten har ändrats till en mörkgrå nyans.

För att lättare få en känsla för hur det är tänkt att den nya grafiska formen skall användas följer några sidor med exempel på användningssätt. Färgplattorna är inte bundna till någon viss placering eller storlek utan kan användas fritt ihop med bilder på sidorna.

En annan nyhet är att RISE logotyp ska finnas med på både första och sista sidan i varje presentation. Se gärna vår koncernpresentation för inspiration.

26 158 144



0 70 164



213 45 26



153 0 153



115 172 29



242 148 18

