EGSIEM

European Gravity Service for Improved Emergency Management

Oceanographic validation of time variable gravity solutions from GRACE

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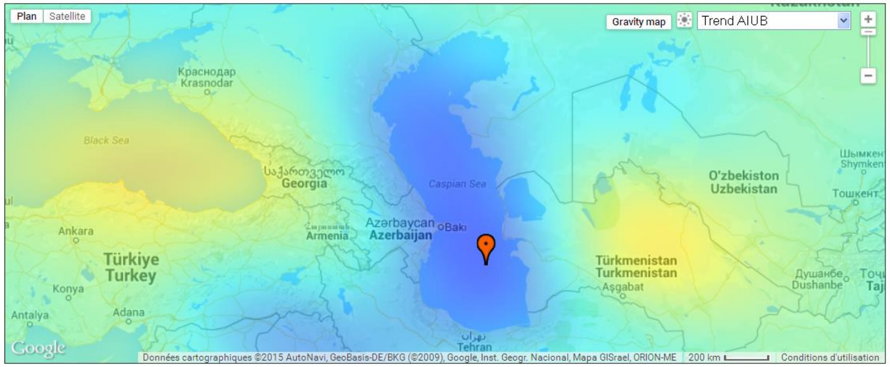
Summary

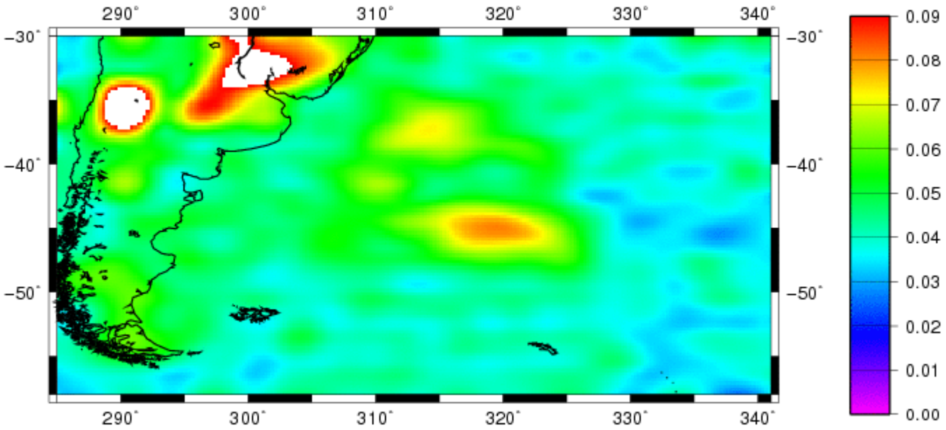
- **Interest of using some oceanic areas as a validation tool for GRACE products:**
  - Availability of precise and densely sampled time series from altimetry
  - The oceanic structures are usually larger than the continental ones → more compatible with GRACE resolution
- **Conditions:**
  - The presence of noticeable mass signal in the GRACE solutions
  - Altimeter heights have to be corrected for the steric component and for the loading effect

❖ Test zones:

➢ **Inland sea: the Caspian sea**



➢ **Open ocean: the Zapiola gyre**



Summary

❖ Data used:

➢ Altimetry:

- open ocean: **AVISO+** (Multi-satellite Gridded Sea Level Anomalies SSALTO/Duacs) daily
- inland seas: **HYDROWEB** (Cretaux et al. 2011) 10-day

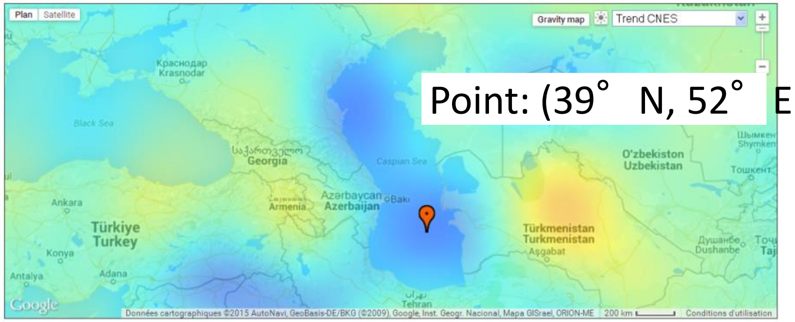
➢ GRACE time series (monthly solutions)*:

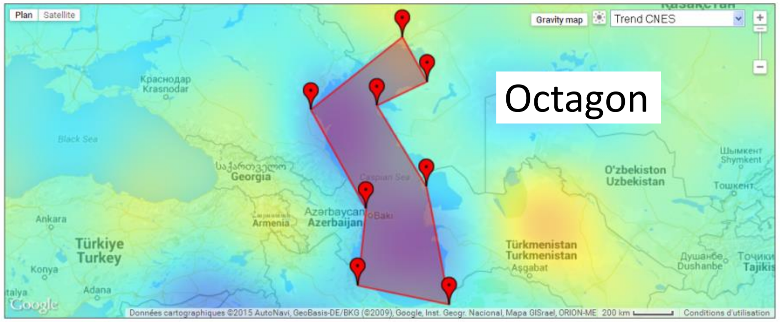
- **AIUB RL02** (DDK-5 filtered)
- **CNES/GRGS RL03-v1** (unfiltered)
- **CSR RL05** (DDK-5 filtered)
- **GFZ RL05a** (DDK-5 filtered)
- **JPL RL05** (DDK-5 filtered)
- **TUGRAZ ITSG14** (DDK-5 filtered)

* All available from the ICGEM web site in unfiltered and DDK-1/2/3/4/5 versions

1- Caspian sea

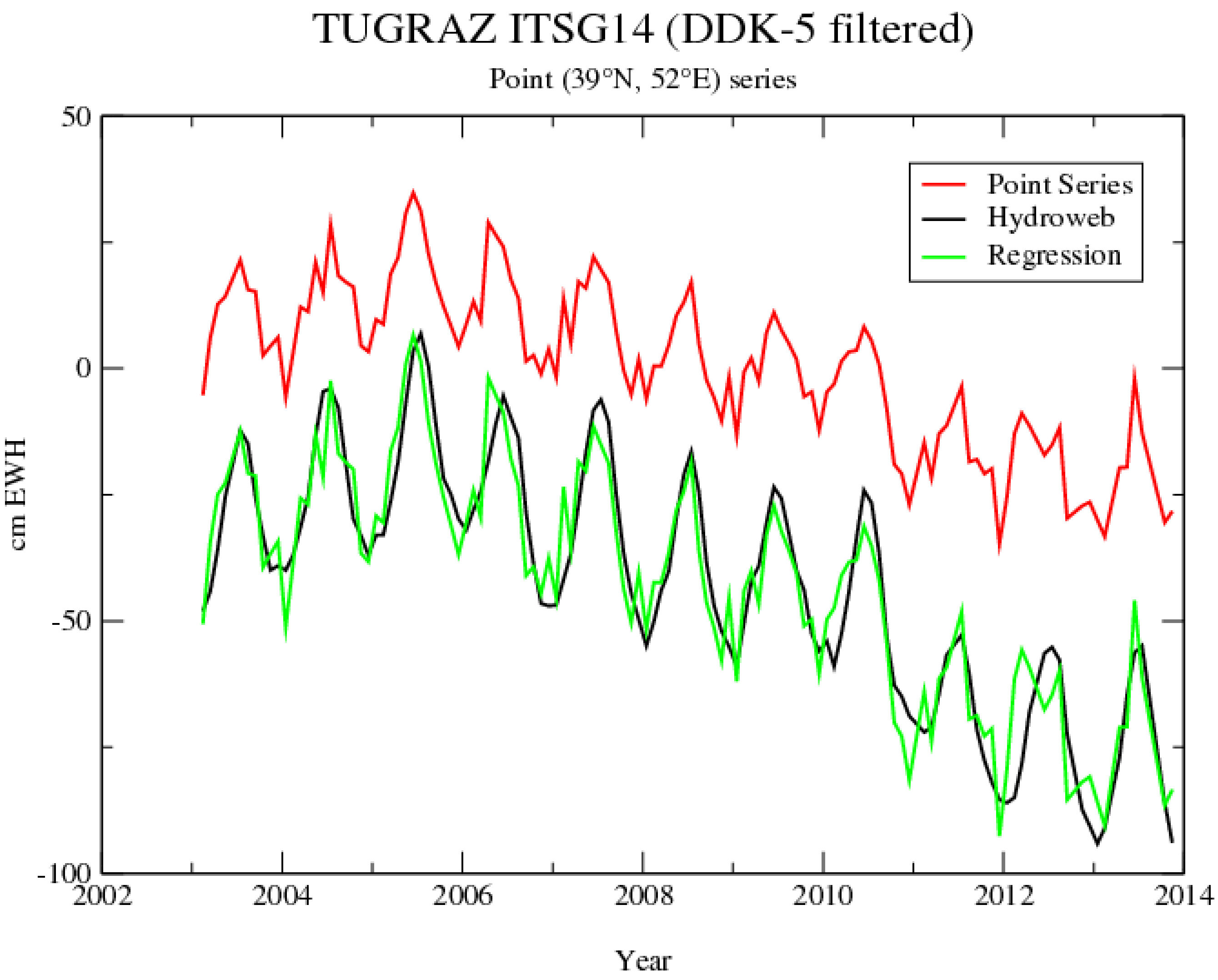
- The largest enclosed inland body of water on Earth: 370,000 km^2 (400 x 900 km)
- Accurate altimeter time series
- Can test the ability of the GRACE solutions to provide spatially pertinent information
- GRACE point-wise and basin-wise time series are tested:





- Test mostly valid in a relative sense; an absolute calibration would require more sophisticated methods (averaging kernel, land hydrology and steric effect removal, cf. Swenson & Wahr 2007)

1- Caspian sea



1- Caspian sea

	Correlation		Scale Factor	
	Point	Basin	Point	Basin
AIUB RL02	0.91	0.94	1.32	1.67
CNES/GRGS RL03-v1	0.96	0.98	1.27	1.75
CSR RL05	0.91	0.93	1.37	1.68
GFZ RL05a	0.86	0.80	1.28	1.39
JPL RL05	0.89	0.89	1.28	1.53
TUGRAZ ITSG14	0.95	0.96	1.43	1.69

➢ Correlation is slightly better for basin-average than for point

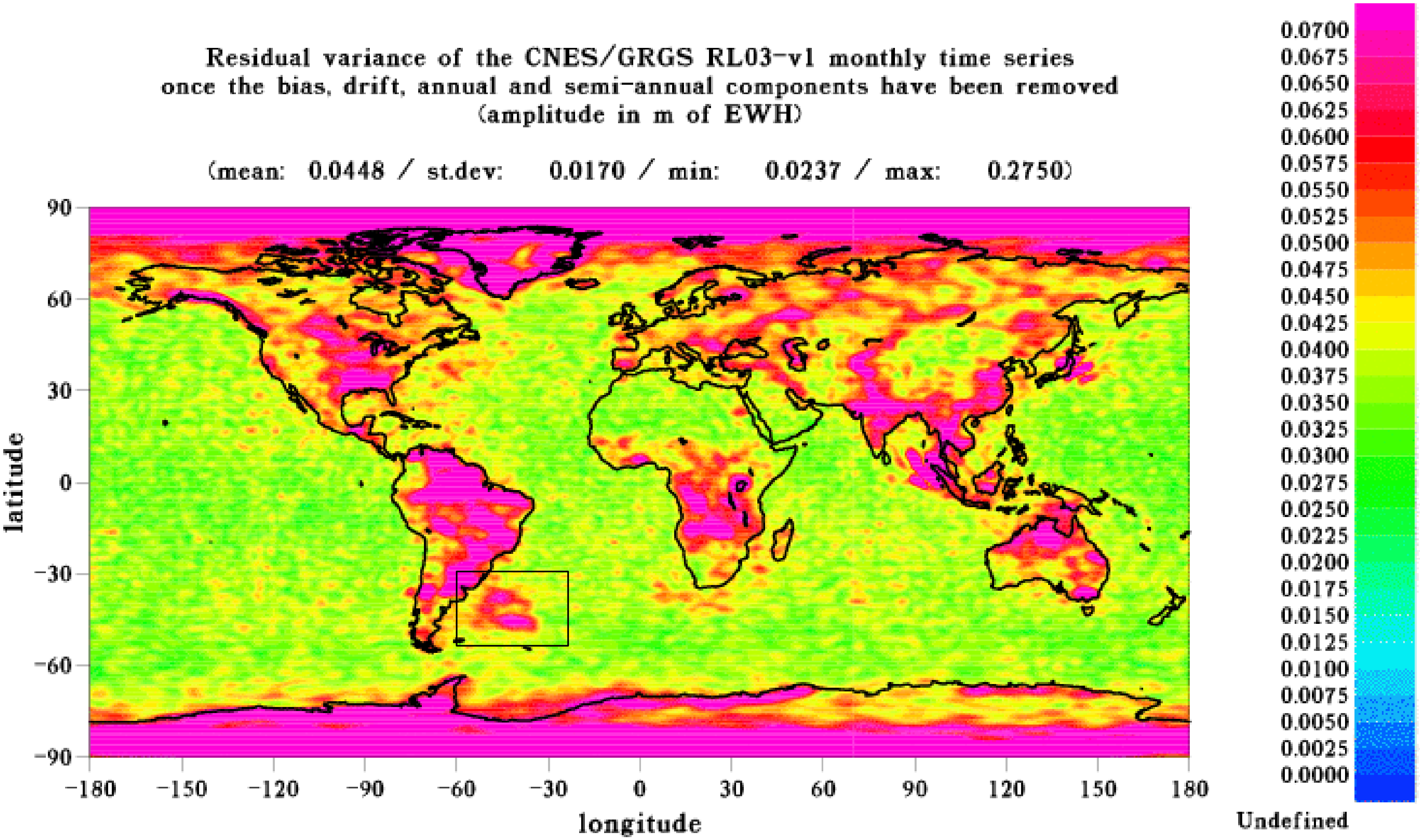
→ **Less noise in the basin-average than in the point time series**

➢ BUT scale factor is much higher for basin-average than for point

→ **The point time series is closer to the actual sea level**

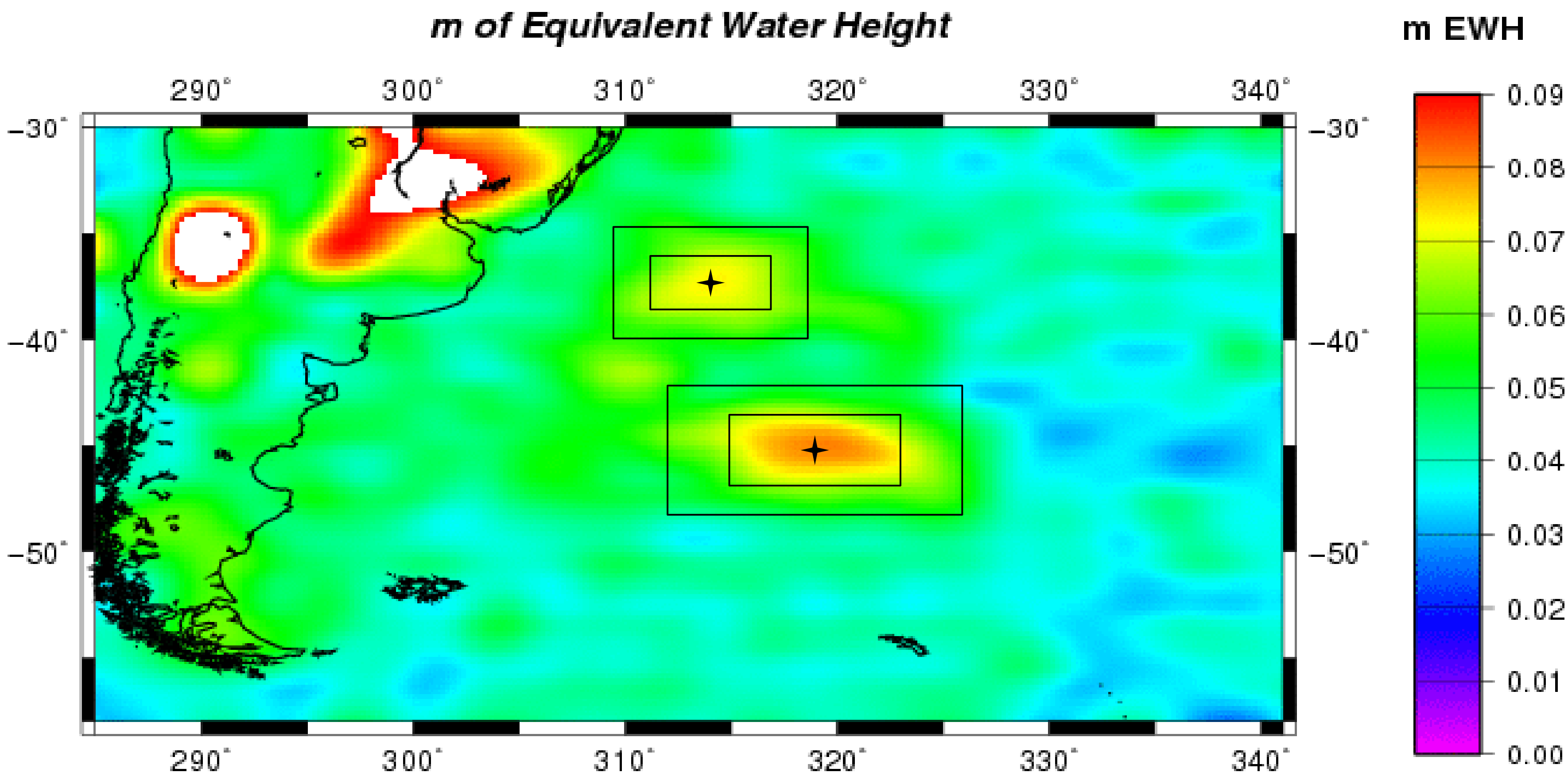
Best correlation is 98 %, best scale factor is 1.27

❖ Large non-periodic mass signal in the GRACE series

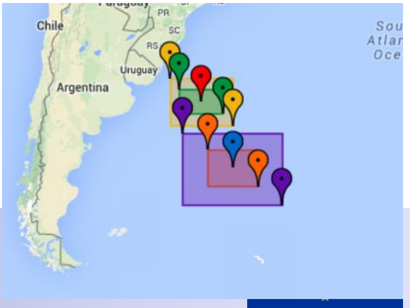


2- Zapiola gyre

Non periodic variability from CNES/GRGS RL03–v1 series



- Point coordinates: (37° S, 46° W) and (45° S, 41° W)
- Small rectangle area: north ~ 316,000 km², south ~ 280,000 km²
- Large rectangle area: north ~ 592,000 km², south ~ 1,120,000 km²



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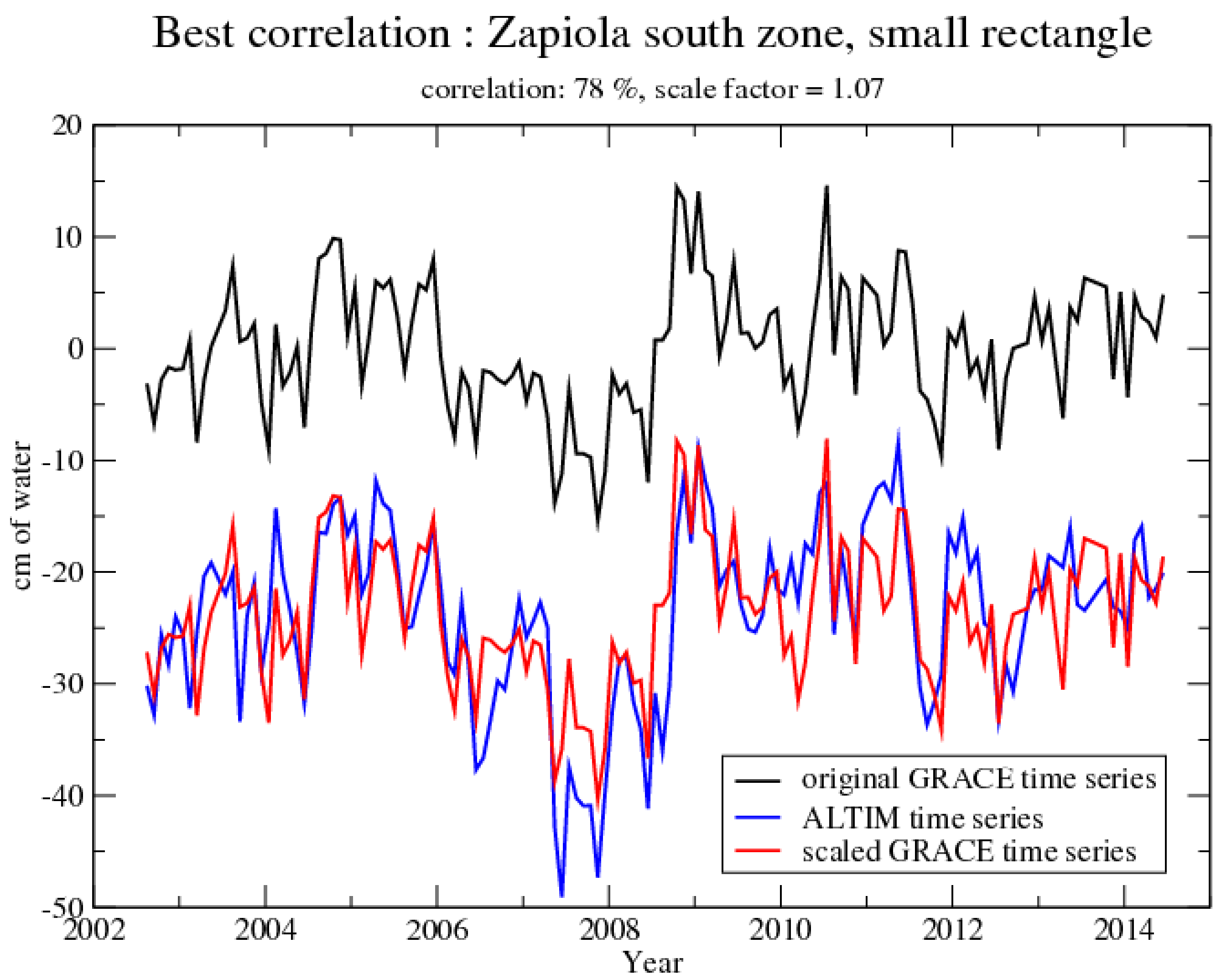

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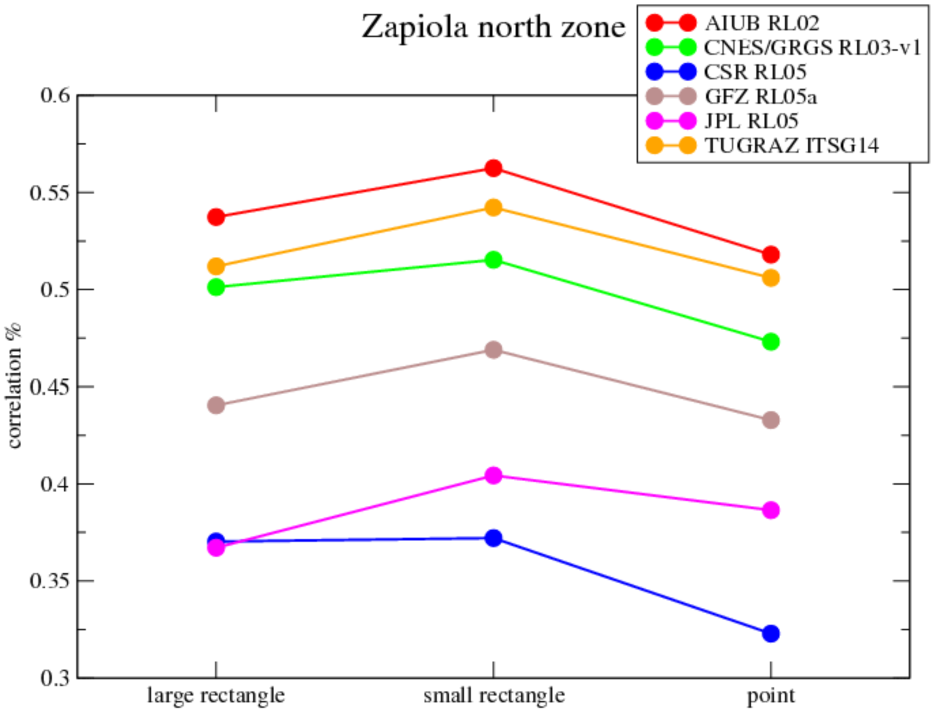

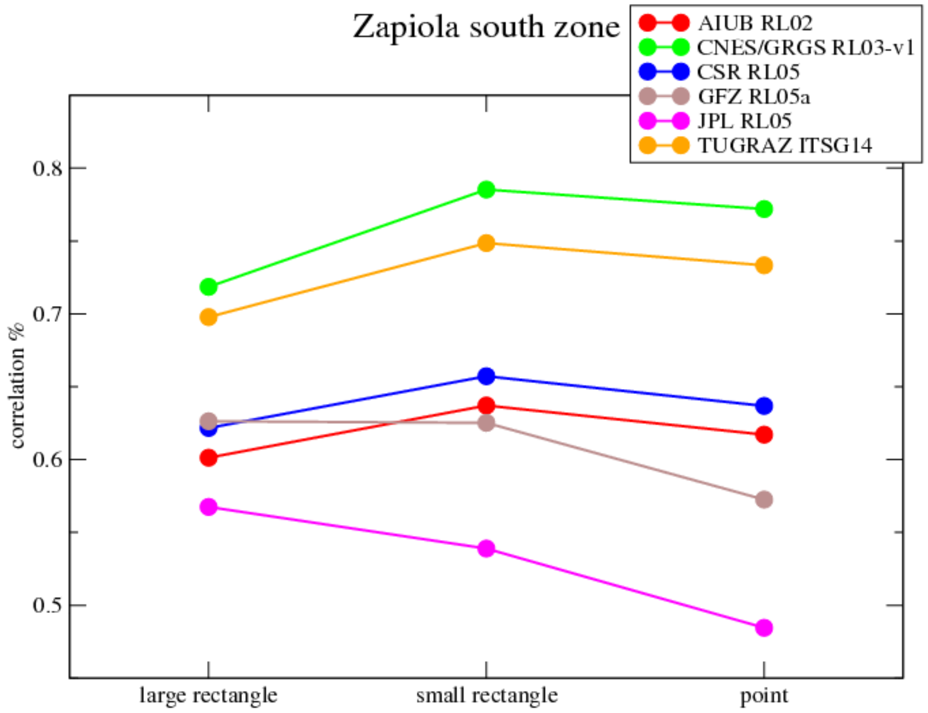

- **The best coherence between altimetry and GRACE is achieved for areas ~ 300,000 km^2**
- **Agreement is much better for the south zone than for the north zone**
- **Best coherence in the south zone = 79 % with a scale factor of 1.07**
- **Worst coherence in the north zone = 37 % with a scale factor of 0.66**

Conclusion

- Altimetry can be a precious tool for GRACE solutions validation
- The selected oceanic areas must present a large mass signal
- They can be far off-coast and therefore escape contamination from continental hydrology
- In the Caspian sea we can reach a very high level of coherence between altimetry and GRACE (98 %) although it is an enclosed sea
- For some time series, the low correlations do not come from the smoothing by DDK-5, but from the intrinsic noise of the time series
- In the Zapiola gyre the variability of the ocean is higher than in the Caspian – spatially and temporally - and is more difficult to capture it with monthly time series from GRACE (max. correlation 79 %)
- The example of the Zapiola gyre shows that in some cases (Zapiola north) the monthly time sampling is not sufficient

  We must go to a shorter time sampling…

Thank you for your attention