

Optimal repeat cycles for gravity field satellite missions regarding ocean tide aliasing

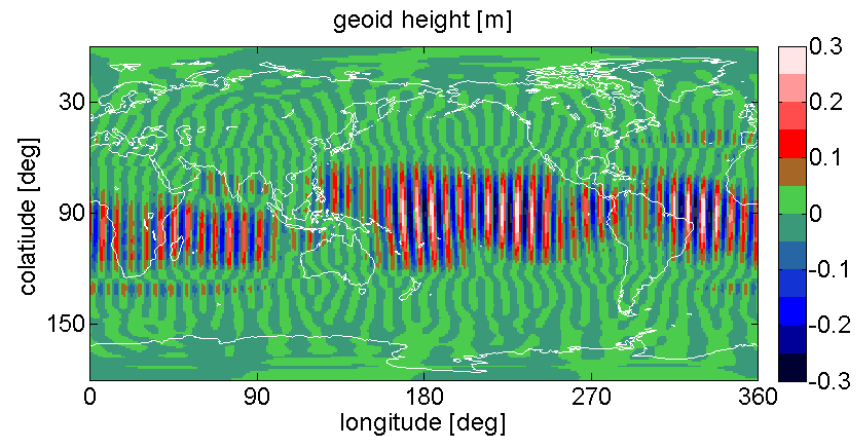
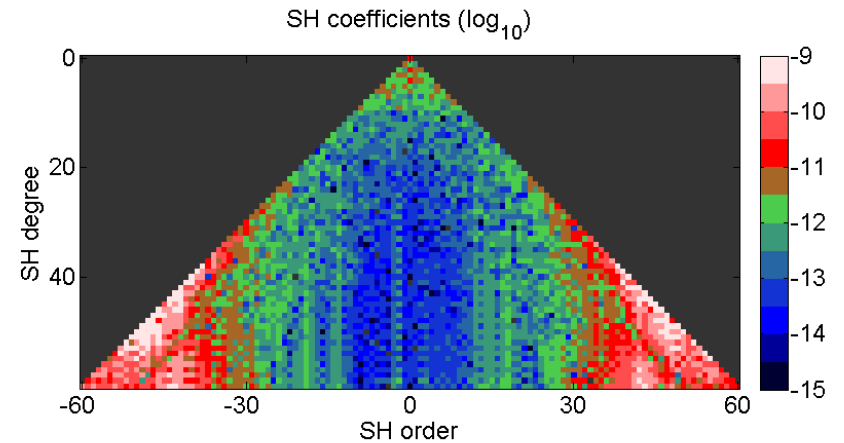
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Motivation

- 219/14 repeat orbit
- M2 signal in terms of gravity potential
- Spherical harmonic (SH) analysis up to d/o 60

- Highly dependent on the SH order
- Strong North-South stripes



Contents

- Analysis of single ocean partial tide mapping
- Alias frequencies in a series of gravity field solutions
- Discrete frequency mapping on repeat cycles
 - Internal aliasing
- Towards an optimal repeat cycle

Alias frequencies in a series of gravity field solutions

- Repeat period T_{rep}
- Harmonic signal T_s
- Phase shift

$$\Delta\varphi = 2\pi \cdot \frac{T_{rep}}{T_s} \in]-\pi; \pi]$$

- Alias period $T_a = \frac{2\pi}{\Delta\varphi}$

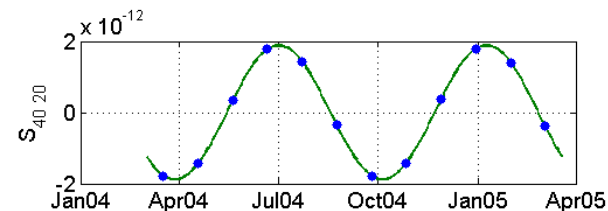
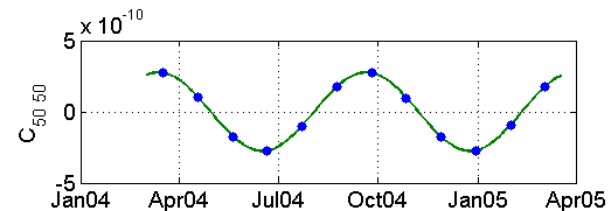
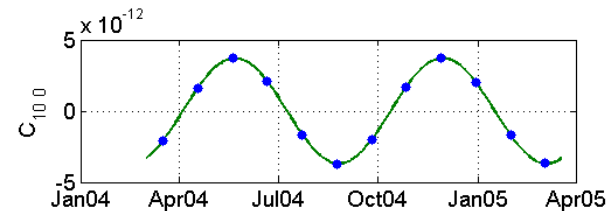
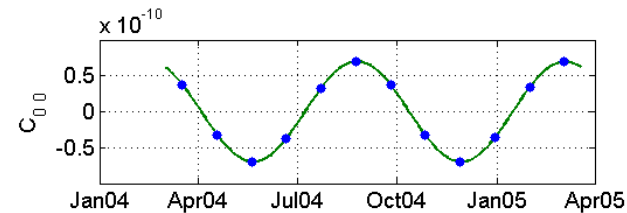
Alias frequencies in a series of gravity field solutions

- Repeat period T_{rep}
- Harmonic signal T_s
- Phase shift

$$\Delta\varphi = 2\pi \cdot \frac{T_{rep}}{T_s} \in]-\pi; \pi]$$

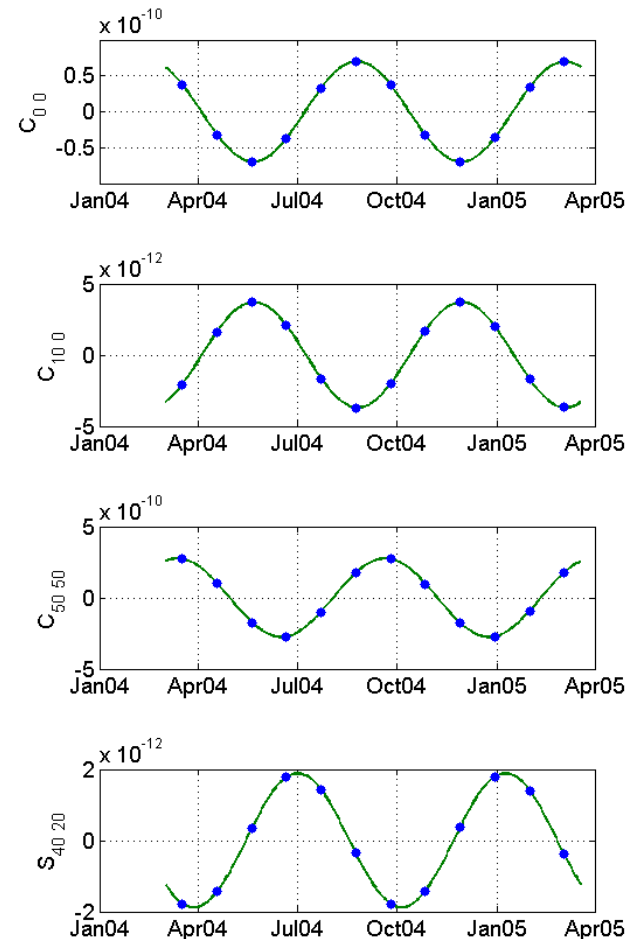
- Alias period $T_a = \frac{2\pi}{\Delta\varphi}$

Example: 32 day repeat orbit
with M2 ocean tide signal
→ $T_a = 191$ days



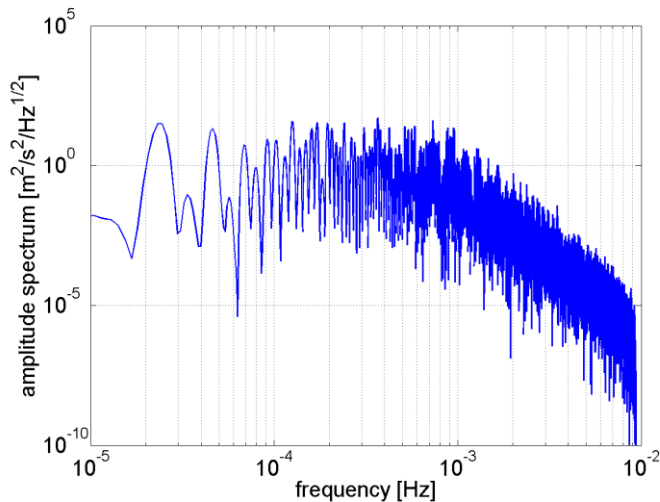
Alias frequencies in a series of gravity field solutions

- Postprocessing: estimation and elimination of the alias signal [Visser et al., GJI, 2010]
- Problem:
 - Superposition of all ocean tides
 - Superposition with other geophysical signals, e.g. hydrology



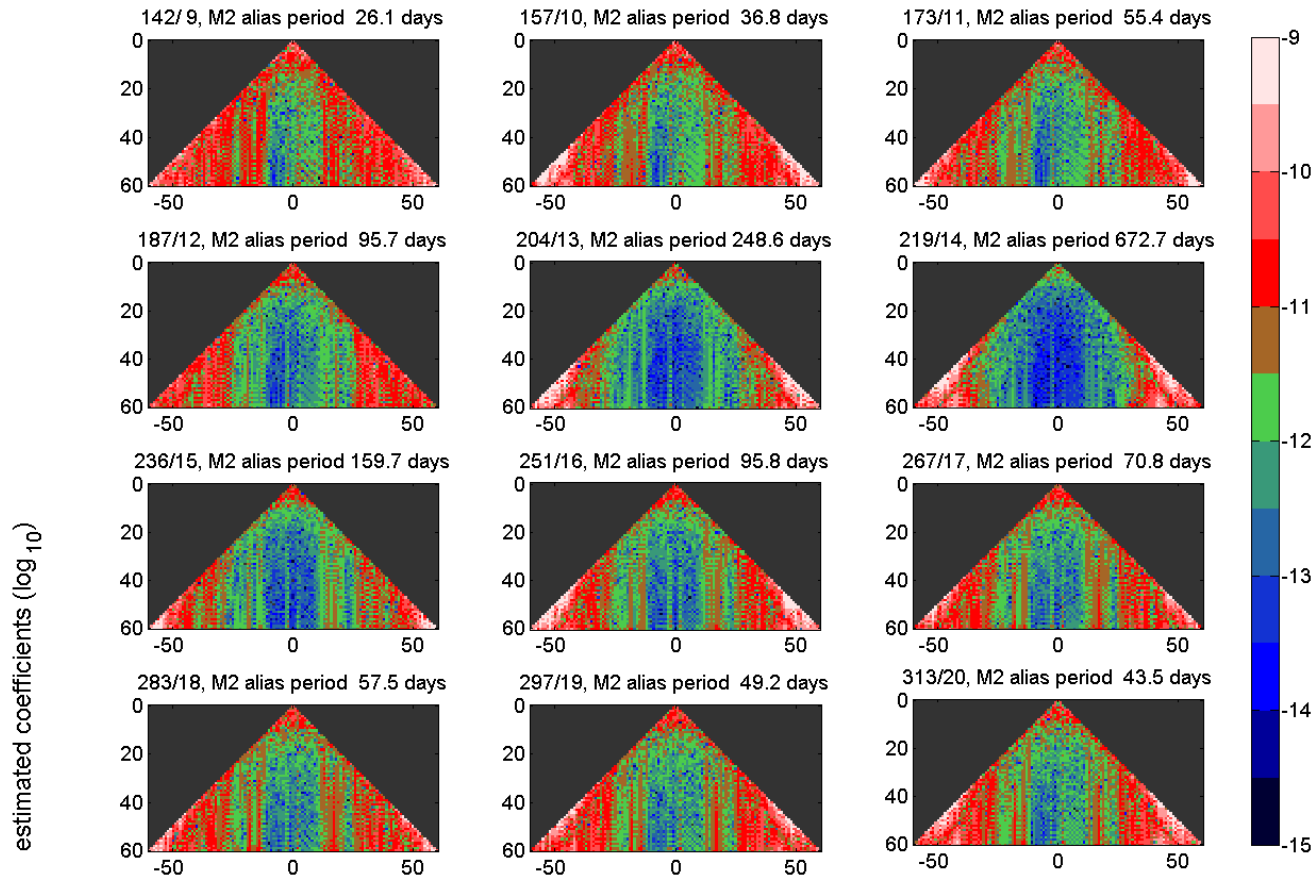
Discrete frequency mapping on repeat cycles

- M2 from GOT00 as gravity potential on repeat orbits
- Same altitude ~350 km

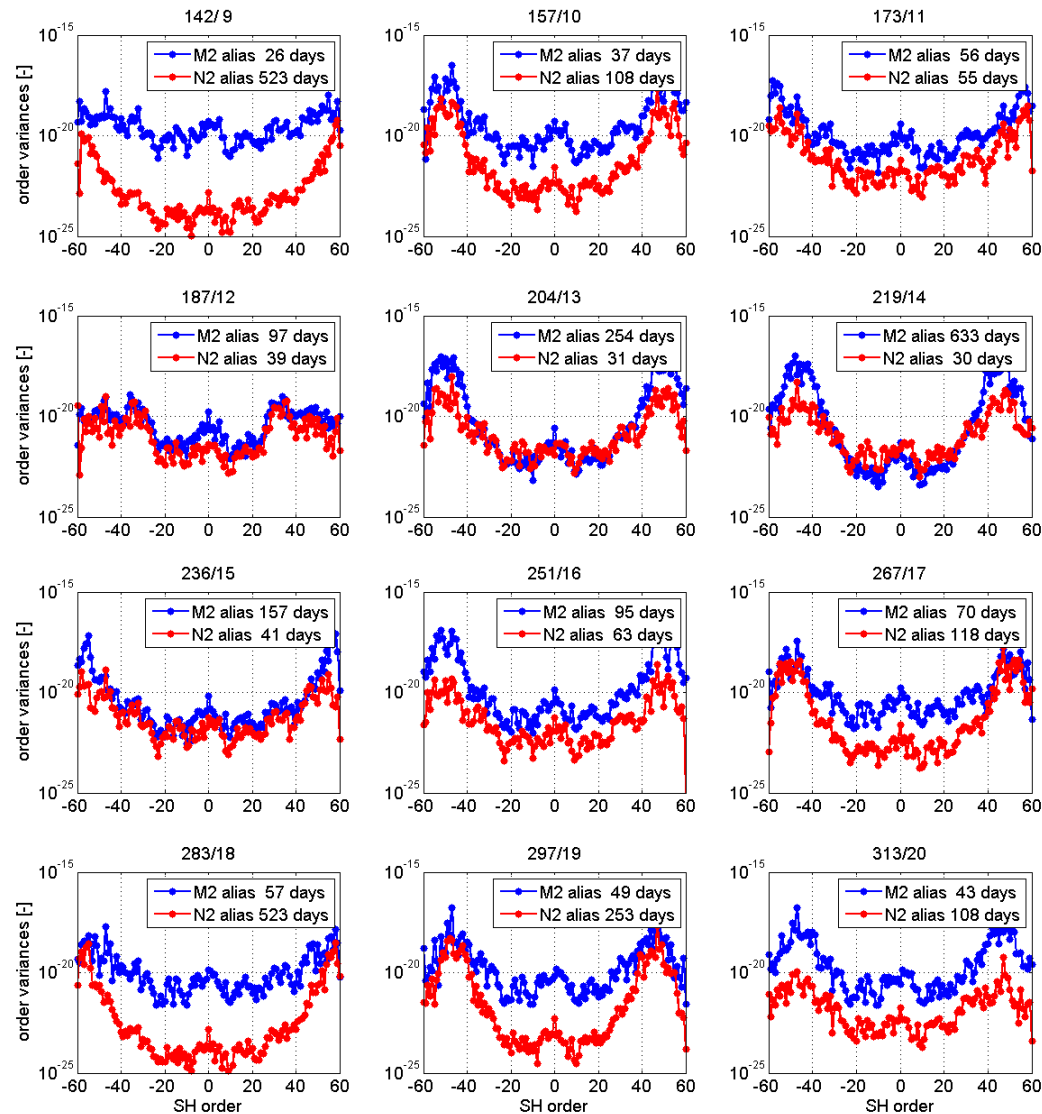


α	β	M2 alias [days]	N2 alias [days]
9	142	26	523
10	157	37	108
11	173	56	55
12	187	97	39
13	204	255	31
14	219	633	30
15	236	157	41
16	251	95	63
17	267	70	118
18	283	57	523
19	297	49	253
20	313	43	108

M2 on different repeat orbits

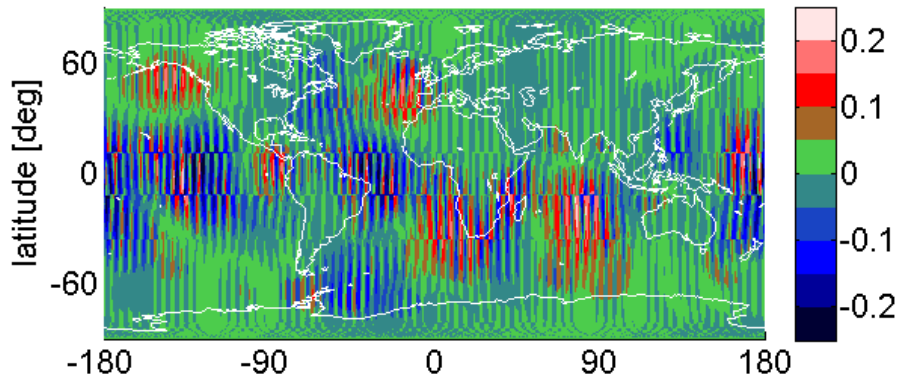


SH order variances

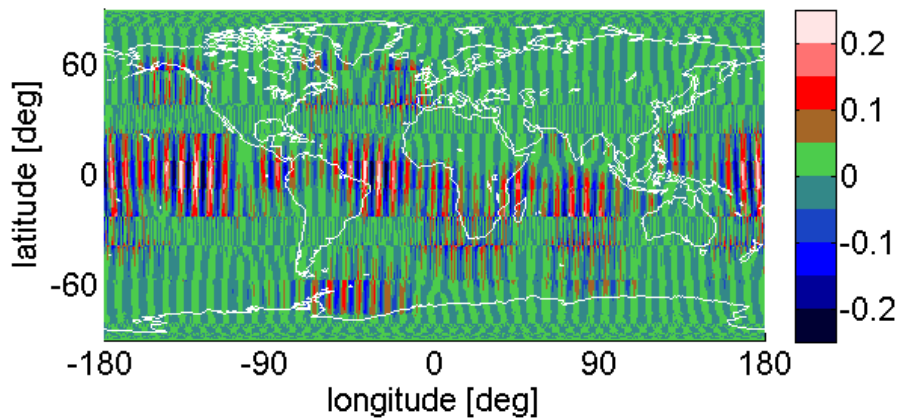


Gridded M2 signal on the orbit

142/9, M2 alias 26 days

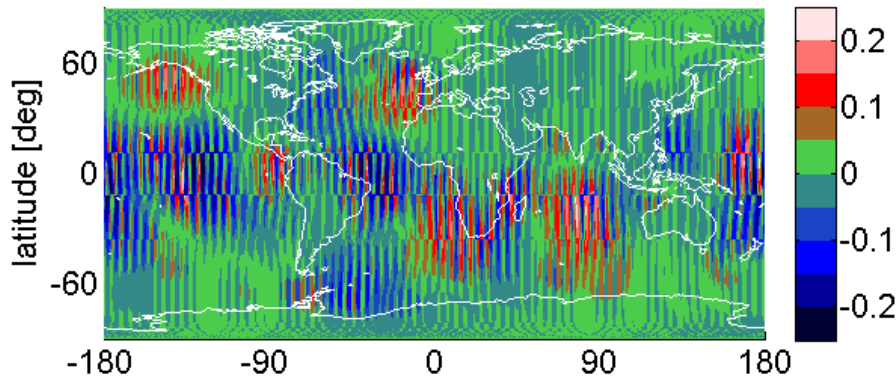


219/14, M2 alias 633 days

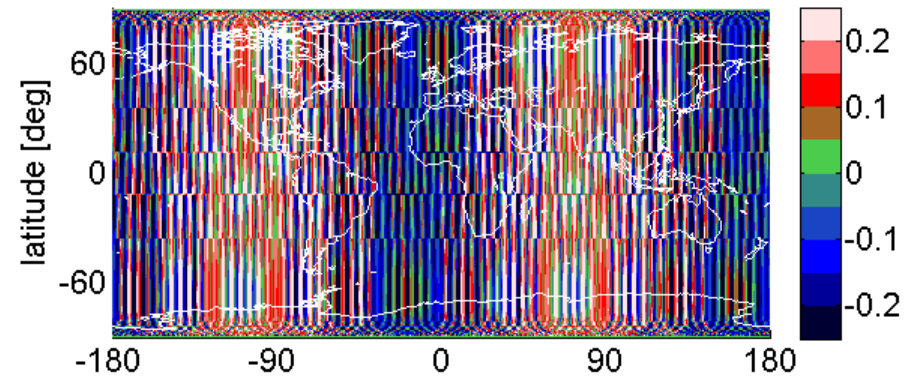


Gridded M2 signal on the orbit

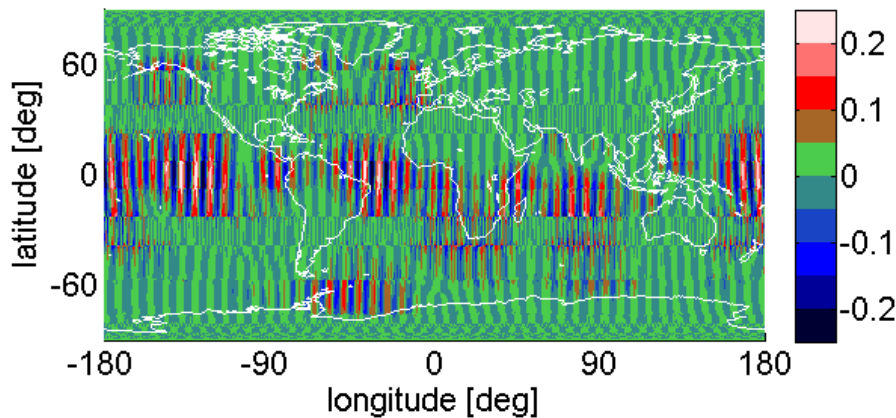
142/9, M2 alias 26 days



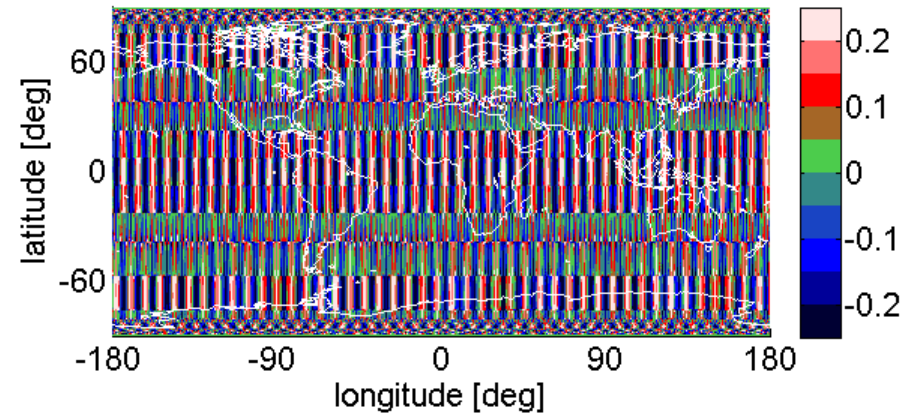
142/9, M2 alias 26 days



219/14, M2 alias 633 days



219/14, M2 alias 633 days



Phase shift of spatial consecutive tracks

The k -th ascending equator crossing is the smallest revolution n , where $\alpha n - k$ is a multiple of β

Example: 142/9

$$9 \cdot 79 - 1 = 5 \cdot 142$$

k	142/9	219/14
1	79	47
2	16	94
3	95	141
...

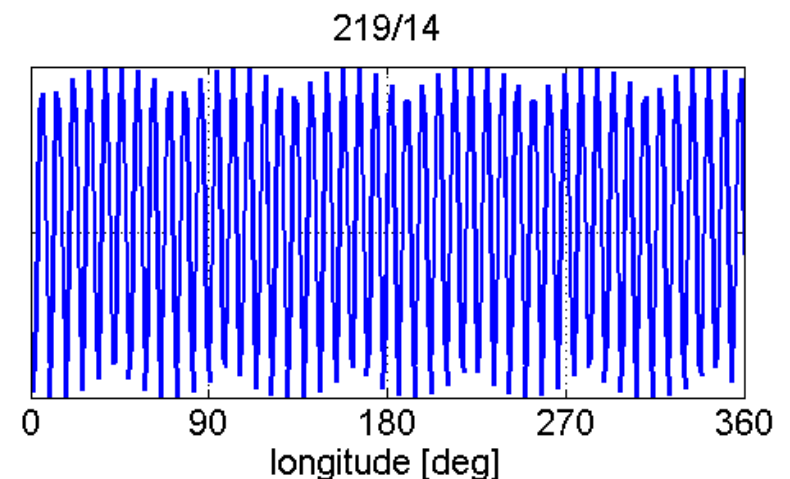
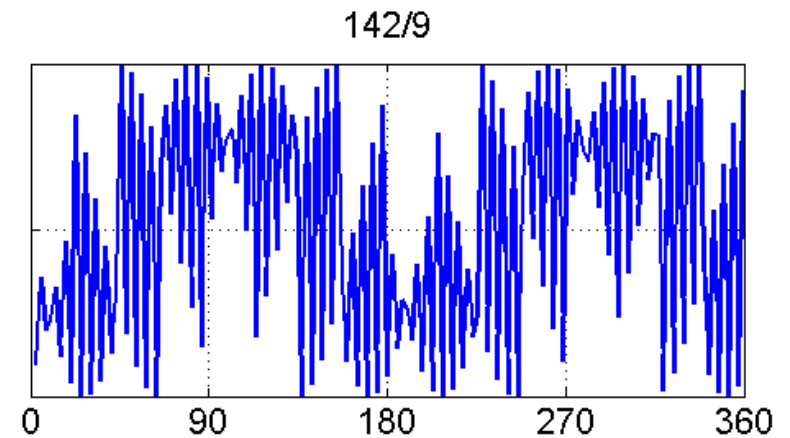
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Example: 142/9

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k	142/9	219/14
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...



Towards an optimal repeat orbit

- Superposition of all ocean tides
 - Analysis of ocean tide errors
 - Superposition with other geophysical signals
- Post processing: elimination of alias signals
 - Analysis of single ocean tide mapping onto repeat orbits
 - Control of affected SH orders by α and β