GRACE De-Aliasing Products
- Impact of Atmospheric Uncertanties -

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Introduction

In the standard gravity field processing short term mass variations in the atmosphere and the ocean are eliminated in the so-called De-Aliasing step. Up to now the background models, used for De-Aliasing, are regarded as error-free. As GRACE has not reached its pre-launch accuracy yet, the De-Aliasing process and related geophysical model uncertainties are regarded as potential error source in GRACE gravity field determination. It is our goal to identify the impact of uncertainties in the background models on the De-Aliasing products and to further improve them by taking into account atmospheric and oceanic model errors. This work will give an overview of the atmospheric De-Aliasing sequence as well as the implemented error-propagation model. Furthermore, the effect of taking or not taking atmospheric model uncertainties into account will be investigated and the impact on the (atmospheric) De-Aliasing product will be shown.

Processing Sheme for the Atmospheric De-Aliasing

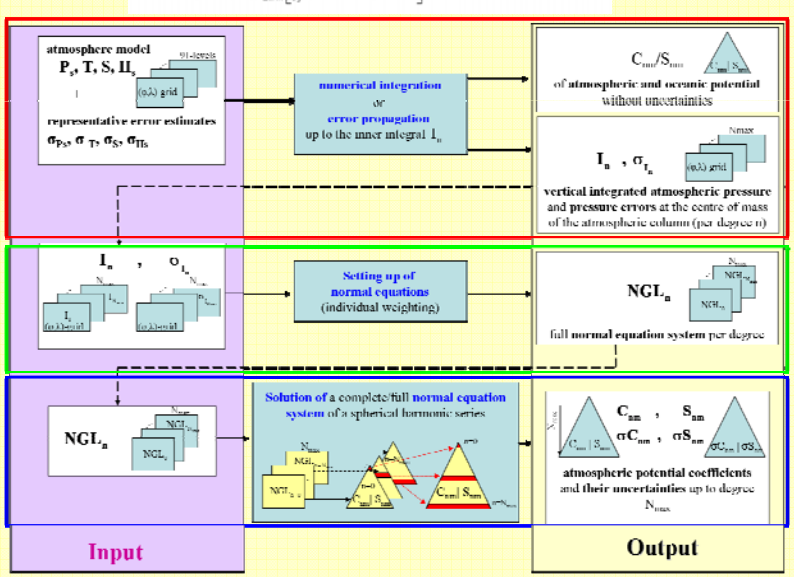
Fundamental formulas:

$$T_v = (1+0.608S)T \quad ; \quad P_{k+1/2} = a_{k+1/2} + b_{k+1/2} P_s$$

$$\Phi_{k+1/2} = \Phi_s + \frac{1}{g}\sum_{j=k+1}^{N_{max}} R_{dry} T_v \ln\frac{P_{j+1/2}}{P_{j-1/2}}$$

$$C_{nm} = -\frac{a^2(1+k_n)}{(2n+1)Mg}\iint_{Earth}\left[\int_{P_0}^{0}\left(\frac{a}{a-\Phi}+\frac{\xi}{a}\right)^{n+4} dP\right] P_{nm}(\cos\theta)\cos m\lambda \sin\theta d\theta d\lambda$$

$$S_{nm} = -\frac{a^2(1+k_n)}{(2n+1)Mg}\iint_{Earth}\left[\int_{P_0}^{0}\left(\frac{a}{a-\Phi}+\frac{\xi}{a}\right)^{n+4} dP\right] P_{nm}(\cos\theta)\sin m\lambda \sin\theta d\theta d\lambda$$



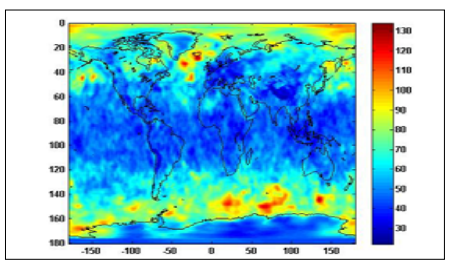


Fig.1: Surface pressure error in [Pa] (01.12.2006 00h)

The error of the vertical integral (Fig.2) is mainly dominated by the surface pressure error (Fig.1). In order to get insight into the effect of atmospheric uncertainties, the error of the vertical integral is further propagated on the potential coefficients C_{nm}/S_{nm}.

Therefore two error-scenarios are performed:

- "**error-free**": all atmospheric input parameters are regarded as error-free (observation weighted equally)
- "**full error**": the uncertainties of all atmo-spheric parameters are taken into account (observations weighted individually)

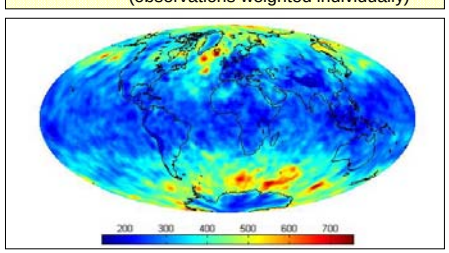


Fig.2: Error σ_I of the vertical integral I_n in [Pa] due to uncertainties in all atmospheric parameters (01.12.2006 00h)

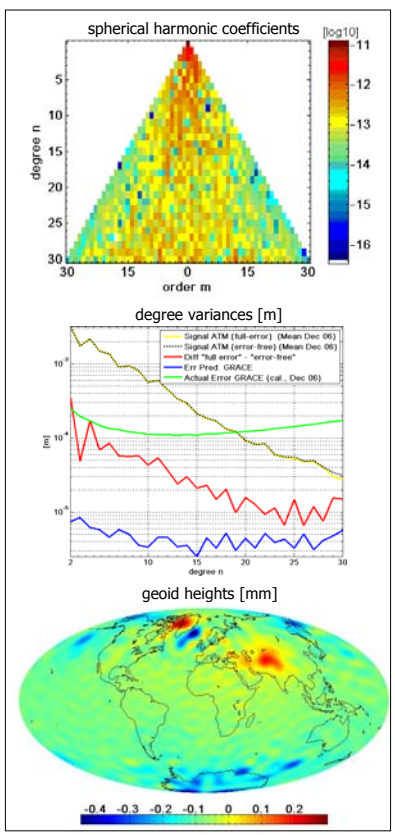


Fig.3: Differences between the „error-free" and „full-error" case (01.12.2006 00h, n_{max}=30)

Fig.3 shows the effect of taking or not taking the atmospheric input parame-ters into account.
The atmospheric de-aliasing coefficients C_{nm}/S_{nm} are calculated once for the „error-free" and once for the „full-error" case.

The differences between these two scenarios are shown in terms of **spherical harmonics**, in terms of **degree variances** (geoid heights [m]) and in terms of **geoid heights** [mm].

Conclusion & Outlook

Conclusion

Considering the pre-launch error prediction of GRACE (Fig.3, degree variances, blue line), the atmospheric model uncertainties will have an effect on GRACE: The difference betwwen the "error-free" and "full-error" case (see Fig.3, degree variances, red line) are clearly above the GRACE baseline.

Therefore:

Model uncertainties should be taken into account during the de-aliasing process!

Outlook

Future investigations will include the ocean and the corresponding error-field.

Furthermore the effect of taking the model uncertainties into account or not on GRACE K-band residuals, as well as on the static and temporal gravity field will be investigated.