

AN EVIDENCE OF HYDROLOGICAL SIGNAL IN GPS TIME SERIES IN POLAND

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Abstract

CURRENTLY well known influence of continental water loading on surface displacement can be measured by various geodetic methods. Among others satellite positioning is the most robust and easily available technique. In this paper

we compare GPS measured position changes with deformations computed on the basis of global water storage models.

We used GPS data from several Polish permanent sites with long-time measurement period available, applying Precise Point Positioning method using consistent IGS products. Results were compared

for other geophysical signals. An overall good agreement (especially for height component) was found.

Paper deals also with possibility of reduction of predominant yearly hydrological signal from post-processing results. Simple model appropriate for studied area is introduced and its accuracy is estimated.

Hydrological loading

In this studies we used WaterGAP Hydrology Model (WGHM) monthly storage values with 0.5° spatial resolution. This model includes all kind of water in land cells. The deformations were computed using Green's function formalism with well known equation.

$$\Delta x(t) = \rho \iint_{\Omega} G(x, y, z, t - \tau) \Delta \sigma(x, y, z, \tau) dx dy dz$$

GPS measured data

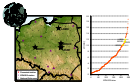


Figure 1. Permanent GNSS Polish site (left graph). Range of height change due hydrological loading for permanent GNSS sites from EPN/IGS network in 2002 year (right graph).

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- DCB - from CODE,
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In Fig. 2 we present time series of height component (daily and smoothed) and computed hydrological induced deformations. An overall good

agreement was found confirming predominant seasonal cycle. Some obvious disagreement are probably PPP technique artifacts.

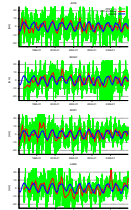


Figure 2. Comparison of PPP results with computed height deformation from hydrological model.

While PPP technique gives good agreement for up component it is insufficient to detect hydrological induced horizontal deformations. In Fig. 3 we present results for Jozefowice site.

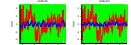


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Seasonal height changes due to continental water storage do not show secular change. Computed loadings, PPP height variation results as well as double differencing results from network, representing shows regular annual repeatability.

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Fig. 4 shows hydrological loading along with annual height variation determined from global network reprocessing (Teamer et al.). One can see good agreement. Yearly harmonic is predominant thus we fitted simple cosine model according to equation, $\Delta h(t) = A \cdot \cos(\omega t - \varphi)$.

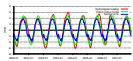


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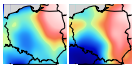


Figure 5. Fitted amplitude (left) and phase (right) to hydrological loading (1987-2007).

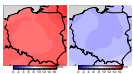
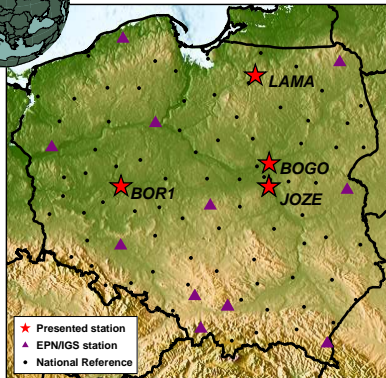


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For Polish territory simple cosine model could be applied for reduction of main part of hydrological loading phenomenon.

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- ★ Presented station
- ▲ EPN/IGS station
- National Reference

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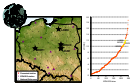


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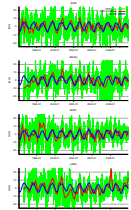


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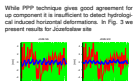


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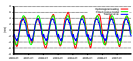


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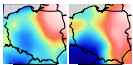


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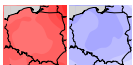


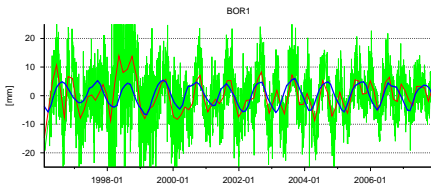
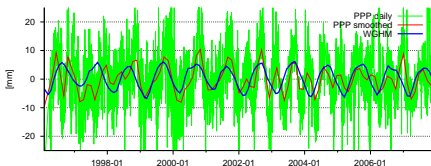
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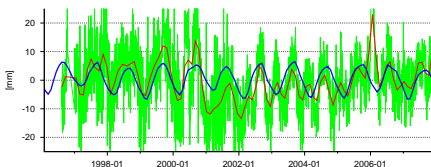
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JOZE



LAMA



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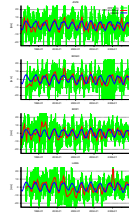
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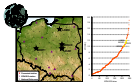


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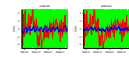


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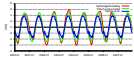


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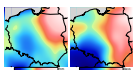


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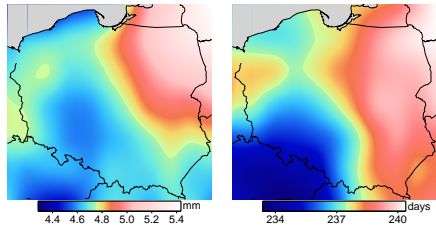
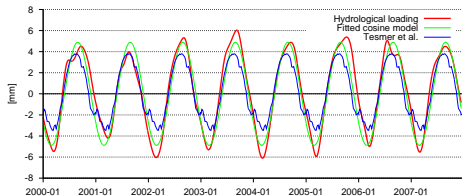


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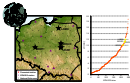


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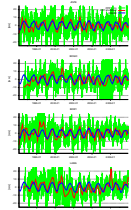


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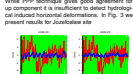


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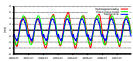


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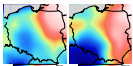


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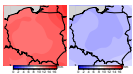


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