The eastern portion of Mexico City is undergoing rapid subsidence due to extraction of ground water in excess of natural recharge and clay-rich sediment consolidation. We use PSInSAR (Persistent Scatterer InSAR, using TU Delft’s Doris and PSI Toolbox) to investigate the link between surface subsidence and groundwater extraction. Using 23 Envisat acquisitions, we obtained a time-series of surface subsidence between January 2004 and July 2006 showing that the eastern portion of the Mexico City metropolitan area is subsiding at rates in excess of 30 cm/year, consistent with the differential InSAR subsidence analysis from Cabrera-Cano et al., (2008). Assuming constant subsidence rates, we have obtained a dense, coherent subsidence map throughout the area. Comparison between permanent GPS and PSInSAR inferred rates show very good agreement in the longer-term signal.

The high density of persistent scatterers allows us to detect differential subsidence of urban infrastructure. Our analysis indicates that in some cases the rate of an individual persistent scatterer can differ about 3-4 cm/yr from the surrounding ground subsidence. Some large buildings show slightly anomalous differential vertical motion due to overcompensated foundations. In other cases, where buildings have different depth reaching piles, or when they have undergone subsequent foundation work (such as historic colonial-time buildings), internal shear stress superimposed to the regional subsidence motion occur. Our results show that the PSI analysis has the potential to become a great tool for structural monitoring where past conventional leveling data is not available.

**Introduction**

Mexico City, the capital of Mexico, is one of the largest and most densely populated urban areas in the world. The city is built on an alluvial flat, which is a sedimentary deposit where the Rio Hondo, a small tributary of the Rio Grande, met the ocean about 12,000 years ago. The area was raised above sea level through a combination of natural processes and human activities, such as deforestation, construction, and water extraction.

Mexico City (Tenochtitlan) was founded in 1325 and has a long history of development and growth. The city was once a major center of trade and culture, with a population estimated at over 3 million people. In 1821, the city became the capital of the new Mexican nation.

**Fast Subsidence Rate**

PSInSAR results for a selected portion of Mexico City show a high rate subsidence that increases to the east. This subsidence pattern is due to the combination of groundwater extraction and thick clay-rich lacustrine deposits, especially to the east. Reduced recharge causes these sediments to consolidate resulting in faster subsidence for areas with thicker sediment layers.

**Table 1**

<table>
<thead>
<tr>
<th>Distance of GPS to PS to GPS</th>
<th>PS Time (Days)</th>
<th>PS Time (Days)</th>
<th>PS Rate (mm/day)</th>
<th>LOS PS Rate (mm/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOCS 12 Jan 0/Jul 06</td>
<td>-153</td>
<td>-175</td>
<td>-3.0</td>
<td>-4.0</td>
</tr>
<tr>
<td>LPEC 15 Apr 04/Jul 06</td>
<td>-108</td>
<td>-88</td>
<td>-2.4</td>
<td>-2.4</td>
</tr>
<tr>
<td>MPRA 560 Aug 04/Jul 06</td>
<td>-145</td>
<td>-199</td>
<td>-2.0</td>
<td>-2.0</td>
</tr>
</tbody>
</table>

**Legend:**

- **MOCS:** Mexico City Subsidence
- **LPEC:** Linea Piramidal
- **MPRA:** Metro Rail

**Diffusional Subsidence**

Differential subsidence map (left) is derived from PS/InSAR velocity map using a spatial filter. Local average motion for each point is calculated using a 300m by 300m moving window and subtracted from the measured velocity.

This high resolution subsidence analysis makes it possible to detect anomalous differential subsidence rates for individual civil engineering structures. The map on the left shows Metro “Line 4” located in the center of the figure in orange-red colors.

**Growth in Mexico City**

Mexico City’s population has been rapidly increasing since the 19th century, and it is now home to over 20 million people. The city’s growth has been facilitated by its strategic location at the heart of the country, as well as its rich cultural heritage and historical significance.

**References**


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