Sea Level Data Rescue and Products in China

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CONTENT

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☐ Sea Level Data Rescue
☐ The application and Knowledge Products
1. National SL Observing Network of China

The national network of sea level observation in China is maintained by State Oceanic Administration(SOA), Ministry of Natural Resources(MNR).

- Fifteen key stations and other basic stations along China coast.
- Six stations have been registered in GLOSS Network and monthly MSL data are sent to PSMSL on time.
- Optimizing the China sea level observing network.
- Carrying out BM leveling survey project.
## GLOSS Stations in China

<table>
<thead>
<tr>
<th>Code</th>
<th>Location</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>723</td>
<td>Laohutan 38°53'N, 121°41'E</td>
<td>• Ongoing, currently using a digital gauge.</td>
</tr>
<tr>
<td>979</td>
<td>Lvsi 32°08'N, 121°37'E</td>
<td>• Ongoing, currently using a digital gauge.</td>
</tr>
<tr>
<td>934</td>
<td>Kanmen 28°05'N, 121°17'E</td>
<td>• Ongoing, currently using a digital gauge.</td>
</tr>
<tr>
<td>933</td>
<td>Zhaopo 21°35'N, 111°50'E</td>
<td>• Ongoing, currently using a digital gauge.</td>
</tr>
<tr>
<td>1745</td>
<td>Xisha 16°50'N, 112°20'E</td>
<td>• Ongoing, currently using a digital gauge.</td>
</tr>
<tr>
<td>1730</td>
<td>Nansha 9°33'N, 112°53'E</td>
<td>• Ongoing, currently using a digital gauge.</td>
</tr>
</tbody>
</table>
Sea level observation

Diagram showing the components of a sea level observation system:

- Benchmark
- Instantaneous water level
- National Datum
- Ellipsoid
- Reading pointer
- Balance weight
- Tidal datum/Zero
- ΔH

Additional elements:
- GPS Receiver
- Additional Benchmark

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2. Sea Level Data Rescue

Sea Level Data is collected, updated and quality controlled by NMDIS.

Factors affecting data quality

- Tide gauge zero level change
- Instrument replacement
- Station relocation
- Maintenance
- Typical phenomena
- . . .
Long-term Data Rescue

- Gauge zero level change
- Station relocation
- Instrument replacement
Long-term Data Rescue

Typical phenomena

Mesoscale eddy, ENSO, and so on

(Wang, et al, 2018)

Characteristics and possible causes of sea level anomalies in the Xisha sea area

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Abstract

Based on the analysis of wind, ocean currents, sea surface temperature (SST) and remote sensing satellite altimeter data, the characteristics and possible causes of sea level anomalies in the Xisha sea area are investigated. The main results are shown as follows: (1) Since 1996, the sea level in the Xisha sea area was obviously higher than normal in 1996, 2001, 2006, 2010 and 2013. Especially, the sea level in 2006 and 2010 was abnormally high, and the sea level in 2010 was 1.2 cm higher than the mean year mean, which is the highest in the history. In 2010, the sea level in the Xisha sea area had risen 43 cm from June to August, with the strength twice the annual variation range. (2) The sea level in the Xisha sea area was not only affected by the tidal force of the lunar bulge, but also closely related to the quasi 2 daily oscillation of tropical western Pacific monsoon and ENSO events. (3) There was a significant negative correlation between sea level in the Xisha sea area and El Nino events. The high sea level anomaly all happened during the developing phase of La Nina. They also show significant negative correlations with Niño 3.4 and Niño 3.4 indices, and the lag correlation coefficients for 2 months and 3 months are -0.46 and -0.45, respectively. (4) During the early La Nina event form June to November in 2010, the anomalous winds field was cyclonic. A strong clockwise vortex was formed for the current in 35 m layer in the Xisha sea area, and the velocity of the current is close to the speed of the Kuroshio near the Luzon Strait. In normal years, there is a "coold" event. While in 2010, from July to August, the SST in the area was 2-3°C higher than that of the same period in the history.

Key words: Xisha sea area, sea level anomalies, ENSO, wind, current, SST


1 Introduction

Under global warming, sea level rising and extreme ocean climate events have become a major global environmental problem. The 5th assessment report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) noted that ocean thermal expansion and glacier mass loss are very likely the dominant contributors to global mean sea level rise during the 21st century. The rate of global mean sea level rise was 1.7 mm/yr during 1901-2010 for a total sea level rise of 0.19 m. The rate was higher at 2.3 mm/yr from 1993 to 2010. For the period of 2001-2006 compared to 1996-2005, global mean sea level rise is likely 0.26-0.62 mm (IPCC, 2013). Sea level rise is the most significant in response to the global warming which has a large impact on humanity.

Regional sea level change and global averaged sea level change are significantly different. Regional sea level changes are affected not only by the global change, but also by the hydrological and meteorological factors such as local monsoon, ocean currents, SST, air pressure, precipitation and so on. The high or low sea level anomaly along the coastal region of China is caused by anomalies non-astronomical factors (including air pressure, wind, precipitation and runoff, etc.), leading to sea level short-term anomaly changes (Fang et al., 1986; Wang et al., 2012). In the coastal region of China, high sea level anomaly in a short period is closely related to the changes of monsoon. It mainly operates through changes in residual water caused by the surface Ekman transport (including Ekman suction pump of an inner zone) and interactions between monsoon currents and terrain (including the local response to the global scale) (LL, 2014), which results in seasonal sea level high or low in the coastal region of China. In the north coast of the Changjiang estuary, the residual water caused by the monsoon (LL, 2014; Li et al., 2015). In recent years, with the frequent occurrence of extreme weather and climate events, the anomalies of seasonal sea level increase is more serious (Wang et al., 2014). "2012 Chinese Sea Level Bulletin" reported that the coastal sea level of the East China Sea (ECS) increased significantly in 2012 with the highest value in June and August since 1980. "2013 Chinese Sea Level Bulletin" reported that the coastal sea level of the ECS reached the highest value in May and October since 1980 (State Oceanic Administration, 2012, 2013). Sea level anomalies are closely related to ENSO events. The
3. Application and Knowledge Products

Main sea level products:
- MSL trend along China coast
- Inter-annual and inter-decadal change
- Extreme sea level events
- Sea level rise projection
- ...

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- MSL trend along China coast

![Graph showing sea level trend along China coast]

- Inter-annual and inter-decadal change

![Graph showing spectral analysis of sea level changes]

(Wang, et al, 2018)
3. Application and Knowledge Products

- Extreme sea level events

**Graph 1:**
- Rise rate: 4.5 mm/yr
- Mean sea level (cm) over years 1980 to 2016

**Graph 2:**
- Rise rate: 9.9 mm/yr
- Extreme sea level (cm) over years 1980 to 2016

**Table:**

<table>
<thead>
<tr>
<th>Return period (Unit: yr)</th>
<th>Station A Extreme sea level (Unit: m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>4.80</td>
</tr>
<tr>
<td>500</td>
<td>4.64</td>
</tr>
<tr>
<td>200</td>
<td>4.43</td>
</tr>
<tr>
<td>100</td>
<td>4.27</td>
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<tr>
<td>50</td>
<td>4.12</td>
</tr>
<tr>
<td>20</td>
<td>3.91</td>
</tr>
<tr>
<td>10</td>
<td>3.75</td>
</tr>
</tbody>
</table>

**Diagram:**
- 200 yr: 4.43 m rise
- 100 yr: 4.27 cm rise

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- Sea level rise projection

<table>
<thead>
<tr>
<th>Year</th>
<th>China SLR/m</th>
<th>RCP 2.6</th>
<th>RCP 4.5</th>
<th>RCP 8.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2050</td>
<td>0.23 [0.13~0.34]</td>
<td>0.24 [0.16~0.36]</td>
<td>0.26 [0.19~0.38]</td>
<td></td>
</tr>
<tr>
<td>2080</td>
<td>0.37 [0.21~0.55]</td>
<td>0.43 [0.29~0.60]</td>
<td>0.53 [0.36~0.74]</td>
<td></td>
</tr>
<tr>
<td>2100</td>
<td>0.47 [0.26~0.70]</td>
<td>0.55 [0.35~0.80]</td>
<td>0.77 [0.52~1.09]</td>
<td></td>
</tr>
</tbody>
</table>
Thanks for your attention!

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