3. Results

3.1. Physical Oceanography

3.1.1. Tide and Water Current

(1) Tide

The time series of tide level are shown in Data Book version of the present report. At all the three points and for both the rainy and the dry seasons, variations of tidal range were apparently induced by spring and neap tidal cycle. The maximum tidal range during the rainy season was nearly 3 m at Humen (T01) whereas during the neap tide it was less than 1.5 m. The range of 3 m was also observed during the dry season.

The tidal range at the outer locations (T02 and T03) was slightly smaller than that at Humen. The dominance of semidiurnal tide was conspicuous at all the locations. In addition, a substantial diurnal inequality of the semidiurnal tide was apparent.

The harmonic tidal constants calculated for the regional tide are presented in Table 3.1.1 for the rainy season and Table 3.1.2 for the dry season. As can be seen, the amplitude of semidiurnal constituent (M_2) was the largest among all the components. The amplitude of M_2 constituent at Humen (T01) was nearly 65 cm in the rainy season and 55 cm in the dry season, and at Zhuhai (T02) and Guishan (T03) around 45 cm for both the seasons. The incremental increase of semidiurnal tide can also be recognized from the bay mouth to the upper bay. The amplitudes of diurnal components (K_1 and O_1 constituents) were also large. The amplitudes of K_1 constituent at the three locations were 36 to 38 cm in the rainy season and 48 to 53 cm in the dry season, and those of O_1 constituent were 29 to 33 cm in the rainy season and 27 to 29 cm in the dry season. The phase difference of M_2 constituent between the upper bay (Humen) and the bay mouth (Guishan) was 56 degrees in the rainy season and 79 degrees in the dry season, meaning that the time when the high tide occurs at the upper bay area trails about 2 and 3 hours from that at the bay mouth.

(2) Water Current

The harmonic constants obtained from the time series of currents are shown in,

- Table 3.1.3 to 3.1.8 for spring tide in the rainy season,
- Table 3.1.9 to 3.1.14 for neap tide in the rainy season,
- Table 3.1.15 to 3.1.20 for spring tide in the dry season, and
- Table 3.1.21 to 3.1.26 for neap tide in the dry season.

The tidal residual currents are shown in,

- Figure 3.1.1 for spring tide in the rainy season,
- Figure 3.1.2 for neap tide in the rainy season,

- Figure 3.1.3 for spring tide in the dry season, and
- Figure 3.1.4 for neap tide in the dry season.

1) Rainy Season

Spring Tide

During spring tide, regular variations of tidal currents were clearly observed at all points and all layers, except some irregularity induced by diurnal inequality of tides.

According to the harmonic analysis, semidiurnal components dominated at all points and in all layers.

The directions of the residual currents at the upper layer at all points showed southerly. However, the directions at the middle and bottom layer showed different in each point.

Neap Tide

The regular variations of tidal currents were also observed at all points and all layers even during neap tide. The amplitudes of tidal variations were significantly smaller than those in the spring tide. The asymmetry between ebb and flood tide during neap tide was also greater than that during the spring tide.

Comparing to the harmonic constants of 25-hour current data for neap tide, the difference from the spring tide was that there were cases in which diurnal component (K_1) was comparable to or greater than the semidiurnal component (M_2).

The direction of residual currents in the upper layer at all points showed southerly. But the directions in the middle and the bottom layers were variable at each point.

2) Dry Season

Spring Tide

During spring tide, regular cycles of tidal currents were clearly observed at all the locations in all the layers, except some irregularity induced by diurnal inequality of tides.

According to the results of harmonic analysis applied for the 24-hour period during spring tide, dominance of semidiurnal component was apparent in all layers at every location.

The tidal residual currents in the upper layer were southerly, while in the lower two layers they were northerly in some points.

Neap Tide

Regular cyclic tidal currents were also seen during neap tide, with smaller tidal amplitudes and greater asymmetry between ebb and flood tides compared to the counterparts during the spring tide.

The harmonic constants for the 25-hour observation period during neap tide showed a notable difference from spring tide. There were some cases in which influence of the diurnal component (K_1) was comparable to or greater than the semidiurnal component (M_2).

Tidal residual currents for the neap tide in the upper layer were southerly at all the locations except P19. In the lower two layers, however, northerly to westerly components were dominant, suggesting possible occurrence of density circulation.

(3) Tidal Level and Currents

Time series of current vectors during the 25-hour period in the three layers of each continuous survey point are shown in,

- Figures 3.1.5 to 3.1.10 for spring tide in the rainy season,
- Figures 3.1.11 to 3.1.16 for neap tide in the rainy season,
- Figures 3.1.17 to 3.1.22 for spring tide in the dry season,
- Figures 3.1.23 to 3.1.28 for neap tide in the dry season,

1) Rainy Season

Spring tide

The variations of tidal current in the three layers at each survey point during spring tide changed regularly along with the variations of the tide. In other words, the current directions were southerly during ebb tide and northerly during flood tide. The timing of change of current direction synchronized in the three layers at most of the survey points. But some phase differences were recognized at the southern survey points.

Neap tide

The tidal range between low and high tide during the neap tide survey was much smaller than that during the spring tide survey. Thus, the amplitude of current velocity during the neap tide survey was also less than that during the spring tide survey at most of the survey points. But the southerly currents at some survey points during the neap tide survey were stronger than those observed during the spring tide survey. It was likely influenced by the river flow. Basically, the current direction was southerly at the ebb tide and northerly at the flood tide. The phase differences in current direction change among the layers were recognized at some survey points, which was different from the spring tide survey.

2) Dry Season

Spring Tide

The tidal currents in the three layers at each survey point during spring tide varied regularly according to the tide, pointing to the south during ebb and to the north during flood. The changes in direction nearly synchronized in the three layers at all the locations with minor delays observed at some southern survey points.

Neap Tide

The phases in current direction changed in the three layers precisely synchronized when the current direction changed from NW to SE. In the upper layer, however, the phase of direction change from SE to NW trailed about 2 hours behind the lower two layers and so did the phase of the peak current occurrence. The duration of southerly current in the upper layer was longer than those observed in the lower two layers.

(4) Vertical Velocity Profile (ADCP)

The harmonic tidal constants obtained from the time series of currents are shown in Table 3.1.27 for 30-day dry season survey and in Table 3.1.28 for 24-hour transient season survey.

1) Dry Season

The harmonic constant of the semidiurnal component (M_2) dominated at all layers followed by the diurnal component (K_1).

The prevailing direction of residual currents was southerly at 0.0 m to 3.0 m-depth and northerly at 3.5 m to 6.5 m-depth. The residual current magnitude ranges from 26.4 cm/s at 0.0 m to 1.9 cm/s at 3.5m-depth. The middle layer, 3.5 m, was the turning layer for both the current direction and the magnitude.

2) Transient Season

The results showed similar trend in the semidiurnal component (M_2). However, the results should be regarded as a reference only since the survey period for the harmonic analysis was short.

3.1.2. Intensive Survey

The results of physical oceanography survey are summarized in three transverse lines shown in Figure 3.1.29 so that the vertical structure of physical property can be seen.

(1) Temperature and Salinity

The vertical distributions of temperature and salinity are shown in:

- Figure 3.1.30 for temperature during spring tide in the rainy season,
- Figure 3.1.31 for salinity during spring tide in the rainy season,
- Figure 3.1.32 for temperature during neap tide in the rainy season,
- Figure 3.1.33 for salinity during neap tide in the rainy season,
- Figure 3.1.34 for temperature during spring tide in the dry season,
- Figure 3.1.35 for salinity during spring tide in the dry season,
- Figure 3.1.36 for temperature during neap tide in the dry season,
- Figure 3.1.37 for salinity during neap tide in the dry season,
- Figure 3.1.38 for temperature during neap tide in the transient season, and
- Figure 3.1.39 for salinity during neap tide in the transient season.

1) Rainy Season

Spring Tide

Temperature and salinity were both well-mixed vertically at the upper bay section during the spring tide. A weak stratification of salinity and temperature existed at the middle section of the estuary to the bay mouth. The extent of low salinity water mass from the upper bay was about 45 km. The distribution of salinity governed the distribution of density in this area.

Temperature along the western line during the spring tide was vertically well- mixed for the stretch of 0 to 25km with some weak stratification beyond 25 km. Temperature along the centerline was also well-mixed for the stretch of 0 to 25km with a weak stratification in the stretch 25 to 75km. In the stretch over 75 km, a clear temperature stratification could be seen at around 9m depth. Temperature along the east line was well mixed vertically for the stretch of 0 to 27 km, and a weak stratification could also be seen from 27 to 50 km. Thus, isotherms run on a slant for that zone. For the stretch over 50 km, a clear salinity stratification could be seen in the depths ranging from 5 m to 10 m.

Salinity along the western line during spring tide was also vertically well mixed for the stretch 0 to 25km with some weak stratification beyond 25 km. Salinity along the central line was also well mixed for the stretch, 0 to 25 km. Relatively clear salinity stratification was observed from 25 to 45 km. From 45 to 60km, the distribution of salinity was almost homogeneous in the stretch from 16 to 20. Beyond 60km, clear salinity stratification was recognized around 7m-depth. Salinity along the east line was well mixed vertically for the stretch of 0 to 27 km and a weak stratification could be seen from 27 to 50 km. Thus, isopleths of ran on a slant in that stretch. In the stretch over 50 km, comparatively clear stratifications could be seen in depths ranging from 3 m to 6 m.

The extent of low salinity water mass at upper layer, which was shown as yellow color in the figure, was about 50km in the center and east line.

Neap Tide

In contrast to the vertical distributions of salinity during the spring tide, the profiles of salinity distribution during the neap tide were horizontal. The extent of low salinity water mass apparently depends on the river inflow.

Temperature along the western line during the neap tide was well-mixed in the 0 to 10m layer, although a weak stratification was recognized in the bottom layer for the horizontal stretch of 0 to 10km and the over 35 km section. Along the centerline, a weak stratification was recognized in the bottom layer for the stretch 0 to 30km. For the stretch over 30km, stratification of salinity was seen of around 5m depth. In the stretch between 35 and 65 km the stratification was particularly pronounced. A weak temperature stratification existed in the stretch 0 between 40 km along the eastern line. The stratification in the stretch over 40 km is more pronounced, stronger than that in the centerline.

Salinity along the western line during the neap tide was well mixed along the entire line except in the bottom layer for the stretch between 0 and 15 km, where a weak stratification of salinity appeared. For the stretch approximately 20 km along the central line, salinity was well mixed in the upper layer. A weak salinity stratification in that section was also recognized in the bottom layer. For the stretch over 20 km, a clear stratification was present in the depth 2 to 5m. For the stretch near 15 km along the eastern line, salinity was well mixed in the upper layer. In the bottom layer of that section, a weak stratification was recognized. For the stretch over 15km, a clear stratification was present in the 2 to 5m-depth. For the stretch beyond 40 km, the stratification was much stronger than along the central line.

The horizontal extent of low salinity water mass in the upper layer, shown in yellow in the figure, exceeded 70km, far greater than 45km that was observed during the spring tide. The Steering Committee suggested that the phenomenon were likely because the river inflow during the neap tide survey was greater than that during the spring tide survey.

2) Dry Season

During the spring tide, temperature along the western line was vertically uniform for the stretch between 0 and 25 km, with some weak stratification observed farther to the south. Along the central line temperature was also vertically uniform for the stretch between 0 and 64 km with minor stratification discernible farther to the south. Along the eastern line, the entire transection shows uniform vertical temperature profile.

During the neap tide, vertical temperature profile along the entire western line was uniform. Along the central line, a weak stratification can be seen in the upper layer, at around 4m-depth for the stretch between 0 and 25 km. A weak temperature stratification was also seen for the stretch between 0 and 30 km along the eastern line.

The temperature range encountered along the three transverses during the dry season survey was only 2°C at the most, far smaller than 8°C observed during the rainy season survey. The temperature stratification during the dry season; therefore, was practically nonexistent.

During the spring tide, vertical salinity profile along the western line was uniform for the extent beyond 14 km toward the south with some weak stratification present in the northern stretch.

Along the central and the eastern lines, vertical salinity profiles were uniform during the spring tide with exceptions of some weak stratification seen in the bay mouth area.

Low-salinity water mass with value under 10 spreads up to 30 km southward along the western line, and up to 10 km along the central- and the eastern lines. There are two of the 8 river mouths, Hongquili and Henmen, in the middle of the western line exemplified by the red-color in the figure. The extent of influence by the freshwater, however, was much smaller than that observed during the previous rainy season survey.

The salinity profile along the western line during the neap tide was nearly homogeneous. Weak salinity stratification was seen in the stretch between 0 and 60km along the central line, and between 0 and 55km along the eastern line.
Presence of low-salinity water mass in the upper layer was not clear except along the western line as influenced by the two river-mouths in the middle of the stretch.

(2) Density

The vertical distributions of density are shown in,

- Figure 3.1.40 for spring tide in the rainy season,
- Figure 3.1.41 for neap tide in the rainy season,
- Figure 3.1.42 for spring tide in the dry season,
- Figure 3.1.43 for neap tide in the dry season, and
- Figure 3.1.44 for neap tide in the transient season.

1) Rainy Season

Spring Tide

The distribution profiles of “sigma-t” in each line were very similar to those of salinity, indicating that the salinity distribution controlled the distribution of density in this area.

Neap Tide

The distribution profile of sigma-t during neap tide was very similar to that of salinity, as the same as that in spring tide. At the bottom of 0 km point (P01), comparatively greater density water mass existed which caused the density circulation, suggested in the current section (See section 3.1.1. (2) 1 Neap Tide).

2) Dry Season

The density profiles (“sigma-t”) along the three lines during both the neap and the spring tides were nearly identical to those of salinity, indicating also that the salinity distribution was the primary factor of the density variation in this region.

In the vicinity of P01, where the water depth was more than 20m, noted was the existence of a comparatively high-density water mass in the bottom layer that may indicate the presence of density circulation.

(3) Turbidity

The vertical distributions of turbidity are shown in,

- Figure 3.1.45 for spring tide in the rainy season,
- Figure 3.1.46 for neap tide in the rainy season,
- Figure 3.1.47 for spring tide in the dry season,
- Figure 3.1.48 for neap tide in the dry season, and
- Figure 3.1.49 for neap tide in the transient season.

Suitable periods were extracted from the data of continuous survey points (P01, P04, P11, P12, P19, and P20) and used as intensive survey data. Longitudinal distances (x-axis) were defined as the distance between P01 and every point.

1) Rainy Season

Spring tide

The turbidity during the spring tide was very high. The shallower the survey point the greater was the turbidity, indicating the influence of high current velocity during the spring tide.

For the stretch up to 15km along the western line, turbidity was over 150 FTU in the bottom layer. And for the stretch 25 to 35 km, turbidity was over 200 FTU in all the layers. For the extent over 35 km, the high turbidity, over 200 FTU, was also observed in the middle to bottom layer.

Along the central line. high turbidity values, over 200 FTU, were also observed in all the layers for the stretch 10 to 25 km Similar turbidity values were observed below 2 m-depth for the stretch between 38 and 64 km along the central line.

Along the eastern line, high turbidity values, over 200 FTU, were also observed in all the layers for the stretch between 10 and 30 km. Similar values were also observed below 2m-depth in the stretch between 45 and 51 km along the eastern line.

Turbidity values tended to be large at the points with depths shallower than10m, suggesting that the influence of tidal current was great at the shallow survey points.

Neap tide

The magnitudes of turbidity during the neap tide were less than those observed during the spring tide.

Along the west line, in the stretch up to15km turbidity was about 100 FTU in the bottom layer. And for the stretch between 35 and 45 km, it was over 200 FTU in the middle to bottom layers.

Along the central line, in the stretch up to 30 km turbidity was over 150 FTU in the bottom layer, and was over 100 FTU in the upper to middle layers.

Along the eastern line, in the stretch between 32 and 39 km turbidity was nearly 100 FTU in all the layers. For the extent around 47km, turbidity was also about 100 FTU in the middle to bottom layers.

Generally, turbidities during the neap tide were lower than those during the spring tide, although they tended to be large at the survey points with depths shallower than 10m.

2) Dry Season

Along the western line, in the stretch up to 10 km, the shallowest of the three, turbidity was strongly stratified, with over 200 FTU in the bottom layer to around 50 FTU in the upper layer while in the southern stretch over 25 km, turbidities were almost uniform at around 50 FTU in the entire depths. The high turbidities over 200 FTU were also noted at several locations along the deeper central line. High-turbidity zones appear more sporadically along the deepest eastern line. The thickness of the high-turbidity layer was also thinner along the eastern line than along the other lines. This suggests the existence of a relationship between water depth and occurrence of high turbidity, which in turn, implies the occurrence of bottom sediment re-suspension where water was shallow and tidal currents were strong.

High-turbidity water masses, over 100 FTU, were seen at every shallow survey points along the three lines during both the spring and the neap tide. Overall, however, turbidity values during the spring tide were higher than those during the spring tide.

(4) Light Quanta

The vertical distributions of turbidity are shown in:

- Figure 3.1.50 for light quanta during spring tide in the rainy season,
- Figure 3.1.51 for light quanta during neap tide in the rainy season,
- Figure 3.1.52 for light quanta during spring tide in the dry season,
- Figure 3.1.53 for light quanta during neap tide in the dry season, and
- Figure 3.1.54 for light quanta during neap tide in the transient season.

The suitable periods were extracted from the data obtained from the continuous survey points (P01, P04, P11, P12, P19, and P20) and were substituted as the intensive survey data. The longitudinal distances (x-axis) were again defined as the distance from P01 and every point.

Light quanta attenuation rate, the ratio of light quanta measured at the survey depth to the quanta measured on-board of the survey vessel simultaneously, was determined to evaluate the so-called compensation depth of primary production. Generally, it is defined that the compensation layer of primary production is the water depth at which the attenuation rate becomes 1%. During nighttime or precipitation, light quanta were not measured.

1) Rainy Season

Spring tide

Compensation depth turned deeper along the longitudinal distance toward the south, indicating a relationship between distribution of turbidity and compensation depth.

Along the central line, in the stretch 0 to 12km, compensation depth was about 1m. In the farther stretch southward, it became deeper. For the stretch over 80km, it was more than 5m.

Along the eastern line, in the stretch 0 to 25km, compensation depth was also about 1m, turning deeper in the farther stretch toward the south. For the stretch beyond 60 km, it was more than 5m.

Comparing the vertical distributions of turbidity, the relationship between low-turbidity and deeper compensation depth is evident.

Neap tide

Compensation depth turned deeper with distance toward the south, similar to the case during the spring tide.

Along the western line, in the stretch near 0km, compensation depth was about 6m. Farther than 10km, it decreased to as shallow as 2m.

Along the central line near 0km, compensation depth was about 6m and farther up to 12km it was about 3m becoming deeper toward the south. Over 40km, it reached almost to the local bottom.

Along the eastern line, for the stretch near 0km, compensation depth was about 6 m. For the stretch near 12km, it was about 3m gradually increasing toward the south. In the stretch over 30km, it was over 5m.

Comparing the vertical distribution of the turbidity, the low turbidity sections, such as at 0km in all the lines or at 85 km in the central line, showed deeper compensation depth. Thus, a relationship between low-turbidity and compensation depth is evident.

2) Dry Season

The compensation depth, as defined, along the western line during neap tide was about 3 m throughout the length of the transverse. The blue area in the upper layer indicates absence of data due to precipitation. Along both the central and the eastern lines, the compensation depth tends to become deeper with the distance toward the south. Comparing with the vertical distribution of turbidity shown, the low turbidity zones such as the 60 to 88 km stretch along the central line or the 42 to 73 km section along the eastern line coincide with the zones of deeper compensation depth.

During the neap tide, while the compensation depth along the western transverse was almost steady at about 4 m throughout the line, it turns deeper with the southward distance along the other two lines, the same tendency observed during the spring tide survey.

3.1.3. Continuous Survey

(1) Temperature and Salinity

The vertical temperature and salinity distributions for 24 hours in 6 survey points are shown in:

- Figure 3.1.55 to 3.1.60 for spring tide in the rainy season,
- Figure 3.1.61 to 3.1.66 for neap tide in the rainy season,
- Figure 3.1.67 to 3.1.72 for spring tide in the dry season, and
- Figure 3.1.73 to 3.1.78 for neap tide in the dry season.

1) Rainy Season

Spring tide

Distribution of temperature and salinity depended on the condition of tide and tidal current i.e.;

- salinity / temperature stratification was present during flood tide or during northerly tidal currents; and,
- salinity / temperature stratification disappeared or became weak during ebb tide or during southerly tidal currents.

The vertical distribution of salinity and temperature at P01 during the spring tide was almost homogeneous through the survey period. At the flood tide (at 23 to 5 LST and 14 to 17 LST), when the tidal current direction was NW, salinity became slightly greater in the bottom layer and temperature became slightly lower. However, the changes were very small.

At P04, the vertical distribution profiles of salinity were almost uniform throughout the survey period in the spring tide. Some changes in the temperature variation were recognized between with ebb and flood, although the differences were very small.

In the time series of salinity at P11, comparatively clear salinity stratification was recognized at 10 to 16 LST and at 22 to 10 LST, except during the period when strong southerly currents dominated. The depth of the stratification turned deeper along with the increase in the current strength. Temperature stratification disappeared after the low tide, when the current speed reached the maximum, and uniform salinity distribution persisted about 6 hours until 22 LST, the high tide. Afterward, comparatively distinct stratification of salinity persisted at around 5 m depth until the survey was terminated. In the latter half of the survey period, salinity stratification persisted even during the ebb tide because of the smaller amplitude of tidal current velocity by diurnal inequality, and it became were pronounced along with the change of tide from ebb to flood at 5 LST. The time series of temperature was similar to that of salinity.

Weak salinity stratification at P12 began to disappear when southerly current started at 12 LST, and uniform-salinity water mass prevailed for 6 hours until northerly current started at 18 LST. In the latter half of the survey period, the stratification persisted even during the ebb tide because of the weaker tidal current velocity influenced by the diurnal inequality, and it turned more distinct along with change of tide from ebb to flood at 5 LST. Salinity stratification in the latter half of the survey period was more pronounced than that in the former half with its depth between 3 and 9 m. A pattern of the temperature variation was similar to that of salinity, although the temperature stratification was much weaker.

Salinity stratification at P19 was weaker compared to the other survey points. The vertical distribution had the tendency to become homogeneous during the flood tide, when the current direction was NW. Weak temperature stratification in the upper layer at P19 became indistinguishable following the change of tide from ebb to flood. The vertical temperature distribution became uniform after 20 LST when the northerly current ceased in the three layers. A cooler water mass appeared at the bottom layer after 4 LST when the tide began to change from low tide to flood and it persisted until the end of the survey.

When southerly current dominated at P20, distinct salinity stratification at 3 to 7 m depths persisted until 23 LST, when the current changed to southerly again. From 16 to 18 LST when the southerly current at three layers reached the maximum, a weak vertical mixing occurred. The same phenomenon was recognized at 11 LST, when the northerly current in the three layers turned southerly. A high salinity water mass was recognized below 10 m-depth at every 6 hours regularly. A weak stratification existed at around 5 m depth all the time except when the aforementioned phenomena occurred. These might indicate the existence of upwelling from the deeper outer sea, which was also suggested by the Steering Committee. The time series of temperature showed the same profiles as those of salinity. The same phenomena, the weak vertical mixing and upwelling of cold water mass, were also recognized.

Neap tide

The degree of salinity / temperature stratification during the neap tide was stronger than that during the spring tide. The stratification persisted at most points throughout the survey regardless of strength and direction of the tidal currents.

During the neap tide, salinity in the upper layer within 5m at P01 always showed 0 value because of the weaker tidal influence. Salinity contour lines formed horizontally throughout the survey, without discernible stratification. A comparatively high salinity water mass persisted in the bottom layer during the survey even when the currents were southerly. Weak temperature stratification persisted at around 10m-depth throughout the survey. Horizontal contour lines formed below 10m-depth similar to that of salinity distribution, although vertical contour lines were observed above 10m-depth.

Unlike the other points, the profiles of time series of salinity at P04 were almost homogeneous. Contour lines of temperature formed vertically, indicating that the water mass at P04 was well mixed by the steady southerly current.

Strong salinity stratification was observed at P11 at 3 to 5m-depths throughout the survey. The stratification was steady, although some turbulence was recognized at the point of tidal transition, such as at 11 LST and at 17 LST. The same tendency appeared in the time series of temperature; however, the changes were much smaller than those of salinity.

The depth of salinity stratification at P12, 2 to 3m below the surface, was shallower than that at P11. The stratification of salinity became unclear at 4 LST when the current velocity at all the layers became weak. A comparatively high salinity water mass appeared in the bottom layer when northerly current persisted, at 13 to 17 LST and 0 to 7 LST. The same tendencies were recognized in the time series of temperature: shallower stratification depth, weak stratification at the point of tidal transition, and appearance of cooler water mass in the bottom layer.

The salinity stratification at P19 persisted throughout the survey period. The depth of stratification varied from 2 to 5m, depending upon the tidal current condition. The depth of stratification became deeper as the southerly current persisted and became shallower during the northerly current. Time series of temperature at P19 showed the same tendency as that of salinity.

The salinity stratification at P20 also persisted throughout the survey period in the depth, 2 to 3m, depending upon the current condition. During the southerly current, the depth of stratification turned deeper and it became shallower after the tidal current changed to northerly. The depth of salinity stratification was 1 m at 5 LST when the strong northerly current started to change its direction. In addition to the upper layer as mentioned above, the secondary salinity stratification formed at around 5m depth, and it became sharper every 6 hours such as at 21, 2, 8, and 9 LST. This suggests the existence of upwelling, as discussed in the previous section. The time series of temperature at P20 showed similar profiles as that of salinity.

2) Dry Season

Spring Tide

The vertical temperature distribution at P01 during the spring tide was almost homogeneous throughout the survey period. Salinity varied with the tidal change. After the northerly flood-currents persisted, a somewhat higher-salinity water mass appeared in the bottom layer (0 to 3 LST). On the other hand, following the southerly ebb-currents, a lower-salinity water mass appeared in the upper layer (7 to 13 LST). The range of salinity variation, however, was small compared to the results found in the previous rainy season survey

At the other survey points during the spring tide, the vertical salinity and temperature distribution profiles remained almost steady. The distribution patterns were vertically mixed and the range of salinity variation was within 5 while that of temperature was less than 2°C, significantly smaller than those observed in the previous rainy season survey.

Neap Tide

During the neap tide at P01, a low-salinity water mass appeared in the upper layer after the prolonged southerly ebb-current (0 to 7 and 13 to 18

LST), forming weak salinity stratification. In the bottom layer, a comparatively high-salinity water mass remained all the time. As the range of temperature change was within 2°C, its distribution profile was almost uniform.

Weak salinity stratification was observed at P11 from 23 to 5 LST, following the persistent southerly ebb-current.

At P12, weak salinity stratification was also observed from 0 to 5 LST, following the southerly ebb-current.

Weak salinity stratification at P19 seen from 23 to 16 LST persisted longer compared to the other survey points. This was likely because the duration of southerly current was longer in the upper layer than in the other two layers, while the southerly current brought high-salinity water masses into the middle and the bottom layers.

At the other survey points, the vertical salinity and temperature profiles were almost uniform throughout the neap tide. The ranges of salinity and temperature fluctuations were within 5, and 2°C, significantly smaller than those observed during the previous rainy season survey.

The patterns of time series for salinity and temperature during the neap tide were primarily horizontal, whereas they were vertical during the spring tide.

The salinity / temperature stratification during the neap tide was significantly stronger than that observed during the spring tide.

Compared to the results of the rainy season survey, salinity values observed at all the survey points were significantly greater in the dry season.

(2) Turbidity

The vertical turbidity distributions for 24 hours in 6 survey points are shown in:

- Figure 3.1.79 to 3.1.80 for spring tide in the rainy season,
- Figure 3.1.81 to 3.1.82 for neap tide in the rainy season,
- Figure 3.1.83 to 3.1.84 for spring tide in the dry season, and
- Figure 3.1.85 to 3.1.86 for neap tide in the dry season.

1) Rainy Season

Spring Tide

Turbidity increased along with the increase of current magnitude, especially at the shallow survey points.

Turbidity at P01 was generally low at all the layers during the survey period compared to the other survey points except P20. However, the values tended to be large when the current velocity increased, for example at 21, 0, 6, 13, and 17 LST.

Turbidity at P04 was consistently greater than at P01. The tendency that the greater the current velocity the higher the values of turbidity, was also recognized at this point.

The background turbidity was very low at P11, although it became much higher following the increase of current magnitude. Turbidity values, over 200 FTU, were observed in almost all the layers at 16 and 17 LST.

At P12, increase turbidity was observed in the bottom layer at 14 LST, and in all the layers at 17 to 21 LST, and at the bottom layer at 6 to 9 LST. The increment of turbidity increase was over 200 FTU each time. The turbidity increase occurred consistently when the tidal current strengthened. However, the increase of turbidity at all the layers from 17 LST trailed about one hour from the maximum tidal velocity.

Turbidity at P19 always was persistently high in the middle to bottom layers throughout the survey, without any relation to the current strength and directions, likely because of the shallow depth. When the current magnitude increased, the turbidity also increased for example at 16 to 17 LST, 1 to 2 LST, and 9 to 10 LST.

Turbidity at P20 was low throughout the survey period except 16 to 20 LST, when it increased in the middle to bottom layers following the increase of the tidal current velocity.

Neap tide

Turbidity at P01 was low throughout the survey period. When the current velocity increased, the turbidity values tended to increase in the bottom layer, for example at 5 LST and from 14 LST.

The southerly tidal current dominated at P04, and the turbidity increased with the increase of current speed. Especially, the turbidity in the latter half of the survey period was higher than that in the first half, because of the stronger tidal currents.

Turbidity at P11 was low throughout the survey period. When the current magnitude increased, the turbidity values tended to increase in the bottom layer, for example at 13 LST and at 3 LST.

Turbidity at P12 was also low throughout the survey period, except some slight increases at 12 to 14, 17, and 0 to 2 LST, when the northerly current dominated.

Turbidity at P19 did not vary significantly throughout the survey period, except for occasional increase in the bottom layer when the tidal currents were strong.

The time series of turbidity at P20 were homogeneous and their values were very low, likely as a result of the weak tidal currents and the deeper depth.

2) Dry Season

Spring Tide

Turbidity during the spring tide showed a clear correlation with the current magnitude especially in the shallow waters.

At P01, turbidities in the bottom layer were generally high during the spring tide. The thickness of high-turbidity layer became greater when the southerly current component increased, as seen in the figures at 6 to 8 LST.

At P11, high-turbidity layer extends from the bottom to the surface at 21 to 23 and 4 to 10 LST at which current magnitudes and turbidities also tended to be higher.

At P12, high-turbidity layer also extended from the bottom to the surface at 4 to 6 LST following the persistent high tidal current.

At P19, turbidity was high all the time except during 20 to 0 LST without apparent relation to the current magnitudes or the directions. The shallowness and the strong influence of tidal currents of the area were likely reasons for this phenomenon.

At P20, turbidity was generally low throughout the survey period except 3 to 7 LST when it increased from the bottom to the surface following the incremental increase in the tidal current magnitude.

At P22, the turbidity was relatively low throughout the survey period. The current magnitude was also small compared to the other survey points.

Neap tide

Turbidity at P01 during the neap tide were also low throughout the survey period. When the current magnitude increased, the turbidity also tended to increase in the bottom layer.

The turbidities at the other locations were comparatively low throughout the neap tide.

(3) Light Quanta

The vertical light quanta distributions for 24 hours in 6 survey points are shown in:

- Figure 3.1.87 to 3.1.88 for spring tide in the rainy season,
- Figure 3.1.89 to 3.1.90 for neap tide in the rainy season,
- Figure 3.1.91 to 3.1.92 for spring tide in the dry season, and

- Figure 3.1.93 to 3.1.94 for neap tide in the dry season.

1) Rainy Season

Spring Tide

A relationship between the compensation depth and turbidity distribution was recognized at several survey points.

At P01, compensation depth was 2 m during the first half of the survey period. The depth tended to be deeper in the latter half. No relationship was detected between the distribution of turbidity and the light attenuation rate.

At P04, compensation depth at was deeper than that at P01. The depth was between 3 m to 5 m throughout the survey period. It reached almost to the bottom at 18 to 19 LST. The compensation depth tended to be deeper at 10 and 15 LST when the turbidity became lower.

At P11, compensation depth was 3 to 5 m throughout the survey period except at the 1 m-depth between 17 and 18 LST, just after the tidal current magnitude reached its maximum. At that time, high turbidity, generated by strong tidal current, reached to the water surface.

At P12, compensation depth was 1 to 4 m throughout the survey period except between 18 and 19 LST and at 6 LST, when the compensation depth reached to the bottom. Both phenomena occurred when the current direction started to change. The high turbidity, which reached to the water surface between 16 and 18 LST, caused the decrease in compensation depth.

At P19, compensation depth was 2 to 4 m throughout the survey period except between 18 and 19 LST, when the direction of tidal current started to change. No relationship was recognized between the distribution of turbidity and the light attenuation rate.

At P20, compensation depth was 3 to 12 m throughout the survey period except between 18 and 19 LST and at 7 LST, when it reached almost to the bottom. It coincided with the change in direction of tidal current.

Although relationship between the turbidity and the light attenuation rate was not precisely clear, the decrease in compensation depth followed the increase of turbidity at surface at several survey points.

Neap tide

Comparing with the spring tide survey, a relationship between the compensation depth and the distribution of turbidity was hardly seen because of the low turbidity values resulting from the weaker tidal current.

At P01, compensation depth was 1 to 3m throughout the survey period except at 12 LST when the compensation depth reached 12 m and the tidal current velocity was at the maximum. No relationship was recognized between the distribution of turbidity and the distribution of attenuation rate.

At P04, compensation depth was 3m in the first half of the survey period. In the latter half, when the turbidity increased by the northerly tidal current, the depth became 1 m.

At P11, compensation depth was 4m throughout the survey period and it was steady. The turbidity was also low.

At P12, compensation depth was 5 to 10m throughout the survey period. No relationship was found between the turbidity and the light attenuation rate.

At P19, compensation depth was 5 to 7m throughout the survey period and it reached to the bottom during most of the survey period. The turbidity at the surface was low throughout the survey.

At P20, compensation depth was 8 to 12m in the first half of the survey period and 8 to 18 m in the latter half. At 10 LST, compensation depth reached to the bottom, 18 m, even though it was relatively deep. The southerly currents at the three layers were not very strong at that time. The upwelling influence, indicated by the clear visibility water mass, could be the reason since such an increase of compensation depth also occurred at 15 LST. No relationship was found between the turbidity and the light attenuation rate.

2) Dry Season

Spring Tide

A clear relationship could be seen at several survey points, between the compensation depth and the turbidity distribution driven by the tidal currents during the spring tide

At P01, compensation depth during the spring tide was 3m in the leading half, increasing toward the trailing half when the high-turbidity layer turns thinner.

At P11, compensation depth was steady at about 2m during the spring tide.

Light quanta data were absent for P12 and P19 because of the rain.

At P20, compensation depth during the spring tide was about 7 m while turbidities remain relatively low.

At P22, compensation depth was about 6m throughout the spring tide while turbidities were also low.

During the neap tide, the compensation depths were typically greater than those during the spring tide coinciding with the lower turbidities and the weaker currents.

Neap tide

At P01, compensation depth during the neap tide was about 3 m from 7 to 11 LST increasing to almost 6m following the persistent northerly currents that brought the low-turbidity water mass from the bay mouth.

At P11, compensation depth during the neap tide varied from 3 to 6 m reaching almost to the bottom. Despite the shallowness, turbidities were comparatively low throughout the period as a result of the weak currents.

The compensation depths at the other survey points during the neap tide were also deep, 3 to 9 m, throughout the period during which turbidities were low and currents were weak.

Table 3.1.1 Harmonic Constants of Tide in the Rainy Season, 31 July to 30 Aug. 2000

HuMen, TO1

分潮	振幅(cm)	遅角(°)
K_1	36.18	318.96
O_1	32.52	268.46
P_1	12.05	318.96
Q_1	5.47	250.56
M_2	64.46	299.80
S_2	23.11	339.53
N_2	13.78	278.05
K_2	6.29	339.53
L_2	4.43	325.79
ν_2	2.67	278.05
μ_2	0.55	129.90
M_4	7.68	127.32
MS_4	5.77	181.02
平均水位	401.73(cm)	

GuiShan, TO3

分潮	振幅(cm)	遅角(°)
K_1	38.29	295.85
O_1	30.46	240.25
P_1	12.75	295.85
Q_1	5.65	216.69
M_2	44.23	243.95
S_2	19.03	279.78
N_2	10.44	226.06
K_2	5.18	279.78
L_2	1.76	253.49
ν_2	2.03	226.06
μ_2	2.43	235.33
M_4	3.88	327.69
MS_4	2.43	17.16
平均水位	288.12(cm)	

Zhuhai, TO2

分潮	振幅(cm)	遅角(°)
K_1	37.80	300.25
O_1	29.41	244.42
P_1	12.59	300.25
Q_1	5.80	221.07
M_2	46.97	253.35
S_2	20.26	289.54
N_2	10.87	236.64
K_2	5.51	289.54
L_2	1.97	264.43
ν_2	2.11	236.64
μ_2	2.59	245.94
M_4	4.09	353.43
MS_4	2.76	43.43
平均水位	282.41(cm)	

Table 3.1.2 Harmonic Constants of Tide in the Dry Season, from 1 to 31 Dec. 2000

[Humen ,T01]

Components	Amplitude (cm)	Retardation(°)
K_1	52.91	301.79
O_1	27.2	268.98
P_1	17.62	301.79
Q_1	5.54	249.83
M_2	55.48	303.72
S_2	18.62	304.15
N_2	11.04	302.25
K_2	5.07	304.15
L_2	1.5	334.89
υ 2	2.14	302.25
μ 2	1.21	166.52
M_4	4	86.12
MS_4	0.84	122.24
Mean Level	372.06(cm)	

[Guishan,T03]

Components	Amplitude (cm)	Retardation(°)
K_1	47.73	268.83
O_1	28.16	235.71
P_1	15.89	263.83
Q_1	6.09	218
M_2	42.2	224.38
S_2	15.7	232.17
N_2	9.03	221.83
K_2	4.27	232.17
L_2	0.78	291.31
υ 2	1.75	221.83
μ 2	2.58	175
M_4	3.28	234.68
MS_4	1.65	254.16
Mean Level	301.92(cm)	

[Zhuhai ,T02]

Components	Amplitude (cm)	Retardation(°)
K_1	48.74	283.91
O_1	28.52	254.52
P_1	16.23	283.91
Q_1	6	235.45
M_2	44.17	263.91
S_2	16.28	272.63
N_2	9.41	260.68
K_2	4.43	272.63
L_2	0.79	333.73
υ 2	1.82	260.68
μ 2	2.62	212.52
M_4	3.94	319.83
MS_4	1.74	340.99
Mean Level	340.99(cm)	

Table 3.1.3 Harmonic Constants (P01, Spring Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/2 20:00 to 2000/8/3 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	34.28	94.83	30.07	288.17	311.16	45.30	280.61	41.16	5.25	10.61
M2	79.36	179.42	79.45	358.47	315.03	112.29	358.95	45.03	0.93	268.95
M4	8.91	85.69	16.18	305.50	334.73	17.72	297.59	64.73	5.21	27.59
Steady component	33.15 (cm/s)		-18.54 (cm/s)		119.22 (degree)			37.98 (cm/s)		

Layer:Middle
Observed period:2000/8/2 20:00 to 2000/8/3 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	31.81	54.23	31.84	240.69	315.02	44.94	237.46	45.02	2.53	327.46
M2	77.07	81.29	79.29	260.34	315.81	110.57	260.80	45.81	0.92	170.80
M4	10.77	281.63	11.89	119.74	317.97	15.84	111.60	47.97	2.51	201.60
Steady component	23.62 (cm/s)		-23.57 (cm/s)		134.94 (degree)			33.37 (cm/s)		

Layer:Lower
Observed period:2000/8/2 20:00 to 2000/8/3 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	25.60	62.13	36.43	230.81	325.09	44.34	234.53	55.09	4.13	144.53
M2	66.88	77.80	81.49	257.09	320.62	105.42	257.38	50.62	0.64	167.38
M4	12.26	296.83	11.67	102.19	313.54	16.79	109.88	43.54	2.15	19.88
Steady component	20.34 (cm/s)		-20.99 (cm/s)		135.91 (degree)			29.23 (cm/s)		

Table 3.1.4 Harmonic Constants (P04, Spring Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/2 20:00 to 2000/8/3 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	24.16	56.54	23.98	231.44	314.78	34.01	234.01	44.78	1.52	144.01
M2	50.93	62.78	53.80	242.71	316.57	74.08	242.74	46.57	0.05	152.74
M4	7.36	289.39	8.78	71.19	321.38	10.85	86.36	51.38	3.68	356.36
Steady component	26.16 (cm/s)		-31.68 (cm/s)		140.45 (degree)			41.08 (cm/s)		

Layer:Middle
Observed period:2000/8/2 20:00 to 2000/8/3 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	27.27	54.85	42.08	224.37	327.23	49.97	227.45	57.23	4.18	137.45
M2	50.33	62.40	66.73	241.49	322.97	83.58	241.82	52.97	0.64	151.82
M4	6.35	246.48	7.56	14.18	322.97	8.90	34.06	52.97	4.27	304.06
Steady component	22.86 (cm/s)		-43.82 (cm/s)		152.45 (degree)			49.42 (cm/s)		

Layer:Lower
Observed period:2000/8/2 20:00 to 2000/8/3 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	15.64	64.84	24.70	233.12	327.90	29.11	236.44	57.90	2.70	146.44
M2	38.81	60.39	49.27	238.72	321.77	62.71	239.36	51.77	0.88	149.36
M4	8.19	286.49	7.61	85.98	312.75	11.00	97.02	42.75	1.99	7.02
Steady component	15.45 (cm/s)		-32.31 (cm/s)		154.44 (degree)			35.81 (cm/s)		

Table 3.1.5 Harmonic Constants (P11, Spring Tide, Rainy Season)

Layer:Upper
Observed period:2000/7/31 9:50 to 2000/8/1 9:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	28.49	4.21	35.50	222.05	322.85	43.19	207.91	52.85	14.36	297.91
M2	12.54	12.08	87.74	228.14	353.36	88.33	227.59	83.36	7.33	317.59
M4	12.42	136.28	16.82	21.28	333.05	18.11	4.92	63.05	10.46	94.92
Steady component	21.32 (cm/s)		-14.66 (cm/s)		124.52 (degree)			25.87 (cm/s)		

Layer:Middle
Observed period:2000/7/31 9:50 to 2000/8/1 9:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	10.93	94.30	43.02	218.51	351.51	43.48	220.26	81.51	8.94	130.26
M2	15.34	40.02	70.03	215.34	347.68	71.68	215.55	77.68	1.22	125.55
M4	3.14	212.59	12.60	348.01	349.64	12.80	349.78	79.64	2.17	259.78
Steady component	-12.01 (cm/s)		-1.39 (cm/s)		263.41 (degree)			12.09 (cm/s)		

Layer:Lower
Observed period:2000/7/31 9:50 to 2000/8/1 9:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	8.93	47.67	33.74	216.42	345.41	34.86	217.14	75.41	1.69	127.14
M2	10.33	30.03	49.28	223.66	348.46	50.30	223.10	78.46	2.38	313.10
M4	3.60	0.04	13.83	322.41	11.94	14.12	324.26	101.94	2.15	54.26
Steady component	-4.09 (cm/s)		0.33 (cm/s)		274.58 (degree)			4.11 (cm/s)		

Table 3.1.6 Harmonic Constants (P12, Spring Tide, Rainy Season)

Layer:Upper
Observed period:2000/7/31 10:00 to 2000/8/1 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	19.47	26.81	24.29	219.27	321.43	30.95	214.41	51.43	3.30	304.41
M2	13.03	330.54	58.64	212.80	353.86	58.97	211.61	83.86	11.47	301.61
M4	8.46	159.74	5.34	258.44	278.78	8.52	334.32	8.78	5.24	244.32
Steady component	-0.17 (cm/s)		-0.55 (cm/s)		196.88 (degree)			0.58 (cm/s)		

Layer:Middle
Observed period:2000/7/31 10:00 to 2000/8/1 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.16	62.79	23.27	196.38	354.60	23.37	196.90	84.60	2.28	106.90
M2	16.00	31.57	68.44	210.40	346.85	70.28	210.46	76.85	0.32	120.46
M4	4.58	310.47	5.63	262.59	36.40	6.67	280.20	126.40	2.87	10.20
Steady component	-3.64 (cm/s)		3.43 (cm/s)		313.32 (degree)			5.01 (cm/s)		

Layer:Lower
Observed period:2000/7/31 10:00 to 2000/8/1 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.12	0.38	29.57	177.22	353.99	29.73	177.25	83.99	0.17	87.25
M2	10.73	342.00	66.50	199.64	352.65	67.05	198.92	82.65	6.50	288.92
M4	3.92	240.65	10.25	305.43	10.44	10.40	301.89	100.44	3.49	211.89
Steady component	-1.41 (cm/s)		8.00 (cm/s)		349.98 (degree)			8.12 (cm/s)		

Table 3.1.7 Harmonic Constants (P19, Spring Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/1 15:30 to 2000/8/2 14:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	32.41	299.90	40.45	210.84	2.10	40.46	212.52	92.10	32.40	302.52
M2	27.71	332.85	68.12	201.95	343.72	70.72	197.19	73.72	20.18	287.19
M4	5.54	33.36	12.91	281.83	349.43	13.10	277.69	79.43	5.08	7.69
Steady component	9.05 (cm/s)		-9.18 (cm/s)		135.42 (degree)			12.89 (cm/s)		

Layer:Middle
Observed period:2000/8/1 15:30 to 2000/8/2 14:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	14.75	305.95	24.26	206.15	350.91	24.46	200.76	80.91	14.42	290.76
M2	21.72	324.46	68.34	191.90	347.22	69.99	189.01	77.22	15.62	279.01
M4	4.86	168.00	5.68	300.05	321.56	6.85	319.17	51.56	2.99	229.17
Steady component	-1.96 (cm/s)		-13.05 (cm/s)		188.56 (degree)			13.20 (cm/s)		

Layer:Lower
Observed period:2000/8/1 15:30 to 2000/8/2 14:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	2.26	345.48	11.11	188.72	349.35	11.31	187.89	79.35	0.88	277.89
M2	19.23	316.40	57.83	184.83	346.80	59.31	181.65	76.80	14.03	271.65
M4	5.75	138.38	9.07	313.31	327.67	10.73	314.77	57.67	0.43	224.77
Steady component	-8.56 (cm/s)		-8.65 (cm/s)		224.70 (degree)			12.17 (cm/s)		

Table 3.1.8 Harmonic Constants (P20, Spring Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/1 14:50 to 2000/8/2 14:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	30.28	348.85	53.34	216.72	335.84	57.72	207.56	65.84	20.76	297.56
M2	37.55	12.08	64.94	214.19	330.93	73.98	208.86	60.93	12.41	298.86
M4	3.66	68.91	16.53	323.05	356.37	16.56	322.28	86.37	3.52	52.28
Steady component	10.19 (cm/s)		-15.31 (cm/s)		146.36 (degree)			18.39 (cm/s)		

Layer:Middle
Observed period:2000/8/1 14:50 to 2000/8/2 14:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.44	129.14	39.17	183.67	2.93	39.23	183.46	92.93	2.80	93.46
M2	20.02	316.21	89.95	185.73	351.54	90.91	184.32	81.54	15.07	274.32
M4	2.55	233.32	22.57	307.30	1.81	22.58	307.11	91.81	2.45	217.11
Steady component	-11.38 (cm/s)		-9.29 (cm/s)		230.77 (degree)			14.69 (cm/s)		

Layer:Lower
Observed period:2000/8/1 14:50 to 2000/8/2 14:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	9.49	271.02	36.64	180.74	359.92	36.64	180.71	89.92	9.49	270.71
M2	10.73	288.14	65.19	180.18	357.02	65.28	179.71	87.02	10.20	269.71
M4	9.58	49.83	18.72	281.22	339.56	19.80	273.63	69.56	7.08	3.63
Steady component	4.09 (cm/s)		-3.85 (cm/s)		133.24 (degree)			5.62 (cm/s)		

Table 3.1.9 Harmonic Constants (P01, Neap Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/09 19:20 to 2000/8/10 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	37.64	283.14	21.58	104.04	299.94	43.23	103.36	29.94	0.29	193.36
M2	55.90	203.74	41.38	26.30	306.50	69.53	24.64	36.50	1.49	114.64
M4	5.95	118.51	4.08	346.40	300.00	6.70	311.57	30.00	2.69	41.57
Steady component	38.21 (cm/s)		-21.95 (cm/s)		119.88 (degree)			44.06 (cm/s)		

Layer:Middle
Observed period:2000/8/09 19:20 to 2000/8/10 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	39.69	241.93	44.88	68.88	318.53	59.80	65.83	48.53	3.60	155.83
M2	44.11	103.10	50.53	282.76	318.88	67.08	282.91	48.88	0.20	192.91
M4	7.04	246.96	8.20	101.57	320.27	10.33	87.25	50.27	3.17	177.25
Steady component	13.75 (cm/s)		-10.05 (cm/s)		126.16 (degree)			17.03 (cm/s)		

Layer:Lower
Observed period:2000/8/09 19:20 to 2000/8/10 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	6.25	176.24	3.19	79.11	274.86	6.27	358.69	4.86	3.16	88.69
M2	8.29	2.02	22.20	195.03	339.89	23.63	193.48	69.89	1.75	283.48
M4	3.31	289.56	9.79	47.48	250.16	9.92	50.36	80.16	2.89	320.36
Steady component	-4.12 (cm/s)		10.09 (cm/s)		337.79 (degree)			10.90 (cm/s)		

Table 3.1.10 Harmonic Constants (P04, Neap Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/09 20:00 to 2000/8/10 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	15.95	275.49	34.80	76.65	336.16	37.99	79.79	66.16	4.72	349.79
M2	16.15	82.37	36.91	270.69	336.52	40.23	269.37	66.52	2.15	359.37
M4	3.25	273.04	7.34	146.73	343.47	7.62	141.12	73.47	2.52	231.12
Steady component	23.60 (cm/s)		-52.51 (cm/s)		155.80 (degree)			57.57 (cm/s)		

Layer:Middle
Observed period:2000/8/09 20:00 to 2000/8/10 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	15.58	262.73	31.20	85.73	333.49	34.87	85.14	63.49	0.73	175.14
M2	17.36	90.85	33.22	268.82	332.42	37.48	269.25	62.42	0.55	179.25
M4	2.79	313.82	4.78	141.71	329.86	5.52	139.72	59.86	0.33	229.72
Steady component	24.86 (cm/s)		-49.64 (cm/s)		153.40 (degree)			55.52 (cm/s)		

Layer:Lower
Observed period:2000/8/09 20:00 to 2000/8/10 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	15.01	262.40	30.65	85.81	333.93	34.12	85.15	63.93	0.80	175.15
M2	16.96	85.92	31.48	265.74	331.69	35.76	265.78	61.69	0.05	175.78
M4	3.46	317.24	6.01	134.34	330.11	6.94	135.06	60.11	0.15	45.06
Steady component	24.19 (cm/s)		-47.85 (cm/s)		153.19 (degree)			53.62 (cm/s)		

Table 3.1.11 Harmonic Constants (P11, Neap Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/7 10:00 to 2000/8/8 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	10.54	55.35	24.77	60.04	23.00	26.91	59.32	113.00	0.79	329.32
M2	15.74	275.40	40.73	226.66	15.46	42.14	230.95	105.46	11.44	320.95
M4	1.79	354.32	7.05	34.74	11.24	7.18	32.93	101.24	1.14	302.93
Steady component	-9.48 (cm/s)		-8.96 (cm/s)		226.62 (degree)			13.05 (cm/s)		

Layer:Middle
Observed period:2000/8/7 10:00 to 2000/8/8 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.64	221.66	3.76	86.08	316.34	4.84	64.81	46.34	1.98	154.81
M2	6.89	6.75	48.79	237.41	354.82	48.98	236.85	84.82	5.31	326.85
M4	3.57	70.63	14.63	17.61	8.67	14.79	19.28	98.67	2.82	109.28
Steady component	-8.90 (cm/s)		-11.94 (cm/s)		216.70 (degree)			14.89 (cm/s)		

Layer:Lower
Observed period:2000/8/7 10:00 to 2000/8/8 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.45	236.18	10.54	123.77	352.19	10.63	121.43	82.19	3.16	211.43
M2	5.40	327.59	47.83	231.27	359.28	47.84	231.18	89.28	5.37	321.18
M4	7.27	68.10	11.86	1.71	19.10	12.36	11.87	109.10	6.40	101.87
Steady component	-1.51 (cm/s)		-2.42 (cm/s)		212.03 (degree)			2.85 (cm/s)		

Table 3.1.12 Harmonic Constants (P12, Neap Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/7 9:50 to 2000/8/8 9:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	2.77	167.36	5.07	71.05	355.13	5.09	68.41	85.13	2.75	158.41
M2	15.60	22.03	33.33	213.79	335.22	36.68	211.71	65.22	2.89	301.71
M4	3.52	126.53	4.30	301.58	320.71	5.55	303.57	50.71	0.24	213.57
Steady component	11.17 (cm/s)		-18.27 (cm/s)		148.56 (degree)			21.41 (cm/s)		

Layer:Middle
Observed period:2000/8/7 9:50 to 2000/8/8 9:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.60	55.44	5.38	345.35	19.73	5.59	357.12	109.73	3.25	87.12
M2	6.04	350.82	30.41	197.28	349.84	30.89	196.40	79.84	2.65	286.40
M4	2.58	28.60	6.23	338.58	16.36	6.47	343.52	106.36	1.90	73.52
Steady component	-0.24 (cm/s)		0.42 (cm/s)		330.78 (degree)			0.48 (cm/s)		

Layer:Lower
Observed period:2000/8/7 9:50 to 2000/8/8 9:50

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	0.87	123.69	2.78	289.48	343.08	2.91	290.71	73.08	0.20	200.71
M2	7.25	339.33	23.92	165.84	343.21	24.98	165.30	73.21	0.79	255.30
M4	0.78	18.33	3.20	195.63	346.27	3.30	195.79	76.27	0.04	105.79
Steady component	-1.60 (cm/s)		-2.17 (cm/s)		216.49 (degree)			2.69 (cm/s)		

Table 3.1.13 Harmonic Constants (P19, Neap Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/8 14:00 to 2000/8/9 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	13.54	72.35	33.15	49.03	21.00	35.45	52.13	111.00	5.01	142.13
M2	21.23	303.71	29.80	211.18	356.36	29.83	208.59	86.36	21.19	298.59
M4	7.16	91.07	4.39	301.70	299.69	8.16	278.87	29.69	1.96	8.87
Steady component	-7.47 (cm/s)		-15.86 (cm/s)		205.20 (degree)			17.53 (cm/s)		

Layer:Middle
Observed period:2000/8/8 14:00 to 2000/8/9 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	10.91	178.00	24.02	97.84	5.53	24.11	100.00	95.53	10.70	190.30
M2	9.02	340.40	29.69	230.95	353.71	29.86	229.16	83.71	8.46	319.16
M4	2.86	173.00	0.76	109.63	82.81	2.88	171.31	172.81	0.67	261.31
Steady component	-6.15 (cm/s)		-8.46 (cm/s)		216.01 (degree)			10.46 (cm/s)		

Layer:Lower
Observed period:2000/8/8 14:00 to 2000/8/9 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	11.58	204.30	14.46	111.54	353.95	14.49	106.71	83.95	11.54	196.71
M2	5.99	287.55	24.69	202.13	1.18	24.70	202.41	91.18	5.96	292.41
M4	2.99	209.81	3.02	336.48	315.58	3.80	2.68	45.58	1.91	272.68
Steady component	-5.46 (cm/s)		-3.25 (cm/s)		239.28 (degree)			6.36 (cm/s)		

Table 3.1.14 Harmonic Constants (P20, Neap Tide, Rainy Season)

Layer:Upper
Observed period:2000/8/8 13:00 to 2000/8/9 14:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	6.85	194.55	21.81	55.66	346.15	22.43	52.91	76.15	4.38	142.91
M2	15.03	10.85	27.93	231.80	335.58	30.40	224.10	65.58	9.05	314.10
M4	2.56	324.46	4.17	358.82	29.21	4.72	350.24	119.21	1.27	260.24
Steady component	5.09 (cm/s)		-26.45 (cm/s)		169.11 (degree)			26.93 (cm/s)		

Layer:Middle
Observed period:2000/8/8 13:00 to 2000/8/9 14:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	7.29	207.12	17.74	44.11	338.30	19.08	41.75	68.30	1.98	131.75
M2	9.23	351.34	26.69	206.65	343.68	27.77	203.55	73.68	5.12	293.55
M4	4.03	134.02	4.57	340.39	319.01	5.93	328.98	49.01	1.38	58.98
Steady component	2.36 (cm/s)		-1.91 (cm/s)		128.91 (degree)			3.04 (cm/s)		

Layer:Lower
Observed period:2000/8/8 13:00 to 2000/8/9 14:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.36	209.71	9.24	357.78	342.29	9.68	0.98	72.29	1.70	270.98
M2	3.58	4.16	17.15	184.18	348.22	17.52	184.18	78.22	0.00	274.18
M4	1.23	287.92	0.82	311.15	57.32	1.46	294.80	147.32	0.27	204.80
Steady component	2.73 (cm/s)		-1.09 (cm/s)		111.84 (degree)			2.94 (cm/s)		

Table 3.1.15 Harmonic Constants (P01, Spring Tide, Dry Season)

Layer:Upper
Observed period:2000/12/13 20:00 to 2000/12/14 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	44.77	46.23	40.84	223.12	312.37	60.58	224.82	42.37	1.64	134.82
M2	60.08	74.46	53.38	253.21	311.62	80.37	253.91	41.62	0.87	163.91
M4	1.97	68.18	7.88	257.47	346.12	8.12	256.93	76.12	0.31	346.93
Steady component	27.90 (cm/s)		-19.96 (cm/s)		125.57 (degree)			34.31 (cm/s)		

Layer:Middle
Observed period:2000/12/13 20:00 to 2000/12/14 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	39.47	46.11	48.48	230.39	320.87	62.47	228.68	50.87	2.28	318.68
M2	51.28	69.22	72.98	246.09	324.92	89.16	247.12	54.92	2.29	157.12
M4	6.38	117.71	6.15	302.94	313.92	8.85	300.22	43.92	0.40	30.22
Steady component	3.97 (cm/s)		4.85 (cm/s)		39.31 (degree)			6.27 (cm/s)		

Layer:Lower
Observed period:2000/12/13 20:00 to 2000/12/14 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	33.22	45.97	44.53	228.57	323.29	55.54	227.64	53.29	1.21	317.64
M2	50.74	64.34	70.95	237.94	324.48	87.11	240.10	54.48	4.61	150.10
M4	6.25	109.04	8.78	322.04	326.24	10.39	311.55	56.24	2.88	41.55
Steady component	-7.92 (cm/s)		11.80 (cm/s)		326.12 (degree)			14.21 (cm/s)		

Table 3.1.16 Harmonic Constants (P11, Spring Tide, Dry Season)

Layer:Upper
Observed period:2000/12/13 20:00 to 2000/12/14 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	8.11	82.61	45.13	207.63	353.98	45.38	208.51	83.98	6.61	118.51
M2	11.35	344.73	49.17	201.59	349.34	50.01	200.15	79.34	6.69	290.15
M4	5.70	189.83	15.20	257.52	9.17	15.37	254.39	99.17	5.22	164.39
Steady component	-17.12 (cm/s)		-28.11 (cm/s)		211.34 (degree)			32.91 (cm/s)		

Layer:Middle
Observed period:2000/12/13 20:00 to 2000/12/14 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	8.05	122.22	54.10	207.82	0.67	54.11	207.72	90.67	8.02	117.72
M2	7.55	265.30	52.90	199.20	3.37	52.99	199.64	93.37	6.89	289.64
M4	5.93	145.94	12.66	272.90	342.09	13.28	279.23	72.09	4.54	189.23
Steady component	-11.59 (cm/s)		-10.37 (cm/s)		228.19 (degree)			15.56 (cm/s)		

Layer:Lower
Observed period:2000/12/13 20:00 to 2000/12/14 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	7.03	47.41	53.58	209.52	352.87	53.99	209.81	82.87	2.14	119.81
M2	7.22	358.61	47.13	201.82	351.96	47.59	201.34	81.96	2.82	291.34
M4	1.97	98.37	12.70	244.65	353.29	12.79	245.17	83.29	0.98	155.17
Steady component	-8.17 (cm/s)		-16.80 (cm/s)		205.93 (degree)			18.68 (cm/s)		

Table 3.1.17 Harmonic Constants (P12, Spring Tide, Dry Season)

Layer:Upper
Observed period:200012/12 15:00 to 2000/12/13 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	11.57	6.26	23.97	204.98	334.99	26.40	201.57	64.99	3.37	291.57
M2	14.47	9.21	39.93	200.93	340.37	42.38	199.59	70.37	2.77	289.59
M4	8.10	64.38	10.35	205.54	323.83	12.44	219.48	53.83	4.22	129.48
Steady component	5.85 (cm/s)		-7.38 (cm/s)		141.59 (degree)			9.41 (cm/s)		

Layer:Middle
Observed period:200012/12 15:00 to 2000/12/13 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	6.61	325.83	29.27	196.69	351.64	29.58	195.25	81.64	5.07	285.25
M2	5.99	1.29	51.88	206.71	354.04	52.16	206.42	84.04	2.56	296.64
M4	4.49	64.56	11.36	212.84	340.72	12.01	216.56	70.72	2.23	126.56
Steady component	-3.31 (cm/s)		5.72 (cm/s)		329.94 (degree)			6.61 (cm/s)		

Layer:Lower
Observed period:200012/12 15:00 to 2000/12/13 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.82	336.53	26.01	198.37	353.69	26.16	197.75	83.69	2.54	287.75
M2	7.88	41.00	45.90	201.67	350.77	46.50	202.18	80.77	2.57	112.18
M4	3.43	49.28	10.51	209.35	342.76	10.99	211.16	72.76	1.12	121.16
Steady component	-2.51 (cm/s)		10.25 (cm/s)		346.22 (degree)			10.56 (cm/s)		

Table 3.1.18 Harmonic Constants (P19, Spring Tide, Dry Season)

Layer:Upper
Observed period:2000/12/12 15:00 to 2000/12/13 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	1.29	331.99	21.30	188.95	357.23	21.33	188.85	87.23	0.77	278.85
M2	7.16	230.99	40.49	195.99	8.32	40.92	196.82	98.32	4.06	286.82
M4	5.15	157.09	10.96	167.53	24.94	12.08	165.66	114.94	0.85	75.66
Steady component	-7.11 (cm/s)		-25.42 (cm/s)		194.05 (degree)			29.29 (cm/s)		

Layer:Middle
Observed period:2000/12/12 15:00 to 2000/12/13 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	6.66	268.55	22.83	187.88	2.96	22.86	188.74	92.96	6.57	278.74
M2	10.04	203.68	38.83	187.54	14.02	40.01	188.50	104.02	2.70	278.50
M4	3.16	213.76	14.29	182.42	10.82	14.54	183.62	100.82	1.61	273.62
Steady component	-9.27 (cm/s)		-20.13 (cm/s)		204.72 (degree)			22.16 (cm/s)		

Layer:Lower
Observed period:2000/12/12 15:00 to 2000/12/13 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	9.44	330.90	27.95	201.71	347.13	28.63	198.44	77.13	7.15	288.44
M2	5.82	310.16	50.72	189.16	356.59	50.81	188.83	86.59	4.98	278.83
M4	2.17	232.82	10.91	170.51	5.44	10.96	171.46	95.44	1.91	261.46
Steady component	-7.28 (cm/s)		-14.24 (cm/s)		207.08 (degree)			15.99 (cm/s)		

Table 3.1.19 Harmonic Constants (P20, Spring Tide, Dry Season)

Layer:Upper
Observed period:2000/12/11 11:00 to 2000/12/12 11:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	23.55	69.42	61.90	244.88	339.22	66.21	245.45	69.22	1.74	155.45
M2	18.98	48.27	56.73	249.55	342.47	59.45	247.55	72.47	6.57	337.55
M4	5.36	131.75	5.34	331.94	314.91	7.45	321.82	44.91	1.33	51.82
Steady component	0.38 (cm/s)		-19.31 (cm/s)		178.86 (degree)			19.32 (cm/s)		

Layer:Middle
Observed period:2000/12/11 11:00 to 2000/12/12 11:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	8.49	65.64	58.23	232.56	351.91	58.82	232.83	81.91	1.90	142.83
M2	13.86	31.24	64.74	243.28	349.59	65.81	242.12	79.59	7.23	332.12
M4	6.55	103.75	8.61	312.63	323.77	10.51	302.37	53.77	2.59	32.37
Steady component	-2.56 (cm/s)		-4.45 (cm/s)		209.89 (degree)			5.13 (cm/s)		

Layer:Lower
Observed period:2000/12/11 11:00 to 2000/12/12 11:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	12.37	36.83	50.35	227.88	346.41	51.80	227.27	76.41	2.31	317.27
M2	13.95	40.87	59.79	235.48	347.24	61.30	234.75	77.24	3.43	324.75
M4	4.92	107.69	6.88	316.66	325.70	8.22	307.27	55.70	1.99	37.27
Steady component	0.32 (cm/s)		-0.30 (cm/s)		132.99 (degree)			0.44 (cm/s)		

Table 3.1.20 Harmonic Constants (P22, Spring Tide, Dry Season)

Layer:Upper
Observed period:2000/12/11 11. 00 to 2000/12/12 11:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	5.24	77.61	16.43	223.55	344.77	17.01	226.15	74.77	2.83	136.15
M2	14.08	6.62	19.18	219.81	325.28	22.91	208.76	55.28	6.46	298.76
M4	3.66	169.42	4.42	298.48	323.47	5.21	317.41	53.47	2.41	227.41
Steady component	-21.33 (cm/s)		-16.08 (cm/s)		232.99 (degree)			26.72 (cm/s)		

Layer:Middle
Observed period:2000/12/11 11. 00 to 2000/12/12 11:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	2.25	50.17	18.68	215.41	353.35	18.81	215.62	83.35	0.57	125.62
M2	11.58	5.08	33.57	218.90	243.48	34.97	215.89	73.48	6.19	305.89
M4	3.37	131.56	2.05	274.70	298.53	3.79	302.64	28.53	1.09	212.64
Steady component	-19.64 (cm/s)		-4.01 (cm/s)		258.46 (degree)			20.05 (cm/s)		

Layer:Lower
Observed period:2000/12/11 11. 00 to 2000/12/12 11:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	1.20	24.02	15.72	211.46	355.68	15.76	211.41	85.68	0.15	301.41
M2	11.12	11.45	30.85	214.35	341.33	32.54	211.91	71.33	4.10	301.91
M4	4.13	92.87	1.58	326.16	284.07	4.25	277.02	14.07	1.23	7.02
Steady component	-14.15 (cm/s)		-1.63 (cm/s)		263.45 (degree)			14.24 (cm/s)		

Table 3.1.21 Harmonic Constants (P01, Neap Tide, Dry Season)

Layer:Upper
Observed period:2000/12/07 20:00 to 2000/12/08 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	19.83	132.54	23.01	302.68	319.32	30.27	306.87	49.32	2.58	216.87
M2	64.10	119.53	66.36	309.02	316.00	91.95	304.44	46.00	7.63	34.44
M4	12.51	311.99	10.24	209.91	293.03	12.95	149.58	23.03	9.67	239.58
Steady component	20.56 (cm/s)		-5.85 (cm/s)		105.88 (degree)			21.38 (cm/s)		1

Layer:Middle
Observed period:2000/12/07 20:00 to 2000/12/08 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	18.68	104.07	27.46	293.51	325.91	33.11	290.54	55.91	2.54	20.54
M2	62.46	106.06	81.95	288.53	322.69	103.01	287.62	52.69	2.14	17.62
M4	8.19	266.22	13.17	92.70	328.21	15.49	90.90	58.21	0.79	180.90
Steady component	-4.45 (cm/s)		2.42 (cm/s)		298.58 (degree)			5.06 (cm/s)		

Layer:Lower
Observed period:2000/12/07 20:00 to 2000/12/08 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	20.80	112.79	32.32	281.08	327.46	38.27	284.48	57.46	3.56	194.48
M2	58.29	99.01	81.65	279.23	324.48	100.32	279.16	54.48	0.18	9.16
M4	6.97	261.05	17.21	107.71	339.54	18.33	104.29	69.54	2.94	194.29
Steady component	-5.01 (cm/s)		10.18 (cm/s)		333.78 (degree)			11.35 (cm/s)		

Table 3.1.22 Harmonic Constants (P11; Neap Tide, Dry Season)

Layer:Upper
Observed period:2000/12/7 20:00 to 2000/12/8 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	11.12	322.60	30.24	282.14	16.45	31.47	285.87	106.45	6.93	15.87
M2	20.32	341.25	58.89	259.01	3.02	58.96	260.04	93.02	20.11	350.04
M4	3.90	296.69	7.97	71.33	338.91	8.48	78.10	68.91	2.61	348.10
Steady component	-5.71 (cm/s)		-6.08 (cm/s)		223.18 (degree)			8.34 (cm/s)		

Layer:Middle
Observed period:2000/12/7 20:00 to 2000/12/8 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	7.68	126.73	13.89	277.67	332.85	15.52	283.97	62.85	3.43	193.97
M2	5.44	116.23	38.80	241.59	355.30	38.93	242.13	85.30	4.42	152.13
M4	0.88	330.72	8.44	46.41	1.49	8.44	46.26	91.49	0.85	316.26
Steady component	-5.63 (cm/s)		-0.59 (cm/s)		264.00 (degree)			5.66 (cm/s)		

Layer:Lower
Observed period:2000/12/7 20:00 to 2000/12/8 20:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	8.86	128.32	13.05	269.94	328.43	15.04	280.98	58.43	4.78	190.98
M2	6.82	121.47	35.84	237.55	355.08	35.97	238.39	85.08	6.10	148.39
M4	1.37	319.16	8.98	40.82	1.29	8.99	40.63	91.29	1.35	310.63
Steady component	-8.03 (cm/s)		-0.38 (cm/s)		267.32 (degree)			8.04 (cm/s)		

Table 3.1:23 Harmonic Constants (P12, Neap Tide, Dry Season)

Layer:Upper
Observed period:2000/12/6 15:00 to 2000/12/7 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	3.01	12.28	17.81	295.56	2.28	17.83	295.94	92.28	2.93	25.94
M2	12.07	73.38	34.75	249.18	340.88	36.77	249.63	70.88	0.84	159.63
M4	4.14	161.59	3.15	306.74	305.67	4.98	329.43	35.67	1.50	239.43
Steady component	10.26 (cm/s)		-8.73 (cm/s)		130.39 (degree)			13.47 (cm/s)		

Layer:Middle
Observed period:2000/12/6 15:00 to 2000/12/7 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	6.24	96.84	12.68	296.24	334.60	14.01	292.60	64.60	1.88	22.60
M2	6.18	48.35	34.68	233.38	349.98	35.40	233.23	79.98	0.53	323.23
M4	1.14	317.28	4.32	305.02	14.45	4.47	305.79	104.45	0.23	35.79
Steady component	-4.28 (cm/s)		1.95 (cm/s)		294.44 (degree)			4.70 (cm/s)		

Layer:Lower
Observed period:2000/12/6 15:00 to 2000/12/7 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	5.07	100.50	10.46	305.44	335.53	11.46	301.01	65.53	1.95	31.01
M2	6.29	58.66	30.34	225.09	348.57	30.95	225.63	78.57	1.45	135.63
M4	3.08	33.09	3.62	283.62	327.84	3.93	260.41	57.84	2.68	350.41
Steady component	-1.62 (cm/s)		2.71 (cm/s)		329.04 (degree)			3.16 (cm/s)		

Table 3.1.24 Harmonic Constants (P19, Neap Tide, Dry Season)

Layer:Upper
Observed period:2000/12/6 15:00 to 2000/12/7 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	13.17	29.62	22.62	316.64	13.64	23.08	324.04	103.64	12.34	54.04
M2	7.41	325.94	32.19	258.22	5.22	32.32	259.33	95.22	6.83	349.33
M4	2.25	28.99	5.30	284.57	352.79	5.34	281.64	82.79	2.16	11.64
Steady component	-12.26 (cm/s)		-19.79 (cm/s)		211.77 (degree)			23.28 (cm/s)		

Layer:Middle
Observed period:2000/12/6 15:00 to 2000/12/7 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	7.94	141.88	6.15	3.54	305.46	9.44	336.44	35.46	3.44	66.44
M2	3.43	345.41	22.63	225.04	355.54	22.70	224.46	85.54	2.95	314.46
M4	3.94	333.94	5.17	225.69	335.64	5.44	209.21	65.64	3.56	299.21
Steady component	-0.76 (cm/s)		1.36 (cm/s)		330.87 (degree)			1.56 (cm/s)		

Layer:Lower
Observed period:2000/12/6 15:00 to 2000/12/7 15:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	4.76	172.60	6.41	321.77	324.66	7.72	332.30	54.66	2.03	242.30
M2	4.55	305.16	22.69	210.39	359.01	22.70	210.20	89.01	4.53	300.20
M4	3.60	346.21	4.77	270.61	20.63	4.93	285.04	110.63	3.37	15.04
Steady component	0.67 (cm/s)		4.14 (cm/s)		9.23 (degree)			4.20 (cm/s)		

Table 3.1.25 Harmonic Constants (P20, Neap Tide, Dry Season)

Layer:Upper
Observed period:2000/12/5 10:00 to 2000/12/6 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	5.93	161.85	18.60	347.19	342.38	19.51	346.70	72.38	0.53	76.70
M2	4.20	18.80	20.54	231.15	350.10	20.85	230.09	80.10	2.21	320.09
M4	1.98	37.63	0.20	319.13	88.85	1.98	37.52	178.85	0.19	127.52
Steady component	-2.23 (cm/s)		4.94 (cm/s)		335.75 (degree)			5.42 (cm/s)		

Layer:Middle
Observed period:2000/12/5 10:00 to 2000/12/6 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	5.86	126.40	16.67	331.39	341.97	17.51	328.88	71.91	2.36	58.88
M2	5.52	5.72	25.91	228.34	350.91	26.23	227.05	80.91	3.69	317.05
M4	1.59	48.42	3.40	320.69	1.36	3.40	321.33	91.36	1.59	51.33
Steady component	-1.96 (cm/s)		5.60 (cm/s)		340.73 (degree)			5.94 (cm/s)		

Layer:Lower
Observed period:2000/12/5 10:00 to 2000/12/6 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	4.44	120.37	12.94	324.45	342.33	13.58	322.13	72.33	1.73	52.13
M2	5.40	5.90	22.36	225.17	349.17	22.76	223.55	79.17	3.36	313.55
M4	1.69	60.15	2.85	303.03	340.07	2.98	293.14	70.07	1.43	23.14
Steady component	0.86 (cm/s)		4.26 (cm/s)		11.38 (degree)			4.35 (cm/s)		

Table 3.1:26 Harmonic Constants (P22, Neap Tide, Dry Season)

Layer:Upper
Observed period:2000/12/05 10:00 to 2000/12/06 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	6.36	143.14	5.66	1.18	310.77	8.06	339.56	40.77	2.75	69.56
M2	7.14	44.44	5.70	232.52	308.52	9.11	227.58	38.52	0.63	317.58
M4	2.54	323.22	0.08	177.21	271.59	2.54	143.25	1.59	0.05	233.25
Steady component	-7.68 (cm/s)		-5.94 (cm/s)		232.29 (degree)			9.71 (cm/s)		

Layer:Middle
Observed period:2000/12/05 10:00 to 2000/12/06 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	5.07	99.99	11.90	318.90	340.48	12.58	314.05	70.48	3.01	44.05
M2	5.88	343.50	14.19	210.90	342.94	14.79	205.97	72.94	4.16	295.97
M4	2.30	44.04	1.73	288.54	298.17	2.49	241.28	28.17	1,44	331.28
Steady component	-6.57 (cm/s)		2.75 (cm/s)		292.74 (degree)			7.13 (cm/s)		

Layer:Lower
Observed period:2000/12/05 10:00 to 2000/12/06 10:00

Constituent	East component		North component		Component of ellipse					
					Long axis			Short axis		
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
M1	2.55	96.93	9.55	316.00	347.99	9.76	314.04	77.99	1.57	44.04
M2	5.40	335.72	11.96	209.66	343.12	12.43	203.80	73.12	4.20	293.80
M4	1.75	58.21	1.46	314.84	295.72	1.83	257.86	25.72	1.36	347.86
Steady component	-4.05 (cm/s)		1.94 (cm/s)		295.64 (degree)			4.49 (cm/s)		

Table 3.1.27(1) Harmonic Constants (ADCP, P11, no.1: 0.0m and 0.5m: from 3 to 27 Dec. 2000)

0.0m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	2.8	169	35.9	121	3	35.9	121	93	2.1	211	35.4	120
O1	8.8	293	17.2	78	336	18.8	84	66	4.6	354	17.9	80
P1	0.9	169	11.9	121	3	12.0	121	93	0.7	211	11.8	120
Q1	1.4	262	4.8	29	349	4.9	31	79	1.1	301	4.9	30
M2	10.1	147	56.4	5	352	57.0	4	82	6.1	94	57.0	4
S2	3.4	174	23.3	355	352	23.5	355	82	0.0	85	23.5	355
N2	0.3	83	11.8	342	360	11.8	342	90	0.3	72	11.7	342
K2	0.9	174	6.3	355	352	6.4	355	82	0.0	85	6.4	355
M4	3.2	26	4.9	227	328	5.8	221	58	1.0	311	5.2	225
MS4	1.6	63	5.5	241	344	5.7	241	74	0.1	151	5.6	241
Steady component	-2.0 (cm/s)		-26.3 (cm/s)		184 (degree)			26.4 (cm/s)			-25.9 (cm/s)	

0.5m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	5.5	223	36.6	117	357	36.6	116	87	5.3	206	36.5	116
O1	7.3	297	19.7	77	343	20.5	81	73	4.5	351	20.2	79
P1	1.8	223	12.2	117	357	12.2	116	87	1.8	206	12.2	116
Q1	0.6	276	5.0	47	356	5.0	47	86	0.4	317	5.0	47
M2	10.6	136	58.7	5	353	59.1	4	83	8.0	94	59.1	5
S2	2.1	171	22.6	354	355	22.7	354	85	0.1	84	22.7	354
N2	0.9	181	12.7	350	356	12.7	350	86	0.2	260	12.7	350
K2	0.6	171	6.1	354	355	6.2	354	85	0.0	84	6.2	354
M4	3.0	24	4.4	232	327	5.2	224	57	1.2	314	4.7	230
MS4	1.8	77	5.1	236	342	5.3	238	72	0.6	148	5.2	237
Steady component	0.3 (cm/s)		-18.9 (cm/s)		179 (degree)			18.9 (cm/s)			18.8 (cm/s)	

Table 3.1.27(2) Harmonic Constants (ADCP, P11, no.2: 1.0m and 1.5m: from 3 to 27 Dec. 2000)

1.0m

Constituent	East component		North component		Component of ellipse						Main Direction	
					Long axis			Short axis			353 (degree)	
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	5.8	241	36.9	116	355	37.1	115	85	4.7	205	37.1	115
O1	6.3	294	19.9	79	345	20.5	82	75	3.5	352	20.3	82
P1	1.9	241	12.3	116	355	12.4	115	85	1.6	205	12.3	115
Q1	0.1	348	5.2	53	0	5.2	53	90	0.1	323	5.2	53
M2	10.6	132	58.8	4	354	59.2	3	84	8.4	93	59.2	3
S2	1.8	163	22.4	351	356	22.4	351	86	0.3	81	22.4	351
N2	1.1	173	12.3	354	355	12.4	354	85	0.0	84	12.4	354
K2	0.5	163	6.1	351	356	6.1	351	86	0.1	81	6.1	351
M4	3.2	22	4.3	238	326	5.1	226	56	1.5	316	4.6	235
MS4	1.8	81	4.7	231	341	5.0	235	71	0.8	145	4.9	233
Steady component	0.7 (cm/s)		-14.5 (cm/s)		177 (degree)			14.6 (cm/s)			-14.5 (cm/s)	

1.5m

Constituent	East component		North component		Component of ellipse						Main Direction	
					Long axis			Short axis			353 (degree)	
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	5.7	262	36.2	115	352	36.5	114	82	3.0	204	36.5	114
O1	5.6	290	19.7	80	346	20.3	82	76	2.7	352	20.2	81
P1	1.9	262	12.1	115	352	12.2	114	82	1.0	204	12.2	114
Q1	0.1	288	5.7	57	360	5.7	57	90	0.1	327	5.7	57
M2	10.4	131	57.8	3	354	58.2	2	84	8.2	92	58.2	2
S2	1.6	173	21.3	350	356	21.3	350	86	0.1	260	21.3	350
N2	1.3	169	12.1	355	354	12.2	355	84	0.1	85	12.2	355
K2	0.4	173	5.8	350	356	5.8	350	86	0.0	260	5.8	350
M4	3.2	24	4.4	243	326	5.2	230	56	1.7	320	4.7	240
MS4	1.7	85	4.6	230	342	4.8	233	72	0.9	143	4.7	231
Steady component	0.8 (cm/s)		-10.9 (cm/s)		176 (degree)			10.9 (cm/s)			-10.9 (cm/s)	

Table 3.1.27(3) Harmonic Constants (ADCP, P11, no.3: 2.0m and 2.5m: from 3 to 27 Dec. 2000)

2.0m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	5.9	282	35.4	114	351	35.9	114	81	1.2	204	35.9	114
O1	5.0	283	19.8	80	347	20.4	82	77	1.9	352	20.3	81
P1	2.0	282	11.8	114	351	11.9	114	81	0.4	204	11.9	114
Q1	0.2	175	6.0	63	359	6.0	63	89	0.2	153	5.9	63
M2	9.8	133	56.9	2	353	57.3	1	83	7.3	91	57.3	1
S2	1.8	191	19.9	349	355	20.0	349	85	0.7	259	20.0	349
N2	1.4	172	11.8	355	353	11.9	355	83	0.1	85	11.9	355
K2	0.5	191	5.4	349	355	5.4	349	85	0.2	259	5.4	349
M4	3.1	17	4.5	244	330	5.1	231	60	2.0	321	4.7	240
MS4	1.6	79	4.5	228	342	4.7	231	72	0.8	141	4.6	229
Steady component	0.3 (cm/s)		-7.8 (cm/s)		178 (degree)			7.8 (cm/s)			-7.7 (cm/s)	

2.5m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	6.5	297	34.7	114	349	35.3	114	79	0.3	24	35.3	114
O1	4.8	278	19.8	80	347	20.3	81	77	1.4	351	20.3	81
P1	2.2	297	11.6	114	349	11.8	114	79	0.1	24	11.8	114
Q1	0.8	185	6.0	69	357	6.0	68	87	0.7	158	6.0	68
M2	8.9	138	55.3	360	353	55.7	359	83	5.9	89	55.6	359
S2	2.0	206	18.5	349	355	18.6	349	85	1.2	259	18.5	349
N2	1.3	180	11.4	356	353	11.5	356	83	0.1	266	11.5	356
K2	0.5	206	5.0	349	355	5.1	349	85	0.3	259	5.0	349
M4	2.9	14	4.9	243	335	5.4	233	65	2.0	323	5.2	239
MS4	1.6	78	4.0	226	341	4.2	230	71	0.8	140	4.1	228
Steady component	-0.2 (cm/s)		-5.1 (cm/s)		182 (degree)			5.1 (cm/s)			-5.0 (cm/s)	

Table 3.1.27(4) Harmonic Constants (ADCP, P11, no.4: 3.0m and 3.5m: from 3 to 27 Dec. 2000)

3.0m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	7.4	308	33.9	114	348	34.6	114.0	78	1.8	24	34.6	114
O1	4.6	275	19.6	81	347	20.1	81.0	77	1.1	351	20.1	81
P1	2.5	308	11.3	114	348	11.5	114.0	78	0.6	24	11.5	114
Q1	1.5	185	5.8	71	354	5.8	69.0	84	1.3	159	5.8	69
M2	8.1	145	53.0	358	353	53.4	358	83	4.3	88	53.4	357
S2	2.2	211	17.5	349	355	17.6	349	85	1.5	259	17.6	350
N2	1.4	175	11.3	356	353	11.3	356	83	0.0	86	11.3	356
K2	0.6	211	4.8	349	355	4.8	349	85	0.4	259	4.8	350
M4	2.5	11	5.3	241	341	5.6	234	71	1.8	324	5.5	238
MS4	1.4	54	3.5	225	338	3.8	226	68	0.2	136	3.7	226
Steady component	-1.1 (cm/s)		-2.3 (cm/s)		204 (degree)			2.6 (cm/s)			-2.2 (cm/s)	

3.5m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	8.2	312	32.8	114	347	33.7	115	77	2.5	25	33.6	114
O1	4.6	274	18.8	80	347	19.3	81	77	1.1	351	19.3	81
P1	2.7	312	10.9	114	347	11.2	115	77	0.9	25	11.2	114
Q1	1.7	199	5.4	71	348	5.5	68	78	1.3	158	5.5	68
M2	6.9	153	49.9	356	353	50.3	356	83	2.7	86	50.3	356
S2	2.3	209	16.6	347	354	16.7	348	84	1.5	258	16.6	348
N2	1.7	186	11.1	356	351	11.3	357	81	0.3	267	11.3	357
K2	0.6	209	4.5	347	354	4.5	348	84	0.4	258	4.5	348
M4	2.4	11	5.2	236	340	5.5	230	70	1.6	320	5.4	233
MS4	1.4	32	3.0	216	336	3.3	217	66	0.1	307	3.2	217
Steady component	-1.8 (cm/s)		0.4 (cm/s)		284 (degree)			1.9 (cm/s)			0.7 (cm/s)	

Table 3.1.27(5) Harmonic Constants (ADCP, P11, no.5: 4.0m and 4.5m: from 3 to 27 Dec. 2000)

4.0m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	9.0	313	32.1	114	345	33.2	115	75	3.0	25	33.1	114
O1	4.6	273	18.8	79	347	19.3	80	77	1.1	350	19.3	80
P1	3.0	313	10.7	114	345	11.1	115	75	1.0	25	11.0	114
Q1	2.0	208	4.9	74	343	5.1	69	73	1.4	159	5.1	71
M2	6.2	169	46.9	355	353	47.3	355	83	0.6	85	47.2	355
S2	2.4	197	15.6	348	352	15.8	349	82	1.1	259	15.8	349
N2	1.9	186	11.0	358	350	11.2	358	80	0.3	268	11.2	358
K2	0.6	197	4.3	348	352	4.3	349	82	0.3	259	4.3	349
M4	2.2	12	5.5	233	342	5.8	228	72	1.4	318	5.7	230
MS4	1.0	19	2.8	222	341	2.9	220	71	0.4	310	2.9	221
Steady component	-2.4 (cm/s)		2.5 (cm/s)		316 (degree)			3.5 (cm/s)			2.9 (cm/s)	

4.5m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	9.5	312	31.2	113	344	32.4	115	74	3.0	25	32.3	114
O1	4.3	270	18.3	81	347	18.8	81	77	0.7	351	18.8	81
P1	3.2	312	10.4	113	344	10.8	115	74	1.0	25	10.8	114
Q1	1.8	213	4.4	68	341	4.7	64	71	0.9	154	4.6	66
M2	6.4	187	43.6	354	352	44.0	354	82	1.5	264	44.0	354
S2	2.3	194	15.0	350	352	15.1	350	82	0.9	260	15.1	350
N2	1.9	184	10.8	356	350	11.0	356	80	0.2	266	11.0	356
K2	0.6	194	4.1	350	352	4.1	350	82	0.2	260	4.1	350
M4	2.1	14	5.2	228	341	5.6	224	71	1.1	314	5.5	226
MS4	1.0	5	2.9	222	344	3.0	219	74	0.6	309	3.0	220
Steady component	-3.0 (cm/s)		4.0 (cm/s)		323 (degree)			5.1 (cm/s)			4.5 (cm/s)	

Table 3.1.27(6) Harmonic Constants (ADCP, P11, no.6: 5.0m and 5.5m: from 3 to 27 Dec. 2000)

5.0m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	9.5	310	28.9	113	342	30.3	115	72	2.6	25	30.1	114
O1	4.1	268	16.8	79	346	17.3	79	76	0.6	349	17.3	79
P1	3.2	310	9.6	113	342	10.1	115	72	0.9	25	10.0	114
Q1	1.3	206	4.3	70	347	4.4	67	77	0.9	157	4.4	67
M2	6.9	198	40.4	351	351	40.9	352	81	3.1	262	40.8	352
S2	2.2	187	14.2	351	351	14.3	352	81	0.6	262	14.3	352
N2	2.2	178	9.9	359	348	10.1	359	78	0.0	89	10.1	359
K2	0.6	187	3.8	351	351	3.9	352	81	0.2	262	3.9	352
M4	1.9	4	5.4	218	343	5.6	215	73	1.0	305	5.6	216
MS4	1.2	357	2.6	215	338	2.8	209	68	0.7	299	2.8	212
Steady component	-3.3 (cm/s)		5.0 (cm/s)		326 (degree)			6.0 (cm/s)			5.5 (cm/s)	

5.5m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	9.6	306	28.6	111	342	30.1	113	72	2.3	23	30.0	112
O1	3.9	261	17.0	81	347	17.4	81	77	0.0	351	17.4	81
P1	3.2	306	9.5	111	342	10.0	113	72	0.8	23	10.0	112
Q1	1.1	198	3.8	65	348	3.9	62	78	0.8	152	3.9	62
M2	7.9	205	39.0	352	350	39.5	353	80	4.2	263	39.5	354
S2	2.1	196	12.7	1	351	12.9	1	81	0.6	271	12.9	1
N2	2.3	176	9.7	357	347	10.0	357	77	0.0	87	10.0	357
K2	0.6	196	3.5	1	351	3.5	1	81	0.2	271	3.5	1
M4	1.7	357	5.3	224	347	5.4	221	77	1.2	311	5.4	221
MS4	1.1	350	2.4	228	344	2.5	222	74	0.9	312	2.5	223
Steady component	-3.6 (cm/s)		4.6 (cm/s)		322 (degree)			5.8 (cm/s)			5.3 (cm/s)	

Table 3.1.27(7) Harmonic Constants (ADCP, P11, no.7: 6.0m and 6.5m: from 3 to 27 Dec. 2000)

6.0m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	9.6	306	24.2	109	339	25.9	111	69	2.7	21	25.7	110
O1	4.0	263	14.1	74	344	14.6	74	74	0.6	344	14.6	74
P1	3.2	306	8.1	109	339	8.6	111	69	0.9	21	8.6	110
Q1	0.8	214	2.9	66	347	3.0	64	77	0.4	154	3.0	64
M2	8.8	209	35.5	346	349	36.1	348	79	5.9	258	36.1	349
S2	2.1	198	13.0	351	352	13.1	351	82	0.9	261	13.0	352
N2	2.4	178	8.7	355	345	9.0	355	75	0.1	265	9.0	355
K2	0.6	198	3.5	351	352	3.6	351	82	0.3	261	3.5	352
M4	1.3	357	5.8	198	348	5.9	197	78	0.5	287	5.9	197
MS4	1.1	341	3.9	202	347	4.0	199	77	0.7	289	4.0	199
Steady component	-3.2 (cm/s)		6.0 (cm/s)		332 (degree)			6.8 (cm/s)			6.6 (cm/s)	

6.5m

Constituent	East component		North component		Component of ellipse						Main Direction 353 (degree)	
					Long axis			Short axis				
	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Direction (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)	Amplitude of velocity (cm/s)	Phase lag (degree)
K1	10.3	308	20.7	105	335	22.9	109	65	3.6	19	22.4	107
O1	4.5	270	12.9	64	342	13.5	67	72	1.9	337	13.5	66
P1	3.4	308	6.9	105	335	7.6	109	65	1.2	19	7.5	107
Q1	0.7	196	2.5	72	351	2.5	70	81	0.6	160	2.5	68
M2	10.1	219	33.9	342	350	34.3	344	80	8.4	254	34.2	345
S2	2.2	210	12.3	344	353	12.4	345	83	1.5	255	12.3	345
N2	2.8	181	7.4	348	339	7.9	350	69	0.6	260	7.8	349
K2	0.6	210	3.3	344	353	3.4	345	83	0.4	255	3.4	346
M4	0.8	279	4.9	181	359	4.9	181	89	0.8	271	4.8	179
MS4	1.5	324	4.0	178	342	4.2	174	72	0.8	264	4.2	175
Steady component	-2.4 (cm/s)		7.6 (cm/s)		343 (degree)			8.0 (cm/s)			8.0 (cm/s)	

Table 3.1.28(1) Harmonic Constants

(ADCP, P19, no.1: from 0.5m and 6.0m: from 5 to 6 March 2001)

Observed period : 2001/03/05 00:00 to 2001/03/06 00:00

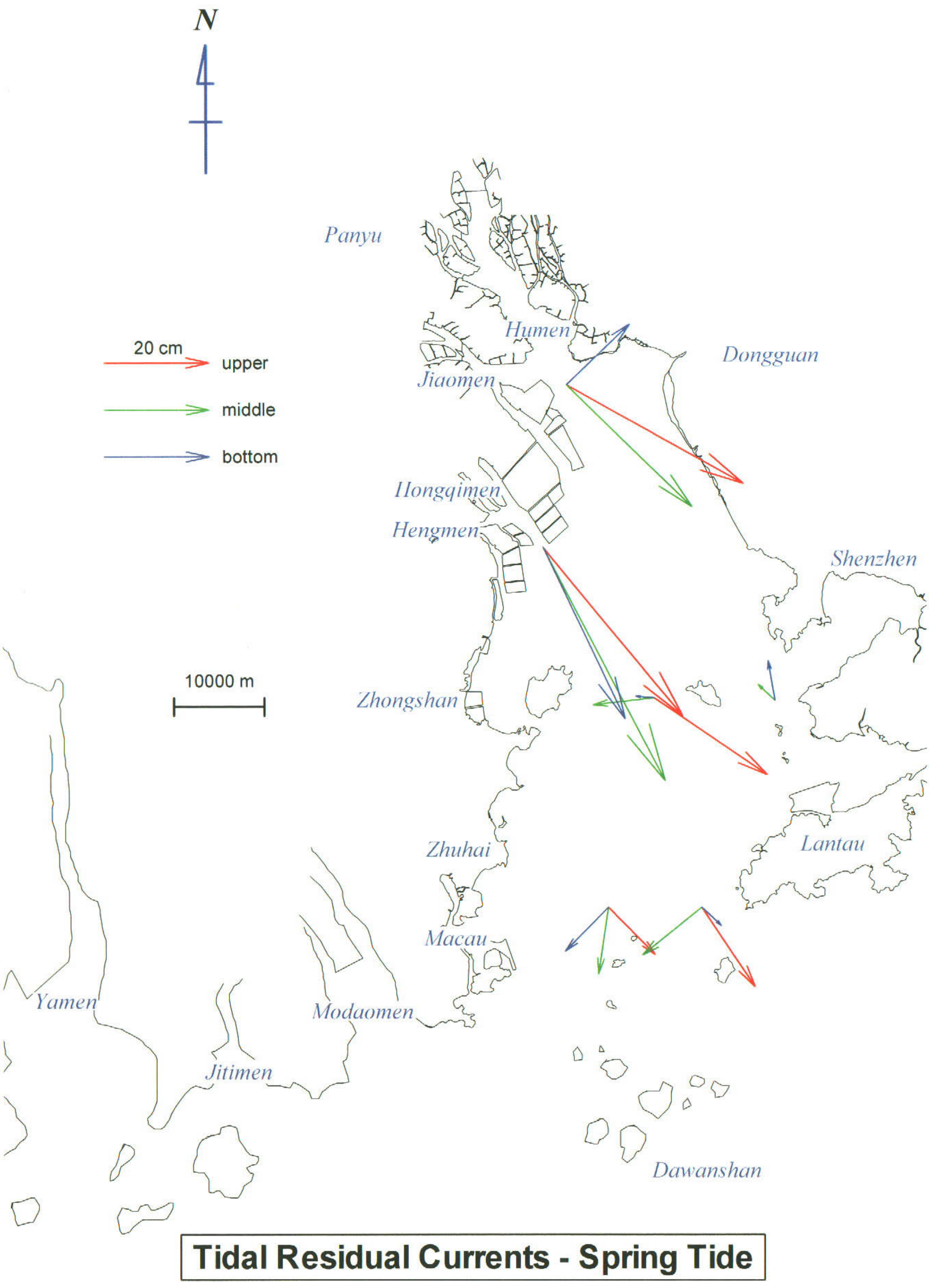
Layer	Constituent	East component		North component		Component of ellipse					
						Long axis			Short axis		
		Amplitude of velocity	Phase lag	Amplitude of velocity	Phase lag	Direction	Amplitude of velocity	Phase lag	Direction	Amplitude of velocity	Phase lag
		(cm/s)	(degree)	(cm/s)	(degree)	(degree)	(cm/s)	(degree)	(degree)	(cm/s)	(degree)
0.5m below sea surface	M1	12.92	40.00	46.93	220.20	344.60	48.68	220.20	74.60	0.05	310.20
	M2	18.11	55.90	53.93	258.20	342.50	56.51	256.10	72.50	6.55	346.10
	M4	3.02	227.10	8.36	20.50	341.70	8.80	23.20	71.70	1.29	293.20
	Steady component	-25.89 (cm/s)		-3.50 (cm/s)		262.30 (degree)			26.13 (cm/s)		
1.0m below sea surface	M1	17.55	34.60	42.60	227.10	338.00	45.94	225.30	68.00	3.53	315.30
	M2	18.04	60.40	56.44	251.90	342.60	59.15	250.90	72.60	3.43	340.90
	M4	6.51	199.20	6.30	24.40	314.00	9.05	21.70	44.00	0.40	111.70
	Steady component	-30.95 (cm/s)		-6.06 (cm/s)		258.90 (degree)			31.54 (cm/s)		
1.5m below sea surface	M1	17.91	28.90	43.66	221.80	338.10	47.04	220.00	68.10	3.71	310.00
	M2	10.86	59.30	54.62	253.20	349.00	55.63	252.70	79.00	2.56	342.70
	M4	5.17	203.20	7.71	28.90	326.20	9.27	27.10	56.20	0.43	117.10
	Steady component	-17.41 (cm/s)		-4.85 (cm/s)		254.40 (degree)			18.07 (cm/s)		
2.0m below sea surface	M1	17.05	17.00	45.90	215.70	340.40	48.70	213.50	70.40	5.14	303.50
	M2	9.17	48.10	52.46	258.10	351.30	53.06	257.40	81.30	4.54	347.40
	M4	2.35	220.50	7.36	27.80	342.60	7.71	28.90	72.60	0.50	298.90
	Steady component	-8.47 (cm/s)		-0.33 (cm/s)		267.80 (degree)			8.47 (cm/s)		
2.5m below sea surface	M1	17.57	13.00	48.20	214.00	340.90	50.95	211.70	70.90	5.97	301.70
	M2	9.53	40.80	52.15	258.90	351.70	52.70	258.00	81.70	5.82	348.00
	M4	0.93	233.60	7.55	15.10	354.40	7.58	15.50	84.40	0.58	285.50
	Steady component	-4.65 (cm/s)		2.21 (cm/s)		295.40 (degree)			5.15 (cm/s)		
3.0m below sea surface	M1	17.52	10.30	48.27	213.80	341.30	50.92	211.30	71.30	6.63	301.30
	M2	9.69	36.50	51.95	257.70	351.90	52.46	256.70	81.90	6.32	346.70
	M4	0.12	285.50	6.70	4.40	0.20	6.70	4.40	90.20	0.12	274.40
	Steady component	-3.86 (cm/s)		3.30 (cm/s)		310.50 (degree)			5.08 (cm/s)		
3.5m below sea surface	M1	17.37	11.10	47.62	213.40	341.00	50.31	210.90	71.00	6.22	300.90
	M2	9.65	38.90	50.73	256.70	351.30	51.31	255.70	81.30	5.84	345.70
	M4	0.54	341.00	6.19	354.70	4.80	6.22	354.60	94.80	0.13	264.60
	Steady component	-2.60 (cm/s)		4.05 (cm/s)		327.30 (degree)			4.81 (cm/s)		
4.0m below sea surface	M1	15.82	12.50	47.43	213.80	342.50	49.69	211.80	72.50	5.48	301.80
	M2	8.90	41.60	49.32	255.50	351.40	49.88	254.70	81.40	4.92	344.70
	M4	0.25	143.70	5.40	344.40	357.50	5.41	344.40	87.50	0.09	74.40
	Steady component	-2.05 (cm/s)		5.42 (cm/s)		339.30 (degree)			5.80 (cm/s)		
4.5m below sea surface	M1	15.22	14.00	46.24	214.50	342.70	48.41	212.60	72.70	5.10	302.60
	M2	8.04	47.80	47.30	255.40	351.40	47.84	254.80	81.40	3.69	344.80
	M4	0.87	277.00	5.11	343.00	4.00	5.12	342.30	94.00	0.79	252.30
	Steady component	-2.02 (cm/s)		6.62 (cm/s)		343.00 (degree)			6.92 (cm/s)		
5.0m below sea surface	M1	14.37	17.70	44.32	215.10	342.70	46.41	213.50	72.70	4.10	303.50
	M2	7.94	53.10	44.96	254.90	350.70	45.56	254.30	80.70	2.92	344.30
	M4	1.36	231.00	4.90	341.80	354.00	4.93	343.30	84.00	1.26	253.30
	Steady component	-1.60 (cm/s)		7.08 (cm/s)		347.30 (degree)			7.25 (cm/s)		
5.5m below sea surface	M1	13.30	23.50	44.26	215.70	343.60	46.13	214.70	73.60	2.69	304.70
	M2	7.91	58.70	42.04	254.10	349.70	42.72	253.60	79.70	2.07	343.60
	M4	2.02	233.10	5.13	334.50	354.70	5.15	336.60	84.70	1.97	246.60
	Steady component	-1.32 (cm/s)		6.81 (cm/s)		349.10 (degree)			6.94 (cm/s)		
6.0m below sea surface	M1	12.35	30.40	42.42	216.10	343.80	44.16	215.60	73.80	1.18	305.60
	M2	8.07	61.10	39.47	253.10	348.70	40.26	252.60	78.70	1.64	342.60
	M4	2.61	242.50	5.59	330.30	1.30	5.59	329.70	91.30	2.61	239.70
	Steady component	-1.14 (cm/s)		6.18 (cm/s)		349.60 (degree)			6.29 (cm/s)		

Table 3.1.28(2) Harmonic Constants

(ADCP, P19, no.2: from 6.5m and 10.5m: from 5 to 6 March 2001)

Observed period : 2001/03/05 00:00 to 2001/03/06 00:00

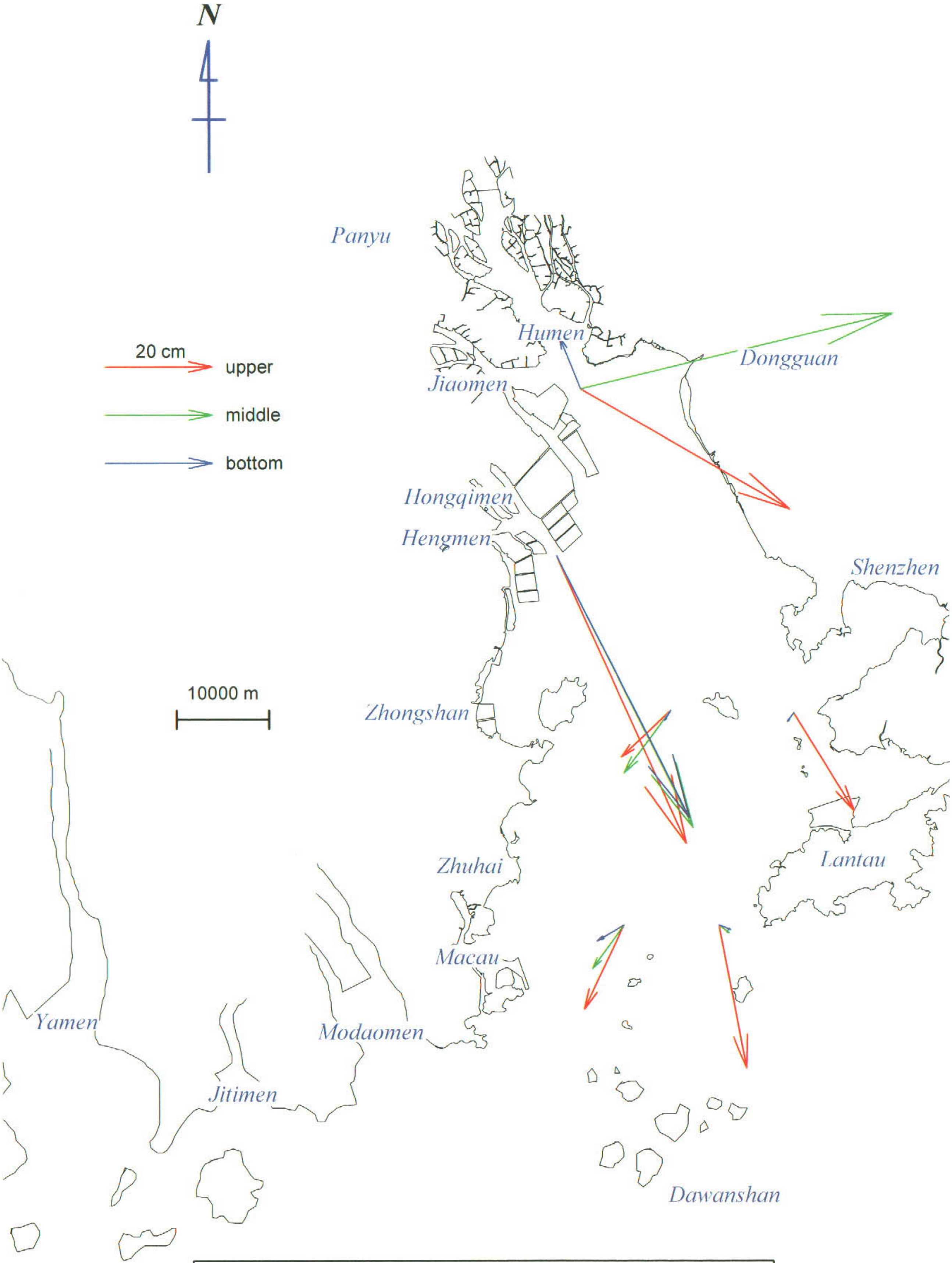
Layer	Constituent	East component		North component		Component of ellupse					
						Long axis			Short axis		
		Amplitude of velocity	Phase lag	Amplitude of velocity	Phase lag	Direction	Amplitude of velocity	Phase lag	Direction	Amplitude of velocity	Phase lag
		(cm/s)	(degree)	(cm/s)	(degree)	(degree)	(cm/s)	(degree)	(degree)	(cm/s)	(degree)
6.5m below sea surface	M1	11.64	31.80	41.29	217.20	344.30	42.88	216.80	74.30	1.05	306.80
	M2	8.51	67.80	37.07	251.60	347.10	38.03	251.50	77.10	0.56	341.50
	M4	2.46	221.90	5.47	326.20	352.20	5.52	329.60	82.20	2.37	239.60
	Steady componen	-1.37 (cm/s)		5.84 (cm/s)		346.80 (degree)			6.00 (cm/s)		
7.0m below sea surface	M1	11.37	36.40	40.13	217.70	344.20	41.71	217.60	74.20	0.26	307.60
	M2	9.44	72.50	35.06	250.00	344.90	36.30	250.20	74.90	0.39	160.20
	M4	2.40	203.10	5.53	321.20	346.60	5.66	326.10	76.60	2.07	236.10
	Steady component	-1.46 (cm/s)		5.74 (cm/s)		345.70 (degree)			5.93 (cm/s)		
7.5m below sea surface	M1	10.67	36.20	39.22	218.80	344.80	40.65	218.60	74.80	0.47	308.60
	M2	9.63	76.90	33.58	248.00	344.10	34.90	248.60	74.10	1.43	158.60
	M4	1.36	197.70	5.56	314.80	353.30	5.59	316.30	83.30	1.20	226.30
	Steady component	-1.27 (cm/s)		5.60 (cm/s)		347.20 (degree)			5.74 (cm/s)		
8.0m below sea surface	M1	10.79	38.70	37.98	219.10	344.10	39.49	219.10	74.10	0.07	309.10
	M2	10.05	81.20	31.77	245.80	342.90	33.23	247.10	72.90	2.55	157.10
	M4	1.59	168.60	5.42	310.40	346.60	5.56	312.70	76.60	0.96	222.70
	Steady component	-1.27 (cm/s)		5.79 (cm/s)		347.70 (degree)			5.93 (cm/s)		
8.5m below sea surface	M1	10.33	38.50	37.41	218.60	344.60	38.81	218.60	74.60	0.02	308.60
	M2	10.47	82.70	30.42	242.80	341.90	31.99	244.80	71.90	3.40	154.80
	M4	1.95	156.20	4.54	312.20	338.00	4.89	315.60	68.00	0.74	225.60
	Steady component	-1.70 (cm/s)		6.06 (cm/s)		344.30 (degree)			6.29 (cm/s)		
9.0m below sea surface	M1	9.77	37.40	35.96	218.10	344.80	37.27	218.00	74.80	0.10	308.00
	M2	10.04	80.00	29.44	243.50	341.70	30.99	245.10	71.70	2.72	155.10
	M4	1.79	151.40	4.67	307.30	340.30	4.96	310.10	70.30	0.69	220.10
	Steady component	-1.49 (cm/s)		6.06 (cm/s)		346.20 (degree)			6.24 (cm/s)		
9.5m below sea surface	M1	9.38	36.20	34.17	217.70	344.70	35.43	217.60	74.70	0.24	307.60
	M2	11.07	80.30	28.53	241.60	339.60	30.42	243.90	69.60	3.32	153.90
	M4	1.55	149.10	4.10	307.20	340.30	4.35	309.80	70.30	0.55	219.80
	Steady component	-2.02 (cm/s)		6.37 (cm/s)		342.40 (degree)			6.68 (cm/s)		
10.0m below sea surface	M1	9.09	36.90	32.94	217.30	344.60	34.17	217.30	74.60	0.06	307.30
	M2	9.38	77.70	26.58	241.50	341.10	28.08	243.20	71.10	2.48	153.20
	M4	2.13	153.20	3.82	311.30	331.80	4.31	316.30	61.80	0.70	226.30
	Steady component	-2.31 (cm/s)		6.29 (cm/s)		339.80 (degree)			6.70 (cm/s)		
10.5m below sea surface	M1	8.25	32.40	31.42	216.30	345.30	32.48	216.10	75.30	0.55	306.10
	M2	9.73	82.40	26.21	239.70	340.80	27.73	242.20	70.80	3.55	152.20
	M4	2.26	140.20	3.35	312.10	326.10	4.04	314.60	56.10	0.26	224.60
	Steady component	-2.16 (cm/s)		6.73 (cm/s)		342.20 (degree)			7.07 (cm/s)		



Tidal Residual Currents - Spring Tide

Figure 3.1.1 Tidal Residual Currents

(Spring Tide, Rainy Season, from 31 July to 30 Aug. 2000)



Tidal Residual Currents - Neap Tide

Figure 3.1.2 Tidal Residual Currents
(Neap Tide, Rainy Season, from 7 Aug. to 10 Aug. 2000)

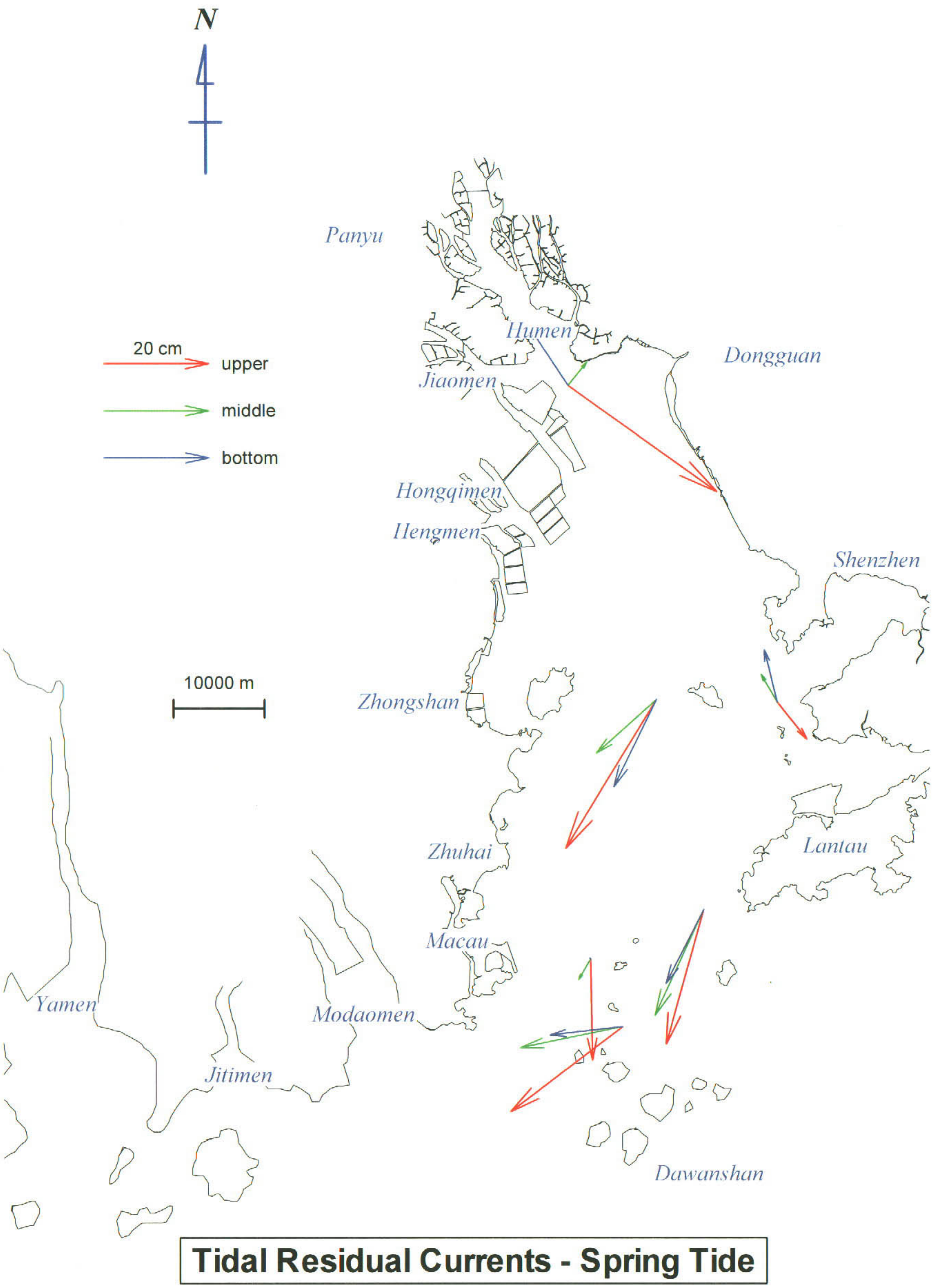
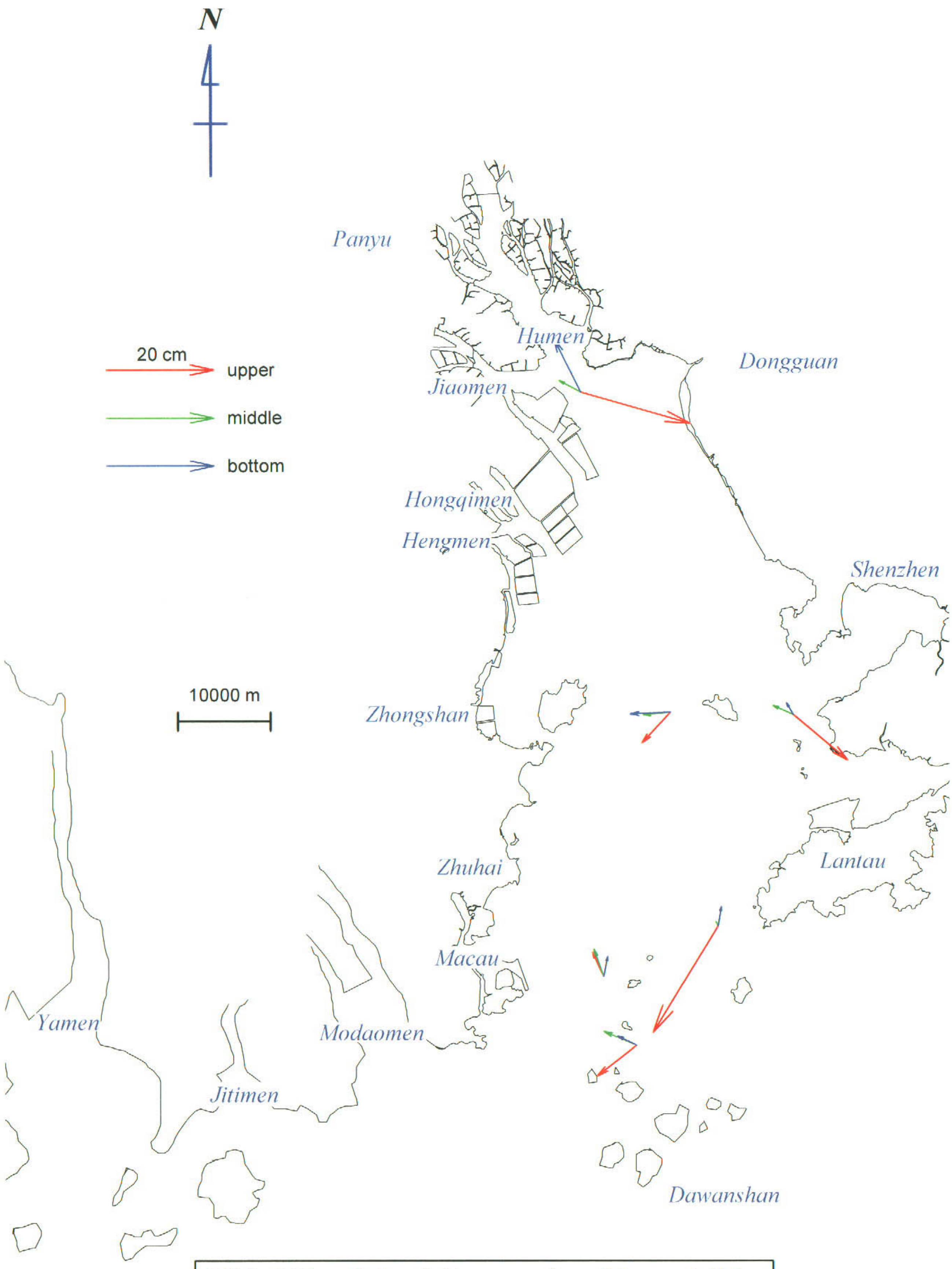


Figure 3.1.3 Tidal Residual Currents
(Spring Tide, Dry Season, from 11 Dec. to 14 Dec. 2000)



Tidal Residual Currents - Neap Tide

Figure 3.1.4 Tidal Residual Currents
(Neap Tide, Dry Season, from 5 Dec. to 8 Dec. 2000)

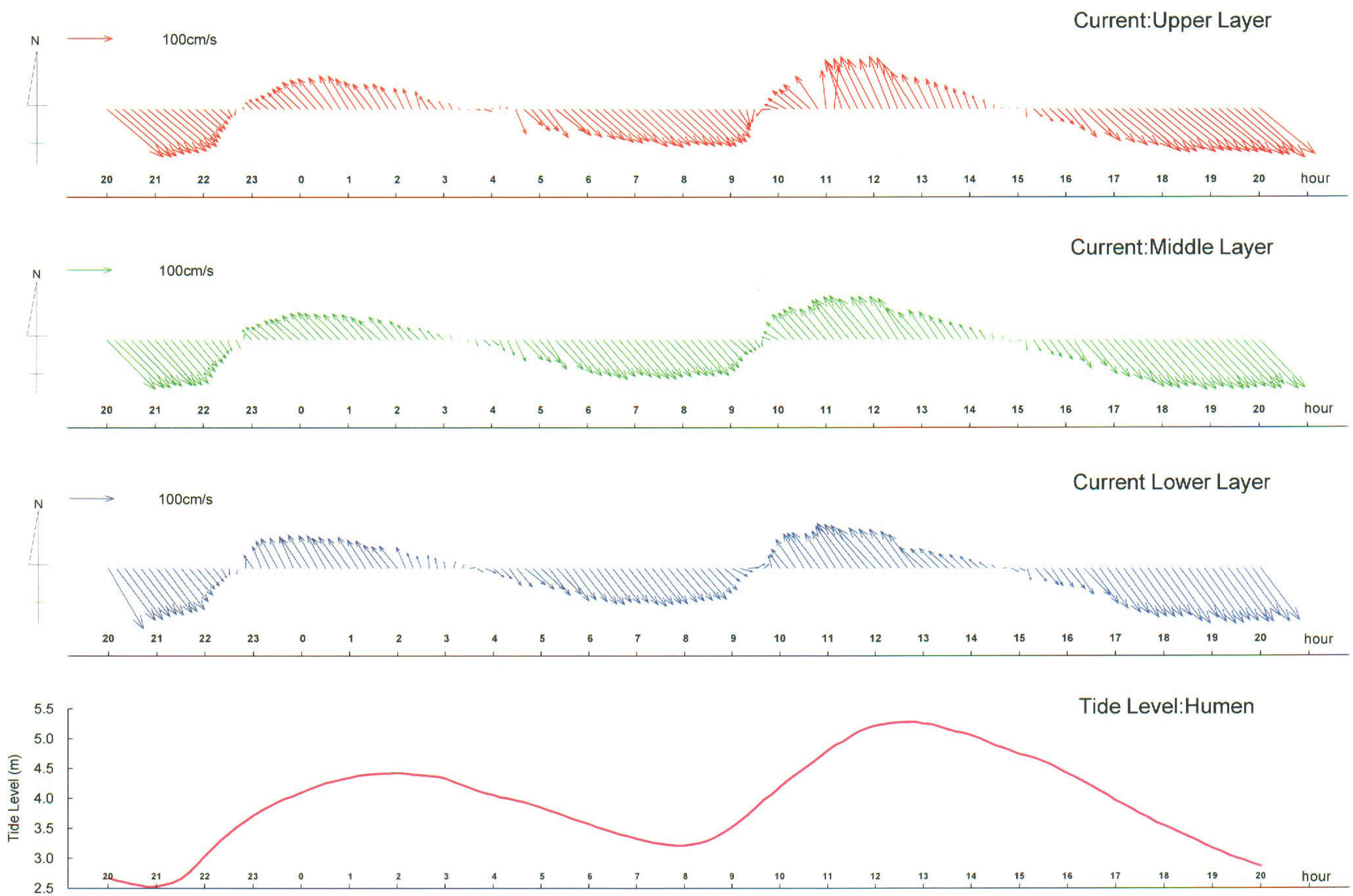


Figure 3.1.5 Time series of Current Vector and Tidal Level
(P01, Dpring Tide, Rainy Season, from 2 to 3 Aug. 2000)