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Evaluation of the Performance of the South Coast Model from September 2005- August 2006

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Kevin J. Horsburgh,
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January 2007

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1. Introduction

Following from a detailed study of fine grid surge models (Flather et al., 2001) it was decided to implement such a model for operational trials. The POL South Coast Model (SCM) is a high-resolution local model designed for surge prediction for the south coast of England. It has a resolution of ~1.2km with longitudinal open boundaries extending south from Newhaven and Weymouth, coinciding with locations of tide gauges on the national network. The southern boundary is located at 50ºN. The SCM grid can be seen in Figure 1. SCM is nested within CS3 which means that operationally, open boundary surge data for SCM is obtained from the corresponding CS3 run and interpolated to the SCM boundary prior to its run.

After successful pre-operational trials, SCM became operational from the midday forecast on 07/12/04. This report describes the evaluation of the performance of the SCM over a 12-month period.

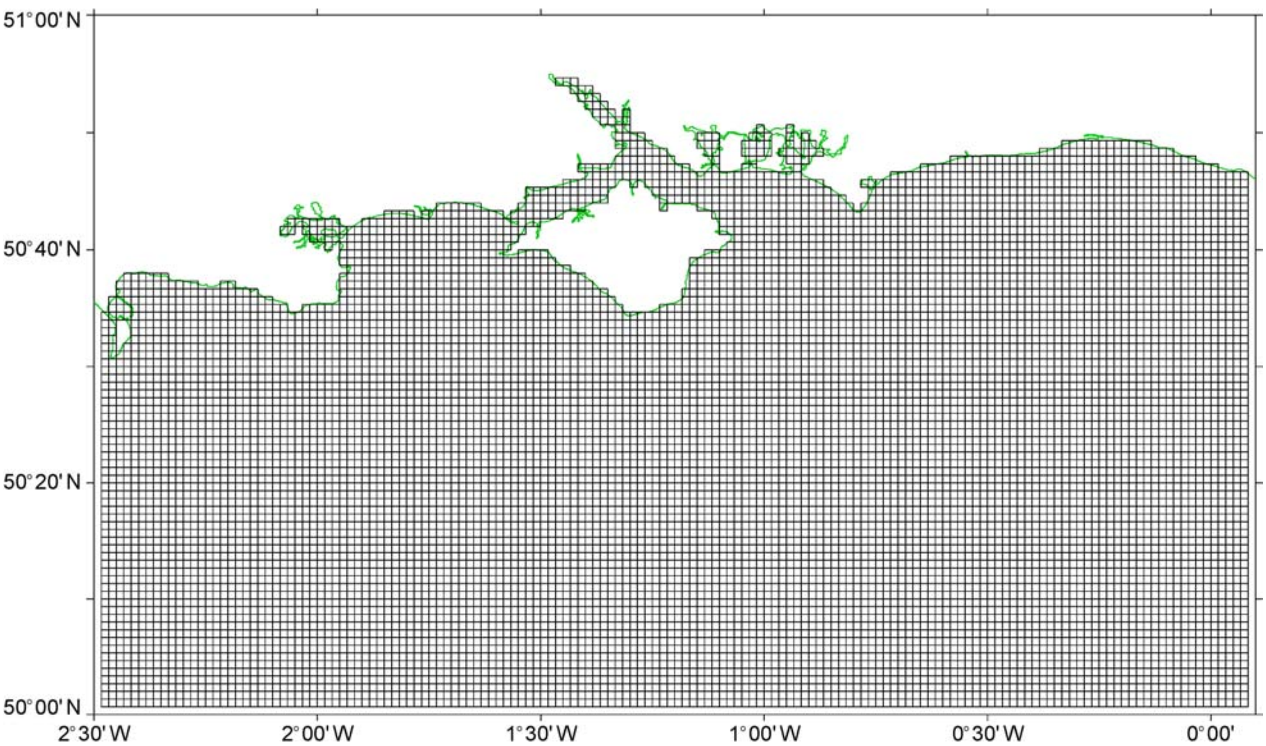

Figure 1: POL South coast model (SCM) resolution ~1.2km.

2. Analysis

During the testing phase of interfacing the surge models with NAE, an error was found in the output of SCM. Further investigation showed an error in the operational script used at the Met Office. Met Office staff were informed and a correction was put into effect from the 6z run 05/07/05. This meant that good archived data were only available from this run onwards.

The period September 2005 to August 2006 was chosen as this covered a full 12-month period and included the most recent observations available at the time of analysis.

Hourly tide gauge data from the A class gauges; Weymouth, Bournemouth, Portsmouth and Newhaven were compiled for this period. Additionally, data from EA gauges at Hamble, Cowes, Ryde, Langstone Harbour, Shoreham and Littlehampton were kindly made available to us by the EA. The EA data were in the form of 15-minute total water levels. Firstly, hourly water levels had to be sub-sampled from the 15-minute data sets. It was then necessary to derive residuals for these locations. As tidal predictions were only available for two of these locations, namely Cowes and Shoreham, residuals could only be easily derived for these locations. For the other locations it was necessary to analyse the total water levels in order to derive residual elevations.

In order to perform a comprehensive evaluation, we compare SCM surge forecasts against CS3 forecasts as well as observations. So it was necessary to extract CS3 forecast data from the monthly port data archive (Williams and Horsburgh, 2006). We required the port data corresponding to the SCM ports shown in Table 1. Due to the coarser resolution of CS3, some of these locations shared a stored point in the archive e.g. Portsmouth and Ryde to the point “PMTH” in the CS3 port data archive. If the corresponding CS3 point was not explicitly specified in the POL port data archive, it was calculated based on the latitude and longitude of the port location supplied by EA. E.g., for Hamble and Cowes, this corresponded to the stored point “STON”. Three of the SCM locations did not have a corresponding stored CS3 forecast point (Langstone Harbour, Littlehampton and Shoreham). For these points it was necessary to update the CS3 re-run archive to the end of August 2006 and then extract data the data from it. Although this would not strictly be equivalent to a forecast, the difference is usually small and should not affect the results.

PORT	SCM PORT	CS3 POINT	CS3 PORT
Weymouth	WEYM	58,112	PLND
Bournemouth	BMTH	61,112	BMTH
Hamble	HAMB	65,110	STON
Cowes	COWS	65,110	STON
Portsmouth	PMTH	66,111	PMTH
Ryde	RYDE	66,111	PMTH
Langstone Harbour	LHHB	66,110	n/a
Littlehampton	LHHM	69,111	n/a
Shoreham	SHHM	71,111	n/a
Newhaven	NHVN	73,111	NHVN

Table 1: SCM output points with CS3 equivalents.

Now we have comparable sets of hourly SCM and CS3 forecast surges with observed surges for the period September 2005 to August 2006 for the 10 tide gauge locations in the SCM table. Time series of hourly model output from both SCM and CS3 were plotted against observations for all 12 months. The month with the most surge activity, and hence the most likely to show any model differences was January 2006, and these comparison plots for all locations can be seen in Appendix 1.

Although the model data are offset from the EA observed data (due to datum inconsistencies), the main conclusion that can be drawn by looking at these plots is that SCM produces almost identical results to CS3. There is little point in comparing in any detail the models with respect to observations. The biggest differences between the two model forecasts occur because the spatial resolution of CS3 is not sufficient to resolve two locations e.g. Hamble and Cowes, which share the same CS3 point. The differences between SCM and CS3 have been quantified by applying the standard statistics to the CS3 and SCM forecasts. Table 2 shows the statistics of the differences at all locations. We can conclude that the differences are statistically insignificant.

PORT	SIZE	CORR	MEAN	S.D.	RMSE
Weymouth	8760	1.00	0	0.01	0.01
Bournemouth	8760	1.00	0	0.01	0.01
Hamble	8760	1.00	0	0.03	0.03
Cowes	8760	1.00	0	0.02	0.02
Portsmouth	8760	1.00	0	0.02	0.02
Ryde	8760	1.00	0	0.02	0.02
Langstone Harbour	8748	0.97	0	0.03	0.03
Littlehampton	8748	0.99	0	0.02	0.02
Shoreham	8748	0.99	0	0.02	0.02
Newhaven	8760	1.00	0	0.01	0.01

Table 2: Standard statistics of the difference between CS3 and SCM forecasts.

3. Conclusions and Recommendations

A comprehensive evaluation of the south coast model surge forecast model has been carried out making use of data from the A-class tide gauge network and EA tide gauges. For reference, comparisons were also made with corresponding output from CS3. Statistical and graphical analysis showed that there was no significant difference between forecasts from CS3 and SCM. In order for SCM to produce improved surges there are further enhancements that can be made. It is therefore recommended that:

- SCM be integrated into NISE10 to provide a higher spatially resolved interface at the open boundaries than is currently available using CS3.
- Assimilation of tide gauge data initially into NISE10 and possibly SCM will improve the boundary conditions at the start of the forecast. This should be investigated.
- SCM should be re-evaluated after these have been implemented.

Acknowledgements

The authors would like to thank staff at the Met Office for their continuing support, which ensures smooth running of the system and facilitates development of the operational surge model. Thanks to Kate Mottram from EA for providing data from EA tide gauges.

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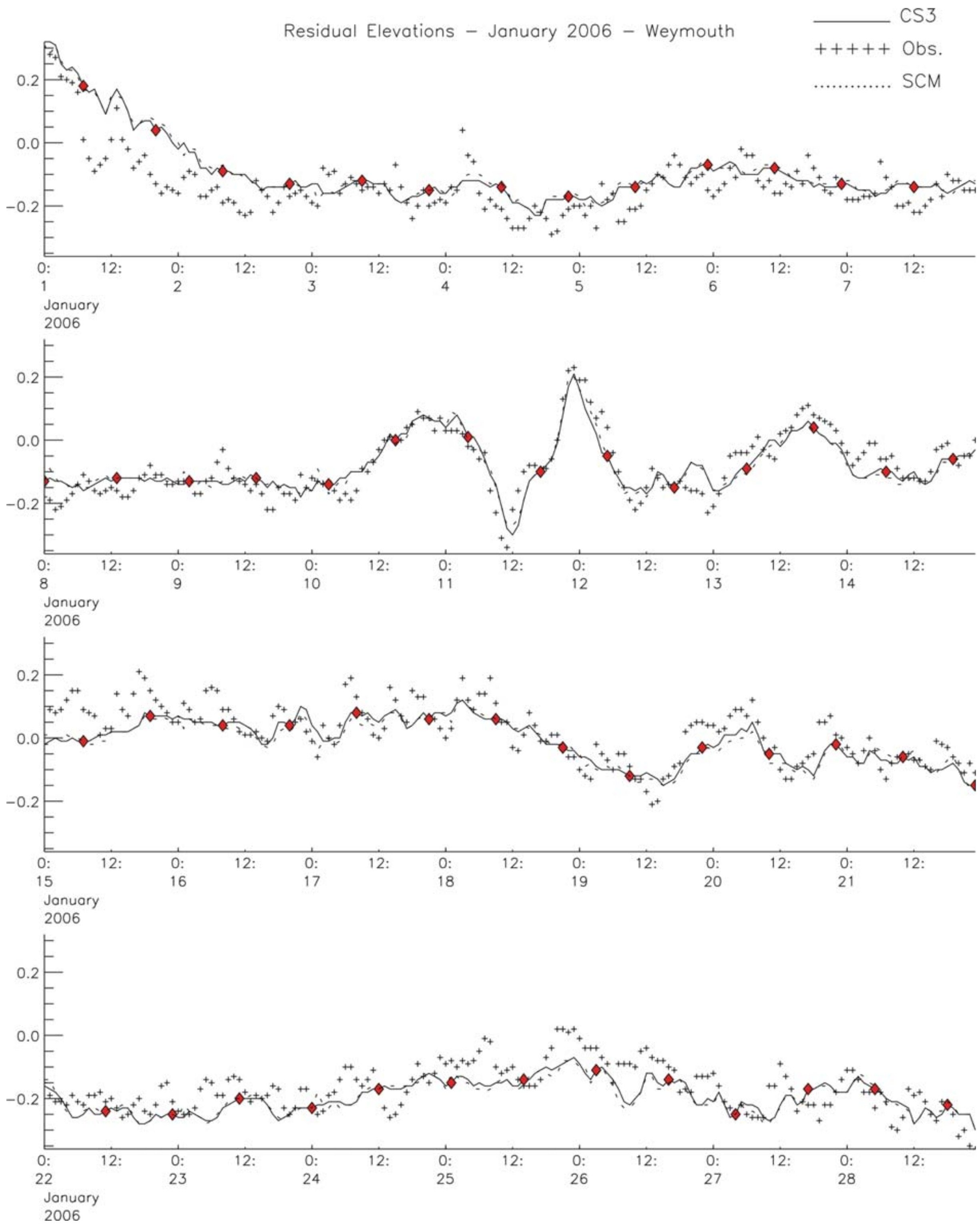
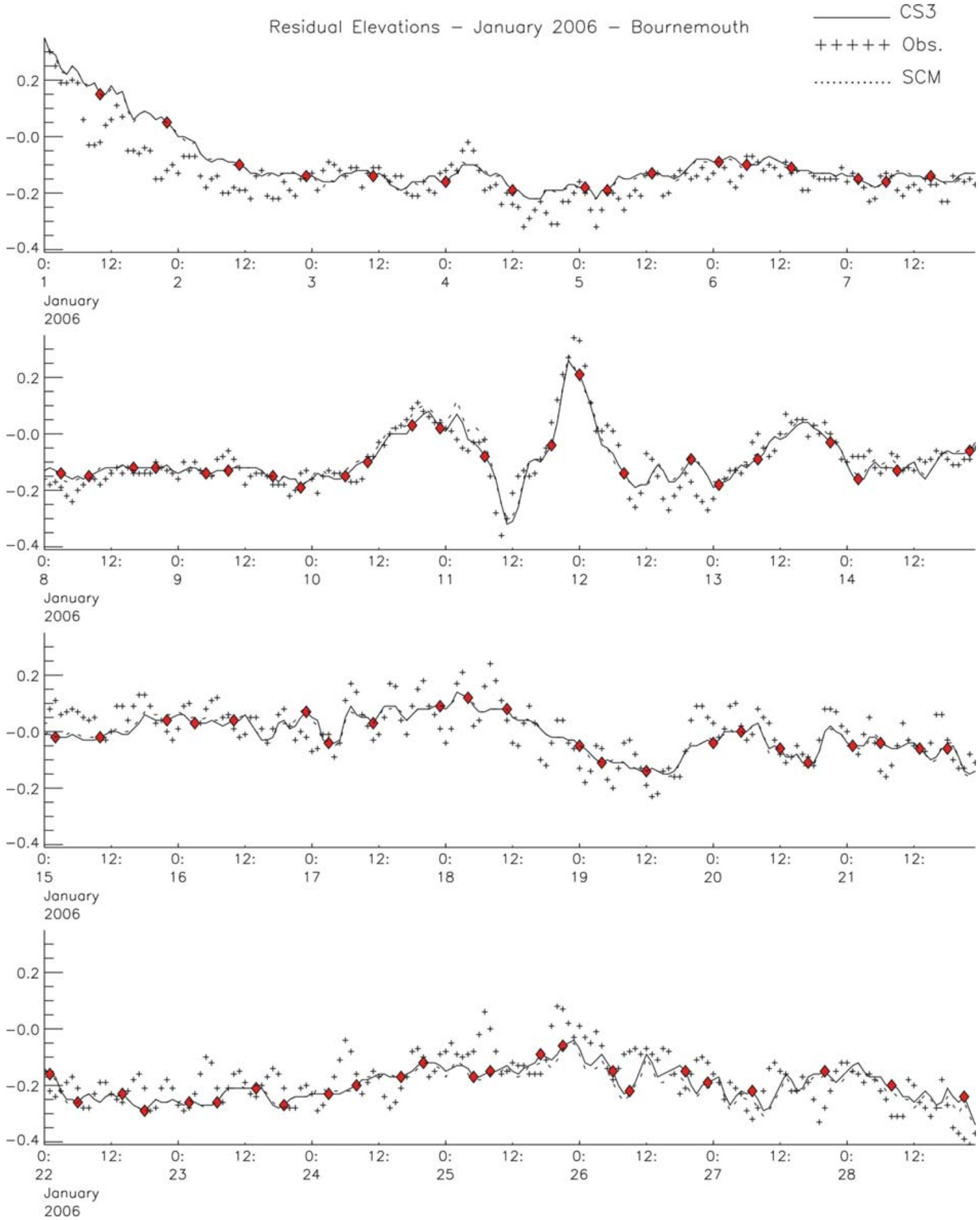
References

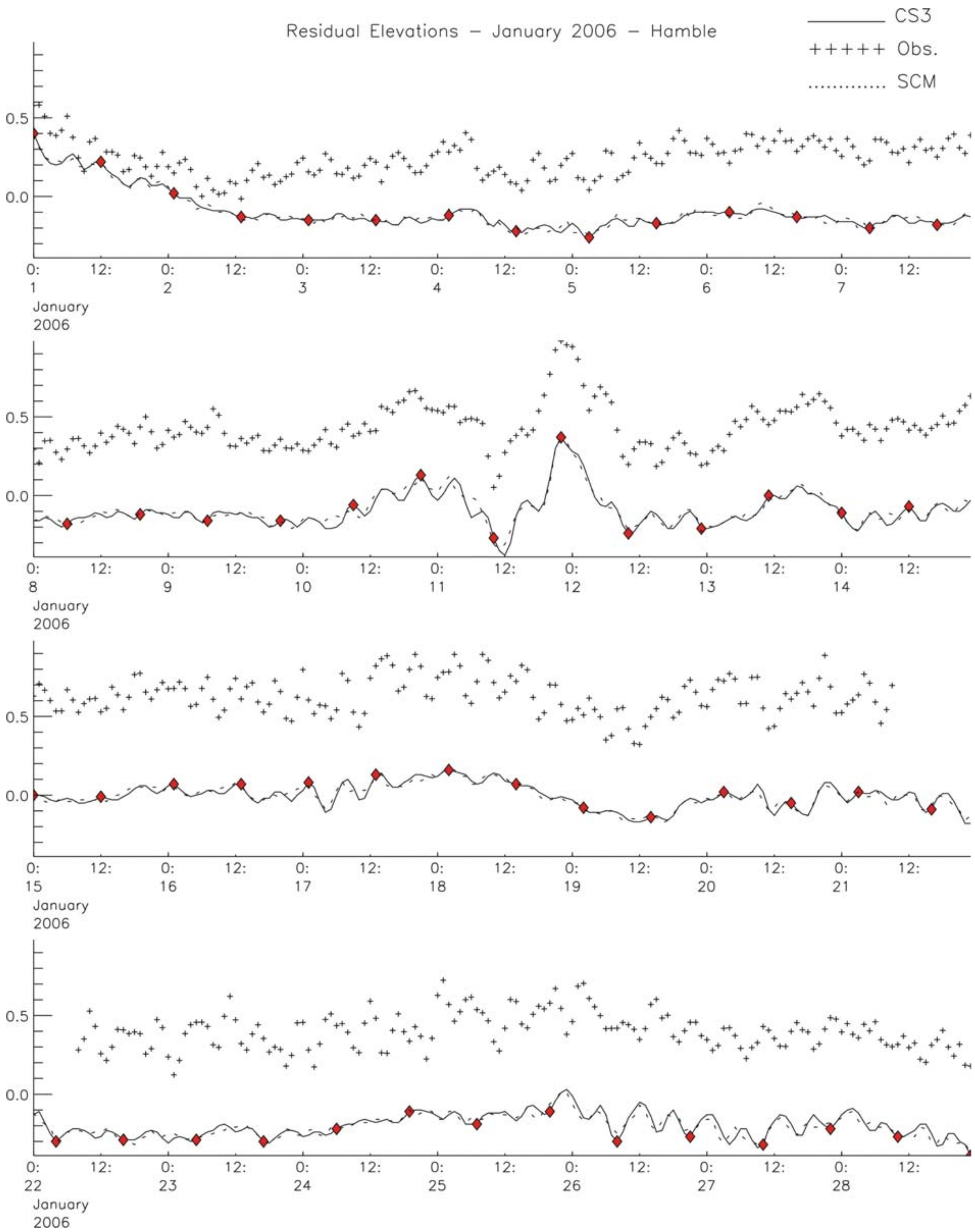
Flather, R.A., J.A. Williams, D.L. Blackman and L.A. Carlin, 2001. Fine grid surge model evaluation. *Proudman Oceanographic Laboratory, Internal Document,* **No. 141**, 52pp.

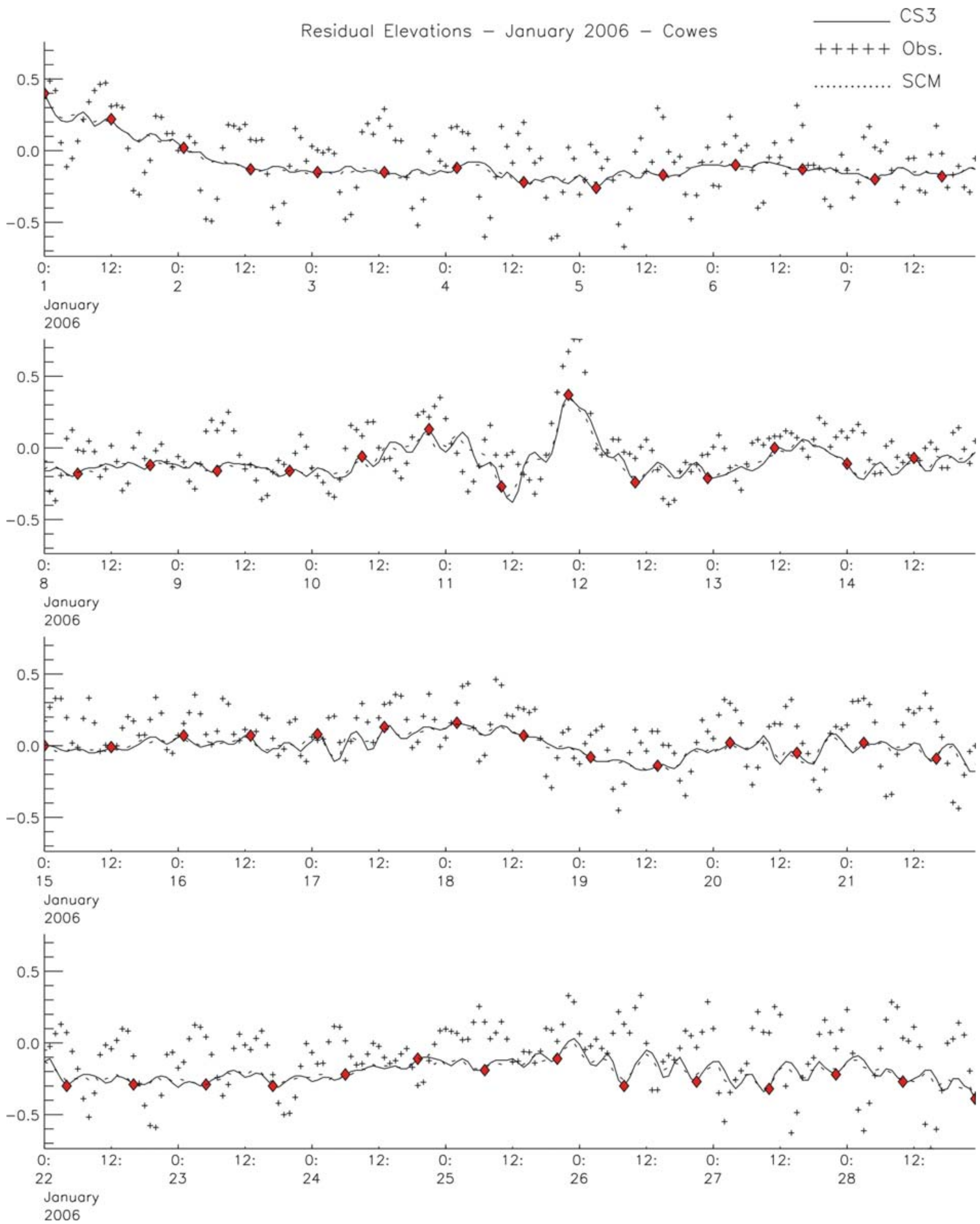
Williams J.A. & Horsburgh, K.J. 2006. The Operational Storm Surge Model: Development, Performance and Maintenance: April 2005 – May 2006. *Proudman Oceanographic Laboratory, Internal Document*, **No. 178**, 49 p.

Appendix A: Time series of model v observed surge elevations for tide gauge locations in SCM.

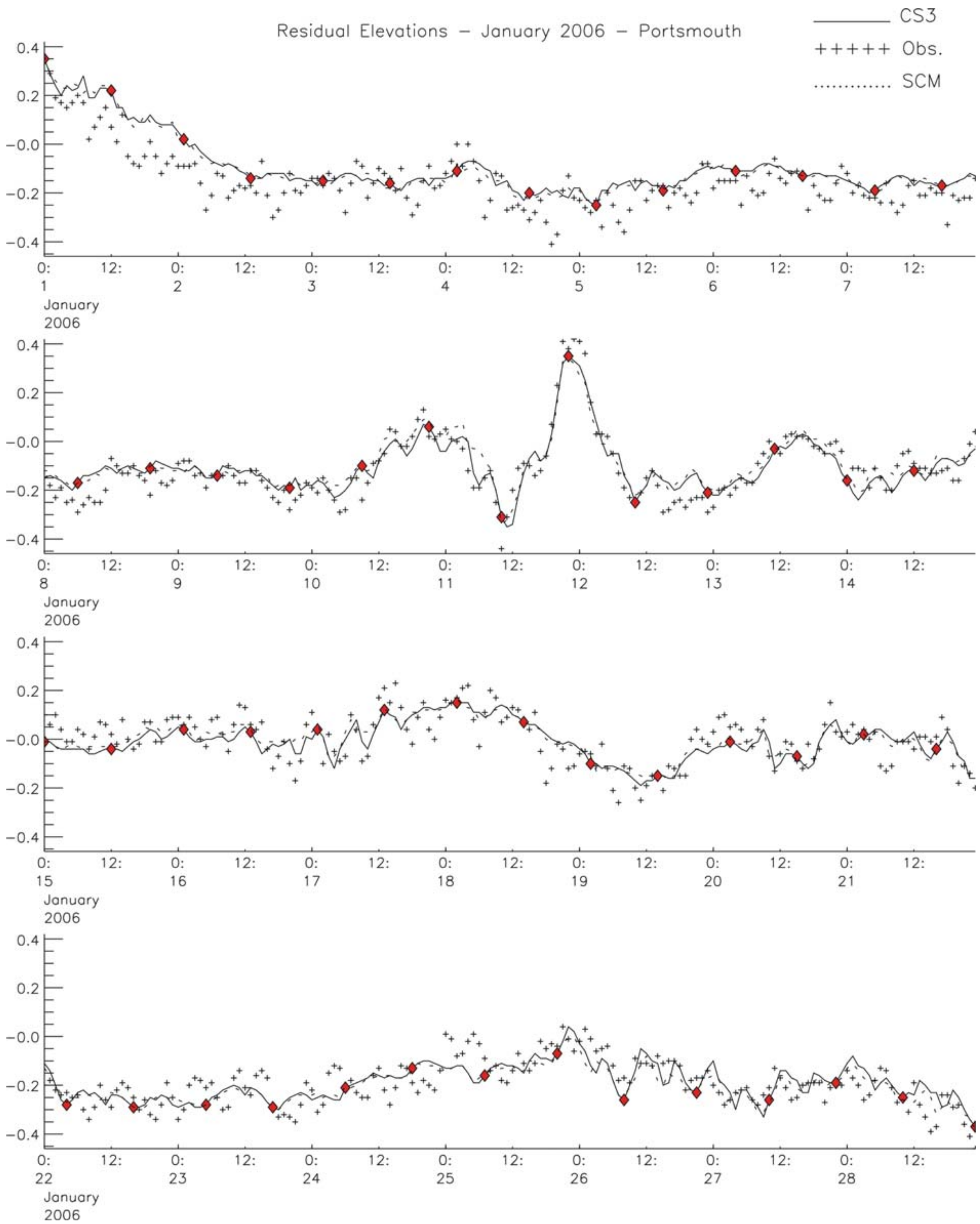

Residual Elevations – January 2006 – Weymouth
CS3
+++++ Obs.
SCM
0.2
0.0
−0.2
0: 12:
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
January
2006

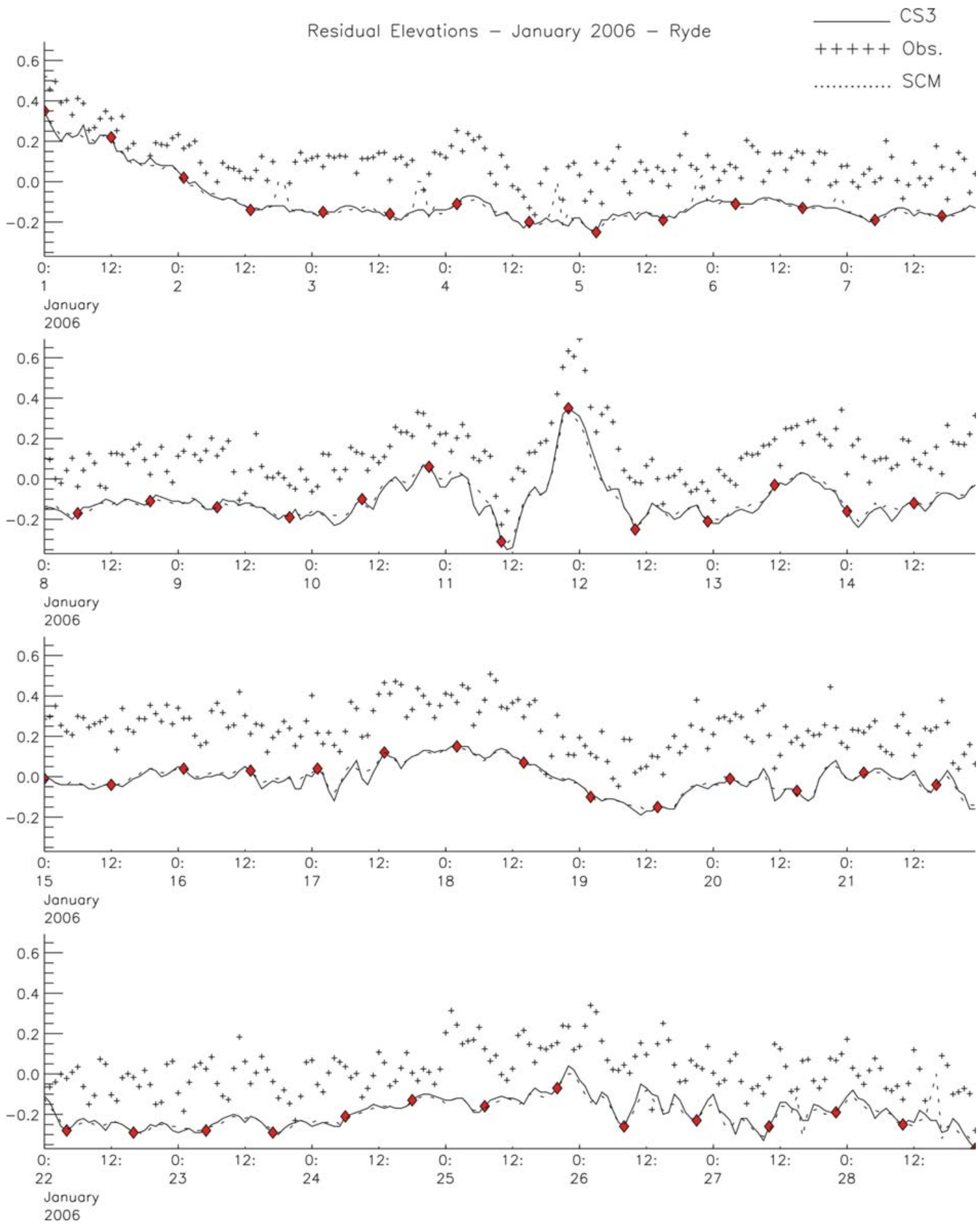

Residual Elevations – January 2006 – Bournemouth
CS3
+++++ Obs.
SCM
0.2
–0.0
–0.2
–0.4
0:
12:
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
January
2006


Residual Elevations – January 2006 – Hamble
CS3
+++++ Obs.
.... SCM
0.5
0.0
0: 1 January 2006
12:
0: 2
0: 3
0: 4
0: 5
0: 6
0: 7
0: 8 January 2006
0: 9
0: 10
0: 11
0: 12
0: 13
0: 14
0: 15 January 2006
0: 16
0: 17
0: 18
0: 19
0: 20
0: 21
0: 22 January 2006
0: 23
0: 24
0: 25
0: 26
0: 27
0: 28



Residual Elevations – January 2006 – Cowes
CS3
+++++ Obs.
SCM
0.5
0.0
−0.5
0:
12:
1
2
3
4
5
6
7
January
2006
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28


Residual Elevations – January 2006 – Portsmouth
CS3
+++++ Obs.
SCM
0.4
0.2
−0.0
−0.2
−0.4
January
2006


Residual Elevations – January 2006 – Ryde
CS3
+++++ Obs.
SCM
0.6
0.4
0.2
0.0
−0.2
0:
12:
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
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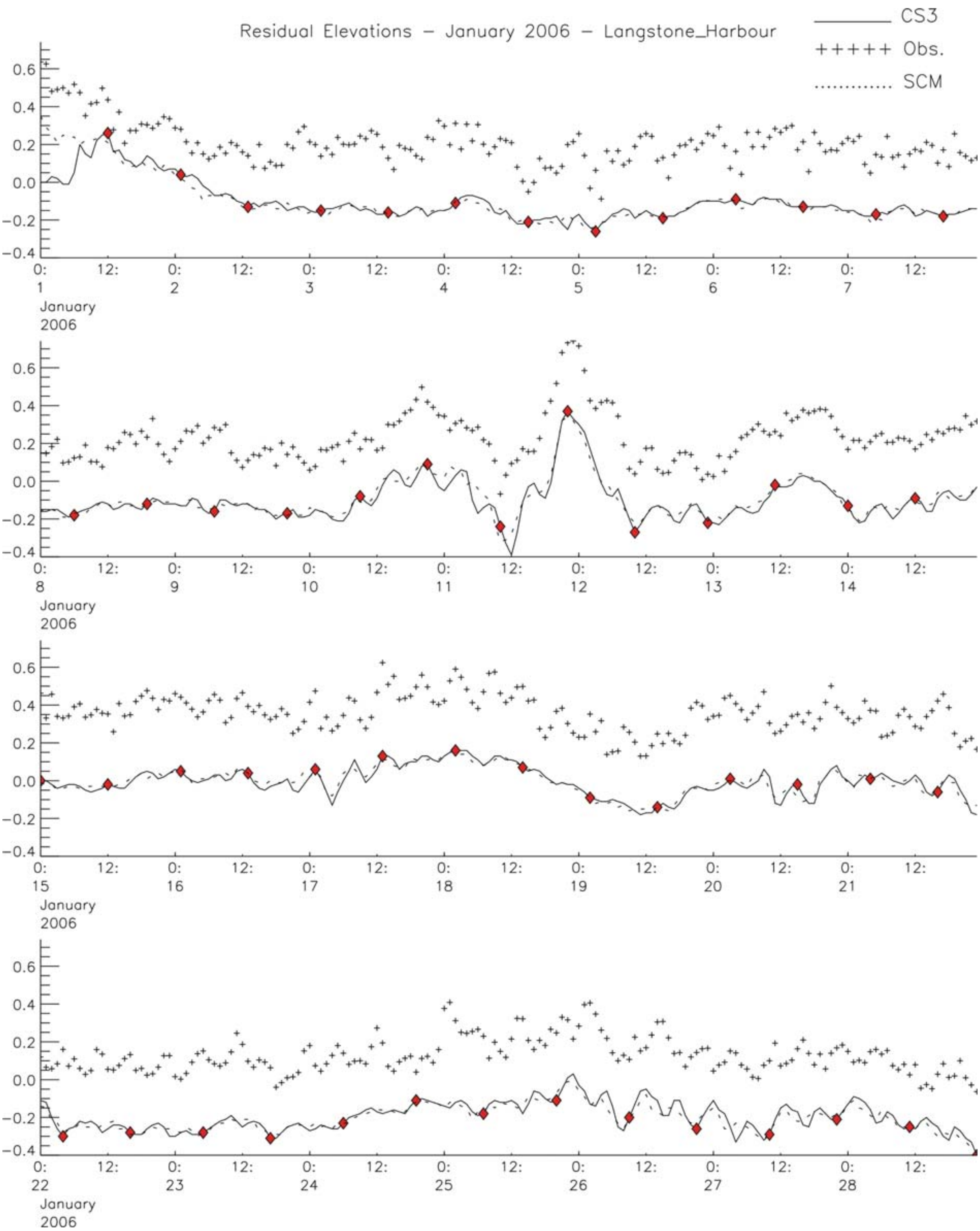
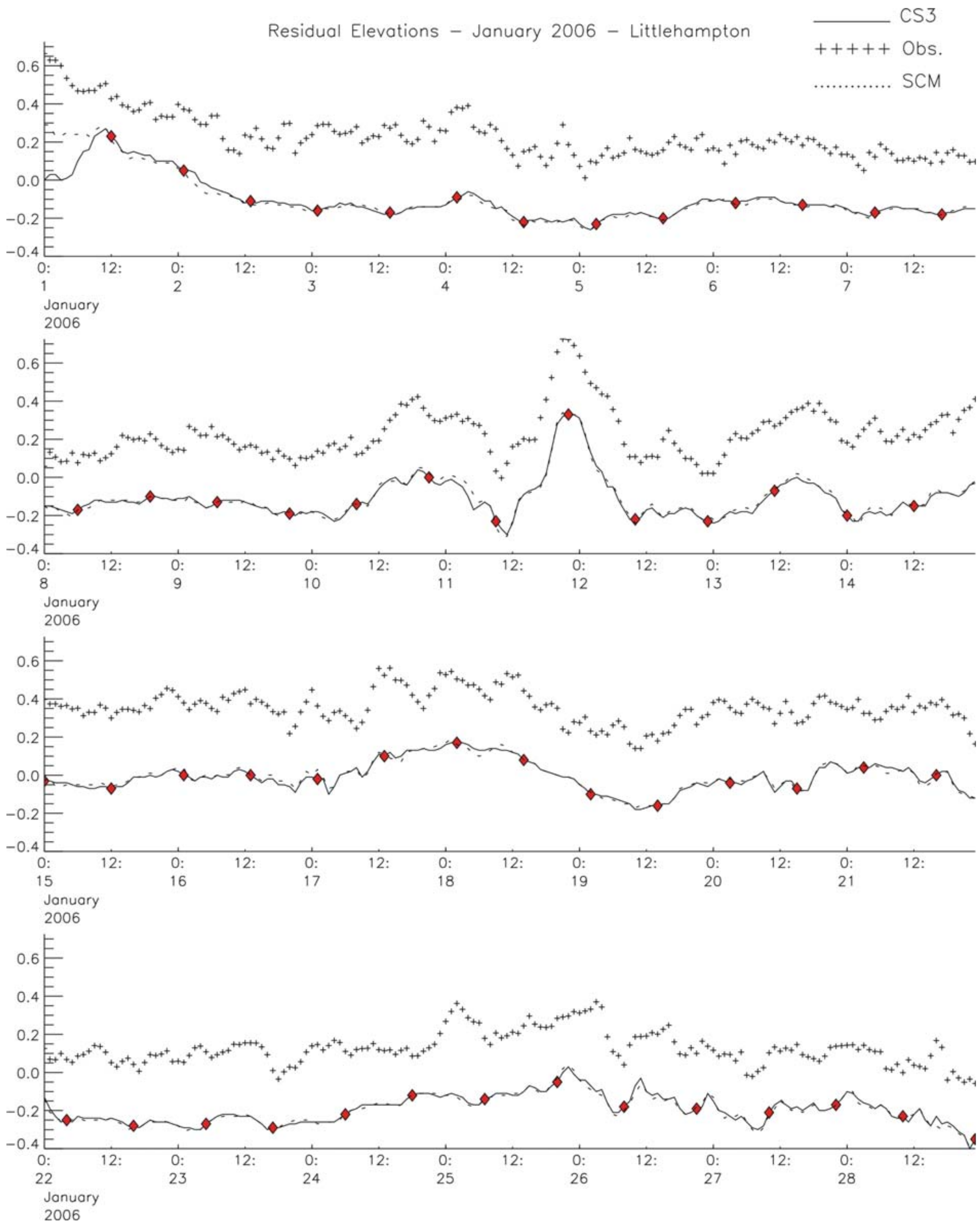
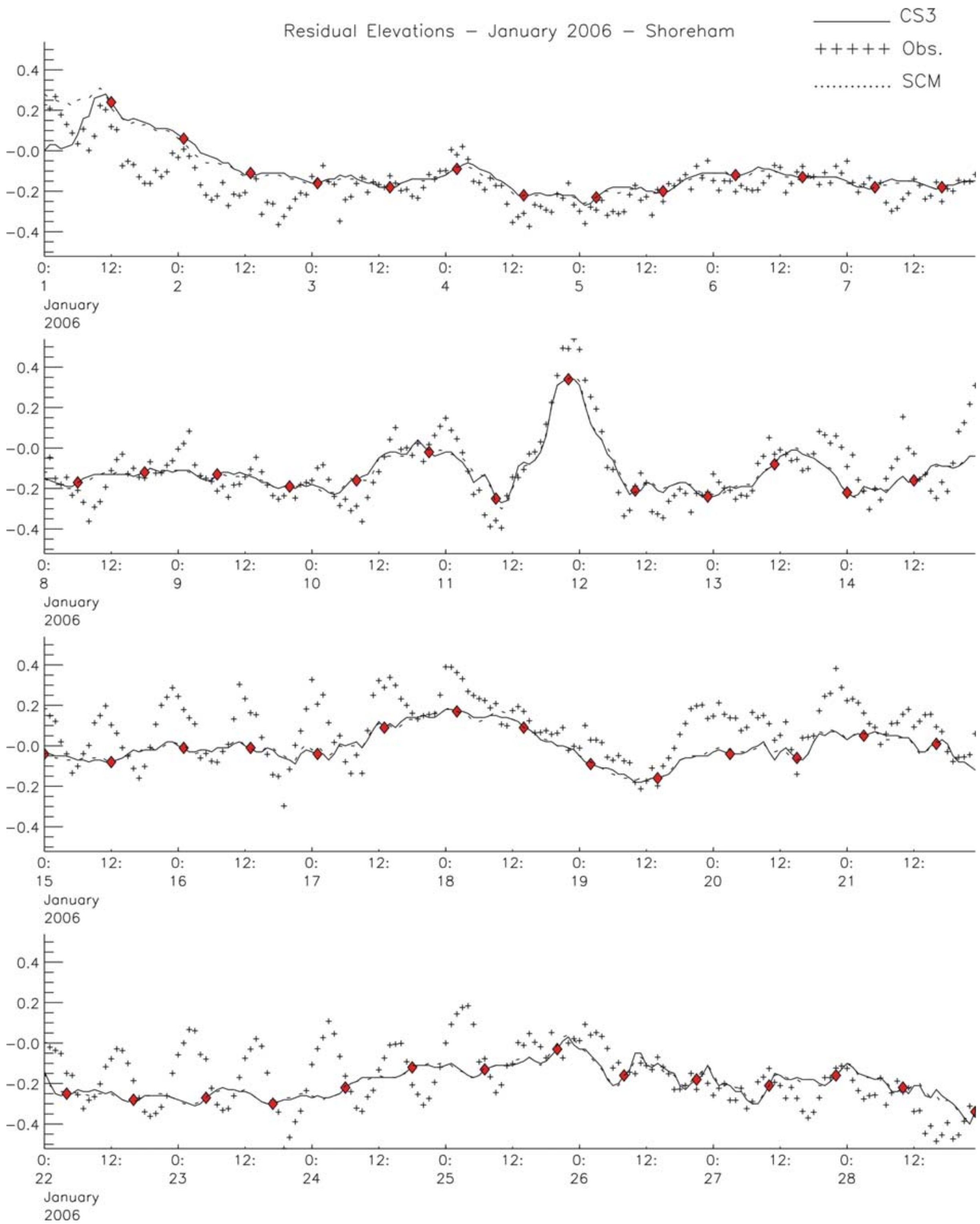
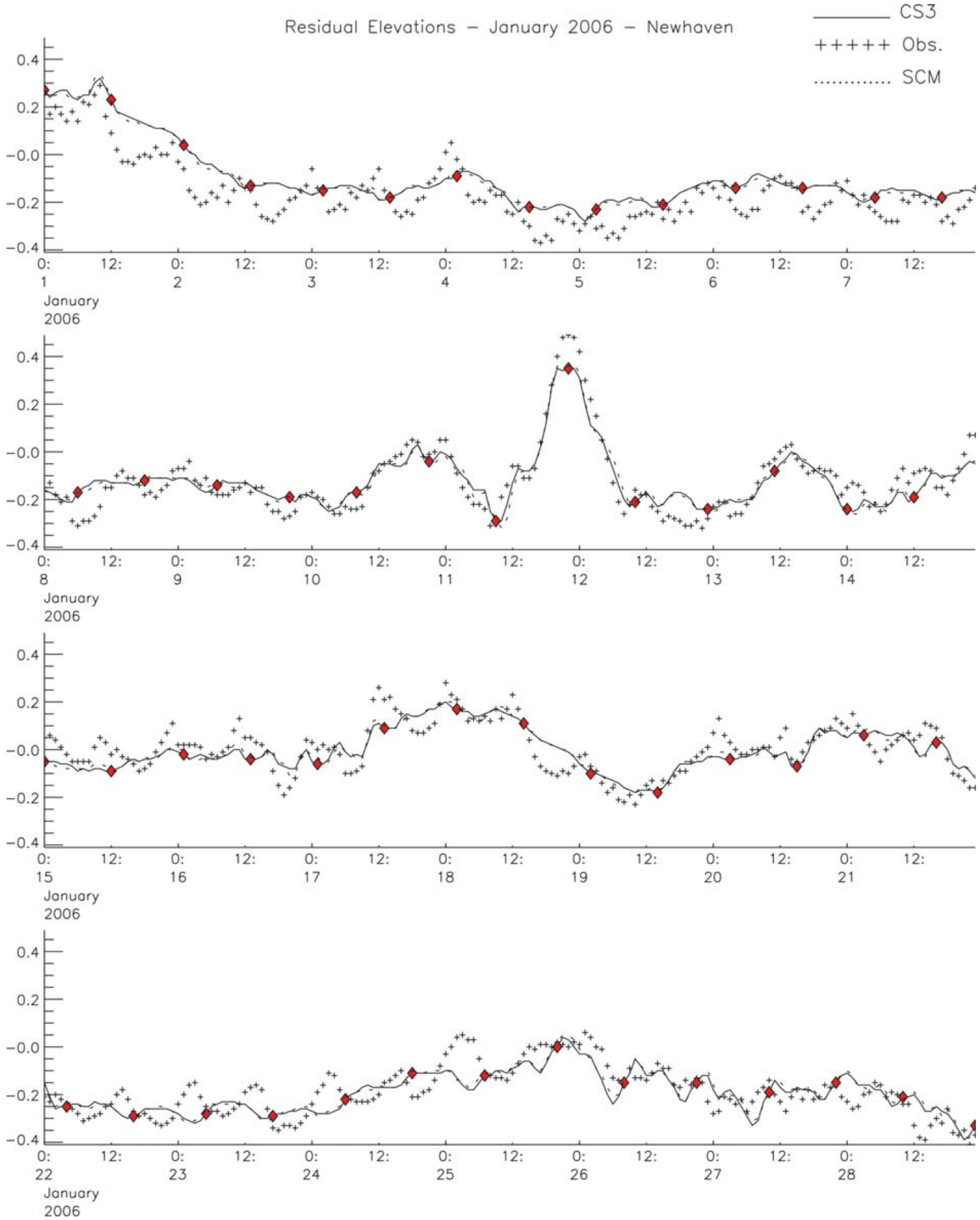
24
25
26
27
28
January
2006


Residual Elevations – January 2006 – Langstone_Harbour
CS3
+++++ Obs.
SCM
0.6
0.4
0.2
0.0
−0.2
−0.4
0: 12: 0: 12: 0: 12: 0: 12: 0: 12: 0: 12: 0: 12:
1 2 3 4 5 6 7
January
2006
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28


Residual Elevations – January 2006 – Littlehampton
CS3
+++++ Obs.
SCM
January
2006


Residual Elevations – January 2006 – Shoreham
CS3
+++++ Obs.
.... SCM
0.4
0.2
–0.0
–0.2
–0.4
0: 12: 0: 12: 0: 12: 0: 12: 0: 12: 0: 12: 0: 12:
1 2 3 4 5 6 7
January 2006
8 9 10 11 12 13 14
January 2006
15 16 17 18 19 20 21
January 2006
22 23 24 25 26 27 28
January 2006


Residual Elevations – January 2006 – Newhaven
CS3
+++++ Obs.
SCM
January
2006