Radial basis function network experiment for sea surface temperature samples

Supplemental Material of

"Reconstruction of Daily Sea Surface Temperature Based on Radial Basis Function Networks"

To illustrate the relationship of the sea surface temperature (SST) samples and radial basis function network (RBFN), we add an experiment with various amounts of SST samples to test the performance of the RBFN method in the paper.

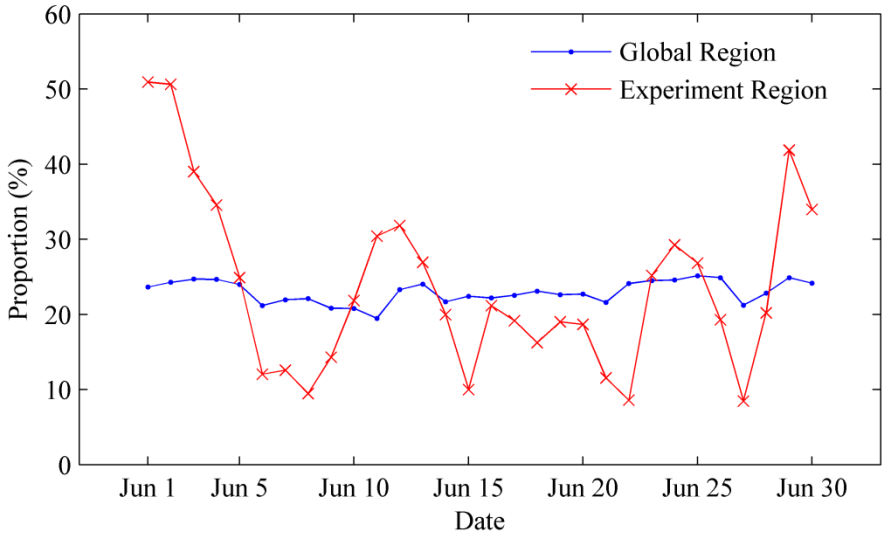

Figure 1 The coverage of SST samples in the global region and the experiment region (20°S~40°S, 140°W~120°W) in June 2014.

In this study, the non-biased SST samples combining the AVHRR L2p data and in-situ SST data as described in the section 2 of the paper are used, and they have been degraded averaged onto a 0.25° grid. These SST samples are selected from the Pacific Ocean (20°S~40°S, 140°W~120°W) in June 2014, in which the distributions of SST sample data change obviously and the coverage ranges from 8.5% to 50.9% as shown in Figure 1. While the coverage of the SST samples stay about 25% in the global region. Since we regard the OISST products as the reference SSTs and the values of SST samples are assigned by the OISST products, the reconstructed SSTs from this RBFN method can be validated with the OISST products in the study.

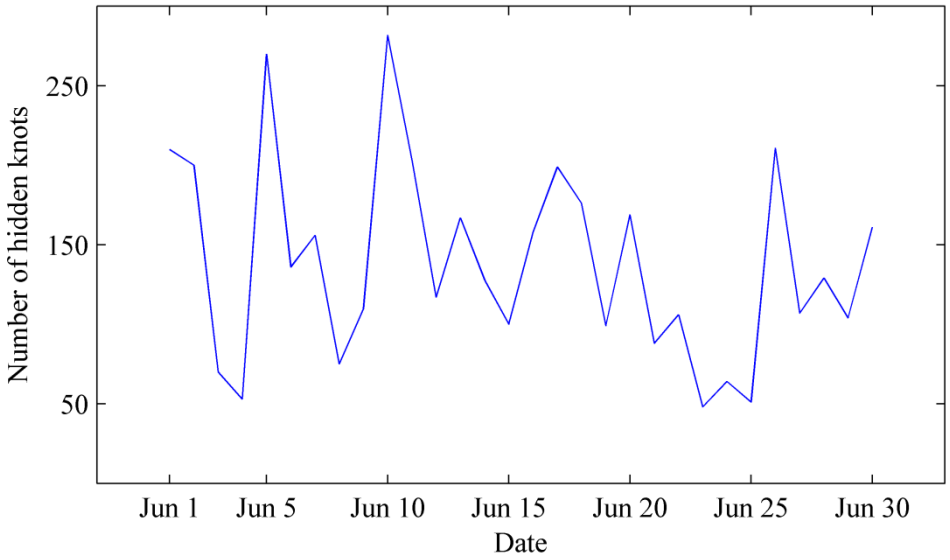

Figure 2 The number of hidden knots for the RBFN in the experimental region (20°S~40°S, 140°W~120°W) in June 2014

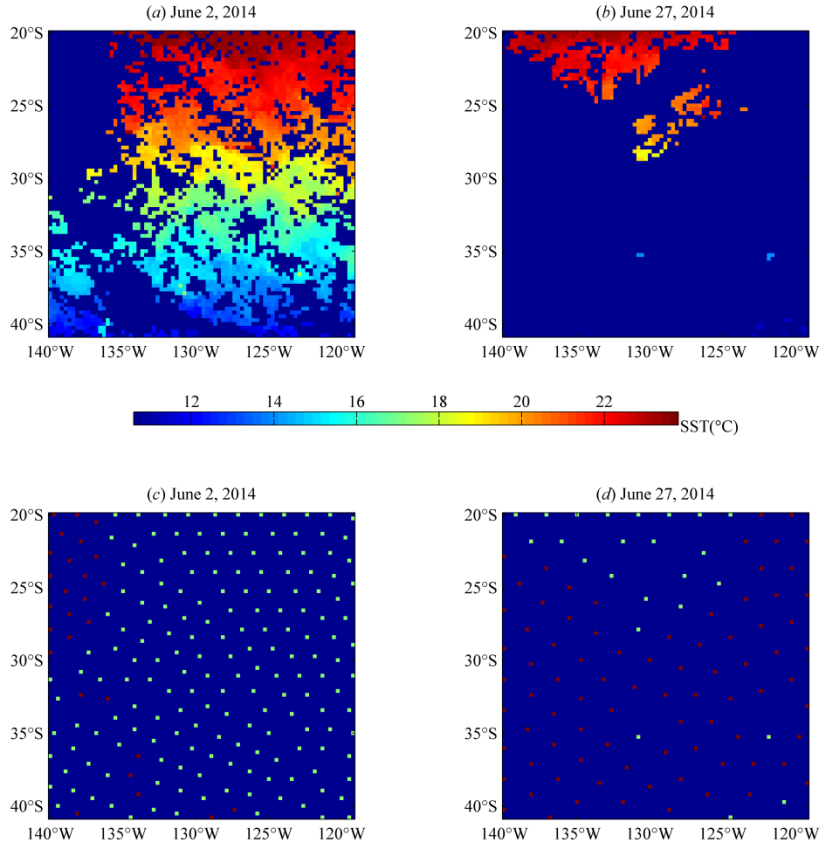

Figure 3 The distributions of SST samples (a, b) and hidden knots (c, d) in the Pacific Ocean (20°S~40°S, 140°W~120°W) on June 2, 2014 and June 27, 2014, respectively.

The optimal hidden knots of RBFNs can be selected by the improved nearest neighbor cluster (INNC) algorithm as described in section 3.3 of the paper, and the number of hidden knots are vary with the distribution of SST samples as shown in Figure 2. For instance, the coverage of SST samples in Figure 3(a) and the number of hidden knots in Figure 3(c)are separately 50.6% and 200 on June 2, including 27 hidden knots (red points) from the background field and 173 hidden knots from the SST samples. While 8.5% of SST samples in Figure 3(b)and 107 hidden knots in Figure 3(d) are obtained on June 27, and only 24 hidden knots are searched from the SST samples.

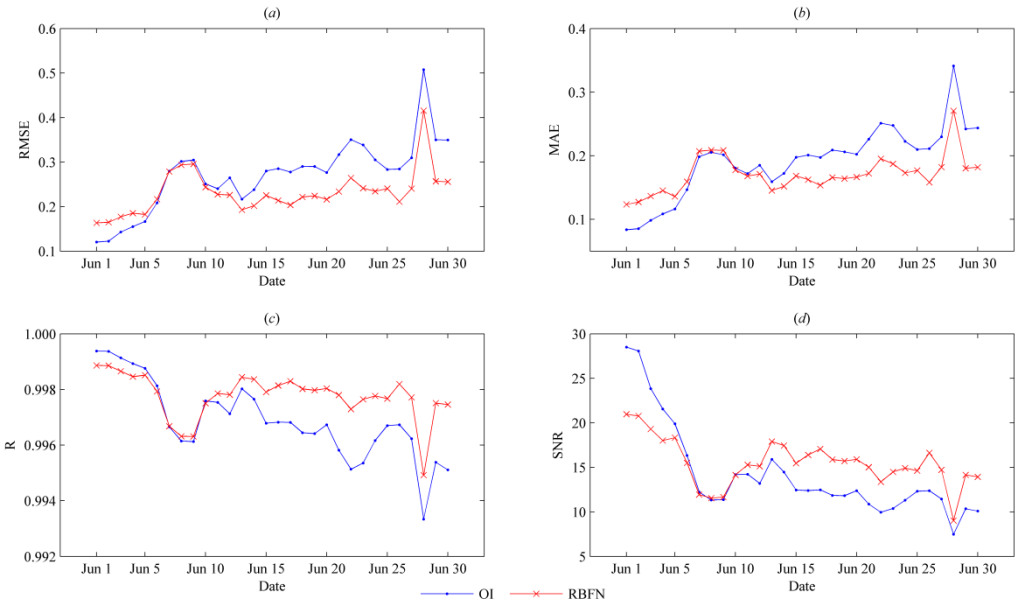

Figure 4 (a) RMSEs, (b) MAEs, (c) Rs and (d) SNRs of the reconstructed SSTs from the OI and RBFN methods in June 2014. The OISST products are selected as reference SSTs and used to validate the accuracy of SST in the study.

Table 1 Statistical results from OI and RBFN methods

	RMSE(°C)	MAE(°C)	R	SNR
OI	0.2702	0.1917	0.9969	14.1705
RBFN	0.2315	0.1708	0.9978	15.5087

Figure 4 displays the RMSEs, MAEs, Rs and SNRs of SSTs from the optimum interpolation (OI) and RBFN methods, respectively. The results indicate that the performances of each error metric from the RBFN method are slightly better than those from the OI method except for the period from June 1 to June 5. The average values of these error metrics in Table 1 indicate that compared with the OI method, the RBFN method can separately increase R and SNR from 0.9969 and 14.1705 to 0.9978 and 18.5087, and decrease RMSE and MAE from 0.2702℃ and 0.1917℃ to 0.2315°C and 0.1708°C, respectively.

It is apparent that the SST accuracy of RBFN and OI method could be affected by the different coverage and distributions of SST samples. For instance, the SST coverage is only 8.5% on June 27 in Figure 2(b) and most of data in the southwest of experimental region are

missing, but the RMSE from the RBFN method is 0.2403°C that is quite less than the value of 0.34°C from the OI method. However, the performance of RBFN method in SST reconstructing is not as good as the results of OI method when the SST coverages are high during the period from June 1 to June 5. As the results from June 2, The coverage on this day in Figure 1 is 50.6% and most of the hidden knots in Figure 3(c) are obtained from the SST samples, but the RMSE of 0.1648°C from the RBFN method is larger than the value of 0.1223°C from the OI method as shown in Figure 4(a).

Therefore, the performance of RBFN method is sensitive to the SST samples. The accuracy of SST field from RBFN method is relatively better than those from the OI method, but the advantage of the RBFN method is not obvious when the coverage of SST samples is high.