**Supplementary** **Material**

The real data is the interferogram obtained from the Sentinel-1 images of Tai Lake, China on 31 December 2019 and 12 January 2020. Figure 9, with a size of 500×500, is obtained by GAMMA software. Figure 9(*a*) is the interferogram without removing the flat earth effect, and Figure 9(*b*) is the coherence map in the corresponding area of the interferogram, and we can see that the coherence of the water is close to 0 and the noise level of water is also very high.

*[Figure 9 near here]*

*[Figure 10 near here]*

*[Table 4 near here]*

We show the filtering results in Figure 10, and the quantitative evaluation indexes corresponding to the Tai Lake data are shown in Table 4. It indicates that the topography adaptive filter has a high smoothness of fringes, but this filter is limited by complex noise of water, whose removal levels of residues are general, SPSD and SPD are also very high. The NL-InSAR filter has a general continuity of fringe and inaccurate results of water areas, so the filtering effect of it is unstable. Concerning the Goldstein and its improved filters, the results of them are relatively stable and they can suppress most noise. Among them, the Zhao and modified LFFE filters are better, with smoother fringes, less residues, relatively better SPSD and SPD. In addition, the AP-Goldstein filter has the least residues, SPSD and SPD, which indicates that the proposed method apparently has the best performance in noise suppression and detail retention.

**Figures**

Figure 9. The Tai Lake dataset used in this experiment: (*a*) interferogram, and (*b*) coherence map.

Figure 10. Filtering results of the Tai Lake data by using different methods: (*a*) topography adaptive filter (*b*) NL-InSAR filter, (*c*) Goldstein filter, (*d*) Baran filter, (*e*) Zhao filter, (*f*) AN-Goldstein filter, (*g*) modified LFFE and (*h*) AP-Goldstein filter.