

Toward the data-assimilation system of marginal/open seas in the SEA-WP region

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Introduction

The South East Asia and West Pacific (SEA-WP) region is a significant reservoir of the world's richest marine biodiversity, but is deteriorating in its coastal ecosystems owing to various environmental threats. For providing a proper conservation strategy, we have started a study that aims at clarifying regional reef connectivity in SEA-WP region and thereby identifying important candidate areas to be properly managed as Marine Protected Areas (MPAs), on the basis of numerical simulations on larval dispersal, molecular biological analysis on meta-population dynamics, and others. To provide realistic ocean currents for the simulation of larval dispersal, we have developed high-resolution ocean general circulation models in the SEA-WP region (Fig.1).

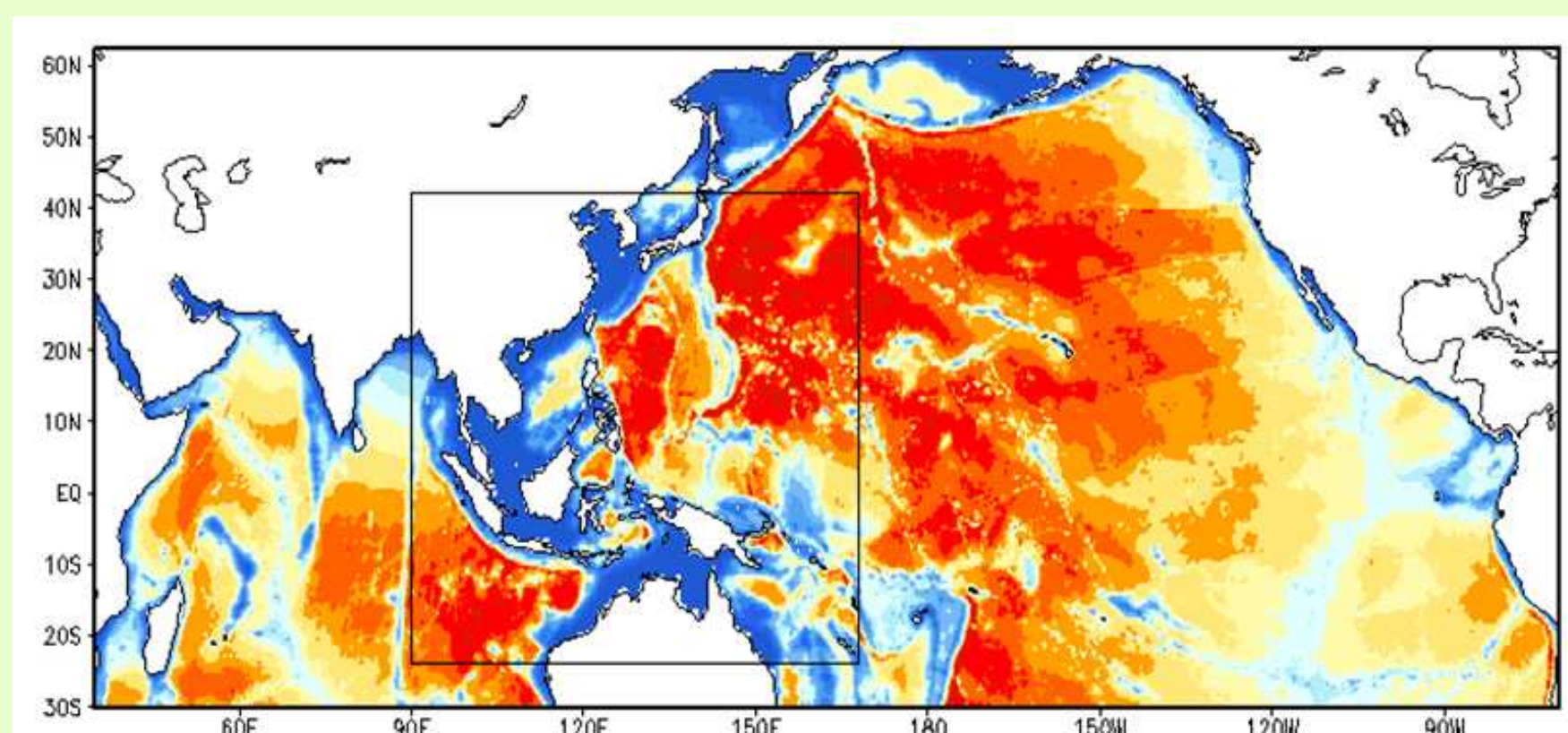


Fig.1. Region of an Indo-Pacific Ocean Model. An inner square indicates a SEA-WP high-resolution model region. Colors denote levels of the bottom topography.

Data assimilation

The data assimilation has potentials for farther improvement of the model skills through combination of both the model and observation. We examined a sensitivity of data assimilation for tracking of drifting buoys using an Indian Ocean forecasting model.(Fig.2) The model is driven by the NCEPGFS atmospheric data and weekly reinitialized by using a 3DVAR method. SSHA(TOPEX/Poseidon, Jason-1, Geosat Follow-On, ERS-1,2, ENVISAT), SST(NOAA), and in-situ T/S profiles(GTSP) are assimilated into the model.

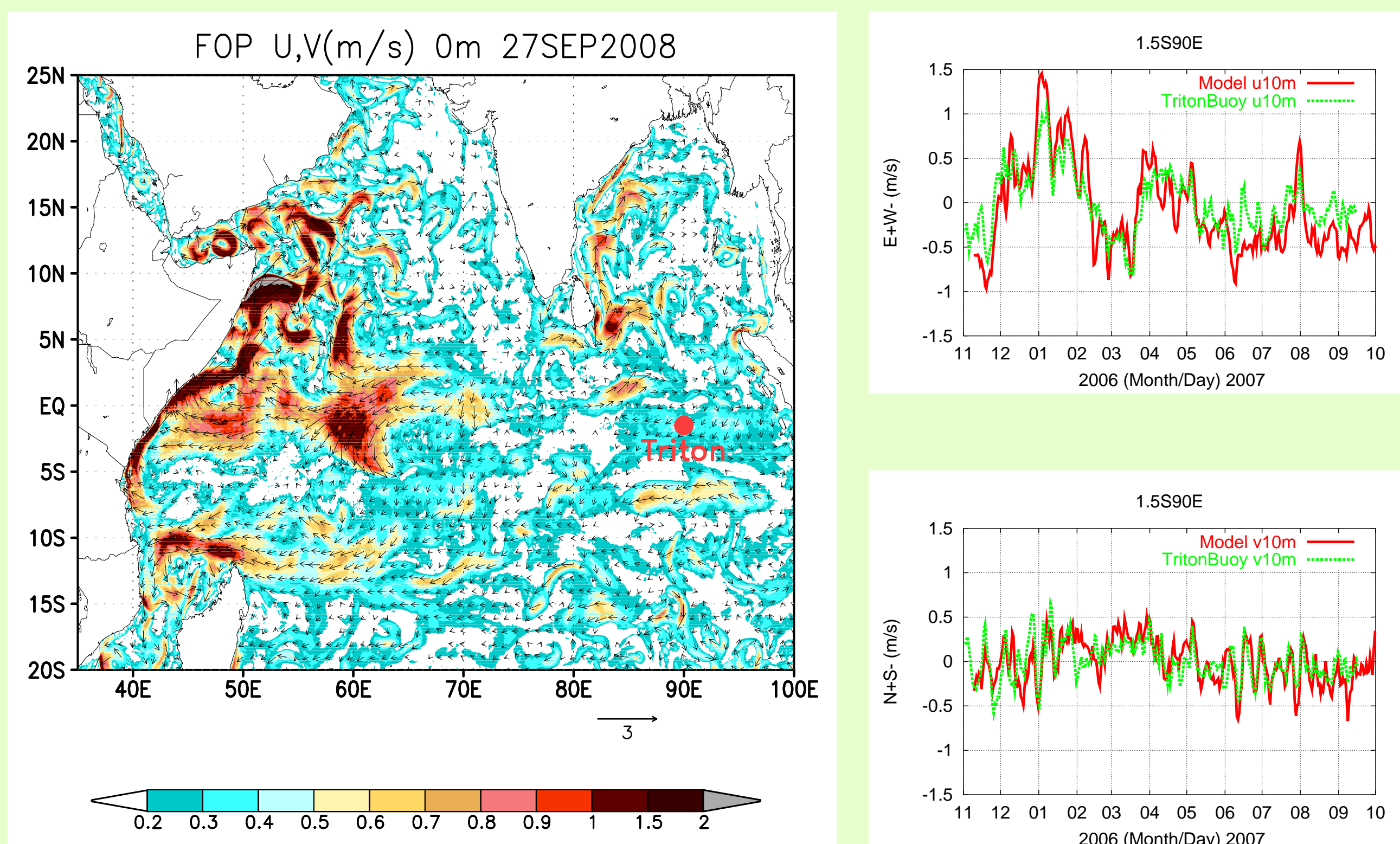


Fig.2. Left : Forecast of ocean currents on 27 Sep. 2007 from initial state on 17 Sep. 2007. Right: Comparison of observed currents from the TRITON buoy and model currents at 10m depth.

Drifting buoy tracking

For investigation of larval dispersal caused by ocean currents, it is useful to conduct particle tracking experiments. To check sensitivity of data assimilation, we performed tracking experiments of drifting buoys using the model currents at 5m depth. Figure 3 indicates the particle tracking well simulated the northeastward movement of the buoy.

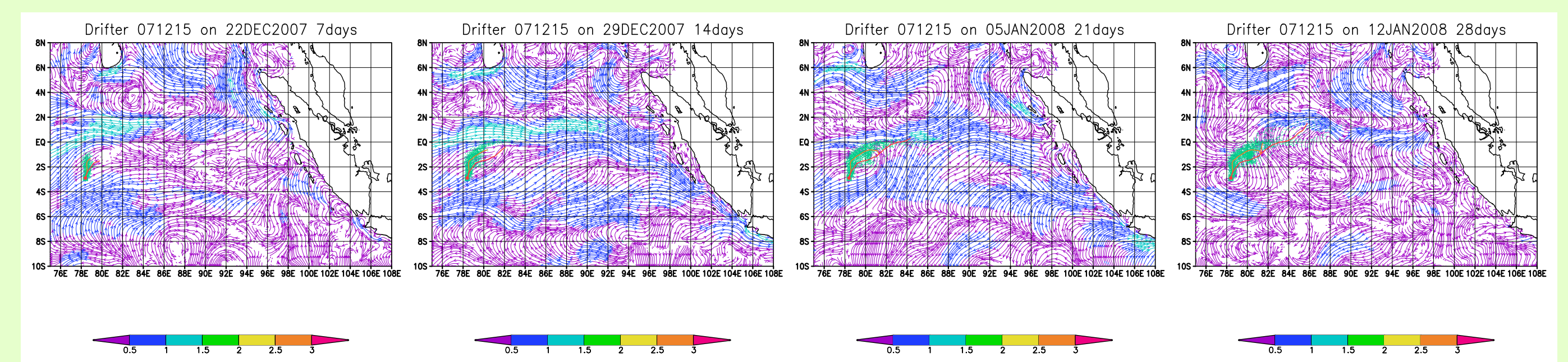


Fig.3. Tracking snapshots of a drifting buoy released on 15 Dec. 2007. Stream lines indicate model results. Red lines denote observed buoy tracks, green points positions of 100 number particles, and orange lines mean of the particle positions.

Comparisons between the model surface currents and the ship drift obtained from the GPS log data (left of Fig.4) showed good skill of the model; Vector correlation was about 0.7. Also, the NCEPGFS wind data well agreed with the observations (right of Fig.4).

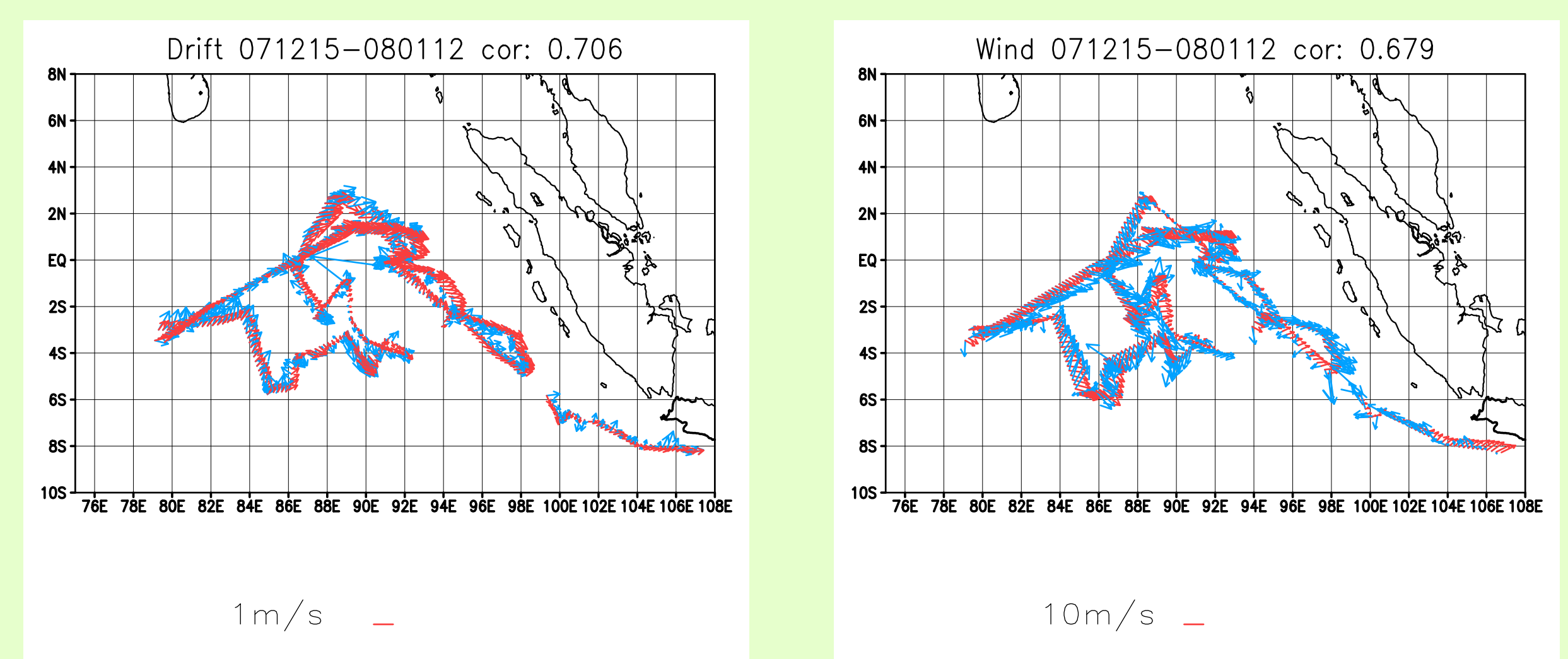


Fig.4. Left : Comparison between the ship drift (blue) and the model surface current vectors (red) from 15 Dec. 2007 to 12 Jan. 2008. Right: As in the left except for the observed wind (blue) and NCEPGFS wind data (red). Decimals indicate vector correlation values.

Sensitivity of data assimilation

We have done two experiments using the currents calculated with and without data assimilation from 18 Oct. 2007. (Fig.5) Without data assimilation, the eastward movement of the buoy was not reproduced owing to weakening of an eastward current near the equator.

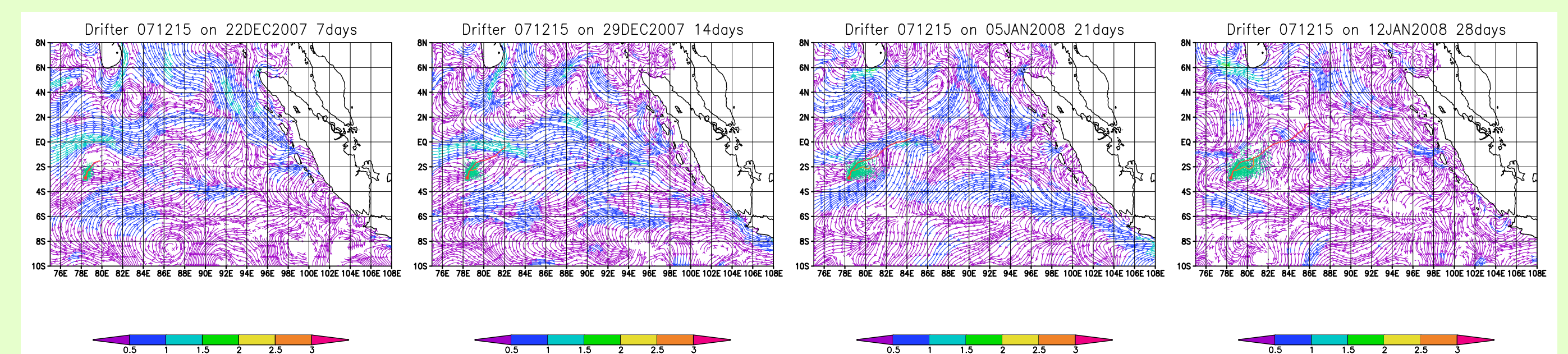


Fig.5. As in Fig.3 except for transportation by the model currents without data assimilation.

Figure 6 also indicates the weakening of the eastward current near the equator due to no data assimilation. (See Fig.4) The strong eastward current near the equator was reproduced by assimilating the SSHA data there. (Fig.7)

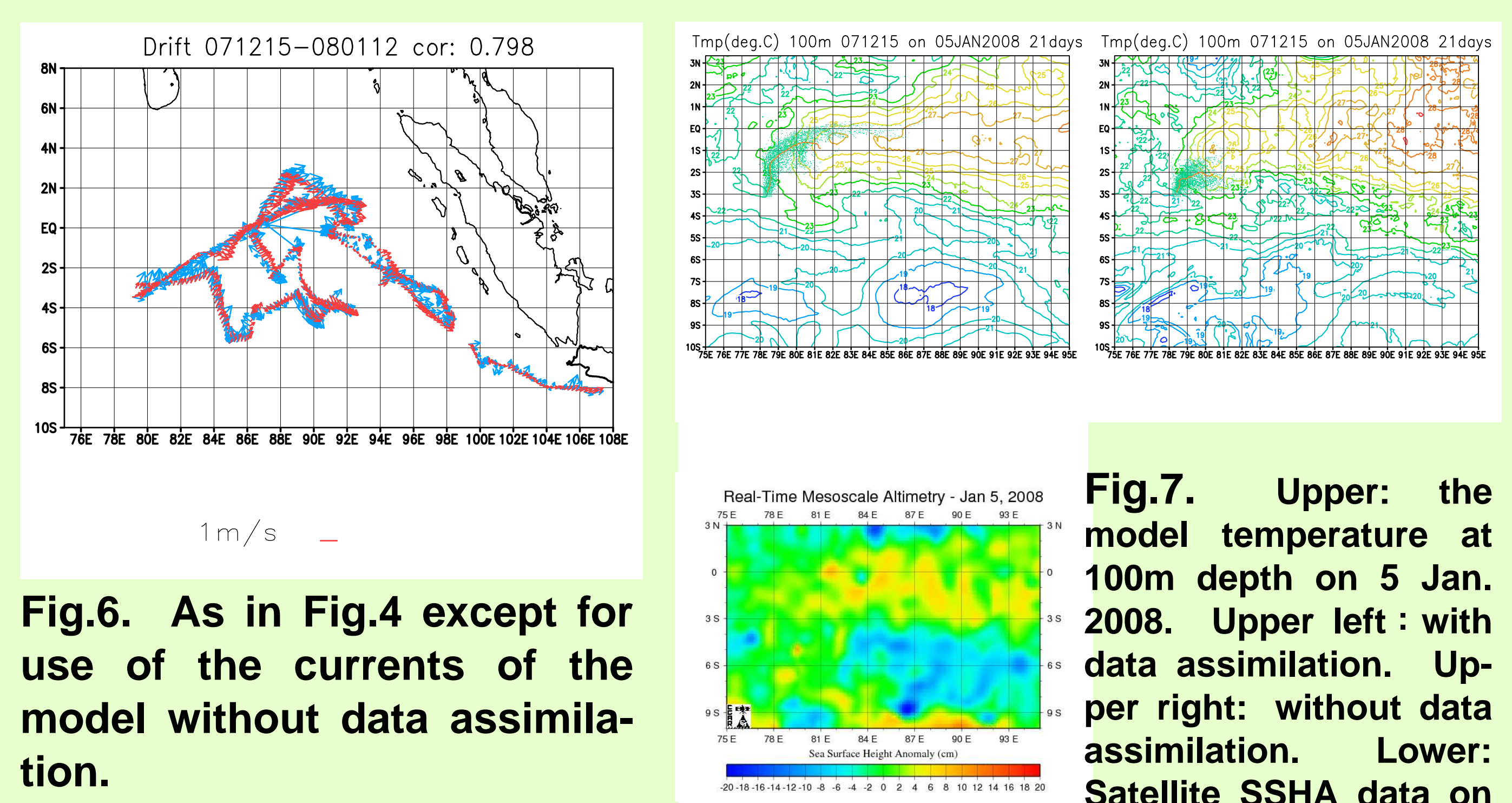


Fig.6. As in Fig.4 except for use of the currents of the model without data assimilation. Fig.7. Upper: the model temperature at 100m depth on 5 Jan. 2008. Upper left : with data assimilation. Upper right: without data assimilation. Lower: Satellite SSHA data on 5 Jan. 2008. (From a Colorado University web site)

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