Comparison of NCOM and ADCP Currents during DART

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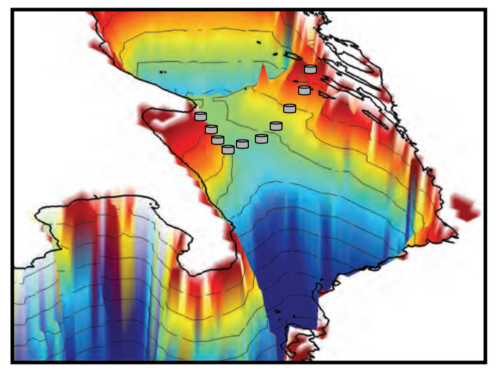


DART

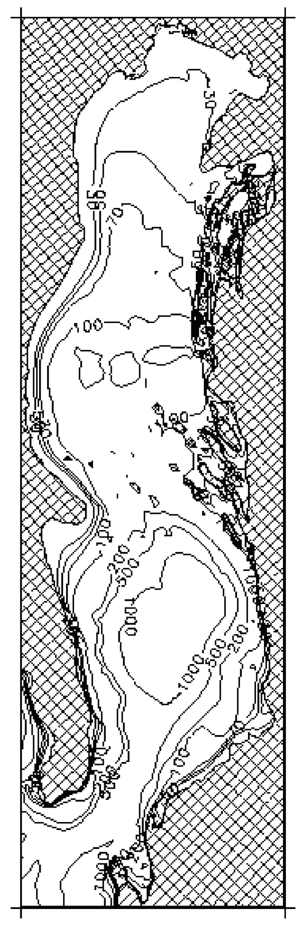
Abstract

Numerical simulations of the Adriatic Sea were conducted with the Navy Coastal Ocean Model (NCOM) during the Dynamics of the Adriatic in Real Time (DART) Experiments conducted between Oct 2005 and Sep 2006. NCOM was run on a high-resolution, 1-km grid. Model forcing included tides, surface fluxes from the ALADIN atmospheric model, relaxation to a daily satellite SST analysis, monthly climate river and runoff discharges with realtime (daily) discharge only for the Po, and open boundary conditions south of Otranto from a global model.

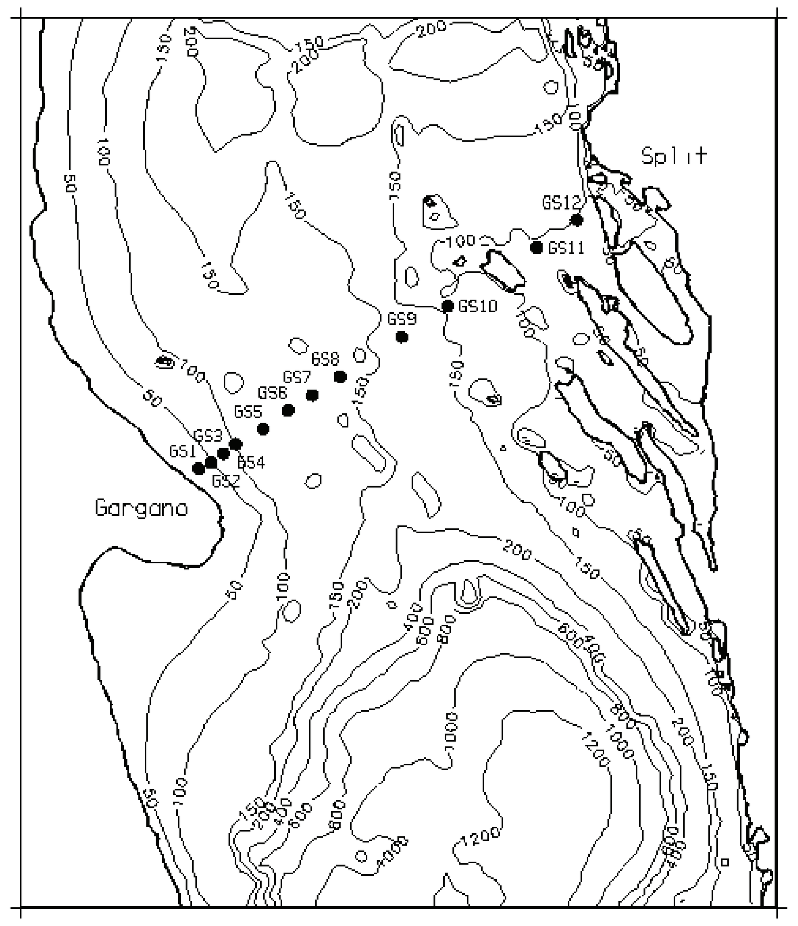
Currents predicted by NCOM were compared with currents from 12 ADCP moorings located along a line between the Gargano Peninsula and Split, Croatia. Tidal analysis of the NCOM and ADCP currents showed generally good agreement. The largest disagreements were near the surface, perhaps due to internal tides. Tidal currents at the moorings were generally small and contributed less than about 10% to the total variance of the ADCP currents at 10-m depth and less than 20% near the bottom.

Further comparisons were conducted using de-tided currents. Correlations between the NCOM and ADCP de-tided currents were highest in the West Adriatic Current (WAC), which flows southeast along the Italian coast, where the path of the current is somewhat constrained. Lowest correlations were in the interior, likely due to non-deterministic variability.

Comparison of current variance also showed best agreement near the Italian and Croatian coasts. In the interior, the NCOM-ADCP mean current variance compared fairly well for Nov-Jan, but for Feb-Aug the NCOM mean variance decreased significantly relative to the ADCPs and the discrepancy increased with depth. Spectral analyses indicate that most of the difference in variance is at frequencies below 0.3 cycles/day.



Model domain



Bathymetry in central Adriatic, depths are in meters. Location of GS moorings is shown, which lie along a line between Gargano Peninsula, Italy and Split, Croatia.

Model

Navy Coastal Ocean Model (NCOM): hydrostatic, Boussinesq, free-surface

Horizontal resolution: 1 km

Vertical grid: 22 sigma layers from surface to 290 m.
10 fixed levels from 290 to 1260 m.

Output: hourly profiles at mooring locations.

Model Forcing

Atmospheric forcing: from ALADIN regional, 8-km model run by Croatian Meteorological and Hydrological Service.

SST: relaxation to satellite SST analysis (NRL's Modular Ocean Data Assimilation System - MODAS).

Boundary conditions: From NRL's Global NCOM.

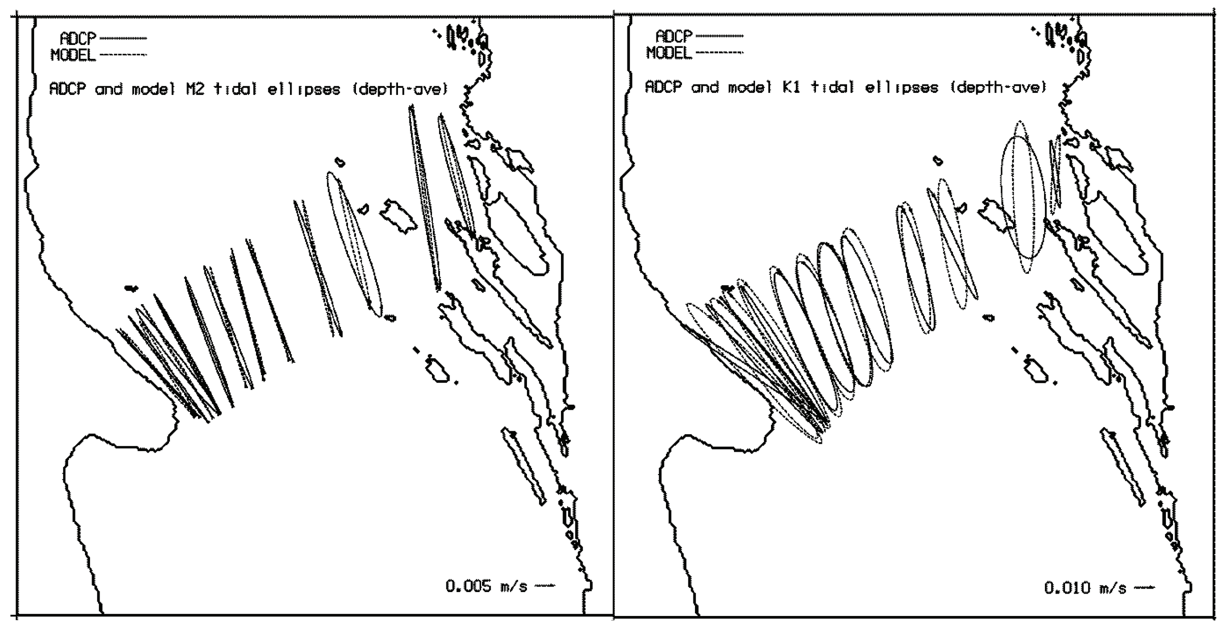
Tides: 8 constituents from OSU global and Med tidal databases and tidal potential forcing in the interior.

Rivers and runoff: monthly climatology for 39 rivers plus runoff from Raicich (1994). Real-time discharge for Po River only.

Mooring data

The moorings consisted of bottom-mounted ADCPs. Bottom pressure, temperature, and salinity were also measured.

Tidal Currents

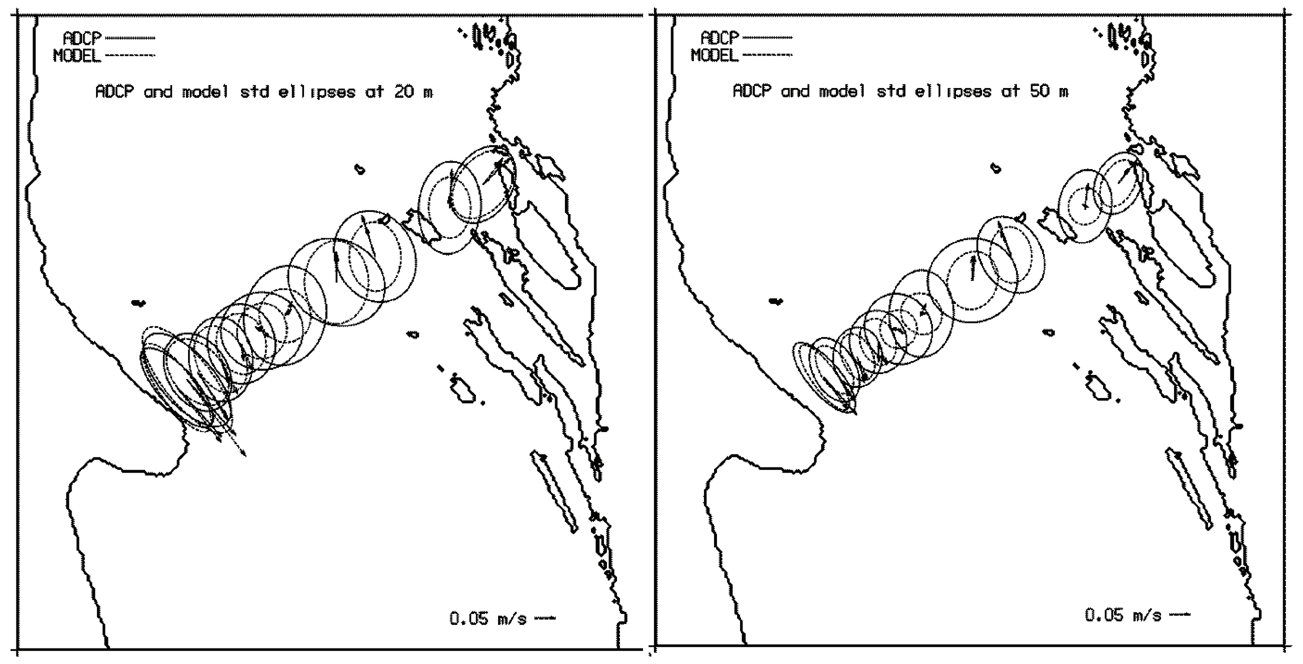


Comparison of NCOM and ADCP M2 and K1 tidal ellipses for depth-averaged current. Dashed line is for the model and solid line is for the ADCPs. Note that scales for the two plots are different. Some of the difference in the tidal ellipses may be due to internal tides.

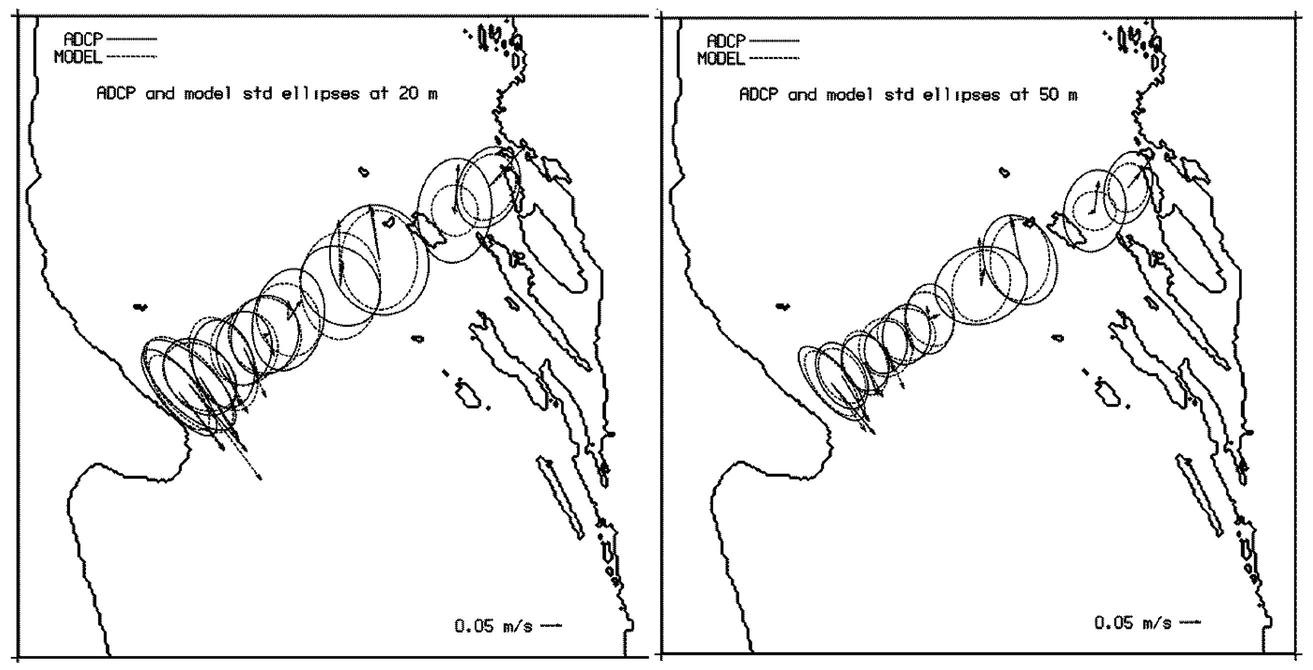
Percent of total current variance of ADCPs due to 8 main tidal constituents

Mooring	surface	bottom
GS1	10.2	9.9
GS2	7.0	11.9
GS3	6.8	12.5
GS4	7.5	16.1
GS5	5.6	18.2
GS6	4.9	12.9
GS7	4.7	11.8
GS8	4.4	8.6
GS9	7.2	7.3
GS10	4.9	8.7
GS11	5.5	10.2
GS12	2.6	5.1

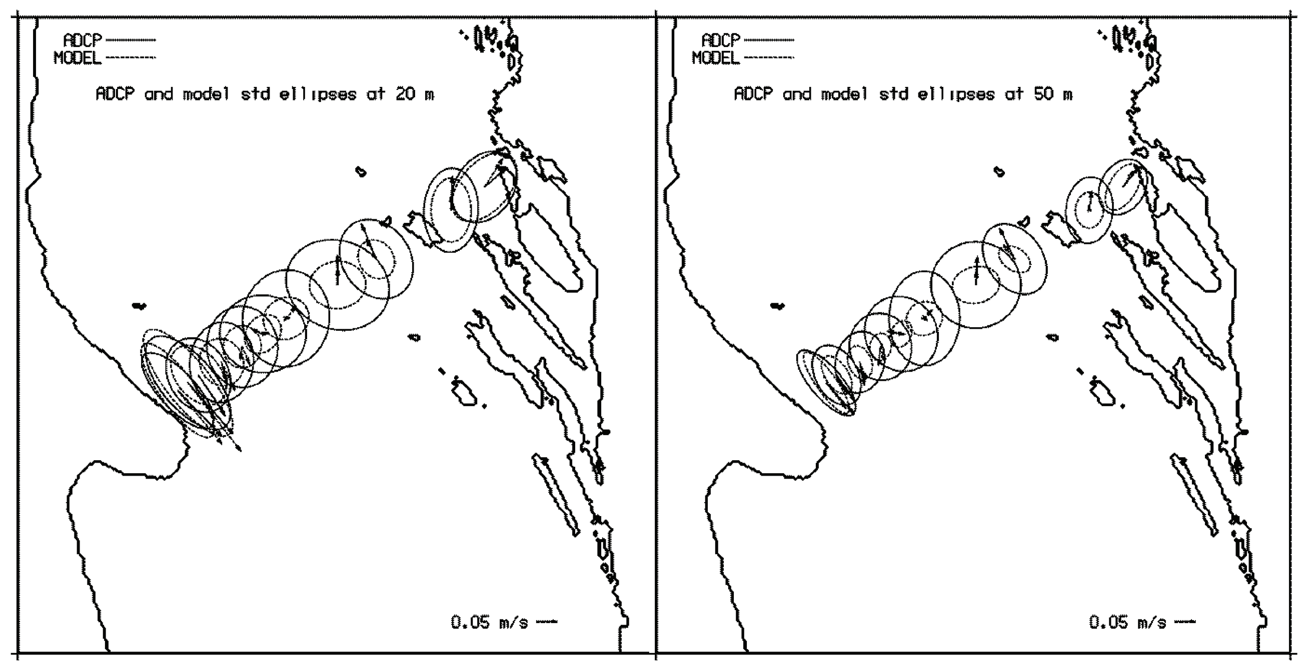
Mean currents and standard deviation ellipses



Comparison of mean currents (vectors) and standard deviation ellipses for period Nov 2005 through Aug 2006 for model (dashed) and for ADCPs (solid) at 20 and 50 m depth. Currents are detided. The current variability of the model is in fair agreement with the ADCPs near the Italian and Croatian coasts, but is noticeably less in the interior and at deeper depths.

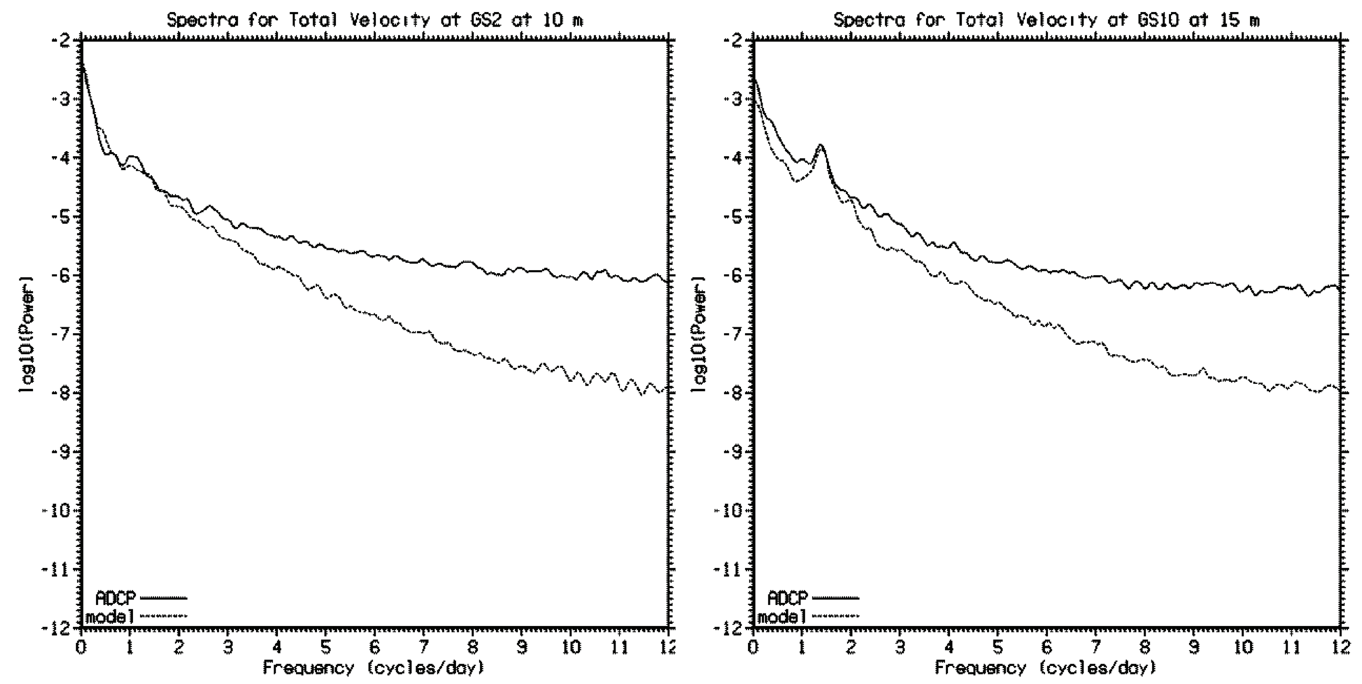


Comparison of mean currents (vectors) and standard deviation ellipses for period Nov 2005 through Jan 2006 for model (dashed) and for ADCPs (solid) at 20 and 50 m depth. Currents are detided. The current variability of the model during this time period agrees much better with the ADCPs than for the later period Feb-Aug 2006 (below).

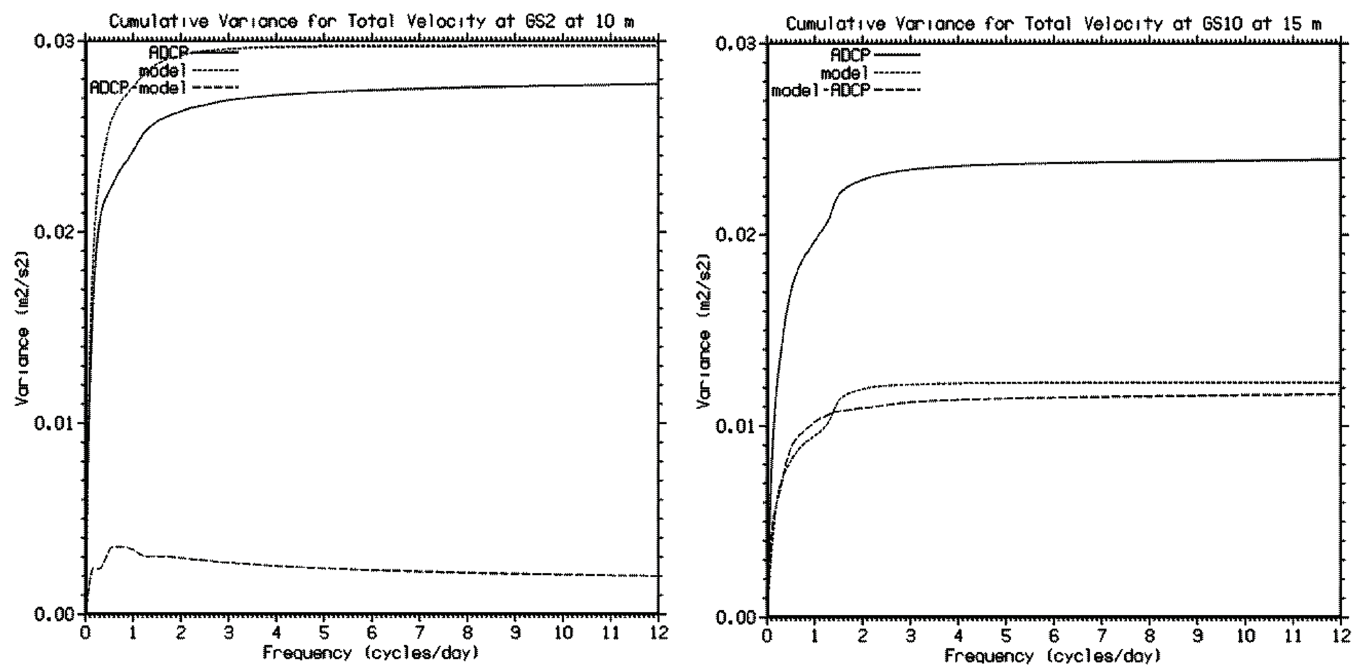


Comparison of mean currents (vectors) and standard deviation ellipses for period Feb 2006 through Aug 2006 for model (dashed) and for ADCPs (solid) at 20 and 50 m depth. Currents are detided. During this time period, the variability of the model currents in the interior of the central Adriatic is significantly less than observed.

Current spectra and variance



Spectra of de-tided currents for period Nov 2005 through Aug 2006 at GS2 at 10 m and at GS10 at 15 m for model (dashed) and ADCPs (solid). The model currents have less variance at high frequencies than observed; however, the fraction of variance at high frequencies is small.



Cumulative variance vs frequency computed from the power spectra at GS2 (10 m) and GS10 (15 m) for model (dotted), ADCPs (solid), and difference (dashed). It can be seen that most of the difference in the total variance at these two moorings is at frequencies below about 0.3 cycles/day. This is also the case at the other moorings. Hence, most of the difference in variance appears to be due to insufficient mesoscale variability in the model.

Error of (de-tided) model currents relative to ADCP currents for Nov 2005 through Aug 2006, averaged over depth. Errors computed are the mean, rms, correlation, and 2nd index of agreement of Willmott et al. (1985).

	principal variance axis				minor variance axis			
moor	mean	rms	correl	index	mean	rms	correl	index
GS1	-0.015	0.113	0.539	0.709	-0.014	0.064	0.035	0.390
GS2	0.016	0.133	0.523	0.714	-0.009	0.072	0.092	0.439
GS3	0.002	0.115	0.599	0.740	-0.010	0.065	0.064	0.413
GS4	-0.017	0.086	0.506	0.684	-0.003	0.067	0.142	0.451
GS5	0.017	0.092	0.194	0.490	0.000	0.075	0.085	0.401
GS6	0.016	0.094	0.128	0.429	0.006	0.078	0.098	0.398
GS7	-0.001	0.096	0.086	0.375	-0.017	0.093	0.114	0.412
GS8	-0.010	0.105	0.221	0.446	0.004	0.093	-0.063	0.319
GS9	0.014	0.106	0.084	0.394	0.007	0.090	0.064	0.363
GS10	0.022	0.096	0.337	0.570	-0.014	0.087	0.065	0.409
GS11	-0.053	0.117	0.186	0.478	-0.004	0.083	0.057	0.406
GS12	-0.023	0.097	0.319	0.572	0.011	0.070	0.175	0.484

The correlation between the model and ADCP currents is highest in the Western Adriatic Current near Italian coast and is lowest in the interior. Correlation of the minor variance axis currents are small at all locations.