SUB-INERTIAL WAVES OBSERVED IN THE GULF OF NAPLES

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Abstract

Inertial oscillations in current records collected in the 1977-1981 period at eleven mooring sites in the Gulf of Naples are analysed. The water kinetic energy associated with near-surface oscillations is more evident during summer months when a 20-30 m surface warm layer is developed, interesting the whole sea area with a strong spatial coherence. The energetic input relative to a sub-inertial event is due to forcing by frontal winds associated with southeastward travelling storm. A shoreward propagation with 20-40 km/day phase velocity, in good agreement with the data reported in the literature, is noted.

Résumé

L'étude des enregistrements courantometriques (des 1977 à 1981) a montré l'importance des ondes sub-inertiales (de frequence 0.05 cycle/heure) pour la dynamique du Golfe de Naples, sourtout dans les mois chauds et dans la couche superficielle mélangée.

Cettes ondes ont une bonne cohérence spatielle, une vitesse de 10 à 20 cm/sec, avec une vitesse de phase de 20 à 40 km/jour. Elle naissent au passagge d'une perturbation météorologique avec une vitesse de déplacement qui est concorde mais d'un ordre de grandeur plus grande que la vitesse de phase.

Since 1977 an oceanographic research in the Gulf of Naples has been carried out (De Maio et al., 1981; Moretti et al., 1981). Like in almost all the Mediterranean sea, also in this Gulf the tides is very small; therefore transient motions generated by at-

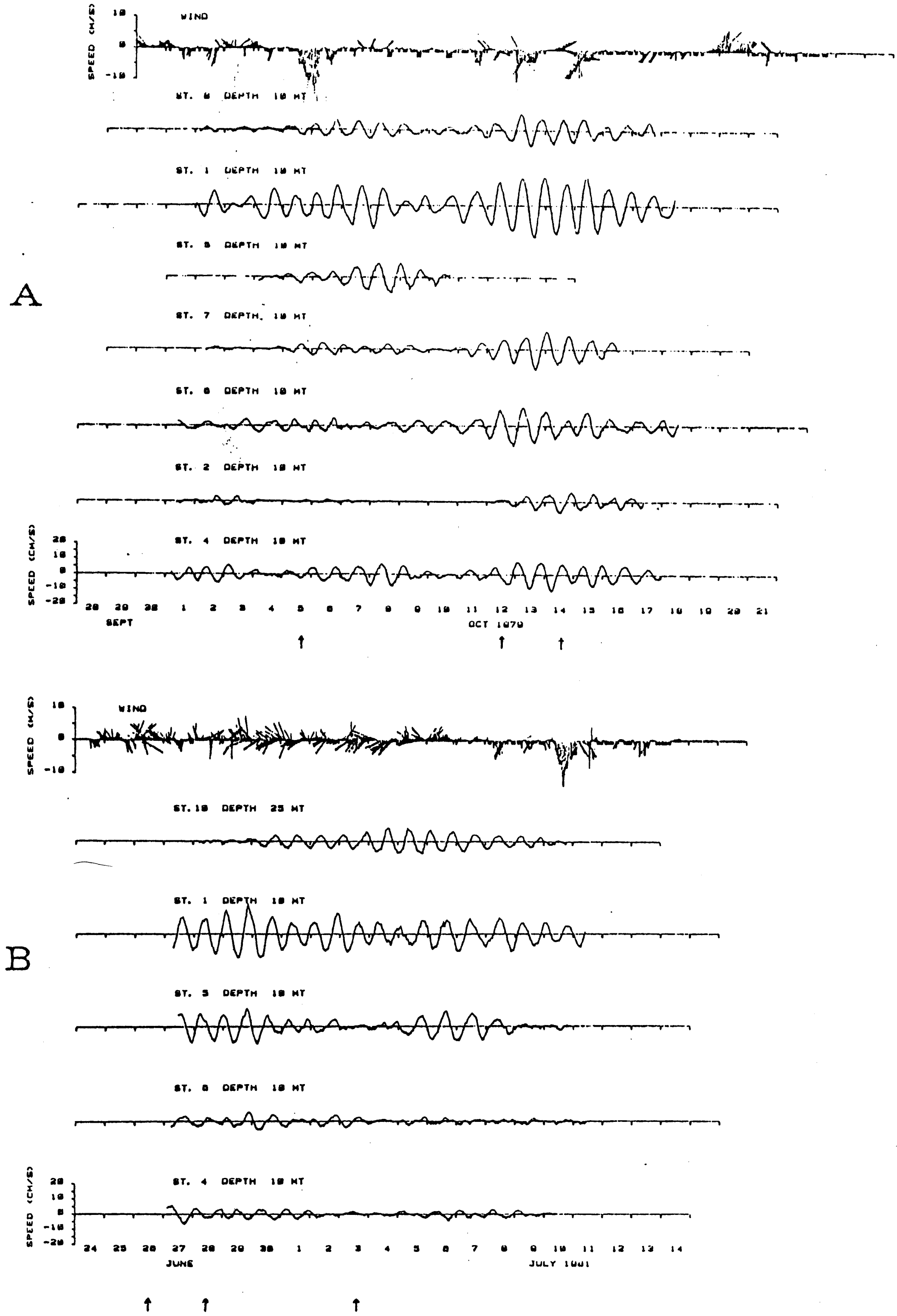


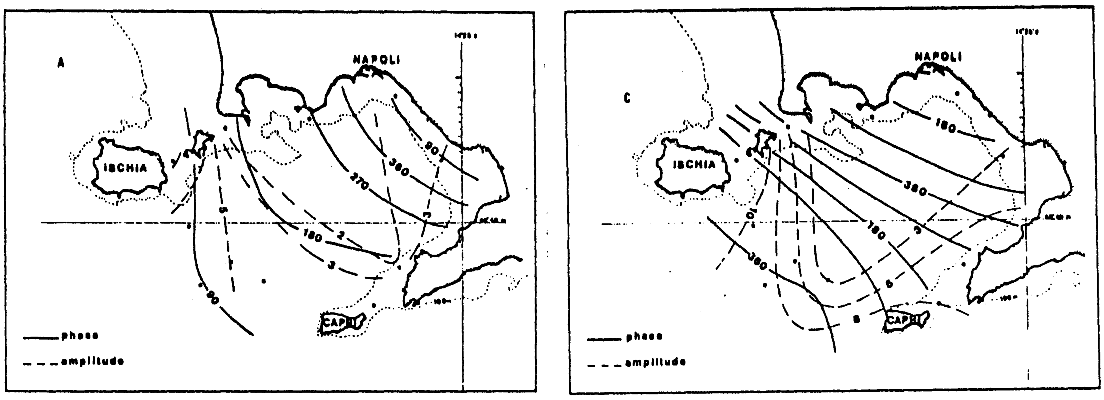
Fig. 2 – Aggregate plots of longshore component of subinertial current for the most representative moorings. Records are band-pass filtered with no filter compensation. Wind vectors are plotted every hour. Arrows mark the time of fronts travelling in the Gulf of Naples. A) First deployment period. B) Second deployment period.

mospheric forcing, i.e. gyroscopic waves with time scale comparable to the inertial period, are the main characteristics of marine dynamics (Millot and Crepon, 1981).

Sub-inertial waves are present episodically when the fluid is well stratifield and almost always their spectral frequency slightly exceeds the local inertial one (0.055 cph, = 40°30') (Le Blond and Mysak, 1980; Gonella, 1971).

Generally the structure of these inertial phenomena interests the whole sea area with a strong spatial coherence in the surface layer as we can deduce from fig. 1, which shows the aggregate plots of long-shore component of a sub-inertial current obtained bya band pass filter with centre frequency 0.055 cph (Bath, 1974; Vultaggio, 1982).

Fig. 1 shows an example of the sub-inertial currents in regad to October 1979 and June-July 1981. We can clearly note at least five events with a characteristic duration of 2-3 days or 3-4 oscillations, which are more prominent in the channel moorings than in the inner part of the Gulf but still coherent with those recorded in outer moorings. This points out that the whole Gulf is generally interested by sub-inertial waves.



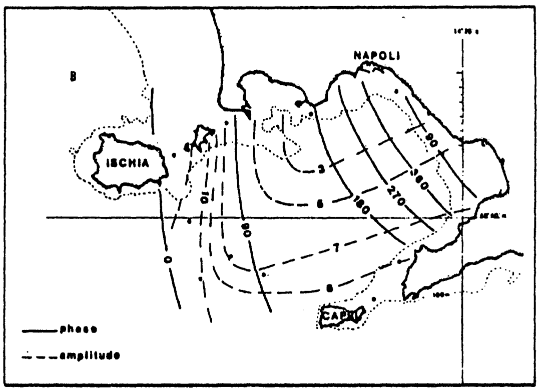


Fig. 2 - Horizontal distributions of amplitudes and phase of the longshore sub-inertial current component during: a)3-8 Oct 79 event; b) 11-16 Oct 79 event; c) 27 June-July 81 event.

We can deduce the wave propagation from horizontal distributions of equiphase lines which are in turn deduced from best-fit computed phase values for each current record and every period.

In fig. 2 we can note shorward propagations with 20-40 km/day phase velocity which agrees with the data reported in the literature (Thomson and Huggett, 1981; Mayer et al., 1981).

The sub-inertial events are almost always associated with a southeasterly storm in the Thyrrenian sea as is case with wave propagation, whose wavelenght seems connected with storm moving.

Generally, deeper current measurements do not record sub-inertial oscillations and that points out a weak downward energy propagation, which agrees with theoretical principles in the case of a very stratified fluing.

In winter, due to very weak stratification, the travels downwards too, so that inertial oscillations are no longer present owing to a quick disipation of their associated energy.

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