

“Capacity Building and Strengthening Institutional Arrangement”

Analysis and sampling of water and water pollution

**REPORT ABOUT MARITIME
METEOROLOGICAL CONDITIONS**

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APAT

Agency for Environmental Protection and Technical Services

THREE MAIN TASKS

- data sources, data collection, data analysis
- modelling systems
- output and results

DATA SOURCES

- ECMWF: ANALYSIS, PREDICTION
- ITALIAN MEASUREMENT NETWORKS: RON, RMN
- ARCHIMEDE PROJECT

ECMWF DATA

The comprehensive earth-system model developed at ECMWF forms the basis for all the data assimilation and forecasting activities

ECMWF 40 Years Re-Analysis describes the climate during 1958 - 2001

ECMWF 15 Years Re-Analysis system generated re - analyses from December 1978 to February 1994

ECMWF forecasts: the model variables for the computation of the forecasts are pressure, temperature, wind and specific humidity. From these primary parameters most meteorological parameters can be derived. Land and sea surface conditions are also described by a series of parameters such as surface roughness, albedo, etc

ECMWF main forecast variables

Upper air parameters



Geopotential height (not on model levels)
 Potential vorticity(*) (not on model levels)
 Temperature
 Vorticity and Divergence (*)
 Wind (U and V components)(*)
 Vertical Velocity
 Specific Humidity
 Cloud ice/water content on model levels

Surface and single level parameters



Mean sea level pressure
 Z, P, u, v, q and ozone mass mixing ratio on PV+2PVU surface
 10 metre wind
 2 metre temperature
 2 metre dew point
 Convective available potential energy
 Maximum and minimum 2m temperature since previous post-processing
 Maximum wind gust since previous post-processing
 Large scale and convective precipitation
 Snowfall
 Surface temperature and soil wetness
 Snow depth
 Total cloud cover
 Low, medium, high and convective cloud cover
 Surface fluxes, surface stress, surface roughness, albedo
 Solar and thermal radiation

RON

-14 directional wave buoys (TRIAxis)

- NEW SITES:



Chioggia
 Civitavecchia
 Siniscola
 Palermo

- upgrading onshore stations
 and control centre in Rome
 - introduction of real-time services

RON

OBJECTIVES

- Measure physical parameters crucial in defining the sea state: H_s , T_p , T_m , θ_m every $\frac{1}{2}$ hrs (on local coastal station)
- Give time series at national scale

HISTORY

- 1989 - 1999, 8 directional wave buoys (WAVEC)
- 1999 - 2002, 10 directional wave buoys (WAVEC)
- 2001 - 2006, 14 directional wave buoys (TRIAxis)

RMN



- IMPERIA
- GENOVA
- LIVORNO
- CIVITAVECCHIA
- PORTO TORRES
- CARLOFORTE
- CAGLIARI
- NAPOLI
- SALERNO
- PALINURO
- PALERMO
- PORTO EMPEDOCLE
- LAMPEDUSA
- CATANIA
- MESSINA
- REGGIO CALABRIA
- CROTONE
- TARANTO
- OTRANTO
- BARI
- VIESTE
- ORTONA
- ANCONA
- RAVENNA
- VENEZIA LIDO SUD
- TRIESTE

RMN

- 26 tide gauge stations, nearly-real time monitoring network of meteorological and marine data
- centre connects by phone with all the stations during the day
- centre performs a preliminary analysis of the data and arranges the information in a data-set

RMN

OBJECTIVES

- Measure sea water level variations and influencing meteorological parameters
- Give time series at national scale

• HISTORY

- The data collection of sea level observation last twenty years in many sites
- The RMN was restructured and upgraded in 1998

ARCHIMEDE PROJECT

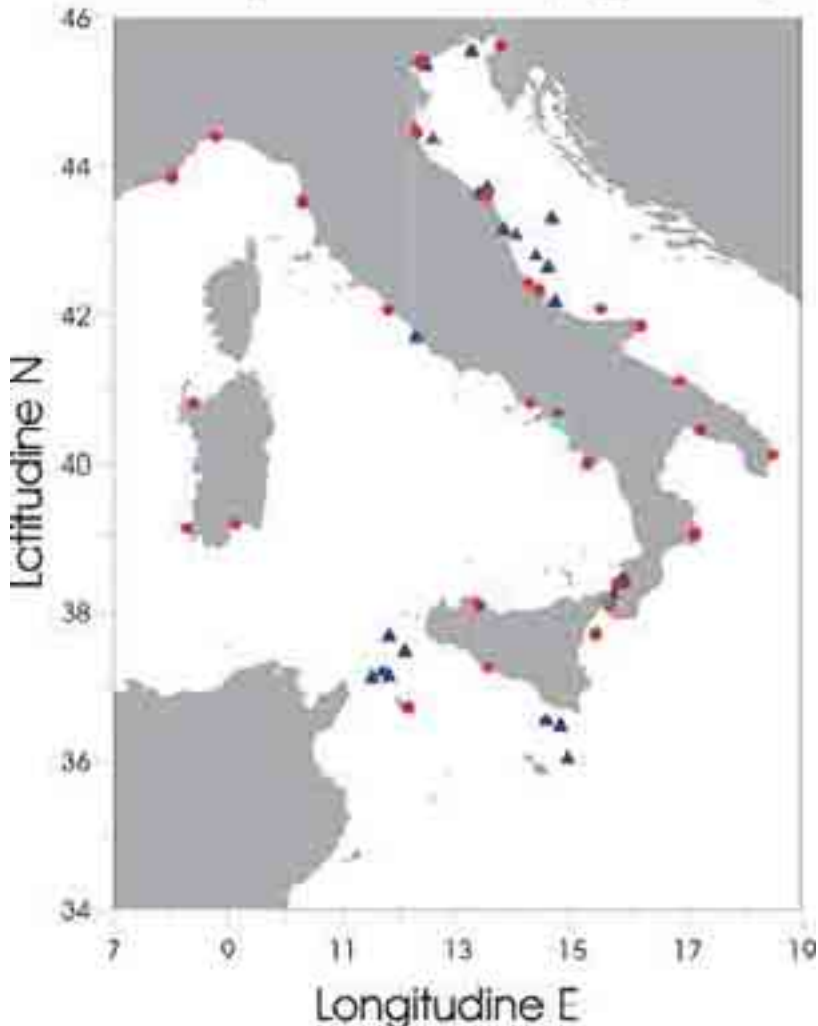
The ARCHIMEDE project aims to facilitate the exchange of national meteo-marine data, gathering data and information which are at the moment spread on multiple sources, as public administrations and private agencies. The collection, the quality control and the storage system of national data meets the needs of make these data available as reference for marine coastal research and actions.

At the moment, data present on this system are those one of the APAT, the National Institute of Oceanography and Experimental Geophysics-OGS of Trieste, the University of Salerno (C.U.G.R.I.) and Snamprogetti S.p.A.






ARCHIMEDE PROJECT

Distribuzione spaziale dei dati di moto ondoso
 42 stazioni (APAT, CUGRI, Snamprogetti e OGS)

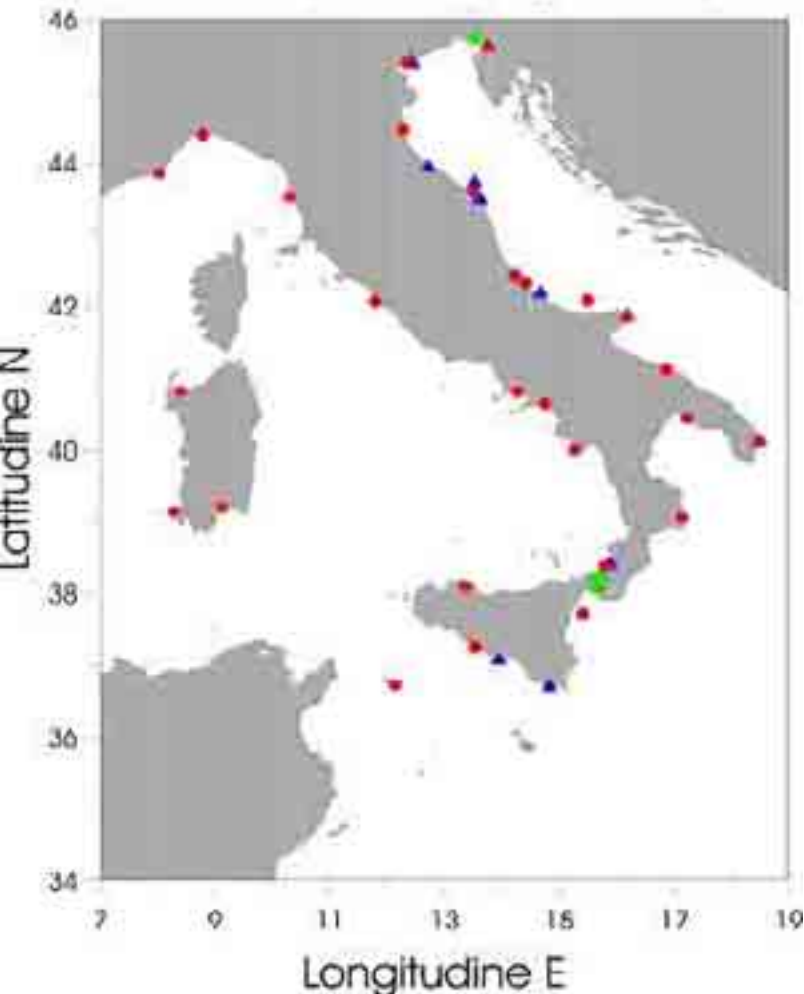


Waves data are recorded from 1971 until to 2004. The total amount of records is 3.281.237 and the number of sites is 45

-  • APAT
-  ★ Snamprogetti
-  OGS

ARCHIMEDE PROJECT

Distribuzione spaziale dei dati di livello marino
 45 stazioni (APAT, Snamprogetti o OGS)

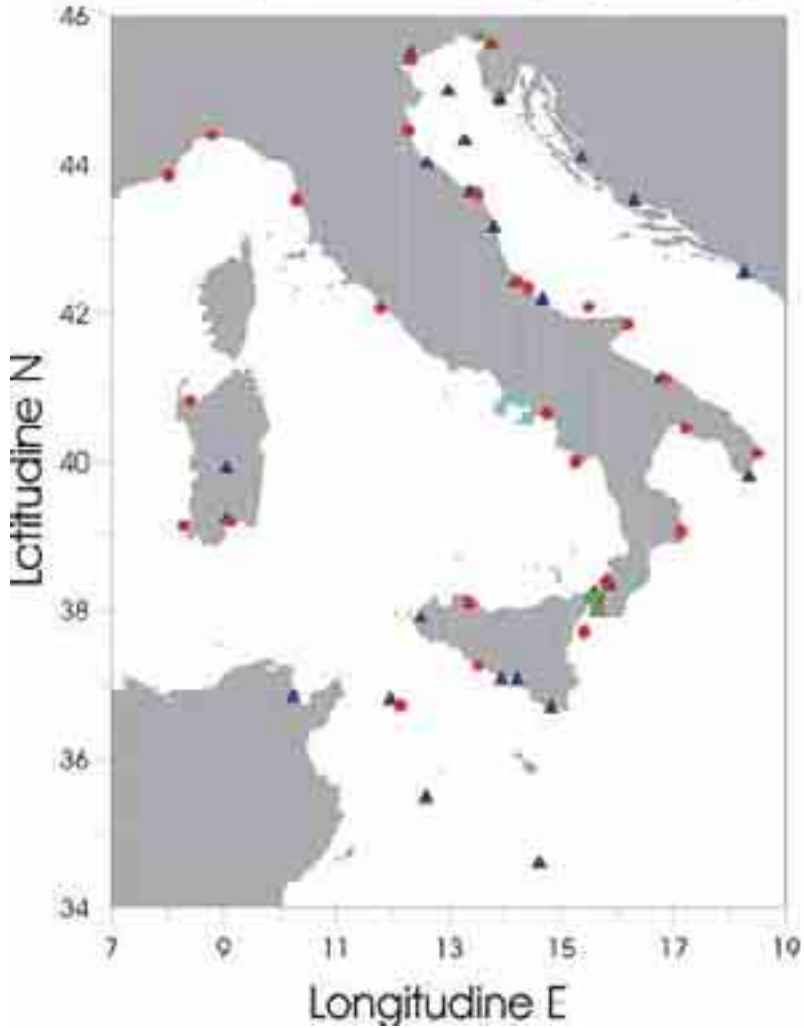


Sea level data are recorded from 1980 until to 2004. The total amount of records is 10.469.912 and the number of sites is 42

-  • APAT
-  ■ CUGRI
-  ★ Snamprogetti
-  ○ OGS

ARCHIMEDE PROJECT

Distribuzione spaziale dei dati meteo e meteo-marini
 67 stazioni (APAT, CUGRI, Snamprogetti e OGS)

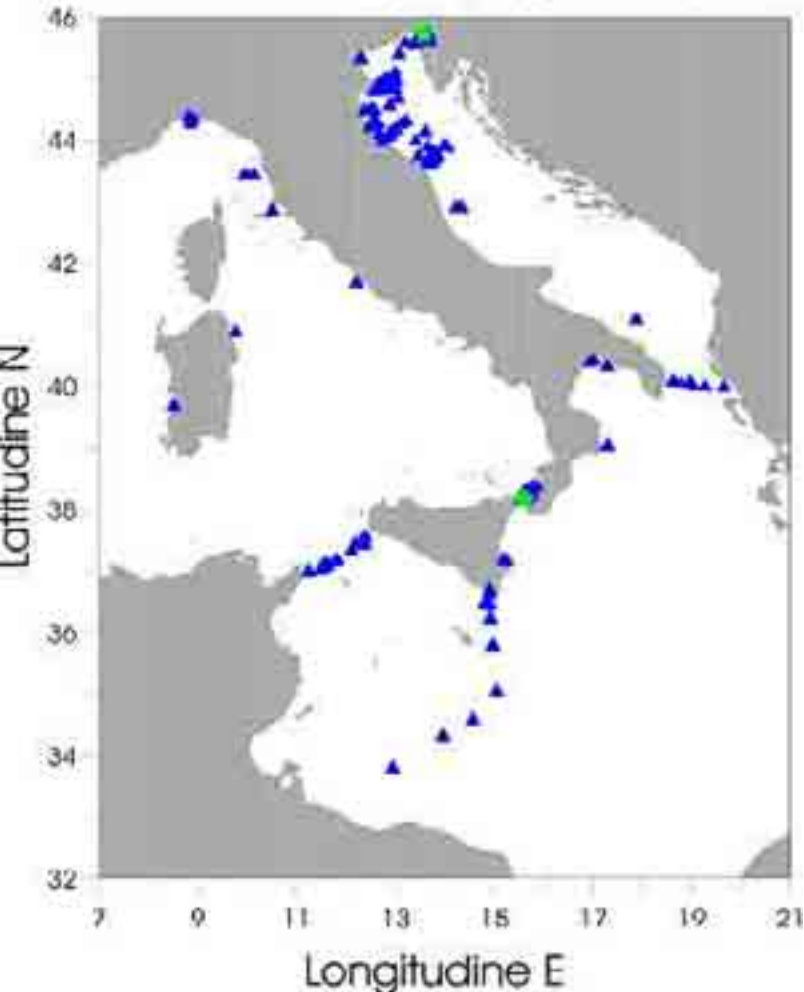


Meteorological data are recorded from 1951 until to 2004. The total amount of records is 2.091.755 and the number of sites is 67

-  • APAT
-  ■ CUGRI
-  ★ Snamprogetti
-  ▲ OGS

ARCHIMEDE PROJECT

Distribuzione spaziale dei dati di corrente marina
 166 stazioni (Snamprogetti e OGS)



Currents data are recorded from 1973 until to 2001. The total amount of records is 5.294.743 and the number of sites is 166



Snamprogetti

★ Snamprogetti



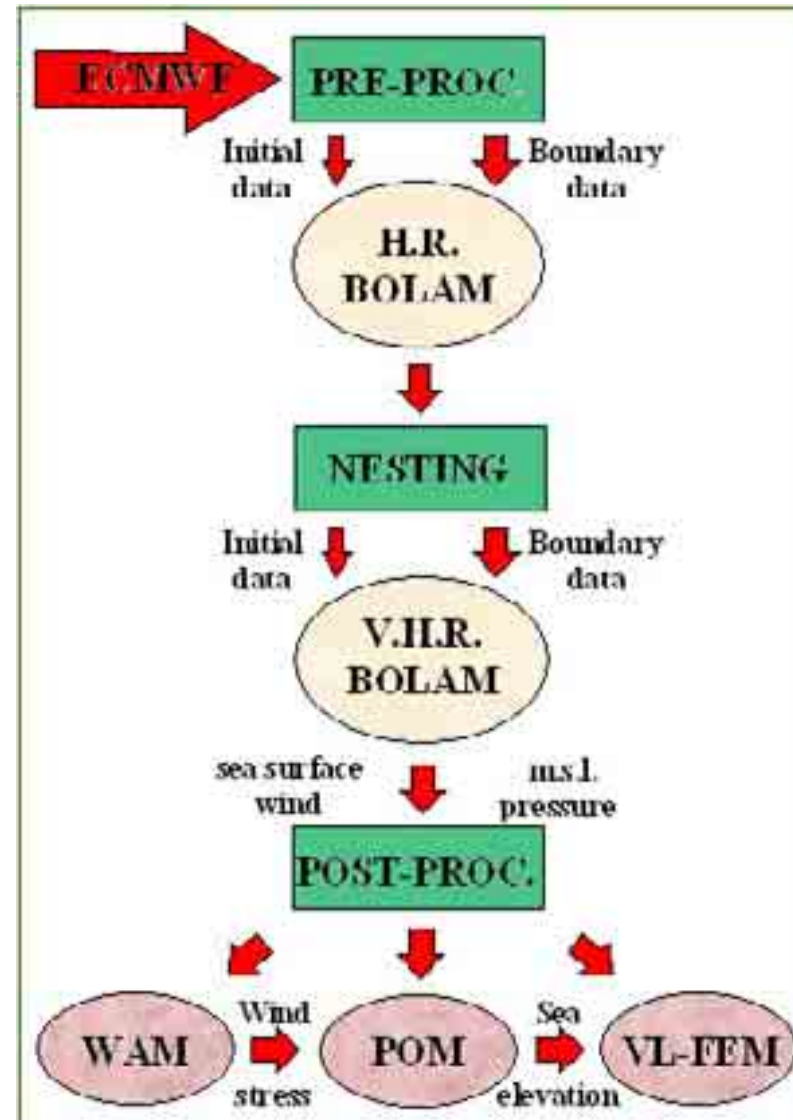
OGS

THREE MAIN TASKS

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SIMM modelling system

The meteorological model with 0.3 degrees grid spacing is initialized using ECMWF analysis fields at 1200 UTC, boundary conditions come from the ECMWF forecast every 6 hours. The run is 60 hours long. The outputs of this run are used as initial and boundary conditions for the higher resolution run. The VHR-BOLAM run start with a delay of 12 hours from the coarser and produces wind and mean sea level pressure field to force WAM, POM-2D and FEM models.



“POSEIDON: An integrated system for analysis and forecast of hydrological, meteorological and surface marine fields in the Mediterranean area”, A. Speranza, 2004

QBOLAM – the atmospheric model: The prognostic variables are longitudinal and latitudinal wind components, potential temperature, specific humidity and surface pressure



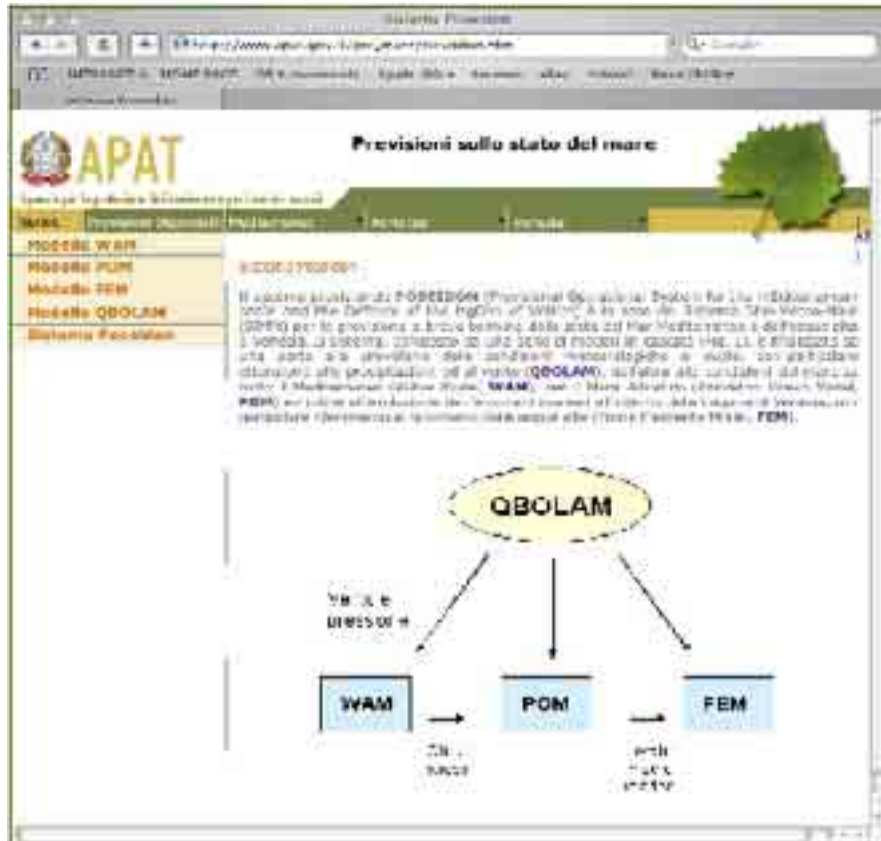
WAM – the wave model: is forced by the atmospheric stress computed using the 10 m surface wind predicted by BOLAM



POM – the ocean model: is driven by the surface wind stress field computed by WAM and by the sea level pressure field computed by BOLAM and it computes the surface elevation



FEM – the finite element model: it is a very high-resolution model of the interior of the Lagoon is used to predict the water level in Venice. In input the model has the levels at the three entrance of the lagoon, evaluated by POM-2D and the stress in the interior of the lagoon derived from the WAM integration



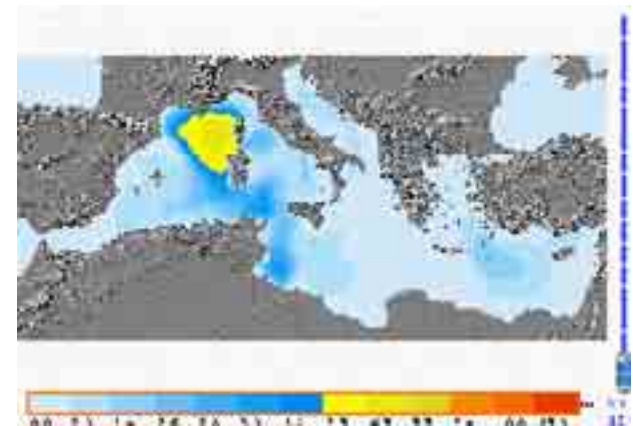
Previsioni sullo stato del mare

Modello QBOLAM

Il sistema di modelli QBOLAM (Quality Based Oceanic Loading Assessment Model) è un sistema di modelli per la previsione dello stato del mare nel Mediterraneo. Il sistema è composto da tre modelli di input: il modello di input del sistema di acque superficiali (SWAM), il modello di input del sistema di acque sotterranee (POM) e il modello di input del sistema di acque marine (FEM). Il modello di output è il modello di qualità delle acque (QBOLAM).

```

    graph TD
      QBOLAM((QBOLAM))
      SWAM[SWAM] -- "IN - SUPERFICIE" --> QBOLAM
      POM[POM] -- "IN - SOTTERRANEA" --> QBOLAM
      FEM[FEM] -- "IN - MARE" --> QBOLAM
      SWAM --> POM
      POM --> FEM
  
```



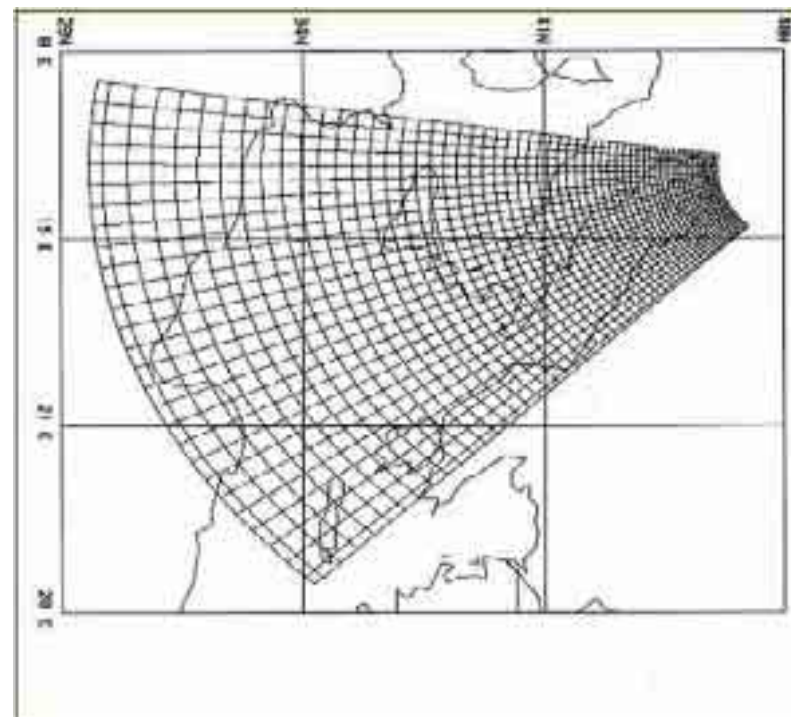
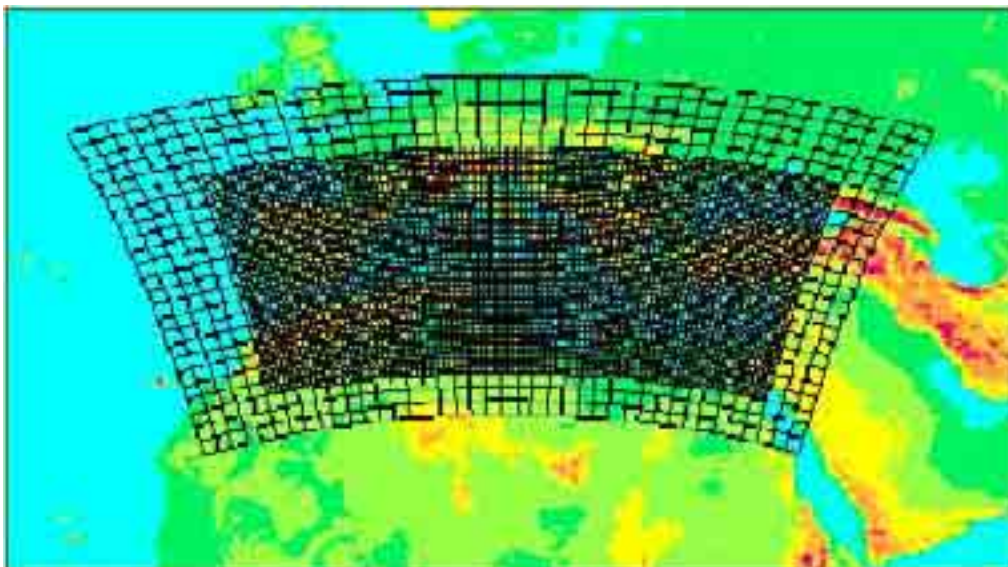

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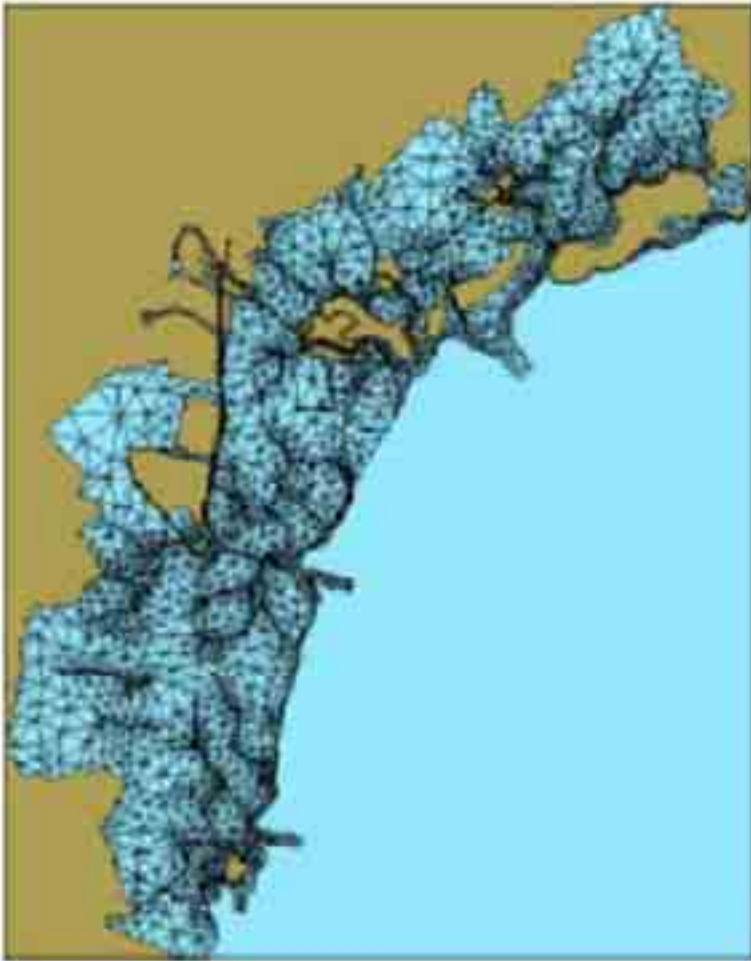


IDRO METEO MARE SYSTEM



“Il Sistema Idro-Meteo-Mare e le reti di monitoraggio marino dell’APAT”, C. Accadia et al.

IDRO METEO MARE SYSTEM

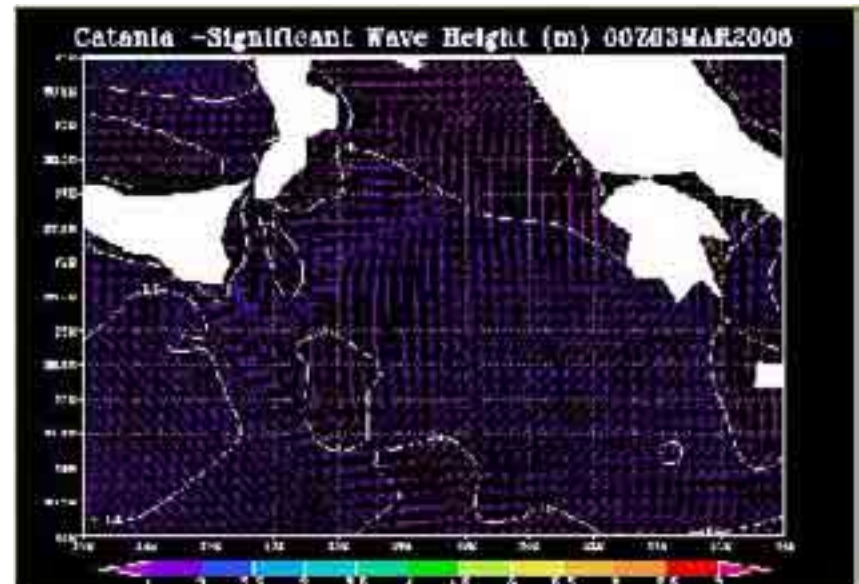
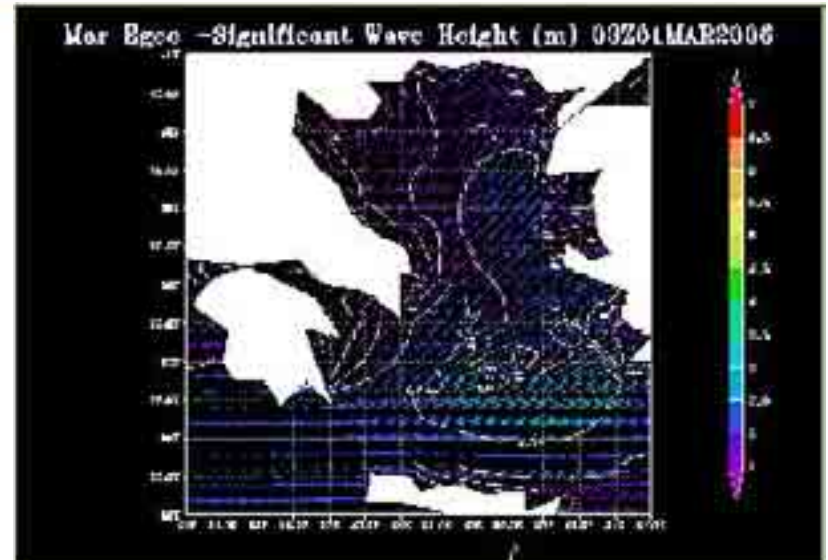
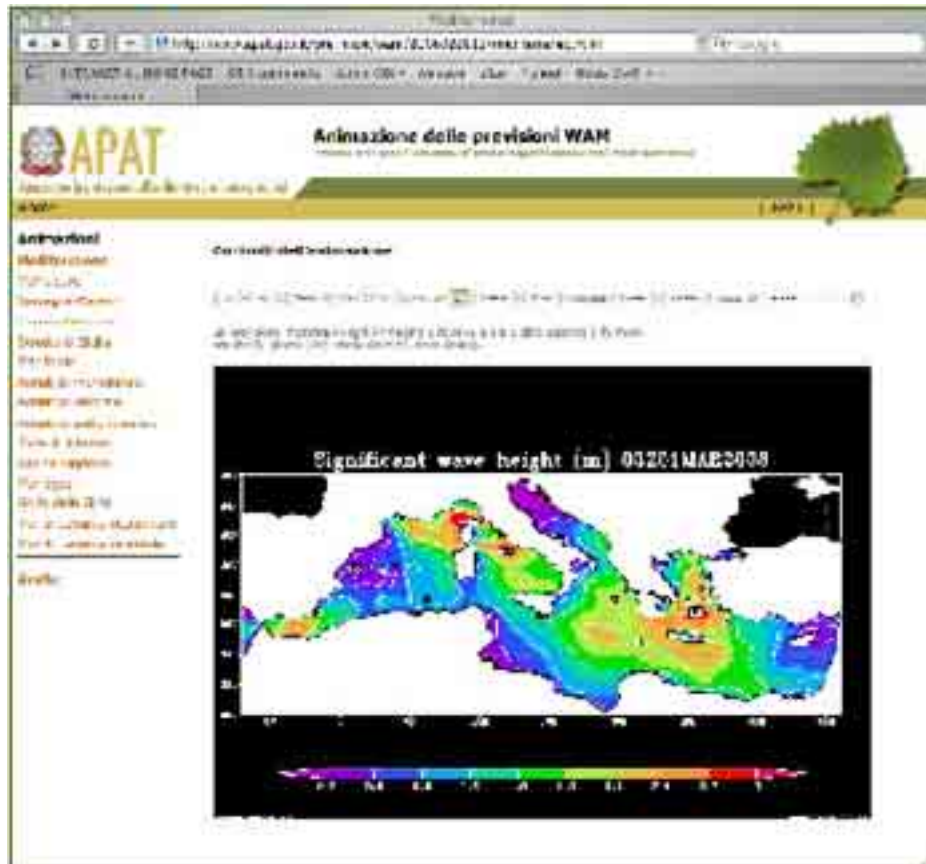


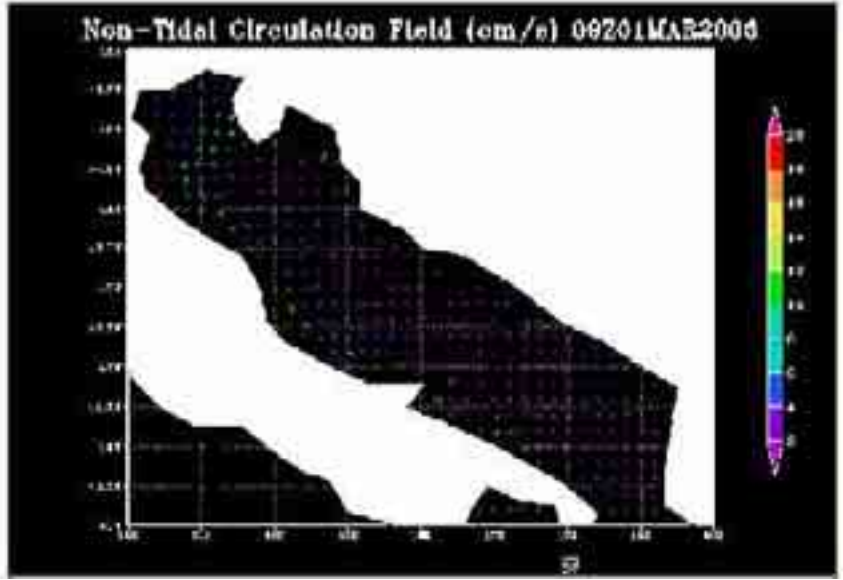
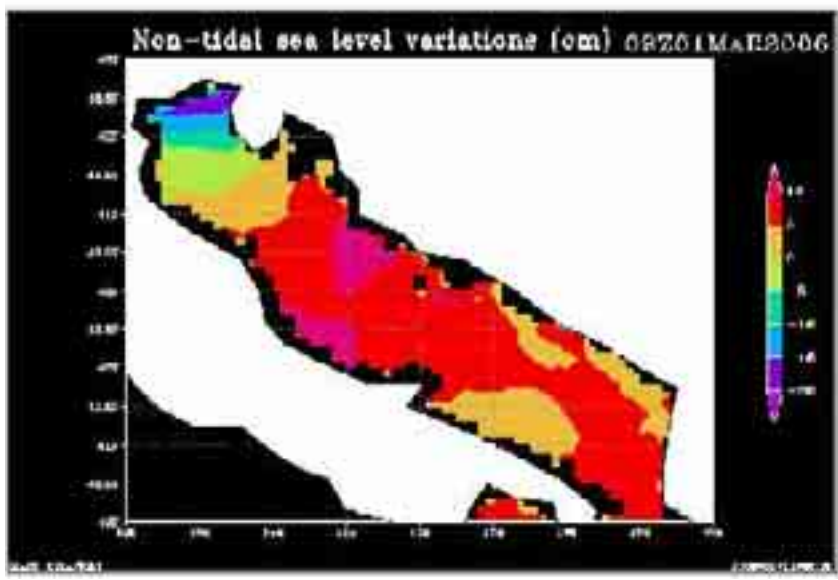
Umgiesser et al., 1988

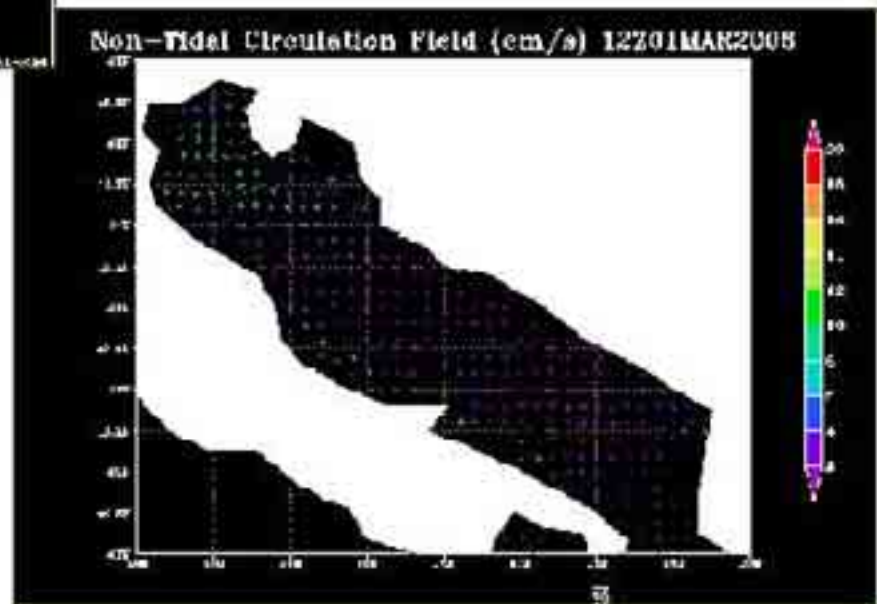
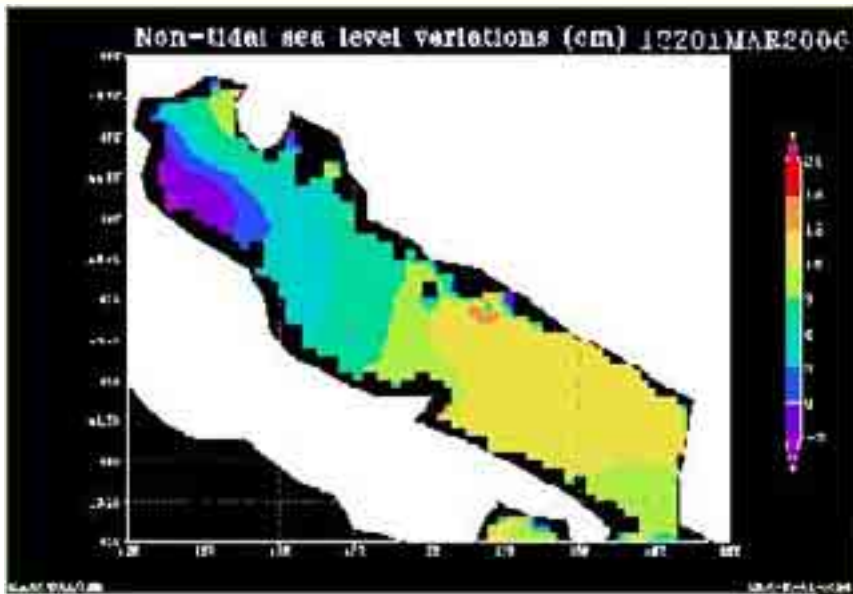
FEM: Finite Element Model

THREE MAIN TASKS

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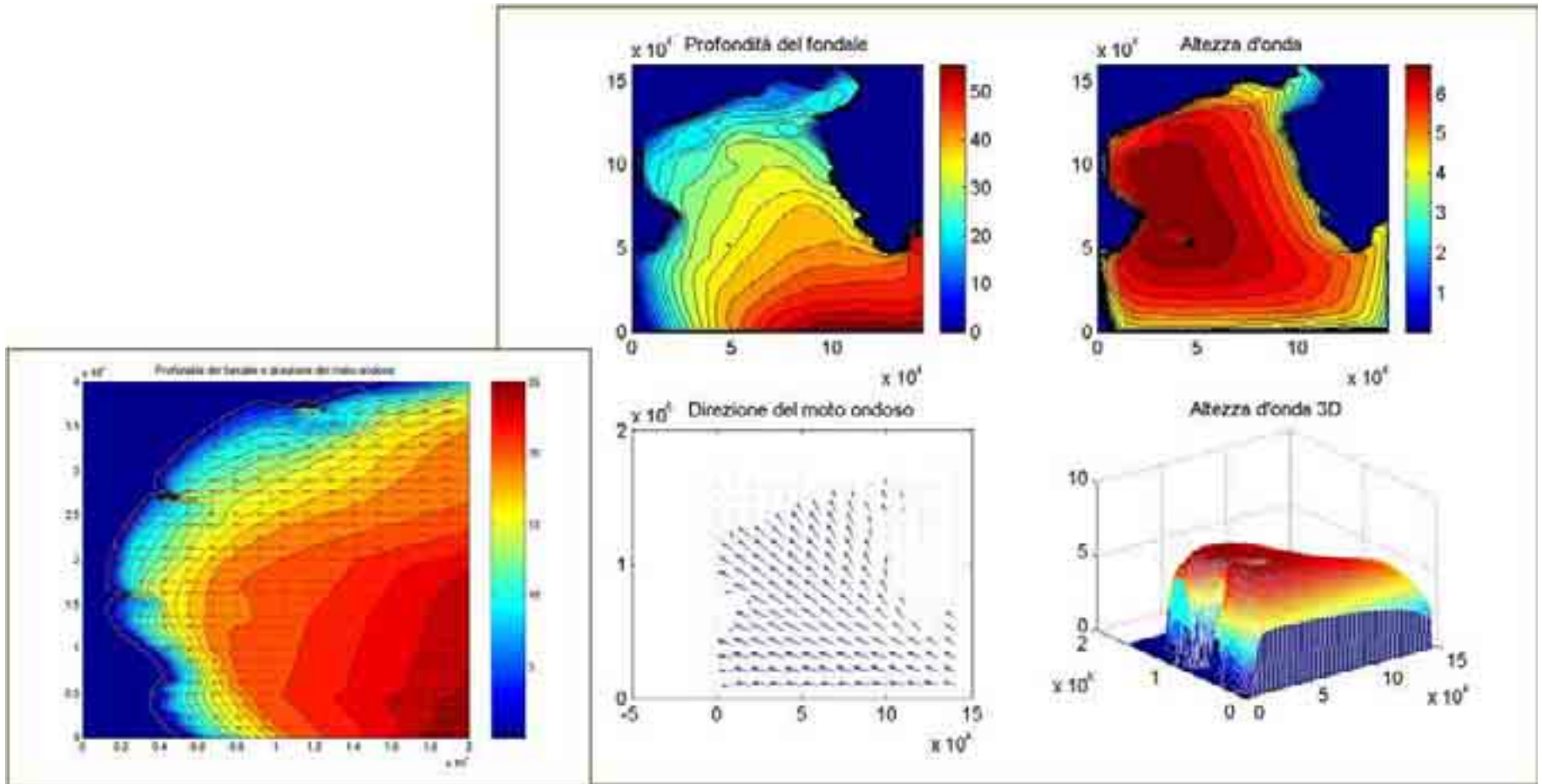
COASTAL AREAS

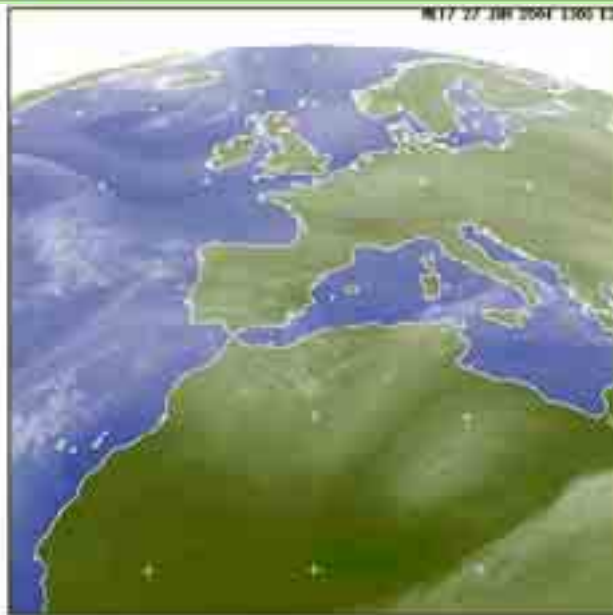
- Large scale models are not able to reproduce coastal physical phenomena (WAM 10-30km)



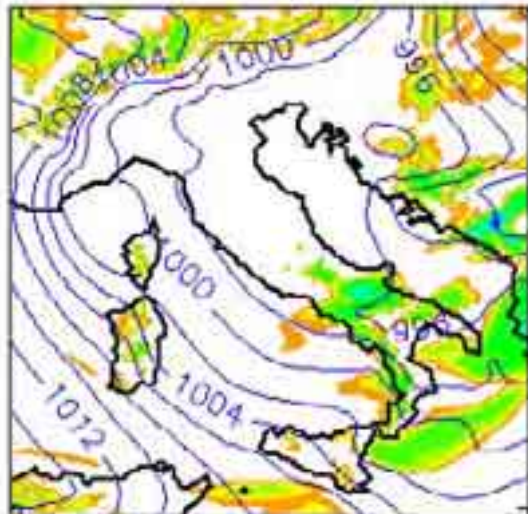
- Nesting with high resolution models: SWAN
- Crucial physical phenomena: shoaling, refraction, reflection, wave breaking due to wave – bottom interaction

SWAN

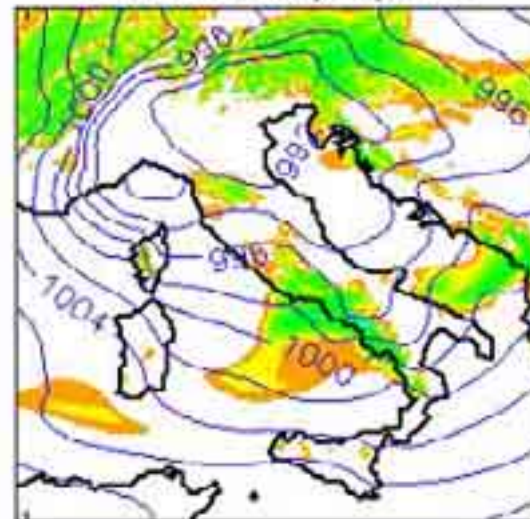




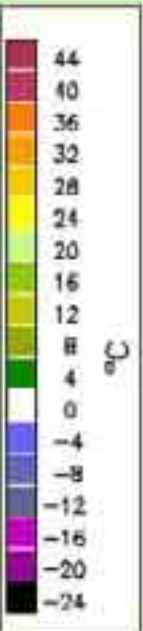
15 UTC del 28/01/2004



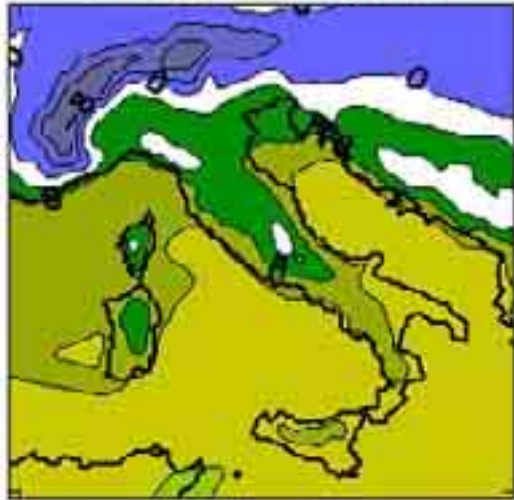
18 UTC del 27/01/2004



Pressure

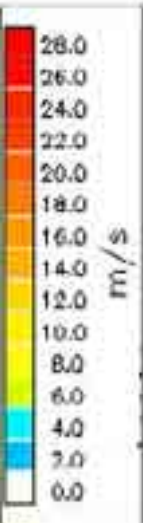


18 UTC del 27/01/2004

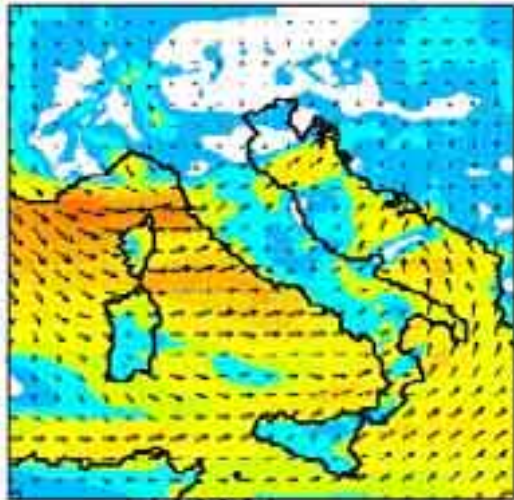


Temperature
(2 m)

18 UTC del 28/01/2004

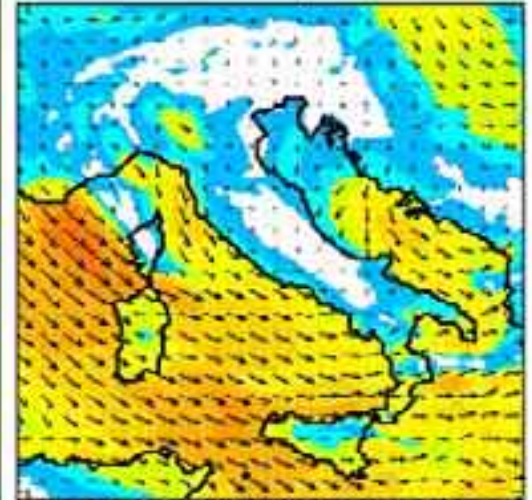


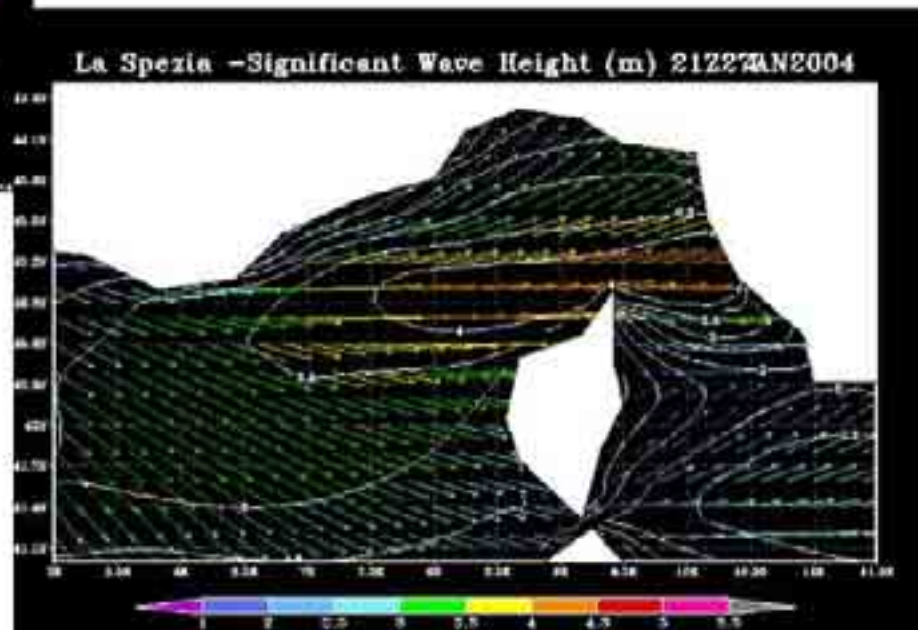
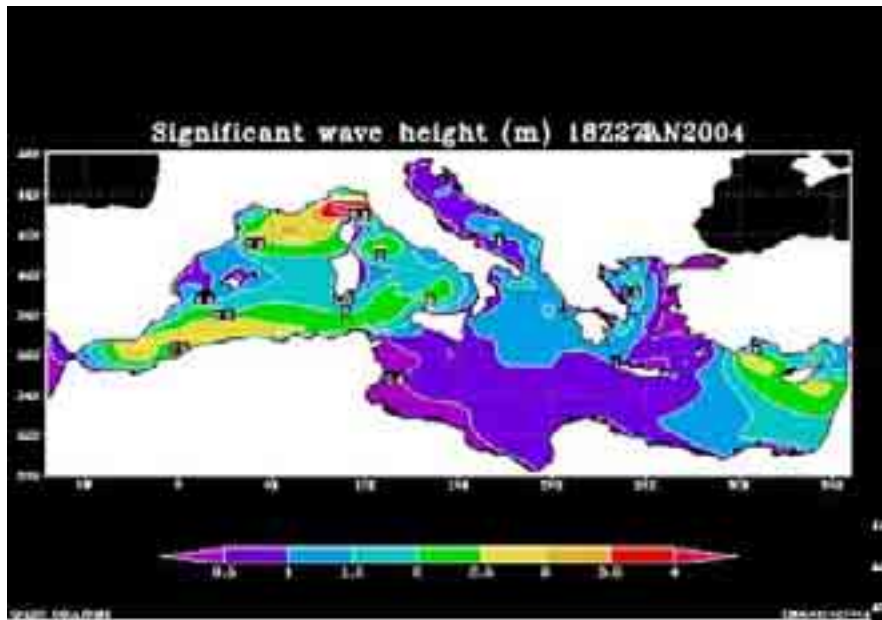
21 UTC del 27/01/2004



Wind
(10 m)

18 UTC del 28/01/2004



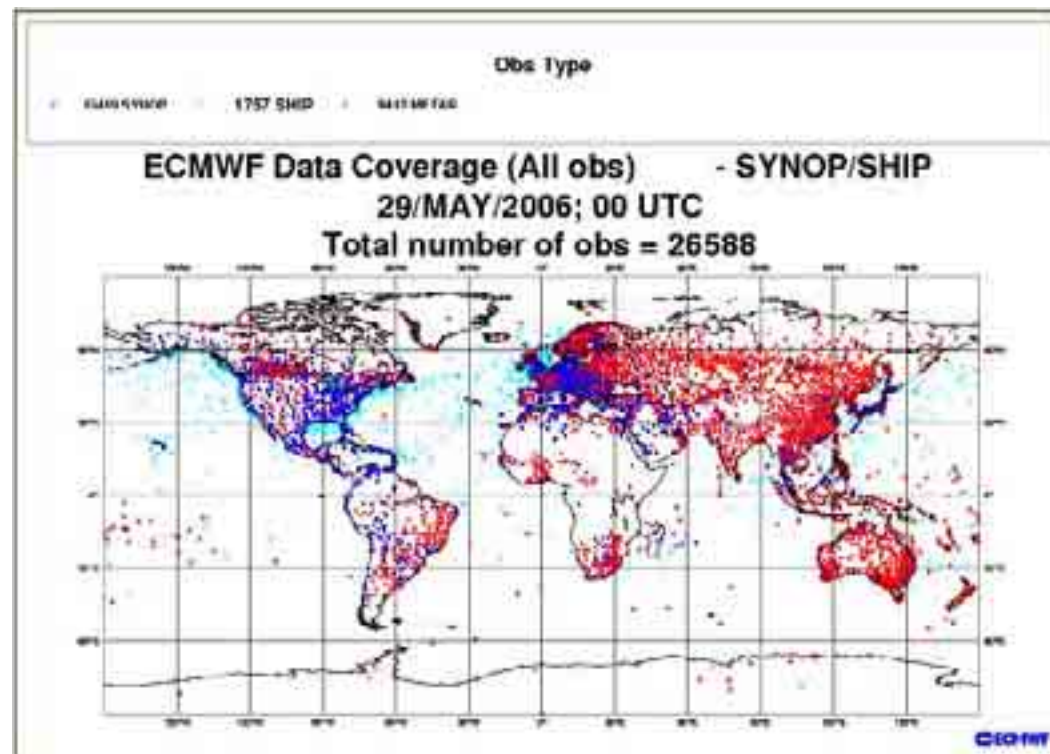


ECMWF MODELLING SYSTEM

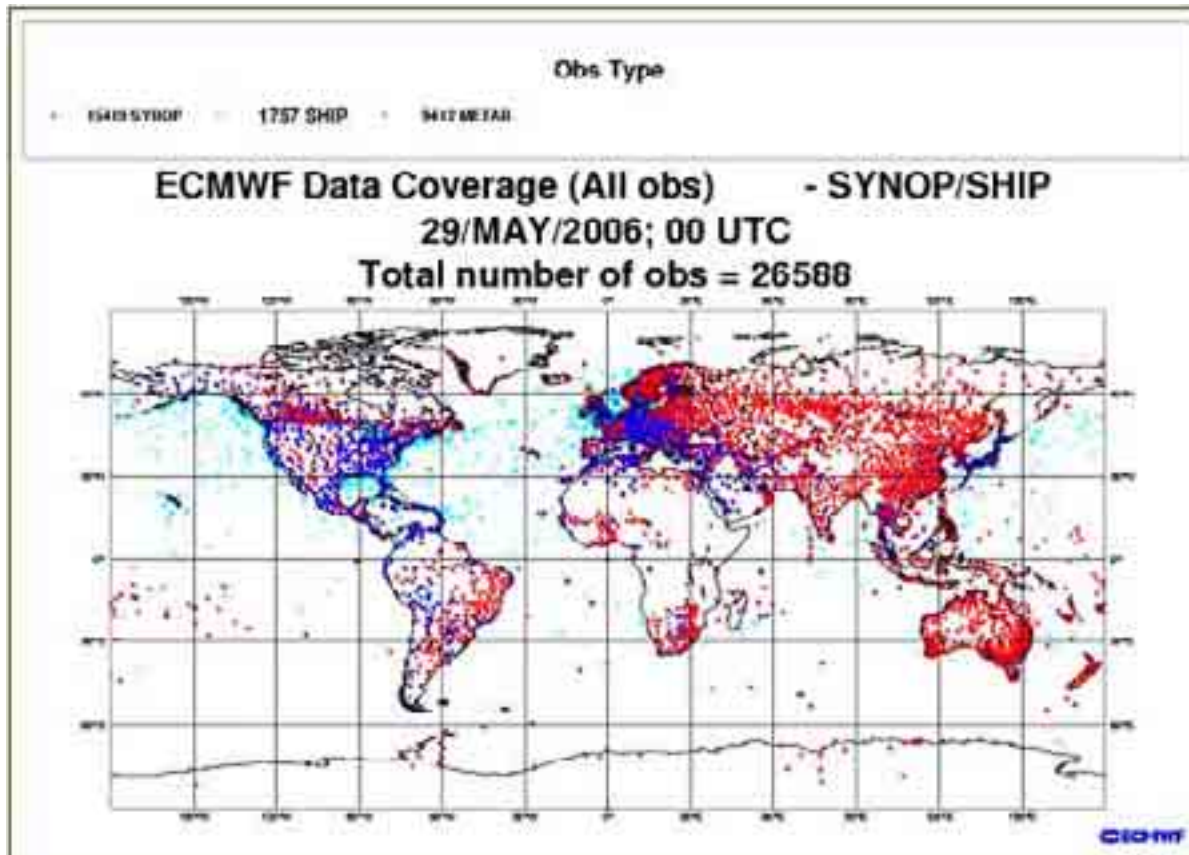
The wave model used at ECMWF is the so called WAM (WAVE Model) which describes the rate of change of the wave spectrum due to advection, wind input, dissipation due to white capping and non-linear wave interactions.

Geographical coverage

The Operational Data Sets provide access to most of the data from the atmospheric model archived at ECMWF. These archives have a higher time and space resolution and contain all parameters (Surface analysis , Pressure level analysis, Model level analysis etc.) This archive includes analysis, first-guess (6-hour forecasts, 4 times per day) and forecast data.



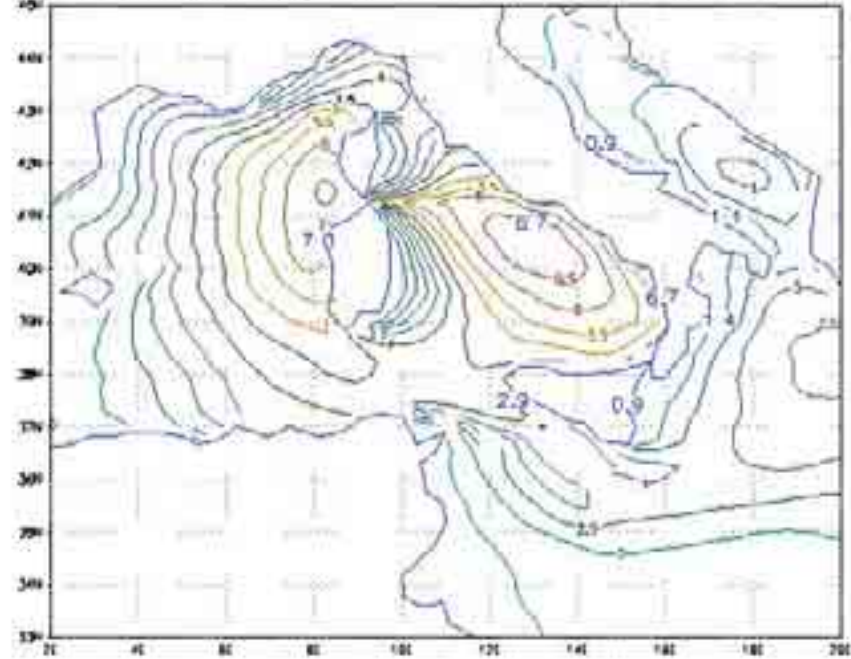
ECMWF MODELLING SYSTEM



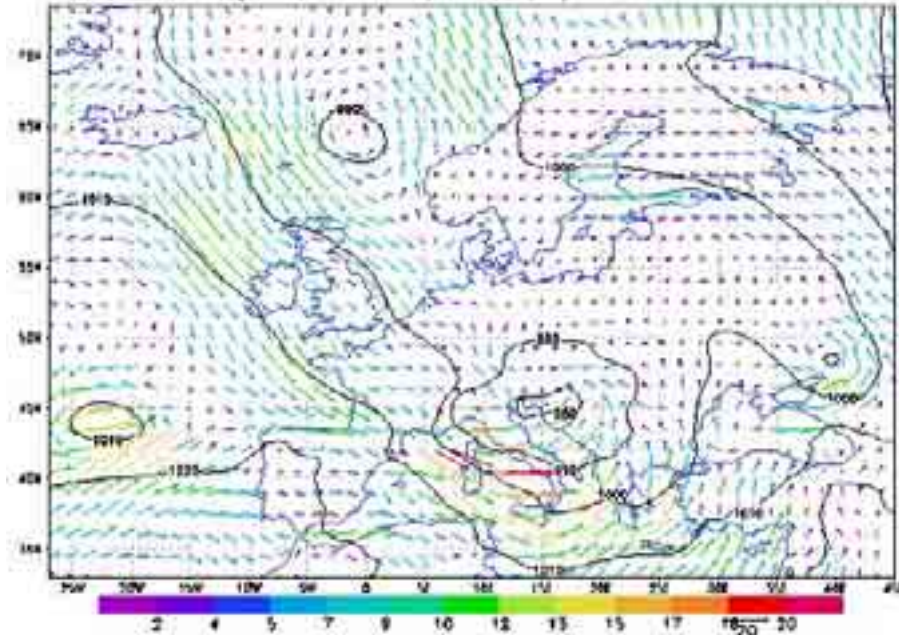
Geographic
 buoys
 distribution

ECMWF MODELLING SYSTEM

Significant wave height (m) ECMWF Analysis 18Z28DEC1999

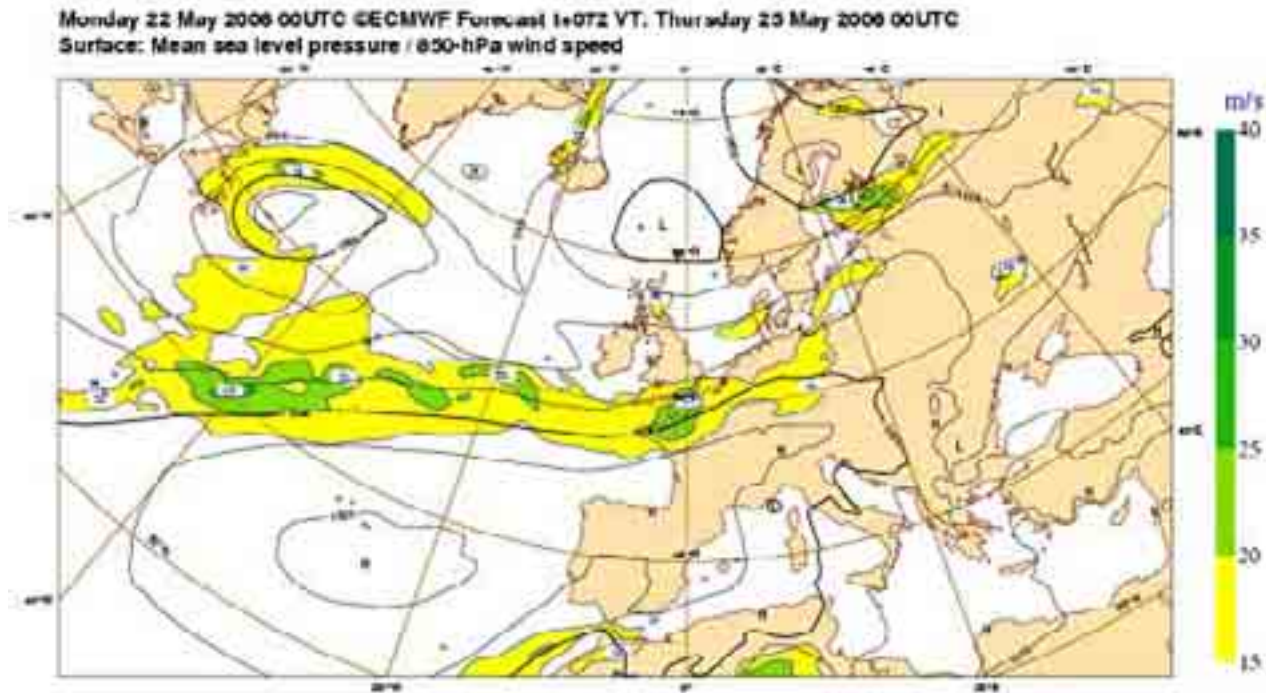


MSL (hPa)&Wind Speed(m/s)12Z28DEC1999



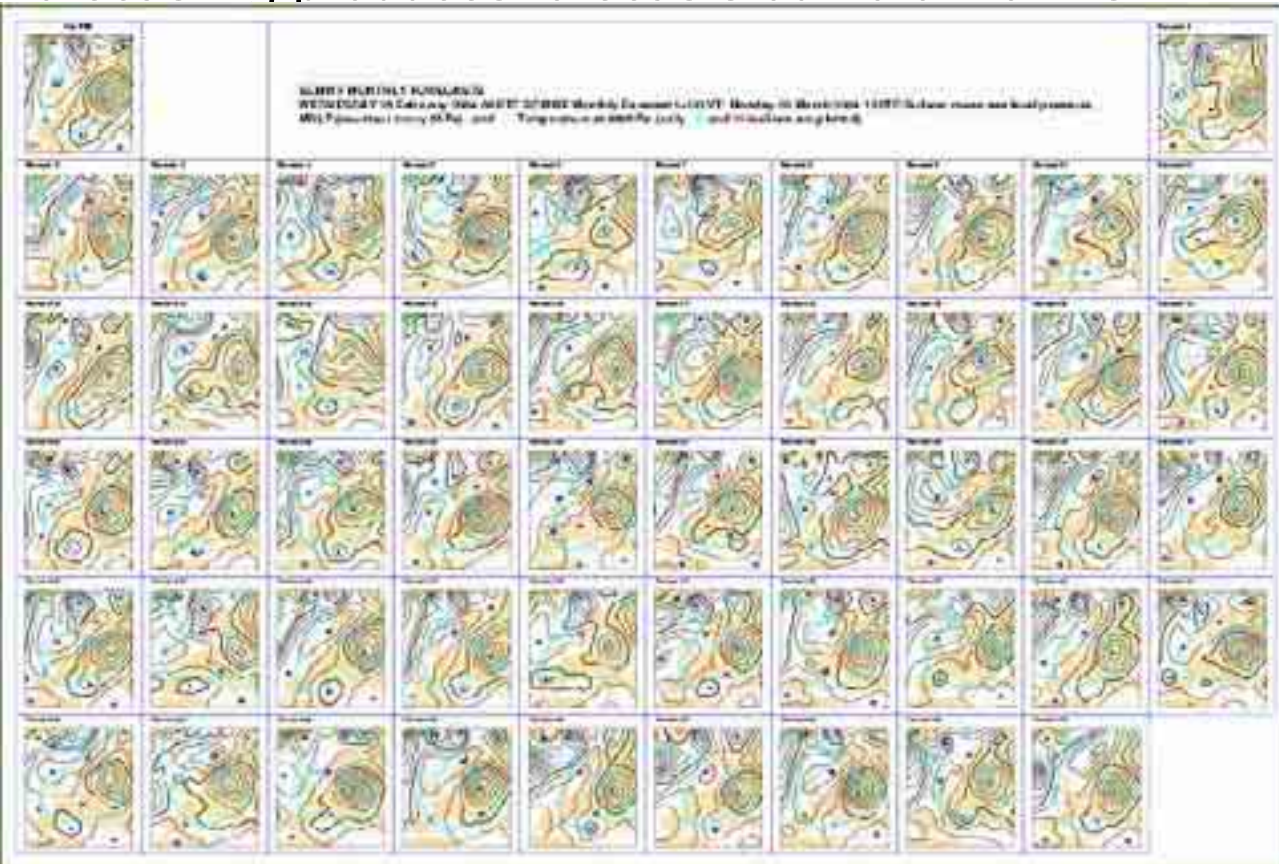
METEOROLOGICAL BULLETINS (ECMWF)

Meteorological forecast of pressure reduced at sea level (Mean Sea Level Pressure), wind speed at low levels and height of the 500-hPa isobaric surface



METEOROLOGICAL BULLETINS (ECMWF)

Two forecasting systems are currently operational at ECMWF: medium-range weather forecasting and seasonal forecasting. Medium-range weather forecasting produces weather forecasts out to 10 days, whereas seasonal forecasting produces forecasts out to 6 months



Monthly forecast: maps of mean sea level pressure and geopotential at 500 hPa. -6 and +16 isotherms are plotted

METEOROLOGICAL BULLETINS

- Warning and Advisory Services for Severe Weather
- Daily Forecasts
- Very Short-range Forecasting of Prediction
- Typhoon Bulletins
- One-week Forecast
- Long-range Forecast
- Marine Forecasts and Warnings
- Flood Forecasting Services
- Other Forecasting Services
- Dissemination of Forecasts and Warnings

WARNING AND ADVISORY SERVICES FOR SEVERE WEATHER

Warnings

Storm	Snow-storm	Heavy rain	Heavy snow
Storm Surge	High waves	Flood	

In case a hazardous weather condition is expected, various messages including warnings, advisories and bulletins are delivered to the general public and disaster prevention authorities so that appropriate measures can be taken against possible hazards.

Warnings are issued when weather conditions are expected to be catastrophic and meet warning criteria

Advisories are issued when weather conditions are expected to be disastrous and meet advisory criteria but are expected to remain below the warning criteria

Bulletins give information to supplement the warnings and advisories

Advisories

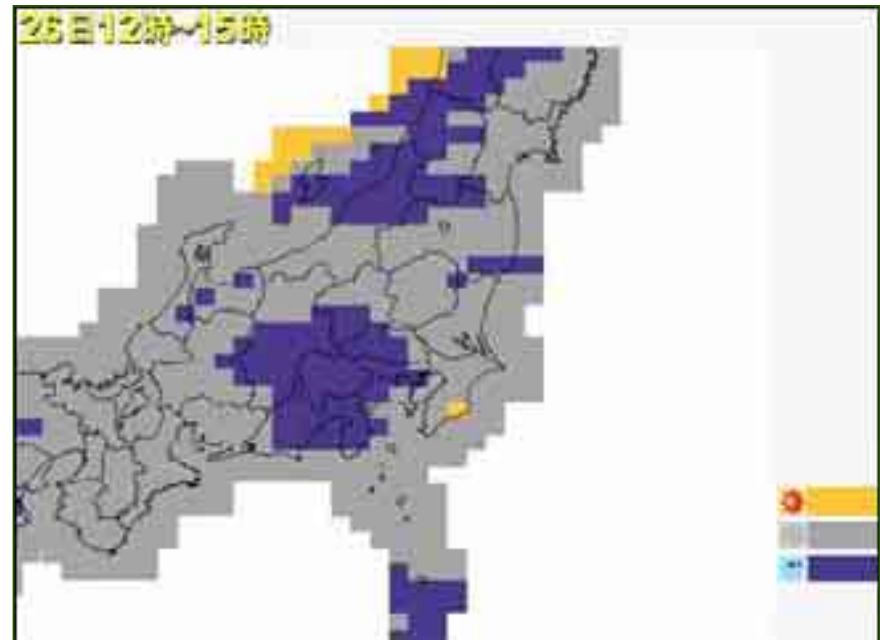
Gale and snow	Gale	Heavy rain
Heavy snow	Dense fog	Thunderstorm
Dry air	Avalanche	Ice(snow) accretion
Frost	Low temperature	Snow-melting
Storm surge	High waves	Flood

Example of criteria of warning/advisory for heavy rain (Tokyo)

	Total 1-hour Precipitation	Total 3-hour Precipitation	Total 24-hour Precipitation
Advisory	30mm	70mm	130mm
Warning	50mm	90mm	200mm

DAILY FORECASTS

- Daily forecasts in text form contain weather predictions for: today, tomorrow, and the day after tomorrow
- Daily forecasts contain information about winds, coastal ocean waves, maximum/minimum temperatures, and probabilities of precipitation
- In addition to the forecasts in plain text, may be provided forecasts in graphic form that show spatial distributions of weather, precipitation, and maximum/minimum temperatures for the whole country

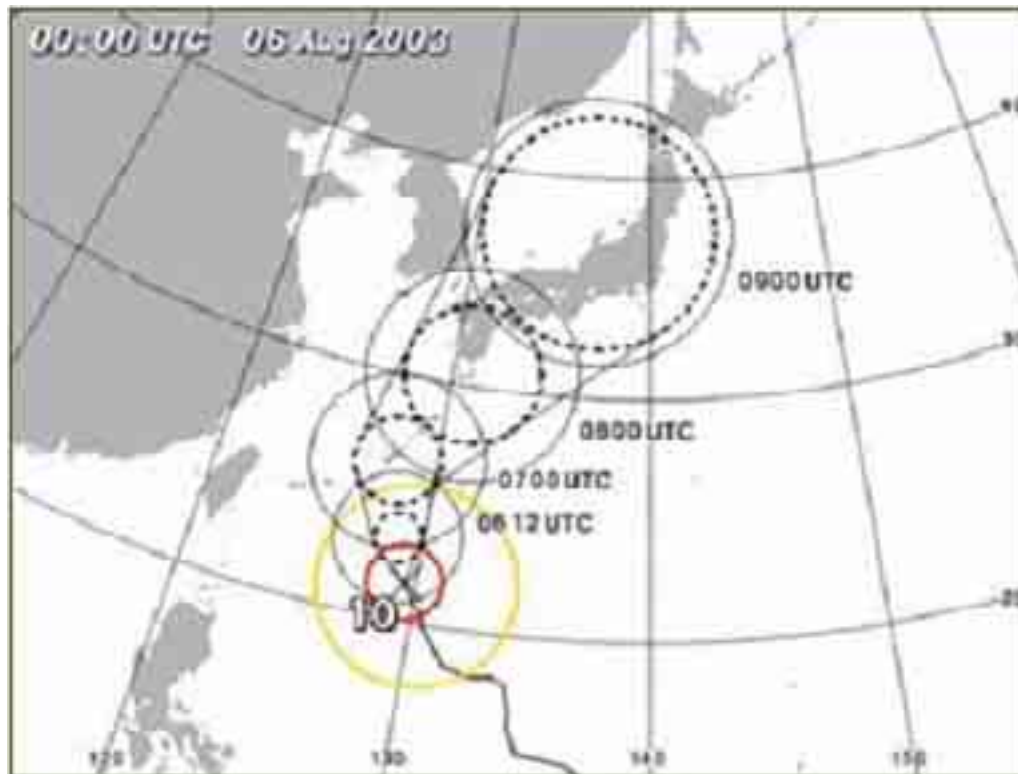


VERY SHORT-RANGE FORECASTING OF PRECIPITATION

- A Very Short-range Forecast of Precipitation is issued twice an hour to provide forecasts of one-hour precipitation amounts for the next six hours with 5km resolution. This forecast is derived from the combination of the Mesoscale Model (MSM) predictions and the extrapolation of Radar/AMeDAS composite precipitation data.

TYPHOON BULLETINS

- Typhoon Bulletins are issued 8 times a day to provide information on tropical cyclones including analysis and forecast of their centre positions and intensity. When a tropical cyclone is moving onshore or in the vicinity of Japan, the Bulletin is issued on an hourly basis



ONE-WEEK FORECAST

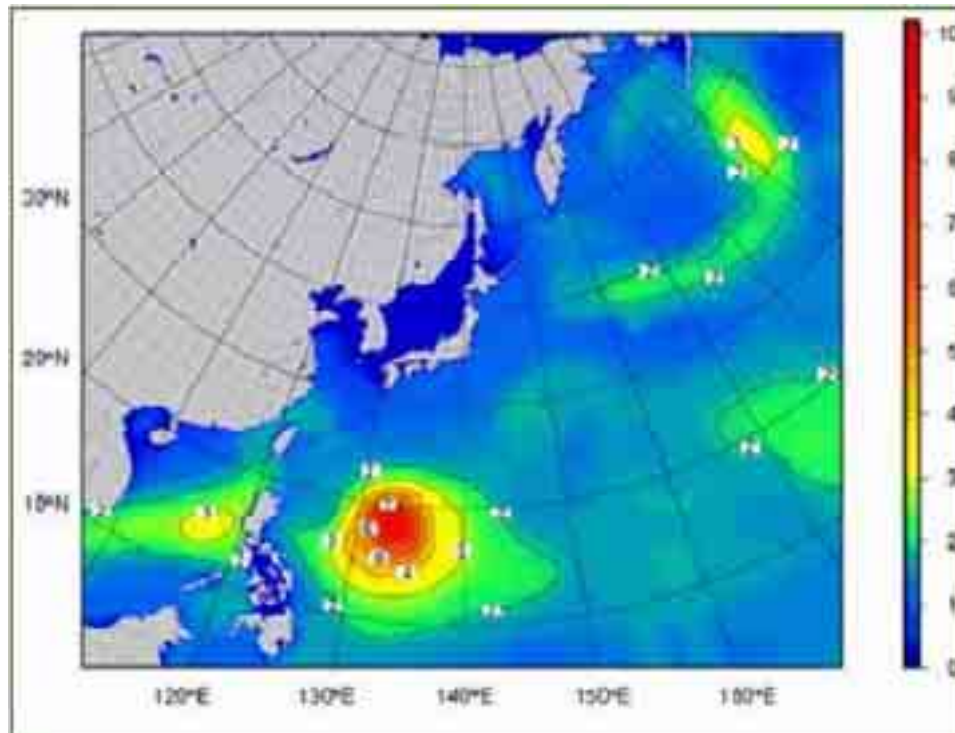
- One-Week Forecast covers a seven-day period starting from tomorrow. It provides a day-to-day forecast of weather, precipitation probability and maximum/minimum temperatures for the whole area. Ensemble prediction techniques, which take advantage of multiple results of numerical prediction, have been employed as the main basis of the one-week forecast

LONG-RANGE FORECAST

- Weather outlooks for the next month to several months are provided by long-range forecasts. These outlooks offer a prognosis on temperature and precipitation (and sunshine duration for one-month forecasts) in three categories; "above normal", "near normal", and "below normal". Ensemble prediction techniques also play an increasing role in the long-range forecasting. They are used as a unique basis for one-month forecasts and are used in combination with statistical techniques for three-month and warm/cold season outlooks

MARINE FORECASTS AND WARNINGS

- Marine meteorological forecasts and warnings such as those of gale, storm, typhoon, and fog are provided for the safety and efficiency of shipping, fisheries and offshore activities. In the winter season, sea ice forecasts and bulletins are also issued



METEOMAR

- Marine meteorological forecasts by METEOMAR



METEOMAR

C.N.M.C.A. - METEOMAR - ENG
WEATHER FORECAST OVER MEDITERRANEAN SEA
ISSUED AT 12:00/UTC ON FRIDAY, 26 MAY 2006
AND VALID UP TO 00:00/UTC OF TOMORROW

1. WARNINGS:

THUNDERSTORMS UNDER COURSE: NIL.
THUNDERSTORMS FORECAST: NIL.
GALES UNDER COURSE:
-NORTHWESTERLY 7 ON NORTHERN JONIAN SEA AND NORTH BALEARI SEA,
-EASTERLY 7 ON ALBORAN SEA.
GALES FORECAST:
-EASTERLY 7 ON ALBORAN SEA.

2. WEATHER SITUATION:

INSTABILITY AREA AROUND CYPRUS IS MOVING EASTWARDS. COLD FRONT ON AEGEAN SEA IS MOVING EAST/SOUTHEASTWARDS. HIGH AND FLAT FIELD OVER ALL ITALIAN SEAS. WEAK WARM FRONT OVER NORTH-WESTERN AFRICA IS MOVING WESTWARDS.

3. FORECAST UP TO 00:00/UTC OF TOMORROW AND 12-HOURS OUTLOOK:

-LIGURIAN SEA: VARIABLE 3 BECOMING SOUTHWESTERLY -FAIR -GOOD VISIBILITY DECREASING -SMOOTH SEA /OUTLOOK: SOUTHWESTERLY 3 -FAIR.
-CORSICAN SEA: NORTHWESTERLY 4 BECOMING SOUTHWESTERLY -FAIR -GOOD VISIBILITY DECREASING -SLIGHT SEA /OUTLOOK: SOUTHWESTERLY 4 -FAIR.
-SARDINIAN SEA: NORTHWESTERLY 4 -PARTLY CLOUDY WEAKENING -GOOD VISIBILITY DECREASING -SLIGHT SEA /OUTLOOK: NORTHWESTERLY 4 -FAIR.
-SARDINIAN CHANNEL: NORTHWESTERLY 4 TEMPORARY INCREASING NORTHEASTERLY EAST SECTOR -PARTLY CLOUDY WEAKENING -GOOD VISIBILITY DECREASING -SLIGHT SEA /OUTLOOK: NORTHWESTERLY 4 -FAIR.
-NORTHERN TYRRHENIAN SEA: NORTHWESTERLY 3 BECOMING WEAK AND VARIABLE -FAIR -GOOD VISIBILITY DECREASING -SMOOTH SEA /OUTLOOK: VARIABLE 3 -FAIR.
-CENTRAL TYRRHENIAN SEA WEST SIDE: NORTHWESTERLY 3 LOCALLY INCREASING -PARTLY CLOUDY WEAKENING -GOOD VISIBILITY DECREASING -SMOOTH SEA /OUTLOOK: NORTHWESTERLY 3 -FAIR.
-CENTRAL TYRRHENIAN SEA EAST SIDE: NORTHWESTERLY 3 OR BREEZE COASTWARD -FAIR -GOOD VISIBILITY DECREASING -SLIGHT SEA WEAKENING /OUTLOOK: WESTERLY 3 -FAIR.

-SOUTHERN TYRRHENIAN SEA WEST SIDE: NORTHWESTERLY 4 BECOMING WEAK AND VARIABLE -PARTLY CLOUDY -GOOD VISIBILITY DECREASING -SLIGHT SEA WEAKENING /OUTLOOK: VARIABLE 3 -FAIR.
-SOUTHERN TYRRHENIAN SEA EAST SIDE: NORTHWESTERLY 4 WEAKENING -FAIR -GOOD VISIBILITY DECREASING -SLIGHT SEA WEAKENING /OUTLOOK: NORTHWESTERLY 3 -FAIR.
-SICILY STRAIT: NORTHWESTERLY 4 LOCALLY INCREASING -PARTLY CLOUDY WEAKENING -GOOD VISIBILITY -SLIGHT SEA /OUTLOOK: NORTHWESTERLY 4 -MOSTLY CLOUDY.
-SOUTHERN JONIAN SEA: NORTHWESTERLY 5 TEMPORARY INCREASING NORTHWESTERLY EAST SECTOR -PARTLY CLOUDY -GOOD VISIBILITY -MODERATE SEA WEAKENING /OUTLOOK: NORTHWESTERLY 4 -PARTLY CLOUDY.
-NORTHERN JONIAN SEA: NORTHWESTERLY 6 TEMPORARY INCREASING NORTHWESTERLY EAST SECTOR -FAIR -GOOD VISIBILITY -MODERATE SEA WEAKENING /OUTLOOK: NORTHWESTERLY 5 -FAIR.
-SOUTHERN ADRIATIC SEA: NORTHWESTERLY 5 TEMPORARY INCREASING NORTHWESTERLY OVER OTRANTO CHANNEL -FAIR -GOOD VISIBILITY -SLIGHT SEA /OUTLOOK: NORTHWESTERLY 4 -FAIR.
-CENTRAL ADRIATIC SEA: NORTHWESTERLY 4 WEAKENING -FAIR -GOOD VISIBILITY DECREASING -SLIGHT SEA WEAKENING /OUTLOOK: NORTHWESTERLY 4 -FAIR.
-NORTHERN ADRIATIC SEA: NORTHERLY 3 BECOMING WEAK AND VARIABLE -FAIR -GOOD VISIBILITY DECREASING -SMOOTH SEA /OUTLOOK: VARIABLE 2 -FAIR.
-ALBORAN SEA: EASTERLY 7 -LOCAL RAIN -MODERATE VISIBILITY -ROUGH SEA /OUTLOOK: EASTERLY 7 -LOCAL RAIN.
-NORTH BALEARI SEA: NORTHWESTERLY 5 WEAKENING -FAIR -GOOD VISIBILITY -MODERATE SEA WEAKENING /OUTLOOK: NORTHEASTERLY 4 -FAIR.
-SOUTH BALEARI SEA: NORTHEASTERLY 5 WEAKENING -PARTLY CLOUDY -GOOD VISIBILITY -MODERATE SEA WEAKENING /OUTLOOK: NORTHEASTERLY 4 -PARTLY CLOUDY.
-LIBYAN SEA: NORTHERLY 5 LOCALLY INCREASING OVER SIDRA GULF -PARTLY CLOUDY WEAKENING -GOOD VISIBILITY -MODERATE SEA WEAKENING OVER SIDRA GULF /OUTLOOK: NORTHERLY 4 -FAIR.
-AEGEAN SEA: NORTHWESTERLY 6 LOCALLY INCREASING -SHOWERS WEAKENING -MODERATE VISIBILITY -MODERATE SEA /OUTLOOK: NORTHWESTERLY 6 -PARTLY CLOUDY.
-SOUTH CRETE SEA: NORTHWESTERLY 6 -FAIR -GOOD VISIBILITY -MODERATE SEA /OUTLOOK: NORTHWESTERLY 6 -FAIR.
-LEVANTINE BASIN SEA: SOUTHWESTERLY 4 -SHOWERS INTENSIFYING -MODERATE VISIBILITY DECREASING -SLIGHT SEA /OUTLOOK: SOUTHWESTERLY 3 -THUNDERSTORMS AROUND CYPRUS.

4. WIND AND SEA STATE OVER ITALIAN SEAS FROM 12:00/UTC OF TOMORROW TO 00:00/UTC OF THE DAY 29/05 12-HOURS INTERVAL: NIL.
END METEOMAR.

FLOOD FORECASTING SERVICES

- These services include flood warnings, flood advisories, and flood bulletins covering the rivers in the desired country which were identified by as the rivers carrying the potential for flood disasters

OTHER FORECASTING SERVICES

- Fire weather alerts are issued to prefectural governments for their fire fighting efforts, when meteorological conditions such as low relative humidity and strong winds raise the risk of fire. Photo-chemical smog bulletins are proper bases for prefectural governments for their announcement of photo-chemical smog alarms. These bulletins provide outlook of the concentration of photochemical oxidants in the air for the day or the following day

DISSEMINATION OF FORECASTS AND WARNINGS

- For the dissemination of forecasts and warnings:
 - dial-up answering systems and direct communication links between meteorological offices and central/local governments as well as mass media
 - information technologies, including Internet
 - it allows for effective and rapid dissemination of information in both text and graphic forms to mass media and disaster prevention authorities.

Information for maritime users is transmitted by the JMA radio facsimile broadcast (JMH) and fishery radio communications, and a broadcast service for ships in the high seas through INMARSAT, the maritime satellite.