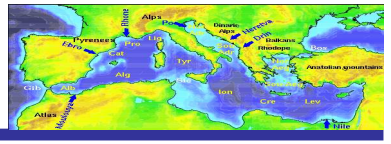

# II. Discussion on the Science Issues for the Intense Sea-Atmosphere interactions

**Some contributions (on the scientific questions)**

- **missing scientific questions?**
- **questions that we cannot reasonably expect answer within HyMex**

**Answer to:**

- **to study the water cycle, what is important, priorities, ?**
- **what we will adress to the HyMex program**

**Summary of the scientific questions reported in the white book**

1. Strong winds over the Mediterranean Sea
2. Mediterranean Sea response to strong wind forcing
    1. Fast response (mixed layer)
    2. Slow response (thermohaline circulation)
3. Air-Sea feedbacks
    1. Atmospheric and oceanic circulations
    2. Role of the marine aerosols
4. Modelling air-sea interactions

# Contributions

- 3 contributions showing that dense water formation can be seen in models but it depends on the spatial scales of the forcing
- 1 contribution showing that the agreement of the heat budget of climatologies can be significantly improved by use of real data

# Issues identified

- What do we mean by strong air-sea interaction?
  - Dense water formed?
  - Strong heat losses from the ocean are important!
  - Different understanding between atmospheric and oceanic scientists- must get on the same wavelength

# Issues identified

- Scales (spatial and temporal) for the forcing
  - Frequency, intensity and duration of wind gusts is needed for the ocean to respond (in reality and in models)- the same for the oceanic influence on the atmosphere (e.g. SST changes)
- Quantification of dense water formation in models and measurements

# Issues identified

- Parametrisation of air-sea fluxes during strong/weak winds, effects of fetch and ability of describing air-sea exchanges near the coast

# Other issues

- Sea state, sea roughness
- Stable water isotopes (in the atmosphere)
- Bio-feedback (methods for identification of dense water formation and take into account for heat content of the mixed layer)
- CO2 and CH4 exchanges - limited out of HyMex
- Sea spray, sea salt and effects on moisture transports

# Scientific challenges

- We need process-oriented study improving the understanding of physical processes during strong air-sea exchanges
- We need larger scale and longer term observations to put the strong air-sea exchanges into context
- We need improvement in parametrisation of models and evaluation of their skill

# (potential) Observational strategies (atmosphere)

- Atmosphere
  - Buoys(air T, water  T, P, W, Q, pitch and roll)
  - Drifting buoys
  - Aircraft (more than 1) during intense events
    - Dropsondes, lidar, radar, other?
  - Continuous monitoring from coast, at specific locations
    - Additional instrumentation for intense air-sea interaction events
  - Radiosondes/baloons around the Med to know the initial state, (3d structure)

# (potential) Observational strategies (ocean)

- Moored Buoys
- Gliders (routine monitoring - more in intense events)
- ARGO profiling instruments (routine and/or special for the intense event?)
- Oceanographic Ship for intense event
- Ships of opportunity (Ferries) - regular routes
- Deep mooring to time the event and its variability
- tracers
- CAN WE CALCULATE DENSE WATER MASS FORMED WITH THESE? What else is needed?

# Comment

- intense -air sea exchanges studies
  - useful for atmospheric scientists to understand processes and improve models
  - Useful for oceanographers to improve understanding of vertical diffusion
  - Useful for oceanographers to understand dense water formation events
  - BUT in order to be useful for heavy precipitation events observational strategy should be at a larger scale (PS1.2)

# Modeling challenges

- High resolution (?), online coupled models to be developed and assessed during the intense air-sea exchange events and compared with simulations run with the improved parametrisation.
- Improved modeling of the energy exchange (taking into account biochemical exchanges)
- Modelers should develop demands for the model processes to be improved and talk to observationalists - and vice versa

# Data issues

- Quality queries for some data
- Monitoring: oceanic adequate but probably not for process measuring and quantification during strong air-sea exchange