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Summary of the Ocean Session

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Introduction

During the Ocean session of the Workshop on Emerging Scatterometer Application five papers were presented, including the chairman introductory paper, and three others were presented as posters.

Various aspects were covered from Global oceanography (e.g. General circulation modelling) to small and meso scale phenomena (e.g Mediterranean sea).

The main result of the ocean session is the strong requirement for the continuation of a C-Band scatterometer mission through the end of the century, and in particular to avoid any gap between the end of ERS operations and the beginning of the Ascat era.

In fact scatterometer data became an important tool for many studies (climatology and phenomena analysis) but a potential gap in the data time serie prevent scientific and industrial applications to be developped.

Generalities

Applications for ocean data, gathered and analysed by a variety of means and methods, have grown steadily and apace over the last few decades. This growth has in turn generated an increased demand for data and improved understanding of the oceans, and for more efficient techniques for utilising and exploiting this information. Programs such as TOGA and WOCE have been successful at advancing the scientific and technical knowledge, but we have been less successful at attracting the continuing, long-term investment that is needed to maintain regional and global observing systems.

Oceanographic applications using scatterometer data are responding to this demand for data and are brought into a larger ensemble which includes parameters measured by other spaceborne instruments (e.g. temperature and ocean topography) and by other techniques (e.g. surface and deep water in-situ measurements). Ocean and Atmosphere modelisation is also a major technique for the derivation of important physical variables describing the ocean - atmosphere interface.

Three points were highlighted during the workshop.

If the traditional operational oceanography is well developped in many countries, space oceanography is only implemented in few of those. The complementarity between these two groups can only be enhanced if they can share and exchange data information and results in an efficient way. This is the scope of Godae (Global Ocean Data Assimilation Experiment) of which the aims to demonstrate the practicality of routine, real-time global ocean data assimilation and prediction. Many agree that such a demonstration is vital if we are to ever realise a permanent, global ocean observing network and prediction system, with all components functional and operating on a global domain. It is also accepted that such a goal requires significant integration across the components. Without this, there is unlikely to be sufficient justification for the individual components to be maintained in their own right beyond the lifetime of research experiments.

Data assimilation in numerical models and data interpretation are two aspects of the oceanography which are complementary and both essential to interpret the phenomena which are observed. These two communities, climatology and phenomena analysis are co-existing, requiring the same geophysical parameters but often in different forms or with different characteristics. New algorithms and techniques have to be developped to answers both requirements.

Maintain a C-Band Scatterometer Mission

It is unanimously recommanded to ESA to avoid any gap in C-Band scatterometry between the end of ERS scatterometer operations and the launch of Metop with the advance scatterometer Ascat.

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It is underlined that Ku-Band and C-Band scatterometer are not equivalent and in conpetition, but are complementary as the phenomena observed are not identical. As a result, both data sets are not interchangeable and it is of great importance to continue the unique temporal serie of C-Band acquisition for climatology and model forcing. In order to provide sensible results a model spin up is typically of 10 years.

It is recalled that the nominal mission for an ERS satellite is of three years. ERS-1 already double its expected life time and ERS-2 flies already for more than three years. Today, the lauch of Metop-1 is foreseen in May 2003, in more than 4 years not considering any delays always possible for such a complex satellite. Even taking into account the strong expertise of ESA engineers, it would be a miracle to have ERS scatterometer operational for such a long period.

Maintaining C-Band acquisition is also important to limit the risk of being without resources in case of instrument, satellite or launch failure (e.g. Adeos-1).

ERS Data Reprocessing

Two aspects have to be distinguished when refering to reprocessing.

On one side it is important to operationaly maintain a uniform quality of the data throughout the mission and, in case of anomaly to reprocess as quickly as possible the dataset acquired during this anomaly, with the operational processor.

On the other side a reprocessing of the overall data set is necessary to take into account the evolution of the instrument knowledge and of the algorithms and models which naturally occured during the few years of the mission. Generally a new processor has to be developped to take this evolution into account.

In the context of ERS, it is noted that ECMWF started the generation of 40 years of daily analysis from 1959 to 1999. As this data set will include ERS data during the period 1991 - 1999, it is recommanded to handle the ERS data reprocessing in close cooperation with ECMWF.

Wind - σ^o modelisation

The limitation in the interpretation of the scatterometer data over the ocean is linked to the understanding of the physics of the interaction of the micro waves with the sea surface.

What is the main factor measured, wind or wind stress, neutral wind or real wind?

Which are the effects of rain, air temperature, sea temperature, fetch, salinity, sea state and wind stability on the measurements?

Today only empirical models are used to derive the wind and very few studies have been started on this subject.

A better quality of the wind derived from scatterometer data will only be possible through an improvement of the algorithms and the models used today.

Algorithms

New algorithmic tools have to be developped in order to combine and assimilate the various new data types made available by spaceborne instruments.

It took few years for the meteorological offices to develop the new algorithmic tools necessary to assimialte adequately the wind products derived from scatterometer measurements. This effort has to be prolongated to all new parameters and to the various interactions between these new parameters and the one already existing.

Oceanography and ice caps

The analysis and the understanding of the interactions between the ice caps, the ocean and the atmosphere is important for oceanography in particular the ice coverage and the ice drifts. The necessity of both C-band and Ku-Band is strongly underlined for ice classification. The need of fan beam, in order to have the same target imaged at various incidence angle, is noted for Antarctic sea/ice analysis and for ice edge monitoring.

Sampling

The basic assumption is that the nominal scatterometer sampling shall be double swath (Ascat type) or equivalent (for example like QuickScat). ERS by far doesn't provide the coverage required because it is single swath and because it is continuously interrupted for SAR acquisitions or by gaps introduced by the switching between Wind and Wind/Wave modes because of the ATSR High rate operations over land.

For climatological applications it is not important to have a better temporal sampling than the one given by a single instrument as soon as important structures (e.g. cyclones) are not systematically missed. In fact it appears that the westward displacement of a cyclone ismore or less in phase with the scatterometer swath displacement. the tropical cyclone "Luis", in 1995, was systematically missed by ERS (only two hits) while "Georges" in 1998 was imaged eleven times.

For other application like risk management and phenomena analysis, it is important to double the sampling by having two instruments at 12 hours interval. Combining C-Band and Ku-Band acquisition on two satellites is an asset.

The spatial resolution for future scatterometer mission shall be set to 25 x 25 km. This is a very strong requirement for phenomena analysis (cyclone, mistral) and coastal studies. It is also foreseable that the requirements for weather forecasting, which are around 100 x 100 km today, will evolve toward a finer resolution probably within the next decade and anyway before the end of the Ascat mission.

Metop and Ascat

Metop is an operational satellite by opposition for example to Jason 1 which is still presented as an experiment. This is an important fact for the oceanographic community.

25 x 25 km resolution is a must (cf Sampling).

It is very important to consider the archiving and the reprocessing of Metop scatterometer data (cf ERS data reprocessing above) in the context of a long time serie which could start in 1991 for 30 years or more. In this context, the Eumetsat climate monitoring mission is of major importance.

Conclusion

There is unanimity to recognise the importance of scatterometer data in oceanography today, both for climatology and for phenomena analysis. The critical step now is to ensure the continuity of the scatterometer data set through the start of the new millenium.