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The role of GMES / Sentinels in Land-Surface Earth System Science

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A general trend in the current status of representation of Land Surface schemes into Earth System models is driven by the parameterisation of "cycles" instead of individual processes. Particular emphasis is made to account for couplings among the individual cycles, as between the carbon and water cycles. Moreover, the current tendency is to use the measured data –time series in most cases- together with models, in a data assimilation scenario where inputs from multiple sources are integrated. Such approach is more and more necessary as land models tend to be more complex, and particularly due to the fact that land surface variability is not just driven by physical and chemical processes, but intricate biological processes also altered by anthropogenic influences. Human influences in the land system (land use changes, urban development, etc.) and the impacts of natural disasters are becoming also part of land models, but critical data in high spatial and temporal resolutions are needed to properly model such processes.

Until now, problems with data availability, data inconsistency and lack of adequate temporal sampling have limited the potential usefulness of such observations in modelling land surface processes. The availability of the GMES / Sentinel series of satellites represents a quite unique opportunity for consolidation of current tendencies and development of new science based on the new type of data that soon will become available. The usefulness of the different Sentinel missions for Land science has been recognised. Although the Sentinel satellite series were primarily designed to provide observations for operational services and routine applications, there is a growing interest in the scientific community towards the usage of Sentinel data for more advanced and innovative science. Moreover, the availability of consistent time series covering a period of over 20 years opens possibilities never explored before, such as systematic data assimilation approaches exploiting the time-series concept, or the incorporation in the modelling approaches of processes covering time scales from weeks to decades.

Sentinel-1 will provide continuity for applications already developed by using ERS-1, ERS-2 and ENVISAT ASAR data, although now with improved capabilities and more regular and systematic data availability. The all-weather capability of radar data provides time series of land surface properties even in areas with persistent cloud coverage. Sentinel-3 will provide continuity to current ENVISAT MERIS/AATSR capabilities, but with enhanced performances by means of the new OLCI and SLST instruments. The results already derived from MERIS will be more systematically exploited by using OLCI in synergy with SLST. Particularly innovative is the case of Sentinel-2, which is specifically designed for land applications, providing global and systematic acquisitions with high spatial resolution and with a high revisit time tailored towards the needs of land monitoring. A key element in the exploitation of the Sentinel series will be the adequate use of data synergy. The synergistic use of the data is recognised as a convenient way of extracting the maximum potential of the combined time series, but in practice the synergy among the different types of data will require new developments due to the different spatial / temporal / spectral sampling of the different Sentinels. Such synergistic exploitation of data coming from the different Sentinels systems will open new possibilities for improved Land Models within the context of Earth System Science, beyond operational services.

The Land community has suffered in the past a large dispersion of objectives due to the intrinsic complicate processes to be addressed involving different approaches and the diversity of scientific topics and applications. The GMES / Sentinel programme can serve as an incentive to put together activities in a coordinated way, making possible a Land Data Assimilation scheme that can guarantee a proper scientific exploitation of the data, studying and monitoring key relevant land surface processes by taking advantage of the unique manifold

of active/passive instrumentation covering all spectral ranges, and the unique combination of global coverage and high spatial / temporal resolutions, and the long-term operational commitment never available before. Steps towards such operational Land Data Assimilation scheme must be initiated soon to get prepared for the amount of data to become available in the near future for land science. This paper review current status and priorities in such direction.