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Earth Observation Convoy: Synergetic Observations with Satellites Flying in Formation with European Operational Missions – Possibilities for New Science

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Over the next few years a number of new long-term operational Earth Observation (EO) satellites will be launched by Europe. These missions include the GMES (Global Monitoring for Environment and Security) Sentinel spacecraft and the EUMETSAT operated Metop satellite series. These missions will provide global, continuous and long-term European capability for systematic observation of a panoply of Earth system parameters.

If additional cost-effective missions could be flown together with these operational missions then the possibilities for meeting new Earth science and application objectives could be far-reaching e.g. fulfilling observational gaps, multipoint measurement of Earth system phenomena, etc.

Therefore, the European Space Agency (ESA) is funding three exploratory activities (known as the EO-Convoy studies). The aim of these studies is two fold: Firstly, to identify scientific and operational objectives and needs which would benefit from additional in-orbit support. Secondly, to identify and develop a number of cost-effective mission concepts that would meet these identified objectives and needs.

Each EO Convoy study is dedicated to a specific theme:
• Study 1: Ocean and Ice
• Study 2: Land
• Study 3: Atmosphere

Each study is based on a comprehensive user needs analysis derived from Earth science analysis, applications and identification of novel data products. Based on this analysis a number of preliminary mission concepts are derived together with possible formation and constellation options. Up to three mission concepts per theme are then selected for detailed analysis including a roadmap for development.

For the Ocean and Ice EO Convoy study the scientific analysis identified a number of areas where support measurements from additional satellites would prove valuable e.g. ocean topography and ocean currents, ocean colour, sea surface salinity, sea-ice drift and thickness, sea-ice melt on-set and duration, snow accumulation on ice sheets, freeze and thaw cycles, snow albedo and the measurement of snow microphysical properties. Based on this analysis over ten mission convoy concepts were identified and subsequently three concepts were selected for detailed analysis:
• A passive C-band SAR to fly with Sentinel-1
• A laser altimeter to fly with Sentinel-3
• A Ku-band Scatterometer to fly with Metop SG.

This paper will present the latest results of the Ocean and Ice EO-Convoy study which will include an overview of the user needs analysis and derived mission concepts (with an emphasis on the three selected concepts) and the resulting roadmaps for further research and development.

For the Land EO Convoy the user needs analysis has identified a number of areas where support measurements from additional satellites would be useful e.g. carbon stocks and flux estimation at improved spatial scales, vegetation height estimation, surface albedo measurement, biomass characterisation, emissivity and land surface temperature measurement at high spatial resolution and improved fire products. The user needs consultation phase has now been completed and the consolidated results will be presented. A number of preliminary convoy concepts

comprising additional satellites flying together with GMES Sentinels 1,2 and 3 have been identified based on this user needs analysis and will be presented. Examples include a high-resolution thermal infrared imager flying with either Sentinel-2 or 3 and additional SAR satellites flying with Sentinel-1.