Plinius Conference Abstracts
Vol. 18, Plinius18-30, 2024, updated on 13 Dec 2024
https://doi.org/10.5194/egusphere-plinius18-30
18th Plinius Conference on Mediterranean Risks

Enhancing weather forecast accuracy for agricultural operations: The MAGDA Project approach.

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The agricultural sector heavily relies on weather forecasts for informed decision-making. However, existing forecasting methods often lack localized precision, leading to significant uncertainties in predicting extreme weather events crucial for agricultural planning and management. The MAGDA H2020 project aims to address these challenges by developing a modular system deployed to farms, integrating observations from European space-based and ground-based assets to enhance tailored weather forecasts. This project represents a significant advancement by synergizing spaceborne, airborne, and ground-based measurement technologies, including GNSS and meteodrones observations, with meteorological models to benefit agriculture and water management operations. The project targets improvements in weather forecast accuracy, particularly concerning severe weather events like heavy rain, hail, windstorms. Inaccurate predictions of these events can lead to substantial crop damage, over-irrigation, or water shortages. Key challenges in Numerical Weather Models (NWM) stem from uncertainties in initial atmospheric conditions at small scales, necessitating enhanced observational data for improved model performance. Recent advancements in forecasting heavy rainfall events through data assimilation techniques show promising results. Studies have demonstrated the positive impact of integrating reflectivity data and in situ observations into meteorological models for predicting severe weather phenomena in various regions. Additionally, experiments incorporating Sentinel-derived and GNSS-derived products into high-resolution NWM have shown positive outcomes, particularly in predicting convective processes. The MAGDA project employs a cloud resolving modeling approach with a grid spacing of 2-3 km, coupled with rapid update cycles every 1-3 hours, to address uncertainties in weather prediction. The assimilation process integrates GNSS data to monitor integrated water vapor content, weather radar reflectivity to reconstruct the 3D cloud field, in situ weather stations for capturing near-surface atmospheric conditions, and meteodrones observations to collect information about the vertical profiles. By leveraging a combination of advanced technologies and data assimilation techniques, the project aims to enhance the accuracy and usefulness of weather forecasts tailored for agriculture and water management applications. The weather forecasts will be used as an input for the irrigation advisory, next to being used for generating warnings for extreme weather events. The warnings and irrigation advisories will ultimately be channeled through a Farm Management System to ensure the capability to effectively reach farmers and agricultural operators.