D3D Project Newsletter — Months 19–24

Period: Months 19–24
Project: *Deep 3D Scattering of Solar Radiation in the Atmosphere due to Clouds* (D3D)
Funded by: Hellenic Foundation for Research and Innovation (H.F.R.I.)

Project Overview — From Research to Operational Validation

Months 19–24 represented a transition from experimental validation to near-operational readiness. The D3D workflow matured into a complete end-to-end system, from real-time ASI data acquisition to fast radiative estimation using deep learning surrogates. This period focused on stress-testing the methodology under diverse atmospheric conditions and assessing its robustness, scalability, and performance.

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2. News Highlights (Months 19–24)

- The project released updated visualizations demonstrating large-scale 3D cloud field reconstructions across extended geographical regions.
- D3D researchers presented integrated system results at international workshops, showcasing real-time radiative estimation capabilities based on deep learning models trained on MYSTIC outputs.
- The project website highlighted new results on cloud-radiation interactions derived from long-term ASI observation campaigns.

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3. Publications & Dissemination

During months 19–24 the project continued to produce contributions:

Journal Articles

- Logothetis, S.-A.; Salamalikis, V.; Kazantzidis, A. A Machine Learning Approach to Retrieving Aerosol Optical Depth Using Solar Radiation Measurements. Remote Sens. 2024, 16, 1132. https://doi.org/10.3390/rs16071132

- Σταύρος-Ανδρέας Λογοθέτης, Ορέστης Παναγόπουλος-Κοντοσταυλάκης, Παναγιώτης Τζουμανίκας, Ανδρέας Καζαντζίδης, ΕΠΙΔΡΑΣΗ ΤΩΝ ΑΙΩΡΟΥΜΕΝΩΝ ΣΩΜΑΤΙΔΙΩΝ ΚΑΙ 3D ΝΕΦΩΝ ΣΤΗΝ ΕΚΤΙΜΗΣΗ ΚΑΙ ΠΡΟΓΝΩΣΗ ΤΗΣ ΗΛΙΑΚΗΣ ΑΚΤΙΝΟΒΟΛΙΑΣ, 13° Εθνικό Συνέδριο για τις ήπιες μορφές ενέργειας • Ι.Η.Τ. • Αθήνα, 15-17.05.2024, ΠΡΑΚΤΙΚΑ

Conference Presentations

- Andreas Kazantzidis, Stavros-Andreas Logothetis, Orestis Panagopoulos-Kontostavlakis, Panagiotis Tzoumanikas, Solar resource under 3D reconstructed cloud fields, EuroSun, 2024
- Kazantzidis, New Challenges in Solar Energy Resource and Forecasting at Different Temporal and Spatial Scales, SECCURe, Rome, 2024.

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4. Research Progress by Work Package

WP1 — Long-term Network Operation

Continuous ASI measurements enabled long-term cloud statistics and trend analyses. Maintenance and recalibration ensured stable performance across seasons.

WP3 — Radiative Transfer Stress Testing

Thousands of MYSTIC simulations were performed to cover diverse cloud and aerosol regimes.
These results defined the training and validation reference for deep learning surrogates.

WP4 — Operational Deep Learning Models

Deep learning models achieved:

- High accuracy across most tested scenarios
- Robust performance under partial cloud cover and broken cloud fields

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5. Scientific Milestones

- Demonstration of a full end-to-end 3D radiative estimation pipeline
- Real-time capable deep learning surrogate for radiative transfer
- Comprehensive evaluation of 3D vs. 1D radiation modeling errors
- Large-scale testing across seasons and atmospheric regimes

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