LSST Cadence Note addendum: maximizing science through Rubin-Euclid Derived Data Products

J.-C. Cuillandre (CEA Saclay) on behalf of the DDP Working Group & DDP community 11/2021

Following up on the second SCOC-Science Collaborations Workshop (November 2021) in the context of the recommendations presently made by the Rubin-Euclid Derived Data Products Working Group on behalf of the DDP community, the present note points out areas of interest from the Rubin-Euclid synergy spring 2021 SCOC note submitted by the The Tri-Agency Survey Coordination Task Force. The DDP report presents a set of initial recommendations (~ 60 DDPs) and will be released late December 2021. A top recommendation of the report indicates that the optimization of the science harvest for both surveys first requires a coordination of each survey's observing strategy: 1) wide surveys overlap and depth, and 2) joint deep fields observing: location, depth, and matched cadence with near-simultaneous observations.

Wide surveys: The new Rubin-LSST baseline (2.0) leads to a generous increase of the two wide surveys overlap through the declination range extension of the WFD. This is fantastic news since it was a top driver of our SCOC note. For consideration for the next SCOC phase, we also made a case in our cadence note for more LSST science with a mini-survey of the extragalactic area of the northern stripe for Targets of Opportunities by upgrading it from g, r, i to g, r, i, z for a grand total of 0.78% of the total number of visits of LSST. This mini-survey would add an extra 2600 deg^2 overlap with Euclid outside of the extended WFD.

Southern deep fields: Euclid selected one of its three deep fields to match the DDF on CDFS (EDF-Fornax, 10 deg^2). There is an informal agreement with Euclid for the fifth DDF field to overlap the Euclid Deep Field South (EDF-South, 23 deg^2) which has been shaped into an elongated area to minimize the Rubin time budget needed to reach a uniform depth across 20 contiguous square degrees required by Euclid's science. EDF-South is now integrated in the LSST baseline, although as two individual half-speed DDFs which would lead to a barely contiguous final area of less than 20 square degrees at the required depth. Interactions between the two projects survey design teams led to the proposed translation dithers illustrated on Figure 1 for which Rubin reaches the Euclid depth goals on 21.6 deg^2 within the 23 deg^2 stadium shape area which will be fully covered by Euclid. This dithered approach is favored on the DDP side as it maximizes the science output of the static astrophysics while creating a uniform joint legacy dataset. Transient science is affected but not undermined by such approach. It is worth noting here that the DDP report recommends for openly shared photometric observations (pixels) of a deep field since the production of the DDPs on the long run would indeed benefit from an openly shared photometric dataset across the two consortia over a small sky area, EDF-South being an ideal candidate considering the mutual engagement. Once Euclid is launched we will know when those two southern deep fields will be visited over the 6-year period. EDF-Fornax and EDF-South will start getting observed regularly on the second year of the space survey, each visit lasting a fixed 5 to 6 days, every 6 months. To optimize transient science, the LSST and Euclid cadence should be optimized as much as possible.

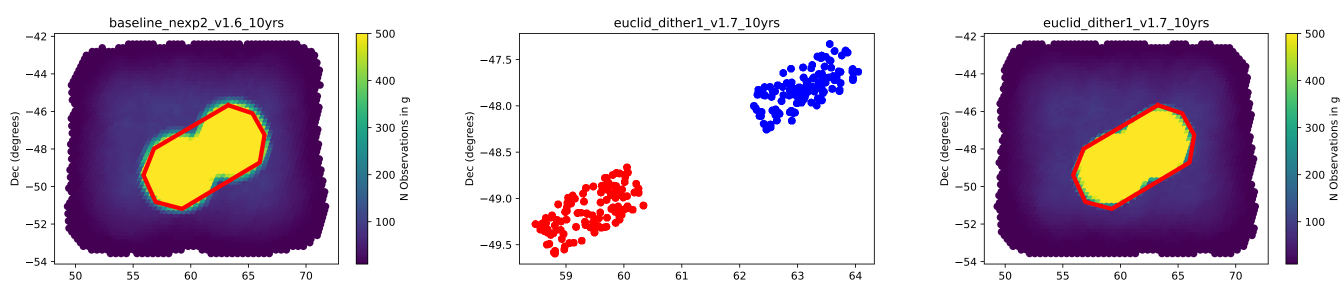

Figure 1 - The stadium shape of EDF-South was chosen to minimize the Rubin time budget needed to cover a contiguous area of at least 20 deg^2, as required by Euclid's science goals. Two independent Rubin DDF positions (left) over EDF-South result in high depth outside the desired footprint. A custom extended Rubin dithering pattern (translation dithers, center) brings better footprint coverage, reaching 21.6 deg^2, out of the stadium's 23 deg^2 footprint, at the required depths (right). Simulations by Peter Yoachim.