

# Options for Alert Production in LSST Operations Year 1 (LOY1)

A Summary of DMTN-107 for the 2019 PCW DIA Parallel Workshop  
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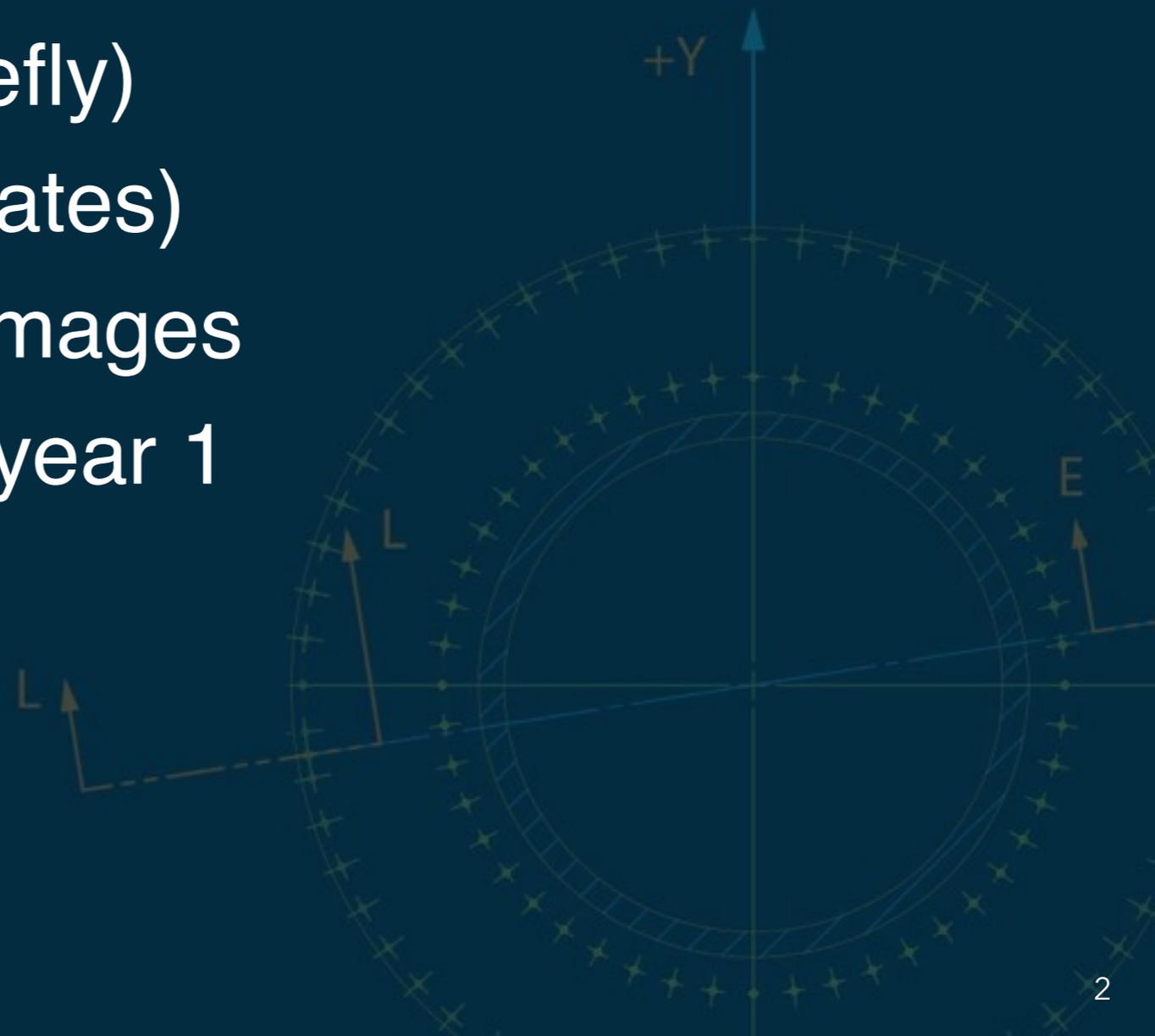


*Large Synoptic Survey Telescope*

The logo features the letters 'LSST' in a bold, black, sans-serif font. The letter 'S' is filled with a blue-to-white gradient, resembling a nebula or a galaxy. Below the logo, the full name 'Large Synoptic Survey Telescope' is written in a smaller, italicized, white serif font.

## Producing Alerts in Year 1

- the need for a plan
- an overview of options
- unpreferred options (briefly)
- preferred options (templates)
- accumulating template images
- alert packet contents in year 1



# The Problem At Hand



Alerts are a product of Difference Image Analysis (**DIA**).

DIA requires that template images exist.

Templates are built during Data Release (**DR**) processing.

The first DR is expected late in LSST Operations Year 1 (**LOY1**).

**Therefore: no alerts would be produced by LSST before DR1, *unless* an interim plan is implemented.**

This is a problem because:

- *time-domain astronomy is an LSST science pillar*
- *alerts are the only public data product*
- *the community is preparing to generate science from alerts asap*

**What are the options for Alerts in LOY1?**

Options Considered	Needs Templates?
Catalog Differencing	no
Image-Image Differencing	no
Commissioning-Data Templates	built <i>before</i> LOY1
LOY1-Data Templates	built <i>during</i> LOY1

## Criteria Considered

Software *Whether new DM development might be needed.*

Consistency *Any differences in the **content or format of LOY1 alerts**, compared to the rest of the LSST survey.*

Science *Is time-domain science maximized in LOY1?*

# Unpreferred Options



Catalog  
Differencing

*Do not build templates. Run source detection on direct images, build source catalogs, and create alert packets for sources changed in brightness by a given threshold.*

Image-Image  
Differencing

*Do not build templates. Reconfigure DIA to perform image-image differencing and release alerts on difference-image sources above a SNR threshold.*

Option	Software	Consistency	Science
Catalog Differencing	new development	no	enables some science
Image-Image Differencing	new development	no	enables some science

# Preferred Options



Commissioning-Data  
Templates

*Build templates from commissioning data before the start of LOY1, and use them to generate alerts.*

LOY1-Data Templates

*Build templates from data obtained during LOY1 (e.g., monthly), and use them to generate alerts. (Alone or in addition to commissioning.)*

Option	Software	Consistency	Science
Commissioning-Data Templates	existing codes are sufficient	somewhat* consistent	enables some** science
LOY1-Data Templates	existing codes are sufficient	somewhat* consistent	enables more** science

\* “somewhat” consistent because alerts cannot contain, e.g., a 12-month history (consistency in LOY1 is discussed further on last slide)

\*\* “some vs. more” is in terms of sky area in which alert generation is possible, the total number of alerts produced, and the filters in which alerts can be produced

# Cumulative Options to Build Templates for LOY1



Use templates already built for science verification...

*~1600 deg<sup>2</sup> from Sci. Val. Survey 1*  
**10% of WFD**

... **and** build templates from all commissioning images...

*+ ~300 deg<sup>2</sup> from Sci. Val. Survey 2*  
*+ ~100 deg<sup>2</sup> from the 20-Year Depth*  
*+ any and all other images*  
**>14% of WFD**

... **and IF\*** more area could be covered in commissioning...

*+ ~10000 deg<sup>2</sup> from an idea\* of a way to maybe cover area during commissioning*  
**50% of WFD**

... and/or building templates from LOY1 images.

*+ imaging data obtained in LOY1 used to build templates on intermediate timescale*  
**>50% of WFD**

*\* (A) ~4 good IQ, non-consecutive nights to obtain 3 visits/field in a single filter (e.g, i-band, to mitigate DCR) over a contiguous area, or (B) a "Template-Building Observing Program", run when agnostic to filter/pointing, could achieve this too*

## How might templates be different in LOY1?

*Requirements: in LOY1, templates may contribute up to 40% of the noise in the difference image; other years, 20% ([ls.st/dmtn-107](#), S.2.3.)*

## How might packet contents be different in LOY1?

*Templates built from images obtained in a short time window might not represent standardized “median” flux for variables.*

*Templates build from recently-obtained images might contain some flux for longer duration transients.*

*In LOY1, alerts cannot contain a 12-month history of LSST data (obviously); impacts variability characterization parameters.*

*Before the first DR, alerts cannot contain matches to the 3 nearest DR Objects (i.e., no contextual info re. star/gal, host photo-z).*

End

