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ESA–MOST Dragon 4 Cooperation

ADVANCED LAND REMOTE SENSING INTERNATIONAL TRAINING COURSE

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Advanced Thermal Applications Using SNAP and Sentinel-3A SLSTR Data

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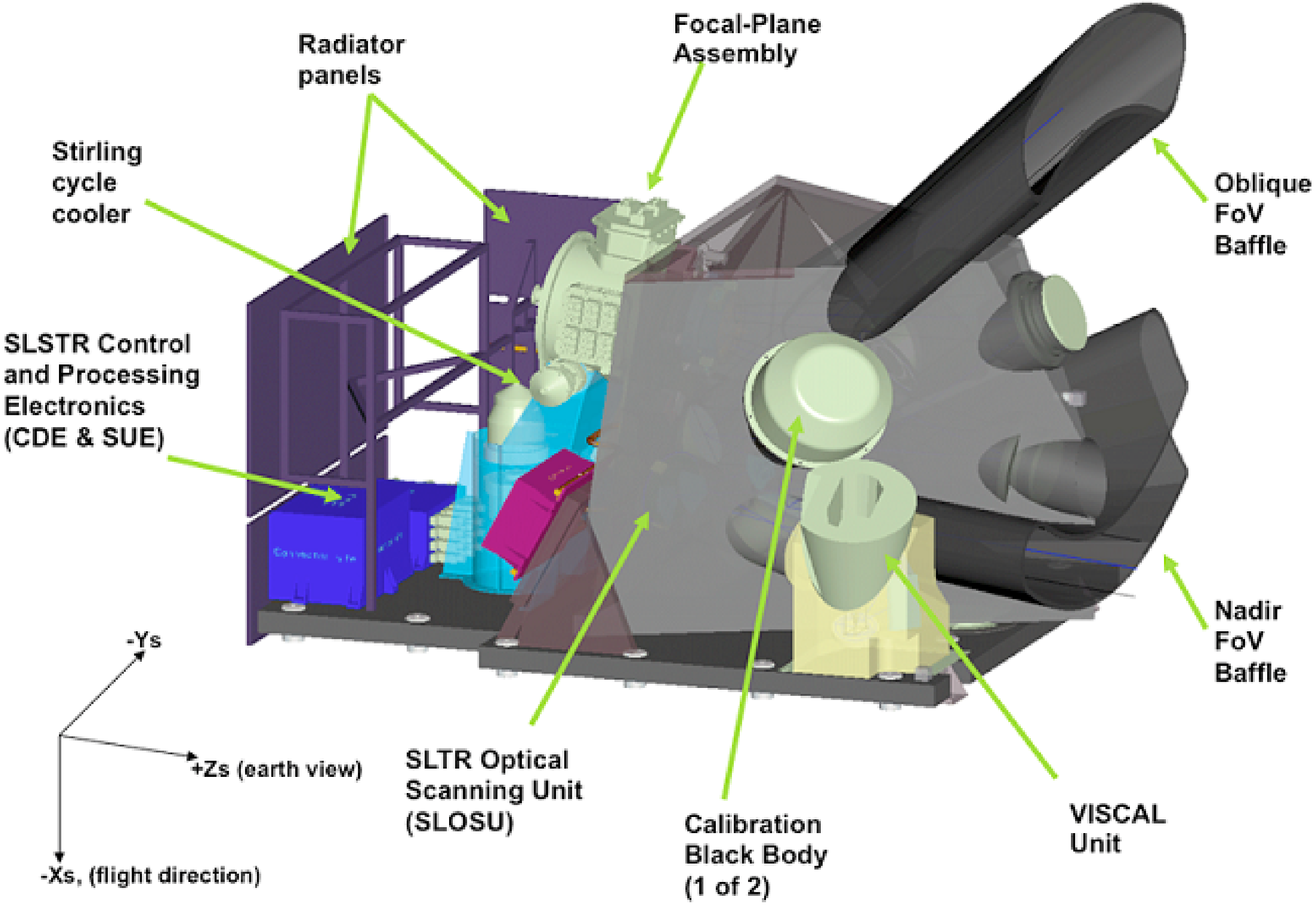
1 Odermatt & Brockmann (Germany) 2 Brockmann Consult (Germany) 3 Image Processing Laboratory (UV, Spain)

Sea and Land Surface Temperature Radiometer (SLSTR)



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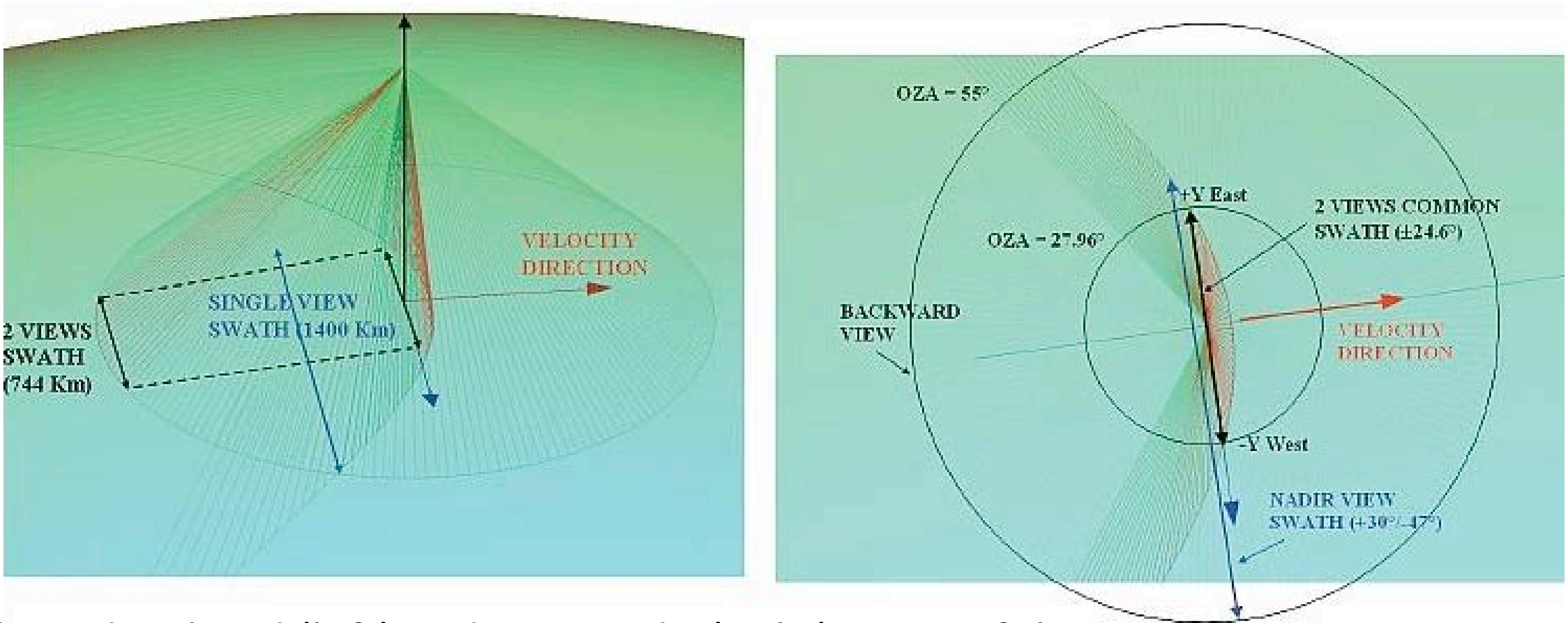


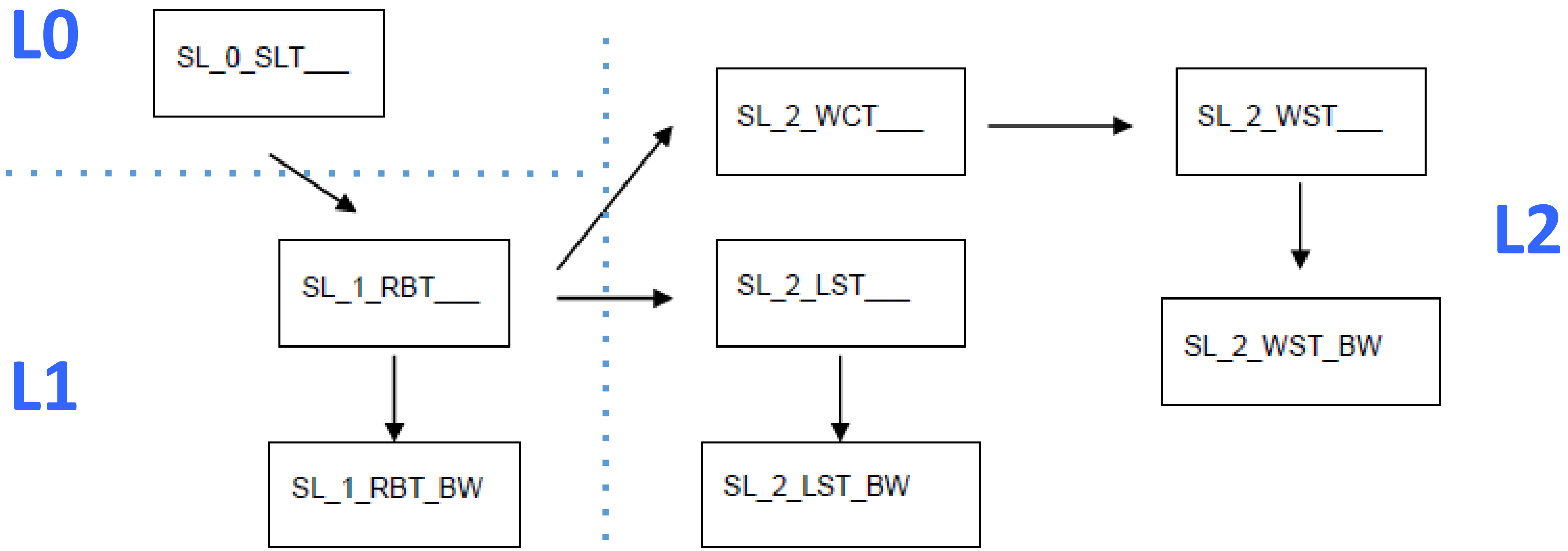
Backward inclined (left) and near nadir (right) views of the scanning mirror geometry

Image credit: SLSTR consortium

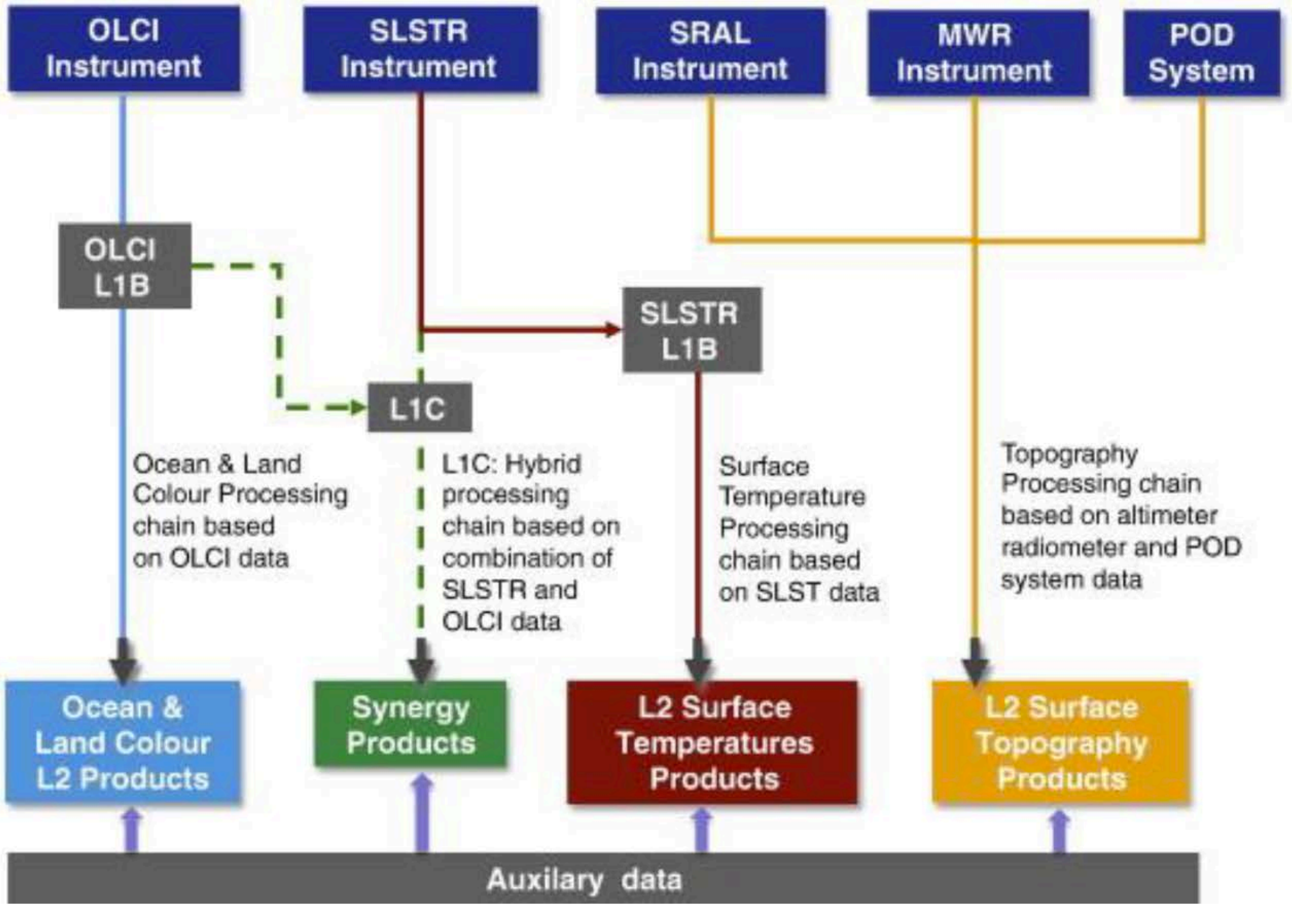
Data and Physical Units in SLSTR Products

Performance	Parameters	SLSTR	AATSR & ATSR-1/2
Swaths	Nadir view	1 400 km	500 km
	Dual view	740 km	500 km
Global coverage revisit time	1 S/C (dual view)	1.9 days	7-14 days
		0.9 days	-
		1 day	7-14 days
		0.5 days	-
SSI at SSP (km)		0.5 km VIS-SWIR 1 km IR-fire	1 km
Spectral channels centre λ (μm)	VIS (not ATSR-1): SWIR: MWIR/TIR: Fire-1/2:	0.555; 0.659; 0.865; 1.375; 1.610; 2.25; 3.74; 10.85; 12; 3.74; 10.85	0.555; 0.659; 0.865; 1.610; 3.74; 10.85; 12; -
Radiometric resolution	VIS (a=0.5%): SWIR (a=0.5%):	SNR > 20 SNR > 20	SNR > 20 SNR > 20
	MWIR (T=270K): TIR (T=270K): Fire-1 (<500 K): Fire-2 (<400 K):	NeΔT < 80 mK NeΔT < 50 mK NeΔT < 1K NeΔT < 0.5 K	NeΔT < 80 mK NeΔT < 50 mK
Radiometric accuracy	VIS-SWIR: (a=2-100%)	< 2% (BOL) < 5% (EOL)	< 5%
	MWIR-TIR (265-310K): Fire (<500k):	< 0.1 k (goal) < 3 K	< 0.1 K
Life time (in orbit)		7.5 years	AATSR: 5 year design, operative since 2002; ATSR-2: 3 year design, operating from 1995 to 2008; ATSR-1: 3 year design, operating from 1991 to 2000

SLSTR Product Types



Sentinel-3 Data Processing Chains



OCLI/SLSTR SYNERGY PRODUCTS

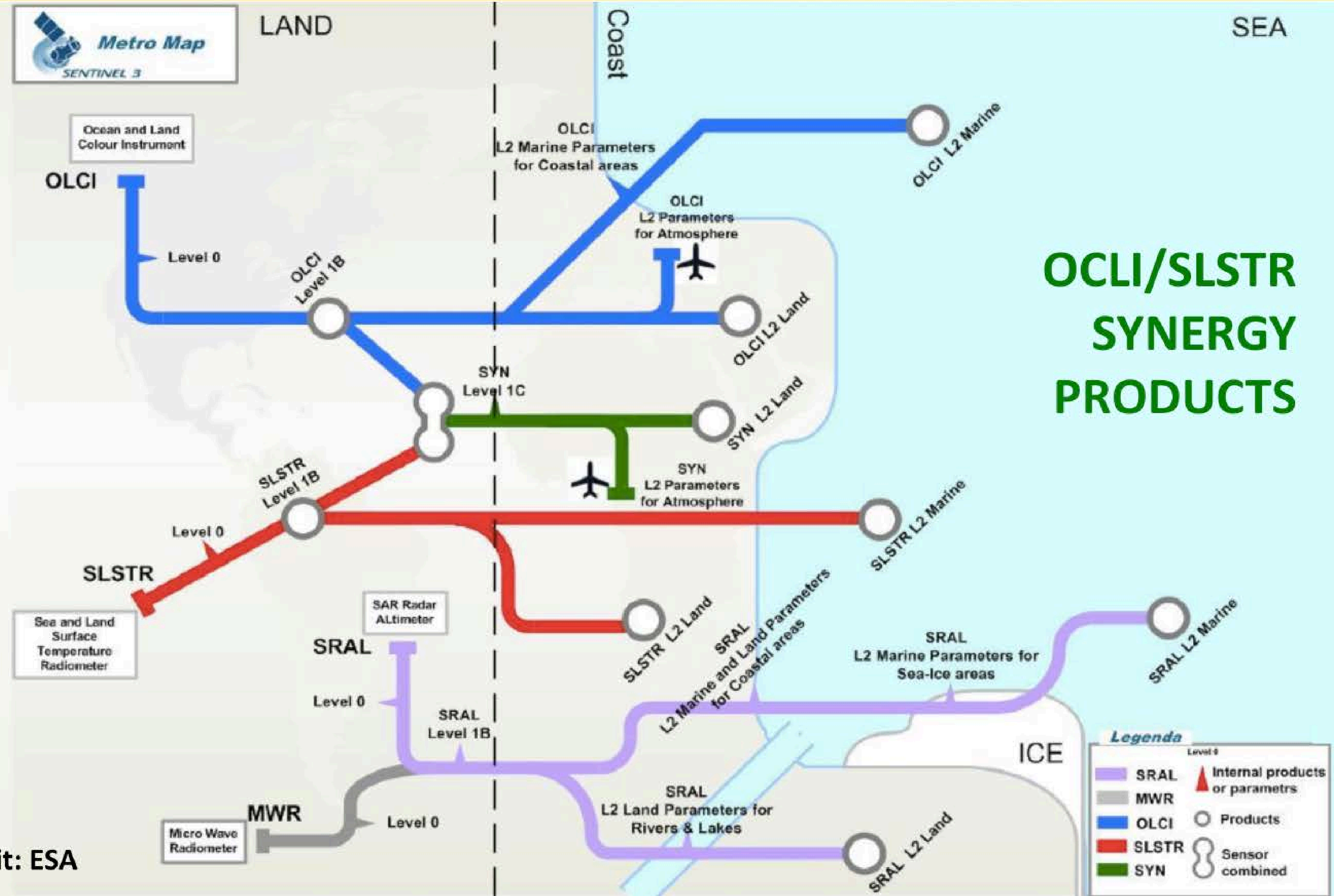


Image credit: ESA

Exercise Overview:

- Goal: To calculate Land Surface Temperatures using the thermal emissivity factors calculated in D2OT-P1
- Source: Sobrino et al. (2008, 2016)
- Procedure:
  - Basic image visualization and manipulation tasks
  - OLCI L1 TOA radiance to reflectance conversion
  - OLCI L1/L2 product collocation
  - Band maths operations
  - Graph builder and batch processing
- Sentinel-3 user guide: https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-3-olci

Land surface temperature using a split-window algorithm

$$T_S = T_i + c_1 (T_i - T_j) + c_2 (T_i - T_j)^2 + c_0$$

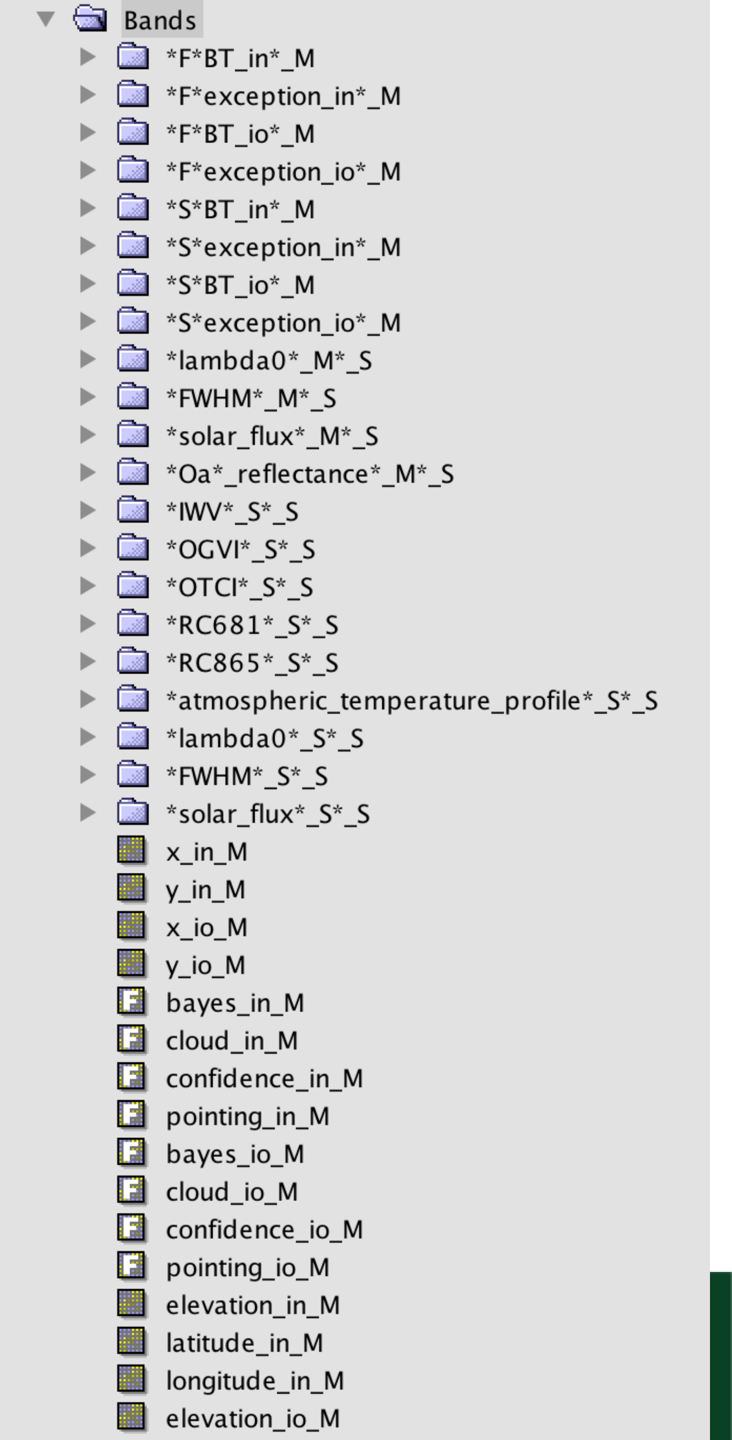
$$+ (c_3 + c_4 W)(1 - \varepsilon) + (c_5 + c_6 W)\Delta\varepsilon \quad (1)$$

where Ts is the LST (in K), $T_{i,j}$ are at-sensor brightness temperatures (in K), W is the atmospheric water vapor content (in $g \cdot cm^{-2}$ or cm), ε is the mean LSE $0.5 \cdot (\varepsilon_i + \varepsilon_j)$, and Δε is the LSE difference $(\varepsilon_i - \varepsilon_j)$. Subindices 'i' and 'j' refer to two different TIR bands, thus leading to the SW algorithm, or to one TIR band but two different view angles (e.g. nadir 'n' and oblique 'o' views), thus leading to the DA algorithm. Coefficients c_0 to c_6 are obtained from statistical regressions performed over simulated data.

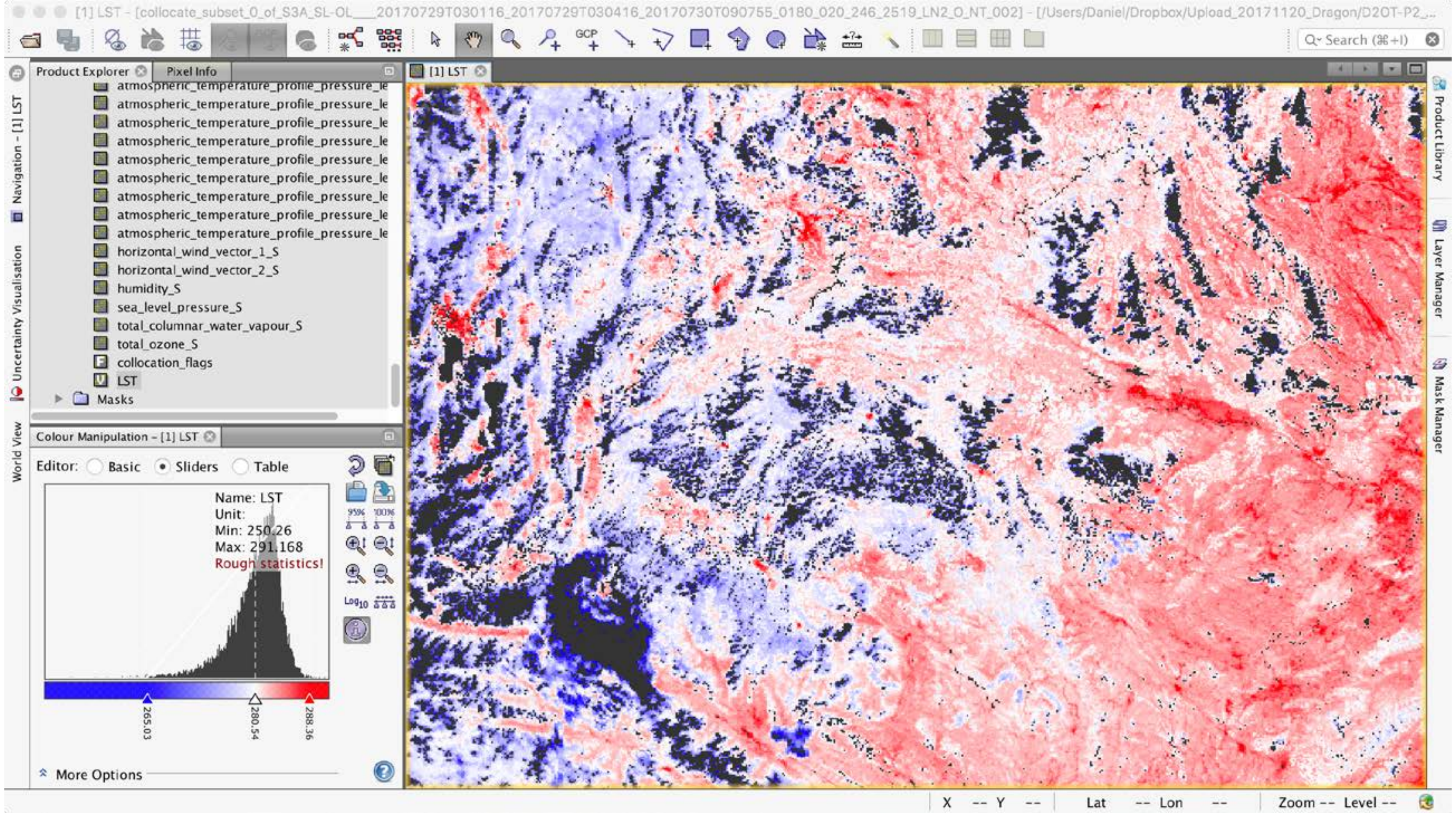
Synergistic use of MERIS and AATSR as a proxy for estimating Land Surface Temperature from Sentinel-3 data; Sobrino et al., 2016, RSE, http://dx.doi.org/10.1016/j.rse.2016.03.035

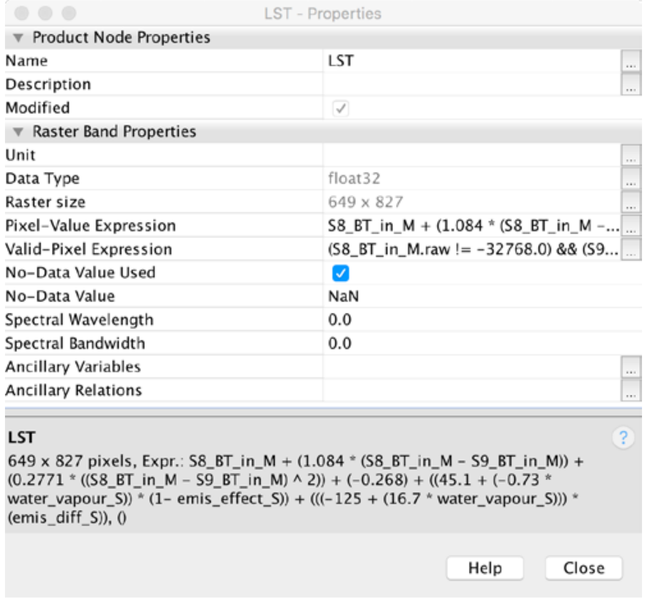
1. SLSTR-OLCI COLLOCATION

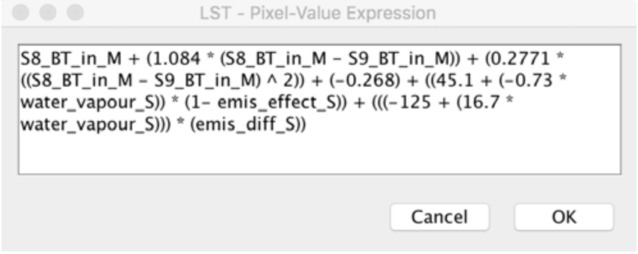
- Use the collocation tool to group the SLSTR and OLCI bands in one product with the same spatial resolution (1 km) and geo-location:
- *Raster/Geometric Operations/Collocation*
- Master file: *subset_0_of_S3A_SL_1_RBT____20170729T030116_20170729T030416_20170730T090755_0180_020_246_2519_LN2_O_NT_002.dim*
- Slave file: *emissivity_collocate_subset_0_of_S3A_OL_1_EFR____20170729T030116_20170729T030416_20170730T064809_0180_020_246_2519_LN1_O_NT_002_radrefl.dim*



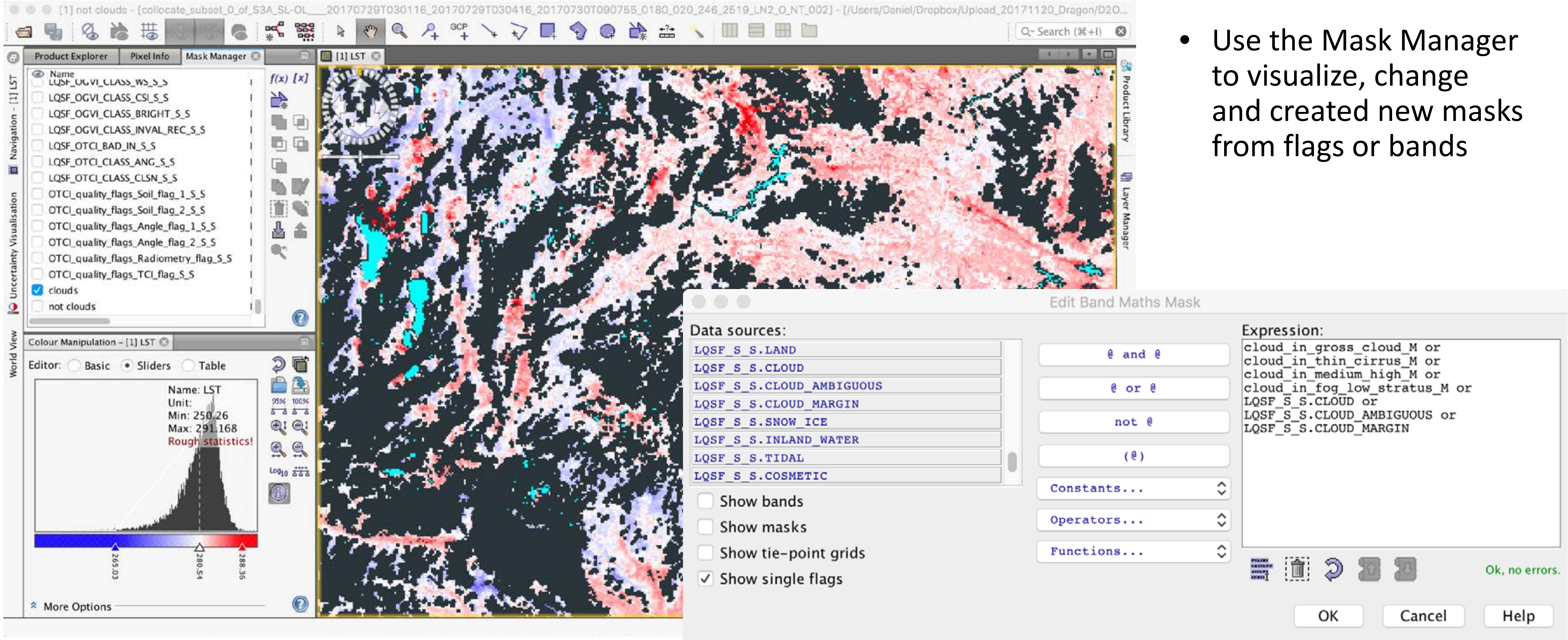
2. LST Algorithm in Band Maths







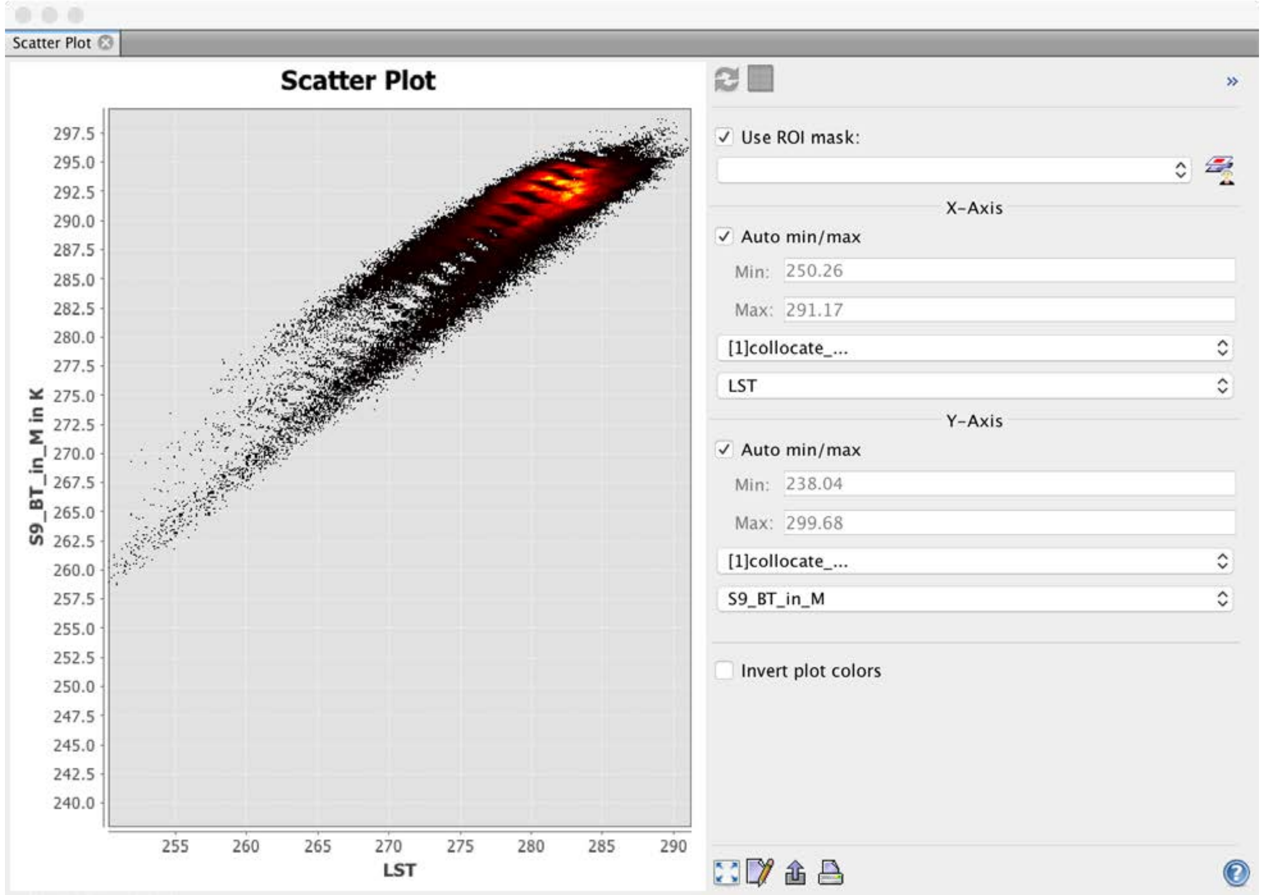
3. FLAGS AND MASKS



- Use the Mask Manager to visualize, change and created new masks from flags or bands

4. Scatter Plot Split Window LST vs. L2

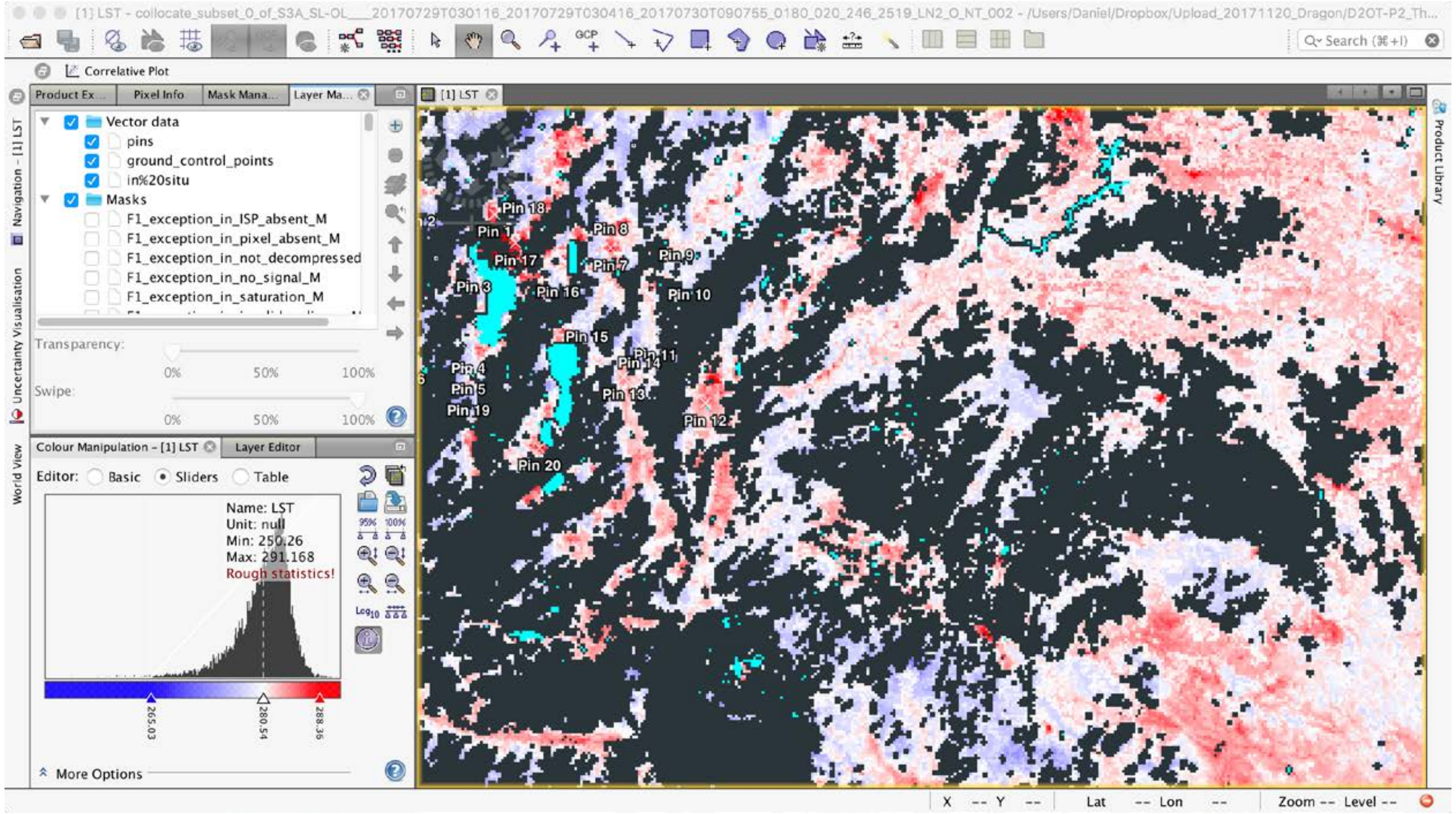
- Compare the split window calculated LST with other thermal bands (Analysis/Scatter Plot)



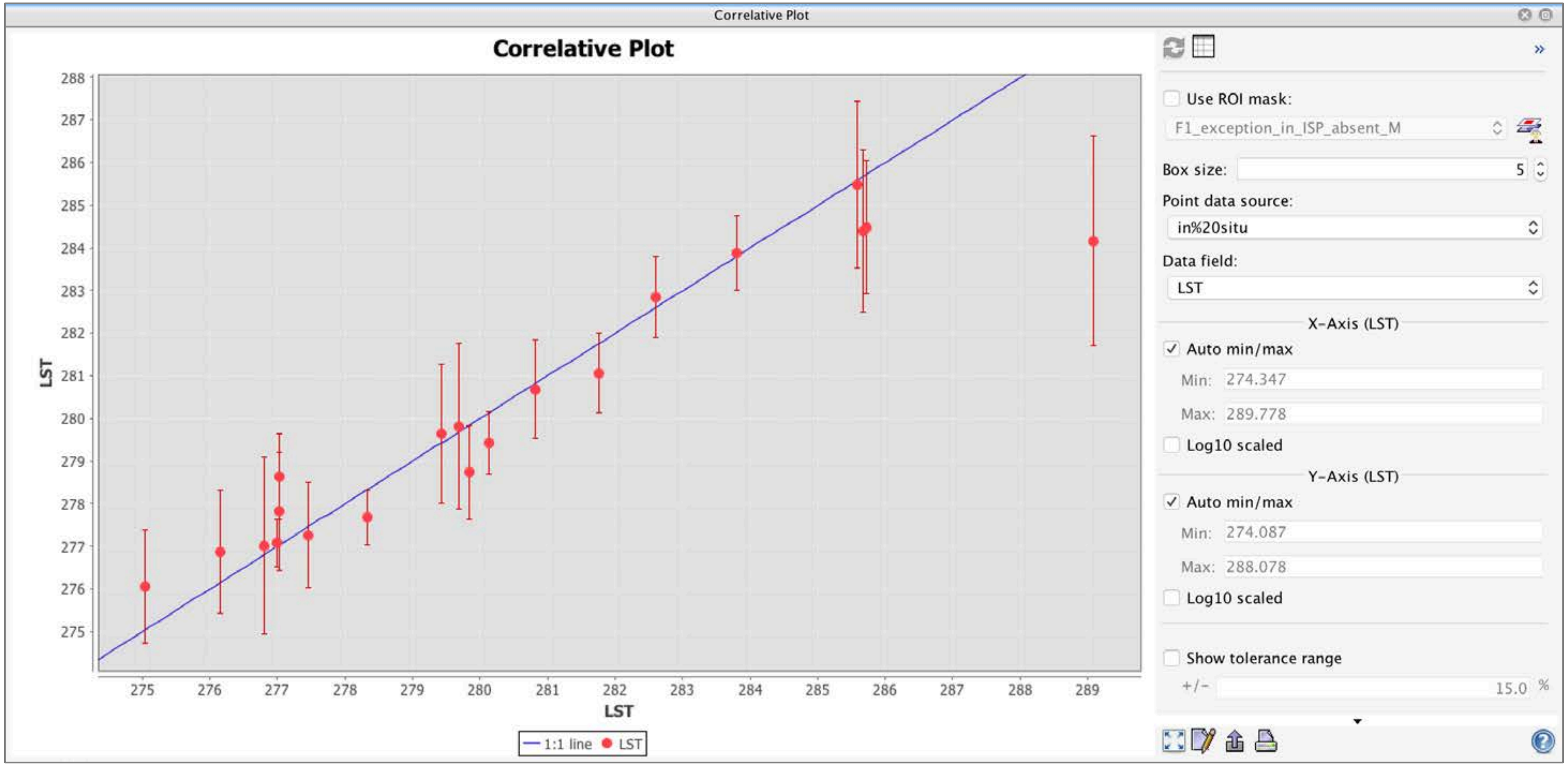
- [Product error?]
  Try to collocate the split window calculated LST with the SLSTR L2 product for comparison (*S3A_SL_2_LST____20170729T030116_20170729T030416_20170729T050111_0180_020_246_2519_SVL_O_NR_002.SEN3*)

5. Import a Shapefile with in situ data

- Use the dialogue *File/Import/Vector data/ESRI shapefile* to open the shapefile *text/in situ.shp* with in situ data
- Check the Vector Data list in the *Layer Manager*
- Select *Analysis/Correlative Plot*



6. Make a Correlation Plot



7. [cont.] Batch Processing