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DIMITRI-DATABASE OF IMAGING MULTISPECTRAL INSTRUMENT AND TOOL FOR RADIOMETRIC INTERCOMPARISON: EVOLUTION AND APPLICATION

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ARGANS

magellium

Numerical Optics Ltd

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Agenda

- DIMITRI-Tool history & improvements
- Applications & Results
- Conclusions

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The views expressed herein can in no way be taken to reflect the official opinion of the European Space Agency or the European Union.

DIMITRI-Tool history & improvements

- **DIMITRI V1.0** was prototyped at ESA/ESTEC by Marc Bouvet.

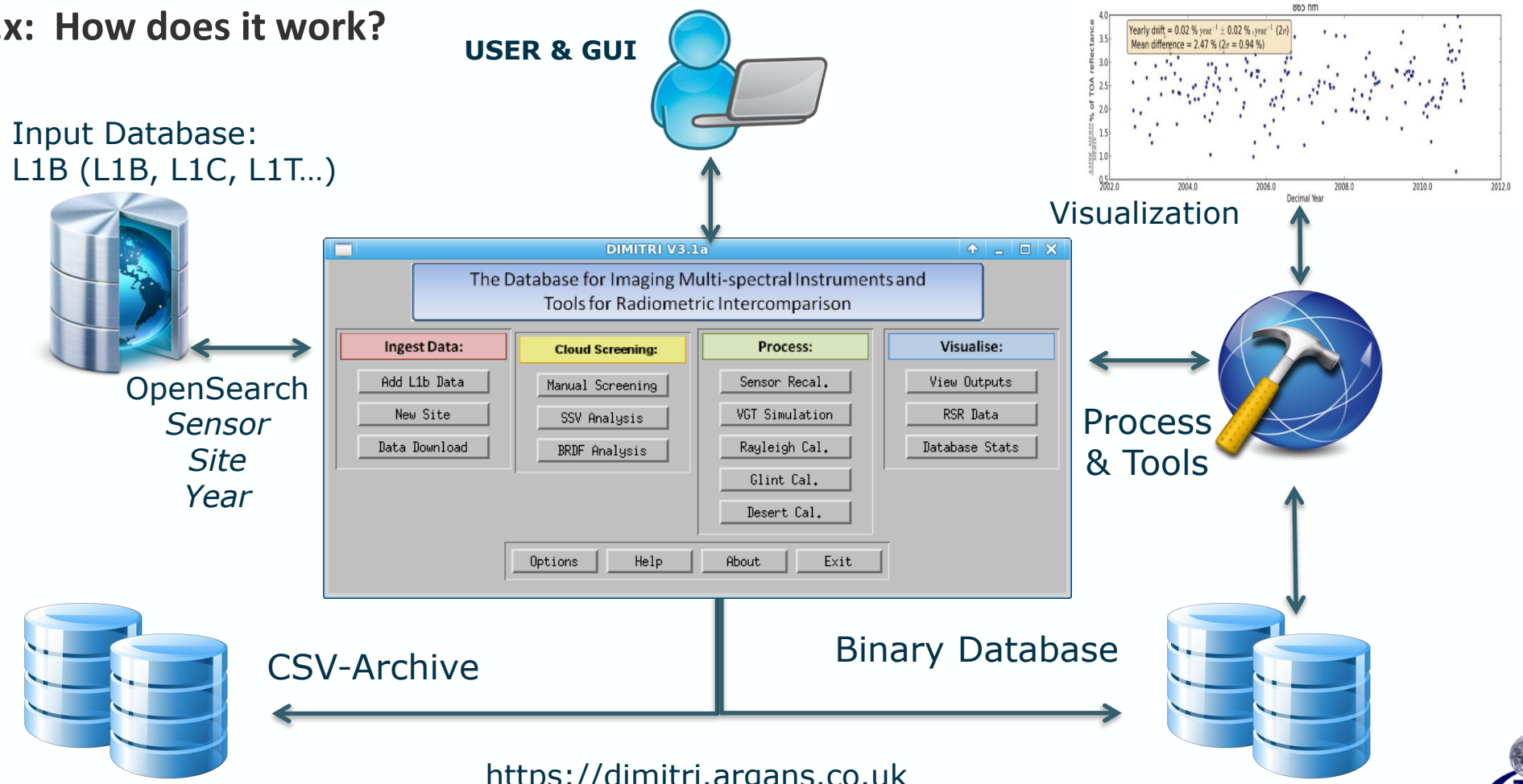
- **DIMITRI V2.0** was developed by ARGANS Ltd in collaboration with ESA/ESTEC:
  - ✓ Includes VIIRS reader & some data,
  - ✓ Limited ingestion capability.

- **DIMITRI V3.x** is developed by ARGANS Ltd in collaboration with ESA/ESTEC.
  - ✓ Improved ingestion capability.
  - ✓ Improved cloud screening
  - ✓ Includes Rayleigh scattering, Sun glint, Desert-PICS, and Angular matching methodologies

- **DIMITRI V4.x** is developed by ARGANS Ltd and MAGELLIUM in collaboration with ESA/ESTEC.
  - ✓ Improved ingestion capability (NCDF format).
  - ✓ Includes installation test functionalities
  - ✓ Include Angular matching methodology (sensor to sensor comparison)
  - ✓ Includes 2 sets of Rayleigh scattering, Sun glint and Desert-PICS and DCC methods
  - ✓ Includes snow-PICS method
  - ✓ Improvement of Rayleigh scattering, Sun glint methods
  - ✓ Includes Synthesis-Plots/statistics unit of the calibration methods

DIMITRI-Tool history & improvements

- **DIMITRI V3.x: How does it work?**



https://dimitri.argans.co.uk

DIMITRI-Tool history & improvements

CalVal-sites Location

13 Land; 8 Water; DCC (where available)

Bright sites:

Desert/Salt:

- 6 CEOS-PICS
- Gobabeb
- RRVP
- BSCN
- TuzGolu
- Uyuni

Ice/Snow

- DOME-C

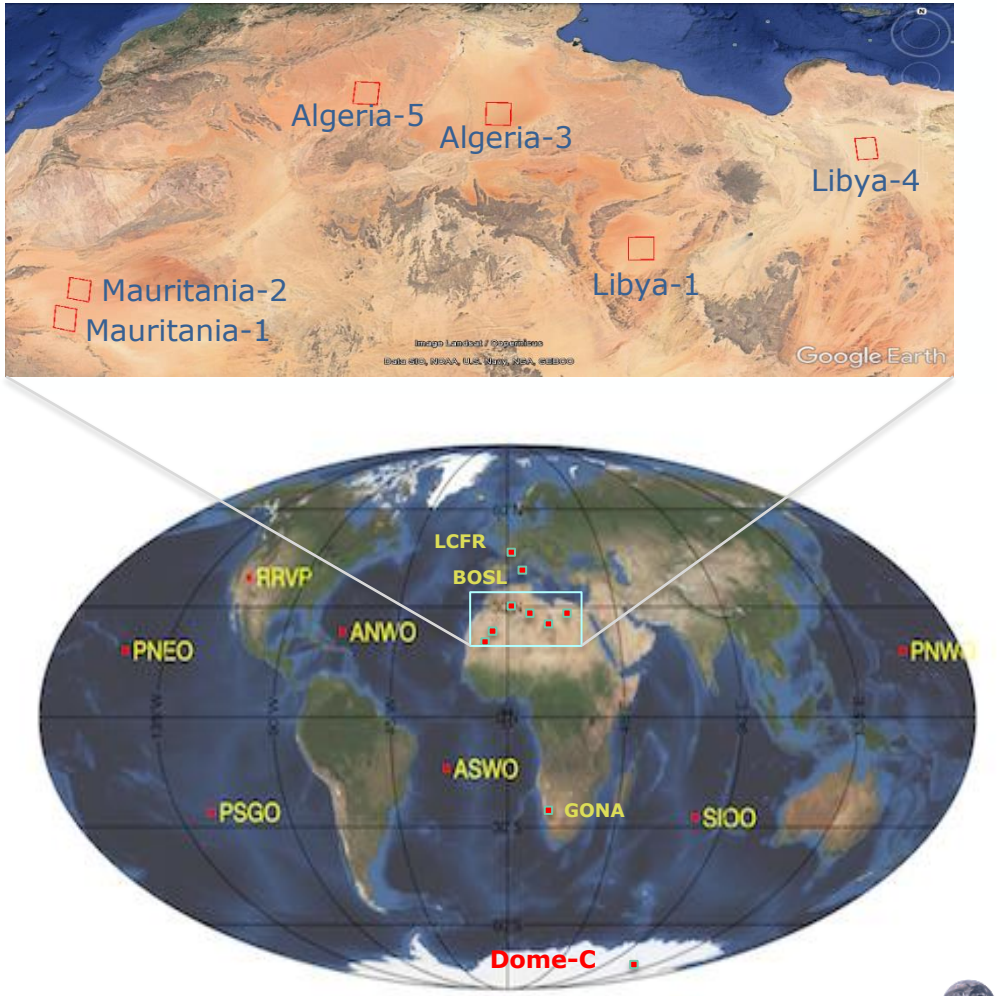
Dark sites:

Land:

- La Crau
- Amazon

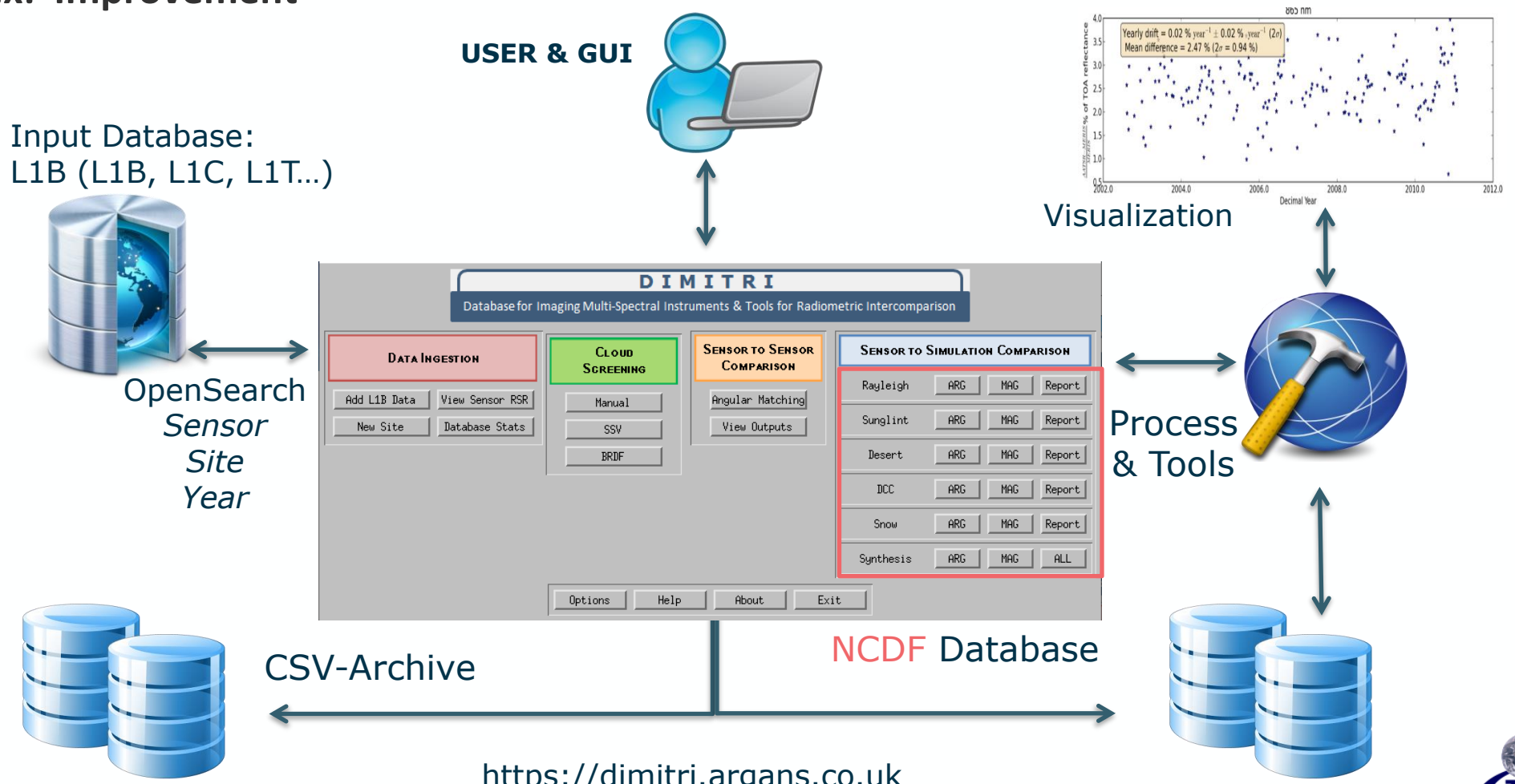
Water

- 6 Open Ocean
- Boussole & MedSea



DIMITRI-Tool history & improvements

- **DIMITRI V4.x: Improvement**



DIMITRI-V4.x: Application & Results

- **Rayleigh Scattering method: Improvements**
  - ✓ **Marine-reflectance BRDF improvement**

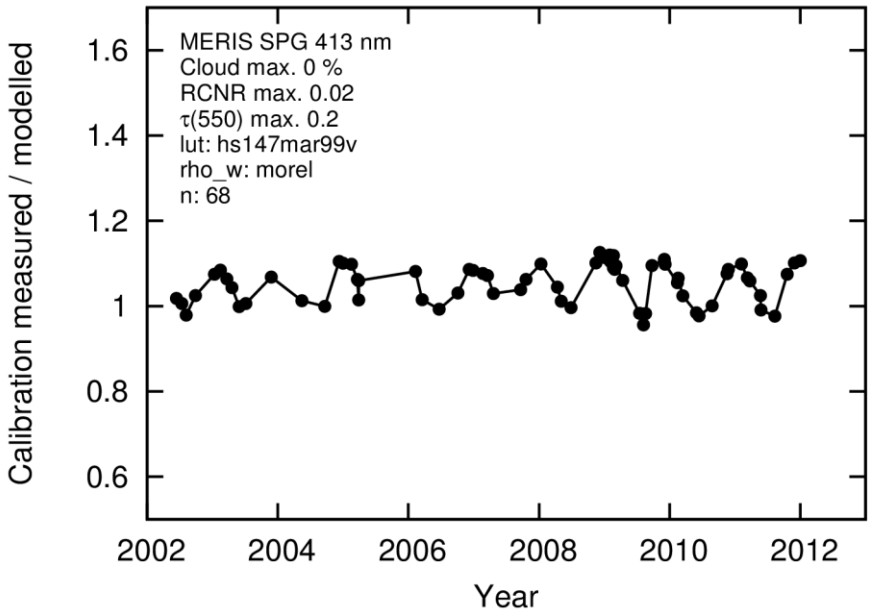
$\rho_w(\lambda)$

Aim is to replace with version that is dependent on solar-view geometry (using **BRDF**)

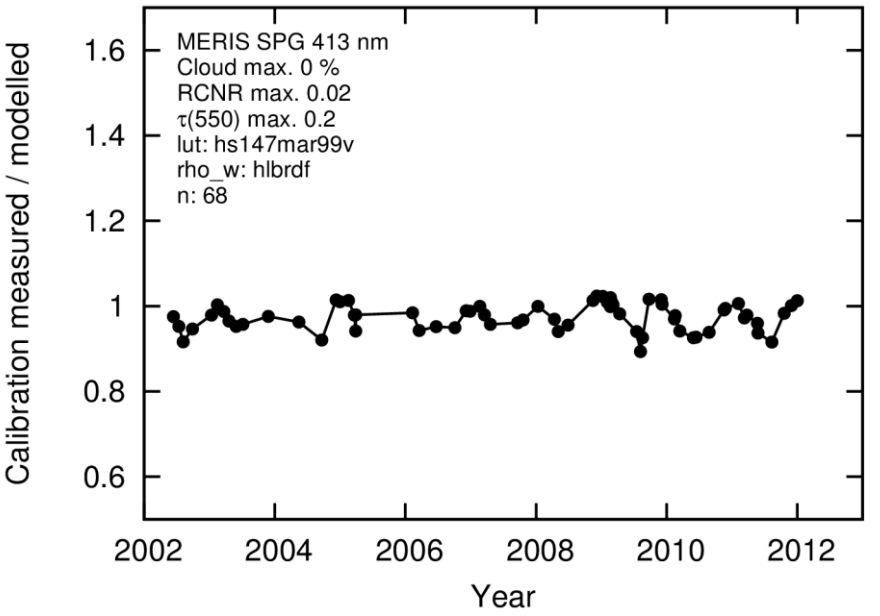
$\rho_w(\lambda, \theta, \theta_0, \Delta\phi)$

- ✓ **SPG-Site: : MERIS 3rd RP**
- ✓ **Slight improvement**

Original water-leaving reflectance



New BRDF

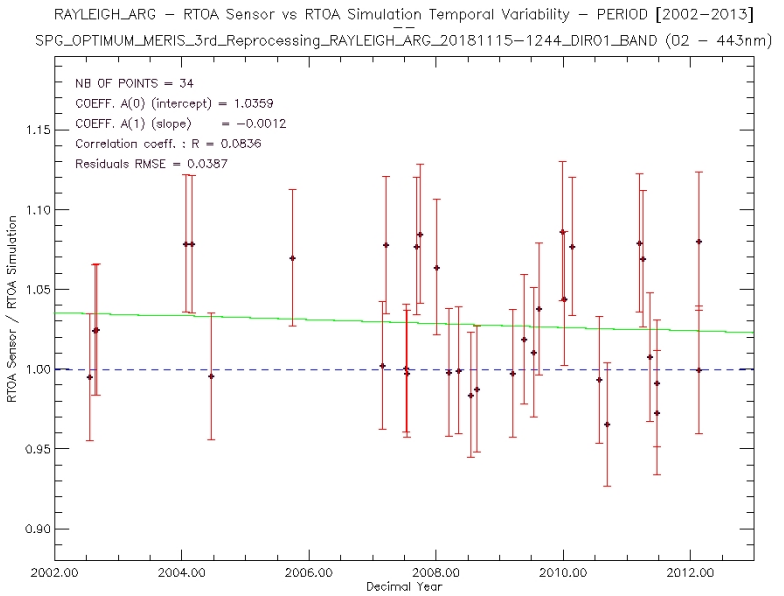


DIMITRI-V4.x: Application & Results

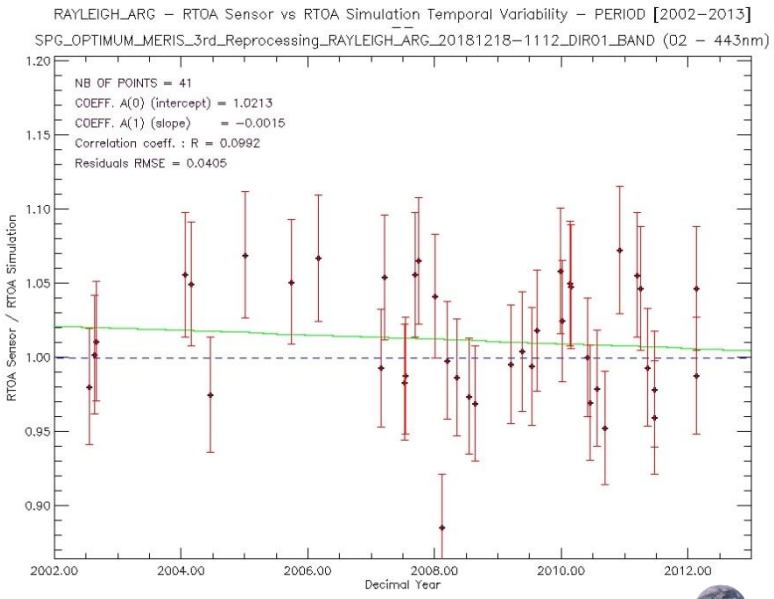
- **Rayleigh Scattering method: Improvements**
  - ✓ **Hyperspectral-LUTS + Atmos Pressure adjustment (Sensor independent)**

- ✓ **SPG-Site: MERIS 3rd RP**
- ✓ **Clear improvement**

Before (443 nm)



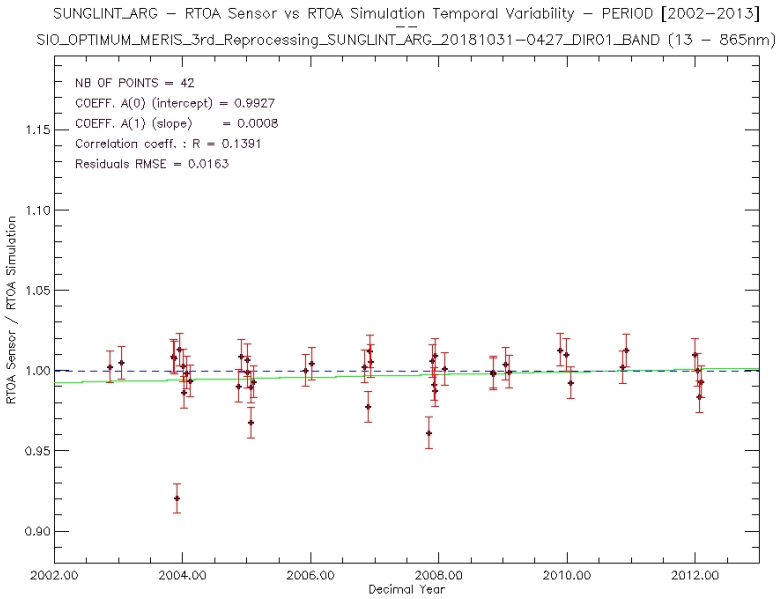
After (443 nm)



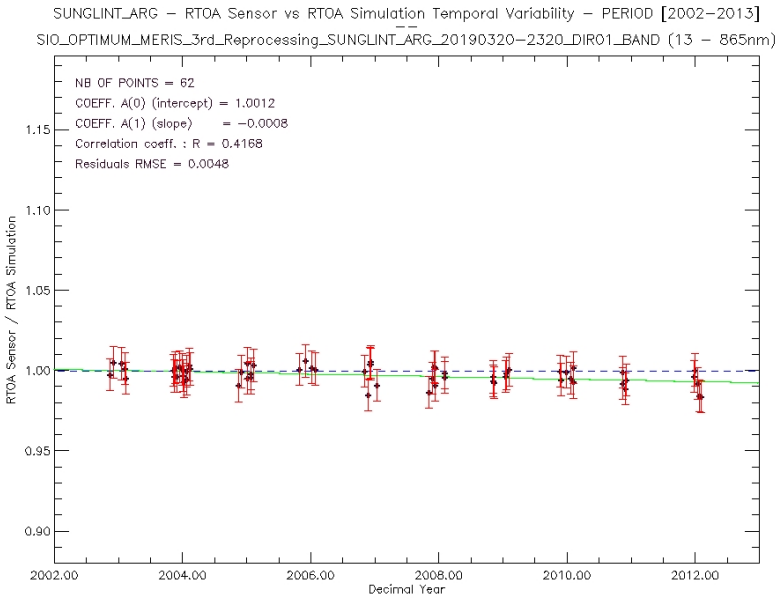
DIMITRI-V4.x: Application & Results

- **Sun-glint method: Improvements**
  - ✓ **Hyperspectral-LUTS + Atmos Pressure adjustment (Sensor independent)**

Before (865 nm)



After (865 nm)



- ✓ **SPG-Site: MERIS 3rd RP**
- ✓ **Clear improvement**

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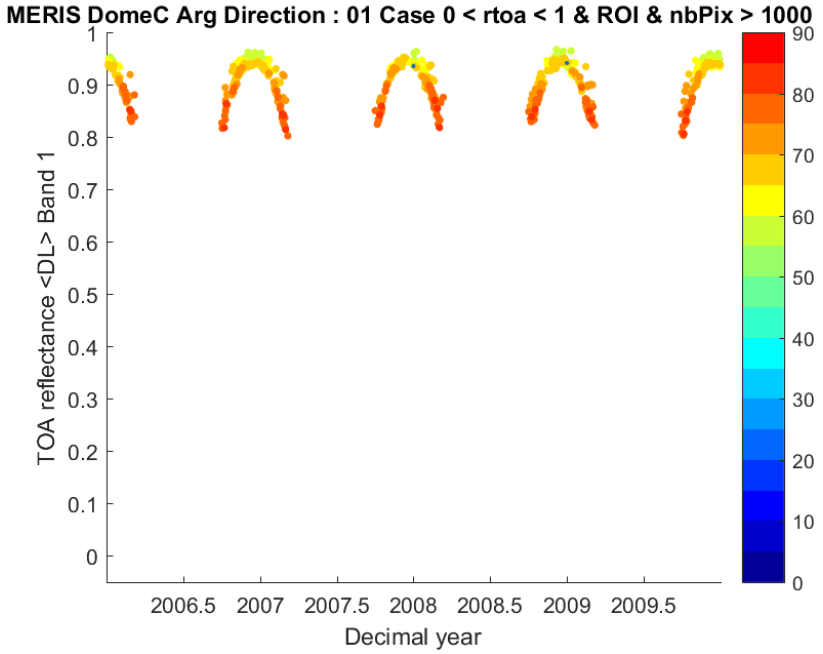
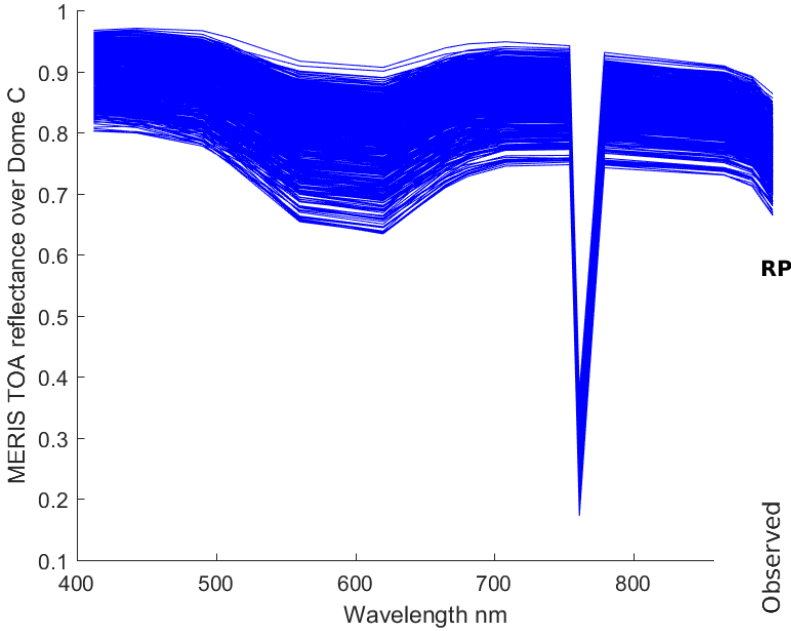
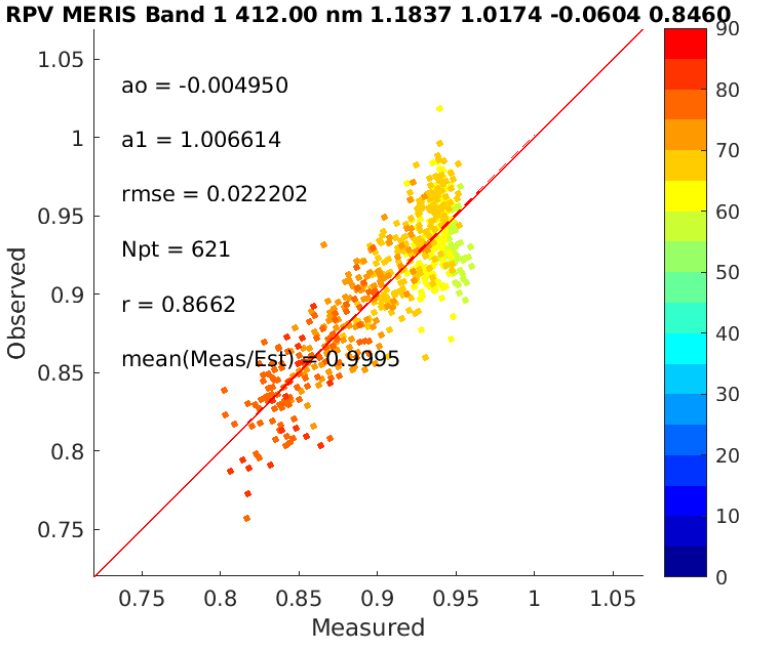
DIMITRI-V4.x: Application & Results

- **Snow-PICS method: Improvement**
  - ✓ **Snow-BRDF modelling**
  - ✓ **Dome-C-Site: MERIS 3rd RP**



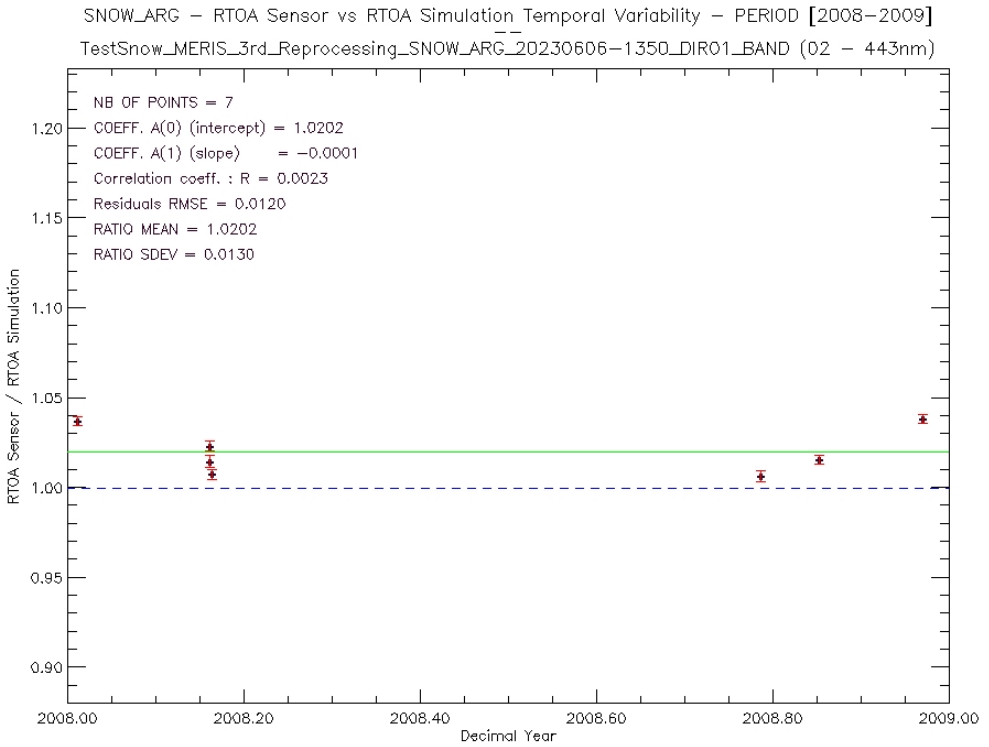


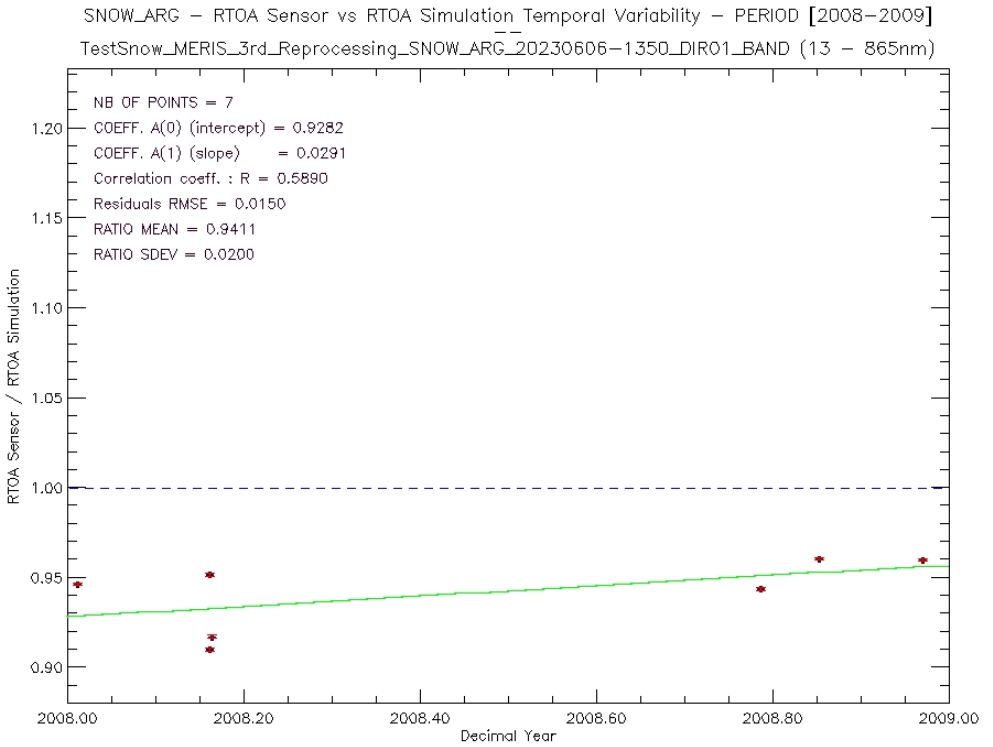


RPV-model inversion of Band B01

DIMITRI-V4.x: Application & Results

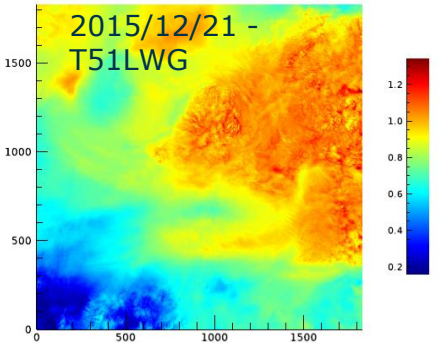
- **Snow-PICS method: Improvements**
  - ✓ **Snow-BRDF modelling**
  - ✓ **Dome-C-Site: MERIS 3rd RP; Good results up to 800 nm (<3% error).**

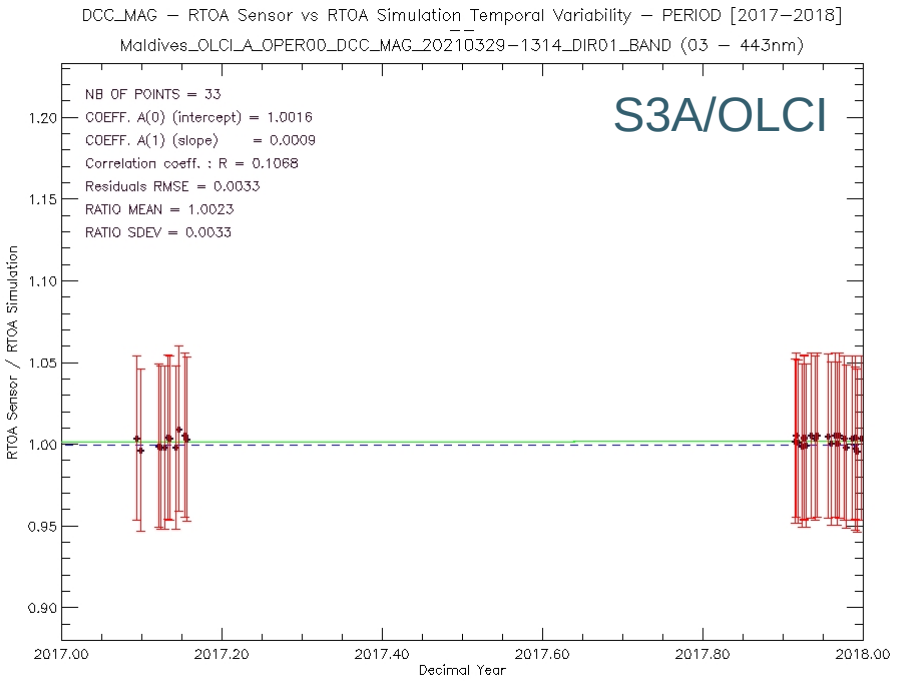


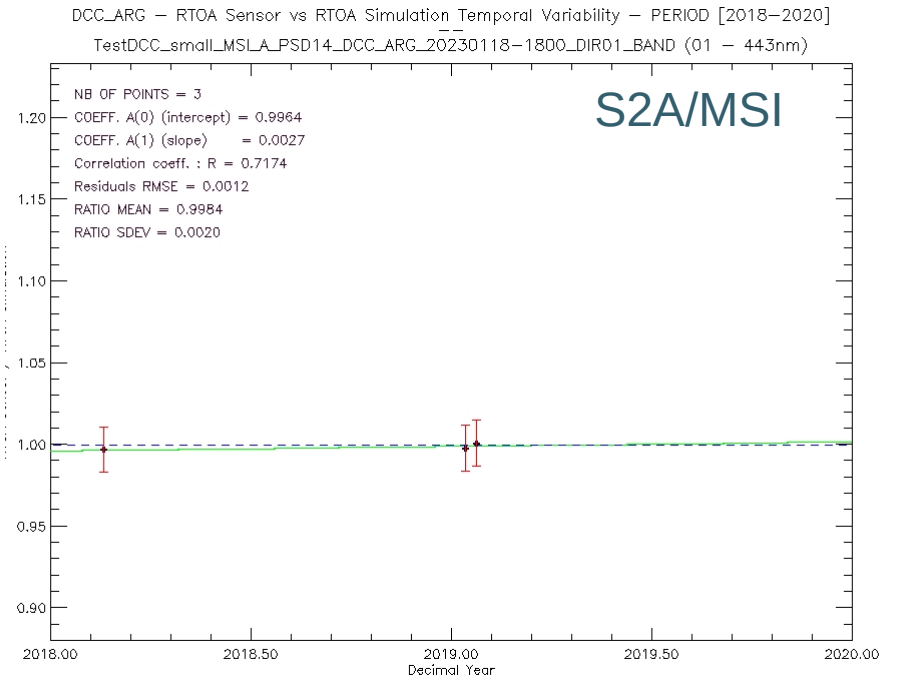


DIMITRI-V4.x: Application & Results

- **DCC methods: Implementation**
  - ✓ **DCC-ARG following Lamquin et al. 2018 (Applicable on Sentinel-2/MSI ; <3% error).**
  - ✓ **DCC-MAG following Fougnie and Bach 2009 (Applicable on Sentinel-3/OLCI; <5% error).**

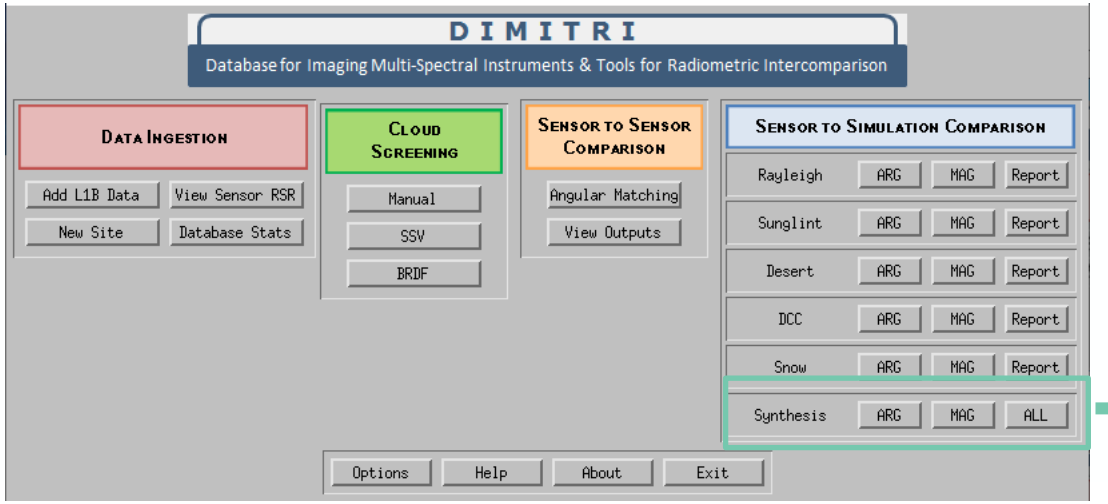


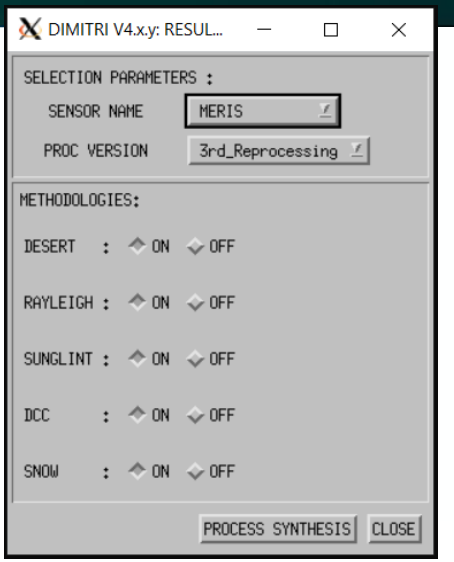


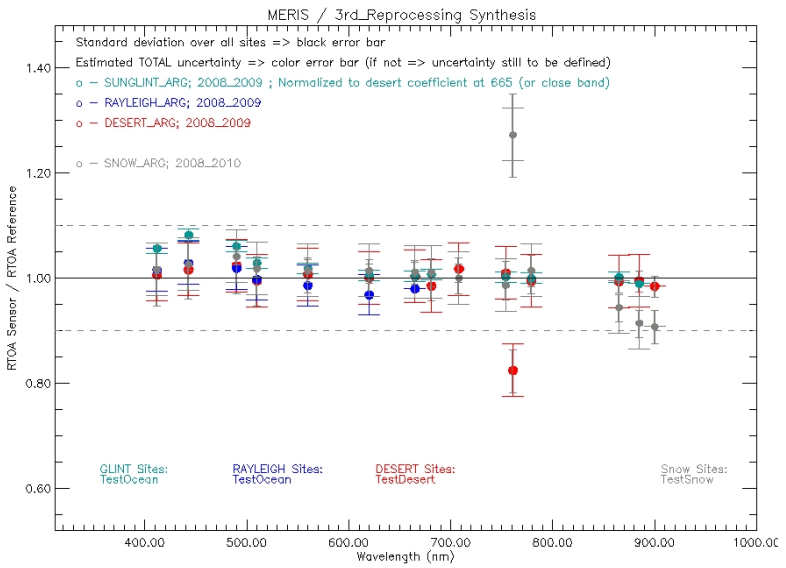


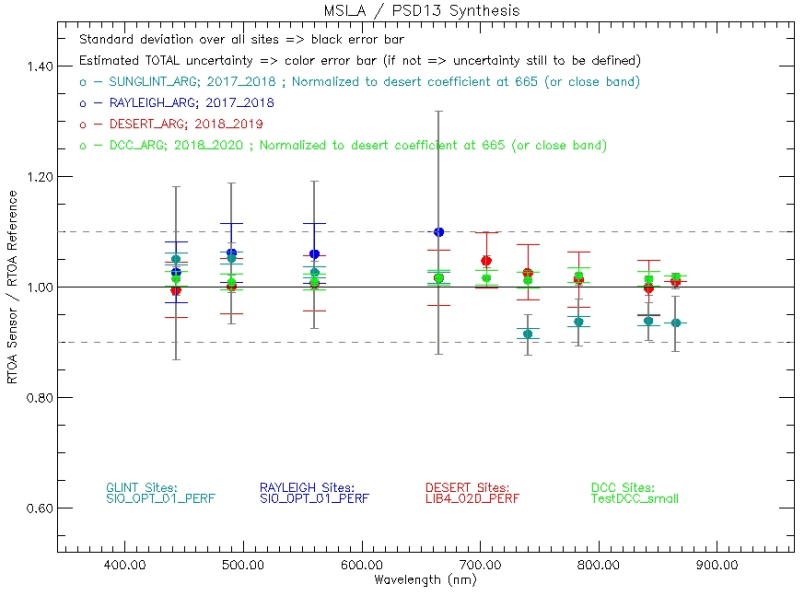
DIMITRI-V4.x: Application & Results

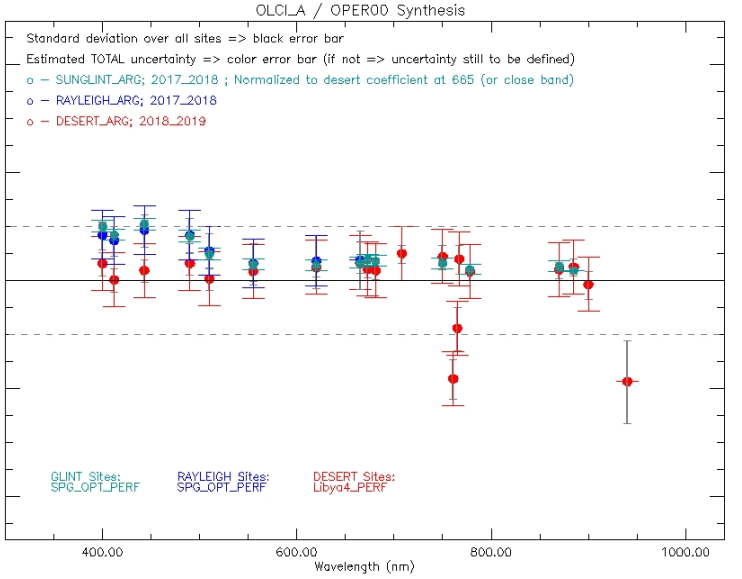
- Synthesis module results:
  - ✓ MERIS, MSI & OLCI: ARG.





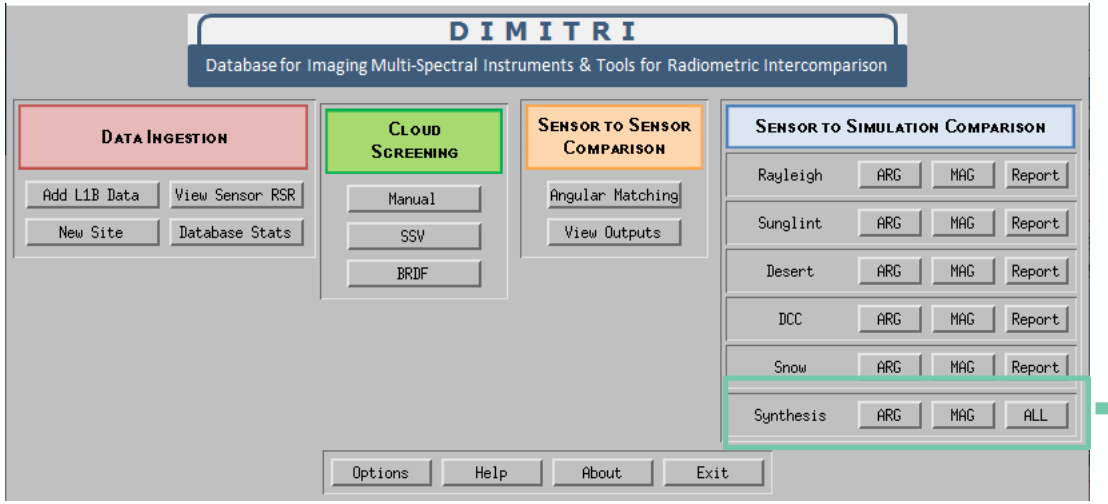


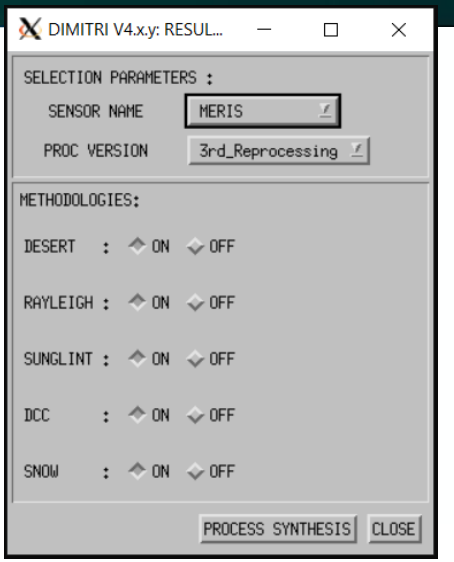


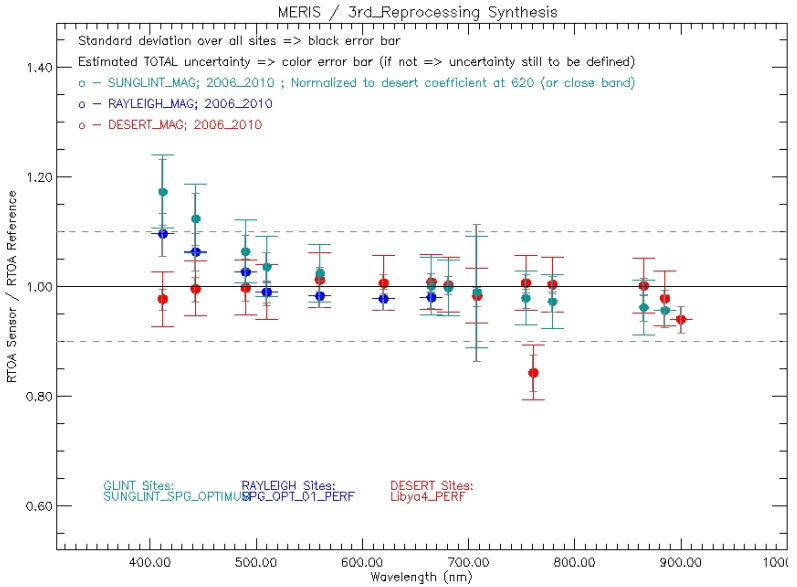


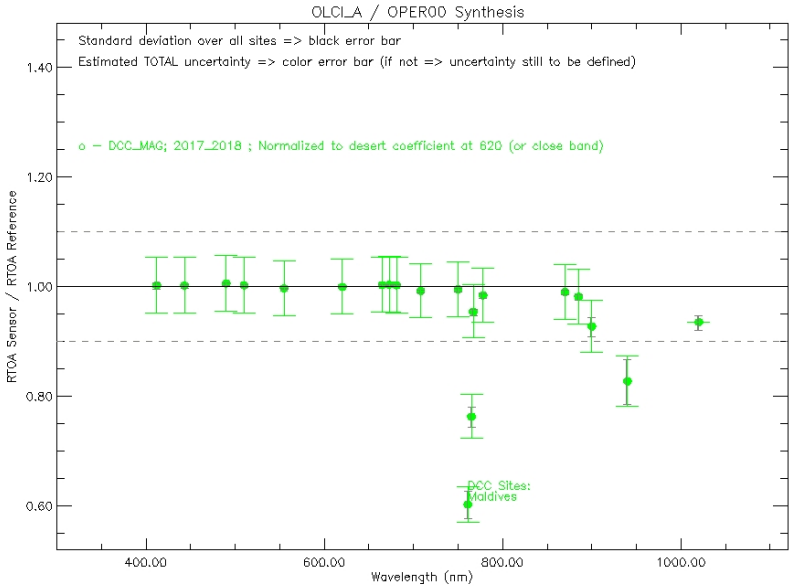
DIMITRI-V4.x: Application & Results

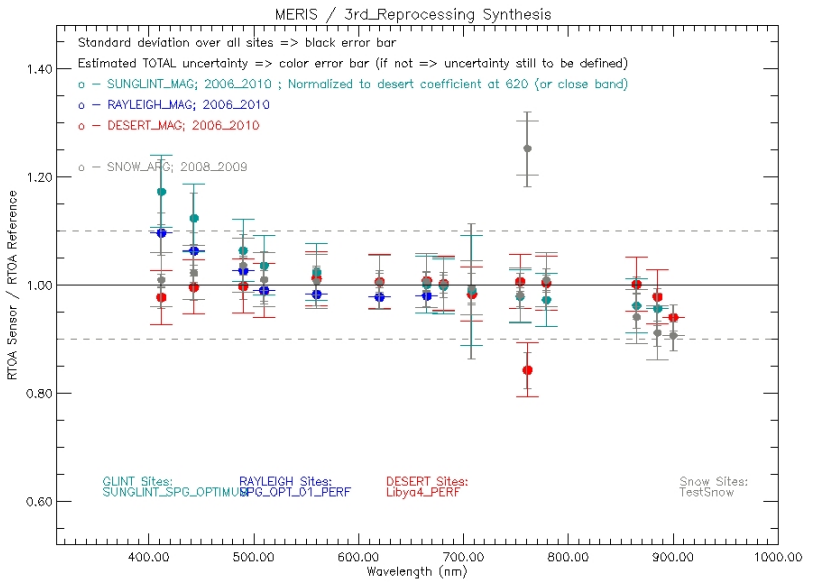
- **Synthesis module results:**
  - ✓ **MERIS & OLCI: MAG and Mixed.**











DIMITRI-V4.x: Application & Results

- **Installation/Performance test unit results: Pre-defined TDS**
  - ✓ **Log-reports.**

```
20230511_123705: Test_main: Test started
20230511_123705: Test_main: DIMITRI V4.7.0
20230511_123705: Test_main: Existing DB backed up
20230511_123705: Test_main: Test DB created
20230511_123705: Test_file_list: All files present
20230511_123705: Test_check_db_files_present: Checking existence of test database file
20230511_123705: Test_check_db_files_present: All files in reference DB found
20230511_124049: Test_ingest: Successfully ingested L1b Data from OLCI_A TestDCC OPER00 2017
20230511_124128: Test_ingest: Successfully ingested L1b Data from AATSR TestDesert 3rd_Reprocessing 2008
20230511_124132: Test_ingest: Successfully ingested L1b Data from MERIS SUNGLINT_Test 3rd_Reprocessing 2008
20230511_124152: Test_ingest: Successfully ingested L1b Data from MERIS TestDesert 3rd_Reprocessing 2008
20230511_124154: Test_ingest: Successfully ingested L1b Data from MERIS TestOcean 3rd_Reprocessing 2008
20230511_124157: Test_ingest: Successfully ingested L1b Data from MERIS TestSnow 3rd_Reprocessing 2008
20230511_124158: Test_ingest: Successfully ingested L1b Data from MERIS TestSnow 3rd_Reprocessing 2009
20230511_124158: Test_ingest: Successfully ingested L1b Data from MODISA TestDesert Collection_6 2008
20230511_124200: Test_ingest: Successfully ingested L1b Data from PARASOL TestDesert Calibration_2 2010
20230511_124733: Test_ingest: Successfully ingested L1b Data from MSI_A TestDCC_small PSD14 2019
20230511_124733: Test_compare_dbs: Database field "SITE_NAME" ingested successfully
20230511_124733: Test_compare_dbs: Database field "SITE_TYPE" ingested successfully
20230511_124733: Test_compare_dbs: Database field "SITE_COORDINATES" ingested successfully
20230511_124733: Test_compare_dbs: Database field "SENSOR" ingested successfully
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20230511_124733: Test_compare_dbs: Database field "AUTO_CS_1_MEAN" ingested successfully
20230511_124733: Test_compare_dbs: Database field "ROI_CS_1_CLEAR_PIX_NUM" ingested successfully
```

```
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20230511_124733: Test_compare_dbs: Database field "AUX_DATA_10" ingested successfully
20230511_124804: Rayleigh_arg_test:  calculated successfully
20230511_124906: Sunglint_arg_test:  calculated successfully
20230511_125811: Desert_arg_test:  calculated successfully
20230511_125904: DCC_arg_test:  calculated successfully
20230511_130053: Snow_arg_test:  calculated successfully
20230511_130226: Rayleigh_mag_test:  calculated successfully
20230511_130245: Sunglint_mag_test:  calculated successfully
20230511_130246: Desert_mag_test: Getting brdfs
20230511_130406: Desert_mag_test: desert mag interface complete
20230511_130406: Desert_mag_test: All files in reference DB found, ingestion can now begin
20230511_130406: Desert_mag_test:  calculated successfully
20230511_130406: Desert_mag_test: Moving output to report folder
20230511_130532: DCC_mag_test:  calculated successfully
20230511_130543: Test_main: Backup DB restored
```

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DIMITRI-Evolution: Conclusions

- DIMITRI V4 is there and functional
- Main improvement feature is the Output Database management (NetCDF format)
- Hyperspectral Atmospheric LUTs; and Atmos-pressure adjustment.
- Introducing the directional effects (BRDF) to the estimation of the marine reflectance.
- Clear improvement over Rayleigh and Sunglint results from MERIS.
- Desert-PICS method is extended to Snow-Ice sites
- Development/implementation of DCC-methods
- Implementation of results synthesis module and installation test-unit
- Addition of Sentinel-2C/D and Sentinel-3C/D
- Full documentations (ATBDs and SUM) will be on the website shortly

DIMITRI-Evolution: Recommendations

- Extension of Desert/Snow PICS methods to the SWIR wavelength range
- Provide an error budget and uncertainty analysis for each method
- Readers development of new missions such as FLEX, CHIME, EnMAP etc.
- Feeding the database with new acquisitions
- Run DIMITRI as operational service
- Development/implementation of new vicarious methodologies

Invitation to submit Manuscript for a Special-Issue of Remote sensing MDPI

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Special Issue "Copernicus Sentinels Missions Calibration, Validation, FRM and Innovation Approaches in Satellite-Data Quality Assessment"

Expected topic areas covered by Copernicus Sentinels missions but are not limited to:

- **remote sensing of atmospheric composition, land, ocean, snow and ice surface,**
- **calibration and sensors' intercomparison,**
- **validation of geophysical data products,**
- **innovations to products' retrieval algorithms and Cal/Val techniques,**
- **Fiducial Reference Measurements (FRM) for satellite data validation.**

https://www.mdpi.com/journal/remotesensing/special_issues/J3CYH3OQV0#editors

Guest-Editors:
Dr. B. Alhammoud, Dr. S. Clerc, Dr. S. Dransfeld, Dr. J-C. Lambert, Mr. P. Féménias

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