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Radiometric & Geometric normalization of Sentinel optical data and VHR data to build-up time-series, an example in Tonga for the monitoring of mangrove health vs. climate change

Romain Serra (1), Anne Valette (1), Amine Taji (2), and Stephen Emsley (3)

(1) ACRI-HE, 260 route du Pin Montard, 06904 Sophia Antipolis cedex, France , (2) ACRI-EC, Rue Mostafa el Maani, Casablanca 20100, Morocco, (3) ARGANS, 1 Davy Road, Plymouth Science Park, Plymouth PL6 8BX, UK

Building climate resilience (i.e. climate change adaptation or self-renew of ecosystems) or planning environment rehabilitations and nature-based solutions to address their vulnerabilities to disturbances has prerequisites:
1- identify the disorder, i.e. stresses caused by events such as hurricanes, tsunamis, heavy rains, hailstone falls, smog… or piled-up along-time such as warming, rainfalls, ocean acidification, soil salinization… and measured by trends; and
2- qualify its impact on the ecosystems, i.e. the resulting strains.

Mitigation of threats is accordingly twofold,
i. on locally temporal scales for protection,
ii. on long scale for prevention and sustainability.

For assessment and evaluation prior to design future scenarios, it requires concomitant acquisition of (a) climate data at global and local spatial scale which describe the changes at the various temporal scales of phenomena without signal aliasing, and of (b) the ecosystems' status at the scales of the forcing and of relaxation times, hysteresis lags, periodicities of orbits in chaotic systems, shifts from one attractor in ecosystems to the others, etc.

Dissociating groups of timescales and spatial scales facilitates the analysis and help set-up monitoring schemes.

The Sentinel-2 mission, with a revisit of the earth every few days and a 10m resolution on-ground is a good automatic spectro-analytical monitoring system because detecting changes in numerous optical & IR bands at proper spatial scales for the description of land parcels. Combined with photo-interpreted VHR data which describe the environment more crudely but with high precision of land parcels' border locations, it helps find the relationship between stress and strains to empirically understand the relationships.

An example is provided for Tonga, courtesy of ESA support and ADB request, with a focus on time-series' consistency that requires radiometric and geometric normalisation of EO data sets. Methodologies have been developed in the frame of ESA programs and EC program (H2020 Co-Resyf).