CSQ-56 Summary

Question	Knowledge Advancement Objectives	Geophysical Observables	Measurement Requirements	Tools & Models	Policies / Benefits
Where and how are ecosystems undergoing critical transitions?	A) Assessing ecosystems heterogeneity (that is, spatial and temporal variation in ecological processes) for improved understanding of ecosystem resilience	• Vegetation structure and cover • Related dynamics over time	• Dense, long time series based on datasets that provide continuity and consistent of all observations from Landsat and Sentinels 1,2	• Various EO time series analysis methods	- UNCBD - IPBES - Nature-based solutions - Restoration efforts
	B) Comprehensive assessment of ecosystem dynamics including the identification of critical changes in ecosystem resilience directly through monitoring disturbance frequency and recovery rates over time	• Vegetation structure and cover • Soil moisture • Disturbances (types and frequency)	• Dense, long time series-based datasets from Landsat, S1/2, SMOS etc.	• Temporal autocorrelation or mapping the rate and speed of recovery after disturbances to quantify resilience directly from remotely sensed data	
	C) Approaches for rapid/near real time monitoring and development of early warning signals for critical transitions to occur	• Disturbance and dynamics monitoring at high frequency and with rapid updating	• Dense time series (daily, weekly coverage) at high spatial resolution)	• Different near/real time/anomaly detection methods	

CSQ-56 Narrative

Where and how are ecosystems undergoing critical transitions?

The systematic monitoring of ecosystem dynamics has been demonstrated using remote sensing time series across a range of ecosystem and change types. With satellite-based time-series from sensors like Landsat and Sentinels 1 and 2 becoming increasingly long and temporally dense, studying ecosystems heterogeneity (that is, spatial and temporal variation in ecological processes) can be improved and leads to a substantially improved understanding of ecosystem resilience. Case study examples have shown the value of using temporal autocorrelation or mapping the rate and speed of recovery after disturbances to quantify resilience directly from remotely sensed data (Verbesselt et al., 2016, Senf, 2022). The ever-increasing length of remote sensing time series on the matter decades underpins a new comprehensive assessment of ecosystem dynamics including the identification of critical changes in ecosystem resilience directly through monitoring disturbance frequency and recovery rates over time, and underpin rapid/near real time monitoring and development of early warning signals for critical transitions to occur (Senf 2022).

From EO-data perspective, the most important objective is to provide time series that are as long and as temporally dense as possible. It is essential here to make use and ensure the long-term continuity and consistent of the all observations from Landsat and Sentinels 1,2 to capture vegetation dynamics and using various sensors (like SMOS) capturing soil and soil moisture dynamics globally.

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