

ESA MOST-NRSCC Dragon 5 cooperation proposal – ID.58516

Monitoring and Modelling Climate Change in Water, Energy and Carbon Cycles in the Pan-Third Pole Environment (CLIMATE-Pan-TPE)

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Dragon 5 research theme and topic

Topic (subtopic)

4. Climate change

(4.1 Climate change modelling)

9. Calibration and Validation

(9.1 Satellite calibration field network and cross calibration)

Executive Summary

The Third Pole Environment centred on the Tibetan plateau and the Himalayas feeds Asia's largest rivers which provide water to 1.5 billion people across ten countries. Due to its high elevation, TPE plays a significant role in global atmospheric circulation and is highly sensitive to climate change. Intensive exchanges of water and energy fluxes take place between the Asian monsoon, the plateau land surface (lakes, glaciers, snow and permafrost) and the plateau atmosphere at various temporal and spatial scales, but a fundamental understanding of the details of the coupling is lacking especially at the climate scale. Expanding westward from the Third Pole, the Pan-Third Pole region covers 20 million km², encompassing the Tibetan Plateau, Pamir, Hindu Kush, Iran Plateau, the Caucasians, the Carpathians, etc. and is home to over 3 billion people. Climate change is expected to dramatically impact the water and energy as well as carbon cycles and exchanges in the Pan-TPE area and consequently alter the water resources, food security, energy transition and ecosystems as well as other related societal challenges. Monitoring and modelling climate change in Pan-TPE reflect key societal issues and contribute to the science component to other international initiatives, e.g. UN sustainable development goals (SDG), GEO societal benefit areas and the ESA EO science for society strategy.

Thus the **objective** of this CLIMATE-Pan-TPE project is: To improve the process understanding of the interactions between the Asian monsoon, the plateau surface (including its permafrost and

lakes) and the Tibetan plateau atmosphere in terms of water, energy and carbon budgets; To assess and monitor changes in cryosphere and hydrosphere; and to model and predict climate change impacts on water resources and ecosystems in the Pan-Third Pole Environment.

A core innovation of the CLIMATE-Pan-TPE project is to verify or falsify recent climate change hypotheses (e.g. links between plateau heating and monsoon circulation, snow cover and monsoon strength, soil moisture and timing of monsoon) and projections of the changes of glaciers and permafrost in relation to surface and tropospheric heating on the Tibetan plateau as precursors of monsoon pattern changes and glaciers retreat, and their impacts on water resources and ecosystems.

Method: We will use earth observation, in-situ measurements and modelling to advance process understanding relevant to monsoon scale predictions, and improve and develop coupled regional scale observation and hydroclimatic models to explain different physical links and scenarios that cannot be observed directly.

Deliverables: The deliverables will be scientific outputs in terms of peer reviewed journal publications, PhD theses and data sets in terms of novel data records and modelling tools of essential climate variables for quantification of water, energy and carbon cycle dynamics in the Pan-Third Pole Environment.