CSQ-15 Summary

Question	Knowledge Advancement Objectives	Geophysical Observables	Measurement Requirements	Tools & Models	Policies / Benefits
Which specific observations are needed: polar / tropical regions, new measurement techniques vs long-term series of observation, large-scale field experiments?	A) To follow the evolution of ECVs in regions more sensitive to climate changes: e.g., polar regions, upper-troposphere-lower stratosphere (UT-LS)	Key observables to follow the evolution of these specific regions	• To concentrate observations in the target regions	Orbits and modes of observation adapted to the target regions: • Molniya orbits to favour observations over the polar regions • Limb observations to observe strong vertical gradients in the UT-LS	• Better understanding of the physical processes involved in the regions more sensitive to climate change. • Better survey of geophysical and environmental hazards
	B) Monitoring of specific events: e.g., earth quakes, volcanic eruptions, flooding	Observables characterizing these specific events	• To adapt the observation schedule on alert	Link with model communities studying these events	
	C) Focus of specific areas: e.g,. cities, regions of high anthropic emissions	Observables characterizing these specific areas	• Operation modes to increase the spatial and temporal coverage of observations in the target areas	Link with the relevant model communities	
	D) To organize a large-scale field experiment to study a specific region for understanding the physical processes taking place	Coordination between satellite, ground-based, airborne observations and models during the field experiment	• Denser observations and measurement of more variables over a period of time	Organisational structure of the field campaign	

CSQ-15 Narrative

Climate changes are amplified in polar regions. They are warming faster than any other area on Earth and they are affected by the ice melting. These regions are less covered by satellite observations. Geostationary satellites can only observe at latitudes smaller than 60° and SSO generally only reach 82.5 degrees leaving a hole over the true poles. It is possible to define orbit configurations allowing to observe more frequently the polar regions. Molniya-type orbits are highly elliptical orbits with a 63.4° inclination and a 12-h period with an apogee above northern latitude. The satellite is above northern latitudes most of the time with a very good coverage of polar regions. Alternatively precessing orbits can be true pole to pole as proposed for e.g. TRUTHS and would have benefits for diurnal cycle characterisation and cal/val. More generally novel orbital configurations may better sample the poles amongst other undersampled or target regions.

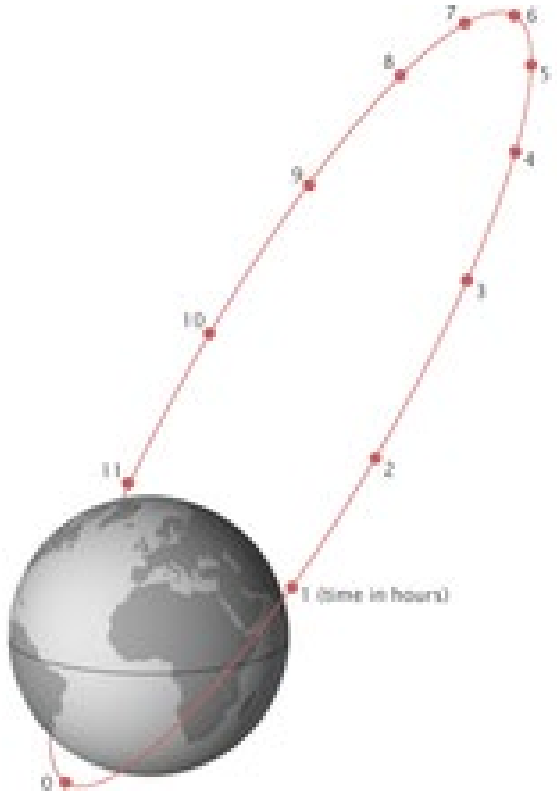

Figure 3: The Molniya orbit. Usually the period from perigee +2 hours to perigee +10 hours is used to transmit to the northern hemisphere. From https://en.wikipedia.org/wiki/Molniya_orbit

It may be interesting to program targeted observations with greater density for a period of time, after a specific geophysical event (earthquake, volcanic eruption, flooding, …) or/and in a particular area, i.e. above cities and region of anthropic emissions. These operation modes should be defined before the launch in order to be able to activate them in flight.

The combination of different modes of observation can bring new information on the vertical and horizontal variability of the atmosphere. For instance, to monitor the vertical gradients in the upper troposphere-lower stratosphere (UT-LS), a critical region in the climate system, it may be useful to combine limb and nadir observations. This was the case for SCIAMACHY instrument on Envisat. If these observations are made in the orbit plane, this would also allow tomography.

In addition to long-term monitoring of certain ECVs, it may be interesting to make denser observations with more variables measured over a period of time and over a targeted area. This is necessary to improve our understanding of physical processes taken place. An efficient way is to organise large-scale field experiments with satellite, ground-based and airborne observations. A good candidate for this is a field experiment in the Amazon rainforest, a key region for the climate and the biodiversity, strongly affected by deforestation.

Long-term series of observations are essential to monitor the evolution of the Earth system but in the same time it is important to develop new measurement techniques to improve the quality and the observations and to measure new variables. Financial resources are limited and an equilibrium should be found between the continuation of well-established and new measurement techniques.