

# Permafrost Research Priorities

## *Preliminary Demographic Statistics and Submitted Questions*

6 October 2014

Below are a few figures describing early results of demographic data from the participants of the PRP Research Questions Survey. A more detailed analysis will be provided with the final research priorities document.

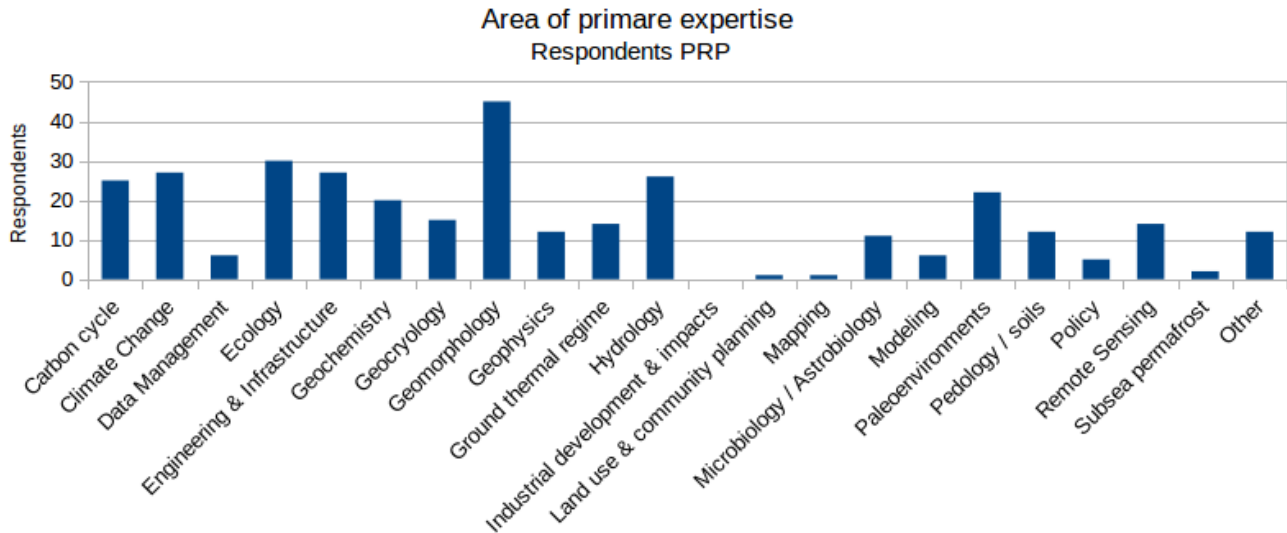


Figure 1. Responses to the question: “Please select your area of primary expertise”. Note that these statistics are preliminary crude results from the survey and have not yet been checked in detail by the core group for any potential errors.

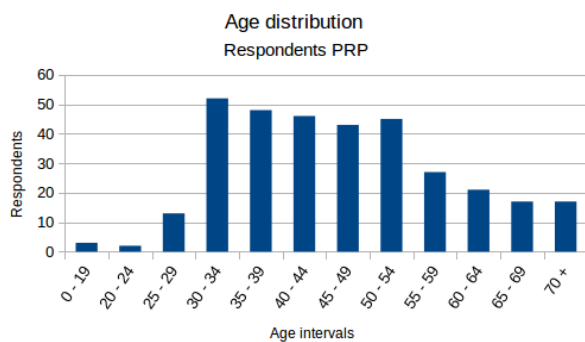


Figure 2. Responses to the question: “What is your age category?” Note that these statistics are preliminary crude results from the survey and have not yet been checked in detail by the core group for any potential errors.

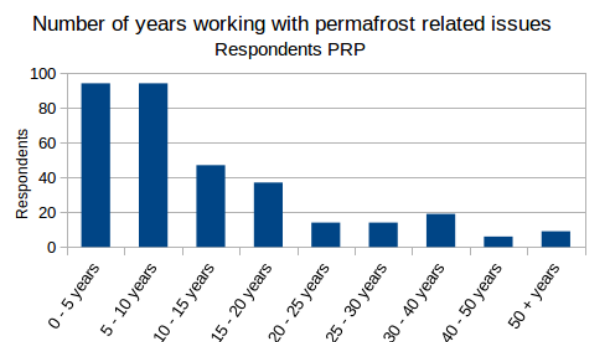


Figure 3. Responses to the question: “How long have you worked on permafrost-related issues over the course of your career?” Note that these statistics are preliminary crude results from the survey and have not yet been checked in detail by the core group for any potential errors.

**Research question**

What is the current extent, state, and dynamics of recently-inundated, shallow-shelf, permafrost?

What are the contributions of/implications of permafrost degradation to atmospheric GHGs?

What processes account for the occurrence of permafrost-associated gas hydrate and what is its likely abundance/distribution?

What is the rate of change in areal permafrost extent?

What is the average change in heterotrophic respiration following permafrost melt?

What is the average change in net primary productivity following permafrost melt?

Permafrost melting has primarily been in focus due to positive feed back loops in relation to methane release. But permafrost may also be considered as a depot of nutrients such as phosphate and iron. To what extend do the nutrients upon their release effect the productivity of the adjacent habitats?

What have been the rates of arctic coastal erosion in permafrost areas since the end of the last ice age?

How much carbon, nutrients and sediments are expected to be delivered to the Arctic Ocean due to coastal erosion under different IPCC scenarios?

How can indigenous people living on permafrost adapt to or mitigate the degradation of natural resources, settlement areas and hunting/fishing grounds due to thermal and mechanical permafrost degradation?

Is there a threshold level of atmospheric carbon beyond which annual methane emissions from the permafrost will increase significantly? That is, what is the shape of the non-linear relationship between annual release rate and the stock of carbon?

What is the feedback effect of large permafrost methane release on triggering further emissions from other potentially large methane sources that are terrestrial or oceanic?

What are the engineering options to stall or revert permafrost release (if any) and what are their associated costs?

Is deep Arctic permafrost homogeneous enough to allow transmission of acoustic (20 kHz) and radio (200MHz signals over km distances.)

I have noticed a significant shortage of papaer on the hydrology and hydrogeology of the permafrost. Because more attention to this aspect is not given?

**Geographical focus**

Arctic Permafrost

Arctic Permafrost

Arctic Permafrost

All

All

All

Arctic Permafrost

Arctic Permafrost

Arctic Permafrost

Arctic Permafrost, Mountain Permafrost

All

All

All

Arctic Permafrost

Antarctic Permafrost, Mountain Permafrost

**Categories**

Climate Change, Geophysics, Subsea permafrost

Carbon cycle, Climate Change, Modeling

Geophysics, Modeling, Remote Sensing

Climate Change, Mapping

Carbon cycle, Climate Change, Pedology / soils

Carbon cycle, Climate Change, Ecology

Carbon cycle, Microbiology/Astrobiology, Modeling

Climate Change, Geomorphology, Paleoenvironments

Carbon cycle, Climate Change, Modeling

Ecology, Engineering & Infrastructure, Land use & community planning

Carbon cycle, Climate Change

Carbon cycle, Climate Change

Carbon cycle, Climate Change, Policy

Remote Sensing, Astroparticle Physics

Hydrology

The papers on permafrost are very classic and that's fine. But it would be more related disciplines (such as hydrogeochemical) with a more creative approach?	Antarctic Permafrost, Mountain Permafrost	Geochemistry, Hydrology
In Antarctica the use of geophysical techniques is scarce. I think it's because few researchers understand both things at once. I think it's a very useful tool. Be possible buescar shape improve this?	Antarctic Permafrost	Geocryology, Geophysics, Hydrology
What do we really know about thermal and hydric behavior of permafrost under a controlled climate warming	All	Climate Change, Ground thermal regime, Modeling
How do thermal and hydric states of the permafrost affect C fluxes ?	All	Carbon cycle, Ground thermal regime, Hydrology
Does preliminary degradation of permafrost OM on earth and in rivers impact its preservation in seawater?	All	Carbon cycle, Climate Change, Geochemistry
What are the effects of biotic and abiotic degradation processes on permafrost OM in rivers?	All	Carbon cycle, Climate Change, Geochemistry
Why photodegradation processes are so exacerbated in Arctic?	Arctic Permafrost	Carbon cycle, Climate Change, Geochemistry
How has the soil organic carbon pool developed over the Holocene period?	Arctic Permafrost	Carbon cycle, Mapping, Pedology / soils
How can the soil organic carbon pool be directly inferred from remote sensing products?	Arctic Permafrost	Carbon cycle, Mapping, Remote Sensing
How variable the quantity and quality of the soil organic carbon pool over the entire permafrost region?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Geochemistry, Mapping, Pedology / soils
The extent of permafrost - what is it now, how has it changed in the past and what worst and best case predictions can be made for the future?	Arctic Permafrost, All	Climate Change, Ecology, Engineering & Infrastructure
How will resource usage effect the environment in the Arctic? Increased activity in the NE and NW sea routes as well as Siberia, N Canada and Alaska are bound to have an impact.	Arctic Permafrost, Planetary Permafrost	Ground thermal regime, Industrial development & impacts, Land use & community planning
Can frozen ground features on other planets/moons be used as analogues for future development on Earth? Most notably Mars has extensive permafrost regions and has experienced severe but predictable climate changes in the past. Using the acquired knowledge base will help us better understand terrestrial phenomena.	Arctic Permafrost, Antarctic Permafrost, Planetary Permafrost	Geomorphology, Paleoenvironments, Remote Sensing
How can satellite data products be adapted to the needs of the permafrost community users via cooperation across disciplines (modeling, insitu)?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Carbon cycle, Modeling, Remote Sensing
How can we optimize the use of the remote sensing data and find an innovative method for upscaling of point measurement of essential information on the aquatic and terrestrial carbon content?		

How can the use of measurements from existing operational networks in high latitudes be improved through sharing data and knowledge across disciplines? Can we expand measurements for the purpose of validation of satellite data products and where would be the key sites?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Ground thermal regime, Hydrology, Remote Sensing
a) How can the permafrost community optimize the use of improved new and future satellite data (e.g. Sentinel-1) that is made available for the scientific community? b) How can finer resolution satellite data (e.g. from Sentinel-1) optimize satellite retrieval of information that is essential for permafrost studies (e.g. surface hydrology)?	Arctic Permafrost, Antarctic Permafrost	Ground thermal regime, Hydrology, Remote Sensing
To what extent will the wetlands that form as result of thawing permafrost contribute to greenhouse gas emissions, thus providing a positive feedback to global warming	Arctic Permafrost	Carbon cycle, Climate Change, Geochemistry
What changes in the structure and functioning of terrestrial and aquatic ecosystems are observed with global warming in permafrost regions, and how do rates of change compare with earlier periods of climate change?	All	Climate Change, Ecology, Palaeoenvironments
What are the most effective policy/measures that can be adopted to help/prepare (native) human populations in permafrost regions to deal with changes in their lives and subsistence as a result of climate change.	Arctic Permafrost, Mountain Permafrost	Engineering & Infrastructure, Land use & community planning, Policy
Permafrost can be a "frozen" wetland (with modern microbial methane), or a "frozen" seepage of geologic (fossil) gas (thermogenic or microbial). What is the global percentage of geologic methane (14C-free) trapped in permafrost?	Arctic Permafrost, Planetary Permafrost	Carbon cycle, Geochemistry, petroleum geology
What spatio-temporal dynamics of various essential climate parameters, such as temperature, vegetation, snow, etc., are observed in the pan-arctic environment during the last decades?	Arctic Permafrost	Climate Change, Modeling, Remote Sensing
Earth Observation derived climate related variables, such as vegetation, land surface temperature as well as snow cover parameters are of high importance for future arctic research. The knowledge of error sources and uncertainties in EO data is essential. How to quantify these errors and uncertainties in EO data?	Arctic Permafrost	Remote Sensing
In the continuous and discontinuous permafrost zones, how do variations in the fire regime influence permafrost degradation?	Arctic Permafrost	Climate Change, Ground thermal regime, Hydrology
How can proximal sensing technologies (e.g., VisNIR, PXRF, EM) be most appropriately applied to permafrost soils? How does fusion of those datasets impact predictive model performance?	All	Carbon cycle, Geochemistry, Pedology / soils
A large knowledge and intellectual gap exists between field knowledge of permafrost and the modelling efforts of global scale. Cooperative research needs to be undertaken to better map permafrost as a geological phenomenon in order to match the concerns and the needs of modellers who are trying to analyse and document permafrost as a climatic phenomenon. set protocols in order to obtain fiable, standardized , and useful scientific information.	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Geocryology, Mapping, overall

The science community needs to ask itself the following question: what are the needs of arctic communities in regard with permafrost issues. It is not a question of scientists reaching to communities, it is a question of letting the communities reach to the scientists.	Arctic Permafrost	Engineering & Infrastructure, Land use & community planning, Policy
What is the distribution of permafrost (fine resolution; e.g., <100m)?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Mapping
What is the rate of permafrost thaw?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Mapping
What areas are most vulnerable to permafrost thaw and why are these areas vulnerable?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Pedology / soils
How important is subsurface wash compared to surface wash in continuous permafrost environments?	All	Geochemistry, Geomorphology, Hydrology
To what extent will changes in Arctic permafrost lead to alterations in the hydrologic cycle, specifically changes in discharge from major rivers?	All	Climate Change, Geophysics, Hydrology
How important is the thermal inertia (i.e. heat capacity) of permafrost in mediating climate change impacts?	All	Climate Change, Ground thermal regime, Remote Sensing
Following permafrost thaw in peatlands, what are the losses of C from previously stored stocks and to what degree are such losses offset by new accumulation of C at the surface?	Arctic Permafrost	Carbon cycle, Ecology, Hydrology
At what rates will thermokarst landforms expand (as a % land cover) in different types of landscapes (lowland peat rich, lowland yedoma, hillslopes with ice-rich soils etc) in response to climate forcings?	Arctic Permafrost	Geomorphology, Pedology / soils, Remote Sensing
Under what conditions with thawing permafrost increase the costs and challenges of construction and maintenance of infrastructure (roads, pipelines, buildings, runways, bridges, etc.), and under what circumstances will thawing permafrost decrease such costs and challenges?	Arctic Permafrost	Engineering & Infrastructure, Land use & community planning, Industrial development & impacts
What is the spatial distribution of permafrost in Antarctica?	Antarctic Permafrost	Geomorphology, Ground thermal regime, Mapping
How did Antarctic permafrost and terrestrial ecosystems respond to warmer climate conditions in the past?	Antarctic Permafrost, All	Geomorphology, Ground thermal regime, Paleoenvironments
What is the magnitude of temperature increase to generate non-linear environmental responses in permafrost environments in the Antarctic Peninsula?	Antarctic Permafrost, All	Geomorphology, Ground thermal regime, Paleoenvironments
Has the spatial distribution of the freshwater fish fauna recently changed? I am especially interested in north Russia and Petchora in particular, but am also interested in changes elsewhere	Arctic Permafrost, Mountain Permafrost	Ecology

We need to address the variability of microbial communities in the ponds that form in Permafrost regions.	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost, All	Carbon cycle, Climate Change, Microbiology/Astrobiology
How is the areal extent of ponds changing over time, and how does this influence climate feedback?	Arctic Permafrost, Mountain Permafrost	Carbon cycle, Climate Change, Remote Sensing
What is the microbiology of subsurface permafrost?	Arctic Permafrost, Planetary Permafrost	Climate Change, Geocryology, Microbiology / Astrobiology
How can support a thermoisolated and solaractive exploitable tent the research in cold regions?	All	Engineering & Infrastructure
Is the organic matter stored in Gelisols sensible to climate change? Whatever the reply, why?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Carbon cycle, Climate Change, Pedology / soils
disclosing soil and geomorphologic processes involved in the formation of patterned ground (sorted features) soils will increase the knowledge of soil ecology in cold regions and understanding the formation of these surfaces in extraterrestrial planets	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost	Ecology, Geomorphology, Pedology / soils
the study of soils from recently deglaciated area will increase our knowledge on soil formation and on progressive landscape transformation	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Ecology, Paleoenvironments, Pedology / soils
How can we characterize permafrosts, multiphase porous materials, from different climate and geological regions such that we can accurately describe their physical and thermodynamic properties, mechanical behavior, interactions with troposphere, and loss in models? This is important to do as soon as possible.	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Geomorphology, Ground thermal regime
Independent of climate policy, permafrost thaw will occur on a large scale. Research should be focused on how resilient ecosystems are to permafrost thaw, how they may recover, and how carbon storage function of these ecosystems may be restored. Again, options for mitigation of effects should be considered.	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Ecology, Land use & community planning
Carbon stored in permafrost soils, and its release upon thawing will remain one of the major research topics. For better prediction of future carbon release, models and field studies should focus on spatial variability soils, ice content and vegetation. In addition, research is needed on options to mitigate carbon release.	Arctic Permafrost	Carbon cycle, Climate Change, Policy
Increasing human activities in the arctic inevitably will increase anthropogenic disturbance of permafrost soils, which in turn can enhance carbon release from these soils. Mitigation studies will remain highly relevant.	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Ecology, Industrial development & impacts, Land use & community planning
What physical processes (and can we quantify them) dictate the rate of "frost heave" and can the rate of heave be accurately be quantified by a physically based model?	Arctic Permafrost	Engineering & Infrastructure, Ground thermal regime, Modeling

How rapidly will climate warming manifest itself in the Arctic hydrologic cycle?	Arctic Permafrost	Climate Change, Ground thermal regime, Hydrology
What will be the future magnitude of coastal erosion due to permafrost warming and sea level rise?	Arctic Permafrost	Climate Change, Land use & community planning
What are the fundamental consequences of warmer temperatures in regions of continuous and discontinuous permafrost?	Arctic Permafrost	Carbon cycle, Climate Change, Ecology
Can a change in permafrost temperatures be documented in the coming Century through a network of distributed monitoring sites in Arctic and boreal ecosystems?	Arctic Permafrost, Mountain Permafrost	Climate Change, Data Management, Ground thermal regime
Can airborne and/or satellite remote sensing platforms be developed to assess thermal and hydraulic properties of active layer and permafrost soils as critical parameters for models?	Arctic Permafrost, Mountain Permafrost	Climate Change, Modeling, Remote Sensing
How does climate change affect mountain permafrost dynamics/distribution?	Mountain Permafrost	Climate Change, Geomorphology
How does mountain permafrost affect the occurrence of natural hazards (e.g. rockfall)?	Mountain Permafrost	Climate Change, Engineering & Infrastructure, Geophysics
What is the role of (changing) permafrost in vegetation and topography interactions specifically with regards to their coupled impact on hydrological connectivity (activation/deactivation of flow pathways) across the landscape?	Arctic Permafrost	Climate Change, Ecology, Hydrology
How dense is the concentration of methane hydrate in the surface sediments on the East Siberian Shelf, and how fast is it likely to be released as the offshore permafrost thaws?	Arctic Permafrost	Carbon cycle, Climate Change, Subsea permafrost
What is the contribution of freshwater ecosystems (i.e. lakes and rivers) to the carbon balance of the permafrost zone? What are the fluxes of CH <sub>4</sub> and CO <sub>2</sub> from these objects compared to that from wetlands and other sources? Will these fluxes increase or decrease during future climate warming?	Arctic Permafrost	Carbon cycle, Climate Change, Modeling
redox status of freezing/thawing soil and soil under frozen layer	All	Carbon cycle, Hydrology, Modeling
spatial distribution of soil thawing	All	Engineering & Infrastructure, Hydrology, Modeling
hydraulic and thermal properties of frozen soil, especially under thermally non-equilibrium conditions	All	Climate Change, Hydrology, Modeling
stability of steep bedrock permafrost: how do cracks/fissures form? what is their long-term development? what are the contributing factors leading to instabilities? and how can these processes be detected/monitored?	Mountain Permafrost	Climate Change, Geomorphology, Geophysics

modern experimental technologies (wireless sensors) create huge amounts of data. how can this data be leveraged (for research)? how much data is necessary to answer pertinent questions with their required level of detail? how can data from different experiments/instruments be joined together into one context?	All	Climate Change, Data Management, Geomorphology
how to design and safely operate remote sensors in field experiments, especially in remote and hostile environments. what part of the data is required online, what part can be left offline? how to structure such experiments and the data management.	Mountain Permafrost, All	Data Management, Geomorphology
What are the major interactions and associated feedbacks between surface-water systems (i.e. rivers and lakes) and permafrost dynamics?	All	Geomorphology, Hydrology
How permafrost degradation in mountain rock walls is acting as a control factor of rockfall occurrence?	Mountain Permafrost	Climate Change, Engineering & Infrastructure, Geomorphology
How vegetation structure linked to permfrost occurance and methane release?	Arctic Permafrost	Ecology, Geocryology, Remote Sensing
How can we map changes in permafrost occurrence and dynamics over large areas or globally?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Mapping, Remote Sensing
no further question	Arctic Permafrost	Carbon cycle
How can we properly define, describe and quantify permafrost change (aggradation and degradation)?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost	Climate Change, Geophysics, Ground thermal regime
How to make a better and widely accepted use of geomorphological indicators in longterm permafrost monitoring?	All	Geomorphology, Mapping, Remote Sensing
How to gain a better understanding of rockglacier dynamics?	Mountain Permafrost	Geomorphology, Ground thermal regime, Modeling
What is the exact distribution of ice wedge polygons on Earth?	Arctic Permafrost, Antarctic Permafrost	Geocryology, Mapping, Remote Sensing
What are carbon contents and quality in deep permafrost soils and sediments?	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Climate Change, Pedology / soils
How can historical data on permafrost, ground ice, and soils existing in closed archives of private companies (especially oil and gas exploration) be made publicly available?	Arctic Permafrost	Data Management, Mapping, Policy
How do potential contaminants move through High Arctic terrain with (well) established permafrost?	Arctic Permafrost	Ecology, Ground thermal regime, Hydrology
How does permafrost compare between a generally wet environment on Earth and a dry environment on Mars - and how does the chemistry of the upper ice layers/the ice-soil boundary change?	All	Geochemistry, Microbiology/Astrobiology, Paleoenvironments



How does vegetation influence the boundary between ice and soil - with an emphasis on chemistry and organic preservation? What can we learn from the soil/rock - ice boundary and its chemistry for the search for (extinct) life on Mars and icy Moons?	All	Geochemistry, Microbiology / Astrobiology, Paleoenvironments
What is the impact of urban development on permafrost?	Arctic Permafrost	Engineering & Infrastructure, Land use & community planning, Industrial development & impacts
What is the interaction between tree growth and permafrost?	Arctic Permafrost	Ecology
What tree species are best suited for urban planting in cities where permafrost occurs?	Arctic Permafrost	Ecology, Land use & community planning
preservation of ancient ice bodies in Antarctica	Antarctic Permafrost, Planetary Permafrost	Geomorphology, Ground thermal regime, Paleoenvironments
What is the proportion of the C mobilized by permafrost thawing that is readily available to microbial utilization (cf the lability and age of C stocks)	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Ecology, Geochemistry
How photolysis in aquatic ecosystems is accelerating the microbial utilization of mobilized carbon stocks (cf the degradation rates)	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Ecology, Hydrology
What are the diffusive and ebullition GHG emission rates from aquatic ecosystems associated to permafrost thaw	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Modeling
GHG emissions induced by changes in climate, hydrology and vegetation in permafrost areas.	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost, All	Carbon cycle, Climate Change, Ecology
What changes have, or are, occurring in permafrost temperature? This needs long term monitoring at a wide range of sites.	All	Climate Change, Data Management, Ground thermal regime
What is the ice content of permafrost, and thus what impacts will occur if the active layer depth changes (increases or decreases)?	All	Climate Change, Ground thermal regime, Pedology / soils
How will changes to organic matter composition in Arctic freshwaters, caused by increasing permafrost thaw, influence the biological and photochemical reactivity of C (and nutrients)?	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Geochemistry, Hydrology
How can we monitor and subsequently measure changes to permafrost inputs into inland freshwaters (lakes, rivers)	Arctic Permafrost	Carbon cycle, Climate Change, Hydrology
How can we relate the age of C in Arctic freshwaters to the age of greenhouse gasses released from them, to enable future modelling of potential feedbacks?	Arctic Permafrost	Carbon cycle, Climate Change, Hydrology
Does the reverse of permafrost active layer exist? The impact of sea water on permafrost regression in a coastal zone.	Arctic Permafrost, Antarctic Permafrost	Climate Change, Geophysics, Ground thermal regime

How chemistry of the guano deposits from bird/penguin colonies decrease the value of melt/freezing point of active layer ? The impact on dynamics of geomorphological processes.	Arctic Permafrost, Antarctic Permafrost	Ecology, Geochemistry, Ground thermal regime
The thickness and frequency of icy layers grows as the result of snow cover melting during warm winters. What is the impact on dynamics of active layer thawing ?	Arctic Permafrost	Geocryology, Geomorphology, Ground thermal regime
Find a reliable field criterium to distinguish inherited non fonctionnal permafrost (for instance in forested areas of Siberia ) from fonctionnal present day permafrost in Arctic areas with a true periglacial environment..	Arctic Permafrost	Geomorphology, Ground thermal regime, Paleoenvironments
To assess the average speed of present day northwards moving of the southern limit of continuous permafrost (for instance in Northern Canada), due to the on-going climatic warming.	Arctic Permafrost	Climate Change, Geomorphology
Modelling the mechanical processes of cryoturbation inside the active layer (mollisol) during the summer.	Arctic Permafrost, Mountain Permafrost	Geocryology, Geomorphology, Ground thermal regime
What is the error and uncertainty in our ability to use remote sensing observations (either airborne or space borne) to map active layer depth across various type of permafrost environments?	Arctic Permafrost, All	Carbon cycle, Mapping, Remote Sensing
How accurately can ice content of permafrost regions be estimated using direct (ground penetrating radar, airborne interferometric SAR, lidar) sensing techniques?	All	Climate Change, Engineering & Infrastructure, Remote Sensing
At what depth can volumetric soil moisture be estimated within 20% error across a range of permafrost environments (from continuous to sporadic)?	Arctic Permafrost	Ecology, Hydrology, Remote Sensing
How to reappraise the age of the so-called "periglacial" landforms and deposits, and replace them into the big picture (i.e. the Cenozoic landform evolution, including both material/form genesis and reworking/reshaping)?	All	Geomorphology
How to develop the use of smallscale periglacial landforms as geoindicators of Past and current climate changes (it is important to put into context the current observations)?	All	Climate Change, Geomorphology, Paleoenvironments
How to bridge the gap between laboratory experiments and field studies ?	All	Geomorphology
Peaceful underground nuclear explosions (PUNE) impact into the modern Arctic Permafrost' degradation. Technogenic thawed ground is the heat and radionuclides conductor by scheme "explosion cavity - geological environment - the earth's surface". In 1965-1988 yy. 51 PUNE of a total capacity of 537.4 kT in trinitrotoluol equivalent were carried in Russian territory of Arctic Permafrost, and most of their areas are not studied until nowadays and the research question stays gaps in knowledge.	Arctic Permafrost	Ecology, Geocryology, Geophysics
Radioactive pollution of Arctic Permafrost ecosystems.Special aspects of radionuclides' migration, accumulation and redistribution in frozen rocks and soils of Arctic Permafrost.	Arctic Permafrost	Ecology, Geochemistry, Geocryology

Tritium in Arctic surface water as after-effects of Novaya Zemlya nuclear weapon tests and of peaceful underground nuclear explosions in Arctic Permafrost.	Arctic Permafrost	Ecology, Geochemistry, Geocryology
How labile (decomposable) is permafrost carbon, and how readily might soil/sediment organic matter become accessible to decomposer microorganisms (including methanogens) following thaw?	Arctic Permafrost, Mountain Permafrost, Planetary Permafrost	Carbon cycle, Climate Change, Pedology / soils
How will permafrost thaw and deepening of the active layer affect water flow-paths and hydrology at hill-slope, catchment (watershed), regional and pan-Arctic/circum-polar scales? How will this affect soil and sediment moisture regimes, redox status and biogeochemical processes across the same suite of spatial scales?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost, All	Carbon cycle, Climate Change, Hydrology
What will be the interplay between on-going and predicted changes in northern vegetation communities and ground thermal regimes?	Arctic Permafrost, Mountain Permafrost	Climate Change, Ecology, Ground thermal regime
Long-term permafrost groundwater balance is not fully understood. More research is needed to understand the recharge and discharge processes.	Arctic Permafrost	Climate Change, Hydrology, Paleoenvironments
Long-term permafrost groundwater balance is not fully understood. More research is needed to understand the recharge and discharge processes.	Arctic Permafrost	Climate Change, Hydrology, Paleoenvironments
What are the present distributions of permafrost and permafrost-related landscapes on Mars?	Planetary Permafrost	Geocryology, Geomorphology, Paleoenvironments
Where and when did Mars recently experience permafrost thaw, including thermokarst development?	Planetary Permafrost	Geomorphology, Ground thermal regime, Hydrology
How is permafrost stability on Mars related to climate change and regolith geochemistry?	Planetary Permafrost	Climate Change, Geochemistry, Geomorphology
How the liquid water will circulate in the (macro-)porosity around the year ?	Mountain Permafrost	Geochemistry, Hydrology, natural hazards
Which scheme of data fusion processing could be elaborated (standardized), according to the data available (geophysics, borehole, geological mapping), in order to reconstruct the 3D planes of the underground of permafrost ?	All	Geocryology, Geophysics, Mapping
How the geotechnic stability of permafrost could be dynamically evaluated around the year/decades, by which methods ?	Mountain Permafrost	Engineering & Infrastructure, Geocryology, natural hazards
There is a need, both from a practical point of view (methods of measuring and modeling) and a theoretical point of view (theory of ice lens formation and growth) to get a grip on the HEAT EXTRACTION RATE from the soil surface. This involves soil properties and surface conditions.	Planetary Permafrost	Hydrology, Modeling, Pedology / soils
How important are cryospheric features (e.g. permafrost and glaciers) to water supply? Specifically, if alpine and subalpine areas serve as water towers, what is the contribution of frozen soil and ice to stream discharge (and groundwater storage)?	Mountain Permafrost	Climate Change, Hydrology, Modeling

How will thawing permafrost impact nutrient (N and P) exports from watersheds? What are the consequences/feedbacks to/within ecosystems?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Ecology, Hydrology
What is the bioavailability and fate of organic matter released/exposed during permafrost thaw?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Carbon cycle, Climate Change, Ecology
What is the impact of flowing water (surface and subsurface) on the dynamics of permafrost degradation	All	Climate Change, Geomorphology, Hydrology
What is the ground ice content of near-surface (0-20m) permafrost?	Arctic Permafrost, Antarctic Permafrost	Climate Change, Geocryology, Geomorphology
What are the mitigation techniques effective to prevent permafrost degradation under transport infrastructure?	Arctic Permafrost, Mountain Permafrost	Climate Change, Engineering & Infrastructure, Ground thermal regime
What factors are most important in the evolution of relict submarine permafrost on the cirum-Arctic shelf and how will climate change impact submarine permafrost and gas hydrate stability?	Arctic Permafrost	Climate Change, Mapping, Subsea permafrost
1) Where is the boundary between "geocryology" (considered as the scientific discipline that studies periglacial features & processes) and "glaciology" (considered as the scientific discipline that studies glacial features & processes) ?	Mountain Permafrost, Planetary Permafrost	Climate Change, Geocryology, environmental mapping
2) Why the definition of Permafrost does not honor its etymological origin (frost, involves always water)? Rationale: present day definition of permafrost, liberates many enemies of the environment, like some unethical mining companies operating in the third world where rules are soft and knowledge of periglacial processes are poor, to destroy many hydrological resources and reserves,	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost, All	Climate Change, Geocryology, Hydrology
What is the specific productivity of mountain permafrost under different hydrical conditions?	Mountain Permafrost	Climate Change, Geocryology, Hydrology
How will permafrost degradation influence rockwall stability	Mountain Permafrost	Engineering & Infrastructure, Geomorphology
How is the quality and bioavailability of the organic matter which becomes accessible again due to permafrost degradation in consequence of ongoing global warming?	Arctic Permafrost	Carbon cycle, Climate Change, Biogeochemistry
How is the impact of old organic carbon becoming accessible again after permafrost degradation on methanogenic communities and with that on the methane cycle and evolution of the global climate?	Arctic Permafrost	Carbon cycle, Climate Change, Microbiology / Astrobiology

What is the range of the permafrost in the world? In the second decade of the twenty-first century, when the technical possibilities allow for remote determination of the Earth's surface with centimeter accuracy, differences in determination of the permafrost extend in the world reach millions of square kilometers. Why is that? Without an answer to this fundamental question survey of permafrost is doubtful and questionable.	All	Geocryology, Mapping, Modeling
Is permafrost also includes glaciers and ice sheets? Seemingly the answer seems to be obvious. Today, however, the need to resolve the question seems to be particularly important, because without it blocking the interdisciplinary nature of the permafrost research	All	Geocryology, Ground thermal regime, Mapping
What are the key processes (e.g. snow accumulation, evapotranspiration, summer albedo, winter albedo, etc.) that determine how the structure and composition of vegetation cover affects the soil thermal properties and stability of permafrost?	Arctic Permafrost, Mountain Permafrost	Ecology, Ground thermal regime
How do different types and intensities of disturbance affect the rate and trajectory of permafrost thaw? For example, what is the relative impact of fires of differing severity, or human disturbance that removes or disturbs the vegetation to a different degree? Are there thresholds in the response to disturbance that can help inform management policies or to predict irreversible responses of permafrost to disturbance?	Arctic Permafrost, Mountain Permafrost	Climate Change, Ecology, Industrial development & impacts
Design reliable mitigation for ground thawing beneath linear infrastructure	Arctic Permafrost, Mountain Permafrost	Climate Change, Engineering & Infrastructure, Ground thermal regime
What is the critical condition required for thermokarst initiation	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Geocryology, Ground thermal regime
How does ground ice and topography control active layer development	Arctic Permafrost, Mountain Permafrost	Climate Change, Geomorphology, Ground thermal regime
How much of the Arctic has undergone significant permafrost degradation over the period of human records, documented by either remote sensing (photographic or satellite) or detailed ground descriptions of landforms or surface topography, where "significant" means a change in hydrology, landform type (e.g. from low-centered polygons to high-centered polygons), or habitat (change in wildlife usage)?	Arctic Permafrost	Climate Change, Geomorphology, Remote Sensing
A question related to # 1 would then be, "What is the rate of significant permafrost degradation in the Arctic?" Estimates would have to be extrapolated from specific areas with data, using vegetation and permafrost maps.	Arctic Permafrost	Climate Change, Geomorphology, Remote Sensing
What is the role of ground ice as potential source of carbon and nutrients upon permafrost degradation?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Carbon cycle, Climate Change, Geocryology
How much of the Arctic shelf is underlain by subsea permafrost?	Arctic Permafrost	Ground thermal regime, Paleoenvironments, Subsea permafrost

What is the role of ground ice for the resilience and vulnerability of permafrost against rising air temperatures and thermal degradation	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Geocryology, Ground thermal regime
A big deal of efforts have been payed on studing prokariotic microbes in permafrost at planetary level. Yet information of eukariots, and in particular on fungi, remain scant. Can permafrost be a reservoir of ancient fungal genotypes? How long fungi may survive in permafrost, and through which strategies? Is fungal biodiversity at different depths a mirror of the one existing at time of permafrost formation?	Planetary Permafrost	Ecology, Microbiology/Astrobiology, Paleoenvironments
What is the rate of frost heave	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Geomorphology, Paleoenvironments
How much carbon dioxide is being relased from melting permafrost	All	Carbon cycle, Climate Change, Geomorphology
What is the rate of permafrost melting	All	Climate Change, Geomorphology, Ground thermal regime
Age of glacial deposits, timing of climate change, how environmental changes are recorded in landscapes, rates of geomorphic processes in periglacial environments.	Antarctic Permafrost, Mountain Permafrost	Climate Change, Geomorphology, Paleoenvironments
With rapidly warming Arctic climate and potential to advance natural resource related economic activities, it is essential that there be good understanding of the current and future variability in permafrost. This is of relevance to related transportation, exploration and development activities.	Arctic Permafrost	Climate Change, Engineering & Infrastructure, Mapping
What is the floral response in the Gondwanan Late Palaeozoic glaciation, when there were discrete glacial events separated by warmer climate periods?	All	Paleoenvironments
What (unique) paleoclimatic information is stored in the different kinds of ground ice, how this information can be explored and can it be used to improve the knowledge about past climate changes in spatial, temporal and seasonal scales?	Arctic Permafrost	Climate Change, Geocryology, Paleoenvironments
What controls the role of permafrost as source or sink of carbon over decadal to glacial/interglacial timescales?	Arctic Permafrost	Carbon cycle, Climate Change
Permafrost as a thermal condition affects not only Earth, but other planets (e.g., Mars). Do typical permafrost processes occur on Mars? What is the role of water? Do freeze-thaw cycles affect the Martian surface? Can Martian permafrost be a habitat, now or in the past? These questions are highly important for astrobiology and human exploration.	Planetary Permafrost	Geomorphology, Microbiology/Astrobiology, Paleoenvironments
How vulnerable is northern urban infrastructure to permafrost thaw-induced subsidence, and how are these vulnerabilities spatially distributed?	Arctic Permafrost	Climate Change, Engineering & Infrastructure, Mapping
Parameterization of climate controls and surface covers for permafrost thermal state modeling	Arctic Permafrost	Geocryology, Ground thermal regime, Modeling

Develop methodology to validate remote-sensing products with field data	Arctic Permafrost	Geocryology, Ground thermal regime, Remote Sensing
Monitoring of land surface deformations/cryogenic processes in relation to local climate fluctuations	Arctic Permafrost	Climate Change, Geomorphology, Remote Sensing
Which infrastructure challenges arise in different Arctic contexts due to permafrost changes?	Arctic Permafrost	Engineering & Infrastructure, Land use & community planning, Policy
Which adaptation measures (to housing, infrastructure etc.) are needed in different Arctic contexts due to thawing permafrost, and which business models can be set up to possibly combine this challenge with job creation and innovation in northern communities?	Arctic Permafrost	Engineering & Infrastructure, Land use & community planning, Policy
What are effects on subsistence activities and, more generally, indigenous peoples' traditional ways of life due to changing permafrost conditions?	Arctic Permafrost	Land use & community planning, Policy, Culture
This is a land-ocean interactions question, which bears crucially on the Arctic Ocean and its shelf seas. Changes in permafrost will affect the phasing and magnitude of discharge and also the dissolved and suspended burdens in of the terrestrial discharge. How do these changes affect the biogeochemistry (and physics) of the adjacent continental shelves? This question is submitted by an oceanographer and not a permafrost expert.	Arctic Permafrost	Carbon cycle, Geochemistry, oceanography
Does no permafrost exist under the large rivers?What is the critical size and discharge for permafrost-free rivers?	Arctic Permafrost	Ground thermal regime, Hydrology
Impact of Climate Change to the Hydrology/Hydrogeology (discharge pattern, water chemistry) of areas affected by Mountain Permafrost	Mountain Permafrost	Climate Change, Geochemistry, Hydrology
Age, ice content and chemistry of ice of active rock glaciers (radiocarbon dating, palynology, isotope studies, anions, kations, heavy metals in permafrost ice) based on the study of cores drilled on active rock glaciers	Mountain Permafrost	Geochemistry, Palynology
What is the significance of changing ground ice conditions on the mobilization of material and sedimentary fluxes?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Geomorphology, Hydrology
How can periglacial and glacial systems be coupled to establish holistic sedimentary budgets in these areas?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Climate Change, Geocryology, Geomorphology
Spatio-temporal variations of mountain permafrost creep: Where, how and at which spatial and temporal scales do rockglacier speeds change, and what can that tell about the frozen bodies and the impacts on them?	Mountain Permafrost	Climate Change, Geomorphology
Spatio-temporal changes in low-land soil motion. How large is and at which temporal and spatial scales does soil turnover change (e.g. in patterned ground, frost-driven soil turnover)?	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Climate Change, Geomorphology

Large-scale (regional-scale) long-term volume changes of low-land permafrost, e.g. from thaw subsidence.	Arctic Permafrost	Carbon cycle, Climate Change, Ground thermal regime
Investigation of paleoenvironments in arctic and subarctic areas is important for understanding of modern natural processes in this region. Palaeoecological methods are using for investigation of paleoenvironments. Palaeoecological data should be accompanied by precise AMS dating. Question is - where to take funds for these expensive analyses?	Arctic Permafrost	Climate Change, Ecology, Paleoenvironments
What is the chemical composition of the permafrost NOM, and their role on the GHG production ?	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Geochemistry, Permafrost chemistry
What is the chemical composition of the permafrost NOM, and their role on trace element, partitioning, speciation and transport in thermokarst lakes?	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Geochemistry
What are the factors controlling the initiation of thermokarst processes and the rates of expansion of thermokarst features?	Arctic Permafrost, Mountain Permafrost	Carbon cycle, Engineering & Infrastructure, Geomorphology
What is the impact of global warming on vegetation, and how will vegetation changes impact permafrost stability in the next 50-100 yrs.	Arctic Permafrost, Mountain Permafrost	Ecology, Engineering & Infrastructure, Modeling
What are the likely impacts of global change on the hydrological cycle in polar regions over the next 50-100 years?	Arctic Permafrost, Antarctic Permafrost	Climate Change, Geomorphology, Hydrology
We know about the deglaciations in Antarctic and Arctic region and therefore exact chronology and climatic conditions are required to understand the deglaciation process.	Arctic Permafrost, Antarctic Permafrost	Climate Change, Geomorphology, Paleoenvironments
The strength of permafrost is temperature dependant. Although there is a lot of data on cold permafrost, research is lacking for permafrost with temperatures warmer than -2 deg C. How does the strength of various permafrost soils (clay/silt/sand/gravel) change with warming temperatures (close to thaw), and what proportion of strength, if any, is related to internal friction rather than cohesion. Consider primarily ice-poor (<10% visible ice) soils to minimize the effects of creep.	All	Climate Change, Engineering & Infrastructure, Industrial development & impacts
How much methane is released through thawing permafrost? Will this methane be found in aquatic or terrestrial environments? Can microorganisms reduce the methane input?	Arctic Permafrost	Carbon cycle, Climate Change, Microbiology/Astrobiology
How can the development in time of stability conditions in steep perennially frozen slopes and rock walls be assessed under conditions of global climate change at local to regional scales?	Mountain Permafrost	Climate Change
How can complex patterns of snow cover in high-mountain topography be monitored/modeled and what is their influence on thermal conditions of mountain slopes and of steep high-mountain rock faces?	Mountain Permafrost	Ground thermal regime
What are the physical conditions and time scales involved with viscous flow features in the permafrost of Mars and how do these features compare with landforms created by cumulative creep deformation of terrestrial permafrost (rock glaciers)?	Planetary Permafrost	Geomorphology



How permafrost degradation influences runoff formation and debris-flow triggering in alpine headwaters? (This is not a novel topic, but it still deserves thorough analysis).	Mountain Permafrost	Geomorphology, Hydrology
Landscapes of northerly temperate regions were impacted by degradation of permafrost from the last glaciation, and yet surprisingly little is understood about sedimentary processes that impacted their physical characteristics (geometry; variability) and concomitant hydrogeology. New AMS ages of organics produced under tundra will provide a temporal framework for landscape evolution.	Arctic Permafrost, Antarctic Permafrost	Ecology, Hydrology, Paleoenvironments
Is methane liberation from permafrost melting a trigger to rapid and uncontrolled transition to warmer climate on Earth? Budzianowski W.M.: Tetra-stable bifurcation structure of the climate system of Earth: Mechanisms triggering potential transition to the greenhouse steady state, International Journal of Global Warming 5(2) (2013a) 152-178 <a href="http://dx.doi.org/10.1504/ijgw.2013.053485">http://dx.doi.org/10.1504/ijgw.2013.053485</a>	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Carbon cycle, Climate Change, Modeling
What is the subsurface extent of permafrost, and how do the details of its distribution effect hydrologic systems, ecosystems, and infrastructure- both today and with regards to future vulnerability?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost, All	Geocryology, Geophysics, Mapping
What impacts will climate change and the resulting permafrost degradation have on transportation infrastructure (highways, culverts, bridges, airstrips) and what mitigations are possible from a design, construction, and operation and maintenance perspective?	Arctic Permafrost	Climate Change, Engineering & Infrastructure, Ground thermal regime
How much (fossil) carbon in dissolved and particulate form is annually exported from Arctic permafrost regions to the ocean under present and past climate conditions?	Arctic Permafrost	Carbon cycle, Climate Change, Geochemistry
How much (fossil) carbon in dissolved and particulate form is annually exported from Arctic permafrost regions to the ocean under present and past climate conditions?	Arctic Permafrost	Carbon cycle, Climate Change, Geochemistry
How could the amounts and spatial distribution of ground ice (of any genesis) be observed using non-penetrative methods at different scales?	All	Engineering & Infrastructure, Geophysics, Remote Sensing
How is the effect of biodiversity on permafrost stability?	All	Ecology, Land use & community planning, Modeling
What amounts of methane-hydrates formed in the interporous media of freezing soils are stored in shallow permafrost?	All	Carbon cycle, Climate Change, Pedology / soils
Need to establish baseline framework for EO driven monitoring program. Is there an optimum combination of EO data for establishing a permafrost monitoring capability? This could be established with a combined literature review and a pilot study with 1 or more sites.	Arctic Permafrost	Ecology, Hydrology, Remote Sensing
Is there an historical record available to establish a baseline or do we start with current data?	Arctic Permafrost	Ecology, Hydrology, Remote Sensing

What is the recommended temporal and spatial resolution for this mapping activity?	Arctic Permafrost	Ecology, Hydrology, Remote Sensing
Assessment of permafrost resilience to projected climate change scenarios: Given the projected arctic warming, what are the tipping points or resilience thresholds which should not be passed when it comes to the rate of extent of permafrost melt?	Arctic Permafrost	Climate Change, Ecology
Which areas of the Arctic region are most prone to thawing, and which consequences will it have in ecological and financial terms? - In these areas, which current/planned infrastructures are most at risk from thawing permafrost and what can be done to reduce adaptation costs (pipelines, powerplants, railways, ports, airfields).	Arctic Permafrost	Engineering & Infrastructure, Land use & community planning, Mapping
Which monitoring data are missing in order to give more accurate or reliable projections and models for future change in Permafrost?	Arctic Permafrost	Data Management, Modeling
1. What is the historical pattern of infrastructure and infrastructure-related thermokarst formation in the regions of industrial development in the Arctic? How do the patterns vary with respect to distance from roads, different types of roads, and in different types of terrain? How can infrastructure-related and climate-change related thermokarst be differentiated?	Arctic Permafrost	Climate Change, Engineering & Infrastructure
2. Are the changes in thermokarst affecting local patterns of plant productivity? If so, are the changes widespread enough to be detected using time-series of global-scale remote sensing products such as Landsat, MODIS, and AVHRR?	Arctic Permafrost	Industrial development & impacts, Modeling, Remote Sensing
How do roads and other infrastructure affect the process of thermokarst. Are the complex interactions between thermokarst formation, hydrology, patterned-ground landforms, and vegetation succession modified in infrastructure-modified environments?	Arctic Permafrost	Ecology, Engineering & Infrastructure, Land use & community planning
What is the role of the researcher in understanding climatic changes and permafrost dynamics today to help educate the public?	Arctic Permafrost, Mountain Permafrost	Ecology, Engineering & Infrastructure, Modeling
What will be the net outcome of thawing permafrost on terrestrial methane emissions? The answer to this question should factor in likely increases in Arctic NPP.	Arctic Permafrost	Carbon cycle, Climate Change, Hydrology
What is the quantitative (i.e. probability) risk of subsea methane hydrate destabilization as linked to IPCC-type emission and sea-level rise scenarios?	All	Climate Change, Modeling, Subsea permafrost
What is the quantitative (i.e. probability) risk of terrestrial methane hydrate destabilization? (This question is most globally relevant for the Arctic)	Arctic Permafrost	Carbon cycle, Climate Change, Ground thermal regime
What changes in potential vegetation and fire regimes can be expected to follow hydrologic changes (such as infiltration and runoff) resulting from permafrost melt or changes in active layer depth?	Arctic Permafrost, Mountain Permafrost	Climate Change, Ecology, Hydrology
What are the effects of uncharacteristically severe boreal forest and tundra fire on permafrost persistence, and what changes in coupled hydrologic-ecological system responses occur over time after such fire events?	Arctic Permafrost, Mountain Permafrost	Climate Change, Ecology, Hydrology

How to carry out a quantitative risk assessment for infrastructure built in permafrost environments considering climate change and potential changes in use?	Arctic Permafrost, Mountain Permafrost	Climate Change, Engineering & Infrastructure, Ground thermal regime
At what rate deep permafrost propagates and vanishes in the ground in different rock types and in different air temperatures? Could this be demonstrated with laboratory experiments?	All	Engineering & Infrastructure, Ground thermal regime, Paleoenvironments
What is the effect of continental ice to permafrost depth in central parts of glaciated areas? This question is related to my first question: "At what rate deep permafrost..." (I have understood that this is poorly known, and different estimates exist)	All	Ground thermal regime, Paleoenvironments
Could it be arranged a laboratory experiments in different parts of present cold regions, where behavior (freezing and thawing) of permafrost could be measured both at the top and at the bottom of deep permafrost? This should be long-lasting experiment.	All	Climate Change
How to raise the awareness of local policy makers about the issue of climate change and its effects on the lithosphere (permafrost, natural hazards, etc.) ? Which applied research is the most important item to reach this result? In other words, which results, evidences or media to communicate these scientific data have a great impact on the governance?	Mountain Permafrost	Climate Change, Land use & community planning, Policy
I am interested in microbial ecological processes related with permafrost.	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Ecology, Microbiology/Astrobiology
My interest is related with climate changes	Arctic Permafrost, Antarctic Permafrost	Carbon cycle, Ecology, Microbiology / Astrobiology
How does climate change affect the stability of permafrost affected slopes?	All	Climate Change, Geomorphology, Ground thermal regime
How much water is in the permafrost layers, especially in the mountain area, like seasonal permafrost over Tibetan Plateau, that is important for the mid-latitude water bodies (river, lake in the high mountains).	Mountain Permafrost	Climate Change, Hydrology, Remote Sensing
From the lack of observations, the relationship between snow depth and permafrost (frost depth) is unclear, questions are raised for the statistic understanding on the mapping of snow/permafrost depth mid-latitude, like Mongolia area, Northern China and CA.	Mountain Permafrost	Climate Change, Mapping, Remote Sensing
Are impending consequences due to climate change in Himalayan region adequately understood ?	Mountain Permafrost	Climate Change, Data Management, inadequate research center
Whether or not funding available for poor Himalayan region is sufficient and equally distributed throughout the region ?	Mountain Permafrost	Engineering & Infrastructure, Industrial development & impacts
Are local people in Himalayan regions aware of climate consequences i.e. are they sufficiently capable of tackling their problems in local scale ?	Mountain Permafrost	Land use & community planning, Policy, capacity building

Is melting alpine permafrost partly responsible for sediment mobilization in the case of a rain-induced debris flow in a periglacial setting.	Mountain Permafrost	Climate Change, Geomorphology
What is the total rate of emission of methane from Arctic shelves and is it increasing?	Arctic Permafrost	Carbon cycle, Climate Change, Policy
Exchange between deep and shallow groundwaters via talik. Active layer dynamics and transport of matters in and between ecosystems via the active layer.	Arctic Permafrost	Climate Change, Hydrology, Modeling
How will aquatic habitats (i.e. water chemistry, suspended matter) be modified and aquatic communities be affected by permafrost degradation?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost, Planetary Permafrost, All	Climate Change, Ecology, Geochemistry
How will important ecological processes, both in soils and freshwaters, be affected by permafrost degradation?	All	Carbon cycle, Ecology, Pedology / soils
What tools are available to monitor the ongoing change in terrestrial and aquatic ecosystems (i.e. freshwater, coastal)?	Arctic Permafrost, Antarctic Permafrost, Mountain Permafrost	Mapping, Remote Sensing, Monitoring
Where is permafrost in the Alps? Define criteria and standards to collect permafrost evidence and data to guide permafrost modelling evaluation and monitoring activities	Mountain Permafrost	Climate Change, Data Management, Land use & community planning
How can we measure permafrost degradation in boreholes? As temperature approaches 0°C, energy is used to melt ice. Thus borehole temperature data are no more useful to monitor permafrost degradation. we need to develop technologies to monitor ice content - soil moisture evolution in boreholes and related impacts on surface phenomena (hydrology, topography, ...)	Mountain Permafrost	Climate Change, Hydrology, Land use & community planning
What is the extent, temperature and ice content of global submarine permafrost and how is are these variables changing?	Arctic Permafrost, Antarctic Permafrost	Climate Change, Mapping, Subsea permafrost
To what degree do these changes mitigate or control greenhouse gas exchange between the cryosphere, hydrosphere and atmosphere?	Arctic Permafrost, Antarctic Permafrost	Climate Change, Mapping, Subsea permafrost
Development of novel technologies for the observation and monitoring of submarine permafrost.	Arctic Permafrost, Antarctic Permafrost	Climate Change, Mapping, Subsea permafrost
What is the likely hood of emission of such substantial quantities of CO <sub>2</sub> and CH <sub>4</sub> that a positive climate feedback will originate from Arctic permafrost	Arctic Permafrost	Carbon cycle, Climate Change, Geochemistry
What are the exact relations between the ecological changes, the sedimentary processes and microbiology that will generate a substantial carbon climate feedback in the Arctic. In other words what mitigation measures can be developed?	Arctic Permafrost	Carbon cycle, Climate Change, Ecology





































































