

WSL Strategy 2035

Research for people and the
environment in a changing world





Context

Global change – climate change, land-use change, and other anthropogenic impacts – is the cause of most of today's pressing environmental and societal challenges. Switzerland and Europe in general are being exposed to increasingly frequent climatic extremes, including warmer, seasonally drier conditions, but also heavy precipitation events. This region is also experiencing increasing population pressure in urban, rural, and natural areas. Intensive agriculture, urbanization, climate change, and introduced non-native organisms threaten native biodiversity. Furthermore, ice loss and permafrost thaw expose mountain regions to increasing risks.

The WSL Strategy 2035 builds on the institute's decades of experience and excellence to address the challenges of global change. It specifically describes four overarching development foci, as well as opportunities for further advancing the well-established five core thematic areas of forest, biodiversity, landscape, natural hazards, and snow and ice.

Mission

Research for people and the environment in a changing world

Development Foci

- Global change impacts
- Sustainable urbanization
- Environmental governance
- Multifunctional landscapes

Methods and Approaches

- Monitoring and infrastructure
- Targeted method development
- Integrated modeling
- Transdisciplinary approaches
- Transfer and cooperation

Core Thematic Areas

- Forest
- Biodiversity
- Landscape
- Natural hazards
- Snow and ice

Development foci

WSL has identified four societally relevant and scientifically promising development foci for the coming decade. They build on WSL's research and expertise in the five core thematic areas, integrate across themes and disciplines, and enhance WSL's contribution to important global challenges.

1. Global change impacts: mitigation and adaptation

Background: Global change is drastically impacting the Earth system at large, including ecosystems and society. Understanding global change is key for projecting its impacts and providing solutions for mitigation and adaptation. Building on decades

of research and monitoring campaigns in its core thematic areas, WSL will make a decisive contribution to addressing this challenge.

Foreseen activities: WSL will develop novel approaches to: (i) understand, quantify, and predict the impacts of global change and the risks to environment and society; (ii) identify tipping-points and key factors for increasing resistance and resilience; (iii) apply and test mitigation and adaptation strategies; (iv) implement solutions for early-warning systems; and (v) analyze options to foster behavioral changes.

2. Sustainable urbanization for livable cities

Background: Rapid urbanization is taking place globally, with most of today's population living in urban areas. Sustainable urbanization addresses the design, renewal, development, and management of urban spaces, as well as the economical use of land and resources. Its goal is to create and maintain socially inclusive, environmentally responsible, economically viable, and biodiverse and healthy cities that are resilient to climate change. With its experience in the core thematic areas, WSL is well equipped

to take the next step in researching and understanding urban spaces and to develop appropriate solutions.

Foreseen activities: WSL will focus on enhancing its system-level understanding and developing sustainable solutions for: (i) health, recreation, and other needs of ageing, growing, and more diverse societies; (ii) biodiversity conservation and management of ecosystem services and risks; (iii) public participation in planning livable cities; and (iv) interactions between urban and non-urban systems.

3. Environmental governance

Background: Management of the environment remains a major governance challenge. A thorough understanding and critical assessment of the key elements of governance are essential for improving decision-making processes, forms of collaboration, formal and informal regulations, and policy implementation. Based on a long history of complementing natural science research with social science studies, WSL will systematize environmental governance research to further increase the effectiveness of its research in all fields.

Foreseen activities: WSL will: (i) strengthen the knowledge and skills at WSL regarding environmental governance; (ii) deepen the understanding of environmental decision-making; (iii) support effective environmental policy elaboration and implementation; and (iv) contribute to the development of governance structures for new fields of action, such as climate change adaptation.

4. Multifunctional landscapes and ecosystems

Background: Pressing demands on landscapes and ecosystems include the provision of food, housing, and energy, protection from natural hazards, long-term environmental conservation and restoration, and sustainable carbon sequestration. The complex interactions of societies with their physical and biological environment manifest themselves in interconnected multifunctional landscapes and ecosystems across Switzerland, from the lowlands to high-alpine regions. This development focus will build on WSL's extensive experience in researching natural resources, ecosystem

services, multifunctionality, and land-use conflicts, as well as physical and perceived landscapes.

Foreseen activities: WSL will develop and synthesize approaches to: (i) identify multifunctional interactions, synergies, and dependencies within and between landscapes and ecosystems; and (ii) propose options to reduce trade-offs between the diverse landscape types and functions along the urban–rural gradient and from lowlands to high-alpine regions.

Advancing WSL's core thematic areas

WSL will embrace emerging challenges and opportunities in research and implementation through the new development foci, as well as by advancing its core thematic areas. It will pursue this with the following objectives and actions:

Forest

Objective: Advance the understanding of forest ecosystems, including their responses to global change and their significance for society, and embrace climate-smart and integrated management strategies.

Actions: Expand research on tree growth, health, and mortality and on soil properties,

with a particular focus on water, carbon, and nutrient fluxes in the soil–plant–atmosphere nexus (this includes aspects ranging from isotopic fractionation and molecular-level processes to ecosystem-level dynamics, and encompasses response resolutions from seconds to millennia); implement near-real-time techniques to improve early-warning systems; assess forests' societal services, as well as their influence on human health; project long-term carbon storage; identify and launch mitigation measures against adverse cascading processes; and improve the understanding of threats from the introduction of invasive species.

Biodiversity


Objective: Transition toward a holistic approach to biodiversity research, encompassing evolutionary aspects, interactions, functions, and ecosystem processes and services, eventually leading to nature-based solutions to mitigate and adapt to global change.

Actions: Assess patterns, processes, and consequences of changing biodiversity, including related interactions and ecosystem functions across space and time; deepen the understanding of how global change affects biodiversity, taking into account the ability to evolve and adapt; establish theo-

ries and methods to evaluate conservation measures; strengthen taxonomic expertise within and across trophic levels to better understand species and function interlinkages; and deepen analysis of biodiversity policies and related financial expenditures.

Landscape

Objective: Strengthen theory development in landscape research, considering the physical landscape, the perceived landscape, and the interactions among the two.



Actions: Expand the framework to understand spatiotemporal patterns and natural processes in landscapes and their changes over time; widen the scope of work by incorporating agroecological research questions and involving actors and institutions; deepen the understanding of landscape perception; develop methods for designing multifunctional landscapes that balance different needs; and expand transdisciplinary approaches to co-produce actionable knowledge on landscapes.

Natural hazards

Objective: In response to climate change, evolve from single-hazard to multi-hazard modeling, understand cascading and compound events, and emphasize water-related processes and hazards and their future changes.

Actions: Develop new models that combine physically based and probabilistic approaches; move towards impact- and risk-based warning systems; establish new comprehensive risk-management and adaptation approaches that include socio-political dimensions.

Snow and ice

Objective: Enhance process-oriented research on snow, ice, glaciers, and permafrost to explain the role of the cryosphere in the Earth system under climate change and assess the environmental, economic, and societal consequences of cryospheric changes.

Actions: Expand research that combines snow science, glaciology, and permafrost science to deepen the understanding of hydrologically relevant cryospheric processes and their interactions with climate at regional and global scales; expand research to areas that are particularly relevant for

cryosphere-related tipping points; improve the preparedness of society and economy in responding to cryospheric changes in high-alpine regions.

Furthering methods and approaches

Research and monitoring methods are undergoing profound change, driven by rapid digitalization and technological innovations. This is particularly the case in artificial intelligence, remote sensing, robotics, near-real-time data assessment, high-resolution (climate) modeling, and molecular information (environmental multiomics). In many areas, WSL already has the means and expertise to combine experiments, monitoring, modeling approaches, and social science methods in a unique way to address urgent research questions in a comprehensive and interdisciplinary manner. In the coming years, WSL will focus on furthering methodological advancements in the following ways:

Monitoring and infrastructure

Advance state-of-the-art design and execution of monitoring and invest in the continuous improvement and integration of monitoring technologies, infrastructure, and networks. Improve early-warning systems for timely responses to emerging environmental challenges.

Targeted method development

Tailor data collection and analysis methodologies across the full spectrum of techniques, from isotope and molecular-level approaches (including DNA analysis), to diverse high-resolution remote sensing in the near and far range, to artificial intelligence applications in modeling, monitoring, and laboratory and field experiments.

Integrated modeling

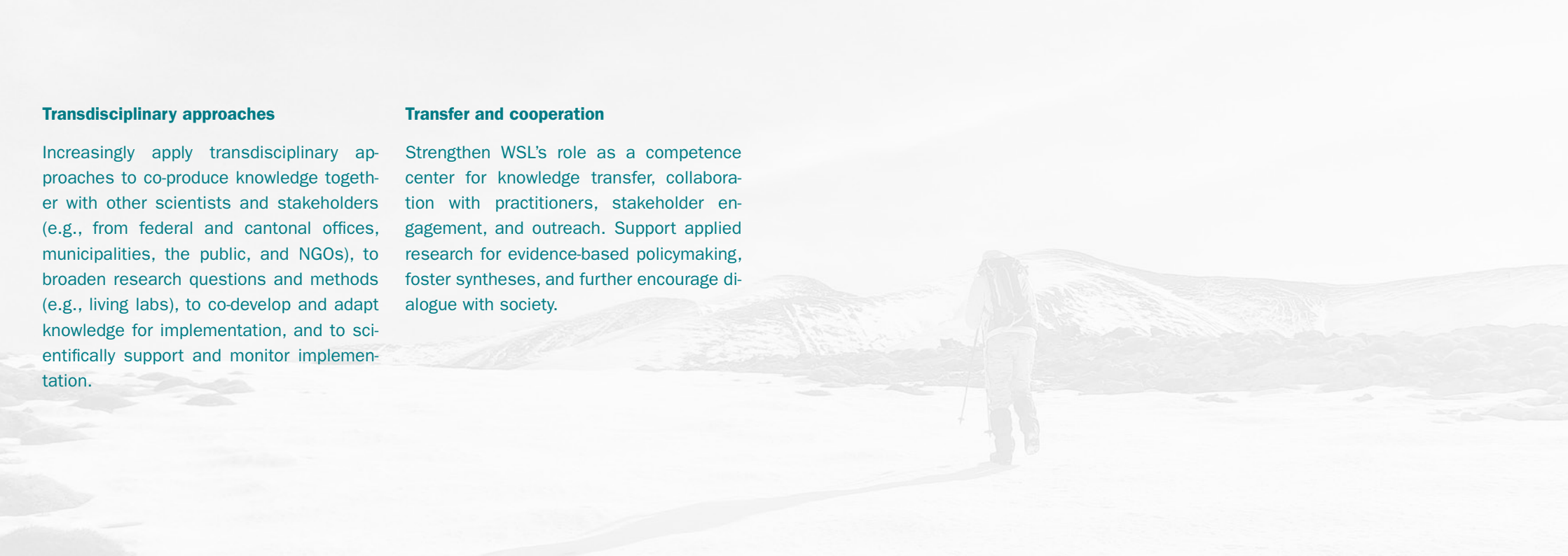
Integrate wide ranges of temporal and spatial scales in models, as well as data and approaches from multiple disciplines, from genetics to social sciences. Improve the capability to understand current and predict near-future environmental states and processes, and to project and assess scenario-based long-term changes – especially rapid changes and extremes – and their impacts.

Transdisciplinary approaches

Increasingly apply transdisciplinary approaches to co-produce knowledge together with other scientists and stakeholders (e.g., from federal and cantonal offices, municipalities, the public, and NGOs), to broaden research questions and methods (e.g., living labs), to co-develop and adapt knowledge for implementation, and to scientifically support and monitor implementation.

Transfer and cooperation

Strengthen WSL's role as a competence center for knowledge transfer, collaboration with practitioners, stakeholder engagement, and outreach. Support applied research for evidence-based policymaking, foster syntheses, and further encourage dialogue with society.



With this Strategy 2035, elaborated in a 9-month participatory process, WSL is ready to embark on the next phase of furthering scientific excellence, enhancing policy readiness, confronting the challenges of a changing world, and offering solutions for policymakers and society.



The Swiss Federal Institute for Forest, Snow and Landscape Research WSL conducts solution-orientated research on forests, landscapes, biodiversity, natural hazards, and snow and ice in a changing world. As a federal research institute and part of the ETH Domain, it is committed to excellence in research and implementation.

Swiss Federal Research Institute WSL
+41 44-739 21 11
wslinfo@wsl.ch, wsl.ch
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