HYRESSA

FP6 - Research Infrastructures - Accompanying Measure
Instrument: SSA

HYperspectral REmote Sensing in Europe – specific Support Actions

AM7 REPORT

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1. Introduction

1.1 Aim of HYRESSA project

HYRESSA aims at investigating the user needs of the European hyperspectral remote sensing research community with respect to access to and accuracy, quality and conformity of hyperspectral images - especially with the advent of next-generation European hyperspectral sensors like APEX and ARES in order to refine protocols related to calibration, acquisition, processing and in-situ measurements in compliance with standards. Furthermore, HYRESSA explores strategies on how to build a Europe-wide network of hyperspectral remote sensing facilities and on how to coordinate a user-oriented hyperspectral remote sensing Research Infrastructure. The HYRESSA outcome will be a starting point to build a European user-oriented hyperspectral remote sensing Research Infrastructure. More information on the project can be found on the project website: www.hyressa.net.

1.2 Aim of Exploratory workshop

In order to meet the objectives of HYRESSA as described in the project proposal (HYRESSA, 2004), an Exploratory Workshop was organized (AM7). The aim of the workshop was:

- to explore strategies to build and coordinate a Europe-wide network of hyperspectral remote sensing facilities
- to assess existing protocols of calibration, acquisition and processing of hyperspectral data and their compliance with standards

taking into account the results of AM5 and AM6.
The outcome of the workshop should guide the further development of a distributed European hyperspectral remote sensing Research Infrastructure (AM9). In addition, it should provide input for the review and refinement of existing protocols in the field of airborne hyperspectral remote sensing (AM8).

1.3 Outline of the report

In this report the results of the HYRESSA Exploratory workshop are presented. The following chapter will explain the methods used during the workshop. The results of the workshop are presented in chapter three. The fourth chapter gives a summary and conclusion of the workshop.

2. Set-up of Exploratory Workshop

2.1 Organization of sessions

In order to fulfill the goals of the HYRESSA Exploratory workshop, three sessions divided over two days were organized:

1. **Plenary Session**: in this session a broad overview was given on current developments and state-of-the-art in remote sensing infrastructures or related research infrastructures. Presentations were given by external experts with expertise on a specific research infrastructure as 20 minute lectures with some additional time for questions.
2. **Interactive Session**: the presenters of the plenary session were asked to join a discussion panel. To make the discussion during this session more focused and clear, five themes related to the development of a hyperspectral remote sensing infrastructure were defined and elaborated prior to the workshop:
   - Are hyperspectral earth observation data unique?
   - The user community for hyperspectral earth observation data
   - Accessibility of hyperspectral data and products
   - The role of standards and products
   - Building an infrastructure

   The panel participants discussed the indicated themes while also participation of the workshop participants was encouraged.
3. **Working Session**: the goal of the working session was to translate the knowledge and experience from the plenary and interactive sessions to the specific goals of the HYRESSA project. Specific questions which were elaborated during this session were:
   - How does a European Hyperspectral Remote Sensing Infrastructure relate to existing global, European and national infrastructures in the field of (hyperspectral) Earth Observation?
   - What are the key end-users and their requirements for a European hyperspectral Remote Sensing Infrastructure?
   - What are the most promising organizational structures for further development?

   As a result of this session, a first road map for future collaboration in a hyperspectral remote sensing infrastructure was prepared.

2.2 Workshop

The Exploratory Workshop was held on Wednesday 14th and Thursday 15th of March 2007 as part of the ISPMSRS'07 conference in Davos, Zwitserland (http://www.ispmsrs07.org/). The complete program of the workshop can be found in Appendix I and on the HYRESSA website (http://www.hyressa.net/davos.htm). The complete program of the ISPMSRS'07 conference can be found in Appendix V.

2.2.1 Speakers

A selected group of experts with an overview on (hyperspectral) remote sensing infrastructures or related research infrastructures was invited to give a presentation during the workshop and to share their experience. The following experts were invited:

- Dr. Michael Rast – Secretariat Group on Earth Observations (GEO) (CH)
- Prof. dr. Susan Ustin – UC Davis (USA)
- Dr. Stephen Briggs – ESA/ESRIN (I)
- Dr. Robert Wolfe – NASA Goddard Space Flight Centre (USA)
- Dr. Jean-Louis Brenguier – METEO France (F)

- Dr. Brigitte Weis – European Commission

2.2.2 Participants

All participants of the ISPMSRS'07 conference were invited to participate in the workshop. In total 130 participants were attending the Wednesday morning Plenary Session of the workshop which was organized as part of the ISPMSRS'07 conference. In total 30 participants of which 15 HYRESSA partners were attending the Interactive Session of the workshop. One third of the participants is a provider of hyperspectral data while two third are considered as users. The participants came from 13 different countries across Europe from universities, research institutes and commercial companies. The participants list can be found in Appendix II.

2.2.3 Reporting

For each of the three workshop sessions, reporters were appointed which made notes of the discussions and feedback during the sessions. In this report, the main outcome of the Exploratory Workshop is summarized. For further background information the reader is referred to the weblinks as provided in the report and the presentations of the workshop which are available through the HYRESSA website: www.hyressa.net/davos.htm.

3. Results

This chapter consists of three parts. In the first part, relevant developments in Earth Observation Infrastructures will be shortly highlighted and links to relevant sources of background information will be indicated. Based on the discussion during the interactive session of the workshop, the second part of this chapter summarizes the specific requirements for a hyperspectral remote sensing research infrastructure. Finally, we will give an overview of the main components which are required to build an European hyperspectral remote sensing infrastructure as they were identified during the working session of the Exploratory Workshop.

3.1 Current developments in Earth Observation Infrastructures

This paragraph gives a short description of the Earth Observation Infrastructures which were presented during the Plenary Session of the workshop. More complete information on the presented infrastructures can be found through their website which can be found in this report, while the complete workshop presentation can be found on www.hyressa.net/davos.htm.

Group on Earth Observations (GEO)
The intergovernmental Group on Earth Observations (GEO) is leading a worldwide effort to build a Global Earth Observation System of Systems (GEOSS) over the next 10 years. GEOSS will work with and build upon existing national, regional, and international systems to provide comprehensive, coordinated Earth observations from thousands of instruments worldwide, transforming the data they collect into vital information for society.
(http://www.earthobservations.org)

National Ecological Observatory Network (NEON)
NEON is envisioned as "a continental scale research infrastructure consisting of geographically distributed infrastructures, networked via state-of-the-art communications. NEON will comprise cutting-edge lab and field instrumentation, site-based experimental infrastructure, natural history archive facilities and/or computational, analytical and modelling capabilities, linked via a computational network. NEON will transform ecological research in the United States by enabling studies on major environmental challenges at regional to continental scales. Scientists and engineers will use NEON to conduct real-time ecological studies spanning all levels of biological organization and temporal and geographical scales. NSF disciplinary and multi-disciplinary programs will support NEON research projects and educational activities." NEON is tentatively scheduled to be operational by 2013, and will process data from 20 stations throughout the United States.
Airborne remote sensing will play a key role in NEON because neither ground-based nor space borne measurements can fully capture the spatial and temporal heterogeneity of ecosystem structural and functional changes that occur at high spatial resolution (or grain size) over large geographic areas. Currently, a proposal has been put forward an airborne system with a hybrid hyperspectral and waveform LiDAR system operational (http://cao.stanford.edu/) which can provide an observational suite that simultaneously probes the biochemical and structural properties of ecosystems. This system will facilitate an operational collection and analysis approach for programs such as NEON.
(http://www.neoninc.org/)

ESA Earth Observation User Services (ESA User Services)
ESA EO User Services provides a vast amount of content, grown and collected over more than a decade: detailed technical information on Earth Observation (EO) missions, satellites and sensors,

EO data products & services, online resources such as catalogues and library, a section dedicated to applications of satellite data, and access to promotional satellite imagery. Together with the EO Help Desk and the EO Principal Investigator Portal, Earthnet Online provides services to the scientific community for access to EO data via the distributed multi-mission ground segment. (http://earth.esa.int or http://envisat.esa.int)

NASA MODIS land products (MODIS LP)
The objective of the MODIS land team is to provide the user community with high quality, consistent and well-calibrated MODIS satellite data to detect and monitor changes and trends in relevant land variables (e.g., LAI, FAPAR, NPP). Developing the next-generation data sets for global change research is the challenge given to the MODIS Science Team.
The Land Processes Distributed Active Archive Center (LP DAAC) was established as part of NASA's Earth Observing System (EOS) Data and Information System (EOSDIS) initiative to process, archive, and distribute land-related data collected by EOS sensors, thereby promoting the interdisciplinary study and understanding of the integrated Earth system.
(http://modis-land.gsfc.nasa.gov/ or http://lpdaac.usgs.gov/)

EUFAR
EUFAR is an Integrated Infrastructure Initiative (I3) of the European Commission under the FP5/FP6 programme. EUFAR aims at coordinating the operations of the European fleet of instrumented aircraft in the field of environmental research in the atmospheric, marine, terrestrial and Earth sciences.
(http://www.eufar.net/)

Summary
The last five years, developments in Earth Observation infrastructures show the capacity of near real-time processing, storage and archiving of large volumes of earth observation data. As a result global remote sensing products are available to end-users via standardized data portals (e.g., MODIS LP, ESA User Services). An important differentiation is the provision of this data at level 2 as surface radiation or as level 3 with a broad range of possible products. However, these developments are mainly sensor driven, while another perspective could be the user driven one, which would mean customizing products to the societal needs or benefit areas as GEO describes them. The before mentioned infrastructures (MODIS LP, ESA User Services and GEO) are aiming at a global coverage mainly based on satellite based earth observation.

Table 1: Overview of remote sensing based infrastructures which were presented in the HYRESSA Exploratory workshop. The keywords relate to the main aspects which would part of a future hyperspectral infrastructure as investigated in the HYRESSA project.

Infrastructure name	**organisation type**	**spatial extent**	**application domain**	**keywords**					
				airborne	*hyper-spectral*	*imaging spectrometer*	*calibration*	*processing/ archiving*	*standards*
GEO	Intergovern-mental group	global	9 benefit areas	X			X		X
NEON AO	Research Infrastructure	continental US	ecology	X	X	X	X	X	?
ESA User Services	Space Agency	global EU	global environment				X	X	X
MODIS LP	Space Agency	global US	land				X	X	X
EUFAR	Research Infrastructure	continental EU	environment	X			X	?	?

On a continental to regional scale, new initiatives for infrastructures are proposed (NEON Airborne Observatory) or have been active now for some years (EUFAR). These infrastructures include new sensor types like waveform LIDAR (NEON) and have the airborne platform (EUFAR) as a basis. A comparison was made of the infrastructures presented during the workshop with the key aspects which were put forward for a future European hyperspectral research infrastructure (Table 1). The comparison was based on the information provided in the presentations and from available web sources. The comparison shows that except for the NEON Airborne Observatory, an EU hyperspectral infrastructure is clearly complementary with the available infrastructures. Because of the different regional focus the overlap with the NEON Airborne Observatory is limited. However, it offers possibilities of synergetic development with knowledge transfer between the same type of infrastructure developed for different continents.

3.2 Requirements of a hyperspectral remote sensing research infrastructure

This paragraph summarizes the outcome of the interactive session of the workshop. The goal of this session was to explore the requirements of a hyperspectral remote sensing research infrastructure both from a producer and end-user perspective. In the first part of the paragraph, an overview of the most critical requirements is given as they were put forward during the interactive session. In the second part of the paragraph, these requirements are compared with the user requirements from the HYRESSA Questionnaire on User Needs and the SWOT and User Needs workshop. Textbox 1 gives an overview of infrastructures, projects or other initiatives which were mentioned during the interactive session and could serve as benchmark or example for the HYRESSA project.

3.2.1. Overview of requirements

The identified requirements have been grouped according to the following themes:

1. Calibration, validation and quality control
2. Development of products
3. Standards
4. User community

Calibration, validation and quality control

- For high-quality hyperspectral data, the availability of high-quality calibration facilities is critical: both including laboratory facilities and vicarious calibration in the field (DLR's Lab Calibration Facility built for APEX calibration and used also for ARES calibration can be used as a basis for Europe).
- Quality control: this can be organized through annual workshops (e.g., AVIRIS); through reports on calibration and validation issues and interaction with user-community to resolve technical problems (e.g., NCAVEO).
- Organize a standardized network of field locations which can be used for vicarious calibration and for which a continuous set of relevant ground data is available.
- Clearly define the spatial-temporal extent of the infrastructure: MODIS focuses on provision of daily global products, while the NEON Airborne Observatory is aiming at regional ad hoc provision of (ecological) products.
- Use already available knowledge: some years ago efforts have been made to prepare an EU Large Scale Facility for Imaging Spectroscopy, however project was left asleep (contact DLR).
- MODIS uses the concept of Science Teams to formulate and assess requirements already in a postlaunch phase but also for development of the products. Science Teams are subject to a periodical peer-review selection procedure which keeps the quality on the required level.

Box 1: Overview of infrastructures and projects which could be relevant for future development of a European hyperspectral remote sensing research infrastructure.

AVIRIS
AVIRIS is a NASA operated and financed airborne imaging spectroscopy sensor. It is a unique optical sensor that delivers calibrated images of the upwelling spectral radiance in 224 contiguous spectral channels (bands) with wavelengths from 400 to 2500 nanometers. AVIRIS has flown North America, Europe, portions of South America, and most recently, Argentina. The main objective of the AVIRIS project is to identify, measure, and monitor constituents of the Earth's surface and atmosphere based on molecular absorption and particle scattering signatures.
(http://aviris.jpl.nasa.gov/)

AERONET
The AERONET (AErosol RObotic NETwork) program is a federation of ground-based remote sensing aerosol networks established by NASA and LOA-PHOTONS (CNRS) and is greatly expanded by collaborators from national agencies, institutes, universities, individual scientists, and partners. The program provides a long-term, continuous and readily accessible public domain database of aerosol optical, mircrophysical and radiative properties for aerosol research and characterization, validation of satellite retrievals, and synergism with other databases. The network imposes standardization of instruments, calibration, processing and distribution.
(http://aeronet.gsfc.nasa.gov/index.html)

ARGO
Argo is a global array of 3,000 free-drifting profiling floats that measures the temperature and salinity of the upper 2000 m of the ocean. This allows, for the first time, continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being relayed and made publicly available within hours after collection.
(http://www.argo.ucsd.edu/FrAbout_Argo.html)

NCAVEO
NCAVEO comprises a network of scientists, engineers and applications specialists interested in the calibration and validation (cal/val) of remotely sensed data. The main aim of NCAVEO is to provide a co-ordinated resource for users from industry and academia and also to facilitate access to benchmark methods and algorithms as well as identifying areas where additional research and improved methods are required. The network holds workshops and technical meetings and these will be advertised on the website. Baseline funding for NCAVEO is provided by the UK Natural Environment Research Council and additional funds for specific activities are sought from a range of sources including government and industry.
(http://www.ncaveo.ac.uk/)

SEAWIFS
The purpose of the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Project is to provide quantitative data on global ocean bio-optical properties to the Earth science community. Subtle changes in ocean color signify various types and quantities of marine phytoplankton (microscopic marine plants), the knowledge of which has both scientific and practical applications. The SeaWiFS Project will develop and operate a research data system that will process, calibrate, validate, archive and distribute data received from an Earth-orbiting ocean color sensor.
(http://oceancolor.gsfc.nasa.gov/SeaWiFS/)

Box 1: continued

VALERI
The objectives of the VALERI (Validation of Land European Remote sensing Instruments) project are to provide high spatial resolution maps of biophysical variables (LAI, fAPAR, fCover) estimated from ground measurements to validate products derived from satellite observations. For this purpose, the VALERI project offers: a methodological framework designed for the derivation of the high spatial resolution maps; a pool of instrumentation and tools for ground measurements and processing; a network of sites distributed over the Earth's surface; and a database of processed and available high spatial resolution maps.
(http://www.avignon.inra.fr/valeri/)

CEOS working group on calibration and validation
To ensure long-term confidence in the accuracy and quality of Earth observation data and products, the WGCV provides a forum for calibration and validation information exchange, coordination, and cooperative activities. The WGCV promotes the international exchange of technical information and documentation, joint experiments, and the sharing of facilities, expertise and resources. The WGCV seeks to be the recognized first point of contact for the international user-community as far as calibration and validation is concerned. To this end, WGCV addresses the need to standardize ways of combining data from different sources to ensure the interoperability required for effective use of existing and future Earth observing systems.
(http://wgcv.ceos.org/)

Hyper-I-Net
The Hyperspectral Imaging Network (HYPER-I-NET) is a four-year (2007-2010) FP6 Marie Curie Research Training Network designed to build an interdisciplinary European research community focusing on hyperspectral imaging activities. The core strategy of HYPER-I-NET will be to create a powerful interdisciplinary synergy between different domains of expertise within Europe, and use it to break new grounds in areas related with hyperspectral imaging.
(http://hyperinet.multimediacampus.it/)

HyperTeach
'HyperTeach', a joint project of the Flemish Institute for Technological Research (VITO), the Management Unit of the North Sea Mathematical Models (MUMM), the Royal Museum for Central Africa (RMCA) and the Katholieke Universiteit Leuven (K.U.Leuven) funded by the Belgian Science Policy Office, developed modular course material to theoretically and practically introduce researchers and policy-makers to the emerging field of Imaging Spectroscopy. There is an equal focus on theory and hands-on exercises in three application domains (water, geolgy and biodiversity).The project includes the organization of training courses in Imaging Spectroscopy.
(http://hyperteach.vgt.vito.be/)

NERC Field Spectroscopy Facility
The NERC Field Spectroscopy Facility (FSF) is an expanding world class facility supporting Earth System Science. It comprises a pool of high quality field spectroradiometers with associated calibration and support equipment. The facility is based in the School of GeoSciences at the University of Edinburgh.
(http://fsf.nerc.ac.uk/)

FLUXNET
FLUXNET is a global network of micrometeorological tower sites that use eddy covariance methods to measure the exchanges of carbon dioxide, water vapor, and energy between terrestrial ecosystem and atmosphere. At present, over 400 tower sites are operating on a long-term and continuous basis. Researchers also collect data on site vegetation, soil, hydrologic, and meteorological characteristics at the tower sites.
(http://www.daac.ornl.gov/FLUXNET/)

- An extensive literature survey for different application domains could be used as a basis for the definition of the most relevant products.
- A literature study on which conventions and standards are applicable for specific application domains, which could differ from the remote sensing domain: harmonization of semantics (e.g., Leaf Area Index vs. Plant Area Index).
- For MODIS, algorithms and products should be globally applicable, what would be the support of HYRESSA (EU?).
- Develop different levels of products (incl. quality and toolboxes) to attract in-experienced user groups: training, education and outreach are essential.

Standards

- First step: ensure that procedures and practices are harmonized and transparent through documentation.
- Standards for processing of derived products need to be transparent and require proper documentation: concept of MODIS product development.
- Following the example of Spatial Data Infrastructure (SDI) development (e.g., INSPIRE in EU), also a hyperspectral remote sensing infrastructure will require standardization and a certain level of interoperability. The key question however is: Who will set the standards?
- Use either bottom-down (close involvement of user community) or top-down approach.
- To avoid extensive discussions on proper standardization, the HYRESSA project can be used to set a standard as a large group of relevant partners is involved. This would require a pro-active action which uses existing conventions, practices, standards and protocols to establish a reference set of standards. This could be an important step forward and should also include the aspect of semantics and terminology (e.g., Schaepman-Strub *et al.*, 2006).
- The FLUXNET community uses a common and agreed protocol which also covers the calibration of the instruments: this could be used as a reference for calibration of fieldspectrometers (e.g., NERC Field Spectroscopy Facility).
- Not only standardization for hyperspectral data processing but also take into account spectral and spatial resolution of sensors.

User community

- An operational community behind an infrastructure is essential: learn from successful infrastructures in other application fields (e.g., AERONET, ARGO, SEAWIFS)
- Education and training essential part of a research infrastructure. For MODIS this is arranged by workshops on the processing and use of MODIS products (inside and outside US). Next to that the user community develops its own training facilities (e.g., in EU Hyper-I-Net, HyperTeach).
- Delivery of data products, for example AVIRIS data are available after 6 months: however (near) real-time delivery is very important to coordinate required fieldwork on the ground. Ideally inflight processing would be most optimal: this is one of the goals of the NEON Airborne Observatory.
- Make efficiently use of already available knowledge and resources.
- Also within both the provider and user community it is important to learn from each other: do not make the same mistakes again and exchange of experience between continents. This would require a globally organized and transparent documentation and reviewing procedure. Although this will take some time to develop, first results from GEO show that we are going in the right direction.
- Create a single entry point for data access through clearing house approach and idea of one-stop-shop.

- Financing an infrastructure is an expensive exercise: money will become available when the benefits for the user community are visible. However, a coordinated infrastructure offers possibilities to reduce duplication and fill gaps and in that way save money. This fulfils the goals of the EU FP7 Research Infrastructures program.

3.2.2. Implications for EU hyperspectral remote sensing research infrastructure

In preparation of the Exploratory Workshop, two other activities within the HYRESSA project already gave a first view on the requirements of actual and potential users of a European hyperspectral remote sensing research infrastructure (reports available at www.hyressa.net).
Key conclusions from the SWOT and User Needs workshop were:

- Standards
- Transparency
- Awareness raising – Education and training
- Provide tools for extracting information from hyperspectral data

Key conclusions from the user questionnaire were:

- Better service (data delivery and cost)
- Reasonable pricing policies
- Individual preferences

Several of the requirements indicated above were also judged as very important during the Exploratory Workshop (e.g., standards, transparency, awareness, and near real-time data delivery). The cost requirement was not treated extensively, however it was indicated that funding will only become available when benefits for the user community are visible. One possible development to achieve this would be to provide instead of only level 2 products (radiance or surface reflectance products) also level 3 products to the end-users (e.g., MODIS concept). This would also require information on the quality of the data product so the user can make its own judgement on the level of operation of this product. Next to this suite of standardized products, additional degrees of freedom are required to deal with individual preferences of specialized users.

As result of the exploratory workshop several additional key requirements for a hyperspectral remote sensing infrastructure were identified:

- A high-quality facility for airborne sensor calibration
- Standardized processing facilities (including metadata and quality control)
- Close collaboration with end-users in domain for development of products and for provision of ground measurements for calibration and validation (concept of science teams).
- Central facility for distribution and access to hyperspectral data and derived products
- Facility for calibration of field spectrometers
- Working group on future development

For the further development of a hyperspectral remote sensing research infrastructure, the following aspects should be elaborated, also indicating explicitly what is *not included* and in what way collaboration is possible with already existing infrastructures:

- **Definition of sensors, instruments and facilities**: sensors on airborne platforms which could be extended by spaceborne sensors and supported by field observations.
- **Definition of spatial-temporal extent**: this relates to the point which scales (local-global) the infrastructure could support (local-global). For example hyperspectral information on a regional scale could support monitoring of EU directives (e.g., Natura2000, Water

Framework Directive). Figure 1 shows an example how the spatial-temporal extent of NEON is visualized.

- **Definition of end-users and application domains**: different strategies possible: focus on most promising domain or include number of key domains or serve all interested domains.
- **Definition of products and services**: extension of level 2 to 3 products with a differentiation into standard products and specialized products; selection of standard products depending on selected application domains.
- **Definition of standards**: adaptation to existing standards or setting new standards

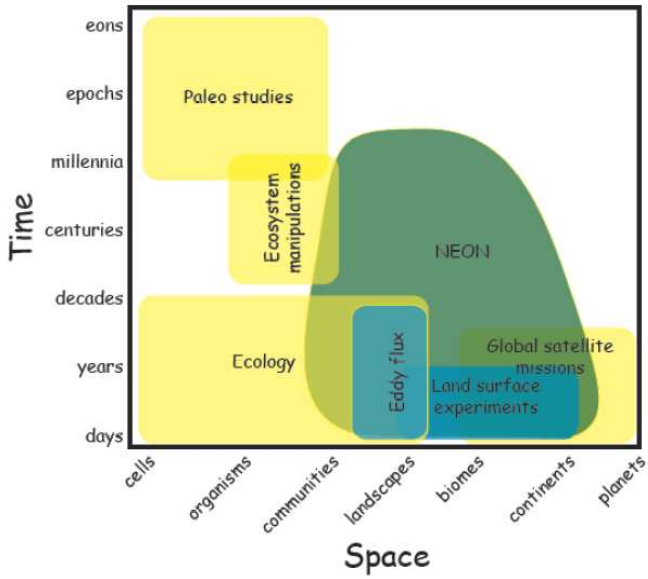

Figure 1: Example of representation of spatial-temporal extent of infrastructure for in this case NEON (taken from: http://www.ecosystemresearch.org/2006%20Meeting/McMahon%20AERC%20pdf.pdf)

3.3 Building a hyperspectral remote sensing infrastructure

During the Exploratory Workshop it was indicated that a hyperspectral remote sensing research infrastructure could provide several benefits to the European user community:

- Provides focus
- Establishes priorities for the future ('vision', 'roadmap')
- Improves coordination, allows EU-wide planning and development
- Reduces duplication of effort, optimises use of resources ('network of facilities')
- Provides platform for international leadership
- Offer transnational access to facilities

In previous HYRESSA activities, SWOT and Users Needs Workshop (AM5), the Questionnaire on User Needs (AM6) and also during the Exploratory Workshop (AM7) the building blocks for a hyperspectral research infrastructure have been identified. A next step now is to identify the most appropriate approach to build a hyperspectral research infrastructure also taking into account experience from existing infrastructures as presented during the plenary session (paragraph 3.1). During the working session of the exploratory workshop, two approaches have been presented which have been characterized as the "chain" approach and the" hub" approach. Below these two approaches are shortly elaborated. For future elaboration the best of both

approaches could be adopted to define a European hyperspectral remote sensing research infrastructure.

3.3.1 The chain approach

The chain approach could be characterized as the producer's perspective on the development of a hyperspectral infrastructure. The infrastructure is constructed as a chain of processing steps which are required to get hyperspectral data of a calibrated sensor after acquisition through a processing chain. The resulting data products (level 2 or 3) are distributed to the end-users and archived. In a presentation by José-Antonio Gómez-Sánchez (INTA), a simplified processing chain consists of the following steps:

1. Calibration
2. Flight campaign planning
3. Flight campaign (incl. fieldwork)
4. Data processing to level 2
5. Distribution
6. Archiving

These steps can be elaborated in more detail, but the main direction is the evolution of hyperspectral data from the producer to the end-user.

The chain approach was presented to give a clear view on the existence of protocols and the development of standards for the different steps of the chain. During the discussion of this approach the following points were put forward:

- For several steps extensive experience for campaign planning and data processing is available (DLR, VITO, INTA) and standards have been developed. Also look at experience of JPL with AVIRIS flights.
- Also for fieldwork several sources for protocols are available (NCAVEO, CSTARS, WUR, NERC Field Spectroscopy Facility). This would also require protocols for vicarious calibration (incl. field sites).
- Would a future infrastructure also facilitate the development of toolboxes (e.g., for derivation of level 3 products).
- An essential part of standardization is also the set-up of a glossary to establish a common terminology (Schaepman-Strub *et al.*, 2006). In Germany a protocol is developed (in German) for an imaging spectroscopy processing chain as preparation of future work with ARES and EnMap.
- Instead of reasoning from data acquisition and processing to set standards and uncertainty levels it would also be valuable to reason back from user requirements with respect to applications and products to identify the most important parts of the chain. This could result a product catalogue with optimal calibration and validation settings per product and could also be a driver for sensor development.

3.3.2 The hub approach

The second approach, indicated as the hub approach, can be considered as a user perspective on how a future hyperspectral remote sensing infrastructure could be developed. The hub approach was presented during the exploratory workshop by Tim Malthus (University of Edinburgh) as a way to visualize the different components of the research infrastructure (Figure 2). Every hub is based on an identified user requirement during the different HYRESSA activities. Part of the hubs coincides with the identified steps of the chain approach. However, some of the hubs also have a typical user perspective, e.g., data modelling, data assimilation and education and training.

Recent publications presented at the 5th EARSel Imaging Spectroscopy Workshop in April 2007, Bruges (Belgium) show that in preparation of the upcoming ARES and APEX several European institutes (DLR, VITO, RSL, INTA) have developed central data processing chains (including quality handbooks) for near real time processing of hyperspectral data to level 2 (Biesemans *et al.*, 2007) and level 3 products (Schapfler and Nieke, 2007). This also includes procedures for automated generation of metadata for quality control (Bachman *et al.*, 2007). These developments could result in considerable reduction in time and costs and assure consistency of the processing quality. In addition, the modular construction approach of these facilities offers the re-use and exchange between processing chains. These developments show that for several of the hubs as indicated in Figure 2 knowledge and facilities are operationally available within Europe.

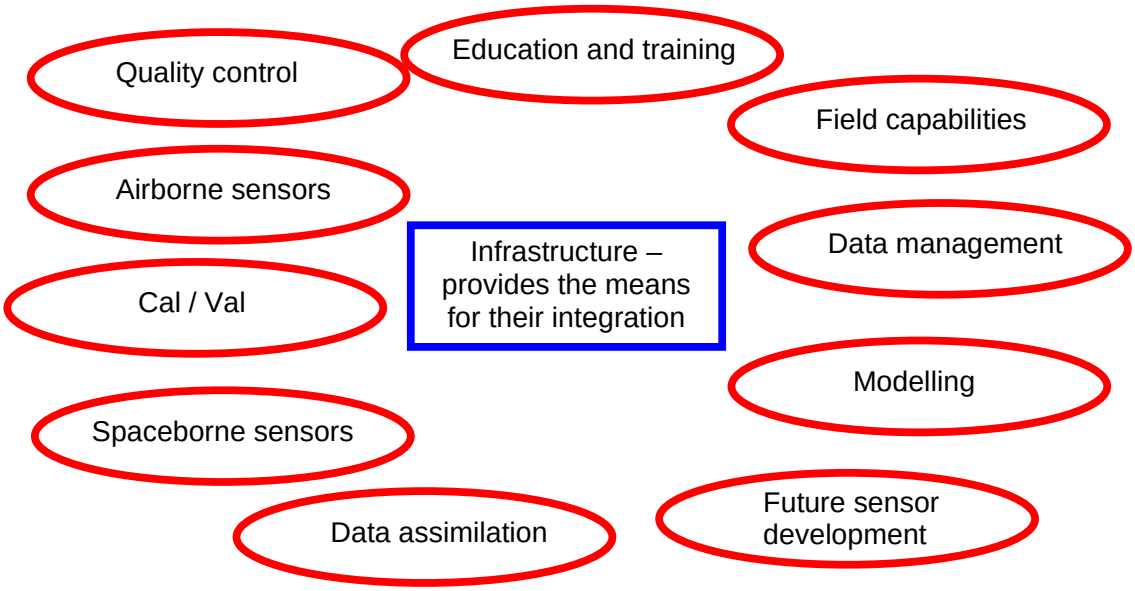

Figure 2: Schematic overview of the different components for a hyperspectral remote sensing research infrastructure according to the hub approach.

3.3.3 Link with EU 7th Framework Programme

Final point of attention is the link of the identified opportunities for a hyperspectral research infrastructure with the requirements of the recently launched 7th Framework Programme of the European Community. During the workshop an overview was given of the latest developments in the FP7 community Research Infrastructure action by EU representative Brigitte Weiss. For details on the content of the presentation we refer to: www.hyressa.net/davos.htm.
Figure 3 gives an overview of the set-up of the FP7 Community Research Infrastructures action. A differentiation is made between existing infrastructures (developed within FP6) and new infrastructures (construction of New Infrastructures is limited limited to projects identified by the European Strategy Forum on Research Infrastructures (ESFRI)). The next relevant call for a continuation of HYRESSA would be the second call for Existing Infrastructures:

- Indicative budget 275 M€ (25-30 projects to be selected)
- Closure spring 2008
- Single stage procedure for evaluation

- No competition within one field of science (in sept. 2007 project managers of HYRESSA and EUFAR will meet to coordinate focus and possible overlap between infrastructures).

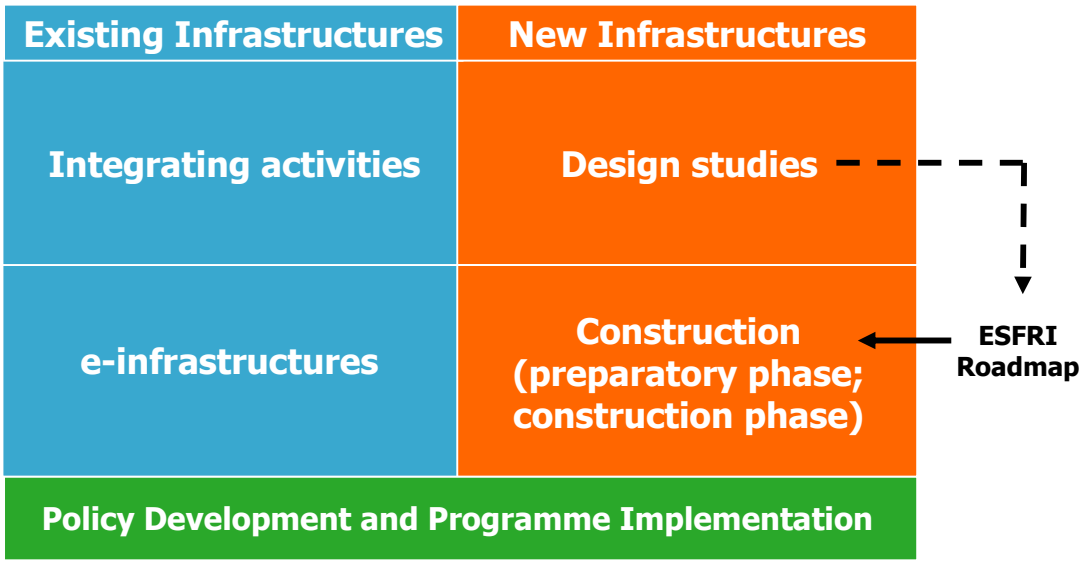

Figure 3: Overview of the set-up of the FP7 Community Research Infrastructures action.

4. Summary

A hyperspectral remote sensing research infrastructure has a unique character related to its relatively long processing chain ranging from sensor development and calibration to the final distribution of derived products to a broad range of specialized users end-users from different application fields (e.g., ecology, limnology, geology).

The proposed European hyperspectral research infrastructure seems to be complementary to already existing infrastructures. However, collaboration with existing infrastructures could result in synergy and optimized use of available facilities and resources. Opportunities have been identified and will be elaborated for the use and access to a fleet of aircrafts (EUFAR) and for central distribution and access to hyperspectral derived data and products (ESA EO User Services).

In addition to the user requirements which were identified in the HYRESSA SWOT and User Needs workshop and the Questionnaire on User Needs, several additional key requirements for a hyperspectral remote sensing infrastructure were identified during the exploratory workshop:

- A high-quality facility for airborne sensor calibration
- Standardized processing facilities (including metadata and quality control)
- Close collaboration with end-users in domain for development of products and for provision of ground measurements for calibration and validation (concept of science teams).
- Central facility for distribution and access to hyperspectral data and derived products
- Facility for calibration of field spectrometers
- Working group on future development

For the further development of a hyperspectral remote sensing research infrastructure, the following aspects need to defined, also indicating explicitly what is *not included* and in what way collaboration is possible with already existing infrastructures:

- Sensors, instruments and facilities
- Spatial-temporal extent
- End-users and application domains
- Products and services
- Standards

As a next step of the HYRESSA project a roadmap for the development of a European hyperspectral remote sensing research infrastructure will be prepared. Within the workshop two possible approaches were presented for building a future infrastructure: a chain approach and a hub approach which could be characterized as the provider and user perspective, respectively. A general motive for this roadmap could be to focus on evolution and not on revolution. This means that as the different experts during the workshop already indicated, optimal use should be made of available knowledge and facilities both on the European and global level. Currently, this is scattered over different locations and not yet used to its full extent. During the workshop, opportunities within the FP7 Community Research Infrastructures action for the development of a hyperspectral remote sensing research infrastructure have been identified.

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Websites:

- http://earth.esrin.esa.it/pub/ESA_DOC/ENVISAT/ENVI87.pdf (4/24/2007) This report describes briefly the ENVISAT mission, the instruments, the Ground Segment and the mission planning constraints, to then focus on the data dissemination methods and the different ways for the users to access the ENVISAT data.
- http://www.cstars.ucdavis.edu/classes/hsgrdtutorial.html: Ground-Truth Data Collection Protocol For Hyperspectral Remote Sensing (Zomer and Ustin, University of California)
- http://www.avignon.inra.fr/valeri/; VALERI: VAlidation of Land European Remote sensing Instruments. (Rosello, Baret *et al*) presented at the CEOS/LPV-VALERI workshop, Davos 2007
- http://www.ceos.org/pages/subs.html#wgcv: CEOS (Committee on Earth Observation Satellites) working group on CAL/VAL

Appendix I – HYRESSA Exploratory Workshop program

Wednesday 14 March 2007

Morning plenary session
Chair: Lammert Kooistra, Wageningen University (NL)

10:20 – 10:40 GEO (Group on Earth Observations) and its Global Earth Observation System of Systems (GEOSS), Michael Rast, Geo Secretariat (CH)
10:40 – 11:00 Plans for the U.S. National Ecological Network -The contribution of remote sensing, Susan Ustin, UC Davis (USA)
11:00 – 11:20 ESA User Services, Stephen Briggs, ESA/ESRIN (I)
11:20 – 11:40 Production and distribution of NASA MODIS Remote Sensing Products, Robert Wolfe, NASA Goddard Flight Centre (USA)
11:40 – 12:00 User-driven requirements of the European Hyperspectral Remote Sensing Community, Jens Nieke, University Zurich (CH)

12:00 – 13:00 Lunch

Afternoon interactive session
Chair: Ils Reusen, VITO (BE)

13:00 – 14:40 HYRESSA Interactive panel discussion
Panel members:
Michael Rast (Geo Secretariat)
Susan Ustin (UC Davis)
Robert Wolfe (NASA Goddard Flight Centre)
Jens Nieke (University Zurich)

19:00 – open HYRESSA dinner

Thursday 15 March 2007

Morning working session

Chair: Michael Schaepman, Wageningen University (NL)

8:15 – 8:30 Welcome and introduction

Part 1: Requirements for acquisition and distribution of hyperspectral images

8:30 – 8:45 The role of protocols and standards in hyperspectral data acquisition and distribution, Jose-Antonio Gomez-Sanchez, INTA (SP)

8:45 – 9:30 Discussion

9:30 – 10:00 Coffee Break

Part 2: Building a European Research Infrastructure

10:00 – 10:15 Opportunities for the development of a European hyperspectral research infrastructure, Tim Malthus, University of Edinburgh (UK)

10:15 – 10:30 Trans-national Access at Equal Terms to national research infrastructures in Europe: The case of research aircraft for environmental studies, Jean-Louis Brenguier (EUFAR Coordinator, METEO France)

10:30 – 11:15 Discussion

11:15 – 11:45 Research Infrastructures in FP7, Dr. Brigitte Weiss (Scientific Officer EU Research Infrastructures)

11:45 – 12:00 Closing remarks and conclusions

12:00 – 13:00 Lunch

13:00 – 17:00 HYRESSA Progress Meeting (HYRESSA project partners)

Appendix II - List of participants

Name	Organisation	Country	E-mail
Martin Bachmann	DLR-DFD German Remote Sensing Data Center	Germany	martin.bachmann@dlr.de
Jean-Louis Brenguier	METEO France	France	jlb@meteo.fr
Stephen Briggs	ESA/ESRIN	Italy	Stephen.Briggs@esa.int
Véronique Carrére	Université de Nantes	France	veronique.carrere@univ-nantes.fr
Mark Danson	University of Salford	United Kingdom	f.m.danson@salford.ac.uk
Eduardo de Miguel	INTA	Spain	demiguel@inta.es
Jose-Antonio Gomez-Sanchez	Instituto Nacional de Tecnica Aeroespacial-INTA	Spain	gomezsj@inta.es
Alemu Gonsamu	University of Helsinki	Finland	alemu.gonsamu@helsinki.fi
Stefanie Holzwarth	German Aerospace Center (DLR)	Germany	stefanie.holzwarth@dlr.de
Klaus Itten	University of Zurich	Switzerland	itten@geo.unizh.ch
Stephane Jacquemoud	University of Paris 7 / IPGP	France	jacquemoud@ipgp.jussieu.fr
Inge Jonckheere	ESF	Belgium	ijonckheere@esf.org
Mathias Kneubühler	University of Zürich	Switzerland	kneub@geo.unizh.ch
Lammert Kooistra	Wageningen University	Netherlands	lammert.kooistra@wur.nl
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Alasdair Mac Arthur	University of Edinburgh	United Kingdom	alasdair.macarthur@ed.ac.uk
Christopher MacLellan	University of Edinburgh	United Kingdom	chris.maclellan@ed.ac.uk
Zbynek Malenovsky	Academy of Sciences of the Czech Republic	Czech Republic	zbynek.malenovsky@gmail.com
Tim Malthus	University of Edinburgh	United Kingdom	tjm@geo.ed.ac.uk
Koen Meuleman	VITO	Belgium	koen.meuleman@vito.be
Matti Mõttus	Tartu Observatory	Estonia	mottus@ut.ee
Jens Nieke	Uni Zurich	Switzerland	nieke@geo.unizh.ch
Petri Pellikka	University of Helsinki	Finland	petri.pellikka@helsinki.fi
Michael Rast	GEO - Group on Earth Observations	Switzerland	mrast@geosec.org
Ils Reusen	VITO	Belgium	ils.reusen@vito.be
Asuncion Riaza	Instituto Geologico y Minero de España	Spain	a.riaza@igme.es
Michael Schaepman	Wageningen University	Netherlands	michael.schaepman@wur.nl
Susan Ustin	University of California, Davis	United States	slustin@ucdavis.edu
Brigitte Weiss	European Commission	Belgium	brigitte.weiss@ec.europa.eu
Robert Wolfe	NASA	United States	rwolfe@pop900.gsfc.nasa.gov

Appendix III - Pictures of HYRESSA Exploratory Workshop

a. 

b. 

c. 

d. 

d. 

e. 

a: Presentation Brigitte Weis Working Session Thursday 15 March 2007
b: Chair Ils Reusen Interactive Session Wednesday 14 March 2007
c: Panel during Interactive Session Wednesday 14 March 2007
d: Participants Working Session Thursday 15 March 2007
e: Participants Working Session Thursday 15 March 2007
f: Presentation Tim Malthus Working Session Thursday 15 March 2007

Appendix IV – Glossary

campaign	realization of several surveys within a given time period
data processing	the radiometric, atmospheric and geometric correction of sensor data
calibration	the process of quantitatively defining the system responses to known, controlled signal inputs.
data provider	any institution offering access to hyperspectral data required over area of interest determined by a user
end-user	anyone interpreting thematic information extracted from hyperspectral data
experienced	anyone in the above fields has more than 10 years of experience or holds a record of more than 10 projects in the respective field
experimental services	access to hyperspectral instruments and/or data for experimental purposes (e.g. Development of methods)
FAPAR	Fraction of Absorbed Photosynthetic Active Radiation
instrument operator	any institution offering access to hyperspectral instruments operated over area of interest determined by a user or a data provider
IS	Imaging Spectroscopy
LAI	Leaf area index
NPP	Net Primary Production
operational services	access to hyperspectral instruments and/or data for operational purposes (e.g. Monitoring applications for governments)
product	thematic information extracted from hyperspectral data, ready to interpret (also called Level 3 product).
protocol	a predefined procedural method in the design and implementation of experiments
research infrastructure	refers to facilities, resources and related services used by the scientific community for leading edge research
standard	a published document which sets out specifications and procedures designed to ensure that a material, product, method or service is fit for its purpose and consistently performs in the way it was intended.
survey	data acquisition over area of interest determined by a user or a data provider
SW developer	anyone providing tools for extracting information from hyperspectral data or/and to alter data in order to facilitate thematic information extraction
temporal coverage	regular data acquisition during a longer period of time (e.g. A survey each year during 10 or more years)
user	anyone generating products (-> products)
validation	the process of assessing, by independent means, the quality of the data products derived from the system outputs
value-adder	anyone altering data in order to facilitate thematic information extraction (e.g. calibration, geo-coding, atmospheric correction)

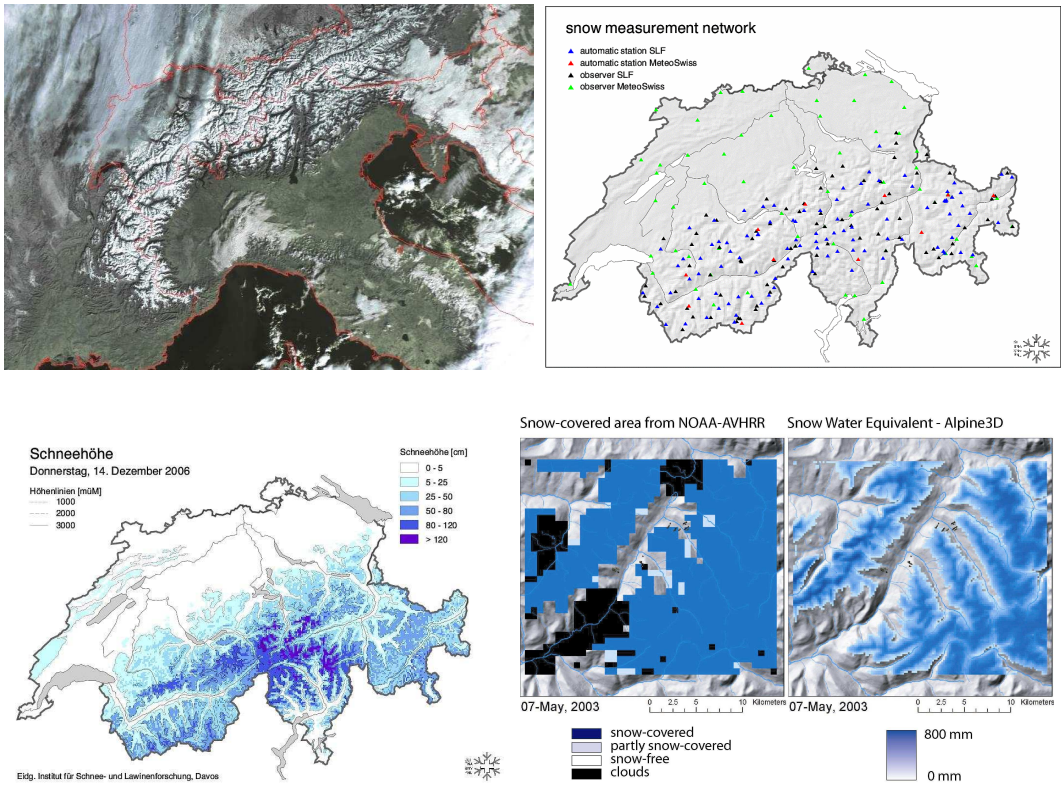
Appendix V – Program ISPMSRS'07 symposium

International Society for Photogrammetry and Remote Sensing (ISPRS)

10th International Symposium on Physical Measurements and Signatures in Remote Sensing

ISPMSRS'07

March 12 – 14, 2007
Davos, Switzerland



In combination with
HYRESSA Exploratory Workshop
March 14 – 15, 2007
CEOS/LPV-VALERI Workshop
March 15, 2007

Content

Introduction

Welcome to the International Symposium on Physical Measurements and Signatures in Remote Sensing (ISPMSRS). This year, it is already the 10th occurrence of this meeting, which is much better known as the 'Spectral Signatures' meeting in the scientific user community. Physical measurements and their spectral signatures remain at the forefront of remote sensing research, and the topic has not suffered from attractivity since the first meeting was held back in 1981 (Intl. Colloquium on Spectral Signatures of Objects in Remote Sensing, Avignon, France).

Gradually and over time, the spectral signatures meeting moved from warmer to colder regions (Bordeaux (F), 1983; Les Arcs (F), 1985), finally arriving in well known ski resorts in France (Aussois 1988, 2001; Courchevel 1991, 1997; Val D'Isère, 1994). The 'French period' of the spectral signatures meetings is closely associated with the name of Gérard Guyot, and we are very grateful that he volunteered to serve as honorary chair for this meeting.

In 2005, the ISPRS WG VII/1 organised the meeting in Beijing and attracted many international visitors and raising the idea to have its today's meeting in Davos. You may conclude that the last two locations where selected in the home countries of the ISPRS WG VII/1 chairpersons origin: we conclude that these locations offer both, an excellent opportunity to exchange scientific ideas and enjoy the diversity of nature, culture and society.

However, we are grateful that you have decided to join this meeting. A meeting structure is usually the most difficult to decide on. For this meeting, we have chosen to organize no parallel sessions and offer you plenty of interaction time with both, young scientists and more experienced senior scientists. This interaction will be possible during the oral presentations, the interactive poster presentations and at the various social events. The goal of this workshop is to exchange state-of-the-art results in spectral signatures research. We hope you will share our goal of this workshop by **actively fostering discussion with at least 3 new scientists you have not met previously**, allowing to strengthen all our networks with new contacts!

Appended to the symposium, you will find smaller workshops organized by the HYRESSA team and the CEOS/LPV-VALERI group. We would like to thank Lammert Kooistra and Frédéric Baret extending the Davos event with their contributions.

Our event in the 'Science City Davos' was only made possible with the significant local support of PMOD/WRC (World Radiation Center), RSL (Remote Sensing Laboratories, Univ. Zürich) and SLF (Swiss Federal Institute for Snow and Avalanche Research).

We would like to take the opportunity to thank our generous sponsors for their support, as well as all the helping hands in the background making this event possible.

We wish you all a fascinating conference and fruitful discussions about the continuously emerging topic of spectral signatures in remote sensing!

Michael Schaepman, Shunlin Liang and Mathias Kneubühler
ISPRS WG VII/1 convenors

Organisation

Programme Committee

Honorary Chair

Gérard Guyot, *former chair of ISPRS WG VII/1*

International Scientific Committee

Michael E. Schaepman, Wageningen University, Wageningen, NL (chair)
Frédéric Baret, INRA, Avignon, F
Mike Barnsley, University of Wales Swansea, UK
Marvin Bauer, University of Minnesota, USA
Jon Atli Benediktsson, University of Iceland, Iceland
Peng Gong, University of California at Berkeley, USA
David Goodenough, Pacific Forestry Centre, Natural Resources, CDN
Klaus I. Itten, RSL, Univ. Zurich, CH
Tom Jackson, USDA/ARS at Beltsville, Maryland, USA
Stéphane Jacquemoud, University of Paris 7 / IPGP, F
David Jupp, CSIRO Earth Observation Centre, Aus
Yann Kerr, CNES/CESBIO, F
Marc Leroy, MEDIAS, F
Philip Lewis, University College London, UK
Xiaowen Li, Beijing Normal University and Institute of Remote Sensing Applications, CN
Shunlin Liang, University of Maryland, USA
John V. Martonchik, Jet Propulsion Laboratory, USA
Ranga Myneni, Boston University, USA
Thomas Painter, University of Colorado, Boulder, USA
Jeff Privette, NOAA, USA
Jon Ranson, NASA/GSFC, USA
Mike Rast, GEO, Geneva, CH
Gabriela Schaepman-Strub, ESA/KNMI/WUR, NL
Werner Schmutz, WRC, Davos, CH
Jose Sobrino, University of Valencia, ES
Karl Staenz, Canada Centre for Remote Sensing, CDN
Alan Strahler, Boston University, USA
Frank Veroustraete, VITO, Mol, B
Charlie Walthall, USDA/ARS at Beltsville, Maryland, USA
Jean-Luc Widlowski, JRC, IES/GEM, Ispra, IT

Local Organising Committee

Mathias Kneubühler, RSL, Univ. Zurich, CH
Truus van den Hoef, CGI, Wageningen University, NL
World Radiation Centre, Davos, CH

Organiser

Working Group VII.1 on 'Fundamental Physics and Modelling' from the International Society for Photogrammetry and Remote Sensing (ISPRS) Technical Commission VII (on Thematic Processing and Analysis of Remotely Sensed Data).

General Information

Venue

The 10th ISPMSRS will consist of *oral presentations* discussing state-of-the-art achievements in one of the symposium topics, as well as an extended *poster session* on emerging issues. There will be no parallel sessions and plenty of room for interaction with scientists.

The symposium will take place in Davos, Switzerland (http://www.davos.ch/), in its modern congress centre (http://www.davos.ch/overview-001-020000-en.htm). The conference will not only be composed of a high quality scientific program, but also on an extended social program, including visits to the World Radiation Centre (http://www.pmodwrc.ch/), the Swiss Federal Institute for Snow and Avalanche Research (http://www.slf.ch/), the ROMC workshop, the 'Remote Sensors on Skis' event (featuring Gabriela Schaepman-Strub (WUR) and Tom Painter (NSIDC)), and a conference dinner.

Davos Congress Center

The Congress Centre is located in the heart of Davos. You enter the Congress Centre through the main entrance located adjacent to the main street of Davos, the 'Promenade'. ISPMSRS'07 is mainly located in the Wing C of the Congress Centre, comprised of the 'Sanada' room (seats 200 persons) as well as the 'Foyer C1' (692 m^2 – for poster exhibition and coffee breaks). You will find appropriate signs everywhere. A Public Wireless LAN hotspot is available for Internet connection through swisscom mobile (Credit card, swisscom Value card, or NATEL payment possibilities (CHF 5.00 30 min. / CHF 19.00 4 hrs / CHF 30.00 1 day (24 hrs))).

Davos Congress
Promenade 67
CH-7270 Davos Platz
phone +41 (0)81 415 21 60
fax +41 (0)81 415 21 69
http://www.davos.ch/wing-c-001-02000103-en.htm

Registration desk / Symposium secretariat

The registration desk is located at the main entrance of the Congress Centre. You may register there any time during the conference. Truus van der Hoef (WUR, NL) will be running the registration desk with the support of students from RSL. The symposium secretariat may be able to help you to organize your stay in Davos and assist you with your needs around the symposium.

Information for presenters

We kindly ask presenters to provide their oral presentations as MS PowerPoint or Adobe PDF file prior to the session to the chairperson listed in the programme. We support USB sticks and drives, as well as CD-ROMs for data transfer.

Information for poster sessions

Posters will be on display during the whole conference period. Please make sure that your poster is hanging on the indicated spot in the Foyer C1 corresponding to reference number given in the programme. Posters of the size A0 (Portrait: 841 mm (w) x 1189 mm (h)) are supported. Poster scheduled for the Interactive poster session I should be on display no later than Tuesday, March 13th 2007, 19:00, poster for the interactive poster session II no later than Wednesday, March 14th 2007, 12:00.

Social Programme

Excursion: Physikalisch-Meteorologisches Observatorium Davos / World Radiation Center – PMOD / WRC

The "Physikalisch-Meteorologisches Observatorium Davos" (PMOD) was founded in 1907 by Carl Dorno as a privately operated institute with the objective to find out why tuberculoses patients were better cured in Davos than elsewhere. The most obvious climatic difference of a station in the Alps compared to one at lower elevations, as e.g. the Baltic sea shore where Dorno originated from, is obviously the radiation environment: the direct solar radiation is much more intense whereas the sky radiance of the dark-blue sky is of lower intensity. With this in mind, Dorno started 1909 operational measurements of the direct solar irradiance, initiating the world's longest and still continuing time series of this kind. Moreover, he started investigating the biologically active ultra-violet radiation - then called Dorno Radiation, what is today UV-B. With his worldwide famous solar and UV radiation measurements he has set the corner-stones for the PMOD which continued his work as an internationally recognized center for research in radiation measurements and instrumentation. Since 1926 PMOD is embedded in the private foundation "Schweizerisches Forschungsinstitut für Hochgebirgsklima und Medizin" (SFI).

In 1971 the PMOD was designated by the World Meteorological Organization (WMO, Geneva) to serve as a *World Radiation Center*. The operation of the WRC was offered by the Swiss government to World Meteorological Organization (WMO, Geneva) as a contribution of Switzerland to the World Weather Watch Program.
A further service was added in 1996 with the operation of the *World Optical depth Research and Calibration Center* (WORCC), a Swiss contribution to the Global Atmosphere Watch of WMO with the following terms of reference:

- Develop accurate radiometric references for spectral solar radiometry used to determine optical depth (as in the case of the World Radiometric Reference for total solar irradiance radiometry);
- Develop procedures to ensure world-wide homogeneity of optical depth measurements by e.g. providing transfer standards for precision filter radiometry (formerly called sunphotometry);
- Develop and test new instrumentation and methods for the determination of optical depth;
- Implement a trial phase at the GAW GLOBAL OBSERVATORIES with Precision Filter Radiometers (PFR) to test methods for optical depth determination and calibration transfer;
- Develop relevant quality control procedures in cooperation with the GAW Quality Assurance/Science Activity Centers;
- Training of operators of Precision Filter Radiometers.

Research Activities

- Development of instruments and calibration procedures for absolute total and spectral solar and long-wave radiometry;
- Investigation of the solar total irradiance, its spectral distribution and variability for global climate research, solar physics and helioseismology (VIRGO Experiment);
- Investigation of the radiation within the atmosphere and at the ground for the determination of its spectral distribution and variability in the UV, for diagnostics of the atmospheric composition and aerosol content as well as for the determination of the surface radiation budget within the ASRB program.

Location of the pmod / wrc in Davos

pmod / wrc
Dorfstrasse 33
CH – 7260 Davos Dorf
Phone +41 81 417 51 11

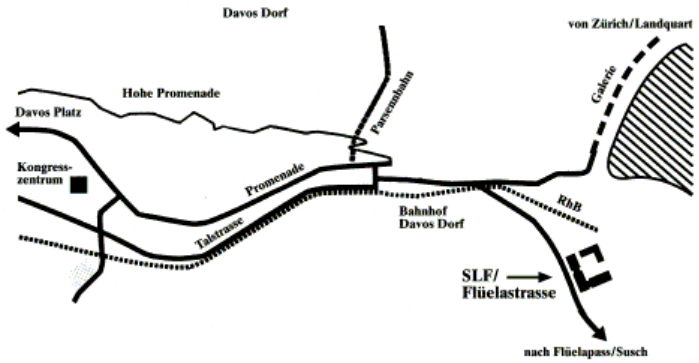
Excursion: Swiss Federal Institute for Snow and Avalanche Research (Davos) – SLF

The Swiss Federal Institute for Forest Snow and Landscape Research (WSL) focuses on the use and protection of landscapes and habitats. Being a part of the ETH domain, the particular function of the research institute is to act as a bridge between pure theoretical science and the practical implementation of scientific findings.

WSL research aims at finding ways to sustainable manage landscapes and forests for maximum benefit to people's quality of life and to handle the natural hazards that typically occur in mountainous countries in the best possible ways for maximum protection at affordable costs. WSL research maintains an international top position and provides the fundamental knowledge for sustainable environmental policies in Switzerland.

In cooperation with partners in the economy, science and society at large, WSL develops strategies to solve problems that are relevant to society. The interdisciplinary and transdisciplinary approach to a research that is problem oriented with a view to practical solutions is a particular strength of WSL. WSL employs around 500 people in Birmensdorf, Davos, Lausanne and Bellinzona and it has a budget of about 65 million Swiss francs.

The SLF is one of the research stations of WSL located in Davos. SLF focuses on research of snow properties and the snowpack as well as avalanche forming and protection.



Location of the SLF in Davos

Eidg. Institut für Schnee und Lawinenforschung (SLF)
Flüelastrasse 11
CH – 7260 Davos Dorf
Phone +41 81 4170 111

Workshop: RAMI On-line Model Checker (ROMC)

The RAMI On-line Model Checker (ROMC) is a web-based tool allowing for the autonomous evaluation of canopy reflectance models against a reference data set established during the third phase of RAMI.

The Radiative transfer Model Intercomparison (RAMI) exercise was first launched in 1999, and then again in 2002 and 2005. RAMI aims at evaluating the performance of canopy reflectance models in absence of any absolute reference truth. It does so by comparing models over a large ensemble of test cases under a variety of spectral and illumination conditions. A series of criteria can be applied to select an ensemble of mutually agreeing 3-D Monte Carlo models to provide a surrogate truth against which all other models can then be compared.

The RAMI Online model checker (ROMC) automates this process by allowing both model developers and users to evaluate the performance of their canopy reflectance models a) against previous RAMI test cases (whose results have already been published in the literature), and b) against test cases that are similar to the RAMI cases, but for which no results will be known a priori. As such the ROMC allows models to be "debugged" and/or "validated" autonomously on a limited number of test cases.

ROMC-certified graphics that document a model's performance can be downloaded for future use in scientific presentations and/or publications.

The workshop will take place in the Café Chamonix in the Congress Centre and the instructor is J.-L. Widlowski (JRC, I).

Event: Skiing

The remote sensors on skis event is taking place in the Parsenn skiing area (http://www.parsenn.ch/?lang=en) in Davos - on some of the oldest skiing slopes of Switzerland. The cable car starts from Promenade 157, Davos Dorf (see Davos City Map, square M2, No. 157), at 5 min bus riding distance (about 15-20 min walking distance) from the congress centre.

All involved costs (lift ticket, rent of skiing equipment) have to be covered by the participants (self pay). The participation at this event is on your own risk (but we will of course stay on the safe prepared runs all time and highly recommend following this rule also when you are skiing on your own)!

Meeting point and time

We meet on March 12 at 13.30 in front of the Parsenn railway (in skiing gear), Promenade 157 Davos Dorf, from where we will guide you to the remote sensors on skis contest. You are then free to ski as long as you wish, last possible descent from Weissfluhjoch is at 17.00, the ISPRMSRS'07 reception will start at 19.00 in the Congress Centre. On March13, we meet at the same time (13.30) in the same place (Parsenn railway (in skiing gear), Promenade 157 Davos Dorf). You are then free to ski as long as you wish, last possible descent from Weissfluhjoch is again at 17.00, the ISPRMSRS conference dinner starts at 18.00.

Ticket for lifts

Afternoon tickets (valid from 1pm) for the Parsenn skiing area (incl. Parsenn railway) are available for 42 SFR (28 Euros). All participants meeting at 13.30 in front of the Parsenn railway (Monday or Tuesday, respectively) will profit from a price reduction on their tickets of 10%.

Skiing gear

Lockers for people bringing their own skis are available at the Congress Centre (you will need a CHF 2.00 coin to operate them).

The skiing equipment needs to be arranged individually, before the meeting time (13.30) in front of the Parsenn railway. The rental services confirmed that they have enough skiing gear and that reservations can directly be done once you arrive in Davos. We provide some addresses for ski rentals located in the proximity of the Parsenn railway:

Ettinger Sport Davos Dorf (just West of the Parsenn railway)
Promenade 153
7260 Davos Dorf
+41 (0)81 410 12 12
http://www.ettinger.ch/rent_en.html

Paarsennsport (just East of the Parsenn railway)
Promenade 159
7260 Davos Dorf
+41 (0)81 410 10 10
http://www.paarsennsport.ch/

Sportgeschäft Peter Frei (2 minutes walking distance from the Parsenn railway)
Dorfstrasse 5
7260 Davos Dorf
+41 (0)81 416 26 36

Price indications (prices seem to be per day, so you could rent the evening before and have the gear stored in the shop or the Congress Centre. If you are renting 2 consecutive days, you need to indicate this on the first day and will get a lower price for the second day. Indicative (but not binding) prices are approximately:

Skis, incl. pols (Category competition – CHF 50, allrounder – CHF 38, beginner – CHF 28)
Ski shoes CHF 19/pair
Ski clothes - jacket CHF 19, trouser CHF 19

Davos Weather

Davos is located at an altitude of 1590 m.a.s.l. (46.78 N; 9.85 E). For the month of March, you may expect monthly averaged minimum temperatures of -8.5 deg C, a mean of -3.3 deg C and a max. of 2.5 deg C. The mean humidity is 73.5 % and the precipitation 61 mm (data from 2006). It is advisable to dress warm and you must expect (partly heavy) snowfall at any time.

Overall Programme

Monday, March 12th 2007

Time	Title	Location
08:00 – 09:00	Registration	Aspen
09:00 – 10:00	Opening and welcome by the organizers	Sanada 1/2
10:00 – 10:30	Plenary Session	Sanada 1/2
10:30 – 11:00	Coffee Break	Foyer C1
11:00 – 12:00	Plenary Session II	Sanada 1/2
12:00 – 14:00	Time for individual lunch	Participants choice
14:00 – 17:00	Social Programme	WRC / SLF / Café Chamonix / Ski slopes
17:00 – 19:00	Time for individual dinner	Participants choice
19:00 – 20:00	Welcome Reception	Foyer C1
20:00 – 21:20	Oral Session	Sanada 1/2

Tuesday, March 13th 2007

Time	Title	Location
08:00 – 08:30	Registration	Aspen
08:30 – 10:00	Oral Session	Sanada 1/2
10:00 – 10:30	Coffee Break	Foyer C1
10:30 – 12:20	Oral Session	Sanada 1/2
12:20 – 14:00	Lunch	Participants choice
14:00 – 18:00	Social Programme	WRC / SLF / Café Chamonix / Ski slopes
14:00 – 18:00	Posters on display	Foyer C1
18:00 – 20:00	Conference dinner	Aspen
20:00 – 21:30	Interactive Poster Session I	Foyer C1

Wednesday, March 14th 2007

Time	Title	Location
08:00 – 08:30	Registration	Aspen
08:30 – 09:50	Oral Session	Sanada 1/2
09:50 – 10:20	Coffee Break	Foyer C1
10:20 – 12:00	Oral Session (HYRESSA)	Sanada 1/2
12:00 – 13:00	Luncheon and posters	Aspen
13:00 – 14:40	Interactive Poster Session II	Foyer C1
13:00 – 14:40	HYRESSA Round table	Sanada 1/2
14:40 – 15:00	Coffee Break	Foyer C1
15:00 – 16:20	Oral Session	Sanada 1/2
16:20 – 17:00	Closing Session	Sanada 1/2

Thursday, March 15th 2007

Time	Title	Location
08:00 – 12:00	**HYRESSA Workshop**	Central Sporthotel, Davos Vetschstube
12:00 – 13:00	Business Lunch	
13:00 – 17:00	**HYRESSA Progress Meeting**	

Time	Title	Location
09:00 – 18:00	**LAI and fAPAR validation under CEOS/LPV-VALERI**	Morosani Post Hotel, Davos

	Workshop		

Detailed Programme

Monday, March 12th 2007

Time	Title	Speaker	Ref.
08:00 – 09:00	**Registration and Opening**		
09:00 – 09:15	Opening and welcome by the organizers	Michael Schaepman and Shunlin Liang *Chairs ISPRS WG VII/1*	
09:15 – 09:30	Welcome by ISPRS	Andrew Skidmore *ITC (NL); Vice-President ISPRS Commission VII*	
09:30 – 09:45	Welcome by Science City Davos – Cutting edge research in a remote place	Britta Allgöwer *Managing Director Science City Davos*	
09:45 – 10:00	Organization ISPMSRS'07	Mathias Kneubühler *Secretary ISPRS WG VII/1*	
	Introduction plenary session	Chair: Klaus Itten *Univ. Zürich (CH)*	
10:00 – 10:30	The Changing Earth	Stephen Briggs *ESA/ESRIN (I), Head, Earth Observation Science, Applications and Future Technologies Department*	T1
10:30 – 11:00	Coffee Break	Offered	
11:00 – 11:20	Evolution of research orientation in the domain of spectral signatures	Gérard Guyot *Founder 'Spectral Signatures Conferences'*	T2
11:20 – 11:40	Space experiments of PMOD/WRC to measure the solar constant and the influence of the solar irradiance on the terrestrial climate	Werner Schmutz *Director PMOD/WRC (CH)*	T3
11:40 – 12:00	The VENμS mission: Earth Observation with High Spatial and Temporal Resolution Capabilities	Gérard Dedieu *CNES (F)*	T4 605
12:00 – 14:00	Time for individual lunch	Not offered	
14:00 – 18:00	Social Programme	Details see Programme	
18:00 – 19:00	Time for individual dinner	Not offered	
19:00 – 20:00	Welcome Reception	Michael Schaepman, Shunlin Liang	
	Surface and atmospheric anisotropy	Chair: Johannes Keller *PSI (CH)*	
20:00 – 20:20	A generic aerosol-surface reflectance retrieval algorithm for MODIS	Alexei Lyapustin *NASA GSFC (USA)*	T5 611
20:20 – 20:40	Atmospheric Correction of Airborne POLDER Polarimetric Imagery Using Vectorized 6S	Christoph Borel *Ball Aerospace (USA)*	T6 712
20:40 – 21:00	CYCLOPES prototype V4 LAI, fAPAR and fCover products derived from VEGETATION and AVHRR sensors: description and validation	Frédéric Baret *INRA (F)*	T7 702
21:00 – 21:20	MERIS land surface BRDF/albedo retrieval using data fusion with MODIS BRDF and its validation	Jan-Peter Muller *Univ. College London (UK)*	T8 661

Tuesday, March 13th 2007

Time	Title	Speaker	Ref.
08:00 – 08:30	Registration		
	Model Access and Data Assimilation	Chair: Gabriela Schaepman-Strub *ESA External Fellow (WUR, KNMI) (NL)*	
08:30 – 09:00	The RAMI On-line Model Checker (ROMC)	Jean-Luc Widlowski *JRC (I)*	T9 628
09:00 – 09:20	A Framework of a Remote Sensing Data Assimilation System	Shunlin Liang *Univ. Maryland (USA)*	T10 723
09:20 – 09:40	Assimilating reflectance data into a ecosystem model to improve estimates of terrestrial carbon flux.	Tristan Quaife *Centre for Terrestrial Carbon Dynamics (UK)*	T11 624
09:40 – 10:00	Preparing for the assimilation of remote sensing products by climate models	Bernard Pinty *JRC (I)*	T12 617
10:00 – 10:30	Coffee Break		
	LOP and Canopy Modelling	Chair: Stéphane Jacquemoud *Univ. De Paris 7 (F)*	
10:30 – 11:00	A Leaf Optical Properties Model Accounting for Differences between The Two Faces	Kai Ma *INRA (F)*	T13 708
11:00 – 11:20	Modelling Canopy reflectance with spectral invariants	Philip Lewis *Univ. College London (UK)*	T14 625
11:20 – 11:40	Approximating photon recollision probability in vegetation canopies	Matti Mõttus *Tartu Observatory (EST)*	T16 527
11:40 – 12:00	Spectral invariant behaviour of a complex 3D forest canopy	Mathias Disney *Univ. College London (UK)*	T15 630
12:00 – 12:20	Retrieval of Coniferous Canopy Chlorophyll Content from High Spatial Resolution Hyperspectral Data	Zbyněk Malenovský *ISBE (Cz)*	T17 608
12:20 – 14:00	Lunch	Not offered	
14:00 – 18:00	Social Programme	Details see programme	
14:00 – 18:00	Posters on display	Details see programme	
18:00 – 20:00	Conference dinner	Michael Schaepman, Shunlin Liang	
	Interactive Poster Session I	Chair: Matti Mõttus *Tartu Observatory (EST)*	
20:00 – 21:30	Interactive Poster Session I	Details see programme	P1-P48

Interactive Poster Session I

Tuesday, March 13th 2007, 20:00 – 21:30

Topic	Title	Presenter	Poster/ID
	Interactive Poster Session I	Chair: Matti Mõttus *Tartu Observatory (EST)*	
Interactive Poster Session I	Normalization of microwave time series observations (1979 - 2005) : surface melting and temperature analysis	Alain Royer (contact), Ghislain Picard, Michel Fily	P1 / 461
	Intercalibration of Vegetation Indices - an Update	Michael STEVEN (contact), Timothy MALTHUS, Frédéric BARET	P2 / 525
	Space-Time Series of MODIS Snow Cover Products for Hydrologic Science	Jeff Dozier, Thomas Painter (contact), James Frew	P3 / 263
	Pyrite mine wastes monitoring with hyperspectral data as a tool to detect climate change	Asuncion Riaza (contact), Cindy Ong, Andreas Mueller	P4 / 520
	Using Reflectance Spectroscopy for Monitoring Settled Dust in an Indoor Environment	Eyal Ben-Dor (contact), Sandra Chudnovski	P5 / 220
	Multitemporal Unmixing of MERIS FR Data	Raul Zurita-Milla (contact), Luis Gomez-Chova, Jan Clevers, Michael Schaepman, Gustavo Camps-Valls	P6 / 561
	A New Multitemporal Classification Approach for Land Cover Mapping in Iran,by Using Hyperspectral Modis Data	Abdolreza Ansari Amoli (contact), Abbass Alimohammadi	P7 / 636
	Classification of multispectral ASTER imagery in the archaeological survey for settlement sites of the Near Ea	Bjoern Menze (contact), Jason Ur	P8 / 644
	Spatio-temporal modelling of grassland degradation and small mammal distributions using MODIS NDVI time-series	Christopher Marston (contact), Richard Armitage, Mark Danson, Alberto Ramirez, Phillip Craig	P9 / 564
	Web-based model for analysis of time series remotely sensed data	Alberto Ramirez (contact), Richard Armitage, Mark Danson, Christopher Marston, Ebenezer Ogunbadewa, Marta Yebra	P10 / 638
	Comparison of Feature Selection Techniques for SVM Classification	Anthony Gidudu (contact), Heinz Ruther	P11 / 524
	Canopy Water Content Retrieval from Hyperspectral Remote Sensing	Jan Clevers (contact), Lammert Kooistra, Michael Schaepman	P12 / 707
	Development of an inversion code, ICARE, able to extract urban areas ground reflectances	Sophie Lachérade (contact), Christophe Miesch, Didier Boldo, Xavier Briottet, Christophe Valorge, Hervé Le Men	P13 / 341
	Reflectance Retrieval in Shade using Adjoint Radiosity	Christoph Borel (contact)	P14 / 710
	Retrieval of aerosol optical depth using multi-date and constant viewing angle images from Formosat2 and VENµS	Olivier Hagolle (contact), Gérard Dedieu, Vincent Debaecker	P15 / 607
	Estimating vegetation parameters of cereals using an ASTER 1A image	Sánchez Nilda (contact), González Raúl, Martínez-Fernández José, Prado Jesús	P16 / 120
	Mapping chlorophyll-a in Swiss lakes with MERIS data	Daniel Odermatt (contact), Jens Nieke, Mathias Kneubühler, Klaus Itten	P17 / 663

Anomaly detection algorithms for hyperspectral imagery	Seyyed Reza Soofbaf (contact), Hamed Fahimnejd, Mohamad Javad Valadan Zoej, Barat Mojaradi	P18 / 716
Determining the Directional Response and Field of View of Two Field Spectroradiometers	Alasdair Mac Arthur (contact)	P19 / 482
The effect of noise in AHS thermal bands in the retrieval of pixel temperature	Eduardo de Miguel (contact), Rafael Garcia, Alix Fernandez-Renau	P20 / 521
Hyperspectral image filtering and implications for environmental spectra related to mining contamination: exam	Lídia Quental (contact), António Sousa, Stuart Marsh	P21 / 563
Preprocessing EO-1 Hyperion hyperspectral data	Hamed Fahimnejad (contact), Seyyed Reza soofbaf, Abbas Alimohammadi, Mohammad Javad Valadan zoej	P22 / 602
Tomographic SAR imaging of forested areas by time-domain back-projection processing	Othmar Frey (contact), Felix Morsdorf, Erich Meier	P23 / 760
Assimilation of snow depth maps for improved runoff nowcasting	Massimiliano Zappa (contact), Annina Morger, Tobias Jonas, Andreas Stoffel, Nando Foppa	P24 / 612
Intercomparison between modelled and satellite-derived snow cover extent within the alpine and subalpine zone	Nando Foppa *meteo swiss (CH)*	P25 / 484
Modeling microwave brightness temperature in Antarctica.	Ghislain Picard (contact), Ludovic Brucker, Michel Fily	P26 / 526
Regional mapping of plant functional types in river floodplain ecosystems using airborne imaging spectroscopy	Lammert Kooistra (contact), Wieger Wamelink, Han Van Dobben, Michael Schaepman	P27 / 603
Crop model data assimilation with the Ensemble Kalman filter for improving regional crop yield forecasts	Allard de Wit (contact), Kees van Diepen	P28 / 662
Fusion of Imaging Spectrometer and LIDAR data using Support Vector Machines for land cover classification	Benjamin Koetz (contact), Felix Morsdorf, Thomas Curt, Sebastian Schiefer, Laurent Borgniet, Daniel Odermatt, Samuel Alleaume, Corinne Lampin, Marielle Jappiot, Britta Allgöwer	P29 / 622
The relevance and use of Atmospheric Data Access for the Geospatial User Community (ADAGUC)	Michael Schaepman (contact), Marc Hoogerwerf, John van der Vegte, Frans van der Wel, Wim Som de Cerff, Richard van Hees, Ben Domenico, Stefano Nativi, Olga Wilhelmi	P30 / 820
Spectral Linear Mixing Model for Endmember Extraction Using High Spatial Resolution and Hyperspectral Data	Yuan Zeng (contact), Michael E. Schaepman, Bingfang Wu, Jan G.P.W. Clevers, Arnold K. Bregt	P31 / 440
Seasonal comparison of carbon flux estimates from C-TESSEL model and Moderate Resolution Imaging Spectroradiometer (MODIS) over several biomes	Li Jia (contact), Voogt, M.H., Jacobs, C.M.J., Van den Hurk, B.J.J.M., De Wit, A., Moors, E.	P32 / 860
Combination of Raman Lidar and Microwave Radiometer Sensed Water Vapour Data	Marc Schneebeli (contact), Ulla Wandinger, Ina Matthis, Emmanuel Brocard, Christian Mätzler	P33 / 533
Abilities of DEMETER Satellite in Observation of Physical	Aida Omani (contact),	P34 / 404

Signatures Perturbation of Ionosphere Associated ...	Mohammad Reza Saradjian	
Albedo Assessment and Evaluation over Arctic Siberian Tundra	Gabriela Schaepman-Strub (contact), Martin Claverie, Thomas Painter, Michael Schaepman	P35 / 720
Environmental change detection in mire ecosystems: Assessing tree growth and shrub encroachment using LiDAR da	Lars Waser (contact), Manos Baltsavias, Henri Eisenbeiss, Armin Gruen, Meinrad Küchler, Patrick Thee	P36 / 560
Towards Near-real Time Global Flood Detection System	Zsofia Kugler (contact), Tom De Groeve}, G. Robert Brakenridge, Thierry Benoist	P37 / 402
Application to MISR land BRFs of the RPV model inversion package to assess environmental patterns	Thomas Lavergne (contact), Thomas Kaminski, Bernard Pinty, Malcolm Taberner, Nadine Gobron, Michel Verstraete, Michael Vossbeck, Jean-Luc Widlowski, Ralf Giering, Ophelie Aussedat	P38 / 618
Validation of remote sensing NDVI time series with ground based measurements from the automated climate station network IMIS	Fabio Fontana (contact), Christian Rixen, Tobias Jonas, Stefan Wunderle	P39 / 640
Towards Global Mapping of Irrigated Agriculture	Mutlu Ozdogan, Garik Gutman (contact)	P40 / 140
Classification of Tree and Shrub Species in KSU Research and Application Forest in Kahramanmaras, Turkey	Abdullah Emin Akay (contact), Ismail Rakip Karas, Recep Gundogan	P41 / 480
A completely automatic spectral rule-based preliminary classification of calibrated Landsat TM and ETM+ images	Andrea Baraldi (contact), Dario Simonetti, Virginia Puzzolo, Stefano Natali	P42 / 562
Alternative application of the k-NN method for mapping forest cover type	Caterina Gagliano (contact), Flora De Natale, Francesca Incerti, Fabio Maselli	P43 / 610
Shadowed Feature Classification in Hyperspectral Images	S.Mohammad Shahrokhy (contact)	P44 / 180
Radiative Transfer Model Inversion Based on Multi-temporal CHRIS/PROBA Data for LAI Estimation	Benjamin Koetz (contact), Mathias Kneubühler, Sylvia Huber, Jürg Schopfer, Frédéric Baret	P45 / 621
Topsoil Mapping Using Hyperspectral Sensing	Thomas Selige (contact), Urs Schmidhalter, Jürgen Böhner	P46 / 724
Application of High-Resolution Thermal Infrared Remote Sensing to assess Land Surface Temperature and Emissivi	JOSÉ A. SOBRINO (contact), J. C. JIMENEZ-MU▽OZ, M. GOMEZ, A. BARELLA-ORTIZ, G. SORIA, Y. JULIEN, M.M. ZARAGOZA-IVORRA, J. A. GÓMEZ, E. de MIGUEL, M. JIMENEZ, B. SU, W. TIMMERMANS, J. MORENO, L. GUANTER, R. BIANCHI	P47 / 627
PAR@METER: a Wireless System for fAPAR and LAI Continuous Monitoring	Frédéric Baret (contact), Georges Billard, Olivier Marloie, Anne Labouret	P48 / 701

Wednesday, March 14th 2007

Time	Title	Speaker	Ref.
	Cold regions and snow	Chair: Petri Pellikka *Univ. Helsinki (Fin)*	
08:30 – 08:50	Circumpolar assessment of the relationship between infrared vegetation indices and leaf area index in forest	Richard Fernandes *Natural Resources (CDN)*	T18 643
08:50 – 09:10	Stochastic radiative transfer model for mixture of discontinuous vegetation canopies	Nikolay Shabanov *Boston University (USA)*	T19
09:10 – 09:30	Assimilation of MODIS snow data in a detailed model of Alpine snow dynamics and snow hydrology	Henning Löwe *SLF (CH)*	T20 641
09:30 – 09:50	Space-Time Series of MODIS Fractional Snow Cover Products	Thomas Painter *NSIDC (USA)*	T21 262
09:50 – 10:20	Coffee Break		
	HYRESSA	Chair: Lammert Kooistra *Wageningen UR (NL)*	
10:20 – 10:40	GEO (Group on Earth Observations) and its Global Earth Observation System of Systems (GEOSS)	Michael Rast *GEO Secretariat (CH)*	T22 H1
10:40 – 11:00	Plans for the U.S. National Ecological Network:-The contribution of remote sensing	Susan Ustin *UC Davis (USA)*	T23 H2
11:00 – 11:20	ESA Earth Observation User Services	Stephen Briggs, *ESA/ESRIN(I)*	T24/H3
11:20 – 11:40	Production and distribution of NASA MODIS Remote Sensing Products	Robert Wolfe *NASA GSFC (USA)*	T25 H4
11:40 – 12:00	User-driven requirements of the European Hyperspectral Remote Sensing Community	Jens Nieke *Univ. Zürich (CH)*	T26 705
12:00 – 13:00	Luncheon and posters	Offered	
	Interactive Poster Session II	Chair: Zbyněk Malenovský *ISBE (Cz)*	
13:00 – 14:40	Interactive Poster Session II		P49 – P97
	HYRESSA Round Table	Chair: Ils Reusen, *VITO (B)*	
13:00 – 14:40	HYRESSA Round table	Ils Reusen, *VITO (B)*	
14:40 – 15:00	Coffee Break		
	Advanced Applications and LIDAR	Chair: Jon Ranson *NASA/GSFC (USA)*	
15:00 – 15:20	A Bayesian optimisation approach for model inversion of hyperspectral-multidirectional observations: the balance with *a priori* information	Wout Verhoef *NLR (NL)*	T27 241
15:20 – 15:40	Three-dimensional forest canopy architecture from terrestrial laser scanning	Mark Danson *Univ. Salford (UK)*	T28 642
15:40 – 16:00	Modeling of small footprint airborne laser scanning returns using ray-tracing and L-systems	Felix Morsdorf *Univ. Zurich (CH)*	T29 725
16:00 – 16:20	Forest Vertical Structure and Biomass Estimation from GLAS Data	Jon Ranson *NASA GSFC (USA)*	T30 718
	Closing Session	Chair: Andrew Skidmore *ITC (NL)*	
16:20 – 17:00	Closing Session	Michael Schaepman, Shunlin Liang *Chairs ISPRS WG VII/1*	

Interactive Poster Session II

Wednesday, March 14th 2007, 13:00 – 14:40

Topic	Title	Presenter	Poster/ID
	Interactive Poster Session II	Chair: Zbyněk Malenovský *ISBE (Cz)*	
Interactive Poster Session II	Angular Unmixing of Photosynthetic and Non-Photosynthetic Vegetation within a Coniferous Forest Using CHRIS-PROBA	Jochem Verrelst (contact), Raul Zurita-Milla, Benjamin Koetz, Michael Schaepman	P49 / 522
	A Study of Surface Directional Shapes Using MISR	John Martonchik (contact), Michael Bull, Van Dang	P50 / 520
	Modelling reflectance of urban chestnut trees: A sensitivity analysis of model inversion for single trees	Alexander Damm (contact), Patrick Hostert	P51 / 523
	CYCLOPES Prototype V4 LAI, fAPAR and fCover Products Derived from VEGETATION and AVHRR Sensors: Description and Validation	Frédéric Baret (contact), Marie Weiss, Patrice Bicheron, Roselyne Lacaze, Marc Leroy	P52 / 702
	Large Seasonal Swings in Leaf Area of Amazon Rainforests	Ranga Myneni *Boston Univ. (USA)*	P53 / 629
	Plant biochemical maps of forage quality	Andrew Skidmore (contact), Jelle Ferwerda, Onisimo Mutanga, Sipke van Wieren, Mike Peel, Rina Grant, Herbert Prins	P54 / 540
	Airborne Hyperspectral Scanner (AHS) Spectral Emissivity Retrieval in 8-13 µm	Marcos Jiménez (contact), Eduardo de Miguel, José A. Gómez, José A. Sobrino, Juan C. Jiménez-Muñoz, Javier Chico, Elena Prado, Cristina Robles	P55 / 613
	Physical modelling of camera RGB responses for application in non-destructive leaf chlorophyll imaging	Frank Veroustraete (contact), Willem W. Verstraeten, Koen Hufkens, Bert Gielen, Filip Colson	P56 / 660
	Simulation studies of the effect of forest spatial structure on InSAR signature	Guoqing Sun, Dawei Liu, Jon Ranson (contact), Benjamin Koetz	P57 / 719
	Correction of Altitude Effects in Measurements of the Depth of A and B Atmospheric Oxygen Absorption Bands.	Fabrice Daumard (contact), Yves Goulas, Abderrahmane Ounis, Roberto Pedros, Ismael Moya	P58 / 722
	Polarization of light from leaves measured from 0.5 - 1.6 um	V.C. Vanderbilt (contact), S.L. Ustin, C.S.T. Daughtry, J.A. Greenberg	P59 / 713
	Using Monte-Carlo ray tracing to investigate the measurement of forest parameters with the Echidna¿ laser scanner	Steven Hancock (contact), Philip Lewis, Jan-Peter Muller, Mathias Disney	P60 / 706
	A biophotonic physiological plants sensor (Field radiometer for canopy remote sensing)	J.P. Frangi, Stephane Jacquemoud, G. de Rosny, Elian Conejo (contact)	P61 / 840
	Influence of Local Incidence Angle Effects on Ground Cover Estimates	Martin Bachmann (contact), Stefanie Holzwarth, Andreas Müller	P62 / 616
	Simulating canopy gap fraction of complex forest scenes	Marion Pfeifer, Mathias Disney (contact), Philip Lewis	P63 / 632

	Comparing three canopy reflectance models with hyperspectral multi-angular satellite data	Martin Schlerf (contact), Wout Verhoef, Joachim Hill, Henning Buddenbaum, Clement Atzberger, Andrew Skidmore	P64 / 340
	Forest Reflectance Modeling in the Arctic Region: Results from a Case Study in Finland	Miina Rautiainen (contact), Pauline Stenberg, Terhikki Manninen, Matti Mõttus, Pekka Voipio	P65 / 342
	Simultaneous Retrieval of Aerosol and Surface Optical Properties using Multi-angle Imaging SpectroRadiometer	Johannes Keller (contact), Andre Prevot, Stephan Bojinski	P66 / 500
	An advanced leaf optical properties model including photosynthetic pigments	Jean-Baptiste FERET (contact), Greg ASNER, Christophe FRANCOIS, Roberta MARTIN, Susan USTIN, Stephane JACQUEMOUD	P67 / 541
	The Role of Image Properties in Determining Change Detection Accuracy	Timothy Warner (contact), Abdullah Almutairi, David Campagna, M. Duane Nellis	P68 / 711
	Contact spectroscopy for determination of stratigraphy of snow optical grain size	Thomas Painter (contact), Noah Molotch, Maureen Cassidy, Mark Flanner, Konrad Steffen	P69 / 261
	A Method for Measuring the Permittivity of Artificial Frozen Soil Using Network Analyzer	Shaojie Zhao (contact), Lixin Zhang, Liying Li	P70 / 531
	Estimating Clear-Sky Land Surface Longwave Radiation Budget from MODIS Data	Wenhui Wang (contact), Shunlin Liang	P71 / 680
	Soil Moisture Experiments 2005: Passive Microwave Polarimetric Signatures of Soil Moisture and Vegetation	Thomas Jackson (contact)	P72 / 160
	Reference Spectrometry for Calibration of Optical Earth Observation Systems	Saber Salim (contact), Nigel Fox, Emma Woolliams, Rainer Winkler, Heather Pegrum, Tong Sun, Ken Grattan	P73 / 300
	Implementation of of Biophysical Factors into the land surface and atmosphere interaction model	Venkat Lakshmi (contact), Bryan Hong, Fei Chen, Eric Small	P74 / 100
	Estimation of forest stand parameters in density classes in arid and semi-arid regions using Landsat ETM+ data	Farzin Naseri (contact), Ali A. Darvishsefat, Hooshang Sobhani, Manuchehr Namiranian	P75 / 240
	The Use of Spectral Signatures in Extracting Information from Water Quality Parameters in the Lake Urmia, IRAN	Seyd Kazem Alavipanah, Reza Amiri (contact), Kamal Khodaei	P76 / 260
	Characterizing Soil Salinity and Sodicity in Irrigated Agricultural Land Using Ground-Based Reflectance	Abdou Bannari (contact), Anne-Marie Guedon, Abderrazak El-Harti, Mohammed Frahi	P77 / 281
	Quantitative Assessment of Soil Parameters in Western Tajikistan using a Soil Spectral Library Approach	Bruno Seiler (contact), Mathias Kneubühler, Bettina Wolfgramm, K.I. Itten	P78 / 528
	Leaf Area Index estimates obtained for mixed forest using hemispherical photography and HyMap data	Anja Visscher von Arx (contact), Silvia Huber, Mathias Kneubuehler, Klaus I. Itten	P79 / 600
	Estimating Nitrogen Concentration from Directional CHRIS/PROBA Data	Silvia Huber (contact), Mathias Kneubühler, Benjamin Koetz, Jürg T. Schopfer, Niklaus E. Zimmermann, Klaus I. Itten	P80 / 601

	Airborne Hyperspectral Scanner (AHS) a priori Mapping Capacity for the Doñana Biological Reserve Shrublands	Marcos Jiménez (contact), Ricardo Díaz-Delgado, Patrick Vaughan, Alix Fernández Renau, Oscar Gutiérrez de la Cámara, Elena Prado	P81 / 614
	Elucidating the interaction of plants in the carbon dioxide cycle using airborne hyperspectral reflectance measurements	Michael Eiden (contact), Sebastian Schiefer, Jan Schween, Christoph Gerbig, Bruno Neininger, Olivier Traullé, Heiner Geiss, Uwe Rascher	P82 / 619
	Spatial variability of the spectral properties of forest structures over the Amazon	Liana Anderson (contact), Yadvinder Malhi, Luiz Aragao, Yosio Shimabukuro	P83 / 635
	Hyperspectral Remote Sensing for Seasonal Estimation of Aboveground Biomass in Swiss Grassland Habitats	Achilleas Psomas (contact), Mathias Kneübhler, Klaus Itten, Niklaus Zimmermann	P84 / 639
	Estimation of Surface Shortwave Radiation Budget from MODIS data	Hye-Yun Kim (contact), Shunlin Liang	P85 / 703
	Effect of Cultivar Specificities on The Radiometric Response: Quantification and Consequences for Biophysical Variables Estimation in Wheat Crops	Kai MA (contact), Frédéric Baret, Guillaume Jubelin, Phillippe Burger, Bruno Roux, Sylvain Labbé, Jean Marie Nolot	P86 / 709
	Classification of Blanket Mire Microhabitats using Field and Imaging Spectroscopy	John Dowens (contact), Tim Malthus, Lisa Belyea	P87 / 715
	The POSTEL Land Surface Thematic Centre	Marc LEROY (contact), Patrice BICHERON, Roselyne LACAZE, Fernando NINO, Frédéric BARET, Jean-Louis ROUJEAN, Olivier HAGOLLE, Gérard DEDIEU, Fabienne MAIGNAN, François-Marie BREON	P88 / 200
	HYRESSA: Towards an Improved Access to Hyperspectral Data in Europe	Ils Reusen (contact)	P89 / 581
	Development of the Gonio RAdiometric Spectrometer System to conduct multi-angular measurements of the surface	Heather Pegrum (contact), Nigel Fox, Edward Milton, Magdalena Chapman	P90 / 280
	Dual Field-of-View Goniometer System FIGOS	Juerg Schopfer (contact), Stefan Dangel, Mathias Kneubühler, Klaus I. Itten	P91 / 623
	The FLuorescence EXplorer (FLEX) Mission - Mission Objectives and derived requirements	Michael Berger (contact), Jose Moreno, and The FLEX Team	P92 / 880
	Spatial Variability and Altitude effects of passive chlorophyll fluorescence measurements over La Mancha (Spain) fields	ISMAEL MOYA (contact), FABRICE DAUMARD, NICOLAE MOISE, YVES GOULAS, ABDERRAHMANE OUNIS	P93 / 714
	The Characterisation of Heather Foliage and Canopies by Hyperspectral Reflectance	Alasdair Mac Arthur (contact)	P94 / 483
	Comparison of different ground techniques to map leaf area index of Norway spruce forest canopy	Lucie Homolova (contact), Zbynek Malenovsky, Jan Hanus, Ivana Tomaskova, Marcela Dvorakova, Radek Pokorny	P95 / 532
	Validation of FAPAR products derived from optical	Nadine Gobron, Bernard Pinty	P96 / 615

	sensors: method and results.	(contact), Ophelie Aussedat, Malcolm Taberner, Frederic Melin, Thomas Lavergne, Monica Robustelli, Jean-Luc Widlowski	
	The NCAVEO 2006 Cal/Val Experiment	Edward Milton (contact)	P97 / 717

Additional Workshops

Wednesday, March 14th 2007 – HYRESSA dinner

Time	Title	Speaker	Comment	Ref.
19:00 – open	HYRESSA dinner	Offered, by invitation only	Central Sporthotel, Davos Restaurant Bündnerstübli	

Thursday, March 15th 2007 – HYRESSA Workshop

Time	Title	Speaker	Comment	Ref.
08:00 – 08:15	Registration		Central Sporthotel, Davos Vetschstube	
08:15 – 08:30	Welcome and Introduction	Lammert Kooistra and Michael Schaepman *WUR (NL)*		
08:30 – 08:45	The role of protocols and standards in hyperspectral data acquisition	Jose-Antonio Gomez-Sanchez *INTA (Sp)*		H1
08:45 – 09:30	Discussion	*All*		
09:30 – 10:00	Coffee Break	*Offered*		
10:00 – 10:15	Opportunities for the development of a European hyperspectral research infrastructure	Tim Malthus *Univ. Edinburgh (UK)*		H2
10:15 – 10:30	Trans-national Access at Equal Terms to national research infrastructures in Europe: The case of research aircraft for environmental studies	Jean-Louis Brenguier *METEO France (F)*		H3
10:30 – 11:15	Discussion	All		
11:15 – 11:45	Research Infrastructures in FP7	Brigitte Weiss *Scientific Officer EU Research Infrastructures*		H4
11:45 – 12:00	Closing remarks and conclusions	Lammert Kooistra *WUR (NL)*		H5
12:00 – 13:00	Business Lunch	*Offered*	Central Sporthotel, Davos Restaurant Bündnerstübli	
13:00 – 15:30	HYRESSA Progress Meeting I	Limited to HYRESSA project participants	Central Sporthotel, Davos Vetschstube	
15:30 – 16:00	Coffee Break	*Offered*		
16:00 – 17:00	HYRESSA Progress Meeting II	Limited to HYRESSA project participants		

Thursday, March 15th 2007 – LAI and fAPAR validation under CEOS/LPV-VALERI

Time	Title	Speaker	Comment	Ref.
			Morosani Post Hotel, Davos http://www.morosani.ch	

09:00 – 9:20	Welcome, Introduction, Objectives of the meeting, Relation to GEO	Frédéric Baret *INRA (F)*	The objectives of the workshop are to identify the several on going and planned validation activities and discuss methodological and more strategic aspects.	L1
09:20 – 12:00	Ongoing direct validation activities	Participants	To be filled by short contributions (about 5-10 minutes) from PIs of validation sites	L2
12:00 – 12:30	Sample results from direct validation activities	S. Garrigues, F. Baret, R. Lacaze, et al.		L3
12:30 – 14:00	Lunch Break			
14:00 – 15:00	Methodological aspects I	Participants	Ground measurements Comparison of results coming from several devices Devices for continuous monitoring of LAI and fAPAR, and productivity The clumping problem Understory problem Interaction with the flux tower community	L4
15:00 – 16:15	Methodological aspects II	Participants	Transfer functions Sampling scheme and their evaluation Choice of transfer functions depending on available information Accounting for uncertainties Uncertainties associated to local estimates	L5
16:15 – 17:30	Methodological aspects III	Participants	Aggregation at medium resolution Scale and interpolation through time Accounting for PSF Combining high temporal tower measures with moderate and high spatial resolution satellite products Evaluation of uncertainties	L6
17:30 – 18:00	General discussion	Participants	Contribution to GEO/GEOSS task Funding of activities Organization and dissemination of data Other issues	L7
18:00	End of Workshop			

How to reach Davos

Davos located in the heart of Graubünden in the Eastern part of Switzerland.

How to reach Davos by Plane

Zürich-Kloten (ZHR) is the most convenient airport to reach Davos in Switzerland. If you are flying Swiss Intl. Airlines, you may request that your luggage be shipped directly to your hotel in Davos (http://www.zurich-airport.com/).
Geneva-Cointrin (GVA) over 500 kilometres (310 miles) away is an alternate airport. Since in winter it is not possible to cross the Alps by train or car, you will end up coming along Zürich as well (http://www.gva.ch).
Engadin Airport in Samedan (SMV) might be another option, however very few flights are offered on a regular basis to Samedan (http://www.engadin-airport.ch/).

How to reach Davos by Car

It will take about 2 hours to get to Davos by car from Zürich (145 km). You will find your way to Davos easily by taking the highway to Landquart (direction Chur).
Depending on road conditions in winter you may need tire chains once you reach Klosters.
http://www.davos.ch/arrival-by-car-001-040200-en.htm

How to reach Davos by Coach

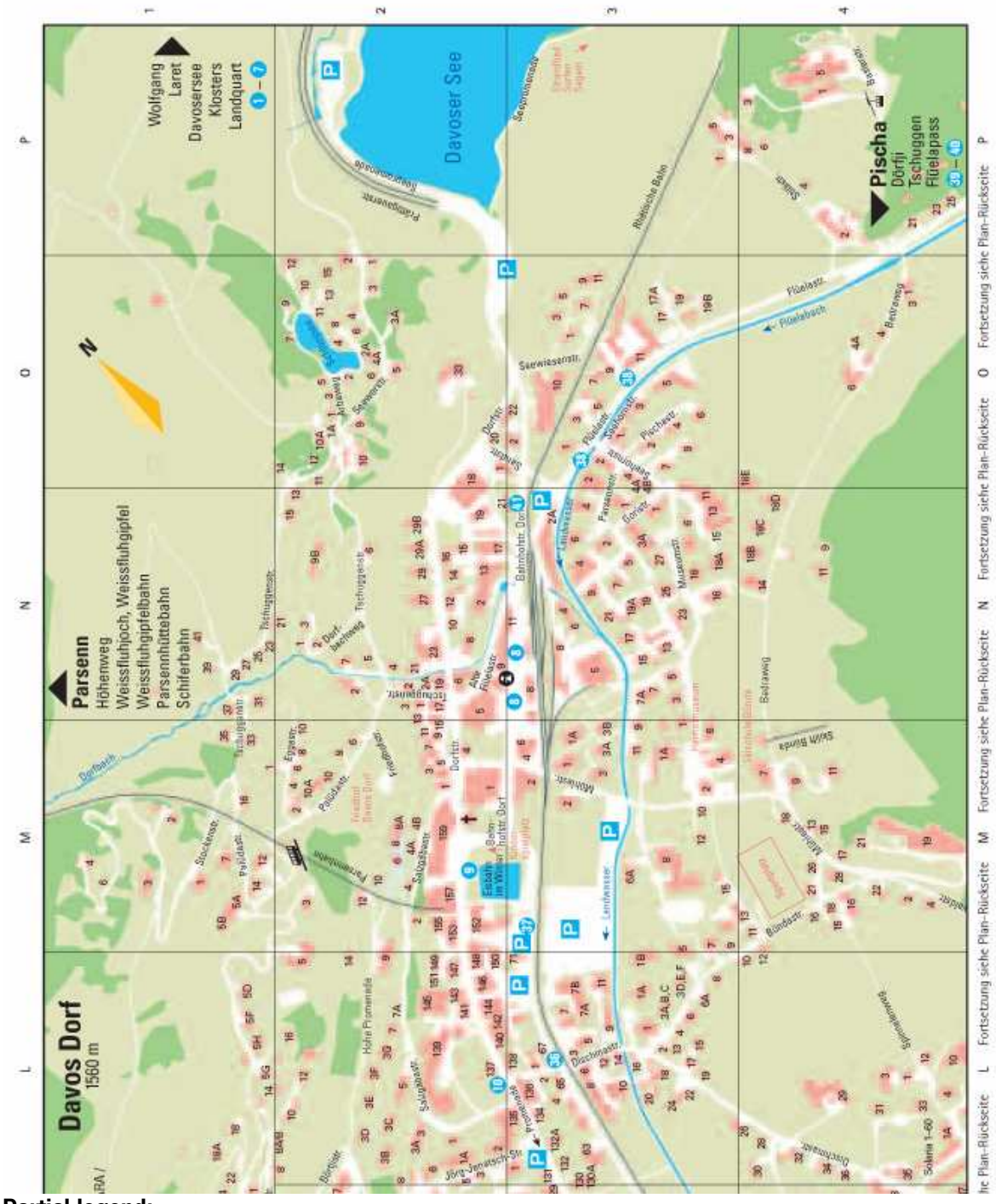
There are regular coach services in winter from Zürich to Davos. Tickets can be bought at the airport.
http://www.davos.ch/arrival-by-coach-001-040206-en.htm

How to reach Davos by Train

It will take about 2.5 to 3 hours to get to Davos by train from Zürich. From Geneva it will take approx. 5.5 hrs, from Basle 3.4 hrs, depending on connections.

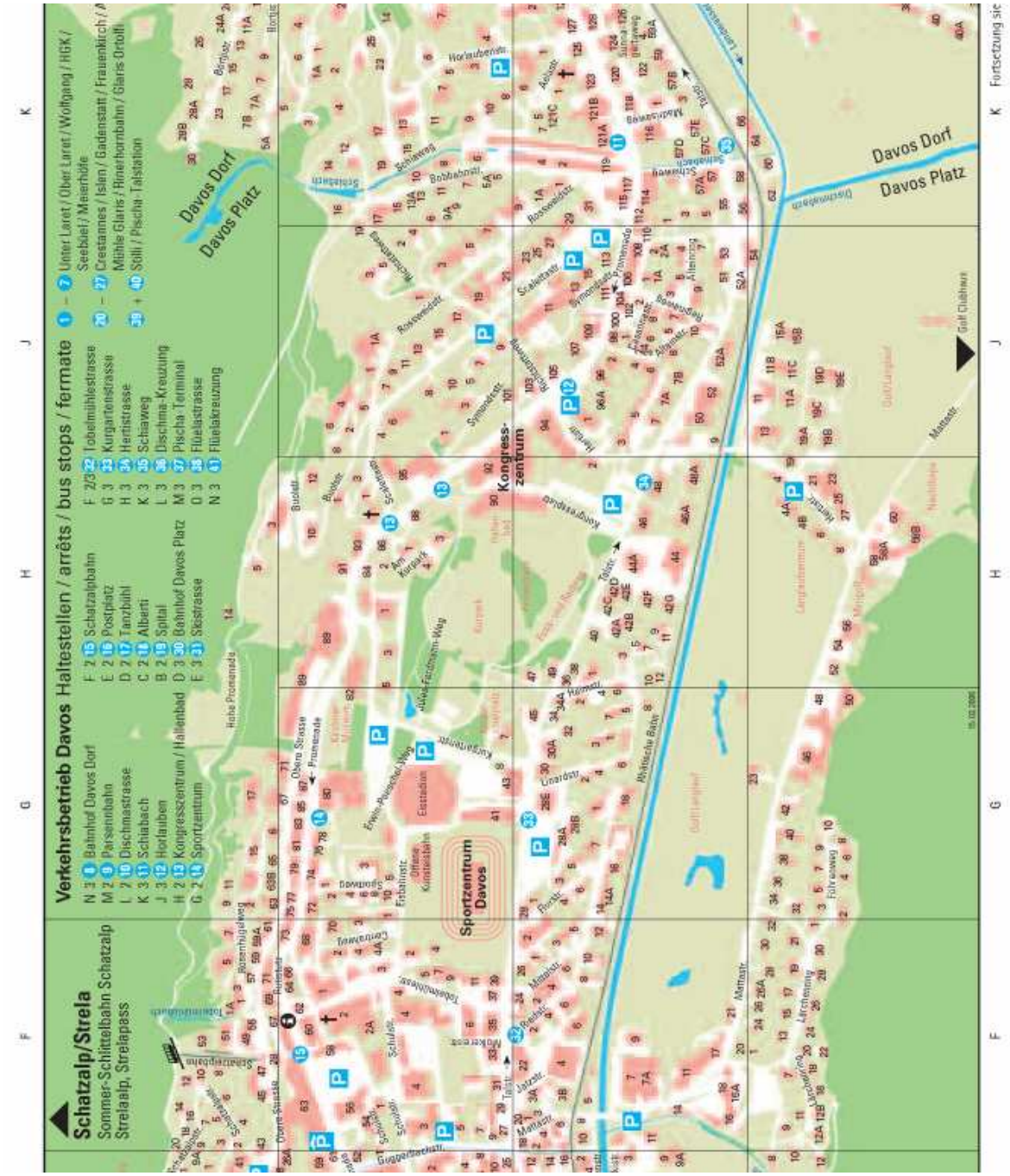
From Zürich airport: In the airport follow the Train icons until you reach the airport train station. Buy your ticket at the counters on the right hand side. Trains bound for Zürich leave about every ten to fifteen minutes. In Zürich, change to an express train bound for Chur. In Landquart (all trains stop there) change to the Rhaetian Railway to Davos. There are two train stations in the city of Davos: Davos Dorf and Davos Platz. Don't get off earlier, e.g. In Davos Wolfgang! Please inform yourself in advance whether Davos Dorf or Davos Platz is closer to your hotel. The Congress Centre is right in between the two. If in doubt, buy your ticket to Davos Platz.
http://www.davos.ch/arrival-by-train-001-040201-en.htm
http://www.sbb.ch/en/index.htm (Swiss railway)

Davos – City Map



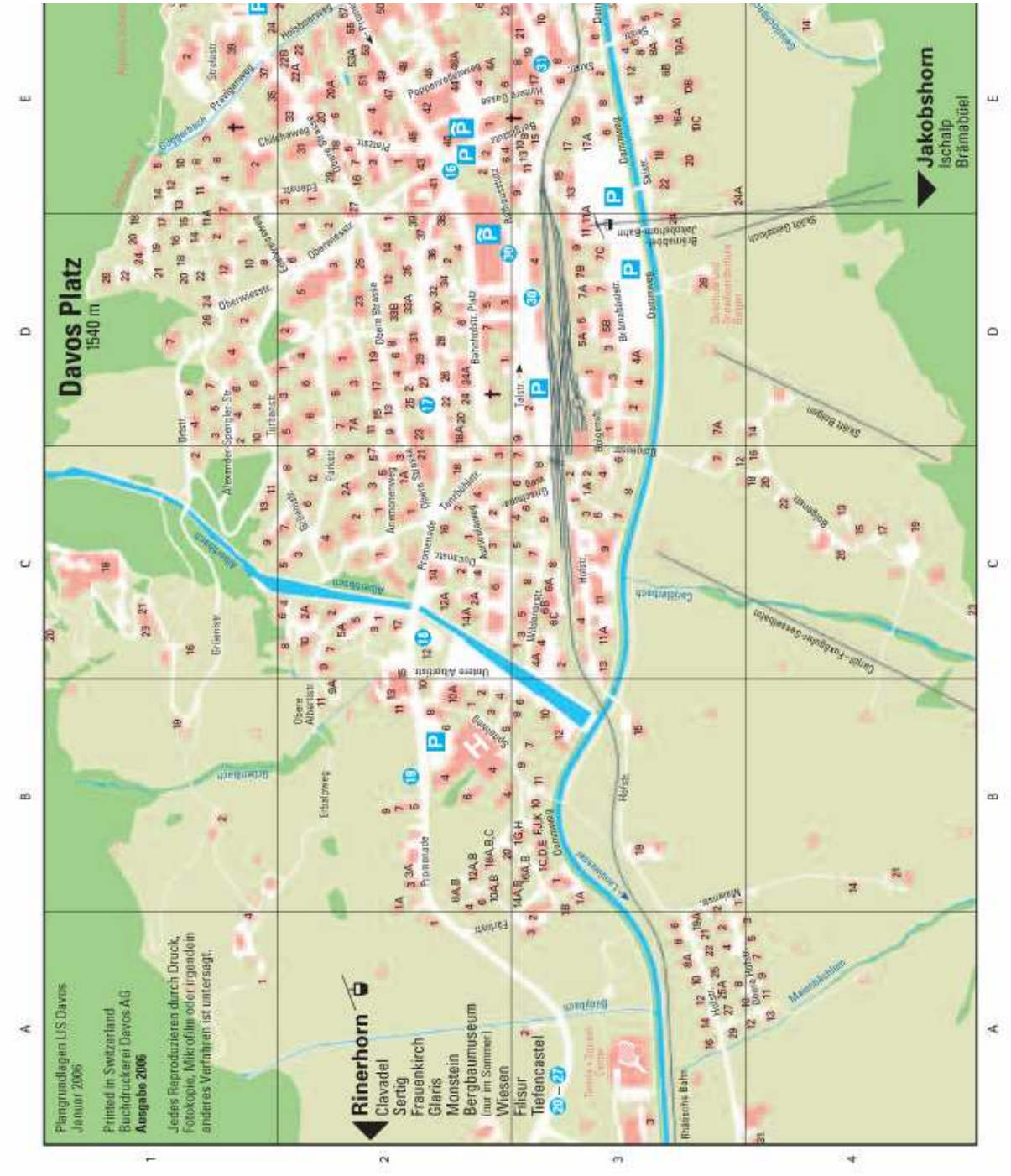
Partial legend:

Map Square	*Number*	*Description*
M2	157	Railway to Parsenn (ski area)
N3	8	Trainstation Davos Dorf
O2	33	WRC / PMOD
O3	11	SLF



Partial legend:

Map Square	*Number*	*Description*
H/J 2/3	92	Congress Centre
G2	82	Kirchner Museum
G2		Ice rink, ice hockey station
F1	28	Railway to Schatzalp
F2	1	Central Sporthotel Davos



Partial legend:

Map Square	*Number*	*Description*
D3	4	Trainstation Davos Platz
D3	11	Cable car Jakobshorn (ski area)
E2	42	Morosani Post Hotel

ISPMSRS'07 Topics

For ISPMSRS'07, we have solicited the submission of contributions related to physical measurements and signatures in remote sensing in the following categories (but not limited to):

- Remote sensing systems (microwave, Lidar, (hyper-)spectral, multiangular, thermal, polarization)
- Advanced preprocessing and processing of remotely sensed data
- Remote sensing data infrastructures
- Physical modelling in remote sensing
- Inversion of biogeophysical and biogeochemical variables
- Advanced methods for time series analysis in remote sensing
- Image classification methods
- Data assimilation and integration of remote sensing in dynamic process models
- Data fusion approaches based on multi-platform or multiple sensor techniques
- Integration of in situ ('SensorWeb') and remotely sensed data
- Validation of remote sensing products
- Radiative transfer based approaches
- Scaling from leaf to canopies to ecosystems
- Quantitative land use/cover change analysis
- Environmental change detection
- Remote sensing in coupled human-environmental systems
- Remote sensing methods for hydrology, carbon cycle, biochemical and –physical cycles, plant ecology, ecosystems, snow, soil moisture, agriculture, natural ecosystems, etc.
- Earth System model approaches using remote sensing

ISPMSRS'07 Follow-up

All submitted full papers for ISPMSRS'07 will be published in the conference proceedings. Please check out the website for submission procedures and deadlines.

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Swiss Academy of Sciences – A network of knowledge for the benefit of society.

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Centre for Geo-Information, Wageningen University (NL)

Remote Sensing Laboratories, University of Zurich (CH)