

ORAL PRESENTATIONS
CSPP/IMAPP USERS GROUP MEETING
EUMETSAT
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Atkinson, Nigel: *“Evaluation of direct broadcast and global microwave sounder data from FY-3C”*
(Authors: Nigel Atkinson, Bill Bell, Katie Lean, Niels Bormann, Heather Lawrence, Stephen English and Qifeng Lu)

Abstract: The Feng-Yun 3C (FY-3C) satellite was launched in September 2013. Level 1 data are available by direct broadcast, through a processing package distributed by CMA. Also, global level 1 data are made available by CMA, and since September 2014 European users have been able to receive the data in near real time via EUMETCast.

The microwave sounders, MWTS-2 and MWHS-2, are enhanced versions of the MWTS and MWHS instruments that were flown on FY-3A and FY-3B. The MWTS-2 includes additional temperature sounding channels in the 50GHz band, and the MWHS-2 includes a new set of channels in the 118GHz oxygen band - not previously flown on a satellite.

Through a collaborative project, the Met Office, ECMWF and CMA have been evaluating the data from FY-3C, with particular emphasis on the microwave sounder data. The evaluation has covered aspects such as: (i) comparison with NWP model background at ECMWF and Met Office, (ii) internal consistency of the data, e.g. the calibration coefficients, and (iii) comparison of direct readout data with global data. Generally the instruments are performing well, with noise levels comparable with those of similar channels on AMSU and ATMS. However, there are some issues with variable bias, relative to NWP, for both instruments. The presentation will describe the findings of these studies and plans for future exploitation of the data.

Bradley, David: *“Direct Readout at the Meteorological Service of Canada”*
(Authors: David Bradley)

Abstract: The Meteorological Service of Canada operates a network of four Direct Readout stations to receive data from polar orbiting meteorological satellites. The data is used to support operational nowcasting, sea and lake ice monitoring, volcanic ash monitoring, numerical weather prediction, and is also provided to the EUMETSAT Advanced Retransmission Service (EARS). This presentation will describe our current data reception and processing environment, highlight some of the applications and experiences using processing software like CSPP, and outline some of the challenges we are working to overcome.

Brunel, Pascal: *“A VIIRS to CrIS mapping for Suomi NPP”*
(Authors: P. Brunel, P. Roquet, N. Atkinson, J. Vidot from Centre de Météorologie Spatiale MétéoFrance, Lannion France and MetOffice, Exeter Great Britain)

Abstract: A VIIRS to CrIS mapping algorithm is proposed for the Suomi NPP. The Cross-track Infrared Sounder (CrIS) on board Suomi-NPP has a ground footprint of 14km at nadir. A good knowledge of the surface conditions will benefit any use of CrIS radiances. The Visible Infrared Imaging Radiometer Suite (VIIRS) can provide exclusive information about clouds or surface in the CrIS field of view. The algorithm does not use navigation routines and take account of the bow-tie effect of the VIIRS instrument. Mapping quality is verified by comparing the VIIRS radiances convolved inside the CrIS field of view to the CrIS radiances convolved with the VIIRS filter response functions. Results performed on local reception data and on one full global orbit show that there is a good quality for CrIS field of regards 1 to 15 and lower quality for field of regards 16 to 30. The algorithm works and will be available soon in AAPP.

Cuozzo, Giovanni: *“A Near Real Time Monitoring System with CSPP for Alpine and Mountain Regions.”*

(Authors: Cuozzo G., Monsorno R., Costa A., Ventura B.)

Abstract: The EURAC Institute for Applied Remote Sensing is located in Bolzano (Italy) and its mission is the integrated environmental monitoring and assessment of mountain regions fusing remote sensing techniques with interdisciplinary approaches.

EURAC owns and manages a satellite receiving station, placed in South Tyrol region at Corno del Renon, in a free obstacle site at 2260 m a.s.l.. Since 2009 EURAC is acquiring data from Aqua and Terra NASA satellites equipped with Moderate Resolution Imaging Spectroradiometer (MODIS) sensors. MODIS data are characterized by coarse spatial resolution, but large coverage and frequent revisit times, therefore they could be crucial for mountain applications. For this reason EURAC applied research has developed several algorithms using MODIS data in order to create added value products adapted for mountain regions, like Snow Coverage, Particulate Matter, Leaf Area Index and Normalized Difference Vegetation Index maps over the Alps. Some of these products, implemented on a common processor structure based on the use of configuration files and a generic processor, are the result of a near real time processing chain and they have automatically delivered to the customers such as the Autonomous Province of Bolzano-Civil Protection office and published on the EURAC WebGIS.

NASA S-NPP mission is equipped with VIIRS (Visible Infrared Imaging Radiometer Suite) sensor, and is considered to be the MODIS successor for Earth science data product generation[1], therefore EURAC decided to configure its receiving system to acquire and process S-NPP data in order to give continuity to the mountain near real time observation. EURAC implemented the configuration of the receiving and processing S-NPP system using the software packages developed by NASA Direct Readout Laboratory[2] (DRL) and CIMSS/SSEC (Cooperative Institute for Meteorological Satellite Studies/Space Science and Engineering Center), UW-Madison. In more detail, the telemetry raw data received by the EURAC X-band antenna are processed with RT-STPS (Real-time

Software Telemetry Processing System) package from DRL that produces RDR files (Raw Data Record) for VIIRS, ATMS (Advanced Technology Microwave Sounder) and CrIS (Cross-Track Infrared Sounder) sensors. RDR are then transferred to a server equipped with the CSPP[3] (Community Satellite Processing Package) software package developed and supported by CIMSS/SSEC. The versatility of the CSPP package allows to subdivide the input file into granules and makes possible the use of parallel computing to produce SDR (Science Data Record) and EDR (Environmental Data Record) products.

EURAC tested successfully the environment described above using six cores for the parallelized production of the SDR obtaining the EDR products within one hour after the acquisition of the data by its antenna. Future work is the consolidation and the operationalization of the S-NPP NRT processing chain and the adaptation of the EURAC MODIS products to the VIIRS sensor case.

[1] <http://oceancolor.gsfc.nasa.gov/VIIRS>

[2] <http://directreadout.sci.gsfc.nasa.gov/>

[3] <http://cimss.ssec.wisc.edu/cspp/>

de Klerk, Helen: *“Synergistic use of remote sensing instruments in data-poor regions to determine causes and policy solutions to high total column CO not explained by biomass burning in southern Africa”*

(Authors: de Klerk, H.M., Smith, N., Munch, Z.M.)

Abstract: World wide biomass burning has been shown to account for a substantial amount of total column CO, and this may be more pronounced over tropical areas, such as the savanna's of Africa. Studies have used a variety of chemical transport models, geostationary satellites and orbiting satellites individually and in combination to characterize CO profiles as well as total column CO patterns world wide, in various hemispheres, and in relation to specific fires. We look at regional scale analysis using geographically weighted regression techniques that are robust to spatial autocorrelation between spatially proximal data points, and which are able to show how the relationship between a dependent variable and an explanatory variable may change over sub-places within a study area. This allows us to identify local areas within

southern Africa where biomass burning is accounting for the majority of total column CO₂, and areas with high total column CO₂ values that are not explained by biomass burning. The latter can be investigated to determine the cause of the high total column CO₂ and policies to address these causes, such as household cooking and warming fires during winter

Dybbroe, Adam: *“The EUMETSAT Nowcasting SAF direct readout package PPS - status”*

(Authors: Adam Dybbroe, Nina Hakansson, Ronald Scheirer, Sara Hornquist, Anke Thoss, Karl-Goran Karlsson, Abhay Devasthale, Martin Raspaud and Jan-Fokke Meirink)

Abstract: The EUMETSAT Polar Platform System (PPS) is a software package developed in the frame of the Satellite Application Facility for Nowcasting and Very Short Range Forecasting (NWCSAF) providing algorithms and infrastructure for generating cloud and precipitation products from VIIRS and AVHRR data.

PPS takes as input VIIRS SDR data as provided by CSPP and AVHRR data as provided by AAPP. The PPS cloud properties include cloud mask, cloud type, cloud top temperature and height (CTTH), precipitation (using AVHRR and AMSU/MHS - only on NOAA/Metop platforms), and cloud microphysical properties.

The cloud microphysical properties are the Cloud phase and Liquid water path (official validated products) as well as the auxiliary parameters Ice water path, Effective radius and Optical thickness. The cloud physical products were developed within the Climate Monitoring SAF and have been adapted to, and harmonized with, the NWCSAF PPS package as part of the 2012 release.

PPS version 2014 was released to users last year. Besides significant improvements to the products it also contains a number of technical updates, among which the new netCDF/CF file format is one of the more prominent ones. Easy installation is now accommodated via the provision of ready built binaries.

PPS is used at a number of National Met. Services in Europe and within the SAFs for Ocean and Sea Ice, Climate Monitoring and Land surface applications.

In this presentation we will summarize the recent improvements implemented in v2014, show recent validation results with VIIRS and colocated CALIPSO data, and discuss the planned future development.

The PPS software is freely available also for commercial use once becoming a registered user via <http://www.nwcsaf.org>.

Foli, Bennet: *“Supporting fisheries management with geospatial information in West Africa”*

(Authors: George Wiafe, Mamadou Niane, Kwame Agyekum, Bennet Foli, Ignatius Williams, Dogbeda Azumah and Afia Boakye)

Abstract: The fishery resource in Western Africa contributes significantly to the socio-cultural and economic well-being of coastal countries in the ECOWAS region. It is estimated that over 3 million people are directly or indirectly employed in the industry. These benefits are presently threatened as a result of poor management practices and ever increasing challenges from illegal, unregulated and unreported (IUU) fishing. The main challenge to resource management in Africa, as a whole, is limited or lack of continuous data. Earth Observation (EO) using satellite platforms is presently providing continuous data for monitoring the environment and its resources.

For West African countries to benefit from the use of geospatial information for resource management, the University of Ghana is implementing the ECOWAS Marine Thema on behalf of the Economic Community of West African States (ECOWAS) as part of a continent-wide Monitoring for Environment and Security in Africa (MESA) Project. University of Ghana as a Regional Implementation Centre (RIC) is also coordinating the activities of beneficiary institutions in 14 countries in western Africa. The countries comprise of 12 ECOWAS member countries (Benin, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Nigeria, Senegal, Sierra Leone and Togo) and 2 non-ECOWAS western African countries (Mauritania, Sao Tome and Principe). Through this initiative, University of Ghana receives EO products via EUMETCast, and process and analyse periodically MODIS ocean colour and sea surface temperature products to support fisheries management in the region. Using thermal fronts and

generalized additive models which are driven by geospatial data the centre generates charts of potential fishing zone (PFZ) maps. As part of the implementation strategies, the PFZ maps will be provided to fisheries managers, the navy and coast guards of the participating countries to support monitoring activities to curb IUU fishing.

Countries participating in this initiative have acknowledged the benefits of the coastal and marine environment and its resources and are committed to ensuring the successful implementation of the project in the region. MESA, therefore, provides a unique opportunity for policy and decision makers to utilize the benefits of EO tools to manage the coastal and marine resources in the ECOWAS region. The RIC in collaboration with other West Africa institutions are providing technical support to build capacity in the use and application of Earth Observation in the region.

Frost, Philip: *“The Advanced Fire Information System, past, present and future”*

(Authors: Philip Frost, Cheewai Lai)

Abstract: The Council for Scientific and Industrial Research (CSIR) lead by die Meraka Institute and supported by partners such as the South African National Space Agency (SANSA) and University of Dundee (Scotland) has developed the Advanced Fire Information System (AFIS) with the aim to provide near real time fire information to disaster managers, fire fighters, farmers and forest managers across Africa, Europe and South America. The system combines satellite data with ground based observations and numerical weather forecast models to provide fire prediction, detection monitoring and assessment information through various dissemination platforms. With the launch of the system in 2004, Eskom (South Africa’ and Africa’s largest power utility) quickly became the biggest user of the system and today more than 300 line managers and support staff all around the country receive cell phone and email fire alert messages whenever a wildfire is within 2km of any of the 28 000km of Eskom transmission lines. Innovative ways to display and package the fire information such as the fire dashboard and AFIS mobile application has enabled the system to be incorporated in to actual firefighting incident command systems globally. The development of an AFIS mobile app for IOS and Android

devices as well as a sophisticated fire reporting tool has expanded the AFIS product offering enabling the dissemination and alerting of forecasted fire danger, alert push notifications of new fire events and the upload of geo tagged photos to the AFIS database. New features such as 3D fire spread visualization will further revolutionise the AFIS product offering and increase to global use of the system in 2015.

Gambacorta, Antonia: *“Using the NOAA Unique CrIS/ATMS processing System (NUCAPS) to explore hyper-spectral sounding capabilities during extreme events: lessons learned from the CalWater 2015 campaign.”*

(Authors: Antonia Gambacorta, Chris Barnet, Mitch Goldberg, Ryan Spackman, Jonathan Rutz, Kathy Strabala)

Abstract: The objective of this talk is to explore and demonstrate the vertical profiling capabilities of hyper-spectral soundings in capturing high impact mesoscale phenomena over the otherwise poorly sampled Pacific Ocean region. The high vertical resolution and spatial coverage of hyper-spectral sounders is a key element to fill this critical observational gap.

We use the NOAA Unique CrIS/ATMS Processing System (NUCAPS) to retrieve vertical profiles of temperature and relative humidity from the Suomi-NPP CrIS/ATMS instruments suite distributed in near real time (less than 1.5 hours) by the CSPP Direct Broadcast. These profiles are collocated to a large number of correlative soundings from the GFS and ECMWF model analyses and in situ radiosonde measurements collected over the North East Pacific during the occurrence of CalWater 2015. Focus of this intensive field campaign, which took place in the months of January and February 2015, was a close study of atmospheric river phenomena and their impact on extreme precipitation events over the West coast of the United States. The near real time availability of NUCAPS soundings from CSPP Direct Broadcast played a critical role in enabling early close up investigations and facilitating flight-planning activities.

This paper attempts at performing two main investigations. A first comparative analysis is aimed at validating the robustness of the NUCAPS retrievals under high relative humidity and cloudy conditions. Secondly, we aim at showcasing the beneficial additional information of the NUCAPS soundings over

the model analyses, in defining crucial moisture structure (position, water vapor content, amplitude) in the vicinity of the complex mesoscale activity associated to the development and landfall of atmospheric river phenomena. This study is aimed at providing a proving ground for assimilation of NUCAPS retrievals into regional model forecasting with the scope of ultimately reducing diagnostic and forecast errors associated with extreme precipitation events such as those caused by atmospheric rivers landfalls over the Western United States.

Ghamary Asl, Mohsen: *“An Effective Algorithm for Estimating the Dust Density of Ahwaz and Abadan Cities in Iran using MODIS Imagery”*
(Authors: Mohsen Ghamary Asl; Mohammad Reza Mobasheri)

Abstract: Dust storm is one of the most important issues in Ahwaz and Abadan cities in Iran. It severely threatens the human being society. This phenomenon may also affect the fertility of the agricultural soils. Dust like other materials present in an area can affect the energy reflected/radiated toward sensors/satellites. In this regard, the density of dust directly influences the intensity of the energy. There seems to be a correlation between dust density and the reflectance of each pixel in satellite images in especial regions of the spectrum. In this paper, the effect of dust density on the reflectance of the MODIS image pixels is calculated using a simple linear spectral unmixing method. The methodology is based on the change of the reflectance in particular pixels having particular surface covers that are invariant in time on different images acquired in different days. In other words, the proposed method is based on the effects of dust aerosols on the reflectance of the surface in each pixel. To estimate the contribution of dust to the reflectance, a linear unmixing approach is deployed. The results were compared with the field-measured dust densities where an R^2 of 0.95 between measured densities and dust reflectance abundances in each pixel (estimated from the linear unmixing) was found. To evaluate the proposed method, it was applied to a new set of samples where an RMSE of about 1.28 (microgram / m³) between model-predicted and field-measured dust densities was achieved. It is expected that this model can perform better for higher values of dust densities.

Grassotti, Christopher: *“Review of Microwave Integrated Retrieval System (MiRS) Improvements and Integration within CSPP”*
(Authors: Christopher Grassotti, Xiwu Zhan, Sid Boukabara, and Jim Davies)

Abstract: The Microwave Integrated Retrieval System (MiRS) has been the NOAA official operational microwave retrieval algorithm since 2007 and is currently run operationally on microwave data from NOAA, Metop, DMSP and Suomi-NPP polar orbiting satellites, and on data from Megha-Tropics/SAPHIR. It has also been run experimentally on data from TRMM/TMI, Aqua/AMSR-E, GCOM-W1/AMSR2, and GPM/GMI. The inversion within MiRS follows a 1D-variational methodology, in which the fundamental physical attributes affecting the microwave observations are retrieved physically, including the profile of atmospheric temperature, water vapor, hydrometeors, as well as surface emissivity and temperature. The community radiative transfer model (CRTM) is used as the forward and Jacobian operator to simulate the radiances at each iteration prior to fitting the measurements to within the noise level. The retrieved surface properties are then used to determine surface physical characteristics, including, when appropriate, cryospheric parameters such as sea ice concentration, ice age, and snow water amount, using pre-determined relationships that link emissivity and effective skin temperature to these parameters. These links are based, in part, on physical modeling of snow and ice radiative properties. In late 2013, MiRS was officially integrated into CSPP. Subsequently, in August 2014, an updated version of MiRS was officially released (V11) which includes a number of technical and scientific improvements. We will present an overview of these recent developments and science improvements to MiRS, as well as examples from CSPP-MiRS which demonstrate the capabilities now available to users.

Hoese, David: *“Polar2Grid Version 2.0”*
(Authors: David Hoese, Kathy Strabala)

Abstract: Polar-orbiting multi-band meteorological sensors such as VIIRS and MODIS pose substantial challenges for taking imagery “the last mile” to forecast offices, scientific analysis environments, and the general public. To do this quickly and easily, the Cooperative Institute for Meteorological Satellite Studies (CIMSS) at the University of Wisconsin has created an open-source, modular application

system, Polar2Grid. This bundled solution automates tools for converting various satellite products like those from VIIRS and MODIS into a variety of output formats, including GeoTIFF and AWIPS, as well as NinJo forecasting workstation formats. Polar2Grid includes perceptual enhancements for products such as the VIIRS Day-Night Band (DNB) and sharpened true color images. Polar2Grid performs conversions and projections in seconds on large swaths of data. Polar2Grid is currently providing VIIRS imagery over the Continental United States, as well as Alaska and Hawaii, from various Direct-Broadcast antennas to forecasters at the NOAA National Weather Service (NWS) offices in their AWIPS terminals, within minutes of an overpass of the Suomi NPP satellite. These images have been used by operational NWS forecasters.

Huang, Allen: *“Community Satellite Processing Packages - Facilitating Improvements in Real-time Satellite Data Applications”*
(Authors: Allen Huang, Liam Gumley, Kathy Strabala and Mitch Goldberg)

Abstract: In cooperation with the NOAA Suomi NPP/JPSS program, CIMSS/SSEC continues to leverage and expand the NASA funded International MODIS/AIRS Processing Package (IMAPP) effort, and to facilitate the use of international polar orbiter satellite data through the development of a unified Community Satellite Processing Package (CSPP) to support the Suomi NPP and JPSS. CSPP is expanding to support operational GOES-R, METOP, FY series, and geostationary meteorological and environmental satellites for the global weather and environmental user community.

We will start with a brief highlight of IMAPP, with more than 1,900 registered users in 70 countries. That will be followed by an overview of recent CSPP developments to transform VIIRS, CrIS, and ATMS Raw Data Records (RDRs) (i.e. Level 0) to Sensor Data Records (SDRs) (i.e. Level 1), and SDRs to Environmental Data Records (EDRs) (i.e. Level 2) in support of Suomi NPP and subsequently the JPSS missions for the direct broadcast (DB) vendors and users.

The main emphasis of this presentation is to report several ongoing and proposed CSPP sister projects including 1) JPSS Analysis Facility for Instrument Impact on Requirement

(JAFIIR) - OSSE for Next-Generation CrIS, 2) Innovative Satellite Enhancement Exploration (ISEE), 3) DB network low-latency S-NPP data forecast impact on the real-time Rapid Refresh system, and 4) NUCAPS Greenhouses Gases for Climate Applications. These efforts seek to advance CSPP towards facilitating enhanced weather forecasts, climate applications and innovative exploration of environmental satellite DB informatics.

Hungershoefer, Katja: *“A new direct-broadcast facility at Deutscher Wetterdienst (DWD)”*
(Authors: K. Hungershoefer, C. Mueller, J. Popp, J. Asmus)

Abstract: New, high-capacity sensors and improved satellite broadcast possibilities call for new acquisition and processing facilities to provide existing and new products to the various users. From a technical point of view the accumulating larger amount of data has to be transmitted. To accommodate this fact, current and future operational weather satellites like Suomi-NPP, JPSS-1/2 as well as the European Polar System (EPS) - Second Generation satellites use an X-band broadcast system instead of the L-band that is used by older satellites from the NOAA POES and EPS programmes.

In early November 2014 Germany's National Weather Service DWD has extended its direct broadcast facility. The former L-band antenna was replaced with a new L-/X-band system ensuring the reception of the current and future weather satellites in the next decade. A new processing chain was built to provide improved satellite images based on MODIS and Suomi-NPP VIIRS to our forecast unit.

The presentation will describe the new facility, the data processing chain and example products.

Kern, Aniko: *“Monitoring Vegetation Activity in Hungary using Direct Broadcast MODIS data”*
(Authors: Aniko Kern¹, Szilard Pasztor¹, Peter Bognar¹, Zoltan Barcza², Gabor Timar¹, Janos Lichtenberger¹, Peter Steinbach³, Gabor Molnar¹ and Csaba Ferencz¹; ¹ Department of Geophysics and Space Science, Eotvos Lorand University, Budapest, Hungary; ² Department of Meteorology, Eotvos Lorand University, Budapest, Hungary; ³ MTA-ELTE Research Group for Geology, Geophysics and Space science)

Abstract: The Eotvos Lorand University operates a polar orbiting satellite receiving station in Budapest, Hungary since 2002. This station receives Earth observation data from polar orbiting satellites including MODerate resolution Imaging Spectroradiometer (MODIS) Direct Broadcast (DB) data stream from satellites Terra and Aqua. The received DB MODIS data are processed real-time to obtain several atmospheric and land surface products. Processing of the MODIS data is based on freely distributed software packages, such as the SeaDAS MODIS Level1DB and the International MODIS/AIRS Processing Package (IMAPP). The derived products are then utilized in several applications, such as the Direct Broadcast Google Earth (DBGE), the Infusing satellite Data into Environmental Applications-International (IDEA-I), the Direct Broadcast CIMSS Regional Assimilation System (DBCRAS) numerical weather prediction software, the Polar2Grid and the MODIS GeoTIFF Web Mapping Service (WMS), all developed by the University of Wisconsin-Madison Space Science Engineering Center (UW SSEC).

To investigate various features of the land surface the MODIS Surface Reflectance Software Package and the MODIS DB Bidirectional Reflectance Distribution Function (BRDF) Software Package are also used. These DB applications serve as invaluable tools to monitor and study the changes of vegetation activity within the Carpathian Basin in general and to understand its relationship with the climate fluctuations based on the derived Vegetation Indices. Using the 10-years-long received DB MODIS data (2005-2014), and also utilizing the official MOD13 Vegetation Indices products, the vegetation characteristics of Hungary was investigated in our research also taking into account archived meteorological data. The main aim was to find those years that can be considered as extreme according to specific indices. Using archive meteorological data the effects of extreme weather on vegetation activity and growth were investigated with emphasis on drought and heat waves.

Martin, Graeme: *“CSPP Geo: The Community Satellite Processing Package for Geostationary Satellite Data”*
(Authors: Graeme Martin, Liam Gumley, Nick Bearson, Jessica Braun, Geoff Cureton, Ray

Garcia, Tommy Jasmin, Scott Mindock, Kathy Strabala)

Abstract: The GOES-R geostationary satellite, to be launched in early 2016, will have a direct broadcast data stream called GOES Rebroadcast (GRB) which can be received by any ground station within view of the satellite with appropriate hardware. The GRB stream will include data from the full suite of instruments, including the high-resolution Advanced Baseline Imager (ABI). The CSPP Geo project will release software capable of processing the GRB stream to recover data from all GOES-R instruments, and further processing ABI data through to Level 2 products. This effort is funded through NOAA in support of their goal of making state-of-the-art software freely available to the international community of direct broadcast users. Here we discuss project status, current and future capabilities, delivery schedule, data formats, Level 2 products, and recommended hardware configuration, as well as current GOES (GVAR) and Himawari AHI processing capabilities.

Melnik, Katerina: *“An overview of meteorological near real-time satellite data usage in Russia”*
(Authors: Katerina Melnik, Dmitry Fedotkin)

Abstract: Meteorological satellites are an important source of information for weather analysis and forecast, natural hazards monitoring, environmental studies and other applications. Data from polar-orbiting meteorological satellites transmitted in direct broadcast mode is particularly relevant for Russia due to several factors: 1) the vast territory that is mostly located at high latitudes and adjoins the Arctic ocean, 2) the relatively low density of ground-based meteorological observations on land and sparse observations over seas; 3) the relatively high number of extreme weather events that cause human lives loss of human lives and property damage. This paper gives an overview of the ground-based technologies developed at ScanEx that enable meteorological satellite data reception, processing and analysis.

ScanEx had been operating in the field of satellite meteorology since 1989 and has been focusing on ground receiving stations manufacturing, software development and education and outreach. Since many remote areas in Russia lack broadband access, having a ground receiving station is sometimes the only way to obtain near real-time satellite

data. From 1989 to 2015 more than 250 L- and X-band ground stations have been installed in Russia and CIS countries. These stations are capable of receiving DB data from NOAA, MetOp, Terra, Aqua, Suomi NPP, Feng-Yun - 3 and Meteor-M satellites. Upon reception, the data is handled by ADPS - the Automatic Data Processing System, which preprocesses the data and generates L1, L2 and visual products. Open source software packages such as RT-STPS, CSPP, IMAPP, AAPP and IAPP are used as a part of the processing system. These packages generate a wide range of atmospheric, land and ocean satellite products. Typical product output formats are HDF and NetCDF. This paper is focused on the user- and application-specific ways of data visualization based on ScanEx's software development experience.

Prasad, Kota: *"SeaSpace users of TeraScan and CSPP software world-wide"*

(Authors: Kota Prasad and Chris Becker)

Abstract: SeaSpace Corporation provides antenna ground stations and TeraScan® software to over 500 customers world-wide, on all seven continents including Antarctica, and on many vessels including U.S. icebreakers. Besides ground stations, SeaSpace Corporation provides real-time data to customers via its WorldMet® data service. The available satellite data include GOES, MTSAT, Himawari-8, COMS, MSG, Meteosat, Suomi NPP, Tera, Aqua, NOAA, and MetOp. With the availability of reliable internet, this is now a viable option for many customers. SeaSpace also provides TeraCATIII, and advanced satellite data cataloging, search and retrieve interface for ground station data management.

SeaSpace integrates the CSPP NPP Processing package as part of a turn-key end-to-end ground station product offering. SeaSpace customers use NPP for a variety of applications. The talk will provide typical examples and applications of NPP data from users around the world who operate SeaSpace ground stations and employ CSPP processing software to generate products.

Raspaud, Martin: *"Reading and Processing VIIRS data efficiently with Pytroll"*

(Authors: Martin Raspaud, Adam Dybbroe, Lars Ø. Rasmussen)

Abstract: After five years of development, Pytroll has become a comprehensive and stable

framework for reading and processing satellite data. It is very easy to add support for new functionality and new instruments and satellites. However, with the increasing number of satellites in space, it is important to be able to read and process weather satellite data efficiently. The latter is particularly true with the VIIRS instrument onboard the Suomi-NPP satellite. While Pytroll has allowed users to explore such data from launch, we have been steadily working towards real efficient reading and processing of VIIRS data.

In this article we will show how we improved the reading of VIIRS SDR files, both standard and EUMETSAT's compact variants in performance and usability, how faster resampling algorithms are being implemented that are able to handle large amounts of data, and how high-efficiency automated data processing is used to generate products and images fast.

Rattenborg, Mikael: *"Global Coordination of Direct Readout And Relay of Satellite Data (DRARS), an initiative of the World Meteorological Organisation"*

(Authors: Jerome Lafeuille, Mikael Rattenborg)

Abstract: The Regional ATOVS Retransmission Service (RARS), which allows fast delivery of ATOVS satellite sounding data acquired by receiving stations around the globe, is a very successful collaborative undertaking of the World Meteorological Organization and its members, which has improved the availability and impact of satellite sounding data on short-term regional and global Numerical Weather Prediction. In recent years, discussions have been held within the Coordination Group for Meteorological Satellites (CGMS) and the International TOVS Scientific Conference (ITSC) on the way forward to extend the RARS concept to advanced satellite sounder data such as METOP/IASI and SNPP/CrIS. This planned extension of the RARS concept, is referred to as DRARS.

The presentation will present the DRARS initiative and the implementation plans, plans that are strongly dependent on the continued progress of the CSPP development.

Rojo, Ester: *“Operational Implementation of Suomi-NPP regional services at EUMETSAT”*

(Authors: Ester Rojo, Anders Meier Soerensen, Thomas Heinemann, Susanne Dieterle, Stephan Zinke)

Abstract: In Summer 2011, the EUMETSAT Council approved the creation of three new regional services based on Suomi-NPP data: EARS-ATMS, EARS-CrIS and EARS-VIIRS. This triggered the update of the EARS stations to support the Suomi-NPP direct readout in X-band, the update of the communication lines and the update of the processing servers to cope with the increased data volume.

In May 2013 the EARS-ATMS and EARS-CrIS regional services were declared operational. EARS-VIIRS service started operationally in October 2014. This presentation will focus on the implementation details of these new services, the installation process of the different processing packages and the service monitoring.

Roquet, Pascale: *“A Snow RGB composite for Suomi NPP VIIRS”*

(Authors: B. Bellec, J. Vidot, P. Roquet P. Brunel)

Abstract: A snow RGB composite algorithm is proposed for the Suomi NPP VIIRS instrument. The algorithm takes the advantage of the M11 channel (centered at 2.25 microns) and M8 channel (centered at 1.24 microns) in order to detect the temporal evolution of the snow physical properties. The algorithm also uses VIIRS M7, M9 and M10 channels in order to detect the different types of clouds. The algorithm shows that snow under thin clouds can be detected. For that, the choice of the RGB composite colours is crucial and we have opted for a colour of snow between yellow and red, depend on the snow reflectance. Three examples of the performance of the algorithm are shown: a snow event in Europe showing the temporal evolution of snow, a snow detection under cirrus clouds in the US and a snow detection over Antarctica under thin stratocumulus. The algorithm can be implemented in the CSPP processing.

Ryppö, Timo: *“Sodankylä National Satellite Data Center (NSDC): Current and Future Satellite Missions and Products”*

Abstract: Finnish Meteorological Institute's Arctic Research Centre (FMI-ARC) hosts a National Satellite Data Center (NSDC) in Sodankylä, Finland. Today, two antennas with 2.4 m and

7.3 m diameters combined with northern location (67°N, 27°E) makes it possible to receive data from several polar satellites up to over ten overpasses per day for one satellite. For data archiving and distributing there is a state-of-the-art server building with 10 Gbps data link to the outside world. The main focus of FMI is to provide data in real-time (Direct Readout) but there is also a capability to receive full orbital data dumps using the 7.3 meter antenna system. Current mission are Terra, Aqua and Aura, part of the NASA's Earth Observing Mission (EOS), Suomi-NPP which is a continuator for EOS mission, Chinese Fengyun 3B and 3C and Italian Cosmo SkyMed constellation (4 satellites) with synthetic aperture radars (SAR) onboard.

Finland is essentially an island as around 90% of its import and export takes place via sea routes. The Baltic Sea freezes over every year so it is important for ice breakers to know where to go and help other vessels. Also some land areas are covered by snow over half of the year. With the help of satellite data authorities can keep Finland up and running through the year. That is the reason why the main products of NSDC are snow and sea ice related.

NSDC has used IMAPP in operational MODIS processing chains for several years. After the launch of Suomi NPP in 2011, NSDC started as a beta tester of CSPP. Today CSPP is used in operation with open source software Py troll to create true and false color RGB images which are delivered to FMI ice service. Based on satellite images and in-situ data the ice service creates ice charts for the Baltic Sea and provides ice information for the ice breakers. Also other IMAPP and CSPP based products will be shown as an example of NSDC product family.

Close collaboration between FMI and China Meteorological Administration (CMA) National Satellite Meteorological Center (NSMC) has given NSDC the possibility to receive and process Fengyun 3B and 3C Medium Resolution Spectral Imager (MERSI) data. The new processing software has just been installed and the tests with FY data will start in February 2015. The first test results and images will be shown in presentation together with user experience.

Sodankyla NSDC is one of the ESA's Sentinel Collaborative Ground Segments (CGS). The collaborative status gives access to ESA Collaborative data hub service from where NSDC can download local Sentinel data faster than from ESA Science data hub service that is open for everyone. NSDC disseminates the local Sentinel data for internal use and for other institutes as well. The existing 7.3 m antenna system will be used to track and process Sentinel-1 data in near-real time. A short status of update of CGS activities will be given in presentation.

Santek, David: *“Real-time Generation of River Ice and Flood Products Derived from VIIRS Imagery”*
(Authors: D. Santek, S. Li, N. Chaoch, J. Hoffman, P. Alabi)

Abstract: During the spring thaw of 2014, two National Weather Service (NWS) river forecast centers participated in an evaluation of river ice and flooding products derived from VIIRS visible channels and the cloud mask product. The two centers were the Alaska-Pacific River Forecast Center (APRFC) and the North Central River Forecast Center (NCRFC). Two products were evaluated: (1) A river flood product developed at George Mason University (GMU) and a river ice product developed at City College of New York (CCNY). The GMU product provides an estimate of flooding water fraction; additionally, regions of ice, cloud, snow cover, and cloud shadow are identified. The CCNY algorithm produces an enhanced river ice mapping product with detailed information on river ice location, extent, and concentration.

The CSPP team at the Space Science and Engineering (SSEC)/University of Wisconsin-Madison facilitated the demonstration by hosting the algorithms from GMU and CCNY, generating the products in near real-time, delivering the products to AWIPS II, and posting images on the SSEC RealEarth Web Map Service. The use of RealEarth provided product visualization for the GMU and CCNY teams and others without access to AWIPS II during this trial period.

This presentation will summarize the generation of the products, their use at the river forecast centers during the spring of 2014 and 2015, and future plans.

Soerensen, Anders: *“Evolution of the EUMETSAT Advanced Retransmission Service (EARS)”*
(Authors: Anders Meier Soerensen, Ester Rojo, Thomas Heinemann, Susanne Dieterle, Stephan Zinke, Alistair Richardson)

Abstract: This presentation will provide an overview the services provided by the EUMETSAT Advanced Retransmission Service (EARS).

It will provide a high level status of the three Suomi NPP based services presented under the title *“EARS-ATMS, EARS-CrIS and EARS-VIIRS: Three New Regional Services”* at the 2013 CSPP/IMAPP Users' Group Meeting. All these are based on the CSPP processing software. Plans to extend these services with additional coverage over the US will be announced.

An overview of the new services under preparation for the FY-3 sounders and imagers will also be presented, including the challenge of upgrading the DB reception systems to be compatible with the current and future FY-3 satellites.

Stevens, Eric: *“Update from the High Latitude Proving Ground”*
(Authors: Eric Stevens, Scott Macfarlane, and Tom Heinrichs)

Abstract: Recent developments in the use of CSPP at the Geographic Information Network of Alaska (GINA) will be described, along with plans for the future. A significant upgrade to GINA's ability to download data from satellites via direct broadcast and to generate products via CSPP is now being implemented by the application of funds related to the Sandy Supplemental. A new feature of the enhanced processing environment is an *“investigator sandbox”* to be hosted at GINA, in which scientists from various Cooperative Institutes can deploy and test new algorithms or approaches in an environment identical to the operational environment feeding products to the National Weather Service (NWS) in Alaska. A primary user of products generated by GINA through the High Latitude Proving Ground (HLPG) is the NWS. Examples of GINA supplying the NWS with products necessary for the fulfillment of its mission will be presented, with special emphasis given to the VIIRS and CrIS instruments of the S-NPP satellite. Lastly, thoughts concerning future development of the HLPG and use of CSPP will be outlined.

Walther, Andi: *“Applications with the VIIRS DNB in CLAVR-x CSPP”*

(Authors: Andrew Heidinger, Steve Miller and Andi Walther)

Abstract: The 2015 release of CLAVR-x in CSPP supports the use of the VIIRS Day-Night Band (DNB) in the CLAVR-x cloud algorithms. This presentation will describe how users can control this feature in CLAVR-x and how the DNB impacts the CLAVR-x products. In particular, we will demonstrate how the DNB helps the day/night consistency in cloud and precipitation detection.

Yang, Lei: *“FY-3C VIRR /MERSI geolocation and on-orbit geometric calibration”*

(Authors: Lei Yang, Chengbao Liu, Ronghua Wu, Min Guan and Zhongdong Yang)

Abstract: FY-3C polar orbit meteorological satellite was launched on 23 September 2013 carrying 12 sets of remote sensing instruments. The Visible infrared scanning radiometer (VIRR) and Medium Resolution Spectral Imager (MERSI) are two important payloads with the ability of obtaining the global earth observation image with 1km spatial resolution in visible, near-infrared and infrared spectral channels. These observations can provide important meteorological element for weather forecasting, climate research, disaster monitoring and environmental monitoring. Well geolocation of the remote sensing data are the key point for retrieving accurate biogeophysical variables. This paper is focused on discussing the geolocation of VIRR/MERSI and its improved measures, where the alignment parameters of instruments are adjusted for adapting the on-orbit status and the impact of terrain correction is analyzed in detail. Meanwhile, the geometric characterizations of instruments and satellite are assessed. Now the geolocation precision on plateau area is improved significantly with the error descending from more than 4 pixels to 1 pixel, and the error on global area is stable in the level of no more than 1pixel. Other 7 payloads onboard FY-3C geolocation results are also described.

Zinke, Stephan: *“Comparison of local CSPP VIIRS SDRs with global NOAA products for validation and monitoring of the EARS-VIIRS service”*

(Authors: Stephan Zinke (EUMETSAT), Thomas Heinemann (EUMETSAT), Anders Soerensen (EUMETSAT))

Abstract: The EARS-VIIRS service complements the EARS-AVHRR service for nowcasting applications by providing locally received VIIRS data from 6 reception stations in Europe and the North Atlantic Region with a timeliness of less than 25 minutes. The data sets consist of medium resolution imagery bands (M01..M16) together with the geolocation information with reference to the ellipsoid (GMODO) of the Suomi NPP satellite in L1 SDRs.

The data are compressed using the EUMETSAT CVIIRS tool and disseminated to the user in the compact VIIRS format [EUM/TSS/DOC/13/708025]. Before the service was declared operational an extensive validation campaign was executed focussing on the consistency between the products from the EARS-VIIRS service, based on the processing by CSPP (V2.0.1) and the global products provided by NOAA-NDE, disregarding any validation of the accuracy of the product calibration itself.

Regarding the format comparison it was observed that the differences in structure of the product are small and do not preclude from using the local products. The only differences introduced by the EARS-VIIRS compacting tool (CVIIRS) are related to the dynamic creation of attributes.

Regarding the data content comparison it was found that the data of local and global products match nearly perfectly: the radiance data of local and reconstructed products are either identical or well within the specified instrument SNRs. The differences can be fully explained by the conversion of the original 32bit floating point to an internal representation as 16bit unsigned integer within the compact format, and converting back to 32bit floating point. The reconstructed reflectance and brightness temperature data of the reconstructed products are, compared to the locally received and processed data, and to the global data, well within the specified instrument SNRs or NEDTs.

The validation exercise highlights the advantage of using local processing packages built around the same kernel of processing software as for the global processing, as recommended by CGMS.