# Assessing the effect of climate change on the hydrology of the Wainganga River basin using VIC model

*Arun Kumar Taxak[1], Dhyan S Arya[1]

1. Indian Institute of Technology Roorkee

Climate change is one of the most important global environmental challenges, which affects the entire earth system in terms of negative impacts on food production, water supply, health, livelihood, energy, etc. The study aims to assess the long-term impact of on the streamflows in the Wainganga basin at Ashti station for period 1951-2014. The Wainganga basin is the biggest sub-basin of the Godavari and accounts for nearly 1.56% of the total geographic area of India and 16.45% of the total area of the Godavari basin. Wainganga is an agricultural basin with around 51% under cultivation land. Changing climate can have huge impact on the livelihood of the people. Precipitation has decreased by 7.95% in the basin during the study period while temperature have increased by 0.48^{o}C. Variable Infiltration Capacity (VIC) model was used for simulating streamflows. 20 years' durations were selected as calibration (1970-1989) and validation (1990-2009) periods. Daily NSE, COD and RE of 0.85, 0.92 and 2.6% and, 0.84, 0.92, and 1.45% were obtained during calibration and validation of the model respectively. Analysis demonstrates a significant decreasing trend in the basin showing 15.02% decrease in mean annual flows. The decrease is due to decrease in precipitation and increase in losses due to increased temperature. The study contributes to the knowledge and understanding of the climate change impact on the local catchment level.

Keywords: Climate change, hydrological modelling, VIC model, streamflow
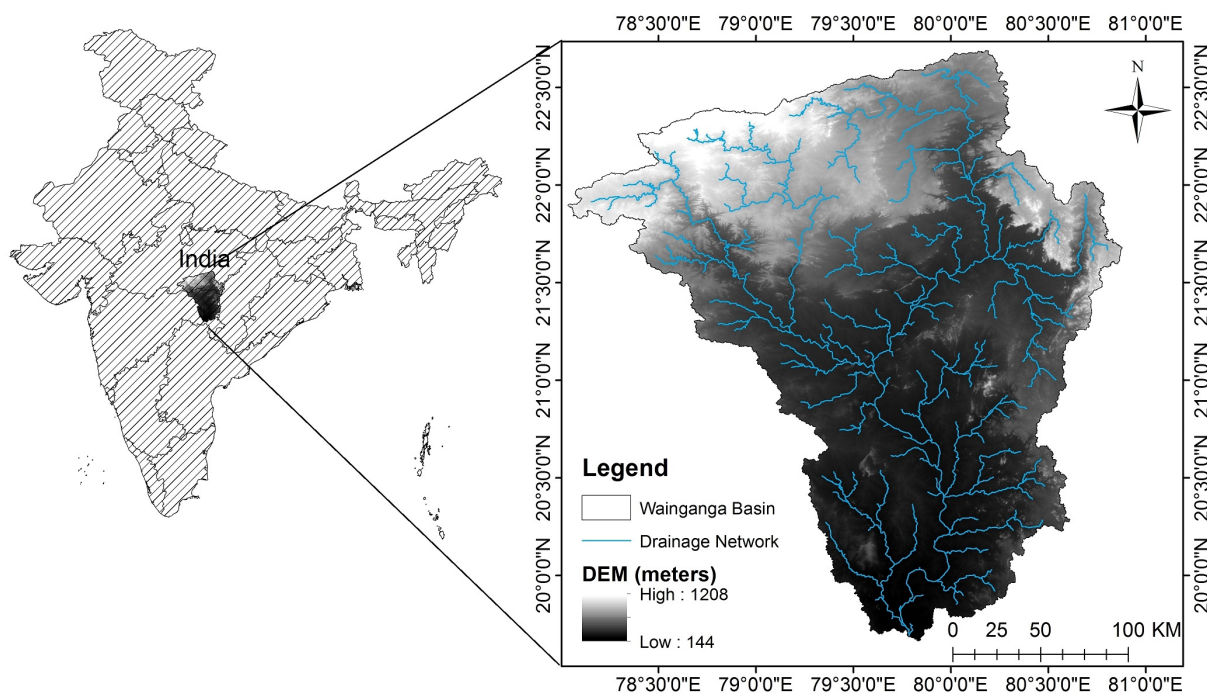
Numerical simulation of the climate effect of high-altitude lakes in the Tibetan Plateau

*Yinhuan Ao[1], Zhaoguo Li[1]

1. Key Laboratory of Land Surface Process and Climate Change in Cold and Arid Regions, Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences

Lakes regulate the water and heat exchange between the ground and the atmosphere on different temporal and spatial scales. However, studies of the lake effect in the high-altitude Tibetan Plateau (TP) are gradually performed until recently and little attention was paid to modelling of frozen lakes. In this study, we employ the WRF v3.6.1 model to conduct the three groups of long-term simulation experiments of Ngoring Lake basin in the TP (original experiment, experiment with a tuned model, and no-lake experiment). Based on these experiments, we evaluate the effect of model improvement on the simulation in the high-altitude lake basin, and investigate the influence of lake on the regional climate. After the lake depth, the roughness lengths and initial surface temperature are corrected in the model, the simulation of the air temperature is distinctly improved. In the experiment with a tuned model, the simulated H on the lake surface is also clearly improved, especially during the periods of ice melting (from late spring to early summer) and freezing (late fall). However, the H on the lake ice is predominantly negative, which exhibits a relatively large difference from the observation. The improvement of LE is primarily manifested by the rapid increase in the correlation coefficient between the simulations and observations, whereas the improvement in the averaged LE is relatively small. The initial surface temperature improvement shows most prominent effect in the first year, and which distinctly weakens after a freezing period. After the lake becomes the grassland in the model, the daytime temperature clearly increases during the freezing and melting periods, the nocturnal cooling appears in other time, especially from September to October. The annual mean H increases by 6.37 times in the regions of original Ngoring Lake and Gyaring Lake areas, and the LE declines by 56.17%. The sum of H and LE increases from 71.23 W m-2 (with lake) to 84.58 W m-2 (without lake). For the entire simulation region, the sum of H and LE also increases slightly. After the lakes disappear, the air temperature increases significantly over the two lakes from June to September, and a typical abnormal convergence field forms. At the same time, the precipitation clearly increases in the original two lakes and surrounding areas, whereas the precipitation generally decreases in other regions. The pattern of the precipitation increase region is consistent with the inter-annual variation of the convergence field.

Keywords: lake effect, Tibetan Plateau, frozen lake, latent heat flux, precipitation

Meteorological drought change evaluation using comparative standardized precipitation index with d4PDF future and past experiments

*Akira Hasegawa[1], Maksym Gusyev[1], Yoichi Iwami[1]

1. International Centre for Water Hazard and Risk Management, Public Works Research Institute

Meteorological drought defines a baseline for the other droughts, such as hydrological, agricultural, and socio-economic droughts. Meteorological drought indices are simply derived using only the meteorological variables, such as precipitation and temperature. The standardized precipitation index (SPI) is used by national meteorological and hydrological services around the world to characterize the meteorological droughts on multiple timescales longer than 1 month. The SPI is computed as follows. The cumulative distribution function (CDF) of the gamma distribution is fitted with the aggregated precipitation dataset at a desired timescale. The fitted CDF is converted to the standardized normal distribution, and the SPI value is computed as the standard score, or Z-score, of the corresponding precipitation. Due to the standardization, the 50th percentile value of precipitation is converted to SPI=0, and the 84.13th and 15.87th percentile values are converted to SPI of +1 and -1, respectively. The SPI values less than -1 are generally treated as the meteorological drought.

The comparative SPI (cSPI) is an extension of the SPI and was developed for meteorological drought assessment under climate change as well as monitoring drought hazards by dividing the input dataset of precipitation into the reference and target datasets. The CDF parameters are estimated with the reference dataset, and the precipitation of the target dataset is converted to the Z-score of the standardized normal distribution related to the CDF using the parameters estimated from the reference dataset. This cSPI approach enables us to estimate the shift of the central condition of the target dataset and the probability changes of dry and wet conditions in the target dataset on the basis of the reference dataset.

The d4PDF (database for Policy Decision-making for Future climate change) consists of three sets of experiments using a general circulation model with 60-km horizontal grid developed by Meteorological Research Institute of Japan: historical climate experiment (100 runs, 60 years from 1951 to 2010), non-warming past experiment (100 runs, 60 years), and +4K future climate experiment (90 runs, 60 years). We compute cSPI of the non-warming past and +4K future climate experiments on the basis of 100 members of the historical climate ensemble experiment, respectively. We demonstrate the changes in the central conditions and in the probabilities of dry and wet conditions with cSPI due to the anthropogenic global warming in future (+4K vs. historical) and past (non-warming vs. historical) climate experiments.

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Hasegawa, A., M. Gusyev, and Y. Iwami (2016) Meteorological drought and flood assessment using the comparative SPI approach in Asia under climate change, J. of Disaster Research, 11(6), 1082-1090, DOI:10.20965/jdr.2016.p1082.

Keywords: meteorological drought, comparative SPI, anthropogenic impacts, climate change, d4PDF

Evaluating Dynamically and Statistically Downscaled Climate Model for Rainfall Extreme: A Case from Karnali Basin in Western Nepal

*Jeeban Panthi[1]

1. Small Earth Nepal

It is well agreed that the climatic extremes events are increasing in last few decades and many scenarios have predicted that those events will increase also in future. There are is an agreement among the climate models on the future increase in temperature, however in case of rainfall, there is a high uncertainty. The global climate models are downscaled either by using the local topography (dynamic) or by establishing a relationship of local weather with the large scale atmospheric phenomenon (statistical). In this paper we attempt to analyze the rainfall extreme events with the dynamically downscaled regional climate models and GCM informed statistically downscaled models for a data scare region of Nepal-Karnali basin. We tested the performances of CORDEX South Asia data and downscaled at the station scale using the SDSM 5.2 (Decision Centric) by providing the GCM informed climate scenarios.

Keywords: Rainfall, Himalayas, Extreme, Models

Evaluation of Uncertainty in Long-term Rainfall-Runoff Forecast for Development of Long-term Prediction Based Water Management System

*SooHee HAN[1], Chanyoung SON[1], Younghyun CHO[1], Aesook SUH[1]

1. Hydrometeorological Cooperation Cenetr

The needs for probabilistic long-term forecast is growing more urgent than ever recently with climate change, because of the greater uncertainty in precipitation, the heightened frequency and intensity of natural disasters such as flood and draught, and the increased social demand for stable water supply. Korea Meteorological Administration, a governmental agency, is currently running a long-term forecast using GloSea5, a global seasonal prediction system, but few research has been done on utilization and application of said system in water management. In this study, we focused on Yongdam Dam and Namgang Dam, the most notable multipurpose dams in Korea's Geum and Nakdong river watershed, respectively; extracted GloSea5's long-term rainfall forecast data (for max. 6 months) for these areas; compared the data with observations and conducted bias correlation on the quantitative differences by the quantile delta mapping (QDM) method; and thereby assessed and measured the accuracy of and the uncertainty in the GloSea5 predictions. In addition, we conducted a long-term runoff analysis taking into account the uncertainty in long-term forecasts, by means of K-DRUM, a distributed rainfall-runoff model generally adopted in dam operations, seeking to establish a long-term plan for dam operation. Our analysis results suggested we could considerably mitigate the quantitative gap between observations and long-term forecasts using the QDM method. The outcome also showed representable patterns comparatively similar to observations. And the result of long-term runoff verification included the observation data within its confidence interval after considering the uncertainty, sufficiently supporting the feasibility of a long-term operation plan for dams. This study concludes it is possible to maintain stable water storages and to plan for water level management by utilizing long-term forecast techniques.

Keywords: GloSea5 Model, Long-term Prediction Forecast, Distributed Rainfall-Runoff Model, Evaluation of Uncertainty

Using HECHMS and WASH123D for operational water stage forecasting of KaoPing River in Taiwan

*Cheng-Hsin Chen[1], Ya-Chi Chang[1], Ming-Chang Wu[1], Dong-Sin Shih[2], I-Chun Hung[3]

1. Taiwan Typhoon and Flood Research Institute, National Applied Research Laboratories, 2. Department of Civil Engineering, National Chung Hsing University, 3. Department of Civil Engineering, National Central University

Extreme typhoon rainfall over Taiwan usually causes severe flood damage. Since the impacts of flooding may include social, economic and environmental problems, it is very important to establish a local flood warning system to prevent or mitigate flood disasters.

In 2010, Taiwan Typhoon and Flood Research Institute (TTFRI) started Taiwan Cooperative Precipitation Ensemble Forecast Experiment (TAPEX) that was designed for providing skillful typhoon predictions to related agencies such as CWB, NCHC, SWCB, WRA, and NCDR. To date, TAPEX has included 26 members and is run operationally 4 times a day. In each run, the 72 hours precipitation forecasts are provided.

The purpose of this study is to establish an operational local water stage forecasting system for KaoPing River in Taiwan using HECHMS as a runoff model and WASH123D as a 1D/2D coupling flood model. Precipitation forecasts provided by TAPEX are used in the forecasting system as the input rainfall data. The performance of the developed forecasting system is verified using rain gauge data and observed water stage data. In addition, a web based data monitoring system is constructed for not only collecting real-time observed data, but also displaying the model results compared with observed data.

Keywords: HECHMS, WASH123D, operational, TAPEX
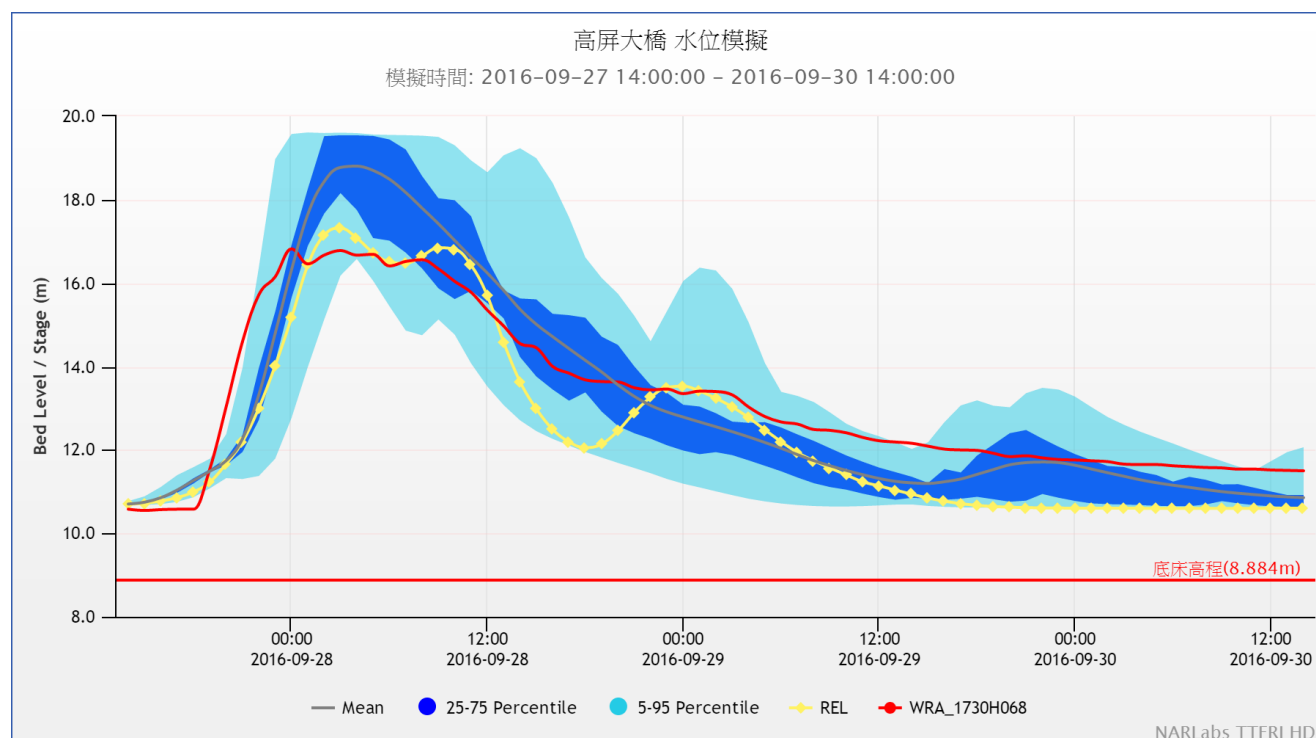
Infrared Sounding Observation of Soil Moisture and Relationship with Skin Temperature

*Daniel K Zhou[1], Allen M Larar[1], Xu Liu[1]

1. NASA Langley Research Center

We have developed a simple, yet effective scheme to derive volumetric soil moisture (VSM) using infrared (IR) land surface emissivity retrieved from satellite measured IR spectral radiance. This novel scheme is applied to a 10-year period of global IR emissivity data retrieved from MetOp-A Infrared Atmospheric Sounding Interferometer (IASI) measurements. The VSM calculated from these IR emissivity data (denoted as IR-VSM) is compared with that routinely retrieved from satellite microwave (MW) multi-sensor measurements (denoted as MW-VSM). Monthly-mean spatially-gridded climatology datasets are then generated to demonstrate VSM spatial variation as well as its seasonal-cycle and inter-annual variability. Positive agreement is shown to exist between IR- and MW-VSM. The relationship between soil moisture and surface skin temperature, as well as the skin temperature diurnal difference (denoted as dTs), were examined globally using the land surface skin temperature (denoted as Ts) retrieved from the same measurements of IASI. We are able to draw the conclusion that both skin temperature and skin temperature diurnal differences follow an inverse relationship with soil moisture.

Keywords: Remote sensing, Infrared, retrieval, soil moisture, skin temperature

Simulating soil moisture dynamics in the overexploited Indo Gangetic alluvium area in Central Punjab, India

*Sakambari Padhi[1], R. Rangarajan[2], Tomochika Tokunaga[1]

1. Department of Environment Systems, Graduate School of Frontier Sciences, The University of Tokyo, Kashiwa, Chiba- 2778563, Japan, 2. Ground Water Division, National Geophysical Research Institute, Uppal Road, Hyderabad-500007, India

In arid and semiarid areas, accurate estimation of groundwater recharge is essential for sustainable management of water resources. In the Indo-Gangetic alluvial plains of Punjab region, India, groundwater is the main source of irrigation. Insufficient rainfall associated with intensive cultivation in the alluvial plains of this region has resulted in the degradation of groundwater regime both in quality and quantity. In view of moderate to low rainfall in the region, return flow from applied irrigation is likely to be a major source of groundwater recharge. In this study, we estimated the contribution of irrigation return flow on groundwater recharge in paddy fields by modeling water flow in the vadose zone using the HYDRUS-1D software and compared the results with the estimated recharge on a rainfed site by the injection of tritium.

Three representative sites in the alluvial plain were selected, one rainfed site and two fields under rice cultivation. For each site, soil moisture was monitored in situ by vertical neutron probe surveys. The hydraulic properties of the soils at the site were determined using in situ experiments and laboratory measurements. Tritium was injected at selected sites and groundwater recharge was estimated from the depth profile of tritium.

At each site, the 1-dimensional flow model was calibrated using climate, soil hydraulic property, and groundwater levels data, and was validated using the measured soil moisture content. Good agreement was achieved between the HYDRUS-1D simulations and field measurements of moisture content for both rainfed and paddy cultivated sites. Based on the calculated results, unsaturated moisture influx was estimated.

Keywords: Irrigation return flow, Soil moisture dynamics, Modeling

Development and Application of a Distributed Source Pollutant Transport Model Based on BTOPMC

Development and Application of a Distributed Source Pollutant Transport Model Based on BTOPMC

*zhang Hongbo[1]、Ao Tianqi[2]、Maksym Gusyev[3]、Li Xiaodong[2]、Wang Haijun[1]、Liu Juan[1]
*bo hong zhang[1], Tianqi Ao[2], Gusyev Maksym[3], Xiaodong Li[2], Haijun Wang[1], Juan Liu[1]

1. KMUST、2. SCU、3. ICHARM
1. KMUST, 2. SCU, 3. ICHARM

   Agricultural non-point and industrial point sources are contributing nitrogen and phosphorus concentrations in Chinese catchments and these pollutants cause degradation of river water quality for a long distances. To evaluate these impacts, a distributed pollutant transport model was developed on the basis of BTOPMC (Block-Wise Use of TOPMODEL with Muskingum-Cunge Method), a grid-based distributed hydrological model. In this model, the water flow routing process of BTOPMC is the carrier of pollutant transport and these pollutants are washed off with a direct runoff. Pollutant flux for each grid is simulated based on mass balance of pollutants within the grid and pollutant transmission occurs between grids in the direction of the water flow on daily time steps. The model was tested in the study area of the Lu county area situated in the Laixi river basin in the Sichuan province of southwest China. The simulated concentrations of nitrogen and phosphorus are compared with the available monthly data at several water quality stations. These results demonstrate a greater pollutant concentration in the beginning of high flow period indicating the main mechanism of pollution transport. From these preliminary results, we suggest that the distributed pollutant transport model can reflect the characteristics of the pollutant transport and reach the expected target.

キーワード：Pollutant transport、BTOPMC、Distributed hydrological model、Muskingum-Cunge
　　　　　　Method、Modeling
Keywords: Pollutant transport, BTOPMC, Distributed hydrological model, Muskingum-Cunge Method,
　　　　　　Modeling

印旛沼流域における窒素負荷量の再検討
Reexamination of Nitrogen Loading in Inbanuma Basin

*堀江 政樹[1]、濱 侃[2]、藤村 葉子[3]、近藤 昭彦[4]
*Masaki Horie[1], Akira Hama[2], Yoko Fujimura[3], Akihiko Kondoh[4]

1. 千葉大学理学部、2. 千葉大学大学院理学研究科・日本学術振興会特別研究員DC、3. 元千葉県環境研究センター、4. 千葉大学環境リモートセンシング研究センター
1. Faculty of Science, Chiba University, 2. Graduate School of Science, Chiba University・JSPS Research Fellow, 3. Former Chiba Prefectural Environmental Research Center, 4. Center for Environmental Remote Sensing, Chiba University

1．はじめに

　地球規模の窒素過多・窒素飽和により、人類に与える影響として最も深刻な環境要素の1つに窒素循環が挙げられている[1]。窒素循環の不健全化が引き起こす問題として閉鎖性水域の富栄養化問題があるが、日本では湖沼法のもとで湖沼水質保全計画を策定し、水質改善を図っている。千葉県の印旛沼は指定湖沼の一つであり、過去30年以上にわたり、水質改善の取り組みが行われている．印旛沼湖沼水質保全計画では原単位を使用した発生汚濁負荷量の算定が行われているが、印旛沼への窒素負荷量は土地利用の変化や下水道普及率の上昇に伴い、年々減少傾向にあるとされている．それにも関わらず印旛沼の全窒素濃度は、環境基準を超過したまま下げ止まりの状況が続いている。個々の土地利用、水処理形態に対応する原単位は過去に設定された値が継続して使われてきたが、過去30年間で変化した社会のあり方、調査研究の進展、等を鑑みて原単位を再評価する必要性があると考えられる。これを受けて、藤村(2015)では原単位に関する検討が行われ、一部の項目で新たな値が提案された[2]．そこで本研究では、湖沼水質保全計画で使われている原単位と藤村(2015)による原単位を用いて、印旛沼流域の窒素負荷量分布図を作成し、比較することにより原単位に関する検討を行った。

2．研究手法

　印旛沼流域を、行政界と流入河川ごとの集水域で分割した区画ごとに、原単位に2010年の統計データを掛けることで、区画ごとに窒素負荷量を算出した．この統計データは千葉県環境生活部水質保全課から提供していただいた。窒素負荷量は、宅地からの生活系負荷量、家畜からの畜産系負荷量、山林や畑地などの面源汚濁負荷である自然系負荷量、事業場からの事業場系負荷量に分類できる．これらの分類した窒素負荷量を、印旛沼流域水循環健全化会議によって作成された2007年の土地利用図の土地分類ごとに、生活系負荷量は宅地に、畜産系負荷量は畑に、事業場系負荷量は市街地に、自然系負荷量は山林や畑地などの土地分類ごとに割り当てた．その後、流域の負荷量データの精度及び分割後の総メッシュ数を勘案し、250mメッシュに分割することで窒素負荷量分布図を作成した．得られた負荷量の妥当性を検討するために、全窒素濃度の水質測定地点を流出口とする集水域を設定し、その集水域における窒素負荷量と流出口における実測の窒素流出量を比較した．窒素流出量は、千葉県環境生活部水質保全課の観測による全窒素濃度と、印旛沼流域水循環健全化会議の観測による河川の流量から算出した．

3．結果・考察

　印旛沼流域の各集水域の窒素負荷量と窒素流出量との相関関係をもとに、回帰モデルを導くと、両者の間に良好な直線関係が示され、集水域における窒素負荷が河川の窒素流出量を増加させていることが示された．湖沼水質保全計画の原単位を使用した場合、回帰直線の傾きは1.40となり、窒素流出量が窒素負荷量を大きく上回ったことから、窒素負荷量を大きく過小評価している可能性がある。一方、藤村(2015)による提案原単位を使用した場合、傾きは1.09となり、窒素負荷量が窒素流出量とほぼ釣り合う結果となった．しかし、現実の流出過程では、脱窒過程により負荷された窒素は減少すると考えられるため、窒素流出量が窒素負荷量を上回ることは考え難く、提案原単位においても窒素負荷量を過小評価している可能性がある。また、本研究で使用した窒素流出量は平水時の観測値から算出したものであり、降雨時のファーストフラッシュによる窒素流出量が考慮されていない。よって、湖沼水質保全計画の原単位はもとより、提案原単位においてもその値は過小評価されている可能性がある。

　流域における窒素負荷量を正確に算定することは印旛沼の水質改善のための基本的なアクションである。今後は調査研究を推進することにより、水循環・窒素循環の実態に即した原単位の算定を行う必要がある。最終的には物理性に基づいたプロセス指向の水・物資循環モデルにより定量的な窒素循環の認識が望ましいが、流域の多様性、物理プロセスの複雑さに起因する解決すべき課題が多く残されている。降雨時の窒素流出量の観測、窒素流出量の季節変化に関する検討、等の課題を解決しながらより実態に合った原単位を求めることにより、印旛沼への窒素負荷量の精度を高めていく予定である。
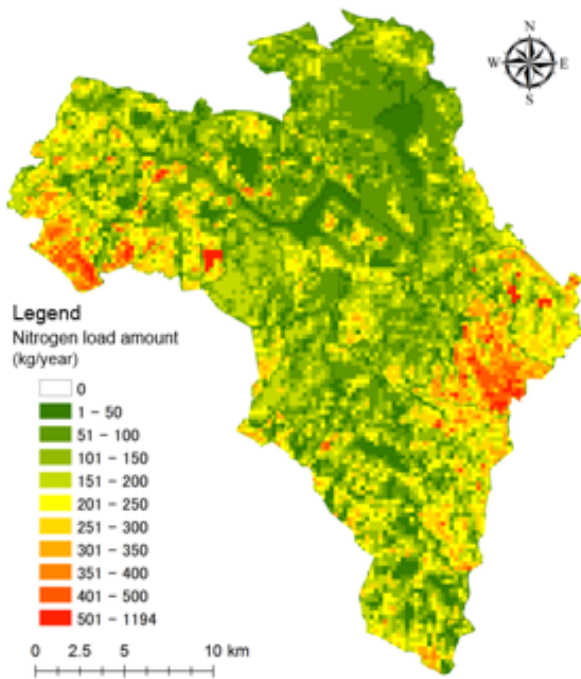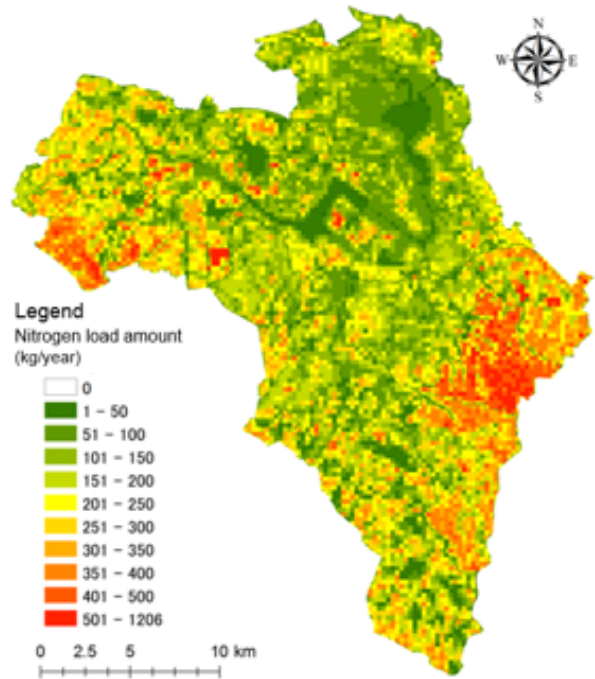
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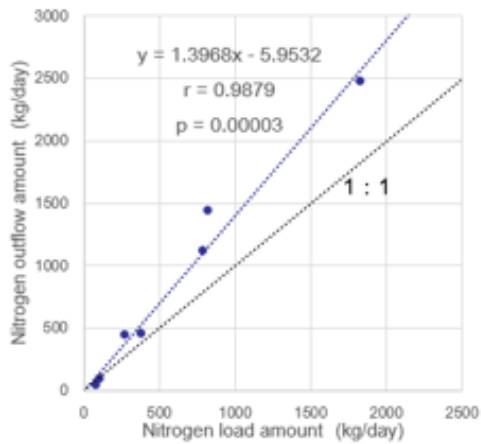　2）藤村葉子，2015，印旛沼・手賀沼の湖沼水質保全計画における面源負荷原単位の現状と課題について．第18回日本水環境学会シンポジウム．

キーワード：窒素循環、原単位、脱窒
Keywords: nitrogen circulation, unit load, denitrification

Legend
Nitrogen load amount
(kg/year)

- 0
- 1 – 50
- 51 – 100
- 101 – 150
- 151 – 200
- 201 – 250
- 251 – 300
- 301 – 350
- 351 – 400
- 401 – 500
- 501 – 1194

0 2.5 5   10 km

Nitrogen load amount distribution map
～Unit load of Lake Water Quality Conservation Plan～

Legend
Nitrogen load amount
(kg/year)

- 0
- 1 – 50
- 51 – 100
- 101 – 150
- 151 – 200
- 201 – 250
- 251 – 300
- 301 – 350
- 351 – 400
- 401 – 500
- 501 – 1206

0 2.5 5   10 km

Nitrogen load amount distribution map
～Unit load of Fujimura (2015)～

y = 1.3968x - 5.9532
r = 0.9879
p = 0.00003

1 : 1

Unit load of Lake Water Quality Conservation Plan
Diagram showing the relationship between nitrogen load amount
and nitrogen outflow amount

y = 1.0938x + 10.962
r = 0.9867
p = 0.00004

1 : 1
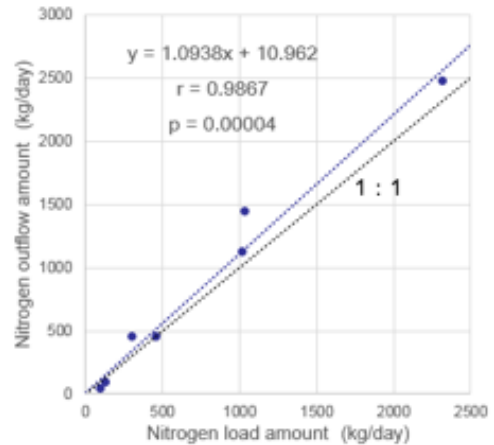
Unit load of Fujimura (2015)
Diagram showing the relationship between nitrogen load amount
and nitrogen outflow amount

琵琶湖に生息する魚類の水銀濃度とそのヒト健康リスク評価
Mercury speciation in fish muscles from Lake Biwa and human health risk assessment

*永淵 修[1]、中澤 暦[1]
*Osamu Nagafuchi[1], Koyomi Nakazawa[1]

1. 福岡工業大学
1. Fukuoka Institute of Technology

Fish are exposed to metals via both aqueous and dietary routes. Some metals such as mercury (Hg) come mainly from dietary sources, with accumulation from aqueous routes providing a small contribution to the total Hg burden. Many studies have been conducted to understand the Hg accumulation focused on marine fish, however, only a few study has been conducted in fresh water. People who live near lake may also eat fresh water fish as well as marine fish. Therefore, it is important to understand the mercury concentration in fresh water fish as well as marine water fish. In our study, mercury concentration and other metals in fish was measured caught from Lake Biwa, the largest lake in Japan. Result from mercury concentration in fish, we estimated the human health risk caused from fish intake. Sampling was conducted during May 2011 to May 2012 sampling campaign. 82 fish sample, plankton sample, and water sample were sampled in Lake Biwa. Mercury concentration in fish muscle tends to be high as the trophic level going up.

キーワード：水銀、魚、琵琶湖
Keywords: mercury, fish, Lake Biwa

水の微量元素組成による地域特性化の試み
Regional characterization of river and spring waters by trace element signature

*平岡 達也[1]

*tatsuya hiraoka[1]

1. 東京理科大学
1. Tokyo University of science

　食品の表示偽装が問題視されている近年、その原料産地を科学的に特定する分析技術が求められている。こうした背景から当研究室では、微量元素組成や同位体比を指標とした食品・農作物の産地判別法の開発を進めており、昨年度からは平成20年に環境省が選定した「平成の名水百選1)」の河川水および湧水を対象とした研究を開始した。水は食品の生産工程、および野菜や農作物の栽培において不可欠であることから、水の微量元素情報は産地判別のための重要な指標となる。水は岩石との相互作用で元素が溶出すると考えられ、地質などの地球科学的情報と関連付けた水の地域特性化が期待される。

　日本全国40地点（河川16地点、湧水24地点）にて、超純水および10%硝酸で予め洗浄したポリエチレン製容器を用いて現地で採水を行い、3%硝酸を加え約4℃の冷暗所で保存した。孔径0.45 μmメンブランフィルターによるろ過により沈殿物を除去し、分析試料とした。軽元素（Na, Mg, K, Ca, Si）の定量には誘導結合プラズマ発光分析装置（ICP-AES：SPS3520UV）を用いて、その他の微量元素（Li, Al, V, Cr, Mn, Co, Ni, Cu, Zn, Rb, Sr, Ba, 希土類元素：REE）の定量には四重極型誘導結合プラズマ質量分析装置（ICP-MSS：Agilent 7500c）を用いた。定量下限を下回るREEはノビアスキレートを用いた濃縮を行った。分析には、内標準元素として115Inを添加し、検量線法を用いることで、20元素以上の濃度の定量を行った。またICP-MSの分析においては、一部の元素についてコリジョンリアクションセルを用いた干渉除去を行った。

　まず検出された各微量元素の由来について考察を行った。Liについては、福島県の荒川、群馬県の神流川源流、山梨県の金峰山・瑞牆山源流で採水された河川水試料で高濃度を示した。この結果は、これらの河川源流では母岩がLiを多く含む花崗岩地質であるためと推察される。なお、他の河川水、湧水試料においては、上流が花崗岩地質ではないところでは、高濃度のLiは検出されなかった。また、富山県の弓の清水は多くのREEを高濃度で含んでいた。弓の清水の付近は堆積岩が広く分布しており、堆積岩中に含まれる燐灰石が風化した際、REEのリン酸塩として溶出した2）と考えられる。長野県のまつもと城下町湧水群は、分析した40試料の中でMg, Ca濃度が最も高かった。Mgは源流である美ヶ原高原の付近に堆積する凝灰岩、Caは石灰岩の影響を受けているとの指摘がある3）。また、高濃度のVが源兵衛川、湧玉池・神田川、十日市場・夏狩湧水群で検出された。いずれも静岡県、山梨県であり、玄武岩地質を反映していると考えられる。

　以上より、湧水や河川水中の微量元素組成はその付近の地質を強く反映していることが示唆された。今後は試料の拡充を進め、さらなる地域特性化と食品の起源分析への応用を目指す。

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キーワード：水、微量元素、ICP-MS / AES
Keywords: water, trace element, ICP-MS / AES

伊豆諸島各島における水質と地質の関係性
Relation between water component and geological conditions in Izu Islands

*大森 寛子[1]、大宮山 怜[1]、木下 絵美[3]、安井 万奈[2]、山崎 淳司[2]、萩谷 宏[1]

*Hiroko Omori[1], Rei Omiyama[1], Emi Kinoshita[3], Mana Yasui[2], Atsushi Yamazaki[2], Hiroshi Hagiya[1]

1. 東京都市大学、2. 早稲田大学、3. 株式会社アサノ大成基礎エンジニアリング
1. Tokyo City University, 2. Waseda University, 3. Asano Taiseikiso Engineering Co.,Ltd

　伊豆諸島を中心に、地質条件が湧水や地下水に与える影響を検討した。玄武岩質火山である伊豆大島、利島、三宅島、八丈島と流紋岩質火山である新島、神津島における湧水や河川水などの水試料全147試料についてICP発光分光分析法、イオンクロマトグラフィーを用いて、各種陽イオン、陰イオンの分析を行った。また、各島83か所における岩石試料の成分分析を蛍光X線分析装置(XRF)を用いて行った。

　その結果、海水組成比Mg^2/Clと比較して玄武岩質火山地域の湧水・地下水にはMg^2の含有が多く、流紋岩質火山地域の湧水・地下水にはMg^2の含有が少ない傾向が見られた。

　また、Mg^2/Ca^2を比較した結果、玄武岩質火山地域のほとんどの水試料と岩石組成比の一致が見られたが、大島の筆島付近で採水した水試料については岩石組成比とのずれが見られ、斑晶の多い筆島火山の岩石の風化プロセスとの関係が考えられる。

　さらに、海水組成比SO^{2-}/Clと水試料を比較した結果、大島の一部と三宅島の水試料には火山ガス由来と思われるSO^2-が多く含まれていた。

キーワード：湧水、地下水、玄武岩質火山、流紋岩質火山、伊豆諸島
Keywords: spring water, groundwater, basaltic volcano, rhyolitic volcano, Izu Islands

離島の水環境に関する比較研究ー長崎県の島嶼を中心にー
A comparative Study on Water Environment of Isolated Islands - Focusing on Islands in Nagasaki Prefecture -

*矢巻 剛[1]、小寺 浩二[1]、浅見 和希[1]、阿部 日向子
*Go Yamaki[1], Koji Kodera[1], Asami Kazuki[1], Hinako Abe

1. 法政大学水文地理学研究室
1. Hosei University Lab.Hydrogeography

　Ⅰ　はじめに　日本には数多くの島嶼が存在し、その独立した環境のためそれぞれ独特の環境を呈する。その多くが比較的小規模で限られた空間であるため、農業などの人間活動のみならず雨水などの降下物の影響が大きく反映される傾向にある。しかし、対馬・壱岐・五島列島に関するものは比較的少ない。本研究では、それぞれの島の陸水や雨水の水質の特性を比較しながら水環境の現状を明らかにすることを目的とする。

　Ⅱ　対象地域　壱岐島は九州北部の玄界灘に位置する面積136.69km²で、地形がなだらかで島の各地に多くの溜池が分布する。対馬は面積約708 km²で壱岐島と比べ標高が高く約89％を山地が占め、大部分が堆積岩で表土も薄く岩石が露出する。五島列島は長崎港から西100kmに位置し総面積約690 km²で、北東から南西に80kmに渡り約140の島々が連なり、地形が変化に富み各島ごとに大きく地質条件が異なる。

　Ⅲ　研究方法　2014〜2016年の春季と秋季に水文観測を行った。現地で気温、水温、EC、pH、RpHを測定し、サンプルを持ち帰りTOCの測定、イオンクロマトグラフィーによる主要溶存成分の分析を行った。雨水についても毎月採取したサンプルを同様に分析した。

　Ⅳ　結果・考察　ほぼ全ての島の陸水には海塩の影響が見られ、壱岐島では海塩よりも地質による寄与が大きく、対馬では上島と下島で水質組成が異なり、下島は風送塩の影響が顕著で、五島列島では地質や土地利用の影響が大きく、壱岐島や対馬と比較して硝酸が多く検出された。

　Ⅴ　おわりに　今後は小流域での解析を進めてゆくほか、より各島における陸水の特徴を明確にしたい。

キーワード：壱岐島、対馬、五島列島、雨水、水環境
Keywords: Iki Island, Tsushima Island, Goto archipelago, rainwater, water environment
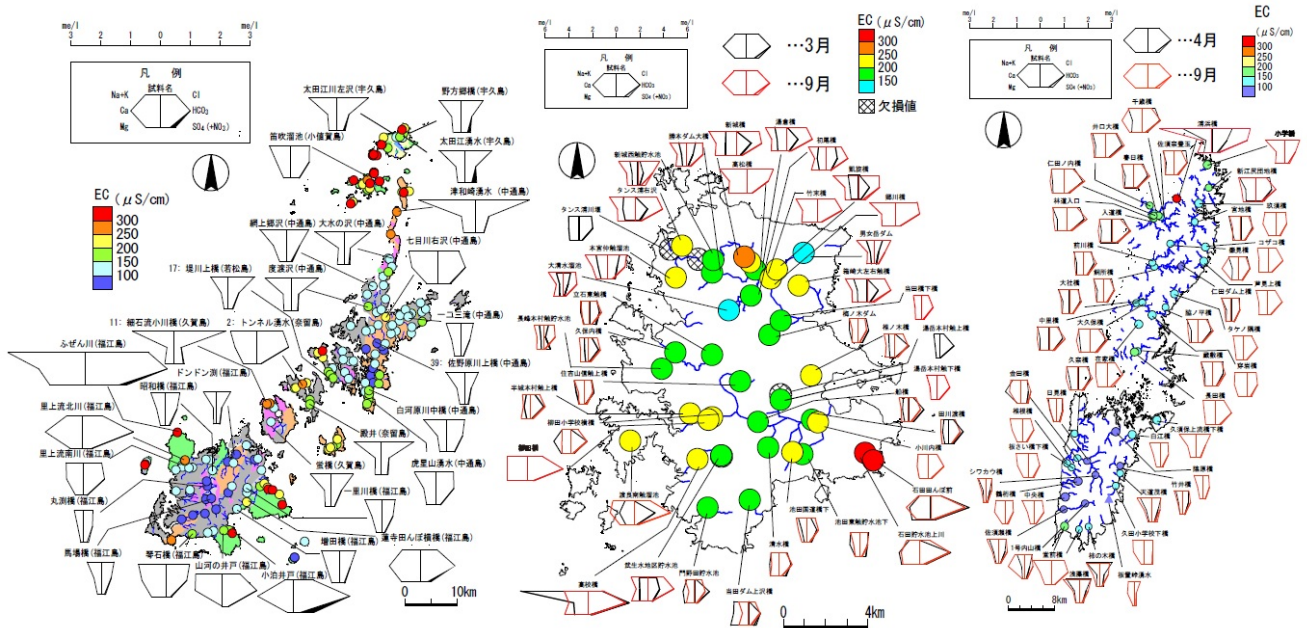
日本の活火山周辺の水環境　－御嶽山・浅間山・箱根山を中心に－
A comparative study of the water environment around active volcano in Japan - mainly Mt.Ontake, Mt.Asama and Mt.Hakone

*猪狩 彬寛[1]、小寺 浩二[1]、浅見 和希[1]、堀内 雅生[1]
*Yoshihiro IGARI[1], Koji Kodera[1], Kazuki ASAMI[1], Masaki HORIUCHI[1]

1. 法政大学水文地理学研究室
1. Hosei University Lab. for hydrogeography

　Ⅰ　はじめに　日本列島には数多くの活火山が存在しているが、その形成要因や山体を構成する成分などは火山によって異なる。また、火山活動の影響で、火山周辺の河川や湧水の水質にも変化が表れることが予想される。そこで、2014年から活動が盛んになった御嶽山、浅間山、箱根山、の3つの火山地域において継続的な水質調査を行った結果を報告する。

　Ⅱ　研究方法　御嶽山では2014年から、浅間山と箱根山は2015年から、それぞれ継続調査をしている。現地調査項目はAT,WT,pH,RpH,EC等である。現地では採水も行ない、持ち帰ったサンプルは、研究室にてTOC,主要溶存成分の分析などを行なっている。

　Ⅲ　結果と考察

　1．pHの比較　pHを比較すると、御嶽山、箱根山では、山体から流れ出る河川の中に酸性を示すものがある一方、浅間山ではアルカリ性を示す河川が多く存在する。

　2．電気伝導度の比較　電気伝導度(EC)は、御嶽山の周辺河川で全体的に値が小さく、浅間山、箱根山の周辺河川で全体的に値が大きい傾向が見られた。特に、箱根山には3000μS/cmを超える河川が存在する。

　3．溶存成分の比較　3地域とも、EC値の小さい地点はCa-$(HCO_3)_2$型の水質組成を示す傾向が見られるが、値が大きい地点では地域によって組成に差が見られ、御嶽山では Ca-SO_4 型の水質が多い。箱根山は温泉地ということもあり、Ca-SO_4 型のほか、Na-Cl型やCa-Cl型の水質組成も見られる。浅間山は、他の地域と比べて、Mg^{2+} の比率が高い地点が多い傾向にあり、Mg-$(HCO_3)_2$型やMg-SO_4型の水質組成が見られる。
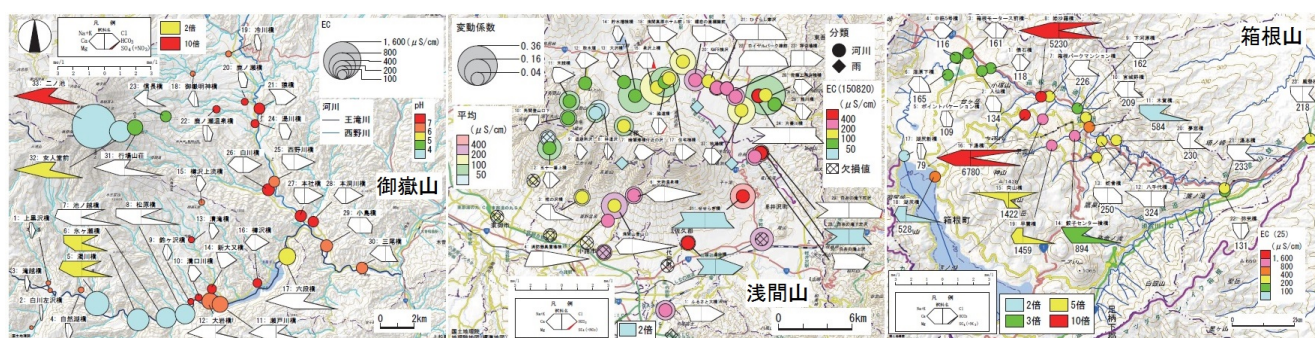
　Ⅳ　おわりに　活火山地域の水質の特性がある程度見えてきた。今後は条件を絞りつつ東北地方や九州地方にある火山地域についても調査を進め、さらに特性を明確にしたい。

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キーワード：活火山、噴火、水質、溶存成分、地質
Keywords: Active Volcano, Eruption, Water quality, Dissolved component, Geology

別府温泉の流動経路と微動アレイ探査によるS速度分布との関係
The relationship between flow path of Beppu Onsen and S velocity distribution by microtremor array survey.

*宮下 雄次[1]、濱元 栄起[2]、山田 誠[3]、谷口 真人[3]、先名 重樹[4]、西島 潤[5]、成富 絢斗[7]、三島 壮智[6]、柴田 智郎[6]、大沢 信二[6]

*Yuji Miyashita[1], Hideki Hamamoto[2], Makoto Yamada[3], Makoto Taniguchi[3], Shigeki Senna[4], Jun Nishijima[5], Kento Naritomi[7], Taketoshi Mishima[6], Tomo Shibata[6], Shinji Ohsawa[6]

1. 神奈川県温泉地学研究所、2. 埼玉県環境科学国際センター、3. 総合地球環境学研究所、4. 防災科学技術研究所、5. 九州大学、6. 京都大学地球熱学研究施設、7. 九州大学・院
1. Hot Springs Research Institute of Kanagawa Prefecture, 2. Center for Environmental Science in Saitama, 3. Research Institute for Humanity and Nature, 4. National Research Institute for Earth Science and Disaster Prevention, 5. KYUSHU UNIVERSITY, 6. Institute for Geothermal Sciences, Kyoto University, 7. KYUSHU UNIVERSITY, Graduate School

　別府温泉では、大沢ほか(1994)及び、大沢・由佐(1996）により、別府温泉南部地域並びに北部地域における温泉水の流動経路が明らかにされている。これらの流動経路は、泉質ごとに3〜4種類に区分され、立体的に重なり合いながら、分岐や変曲が見られる。

　これらの流動経路と地質構造との関係を明らかにするため、半径0.6m〜350mの微動アレイ探査を105地点で実施し、S波速度の三次元分布を明らかにした。

　その結果、南部地域においては、標高-300mにある透水性が低い基盤とみられるS波速度の速い領域にNa-Cl型の温泉流路が遮られ、それらの両側に回り込んでいることが明らかとなった。

　一方、北部地域では、Ca-Mg-HCO3型の流路が、標高-100〜-200mにおける透水性が低いS波速度の高い領域にぶつかって北方に変曲していた。そして、標高-400〜-600mでは、透水性が比較的高いS波速度が中程度の領域部分を、Na-Cl型の温泉が通過して東方に流下していた。

キーワード：別府、微動探査、温泉流動経路
Keywords: Beppu, microtremor array survey, Flow path of Beppu Onsen

Preliminary paleomagnetic results from the manganese wad deposit at the Niimi hot springs, Hokkaido.

*川崎 一雄[1]、鈴木 秀乙[2]
*Kazuo Kawasaki[1], Hideto Suzuki[2]

1. 富山大学大学院理工学研究部（理学）、2. 富山大学理学部
1. Graduate School of Science and Engineering for Research, University of Toyama, 2. Faculty of Science, University of Toyama

Paleomagnetic results are reported for the manganese wad deposit at the Niimi hot springs, Hokkaido, Japan. The hot spring is located at the foot of Mt. Shyakunage in the active Niseko volcanic area. The area is covered by Quaternary pyroclastics erupted from Mt. Syakunage. The manganese wad deposit was formed from the hot spring water by biomineralization processes. The hot spring's water emerges from a local spa that closed in March 2016 and forms two small waterfalls. Paleomagnetic analysis was done on 144 manganese wad specimens that were collected from a wall surface next to one waterfall. The wad was about ˜65 cm in thickness and oriented specimens were collected with 7 cc non-magnetic plastic cube at 14 levels between ˜5.5 cm and ˜62 cm in thickness. Alternating field step demagnetization appears to isolate either one or two stable characteristic remanent magnetization (ChRM) components. The lower coercivity component shows clustered ChRM directions at each sampling level and likely retains paleosecular variation. Conversely, the higher coercivity component shows scattered directions. When the observed ChRM directions are compared with the paleosecular variation records for Japan, the duration of the manganese wad deposition appears to have lasted at least 600 years. In other words, the regional hydrothermal system has been active for at least 600 years.

キーワード：古地磁気学、マンガン土、熱水流体
Keywords: Paleomagnetism, Manganese wad, Hydrothermal fluid