

Introduction of the SCOSTEP' s VarSITI program - Variability of the Sun and Its Terrestrial Impact

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The Scientific Committee on Solar Terrestrial Physics (SCOSTEP) is an interdisciplinary body of the International Council for Science (ICSU) to run international interdisciplinary scientific programs and promotes solar-terrestrial physics research. The last solar minimum in 2008-2009 and the current solar maximum of sunspot cycle 24 show much lower activities compared with the previous two solar cycles 22 and 23. The scientists in the solar-terrestrial physics are watching very low solar activities and their consequences on Earth, which have never been observed since modern scientific measurements become available. The SCOSTEP program "Variability of the Sun and Its Terrestrial Impact (VarSITI)" (2014-2018) will focus on this particular low solar activity and their consequences on Earth, for various times scales from the order of thousands years to milliseconds, and for various locations and their connections from the solar interior to the Earth's atmosphere. In order to elucidate various sun-earth connections, we encourage communication between solar scientists (solar interior, sun, and the heliosphere) and geospace scientists (magnetosphere, ionosphere, and atmosphere). Campaign observations will be promoted for particular interval in collaboration with relevant satellite and ground-based missions as well as modeling efforts. Four scientific projects will be carried out in VarSITI as (1) Solar Evolution and Extrema (SEE), (2) International Study of Earth-Affecting Solar Transients (ISEST/Minimax24), (3) Specification and Prediction of the Coupled Inner-Magnetospheric Environment (SPeCIMEN), and (4) Role Of the Sun and the Middle atmosphere/thermosphere/ionosphere In Climate (ROSMIC). In this presentation we introduce the VarSITI program and its four projects to promote interdisciplinary studies among different fields.

キーワード: VarSITI, 太陽活動, 気候変動, 大気圏, 電磁気圏, 太陽圏

Keywords: VarSITI, solar activity, climate change, atmosphere, magnetosphere and ionosphere, heliosphere

California Nino/Nina in boreal summer California Nino/Nina in boreal summer

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Anomalous warming/cooling in the coastal ocean off Baja and Alta California has attracted broad attention due to its significant impacts on the coastal marine ecosystem. The anomalous warming/cooling has been attributed, especially in boreal winter, to the remote forcing of the tropical El Nino/Southern Oscillation (ENSO) through both oceanic and atmospheric teleconnections and/or the ENSO-independent basin-wide atmospheric circulation anomalies in mid-latitudes. In the present study, we show for the first time the existence of coastal air-sea coupled phenomenon in the coastal ocean off Baja and Alta California in boreal summer. An initial decrease/increase in the southward alongshore surface winds along the coast weakens/strengthens the coastal upwelling and raises/lowers the coastal sea surface temperatures (SSTs) through oceanic mixed-layer processes. The resultant coastal warming/cooling, in turn, heats/cool the overlying atmosphere anomalously, decreases/increases the atmospheric pressure in the lower troposphere, generates an anomalous cross-shore pressure gradient, and thus reinforces or maintains the alongshore surface wind anomalies. The air-sea coupled phenomenon is analogous to the well-known ENSO in the tropical Pacific but with much smaller time and space scales, and referred to as California Nino/Nina (CAN) after the pioneer work that describe the warming events in the coastal ocean off Baja and Alta California as California El Nino.

キーワード: California Nino/Nina, coastal air-sea interaction

Keywords: California Nino/Nina, coastal air-sea interaction

River discharges, ocean circulation and material transport in Japanese coastal waters: simulation with JCOPE ocean model
River discharges, ocean circulation and material transport in Japanese coastal waters: simulation with JCOPE ocean model

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The total volume of fresh water discharged by rivers into the world ocean is incompatible with the total mass of ocean waters; however these discharges contribute significantly into formation of fresher coastal waters and details of coastal ocean circulation.

This impact is not local, and supports presence of lower salinity waters in wide coastal areas along Japanese coast. In an absence of rivers in ocean model for appropriate reproducibility of ocean surface salinity it is often required to apply salinity restoration approach. Additionally, rivers could bring to ocean surface-floating, suspended and dissolved substances, some of which are hazardous, like radioactive materials initially dropped on the ground following such disasters as Fukushima Dai-Ichi nuclear power plant accident. These could be washed to rivers by strong rainfalls.

Method of counting inflow of fresh water from rivers as horizontal fluxes to the designated model cells is used. Demonstrated are direct impacts of rivers on formation of fresher waters along the coast of Japan and some cases of induced by discharges local ocean circulation patterns near the river mouth locations. A preliminary experiment when the model utilizes the hourly information on the amount of river discharges demonstrates an importance of such approach for the correct simulation of transport processes in extreme conditions like the typhoon-induced precipitations that often take place in Japan and East Asia. For achieving of this capacity, we are looking for utilization of simple land waters hydrological models for main river basins that could transfer the detailed meteorological precipitation forecast information into the approximate forecasts of river discharges.

キーワード: river discharge, ocean circulation, river-ocean interaction, coastal ocean processes

Keywords: river discharge, ocean circulation, river-ocean interaction, coastal ocean processes

東日本大震災に伴う、パーフルオロアルキル基を有する化学物質の日本沿岸から北西太平洋への突発的流入
A spike-like input of perfluoroalkyl substances into the Western North Pacific from the Japanese Coast associated with t

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The recent great earthquake of magnitude 9.0 on 11 March 2011 followed by TSUNAMI and fire in Japan has resulted in serious environmental problems in and around Japan. A huge amount of materials has been discharged into the ocean after the tremendous flood damage by TSUNAMI. A research group of the National Institute of Advanced Industrial Science and Technology has sampled the perfluoroalkyl substances (PFAs), which are chemical materials included in the industrial products, in the Western North Pacific for past a few years. They found some evidences showing an abrupt increase of the PFAs concentration east of Japan in 2011 after the great earthquake. To confirm the anomalous input of two typical PFAs (PFOA and PFOS) from the Japanese coast into the ocean, we conducted a series of chemical tracer simulations using an eddy-resolving ocean reanalysis product, JCOPE2, by assuming the oceanic dispersion of the PFAs dissolved in sea water mainly driven by the ocean current. Comparison of the simulation results with the observation actually indicates a spike-like input of PFOA into the Western North Pacific after the great earthquake; however, the simulations could not well explain the observed distribution of PFOS, suggesting some differences in the oceanic dispersion processes between PFOA and PFOS. We discuss estimates of the total emission amounts of PFOA and PFOS based on a simple process representing the TSUNAMI effect on the emission from the land.

キーワード: パーフルオロアルキル基, 東日本大震災, 海洋分散, 津波, 海洋観測, 数値シミュレーション

Keywords: perfluoroalkyl substances, the great earthquake 0311, oceanic dispersion, Tsunami, oceanic observation, numerical simulation

スーパーコンピュータ「京」を用いた集中豪雨の超高解像度実験 Super high resolution experiments of torrential rainfall events with the K super computer

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近年、局所的な大雨による災害が増加している。例えば、神戸では2008年7月にゲリラ豪雨による突発的な洪水が発生し、昨年は伊豆大島で土石流が発生し、人命が失われる等の被害を引き起こした。これらの災害で特徴的なのは、狭い範囲で雨の降り方が異なる点である。神戸のケースでは、14km²の小さな流域の3割を占める都市部からの流出が7割であった事が報告されている。伊豆大島のケースでは、4kmしか離れていないアメダス観測所の雨量が約2倍も違っていた。これらの現象は地形に強く依存していると考えられており、気象モデルで、数百mスケールの高解像度実験を行う事は非常に重要である。発表では、スーパーコンピュータ「京」と気象庁非静力学モデル (JMA-NHM) を用いて行った結果を報告する。

キーワード: 数値気象モデル, 気象庁非静力学モデル, スーパーコンピュータ京
Keywords: Numerical weather prediction model, JMA-NHM, Kei super computer

Interannual variability of Kuroshio nitrate flux and transport along western boundary in the North Pacific Interannual variability of Kuroshio nitrate flux and transport along western boundary in the North Pacific

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An eddy-resolving coupled physical-biological ocean model has been employed to examine the interannual variability of nitrate flux and transport mechanism by the Kuroshio during 1995-2012. The Kuroshio provides an advective flux of nitrate carried in subsurface waters, redistributing nitrate from the tropics to the mid-latitude. Some observed data capture the nitrate flux and transport in the subsurface layers by the Kuroshio. The maximum nitrate flux core appears about 400 m depth in the East China Sea, and the nitrate transport by the Kuroshio had a mean of 170 kmol s⁻¹. The model reproduces the maximum nitrate flux core in the subsurface layer from the Luzon strait to the Kuroshio Extension with the downstream. Along the vertical section of east side of Taiwan (24N), west side of Okinawa (28N), south of Kagoshima (130E), the time series of nitrate flux, volume transport, and nitrate concentration show the interannual variation. The variability of nitrate flux is strongly correlated with the variability of Kuroshio volume transport, but the nitrate concentration shows the increasing trend between 1995 and 2008. This trend may be related to the variability of nitrate concentration in the upstream of Kuroshio.

キーワード: Nitrate transport, Kuroshio, Interannual variability, High-resolution ocean physical-biological model
Keywords: Nitrate transport, Kuroshio, Interannual variability, High-resolution ocean physical-biological model

High Resolution, Terrain Independent Radiation Mapping High Resolution, Terrain Independent Radiation Mapping

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The University of Bristol has developed a terrain-independent, wide area radiation mapping system using an UAV (Unmanned Aerial Vehicle). At the heart of the system is a micro computer, carried by a semi-autonomous multi-rotor copter (drone), combining data from a lightweight gamma spectrometer, laser range finder, and GPS, to geospatially map radioactive anomalies.

Aerial vehicles can be purpose built, according to range/flight time required, payload/sensing strategy and operational environment. For example, an unmanned vehicle could be tailored for mapping over both land and sea areas, where it could land in the sea at different locations to make water based gamma measurements. The system is also adaptable for use on ground vehicles, or handheld, walking surveys.

Information is streamed in real-time, providing high resolution detail on source isotopes, intensity and location of the radiation anomaly. More than just a flying Geiger counter, the system can differentiate between natural and man-made anomalies - such as types of nuclear fuel, radioactive waste or spent munitions.

This is all achieved from a safe distance, keeping people and manned aircraft away from hazardous environments.

Examples of uses include;

*Rapid disaster response monitoring of nuclear events, providing real-time data on spread, source and intensity. This could range from site incidents to terrorist events.

*Routine monitoring of nuclear sites (internally and externally), mining operations and oil and gas facilities.

*Nuclear plants - new build: site survey and characterisation of pre and post construction and monitoring during plant life time.

*Environmental monitoring for site decommissioning.

*Environmental monitoring of war zones for spent depleted uranium munitions.

*Homeland security and nuclear material detection.

The instrument securely transmits the location, identity and intensity of radionuclide contamination to a remote operator or base station. Sub metre resolution is attainable by flying slowly, even to the point of a fixed hover, relatively close to the ground.

It can be operated manually, using traditional radio-controls or semi autonomously via programmed GPS waypoints. Grid lines are used to create survey routes that provide detailed geographical coverage of a designated area. Programming can include automated landing and take-off, such that the device can gather long exposure spectra of the region of interest.

Heat budget analysis on cooling events associated with typhoon passages in Seto Inland Sea, Japan

Heat budget analysis on cooling events associated with typhoon passages in Seto Inland Sea, Japan

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Typhoons alter coastal oceans significantly through several mechanisms including the enhanced vertical mixing through increased surface wind and waves, resulting in extensive cooling of the upper oceans. In the present study, we investigate impacts of typhoon passages with a detailed ocean modeling in particular on the temperature structure in Seto Inland Sea, the largest semi-enclosed estuary in Japan. We develop a synoptic, double nested downscaling ROMS model (Shchepetkin and McWilliams, 2005; 2008) forced by the assimilative JCOPE oceanic reanalysis (Miyazawa *et al.*, 2009) and JMA GPV-MSM atmospheric reanalysis for the surface momentum, heat and radiation fluxes by exploiting a bulk formula developed for COAMPS. The horizontal grid refinement occurs from 1/12 degree (JCOPE2) to 2 km (ROMS-L1) and to 600 m (ROMS-L2), where the L2 model running for about two years (2012-2013) is our test bed for the comprehensive heat budget analysis. The persistent clockwise estuarine circulation and the eastward-flowing Kuroshio are key features that cause the overall circulations of the estuary.

In the fall 2012, SST is found to decrease about two degrees for a two-week period during three consecutive typhoons passing nearby. The first EOF mode of the modeled SST corresponds to the seasonal cooling along with mixed-layer deepening, whereas the effects of the typhoons appear in higher modes. Kuroshio interacts with the topography to form standing cyclonic cold-core eddies as extracted in the second mode, resulting in intermittent eastward cold-water transport beyond the headlands. The third and fourth modes jointly represent cold water formation associated with storm-driven coastal upwelling that propagates with the estuarine circulation. Similar EOF modes are detected in the SST during the fall 2013 when two typhoons attacked the study area.

In the falls in 2012 and 2013 after the mid September when a series of typhoons pass by the estuary, the heat budget analysis exhibits that the net heat flux at surface becomes negative to induce prominent surface cooling and cold-water formation in the upper ocean. Whereas divergence of the horizontal advective heat flux is crucial in the daily-averaged heat budget, the surface net heat flux is essential to long-term temperature variation. Latent heat flux is found to play a primary role in the negative net surface flux as well as decrease of downward shortwave (solar) radiation. Unstable lowest atmospheric planetary boundary layer leads to pronounced changes in the latent heat flux in response to surface wind and abrupt decrease of the near-surface humidity after the typhoon passages.

Keywords: typhoon, estuary, heat budget analysis, EOF analysis, ROMS

海洋ー水文結合モデルの開発 Development of a hydro-ocean coupled model

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A new hydro-oceanic coupled model is developed for examining the basic dynamics of river-ocean interaction in estuary zones during high water discharge events. These high frequency and vigorous events are not reproduced in climatological river transport data sets that are often used in ocean circulation models. The new hydro-oceanic model is based on an isopycnal layer model. It treats continental and oceanic water with separate layers but allows dynamical interaction between the two. Mixing between the two layers occurs through a Richardson number criterion. When the model is forced with Radar-Rain gauge analyzed precipitation data around eastern Japan, the model simulates the river discharge of Abukuma river basin that is analogous to observations. The abrupt changes in the water mass transport at upstream and downstream locations are well captured, showing its applicability for hydrological basin analysis. Freshwater plumes that hug along the oceanic coasts are also well captured. We find the model, based on single dynamical core, useful for both hydrological catchment and estuary mixing zone and can be used for examining the impact of weather related events.

キーワード: 海洋モデル, 水文モデル
Keywords: Ocean model, Hydrological model

FIELD OBSERVATION ON PHYSICAL CHARACTERISTICS OF ABUKUMA RIVER ESTUARY IN SENDAI BAY

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Higher amount of radiocaesium transport from Abukuma river into Pacific Ocean, especially during the extreme events, has already estimated. The current study aims to clarify the following: i) to survey estuary mixing processes during freshwater and turbidity intrusion from Abukuma river mouth, largest river basin affected fallout, where annual radiocaesium flux reached 10 Terabecquerel during our observation in 2011-2012; ii) To identify bottom-sediment contamination along the river mouth by sediment sampling. Field observation was conducted both in March 18 and September 2-3 in Sendai Bay. Vertical temperature and turbidity, together with the salinity field are observed using fishing vessel. We analyzed also vertical velocity profile using ADCP to identify the current movement of the bay. The velocity fields in Sendai Bay of the observation date are illustrated using JCOPE2 program. Figures 1 illustrates observation points, vertical salinity, turbidity and temperature field in each points, and vertical velocity profile observed in 18 March 2013. The eastward surface current was observed in each transection line. At near bottom of the sea, westward current was observed, indicating estuary circulation. Southward surface current was observed in most of latitudinal section, weak northward bottom current was also found. Freshwater intrusion was observed on some of the stations in transection A which is located near the mouth of Abukuma River. In most of the station, turbidity peak was observed in near bottom of the sea, except in some station in transection A where the peak of turbidity was found in surface similar to the location of freshwater intrusion. Higher concentration of radiocaesium in the bottom sediment near the Abukuma river mouth is observed where fine argilliferous soil are found, much higher than that in surrounded area, giving important evidence of radiocaesium in particulate form supplied from Abukuma River. Peaks of turbidity near the river mouth were found at slightly lower position than the freshwater-saline boundary at stations 1 and 3 (March 20), implying that the occurrence of coagulation of suspended particulate matter through mixing with saline water, supporting the observed concentration found in (1).

キーワード: Abukuma river, Coastal zone, Estuary circulation, Mixing zone, Radiocaesium
Keywords: Abukuma river, Coastal zone, Estuary circulation, Mixing zone, Radiocaesium



地理観測用衛星データ操作ソフト「Geo-Sim」の開発 Development of Satellite data manipulator for geography analysis

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地理観測用衛星データ操作ソフト「Geo-Sim」の開発

1. 衛星データの多機能化

地球観測衛星によって取得されたデータは、土地利用や災害監視など幅広い分野で活用されている。特に過去10年ほどの間に、搭載される各種センサやレーダーが高性能化し、取得される衛星データの解像度は急速に向上した。とくに我が国の陸域観測技術衛星 ALOS (Advanced Land Observing Satellite:通称「だいち」) は、地表面の凹凸を高い精度で観測できるセンサ PRISM を搭載し、DSM (Digital Surface Model) データの取得を可能にした。こうした先進的なセンサによって取得されるデータを活用することにより、2次元の平面で扱うことが一般的であった衛星データを、立体的な3次元のデータとすることが可能になる。衛星データを3次元として扱うことは、利活用範囲の拡大を意味し、これまでにない多機能化が期待できる。

2. 「Geo-Sim」の開発

衛星データは GB 単位になることが珍しくはなく、市販のコンピュータによる3次元化は負荷が大きかった。しかし近年、コンピュータの高性能化と低価格化により、その障壁は低くなった。そこで我々は、ALOS データをはじめとする各種衛星データを、市販のコンピュータ上で3次元表示できる Viewer を開発した。これにより一般の人々でも、マウス等の操作により立体的な地形を自在な角度から観察したり、地盤を傾斜させたり、さらには海水準を変動させるなどして海岸線の変化を確認することが可能になった (図 1.)。

図 1. iPad による Geo-Sim の操作

さらに GPS と連動した iPad 上に3次元衛星データを表示し、通信環境のないエリアでも使用可能な「Geo-Sim」を開発した。これにより、土石流の発生状況、あるいは古代の海岸線などを CG によって再現し、かつ現場における照合作業が可能になる。

3. ALOS-2 の打ち上げ

陸域観測衛星 ALOS (「だいち」) は、東日本大震災発生直後に被災地周辺を集中的に観測した後、電力異常により運用停止となった。2014年春に打ち上げ予定の後継機 ALOS-2 は、ALOS とは異なり搭載される機能は合成開口レーダーに限定される。しかし解像度は極めて高くなるため、土石流発生箇所の観測精度は向上することが期待できる。また、水面の波による反射から、風の影響を可視化することも期待される。

4. 今後の計画

「Geo-Sim」は、3DCG による古代景観の再現を表示するなど主として観光用を目的としたソフトウェアとして、民間企業により実用化に向けた計画が最終段階に入っている。我々は、これまで蓄積してきた技術をもとに、海底地形データと、衛星による陸域のデータを融合し、海水準の上昇だけではなく降下も含めた、さまざまなシミュレーションに対応する、新たなソフトウェア「地理学シミュレータ」の開発に取り組む予定である。

キーワード: ALOS, AVNIR-2, PRISM/DSM, DEM, Geo-Sim
Keywords: ALOS, AVNIR-2, PRISM/DSM, DEM, Geo-Sim

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図1. iPadによるGeo-Sim の操作