ACG06-01	Room:304	Time:May 19 11:10-11:25

Superflares and Their Possible Impact on on Terrestrial Environments

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Supeflares are very big flares that release total energy much greater than that of the biggest solar flares with energy of ~ 3 x 10^{32} erg. If such superflares will occur on our Sun, we would have extreme space weather events, which might lead to big hazards of terrestrial environments and our civilization. Recent observations of solar type stars with Kepler satellite have revealed existence of superflares (with energy of 10^{34}-10^{35} erg) on the Sun-like stars with similar surface temperature (5600-6000 K) and slow rotation (< 10 km/s) (Maehara et al. 2012, Nature). From the statistical analysis of these superflare observations, it is found that superflares with energy 10^{34} erg occur once in 800 years and superflares with 10^{35} erg occur once in 5000 years on the Sun-like stars. These observations suggest that we may not be able to avoid the frightening possibility that superflares with 10^{34}-10^{35} erg would occur once in 800-5000 years on the present Sun. Finally, I will argue possible impact of such solar superflares on the terrestrial magnetosphere, atmosphere, and infra-structure of our mocern civilization such as power-grids, radio communication, and artificial satellites.

Keywords: solar flares, stellar flares, space weather, geomagnetic storm, solar energetic particles

ACG06-02 Room:304 Time:May 19 11:25-11:40

Role of air-sea interactions in the simulation of southern Africa summer climate

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The importance of air-sea interactions in the simulation of southern Africa summer climate is studied by coupling Advanced Research Weather Research and Forecasting (WRF) regional model to a simple mixed layer Price-Weller-Pinkel Ocean model. The coupled model was run for twelve austral summer seasons, DJF 1998/99 to DJF 2009-10 using the boundary conditions derived from the NCEP reanalysis data. Analysis shows the coupled WRF model to have smaller biases in the spatial distribution of precipitation over southern Africa landmass compared to the standalone WRF. Also, an improvement in the simulation of number of wet and dry days is seen in the coupled model. The improvement in the simulation of precipitation in the coupled WRF model is mainly due to improvement in the representation of moisture fluxes compared to WRF model. Experiments with boundary conditions derived from SINTEX-F forecasts also showed similar improvements in the coupled WRF forecasts compared to standalone WRF model, showing that air-sea interactions play an important role in the simulation/forecast of austral summer climate of southern Africa.

Keywords: WRF model, southern Africa, PWP mixed layer Ocean model

ACG06-03   Room:304   Time:May 19 11:40-11:55

Assessment of future precipitation change in Shikoku region using statistical downscaling

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The objective of this study was to downscale large-scale atmospheric variables from GCM outputs to produce climate variables at a regional- and local-scale using statistical downscaling methods and investigate the impact of future climate change scenarios on hydrological and agriculture. Statistical downscaling methods were evaluated to simulate local-scale mean and extreme precipitation indices such as number of days greater than 10 mm/day (R10), maximum total precipitation accumulated over 5-days (R5d), max dry-spell length (MaDSL) and max wet-spell length (MaWSL) in the Shikoku region of Japan. We obtained the following conclusions.

1. The performance of downscaling methods is compared for both the calibration period (1961-1990) and the validation period (1991-2000). The overall R2 and SE of each month during the calibration period have clear seasonal variation, and that the simulation results were better in the winter than in the summer. In modeling the monthly precipitation, the annual mean R2 values are over 0.20. The overall trend was revealed successfully and SDSM was adaptable in Shikoku region. In validation periods, the simulation results by NCEP, HadCM3 are largely underestimated MDP in autumn, and almost overestimate it in winter. However, it demonstrates that the validate model reproduces the monthly and annual MDP values well.

2. For tadotsu, matsuyama, shimizu, murotomisaki, tsurugisan and tokushima, the representation less than 10 mm/day in the distribution will increase, and for rainfall maxima are also more decreased in the future. In contrast, the distribution at takamatsu, uwajima, sukumo and kochi shows the opposite trend. The summer and annual MDP in future compared to present precipitation would be consistently negative across models for stations of northern Shikoku, but were positively for kochi and sukumo. In addition, for most locations, absolute annual change MDP values in precipitation across HadCM3 were larger than that of CGCM3.

3. The future change of annual R10 would increase in southern and western part of Shikoku and decrease in northern Shikoku. The future change of annual R5d would decrease under H3A2 and H3B2 in north-eastern Shikoku. MaDSL would increase in the northern Shikoku and MaWSL would decrease in north-eastern Shikoku. It found that the future change of extreme precipitation indices provide a potential to cause an increase in the drought events across the north-eastern Shikoku, especially A2 and A1B scenario. On the other hand, it is suggested that future precipitation indices change is increasing the risk of flood in kochi. The regional difference of extreme precipitation indices cannot be markedly seen in the B2 scenario compared to the other scenarios. These results would provide important scientific base and practical information for agricultural, hydrological field and water resources management in this region.

Keywords: Climate change, GCM, Precipitation, Statistical downscaling model, Shikoku

ACG06-04   Room:304   Time:May 19 11:55-12:10

Variability of Kuroshio nitrate flux and transport in the western North Pacific: A model study

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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 1995-2010. 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 model reproduces the maximum nitrate flux core in the subsurface layer from the eastern side of Luzon (16N) to the Kuroshio Extension (36N) with the downstream. High phytoplankton blooms along the south of Japan (subpolar region) in the winter and spring seasons appear in the model, and the advective flux of nitrate with the downstream to the subpolar region contributes to the high blooms. Because the downstream of nitrate transport by the Kuroshio appears under the winter mixed layer in the south of Japan, the high blooms are enhanced. The model also reproduces the interannual variability of nitrate flux and transport by the Kuroshio in the North Pacific. The change of Kuroshio speed and structure are major causes for interannual variability of nitrate flux and transport. The simulated nitrate concentration in the Kuroshio shows interannual variation.

Keywords: Nitrate transport, Kuroshio, Interannul variability, High-resolution ocean physical-biological model

ACG06-05   Room:304   Time:May 19 12:10-12:25

Evaluation of Radioactive sediment transport in Tokyo Bay released from TMR

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Radioactive contaminants released from the TEPCO Fukushima nuclear power plant on 21-22 March 2011 into the Tokyo Metropolitan Region (TMR) are accumulated via hydrological cycle and released into the shallow estuary of Tokyo Bay.Major streams (such as the Edo, Ara, and Tama rivers) carry radionuclides via suspended material; some of them may stay in the riverbed and finally be transported into the river outlets. Using the Hydro3D model (a catchment-estuary integrated model), the study estimated the concentration of Cs-137, Cs-134 and I-131 (three major radionuclides) based on the initial radioactive distribution recomposed from aerial radioactive monitoring done by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT).

The transport of radionuclides into the TMR were calculated using both the Euler Surface Dissolved/Non-Dissolved Transport and the Lagrangian Form Sediment-Marker Transport models. Effects of particle coagulation at the river outlets were calculated according to the salinity and diameter of suspended particulate material.According to the numerical simulation, the radioactive sediment concentration composed with Fission Products in Tokyo Bay may increase due to increase of hydrological transport within three years (mainly induced by the Cs-137/134) and then last more than 10 years (mainly by Cs-137). The average concentration at Edo and Ara river mouths estimated around 300 Bq/kg however occasionally higher concentration more than 4,000 Bq/kg has been estimated at those points. Bottom-sediment contamination near the Obitsu River outlet is predicted by the numerical simulation with around 150-300 Bq/kg, in addition to the above hotspots predicted at outlets of Edo and Ara rivers.

Keywords: Tokyo Bay, Radiocesium, Bottom sediment, contamination, River inflow

ACG06-06 Room:304 Time:May 19 12:25-12:40

Impact assessment of flux estimation from international river basin using GEMS/Water dataset

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In this study, we aim to estimate nutrient loading from Land Zone throughout international river basin using the GEMS/Water (Global Environment Monitoring System / Water) Dataset for the purpose of estimating the gross nutrient loading to the marine environment to provide dataset necessary for assessment of the current status of the coastal zone, especially for the water quality of Bays and Estuary zone. In this procedure we have used the set of discharge data obtained from GRDC (Global Runoff Data Centre) as to be used for the loading estimate based on the "observed" data. The locations of GEMS/Water and GRDC station have been compared to identify appropriate station set to calculate loading. The characteristics land use of each target river basin has also been analyzed using the Global Land Cover Characterization dataset prepared by USGS.

Monthly average fluxes for 14 international river streams are estimated using above dataset. As a result, fluxes of NH4-N and BOD of those rivers that flow into the Arctic Ocean are higher than other 13 rivers, which might be caused either by livestock cultivation in the basin or by deoxidization of Nitrogen associated with permafrost melting.

In addition, we have estimated Suspended Solid (SS) and NH4-N Loading from Rhine River using both GRDC discharge datasets. Rhine River has significantly decreased from 1980's to 1990's by loading estimation using GRDC and GEMS/Water Dataset. The Rhine basin is mostly covered with Dry land Cropland and Pasture, which is generally considered as high nitrogen compounds loading throughout the livestock farming. The decrease in concentration may have introduced by strict nutrient control in the basin.

Keywords: Nutrient loading, GEMS/Water, Land Use, Water Quality

ACG06-07   Room:304   Time:May 19 14:15-14:30

Saline contamination and its mitigation in groundwater at a coastal watershed, north-east Tunisia

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We investigated surface water and groundwater interaction under a saline contamination due to oil field brine and sea water intrusion by using tracer hydrological approach, geophysical approach and numerical simulation approach at a coastal watershed facing Mediterranean sea, north-east Tunisia. We present dynamics of groundwater flow and saline contaminants behavior, and propose a mitigation way of saline contamination by artificial groundwater recharge using a treated domestic waste water based on a numerical simulation.

Keywords: saline contamination, oil field brine, sea water intrusion, groundwater and surface water interaction

ACG06-08   Room:304   Time:May 19 14:30-14:45

Oceanic dispersion model intercomparison: The Fukushima case

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There are several attempts to simulate oceanic dispersion of radionuclides discharged into the ocean after the accident of Fukushima Daiichi Nuclear Power Plant on March 11, 2011. Together with monitoring observations of radionuclides in the sea water and bottom sediments, some crude ideas on distributions and magnitude of radioactivity within the ocean, particularly for Cesium 134 and 137, and on estimations of the leakage amount from the power plant were derived from the dispersion simulations. However, there are significant differences, as well as the similarlities, among the simulated results, whose causes should be investigated in more detail. A model intercomparison project under the Oceanographic Society of Japan Working group and Japan Science Councile is now trying to compare results from several downscaling dispersion models focusing on the Fukushima case. This presentation introduces the model intercomparison activities and discuss some preliminary results of the comparisons.

Keywords: Oceanic dispersion, radionuclide, Fukushima Daiichi Nuclear Power Plant, numerical model

The impact of oceanic circulation and phase transfer on the dispersion of radionuclides from the coast

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The processes behind the dispersion of radionuclides released from the coast of Fukushima are investigated using a numerical ocean model and Lagrangian particle tracking model. This coupled model solves the concentration of radionuclides for those dissolved in seawater and those adsorbed in particulates and bottom sediments while advecting the particles based on the oceanic flow field. Many radionuclides are found to remain near the coast. We find the spatial pattern to depend strongly on the oceanic circulation during the first month of the release because this is when most of the adsorption to bottom sediments occurs. We also find vertical mixing to play an important role since it enables the radionuclides to be carried to the sea floor. This suggests that oceanic dispersion of radionuclides is likely to change with season and whether it was introduced to the ocean through river input or directly into the ocean waters.

Keywords: Ocean Model, Radionuclides, Sediments

Internal tide variability around Japan revealed by modeling and observation

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Recent development of ocean modeling allows concurrent simulation of the ocean circulation and tide. Investigation of possible occurrence of their interactions is of importance for deeper understanding of the oceanic phenomena. Internal tide is one of key processes that are responsible for the interactions between the ocean circulation and tide. The Izu-Ogasawara Ridge south of Japan is considered as an active generation site of internal tide. We try to detect M2 internal tide signals there from products of the operational tide-resolving ocean circulation model (JCOPE-T) and satellite altimeters (Topex/Poseidon, Jason-1, 2). The amplitude of simulated M2 internal tide harmonics agrees with the observed one, while the simulated phase structure is not much similar to the observation. The model result indicates standing wave features associated with remote propagation of the M2 internal tide south of Japan. We discuss possible modulation of the M2 internal tide variability due to mesoscale eddies and its implications on the vertical mixing and river runoff processes.

Keywords: Eddies and mesoscale processes, Internal and inertial waves, Surface waves and tides

Initial oceanic dispersion mechanism of radionuclides released from Fukushima

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The 2011 earthquake off the Pacific coast of Tohoku, Japan, and the subsequent tsunami caused a severe nuclear accident at the Fukushima Daiichi Nuclear Power Plant (FNPP), leading to radionuclides leaking into the coastal ocean. A retrospective, double-nested high-resolution numerical model at 1 km horizontal resolution based on the JCOPE2-ROMS downscaling framework (Uchiyama et al., 2012) is utilized to evaluate oceanic/coastal dispersion of the released cesium-137 (^{137}Cs) from FNPP. A rational leakage submodel proposed by Tsumune et al. (2011) based on the iodine-cesium ration is employed for the realistic cesium-137 release. Among several oceanic radionuclide dispersal models including the present one, there still is a discrepancy in the prevailing direction of initial dispersion (for the first several weeks) of the leaked materials, which remains an open question.

The present model successfully reproduces the overall oceanic structure as well as the dispersal of cesium-137, according to an extensive model-data comparison exploiting the satellite altimetry, the in $situ$ cesium-137 concentration monitored by TEPCO and MEXT, and the aerial snapshot taken by NSSA. Alongshore distribution of the concentrations is found to be highly inhomogeneous with diluted patterns distributed widely in the south of FNPP, while medium concentration appears in the north. The initial dispersion predominantly occurs in the northward direction for the first 30 days, followed by the southward cesium-137 transport down to the Kuroshio extension to be drifted far to the North Pacific. The model also demonstrates that an isolated, anti-cyclonic mesoscale eddy persists off Kashima Coast (south of Fukushima) shed around Cape Inubo where the Kuroshio separation takes place. This standing anti-cyclone enhances the poleward coastal jet about less than 50 km from the shore, especially 3-4 weeks after the accident. A cross-spectral analysis exhibits a prominent correlation between northward wind and along-shelf oceanic currents in a fairly broad period band of 72 - 240 hours peaked at 168 hours. The highest coherence (coh^2 > 0.92) is most evident in the nearshore area within about 10 km from the shore, while it exponentially decreases offshore. This result strongly suggests the presence of wind-driven shelf waves as a potential agent of the alongshore cesium transport as argued by Miyazawa et al. (2012). In contrast, a positive buoyancy input through four major rivers discharging into Sendai Bay (about 80 km north of FNPP) is found to be substantial to the southward cesium transport. This buoyancy input is attributed to a prevailing equatorward flow contracted in a quite narrow coastal strip within about 10 km from the shore.

In summary, the initial dilution and dispersal of the leaked radionuclide from FNPP are primarily constrained in the nearshore area around Fukushima Coast with reduction of the equatorward transport. The narrow coastal strip of the predominant alongshelf transport is characterized by the "three-layered system" in the cross-shelf direction consisting of (1) the innermost southward transport by the positive buoyancy (about 0-10 km off the shore), (2) the prevailing poleward coastal jet associated with a standing anti-cyclonic mesoscale eddy formed off Kashima Coast that most likely influenced by wind-driven shelf waves, and (3) the overall equatorward transport in the offshore farther than about 50 km.

Keywords: cesium 137, oceanic dispersal, mesoscale eddy, shelf wave, ocean model

ACG06-12   Room:304   Time:May 19 15:30-15:45

Evaluation of river discharge due to heavy rain using water level data in a large lake

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We aimed to evaluate the river discharge due to heavy rain in Lake Biwa, the largest lake of Japan. For this purpose, we analyzed high-resolution water level data measured at the lake. We then calculated the response of the water level of Lake Biwa to the river inflows. The fluctuations in the water level of Lake Biwa were investigated during the period 2010?2012. These fluctuations were attributed to precipitation in a catchment area in the southwest region of Shiga Prefecture, Japan; a river flowed through this catchment area into Lake Biwa. A water level instrument with a resolution of 1 mm was used, and the sampling interval for the data logger was 2 min. Given that many factors control the water level in Lake Biwa, we performed multiple time scale analysis. This allowed us to separate the effect of inherent oscillations on the water level of the lake.

The change in the water level of the lake is balanced by inflow and outflow. The factors affecting the water level in the lake include seiches, wind, waves, precipitation (on the surface of a lake, via a drainage basin, and via groundwater), evaporation, and outflow, which have different spatiotemporal scales. Surface seiches can lead to short-term changes in the water level, whereas precipitation results in the greatest changes in the water level. Precipitation that directly occurs over a lake results in an increase in the water level, whereas precipitation over the catchment area flows into the lake through a river or as groundwater. However, the amount by which the water level of a lake can increase because of rapid precipitation has not been discussed in detail thus far. Hence, we evaluated the contribution of precipitation flowing into Lake Biwa through a river; for this purpose, we used high-resolution water level data of Lake Biwa. We then calculated the response of the water level of Lake Biwa to the river inflow. As a result, if the amount of riverine precipitation increases, and particularly if the precipitation exceeds 100 mm, it turned out that the volume of riverine input increases 40 to 60 % of precipitation sharply that flow into Lake Biwa.

Keywords: Lake Biwa, Water Level, contribute ratio of river flow, precipitation