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**Educational management**

**Building A Global Partnership to Advance the New Development of Space Education and Capacity Building**

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**Abstract**

The United Nations has always attached great importance to the promotion and applications of space technology. The UN Regional Centre in China was established in 2014. It is located at the campus of Beihang University. The main education and training fields include Remote Sensing and Geographic Information System (RS&GIS), Satellite Communications, Global Navigation Satellite Systems (GNSS), Micro-satellite Technology, Space Law and Policy, Space Science and Environment, etc. Up to now, RCSSTEAP has trained three hundred and nineteen (395) postgraduates for twenty-seven (27) developing countries. The Centre has held more than twenty (20) short-term training programmes and trained over one thousand (2,000) participants from more than seventy (70) countries in total. RCSSTEAP has invited a total of more than thirty (30) international experts and over one hundred and forty (140) domestic experts to give lectures to the participants. The Centre has continuously improved and strengthened its capacity building to create

a learning and working environment with uniform style and well-equipped facilities. In this presentation, we propose to strengthen the cooperation among UN Regional Centres, relevant space universities and space industry, to build a global partnership and advance new developments in space education and capacity building.

**Keywords:** *space education, capacity building,*

## **Disaster Risk Management**

### **The Role of Volcanic Eruptions in Climate Variability and Predictability**

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#### **Abstract**

Major explosive eruptions inject large amounts of volcanic gases, aerosol droplets, water vapor, and ash into the stratosphere. While most of these materials are removed within several days to weeks, stratospheric sulfate aerosols can persist and influence atmospheric radiative and dynamical processes. As a result, they can affect the climate and its predictability on both global and regional scales. In my presentation, I will begin with a brief introduction to the mechanisms through which volcanic activity influences climate. I will then present several examples of how volcanic eruptions impact climate variability, predictability, and near-term prediction skill.

**Keywords:** *volcanism; climate predictability; prediction skill*

## **Environmental science**

### **Near-Real-Time Monitoring of Anthropogenic Carbon Emissions**

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#### **Abstract**

Tracking carbon emissions in near-real-time is essential for informing timely climate action and evaluating the effectiveness of mitigation policies. This work focuses on developing high-resolution, near-real-time datasets of anthropogenic CO<sub>2</sub> emissions, integrating satellite observations, ground-based activity data, and machine learning. This dataset contributes to projects such as Carbon Monitor (<https://carbonmonitor.org/>) and GRACED (<https://carbonmonitor-graced.com/>), which provide daily CO<sub>2</sub> emission estimates across multiple sectors for global coverage. These data are used to assess the immediate impact of socio-economic changes, such as the pandemic or energy crises, on emissions. Moving forward, this research aspires to shed light on the dance between the energy transition and GHG emissions, offering insights to guide future policy decisions and technological advancements.

**Keywords:** *carbon emissions accounting; near-real-time monitoring; GHG emissions; spatiotemporal trends and climate policy*

## Resilience Science

### Evaluation and Optimization of Road Network Resilience under Urban Rainstorm Scenarios

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#### Abstract

Increasingly frequent extreme rainfall events trigger urban flooding disasters, posing severe threats to urban transportation—particularly road passability. To identify critical areas affecting urban road network resilience and propose emergency traffic management strategies, this study develops an evaluation framework based on resilience triangle theory using taxi GPS data from both sunny and stormy days. The methodology includes: (1) Linear model-based road resilience evaluation: A multi-scale assessment framework ("entire network-road classes-road segments") measures road network resilience during rainstorms. Using average speed as the key performance indicator, it plots performance curves under storm conditions and quantitatively evaluates resilience at three scales through metrics including disturbance duration, disruption time, recovery time, resilience loss, and system resilience. (2) Grid model-based road resilience evaluation: A 500m×500m spatial grid model extracts traffic parameters (e.g., grid-average speed) from vehicle trajectory time-series data. Clustering algorithms identify road resilience clusters by analyzing spatiotemporal patterns of grid resilience changes. Using Shenzhen City's rainstorm event (September 2019) and normal weather data as a case study, this approach pinpoints vulnerable areas with weak disaster resistance/recovery capabilities during storms. Targeted resilience enhancement strategies are proposed, providing decision-making support for urban emergency vehicle routing during flood disasters.

**Keywords:** *taxi GPS data; urban roads; urban flood disasters; road network resilience; China*

## Resilience Science

### Research on the Evaluation and Improvement Strategy of Port Traffic Congestion Resilience

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#### Abstract

As one of the world's largest trading nations, China's port cargo throughput has exceeded 14 billion tons for five consecutive years. While demonstrating its pivotal role in global trade, this sustained growth has led to increasingly severe port congestion issues. Based on AIS data and port

information, this study quantifies the resilience level of port traffic congestion and conducts comparative analysis on the implementation effects of congestion resilience enhancement strategies. The study uses container AIS data from Qinzhou Port during January to June 2021 as an empirical case. The sliding window method is employed to extract vessel stay events, while fuzzy logic and evidence reasoning theory are combined to calculate the port congestion resilience index. A discrete-event simulation model is built on the AnyLogic platform to simulate container handling processes and verify the effectiveness of different strategies. The study proposes a model for quantifying port traffic congestion resilience levels. Optimizing vessel arrival times and back-to-back berthing operations improved the port traffic congestion resilience index by 52.51% and 29.43% respectively.

**Keywords:** *waterway transportation; resilience assessment; fuzzy-evidential reasoning; port traffic congestion resilience; port simulation*

### Engineering, Architecture, Environmental Technology

#### Evaluación de la iluminancia melanópica en viviendas: del diseño a la construcción

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#### Resumen

Este artículo presenta un análisis detallado del desempeño no visual de la iluminación natural en una vivienda-oficina de nueva construcción, de un solo nivel y carbono neutral, ubicada en el clima subtropical húmedo del este de Texas, EE. UU. Texas es conocido por sus numerosos días soleados y cielos despejados. Sin embargo, muchas viviendas en la región están diseñadas con ventanas relativamente pequeñas para mantener el confort térmico interior, lo que a menudo limita la disponibilidad de luz natural. La vivienda analizada en este estudio se encuentra en College Station, Texas, a una latitud de 30.6° N y longitud 96.3255° O. El sitio experimenta aproximadamente un 86 % de días despejados o parcialmente nublados y un 14 % de días nublados al año [1], con una iluminancia media anual del cielo de 40,556 lux entre el amanecer y el atardecer, según los datos del archivo climático EnergyPlus Weather File (EPW) de 2011–2021.

La casa cuenta con un área acondicionada de 158 m<sup>2</sup> dispuesta en una planta rectangular orientada a lo largo del eje este-oeste. Incorpora varias estrategias bioclimáticas, incluyendo iluminación natural, ventilación cruzada, sombreadamiento, alto aislamiento térmico, mínima infiltración de aire, una envolvente de alto rendimiento y materiales de colores claros con alto albedo y baja emisividad. Los espacios de ocupación regular están equipados con ventanas en dos fachadas para mejorar tanto la iluminación natural como la ventilación cruzada. Una combinación de ventanas laterales, tragaluces y ventanas altas tipo clerestory asegura abundante luz natural durante el día, reduciendo la necesidad de iluminación eléctrica hasta la puesta del sol o en días nublados. La mayoría de las ventanas son grandes —de 1.5 m × 1.4 m— para maximizar la penetración de luz natural y proporcionar vistas sin obstrucción al exterior. El edificio cumple con la norma EN 17037 [2] para exposición solar, alcanzando más de cuatro horas de luz solar directa durante el mes de febrero. Durante los meses más calurosos, los aleros y el garaje separado proporcionan sombra, mientras que en invierno, las ventanas orientadas al sur permiten ganancias solares que calientan los

espacios interiores. La relación ventana-muro (WWR) de la vivienda es del 12 %, y la relación tragaluz-piso (SFR) es del 0.6 %.

La casa fue simulada en ClimateStudio para generar datos horarios anuales de iluminancia basados en el clima, y en ALFA para estimar el impacto circadiano de la luz. También se realizaron mediciones fotométricas y espectrales in situ para comparar con los resultados de las simulaciones y evaluar el cumplimiento con los umbrales recomendados de Iluminancia Equivalente Melanópica de Luz Natural (M-EDI). Los resultados indican que los niveles de M-EDI en los puestos de trabajo de oficina y en las áreas de sala-comedor superan la recomendación mínima de 250 lux por un factor de 2 a 6 en condiciones de cielo despejado. Los niveles de iluminancia fotópica también superan los requisitos especificados por los estándares LEED y WELL [3], [4], [5] para créditos de iluminación natural. El diseño de la casa incorpora ventanas pequeñas y sombreado mínimo para controlar el deslumbramiento y las ganancias térmicas.

**Descriptor:** *Iluminación natural, iluminancia melanópica equivalente, lux melanópico equivalente, regulación circadiana, sueño, estado de alerta.*

### Abstract

This paper presents a detailed analysis of the non-visual daylighting performance of a newly constructed, carbon-neutral, single-story home-office located in the humid subtropical climate of East Texas, USA. Texas is known for its many sunny days and clear blue skies. However, many homes in the region are designed with relatively small windows to maintain indoor thermal comfort, which often limits the availability of natural light. The house examined in this study is in College Station Texas at latitude 30.6° N, longitude 96.3255° W. The site experiences approximately 86% clear or partly cloudy days and 14% overcast days annually [1], with an annual median sky illuminance of 40,556 lux between dawn and dusk, based on EnergyPlus Weather File (EPW) data from 2011-2021.

The house features a conditioned area of 158 m<sup>2</sup> arranged in a rectangular layout oriented along the east-west axis. It incorporates several bioclimatic strategies, including daylighting, natural ventilation, shading, high insulation, minimum air infiltration, a high-performance envelope, and light-colored materials with high albedo and low emittance. Regularly occupied spaces are equipped with windows on two sides to enhance both daylight and cross-ventilation. A combination of sidelight windows, skylights, and clerestories ensures abundant natural light throughout the day, reducing the need for electric lighting until sunset or on overcast days. Most windows are large—measuring 1.5 m × 1.4 m—to maximize daylight penetration and provide unobstructed outdoor views. The building meets the EN 17037 [2] standard for sunlight exposure, achieving more than four hours of direct sunlight throughout the month of February. During the hottest months, overhangs and the detached garage provide shade, while in winter, south-facing windows allow solar gains to warm the interior spaces. The overall window-to-wall ratio (WWR) of the house is 12%, and the skylight-to-floor ratio (SFR) is 0.6%.

The house was simulated in ClimateStudio to generate climate-based annual hourly illuminance data, and in ALFA to estimate the circadian impact of light. On-site photometric and spectral measurements were conducted to compare with simulation outputs and assess compliance with recommended Melanopic Equivalent Daylight Illuminance (M-EDI) thresholds. Results indicate that M-EDI levels at office workstations and in the living-dining areas exceed the 250-lux minimum recommendation by a factor of 2 to 6 under clear sky conditions. Photopic illuminance levels also surpass the requirements specified by LEED and WELL standards [3], [4], [5] for daylighting credits. The house design features small windows and minimal shading to manage glare and thermal gains.

**Keywords:** *Daylighting, Melanopic EDI, EML, circadian regulation, sleep, alertness*

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## Ingeniería

### Zoeppritz equations: from seismology to medical exploration

### Ecuaciones de Zoeppritz: de sismología a exploración médica

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### Abstract:

More than a century ago, Karl Zoeppritz derived the equations that determine the reflected and transmitted coefficients at a planar interface for an incident seismic wave. The coefficients so obtained are a function of the elastic parameters of the media on each side of the interface and the angle of incidence. Approximations of the equations have been proposed and used in geophysical exploration, however, full use of the equations and their generalization to multiple layers could offer richer information about the properties of the media and be helpful in medical diagnosis via ultrasound. In this work, we investigate how to extract information from the angle-dependent reflection coefficients, including critical angles and the wave distortion at the interface between two and three media even with sub-wavelength resolution.