SOED 国重室海星公开课系列

（2017 年度春夏季课程）

SOED Ocean-Star Open Course Series

（2017 Spring and Summer Courses）

中国 ● 杭州

Hangzhou · China

卫星海洋环境动力学国家重点实验室

State Key Laboratory of Satellite Ocean Environment Dynamics

卫星海洋环境动力学国家重点实验室（SOED）的特色是以维护海洋权益与防灾减灾等国家重大需求为牵引，以建立海洋环境立体观测和预测的技术和理论体系为目标，开展以应用基础研究为主的卫星海洋环境动力学研究。

Led by vital national needs for protecting maritime rights and interests and for disaster prevention and mitigation, and with the goals of improving technology and theory used for establishing three-dimensional marine environmental monitoring and prediction systems, State Key Laboratory of Satellite Ocean Environment Dynamics (SOED) carries out research on satellite marine environment dynamics.

SOED 正在构建特色鲜明的、具有显著国际影响力的海洋科技基地。为推进实验室对外开放，SOED 设立了一系列的“**海星公开课**”，邀请国际知名的资深科学家授课，面向全国招生，促进交流。2017 年春夏季将开设卫星海洋学、地球循环系统、海洋光学及水色遥感简介和海洋化学四门短期课程，详细信息请留意实验室网站（http://www.soed.org.cn/）。

SOED is creating a unique marine science and technology platform with distinctive international influence. To showcase the lab, SOED has set up a series of “Ocean-Star Open Courses,” which are open to Ph. D. candidates and young researchers nationwide by inviting internationally renowned scientists to teach. In 2017, four short courses will be offered in spring and summer, namely, Satellite Oceanography, Cycles in the Earth System, Introduction to Optical Oceanography and Ocean Color Remote Sensing, and Chemical Oceanography. Detailed information is available at the official website of SOED (http://www.soed.org.cn/).

课程信息/Course Information

授课老师/Instructor	单位/Organization	课程名称/Course Title	授课时间/Time
Andrew Thomas	美国缅因大学/ **University of Maine**	卫星海洋学/ **Satellite Oceanography**	2017.03.06-03.17
Raghu Murtugudde	美国马里兰大学/ **University of Maryland**	地球循环系统/ **Cycles in the Earth System**	2017.03.20-03.24
Curtis D. Mobley	美国红杉科学公司/ **Sequoia Scientific, Inc (HydroLight Developer)**	海洋光学及水色遥感简介 **/Introduction to Optical Oceanography and Ocean Color Remote Sensing**	2017.05.08-05.19
陈镇东/Chen-Tung Arthur Chen	台湾国立中山大学/National SunYat-sen University	海洋化学/ **Chemical Oceanography**	2017.07.03-07.28

Prof. Andrew Thomas

Andrew Thomas 博士是美国缅因大学教授，主要基于遥感数据研究海洋浮游植物的时空分布特征、以及物理海洋过程与其分布特征之间的相互作用。他讲授卫星海洋学已 15 余年，其中包括许多国际课程。他于 1988 年获加拿大英属哥伦比亚大学海洋学博士学位；已发表论文 70 余篇。

Dr. Andrew Thomas is a professor of Oceanography at the University of Maine. His main research interests are focused on the spatial and temporal patterns of plankton in the oceans and the interaction between physical ocean processes and biological patterns. His specialty is the use of satellite data to examine these patterns. He has taught Satellite Oceanography for over 15 years, including many international courses. He received his Ph. D. in Oceanography from University of British Columbia, Vancouver, Canada in 1998, and is author of more than 75 publications.

课程名称：卫星海洋学　　**授课时间：**2017 年 3 月 6 日至 17 日

授课语言：英文　　**授课对象：**博士二年级学生以上及青年科研人员

课程简介：本课程将介绍海洋遥感的不同传感器及其搭载平台，它们的历史、所获取数据的类型、数据的获取流程，以及数据的应用。课程还会简单讨论海洋卫星的轨道以及卫星海洋数据的主要误差和局限性。

Course Title: Satellite Oceanography

Language: English　**Time:** 6th - 17th March, 2017

Qualification to attend: Second year of Ph.D. candidates, or young researchers

Introduction: The course will be an introductory survey of many different instruments and platforms used by oceanographers, their histories, the types of data and measurements they collect, how they collect them, and the applications they support. It will include brief discussions of orbits and the main errors and constraints on satellite measurements of the ocean.

Syllabus for Satellite Oceanography

Objectives

The objectives of the course are to provide students with a broad introduction to the multi-disciplinary capabilities of Earth-observation satellite data for applications in oceanography: their advantages, the nature of their data and their main limitations and challenges.

Contents

Topic 1: Introduction: Why satellites? Some history, some politics, and who is involved.

Topic 2: Satellites, platforms, programs and instruments.

Topic 3: Satellite orbits, viewing geometry, technical terms

Topic 4: Very basic / very quick overview of some of the physics involved

Topic 5: Sea surface temperature: measurements in the infrared.

Topic 6: Ocean color: multispectral visible measurements and diverse biogeochemical products.

Topic 7: Sea surface height: altimeters and physical oceanography.

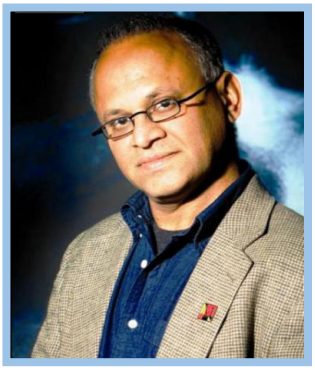
Topic 8: Ocean wind vectors: scatterometers.

Topic 9: Microwave ocean retrievals: salinity, temperature, ice, wind, etc,

Topic 10: A brief overview of what we did NOT talk about: other measurements, other instruments, other applications.

Topic 11: Conclusions: Present research directions, the main challenges, upcoming missions:

Prof. Raghu Murtugudde



Raghu Murtugudde 博士是美国马里兰大学教授，资深海洋学家，主要从事物理海洋学方面的研究。他在 1994 年获美国哥伦比亚大学博士学位，曾任印度科学院（IISc）客座教授。已合作出版多本书籍，包括 *Physical Oceanography, Developments since 1950*。（个人主页：http://raghu.umd.edu/）

Dr. Raghu Murtugudde is a professor at the University of Maryland, and a distinguished oceanographer. He mainly conducts research in Physical Oceanography. In 1994, he received his Ph. D. in Mechanical Engineering from Columbia University. Prof. Murtugudde was a visiting professor at the Indian Institute of Science (IISc), and has co-authored many books such as Physical Oceanography, Developments since 1950. (Website: http://raghu.umd.edu/)

课程名称：地球循环系统　　**授课时间：**2017 年 3 月 20 日至 24 日

授课语言：英文　　**授课对象：**博士二年级学生以上及青年科研人员

课程简介：地球系统是通过一些基本循环过程如水循环、能量循环和碳循环在不断运行。本课程以 Geol / Geog 为基础，介绍地球系统内部的反馈、全球能量平衡和温室效应，接着对大气和海洋环流作简要介绍以及陆地、海洋和大气与地球系统联系起来的水循环。随后介绍全球碳、氮和硫循环过程，以及长期气候调节和短期气候变化这些概念。 最后讲授全球变暖和臭氧耗竭下地球系统的循环、反馈、强迫和响应，并介绍未来的政策选择。

Course Title: Cycles in the Earth System

Language: English　　**Time:** 20th - 24th March, 2017

Qualification to attend: Second year of Ph.D. candidates, or young researchers

Introduction: The Earth System operates through some fundamental cycles such as the Water, Energy, and Carbon Cycles. This course will build on Geol/Geog, starting with concepts of feedbacks within the Earth System, global energy balance, and the

Greenhouse Effect. A brief introduction to the atmospheric and oceanic circulations will lead to the water cycle connecting the land, ocean, and atmosphere to the Earth System. Introduction to the global carbon, nitrogen, and sulfur cycles will be followed by the concepts of long-term climate regulation and short-term climate variability. The concepts of cycles, feedbacks, forcing, and responses in the Earth System will be applied to Global Warming and Ozone Depletion, with an introduction to policy choices for the future.

Syllabus for Cycles in the Earth System

- **Desired Background: Math 240** - Calculus III or higher, **Phys 161** - General Physics - Mechanics and Particle Dynamics., **Phys 171** - Introductory Physics, Mechanics and Relativity, **Geol/Geog**– Causes and Implications of Global Change, or the consent of the instructor.
- **Text:** The Earth System by Kump, Kasting, and Crane. Reference: Earth System Science by Jacobson, Charlson, Rodhe, and Orians (notes provided).

Note：The actual content of the course is subject to the arrangement of the instructor.

Topic 1: Global change on short and long time-scales: Global warming and Greenhouse Effects, role of long-term variability of solar luminosity.
Topic 2: Introduction to Systems and feedbacks: Systems, components, Daisy World.
Topic 3: Global Energy balance, Greenhouse effect: Greehouse gases, clouds, radiation balance.
Topic 4: Oceans and the Atmosphere-I (Projects): Wind-belts, ocean currents, Coriolis effect, Solar forcing. Define class projects.
Topic 5: Oceans and the Atmosphere-II: Atmospheric and oceanic circulation, cells, seasons, deserts.
Topic 6: Global Carbon Cycle-Recycling elements: Life on Earth, marine productivity, in/organic carbon, warm/cold waters, residence/response times, missing sink.
Topic 7: Global Carbon Cycle: Ecosystems, biological pump, biomass, biodiversity, stability, and interactions with the environment.
Topic 8: Other elemental cycles: Nitrogen, Phosphorus, Silica.
Topic 9: Long-term Climate Regulation: Faint Young Sun Paradox.
Topic 10: Pleistocene Glaciations: Milankovitch Cycles.Short-term climate variability: The Holocene, El Niño, and present-day climate variability.
Topic 11: Global Warming.

Dr. Curtis D. Mobley

Curtis Mobley 博士是美国红杉科学公司副总裁和资深科学家。 他是海洋光学和海洋水色遥感辐射传输理论的国际知名专家。他的论文和书籍被引用近 10，000 次。 世界各地的研究人员都在使用他的 HydroLight 软件。鉴于他对海洋光学领域的贡献， Mobley 博士在 2016 年获 Jerlov 奖。

Dr. Curtis Mobley is a Vice President and Senior Scientist at Sequoia Scientific, Inc. He is an internationally recognized expert in radiative transfer theory applied to Optical Oceanography and ocean color remote sensing. His papers and books have been cited almost 10,000 times; his HydroLight software is used by researchers around the world. Dr. Mobley received the 2016 Jerlov Award for his lifetime of contributions to Optical Oceanography.

课程名称：海洋光学及水色遥感简介　**授课时间：**2017 年 5 月 8 日至 19 日

授课语言：英文　　**授课对象：**博士二年级学生以上及青年科研人员

课程简介：课程第一周将介绍海洋光学基础，包括辐射测量、水体固有和表观光学性质、吸收和散射的理论及模型、以及辐射传输理论。 另外，学生将学习使用 HydroLight 软件。 第二周将学习海洋水色遥感，包括卫星和航空传感器的大气校正，以及用于反演深水和浅水水体要素的统计和半分析算法。 还将讨论如何将海洋水色遥感与海洋生态系统模型进行有机结合。

Course Title: Introduction to Optical Oceanography and Ocean Color Remote Sensing　**Language:** English　**Time:** 8th - 19th May, 2017

Qualification to attend: Second year of Ph.D. candidates, or young researchers

Introduction of Course: In Week One, we will cover the basics of Optical Oceanography, including radiometry, inherent and apparent optical properties, theory and models for absorption and scattering, and radiative transfer theory. Students will learn to use the HydroLight radiative transfer software. In Week Two, we will learn ocean color remote sensing, including atmospheric correction for both satellite and

aircraft sensors, and statistical and semi-analytical algorithms for retrieval of environmental information in both deep and shallow waters. Incorporation of optics into ocean ecosystem models will also be discussed.

Syllabus for Introduction to Optical Oceanography and Ocean Color Remote Sensing

WEEK ONE: Overview of the basics and introduction to HydroLight. Two lectures (2.5 hours) in the morning. HydroLight labs in some afternoons.

Monday: Begin review of the basics.

Lecture 1: Light and Radiometry. Basic definitions for light (radiance, irradiance, etc.) and associated mathematics (solid angle, etc.)

Lecture 2: Defining Inherent Optical Properties. Definitions of IOPs and generic instrument designs for measuring IOPs.

Tuesday:

Lecture 3: The Radiative Transfer Equation. Derivation, inputs and boundary conditions needed for its solution.

Lecture 4: Defining Apparent Optical Properties. Definitions of diffuse attenuation functions, reflectance, etc.

Wednesday: Finish basic theory

Lecture 5: Bio-optical Models for Absorption. Data and commonly used models.

Lecture 6: Bio-optical Models for Scattering. Data and commonly used models.

Thursday: Begin to work with HydroLight. Afternoon lab.

Lecture 7: Overview of HydroLight. What it does and does not do.

Lecture 8: Demonstration Runs with HydroLight. Runs for simple problems; how to view output.

Lab 1: Running HydroLight for Simple Problems. Students install and begin to run HydroLight to solve assigned problems. Get experience with HydroLight for simple simulations.

Friday: Comments on what is needed for field work

Lecture 9: Model-data Closure

Lecture 10: Designing the Perfect Field Experiment

WEEK TWO: Lectures in the mornings. Students work with HydroLight in the afternoons as desired, e.g., working with their data.

Monday: Advanced features of HydroLight and afternoon labs

Lecture 11: Advanced Features of Hydrolight. Demonstration of building up IOPs from many components, e.g., for simulation of Case 2 waters.

Lecture 12: Advanced Features of HydroLight: Writing your own IOP models, etc.

Lab 2: Students Run HydroLight for Assigned Problems (with my assistance)

Tuesday: Begin lectures on remote sensing. Students continue to work with HydroLight in the afternoons as they desire.

Lecture 13: Overview of Remote Sensing

Lecture 14: Atmospheric Correction 1: Deep Case 1 Water. Review what is used for most satellite, multispectral, and systems, and why it doesn't work for shallow or Case 2 waters.

Wednesday:

Lecture 15: Atmospheric Correction 2: Shallow and Case 2 Water. What is currently done for Case 2 and shallow waters.

Lecture 16: Statistical Methods for Remote Sensing. Remote sensing as an inverse problem. Band-ratio algorithms and neural networks.

Thursday:

Lecture 17: Semi-analytical Methods for Remote Sensing

Lecture 18: Spectrum-matching Techniques for Shallow-water Remote Sensing. Retrieval of bathymetry and bottom classification in optically shallow waters.

Friday: Optics for ecosystem modeling

Lecture 19: EcoLight-S: What it is and how it is used. Optics needs for ocean ecosystem models.

Lecture 20: Incorporation of Optics into Coupled Physical-Biological-Optical Ecosystem Models. Example ecosystem simulations using EcoLight-S.

Note：The actual content of the course is subject to the arrangement of the instructor.

陈镇东教授/Prof. Chen-Tung Arthur Chen

陈镇东博士是台湾中山大学教授、卫星海洋环境动力学国家重点实验室资深访问海星学者、海洋碳循环领域的杰出科学家。他的研究领域包括海水营养盐及碳化学、海洋酸化、全球气候变化（含古气候学）等，已在 *Nature*、*Science* 等 SCI 刊物上发表论文 200 余篇。

（个人主页: http://ctchen.ocean.nsysu.edu.tw/index.htm）

Dr. Chen is a professor of the National Sun Yat-sen University, a distinguished Ocean-Star Scholar of SOED, and an outstanding oceanographer of ocean carbon cycle. His research fields include nutrients and carbon chemistry in the oceans, ocean acidification, global climate change (including paleoclimate), among others. He has published over 200 papers in SCI journals including *Nature* and *Science*. (Website: http://ctchen.ocean.nsysu.edu.tw/index.htm)

课程名称：海洋化学　**授课时间**：2017 年 7 月 3 日至 28 日

授课语言：中文　　**授课对象**：博士二年级学生以上及青年科研人员

课程简介：本课程主要内容包括海洋学简介、纯净水及海水之结构及物理性质、海水之组成及热力学性质、海水分析化学、同位素海洋化学、海水中之气体、营养盐、碳酸盐系统、海水中之有机物及基础生产力、海洋的介面、海洋非生物资源。

Course Title: Chemical Oceanography

Language: Chinese　　**Time:** 3rd - 28th July, 2017

Qualification to attend: Second year Ph.D. candidates, or young researchers

Introduction: The main contents of the course include introduction to ocean sciences, physical and chemical properties of seawater, composition and thermodynamic properties of seawater, analytical chemistry of seawater, isotope ocean chemistry, gases in seawater, nutrients, carbonate system, seawater organic matter and primary productivity, marine interface, and marine non-living resources.

课程大纲--高等化学海洋学

课程大纲：海洋简介、纯水及海水之结构及物理性质、海水之组成及热力学性质、海水分析化学、同位素海洋化学、海水中之气体、营养盐、碳酸盐系统、海水中之有机物及基础生产力、海洋的介面、海洋非生物资源。

教学目标：讲授化学海洋学。目标除传授如何应用化学海洋学之基本知识外，诉求引导学生利用基本知识，推导问题之可能答案。

授课方式：课堂授课。

评分标准：1.期中考试成绩 35%、2.期末考试成绩 35%、3.上课表现 30%

参考书/教科书：（1）海洋化学，陈镇东著，国立编译馆，民 83 年。ISBN# 957-8981-09-0

（2）海洋化学原理及应用，张正斌、陈镇东等，海洋出版社， 民国 88 年，ISBN# 7-5027-4307-3

每次课程内容及预计进度：2017 年 7 月 03 日~2017 年 7 月 28 日，共 16 次。

第 1 次：1.前言：海洋化学及化学海洋学、研究历史、海洋资源、海洋污染。

第 2、3 次：2.海洋简介：海底地形、地貌；洋流；温度、盐度分布；温/盐曲线。

第 4 次：3.水之结构及物理性质：水分子及水之结构、冰的结构、水之物理性质。

第 5 次：4.海水之结构及物理性质：盐度及氯度、海水之结构及物理性质、海冰。

第 6 次：5.海水之组成及热力学性质：海水之组成、影响海洋中元素分布之因素、海水之热力学性质。

第 7 次：6.海水分析化学：海洋现场测量分析系统、微量元量的测定、有机物的测定、同位素的测定。

第 8 次：7.同位素海洋化学：稳定同位素、天然放射性同位素、人造放射性同位素、放射性同位素定年。

第 9 次：不上课 (期中考试)：

第 10 次：8.海水中之气体：气体组成及溶解度、氧之分布、氮及其他稀有气体之分布、二氧化碳。

第 11、12 次：9.营养盐：磷酸盐；无机氮；矽盐；碳、氮、磷、氧之间之相关性。

第 13 次：10.碳酸盐系统：钙及碱度；酸碱值、总二氧化碳及 pCO2；碳酸钙饱和程度；有机碳与无机碳之分解比例；化石燃料二氧化碳之分布。

第 14 次：11.海水中之有机物及基础生产力：溶解有机物、粒状有机物、光合作用及呼吸作用、基础生产力、浮游植物之组成、全球变迁与沿岸区之生产力。

第 15 次：12.海洋的介面：海气间之水气及能量交换、海气间之化合物交换、河口、沿岸地区之海陆交互作用、沉积物、海底热泉的物质交换作用。

13.海洋非生物资源、海水淡化、海水制盐、海水提炼元素、海洋非生物资源、海水化学资源的综合利用、矿物资源、能源及空间资源、专属经济区。

第 16 次：不上课（期末考试）。

注：上课具体内容以授课教师安排为准。

申请指南

一、申请对象

博士二年级学生以上及青年科研人员

二、 申请方式

1. **步骤一：**关注“卫星海洋环境动力学国重室”微信公众号，进入“科学”-“活动报名”填写报名信息；

2. **步骤二**：填写附录 1 中的报名表 （注意正确填写联系方式及所报课程名称）， 连同简历发至 raojinyi@sio.org.cn。注：简历及报名表中的信息将作为申请选拔依据，请认真填写。

三、 申请时间

1. 卫星海洋学：即日起至 2017 年 2 月 20 日；

2. 地球循环系统：即日起至 2017 年 2 月 20 日；

3. 海洋光学及水色简介：即日起至 2017 年 4 月 8 日；

4. 海洋化学：即日起至 2017 年 6 月 3 日。

四、 报到时间

1. 卫星海洋学：2017 年 3 月 5 日；2. 地球循环系统：2017 年 3 月 19 日；

3. 海洋光学及水色简介：2017 年 5 月 7 日； 4. 海洋化学：2017 年 7 月 2 日。

五、 授课地点

国家海洋局第二海洋研究所 （浙江省杭州市西湖区保俶北路 36 号）

六、 课程费用

此公开课系列为免费课程，学员只需自理食宿及行程费用 （周边住宿参考附件 2）。

七、 联系方式

联系人：饶晋一　　电话：0571-81963198

传真：0571-88839374　　邮箱：raojinyi@sio.org.cn

微信公众号：卫星海洋环境动力学国重室

Application Guideline

I. Qualification to Attend

Second year Ph.D. candidates, or young researchers

II. How to Apply

Please fill out the **Application Form** in Appendix 1 (please correctly write the contact information and the name of the course you apply for) and send it to raojinyi@sio.org.cn together with your **resume**. Note: The resume and the information in the application form will be used for selecting participants, please prepare them carefully.

III. Application Deadline

1. Satellite Oceanography: now to 20th February 2017;
2. Cycles in the Earth System: now to 20th February 2017;
3. Introduction to Optical Oceanography and Ocean Color Remote Sensing: now to 8th April 2017;
4. Chemical Oceanography: now to 3rd June 2017.

IV. Registration Date

1. Satellite Oceanography: 5th March 2017; 2. Cycles in the Earth System: 19th March 2017;
3. Introduction to Optical Oceanography and Ocean Color Remote Sensing: 7th May 2017;
4. Chemical Oceanography: 2nd May 2017.

V. Course Venue

Second Institute of Oceanography, State Oceanic Administration (No. 36 North Baochu Road, Xihu District, Hangzhou, China)

VI. Fee

The Open Courses of SOED are free. The attendants need only to cover their own accommodation and travel expenses. (For references of nearby hotels, please see Appendix 2)

VII. Contact Information

Contact Person: RAO Jinyi Tel: 0571-81963198

Fax: 0571-88839374 E-mail: raojinyi@sio.org.cn

附件 1/Appendix 1：

2017 年度 SOED 国重室海星公开课系列报名表

Application From Of 2017 SOED Ocean-Star Open Course Series

姓名/name		性别 /Gender		职称 /Professional Title	
单位 /Organization				研究方向 /Research Direction	
电子信箱 /E-mail				联系电话 /Contact	
报名课程/ Course intend to apply for					
报名此课程的原因/Why to apply for this course					
此课程可能对本人的学习、研究工作产生的影响/The affect that the course you apply for might have on your study and research					

附件 2/Appendix 2：周边住宿参考/Hotels Nearby

① 浙江新世纪大酒店/Zhejiang New Century Hotel

地址：杭州市西湖区文三路 18 号（与莫干山路交叉口） 电话：0571-88391111

Address: No.18 Wensan Road, Xihu District, Hangzhou Tel:0571-88391111

② 杭州伊美大酒店/Hangzhou E M Grand Hotel

地址：杭州市西湖区文三路 8 号(近莫干山路) 电话：0571-89988888

Address: No.8 Wensan Road, Xihu District, Hangzhou Tel:0571-89988888

③ 全季酒店/All Seasons Hotel

地址：杭州市西湖区文三路 121 号武林综合楼 1 层 电话：0571-81902299

Address: No.121 Wensan Road, Xihu District, Hangzhou Tel:0571-81902299

④ 文华大酒店/Zhejiang Culture Plaza Hotel

地址：杭州市西湖区文二路 38 号 电话：0571-88825888

Address: No.38 Wener Road, Xihu District, Hangzhou Tel:0571-88825888

⑤ 锦华苑宾馆/Jinhuayuan Hotel

地址：杭州市西湖区保俶北路 52 号 电话：0571-88233288

Address: No. 52 North Baochu Road, Xihu District, Hangzhou Tel:0571-88233288

⑥莫泰 168/MOTEL 168

地址：杭州市西湖区教工路 130 号 电话：0571-88111000

Address: No. 130 Jiaogong Road, Xihu District, Hangzhou Tel: 0571-88111000

⑦浙大新宇培训宾馆/Zhejiang University Xinyu Hotel

地址：杭州市西湖区教工路 118 号 电话：0571-87758878

Address: No. 118 Jiaogong Road, Xihu District, Hangzhou Tel: 0571-87758878