Earth System Science (ESS)
FY2012 Information Sheet

Program Overview and Goals

The Earth System Science (ESS) program aims to provide a process-level understanding of the climate system through observation, modeling, research analysis and field studies to support the development of improved climate models and predictions.

ESS-sponsored activities are carried out at NOAA and other federal laboratories, NOAA Cooperative Institutes, and academic institutions. Research supported by ESS advances understanding of: 1) the behavior and predictability of land-atmosphere-ocean-cryosphere system interactions giving rise to climate variability and change on multiple timescales, 2) the location and quantification of global carbon sources and sinks, 3) the role of aerosols and chemically-active greenhouse gases in the global climate system, and 4) ocean ecosystems and climate.

Research supported by ESS is coordinated with major national and international scientific bodies including the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP), and the U.S. Global Change Research Program (USGCRP).

In FY2012, the ESS program will accept proposals in three main areas: 1) Understanding and Improving Prediction of Tropical Convection in Support of DYNAMO, 2) Global Carbon Cycle, and 3) Aerosols, Atmospheric Chemistry, and Climate. Each of these areas directly contributes to the *"Improved Scientific Understanding of the Changing Climate System and its Impacts"* objective in NOAA's Next-Generation Strategic Plan (December 2010) available at: http://www.ppi.noaa.gov/ngsp/.

1) Understanding and Improving Prediction of Tropical Convection in Support of DYNAMO

The Dynamics of the Madden-Julian Oscillation (DYNAMO) is an international research program (http://www.eol.ucar.edu/projects/dynamo/) motivated by two outstanding problems: (i) Current prediction skill for the Madden-Julian Oscillation (MJO) is very limited and is lowest for the MJO initiation phase over the Indian Ocean, and (ii) The inability of state-of-the-art global models to produce the MJO degrades their seasonal to interannual predictions and weakens our confidence in their ability to project future climate.

The goal of DYNAMO is to expedite the understanding of processes key to the MJO, especially its initiation, in the Indian Ocean region and our ability to simulate/predict the MJO. DYNAMO consists of four integrated components: field observations, data analysis, modeling, and forecasting. The DYNAMO field campaign is proposed as the US component of CINDY2011 (Cooperative Indian Ocean Experiment on Intraseasonal Variability in Year 2011), an international field program planned for October 2011 – March 2012 over the equatorial central Indian Ocean. Four countries (France, India, Japan, and the United States) will participate. The DYNAMO campaign will be augmented by other field programs (AMIE, HARIMAU, PAC3E-

SA, ONR air-sea interaction) also taking place in late 2011 - early 2012.

In FY2012, the ESS program invites modeling and analysis proposals using data collected during the DYNAMO field campaign. Proposals should focus on improving the understanding of one or more of the three aspects of physical processes deemed to be critical to the MJO initiation and its representation in models: interaction between convection and environmental moisture, the dynamic evolution of the cloud population, and air-sea interaction. DYNAMO hypotheses target critical, but poorly observed processes in MJO initiation: shallow cloud moistening, convective sensitivity to environmental moisture, low- vs. upper-level diabatic heating, large-scale moisture advection and convergence, surface evaporation, the ocean barrier layer, upper-ocean mixing and entrainment, among others. A better understanding of these processes is an essential step toward improving their representations in numerical models and improving MJO simulation and prediction. Proposals will be considered that either focus solely on model analysis of events during this time period or direct analysis of data collected during the campaign, or a combination of both of these activities.

2) Global Carbon Cycle

Understanding the processes that govern the carbon cycle and its variability is vital for science and society. Significant uncertainties still remain about what processes cause the observed changes in the atmospheric composition of CO_2 and other trace gases and their potential impact on current and future climate.

In FY 2012 research is solicited that focuses on the analysis and modeling of terrestrial, atmospheric, and oceanic observations and processes in collaboration with NOAA ESRL CarbonTracker (http://www.esrl.noaa.gov/gmd/ccgg/carbontracker/) team members to incorporate alternative models of atmospheric transport and surface CO_2 exchange in the CarbonTracker analysis framework, research into assimilation methods for using carbon dioxide mole fraction estimates from aircraft measurements and satellite retrievals in CarbonTracker, and improvements to the representation of boundary layer dynamics in atmospheric transport models with the aim of successfully representing observed diurnal variability of CO_2 near Earth's surface. Also included is research that focuses on scientific analyses to put observational constraints on atmospheric mixing between the planetary boundary layer and the free troposphere, and to quantify natural emissions as well as anthropogenic emissions, including trends and emissions ratios. An example would be the regional emissions from a metropolitan area.

Additionally, research is solicited that focuses on the analysis of biogeochemical feedbacks and processes using publicly available data (via the CMIP5 archive) of the GFDL and other institutions' Earth System Model (ESM) results. To be most useful, these analyses should be performed at global and very large regional scales (continental and larger). The analysis could include model to observations comparisons and model-to-model comparisons when observations are limited or missing. The development of metrics to evaluate models (historical model/observations comparisons) would also be very helpful. The focus should be on decadal and longer time scale processes. Understanding the role of shorter time scales (diurnal, seasonal, interannual) processes on the long time scales would also be important.

3) Aerosols, Atmospheric Chemistry, and Climate

NOAA has conducted numerous field campaigns and has monitored key climate relevant atmospheric species over the past several decades. An extensive database of measurements is readily accessible. Field missions are identified and described at http://www.esrl.noaa.gov/csd/field.html, and monitoring data are located at http://www.esrl.noaa.gov/gmd/dv/ftpdata.html. These measurements have already contributed to our understanding of atmospheric composition and climate. However, it is important to continue their use in addressing scientific questions, given the most recent additions to available data (e.g. CalNex measurements) and ongoing improvements in modeling capabilities.

In FY2012, ESS invites modeling and analysis proposals that employ multiple NOAA data sets (as well as complementary data collected by other agencies) to focus on the elements of the nitrogen cycle that are relevant to stratospheric ozone and climate, including interactions between the nitrogen and carbon cycles.

Program Contact information:

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