The Energy and Water Cycle - talks		
Christopher M. Taylor	Frequency of extreme Sahelian storms tripled since 1982 in satellite observations	Detecting changes in extreme rainfall from satellite records is challenging because of poor temporal sampling and relatively short datasets. Here we use the 35-year Meteosat record of cloud-top temperatures to document a remarkable rise in the frequency of intense Mesoscale Convective Systems (MCS) across the Sahel. Sahelian MCS frequency is highly correlated with global, but not local, temperatures. We show that the rapid intensification of MCS is consistent with warming in the Sahara to the north, which has been driven by anthropogenic emissions. The enhanced temperature gradient affects MCS intensity through changes in wind shear and the Saharan Air Layer.
Richard P. Allan, Chunlei Liu	A new global surface flux estimation and its contribution to the eastern Pacific cooling	A new global net surface energy flux is presented (Liu et al 2015, 2017) using the satellite-derived radiative fluxes at TOA (Allan et al 2014) and the atmospheric energy tendencies and transports from the ERA-Interim reanalysis (Berrisford et al 2011). Surface energy flux estimates, including derived turbulent fluxes, inferred global and Atlantic meridional heat transports and ocean energy transport at 26oN are evaluated against available observations. The surface flux contribution, particularly the latent heat flux contribution, to eastern Pacific cooling associated with slower than expected global warming in the first decade of the 21st century is also investigated.
Alessandro Battaglia, Frederic Tridon, Joe Turk, Simone Tanelli, Stefan Kneifel, Jussi Leinonen, Pavlos Kollias, Kamil Mroz	Multi-Frequency Radar/Passive Microwave retrievals of Cold Season Precipitation from OLYMPEX data	Due to the large natural variability of its microphysical properties, the characterization of solid precipitation over the variety of Earth surface conditions remain longstanding open issues for space-based radar and passive microwave (MW) observing systems, such the current Global Precipitation measurement (GPM) core satellite and the precipitation products produced by its constellation radiometers. To assess the requirements for future cloud/precipitation observing systems, observations from the NASA DC-8 (radar profiles from the Advanced Precipitation Radar (APR-3) and two HF radiometers) were collected during November-December 2015 as part of the OLYMPEX-RADEX campaign in western Washington state, covering orographically evolving precipitation events with flight transects that covered transitions from ocean, coast, vegetation and snow-covered surfaces, regimes where there is less experience in modelling the joint atmospheric and land surface properties.

Anna Mackie	Dust storms and monsoons: reconciling observed and modelled TOA broadband radiation fluxes in a Sahelian environment	The balance of solar and thermal radiation fluxes at the top-of-the-atmosphere (TOA) fundamentally drives the Earth's climate. These fluxes vary over a range of spatial and temporal scales, driven by, for example, cloud coverage and atmospheric aerosol loading. The ability of climate models to describe observed variations in TOA fluxes provides a test of their ability to describe future changes in climate, particularly over geographical regions vulnerable to changes in climate, such as West Africa. We present an analysis of temporal variation in TOA radiation fluxes over Niamey, Niger, from both observations and model output.
Anthony Illingworth	Proposed Satellite to provide global winds, ice water content and rainfall	We report further developments funded by CEOI and ESA of a proposed conically scanning space-borne Dopplerised 94GHz with a broad (800km) ground track to provide global measurements of winds, rainfall and cloud ice water content using the radar returns from cloud and precipitation particles. The observations will have 50km horizontal and 1km vertical resolution with visits every day at European latitudes. Windstorms are the single most damaging meteorological phenomenon in Europe with high losses also resulting from flooding. We describe aircraft and ground based observations demonstrating that in-cloud winds should be estimated to an accuracy of 1 to 2m/s.
The Energy and Water Cycle – posters – and poster board number		
Caroline Dunning, Richard P. Allan, Emily Black	1 Evaluation of seasonality in rainfall simulated by CMIP5 models over Africa	Objective estimates of Africa rainfall seasonality (regime, progression and timing of the wet seasons) is used to evaluate CMIP5 simulations. Atmosphere-only and coupled integrations capture the observed patterns of seasonal progression: mean onset/cessation dates are within 16 days of the observational dates for 11 of 13 regions considered although the Long rains over East Africa are 20 days late on average in coupled simulations. Biannual rainfall regimes are identified for East and Central Africa but coupled simulations fail to capture the biannual regime over the southern West African coastline which is linked with Gulf of Guinea sea surface temperature.

Chris Banks	2 Out of the freezer: CryoSat altimetry performance in the global oceans	Although CryoSat is focussed on the Cryosphere the data returned from the global oceans are important for oceanographic studies. In fact, operational marine products from CryoSat, generated by a dedicated processor, have been available since April 2014. Here we present some results of a verification and scientific validation of the Geophysical Ocean Products, which have consolidated orbits and are available 30 days after acquisition. This assessment, carried out within the ESA-funded CryOcean-QCV project, is performed for sea surface height, significant wave height and wind speed. In addition, we will present examples of the benefits of these products for oceanographic studies.
Bo Dong , Keith Haines	3 Variations of the atmospheric overturning circulation and energy transport under global warming	The phase transition of the Interdecadal Pacific Oscillation (IPO) is one possible cause of the early 2000 global warming hiatus. To physically understand the modulation mechanism, changes in atmospheric overturning circulations and the associated energy transport for the IPO and global warming are quantified and contrasted. Results show that during the warming hiatus period, the IPO acts opposed to the global warming by balancing out its Walker and Hadley circulation anomalies. The associated changes in atmospheric energy transport are further quantified and its implications on ocean-atmosphere heat exchange are discussed.
Darren Ghent	4 An assessment of long-term Land Surface Temperature data	Land surface temperature (LST) has a long heritage of satellite observations that have facilitated our understanding of land surface and climate change processes. Here we assess a first Climate Data Record (CDR) for LST from the Along-Track Scanning Radiometers ATSRs spanning the time period August 1995 to March 2012. With LST recently classified as a new Essential Climate Variable (ECV) in the 2016 GCOS Implementation plan, which aims to guide climate observations over the next 10 years, it is timely to consider both the quality of current LST CDRs and the methodologies used in their assessments.
Claire MacIntosh	Uncertainty in Steric Sea level (not presenting)	Steric sea level describes sea level change related to temperature and salinity changes. On a global scale, it provides an integrated measure of energy storage in the oceans. Closure of the sea level budget is still a significant challenge for the community. In addition to understanding the processes that contribute to changes in sea level, budget closure studies require frameworks for understanding uncertainty address the classification and propagation of uncertainty information. For this approach to succeed, an understanding of relevant contributions and appropriate methods to combine uncertainties must be developed. In this study we combine real world and synthetic

		Argo profiles to discuss contributions to the uncertainty budget for a particular estimate of steric sea level.
Shannon Mason	5 Using EarthCARE's Doppler radar to improve estimates of global precipitation	Precipitation estimates from satellite observations are sensitive to many microphysical assumptions, with large uncertainties for the global energy and water cycle. Raindrop size and concentration vary significantly from liquid clouds or melting ice, while in mixed-phase clouds precipitation can range from low-density aggregates to heavily rimed graupel. The upcoming ESA/JAXA satellite EarthCARE will carry the first Doppler radar in space. In this work we use airborne and ground-based Doppler radar observations to demonstrate the contribution of Doppler velocity measurements to improved estimates of raindrop size distribution in tropical rain, and the density of ice particles from high-latitude mixed-phase clouds.
Kamil Mroz	6 Hail detection algorithm for the Global Precipitation Measuring mission core satellite sensors	By exploiting an abundant number of extreme storms observed simultaneously by the Global Precipitation Measurement (GPM) mission core satellite's suite of sensors and by the ground-based S-band Next-Generation Radar (NEXRAD) network over continental US, proxies for the identification of hail are developed based on the GPM core satellite observables. The full capabilities of the GPM observatory are tested by analyzing more than twenty observables and adopting the hydrometeor classification based on ground-based polarimetric measurements as truth. The proxies have been tested using the Critical Success Index (CSI) as a verification measure. The hail detection algorithm based on the mean Ku reflectivity in the mixed-phase layer performs the best, out of all considered proxies (CSI of 45%). Outside the Dual frequency Precipitation Radar (DPR) swath, the Polarization Corrected Temperature at 18.7 GHz shows the greatest potential for hail detection among all GMI channels (CSI of 26% at a threshold value of 261 K). Global map of hail occurrence, based on the best performing Ku-only proxy applied to the first two years of GPM data, is presented.
Dr Louisa Reynolds	7 In a state of flux: Sensing the surface energy balance from space	Net available energy is a key ingredient of the Earth's energy system, driving the turbulent fluxes from the land surface. Current methods for its estimation have tended to rely on measurements taken at the ground and this has limitations. In this thesis a new approach is proposed using satellite data only. Radiative flux components and system heat uptake were derived and brought together to obtain values of net available energy reaching the Earth's surface. The results show that this method may be useful when taken at monthly resolution and is applicable over a wide range of climate types.

Tim Trent	8 Observing Near Surface Layer Water Vapour From The SWIR	Observations of water vapour from planetary boundary layer can be employed for evaluating/developing of land-atmosphere coupling in weather and climate models. The Greenhouse Gases Observing SATellite (GOSAT) carries the TANSO-FTS instrument which has three spectral bands (0.76, 1.6 and 2.0 µm) that operate in the short wave infrared (SWIR). The SWIR can be used for H2O retrievals with high sensitivity to the lower troposphere. With sensitivity to several H2O absorption bands, GOSAT XH2O retrievals have the ability to distinguish at least two pieces of information. In this study preliminary results from an assessment of GOSAT near-surface layer XH2O are presented.
Climate and Long-term Datasets - talks		
Gareth Thomas, Matt Christensen	Cloud contamination in satellite products enhances the aerosol indirect forcing estimate	Anthropogenic aerosols may significantly affect the rate of global warming through their cooling potential and influence on clouds. A new Cloud-Aerosol Pairing Algorithm (CAPA) has been developed for the Optimal Retrieval of Aerosol and Cloud (ORAC) algorithm to examine the strength of aerosol-cloud relationships. CAPA matches aerosols and clouds together using a nearest neighbour algorithm at the nominal spatial scale resolution (~1 km) of the satellite instrument. By applying CAPA to AATSR data we demonstrate that previous satellite-based radiative forcing estimates represented in key climate reports may be exaggerated due to including retrieval artefacts in the aerosol located near clouds.
Chris Merchant Co-authors: R. I. Woolway and L. Carrea	Inland waters temperatures in relation to climate	Lakes and other inland waters are sensitive to climate change, both in terms of physical properties, particularly temperature, and biogeochemical functioning (for which temperature is an important control). Thermal remote sensing of lake surface water temperature (LSWT) is a critical source of information about lake-climate interactions, since sustained measurements are rare, and where present, are not necessarily representative. Using satellite LSWT observations, we give present the global picture of LSWT warming. Some lakes amplify the surface-air climate change signal, a mechanism for this amplification being evident from analysis of the LSWT dataset. The data also reveal that within-lake climate responses are complex and require further study.

Roger Saunders	Use of satellite data for climate modeling applications	Now that satellite datasets are extending over several decades and in some cases almost 50 years they are increasingly being used for climate research applications. This talk will give an overview of how satellite data is being used for a variety of different applications related to climate research and provide some examples.
Helen Brindley and Richard Bantges	Can IASI be used to quantify trends in the Earth's spectrally resolved OLR?	Nine years of IASI MetOp-A data from 2008-2016 are used to evaluate variability and trends in the Earth's spectrally resolved OLR. Compared with a previous 5 year study our results show a marked increase in variability but a trend which is inconsistent with that seen in the corresponding CERES record. Analysis of contemporaneous IASI MetOp-B data identifies a shift in the IASI MetOp-A record, consistent with the timing of a processing change. We investigate whether this change could be responsible for the observed behaviour and discuss the implications for the use of the current IASI record for climate trend evaluation.
Giorgio Savini	Update on the LOCUS Breadboard 8th call activity	The LOCUS satellite concept aims to link observations of climate, the upper atmosphere and space weather by studying the molecular composition of the Mesosphere-Lower Thermosphere region performing limb sounding measurements at both THz frequencies and IR wavelengths. The compact breadboard designed for an LEO standard SSTL-150 platform includes an all-Aluminium telescope and optical bench, a 1.15 THz receiver novel split-block design housing a QCL-pumped Schottky mixer and a compact cooler designed for a small payload. The activity is entering its final phases with upcoming optical, IR and THz beam tests and thermal-vacuum tests to assess cooler and radiative panels performance.
Climate and Long-term Datasets – posters – and poster board number		
Claire Bulgin	9 Validation strategies and techniques for Earth Observation data across communities	Common challenges in Earth Observation (EO) validation across communities can be recognised despite diverse approaches to addressing this issue. These include the need for fiducial reference measurements, clear definition of dataset requirements to validate against, clear understanding of dataset uncertainties and their validation, and dealing with issues of spatial-temporal mismatch in comparing EO data to reference datasets. A group of scientists with interests across the terrestrial, atmospheric, oceanographic and mathematical sciences discussed these questions at two recent workshops at the International Space Studies Institute (ISSI). A comprehensive review paper was written addressing EO validation and providing recommendations for common practice.

Martyn Chipperfield	10 Quantifying the current extent of stratospheric ozone recovery from observations and models	Depletion of the ozone layer over the past few decades has been caused by increases in stratospheric chlorine and bromine due to human activity. Following controls by the Montreal Protocol, the atmospheric loading of chlorine and bromine is now slowly decreasing. The ozone layer is expected to recover in this century. Currently, however, relatively short data records and atmospheric variability confounds the search for early signs of this recovery. Here we discuss the nature and timescales of ozone layer recovery, and explore the extent to which it is underway in different atmospheric regions.
Sandip Dhomse	11 Evaluating stratospheric chemistry and aerosol in the UK CCM (UKCA) and CTM (SLIMCAT) using various satellite datasets	Chemistry climate models (CCMs) and chemical transport models (CTMs) are widely used to understand past and predict future changes in the stratosphere. Here, we use the various satellite instrument data sets (e.g. ACE, SAGE, HALOE, MLS, MIPAS) to evaluate various chemical specie in the UK CCM (Chemistry and Aerosol model- UKCA) and CTM (SLIMCAT). Primarily we will present analysis about inter-annual and long term changes in the stratospheric ozone, HNO3, CH4 and N2O. Evaluation of stratospheric aerosol properties (e.g. extinctions, effective radius, aerosol optical depth) following large and small volcanic eruptions would also be presented.
Owen Embury	12 SST retrieval methods in the ESA Climate Change Initiative	The ESA Sea Surface Temperature Climate Change Initiative (SST-CCI) aims to produce a ~35 year record of satellite-only SST. The core products are level-2 and level-3 from the Along Track Scanning Radiometer (ATSR) and Advanced Very High Resolution Radiometer (AVHRR), and a level-4 SST analysis based on the Met Office OSTIA system. In this presentation we describe the SST retrieval algorithms used in SST-CCI. For the ATSR instruments we use a dual-view retrieval based on methods developed for the ATSR Reprocessing for Climate project. For the AVHRR instruments we use Optimal Estimation referenced to the ATSR SST for consistency. In addition to the SST we also provide estimates of the uncertainty due to uncorrelated errors, synoptically correlated errors, and sampling errors. In order to reduce the effects of instrument noise in L2P products we use a multiple-pixel retrieval.

Owen Embury	13 Stratospheric aerosol and impacts on infrared SST retrievals	Large explosive volcanic eruptions, such as Mount Pinatubo (1991) and El Chichón (1982), can inject megatons of sulphur dioxide into the stratosphere. The gas quickly forms a sulphuric acid aerosol which remains in the stratosphere for a couple of years. In addition to its direct impact on the planets climate, stratospheric aerosol can cause cold biases over 1 K in infrared SST retrievals from space. We present here a climatology of infrared aerosol index retrieved from the High-resolution Infrared Radiation Sounder (HIRS) which has been carried on board NOAA polar orbiters since 1978. This aerosol index provides the information necessary to adapt the AVHRR SST retrievals for the present of volcanic sulphate aerosol. We show how this approach reduces the significant biases otherwise present in the AVHRR climate data record.
Paul Green	14 GAIA-CLIM: Gap Analysis for Integrated Atmospheric ECV CLImate Monitoring	GAIA-CLIM is a H2020 project undertaken to make significant advances in the consistency and cross-calibration/validation of long-term space-based measurements from ground-based reference measurements, providing a better overview of the uncertainty of available data used to generate Climate Data Records, including the impacts on gaps in information. The tools developed within this project will increase access to, usability and metrological confidence in ground-based reference measurements applied to the validation of future EO mission products, facilitating their widest applicability, so open up new opportunities for their usage in long-term environmental monitoring of ECVs.
Robert Hargreaves	15 A scaled linear retrieval technique	Fast retrieval methods for the detection of atmospheric trace gases from satellite observations often provide unreliable total column measurements, whereas more accurate iterative retrievals require large processing times. We present a scaled linear retrieval method that aims to provide a better estimate for the total column of tropospheric trace gases, while remaining fast to compute. The performance of this method is compared to current retrieval methods for ammonia.
Said Kharbouche (on behalf of Jan-Peter Muller)	16 A new 33 year record of land surface albedo derived using optimal estimation from data fusion of AVHRR and GEO	The ESA GlobAlbedo processing scheme was modified to work with AVHRR LTDR and surface BRF data processed by EUMETSAT on the CEMS system to produce a 33 year record of land surface BRDF and albedo at shortwave_only and using AVHRR_only at tri-spectral broadbands (VIS, NIR, SW). The system is described and examples of all the challenges that had to be overcome with AVHRR data and how they were overcome will be discussed. An initial evaluation against MODIS and GlobAlbedo will be shown along with a validation against tower measurements of albedo.

Barry Latter	17 The production of 20+ year height-resolved ozone data from GOME-class instruments for ESA-CCI and C3S	RAL's ozone profile retrieval scheme for the GOME-class of solar uv/vis backscatter spectrometer has sensitivity to tropospheric ozone, which led to its selection for nadir ozone profile retrieval from this class of sensor in ESA's Climate Change Initiative (CCI) and also now EC C3S. The retrieval scheme has now been improved in its adaptation to NASA's Aura OMI, and the OMI time-series contributed to the IGAC Tropospheric Ozone Assessment Report. Results from the improved uv scheme applied to GOME-1, GOME-2A and -2B and SCIAMACHY data spanning 1995-present are presented, together with early results from our MetOp IASI ir scheme.
Dionysios E. Raitsos, Robert J.W. Brewin,2, Peng Zhan, Denis Dreano, Yaswant Pradhan, Gerrit B. Nanninga, Ibrahim Hoteit	18 Sensing coral reef connectivity pathways from space	Coral reefs — the rainforests of the marine realm — rely on inter-habitat connectivity to maintain gene flow, biodiversity and ecosystem resilience. The coral reef communities of the Red Sea were shown to exhibit remarkable genetic homogeneity across most of the Arabian Peninsula coastline, which is interrupted by a genetic break towards the southern part of the basin. While previous studies have attributed these patterns to environmental heterogeneity, we hypothesize that they may also emerge as a result of dynamic circulation flow; yet, such linkages remain undemonstrated. Here, we integrate satellite-derived biophysical observations, particle dispersion model simulations, genetic population data and ship-borne in situ profiles to assess reef connectivity in the Red Sea. We computed long-term (>20 yrs.) connectivity estimates of simulated particles driven by satellite observations of sea level elevation. Outputs were then compared with an existing data set of genetic distance among populations of the anemonefish, Amphiprion bicinctus, along the eastern Red Sea coastline.
Nick Rayner	19 The EUSTACE project: delivering global, daily information on surface air temperature	Day-to-day variations in surface air temperature affect society in many ways; however, daily surface air temperature measurements are not available everywhere. To achieve a global daily analysis, we are incorporating satellite retrievals in the EUSTACE project (https://www.eustaceproject.eu). This involves developing an understanding of the relationships between surface air temperature measurements and retrievals of surface skin temperature over all Earth's surfaces. Here we summarise our progress towards producing a global, centennial daily ensemble surface air temperature analysis, integrating different data types and creating globally-complete fields in the past using new statistical models of how surface air temperature varies temporally and spatially.

Gareth Thomas	20 The ORAC Aerosol_cci (A)ATSR dataset	Over the past seven years the NCEO has supported the development of the Optimal Retrieval of Aerosol and Cloud algorithm and its role in producing a global aerosol dataset from the full ATSR-2/AATSR record in ESA's Aerosol_cci project (part of the Agency's Climate Change Initiative programme). This poster presents the final ORAC Aerosol_cci dataset, and discusses the future prospects of this work.
Tim Trent	FIDUCEO: Assessing the HIRS FCDR Through SNO matchups. (not presenting)	Results from the HIRS inter satellite comparison are presented within the context of the FIDUCEO project.
Alison Waterfall	The CCI Open Data Portal (not presenting)	The CCI Open Data Portal has been developed within the ESA Climate Change Initiative to provide a central location to access all the key ECV products produced by all the different teams funded under the CCI programme. It aims to provide access to the data via a range of access protocols, in order to distribute the data as widely as possible. In the last year the portal front end has gone live, providing a dashboard view and faceted search across all datasets. This presentation will describe the CCI portal and the challenges of integrating the wide variety of CCI datasets within it, and will explain how users can access the CCI data.
Ocean and Ice - talks		
Christine Gommenginger, Adrien Martin, Bertrand Chapron, Jose Marquez, Sam Doody & the SEASTAR Science Team	SEASTAR: a new satellite mission to observe sub-mesoscale ocean dynamics and air/sea coupling	SEASTAR is a new satellite mission being prepared for submission to the European Space Agency as an Earth Explorer Core mission. The mission is led by the National Oceanography Centre, supported by a close partnership with Airbus Defence & Space Ltd and a large international science team. Based single-pass squinted SAR along-track interferometry, the mission seeks to deliver two-dimensional maps of ocean surface current and wind vectors with unprecedented accuracy and resolution. The paper will present the state of development of the mission, highlighting recent advances and outstanding issues.
Steve Groom	Ocean colour from Sentinel 3 OLCI	The Copernicus/ESA Sentinel 3 OLCI sensor will provide the main source of ocean colour data for NCEO research and support to science through NCEO/NEODAAS for the next 20 years. With a heritage of the MERIS sensor, a two-satellite constellation, global coverage at 300m and additional wavebands, OLCI will provide higher resolution coastal as well as global ocean observations. This presentation will describe efforts to validate OLCI with in situ observations, progress in establishing an OLCI service for NEODAAS and synergy with Sentinel 2 MSI in the coastal zone.

Emma Dodd	An Extension to the ATSR Arctic combined Surface Temperature (AAST) dataset Surface Temperature Time Series	Surface Temperature (ST) changes in the Polar Regions are predicted to be more rapid than either global averages or responses in lower latitudes. Observations increasingly confirm this for the Arctic. Previously we have produced a combined land, ocean and ice ST dataset for the Arctic using ATSR data (1995-2012). In order to facilitate investigation of more recent changes, such as recent high profile events of anomalously warm winter temperatures, we are working to extend this dataset to 2016 using MODIS and AVHRR data. The dataset methods will be described, preliminary results will be presented, and future work outlined.
Michel Tsamados	Sensitivity of Arctic and Antarctic sea ice to form drag parameterization: model results and remote sensing observations	A new drag parametrization accounting explicitly for form drag has been recently formulated and applied to the Arctic sea ice (Lupkes et al, 2012 and Tsamados et al, 2014). We summarize here the fundamental elements of this formulation and we then adapt it to the Antarctic sea ice. Considering the general expression of the momentum balance of sea ice, we analyze the total (neutral) drag coefficients by studying separately air-ice and ocean-ice momentum fluxes, and by introducing the parameterization for both the atmospheric neutral drag coefficient (ANDC) and the oceanic neutral drag coefficient (ONDC). The two coefficients are calculated as a sum of their skin frictional contribution and form drag contribution, which comes from ridges and floe edges for the ANDC and keels and floe edges for the ONDC. Due to the contrasting geography of the two polar regions, there are important differences, both dynamic and thermodynamic, between Arctic and Antarctic sea ice. In the Antarctic, sea ice is younger, less ridged (hence thinner and smoother). Due to the intense snowfalls, the snow cover is generally thicker than in the Arctic, with values that vary significantly both seasonally and regionally and can affect the roughness of the surface and can lead to flooding of the ice. At the outer boundary of the Southern Ocean, the ice is unconstrained by land, divergent and subject to meridional advection, which leads to a much faster ice drift than in the Arctic. We show here how the new parameterization accounting for form drag influences the Antarctic sea ice characteristics.

Christophe Bellisario	Retrievals of the Far Infrared emissivity of snow over the Greenland Plateau using the Tropospheric Airborne Fourier Transform Spectrometer (TAFTS).	The Tropospheric Airborne Fourier Transform Spectrometer (TAFTS) measured near surface upwelling and downwelling radiances within the far infrared (FIR) over Greenland to provide in-situ estimates of FIR snow emissivity. The flight campaign and instrumental set-up are described as well as the retrieval method, including the quality controls performed on the observations. The spectral variation of the retrieved emissivity is displayed and a comparison is performed with our estimates falling within the range of the theoretical values.
Tristan Valenzuela	Gravity Mapping from Space using Cold Atom Sensors	The GRACE and GOCE missions have very successfully mapped the earth gravity field, allowing us to understand the mass distribution and changes in the earth system at a global scale. Classical sensors have an inherently limited sensitivity due to construction imperfections and thus the temporal and spatial resolution (of the order of 100 km) of the current gravity missions is limited to quasi-static and regional events. With the advent of the new wave of quantum technologies during the last decade, the sensitivity of gravity sensors has improved, on ground based devices, by orders of magnitude. This sensitivity improvement has been mainly limited by the constraints given by ground-based operation thus promising a further improvement when operating in the micro-gravity environment of a drag-free spacecraft. This would lead to spatial resolutions of 10s of km. This will have a transformative effect on the science that can be done with gravity data. It will be possible to measure more river basins, begin to resolve outlet glaciers, monitor ocean-drivers of climate variability and detect far smaller earthquakes that was possible with GRACE.
Ocean and Ice – posters – and poster board number		
Bob Brewin	21 Evaluating AVHRR SST data at the coastline using surfers	Owing to a large network of in situ platforms, there is a reasonable understanding of the performance of Earth Observation (EO) Sea Surface Temperature (SST) data in the open ocean. However, at the coastline this performance is not well known, impeded by a lack of in situ data. Here, we used in situ SST measurements collected by a group of surfers in the coastal waters of the UK and Ireland, to improve our understanding of the performance of AVHRR SST data at the coastline.

Tiago Dotto	22 Variability of the Sea Surface Height of the Ross Sea	The Ross Gyre (RG) is one of the main current systems of the polar Southern Ocean and changes in its strength could bring more warm waters onto the continental shelf, impacting the stability of the Ross Ice Shelf. Here, altimetry data is used to study aspects of the circulation of the RG and adjacent regions in a seasonal timescale. The RG extension was identified, and its dynamic ocean topography and area change accordingly to its strength variability in seasonal timescales. Preliminary results indicate that the variability of the wind stress curl plays a role to set the variability of the RG. More efforts are needed to fully comprehend the role of the atmosphere-sea ice-ocean interactions play on the variability of the RG.
Technologies and Tools - talks		
Marko Huebner, Alex Hoffmann, Neil Macleod, & Damien Weidmann	Demonstration of a thermal IR Laser Heterodyne Radiometer (LHR) in emission sounding mode	Ground-based thermal infrared laser heterodyne radiometry (LHR) for high-spectral-resolution atmospheric remote sensing has been developed and demonstrated using direct sunlight as a source (transmission mode). To enable airborne and space-borne sensor deployment in nadir or emission limb viewing geometries, the technology and its operating principles need to be developed and studied in the context of emission spectro-radiometry. To that end, recent results from a lab-bench system demonstrating spectral emission measurements using gas cell analogues, and first attempts at recording atmospheric CO2 and H2O emission spectra are presented.
Ciaran Robb	Near-real-time forest monitoring with Sentinel-2 and mobile technology	With the launch of the ESA Sentinel satellites, there is the potential to monitor forest cover change at more regular intervals and in greater detail. A near real time solution to forest change monitoring is presented, which utilises Sentinel 2 data, cloud computing and mobile technology. The system has been developed in Kenya in partnership with the Kenya Forestry Service and the mobile app company Akida. Forest cover change alert information is delivered directly in an easily accessible reporting format via a smartphone app (AKIDA) to community forest associations and national agencies. Information comes full circle via the reports of forest practitioners and community members for verification purposes and possible intervention.

Yu Tao	Super-resolution restoration from multi-angle EO imagery	UCL-MSSL Imaging Group have developed unique technology for retrieving up to 5 times native resolution by exploiting repeat pass imagery at multiple angles. Originally, Tao & Muller (2016) showed its application to production of 5cm SuperResolution Restoration (SRR) from stacks of >5 25cm NASA HiRISE imagery of the Martian surface. More recently in collaboration with UrtheCast®, 4m repeat pass imagery over urban and vegetated areas has been resolved up to 1m. We will demonstrate SRR experimental results from MISR imagery, UrtheCast® Deimos-2 imagery and the SSTL Carbonite-1 <1m stop-and-stare video data.
Damien Weidmann, Alex Hoffmann, Neil Macleod, Kevin Middleton, Doug Griffin, Joe Kurtz, Simon Barraclough	MISO : a micro-sat IOD mission contributing to the global GHG observing network	Enabling cost-effective yet accurate greenhouse gas (GHG) observations from microsatellite platforms requires novel miniaturized sensing technologies to be developed, matured, and demonstrated in orbit. The MISO mission is a UK/Australia bilateral endeavour focusing on providing GHG measurements through solar occultation sounding in the UTLS with the prospective goal to constrain models and contribute to improving assimilated measurements. In addition to establishing very high resolution spectroscopic sensing from a 6U CubeSat, the mission aims to demonstrate the laser heterodyne spectro-radiometer technology as well as the hollow waveguide integration technology underpinning optical system miniaturization in space. Outcomes from a phase A study are reported.
Emma Woolliams	Post-launch calibration approaches	We review methods established and proposed for the post-launch calibration, validation and comparison of radiometric satellite sensors; including the new CEOS Radiometric Calibration Network (RadCalNet) of instrumented sites, which will become operational in late 2017, and the use of Pseudo Invariant Calibration Sites (PICS); e.g. those in the Saharan desert. We also describe CEOI-funded activity that demonstrates how the proposed SI-traceable climate and calibration mission TRUTHS will improve the traceability and resultant accuracy of these, and other, CEOS sites and thus reduce the uncertainty of missions such as Sentinel 2 and 3, and underpin the development of concepts such as ‘Analysis Ready Data’ (ARD).

Technologies and Tools – posters – and poster board number		
Steve Donegan	23 EO Data and Services at CEDA	The Centre for Environmental Data Analysis (CEDA) provides the data archive component for NCEO. CEDA provides access to over two petabytes of EO data, including data from the Sentinel, Landsat and ENVISAT missions. CEDA also provides access to data from the NERC ARF as well as many other missions. CEDA provides access to this data via a number of methods, not least fast access via the JASMIN environment which allows users access to the data using a world class fast parallel processing cluster. CEDA is consistently engaged in developing systems to manage the large volumes of data curated as well as tools to find and access this data.
Anu Dudhia	24 The Reference Forward Model	The RFM is a line-by-line radiative transfer model suitable for a wide range of applications requiring modelling of atmospheric transmittance in the infrared and microwave regions
Fiona Smith, Stephan Havemann, Alex Hoffmann, William Bell, Damien Weidmann and Stuart Newman	25 Evaluation of Laser Heterodyne Radiometry (LHR) for Numerical Weather Prediction Applications	Roughly half of the gain in NWP forecast skill in recent decades has been attributed to the availability and improved assimilation of satellite observations, in particular of radiometric data from hyperspectral infrared sounders such as IASI. Here, we explore whether the very high spectral resolution measurements achievable with LHR over narrow microwindows (<1 cm-1) may theoretically be suitable for future nadir-viewing instruments on-board small satellites or piggybacking onto larger missions. Appropriate microwindows with CO2 lines apt for temperature sounding are identified, and information content analysis used to study the performance of idealized instruments in an operational NWP data assimilation context.
Ed Williamson	26 Sentinel Data at CEDA	CEDA now hold over 1.8 petabytes of Sentinel data and are currently downloading over 5.5 terabytes per day soon to rise to 10 terabytes with the ESA satellite releases. This means older files are transferred to tape which can be made available from the Near Line Archive (NLA). CEDA's latest Sentinel dataset that we have released is the Level 1 SLSTR data. CEDA have developed a Satellite Data Finder allowing the Sentinel data on the CEDA archive to be geographically searchable. This data finder currently has all of the Sentinel and Landsat data that CEDA hold, available to search.

Chen Yu	27 GACOS: Generic Atmospheric Correction Online Service for InSAR	We have developed an online service for correcting tropospheric effects on InSAR measurements. GACOS integrates High Resolution ECMWF and, whenever available, GNSS ZTD estimates to separate stratificated component from turbulent one and then generate high resolution tropospheric delay maps with a precision of approximately 1 cm. GACOS is globally available in all-weather conditions at any time (and even in near real time). Quality control indicators have been developed to allow users to perform an automatic and flexible atmospheric correction.
Esther Conway	28 PV2018 (Preservation and Value Add Conference 2018)	For its ninth edition, the PV conference series moves to the Harwell Campus Space Cluster in the UK to continue addressing prospects in the domain of data preservation, stewardship and value adding of scientific data and research related information. NCEO – CEDA and RAL Space will be hosting this international conference on behalf of the UK Space Agency. Areas of interest to the NCEO Science community include, data standards, uncertainty, validation, reprocessing, value added services and use of collaborative environments such as JASMIN.
Land-Atmosphere Observations and Interactions - talks		
Diane Knappett	Improved global methane distributions from IASI through joint pre-retrieval of temperature, humidity and surface spectral emissivity and other developments	Following on from the publication of the RAL IASI methane retrieval algorithm and validation paper (R.Siddans et al., doi:10.5194/amt-2016-290) and archival of the IASI methane v1.0 dataset with CEDA, the IASI methane retrieval scheme has undergone significant modifications in preparation for an upcoming full mission reprocessing (v2.0). Temperature and water vapour profiles and surface spectral emissivity are jointly retrieved by our MetOp Infrared Microwave Sounder (IMS) scheme and used in place of met analyses to improve methane retrieval and potentially for climate monitoring in their own right. To improve methane source detection and attribution, all cloud-free IASI detector pixels will be processed in v2.0, to produce a full resolution, global dataset, and preliminary co-retrieval of 13CH4 has been implemented.

Tianran Zhang	Agricultural fire emissions inferred from VIIRS are much higher than current bottom-up inventories	This purpose of this research is to provide a new smoke emissions from eastern China's agricultural residue burning. To meet this target, a small fire detection algorithm was developed using VIIRS data, following by field UAV validation and evaluation. A VIIRS-IM 'synergy' FRP product was developed blending the advantages offered by the I-Band sensitivity with M-Band FRP retrieval over higher FRP fires, which combined with diurnal cycle generated using 15-min resolution FRP data from Himawari-8 to derive to daily FRE. At the same time, instantaneous in-situ gas/particle measurements of crop residue fires have been made with a new developed sampling system. Finally a high spatial-temporal resolution agricultural fires emission inventory was derived using the above daily FRE results and EFs calculated using field data.
Tim Keslake	Biomass burning influences on atmospheric composition during the SAMBBA flight campaign	Fires in the Amazon can have a significant impact on local atmospheric composition. Changes in aerosol and ozone precursor concentrations from fires can impact local human and plant health. Due to the inhomogeneity of fires, model predictions of their emissions have traditionally had large uncertainties. Here we combine satellite and model data using C-IFS with GFAS fire emissions to assess how well models can capture composition changes from fires. To do this analysis and model products are validated against independent aircraft, ground and satellite observations. Results show a general underestimation of fire emissions leading to smaller than observed composition changes.
Emma J Barton	Aircraft Observations of Land-Atmosphere Coupling in Northern India	The Anglo-Indian collaborative project INCOMPASS was set up to investigate the key land-atmosphere processes that shape the Indian summer monsoon, and ultimately improve rainfall prediction. This study presents observational evidence of coupling between surface hydrology, driven by both irrigation and rainfall, and the planetary boundary layer (PBL) during monsoon onset in northern India. Analysis of aircraft and satellite data reveals the influence of soil moisture on physical conditions in the PBL and cloud formation on different spatial scales. These unique observations will serve as a powerful tool for understanding the dominant land-atmosphere coupling mechanisms that influence the summer monsoon.

Land-Atmosphere Observations and Interactions – posters – and poster board number		
Edward Malina	29 Global d13C estimates of Methane from GOSAT	d13C Methane measurements to date have largely been obtained from a limited number of in-situ flask/CRDS measurements, or from dedicated aircraft campaigns. These limited measurements have led to research groups extrapolating limited amounts of data to make judgments on global trends in d13C. We present an application of the University of Leicester proxy optimal estimation method for global measurements of d13C, aimed at retrieving concentrations of d13C with GOSAT. We comment on global spatio-temporal distributions of d13C over the lifetime of GOSAT, and the errors and variations expected with GOSAT.
David Moore	30 Long-term changes in ethane observed by MIPAS	Ethane is the most abundant hydrocarbon in the Earth's atmosphere, after methane, and acts as a precursor to tropospheric ozone. By using a simple linear approximation, taking into account variability to define errors on the fit, we derive changes in ethane in the upper troposphere and lower stratosphere over 2007-2012. We find a relationship between MIPAS ethane and methane growth rate in the upper troposphere, with increased methane growth rates occurring when ethane concentrations begin to fall during the summer months each year. Data are compared to HIPPO in-situ observations to check consistency.
Rob Parker	31 Assessing the inter-annual variability of wetland methane emissions	In this work we use atmospheric observations of total column CH4 from the GOSAT satellite to evaluate current state-of-the-art methane wetland emission estimates. We find that for certain time periods there are large discrepancies between simulation and observation. In particular, strong enhancements in the methane seasonal cycle are observed over the Pantanal and Llanos de Moxos region in 2010, 2011 and 2014 and over the Parana River region in 2010 and 2014. We find extremely consistent behaviour between the time and location of these methane anomalies and the change in wetland extent, itself driven by precipitation related to ENSO activity.

Environmental hazards – posters – and poster board number		
Daniel Fisher	32 Landscape fire emission estimation over the Americas from GOES FRE observations and MODIS ORAC AOD retrievals.	Recent work by Mota and Wooster has demonstrated the potential for estimating landscape fire emissions and fuel consumption directly from observations of FRP over Southern Africa. The approach is based on finding a linear model that relates time integrated FRP observations from SEVIRI to observations of aerosol optical depth (AOD) from MODIS. Here we extend this work to the Americas using the GEOS sensor to provide FRP and derive AOD from MODIS using the ORAC algorithm. The use of the ORAC algorithm provides AOD retrievals at 1km resolution, which will potentially result in improved emissions estimates via this novel approach.
Richard Pope	33 Influence of the North Atlantic Oscillation on European tropospheric composition: an observational and modelling study	The North Atlantic Oscillation (NAO) is an important winter-time climatological phenomenon, where the different modes (NAO+ and NAO-) control regional circulation patterns. In this study, we use trace gas (nitrogen dioxide-NO2, ozone-O3) satellite observations and model simulations to investigate the impact of the NAO on European tropospheric composition. Typically, NAO+ (NAO-) is associated with strong (weakened) westerly flow into North-West Europe. As a result, NO2 concentrations are reduced (increased) as they are transported away from (accumulate over) pollution source regions. O3 is anti-correlated with NO2 as NAO+ (NAO-) transports (blocks) enriched O3 Atlantic air replacing European NO2 enriched air.
Nibedita S Ray-Bennett, Gilbert Ouma, Dr Sophie Hebden, Nelson Mutanda, Ahmed Amdihun, Samuel Akera and Denise Corsel.	34 Earth Observation for Early Warning Systems: Strengths and Limitations	The use of Earth Observation (EO) is emphasised by the UN's 'Sendai Framework for Disaster Risk Reduction 2015-2030'. Funded by NERC's International Development Innovation and Impact Awards our project entitled 'Earth Observation for Disaster Risk Resilience in Kenya' identified the scopes of EO to improve early warning systems for disaster risk management in Kenya. At the 'Earth Observation Conference' we would share the findings of our content analysis of the Sendai Framework on EO and also aim to assess critically the application of EO tools in Kenya from the perspectives of the UNDP, IGAD-ICPAC and the Government of Kenya.

Lucy Ventress	35 Trace Gas Anomaly Detection for IASI Time-Series	In order to provide near real-time monitoring of atmospheric contaminants, fast and reliable methods are required to detect anomalies in the atmospheric state. Full optimal estimation retrievals are computationally expensive, therefore, faster methods are needed to identify such anomalous events and flag their presence. The method shown makes full use of the information from the hyperspectral sounder IASI to detect enhancements in atmospheric species that are important contaminants in pollution monitoring and forest fire detection. The full IASI time-series has been processed for over 20 species, enabling analysis of past events and long term trends.
The Carbon Cycle - talks		
Joao Carreiras, Shaun Quegan, Susan Page, Kevin Tansey	Mapping the 2015 forest fires in the peatlands of Central Kalimantan (Indonesia) with temporal stacks of Sentinel-1 data	An area of ~2.6 Mha burned during the 2015 fire season (July-October) in Indonesia, of which 1/3 affected carbon-rich and high-biodiversity peatlands. We tested whether monthly Sentinel-1A C-band radar data could map the progression of burnt areas in a ~6 Mha region (~40% being peatland) in Central Kalimantan. Burnt-unburnt maps with an overall accuracy of ~89% were produced but with omission errors of 16-36% in the burnt class. The overall burnt area was ~0.6 Mha, of which 75% burned in Sept-Oct. We discuss the benefits and limitations of Sentinel-1 for mapping forest fires in areas with endemic high cloud cover.
Liang Feng, Paul Palmer, Jing Wang, Robert Parker, Hartmut Boesch	Chinese CH4 and CO2 emissions inferred from GOSAT proxy XCH4:XCO2 retrievals	We use an ensemble Kalman Filter (EnKF) to infer simultaneously regional CO2 and CH4 fluxes from 2009 to 2015 by assimilating proxy GOSAT XCH4:XCO2 retrievals and NOAA in situ data. Compared to full physics retrievals, the proxy retrieval method is less sensitivity to fitting artefacts, resulting in more useful retrievals over China. We find that compared to fluxes inferred from in situ data, the GOSAT inversions have different seasonal cycles and inter-annual variations. We discuss the correlation between the inter-annual variation of the resulting CO2 and CH4 fluxes, with the observed land properties.
Hartmut Boesch	The Tropical Carbon Mission: Quantifying Tropical Carbon Fluxes from Space	We will present recent technology advances associated with the Tropical Carbon Mission (TCM) concept, which is designed to improve knowledge of the magnitude and distribution of tropical CO2 fluxes. TCM includes a SWIR multi-view spectrometer that will measure CO2 and complementary gases, an aerosol imager, a cloud imager. It will be launched in a 35-degree orbit so that it processes over tropical latitudes to maximize the frequency and coverage of cloud-free scenes. TCM data will enable scientists to quantify the pan-tropical carbon sink and to begin understanding the underlying

		processes, and to inform discussions on decarbonizing the world economy.
Shubha Sathyendranath, Victor Martinez-Vicente, Hayley Evers-King, Robert Brewin, Giorgio Dall'Olmo, Trevor Platt	Algorithms for satellite estimations of particulate organic carbon and phytoplankton carbon in the ocean	Various algorithms have been proposed for detection of particulate organic carbon (POC) and phytoplankton carbon (PC) in the ocean from satellite ocean-colour data. We have assembled large datasets of in situ measurements of POC and PC in the surface layers of the ocean, and then matched the in situ observations with concurrent in-water bio-optical properties provided by the Ocean-Colour Climate Change Initiative. Candidate algorithms were applied to the satellite data and compared with the in situ validation data. The POC algorithms performed well in the open ocean, and one or two of the better-performing algorithms appear to be ready for operational implementation. The choice of algorithms should take into account not just the comparison with in situ data, but also whether they reproduce faithfully the regional variations that are known to exist in POC, as well as the anticipated relationship of POC with other oceanic variables such as chlorophyll concentration. The PC algorithms, on the other hand, revealed some difficulties, some of which are associated with the limitations of the in situ data themselves. The comparison points to avenues for improving PC algorithms, and also highlights the importance of appropriate in situ data for validation.
Heiko Balzter	Forest cover change detection from space to provide official development assistance	Forests provide vital ecosystem services to local communities. Deforestation and forest degradation lead to greenhouse gas emissions and losses of natural resources. Earth observation data offer solutions to the monitoring of forest cover change which benefits low and middle-income countries. 'Forests 2020' supports 6 DAC countries in monitoring their forests more effectively. Methodological issues and data access and infrastructure issues are presented.
The Carbon Cycle – posters – and poster board number		
Heiko Balzter	36 How can EO support the mapping of natural capital and ecosystem services?	The quantification of natural capital and ecosystem services provided by the environment is a policy priority in the UK. Historically, the use of EO in this context has focused largely on land cover maps and ecosystem services value functions. Biophysical parameters provide a more direct way of estimating certain aspects of natural capital. The outcomes of the BESS-EO working group are presented, and a range of examples is given where EO (and particularly the Copernicus Sentinel-1 and 2 missions) can make greater contributions to this field of applications.

Richard Brownsword, Hilke Oetjen, Hartmut Bösch, Damien Weidmann, Paul Palmer	37 First compliant results of the prospective UK TCCON facility for GHG satellite data ground-truthing	The need to improve understanding and monitoring of the fate of greenhouse gas (GHG) emissions has driven international effort in deploying satellite-borne GHG sensors. TCCON is a global network of ground-based high-resolution FTIR spectrometers that record near-infrared solar spectra from which accurate and precise column-averaged abundances of GHGs are retrieved. TCCON provides the primary dataset for validation and ground-truthing of space-borne remote sensors and therefore constitutes a pivotal infrastructure for data quality assurance. The Harwell site is well-suited to characterize both local emissions and exchanges between continental Europe and the North Atlantic. First compliant results of the facility are reported.
Mike Burton	The role of volcanic CO2 emissions in the carbon cycle (not presenting)	Volcanoes produce CO2 both between and during eruptions. Recent work has greatly increased our knowledge of the global emissions from volcanic sources, and with each new measurement the global volcanic CO2 flux estimates increase. While IPCC reports that geological CO2 sources are ~1% of anthropogenic sources, the most recent global volcanic CO2 estimates are 3-5% of anthropogenic. This implies a faster geological carbon cycle than previously thought. Here, I present the state of the art in measurements of volcanic gas emissions from ground and space, and examine the implications of a larger than previously thought geological source for CO2.
Stefano Ciavatta, Robert Brewin, Luca Polimene, Jozef Skakala, David Sursham, Peter Jan van Leeuwen	38 Assimilation of remotely sensed phytoplankton size classes into a marine ecosystem model.	Marine ecosystems are crucial components of the carbon budget at both regional and global scales. In this work we show that improved estimates of carbon pools and fluxes at the ocean – atmosphere interface can be obtained by integrating ocean observations and marine ecosystem models using data assimilation in decadal reanalysis. In particular, we show that the assimilation of novel ocean colour products (e.g. phytoplankton size classes) is a promising new approach to better constrain the simulated trophic dynamics, hence the estimated fluxes and stocks of carbon in the North East Atlantic ecosystem.
Stefano Ciavatta, Susan Kay, Stephane Saux-picart, Momme Butenschon and Icarus Allen	39 Decadal reanalysis of biogeochemical indicators and fluxes in the North West European shelf ecosystem	We present the first decadal reanalysis of the biogeochemistry of the North West European shelf and we describe the variability of biogeochemical indicators and fluxes in this ecosystem. Ocean Colour from ESA's Climate Change Initiative (ESA CCI_OC) were assimilated into a state-of-the-art marine ecosystem model of the shelf sea, by using the localized Ensemble Kalman filter, in a reanalysis spanning the period 1998-2009. We provided the confidence level of the reanalysis estimates, by computing the percentiles of the ensemble distribution. The work provided maps of oxygen deficiency and carbon fluxes in the shelf, to support the management and understanding of the ecosystem.

Giorgio Dall'Olmo	40 Substantial energy input to the mesopelagic ecosystem from the seasonal mixed-layer pump	The ocean mesopelagic zone (100–1,000 m), harbours one of the largest ecosystems and fish stocks on the planet. Life in this region is believed to rely on sinking particulate organic carbon (POC). Yet this supply appears insufficient to meet mesopelagic metabolic demands. An additional organic-carbon source could be provided by the mixed-layer pump. We combine Argo data with satellite estimates of POC to show that in high-latitude regions this flux amounts on average to 23% of the carbon supplied by fast sinking particles, but it can be greater than 100%.
Mathias Disney	41 How can we better quantify the biomass of tropical forests?	Tropical forests contain between 30 and 50% of the world's terrestrial above ground biomass (AGB). The uncertainty in this number is due to the small number of sparse, unrepresentative samples of AGB measurements made, and the resulting difficulty of extrapolating to wide regions. We present new results combining terrestrial laser scanning (TLS), airborne and spaceborne EO, across various regions in the tropics, to estimate AGB with much improved accuracy. We also show how the uncertainty in AGB can be reduced through a combination of new observations from forthcoming EO missions, and improved models.
Jean-François Exbrayat	42 Impact of historical land use change on tropical biomass stocks	We combine a satellite-derived biomass map, climate data and historical land use change to reconstruct maps of potential biomass stocks under pre-industrial land use distribution. Comparing potential biomass with observations allow us to estimate a 76 Pg C current deficit in pantropical biomass. We identify the loss of primary forests as the main driver of the deficit in the Americas and South-East Asia while African biomass deficit is linked to the erosion of other ecosystem types such as savannas. Our results provide baseline estimates for regeneration potential and will be extended to foresee the impact of future of land use.
Mariano Garcia	43 Modelling forest structure using airborne LiDAR and satellite Radar data	This study aims at developing algorithms for the extrapolation of LiDAR-based forest height using satellite Radar data. We selected four study sites corresponding to two different biomes, temperate broadleaf/mixed and Mediterranean forests. The impact of environmental factors (moisture), the scale and the transferability of models was also evaluated. Additionally, the importance of the metrics used and the impact of the sample size were analyzed.

Jose Gómez-Dans	44 Consistent multi-parameter retrievals from heterogeneous sensors	There is a pressing need for an overarching, internally consistent and uncertainty quantified set of land surface parameters derived from EO data. We show how the use of emulators and standard data assimilation methods results in a processing chain that is able to produce this. We show some examples with MODIS and Sentinel-3 data that exploit the ability of the emulators to provide fast and computationally efficient approximations to the gradient of the observation operator to provide a solution that scales to large scale problems.
Alex Hoffmann, Marko Huebner, Neil Macleod & Damien Weidmann	45 Arctic field deployment of the CO2 Laser Heterodyne Radiometer (LHR) within the FRM4GHG instrument intercomparison campaign	A compact version of the RAL Space LHR for carbon dioxide measurements has been deployed to an arctic field site in Northern Finland, within the context of the Fiducial Reference Measurements for GreenHouse Gases international campaign. Remote sensing observations over the 2017 summer season will be taken to intercompare different spectrometers, validate them against in situ profiles from balloon-borne AirCore sampling, and harmonize retrievals. The campaign also seeks to collect data for satellite product validation and to identify future candidates for a lower-cost novel GHG observing system, potentially complementing TCCON. This poster focuses on deployment and preliminary results.
Tristan Quaife	46 The complex impact of canopy structure on global photosynthesis	Most models of the terrestrial biosphere assume vegetation can be treated as a 1D turbid medium for the calculation of absorbed light and hence photosynthesis. In reality, however, much vegetation has complex 3D structure that departs significantly from this assumption. The simplest and most widely used correction is to apply a so-called 'clumping' factor, which reduces the amount of light absorbed. Intuitively we might expect this to reduce photosynthesis, and indeed this has been shown in previous modelling studies. Using JULES and an EO derived map of clumping we show that structure can actually enhance photosynthesis, in particular in the tropics.
Pedro Rodriguez Veiga	47 Aboveground Biomass Stocks and Changes in Forests of the Yucatan Peninsula	The ESA DUE GlobBiomass project is developing state-of-the art approaches to map AGB and AGB-changes for the period from 2005 to 2015. The GlobBiomass case study in the Yucatan peninsula uses a data mining approach on Landsat surface reflectance multi-temporal composites generated using Google Earth Engine cloud computing, L-band SAR dual polarization ALOS PALSAR, and elevation data from the SRTMv3. An extensive in-situ forest inventory dataset is also used for calibration and validation purposes. Maps of AGB at 25m spatial resolution and AGB-changes are developed for the periods 2005, 2010, and 2015.

Jelizaveta Ross, Giorgio Dall'Olmo, Keith Haines	48 Optical Proxies for Particulate Organic Carbon in the Atlantic Ocean	We study the spatial and temporal distribution of particulate organic carbon (POC) in the Atlantic Ocean. Optical measurements from satellites and in situ sensors co-vary with the concentration of POC in the water column and, therefore, they can help to improve our understanding of the key biologically mediated processes in the oceanic carbon cycle. We want to present our findings on POC distribution along the Atlantic Meridional Transect and describe the relationship between POC and optical measurements focusing on the relatively unexplored mesopelagic region. We will also present a detailed analysis of the measurement uncertainties based on the blanks and replicates collected during the cruise.
Shovonlal Roy	49 New estimates of the stocks of oceanic phytoplankton carbon using EO data	The stocks of oceanic phytoplankton carbon are fundamental to carbon fixation in the ocean and global carbon cycle. An accurate estimation of these stocks, however, is a non-trivial task. Some new developments in estimating these carbon stocks using EO data will be presented. The focus will be on new estimates of phytoplankton carbon using a novel ocean-colour-based method that combines cellular allometric properties and light-absorption properties of oceanic phytoplankton. The similarities and differences among various estimates of phytoplankton carbon from ocean-colour methods and biogeochemical models including data assimilation, will be presented. Further challenges in obtaining the carbon stocks in various phytoplankton types, and minimizing the estimation uncertainties, will be discussed.
Phil Wilkes	50 Estimating the Urban Carbon Sink: a case study in Camden	Urban trees are revered for a number of attributes e.g. aesthetic, pollution mitigation etc., yet are overlooked as a carbon sink. Here we demonstrate that urban ecosystems can store >250 Mg C ha-1, equivalent to some tropical and boreal forest. Model-based inference was used to estimate tree biomass across the Borough of Camden. Biomass for ~80 individual trees was estimated using TLS derived Quantitative Structure Models. These were used to construct a model to infer biomass from tree height, where Individual trees were extracted from the Environment Agency airborne LiDAR dataset. This method can be easily scaled to larger areas and other UK cities.
Bob Brewin	51 Modelling size-fractionated primary production in the Atlantic Ocean from remote sensing	Marine primary production influences the transfer of carbon dioxide between the ocean and atmosphere, and the availability of energy for the pelagic food web. Both the rate and the fate of organic carbon from primary production are dependent on phytoplankton size. We re-tune a remote-sensing primary production model to estimate production in three size fractions of phytoplankton (<2 µm, 2–10 µm and >10 µm) in the Atlantic Ocean. Application to satellite data in 2007 suggests the contribution of cells <2

		µm and >2 µm to total primary production is approximately equal in the Atlantic Ocean.
Data Assimilation and Models - talks		
Jemima Tabeart	Accounting for correlated observation errors in variational data assimilation	In numerical weather prediction, using high resolution observations requires the correct treatment of observation statistics in data assimilation. We investigate convergence of the minimisation of a variational data assimilation system with correlated observation errors. We show that the minimum eigenvalue of the observation error correlation matrix is significant numerically and theoretically for the conditioning of the assimilation system. To reduce operational costs of the assimilation, we alter the eigenvalues of the observation error correlation matrix. Experiments with a 1D-Var system used by the Met Office for satellite retrievals demonstrate that using reconditioned observation error matrices in the assimilation improves convergence.
Daniel Lea	Assimilation using large scale EOF error covariances	In ocean data assimilation systems relatively small length-scale error covariance structures are used. Due to the historically inhomogeneous distribution of ocean observations, these covariances lead to large areas of the ocean not being corrected. We describe an enhancement to a variational data assimilation system (NEMOVAR) to use Empirical Orthogonal Function (EOF) error covariances. We assess the system by assimilating subsampled modern day observations to emulate historical data distributions. The EOF DA method is shown to work efficiently in a 1/4 degree global configuration and does a good job of filling in the large data gaps.
Sylvain Delahaies	Adjoint-free variational method for site based carbon cycle inverse problems	Variational methods have proven useful to estimate ecosystem parameters and to quantify uncertainty for the terrestrial ecosystem model DALEC: adjoint techniques provide efficient methods to compute the gradient of the cost function and to derive diagnostic tools such as resolution matrices. Here we explore an ensemble method to approximate the gradient of the cost and demonstrate its efficiency for DALEC. Moreover we revisit the definition of resolution matrix from a maximum likelihood estimator point of view and we propose an adjoint-free derivation using graphic processing unit programming.

Ewan Pinnington	Using data assimilation to understand the effect of disturbance on the carbon balance of a managed woodland	This study focuses on the effect of selective felling (thinning) at a managed forest site. Previous statistical analyses of eddy covariance data at the study site had found that disturbance from thinning resulted in no significant change to net ecosystem carbon uptake. In order to better understand the effect of thinning on carbon fluxes, we use four-dimensional variational data assimilation. Our results support previous analyses, with little change found in the predicted net ecosystem carbon uptake for the thinned forest. We show that this is likely due to reduced ecosystem respiration postdisturbance compensating for a reduction in gross primary productivity.
Jozef Skakala	Data assimilation of chlorophyll in the North-West European Shelf	Shelf seas, apart from being of major socio-economic significance, play a crucial role in understanding of marine ecosystems. Correct representation of phytoplankton is an essential element in marine ecosystem modelling. The data assimilation scheme was developed for chlorophyll in NEMO-ERSEM and the satellite data were assimilated into the model in a re-analysis run. The data assimilation scheme for chlorophyll is complemented by a balancing scheme for the nutrients. The skill of the DA re-analysis was subsequently evaluated for selected biogeochemical variables.
Data Assimilation and Models - posters and model demonstrations – and poster board number		
Javier Amezcua	52 Properties of ensembles of weak-constraint 4DEnsembleVar's	4DVar is one of the most widely used methods in data assimilation, and it is at the backbone of numerical weather prediction. Lately, some centres (e.g UK Met Office, ECMWF) have started using ensembles of 4DVar as a way to include flow-dependent statistics (background error covariance). We provide an analysis of the properties of these ensembles without the assumption of having a perfect model, i.e. in the weak-constraint case.
Ross Bannister	53 Model errors for UM winds – can we estimate these well with dense observations?	Data assimilation relies on error statistics of all aspects of the system, which includes model errors pertaining to the operator that predicts the observations in the assimilation algorithm. These are difficult to estimate in general for a real system, but we have a special collection of data that may allow model error statistics to be estimated for a convective-scale version of the Unified Model over the Southern UK for a particular day (20th September 2011). These data include a reasonably large ensemble (93 members) of convective-scale forecasts, and a set of millions of Doppler wind measurements from the Chilbolton Observatory.

Gernot Geppert	Getting started with the parallel, high-performance data assimilation framework EMPIRE - *Demonstration on Thursday at 1700 hours, Lecture Theatre*	EMPIRE is a Fortran-based ensemble data assimilation framework that relies on the Message Passing Interface Standard (MPI) to exchange data with models of arbitrary size and complexity. I will demonstrate the necessary steps to couple your model to EMPIRE. These steps include changing the MPI communication within the model (or introducing MPI) and providing a set of model- and observation-specific Fortran subroutines. I will explain these steps using prepared, working examples of model and data assimilation source code and conclude the demonstration with a brief data assimilation experiment on a high-performance computing system.
Gernot Geppert	pyenda – Using Python for your data assimilation experiments - *Demonstration on Thursday at 1730 hours, Lecture Theatre*	The Python-based ensemble data assimilation framework pyenda uses a Python interface, f2py, or the Message Passing Interface Standard (MPI) to exchange data with arbitrary models. pyenda is designed for small-scale assimilation problems that benefit from the accelerated development process Python offers compared to compiled languages. I will demonstrate how to couple models written in Python and Fortran to pyenda and explain which model- and observation-specific functions need to be provided. I will conclude with a small-scale data assimilation experiment.
Keith Haines and Chunlei Liu	54 Towards a variational analysis of the Earth's energy budget	L'Ecuyer et al (2015) used a variational technique to adjust multiple satellite data products for air-sea-land fluxes of heat and freshwater, achieving closed budgets on a regional and global scale. However their treatment of horizontal energy and water redistribution was limited, and these can now be derived from multiple reanalysis products. Liu et al (2015) also redistribute surface heat fluxes between land and ocean to more closely balance energy budgets. We propose balancing the global energy and water cycle using variational methods similar to L'Ecuyer but rigorously introducing atmosphere and ocean reanalysis products to quantify horizontal redistributions and their uncertainties.
Jeremy Harrison	Observations and modelling of inorganic halogenated reservoir species in the stratosphere (not presenting)	Most of the chlorine and fluorine in the atmosphere has arisen from anthropogenic emissions of 'organic' species such as chlorofluorocarbons. Observations of the atmospheric degradation reservoir species provide information on changes in source gas concentrations, and provide a measure of the success of the Montreal Protocol. The comparison of these observations with chemical transport models such as SLIMCAT provides a more detailed understanding of the chlorine and fluorine budgets. In the case of carbonyl chloride (phosgene, COCl2) in the lower stratosphere, ACE-FTS observations and SLIMCAT calculations reveal contributions from very short-lived substances (VSLSs), such as dichloromethane and chloroform, which have not been

		detected by satellite before.
Sophie Hebden, John Remedios, Darren Ghent	55 Evaluation of the surface temperature in UKESM with land surface temperature datasets from space	Satellite land surface temperature (LST) datasets are constantly improving in user accessibility, time-series length and cloud clearing, to the extent that they are now being used to validate the Met Office's forecasting model. This work indicates there are significant cold biases in the model in arid and semi-arid conditions that are not so prominent in the 1.5m air temperature. The nearly-available UKESM model outputs will provide an opportunity to compare satellite LST with modelled surface temperatures for different climatic regimes, land uses and topography on a global scale, and investigate any biases using different model runs to unpack the physical processes in the model that are causing problems, such as the semi-arid regime issue already identified. This presentation will demonstrate preparatory comparison frameworks using CMIP5 model datasets and LST datasets produced at Leicester.
Joe McNorton	56 Source/sink attribution to CH4 trends	Atmospheric observations highlight two notable changes in CH4 since 2007. Firstly, the growth rate of methane increased to ~7ppb/yr. Secondly, the CH4 13C/12C-ratio (δ13C) has become increasingly 13C-depleted. We have performed a synthesis inversion using a 3-D atmospheric global chemical transport model, TOMCAT, for both CH4 and δ13C from 2005-2014. The inversion uses surface observations of both CH4 and δ13C to spatially constrain source types and possible changes to OH concentration. We will use results from this synthesis inversion to attribute the upturn in CH4 growth to specific source and sinks, and to discuss the uncertainties in this attribution.
Nancy Nichols, Co-authors E.S.Cooper, S.L. Dance, J. Garcia-Pintado, P.J. Smith	57 Observation impact in data assimilation for flood inundation forecasting	Data assimilation is applied here to combine hydrodynamic model forecasts with observations of water levels to improve flood predictions. We simulate flooding in an idealized river topography and perform twin experiments with synthetic observations that mimic data from satellite images. We find that data assimilation with an Ensemble Transform Kalman Filter accurately corrects water levels at the time of assimilation and that observation impact is longer-lived in a longer domain. A state-augmentation technique is introduced to correct both water levels and the friction parameter in the model and shown to improve the forecast significantly.

Luke Surl	58 What is driving HCHO columns over India? Insights from satellites and modelling	Oxidation of volatile organic compounds leads to the formation of secondary air pollutants (e.g. formaldehyde, HCHO) and secondary organic aerosol linked with deleterious impacts on human health. Our focus is the Indian subcontinent where there is a range of chemical environments. We use space-borne column observations of HCHO from the Ozone Monitoring Instrument, in coordination with the GEOS-Chem atmospheric chemistry transport model, to provide insight into the emissions and photochemical processes in the atmosphere. We find that over one calendar year the main driver of seasonal and regional variations of HCHO over India are biogenic VOC emissions.
David Sursham	59 Improving Marine Ecosystem Understanding and Predictions using a Novel Data Assimilation Technique	The carbon cycle between the ocean and the atmosphere is dependent on many biological processes which are components of the air-sea carbon flux. This project makes use of ensemble-based data assimilation techniques (LETKF and IEWPF) in a twin experiment which aims to improve the representation of carbon pumps. The observations in this experiment are based on remotely-sensed ocean colour, and the model used is the biogeochemical marine ecosystem model ERSEM, coupled to the 1D physical model GOTM.
Michel Tsamados	60 Using Ice Thickness Distribution from Cryosat to Initialise Sea Ice Models	We extract for the first time the local sea ice thickness distribution (ITD) from the along track Cryosat individual thickness measurements and compare these distributions with high resolution airborne data from Operation IceBridge. We use the state of the art sea ice model CICE that was previously used to successfully forecast September sea ice extent from the melt onset pond coverage in May to assess its sensitivity to a sub-grid scale ITD initialised from a distribution derived from Cryosat. CICE model runs initialized from a Cryosat ITD in November and April are compared with the corresponding model runs without initialisation and with the observed Cryosat thickness maps for the following April (lead time of 6 and 12 months respectively). We demonstrate that this type of ITD initialisation from Cryosat thickness data shows potential to improve sea ice forecast both in term of its concentration and thickness with lead times of up to a year

Chris Wilson	61 Quantifying South American emissions of CH4 using a 4D-Var inverse model and remote sensing observations from GOSAT and IASI.	We present results from global inversions of methane for the period 2010-2015 in which flask measurements and remote sensing observations have been assimilated using a 4D-Var framework. Focusing on South America, we compare the results of inversions based on both the "proxy" and "full physics" versions of GOSAT CH4 retrievals from the University of Leicester, and also from the IASI retrievals provided by the Rutherford Appleton Laboratory. We quantify the total emissions, seasonal variations, trends and posterior error reductions produced in each inversion and assess the ability of each inversion to accurately characterise South American methane emissions over this decade.
Chris Wilson	62 New evidence based on inverse modelling indicates that increasing US emissions are driving recent observed trends of ethane.	We use an inverse model to estimate global emissions of ethane between 2008 and 2014 through the assimilation of surface flask observations. We find that the current global emission inventories significantly underestimate emissions of ethane during this period. We show that recent increasing Northern Hemisphere concentrations of ethane are due to increasing emissions of the species within the US, which increase by almost 50% over this period. We also find a smaller negative trend in European emissions. Using estimates of co-emission factors of ethane and methane, we estimate the change in methane from US sources over the same period.
Working with Industry and Government - talks		
Sophie Hebden, Farhana Amin, Beth Greenaway, John Remedios, Zofia Stott	UK Joint GEO/CEOS Office	NCEO is hosting the UK's Joint GEO/CEOS Office on behalf of the Principal Funders the UK Space Agency, Defra and NERC (via NCEO). The aim is to support UK government policy and the international activities of the UK's EO community, interfacing to two major international initiatives: the Group on Earth Observations (GEO), and the Committee on Earth Observation Satellites (CEOS). We will explain how the Office operates and how it supports UK EO practitioners to be involved in global projects. We will share our successes and future plans, including key inputs on forestry, calibration and validation activities, future data architectures, the GEO data portal, and facilitating engagement on disaster risk reduction in the Horn of Africa.
Debbie Clifford	Turning environmental data into competitive advantage	We help companies make sense of environmental data, typically in short, effective projects trialling new ideas. In this talk I will present some recent projects, and ways NCEO can collaborate with us, and our partner organisations, to maximize the impact from cutting-edge EO research.

Mark Cleverley	Ecometrica's Earth Observation Labs	Ecometrica and partners in the UK, Mexico and Brazil, collaborated on a UKSA international partnership space programme project to advance EO applications in forests. Outcomes include high research impact, more effective collaboration, better availability and usefulness of information.
Gerardo Lopez-Saldana	From observations to Land Cover and Land Use changes.	As part of the FP7 funded MELODIES project a Land Cover/Land Use (LC/LU) change was developed at the University of Reading. The main goal was to characterize the land surface and then associate changes in the annual surface reflectance with (LC/LU) changes in order to improve GHG emmision inventories. Assimila has been improving this framework using new MODIS data, better training datasets and introducing historical data from the AVHRR sensor. The enhanced framework is being assessed by the Department for Business, Energy & Industrial Strategy (BEIS) to be part of a systematic and consistent multi-resolution LC/LU change strategy to compile information to support UNFCCC emissions reporting.
Richard Bantges	NCEO's Frequency Spectrum Activities	There is a continual and ever-growing pressure placed on Ofcom by a wide range of bodies including Government, Industry and Science, to both protect existing and provide new frequency spectrum allocations. NCEO has been engaging with several organisation including Ofcom, UKSA, the Met Office and Tech Uk, to provide expert advice on existing and future use of the frequency spectrum by the Earth Observation Community. Here I will provide an overview of NCEO's activities to ensure that the various organisations are fully aware of the value and importance of protecting and regulating the use of the frequency spectrum.
Shaun Quegan, Alasdair Helliwell	Industry-academia links in the BIOMASS mission	Airbus UK is Prime Contractor for the BIOMASS mission, which involves implementing the whole system to generate Level-1 data that meet the specifications set out in the System Requirements Document (which is essentially science-driven). This involves ionospheric correction and system calibration, both of which involve serious scientific questions that have never been addressed before at the long wavelength (~70 cm) of BIOMASS and which are best addressed by academia. We will describe the nature of these problems and how knowledge gained in academia is transferred to the industrial sector within the ESA system.
Yvonne Munro, Sam Doody	RF Sensing from UASs	EO from unmanned airborne systems has many potential applications. However, active RF payloads are typically large and power hungry. Therefore, novel solutions are required to meet the operational constraints of such platforms. The constraints, concept, performance and development plan are presented for one potential

		application.
Giuseppe Foti (NOC), Christine Gommenginger (NOC), Martin Unwin (SSTL), Philip Jales (SSTL), Josep Rosello (ESA)	Spaceborne GNSS-R: results from the UK TechDemoSat-1 mission	GNSS-Reflectometry (GNSS-R) is a novel remote sensing technique exploiting signals from Global Navigation Satellite Systems (GNSS) to retrieve information about the surface of the Earth. Small inexpensive GNSS receivers are available, and this makes GNSS-R an attractive technique to potentially deliver global coverage at high resolution using e.g. a constellation of instruments flying as payloads of opportunity. Large amounts of spaceborne GNSS-R data have been acquired by the TechDemoSat-1 (TDS-1) mission, a UK-led demonstrator launched in 2014. This paper presents some of the ground-breaking scientific findings and technological advances achieved thanks to the long-lasting partnership between NOC, SSTL and ESA.
Working with Industry and Government – posters – and poster board number		
Jose Gómez-Dans	63 Assimilating industry	In this contribution, I will present how the EO-LDAS framework is being used in a number of external projects that have non-academic partners. These projects range from the retrieval of biophysical parameters to monitor agriculture, to the production of global datasets.
David Moore	64 Sarin detection from a conceptual dispersive spectrometer	There is ever-growing interest in detecting the use of chemical weapon agents. Sarin is widely stockpiled and has been allegedly used in recent chemical weapons attacks in the Middle East. In this work we have used a state-of-the-art radiative transfer model (RFM) to investigate the requirements of a conceptual dispersive spectrometer to detect sarin gas. We find that sarin can be detected up to 60 minutes after a 100 kg release, in summertime conditions (i.e. high surface temperature). More typically, sarin signals from both 10 kg and 100 kg releases are seen up to 30 minutes after release.
EE-9 Mission Proposals – posters – and poster board number		
Helen Brindley	65 The FORUM Mission	This poster describes the Far-infrared-Outgoing-Radiation Understanding and Monitoring (FORUM) mission, submitted to the recent ESA Earth Explorer 9 Call. Flying in tandem with IASI-NG, FORUM will supply a complete characterisation of the Earth's Outgoing Longwave Radiation (OLR) spectrum, including, for the first time, observations spanning the energetically critical Far Infrared. These data can be used directly to provide a strong constraint on climate model performance while simultaneously improving our knowledge of upper-tropospheric/lower stratospheric water vapour, cirrus cloud properties and polar surface emissivity, all implicated in key climate

		feedback processes. Italian led, the proposal has strong UK scientific and industrial involvement.
Emma Woolliams	66 The TRUTHS Mission	The establishment of an observational climate benchmark data set of sufficient accuracy to enable the unequivocal detection of climate change with the ability to constrain and test climate forecast models on a decadal time scale is one of the key challenges laid down by the international climate science community. The UK led TRUTHS (Traceable Radiometry Underpinning Terrestrial- and Helio- Studies) and its US sister, CLARREO (Climate Absolute Reflectance and Refractivity Observatory) are mission concepts proposed to address this exacting issue. TRUTHS' primary goal is to provide benchmark measurements of both incoming (solar) and outgoing (reflected solar) radiation with sufficient spectral resolution and accuracy to detect the subtle changes in as short a timescale as possible (~12 yrs) - limited by natural variability of the climate system. In summary, measuring global spectrally resolved (5-10 nm) Earth radiances, continuously sampled (spectrally and spatially) with GIFOV of ~50 m from 320 - 2350 nm and the corresponding solar spectral irradiances both with uncertainties to SI units of <0.3%.
Darren Ghent, Michael Perry and Martin Wooster	67 The TMAX Mission	TMAX is a candidate EE9 Mission focused on quantitative thermal infrared remote sensing. TMAX provides a unique ability to deliver calibrated, multi-spectral Earth imagery across the middle-infrared to longwave infrared spectral range, in multiple bands and at moderate spatial resolution (< 100 m). It provides a strong, highly complementary companion to VIS-SWIR multispectral imaging missions such as Sentinel-2, and provides data flows capable of driving land surface temperature (LST) Temperature & Emissivity Separation (TES) algorithms, as well as for characterising higher temperature events and gaseous emission plumes associated with both biomass burning and volcanic processes. Data from TMAX are designed to support a wide range of applications, including those related to evapotranspiration and plant health, inland and Coastal Waters, urban energy balance processes (e.g. heat island effects), landscape fire emissions characterisation and fire climatology's, characterisation of soil properties, and identification and quantification of volcanic and wider geophysical phenomena.
Yu Tao, Peter Jan van Leeuwen	68 The FLIRt Mission	Cloud dynamics and their interplay with aerosols and the effect on atmospheric circulation represent the greatest uncertainty in weather and climate forecasting. The development of clouds is governed predominately by convective vertical velocities. The Flow by IR tandem mission (FLIRt) will use a unique combination of Sentinel-3 and

		dual/tandem satellites dedicated to thermal IR wind retrieval to produce winds 24 hours per day with a wide swath (1500km) at high horizontal resolution (down to 0.5km) by tracking clouds and simultaneously retrieving their height to ≤150m vertical accuracy and their advective and vertical updraft wind-fields to ≤1.0 m/s by combining several simultaneous views at each location. The cloud-top updraft speeds are highly correlated with "within-cloud" updrafts, so that within-cloud dynamics can be retrieved from cloud-top surface measurements, a critical factor for the use of passive remote sensing. These measurements will therefore address the most significant remaining uncertainties left in both NWP forecast improvement and the prediction of climate change.
Georgia Savini	69 The LOCUS Mission	The LOCUS satellite concept aims to link observations of climate, the upper atmosphere and space weather by studying the molecular composition of the Mesosphere-Lower Thermosphere region performing limb sounding measurements at both THz frequencies and IR wavelengths. The compact breadboard designed for an LEO standard SSTL-150 platform includes an all-Aluminium telescope and optical bench, a 1.15 THz receiver novel split-block design housing a QCL-pumped Schottky mixer and a compact cooler designed for a small payload. The activity is entering its final phases with upcoming optical, IR and THz beam tests and thermal-vacuum tests to assess cooler and radiative panels performance.