

Report for the year 2022 and future activities

SOLAS ‘Ireland’ compiled by: ‘Peter Croot’

This report has two parts:

- **Part 1:** reporting of activities in the period of January 2022 - Jan/Feb 2023
- **Part 2:** reporting on planned activities for 2023 and 2024.

The information provided will be used for reporting, fundraising, networking, strategic development and updating of the live web-based implementation plan. As much as possible, please indicate the specific SOLAS 2015-2025 Science Plan Themes addressed by each activity or specify an overlap between Themes or Cross-Cutting Themes.

- 1 Greenhouse gases and the oceans;
 - 2 Air-sea interfaces and fluxes of mass and energy;
 - 3 Atmospheric deposition and ocean biogeochemistry;
 - 4 Interconnections between aerosols, clouds, and marine ecosystems;
 - 5 Ocean biogeochemical control on atmospheric chemistry;
- Integrated studies of high sensitivity systems;
Environmental impacts of geoengineering;
Science and society.

IMPORTANT: *This report should reflect the efforts of the SOLAS community in the entire country you are representing (all universities, institutes, lab, units, groups, cities).*

First things first...Please tell us what the IPO may do to help you in your current and future SOLAS activities. ?

As there is an IPO based in Ireland, at the University of Galway, where most Irish researchers in SOLAS are based, interactions between Ireland and the IPO are really a two way street as there is also plenty that SOLAS researchers can do to help the IPO, particularly around the joint activities regarding the SOLAS MSc course. One area where the IPO could help though is in helping to identify other potential SOLAS researchers in Ireland and to strengthen links with Future Earth, as currently there is very little interaction between SOLAS Ireland and Future Earth Ireland directly.

PART 1 - Activities from January 2022 to Jan/Feb 2023

1. Scientific highlight

Unique in the marine boundary layer, new particle formation involves iodine-oxide nucleation; however, challenges remain in explaining the growth. Condensation of organic vapors has been suggested as the most probable mechanism, but condensation growth requires condensing organic molecules of low effective volatilities. Here, we show, through a combination of laboratory

experiments, ambient field measurements, and model studies, that exposure of iodine-oxide nanoparticles to organic vapors may lead to accelerated particle growth through heterogeneous reactions forming low-volatility organic acids and alkylammonium salts in the particle phase. Moreover, we show that a notable fraction of iodine is recycled back into the gas phase during particle growth, providing insights into iodine-organic multiphase reactions for marine new particle formation.

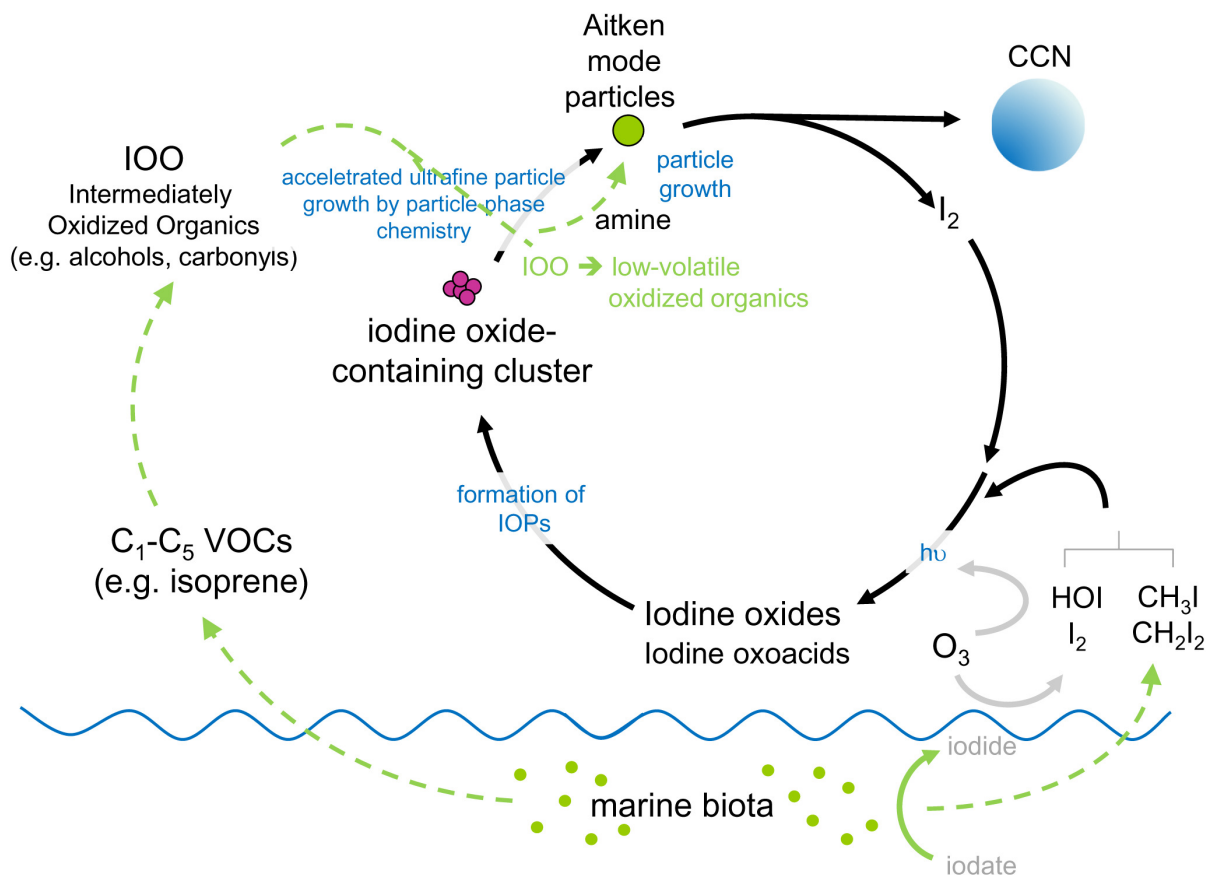


Figure: Insights into iodine-organic multiphase reactions fast-tracking marine new particle formation. Iodine released from the ocean surface is photolyzed and oxidized to form iodine oxides or iodine oxoacids (HIO₃ and HIO₂), which can nucleate to form IOPs or contribute to the early cluster growth by chemical activation of the pre-nucleation cluster. Within the recently formed ultrafine particles heterogeneous reactions between the higher iodine oxides and condensing alcohols or carbonyls from oxidation of marine VOCs lead to the formation of low volatility oxidized organics where the produced organic acids can further react with basic molecules (e.g., amines) to form highly hygroscopic salts, accelerating the early particle growth into Aitken mode and ultimately CCN. During this process, the higher iodine oxides are recycled, restarting the reaction sequence.

Citation: Huang, R.-J., Hoffmann, T., Ovadnevaite, J., Laaksonen, A., Kokkola, H., Xu, W., Xu, W., Ceburnis, D., Zhang, R., Seinfeld, J.H., O'Dowd, C., 2022. Heterogeneous iodine-organic chemistry fast-tracks marine new particle formation. *Proceedings of the National Academy of Sciences* 119, e2201729119.

2. Activities/main accomplishments in 2022 (e.g., projects; field campaigns; workshops and conferences; model and data intercomparisons; capacity building; international collaborations; contributions to int. assessments such as IPCC; collaborations with social sciences, humanities, medicine, economics and/or arts; interactions with policy makers, companies, and/or journalists and media).

Dr B. Ward (UG) was Chief Scientist for a joint Ireland-Canada expedition “The North Atlantic as a Climate Ocean: Projecting Future Changes in Productivity and the Biological Carbon Pump” on the Celtic Explorer CE22009 in the Labrador Sea (May-June 2022).

Workshop and institutional collaboration visit to Korean Polar Research Institute, Incheon, South Korea, October 4-26, 2022. (Dr D. Ceburnis)

Instrument deployment and field campaign at King Sejong station, Antarctica, November 24 – December 19th. (Dr D. Ceburnis)

During the reporting period the EPA/MI funded project, NUTS&BOLTS (PI Prof. Croot), undertook activities in 7 local schools in Q4 2022, this was facilitated by scientific educator, Benny Joyce, and this will continue in Q1 2023. An example of this type of outreach work can be found online at <https://cloonliffen.com/2022/12/14/science-workshop/> where Benny worked with local school children in making secchi disks. NUTS&BOLTS is an IMBER endorsed project but has significant overlap with SOLAS activities. As part of NUTS&BOLTS outreach, in October 2022 UG hosted a public seminar by Prof. Karen Wiltshire, vice-director of the Alfred Wegener Institute (AWI) in Germany, entitled ‘Coastal seas in the fast lane of climate change: Resilience and adaptation for a sustainable future.’ This lecture was the third in the series of Royal Irish Academy Sustainability Series.

In September 2022, Prof. Croot participated in PS132 onboard the Polarstern from Bremerhaven to Cape Town as part of the onboard teaching team for the AWI/POGO/NF programme training international students at sea. While at sea Prof. Croot was in charge of the Oceanography program, making 10 full depth CTD stations along the transect, while also introducing the students to relevant activities in SCOR programs, most noticeably SOLAS, IMBER and GEOTRACES.

Since Jan 2022, Prof. Croot is part of the European Marine Board’s working group on Ocean Oxygen, a scientific report resulting from this work will be released in June 2022 at the ASLO meeting in Mallorca. Prof. Croot also attended the UN Ocean Conference in July 2022 in Lisbon, Portugal as a representative of the National University of Ireland Galway (now University of Galway). In October 2022, Prof. Croot participated in the GESAMP WG38 workshop in Gqeberha, South Africa on the “Potential role of atmospheric deposition in driving ocean productivity in the Southwest Indian Ocean”. At the international SCOR meeting in Oct 2022, Prof. Croot was also elected to the position of Secretary to the Executive Committee (2022-2026), and will also participate in SCOR WG167 “Reducing Uncertainty in Soluble aerosol Trace Element Deposition (RUSTED)”.

3. SOLAS related publications in 2022 (only PUBLISHED articles) and if any, weblinks to models, datasets, products, etc.

Azcárate-García, T., Beca-Carretero, P., Cara, C.L., Villamayor, B., Cosnett, E., Bermejo, R., Hernández, I., Brun, F.G., Stengel, D.B., 2022. Seasonal plant development and meadow structure of Irish and southern Spanish seagrass populations. *Aquatic Botany* 183, 103569.

Chen, G., Canonaco, F., Tobler, A., Aas, W., Alastuey, A., Allan, J., Atabakhsh, S., Aurela, M., Baltensperger, U., Bougiatioti, A., De Brito, J.F., Ceburnis, D., Chazeau, B., Chebaicheb, H., Daellenbach, K.R., Ehn, M., El Haddad, I., Eleftheriadis, K., Favez, O., Flentje, H., Font, A., Fossum, K., Freney, E., Gini, M., Green, D.C., Heikkinen, L., Herrmann, H., Kalogridis, A.-C., Keernik, H., Lhotka, R., Lin, C., Lunder, C., Maasikmets, M., Manousakas, M.I., Marchand, N., Marin, C., Marmureanu, L., Mihalopoulos, N., Močnik, G., Nęcki, J., O'Dowd, C., Ovadnevaite, J., Peter, T., Petit, J.-E., Pikridas, M., Matthew Platt, S., Pokorná, P., Poulain, L., Priestman, M., Riffault, V., Rinaldi, M., Rózański, K., Schwarz, J., Sciare, J., Simon, L., Skiba, A., Slowik, J.G., Sosedova, Y., Stavroulas, I., Styszko, K., Teinmaa, E., Timonen, H., Tremper, A., Vasilescu, J., Via, M., Vodička, P., Wiedensohler, A., Zografou, O., Cruz Minguillón, M., Prévôt, A.S.H., 2022. European aerosol phenomenology – 8: Harmonised source apportionment of organic aerosol using 22 Year-long ACSM/AMS datasets. *Environment International* 166, 107325.

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- Fossum, K.N., Ovadnevaite, J., Liu, D., Flynn, M., O'Dowd, C., Ceburnis, D., 2022. Background levels of black carbon over remote marine locations. *Atmospheric Research* 271, 106119.
- Huang, R.-J., Hoffmann, T., Ovadnevaite, J., Laaksonen, A., Kokkola, H., Xu, W., Xu, W., Ceburnis, D., Zhang, R., Seinfeld, J.H., O'Dowd, C., 2022. Heterogeneous iodine-organic chemistry fast-tracks marine new particle formation. *Proceedings of the National Academy of Sciences* 119, e2201729119.
- Lin, C., Ceburnis, D., O'Dowd, C., Ovadnevaite, J., 2022. Seasonality of Aerosol Sources Calls for Distinct Air Quality Mitigation Strategies. *Toxics* 10, 121.
- Malila, M.P., Thomson, J., Breivik, Ø., Benetazzo, A., Scanlon, B., Ward, B., 2022. On the Groupiness and Intermittency of Oceanic Whitecaps. *Journal of Geophysical Research: Oceans* 127, e2021JC017938.
- Mansour, K., Rinaldi, M., Preißler, J., Decesari, S., Ovadnevaite, J., Ceburnis, D., Paglione, M., Facchini, M.C., O'Dowd, C., 2022. Phytoplankton Impact on Marine Cloud Microphysical Properties Over the Northeast Atlantic Ocean. *Journal of Geophysical Research: Atmospheres* 127, e2021JD036355.
- Simonella, L.E., Cosentino, N.J., Montes, M.L., Croot, P.L., Palomeque, M.E., Gaiero, D.M., 2022. Low source-inherited iron solubility limits fertilization potential of South American dust. *Geochimica et Cosmochimica Acta* 335, 272-283.
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- Stipcich, P., Pansini, A., Beca-Carretero, P., Stengel, D.B., Ceccherelli, G., 2022. Field thermo acclimation increases the resilience of *Posidonia oceanica* seedlings to marine heat waves. *Marine Pollution Bulletin* 184, 114230.
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- Zhong, H., Huang, R.J., Lin, C., Xu, W., Duan, J., Gu, Y., Huang, W., Ni, H., Zhu, C., You, Y., Wu, Y., Zhang, R., Ovadnevaite, J., Ceburnis, D., O'Dowd, C.D., 2022. Measurement report: On the contribution of long-distance transport to the secondary aerosol formation and aging. *Atmos. Chem. Phys.* 22, 9513-9524.

4. Did you engage any stakeholders/societal partners/external research users in order to co-produce knowledge in 2022? If yes, who? How did you engage?

Samhail- Spéirsceálta project – project team works with artistic practice a place of their own and in innovative engagements, brings scientific knowledge with artistic practice and storytelling to uncover stories from various communities about our collective relationship with the atmosphere, and elucidate environmental solutions, situated locally, with global impact. **Samhail Project** [Samhail \(@Samhail_2022\) / Twitter](#)

During the reporting period, Prof Croot gave two public lectures on the data/policy/governance interface for marine systems using data from NUTS&BOLTS, and other studies, as test case examples. (i) “Marine data to inform policy” 12th Annual Marine Economics and Policy Research Symposium, Marine Institute, Galway, Ireland (6 Dec 2022). (ii) “Science communication in the framework of the UN Decade of Ocean Science for Sustainable Development” iCRAG2022, Croke Park, Dublin, Ireland (1 Dec 2022).

PART 2 - Planned activities for 2023 and 2024

1. Planned major national and international field studies and collaborative laboratory and modelling studies (incl. all information possible, dates, locations, teams, work, etc.).

O3I – National Project investigating the contributions to national ozone pollution over Ireland. 1 year project, starting May 2023, Funded by the Irish EPA, collaborating with modelling partners in IASS, Potsdam

Long-term measurement of aerosol hygroscopicity and cloud condensation nuclei activity at King Sejong station during the entire 2023.

iCRAG (Irish Centre for Research in Applied Geoscience) researchers will participate in an international research expedition to the Arctic in 2023 onboard the Celtic Explorer. Chief Scientist, Dr Audrey Morley (iCRAG@UG), will lead, SiTrAc: Signal Tracking to unveil Arctic Climate variability, a follow up expedition to the 2020 expedition CIAAN Constraining the Impact of Arctic Amplification in the Nordic Sea: A biogeochemical approach. FI Dr Brian Ward (iCRAG@UG) will also participate on the expedition along with scientists from Norway, Germany, the UK and the USA.

2. Events like conferences, workshops, meetings, summer schools, capacity building etc. (incl. all information possible).

Joint SOLAS-CNAA session at ICNAA 2023 conference (<https://www.icnaa2023.com.au/program>), chair Jurgita Ovadnevaite

Currently there are plans for a workshop late in 2023, around the theme of "sustainability of Irish marine transitional zones", this would be in cooperation with a number of Irish agencies and be a contribution from Ireland's SOLAS, IMBER and Future Earth communities. This workshop is an output from the EPA (Ireland) funded project, NUTS&BOLTS, which is also endorsed by IMBER.

3. Funded national and international projects/activities underway.

COAST-VOC: Linking coastal marine biodiversity to climate through volatile organic compounds. A collaborative project between Finland, Ireland and Sweden, funded by BNP Paribas Foundation-Environment 2023.

PI Prof. Croot (UG) was awarded €688,970 for the Marine Institute (MI) funded project "Changing Ocean Ireland: Forecasting Biodiversity and Ecosystem Response (CÓIR)". The CÓIR project brings together an interdisciplinary group of marine scientists based at NUI Galway to work on an integrative national climate change project with colleagues at the Marine Institute and throughout Ireland via existing networks of marine researchers within the SFI centres iCRAG and MaREI.

Two new SOLAS related PhD projects were funded at UG within the 2nd phase of the SFI Research Centre iCRAG. (i) Prof. Croot - "Primary Productivity in surface waters of the Irish EEZ." This project seeks to constrain estimates of phytoplankton productivity using a suite of primary productivity measurements. (ii) Dr. Ward "The Impact of Upper Ocean Turbulence and Air-Sea Fluxes on the Onset of a Phytoplankton Bloom"

NUTS&BOLTS PI's, Stengel and Cave are now working in the BlueC research team funded by the Marine Institutes 2021 Blue Carbon Call, a project focused on the carbon storage capacity of saltmarsh and seagrass meadows around Ireland.

4. Plans / ideas for future national or international projects, programmes, proposals, etc. (please indicate the funding agencies and potential submission dates).

At the time of this report, there are SOLAS related projects submitted as part of new national or international projects, though at this stage the outcome is not known. Researchers are also looking at upcoming EC calls for potential involvement and collaboration with other European partners.

In the context of the UN Decade for Ocean Science, a number of researchers were involved in endorsed projects but as of yet there was no joint funding applications being made and no national funding linked to the UN Decade.

5. Engagements with other international projects, organisations, programmes, etc.

As mentioned above, Prof Croot is currently a member of both the SCOR WG167 Reducing Uncertainty in Soluble aerosol Trace Element Deposition (RUSTED) and the European Marine Board Working Group on Ocean Oxygen.

Comments

The SOLAS Ireland community continues to work directly with the SOLAS IPO in Ireland to help integrate the IPO into the local networks and helping to facilitate the development of new activities in Ireland and internationally.