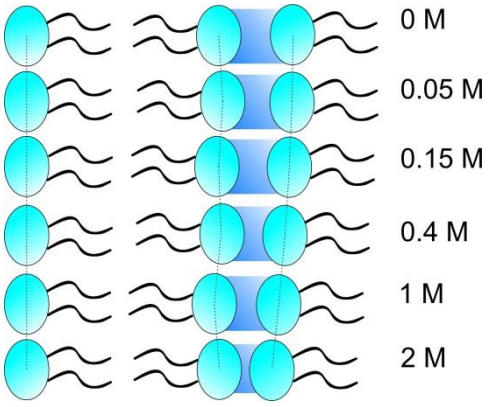
CDT Thesis Twitter Conference entries

18th May 2018

Please note some entries contain gifs and videos, to view them please see #cdttwecon or visit @CDTFluidsLeeds

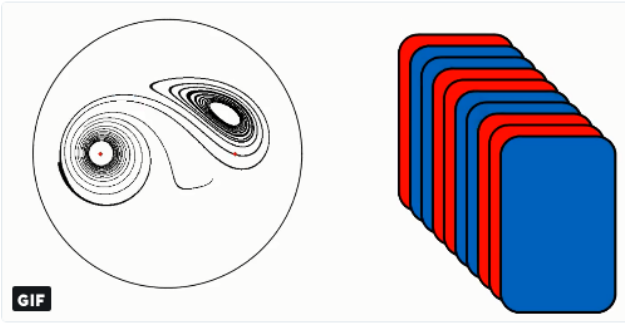
Denise Li, Soft Matter CDT @denise1302_li

1. The influence of humectants on the structure of phospholipids found in skin cream formulations #CDTTweCon
2. Humectants are used in skin cream formulations to provide a source of moisture. Phospholipids are the main structural component in skin creams, in water they will self-assemble into a sort of onion shape. Little is known on how humectants influence their properties. #CDTTweCon
3. The effect of three humectants on a particular phospholipid called DPPC was studied. X-ray scattering results show that the layer of water between each bilayer of lipid becomes thinner with the addition of humectant and increasing concentration. #CDTTweCon

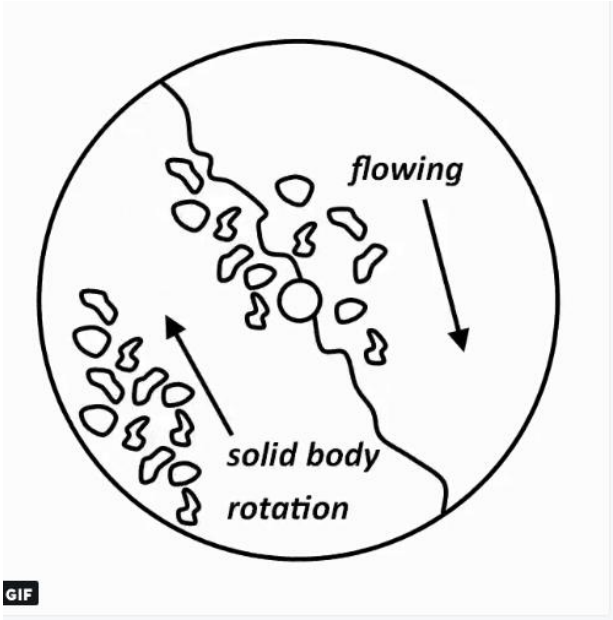


Hannah Kreczak, Fluid Dynamics CDT @hannah_krec

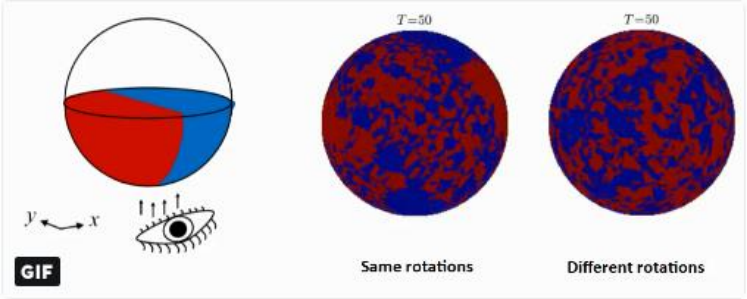
1. Mixing by cutting and shuffling - in engineering we mix different materials in different ways. Can we predict how fast they will mix to help us design the best mixers? Lots is known about stirring but what if we have cutting and shuffling too? #CDTTweCon



2. Granular tumblers have both shear-like mixing where the material flows at the top and cutting and shuffling in the bulk which is in solid body rotation. We investigate the limit of no flowing layer and ask how well can we mix by just cutting and shuffling #CDTTweCon

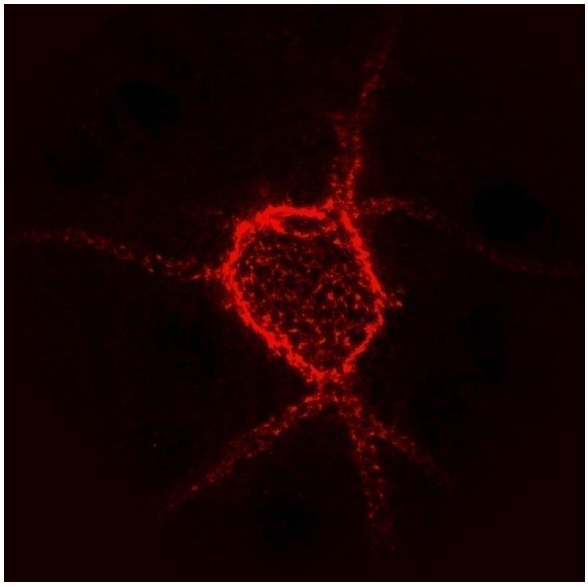


3. Using the same cut and shuffle at each stage creates unmixed islands and re-assembly of like-material. Using a different cut and shuffle at each turn would be better if we mixed for a long time. Currently we are asking which shuffles are the fastest #CDTTweCon

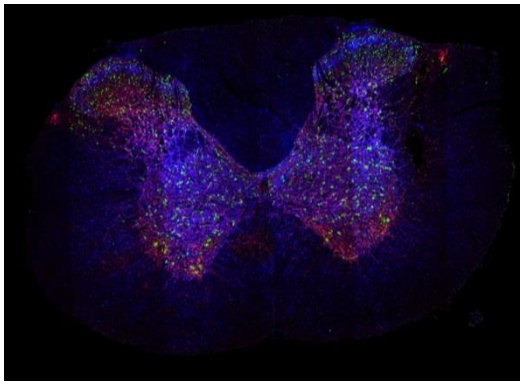


Luke Souter, Tissue Engineering CDT @LukeSouter

1. 'The interplay of biochemical and biophysical properties to the functions of perineuronal nets'
   We have beautiful net-like structures that surround cells in our brain and spine that have been implicated in making memories. I want to understand how / if they do this #CDTTweCon



2. Removing these net structures, called perineuronal nets, may help people suffering from memory loss.
   First, I was interested in the ingredients of the nets. I found brain and spine nets contain different ingredients. Are they involved in different processes? #CDTTweCon

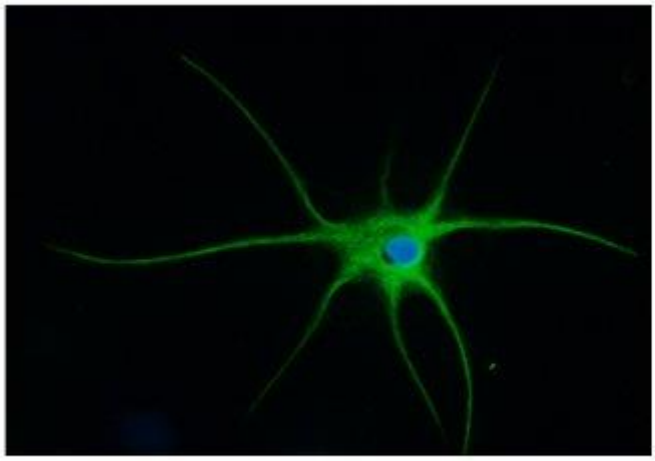


3. The differences I have found may affect the way the nets feel. Amazingly, cells in the brain and spine can sense differences in surfaces! One net type

may be softer, causing cells to detect these changes and behave differently. This is what I am now testing. #CDTTweCon

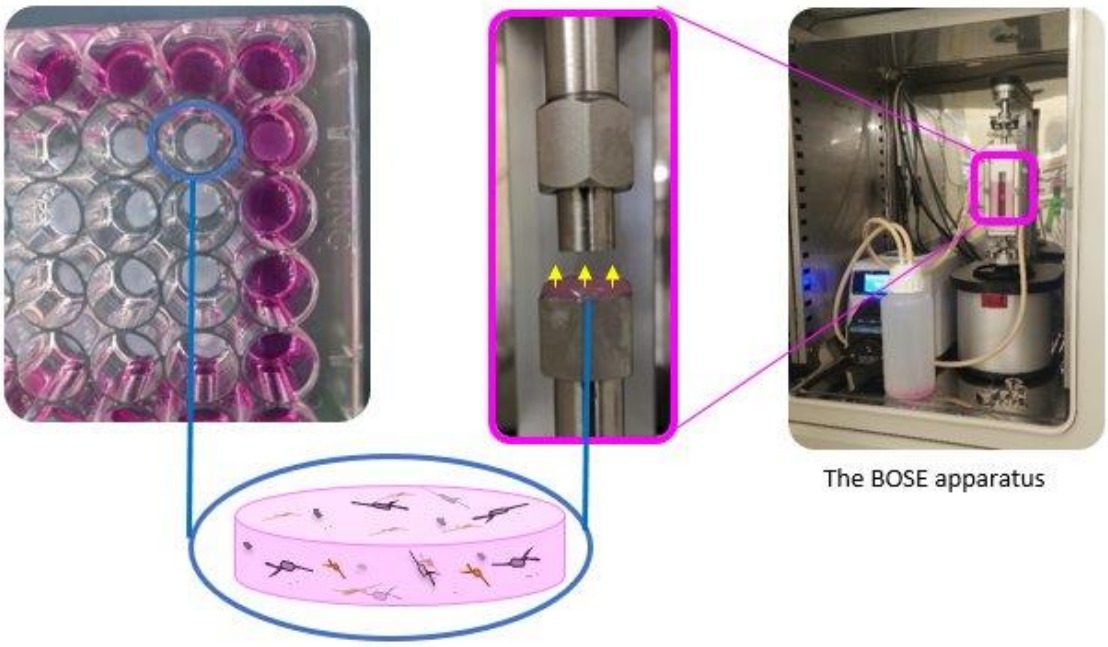
Katie Timms, Tissue Engineering CDT @KVTimms

1. The spinal cord comprises nerve cells, and lesser-known astrocytes. Astrocytes are star-shaped cells which detect changes in the spinal cord environment due to their unique shape. How they do this in non-traumatic, slow velocity injuries is poorly understood. #CDTTweCon



An astrocyte (nucleus in blue; cell body and processes in green)

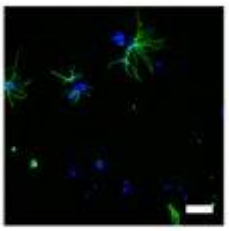
2. I mimic these injuries by making collagen gels filled with astrocytes. Then, I apply a mechanical insult using a BOSE Electroforce bioreactor. This allows accurate control of velocities and displacements, mimicking either traumatic or non-traumatic injuries #CDTTweCon



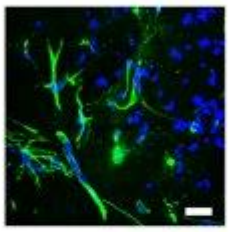
The BOSE apparatus

Astrocytes in collagen gel

3. Then, over the next 2 weeks I evaluate the cells: do they die? Do they clump together? Do they grow more processes? Using this model I can de-couple the effects of each mechanical parameter and their cell responses; learning more about spinal cord injuries #CDTTweCon



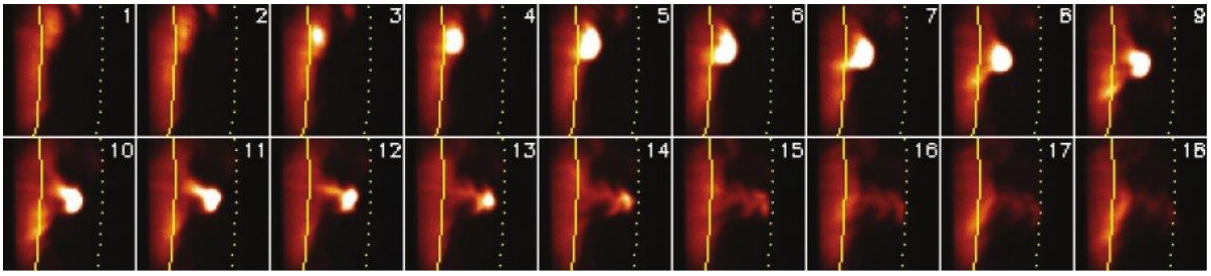
Astrocytes in control gels



Astrocytes in compressed gels

Fryderyk Wilczynski, Fluid Dynamics CDT @FreddieW93

1. “Stability problem in fusion plasma”
   Nuclear fusion experiments use magnetic field to confine hot plasma fuel in a toroidally shaped vacuum vessel. This configuration is inherently susceptible to a variety of instabilities; the one I study looks like this. #CDTTweCon



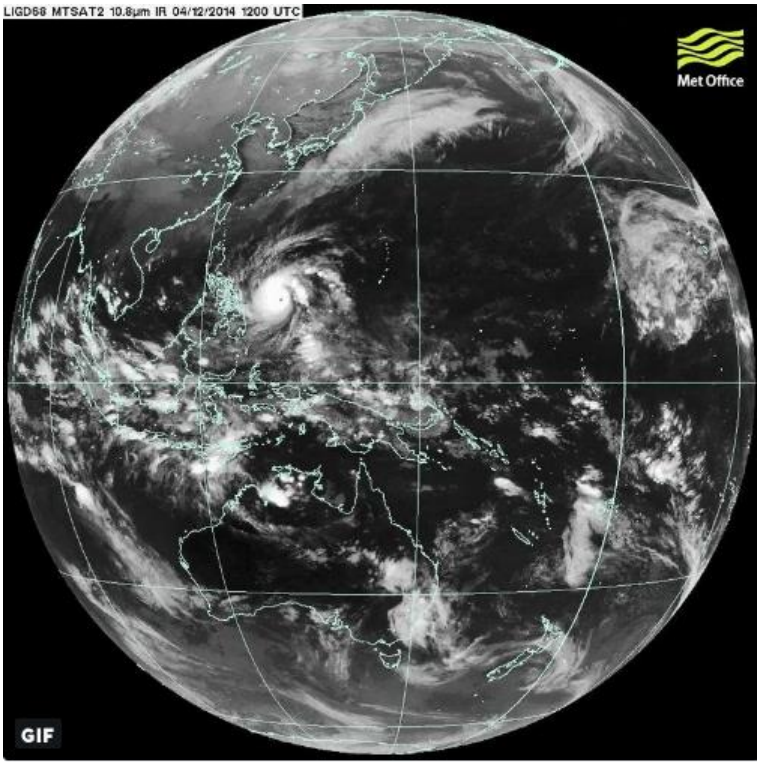
2. - violent ejections of dense plasma blobs at the edge of the core confinement region. These drain energy from the core and inhibit fusion reactions. I am attempting to study the mechanism behind this instability by comparing hot plasma edge to a boiling pot of water. #CDTTweCon

3. It's an extension of a classical problem of instability in a fluid layer heated from below – a modified Rayleigh-Benard convection. Current aim is to

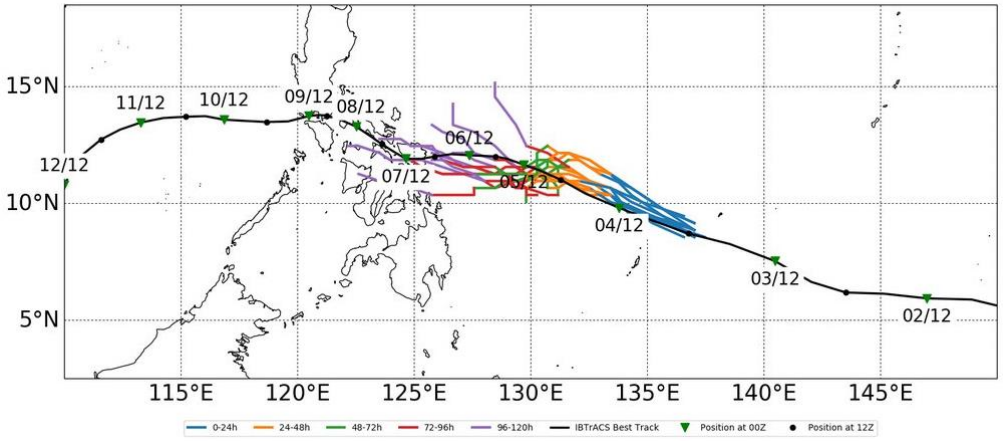
characterise the conditions at which the plasma becomes unstable to small perturbations. #CDTTweCon

John Ashcroft, Fluid Dynamics CDT @JohnAsh92

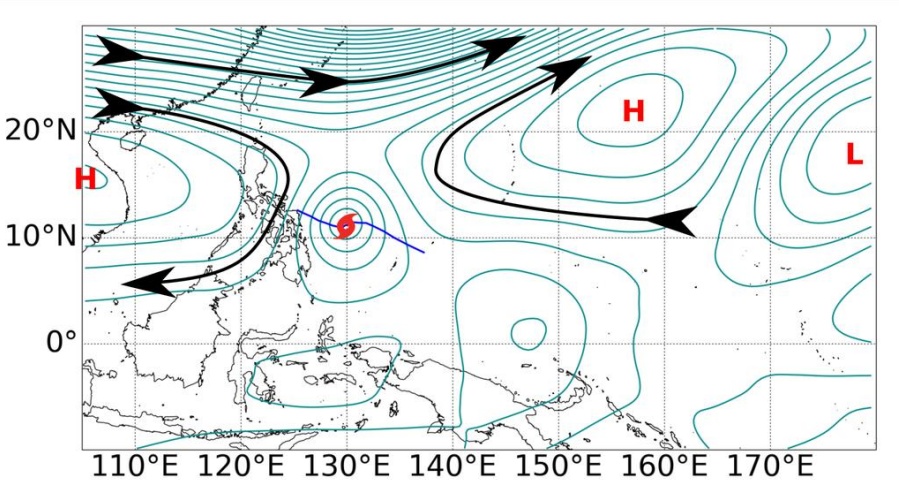
1. 'The Uncertainty of Typhoon Hagupit (2014)'. Tropical cyclones (TCs) are amongst the deadliest natural phenomena in the world. Accurately predicting these storms is vital for the communities they affect. However, to predict them we must also understand them. #CDTTweCon



2. Mathematical models generally do a good job at predicting a TC's motion… But not always. Hagupit was one such case where the track was poorly predicted. Ensemble forecasts showed large uncertainty in where the storm would go. Across the Philippines or turn north? #CDTTweCon



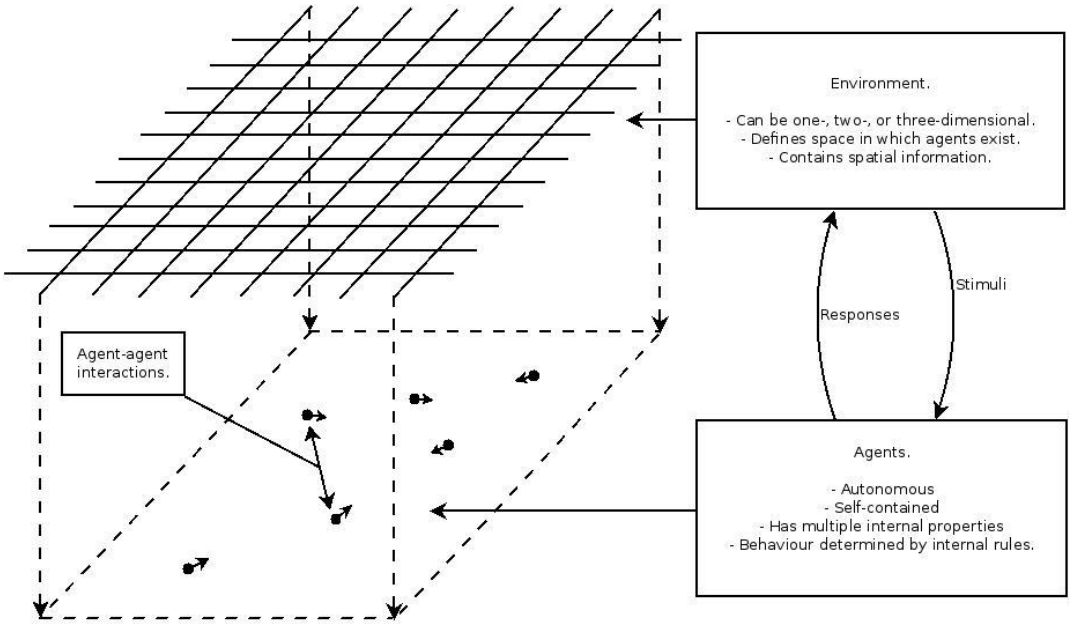
3. Using @MetOffice_Sci's unified model, analysis of Hagupit shows the uncertainty to be linked with the storm moving into a saddle point in the environment. Even with a perfect model, one small difference in initial position can lead to a completely different track. #CDTTweCon



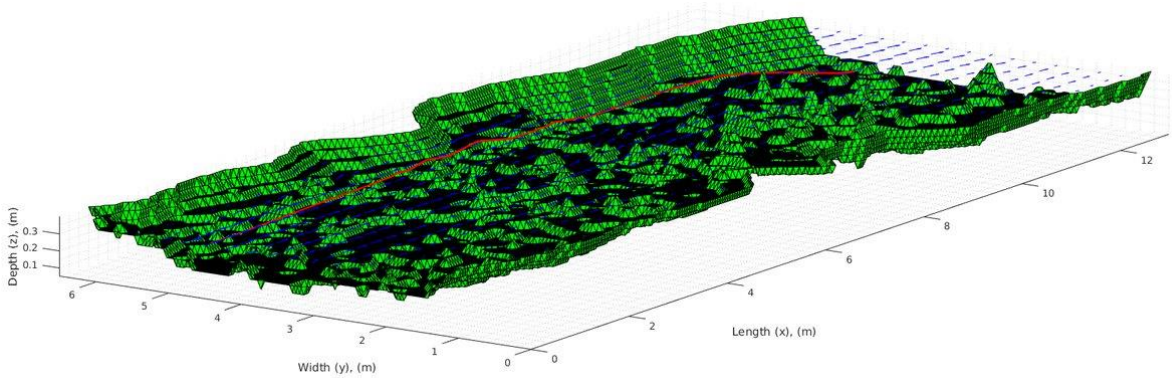
Thomas Padgett, Fluid Dynamics CDT @ThomasEPadgett

1. 1/3 Loads of fish move through rivers but must overcome many man-made barriers. These barriers segment rivers, reducing available habitats. This angers the fish. We need to understand how they behave to help them overcome barriers! I do this with FISHY AGENTS! #CDTTweCon

2. How does it work? - Agent-based models are used to simulate complex systems using multiple simplistic components called agents. The agents (fish) exist within an environment (river) and react to stimuli from the environment or from other agents. #CDTTweCon

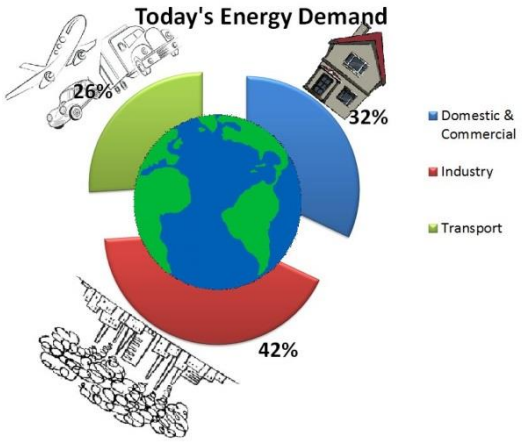


3. How's it going? - While still in development, the code successfully predicts the path of a virtual fish through an example environment (red line in fig). I'm now calibrating the code based on experimental data. When finished it will be available for anyone to use! #CDTTweCon



Inna Gorbatenko, Fluid Dynamics CDT @i_gorbatenko

1. Bio -fuels: What the future holds? Energy is the crucial part of our daily lives. It is predicted that the global energy demand can rise by 32% by 2035 with the increased world population and the urbanisation. Can we meet this growing demand? #CDTTweCon



2. If we are so heavily relying on the fossil fuels, how can we tackle the climate change? Bio-fuels are expected to play an important part in the

energy mix future. They are renewable fuels that can be used on their own or blended into petrol or diesel. #CDTTweCon

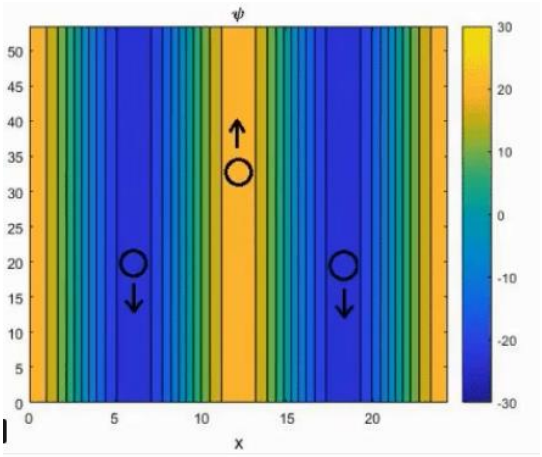
3. Biofuels will be particularly needed in aviation, shipping and heavy goods vehicles where there are few alternatives to fossil fuels. However, it would require a collaborative efforts and the mix of all available energy sources to create a lower-carbon future.#CDTTweCon

Thomas Goodfellow, Fluid Dynamics CDT @GoodfellowTJ

1. Love in an Ocean Elevator -- Oceans are tricky beasts. Large-scale mixing of heat and salt drive ocean currents and affect our climate. The origins of such motions, however, are modest. We study the evolution of small-scale 'elevators' in the Arctic Ocean. #CDTTweCon

Ladies and Gentlemen -- Steven Tyler by the ocean.

2. Diffusion is key here; a tiny blob of salty water cools down much quicker than it loses 'saltiness'. This diffusive interplay kick-starts a chain reaction in a stationary fluid, beginning with adjacent columns of fluid moving up and down -- like elevators! #CDTTweCon

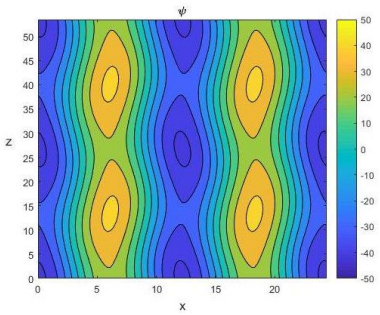


3. We use (relatively) simple maths to see what emerges from these elevators. It turns out that the rubbing of adjacent elevators gives them sexy curves. The curves grow to eventually destroy the elevators, leading to new motion and, ultimately, km-scale phenomena. #CDTTweCon

Simple Maths.

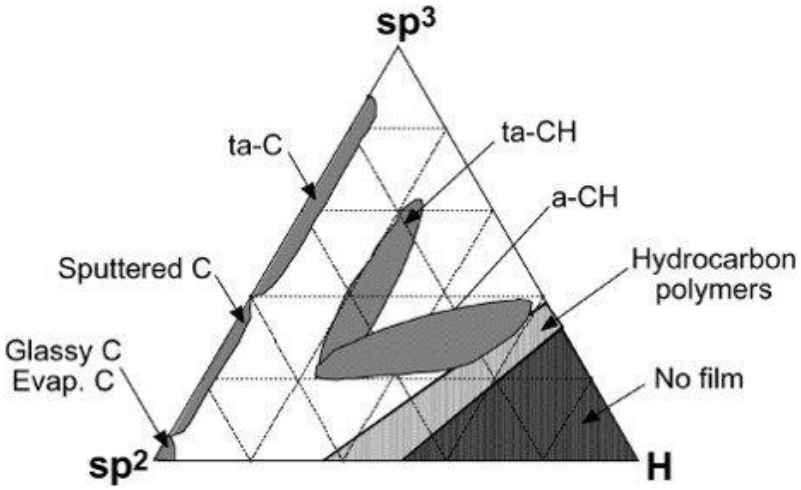
$$\begin{pmatrix}\psi'\\T'\\S'\end{pmatrix} = \exp(ifk_x x + ik_z z + \lambda t)\sum_{n=-\infty}^{\infty}\sum_{m=-\infty}^{\infty}\begin{pmatrix}\psi_{n,m}\\T_{n,m}\\S_{n,m}\end{pmatrix}\exp(ink_x + im\omega t).$$

Curves



Sam McMaster, Integrated Tribology CDT @mrsampablo

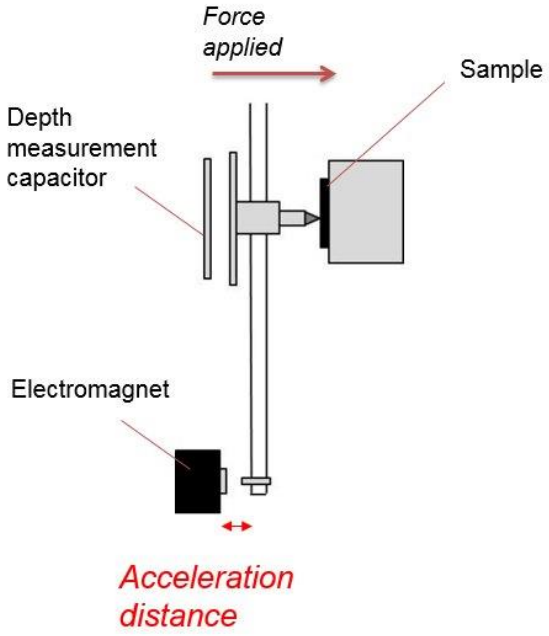
1. “Nanomechanical and Impact-Erosion Characterisation of Diamond-like Carbon Coating Systems” DLCs are a metastable carbon films, they’re used extensively in automotive & aerospace industries. They’re seeing more use in oil and gas with flow assurance devices. #CDTTweCon



2. We want to understand how properties vary with depth. Using nanoindentation we can map changes in hardness and elastic modulus through the coating. This can be used to investigate impact-erosion wear resistance by relating mechanics with the wear processes. #CDTTwecon

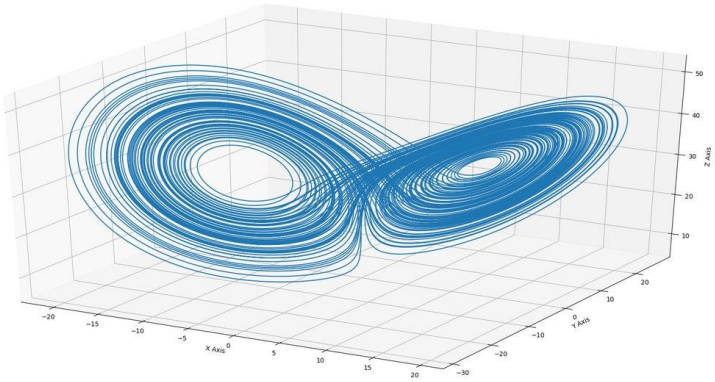
3. How to achieve this? Relate the energies dissipated in the coating during each process and compare the types of wear. End goal is being able to use nano/micro-impact to predict erosion performance as it's a much more easily controllable process. #CDTTweCon

Micro-impact testing

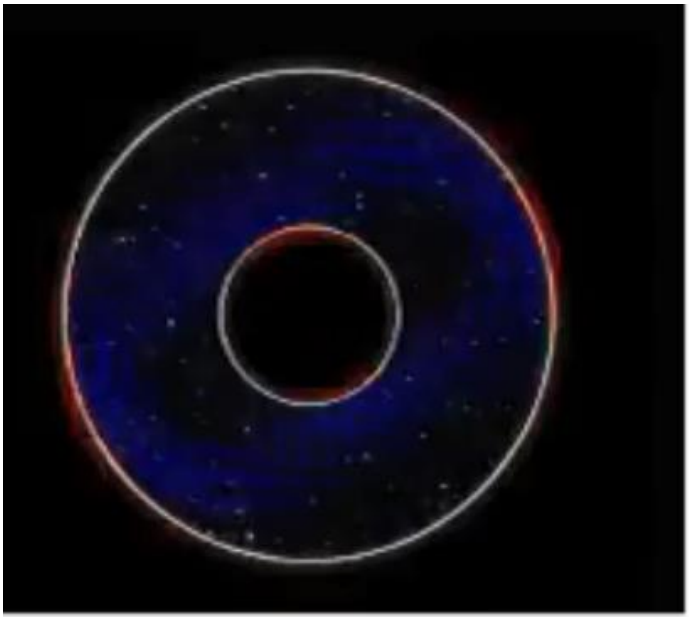


Godwin Madho, Fluid Dynamics CDT @laptopracer

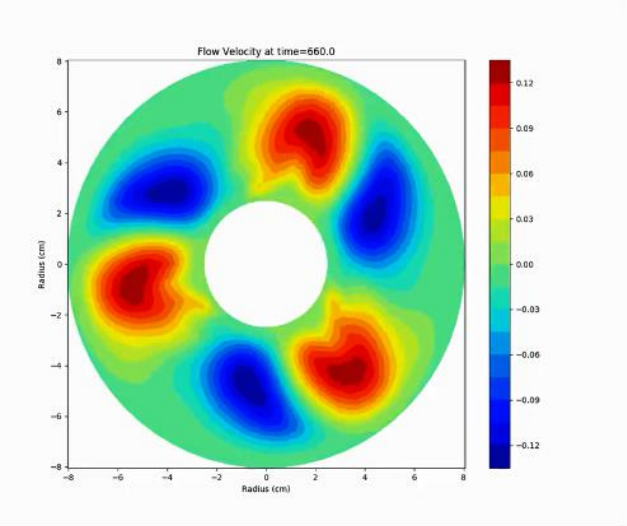
1. Using Data assimilation techniques to validate fluid flow models: All models are imperfect, so how can we predict chaotic behaviour without using high resolution models to compensate for imperfect models? #CDTTweCon



2. Data assimilation is a process where simulation is corrected using observations. Use multiple low resolution models and correcting them at frequent intervals to nudge them in the correct direction. We apply this to a rotation fluid study #CDTTweCon

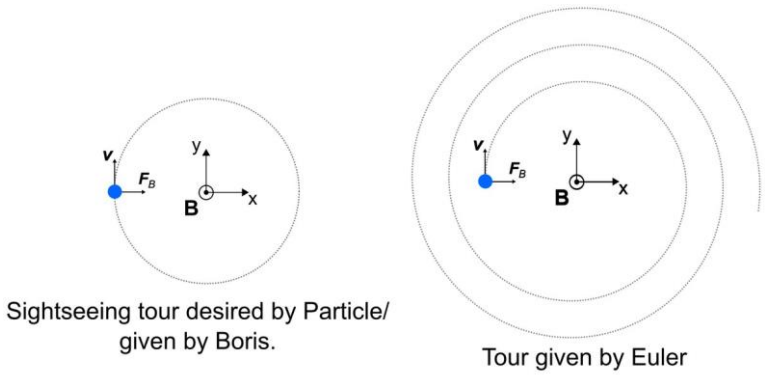


3. So far we have applied this method to a steady flow at 1rad/s. A major issue is ensemble convergence and the drifting of ensemble compared to the observation. Different tuning methods are being tested to fix these issues before moving to more chaotic behaviour #CDTTweCon

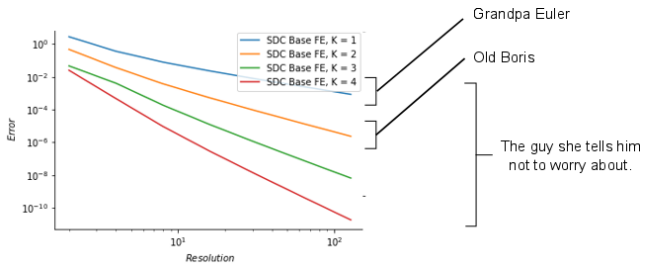


Kristoffer Smedt, Fluid Dynamics CDT @krissmedt

1. Pushing particles with Boris: Is it time for the old man to retire? Boris the Numerical Integrator is a dependable, but old guy. His job is meeting with particles, checking their records and moving them along. He does it somewhat better than his predecessor Euler.. #CDTTweCon



2. At our rivalling particle travel agency we are currently training fresh new talent hoping to put old Boris out of a job! If successful, the new star Boris-SDC, who may or may not be a cyborg clone of Boris, will do all Boris can but faster, better. #CDTTweCon

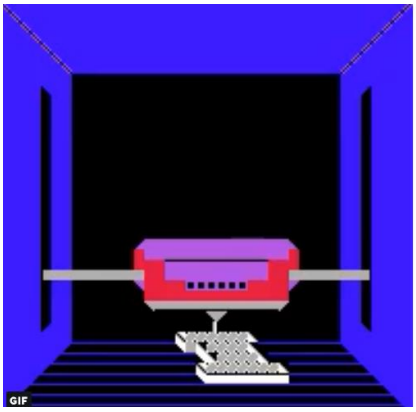


3. Over the past year, we have managed to get a few technological... gadgets, called Collocation and Spectral Deferred Corrections working as well as a suspiciously Boris-shaped operating table (and cloning vat). So, anybody have any Boris-tissue we can borrow? #CDTTweCon

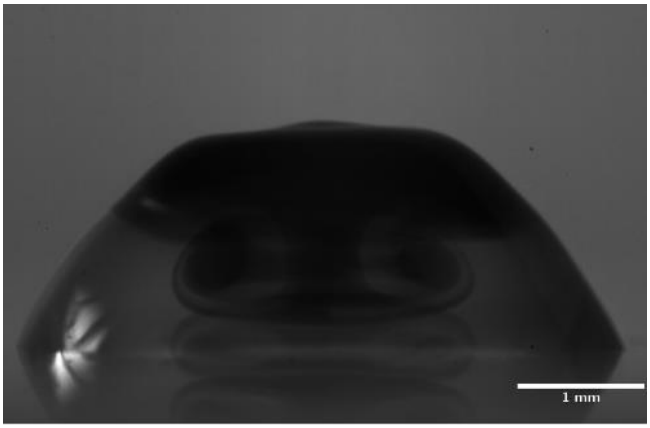
Thomas Sykes, Fluid Dynamics CDT @FluidsTom

1. Internal flows in coalescing drops. Where does the fluid from each drop end up in the final coalesced drop? How well mixed is the fluid? #CDTTweCon

2. I use #OpenFOAM simulations and experiments to study this problem, in various configurations, e.g. a drop impacting another on a surface, for inkjet printing applications. #CDTTweCon



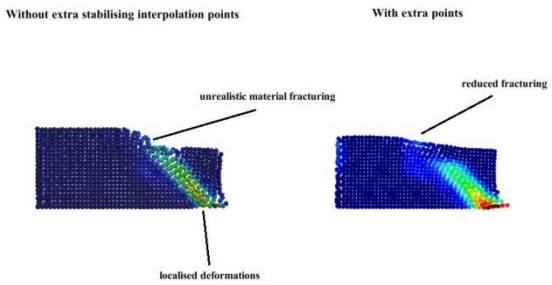
3. So far, I've developed a working model in #OpenFOAM and an experimental setup (with image processing algorithm) to study these flows. #CDTTweCon



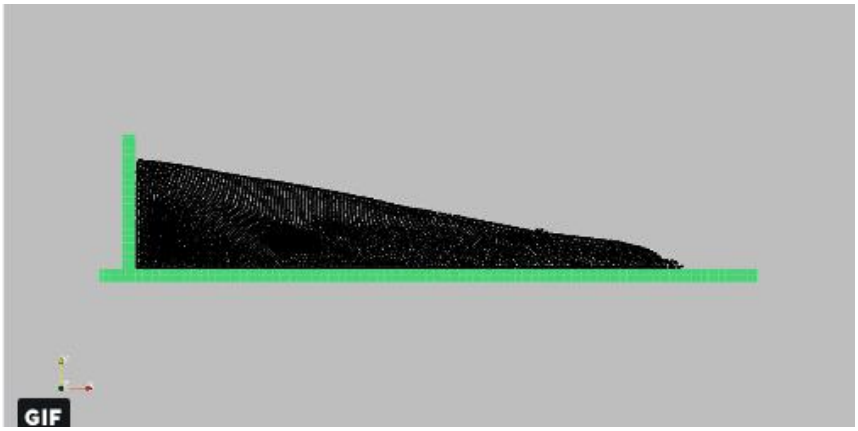
Caitlin Chalk, Fluid Dynamics CDT @ChalkCaitlin

1. Landslide behaviour: A viscoplastic modelling approach for failure and propagation. Landslides are complex, but we can simplify them for modelling purposes. Viscoplastic materials can handle loads under a critical level, but above this undergo irreversible change #CDTTweCon

2. These deformations localise in bands, which causes soil to fail and landslides to occur. This can be modelled computationally as a group of particles (SPH), but instabilities occur and create unrealistic fracturing. I've added extra points to stabilise SPH #CDTTweCon



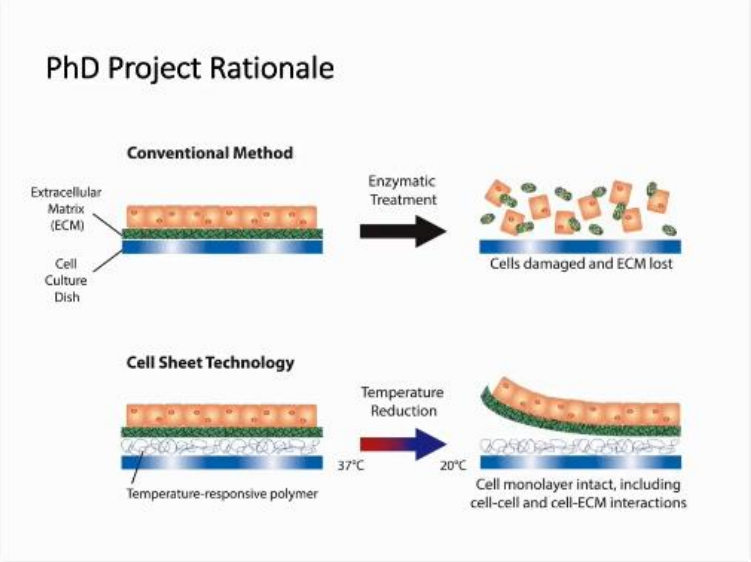
3. After failure the soil flows as a highly viscous fluid & can be described by the viscoplastic model. I've extended SPH with the stabilisation points to simulate this behaviour, bridging the gap between failure & landslide propagation #CDTTweCon



Elizabeth Kapasa, Tissue Engineering CDT @ElizabethKapasa

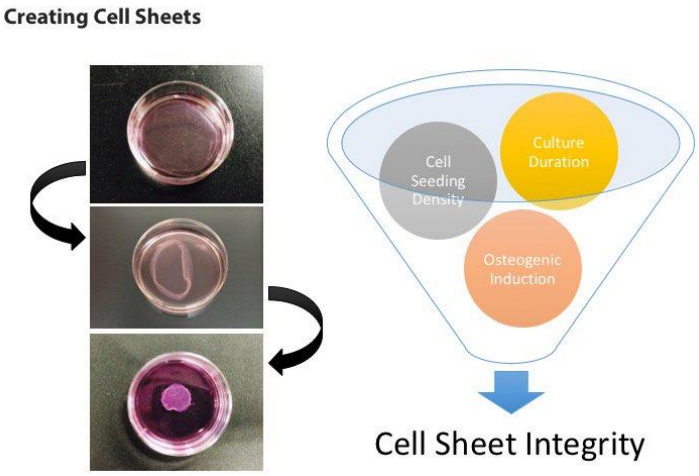
1. Building Bone Grafts: Bone Tissue Engineering using a Novel Multi-Layered Cell Sheet Technology.

   GBBO isn't just for TV - I use a technology that layers sheets of cells like a cake to make a 3D bone tissue in order to help millions repair their damaged bones! 💪 #CDTTweCon



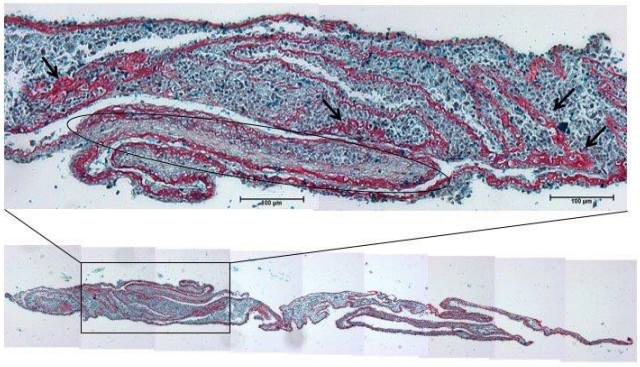
(video best viewed online)

2. From handling the CSs increasing culture duration, seeding cell density and osteogenic induction significantly improved the size and integrity of the CSs. However a compromise needs to be made between quality and the cost of cells and length of culture. #CDTTweCon



3. This histological staining shows the presence of important components for bone in the MLCS - collagen! Current results have demonstrated the feasibility of creating and using osteogenic MLCS to create 3D tissues in vitro for bone tissue engineering. #CDTTweCon

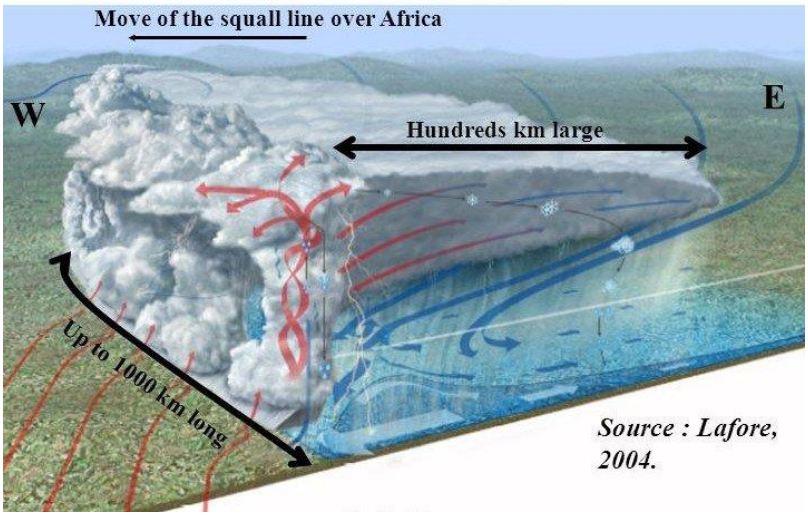
Histology of MLCS: Picosirius Red & Alcian Blue staining showing collagen deposition and presence of glucosaminoglycans



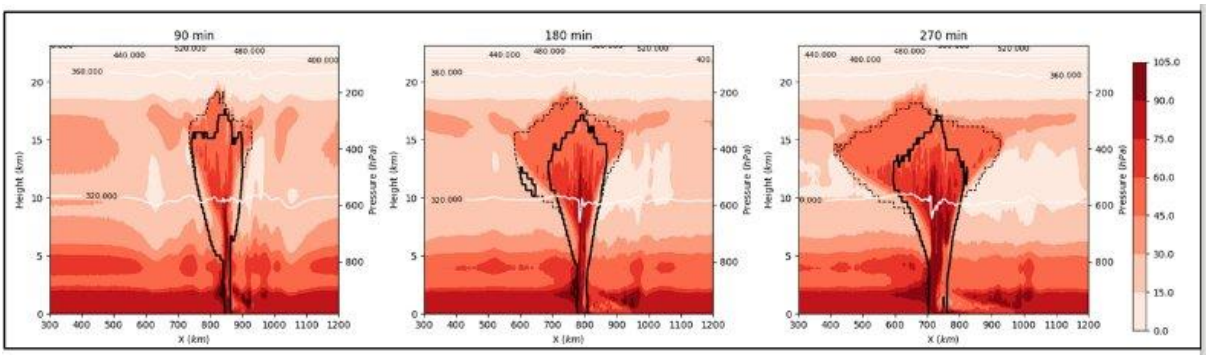
Megan Bickle, Fluid Dynamics CDT @MeganBickle

1. The Sahel region of West Africa is experiencing more of the most intense storms and less rainy days annually. Currently these storms and therefore rainfall aren't well predicted, making it difficult to know when to plant crops in this agriculturally dependent region. #cdttwecon

2. Through idealised simulations I'm researching why the wind speed changing with height can cause more intense storms. Is it because stronger winds at the surface supply air which feeds the system or because they balance the cold air spreading outwards from the storm? #cdttwecon

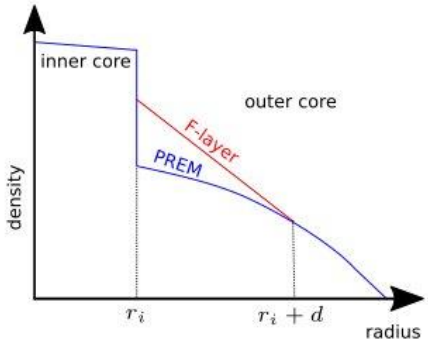


3. So far I've worked on producing a simulated storm from an average profile of the region. Next I'm going to apply predicted climatic changes to temperature, winds and humidity to see the effect and what we might expect in the future. #cdttwecon



Jenny Wong, Fluid Dynamics CDT @jenny_wong_

1. NEWS REPORT: seismic evidence seems to suggest that the F-layer, situated at the base of the liquid outer core, is stably-stratified. #CDTTweCon



2. Margaret, 50, from Kent says: "Well if the inner core was crystallising and dumping light elements into the liquid directly at the inner core boundary, surely that would disturb a stable F-layer? " More news updates to follow. #CDTTweCon

3. WEATHER ALERT: iron snow is expected in the F-layer. Local residents observe that solid iron particles precipitate and release light elements throughout the layer rather than at the inner core boundary. Temperatures are in the high 5000s and are on the liquidus. #CDTTwecon