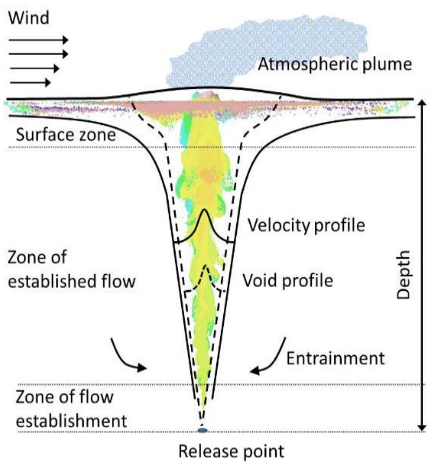
SUBSEA GAS RELEASE

Subsea gas blowouts and gas releases pose a threat to human life, offshore assets and the environment. Reliable risk assessments are required to secure safety at offshore operations. For subsea gas releases a risk assessment includes predictions on how much gas and how gas reaches the ocean surface. This provides input to a calculation of atmospheric dispersion predictions on the distribution of gas in the atmosphere above the release. The uncertainty in the subsea estimate has historically been identified as the greatest uncertainty in the risk assessment. Due to this a series of projects was initiated after 2005 with the objective to increase the reliability in estimates of how and how much gas reaches the ocean surface.



The SURE-projects run by SINTEF was a result of this commitment. The initiative was originally supported by Statoil (now Equinor), Total, Gassco, BP, Shell, Safetec, Wild Well Control, DNV and Petroleum Safety Authority Norway. A CFD-model[1] was identified as the method to deliver enhanced predictions of gas dispersion in the ocean. This was supported by experimental efforts in the lab, in coastal waters and in the North Sea. The early model was based on a standard, but somewhat simplified turbulence model and gas dissolution was not accounted for. Due to lack of knowledge on the mass transfer and gas dissolution in seawater, a series of experiments (both in lab and in ocean) was performed on the topic. As a result of this a mass transfer model was implemented in the CFD-model to account for gas dissolution. A more advanced and dynamic turbulence model which is less dependent on uncertain tuning coefficients was also implemented. The modelling concept is consistent with a wide range of field observations and experiments.

The CFD-model tracks bubble motion due to buoyancy and drag. The drag stems from the motion of the surrounding water which is calculated based on conservation of mass, momentum and energy. Turbulence is accounted for by a so-called VLES-model. Mass transfer between gas bubbles and water is included and the concentration of dissolved gas in the ocean is an outcome of this. This mechanism depends on bubble size and therefore a bubble size model is implemented. Material properties (e.g. density, solubility, diffusivity, viscosity) are functions of pressure, temperature and salinity. From this model it is possible to predict how much gas surfaces, where and when it surfaces and how it is distributed at the surface. This can be used as direct input to atmospheric dispersion modelling to assess size of exclusion zones. It is also possible to assess hydrodynamic loads on surface vessels and subsea devices. The focus has been on methane release, but the model is applicable to natural gas and CO_2.

[1] CFD: computational fluid dynamics

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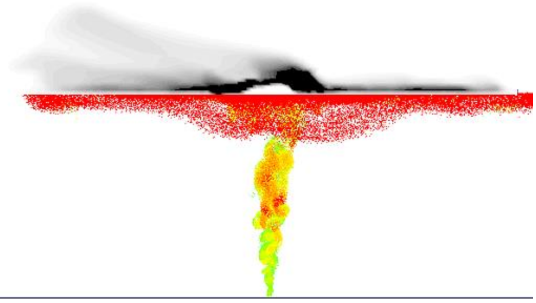

Calculated subsea plume and atmospheric gas plume

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