# Drift simulations of person missing off the coast of Norway, using the met.no "Leeway" model

**Briefly about the model:**

Leeway is an ensemble trajectory model that computes the trajectories of objects on the sea surface under influence of wind (10 m) and surface currents (nominally 50 cm below sea surface).

The model essentially estimates a search area by quantifying a number of unknowns (the last known position, the object type and the wind, sea state, and currents affecting the object), then computes the evolution of the search area with time.

A source of uncertainty lies in the wind and current data. The fields will always contain errors, whether they are modeled or observed. Additionally, fluctuations on a scale smaller than those resolved by the forecast models or observing systems will always be present.

There is a large ingredient of chance involved in the calculation of an object's motion on the sea surface, thus a probabilistic formulation is used to tackle the uncertainties involved. Rather than forecasting the exact trajectory of the object, a most probable area is sought, i.e., an evolving probability density function in space. We employ a Monte Carlo technique to compute the probability density function (interpreted as the search area) for the location of the object by perturbing the different parameters that have a bearing on the object's trajectory.

The particles are seeded within a circle with a certain start radius r0. The exact positions of the particles are determined by a selecting from a circular normal distribution with a given standard deviation from a center position along a great circle arc connecting the start and end positions. The radius of uncertainty equals two standard deviations (2*sigma) in the circular normal distribution, i.e., 86% of the particles will on average fall within the radius.

If the last known position (LKP) is assumed to be rather precise (e.g., a distress call is received from a ship with a GPS unit), a small radius of uncertainty may be assigned to this position and consequently all ensemble members will be released simultaneously and within short distance of each other.

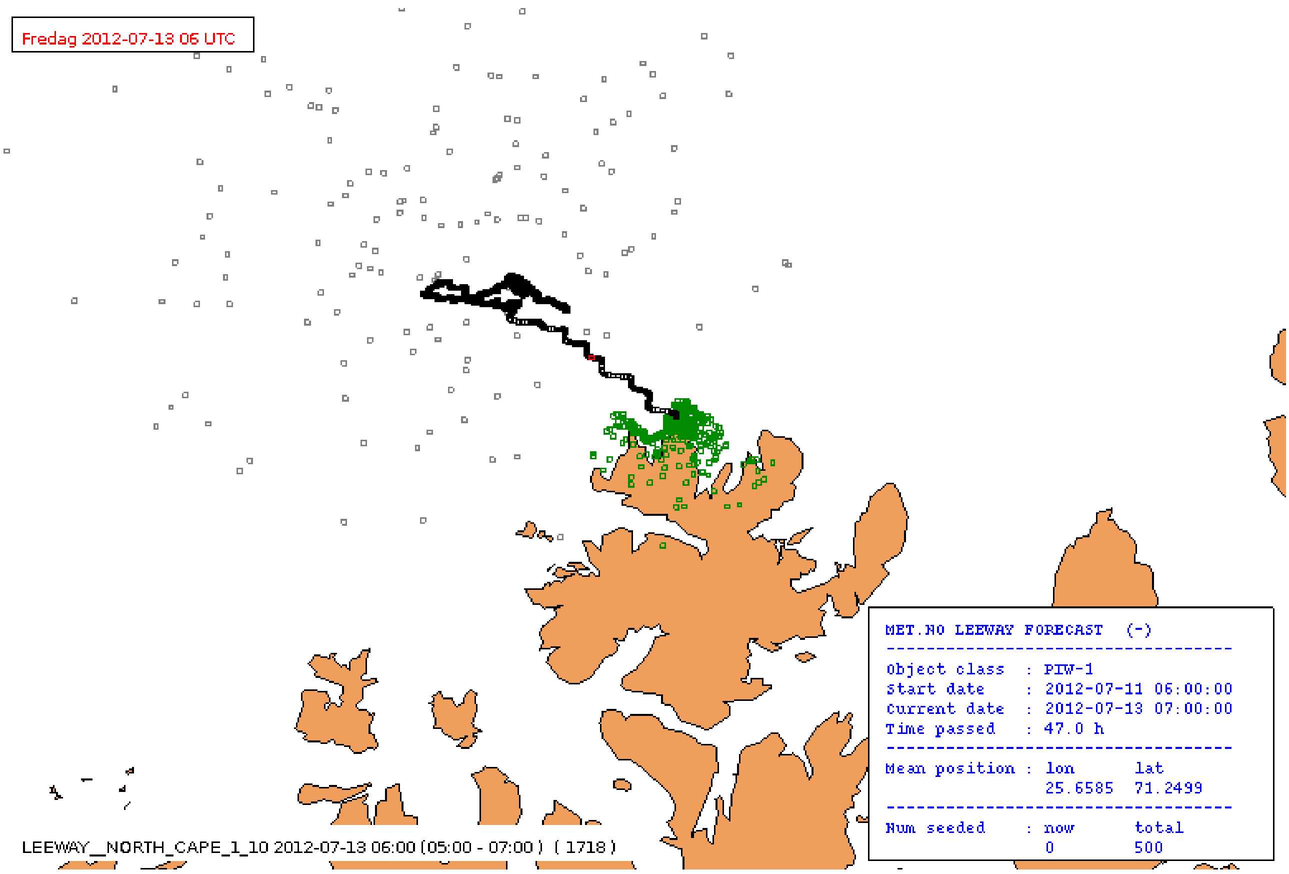
**Simulations:**

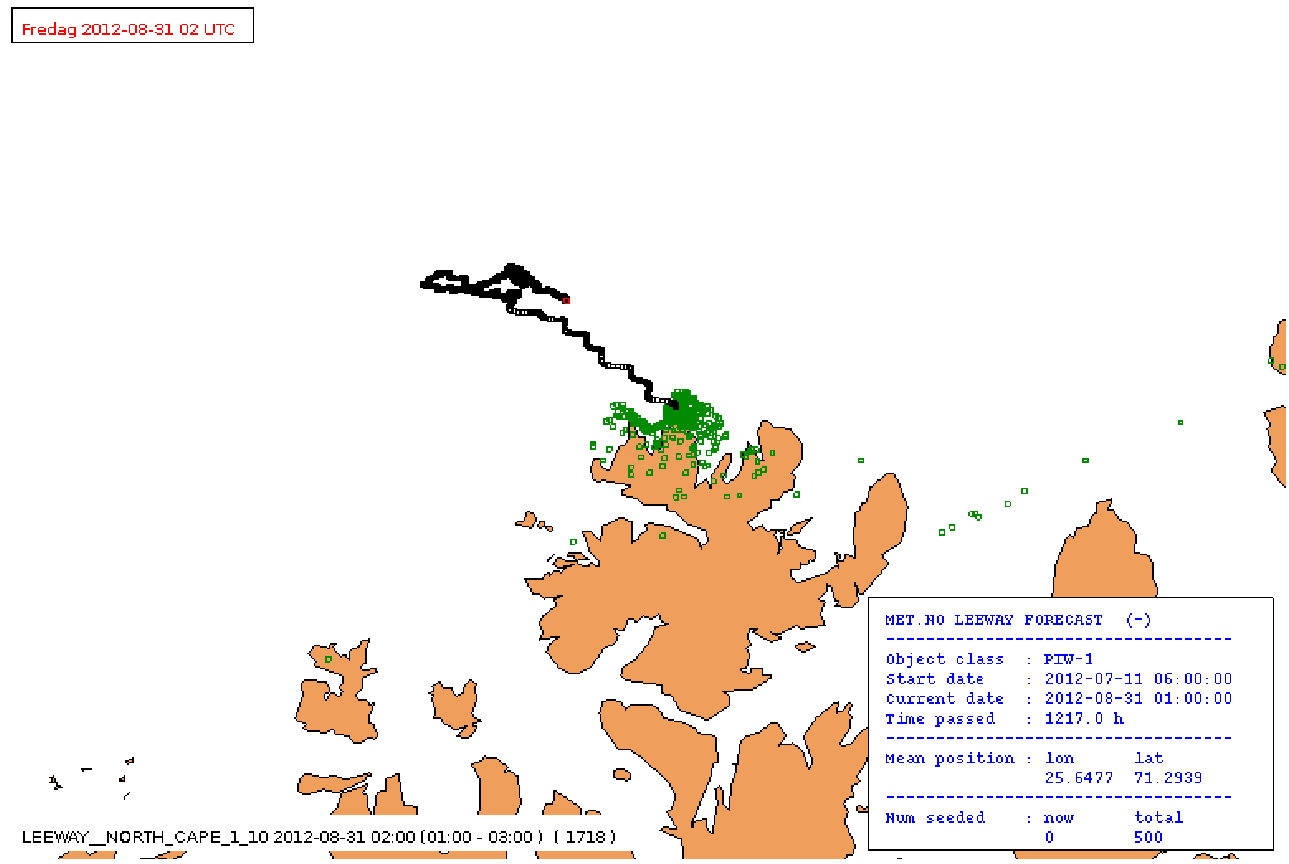
Since the man started off (presumably) standing on land, we have set the start radius equal to 1km.

The start date is set at 11.07.2012. We assume that the man disappeared some time between 06:15 and 12:00. For the simulations we selected object class «PIW-1»: Person-in-water (PIW), unknown state. We then did several simulations lasting until 31.08.2012, varying several such as the total number of seeded particles and the start radius.

In order to determine a search area, we focus on the number of stranded particles (in green), rather than the ensemble mean trajectory (in black), or the particles floating at sea (in grey). After 48 hours a certain number of particles had stranded, and even if we ran the simulation for several weeks, this number did not change significantly. The particles that did not strand just ended up being carried further and further away from shore, drifting with the strong currents off the coast. For this reason, I don't think the 2-3 week run of this scenario adds much information - there is not much increase in stranding after the first 48 hours.

Attached is the result after 48 hours for the simulation that gave the most plausible search region. For comparison, we also attach an image of the results after several weeks' simulation.


Fredag 2012-07-13 06 UTC
MET.NO LEEWAY FORECAST (-)
Object class : PIW-1
Start date : 2012-07-11 06:00:00
Current date : 2012-07-13 07:00:00
Time passed : 47.0 h
Mean position : lon lat
25.6585 71.2499
Num seeded : now total
0 500
LEEWAY__NORTH_CAPE_1_10 2012-07-13 06:00 (05:00 - 07:00 ) ( 1718 )


Fredag 2012-08-31 02 UTC
MET.NO LEEWAY FORECAST (-)
Object class : PIW-1
Start date : 2012-07-11 06:00:00
Current date : 2012-08-31 01:00:00
Time passed : 1217.0 h
Mean position : lon lat
25.6477 71.2939
Num seeded : now total
0 500
LEEWAY__NORTH_CAPE_1_10 2012-08-31 02:00 (01:00 - 03:00 ) ( 1718 )