NOOS-Drift

A transnational multi-models ensemble system to assess and improve drift forecast accuracy in the European North West Continental Shelf Seas

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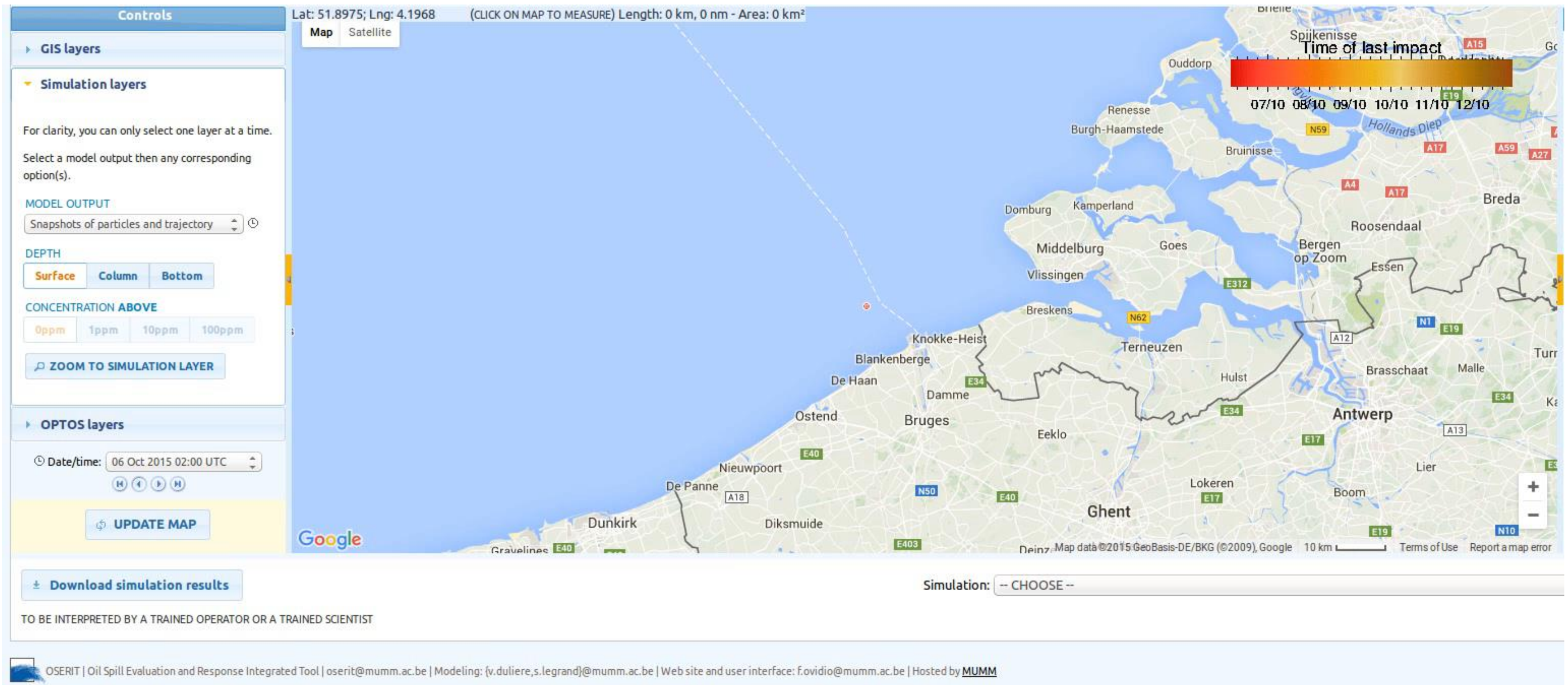
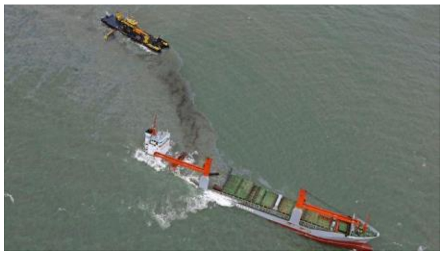
Drift models = Tracking items adrift in a extremely dynamic environment



Flinterstar case – 6-9 Oct 2015

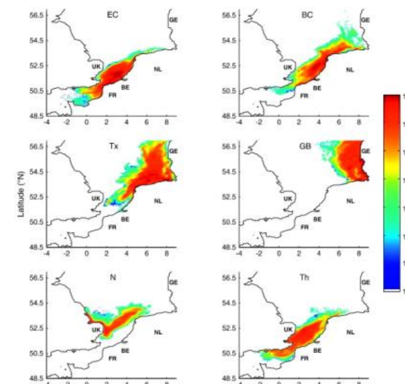
Activated 1000's times / country / year

MARITIME SAFETY



COASTAL AND MARINE ENVIRONMENT

MARINE RESOURCES



Fish stock connectivity

End-users' request :
What is the (in-)accuracy/uncertainty of your forecast?

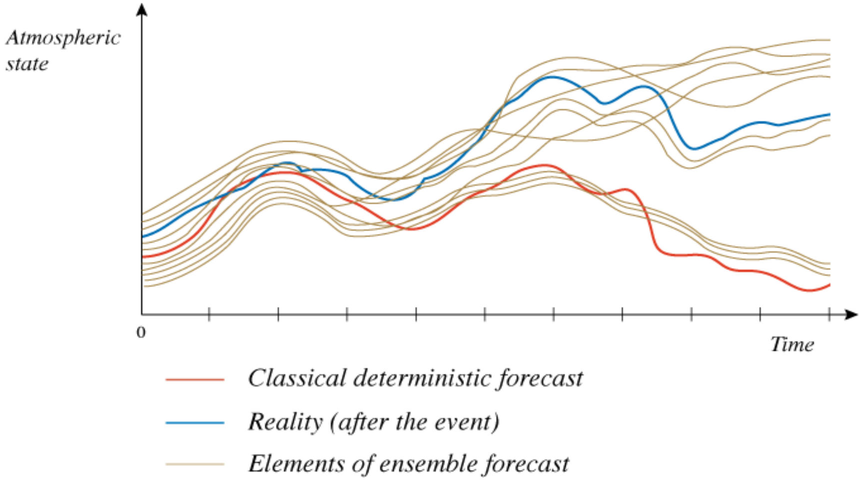
(in-)accuracy due to the met-ocean forcing

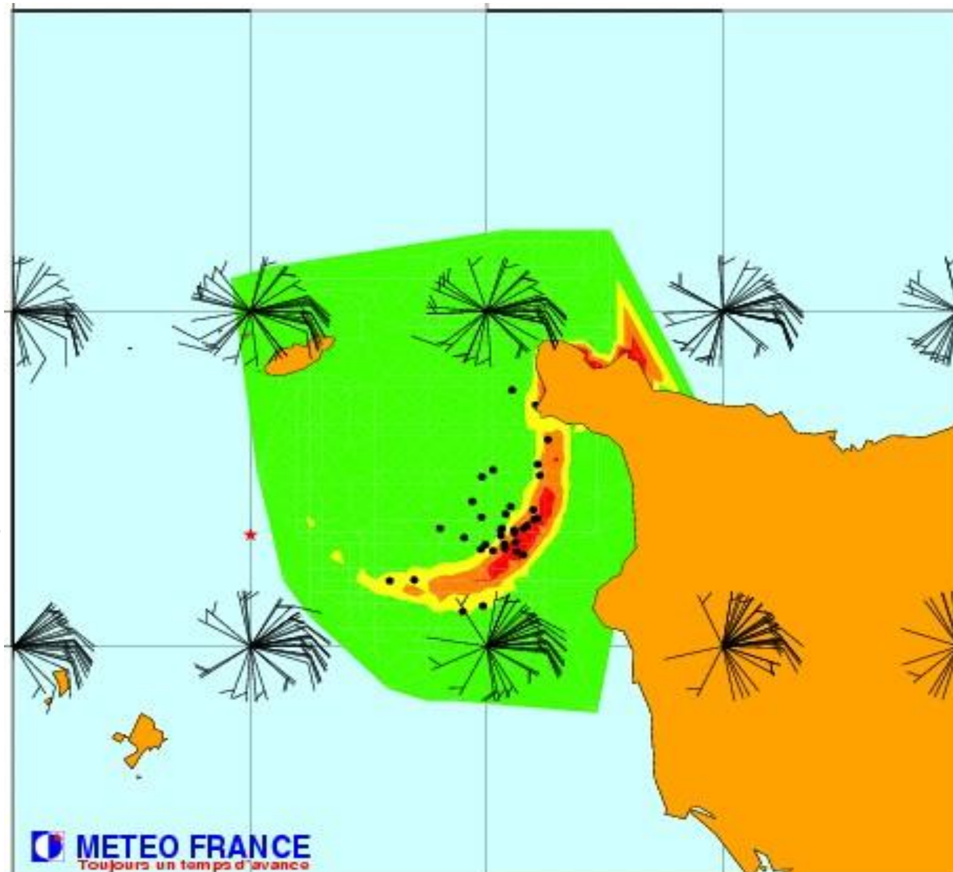
(In-)accuracy inherent to the drift model

Efficient communication towards end-user

Inaccuracy in tide dominated areas

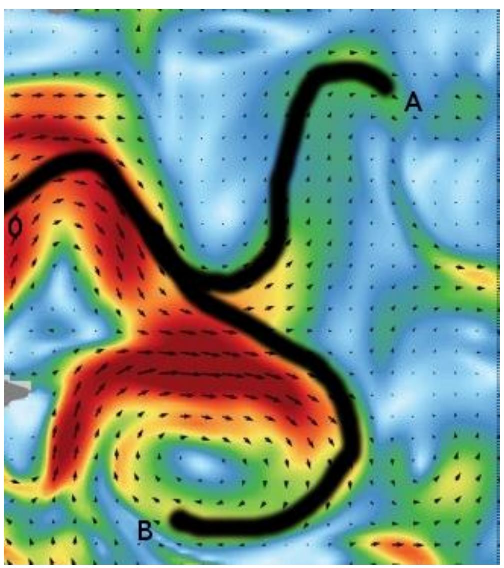
- Wind and tidal regions (Channel, North Sea)
  - use of atmospheric ensemble prediction

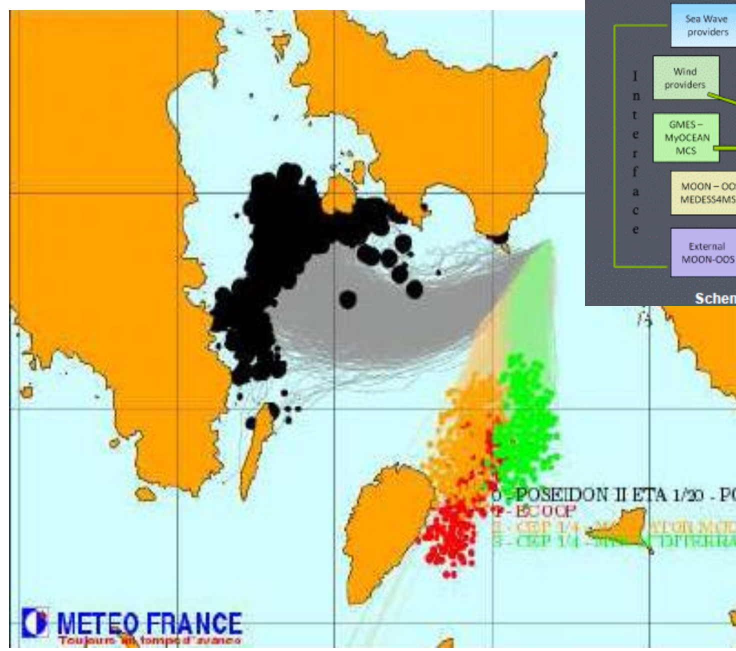


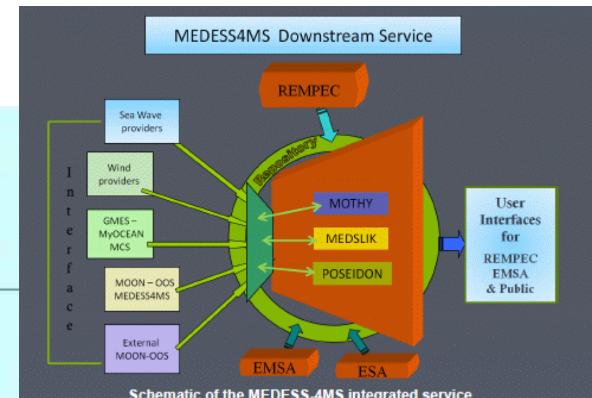


Inaccuracy in areas with eddies

- Areas with ocean eddies (Mediterranean Sea, Atlantic margin)
  - multi ocean forcing, multi models

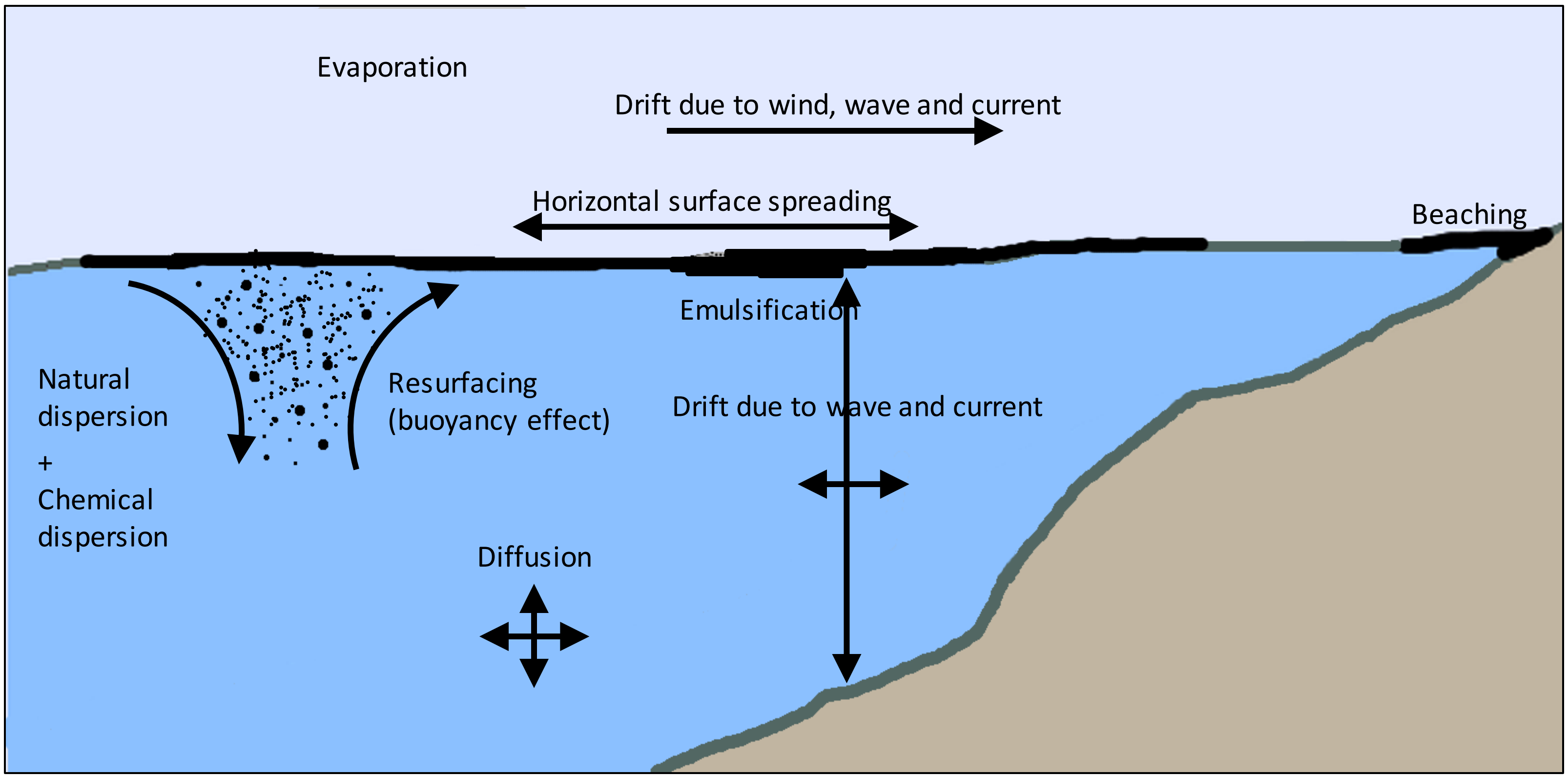






MEDESS-4MS 2012-2015

Many possible differences in process parametrizations and implementation choice drift trajectory model



+ different oil data bases
+ different SAR target data bases

End-users' request :
What is the (in-)accuracy/uncert... our fo...

NWGD reply:

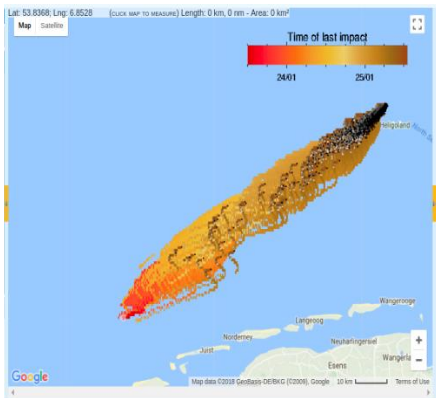
Only a multi-models ensemble joint analysis can answer these challenge

Let's develop it !

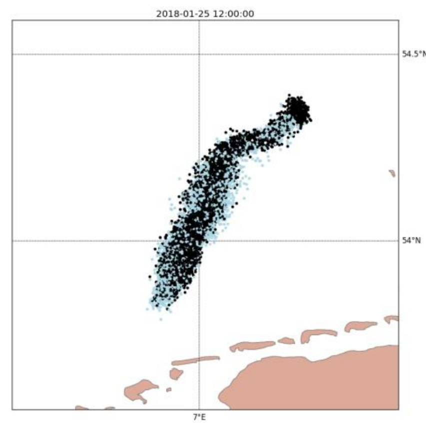
...er

Decision-making process might be different if multi-model ensemble is taken into account!

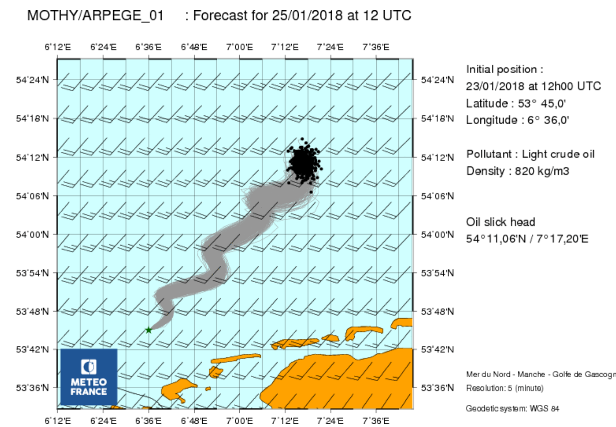
OSERIT



openDrift



MOTHY



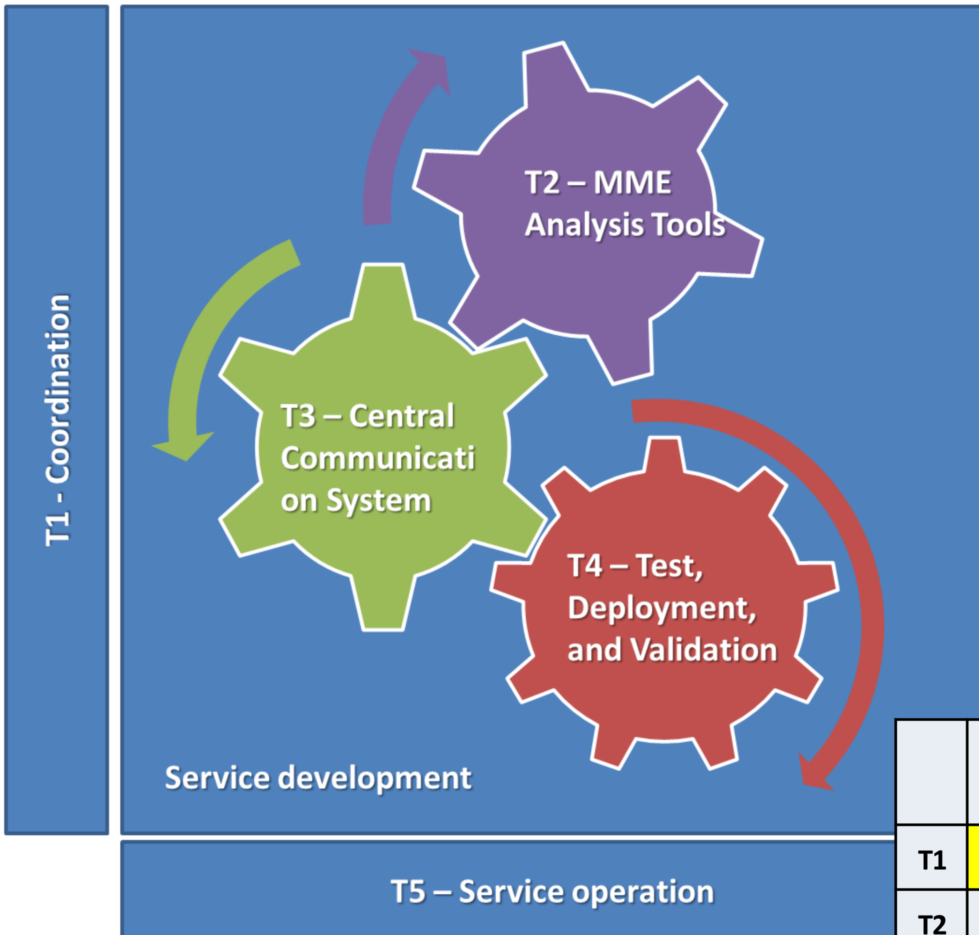
A realistic example:

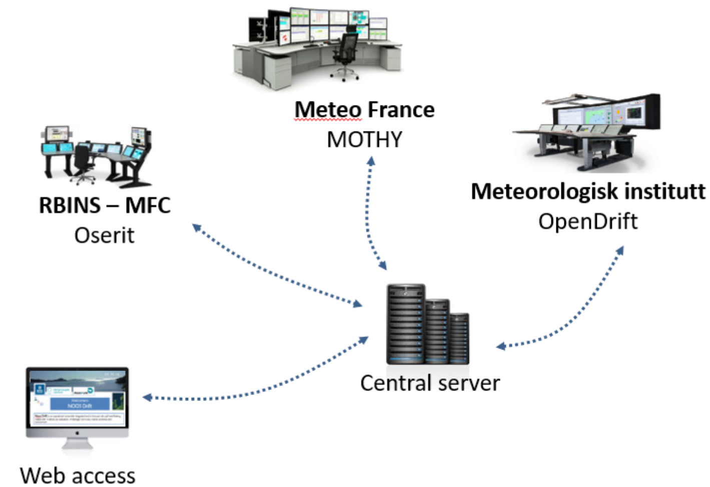
> 100km difference after 2 days adrift (stormy weather!)

NOOS-Drift challenges

- Automatic activation of several drift models
- Joint analysis of the different models results (spread due to met-forcing, spread inherent to the models , outlier identification,etc)
- Uncertainty range/metric
- Risk maps indicating chance for a site to be impacted
- Efficient communication -> standard file format, uniform visualization

NOOS-Drift work flow





	T0-T0+3	T0+3-T0+6	T0+6-T0+9	T0+9-T0+12	T0+12-T0+15	T0+15-T0+18
T1						
T2						
T3						
T4						
T5						

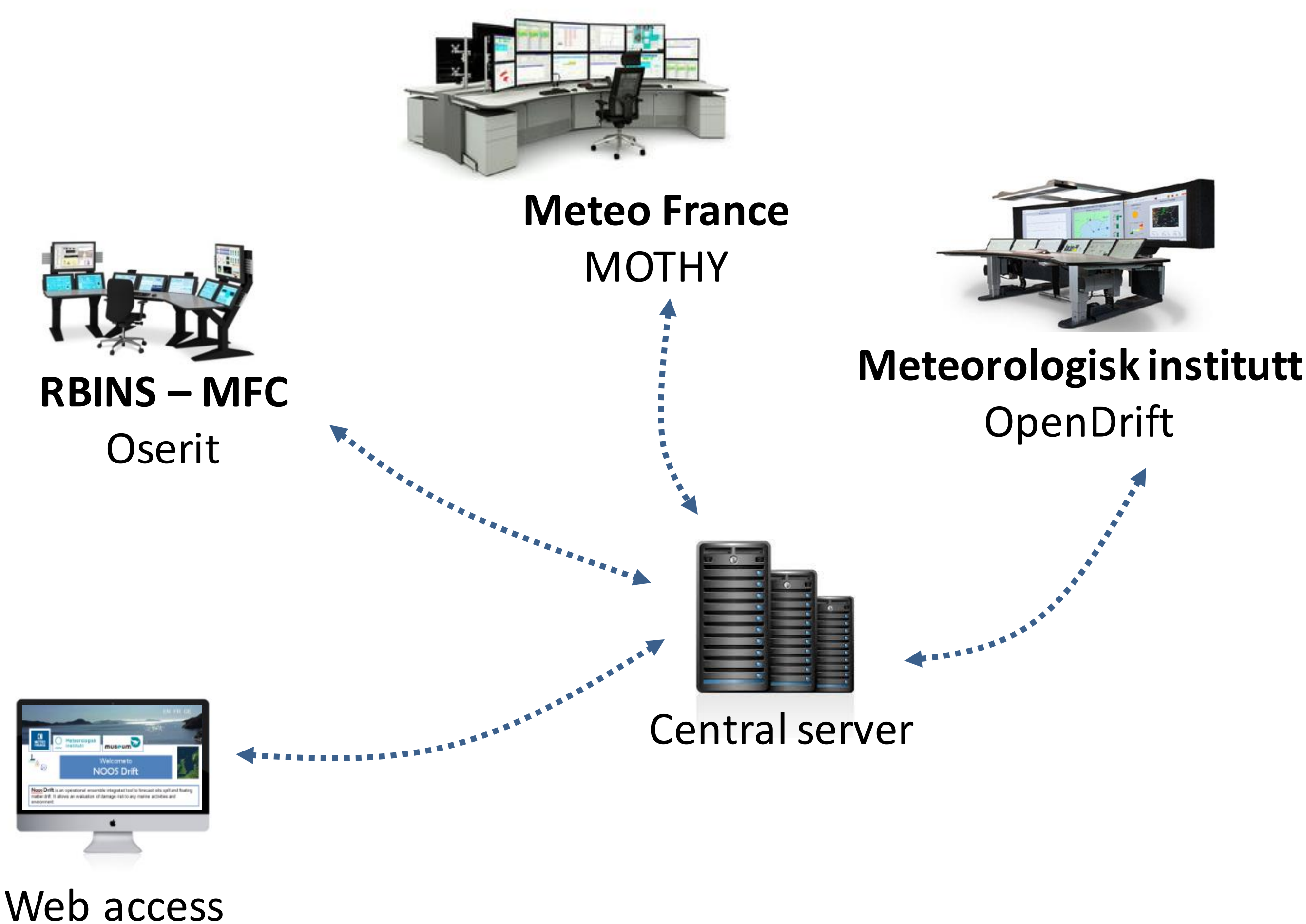
today

Challenge 1:
Automatic activation of the service?

Constraint : KISS principle

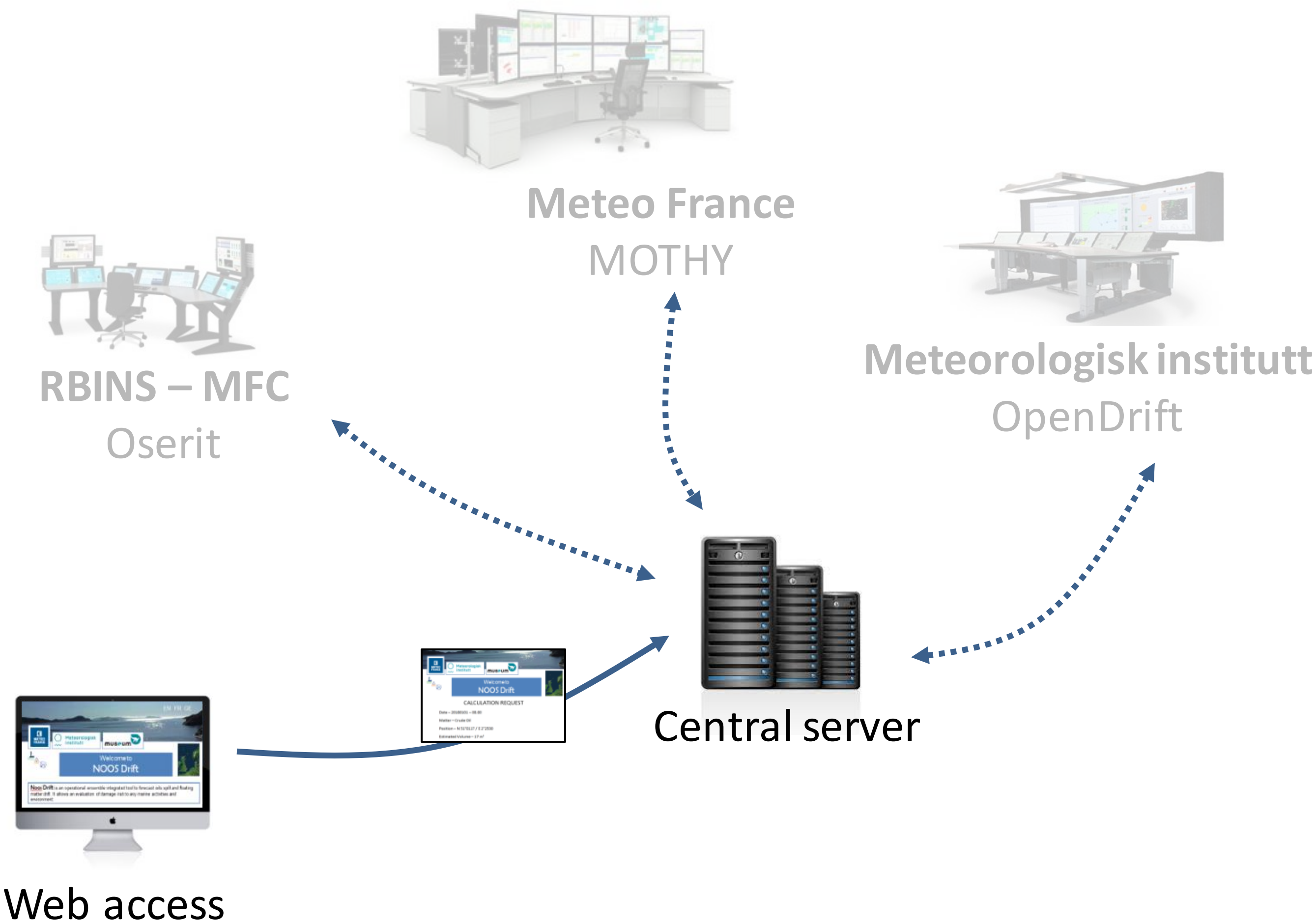
Global architecture

All systems are inter-connected via a central server.
Users can call the service via a web-based interface.



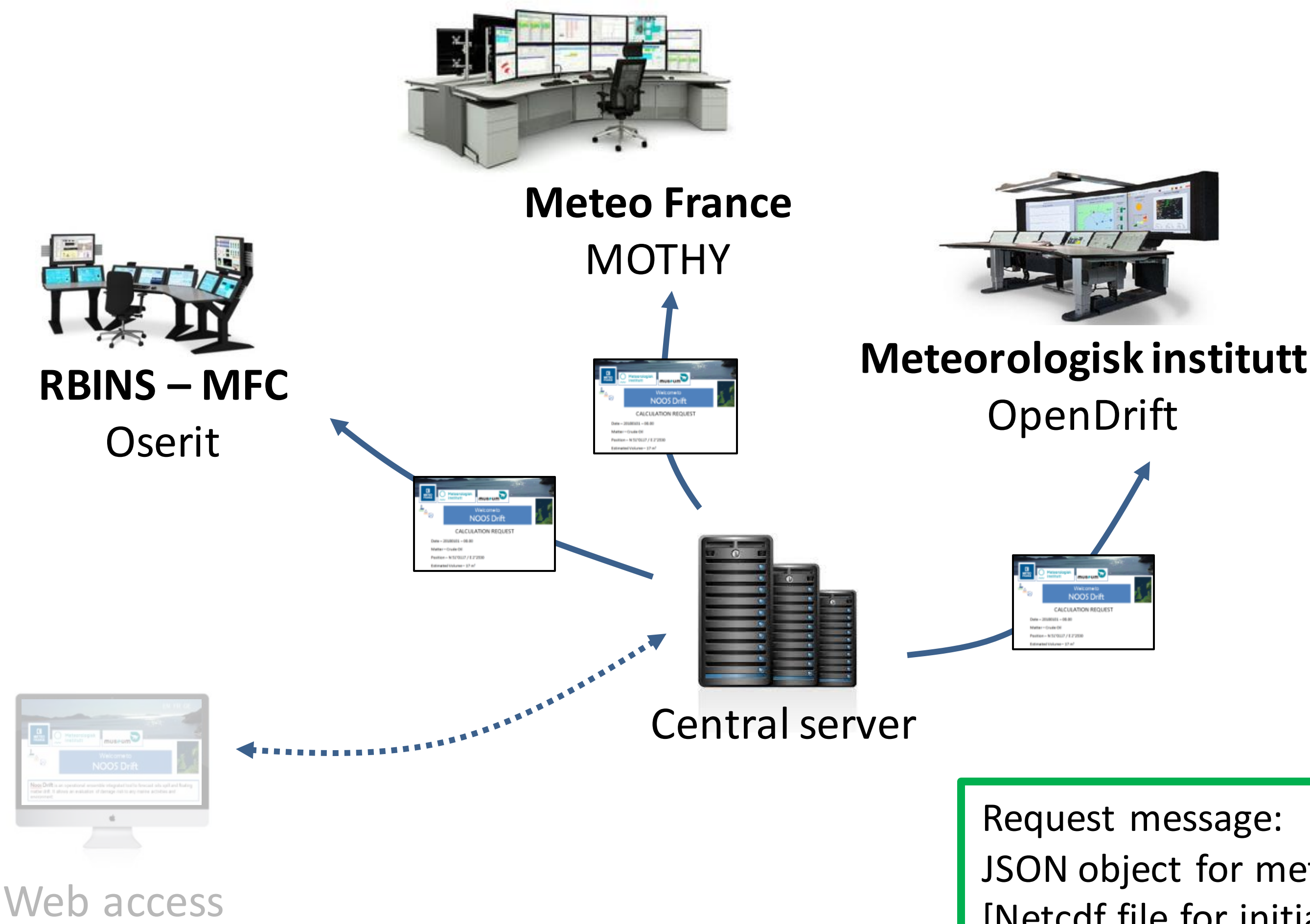
1. Service request

The central server collects the incoming service request.



2. Service request dispatched

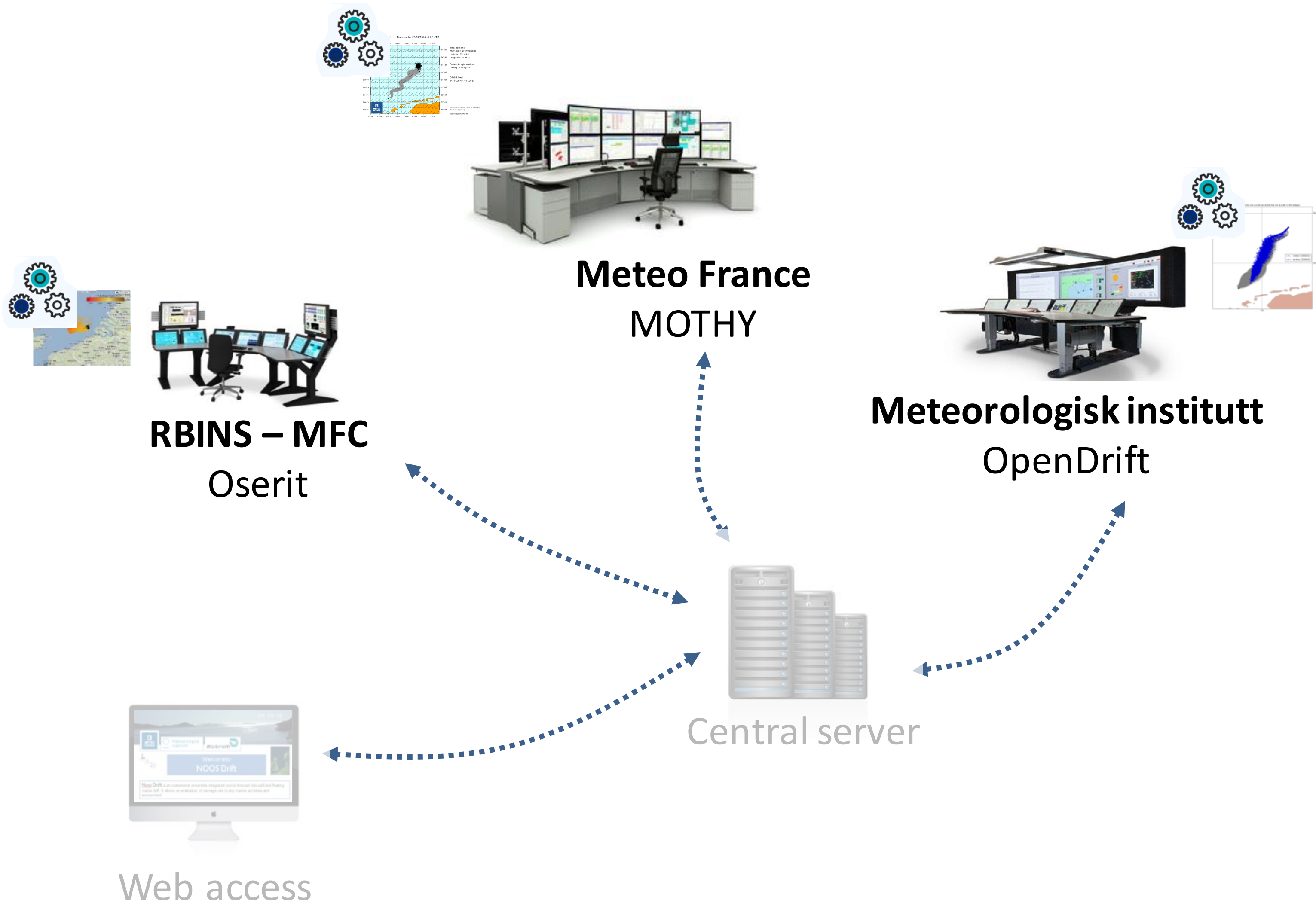
The central server dispatches the incoming service request towards the calculation centers.



Request message:
JSON object for metadata +
[Netcdf file for initial conditions]

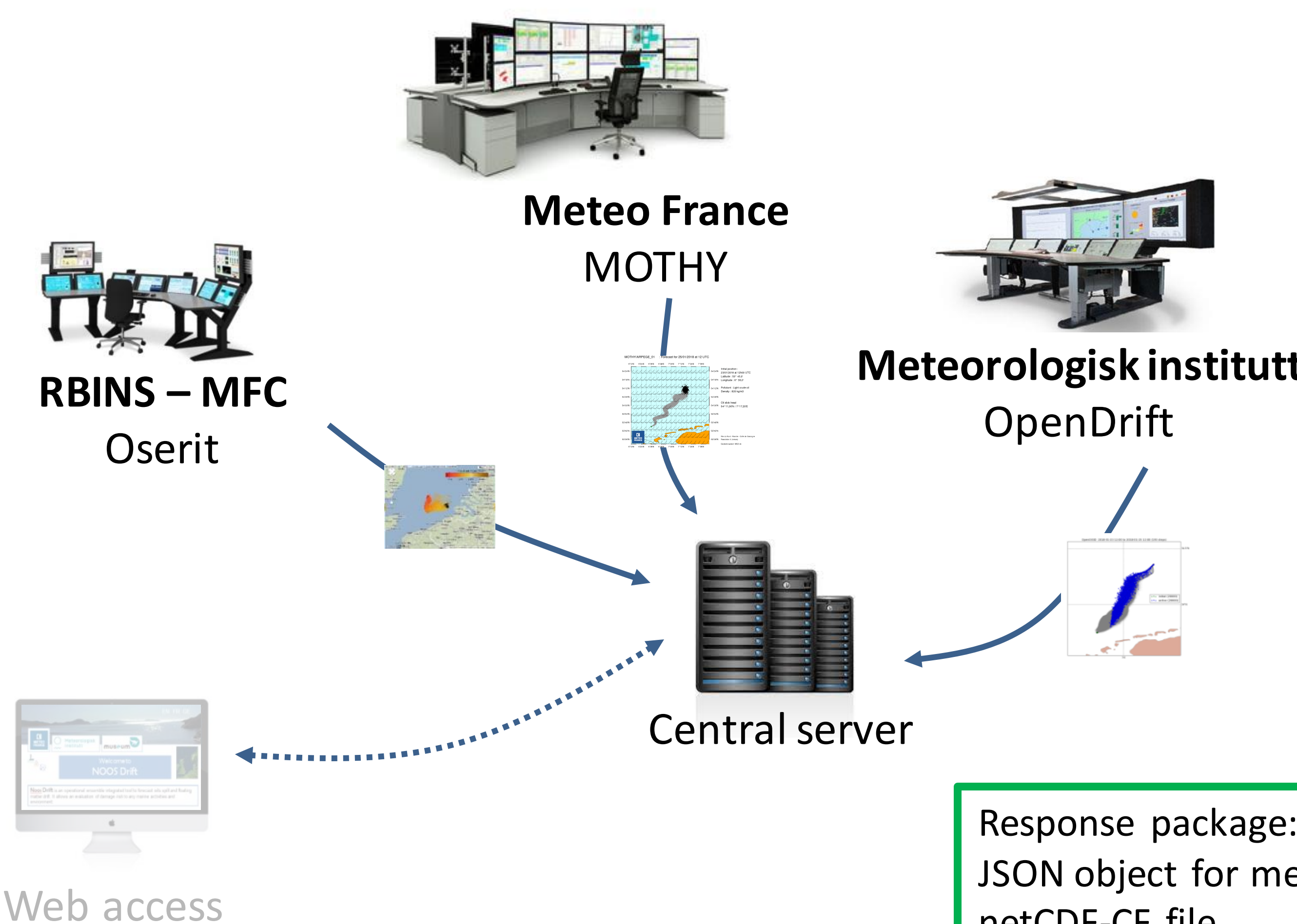
3. Distributed computation

Each model computes its drift forecast



4. Forecasts collection

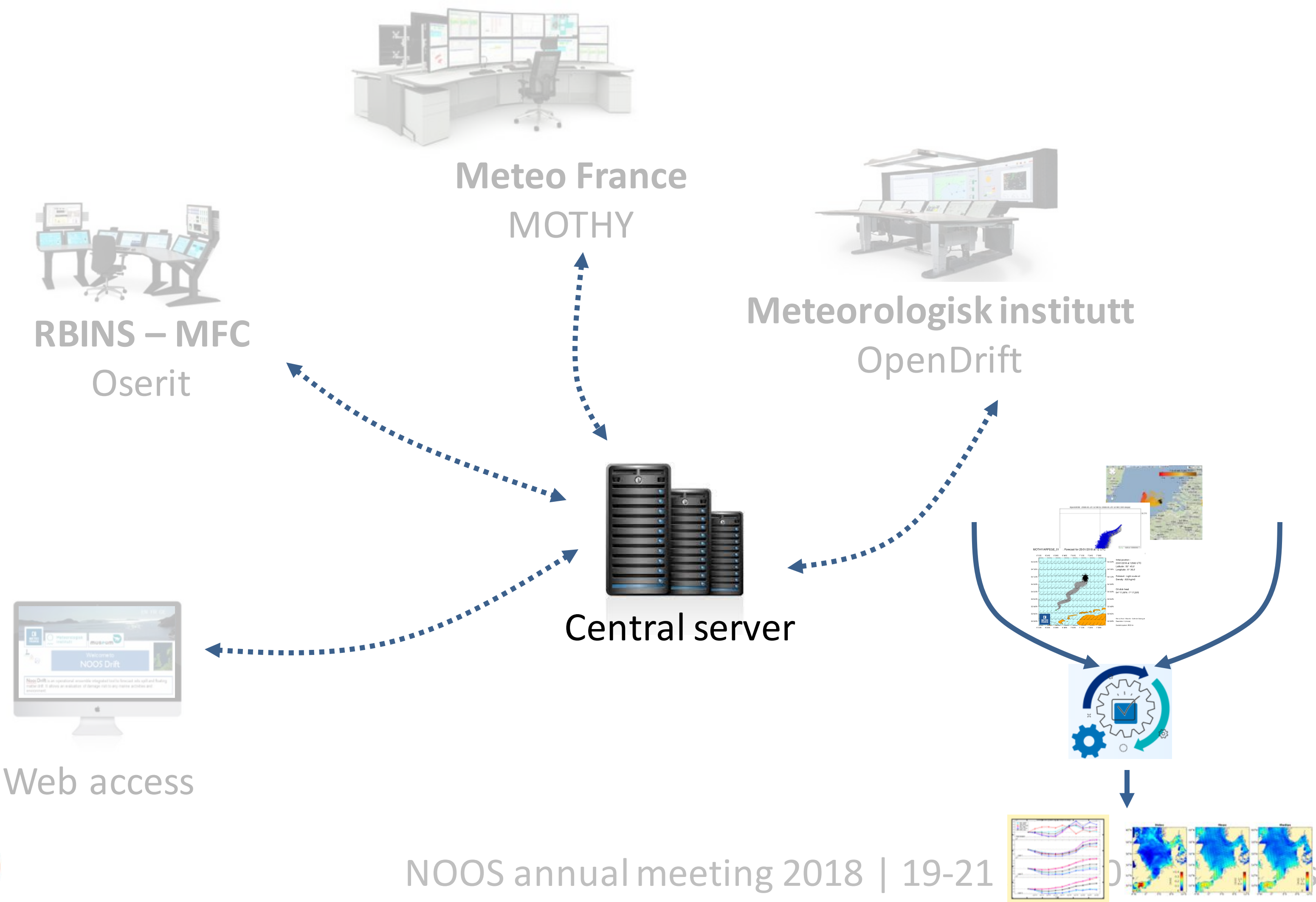
The central server collects the forecasts of the drift models.



Response package:
JSON object for metadata +
netCDF-CF file

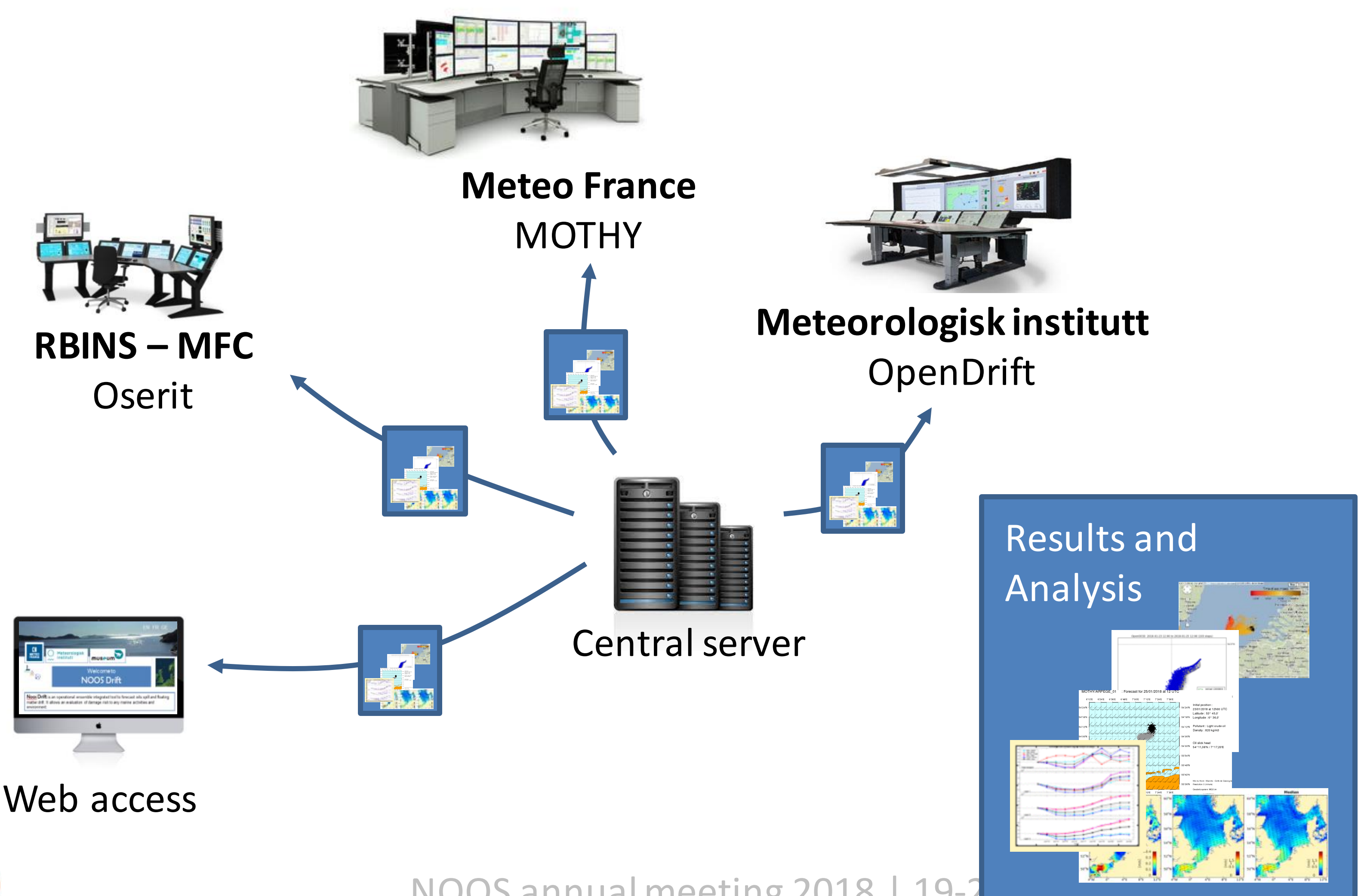
5. Ensemble Analysis

The central server performs an ensemble analysis of the forecasts.



6. Results distribution

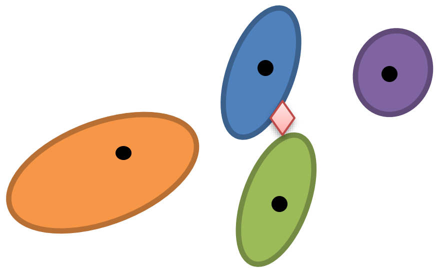
The central server distributes the results and the ensemble analysis to all parties.



Challenges 2,3,4:
Ensemble joint analysis

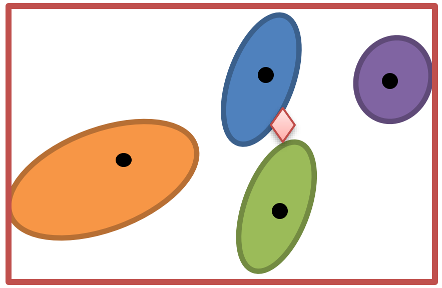
Assessing drift uncertainty?
Identifying outliers?
Quantifying risk?

Good case



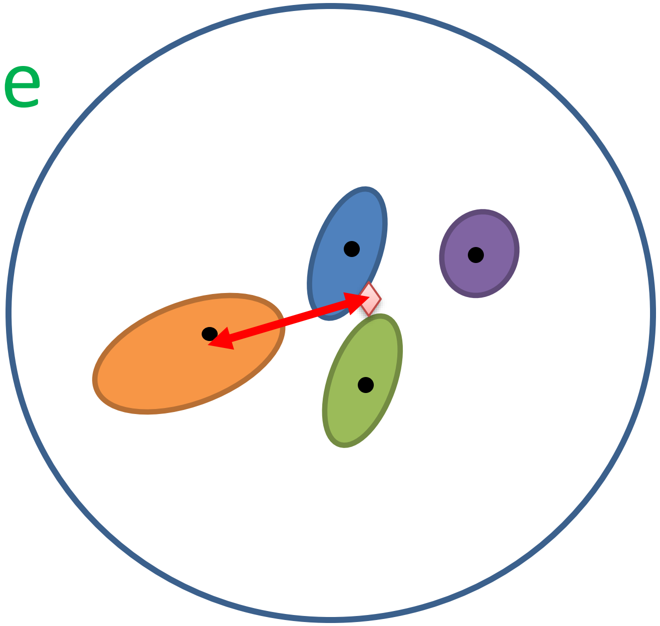
- Center of mass / member •
- Center of mass of all members ◇

Good case



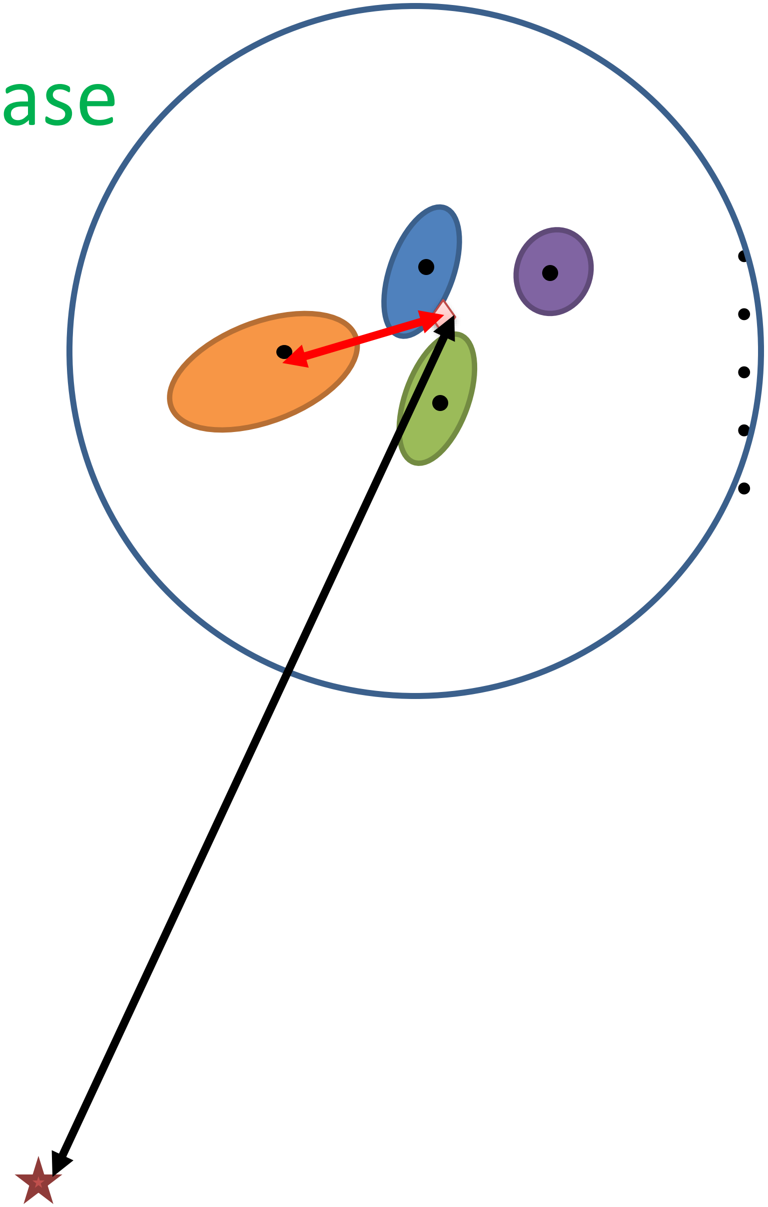
- Center of mass / member •
- Center of mass of all members ◇
- M0 : bounding box method

Good case



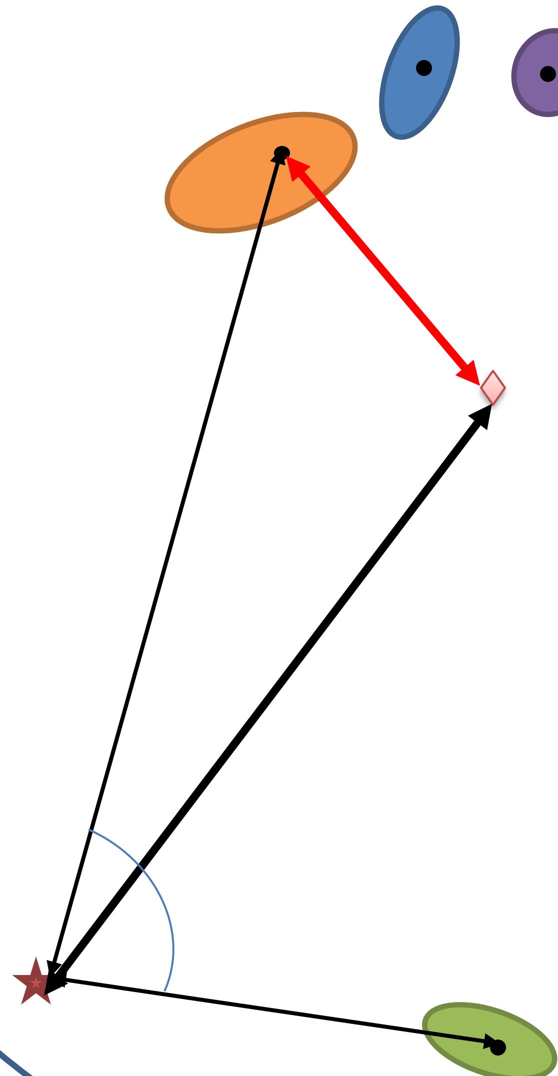
- Center of mass / member •
- Center of mass of all members
- M0 : Bounding box method
- M1 : 3*σ [d(• ,◊)]

Good case



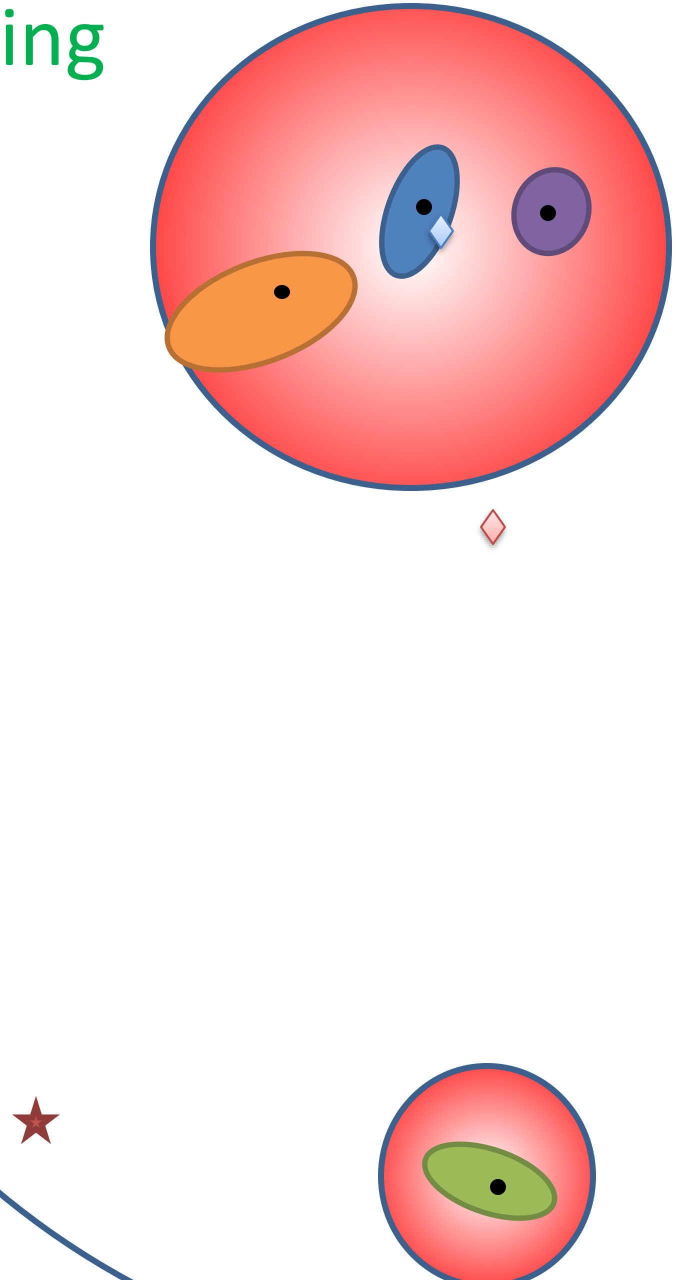
- Center of mass / member •
- Center of mass of all members ◊
- M0 : Bounding box method
- M1 : 3*σ [d(• ,◊)]
- M1' : σ [d(•,◊)] / d(•,★)

Outlier



- Center of mass / member •
- Center of mass of all members ◊
- M0 : Bounding box method
- M1 : 3*σ [d(• ,◊)]
- M1’ : σ [d(•,◊)] / d(◊,★)
- Outlier detection: θ (• ,•) and d (•,•)

Clustering



- Center of mass / member •
- Center of mass of all members ◊
- M0 : Bounding box method
- M1 : 3*σ [d(• ,◊)]
- M1’ : σ [d(•,◊)] / d(◊,★)
- Outlier detection: θ (• ,•) and d (•,•)

- Make the analysis globally and by clusters

- Risk maps by weighted sum of the clusters

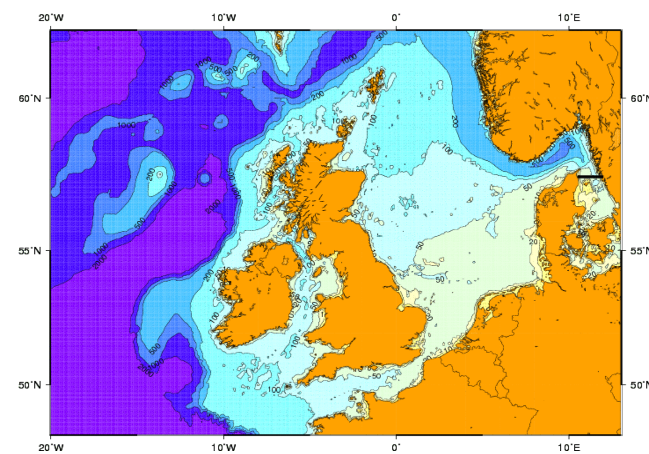
(Likely) NOOS-Drift joint analysis strategy

- **Clustering (n+1)**
- **Likely impacted areas per cluster**
  (mass centers and radius)
- **Risk map**
  (weighted sums of the impacted areas)

Which ensemble?
Which met-ocean forcing?

- At each NOOS-drift activation, All MSP deliver a drift forecast
  - [mandatory] with their standard met-ocean forcing
  - [mandatory] With CMEMS met-ocean forcing for the NWS
  - [optional] with CMEMS met-ocean forcing for Global, IBI and ARCTIC regions

- Added-value:
  - More members in the joint analysis
  - Each MSP have at least one set-up covering the the service domain
  - Possibility to make assess uncertainty inherent to model differences



Take home messages

- NOOS-Drift = A transnational multi-models ensemble system to assess and improve drift forecast accuracy in the NWS area
- After 3 months of work,
  technical agreement reached
- Specifications to be sent to NWGD for information
- It remains one year to really implement, test and validate the system