# REQUEST FOR A SPECIAL PROJECT 2018–2020

**MEMBER STATE:** CROATIA
This form needs to be submitted via the relevant National Meteorological Service.


**Principal Investigator[1]:** Ivica Janekovic

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**Project Title:** PSAS Data Assimilation for the Adriatic Sea using Regional Ocean Modelling System (ROMS)

| | | |
|---|---|---|
| If this is a continuation of an existing project, please state the computer project account assigned previously. | **SP** _____ | |
| Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.) | 2018 | |
| Would you accept support for 1 year only, if necessary? | YES ☒ | NO ☐ |

| **Computer resources required for 2018-2020:** (To make changes to an existing project please submit an amended version of the original form.) | | **2018** | **2019** | **2020** |
|---|---|---|---|---|
| High Performance Computing Facility | (SBU) | 900,000 | 900,000 | 900,000 |
| Accumulated data storage (total archive volume)[2] | (GB) | 4500 | 4500 | 4500 |

***An electronic copy of this form must be sent via e-mail to:*** *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date): 12 June 2017

*Continue overleaf*

1The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.[2] If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year.

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# Extended abstract

Data Assimilation (DA) is currently in the focus of numerical modelling efforts, in the atmosphere and ocean science, developed with many international groups. Benefits of using DA are seen from superior re-analysis (i.e. ECMWF weather reanalysis for past 40 years) to the current weather and ocean forecasts, used by many end-users ranging from scientific projects to every day people's activities. I base my project on the ROMS model which is one of the most common and advanced ocean models nowadays, it is open source, providing written ADJOINT model (inverse model), Tangent Linear version (used as forward model for propagating perturbations in DA) along with standard Non-linear code. Large user community supports the model development and at the same time promise high impact of outcome of this project.

DA is an expensive task from the computing point, we have to integrate the adjoint and tangent linear model many times during the minimisation problem. New computer facilities, as well hardware (new Intel CPUs), compilers, storage, parallel netCDF writing, fast interconnections should boost model's performance. Solving the real-life application system is only possible on architectures like HPC, simply as dimensionality of the system is big. To illustrate the size of the problem when applying it on the Adriatic Sea, we can imagine numerical model grid of spatial resolution of 1km and in vertical with 30 levels which in our case is grid size of 775x269x30, or 6,2 million cells in which we solve for 7 state variables at every minute time step. Model outputs are large netCDF files ~TB where fine tuning of lustre FS or stripping could make a significant difference.

From the application point of view this project will use all existing available observation data at the Adriatic Sea, from many different observation platforms (HF radars, Acoustic Doppler Current Profiler - ADCP data, Temperature and Salinity profiles, Surface temperature of the sea based on Satellite measurements, ARGO buoys, Sea level anomaly from Altimeter Satellites) along with dynamics from solving the model equations at the same time.

Impact studies of each of assimilated platforms to the overall improvement could point into more efficient observation network design in the future. Analysing increments made to the atmosphere could indicate what fields are mainly responsible for model to data miss-match and are possible candidates for improvement.

Typically during the 4 day assimilation cycle I use ~1 million observations. Using mentioned system we can estimate superior ocean state (sea level, currents, temperature, salinity) taking at the same time the best from the observations and model dynamics in a consistent way. Any other research or application relaying on the ocean state variables like currents, temperature etc. could benefit from the results of the project (such as coupling with atmospheric model having corrected surface temperature).