

# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP1	Type of activity <sup>54</sup>	RTD
Work package title	Biochemical processes and feedbacks		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	17		

## Objectives

- To quantitatively assess the magnitude of the feedbacks on the ocean uptake of CO<sub>2</sub> by changes in vertical fluxes of organic carbon, testing new model parameterizations and producing model output that will be used in model-model intercomparison
- To assess the role of lateral fluxes of carbon into the open ocean for variations in air-sea carbon fluxes, integrating models and observations

## Description of work and role of partners

### Description of work

Task 1.1 - Sensitivity of atmospheric carbon to changes in organic matter remineralisation rates and sinking, potential stoichiometry changes as a consequence of changes in CO<sub>2</sub> partial pressure: Changes in the vertical flux attenuation of carbon fluxes are among the stronger feedbacks that had been considered in CARBOOCEAN. Further mechanisms that will be investigated here are: a) changes in the remineralisation of organic matter through the temperature dependence of bacterial activity, b) changes in sinking speeds through changes in ballasting (e.g. through changes in dust deposition or production of calcium carbonate), and c) variable stoichiometry in both production and consumption. A major aim is to quantify the sensitivity of the global carbon flux to these mechanisms better, by also taking into account the interaction between the different feedbacks .

Partners: ETHZürich (remineralisation feedback), CEA(LSCE) (sensitivity of air-sea CO<sub>2</sub> fluxes to changes in organic matter remineralisation depth), UniHB (CFC estimation of remineralisation rates), GEOMAR (calibration of export with TMM and monthly oxygen fields), MPG + VitusLab (temperature dependence on remineralisation), AWI (C:N:Si stoichiometry in export).

Task 1.2 - Sensitivity of oceanic CO<sub>2</sub> and air-sea CO<sub>2</sub> fluxes to changes in vertical carbon flux through changes in plankton community structure: The role of primary and secondary producers for export strength shall be investigated using several sets of observational data (in situ microscopy and flow cytometry counts, HPLC pigments or satellite observations) and results from multiple ocean ecosystem models containing at least two plankton functional types (PFTs).

Partners: ETHZürich, AWI (both: Model runs several phytoplankton types, generation of datasets for validation)

Task 1.3 - Role of organic and inorganic export of carbon from continental margins to the Atlantic Ocean: The continental margins supply organic carbon (OC) and nutrients to the open ocean, which can lead to downstream productivity and respiration changes that influence the air-sea CO<sub>2</sub> balance of the open ocean substantially. The roles of the offshore transport of OC and nutrients on the carbon cycle in the North-West African margin and the Mediterranean outflow will be considered. To this end, combined experimental studies taking advantage of the substantial number of satellite data sets available for the continental margins, and using state-of-the-art coupled high resolution physical / biogeochemical / ecological models configured for the Atlantic and regional models for the North-West African Margin will be applied. The integration of models and observations will lead to better understanding of the feedback strength between offshore transport and open ocean carbon in the Subtropical Atlantic.

Partners: ETHZürich (modelling shelf-open-ocean transfer), ULPGC-INRH (North-West African Margin), CSIC (Mediterranean outflow), CSIR (Atlantic sector of Southern Ocean)

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## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
2	VITUS	2.00
4	CEA	6.00
6	AWI	9.00
8	MPG	3.50
9	UniHB	6.00
12	INRH	2.00
16	CSIC	5.00
17	ULPGC	10.00
19	ETH Zürich	18.00
26	CSIR	0.01
29	GEOMAR	9.00
Total		70.51

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D1.1	D1.1 Sensitivity of air-sea CO <sub>2</sub> fluxes and atmospheric CO <sub>2</sub>	1	8.00	R	PP	24
D1.2	D1.2 Calibration and assessment of particle export and remineralisation	29	8.00	R	PP	24
D1.3	D1.3 Estimation of remineralisation and oxygen consumption rates	9	8.00	R	PP	36
D1.4	D1.4 Validation of ocean ecosystem models	19	7.51	R	PP	36
D1.5	D1.5 Quantification of biological processes (part 1)	6	8.00	R	PP	36
D1.6	D1.6 Quantification of biological processes (part 2)	6	8.00	R	PP	48
D1.7	D1.7 Biogeochemistry in Atlantic related to African upwelling (part 1)	19	8.00	R	PP	24
D1.8	D1.8 Biogeochemistry in Atlantic related to African upwelling (part 2)	19	8.00	R	PP	48
D1.9	D1.9 Report on carbon flux through Strait of Gibraltar (part 1)	16	3.50	R	PP	24
D1.10	D1.10 Report on carbon flux through Strait of Gibraltar (part 2)	16	3.50	R	PP	48
Total			70.51			

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## Description of deliverables

- D1.1) D1.1 Sensitivity of air-sea CO<sub>2</sub> fluxes and atmospheric CO<sub>2</sub>: Global and regional sensitivity of air-sea CO<sub>2</sub> fluxes and atmospheric CO<sub>2</sub> to changes in organic matter remineralisation depth over different time-scales, output for model intercomparison (WP7) (UiB, ETHZürich, CEA, MPG, VitusLab) [month 24]
- D1.2) D1.2 Calibration and assessment of particle export and remineralisation: Calibration and assessment of particle export and remineralisation model parameterisations against observed oxygen distributions (GEOMAR) [month 24]
- D1.3) D1.3 Estimation of remineralisation and oxygen consumption rates: Estimation of remineralisation and oxygen consumption rates in the tropical and South Atlantic using CFC data and changes with respect to historical data (UniHB) [month 36]
- D1.4) D1.4 Validation of ocean ecosystem models: Validation of ocean ecosystem models containing more than two plankton functional types (PFTs) using observational data, output for model-model intercomparison (ETHZürich, AWI) [month 36]
- D1.5) D1.5 Quantification of biological processes (part 1): Quantification of the relation between the biological pump and changes in community composition and quantification of the effect on the vertical distribution of dissolved inorganic carbon and atmospheric CO<sub>2</sub> from model runs (AWI, ETHZürich) [month 36]
- D1.6) D1.6 Quantification of biological processes (part 2): Quantification of the relation between the biological pump and changes in community composition and quantification of the effect on the vertical distribution of dissolved inorganic carbon and atmospheric CO<sub>2</sub> from model runs (AWI, ETHZürich) [month 48]
- D1.7) D1.7 Biogeochemistry in Atlantic related to African upwelling (part 1): Report on biogeochemical processes and changes affecting the carbon sources and sinks in the Atlantic originating from the African upwelling to quantify and define the time variations from seasonal to decadal timescales. (ETHZürich, ULPGC, INRH) [month 24]
- D1.8) D1.8 Biogeochemistry in Atlantic related to African upwelling (part 2): Report on biogeochemical processes and changes affecting the carbon sources and sinks in the Atlantic originating from the African upwelling to quantify and define the time variations from seasonal to decadal timescales. (ETHZürich, ULPGC, INRH) [month 48]
- D1.9) D1.9 Report on carbon flux through Strait of Gibraltar (part 1): Report on the impact of processes affecting the magnitude and variability of CO<sub>2</sub> outflow through the Strait of Gibraltar in the North Atlantic Ocean. (CSIC, INRH) [month 24]
- D1.10) D1.10 Report on carbon flux through Strait of Gibraltar (part 2): Report on the impact of processes affecting the magnitude and variability of CO<sub>2</sub> outflow through the Strait of Gibraltar in the North Atlantic Ocean. (CSIC, INRH) [month 48]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS11	M1.1 Organic matter remineralisation data delivered to WP 7	19	24	
MS12	M1.2 First series of reports on biological pump, time variations and CO <sub>2</sub> outflow submitted	17	24	
MS13	M1.3 Plankton model data submitted to WP7 for model-model intercomparison	6	36	

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## One form per Work Package

Work package number <sup>53</sup>	WP2	Type of activity <sup>54</sup>	RTD
Work package title	Physical processes and feedbacks		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	29		

## Objectives

- To quantitatively assess the feedback on the oceanic uptake of CO<sub>2</sub> by changes in physical processes in the North Atlantic Ocean, including the Arctic Ocean and Nordic Seas, and the Southern Ocean.
- To assess the representation of small-scale processes involved in the feedbacks (e.g. eddies) in carbon-climate models and guide development of improved subgrid-scale parameterisations.

## Description of work and role of partners

T2.1 – Sea ice cover and deep water formation: Quantify the impact of changes in Arctic sea ice cover and deep-water formation on oceanic CO<sub>2</sub> uptake in the Arctic. Observational process studies will be combined with regional process models. (UGOT, NERSC)

T2.2 – Variability of deep-water formation: Assess the impact of changes in deep-water formation, overflow to the North Atlantic, and the meridional overturning on CO<sub>2</sub> uptake in the Atlantic Ocean. Identify dominant modes of variability from observed changes in hydrographic and biogeochemical properties in the North Atlantic and the Nordic Seas (WP1, WP4, WP5). Identify mechanisms driving observed and possible future changes by performing sensitivity experiments with forced ocean models. (UiB, ULPGC, IFREMER)

T2.3 – Variability in air-sea CO<sub>2</sub> flux: Assess the relative importance of the major processes that drive interannual to decadal variability in air-sea CO<sub>2</sub> fluxes in the Atlantic. Provide (WP7) and archive (WP9) high-resolution global coupled biogeochemical-physical model simulation forced by atmospheric reanalysis fields over the last 50 years. Analyse modes of variability and identify mechanisms driving these both in historical observations and in the model simulation. (CEA/LSCE, IFREMER)

T2.4 – Eddies, Southern Ocean: Quantify the impact of Southern Ocean wind-stress changes on the CO<sub>2</sub> uptake of the eddying ocean. Run coupled biogeochemical-physical eddy-resolving Southern-Ocean models and quantify the role of eddies in moderating the response of CO<sub>2</sub> uptake to wind-stress changes. Joint analysis of observational data provided from SOCAT (WP8) CARIOCA buoys and ARGO floats to assess impact of eddies on the uptake and transport of CO<sub>2</sub>. (ETH, GEOMAR, UPMC, CSIR)

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
1	UiB	6.00
3	IFREMER	24.00
4	CEA	10.00
5	UPMC	11.00
14	NERSC	4.30
17	ULPGC	6.00
18	UGOT	10.00
19	ETH Zürich	12.00

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## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
26	CSIR	0.01
29	GEOMAR	10.00
Total		93.31

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D2.1	D2.1 Workshop of modelling and observational groups	29	2.01	O	PP	3
D2.2	D2.2 Report on the feedback of physical processes (part 1)	18	12.00	R	PU	24
D2.3	D2.3 Report on the feedback of physical processes (part 2)	18	10.30	R	PU	40
D2.4	D2.4 Deepwater production and atmospheric CO2	1	11.00	R	PU	48
D2.5	D2.5 Report on physical processes in the Atlantic	3	24.00	R	PU	36
D2.6	D2.6 Session on impact of changes in the Southern Ocean	19	12.00	O	PP	36
D2.7	D2.7 Report on impact of Southern Ocean wind-stress	19	12.00	R	PU	40
D2.8	D2.8 Report on Southern Ocean eddy impacts	5	10.00	R	PU	40
Total			93.31			

## Description of deliverables

D2.1) D2.1 Workshop of modelling and observational groups: Joint Workshop of modelling and observational groups to prioritize process studies (GEOMAR). [month 3]

D2.2) D2.2 Report on the feedback of physical processes (part 1): Reports on the feedback of physical processes (e.g. ice coverage, brine formation, shelf-basin water exchange, vertical mixing and pycnocline depth) on carbon fluxes in the Arctic Ocean (UGOT, NERSC) [month 24]

D2.3) D2.3 Report on the feedback of physical processes (part 2): Reports on the feedback of physical processes (e.g. ice coverage, brine formation, shelf-basin water exchange, vertical mixing and pycnocline depth) on carbon fluxes in the Arctic Ocean (UGOT, NERSC) [month 40]

D2.4) D2.4 Deepwater production and atmospheric CO2: Report on interaction between deepwater production and atmospheric CO2 (UiB, ULPGC) [month 48]

D2.5) D2.5 Report on physical processes in the Atlantic: Report on physical processes that govern observed sea surface and interior CO2 trends in the Atlantic (IFREMER, CEA/LSCE) [month 36]

D2.6) D2.6 Session on impact of changes in the Southern Ocean: Joint session on impact of changes in the Southern Ocean on air-sea CO2 fluxes, 3rd annual meeting (month 36, O, PP), (ETHZürich, GEOMAR, UPMC). [month 36]

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D2.7) D2.7 Report on impact of Southern Ocean wind-stress: Report on impact of Southern Ocean wind-stress changes on CO2 uptake in eddy-resolving models (ETHZürich, GEOMAR) [month 40]

D2.8) D2.8 Report on Southern Ocean eddy impacts: Report on Southern Ocean eddy impacts diagnosed from combined analysis of CARIOCA buoys and ARGO floats (UPMC) [month 40]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS21	M2.1 Archived output of high-res. (1/4 deg) glob. coupl. biogeochem.-phys. model simul., last 50 yr	4	18	

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## One form per Work Package

Work package number <sup>53</sup>	WP3	Type of activity <sup>54</sup>	RTD
Work package title	Future scenarios under different emission curves and vulnerability analysis		
Start month	1		
End month	42		
Lead beneficiary number <sup>55</sup>	4		

## Objectives

- To assess the vulnerability of oceanic carbon sources or sinks with respect to future emission scenarios and associated climate change projections, on different time-scales (from multi-decadal to multi-centennial) through the use of earth system models of variable complexity (ESMs and EMICs).
- To identify the processes responsible for the simulated future changes in carbon sources and sinks and develop methods to determine the probability density distributions of their future evolution.

## Description of work and role of partners

Task 3.1 – Vulnerability of sources and sinks: Simulations of the evolution of oceanic sources and sinks of CO<sub>2</sub> under different IPCC-AR5 scenarios over the next 100 yrs, with at least 5 ESMs (IPSL-CM5, NorESM/BCCR, MPI-M, HadCM3-HadGEM, NCAR-CCSM) and 1 EMIC (Bern3D). The scenarios will be chosen from the IPCC Radiative Concentration Pathways scenarios (RCPs). Different mitigation options (with a focus on green scenarios) will be investigated. Both coupled and uncoupled simulations will be performed to evaluate climate-carbon feedbacks. Output will be provided to WP9 and used in WP7 for model intercomparisons and evaluations (LSCE, MPG, MetO, UiB, UBern).

Task 3.2 - Probabilistic distribution of vulnerability: Simulations with Monte-Carlo type parameter variations / Ensemble simulations to determine probability density distributions of the future evolution of CO<sub>2</sub>, climate and carbon sources and sinks for a range of scenarios and 2 models of different complexity (Bern3D and HadCM3) (MetO, UBern).

Task 3.3 - Stabilization: Long-term simulations (to 2500) using same or fast versions of ESMs (IPSL-CM5, HadCM3) or EMICs (Bern3D) will be performed to investigate long-term changes in the climate-carbon system (stabilization scenarios – collapse of THC – Greenland melting ). Output will be provided to WP9, used in WP7 for model intercomparisons (UBern, MetO, CEA/LSCE).

Task 3.4 – Detectability: Analysis of ESMs (IPSLCM5, NorESM/BCCR, MPG, HadCM3, NCAR-CCSM) simulated decadal variability of CO<sub>2</sub> fluxes in global warming and control simulations will be carried out to assess when climate change impact is unambiguously separable from decadal variability. Forced ocean only simulations (hindcast simulations, 1950-2010, WP7) will be used to compare simulated decadal trends in both coupled and forced simulations with the observed ones. Results from this task will be combined with those from Task 7.5 of WP7 using detection-attribution methods. (LSCE).

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
1	UiB	10.00
4	CEA	17.00
8	MPG	11.00
20	UBERN	16.00
21	MetO	22.00

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## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
	Total	76.00

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D3.1	D3.1 Simulations of carbon sources and sinks	4	30.00	R	RE	6
D3.2	D3.2 Report on vulnerability of carbon sources and sinks	21	10.00	R	RE	12
D3.3	D3.3 Report on feasibility of mitigation scenarios	21	8.00	R	RE	24
D3.4	D3.4 Mechanisms that contribute to carbon source/sink changes	4	8.00	R	RE	18
D3.5	D3.5 Probabilistic carbon sources and sink assessment for the 21st century	20	5.00	R	RE	42
D3.6	D3.6 Long-term simulations	20	10.00	R	RE	36
D3.7	D3.7 Assessment of detection	4	5.00	R	RE	42
		Total	76.00			

## Description of deliverables

D3.1) D3.1 Simulations of carbon sources and sinks: Simulations of carbon sources and sinks under IPCC AR5 scenarios (1860-2100) with ESMs and EMICs (month 6, all partners) [month 6]

D3.2) D3.2 Report on vulnerability of carbon sources and sinks: Report on vulnerability of carbon sources and sinks as a function of model and scenario (month 12, MetO leads, all partners) [month 12]

D3.3) D3.3 Report on feasibility of mitigation scenarios: Report on feasibility of different green scenarios / mitigation options (month 24, MetO leads, all partners) [month 24]

D3.4) D3.4 Mechanisms that contribute to carbon source/sink changes: Report on mechanisms that contribute to simulated changes in carbon sources and sinks (month 18, LSCE and ETHZürich leads, all partners) [month 18]

D3.5) D3.5 Probabilistic carbon sources and sink assessment for the 21st century: Probabilistic carbon sources and sink assessment for the 21st century from a range of sensitivity simulations (Bern 3D and HadCM3) including different parameterisations and an optimally-tuned model version (month 42, UBern and MetO leads) [month 42]

D3.6) D3.6 Long-term simulations: Long-term simulations (to 2500) using same or fast versions of ESMs (IPSL-CM, HadCM3) or EMICS (Bern3D) to investigate long-term changes in the climate-carbon system (month 36, UBern leads, LSCE, MetO) [month 36]

D3.7) D3.7 Assessment of detection: Assessment of when climate impact on carbon fluxes is detectable in the future, for different models and different scenarios (month 42, LSCE leads, all partners). [month 42]



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Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS31	M3.1 Simulations of carbon sources and sinks under IPCC AR5 scenarios (1860-2100) with ESMs & EMICs	4	6	
MS32	M3.2 Long-term simulations performed (2100 to 2500) with a subset of ESMs and EMICs	20	36	
MS33	M3.3 Ensemble simulations / Monte-Carlo simulations with Bern3D / HadCM3 performed	21	42	

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## One form per Work Package

Work package number <sup>53</sup>	WP4	Type of activity <sup>54</sup>	RTD
Work package title	Surface observing system		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	31		

## Objectives

- Set up and evaluate a network of observations to track trends in atmosphere-ocean carbon fluxes in critical regions, and changes in both the natural carbon cycle and the trends due to the penetration of anthropogenic carbon in the ocean. The evaluation will include assessment of the accuracy and precision of analyses, evaluation of the data intercalibration methods and documentation, and standardization where agreed best practice is identified, of the techniques being used by the partners.
- In the North and Tropical Atlantic, support and build on the prototype CARBOOCEAN network: Improve its efficiency of operation by a more co-ordinated approach. Improvements that need to be made are: better co-ordination to avoid data gaps due to the uncertainties of the shipping industry, more traceability in calibration, more accurate atmospheric measurements to be useable in inversion models, and useful in-water oxygen measurements. A co-ordination unit will be initiated to provide this extra level of support.
- In the Southern ocean use repeated transects of research vessels to enable a decadal picture to be built up in the Atlantic and Indian sectors. These large-scale / long-term investigations will be complemented by smaller-scale studies based on drifters' measurements, characterising the variability under-sampled by ship observations.
- In the atmosphere we will undertake high-precision atmospheric observations of CO2 and oxygen / nitrogen to enable us to test the use of regional patterns of atmospheric potential oxygen as an independent method of observing air-sea carbon fluxes over the North Atlantic.

## Description of work and role of partners

Task 4.1: Set up and evaluate an observational network for estimates of the air-sea flux of CO2 (UPMC, GEOMAR, NUIG, UNIRESEARCH, ULPGC, NERC, PML, UEA,).

Task 4.2: Co-ordinate the Atlantic/Southern Ocean observational network, trace gas calibrations, improve sea surface oxygen data, and improve atmospheric measurements on VOS. (UEA, UNEXE).

Task 4.3: Collect surface water CO2 and associated data in the Atlantic. As part of the observing network, 9 ships will be equipped with pCO2 equipment as Voluntary Observing Ships (VOS); additionally, there will be 2 PIRATA moorings in the Tropical Atlantic, equipped with pCO2 sensors. (UPMC, AWI, GEOMAR, NUIG, UNIRESEARCH, ULPGC, NERC, UEA, UNEXE).

Task 4.4: Collect surface water CO2 and associated data in the Southern Ocean, from 3 research vessels: Marion Dufresnes/OISO cruises in the Indian Ocean, FS Polarstern and RRS James Clark Cross in the Atlantic section of the Southern Ocean (UPMC, AWI, PML, CSIR).

Task 4.5: Collect CO2 and O2/N2 data in the atmosphere at Mace Head, Ireland, and Ivittuut, Southern Greenland. (CEA/LSCE), NUIG, UEA).

Task 4.6: Estimate seasonal to interannual variability of the air-sea flux of CO2 on a yearly basis (UPMC, AWI, GEOMAR, NUIG, UNIRESEARCH, ULPGC, NERC, PML, UEA, UNEXE).

Task 4.7: Create a climatology of seasonal sea surface pH for the Atlantic and the Atlantic section of the Southern Ocean (UPMC, GEOMAR, NUIG, UNIRESEARCH, ULPGC, NERC, PML, UNEXE).

Task 4.8: Estimate the effect of high frequency variability as sampled by CARIOCA instruments onto ship based air-sea CO2 flux estimates (UPMC)

Task 4.9: Collaborate with WP8 with quality controlled data (CEA /LSCE, UPMC, AWI, GEOMAR, NUIG, UNIRESEARCH, ULPGC, NERC, PML, UNEXE).

Task 4.10: Assess CO2 air-sea fluxes by atmospheric observations, and compare with in-water techniques (CEA/LSCE, GEOMAR, NUIG, UEA).

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## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
4	CEA	1.00
5	UPMC	35.00
6	AWI	7.00
11	NUIG	5.00
15	UNIRESEARCH	12.00
17	ULPGC	30.00
22	NERC	7.70
23	PML	8.00
25	UEA	24.20
26	CSIR	0.01
28	DU	0.01
29	GEOMAR	8.00
31	UNEXE	18.80
Total		156.72

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D4.1	D4.1 Network set up	25	10.00	R	PU	12
D4.2	D4.2 Report on Co-ordination (part 1)	25	2.00	R	PU	12
D4.3	D4.3 Report on Co-ordination (part 2)	25	2.00	R	PU	24
D4.4	D4.4 Report on Co-ordination (part 3)	31	2.00	R	PU	36
D4.5	D4.5 Report on Co-ordination (part 4)	31	2.00	R	PU	48
D4.6	D4.6 Delivery of Atlantic data (part 1)	25	10.00	R	PP	12
D4.7	D4.7 Delivery of Atlantic data (part 2)	1	10.00	R	PP	24
D4.8	D4.8 Delivery of Atlantic data (part 3)	31	10.00	R	PP	36
D4.9	D4.9 Delivery of Atlantic data (part 4)	31	10.00	R	PP	48
D4.10	D4.10 Delivery of Southern Ocean data (part 1)	25	10.00	R	PP	12
D4.11	D4.11 Delivery of Southern Ocean data (part 2)	25	10.00	R	PP	24
D4.12	D4.12 Delivery of Southern Ocean data (part 3)	31	10.00	R	PP	36
D4.13	D4.13 Delivery of Southern Ocean data (part 4)	1	10.00	R	PP	48

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Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D4.14	D4.14 Delivery of atmospheric data (part 1)	25	9.00	R	PU	12
D4.15	D4.15 Delivery of atmospheric data (part 2)	1	9.00	R	PU	24
D4.16	D4.16 Delivery of atmospheric data (part 3)	25	8.00	R	PU	36
D4.17	D4.17 Delivery of atmospheric data (part 4)	25	8.00	R	PU	48
D4.18	D4.18 Seasonal to interannual variability (part 1)	25	5.00	R	PU	24
D4.19	D4.19 Seasonal to interannual variability (part 2)	31	5.00	R	PU	48
D4.20	D4.20 Report on the effect of high frequency variability	5	5.00	R	PU	48
D4.21	D4.21 Report on climatology of seasonal sea surface pH	31	5.00	R	PU	48
D4.22	D4.22 Assessment of air-sea fluxes by atmospheric observations	4	4.71	R	PU	48
<b>Total</b>			<b>156.71</b>			

## Description of deliverables

- D4.1) D4.1 Network set up: Observational network set up (12, UEA with all participating partners), (R, PU). [month 12]
- D4.2) D4.2 Report on Co-ordination (part 1): Reports on Co-ordination of observational network (12,24,36,48, UEA), (R, PU). [month 12]
- D4.3) D4.3 Report on Co-ordination (part 2): Reports on Co-ordination of observational network (12,24,36,48, UEA), (R, PU). [month 24]
- D4.4) D4.4 Report on Co-ordination (part 3): Reports on Co-ordination of observational network (12,24,36,48, UNEXE, UEA), (R, PU). [month 36]
- D4.5) D4.5 Report on Co-ordination (part 4): Reports on Co-ordination of observational network (12,24,36,48, UNEXE, UEA), (R, PU). [month 48]
- D4.6) D4.6 Delivery of Atlantic data (part 1): Delivery of CO2 and related parameters in the Atlantic to WP9 (12,24,36,48, UEA, GEOMAR, UNIRESEARCH, ULPGC, UPMC), (R, PP). [month 12]
- D4.7) D4.7 Delivery of Atlantic data (part 2): Delivery of CO2 and related parameters in the Atlantic to WP9 (12,24,36,48, UEA, GEOMAR, UNIRESEARCH, ULPGC, UPMC), (R, PP). [month 24]
- D4.8) D4.8 Delivery of Atlantic data (part 3): Delivery of CO2 and related parameters in the Atlantic to WP9 (12,24,36,48, UEA, UNEXE, GEOMAR, UNIRESEARCH, ULPGC, UPMC), (R, PP). [month 36]
- D4.9) D4.9 Delivery of Atlantic data (part 4): Delivery of CO2 and related parameters in the Atlantic to WP9 (12,24,36,48, UNEXE, UEA, GEOMAR, UNIRESEARCH, ULPGC, UPMC), (R, PP). [month 48]
- D4.10) D4.10 Delivery of Southern Ocean data (part 1): Delivery of CO2 and related parameters in the Southern Ocean to WP9 (12,24,36,48, UEA, UPMC, PML), (R, PP). [month 12]

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- D4.11) D4.11 Delivery of Southern Ocean data (part 2): Delivery of CO2 and related parameters in the Southern Ocean to WP9 (12,24,36,48, UEA, UPMC, PML), (R, PP). [month 24]
- D4.12) D4.12 Delivery of Southern Ocean data (part 3): Delivery of CO2 and related parameters in the Southern Ocean to WP9 (12,24,36,48, UNEXE, UEA, UPMC, PML), (R, PP). [month 36]
- D4.13) D4.13 Delivery of Southern Ocean data (part 4): Delivery of CO2 and related parameters in the Southern Ocean to WP9 (12,24,36,48, UEA, UPMC, PML), (R, PP). [month 48]
- D4.14) D4.14 Delivery of atmospheric data (part 1): Delivery of atmospheric CO2 and O2/N2 to WP9 (12,24,36,48, UEA with NUIG, CEA/LSCE) (R, PU). [month 12]
- D4.15) D4.15 Delivery of atmospheric data (part 2): Delivery of atmospheric CO2 and O2/N2 to WP9 (12,24,36,48, UEA with NUIG, CEA/LSCE) (R, PU). [month 24]
- D4.16) D4.16 Delivery of atmospheric data (part 3): Delivery of atmospheric CO2 and O2/N2 to WP9 (12,24,36,48, UEA with NUIG, CEA/LSCE) (R, PU). [month 36]
- D4.17) D4.17 Delivery of atmospheric data (part 4): Delivery of atmospheric CO2 and O2/N2 to WP9 (12,24,36,48, UEA with NUIG, CEA/LSCE) (R, PU). [month 48]
- D4.18) D4.18 Seasonal to interannual variability (part 1): Report on seasonal to interannual variability of the air-sea flux of CO2 (24, 48, UEA, AWI, GEOMAR, NERC, PML, UNIRESEARCH, ULPGC, UPMC), (R, PU)). [month 24]
- D4.19) D4.19 Seasonal to interannual variability (part 2): Report on seasonal to interannual variability of the air-sea flux of CO2 (24, 48, UNEXE, UEA, AWI, GEOMAR, NERC, PML, UNIRESEARCH, ULPGC, UPMC), (R, PU)). [month 48]
- D4.20) D4.20 Report on the effect of high frequency variability: Report on the effect of high frequency variability as observed by CARIOCA instruments onto ship based air-sea CO2 flux estimates (UPMC), (R, PU)) [month 48]
- D4.21) D4.21 Report on climatology of seasonal sea surface pH: Report on climatology of seasonal sea surface pH for the Atlantic and the Atlantic section of the Southern Ocean (48, UNEXE, UEA, GEOMAR, NERC, PML, UNIRESEARCH, ULPGC, UPMC), (R, PU)). [month 48]
- D4.22) D4.22 Assessment of air-sea fluxes by atmospheric observations: Assessment of air-sea fluxes by atmospheric observations, comparison with in-water techniques (48, CEA/LSCE), UEA, NUIG, UPMC), (R, PU) [month 48]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS41	M4.1 Observational network set up	25	12	
MS42	M4.2 Quality-controlled data delivered to WP 9	25	12	
MS43	M4.3 Quality-controlled data delivered to WP 9	25	24	
MS44	M4.4 Quality-controlled data delivered to WP 9	31	36	
MS45	M4.5 Quality-controlled data delivered to WP 9	31	48	
MS46	M4.6 Climatology of seasonal sea surface pH for the Atlantic and the Atl. section of the South. Oc.	31	24	

# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP5	Type of activity <sup>54</sup>	RTD
Work package title	Deep ocean, time series, choke points		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	16		

## Objectives

- Coordinate and conduct time-series and deep section measurements of the vertical structure of ocean carbon. New and existing high-frequency observations (<seasonal) at time series stations and lower-frequency (multi-annual/decadal) hydrographic sections will be used to estimate the variability of (regional budgets of) natural and anthropogenic CO<sub>2</sub> and resolve internal ocean processes affecting the variability of oceanic CO<sub>2</sub> parameters.
- Evaluate the carbon storage and its vulnerability in the interior ocean with respect to anthropogenic changes, oceanic circulation and biogeochemical processes, linked to model outputs and skills.

## Description of work and role of partners

Because circulation and biological changes can vary in response to local or regional climate forcing whose timescales are not yet fully understood, it is critical to determine changes in natural and anthropogenic carbon inventories and ocean acidification and how they interact with changing ocean circulation patterns and biogeochemical cycles. For this it is essential to resolve the sub-surface vertical structure of ocean carbon. Repeat hydrographic sections with carbon and ancillary quantities at defined choke points across the Atlantic Ocean basin provides an effective approach to accurately quantify changes in the world oceans. This includes both decadal-scale repeats and repeat sections with a frequency of 2-3 years in key regions for water mass formation. As a second prong of this work package, time series stations at choking points are necessary for high frequency processes and mechanisms, and are complementary to deep sections.

The approach is to implement repeat sections and ocean time-series stations within the Atlantic Ocean and natural adjacent regions of the Arctic Seas and Southern Ocean. We will carry out repeat sections that will contribute to the long-term observation, i.e. those that have a long history, those at critical sites and those that have a good chance to be continued after the project. Hydrographic sections provide information on changing carbon inventories and can be used for estimating large-scale transports of carbon within the ocean and serve as a benchmark for testing prognostic and predictive models. Time series stations will provide information on seasonal variations of the carbon cycle in the upper layers and will serve as focal points for process studies and high-frequency data sets. In addition to tracing the increase of anthropogenic CO<sub>2</sub> and acidification in the upper ocean, time series stations and repeat sections permit to quantify the downward spreading of the acidifying seawater. Apart from carbon system measurements, also a suite of auxiliary data will be collected including temperature and salinity, nutrients, oxygen, transient tracers, optionally isotopes like <sup>13</sup>C and <sup>14</sup>C. For carbon measurements, community-wide recognized certified reference material, obtained from Prof. A. Dickson (Scripps Institution of Oceanography), will be used to make data intercomparable; this will also be done for other measured quantities, as far as internationally recognized standards are available. Moreover, all collected data will be compared with the data from the synthesis projects GLODAP and CARINA (in which many CarboChange investigators have been heavily involved), which ensures internal consistency of all relevant data, both present and historic.

Task 5.1: Collect oceanic time series data at the 7 predefined time series (Irminger and Iceland Seas, GIFT, ESTOC, TENATSO, PIRATA, PAP) in the Atlantic Ocean and the Nordic Seas in coordination with OceanSites (GEOMAR, AWI, ULPGC, CSIC, MRI-UI, UPMC, NERC)

### Description of work

Because circulation and biological changes can vary in response to local or regional climate forcing whose timescales are not yet fully understood, it is critical to determine changes in natural and anthropogenic carbon

# WT3: Work package description

inventories and ocean acidification and how they interact with changing ocean circulation patterns and biogeochemical cycles. For this it is essential to resolve the sub-surface vertical structure of ocean carbon. Repeat hydrographic sections with carbon and ancillary quantities at defined choke points across the Atlantic Ocean basin provides an effective approach to accurately quantify changes in the world oceans. This includes both decadal-scale repeats and repeat sections with a frequency of 2-3 years in key regions for water mass formation. As a second prong of this work package, time series stations at choking points are necessary for high frequency processes and mechanisms, and are complementary to deep sections.

The approach is to implement repeat sections and ocean time-series stations within the Atlantic Ocean and natural adjacent regions of the Arctic Seas and Southern Ocean. We will carry out repeat sections that will contribute to the long-term observation, i.e. those that have a long history, those at critical sites and those that have a good chance to be continued after the project. Hydrographic sections provide information on changing carbon inventories and can be used for estimating large-scale transports of carbon within the ocean and serve as a benchmark for testing prognostic and predictive models. Time series stations will provide information on seasonal variations of the carbon cycle in the upper layers and will serve as focal points for process studies and high-frequency data sets. In addition to tracing the increase of anthropogenic CO<sub>2</sub> and acidification in the upper ocean, time series stations and repeat sections permit to quantify the downward spreading of the acidifying seawater. Apart from carbon system measurements, also a suite of auxiliary data will be collected including temperature and salinity, nutrients, oxygen, transient tracers, optionally isotopes like <sup>13</sup>C and <sup>14</sup>C. For carbon measurements, community-wide recognized certified reference material, obtained from Prof. A. Dickson (Scripps Institution of Oceanography), will be used to make data intercomparable; this will also be done for other measured quantities, as far as internationally recognized standards are available. Moreover, all collected data will be compared with the data from the synthesis projects GLODAP and CARINA (in which many CarboChange investigators have been heavily involved), which ensures internal consistency of all relevant data, both present and historic.

Task 5.1: Collect oceanic time series data at the 7 predefined time series (Irminger and Iceland Seas, GIFT, ESTOC, TENATSO, PIRATA, PAP) in the Atlantic Ocean and the Nordic Seas in coordination with OceanSites (GEOMAR, AWI, ULPGC, CSIC, MRI-UI, UPMC, NERC)

Task 5.2: Collect CO<sub>2</sub> and associated data along 10 predefined sections (75°N, Arctic, Greenland, OVIDE, Subpolar Atlantic, MOC2 at 8°N, 24°N, 28°N-14-12°W, Southern Ocean Prime Meridian and Weddell Sea, FICARAM South Atlantic, all West Atlantic) in the Atlantic Ocean and adjacent regions (CSIC, AWI, UNIRESEARCH, UGOT, UniHB, UEA, NIOZ, INRH, UPMC)

Task 5.3: Assess the variability of natural and anthropogenic carbon storage and the factors affecting this in critical regions and at choke points: 75°N, Greenland, 8°N, Irminger, Iceland, Labrador, Strait of Gibraltar, Drake Passage, Prime Meridian and Weddell Sea (UniHB, UGOT, UNIRESEARCH, MRI-UI, CSIC, NIOZ, UEA, AWI).

Task 5.4: Assess regional carbon inventories and decadal and interannual changes in these for testing the prognostic and predictive models, in collaboration with Task 8.3 (CSIC, UNIRESEARCH, AWI, UniHB, NIOZ, UEA)

Task 5.5: Determine natural variability of the carbon cycle in the upper ocean using high frequency data from time series stations (GEOMAR, CSIC, ULPGC, MRI-UI, UPMC)

Task 5.6: Assess trends on ocean acidification using data from time series and repeat sections and generate synergies with international projects addressing this topic (ULPGC, CSIC, AWI, MRI-UI, GEOMAR, UEA)

Task 5.7: Contribute quality controlled data to Task 8.3 (AWI, all partners)

Task 5.8: Set first steps to provide a link between the uptake of CO<sub>2</sub> from the atmosphere with the deep-water increase of CO<sub>2</sub>, in collaboration with WP4 (UEA, CSIC, GEOMAR, AWI, UNIRESEARCH, UPMC, NERC)

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
5	UPMC	7.00
6	AWI	27.00
9	UniHB	7.00
10	MRI-UI	7.00
12	INRH	5.00

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## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
13	NIOZ	18.00
15	UNIRESEARCH	8.00
16	CSIC	37.00
17	ULPGC	15.00
18	UGOT	3.00
22	NERC	3.40
25	UEA	4.50
27	PU-AOS	0.01
28	DU	0.01
29	GEOMAR	24.00
	Total	165.92

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D5.1	D5.1 Submission of quality controlled data (part 1)	29	11.00	R	PP	18
D5.2	D5.2 Submission of quality controlled data (part 2)	29	11.00	R	PP	30
D5.3	D5.3 Submission of quality controlled data (part 3)	29	11.00	R	PP	42
D5.4	D5.4 Submission of quality controlled data (part 4)	29	11.00	R	PP	48
D5.5	D5.5 Collection of section data (part 1)	16	16.00	R	PP	18
D5.6	D5.6 Collection of section data (part 2)	16	15.00	R	PP	30
D5.7	D5.7 Collection of section data (part 3)	16	15.00	R	PP	42
D5.8	D5.8 Collection of section data (part 4)	16	15.00	R	PP	48
D5.9	D5.9 Regional carbon inventories	16	10.00	R	PU	40
D5.10	D5.10 Variability of the carbon cycle from time series	29	10.00	R	PU	40
D5.11	D5.11 Trends in ocean acidification	17	10.00	R	PU	36
D5.12	D5.12 Publication on deep storage variability	25	10.00	O	PU	46



# WT3: Work package description

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D5.13	D5.13 Atlantic synthesis papers	25	10.00	O	PU	46
D5.14	D5.14 Constraints for climate/ocean circulation models	6	10.90	R	PU	46
Total			165.90			

## Description of deliverables

- D5.1) D5.1 Submission of quality controlled data (part 1): Submission of quality controlled data to WP9 (GEOMAR, ULPGC, CSIC, MRI-UI, UPMC, NERC) (month 18, 30, 42, 48) (R, PP) [month 18]
- D5.2) D5.2 Submission of quality controlled data (part 2): Submission of quality controlled data to WP9 (GEOMAR, ULPGC, CSIC, MRI-UI, UPMC, NERC) (month 18, 30, 42, 48) (R, PP) [month 30]
- D5.3) D5.3 Submission of quality controlled data (part 3): Submission of quality controlled data to WP9 (GEOMAR, ULPGC, CSIC, MRI-UI, UPMC, NERC) (month 18, 30, 42, 48) (R, PP) [month 42]
- D5.4) D5.4 Submission of quality controlled data (part 4): Submission of quality controlled data to WP9 (GEOMAR, ULPGC, CSIC, MRI-UI, UPMC, NERC) (month 18, 30, 42, 48) (R, PP) [month 48]
- D5.5) D5.5 Collection of section data (part 1): Collection of carbon data for 9 sections and submission to WP9 (month 12, 24, 36, 48) and submission of quality controlled data from time series and deep sections to data centre (CSIC, AWI, UNIRESEARCH, UGOT, UniHB, NIOZ, INRH, UEA) (month 18, 30, 42, 48) (R, PP) [month 18]
- D5.6) D5.6 Collection of section data (part 2): Collection of carbon data for 9 sections and submission to WP9 (month 12, 24, 36, 48) and submission of quality controlled data from time series and deep sections to data centre (CSIC, AWI, UNIRESEARCH, UGOT, UniHB, NIOZ, INRH, UEA) (month 18, 30, 42, 48) (R, PP) [month 30]
- D5.7) D5.7 Collection of section data (part 3): Collection of carbon data for 9 sections and submission to WP9 (month 12, 24, 36, 48) and submission of quality controlled data from time series and deep sections to data centre (CSIC, AWI, UNIRESEARCH, UGOT, UniHB, NIOZ, INRH, UEA) (month 18, 30, 42, 48) (R, PP) [month 42]
- D5.8) D5.8 Collection of section data (part 4): Collection of carbon data for 9 sections and submission to WP9 (month 12, 24, 36, 48) and submission of quality controlled data from time series and deep sections to data centre (CSIC, AWI, UNIRESEARCH, UGOT, UniHB, NIOZ, INRH, UEA) (month 18, 30, 42, 48) (R, PP) [month 48]
- D5.9) D5.9 Regional carbon inventories: Report on regional carbon inventories and their decadal changes (CSIC, UNIRESEARCH, AWI, UniHB, NIOZ, UEA) (month 40) (R, PU) [month 40]
- D5.10) D5.10 Variability of the carbon cycle from time series: Report on the variability of the carbon cycle in the upper ocean using data from time series stations (GEOMAR, CSIC, ULPGC, MRI-UI, UPMC) (month 40) [month 40]
- D5.11) D5.11 Trends in ocean acidification: Report on trends in ocean acidification in different regions of the Atlantic Ocean (ULPGC, CSIC, AWI, MRI-UI, GEOMAR, UEA) (month 36) (R, PU) [month 36]
- D5.12) D5.12 Publication on deep storage variability: Publication in the peer-reviewed international literature on the regional and basin-wide variability of deep carbon storage (UEA, CSIC, AWI, UniHB, UNIRESEARCH, UGOT, MRI-UI, NIOZ, INRH) (month 46) (O, PU) [month 46]
- D5.13) D5.13 Atlantic synthesis papers: Synthesis papers for the Atlantic Ocean and for adjacent regions (in collaboration with WP8) [month 46]

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D5.14) D5.14 Constraints for climate/ocean circulation models: With the deep section and time series network, deliver constraints for climate/ocean circulation models (all Tasks) in connection with the model-data-comparison group (WP7) (all partners) (month 46) [month 46]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS51	M5.1 Quality-controlled data submitted to WP 9	6	18	
MS52	M5.2 Quality-controlled data submitted to WP 9	6	30	
MS53	M5.3 Quality-controlled data submitted to WP 9	6	42	
MS54	M5.4 Quality-controlled data submitted to WP 9	6	48	
MS55	M5.5 Synthesis paper for Atlantic ocean and adjacent regions submitted	6	48	

# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP6	Type of activity <sup>54</sup>	RTD
Work package title	Systematic model calibration using observational data		
Start month	1		
End month	36		
Lead beneficiary number <sup>55</sup>	14		

## Objectives

- To integrate the ocean carbon models with observations available from WP4 (surface), WP5 (interior, time series) and WP8 (synthesis) and calibrate the biogeochemical parameters for accurate reconstruction of carbon and related tracers on different time scales. Advanced stand-alone models and a coupled terrestrial-ocean model will be used over decadal time scales, EMICs over centennial time scales and stationary transport matrices for millennial time scales. The validation metrics defined in WP7 at Mo 12 will be implemented in each of the 3D models used in WP6 to demonstrate the benefits of calibration.
- To provide the calibrated models for reconstructions (hindcasts) for the synthesised assessment in WP8 and for synthesis activities beyond the IPCC AR5 time frame.,

## Description of work and role of partners

Task 6.1 - Calibration of biogeochemical parameters in a stand alone isopycnic ocean on interannual time scale: An EnKF system is set up around the coupled MICOM-HAMOCC model and applied for calibration of the main physical and biological parameters with focus on interannual variability over a recent four-year period using observations from WP4. The calibrated model is then integrated within the Earth system model NorESM for climate projections. (NERSC, UiB)

Task 6.2 - Calibration of biogeochemical process parameters in a stand alone ocean and simultaneously with terrestrial biosphere model on decadal time scale: Build and operate a variational assimilation system around the BGC version of the MITgcm (MITBOGCM) to systematically calibrate the biogeochemical process parameters using a range of oceanic observations plus a system that can calibrate the ocean model simultaneously with the terrestrial biosphere model BETHY by using observed atmospheric concentrations (in addition to the oceanic observations). The calibrated ocean model can be used for long simulations within the MITEMIC(UiB, AWI).

Task 6.3 - EMIC calibration for improved predictability and constrained biogeochemical fluxes: An EnKF System is set up around the Bern3D model and applied for calibration of physical and biogeochemical process parameters (further used in WP3) and to constrain fluxes of potential alkalinity and carbon. Use of temperature, salinity, CFCs, radiocarbon, carbon, nutrient and alkalinity data (UBern).

Task 6.4 - Calibration of process parameters in a set of stand alone biogeochemical models for circulation fields from a range of IPCC models on millennial time scale: To speed up the simulation, the circulations (including those from MIT, NCAR, NEMO, GFDL) will be approximated by transport matrices resulting in a seasonally cycling stationary solution that is fit will be fit to measured alkalinity, nutrient and oxygen distributions and estimated pre-industrial dissolved inorganic carbon (GEOMAR).

Task 6.5 - Calibration of biogeochemical process parameters in a one dimensional version of a stand alone model: Variational calibration of the PISCES biogeochemistry model with biogeochemical observations from individual sites and satellite products (CLIMMOD).

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
4	CEA	6.00
6	AWI	15.00

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## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
14	NERSC	17.00
20	UBERN	19.00
24	UNIVBRIS	19.00
29	GEOMAR	16.00
30	CLIMMOD	1.50
Total		93.50

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D6.1	D6.1 Calibrated version of MICOM-HAMOCC	14	11.00	R	PU	24
D6.2	D6.2 Report on constrained CaCO <sub>3</sub> dissolution fluxes (Bern3D)	20	19.00	R	PU	30
D6.3	D6.3 Report on calibrated versions of MITBOGCM	24	34.00	R	PU	36
D6.4	D6.4 Report on assimilation (MICOM-HAMOCC)	14	6.00	R	PU	36
D6.5	D6.5 Report on parameter optimisation (PISCES)	30	23.50	R	PU	36
Total			93.50			

## Description of deliverables

D6.1) D6.1 Calibrated version of MICOM-HAMOCC: Calibrated version of stand alone MICOM-HAMOCC after 5-years assimilation run for WP3 (month 24, P, PU), (NERSC) [month 24]

D6.2) D6.2 Report on constrained CaCO<sub>3</sub> dissolution fluxes (Bern3D): Report on constrained CaCO<sub>3</sub> dissolution fluxes and implications for carbon sources and sinks as simulated by Bern3D model (month 30, R, PU), (UBern) [month 30]

D6.3) D6.3 Report on calibrated versions of MITBOGCM: Report on calibrated versions of MITBOGCM stand alone and with terrestrial biosphere (month 36, R, PU), (UNIVBRIS) [month 36]

D6.4) D6.4 Report on assimilation (MICOM-HAMOCC): Report on assimilation vs. control run MICOM-HAMOCC (month 36, R, PU), (NERSC) [month 36]

D6.5) D6.5 Report on parameter optimisation (PISCES): Report on optimised parameter values for the PISCES model (month 36; R), (PU) [month 36]

# WT3: Work package description

Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS61	M6.1 EnKF Assimilation implemented in MICOM-HAMOCC	14	12	
MS62	M6.2 EnKF system around Bern3D model implemented	20	12	
MS63	M6.3 Systems for calibration of MITBOGCM stand alone and with terrestrial biosphere implemented	24	28	

# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP7	Type of activity <sup>54</sup>	RTD
Work package title	Data-model and model-model comparison		
Start month	1		
End month	36		
Lead beneficiary number <sup>55</sup>	29		

## Objectives

- To compare data-based estimates concerning ocean carbon and related tracers to simulated results from ocean carbon cycle models, both in forced mode (50-year hindcasts) and in coupled mode (part of Earth System Models).
- To develop regional data metrics and use them to evaluate and weigh these models to provide optimal estimates for the changing ocean carbon sink (preindustrial through modern to 2100 and beyond) and carbon-climate feedbacks.

## Description of work and role of partners

Task 7.1 – Global comparison and evaluation: Compare models, including those focused on interannual-to-decadal variability (forced hindcast models in WP2, WP8) and those focused on future change (Earth System Models in WP3) using their output in the project archive (WP9), to one another and to the most up-to-date relevant ocean carbon-related data. Data references will include time series and global databases for surface pCO<sub>2</sub> (SOCAT) and derived air-sea CO<sub>2</sub> fluxes, interior ocean DIC and alkalinity (GLODAP and CARINA), O<sub>2</sub>, nutrients, CFCs, radiocarbon, temperature, and salinity. Model intercomparison will be extended to also include the international group of IPCC AR5 Earth System Models (CMIP5) and the international group of forced ocean models making hindcast simulations as part of the Marine Ecosystem Model Intercomparison project (MAREMIP) (LSCE, GEOMAR, UBern, ETHZürich, UEA, UPMC, UiB, NERSC, MetO, MPG, AWI).

Task 7.2 – Performance indices: Develop quantitative data-based performance indices (metrics) to assess model skill; combine these metrics to provide a weighted-mean “best” assessment for projected changes (UBern, ETHZurich, CEA/LSCE, UPMC, GEOMAR).

Task 7.3 – Links across timescales: Assess correlations between performance indices on different time scales (mean state, seasonal variability, and interannual-to-decadal variability) across the model spectrum to assess how useful it is to use them to weigh future projections (CEA/LSCE).

Task 7.4 – Feedbacks: Assess carbon-climate feedbacks at the regional scale across the range of Earth system models, constrain feedbacks with data, and quantify how these carbon-climate feedbacks compare with cloud feedbacks (UBern, CEA/LSCE).

Task 7.5 – Attribution: Quantify contribution of climate change to recent changes in observed carbon-cycle variables using fingerprints of climate change and climate variability from the forced hindcast model outputs and detection-attribution methods Results from this task will be combined with those from Task 3.4 of WP3 using Earth system models. (UEA)

Task 7.6 – Deep-ocean evaluation: Apply efficient Transport Matrix Method (TMM) to bypass intensive computational resources needed to evaluate the natural mean state. Use TMM to evaluate the mean state for natural radiocarbon, DIC, and alkalinity (GEOMAR)

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
1	UiB	1.00
4	CEA	24.00

# WT3: Work package description

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
5	UPMC	21.00
6	AWI	2.00
8	MPG	1.00
14	NERSC	0.50
19	ETH Zürich	18.00
20	UBERN	21.00
21	MetO	2.00
25	UEA	14.00
26	CSIR	0.01
29	GEOMAR	21.00
Total		125.51

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D7.1	D7.1 Report on first comparisons	4	40.00	R	PU	12
D7.2	D7.2 Workshop on new metrics	19	10.00	O	PU	12
D7.3	D7.3 Evaluation with C-14	29	15.00	R	PU	24
D7.4	D7.4 Workshop on methods to weigh models	20	10.00	O	PU	24
D7.5	D7.5 Report on metrics	4	25.00	R	PU	30
D7.6	D7.6 Report on Detection-Attribution	25	10.50	R	PU	36
D7.7	D7.7 Session on weighted optimal estimates	20	15.00	O	PU	36
Total			125.50			

## Description of deliverables

D7.1) D7.1 Report on first comparisons: Report on 1st model-model & model-data comparisons (month 12, CEA/LSCE leads, all partners contribute) (R, PU) [month 12]

D7.2) D7.2 Workshop on new metrics: Workshop on new metrics and data-model evaluation (month 12, ETHZürich leads; all partners contribute) (O, PU) [month 12]

D7.3) D7.3 Evaluation with C-14: Presentation on deep-ocean evaluation of forced models with natural C-14 (month 24, GEOMAR, CEA/LSCE) (R, PU) [month 24]

D7.4) D7.4 Workshop on methods to weigh models: Workshop on methods to weigh models and constrain feedbacks (month 24, UBern leads; all partners contribute) (O, PU) [month 24]

D7.5) D7.5 Report on metrics: Report on "Metrics across time scales" (month 30, CEA/LSCE leads, all partners contribute) [month 30]

# WT3: Work package description

D7.6) D7.6 Report on Detection-Attribution: Report on Detection-Attribution of fingerprints of climate change on observed ocean carbon cycle (month 36, UEA) [month 36]

D7.7) D7.7 Session on weighted optimal estimates: Session on weighted optimal estimates and feedbacks at 3rd annual meeting (month 36, UBern, ETHZürich, CEA/LSCE lead; other partners contribute) [month 36]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS71	M7.1 Protocol distributed to model groups to make 1-timestep dye simulations for TMM evaluations	29	6	
MS72	M7.2 Model output fr. interann. variability simulations (forced ocean-model hindcasts) subm. to WP9	6	12	
MS73	M7.3 Model output fr. future climate-change simulations (ESMs und. IPCC AR5 scenarios) subm. to WP9	4	12	
MS74	M7.4 Output from dye simulations in set of forced ocean models made available to GEOMAR	29	12	
MS75	M7.5 Detection-attribution analysis of patterns underway with existing model output completed	25	18	
MS76	M7.6 Begin analysis of cross-timescale, data metric-correlations	4	18	
MS77	M7.7 Results from TMM simulations for natural C14 made available to WP9 for archiving	29	18	
MS78	M7.8 Output from models with data assimilation submitted to WP9 archive	1	24	



# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP8	Type of activity <sup>54</sup>	RTD
Work package title	Global synthesis and outreach to policy makers		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	25		

## Objectives

- Produce high level synthesized products on an annual basis that provide key information on the uptake of CO<sub>2</sub> by the ocean at the regional and global level and on the regional drivers of change.
- Synthesize information on the state of the ocean carbon cycle.
- Synthesize information on the vulnerability of the oceanic CO<sub>2</sub> sink.

## Description of work and role of partners

WP8 will synthesize the information produced within CARBOCHANGE, combine it with existing data and provide synthesis products that can be used in international assessments such as the 5th IPCC Assessment Report and by the annual CO<sub>2</sub> budgets of the Global Carbon Project. We will produce four types of products: (Task 1) annual CO<sub>2</sub> budgets for the global and regional ocean, (Task 2) biennial updates of surface ocean fCO<sub>2</sub> observations, (Task 3) global atlas of key carbonate variables for the oceans, (Task 4) synthesis reports and papers in outreach journals.

Task 8.1 - Prepare annual releases of air-sea CO<sub>2</sub> fluxes for the global ocean and by basin: These releases will be based on the average of several model simulations forced by increasing atmospheric CO<sub>2</sub> and changes in climate (3 from CARBOCHANGE groups plus at least 2 from US groups). The releases will include an estimate of additional uncertainty caused by model spread, and of the confidence level based on the model spread and on the observed regional air-sea CO<sub>2</sub> fluxes (in co-ordination with Task 2 and WP4). The releases will include associated press material, pictures, and a web summary for a lay audience. (UEA, UiB, LSCE)

Task 8.2 – Release of the Surface ocean CO<sub>2</sub> atlas: Second level quality control and release of the Surface Ocean CO<sub>2</sub> Atlas (SOCAT) and of a gridded product every two years (in co-ordination with Task 1 and WP4 and WP9). The work will be carried out according to approved SOCAT routines (see SOCAT cookbook and SOCAT input database documentation on <http://www.socat.info/>). Analyse observations to validate the model estimates and provide a confidence level based on the terminology developed by the IPCC. (UEA, UPCM)

Task 8.3 - Merge the GLODAP and CARINA datasets into a unified, consistent dataset: This task requires reassessing the adjustments applied to the GLODAP dataset in the Atlantic and Southern Oceans to ensure full compatibility with the CARINA dataset. Further expand this global database by inclusion of new data from the post CARINA era (after 2004), quality controlled using tools developed during CARBOOCEAN (Tanhua, T., et al., 2010. Quality control procedures and methods of the CARINA database, Earth System Science Data, 2, 35-49). Create a 3-dimensional (3D) atlas of ocean DIC, TA, pH and CaCO<sub>3</sub> saturation. The database and atlas will serve to assess ocean carbon cycle variability and to evaluate the performance of ocean models in collaboration with WP5 and WP6. Extend and apply the AWI global adjoint model for the quantification of monthly CO<sub>2</sub> air-sea fluxes, carbon export fluxes and 3D carbon transport in the water column by assimilation of the SOCAT fCO<sub>2</sub> data, the merged and expanded GLODAP-CARINA water column data, other data from the World Ocean Database, and remote sensing data (SeaWiFS and MODIS chlorophyll). (UNIRESEARCH, GEOMAR, AWI, PU-AOS)

Task 8.4 – Report on vulnerability of the oceanic CO<sub>2</sub> sink: Write a report on the vulnerability of the oceanic CO<sub>2</sub> sink in collaboration with WP3, and at least three outreach papers on topics centered around high latitude CO<sub>2</sub> fluxes, monitoring surface ocean CO<sub>2</sub> in the long-term, and the oceanic CO<sub>2</sub> sink and climate change. (LSCE, UGOT, UEA, UiB)

# WT3: Work package description

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
1	UiB	7.00
4	CEA	3.00
5	UPMC	3.00
6	AWI	11.00
15	UNIRESEARCH	8.00
18	UGOT	1.00
25	UEA	16.00
27	PU-AOS	0.01
28	DU	0.01
29	GEOMAR	3.00
Total		52.02

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D8.1	D8.1 Annual estimates of oceanic CO2 sinks (part 1)	25	4.00	R	PP	8
D8.2	D8.2 Annual estimates of oceanic CO2 sinks (part 2)	25	4.00	R	PP	20
D8.3	D8.3 Annual estimates of oceanic CO2 sinks (part 3)	25	4.00	R	PP	32
D8.4	D8.4 Annual estimates of oceanic CO2 sinks (part 4)	25	4.00	R	PP	44
D8.5	D8.5 SOCAT update no. 1	25	4.00	R	PP	20
D8.6	D8.6 SOCAT update no. 2	25	4.00	R	PP	44
D8.7	D8.7 Unified CARINA-GLODAP dataset	15	6.00	O	RE	24
D8.8	D8.8 Atlas of carbonate variables	6	6.00	O	PP	36
D8.9	D8.9 Atlas for near present conditions	25	6.00	O	PP	36
D8.10	D8.10 Report on vulnerability	4	5.00	R	PU	36
D8.11	D8.11 Summarising outreach paper	25	5.00	O	PU	48
Total			52.00			

## Description of deliverables

D8.1) D8.1 Annual estimates of oceanic CO2 sinks (part 1): Annual estimates of the global and regional oceanic CO2 sinks including the uncertainty, driving processes, and confidence level from observations (months 8, 20, 32, 44) [month 8]

# WT3: Work package description

D8.2) D8.2 Annual estimates of oceanic CO<sub>2</sub> sinks (part 2): Annual estimates of the global and regional oceanic CO<sub>2</sub> sinks including the uncertainty, driving processes, and confidence level from observations (months 8, 20, 32, 44) [month 20]

D8.3) D8.3 Annual estimates of oceanic CO<sub>2</sub> sinks (part 3): Annual estimates of the global and regional oceanic CO<sub>2</sub> sinks including the uncertainty, driving processes, and confidence level from observations (months 8, 20, 32, 44) [month 32]

D8.4) D8.4 Annual estimates of oceanic CO<sub>2</sub> sinks (part 4): Annual estimates of the global and regional oceanic CO<sub>2</sub> sinks including the uncertainty, driving processes, and confidence level from observations (months 8, 20, 32, 44) [month 44]

D8.5) D8.5 SOCAT update no. 1: Biennial releases of the SOCAT updated database and gridded product (months 20 and 44) [month 20]

D8.6) D8.6 SOCAT update no. 2: Biennial releases of the SOCAT updated database and gridded product (months 20 and 44) [month 44]

D8.7) D8.7 Unified CARINA-GLODAP dataset: Unified and fully consistent CARINA and GLODAP dataset, including new available data (month 24) [month 24]

D8.8) D8.8 Atlas of carbonate variables: Atlas of carbonate variables for 3D fields of annual mean DIC, TA, pH and CaCO<sub>3</sub> saturation states in the water column (month 36) [month 36]

D8.9) D8.9 Atlas for near present conditions: Atlas for near present conditions for monthly air-sea CO<sub>2</sub> fluxes, carbon transports and sinking flux of particulate organic carbon (POC) and CaCO<sub>3</sub> (month 36) [month 36]

D8.10) D8.10 Report on vulnerability: Report on the vulnerability of the oceanic CO<sub>2</sub> sink (month 36) [month 36]

D8.11) D8.11 Summarising outreach paper: Summarising outreach paper on oceanic CO<sub>2</sub> fluxes (months 48) [month 48]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS81	M8.1 SOCAT updated database released	15	20	
MS82	M8.2 SOCAT updated database released	15	44	
MS83	M8.3 CARINA and GLODAP dataset unified and updated	29	24	
MS84	M8.4 Atlas for carbonate variables for near-present conditions released	29	36	

# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP9	Type of activity <sup>54</sup>	RTD
Work package title	Data and information management		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	1		

## Objectives

Providing

- continuous data management
- continues data management for model output
- continuous information management
- continuous technical and organizational data management infrastructure for observational data
- software for efficient use with large datasets
- yearly updates for the SOCAT (Surface Ocean CO2 Atlas) input database

## Description of work and role of partners

Task 9.1 - Observational data management implies (UiB):

- data actions: rescue; acquisition; harmonization; assimilation; formatting; processing; archival; integration; quality control; attribution to PI; documentation; sharing; online access; long term preservation; synthesis; dissemination; visualization. Providing existing multidisciplinary data sets (e.g., WOCE, GLODAP, CARINA, etc.)  
 - management components: networking among the scientific and database partners; according to international standards and protocols (ISO, SOAP, WSDL, XML); structuring and organizing data flow between and among core themes, WPs, data centers, etc.; data exchange between national (eg NFR funded Merclim and CarbonHeat; DFG funded SOPRAN PHASE II) and EC funded projects (eg EU FP7 IP EPOCA) according to intellectual property rights as stated in the CARBOCHANGE data policy; timely data exchange and collaboration with international partners/projects is strongly encouraged; feeding metadata and data streams into international programs (eg. GEO, GEOSS and GMES; NASA's GCMD) as encouraged by FP7 COCOS; providing access (according to intellectual property rights) to all CARBOCHANGE data (observed and modelled data) while elaborating a comprehensive short term (data rescue) and long term (data preservation) data management plan; providing an appropriate data policy with respect to ESF and ICSU/CODATA "Good scientific practice in research" 1,2, the WIPO copyright treaty 3, and the DOE-NIH Guidelines for Sharing Data and Resources 4 organizing and participating to regular data and information management meetings.

Task 9.2- Model output data management comprises (CEA/LSCE):

- expand model-output archive used in the CARBOOCEAN & EPOCA projects (4 ESM) to accommodate new and updated ESMs and hindcast simulations with forced ocean models (from WPs 2, 3, 8, 9) following OCMIP4, C4MIP, and CMIP5.

Task 9.3 - Information management (UiB):

- sophisticated communication modules to guarantee efficient and smooth flow of information: creating a project name Information Service Center (UiB, WDC-MARE); supplying a pivotal communication platform (communication server, document server, electronic mailing lists, web sites, data portal, etc.); providing access to the international alliance WDC/ICSU (WDC Cluster) ; developing and maintaining the central www based project portal to all stakeholders; elaborate user interfaces scalable for different stakeholders; develop and maintain links to groups with complementary/overlapping scientific interest/issues and/or institutional overlap: FP7 EPOCA, COCOS; ICOS; SCOR/IGBP IMBER, SOLAS; UNESCO-IOC IOCCP; GCP; LOICZ; national ocean acidification projects; etc.

Task 9.4 - Technical and organizational data management infrastructure for observational data comprises (UniHB):

# WT3: Work package description

- data storage and access; hardware and services for long term archival, distribution, citable publication via DOI (Digital Object Identifier); establishing a metadata and data information system (data portal); retrieval via data warehouse and data portal technology

Task 9.5- Assistance in creating datasets and software optimization comprises (AWI):

- assist in the creation of surface ocean and water column carbon datasets that will be used for model assimilation and validation. Provide enhanced versions of the enhancement the Ocean data View (ODV) Software

Task 9.6 - Updates of the SOCAT input database comprises (UiB):

- acquisition, harmonization, recalculation, formatting, documentation, primary quality control and inclusion of public underway data on a global scale; updating of already existing cruises; merging new and updated cruises with older versions of the SOCAT input database on a yearly basis; joint dissemination of SOCAT in collaboration with WP8 after performed secondary QC (see WP8 Task 2)

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
1	UiB	18.00
4	CEA	9.00
6	AWI	5.00
9	UniHB	4.00
27	PU-AOS	0.01
Total		36.01

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D9.1	D9.1 Data management implementation plan	1	0.20	O	RE	1
D9.2	D9.2 First version of CARBOCHANGE data portal	9	4.00	O	RE	3
D9.3	D9.3 Update of the SOCAT input database	1	6.00	O	RE	12
D9.4	D9.4 First update of model output database	4	3.00	O	RE	12
D9.5	D9.5 Databases of observational data and selected model data (part 1)	1	4.45	O	RE	6
D9.6	D9.6 Databases of observational data and selected model data (part 2)	1	4.45	O	RE	12
D9.7	D9.7 Databases of observational data and selected model data (part 3)	1	4.45	O	RE	24
D9.8	D9.8 Databases of observational data and selected model data (part 4)	1	4.45	O	RE	36
D9.9	D9.9 Ocean Data View optimisation	6	5.00	O	RE	18
Total			36.00			

# WT3: Work package description

## Description of deliverables

- D9.1) D9.1 Data management implementation plan: Data and information management implementation plan (short/long term); data policy; presented during kick-off meeting (UiB; Month 1) (O, RE) [month 1]
- D9.2) D9.2 First version of CARBOCHANGE data portal: First version of CARBOCHANGE data portal ("web services" via standard interfaces linking all metadata and data inventories engaged) (UiB; Month 3) (O, RE) [month 3]
- D9.3) D9.3 Update of the SOCAT input database: Update of the SOCAT input database (UiB; Month 12) (O, RE) [month 12]
- D9.4) D9.4 First update of model output database: First update of model output database made available to partners (CEA/LSCE; Month 12) (O, RE) [month 12]
- D9.5) D9.5 Databases of observational data and selected model data (part 1): Databases of observational data; databases of selected model data (UiB; LSCE, continuously updated, Month 6, 12, 24, 36) (O, RE) [month 6]
- D9.6) D9.6 Databases of observational data and selected model data (part 2): Databases of observational data; databases of selected model data (UiB; LSCE, continuously updated, Month 6, 12, 24, 36) (O, RE) [month 12]
- D9.7) D9.7 Databases of observational data and selected model data (part 3): Databases of observational data; databases of selected model data (UiB; LSCE, continuously updated, Month 6, 12, 24, 36) (O, RE) [month 24]
- D9.8) D9.8 Databases of observational data and selected model data (part 4): Databases of observational data; databases of selected model data (UiB; LSCE, continuously updated, Month 6, 12, 24, 36) (O, RE) [month 36]
- D9.9) D9.9 Ocean Data View optimisation: Ocean Data View Software optimised for large data products (AWI; continuously updated, Month 18) (O, RE) [month 18]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS91	M9.1 Data management in full operation	1	3	
MS92	M9.2 Data exchange between observational scientists and modellers runs smoothly	1	12	
MS93	M9.3 Project's data sets readily accessible	1	12	

# WT3: Work package description

Project Number <sup>1</sup>	264879	Project Acronym <sup>2</sup>	CARBOCHANGE
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## One form per Work Package

Work package number <sup>53</sup>	WP10	Type of activity <sup>54</sup>	MGT
Work package title	Management of the project		
Start month	1		
End month	48		
Lead beneficiary number <sup>55</sup>	1		

## Objectives

- Efficient scientific project management.
- Efficient administrative/financial project management.
- Provide the contact between the project consortium and the European Commission
- Review and assessment of project results
- Communication internally in the consortium, with the scientific community, the general public, and policy makers

## Description of work and role of partners

WP10 is dedicated to all managerial aspects of the project (details are also described in section 2.1 of this proposal). This includes the scientific management and the administrative/financial management. A considerable part of the management person effort is dedicated to producing the scientific as well as financial periodic reports (the person effort has been included in the delivery of annual meetings).

Task 10.1: Internal communication within the consortium (including the scientific steering committee, the executive board, and the international advisory board),

Task 10.2: Communication between the European Commission and the coordinator as well as the consortium through email, phone, fax, and mail.

Task 10.3: Survey of project tasks and deadlines, timely notification of partners on upcoming deadlines (deliverables, milestones, project meetings, reporting), updating of important project lists and archives (deliverables, publications, partner lists and addresses, email-lists).

Task 10.4: General coordination, supervision, accomplishment and submission of periodic reports (scientific and financial parts).

Task 10.5: Solution of problems through addressing corresponding panels.

Task 10.6: General project dissemination/outreach to the scientific community and the general public, press contacts, in collaboration with outreach activities of WP 8 and the panel for Outreach to policy makers and training (see B2.1)

Task 10.7: Design, maintenance, and continuous updating of the project homepage on the internet.

## Person-Months per Participant

Participant number <sup>10</sup>	Participant short name <sup>11</sup>	Person-months per participant
1	UiB	18.00
	Total	18.00

# WT3: Work package description

## List of deliverables

Deliverable Number <sup>61</sup>	Deliverable Title	Lead beneficiary number	Estimated indicative person-months	Nature <sup>62</sup>	Dissemination level <sup>63</sup>	Delivery date <sup>64</sup>
D10.1	D10.1 Kick-off meeting	1	1.00	O	PU	1
D10.2	D10.2 Project website	1	1.00	O	PU	1
D10.3	D10.3 Annual project meetings (part 1)	1	1.50	O	PU	12
D10.4	D10.4 Annual project meetings (part 2)	1	3.00	O	PU	24
D10.5	D10.5 Annual project meetings (part 3)	1	3.00	O	PU	36
D10.6	D10.6 Annual project meetings (part 4)	1	3.00	O	PU	48
D10.7	D10.7 First outreach paper to policy makers	1	3.00	R	PU	24
D10.8	D10.8 Second outreach paper to policy makers	1	2.50	R	PU	36
Total			18.00			

## Description of deliverables

D10.1) D10.1 Kick-off meeting: Organisation of kick-off meeting [month 1]  
D10.2) D10.2 Project website: First version of project website [month 1]  
D10.3) D10.3 Annual project meetings (part 1): Organisation of annual project meetings [month 12]  
D10.4) D10.4 Annual project meetings (part 2): Organisation of annual project meetings [month 24]  
D10.5) D10.5 Annual project meetings (part 3): Organisation of annual project meetings [month 36]  
D10.6) D10.6 Annual project meetings (part 4): Organisation of annual project meetings [month 48]  
D10.7) D10.7 First outreach paper to policy makers: First outreach paper to policy makers and dialogue event at Brussels (or annual meeting) [month 24]  
D10.8) D10.8 Second outreach paper to policy makers: Second outreach paper to policy makers and dialogue event at Brussels (or annual meeting) [month 36]

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS101	M10.1 First reporting period accomplished and documented	1	19	
MS102	M10.2 Second reporting period accomplished and documented	1	37	



# WT3: Work package description

## Schedule of relevant Milestones

Milestone number <sup>59</sup>	Milestone name	Lead beneficiary number	Delivery date from Annex I <sup>60</sup>	Comments
MS103	M10.3 Third reporting period accomplished and documented	1	48	Month 49