Code integration in the CERA framework

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Development of the CERA system

- CERA is developed by the reanalysis section in collaboration with the marine section
- The code is regularly updated to take on board the developments made by RD
- In ERA-CLIM2, new developments have been planned by external partners

4DVAR code has been integrated successfully in the CERA system!

What can we learn from that experience to integrate effectively other developments?

Code development and integration in the CERA system

1. Scientific idea
2. Code development
3. Code validation and test case
4. Scientific assessments
5. Code transfer to ECMWF
6. Code compilation
7. Run the test case
8. Run the code
9. Scientific assessments

Scientific idea

1. **Scientific idea**
2. Code development
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Development of the 4DVAR in the ocean component

Code development

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2. **Code development**
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NEMOVAR framework is used

Tangent and adjoint codes are written at INRIA

☺NEMOVAR is designed to handle 4DVAR

☺ECMWF is in the NEMOVAR consortium

☺ECMWF has a long experience with NEMOVAR

Code validation and test case

Dot-product test:

$$y^T(Ax) = (y^T A)x$$
$$y^T(Ax) = (A^T y^T)x$$

☺Run the dot-product test:

$\rightarrow$ failing the test prove that the code is incorrect

$\rightarrow$ passing the test does not prove that the code is correct

Scientific assessments

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Experiments with one assimilation cycle at INRIA

☺Better fit to observations compared to 3DVAR

Code transfer to ECMWF

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INRIA visits ECMWF (February 2014)

☺Essential to be at the same place
→Explain the code and the way it works

Code compilation

1. Scientific idea
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5. Code transfer to ECMWF
6. **Code compilation**
7. Run the test case
8. Run the code
9. Scientific assessments

☹ Compilation crashed! (March 2014)

→ Different compilers, require some code modifications

Run the test case

1. Scientific idea
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6. Code compilation
7. **Run the test case**
8. Run the code
9. Scientific assessments

☹ Test case crashed!

→ Run on a different number of processors

→ NEMO and NAMEVAR namelists are different

Run the code

1. Scientific idea
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3. Code validation and test case
4. Scientific assessments
5. Code transfer to ECMWF
6. Code compilation
7. Run the test case
8. **Run the code**
9. Scientific assessments

4DVAR runs at ECMWF (April 2014)

☹ New version of tangent and adjoint codes
→ fixed bugs, major revision of some routines
→ go back to step 5 and redo step 5-8 (August 2014)

Scientific assessments

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3. Code validation and test case
4. Scientific assessments
5. Code transfer to ECMWF
6. Code compilation
7. Run the test case
8. Run the code
9. **Scientific assessments**

Run the 4DVAR over several months (September 2014)

Compare with 3DVAR

☺ Interesting and promising results

☺ A lot of open scientific questions

Conclusions

1. Scientific idea
2. Code development
3. Code validation and test case
4. Scientific assessments
5. Code transfer to ECMWF
6. Code compilation
7. Run the test case
8. Run the code
9. Scientific assessments

Code integration is not an easy task!

A lot of unpredictable problems can arise
→ developer is involved from step 1 to 9
→ provide simple test case

Good communication and quick response is essential
→ working at the same time at the same place
→ dedicated day to work on the code integration

Avoid code changes during the code integration
→ not always possible as bugs have to be fixed

Scientific assessment is a key point
→ a good collaboration is still required
→ analysing data is time-consuming