

IMECC NA2

Development of a Network Design Tool

FastOpt, LSCE, and University of Bristol

IMECC Final Meeting, September 2011, Garmisch-Partenkirchen



FastOpt

Question

Question:

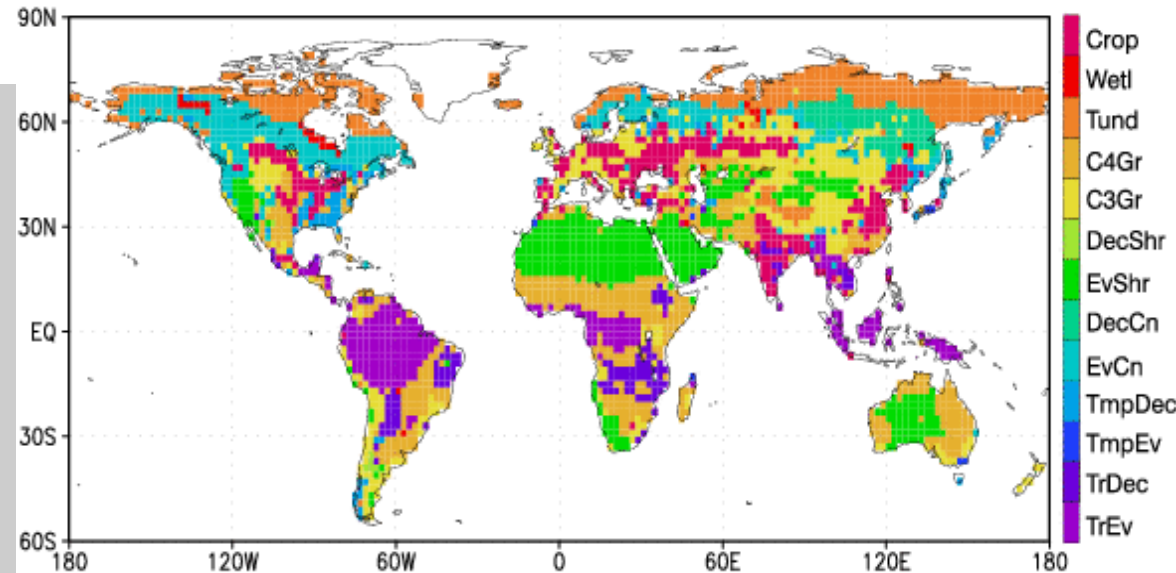
What is the performance of a given observational network for the carbon cycle as specified by the posterior uncertainty for a target quantity of interest?

NA2 Objective:

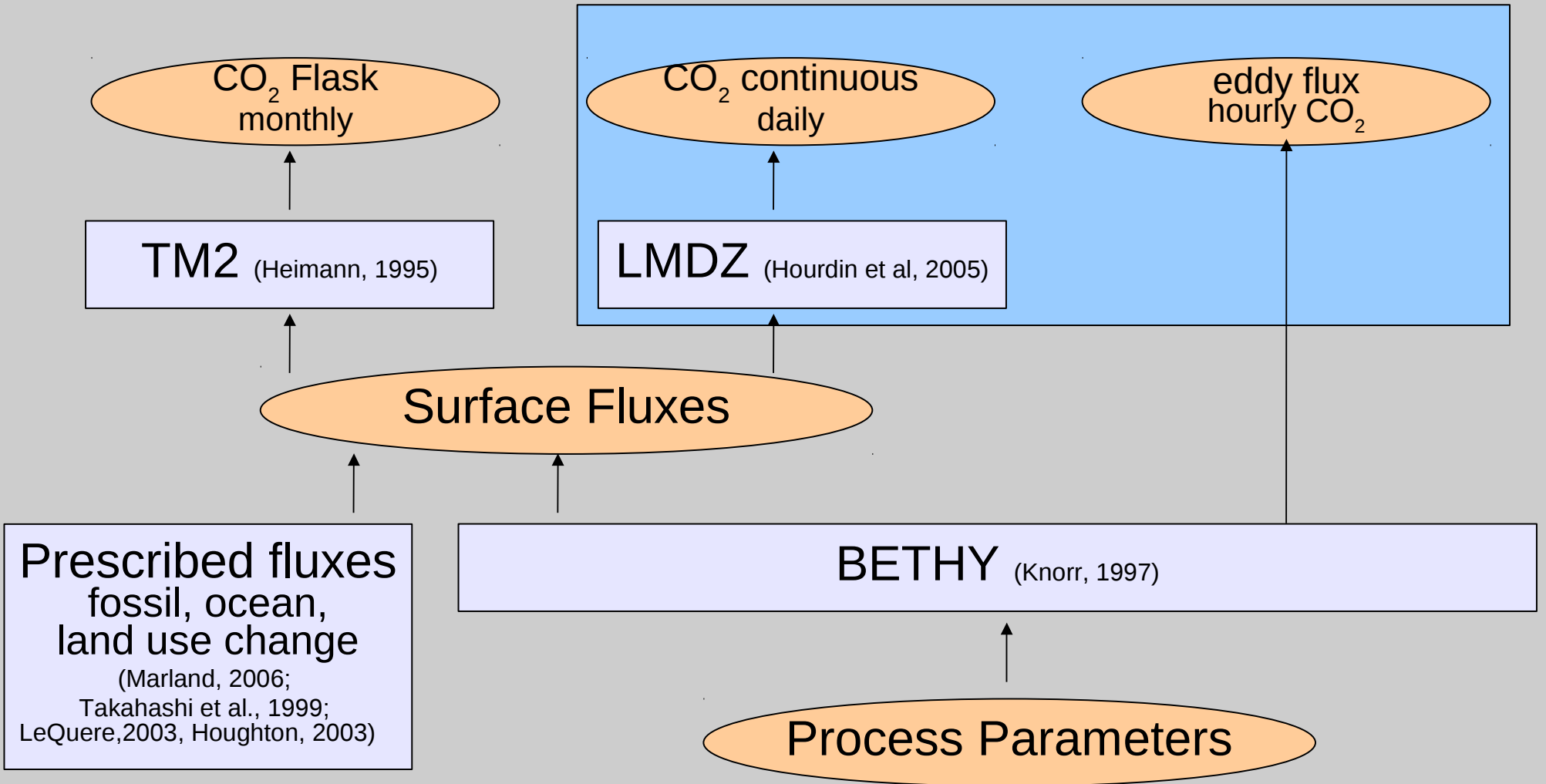
Construct a software tool that allows to evaluate the performance of potential networks in terms of the posterior uncertainty for a number of target quantities.

BETHY setup

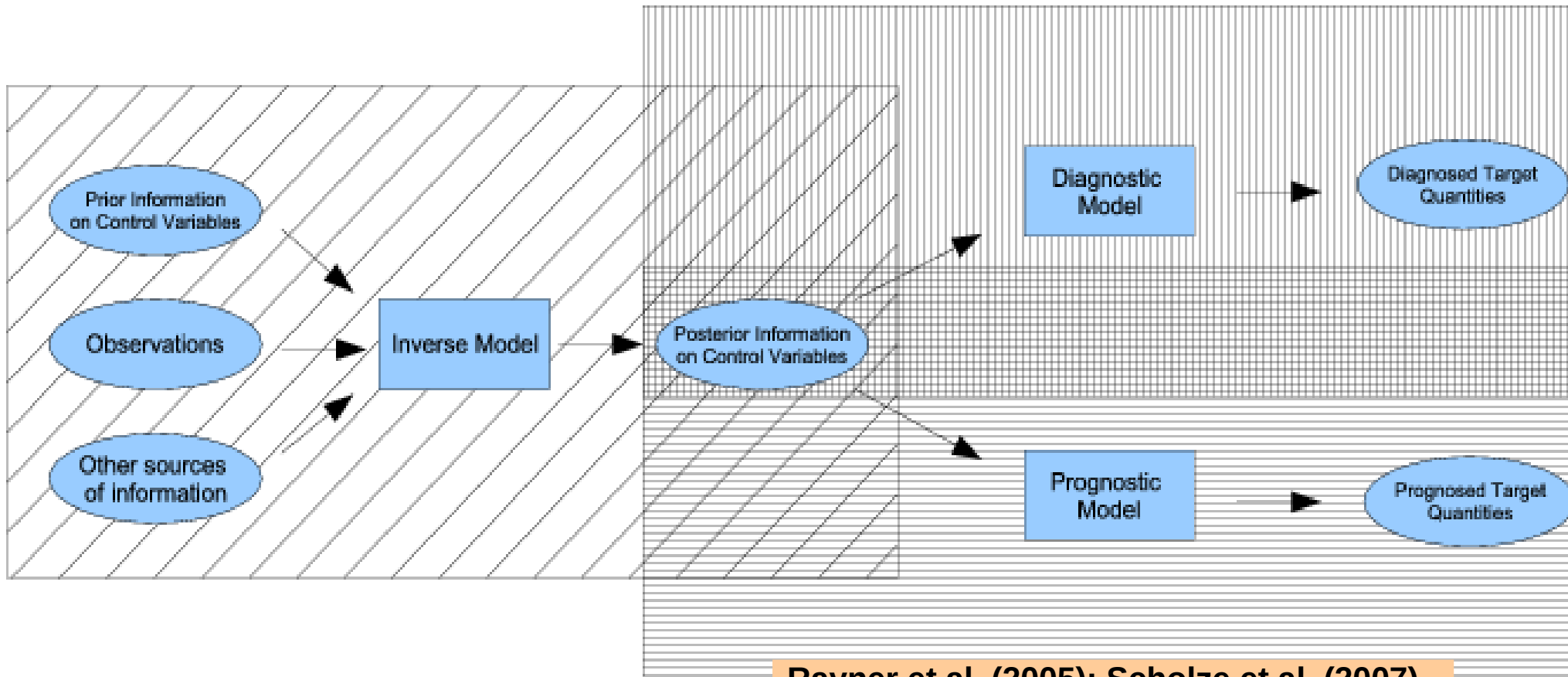
- 2 by 2 degrees, global
- 13 Plant Functional Types
- 57 Process Parameters
 - 3 PFT specific
 - 17 not PFT specific
 - 1 atmospheric
- Parameter values taken from Scholze et al. (2007)
- Prior parameter uncertainties taken from Scholze et al. (2007), in the order of 25%



Carbon Cycle Data Assimilation System (CCDAS) Forward Modelling Chain



CCDAS scheme



Rayner et al. (2005); Scholze et al. (2007)

Data Types

- 20 years of observations
- Data uncertainties for each site to be specified by user
- Flask: monthly mean values, precomputed for selected sites
- Continuous: daily mean values, precomputed for selected sites
- Flux (one point configuration):
 - hourly mean values
 - climate from 2 x 2 degree grid
 - mix between up to 3 prescribed PFTs to be specified by the user

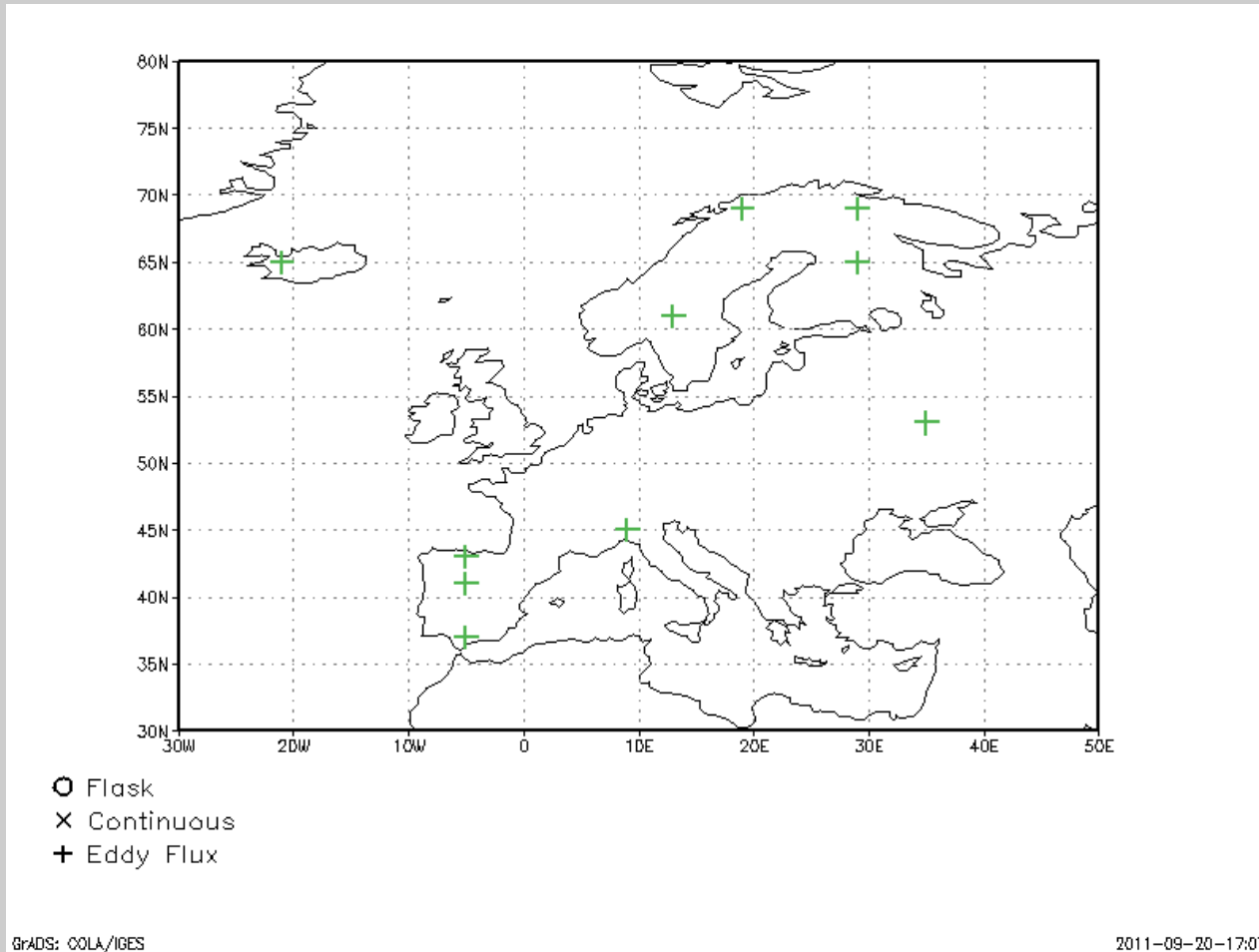
Target quantities

Uncertainty in annual mean average over twenty years

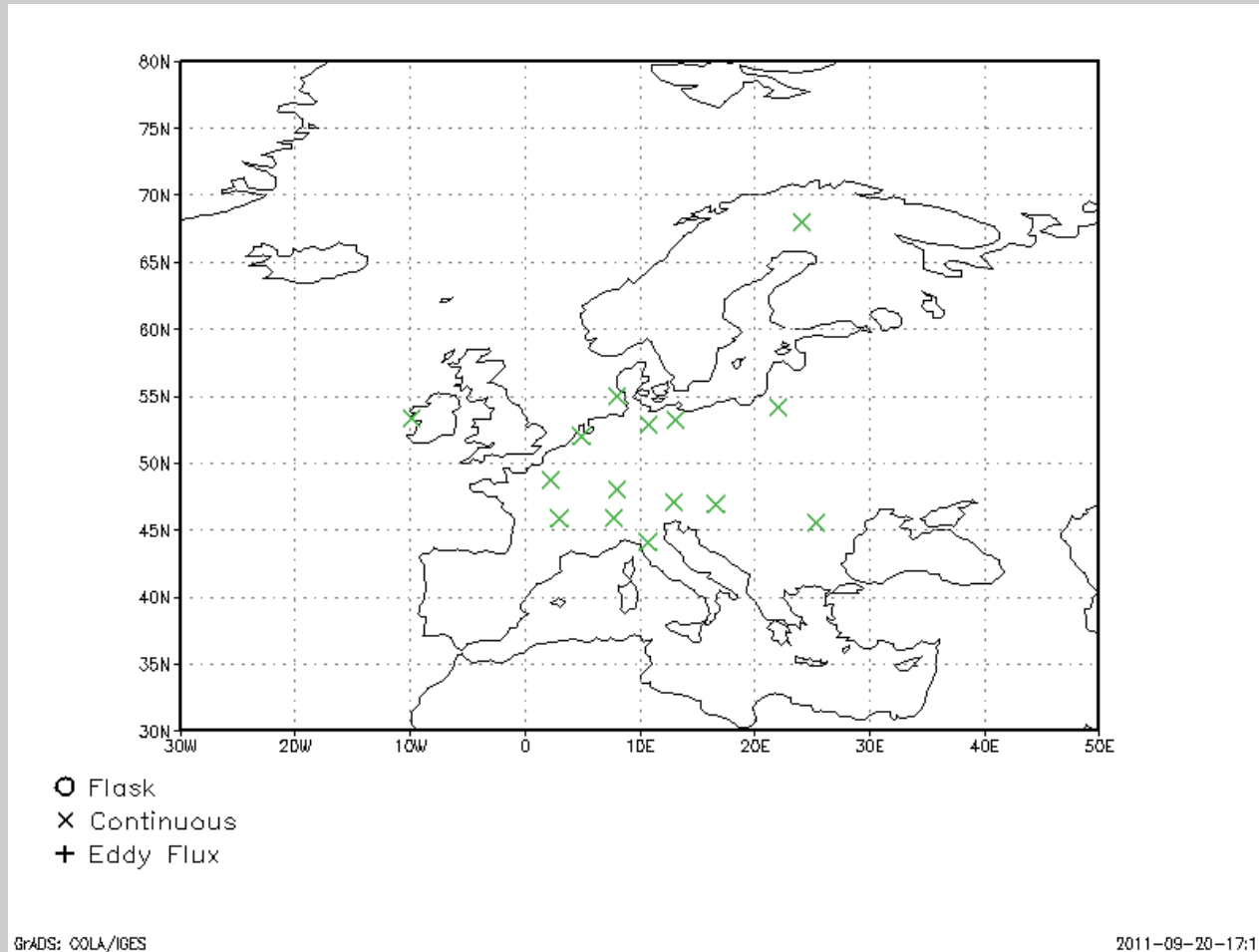
- NEP over three regions
- NPP over three regions
- NEP at 2 by 2 degree resolution (Uncertainty reduction)

Uncertainty contribution from model error in simulation of target quantity as a user-defined percentage of NPP

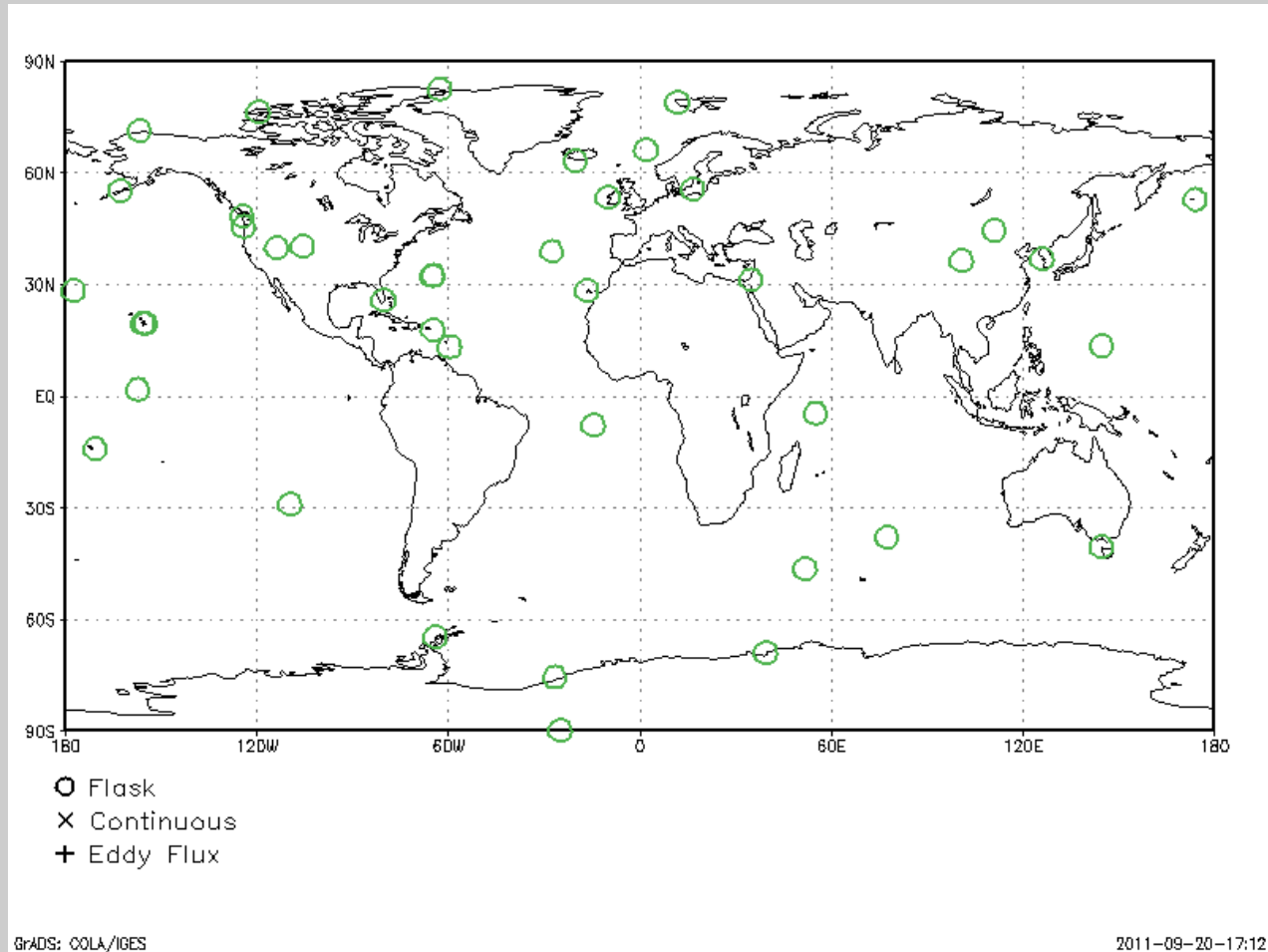
Candidate Networks: "flux"



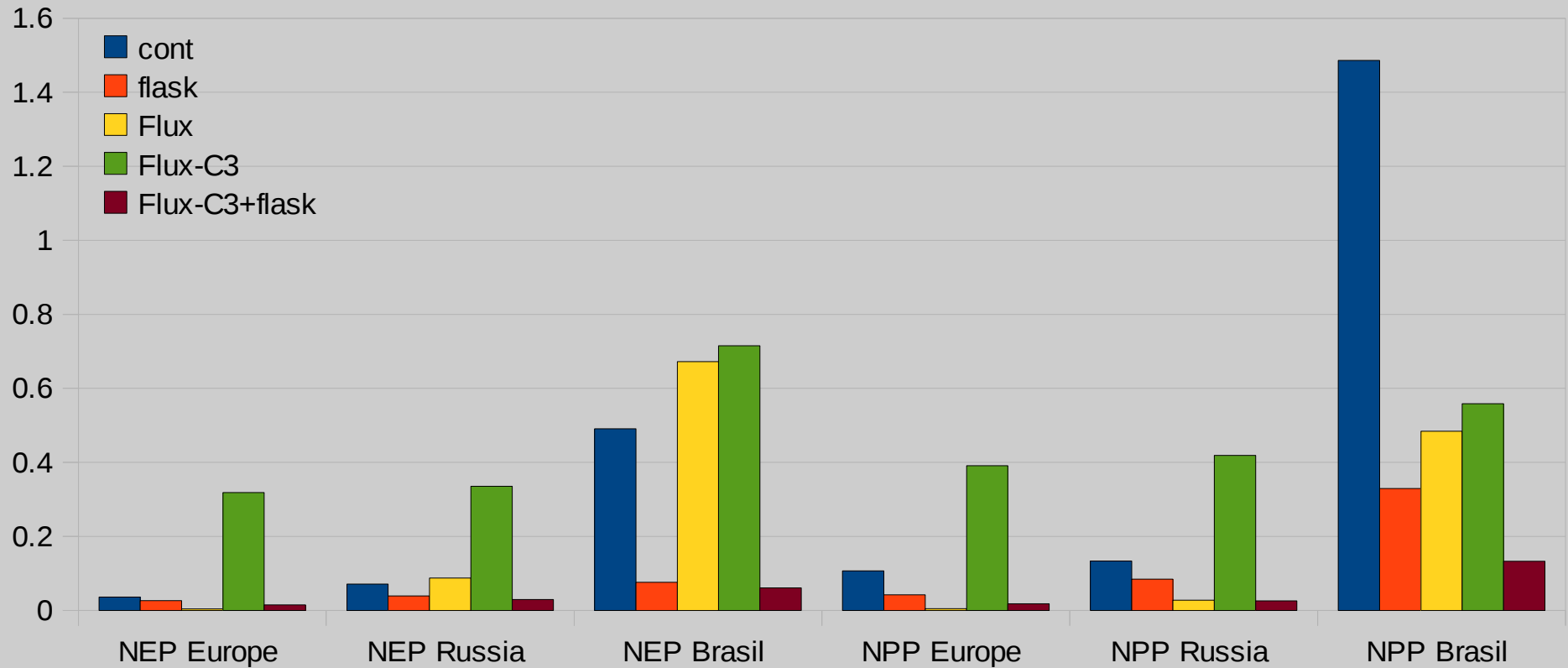
Candidate Networks: "cont"



Candidate Networks: “flask”



Testing candidate networks



Testing Candidate Networks

- Complete Flux network very efficient
- Incomplete Flux network very inefficient
- Flux networks are risky
- Combination with atmosphere reduces the risk (insurance)

More findings from similar experiments:

- Flux network only efficient when PFTs are observed separately
- Similar findings in model setups with more PFTs (tested up to 127 PFTs)

Deliverables from original project plan

Deliverable No		Deliverable title	Delivery date	Nature	Task
D_NA2.1	✓	Product web site set up	3	Web Site	NA4.1
D_NA2.2	✓	Repository for source code of product code set up	3	Report	NA4.1
D_NA2.3	✓	Demonstration of algorithm for propagation of uncertainties in test configuration with observations from a flask sampling site and the European sink as target quantity.	16	Report	NA4.2
D_NA2.4	✓	Complete derivative code verified after integration of LMDz. Comparison of impact calculations with LMDz and TM2.	20	Report	NA4.3
D_NA2.5	✓	Demonstration of the impact of an additional flux site on a set of target quantities	30	Report	NA4.4
D_NA2.6	✓	Presentation, demonstration, and distribution of the prototype for testing and feed-back to the IMECC consortium and the public	36	Workshop	NA4.4
D_NA2.7	✓	Final product, including manual, online description ready for users	48 -> 54	Report	NA4.4

Summary

The tool works!

It can evaluate complex networks. It has evaluated candidate networks in support of ICOS. General findings appear not be model dependent.

Report from 1st ICOS/IMECC workshop (Paris, 2009): *“We noted that the CCDAS tool being used in IMECC-NA2 is the only one currently using flux and concentration measurements simultaneously. It seemed valuable to use this shell around several models.”*

Report from 2st ICOS/IMECC workshop (Egham, 2010): *“The tool is conceptually valuable and applicable to ICOS objectives, but needs to be more elaborated over Europe. Further suggestions:*

- *Include ocean network*
- *A network for future climate*
- *Flexibility for users to select atmospheric sites*
- *Investigate model dependence”*

Recent suggestions by ICOS community via mailing list:

- Sweden: *“Provide ICOS network (as a basis) for evaluating national extensions”*
- Spain: *“Provide more “one point setups” for flux sites, i.e. more climate/PFT combinations”*

Work Plan for potential follow up (from RICCO)

Objective: To provide

- enhanced functionality of IMECC QND tool as required by the ICOS community and
- end-to-end performance assessment of a set of integrated Ocean+ATM+ECO ICOS networks.

Work plan:

- Task X.1: Extend IMECC tool by an oceanic observational data type. (DX.1: Evaluation of oceanic test network in terms of its constraint on the European carbon uptake.)
- Task X.2: Increase spatial resolution of terrestrial model over Europe to about 25 km and increase the resolution in PFT space. (DX.2: Sample calculation of regional high resolution map of flux uncertainties for test network.)
- Task X.3: Extend IMECC tool to allow evaluation of the network performance under climate change via inclusion of simulated future fluxes as additional target quantity (DX.3: Assessment of the performance of a set of test networks in terms of constraining climate change simulations.)
- Task X.4: Assessment of expected uncertainty from model error and errors in background fluxes for individual observational data types. (DX.4: Set of 2/3 dimensional uncertainty maps/fields.)
- Task X.5: Allow arbitrary ATM sampling location and height. (DX.5: Assessment of sensitivity of target uncertainties to small-scale change in ATM sampling position and height.)
- Task X.6: Extend IMECC tool by an inventory observational data type. (DX.6: Evaluation of inventory test network in terms of its constraint on the European carbon uptake.)
- Task X.7: End-to-end performance assessment of a set of potential networks. (DX.7: Integrated assessment of performance of set of Ocean+ATM+ECO networks and their complementarity.)