Numerical estimate of river discharge in the Mediterranean basin

Maria Vittoria Struglia, Giovanna Pisacane
ENEA – UTMEA/CLIM C.R. CASACCIA Roma

HyMeX
HYdrological cycle in Mediterranean EXperiment

4th HyMeX Workshop, Bologna
8th – 11th June 2010

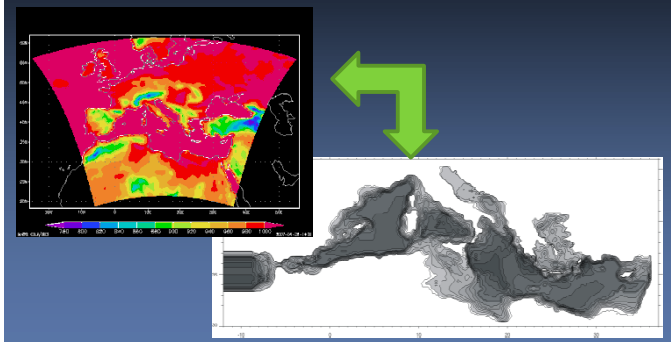
Outline

- Motivations
- Recent past and near future: observations and models
- IRIS module description
- Validation and regional model intercomparison: the ENSEMBLES runs
- Conclusions

Mediterranean river runoff estimates can be useful in…

… assessing Mediterranean Hydrological Cycle and possible changes in water mass characteristics

… assessing impacts on sea environment of river nutrient loads



… giving fresh water boundary condition to the ocean module of regional coupled models

Recent past and near future… what is available?

- XX century :

Historical time series of river discharge from several on-line database (GRDC, MMA, Med-Hycos, sage, UNESCO)

Struglia et al., 2004, Journ. Clim.

Ludwig et al.,2009, Progress in Oceanography

- XXI century:

Climate models simulations

-Empirical modeling (P,T,R)

- Surface integration of R

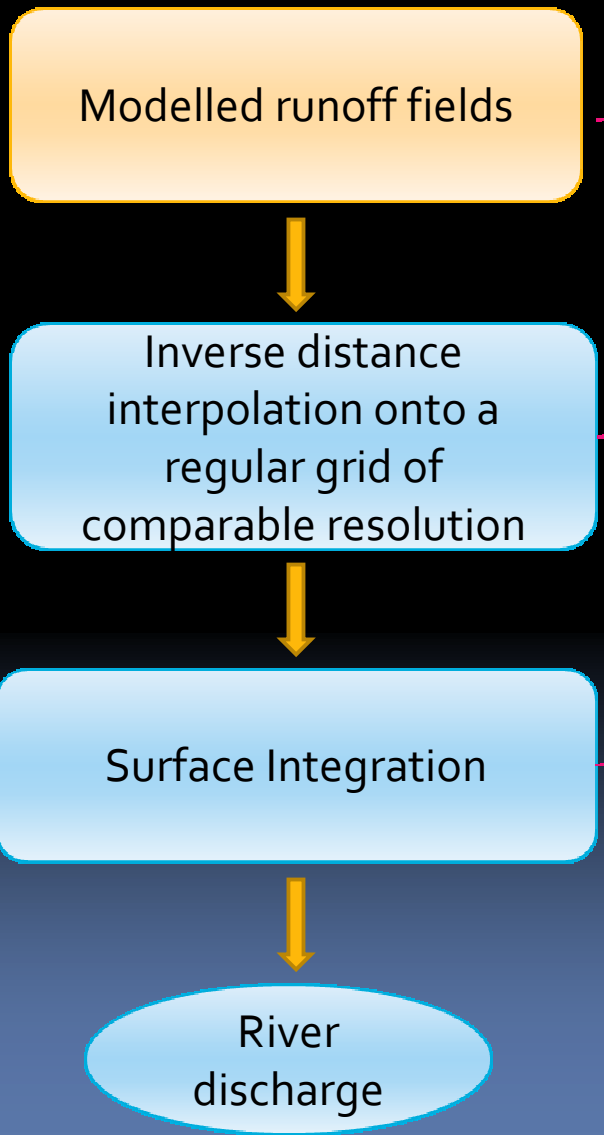
-Macroscale Hydrological mod

IRIS – Interactive RIver Scheme

- IRIS estimates river discharge into the Mediterranean Sea from modelled runoff data
- IRIS functions either off-line or interactively within the regional Mediterranean coupled model PROTHEUS developed at ENEA
- IRIS has been tested using the surface runoff fields computed by Regional Models run within ENSEMBLES project (ERA40 driven) and validated against historical discharge data

G.Pisacane, M.V.Struglia in preparation

IRIS description

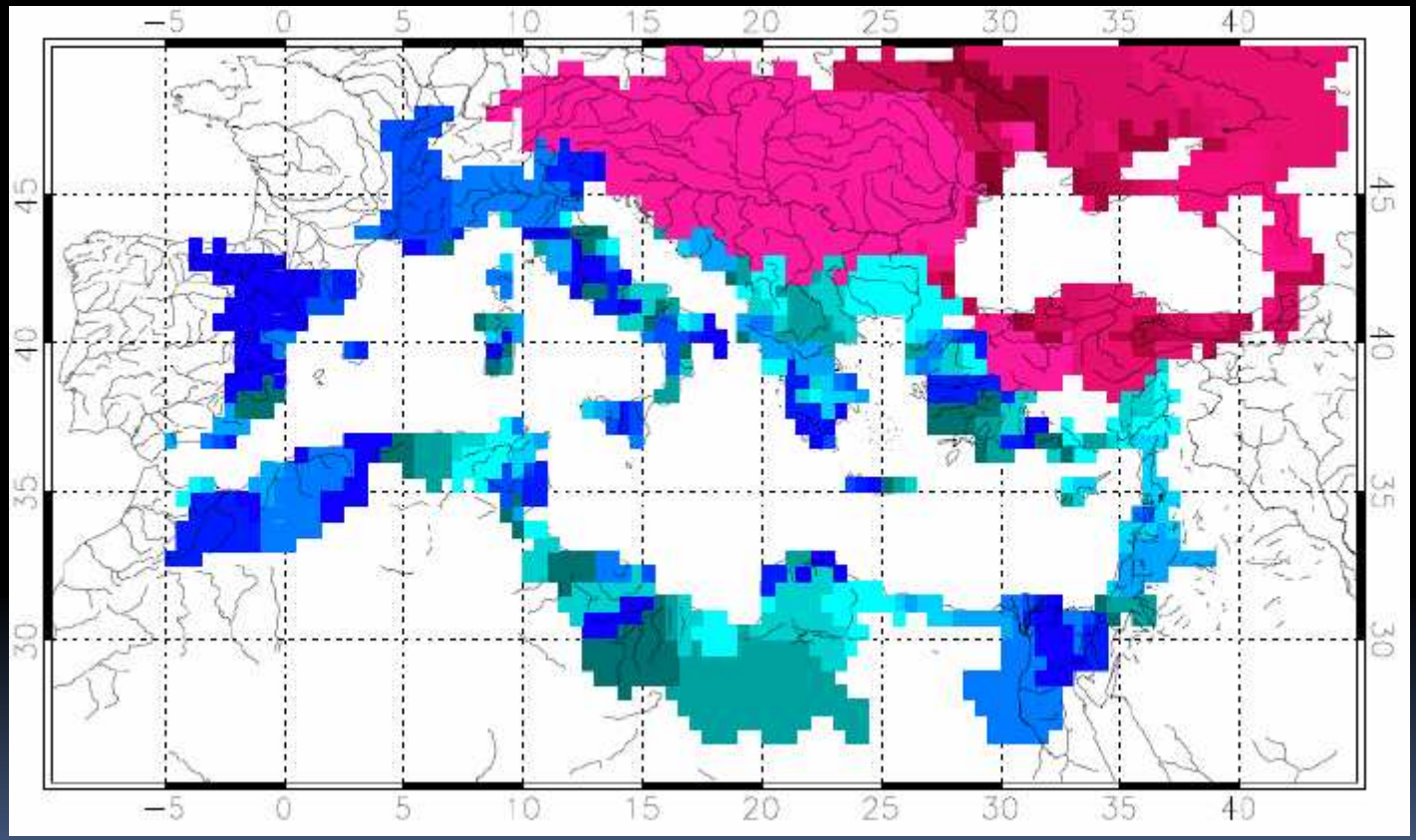


-Soil parametrization schemes
- Vertical balance: P =R+E+ΔS
P cumulated precipitation,
R cumulated total runoff,
E cumulated evaporation
ΔS soil storage variation

Basing on the Total Runoff Integrated Pathway (TRIP) (Oki and Sud,1998 *Earth Interactions*, 2)

Catchment scale, monthly means

Mediterranean catchment in IRIS



-186 distinct basins directly falling into the MedSea (blue)
-236 distinct basins when the Black Sea catchment is included (pink)

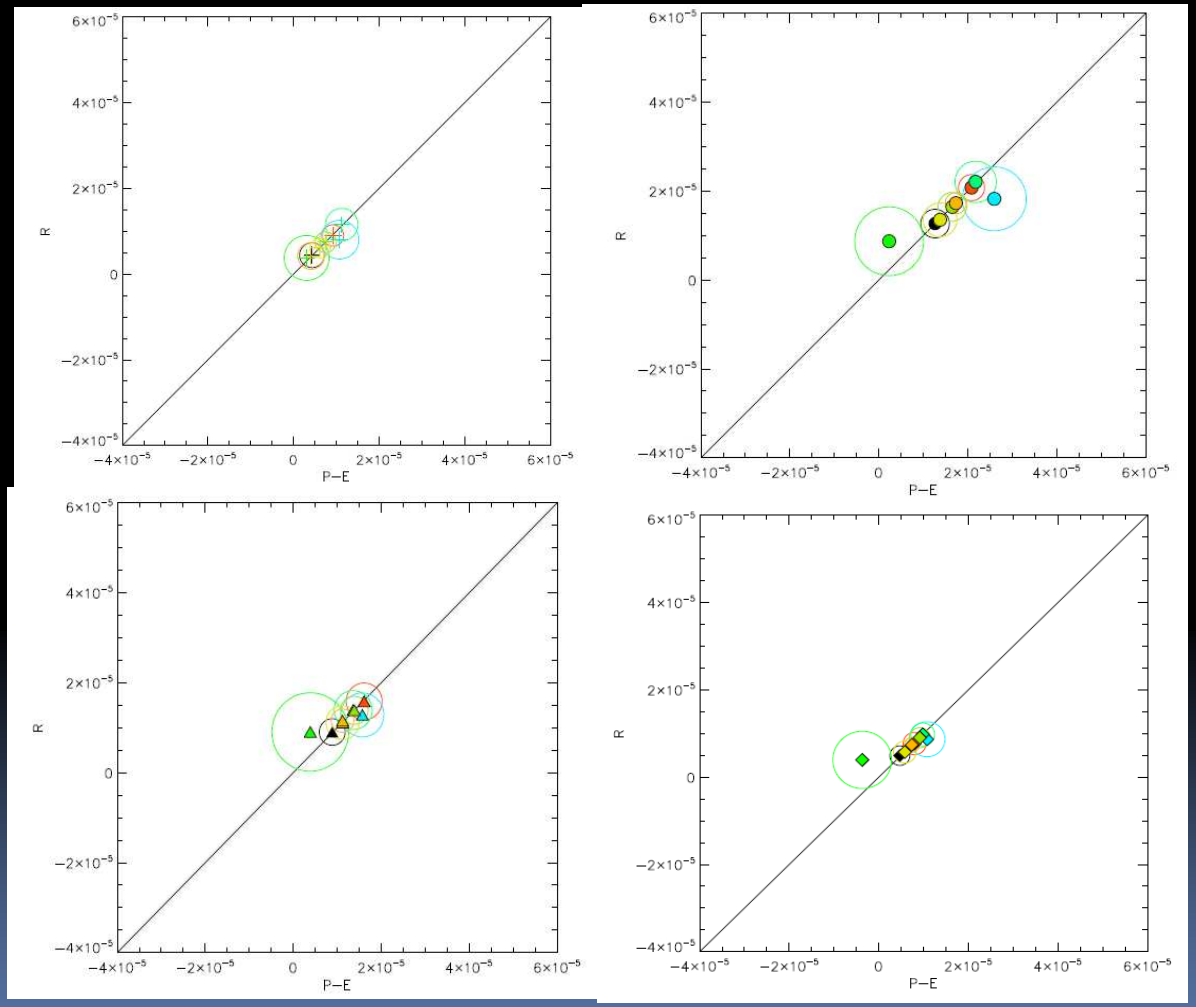
Elaboration from the TRIP database

Validation and model intercomparison

ERA 40 driven simulations from ENSEMBLES (1961-2000)

HIRHAM	DMI	ECHAM4 physics Dumenil,Todini 1992
REMO	MPI	Modified ECHAM4 physics DWD physics
REGCM3	ICTP	REGCM3 Physics Soil scheme: BATS
HIRHAM	METNO	ECHAM4 physics Dumenil,Todini 1992
RM4	CNRM	Soil scheme:ISBA
HADRM3	HC	WHS
RACMO	KNMI	ECMWF physics TESSEL
CRCMO	OURANOS	CLASS 2.7

Vertical balance condition

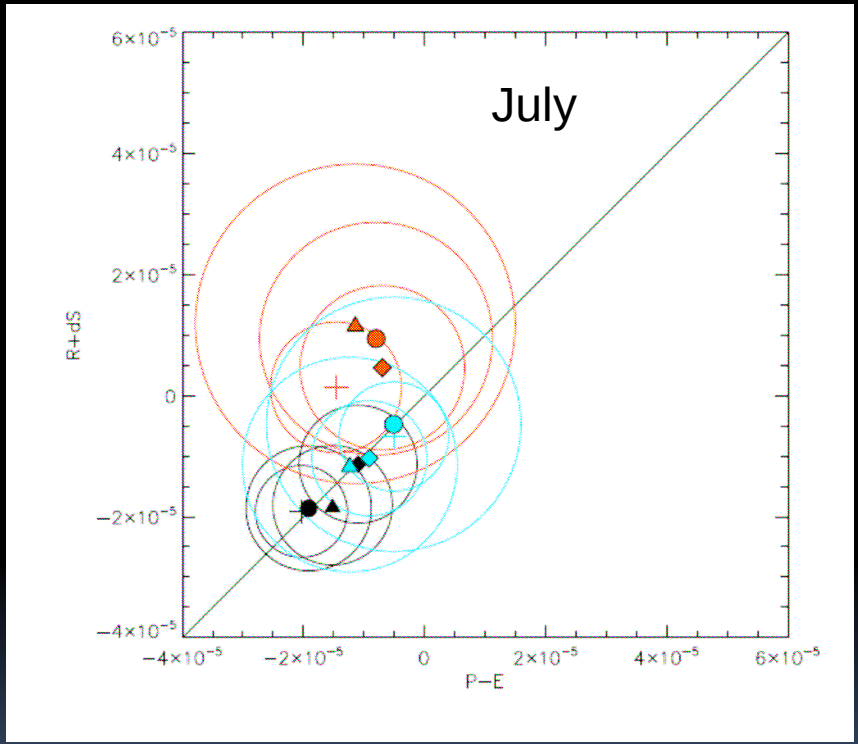


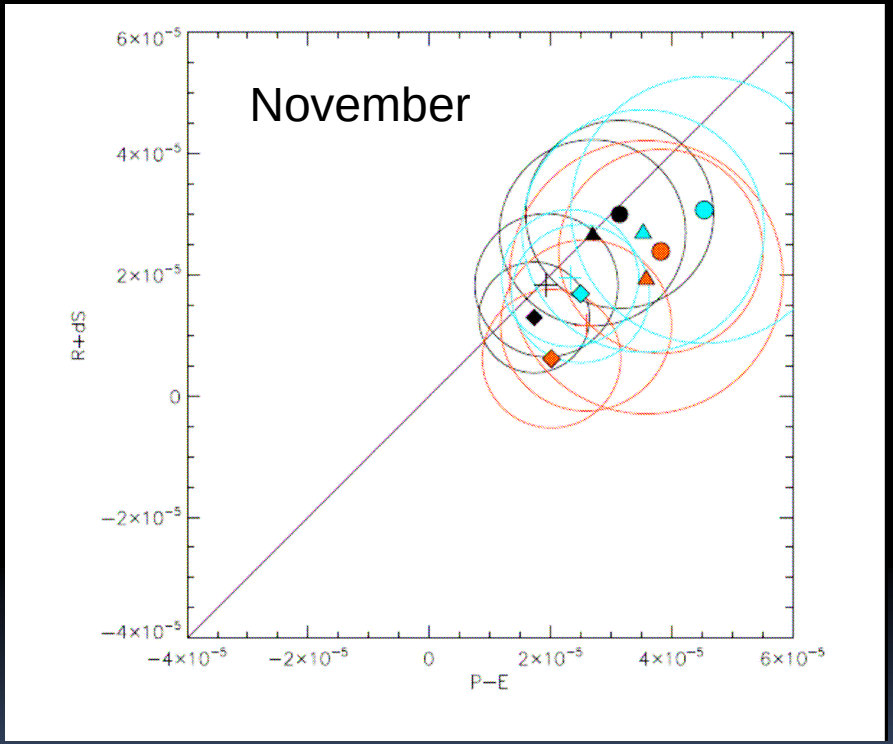
Mean annual balance :
net evap (P-E) vs runoff (R)

Units are mm/s.

Black: REMO
Red: METNO-HIRHAM
Green: DMI-HIRHAM
Light blue: RegCM3
Light green: HadRM3
Apple green: RM4
Light Yellow: RACMO
Gold: OURANOS
Cross: Ebro
Circle: Rhone
Triangle: Po
Diamond: Danube.
Circumferences of radius SD are drawn.

Vertical balance: month extremes



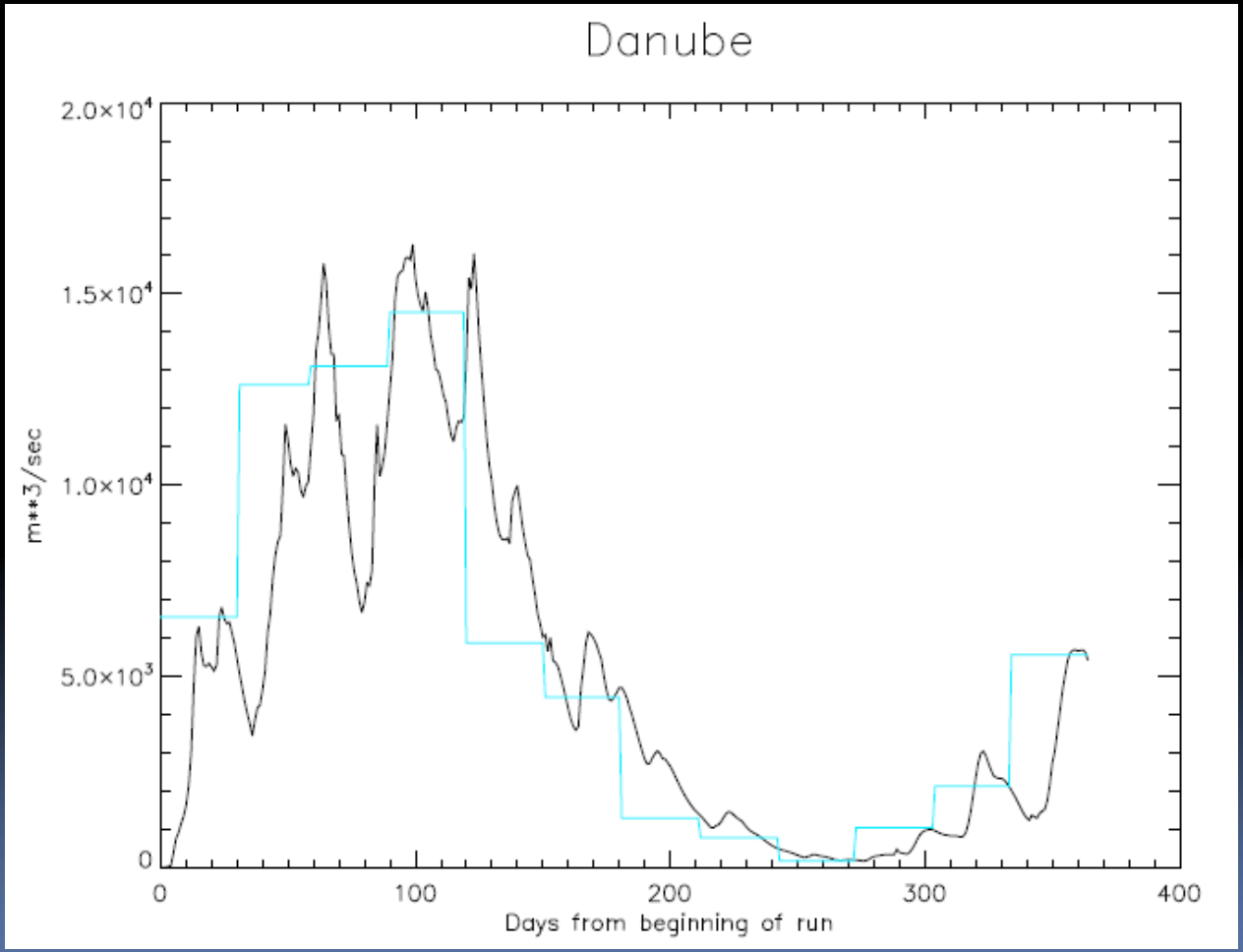


Mean monthly balance between net evaporation (P-E) and runoff plus soil storage (R+dS) for the different models (colours) and different basins(symbols). Units are mm/s. Black: REMO , red: HIRHAM, light blue: RegCM3 . Cross: Ebro, circle: Rhone, triangle: Po, diamond: Danube. Circumferences of radius SD are drawn

Runoff monthly integration over the Danube catchment

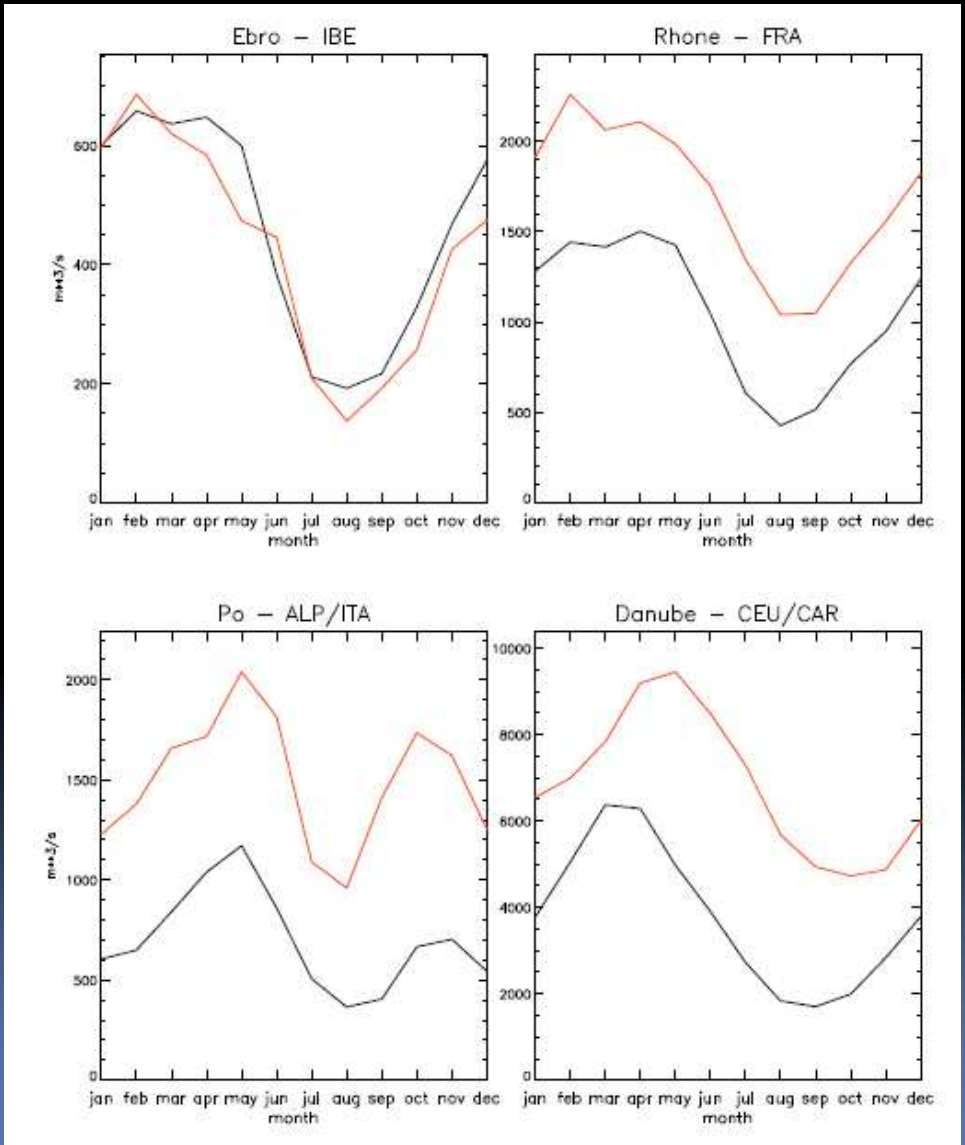
vs

explicit routing of daily runoff*



* WBM plus (extension of the model presented in Vorosmarty et al., J.Hydrology,207 ,1998)

Climatology: 25km



Red: Observations

Black: Ensemble mean

Conclusions

IRIS is:

- Versatile run-time & off-line module, works with any climate model output
- Adequate to climate studies purposes (seasonal and interannual variability)
- Useful to assess the quality of the simulation of HC (using observed R D)