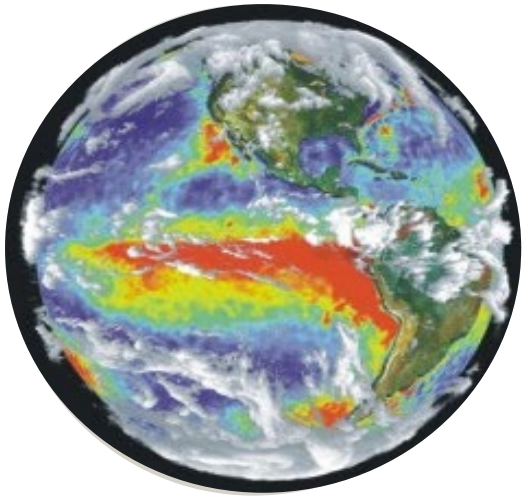
Skill analysis of seasonal forecasts of runoff in South America

EGU, 2020, session HS4.4: Friday, May 8, 10:45 – 12:30

Wouter Greuell and Ronald Hutjes



WAGENINGEN UNIVERSITY & RESEARCH

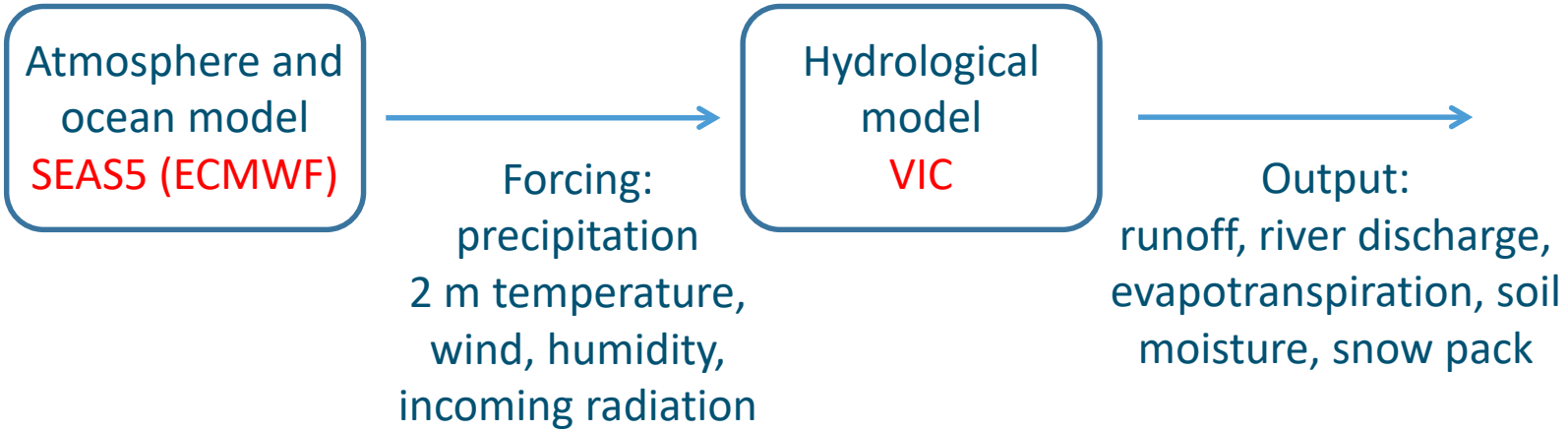
BELMONT FORUM

JPI Climate

NWO

CLIMAX BELMONT JPI CLIMATE

THE FORECAST SYSTEM: TWO TYPES OF SIMULATIONS (HINDCASTS)



HINDCASTS

- Forcing from SEAS5 (ECMWF) hindcasts
  - Period 1981-2015
  - Start each month (so 12 x 35 starting dates)
  - 25 members (so 12 x 35 x 25 = 10500 runs)
  - Duration of runs: 7 months

- Hydrological model: VIC
- Resolution: 0.5 degrees; domain South America
- Initial conditions from reference simulation (see next slide)

REFERENCE SIMULATION

The best possible simulation of the hydrological system during the period of the hindcasts: hydrological simulation forced with meteorological observations (WFDEI with precipitation data from GPCC)

Purpose:

- create initial states for hindcasts (snow, soil moisture)
- create pseudo-observations of hydrological variables for skill assessment

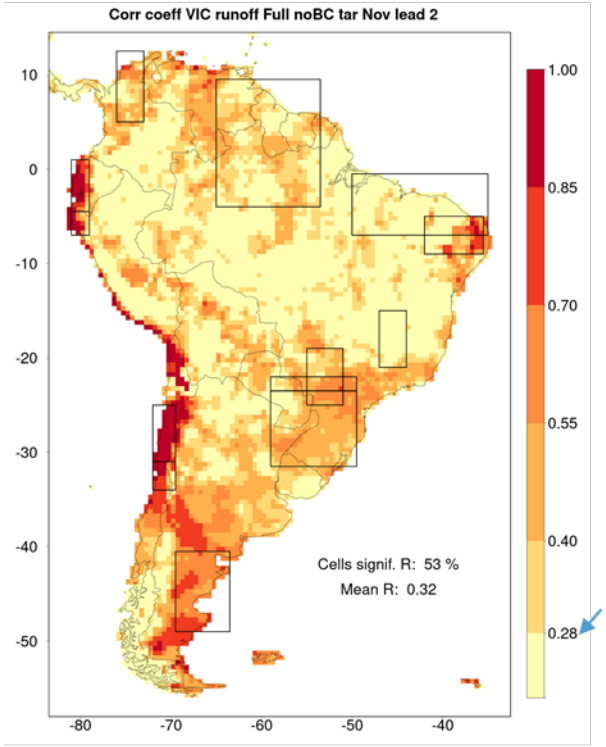
EVALUATION OF FULL HINDCASTS

- **Evaluation**
  - Runoff (i.e. streamflow in *local* rivers) against pseudo-observations, (i.e. runoff from reference simulation)
  - Metric: correlation coefficient between observation and ensemble mean of forecasts; significant when exceeding 95% confidence level

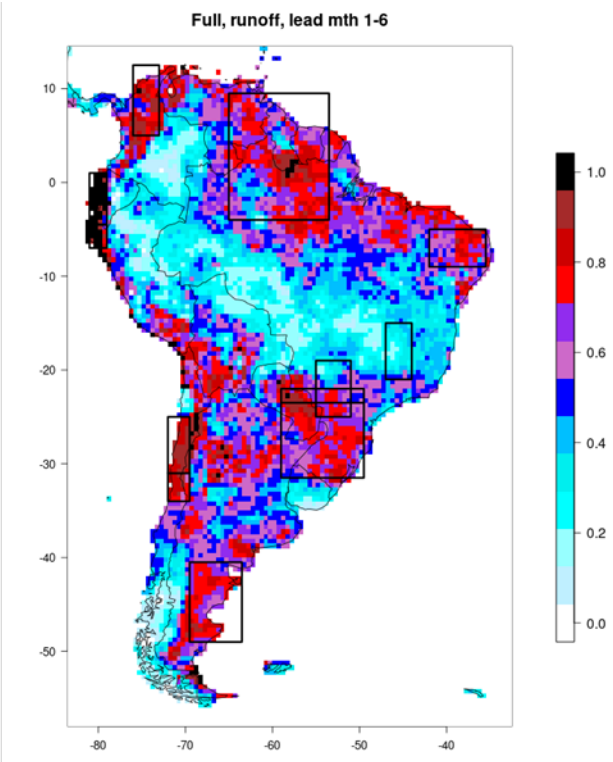
EVALUATION OF FULL HINDCASTS

- Example of evaluation: target month November with initialization on September 1 (lead time: 2 months)

Technical description of graphs in notes!



- Summary of evaluation: fraction of all (12) target and 6 lead months (first is excluded) with significant skill



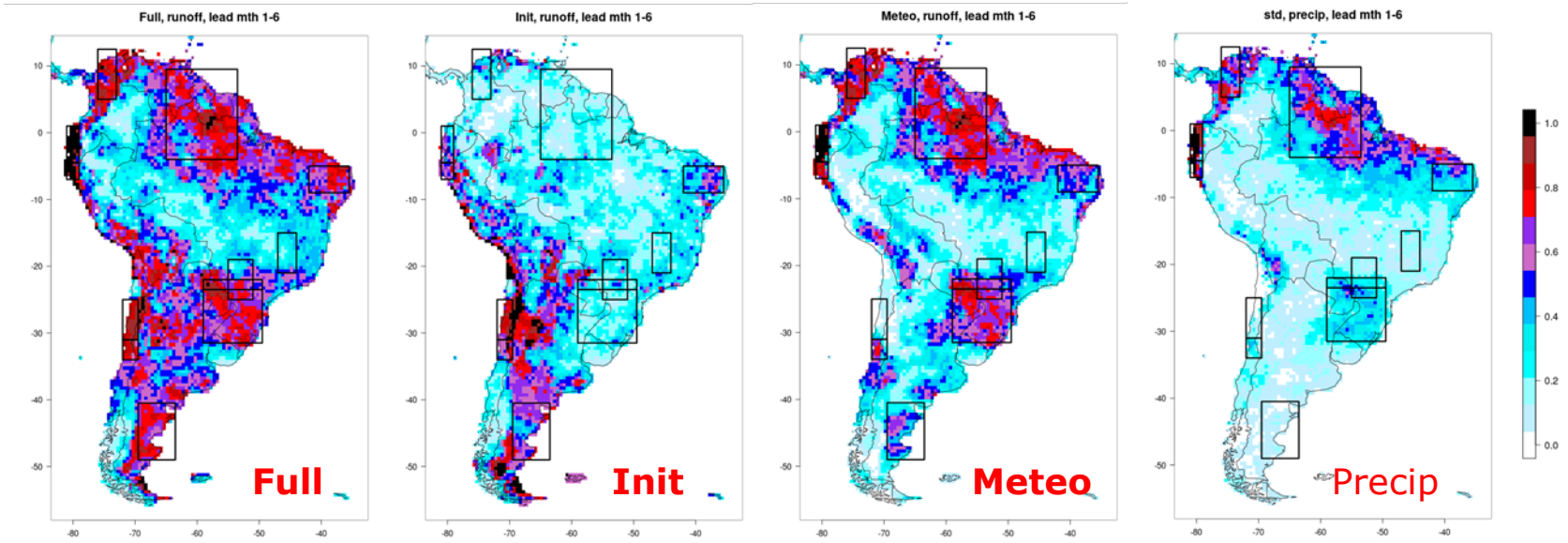
SOURCES OF (DISCRIMINATION) SKILL

- 3 sets of hindcasts
- Note: this example represents all hindcasts with initialization on April 1. Scheme is similar for initialization in other calendar months!

Name set	Full	Init	Meteo
Includes skill due to …	Forcing and initial conditions	Initial conditions only	Forcing only
Forcing year i	SEAS5 initialized on April 1, year i	Each year the same selection (25 different ensemble members from different years) of SEAS5 initialized on Apr. 1	SEAS5 initialized on April 1, year i
Initial conditions year i	From reference simulation on April 1, year i	From reference simulation on April 1, year i	Mean (of all 35 years) of initial conditions on April 1

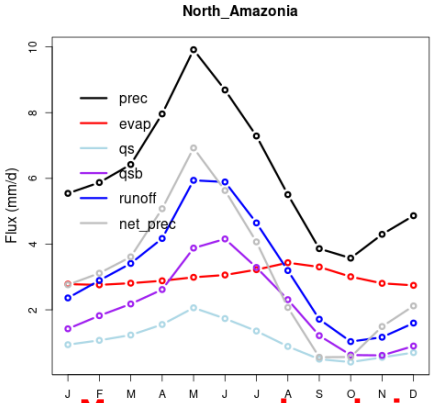
SOURCES OF SKILL IN RUNOFF: spatial patterns

- Discrimination skill is due to both forcing and initial conditions, but overall forcing is the largest source
  - **Meteo** more skill in parts of the tropics and south-east South America; **Init** more skill in large parts Argentina
  - more skill in **Meteo** than in precipitation forecast itself

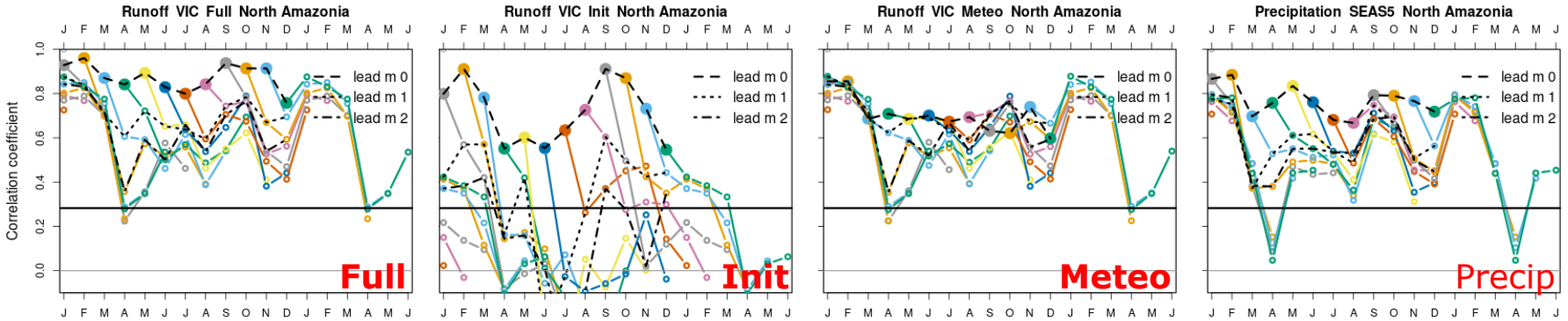


EVALUATION NORTH AMAZONIA

- In this wet, tropical region, precipitation forecasts have significant skill at all lead times, except in target month April
- Except for the first lead month, skill in runoff is almost exclusively due to skill in the forcing
- Skill in runoff tends to be larger than skill in precipitation
- Technical description of graphs in notes

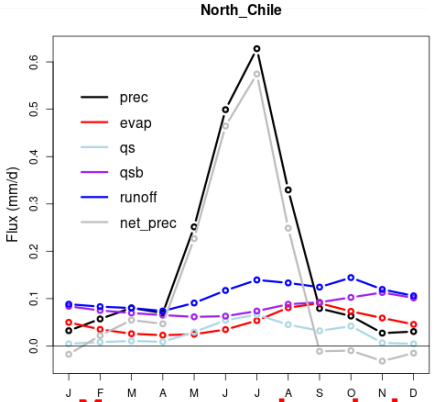


Mean annual cycle in reference simulation

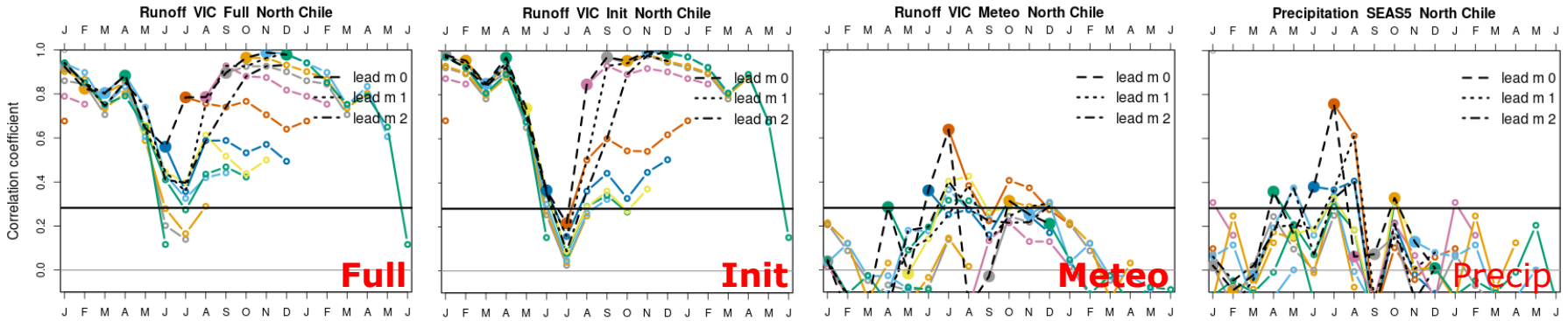


EVALUATION NORTH CHILI

- In this dry, subtropical region, precipitation forecasts have little skill, except in the wet season (JJA)
- Skill in runoff is considerable and almost exclusively due to initial conditions
- Compare **Full** with **Init:**
  - in JJA skillful forcing enhances skill in runoff
  - in almost dry months forcing degrades skill in runoff



Mean annual cycle in reference simulation



GENERAL CONCLUSION

- In South America, the forcing (ECMWF SEAS5) of the hydrological model (precipitation is the most important) has significant skill in large parts of the continent, for many target months and even at long lead times. *As a result, forcing is the largest source of skill in runoff forecasts at continental scales in South America.* Regionally, initial conditions dominate, e.g. in large parts of Argentina.
- This contrasts with previous work on seasonal hydrological forecasts for Europe[1, see notes], where precipitation forecasts (ECMWF SYS4) possess very little discrimination skill beyond the first lead month. *As a result, initial conditions are the largest source of skill in runoff and discharge forecasts at continental scales in Europe,* mainly initial conditions of soil moisture with contributions by those of snow in relevant areas.

Skill analysis of seasonal forecasts of runoff in South America

wouter.greuell@wur.nl

ronald.hutjes@wur.nl