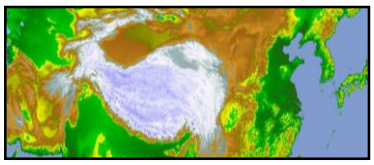
2016 Call for Proposals for International Teams in Space and Earth Sciences at the ISSI-Beijing. Domain: Earth Sciences using Space data

Team: Snow reanalyses over the Himalaya-Tibetan Plateau region and the monsoons
Team leaders: Yvan Orsolini (Norway) and Gianpaolo Balsamo (UK)



ABSTRACT

The aim of this proposal is to inter-compare and assess available re-analyses and snow datasets over the Himalaya-Tibetan Plateau region in the satellite era, and the impact of the improved snow re-analyses over that region upon subseasonal-to-seasonal forecasts of the Asian monsoons. The Asian monsoons are among the climate phenomena that have the strongest social and economic impacts. The types of snow analyses used by operational meteorological centers to initialize subseasonal-to-seasonal forecasts, are now rapidly evolving. *Land re-analyses* which include assimilated satellite and in-situ observations are currently being tested at operational meteorological centers for the next generation of prediction systems. They harbinger the foreseen development of strongly coupled data assimilation method, involving the different subsystems of the forecast model. While snow datasets and re-analyses have been compared over hemispheric or continental scales for variability and trends, their quality over the Himalaya-Tibetan Plateau region, sometimes called the Third Pole, is quite uncertain. While complicated by high orography and a paucity of in-situ data, it is nevertheless important for monsoon forecast initialisation. The aim is to provide a synthesis evaluation paper and, ultimately, recommendation about what is needed to better initialize subseasonal-to-seasonal forecasts.

1. Background and Motivation

The Indian Summer Monsoon (ISM) and the East Asian Summer Monsoon (EASM) are among the climate phenomena that have the strongest social and economic impacts, affecting the most densely populated parts of the world. They are also complex manifestations of the coupled ocean-atmosphere-land system. The prediction of monsoonal onset and rainfall has been an important research activity for decades.

Snow, the ISM and the EASM. Among the various factors influencing the ISM[2,17], the springtime snowpack over the Himalaya-Tibetan Plateau (HTP) region has long been suggested to play a role on its onset. The physical basis for this hypothesis is that a thick snowpack over the HTP region reduces the surface sensible heating of the overlying air and the deep heating of the troposphere, hence delaying the reversal of the large-scale meridional temperature gradient that marks the ISM onset. Snow-covered land can influence the above-lying atmosphere because of the snow remarkable insulating and reflecting properties, and its role in the hydrological cycle[1]. Nevertheless, contradictory conclusions on such a high snow/delayed ISM linkage were found in observational studies, depending on whether snow depth or snow cover, on whether in-situ or satellite snow observations were considered, and on the length of the period. Several modeling studies have also addressed this hypothesis, but again with mixed results[2].

The summer monsoon is not limited to Indian subcontinent, and affects South Asia at large. Its onset and advance starts in the Bay of Bengal in early May, followed by the onset of South China Sea summer monsoon in mid–late May[15]. The EASM and its summer rain belts[12] also displays significant variability at intraseasonal and interannual time scales. While sea surface temperatures over the Indo-Pacific Ocean are the major forcing, the snow cover over Eurasia has nevertheless been shown to be a contributing factor to summer rainfall over China[3,16].

Snow and the seasonal prediction of monsoons. The implications of this potential snow/ISM onset linkage for seasonal forecasting have been just began to be explored with modern dynamical prediction systems[5,6]. The skill of these systems in predicting the ISM onset is still limited[4]. In line with the renewed interest in tapping into the potential of the land surface to improve the subseasonal-to-seasonal prediction skill, the impact of realistic snow initialization over the HTP region in spring on predicting the ISM onset was investigated[5] using the coupled ocean-atmosphere Seasonal Forecasting System 4 of the European Centre for Medium-Range Weather Forecasts (ECMWF-S4). In high snow years, the ISM onset is delayed by about 8 days (Fig. 1), leading to persisting dry and warm conditions over India. *The analysis of forecasts attributed half of this delay to the initialization of snow over the HTP region, highlighting the importance of realistic land re-analyses over that region to improve seasonal forecast of the ISM*. However, the above-mentioned linkage is a statistical relationship that can be broken in some specific years, indicating that the snow forcing is only one among the many interacting factors influencing the early development of the monsoon, a challenge for seasonal forecasting.

The types of snow analyses used by meteorological centers to initialize subseasonal-to-seasonal forecasts are now rapidly evolving. The current seasonal prediction system at ECMWF (S4) uses off-line land re-analyses[13] (ERAINT-land) corrected for precipitation biases, i.e. the HTESSEL land surface model driven by meteorological forcing, with no snow data assimilation. Others like the operational medium-range forecast at ECMWF (IFS) use an optimal interpolation approach, blending satellite snow cover from the Interactive Multisensor Snow and Ice Mapping System (IMS) at high resolution (4km) and in-situ snow depth data. The introduction of this new optimal interpolation has been shown to improve forecast of surface temperature and mid-tropospheric height[7]. The NCEP Global Forecast System (CFSv2) is initialized with re-analyses (CFSR); its land data assimilation component (GLDAS/LIS) incorporates snow analyses derived from the Air Force Weather Agency's model, which combines satellite microwave and in-situ observations, and IMS snow cover[14].

Newer, improved snow products combining passive satellite microwave and in-situ snow depths are being developed to improve skill and reduce biases, using optimal interpolation[8], or else data assimilation as in the ESA GlobSnow product[9]. Furthermore, blended snow products (e.g. snow water equivalents) are now developed using an ensemble of gridded observational products or re-analyses, aimed at providing a mean reference, a measure of observational uncertainty and an estimation of regional or temporal biases in particular datasets[10]. Such blended products are important not only for forecast initialisation but also for snow forecast verification. Hence, *land re-analyses,* which include assimilated satellite and in-situ observations are currently being tested at operational meteorological centers for the next generation of prediction systems. They harbinger the foreseen development of strongly coupled data assimilation method, involving the different subsystems of the forecast model.

While snow datasets and re-analyses have been compared over hemispheric or continental scales for variability and trends[10,11], their quality over the HTP region, sometimes called the Third Pole, is quite uncertain, complicated by high orography and a paucity of in-situ data. The former poses major accuracy issues for passive microwave remote sensing.

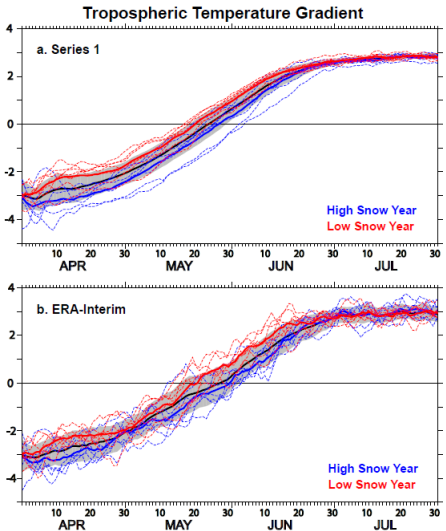


Fig. 1. Daily time evolution of the meridional tropospheric temperature gradient over the Indian monsoon region in (a) seasonal forecasts and (b) ERA-Interim for the different high snow (blue dashed) and low snow (red dashed) years and their composite mean (thick blue and red lines respectively). Also plotted are the climatological mean and the spread for the 1981-2010 period. When there is high snow in April over the HTP region, the monsoon is delayed (thick blue curve shift with respect to thick red curve). (After

Senan et al., 2016).

2. ***Objectives***

The primary objective of this proposal is to inter-compare and assess available re-analyses and snow datasets over the HTP region in the satellite era. A secondary objective is to test the impact of the improved snow re-analyses upon subseasonal-to-seasonal forecasts of the Asian monsoons. The aim is to provide a synthesis evaluation paper and, ultimately, input about what is needed to better initialize subseasonal-to-seasonal forecasts. The dissemination of results will occur via publications in the peer-reviewed literature, and conferences on Earth Observation and the Climate System. *While the proposal main focus is the HTP region, the potential prediction results have to be put in the perspective of the influence of the continental Eurasian snow.* These activities will also shed some light on the physical processes by which the HTP snowpack could affect the local atmospheric heating source, and on climate patterns, which cause seasonal snow anomalies over the HTP region.

More specifically, the objectives are to:

- ✓ Evaluate multiple snow data sources over the HTP region (including land and atmospheric reanalyses, station data and satellite-based blended dataset)
- ✓ Identify an optimal index of the HTP snowpack based on the evaluations of the multiple datasets.
- ✓ Determine the potential and actual predictability of snow water equivalent using state-of-the-art dynamical prediction systems over the HTP and Eurasia.
- ✓ Investigate the influences of HTP snowpack in boreal winter and spring on the predictability of the Asian monsoons, using standard skill metrics.

The interdisciplinary research activities will rely on:

- Multi-decadal satellite and in-situ observations of snow variables (cover or depth).
- Off-line simulations and data assimilation with land surface models.
- Subseasonal-to-seasonal forecasting prediction systems.

3. **Relevance to international programmes, to ISSI and timeliness.**

Several on-going projects supported ESA and WMO are aimed at development and intercomparison of snow retrieval algorithms and products (e.g., SnowPEX, Globsnow). The current initiative is "downstream" of that effort, in that it aims to assess the relevance of existing datasets in a specific geographical area (the HTP region) and in a quasi-operational monsoon prediction context.

The assessment of the snow initialisation over the HTP region and its impacts on monsoon forecasting is quite relevant given the new WMO WCRP Subseasonal to Seasonal Prediction Project (www.wmo.int/pages/prog/arep/wwrp/new/S2S_project_main_page.html). It is also relevant to the Land Surface, Snow and Soil Moisture Model Intercomparison Project LS3MIP (www.climate-cryosphere.org/activities/targeted/ls3mip) for the CMIP6 round of climate model intercomparison. The proposal is also timely as the method of snow initialisation for the future ECMWF seasonal prediction system (S5) is contemplated. A new "SNOWGLACE" initiative was recently sponsored by the WMO working group on Seasonal-to-Interannual Prediction (WG-SIP) (www.wcrp-climate.org/index.php/wgsip-overview) to investigate the effect of snow on subseasonal-to-seasonal forecasts through a multi-model comparison, with Drs. Orsolini and Jeong as a co-leaders.

The Team activity will be relevant to ISSI's focus on Earth Observation (EO), and the results will be of great interest to (i) ***Space agencies:*** Results will provide information on the quality of satellite snow data over the HTP region, and will help guide plans for future EO missions; they might also understand shortcomings of satellite measurements over the region. **(ii)** ***Weather agencies:*** Results will assess the importance of snow

initialisation over the HTP region, and contribute to improve subseasonal-to-seasonal forecasting of the Asian monsoons.

Table 1: Tentative list of re-analyses (blue), satellite datasets (orange) and forecast model (purple) to be considered.

Datasets/Model	Type	Horizontal Resolution	Period	Characteristics
ERA-Interim (ERAINT)	Atmos. reanalyses	T255	1979->	TESSEL; O-I in-situ & IMS (since 2004).
ERA-Interim-land (ERAINT-l)	Land reanalyses	T255	1979->2010	HTESSEL; 1-layer snow scheme; forcing by ERAINT, precipitation dataset
NCEP CFSR	Atmos. reanalyses	T382	1979-> 2011	
MERRA land	Land reanalyses	1 by 1 degree	1980->	Multi-layer snow scheme; forcing by MERRA, precipitation dataset
AMSR-2	Microwave (+in-situ)	25km	2012	GCOM-W1 Satellite ; bias removal using in-situ (prototype)
IMS	Multi-sensor visible, microwave	4km	1997->	
GlobSnow	Microwave & in-situ	25km	1979-> 2015	Assimilation
NSIDC	Microwave AMSR-E	25km	2002-2011	
ECMWF S4	reforecasts	T255	1981-2014	Snow initialisation :ERAINT-l corrected
ECMWF SNOWGLACE	reforecasts	T255	2004-2014	Snow initialisation :ERAINT-l corrected; newer model than S4
NorCPM	forecast	1 by 1 degree	2004-2014	Prototype model based on Nor-ESM version of CESM; Snow initialisation with CLM
NCEP CFSv2	reforecasts	T126	1982-2010	Noah land surface model ; initialized with CFSR

4. **Role of ISSI-Beijing and team composition.**

The International Team activity will allow partners to hold two week-long meetings in a focused environment, something that partners do not have funds to do. Second, the Team will provide a focused environment for developing and strengthening collaborations between European and Chinese seasonal forecasting community, which have rare opportunities to interact. We intend to team up with Chinese scientists, as the role of the HTP region on the climate of South and East Asia, and of China, and more generally understanding and forecasting of the monsoons, have been main foci of meteorological research in China. Our recent publication on the monsoon[1] made use of meteorological station data over Tibet, and the collaboration with Chinese scientists would allow tapping on additional data and knowledge relevant to the meteorology of the region. Besides the two PIs, the team comprises additional scientists from the ECMWF, and experts from two leading Chinese research centres in atmospheric sciences, with expertise on seasonal forecasting, snow, Tibetan Plateau meteorology, and monsoon circulations. These two centres are **the Nansen-Zhu Centre at Institute of Atmospheric Physics of the Chinese Academy of Science, and the Chinese Academy of Meteorological Sciences**, both located in Beijing.

Fields covered by participants:

- Snow data (satellite, in situ, re-analyses): Dutra, de Rosnay, Wegmann, Balsamo
- Subseasonal-to-seasonal forecasting: Orsolini, Balsamo (ECMWF model), Gao (NorCPM), C. Zhu, Zuo (NCEP CFS), Jeong
- Land surface models and data assimilation: de Rosnay, Dutra, Balsamo, Jeong
- Monsoon Circulations: C. Zhu, Y. Zhu, Liu, Zuo, Gao, Orsolini, Jeong

5. **Financial requirements and schedule**

Team leader: travel expenses from Europe to Beijing (1 return trip for each team co-leader). "International Team" meeting: accommodation and living expenses for participants (including Team leaders). However, four participants do reside in Beijing, and might not need accomodation. Confirmed team members have funds to support their travel to Beijing. The two one-week meetings will be held in Beijing over the course of the two-year project.

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Appendix 1: "International Team" addresses - details

The team comprises 11 members, of which 4 are female scientists, and 3 have received their PhD in the last 5 years.

Team Leaders :

***Dr. Yvan J. ORSOLINI**, Senior Scientist*
NILU - Norwegian Institute for Air Research
and Birkeland Centre for Space Science, University of Bergen
and Bjerknes Centre for Climate Research (Norway)
orsolini@nilu.no
https://www.researchgate.net/profile/YJ_Orsolini/publications/

***Dr. Gianpaolo BALSAMO**, Senior Scientist,*
Earth System Modelling Section, Coupled-Processes Team (Head),
European Centre for Medium-Range Weather Forecasts (ECMWF)
Shinfield Park, Reading, United Kingdom
gianpaolo.balsamo@ecmwf.int
http://www.ecmwf.int/en/staff/gianpaolo-balsamo

Name	Email	Address
Yvan ORSOLINI (M)	orsolini@nilu.no	Norwegian Institute for Air Research (NILU) Instituttveien 18, PO Box 100 Kjeller, 2027, **Norway** Tel: +47-63898183 Fax: +47-63898050
Gianpaolo BALSAMO (M)	gianpaolo.balsamo@ecmwf.int	Earth System Modelling Section, Coupled-Processes Team (Head), European Centre for Medium-Range Weather Forecasts (ECMWF) Shinfield Park, Reading, **United Kingdom** Tel:+44 118 949 9000
Emanuel DUTRA (M)	emanuel.dutra@ecmwf.int	European Centre for Medium-Range Weather Forecasts (ECMWF) Shinfield Park, Reading, **United Kingdom** Tel:+44 118 949 9000
Patricia DE ROSNAY (F)	patricia.rosnay@ecmwf.int	European Centre for Medium-Range Weather Forecasts (ECMWF) Shinfield Park, Reading, **United Kingdom** Tel:+44 118 949 9000
Yongqi GAO (M)	yongqi.gao@nersc.no	Nansen Environment and Remote Sensing Centre (NERSC), (also at Nansen-Zhu International Research Center（NZC), Inst. of Atmospheric Physics, Chinese Academy of Sciences) Thormøhlens gate 47, NO-5006 Bergen, **Norway** Work: +47 55 20 58 00, Fax: +47 55 20 58 01

Yali ZHU (F)	zhuyl@mail.iap.ac.cn	Nansen-Zhu International Research Center（NZC), Inst. of Atmospheric Physics, Chinese Academy of Sciences. No. 40, Hua Yan Li, Qi Jia Huo Zi, Chao Yang District, P. O. Box 9804,Beijing 100029, P. R. China Tel: +86-10-82995057 Fax: +86-10-82995057
Congwen ZHU (M)	tomzhu@camscma.cn	Chinese Academy of Meteorological Sciences Nandajie 46, Zhongguancun,Haidian, Beijing 100081, **China** Phone: +86-10-6840-7544(office)
Boqi LIU (M)	bqliu@camscma.cn	Chinese Academy of Meteorological Sciences, No. 46 Zhong-guan-cun South Ave., Haidian District, Beijing, **China**, 100081 Office Tel: +86-10-68409060
Zhyian ZUO (F)	zyzuo@camscma.cn	Chinese Academy of Meteorological Sciences, Room 1007, No. 46 Zhongguancun South Street, Beijing 100081, **China** Tel: +86-10-68408734 (O) Fax: +86-10-68408734
Martin WEGMANN (M)	martin.wegmann@lgge.obs.ujf-grenoble.fr	Laboratoire de Glaciologie et Géophysique de l'Environment 54, rue Molière 38402 Saint-Martin d'Hères **France** Tel: +33 (0) 476824200
Jee-Hoon JEONG (M)	jjeehoon@jnu.ac.kr	Faculty of Earth Systems & Environmental Sciences, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju, 500-757, **Korea** Tel: (+82) 62-530-3466

CURRICULUM VITAE : Dr. Yvan ORSOLINI

Date and place of birth: 02/02/1961, Belgium

Present position: Senior Research Scientist, NILU - Norwegian Institute for Air Research and (part-time 20%) Birkeland Centre for Space Science, University of Bergen, Norway

Education

1983 Diplome de Sciences Physiques, Université Libre de Bruxelles, Belgium

1986 MSc in Atmospheric Sciences, University of Illinois (Urbana), USA

1991 PhD in Geophysics, University of Washington, Seattle, USA

Research fields : Dynamics, chemistry and satellite remote sensing of the middle and upper atmosphere, and impact of cryosphere on seasonal forecasting

Coordinator or PI for NILU of several European projects and Research Council of Norway projects

Employment

1992-98 Visiting Scientist, Météo-France, Centre National de Recherches Météorologiques, Toulouse, France.

Since 03/98 Senior Research Scientist, Norwegian Institute for Air Research, Kjeller, Norway.

2010-2013 Senior Research Scientist (part-time 20%), Bjerknes Centre for Climate Research, University of Bergen, Norway.

Community Duties

- Member of the WMO Working-Group on Seasonal-to-Interannual Prediction (WGSIP)
- Member of International Commission on the Middle Atmosphere (ICMA)
- Co-author in the Polar Ozone chapter in WMO-UNEP Ozone assessment (2006; 2014)
- COSPAR (Committee for Space Research): National Representative (since June 2014), and Main or Deputy Session Organiser for C23 "Advances in Observations, Theory and Modeling related to the Mechanisms of external forcing of the Middle Atmosphere" at COSPAR General Assemblies 2010, 2012, 2014 and 2016

FIVE RELEVANT PUBLICATIONS (out of 72: ISI Citation h-Index 24)

- Orsolini, Y.J., Senan, R., Balsamo, G., Doblas-Reyes, F., Vitart, D., Weisheimer, A., Carrasco, A., Benestad, R. (2013), Impact of snow initialization on sub-seasonal forecasts , Clim. Dyn., DOI: 10.1007/s00382-013-1782-0.
- Orsolini Y, Zhang L, Peters D, Fraedrich K, Schneideret A., X. Zhu (2015) Extreme Precipitation events over North China in August 2010 and their link to eastward-propagating wave-trains across Eurasia: observations and monthly forecasting. Quart J Roy Met Soc, doi:10.1002/qj.2594 (2015).
- Wegmann, M, Y. Orsolini, M. Vázquez Dominguez, L. Gimeno, R. Nieto,O. Bulygina, R. Jaiser, D. Handorf, A. Rinke, K. Dethloff, A. Sterin., S. Brönnimann (2015), Arctic moisture source for Eurasian snow cover variations in autumn, Environ. Res. Lett. 10, 054015.
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CURRICULUM VITAE : Dr. Gianpaolo BALSAMO

Senior scientist in Earth System Modelling Section

Education

1994 Diploma of Computer Science, Institute G. Peano, Turin, Italy
1999 Master degree in General Physics, (speciality in Atmospheric Physics), University of Turin, Italy
2003 PhD in Meteorology, University Paul Sabatier, Toulouse, France
2012 Habilitation in Meterology, University Paul Sabatier, Toulouse, France

Experience relating to the project

Research scientist responsible for the development of the Earth surface components (e.g. soil, vegetation, snow, water-bodies) within the ECMWF Integrated Forecasting System (ESM/PA sections, 2006-present), previously affiliated with the Meteorological Research Branch of the Meteorological Service of Canada (RPN team, 2004-2005) and with Météo-France/CNRM (GMAP team, 2000-2003) developing the modelling and data assimilation components for representing continental surfaces in weather forecasting and climate applications.

FIVE RELEVANT PUBLICATIONS

- G. Balsamo, Albergel, C., Beljaars, A., Boussetta, S., Brun, E., Cloke, H., Dee, D., Dutra, E., Muñoz-Sabater, J., Pappenberger, F., de Rosnay, P., Stockdale, T., and Vitart, F., 2015: ERA-Interim/Land: a global land surface reanalysis data set, Hydrol. Earth Syst. Sci., 19, 389-407, doi: 10.5194/hess-19-389-2015.
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Participation in research projects

2014-2017 EU–EARTH2OBSERVE: Leader in Water Resources Reanalysis WP, Use of Global Earth Observations for Integrated Water Resource Assessment.
2013-2015 EU–IMAGINES: co-PI Biosphere product WP, Enhance Global Biosphere Monitoring via multi-sensor/multi-scale biophysical land variables exploiting Sentinel sensor data.
2006-2012 EU–GEOLAND I&II: co-PI Land Carbon WP, Enhance Global Operational Land Surface Modelling and Data Assimilation for Vegetation state and Carbon dioxide exchange.

CURRICULUM VITAE : Dr. *Emanuel DUTRA*

European Centre for Medium-Range Weather Forecasts (ECMWF)
Shinfield Park, Reading, United Kingdom

Education and Degrees

2011 Doctor of Philosophy: University of Lisbon · Instituto Geofísico do Infante D. Luiz, Portugal

Research Experience

March 2011 – present : Scientist European Center For Medium Range Weather Forecasts · Research Department · Physical Aspects section, United Kingdom · Shinfield

Jan 2008– Feb 2011 : PhD Student, University of Lisbon · Instituto Geofísico do Infante D. Luiz, Portugal · Lisbon

Experience relating to the project **:**

Emanuel Dutra is a scientist at ECMWF in the Earth System Modeling section. His expertise encompasses land surface processes, large-scale hydrology and drought monitoring and forecasting. He is responsible for the development and evaluation of cold land surface processes (e.g. snow and soil freezing), in the ECMWF land model, their impact on numerical weather prediction and on hydrological forecasts. His expertise is documented in 40 publications in international peer reviewed journals and book chapters. Emanuel Dutra is involved in the snow modelling and cryosphere-atmosphere coupling methodologies.

FIVE RELEVANT PUBLICATIONS (ISI Citation h-Index 20)

- Boussetta, S., G. Balsamo, E, Dutra, A. Beljaars, C. Albergel, Assimilation of surface albedo and vegetation states from satellite observations and their impact on numerical weather prediction, Remote Sensing of Environment (2015), http://dx.doi.org/10.1016/j.rse.2015.03.009

- Senan, R., Orsolini, Y.J., Balsamo, G., Dutra, E., Doblas-Reyes, F., Vitart, F., Weisheimer, A., D. Basang, Impact of springtime Himalayan-Tibetan Plateau snowpack on the onset of the Indian summer monsoon in coupled seasonal forecasts, Clim. Dyn., in press, doi:10.1007/s00382-016-2993-y. (2015)

- Dutra E, Schär C, Viterbo P, Miranda PMA (2011) Land-atmosphere coupling associated with snow cover. Geophys Res Lett 38:L15707. doi: 10.1029/2011GL048435

- Dutra, E., L Magnusson, F Wetterhall, HL Cloke, G Balsamo, S Boussetta, (2013) The 2010–2011 drought in the Horn of Africa in ECMWF reanalysis and seasonal forecast products, International Journal of Climatology 33 (7), 1720-1729

- Dutra E., S Kotlarski, P Viterbo, G Balsamo, P Miranda, C Schär, P Bissolli, (2011) Snow cover sen sitivity to horizontal resolution, parameterizations, and atmospheric forcing in land surface mo del Journal of Geophysical Research: Atmospheres 116 (D21)

CURRICULUM VITAE : Dr. *Patricia de ROSNAY*

European Centre for Medium-Range Weather Forecasts (ECMWF)
Shinfield Park, Reading, United Kingdom

Education

1999: PhD degree in Oceanography Meteorology: "Representation des interactions sol-plant-atmosphre dans le modele de circulation generale du LMD" , University Paris 6, Pierre et Marie Curie

1994: Master degree in Oceanology, Meteorology and Environment, University Paris 6, Pierre et Marie Curie

1993: Master degree in Fluid Mechanics, University Paris 6, Pierre et Marie Curie

Research Experience

2007-present European Centre for Medium-Range Weather Forecasts, UK

2013-present: Senior Scientist, Land Surface Data Assimilation (LDAS) Team Leader, Data Assimilation Section

2011-2013: Senior Scientist, Consultant, Land Surface Analysis, Data Assimilation Section

2008-2011: Scientist, Consultant, Land Surface Analysis, Data Assimilation Section

2007-2008: Scientist Consultant, for the SMOS global monitoring and data assimilation study (ESA contract)

2002-2007 Centre National de la Recherche Scientifique (CNRS), France

1994-2002 Laboratoire de Météorologie Dynamique/ Institut Pierre Simon Laplace (LMD/IPSL), France

Experience relating to the project

Patricia de Rosnay is a senior scientist at ECMWF responsible for a team working on coupled data assimilation activities. Her research activities include development of land surface observations monitoring (SMOS, ASCAT and conventional surface observations) and Land Data Assimilation System (LDAS) developments for Numerical Weather Prediction. She implemented a new Optimal Interpolation snow analysis and an Extended Kalman Filter soil moisture analysis in the ECMWF Integrated Forecasting System. Her expertise is documented in 80 publications in international peer reviewed journals and book chapters. She is vice chair of the HarmoSnow COST action, member of the WMO Snow Watch Team and of the GEWEX GLASS panel, as well as the NASA Application Working Group of the future SMAP (Soil moisture Active Passive) mission and the SRNWP (Short-Range Numerical Weather Prediction Programme) surface expert. Patricia de Rosnay is involved in the global data assimilation of snow observations including in-situ and remote-sensing products.

FIVE RELEVANT PUBLICATIONS (ISI Citation h-Index 38)

- de Rosnay P., G. Balsamo, C. Albergel J. Muñoz-Sabater and L. Isaksen: Initialisation of land surface variables for Numerical Weather Prediction, Surveys in Geophysics, 35(3), pp 607-621, 2014.
- Balsamo G., C. Albergel, A. Beljaars, S. Boussetta, H. L. Cloke, D. Dee, E. Dutra, J. Muñoz-Sabater, F. Pappenberger, P. De Rosnay, T. Stockdale, and F. Vitart: ERA-Interim/Land: A global land water resources dataset, Hydrol and Earth Sci Syst., 19, pp 389-407, doi: 10.5194/hess-19-389-2015
- Mecklenburga S., M. Drusch, L. Kaleschke, N. Rodriguez-Fernandez, N. Reul, Y. Kerr, J. Font, M. Martin-Neira, R. Oliva, E. Daganzo-Eusebio, J.P. Grant, R. Sabia, G. Macelloni, K. Rautiainen, J. Fauste, P. de Rosnay, J. Muñoz-Sabater, N. Verhoest, H. Lievens, S. Delwart, R. Crapolicchio, A. de la Fuente, M. Kornber: ESA's Soil Moisture and Ocean Salinity mission: From science to operational applications, in press, Remote Sensing of Environment, 2016, doi:10.1016/j.rse.2015.12.025
- de Rosnay P., M. Drusch, D. Vasiljevic, G. Balsamo, C. Albergel and L. Isaksen: A simplified Extended Kalman Filter for the global operational soil moisture analysis at ECMWF, Q. J. R. Meteorol. Soc., 139(674):1199-1213, 2013.
- Gruhier, C., de Rosnay, P., Hasenauer, S., Holmes, T., de Jeu, R., Kerr, Y., Mougin, E., Njoku, E., Timouk, F., Wagner, W., and Zribi, M, "Soil moisture active and passive microwave products: intercomparison and evaluation over a Sahelian site", Hydrol. Earth Syst. Sci. vol 14, pp 141-156, 2010

CURRICULUM VITAE : Prof. Dr Yongqi GAO

Affiliation:

1. Nansen Environmental and Remote Sensing Center (NERSC), Bergen, Norway
2. Nansen-Zhu International Research Center (NZC), Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS), Beijing, China
3. University of Bergen (UiB)

Position: Research Director at NERSC, Co-director and Professor at NZC, Adjunct Prof. at UiB
Email: yongqi.gao@nersc.no, gyq@mail.iap.ac.cn
Tel: 0047 45243709, 00861062045641

Journal Publications:

Gao has been co-authored 80 scientific papers in peer-reviewed journals. Gao has been working with the exchange (volume, heat, sea ice) between the North Atlantic and the Nordic Seas, and between the Nordic Seas and the Arctic Ocean. In recent years, Gao has strong interest in the air-sea interactions with special focus on how climate in different regions (Arctic, Atlantic and Pacific Oceans) influence the East Asian monsoons. Gao has been leaders of projects supported by the Research Council of Norway, the National Natural Science Foundation of China and the Nordic Council of Ministers and has been PIs in EU projects of THOR and NACLIM.

FIVE RELEVANT PUBLICATIONS

- Suo, L.L., **Gao, Y.Q.**, Guo, D., Liu, J.P., Wang, H.J., Johannessen, O.M. (2015): Atmospheric response to the autumn sea-ice free Arctic and its detectability. *Climate Dynamics*, doi: 10.1007/s00382-015-2689-8
- **Gao, Yongqi**, and co-authors (2015): Arctic sea ice and Eurasian climate: a review. *Adv. Atmos. Sci*. 32, 92-114. doi: 10.1007/s00376-014-0009-6.
- Cui, X.D., **Gao, Y.Q.**, Sun,J.Q., Guo, D., Li, S.L., Johannessen, O.M. (2014): Role of external forcing factors in modulating the Indian summer monsoon rainfall, the North Atlantic Oscillation and their relationship on inter-decadal timescale *Climate Dynamics, 43, 2283-2295,* DOI: 10.1007/s00382-014-2053-4
- Guo, D., **Gao, Y.Q.**, Bethke, I., Gong, D.Y., Johannessen, O.M., Wang, H.J. (2014): Mechanism on how the spring Arctic sea ice impacts the East Asian summer monsoon. *Theoretical and Applied Climatology, 115, 107-119,* DOI: 10.1007/s00704-013-0872-6
- Gong, D.Y., **Gao, Y.Q.**, Guo, D., Mao, R., Yang, J., Hu, M., Gao, M.N., (2014): Interannual linkage between Arctic/NorthAtlantic Oscillation and tropical Indian Ocean precipitation during boreal winter. *Climate Dynamics, 42, 1007-1027,* DOI 10.1007/s00382-013-1681-43-540-24232-1

CURRICULUM VITAE : Yali ZHU

Personal Information:

Date of Birth: 16 May, 1983 Nationality: China
Tel/Fax: 86 10 82995057 eMail: zhuyl@mail.iap.ac.cn

Research Area:

East Asian climate variation; interaction between low and high latitude climate systems; global climate change, based on observation, and model data; decadal climate change.

Working Experience:

Mar. 2009-May. 2009: City University of Hong Kong, Visiting Fellow.
Jun. 2009-May. 2012: Assistant Professor in Nansen-Zhu International Research Centre (NZC), Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS).
June. 2012-present: Associate Professor in NZC, IAP, CAS.

Education Background:

Sep. 2000 - Jun. 2004: College of Atmospheric Sciences, Lanzhou University. M.A.
Sep. 2004 - Dec. 2008: Institute of Atmospheric Physics, Chinese Academy of Sciences. Ph. D.

FIVE RELEVANT PUBLICATIONS (out of 16 published papers, including 8 SCI-indexed ones as the first-author).

- Zhu, Y. L., T. Wang, and J. H. Ma, 2016: Influence of internal decadal variability on the summer rainfall in eastern China as simulated by CCSM4, *Advances in Atmospheric Sciences*, DOI: 10.1007/s00376-016-5269-x..
- Zhu, Y. L., T. Wang, and H. J. Wang, 2016: Relative contribution of the anthropogenic forcing and natural variability to the interdecadal shift of climate during the late 1970s and 1990s, *Science Bulletin*, 61(5), 416-424, DOI: 10.1007/s11434-016-1012-3.
- Zhu, Y. L., H. J. Wang, J. H. Ma, T. Wang, and J. Q. Sun, 2015: Contribution of the phase transition of Pacific Decadal Oscillation to the late 1990s' shift in East China summer rainfall, *Journal of Geophysical Research*, 120 (17), 8817-8827. DOI: 10.1002/2015JD023545.
- Zhu, Y. L., 2011: A seasonal prediction model for the summer rainfall in Northeast China using the year-to-year increment approach, *Atmospheric and Oceanic Science Letters*, 4(3), 146-150.
- Zhu, Y. L., H. J. Wang, W. Zhou, and J. H. Ma, 2011: Recent changes in the summer precipitation pattern in East China and the background circulation, *Climate Dynamics*, 36, 1463-1473. DOI: 10.1007/s00382-010-0852-9.

CURRICULUM VITAE Dr Congwen ZHU

Senior Researcher/Deputy director

Institute of Climate System (ICS), Chinese Academy of Meteorological Sciences
Nandajie 46, Zhongguancun,Haidian, Beijing 100081, China
Phone: +86-10-6840-7544(office);
E-mail; tomzhu@camscma.cn
Personal website: http://people.ucas.ac.cn/~ZhuCongwen?language=en

Education:

- **1998** - Ph.D. (Climate dynamics), Nanjing Institute of Meteorology, China
- **1995** - M.S. (Atmospheric Sciences), Chinese Academy of Meteorological Sciences;
- **1989** - B.S. (Meteorological dynamics), Nanjing Institute of Meteorology, China

Five Relevant Publications

- Kang Xu,**Congwen Zhu** and Weiqiang Wang,2016： The cooperative impacts of the El Niño–Southern Oscillation and the Indian Ocean Dipole on the interannual variability of autumn rainfall in China. Int. J. Climatol. 36, 1987‐1999. DOI: 10.1002/joc.4475
- Liu Kai, **Zhu Congwen**. 2015. Regime shift of winter North Pacific sea surface temperature after 1990 and its possible causes. Chinese Journal of Atmospheric Sciences (in Chinese), 39 (5): 926–940, doi:10.3878/j.issn.1006-9895.1411.14218.
- Xu, K., **C., Zhu**, and J. H. He, 2013: Two types of El Niño-related Southern Oscillation and their different impacts on global land precipitation. ***Adv. Atmos. Sci.***, 30(6), 1743-1757, doi:10.1007/s00376-013-2272-3.
- Lin X, **C., Zhu***, Lü J M., 2013: Decadal change of the East Asian summer monsoon and its related surface temperature in Asia-Pacific during 1880–2004.***Chin Sci Bull***, doi: 10.1007/s11434-013-5969-x
- **Zhu, C.**, B. Wang, W. Qian, and B. Zhang, 2012: Recent weakening of northern East Asian summer monsoon: A possible response to global warming, ***Geophys. Res. Lett.***, 39, L09701, doi:10.1029/2012GL051155.

CURRICULUM VITAE Dr Boqi LIU

- WORK EXPERIENCE

(1) Associate researcher, Institute of Climate System, Chinese Academy of Meteorological Sciences, China, form 12/2015 by now.
(2) Research assistant, Institute of Climate System, Chinese Academy of Meteorological Sciences, China, form 06/2015 to 11/2015.
(3) Postdoc., LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences, China, from 05/2013 to 05/2015.

- EDUCATION

(1) Ph. D., College of atmospheric sciences, Nanjing University of Information and Science Technology, China, 2013
Concentrations: monsoon dynamics and air-land-sea interaction
Dissertation: Formation and Pattern Variations of the South Asian High and Their Impacts on the Asian Summer Monsoon Onset
Supervisor: Prof. Jinhai He and Prof. Guoxiong Wu
(2) M.A., College of atmospheric sciences, Nanjing University of Information and Science Technology, China, 2009
Concentrations: monsoon dynamics
Dissertation: The Characteristics of the South Asia High Seasonal Mutation Processes from April to May and Their Possible Mechanism
Supervisor: Prof. Jinhai He
(3) B.A., College of atmospheric sciences, Nanjing University of Information and Science Technology, China, 2006

- **FIVE RELEVANT PUBLICATIONS**

- Liu, B. Q., G. X. Wu and R. C. Ren, 2015: Influences of ENSO on the vertical coupling of atmospheric circulation during the onset of South Asian summer monsoon. Climate Dyn., doi: 10.1007/s00382-014-2439-3.
- Liu, B.Q., Y.M. Liu, G.X. Wu, J.H. Yan, J.H. He and S.L. Ren, 2015: Asian summer monsoon onset barrier and its formation mechanism. Climate Dyn., doi: 10.1007/s00382-014-2296-0.
- Wu, G.X. and B.Q. Liu. 2014: Role of forced and inertially unstable convection development in the onset process of Indian summer monsoon. Sci China: Earth Sci, 57, 1438–1451.
- Liu, B.Q., G.X. Wu, J.Y. Mao, and J.H. He, 2013: Genesis of the South Asian High and Its Impact on the Asian Summer Monsoon Onset. J. Climate, 26, 2976–2991.
- Guoxiong Wu, Suling Ren, Jianmin Xu, Dongxiao Wang, Qing Bao, Boqi Liu, Yimin Liu, 2013, Impact of tropical cyclone development on the instability of South Asian High and the summer monsoon onset over Bay of Bengal, Clim Dyn (2013) 41:2603–2616, DOI 10.1007/s00382-013-176.

- STUDY INTERESTS

Monsoon dynamics, monsoon onset & propagation processes and related air-land-sea interaction

Curriculum Vitae: Zhiyan ZUO

PERSONAL INFORMATION AND AFFILIATION

Personal Information: Female, Born in Feb. 26, 1980 in Shangrao City, China.

Affiliation: Chinese Academy of Meteorological Sciences (CAMS), Chinese Meteorological Administration (CMA)

EDUCATION

Ph.D., 2007, in Meteorology, Chinese Academy of Sciences, Beijing, China
M.S., 2004, in Meteorology, CAMS, CMA, Beijing, China
B.S., 2001, in Meteorology, Nanjing institute of Meteorology, Nanjing, China

PROFESSIONAL EXPERIENCE

2013.6-2013.8, **Visiting Scientist,** National Climate Center, CMA, Beijing, China
2010.11-2011.11, **Visiting Scientist,** NOAA's Climate Prediction Center, USA
2010.10-Present, **Associate Researcher,** CAMS, CMA, Beijing, China
2007.7-2010.10, **Assistant Researcher,** CAMS, CMA, Beijing, China

PROJECT---related with snow

National Natural Science Foundation of China: Influence of Eurasian spring snow anomalies on the prediction of summer rainfall over China in NCEP CFSv2 (41205059), 2013-2015, PI
National Basic Research Program of China (973 Program): Cryospheric processes in China and their climatic, hydrologic and ecologic effects and adaptation, 2007-2011, Member

5 RELEVANT PUBLICATIONS---related to snow cover/Asian monsoon/Tibetan Plateau

- He, Qiong, **Zhiyan Zuo,** Renhe Zhang, Song Yang, Wanqiu Wang, Ruonan Zhang, Emily Riddle. 2015: Prediction skill and predictability of Eurasian snow cover fraction in the NCEP Climate Forecast version 2 reforecasts. *International Journal of Climatology*. DOI: 10.1002/joc.4618.
- Zhang, Ruonan, Renhe Zhang, **Zhiyan Zuo**, Weijing Li, 2015: Climatology and interannual variability of the wintertime snow cover over China. *International Journal of Climatology*. DOI: 10.1002/joc.4599.
- **Zuo, Zhiyan**, Song Yang, Renhe Zhang, Dong Xiao, Dong Guo and Lijuan Ma. 2015: Response of summer rainfall over China to spring snow anomalies over Siberia in the NCEP CFSv2 reforecast. *Quarterly Journal of the Royal Meteorological Society*, 141: 939-944. doi: 10.1002/qj.2413.
- **Zuo, Zhiyan**, Song Yang, Zeng-Zhen Hu, Renhe Zhang, Wanqiu Wang, Bohua Huang and Fang wang. 2013. Predictable patterns and predictive skills of monsoon precipitation in northern Hemisphere summer in NCEP CFSv2 reforecast. *Climate Dynamics,* 40: 3071-3088. DOI: 10.1007/s00382-013-1772-2.
- **Zuo, Zhiyan**, Song Yang, Renhe Zhang, Pinping Jiang, Li Zhang and Fang Wang. 2013. Long-term variations of broad-scale Asian summer monsoon circulation and possible causes. *Journal of Climate,* 26: 8947-8961. DOI: 10.1075/JCLI-D-12-00691.1s.

Curriculum Vitae: Martin WEGMANN

Education

- **PhD**
  Climate Science
  University of Bern
  2012 - 2015

- **Master of Science**
  Climate Science
  University of Bern
  2010 - 2012

- **Bachelor of Science**
  Geography
  Ruhr University Bochum
  2006 - 2009

Experience

- **PostDoc**
  Lab of Glaciology & Environ. Geophysics
  University of Grenoble
  2016 - present

- **Student Assistant**
  Institute of Geography, Climatology Group
  University of Bern
  2011 - 2012

- **Student Assistant**
  Institute of Economics Research RWI
  Essen, Germany
  2009 - 2010

Peer Reviewed Publications

Wegmann, M., Brönnimann, S. & Compo, G.P. (2015). Tropospheric circulation during the early twentieth century Arctic warming. Climate Dynamics, submitted.

Wegmann, M., Orsolini, Y., Vázquez, M., Gimeno, L., Nieto, R., Bulygina, O., ... & Brönnimann, S. (2015). Arctic moisture source for Eurasian snow cover variations in autumn. Environmental Research Letters, 10(5), 054015.

Wegmann, M., Brönnimann, S., Bhend, J., Franke, J., Folini, D., Wild, M., & Luterbacher, J. (2014). Volcanic Influence on European Summer Precipitation through Monsoons: Possible Cause for " Years without Summer" . Journal of Climate, 27(10), 3683-3691.

Auchmann, R., Arfeuille, F., Wegmann, M., Franke, J., Barriendos, M., Prohom, M., ... & Brönnimann, S. (2013). Impact of volcanic stratospheric aerosols on diurnal temperature range in Europe over the past 200 years: Observations versus model simulations. Journal of Geophysical Research: Atmospheres, 118(16), 9064-9077.

Curriculum Vitae: *Jee-Hoon JEONG*

Faculty of Earth Systems & Environmental Sciences, Chonnam National University
Leader of Climate Prediction Lab.
77 Yongbong-ro, Buk-gu, Gwangju, 500-757, Korea
Tel: (+82) 62-530-3466, E-mail: jjeehoon@jnu.ac.kr; jjeehoon@gmail.com

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Education and Degrees

· *Docent in geoscience*, 2015: University of Gothenburg, Sweden
· *Doctor of Philosophy*, 2005: Earth and Environmental Sciences, Seoul National University
· *Master of Science*, 2001: Earth and Environmental Sciences, Seoul National University
· *Bachelor of Science*, 1999: Department of Atmospheric Science, Seoul National University

Employments

· *Assistant Professor*: Faculty of Earth Systems & Environmental Sciences, Chonnam National University, Aug 2012–present)
· *Assistant Professor*: Department of Earth Sciences, University of Gothenburg, *Universitetlektor* (permanent position; Feb 2012–), *Biträdande lektor* (Feb 2011–Jan 2012), *Forskaassistant* (Feb 2008–Jan 2012),
· *Postdoctoral Researcher*: Research Institute of Basic Sciences, Seoul National University, Sep. 2005 – Jan 2008 (*including military service*)

Research Fields

· Land-atmosphere interaction: soil-moisture, snow, and vegetation feedbacks
· Dynamical sub-seasonal to seasonal climate prediction
· Arctic-extratropics interaction, cold extremes

5 RELEVANT PUBLICATIONS *Total 47 journal papers including*

- Kug, J.-S., **J.-H. Jeong,** et al. (2015) Two distinct influences of Arctic warming on cold winters over North America and East Asia. *Nature Geosci,* 8, 759-762..
- **Jeong, J.-H.** et al. (2014), Intensified Arctic warming under greenhouse warming by vegetation–atmosphere–sea ice interaction, *Environmental Research Letters*, 9(9)
- B.-M. Kim, and 7 co-authors including **J.-H. Jeong** (2014), Weakening of the Stratospheric Polar Vortex by Arctic Sea-Ice Loss, *Nature Communications*, 5(4646)
- **Jeong, J.-H.** et al. (2013), Impacts of Snow Initialization on Subseasonal Forecasts of Surface Air Temperature for the Cold Season, *Journal of Climate*, 26(6)
- **Jeong, J.-H.** et al. (2011), Recent recovery of the Siberian High intensity, 116, D23102, *Journal of Geophysical Research*

Current research projects

- Development of prediction methods based on midlatitudes-tropics predictors for improvements in predictability of winter climate), 2015-2018, 382 MKRW/year, PI, Korea Meteorological Administration R&D program
- modelling and observation studies on vegetation feedback effect under climate change over the Arctic and high-latitudes), 2015-2016, 60 MKRW/year, funded by Korea NRF [PI]